Formulierversie
2020.01

Aanvraaggegevens

Algemeen

Aanvraagnummer	6855957
Aanvraagnaam	ENS-ZL Aanpassen bestaande hoogspanningsmasten ZWL
Uw referentiecode	-
Ingediend op	07-04-2022
Soort procedure	Reguliere procedure
Projectomschrijving	Het beperkt constructief aanpassen van vijftien hoogspanningsmasten in het kader van het project ENS-ZL 380kV.
Opmerking	Totale projectkosten zijn nog niet te geven. Zie voor een toelichting op de aanvraag bijlage 1.
Gefaseerd	Nee
Blokkerende onderdelen weglaten	Nee
Persoonsgegevens openbaar maken	Nee
Kosten openbaar maken	Nee
Bijlagen die later komen	Bouwveiligheidsplan UO ontwerp (berekeningen en tekeningen) funderingen.
Bijlagen n.v.t. of al bekend	nvt

Bevoegd gezag

Naam:	Gemeente Zwartewaterland
Bezoekadres:	Telvorenstraat 2, Hasselt
Postadres:	Postbus 23 8060 AA Hasselt
Telefoonnummer:	14 038
E-mailadres:	info@zwartewaterland.nl
Website:	www.zwartewaterland.nl
Contactpersoon:	Team vergunningverlening

Overzicht bijgevoegde modulebladen

Aanvraaggegevens

Aanvragergegevens

Locatie van de werkzaamheden

Werkzaamheden en onderdelen

Overige veranderingen aan bestaande bouwwerken

- Bouwen

Bijlagen

Kosten

Aanvrager bedrijf

1 Bedrijf

KvK-nummer	09155985
Vestigingsnummer	000020300360
(Statutaire) naam	TenneT TSO B.V.
Handelsnaam	TenneT TSO

2 Contactpersoon

Geslacht	☑ Man ☐ Vrouw
Voorletters	
Voorvoegsels	-
Achternaam	
Functie	Adviseur vergunningen

3 Vestigingsadres bedrijf

Postcode	6812AR
Huisnummer	310
Huisletter	-
Huisnummertoevoeging	M01
Straatnaam	Utrechtseweg
Woonplaats	Arnhem

4 Correspondentieadres

Postbus	718
Postcode	6800AS
Plaats	Arnhem

5 Contactgegevens

Telefoonnummer	
Faxnummer	-
E-mailadres	

6 Akkoordverklaring

Akkoordverklaring	☑ Hierbij verklaar ik dat ik de aanvraag/melding naar waarheid heb ingevuld, dat ik correspondentie over mijn aanvraag/melding wil ontvangen op het door mij opgegeven e-mailadres of op het door mij opgegeven adres van de berichtenbox en dat ik weet dat er kosten verbonden kunnen zijn aan het indienen van een aanvraag.

Locatie

1 Kadastraal perceelnummer

Burgerlijke gemeente	Zwartewaterland
Kadastrale gemeente	Genemuiden
Kadastrale sectie	M
Kadastraal perceelnummer	302
Bouwplannaam	-
Bouwnummer	-
Gelden de werkzaamheden in deze aanvraag/melding voor meerdere adressen of percelen?	☑ Ja ☐ Nee
Specificatie locatie	Voor een volledig overzicht van de kadastrale percelen, wordt verwezen naar bijlage 2.

2 Eigendomssituatie

Eigendomssituatie van het perceel	☐ U bent eigenaar van het perceel ☐ U bent erfpachter van het perceel ☐ U bent huurder van het perceel ☑ Anders
Uw belang bij deze aanvraag	Zakelijk recht overeenkomst

3 Toelichting

Eventuele toelichting op locatie	Het betreffen bestaande hoogspanningsmasten in een bestaande hoogspanningsverbinding.

Bouwen

Overige veranderingen aan bestaande bouwwerken

1 Woonboten en drijvende objecten

Betreft het bouwwerk een drijvend object?	☐ Ja ☑ Nee

2 Woning

Gaat het om de bouw van één of meer woningen?	☐ Ja ☑ Nee

3 De bouwwerkzaamheden

Wat is er op het bouwwerk van toepassing?	☐ Het wordt geheel vervangen ☑ Het wordt gedeeltelijk vervangen ☐ Het wordt nieuw geplaatst
Eventuele toelichting	Het betreft het uitwisselen/toevoegen van enkele stalen profielen in de mast en het vervangen van bijbehorende bouten. Het aanzicht en de kleur wijzigen hierbij niet of nauwelijks. Hiernaast wordt bij twee masten extra ballast aan de mastfundering aangebracht.
Hebt u voor deze bouwwerkzaamheden al eerder een vergunning aangevraagd?	☐ Ja ☑ Nee

4 Plaats van het bouwwerk

Waar gaat u bouwen?	Bijgebouw
Naam van het bijgebouw of bouwwerk	hoogspanningsmast

5 Seizoensgebonden en tijdelijke bouwwerken

Gaat het om een seizoensgebonden bouwwerk?	☐ Ja ☑ Nee
Gaat het om een tijdelijk bouwwerk?	☐ Ja ☑ Nee

6 Gebruik

Waar gebruikt u het bouwwerk en/of terrein momenteel voor?	☐ Wonen ☑ Overige gebruiksfuncties
Geef aan waar u het bouwwerk en/of terrein momenteel voor gebruikt.	hoogspanningsmast
Waar gaat u het bouwwerk voor gebruiken?	☐ Wonen ☑ Overige gebruiksfuncties

Geef aan waar u het bouwwerk voor gaat gebruiken.	hoogspanningsmast

7 Gebruiksfuncties

In onderstaande tabel staan in de eerste kolom mogelijke gebruiksfuncties die in een bouwwerk kunnen voorkomen. Vul voor alle gebruiksfuncties die voor u van toepassing zijn het aantal personen, de totale gebruiksoppervlakte en de totale vloeroppervlakte van het verblijfsgebied in m2 in hele getallen in.

Gebruiksfunctie	Aantal personen	Gebruiksoppervlakte (m2)	Verblijfsoppervlakte (m2)
Bijeenkomst	-	-	-
Cel	-	-	-
Gezondheidszorg	-	-	-
Industrie	-	-	-
Kantoor	-	-	-
Logies	-	-	-
Onderwijs	-	-	-
Sport	-	-	-
Winkel	-	-	-
Overige gebruiksfuncties	-	-	-

8 Uiterlijk bouwwerk/welstand

Beschrijf van de onderstaande onderdelen de materialen en kleuren die u voor het bouwwerk gebruikt. U mag het veld leeg laten als u materialen en kleuren in de bijlagen vermeldt

Onderdelen	Materiaal	Kleur
Gevels	-	-
- Plint gebouw	-	-
- Gevelbekleding	-	-
- Borstweringen	-	-
- Voegwerk	-	-
Kozijnen	-	-
- Ramen	-	-
- Deuren	-	-
- Luiken	-	-
Balkonhekken	-	-
Dakgoten en boeidelen	-	-
Dakbedekking	-	-

Vul hier overige onderdelen en bijbehorende materialen en kleuren in.	Metalen profielen mast. Kleur grijs (gelijk aan huidige kleur). Ballast poeren: beton, grijs.

9 Mondeling toelichten

Ik wil mijn bouwplan mondeling toelichten voor de welstandscommissie/ stadsbouwmeester.	☐ Ja ☑ Nee

Bijlagen

Formele bijlagen

Naam bijlage	Bestandsnaam	Type	Datum ingediend	Status document
2__Kadastraal_Mastenboek_v8_2_pdf	2. Kadastraal Mastenboek_v8.2.pdf	Anders	07-04-2022	In behandeling
3__Overzicht_masten_pdf	3. Overzicht masten.pdf	Anders	07-04-2022	In behandeling
4_1_DO_Mast_S-6_R_pdf	4.1 DO Mast S-6 R.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
4_2_DO_Mast_HB_0_R_X_pdf	4.2 DO Mast HB_0 R_X.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
4_3_DO_Mast_HB_9_R_X_pdf	4.3 DO Mast HB_9 R_X.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
4_4_DO_Mast_HC-3_RC_pdf	4.4 DO Mast HC-3 RC.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_1_1_S-6R_Mast_Overzichtstek_pdf	5.1.1 S-6R Mast Overzichtstek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_1_2_S-6R_Mast_Onderdeeltek_pdf	5.1.2 S-6R Mast Onderdeeltek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_1_3_S-6R_Mast_Lijsten_pdf	5.1.3 S-6R Mast Lijsten.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_1_4_S-6R_Mast_Detailberekeningen_pdf	5.1.4 S-6R Mast Detailberekeningen.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en	07-04-2022	In behandeling

Naam bijlage	Bestandsnaam	Type	Datum ingediend	Status document
		detailtekeningen bouwen complexere bouwwerken		
5_2_1_HB_0_RX_Mast_-35_Overzichtstek_pdf	5.2.1 HB_0 RX Mast 35 Overzichtstek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_2_2_HB_0_RX_Mast_-35_Onderdeeltek_pdf	5.2.2 HB_0 RX Mast 35 Onderdeeltek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_2_3_HB_0_RX_Mast_-35_Lijsten_pdf	5.2.3 HB_0 RX Mast 35 Lijsten.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_2_4_HB_0_RX_Mast_-35_Detailberek_pdf	5.2.4 HB_0 RX Mast 35 Detailberek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_3_1_HB_9_RX_Mast_-65_Overzichtstek_pdf	5.3.1 HB_9 RX Mast 65 Overzichtstek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_3_2_HB_9_RX_Mast_-65_Onderdeeltek_pdf	5.3.2 HB_9 RX Mast 65 Onderdeeltek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_3_3_HB_9_RX_Mast_-65_Lijsten_pdf	5.3.3 HB_9 RX Mast 65 Lijsten.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_3_4_HB_9_RX_Mast_-65_Detailber_pdf	5.3.4 HB_9 RX Mast 65 Detailber.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_4_1_HC-3_RC_mast_-73_Overzichtstek_pdf	5.4.1 HC-3 RC mast 73 Overzichtstek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_4_2_HC-3_RC_mast_-73_Onderdeeltek_pdf	5.4.2 HC-3 RC mast 73 Onderdeeltek.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
5_4_3_HC-3_RC_mast_-73_Lijsten_pdf	5.4.3 HC-3 RC mast 73 Lijsten.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling

Naam bijlage	Bestandsnaam	Type	Datum ingediend	Status document
5_4_4_HC-3_RC_mast_-73_Detailber_pdf	5.4.4 HC-3 RC mast 73 Detailber.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
6__Archeologie_Zwartewaterland_pdf	6. Archeologie Zwartewaterland.pdf	Anders	07-04-2022	In behandeling
7__Verk_Natuuronderz_ZL-ENS_pdf	7. Verk Natuuronderz ZL-ENS.pdf	Anders	07-04-2022	In behandeling
8__Voortoets_werkzaamh_Zwolle--Ens_pdf	8. Voortoets werkzaamh Zwolle-Ens.pdf	Anders	07-04-2022	In behandeling
9__Principetek_fundaties-_mast_61_64_pdf	9. Principetek fundaties mast 61_64.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
10__Rapportage_fundaties_mast_61_64_pdf	10. Rapportage fundaties mast 61_64.pdf	Constructieve veiligheid complexere bouwwerken Plattegronden, doorsneden en detailtekeningen bouwen complexere bouwwerken	07-04-2022	In behandeling
11_1_verk_bodemonderzoek_mast_61_pdf	11.1 verk bodemonderzoek mast 61.pdf	Anders	07-04-2022	In behandeling
11_2_verk_bodemonderzoek_mast_64_pdf	11.2 verk bodemonderzoek mast 64.pdf	Anders	07-04-2022	In behandeling
1__begeleidend_schrijven_Zwl_pdf	1. begeleidend schrijven Zwl.pdf	Anders	07-04-2022	In behandeling

Kosten

Bouwen

Overige veranderingen aan bestaande bouwwerken

Wat zijn de geschatte kosten in euro's (exclusief BTW)?	273000

Projectkosten

Wat zijn de geschatte kosten voor het totale project in euro's (exclusief BTW)?	273000

Postbus 718, 6800 AS Arnhem, Nederland

Gemeente Zwartewaterland
T.a.v. college van burgemeester en wethouders
Postbus 23
8060 AA HASSELT
Nederland

CLASSIFICATIE	C1 - Publieke Informatie
DATUM	1 april 2022
ONZE REFERENTIE	002.515.20 1011145
BEHANDELD DOOR	
TELEFOON DIRECT	
E-MAIL	

BETREFT Aanvraag omgevingsvergunning bouwen t.b.v. Ens-Zwolle 380 kV

Geacht college,

Hierbij vraagt TenneT TSO B.V. (hierna: TenneT) een omgevingsvergunning onderdeel bouwen aan voor het constructief aanpassen van bestaande 380 kV hoogspanningsmasten van de verbinding Ens – Zwolle 380kV binnen de gemeente Zwartewaterland.

1. Achtergrond

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen zodat een grotere transportcapaciteit mogelijk wordt gemaakt. Om die reden is TenneT voornemens de bestaande landelijke 380 kV ring, de 'ruggengraat' van het landelijk hoogspanningsnet, op te waarderen. Dit gebeurt binnen het programma Beter Benutten Bestaande 380 kV. Binnen het betreffende programma valt ook het deelproject Opwaardering 380 kV-verbinding Ens - Zwolle (ENS-ZL).
Het opwaarderen van de 380kV ring, inclusief de hieronder vallende deelprojecten vallen onder de Rijkscoördinatieregeling.

2. Werkzaamheden

Voor de opwaardering van de bestaande 380 kV verbinding ENS-ZL moeten diverse werkzaamheden worden uitgevoerd. In de basis betreft dit het ophangen van nieuwe HTLS (High Temperature Low Sag) geleiders met een hogere transportcapaciteit dan de huidige geleiders. De nieuwe geleiders zijn qua omvang en aantal gelijk aan de bestaande maar kunnen meer stroom transporteren, doordat ze hogere temperaturen kunnen weerstaan zonder te ver door te gaan hangen. De huidige hoogspanningsverbinding is bovendien inmiddels 35 jaar oud. Om deze reden worden ook andere onderdelen, zoals de isolatorkettingen en bliksemdraden als levensduur verlengende activiteit vervangen. In het kader van deze -niet omgevingsvergunningplichtige werkzaamheden - worden ook de hoogspanningsmasten en de mastfunderingen opnieuw constructief beschouwd.

Deze aanvraag omgevingsvergunning, onderdeel bouwen, heeft betrekking op het constructief aanpassen van 15 mastlichamen en 2 funderingen. Hieronder worden deze werkzaamheden toegelicht.

2.1 Aanpassingen mastlichaam

Per masttype is een constructieve controle uitgevoerd. Op basis hiervan is gebleken of- en in welke mast aanpassingen moeten plaatsvinden. Hiervan wordt vervolgens per masttype een detailontwerp gemaakt van de aanpassingen.
De aanpassingen van het mastlichaam bestaan op hoofdlijnen uit onderstaande werkzaamheden waarbij de hoofdopzet en de uitstraling van de masten niet wijzigt.
- Bouten vervangen
- Mastprofielen uitwisselen en/of toevoegen
- Knikverkorters toevoegen

Een overzicht met de aanpassingen per mast is opgenomen in bijlage 3 en de berekening van de mastconstructies in bijlagen 4.
Nadat alle werkzaamheden zijn uitgevoerd worden de masten waar nodig lokaal bijgewerkt met schilderwerk in de bestaande kleur.

2.2 Aanpassingen funderingen

Naast het aanpassen van de mastlichamen kan ook het aanpassen van de fundering aan de orde zijn. Per mastfundering is een constructieve controle uitgevoerd (bijlagen 9 t/m 11). Op basis hiervan is gebleken óf en hoe de aanpassingen moeten plaatsvinden. Hiervan is vervolgens een detailontwerp gemaakt van de aanpassingen.

De aanpassingen van de funderingen bestaan uit het toevoegen van extra ballast aan de bestaande poeren. Er hoeven geen heipalen te worden bijgeplaatst. Het ontwerp hiervoor is in 5 op UO niveau uitgewerkt.

2.3 Archeologie

Ter plaatse van de werkzaamheden van de verbinding KIJ-GT is een archeologisch onderzoek uitgevoerd. Er is geen noodzaak tot vervolgonderzoek. Het uitgevoerde archeologische onderzoek betreffende gemeente Molenlanden is bijgevoegd in bijlage 6.

2.4 Natuur

Adviesbureau Sweco heeft in 2021 onderzoek gedaan naar de aanwezigheid van beschermde flora en fauna op het tracé. Tevens zijn in het onderzoek de effecten ten aanzien van Natura 2000-gebieden onderzocht. Op basis van het uitgevoerde natuuronderzoek is geconcludeerd dat in één mast van de verbinding ENS-ZL (mast 50, gemeente Zwolle) een jaarrond bescherm nest aanwezig is. Hiervoor is een ontheffing voor soortenbescherming in het kader van de Wet natuurbescherming (Wnb) aangevraagd. Opgemerkt wordt hierbij dat er in de loop van 2022 nog verder onderzoek zal plaatsvinden naar nesten in masten omdat de werkzaamheden pas in de loop van 2023 van start zullen gaan. Dit omdat er anders 2 broedseizoenen zitten tussen het eerste onderzoek en realisatie.
Het uitgangspunt is dat er met een werkprotocol zodanig gewerkt kan worden, dat nesten zo veel mogelijk behouden kunnen blijven en niet verstoord worden. Indien er uit het nader onderzoek (blijkt dat er toch andere jaarrond beschermde nesten verstoord of (tijdelijk) verwijderd moeten worden, dan zal hiervoor later zo nodig aanvullend een ontheffing worden aangevraagd. Het uitvoeren van de werkzaamheden zal verder

onder ecologische begeleiding worden uitgevoerd.
Een vergunning voor gebiedsbescherming in het kader van de Wnb is niet noodzakelijk. Het ministerie van Landbouw, Natuur en Voedselkwaliteit (LNV) is op grond van artikel 1.3 lid 5 van de Wnb bevoegd gezag.

3. Vergunning en procedures

3.1 Omgevingsvergunning

Voor de werkzaamheden als benoemd in paragraaf 2 vraagt TenneT een omgevingsvergunning aan voor de volgende in de Wet algemene bepalingen omgevingsrecht (Wabo) genoemde activiteiten:

- het bouwen van een bouwwerk (veranderen), artikel 2.1 lid 1 onder a Wabo.

3.2 Rijkscoördinatieregeling

Ten aanzien van uw besluit op deze aanvraag ingevolge artikel 2.1 van de Wet algemene bepalingen omgevingsrecht is op grond van artikel 20c Elektriciteitswet j° artikel 2 lid 1 onder a Uitvoeringsbesluit Rijkscoördinatieregeling energie-infrastructuurprojecten de Rijkscoördinatieregeling uit de Wet op de ruimtelijke ordening van toepassing (artikel 3.35). Hierbij is de minister van Economische Zaken de aangewezen minister voor de coördinatie van de besluiten.
In verband daarmee heeft de minister van Economische Zaken ons gevraagd het volgende op te nemen in deze aanvraag:
1. Ingevolge de Rijkscoördinatieregeling dient u een kopie van onderhavige aanvraag te verzenden aan de minister van Economische Zaken. TenneT zal er echter voor zorgen dat de minister van Economische Zaken een exemplaar van deze aanvraag ontvangt. U hoeft dus geen exemplaar door te sturen.
2. In reactie op deze kopie van de aanvraag zal de minister u per brief melden wanneer van u verwacht wordt een ontwerpbesluit gereed te hebben.
3. U wordt verzocht het ontwerpbesluit en later ook het besluit aan de minister van Economische Zaken te verzenden. Deze zal het besluit doorzenden naar TenneT.

3.3 Uitgestelde gegevensverstrekking

De detailengineering van de funderingen is nog niet gereed. Onder verwijzing naar artikel 2.7 van de Regeling omgevingsrecht (Mor) verzoeken wij u om in uw besluit te bepalen dat de in artikel 2.7 lid 1 en 3 Mor bedoelde gegevens uiterlijk 3 weken voorafgaand aan de start van de werkzaamheden van de mastaanpassing of fundering, ter goedkeuring zullen worden aangeleverd.
Het gaat in ieder geval om de volgende gegevens:

- (Bouw)veiligheidsplan.
- Uitvoeringsontwerp (detailberekeningen en tekeningen) funderingsaanpassingen.

3.4 Bouwkosten voor legesbepaling

Een inschatting van de bouwkosten ten behoeve van legesbepaling is op basis van ervaringen met andere projecten door onze cost-engineer ingeschat. Zodra het werk is aanbesteed (eind 2022) zijn definitieve bedragen beschikbaar.

4. Werkproces en overige vergunningen

Voor het feitelijk uitvoeren van de werkzaamheden zullen nog diverse andere vergunningen en meldingen benodigd zijn. Te denken is hierbij aan kruisingen met (spoor)wegen en waterwegen, bemaling, uitritten etc. Voor deze aanvragen of meldingen zijn veel details nodig die door de aannemer worden uitgewerkt. Het aanvragen van deze vergunningen/meldingen zal daarom grotendeels op een later tijdstip door de aannemer worden gedaan.
Met de eigenaren van de gronden waarop de masten staan heeft TenneT privaatrechtelijke overeenkomsten gesloten. De werkzaamheden worden in nauw overleg met alle rechthebbenden uitgevoerd.

4.1 Planning

Volgens de huidige inzichten zullen de werkzaamheden in het tweede kwartaal van 2023 starten.

4.2 Omgevingsveiligheid

Aannemers worden contractueel verplicht te werken volgens de veiligheidsvoorschriften van TenneT, te weten:
- "General SHE requirements for contractors, referentie SSC 15-037"
- "Operational SHE requirements for contractors – Onshore NL, referentie SSC 16-004"
(https://www.tennet.eu/nl/bedrijf/safety-bij-tennet/safety-publicaties/)

5. Ondertekening

Wij verzoeken u de vergunning op naam te stellen van TenneT TSO B.V.

Wij verzoeken u alle inhoudelijke correspondentie met betrekking tot deze aanvraag te richten aan:

TenneT TSO B.V.

Postbus 718
6800 AS Arnhem

Wij verzoeken u het ontwerpbesluit en het definitieve besluit te zenden naar:

Ministerie van Economische Zaken
T.a.v. Bureau Energieprojecten
Postbus 93144
2509 AC Den Haag

Met vriendelijke groet,
TenneT TSO B.V.

Bijlagenblad

1. Brief / begeleidend schrijven
2. Mastenboek voorzien van Kadastrale gegevens (gehele verbinding)
3. Overzicht van aan te passen masten
4. Gegevens DO per masttype
5. Gegevens UO per masttype
6. Archeologisch onderzoek
7. Natuuronderzoek, verkennend
8. Natuuronderzoek, voortoets

Funderingsaanpassingen

9. Tekeningen DO
10. Berekeningen DO
11. Milieukundig bodemonderzoek

Bijlagenoverzicht

1. Brief / begeleidend schrijven
2. Mastenboek voorzien van Kadastrale gegevens (gehele verbinding)
3. Overzicht van aan te passen masten
4. Gegevens DO per masttype
5. Gegevens UO per masttype
6. Archeologisch onderzoek
7. Natuuronderzoek, verkennend
8. Natuuronderzoek, voortoets

Funderingsaanpassingen

9. Tekeningen DO
10. Berekeningen DO
11. Milieukundig bodemonderzoek

Bijlage 2

Kadastraal Mastenboek

Beter Benutten

Mastenboek Ens - Zwolle

kaart 1

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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Station Ens 110

Station Ens 220

Station Ens 380

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NOP00C 2732

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NOP00C 3295

NOP00C 3761

NOP00C 2731

NOP00C 3294

NOP00C 2421

NOP00C 4264

NOP00C 3059

NOP00C 3888

NOP00C 2594

Beter Benutten

Mastenboek Ens - Zwolle

kaart 2

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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NOP00C 3374
NOP00C 4264
NOP00C 3888
NOP00C 3885
NOP00C 2606

Beter Benutten

Mastenboek Ens - Zwolle

kaart 3

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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NOP00C 3885
NOP00C 1343

Beter Benutten

Mastenboek Ens - Zwolle

kaart 4

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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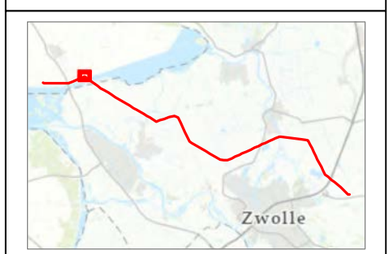
Mastenboek Ens - Zwolle

kaart 5

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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Mastenboek Ens - Zwolle

kaart 6

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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Kampen
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KPN01S 536
KPN01S 532

Beter Benutten

Mastenboek Ens - Zwolle

kaart 7

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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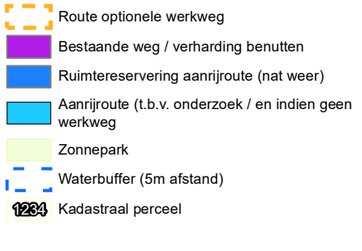
Mastenboek Ens - Zwolle

kaart 8

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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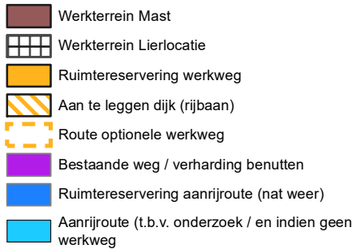
Beter Benutten

Mastenboek Ens - Zwolle

kaart 9

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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Beter Benutten

Mastenboek Ens - Zwolle

kaart 10

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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Beter Benutten

Mastenboek Ens - Zwolle

kaart 11

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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Mastenboek Ens - Zwolle

kaart 12

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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KPN01T 178

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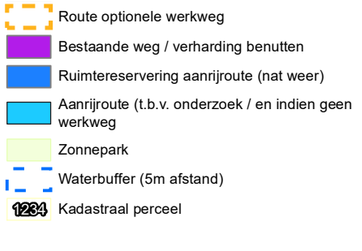
Beter Benutten

Mastenboek Ens - Zwolle

kaart 13

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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ISM02I 2602
ISM02I 2750
ISM02I 202
KPN01T 230
KPN01T 191
ISM02I 682

Beter Benutten

Mastenboek Ens - Zwolle

kaart 14

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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ISM02I 266
032
ISM02I 1415
ISM02I 255
ISM02I 263
ISM02I 264
ISM02I 261
ISM02I 262

Beter Benutten

Mastenboek Ens - Zwolle

kaart 15

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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Mastenboek Ens - Zwolle

kaart 16

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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Mastenboek Ens - Zwolle

kaart 17

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:3.500	Formaat	A3
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0 20 40 60 80 100 m.

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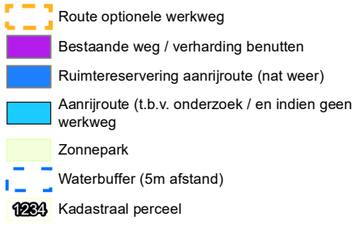
Beter Benutten

Mastenboek Ens - Zwolle

kaart 18

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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GNM00M 336
GNM00M 337
GNM00M 576
ISM02M 368
ISM02M 228
038
GNM00M 299
Zwartewaterland
Kampen
ISM02M 377
ISM02M 371
039
ISM02M 5
ISM02M 6

Beter Benutten

Mastenboek Ens - Zwolle

kaart 19

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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ISM02M 7
ISM02M 8
041
ISM02M 11
ISM02M 10
ISM02M 20
042
ISM02M 245
ISM02M 446
ISM02M 230
ISM02M 232

Beter Benutten

Mastenboek Ens - Zwolle

kaart 20

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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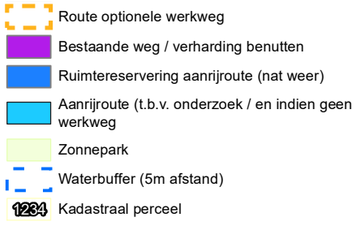
Mastenboek Ens - Zwolle

kaart 21

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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ISM02M 393
044
ISM02M 443
045
ISM02M 442
ISM02M 56
ISM02M 217
ISM02M 82
ISM02M 60
046
ISM02M 72
ISM02M 61
047
ISM02M 62
ISM02M 247
ISM02M 248
048
ISM02M 213
ISM02M 214

Beter Benutten

Mastenboek Ens - Zwolle

kaart 22

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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0 20 40 60 80 100 m.

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ISM02M 217
Zwartewaterland
Kampen
ISM02M 61
ISM02M 247
047
ISM02M 248
ISM02M 213
ISM02M 214
048
Kampen
Zwolle
ZLE00Y 114

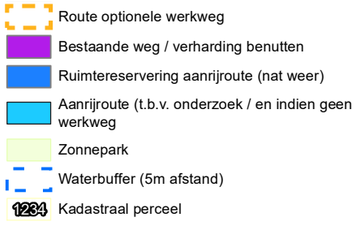
Beter Benutten

Mastenboek Ens - Zwolle

kaart 23

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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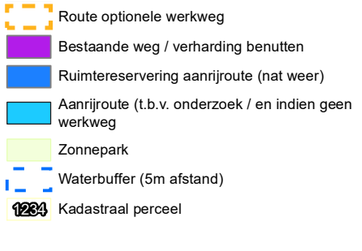
Mastenboek Ens - Zwolle

kaart 24

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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Zwartewaterland
Zwolle
ZLE00Y 5
ZLE00Y 33
ZLE00Y 21
ZLE00Y 19
053
ZLE00Y 23
052
ZLE00Y 22
ZLE00Y 113
ZLE00Y 24
050
051
ZLE00Y 46
ZLE00Y 47
ZLE00Y 63

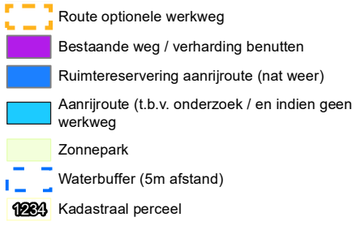
Beter Benutten

Mastenboek Ens - Zwolle

kaart 25

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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Mastenboek Ens - Zwolle

kaart 26

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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Zwartewaterland

Zwolle

056

ZLE00Y 5

055

054

Beter Benutten

Mastenboek Ens - Zwolle

kaart 27

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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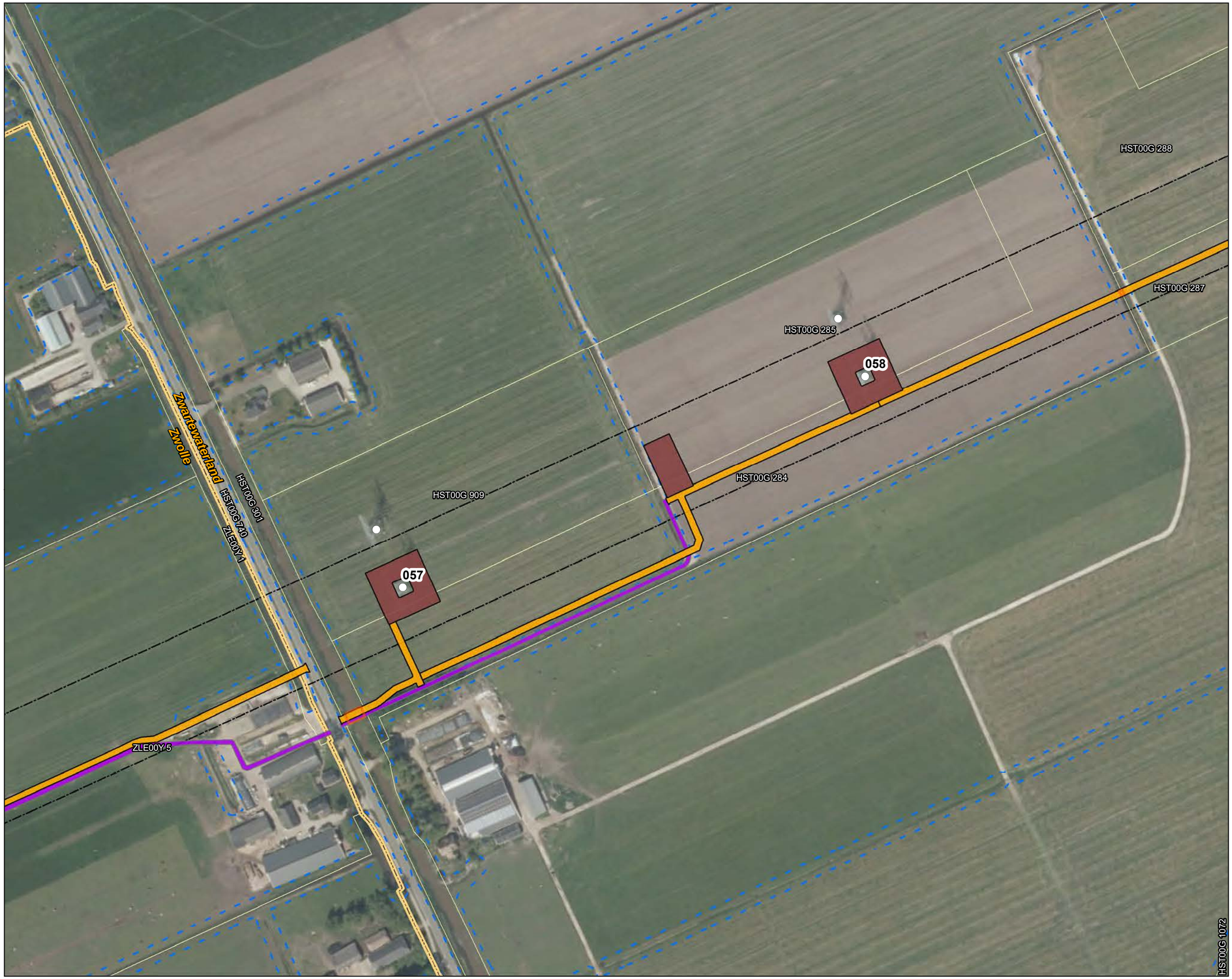

Beter Benutten

Mastenboek Ens - Zwolle

kaart 28

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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HST00G 921
HST00G 922
HST00G 288
059
HST00G 287
HST00G 284

Beter Benutten

Mastenboek Ens - Zwolle

kaart 29

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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Mastenboek Ens - Zwolle

kaart 30

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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HST00B 1914
HST00B 1862
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HST00B 1870
HST00B 1916
HST00B 1869
HST00B 1868
HST00B 1918
HST00B 1851
HST00B 1849
065
066
067
064
063
Zwartewaterland
Zwolle

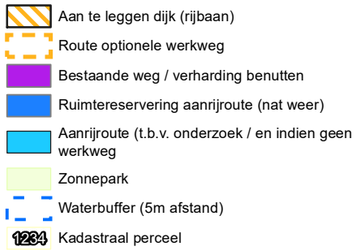
Beter Benutten

Mastenboek Ens - Zwolle

kaart 31

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



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HST00B 1858
HST00F 82
HST00F 155
HST00F 521
HST00B 1870
HST00B 1916
HST00B 1849
067
HST00F 105
HST00F 540
HST00F 428
HST00B 1869
068
HST00F 156
HST00F 539
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069
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HST00F 731
HST00F 158
HST00F 79
HST00F 464
HST00F 183
HST00F 182
HST00F 181

Beter Benutten

Mastenboek Ens - Zwolle

kaart 32

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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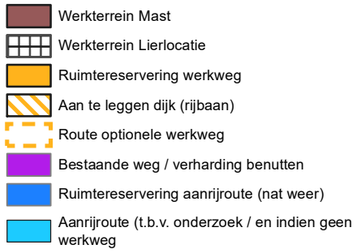
Mastenboek Ens - Zwolle

kaart 33

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
Kenmerk	J:\GisData\p_overig\Beter benutten bestaande 380kV\Producten\ENS-ZL\producten\mastenboek\220209_ENS-ZL_Mastenboek_v8.2_GerUan.mxd		

0 20 40 60 80 100 m.

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HST00F 568
HST00F 164
HST00F 570
HST00F 691
HST00F 692
HST00F 417
HST00F 165
HST00F 418
072
073
HST00F 166
HST00F 207
HST00F 419
HST00F 206
HST00F 167
HST00F 571
HST00F 572
HST00F 531
HST00F 556
HST00F 204
074
HST00F 205
HST00F 260
HST00F 261
HST00F 264
HST00F 631

Beter Benutten

Mastenboek Ens - Zwolle

kaart 34

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:3.500	Formaat	A3
Kenmerk	J:\GisData\p_overig\Beter benutten bestaande 380kV\Producten\ENS-ZL\producten\mastenboek\220209_ENS-ZL_Mastenboek_v8.2_GertJan.mxd		

0 20 40 60 80 100 m.

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HST00F 205
HST00F 206
HST00F 264
HST00F 207
HST00F 631
075
HST00F 632
HST00F 266
HST00F 709
076
HST00F 268
HST00F 270
HST00F 269
HST00F 509
HST00F 344
077
HST00F 645

Beter Benutten

Mastenboek Ens - Zwolle

kaart 35

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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Beter Benutten

Mastenboek Ens - Zwolle

kaart 36

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
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- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
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079
ZLK00W 110
ZLK00W 111
ZLK00W 210
ZLK00W 114
ZLK00W 102
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ZLK00W 76
ZLK00W 77
ZLK00W 78
080
ZLK00W 291
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ZLK00W 79
ZLK00W 508
ZLK00W 510
ZLK00W 509
ZLK00W 511
ZLK00W 226
ZLK00W 227
ZLK00W 100
ZLK00W 307
ZLK00W 146
081
ZLK00W 145

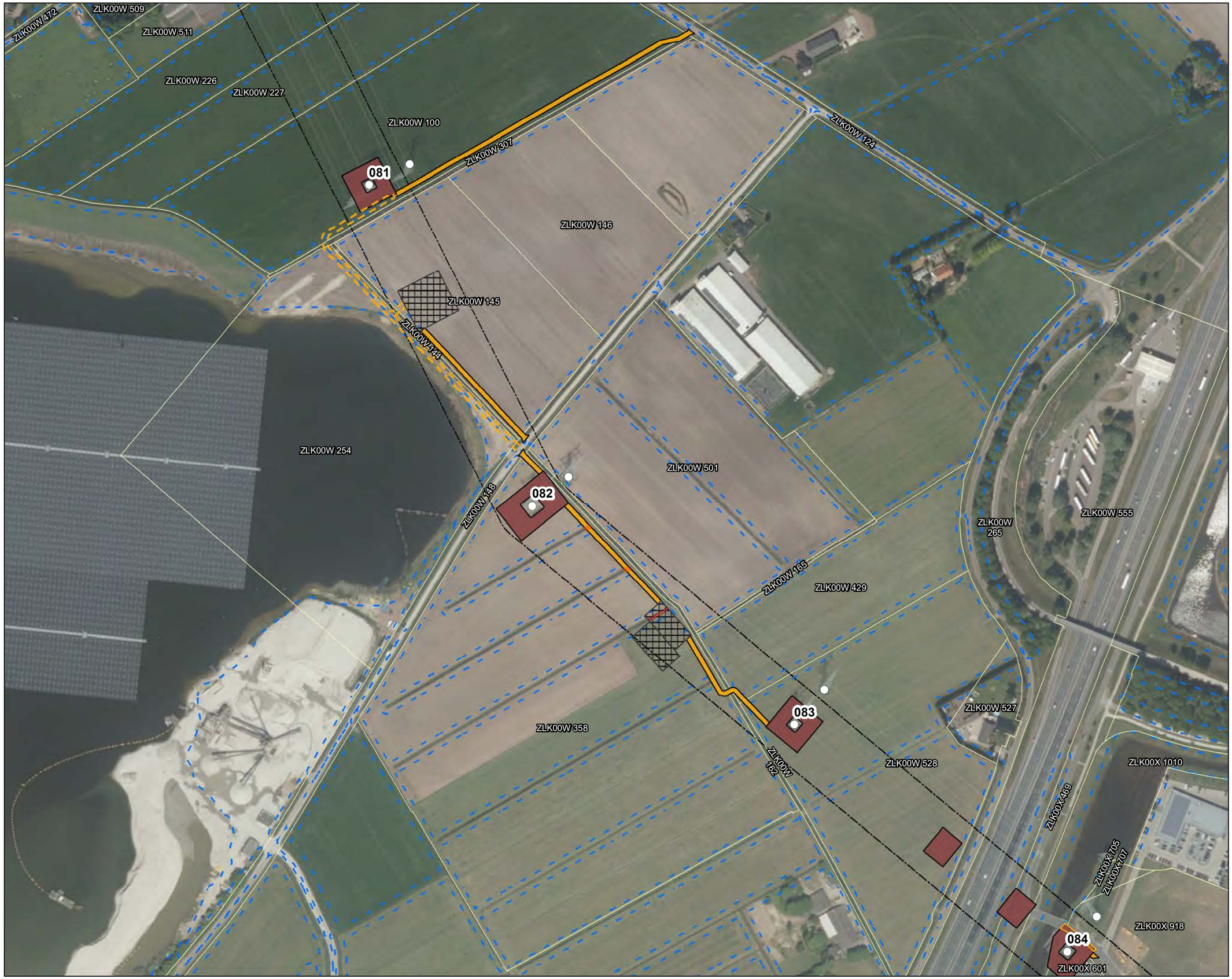
Beter Benutten

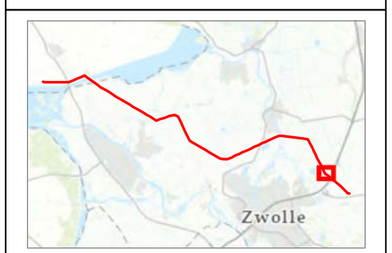
Mastenboek Ens - Zwolle

kaart 37

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel





Versie	8.2	Datum	10-2-2022
Schaal	1:3.500	Formaat	A3
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Beter Benutten

Mastenboek Ens - Zwolle

kaart 38

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
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- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
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Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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ZLK00X 1010
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ZLK00W 265
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085
ZLK00X 602
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ZLK00X 475
ZLK00X 111
ZLK00X 586
ZLK00X 595
ZLK00X 1195
086
ZLK00X 649
ZLK00X 1214
ZLK00X 650

Beter Benutten

Mastenboek Ens - Zwolle

kaart 39

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
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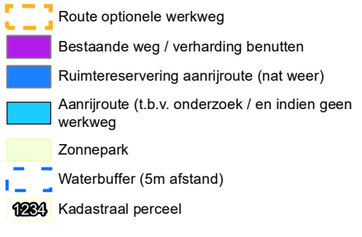
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel



Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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0 20 40 60 80 100 m.

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ZLK00X 586
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086
ZLK00X 649
ZLK00X 1222
ZLK00X 1215
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ZLK00X 1217
ZLK00X 1225
ZLK00X 1214
087
ZLK00X 1221
ZLK00X 119
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ZLK00X 726
ZLK00X 1122
ZLK00X 929
ZLK00X 1101
ZLK00X 1200
ZLK00X 661
ZLK00X 1108
ZLK00X 1188
088
ZLK00X 1095
ZLK00X 1123
ZLK00X 1103
ZLK00X 1124
ZLK00X 1093
ZLK00X 127
ZLK00X 1090
ZLK00X 1194
ZLK00X 1193
ZLK00X 1125
ZLK00X 1175

Beter Benutten

Mastenboek Ens - Zwolle

kaart 40

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
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0 20 40 60 80 100 m.

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087
088
089
090
ZLK00X 1214
ZLK00X 1221
ZLK00X 1225
ZLK00X 1217
ZLK00X 726
ZLK00X 1105
ZLK00X 1122
ZLK00X 929
ZLK00X 1200
ZLK00X 1101
ZLK00X 119
ZLK00X 661
ZLK00X 1108
ZLK00X 1188
ZLK00X 1096
ZLK00X 1123
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ZLK00X 1103
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ZLK00X 1090
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ZLK00X 664
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ZLK00X 348
ZLK00X 131
ZLK00X 132
ZLK00X 193
ZLK00X 134
ZLK00X 135
ZLK00X 160
ZLK00X 666
ZLK00X 1194
ZLK00X 1125
ZLK00X 1175
Station Zwolle Hessenweg 110
Station Hessenweg 220
ZLK00X 694
ZLK00X 695
ZLK00X 667
ZLK00X 1066
ZLK00X 1084
ZLK00X 1193
ZLK00X 1174
ZLK00X 820
ZLK00X 618
ZLK00X 162
ZLK00X 1171
ZLK00X 1177
ZLK00X 1170
Station Zwolle 380
MPC
ZLK00X 371
ZLK00X 1169
ZLK00X 380
ZLK00X 370
ZLK00X 373
ZLK00X 944
ZLK00X 508
ZLK00X 1183
ZLK00X 1172
DSN01N 884

Beter Benutten

Mastenboek Ens - Zwolle

kaart 41

Legenda

- Mastfundering aanpassen
- Mastfundering niet aanpassen
- Zakelijk rechtstrook
- Station
- Mogelijk snoeien
- Op weg of spoorweg
- Op water
- Over water
- Werkterrein Mast
- Werkterrein Lierlocatie
- Ruimtereservering werkweg
- Aan te leggen dijk (rijbaan)
- Route optionele werkweg
- Bestaande weg / verharding benutten
- Ruimtereservering aanrijroute (nat weer)
- Aanrijroute (t.b.v. onderzoek / en indien geen werkweg
- Zonnepark
- Waterbuffer (5m afstand)
- 1234 Kadastraal perceel

Versie	8.2	Datum	10-2-2022
Schaal	1:2.500	Formaat	A3
Kenmerk	J:\GisData\p_overig\Beter benutten bestaande 380kV\Producten\ENS-ZL\producten\mastenboek\220209_ENS-ZL_Mastenboek_v8.2_GerUan.mxd		

0 20 40 60 80 100 m.

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ZLK00X 1105
ZLK00X 1122
ZLK00X 1101
ZLK00X 1217
ZLK00X 661
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ZLK00X 119
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DSN01N 38
DSN01N 641
ZLK00X 131
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ZLK00X 193
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088
ZLK00X 1221
ZLK00X 1095
ZLK00X 1188
ZLK00X 1123
ZLK00X 664
ZLK00X 1124
ZLK00X 1103
ZLK00X 134
ZLK00X 1093
ZLK00X 127
ZLK00X 1090
ZLK00X 666
ZLK00X 160
ZLK00X 135
DSN01N 1
ZLK00X 374
ZLK00X 375
ZLK00X 1194
ZLK00X 1125
ZLK00X 376
Station Zwolle Hessenweg 110
Station Hessenweg 220
ZLK00X 1175
ZLK00X 694
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ZLK00X 1084
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DSN01N 1114
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ZLK00X 1174
ZLK00X 1170
ZLK00X 820
Zwolle
Dalfsen
DSN01N 1115
Station Zwolle 380
089
ZLK00X 1171
ZLK00X 373
ZLK00X 1177
ZLK00X 818
090
ZLK00X 377
MPC
ZLK00X 370
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ZLK00X 780
ZLK00X 378
DSN01N 1117
ZLK00X 508
ZLK00X 1183
ZLK00X 155

Bijlage 3

Overzicht Masten

mastnummer	masttype	aanpassen mast	aanpassen fundering	gemeente
portaal ENS	Portaal	nee		Noordoostpolder
1	EC-3 RX	ja		Noordoostpolder
2	S-3	n		Noordoostpolder
3	S-3	n		Noordoostpolder
4	S-3	n		Noordoostpolder
5	S-3	n		Noordoostpolder
5a	S+6	nee		Noordoostpolder
6	HB-3 RX	ja		Noordoostpolder
7	S+0	n		Noordoostpolder
8	S+0	n		Noordoostpolder
9	S+0	n		Noordoostpolder
10	HC-3 RII	ja		Noordoostpolder
11	S+30	n		Noordoostpolder
12	S+30	n		Noordoostpolder
13	S+0	n		Kampen
14	HA-3	nee		Kampen
15	S-3	n		Kampen
16	S-3	n		Kampen
17	S-3	n		Kampen
18	S-3	n		Kampen
19	S-6 R	ja		Kampen
20	S-6 R	ja		Kampen
21	S-6 R	ja		Kampen
22	S-6 R	ja		Kampen
23	S-6 R	ja		Kampen
24	S-6 R	ja		Kampen
25	S-6 R	ja		Kampen
26	S+12	n		Kampen
27	S+12	n		Kampen
28	S-6 R	ja		Kampen
29	S-6 R	ja		Kampen
30	HC-3 R	ja		Kampen
31	S-3	n		Kampen
32	S+0	n		Kampen
33	S+0	n		Kampen
34	HC-3 R	ja		Kampen
35	HB+0 RX	ja		Zwartewaterland
36	S-3	n		Zwartewaterland
37	S-3	n		Zwartewaterland
38	S+0	n		Kampen
39	S-3	n		Kampen
40	HB-3 R	ja		Kampen
41	S-6 R	ja		Kampen
42	S-6 R	ja		Kampen
43	S-6 R	ja		Kampen
44	S-6 R	ja	ja	Kampen
45	S-6 R	ja	ja	Kampen
46	S-6 R	ja		Kampen

	47	S-6 R	ja		Kampen
	48	S-6 R	ja	ja	Kampen
	49	HB-3 R	ja		Zwolle
	50	S-6 R	ja		Zwolle
	51	HB-3 R	ja		Zwolle
	52	S-6 R	ja		Zwolle
	53	S-6 R	ja		Zwolle
	54	S-6 R	ja		Zwolle
	55	S-3	n		Zwolle
	56	S-3	n		Zwolle
	57	S-3	n		Zwartewaterland
	58	S-6 R	ja		Zwartewaterland
	59	S-6 R	ja		Zwartewaterland
	60	S-6 R	ja		Zwartewaterland
	61	S-6 R	ja	ja	Zwartewaterland
	62	S-6 R	ja		Zwartewaterland
	63	S-6 R	ja		Zwartewaterland
	64	S-6 R	ja	ja	Zwartewaterland
	65	HB+9 RX	ja		Zwartewaterland
	66	S+12	n		Zwartewaterland
	67	S+0	n		Zwartewaterland
	68	S-6 R	ja		Zwartewaterland
	69	S-6 R	ja		Zwartewaterland
	70	S-6 R	ja		Zwartewaterland
	71	S-6 R	ja		Zwartewaterland
	72	S-6 R	ja		Zwartewaterland
	73	HC-3RC	ja		Zwartewaterland
	74	S-3	n		Zwartewaterland
	75	S-6	nee		Zwartewaterland
	76	S-6	nee		Zwartewaterland
	77	S-6	nee		Zwartewaterland
	78	S-6	nee		Zwolle
	79	S-6	nee		Zwolle
	80	S-6	nee		Zwolle
	81	S-6	nee		Zwolle
	82	HA-6 RC	ja		Zwolle
	83	S-6	nee		Zwolle
	84	S-3	nee		Zwolle
	85	S-6	nee		Zwolle
	86	S-6	nee		Zwolle
	87	S-6	nee		Zwolle
	88	HA-6RC	ja		Zwolle
	89	S+15 R	ja		Zwolle
	90	EC-3 RX	ja		Zwolle
portaal Zwolle		juk	n		Zwolle

Bijlage 4

Gegevens DO per masttype

TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380

ENS-ZL380 – Rapportage masttype S-6/R

TenneT TSO B.V.

Rapport nr.: 22-0535, Rev. 0
Meridian doc.nr.: 002.515.40 1007973
Datum: 2022-04-01

Projectnaam:	Toetsing en herontwerp masten en fundaties BBB380	Energy Systems
Rapport titel:	ENS-ZL380 – Rapportage masttype S-6/R	DNV Netherlands B.V.
Klant:	TenneT TSO B.V.,	Utrechtseweg 310-B50
Contactpersoon klant:	P. v.d. Horst	6812 AR Arnhem
Datum uitgave:	2022-04-01	
Project nr.:	10166260	
Organisatie unit:	TDT	Tel: 026 356 9111
Meridian doc.nr..:	002.515.40 1007973	Handelsregister Arnhem 09006404
Rapport nr.:	22-0535, Rev. 0	

Geschreven door:	Beoordeeld door:	Goedgekeurd door:
M.H. Khan	A.J. Börger	C. Schutte

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*Specificatie distributie: --

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1 INLEIDING

1.1 Inleiding

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen zodat er een grotere transportcapaciteit mogelijk wordt gemaakt.

Om die reden is de opdrachtgever (OG) voornemens de bestaande 380 kV-koppelnetring op te waarderen. Het opwaarderen van de bestaande verbindingen valt onder het programma “Beter benutten bestaande 380 kV-ring” en omvat de volgende deelprojecten:

- Opwaardering 380 kV-verbinding Lelystad – Ens (LLS-ENS380)
- Opwaardering 380 kV-verbinding Diemen – Lelystad (DIM-LLS380)
- Opwaardering 380 kV-verbinding Rilland – Zandvliet (RLL-ZVL380)
- Opwaardering 380 kV-verbinding Krimpen aan den IJssel - Geertruidenberg (KIJ-GT380)
- Opwaardering 380 kV-verbinding Ens - Zwolle (ENS-ZL380)
- Opwaardering 380 kV-verbinding Maasbracht - Eindhoven (MBT-EHV380)

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV opdracht verstrekt voor de volgende onderdelen:

1. In eerste fase het opstellen en creëren van:

1.1 E-studie deel 1

1.2 Uitgangspuntenrapporten ten behoeve van de constructieve analyse van masten en fundaties

1.3 Sonderingmodellen

1.4 Fundatiemodellen

1.5 Mastmodellen

2. In tweede fase de uitvoering van de DO-fase bevattende:

2.1 Toetsing conform het uitgangspuntenrapport van de bestaande fundaties

2.2 Globale specificatie van benodigde fundatieversterkingen ten behoeve van aanbesteding

2.3 Toetsing conform het uitgangspuntenrapport van de bestaande masten

2.4 Globale specificatie van benodigde mastversterkingen ten behoeve van aanbesteding

2.5 E-studie deel 2

1.2 Doel van dit rapport

In dit rapport wordt voor de hoogspanningslijn Ens - Zwolle de controle van de mastconstructie van masttype S-6/R gerapporteerd. Het doel is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de nieuwe ACCC-Warsaw geleider waarmee een hogere capaciteit kan worden gerealiseerd.

Nadat de wijzigingen zijn toegepast dient aantoonbaar geverifieerd te worden dat het systeem voldoet aan de vigerende eisen.

In de defintief-ontwerpfase zijn ten behoeve van de contractvorming Engelstalige rapporten geleverd. Het voorliggende rapport is bedoeld voor vergunningsaanvraag en is inhoudelijk ongewijzigd ten opzichte van de Engelse versie. Om deze reden zijn de bijlagen in dit rapport één op één overgenomen uit de Engelse versie. Hierdoor wijkt het revisienummer van de bijlagen af van het revisienummer van de rapportage.

1.3 Gerelateerde documenten

1.3.1 Verificatie & validatieplan

De door TenneT aangeleverde set met eisen is beoordeeld op relevantie en voor de relevante eisen is aangegeven in welk document wordt aangetoond dat er aan de eis wordt voldaan. De resultaten hiervan zijn opgenomen in het rapport “Verificatie & Validatieplan 380 kV verbinding Ens - Zwolle”.

1.3.2 E-studie deel 1

In de rapportage “ENS-ZL380 - E-studie deel 1” [1] is bepaald welke aanpassingen benodigd zijn om de ACCC-Warsaw geleider toe te passen binnen de verbinding Ens – Zwolle.

Op een aantal masten locaties waar masttype S-6/R staat is sprake van overschrijdingen op de interne afstanden. Dit omvat mast 28 en 72. Voor deze masten is het vereist dat de ophangisolatoren worden gewijzigd in een V-ophanging bestaande uit stijve post-isolatoren

1.3.3 Uitgangspuntendocument

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport “Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” [2].

2 EISEN

In onderstaande Tabel 1zijn de eisen opgenomen die binnen deze rapportage worden getoetst.

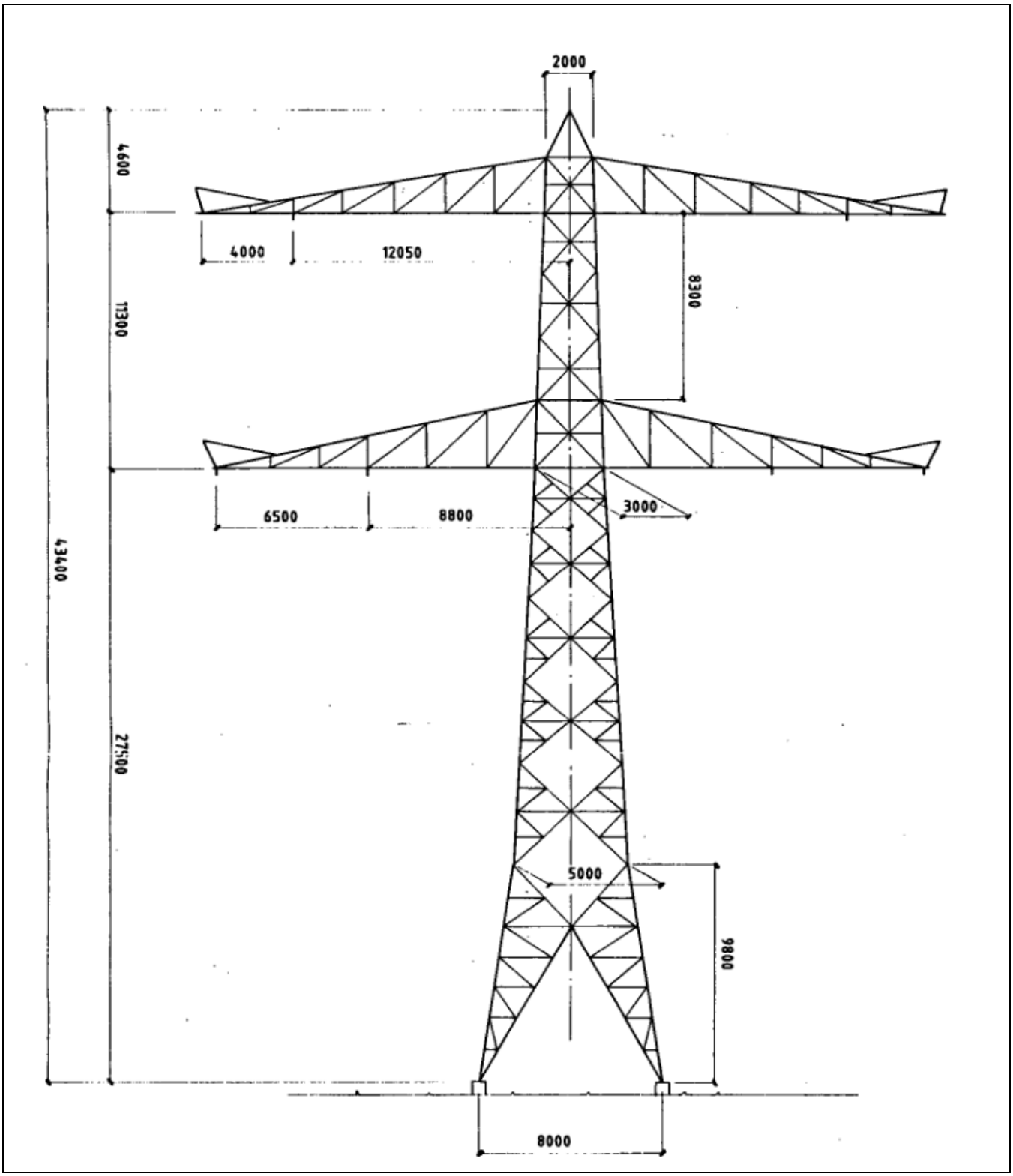
Tabel 1 Relevante eisen

Req. Id	Title	Req. text	Verification
BO Eis: H2.7-6	Omgeving, beperkingsfactoren	Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid.	Tabel 6
PVE.05.001 5.14	Masten	Aanwijzingen t.a.v. klimvoorziening en valbeveiliging: Huidige klimweg blijft gehandhaafd en zal voldoen aan de eisen zoals opgenomen in de NEN 1060:1987. Valbeveiliging is/zal worden uitgevoerd in het type "latch way". Indien staaldelen in de nabijheid (aangrenzend profiel) van de klimweg gewijzigd worden, dient geverifieerd te worden dat de klimvoorziening in overeenstemming is met de NEN 1060:1987.	Tabel 6

3 BEREKENINGEN

3.1 Mastbeeld

Het mastbeeld op basis van de Asset-data is weergegeven in Figuur 1.



Figuur 1 Mastbeeld S-6/R

3.2 Mastenlijst

In deze rapportage wordt masttype S-6/R getoetst. De S-6/R masten bevinden zich in windgebied II. De geleider belastingen zijn gebaseerd op hoogte van aangrenzende masten (positieve waarden duiden op een toename in hoogte). De wind en span van de verschillende masten zijn in Tabel 2 weergegeven.

Masten 28 en 72 vereisen V-fixaties vanwege overschrijdingen met de interne afstanden, daarom wordt mast 28 als maatgevende mast van 28 en 72 ook berekend in dit rapport.

Tabel 2 Mastnummers

Tower number	Tower type	Governing tower number	Wind span (m)	Weight span (m)	Height difference back (m)	Height difference ahead (m)
19	S-6/R	22	347	334	3,1	-0,3
20	S-6/R	22	351	350	0,3	-0,1
21	S-6/R	22	355	356	0,1	-0,1
22	S-6/R	22	361	360	0,1	0,4
23	S-6/R	22	341	343	-0,4	-0,2
24	S-6/R	22	320	321	0,2	-0,2
25	S-6/R	22	341	243	0,2	18,3
28	S-6/R	22	298	174	19,8	-0,4
29	S-6/R	22	302	291	0,4	1,6
41	S-6/R	22	289	267	2,7	0,0
42	S-6/R	22	350	351	0,0	0,0
43	S-6/R	22	347	346	0,0	0,3
44	S-6/R	22	350	352	-0,3	0,0
45	S-6/R	22	343	343	0,0	0,1
46	S-6/R	22	339	340	-0,1	0,1
47	S-6/R	22	342	344	-0,1	-0,1
48	S-6/R	22	347	331	0,1	3,0
50	S-6/R	22	316	284	2,8	2,7
52	S-6/R	22	363	350	3,1	0,2
53	S-6/R	22	358	358	-0,2	0,0
54	S-6/R	22	304	283	0,0	3,0
58	S-6/R	22	358	344	3,0	0,0
59	S-6/R	22	358	357	0,0	0,6
60	S-6/R	22	324	326	-0,6	0,1
61	S-6/R	22	320	322	-0,1	0,1
62	S-6/R	22	350	352	-0,1	-0,2
63	S-6/R	22	287	279	0,2	1,0
64	S-6/R	22	281	206	-1,0	16,7
68	S-6/R	22	341	309	6,5	-0,7
69	S-6/R	22	354	351	0,7	-0,2
70	S-6/R	22	350	350	0,2	-0,2
71	S-6/R	22	346	347	0,2	0,2
72	S-6/R	22	265	152	-0,2	12,4

3.3 Uitgangspunten berekening

De berekening is uitgevoerd op basis van de uitgangspunten zoals opgenomen in het uitgangspuntenrapport [2]. Hierin is een volledig overzicht opgenomen van de belastingcombinaties en toegepaste belastingfactoren

Tabel 3 Uitgangspunten berekening

Algemeen	Norm	NEN-EN50341-2-15:2019
	Windgebied	III
	Terreincategorie	II (onbebouwde omgeving)
	Reductiefactor cdir	1,00
Situatie initieel	Gevolgklasse	CC2-0
	Betrouwbaarheidsniveau	Afkeur CC2-0
	Referentieperiode	30 jaar
Situatie na aanpassingen	Gevolgklasse	CC2
	Betrouwbaarheidsniveau	Verbouw
	Referentieperiode	50 jaar

3.4 Proces stappen

Het proces van het bepalen van eventueel benodigde verstevigingen bestaat uit de volgende stappen:

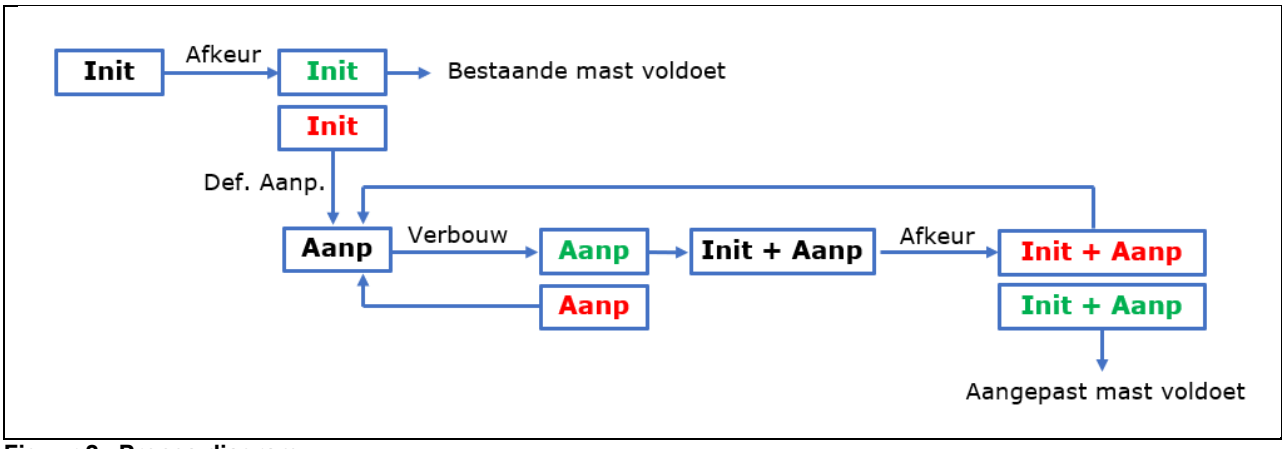
Stap 1: Toets bestaande (Init) mast op Afkeur

Stap 2: Definiëren benodigde aanpassingen indien initiële mast niet voldoet aan toets op Afkeur (Def. Aanp.)

Stap 3: Het toetsen van (alleen) de uitgewerkte aanpassingen (Aanp) op Verbouw

Stap 4: Het opnieuw toetsen van de complete mast inclusief aanpassingen (Initi + Aanp) op Afkeur

Het hierboven omschreven proces is in Figuur 2 weergegeven.



Figuur 2 Proces diagram

3.5 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV. In Appendix A zijn de resultaten van de geleiderbelastingen samengevat.

3.6 Reacties op de fundering

De oplegreacties op de fundering worden ontleend aan de uitvoer van het geleiderbelastingenprogramma, zie ook Appendix A.

3.7 Modellering

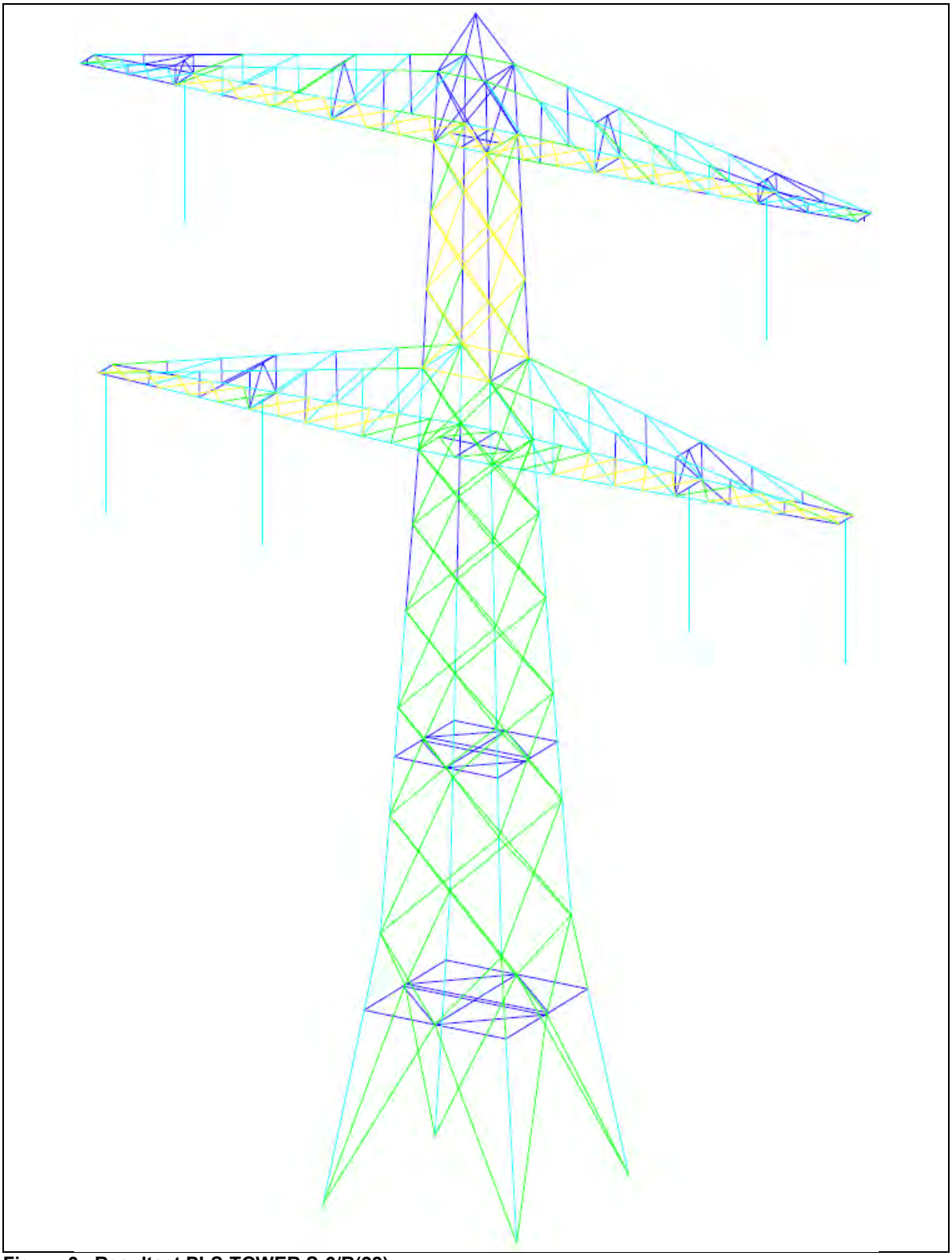
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

De geleiderbelastingen vanuit het geleiderbelastingenprogramma zijn als invoer voor de belastingen gebruikt.

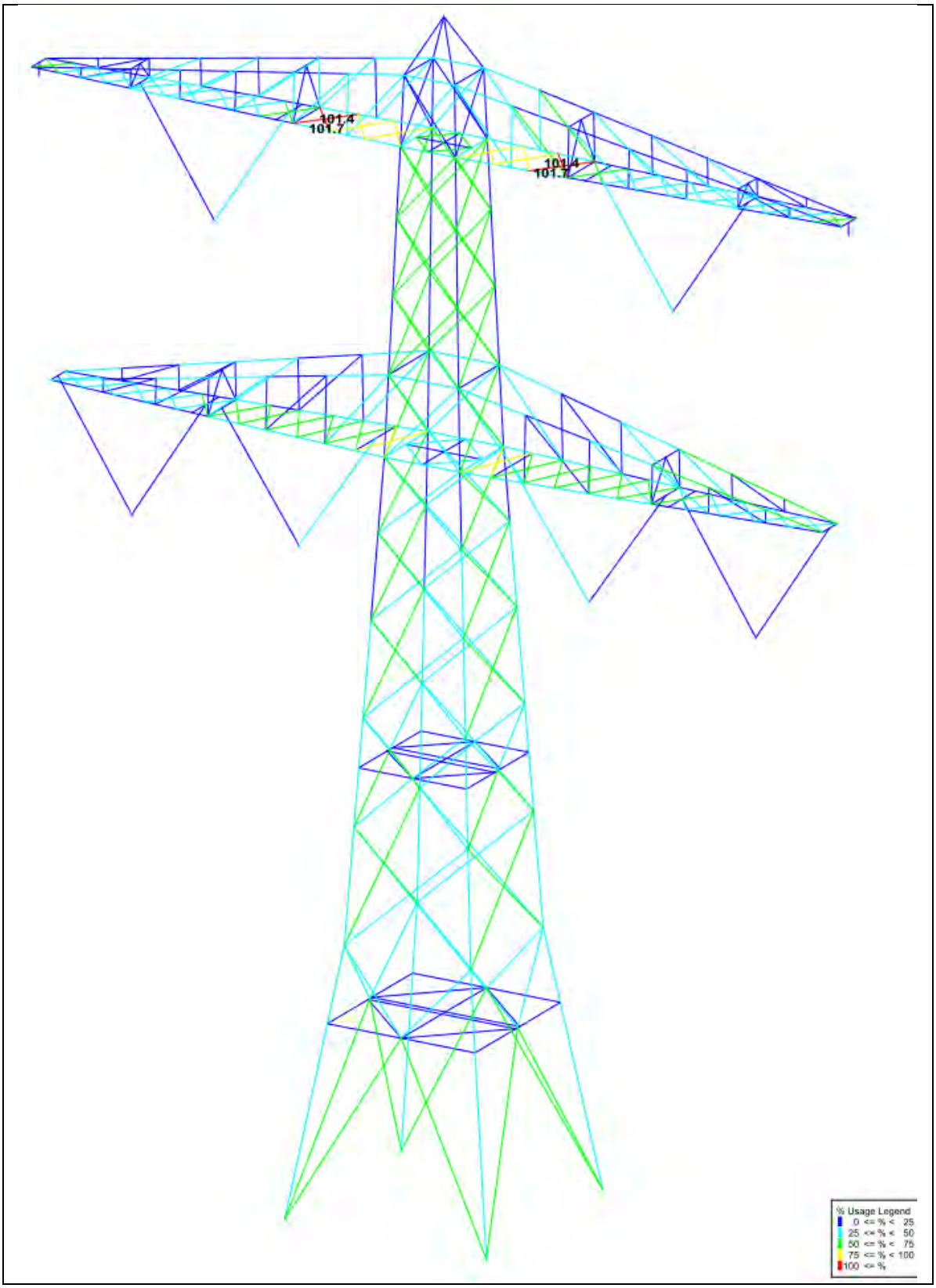
Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

4 TOETSING MASTCONSTRUCTIE

Het resultaat van de controle van de mastconstructie type S-6/R met belastingen op afkeurniveau is weergegeven in Figuur 3 en Figuur 4.



Figuur 3 Resultaat PLS-TOWER S-6/R(22)



Figuur 4 Resultaat PLS-TOWER S-6/R(28)

De resultaten van de controles van profielen, knikverkorters en ankers randstijl zijn opgenomen in Tabel 4.

Sommige profielen in PLS-TOWER zijn berekend aan de hand van een conservatieve aanpak met betrekking tot de stuikcapaciteit, daarom heeft DNV de capaciteit overschreven van deze profielen (Groep 316, 317,320, 321, 322, 323 en 418) aan de hand van handmatige berekeningen. Deze berekeningen zijn weergegeven in Appendix D.

Tabel 4 Samenvatting controle

Controle van	Beoordeling		Referentie
Profielen van S-6/R (22)	Voldoen		Figuur 3 Appendix B
Profielen van S-6/R (28)		Voldoen niet	Figuur 4 Appendix B
Knikverkorters	Voldoen		Appendix C
Blokdeuvels	Voldoen		Appendix D

5 AANPASSINGEN

5.1 Inleiding

In deze paragraaf worden versterkingen voorgesteld om ervoor te zorgen dat de mast aan de eisen van het “afkeurniveau” voldoet. Het voorstel bevat de volgende maatregelen:

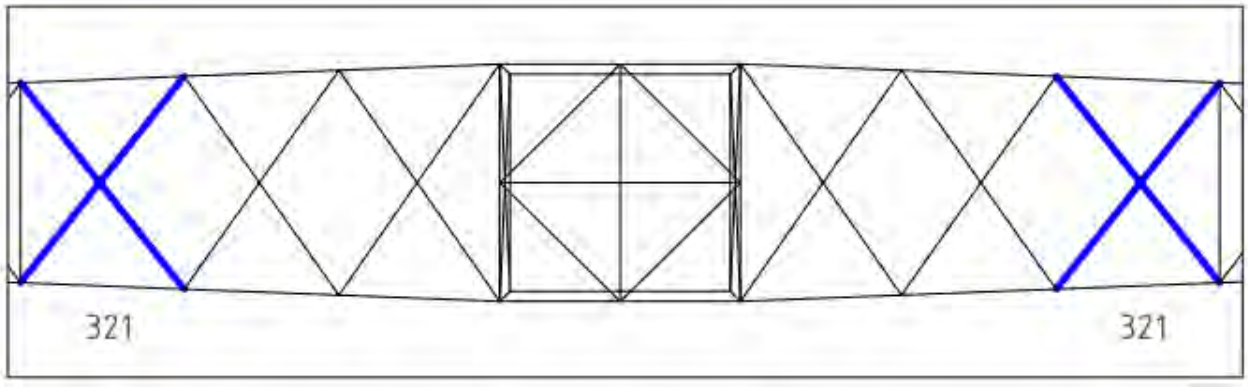
- Uitwisselen van een kruisende diagonaal in de onderste koorde van de bovenste traverse;

- Extra nieuwe liggers ter ondersteuning van V-bevestigingen;

- Extra klimladder.

5.2 Aanpassingen

Overeenkomstig de resultaten in Appendix B moeten de eerder in dit hoofdstuk beschreven wijzigingen worden toegepast.



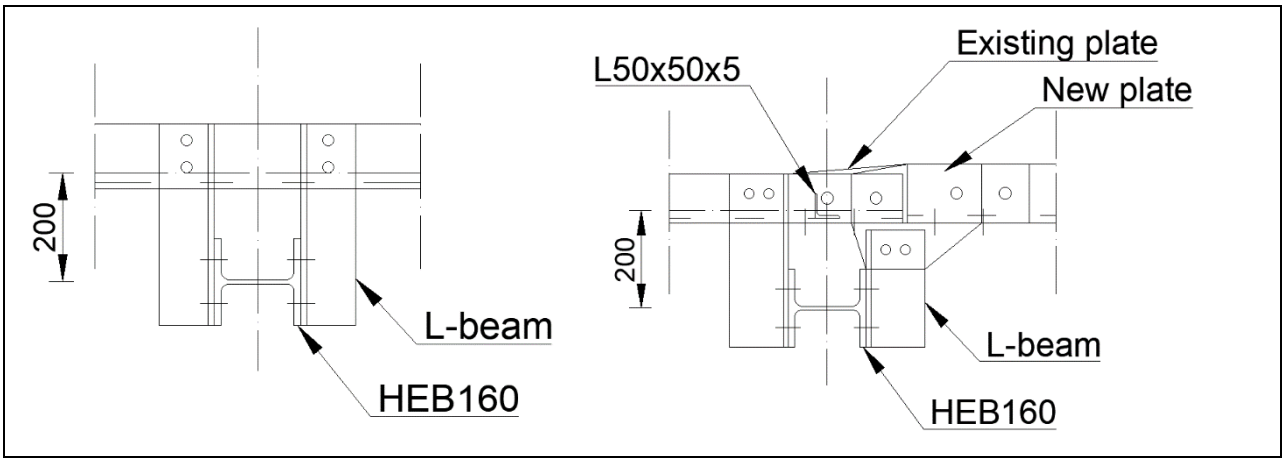
Figuur 5 Bovenaanzicht - Ondervlak van boventraverse (Mast 28)

5.2.1 Controle van nieuwe liggers

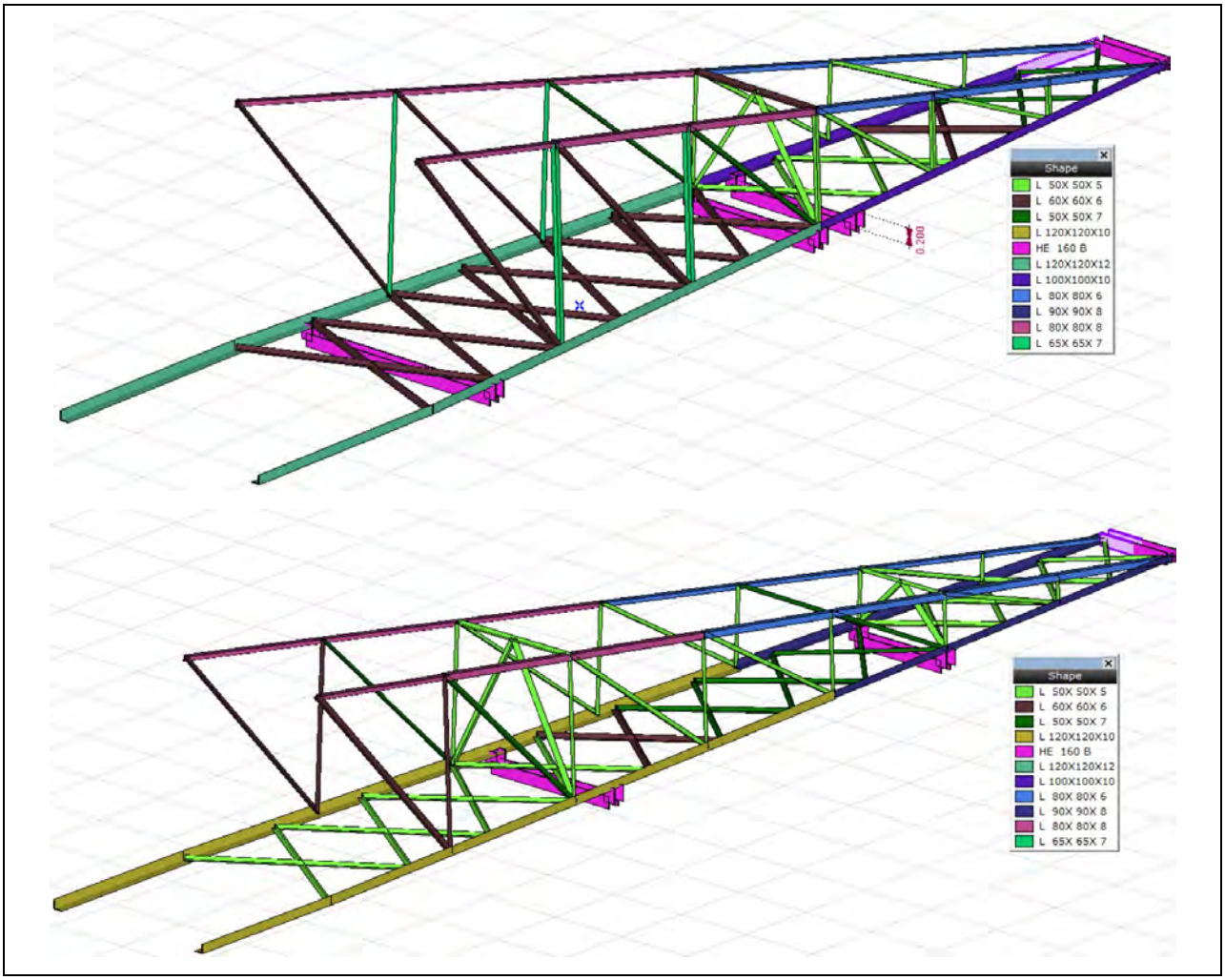
Voor de ophanging van de isolatorkettingen zijn onder de traverse nieuwe HE-balken aangebracht. Het ontwerp van de liggers is afgeleid van bestaande S+0 masten van RLL-ZVL. Zie Figuur 6.

Figuur 6 Principe ophanging isolator kettingen met HE-balken

Om de nieuwe locatie van de isolator te ondersteunen, zijn onder extra liggers toegevoegd. Zie Figuur 7 voor de principe aansluitingen op bestaande liggers en zie figuur 5 4 voor een overzicht van de staven.



Figuur 7 Principe aansluitingen op bestaande liggers



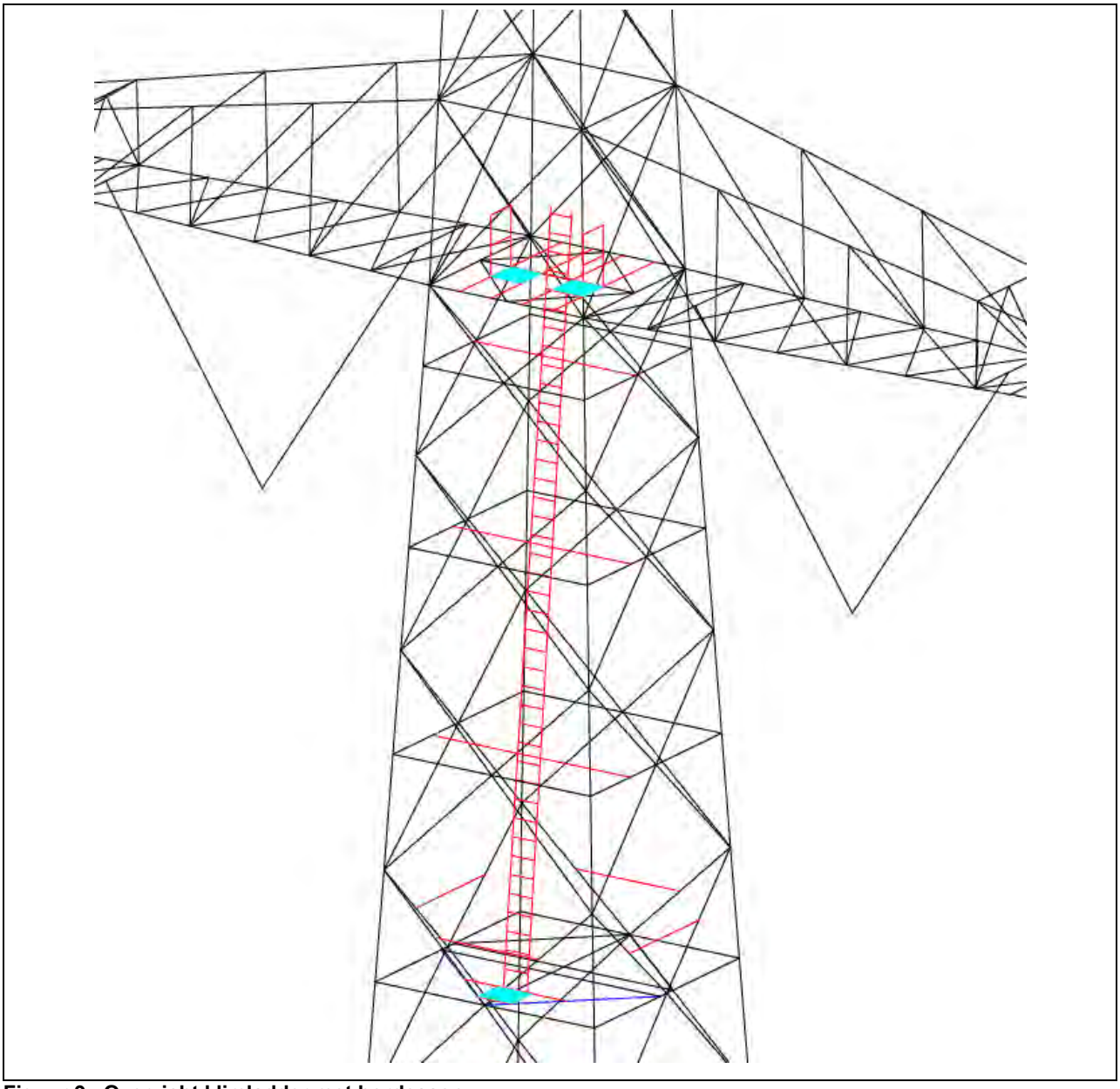
Figuru 8 Overzicht mast leden

Berekening van de traverse met nieuwe toegevoegde staven is te vinden in Appendix F.

5.2.2 Klimladder

De geleiders worden dichter bij het mastenlichaam geplaatst. Er moet een centrale klimweg worden voorzien om veilige klimafstanden te kunnen halen. Deze loopt van het horizontaal verband in het tussenstuk naar de onderste traverse. Bestaande klimpennen dienen over de hoogte van de ladder te worden verwijderd. Een valbeveiligingssysteem in de vorm van een vergrendelingssysteem of gelijkwaardig loopt met de ladder mee. De ladder wordt uitgevoerd met bordessen aan de boven- en onderkant.

De berekening van de klimladder is afgeleid van de ladder van masttype S+0/K van RLL-ZVL. De afmetingen van de ladder van masten S-6/R (28) zijn kleiner in vergelijking met S+0/K, waardoor het veilig is om dezelfde geometrie te gebruiken. Voor de berekening van de klimladder zie Appendix G.



Figuur 9 Overzicht klimladder met bordessen

Voor informatie over staafmaten en boutmaten, zie tekening in Appendix E. De afmetingen zijn weergegeven in Tabel 5. Extra gewichten voor bouten en platen in de verbindingen zijn niet inbegrepen.

Tabel 5 Gewicht van profielen vereist voor aanpassingen aan masten S-6/R (28)

Group Label	Profile ini.	Material ini.	Bolts ini.	Profile new	Material new	Bolts new	Mitigation	Number	Length (m)	Weight (kg)
321	L50.5	S235	1M16-8.8t	L50.5	S355	1M16-8.8t	Profile exchanged	4	2.41	36.3
L1				L100.50.6	S355	M16-8.8t	Profile added	2	12.36	169.1
L2				Rod 20mm diam	S355	M16-8.8t	Profile added	42	0.40	41.5
L3				L60.6	S355	M16-8.8t	Profile added	3	0.60	9.76
L4				L80.8	S355	M16-8.8t	Profile added	1	1.80	18
L5				L100.8	S355	M16-8.8t	Profile added	1	4.19	52
L6				L80.8	S355	M16-8.8t	Profile added	1	3.66	36
L7				L80.8	S355	M16-8.8t	Profile added	1	3.20	31
L8				L80.8	S355	M16-8.8t	Profile added	4	3.00	118
L9				L80.8	S355	M16-8.8t	Profile added	1	1.80	18
L10				L80.8	S355	M16-8.8t	Profile added	2	0.60	12
R1				L60.6	S355	M16-8.8t	Profile added	4	1.00	22
R2				L60.6	S355	M16-8.8t	Profile added	4	0.60	13
R3				L60.6	S355	M16-8.8t	Profile added	4	2.25	50
T1				HEB160	S355	M24-8.8t	Profile added	2	1.78	151.66
T2				HEB160	S355	M24-8.8t	Profile added	2	1.31	111.61
T3				HEB160	S355	M24-8.8t	Profile added	2	2.82	240.26
T4				HEB160	S355	M24-8.8t	Profile added	2	1.94	165.29
T5				HEB160	S355	M24-8.8t	Profile added	2	1.84	156.77
T6				HEB160	S355	M24-8.8t	Profile added	2	1.00	85.2
T7				L50.5	S355	M16-8.8t	Profile added	2	1.84	13.87
229	L60.6	S235	1M16-8.8t	L80.8	S355	1M20-8.8t	Profile exchanged	2	2.89	55.6
Totaal									127.05	1606.97

5.3 Eisenverificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 6.

Tabel 6 Verificatie eisen

Eis Id	Eis Tekst	Ja	Nee	N.v.t.	toelichting
BO Eis: H2.7-6	Aanpassingen uitvoerbaar?	X			De toe te voegen staalonderdelen zijn met geboute verbindingen te bevestigen. Dit is een bewezen methode.
PVE.05.001 5.14	Staaldelen in nabijheid van klimweg gewijzigd?	X			De wijzigingen in de nabijheid van de klimweg (knikverkorters) zijn in te passen zonder negatieve invloed op de begaanbaarheid.
	klimvoorziening nog in overeenstemming is met de NEN 1060:1987?	X			Geen wijzigingen

6 REFERENTIES

[1] „002.515.40 0825824 - 21-0462 - Verificatie & validatieplan 380kV verbinding Ens - Zwolle”.
[2] „002.515.40 0825812 - 20-1465 - E-studie deel 1 380kV verbinding Ens - Zwolle”.
[3] „002.515.40 0825820 - 20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle”.

APPENDIX A
Geleiderbelastingen

Inhoud

- Uitgangspunten p. 2
- Mastconstructie p. 6
- Tussenresultaten p. 8
- Belastingen initiëel p. 10
- Belastingen na aanpassing p. 15

Gegevens

Norm	NEN-EN50341-2-15:2019
Initieel	
Gevolgklasse	CC2-0
Betrouwbaarheidsniveau	Afkeur
Referentieperiode	30 jaar
Na aanpassing	
Gevolgklasse	CC2
Betrouwbaarheidsniveau	Verbouw
Referentieperiode	50 jaar
Windgebied	III
Terreincategorie	II
IJsgebied	B
Masttype	Steunmast
Masthoogte	43,4 m
Veldlengte	372,2 m
Lijnhoek	180°
Trekparameter	1760 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-10-30			

Client: TenneT – Taking power further

DNV·GL

Title:

Berekening masttype S-6 R

JOB No.	-	DATE	-
DRAWN	-	CHKD	-
DESIGN	-	APPD	-

Document name:

ENS-ZL_S-6 R_22_Report.pdf

Project number:

Project client number:

0.0											

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Geleiderbelastingen

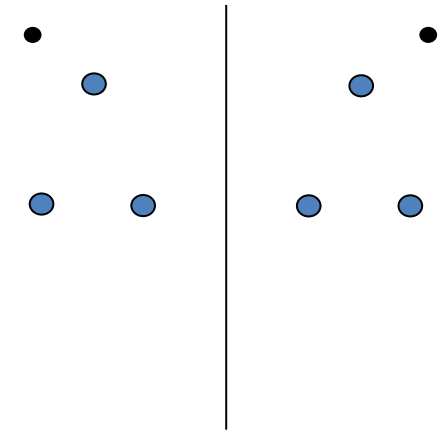
Auteur: TBR
Versie: v10.4

Algemeen

Benaming	S-6 R
Masttype	Steunmast
Aantal circuits	2
Configuratie	2-circuit-donau
Aantal bliksemgeleiders	2

Uitgangspunten

Norm	NEN-EN50341-2-15:2019
Gevolgklasse initieel	CC2-0
Betrouwbaarheidsniveau initieel	Afkeur CC2-0
Referentieperiode initieel	30 jaar
Gevolgklasse na aanpassing	CC2
Betrouwbaarheidsniveau na aanpassing	Verbouw
Referentieperiode na aanpassing	50 jaar
Windgebied	III
Terreincategorie	II
Reductiefactor c_{dir}	1,00
IJsgebied fasegeleider	B
IJsgebied bliksemgeleider	B



Configuratie geleiders

Geleiders Back

Omschrijving	Spanning	Geleider Back	Bundel Ba	IJsgebied	Toeslag gewicht	Toeslag diameter	Intrekwaarden P_{back}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Geleiders Ahead

Omschrijving	Spanning	Geleider Ahead	Bundel Ah	IJsgebied	Toeslag gewicht	Toeslag diameter	Intrekwaarden P_{ahead}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Isolatoren *(1)*

Omschrijving	Ophanging	Gewicht [kN]	Lengte [m]	Windopp. [m^2]
Circuit 1	Halfverankering	2,00	4,50	1,00
Circuit 2	Halfverankering	2,00	4,50	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,30	0,10
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,30	0,10

1. Eigenschappen gelden voor geheel van de isolatorset

Ophanghoogte en positie in mast

Circuits	Aanduiding	Nummer	Ophanghoogte	Aangrijppunt	Positie in mast (3) Horizontale afstand
Circuit 1	10	380ct1f1	23,0 m	27,5 m	-15,3 m
Circuit 1	11	380ct1f2	23,0 m	27,5 m	-8,8 m
Circuit 1	12	380ct1f3	34,3 m	38,8 m	-12,1 m
Circuit 2	21	380ct2f1	23,0 m	27,5 m	15,3 m
Circuit 2	20	380ct2f2	23,0 m	27,5 m	8,8 m
Circuit 2	22	380ct2f3	34,3 m	38,8 m	12,1 m
Bliksemdraad 1	1	bl1	38,5 m	38,8 m	-16,0 m
Bliksemdraad 2	3	bl2	38,5 m	38,8 m	16,0 m

1. Positief = aangrenzende mast hoger
2. Positief = in draairichting assenstelsel x => y

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Hoogteaanpassing naastgelegen masten (aanpassing wind- en weight span)

	Back	Ahead	
Verhoging voor windbelasting	3,0 m	3,0 m	(positief: omhoog)
Verlaging voor verticale belasting	0,0 m	0,0 m	(negatief: omlaag, grotere weight span)

Verlaging: Niet in 0,9EG-combinaties

Hoogteafwijking mastbeeld naastgelegen masten en richtingsverandering t.o.v. Lijnrichting

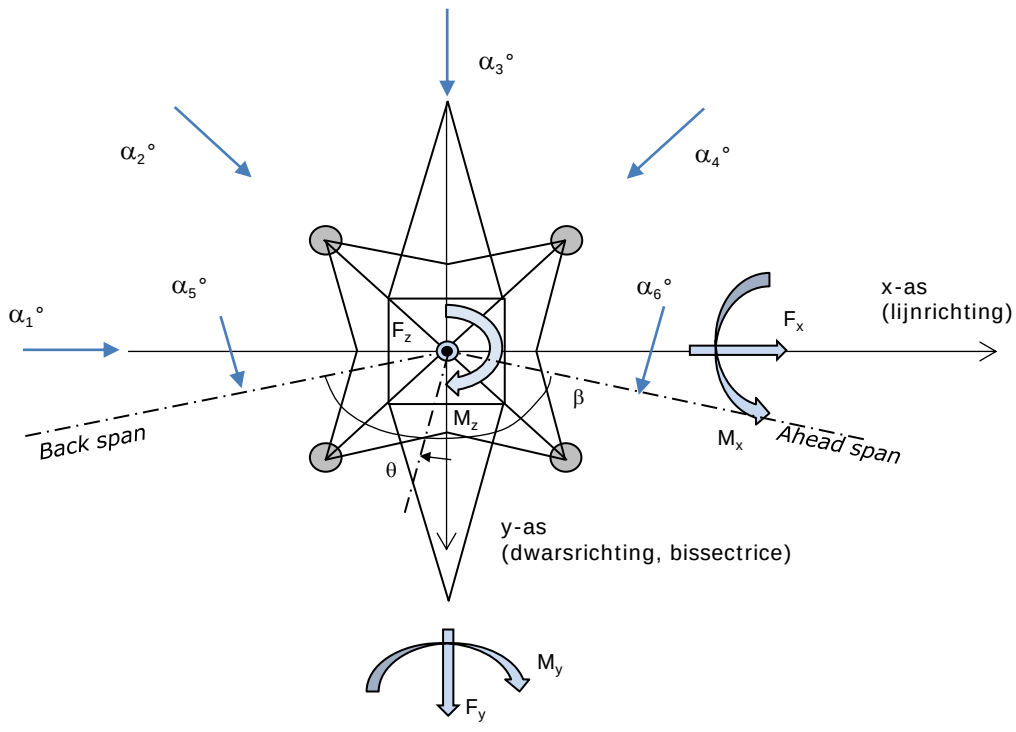
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	0,1	0,4 m	0,0	0,0 m
Circuit 1	11	380ct1f2	0,1	0,4 m	0,0	0,0 m
Circuit 1	12	380ct1f3	0,1	0,4 m	0,0	0,0 m
Circuit 2	21	380ct2f1	0,1	0,4 m	0,0	0,0 m
Circuit 2	20	380ct2f2	0,1	0,4 m	0,0	0,0 m
Circuit 2	22	380ct2f3	0,1	0,4 m	0,0	0,0 m
Bliksemdraad 1	1	bl1	0,1	0,4 m	0,0	0,0 m
Bliksemdraad 2	3	bl2	0,1	0,4 m	0,0	0,0 m

Lijn- en mastgegevens

		Back	Ahead	
Overspanning		350,5	372,2	m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		343,9	343,9	m
Lijnhoek	β	180	°	
Rotatie mast t.o.v. bissectrice	θ	0	°	
Vaklengte		5416	5416	m
Hoogte onderkant mast t.o.v. maaiveld		0,5	m	
Beschouwde windrichtingen	α_1	0	°	
Windrichtingen volgens:	α_2	45	°	
Geleiderbelastingen	α_3	90	°	
	α_4	135	°	
	α_5	-	°	
	α_6	-	°	

Windrichtingen gelden t.o.v. hoofdrichting mastconstructie, niet t.o.v. bissectrice.

Windrichtingen en positieve richtingen belastingen



Beschouwd aantal windrichtingen

1a	4
3	4
4	1
6	1
Overig	1

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

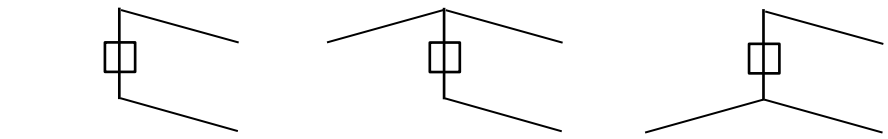
Geleiderafval

		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	0,8	0
Circuit 1	380ct1f2	1	0	1	0	0,8	0
Circuit 1	380ct1f3	1	0	1	0	0,8	0
Circuit 2	380ct2f1	0	1	1	0	0,8	0
Circuit 2	380ct2f2	0	1	1	0	0,8	0
Circuit 2	380ct2f3	0	1	1	0	0,8	0
Bliksemdraad 1	bl1	1	0	1	0	1	0
Bliksemdraad 2	bl2	0	1	1	0	1	0

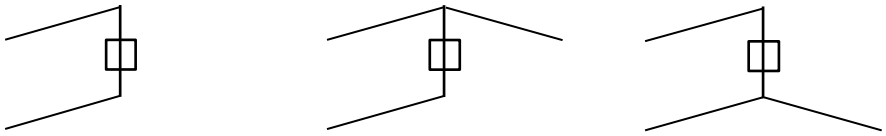
Belastingsituaties SPLS

Beschouwde situaties SPLS: SPLS bij steunmast niet van toepassing

Principe belastingssituaties:



1. Ba All cts | 2. Ba ct1 | 3. Ba ct2



4. Ah All cts | 5. Ah ct1 | 6. Ah ct2

Belastingsituaties 5a. Geleiderbreuk

Beschouwde situaties geleiderbreuk 5a: 1 en 2, alle mogelijke situaties.

Principe belastingssituaties:

1. Ba | 2. Ah

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

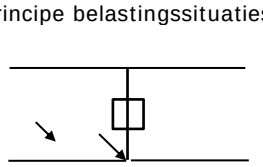
Belastingsituaties 6. Bouw- en onderhoud
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht.
Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate controle bordessen etc. De situaties worden in ULS en in iedere SPLS-situatie (in geval van hoekmast) toegepast.

	Fase	Bliksem
Lijnwagen	3,0 kN	2,0 kN
Puntlast op traverse	1,0 kN	1,0 kN

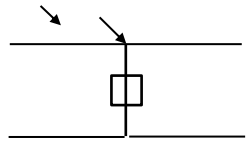
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

Aanwezigheid lijnwagen: Circuit, belasting tegelijk aanwezig in alle geleiders per circuit.

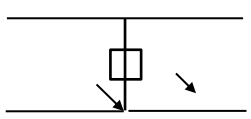
Principe belastingssituaties:



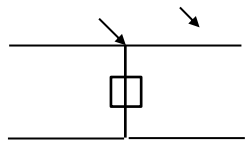
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

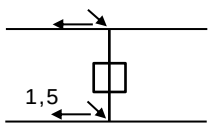
Belastingsituaties 8. Lijndansen als statische belasting

Geleider	Lijnrichting	Verticaal
Steunmast fase	0,866 W	1,5 W
Steunmast bliksem	1,5 EDS	1,5 W
Hoekmast fase en bliksem	1,5 EDS	1,5 W

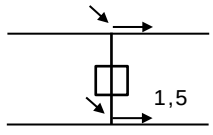
Beschouwde situaties lijndansen 8: Geen

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:



1. Ba



2. Ah

Belastingcombinatie 8. Lijndansen als dynamische belasting
Alleen van toepassing op hoek- en eindmasten
Belasting bestaat uit EDS-trekbelasting in één van de geleiders aan één zijde van de mast
Door gebruiker via het belastingsspectrum van tabel 4.11/NL.1 om te zetten naar spanningspectrum

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Mastconstructie

Eigenschappen

Masttype	Steunmast		
Mastbenaming	S-6 R		
Voetplaat t.o.v. maaiveld	0,5	m	
Masthoogte t.o.v. voetplaat	43,4	m	
Gewicht mast	200,0	kN	
Breedte en helling mast bij fundatie	x-ri.	y-ri.	
Pootsprei	8,00	8,00	m
Helling van de randstijl	0,153	0,153	-
Factor spatkracht	1,3	1,3	-

Berekening windbelasting

Dynamische invloed G_T	1,00 *(Masthoogte < 60 m)*
Windbelasting overhoeks op mastlichaam evenredig met:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Windbelasting overhoeks op traverse evenredig met:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Vergroting wind overhoeks mastlichaam	(1+0,2sin^2(2phi))
Vergroting wind overhoeks traverse	(1+0,2sin^2(2phi))
Factor wind evenwijdig t.o.v. haaks op traverse	0,4

Eigenschappen mastsecties lijnrichting (vooraanzicht, yz-vlak)

Omschrijving	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	9,80	8,00	5,00	9,80	0,153	63,70	8,48	0,13	3,24
Eerste tussenstuk	18,05	5,00	4,07	8,25	0,056	37,41	6,27	0,17	3,08
Tweede tussenstuk	27,50	4,07	3,00	9,45	0,057	33,40	6,78	0,20	2,92
Bovenstuk 1	33,40	3,00	2,58	5,90	0,036	16,45	3,83	0,23	2,79
Bovenstuk 2	41,40	2,58	2,00	8,00	0,036	18,30	4,44	0,24	2,75
Topstuk	43,40	2,00		2,00		2,00	0,38	0,19	2,97
Ondertraverse	27,50	13,80		3,00		20,70	4,66	0,22	2,82
Boventraverse	38,80	15,00		2,60		19,50	4,82	0,25	2,73

Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)

Omschrijving	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	9,80	8,00	5,00	9,80	0,153	63,70	8,48	0,13	3,24
Eerste tussenstuk	18,05	5,00	4,07	8,25	0,056	37,41	6,27	0,17	3,08
Tweede tussenstuk	27,50	4,07	3,00	9,45	0,057	33,40	6,78	0,20	2,92
Bovenstuk 1	33,40	3,00	2,58	5,90	0,036	16,45	3,83	0,23	2,79
Bovenstuk 2	41,40	2,58	2,00	8,00	0,036	18,30	4,44	0,24	2,75
Topstuk	43,40	2,00		2,00		2,00	0,38	0,19	2,97
Ondertraverse	27,50	13,80		3,00		20,70	4,66	0,22	2,82
Boventraverse	38,80	15,00		2,60		19,50	4,82	0,25	2,73

NB: oppervlakte traverse dwarsrichting wordt in berekening gereduceerd.

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Windoppervlak feeders telecominstallaties

Onderdeel	A (m^2/m)	Δh	A_1
Broekstuk			
Eerste tussenstuk			
Tweede tussenstuk			
Bovenstuk 1			
Bovenstuk 2			

Invoer antennes

Omschrijving	A	h	C_f
Antenne top			
Antenne o.t.			

Belastingen mastsectie langsrichting (x-richting) per windrichting

Omschrijving	p_w	F_{x1}	F_{x2}	F_{x3}	F_{x4}	h_{ef}	M_{y1}	M_{y2}	M_{y3}	M_{y4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0,70	19,3	16,3	0,0	-16,3	4,9	94,4	80,1	0,0	-80,1
Eerste tussenstuk	0,78	15,1	12,8	0,0	-12,8	13,9	210,4	178,5	0,0	-178,5
Tweede tussenstuk	0,91	18,1	15,3	0,0	-15,3	22,8	411,1	348,9	0,0	-348,9
Bovenstuk 1	0,99	10,6	9,0	0,0	-9,0	30,5	323,2	274,2	0,0	-274,2
Bovenstuk 2	1,05	12,8	10,9	0,0	-10,9	37,4	480,3	407,5	0,0	-407,5
Topstuk	1,09	1,2	1,0	0,0	-1,0	42,4	52,1	44,2	0,0	-44,2
Ondertraverse	0,97	25,6	15,2	0,0	-15,2	28,5	730,1	433,7	0,0	-433,7
Boventraverse	1,07	28,1	16,7	0,0	-16,7	39,7	1116,0	662,9	0,0	-662,9
Totaal		130,9	97,4	0,0	-97,4		3417,6	2430,0	0,0	-2430,0

Belastingen mastsectie langsrichting (y-richting) per windrichting

Omschrijving	p_w	F_{y1}	F_{y2}	F_{y3}	F_{x4}	h_{ef}	M_{x1}	M_{x2}	M_{x3}	M_{x4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0,70	0,0	16,3	19,3	16,3	4,9	0,0	80,1	94,4	80,1
Eerste tussenstuk	0,78	0,0	12,8	15,1	12,8	13,9	0,0	178,5	210,4	178,5
Tweede tussenstuk	0,91	0,0	15,3	18,1	15,3	22,8	0,0	348,9	411,1	348,9
Bovenstuk 1	0,99	0,0	9,0	10,6	9,0	30,5	0,0	274,2	323,2	274,2
Bovenstuk 2	1,05	0,0	10,9	12,8	10,9	37,4	0,0	407,5	480,3	407,5
Topstuk	1,09	0,0	1,0	1,2	1,0	42,4	0,0	44,2	52,1	44,2
Ondertraverse	0,97	0,0	15,2	10,2	15,2	28,5	0,0	433,7	292,0	433,7
Boventraverse	1,07	0,0	16,7	11,3	16,7	39,7	0,0	662,9	446,4	662,9
Totaal		0,0	97,4	98,6	97,4		0,0	2430,0	2309,9	2430,0

Resulterende belastingen vanuit mastconstructie incl. antenne zonder geleiders niveau fundatie (kar. waarde)

Belasting / windrichting	F_x	F_y	F_z	M_x	M_y	M_z
	[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
Permanente belasting	0	0	200	0	0	0
Windrichting 0°	131	0	0	0	3418	0
Windrichting 45°	97	97	0	2430	2430	0
Windrichting 90°	0	99	0	2310	0	0
Windrichting 135°	-97	97	0	2430	-2430	0

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Tussenresultaten geleiderbelastingen

Geleiders back

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Circuit 2	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Bliksemdraad 1	OPGW 226	21,7	264,0	9,80	81000	2,30E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Geleiders ahead

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Circuit 2	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Bliksemdraad 1	OPGW 226	21,7	264,0	9,80	81000	2,30E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Verticale belasting back

Circuit	Bundel [-]	Toeslag [%]	$w_{z,G}$ [N/m]	IJsgebied	Formule	$w_{z,ijs}$ [N/m]	$w_{z,ijs,bundel}$ [N/m]
Circuit 1	3	3	46,3	B	4+0,2d	9,5	28,6
Circuit 2	3	3	46,3	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	3	10,1	B	4+0,2d	8,3	8,3
Bliksemdraad 2	1	3	10,1	B	4+0,2d	8,3	8,3

Verticale belasting ahead

Circuit	Bundel [-]	Toeslag [%]	$w_{z,G}$ [N/m]	IJsgebied	Formule	$w_{z,ijs}$ [N/m]	$w_{z,ijs,bundel}$ [N/m]
Circuit 1	3	3	46,3	B	4+0,2d	9,5	28,6
Circuit 2	3	3	46,3	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	3	10,1	B	4+0,2d	8,3	8,3
Bliksemdraad 2	1	3	10,1	B	4+0,2d	8,3	8,3

Isolatoren

Geleider	$G_{isolator}$ [kN]	Aantal -	$F_{v,iso}$ [kN]	Lengte [m]	Windopp. [m^2]	Windhoogte [m]	Stuwdruk [kN/m^2]	Vormfactor [-]	$F_{h,iso}$ [kN]
380ct1f1	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct1f2	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct1f3	2,00	1	2	4,5	1,0	37,05	1,05	1,2	1,26
380ct2f1	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct2f2	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct2f3	2,00	1	2	4,5	1,0	37,05	1,05	1,2	1,26
bl1	0,10	1	0,1	0,3	0,1	39,15	1,06	1,2	0,13
bl2	0,10	1	0,1	0,3	0,1	39,15	1,06	1,2	0,13

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Windbelasting back

Geleider	hoogte wind	Stuwdruk	G_{c_dwars}	G_{c_trek}	C_c	$d_{toeslag}$	w_y	$w_{y,vak}$	$D_{ijs,toeslag}$	$w_{y,ijs}$	$w_{y,ijs,vak}$
	[m]	[kN/m^2]	[-]	[-]	[-]	[mm]	[N/m]	[N/m]	[mm]	[N/m]	[N/m]
380ct1f1	19,2	0,87	0,55	0,45	1,13	28,53	46,2	38,1	47,4	81,3	67,0
380ct1f2	19,2	0,87	0,55	0,45	1,13	28,53	46,2	38,1	47,4	81,3	67,0
380ct1f3	30,5	0,99	0,59	0,48	1,10	28,53	54,7	45,0	47,4	99,4	81,7
380ct2f1	19,2	0,87	0,55	0,45	1,13	28,53	46,2	38,1	47,4	81,3	67,0
380ct2f2	19,2	0,87	0,55	0,45	1,13	28,53	46,2	38,1	47,4	81,3	67,0
380ct2f3	30,5	0,99	0,59	0,48	1,10	28,53	54,7	45,0	47,4	99,4	81,7
bl1	35,7	1,04	0,60	0,49	1,20	22,35	16,7	13,7	41,8	31,2	25,6
bl2	35,7	1,04	0,60	0,49	1,20	22,35	16,7	13,7	41,8	31,2	25,6

Windbelasting ahead

Geleider	hoogte wind	Stuwdruk	$G_{c\ dwars}$	$G_{c\ trek}$	C_c	$d_{toeslag}$	w_y	$w_{y,vak}$	$D_{ijs,toeslag}$	$w_{y,ijs}$	$w_{y,ijs,vak}$
	[m]	[kN/m^2]	[-]	[-]	[-]	[mm]	[N/m]	[N/m]	[mm]	[N/m]	[N/m]
380ct1f1	18,6	0,86	0,55	0,45	1,14	28,53	45,7	37,7	47,4	80,1	66,0
380ct1f2	18,6	0,86	0,55	0,45	1,14	28,53	45,7	37,7	47,4	80,1	66,0
380ct1f3	29,9	0,99	0,58	0,48	1,10	28,53	54,4	44,7	47,4	98,5	81,0
380ct2f1	18,6	0,86	0,55	0,45	1,14	28,53	45,7	37,7	47,4	80,1	66,0
380ct2f2	18,6	0,86	0,55	0,45	1,14	28,53	45,7	37,7	47,4	80,1	66,0
380ct2f3	29,9	0,99	0,58	0,48	1,10	28,53	54,4	44,7	47,4	98,5	81,0
bl1	35,2	1,03	0,60	0,49	1,20	22,35	16,6	13,6	41,8	31,0	25,5
bl2	35,2	1,03	0,60	0,49	1,20	22,35	16,6	13,6	41,8	31,0	25,5

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Geleiderbelastingen

Auteur: TBR
Versie: v10.4

Uitgangspunten
Betrouwbaarheidsniveau Afkeur CC2-0
Referentieperiode 30 jaar

ULS (bezwijksterkte)		NEN-EN50341-2-15:2019						
Belastingsgeval	omschrijving	Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	γ_a A_k
ULS 1a	Wind	10°	1,05	1,05	0,00	1,12	0,00	0,0
ULS 1a_0,9	Wind 0,9Gk alleen mast	10°	0,90	1,05	0,00	1,12	0,00	0,0
ULS 1a_0,9_0,9	Wind 0,9Gk ook geleider	10°	0,90	0,90	0,00	1,12	0,00	0,0
ULS 3	Wind+ijs	-5°	1,05	1,05	0,00	0,34	0,97	0,0
ULS 3_0,9	Wind+ijs 0,9	-5°	0,90	1,05	0,00	0,34	0,97	0,0
ULS 4	Koude+wind	-20°	1,05	1,05	0,00	0,22	0,00	0,0
ULS 4_0,9	Koude+wind 0,9	-20°	0,90	1,05	0,00	0,22	0,00	0,0
ULS 5a	Torsional loads	10°	1,00	1,00	1,00	0,00	0,00	1,0
ULS 5b	Longitudinal loads	10°	1,00	1,00	0,00	0,00	0,00	1,0
ULS 6	Construction + maintainence	5°	1,05	1,05	1,20	0,22	0,00	0,0
ULS 6_0,9	Construction + maintainence	5°	1,05	1,05	0,00	0,22	0,00	0,0
ULS 7	Permanent	10°	1,15	1,15	0,00	0,00	0,00	0,0
ULS 8	Special	10°	1,00	1,00	0,00	0,00	0,00	1,0
SPLS	(Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders)			γ_G G_k	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1,05	1,05	0,0	0,78	0,00	0,0
SPLS 1a_0,9	Wind 0,9	10°	0,90	1,05	0,0	0,78	0,00	0,0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0,90	1,05	0,0	0,78	0,00	0,0
SPLS 3	Wind+ijs	-5°	1,05	1,05	0,0	0,36	0,34	0,0
SPLS 3_0,9	Wind+ijs 0,9	-5°	0,90	1,05	0,0	0,36	0,34	0,0
SPLS 4	Koude+wind	-20°	1,05	1,05	0,0	0,24	0,00	0,0
SPLS 4_0,9	Koude+wind 0,9	-20°	0,90	1,05	0,0	0,24	0,00	0,0
SPLS 6	Onderhoud	5°	1,05	1,05	1,2	0,24	0,0	0,0
SPLS 6_0,9	Onderhoud	5°	1,05	1,05	0,0	0,24	0,0	0,0
SLS	(controle van de vervormingen, vermoeiing, EDS)			G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1,00	1,00	0,0	0,94	0,0	0,0
SLS 3	Wind+ijs	-5°	1,00	1,00	0,0	0,28	0,88	0,0
SLS 4	Wind	-20°	1,00	1,00	0,0	0,19	0,0	0,0
SLS 6	Onderhoud	5°	1,00	1,00	0,0	0,19	0,0	0,0
SLS 7	PB	10°	1,00	1,00	0,0	0,00	0,0	0,0

Aantal windrichtingen 4
Aantal belastingcombinaties ULS 44
Aantal belastingcombinaties SPLS 0
Aantal belastingcombinaties SLS 11
Aantal knooplasten 440

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Samenvattingstabellen geleiderbelastingen

In de onderstaande vier tabellen is weergegeven:
- De maximale geleiderbelasting in het globale assenstelsel, gesplitst in aandeel van back en ahead span
- De gecombineerde geleiderbelasting in het globale assenstelsen met in het lokale assenstelsel de maximaal optredende trekkracht. Componenten Fx en Fy als absolute waarde
- De alledaagse (EDS) waarden van de gecombineerde geleiderbelastingen (ba+Ah) met bijbehorende trekkrachten
- Controle op uplift, waar een negatieve waarde duidt op uplift

Note: Maximale waarden voor Fx, Fy en Fz behoren niet noodzakelijkerwijs tot dezelfde belastingscombinatie.

Maximale waarden voor back en ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-37,0	37,0	3,3	3,5	4,9	5,2
bl2	-37,0	37,0	3,3	3,5	4,9	5,2
380ct1f1	-132,2	132,2	9,7	10,1	14,4	15,1
380ct1f2	-132,2	132,2	9,7	10,1	14,4	15,1
380ct1f3	-134,1	134,1	11,4	12,0	14,4	15,1
380ct2f1	-132,2	132,2	9,7	10,1	14,4	15,1
380ct2f2	-132,2	132,2	9,7	10,1	14,4	15,1
380ct2f3	-134,1	134,1	11,4	12,0	14,4	15,1

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Maximale waarden back+ahead span

Geleider	Fx [kN]	Fy [kN]	Fz [kN]
bl1	21,2	6,8	7,7
bl2	21,2	6,8	7,7
380ct1f1	65,2	19,8	29,5
380ct1f2	65,2	19,8	29,5
380ct1f3	65,2	23,4	29,5
380ct2f1	65,2	19,8	29,5
380ct2f2	65,2	19,8	29,5
380ct2f3	65,2	23,4	29,5

Maximale waarden trekkracht geleider

Geleider	Ft_ba [kN]	Ft_ah [kN]
bl1	-40,0	40,0
bl2	-40,0	40,0
380ct1f1	-132,2	132,1
380ct1f2	-132,2	132,1
380ct1f3	-134,1	134,0
380ct2f1	-132,2	132,1
380ct2f2	-132,2	132,1
380ct2f3	-134,1	134,0

EDS-belastingen geleiders

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	3,7	-21,2	21,2
bl2	0,0	0,0	3,7	-21,2	21,2
380ct1f1	0,0	0,0	18,6	-81,5	81,5
380ct1f2	0,0	0,0	18,6	-81,5	81,5
380ct1f3	0,0	0,0	18,6	-81,5	81,5
380ct2f1	0,0	0,0	18,6	-81,5	81,5
380ct2f2	0,0	0,0	18,6	-81,5	81,5
380ct2f3	0,0	0,0	18,6	-81,5	81,5

Controle uplift SLS-wind

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 1a	bl1	1,8	1,9
	bl2	1,8	1,9
	380ct1f1	9,1	9,5
	380ct1f2	9,1	9,5
	380ct1f3	9,1	9,5
	380ct2f1	9,1	9,5
	380ct2f2	9,1	9,5
	380ct2f3	9,1	9,5

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

ULS-fundatiebelasting combinatie 1 en 3 wind haaks op de lijn of bissectrice en EDS, vanuit geleiders

Combinatie	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	140	125	4527	0	0
ULS 1a_0,9_90	0	140	125	4527	0	0
ULS 3_90	0	73	191	2374	0	0
ULS 3_0,9_90	0	73	191	2374	0	0
SLS 7	0	0	119	0	0	0

ULS-fundatiebelasting combinatie 1 en 3 wind haaks op de lijn of bissectrice en EDS, totaal geleiders en mast

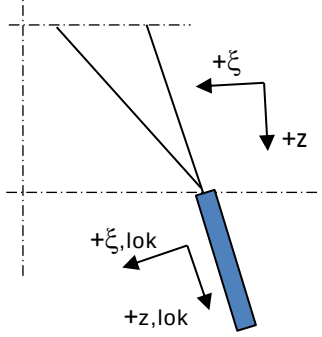
Combinatie	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	250	335	7107	0	0
ULS 3_90	0	106	401	3148	0	0
SLS 7	0	0	319	0	0	0

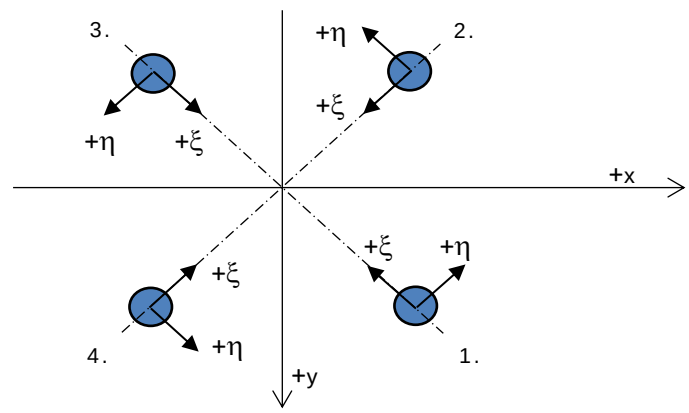
Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde

Combinatie	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_0,9_90	0	250	287	7107	0	0
ULS 1a_0	148	0	335	0	3890	0
ULS 5a Ba 10	65	0	319	124	1792	-997
ULS 1a_45	110	180	335	5031	2765	0

Noot: grootste waarden kunnen in meerdere combinaties voorkomen, een combinatie is weergegeven.

Oplegreacties op fundering per randstijl





Assenstelsels

Maximale drukbelasting

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 1a_45	107	96	571	8	-144	-20	584
2	ULS 1a_0	54	-65	327	8	-84	-13	334
3	ULS 5a Ah 22	-9	-72	244	-45	-57	-4	250
4	ULS 1a_135	-107	96	571	-8	-144	-20	584

Maximale trekbelasting

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 22	-26	9	-85	-25	12	-6	-87
2	ULS 1a_0,9_0,9_135	-76	65	-415	8	100	10	-425
3	ULS 1a_0,9_0,9_45	76	65	-415	-8	100	10	-425
4	ULS 1a_0,9_0,9_0	23	-34	-171	-8	40	3	-175

Maximale torsiebelasting (positief)

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 10	32	-38	-24	49	4	-2	-25
2	ULS 5a Ba 21	3	-69	200	47	-51	-8	204
3	ULS 5a Ba 21	-32	38	-25	49	4	-2	-25
4	ULS 5a Ah 10	-3	69	200	47	-51	-8	204

Maximale torsiebelasting (negatief)

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ba 10	3	69	200	-47	-51	-8	204
2	ULS 5a Ah 21	32	38	-24	-49	4	-2	-25
3	ULS 5a Ah 21	-3	-69	200	-47	-51	-8	204
4	ULS 5a Ba 10	-32	-38	-25	-49	4	-2	-25

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Combinatie Ftrek+Fh

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 12	25	-40	-72	46	10	-5	-74
2	ULS 1a_0,9_0,9_135	-76	65	-415	8	100	10	-425
3	ULS 1a_0,9_0,9_45	76	65	-415	-8	100	10	-425
4	ULS 5a Ba 12	-25	-40	-72	-46	10	-5	-74

Permanente belasting

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	80	0	-22	-5	82
2	SLS 7	16	-16	80	0	-22	-5	82
3	SLS 7	-16	-16	80	0	-22	-5	82
4	SLS 7	-16	16	80	0	-22	-5	82

Omhullenden ongeacht stijl

Belasting	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. druk	ULS 1a_45	107	96	571	8	-144	-20	584
Max. trek	ULS 1a_0,9_0,9_45	76	65	-415	-8	100	10	-425
Max. pos. torsie	ULS 5a Ah 10	32	-38	-24	49	4	-2	-25
Max. neg. torsie	ULS 5a Ah 21	32	38	-24	-49	4	-2	-25
Comb. trek+torsie	ULS 1a_0,9_45	76	65	-415	-8	100	10	-425

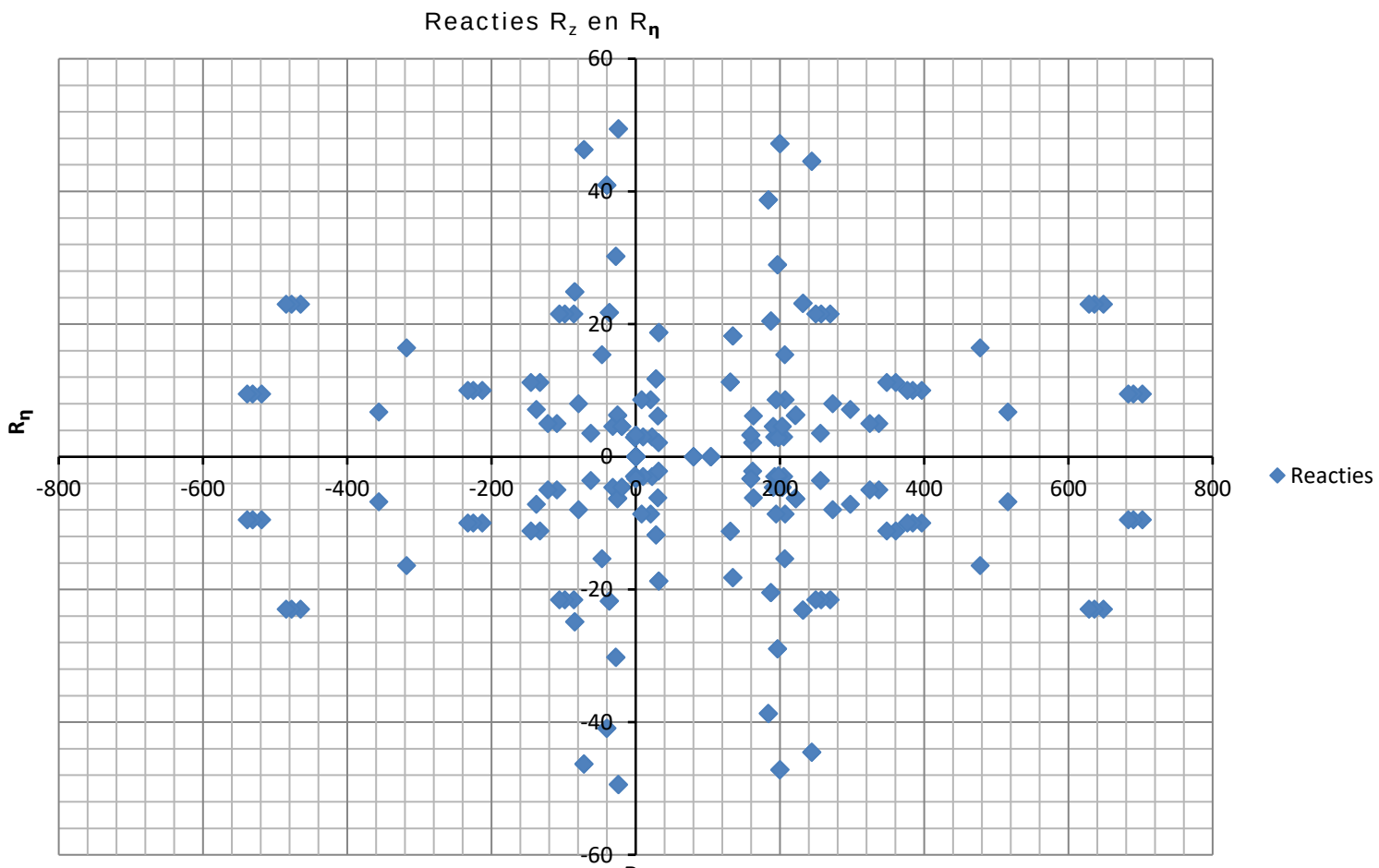
Maximale trekbelasting SLS

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	80	0	-22	-5	82
2	SLS 1a_135	-60	51	-332	6	79	7	-339
3	SLS 1a_45	60	51	-332	-6	79	7	-339
4	SLS 1a_0	15	-25	-126	-7	29	1	-128

Maximale drukbelasting SLS

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	92	83	491	6	-124	-17	503
2	SLS 1a_0	47	-57	285	7	-74	-12	292
3	SLS 7	-16	-16	80	0	-22	-5	82
4	SLS 1a_135	-92	83	491	-6	-124	-17	503

Project: ENS-ZL
Masttype: S-6 R
Mast: 22



Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Geleiderbelastingen

Auteur: TBR
Versie: v10.4

Uitgangspunten

Betrouwbaarheidsniveau	Verbouw CC2
Referentieperiode	50 jaar

ULS (bezwijksterkte)		NEN-EN50341-2-15:2019						
Belastingsgeval	omschrijving	Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	γ_a A_k
ULS 1a	Wind	10°	1,15	1,15	0,00	1,40	0,00	0,0
ULS 1a_0,9	Wind 0,9Gk alleen mast	10°	0,90	1,15	0,00	1,40	0,00	0,0
ULS 1a_0,9_0,9	Wind 0,9Gk ook geleider	10°	0,90	0,90	0,00	1,40	0,00	0,0
ULS 3	Wind+ijs	-5°	1,15	1,15	0,00	0,42	1,30	0,0
ULS 3_0,9	Wind+ijs 0,9	-5°	0,90	1,15	0,00	0,42	1,30	0,0
ULS 4	Koude+wind	-20°	1,15	1,15	0,00	0,28	0,00	0,0
ULS 4_0,9	Koude+wind 0,9	-20°	0,90	1,15	0,00	0,28	0,00	0,0
ULS 5a	Torsional loads	10°	1,00	1,00	1,00	0,00	0,00	1,0
ULS 5b	Longitudinal loads	10°	1,00	1,00	0,00	0,00	0,00	1,0
ULS 6	Construction + maintainence	5°	1,15	1,15	1,30	0,28	0,00	0,0
ULS 6_0,9	Construction + maintainence	5°	1,15	1,15	0,00	0,28	0,00	0,0
ULS 7	Permanent	10°	1,30	1,30	0,00	0,00	0,00	0,0
ULS 8	Special	10°	1,00	1,00	0,00	0,00	0,00	1,0
SPLS	(Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders)			γ_G G_k	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1,15	1,15	0,0	0,78	0,00	0,0
SPLS 1a_0,9	Wind 0,9	10°	0,90	1,15	0,0	0,78	0,00	0,0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0,90	1,15	0,0	0,78	0,00	0,0
SPLS 3	Wind+ijs	-5°	1,15	1,15	0,0	0,36	0,34	0,0
SPLS 3_0,9	Wind+ijs 0,9	-5°	0,90	1,15	0,0	0,36	0,34	0,0
SPLS 4	Koude+wind	-20°	1,15	1,15	0,0	0,24	0,00	0,0
SPLS 4_0,9	Koude+wind 0,9	-20°	0,90	1,15	0,0	0,24	0,00	0,0
SPLS 6	Onderhoud	5°	1,15	1,15	1,2	0,24	0,0	0,0
SPLS 6_0,9	Onderhoud	5°	1,15	1,15	0,0	0,24	0,0	0,0
SLS	(controle van de vervormingen, vermoeiing, EDS)			G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1,00	1,00	0,0	1,00	0,0	0,0
SLS 3	Wind+ijs	-5°	1,00	1,00	0,0	0,30	1,00	0,0
SLS 4	Wind	-20°	1,00	1,00	0,0	0,20	0,0	0,0
SLS 6	Onderhoud	5°	1,00	1,00	0,0	0,20	0,0	0,0
SLS 7	PB	10°	1,00	1,00	0,0	0,00	0,0	0,0

Aantal windrichtingen	4
Aantal belastingcombinaties ULS	44
Aantal belastingcombinaties SPLS	0
Aantal belastingcombinaties SLS	11
Aantal knooplasten	440

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Samenvattingstabellen geleiderbelastingen

In de onderstaande vier tabellen is weergegeven:
- De maximale geleiderbelasting in het globale assenstelsel, gesplitst in aandeel van back en ahead span
- De gecombineerde geleiderbelasting in het globale assenstelsen met in het lokale assenstelsel de maximaal optredende trekkracht. Componenten Fx en Fy als absolute waarde
- De alledaagse (EDS) waarden van de gecombineerde geleiderbelastingen (ba+Ah) met bijbehorende trekkrachten
- Controle op uplift, waar een negatieve waarde duidt op uplift

Note: Maximale waarden voor Fx, Fy en Fz behoren niet noodzakelijkerwijs tot dezelfde belastingscombinatie.

Maximale waarden voor back en ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-41,9	41,9	4,2	4,4	5,4	5,6
bl2	-41,9	41,9	4,2	4,4	5,4	5,6
380ct1f1	-150,4	150,4	12,1	12,7	17,0	17,8
380ct1f2	-150,4	150,4	12,1	12,7	17,0	17,8
380ct1f3	-152,8	152,8	14,3	15,0	17,0	17,8
380ct2f1	-150,4	150,4	12,1	12,7	17,0	17,8
380ct2f2	-150,4	150,4	12,1	12,7	17,0	17,8
380ct2f3	-152,8	152,8	14,3	15,0	17,0	17,8

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Maximale waarden back+ahead span

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	21,2	8,6	8,4	-42,4	42,4
bl2	21,2	8,6	8,4	-42,4	42,4
380ct1f1	65,2	24,8	34,8	-150,5	150,4
380ct1f2	65,2	24,8	34,8	-150,5	150,4
380ct1f3	65,2	29,4	34,8	-152,8	152,7
380ct2f1	65,2	24,8	34,8	-150,5	150,4
380ct2f2	65,2	24,8	34,8	-150,5	150,4
380ct2f3	65,2	29,4	34,8	-152,8	152,7

Maximale waarden trekkracht geleider

EDS-belastingen geleiders

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	3,7	-21,2	21,2
bl2	0,0	0,0	3,7	-21,2	21,2
380ct1f1	0,0	0,0	18,6	-81,5	81,5
380ct1f2	0,0	0,0	18,6	-81,5	81,5
380ct1f3	0,0	0,0	18,6	-81,5	81,5
380ct2f1	0,0	0,0	18,6	-81,5	81,5
380ct2f2	0,0	0,0	18,6	-81,5	81,5
380ct2f3	0,0	0,0	18,6	-81,5	81,5

Controle uplift SLS-wind

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 1a	bl1	1,8	1,9
	bl2	1,8	1,9
	380ct1f1	9,1	9,5
	380ct1f2	9,1	9,5
	380ct1f3	9,1	9,5
	380ct2f1	9,1	9,5
	380ct2f2	9,1	9,5
	380ct2f3	9,1	9,5

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

ULS-fundatiebelasting combinatie 1 en 3 wind haaks op de lijn of bissectrice en EDS, vanuit geleiders

Combinatie	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	175	137	5675	0	0
ULS 1a_0,9_90	0	175	137	5675	0	0
ULS 3_90	0	92	225	2976	0	0
ULS 3_0,9_90	0	92	225	2976	0	0
SLS 7	0	0	119	0	0	0

ULS-fundatiebelasting combinatie 1 en 3 wind haaks op de lijn of bissectrice en EDS, totaal geleiders en mast

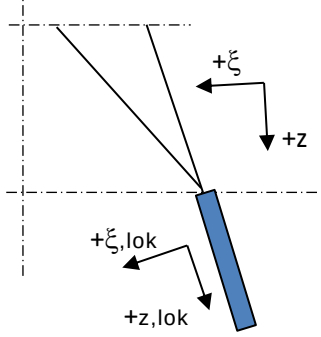
Combinatie	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	313	367	8909	0	0
ULS 3_90	0	133	455	3946	0	0
SLS 7	0	0	319	0	0	0

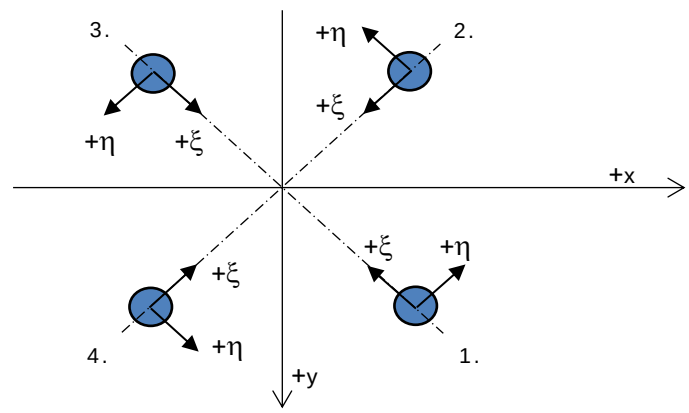
Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde

Combinatie	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	313	367	8909	0	0
ULS 1a_0	186	0	367	0	4876	0
ULS 5a Ba 10	65	0	319	124	1792	-997
ULS 1a_45	138	226	367	6307	3467	0

Noot: grootste waarden kunnen in meerdere combinaties voorkomen, een combinatie is weergegeven.

Oplegreacties op fundering per randstijl





Assenstelsels

Maximale drukbelasting

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 1a_45	131	118	703	9	-176	-24	719
2	ULS 1a_0	65	-79	397	10	-102	-16	406
3	ULS 5a Ah 22	-9	-72	244	-45	-57	-4	250
4	ULS 1a_135	-131	118	703	-9	-176	-24	719

Maximale trekbelasting

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 22	-26	9	-85	-25	12	-6	-87
2	ULS 1a_0,9_0,9_135	-99	85	-539	9	130	13	-552
3	ULS 1a_0,9_0,9_45	99	85	-539	-9	130	13	-552
4	ULS 1a_0,9_0,9_0	32	-46	-233	-10	56	5	-238

Maximale torsiebelasting (positief)

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 10	32	-38	-24	49	4	-2	-25
2	ULS 5a Ba 21	3	-69	200	47	-51	-8	204
3	ULS 5a Ba 21	-32	38	-25	49	4	-2	-25
4	ULS 5a Ah 10	-3	69	200	47	-51	-8	204

Maximale torsiebelasting (negatief)

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ba 10	3	69	200	-47	-51	-8	204
2	ULS 5a Ah 21	32	38	-24	-49	4	-2	-25
3	ULS 5a Ah 21	-3	-69	200	-47	-51	-8	204
4	ULS 5a Ba 10	-32	-38	-25	-49	4	-2	-25

Project: ENS-ZL
Masttype: S-6 R
Mast: 22

Combinatie Ftrek+Fh

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 12	25	-40	-72	46	10	-5	-74
2	ULS 1a_0,9_0,9_135	-99	85	-539	9	130	13	-552
3	ULS 1a_0,9_0,9_45	99	85	-539	-9	130	13	-552
4	ULS 1a_0,9_0,9_0	32	-46	-233	-10	56	5	-238

Permanente belasting

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	80	0	-22	-5	82
2	SLS 7	16	-16	80	0	-22	-5	82
3	SLS 7	-16	-16	80	0	-22	-5	82
4	SLS 7	-16	16	80	0	-22	-5	82

Omhullenden ongeacht stijl

Belasting	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. druk	ULS 1a_45	131	118	703	9	-176	-24	719
Max. trek	ULS 1a_0,9_0,9_45	99	85	-539	-9	130	13	-552
Max. pos. torsie	ULS 5a Ah 10	32	-38	-24	49	4	-2	-25
Max. neg. torsie	ULS 5a Ah 21	32	38	-24	-49	4	-2	-25
Comb. trek+torsie	ULS 1a_0,9_45	99	85	-539	-9	130	13	-552

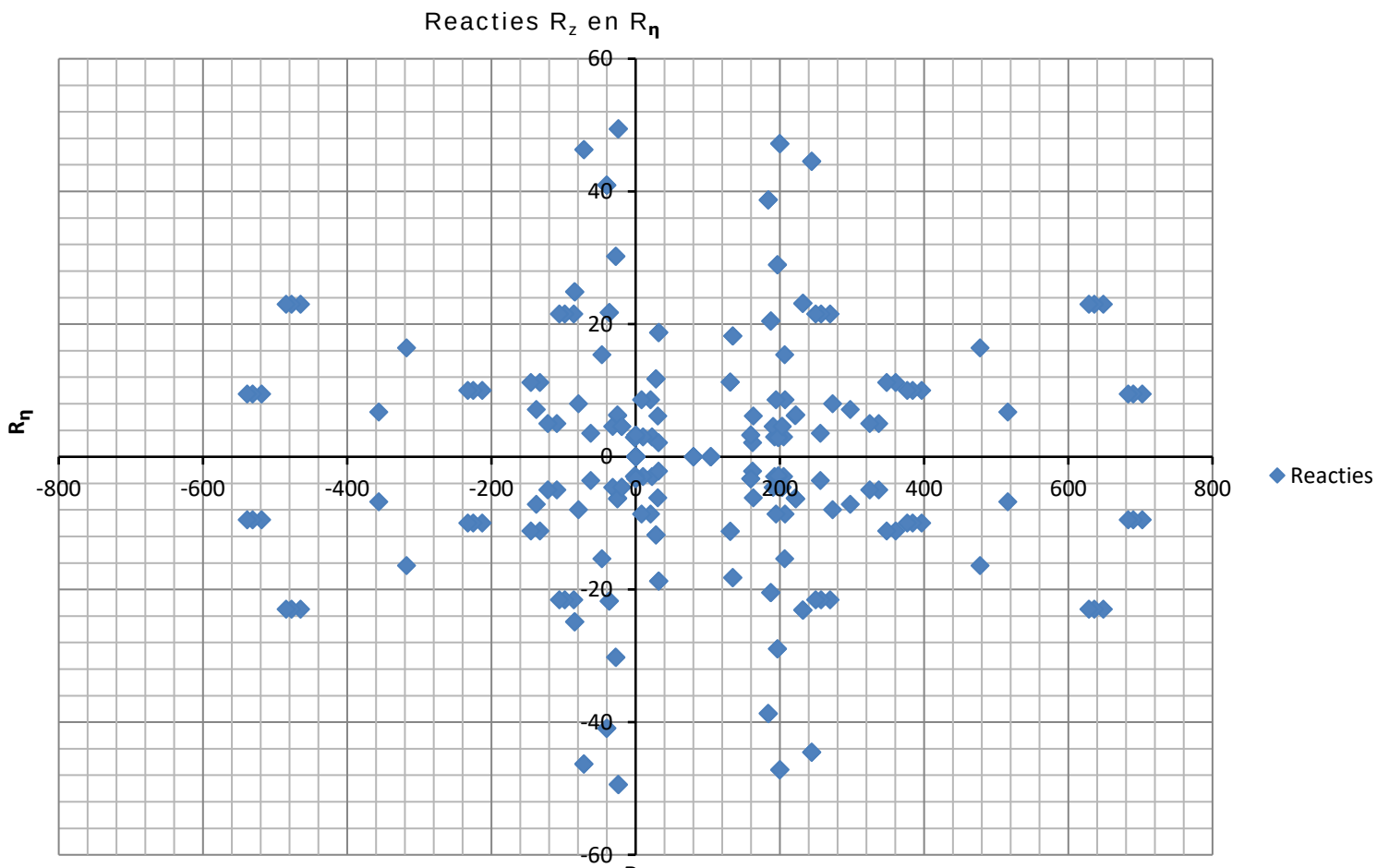
Maximale trekbelasting SLS

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	80	0	-22	-5	82
2	SLS 1a_135	-65	55	-357	7	85	8	-365
3	SLS 1a_45	65	55	-357	-7	85	8	-365
4	SLS 1a_0	17	-27	-138	-7	32	2	-141

Maximale drukbelasting SLS

Stijl	Combinatie	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	97	87	516	7	-130	-18	528
2	SLS 1a_0	49	-59	297	7	-77	-12	304
3	SLS 7	-16	-16	80	0	-22	-5	82
4	SLS 1a_135	-97	87	516	-7	-130	-18	528

Project: ENS-ZL
Masttype: S-6 R
Mast: 22



Content

- Starting point p. 2
- Tower construction p. 6
- In between results p. 8
- Loads initial p. 10
- Loads after adjustment p. 15

Data

Norm	NEN-EN50341-2-15:2019
Initial	
Consequence class	CC2-0
Reliability level	Afkeur
Reference period	30 jaar
After adjustment	
Consequence class	CC2
Reliability level	Verbouw
Reference period	50 jaar
Wind zone	III
Wind speed	24.5 m/s
Terrain categorie	II
Reduction factor Cdir	1.00
Ice region	B
Tower type	Steunmast
Tower height	43.4 m
Max. Span	305.2 m
Line angle	180°
Catenary	1760 m
Wind span	298 m
EDS Weight span	180 m
Min. Weight span	23 m
Max. Weight span	191 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-02-19			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype S-6 R

JOB No.	-	DATE	-
DRAWN	-	CHKD	-
DESIGN	-	APPD	-

Document name:

ENS-ZL_S-6 R_28_Report.pdf

Project number:

Project client number:

0.0											

Project: ENS-ZL
Tower: S-6 R
Number: 28

Conductor loads

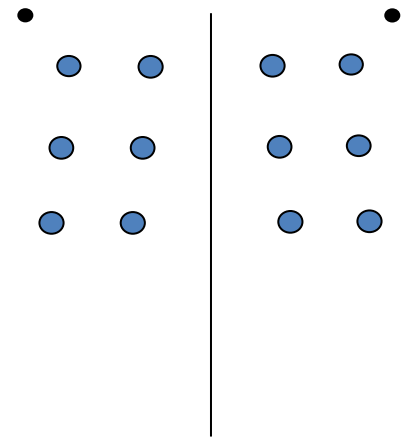
Auteur: TBR
Versie: v11.6

General

Description	S-6 R
Tower type	Steunmast
Number of circuits	2
Configuration	2-circuit-donau
Number of earth wires	2

Starting points

Norm	NEN-EN50341-2-15:2019	
Consequence class	CC2-0	
Reliability level initial	Afkeur CC2-0	
Reference period intial	30 jaar	
Consequence class modified	CC2	
Reliability level modified	Verbouw	
Reference period modified	50 jaar	
Wind zone	III	
Terrain category	24.5	m/s
Reduction factor c_{dir}	II	
Ice region phase conductor	1.00	
Ice region earth conductor	B	
	B	



Configuratie geleiders

Conductors back

Description	Voltage	Conductor Back	Bundle Ba	Ice region	Additional weight	Additional diameter	Catenary P_{back}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Conductors ahead

Description	Voltage	Conductor Ahead	Bundle Ah	Ice region	Additional weight	Additional diameter	Catenary P_{ahead}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	V-ketting	3.00	4.50	2.00
Circuit 2	V-ketting	3.00	4.50	2.00
Bliksemdraad 1	Vast (Bliksemdraad)	0.10	0.30	0.10
Bliksemdraad 2	Vast (Bliksemdraad)	0.10	0.30	0.10

1. Properties apply to the entire isolator set

Suspension height and position in mast

Circuits	Designation	Number	Suspension height	Attach point	Position in tower Horizontal distance
Circuit 1	10	380ct1f1	23.0 m	27.5 m	-12.4 m
Circuit 1	11	380ct1f2	23.0 m	27.5 m	-5.7 m
Circuit 1	12	380ct1f3	34.3 m	38.8 m	-9.1 m
Circuit 2	21	380ct2f1	23.0 m	27.5 m	12.4 m
Circuit 2	20	380ct2f2	23.0 m	27.5 m	5.7 m
Circuit 2	22	380ct2f3	34.3 m	38.8 m	9.1 m
Bliksemdraad 1	1	bl1	38.5 m	38.8 m	-16.0 m
Bliksemdraad 2	3	bl2	38.5 m	38.8 m	16.0 m

Project: ENS-ZL
Tower: S-6 R
Number: 28

Height adjustment adjacent masts (wind and weight span adjustment)

	Back	Ahead	
Height increase for wind pressure	0.0 m	0.0 m	(positive: higher)
Height decrease for vertical load	0.0 m	0.0 m	(negative: decrease, more weight span)

Decrease: Niet in 0,9EG-combinaties

Height difference adjacent tower and change of direction with respect to Line direction

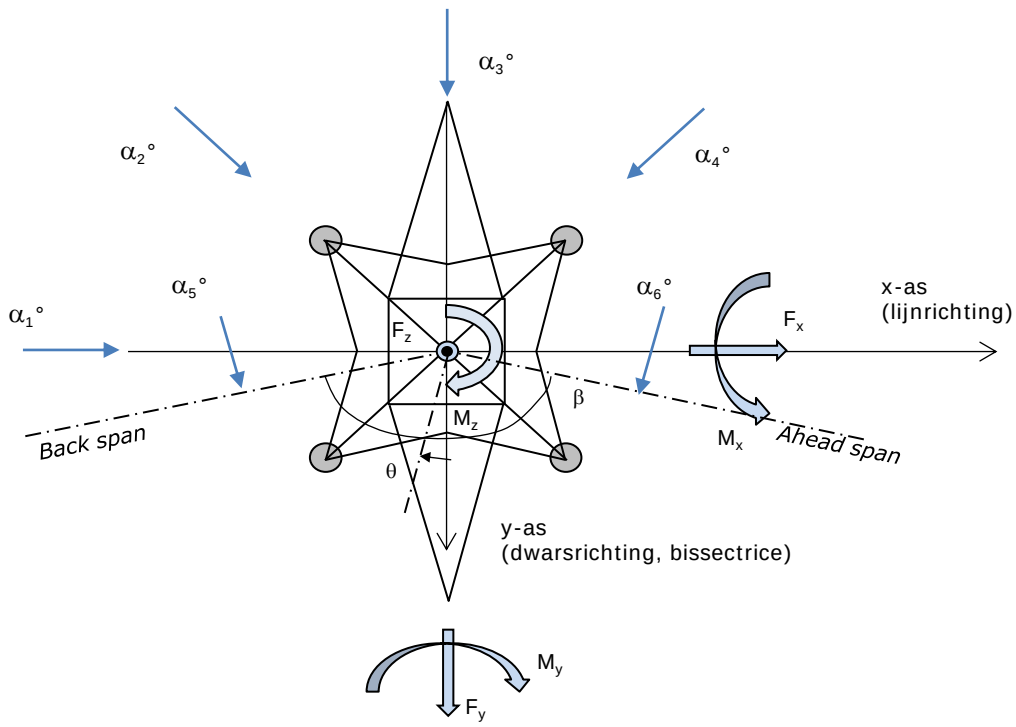
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	19.8	-0.4 m	0.0	0.0 m
Circuit 1	11	380ct1f2	19.8	-0.4 m	0.0	0.0 m
Circuit 1	12	380ct1f3	19.8	-0.4 m	0.0	0.0 m
Circuit 2	21	380ct2f1	19.8	-0.4 m	0.0	0.0 m
Circuit 2	20	380ct2f2	19.8	-0.4 m	0.0	0.0 m
Circuit 2	22	380ct2f3	19.8	-0.4 m	0.0	0.0 m
Bliksemdraad 1	1	bl1	19.8	-0.4 m	0.0	0.0 m
Bliksemdraad 2	3	bl2	19.8	-0.4 m	0.0	0.0 m

Line and tower data

		Back	Ahead	
		290.2	305.2	m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		343.9	343.9	m
Line angle	β	180	°	
Tower orientation with respect to bi	θ	0	°	
Section length		5416	5416	m
Height bottom of tower to ground level		0.5	m	
Wind directions considered	α_1	0	°	
Wind directions according to:	α_2	45	°	
Geleiderbelastingen	α_3	90	°	
	α_4	135	°	
	α_5	-	°	
	α_6	-	°	

Wind directions apply to the main direction of mast construction, not to the bisector.

Windrichtingen en positieve richtingen belastingen



Considered number of wind directions

1a	4
3	4
4	1
6	1
Overig	1

Project: ENS-ZL
Tower: S-6 R
Number: 28

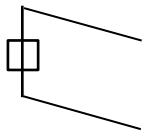
Absence of conductors

		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	0.8	0
Circuit 1	380ct1f2	1	0	1	0	0.8	0
Circuit 1	380ct1f3	1	0	1	0	0.8	0
Circuit 2	380ct2f1	0	1	1	0	0.8	0
Circuit 2	380ct2f2	0	1	1	0	0.8	0
Circuit 2	380ct2f3	0	1	1	0	0.8	0
Bliksemdraad 1	bl1	1	0	1	0	1	0
Bliksemdraad 2	bl2	0	1	1	0	1	0

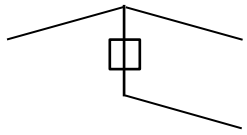
Load situations SPLS

Considered situations SPLS: SPLS for suspension tower not applicable

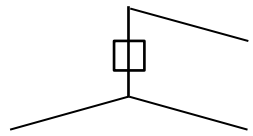
Principle of load situations:



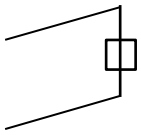
1. Ba All cts



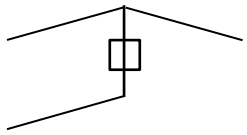
2. Ba ct1



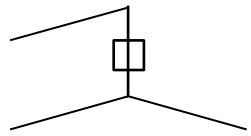
3. Ba ct2



4. Ah All cts



5. Ah ct1

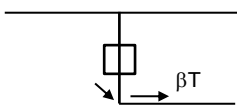


6. Ah ct2

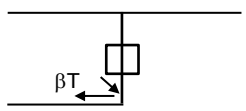
Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1 and 2, all possible situations

Principle of load situations:



1. Ba



2. Ah

Project: ENS-ZL
Tower: S-6 R
Number: 28

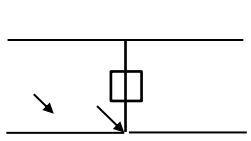
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations are applied in ULS and in every SPLS situation (in case of angle tower).

3.0 kN	2.0 kN
1.0 kN	1.0 kN

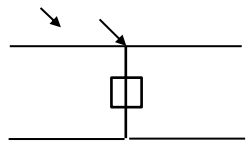
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

Presence line vehicle: Circuit, load present in all conductors of a circuit

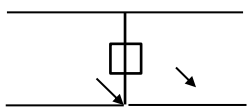
Principle of load situations:



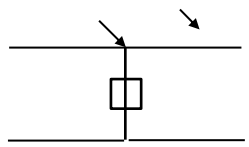
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

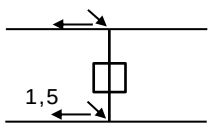
Load situations 8. Galloping as a static load

Conductor		
Suspension tower phase	0.866 W	1.5 W
Suspension tower earth	1.5 EDS	1.5 W
Strain tower phase and earth	1.5 EDS	1.5 W

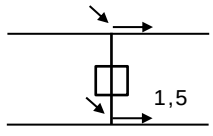
Considered situations galloping 8: None (existing structure)

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principle of load situations:



1. Ba



2. Ah

Load combination 8. Galloping as a dynamic load
Only applies to tension towers
Load consists of EDS tensile load in one of the conductors on one side of the tower
Can be converted by user to fatigue spectrum via the load spectrum of table 4.11 / NL.1

Project: ENS-ZL
Tower: S-6 R
Number: 28

Tower structure

Properties

Tower type	Steunmast		
Tower designation	S-6 R		
Base plate w.r.t. ground level	0.5		m
Tower height w.r.t. base plate	43.4		m
Tower self weight	200.0		kN
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	8.00	8.00	m
Inclination of main leg	0.153	0.153	-
Horizontal force factor	1.3	1.3	-

Calculation Wind load

Dynamic factor G_T	1.00 *(Masthoogte < 60 m)*
Wind load diagonally to tower body proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Wind load diagonally on traverse proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Magnification factor diagonal wind to tower body	(1+0,2sin^2(2phi))
Magnification factor diagonal wind to cross arm	(1+0,2sin^2(2phi))
Magnification factor wind parallel to perpendicular to cross a	0.4

Properties mast sections longitudinal direction (front view, yz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	9.80	8.00	5.00	9.80	0.153	63.70	8.49	0.13	3.24
Eerste tussenstuk	18.05	5.00	4.07	8.25	0.056	37.41	6.41	0.17	3.06
Tweede tussenstuk	27.50	4.07	3.00	9.45	0.057	33.40	7.92	0.24	2.77
Bovenstuk 1	33.40	3.00	2.58	5.90	0.036	16.45	4.06	0.25	2.73
Bovenstuk 2	41.40	2.58	2.00	8.00	0.036	18.30	4.44	0.24	2.75
Topstuk	43.40	2.00		2.00		2.00	0.36	0.18	3.02
Ondertraverse	27.50	13.80		3.00		20.70	4.66	0.22	2.82
Boventraverse	38.80	15.00		2.60		19.50	4.82	0.25	2.73

Properties tower sections transversal direction (side view, xz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	9.80	8.00	5.00	9.80	0.153	63.70	8.49	0.13	3.24
Eerste tussenstuk	18.05	5.00	4.07	8.25	0.056	37.41	6.41	0.17	3.06
Tweede tussenstuk	27.50	4.07	3.00	9.45	0.057	33.40	7.92	0.24	2.77
Bovenstuk 1	33.40	3.00	2.58	5.90	0.036	16.45	4.06	0.25	2.73
Bovenstuk 2	41.40	2.58	2.00	8.00	0.036	18.30	4.44	0.24	2.75
Topstuk	43.40	2.00		2.00		2.00	0.36	0.18	3.02
Ondertraverse	27.50	13.80		3.00		20.70	4.66	0.22	2.82
Boventraverse	38.80	15.00		2.60		19.50	4.82	0.25	2.73

Note: Surface transverse direction is reduced in calculation.

Project: ENS-ZL
Tower: S-6 R
Number: 28

Wind surface feeders telecom installations

Part	A (m^2/m)	Factor	Δh	A_1
Broekstuk				
Eerste tussenstuk				
Tweede tussenstuk				
Bovenstuk 1				
Bovenstuk 2				

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne top			
Antenne o.t.			

Tower section loads longitudinal (x-direction) per wind direction

Description	p_w [kN/m^2]	F_{x1} [kN]	F_{x2} [kN]	F_{x3} [kN]	F_{x4} [kN]	h_{ef} [m]	M_{y1} [kNm]	M_{y2} [kNm]	M_{y3} [kNm]	M_{y4} [kNm]
Broekstuk	0.70	19.3	16.4	0.0	-16.4	4.9	94.5	80.2	0.0	-80.2
Eerste tussenstuk	0.78	15.4	13.0	0.0	-13.0	13.9	213.8	181.4	0.0	-181.4
Tweede tussenstuk	0.91	20.1	17.0	0.0	-17.0	22.8	456.7	387.5	0.0	-387.5
Bovenstuk 1	1.00	11.1	9.4	0.0	-9.4	30.5	337.3	286.2	0.0	-286.2
Bovenstuk 2	1.05	12.8	10.9	0.0	-10.9	37.4	480.1	407.4	0.0	-407.4
Topstuk	1.09	1.2	1.0	0.0	-1.0	42.4	49.9	42.3	0.0	-42.3
Ondertraverse	0.97	25.6	15.2	0.0	-15.2	28.5	730.1	433.7	0.0	-433.7
Boventraverse	1.07	28.1	16.7	0.0	-16.7	39.7	1116.0	662.9	0.0	-662.9
Totaal		133.5	99.6	0.0	-99.6		3478.5	2481.7	0.0	-2481.7

Tower section loads transversal (y-direction) per wind direction

Description	p_w [kN/m^2]	F_{y1} [kN]	F_{y2} [kN]	F_{y3} [kN]	F_{x4} [kN]	h_{ef} [m]	M_{x1} [kNm]	M_{x2} [kNm]	M_{x3} [kNm]	M_{x4} [kNm]
Broekstuk	0.70	0.0	16.4	19.3	16.4	4.9	0.0	80.2	94.5	80.2
Eerste tussenstuk	0.78	0.0	13.0	15.4	13.0	13.9	0.0	181.4	213.8	181.4
Tweede tussenstuk	0.91	0.0	17.0	20.1	17.0	22.8	0.0	387.5	456.7	387.5
Bovenstuk 1	1.00	0.0	9.4	11.1	9.4	30.5	0.0	286.2	337.3	286.2
Bovenstuk 2	1.05	0.0	10.9	12.8	10.9	37.4	0.0	407.4	480.1	407.4
Topstuk	1.09	0.0	1.0	1.2	1.0	42.4	0.0	42.3	49.9	42.3
Ondertraverse	0.97	0.0	15.2	10.2	15.2	28.5	0.0	433.7	292.0	433.7
Boventraverse	1.07	0.0	16.7	11.3	16.7	39.7	0.0	662.9	446.4	662.9
Total		0.0	99.6	101.3	99.6		0.0	2481.7	2370.8	2481.7

Resulting loads from mast construction incl. Antenna without conductors level foundation (char. Value)

Load / wind direction	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
Permanente belasting	0	0	200	0	0	0
Windrichting 0°	134	0	0	0	3478	0
Windrichting 45°	100	100	0	2482	2482	0
Windrichting 90°	0	101	0	2371	0	0
Windrichting 135°	-100	100	0	2482	-2482	0

Project: ENS-ZL
Tower: S-6 R
Number: 28

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Bliksemdraad 1	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05

Conductors ahead

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Bliksemdraad 1	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05

Vertical load back

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	$w_{z,ijs}$ [N/m]	$w_{z,ijs,bundel}$ [N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Bliksemdraad 1	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3

Vertical load ahead

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	[N/m]	[N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Bliksemdraad 1	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3

Insulators

Conductor	$G_{isolator}$ [kN]	Number -	$F_{v,iso}$ [kN]	Length [m]	Wind surf. [m^2]	Wind heigth [m]	Pressure [kN/m^2]	Drag factor [-]	$F_{h,iso}$ [kN]
380ct1f1	3.00	1	3	4.5	2.0	25.75	0.95	1.2	2.27
380ct1f2	3.00	1	3	4.5	2.0	25.75	0.95	1.2	2.27
380ct1f3	3.00	1	3	4.5	2.0	37.05	1.05	1.2	2.52
380ct2f1	3.00	1	3	4.5	2.0	25.75	0.95	1.2	2.27
380ct2f2	3.00	1	3	4.5	2.0	25.75	0.95	1.2	2.27
380ct2f3	3.00	1	3	4.5	2.0	37.05	1.05	1.2	2.52
bl1	0.10	1	0.1	0.3	0.1	39.15	1.06	1.2	0.13
bl2	0.10	1	0.1	0.3	0.1	39.15	1.06	1.2	0.13

Project: ENS-ZL
Tower: S-6 R
Number: 28

Wind load back

Conductor	Height wind [m]	Pressure [kN/m^2]	$G_{c\ dwars}$ [-]	$G_{c\ trek}$ [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	29.4	0.98	0.60	0.48	1.10	28.53	55.5	44.4	47.4	100.4	80.4
380ct1f2	29.4	0.98	0.60	0.48	1.10	28.53	55.5	44.4	47.4	100.4	80.4
380ct1f3	40.7	1.08	0.63	0.50	1.08	28.53	61.9	49.4	47.4	114.7	91.6
380ct2f1	29.4	0.98	0.60	0.48	1.10	28.53	55.5	44.4	47.4	100.4	80.4
380ct2f2	29.4	0.98	0.60	0.48	1.10	28.53	55.5	44.4	47.4	100.4	80.4
380ct2f3	40.7	1.08	0.63	0.50	1.08	28.53	61.9	49.4	47.4	114.7	91.6
bl1	45.6	1.11	0.63	0.51	1.19	22.35	18.7	15.0	41.8	35.3	28.2
bl2	45.6	1.11	0.63	0.51	1.19	22.35	18.7	15.0	41.8	35.3	28.2

Wind load ahead

Conductor	Height wind [m]	Pressure [kN/m^2]	G_{c_dwars} [-]	G_{c_trek} [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	18.9	0.86	0.56	0.45	1.14	28.53	47.1	37.9	47.4	82.7	66.5
380ct1f2	18.9	0.86	0.56	0.45	1.14	28.53	47.1	37.9	47.4	82.7	66.5
380ct1f3	30.2	0.99	0.60	0.48	1.10	28.53	56.0	44.8	47.4	101.5	81.3
380ct2f1	18.9	0.86	0.56	0.45	1.14	28.53	47.1	37.9	47.4	82.7	66.5
380ct2f2	18.9	0.86	0.56	0.45	1.14	28.53	47.1	37.9	47.4	82.7	66.5
380ct2f3	30.2	0.99	0.60	0.48	1.10	28.53	56.0	44.8	47.4	101.5	81.3
bl1	35.1	1.03	0.61	0.49	1.20	22.35	17.0	13.6	41.8	31.8	25.4
bl2	35.1	1.03	0.61	0.49	1.20	22.35	17.0	13.6	41.8	31.8	25.4

Project: ENS-ZL
Tower: S-6 R
Number: 28

Conductor loads

Auteur: TBR
Versie: v11.6

Starting points
Consequence class Afkeur CC2-0
Reference period 30 jaar

ULS (strength) Load case	description	NEN-EN50341-2-15:2019 Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	γ_a A_k
ULS 1a	Wind	10°	1.05	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.12	0.00	0.0
ULS 3	Wind+ice	-5°	1.05	1.05	0.00	0.34	0.97	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.05	0.00	0.34	0.97	0.0
ULS 4	Cold+wind	-20°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.05	0.00	0.22	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.05	1.05	1.20	0.22	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 7	Permanent	10°	1.15	1.15	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G G_k	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.05	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.05	1.05	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.05	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.05	1.05	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.05	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.05	1.05	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.05	1.05	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	0.94	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.28	0.88	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions 4
Number of load combinations for ULS 44
Number of load combinations for SPLS 0
Number of load combinations for SLS 11
Number of concentrated loads 440

Project: ENS-ZL
Tower: S-6 R
Number: 28

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-37.3	37.3	3.1	3.0	1.5	4.5
380ct1f1	-133.0	133.0	10.3	9.3	4.4	13.4
380ct1f2	-133.0	133.0	10.3	9.3	4.4	13.4
380ct1f3	-134.8	134.8	11.4	10.9	4.3	13.4
380ct2f1	-133.0	133.0	10.3	9.3	4.4	13.4
380ct2f2	-133.0	133.0	10.3	9.3	4.4	13.4
380ct2f3	-134.8	134.8	11.4	10.9	4.3	13.4
bl2	-37.3	37.3	3.1	3.0	1.5	4.5

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	93.2	115.5	157.0
380ct1f1	147.8	157.8	179.7
380ct1f2	147.8	157.8	179.7
380ct1f3	141.7	157.4	179.7
380ct2f1	147.8	157.8	179.7
380ct2f2	147.8	157.8	179.7
380ct2f3	141.7	157.4	179.7
bl2	93.2	115.5	157.0

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	159.1	172.5
380ct1f1	180.9	185.0
380ct1f2	180.9	185.0
380ct1f3	180.9	185.0
380ct2f1	180.9	185.0
380ct2f2	180.9	185.0
380ct2f3	180.9	185.0
bl2	159.1	172.5

Envelop of weight span over all combinations (incl. 0,9 combinations)

For all conductors		Wind / Weight span ratio
Max. weight span	188.3 m	0.633 -
Min. weight span	55.7 m	0.187 -

Project: ENS-ZL
Tower: S-6 R
Number: 28

Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	21.2	6.1	5.0	-40.1	40.0
380ct1f1	65.2	19.6	17.3	-133.9	132.2
380ct1f2	65.2	19.6	17.3	-133.9	132.2
380ct1f3	65.2	22.4	17.3	-135.6	134.0
380ct2f1	65.2	19.6	17.3	-133.9	132.2
380ct2f2	65.2	19.6	17.3	-133.9	132.2
380ct2f3	65.2	22.4	17.3	-135.6	134.0
bl2	21.2	6.1	5.0	-40.1	40.0

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0.0	0.0	1.7	-21.2	21.2
380ct1f1	0.0	0.0	11.3	-81.5	81.5
380ct1f2	0.0	0.0	11.3	-81.5	81.5
380ct1f3	0.0	0.0	11.3	-81.5	81.5
380ct2f1	0.0	0.0	11.3	-81.5	81.5
380ct2f2	0.0	0.0	11.3	-81.5	81.5
380ct2f3	0.0	0.0	11.3	-81.5	81.5
bl2	0.0	0.0	1.7	-21.2	21.2

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	-0.4	1.6
	380ct1f1	1.6	8.7
	380ct1f2	1.6	8.7
	380ct1f3	1.6	8.7
	380ct2f1	1.6	8.7
	380ct2f2	1.6	8.7
	380ct2f3	1.6	8.7
	bl2	-0.4	1.6

Project: ENS-ZL
Tower: S-6 R
Number: 28

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		0	135	62	4359	0	0
ULS 1a_0,9_90		0	135	62	4359	0	0
ULS 3_90		0	69	107	2250	0	0
ULS 3_0,9_90		0	69	107	2250	0	0
SLS 7		0	0	71	0	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

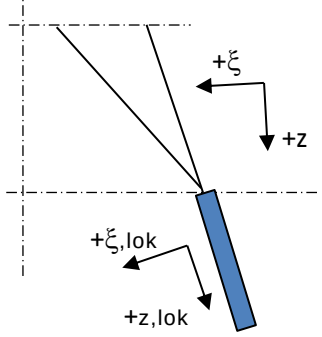
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	248	272	7007	0	0
ULS 3_90	0	103	317	3044	0	0
SLS 7	0	0	271	0	0	0

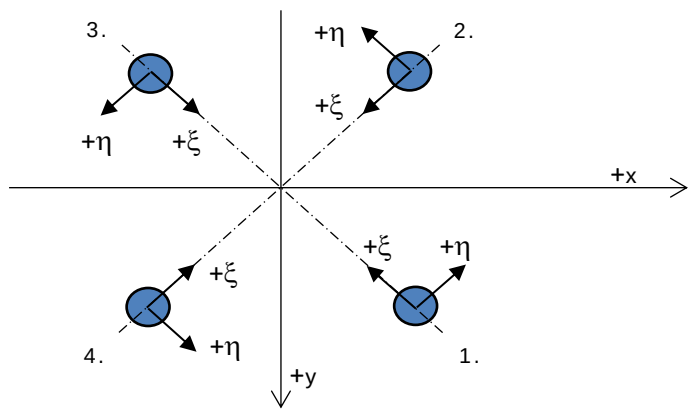
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	248	272	7007	0	0
ULS 1a_0	157	0	285	0	4144	0
ULS 5a Ba 10	65	0	278	14	1792	-807
ULS 1a_135	-117	182	281	5056	-2955	0

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 1a_45	106	96	571	7	-143	-20	584
2	ULS 1a_0	54	-66	330	9	-84	-13	338
3	ULS 5a Ah 22	-12	-63	230	-36	-53	-4	235
4	ULS 1a_135	-106	96	571	-7	-143	-20	584

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 22	-22	1	-94	-16	15	-5	-96
2	ULS 1a_0,9_0,9_135	-80	70	-441	7	107	11	-451
3	ULS 1a_0,9_0,9_45	80	70	-441	-7	107	11	-451
4	ULS 1a_0,9_0,9_0	27	-39	-198	-9	47	4	-203

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 10	24	-34	-38	41	7	-1	-39
2	ULS 5a Ba 21	5	-61	182	40	-47	-7	187
3	ULS 5a Ba 21	-23	34	-42	40	8	-1	-43
4	ULS 5a Ah 10	-6	61	186	39	-47	-7	190

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ba 10	5	61	182	-40	-47	-7	187
2	ULS 5a Ah 21	24	34	-38	-41	7	-1	-39
3	ULS 5a Ah 21	-6	-61	186	-39	-47	-7	190
4	ULS 5a Ba 10	-23	-34	-42	-40	8	-1	-43

Project: ENS-ZL
Tower: S-6 R
Number: 28

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 12	17	-36	-86	37	14	-5	-88
2	ULS 1a_0,9_0,9_135	-80	70	-441	7	107	11	-451
3	ULS 1a_0,9_0,9_45	80	70	-441	-7	107	11	-451
4	ULS 1a_0,9_0,9_0	27	-39	-198	-9	47	4	-203

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	uls 1a_90	101	76	506	18	-125	-15	518
2	uls 1a_90	-74	49	-370	18	86	6	-379
3	uls 1a_90	74	49	-370	-18	86	6	-379
4	uls 1a_90	-101	76	506	-18	-125	-15	518

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_45	106	96	571	7	-143	-20	584
Max. tension	ULS 1a_0,9_0,9_45	80	70	-441	-7	107	11	-451
Max. pos. torsie	ULS 5a Ah 10	24	-34	-38	41	7	-1	-39
Max. neg. torsie	ULS 5a Ah 21	24	34	-38	-41	7	-1	-39
Comb. tension+torsie	ULS 1a_45	80	70	-441	-7	107	11	-451

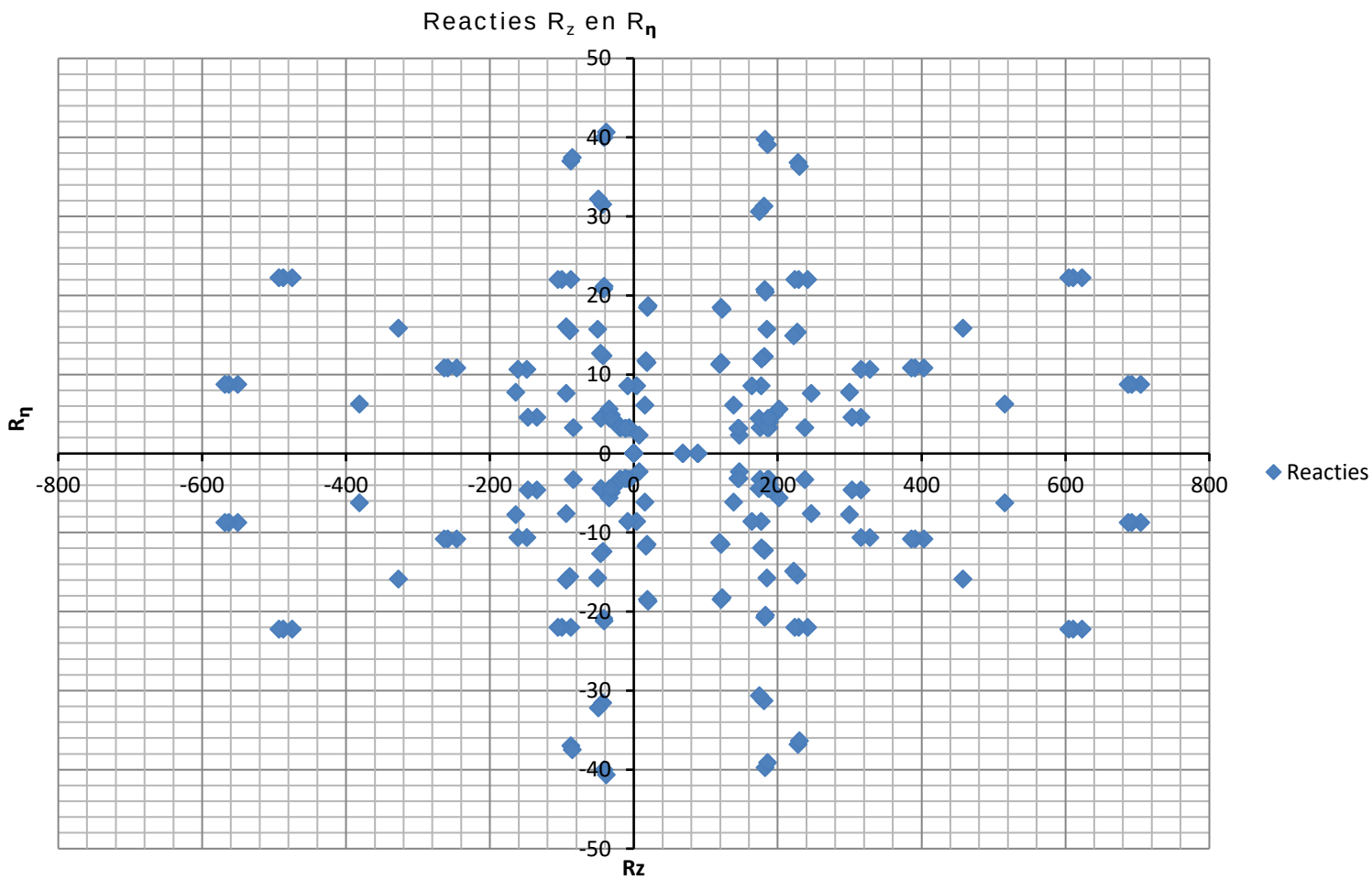
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	13	13	68	0	-19	-4	69
2	SLS 1a_135	-64	56	-356	6	85	8	-364
3	SLS 1a_45	64	56	-356	-6	85	8	-364
4	SLS 1a_0	20	-30	-151	-7	35	3	-154

Maximum compression load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	91	83	490	6	-123	-17	501
2	SLS 1a_0	47	-57	287	7	-73	-11	293
3	SLS 7	-13	-13	68	0	-19	-4	69
4	SLS 1a_135	-91	83	490	-6	-123	-17	501

Project: ENS-ZL
Tower: S-6 R
Number: 28



Project: ENS-ZL
Tower: S-6 R
Number: 28

Conductor loads

Auteur: TBR
Versie: v11.6

Starting points

Consequence class	Verbouw CC2
Reference period	50 jaar

ULS (strength) Load case	description	NEN-EN50341-2-15:2019 Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	γ_a A_k
ULS 1a	Wind	10°	1.15	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.40	0.00	0.0
ULS 3	Wind+ice	-5°	1.15	1.15	0.00	0.42	1.30	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.15	0.00	0.42	1.30	0.0
ULS 4	Cold+wind	-20°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.15	0.00	0.28	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.15	1.15	1.30	0.28	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 7	Permanent	10°	1.30	1.30	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G G_k	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.15	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.15	1.15	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.15	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.15	1.15	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.15	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.15	1.15	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.15	1.15	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	1.00	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.30	1.00	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions	4
Number of load combinations for ULS	44
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	440

Project: ENS-ZL
Tower: S-6 R
Number: 28

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-42.1	42.1	3.9	3.7	1.7	4.8
380ct1f1	-151.5	151.5	12.9	11.7	4.9	15.7
380ct1f2	-151.5	151.5	12.9	11.7	4.9	15.7
380ct1f3	-153.7	153.7	14.3	13.7	4.9	15.7
380ct2f1	-151.5	151.5	12.9	11.7	4.9	15.7
380ct2f2	-151.5	151.5	12.9	11.7	4.9	15.7
380ct2f3	-153.7	153.7	14.3	13.7	4.9	15.7
bl2	-42.1	42.1	3.9	3.7	1.7	4.8

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	87.6	115.1	157.0
380ct1f1	144.5	157.6	179.7
380ct1f2	144.5	157.6	179.7
380ct1f3	137.9	157.2	179.7
380ct2f1	144.5	157.6	179.7
380ct2f2	144.5	157.6	179.7
380ct2f3	137.9	157.2	179.7
bl2	87.6	115.1	157.0

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	162.9	180.6
380ct1f1	182.9	189.9
380ct1f2	182.9	189.9
380ct1f3	182.9	189.9
380ct2f1	182.9	189.9
380ct2f2	182.9	189.9
380ct2f3	182.9	189.9
bl2	162.9	180.6

Envelop of weight span over all combinations (incl. 0,9 combinations)

For all conductors		Wind / Weight span ratio
Max. weight span	191.2 m	0.642 -
Min. weight span	23.5 m	0.079 -

Project: ENS-ZL
Tower: S-6 R
Number: 28

Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	21.2	7.6	5.5	-42.5	42.4
380ct1f1	65.2	24.5	20.6	-152.6	150.4
380ct1f2	65.2	24.5	20.6	-152.6	150.4
380ct1f3	65.2	28.1	20.6	-154.7	152.8
380ct2f1	65.2	24.5	20.6	-152.6	150.4
380ct2f2	65.2	24.5	20.6	-152.6	150.4
380ct2f3	65.2	28.1	20.6	-154.7	152.8
bl2	21.2	7.6	5.5	-42.5	42.4

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0.0	0.0	1.7	-21.2	21.2
380ct1f1	0.0	0.0	11.3	-81.5	81.5
380ct1f2	0.0	0.0	11.3	-81.5	81.5
380ct1f3	0.0	0.0	11.3	-81.5	81.5
380ct2f1	0.0	0.0	11.3	-81.5	81.5
380ct2f2	0.0	0.0	11.3	-81.5	81.5
380ct2f3	0.0	0.0	11.3	-81.5	81.5
bl2	0.0	0.0	1.7	-21.2	21.2

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	-0.4	1.6
	380ct1f1	1.6	8.7
	380ct1f2	1.6	8.7
	380ct1f3	1.6	8.7
	380ct2f1	1.6	8.7
	380ct2f2	1.6	8.7
	380ct2f3	1.6	8.7
	bl2	-0.4	1.6

Project: ENS-ZL
Tower: S-6 R
Number: 28

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		0	169	65	5465	0	0
ULS 1a_0,9_90		0	169	65	5465	0	0
ULS 3_90		0	87	128	2821	0	0
ULS 3_0,9_90		0	87	128	2821	0	0
SLS 7		0	0	71	0	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

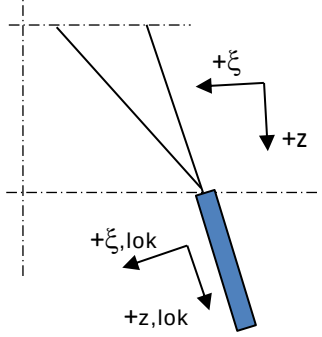
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	311	295	8784	0	0
ULS 3_90	0	130	358	3816	0	0
SLS 7	0	0	271	0	0	0

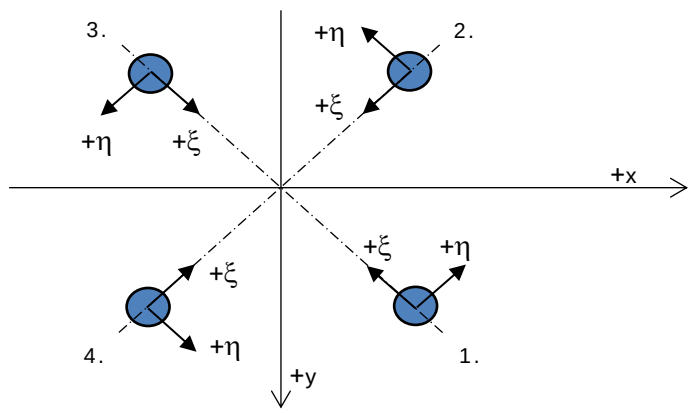
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	311	295	8784	0	0
ULS 1a_0	197	0	313	0	5195	0
ULS 5a Ba 10	65	0	278	14	1792	-807
ULS 1a_45	147	228	308	6339	3704	0

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 1a_45	131	118	705	9	-176	-24	721
2	ULS 1a_0	65	-80	403	11	-103	-15	412
3	ULS 5a Ah 22	-12	-63	230	-36	-53	-4	235
4	ULS 1a_135	-131	118	705	-9	-176	-24	721

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 22	-22	1	-94	-16	15	-5	-96
2	ULS 1a_0,9_0,9_135	-104	91	-569	9	138	15	-582
3	ULS 1a_0,9_0,9_45	104	91	-569	-9	138	15	-582
4	ULS 1a_0,9_0,9_0	37	-52	-264	-11	63	6	-270

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 10	24	-34	-38	41	7	-1	-39
2	ULS 5a Ba 21	5	-61	182	40	-47	-7	187
3	ULS 5a Ba 21	-23	34	-42	40	8	-1	-43
4	ULS 5a Ah 10	-6	61	186	39	-47	-7	190

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ba 10	5	61	182	-40	-47	-7	187
2	ULS 5a Ah 21	24	34	-38	-41	7	-1	-39
3	ULS 5a Ah 21	-6	-61	186	-39	-47	-7	190
4	ULS 5a Ba 10	-23	-34	-42	-40	8	-1	-43

Project: ENS-ZL
Tower: S-6 R
Number: 28

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 12	17	-36	-86	37	14	-5	-88
2	ULS 1a_0,9_0,9_135	-104	91	-569	9	138	15	-582
3	ULS 1a_0,9_0,9_45	104	91	-569	-9	138	15	-582
4	ULS 1a_0,9_0,9_0	37	-52	-264	-11	63	6	-270

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	uls 1a_90	124	93	623	22	-153	-18	637
2	uls 1a_90	-95	63	-475	22	111	9	-486
3	uls 1a_90	95	63	-475	-22	111	9	-486
4	uls 1a_90	-124	93	623	-22	-153	-18	637

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_45	131	118	705	9	-176	-24	721
Max. tension	ULS 1a_0,9_0,9_45	104	91	-569	-9	138	15	-582
Max. pos. torsie	ULS 5a Ah 10	24	-34	-38	41	7	-1	-39
Max. neg. torsie	ULS 5a Ah 21	24	34	-38	-41	7	-1	-39
Comb. tension+torsie	ULS 1a_0,9_45	104	91	-569	-9	138	15	-582

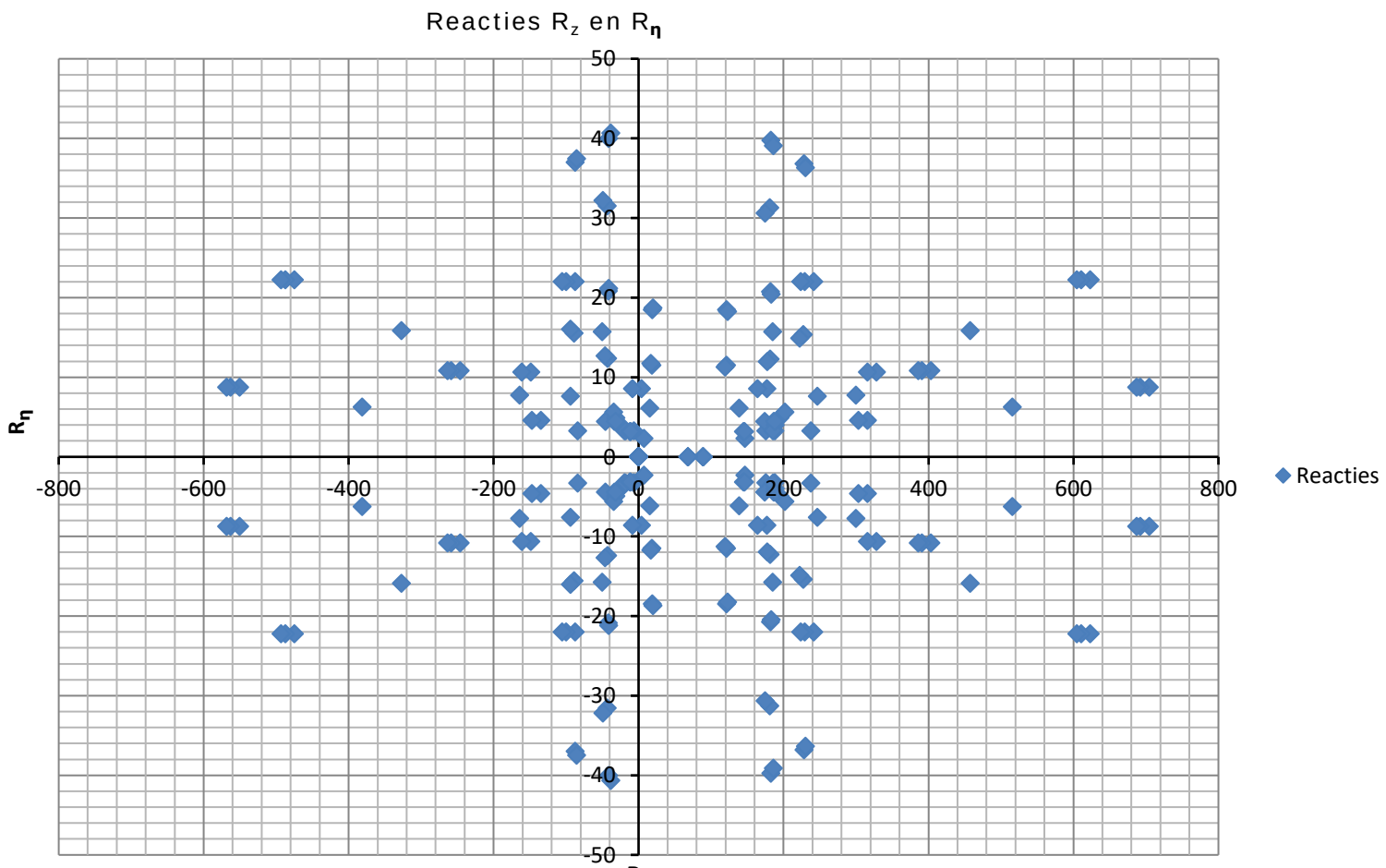
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	13	13	68	0	-19	-4	69
2	SLS 1a_135	-69	60	-381	6	92	9	-390
3	SLS 1a_45	69	60	-381	-6	92	9	-390
4	SLS 1a_0	22	-33	-164	-8	38	3	-168

Maximum compression load - SLS

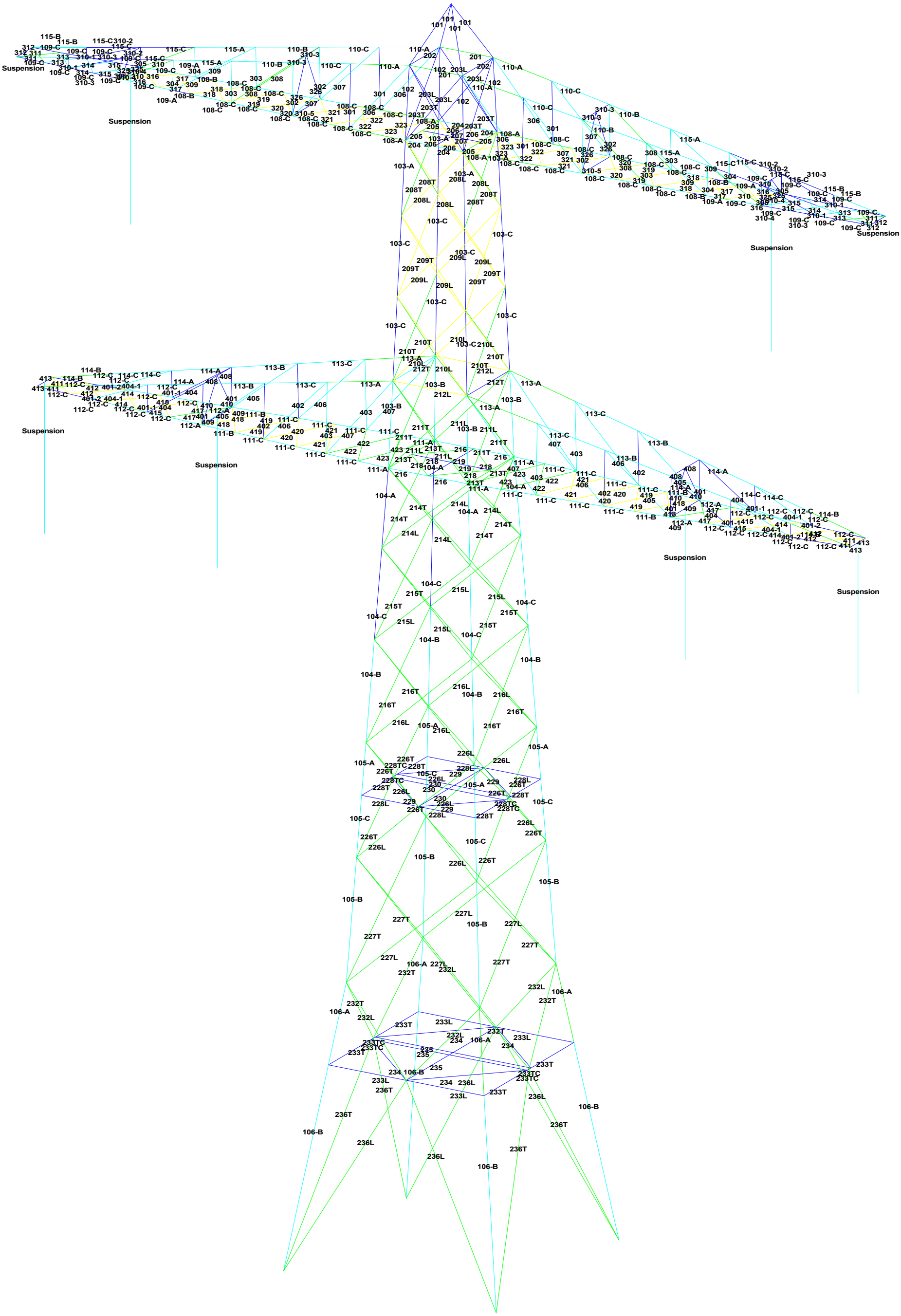
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	96	87	515	6	-129	-18	527
2	SLS 1a_0	49	-60	300	8	-77	-12	307
3	SLS 7	-13	-13	68	0	-19	-4	69
4	SLS 1a_135	-96	87	515	-6	-129	-18	527

Project: ENS-ZL
Tower: S-6 R
Number: 28



APPENDIX B
Uitvoer PLS-TOWER

DNV GL Nederlands BV, Project: "S-6_R (hv) ini"
Tower Version 16.12, 16:07:26 Thursday, 29 October, 2020
Undeformed geometry displayed


Suspension
Suspension
Suspension

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date	30-10-20
Author	MKh
Version	1.0

ENS-ZL 380
S-6_R
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Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
101	Earth Peak	80x80x7#	S235	2M20-8.8t	1.00	1.00	1.00	155	**-15.0**	ULS 5a Ba 12	87.1	188.2	151.2	0.17		**14.9**	ULS 5a Ba 22	129.9	188.2	137.5	0.11	
102	Main Leg Level 6	100x100x8	S355	7M20-8.8t	0.52	0.52	0.52	69	**-49.5**	ULS 5a Ah 12	394.0	658.6	823.2	0.13		**4.4**	ULS 5a Ah 22	422.7	658.6	823.2	0.01	
103-A	Main Leg Level 5	120x120x10	S355	4M24-8.8t	0.52	0.52	0.52	57	**-49.4**	ULS 1a_135	656.6	542.2	705.6	0.09		**29.8**	ULS 5a Ah 22	635.0	542.2	663.4	0.05	
103-B	Main Leg Level 5	120x120x10	S355	8M24-8.8t	0.52	0.52	0.52	66	**-184.1**	ULS 1a_45	607.0	2168.8	1411.2	0.30		**98.4**	ULS 1a_0,9_0,9_135	635.0	2168.8	1411.2	0.15	
103-C	Main Leg Level 5	120x120x10	S355		0.52	0.52	0.52	64	**-145.0**	ULS 1a_135	619.8	0.0	0.0	0.23		**96.2**	ULS 1a_0,9_0,9_45	823.6	0.0	0.0	0.12	
104-A	Main Leg Level 4	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	49	**-282.9**	ULS 1a_135	1050.7	2168.8	1693.4	0.27		**175.9**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1461.9	0.17	
104-B	Main Leg Level 4	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	63	**-419.6**	ULS 1a_135	940.1	2168.8	1693.4	0.45		**302.6**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1461.9	0.30	
104-C	Main Leg Level 4	150x150x12	S355		0.52	0.52	0.52	56	**-350.7**	ULS 1a_45	998.1	0.0	0.0	0.35		**230.2**	ULS 1a_0,9_0,9_45	1235.4	0.0	0.0	0.19	
105-A	Main Leg Level 3	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	32	**-478.8**	ULS 1a_45	1155.2	2168.8	1693.4	0.41		**350.6**	ULS 1a_0,9_0,9_135	1007.6	2168.8	1461.9	0.35	
105-B	Main Leg Level 3	150x150x12	S355	8M24-8.8t	0.25	0.25	0.25	37	**-561.3**	ULS 1a_135	1128.8	2168.8	1693.4	0.50		**424.5**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1461.9	0.42	
105-C	Main Leg Level 3	150x150x12	S355		0.52	0.52	0.52	38	**-479.9**	ULS 1a_135	1121.1	0.0	0.0	0.43		**349.4**	ULS 1a_0,9_0,9_135	1235.4	0.0	0.0	0.28	
106-A	Main Leg Level 1 (Base)	150x150x12	S355	10M24-8.8t	0.52	0.52	0.52	51	**-519.3**	ULS 1a_45	1037.3	2711.0	2116.8	0.50		**404.7**	ULS 1a_0,9_0,9_135	1007.6	2711.0	1827.3	0.40	
106-B	Main Leg Level 1 (Base)	150x150x12	S355	8M24-8.8t	0.20	0.20	0.20	49	**-521.3**	ULS 1a_135	1051.2	2168.8	1693.4	0.50		**402.6**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1592.1	0.40	
108-A	Boven Traverse Lower 1	120x120x10	S355	12M24-8.8t	1.00	1.47	1.00	62	**-358.2**	ULS 5a Ba 22	630.9	1562.2	2116.8	0.57		**240.1**	ULS 5a Ah 12	635.0	1562.2	1990.2	0.38	
108-C	Boven Traverse Lower 1	120x120x10	S355		3.11	2.03	1.00	59	**-331.3**	ULS 5a Ba 12	648.8	0.0	0.0	0.51		**216.1**	ULS 5a Ah 22	823.6	0.0	0.0	0.26	
108-B	Boven Traverse Lower 1	120x120x10	S355	4M24-8.8t	1.86	3.28	1.00	61	**-128.2**	ULS 5a Ba 3	634.8	542.2	705.6	0.24		**33.9**	ULS 5a Ah 12	635.0	542.2	663.4	0.06	
109-A	Boven Traverse Lower 2	90x90x8	S355	4M24-8.8t	3.38	2.16	1.00	73	**-113.0**	ULS 5a Ba 1	338.8	542.2	564.5	0.33		**42.5**	ULS 5a Ah 12	343.6	542.2	530.7	0.12	
109-C	Boven Traverse Lower 2	90x90x8	S355		1.00	1.42	1.00	80	**-96.2**	ULS 5a Ba 1	311.0	0.0	0.0	0.31		**32.4**	ULS 5a Ah 1	493.5	0.0	0.0	0.07	
110-A	Boven Traverse Upper	80x80x8	S235	4M20-8.8t	1.00	1.98	1.00	186	**0.0**		73.9	376.3	345.6	0.00		**101.4**	ULS 3_0	168.3	376.3	310.2	0.60	
110-B	Boven Traverse Upper	80x80x8	S235	4M20-8.8t	1.00	2.81	1.00	276	**0.0**		41.7	376.3	345.6	0.00		**78.5**	ULS 3_0	227.6	376.3	314.2	0.35	
110-C	Boven Traverse Upper	80x80x8	S235		1.00	1.98	1.00	182	**0.0**		76.1	0.0	0.0	0.00		**91.6**	ULS 3_135	289.1	0.0	0.0	0.32	
115-A	Boven Traverse Upper	80x80x6#	S235	4M20-8.8t	1.00	2.93	1.00	271	**0.0**		32.7	376.3	259.2	0.00		**59.2**	ULS 3_0	175.2	376.3	235.6	0.34	
115-B	Boven Traverse Upper	80x80x6#	S235	2M20-8.8t	1.00	2.00	1.00	164	**-1.4**	ULS 5a Ah 1	66.2	188.2	129.6	0.02		**29.4**	ULS 5a Ah 22	93.1	188.2	100.8	0.32	
115-C	Boven Traverse Upper	80x80x6#	S235		1.00	2.00	1.00	164	**-1.4**	ULS 5a Ah 3	66.2	0.0	0.0	0.02		**34.4**	ULS 5a Ba 22	220.9	0.0	0.0	0.16	
111-A	Onder Traverse Lower 1	120x120x12	S355	11M24-8.8t	2.04	1.00	1.00	67	**-350.9**	ULS 5a Ba 10	712.0	1447.6	2328.5	0.49		**208.9**	ULS 5a Ah 10	750.1	1447.6	2189.2	0.28	
111-C	Onder Traverse Lower 1	120x120x12	S355		1.96	1.00	1.00	67	**-340.6**	ULS 5a Ba 10	711.2	0.0	0.0	0.48		**199.8**	ULS 5a Ah 10	976.3	0.0	0.0	0.20	
111-B	Onder Traverse Lower 1	120x120x12	S355	4M24-8.8t	1.00	1.85	1.00	66	**-262.6**	ULS 5a Ba 10	719.7	542.2	846.7	0.48		**161.3**	ULS 5a Ah 21	750.1	542.2	796.1	0.30	
112-A	Onder Traverse Lower 2	100x100x10	S355	4M24-8.8t	1.00	1.67	1.00	71	**-223.1**	ULS 5a Ba 10	476.0	542.2	705.6	0.47		**153.3**	ULS 5a Ah 10	493.9	542.2	663.4	0.31	
112-C	Onder Traverse Lower 2	100x100x10	S355		1.50	2.50	1.00	71	**-195.9**	ULS 5a Ba 10	476.2	0.0	0.0	0.41		**129.5**	ULS 5a Ah 10	681.6	0.0	0.0	0.19	
113-A	Onder Traverse Upper 1	80x80x8	S235	4M20-8.8t	2.90	1.00	1.00	313	**0.0**		34.3	376.3	345.6	0.00		**119.3**	ULS 3_0	168.3	376.3	310.2	0.71	
113-B	Onder Traverse Upper 1	80x80x8	S235	4M20-8.8t	3.09	1.00	1.00	313	**0.0**		34.3	376.3	345.6	0.00		**81.7**	ULS 3_0	227.6	376.3	314.2	0.36	
113-C	Onder Traverse Upper 1	80x80x8	S235		3.02	1.00	1.00	312	**0.0**		34.3	0.0	0.0	0.00		**103.9**	ULS 3_45	289.1	0.0	0.0	0.36	
114-A	Onder Traverse Upper 2	80x80x6#	S235	4M20-8.8t	3.00	1.00	1.00	270	**0.0**		33.0	376.3	259.2	0.00		**77.9**	ULS 3_0	175.2	376.3	235.6	0.44	
114-B	Onder Traverse Upper 2	80x80x6#	S235	4M20-8.8t	3.00	1.00	1.00	270	**0.0**		33.0	376.3	259.2	0.00		**71.7**	ULS 3_0	116.4	376.3	196.0	0.62	
114-C	Onder Traverse Upper 2	80x80x6#	S235		3.00	1.00	1.00	270	**0.0**		33.0	0.0	0.0	0.00		**71.6**	ULS 3_0	220.9	0.0	0.0	0.32	
201	Earth Peak Hrz Trans	80x80x8	S235	4M20-8.8t	1.00	1.00	1.00	128	**0.0**		122.6	376.3	345.6	0.00		**107.8**	ULS 3_0	157.3	376.3	277.6	0.69	
202	Earth Peak Hrz Long	60x60x6	S235	2M16-8.8t	1.00	1.00	1.00	171	**-1.6**	ULS 5a Ah 22	48.7	120.6	103.7	0.03		**1.4**	ULS 5a Ah 22	78.2	120.6	67.3	0.02	
203L	Boven Cross-Arm to Mast Int X-Diag Trar	80x80x6#	S235	2M20-8.8t	0.52	0.52	0.52	109	**-26.1**	ULS 5a Ah 22	110.0	188.2	129.6	0.24		**19.8**	ULS 5a Ah 22	112.1	188.2	117.8	0.18	
203T	Boven Cross-Arm to Mast Int X-Diag Long	80x80x6#	S235	2M20-8.8t	0.52	0.52	0.52	109	**-15.6**	ULS 5a Ah 12	110.0	188.2	129.6	0.14		**8.9**	ULS 5a Ah 22	112.1	188.2	117.8	0.08	
204	Boven Cross-Arm to Mast Hrz Trans	120x120x10	S355	12M24-8.8t	1.00	2.00	1.00	60	**-278.9**	ULS 5a Ba 22	644.6	1562.2	2116.8	0.43		**140.3**	ULS 5a Ah 22	635.0	1562.2	1990.2	0.22	
205	Boven Cross-Arm to Mast Hrz Long	65x65x7	S235	4M20-8.8t	1.00	2.00	1.00	112	**-60.4**	ULS 5a Ah 22	94.3	376.3	302.4	0.64		**75.0**	ULS 5a Ah 12	145.7	376.3	190.9	0.51	
206	Boven Cross-Arm to Mast Internal Diag	80x80x6#	S235	2M20-8.8t	1.00	1.00	1.00	97	**-92.2**	ULS 5a Ba 12	121.6	188.2	129.6	0.76		**92.2**	ULS 5a Ba 22	99.4	188.2	110.5	0.93	
207	Boven Cross-Arm to Mast Interal X-Brac	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	113	**-0.3**	ULS 3_0	43.6	60.3	43.2	0.01		**0.2**	ULS 3_0	46.1	60.3	32.7	0.01	
208L	Mast Level 6 Cross-Diag 1 T	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	102	**-139.4**	ULS 5a Ba 12	172.5	271.1	207.4	0.81		**144.5**	ULS 5a Ah 22	159.7	271.1	183.4	0.90	
208T	Mast Level 6 Cross-Diag 1 L	100x100x8	S235	3M24-8.8t	0.52	0.52	0.52	92	**-151.0**	ULS 5a Ba 22	209.6	406.7	311.0	0.72		**150.3**	ULS 5a Ah 22	211.1	406.7	276.0	0.71	
209L	Mast Level 6 Cross-Diag 2 T	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	110	**-134.0**	ULS 5a Ah 12	161.0	271.1	207.4	0.83		**127.2**	ULS 5a Ba 12	159.7	271.1	183.4	0.80	
209T	Mast Level 6 Cross-Diag 2 L	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	99	**-138.1**	ULS 5a Ah 22	197.3	271.1	207.4	0.70		**138.5**	ULS 5a Ba 12	181.4	271.1	189.2	0.76	
210L	Mast Level 6 Cross-Diag 3 T	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	117	**-114.2**	ULS 5a Ba 12	152.7	271.1	207.4	0.75		**120.5**	ULS 5a Ah 22	159.7	271.1	183.4	0.75	
210T	Mast Level 6 Cross-Diag 3 L	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	105	**-125.3**	ULS 5a Ba 22	188.3	271.1	207.4	0.67		**124.0**	ULS 5a Ah 22	181.4	271.1	189.2	0.68	
212L	Onder Cross-Arm to Mast Upper Hrz Tran	80x80x8	S235	3M20-8.8t	1.00	1.00	1.00	178	**0.0**		82.0	282.2	259.2	0.00		**129.7**	ULS 3_0	168.3	282.2	234.2	0.77	
212T	Onder Cross-Arm to Mast Upper Hrz Long	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	178	**-23.5**	ULS 1a_0,9_0,9_90	82.0	188.2	172.8	0.29		**28.1**	ULS 1a_90	146.3	188.2	157.1	0.19	
211L	Onder Cross-Arm to Mast Int X-Diag Trar	100x100x10	S235	2M24-8.8t	0.52	0.52	0.52	111	**-120.3**	ULS 5a Ba 12	221.0	271.1	259.2	0.54		**120.6**	ULS 5a Ah 22	224.3	271.1	236.4	0.54	
211T	Onder Cross-Arm to Mast Int X-Diag Long	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	111	**-119.3**	ULS 5a Ba 22	179.3	271.1	207.4	0.67		**104.9**	ULS 5a Ah 22	181.4	271.1	189.2	0.58	
216	Hor Verb D Hrz Trans	120x120x12	S355	11M24-8.8t	1.00	2.00	1.00	82	**-268.1**	ULS 5a Ba 21	597.6	1447.6	2328.5	0.45		**114.4**	ULS 5a Ah 21	750.1	1447.6	2189.2	0.15	
213T	Hor Verb D Hrz Long	80x80x6#	S235	4M20-8.8t	1.00	2.00	1.00	121	**-54.9**	ULS 5a Ah 21	93.7	376.3	259.2	0.59		**75.8**	ULS 5a Ah 10	175.2	376.3	235.6	0.43	
218	Hor Verb D Internal Diag	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	121	**-90.1**	ULS 5a Ah 21	147.8	271.1	207.4	0.61		**90.3**	ULS 5a Ba 21	159.7	271.1	183.4	0.57	
219	Hor Verb D X-Brace	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	155	**-0.4**	ULS 3_0	30.8	60.3	43.2	0.01		**0.4**	ULS 3_0	46.1	60.3	32.7	0.01	
214L	Mast Level 4 Cross-Diag 1 T	100x100x8	S235	2M24-8.8t	0.53	0.27	0.27	73	**-111.4**	ULS 5a Ba 10	231.3	271.1	207.4	0.54		**106.6**	ULS 5a Ah 21	181.4	271.1	189.2	0.59	
214T	Mast Level 4 Cross-Diag 1 L	100x100x8	S235	2M24-8.8t	0.53	0.27	0.27	73	**-124.3**	ULS 5a Ba 21	231.3	271.1	207.4	0.60		**123.6**	ULS 5a Ah 10	181.4	271.1	189.2	0.68	
215L	Mast Level 4 Cross-Diag 2 T	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	91	**-98.6**	ULS 5a Ah 10	179.1	271.1	207.4	0.55		**100.9**	ULS 5a Ba 10	173.9	271.1	193.2	0.58	
215T	Mast Level 4 Cross-Diag 2 L	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	91	**-113.7**	ULS 5a Ba 21	179.1	271.1	207.4	0.63		**114.5**	ULS 5a Ba 21	173.9	271.1	193.2	0.66	
216L	Mast Level 4 Cross-Diag 3 T	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	102	**-91.5**	ULS 5a Ah 10	163.9	271.1	207.4	0.56		**88.9**	ULS 5a Ah 10	159.7	271.1	183.4	0.56	
216T	Mast Level 4 Cross-Diag 3 L	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	102	**-104.4**	ULS 5a Ba 21	163.9	271.1	207.4	0.64		**103.0**	ULS 5a Ba 10	159.7	271.1	183.4	0.64	
226T	Mast Level 3 Cross-Diag 1 T	90x90x8	S235	2M24-8.8t	1.00	0.52	0.52	114	**-98.6**	ULS 5a Ba 10	148.1	271.1	207.4	0.67		**92.6**	ULS 5a Ah 21	159.7	271.1	183.4	0.58	
226L	Mast Level 3 Cross-Diag 1 L	90x90x8	S235	2M24-8.8t	1.00	0.52	0.52	114	**-81.1**	ULS 5a Ah 10	148.1	271.1	207.4	0.55		**81.6**	ULS 5a Ah 21	159.7	271.1	183.4	0.51	
227T	Mast Level 3 Cross-Diag 2 T	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	124	**-83.1**	ULS 5a Ah 10	135.5	271.1	207.4	0.61		**86.5**	ULS 5a Ba 10	159.7	271.1	183.4	0.54	
227L	Mast Level 3 Cross-Diag 2 L	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	124	**-72.3**	ULS 5a Ah 10	135.5	271.1	207.4	0.53		**71.0**	ULS 5a Ah 21	159.7	271.1	183.4	0.44	
228T	Hor Verb G Hrz Trans	60x60x6	S235	1M16-8.8t	1.10	1.00	1.00	166	**-2.1**	ULS 1a_0,9_0,9_45	45.4	60.3	51.8	0.05		**1.8**	ULS 1a_135	48.4	60.3	33.7	0.05	
228TC	Hor Verb G Hrz Trans	60x60x6	S235		2.00	11.24	1.00	117	**-3.7**	ULS 1a_0,9_0,9_45	71.2	0.0	0.0	0.05		**3.6**	ULS 1a_0,9_45	162.2	0.0	0.0	0.02	
228L	Hor Verb G Hrz Long	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	183	**-1.8**	ULS 1a_0,9_0,9_45	40.1	60.3	51.8	0.05		**1.8**	ULS 1a_45	48.4	60.3	33.7	0.05	
229	Hor Verb G Internal Diag	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	247	**-1.5**	ULS 1a_135	23.1	60.3	51.8	0.07		**1.8**	ULS 1a_0,9_0,9_45	48.4	60.3	33.7	0.05	
230	Hor Verb G Internal X-Brace	60x60x6	S235	1M16-8.8t	0.50	0.50	0.50	183	**-0.4**	ULS 1a_0	35.7	60.3	51.8	0.01		**0.3**	ULS 1a_0,9_0	48.4	60.3	33.7	0.01	
232T	Mast Level 1 Cross-Diag 1 T	100x100x8	S235	2M24-8.8t	0.52	1.00	0.52	123	**-79.9**	ULS 5a Ah 22	152.0	271.1	207.4	0.53		**58.3**	ULS 1a_0,9_0,9_90	181.4	271.1	189.2	0.32	
232L	Mast Level 1 Cross-Diag 1 L	100x100x8	S235	2M24-8.8t	0.52	1.00	0.52	123	**-85.8**	ULS 5a Ba 21	152.0	271.1	207.4	0.56		**72.6**	ULS 5a Ah 10	181.4	271.1	189.2	0.40	
233T	Hor Verb E Hrz Trans	60x60x6	S235	1M16-8.8t	1.00	1.04	1.00	240	**-2.5**	ULS 1a_45	27.1	60.3	51.8	0.09		**0.8**	ULS 1a_0,9_0	48.4	60.3	33.7	0.02	
233TC	Hor Verb E Hrz Trans	60x60x6	S235		23.81	2.00	1.00	161	**-5.1**	ULS 1a_45	50.0	0.0	0.0	0.10		**3.4**	ULS 1a_0,9_0,9_135	162.2	0.0	0.0	0.02	
233L	Hor Verb E Hrz Long	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	250	**-2.6**	ULS 1a_90	25.4	60.3	51.8	0.10		**0.6**	ULS 1a_0,9_135	48.4	60.3	33.7	0.02	
234	Hor Verb E Internal Diag	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	347	**-2.3**	ULS 1a_45	13.5	60.3	51.8	0.17		**2.6**	ULS 1a_0,9_0,9_45	48.4	60.3	33.7	0.08	
235	Hor Verb E Internal X-Brace	65x65x7	S235	1M16-8.8t	0.50	0.50	0.50	232	**-0.8**	ULS 1a_0	31.9	60.3	60.5	0.02		**0.2**	ULS 1a_0,9_0,9_0	72.6	60.3	52.3	0.00	
236T	Mast Level 1 Cross-Diag 2 T	80x80x8	S235	2M20-8.8t	0.20	0.20	0.20	104	**-103.5**	ULS 5a Ah 12	150.1	188.2	172.8	0.69		**76.3**	ULS 5a Ba 12	138.0	188.2	151.7	0.55	
236L	Mast Level 1 Cross-Diag 2 L	80x80x8	S235	2M20-8.8t	0.20	0.20	0.20	104	**-104.5**	ULS 5a Ba 21	150.1	188.2	172.8	0.70		**93.0**	ULS 5a Ah 21	138.0	188.2	151.7	0.67	
301	Upper Cross-Arm Trans Face Vert Brace 1	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	189	**-8.5**	ULS 3_0	34.0	60.3	51.8	0.25		**0.0**		48.4	60.3	33.7	0.00	
302	Upper Cross-Arm Trans Face Vert Brace 2	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	189	**-8.4**	ULS 3_0	23.7	60.3	43.2	0.35		**0.0**		37.4	60.3	25.7	0.00	
303	Upper Cross-Arm Trans Face Diag Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	147	**-9.5**	ULS 3_0	32.7	60.3	43.2	0.29		**0.0**		37.4	60.3	25.7	0.00	

DNV·GL

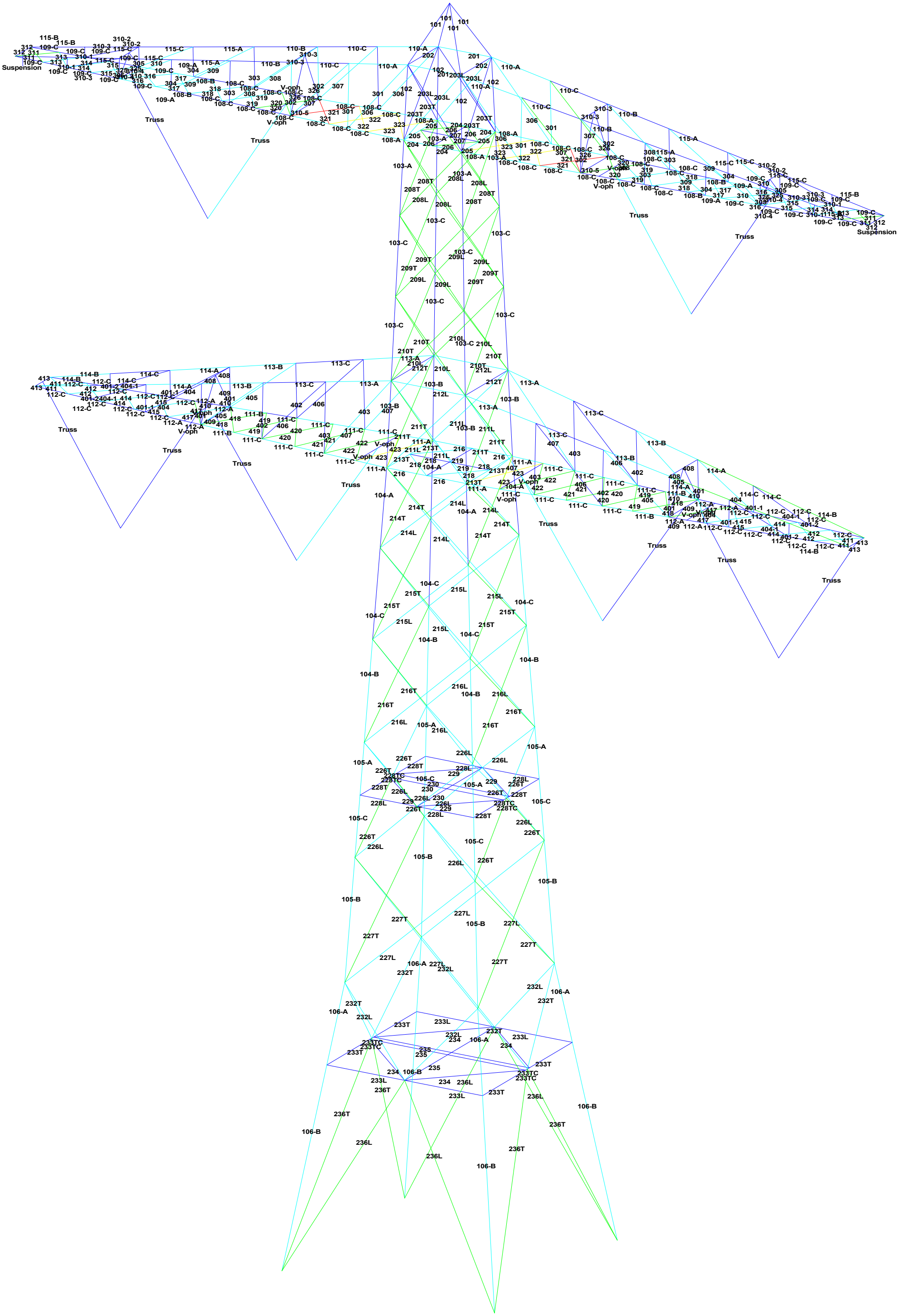
Assessment of groups for initial mast (afkeur level)

Date 30-10-20
Author MKh
Version 1.0

ENS-ZL 380
S-6_R
22

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
304	Upper Cross-Arm Trans Face Diag Brace :	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	107	**-11.5**	ULS 3_0	45.8	60.3	43.2	0.27		**0.0**		37.4	60.3	25.7	0.00	
305	Upper Cross-Arm Trans Face Diag Brace :	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	71	**-1.1**	ULS 5a Ba 3	58.4	60.3	43.2	0.02		**0.0**		37.4	60.3	25.7	0.00	
306	Upper Cross-Arm Trans Face Diag Brace «	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	294	**0.0**		17.6	60.3	51.8	0.00		**11.7**	ULS 3_0	48.4	60.3	33.7	0.35	
307	Upper Cross-Arm Trans Face Diag Brace !	50x50x7	S235	1M16-8.8t	1.00	1.00	1.00	328	**0.0**		14.0	60.3	60.5	0.00		**13.7**	ULS 3_0	52.4	60.3	36.0	0.38	
308	Upper Cross-Arm Bovenvlak Lateral Brac	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	307	**0.0**		11.4	60.3	43.2	0.00		**16.7**	ULS 3_0	37.4	60.3	25.7	0.65	
309	Upper Cross-Arm Ondervlak Lateral Brac	50x50x5	S235	2M16-8.8t	1.00	1.00	1.00	275	**0.0**		17.0	120.6	86.4	0.00		**23.4**	ULS 3_0	52.4	120.6	51.4	0.45	
310	Upper Cross-Arm Internal Diagonal Brace	50x50x7	S235	2M16-8.8t	1.00	1.00	1.00	237	**0.0**		29.1	120.6	121.0	0.00		**35.7**	ULS 3_0	71.2	120.6	72.0	0.50	
311	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	80	**-14.4**	ULS 5a Ba 1	56.0	60.3	43.2	0.33		**13.6**	ULS 5a Ah 3	37.4	60.3	25.7	0.53	
312	Upper Cross-Arm End Hrz Brace	HEB160	S355	2M20-8.8t	1.00	2.00	1.00	15	**-10.3**	ULS 5a Ah 1	1562.7	188.2	235.2	0.06		**10.9**	ULS 5a Ba 1	1739.7	188.2	0.0	0.06	
313	Upper Cross-Arm Ondervlak Cross-Diag 2	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	78	**-12.3**	ULS 5a Ah 1	56.5	60.3	43.2	0.28		**12.6**	ULS 5a Ba 3	37.4	60.3	25.7	0.49	
314	Upper Cross-Arm Ondervlak Cross-Diag 3	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	81	**-11.3**	ULS 5a Ba 1	55.6	60.3	43.2	0.26		**11.3**	ULS 5a Ba 1	37.4	60.3	25.7	0.44	
315	Upper Cross-Arm Ondervlak Cross-Diag 4	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	89	**-10.8**	ULS 5a Ba 3	53.1	60.3	43.2	0.25		**10.3**	ULS 5a Ah 3	37.4	60.3	25.7	0.40	
316	Upper Cross-Arm Ondervlak Cross-Diag 5	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	108	**-46.5**	ULS 5a Ba 22	62.2	60.3	60.5	0.77		**42.3**	ULS 5a Ah 22	52.4	60.3	36.0	0.90	stuik
317	Upper Cross-Arm Ondervlak Cross-Diag 6	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	107	**-37.0**	ULS 5a Ah 12	62.6	60.3	60.5	0.61		**39.9**	ULS 5a Ba 12	52.4	60.3	36.0	0.85	stuik
318	Upper Cross-Arm Ondervlak Cross-Diag 7	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	111	**-35.8**	ULS 5a Ba 12	60.4	60.3	60.5	0.59		**33.7**	ULS 5a Ah 12	52.4	60.3	36.0	0.94	
319	Upper Cross-Arm Ondervlak Cross-Diag 8	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	94	**-31.5**	ULS 5a Ah 12	73.4	60.3	51.8	0.61		**32.9**	ULS 5a Ba 12	48.4	60.3	33.7	0.98	
320	Upper Cross-Arm Ondervlak Cross-Diag 9	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	120	**-30.8**	ULS 5a Ba 22	40.9	60.3	43.2	0.75		**29.1**	ULS 5a Ah 22	37.4	60.3	25.7	0.85	stuik
321	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	129	**-30.0**	ULS 5a Ba 12	37.9	60.3	43.2	0.79		**27.3**	ULS 5a Ah 12	37.4	60.3	25.7	0.80	stuik
322	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	132	**-25.5**	ULS 5a Ah 12	37.2	60.3	43.2	0.69		**27.2**	ULS 5a Ba 12	37.4	60.3	25.7	0.80	stuik
323	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	138	**-23.8**	ULS 5a Ba 22	35.1	60.3	43.2	0.68		**21.6**	ULS 5a Ah 22	37.4	60.3	25.7	0.84	
325	Upper Cross-Arm Internal Diagonal Brac1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	98	**-1.6**	ULS 1a_0	49.2	60.3	43.2	0.04		**1.2**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.05	
326	Upper Cross-Arm Internal Diagonal Brac2	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	211	**-2.4**	ULS 1a_0	20.2	60.3	43.2	0.12		**2.0**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.08	
401	Lower Cross-Arm Trans Face Vert Brace 1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	145	**-2.5**	ULS 5a Ah 21	33.4	60.3	43.2	0.07		**0.0**		46.1	60.3	32.7	0.00	
402	Lower Cross-Arm Trans Face Vert Brace 2	65x65x7	S235	1M16-8.8t	1.00	1.00	1.00	152	**-13.9**	ULS 3_0	63.9	60.3	60.5	0.23		**0.0**		84.7	60.3	52.3	0.00	
403	Lower Cross-Arm Trans Face Vert Brace 3	65x65x7	S235	1M16-8.8t	1.00	1.00	1.00	194	**-12.3**	ULS 3_0	46.4	60.3	60.5	0.26		**0.0**		84.7	60.3	52.3	0.00	
404	Lower Cross-Arm Trans Face Diag Brace :	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	266	**0.0**		14.3	60.3	43.2	0.00		**5.6**	ULS 5a Ba 21	46.1	60.3	32.7	0.17	
405	Lower Cross-Arm Trans Face Diag Brace :	50x50x7	S235	2M16-8.8t	1.00	1.00	1.00	324	**0.0**		17.9	120.6	121.0	0.00		**29.2**	ULS 3_0	71.2	120.6	72.0	0.41	
406	Lower Cross-Arm Trans Face Diag Brace :	60x60x6	S235	2M16-8.8t	1.00	1.00	1.00	296	**0.0**		21.7	120.6	103.7	0.00		**21.3**	ULS 3_0	78.2	120.6	67.3	0.32	
407	Lower Cross-Arm Trans Face Diag Brace «	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	337	**0.0**		14.1	60.3	51.8	0.00		**16.4**	ULS 3_135	48.4	60.3	33.7	0.49	
408	Lower Cross-Arm Bovenvlak Lateral Brac	60x60x6	S235	1M16-8.8t	1.00	2.00	1.00	101	**-1.0**	ULS 1a_0	73.8	60.3	51.8	0.02		**0.9**	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.03	
409	Lower Cross-Arm Ondervlak Lateral Brac	HEB160	S235	2M20-8.8t	2.00	2.00	2.00	48	**-30.0**	ULS 5a Ah 11	960.6	188.2	172.8	0.17		**35.2**	ULS 5a Ba 11	1278.1	188.2	0.0	0.20	
410	Lower Cross-Arm Internal Diagonal Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	176	**-2.3**	ULS 1a_0	26.1	60.3	43.2	0.09		**1.8**	ULS 1a_0,9_0,9_0	46.1	60.3	32.7	0.05	
411	Lower Cross-Arm Ondervlak Cross-Diag 1	50x50x7	S235	1M16-8.8t	0.55	0.55	0.55	98	**-46.7**	ULS 5a Ba 10	67.3	60.3	60.5	0.77		**44.0**	ULS 5a Ah 21	64.5	60.3	45.8	0.96	
412	Lower Cross-Arm Ondervlak Cross-Diag 2	50x50x7	S235	1M16-8.8t	0.54	0.54	0.54	104	**-35.9**	ULS 5a Ah 10	64.3	60.3	60.5	0.60		**37.4**	ULS 5a Ba 10	56.4	60.3	39.3	0.95	
413	Lower Cross-Arm End Hrz Brace	HEB160	S235	2M20-8.8t	2.00	2.00	2.00	25	**-31.8**	ULS 5a Ah 21	1067.2	188.2	172.8	0.18		**33.7**	ULS 5a Ba 21	1278.1	188.2	0.0	0.20	
414	Lower Cross-Arm Ondervlak Cross-Diag 3	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	87	**-30.3**	ULS 5a Ba 21	77.4	60.3	51.8	0.58		**29.1**	ULS 5a Ah 10	48.4	60.3	33.7	0.86	
415	Lower Cross-Arm Ondervlak Cross-Diag 4	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	113	**-24.6**	ULS 5a Ah 10	43.5	60.3	43.2	0.57		**25.5**	ULS 5a Ba 10	46.1	60.3	32.7	0.78	
417	Lower Cross-Arm Ondervlak Cross-Diag 6	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	121	**-21.9**	ULS 5a Ba 10	40.6	60.3	43.2	0.54		**20.6**	ULS 5a Ah 10	46.1	60.3	32.7	0.63	
418	Lower Cross-Arm Ondervlak Cross-Diag 7	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	107	**-37.7**	ULS 5a Ba 20	65.6	60.3	51.8	0.73		**33.9**	ULS 5a Ah 11	48.4	60.3	33.7	0.83	stuik

DNV GL Nederlands BV, Project: "S-6_R (V) inl"
Tower Version 16.63, 09:19:25 Monday, 22 February, 2021
Undeformed geometry displayed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DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 22-02-21
Author MKh
Version 1.0

ENS-ZL 380
S-6_R
28

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
101	Earth Peak	80x80x7#	S235	2M20-8.8t	1.00	1.00	1.00	155	**-10.1**	ULS 5a Ba 12	87.1	188.2	151.2	0.12		**10.0**	ULS 5a Ba 22	129.9	188.2	137.5	0.08	
102	Main Leg Level 6	100x100x8	S355	7M20-8.8t	0.52	0.52	0.52	69	**-35.0**	ULS 5a Ah 12	394.0	658.6	823.2	0.09		**8.2**	ULS 1a_0,9_0,9_90	422.7	658.6	823.2	0.02	
103-A	Main Leg Level 5	120x120x10	S355	4M24-8.8t	0.52	0.52	0.52	57	**-39.1**	ULS 5a Ba 22	656.6	542.2	705.6	0.07		**22.2**	ULS 5a Ah 12	635.0	542.2	663.4	0.04	
103-B	Main Leg Level 5	120x120x10	S355	8M24-8.8t	0.52	0.52	0.52	66	**-139.8**	ULS 1a_45	607.0	2168.8	1411.2	0.23		**78.7**	ULS 1a_0,9_0,9_135	635.0	2168.8	1411.2	0.12	
103-C	Main Leg Level 5	120x120x10	S355		0.52	0.52	0.52	64	**-120.7**	ULS 1a_135	619.8	0.0	0.0	0.19		**82.4**	ULS 1a_0,9_0,9_45	823.6	0.0	0.0	0.10	
104-A	Main Leg Level 4	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	49	**-227.2**	ULS 1a_135	1050.7	2168.8	1693.4	0.22		**141.1**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1461.9	0.14	
104-B	Main Leg Level 4	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	63	**-377.6**	ULS 1a_45	940.1	2168.8	1693.4	0.40		**280.7**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1461.9	0.28	
104-C	Main Leg Level 4	150x150x12	S355		0.52	0.52	0.52	56	**-300.7**	ULS 1a_45	998.1	0.0	0.0	0.30		**202.5**	ULS 1a_0,9_0,9_135	1235.4	0.0	0.0	0.16	
105-A	Main Leg Level 3	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	32	**-443.0**	ULS 1a_45	1155.2	2168.8	1693.4	0.38		**335.0**	ULS 1a_0,9_0,9_135	1007.6	2168.8	1461.9	0.33	
105-B	Main Leg Level 3	150x150x12	S355	8M24-8.8t	0.25	0.25	0.25	37	**-532.7**	ULS 1a_135	1128.8	2168.8	1693.4	0.47		**414.4**	ULS 1a_0,9_0,9_135	1007.6	2168.8	1461.9	0.41	
105-C	Main Leg Level 3	150x150x12	S355		0.52	0.52	0.52	38	**-444.3**	ULS 1a_45	1121.1	0.0	0.0	0.40		**333.7**	ULS 1a_0,9_0,9_45	1235.4	0.0	0.0	0.27	
106-A	Main Leg Level 1 (Base)	150x150x12	S355	10M24-8.8t	0.52	0.52	0.52	51	**-500.6**	ULS 1a_45	1037.3	2711.0	2116.8	0.48		**401.9**	ULS 1a_0,9_0,9_45	1007.6	2711.0	1827.3	0.40	
106-B	Main Leg Level 1 (Base)	150x150x12	S355	8M24-8.8t	0.20	0.20	0.20	49	**-502.6**	ULS 1a_135	1051.2	2168.8	1693.4	0.48		**399.8**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1592.1	0.40	
108-A	Boven Traverse Lower 1	120x120x10	S355	12M24-8.8t	1.00	1.47	1.00	62	**-258.5**	ULS 5a Ba 12	630.9	1562.2	2116.8	0.41		**173.3**	ULS 5a Ah 22	635.0	1562.2	1990.2	0.27	
108-C	Boven Traverse Lower 1	120x120x10	S355		3.11	2.03	1.00	59	**-226.3**	ULS 5a Ba 22	648.8	0.0	0.0	0.35		**143.7**	ULS 5a Ah 12	823.6	0.0	0.0	0.17	
108-B	Boven Traverse Lower 1	120x120x10	S355	4M24-8.8t	1.86	3.28	1.00	61	**-108.4**	ULS 5a Ba 1	634.8	542.2	705.6	0.20		**49.3**	ULS 5a Ah 3	635.0	542.2	663.4	0.09	
109-A	Boven Traverse Lower 2	90x90x8	S355	4M24-8.8t	3.38	2.16	1.00	73	**-100.7**	ULS 5a Ba 1	338.8	542.2	564.5	0.30		**54.8**	ULS 5a Ah 1	343.6	542.2	530.7	0.16	
109-C	Boven Traverse Lower 2	90x90x8	S355		1.00	1.42	1.00	80	**-84.8**	ULS 5a Ba 1	311.0	0.0	0.0	0.27		**42.3**	ULS 5a Ah 3	493.5	0.0	0.0	0.09	
110-A	Boven Traverse Upper	80x80x8	S235	4M20-8.8t	1.00	1.98	1.00	186	**0.0**		73.9	376.3	345.6	0.00		**65.0**	ULS 3_90	168.3	376.3	310.2	0.39	
110-B	Boven Traverse Upper	80x80x8	S235	4M20-8.8t	1.00	2.81	1.00	276	**-7.2**	ULS 1a_0,9_0,9_90	41.7	376.3	345.6	0.17		**49.9**	ULS 1a_90	227.6	376.3	314.2	0.22	
110-C	Boven Traverse Upper	80x80x8	S235		1.00	1.98	1.00	182	**-4.3**	ULS 1a_0,9_0,9_90	76.1	0.0	0.0	0.06		**58.4**	ULS 1a_90	289.1	0.0	0.0	0.20	
115-A	Boven Traverse Upper	80x80x6#	S235	4M20-8.8t	1.00	2.93	1.00	271	**-2.3**	ULS 1a_0,9_0,9_90	32.7	376.3	259.2	0.07		**35.9**	ULS 3_90	175.2	376.3	235.6	0.20	
115-B	Boven Traverse Upper	80x80x6#	S235	2M20-8.8t	1.00	2.00	1.00	164	**-6.1**	ULS 5a Ah 3	66.2	188.2	129.6	0.09		**21.1**	ULS 5a Ba 3	93.1	188.2	100.8	0.23	
115-C	Boven Traverse Upper	80x80x6#	S235		1.00	3.30	1.00	271	**-3.1**	ULS 5a Ah 3	32.7	0.0	0.0	0.09		**25.4**	ULS 5a Ba 3	220.9	0.0	0.0	0.12	
111-A	Onder Traverse Lower 1	120x120x12	S355	11M24-8.8t	2.04	1.00	1.00	67	**-268.3**	ULS 5a Ba 10	712.0	1447.6	2328.5	0.38		**179.2**	ULS 5a Ah 10	750.1	1447.6	2189.2	0.24	
111-C	Onder Traverse Lower 1	120x120x12	S355		1.96	1.00	1.00	67	**-255.6**	ULS 5a Ba 10	711.2	0.0	0.0	0.36		**162.8**	ULS 5a Ah 21	976.3	0.0	0.0	0.17	
111-B	Onder Traverse Lower 1	120x120x12	S355	4M24-8.8t	1.00	1.85	1.00	66	**-158.7**	ULS 5a Ba 10	719.7	542.2	846.7	0.29		**94.5**	ULS 5a Ah 21	750.1	542.2	796.1	0.17	
112-A	Onder Traverse Lower 2	100x100x10	S355		1.00	1.00	1.00	33	**-125.4**	ULS 5a Ba 10	632.9	0.0	0.0	0.20		**78.6**	ULS 5a Ah 10	681.6	0.0	0.0	0.12	
112-C	Onder Traverse Lower 2	100x100x10	S355		1.50	2.50	1.00	71	**-109.9**	ULS 5a Ba 21	476.2	0.0	0.0	0.23		**54.0**	ULS 5a Ah 10	681.6	0.0	0.0	0.08	
113-A	Onder Traverse Upper 1	80x80x8	S235	4M20-8.8t	2.90	1.00	1.00	313	**0.0**		34.3	376.3	345.6	0.00		**75.2**	ULS 1a_90	168.3	376.3	310.2	0.45	
113-B	Onder Traverse Upper 1	80x80x8	S235		3.09	1.00	1.00	313	**-14.0**	ULS 1a_0,9_0,9_90	34.3	376.3	345.6	0.41		**57.1**	ULS 1a_90	227.6	376.3	314.2	0.25	
113-C	Onder Traverse Upper 1	80x80x8	S235		3.02	1.00	1.00	312	**-3.7**	ULS 1a_0,9_0,9_90	34.3	0.0	0.0	0.11		**66.9**	ULS 1a_90	289.1	0.0	0.0	0.23	
114-A	Onder Traverse Upper 2	80x80x6#	S235	4M20-8.8t	3.00	1.00	1.00	270	**-21.3**	ULS 1a_0,9_0,9_90	33.0	376.3	259.2	0.64		**55.4**	ULS 1a_90	175.2	376.3	235.6	0.32	
114-B	Onder Traverse Upper 2	80x80x6#	S235	4M20-8.8t	3.00	1.00	1.00	270	**-22.3**	ULS 1a_0,9_0,9_90	33.0	376.3	259.2	0.67		**49.4**	ULS 1a_90	116.4	376.3	196.0	0.42	
114-C	Onder Traverse Upper 2	80x80x6#	S235		3.00	1.00	1.00	270	**-22.1**	ULS 1a_0,9_0,9_90	33.0	0.0	0.0	0.67		**49.2**	ULS 1a_90	220.9	0.0	0.0	0.22	
201	Earth Peak Hrz Trans	80x80x8	S235	4M20-8.8t	1.00	1.00	1.00	128	**0.0**		122.6	376.3	345.6	0.00		**62.9**	ULS 3_0	157.3	376.3	277.6	0.40	
202	Earth Peak Hrz Long	60x60x6	S235	2M16-8.8t	1.00	1.00	1.00	171	**-2.1**	ULS 1a_0,9_0,9_90	48.7	120.6	103.7	0.04		**2.7**	ULS 1a_90	78.2	120.6	67.3	0.04	
203L	Boven Cross-Arm to Mast Int X-Diag Trar	80x80x6#	S235	2M20-8.8t	0.52	0.52	0.52	109	**-28.3**	ULS 1a_90	110.0	188.2	129.6	0.26		**26.3**	ULS 1a_0,9_0,9_90	112.1	188.2	117.8	0.23	
203T	Boven Cross-Arm to Mast Int X-Diag Long	80x80x6#	S235	2M20-8.8t	0.52	0.52	0.52	109	**-10.8**	ULS 5a Ah 12	110.0	188.2	129.6	0.10		**5.5**	ULS 5a Ah 22	112.1	188.2	117.8	0.05	
204	Boven Cross-Arm to Mast Hrz Trans	120x120x10	S355	12M24-8.8t	1.00	2.00	1.00	60	**-198.1**	ULS 5a Ba 22	644.6	1562.2	2116.8	0.31		**105.9**	ULS 5a Ah 12	635.0	1562.2	1990.2	0.17	
205	Boven Cross-Arm to Mast Hrz Long	65x65x7	S235	4M20-8.8t	1.00	2.00	1.00	112	**-41.5**	ULS 5a Ah 12	94.3	376.3	302.4	0.44		**52.0**	ULS 5a Ah 22	145.7	376.3	190.9	0.36	
206	Boven Cross-Arm to Mast Internal Diag	80x80x6#	S235	2M20-8.8t	1.00	1.00	1.00	97	**-64.1**	ULS 5a Ba 22	121.6	188.2	129.6	0.53		**64.2**	ULS 5a Ba 22	99.4	188.2	110.5	0.65	
207	Boven Cross-Arm to Mast Interal X-Brac	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	113	**-0.2**	ULS 3_0	43.6	60.3	43.2	0.00		**0.2**	ULS 3_0	46.1	60.3	32.7	0.01	
208L	Mast Level 6 Cross-Diag 1 T	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	102	**-106.7**	ULS 5a Ba 12	172.5	271.1	207.4	0.62		**107.9**	ULS 5a Ah 12	159.7	271.1	183.4	0.68	
208T	Mast Level 6 Cross-Diag 1 L	100x100x8	S235	3M24-8.8t	0.52	0.52	0.52	92	**-120.1**	ULS 5a Ba 22	209.6	406.7	311.0	0.57		**118.6**	ULS 5a Ah 22	211.1	406.7	276.0	0.56	
209L	Mast Level 6 Cross-Diag 2 T	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	110	**-100.0**	ULS 5a Ah 22	161.0	271.1	207.4	0.62		**97.5**	ULS 5a Ba 22	159.7	271.1	183.4	0.61	
209T	Mast Level 6 Cross-Diag 2 L	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	99	**-109.0**	ULS 5a Ah 12	197.3	271.1	207.4	0.55		**110.4**	ULS 5a Ba 22	181.4	271.1	189.2	0.61	
210L	Mast Level 6 Cross-Diag 3 T	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	117	**-87.7**	ULS 5a Ba 22	152.7	271.1	207.4	0.57		**89.9**	ULS 5a Ah 22	159.7	271.1	183.4	0.56	
210T	Mast Level 6 Cross-Diag 3 L	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	105	**-99.8**	ULS 5a Ba 22	188.3	271.1	207.4	0.53		**97.9**	ULS 5a Ah 22	181.4	271.1	189.2	0.54	
212L	Onder Cross-Arm to Mast Upper Hrz Tran	80x80x8	S235	3M20-8.8t	1.00	1.00	1.00	178	**0.0**		82.0	282.2	259.2	0.00		**76.1**	ULS 1a_0	168.3	282.2	234.2	0.45	
212T	Onder Cross-Arm to Mast Upper Hrz Long	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	178	**-13.2**	ULS 1a_0,9_0,9_90	82.0	188.2	172.8	0.16		**18.3**	ULS 1a_90	146.3	188.2	157.1	0.13	
211L	Onder Cross-Arm to Mast Int X-Diag Trar	100x100x10	S235	2M24-8.8t	0.52	0.52	0.52	111	**-99.5**	ULS 5a Ba 22	221.0	271.1	259.2	0.45		**94.8**	ULS 5a Ah 22	224.3	271.1	236.4	0.42	
211T	Onder Cross-Arm to Mast Int X-Diag Long	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	111	**-96.5**	ULS 5a Ba 22	179.3	271.1	207.4	0.54		**82.9**	ULS 5a Ah 22	181.4	271.1	189.2	0.46	
216	Hor Verb D Hrz Trans	120x120x12	S355	11M24-8.8t	1.00	2.00	1.00	82	**-196.7**	ULS 5a Ba 21	597.6	1447.6	2328.5	0.33		**107.2**	ULS 5a Ah 10	750.1	1447.6	2189.2	0.14	
213T	Hor Verb D Hrz Long	80x80x6#	S235	4M20-8.8t	1.00	2.00	1.00	121	**-42.5**	ULS 5a Ah 21	93.7	376.3	259.2	0.45		**56.3**	ULS 5a Ah 10	175.2	376.3	235.6	0.32	
218	Hor Verb D Internal Diag	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	121	**-68.4**	ULS 5a Ah 10	147.8	271.1	207.4	0.46		**68.7**	ULS 5a Ba 21	159.7	271.1	183.4	0.43	
219	Hor Verb D X-Brace	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	155	**-0.5**	ULS 5a Ba 20	30.8	60.3	43.2	0.02		**0.6**	ULS 5a Ba 11	46.1	60.3	32.7	0.02	
214L	Mast Level 4 Cross-Diag 1 T	100x100x8	S235	2M24-8.8t	0.53	0.27	0.27	73	**-90.3**	ULS 5a Ba 10	231.3	271.1	207.4	0.44		**85.7**	ULS 5a Ah 21	181.4	271.1	189.2	0.47	
214T	Mast Level 4 Cross-Diag 1 L	100x100x8	S235	2M24-8.8t	0.53	0.27	0.27	73	**-104.6**	ULS 5a Ba 10	231.3	271.1	207.4	0.50		**103.0**	ULS 5a Ah 10	181.4	271.1	189.2	0.57	
215L	Mast Level 4 Cross-Diag 2 T	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	91	**-79.5**	ULS 5a Ah 10	179.1	271.1	207.4	0.44		**81.5**	ULS 5a Ba 10	173.9	271.1	193.2	0.47	
215T	Mast Level 4 Cross-Diag 2 L	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	91	**-94.8**	ULS 5a Ba 21	179.1	271.1	207.4	0.53		**96.6**	ULS 5a Ba 21	173.9	271.1	193.2	0.56	
216L	Mast Level 4 Cross-Diag 3 T	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	102	**-73.6**	ULS 5a Ah 21	163.9	271.1	207.4	0.45		**71.5**	ULS 5a Ah 10	159.7	271.1	183.4	0.45	
216T	Mast Level 4 Cross-Diag 3 L	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	102	**-88.1**	ULS 5a Ah 21	163.9	271.1	207.4	0.54		**85.8**	ULS 5a Ba 21	159.7	271.1	183.4	0.54	
226T	Mast Level 3 Cross-Diag 1 T	90x90x8	S235	2M24-8.8t	1.00	0.52	0.52	114	**-82.9**	ULS 5a Ba 10	148.1	271.1	207.4	0.56		**78.0**	ULS 5a Ah 21	159.7	271.1	183.4	0.49	
226L	Mast Level 3 Cross-Diag 1 L	90x90x8	S235	2M24-8.8t	1.00	0.52	0.52	114	**-65.8**	ULS 5a Ba 21	148.1	271.1	207.4	0.44		**65.8**	ULS 5a Ah 10	159.7	271.1	183.4	0.41	
227T	Mast Level 3 Cross-Diag 2 T	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	124	**-69.5**	ULS 5a Ah 10	135.5	271.1	207.4	0.51		**72.6**	ULS 5a Ba 21	159.7	271.1	183.4	0.45	
227L	Mast Level 3 Cross-Diag 2 L	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	124	**-58.1**	ULS 5a Ah 10	135.5	271.1	207.4	0.43		**57.8**	ULS 5a Ba 10	159.7	271.1	183.4	0.36	
228T	Hor Verb G Hrz Trans	60x60x6	S235	1M16-8.8t	1.10	1.00	1.00	166	**-1.9**	ULS 1a_0,9_0,9_45	45.4	60.3	51.8	0.04		**1.6**	ULS 1a_135	48.4	60.3	33.7	0.05	
228TC	Hor Verb G Hrz Trans	60x60x6	S235		2.00	11.24	1.00	117	**-3.6**	ULS 1a_0,9_0,9_45	71.2	0.0	0.0	0.05		**3.4**	ULS 1a_135	162.2	0.0	0.0	0.02	
228L	Hor Verb G Hrz Long	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	183	**-1.9**	ULS 1a_0,9_0,9_135	40.1	60.3	51.8	0.05		**1.7**	ULS 1a_135	48.4	60.3	33.7	0.05	
229	Hor Verb G Internal Diag	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	247	**-1.6**	ULS 1a_135	23.1	60.3	51.8	0.07		**1.8**	ULS 1a_0,9_135	48.4	60.3	33.7	0.05	
230	Hor Verb G Internal X-Brace	60x60x6	S235	1M16-8.8t	0.50	0.50	0.50	183	**-0.4**	ULS 1a_0	35.7	60.3	51.8	0.01		**0.3**	ULS 1a_0,9_0	48.4	60.3	33.7	0.01	
232T	Mast Level 1 Cross-Diag 1 T	100x100x8	S235	2M24-8.8t	0.52	1.00	0.52	123	**-67.4**	ULS 1a_90	152.0	271.1	207.4	0.44		**51.4**	ULS 1a_0,9_0,9_90	181.4	271.1	189.2	0.28	
232L	Mast Level 1 Cross-Diag 1 L	100x100x8	S235	2M24-8.8t	0.52	1.00	0.52	123	**-75.4**	ULS 5a Ba 10	152.0	271.1	207.4	0.50		**60.3**	ULS 5a Ah 21	181.4	271.1	189.2	0.33	
233T	Hor Verb E Hrz Trans	60x60x6	S235	1M16-8.8t	1.00	1.04	1.00	240	**-2.5**	ULS 1a_45	27.1	60.3	51.8	0.09		**0.8**	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.02	
233TC	Hor Verb E Hrz Trans	60x60x6	S235		23.81	2.00	1.00	161	**-5.1**	ULS 1a_45	50.0	0.0	0.0	0.10		**3.4**	ULS 1a_0,9_0,9_45	162.2	0.0	0.0	0.02	
233L	Hor Verb E Hrz Long	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	250	**-2.5**	ULS 1a_135	25.4	60.3	51.8	0.10		**0.6**	ULS 1a_0,9_0,9_45	48.4	60.3	33.7	0.02	
234	Hor Verb E Internal Diag	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	347	**-2.4**	ULS 1a_45	13.5	60.3	51.8	0.18		**2.6**	ULS 1a_0,9_0,9_135	48.4	60.3	33.7	0.08	
235	Hor Verb E Internal X-Brace	65x65x7	S235	1M16-8.8t	0.50	1.00	0.50	299	**-0.1**	ULS 1a_0	5.2	60.3	60.5	0.02		**0.1**	ULS 1a_0,9_0,9_0	72.6	60.3	52.3	0.00	
236T	Mast Level 1 Cross-Diag 2 T	80x80x8	S235	2M20-8.8t	0.20	0.20	0.20	104	**-85.1**	ULS 5a Ah 12	150.1	188.2	172.8	0.57		**60.9**	ULS 5a Ba 12	138.0	188.2	151.7	0.44	
236L	Mast Level 1 Cross-Diag 2 L	80x80x8	S235	2M20-8.8t	0.20	0.20	0.20	104	**-90.7**	ULS 5a Ba 21	150.1	188.2	172.8	0.60		**76.1**	ULS 5a Ah 10	138.0	188.2	151.7	0.55	
301	Upper Cross-Arm Trans Face Vert Brace 1	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	189	**-10.9**	ULS 1a_90	34.0	60.3	51.8	0.32		**0.0**		48.4	60.3	33.7	0.00	
302	Upper Cross-Arm Trans Face Vert Brace 2	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	189	**-5.9**	ULS 3_90	23.7	60.3	43.2	0.25		**0.0**		37.4	60.3	25.7	0.00	
303	Upper Cross-Arm Trans Face Diag Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	147	**-7.7**	ULS 1a_90	32.7	60.3	43.2	0.23		**2.0**	ULS 1a_0,9_0,9_90	37.4	60.3	25.7	0.08	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 22-02-21
Author MKh
Version 1.0

ENS-ZL 380
S-6_R
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Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
304	Upper Cross-Arm Trans Face Diag Brace :	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	107	**-8.7**	ULS 1a_90	45.8	60.3	43.2	0.20		**3.1**	ULS 1a_0,9_0,9_90	37.4	60.3	25.7	0.12	
305	Upper Cross-Arm Trans Face Diag Brace :	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	71	**-1.1**	ULS 5a Ba 1	58.4	60.3	43.2	0.02		**0.0**		37.4	60.3	25.7	0.00	
306	Upper Cross-Arm Trans Face Diag Brace «	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	294	**0.0**		17.6	60.3	51.8	0.00		**13.9**	ULS 1a_135	48.4	60.3	33.7	0.41	
307	Upper Cross-Arm Trans Face Diag Brace !	50x50x7	S235	1M16-8.8t	1.00	1.00	1.00	328	**0.0**		14.0	60.3	60.5	0.00		**18.1**	ULS 1a_90	52.4	60.3	36.0	0.50	
308	Upper Cross-Arm Bovenvlak Lateral Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	307	**0.0**		11.4	60.3	43.2	0.00		**11.6**	ULS 3_90	37.4	60.3	25.7	0.45	
309	Upper Cross-Arm Ondervlak Lateral Brace	50x50x5	S235	2M16-8.8t	1.00	1.00	1.00	275	**-5.9**	ULS 1a_0,9_0,9_90	17.0	120.6	86.4	0.35		**18.8**	ULS 1a_90	52.4	120.6	51.4	0.37	
310	Upper Cross-Arm Internal Diagonal Brace	50x50x7	S235	2M16-8.8t	1.00	1.00	1.00	237	**-10.8**	ULS 1a_0,9_0,9_90	29.1	120.6	121.0	0.37		**27.0**	ULS 1a_90	71.2	120.6	72.0	0.38	
311	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	80	**-14.5**	ULS 5a Ba 1	56.0	60.3	43.2	0.33		**13.9**	ULS 5a Ah 1	37.4	60.3	25.7	0.54	
312	Upper Cross-Arm End Hrz Brace	HEB160	S355	2M20-8.8t	1.00	2.00	1.00	15	**-10.4**	ULS 5a Ah 1	1562.7	188.2	235.2	0.06		**10.9**	ULS 5a Ba 1	1739.7	188.2	0.0	0.06	
313	Upper Cross-Arm Ondervlak Cross-Diag 2	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	78	**-12.3**	ULS 5a Ah 1	56.5	60.3	43.2	0.28		**12.6**	ULS 5a Ba 1	37.4	60.3	25.7	0.49	
314	Upper Cross-Arm Ondervlak Cross-Diag 3	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	81	**-11.3**	ULS 5a Ba 3	55.6	60.3	43.2	0.26		**11.3**	ULS 5a Ba 1	37.4	60.3	25.7	0.44	
315	Upper Cross-Arm Ondervlak Cross-Diag 4	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	89	**-10.8**	ULS 5a Ba 3	53.1	60.3	43.2	0.25		**10.3**	ULS 5a Ah 1	37.4	60.3	25.7	0.40	
316	Upper Cross-Arm Ondervlak Cross-Diag 5	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	108	**-23.9**	ULS 5a Ba 22	62.2	60.3	60.5	0.40		**19.9**	ULS 5a Ah 22	52.4	60.3	36.0	0.42	
317	Upper Cross-Arm Ondervlak Cross-Diag 6	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	107	**-17.0**	ULS 5a Ah 22	62.6	60.3	60.5	0.28		**20.6**	ULS 5a Ba 22	52.4	60.3	36.0	0.44	
318	Upper Cross-Arm Ondervlak Cross-Diag 7	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	111	**-19.1**	ULS 5a Ba 22	60.4	60.3	60.5	0.32		**16.0**	ULS 5a Ah 22	52.4	60.3	36.0	0.44	
319	Upper Cross-Arm Ondervlak Cross-Diag 8	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	94	**-12.6**	ULS 5a Ah 22	73.4	60.3	51.8	0.24		**15.4**	ULS 5a Ba 12	48.4	60.3	33.7	0.46	
320	Upper Cross-Arm Ondervlak Cross-Diag 9	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	120	**-22.8**	ULS 5a Ba 12	40.9	60.3	43.2	0.56		**22.9**	ULS 5a Ah 22	37.4	60.3	25.7	0.67	
321	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	129	**-36.8**	ULS 5a Ba 12	37.9	60.3	43.2	0.97		**34.6**	ULS 5a Ah 12	37.4	60.3	25.7	1.02	stuik
322	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	132	**-29.7**	ULS 5a Ah 22	37.2	60.3	43.2	0.80		**31.5**	ULS 5a Ba 22	37.4	60.3	25.7	0.93	stuik
323	Upper Cross-Arm Ondervlak Cross-Diag 1	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	138	**-28.5**	ULS 5a Ba 22	35.1	60.3	43.2	0.81		**26.7**	ULS 5a Ah 22	37.4	60.3	25.7	0.79	stuik
325	Upper Cross-Arm Internal Diagonal Brac	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	98	**-1.6**	ULS 1a_0	49.2	60.3	43.2	0.04		**1.2**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.05	
326	Upper Cross-Arm Internal Diagonal Brac	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	211	**-2.3**	ULS 1a_0	20.2	60.3	43.2	0.11		**1.9**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.07	
401	Lower Cross-Arm Trans Face Vert Brace 1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	145	**-3.7**	ULS 1a_90	33.4	60.3	43.2	0.11		**0.0**		46.1	60.3	32.7	0.00	
402	Lower Cross-Arm Trans Face Vert Brace 2	65x65x7	S235	1M16-8.8t	1.00	1.00	1.00	152	**-10.0**	ULS 3_135	63.9	60.3	60.5	0.17		**0.0**		84.7	60.3	52.3	0.00	
403	Lower Cross-Arm Trans Face Vert Brace 3	65x65x7	S235	1M16-8.8t	1.00	1.00	1.00	194	**-8.3**	ULS 3_135	46.4	60.3	60.5	0.18		**0.0**		84.7	60.3	52.3	0.00	
404	Lower Cross-Arm Trans Face Diag Brace :	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	266	**0.0**		14.3	60.3	43.2	0.00		**9.1**	ULS 1a_90	46.1	60.3	32.7	0.28	
405	Lower Cross-Arm Trans Face Diag Brace :	50x50x7	S235	2M16-8.8t	1.00	1.00	1.00	324	**0.0**		17.9	120.6	121.0	0.00		**20.8**	ULS 3_45	71.2	120.6	72.0	0.29	
406	Lower Cross-Arm Trans Face Diag Brace :	60x60x6	S235	2M16-8.8t	1.00	1.00	1.00	296	**0.0**		21.7	120.6	103.7	0.00		**14.2**	ULS 3_135	78.2	120.6	67.3	0.21	
407	Lower Cross-Arm Trans Face Diag Brace «	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	337	**0.0**		14.1	60.3	51.8	0.00		**15.7**	ULS 3_90	48.4	60.3	33.7	0.47	
408	Lower Cross-Arm Bovenvlak Lateral Brace	60x60x6	S235	1M16-8.8t	1.00	2.00	1.00	101	**-1.0**	ULS 1a_0	73.8	60.3	51.8	0.02		**0.9**	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.03	
409	Lower Cross-Arm Ondervlak Lateral Brace	HEB160	S235	2M20-8.8t	2.00	2.00	2.00	48	**-15.4**	ULS 5a Ah 20	960.6	188.2	172.8	0.09		**17.1**	ULS 5a Ba 20	1278.1	188.2	0.0	0.10	
410	Lower Cross-Arm Internal Diagonal Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	176	**-2.2**	ULS 1a_0	26.1	60.3	43.2	0.09		**1.7**	ULS 1a_0,9_0,9_0	46.1	60.3	32.7	0.05	
411	Lower Cross-Arm Ondervlak Cross-Diag 1	50x50x7	S235	1M16-8.8t	0.55	0.55	0.55	98	**-23.7**	ULS 5a Ba 21	67.3	60.3	60.5	0.39		**21.5**	ULS 5a Ah 10	64.5	60.3	45.8	0.47	
412	Lower Cross-Arm Ondervlak Cross-Diag 2	50x50x7	S235	1M16-8.8t	0.54	0.54	0.54	104	**-17.0**	ULS 5a Ah 10	64.3	60.3	60.5	0.28		**19.1**	ULS 5a Ba 10	56.4	60.3	39.3	0.49	
413	Lower Cross-Arm End Hrz Brace	HEB160	S235	2M20-8.8t	2.00	2.00	2.00	25	**-16.4**	ULS 5a Ah 10	1067.2	188.2	172.8	0.09		**16.1**	ULS 5a Ba 21	1278.1	188.2	0.0	0.09	
414	Lower Cross-Arm Ondervlak Cross-Diag 3	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	87	**-15.9**	ULS 5a Ba 10	77.4	60.3	51.8	0.31		**14.1**	ULS 5a Ah 21	48.4	60.3	33.7	0.42	
415	Lower Cross-Arm Ondervlak Cross-Diag 4	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	113	**-10.6**	ULS 5a Ah 21	43.5	60.3	43.2	0.25		**12.0**	ULS 5a Ba 10	46.1	60.3	32.7	0.37	
417	Lower Cross-Arm Ondervlak Cross-Diag 6	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	121	**-15.1**	ULS 5a Ba 21	40.6	60.3	43.2	0.37		**16.5**	ULS 5a Ah 21	46.1	60.3	32.7	0.50	
418	Lower Cross-Arm Ondervlak Cross-Diag 7	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	107	**-27.8**	ULS 5a Ba 21	65.6	60.3	51.8	0.54		**26.3**	ULS 5a Ah 21	48.4	60.3	33.7	0.64	
419	Lower Cross-Arm Ondervlak Cross-Diag 8	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	110	**-22.8**	ULS 5a Ah 21	64.3	60.3	51.8	0.44		**24.6**	ULS 5a Ba 10	48.4	60.3	33.7	0.73	
420	Lower Cross-Arm Ondervlak Cross-Diag 9	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	121	**-23.2**	ULS 5a Ba 21	58.6	60.3	51.8	0.45		**21.5**	ULS 5a Ah 21	48.4	60.3	33.7	0.64	
421	Lower Cross-Arm Ondervlak Cross-Diag 1	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	125	**-19.4**	ULS 5a Ah 10	56.6	60.3	51.8	0.37		**20.7**	ULS 5a Ba 10	48.4	60.3	33.7	0.62	
422	Lower Cross-Arm Ondervlak Cross-Diag 1	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	134	**-18.9**	ULS 5a Ba 21	52.6	60.3	51.8	0.36		**18.0**	ULS 5a Ah 10	48.4	60.3	33.7	0.53	
423	Lower Cross-Arm Ondervlak Cross-Diag 1	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	140	**-26.9**	ULS 5a Ah 20	49.9	60.3	51.8	0.54		**26.6**	ULS 5a Ba 11	48.4	60.3	33.7	0.79	
310-1	Boven Traverse Upper	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	36	**-0.5**	ULS 5a Ba 3	68.1	60.3	43.2	0.01		**0.0**		37.4	60.3	25.7	0.00	
310-2	Boven Traverse Upper	50x50x5	S235	1M16-8.8t	1.00	2.00	1.00	84	**-0.8**	ULS 1a_0,9_0,9_0	59.0	60.3	43.2	0.02		**0.8**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.03	
310-3	Boven Traverse	50x50x5	S235	1M16-8.8t	1.00	2.00	1.00	113	**-0.8**	ULS 1a_0	46.3	60.3	43.2	0.02		**4.4**	ULS 6a_90 Ah Ct1	37.4	60.3	25.7	0.17	
310-4	Boven Traverse	HEB160	S355	2M20-8.8t	1.00	2.00	1.00	19	**-14.2**	ULS 5a Ah 22	1527.7	188.2	235.2	0.08		**17.9**	ULS 5a Ba 22	1739.7	188.2	0.0	0.10	
310-5	Boven Traverse	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	190	**-2.4**	ULS 1a_0,9_0,9_90	23.5	60.3	43.2	0.10		**3.7**	ULS 1a_90	37.4	60.3	25.7	0.14	
401-1	Lower Cross-Arm Trans Face Vert Brace 1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	96	**-1.8**	ULS 1a_90	50.0	60.3	43.2	0.04		**0.0**		46.1	60.3	32.7	0.00	
401-2	Lower Cross-Arm Trans Face Vert Brace 1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	48	**-0.8**	ULS 1a_90	64.8	60.3	43.2	0.02		**0.0**		46.1	60.3	32.7	0.00	
404-1	Lower Cross-Arm Trans Face Diag Brace :	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	244	**0.0**		16.4	60.3	43.2	0.00		**6.7**	ULS 1a_90	46.1	60.3	32.7	0.20	
V-oph	Lower Cross-Arm Ondervlak V-suspensior	HEB160	S235		1.00	1.00	1.00	35	**-15.5**	ULS 5a Ah 11	984.4	0.0	0.0	0.00		**18.2**	ULS 5a Ba 10	1276.1	0.0	0.0	0.00	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 22-02-21
Author MKh
Version 1.0

ENS-ZL 380
S-6_R
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Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compres	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)
101	Earth Peak	80x80x7#	S235	2M20-8.8t	1.00	1.00	1.00	155	**-10.1**	ULS 5a Ba 12	87.1	188.2	151.2	0.12		**10.0**	ULS 5a Ba 22	129.9	188.2	137.5	0.08
102	Main Leg Level	100x100x8	S355	7M20-8.8t	0.52	0.52	0.52	69	**-35.0**	ULS 5a Ah 12	394.0	658.6	823.2	0.09		**8.2**	ULS 1a_0,9_0,9_90	422.7	658.6	823.2	0.02
103-A	Main Leg Level	120x120x10	S355	4M24-8.8t	0.52	0.52	0.52	57	**-39.1**	ULS 5a Ba 22	656.6	542.2	705.6	0.07		**22.2**	ULS 5a Ah 12	635.0	542.2	663.4	0.04
103-B	Main Leg Level	120x120x10	S355	8M24-8.8t	0.52	0.52	0.52	66	**-139.8**	ULS 1a_45	607.0	2168.8	1411.2	0.23		**78.7**	ULS 1a_0,9_0,9_135	635.0	2168.8	1411.2	0.12
103-C	Main Leg Level	120x120x10	S355		0.52	0.52	0.52	64	**-120.7**	ULS 1a_135	619.8	0.0	0.0	0.19		**82.4**	ULS 1a_0,9_0,9_45	823.6	0.0	0.0	0.10
104-A	Main Leg Level	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	49	**-227.2**	ULS 1a_135	1050.7	2168.8	1693.4	0.22		**141.1**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1461.9	0.14
104-B	Main Leg Level	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	63	**-377.6**	ULS 1a_45	940.1	2168.8	1693.4	0.40		**280.7**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1461.9	0.28
104-C	Main Leg Level	150x150x12	S355		0.52	0.52	0.52	56	**-300.7**	ULS 1a_45	998.1	0.0	0.0	0.30		**202.5**	ULS 1a_0,9_0,9_135	1235.4	0.0	0.0	0.16
105-A	Main Leg Level	150x150x12	S355	8M24-8.8t	0.52	0.52	0.52	32	**-443.0**	ULS 1a_45	1155.2	2168.8	1693.4	0.38		**335.0**	ULS 1a_0,9_0,9_135	1007.6	2168.8	1461.9	0.33
105-B	Main Leg Level	150x150x12	S355	8M24-8.8t	0.25	0.25	0.25	37	**-532.7**	ULS 1a_135	1128.8	2168.8	1693.4	0.47		**414.4**	ULS 1a_0,9_0,9_135	1007.6	2168.8	1461.9	0.41
105-C	Main Leg Level	150x150x12	S355		0.52	0.52	0.52	38	**-444.3**	ULS 1a_45	1121.1	0.0	0.0	0.40		**333.7**	ULS 1a_0,9_0,9_45	1235.4	0.0	0.0	0.27
106-A	Main Leg Level	150x150x12	S355	10M24-8.8t	0.52	0.52	0.52	51	**-500.6**	ULS 1a_45	1037.3	2711.0	2116.8	0.48		**401.9**	ULS 1a_0,9_0,9_45	1007.6	2711.0	1827.3	0.40
106-B	Main Leg Level	150x150x12	S355	8M24-8.8t	0.20	0.20	0.20	49	**-502.6**	ULS 1a_135	1051.2	2168.8	1693.4	0.48		**399.8**	ULS 1a_0,9_0,9_45	1007.6	2168.8	1592.1	0.40
108-A	Boven Traverse	120x120x10	S355	12M24-8.8t	1.00	1.47	1.00	62	**-258.5**	ULS 5a Ba 12	630.9	1562.2	2116.8	0.41		**173.3**	ULS 5a Ah 22	635.0	1562.2	1990.2	0.27
108-C	Boven Traverse	120x120x10	S355		3.11	2.03	1.00	59	**-226.3**	ULS 5a Ba 22	648.8	0.0	0.0	0.35		**143.7**	ULS 5a Ah 12	823.6	0.0	0.0	0.17
108-B	Boven Traverse	120x120x10	S355	4M24-8.8t	1.86	3.28	1.00	61	**-108.4**	ULS 5a Ba 1	634.8	542.2	705.6	0.20		**49.3**	ULS 5a Ah 3	635.0	542.2	663.4	0.09
109-A	Boven Traverse	90x90x8	S355	4M24-8.8t	3.38	2.16	1.00	73	**-100.7**	ULS 5a Ba 1	338.8	542.2	564.5	0.30		**54.8**	ULS 5a Ah 1	343.6	542.2	530.7	0.16
109-C	Boven Traverse	90x90x8	S355		1.00	1.42	1.00	80	**-84.8**	ULS 5a Ba 1	311.0	0.0	0.0	0.27		**42.3**	ULS 5a Ah 3	493.5	0.0	0.0	0.09
110-A	Boven Traverse	80x80x8	S235	4M20-8.8t	1.00	1.98	1.00	186	**0.0**		73.9	376.3	345.6	0.00		**65.0**	ULS 3_90	168.3	376.3	310.2	0.39
110-B	Boven Traverse	80x80x8	S235	4M20-8.8t	1.00	2.81	1.00	276	**-7.2**	ULS 1a_0,9_0,9_90	41.7	376.3	345.6	0.17		**49.9**	ULS 1a_90	227.6	376.3	314.2	0.22
110-C	Boven Traverse	80x80x8	S235		1.00	1.98	1.00	182	**-4.3**	ULS 1a_0,9_0,9_90	76.1	0.0	0.0	0.06		**58.4**	ULS 1a_90	289.1	0.0	0.0	0.20
115-A	Boven Traverse	80x80x6#	S235	4M20-8.8t	1.00	2.93	1.00	271	**-2.3**	ULS 1a_0,9_0,9_90	32.7	376.3	259.2	0.07		**35.9**	ULS 3_90	175.2	376.3	235.6	0.20
115-B	Boven Traverse	80x80x6#	S235	2M20-8.8t	1.00	2.00	1.00	164	**-6.1**	ULS 5a Ah 3	66.2	188.2	129.6	0.09		**21.1**	ULS 5a Ba 3	93.1	188.2	100.8	0.23
115-C	Boven Traverse	80x80x6#	S235		1.00	3.30	1.00	271	**-3.1**	ULS 5a Ah 3	32.7	0.0	0.0	0.09		**25.4**	ULS 5a Ba 3	220.9	0.0	0.0	0.12
111-A	Onder Traverse	120x120x12	S355	11M24-8.8t	2.04	1.00	1.00	67	**-268.3**	ULS 5a Ba 10	712.0	1447.6	2328.5	0.38		**179.2**	ULS 5a Ah 10	750.1	1447.6	2189.2	0.24
111-C	Onder Traverse	120x120x12	S355		1.96	1.00	1.00	67	**-255.6**	ULS 5a Ba 10	711.2	0.0	0.0	0.36		**162.8**	ULS 5a Ah 21	976.3	0.0	0.0	0.17
111-B	Onder Traverse	120x120x12	S355	4M24-8.8t	1.00	1.85	1.00	66	**-158.7**	ULS 5a Ba 10	719.7	542.2	846.7	0.29		**94.5**	ULS 5a Ah 21	750.1	542.2	796.1	0.17
112-A	Onder Traverse	100x100x10	S355		1.00	1.00	1.00	33	**-125.4**	ULS 5a Ba 10	632.9	0.0	0.0	0.20		**78.6**	ULS 5a Ah 10	681.6	0.0	0.0	0.12
112-C	Onder Traverse	100x100x10	S355		1.50	2.50	1.00	71	**-109.9**	ULS 5a Ba 21	476.2	0.0	0.0	0.23		**54.0**	ULS 5a Ah 10	681.6	0.0	0.0	0.08
113-A	Onder Traverse	80x80x8	S235	4M20-8.8t	2.90	1.00	1.00	313	**0.0**		34.3	376.3	345.6	0.00		**75.2**	ULS 1a_90	168.3	376.3	310.2	0.45
113-B	Onder Traverse	80x80x8	S235	4M20-8.8t	3.09	1.00	1.00	313	**-14.0**	ULS 1a_0,9_0,9_90	34.3	376.3	345.6	0.41		**57.1**	ULS 1a_90	227.6	376.3	314.2	0.25
113-C	Onder Traverse	80x80x8	S235		3.02	1.00	1.00	312	**-3.7**	ULS 1a_0,9_0,9_90	34.3	0.0	0.0	0.11		**66.9**	ULS 1a_90	289.1	0.0	0.0	0.23
114-A	Onder Traverse	80x80x6#	S235	4M20-8.8t	3.00	1.00	1.00	270	**-21.3**	ULS 1a_0,9_0,9_90	33.0	376.3	259.2	0.64		**55.4**	ULS 1a_90	175.2	376.3	235.6	0.32
114-B	Onder Traverse	80x80x6#	S235	4M20-8.8t	3.00	1.00	1.00	270	**-22.3**	ULS 1a_0,9_0,9_90	33.0	376.3	259.2	0.67		**49.4**	ULS 1a_90	116.4	376.3	196.0	0.42
114-C	Onder Traverse	80x80x6#	S235		3.00	1.00	1.00	270	**-22.1**	ULS 1a_0,9_0,9_90	33.0	0.0	0.0	0.67		**49.2**	ULS 1a_90	220.9	0.0	0.0	0.22
201	Earth Peak Hrz	80x80x8	S235	4M20-8.8t	1.00	1.00	1.00	128	**0.0**		122.6	376.3	345.6	0.00		**62.9**	ULS 3_0	157.3	376.3	277.6	0.40
202	Earth Peak Hrz	60x60x6	S235	2M16-8.8t	1.00	1.00	1.00	171	**-2.1**	ULS 1a_0,9_0,9_90	48.7	120.6	103.7	0.04		**2.7**	ULS 1a_90	78.2	120.6	67.3	0.04
203L	Boven Cross-An	80x80x6#	S235	2M20-8.8t	0.52	0.52	0.52	109	**-28.3**	ULS 1a_90	110.0	188.2	129.6	0.26		**26.3**	ULS 1a_0,9_0,9_90	112.1	188.2	117.8	0.23
203T	Boven Cross-An	80x80x6#	S235	2M20-8.8t	0.52	0.52	0.52	109	**-10.8**	ULS 5a Ah 12	110.0	188.2	129.6	0.10		**5.5**	ULS 5a Ah 22	112.1	188.2	117.8	0.05
204	Boven Cross-An	120x120x10	S355	12M24-8.8t	1.00	2.00	1.00	60	**-198.1**	ULS 5a Ba 22	644.6	1562.2	2116.8	0.31		**105.9**	ULS 5a Ah 12	635.0	1562.2	1990.2	0.17
205	Boven Cross-An	65x65x7	S235	4M20-8.8t	1.00	2.00	1.00	112	**-41.5**	ULS 5a Ah 12	94.3	376.3	302.4	0.44		**52.0**	ULS 5a Ah 22	145.7	376.3	190.9	0.36
206	Boven Cross-An	80x80x6#	S235	2M20-8.8t	1.00	1.00	1.00	97	**-64.1**	ULS 5a Ba 22	121.6	188.2	129.6	0.53		**64.2**	ULS 5a Ba 22	99.4	188.2	110.5	0.65
207	Boven Cross-An	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	113	**-0.2**	ULS 3_0	43.6	60.3	43.2	0.00		**0.2**	ULS 3_0	46.1	60.3	32.7	0.01
208L	Mast Level 6 Cr	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	102	**-106.7**	ULS 5a Ba 12	172.5	271.1	207.4	0.62		**107.9**	ULS 5a Ah 12	159.7	271.1	183.4	0.68
208T	Mast Level 6 Cr	100x100x8	S235	3M24-8.8t	0.52	0.52	0.52	92	**-120.1**	ULS 5a Ba 22	209.6	406.7	311.0	0.57		**118.6**	ULS 5a Ah 22	211.1	406.7	276.0	0.56
209L	Mast Level 6 Cr	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	110	**-100.0**	ULS 5a Ah 22	161.0	271.1	207.4	0.62		**97.5**	ULS 5a Ba 22	159.7	271.1	183.4	0.61
209T	Mast Level 6 Cr	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	99	**-109.0**	ULS 5a Ah 12	197.3	271.1	207.4	0.55		**110.4**	ULS 5a Ba 22	181.4	271.1	189.2	0.61
210L	Mast Level 6 Cr	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	117	**-87.7**	ULS 5a Ba 22	152.7	271.1	207.4	0.57		**89.9**	ULS 5a Ah 22	159.7	271.1	183.4	0.56
210T	Mast Level 6 Cr	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	105	**-99.8**	ULS 5a Ba 22	188.3	271.1	207.4	0.53		**97.9**	ULS 5a Ah 22	181.4	271.1	189.2	0.54
212L	Onder Cross-An	80x80x8	S235	3M20-8.8t	1.00	1.00	1.00	178	**0.0**		82.0	282.2	259.2	0.00		**76.1**	ULS 1a_0	168.3	282.2	234.2	0.45
212T	Onder Cross-An	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	178	**-13.2**	ULS 1a_0,9_0,9_90	82.0	188.2	172.8	0.16		**18.3**	ULS 1a_90	146.3	188.2	157.1	0.13
211L	Onder Cross-An	100x100x10	S355	2M24-8.8t	0.52	0.52	0.52	111	**-99.5**	ULS 5a Ba 22	221.0	271.1	259.2	0.45		**94.8**	ULS 5a Ah 22	224.3	271.1	236.4	0.42
211T	Onder Cross-An	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	111	**-96.5**	ULS 5a Ba 22	179.3	271.1	207.4	0.54		**82.9**	ULS 5a Ah 22	181.4	271.1	189.2	0.46
216	Hor Verb D Hrz	120x120x12	S355	11M24-8.8t	1.00	2.00	1.00	82	**-196.7**	ULS 5a Ba 21	597.6	1447.6	2328.5	0.33		**107.2**	ULS 5a Ah 10	750.1	1447.6	2189.2	0.14
213T	Hor Verb D Hrz	80x80x6#	S235	4M20-8.8t	1.00	2.00	1.00	121	**-42.5**	ULS 5a Ah 21	93.7	376.3	259.2	0.45		**56.3**	ULS 5a Ah 10	175.2	376.3	235.6	0.32
218	Hor Verb D Inte	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	121	**-68.4**	ULS 5a Ah 10	147.8	271.1	207.4	0.46		**68.7**	ULS 5a Ba 21	159.7	271.1	183.4	0.43
219	Hor Verb D X-Bi	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	155	**-0.5**	ULS 5a Ba 20	30.8	60.3	43.2	0.02		**0.6**	ULS 5a Ba 11	46.1	60.3	32.7	0.02
214L	Mast Level 4 Cr	100x100x8	S235	2M24-8.8t	0.53	0.27	0.27	73	**-90.3**	ULS 5a Ba 10	231.3	271.1	207.4	0.44		**85.7**	ULS 5a Ah 21	181.4	271.1	189.2	0.47
214T	Mast Level 4 Cr	100x100x8	S235	2M24-8.8t	0.53	0.27	0.27	73	**-104.6**	ULS 5a Ba 10	231.3	271.1	207.4	0.50		**103.0**	ULS 5a Ah 10	181.4	271.1	189.2	0.57
215L	Mast Level 4 Cr	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	91	**-79.5**	ULS 5a Ah 10	179.1	271.1	207.4	0.44		**81.5**	ULS 5a Ba 10	173.9	271.1	193.2	0.47
215T	Mast Level 4 Cr	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	91	**-94.8**	ULS 5a Ba 21	179.1	271.1	207.4	0.53		**96.6**	ULS 5a Ba 21	173.9	271.1	193.2	0.56
216L	Mast Level 4 Cr	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	102	**-73.6**	ULS 5a Ah 21	163.9	271.1	207.4	0.45		**71.5**	ULS 5a Ah 10	159.7	271.1	183.4	0.45
216T	Mast Level 4 Cr	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	102	**-88.1**	ULS 5a Ah 21	163.9	271.1	207.4	0.54		**85.8**	ULS 5a Ba 21	159.7	271.1	183.4	0.54
226T	Mast Level 3 Cr	90x90x8	S235	2M24-8.8t	1.00	0.52	0.52	114	**-82.9**	ULS 5a Ba 10	148.1	271.1	207.4	0.56		**78.0**	ULS 5a Ah 21	159.7	271.1	183.4	0.49
226L	Mast Level 3 Cr	90x90x8	S235	2M24-8.8t	1.00	0.52	0.52	114	**-65.8**	ULS 5a Ba 21	148.1	271.1	207.4	0.44		**65.8**	ULS 5a Ah 10	159.7	271.1	183.4	0.41
227T	Mast Level 3 Cr	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	124	**-69.5**	ULS 5a Ah 10	135.5	271.1	207.4	0.51		**72.6**	ULS 5a Ba 21	159.7	271.1	183.4	0.45
227L	Mast Level 3 Cr	90x90x8	S235	2M24-8.8t	0.53	0.27	0.27	124	**-58.1**	ULS 5a Ah 10	135.5	271.1	207.4	0.43		**57.8**	ULS 5a Ba 10	159.7	271.1	183.4	0.36
228T	Hor Verb G Hrz	60x60x6	S235	1M16-8.8t	1.10	1.00	1.00	166	**-1.9**	ULS 1a_0,9_0,9_45	45.4	60.3	51.8	0.04		**1.6**	ULS 1a_135	48.4	60.3	33.7	0.05
228TC	Hor Verb G Hrz	60x60x6	S235		2.00	11.24	1.00	117	**-3.6**	ULS 1a_0,9_0,9_45	71.2	0.0	0.0	0.05		**3.4**	ULS 1a_135	162.2	0.0	0.0	0.02
228L	Hor Verb G Hrz	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	183	**-1.9**	ULS 1a_0,9_0,9_135	40.1	60.3	51.8	0.05		**1.7**	ULS 1a_135	48.4	60.3	33.7	0.05
229	Hor Verb G Inte	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	247	**-1.6**	ULS 1a_135	23.1	60.3	51.8	0.07		**1.8**	ULS 1a_0,9_135	48.4	60.3	33.7	0.05
230	Hor Verb G Inte	60x60x6	S235	1M16-8.8t	0.50	0.50	0.50	183	**-0.4**	ULS 1a_0	35.7	60.3	51.8	0.01		**0.3**	ULS 1a_0,9_0	48.4	60.3	33.7	0.01
232T	Mast Level 1 Cr	100x100x8	S235	2M24-8.8t	0.52	1.00	0.52	123	**-67.4**	ULS 1a_90	152.0	271.1	207.4	0.44		**51.4**	ULS 1a_0,9_0,9_90	181.4	271.1	189.2	0.28
232L	Mast Level 1 Cr	100x100x8	S235	2M24-8.8t	0.52	1.00	0.52	123	**-75.4**	ULS 5a Ba 10	152.0	271.1	207.4	0.50		**60.3**	ULS 5a Ah 21	181.4	271.1	189.2	0.33
233T	Hor Verb E Hrz	60x60x6	S235	1M16-8.8t	1.00	1.04	1.00	240	**-2.5**	ULS 1a_45	27.1	60.3	51.8	0.09		**0.8**	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.02
233TC	Hor Verb E Hrz	60x60x6	S235		23.81	2.00	1.00	161	**-5.1**	ULS 1a_45	50.0	0.0	0.0	0.10		**3.4**	ULS 1a_0,9_0,9_45	162.2	0.0	0.0	0.02
233L	Hor Verb E Hrz	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	250	**-2.5**	ULS 1a_135	25.4	60.3	51.8	0.10		**0.6**	ULS 1a_0,9_0,9_45	48.4	60.3	33.7	0.02
234	Hor Verb E Inte	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	347	**-2.4**	ULS 1a_45	13.5	60.3	51.8	0.18		**2.6**	ULS 1a_0,9_0,9_135	48.4	60.3	33.7	0.08
235	Hor Verb E Inte	65x65x7	S235	1M16-8.8t	0.50	1.00	0.50	299	**-0.1**	ULS 1a_0	5.2	60.3	60.5	0.02		**0.1**	ULS 1a_0,9_0,9_0	72.6	60.3	52.3	0.00
236T	Mast Level 1 Cr	80x80x8	S235	2M20-8.8t	0.20	0.20	0.20	104	**-85.1**	ULS 5a Ah 12	150.1	188.2	172.8	0.57		**60.9**	ULS 5a Ba 12	138.0	188.2	151.7	0.44
236L	Mast Level 1 Cr	80x80x8	S235	2M20-8.8t	0.20	0.20	0.20	104	**-90.7**	ULS 5a Ba 21	150.1	188.2	172.8	0.60		**76.1**	ULS 5a Ah 10	138.0	188.2	151.7	0.55

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 22-02-21
Author MKh
Version 1.0

ENS-ZL 380
S-6_R
28

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compres	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)
301	Upper Cross-Arı	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	189	**-10.9**	ULS 1a_90	34.0	60.3	51.8	0.32		**0.0**		48.4	60.3	33.7	0.00
302	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	189	**-5.9**	ULS 3_90	23.7	60.3	43.2	0.25		**0.0**		37.4	60.3	25.7	0.00
303	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	147	**-7.7**	ULS 1a_90	32.7	60.3	43.2	0.23		**2.0**	ULS 1a_0,9_0,9_90	37.4	60.3	25.7	0.08
304	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	107	**-8.7**	ULS 1a_90	45.8	60.3	43.2	0.20		**3.1**	ULS 1a_0,9_0,9_90	37.4	60.3	25.7	0.12
305	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	71	**-1.1**	ULS 5a Ba 1	58.4	60.3	43.2	0.02		**0.0**		37.4	60.3	25.7	0.00
306	Upper Cross-Arı	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	294	**0.0**		17.6	60.3	51.8	0.00		**13.9**	ULS 1a_135	48.4	60.3	33.7	0.41
307	Upper Cross-Arı	50x50x7	S235	1M16-8.8t	1.00	1.00	1.00	328	**0.0**		14.0	60.3	60.5	0.00		**18.1**	ULS 1a_90	52.4	60.3	36.0	0.50
308	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	307	**0.0**		11.4	60.3	43.2	0.00		**11.6**	ULS 3_90	37.4	60.3	25.7	0.45
309	Upper Cross-Arı	50x50x5	S235	2M16-8.8t	1.00	1.00	1.00	275	**-5.9**	ULS 1a_0,9_0,9_90	17.0	120.6	86.4	0.35		**18.8**	ULS 1a_90	52.4	120.6	51.4	0.37
310	Upper Cross-Arı	50x50x7	S235	2M16-8.8t	1.00	1.00	1.00	237	**-10.8**	ULS 1a_0,9_0,9_90	29.1	120.6	121.0	0.37		**27.0**	ULS 1a_90	71.2	120.6	72.0	0.38
311	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	80	**-14.5**	ULS 5a Ba 1	56.0	60.3	43.2	0.33		**13.9**	ULS 5a Ah 1	37.4	60.3	25.7	0.54
312	Upper Cross-Arı	HEB160	S355	2M20-8.8t	1.00	2.00	1.00	15	**-10.4**	ULS 5a Ah 1	1562.7	188.2	235.2	0.06		**10.9**	ULS 5a Ba 1	1739.7	188.2	0.0	0.06
313	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	78	**-12.3**	ULS 5a Ah 1	56.5	60.3	43.2	0.28		**12.6**	ULS 5a Ba 1	37.4	60.3	25.7	0.49
314	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	81	**-11.3**	ULS 5a Ba 3	55.6	60.3	43.2	0.26		**11.3**	ULS 5a Ba 1	37.4	60.3	25.7	0.44
315	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	89	**-10.8**	ULS 5a Ba 3	53.1	60.3	43.2	0.25		**10.3**	ULS 5a Ah 1	37.4	60.3	25.7	0.40
316	Upper Cross-Arı	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	108	**-23.9**	ULS 5a Ba 22	62.2	60.3	60.5	0.40		**19.9**	ULS 5a Ah 22	52.4	60.3	36.0	0.42
317	Upper Cross-Arı	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	107	**-17.0**	ULS 5a Ah 22	62.6	60.3	60.5	0.28		**20.6**	ULS 5a Ba 22	52.4	60.3	36.0	0.44
318	Upper Cross-Arı	50x50x7	S235	1M16-8.8t	0.52	0.52	0.52	111	**-19.1**	ULS 5a Ba 22	60.4	60.3	60.5	0.32		**16.0**	ULS 5a Ah 22	52.4	60.3	36.0	0.44
319	Upper Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	94	**-12.6**	ULS 5a Ah 22	73.4	60.3	51.8	0.24		**15.4**	ULS 5a Ba 12	48.4	60.3	33.7	0.46
320	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	120	**-22.8**	ULS 5a Ba 12	40.9	60.3	43.2	0.56		**22.9**	ULS 5a Ah 22	37.4	60.3	25.7	0.67
321	Upper Cross-Arı	50x50x5	**S355**	1M16-8.8t	0.52	0.52	0.52	129	**-36.8**	ULS 5a Ba 12	44.9	60.3	58.8	0.82		**34.6**	ULS 5a Ah 12	51.0	60.3	35.0	0.99
322	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	132	**-29.7**	ULS 5a Ah 22	37.2	60.3	43.2	0.80		**31.5**	ULS 5a Ba 22	37.4	60.3	25.7	0.93
323	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	138	**-28.5**	ULS 5a Ba 22	35.1	60.3	43.2	0.81		**26.7**	ULS 5a Ah 22	37.4	60.3	25.7	0.79
325	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	98	**-1.6**	ULS 1a_0	49.2	60.3	43.2	0.04		**1.2**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.05
326	Upper Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	211	**-2.3**	ULS 1a_0	20.2	60.3	43.2	0.11		**1.9**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.07
401	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	145	**-3.7**	ULS 1a_90	33.4	60.3	43.2	0.11		**0.0**		46.1	60.3	32.7	0.00
402	Lower Cross-Arı	65x65x7	S235	1M16-8.8t	1.00	1.00	1.00	152	**-10.0**	ULS 3_135	63.9	60.3	60.5	0.17		**0.0**		84.7	60.3	52.3	0.00
403	Lower Cross-Arı	65x65x7	S235	1M16-8.8t	1.00	1.00	1.00	194	**-8.3**	ULS 3_135	46.4	60.3	60.5	0.18		**0.0**		84.7	60.3	52.3	0.00
404	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	266	**0.0**		14.3	60.3	43.2	0.00		**9.1**	ULS 1a_90	46.1	60.3	32.7	0.28
405	Lower Cross-Arı	50x50x7	S235	2M16-8.8t	1.00	1.00	1.00	324	**0.0**		17.9	120.6	121.0	0.00		**20.8**	ULS 3_45	71.2	120.6	72.0	0.29
406	Lower Cross-Arı	60x60x6	S235	2M16-8.8t	1.00	1.00	1.00	296	**0.0**		21.7	120.6	103.7	0.00		**14.2**	ULS 3_135	78.2	120.6	67.3	0.21
407	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	337	**0.0**		14.1	60.3	51.8	0.00		**15.7**	ULS 3_90	48.4	60.3	33.7	0.47
408	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	1.00	2.00	1.00	101	**-1.0**	ULS 1a_0	73.8	60.3	51.8	0.02		**0.9**	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.03
409	Lower Cross-Arı	HEB160	S235	2M20-8.8t	2.00	2.00	2.00	48	**-15.4**	ULS 5a Ah 20	960.6	188.2	172.8	0.09		**17.1**	ULS 5a Ba 20	1278.1	188.2	0.0	0.10
410	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	176	**-2.2**	ULS 1a_0	26.1	60.3	43.2	0.09		**1.7**	ULS 1a_0,9_0,9_0	46.1	60.3	32.7	0.05
411	Lower Cross-Arı	50x50x7	S235	1M16-8.8t	0.55	0.55	0.55	98	**-23.7**	ULS 5a Ba 21	67.3	60.3	60.5	0.39		**21.5**	ULS 5a Ah 10	64.5	60.3	45.8	0.47
412	Lower Cross-Arı	50x50x7	S235	1M16-8.8t	0.54	0.54	0.54	104	**-17.0**	ULS 5a Ah 10	64.3	60.3	60.5	0.28		**19.1**	ULS 5a Ba 10	56.4	60.3	39.3	0.49
413	Lower Cross-Arı	HEB160	S235	2M20-8.8t	2.00	2.00	2.00	25	**-16.4**	ULS 5a Ah 10	1067.2	188.2	172.8	0.09		**16.1**	ULS 5a Ba 21	1278.1	188.2	0.0	0.09
414	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	87	**-15.9**	ULS 5a Ba 10	77.4	60.3	51.8	0.31		**14.1**	ULS 5a Ah 21	48.4	60.3	33.7	0.42
415	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	113	**-10.6**	ULS 5a Ah 21	43.5	60.3	43.2	0.25		**12.0**	ULS 5a Ba 10	46.1	60.3	32.7	0.37
417	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	0.52	0.52	0.52	121	**-15.1**	ULS 5a Ba 21	40.6	60.3	43.2	0.37		**16.5**	ULS 5a Ah 21	46.1	60.3	32.7	0.50
418	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	107	**-27.8**	ULS 5a Ba 21	65.6	60.3	51.8	0.54		**26.3**	ULS 5a Ah 21	48.4	60.3	33.7	0.64
419	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	110	**-22.8**	ULS 5a Ah 21	64.3	60.3	51.8	0.44		**24.6**	ULS 5a Ba 10	48.4	60.3	33.7	0.73
420	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	121	**-23.2**	ULS 5a Ba 21	58.6	60.3	51.8	0.45		**21.5**	ULS 5a Ah 21	48.4	60.3	33.7	0.64
421	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	125	**-19.4**	ULS 5a Ah 10	56.6	60.3	51.8	0.37		**20.7**	ULS 5a Ba 10	48.4	60.3	33.7	0.62
422	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	134	**-18.9**	ULS 5a Ba 21	52.6	60.3	51.8	0.36		**18.0**	ULS 5a Ah 10	48.4	60.3	33.7	0.53
423	Lower Cross-Arı	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	140	**-26.9**	ULS 5a Ah 20	49.9	60.3	51.8	0.54		**26.6**	ULS 5a Ba 11	48.4	60.3	33.7	0.79
310-1	Boven Traverse	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	36	**-0.5**	ULS 5a Ba 3	68.1	60.3	43.2	0.01		**0.0**		37.4	60.3	25.7	0.00
310-2	Boven Traverse	50x50x5	S235	1M16-8.8t	1.00	2.00	1.00	84	**-0.8**	ULS 1a_0,9_0,9_0	59.0	60.3	43.2	0.02		**0.8**	ULS 1a_0,9_0,9_0	37.4	60.3	25.7	0.03
310-3	Boven Traverse	50x50x5	S235	1M16-8.8t	1.00	2.00	1.00	113	**-0.8**	ULS 1a_0	46.3	60.3	43.2	0.02		**4.4**	ULS 6a_90 Ah Ct1	37.4	60.3	25.7	0.17
310-4	Boven Traverse	HEB160	S355	2M20-8.8t	1.00	2.00	1.00	19	**-14.2**	ULS 5a Ah 22	1527.7	188.2	235.2	0.08		**17.9**	ULS 5a Ba 22	1739.7	188.2	0.0	0.10
310-5	Boven Traverse	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	190	**-2.4**	ULS 1a_0,9_0,9_90	23.5	60.3	43.2	0.10		**3.7**	ULS 1a_90	37.4	60.3	25.7	0.14
401-1	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	96	**-1.8**	ULS 1a_90	50.0	60.3	43.2	0.04		**0.0**		46.1	60.3	32.7	0.00
401-2	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	48	**-0.8**	ULS 1a_90	64.8	60.3	43.2	0.02		**0.0**		46.1	60.3	32.7	0.00
404-1	Lower Cross-Arı	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	244	**0.0**		16.4	60.3	43.2	0.00		**6.7**	ULS 1a_90	46.1	60.3	32.7	0.20
V-oph	Lower Cross-Arı	HEB160	S235		1.00	1.00	1.00	35	**-15.5**	ULS 5a Ah 11	984.4	0.0	0.0	0.00		**18.2**	ULS 5a Ba 10	1276.1	0.0	0.0	0.00

DNV·GL

Assessment of groups for strengthened mast (verbouw level)

Date	22-02-21
Author	MKh
Version	1.0

ENS-ZL 380
S-6_R
28

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	mpression	Load Case (Compres	Buckling	Shear (Comp)	earing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	hear (Tens)	earing (Tens)	U.C. (Tens)
321	Upper Cross-Arr	50x50x5	**S355**	1M16-8.8t	0.52	0.52	0.52	129	**-36.8**	ULS 5a Ba 12	44.9	60.3	58.8	0.82		**34.6**	ULS 5a Ah 12	51.0	60.3	35.0	0.99

APPENDIX C
Toetsing knikverkorters

DNV·GL

Knikverkorters initial construction (afkeur)

Date: 2021-02-22
Author: K H Chan
Version: 1.8

ENS - ZL
S-6_R
22&28

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Net Section Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Notes
1021	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	0.57	0	59	**10.5**	**0.14**	61.9	60.3	30.3	31.7	0.72	0.35		
1019	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	1.42	69	146	**10.5**	**0.00**	33.1	60.3	30.3	31.7	0.72	0.35		
1018	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	1.12	0	115	**10.5**	**0.28**	42.9	60.3	30.3	31.7	0.72	0.39		
1017	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	1.72	56	177	**10.5**	**0.00**	25.9	60.3	30.3	31.7	0.72	0.41		
1016	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	1.70	0	175	**10.5**	**0.43**	26.3	60.3	30.3	31.7	0.72	0.59		
1015	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	2.09	43	215	**10.5**	**0.00**	19.8	60.3	30.3	31.7	0.72	0.53		
1014	Onderstuk	Enkele staaf	L60.6	S235	M16	8.8	2.28	0	195	**10.5**	**0.57**	32.6	60.3	38.4	72.6	1.24	0.46		
1012	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	2.54	34	261	**10.5**	**0.00**	14.8	60.3	30.3	31.7	0.72	0.71		
1007	Onderstuk	Enkele staaf	L60.6	S235	M16	8.8	2.88	0	246	**10.5**	**0.72**	23.2	60.3	38.4	72.6	1.24	0.58		
1011	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	2.12	39	218	**10.5**	**0.00**	19.4	60.3	30.3	31.7	0.72	0.54		
1010	Onderstuk	Enkele staaf	L50.5	S235	M16	8.8	1.44	0	148	**10.5**	**0.36**	32.5	60.3	30.3	31.7	0.72	0.50		
1029	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	0.78	0	81	**1.5**	**0.20**	55.8	60.3	30.3	31.7	0.72	0.27		
1025	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	1.57	76	161	**1.5**	**0.00**	29.3	60.3	30.3	31.7	0.72	0.05		
1028	Pootverband	Kniksteun en verticale steur	L50.5	S235	M16	8.8	1.55	0	102	**1.5**	**0.19**	36.7	60.3	30.3	31.7	0.54	0.37		
1024	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	1.79	64	184	**1.5**	**0.00**	24.6	60.3	30.3	31.7	0.72	0.06		
1027	Pootverband	Kniksteun en verticale steur	L60.6	S235	M16	8.8	2.38	0	131	**1.5**	**0.30**	41.9	60.3	38.4	72.6	0.93	0.33		
1023	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	1.99	53	204	**1.5**	**0.00**	21.2	60.3	30.3	31.7	0.72	0.07		
1026	Pootverband	Kniksteun en verticale steur	L60.6	S235	M16	8.8	3.21	0	177	**1.5**	**0.40**	29.9	60.3	38.4	72.6	0.93	0.45		
1022	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.23	44	229	**1.5**	**0.00**	18.0	60.3	30.3	31.7	0.72	0.08		
1008	Tussenschot	Kniksteun en verticale steur	L60.6	S235	M16	8.8	3.91	0	215	**0.3**	**0.49**	23.2	60.3	38.4	72.6	0.93	0.54		
1009	Tussenschot	Kruisende staaf halverwege	L65.7	S235	M16	8.8	5.75	0	293	**0.3**	**0.72**	18.9	60.3	44.8	84.7	1.69	0.43		
1610	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.18	0	121	**11.6**	**0.30**	40.6	60.3	30.3	31.7	0.72	0.41		
1611	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.61	45	165	**11.6**	**0.00**	28.3	60.3	30.3	31.7	0.72	0.41		
1612	1e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	2.37	0	203	**11.6**	0.59	30.9	60.3	38.4	72.6	1.2	0.48		
1613	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.60	35	164	**11.6**	**0.00**	28.6	60.3	30.3	31.7	0.72	0.40		
1614	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.16	0	119	**11.6**	**0.29**	41.3	60.3	30.3	31.7	0.72	0.40		
1615	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.06	0	109	**11.6**	**0.27**	45.1	60.3	30.3	31.7	0.72	0.38		
1616	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.47	45	151	**11.6**	**0.00**	31.7	60.3	30.3	31.7	0.72	0.38		
1629	1e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	2.00	0	171	**11.6**	**0.50**	39.0	60.3	38.4	72.6	1.24	0.40		
1630	1e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	2.87	0	246	**11.6**	**0.72**	23.3	60.3	38.4	72.6	1.24	0.58		
1632	1e tussenstuk	Kruisende staaf halverwege	L60.6	S235	M16	8.8	4.36	0	240	**11.6**	0.55	20.0	60.3	38.4	72.6	1.2	0.58		
1617	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.39	65	143	**11.6**	0.00	33.9	60.3	30.3	31.7	0.7	0.38		
1618	1e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.05	0	108	**11.6**	**0.26**	45.4	60.3	30.3	31.7	0.72	0.38		
1619	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	0.96	0	99	**10.5**	**0.24**	49.1	60.3	30.3	31.7	0.72	0.35		
1620	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.32	45	136	**10.5**	**0.00**	36.0	60.3	30.3	31.7	0.72	0.35		
1621	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.92	0	197	**10.5**	**0.48**	22.3	60.3	30.3	31.7	0.72	0.67		
1622	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.26	40	129	**10.5**	**0.00**	37.9	60.3	30.3	31.7	0.7	0.35		
1623	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.18	46	121	**10.5**	**0.00**	40.6	60.3	30.3	31.7	0.7	0.35		
1624	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.74	0	178	**10.5**	0.43	25.6	60.3	30.3	31.7	0.7	0.60		
1625	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.12	39	115	**10.5**	**0.00**	42.8	60.3	30.3	31.7	0.7	0.35		
1626	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.06	45	109	**10.5**	**0.00**	45.1	60.3	30.3	31.7	0.7	0.35		
1627	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.57	0	161	**10.5**	**0.39**	29.3	60.3	30.3	31.7	0.7	0.55		
1628	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.01	37	104	**10.5**	**0.00**	47.0	60.3	30.3	31.7	0.7	0.35		

APPENDIX D
Toetsing blokdeuvels

Project: ENS-ZL380
Mast: S-6 R (22)

Blokdeuvels

NEN-EN 1993-1-1 en NEN-EN 1994-1-1

Datum: 2020-10-28
Auteur: TBR
Versie: 1.2

Belasting				**Conclusie**			
Druk	$F_{Ed,druk}$	571	kN	Druk	U.C.	0.51	< 1,00 OK
Trek	$F_{Ed,trek}$	415	kN	Trek	U.C.	0.39	< 1,00 OK

Hoekstijl

Profiel		L150.12	
Staalsoort		S355	
Oppervlak		3480	mm^2
Doorsnedecapaciteit	N_{pl}	1235	kN
Breedte	b	150	mm
Dikte	t	12	mm
Ingestorte lengte		1200	mm

Blokdeuvels randstijl

Breedte	b	50	mm
Dikte	h	30	mm
Lengte	L	160	mm
Lassen	a	5	mm
Hoh afstand	s	250	mm
Aantal voor druk	n	8	-
Aantal voor trek	n	8	-

Voetplaat

Dikte	t	20	mm
Overstek	m	30	mm
Lassen	a	5	mm

Paal

Benaming		Buispaal
Diameter	588	mm
Wanddikte	10	mm
Oppervlak	18158	mm^2
Staalsoort	S235	
Doorsnedecapaciteit	4267	kN
Betonkwaliteit	C20/25	

Blokdeuvels paal

Toetsing		Druk en trek	
Breedte	b	50	mm
Dikte	h	30	mm
Lengte	L	1000	mm
Lassen	a	5	mm
Hoh afstand	s	500	mm
Aantal voor druk	n	3	-
Aantal voor trek	n	3	-

Rekenwaarde druksterkte

Materiaalfactor	γ_c	1.5	
Extra mat.factor	γ_m	1.25	-
f_{cd} =		10.7	N/mm^2

Staal randstijl

Vloeigrens	f_{yd} =	355	N/mm^2
Treksterkte	f_{ud} =	510	N/mm^2

Capaciteit blokdeuvels hoekstijl

A_{f1} =	4800	mm^2
A_{f2} =	16800	mm^2
Helling	1: 5	
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.87	
$f_{jd} = C_A \times f_{cd}$ =	20.0	N/mm^2
$F_{Rd,druk} = n \times A_{f1} \times f_{jd}$ =	766	kN
$F_{Rd,trek} = n \times A_{f1} \times f_{jd}$ =	766	kN

Capaciteit voetplaat

k_d =	1.73	-
$f_{jd} = C_A \times f_{cd}$ =	18.5	N/mm^2
$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	49	mm
m* = min(c,m) =	30	mm
Type voetplaat	Diagonaal afgesneden	
Effectief op	Druk en trek	
$A_{p,trek}$ =	15768	mm^2
$F_{Rd} = A_{p,trek} \times f_{jd}$ =	291	kN
Lassen voetplaat	754	kN
$A_{p,druk}$ =	19248	mm^2
$F_{Rd} = A_{p,druk} \times f_{jd}$ =	356	kN

Capaciteit blokdeuvels paal

A_{f1} =	30000	mm^2
A_{f2} =	90000	mm^2
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.73	-
$f_{jd} = k_d \times f_{cd}$ =	18.5	N/mm^2
$F_{Rd,druk} = n \times A_{f1} \times f_{jd}$ =	1663	kN
$F_{Rd,trek} = n \times A_{f1} \times f_{jd}$ =	1663	kN

"Splijten" paal

Spreidingshoek		45	°
Lengte krachtsoverdracht		916	mm
Splijtkracht		227	kN/m
Vloeigrens buiswand	f_{yd} =	235	N/mm^2
Capaciteit buis		4700	kN/m
U.C.		0.05	< 1,00 OK

Capaciteiten

Randstijl op trek	1058 kN
Buis op trek	1663 kN
Randstijl op druk	1122 kN
Buis op druk	1663 kN

Toetsing lassen

Deuvels randstijl	0.28 < 1,00 OK
Deuvels paal	0.39 < 1,00 OK

Project: ENS-ZL380
Mast: 22

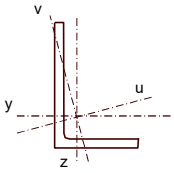
DNV·GL

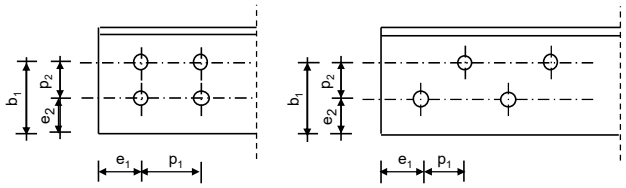
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G129**	***Conclusion***	
Section	**L60.6**	U.C. (compression)	**0.72** **< 1,0 OK**
		U.C. (tension)	**0.82** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-38**	kN
Tensile force		**34**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**34**	kN
Max. comp. force diagonal 1	**-38**	kN
Position crossing diagonal y-axis	1.26	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.42	m
System length z-axis	$L_{z,buc}$ =	1.26	m
System length v-axis	$L_{v,buc}$ =	1.26	m

Member type **Other**
Type bracing Non staggered

End conditions

Begin One bolt
End Continuous
Restraint code TOWER C5

Bolted connection

Bolt type	M16	
Bolt class	8.8	
Number of bolts per leg	1	
Shearplane through	Thread	
Boltpattern	Line	
Boltpattern (leg-member only)	Non staggered	

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	23	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	120	mm	OK
	t_p =	12	mm	OK
	e_2 =	35	mm	OK

A		691	mm^2
G		5.5	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	$\lambda_{max} = L / i$:	108	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ =	0.91	kNm
U.C. =	**0.73**	**< 1,00 OK**

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1.26	m	0.74	0,4+0,7 l	0.92	0.65	0.9	95	0.40
$L_{z,buc}$ =	1.26	m	0.74	0,4+0,7 l	0.92	0.65	0.9	95	0.40
$L_{v,buc}$ =	1.26	m	1.15	0,35+0,70 l	1.15	0.50	0.9	74	0.52

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	162	0.23		*Net section angle*	$F_{u;Rd}$ =	48	0.70	
Cross section tie plate	$F_{u;Rd}$ =	338	0.11		*Net section tie plate*	$F_{u;Rd}$ =	317	0.11	
Shear strength	$F_{v;Rd}$ =	60	0.63		*Block shear*	$F_{u;Rd}$ =	50	0.68	
Bearing strength	$F_{b;Rd}$ =	53	0.72		*Shear strength*	$F_{v;Rd}$ =	60	0.56	
Combined effect	$F_{v;Rd}$ =	53	0.72	plastisch	*Bearing strength*	$F_{b;Rd}$ =	41	0.82	
					Combined effect	$F_{v;Rd}$ =	41	0.82	plastisch

Project: ENS-ZL380
Mast: 22

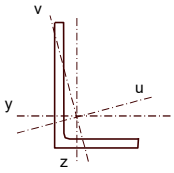
DNV·GL

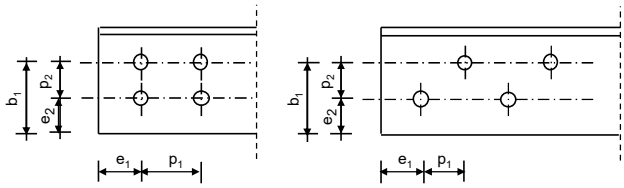
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G176**	***Conclusion***	
Section	**L50.7**	U.C. (compression)	**0.78** **< 1,0 OK**
		U.C. (tension)	**0.91** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-47**	kN
Tensile force		**43**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**43**	kN
Max. comp. force diagonal 1	**-47**	kN
Position crossing diagonal y-axis	1.02	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.00	m
System length z-axis	$L_{z,buc}$ =	1.02	m
System length v-axis	$L_{v,buc}$ =	1.02	m

Member type	**Other**
Type bracing	Non staggered

End conditions

Begin	One bolt
End	Continuous
Restraint code TOWER	C5

Bolted connection

Bolt type	M16
Bolt class	8.8
Number of bolts per leg	1
Shearplane through	Thread
Boltpattern	Line
Boltpattern (leg-member only)	Non staggered

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	90	mm	OK
	t_p =	8	mm	OK
	e_2 =	27	mm	OK

A		656	mm^2
G		5.2	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	$\lambda_{max} = L / i$:	107	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ =	0.75	kNm
U.C. =	**0.77**	**< 1,00 OK**

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1.02	m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.52
$L_{z,buc}$ =	1.02	m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.52
$L_{v,buc}$ =	1.02	m	1.14	0,35+0,70 l	1.15	0.51	0.9	71	0.67

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	154	0.30		*Net section angle*	$F_{u;Rd}$ =	52	0.82	
Cross section tie plate	$F_{u;Rd}$ =	169	0.28		*Net section tie plate*	$F_{u;Rd}$ =	149	0.29	
Shear strength	$F_{v;Rd}$ =	60	0.78		*Block shear*	$F_{u;Rd}$ =	56	0.76	
Bearing strength	$F_{b;Rd}$ =	62	0.76		*Shear strength*	$F_{v;Rd}$ =	60	0.71	
Combined effect	$F_{v;Rd}$ =	60	0.78	elastisch	*Bearing strength*	$F_{b;Rd}$ =	47	0.91	
					Combined effect	$F_{v;Rd}$ =	47	0.91	plastisch

Project: ENS-ZL380
Mast: 22

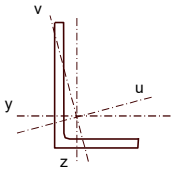
DNV·GL

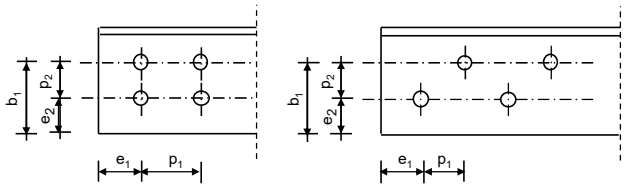
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G177**	***Conclusion***	
Section	**L50.7**	U.C. (compression)	**0.61** **< 1,0 OK**
		U.C. (tension)	**0.85** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-37**	kN
Tensile force		**40**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**40**	kN
Max. comp. force diagonal 1	**-37**	kN
Position crossing diagonal y-axis	1.02	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.00	m
System length z-axis	$L_{z,buc}$ =	1.02	m
System length v-axis	$L_{v,buc}$ =	1.02	m

Member type **Other**
Type bracing Non staggered

End conditions

Begin One bolt
End Continuous
Restraint code TOWER C5

Bolted connection

Bolt type	M16	
Bolt class	8.8	
Number of bolts per leg	1	
Shearplane through	Thread	
Boltpattern	Line	
Boltpattern (leg-member only)	Non staggered	

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	90	mm	OK
	t_p =	8	mm	OK
	e_2 =	27	mm	OK

A		656	mm^2
G		5.2	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness $\lambda_{max} = L / i$: 106 -
Allowed: 180 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0.75 kNm
U.C. = **0.77** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{v,buc}$ =	1.02 m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.41
$L_{z,buc}$ =	1.02 m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.41
$L_{v,buc}$ =	1.02 m	1.13	0,35+0,70 l	1.14	0.51	0.9	71	0.52

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	154	0.24		*Net section angle*	$F_{u;Rd}$ =	52	0.76	
Cross section tie plate	$F_{u;Rd}$ =	169	0.22		*Net section tie plate*	$F_{u;Rd}$ =	149	0.27	
Shear strength	$F_{v;Rd}$ =	60	0.61		*Block shear*	$F_{u;Rd}$ =	56	0.71	
Bearing strength	$F_{b;Rd}$ =	62	0.60		*Shear strength*	$F_{v;Rd}$ =	60	0.66	
Combined effect	$F_{v;Rd}$ =	60	0.61	elastisch	*Bearing strength*	$F_{b;Rd}$ =	47	0.85	
					Combined effect	$F_{v;Rd}$ =	47	0.85	plastisch

Project: ENS-ZL380
Mast: 22

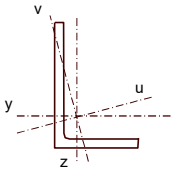
DNV·GL

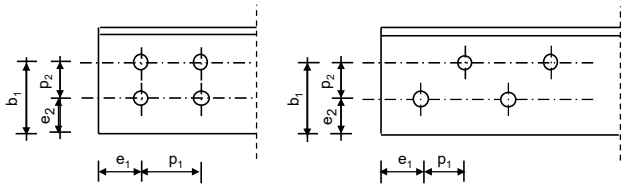
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G180**	***Conclusion***	
Section	**L50.5**	U.C. (compression)	**0.70** **< 1,0 OK**
		U.C. (tension)	**0.89** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-31**	kN
Tensile force		**30**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**30**	kN
Max. comp. force diagonal 1	**-31**	kN
Position crossing diagonal y-axis	1.17	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.25	m
System length z-axis	$L_{z,buc}$ =	1.17	m
System length v-axis	$L_{v,buc}$ =	1.17	m

Member type	**Other**
Type bracing	Non staggered

End conditions

Begin	One bolt
End	Continuous
Restraint code TOWER	C5

Bolted connection

Bolt type	M16
Bolt class	8.8
Number of bolts per leg	1
Shearplane through	Thread
Boltpattern	Line
Boltpattern (leg-member only)	Non staggered

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	110	mm	OK
	t_p =	10	mm	OK
	e_2 =	35	mm	OK

A		480	mm^2
G		3.8	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	λ_{max} = L / i :	120	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =	0.84	kNm
U.C. =	**1.18**	> 1,00 Not OK

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{v,buc}$ =	1.17	m	0.82	0,4+0,7 l	0.98	0.61	0.9	62	0.50
$L_{z,buc}$ =	1.17	m	0.82	0,4+0,7 l	0.98	0.61	0.9	62	0.50
$L_{v,buc}$ =	1.17	m	1.28	0,35+0,70 l	1.25	0.45	0.9	46	0.67

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	113	0.27		*Net section angle*	$F_{u;Rd}$ =	37	0.80	
Cross section tie plate	$F_{u;Rd}$ =	259	0.12		*Net section tie plate*	$F_{u;Rd}$ =	238	0.13	
Shear strength	$F_{v;Rd}$ =	60	0.51		*Block shear*	$F_{u;Rd}$ =	40	0.74	
Bearing strength	$F_{b;Rd}$ =	44	0.70		*Shear strength*	$F_{v;Rd}$ =	60	0.50	
Combined effect	$F_{v;Rd}$ =	44	0.70	plastisch	*Bearing strength*	$F_{b;Rd}$ =	34	0.89	
					Combined effect	$F_{v;Rd}$ =	34	0.89	plastisch

Project: ENS-ZL380
Mast: 22

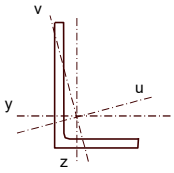
DNV·GL

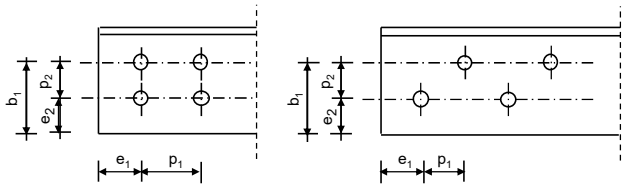
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G184**	***Conclusion***	
Section	**L50.5**	U.C. (compression)	**0.72** **< 1,0 OK**
		U.C. (tension)	**0.83** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-31**	kN
Tensile force		**28**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**28**	kN
Max. comp. force diagonal 1	**-31**	kN
Position crossing diagonal y-axis	1.25	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.41	m
System length z-axis	$L_{z,buc}$ =	1.25	m
System length v-axis	$L_{v,buc}$ =	1.25	m

Member type **Other**
Type bracing Non staggered

End conditions

Begin One bolt
End Continuous
Restraint code TOWER C5

Bolted connection

Bolt type	M16	
Bolt class	8.8	
Number of bolts per leg	1	
Shearplane through	Thread	
Boltpattern	Line	
Boltpattern (leg-member only)	Non staggered	

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	110	mm	OK
	t_p =	10	mm	OK
	e_2 =	35	mm	OK

A		480	mm^2
G		3.8	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness $\lambda_{max} = L / i$: 128 -
Allowed: 180 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0.90 kNm
U.C. = **1.26** > 1,00 Not OK

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{v,buc}$ =	1.25 m	0.88	0,4+0,7 l	1.02	0.59	0.9	60	0.52
$L_{z,buc}$ =	1.25 m	0.88	0,4+0,7 l	1.02	0.59	0.9	60	0.52
$L_{v,buc}$ =	1.25 m	1.37	0,35+0,70 l	1.31	0.42	0.9	43	0.72

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	113	0.27		*Net section angle*	$F_{u;Rd}$ =	37	0.75	
Cross section tie plate	$F_{u;Rd}$ =	259	0.12		*Net section tie plate*	$F_{u;Rd}$ =	238	0.12	
Shear strength	$F_{v;Rd}$ =	60	0.51		*Block shear*	$F_{u;Rd}$ =	40	0.69	
Bearing strength	$F_{b;Rd}$ =	44	0.70		*Shear strength*	$F_{v;Rd}$ =	60	0.46	
Combined effect	$F_{v;Rd}$ =	44	0.70	plastisch	*Bearing strength*	$F_{b;Rd}$ =	34	0.83	
					Combined effect	$F_{v;Rd}$ =	34	0.83	plastisch

Project: ENS-ZL380
Mast: 22

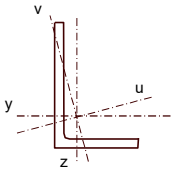
DNV·GL

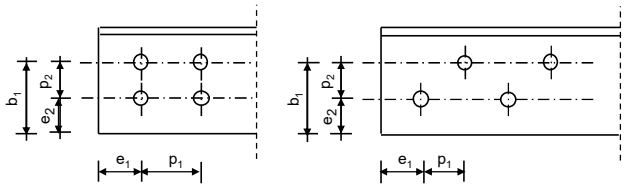
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G185**	***Conclusion***	
Section	**L50.5**	U.C. (compression)	**0.62** **< 1,0 OK**
		U.C. (tension)	**0.83** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-26**	kN
Tensile force		**28**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**28**	kN
Max. comp. force diagonal 1	**-26**	kN
Position crossing diagonal y-axis	1.28	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.46	m
System length z-axis	$L_{z,buc}$ =	1.28	m
System length v-axis	$L_{v,buc}$ =	1.28	m

Member type	**Other**
Type bracing	Non staggered

End conditions

Begin	One bolt
End	Continuous
Restraint code TOWER	C5

Bolted connection

Bolt type	M16
Bolt class	8.8
Number of bolts per leg	1
Shearplane through	Thread
Boltpattern	Line
Boltpattern (leg-member only)	Non staggered

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	110	mm	OK
	t_p =	10	mm	OK
	e_2 =	35	mm	OK

A		480	mm^2
G		3.8	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	λ_{max} = L / i :	132	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =	0.92	kNm
U.C. =	**1.28**	**> 1,00 Not OK**

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1.28	m	0.90	0,4+0,7 l	1.03	0.58	0.9	59	0.44
$L_{z,buc}$ =	1.28	m	0.90	0,4+0,7 l	1.03	0.58	0.9	59	0.44
$L_{v,buc}$ =	1.28	m	1.40	0,35+0,70 l	1.33	0.41	0.9	42	0.62

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	113	0.23		*Net section angle*	$F_{u;Rd}$ =	37	0.75	
Cross section tie plate	$F_{u;Rd}$ =	259	0.10		*Net section tie plate*	$F_{u;Rd}$ =	238	0.12	
Shear strength	$F_{v;Rd}$ =	60	0.43		*Block shear*	$F_{u;Rd}$ =	40	0.69	
Bearing strength	$F_{b;Rd}$ =	44	0.59		*Shear strength*	$F_{v;Rd}$ =	60	0.46	
Combined effect	$F_{v;Rd}$ =	44	0.59	plastisch	*Bearing strength*	$F_{b;Rd}$ =	34	0.83	
					Combined effect	$F_{v;Rd}$ =	34	0.83	plastisch

DNV·GL

Project: ENS-ZL380
Mast: S-6 R (28)

Shear blocks

NEN-EN 1993-1-1 en NEN-EN 1994-1-1

Datum: 2021-02-22
Auteur: TBR
Versie: 1.4

Load				***Results***			
Compression	$F_{Ed,c}$	**584**	kN	Compression	U.C.	0.52	< 1,00 OK
Tension	$F_{Ed,t}$	**451**	kN	Tension	U.C.	0.43	< 1,00 OK

Main leg

Profile		**L150.12**	
Steel material		S355	
Cross section		3480	mm^2
Axial capacity	N_{pl}	1235	kN
Width	b	150	mm
Thickness	t	12	mm
Length in concrete		1200	mm

Shear blocks main leg

Width	b	50	mm
Thickness	h	30	mm
Length	L	160	mm
Welds	a	5	mm
c.t.c. separation	s	250	mm
Number for compr.	n_c	8	-
Number for tension	n_t	8	-

Foot plate

Thickness	t	20	mm
Ext. length	m	30	mm
Welds	a	5	mm

Pile

Name		Buispaal	
Diameter		558	mm
Thickness		10	mm
Cross section		17216	mm^2
Steel material		S235	
Capacity		4046	kN
Concrete strength		C20/25	

Shear blocks pile

Width	b	50	mm
Thickness	h	30	mm
Length	L	1000	mm
Welds	a	5	mm
c.t.c. separation	s	500	mm
Number for compr.	n_c	3	-
Number for tension	n_t	3	-

Design value concrete strength

Material factor	γ_c	1.5	
Add. mat. factor	γ_m	1.25	-
f_{cd} =		10.7	N/mm^2

Steel tower stub

Yield strength	f_{yd} =	355	N/mm^2
Tensile strength	f_{ud} =	490	N/mm^2

Capacity shear blocks main leg

A_{f1} =	4800	mm^2
A_{f2} =	16800	mm^2
Slope	1: 5	
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.87	
$f_{jd} = C_A \times f_{cd}$ =	20.0	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	766	kN
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	766	kN

Capacity foot plate

k_d =	1.73	-
$f_{jd} = C_A \times f_{cd}$ =	18.5	N/mm^2
$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	49	mm
m* = min(c,m) =	30	mm
Type foot plate	Diagonally cut	
Effective for	Compr. and tension	
$A_{p,c}$ =	19248	mm^2
$F_{Rd,c} = A_{p,druk} \times f_{jd}$ =	356	kN
$A_{p,t}$ =	15768	mm^2
$F_{Rd,t} = A_{p,t} \times f_{jd}$ =	291	kN

Capacities

$F_{rd,c,plate}$ =	356	kN
$F_{rd,blocks,c}$ =	766	kN
$F_{rd,c} = F_{rd,blck} + F_{rd,footplate}$ =	**1122**	kN
U.C. compression	0.52	< 1,00 OK
Welds foot plate (see next page)	724	kN
$F_{rd,t}$ = min. (welds / foot plate) =	291	kN
$F_{rd,blocks,t}$ =	766	kN
$F_{rd,t} = F_{rd,blck} + F_{rd,footplate}$ =	**1058**	kN
U.C. tension	0.43	< 1,00 OK
U.C. welds	0.39	< 1,00 OK

Capacity shear blocks pile

A_{f1} =	30000	mm^2
A_{f2} =	90000	mm^2
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.73	-
$f_{jd} = k_d \times f_{cd}$ =	18.5	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	**1663**	kN
U.C. compression	0.35	< 1,00 OK
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	**1663**	kN
U.C. tension	0.27	< 1,00 OK
U.C. welds	0.34	< 1,00 OK

"Splitting" of pile

Spread of forces		45	°
Length force flow		931	mm
Splitting force		242	kN/m
Yield strength wall	f_{yd} =	235	N/mm^2
Capacity tubular pile		4700	kN/m
U.C.		0.05	< 1,00 OK

Project: ENS-ZL380
Mast: S-6 R (28)

Welds of shear blocks of main leg

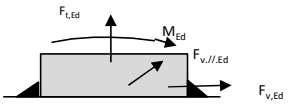
Out-of-plane loading

Plate

t =	50	mm
Grade	S355	
f_{yd} =	355	N/mm²
f_u =	490	N/mm²

Welds

a =	5	mm
l =	150	mm
β_w =	0.9	-
γ_{M2} =	1.25	-



Member forces

Factor	1.2	
$F_{t,Ed}$ =	**0**	kN
$F_{v,Ed} = F_{rd,c} / n$ =	**115**	kN
$F_{v//,Ed}$ =	**0**	kN
$M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ =	**1.72**	kNm

Stress components

$\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ =	0	N/mm²
$\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ =	54	N/mm²
	54	N/mm²
$b^* = b + 2/3a\sqrt{2}$	54.7	mm
$\sigma_1 = \tau_1 = 0{,}706 M_{Ed} / al\ b^*$ =	30	N/mm²
$\tau_{//} = F_{w//,Ed} / 2al$ =	0	N/mm²
$\sigma_{w,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	168	N/mm²

Check

$\sigma_{vw,Ed}$ =	168	N/mm²	≤	$f_u / \beta_w \gamma_{M2}$ =	436	N/mm²	U.C. = **0.39** OK
σ_1 =	84	N/mm²	≤	$0{,}9 f_u / \gamma_{M2}$ =	353	N/mm²	U.C. = **0.24** OK

Welds of shear blocks of pile

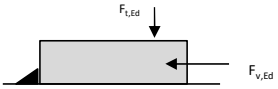
Out-of-plane loading

Plate

t =	50	mm
Grade	S235	
f_{yd} =	235	N/mm²
f_u =	360	N/mm²

Welds

a =	5	mm
l =	1000	mm
β_w =	0.8	-
γ_{M2} =	1.25	-



Member forces

Factor	1.2	
$F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ =	**200**	kN
$F_{v,Ed}$ =	**665**	kN
$F_{v//,Ed}$ =	**0**	kN
M_{Ed} =	**0.00**	kNm

Stress components

$\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ =	14	N/mm²
$\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ =	47	N/mm²
	61	N/mm²
$\tau_{//} = F_{w//,Ed} / 2al$ =	0	N/mm²
$\sigma_{w,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	122	N/mm²

Check

$\sigma_{vw,Ed}$ =	122	N/mm²	≤	$f_u / \beta_w \gamma_{M2}$ =	360	N/mm²	U.C. = **0.34** OK
σ_1 =	61	N/mm²	≤	$0{,}9 f_u / \gamma_{M2}$ =	259	N/mm²	U.C. = **0.24** OK

Welds of foot plate

$f_u / \beta_w \gamma_{M2}$ =		436	N/mm²
Weld size	a =	5	mm
Length	l = 2b+ 2b - t =	576	mm
Capacity	$F_{Rd} = a \times l \times f_{w,d} / \sqrt{3}$ =	**724**	kN

Project: ENS-ZL380
Mast: 22

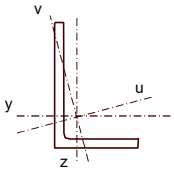
DNV·GL

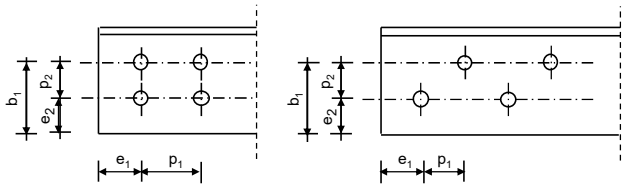
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G129**	***Conclusion***	
Section	**L60.6**	U.C. (compression)	**0.72** **< 1,0 OK**
		U.C. (tension)	**0.82** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-38**	kN
Tensile force		**34**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**34**	kN
Max. comp. force diagonal 1	**-38**	kN
Position crossing diagonal y-axis	1.26	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.42	m
System length z-axis	$L_{z,buc}$ =	1.26	m
System length v-axis	$L_{v,buc}$ =	1.26	m

Member type **Other**
Type bracing Non staggered

End conditions

Begin One bolt
End Continuous
Restraint code TOWER C5

Bolted connection

Bolt type	M16	
Bolt class	8.8	
Number of bolts per leg	1	
Shearplane through	Thread	
Boltpattern	Line	
Boltpattern (leg-member only)	Non staggered	

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	23	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	120	mm	OK
	t_p =	12	mm	OK
	e_2 =	35	mm	OK

A		691	mm^2
G		5.5	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	$\lambda_{max} = L / i$:	108	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ =	0.91	kNm
U.C. =	**0.73**	**< 1,00 OK**

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1.26	m	0.74	0,4+0,7 l	0.92	0.65	0.9	95	0.40
$L_{z,buc}$ =	1.26	m	0.74	0,4+0,7 l	0.92	0.65	0.9	95	0.40
$L_{v,buc}$ =	1.26	m	1.15	0,35+0,70 l	1.15	0.50	0.9	74	0.52

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	162	0.23		*Net section angle*	$F_{u;Rd}$ =	48	0.70	
Cross section tie plate	$F_{u;Rd}$ =	338	0.11		*Net section tie plate*	$F_{u;Rd}$ =	317	0.11	
Shear strength	$F_{v;Rd}$ =	60	0.63		*Block shear*	$F_{u;Rd}$ =	50	0.68	
Bearing strength	$F_{b;Rd}$ =	53	0.72		*Shear strength*	$F_{v;Rd}$ =	60	0.56	
Combined effect	$F_{v;Rd}$ =	53	0.72	plastisch	*Bearing strength*	$F_{b;Rd}$ =	41	0.82	
					Combined effect	$F_{v;Rd}$ =	41	0.82	plastisch

Project: ENS-ZL380
Mast: 22

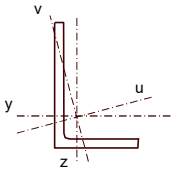
DNV·GL

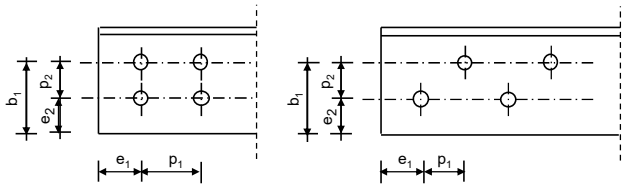
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G176**	***Conclusion***	
Section	**L50.7**	U.C. (compression)	**0.78** **< 1,0 OK**
		U.C. (tension)	**0.91** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-47**	kN
Tensile force		**43**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**43**	kN
Max. comp. force diagonal 1	**-47**	kN
Position crossing diagonal y-axis	1.02	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.00	m
System length z-axis	$L_{z,buc}$ =	1.02	m
System length v-axis	$L_{v,buc}$ =	1.02	m

Member type	**Other**
Type bracing	Non staggered

End conditions

Begin	One bolt
End	Continuous
Restraint code TOWER	C5

Bolted connection

Bolt type	M16
Bolt class	8.8
Number of bolts per leg	1
Shearplane through	Thread
Boltpattern	Line
Boltpattern (leg-member only)	Non staggered

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	90	mm	OK
	t_p =	8	mm	OK
	e_2 =	27	mm	OK

A		656	mm^2
G		5.2	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	$\lambda_{max} = L / i$:	107	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ =	0.75	kNm
U.C. =	**0.77**	**< 1,00 OK**

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1.02	m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.52
$L_{z,buc}$ =	1.02	m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.52
$L_{v,buc}$ =	1.02	m	1.14	0,35+0,70 l	1.15	0.51	0.9	71	0.67

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	154	0.30		*Net section angle*	$F_{u;Rd}$ =	52	0.82	
Cross section tie plate	$F_{u;Rd}$ =	169	0.28		*Net section tie plate*	$F_{u;Rd}$ =	149	0.29	
Shear strength	$F_{v;Rd}$ =	60	0.78		*Block shear*	$F_{u;Rd}$ =	56	0.76	
Bearing strength	$F_{b;Rd}$ =	62	0.76		*Shear strength*	$F_{v;Rd}$ =	60	0.71	
Combined effect	$F_{v;Rd}$ =	60	0.78	elastisch	*Bearing strength*	$F_{b;Rd}$ =	47	0.91	
					Combined effect	$F_{v;Rd}$ =	47	0.91	plastisch

Project: ENS-ZL380
Mast: 22

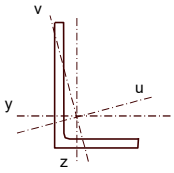
DNV·GL

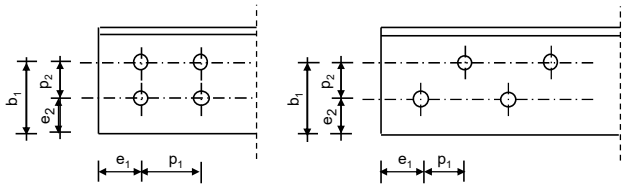
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G177**	***Conclusion***	
Section	**L50.7**	U.C. (compression)	**0.61** **< 1,0 OK**
		U.C. (tension)	**0.85** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-37**	kN
Tensile force		**40**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**40**	kN
Max. comp. force diagonal 1	**-37**	kN
Position crossing diagonal y-axis	1.02	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.00	m
System length z-axis	$L_{z,buc}$ =	1.02	m
System length v-axis	$L_{v,buc}$ =	1.02	m

Member type **Other**
Type bracing Non staggered

End conditions

Begin One bolt
End Continuous
Restraint code TOWER C5

Bolted connection

Bolt type	M16	
Bolt class	8.8	
Number of bolts per leg	1	
Shearplane through	Thread	
Boltpattern	Line	
Boltpattern (leg-member only)	Non staggered	

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	90	mm	OK
	t_p =	8	mm	OK
	e_2 =	27	mm	OK

A		656	mm^2
G		5.2	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness $\lambda_{max} = L / i$: 106 -
Allowed: 180 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0.75 kNm
U.C. = **0.77** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{v,buc}$ =	1.02 m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.41
$L_{z,buc}$ =	1.02 m	0.73	0,4+0,7 l	0.91	0.65	0.9	91	0.41
$L_{v,buc}$ =	1.02 m	1.13	0,35+0,70 l	1.14	0.51	0.9	71	0.52

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	154	0.24		*Net section angle*	$F_{u;Rd}$ =	52	0.76	
Cross section tie plate	$F_{u;Rd}$ =	169	0.22		*Net section tie plate*	$F_{u;Rd}$ =	149	0.27	
Shear strength	$F_{v;Rd}$ =	60	0.61		*Block shear*	$F_{u;Rd}$ =	56	0.71	
Bearing strength	$F_{b;Rd}$ =	62	0.60		*Shear strength*	$F_{v;Rd}$ =	60	0.66	
Combined effect	$F_{v;Rd}$ =	60	0.61	elastisch	*Bearing strength*	$F_{b;Rd}$ =	47	0.85	
					Combined effect	$F_{v;Rd}$ =	47	0.85	plastisch

Project: ENS-ZL380
Mast: 22

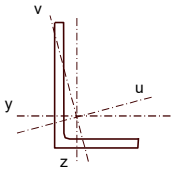
DNV·GL

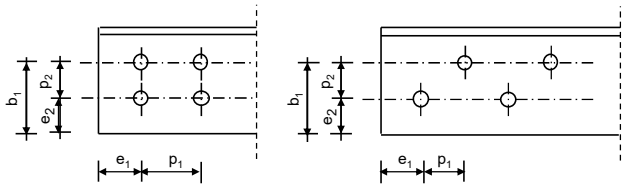
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G180**	***Conclusion***	
Section	**L50.5**	U.C. (compression)	**0.70** **< 1,0 OK**
		U.C. (tension)	**0.89** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-31**	kN
Tensile force		**30**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**30**	kN
Max. comp. force diagonal 1	**-31**	kN
Position crossing diagonal y-axis	1.17	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.25	m
System length z-axis	$L_{z,buc}$ =	1.17	m
System length v-axis	$L_{v,buc}$ =	1.17	m

Member type	**Other**
Type bracing	Non staggered

End conditions

Begin	One bolt
End	Continuous
Restraint code TOWER	C5

Bolted connection

Bolt type	M16
Bolt class	8.8
Number of bolts per leg	1
Shearplane through	Thread
Boltpattern	Line
Boltpattern (leg-member only)	Non staggered

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	110	mm	OK
	t_p =	10	mm	OK
	e_2 =	35	mm	OK

A		480	mm^2
G		3.8	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	λ_{max} = L / i :	120	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =	0.84	kNm
U.C. =	**1.18**	> 1,00 Not OK

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{v,buc}$ =	1.17	m	0.82	0,4+0,7 l	0.98	0.61	0.9	62	0.50
$L_{z,buc}$ =	1.17	m	0.82	0,4+0,7 l	0.98	0.61	0.9	62	0.50
$L_{v,buc}$ =	1.17	m	1.28	0,35+0,70 l	1.25	0.45	0.9	46	0.67

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	113	0.27		*Net section angle*	$F_{u;Rd}$ =	37	0.80	
Cross section tie plate	$F_{u;Rd}$ =	259	0.12		*Net section tie plate*	$F_{u;Rd}$ =	238	0.13	
Shear strength	$F_{v;Rd}$ =	60	0.51		*Block shear*	$F_{u;Rd}$ =	40	0.74	
Bearing strength	$F_{b;Rd}$ =	44	0.70		*Shear strength*	$F_{v;Rd}$ =	60	0.50	
Combined effect	$F_{v;Rd}$ =	44	0.70	plastisch	*Bearing strength*	$F_{b;Rd}$ =	34	0.89	
					Combined effect	$F_{v;Rd}$ =	34	0.89	plastisch

Project: ENS-ZL380
Mast: 22

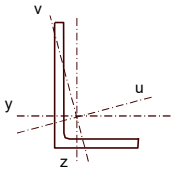
DNV·GL

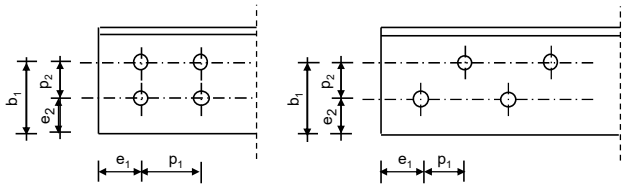
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2020-10-28
Auteur: TBR
Versie: 2.7

Member name	**G185**	***Conclusion***	
Section	**L50.5**	U.C. (compression)	**0.62** **< 1,0 OK**
		U.C. (tension)	**0.83** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-26**	kN
Tensile force		**28**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**28**	kN
Max. comp. force diagonal 1	**-26**	kN
Position crossing diagonal y-axis	1.28	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.46	m
System length z-axis	$L_{z,buc}$ =	1.28	m
System length v-axis	$L_{v,buc}$ =	1.28	m

Member type	**Other**
Type bracing	Non staggered

End conditions

Begin	One bolt
End	Continuous
Restraint code TOWER	C5

Bolted connection

Bolt type	M16
Bolt class	8.8
Number of bolts per leg	1
Shearplane through	Thread
Boltpattern	Line
Boltpattern (leg-member only)	Non staggered

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	110	mm	OK
	t_p =	10	mm	OK
	e_2 =	35	mm	OK

A		480	mm^2
G		3.8	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness	λ_{max} = L / i :	132	-
Allowed:		180	**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =	0.92	kNm
U.C. =	**1.28**	**> 1,00 Not OK**

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1.28	m	0.90	0,4+0,7 l	1.03	0.58	0.9	59	0.44
$L_{z,buc}$ =	1.28	m	0.90	0,4+0,7 l	1.03	0.58	0.9	59	0.44
$L_{v,buc}$ =	1.28	m	1.40	0,35+0,70 l	1.33	0.41	0.9	42	0.62

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	113	0.23		*Net section angle*	$F_{u;Rd}$ =	37	0.75	
Cross section tie plate	$F_{u;Rd}$ =	259	0.10		*Net section tie plate*	$F_{u;Rd}$ =	238	0.12	
Shear strength	$F_{v;Rd}$ =	60	0.43		*Block shear*	$F_{u;Rd}$ =	40	0.69	
Bearing strength	$F_{b;Rd}$ =	44	0.59		*Shear strength*	$F_{v;Rd}$ =	60	0.46	
Combined effect	$F_{v;Rd}$ =	44	0.59	plastisch	*Bearing strength*	$F_{b;Rd}$ =	34	0.83	
					Combined effect	$F_{v;Rd}$ =	34	0.83	plastisch

Project: ENS-ZL380
Mast: 28

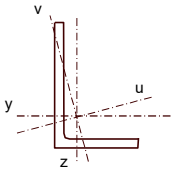
DNV·GL

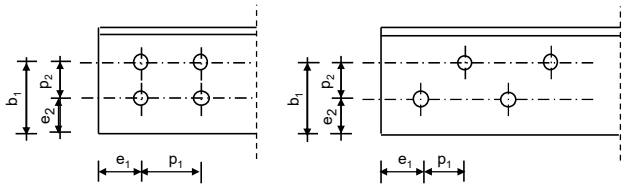
Angle check

NEN-EN1993-1-1 and EN1993-3-1

Datum: 2021-02-22
Auteur: TBR
Versie: 2.7

Member name	**G186**	***Conclusion***	
Section	**L50.5**	U.C. (compression)	**0.73** **< 1,0 OK**
		U.C. (tension)	**0.80** **< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**-29**	kN
Tensile force		**27**	kN

Crossing diagonal loads

Applicable:	**Yes**	
Min. tensile force diagonal 2	**27**	kN
Max. comp. force diagonal 1	**-29**	kN
Position crossing diagonal y-axis	1.34	m

Construction loads

Vertical construction load	**1.0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2.58	m
System length z-axis	$L_{z,buc}$ =	1.34	m
System length v-axis	$L_{v,buc}$ =	1.34	m

Member type **Other**
Type bracing Non staggered

End conditions

Begin One bolt
End Continuous
Restraint code TOWER C5

Bolted connection

Bolt type	M16	
Bolt class	8.8	
Number of bolts per leg	1	
Shearplane through	Thread	
Boltpattern	Line	
Boltpattern (leg-member only)	Non staggered	

End distance	e_1 =	35	mm	Ok
Separation distance //	p_1 =	55	mm	Ok
Separation distance |	p_2 =	0	mm	Ok
End distance ⌟	e_2 =	22	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	110	mm	OK
	t_p =	10	mm	OK
	e_2 =	35	mm	OK

A		480	mm^2
G		3.8	kg/m
Partial safety factor	$\gamma_{f;Q}$ =	1.50	
Material factors	γ_{M0} =	1.00	
	γ_{M1} =	1.00	
	γ_{M2} =	1.25	
Shear strength bolt	$F_{v;b;Rd}$ =	60.3	kN

Slenderness $\lambda_{max} = L / i$: 138 -
Allowed: 180 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0.97 kNm
U.C. = **1.35** > 1,00 Not OK

Results stability

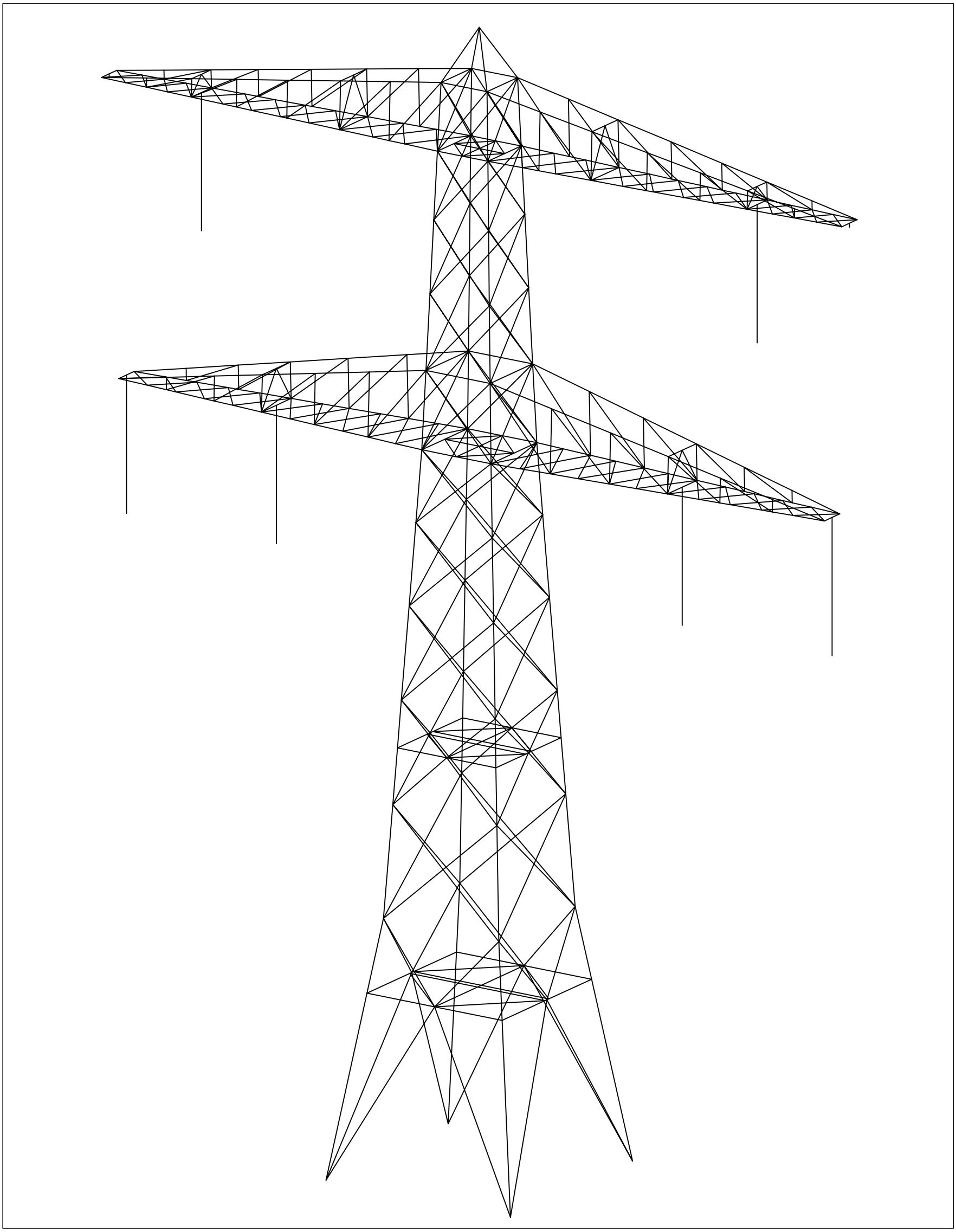
			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{v,buc}$ =	1.34	m	0.94	0,4+0,7 l	1.06	0.56	0.9	57	0.51
$L_{z,buc}$ =	1.34	m	0.94	0,4+0,7 l	1.06	0.56	0.9	57	0.51
$L_{v,buc}$ =	1.34	m	1.47	0,35+0,70 l	1.38	0.39	0.9	40	0.73

Bolted connection

Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	113	0.26		*Net section angle*	$F_{u;Rd}$ =	37	0.72	
Cross section tie plate	$F_{u;Rd}$ =	259	0.11		*Net section tie plate*	$F_{u;Rd}$ =	238	0.11	
Shear strength	$F_{v;Rd}$ =	60	0.48		*Block shear*	$F_{u;Rd}$ =	40	0.67	
Bearing strength	$F_{b;Rd}$ =	44	0.66		*Shear strength*	$F_{v;Rd}$ =	60	0.45	
Combined effect	$F_{v;Rd}$ =	44	0.66	plastisch	*Bearing strength*	$F_{b;Rd}$ =	34	0.80	
					Combined effect	$F_{v;Rd}$ =	34	0.80	plastisch

APPENDIX E
Tekeningen

Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)



Overview

Notes and legend:

- New redundants according to drawing
- Size for new redundants is L50x50x5
- Other changes according to the table

All changes are symmetrical unless otherwise indicated

- Material quality t ≤ 16mm S355J0
- Material quality t > 16mm S355J2
- Bolt quality 8.8 rolled

Profile exchanged
New redundant
Bolt exchanged

01	22-02-2021	Dimension added
00	30-10-2020	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-037

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	22-02-2021	Units:	m	
Checked by:	TBR	22-02-2021	Project no:	10166260	
Approved by:	JHu	22-02-2021	Company:	TenneT	

Description: Modifications overview for mast type S-6_R (Mast 22) page 1 of 2

Revision: 00

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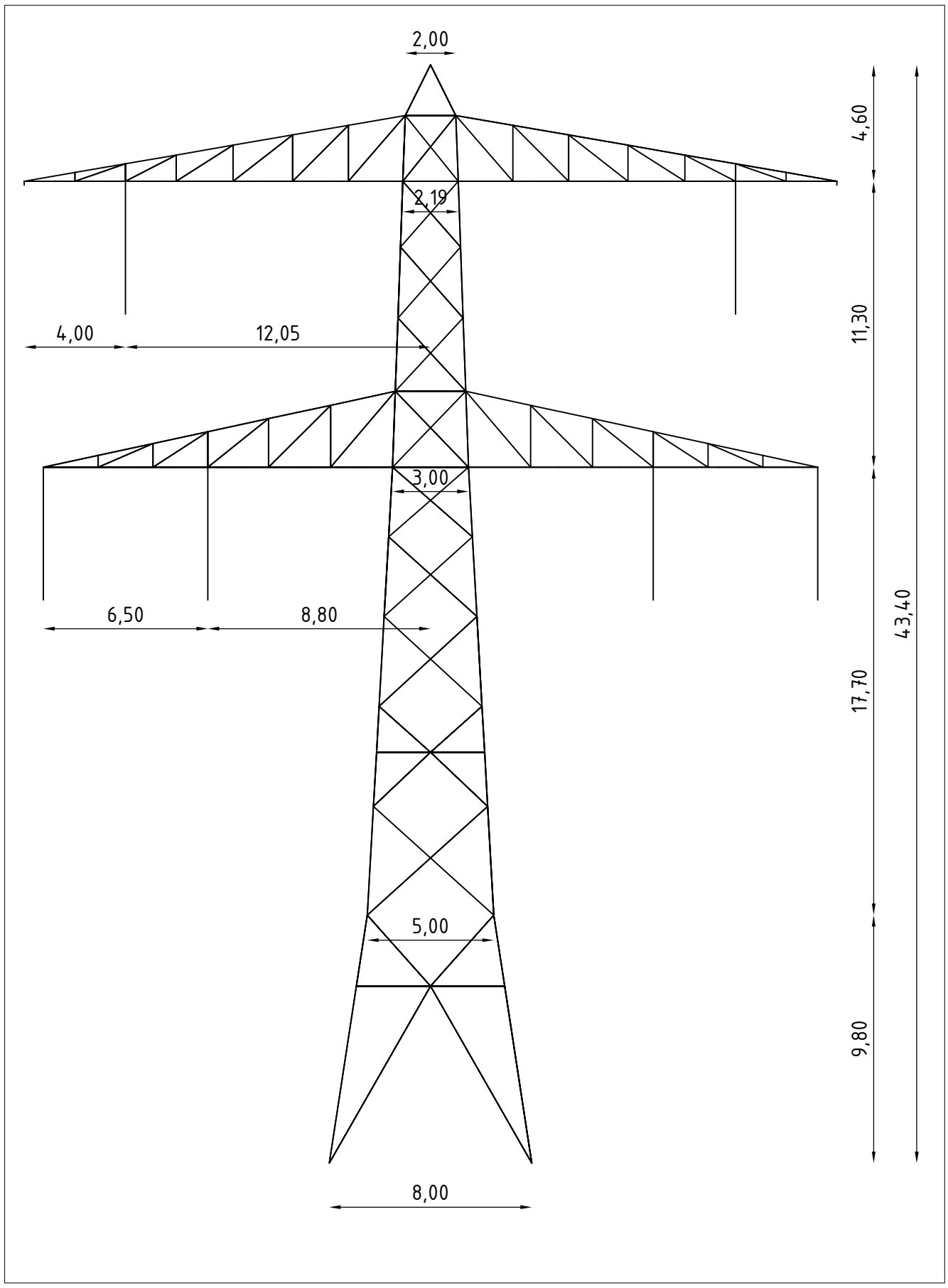
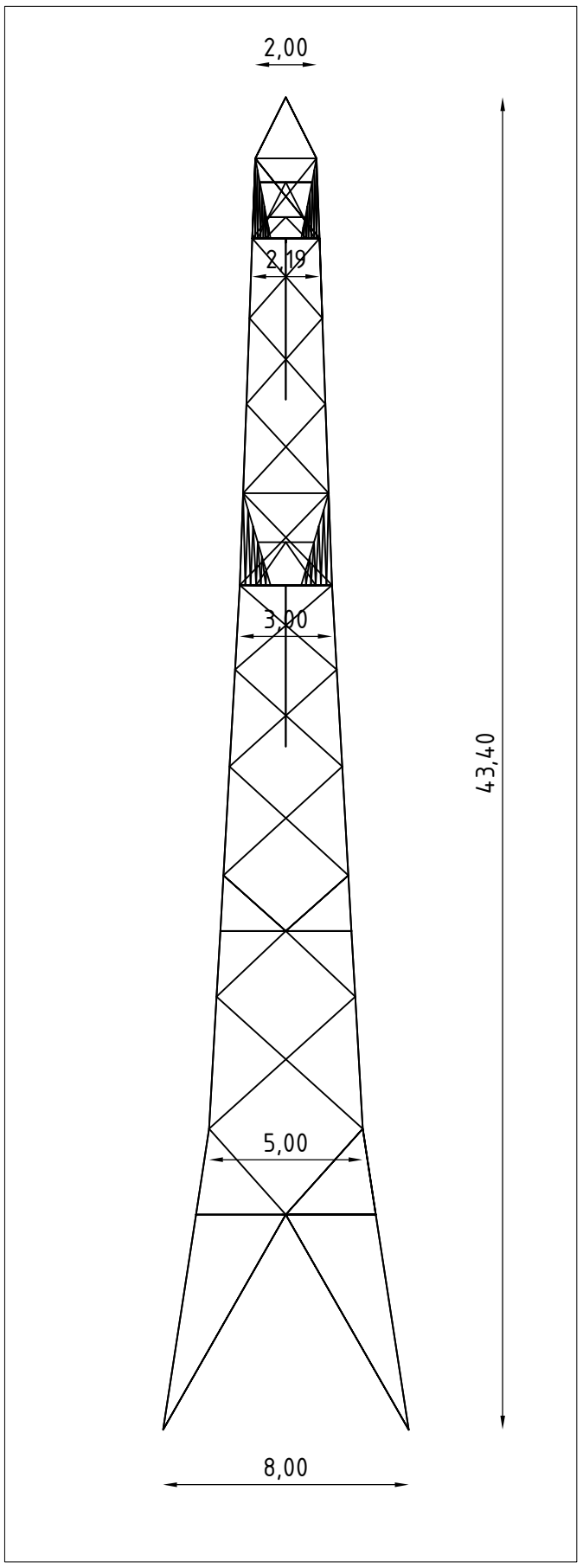


Front View



Side View

Notes and legend:

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- Other changes according to the table
All changes are symmetrical unless otherwise indicated
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- Material quality t > 16mm S355J2
- Bolt quality 8.8 rolled

Profile exchanged
New redundant
Bolt exchanged

01	22-02-2021	Dimension added
00	30-10-2020	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-037

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	22-02-2021	Units:	m	
Checked by:	TBR	22-02-2021	Project no:	10166260	
Approved by:	JHu	22-02-2021	Company:	TenneT	

Description: Modifications overview for mast type S-6_R (Mast 22) page 2 of 2

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Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
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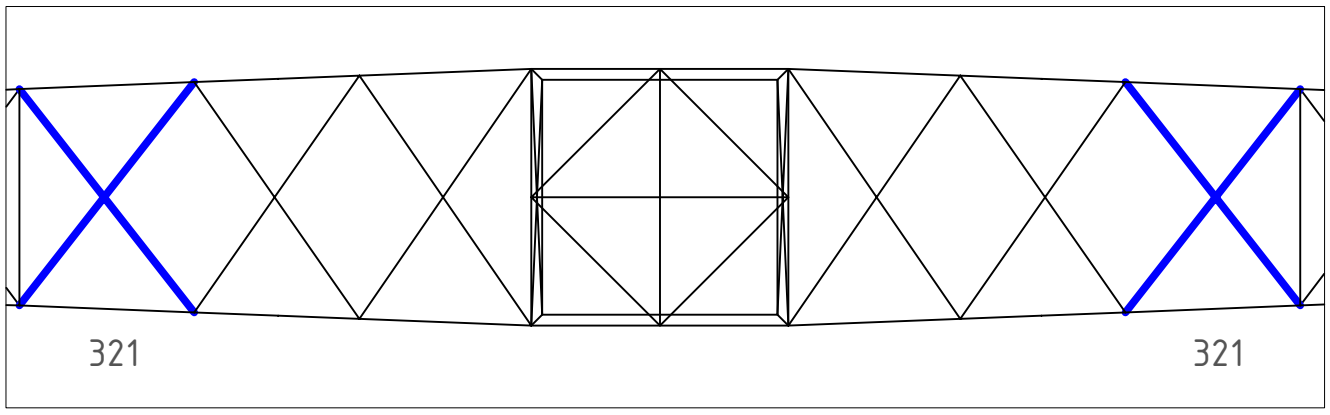
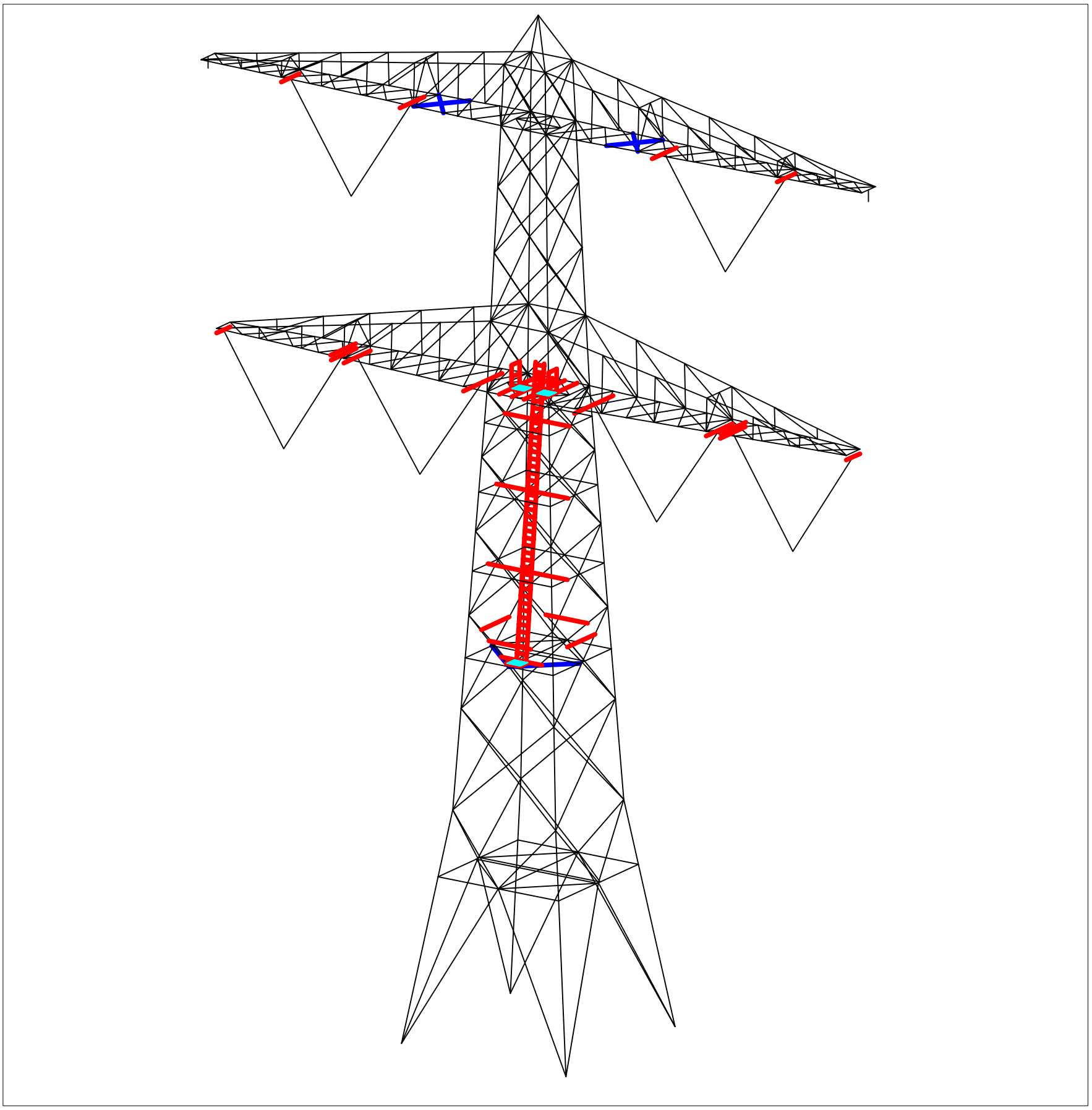


Top View - Upper Crossarm



Overview

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- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Gratings
New profile
Profile exchanged
New redundant
Bolt exchanged

00	22-02-2021	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-061

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	22-02-2021	Units:	m	
Checked by:	TBR	22-02-2021	Project no:	10166260	
Approved by:	JHu	22-02-2021	Company:	TenneT	

Description: Modifications overview for mast type S-6_R (Mast 28) page 1 of 5

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Format: A2

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Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
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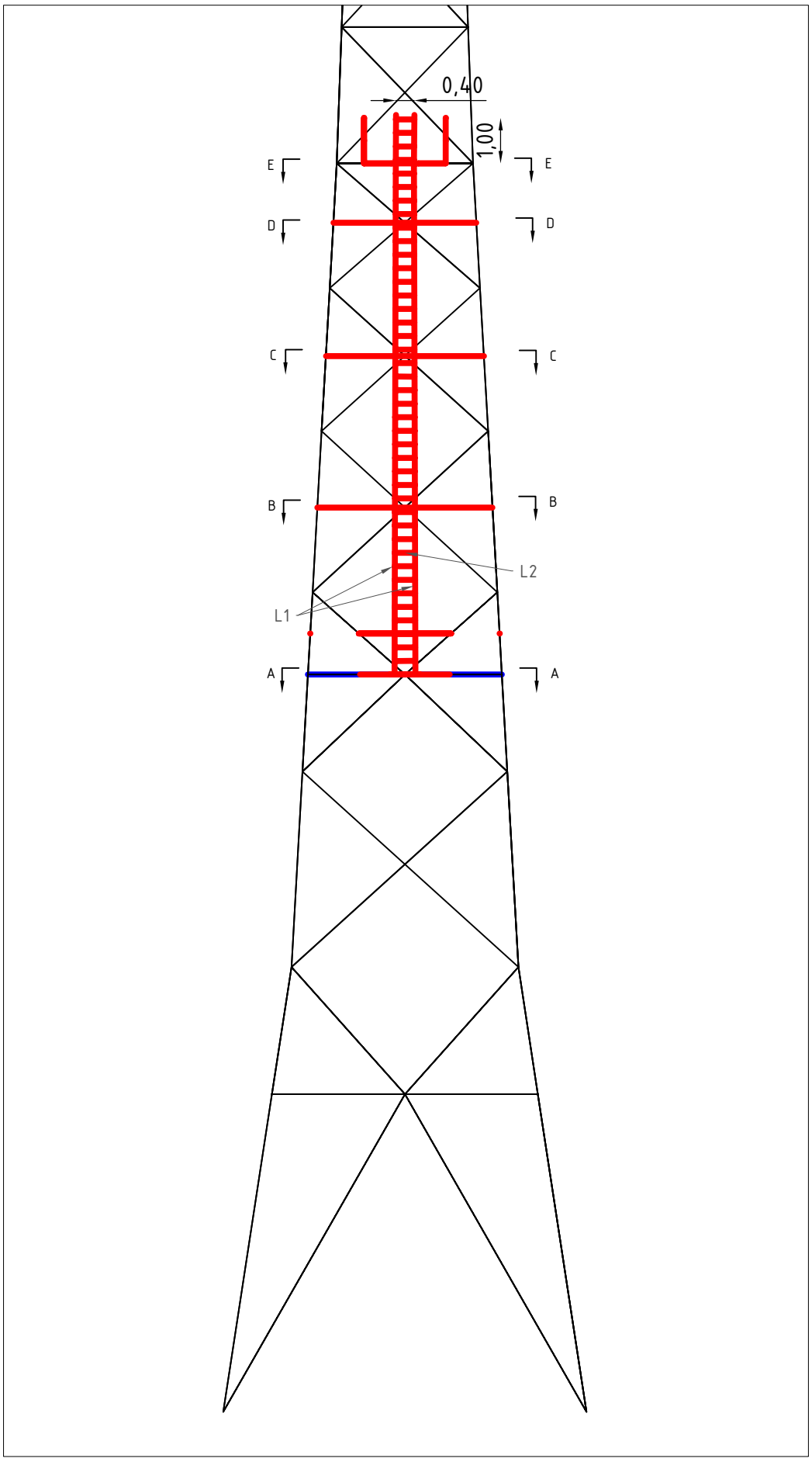
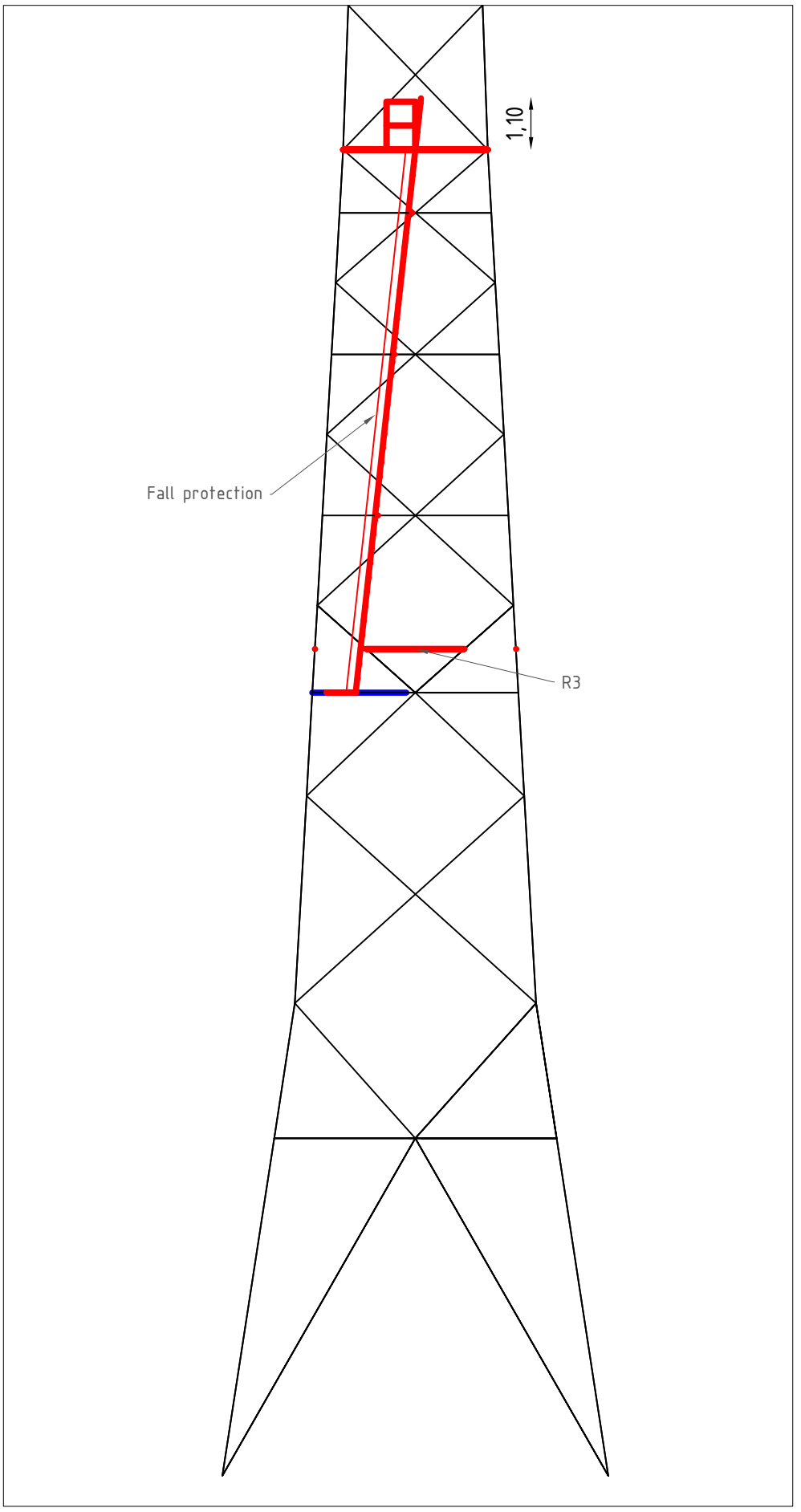
L2					ø	20mm diam	S355 t=<40	
R3					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012



Front View - Climbing Ladder



Side View - Climbing Ladder

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5**
- **Other changes according to the table**
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- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Gratings
New profile
Profile exchanged
New redundant
Bolt exchanged

00	22-02-2021	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-061

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	22-02-2021	Units:	m	
Checked by:	TBR	22-02-2021	Project no:	10166260	
Approved by:	JHu	22-02-2021	Company:	TenneT	

Description: Modifications overview for mast type S-6_R (Mast 28) page 2 of 5

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Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
L3					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
L4					EA	L80x8	S355 t=<40	M16-8.8t-NEN2012
L5					EA	L100x8	S355 t=<40	M16-8.8t-NEN2012
L6					EA	L80x8	S355 t=<40	M16-8.8t-NEN2012
L7					EA	L80x8	S355 t=<40	M16-8.8t-NEN2012
L8					EA	L80x8	S355 t=<40	M16-8.8t-NEN2012
L9					EA	L80x8	S355 t=<40	M16-8.8t-NEN2012
L10					EA	L80x8	S355 t=<40	M16-8.8t-NEN2012
R1					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
R2					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
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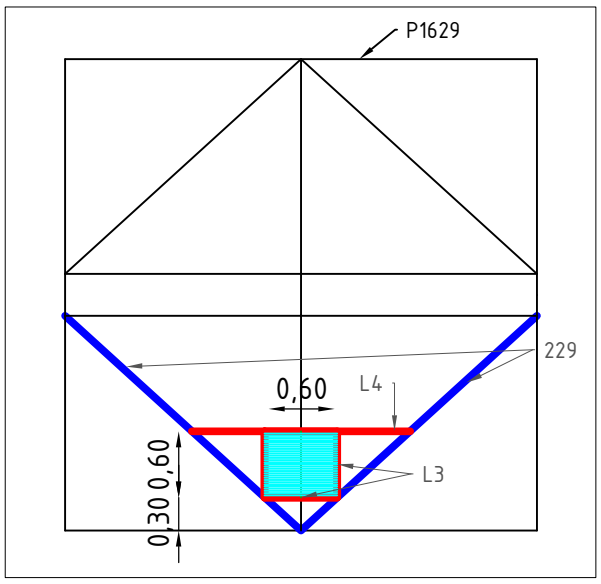

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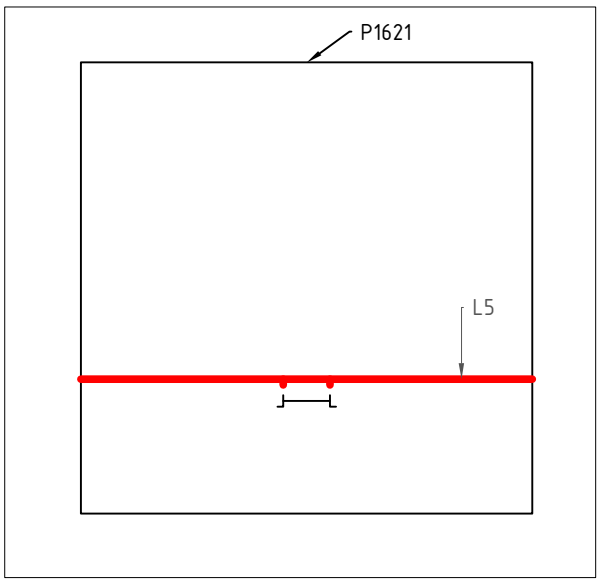

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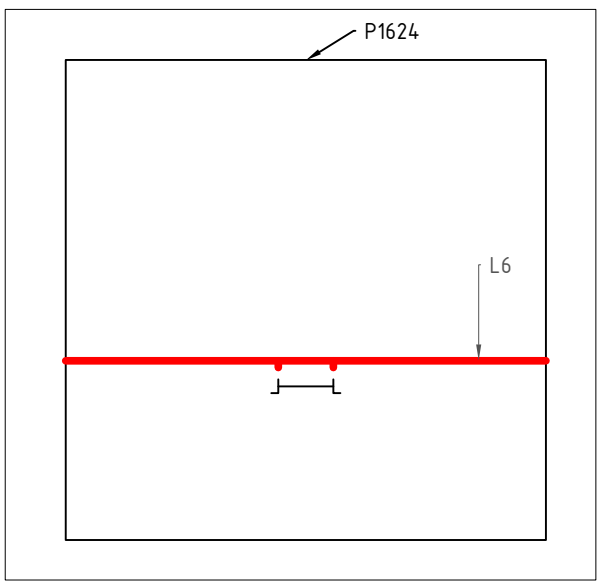

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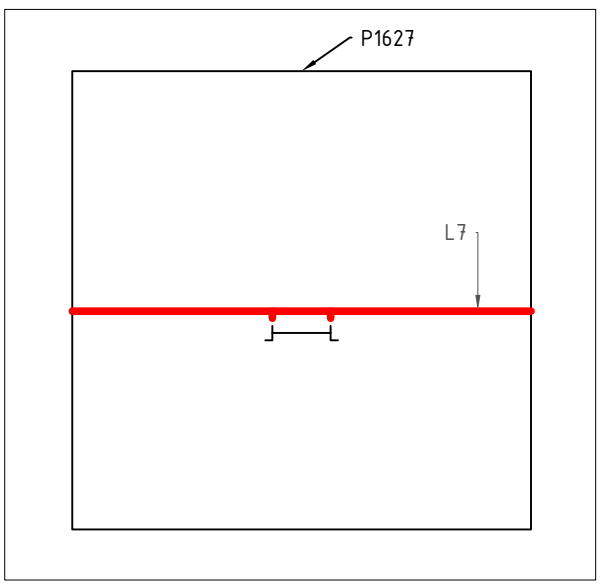

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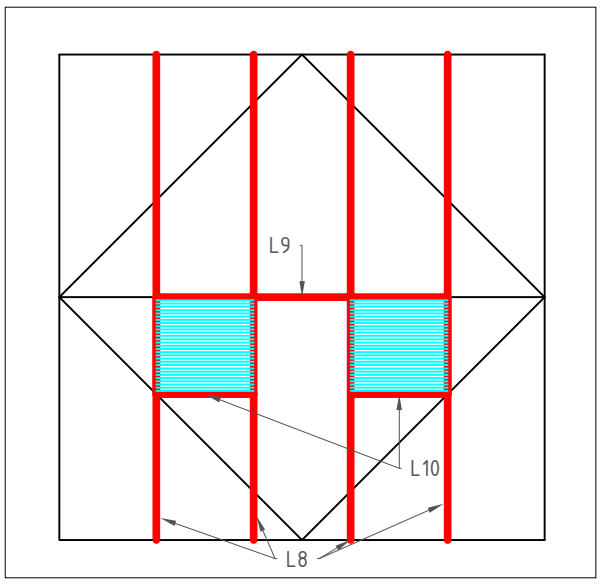

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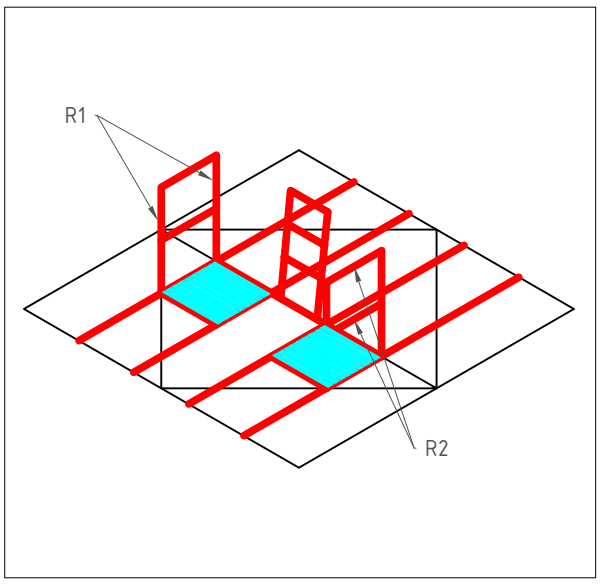

Section E-E Overview

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Gratings
New profile
Profile exchanged
New redundant
Bolt exchanged

00	22-02-2021	Version 1.0

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Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-061

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	22-02-2021	Units:	m	Description: Modifications overview for mast type S-6_R (Mast 28) page 3 of 5
Checked by:	TBR	22-02-2021	Project no:	10166260	Revision: 00
Approved by:	JHu	22-02-2021	Company:	TenneT	Format: A2

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Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
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T3					HEB	HEB160	S355 t=<40	M24-8.8t-NEN2012
T4					HEB	HEB160	S355 t=<40	M24-8.8t-NEN2012
T5					HEB	HEB160	S355 t=<40	M24-8.8t-NEN2012
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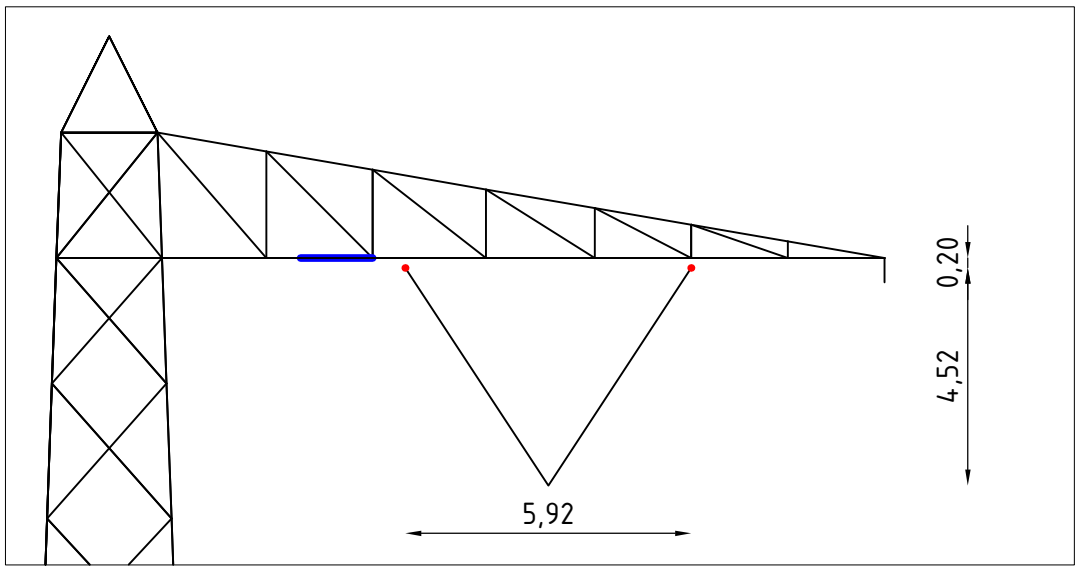
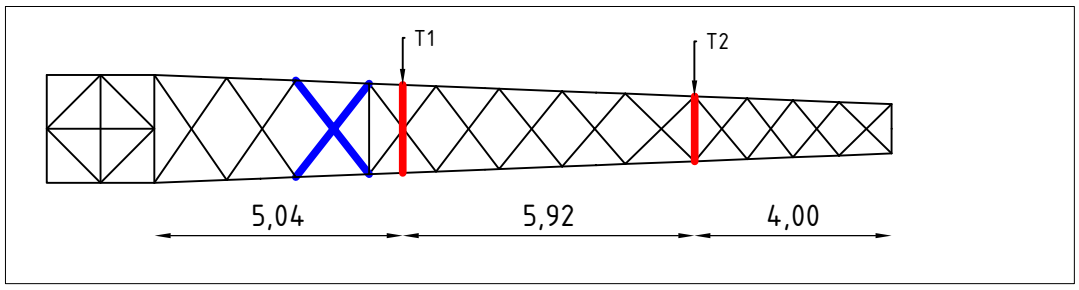
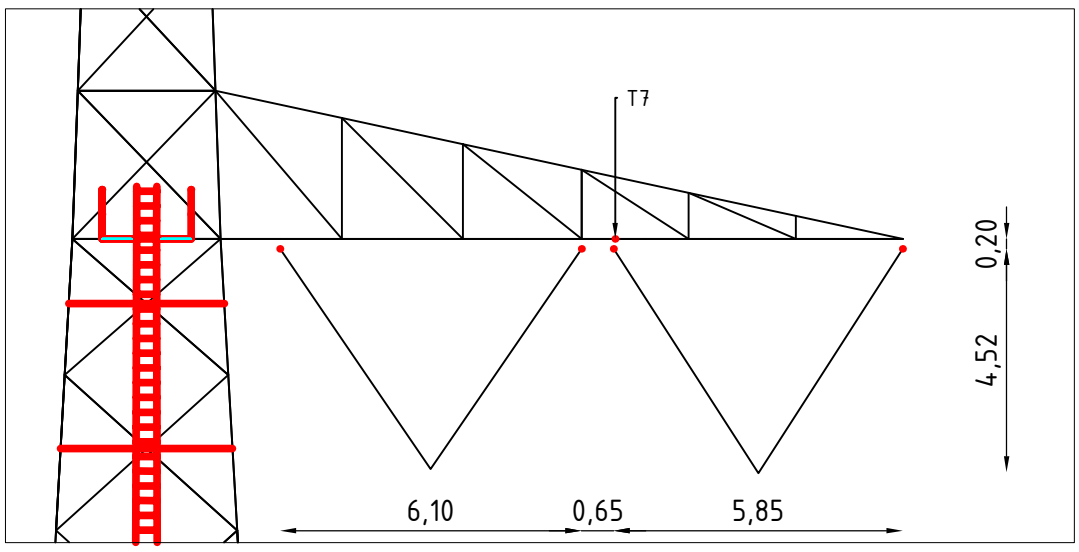


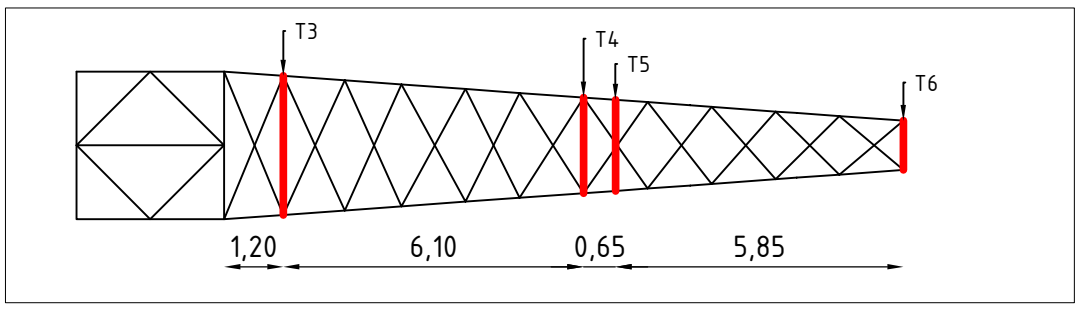
Front View - Upper Crossarm



Top View - Upper Crossarm



Front View - Lower Crossarm



Top View - Lower Crossarm

Notes and legend:

- **New redundants according to drawing**
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- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Gratings
New profile
Profile exchanged
New redundant
Bolt exchanged

00	22-02-2021	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-061

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	22-02-2021	Units:	m	
Checked by:	TBR	22-02-2021	Project no:	10166260	
Approved by:	JHu	22-02-2021	Company:	TenneT	

Description: Modifications overview for mast type S-6_R (Mast 28) page 4 of 5

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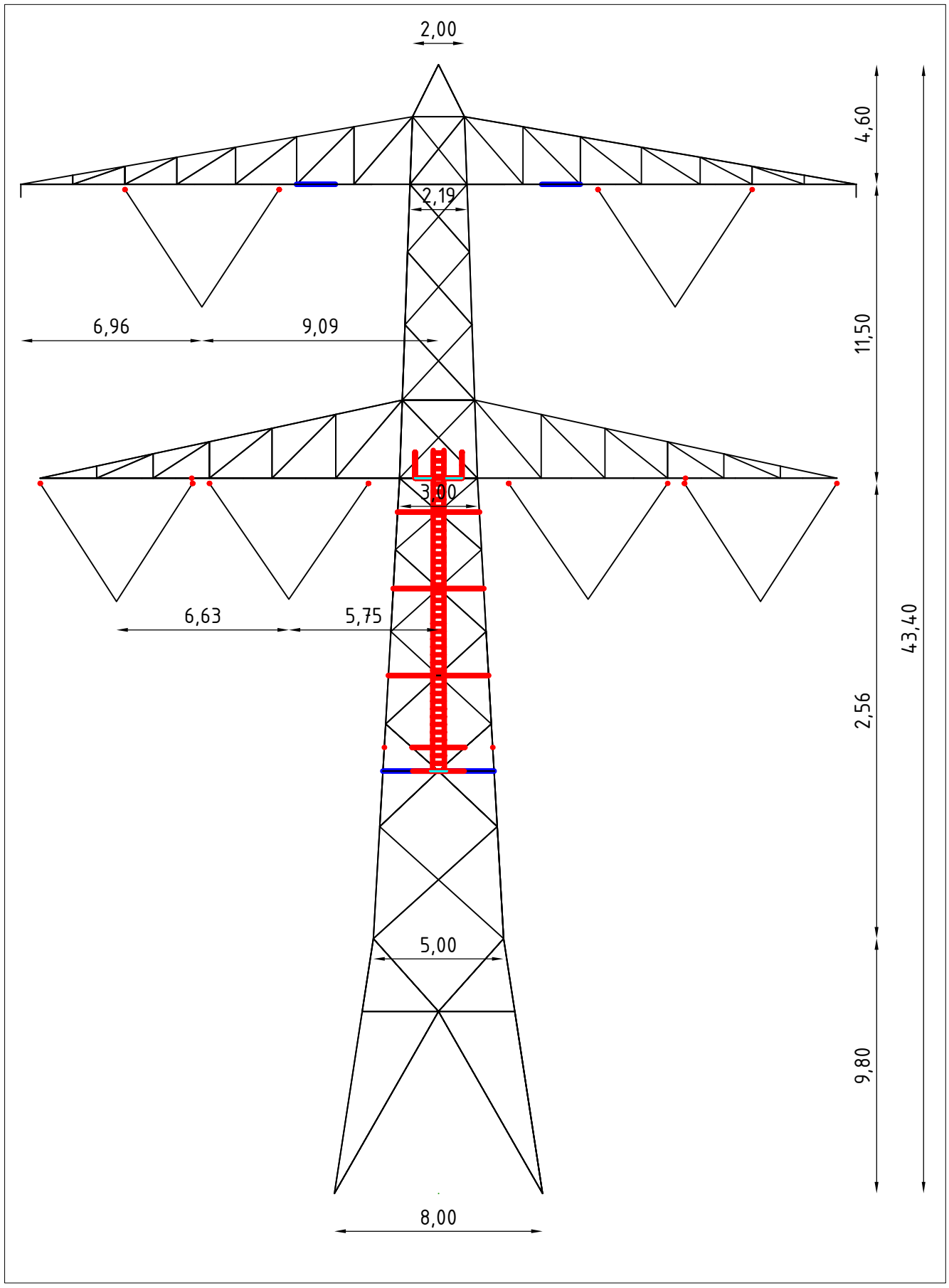
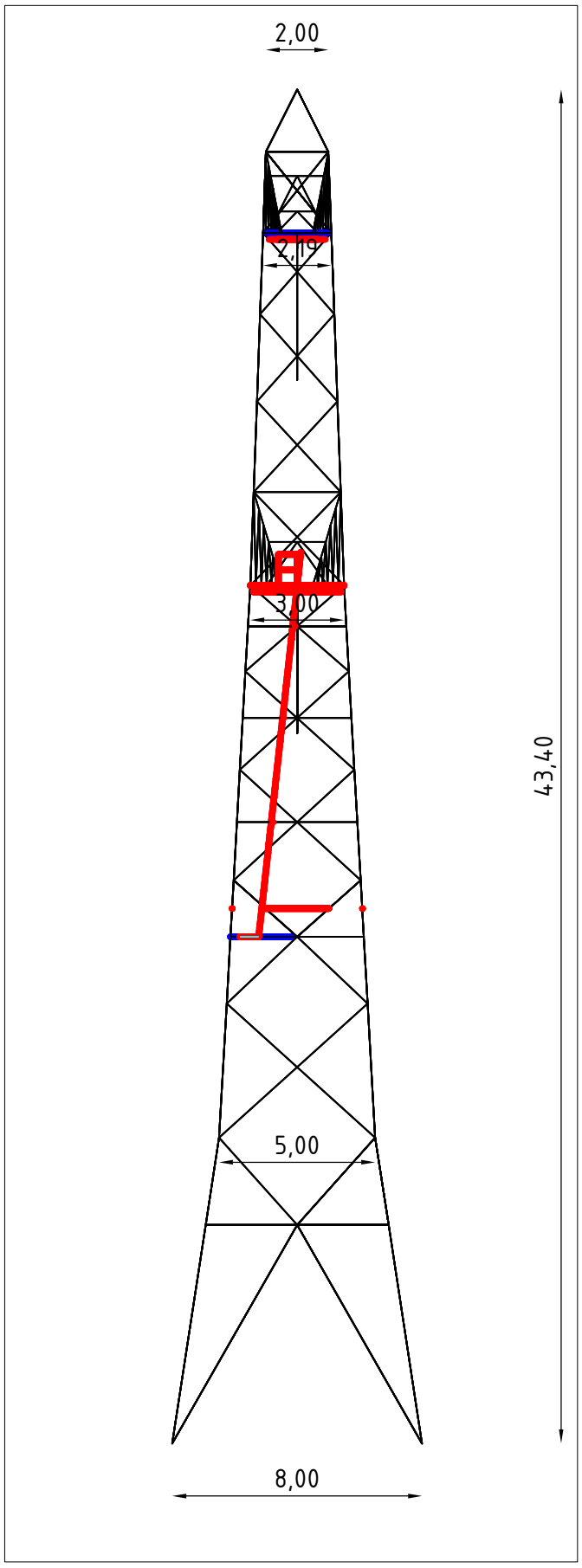


Front View



Side View

Notes and legend:

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Gratings
New profile
Profile exchanged
New redundant
Bolt exchanged

00	22-02-2021	Version 1.0

DNV·GL

Projectname: Mast constructions ENS – ZL 380 kV

Third angle projection:

Drawing no.: 10166260-061

Design state:	FINAL		Scale:	–	
Drawn by:	KCh	22-02-2021	Units:	m	
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Approved by:	JHu	22-02-2021	Company:	TenneT	

Description: Modifications overview for mast type S-6_R (Mast 28) page 5 of 5

Revision: 00

Format: A2

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APPENDIX F
Berekening onderdelen V-fixaties

NEW MEMBERS LOWER CROSS ARM S-6 MAST 28

Contents

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4 RESULTS 8
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1 INTRODUCTION

The mast 28 and 72 is categorized as S-6 T tower in the "ENS ZWL" project. The PLS tower model of the tower with V-ketting configuration is shown in Figure 1. The insulators are changed to V – ketting configuration. There are two sets of the insulator in the bottom cross-arm (referred to as BCA Herforth) and one set in the top cross arm (referred to as TCA here forth).

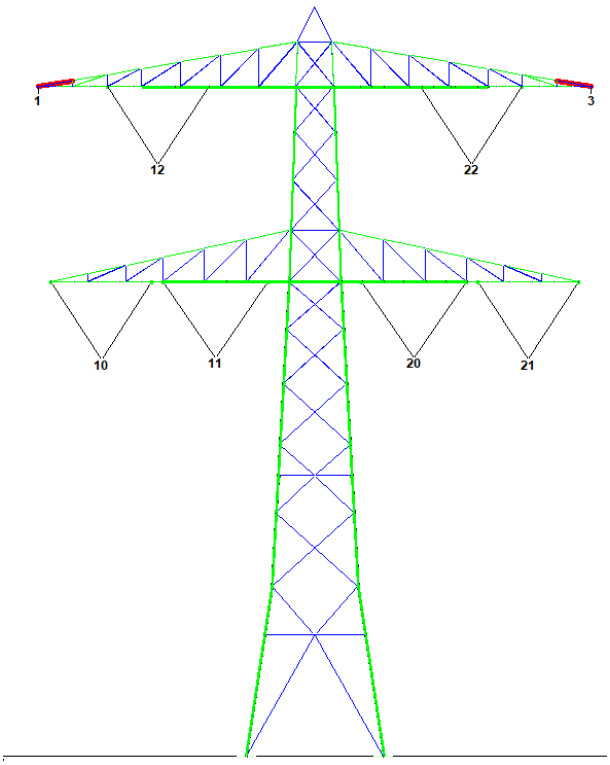


Figure 1 (a) S-6 PLS tower model

Figure 1 was taken from the PLS-Tower application for visualization. The insulators ID's: 10-12 and 20-22 are shown in black in the figure. The earth wire location is indicated by 1 and 3. The following report explores the effect of bending in the bottom chord of the cross-arms of the S-6 tower. The report highlights the geometry and the loading on the cross arm. The cross arms are analysed in isolation with the rest of the tower body. The report further compares the forces developing the cross arm with a focus on the bottom chord due to the bending forces induced by conductor loading via an insulator. Furthermore, the H beams housing the insulators are checked for torsion. The efficacy of the H – beams are checked as per EC-3. Axis VM report is attached as " Appendix – report AXIS-VM".

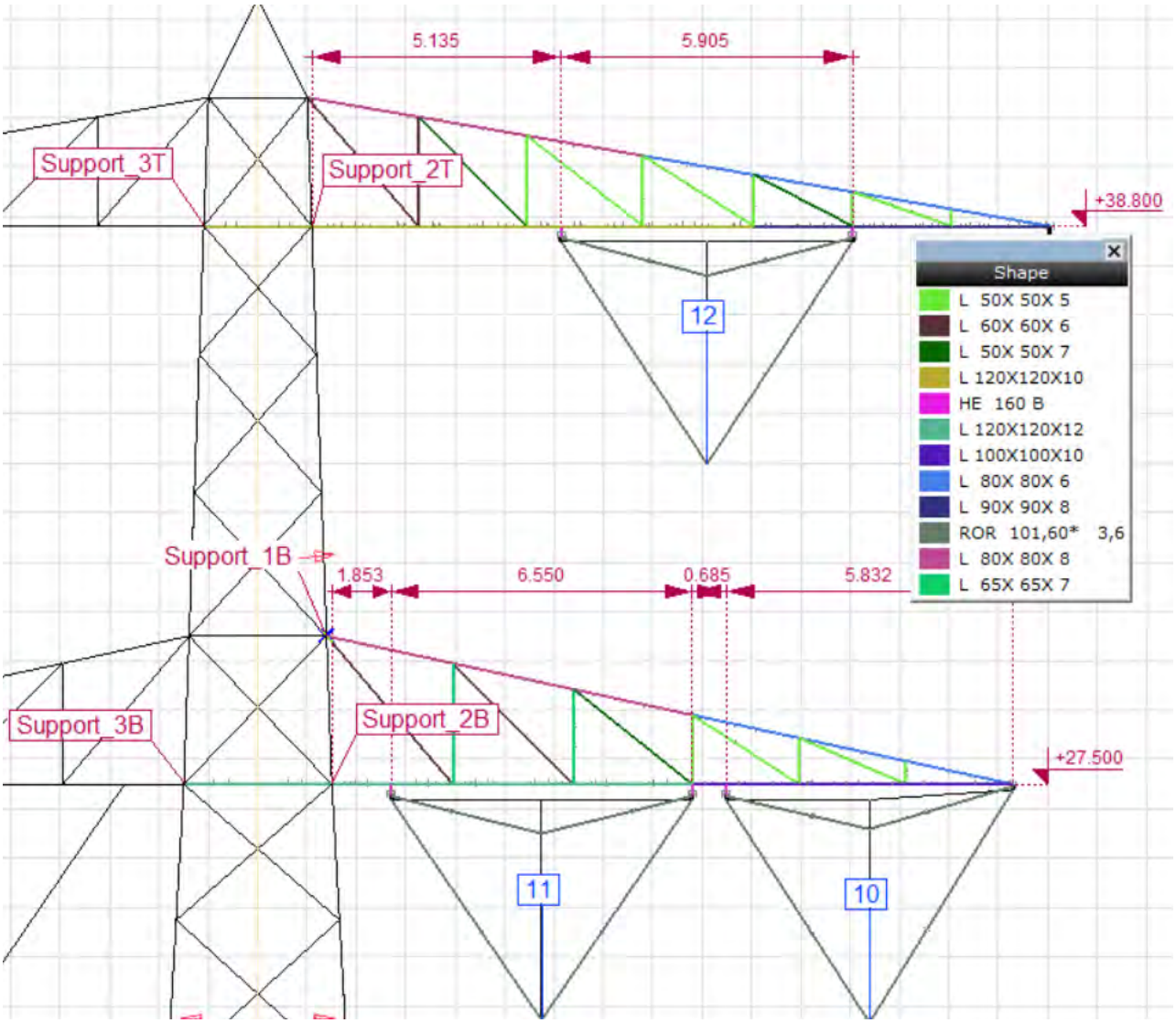


Figure 2 Location of the v-ketting insulator assembly in S-6 tower

Figure 2 shows a side view of the cross-arms. The figure also shows the V-ketting insulators marked in blue boxes. The no.s will be used to refer to the insulators in this report here forth.

2 GEOMETRY

To support the new location of the insulator additional members are added below the bottom chord. The newly added geometry is been shown in Figure 3. It also highlights the cross-section properties of these members. The v-ketting isolators have been modelled as Φ-101x3.6 mm bars.

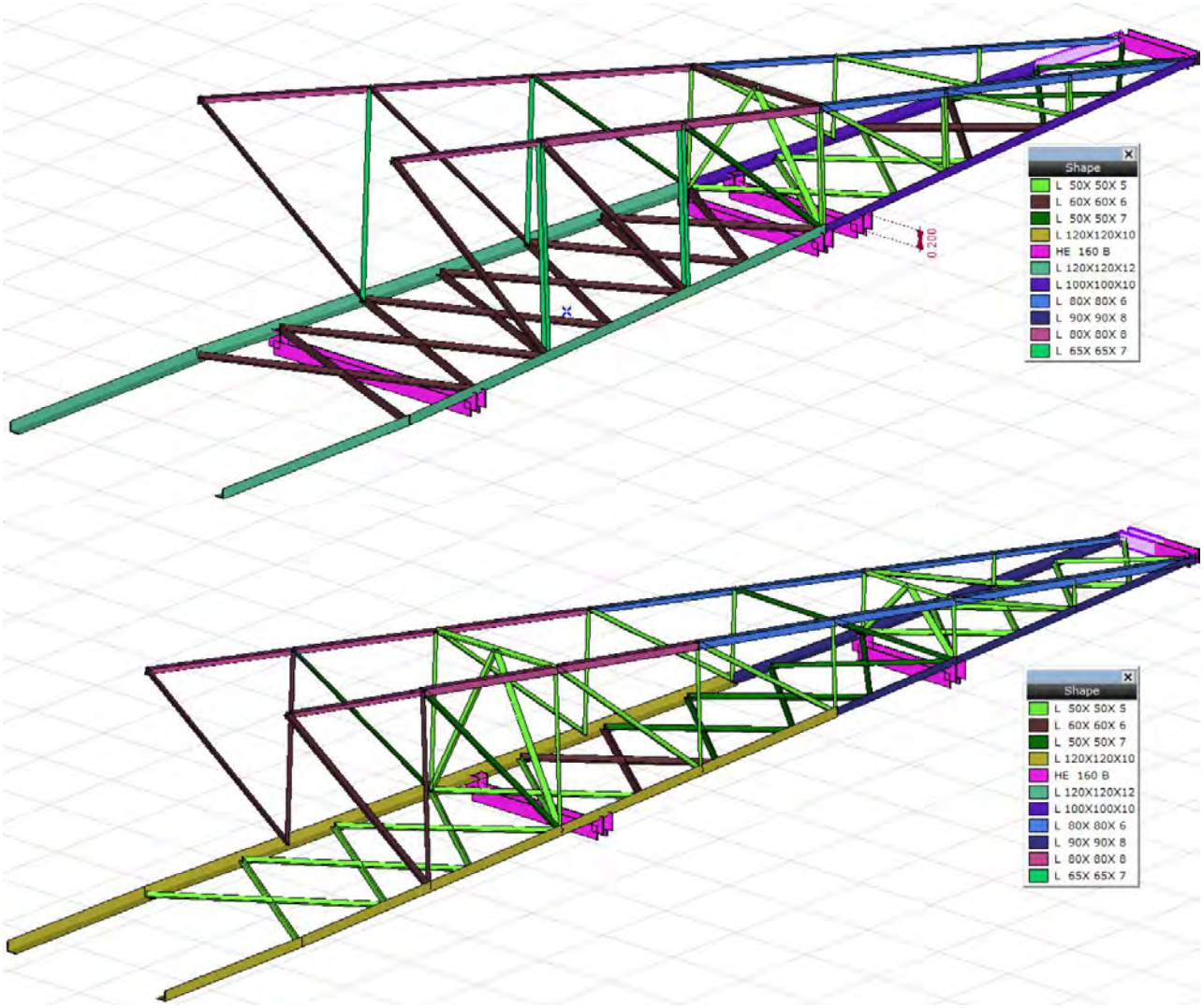


Figure 3 3D rendered geometry of the Cross arm.

Figure 4 shows the elevation 3d render of the cross arm. The V-ketting insulators are attached to an HEB 160 steel beam. The HEB 160 beams are in purple. They are located below the plane of the bottom chord with an offset of 200mm roughly. Figure 4 shows an image of the attachment point of an isolator. The centre lines of the bottom chord, H beam and in-plane hinge of the isolator is shown via white, yellow and red lines. The distance between the H beam (yellow) and the hinge (red) is 70+45 = 115 mm. The above-explained offsets were incorporated in the axis VM model via dummy elements with HEB 160 profile. The figure shows the H beams with relevant offsets. The isolators are hinged at the attachment points. This is in conjunction with the in-plane swing mechanism of the isolators. The v-ketting swing out of plane about a swing which is 45 mm the centre of the H beam.

The bottom chords are assumed to be continuous members. This assumption mandates that the connection at the transition of cross-section profiles in the top and bottom chords are capable of

transferring moments. As a precautionary measure, the moments at and near the transition point need to be kept to a minimum.

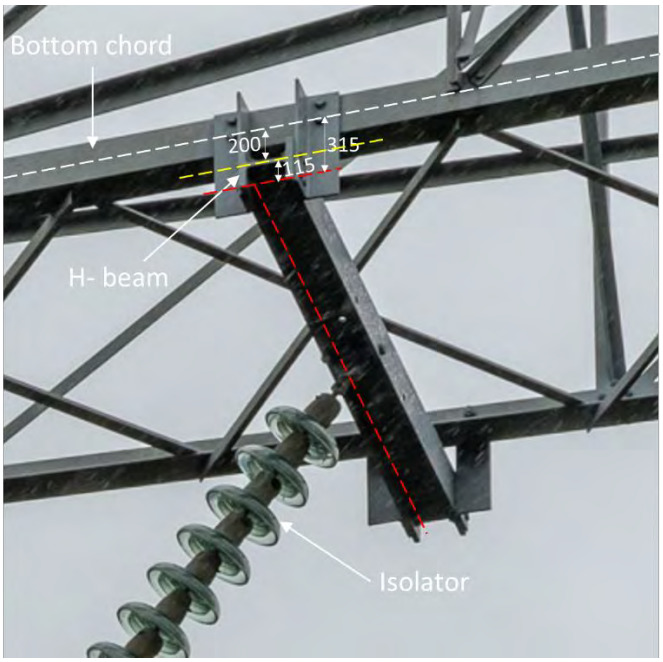


Figure 4 Zoomed image of isolator attachment point in S+6 tower.
The members of the cross arms expect the top and bottom chord is given release for rotation at both of their ends. This is done to simulated simple moment free joints. The release is shown in figure 2.

2.1 Supports

Only the cross arm of the tower is considered in isolation in this study. This assumes that the existing cross arm will be safe and the internal forces in it will not change a lot. Thus, the change in isolators will not have a global effect and only the new members required to connect the repositioned isolators to the cross arm need to be checked for efficacy. The part cross-arm is modelled and its connections with leg members are constrained (supported) as given in Table 1. The support_1 and support_2 are the connections of the bottom chord with the tower leg. Support_3 is the connection point between the top chord and tower leg. The B and T at the stands for the bottom and Top cross arms.

Table 1 Details of supports of the cross-arm model

ID	Node	K_x [kN/m]	K_y [kN/m]	K_z [kN/m]
Support_1B	22	1.00E+10	1.00E+10	1.00E+10
Support_1B	25	1.00E+10	1.00E+10	1.00E+10
Support_1T	3	1.00E+10	1.00E+10	1.00E+10
Support_1T	4	1.00E+10	1.00E+10	1.00E+10
Support_2B	26	1.00E+10	–	1.00E+10
Support_2B	29	1.00E+10	–	1.00E+10
Support_2T	7	1.00E+10	–	1.00E+10
Support_2T	8	1.00E+10	–	1.00E+10
Support_3T	6	–	1.00E+10	1.00E+10
Support_3T	9	–	1.00E+10	1.00E+10

Support_3B	27	–	1.00E+10	1.00E+10
Support_3B	28	–	1.00E+10	1.00E+10

3 LOADING

The loads are applied in the Axis VM model for the critical load cases. The loads are in conjunction with the loads applied in the PLS Tower model for the existing model. The loads are applied at the tip of the V-ketting isolators. The ID of the isolator is given in figure 2. The ID is matched with the PLS tower model. The ID of the isolators is used to identify and load the cross arms in Axis VM. The name of the load cases in the AxisVM model is also consistent with their counterparts in the PLS tower model. Furthermore, extra load cases are developed for ULS 1a_90 and ULS_3_90 with the angle at the end being 270. The direction of horizontal loads is reversed for these cases. Load case 1 is the worst wind and self-weight of the cross arm. Load case 3 has loaded from both self-weight, wind and ice with relevant partial load factors. Load case 5a is the special case, for the failure in the conductor. The conductor failure in conductor 20, 21 and 22 along with failure in earth conductor is simulated in Axis VM simulation. Table 2 shows the details of the individual load cases. Table 2 refers to the position of the isolator being the default or broken. The position of the isolator in case of the conductor being intact on both side (default and operating situation) by box b in figure 5. The position of the isolator when the conductor fails on 1 side is shown by box A in magenta in the figure below.

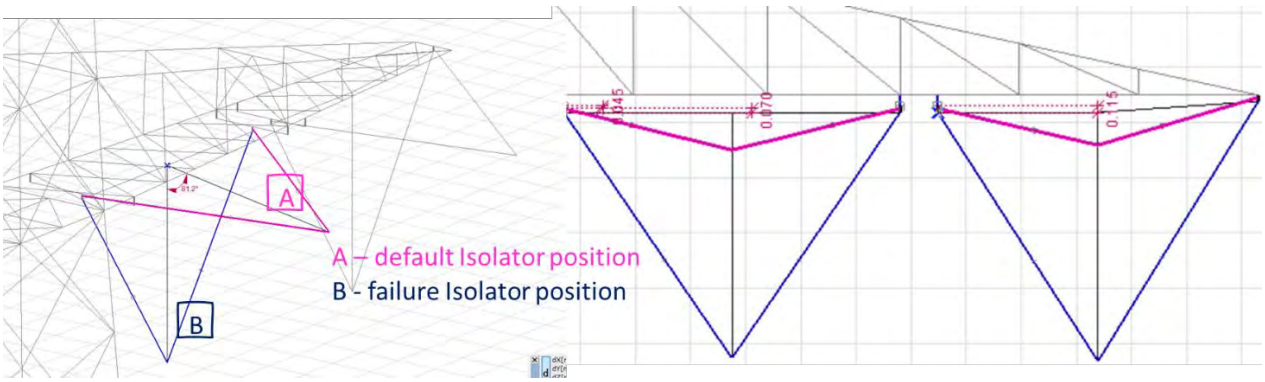
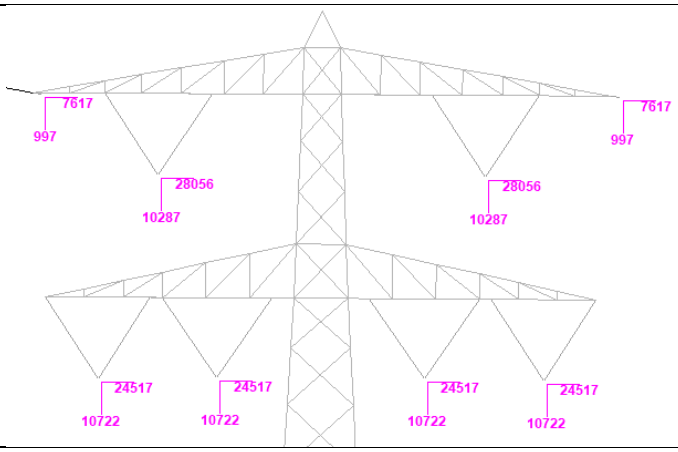
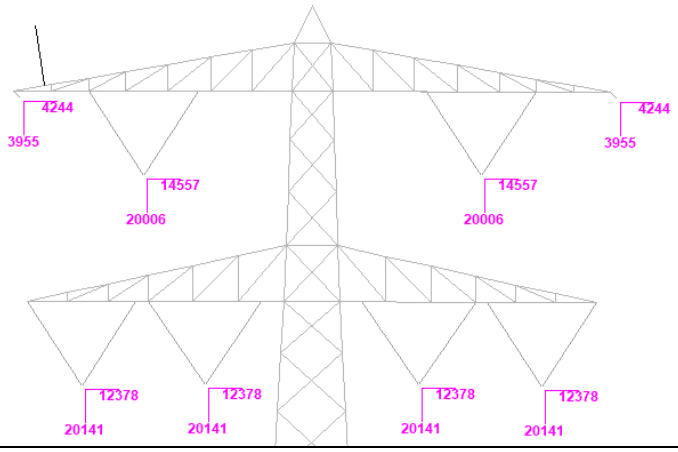
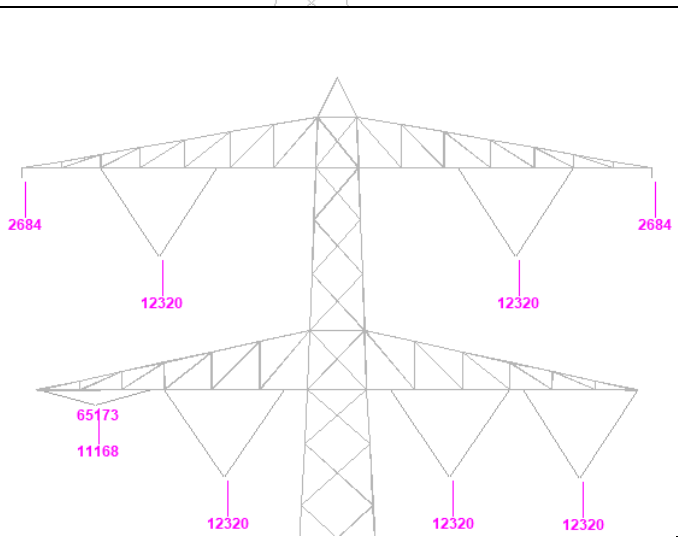
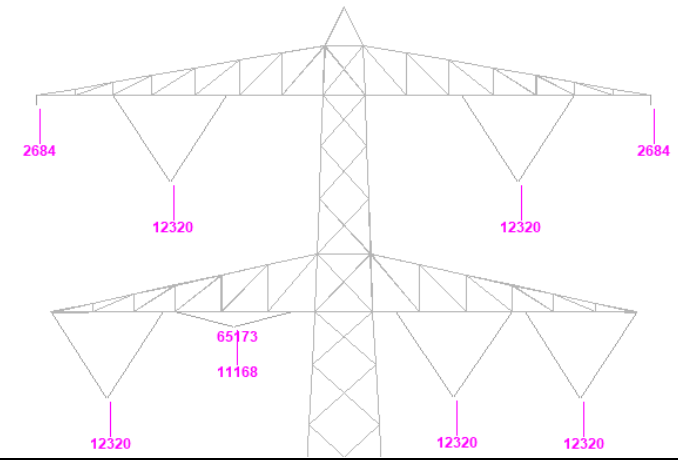
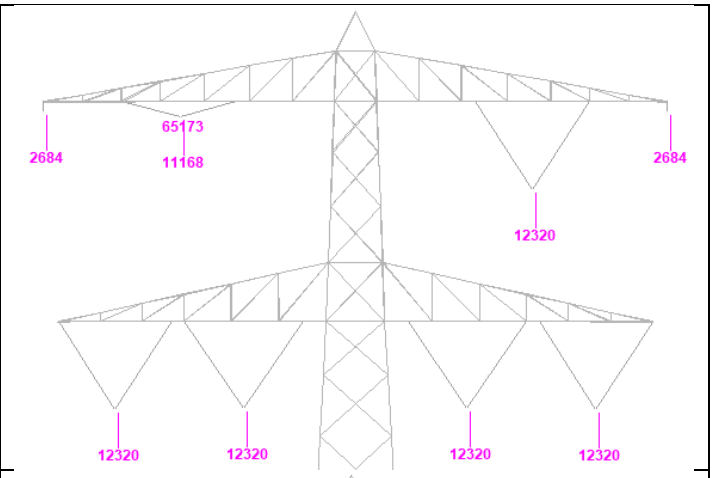
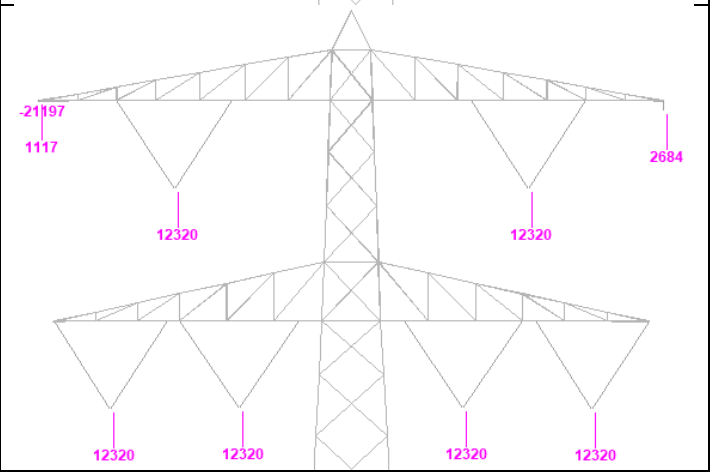


Figure 5 position of the isolators in working and broken conductors

Table 2 Details of load cases

Sr. No.	Load Case	Particular	The load applied in the PLS tower model
1	03 ULA 1a_90: isolator position B	Wind load – Critical for the max horizontal load. The isolators are modelled and thus the loads are applied at the tip of the v-ketting	

2	15 ULA 3a_90 (max – vertical load): isolator position B	Ice + wind – load case for the critical vertical load. Read the previous para for its application in the axisVM model.	
3	33 ULS 5a Ba 20: isolator position A only for isolator 20.	Failure of the conductor – 20 and 12: The load on the isolator with broken conductor 20 is applied at the isolator position shown in box A. The 150kV conductor in the bottom cross-arm fails. The rest of the loads are applied at the default isolator tip.	
4	34 ULS 5a Ba 21: isolator position A only for isolator 21.	Failure of the conductor - 22 and 11. The 380 kV conductor in the bottom cross-arm fails.	

5	35 ULS 5a Ba 22: isolator position A only for isolator 22.	Failure of the conductor - 22 and 10.	
	23 ULA 5a Ah 1:	Failure of earth conductor.	

Self-weight for the cross arms is applied in the load case EG. The load cases are applied. The loads in table 2 are combined with self-weight with factor 1.

4 RESULTS

4.1 H beams in torsion:

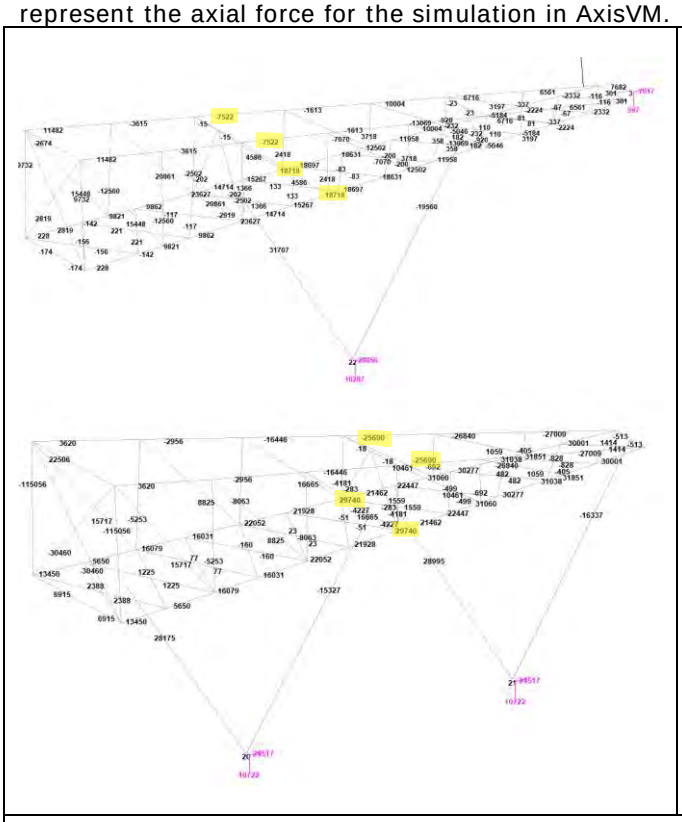
The HEB 160 beams are checked for the combined action of torsion and bending. Axis VM does not calculate the warping moments due to torsion. Therefore, the calculation shown in Figure 6 is used to verify the efficacy of the H beams under torsion. The location of the H beam is determined via the isolator it's housing. The beam ID of axis Vm is given to correlate to the detailed output in the axis VM report. The stress for bending and torsion are added and the max stress in the beams is 181 N/mm^2. Thus, the utility ratio is 0.54. There is ample reserve strength for the stability of the beams.

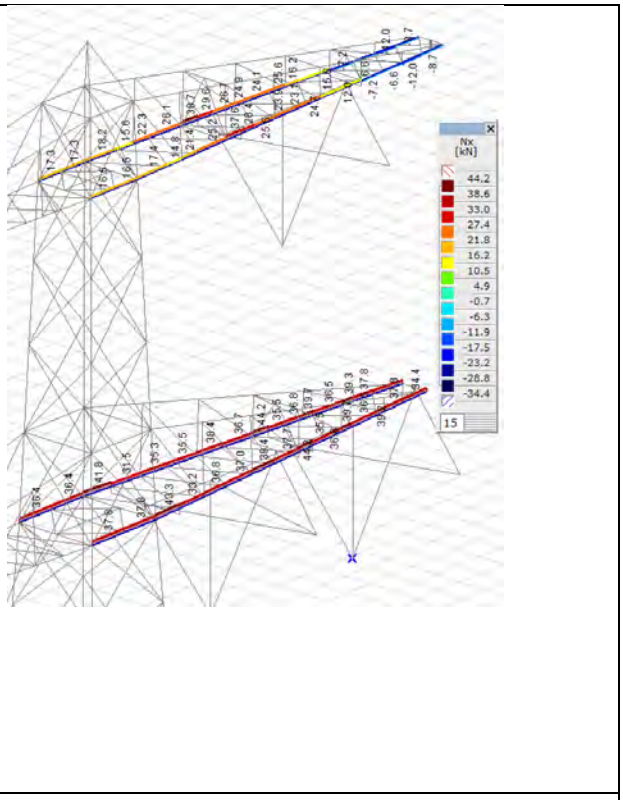
Axis VM ID		238,239	236,248	234,235	239,230	240,241	249,250	
Conductor ID		21	21	20	20	22	22	
position		left	right	left	right	left	right	
Profile of beam		HEB 160	HEB 160	HEB 160	HEB 160	HEB 160	HEB 160	
$M_{w,Ed}$ =								
$M_{y,Ed}$ =		11.5	8.8	9.4	6.2	9.5	6.9	*kNm*
$M_{z,Ed}$ =		15.8	11	9.7	5	9.8	7.5	*kNm*
Torsion =		0.3	0.37	0.92	0.89	0.83	0.83	*kNm*
Orientation of beam		z-as	z-as	z-as	y-as	y-as	y-as	
Torsional moment	T	0.30	0.37	0.92	0.89	0.83	0.83	*kNm*
Beams								
Beam length	L	3600	987	3748	3000	3000	3000	*mm*
Yield stress	f_y	355	355	355	355	355	355	*Mpa*
Elastic modulus	E	210000	210000	210000	210000	210000	210000	*Mpa*
Shear modulus	G	81000	81000	81000	81000	81000	81000	*Mpa*
Profile		HEB 160	HEB 160	HEB 160	HEB 160	HEB 160	HEB 160	
		HEB160	HEB160	HEB160	HEB160	HEB160	HEB160	
Height	h	160	160	160	160	160	160	*mm*
Width	b	160	160	160	160	160	160	*mm*
Web thickness	t_w	8.0	8.0	8.0	8.0	8.0	8.0	*mm*
Flange thickness	t_f	13.0	13.0	13.0	13.0	13.0	13.0	*mm*
Torsional constant	I_t	31	31	31	31	31	31	mm^4
Warping constant	I_{wa}	47943	47943	47943	47943	47943	47943	mm^6
Moment of inertia	I_y	2492	2492	2492	2492	2492	2492	mm^4
	I_z	889	889	889	889	889	889	mm^4
Flange stiffness	$I_f = I_z / 2$ =	445	445	445	445	445	445	mm^3
Moment of resistance	$W_{y,el}$	311	311	311	311	311	311	mm^3
	$W_{z,el}$	111	111	111	111	111	111	mm^3
Torsional bending constant	d	630	630	630	630	630	630	*mm*
	L/d	5.7	1.6	5.9	4.8	4.8	4.8	
	α	0.5	0.5	0.5	0.5	0.5	0.5	
Acting moments:								
$M_{w,Ed} = E \cdot I_f \cdot (h-t_f) \cdot \phi'' / 2$ =		0.6	0.5	2.0	1.9	1.8	1.8	*kNm*
$M_{y,Ed} = 1/4 \cdot F \cdot L$ =		11.5	8.8	9.4	6.2	9.5	6.9	*kNm*
$M_{z,Ed} = 1/4 \cdot F \cdot L$ =		15.8	11.0	9.7	5.0	9.8	7.5	*kNm*
Capacities of beams:								
$M_{w,Rd} = W_{z,el} \cdot f_y / 2$ =		19.7	19.7	19.7	19.7	19.7	19.7	*kNm*
$M_{y,Rd} = W_{y,el} \cdot f_y$ =		110.6	110.6	110.6	110.6	110.6	110.6	*kNm*
$M_{z,Rd} = W_{z,el} \cdot f_y$ =		39.5	39.5	39.5	39.5	39.5	39.5	*kNm*
Combined check of beam:								
UC		0.54	0.38	0.43	0.28	0.42	0.34	
Displacements:								
Factor F_{ed} / F_k		1.2	1.2	1.2	1.2	1.2	1.2	
Displacement y-direction	u_y	2.72	0.14	1.81	0.60	1.17	0.90	*mm*
Relative displacement	rel.	1325	6941	2073	5024	2563	3349	-
Displacement z-direction	u_z	5.54	0.32	4.91	2.08	3.18	2.31	*mm*
Relative displacement	rel.	650	3096	763	1446	944	1299	-

Figure 6 HEB 160 beams checked for torsion

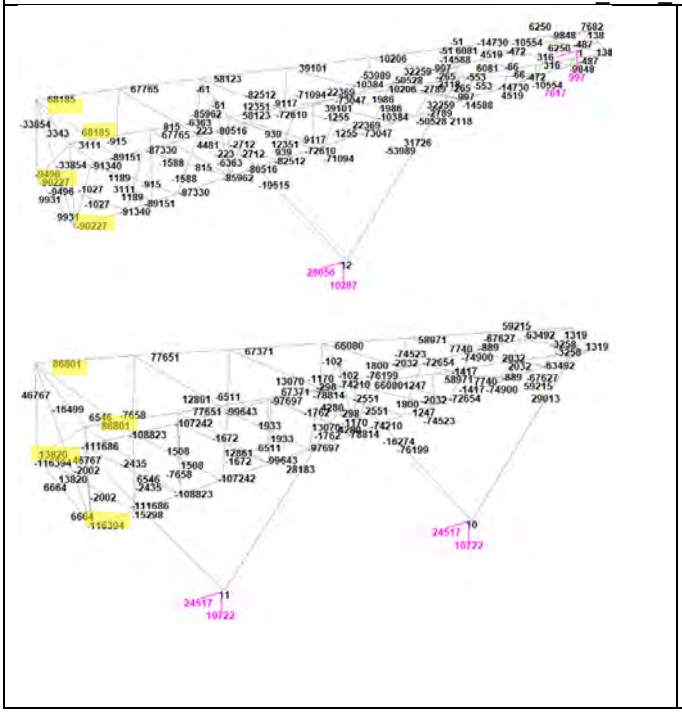
4.2 Comparison of the bottom chord with PLS-TOWER results

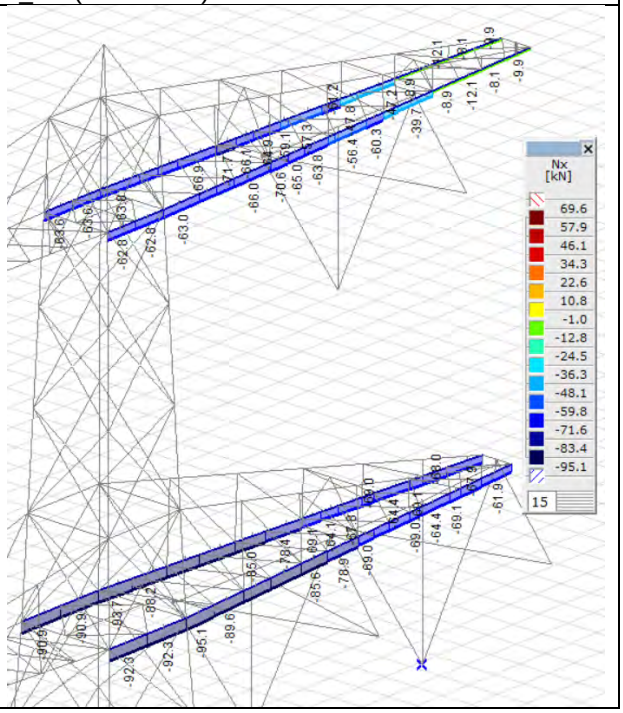
The existing model was analyzed in the PLS Tower application. This application can analyze the structure as a truss member and hence gives only axial forces as the output. Maximum compression occurs in the bottom chord and is also the most critical element in the structure. The axial force in the arms for the load 1) 03 ULA 1a_90, 2) 15 ULA 3a_90, 3) 33 ULS 5a Ba 20, 4) 34 ULS 5a Ba 21 and 5) 35 ULS 5a Ba 22 for PLS-TOWER and AxisVM is given in Figure 7. The compressive force has a negative sign. The Figures on the left are for the existing situation from the PLS Tower model while the ones on the right represent the axial force for the simulation in AxisVM.



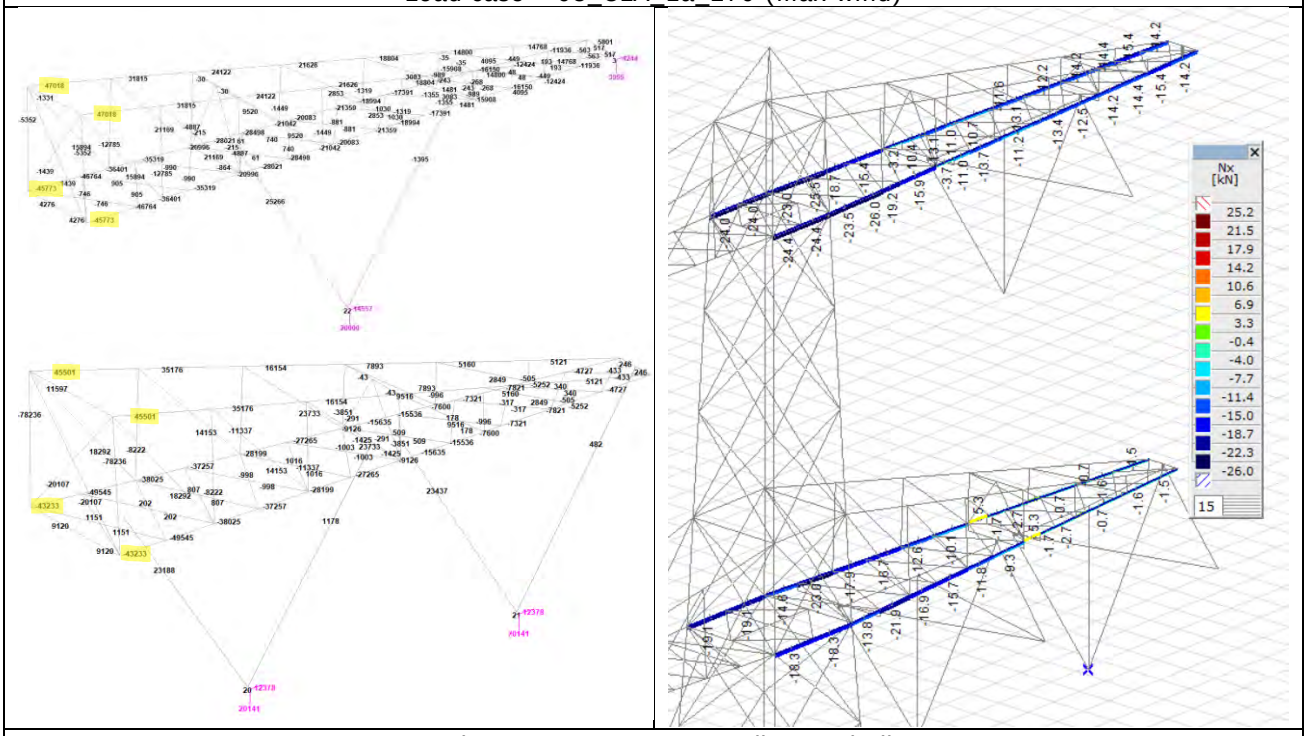


Load case – 03_ULA_1a_90 (max wind)

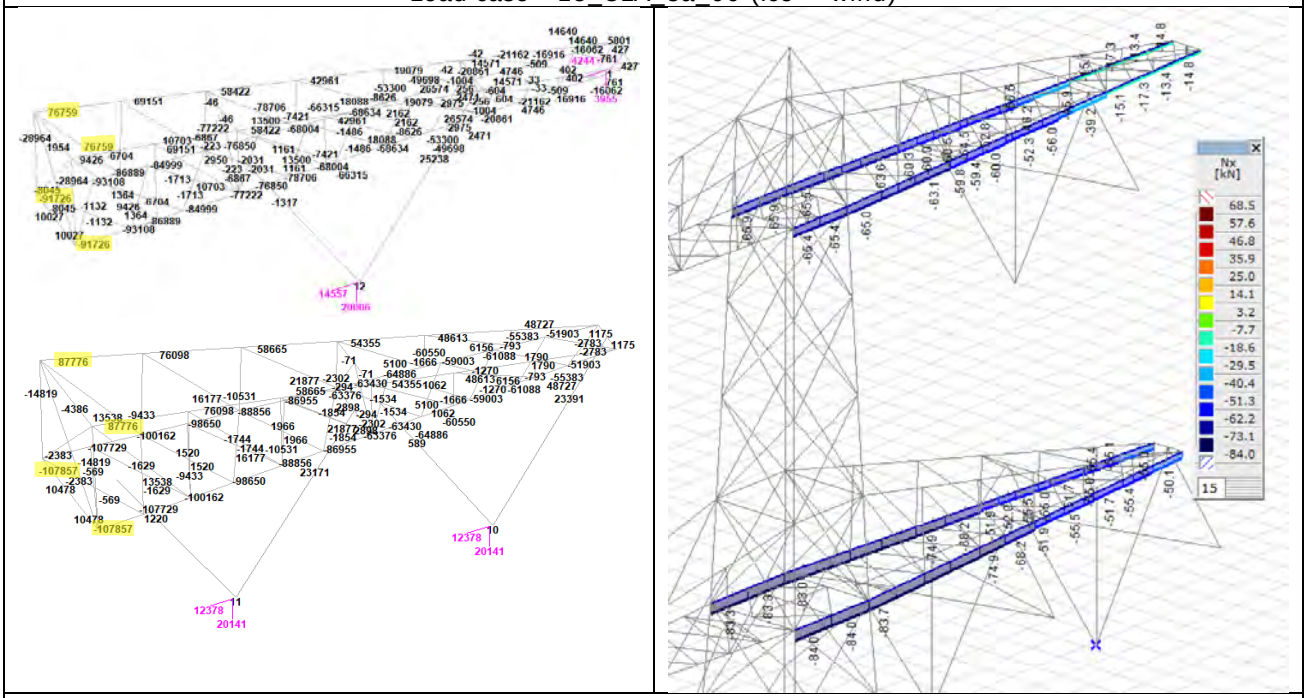




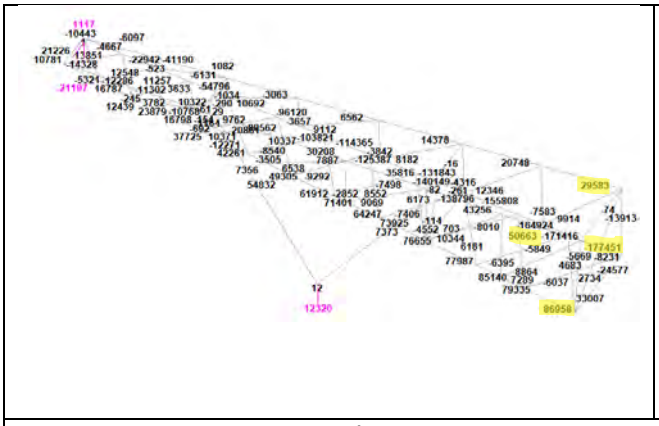
Load case – 03_ULA_1a_270 (max wind)

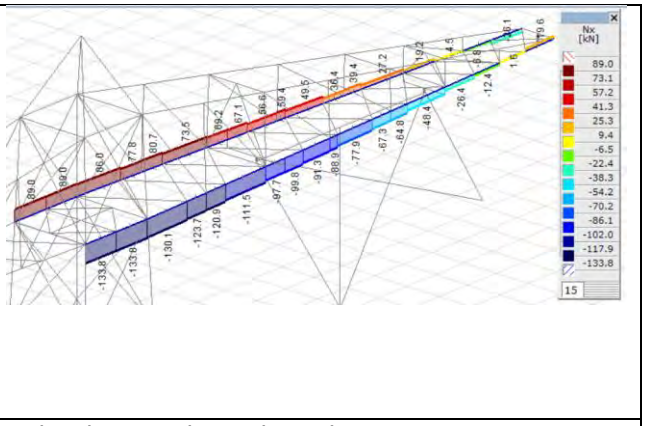


Load case - 15_ULA_3a_90 (ice + wind)

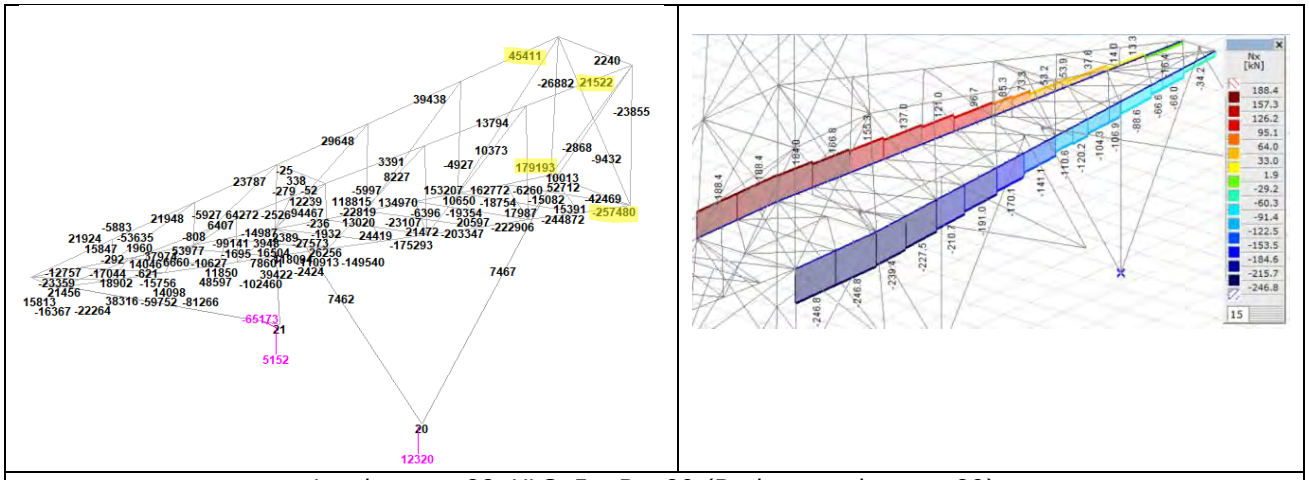


Load case - 15_ULA_3a_270 (ice + wind)

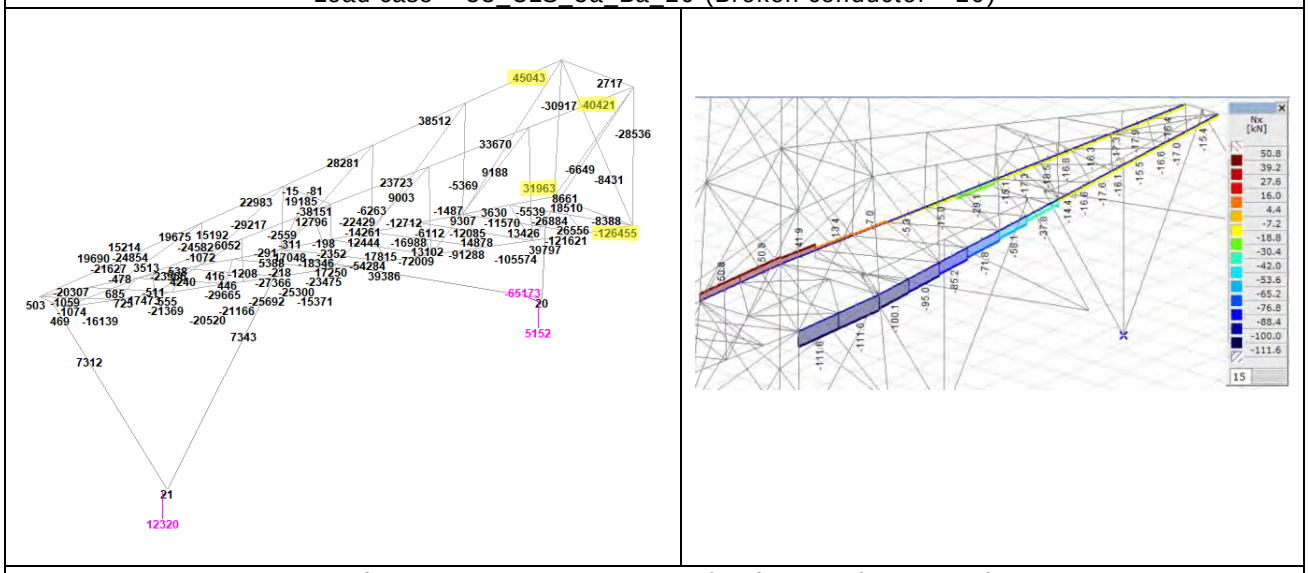




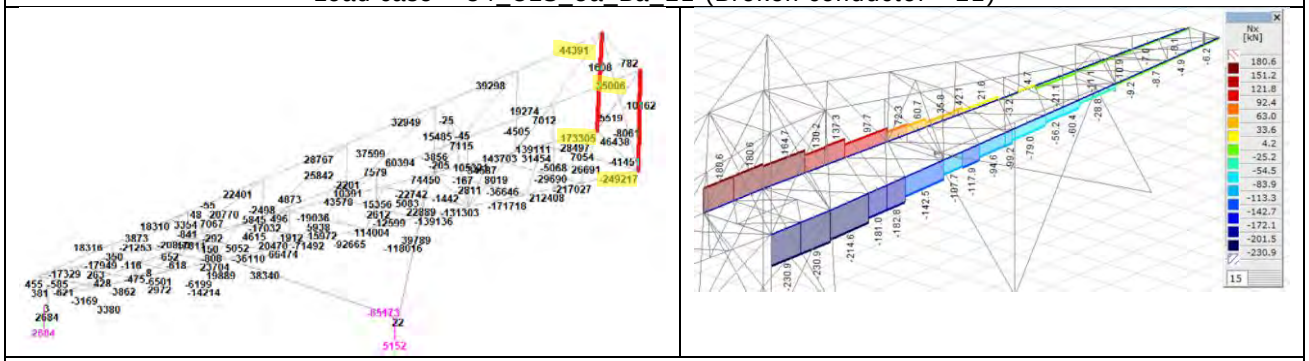
Load case – 33_ULS_5a_Ba_01 (Broken earth conductor)



Load case – 33_ULS_5a_Ba_20 (Broken conductor - 20)



Load case – 34_ULS_5a_Ba_21 (Broken conductor - 21)



Load case – 35_ULS_5a_Ba_22 (Broken conductor - 22)

Figure 7 Axial forces in the exiting cross-arm for vertical isolators

The forces in the bottom chord in the existing and new situation are tabulated in table 3. The maximum force occurs in loads case 35_ULS_5a_BA_20 across the models and the critical force is 246 kN in the bottom cross-arm in axisVM analysis. The corresponding force in the PLS output is 257 kN. The compressive force has reduced in the axis VM analysis compared to the PLS tower output as seen in table 3.

Table 3 Comparison of compressive force in kN

Load Case	PLS tower		AxisVM	
	TCA	BCA	TCA	BCA
03_ULS_1a_90	18.7	29.7	16.5	37.8
03_ULS_1a_270	90.3	116.4	62.8	92.3
15_ULA_3a_90	45.7	42.3	24.4	18.3
15_ULA_3a_270	91.8	107.8	65.4	84
22_ULS_5a_Ba_1	177		133	
33_ULS_5a_Ba_20	-	257	-	246
34_ULS_5a_Ba_21	-	126	-	116
35_ULS_5a_Ba_22	249	-	230	-

The maximum, stress in the bottom chord, other members of the existing cross arm and the newly added members are shown in Figure 8. The maximum stress of 218 MPa across the bottom chord of the cross arms. The yield stress of the bottom chord is 355 MPa (S355 steel grade). Thus the max utility ratio os 0.62 develops in the added members. There is reserve capacity in the members to consider stability issues.

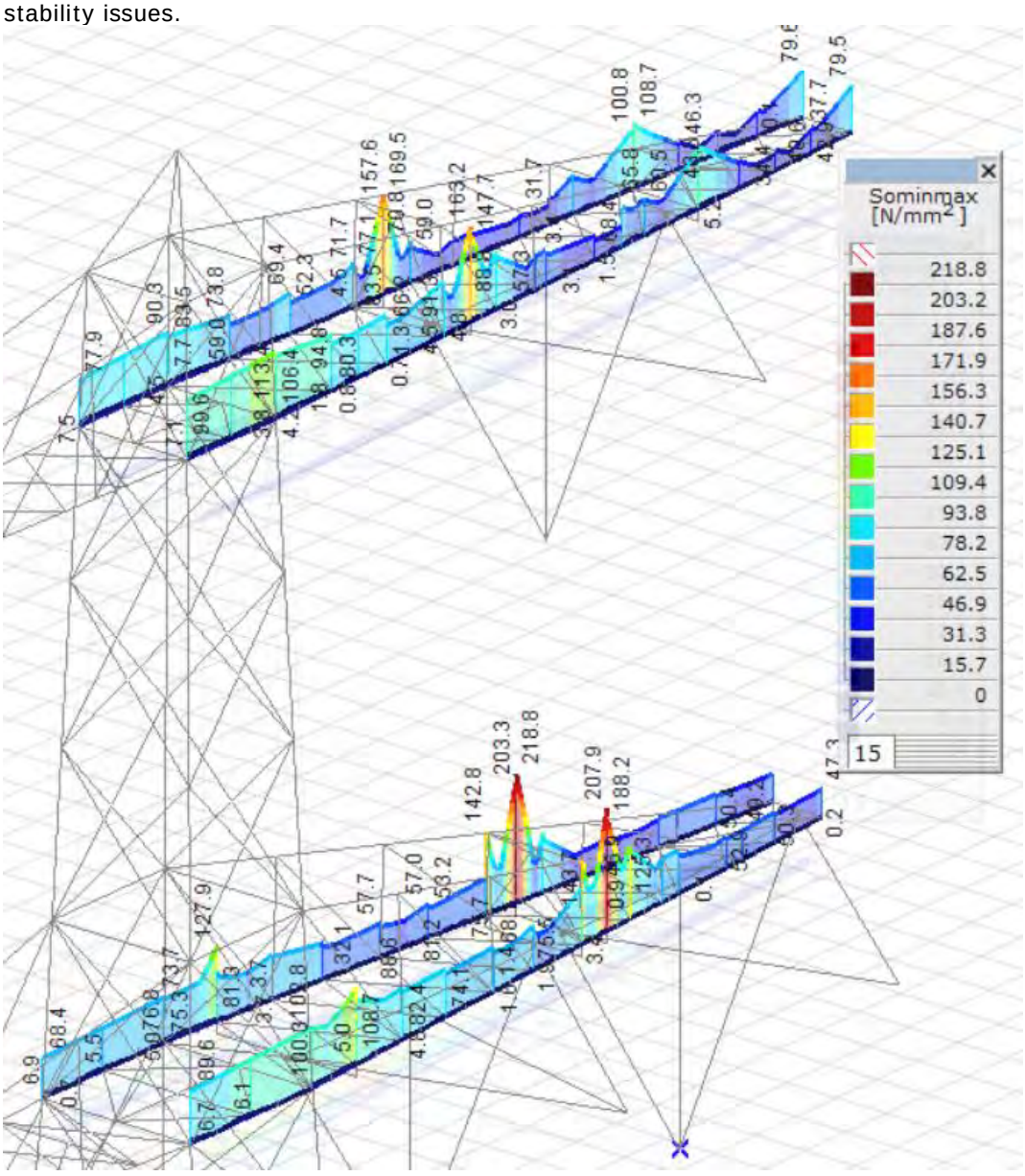
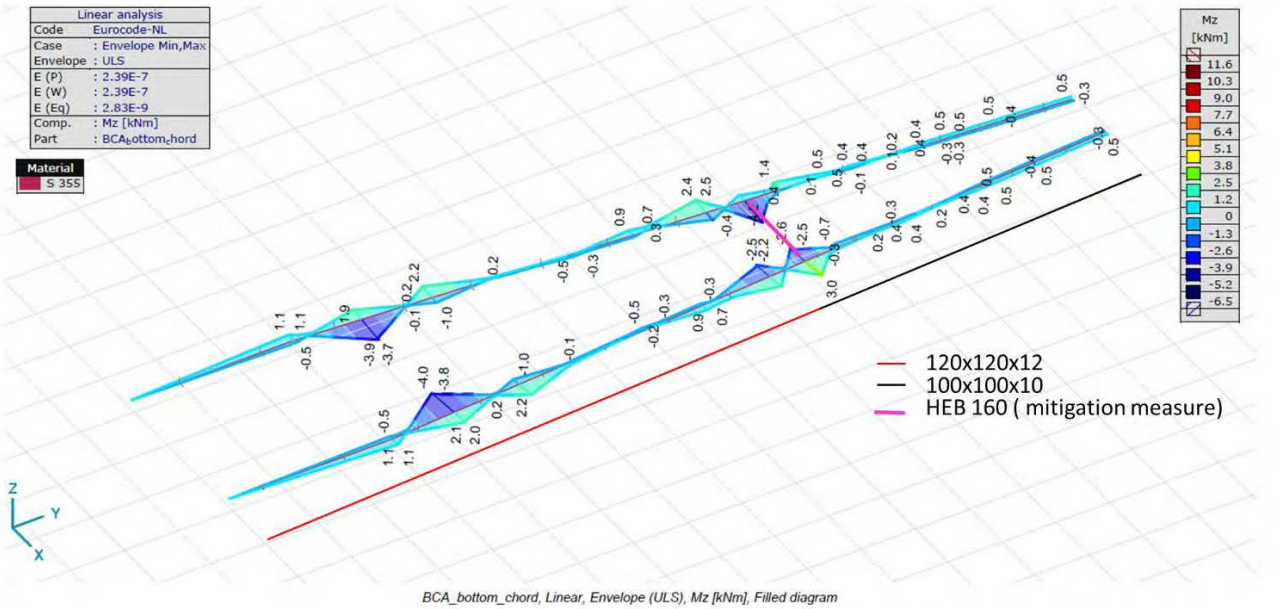


Figure 8 Stress for ULS Envelope in members

Spikes at the moment are seen in figure 8. These spiked are attributed to large minor axis moment (M_{yy}) at the points where the HEB 160 beams are connected to the bottom chord. Figure 9 confirms the peaks in M_{yy} in the bottom chord. The transition of the cross-section profiles occurs 0.5 m between the location of the peaks in the bottom chord. This can be detrimental and unsafe. A horizontal (L50x50x5) is added in the bottom chord just above the H beams as seen



BCA_bottom_chord, Linear, Envelope (ULS), Mz [kNm], Filled diagram

in figure 9 in magenta colour.

Figure 9 Minor axis moment (M_{yy}) in the bottom chord of the bottom cross arm

Successive run after adding the horizontal shows the decrease in the Myy at the critical location from 3 to 2.1 kNm. The decrease is approx. 25%.

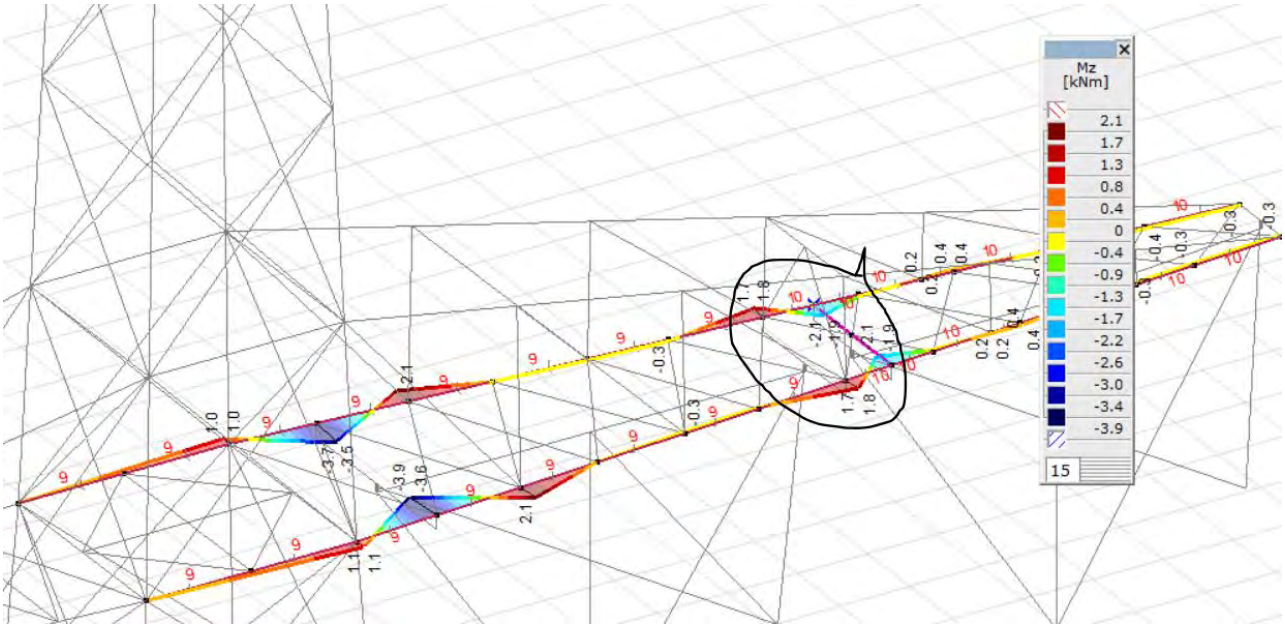
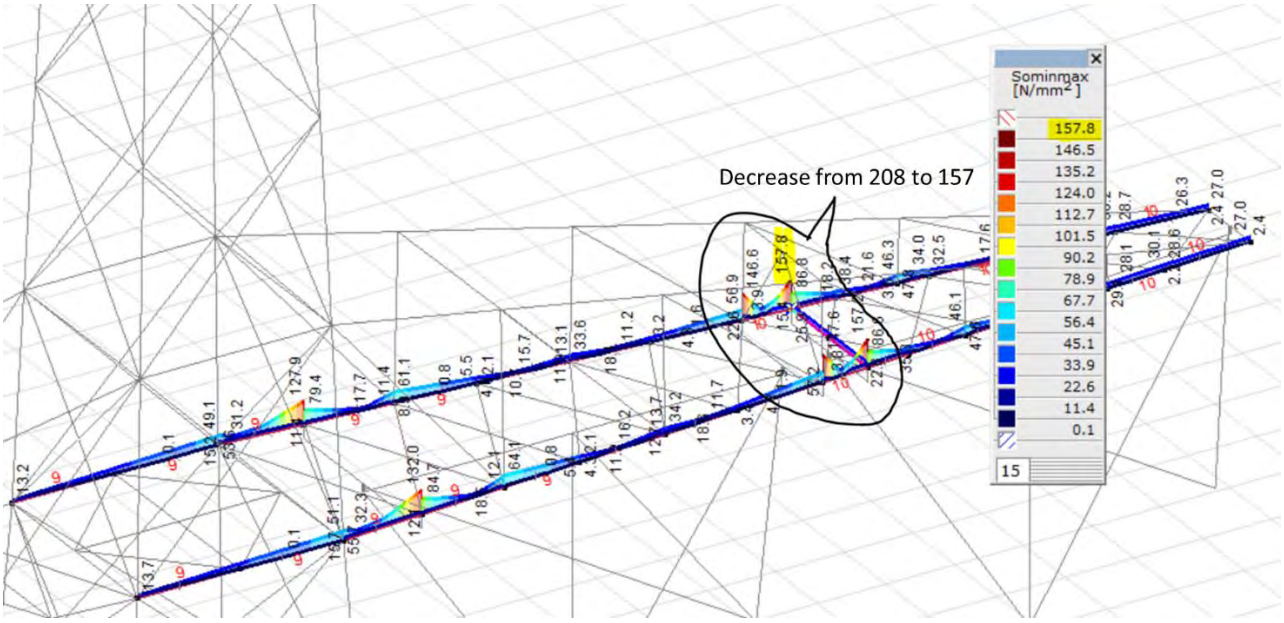


Figure 10 Minor axis moment in the strengthened bottom cross arm

The stress at the critical locations has decreased. The maximum stress has decreased to 158 MPa. This is a decrease of roughly 25% of the previous value of 208 MPa. The max stress is below 50 % of the yield stress of S355 grade steel. This is acceptable even with the local peaks occurring so close to the transition point.



4.3 Check of members

The H beams in the tower are classified as class 3 members as per Euro code classification. The max utilization as per guidelines of EC-3:1993 is 0.51 in Axis VM. The max utilization seen from the torsion + bending stress in excel is 0.54. The additional strength can be used for the losses in connection. Thus the structure is assumed to saf

5 CONCLUSION:

The maximum compressive force in the bottom chord has not increased from the PLS-TOWER. The existing cross arm can be assumed safe for the loads imposed by the torsion in the v – ketting isolator configuration. This ratifies the initial assumption of studying the cross arm in isolation.

The connection between the transition of the cross-section profiles in the top and bottom chord of the all cross arm should be capable of transferring moments. The concerned connection should be checked for the resulting moments. The moments at the connection should be minimised if possible as explained in the previous section.

The H beams are checked by comparing the combined stress (bending + torsion in excel) from the analysis to their yield stress and as well as by the checks as per Eurocode 3 in Axis VM. The additional capacity of approx. 40% is observed and is kept as a reserve for bolt holes and other unseen circumstances.

The H beams added to support the v-ketting insulators are shown in the figure below. The figure from left corresponds to (1) top view of the top cross arm, (2) top view of the bottom cross arm and (3) side view of the cross arms. The HEB 160 beams are highlighted in magenta. The additional horzontal on top of the bottom chord in BCA is shown in green.

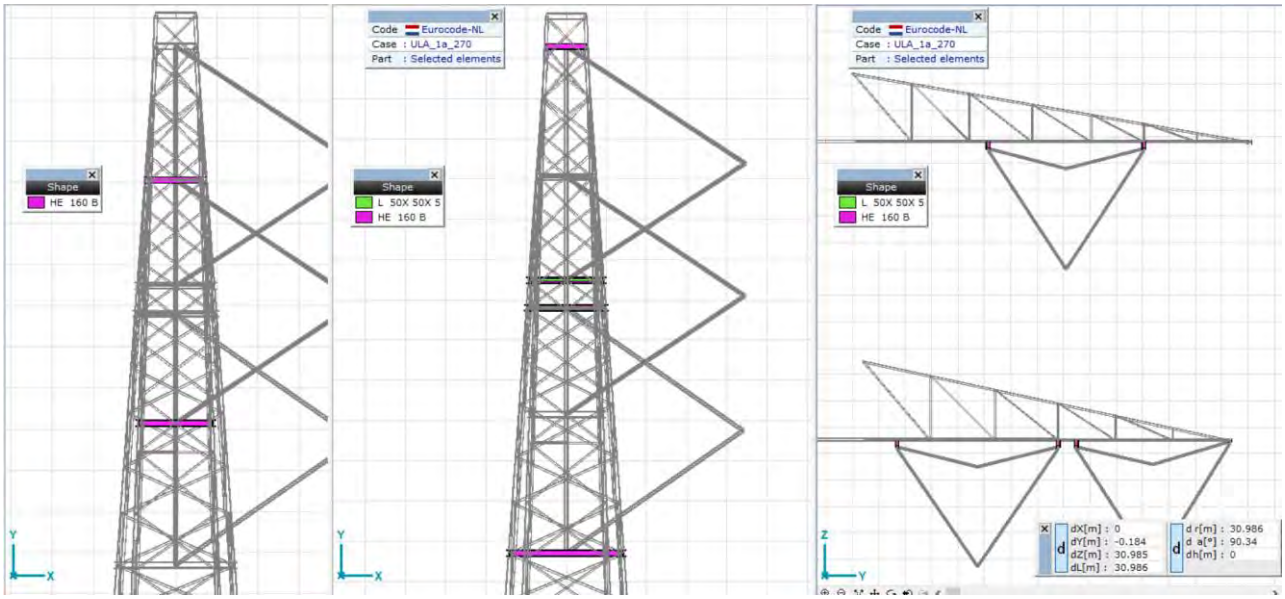


Figure 11 Beams added to support v-ketting insulator configuration

6 BIJLAGE: UITVOER AXISVM.

Project

Analysis by

AxisVM X5 R4h · Registered to DNV GL - Energy

S-6_v_ketting_1.axs

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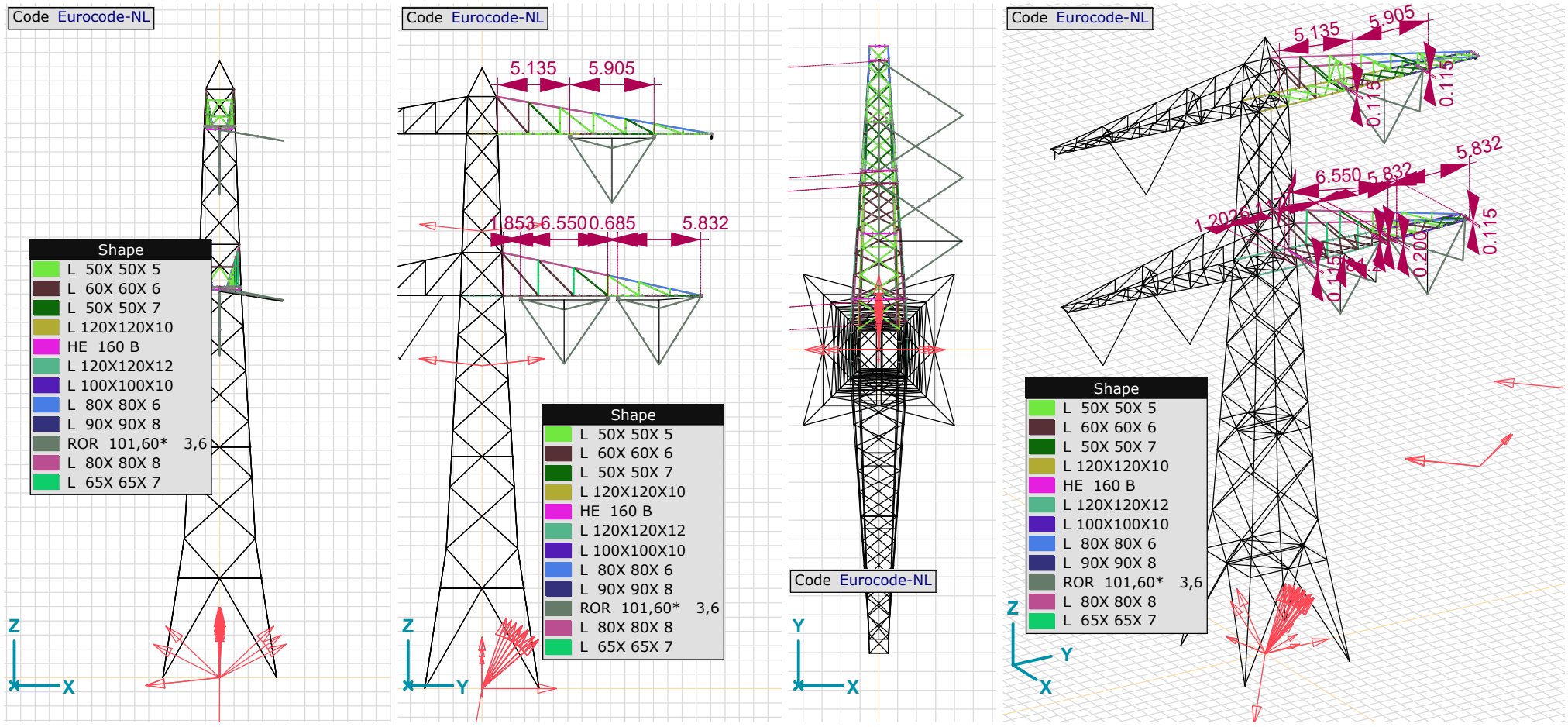


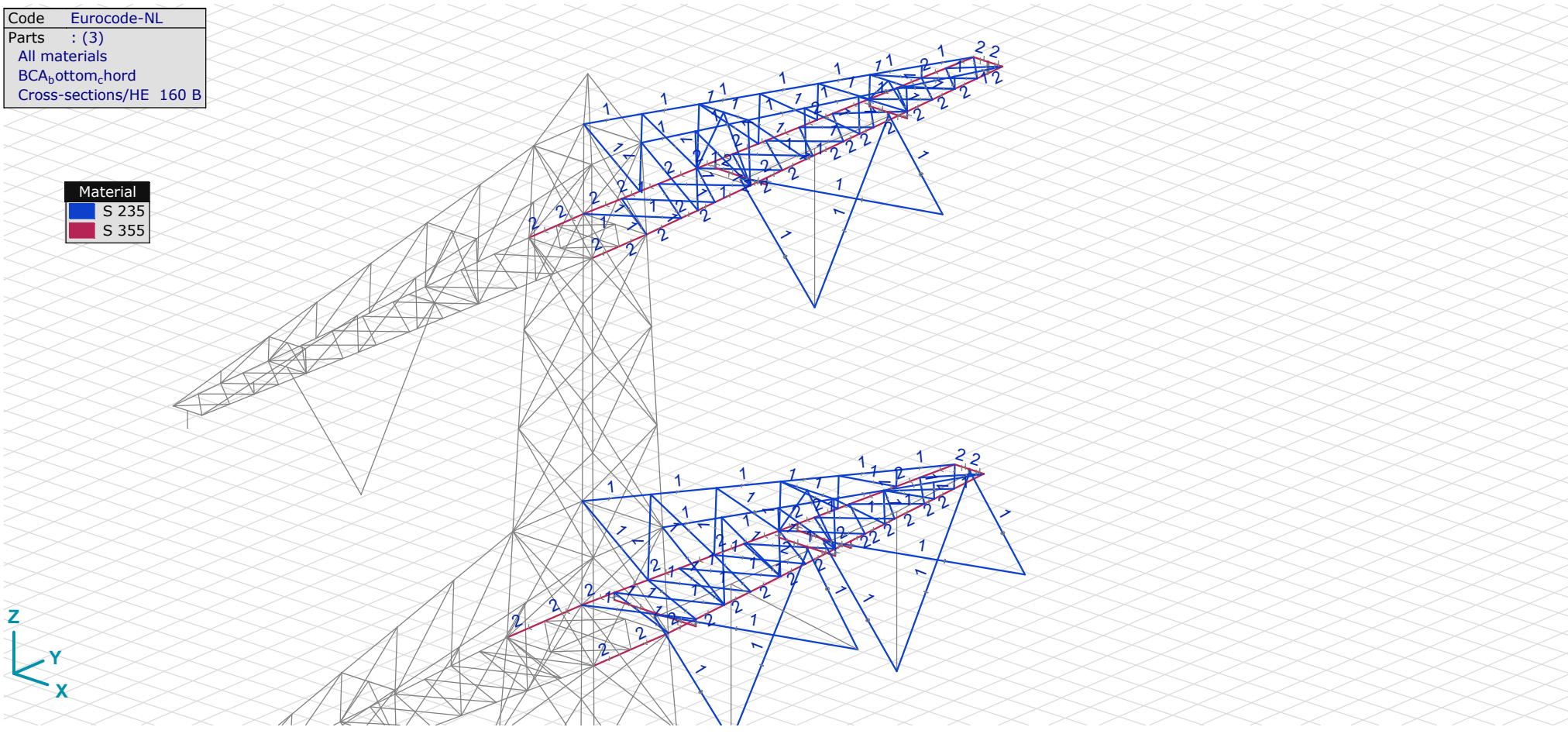
S-6 tower_views

Materials

	Name	Type	National design code	Material code	Model	E_x [N/mm²]	E_y [N/mm²]	ν	α_T [1/°C]	ρ [kg/m³]	Material color	Contour color	Texture
1	S 235	Steel	Eurocode-NL	SN EN 10025	NL elastic	210000	210000	0.30	1E-5	7850			Steel
2	S 355	Steel	Eurocode-NL	10025-2	NL elastic	210000	210000	0.30	1.2E-5	7850			Steel

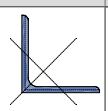
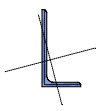
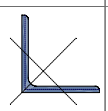
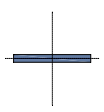
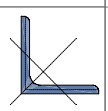
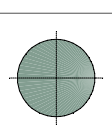
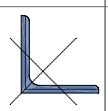
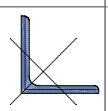
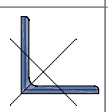
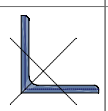
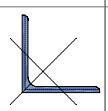
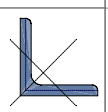
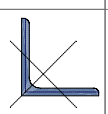
	Name	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}
1	S 235	f_y[N/mm²] = 235.00	f_u[N/mm²] = 360.00	f_y^*[N/mm²] = 215.00	f_u^*[N/mm²] = 340.00										
2	S 355	f_y[N/mm²] = 355.00	f_u[N/mm²] = 510.00	f_y^*[N/mm²] = 335.00	f_u^*[N/mm²] = 470.00										

Name: Material name; **Type:** Type of material; **Model:** Material model; **E_x:** Young's modulus of elasticity in local x direction; **E_y:** Young's modulus of elasticity in local y direction; **ν:** Poisson's ratio; **α_T:** Thermal expansion coefficient; **ρ:** Density; **Contour color:** Material outline color; **P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}:** Design parameter;



model_Material_details

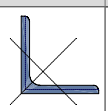
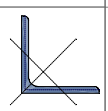
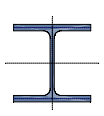
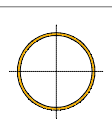
Cross-sections

	Name	Drawing	Process	Shape	h [mm]	b [mm]	tw [mm]	tf [mm]	r_1 [mm]	r_2 [mm]	r_3 [mm]	Ax [mm^2]	Ay [mm^2]	Az [mm^2]
1	L 100X100X 8		Rolled	L	100.0	100.0	8.0	8.0	12.0	6.0	0	1551.52	669.67	678.46
2	L 100X 50X 6X		Rolled	L	100.0	50.0	6.0	6.0	9.0	4.5	0	872.73	231.48	516.47
3	L 120X120X10		Rolled	L	120.0	120.0	10.0	10.0	13.0	6.5	0	2318.22	1004.33	1014.85
4	80x8		Rolled	Rect.	8.0	80.0	0	0	0	0	0	640.00	533.33	533.33
5	L 55X 55X 6		Rolled	L	55.0	55.0	6.0	6.0	8.0	4.0	0	630.90	278.51	282.29
6	O 20		Other	Round	20.0	20.0	0	0	0	0	0	314.10	269.22	269.22
7	L 60X 60X 6		Rolled	L	60.0	60.0	6.0	6.0	8.0	4.0	0	690.90	302.80	306.64
8	L 80X 80X 8		Rolled	L	80.0	80.0	8.0	8.0	10.0	5.0	0	1226.78	537.99	544.05
9	L 120X120X12		Rolled	L	120.0	120.0	12.0	12.0	13.0	6.5	0	2754.22	1208.71	1219.23
10	L 100X100X10		Rolled	L	100.0	100.0	10.0	10.0	12.0	6.0	0	1915.52	840.25	849.06
11	L 80X 80X 6		Rolled	L	80.0	80.0	6.0	6.0	10.0	5.0	0	934.78	402.15	407.43
12	L 50X 50X 7		Rolled	L	50.0	50.0	7.0	7.0	7.0	3.5	0	656.28	298.47	301.38
13	L 50X 50X 5		Rolled	L	50.0	50.0	5.0	5.0	7.0	3.5	0	480.28	210.38	213.29

	Name	Ix [mm^4]	Iy [mm^4]	Iz [mm^4]	Iyz [mm^4]	I_1 [mm^4]	I_2 [mm^4]	α [°]	Iω [mm^6]	$W_{1,el,t}$ [mm^3]	$W_{1,el,b}$ [mm^3]	$W_{2,el,t}$ [mm^3]	$W_{2,el,b}$ [mm^3]
1	L 100X100X 8	36218.9	1448264.0	1448264.0	−849655.4	2297919.0	598608.2	45.00	2.3E+07	32497.5	32497.5	17014.9	15467.6
2	L 100X 50X 6X	11460.0	897072.9	152537.5	−207618.9	951054.9	98555.4	14.57	5624540	14496.4	21734.5	3281.0	5221.4
3	L 120X120X10	82759.6	3129113.0	3129113.0	−1840138.0	4969251.0	1288975.0	45.00	7.9E+07	58563.2	58563.2	30420.2	27507.4
4	80x8	12791.5	3413.3	341333.3	0	341333.3	3413.3	90.00	1736982	8533.3	8533.3	853.3	853.3
5	L 55X 55X 6	8324.3	172850.1	172850.2	−101063.0	273913.2	71787.1	45.00	1527235	7043.1	7043.1	3705.3	3247.9
6	O 20	15708.0	7850.8	7850.8	0	7850.8	7850.8	0	0	785.1	785.1	785.1	785.1
7	L 60X 60X 6	9044.2	227898.9	227898.9	−133497.7	361396.6	94401.2	45.00	2037188	8518.2	8518.2	4463.6	3956.0
8	L 80X 80X 8	28221.9	722397.8	722397.8	−423612.4	1146010.0	298785.4	45.00	1.2E+07	20258.8	20258.8	10570.7	9369.6
9	L 120X120X12	139579.2	3676399.0	3676399.0	−2160249.0	5836648.0	1516150.0	45.00	1.3E+08	68785.5	68785.5	35578.9	31565.4
10	L 100X100X10	68400.0	1766604.0	1766604.0	−1036581.0	2803186.0	730023.0	45.00	4.4E+07	39643.0	39643.0	20631.6	18290.5
11	L 80X 80X 6	12473.9	558166.2	558166.2	−326876.9	885043.1	231289.3	45.00	5085144	15645.5	15645.5	8233.3	7546.6
12	L 50X 50X 7	11417.9	146096.1	146096.2	−84979.3	231075.5	61116.8	45.00	1717204	6535.8	6535.8	3423.8	2909.6
13	L 50X 50X 5	4408.9	109629.1	109629.1	−64162.8	173791.9	45466.3	45.00	678722	4915.6	4915.6	2584.4	2290.7

	Name	$W_{1,pl}$ [mm^3]	$W_{2,pl}$ [mm^3]	i_y [mm]	i_z [mm]	Hy [mm]	Hz [mm]	y_G [mm]	z_G [mm]	y_s [mm]	z_s [mm]	S.p.
1	L 100X100X 8	51224.3	26412.7	30.6	30.6	100.0	100.0	27.4	27.4	−22.6	−22.6	4
2	L 100X 50X 6X	25285.3	7359.8	32.1	13.2	50.0	100.0	10.4	34.9	−7.3	−30.2	4
3	L 120X120X10	92246.3	47331.9	36.7	36.7	120.0	120.0	33.1	33.1	−27.3	−27.3	4
4	80x8	12800.0	1280.0	2.3	23.1	80.0	8.0	40.0	4.0	0	0	5
5	L 55X 55X 6	11266.6	5820.9	16.6	16.6	55.0	55.0	15.6	15.6	−12.0	−12.0	4
6	O 20	1332.9	1332.9	5.0	5.0	20.0	20.0	10.0	10.0	0	0	5
7	L 60X 60X 6	13554.5	6989.1	18.2	18.2	60.0	60.0	16.9	16.9	−13.3	−13.3	4
8	L 80X 80X 8	32196.1	16562.3	24.3	24.3	80.0	80.0	22.5	22.5	−17.8	−17.8	4
9	L 120X120X12	109074.8	55859.7	36.5	36.5	120.0	120.0	34.0	34.0	−27.0	−27.0	4
10	L 100X100X10	62957.8	32342.2	30.4	30.4	100.0	100.0	28.2	28.2	−22.3	−22.3	4
11	L 80X 80X 6	24644.0	12753.5	24.4	24.4	80.0	80.0	21.7	21.7	−18.1	−18.1	4
12	L 50X 50X 7	10576.2	5453.1	14.9	14.9	50.0	50.0	14.9	14.9	−10.6	−10.6	4
13	L 50X 50X 5	7830.3	4045.4	15.1	15.1	50.0	50.0	14.0	14.0	−11.0	−11.0	4

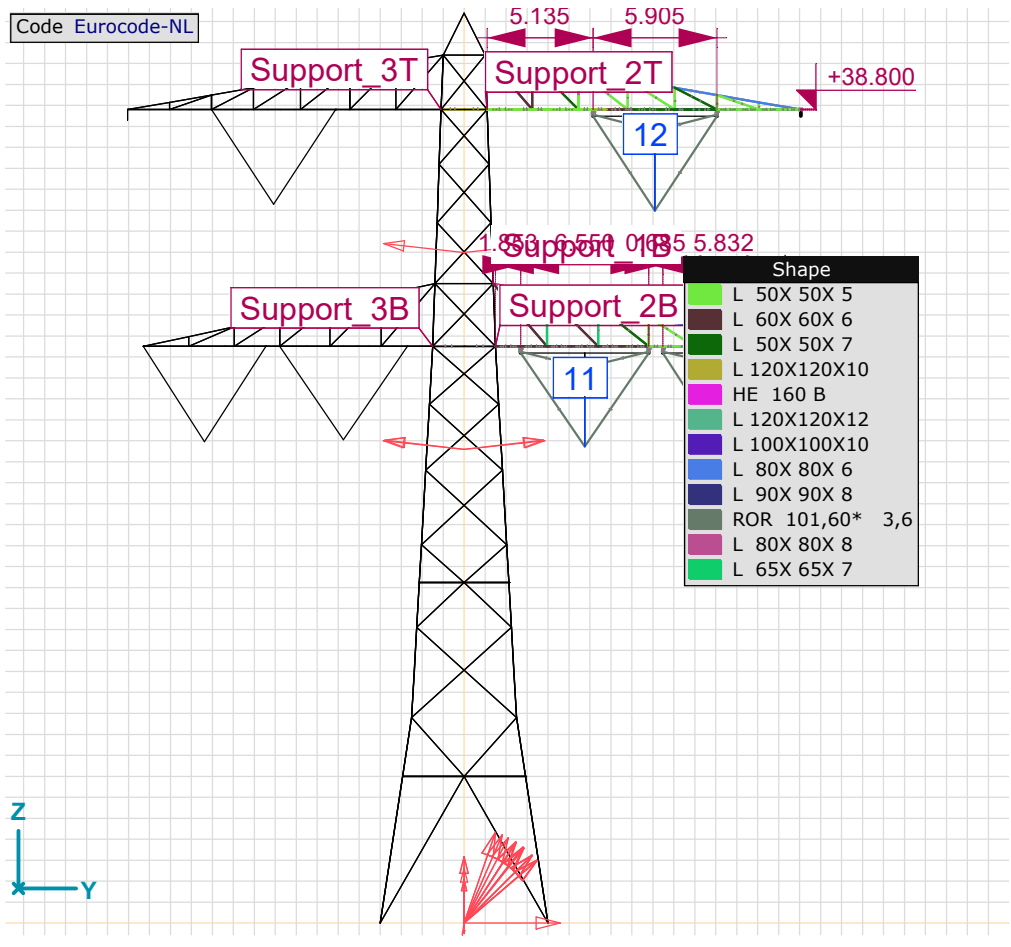
Cross-sections

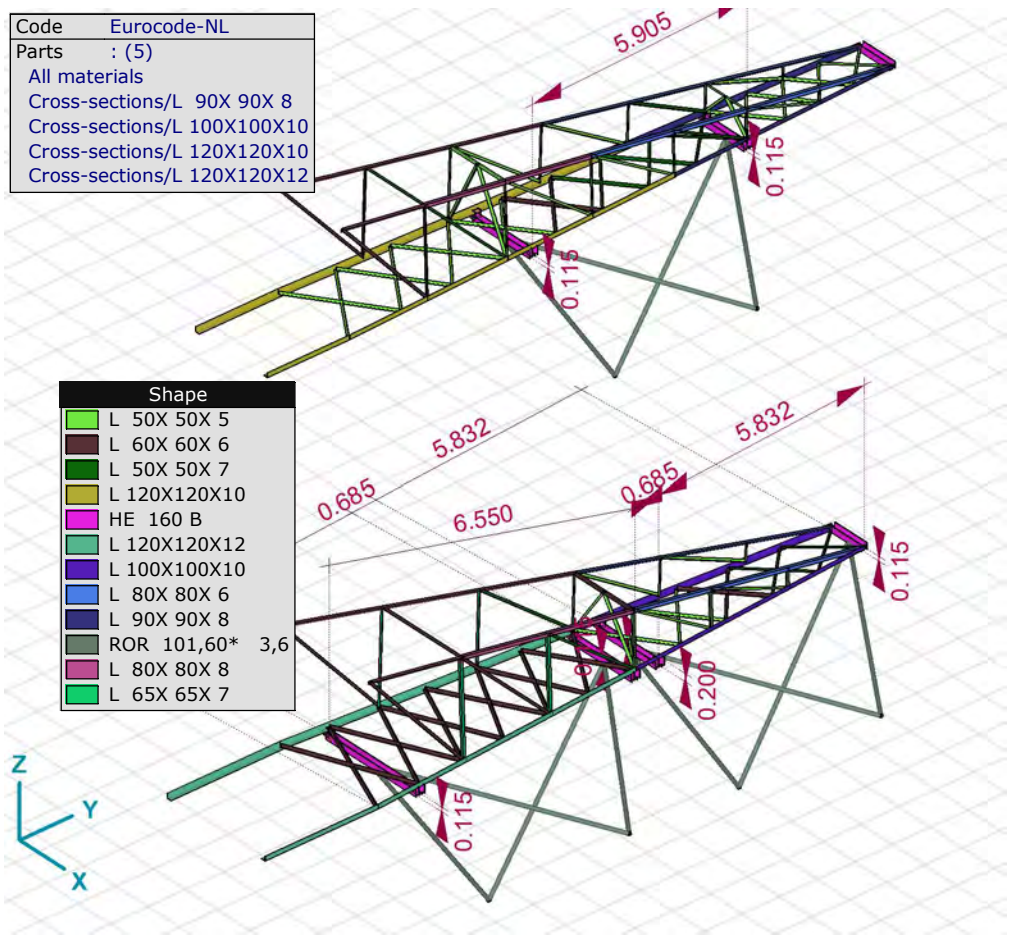
	Name	*Drawing*	*Process*	*Shape*	*h [mm]*	*b [mm]*	*tw [mm]*	*tf [mm]*	*r_1 [mm]*	*r_2 [mm]*	*r_3 [mm]*	*Ax [mm²]*	*Ay [mm²]*	*Az [mm²]*
14	L 65X 65X 7		Rolled	L	65.0	65.0	7.0	7.0	9.0	4.5	0	869.73	383.63	388.46
15	L 90X 90X 8		Rolled	L	90.0	90.0	8.0	8.0	11.0	5.5	0	1389.04	603.70	611.07
16	HE 160 B		Rolled	I	160.0	160.0	8.0	13.0	15.0	0	0	5426.04	3754.44	1237.48
17	ROR 101,60* 3,6		Rolled	Pipe	101.6	101.6	3.6	3.6	0	0	0	1106.95	554.66	554.72

	Name	*Ix [mm⁴]*	*Iy [mm⁴]*	*Iz [mm⁴]*	*Iyz [mm⁴]*	*I_1 [mm⁴]*	*I_2 [mm⁴]*	*α [°]*	*Iω [mm⁶]*	*$W_{1,el,t}$ [mm³]*	*$W_{1,el,b}$ [mm³]*	*$W_{2,el,t}$ [mm³]*	*$W_{2,el,b}$ [mm³]*
14	L 65X 65X 7	15488.8	334281.2	334281.2	−195612.7	529893.8	138668.5	45.00	4036559	11529.0	11529.0	6046.7	5310.0
15	L 90X 90X 8	32189.4	1043715.0	1043715.0	−612406.8	1656122.0	431308.0	45.00	1.7E+07	26023.4	26023.4	13599.0	12217.6
16	HE 160 B	317826.3	2.5E+07	8892444.0	0	2.5E+07	8892443.0	0	4.7E+10	311542.7	311542.7	111155.5	111155.5
17	ROR 101,60* 3,6	2663810.0	1328996.0	1328996.0	0	1328996.0	1328996.0	0	0	26161.3	26161.3	26161.3	26161.3

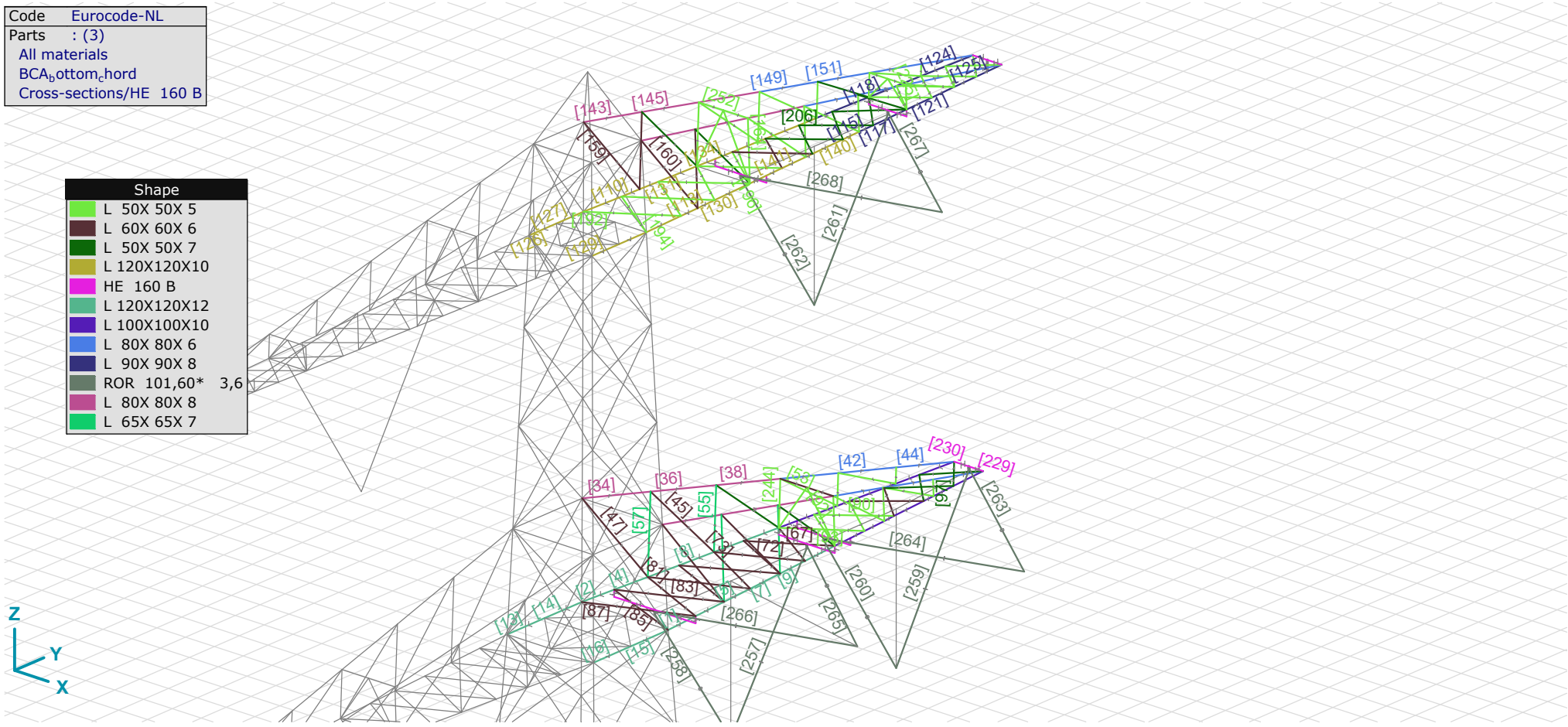
	Name	*$W_{1,pl}$ [mm³]*	*$W_{2,pl}$ [mm³]*	*i_y [mm]*	*i_z [mm]*	*Hy [mm]*	*Hz [mm]*	*y_G [mm]*	*z_G [mm]*	*y_s [mm]*	*z_s [mm]*	*S.p.*
14	L 65X 65X 7	18413.0	9497.5	19.6	19.6	65.0	65.0	18.5	18.5	−14.2	−14.2	4
15	L 90X 90X 8	41166.2	21197.0	27.4	27.4	90.0	90.0	25.0	25.0	−20.2	−20.2	4
16	HE 160 B	354020.6	169972.2	67.8	40.5	160.0	160.0	80.0	80.0	0	0	9
17	ROR 101,60* 3,6	34524.1	34524.1	34.6	34.6	101.6	101.6	50.8	50.8	0	0	5

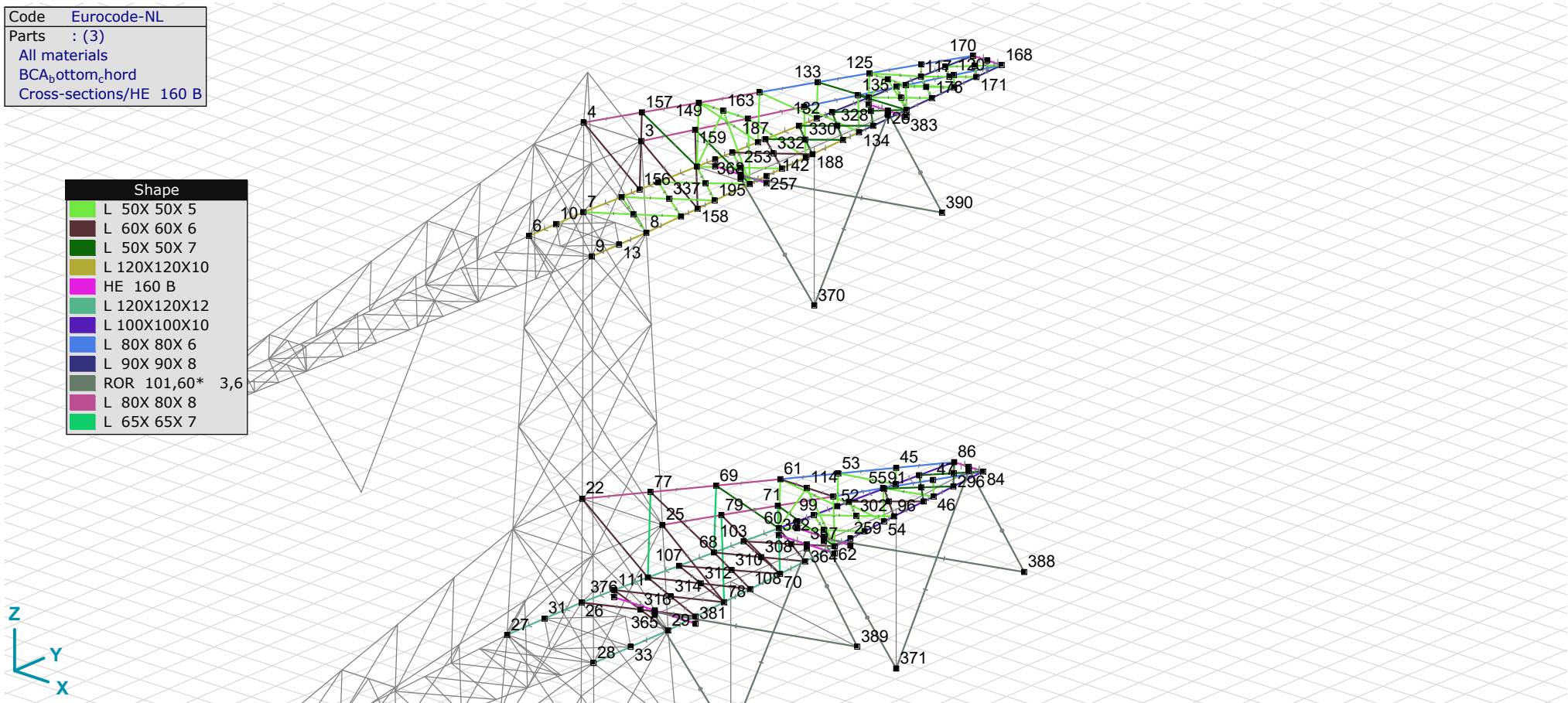
Name: Cross-section name; **Process:** Manufacturing process; **h:** Cross-section height; **b:** Cross-section width; **tw:** Web thickness; **tf:** Flange thickness; **r_1, r_2, r_3:** Rounding radius; **Ax:** Cross-section area; **Ay, Az:** Shear area; **Ix:** Torsional inertia; **Iy, Iz:** Flexural inertia; **Iyz:** Centrifugal inertia; **I_1, I_2:** Principal flexural inertia; **α:** Principal directions; **Iω:** Warping constant; **$W_{1,el,t}$, $W_{1,el,b}$, $W_{2,el,t}$, $W_{2,el,b}$:** Elastic modulus; **$W_{1,pl}$, $W_{2,pl}$:** Plastic modulus; **i_y, i_z:** Radius of inertia; **Hy:** Dimension in local y direction; **Hz:** Dimension in local z direction; **y_G:** y coordinate of the center of gravity; **z_G:** z coordinate of the center of gravity; **y_s:** y coordinate of the shear (torsion) center relative to the center of gravity; **z_s:** z coordinate of the shear (torsion) center relative to the center of gravity; **S.p.:** Stress calculation points;





cross_arm_details

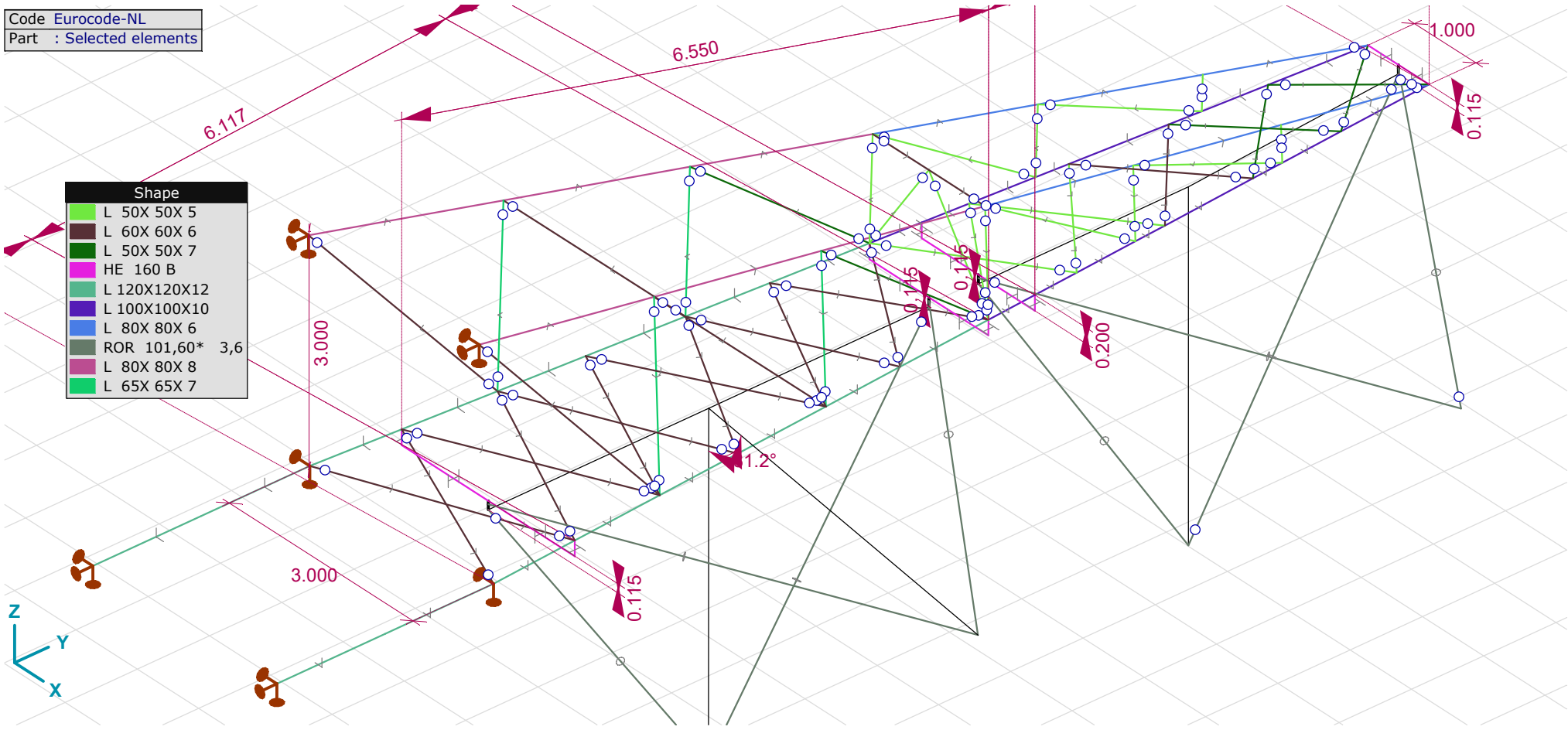




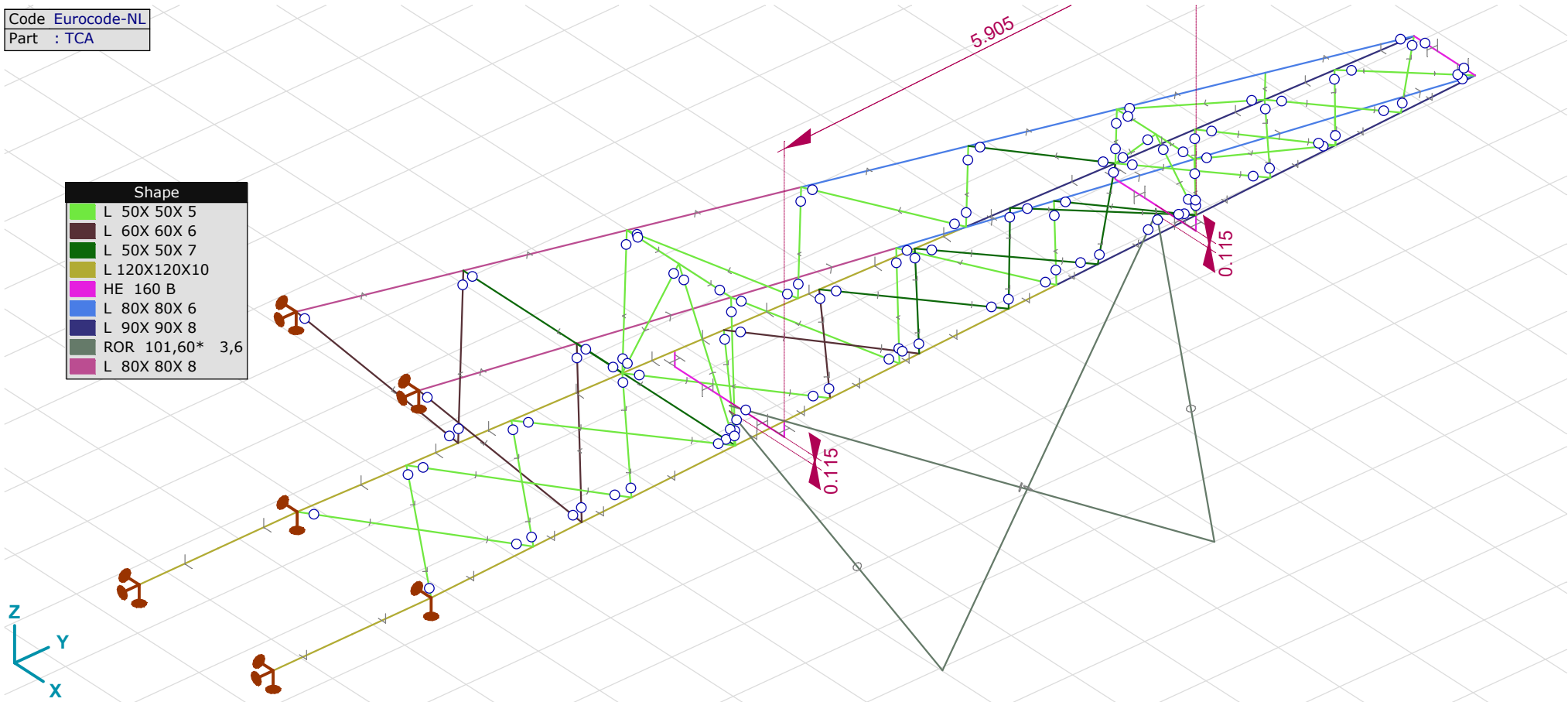
Spring characteristics

	Name	*Type*	*Degree of freedom*	*Model*	*K*	K_V
1	Soft - Translational	N-N	Translational	Linear	1E+0 kN/m	1E+0 kN/m
2	Rigid - Translational	N-N	Translational	Linear	1E+10 kN/m	1E+10 kN/m
3	Soft - Rotational	N-N	Rotational	Linear	1E+0 kNm/rad	1E+0 kNm/rad
4	Rigid - Rotational	N-N	Rotational	Linear	1E+10 kNm/rad	1E+10 kNm/rad

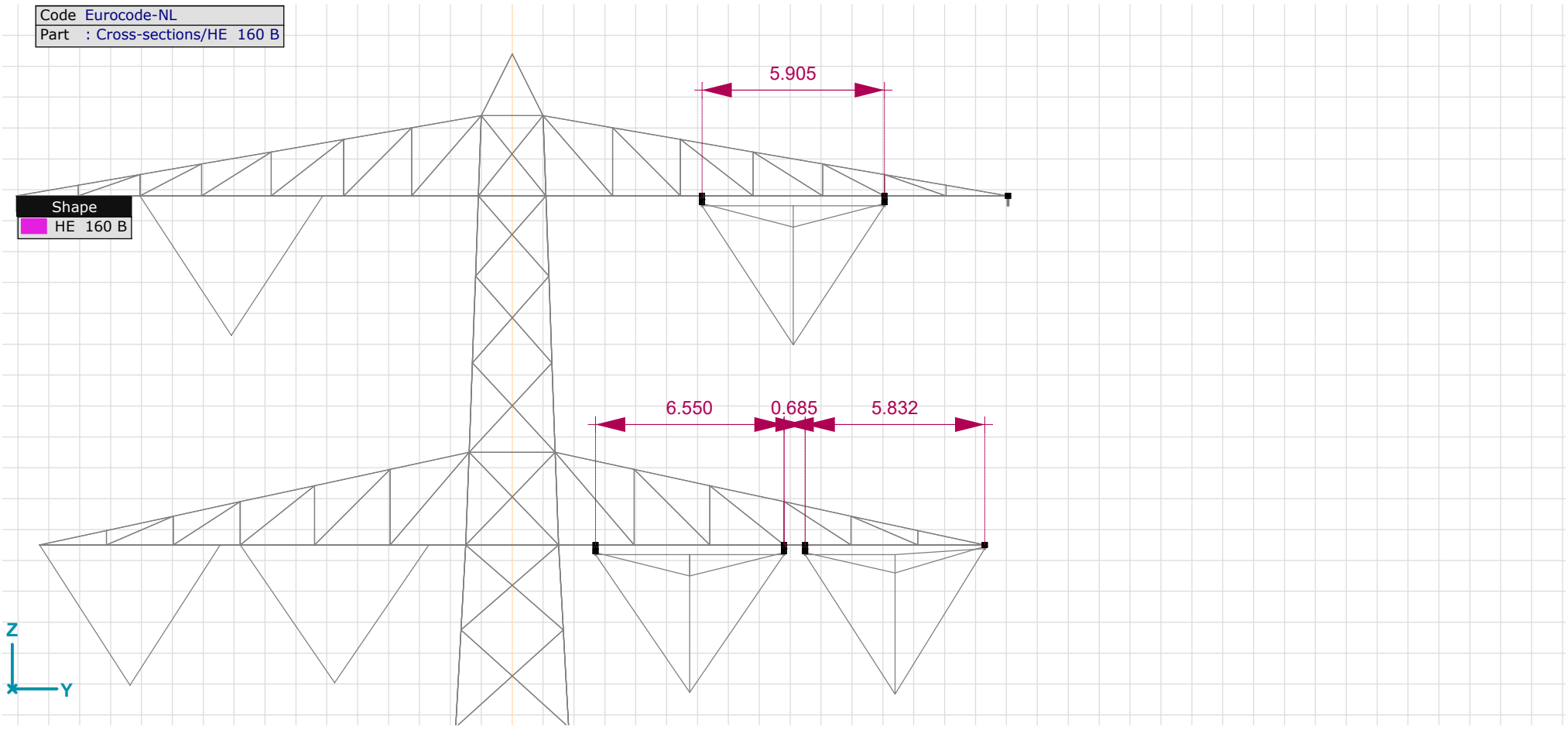
Name: Name of the spring characteristics; **Model:** Material model; **K:** Initial stiffness; **K_V:** Vibration stiffness;



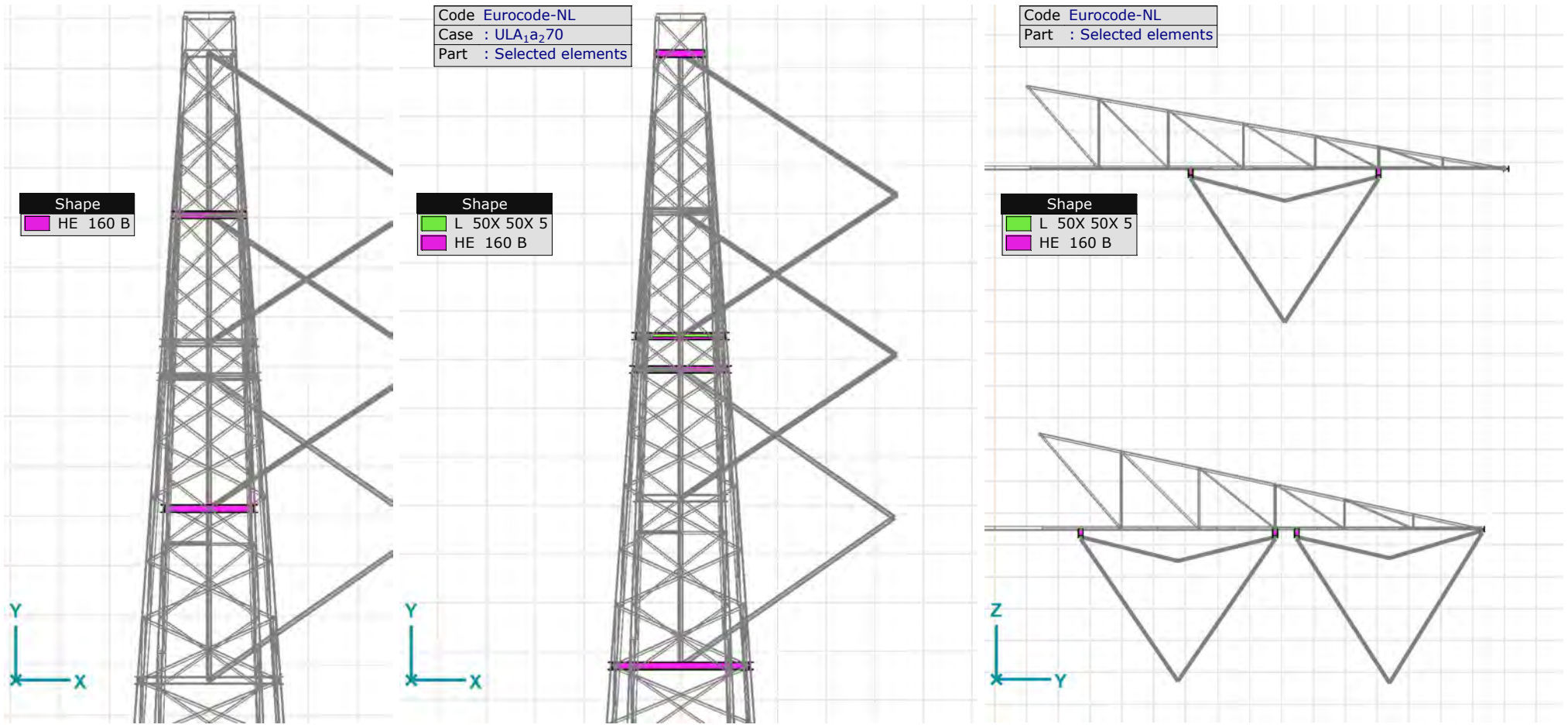
BCA_geometry_details



TCA_geometry_details



Location of added H beams housing insulators



Top and side view added members

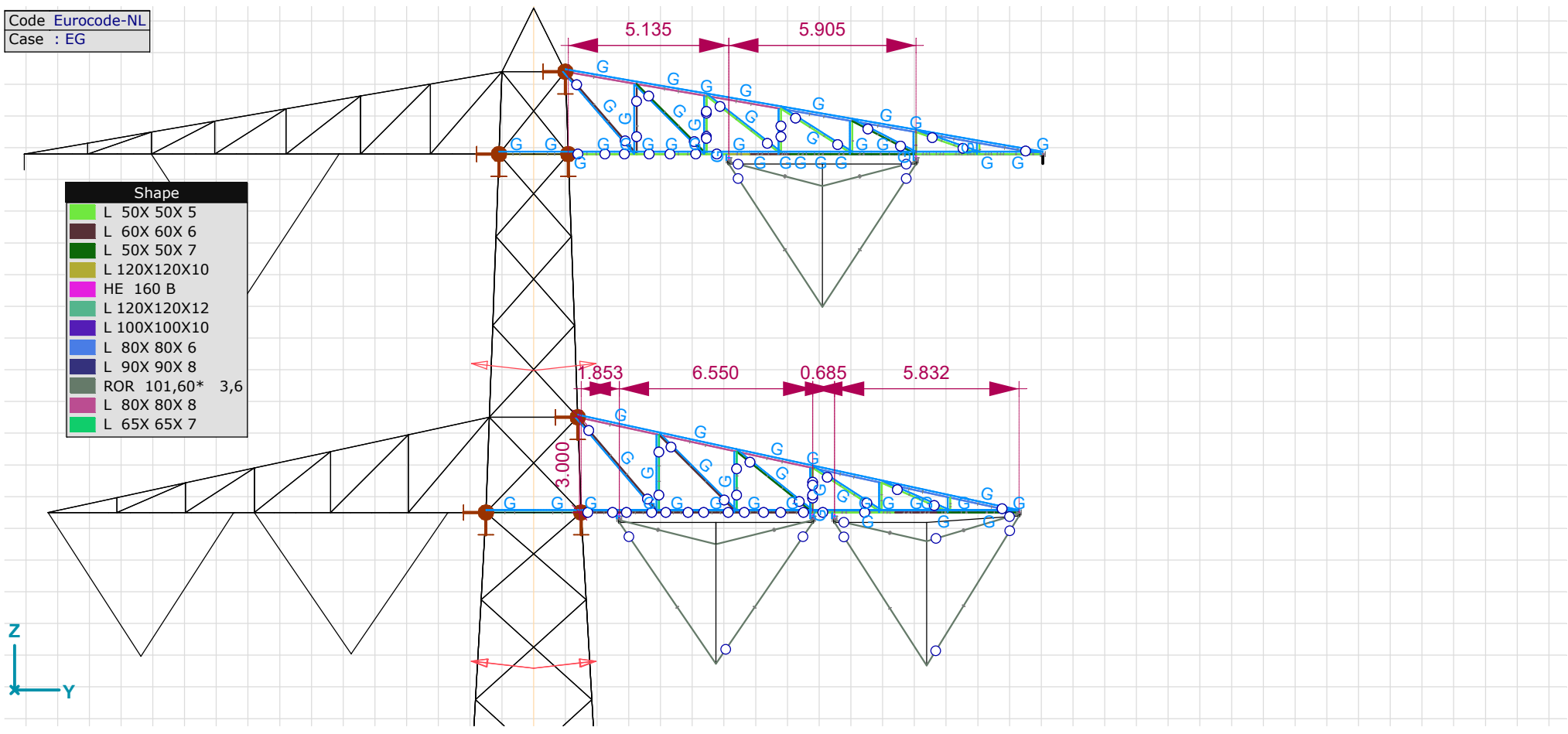
Nodal supports

	Node	X [m]	Y [m]	Z [m]
1	22	−1.392	1.392	30.500
2	25	1.392	1.392	30.500
3	3	1.000	1.000	41.400
4	4	−1.000	1.000	41.400
5	26	−1.500	1.500	27.500
6	29	1.500	1.500	27.500
7	7	−1.093	1.093	38.800
8	8	1.093	1.093	38.800
9	6	−1.093	−1.094	38.800
10	9	1.093	−1.094	38.800
11	27	−1.500	−1.500	27.500
12	28	1.500	−1.500	27.500

	Node	Type	$Name_x$	K_x [kN/m]	K_{xV} [kN/m]	$Name_y$	K_y [kN/m]	K_{yV} [kN/m]	$Name_z$	K_z [kN/m]	K_{zV} [kN/m]	$Name_{xx}$	K_{xx} [kNm/rad]	K_{xxV} [kNm/rad]
1	22	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
2	25	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
3	3	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
4	4	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
5	26	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
6	29	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
7	7	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
8	8	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
9	6	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
10	9	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
11	27	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
12	28	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–

	Node	$Name_{yy}$	K_{yy} [kNm/rad]	K_{yyV} [kNm/rad]	$Name_{zz}$	K_{zz} [kNm/rad]	K_{zzV} [kNm/rad]
1	22	—	–	–	—	–	–
2	25	—	–	–	—	–	–
3	3	—	–	–	—	–	–
4	4	—	–	–	—	–	–
5	26	—	–	–	—	–	–
6	29	—	–	–	—	–	–
7	7	—	–	–	—	–	–
8	8	—	–	–	—	–	–
9	6	—	–	–	—	–	–
10	9	—	–	–	—	–	–
11	27	—	–	–	—	–	–
12	28	—	–	–	—	–	–

Node: Supported node; **Type:** Support type; **$Name_x$:** Name of the spring characteristics; **K_x:** Initial stiffness; **K_{xV}:** Vibration stiffness; **$Name_y$:** Name of the spring characteristics; **K_y:** Initial stiffness; **K_{yV}:** Vibration stiffness; **$Name_z$:** Name of the spring characteristics; **K_z:** Initial stiffness; **K_{zV}:** Vibration stiffness; **$Name_{xx}$:** Name of the spring characteristics; **K_{xx}:** Initial stiffness; **K_{xxV}:** Vibration stiffness; **$Name_{yy}$:** Name of the spring characteristics; **K_{yy}:** Initial stiffness; **K_{yyV}:** Vibration stiffness; **$Name_{zz}$:** Name of the spring characteristics; **K_{zz}:** Initial stiffness; **K_{zzV}:** Vibration stiffness;

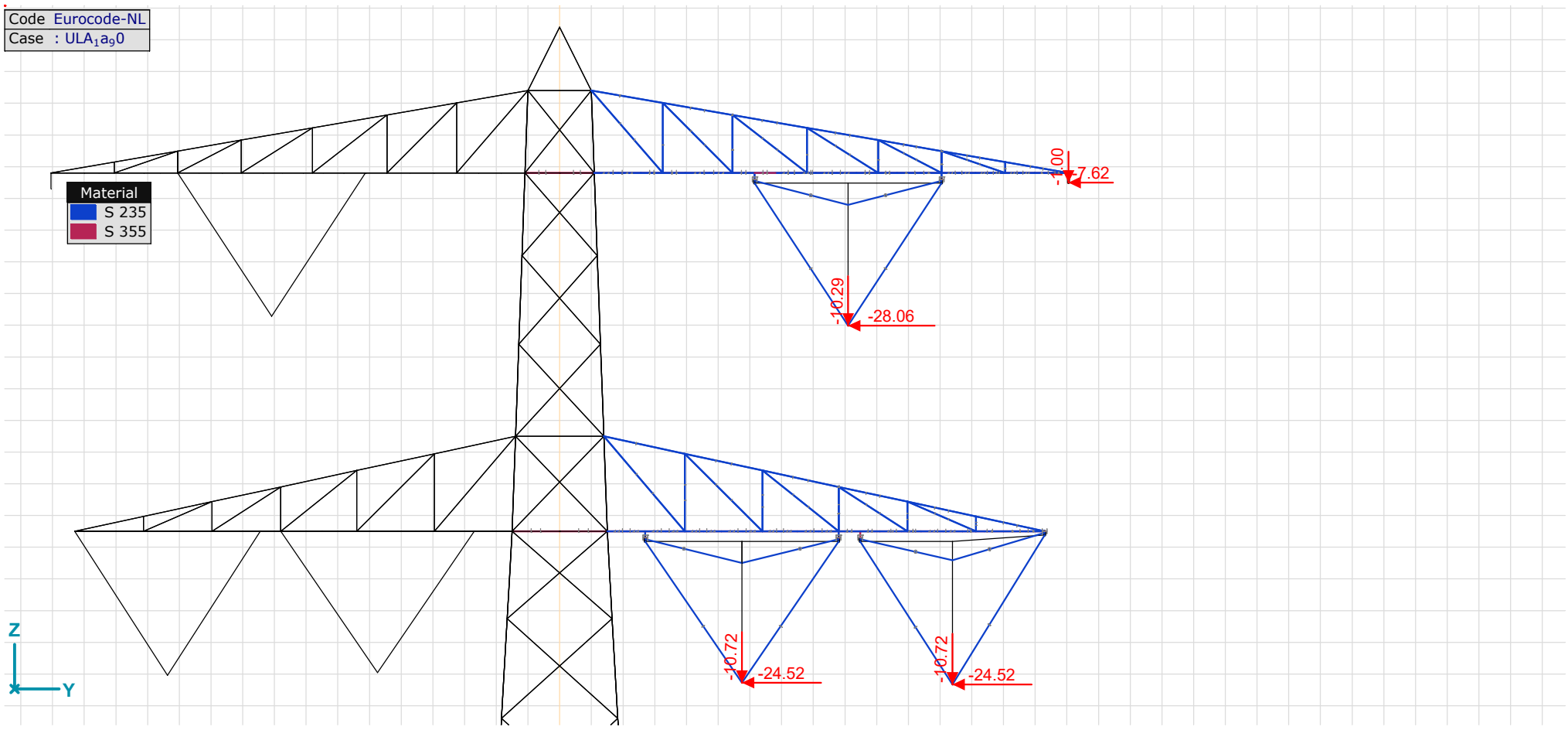


Load_self_weight

ULA_1a_90: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
251	Global	0	−24.52	−10.72	0	0	0
264	Global	0	−7.62	−1.00	0	0	0
370	Global	0	−28.06	−10.29	0	0	0
371	Global	0	−24.52	−10.72	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

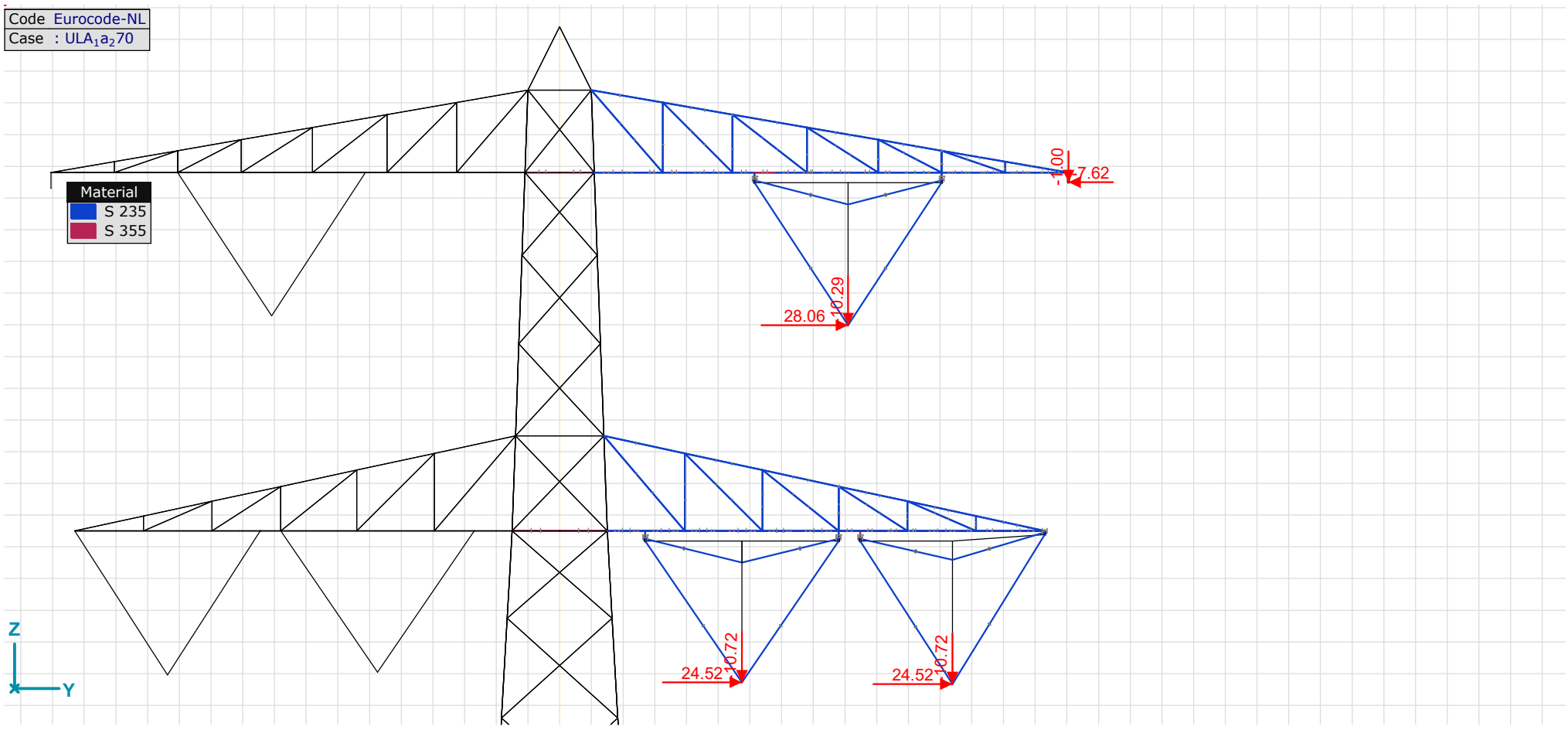


ULA_1a_90, Side view

ULA_1a_270: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
251	Global	0	24.52	−10.72	0	0	0
264	Global	0	−7.62	−1.00	0	0	0
370	Global	0	28.06	−10.29	0	0	0
371	Global	0	24.52	−10.72	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

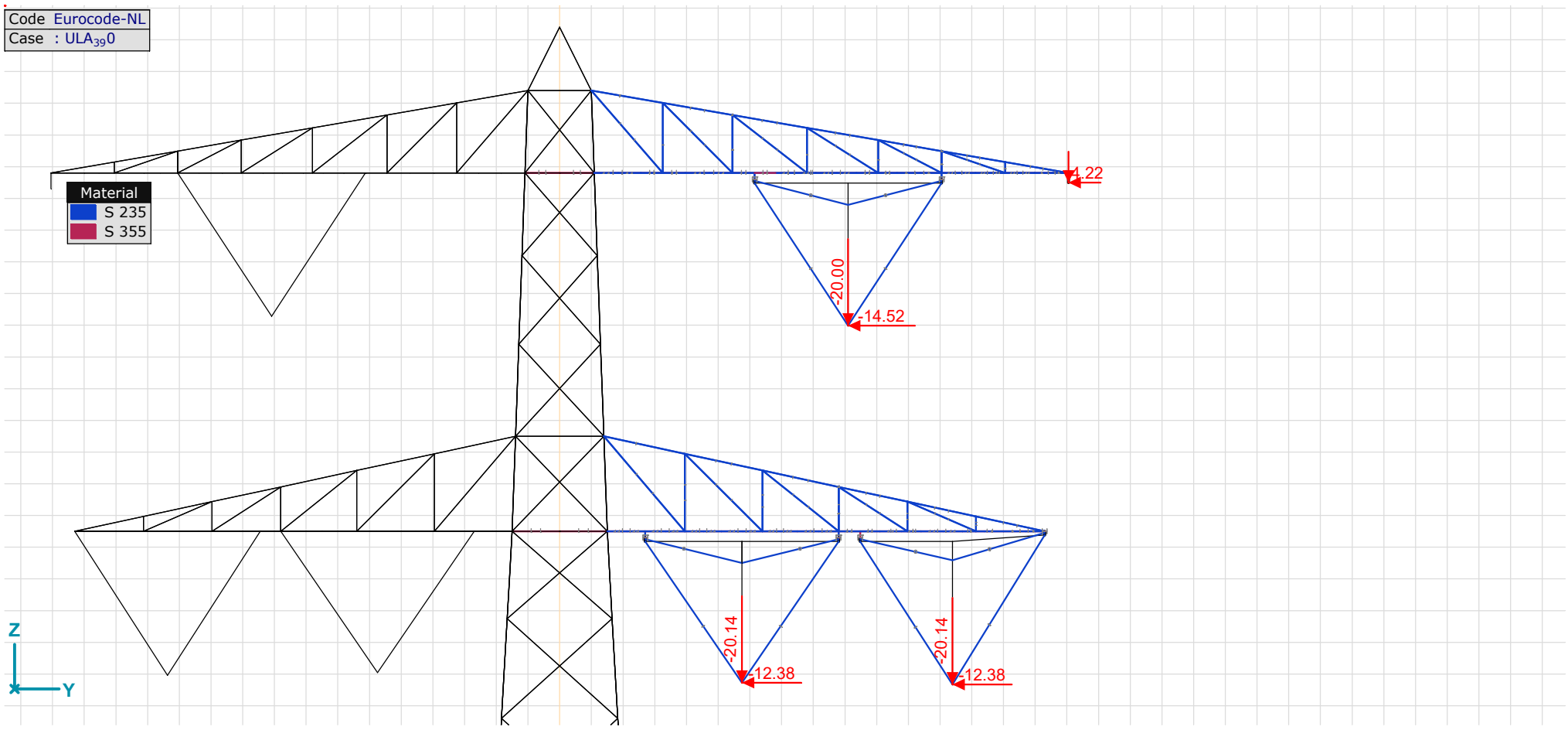


ULA_1a_270, Side view

ULA_3_90: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
251	Global	0	−12.38	−20.14	0	0	0
264	Global	0	−4.22	−3.95	0	0	0
370	Global	0	−14.52	−20.00	0	0	0
371	Global	0	−12.38	−20.14	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

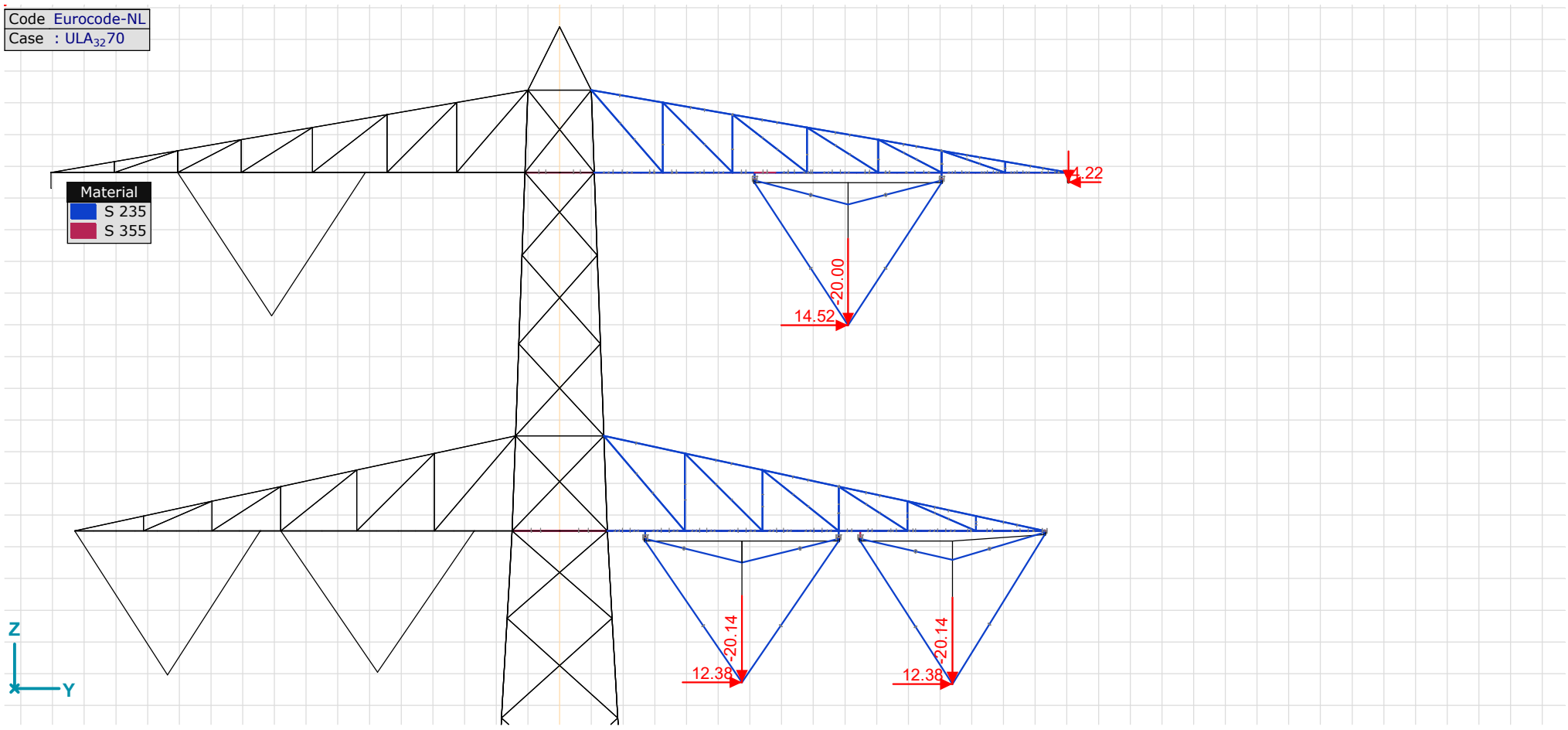


ULA_3_90, Side view

ULA_3_270: Nodal loads

	Direction	*Fx [kN]*	*Fy [kN]*	*Fz [kN]*	*Mx [kNm]*	*My [kNm]*	*Mz [kNm]*
251	Global	0	12.38	−20.14	0	0	0
264	Global	0	−4.22	−3.95	0	0	0
370	Global	0	14.52	−20.00	0	0	0
371	Global	0	12.38	−20.14	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

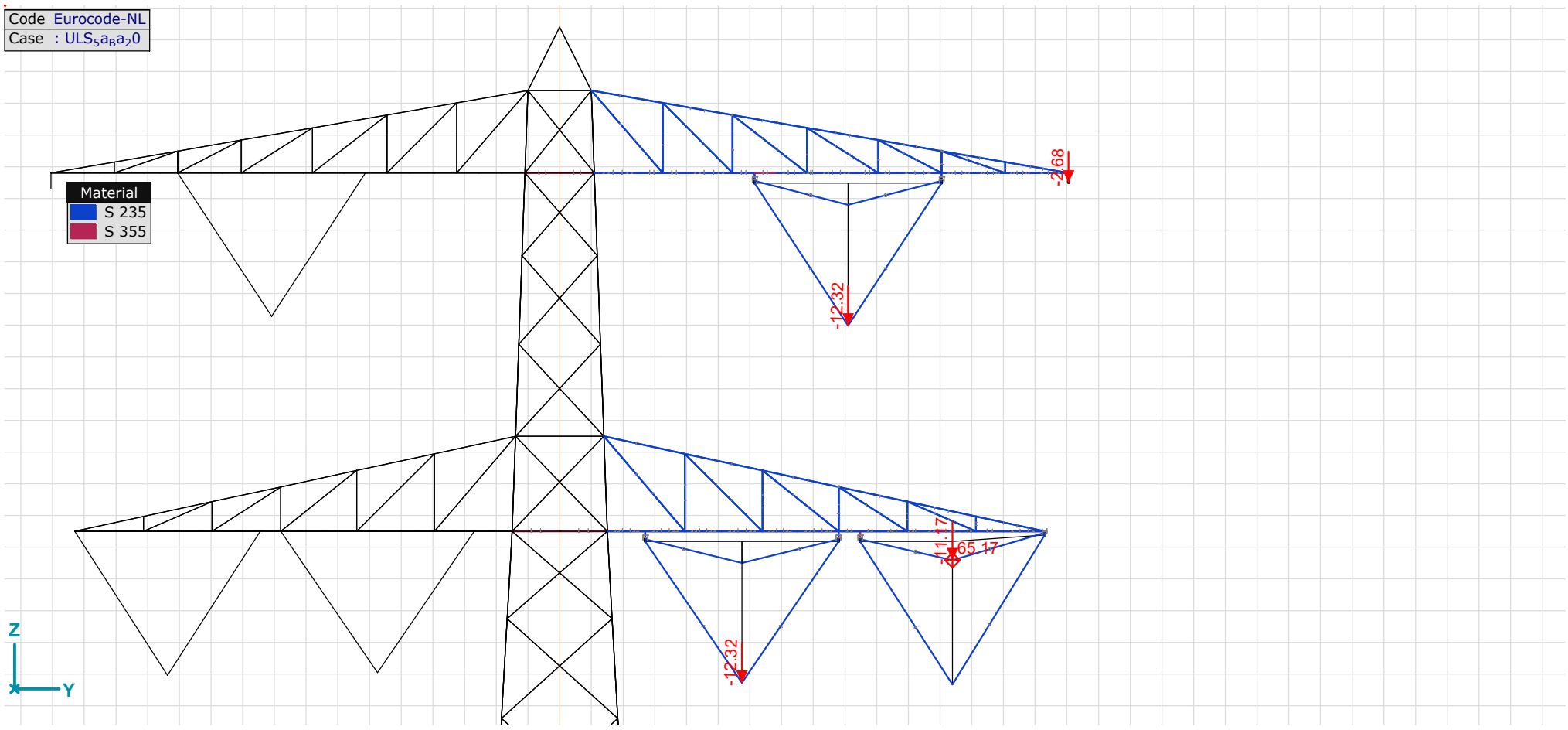


ULA_3_270, Side view

ULS_5a_Ba_20: Nodal loads

	Direction	*Fx [kN]*	*Fy [kN]*	*Fz [kN]*	*Mx [kNm]*	*My [kNm]*	*Mz [kNm]*
251	Global	0	0	−12.32	0	0	0
264	Global	0	0	−2.68	0	0	0
370	Global	0	0	−12.32	0	0	0
388	Global	65.17	0	−11.17	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

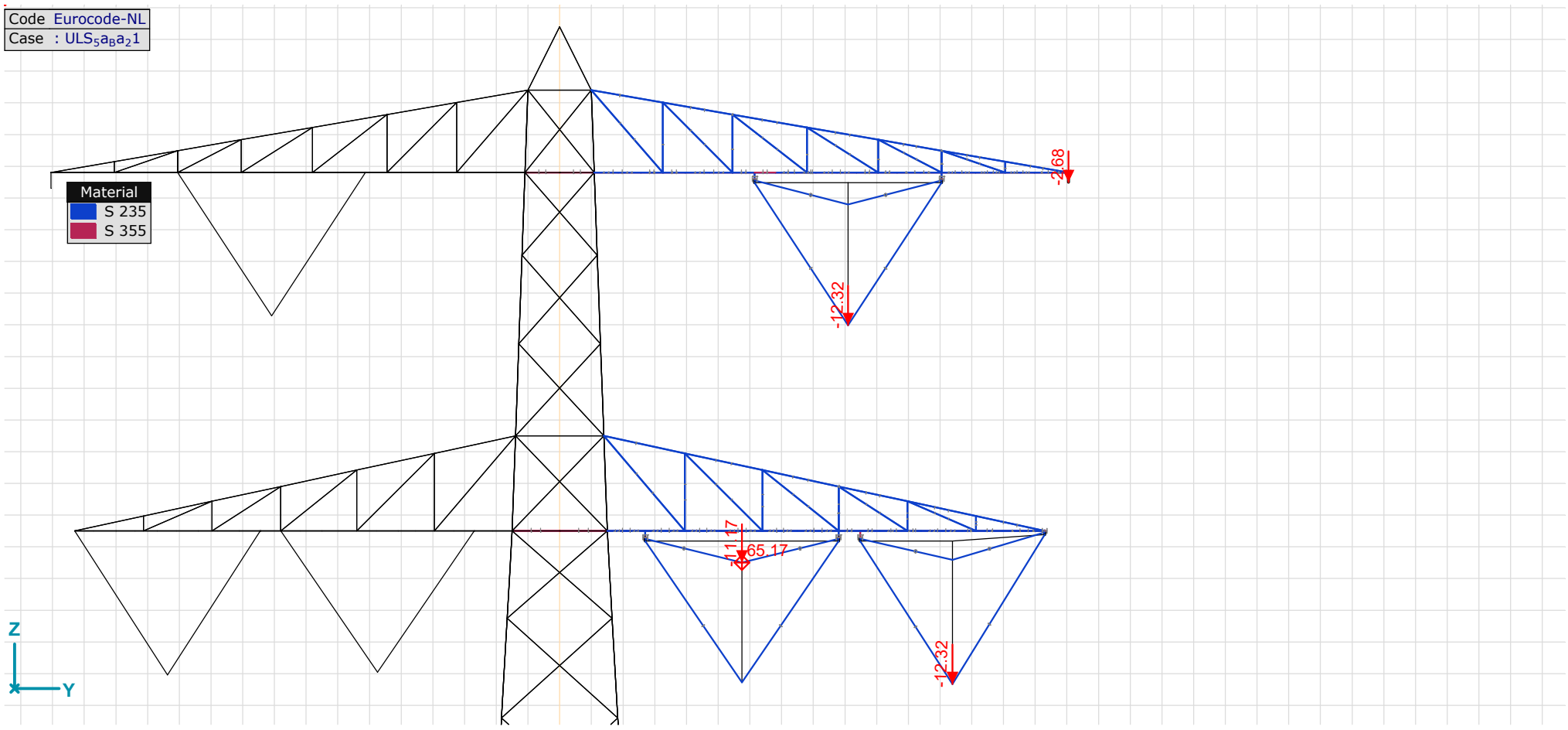


ULS_5a_Ba_20, Side view

ULS_5a_Ba_21: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
264	Global	0	0	−2.68	0	0	0
370	Global	0	0	−12.32	0	0	0
371	Global	0	0	−12.32	0	0	0
389	Global	65.17	0	−11.17	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

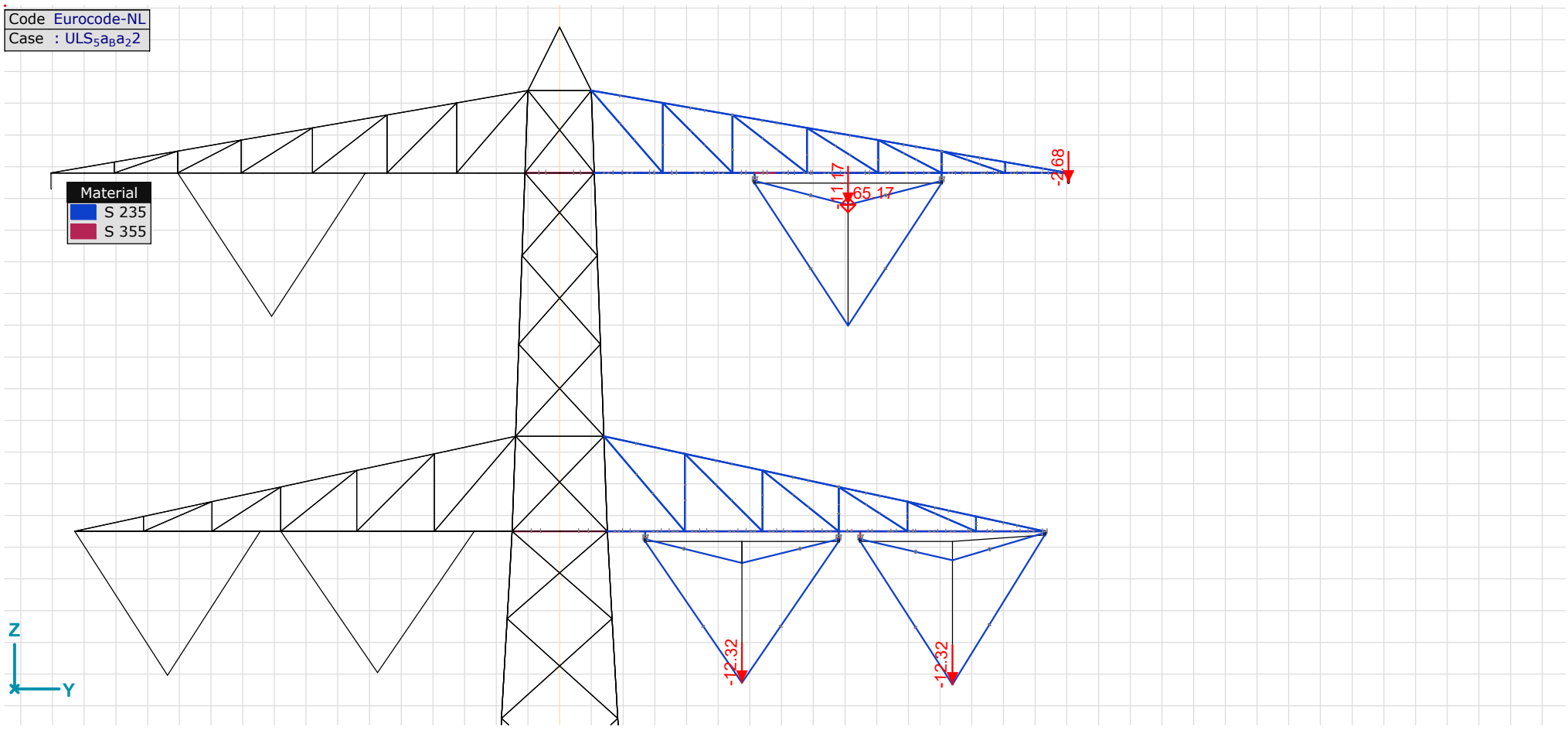


ULS_5a_Ba_21, Side view

ULS_5a_Ba_22: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
251	Global	0	0	−12.32	0	0	0
264	Global	0	0	−2.68	0	0	0
371	Global	0	0	−12.32	0	0	0
390	Global	65.17	0	−11.17	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

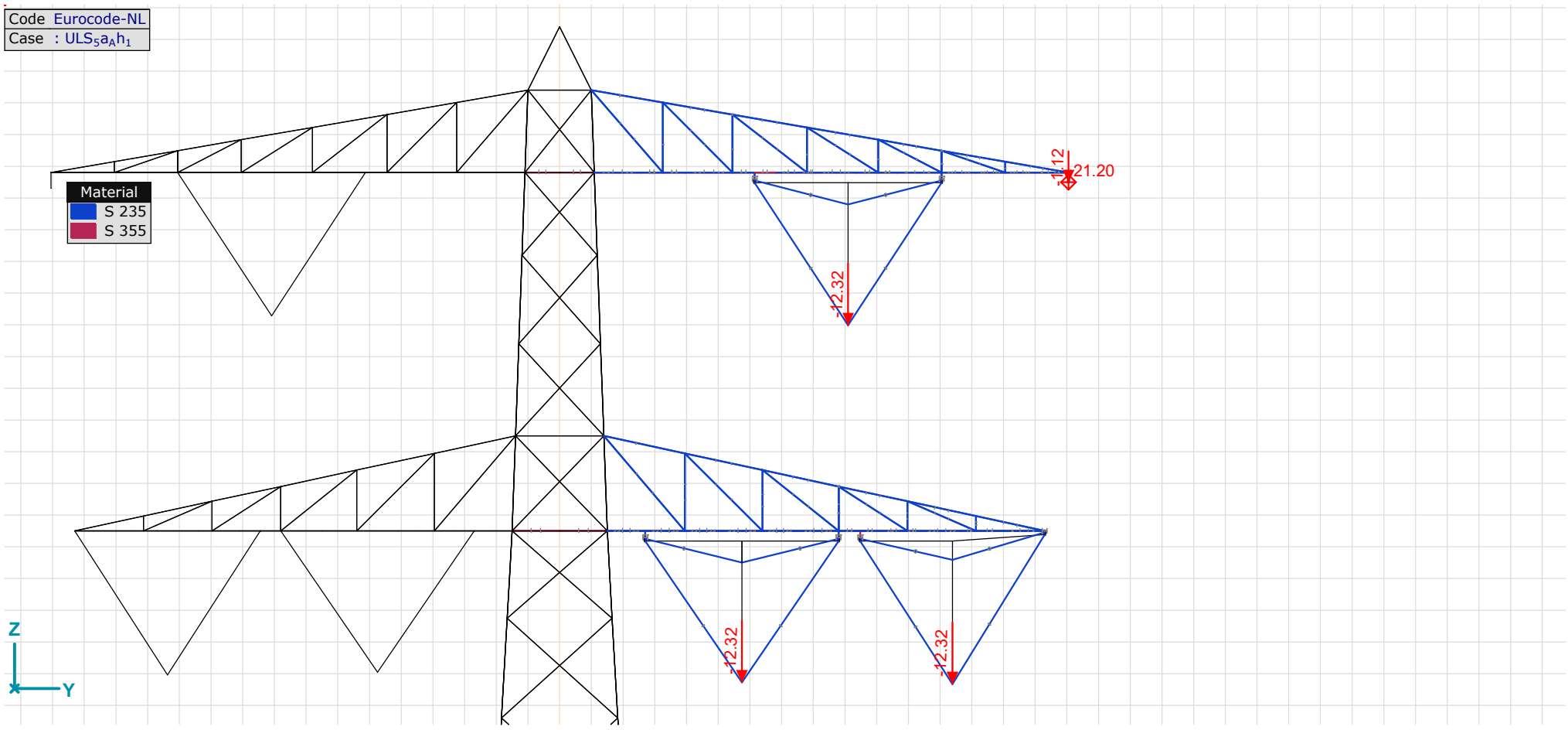


ULS_5a_Ba_22, Side view

ULS_5a_Ah_1: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
251	Global	0	0	−12.32	0	0	0
264	Global	21.20	0	−1.12	0	0	0
370	Global	0	0	−12.32	0	0	0
371	Global	0	0	−12.32	0	0	0

Fx, Fy, Fz: Load force component; **Mx, My, Mz:** Load moment component;

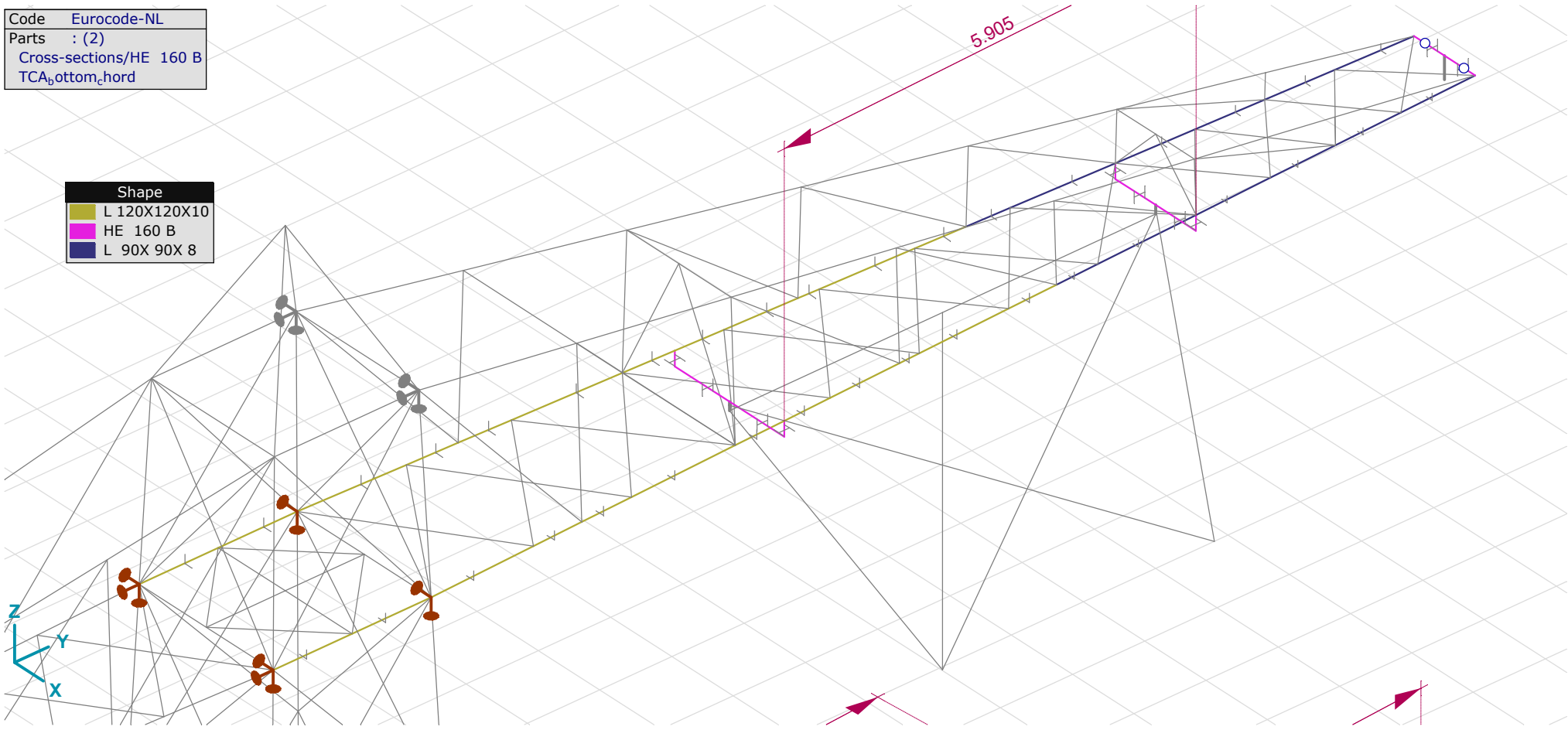


ULS_5a_Ah_1, Side view

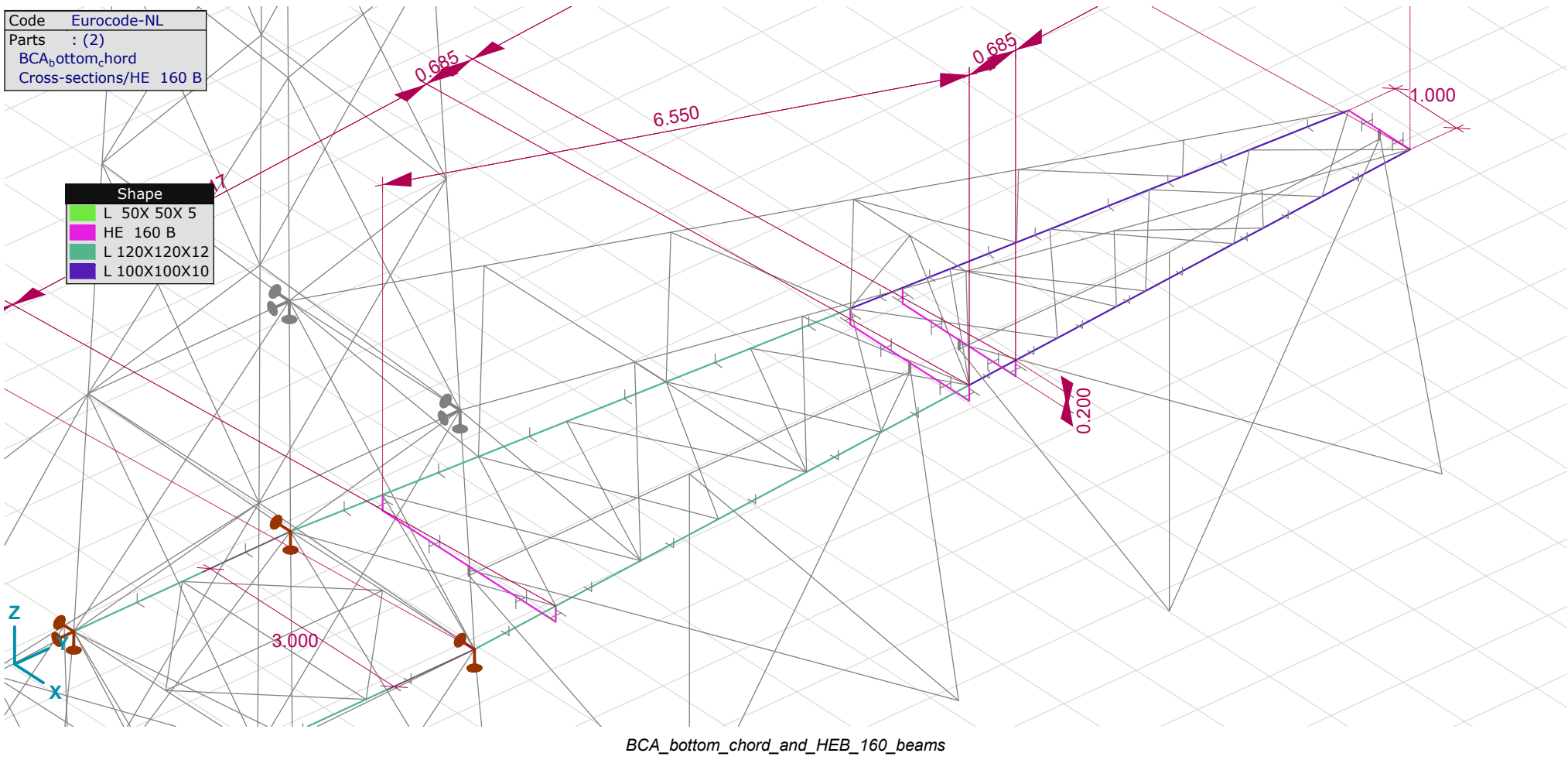
Custom load combinations by load cases

	Name	Type	EG	ULA_1a_90	ULA_1a_270	ULA_3_90	ULA_3_270	ULS_5a_Ba_20	ULS_5a_Ba_21	ULS_5a_Ba_22	ULS_5a_Ah_1	Comment
1	Co #1	ULS	1.00	1.00	0	0	0	0	0	0	0	
2	Co #2	ULS	1.00	0	0	1.00	0	0	0	0	0	
3	Co #3	ULS	1.00	0	0	0	0	1.00	0	0	0	
4	Co #4	ULS	1.00	0	0	0	0	0	1.00	0	0	
5	Co #5	ULS	1.00	0	0	0	0	0	0	1.00	0	
6	Co #6	ULS	1.00	0	0	0	0	0	0	0	1.00	
7	Co #1a	ULS	1.00	0	1.00	0	0	0	0	0	0	
8	Co #2a	ULS	1.00	0	0	0	1.00	0	0	0	0	

Name: Load combination name; **Type:** Load combination type; **EG, ULA$_1$a$_9$0, ULA$_1$a$_2$70, ULA$_{39}$0, ULA$_{32}$70, ULS$_5$a$_B$a$_2$0, ULS$_5$a$_B$a$_2$1, ULS$_5$a$_B$a$_2$2, ULS$_5$a$_A$h$_1$:** Factor;



TCA_bottom_chord_and_HEB_160_beams



BCA_bottom_chord_and_HEB_160_beams

APPENDIX G
Berekening klimladder

DNV·GL

LADDER STRUCTURE S-6 MAST 28

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6 BIJLAGE: UITVOER AXISVM. 14

1 INTRODUCTION

The following report contains structural calculations for the ladder in tower 28. The report also studies the platforms at the cross arms and plan brace at the third crossing of the tower diagonals. These additional built structures are required to access the tower for maintenance purposes. Tower 28 is of the type S-6. The tower provides the access to the crossarms from the third crossing diagonal.

Figure 1 shows the ladder embedded in the tower body. The ladder is supported on the existing members of the tower. The ladder is supported laterally at crossing of the tower diagonals by a new element between the horizontals in the tower body at that location. The ladder system is checked for wind loading as well as the live loading as per Eurocodes and TenneT recommendations. The efficacy of the structural system supporting the ladder is checked by comparing the stress developed in the model using a non-linear calculation with the allowable stress. Axis VM report is attached behind this report within appendix G.

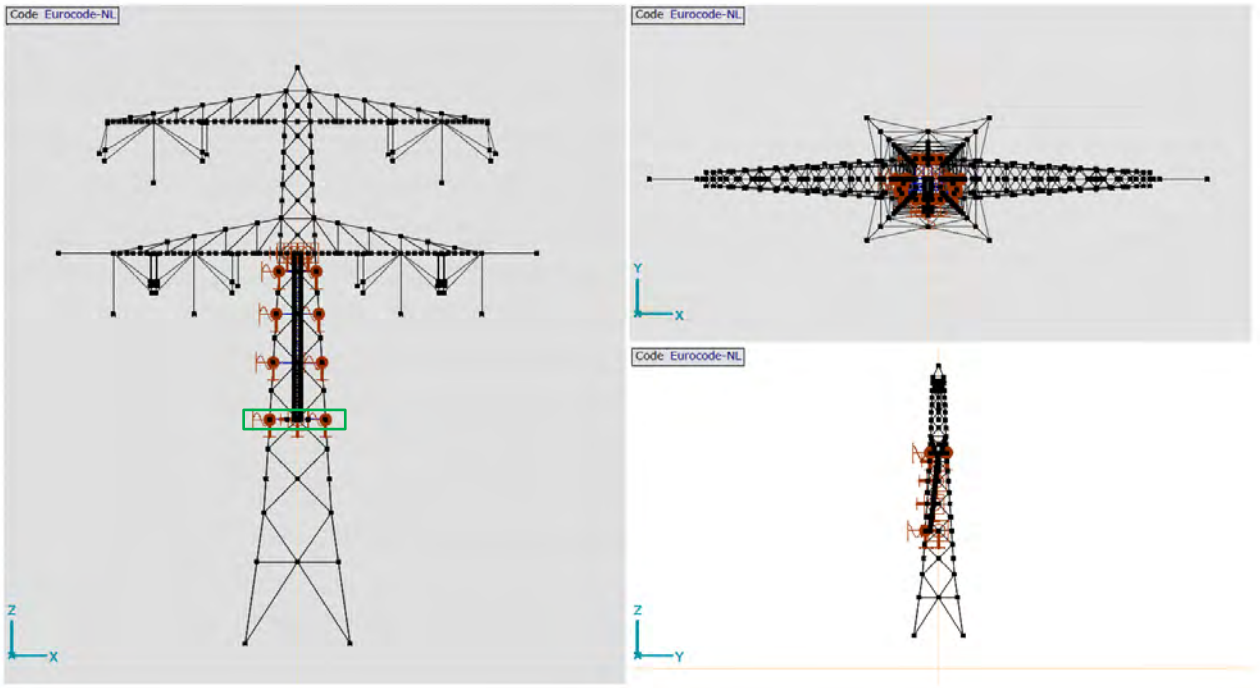


Figure 1 Location of ladder in the S-6 tower.

2 GEOMETRY

Stepping rungs have a width of 400mm, 20 mm diameter steel rods acts as rungs. The rungs are spaced at 300mm c/c along the length of the ladder. The platforms at the bottom and the top are 600mm x 600mm in size, this is based on NEN-EN 50341-2-15. The geometry of the ladder is shown in Figure 2. The chords of the ladder is L100x50x6. Furthermore, the chords of the ladder are supported in the horizontal at every in between crossing of the diagonals. The platforms both at top and bottom are supported by adding new elements to the exiting plan bracing of the tower. The majority of the new elements supporting platform are L80x80x8. An overview sketch is provided in Figure 2.

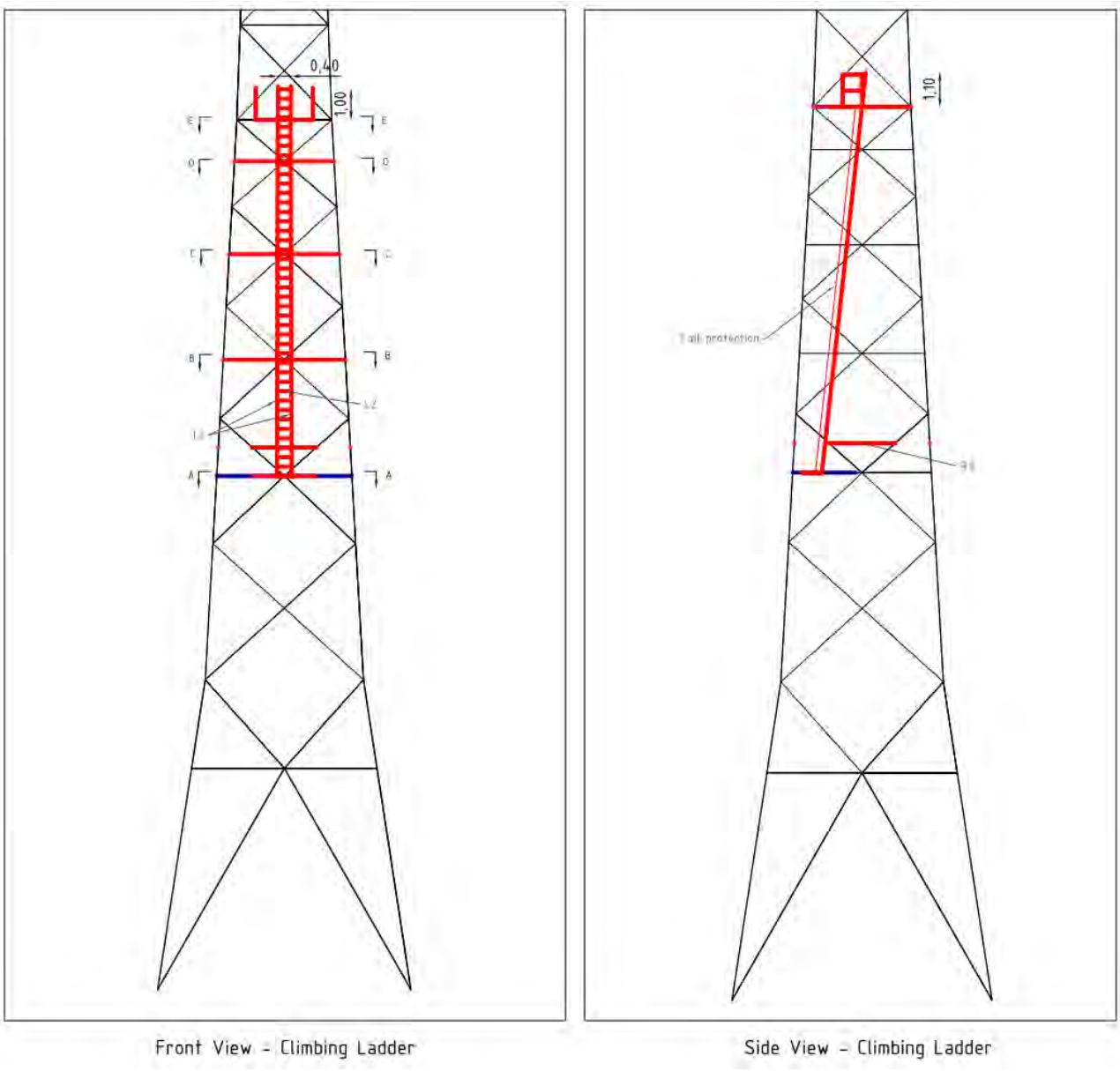


Figure 2a Overview sketch of ladder

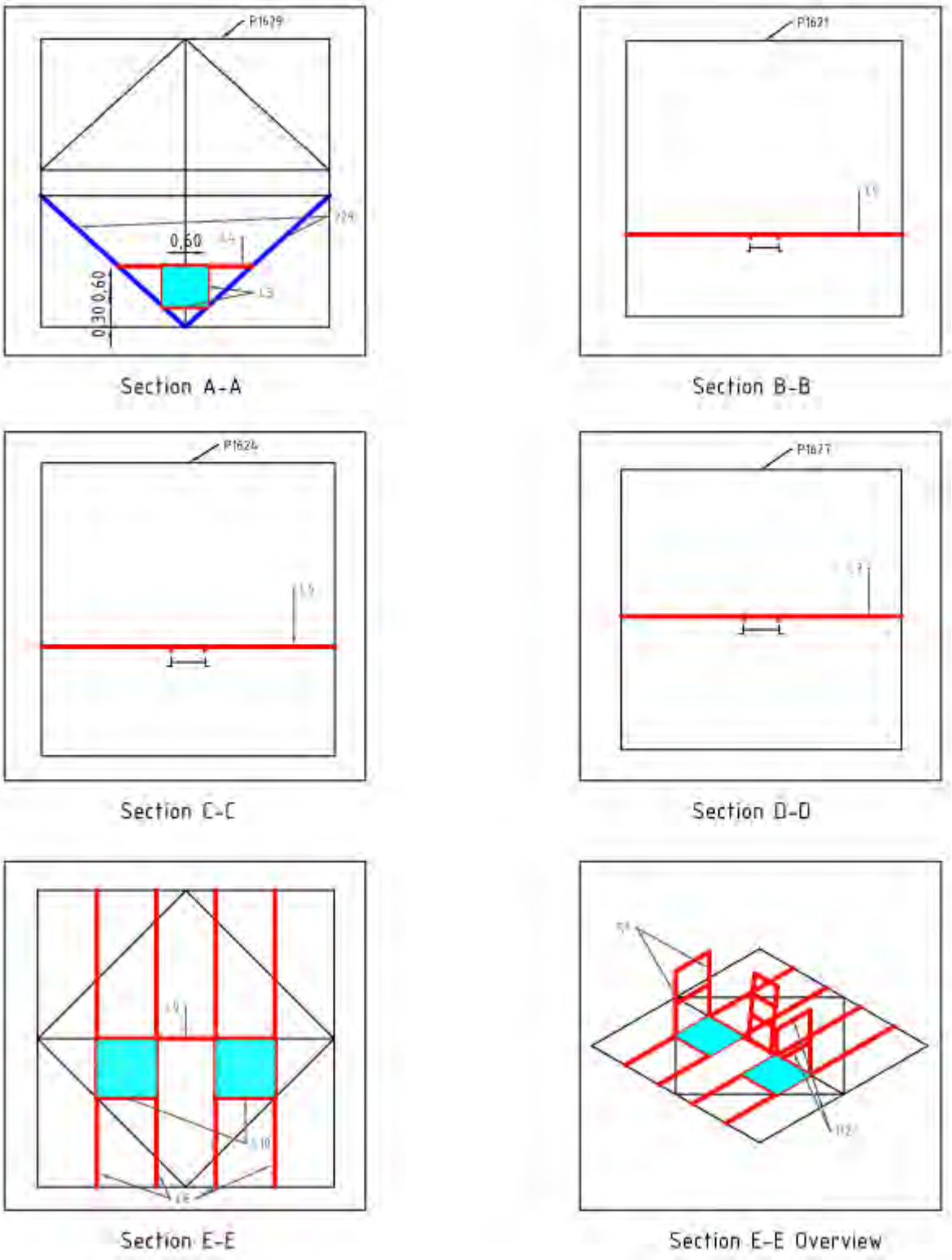


Figure 2b Overview sections of ladder

The details of the cross section are given in Figure 3.

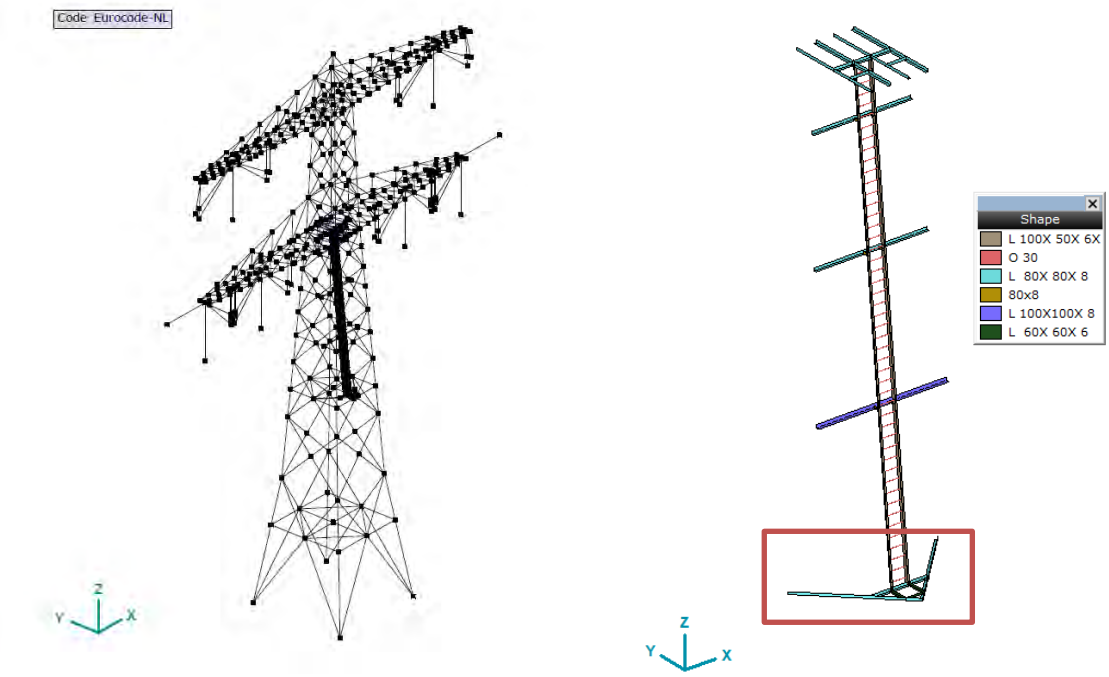


Figure 3 Geometry of the isolated ladder from the S-6 tower

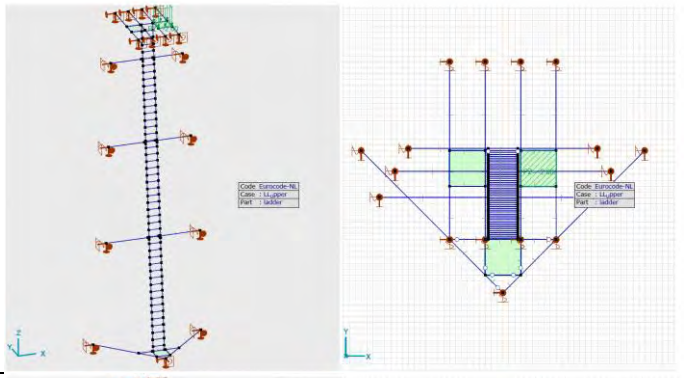
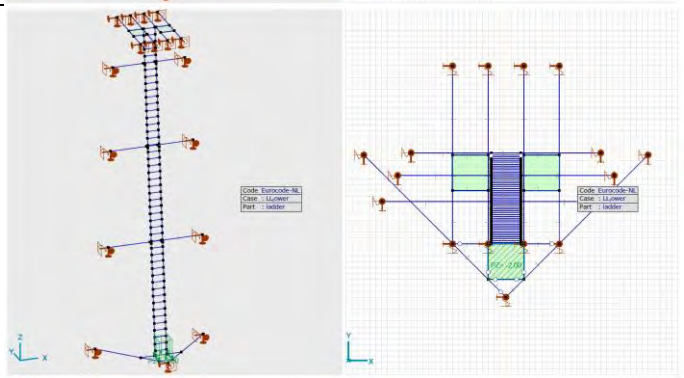
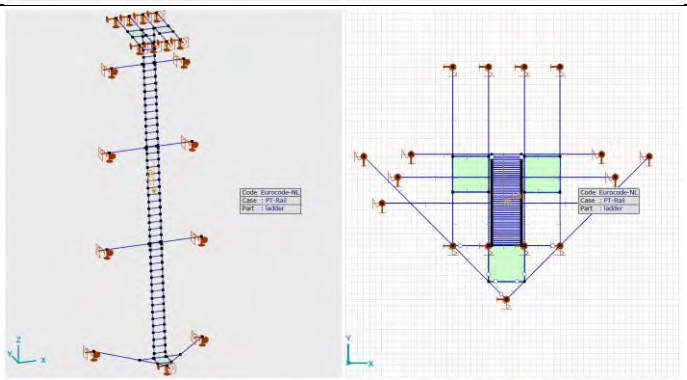
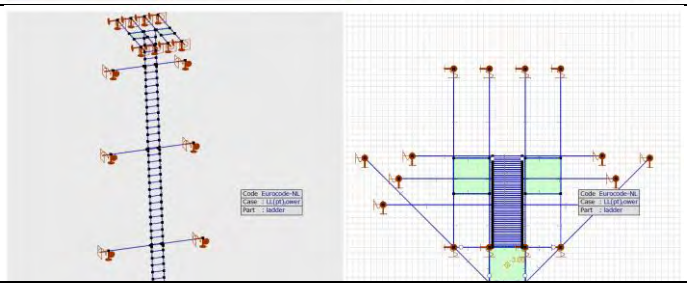
2.1 Supports

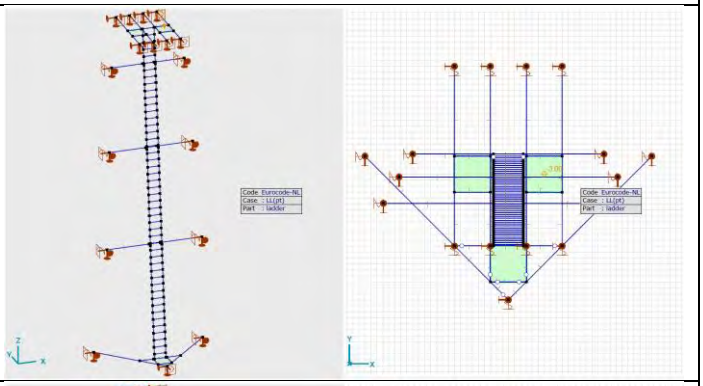
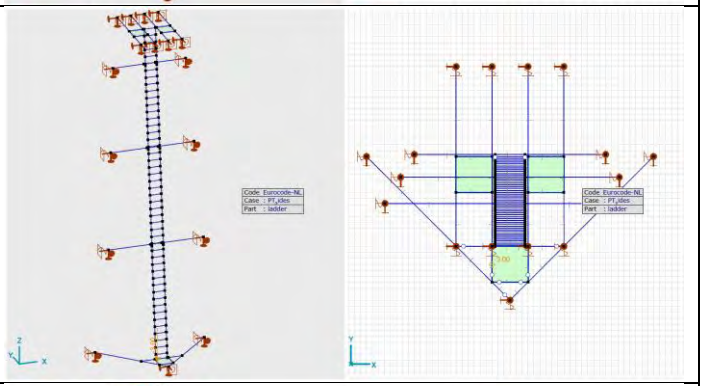
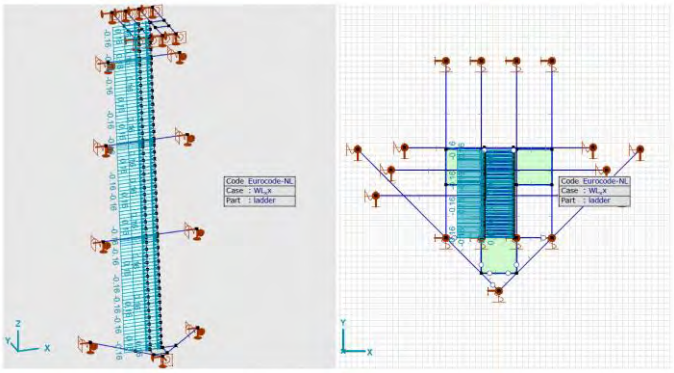
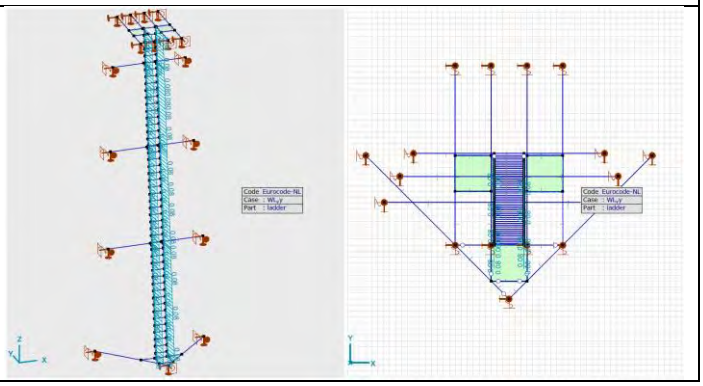
The elemets supporting the ladder and platforms are given hinged supports. The supports are the location where the new elements get integrated with the existing members of the tower. The exiting tower members are asuumed to be rigid compared to the new elements in translation. The connection are assumed to provided suffiencient torsional rigidity. The small elements of 80 x 8 mm flats are released at ends to transfer only horizontal force to the chord members of the ladder at intermidiate supporting points. The entire vertical load in ladder is taken by the members forming the bottom platform as marked in red box in Figure 3.

3 LOADING

The loading applied on the ladder is in accordance with the Eurocodes with preference to the TenneT recommendations. Live load applied on the platform and ladder is in accordance to NEN-EN 50341-2-15(2019) : Table 4.9/NL.1. The details of the loading are given in the table 1 below:

Table 1 Details of load cases

Sr. No.	Load Case	Particular	Load aplied in PLS tower model
1	LL_upper	Live load is applied to one of the platform taking advantage of the symetry. The applied load is 2kN/m^2.	
2	LL_lower	The live load explained in the previous load case is applied at the bottom platform.	
3	PT_Rail	A point load of 1.5kN is the middle of the middle span of the ladder. The middle span is chosen as it's the longest.	
4	LL_pt_lower	3kN point load is applied on the middle of the lower platform.	

5	LL_pt_upper	3kN point load is applied on the middle of the upper platform.	
	PT_sides	Point load of 3kN is applied on the edge of the lower platform. This is simulates the case of heavy load kooked to the edge of the platform.	
	Wind_xx	Wind load is applied as per the calculations in the Geleiderbealsting sheet for the corresponding tower. The pressure P_z = 1.6kN/m^2. The pressure is multiplied with the width of the crossection of the (100mm) and a drag factor of 1. The value of UDL applied is 0.16kN/m.	
	Wind_yy	The loads are calculated as expalined for Wind_xx load case. The only difference is the width of the crossection (50 mm). Hence the applied UDL is 0.08kN/m.	

	EG	Self weight is applied as shown on right.	

Load combination: The load combinations developed in the axis VM model is as per the TenneT recommendation defined in : page 73: PVE.05.000 Lijnen. The figure below shows the recommendation values for loads for verbouwniveau. The important load combinations are boxed in red.

4.13/NL.1 - Partial factors and combination factors (Ultimate Limit State, ULS)

"Repair or Renewal" Verbouw/CC2/50j

Nr	Loadcase	Temp [°C]	γg(1)	γq			γa
			Gk	Qpk	Qwk	Qik	Ak
1a	Wind	10	1,15	-	1,40	-	-
2	Not relevant	-	-	-	-	-	-
3	Wind + ice	-5	1,15	-	0,42	1,30	-
4	Min temp + wind	-20	1,15	-	0,28	-	-
5a	Torsional loads	10	1,0	1,0	-	-	1,0
5b	Longitudinal loads	10	1,0	-	-	-	1,0
6a	Construction + maintenance	5	1,15	1,3	0,28	-	-
6b	Weight of linesmen	5	1,15	1,3	0,28	-	-
7	Permanent	10	1,30	-	-	-	-
8	Special	10	1,0	-	-	-	1,0

4 RESULTS

The results from the axis VM are presented below and conclusions are laid out in the subsequent sections.

4.1 Deflection

The max deflection of 16 mm is observed in the ladder middle of the ladder, it is because the supporting beams act as flexible supports. This equates to a ratio of l/810. This is within the acceptable limit of l/250. The deflection in the post processing of Axis VM is shown in Figure 4.

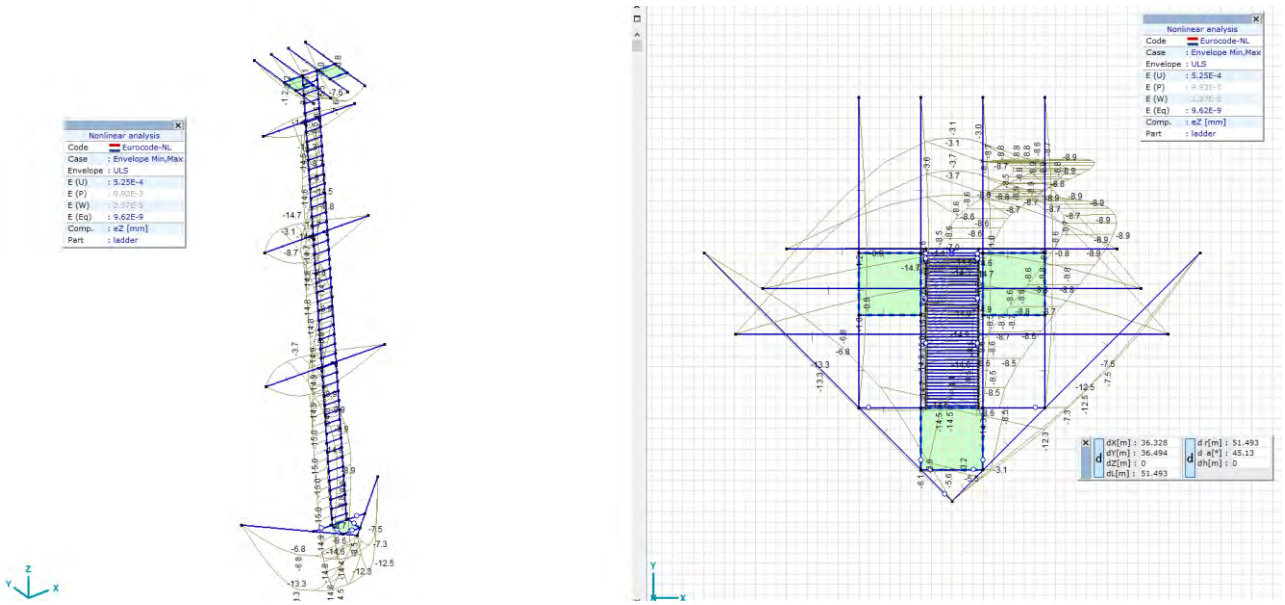


Figure 4 Deflection in the ladder

4.2 Internal forces

The internal forces in the ladder in shown in Figure 5. The chord members forming the ladder are loaded by axial force. The horizontal members have larger bending in both major and minor axis. The maximum internal forces in the ladder and platform is

N (axial force) − 11.4 kN (tension) & 4.1 kN (compression)

Myy (major axis moment) - 2.1 kNm

Mzz (minor axis moment) - 1.4 kNm

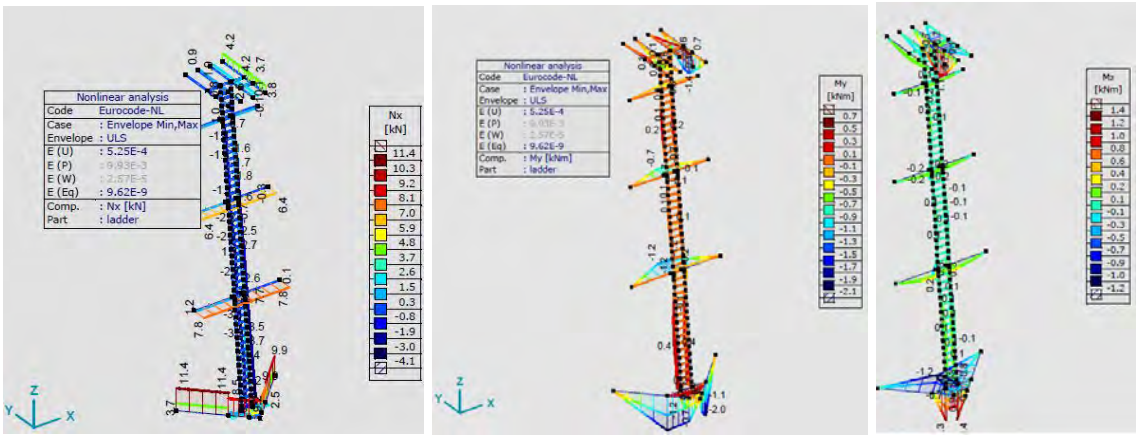


Figure 5 Internal forces in the ladder and platform.

4.3 Stability in vortex shedding and galloping

The natural frequency of the structure is calculated via the vibration analysis of the Axis VM. The natural frequency is the 4.7 Hz. This is used to calculate the critical velocity for vortex shedding. The natural frequency and the primary mode of deformation of the structure is shown in Figure 6.

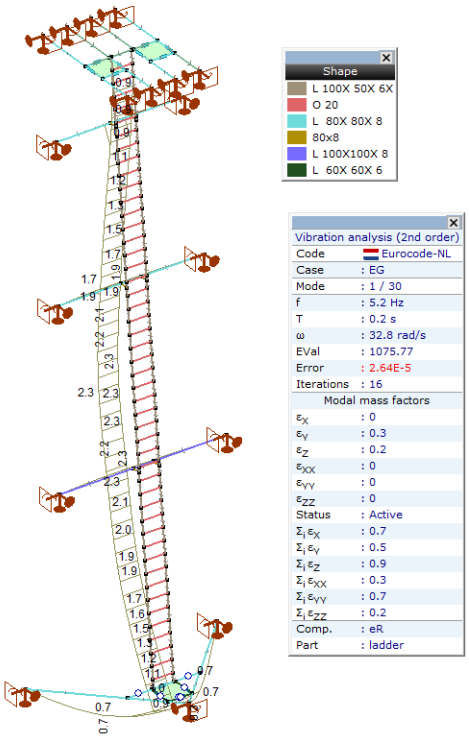


Figure 6 Primary mode of vibration of ladder.

The check for the dynamic stability of the ladder as is shown in the scanned images of calculations below:

(a) Check for Vortex shedding :- (Annex E)

(A) → Criteria for Vortex shedding

(1) $\frac{\text{Largest dimension}}{\text{smallest dimension}} = \frac{15.3}{0.45} > 6$ — ✓ — E.1.2

(2) Porosity of structure < 8% — × — ICE recomendation

→ structure not susceptible to vortex shedding

→ Initial indication of no vortex shedding

→ Mathematical criteria of vortex shedding

Equation E.1.2 — eq. — (E1)

$V_{crit,i} > 1.25\, V_m$.

V_m – 10 min mean speed.

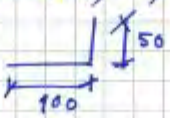
(B) Equation (E.3) — $V_{crit,i} = \frac{b}{S_t} n_{iy}$

b – dimension of element

n_{iy} – Natural frequency

S_t – strouhal no.

→ Referencing S_t (strouhal no.) from table E.1

for d/b  $= \frac{100}{50} = 2$

$S_t = 0.07$

$b = 50$ mm.

n_{iy} (axis V_M calc.) $= 5.2$ Hz

$V_{mean} = 20 - 30$ m/sec.

$V_{crit,i} = \frac{50 \times 5.2}{1000 \times 0.07} = 4.0$ m/sec.

$\boxed{\not> 1.5 \times 20}$ — no lock in.

→ Critical wind velocity for structure doesnot occur.

(C) E.1.3.3 :- The susceptibility of vibration depends on structural damping and the ratio of structural mass to fluid mass.

Equation E.4 — $S_c = \frac{2\delta_s . m_{i,e}}{\rho . b^2}$

δ_c – structural damping

$m_{i,e}$ – mass unit length

δ_c (for steel work) $= 0.012$.

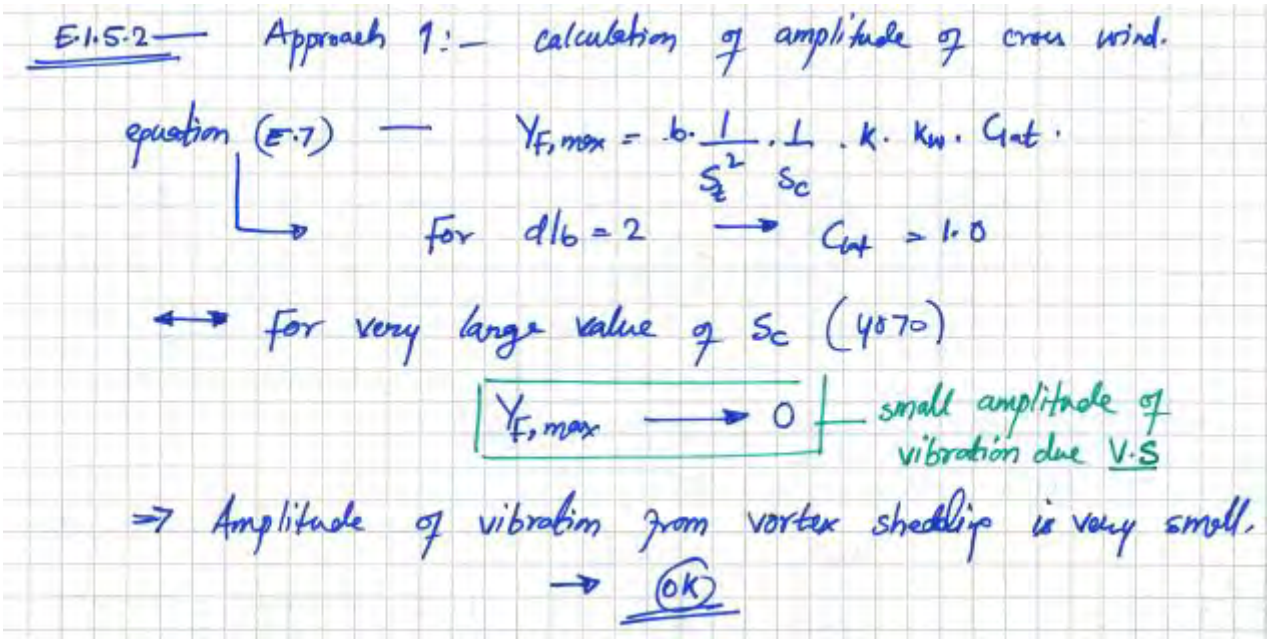
$\Rightarrow S_c = \frac{2 \times 0.012 \times 530}{1.25 \times (0.05)^2}$

$= 4070 > V_{mean}$

For mode 1 :- $m_{i,e}$ (mass/unit length) $= \frac{2 \times (100 \times 50) \times 2 + \pi . (20)^2 \times 450 \times 0.3}{10^6} \times 7850$

D

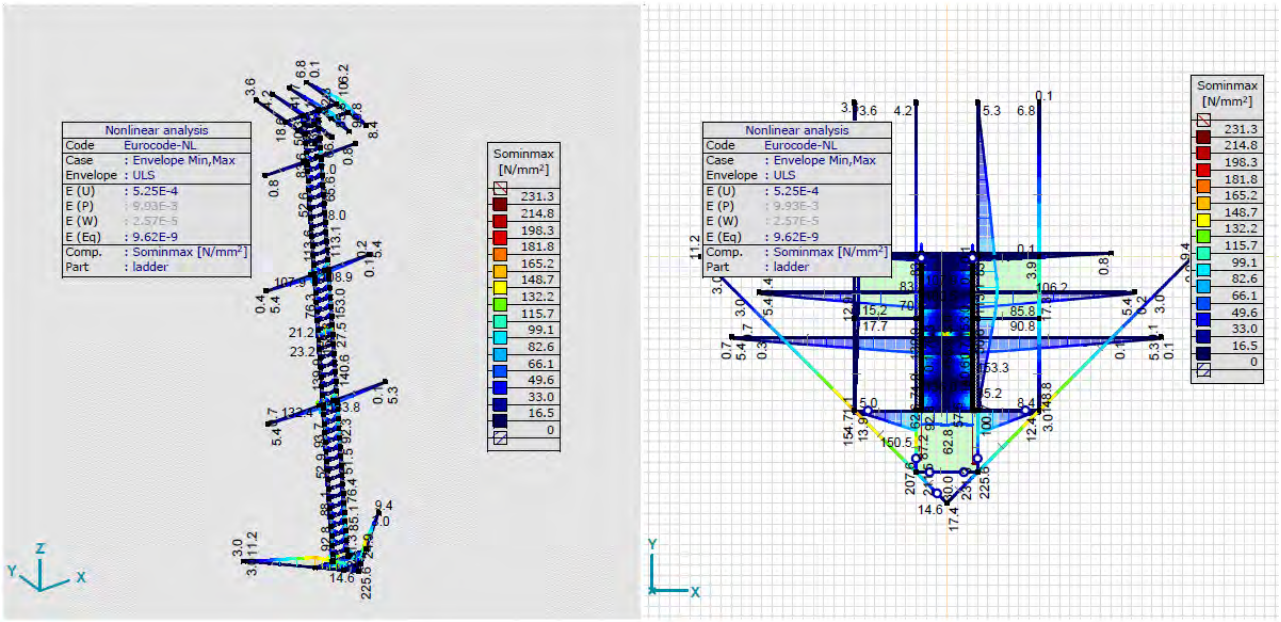
≈ 530 kg



The structure is found immune to vortex shedding as shown above.

4.4 Check of members

The max stress observed in the structure is 173 MPa for the envelope of the ULS load combinations. This is considerably less than the yield limit of 355 MPa. This additional load carrying capacity should be enough for the losses due to effects in connections (bolt holes).



5 CONCLUSION

The system acting as ladder and supporting the platforms is found adequate in ULS loading. The efficacy is checked by comparing the stress in the structure due to loading to the permissible stress of S355 steel. Furthermore, the struture is found safe in dynamic stability check as per Eurocode.

6 BIJLAGE: UITVOER AXISVM.

Project

Analysis by

AxisVM X5 R4a · Registered to DNV GL - Energy
Model_ladder.axs

Report

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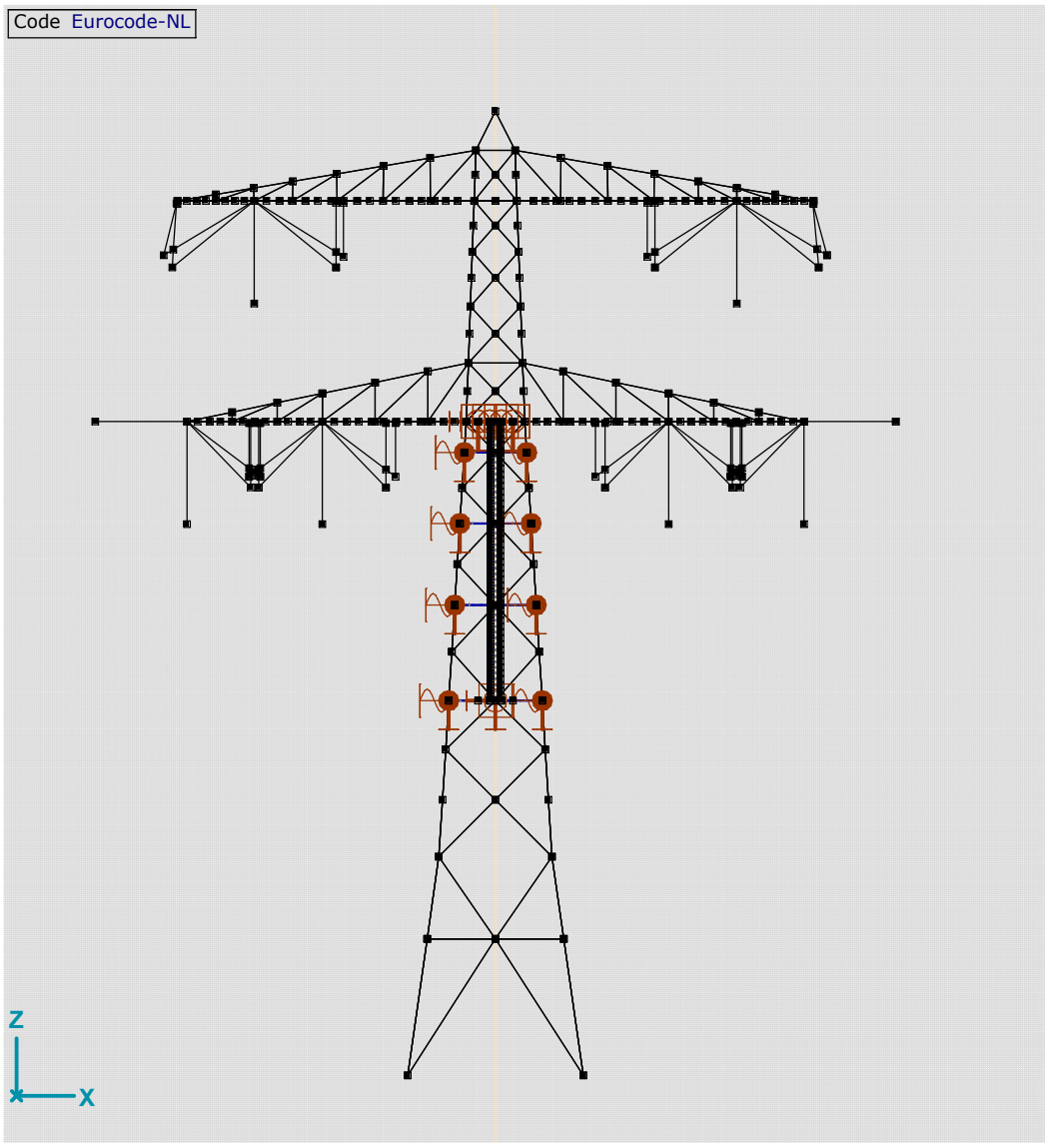
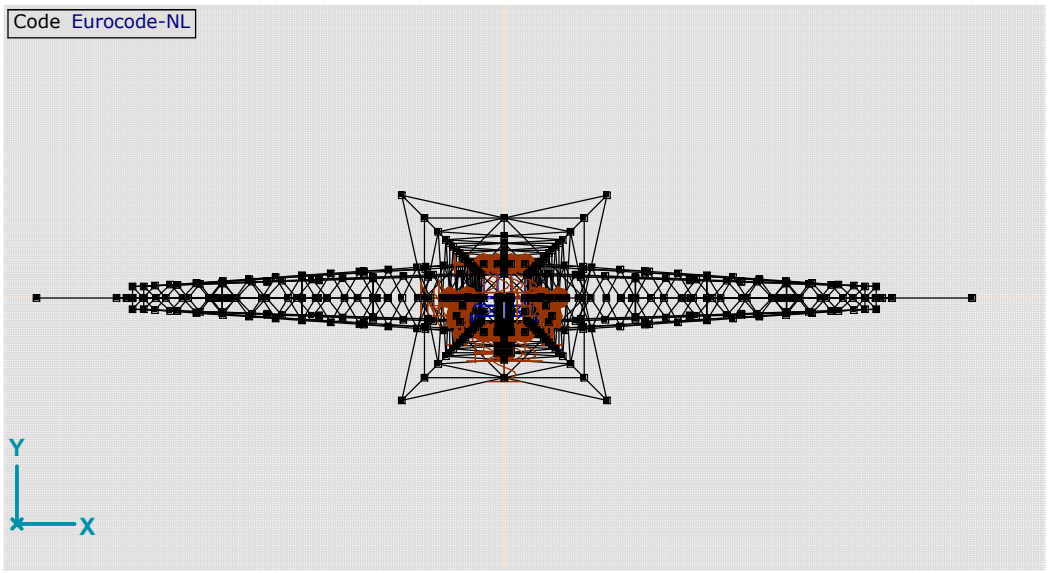
Materials

	Name	Type	National design code	Material code	Model	E_x [N/mm²]	E_y [N/mm²]	ν	α_T [1/°C]	ρ [kg/m³]	Material color	Contour color	Texture	P_1
1	S 235	Steel	SIA 26x (Swiss)	SN EN 10025	Linear	210000	210000	0.30	1E-5	7850			Steel	f_y[N/mm²] = 235.00
2	S 355	Steel	Eurocode-NL	10025-2	Linear	210000	210000	0.30	1.2E-5	7850			Steel	f_y[N/mm²] = 355.00

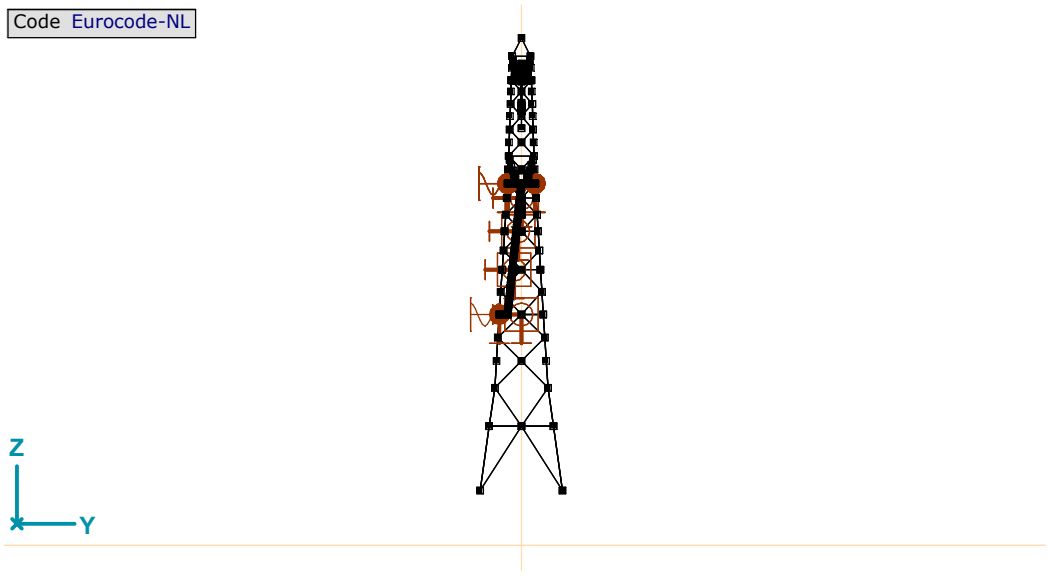
	Name	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}
1	S 235	f_u[N/mm²] = 360.00	f_y^*[N/mm²] = 215.00	f_u^*[N/mm²] = 340.00										
2	S 355	f_u[N/mm²] = 510.00	f_y^*[N/mm²] = 335.00	f_u^*[N/mm²] = 470.00										

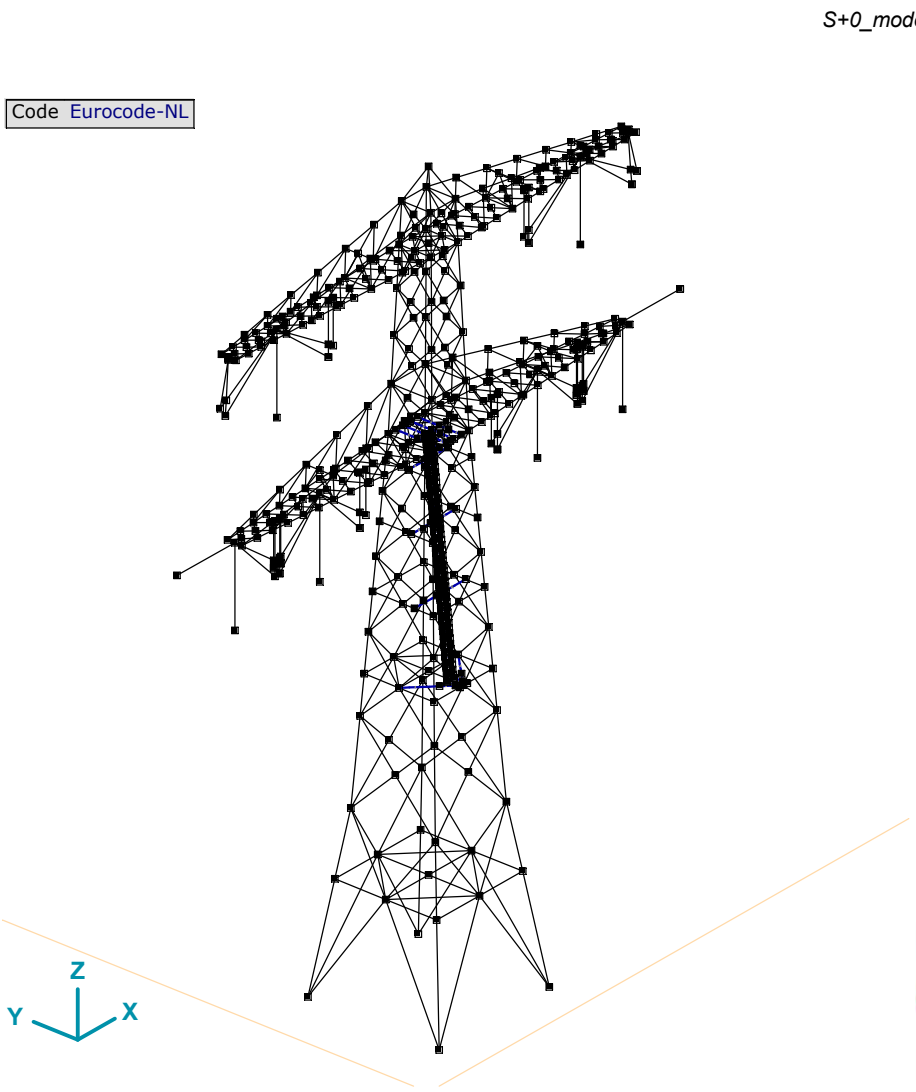
Name: Material name; **Type:** Type of material; **Model:** Material model; **E_x:** Young's modulus of elasticity in local x direction; **E_y:** Young's modulus of elasticity in local y direction; **ν:** Poisson's ratio; **α_T:** Thermal expansion coefficient; **ρ:** Density; **Contour color:** Material outline color; **P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}:** Design parameter;



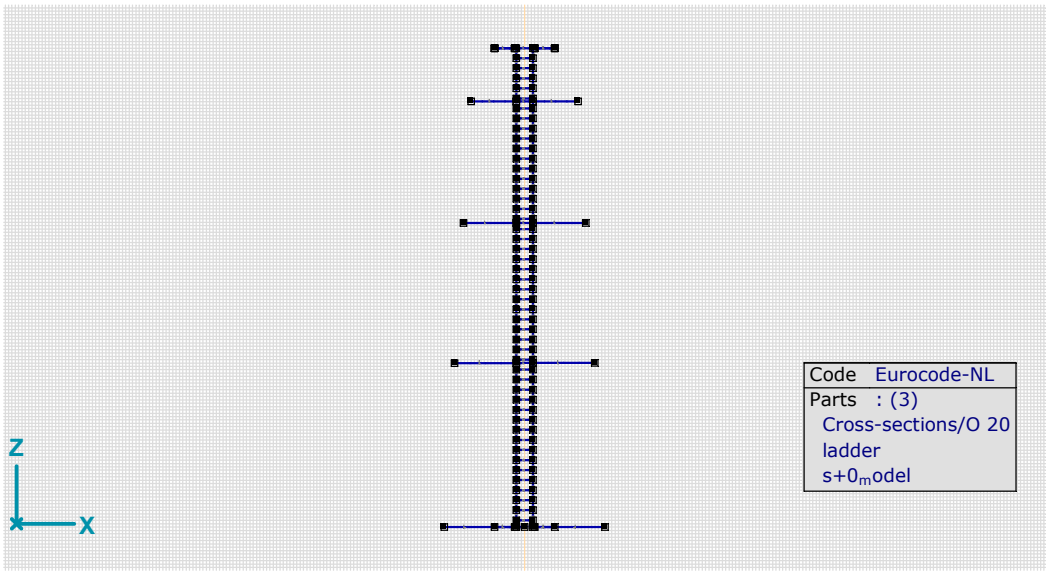


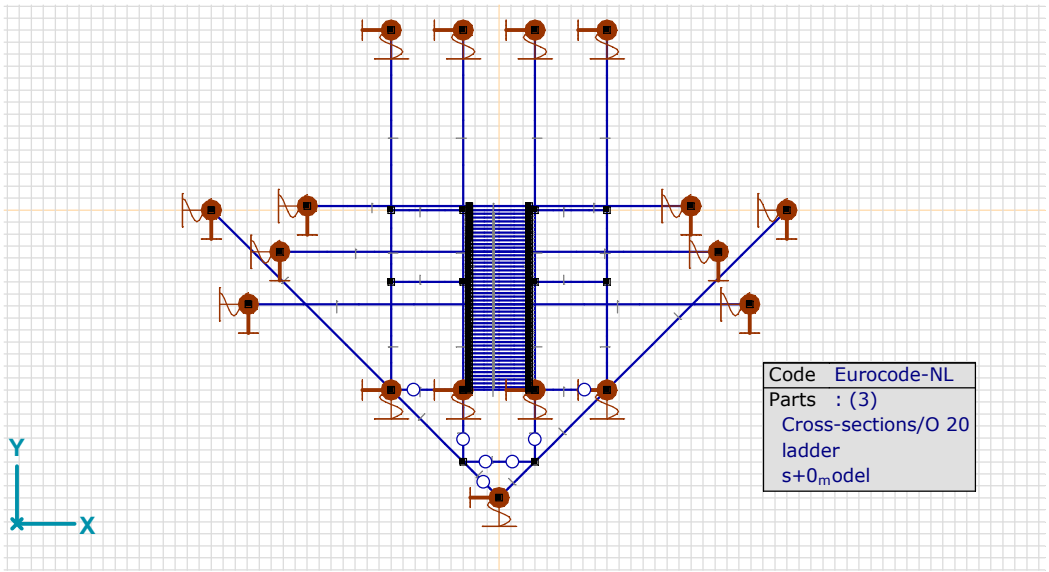
S+0_model_ladder

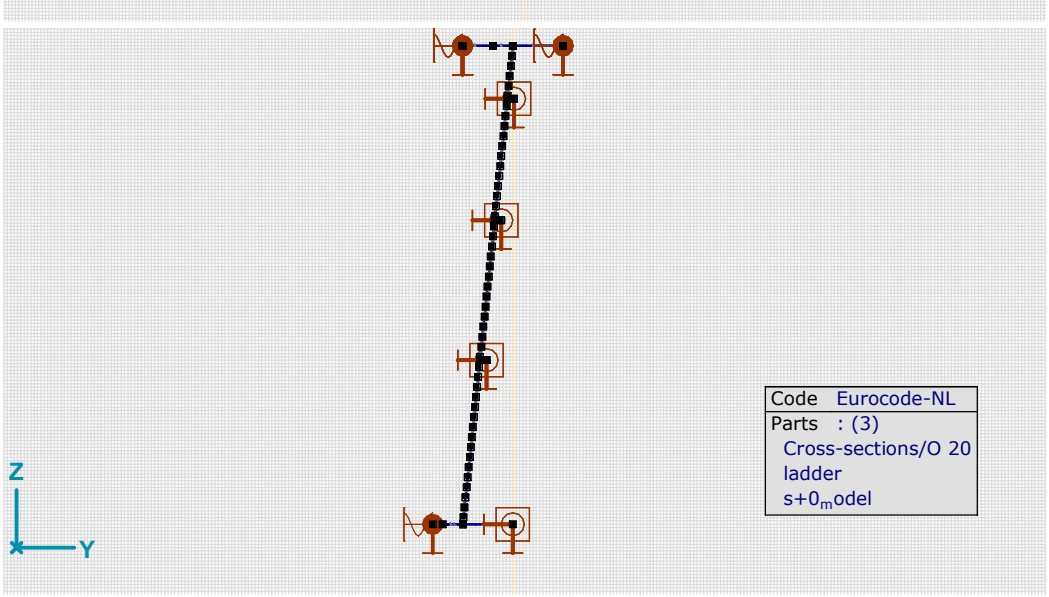


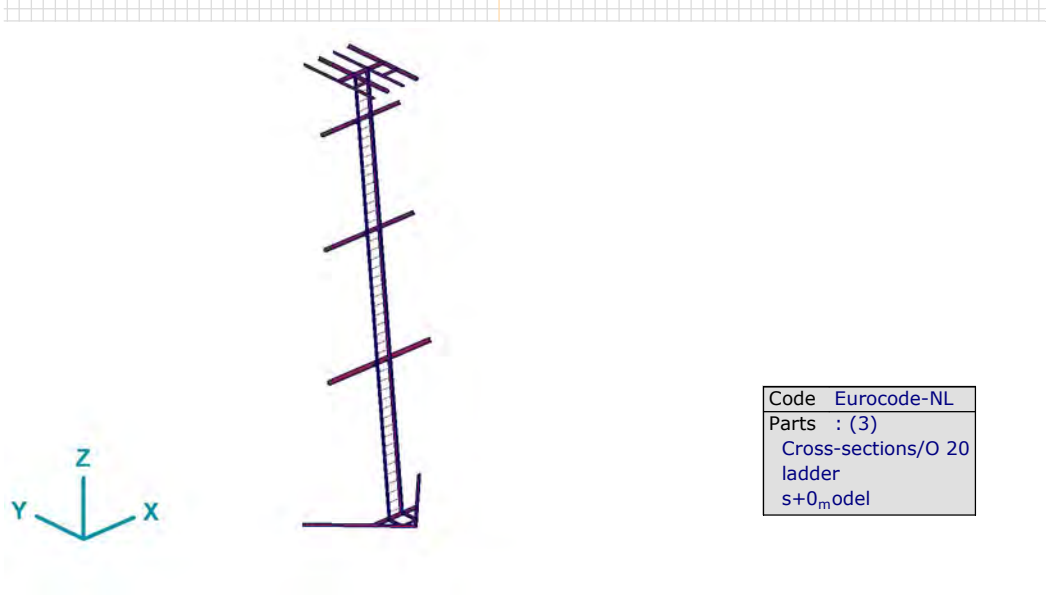


ladder_3D









ladder_isolated_views

Nodes [ladder]

	X [m]	Y [m]	Z [m]	e_X	e_Y	e_Z	θ_X	θ_Y	θ_Z
184	0	−2.398	25.200	f	f	f	f	f	f
185	2.398	0	25.200	f	f	f	f	f	f
186	−2.398	0	25.200	f	f	f	f	f	f
420	−0.300	−2.098	25.200	f	f	f	f	f	f
421	0.300	−2.098	25.200	f	f	f	f	f	f
422	0.300	−1.498	25.200	f	f	f	f	f	f
423	−0.300	−1.498	25.200	f	f	f	f	f	f
424	−0.900	−1.498	25.200	f	f	f	f	f	f
425	0.900	−1.498	25.200	f	f	f	f	f	f
428	−0.250	−1.498	25.200	f	f	f	f	f	f
429	0.250	−1.498	25.200	f	f	f	f	f	f
430	−0.300	1.500	39.500	f	f	f	f	f	f
431	−0.300	−1.500	39.500	f	f	f	f	f	f
432	0.300	−1.500	39.500	f	f	f	f	f	f
433	0.300	1.500	39.500	f	f	f	f	f	f
434	−0.900	−1.500	39.500	f	f	f	f	f	f
435	−0.900	1.500	39.500	f	f	f	f	f	f
436	−0.900	−0.600	39.500	f	f	f	f	f	f
437	−0.300	−0.600	39.500	f	f	f	f	f	f
438	0.300	−0.600	39.500	f	f	f	f	f	f
439	0.900	−0.600	39.500	f	f	f	f	f	f
440	0.900	1.500	39.500	f	f	f	f	f	f
441	0.900	−1.500	39.500	f	f	f	f	f	f
442	−0.249	0	39.500	f	f	f	f	f	f
443	0.251	0	39.500	f	f	f	f	f	f
444	−0.900	0	39.500	f	f	f	f	f	f
445	0.900	0	39.500	f	f	f	f	f	f
450	−0.250	−0.985	30.100	f	f	f	f	f	f
451	0.250	−0.985	30.101	f	f	f	f	f	f
456	0.251	−0.547	34.281	f	f	f	f	f	f
457	−0.249	−0.547	34.281	f	f	f	f	f	f
458	0.251	−0.347	34.280	f	f	f	f	f	f
459	1.827	−0.347	34.280	f	f	f	f	f	f
460	−0.249	−0.347	34.280	f	f	f	f	f	f
461	−1.827	−0.347	34.280	f	f	f	f	f	f
462	−0.250	−0.785	30.100	f	f	f	f	f	f
463	−2.090	−0.785	30.100	f	f	f	f	f	f
464	0.250	−0.785	30.101	f	f	f	f	f	f
465	2.090	−0.785	30.102	f	f	f	f	f	f
470	0.251	−0.166	37.914	f	f	f	f	f	f
471	−0.249	−0.166	37.914	f	f	f	f	f	f
472	0.251	0.034	37.914	f	f	f	f	f	f
473	1.599	0.034	37.913	f	f	f	f	f	f
474	−0.249	0.034	37.914	f	f	f	f	f	f
475	−1.599	0.034	37.913	f	f	f	f	f	f
476	−0.249	−0.031	39.200	f	f	f	f	f	f
477	0.251	−0.031	39.200	f	f	f	f	f	f
478	−0.249	−0.063	38.900	f	f	f	f	f	f
479	0.251	−0.063	38.900	f	f	f	f	f	f
480	−0.249	−0.094	38.600	f	f	f	f	f	f
481	0.251	−0.094	38.600	f	f	f	f	f	f
482	−0.249	−0.126	38.301	f	f	f	f	f	f
483	0.251	−0.126	38.301	f	f	f	f	f	f
484	−0.249	−0.157	38.001	f	f	f	f	f	f
485	0.251	−0.157	38.001	f	f	f	f	f	f
486	−0.249	−0.188	37.701	f	f	f	f	f	f
487	0.251	−0.188	37.701	f	f	f	f	f	f
488	−0.249	−0.220	37.401	f	f	f	f	f	f
489	0.251	−0.220	37.401	f	f	f	f	f	f
490	−0.249	−0.251	37.101	f	f	f	f	f	f
491	0.251	−0.251	37.101	f	f	f	f	f	f
492	−0.249	−0.283	36.801	f	f	f	f	f	f
493	0.251	−0.283	36.801	f	f	f	f	f	f
494	−0.249	−0.314	36.501	f	f	f	f	f	f
495	0.251	−0.314	36.501	f	f	f	f	f	f
496	−0.249	−0.346	36.201	f	f	f	f	f	f
497	0.251	−0.346	36.201	f	f	f	f	f	f
498	−0.249	−0.377	35.902	f	f	f	f	f	f
499	0.251	−0.377	35.902	f	f	f	f	f	f
500	−0.249	−0.408	35.602	f	f	f	f	f	f
501	0.251	−0.408	35.602	f	f	f	f	f	f
502	−0.249	−0.440	35.302	f	f	f	f	f	f
503	0.251	−0.440	35.302	f	f	f	f	f	f
504	−0.249	−0.471	35.002	f	f	f	f	f	f
505	0.251	−0.471	35.002	f	f	f	f	f	f
506	−0.249	−0.503	34.702	f	f	f	f	f	f
507	0.251	−0.503	34.702	f	f	f	f	f	f
508	−0.249	−0.534	34.402	f	f	f	f	f	f
509	0.251	−0.534	34.402	f	f	f	f	f	f
510	−0.249	−0.565	34.102	f	f	f	f	f	f
511	0.251	−0.565	34.102	f	f	f	f	f	f
512	−0.249	−0.597	33.802	f	f	f	f	f	f
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514	−0.249	−0.628	33.503	f	f	f	f	f	f
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516	−0.249	−0.660	33.203	f	f	f	f	f	f
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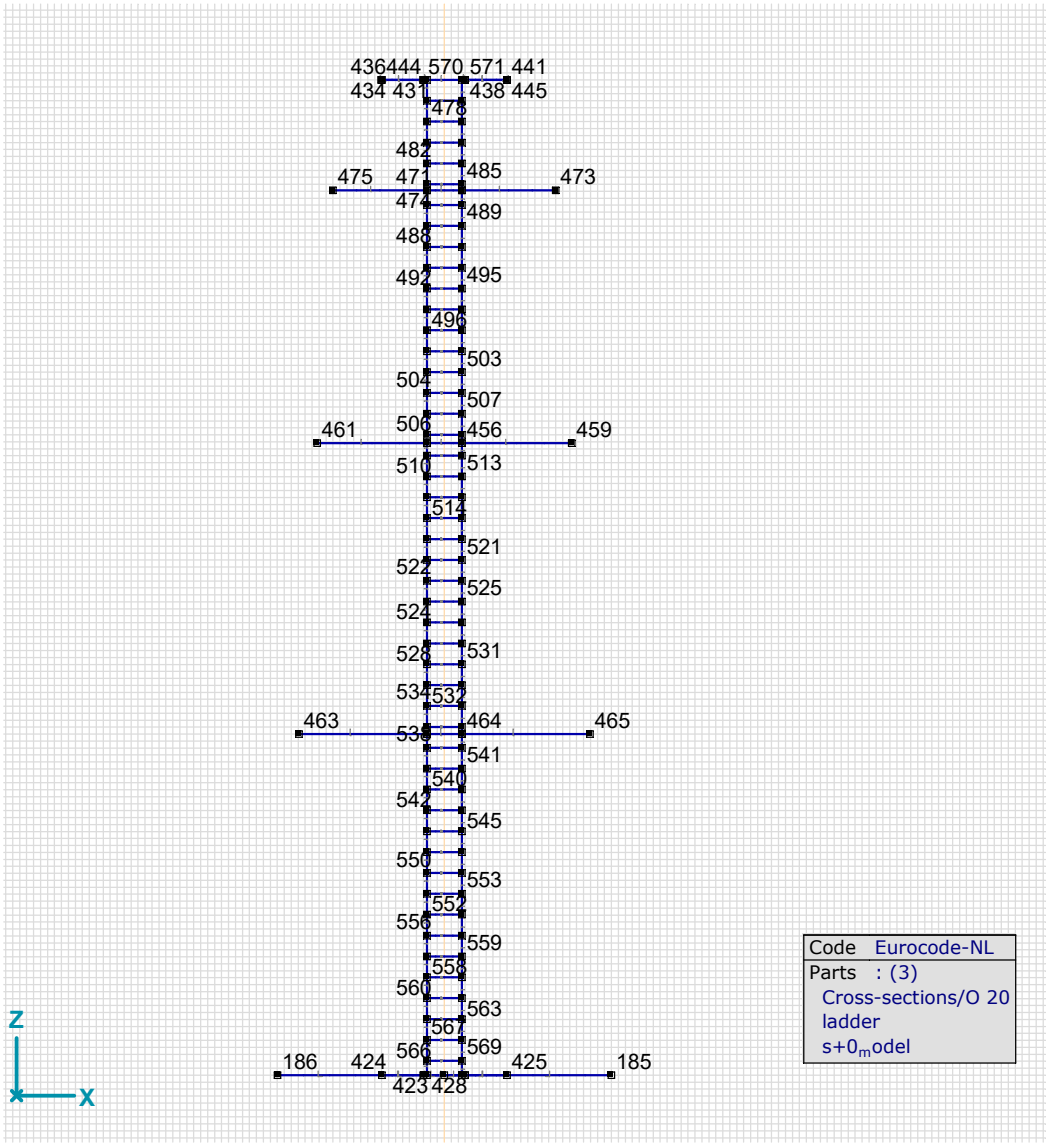
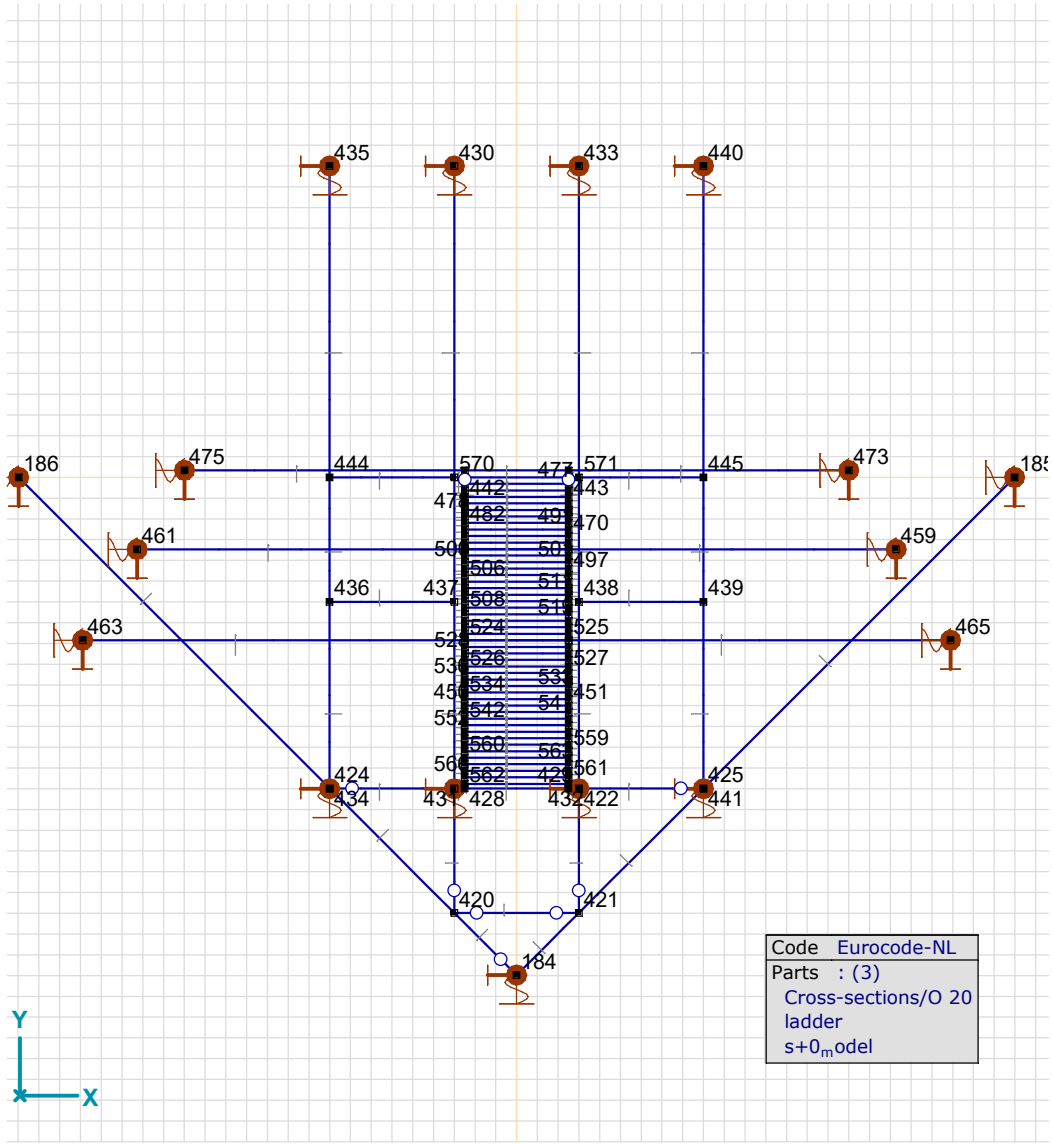
518	−0.249	−0.691	32.903	f	f	f	f	f	f
519	0.251	−0.691	32.903	f	f	f	f	f	f
520	−0.249	−0.722	32.603	f	f	f	f	f	f
521	0.251	−0.722	32.603	f	f	f	f	f	f
522	−0.249	−0.754	32.303	f	f	f	f	f	f
523	0.251	−0.754	32.303	f	f	f	f	f	f
524	−0.249	−0.785	32.003	f	f	f	f	f	f
525	0.251	−0.785	32.003	f	f	f	f	f	f
526	−0.249	−0.817	31.703	f	f	f	f	f	f
527	0.251	−0.817	31.703	f	f	f	f	f	f
528	−0.249	−0.848	31.404	f	f	f	f	f	f
529	0.251	−0.848	31.404	f	f	f	f	f	f
530	−0.249	−0.880	31.104	f	f	f	f	f	f
531	0.251	−0.880	31.104	f	f	f	f	f	f
532	−0.250	−0.911	30.804	f	f	f	f	f	f
533	0.250	−0.911	30.804	f	f	f	f	f	f
534	−0.250	−0.942	30.504	f	f	f	f	f	f
535	0.250	−0.942	30.504	f	f	f	f	f	f
536	−0.250	−0.974	30.204	f	f	f	f	f	f
537	0.250	−0.974	30.204	f	f	f	f	f	f
538	−0.250	−1.005	29.904	f	f	f	f	f	f
539	0.250	−1.005	29.904	f	f	f	f	f	f
540	−0.250	−1.037	29.604	f	f	f	f	f	f
541	0.250	−1.037	29.604	f	f	f	f	f	f
542	−0.250	−1.068	29.304	f	f	f	f	f	f
543	0.250	−1.068	29.304	f	f	f	f	f	f
544	−0.250	−1.099	29.005	f	f	f	f	f	f
545	0.250	−1.099	29.005	f	f	f	f	f	f
546	−0.250	−1.131	28.705	f	f	f	f	f	f
547	0.250	−1.131	28.705	f	f	f	f	f	f
548	−0.250	−1.162	28.405	f	f	f	f	f	f
549	0.250	−1.162	28.405	f	f	f	f	f	f
550	−0.250	−1.194	28.105	f	f	f	f	f	f
551	0.250	−1.194	28.105	f	f	f	f	f	f
552	−0.250	−1.225	27.805	f	f	f	f	f	f
553	0.250	−1.225	27.805	f	f	f	f	f	f
554	−0.250	−1.256	27.505	f	f	f	f	f	f
555	0.250	−1.256	27.505	f	f	f	f	f	f
556	−0.250	−1.288	27.205	f	f	f	f	f	f
557	0.250	−1.288	27.205	f	f	f	f	f	f
558	−0.250	−1.319	26.905	f	f	f	f	f	f
559	0.250	−1.319	26.905	f	f	f	f	f	f
560	−0.250	−1.351	26.606	f	f	f	f	f	f
561	0.250	−1.351	26.606	f	f	f	f	f	f
562	−0.250	−1.382	26.306	f	f	f	f	f	f
563	0.250	−1.382	26.306	f	f	f	f	f	f
564	−0.250	−1.414	26.006	f	f	f	f	f	f
565	0.250	−1.414	26.006	f	f	f	f	f	f
566	−0.250	−1.445	25.706	f	f	f	f	f	f
567	0.250	−1.445	25.706	f	f	f	f	f	f
568	−0.250	−1.476	25.406	f	f	f	f	f	f
569	0.250	−1.476	25.406	f	f	f	f	f	f
570	−0.300	0	39.500	f	f	f	f	f	f
571	0.300	0	39.500	f	f	f	f	f	f

e_X: Nodal DOF (translation constraint X); **e_Y:** Nodal DOF (translation constraint Y); **e_Z:** Nodal DOF (translation constraint Z); **θ_X:** Nodal DOF (rotation constraint about X-Axis); **θ_Y:** Nodal DOF (rotation constraint about Y-Axis); **θ_Z:** Nodal DOF (rotation constraint about Z-Axis);





ladder_nodes

Beams [ladder]

	Node i	Node j	Length	Local x	Material	Start cross-section	End cross-section	Ref_z	ER_{St}	ER_{End}
1	436	→ 437	0.60	i - j	S 355	8	8	Auto	.	.
2	438	→ 439	0.60	i - j	S 355	8	8	Auto	.	.
3	435	← 444	1.50	j - i	S 355	8	8	R1	.	.
4	443	→ 571	0.05	i - j	S 355	1	1	R1	.	.
5	440	← 445	1.50	j - i	S 355	8	8	Auto	.	.
6	439	← 441	0.90	j - i	S 355	8	8	Auto	.	.
7	420	→ 421	0.60	i - j	S 355	7	7	Auto	Hng-y	Hng-y
8	421	→ 422	0.60	i - j	S 355	7	7	Auto	Hng-y	.
9	420	→ 423	0.60	i - j	S 355	7	7	Auto	Hng-y	.
10	423	← 424	0.60	j - i	S 355	8	8	R1	Hng-y	.
11	422	→ 425	0.60	i - j	S 355	8	8	R1	.	Hng-y
12	458	→ 459	1.58	i - j	S 355	8	8	R1	.	.
13	460	← 461	1.58	j - i	S 355	8	8	R1	.	.
14	458	← 460	0.50	j - i	S 355	8	8	R1	.	.
15	457	→ 460	0.20	i - j	S 355	4	4	Auto	Hng-y	Hng-yz
16	456	→ 458	0.20	i - j	S 355	4	4	Auto	Hng-y	Hng-yz
17	462	← 463	1.84	j - i	S 355	1	1	R1	.	.
18	462	→ 464	0.50	i - j	S 355	1	1	R1	.	.
19	464	→ 465	1.84	i - j	S 355	1	1	R1	.	.
20	450	→ 462	0.20	i - j	S 355	4	4	Auto	Hng-y	Hng-yz
21	451	→ 464	0.20	i - j	S 355	4	4	Auto	Hng-y	Hng-yz
22	472	→ 473	1.35	i - j	S 355	8	8	R1	.	.
23	472	← 474	0.50	j - i	S 355	8	8	R1	.	.
24	474	← 475	1.35	j - i	S 355	8	8	R1	.	.
25	471	→ 474	0.20	i - j	S 355	4	4	Auto	Hng-y	Hng-yz
26	470	→ 472	0.20	i - j	S 355	4	4	Auto	Hng-y	Hng-yz
27	184	→ 421	0.42	i - j	S 355	8	8	Auto	.	.
28	185	← 425	2.12	j - i	S 355	8	8	Auto	.	.
29	184	← 420	0.42	j - i	S 355	8	8	Auto	.	Hng-yz
30	186	→ 424	2.12	i - j	S 355	8	8	Auto	.	.
31	442	→ 443	0.50	i - j	S 355	8	8	R1	.	.
32	476	→ 477	0.50	i - j	S 355	6	6	Auto	.	.
33	478	→ 479	0.50	i - j	S 355	6	6	Auto	.	.
34	480	→ 481	0.50	i - j	S 355	6	6	Auto	.	.
35	482	→ 483	0.50	i - j	S 355	6	6	Auto	.	.
36	484	→ 485	0.50	i - j	S 355	6	6	Auto	.	.
37	486	→ 487	0.50	i - j	S 355	6	6	Auto	.	.
38	488	→ 489	0.50	i - j	S 355	6	6	Auto	.	.
39	490	→ 491	0.50	i - j	S 355	6	6	Auto	.	.
40	492	→ 493	0.50	i - j	S 355	6	6	Auto	.	.
41	494	→ 495	0.50	i - j	S 355	6	6	Auto	.	.
42	496	→ 497	0.50	i - j	S 355	6	6	Auto	.	.
43	498	→ 499	0.50	i - j	S 355	6	6	Auto	.	.
44	500	→ 501	0.50	i - j	S 355	6	6	Auto	.	.
45	502	→ 503	0.50	i - j	S 355	6	6	Auto	.	.
46	504	→ 505	0.50	i - j	S 355	6	6	Auto	.	.
47	506	→ 507	0.50	i - j	S 355	6	6	Auto	.	.
48	508	→ 509	0.50	i - j	S 355	6	6	Auto	.	.

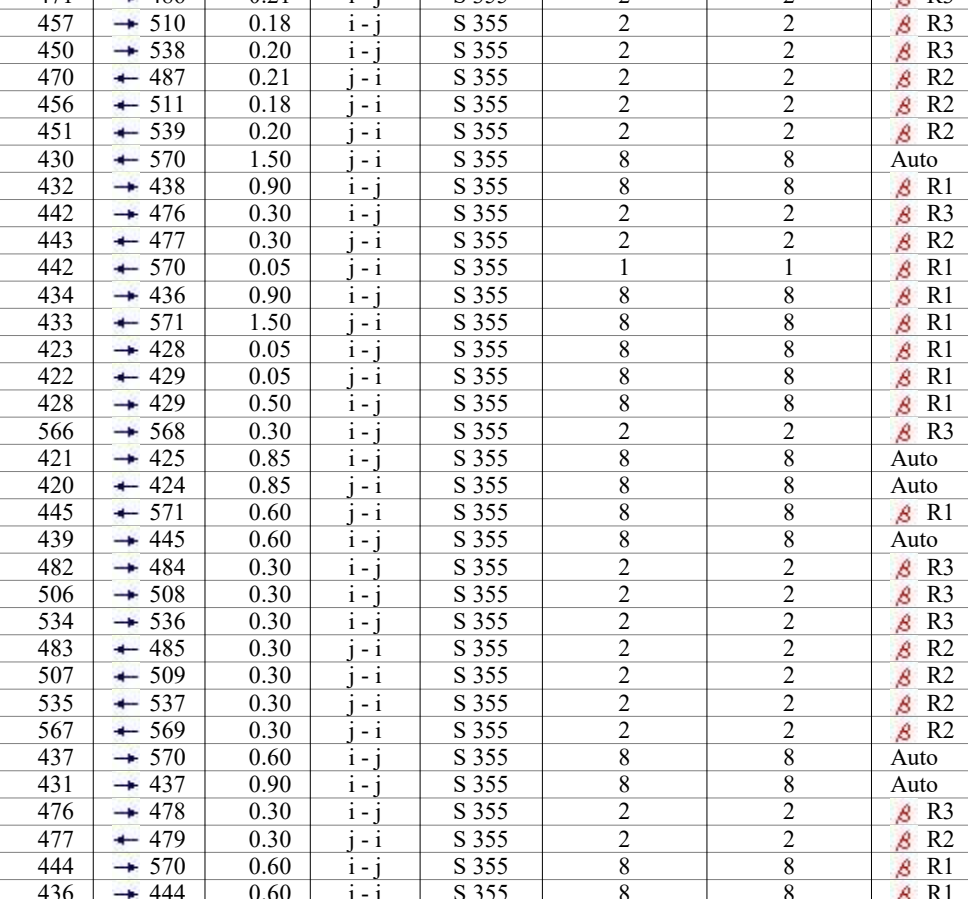
Beams [ladder]

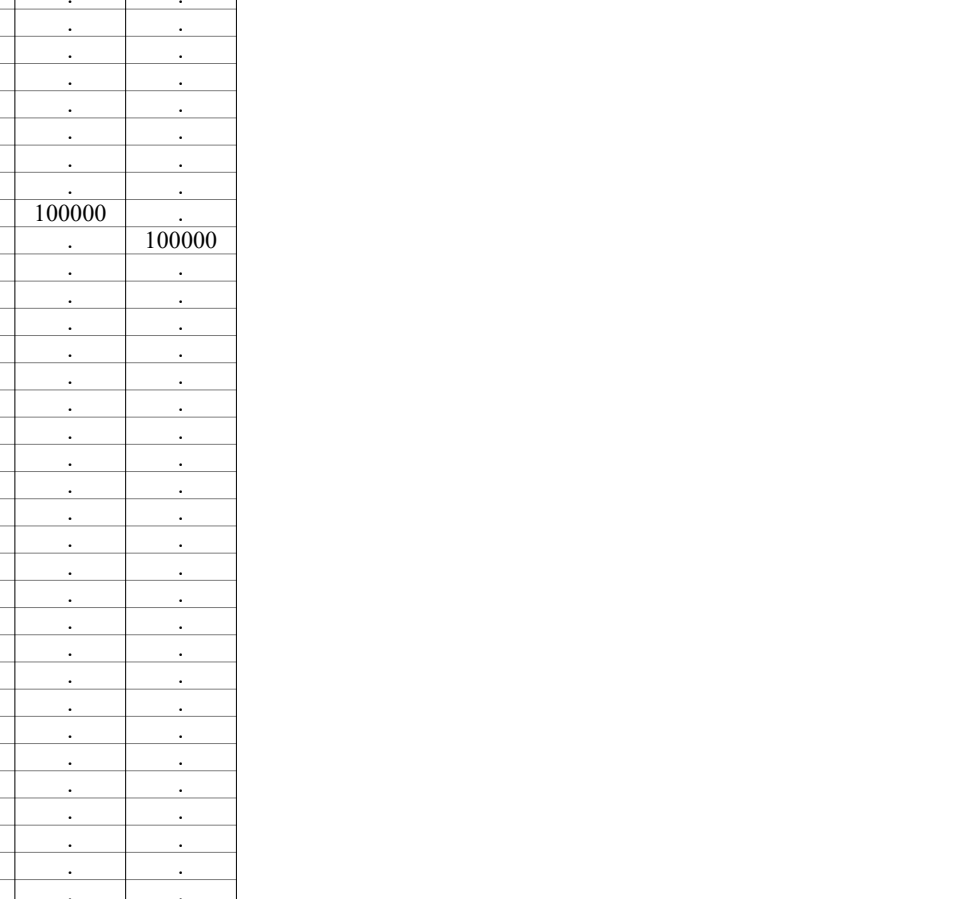
	Node i	*Node j*	*Length*	*Local x*	*Material*	*Start cross-section*	*End cross-section*	*Ref$_z$*	*ER$_{St}$*	*ER$_{End}$*
49	510	→ 511	0.50	i - j	S 355	6	6	Auto	.	.
50	512	→ 513	0.50	i - j	S 355	6	6	Auto	.	.
51	514	→ 515	0.50	i - j	S 355	6	6	Auto	.	.
52	516	→ 517	0.50	i - j	S 355	6	6	Auto	.	.
53	518	→ 519	0.50	i - j	S 355	6	6	Auto	.	.
54	520	→ 521	0.50	i - j	S 355	6	6	Auto	.	.
55	522	→ 523	0.50	i - j	S 355	6	6	Auto	.	.
56	524	→ 525	0.50	i - j	S 355	6	6	Auto	.	.
57	526	→ 527	0.50	i - j	S 355	6	6	Auto	.	.
58	528	→ 529	0.50	i - j	S 355	6	6	Auto	.	.
59	530	→ 531	0.50	i - j	S 355	6	6	Auto	.	.
60	532	→ 533	0.50	i - j	S 355	6	6	Auto	.	.
61	534	→ 535	0.50	i - j	S 355	6	6	Auto	.	.
62	536	→ 537	0.50	i - j	S 355	6	6	Auto	.	.
63	538	→ 539	0.50	i - j	S 355	6	6	Auto	.	.
64	540	→ 541	0.50	i - j	S 355	6	6	Auto	.	.
65	542	→ 543	0.50	i - j	S 355	6	6	Auto	.	.
66	544	→ 545	0.50	i - j	S 355	6	6	Auto	.	.
67	546	→ 547	0.50	i - j	S 355	6	6	Auto	.	.
68	548	→ 549	0.50	i - j	S 355	6	6	Auto	.	.
69	550	→ 551	0.50	i - j	S 355	6	6	Auto	.	.
70	552	→ 553	0.50	i - j	S 355	6	6	Auto	.	.
71	554	→ 555	0.50	i - j	S 355	6	6	Auto	.	.
72	556	→ 557	0.50	i - j	S 355	6	6	Auto	.	.
73	558	→ 559	0.50	i - j	S 355	6	6	Auto	.	.
74	560	→ 561	0.50	i - j	S 355	6	6	Auto	.	.
75	562	→ 563	0.50	i - j	S 355	6	6	Auto	.	.
76	564	→ 565	0.50	i - j	S 355	6	6	Auto	.	.
77	566	→ 567	0.50	i - j	S 355	6	6	Auto	.	.
78	568	→ 569	0.50	i - j	S 355	6	6	Auto	.	.
79	478	→ 480	0.30	i - j	S 355	2	2	R3	.	.
80	480	→ 482	0.30	i - j	S 355	2	2	R3	.	.
81	471	← 484	0.09	j - i	S 355	2	2	R2	.	.
82	486	→ 488	0.30	i - j	S 355	2	2	R3	.	.
83	488	→ 490	0.30	i - j	S 355	2	2	R3	.	.
84	490	→ 492	0.30	i - j	S 355	2	2	R3	.	.
85	492	→ 494	0.30	i - j	S 355	2	2	R3	.	.
86	494	→ 496	0.30	i - j	S 355	2	2	R3	.	.
87	496	→ 498	0.30	i - j	S 355	2	2	R3	.	.
88	498	→ 500	0.30	i - j	S 355	2	2	R3	.	.
89	500	→ 502	0.30	i - j	S 355	2	2	R3	.	.
90	502	→ 504	0.30	i - j	S 355	2	2	R3	.	.
91	504	→ 506	0.30	i - j	S 355	2	2	R3	.	.
92	457	← 508	0.12	j - i	S 355	2	2	R2	.	.
93	510	→ 512	0.30	i - j	S 355	2	2	R3	.	.
94	512	→ 514	0.30	i - j	S 355	2	2	R3	.	.
95	514	→ 516	0.30	i - j	S 355	2	2	R3	.	.
96	516	→ 518	0.30	i - j	S 355	2	2	R3	.	.
97	518	→ 520	0.30	i - j	S 355	2	2	R3	.	.
98	520	→ 522	0.30	i - j	S 355	2	2	R3	.	.
99	522	→ 524	0.30	i - j	S 355	2	2	R3	.	.
100	524	→ 526	0.30	i - j	S 355	2	2	R3	.	.
101	526	→ 528	0.30	i - j	S 355	2	2	R3	.	.
102	528	→ 530	0.30	i - j	S 355	2	2	R3	.	.
103	530	→ 532	0.30	i - j	S 355	2	2	R3	.	.
104	532	→ 534	0.30	i - j	S 355	2	2	R3	.	.
105	450	← 536	0.11	j - i	S 355	2	2	R3	.	.
106	538	→ 540	0.30	i - j	S 355	2	2	R3	.	.
107	540	→ 542	0.30	i - j	S 355	2	2	R3	.	.
108	542	→ 544	0.30	i - j	S 355	2	2	R3	.	.
109	544	→ 546	0.30	i - j	S 355	2	2	R3	.	.
110	546	→ 548	0.30	i - j	S 355	2	2	R3	.	.
111	548	→ 550	0.30	i - j	S 355	2	2	R3	.	.
112	550	→ 552	0.30	i - j	S 355	2	2	R3	.	.
113	552	→ 554	0.30	i - j	S 355	2	2	R3	.	.
114	554	→ 556	0.30	i - j	S 355	2	2	R3	.	.
115	556	→ 558	0.30	i - j	S 355	2	2	R3	.	.
116	558	→ 560	0.30	i - j	S 355	2	2	R3	.	.
117	560	→ 562	0.30	i - j	S 355	2	2	R3	.	.
118	562	→ 564	0.30	i - j	S 355	2	2	R3	.	.
119	564	→ 566	0.30	i - j	S 355	2	2	R3	.	.
120	428	← 568	0.21	j - i	S 355	2	2	R3	.	.
121	479	← 481	0.30	j - i	S 355	2	2	R2	.	.
122	481	← 483	0.30	j - i	S 355	2	2	R2	.	.
123	470	→ 485	0.09	i - j	S 355	2	2	R3	.	.
124	487	← 489	0.30	j - i	S 355	2	2	R2	.	.
125	489	← 491	0.30	j - i	S 355	2	2	R2	.	.
126	491	← 493	0.30	j - i	S 355	2	2	R2	.	.
127	493	← 495	0.30	j - i	S 355	2	2	R2	.	.
128	495	← 497	0.30	j - i	S 355	2	2	R2	.	.
129	497	← 499	0.30	j - i	S 355	2	2	R2	.	.
130	499	← 501	0.30	j - i	S 355	2	2	R2	.	.
131	501	← 503	0.30	j - i	S 355	2	2	R2	.	.
132	503	← 505	0.30	j - i	S 355	2	2	R2	.	.
133	505	← 507	0.30	j - i	S 355	2	2	R2	.	.
134	456	→ 509	0.12	i - j	S 355	2	2	R2	.	.
135	511	← 513	0.30	j - i	S 355	2	2	R2	.	.
136	513	← 515	0.30	j - i	S 355	2	2	R2	.	.
137	515	← 517	0.30	j - i	S 355	2	2	R2	.	.
138	517	← 519	0.30	j - i	S 355	2	2	R2	.	.
139	519	← 521	0.30	j - i	S 355	2	2	R2	.	.
140	521	← 523	0.30	j - i	S 355	2	2	R2	.	.

Beams [ladder]

	Node i	*Node j*	*Length*	*Local x*	*Material*	*Start cross-section*	*End cross-section*	*Ref$_z$*	*ER$_{St}$*	*ER$_{End}$*
141	523	← 525	0.30	j - i	S 355	2	2	R2	.	.
142	525	← 527	0.30	j - i	S 355	2	2	R2	.	.
143	527	← 529	0.30	j - i	S 355	2	2	R2	.	.
144	529	← 531	0.30	j - i	S 355	2	2	R2	.	.
145	531	← 533	0.30	j - i	S 355	2	2	R2	.	.
146	533	← 535	0.30	j - i	S 355	2	2	R2	.	.
147	451	→ 537	0.10	i - j	S 355	2	2	R2	.	.
148	539	← 541	0.30	j - i	S 355	2	2	R2	.	.
149	541	← 543	0.30	j - i	S 355	2	2	R2	.	.
150	543	← 545	0.30	j - i	S 355	2	2	R2	.	.
151	545	← 547	0.30	j - i	S 355	2	2	R2	.	.
152	547	← 549	0.30	j - i	S 355	2	2	R2	.	.
153	549	← 551	0.30	j - i	S 355	2	2	R2	.	.
154	551	← 553	0.30	j - i	S 355	2	2	R2	.	.
155	553	← 555	0.30	j - i	S 355	2	2	R2	.	.
156	555	← 557	0.30	j - i	S 355	2	2	R2	.	.
157	557	← 559	0.30	j - i	S 355	2	2	R2	.	.
158	559	← 561	0.30	j - i	S 355	2	2	R2	.	.
159	561	← 563	0.30	j - i	S 355	2	2	R2	.	.
160	563	← 565	0.30	j - i	S 355	2	2	R2	.	.
161	565	← 567	0.30	j - i	S 355	2	2	R2	.	.
162	429	→ 569	0.21	i - j	S 355	2	2	R2	.	.
163	471	→ 486	0.21	i - j	S 355	2	2	R3	.	.
164	457	→ 510	0.18	i - j	S 355	2	2	R3	.	.
165	450	→ 538	0.20	i - j	S 355	2	2	R3	.	.
166	470	← 487	0.21	j - i	S 355	2	2	R2	.	.
167	456	← 511	0.18	j - i	S 355	2	2	R2	.	.
168	451	← 539	0.20	j - i	S 355	2	2	R2	.	.
169	430	← 570	1.50	j - i	S 355	8	8	Auto	.	.
170	432	→ 438	0.90	i - j	S 355	8	8	R1	.	.
171	442	→ 476	0.30	i - j	S 355	2	2	R3	100000	.
172	443	← 477	0.30	j - i	S 355	2	2	R2	.	100000
173	442	← 570	0.05	j - i	S 355	1	1	R1	.	.
174	434	→ 436	0.90	i - j	S 355	8	8	R1	.	.
175	433	← 571	1.50	j - i	S 355	8	8	R1	.	.
176	423	→ 428	0.05	i - j	S 355	8	8	R1	.	.
177	422	← 429	0.05	j - i	S 355	8	8	R1	.	.
178	428	→ 429	0.50	i - j	S 355	8	8	R1	.	.
179	566	→ 568	0.30	i - j	S 355	2	2	R3	.	.
180	421	→ 425	0.85	i - j	S 355	8	8	Auto	.	.
181	420	← 424	0.85	j - i	S 355	8	8	Auto	.	.
182	445	← 571	0.60	j - i	S 355	8	8	R1	.	.
183	439	→ 445	0.60	i - j	S 355	8	8	Auto	.	.
184	482	→ 484	0.30	i - j	S 355	2	2	R3	.	.
185	506	→ 508	0.30	i - j	S 355	2	2	R3	.	.
186	534	→ 536	0.30	i - j	S 355	2	2	R3	.	.
187	483	← 485	0.30	j - i	S 355	2	2	R2	.	.
188	507	← 509	0.30	j - i	S 355	2	2	R2	.	.
189	535	← 537	0.30	j - i	S 355	2	2	R2	.	.
190	567	← 569	0.30	j - i	S 355	2	2	R2	.	.
191	437	→ 570	0.60	i - j	S 355	8	8	Auto	.	.
192	431	→ 437	0.90	i - j	S 355	8	8	Auto	.	.
193	476	→ 478	0.30	i - j	S 355	2	2	R3	.	.
194	477	← 479	0.30	j - i	S 355	2	2	R2	.	.
195	444	→ 570	0.60	i - j	S 355	8	8	R1	.	.
196	436	→ 444	0.60	i - j	S 355	8	8	R1	.	.
197	438	→ 571	0.60	i - j	S 355	8	8	R1	.	.

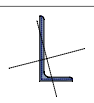
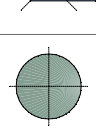
Node i: Node at i end; **Node j:** Node at j end; **Length:** Beam length; **Local x:** Local x direction; **Ref$_z$:** Reference for local z direction; **ER$_{St}$:** End releases at start point; **ER$_{End}$:** End releases at end point;





ladder_Beams

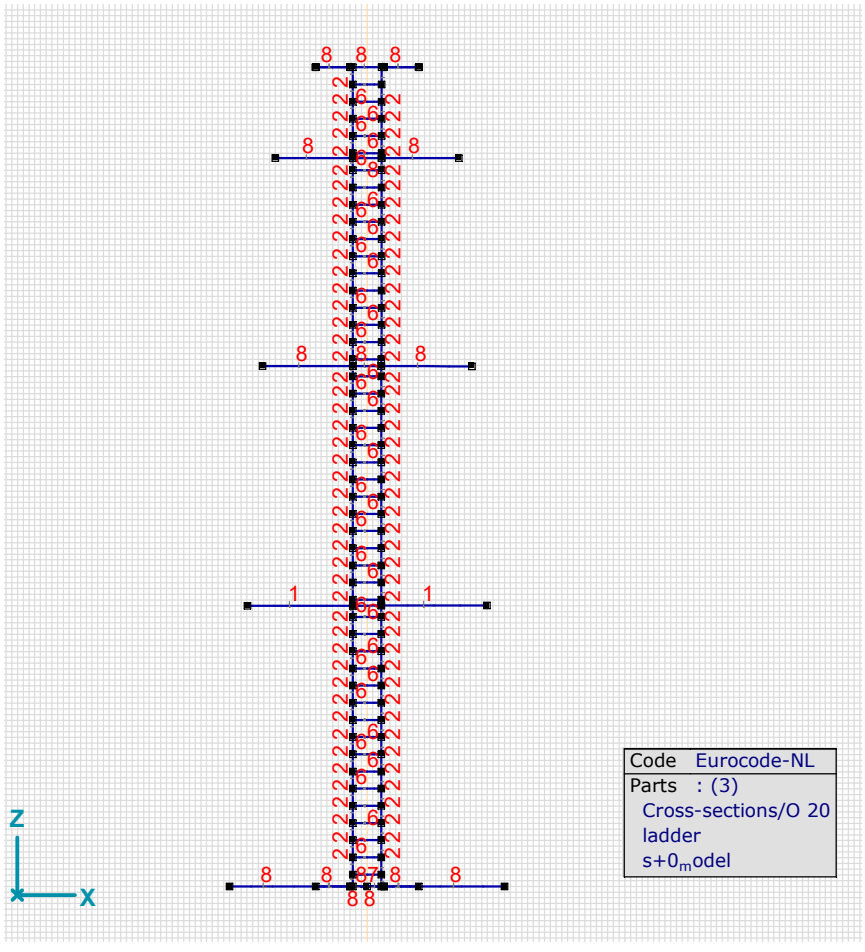
Cross-sections

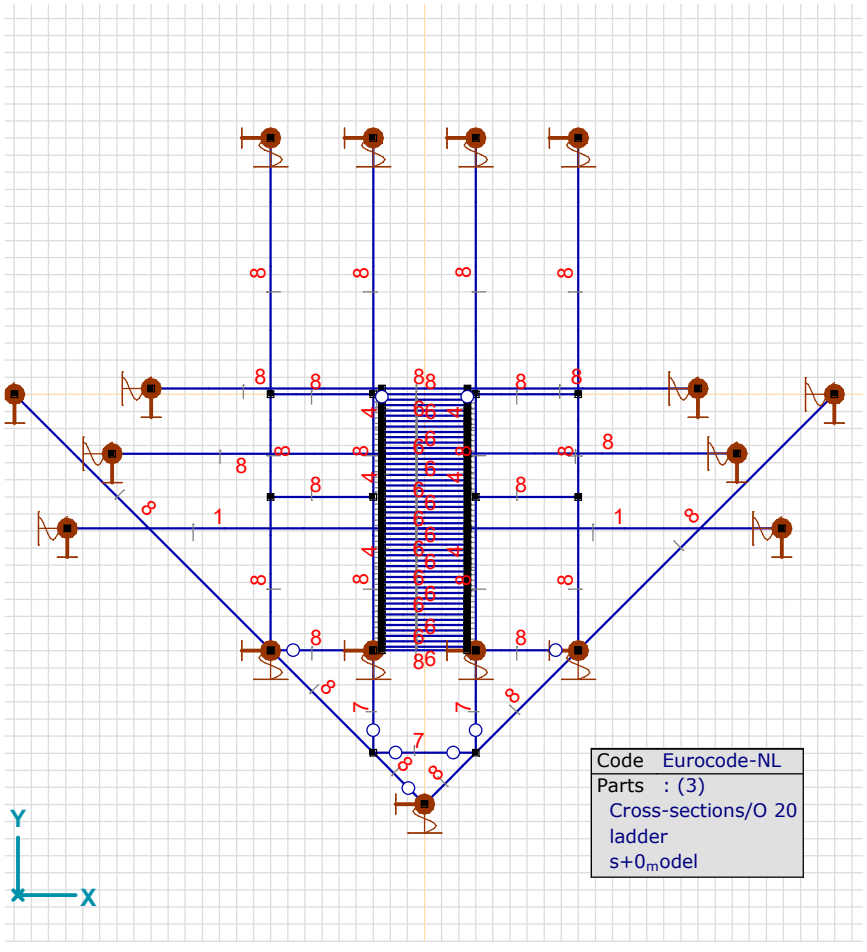
	Name	Drawing	Process	Shape	h [mm]	b [mm]	tw [mm]	tf [mm]	r_1 [mm]	r_2 [mm]	r_3 [mm]	Ax [mm²]	Ay [mm²]	Az [mm²]	Ix [mm⁴]	Iy [mm⁴]	Iz [mm⁴]
1	L 100X100X 8		Rolled	L	100.0	100.0	8.0	8.0	12.0	6.0	0	1551.52	669.67	678.46	36218.9	1448264.0	1448264.0
2	L 100X 50X 6X		Rolled	L	100.0	50.0	6.0	6.0	9.0	4.5	0	872.73	231.48	516.47	11460.0	897072.9	152537.5
3	L 120X120X10		Rolled	L	120.0	120.0	10.0	10.0	13.0	6.5	0	2318.22	1004.33	1014.85	82759.6	3129113.0	3129113.0
4	80x8		Rolled	Rect.	8.0	80.0	0	0	0	0	0	640.00	533.33	533.33	12791.5	3413.3	341333.3
5	L 55X 55X 6		Rolled	L	55.0	55.0	6.0	6.0	8.0	4.0	0	630.90	278.51	282.29	8324.3	172850.1	172850.2
6	O 20		Other	Round	20.0	20.0	0	0	0	0	0	314.10	269.22	269.22	15708.0	7850.8	7850.8
7	L 60X 60X 6		Rolled	L	60.0	60.0	6.0	6.0	8.0	4.0	0	690.90	302.80	306.64	9044.2	227898.9	227898.9
8	L 80X 80X 8		Rolled	L	80.0	80.0	8.0	8.0	10.0	5.0	0	1226.78	537.99	544.05	28221.9	722397.8	722397.8

	Name	Iyz [mm⁴]	I_1 [mm⁴]	I_2 [mm⁴]	α [°]	Iω [mm⁶]	$W_{1,el,t}$ [mm³]	$W_{1,el,b}$ [mm³]	$W_{2,el,t}$ [mm³]	$W_{2,el,b}$ [mm³]	$W_{1,pl}$ [mm³]	$W_{2,pl}$ [mm³]	i_y [mm]	i_z [mm]	Hy [mm]	Hz [mm]
1	L 100X100X 8	−849655.4	2297919.0	598608.2	45.00	2.3E+07	32497.5	32497.5	17014.9	15467.6	51224.3	26412.7	30.6	30.6	100.0	100.0
2	L 100X 50X 6X	−207618.9	951054.9	98555.4	14.57	5624540	14496.4	21734.5	3281.0	5221.4	25285.3	7359.8	32.1	13.2	50.0	100.0
3	L 120X120X10	−1840138.0	4969251.0	1288975.0	45.00	7.9E+07	58563.2	58563.2	30420.2	27507.4	92246.3	47331.9	36.7	36.7	120.0	120.0
4	80x8	0	341333.3	3413.3	90.00	1736982	8533.3	8533.3	853.3	853.3	12800.0	1280.0	2.3	23.1	80.0	8.0
5	L 55X 55X 6	−101063.0	273913.2	71787.1	45.00	1527235	7043.1	7043.1	3705.3	3247.9	11266.6	5820.9	16.6	16.6	55.0	55.0
6	O 20	0	7850.8	7850.8	0	0	785.1	785.1	785.1	785.1	1332.9	1332.9	5.0	5.0	20.0	20.0
7	L 60X 60X 6	−133497.7	361396.6	94401.2	45.00	2037188	8518.2	8518.2	4463.6	3956.0	13554.5	6989.1	18.2	18.2	60.0	60.0
8	L 80X 80X 8	−423612.4	1146010.0	298785.4	45.00	1.2E+07	20258.8	20258.8	10570.7	9369.6	32196.1	16562.3	24.3	24.3	80.0	80.0

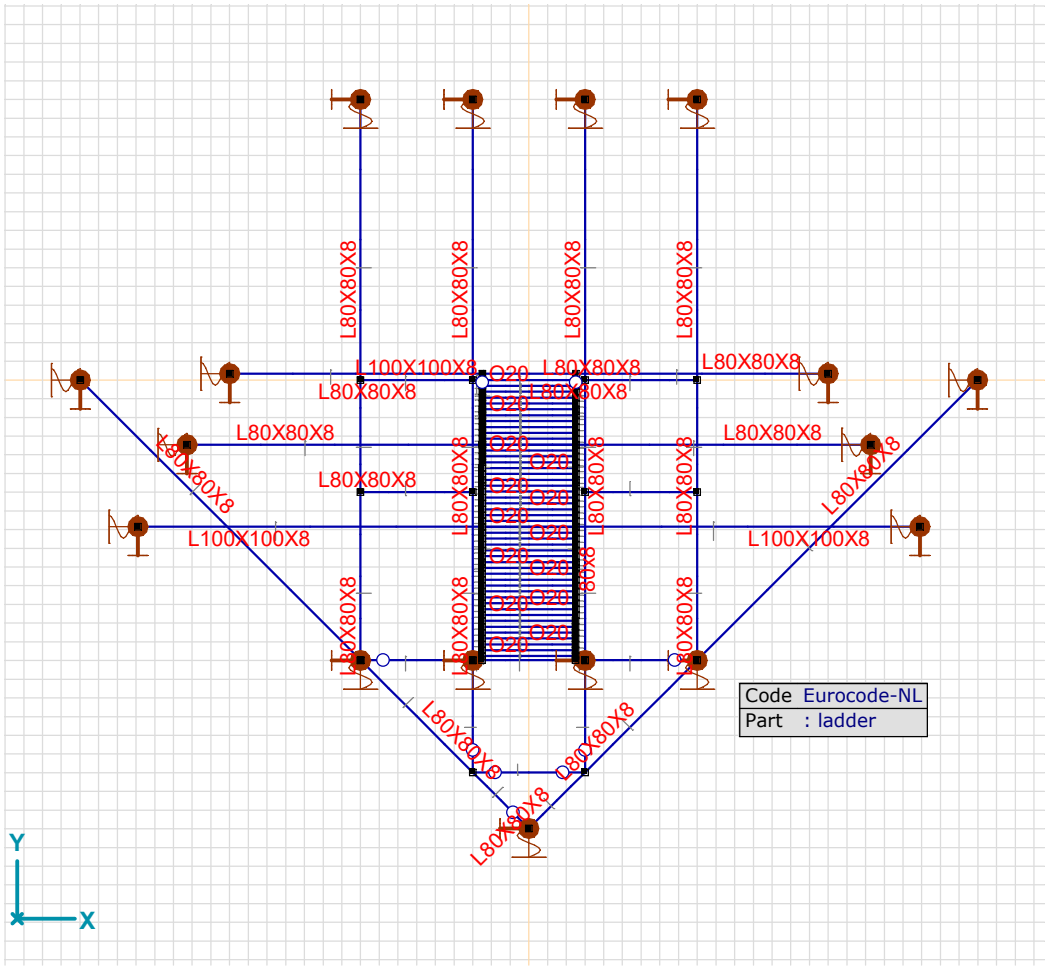
	Name	y_G [mm]	z_G [mm]	y_s [mm]	z_s [mm]	S.p.
1	L 100X100X 8	27.4	27.4	−22.6	−22.6	4
2	L 100X 50X 6X	10.4	34.9	−7.3	−30.2	4
3	L 120X120X10	33.1	33.1	−27.3	−27.3	4
4	80x8	40.0	4.0	0	0	5
5	L 55X 55X 6	15.6	15.6	−12.0	−12.0	4
6	O 20	10.0	10.0	0	0	5
7	L 60X 60X 6	16.9	16.9	−13.3	−13.3	4
8	L 80X 80X 8	22.5	22.5	−17.8	−17.8	4

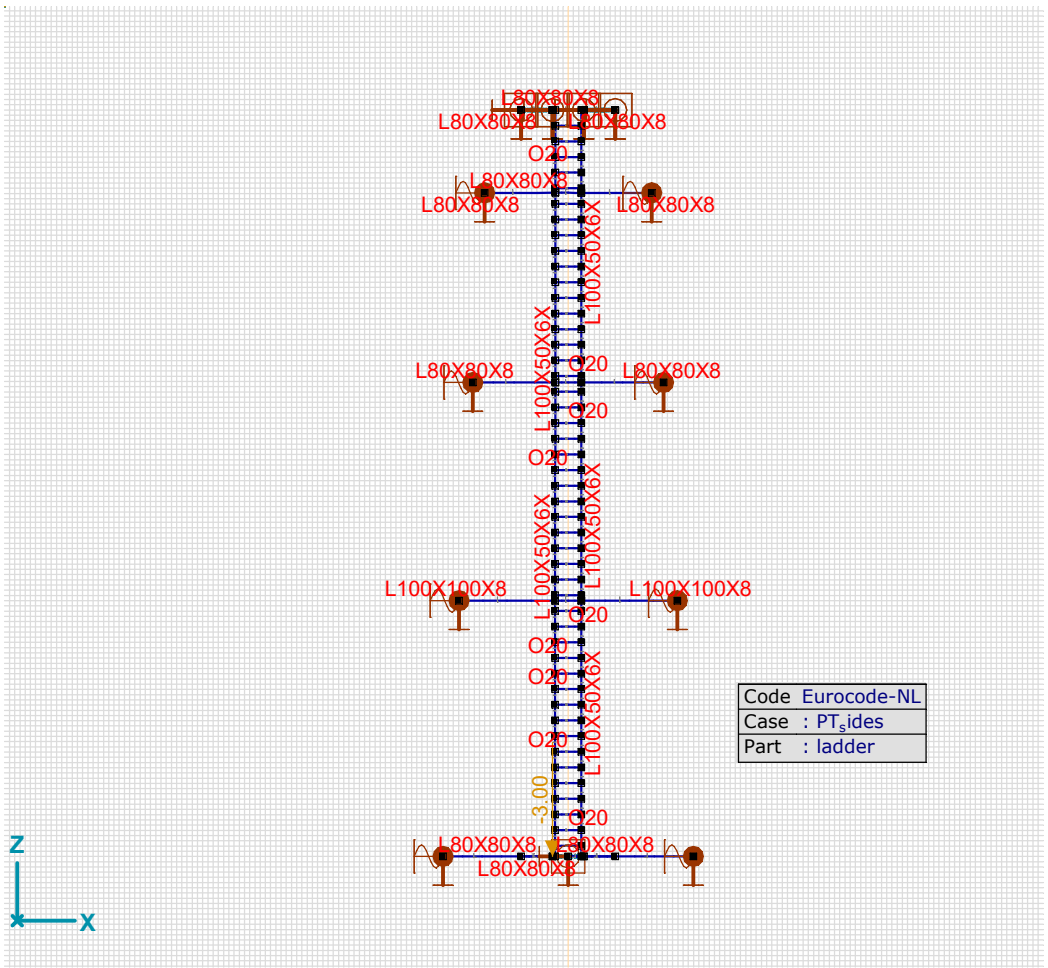
Name: Cross-section name; **Process:** Manufacturing process; **h:** Cross-section height; **b:** Cross-section width; **tw:** Web thickness; **tf:** Flange thickness; **r_1, r_2, r_3:** Rounding radius; **Ax:** Cross-section area; **Ay, Az:** Shear area; **Ix:** Torsional inertia; **Iy, Iz:** Flexural inertia; **Iyz:** Centrifugal inertia; **I_1, I_2:** Principal flexural inertia; **α:** Principal directions; **Iω:** Warping constant; **$W_{1,el,t}$, $W_{1,el,b}$, $W_{2,el,t}$, $W_{2,el,b}$:** Elastic modulus; **$W_{1,pl}$, $W_{2,pl}$:** Plastic modulus; **i_y, i_z:** Radius of inertia; **Hy:** Dimension in local y direction; **Hz:** Dimension in local z direction; **y_G:** y coordinate of the center of gravity; **z_G:** z coordinate of the center of gravity; **y_s:** y coordinate of the shear (torsion) center relative to the center of gravity; **z_s:** z coordinate of the shear (torsion) center relative to the center of gravity; **S.p.:** Stress calculation points;





ladder_cross_section





ladder_cross_section_name

Nodal supports [ladder]

	Node	*X [m]*	*Y [m]*	*Z [m]*
1	185	2.398	0	25.200
2	186	−2.398	0	25.200
3	430	−0.300	1.500	39.500
4	431	−0.300	−1.500	39.500
5	432	0.300	−1.500	39.500
6	433	0.300	1.500	39.500
7	434	−0.900	−1.500	39.500
8	435	−0.900	1.500	39.500
9	440	0.900	1.500	39.500
10	441	0.900	−1.500	39.500
11	459	1.827	−0.347	34.280
12	461	−1.827	−0.347	34.280
13	463	−2.090	−0.785	30.100
14	465	2.090	−0.785	30.102
15	473	1.599	0.034	37.913
16	475	−1.599	0.034	37.913
17	184	0	−2.398	25.200

	Node	*Type*	*$Name_x$*	*K_x [kN/m]*	*K_{xV} [kN/m]*	*$Name_y$*	*K_y [kN/m]*	*K_{yV} [kN/m]*	*$Name_z$*	*K_z [kN/m]*	*K_{zV} [kN/m]*	*$Name_{xx}$*	*K_{xx} [kNm/rad]*
1	185	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
2	186	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
3	430	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
4	431	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
5	432	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
6	433	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
7	434	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
8	435	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
9	440	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
10	441	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–
11	459	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
12	461	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
13	463	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
14	465	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
15	473	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
16	475	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Rotational	1E+10
17	184	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–

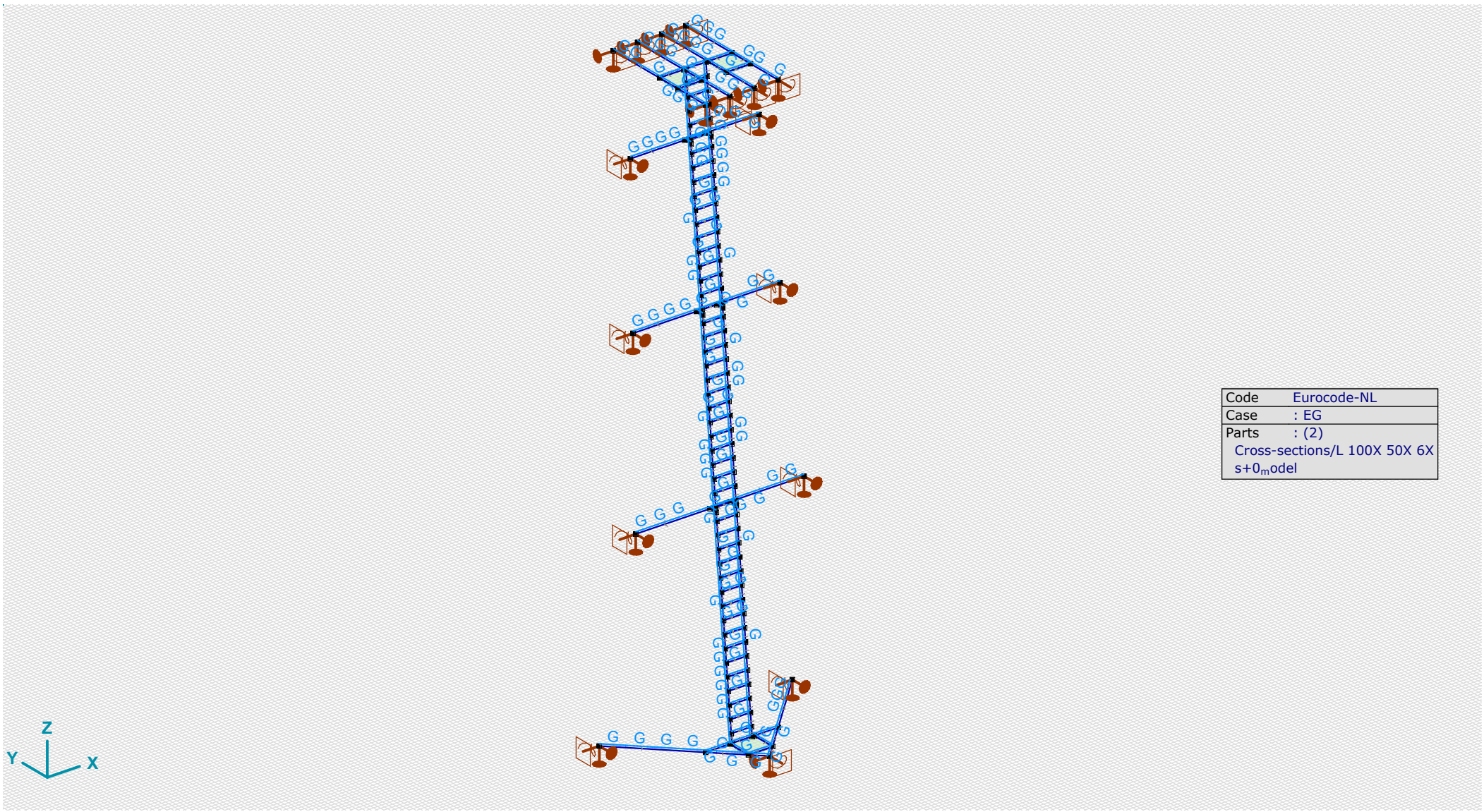
	Node	*K_{xxV} [kNm/rad]*	*$Name_{yy}$*	*K_{yy} [kNm/rad]*	*K_{yyV} [kNm/rad]*	*$Name_{zz}$*	*K_{zz} [kNm/rad]*	*K_{zzV} [kNm/rad]*
1	185	1E+10	—	–	–	—	–	–
2	186	1E+10	—	–	–	—	–	–
3	430	–	Rigid - Rotational	1E+10	1E+10	—	–	–
4	431	–	Rigid - Rotational	1E+10	1E+10	—	–	–
5	432	–	Rigid - Rotational	1E+10	1E+10	—	–	–
6	433	–	Rigid - Rotational	1E+10	1E+10	—	–	–
7	434	–	Rigid - Rotational	1E+10	1E+10	—	–	–
8	435	–	Rigid - Rotational	1E+10	1E+10	—	–	–
9	440	–	Rigid - Rotational	1E+10	1E+10	—	–	–
10	441	–	Rigid - Rotational	1E+10	1E+10	—	–	–
11	459	1E+10	—	–	–	—	–	–
12	461	1E+10	—	–	–	—	–	–
13	463	1E+10	—	–	–	—	–	–
14	465	1E+10	—	–	–	—	–	–
15	473	1E+10	—	–	–	—	–	–
16	475	1E+10	—	–	–	—	–	–
17	184	–	Rigid - Rotational	1E+10	1E+10	—	–	–

Node: Supported node; **Type:** Support type; **$Name_x$:** Name of the spring characteristics; **K_x:** Initial stiffness; **K_{xV}:** Vibration stiffness; **$Name_y$:** Name of the spring characteristics; **K_y:** Initial stiffness; **K_{yV}:** Vibration stiffness; **$Name_z$:** Name of the spring characteristics; **K_z:** Initial stiffness; **K_{zV}:** Vibration stiffness; **$Name_{xx}$:** Name of the spring characteristics; **K_{xx}:** Initial stiffness; **K_{xxV}:** Vibration stiffness; **$Name_{yy}$:** Name of the spring characteristics; **K_{yy}:** Initial stiffness; **K_{yyV}:** Vibration stiffness; **$Name_{zz}$:** Name of the spring characteristics; **K_{zz}:** Initial stiffness; **K_{zzV}:** Vibration stiffness;

EG: Beam self weight [ladder]

	Σ [kg]
1–452	615.009
Total	**615.009**

Σ: Total mass;

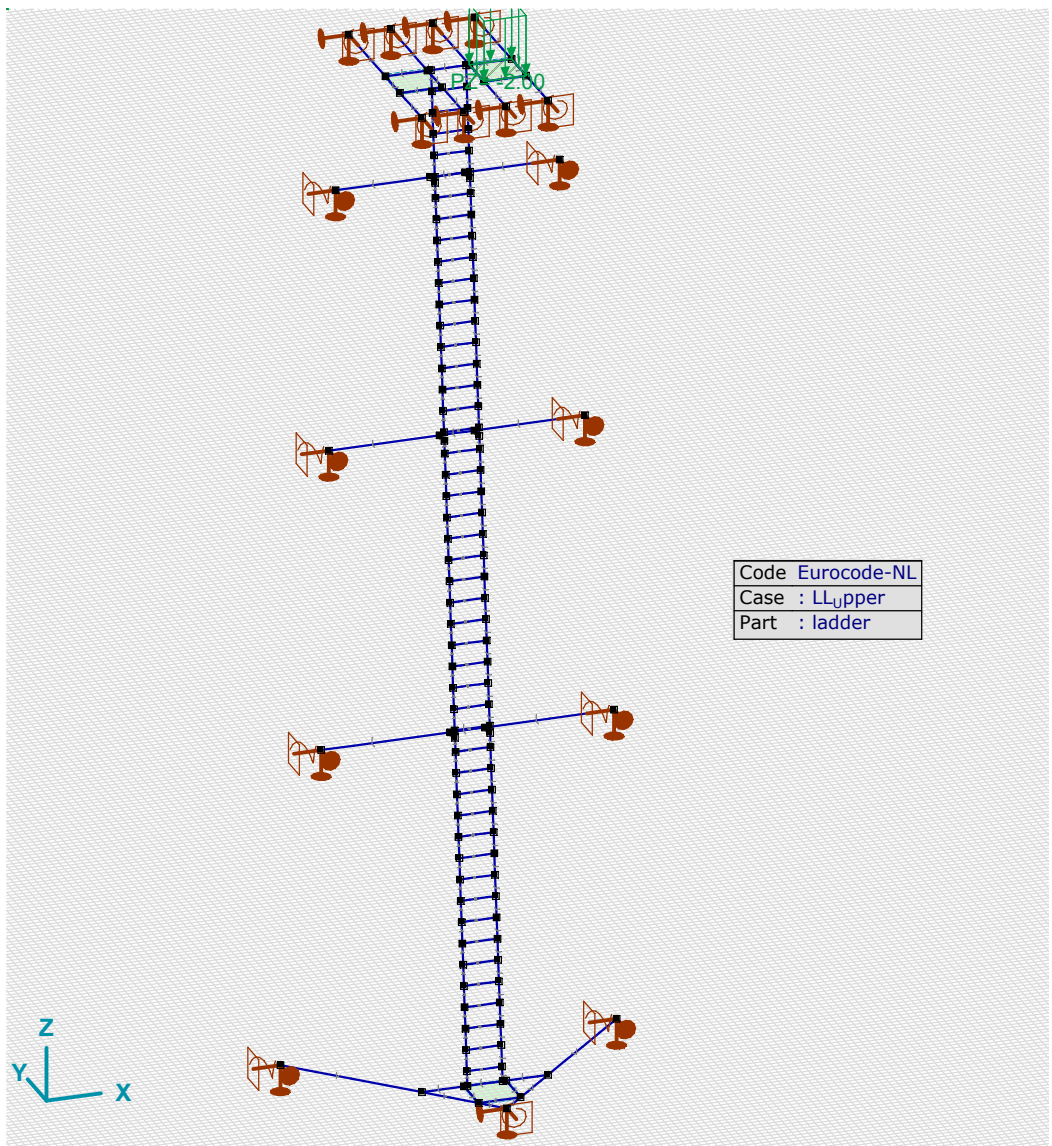


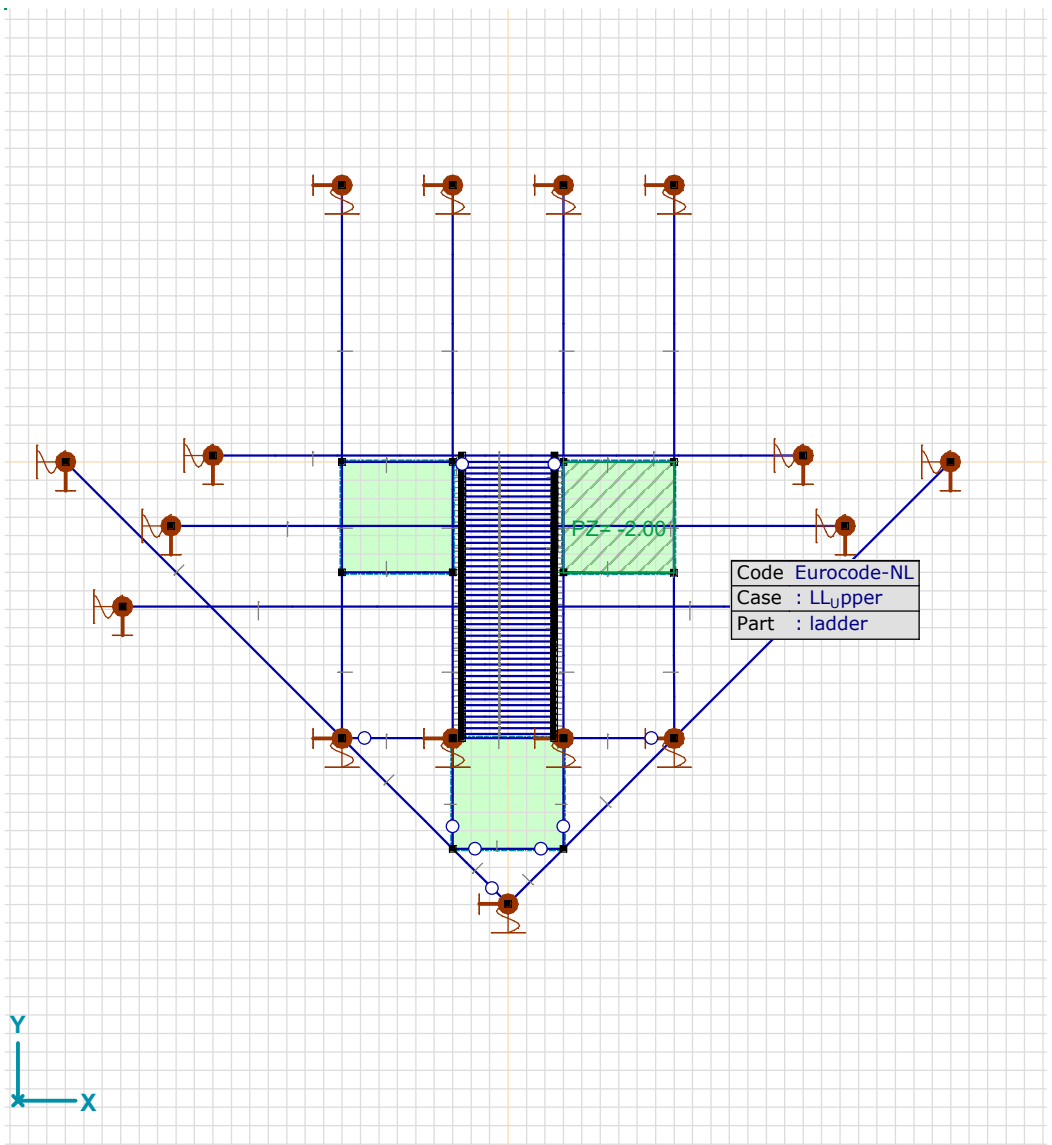
ladder_EG

LL_Upper: Domain area load [ladder]

	Element	*Index*	*Direction*	*Type*	*In hole*	*Comp.*	*Value [kN/m²]*	*X [m]*	*Y [m]*	*Z [m]*
	Panel*	1	Global	Constant	no	pX =	0	0.900	−0.600	39.500
						pY =	0	0.900	0	39.500
						pZ =	−2.00	0.300	0	39.500
								0.300	−0.600	39.500

In hole: Loads allowed on holes; **Comp.:** Component; **Value:** Load component value; **X:** X coordinate of the load polygon vertices; **Y:** Y coordinate of the load polygon vertices; **Z:** Z coordinate of the load polygon vertices;



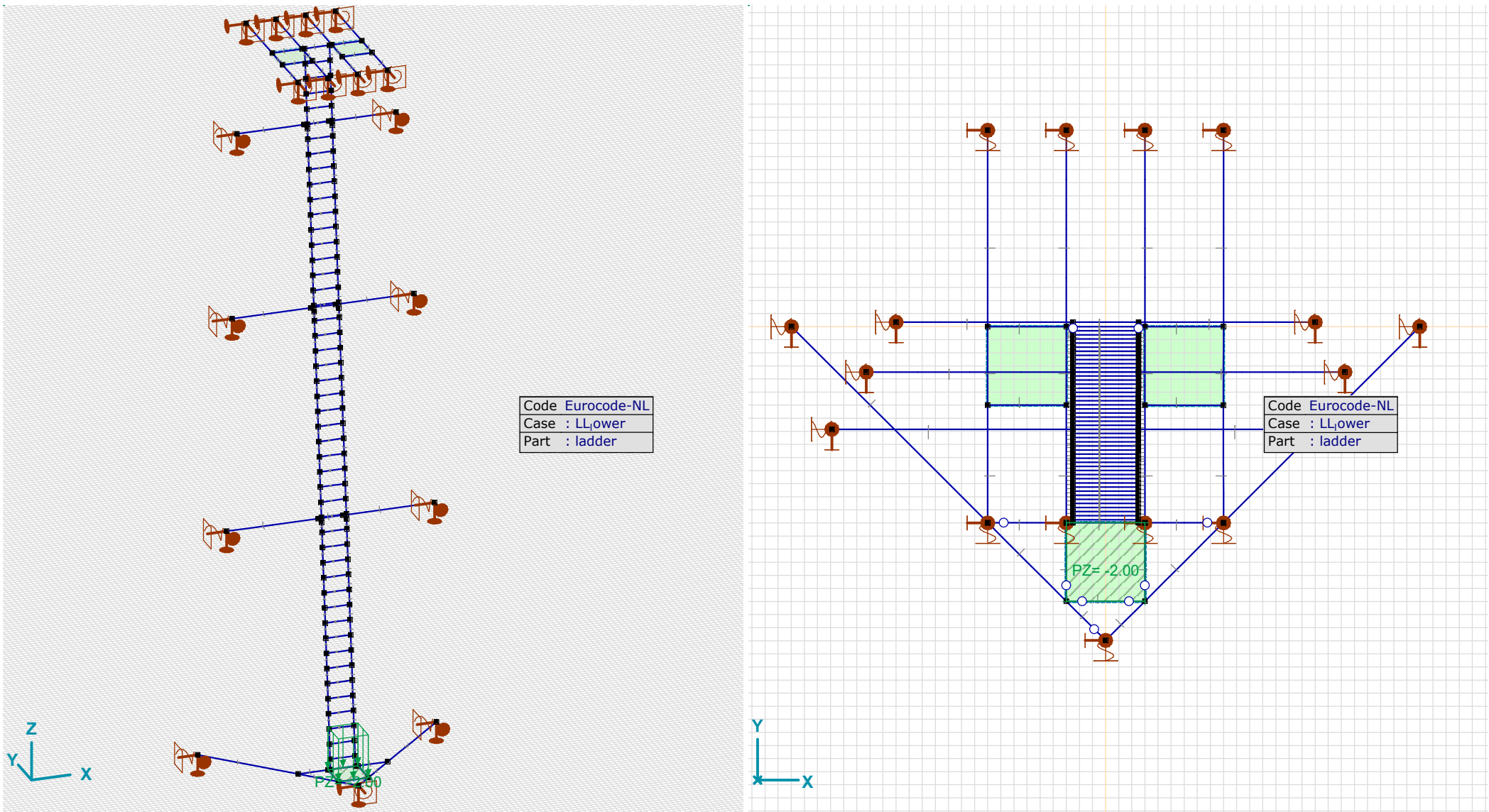


> ladder, LL_Upper

LL_lower: Domain area load [ladder]

	Element	*Index*	*Direction*	*Type*	*In hole*	*Comp.*	*Value [kN/m²]*	*X [m]*	*Y [m]*	*Z [m]*
	Panel*	3	Global	Constant	no	pX =	0	−0.300	−1.498	25.200
						pY =	0	−0.300	−2.098	25.200
						pZ =	−2.00	0.300	−2.098	25.200
								0.300	−1.498	25.200

In hole: Loads allowed on holes; **Comp.:** Component; **Value:** Load component value; **X:** X coordinate of the load polygon vertices; **Y:** Y coordinate of the load polygon vertices; **Z:** Z coordinate of the load polygon vertices;

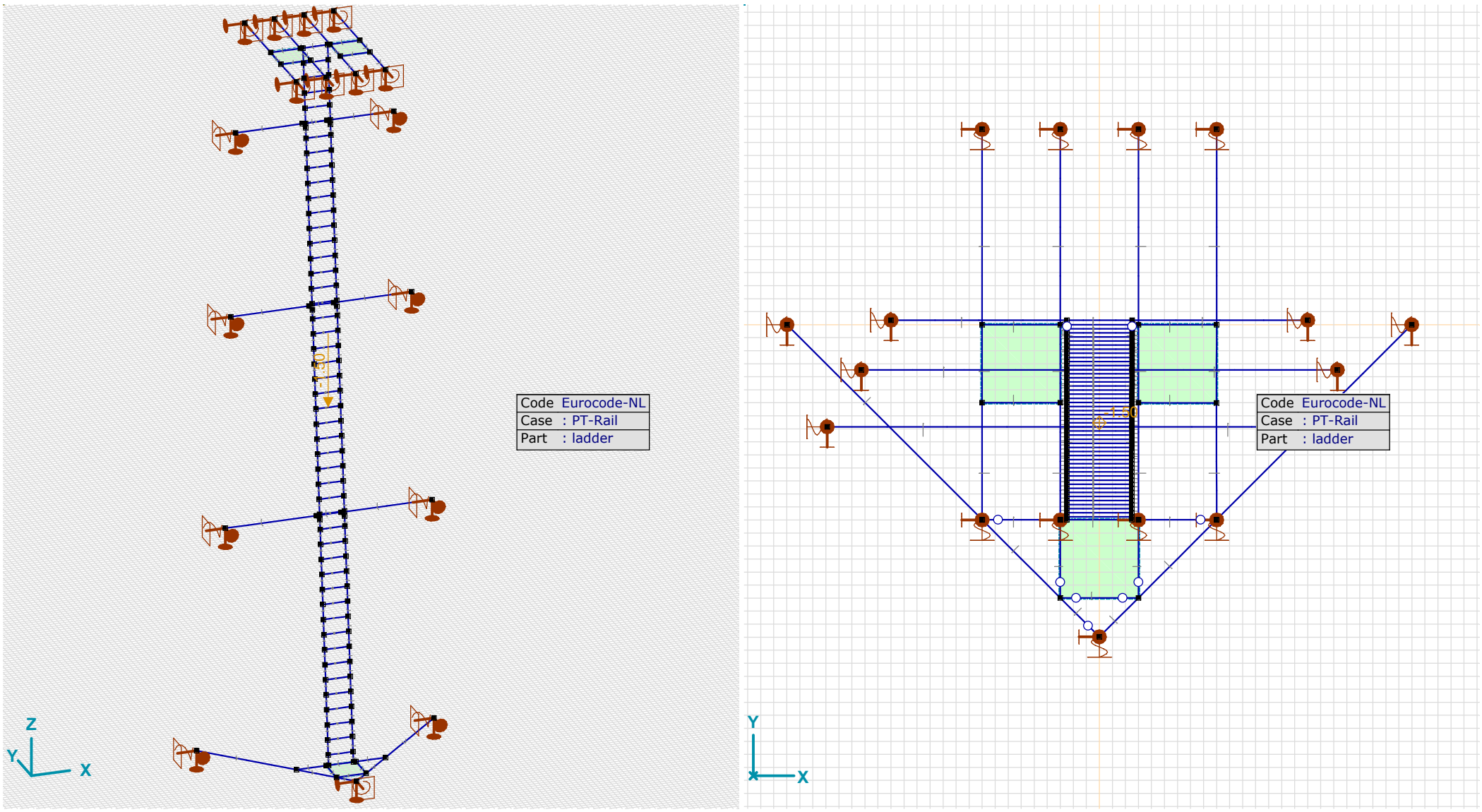


> ladder, LL_lower

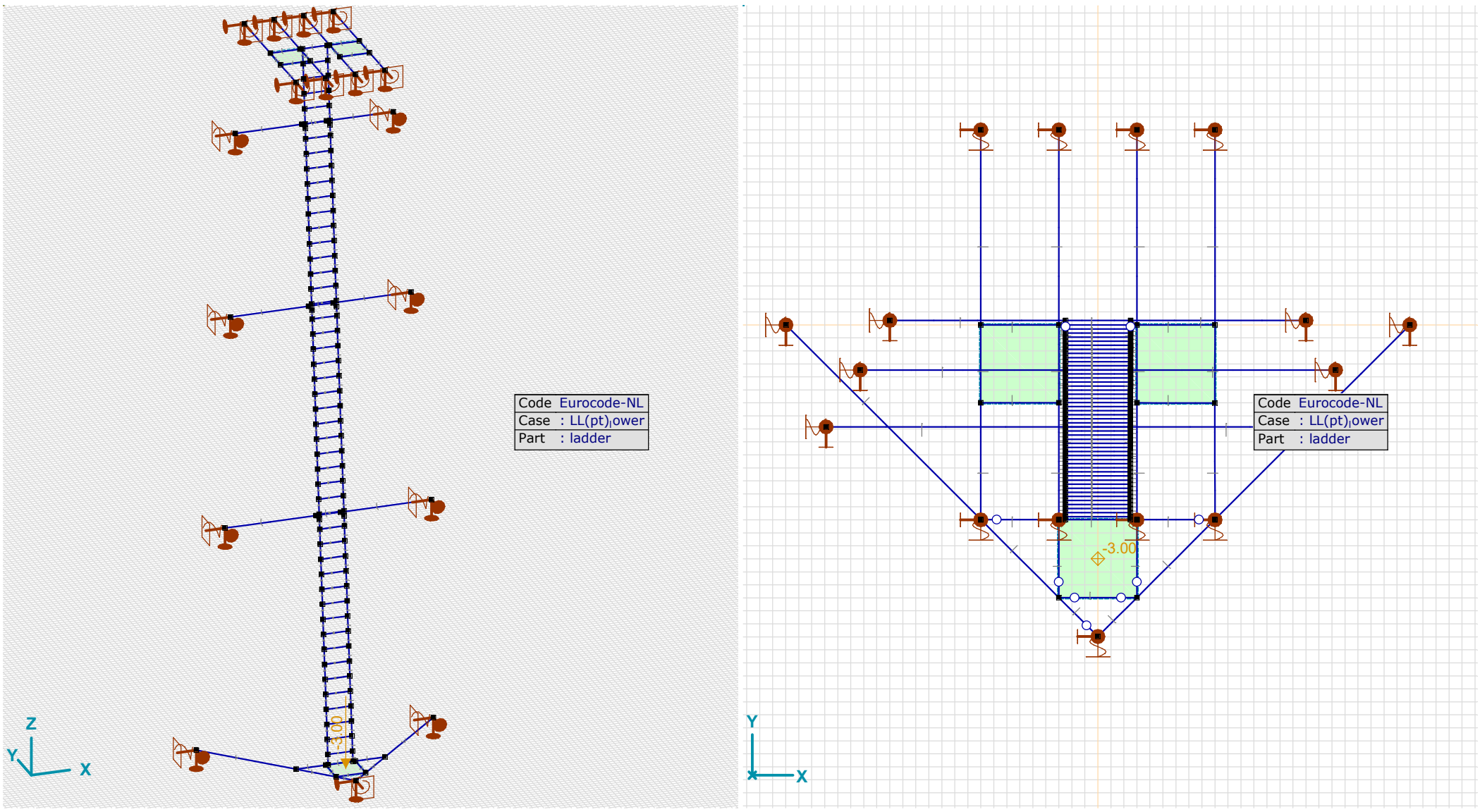
PT-Rail: Concentrated loads on beams [ladder]

	Type	*Length [m]*	*a/d*	*Pos.*	*Fx [kN]*	*Fy [kN]*	*Fz [kN]*	*Mx [kNm]*	*My [kNm]*	*Mz [kNm]*
55	Beam G	0.50	a	0.500	0	0	−1.50	0	0	0

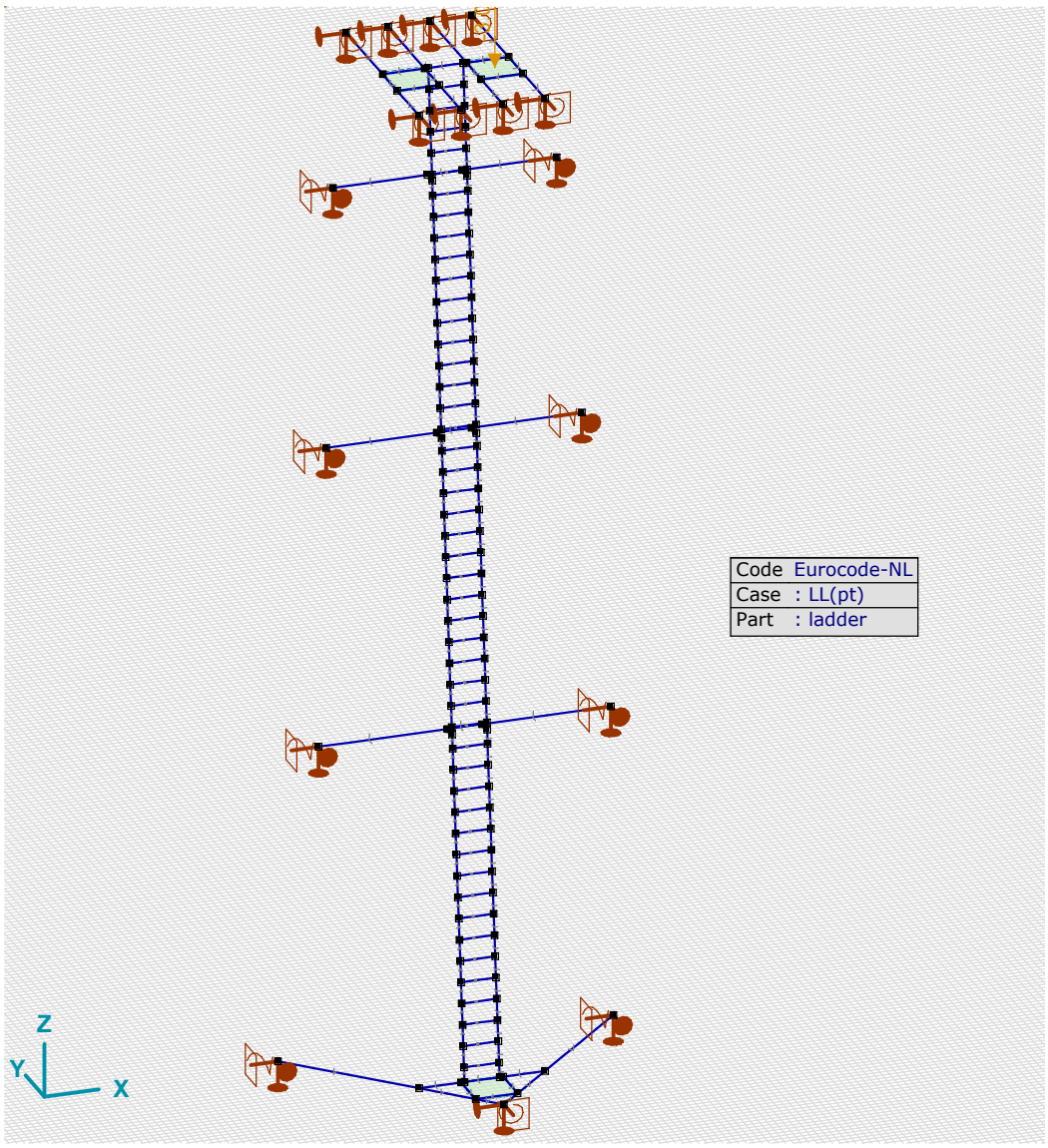
Type: Load type; **Length:** Beam length; **a/d:** Position by ratio(a) or by length(d); **Pos.:** Position; **Fx, Fy, Fz:** Load force component; **Mx, My, Mz:** Load moment component;

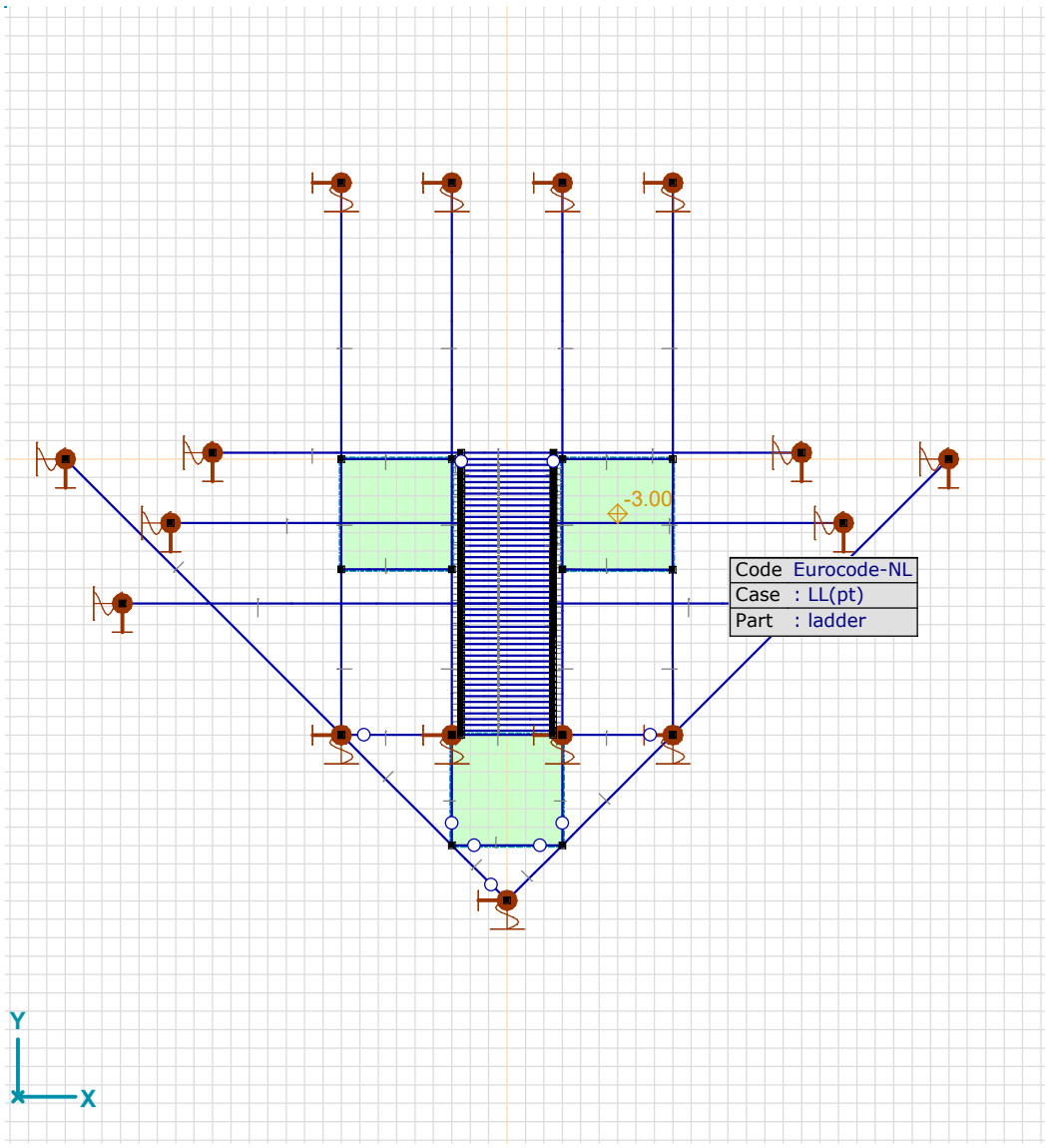


ladder, PT-Rail

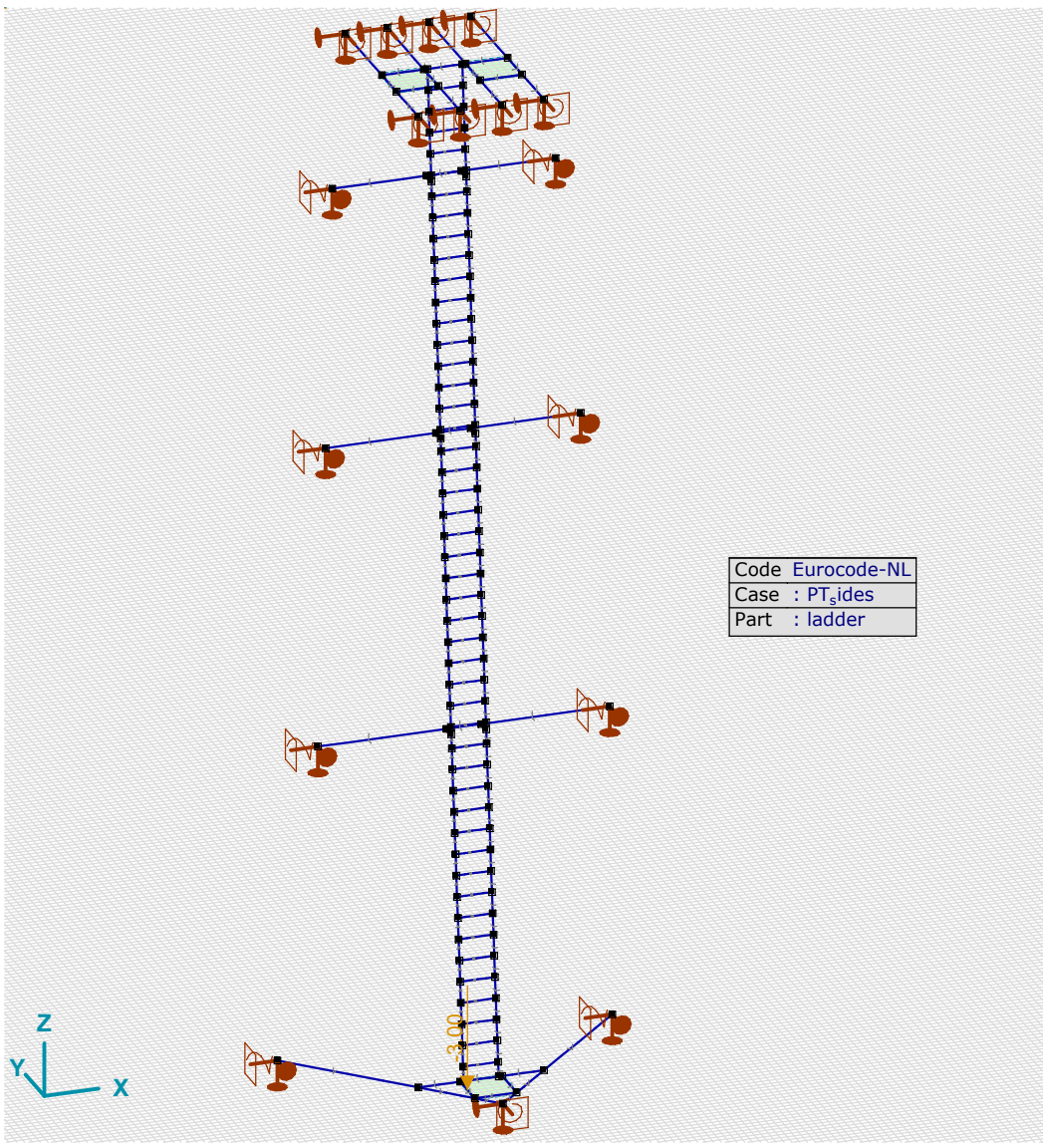


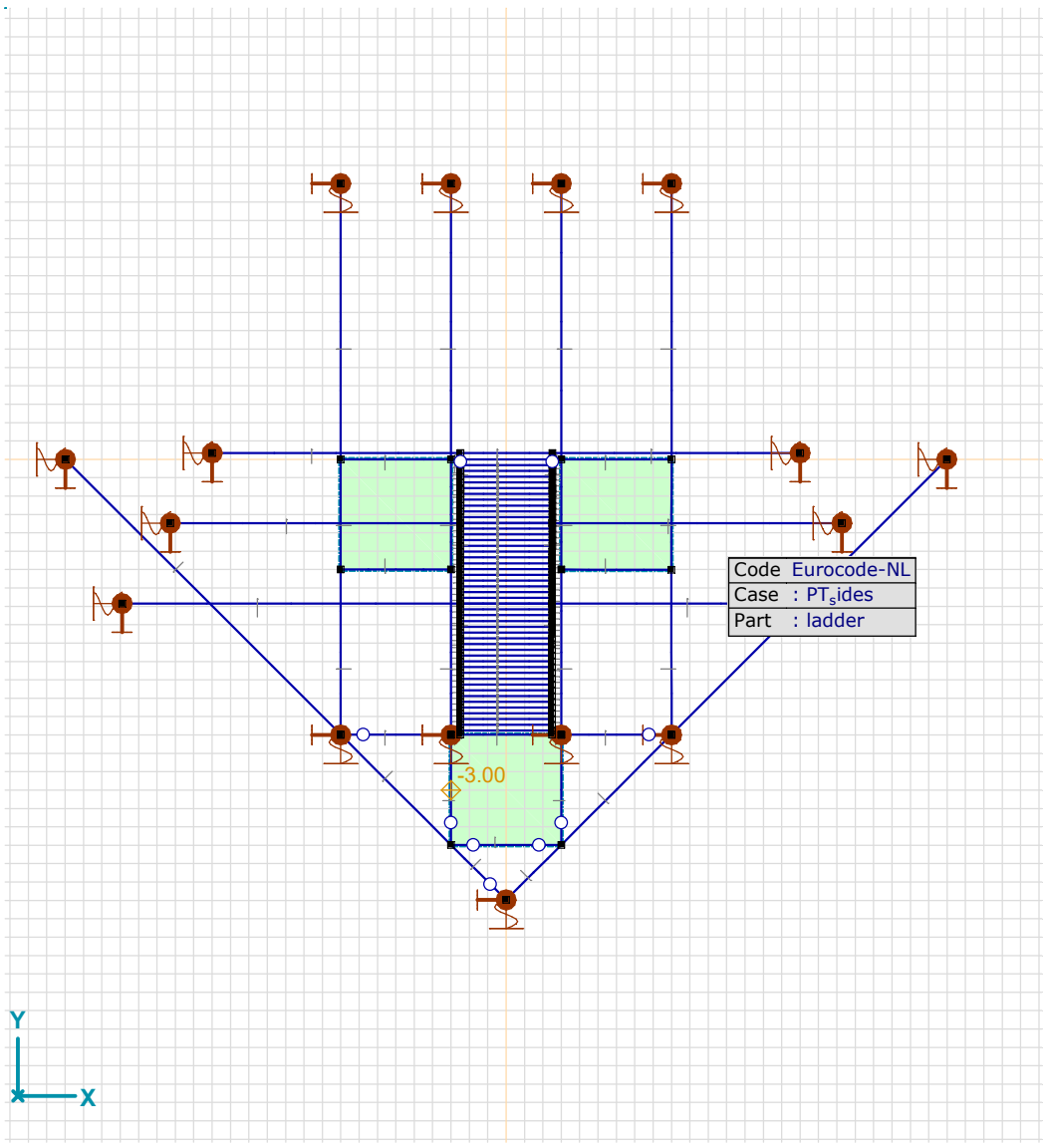
ladder_LL(pt)_lower





ladder_LL(pt)





ladder_PT_sides

WL_xx: Distributed loads on beams and ribs [ladder]

	Type	*Length [m]*	*a/d*	*Pos.*	*px [kN/m]*	*py [kN/m]*	*pz [kN/m]*	m_{tor} *[kNm/m]*
79	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
80	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0

	Type	*Length [m]*	*a/d*	*Pos.*	*px [kN/m]*	*py [kN/m]*	*pz [kN/m]*	m_{tor} *[kNm/m]*
81	Beam L	0.09	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
82	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0

WL_xx: Distributed loads on beams and ribs [ladder]

	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
83	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
84	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
85	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
86	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
87	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
88	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
89	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
90	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
91	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
92	Beam L	0.12	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
93	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
94	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
95	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
96	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
97	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
98	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
99	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
100	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
101	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
102	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
103	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
104	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
105	Beam L	0.11	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
106	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
107	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
108	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
109	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
110	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
111	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
112	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
113	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
114	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
115	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
116	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
117	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
118	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
119	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
120	Beam L	0.21	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
121	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
122	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
123	Beam L	0.09	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
124	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
125	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
126	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
127	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
128	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0

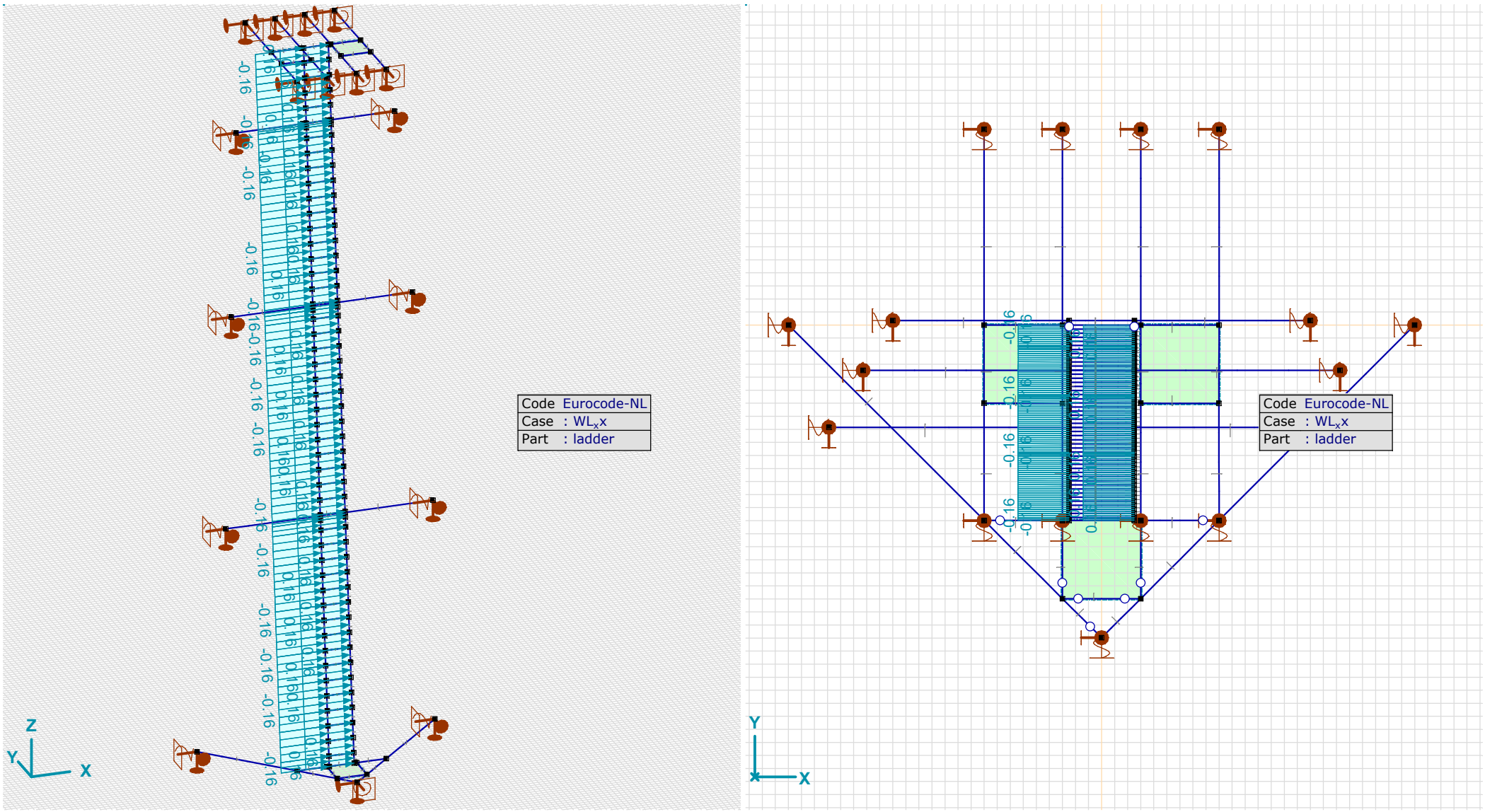
	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
129	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
130	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
131	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
132	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
133	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
134	Beam L	0.12	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
135	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
136	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
137	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
138	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
139	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
140	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
141	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
142	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
143	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
144	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
145	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
146	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
147	Beam L	0.10	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
148	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
149	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
150	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
151	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
152	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
153	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
154	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
155	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
156	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
157	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
158	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
159	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
160	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
161	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
162	Beam L	0.21	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
163	Beam L	0.21	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
164	Beam L	0.18	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
165	Beam L	0.20	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
166	Beam L	0.21	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
167	Beam L	0.18	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
168	Beam L	0.20	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
171	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
172	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
179	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
184	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
185	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
186	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0

WL_xx: Distributed loads on beams and ribs [ladder]

	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
187	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
188	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
189	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0

	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
190	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0
193	Beam L	0.30	a	0	0	−0.16	0	0
				1.000	0	−0.16	0	0
194	Beam L	0.30	a	0	0	0.16	0	0
				1.000	0	0.16	0	0

Type: Load type; **Length:** Beam length; **a/d:** Position by ratio(a) or by length(d), * = throughout; **Pos.:** Position; **px, py, pz:** Load force component; **m_{tor}:** Load moment component;



ladder_WL_xx

WL_yy: Distributed loads on beams and ribs [ladder]

	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
79	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
80	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
81	Beam L	0.09	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
82	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
83	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
84	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
85	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
86	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
87	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
88	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
89	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
90	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
91	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
92	Beam L	0.12	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
93	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
94	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
95	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0

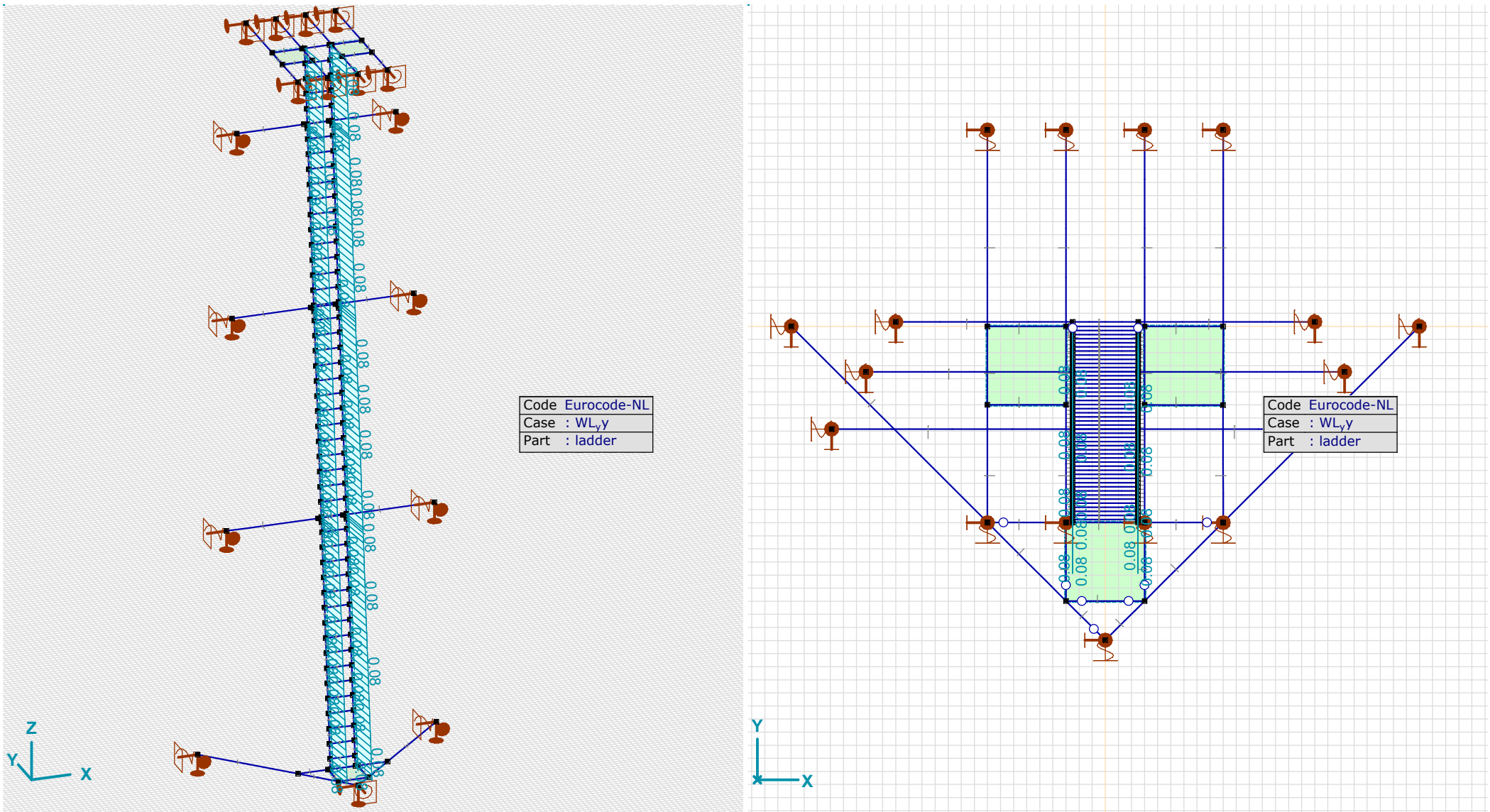
	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
96	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
97	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
98	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
99	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
100	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
101	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
102	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
103	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
104	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
105	Beam L	0.11	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
106	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
107	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
108	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
109	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
110	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
111	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
112	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0

WL_yy: Distributed loads on beams and ribs [ladder]

	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
113	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
114	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
115	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
116	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
117	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
118	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
119	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
120	Beam L	0.21	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
121	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
122	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
123	Beam L	0.09	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
124	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
125	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
126	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
127	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
128	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
129	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
130	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
131	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
132	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
133	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
134	Beam L	0.12	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
135	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
136	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
137	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
138	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
139	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
140	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
141	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
142	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
143	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
144	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
145	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
146	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0

	Type	Length [m]	a/d	Pos.	px [kN/m]	py [kN/m]	pz [kN/m]	m_{tor} [kNm/m]
147	Beam L	0.10	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
148	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
149	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
150	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
151	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
152	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
153	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
154	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
155	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
156	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
157	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
158	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
159	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
160	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
161	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
162	Beam L	0.21	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
163	Beam L	0.21	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
164	Beam L	0.18	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
165	Beam L	0.20	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
166	Beam L	0.21	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
167	Beam L	0.18	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
168	Beam L	0.20	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
171	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
172	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
179	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
184	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
185	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
186	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
187	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
188	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
189	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
190	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
193	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0
194	Beam L	0.30	a	0	0	0	0.08	0
				1.000	0	0	0.08	0

Type: Load type; **Length:** Beam length; **a/d:** Position by ratio(a) or by length(d), * = throughout; **Pos.:** Position; **px, py, pz:** Load force component; **m_{tor}:** Load moment component;



ladder_WL_yy

Custom load combinations by load cases

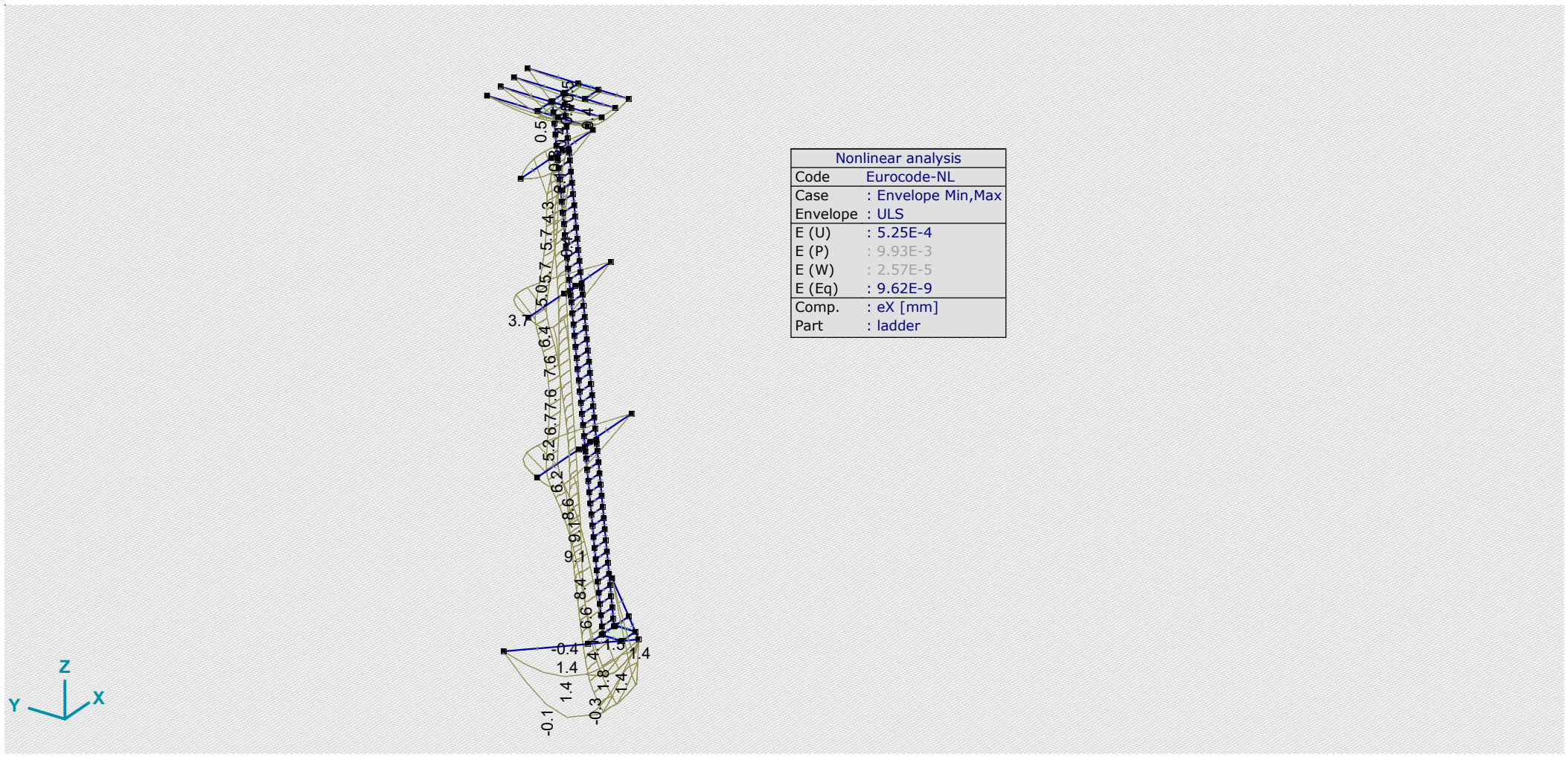
	Name	*Type*	*EG*	*LL_Upper*	*LL(pt)*	*ladder_pt_Upper*	*LL_lower*	*LL(pt)_lower*	*PT-Rail*	*PT_sides*	*WL_xx*	*WL_yy*	*Comment*
1	Co #1	ULS	1.15	1.30	0	0	0	0	0	0	0	0	
2	Co #2	ULS	1.15	0	1.30	0	0	0	0	0	0	0	
3	Co #3	ULS	1.15	0	0	1.30	0	0	0	0	0	0	
4	Co #4	ULS	1.15	0	0	0	1.30	0	0	0	0	0	
5	Co #5	ULS	1.15	0	0	0	0	1.30	0	0	0	0	
6	Co #6	ULS	1.15	0	0	0	0	0	1.30	0	0	0	
7	Co #7	ULS	1.15	0	0	0	0	0	0	1.30	0	0	
8	Co #8	ULS	1.15	0	0	0	0	0	0	0	1.40	0	
9	Co #9	ULS	1.15	0	0	0	0	0	0	0	0	1.40	

Name: Load combination name; **Type:** Load combination type; **EG, LL$_U$pper, LL(pt), ladder$_p$t$_U$pper, LL$_l$ower, LL(pt)$_l$ower, PT-Rail, PT$_s$ides, WL$_x$x, WL$_y$y:** Factor;

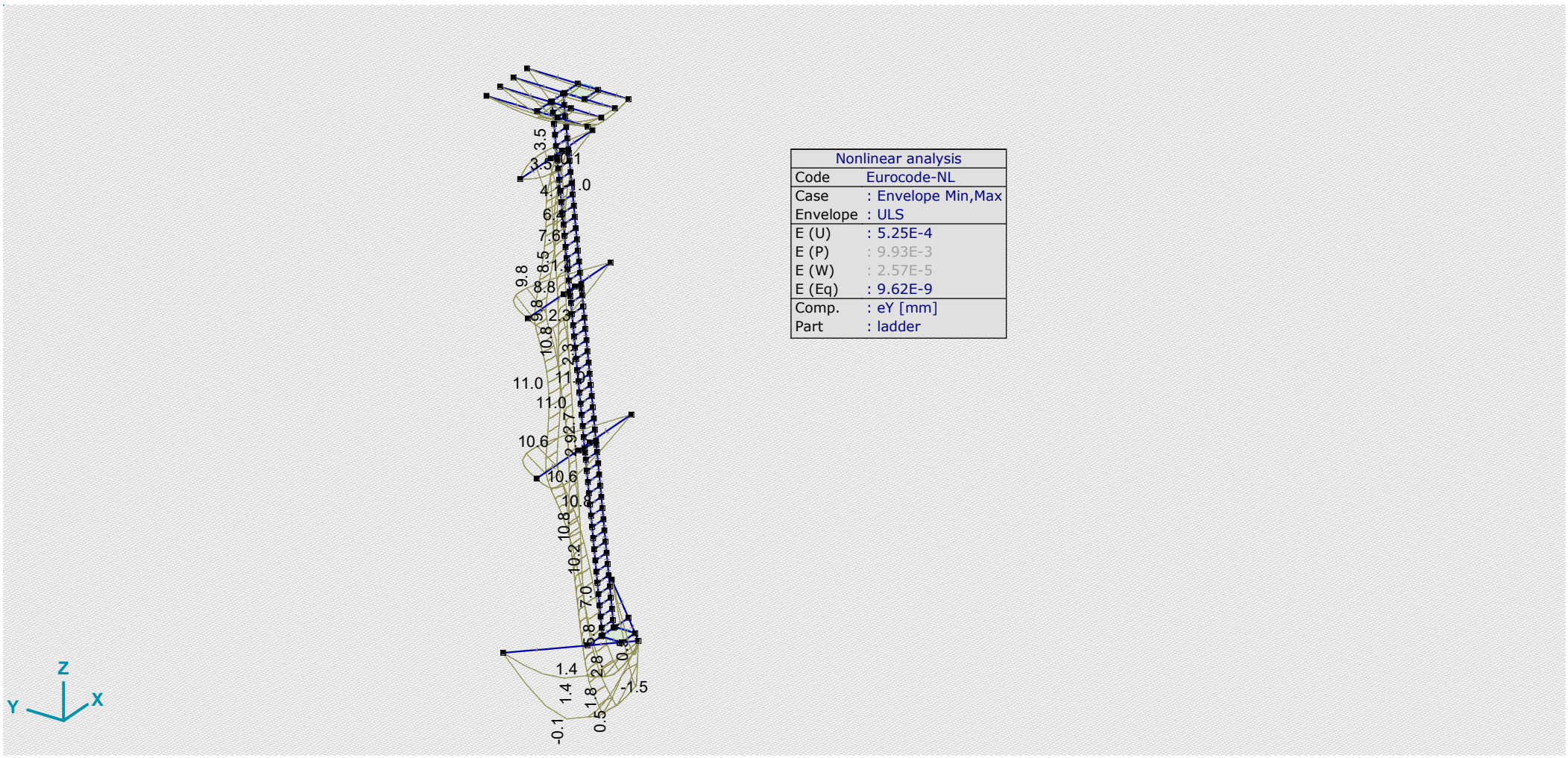
Nodal displacements [Nonlin., Envelope (ULS), ladder]

Ext.	C	min. max.	Case	eX [mm]	eY [mm]	eZ [mm]	eR [mm]	fX [rad]	fY [rad]	fZ [rad]	fR [rad]
480	eX	min	Co #2 [1] (1.000)	**−0.6**	0.4	−8.6	8.6	0	0	0	0
481		min	Co #2 [1] (1.000)	**−0.6**	0.2	−8.6	8.6	0	0	0	0
641		min	Co #2 [1] (1.000)	**−0.6**	0.3	−8.6	8.6	0	0	0	0
642		min	Co #2 [1] (1.000)	**−0.6**	0.3	−8.6	8.6	0	0	0	0
643		min	Co #2 [1] (1.000)	**−0.6**	0.3	−8.6	8.6	0	0	0	0
552		max	Co #8 [1] (1.000)	**9.1**	2.7	−8.7	12.8	0	0	0	0
553		max	Co #8 [1] (1.000)	**9.1**	4.8	−9.1	13.7	0	0	0	0
749		max	Co #8 [1] (1.000)	**9.1**	3.2	−8.8	13.0	0	0	0	0
750		max	Co #8 [1] (1.000)	**9.1**	3.7	−8.9	13.2	0	0	0	0
751		max	Co #8 [1] (1.000)	**9.1**	4.2	−9.0	13.5	0	0	0	0
817	eY	min	Co #8 [1] (1.000)	1.5	**−1.5**	−8.2	8.5	0	0	0	0
524		max	Co #9 [1] (1.000)	0	**11.0**	−11.0	15.6	0	0	0	0
525		max	Co #9 [1] (1.000)	0	**11.0**	−11.0	15.6	0	0	0	0
707		max	Co #9 [1] (1.000)	0	**11.0**	−11.0	15.6	0	0	0	0
708		max	Co #9 [1] (1.000)	0	**11.0**	−11.0	15.6	0	0	0	0
709		max	Co #9 [1] (1.000)	0	**11.0**	−11.0	15.6	0	0	0	0
546	eZ	min	Co #7 [1] (1.000)	−0.2	4.7	**−15.0**	15.7	0	0	0	0
548		min	Co #7 [1] (1.000)	−0.3	4.8	**−15.0**	15.8	0	0	0	0
550		min	Co #7 [1] (1.000)	−0.3	4.8	**−15.0**	15.8	0	0	0	0
552		min	Co #7 [1] (1.000)	−0.3	4.7	**−15.0**	15.7	0	0	0	0
554		min	Co #7 [1] (1.000)	−0.3	4.6	**−15.0**	15.7	0	0	0	0
184		max	Co #8 [1] (1.000)	0	0	**0**	0	0	0	0	0
184	eR	min	Co #3 [1] (1.000)	0	0	0	**0**	0	0	0	0
548		max	Co #7 [1] (1.000)	−0.3	4.8	−15.0	**15.8**	0	0	0	0
549		max	Co #5 [1] (1.000)	0	5.0	−14.9	**15.7**	0	0	0	0
550		max	Co #7 [1] (1.000)	−0.3	4.8	−15.0	**15.8**	0	0	0	0
551		max	Co #5 [1] (1.000)	0	5.1	−14.9	**15.8**	0	0	0	0
552		max	Co #7 [1] (1.000)	−0.3	4.7	−15.0	**15.7**	0	0	0	0
553		max	Co #5 [1] (1.000)	0	5.1	−14.9	**15.8**	0	0	0	0
743		max	Co #7 [1] (1.000)	−0.3	4.8	−15.0	**15.7**	0	0	0	0
744		max	Co #5 [1] (1.000)	0	5.0	−14.9	**15.7**	0	0	0	0
745		max	Co #5 [1] (1.000)	0	5.0	−14.9	**15.7**	0	0	0	0
746		max	Co #7 [1] (1.000)	−0.3	4.9	−15.0	**15.8**	0	0	0	0
747		max	Co #5 [1] (1.000)	0	5.1	−14.9	**15.8**	0	0	0	0
748		max	Co #5 [1] (1.000)	0	5.1	−14.9	**15.8**	0	0	0	0
749		max	Co #7 [1] (1.000)	−0.3	4.8	−15.0	**15.7**	0	0	0	0
750		max	Co #5 [1] (1.000)	0	5.1	−14.9	**15.8**	0	0	0	0
751		max	Co #5 [1] (1.000)	0	5.1	−14.9	**15.8**	0	0	0	0

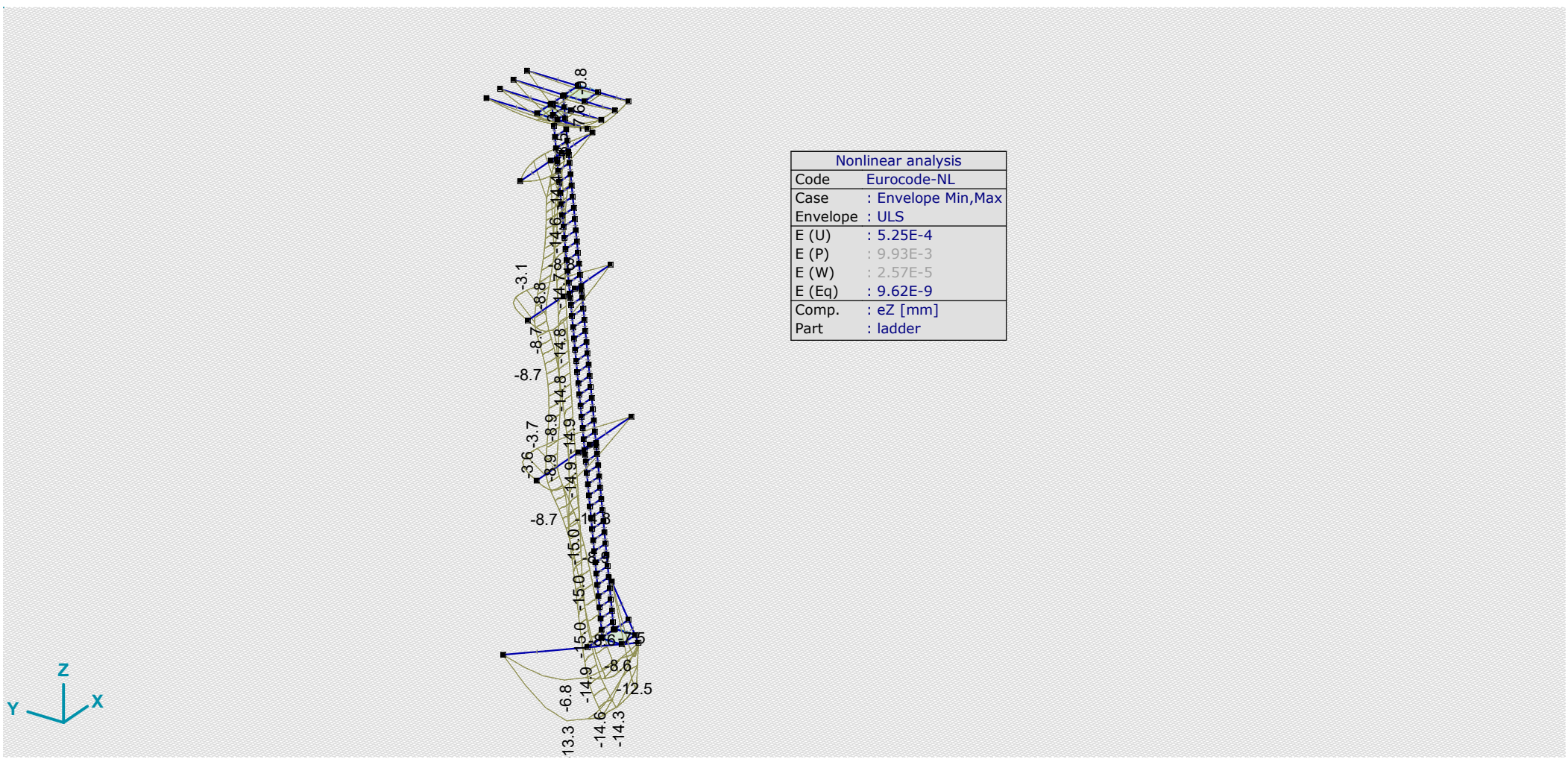
C: Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **eX:** Translation in X direction; **eY:** Translation in Y direction; **eZ:** Translation in Z direction; **eR:** Resultant translation; **fX:** Rotation in X direction; **fY:** Rotation in Y direction; **fZ:** Rotation in Z direction; **fR:** Resultant rotation;



[II], > ladder, Nonlin., Envelope (ULS), eX, Diagram



[II], > ladder, Nonlin., Envelope (ULS), eY, Diagram



[II], > ladder, Nonlin., Envelope (ULS), eZ, Diagram

Beam internal forces [Nonlin., Envelope (All ULS)]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Nx [kN]	Vy [kN]	Vz [kN]	Tx [kNm]	My [kNm]	Mz [kNm]
Ext.													
7	7	L 60X 60X 6	Nx	min	Co #9 [1] (1.000)	0	(420)	**−0.5**	0	0	0	0	0
8	7	L 60X 60X 6		max	Co #5 [1] (1.000)	0	(421)	**1.0**	0.1	−1.2	0	0	−0.1
9	7	L 60X 60X 6	My	min	Co #7 [1] (1.000)	0.30		0.9	0.2	1.4	0	**−0.7**	−0.3
8	7	L 60X 60X 6		max	Co #5 [1] (1.000)	0	(421)	1.0	0.1	−1.2	0	**0**	−0.1
9	7	L 60X 60X 6	Mz	min	Co #7 [1] (1.000)	0.60	(423)	0.9	0.2	1.4	0	−0.3	**−0.3**
7	7	L 60X 60X 6		max	Co #7 [1] (1.000)	0	(420)	0.4	0.2	0	0	0	**0.1**

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:** Flexural moment about local y axis; **Mz:** Flexural moment about local z axis;

Beam internal forces [Nonlin., Envelope (All ULS), L 80X 80X 8]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Nx [kN]	Vy [kN]	Vz [kN]	Tx [kNm]	My [kNm]	Mz [kNm]
Ext.													
22	8	L 80X 80X 8	Nx	min	Co #8 [1] (1.000)	0.34	(623)	**−0.5**	0.1	0	0	0	0.1
30	8	L 80X 80X 8		max	Co #7 [1] (1.000)	0	(186)	**11.4**	0.6	−1.0	0	0	0
30	8	L 80X 80X 8	My	min	Co #7 [1] (1.000)	2.12	(424)	11.4	0.6	−0.9	0	**−2.1**	−1.2
10	8	L 80X 80X 8		max	Co #7 [1] (1.000)	0.60	(423)	2.8	−1.7	1.2	0	**0.7**	1.0
30	8	L 80X 80X 8	Mz	min	Co #7 [1] (1.000)	2.12	(424)	11.4	0.6	−0.9	0	−2.1	**−1.2**
181	8	L 80X 80X 8		min	Co #7 [1] (1.000)	0	(424)	8.5	−0.5	0.7	0	−2.0	**−1.2**
177	8	L 80X 80X 8		max	Co #7 [1] (1.000)	0	(429)	2.6	2.7	0	−0.4	0.6	**1.4**

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:** Flexural moment about local y axis; **Mz:** Flexural moment about local z axis;

Beam internal forces [Nonlin., Envelope (All ULS), L 100X 50X 6X]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Nx [kN]	Vy [kN]	Vz [kN]	Tx [kNm]	My [kNm]	Mz [kNm]
Ext.													
113	2	L 100X 50X 6X	Nx	min	Co #8 [1] (1.000)	0.30	(554)	**−4.1**	0	0.1	0	0.2	0.1
154	2	L 100X 50X 6X		max	Co #8 [1] (1.000)	0.30	(551)	**1.7**	−0.1	0	0	0.1	0
147	2	L 100X 50X 6X	My	min	Co #9 [1] (1.000)	0	(451)	−1.0	0.1	0.3	0	**−0.2**	0
168	2	L 100X 50X 6X		min	Co #9 [1] (1.000)	0.20	(451)	−1.1	0.1	−0.4	0	**−0.2**	0
162	2	L 100X 50X 6X		max	Co #7 [1] (1.000)	0	(429)	−3.2	2.2	−0.1	0	**0.4**	0.5
105	2	L 100X 50X 6X	Mz	min	Co #8 [1] (1.000)	0.11	(450)	−2.4	0.4	0.5	−0.1	0	**−0.2**
162	2	L 100X 50X 6X		max	Co #8 [1] (1.000)	0	(429)	−0.2	1.9	0	0	0.2	**0.5**

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:** Flexural moment about local y axis; **Mz:** Flexural moment about local z axis;

Beam internal forces [Nonlin., Envelope (All ULS), L 100X100X 8]

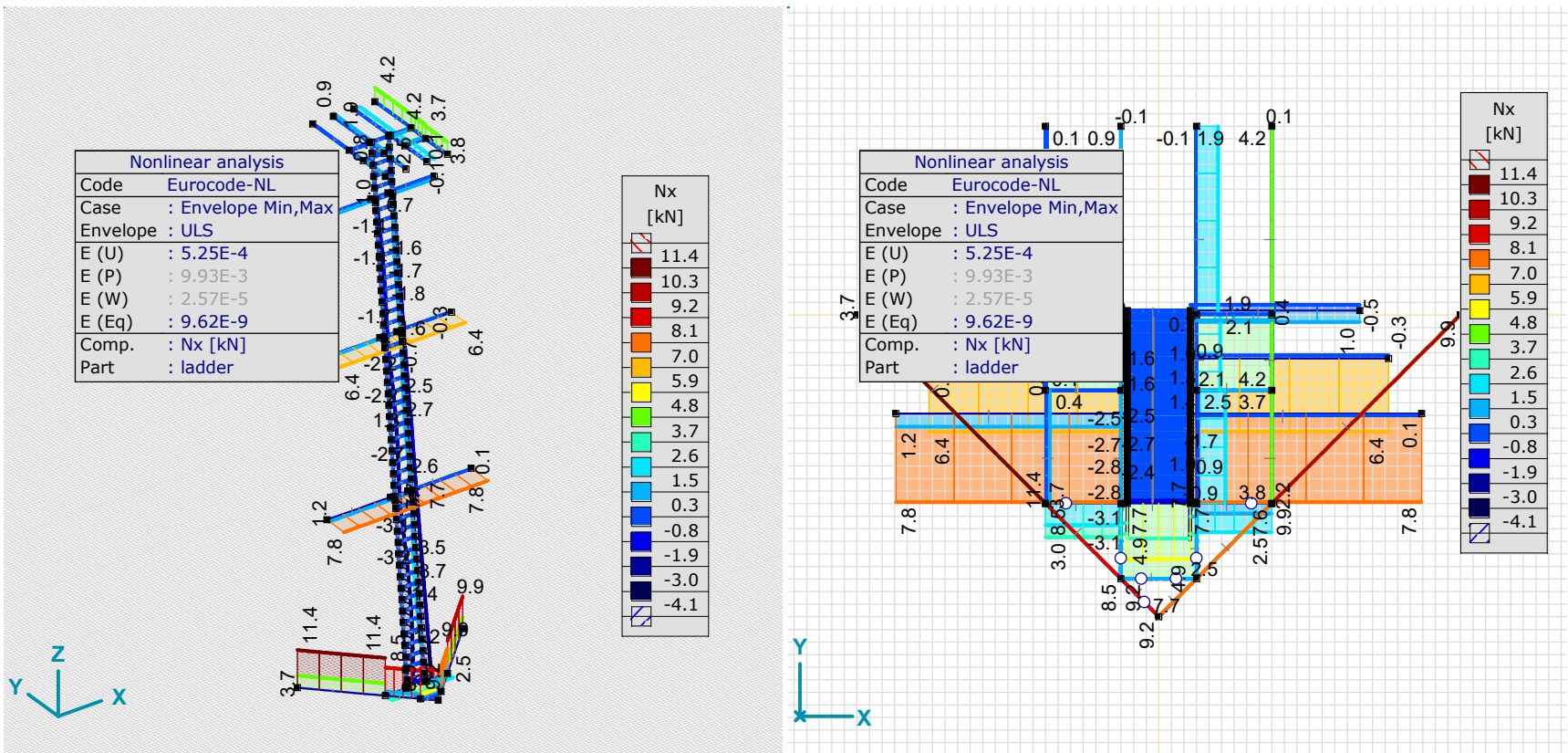
	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Nx [kN]	Vy [kN]	Vz [kN]	Tx [kNm]	My [kNm]	Mz [kNm]
Ext.													
4	1	L 100X100X 8	Nx	min	Co #8 [1] (1.000)	0	(443)	**−0.3**	0	0	0	0	−0.1
17	1	L 100X100X 8		max	Co #9 [1] (1.000)	0	(463)	**7.8**	−0.2	−0.6	0	0	0
18	1	L 100X100X 8		max	Co #9 [1] (1.000)	0.50	(464)	**7.7**	0	0	0	−1.2	0.2
19	1	L 100X100X 8		max	Co #9 [1] (1.000)	1.84	(465)	**7.8**	0.2	0.6	0	0	0
17	1	L 100X100X 8	My	min	Co #9 [1] (1.000)	1.84	(462)	7.7	0	−0.7	0	**−1.2**	0.2
18	1	L 100X100X 8		min	Co #9 [1] (1.000)	0	(462)	7.7	−0.1	0	0	**−1.2**	0.2
4	1	L 100X100X 8		max	Co #2 [1] (1.000)	0.05	(571)	−0.1	−0.5	0.2	0	**0**	0
4	1	L 100X100X 8	Mz	min	Co #8 [1] (1.000)	0	(443)	−0.3	0	0	0	0	**−0.1**
18	1	L 100X100X 8		max	Co #8 [1] (1.000)	0.13	(617)	1.1	0	−0.7	0	−0.1	**0.3**
19	1	L 100X100X 8		max	Co #8 [1] (1.000)	0	(464)	0.1	0	0.2	0	−0.4	**0.3**

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:** Flexural moment about local y axis; **Mz:** Flexural moment about local z axis;

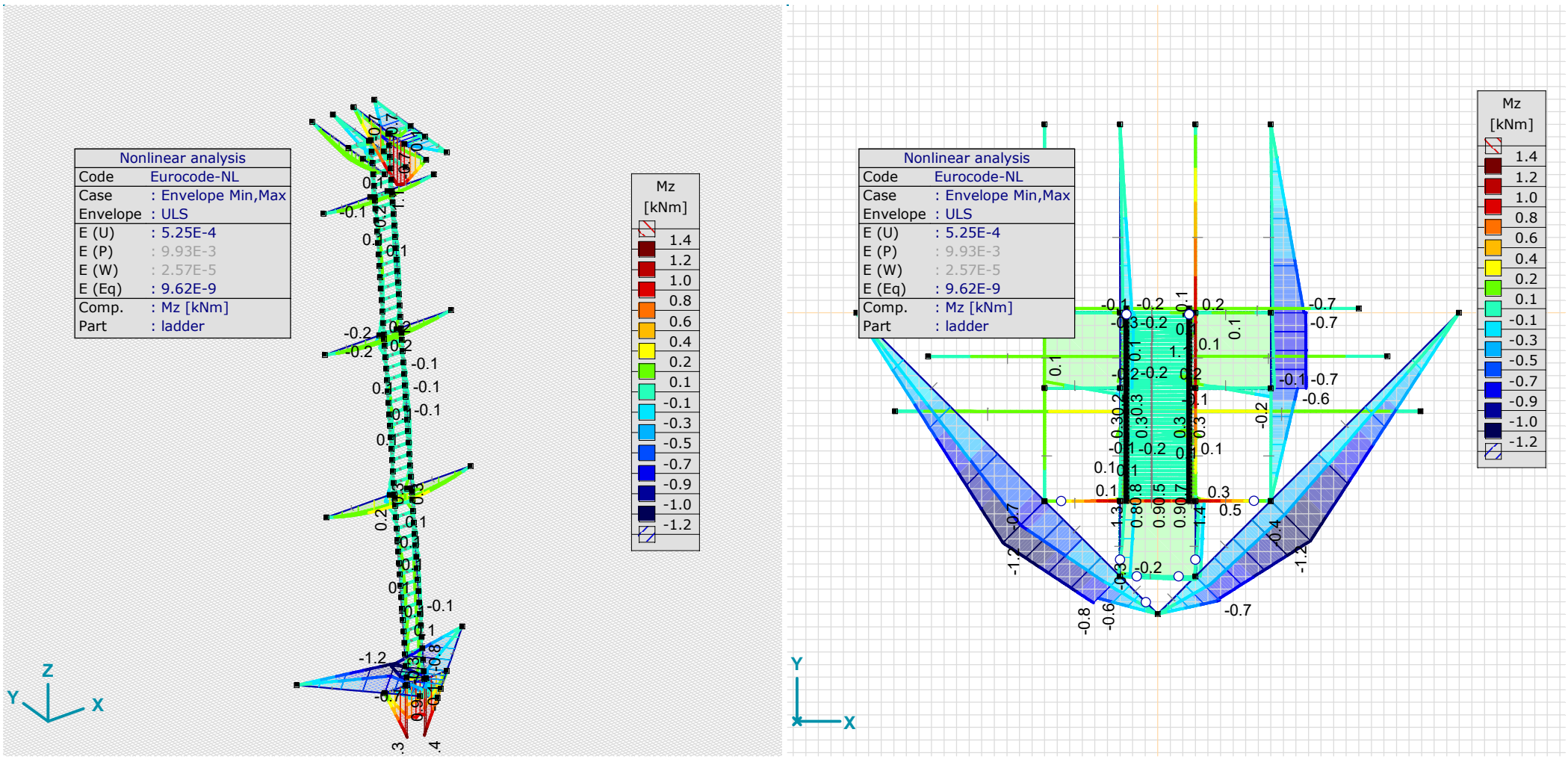
Beam internal forces [Nonlin., Envelope (All ULS), O 20]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Nx [kN]	Vy [kN]	Vz [kN]	Tx [kNm]	My [kNm]	Mz [kNm]
Ext.													
78	6	O 20	Nx	min	Co #5 [1] (1.000)	0.38	(775)	**−2.5**	0	0	0	0	0
77	6	O 20		max	Co #5 [1] (1.000)	0	(566)	**0.3**	0	0	0	0	0
55	6	O 20	My	min	Co #6 [1] (1.000)	0.25	(705)	0	0	1.0	0	**−0.1**	0
55	6	O 20		max	Co #6 [1] (1.000)	0	(522)	0	0	−1.0	0	**0.1**	0
62	6	O 20	Mz	min	Co #8 [1] (1.000)	0	(536)	0	−0.4	0	0	0	**−0.1**
62	6	O 20		max	Co #8 [1] (1.000)	0.50	(537)	0	−0.4	0	0	0	**0.1**

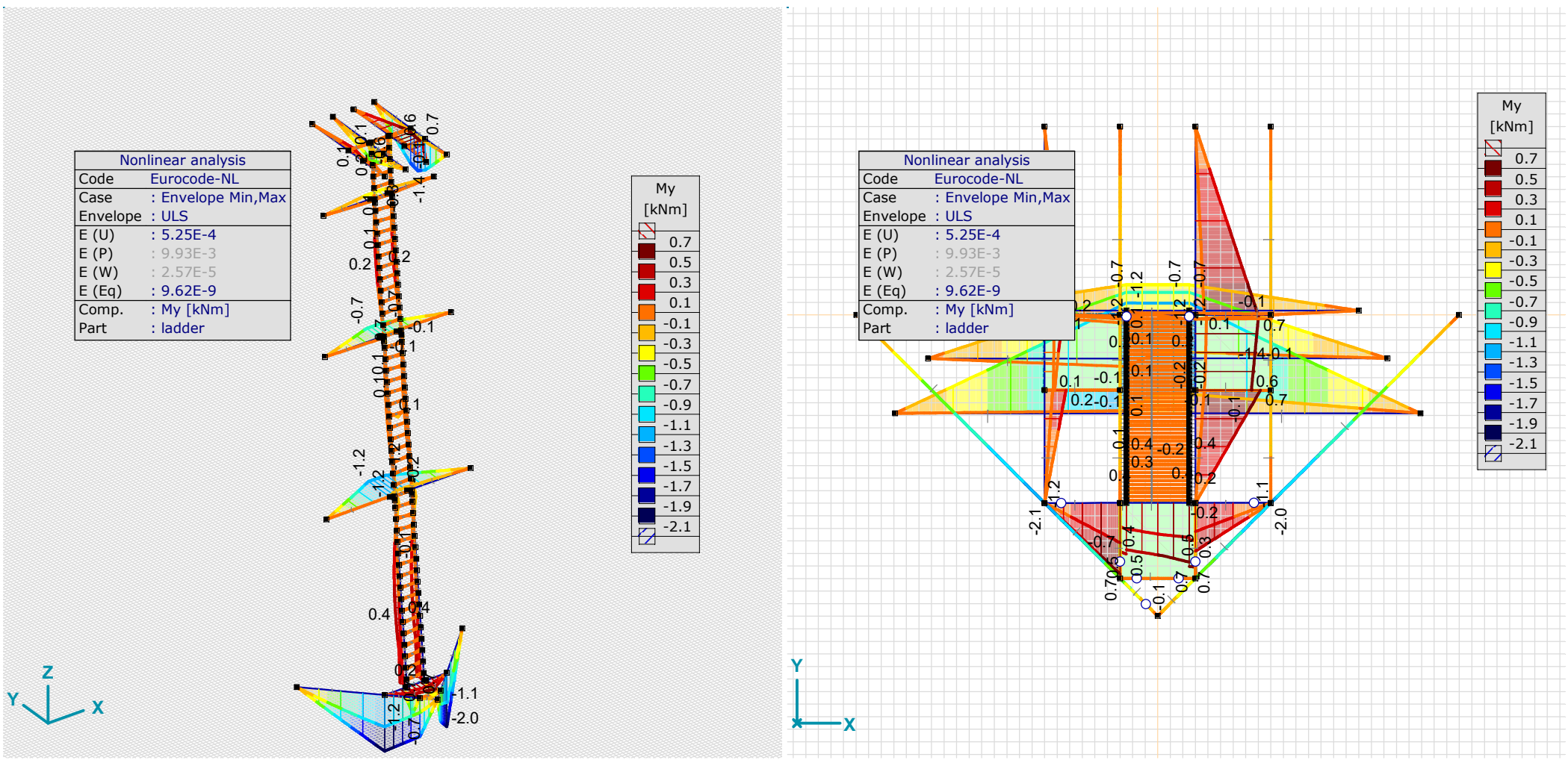
Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:** Flexural moment about local y axis; **Mz:** Flexural moment about local z axis;



[II], > ladder, Nonlin., Envelope (ULS), Nx, Filled diagram, x 2



[II], > ladder, Nonlin., Envelope (ULS), Mz, Filled diagram, x 2



[II], > ladder, Nonlin., Envelope (ULS), My, Filled diagram, x 2

Beam stresses [Nonlin., Envelope (All ULS)]

	Sh.	*Cross-section name*	*C*	*min. max.*	*Case*	*Loc. [m]*	*Node*	*Smin [N/mm²]*	*Smax [N/mm²]*	*Vmin [N/mm²]*	*Vmax [N/mm²]*	*Somin [N/mm²]*	*Somax [N/mm²]*	*Vymean [N/mm²]*	*Vzmean [N/mm²]*
Ext.															
9	7	L 60X 60X 6	Smin	min	Co #7 [1] (1.000)	0.30		**−150.5**	89.1	0	5.4	1.3	150.5	0.2	2.0
7	7	L 60X 60X 6		max	Co #7 [1] (1.000)	0.35		**0.1**	1.0	0	0.7	0.5	1.4	0.3	0
7	7	L 60X 60X 6	Smax	min	Co #9 [1] (1.000)	0.35		−1.2	**−0.5**	0	0.1	0.5	1.2	0	0
9	7	L 60X 60X 6		max	Co #7 [1] (1.000)	0.30		−150.5	**89.1**	0	5.4	1.3	150.5	0.2	2.0
7	7	L 60X 60X 6	Somin	min	Co #9 [1] (1.000)	0.41		−1.0	0	0	0.1	**0**	1.0	0	0
8	7	L 60X 60X 6		max	Co #5 [1] (1.000)	0	(421)	−17.5	24.8	0	4.0	**1.4**	24.9	0.2	−1.7
7	7	L 60X 60X 6	Somax	min	Co #3 [1] (1.000)	0.36		−0.5	0.5	0	0.1	0.1	**0.5**	0.1	0
9	7	L 60X 60X 6		max	Co #7 [1] (1.000)	0.30		−150.5	89.1	0	5.4	1.3	**150.5**	0.2	2.0

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Smin:** Axial stress cross-Section minimum; **Smax:** Axial stress cross-Section maximum; **Vmin:** Shear stress cross-section minimum; **Vmax:** Shear stress cross-section maximum; **Somin:** Von Mises stress cross-section minimum; **Somax:** Von Mises stress cross-section maximum; **Vymean:** Shear stress in local y direction; **Vzmean:** Shear stress in local z direction;

Beam stresses [Nonlin., Envelope (All ULS), L 100X 50X 6X]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Smin [N/mm²]	Smax [N/mm²]	Vmin [N/mm²]	Vmax [N/mm²]	Somin [N/mm²]	Somax [N/mm²]	Vymean [N/mm²]	Vzmean [N/mm²]
Ext.															
162	2	L 100X 50X 6X	Smin	min	Co #8 [1] (1.000)	0	(429)	**−153.3**	75.7	0	6.8	0.2	153.3	2.2	0
144	2	L 100X 50X 6X		max	Co #8 [1] (1.000)	0	(531)	**1.1**	1.3	0	1.9	1.2	3.5	0.3	0
107	2	L 100X 50X 6X	Smax	min	Co #8 [1] (1.000)	0.18		−3.6	**−2.7**	0	2.2	2.9	5.2	−0.5	0.1
162	2	L 100X 50X 6X		max	Co #8 [1] (1.000)	0	(429)	−153.3	**75.7**	0	6.8	0.2	153.3	2.2	0
171	2	L 100X 50X 6X	Somin	min	Co #2 [1] (1.000)	0	(442)	−26.3	53.1	0	1.2	**0**	53.1	−0.1	0.1
115	2	L 100X 50X 6X		max	Co #8 [1] (1.000)	0.30	(558)	−23.7	7.8	0	1.5	**4.6**	23.8	0.2	0.1
79	2	L 100X 50X 6X	Somax	min	Co #7 [1] (1.000)	0.12		−0.2	0.1	0	0.1	0	**0.2**	0	0.1
162	2	L 100X 50X 6X		max	Co #8 [1] (1.000)	0	(429)	−153.3	75.7	0	6.8	0.2	**153.3**	2.2	0

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Smin:** Axial stress cross-Section minimum; **Smax:** Axial stress cross-Section maximum; **Vmin:** Shear stress cross-section minimum; **Vmax:** Shear stress cross-section maximum; **Somin:** Von Mises stress cross-section minimum; **Somax:** Von Mises stress cross-section maximum; **Vymean:** Shear stress in local y direction; **Vzmean:** Shear stress in local z direction;

Beam stresses [Nonlin., Envelope (All ULS), L 80X 80X 8]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Smin [N/mm²]	Smax [N/mm²]	Vmin [N/mm²]	Vmax [N/mm²]	Somin [N/mm²]	Somax [N/mm²]	Vymean [N/mm²]	Vzmean [N/mm²]
Ext.															
181	8	L 80X 80X 8	Smin	min	Co #7 [1] (1.000)	0	(424)	**−154.7**	73.7	0	2.8	6.9	154.7	−0.4	0.6
30	8	L 80X 80X 8		max	Co #7 [1] (1.000)	0	(186)	**8.8**	10.0	0	4.0	9.3	11.2	0.5	−0.8
22	8	L 80X 80X 8	Smax	min	Co #8 [1] (1.000)	1.35	(473)	−0.4	**−0.4**	0	0.2	0.4	0.5	0.1	0
30	8	L 80X 80X 8		max	Co #7 [1] (1.000)	2.12	(424)	−153.8	**75.7**	0	2.0	9.3	153.8	0.5	−0.8
196	8	L 80X 80X 8	Somin	min	Co #8 [1] (1.000)	0	(436)	−15.2	6.3	0	0.4	**0**	15.2	−0.1	0.1
30	8	L 80X 80X 8		max	Co #7 [1] (1.000)	0	(186)	8.8	10.0	0	4.0	**9.3**	11.2	0.5	−0.8
31	8	L 80X 80X 8	Somax	min	Co #4 [1] (1.000)	0.01		−0.1	0	0	0	0	**0.1**	0	0
177	8	L 80X 80X 8		max	Co #7 [1] (1.000)	0	(429)	−109.4	56.0	0	121.0	2.1	**231.3**	2.2	0

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Smin:** Axial stress cross-Section minimum; **Smax:** Axial stress cross-Section maximum; **Vmin:** Shear stress cross-section minimum; **Vmax:** Shear stress cross-section maximum; **Somin:** Von Mises stress cross-section minimum; **Somax:** Von Mises stress cross-section maximum; **Vymean:** Shear stress in local y direction; **Vzmean:** Shear stress in local z direction;

Beam stresses [Nonlin., Envelope (All ULS), O 20]

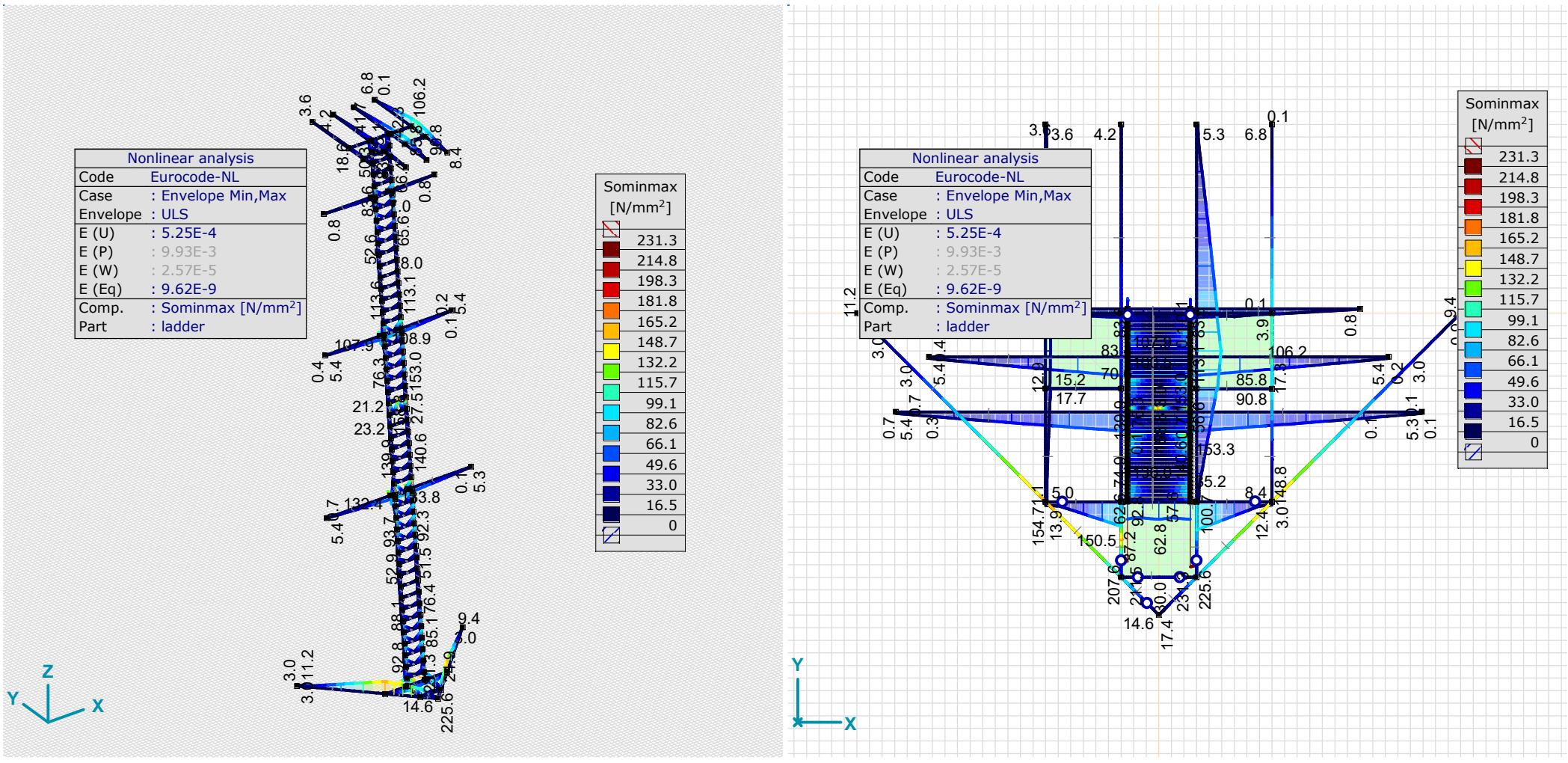
	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Smin [N/mm²]	Smax [N/mm²]	Vmin [N/mm²]	Vmax [N/mm²]	Somin [N/mm²]	Somax [N/mm²]	Vymean [N/mm²]	Vzmean [N/mm²]
Ext.															
55	6	O 20	Smin	min	Co #6 [1] (1.000)	0.25	(705)	**−158.5**	158.8	0	4.7	8.1	158.8	0	3.1
77	6	O 20		max	Co #5 [1] (1.000)	0.43		**1.0**	1.1	0	0	1.0	1.1	0	0
78	6	O 20	Smax	min	Co #7 [1] (1.000)	0.06		−7.8	**−7.3**	0	0.6	7.4	7.8	0	0
55	6	O 20		max	Co #6 [1] (1.000)	0.25	(705)	−158.5	**158.8**	0	4.7	8.1	158.8	0	3.1
42	6	O 20	Somin	min	Co #4 [1] (1.000)	0.10		−0.1	0.1	0	0	**0**	0.1	0	0
55	6	O 20		max	Co #6 [1] (1.000)	0	(522)	−152.8	153.1	0	4.7	**8.1**	153.1	0	−3.1
40	6	O 20	Somax	min	Co #1 [1] (1.000)	0.47		0	0	0	0	0	**0**	0	0
55	6	O 20		max	Co #6 [1] (1.000)	0.25	(705)	−158.5	158.8	0	4.7	8.1	**158.8**	0	3.1

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Smin:** Axial stress cross-Section minimum; **Smax:** Axial stress cross-Section maximum; **Vmin:** Shear stress cross-section minimum; **Vmax:** Shear stress cross-section maximum; **Somin:** Von Mises stress cross-section minimum; **Somax:** Von Mises stress cross-section maximum; **Vymean:** Shear stress in local y direction; **Vzmean:** Shear stress in local z direction;

Beam stresses [Nonlin., Envelope (All ULS), L 100X100X 8]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Smin [N/mm²]	Smax [N/mm²]	Vmin [N/mm²]	Vmax [N/mm²]	Somin [N/mm²]	Somax [N/mm²]	Vymean [N/mm²]	Vzmean [N/mm²]
Ext.															
19	1	L 100X100X 8	Smin	min	Co #9 [1] (1.000)	0	(464)	**−68.0**	68.7	0	0.9	5.0	68.8	0	0.4
17	1	L 100X100X 8		max	Co #9 [1] (1.000)	0	(463)	**5.0**	5.0	0	1.2	5.0	5.4	−0.2	−0.4
19	1	L 100X100X 8		max	Co #9 [1] (1.000)	1.84	(465)	**5.0**	5.0	0	1.0	5.0	5.3	0.2	0.4
19	1	L 100X100X 8	Smax	min	Co #8 [1] (1.000)	1.84	(465)	0.1	**0.1**	0	0.3	0.1	0.5	0.2	0.1
19	1	L 100X100X 8		max	Co #9 [1] (1.000)	0	(464)	−68.0	**68.7**	0	0.9	5.0	68.8	0	0.4
4	1	L 100X100X 8	Somin	min	Co #9 [1] (1.000)	0	(443)	−1.3	1.5	0	30.3	**0**	52.5	0	0.1
17	1	L 100X100X 8		max	Co #9 [1] (1.000)	0	(463)	5.0	5.0	0	1.2	**5.0**	5.4	−0.2	−0.4
18	1	L 100X100X 8		max	Co #9 [1] (1.000)	0.50	(464)	−67.9	68.5	0	0.9	**5.0**	68.5	0	0
19	1	L 100X100X 8		max	Co #9 [1] (1.000)	1.84	(465)	5.0	5.0	0	1.0	**5.0**	5.3	0.2	0.4
19	1	L 100X100X 8	Somax	min	Co #8 [1] (1.000)	1.84	(465)	0.1	0.1	0	0.3	0.1	**0.5**	0.2	0.1
19	1	L 100X100X 8		max	Co #9 [1] (1.000)	0	(464)	−68.0	68.7	0	0.9	5.0	**68.8**	0	0.4

Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Smin:** Axial stress cross-Section minimum; **Smax:** Axial stress cross-Section maximum; **Vmin:** Shear stress cross-section minimum; **Vmax:** Shear stress cross-section maximum; **Somin:** Von Mises stress cross-section minimum; **Somax:** Von Mises stress cross-section maximum; **Vymean:** Shear stress in local y direction; **Vzmean:** Shear stress in local z direction;



[II], > ladder, Nonlin., Envelope (ULS), Sominmax, Filled diagram, x 2

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TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380

ENS-ZL380 – Rapportage masttype HB+0/R_X

TenneT TSO B.V.

Rapport nr.: 22-0510, Rev. 0
Meridian doc.nr.: 002.515.40 - 1007989
Datum: 2022-04-01

Projectnaam:	Toetsing en herontwerp masten en fundaties BBB380	Energy Systems
Rapport titel:	ENS-ZL380 – Rapportage masttype HB+0/R_X	DNV Netherlands B.V.
Klant:	TenneT TSO B.V.,	Utrechtseweg 310-B50
Contactpersoon klant:	P. v.d. Horst	6812 AR Arnhem
Datum uitgave:	2022-04-01	
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Geschreven door:	Beoordeeld door:	Goedgekeurd door:
M.H. Khan	A.J. Börger	C. Schutte

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1 INLEIDING

1.1 Inleiding

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen zodat er een grotere transportcapaciteit mogelijk wordt gemaakt.

Om die reden is de opdrachtgever (OG) voornemens de bestaande 380 kV-koppelnetring op te waarderen. Het opwaarderen van de bestaande verbindingen valt onder het programma “Beter benutten bestaande 380 kV-ring” en omvat de volgende deelprojecten:

- Opwaardering 380 kV-verbinding Lelystad – Ens (LLS-ENS380);
- Opwaardering 380 kV-verbinding Diemen – Lelystad (DIM-LLS380);
- Opwaardering 380 kV-verbinding Rilland – Zandvliet (RLL-ZVL380);
- Opwaardering 380 kV-verbinding Krimpen aan den IJssel - Geertruidenberg (KIJ-GT380);
- Opwaardering 380 kV-verbinding Ens - Zwolle (ENS-ZL380);
- Opwaardering 380 kV-verbinding Maasbracht - Eindhoven (MBT-EHV380).

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV opdracht verstrekt voor de volgende onderdelen:

1. In eerste fase het opstellen en creëren van:

1.1 E-studie deel 1

1.2 Uitgangspuntenrapporten ten behoeve van de constructieve analyse van masten en fundaties

1.3 Sonderingmodellen

1.4 Fundatiemodellen

1.5 Mastmodellen

2. In tweede fase de uitvoering van de DO-fase bevattende:

2.1 Toetsing conform het uitgangspuntenrapport van de bestaande fundaties

2.2 Globale specificatie van benodigde fundatieversterkingen ten behoeve van aanbesteding

2.3 Toetsing conform het uitgangspuntenrapport van de bestaande masten

2.4 Globale specificatie van benodigde mastversterkingen ten behoeve van aanbesteding

2.5 E-studie deel 2

1.2 Doel van dit rapport

In dit rapport wordt voor de hoogspanningslijn Ens - Zwolle de controle van de mastconstructie van masttype HB+0/R_X gerapporteerd. Het doel is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de nieuwe ACCC-Warsaw geleider waarmee een hogere capaciteit kan worden gerealiseerd.

Nadat de wijzigingen zijn toegepast dient aantoonbaar geverifieerd te worden dat het systeem voldoet aan de vigerende eisen.

In de defintief-ontwerpfase zijn ten behoeve van de contractvorming Engelstalige rapporten geleverd. Het voorliggende rapport is bedoeld voor vergunningsaanvraag en is inhoudelijk ongewijzigd ten opzichte van de Engelse versie. Om deze reden zijn de bijlagen in dit rapport één op één overgenomen uit de Engelse versie. Hierdoor wijkt het revisienummer van de bijlagen af van het revisienummer van de rapportage.

1.3 Gerelateerde documenten

1.3.1 Verificatie & validatieplan

De door TenneT aangeleverde set met eisen is beoordeeld op relevantie en voor de relevante eisen is aangegeven in welk document wordt aangetoond dat er aan de eis wordt voldaan. De resultaten hiervan zijn opgenomen in het rapport “Verificatie & Validatieplan 380 kV verbinding Ens - Zwolle”.

1.3.2 E-studie deel 1

In de rapportage “ENS-ZL380 - E-studie deel 1” [1] is bepaald welke aanpassingen benodigd zijn om de ACCC-Warsaw geleider toe te passen binnen de verbinding Ens – Zwolle. Mast HB+0/R is aanwezig op één locatie in ENS-ZL, Nummer 35. De constructie wordt aangepast om een wisselmast te worden. Deze wordt nu HB+0/R_X genoemd.

De aanpassingen zoals deze hierboven genoemd zijn, zijn de enige aanpassingen welke relevant zijn voor de structurele analyse in dit rapport. Een complete lijst met aanpassingen gerelateerd aan de HB+0/R_X is te vinden in “ENS-ZL380 – E-studie deel 1”.

1.3.3 Uitgangspuntendocument

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport “Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” [2].

2 EISEN

In onderstaande Tabel 1 zijn de eisen opgenomen die binnen deze rapportage worden getoetst.

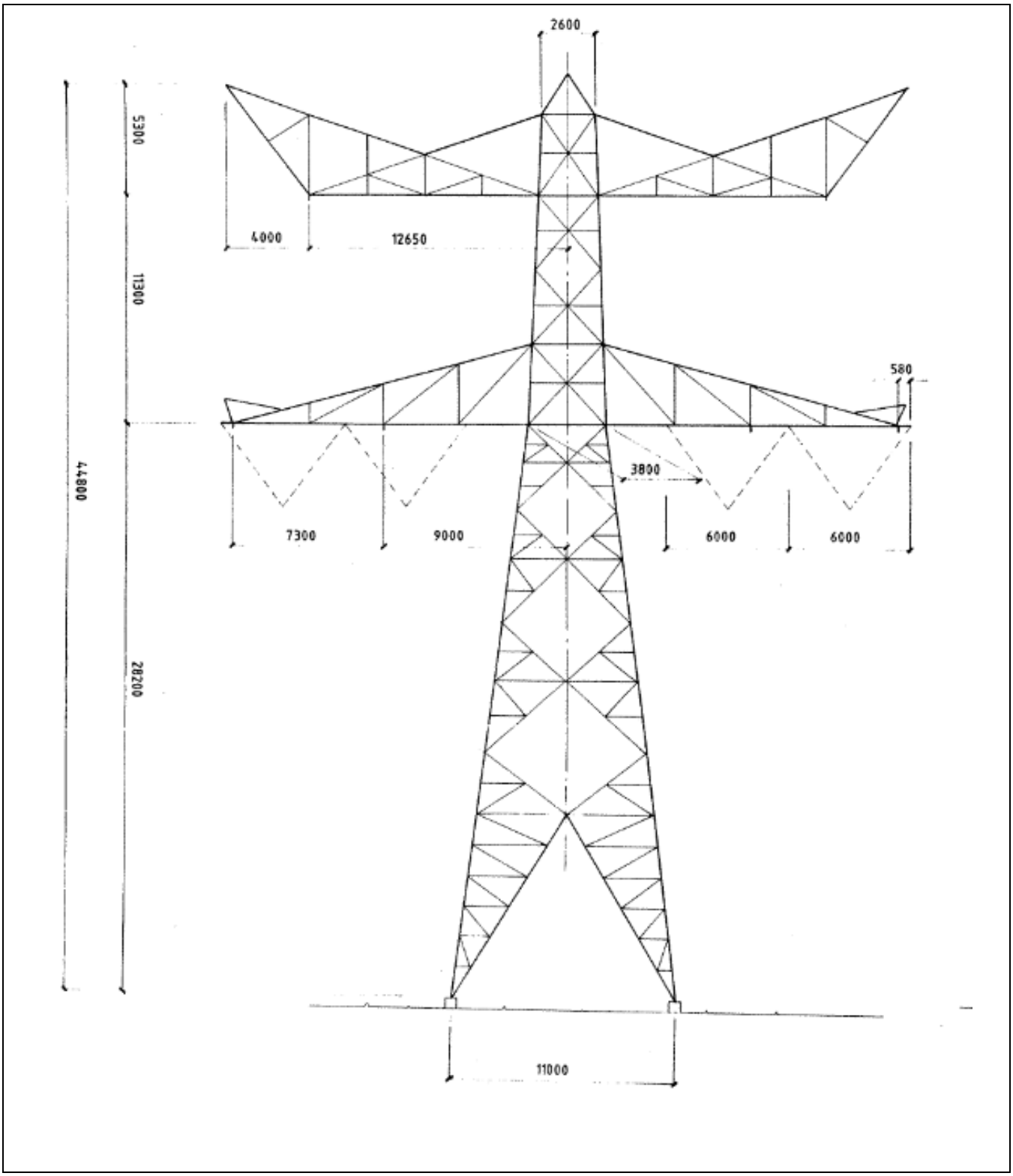
Tabel 1 Relevante eisen

Req. Id	Title	Req. text	Verification
BO Eis: H2.7-6	Omgeving, beperkingsfactoren	Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid.	Tabel 6
PVE.05.001 5.14	Masten	Aanwijzingen t.a.v. klimvoorziening en valbeveiliging: Huidige klimweg blijft gehandhaafd en zal voldoen aan de eisen zoals opgenomen in de NEN 1060:1987. Valbeveiliging is/zal worden uitgevoerd in het type "latch way". Indien staaldelen in de nabijheid (aangrenzend profiel) van de klimweg gewijzigd worden, dient geverifieerd te worden dat de klimvoorziening in overeenstemming is met de NEN 1060:1987.	Tabel 6

3 BEREKENINGEN

3.1 Mastbeeld

Het mastbeeld op basis van de Asset-data is weergegeven in Figuur 1.



Figuur 1 Mastbeeld HB+0/R_X (beoogde fasewisseling niet weergegeven)

3.2 Mastenlijst

In deze rapportage wordt masttype HB+0/R_X getoetst. Er is één HB+0/R_X mast en deze valt binnen windgebied III. De berekening is uitgevoerd voor windgebied II en windgebied III. De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven. Er is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde).

Tabel 2 Mastnummers

Tower number	Tower type	Governing tower number	Wind span (m)	Weight span (m)	Height difference back (m)	Height difference ahead (m)
35	HB+0_R_X	35	409	440	-3.5	-2.9

3.3 Uitgangspunten berekening

De berekening is uitgevoerd op basis van de uitgangspunten zoals opgenomen in het uitgangspuntenrapport [3]. Hierin is een volledig overzicht opgenomen van de belastingcombinaties en toegepaste belastingfactoren:

Tabel 3 Uitgangspunten berekening

Algemeen	Norm	NEN-EN50341-2-15:2019
	Windgebied	II/III
	Terreincategorie	II (onbebouwde omgeving)
	Reductiefactor cdir	1,00
Situatie initieel	Gevolgklasse	CC2-0
	Betrouwbaarheidsniveau	Afkeur CC2-0
	Referentieperiode	30 jaar
Situatie na aanpassingen	Gevolgklasse	CC2
	Betrouwbaarheidsniveau	Verbouw
	Referentieperiode	50 jaar

3.4 Proces stappen

Het proces van het bepalen van eventueel benodigde verzwaringen bestaat uit de volgende stappen:

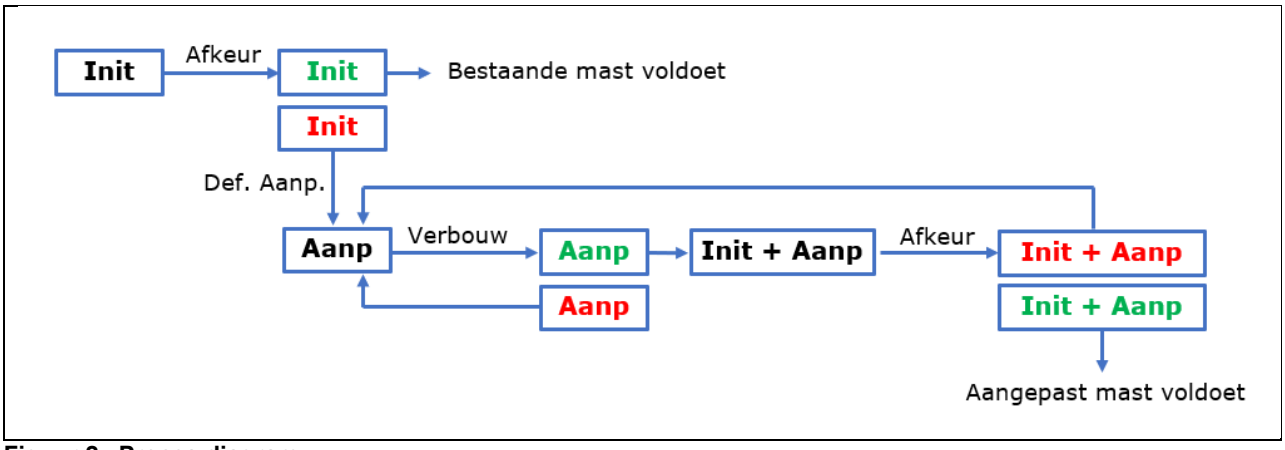
Stap 1: Toets bestaande (Init) mast op Afkeur

Stap 2: Definiëren benodigde aanpassingen indien initiële mast niet voldoet aan toets op Afkeur (Def. Aanp.)

Stap 3: Het toetsen van (alleen) de uitgewerkte aanpassingen (Aanp) op Verbouw

Stap 4: Het opnieuw toetsen van de complete mast inclusief aanpassingen (Initi + Aanp) op Afkeur

Het hierboven omschreven proces is in Figuur 2 weergegeven.



Figuur 2 Proces diagram

3.5 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV. In Appendix A zijn de resultaten van de geleiderbelastingen samengevat.

3.6 Reacties op de fundering

De oplegreacties op de fundering worden ontleend aan de uitvoer van het geleiderbelastingenprogramma, zie ook Appendix A.

3.7 Modellering

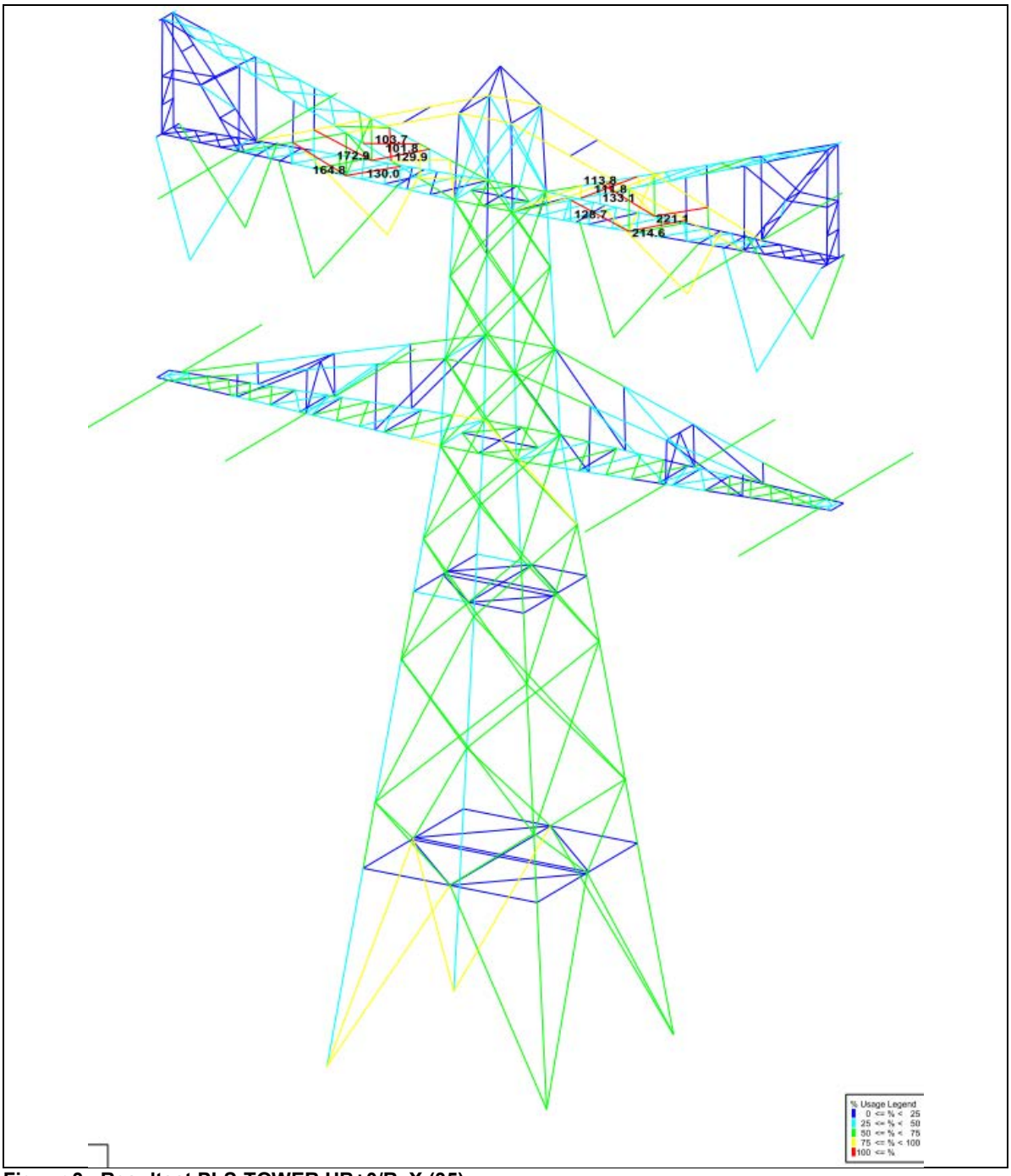
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

De geleiderbelastingen vanuit het geleiderbelastingenprogramma zijn als invoer voor de belastingen gebruikt.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

4 TOETSING MASTCONSTRUCTIE

Het resultaat van de controle van de mastconstructie type HB+0/R_X met belastingen op afkeurniveau is weergegeven in Figuur 3.



Figuur 3 Resultaat PLS-TOWER HB+0/R_X (35)

De diagonalen in één paneel in de boventraverse falen vanwege een te kleine eindafstand van de enkele bout (22 mm).

De toegevoegde verzwaringen van de fase wisseling resulteert in een overbelasting in de knikverkorters van de boventraverse. De hoofdprofielen hebben voldoende capaciteit.

De resultaten van de controles van profielen, knikverkorters en ankers randstijl zijn opgenomen in Tabel 4.

Sommige knikverkorters falen door knik vanwege de overschrijding van het 1% criterium op drukkracht weerstand van de randstijl. Daarom moeten de knikverkorters vervangen worden.

Tabel 4 Samenvatting controle

Controle van	Beoordeling		Referentie
Profielen		Voldoen niet	Figuur 3 Appendix B
Knikverkorters		Voldoen niet	Appendix C
Blokdeuvels	Voldoen		Appendix D

5 AANPASSINGEN

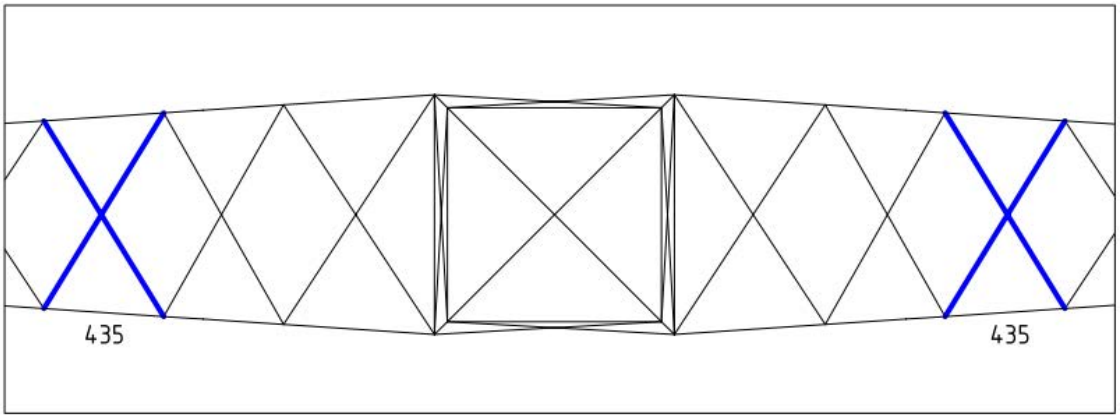
5.1 Inleiding

Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Vervangen van de overbelaste horizontale diagonalen in de bovenzijde van de boventraverse.
- Vervangen van verschillende knikverkorters in de onderste randstijl.
- Vervangen van verschillende verticale verzwaringen in de boventraverse
- Toevoegen van extra profielen ter ondersteuning van de fasewisseling
- Verlengen van het horizontale profiel in de boventraverse.

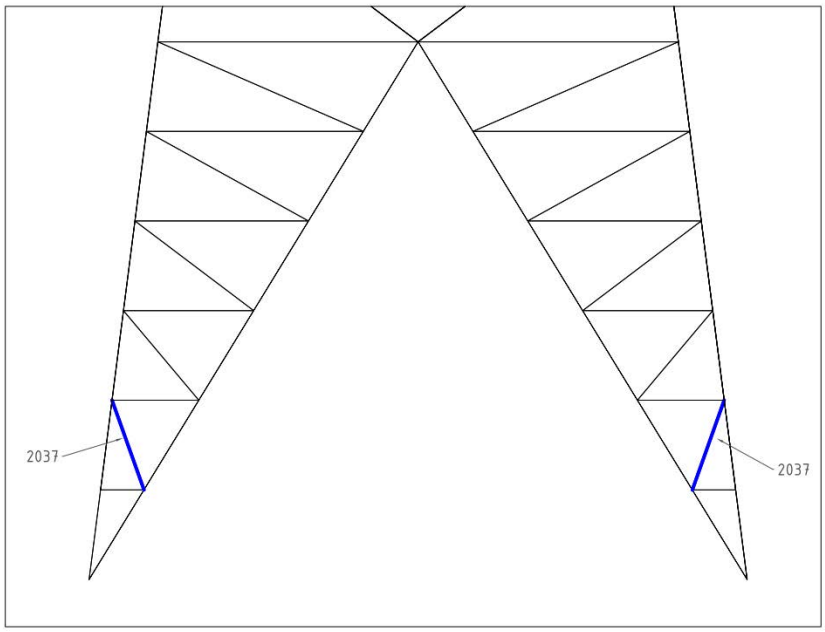
5.2 Aanpassingen

Zoals blijkt uit Appendix B dienen de aanpassingen welke worden toegepast in dit hoofdstuk toegelicht te worden. In de volgende figuur zijn de horizontale diagonalen weergegeven welke vervangen dienen te worden.

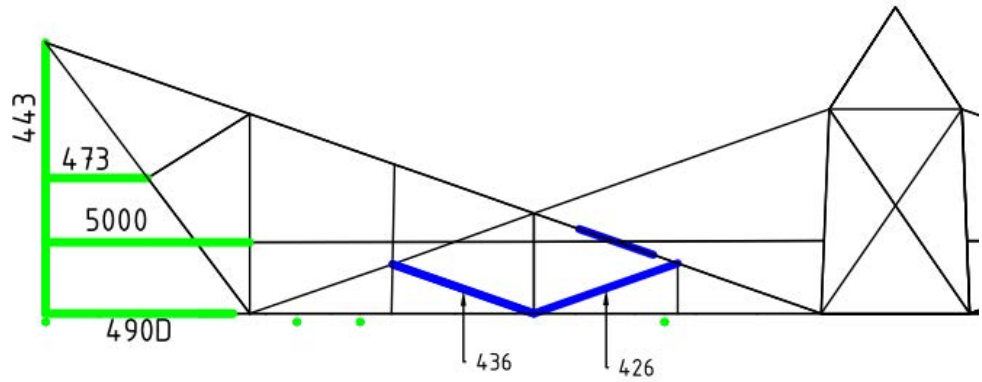


Figuur 4 Bovenaanzicht – Boventraverse

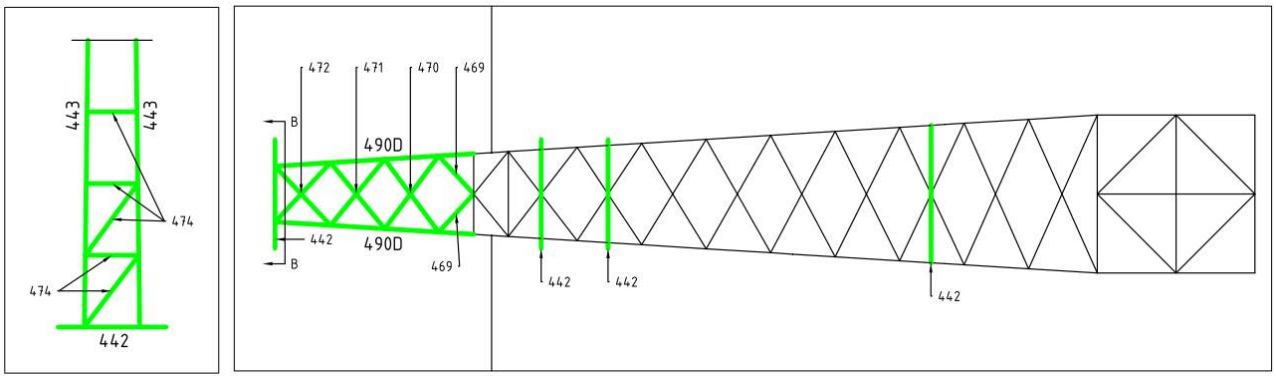
Knikverkorters in Figuur 6 dienen te worden vervangen.



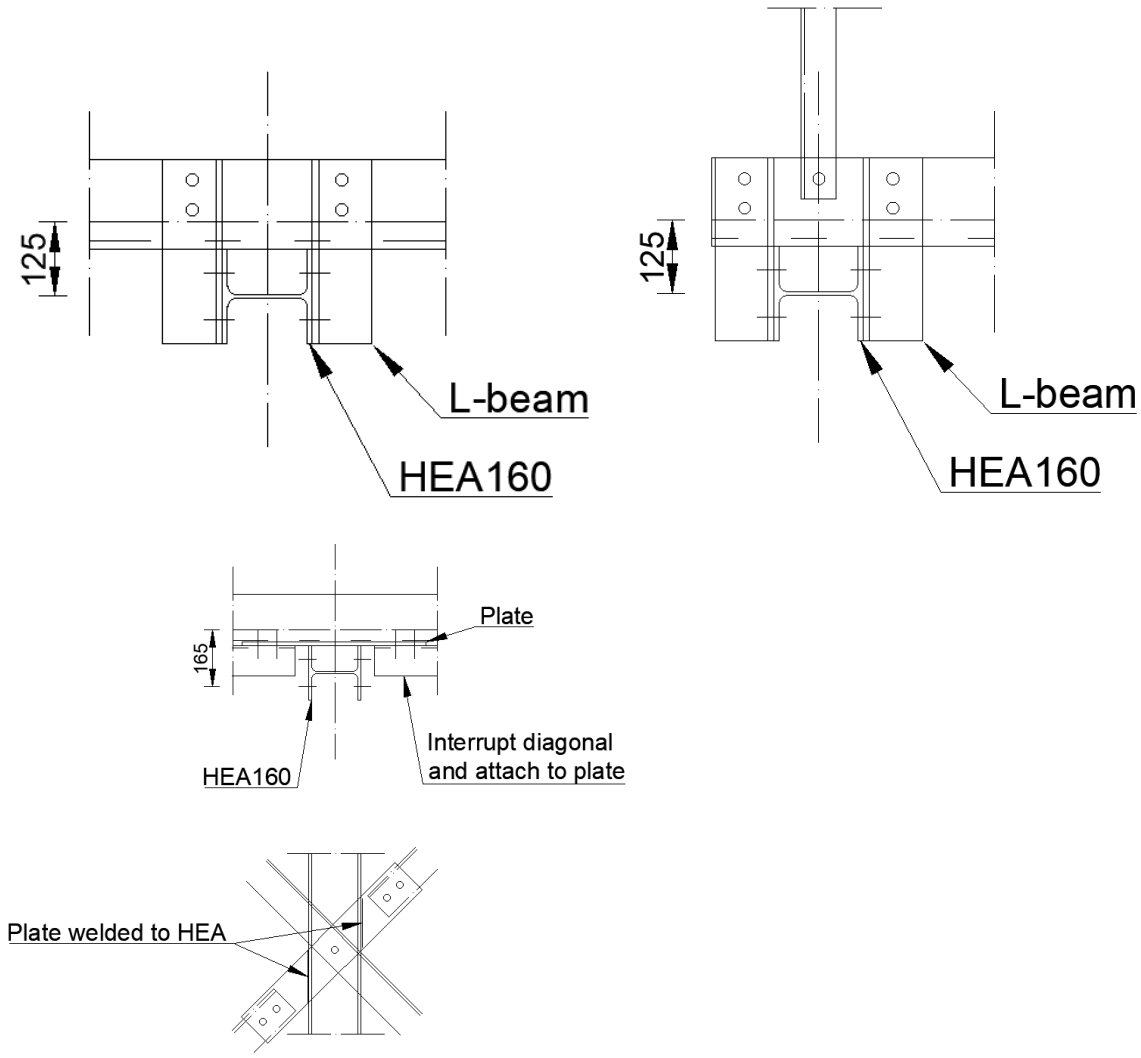
Figuur 5 Vooraanzicht – onderste randstijl



Figuur 6 Vooraanzicht – boventraverse



Figuur 7 Bovenaanzicht – boventraverse



Figuur 8 Principedetails

Meer informatie met betrekking tot de profielmaten en de boutmaten zijn te vinden in Appendix E. De maten zijn weergegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten en ander hulpstaal als onderdeel van de verbinding is niet meegenomen.

Tabel 5 Gewichten HB+0/R_X van toegevoegde knikverkorters en uitgewisselde profielen

Group Label	Profile ini.	Material ini.	Bolts ini.	Profile new	Material new	Bolts new	Mitigation	Number	Length (m)	Weight (kg)
Pos 2037	L50.5	S235	1M16-8.8t	L50.5	S355	1M16-8.8t	Profile exchanged	8	1.61	49.4
435	L60x6	S235	1M16-8.8t	L60x6	S355	1M16-8.8t	Profile exchanged	4	2.83	61.3
426	L50x5	S235	1M16-8.8t	L70x7	S355	1M16-8.8t	Profile exchanged	4	2.98	88.0
436	L50x5	S235	1M16-8.8t	L70x7	S355	1M16-8.8t	Profile exchanged	4	2.96	87.4
490D				L150x14	S355	M20-8.8t	Profile added	4	3.67	463.9
469				L50x5	S355	M16-8.8t	Profile added	4	0.95	14.3
470				L50x5	S355	M16-8.8t	Profile added	4	1.67	25.2
471				L50x5	S355	M16-8.8t	Profile added	4	1.57	23.7
472				L50x5	S355	M16-8.8t	Profile added	4	1.49	22.5
473				L60x6	S355	M16-8.8t	Profile added	4	2.0	43.4
474				L50x5	S355	M16-8.8t	Profile added	10	1.32	49.7
442				HEA160	S355	M20-8.8t	Profile added	8	2.0	486.4
443				L60x6	S355	M16-8.8t	Profile added	4	5.3	114.9
5000				L60x6	S355	M16-8.8t	Profile added	4	4.0	86.7

5.3 Eisenverificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 6.

Tabel 6 Verificatie eisen

Eis Id	Eis Tekst	Ja	Nee	N.v.t.	Toelichting
BO Eis: H2.7-6	Aanpassingen uitvoerbaar?	X			De toe te voegen staalonderdelen zijn met geboute verbindingen te bevestigen. Dit is een bewezen methode.
PVE.05.001 5.14	Staaldelen in nabijheid van klimweg gewijzigd?		X		De wijzigingen in de nabijheid van de klimweg (knikverkorters) zijn in te passen zonder negatieve invloed op de begaanbaarheid.
	klimvoorziening nog in overeenstemming is met de NEN 1060:1987?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.515.40 0825824 - 21-0462 - Verificatie & validatieplan 380kV verbinding Ens - Zwolle”.
[2] „002.515.40 0825812 - 20-1465 - E-studie deel 1 380kV verbinding Ens - Zwolle”.
[3] „002.515.40 0825820 - 20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle”.

APPENDIX A
Geleiderbelastingen

Content

- Starting point p. 2
- Tower construction p. 6
- In between results p. 8
- Loads initial p. 10
- Loads after adjustment p. 15

Data

Norm	NEN-EN50341-2-15:2019
Initial	
Consequence class	CC2-0
Reliability level	Afkeur
Reference period	30 jaar
After adjustment	
Consequence class	CC2
Reliability level	Verbouw
Reference period	50 jaar
Wind zone	III
Wind speed	24.5 m/s
Terrain categorie	II
Reduction factor Cdir	1.00
Ice region	B
Tower type	Hoekmast
Tower height	45.5 m
Max. Span	450.1 m
Line angle	142.3°
Catenary	1760 m
Wind span	409 m
EDS Weight span	443 m
Min. Weight span	435 m
Max. Weight span	477 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-12-10			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype HB+0_R_X

JOB No.	-	DATE	-
DRAWN	-	CHKD	-
DESIGN	-	APPD	-

Document name:

ENS-ZL_HB+0_R_X_35_Report.pdf

Project number:

Project client number:

0.0											

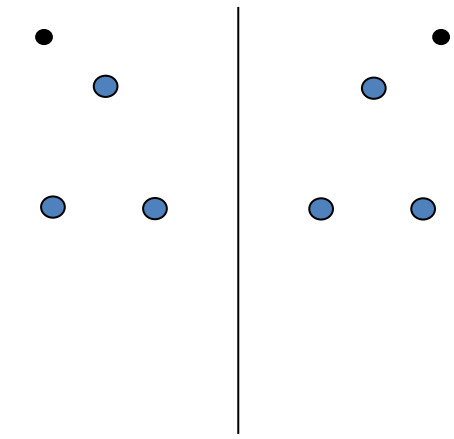
Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Conductor loads

Auteur: TBR
Versie: v11.7

General

Description	HB+0_R_X
Tower type	Hoekmast
Number of circuits	2
Configuration	2-circuit-vlak
Number of earth wires	2



Configuratie geleiders

Starting points

Norm	NEN-EN50341-2-15:2019
Consequence class	CC2-0
Reliability level initial	Afkeur CC2-0
Reference period intial	30 jaar
Consequence class modified	CC2
Reliability level modified	Verbouw
Reference period modified	50 jaar
Wind zone	III
Wind speed (m/s)	24.5 m/s
Terrain category	II
Reduction factor c_{dir}	1.00
Ice region phase conductor	B
Ice region earth conductor	B

Conductors back

Description	Voltage	Conductor Back	Bundle Ba	Ice region	Additional weight	Additional diameter	Catenary P_{back}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Conductors ahead

Description	Voltage	Conductor Ahead	Bundle Ah	Ice region	Additional weight	Additional diameter	Catenary P_{ahead}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Afspanketting	2.00	4.50	1.00
Circuit 2	Afspanketting	2.00	4.50	1.00
Bliksemdraad 1	Vast (Bliksemdraad)	0.10	0.30	0.10
Bliksemdraad 2	Vast (Bliksemdraad)	0.10	0.30	0.10

1. Properties apply to the entire isolator set

Suspension height and position in mast

Circuits	Designation	Number	Suspension height	Attach point	Position in tower Horizontal distance
Circuit 1	10	380ct1f1	28.2 m	28.2 m	-16.3 m
Circuit 1	11	380ct1f2	28.2 m	28.2 m	-9.0 m
Circuit 1	12	380ct1f3	39.5 m	39.5 m	-12.7 m
Circuit 2	21	380ct2f1	28.2 m	28.2 m	16.3 m
Circuit 2	20	380ct2f2	28.2 m	28.2 m	9.0 m
Circuit 2	22	380ct2f3	39.5 m	39.5 m	12.7 m
Bliksemdraad 1	1	bl1	44.5 m	44.8 m	-16.7 m
Bliksemdraad 2	3	bl2	44.5 m	44.8 m	16.7 m

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Height adjustment adjacent masts (wind and weight span adjustment)

	Back	Ahead	
Height increase for wind pressure	0.0 m	0.0 m	(positive: higher)
Height decrease for vertical load	0.0 m	0.0 m	(negative: decrease, more weight span)

Decrease: Niet in 0,9EG-combinaties

Height difference adjacent tower and change of direction with respect to Line direction

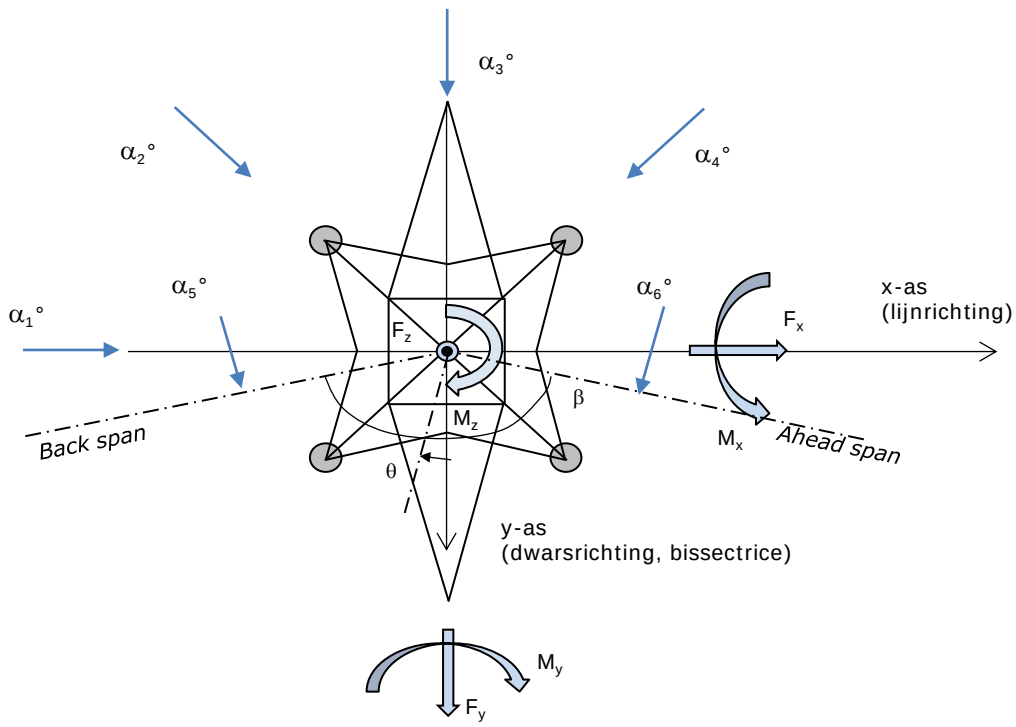
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	-3.5	-2.9 m	0.0	0.0 m
Circuit 1	11	380ct1f2	-3.5	-2.9 m	0.0	0.0 m
Circuit 1	12	380ct1f3	-3.5	-2.9 m	0.0	0.0 m
Circuit 2	21	380ct2f1	-3.5	-2.9 m	0.0	0.0 m
Circuit 2	20	380ct2f2	-3.5	-2.9 m	0.0	0.0 m
Circuit 2	22	380ct2f3	-3.5	-2.9 m	0.0	0.0 m
Bliksemdraad 1	1	bl1	-3.5	-2.9 m	0.0	0.0 m
Bliksemdraad 2	3	bl2	-3.5	-2.9 m	0.0	0.0 m

Line and tower data

		Back	Ahead	
		367.9	450.1	m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		367.9	443.5	m
Line angle	β	142.3		°
Tower orientation with respect to bis	θ	0		°
Section length		368	2214	m
Height bottom of tower to ground level		0.5		m
Wind directions considered	α_1	0		°
Wind directions according to:	α_2	45		°
Geleiderbelastingen	α_3	90		°
	α_4	135		°
	α_5	71.15		°
	α_6	108.85		°

Wind directions apply to the main direction of mast construction, not to the bisector.

Windrichtingen en positieve richtingen belastingen



Considered number of wind directions

1a	6
3	6
4	1
6	1
Overig	1

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

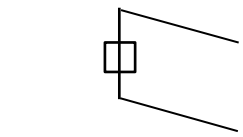
Absence of conductors

		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	1	0
Circuit 1	380ct1f2	1	0	1	0	1	0
Circuit 1	380ct1f3	1	0	1	0	1	0
Circuit 2	380ct2f1	0	1	1	0	1	0
Circuit 2	380ct2f2	0	1	1	0	1	0
Circuit 2	380ct2f3	0	1	1	0	1	0
Bliksemdraad 1	bl1	1	0	1	0	1	0
Bliksemdraad 2	bl2	0	1	1	0	1	0

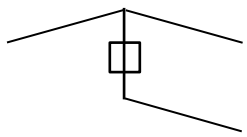
Load situations SPLS

Considered situations SPLS: 1 up to 6, All possible situations

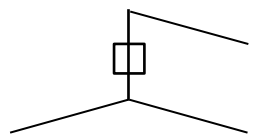
Principle of load situations:



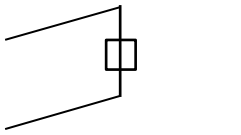
1. Ba All cts



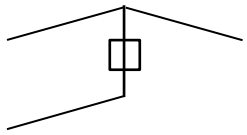
2. Ba ct1



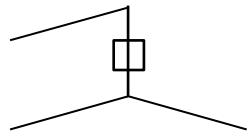
3. Ba ct2



4. Ah All cts



5. Ah ct1

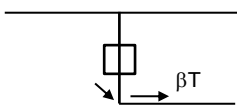


6. Ah ct2

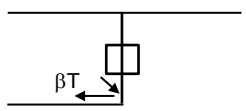
Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1 and 2, all possible situations

Principle of load situations:



1. Ba



2. Ah

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

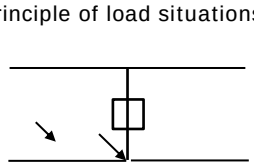
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations are applied in ULS and in every SPLS situation (in case of angle tower).

	Phase	Earth
Line vehicle	3.0 kN	2.0 kN
Concentrated load cross arm	1.0 kN	1.0 kN

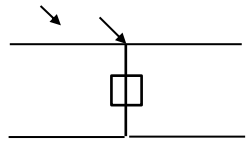
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

Presence line vehicle: Circuit, belasting tegelijk aanwezig in alle geleiders per circuit.

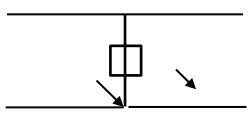
Principle of load situations:



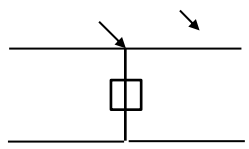
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

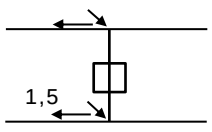
Load situations 8. Galloping as a static load

Conductor		
Suspension tower phase	0.866 W	1.5 W
Suspension tower earth	1.5 EDS	1.5 W
Strain tower phase and earth	1.5 EDS	1.5 W

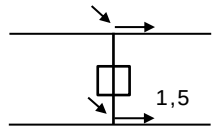
Considered situations galloping 8: None (existing structure)

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principle of load situations:



1. Ba



2. Ah

Load combination 8. Galloping as a dynamic load
Only applies to tension towers
Load consists of EDS tensile load in one of the conductors on one side of the tower
Can be converted by user to fatigue spectrum via the load spectrum of table 4.11 / NL.1

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Tower structure

Properties

Tower type	Hoekmast		
Tower designation	HB+0_R_X		
Base plate w.r.t. ground level	0.5		m
Tower height w.r.t. base plate	45.5		m
Tower self weight	504.0		kN
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	11.00	11.00	m
Inclination of main leg	0.128	0.128	-
Horizontal force factor	1.3	1.3	-

Calculation Wind load

Dynamic factor G_T	1.00 *(Masthoogte < 60 m)*
Wind load diagonally to tower body proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Wind load diagonally on traverse proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Magnification factor diagonal wind to tower body	(1+0,2sin^2(2phi))
Magnification factor diagonal wind to cross arm	(1+0,2sin^2(2phi))
Magnification factor wind parallel to perpendicular to cross a	0.4

Properties mast sections longitudinal direction (front view, yz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	12.00	11.00	7.94	12.00	0.128	113.62	18.67	0.16	3.09
Eerste tussenstuk	18.50	7.94	6.29	6.50	0.127	46.23	6.97	0.15	3.15
Tweede tussenstuk	28.20	6.29	3.80	9.70	0.128	48.93	11.33	0.23	2.80
Bovenstuk 1	36.00	3.80	3.19	7.80	0.039	27.25	6.37	0.23	2.79
Bovenstuk 2	43.50	3.19	2.60	7.50	0.039	21.70	5.23	0.24	2.76
Topstuk	45.50	2.60		2.00		2.60	0.38	0.15	3.17
Ondertraverse	28.20	14.40		4.00		28.80	6.30	0.22	2.85
Boventraverse	39.50	15.19		5.30		40.26	7.90	0.20	2.95

Properties tower sections transversal direction (side view, xz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	12.00	11.00	7.94	12.00	0.128	113.62	18.67	0.16	3.09
Eerste tussenstuk	18.50	7.94	6.29	6.50	0.127	46.23	6.97	0.15	3.15
Tweede tussenstuk	28.20	6.29	3.80	9.70	0.128	48.93	11.33	0.23	2.80
Bovenstuk 1	36.00	3.80	3.19	7.80	0.039	27.25	6.37	0.23	2.79
Bovenstuk 2	43.50	3.19	2.60	7.50	0.039	21.70	5.23	0.24	2.76
Topstuk	45.50	2.60		2.00		2.60	0.38	0.15	3.17
Ondertraverse	28.20	14.40		4.00		28.80	6.30	0.22	2.85
Boventraverse	39.50	15.19		5.30		40.26	7.90	0.20	2.95

Note: Surface transverse direction is reduced in calculation.

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Wind surface feeders telecom installations

Part	A (m^2/m)	Factor	Δh	A_1
Broekstuk				
Eerste tussenstuk				
Tweede tussenstuk				
Bovenstuk 1				
Bovenstuk 2				

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne top			
Antenne o.t.			

Tower section loads longitudinal (x-direction) per wind direction

Description	p_w [kN/m^2]	F_{x1} [kN]	F_{x2} [kN]	F_{x3} [kN]	F_{x4} [kN]	h_{ef} [m]	M_{y1} [kNm]	M_{y2} [kNm]	M_{y3} [kNm]	M_{y4} [kNm]
Broekstuk	0.70	40.5	34.3	0.0	-34.3	6.0	242.8	206.0	0.0	-206.0
Eerste tussenstuk	0.81	17.7	15.1	0.0	-15.1	15.3	270.6	229.6	0.0	-229.6
Tweede tussenstuk	0.92	29.1	24.7	0.0	-24.7	23.4	680.2	577.2	0.0	-577.2
Bovenstuk 1	1.01	18.0	15.2	0.0	-15.2	32.1	576.5	489.2	0.0	-489.2
Bovenstuk 2	1.07	15.4	13.1	0.0	-13.1	39.8	612.7	519.9	0.0	-519.9
Topstuk	1.10	1.3	1.1	0.0	-1.1	44.5	59.4	50.4	0.0	-50.4
Ondertraverse	0.98	35.4	21.0	0.0	-21.0	29.5	1044.2	620.2	0.0	-620.2
Boventraverse	1.08	50.2	29.8	0.0	-29.8	41.3	2073.5	1231.6	0.0	-1231.6
Totaal		207.6	154.4	0.0	-154.4		5559.9	3924.1	0.0	-3924.1

Tower section loads transversal (y-direction) per wind direction

Description	p_w [kN/m^2]	F_{y1} [kN]	F_{y2} [kN]	F_{y3} [kN]	F_{x4} [kN]	h_{ef} [m]	M_{x1} [kNm]	M_{x2} [kNm]	M_{x3} [kNm]	M_{x4} [kNm]
Broekstuk	0.70	0.0	34.3	40.5	34.3	6.0	0.0	206.0	242.8	206.0
Eerste tussenstuk	0.81	0.0	15.1	17.7	15.1	15.3	0.0	229.6	270.6	229.6
Tweede tussenstuk	0.92	0.0	24.7	29.1	24.7	23.4	0.0	577.2	680.2	577.2
Bovenstuk 1	1.01	0.0	15.2	18.0	15.2	32.1	0.0	489.2	576.5	489.2
Bovenstuk 2	1.07	0.0	13.1	15.4	13.1	39.8	0.0	519.9	612.7	519.9
Topstuk	1.10	0.0	1.1	1.3	1.1	44.5	0.0	50.4	59.4	50.4
Ondertraverse	0.98	0.0	21.0	14.1	21.0	29.5	0.0	620.2	417.7	620.2
Boventraverse	1.08	0.0	29.8	20.1	29.8	41.3	0.0	1231.6	829.4	1231.6
Total		0.0	154.4	156.3	154.4		0.0	3924.1	3689.3	3924.1

Resulting loads from mast construction incl. Antenna without conductors level foundation (char. Value)

Load / wind direction	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
Permanente belasting	0	0	504	0	0	0
Windrichting 0°	208	0	0	0	5560	0
Windrichting 45°	154	154	0	3924	3924	0
Windrichting 90°	0	156	0	3689	0	0
Windrichting 135°	-154	154	0	3924	-3924	0

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Bliksemdraad 1	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05

Conductors ahead

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Bliksemdraad 1	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05

Vertical load back

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	$w_{z,ijs}$ [N/m]	$w_{z,ijs,bundel}$ [N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Bliksemdraad 1	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3

Vertical load ahead

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	[N/m]	[N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Bliksemdraad 1	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3

Insulators

Conductor	$G_{isolator}$ [kN]	Number -	$F_{v,iso}$ [kN]	Length [m]	Wind surf. [m^2]	Wind heigth [m]	Pressure [kN/m^2]	Drag factor [-]	$F_{h,iso}$ [kN]
380ct1f1	2.00	1	2	4.5	1.0	28.70	0.98	1.2	1.17
380ct1f2	2.00	1	2	4.5	1.0	28.70	0.98	1.2	1.17
380ct1f3	2.00	1	2	4.5	1.0	40.00	1.07	1.2	1.28
380ct2f1	2.00	1	2	4.5	1.0	28.70	0.98	1.2	1.17
380ct2f2	2.00	1	2	4.5	1.0	28.70	0.98	1.2	1.17
380ct2f3	2.00	1	2	4.5	1.0	40.00	1.07	1.2	1.28
bl1	0.10	0.5	0.05	0.3	0.1	45.00	1.10	1.2	0.13
bl2	0.10	0.5	0.05	0.3	0.1	45.00	1.10	1.2	0.13

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Wind load back

Conductor	Height wind [m]	Pressure [kN/m^2]	$G_{c\ dwars}$ [-]	$G_{c\ trek}$ [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	20.5	0.88	0.55	0.61	1.13	28.53	46.6	52.2	47.4	82.4	92.1
380ct1f2	20.5	0.88	0.55	0.61	1.13	28.53	46.6	52.2	47.4	82.4	92.1
380ct1f3	31.8	1.01	0.58	0.65	1.09	28.53	54.6	61.1	47.4	99.5	111.2
380ct2f1	20.5	0.88	0.55	0.61	1.13	28.53	46.6	52.2	47.4	82.4	92.1
380ct2f2	20.5	0.88	0.55	0.61	1.13	28.53	46.6	52.2	47.4	82.4	92.1
380ct2f3	31.8	1.01	0.58	0.65	1.09	28.53	54.6	61.1	47.4	99.5	111.2
bl1	37.9	1.05	0.59	0.66	1.20	22.35	16.8	18.8	41.8	31.4	35.1
bl2	37.9	1.05	0.59	0.66	1.20	22.35	16.8	18.8	41.8	31.4	35.1

Wind load ahead

Conductor	Height wind [m]	Pressure [kN/m^2]	G_{c_dwars} [-]	G_{c_trek} [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	17.7	0.85	0.53	0.48	1.14	28.53	44.0	39.5	47.4	76.9	69.1
380ct1f2	17.7	0.85	0.53	0.48	1.14	28.53	44.0	39.5	47.4	76.9	69.1
380ct1f3	29.0	0.98	0.57	0.51	1.10	28.53	52.9	47.4	47.4	95.7	85.7
380ct2f1	17.7	0.85	0.53	0.48	1.14	28.53	44.0	39.5	47.4	76.9	69.1
380ct2f2	17.7	0.85	0.53	0.48	1.14	28.53	44.0	39.5	47.4	76.9	69.1
380ct2f3	29.0	0.98	0.57	0.51	1.10	28.53	52.9	47.4	47.4	95.7	85.7
bl1	35.5	1.04	0.59	0.53	1.20	22.35	16.4	14.7	41.8	30.6	27.4
bl2	35.5	1.04	0.59	0.53	1.20	22.35	16.4	14.7	41.8	30.6	27.4

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class	Afkeur CC2-0
Reference period	30 jaar

ULS (strength)		NEN-EN50341-2-15:2019						
Load case	description	Temp	γ_G	γ_G	γ_Q			γ_a
		°C	$G_{k,mast}$	$G_{k,geleider}$	Q_{pk}	Q_{wk}	Q_{ik}	A_k
ULS 1a	Wind	10°	1.05	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.12	0.00	0.0
ULS 3	Wind+ice	-5°	1.05	1.05	0.00	0.34	0.97	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.05	0.00	0.34	0.97	0.0
ULS 4	Cold+wind	-20°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.05	0.00	0.22	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.05	1.05	1.20	0.22	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 7	Permanent	10°	1.15	1.15	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G	γ_Q			
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.05	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.05	1.05	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.05	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.05	1.05	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.05	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.05	1.05	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.05	1.05	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)								
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	0.94	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.28	0.88	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions	6
Number of load combinations for ULS	54
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5820

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-37.5	36.4	15.8	15.3	6.0	6.3
380ct1f1	-127.4	125.6	49.6	49.4	17.4	20.1
380ct1f2	-127.4	125.6	49.6	49.4	17.4	20.1
380ct1f3	-130.1	127.5	54.4	52.2	17.5	20.1
380ct2f1	-127.4	125.6	49.6	49.4	17.4	20.1
380ct2f2	-127.4	125.6	49.6	49.4	17.4	20.1
380ct2f3	-130.1	127.5	54.4	52.2	17.5	20.1
bl2	-37.5	36.4	15.8	15.3	6.0	6.3
Post 40	0.0	0.0	0.0	0.0	0.0	
Post 41	0.0	0.0	0.0	0.0	0.0	
Post 42	0.0	0.0	0.0	0.0	0.0	
Post 43	0.0	0.0	0.0	0.0	0.0	

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	442.9	450.8	442.5
380ct1f1	437.2	441.2	437.1
380ct1f2	437.2	441.2	437.1
380ct1f3	437.3	441.4	437.1
380ct2f1	437.2	441.2	437.1
380ct2f2	437.2	441.2	437.1
380ct2f3	437.3	441.4	437.1
bl2	442.9	450.8	442.5
Post 40			
Post 41			
Post 42			
Post 43			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	461.9	441.9
380ct1f1	445.7	437.2
380ct1f2	445.7	437.2
380ct1f3	448.4	437.7
380ct2f1	445.7	437.2
380ct2f2	445.7	437.2
380ct2f3	448.4	437.7
bl2	461.9	441.9
Post 40		
Post 41		
Post 42		
Post 43		

Envelop of weight span over all combinations (incl. 0,9 combinations)

For all conductors		Wind / Weight span ratio
Max. weight span	469.0 m	1.147 -
Min. weight span	436.1 m	1.066 -

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	37.5	29.0	6.3	-39.9	38.9
380ct1f1	109.1	96.8	20.1	-136.4	134.9
380ct1f2	109.1	96.8	20.1	-136.4	134.9
380ct1f3	113.6	100.4	20.1	-139.7	137.4
380ct2f1	109.1	96.8	20.1	-136.4	134.9
380ct2f2	109.1	96.8	20.1	-136.4	134.9
380ct2f3	113.6	100.4	20.1	-139.7	137.4
bl2	37.5	29.0	6.3	-39.9	38.9
Post 40	1.9	1.9	5.8	0.0	
Post 41	1.9	1.9	5.8	0.0	
Post 42	1.9	1.9	5.8	0.0	
Post 43	1.9	1.9	5.8	0.0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	20.1	6.8	2.5	-21.2	21.2
380ct1f1	77.1	26.3	12.9	-81.5	81.5
380ct1f2	77.1	26.3	12.9	-81.5	81.5
380ct1f3	77.1	26.3	12.9	-81.5	81.5
380ct2f1	77.1	26.3	12.9	-81.5	81.5
380ct2f2	77.1	26.3	12.9	-81.5	81.5
380ct2f3	77.1	26.3	12.9	-81.5	81.5
bl2	20.1	6.8	2.5	-21.2	21.2
Post 40	0.0	0.0	5.0	0.0	
Post 41	0.0	0.0	5.0	0.0	
Post 42	0.0	0.0	5.0	0.0	
Post 43	0.0	0.0	5.0	0.0	

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0.0	0.0
	380ct1f1	0.0	0.0
	380ct1f2	0.0	0.0
	380ct1f3	0.0	0.0
	380ct2f1	0.0	0.0
	380ct2f2	0.0	0.0
	380ct2f3	0.0	0.0
	bl2	0.0	0.0
	Post 40	0.0	
	Post 41	0.0	
	Post 42	0.0	
	Post 43	0.0	

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		-68	630	186	20851	-2264	0
ULS 1a_0,9_0		13	359	180	11643	467	-80
ULS 1a_0,9_0,9_90		-78	604	161	20023	-2588	0
ULS 3_0		14	548	262	17865	487	-24
SLS 7		0	343	175	11108	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

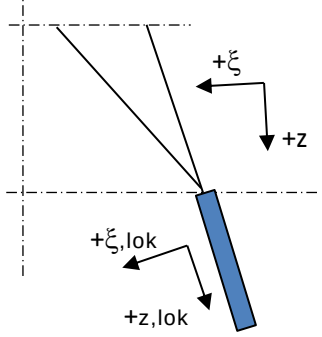
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-68	805	716	24971	-2264	0
ULS 1a_0,9_0,9_90	-78	778	614	24143	-2588	0
SLS 7	0	343	679	11108	0	0

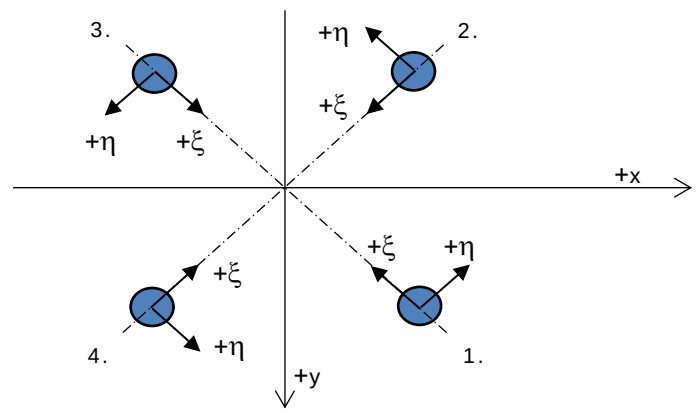
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_90	-68	805	637	25003	-2264	0
SPLS 3_71.15 Ah All Cts	-708	338	652	10462	-23692	-8
SPLS 3_71.15 Ba Ct1	319	445	703	14490	10329	-4750
SPLS 3_0,9_71.15 Ah All Cts	-708	338	574	10494	-23692	-8

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_108.85 Ba All Cts	273	280	1652	-5	-391	-92	1679
2	SPLS 3_0 Ba All Cts	156	-149	914	-5	-216	-51	929
3	SPLS 3_135 Ah All Cts	-138	-128	804	7	-188	-43	817
4	SPLS 3_71.15 Ah All Cts	-283	290	1716	5	-405	-96	1743

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-86	-78	-497	-5	116	26	-505
2	SPLS 3_0,9_71.15 Ah All Cts	-232	240	-1411	-5	334	79	-1433
3	SPLS 3_0,9_108.85 Ba All Cts	221	228	-1341	5	317	75	-1363
4	SPLS 1a_0,9_0 Ba All Cts	107	-100	-603	5	146	37	-613

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct1 Ba Ct1	135	-76	171	149	-42	-11	174
2	SPLS 6a_90 Ah Ct1 Ba Ct1	-259	49	-925	149	218	51	-940
3	SPLS 6a_90 Ba Ct2 Ba Ct1	-9	213	-586	158	144	39	-595
4	SPLS 3_71.15 Ba Ct2	56	170	320	160	-80	-23	325

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct2 Ba Ct2	-82	137	145	-155	-39	-13	147
2	SPLS 6a_90 Ah Ct2 Ba Ct2	-42	262	-898	-155	215	53	-913
3	SPLS 6a_90 Ba Ct1 Ba Ct2	215	-2	-640	-153	151	35	-650
4	SPLS 6a_90 Ba Ct1 Ba Ct2	-187	-27	484	-152	-113	-25	491

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah All Cts Ba Ct1	-41	-90	-412	35	93	18	-419
2	SPLS 3_0,9_71.15 Ah Ct1	-280	88	-1111	136	260	59	-1129
3	SPLS 3_0,9_90 Ba Ct1	273	64	-1010	-148	238	56	-1026
4	SPLS 1a_0,9_0 Ba All Cts	107	-100	-603	5	146	37	-613

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	112	114	675	-1	-160	-38	685
2	SLS 7	-56	58	-335	-1	80	20	-341
3	SLS 7	56	58	-335	1	80	20	-341
4	SLS 7	-112	114	675	1	-160	-38	685

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 3_71.15 Ah All Cts	-283	290	1716	5	-405	-96	1743
Max. tension	SPLS 3_0,9_71.15 Ah All Cts	-232	240	-1411	-5	334	79	-1433
Max. pos. torsie	SPLS 3_71.15 Ba Ct2	56	170	320	160	-80	-23	325
Max. neg. torsie	SPLS 6a_90 Ah Ct2 Ba Ct2	-42	262	-898	-155	215	53	-913
Comb. tension+torsie	SPLS 3_0,9_71.15 Ah Ct1	-280	88	-1111	136	260	59	-1129

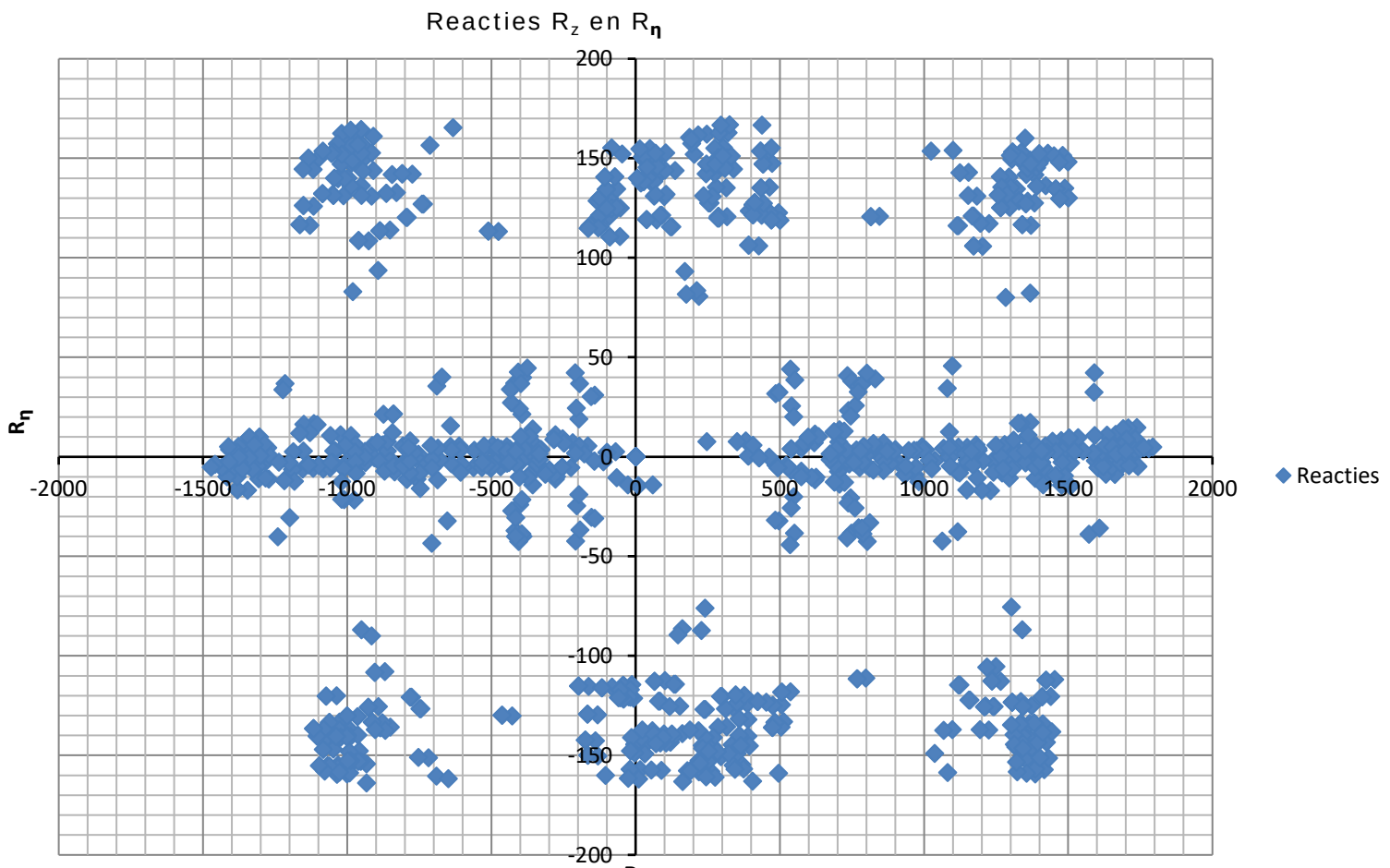
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	112	114	675	-1	-160	-38	685
2	SLS 1a_90	-154	165	-927	-8	225	58	-942
3	SLS 1a_90	125	136	-752	8	184	49	-764
4	SLS 1a_0	-62	70	421	6	-94	-18	428

Maximum compression load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 3_90	186	191	1121	-3	-266	-64	1139
2	SLS 1a_0	-3	17	-82	-10	14	-1	-83
3	SLS 7	56	58	-335	1	80	20	-341
4	SLS 1a_90	-210	221	1267	8	-305	-76	1288

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35



Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class	Verbouw CC2
Reference period	50 jaar

ULS (strength) Load case	description	NEN-EN50341-2-15:2019 Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	γ_a A_k
ULS 1a	Wind	10°	1.15	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.40	0.00	0.0
ULS 3	Wind+ice	-5°	1.15	1.15	0.00	0.42	1.30	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.15	0.00	0.42	1.30	0.0
ULS 4	Cold+wind	-20°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.15	0.00	0.28	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.15	1.15	1.30	0.28	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 7	Permanent	10°	1.30	1.30	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G G_k	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.15	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.15	1.15	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.15	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.15	1.15	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.15	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.15	1.15	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.15	1.15	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	1.00	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.30	1.00	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions	6
Number of load combinations for ULS	54
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5820

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-41.5	41.4	18.5	18.1	6.5	6.9
380ct1f1	-145.7	144.7	58.0	57.6	20.4	23.6
380ct1f2	-145.7	144.7	58.0	57.6	20.4	23.6
380ct1f3	-149.1	147.1	64.0	61.6	20.5	23.7
380ct2f1	-145.7	144.7	58.0	57.6	20.4	23.6
380ct2f2	-145.7	144.7	58.0	57.6	20.4	23.6
380ct2f3	-149.1	147.1	64.0	61.6	20.5	23.7
bl2	-41.5	41.4	18.5	18.1	6.5	6.9
Post 40	0.0	0.0	0.0	0.0	0.0	
Post 41	0.0	0.0	0.0	0.0	0.0	
Post 42	0.0	0.0	0.0	0.0	0.0	
Post 43	0.0	0.0	0.0	0.0	0.0	

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	442.9	450.9	442.5
380ct1f1	437.2	441.3	437.1
380ct1f2	437.2	441.3	437.1
380ct1f3	437.3	441.4	437.1
380ct2f1	437.2	441.3	437.1
380ct2f2	437.2	441.3	437.1
380ct2f3	437.3	441.4	437.1
bl2	442.9	450.9	442.5
Post 40			
Post 41			
Post 42			
Post 43			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	464.4	440.2
380ct1f1	447.2	436.3
380ct1f2	447.2	436.3
380ct1f3	450.3	436.8
380ct2f1	447.2	436.3
380ct2f2	447.2	436.3
380ct2f3	450.3	436.8
bl2	464.4	440.2
Post 40		
Post 41		
Post 42		
Post 43		

Envelop of weight span over all combinations (incl. 0,9 combinations)

For all conductors		Wind / Weight span ratio
Max. weight span	477.5 m	1.167 -
Min. weight span	435.1 m	1.064 -

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	38.6	34.0	6.9	-44.7	44.7
380ct1f1	114.3	112.2	23.6	-156.3	155.6
380ct1f2	114.3	112.2	23.6	-156.3	155.6
380ct1f3	118.4	117.0	23.7	-160.3	158.7
380ct2f1	114.3	112.2	23.6	-156.3	155.6
380ct2f2	114.3	112.2	23.6	-156.3	155.6
380ct2f3	118.4	117.0	23.7	-160.3	158.7
bl2	38.6	34.0	6.9	-44.7	44.7
Post 40	2.3	2.3	6.5	0.0	
Post 41	2.3	2.3	6.5	0.0	
Post 42	2.3	2.3	6.5	0.0	
Post 43	2.3	2.3	6.5	0.0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	20.1	6.8	2.5	-21.2	21.2
380ct1f1	77.1	26.3	12.9	-81.5	81.5
380ct1f2	77.1	26.3	12.9	-81.5	81.5
380ct1f3	77.1	26.3	12.9	-81.5	81.5
380ct2f1	77.1	26.3	12.9	-81.5	81.5
380ct2f2	77.1	26.3	12.9	-81.5	81.5
380ct2f3	77.1	26.3	12.9	-81.5	81.5
bl2	20.1	6.8	2.5	-21.2	21.2
Post 40	0.0	0.0	5.0	0.0	
Post 41	0.0	0.0	5.0	0.0	
Post 42	0.0	0.0	5.0	0.0	
Post 43	0.0	0.0	5.0	0.0	

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0.0	0.0
	380ct1f1	0.0	0.0
	380ct1f2	0.0	0.0
	380ct1f3	0.0	0.0
	380ct2f1	0.0	0.0
	380ct2f2	0.0	0.0
	380ct2f3	0.0	0.0
	bl2	0.0	0.0
	Post 40	0.0	
	Post 41	0.0	
	Post 42	0.0	
	Post 43	0.0	

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		-82	736	205	24395	-2729	0
ULS 1a_0,9_0		18	388	196	12596	655	-101
ULS 1a_0,9_0,9_90		-98	698	162	23207	-3261	0
ULS 3_0		25	626	307	20436	863	-30
SLS 7		0	343	175	11108	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

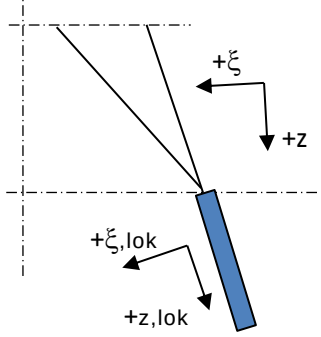
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-82	955	784	29560	-2729	0
ULS 1a_0,9_0,9_90	-98	917	616	28372	-3261	0
SLS 7	0	343	679	11108	0	0

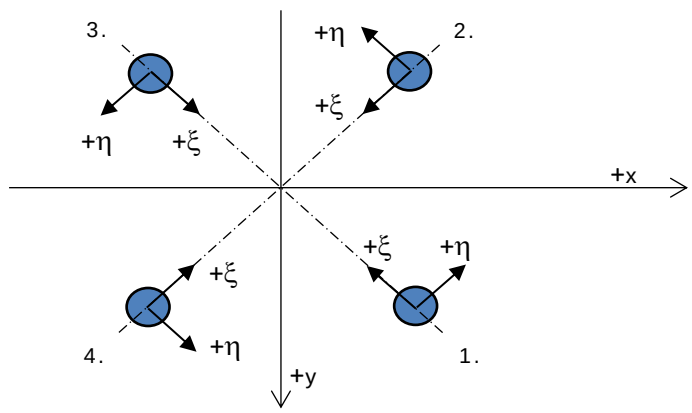
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_90	-82	955	653	29614	-2729	0
SPLS 3_0 Ba All Cts	764	232	726	7402	24789	-26
SPLS 6a_90 Ba Ct1 Ba Ct2	198	393	779	13047	6448	-4963
SPLS 3_0,9_71.15 Ah All Cts	-740	349	582	10848	-24728	-8

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_108.85 Ba All Cts	288	294	1741	-5	-412	-97	1769
2	SPLS 3_0 Ba All Cts	166	-159	972	-5	-230	-54	988
3	SPLS 3_135 Ah All Cts	-147	-137	859	7	-200	-45	873
4	SPLS 3_71.15 Ah All Cts	-296	303	1793	5	-424	-100	1822

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-92	-84	-533	-5	124	28	-542
2	SPLS 3_0,9_71.15 Ah All Cts	-242	250	-1472	-5	348	82	-1495
3	SPLS 3_0,9_108.85 Ba All Cts	233	240	-1413	5	334	79	-1435
4	SPLS 1a_0,9_0 Ba All Cts	114	-106	-643	5	155	39	-653

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct1 Ba Ct1	145	-78	194	157	-47	-12	197
2	SPLS 6a_90 Ah Ct1 Ba Ct1	-272	50	-964	157	227	53	-980
3	SPLS 6a_90 Ba Ct2 Ba Ct1	-7	227	-634	165	156	42	-644
4	SPLS 3_71.15 Ba Ct2	60	176	326	167	-82	-23	331

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct2 Ba Ct2	-85	146	163	-163	-44	-14	166
2	SPLS 6a_90 Ah Ct2 Ba Ct2	-42	274	-933	-164	224	55	-949
3	SPLS 6a_90 Ba Ct1 Ba Ct2	228	2	-691	-160	163	38	-703
4	SPLS 6a_90 Ba Ct1 Ba Ct2	-194	-31	495	-159	-115	-26	503

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-92	-84	-533	-5	124	28	-542
2	SPLS 3_0,9_71.15 Ah Ct1	-293	89	-1153	145	270	62	-1172
3	SPLS 3_0,9_90 Ba Ct1	288	68	-1068	-155	252	59	-1085
4	SPLS 1a_0,9_0 Ba All Cts	114	-106	-643	5	155	39	-653

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	112	114	675	-1	-160	-38	685
2	SLS 7	-56	58	-335	-1	80	20	-341
3	SLS 7	56	58	-335	1	80	20	-341
4	SLS 7	-112	114	675	1	-160	-38	685

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 3_71.15 Ah All Cts	-296	303	1793	5	-424	-100	1822
Max. tension	SPLS 3_0,9_71.15 Ah All Cts	-242	250	-1472	-5	348	82	-1495
Max. pos. torsie	SPLS 3_71.15 Ba Ct2	60	176	326	167	-82	-23	331
Max. neg. torsie	SPLS 6a_90 Ah Ct2 Ba Ct2	-42	274	-933	-164	224	55	-949
Comb. tension+torsie	SPLS 3_0,9_71.15 Ah Ct1	-293	89	-1153	145	270	62	-1172

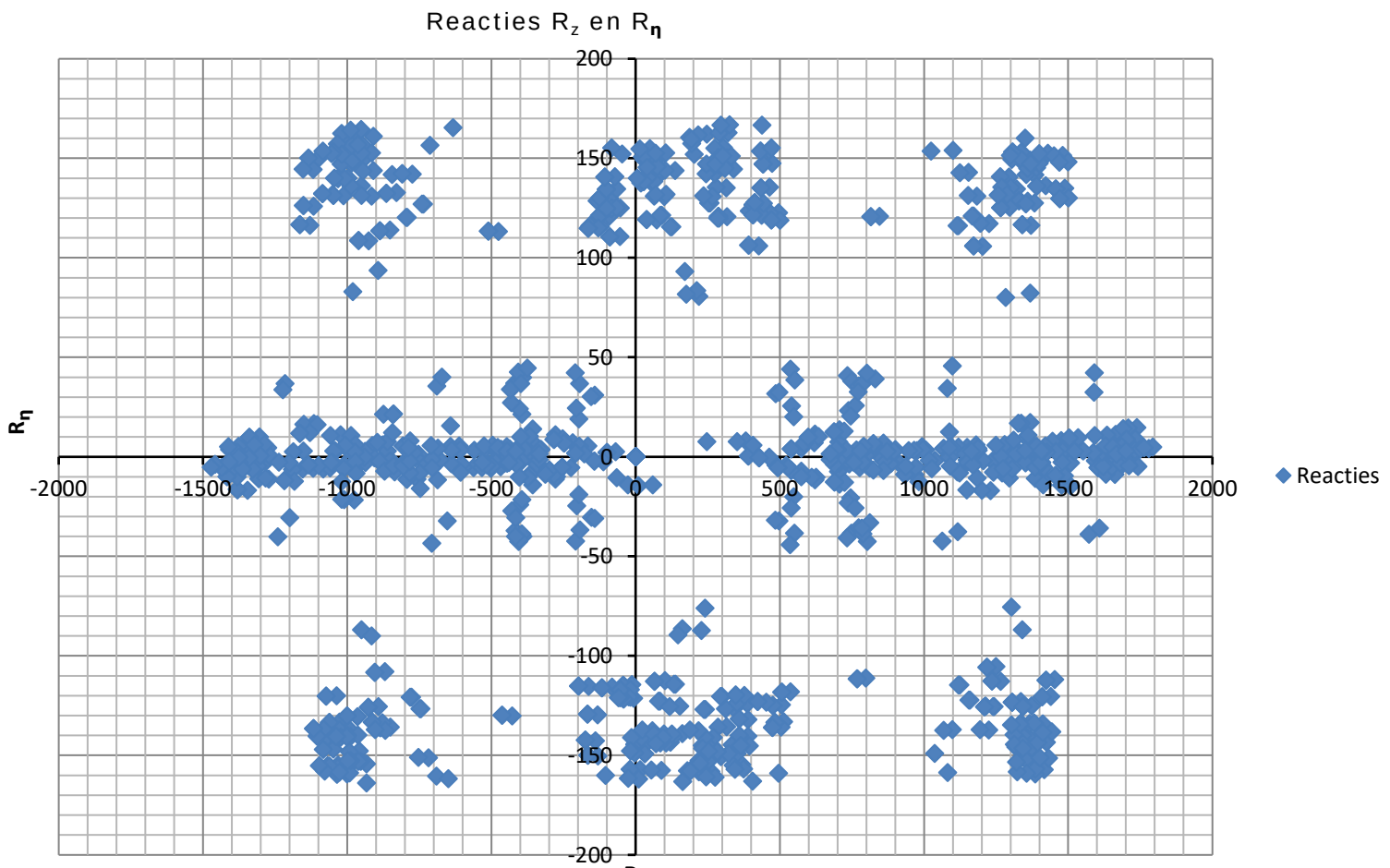
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	112	114	675	-1	-160	-38	685
2	SLS 1a_90	-161	173	-970	-8	236	61	-986
3	SLS 3_90	130	135	-786	3	188	46	-799
4	SLS 1a_0	-59	68	406	6	-90	-17	412

Maximum compression load - SLS

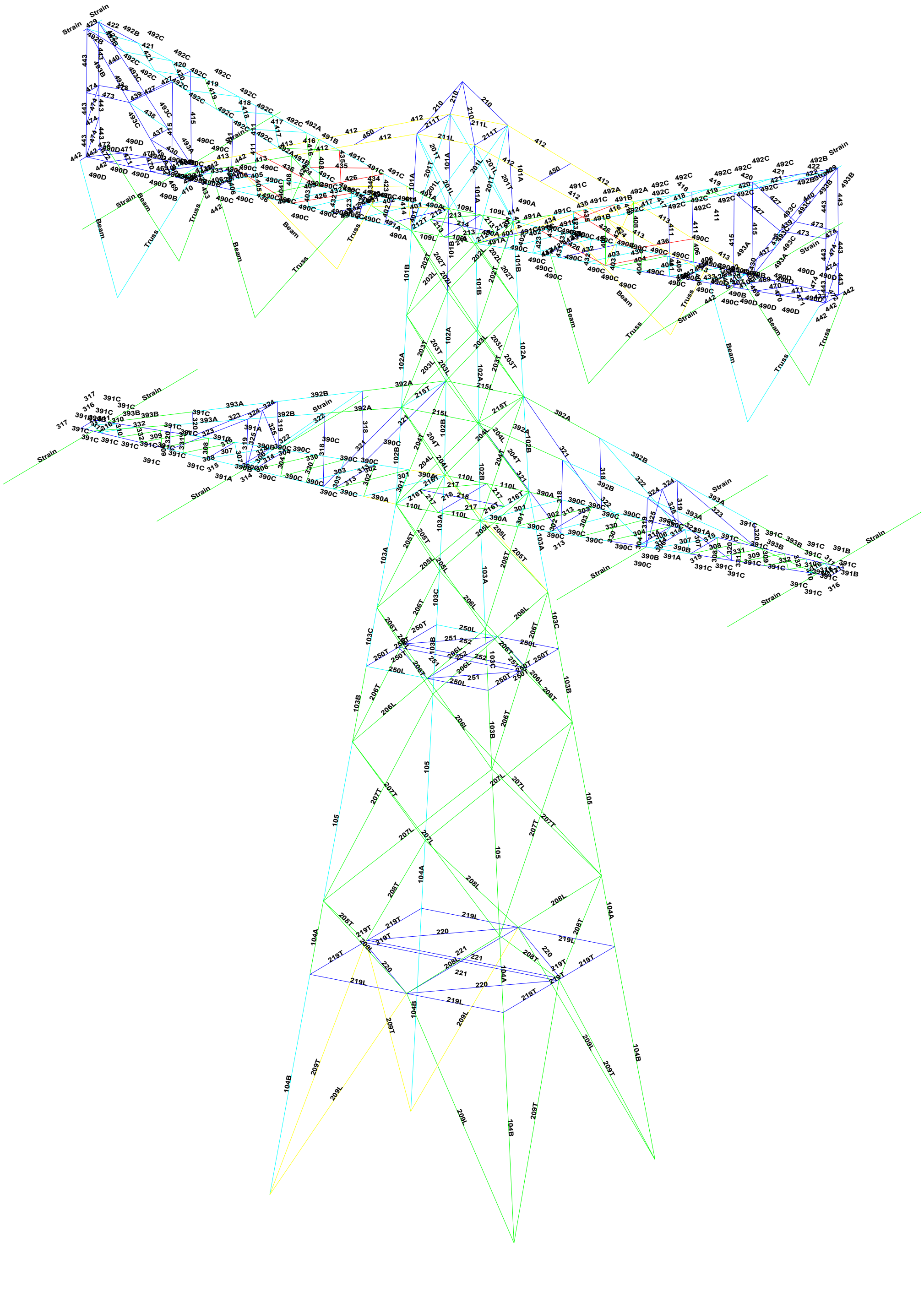
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 3_90	194	198	1166	-3	-277	-67	1185
2	SLS 1a_0	0	15	-67	-11	10	-2	-68
3	SLS 7	56	58	-335	1	80	20	-341
4	SLS 1a_90	-217	229	1311	8	-316	-79	1332

Project: ENS-ZL
Tower: HB+0_R_X
Number: 35

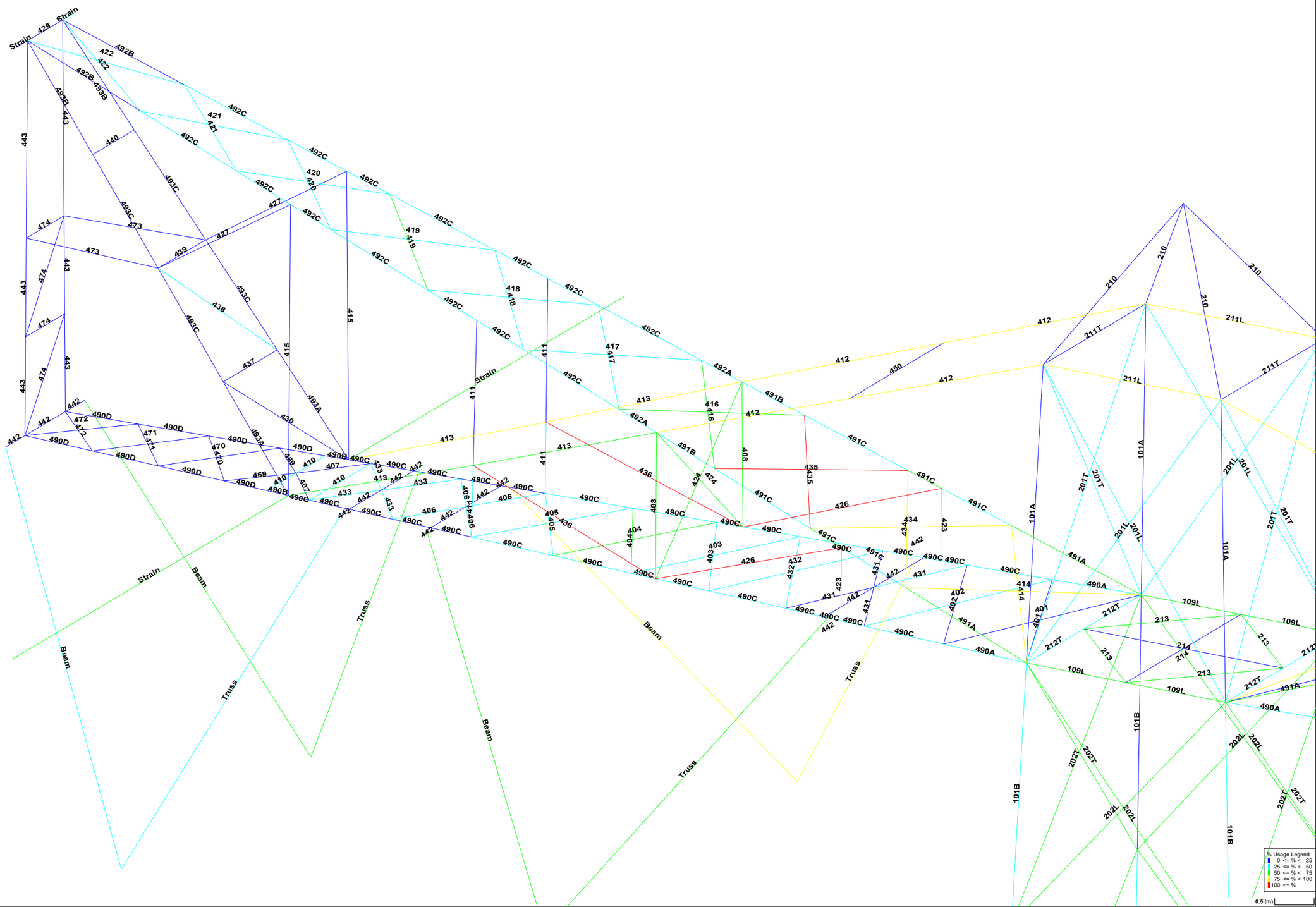


APPENDIX B
Uitvoer PLS-TOWER

DNV GL Nederlands BV, Project: "HB+0_R_X ini"
Tower Version 16.86, 11:52:57 Monday, 8 November, 2021
Undeformed geometry displayed



DNV GL Nederlands BV, Project: "HB+0_R_X ini"
Tower Version 16.86, 11:56:25 Monday, 8 November, 2021
Undeformed geometry displayed



DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 05-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+0 R_X
35

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
101A	Leg	120x120x10	S355	7M24-8.8t	0.50	0.50	0.50	85	-87.2	SPLS 6a_90 Ah Ct1 Ba Ct2	485.4	945.9	1234.8	0.18		17.5	S 3_0_9_71.15 Ah All Cts	635.0	945.9	1160.9	0.03	
101B	Leg	120x120x10	S355	8M24-8.8t	0.50	0.50	0.50	74	-199.2	SPLS 6a_90 Ah All Cts Ba Ct2	557.9	1084.4	1411.2	0.36		160.5	SPLS 3_0_9_71.15 Ah Ct1	635.0	1084.4	1326.8	0.25	
102A	Leg	150x150x14	S355	8M24-8.8t	0.50	0.50	0.50	65	-497.5	SPLS 3_71.15 Ah All Cts	1065.0	1084.4	1975.7	0.47		372.9	S 3_0_9_71.15 Ah All Cts	1159.3	1084.4	1857.5	0.34	
102B	Leg	150x150x14	S355	10M24-8.8t	0.50	0.50	0.50	68	-436.3	SPLS 3_71.15 Ah All Cts	1030.1	1336.5	2469.6	0.42		327.7	S 3_0_9_71.15 Ah All Cts	1159.3	1336.5	2237.4	0.28	
103A	Leg	200x200x16	S355	8M24-8.8t	0.28	0.28	0.28	31	-961.3	SPLS 3_71.15 Ah All Cts	2066.2	2168.8	2257.9	0.47		763.2	S 3_0_9_71.15 Ah All Cts	1886.8	2168.8	1949.1	0.40	
103B	Leg	200x200x16	S355	10M24-8.8t	0.56	0.56	0.56	44	-1203.3	SPLS 3_71.15 Ah All Cts	1916.7	2711.0	2822.4	0.63		981.6	S 3_0_9_71.15 Ah All Cts	1886.8	2711.0	2436.4	0.52	
103C	Leg	200x200x16	S355		0.56	0.56	0.56	35	-1200.5	SPLS 3_71.15 Ah All Cts	2025.1	0.0	0.0	0.59		986.1	S 3_0_9_71.15 Ah All Cts	2193.9	0.0	0.0	0.45	
104A	Leg	250x250x18	S355	10M24-8.8t	0.55	0.55	0.55	34	-1582.6	SPLS 3_71.15 Ah All Cts	2801.6	2558.5	3175.2	0.62		1310.3	S 3_0_9_71.15 Ah All Cts	2763.8	2558.5	2985.2	0.51	
104B	Leg	250x250x18	S355	12M24-8.8t	0.17	0.17	0.17	31	-1588.2	SPLS 3_71.15 Ah All Cts	2835.0	3087.2	3810.2	0.56		1303.3	S 3_0_9_71.15 Ah All Cts	2763.8	3087.2	3582.3	0.47	
105	Leg	200x200x22	S355	10M24-8.8t	0.28	0.28	0.28	48	-1461.8	SPLS 3_71.15 Ah All Cts	2535.6	2711.0	3880.8	0.58		1205.9	S 3_0_9_71.15 Ah All Cts	2542.6	2711.0	3350.1	0.47	
390A	Onderregel eerste dwarsarm	200x200x16	S355	8M24-8.8t	1.00	2.26	1.00	56	-751.2	SPLS 6a_90 Ah Ct1 Ba Ct1	1764.9	920.6	2257.9	0.82		536.6	SPLS 3_0_9_71.15 Ah Ct2	1467.5	920.6	2122.8	0.58	
390B	Onderregel eerste dwarsarm	200x200x16	S355	6M24-8.8t	2.00	###	1.00	59	-402.1	SPLS 6a_90 Ah Ct1 Ba Ct1	1719.3	781.1	1693.4	0.51		276.4	SPLS 3_0_9_71.15 Ah Ct2	1338.5	781.1	1592.1	0.35	
390C	Onderregel eerste dwarsarm	200x200x16	S355		1.00	2.38	1.00	56	-706.4	SPLS 6a_90 Ah Ct1 Ba Ct1	1765.1	0.0	0.0	0.40		490.6	SPLS 3_0_9_71.15 Ah Ct2	2193.9	0.0	0.0	0.22	
391A	Onderregel eerste dwarsarm	160x160x15	S355	6M24-8.8t	1.00	2.36	1.00	75	-373.1	SPLS 6a_90 Ah Ct1 Ba Ct1	1118.1	813.3	1587.6	0.46		244.9	SPLS 3_0_9_71.15 Ah Ct2	1372.7	813.3	1370.5	0.30	
391B	Onderregel eerste dwarsarm	160x160x15	S355		1.00	2.32	1.00	12	-1.6	SPLS 3_0_9_71.15 Ah Ct1	1658.2	0.0	0.0	0.00		0.6	SPLS 3_0_9_71.15 Ah Ct1	1658.2	0.0	0.0	0.00	
391C	Onderregel eerste dwarsarm	160x160x15	S355		1.00	3.29	1.00	75	-339.2	SPLS 6a_90 Ah Ct1 Ba Ct1	1118.5	0.0	0.0	0.30		207.7	SPLS 3_0_9_71.15 Ah Ct2	1658.2	0.0	0.0	0.13	
490A	Onderregel tweede dwarsarm	150x150x14	S355	10M24-8.8t	2.23	1.00	1.00	62	-458.2	SPLS 6a_90 Ah Ct1 Ba Ct1	1096.8	1342.8	2469.6	0.42		273.3	SPLS 3_0_9_71.15 Ah Ct2	1159.3	1342.8	2321.8	0.24	
490B	Onderregel tweede dwarsarm	150x150x14	S355		1.95	###	1.00	87	-7.7	SPLS 1a_0 Ah Ct1	810.2	0.0	0.0	0.01		15.0	ULS 1a_0_9_0	1425.0	0.0	0.0	0.01	
490C	Onderregel tweede dwarsarm	150x150x14	S355		2.39	1.00	1.00	63	-443.7	SPLS 6a_90 Ah Ct1 Ba Ct1	1084.6	0.0	0.0	0.41		254.6	SPLS 3_0_9_71.15 Ah Ct2	1425.0	0.0	0.0	0.18	
392A	Bovenregel eerste dwarsarm	90x90x8	S235	4M24-8.8t	2.01	1.00	1.00	275	0.0		47.2	542.2	414.7	0.00		133.1	ULS 3_71.15	185.9	542.2	357.1	0.72	
392B	Bovenregel eerste dwarsarm	90x90x8	S235	4M20-8.8t	1.99	1.00	1.00	275	0.0		47.2	376.3	345.6	0.00		99.8	ULS 3_71.15	269.1	376.3	314.2	0.37	
393A	Bovenregel eerste dwarsarm	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	313	0.0		34.3	376.3	345.6	0.00		88.2	ULS 3_71.15	227.6	376.3	314.2	0.39	
393B	Bovenregel eerste dwarsarm	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	313	0.0		34.3	376.3	345.6	0.00		88.4	ULS 3_71.15	168.3	376.3	304.4	0.52	
491A	Bovenregel tweede dwarsarm	120x120x10	S355	3M24-8.8t	1.54	1.00	1.00	82	-257.6	SPLS 6a_90 Ah All Cts Ba Ct1	419.0	406.7	529.2	0.63		228.3	SPLS 6a_90 Ah All Cts Ba Ct2	441.0	406.7	493.6	0.56	
491B	Bovenregel tweede dwarsarm	120x120x10	S355	6M24-8.8t	3.19	1.65	1.00	81	-162.7	SPLS 6a_90 Ah Ct1 Ba Ct1	418.9	813.3	1058.4	0.39		147.6	SPLS 6a_90 Ah Ct2 Ba Ct2	635.0	813.3	995.1	0.23	
491C	Bovenregel tweede dwarsarm	120x120x10	S355		3.06	5.91	1.00	81	-219.0	SPLS 6a_90 Ah All Cts Ba Ct1	419.2	0.0	0.0	0.52		206.3	SPLS 6a_90 Ah All Cts Ba Ct2	823.6	0.0	0.0	0.25	
492A	Bovenregel tweede dwarsarm	120x120x10	S355	6M24-8.8t	2.55	4.58	1.00	75	-189.7	SPLS 6a_90 Ah All Cts Ba Ct1	446.0	813.3	1058.4	0.43		204.5	SPLS 6a_90 Ah All Cts Ba Ct2	635.0	813.3	995.1	0.32	
492B	Bovenregel tweede dwarsarm	120x120x10	S355	4M24-8.8t	2.33	1.00	1.00	116	-38.6	SPLS 6a_90 Ah All Cts Ba Ct1	294.4	542.2	705.6	0.13		41.2	SPLS 6a_90 Ah All Cts Ba Ct2	635.0	542.2	663.4	0.08	
492C	Bovenregel tweede dwarsarm	120x120x10	S355		1.88	1.00	1.00	79	-172.7	SPLS 6a_90 Ah All Cts Ba Ct1	429.0	0.0	0.0	0.40		185.2	SPLS 6a_90 Ah All Cts Ba Ct2	823.6	0.0	0.0	0.22	
493A	Tussenregel tweede dwarsarm	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-32.3	ULS 5a Ba 22	138.8	188.2	172.8	0.23		0.0		187.5	188.2	172.8	0.00	
493B	Tussenregel tweede dwarsarm	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-28.7	SPLS 6a_90 Ba Ct1 Ba Ct2	138.8	188.2	172.8	0.21		0.0		168.5	188.2	172.8	0.00	
493C	Tussenregel tweede dwarsarm	90x90x8	S235		2.00	1.00	1.00	121	-31.6	ULS 5a Ah 22	138.8	0.0	0.0	0.23		0.0		326.7	0.0	0.0	0.00	
201L	Diagonaal	100x100x8	S235	2M20-8.8t	0.53	0.53	0.53	131	-69.5	SPLS 3_90 Ah Ct1	150.4	188.2	172.8	0.46		51.9	SPLS 6a_90 Ah Ct1 Ah Ct2	190.7	188.2	157.1	0.33	
201T	Diagonaal	100x100x8	S235	1M24-8.8t	1.00	0.53	0.53	159	-38.8	SPLS 6a_90 Ba Ct1 Ba Ct2	114.5	135.6	103.7	0.37		17.4	ULS 3_0_9_108.85 Ah Ct1	170.5	135.6	97.5	0.18	
202L	Diagonaal	160x160x15	S235	4M24-8.8t	0.53	0.53	0.53	78	-359.8	SPLS 3_71.15 Ba Ct1	702.9	542.2	777.6	0.66		306.0	SPLS 3_0_9_71.15 Ba Ct2	673.4	542.2	691.1	0.56	
202T	Diagonaal	150x150x12	S235	4M24-8.8t	0.53	0.53	0.53	83	-289.3	SPLS 6a_90 Ah Ct1 Ba Ct1	502.9	542.2	622.1	0.58		299.6	SPLS 6a_90 Ah Ct1 Ba Ct1	498.3	542.2	535.6	0.60	
203L	Diagonaal	150x150x12	S235	4M24-8.8t	0.52	0.52	0.52	89	-280.1	SPLS 3_0_9_71.15 Ba Ct2	480.6	542.2	622.1	0.58		327.5	SPLS 3_71.15 Ba Ct1	498.3	542.2	535.6	0.66	
203T	Diagonaal	150x150x12	S235	4M24-8.8t	0.52	0.52	0.52	89	-273.4	SPLS 6a_90 Ah Ct1 Ba Ct1	480.6	542.2	622.1	0.57		263.0	SPLS 6a_90 Ah Ct1 Ba Ct1	498.3	542.2	535.6	0.53	
204L	Diagonaal	160x160x17	S235	4M24-8.8t	0.52	0.52	0.52	90	-385.2	SPLS 3_90 Ah Ct1	714.2	542.2	881.3	0.71		306.2	SPLS 6a_90 Ah Ct2 Ba Ct2	746.8	542.2	783.2	0.56	
204T	Diagonaal	160x160x17	S235	4M24-8.8t	0.52	0.52	0.52	90	-337.9	SPLS 3_71.15 Ba Ct2	714.2	542.2	881.3	0.62		316.1	SPLS 3_0_9_90 Ah Ct1	746.8	542.2	783.2	0.58	
205L	Diagonaal	200x200x16	S235	5M24-8.8t	0.28	0.55	0.28	54	-490.7	SPLS 3_71.15 Ba Ct2	1047.8	649.5	1036.8	0.76		470.5	SPLS 3_0_9_71.15 Ba Ct2	1162.0	649.5	974.8	0.72	
205T	Diagonaal	200x200x16	S235	5M24-8.8t	0.28	0.55	0.28	54	-480.2	SPLS 6a_90 Ah Ct1 Ba Ct1	1047.8	649.5	1036.8	0.74		468.3	SPLS 3_0_9_71.15 Ba Ct2	1162.0	649.5	974.8	0.72	
206L	Diagonaal	160x160x17	S235	4M24-8.8t	0.55	1.00	0.55	90	-376.8	SPLS 3_71.15 Ba Ct1	671.9	542.2	881.3	0.69		385.5	SPLS 3_71.15 Ba Ct2	696.3	542.2	675.7	0.71	
206T	Diagonaal	160x160x17	S235	4M24-8.8t	0.55	1.00	0.55	90	-380.2	SPLS 3_71.15 Ba Ct2	671.9	542.2	881.3	0.70		377.2	SPLS 6a_90 Ah Ct1 Ba Ct1	696.3	542.2	675.7	0.70	
207L	Diagonaal	150x150x15	S235	3M24-8.8t	0.27	0.55	0.27	116	-294.1	SPLS 3_0_9_71.15 Ba Ct2	447.7	406.7	583.2	0.72		284.3	SPLS 3_71.15 Ba Ct1	563.0	406.7	445.6	0.70	
207T	Diagonaal	150x150x15	S235	3M24-8.8t	0.27	0.55	0.27	116	-285.2	SPLS 3_0_9_71.15 Ba Ct1	447.7	406.7	583.2	0.70		286.7	SPLS 3_71.15 Ba Ct2	563.0	406.7	445.6	0.71	
208L	Diagonaal	150x150x12	S235	3M24-8.8t	0.55	1.00	0.55	108	-219.9	SPLS 3_71.15 Ba Ct1	387.3	406.7	466.6	0.57		220.9	SPLS 3_0_9_71.15 Ba Ct2	456.2	406.7	356.5	0.62	
208T	Diagonaal	150x150x12	S235	3M24-8.8t	0.55	1.00	0.55	108	-220.4	SPLS 3_71.15 Ba Ct2	387.3	406.7	466.6	0.57		214.7	SPLS 3_0_9_71.15 Ba Ct1	456.2	406.7	356.5	0.60	
209L	Diagonaal	150x150x14	S235	4M24-8.8t	0.17	0.17	0.17	61	-337.0	SPLS 3_71.15 Ba Ct1	679.1	542.2	725.8	0.62		333.9	SPLS 3_0_9_71.15 Ba Ct2	525.6	542.2	378.4	0.88	
209T	Diagonaal	150x150x14	S235	4M24-8.8t	0.17	0.17	0.17	61	-330.5	SPLS 3_71.15 Ba Ct2	679.1	542.2	725.8	0.61		310.8	SPLS 3_0_9_71.15 Ba Ct1	525.6	542.2	378.4	0.82	
210	Top	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	174	-19.2	SPLS 3_71.15 Ba Ct1	84.7	188.2	172.8	0.23		19.1	SPLS 3_71.15 Ba Ct1	146.3	188.2	157.1	0.13	
211L	Tweede dwarsarm in tower	90x90x8	S235	3M24-8.8t	1.00	1.00	1.00	148	0.0		117.9	406.7	311.0	0.00		142.3	ULS 3_0	185.9	406.7	270.2	0.77	
211T	Tweede dwarsarm in tower	70x70x7	S235	1M16-8.8t	1.00	1.00	1.00	191	-4.2	SPLS 3_0_9_71.15 Ah Ct1	45.6	60.3	60.5	0.09		8.1	SPLS 6a_90 Ah Ct1 Ba Ct2	92.7	60.3	52.3	0.15	
109L	Tweede dwarsarm in tower	150x150x14	S355	10M24-8.8t	1.00	2.00	1.00	64	-600.5	SPLS 3_71.15 Ah All Cts	1076.4	1342.8	2469.6	0.56		446.5	S 3_0_9_71.15 Ah All Cts	1159.3	1342.8	2321.8	0.39	
212T	Tweede dwarsarm in tower	120x120x10	S235	6M24-8.8t	1.00	2.00	1.00	79	-120.0	SPLS 6a_90 Ba Ct1 Ba Ct2	328.5	813.3	777.6	0.37		144.6	SPLS 6a_90 Ba Ct1 Ba Ct2	466.6	813.3	731.1	0.31	
213	Tweede dwarsarm in tower	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	87	-175.9	SPLS 6a_90 Ah Ct1 Ba Ct1	325.4	406.7	388.8	0.54		175.8	SPLS 6a_90 Ah Ct1 Ba Ct1	324.0	406.7	359.4	0.54	
214	Tweede dwarsarm in tower	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	150	-0.6	ULS 3_0	31.9	60.3	43.2	0.02		0.5	ULS 3_0	46.1	60.3	32.7	0.02	
215L	Eerste dwarsarm in tower	120x120x10	S235	5M24-8.8t	1.00	1.00	1.00	148	-41.0	SPLS 3_0_9_90 Ah All Cts	196.8	677.8	648.0	0.21		202.5	SPLS 3_0 Ba All Cts	324.0	677.8	576.5	0.62	
215T	Eerste dwarsarm in tower	150x150x12	S235	2M24-8.8t	1.00	1.00	1.00	118	-106.0	ULS 1a_0_9_90	377.6	271.1	311.0	0.39		137.7	ULS 1a_90	638.7	271.1	292.4	0.51	
110L	Eerste dwarsarm in tower	200x200x16	S355	8M24-8.8t	1.00	2.00	1.00	62	-590.4	SPLS 3_71.15 Ah All Cts	1686.0	920.6	2257.9	0.64		436.0	S 3_0_9_71.15 Ah All Cts	1467.5	920.6	2122.8	0.47	
216T	Eerste dwarsarm in tower	120x120x10	S235	5M24-8.8t	1.00	2.00	1.00	104	-129.0	SPLS 3_0_9_71.15 Ba Ct1	269.2	677.8	648.0	0.48		161.7	SPLS 3_71.15 Ba Ct1	466.6	677.8	609.2	0.35	
217	Eerste dwarsarm in tower	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	114	-181.6	SPLS 3_0_9_71.15 Ba Ct1	261.1	406.7	388.8	0.70		182.5	SPLS 3_71.15 Ba Ct1	324.0	406.7	359.4	0.56	
218	Eerste dwarsarm in tower	50x50x7	S235	1M16-8.8t	0.50	0.50	0.50	200	-0.8	ULS 3_0	29.9	60.3	60.5	0.03		0.8	ULS 3_0	64.5	60.3	45.8	0.02	
219L	Onderstuk in tower	90x90x8	S235	2M16-8.8t	1.00	1.00	1.00	247	-9.2	SPLS 1a_0_9_90 Ah All Cts	58.0	120.6	138.2	0.16		4.0	S 1a_0_9_108.85 Ah Ct2	227.3	120.6	119.5	0.03	
219T	Onderstuk in tower	90x90x8	S235	4M16-8.8t	###	2.00	1.00	159	-12.6	ULS 1a_135	102.3	241.2	276.5	0.12		9.9	ULS 1a_0_9_45	285.6	241.2	238.9	0.04	
220	Onderstuk in tower	80x80x6#	S235	1M16-8.8t	1.00	0.50	0.50	245	-5.9	ULS 1a_71.15	26.4	60.3	51.8	0.22		5.0	ULS 1a_0_9_135	107.1	60.3	44.8	0.11	
221	Onderstuk in tower	80x80x8	S235	1M16-8.8t	0.50	0.50	0.50	279	-1.8	ULS 1a_0	34.1	60.3	69.1	0.05		0.2	ULS 1a_0_9_0_9_0	142.8	60.3	59.7	0.00	
301	Diagonaal onderregel eerste dwarsarm	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	140	-54.6	SPLS 3_0_9_71.15 Ah All Cts	111.3	188.2	172.8	0.49		60.1	SPLS 3_71.15 Ah All Cts	149.6	188.2	139.6	0.43	
302	Diagonaal onderregel eerste dwarsarm	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	130	-67.3	SPLS 6a_90 Ah Ct2 Ba Ct2	120.9	188.2	172.8	0.56		63.9	SPLS 3_0_9_71.15 Ah Ct2	151.2	188.2	139.6	0.46	
303	Diagonaal onderregel eerste dwarsarm	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	120	-68.2	SPLS 3_71.15 Ah All Cts	131.9	188.2	172.8	0.52		69.2	S 3_0_9_71.15 Ah All Cts	149.6	188.2	139.6	0.50	
304	Diagonaal onderregel eerste dwarsarm	90x90x8	S235	2M24-8.8t	0.55	0.55	0.55	93	-87.0	SPLS 3_71.15 Ah All Cts	186.3	271.1	207.4	0.47		88.5	S 3_0_9_71.15 Ah All Cts	150.3	271.1	141.8	0.62	
306	Diagonaal onderregel eerste dwarsarm	80x80x6#	S235	2M24-8.8t	0.50	0.50	0.50	81	-36.0	SPLS 3_71.15 Ah All Cts	138.2	271.1	155.5	0.26		47.1	S 3_0_9_71.15 Ah All Cts	96.6	271.1	121.8	0.49	
307	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	112	-35.4	SPLS 6a_90 Ah All Cts Ba Ct1	107.5	188.2	151.2	0.33		34.3	S 3_0_9_71.15 Ah All Cts	90.5	188.2	79.7	0.43	
308	Diagonaal onderregel eerste dwarsarm	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	110	-34.0	SPLS 6a_90 Ah All Cts Ba Ct2	80.5	120.6	103.7	0.42		33.2	S 3_0_9_71.15 Ah All Cts	67.0	120.6	56.7	0.59	
309	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	79	-46.3	SPLS 3_71.15 Ah All Cts	140.3	188.2	151.2	0.33		47.7	S 3_0_9_71.15 Ah All Cts	90.5	188.2	82.6	0.58	
310	Diagonaal onderregel eerste dwarsarm	90x90x8	S235	2M20-8.8t	0.55	0.55	0.55	49	-61.6	SPLS 3_71.15 Ah Ct2	252.8	188.2	172.8	0.36		60.8	S 3_0_9_71.15 Ah All Cts	139.9	188.2	116.9	0.52	
311	Diagonaal onderregel eerste dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	51	-39.2	SPLS 3_0_9_71.15 Ah Ct1	250.3	271.1	207.4	0.19		31.0	SPLS 3_0_9_71.15 Ah Ct1	136.2	271.1	104.6	0.30	
313	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-8.8t	1.00	2.00	1.00	50	0.0		680.7	188.2	216.0	0.00		4.6	ULS 3_71.15	766.1	188.2	0.0	0.02	
314	Dwarsligger onderregel eerste dwarsarm	150x150x12	S355	2M24-8.8t	2.00	2.00	2.00	83	0.0		656.2	271.1	423.4	0.00		55.0	ULS 3_90	536.9	271.1	379.9	0.20	
315	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-8.8t	1.00	2.00	1.00	33	-3.3	ULS 1a_0_9_90	745.6	188.2	216.0	0.02		4.2	ULS 5a Ba 11	766.1	188.2	0.0	0.02	
316	Dwarsligger onderregel eerste dwarsarm	150x150x12	S355	2M24-8.8t	2.00	1.00	1.00	24	0.0		1022.5	271.1	423.4	0.00		83.2	ULS 3_0_9_71.15	496.7	271.1	191.8	0.43	
317	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	26	-13.9	ULS 3_0_9_71.15	790.1	188.2	216.0	0.07		0.0		766.1	188.2	0.0	0.00	
318	Verticaal eerste dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	171	-19.4	ULS 3_0	98.0	271.1	207.4	0.20		0.0		159.7	271.1	183.4	0.00	
319	Verticaal eerste dwarsarm	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	172	-4.4	SPLS 6a_90 Ba Ct1 Ah Ct1	38.8	60.3	51.8	0.11		0.0		48.4	60.3	21.2	0.00	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 05-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+0 R_X
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Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
320	Verticaal eerste dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	104	-1.1	ULS 3_71.15	47.2	60.3	43.2	0.03		0.0		46.1	60.3	32.7	0.00	
321	Diagonaal eerste dwarsarm	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	345	0.0		30.1	188.2	172.8	0.00		31.2	ULS 3_71.15	162.8	188.2	157.1	0.20	
322	Diagonaal eerste dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	269	0.0		50.9	271.1	207.4	0.00		43.5	SLS 6a_90 Ba Ct2 Ah Ct2	136.2	271.1	161.3	0.32	
323	Diagonaal eerste dwarsarm	70x70x7	S235	1M20-8.8t	1.00	1.00	1.00	307	0.0		22.4	94.1	75.6	0.00		14.7	SLS 6a_90 Ba Ct1 Ah Ct1	84.7	94.1	65.2	0.23	
324	Dwarsligger bovenregel eerste dwarsarm	70x70x7	S235	1M20-8.8t	2.00	1.00	1.00	110	-0.8	ULS 1a_0	103.5	94.1	75.6	0.01		0.7	ULS 1a_0,9_0,9_0	84.7	94.1	65.2	0.01	
325	Tussen diagonaal eerste dwarsarm	80x80x8	S235	1M20-8.8t	1.00	1.00	1.00	151	-2.2	ULS 1a_0	81.0	94.1	86.4	0.03		1.4	ULS 1a_0,9_0,9_0	133.6	94.1	78.5	0.02	
401	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	125	-21.2	SPLS 1a_0 Ba Ct2	95.9	188.2	151.2	0.22		20.5	SPLS 1a_0 Ba All Cts	90.5	188.2	91.6	0.23	
402	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	119	-23.7	SPLS 1a_0 Ba Ct1	101.4	188.2	151.2	0.23		27.7	SPLS 1a_0 Ba Ct2	90.5	188.2	100.8	0.31	
403	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	97	-32.7	SPLS 3_0 Ba Ct1	122.0	188.2	151.2	0.27		33.2	SPLS 3_71.15 Ah Ct2	90.5	188.2	100.8	0.37	
404	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	97	-48.6	SPLS 3_71.15 Ah All Cts	121.5	188.2	151.2	0.40		50.1	SPLS 3_71.15 Ah Ct1	90.5	188.2	117.6	0.55	
405	Diagonaal onderregel tweede dwarsarm	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	68	-57.9	SPLS 3_71.15 Ah Ct1	224.7	271.1	207.4	0.28		52.3	SLS 3_0,9_71.15 Ah All Cts	136.2	271.1	141.8	0.38	
406	Diagonaal onderregel tweede dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	59	-61.5	SPLS 3_71.15 Ah Ct1	239.1	271.1	207.4	0.30		55.4	SPLS 3_71.15 Ah Ct1	139.3	271.1	124.1	0.45	
407	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	2M24-8.8t	1.00	1.00	1.00	65	-36.5	SPLS 3_71.15 Ah Ct1	203.3	271.1	207.4	0.18		26.6	SPLS 3_0,9_71.15 Ah Ct1	120.5	271.1	141.8	0.22	
408	Diagonaal onderregel tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	202	-8.8	SPLS 3_0,9_90 Ah All Cts	21.5	60.3	43.2	0.41		20.5	SLS 6a_90 Ah All Cts Ba Ct2	46.1	60.3	32.7	0.63	
410	Dwarsligger onderregel tweede dwarsarm	150x150x12	S355	2M20-8.8t	1.00	2.00	1.00	32	0.0		971.1	188.2	352.8	0.00		74.6	ULS 3_0,9_90	496.7	271.1	199.0	0.37	
411		50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	99	-4.0	SPLS 1a_0,9_0 Ah Ct1	54.9	60.3	43.2	0.09		16.4	SPLS 1a_0 Ah Ct2	46.1	60.3	32.7	0.50	
412	Bovenregel tweede dwarsarm	90x90x8	S235	3M24-8.8t	2.00	2.00	2.00	349	0.0		33.6	406.7	311.0	0.00		171.9	SLS 6a_90 Ba All Cts Ah Ct2	185.9	406.7	270.2	0.92	
413	Bovenregel tweede dwarsarm	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	244	0.0		50.3	376.3	345.6	0.00		157.9	ULS 3_135	168.3	376.3	310.2	0.94	
414	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	160	-25.5	SPLS 6a_90 Ah All Cts Ba Ct2	42.5	60.3	51.8	0.60		26.0	SLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.92	
415	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	334	-2.6	SPLS 1a_71.15 Ah All Cts	14.3	60.3	51.8	0.18		0.0		48.4	60.3	33.7	0.00	
416	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	126	-25.9	SPLS 6a_90 Ah All Cts Ba Ct2	56.3	60.3	51.8	0.50		22.5	SLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.80	
417	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	118	-9.4	SPLS 6a_90 Ah Ct2 Ba Ct2	59.8	60.3	51.8	0.18		8.9	SLS 6a_90 Ah Ct2 Ba Ct2	72.6	60.3	28.2	0.32	
418	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	111	-13.4	SPLS 6a_90 Ah All Cts Ba Ct2	63.5	60.3	51.8	0.26		14.0	SLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.50	
419	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	105	-15.9	SPLS 6a_90 Ah All Cts Ba Ct2	66.8	60.3	51.8	0.31		14.9	SLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.53	
420	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	97	-17.9	SPLS 6a_90 Ah All Cts Ba Ct2	89.1	120.6	103.7	0.20		19.2	SLS 6a_90 Ah All Cts Ba Ct2	78.2	120.6	56.3	0.34	
421	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	92	-25.2	SPLS 6a_90 Ah All Cts Ba Ct2	92.9	120.6	103.7	0.27		22.9	SLS 6a_90 Ah All Cts Ba Ct2	78.2	120.6	56.3	0.41	
422	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	2M16-8.8t	0.57	0.57	0.57	101	-33.6	SPLS 6a_90 Ah Ct1 Ba Ct1	86.3	120.6	103.7	0.39		37.6	SLS 6a_90 Ah All Cts Ba Ct2	78.2	120.6	76.8	0.49	
423	Verticaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	101	-0.8	ULS 1a_0,9_0,9_0	48.1	60.3	43.2	0.02		8.8	SPLS 1a_0 Ah Ct2	46.1	60.3	32.7	0.27	
424	Verticaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	0.51	0.51	0.51	155	-24.4	SPLS 6a_90 Ah All Cts Ba Ct2	30.8	60.3	43.2	0.79		24.3	SLS 6a_90 Ah All Cts Ba Ct2	46.1	60.3	32.7	0.74	
426	Diagonaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	308	-15.1	SPLS 1a_0 Ah Ct2	11.4	60.3	43.2	1.33	knik	0.0		46.1	60.3	25.2	0.00	
427	Diagonaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	244	0.0		16.4	60.3	43.2	0.00		1.1	ULS 1a_108.85	46.1	60.3	20.5	0.05	
429	Dwarsligger bovenregel tweede dwarsarm	UNP160	S235	3M20-8.8t	1.00	1.00	1.00	47	0.0		409.5	282.2	243.0	0.00		34.9	ULS 3_0,9_90	306.9	282.2	187.2	0.19	
430	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	227	-1.4	ULS 1a_0,9_0,9_135	18.2	60.3	43.2	0.08		1.9	ULS 1a_0,9_0	46.1	60.3	32.7	0.06	
431		70x70x7	S235	2M20-8.8t	1.00	1.00	1.00	106	-31.5	SPLS 1a_0 Ba Ct2	113.1	188.2	151.2	0.28		25.7	SPLS 1a_0 Ba Ct2	90.5	188.2	100.8	0.28	
432		70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	107	-28.4	SPLS 3_90 Ah Ct2	111.7	188.2	151.2	0.25		26.1	SPLS 1a_0 Ba Ct1	90.5	188.2	100.8	0.29	
433		90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	62	-63.9	SPLS 3_71.15 Ah All Cts	234.4	271.1	207.4	0.31		69.2	SPLS 3_71.15 Ah Ct1	155.0	271.1	141.8	0.49	
434		60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	141	-27.0	SPLS 6a_90 Ah All Cts Ba Ct2	49.5	60.3	51.8	0.55		26.3	SLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.93	
435		60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	133	-31.3	SPLS 6a_90 Ah All Cts Ba Ct2	52.8	60.3	51.8	0.60		32.1	SLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	1.14	stuik
436		50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	303	-25.7	SPLS 1a_0 Ah Ct2	11.6	60.3	43.2	2.21	knik	5.0	SPLS 1a_0,9_0 Ah Ct1	46.1	60.3	32.7	0.15	
437	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	141	-2.6	SPLS 1a_0,9_0 Ah All Cts	34.4	60.3	43.2	0.08		2.4	SLS 1a_0,9_135 Ba All Cts	46.1	60.3	32.7	0.07	
438	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	217	-6.6	SPLS 1a_0,9_135 Ba All Cts	19.5	60.3	43.2	0.34		7.8	SPLS 1a_0,9_0 Ah All Cts	46.1	60.3	32.7	0.24	
439	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	125	-2.5	SPLS 1a_0,9_0 Ah All Cts	39.5	60.3	43.2	0.06		2.1	SLS 1a_0,9_135 Ba All Cts	46.1	60.3	32.7	0.06	
440	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	108	0.0	ULS 5a Ah 22	45.3	60.3	43.2	0.00		0.0	ULS 3_135	46.1	60.3	32.7	0.00	
330		80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	111	-76.5	SPLS 3_0,9_71.15 Ah All Cts	141.9	188.2	172.8	0.54		73.9	SPLS 3_71.15 Ah All Cts	149.6	188.2	139.6	0.53	
331		60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	100	-40.0	SPLS 3_71.15 Ah All Cts	87.4	120.6	103.7	0.46		39.9	SPLS 3_71.15 Ah All Cts	67.0	120.6	56.7	0.70	
332		70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	73	-54.5	SPLS 3_0,9_71.15 Ah All Cts	147.1	188.2	151.2	0.37		51.5	SPLS 3_71.15 Ah All Cts	90.5	188.2	82.6	0.62	
250L		60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	235	-7.1	SPLS 3_0,9_71.15 Ah All Cts	24.9	60.3	51.8	0.29		4.5	SLS 1a_0,9_90 Ah All Cts	48.4	60.3	33.7	0.13	
250T		60x60x6	S235	1M16-8.8t	1.09	1.00	1.00	216	-4.9	SPLS 3_0,9_90 Ah All Cts	28.2	60.3	51.8	0.17		3.0	ULS 1a_0,9_135	48.4	60.3	33.7	0.09	
251		90x90x8	S235	1M16-8.8t	1.00	1.00	1.00	212	-4.3	SPLS 1a_71.15 Ba Ct1	58.3	60.3	69.1	0.07		3.3	SLS 1a_0,9_71.15 Ba Ct2	165.9	60.3	59.7	0.06	
252		60x60x6	S235	1M16-8.8t	0.50	0.50	0.50	235	-1.0	ULS 1a_0	24.9	60.3	51.8	0.04		0.2	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.01	
450		50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	246	-0.1	SPLS 1a_0,9_45 Ah All Cts	16.2	60.3	43.2	0.00		0.1	SPLS 1a_0,9_0 Ba All Cts	46.1	60.3	32.7	0.00	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 05-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+0 R_X
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Staafgroep	Omschrijving	Profiel	Staalsoort	Bouten	RLX	RLY	RLZ	Slankheid	Druk	Combinatie druk	Knik	Afschuiving	Stuik (druk)	U.C. (druk)	Opm.	Trek	Combinatie trek	Nettodsn.	Afschuif	Stuik (trek)	U.C. (trek)
101A	Leg	120x120x10	S355	7M24-8.8t	0.50	0.50	0.50	85	-87.4	SPLS 6a_90 Ah Ct1 Ba	485.4	945.9	1234.8	0.18		17.4	SPLS 3_0,9_71.15 Ah	635.0	945.9	1160.9	0.03
101B	Leg	120x120x10	S355	8M24-8.8t	0.50	0.50	0.50	74	-199.5	SPLS 6a_90 Ah All Cts	557.9	1084.4	1411.2	0.36		160.3	SPLS 3_0,9_71.15 Ah	635.0	1084.4	1326.8	0.25
102A	Leg	150x150x14	S355	8M24-8.8t	0.50	0.50	0.50	65	-497.9	SPLS 3_71.15 Ah All Cts	1065.0	1084.4	1975.7	0.47		372.6	SPLS 3_0,9_71.15 Ah	1159.3	1084.4	1857.5	0.34
102B	Leg	150x150x14	S355	10M24-8.8t	0.50	0.50	0.50	68	-436.5	SPLS 3_71.15 Ah All Cts	1030.1	1336.5	2469.6	0.42		327.5	SPLS 3_0,9_71.15 Ah	1159.3	1336.5	2237.4	0.28
103A	Leg	200x200x16	S355	8M24-8.8t	0.28	0.28	0.28	31	-961.7	SPLS 3_71.15 Ah All Cts	2066.2	2168.8	2257.9	0.47		763.0	SPLS 3_0,9_71.15 Ah	1886.8	2168.8	1949.1	0.40
103B	Leg	200x200x16	S355	10M24-8.8t	0.56	0.56	0.56	44	-1203.6	SPLS 3_71.15 Ah All Cts	1916.7	2711.0	2822.4	0.63		981.4	SPLS 3_0,9_71.15 Ah	1886.8	2711.0	2436.4	0.52
103C	Leg	200x200x16	S355		0.56	0.56	0.56	35	-1200.8	SPLS 3_71.15 Ah All Cts	2025.1	0.0	0.0	0.59		985.9	SPLS 3_0,9_71.15 Ah	2193.9	0.0	0.0	0.45
104A	Leg	250x250x18#	S355	10M24-8.8t	0.55	0.55	0.55	34	-1583.0	SPLS 3_71.15 Ah All Cts	2801.6	2558.5	3175.2	0.62		1310.1	SPLS 3_0,9_71.15 Ah	2763.8	2558.5	2985.2	0.51
104B	Leg	250x250x18#	S355	12M24-8.8t	0.17	0.17	0.17	31	-1588.5	SPLS 3_71.15 Ah All Cts	2835.0	3087.2	3810.2	0.56		1303.1	SPLS 3_0,9_71.15 Ah	2763.8	3087.2	3582.3	0.47
105	Leg	200x200x22	S355	10M24-8.8t	0.28	0.28	0.28	48	-1462.2	SPLS 3_71.15 Ah All Cts	2535.6	2711.0	3880.8	0.58		1205.7	SPLS 3_0,9_71.15 Ah	2542.6	2711.0	3350.1	0.47
390A	Onderregel eers	200x200x16	S355	8M24-8.8t	1.00	2.26	1.00	56	-751.2	SPLS 6a_90 Ah Ct1 Ba	1764.9	920.6	2257.9	0.82		536.6	SPLS 3_0,9_71.15 Ah	1467.5	920.6	2122.8	0.58
390B	Onderregel eers	200x200x16	S355	6M24-8.8t	2.00	11.06	1.00	59	-402.1	SPLS 6a_90 Ah Ct1 Ba	1719.3	781.1	1693.4	0.51		276.4	SPLS 3_0,9_71.15 Ah	1338.5	781.1	1592.1	0.35
390C	Onderregel eers	200x200x16	S355		1.00	2.38	1.00	56	-706.4	SPLS 6a_90 Ah Ct1 Ba	1765.1	0.0	0.0	0.40		490.6	SPLS 3_0,9_71.15 Ah	2193.9	0.0	0.0	0.22
391A	Onderregel eers	160x160x15#	S355	6M24-8.8t	1.00	2.36	1.00	75	-373.1	SPLS 6a_90 Ah Ct1 Ba	1118.1	813.3	1587.6	0.46		244.9	SPLS 3_0,9_71.15 Ah	1372.7	813.3	1370.5	0.30
391B	Onderregel eers	160x160x15#	S355		1.00	2.32	1.00	12	-1.6	SPLS 3_0,9_71.15 Ah	1658.2	0.0	0.0	0.00		0.6	SPLS 3_0,9_71.15 Ah	1658.2	0.0	0.0	0.00
391C	Onderregel eers	160x160x15#	S355		1.00	3.29	1.00	75	-339.2	SPLS 6a_90 Ah Ct1 Ba	1118.5	0.0	0.0	0.30		207.7	SPLS 3_0,9_71.15 Ah	1658.2	0.0	0.0	0.13
490A	Onderregel twe	150x150x14	S355	10M24-8.8t	2.23	1.00	1.00	62	-458.3	SPLS 6a_90 Ah Ct1 Ba	1096.8	1342.8	2469.6	0.42		272.9	SPLS 3_0,9_71.15 Ah	1159.3	1342.8	2321.8	0.24
490B	Onderregel twe	150x150x14	S355		1.95	12.10	1.00	87	-7.8	SPLS 1a_0 Ah Ct1	810.2	0.0	0.0	0.01		15.1	ULS 1a_0,9_0	1425.0	0.0	0.0	0.01
490C	Onderregel twe	150x150x14	S355		2.39	1.00	1.00	63	-443.7	SPLS 6a_90 Ah Ct1 Ba	1084.6	0.0	0.0	0.41		254.3	SPLS 3_0,9_71.15 Ah	1425.0	0.0	0.0	0.18
392A	Bovenregel eers	90x90x8	S235	4M24-8.8t	2.01	1.00	1.00	275	0.0		47.2	542.2	414.7	0.00		133.1	ULS 3_71.15	185.9	542.2	357.1	0.72
392B	Bovenregel eers	90x90x8	S235	4M20-8.8t	1.99	1.00	1.00	275	0.0		47.2	376.3	345.6	0.00		99.8	ULS 3_71.15	269.1	376.3	314.2	0.37
393A	Bovenregel eers	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	313	0.0		34.3	376.3	345.6	0.00		88.2	ULS 3_71.15	227.6	376.3	314.2	0.39
393B	Bovenregel eers	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	313	0.0		34.3	376.3	345.6	0.00		88.4	ULS 3_71.15	168.3	376.3	304.4	0.52
491A	Bovenregel twe	120x120x10	S355	3M24-8.8t	1.54	1.00	1.00	82	-258.2	SPLS 6a_90 Ah All Cts	419.0	406.7	529.2	0.63		227.8	SPLS 6a_90 Ah All Cts	441.0	406.7	493.6	0.56
491B	Bovenregel twe	120x120x10	S355	6M24-8.8t	3.19	1.65	1.00	81	-162.6	SPLS 6a_90 Ah Ct1 Ba	418.9	813.3	1058.4	0.39		147.7	SPLS 6a_90 Ah Ct2 Ba	635.0	813.3	995.1	0.23
491C	Bovenregel twe	120x120x10	S355		3.06	5.91	1.00	81	-218.9	SPLS 6a_90 Ah All Cts	419.2	0.0	0.0	0.52		206.3	SPLS 6a_90 Ah All Cts	823.6	0.0	0.0	0.25
492A	Bovenregel twe	120x120x10	S355	6M24-8.8t	2.55	4.58	1.00	75	-189.5	SPLS 6a_90 Ah All Cts	446.0	813.3	1058.4	0.42		204.6	SPLS 6a_90 Ah All Cts	635.0	813.3	995.1	0.32
492B	Bovenregel twe	120x120x10	S355	4M24-8.8t	2.33	1.00	1.00	116	-38.4	SPLS 6a_90 Ah All Cts	294.4	542.2	705.6	0.13		41.2	SPLS 6a_90 Ah All Cts	635.0	542.2	663.4	0.08
492C	Bovenregel twe	120x120x10	S355		1.88	1.00	1.00	79	-172.5	SPLS 6a_90 Ah All Cts	429.0	0.0	0.0	0.40		185.2	SPLS 6a_90 Ah All Cts	823.6	0.0	0.0	0.22
493A	Tussenregel twe	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-32.4	ULS 5a Ba 22	138.8	188.2	172.8	0.23		0.0		187.5	188.2	172.8	0.00
493B	Tussenregel twe	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-28.9	SPLS 6a_90 Ba Ct1 Ba	138.8	188.2	172.8	0.21		0.0		168.5	188.2	172.8	0.00
493C	Tussenregel twe	90x90x8	S235		2.00	1.00	1.00	121	-31.7	ULS 5a Ah 22	138.8	0.0	0.0	0.23		0.0		326.7	0.0	0.0	0.00
201L	Diagonaal	100x100x8	S235	2M20-8.8t	0.53	0.53	0.53	131	-69.5	SPLS 3_90 Ah Ct1	150.4	188.2	172.8	0.46		51.8	SPLS 6a_90 Ah Ct1 Ah	190.7	188.2	157.1	0.33
201T	Diagonaal	100x100x8	S235	1M24-8.8t	1.00	0.53	0.53	159	-38.9	SPLS 6a_90 Ba Ct1 Ba	114.4	135.6	103.7	0.37		17.4	SPLS 3_0,9_108.85 Ah	170.5	135.6	97.5	0.18
202L	Diagonaal	160x160x15#	S235	4M24-8.8t	0.53	0.53	0.53	78	-359.9	SPLS 3_71.15 Ba Ct1	702.9	542.2	777.6	0.66		305.9	SPLS 3_0,9_71.15 Ba	673.4	542.2	691.1	0.56
202T	Diagonaal	150x150x12	S235	4M24-8.8t	0.53	0.53	0.53	83	-289.3	SPLS 6a_90 Ah Ct1 Ba	502.9	542.2	622.1	0.58		299.6	SPLS 6a_90 Ah Ct1 Ba	498.3	542.2	535.6	0.60
203L	Diagonaal	150x150x12	S235	4M24-8.8t	0.52	0.52	0.52	89	-280.1	SPLS 3_0,9_71.15 Ba	480.6	542.2	622.1	0.58		327.6	SPLS 3_71.15 Ba Ct1	498.3	542.2	535.6	0.66
203T	Diagonaal	150x150x12	S235	4M24-8.8t	0.52	0.52	0.52	89	-273.4	SPLS 6a_90 Ah Ct1 Ba	480.6	542.2	622.1	0.57		263.0	SPLS 6a_90 Ah Ct1 Ba	498.3	542.2	535.6	0.53
204L	Diagonaal	160x160x17#	S235	4M24-8.8t	0.52	0.52	0.52	90	-385.4	SPLS 3_90 Ah Ct1	714.2	542.2	881.3	0.71		306.1	SPLS 6a_90 Ah Ct2 Ba	746.8	542.2	783.2	0.56
204T	Diagonaal	160x160x17#	S235	4M24-8.8t	0.52	0.52	0.52	90	-338.0	SPLS 3_71.15 Ba Ct2	714.2	542.2	881.3	0.62		316.1	SPLS 3_0,9_90 Ah Ct1	746.8	542.2	783.2	0.58
205L	Diagonaal	200x200x16	S235	5M24-8.8t	0.28	0.55	0.28	54	-490.7	SPLS 3_71.15 Ba Ct2	1047.8	649.5	1036.8	0.76		470.5	SPLS 3_0,9_71.15 Ba	1162.0	649.5	974.8	0.72
205T	Diagonaal	200x200x16	S235	5M24-8.8t	0.28	0.55	0.28	54	-480.2	SPLS 6a_90 Ah Ct1 Ba	1047.8	649.5	1036.8	0.74		468.3	SPLS 3_0,9_71.15 Ba	1162.0	649.5	974.8	0.72
206L	Diagonaal	160x160x17#	S235	4M24-8.8t	0.55	1.00	0.55	90	-376.8	SPLS 3_71.15 Ba Ct1	671.9	542.2	881.3	0.69		385.5	SPLS 3_71.15 Ba Ct2	696.3	542.2	675.7	0.71
206T	Diagonaal	160x160x17#	S235	4M24-8.8t	0.55	1.00	0.55	90	-380.2	SPLS 3_71.15 Ba Ct2	671.9	542.2	881.3	0.70		377.2	SPLS 6a_90 Ah Ct1 Ba	696.3	542.2	675.7	0.70
207L	Diagonaal	150x150x15	S235	3M24-8.8t	0.27	0.55	0.27	116	-294.1	SPLS 3_0,9_71.15 Ba	447.7	406.7	583.2	0.72		284.3	SPLS 3_71.15 Ba Ct1	563.0	406.7	445.6	0.70
207T	Diagonaal	150x150x15	S235	3M24-8.8t	0.27	0.55	0.27	116	-285.2	SPLS 3_0,9_71.15 Ba	447.7	406.7	583.2	0.70		286.7	SPLS 3_71.15 Ba Ct2	563.0	406.7	445.6	0.71
208L	Diagonaal	150x150x12	S235	3M24-8.8t	0.55	1.00	0.55	108	-219.9	SPLS 3_71.15 Ba Ct1	387.3	406.7	466.6	0.57		220.9	SPLS 3_0,9_71.15 Ba	456.2	406.7	356.5	0.62
208T	Diagonaal	150x150x12	S235	3M24-8.8t	0.55	1.00	0.55	108	-220.4	SPLS 3_71.15 Ba Ct2	387.3	406.7	466.6	0.57		214.7	SPLS 3_0,9_71.15 Ba	456.2	406.7	356.5	0.60
209L	Diagonaal	150x150x14	S235	4M24-8.8t	0.17	0.17	0.17	61	-337.0	SPLS 3_71.15 Ba Ct1	679.1	542.2	725.8	0.62		333.9	SPLS 3_0,9_71.15 Ba	525.6	542.2	378.4	0.88
209T	Diagonaal	150x150x14	S235	4M24-8.8t	0.17	0.17	0.17	61	-330.5	SPLS 3_71.15 Ba Ct2	679.1	542.2	725.8	0.61		310.8	SPLS 3_0,9_71.15 Ba	525.6	542.2	378.4	0.82
210	Top	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	174	-19.2	SPLS 3_71.15 Ba Ct1	84.7	188.2	172.8	0.23		19.1	SPLS 3_71.15 Ba Ct1	146.3	188.2	157.1	0.13
211L	Tweede dwarsa	90x90x8	S235	3M24-8.8t	1.00	1.00	1.00	148	0.0		117.9	406.7	311.0	0.00		143.0	ULS 3_0	185.9	406.7	270.2	0.77
211T	Tweede dwarsa	70x70x7	S235	1M16-8.8t	1.00	1.00	1.00	191	-4.2	SPLS 3_0,9_71.15 Ah	45.6	60.3	60.5	0.09		8.1	SPLS 6a_90 Ah Ct1 Ba	92.7	60.3	52.3	0.15
109L	Tweede dwarsa	150x150x14	S355	10M24-8.8t	1.00	2.00	1.00	64	-601.0	SPLS 3_71.15 Ah All Cts	1076.4	1342.8	2469.6	0.56		445.9	SPLS 3_0,9_71.15 Ah	1159.3	1342.8	2321.8	0.38
212T	Tweede dwarsa	120x120x10	S235	6M24-8.8t	1.00	2.00	1.00	79	-119.9	SPLS 6a_90 Ba Ct1 Ba	328.5	813.3	777.6	0.37		144.7	SPLS 6a_90 Ba Ct1 Ba	466.6	813.3	731.1	0.31
213	Tweede dwarsa	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	87	-175.9	SPLS 6a_90 Ah Ct1 Ba	325.4	406.7	388.8	0.54		175.8	SPLS 6a_90 Ah Ct1 Ba	324.0	406.7	359.4	0.54
214	Tweede dwarsa	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	150	-0.6	ULS 3_0	31.9	60.3	43.2	0.02		0.5	ULS 3_0	46.1	60.3	32.7	0.02
215L	Eerste dwarsarr	120x120x10	S235	5M24-8.8t	1.00	1.00	1.00	148	-41.0	SPLS 3_0,9_90 Ah All Cts	196.8	677.8	648.0	0.21		202.5	SPLS 3_0 Ba All Cts	324.0	677.8	576.5	0.63
215T	Eerste dwarsarr	150x150x12	S235	2M24-8.8t	1.00	1.00	1.00	118	-106.0	ULS 1a_0,9_90	377.6	271.1	311.0	0.39		137.9	ULS 1a_90	638.7	271.1	292.4	0.51
110L	Eerste dwarsarr	200x200x16	S355	8M24-8.8t	1.00	2.00	1.00	62	-590.4	SPLS 3_71.15 Ah All Cts	1686.0	920.6	2257.9	0.64		436.0	SPLS 3_0,9_71.15 Ah	1467.5	920.6	2122.8	0.47
216T	Eerste dwarsarr	120x120x10	S235	5M24-8.8t	1.00	2.00	1.00	104	-129.0	SPLS 3_0,9_71.15 Ba	269.2	677.8	648.0	0.48		161.7	SPLS 3_71.15 Ba Ct1	466.6	677.8	609.2	0.35
217	Eerste dwarsarr	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	114	-181.6	SPLS 3_0,9_71.15 Ba	261.1	406.7	388.8	0.70		182.5	SPLS 3_71.15 Ba Ct1	324.0	406.7	359.4	0.56
218	Eerste dwarsarr	50x50x7	S235	1M16-8.8t	0.50	0.50	0.50	200	-0.8	ULS 3_0	29.9	60.3	60.5	0.03		0.8	ULS 3_0	64.5	60.3	45.8	0.02
219L	Onderstuk in to	90x90x8	S235	2M16-8.8t	1.00	1.00	1.00	247	-9.2	SPLS 1a_0,9_90 Ah All	58.0	120.6	138.2	0.16		4.0	SPLS 1a_0,9_108.85 A	227.3	120.6	119.5	0.03
219T	Onderstuk in to	90x90x8	S235	4M16-8.8t	32.96	2.00	1.00	159	-12.6	ULS 1a_135	102.3	241.2	276.5	0.12		9.9	ULS 1a_0,9_45	285.6	241.2	238.9	0.04
220	Onderstuk in to	80x80x6#	S235	1M16-8.8t	1.00	0.50	0.50	245	-5.9	ULS 1a_71.15	26.4	60.3	51.8	0.22		5.0	ULS 1a_0,9_135	107.1	60.3	44.8	0.11
221	Onderstuk in to	80x80x8	S235	1M16-8.8t	0.50	0.50	0.50	279	-1.8	ULS 1a_0	34.1	60.3	69.1	0.05		0.2	ULS 1a_0,9_0,9_0	142.8	60.3	59.7	0.00
301	Diagonaal onde	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	140	-54.5	SPLS 3_0,9_71.15 Ah	111.3	188.2	172.8	0.49		60.1	SPLS 3_71.15 Ah All Cts	149.6	188.2	139.6	0.43
302	Diagonaal onde	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	130	-67.3	SPLS 6a_90 Ah Ct2 Ba	120.9	188.2	172.8	0.56		63.9	SPLS 3_0,9_71.15 Ah	151.2	188.2	139.6	0.46
303	Diagonaal onde	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	120	-68.2	SPLS 3_71.15 Ah All Cts	131.9	188.2	172.8	0.52		69.2	SPLS 3_0,9_71.15 Ah	149.6	188.2	139.6	0.50
304	Diagonaal onde	90x90x8	S235	2M24-8.8t	0.55	0.55	0.55	93	-87.0	SPLS 3_71.15 Ah All Cts	186.3	271.1	207.4	0.47		88.5	SPLS 3_0,9_71.15 Ah	150.3	271.1	141.8	0.62
306	Diagonaal onde	80x80x6#	S235	2M24-8.8t	0.50	0.50	0.50	81	-36.0	SPLS 3_71.15 Ah All Cts	138.2	271.1	155.5	0.26		47.1	SPLS 3_0,9_71.15 Ah	96.6	271.1	121.8	0.49
307	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	112	-35.4	SPLS 6a_90 Ah All Cts	107.5	188.2	151.2	0.33		34.3	SPLS 3_0,9_71.15 Ah	90.5	188.2	79.7	0.43
308	Diagonaal onde	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	110	-34.0	SPLS 6a_90 Ah All Cts	80.5	120.6	103.7	0.42		33.2	SPLS 3_0,9_71.15 Ah	67.0	120.6	56.7	0.59
309	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	79	-46.3	SPLS 3_71.15 Ah All Cts	140.3	188.2	151.2	0.33		47.7	SPLS 3_0,9_71.15 Ah	90.5	188.2	82.6	0.58
310	Diagonaal onde	90x90x8	S235	2M20-8.8t	0.55	0.55	0.55	49	-61.6	SPLS 3_71.15 Ah Ct2	252.8	188.2	172.8	0.36		60.8	SPLS 3_0,9_71.15 Ah	139.9	188.2	116.9	0.52
311	Diagonaal onde	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	51	-39.2	SPLS 3_0,9_71.15 Ah	250.3	271.1	207.4	0.19		31.0	SPLS 3_0,9_71.15 Ah	136.2	271.1	104.6	0.30
313	Dwarsligger onc	HEA160	S235	2M20-8.8t	1.00	2.00	1.00	50	0.0		680.7	188.2	216.0	0.00		4.6	ULS 3_71.15	766.1	188.2	0.0	0.02
314	Dwarsligger onc	150x150x12	S355	2M24-8.8t	2.00	2.00	2.00	83	0.0		656.2	271.1	423.4	0.00		55.0	ULS 3_90	536.9	271.1	379.9	0.20
315	Dwarsligger onc	HEA160	S235	2M20-8.8t	1.00	2.00	1.00	33	-3.3	ULS 1a_0,9_90	745.6	188.2	216.0	0.02		4.2	ULS 5a Ba 11	766.1	188.2	0.0	0.02
316	Dwarsligger onc	150x150x12	S355	2M24-8.8t	2.00	1.00	1.00	24	0.0		1022.5	271.1	423.4	0.00		83.2	ULS 3_0,9_71.15	496.7	271.1	191.8	0.43

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 05-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+0 R_X
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Staafgroep	Omschrijving	Profiel	Staalsoort	Bouten	RLX	RLY	RLZ	Slankheid	Druk	Combinatie druk	Knik	Afschuiving	Stuik (druk)	U.C. (druk)	Opm.	Trek	Combinatie trek	Nettodsn.	Afschuif	Stuik (trek)	U.C. (trek)
317	Dwarsligger onc	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	26	-13.9	ULS 3_0,9_71.15	790.1	188.2	216.0	0.07		0.0		766.1	188.2	0.0	0.00
318	Verticaal eerste	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	171	-19.4	ULS 3_0	98.0	271.1	207.4	0.20		0.0		159.7	271.1	183.4	0.00
319	Verticaal eerste	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	172	-4.4	SPLS 6a_90 Ba Ct1 Ah	38.8	60.3	51.8	0.11		0.0		48.4	60.3	21.2	0.00
320	Verticaal eerste	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	104	-1.1	ULS 3_71.15	47.2	60.3	43.2	0.03		0.0		46.1	60.3	32.7	0.00
321	Diagonaal eerst	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	345	0.0		30.1	188.2	172.8	0.00		31.2	ULS 3_71.15	162.8	188.2	157.1	0.20
322	Diagonaal eerst	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	269	0.0		50.9	271.1	207.4	0.00		43.5	SPLS 6a_90 Ba Ct2 Ah	136.2	271.1	161.3	0.32
323	Diagonaal eerst	70x70x7	S235	1M20-8.8t	1.00	1.00	1.00	307	0.0		22.4	94.1	75.6	0.00		14.7	SPLS 6a_90 Ba Ct1 Ah	84.7	94.1	65.2	0.23
324	Dwarsligger bo	70x70x7	S235	1M20-8.8t	2.00	1.00	1.00	110	-0.8	ULS 1a_0	103.5	94.1	75.6	0.01		0.7	ULS 1a_0,9_0,9_0	84.7	94.1	65.2	0.01
325	Tussen diagona	80x80x8	S235	1M20-8.8t	1.00	1.00	1.00	151	-2.2	ULS 1a_0	81.0	94.1	86.4	0.03		1.4	ULS 1a_0,9_0,9_0	133.6	94.1	78.5	0.02
401	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	125	-21.2	SPLS 1a_0 Ba Ct2	95.9	188.2	151.2	0.22		20.5	SPLS 1a_0 Ba All Cts	90.5	188.2	91.6	0.23
402	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	119	-23.8	SPLS 1a_0 Ba Ct1	101.4	188.2	151.2	0.23		27.8	SPLS 1a_0 Ba Ct2	90.5	188.2	100.8	0.31
403	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	97	-32.7	SPLS 3_0 Ba Ct1	122.0	188.2	151.2	0.27		33.2	SPLS 3_71.15 Ah Ct2	90.5	188.2	100.8	0.37
404	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	97	-48.6	SPLS 3_71.15 Ah All Cl	121.5	188.2	151.2	0.40		50.1	SPLS 3_71.15 Ah Ct1	90.5	188.2	117.6	0.55
405	Diagonaal onde	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	68	-57.9	SPLS 3_71.15 Ah Ct1	224.7	271.1	207.4	0.28		52.3	SPLS 3_0,9_71.15 Ah ,	136.2	271.1	141.8	0.38
406	Diagonaal onde	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	59	-61.5	SPLS 3_71.15 Ah Ct1	239.1	271.1	207.4	0.30		55.4	SPLS 3_71.15 Ah Ct1	139.3	271.1	124.1	0.45
407	Diagonaal onde	80x80x8	S235	2M24-8.8t	1.00	1.00	1.00	65	-36.5	SPLS 3_71.15 Ah Ct1	203.3	271.1	207.4	0.18		26.6	SPLS 3_0,9_71.15 Ah (	120.5	271.1	141.8	0.22
408	Diagonaal onde	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	202	-8.6	SPLS 3_0,9_90 Ah All (	21.5	60.3	43.2	0.40		20.5	SPLS 6a_90 Ah All Cts	46.1	60.3	32.7	0.63
410	Dwarsligger onc	150x150x12	S355	2M20-8.8t	1.00	2.00	1.00	32	0.0		971.1	188.2	352.8	0.00		74.6	ULS 3_0,9_90	496.7	271.1	199.0	0.37
411	0	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	99	-4.3	SPLS 1a_0,9_0 Ah Ct1	54.9	60.3	43.2	0.10		17.2	SPLS 1a_0 Ah Ct2	46.1	60.3	32.7	0.53
412	Bovenregel twe	90x90x8	S235	3M24-8.8t	2.00	2.00	2.00	349	0.0		33.6	406.7	311.0	0.00		172.5	SPLS 6a_90 Ba All Cts	185.9	406.7	270.2	0.93
413	Bovenregel twe	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	244	0.0		50.3	376.3	345.6	0.00		158.6	ULS 3_135	168.3	376.3	310.2	0.94
414	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	160	-25.5	SPLS 6a_90 Ah All Cts	42.5	60.3	51.8	0.60		26.0	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.92
415	Diagonaal bove	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	334	-2.6	SPLS 1a_71.15 Ah All (	14.3	60.3	51.8	0.18		0.0		48.4	60.3	33.7	0.00
416	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	126	-25.9	SPLS 6a_90 Ah All Cts	56.3	60.3	51.8	0.50		22.5	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.80
417	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	118	-9.3	SPLS 6a_90 Ah Ct2 Ba	59.8	60.3	51.8	0.18		8.9	SPLS 6a_90 Ah Ct2 Ba	72.6	60.3	28.2	0.32
418	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	111	-13.4	SPLS 6a_90 Ah All Cts	63.5	60.3	51.8	0.26		14.0	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.50
419	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	105	-15.9	SPLS 6a_90 Ah All Cts	66.8	60.3	51.8	0.31		14.9	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.53
420	Diagonaal bove	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	97	-17.9	SPLS 6a_90 Ah All Cts	89.1	120.6	103.7	0.20		19.2	SPLS 6a_90 Ah All Cts	78.2	120.6	56.3	0.34
421	Diagonaal bove	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	92	-25.2	SPLS 6a_90 Ah All Cts	92.9	120.6	103.7	0.27		22.8	SPLS 6a_90 Ah All Cts	78.2	120.6	56.3	0.41
422	Diagonaal bove	60x60x6	S235	2M16-8.8t	0.57	0.57	0.57	101	-33.6	SPLS 6a_90 Ah Ct1 Ba	86.3	120.6	103.7	0.39		37.6	SPLS 6a_90 Ah All Cts	78.2	120.6	76.8	0.49
423	Verticaal tweed	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	101	-0.8	ULS 1a_0,9_0,9_0	48.1	60.3	43.2	0.02		9.3	SPLS 1a_0 Ah Ct2	46.1	60.3	32.7	0.28
424	Verticaal tweed	50x50x5	S235	1M16-8.8t	0.51	0.51	0.51	155	-24.4	SPLS 6a_90 Ah All Cts	30.8	60.3	43.2	0.79		24.3	SPLS 6a_90 Ah All Cts	46.1	60.3	32.7	0.74
426	Diagonaal twee	70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	219	-16.1	SPLS 1a_0 Ah Ct2	41.5	60.3	82.3	0.39		0.0		87.8	60.3	48.1	0.00
427	Diagonaal twee	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	244	0.0		16.4	60.3	43.2	0.00		1.1	ULS 1a_108.85	46.1	60.3	20.5	0.05
429	Dwarsligger bo	UNP160	S235	3M20-8.8t	1.00	1.00	1.00	47	0.0		409.5	282.2	243.0	0.00		34.9	ULS 3_0,9_90	306.9	282.2	187.2	0.19
430	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	227	-1.4	ULS 1a_0,9_0,9_135	18.2	60.3	43.2	0.08		1.9	ULS 1a_0,9_0	46.1	60.3	32.7	0.06
431	0	70x70x7	S235	2M20-8.8t	1.00	1.00	1.00	106	-31.5	SPLS 1a_0 Ba Ct2	113.1	188.2	151.2	0.28		25.7	SPLS 1a_0 Ba Ct2	90.5	188.2	100.8	0.28
432	0	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	107	-28.4	SPLS 3_90 Ah Ct2	111.7	188.2	151.2	0.25		26.1	SPLS 1a_0 Ba Ct1	90.5	188.2	100.8	0.29
433	0	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	62	-63.8	SPLS 3_71.15 Ah All Cl	234.4	271.1	207.4	0.31		69.2	SPLS 3_71.15 Ah Ct1	155.0	271.1	141.8	0.49
434	0	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	141	-27.0	SPLS 6a_90 Ah All Cts	49.5	60.3	51.8	0.55		26.3	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.93
435	0	60x60x6	S355	1M16-8.8t	0.55	0.55	0.55	133	-31.2	SPLS 6a_90 Ah All Cts	62.2	60.3	70.6	0.52		32.0	SPLS 6a_90 Ah All Cts	98.8	60.3	38.3	0.84
436	0	70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	216	-27.4	SPLS 1a_0 Ah Ct2	42.4	60.3	82.3	0.65		5.5	SPLS 1a_0,9_0 Ah Ct1	87.8	60.3	62.3	0.09
437	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	141	-2.6	SPLS 1a_0,9_0 Ah All (	34.4	60.3	43.2	0.08		2.4	SPLS 1a_0,9_135 Ba A	46.1	60.3	32.7	0.07
438	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	217	-6.6	SPLS 1a_0,9_135 Ba A	19.5	60.3	43.2	0.34		7.7	SPLS 1a_0,9_0 Ah All (	46.1	60.3	32.7	0.24
439	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	125	-2.5	SPLS 1a_0,9_0 Ah All (	39.5	60.3	43.2	0.06		2.1	SPLS 1a_0,9_135 Ba A	46.1	60.3	32.7	0.06
440	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	108	0.0	ULS 5a Ah 22	45.3	60.3	43.2	0.00		0.0	ULS 3_0,9_135	46.1	60.3	32.7	0.00
330	0	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	111	-76.5	SPLS 3_0,9_71.15 Ah ,	141.9	188.2	172.8	0.54		73.9	SPLS 3_71.15 Ah All Cl	149.6	188.2	139.6	0.53
331	0	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	100	-40.0	SPLS 3_71.15 Ah All Cl	87.4	120.6	103.7	0.46		39.9	SPLS 3_71.15 Ah All Cl	67.0	120.6	56.7	0.70
332	0	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	73	-54.5	SPLS 3_0,9_71.15 Ah ,	147.1	188.2	151.2	0.37		51.5	SPLS 3_71.15 Ah All Cl	90.5	188.2	82.6	0.62
250L	0	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	235	-7.1	SPLS 3_0,9_71.15 Ah ,	24.9	60.3	51.8	0.29		4.5	SPLS 1a_0,9_90 Ah All	48.4	60.3	33.7	0.13
250T	0	60x60x6	S235	1M16-8.8t	1.09	1.00	1.00	216	-4.9	SPLS 3_0,9_90 Ah All (	28.2	60.3	51.8	0.17		3.0	ULS 1a_0,9_135	48.4	60.3	33.7	0.09
251	0	90x90x8	S235	1M16-8.8t	1.00	1.00	1.00	212	-4.3	SPLS 1a_71.15 Ba Ct1	58.3	60.3	69.1	0.07		3.3	SPLS 1a_0,9_71.15 Ba	165.9	60.3	59.7	0.06
252	0	60x60x6	S235	1M16-8.8t	0.50	0.50	0.50	235	-1.0	ULS 1a_0	24.9	60.3	51.8	0.04		0.2	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.01
450	0	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	246	-0.1	SPLS 1a_0,9_45 Ah All	16.2	60.3	43.2	0.00		0.1	SPLS 1a_0,9_0 Ba All (	46.1	60.3	32.7	0.00
490D	490D	150x150x14	S355		1.00	6.20	1.00	87	-11.1	ULS 1a_0	808.6	0.0	0.0	0.01		8.2	8.225	ULS 1a_0,9_(	1425.0	0.0	0.01
442	442	HEA160	S355	2M20-5.6t	2.00	2.00	2.00	5	-4.5	ULS 1a_0	1198.4	117.6	294.0	0.04		3.7	3.739	SPLS 6a_90 A	1042.7	0.0	0.03
443	443	60x60x6	S355	1M16-8.8t	2.00	1.00	1.00	146	-0.9	ULS 1a_0	59.3	60.3	70.6	0.02		12.2	12.191	ULS 1a_45	98.8	61.0	0.20
469	469	50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	98	-4.3	ULS 1a_0	61.6	60.3	58.8	0.07		3.4	3.385	ULS 1a_0,9_(	51.0	35.0	0.10
470	470	50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	91	-5.5	ULS 1a_0,9_0	66.1	60.3	58.8	0.09		3.7	3.73	ULS 1a_0,9_(	51.0	35.0	0.11
471	471	50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	86	-6.1	ULS 1a_0	69.9	60.3	58.8	0.10		4.7	4.657	ULS 1a_0,9_(	51.0	35.0	0.13
472	472	50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	82	-4.0	SPLS 1a_0 Ah All Cts	73.1	60.3	58.8	0.07		1.3	1.332	SPLS 1a_45 A	51.0	35.0	0.04
473	473	60x60x6	S355	1M16-8.8t	1.00	1.00	1.00	171	-0.2	ULS 1a_0,9_0,9_135	44.2	60.3	70.6	0.00		0.2	0.194	ULS 1a_0,9_(	61.2	42.0	0.00
474	474	50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	172	-2.2	ULS 1a_0	30.6	60.3	58.8	0.07		1.8	1.832	ULS 1a_135	51.0	35.0	0.05

DNV·GL

Assessment of groups for strengthened mast (verbouw level)

Date 05-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+0 R_X
35

Staafgroep	Omschrijving	Profiel	Staalsoort	Bouten	RLX	RLY	RLZ	Slankheid	Druk	Combinatie druk	Knik	Afschuiving	Stuik (druk)	U.C. (druk)	Opm.	Trek	Combinatie trek	Nettodsn.	Afschuif	Stuik (trek)	U.C. (trek)
426	Diagonaal twee	70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	219	-17.9	ULS 1a_0	41.5	60.3	82.3	0.43		1.1	ULS 1a_0,9_0,9_0	87.8	60.3	48.1	0.02
435		60x60x6	S355	1M16-8.8t	0.55	0.55	0.55	133	-32.5	SPLS 6a_90 Ah All Cts	62.2	60.3	70.6	0.54		33.4	SPLS 6a_90 Ah All Cts	98.8	60.3	38.3	0.87
436		70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	216	-29.4	SPLS 1a_0 Ah Ct2	42.4	60.3	82.3	0.69		5.9	SPLS 1a_0,9_0 Ah Ct1	87.8	60.3	62.3	0.10
490D	Onderregel twe	150x150x14	S355		1.00	6.20	1.00	87	-13.7	ULS 1a_0	808.6	0.0	0.0	0.02		10.6	ULS 1a_0,9_0,9_0	1425.0	0.0	0.0	0.01
442	Dwarsligger on	HEA160	S355	2M20-5.6t	2.00	2.00	2.00	5	-5.4	ULS 1a_0	1198.4	117.6	294.0	0.05		4.0	SPLS 6a_90 Ba All Cts	1042.7	117.6	0.0	0.03
443		60x60x6	S355	1M16-8.8t	2.00	1.00	1.00	146	-1.1	ULS 1a_0	59.3	60.3	70.6	0.02		14.3	ULS 1a_45	98.8	60.3	61.0	0.24
469		50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	98	-5.3	ULS 1a_0	61.6	60.3	58.8	0.09		4.3	ULS 1a_0,9_0,9_0	51.0	60.3	35.0	0.12
470		50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	91	-6.9	ULS 1a_0,9_0	66.1	60.3	58.8	0.12		4.9	ULS 1a_0,9_0,9_0	51.0	60.3	35.0	0.14
471		50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	86	-7.6	ULS 1a_0	69.9	60.3	58.8	0.13		6.1	ULS 1a_0,9_0	51.0	60.3	35.0	0.17
472		50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	82	-4.6	ULS 1a_0	73.1	60.3	58.8	0.08		1.4	SPLS 1a_45 Ah All Cts	51.0	60.3	35.0	0.04
473		60x60x6	S355	1M16-8.8t	1.00	1.00	1.00	171	-0.2	ULS 1a_0,9_0,9_135	44.2	60.3	70.6	0.01		0.2	ULS 1a_0,9_0,9_71.15	61.2	60.3	42.0	0.01
474		50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	172	-2.8	ULS 1a_0	30.6	60.3	58.8	0.09		2.3	ULS 1a_135	51.0	60.3	35.0	0.07

APPENDIX C
Toetsing knikverkorters

DNV·GL

Knikverkorters initial construction (afkeur)

Date: 2021-12-10
Author: K H Chan
Version: 1.8

ENS - ZL
HB+0_R_X
Mast: 35

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Net Section Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Notes
2038	Broekstuk	Enkele staaf	L50.5	S235	M16	8.8	0.543	0	56	28.4	0.14	62.7	60.3	30.3	31.7	0.72	0.93		
2037	Broekstuk	Enkele staaf	L50.5	S235	M16	8.8	1.61	71	165	28.4	0.00	28.3	60.3	30.3	31.7	0.72	1.00	Buckling	
2036	Broekstuk	Enkele staaf	L50.5	S235	M16	8.8	1.27	0	130	28.4	0.32	37.6	60.3	30.3	31.7	0.72	0.93		
2035	Broekstuk	Enkele staaf	L60.6	S235	M16	8.8	1.89	53	161	28.4	0.00	42.0	60.3	38.4	72.6	1.24	0.74		
2034	Broekstuk	Enkele staaf	L60.6	S235	M16	8.8	1.99	0	171	28.4	0.50	39.1	60.3	38.4	72.6	1.24	0.74		
2033	Broekstuk	Enkele staaf	L70.7	S235	M16	8.8	2.37	40	174	28.4	0.00	52.0	60.3	44.8	104.8	1.98	0.63		
2032	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.72	0	173	28.4	0.68	52.0	60.3	38.4	107.1	2.25	0.74		
2031	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.96	31	188	28.4	0.00	46.5	60.3	38.4	107.1	2.25	0.74		
2030	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	3.44	0	219	28.4	0.86	37.4	60.3	38.4	107.1	2.25	0.76		
2029	Broekstuk	Enkele staaf	L80.8	S235	M16	8.8	3.56	25	228	28.4	0.81	46.3	60.3	51.2	142.8	2.95	0.61		
2025	Broekstuk	Enkele staaf	L70.7	S235	M16	8.8	2.60	28	191	28.4	0.57	45.8	60.3	44.8	104.8	1.98	0.63		
2026	Broekstuk	Enkele staaf	L60.6	S235	M16	8.8	2.01	0	172	28.4	0.50	38.6	60.3	38.4	72.6	1.24	0.74		
2057	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	0.85	0	87	6.8	0.21	53.9	60.3	30.3	31.7	0.72	0.30		
2056	Pootverband	Kniksteun en verticale steur	L60.6	S235	M16	8.8	1.87	0	103	6.8	0.23	52.5	60.3	38.4	72.6	0.93	0.26		
2055	Pootverband	Kniksteun en verticale steur	L60.6	S235	M16	8.8	2.90	0	160	6.8	0.36	33.7	60.3	38.4	72.6	0.93	0.40		
2050	Pootverband	Kniksteun en verticale steur	L70.7	S235	M16	8.8	3.93	0	185	6.8	0.49	38.4	60.3	44.8	104.8	1.48	0.34		
2051	Pootverband	Kniksteun en verticale steur	L80.6	S235	M16	8.8	4.95	0	203	6.8	0.62	34.0	60.3	38.4	107.1	1.77	0.37		
2054	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	1.80	76	185	6.8	0.00	24.4	60.3	30.3	31.7	0.72	0.28		
2053	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	1.97	62	202	6.8	0.00	21.6	60.3	30.3	31.7	0.72	0.32		
2052	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.25	50	231	6.8	0.00	17.8	60.3	30.3	31.7	0.72	0.38		
2048	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.60	41	267	6.8	0.00	14.2	60.3	30.3	31.7	0.72	0.48		
2049	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.95	33	303	6.8	0.00	11.6	60.3	30.3	31.7	0.72	0.58		
2027	Tussenschot	Enkele staaf	L90.8	S235	M16	8.8	4.30	0	244	28.4	1.07	47.3	60.3	51.2	165.9	3.77	0.60		
2046	Tussenschot	Kniksteun en verticale steur	L80.6	S235	M16	8.8	5.85	0	239	0.6	0.73	27.2	60.3	38.4	107.1	1.8	0.43		
2070	Tussenschot	Kruisende staaf halverwege	L80.8	S235	M16	8.8	8.51	0	351	0.6	1.06	20.4	60.3	51.2	142.8	2.95	0.36		
2253	Eerste TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.71	0	175	25.4	0.43	26.2	60.3	30.3	31.7	0.72	0.97		
2254	Eerste TSNSTK	Enkele staaf	L60.6	S235	M16	8.8	2.37	50	203	25.4	0.00	30.9	60.3	38.4	72.6	1.24	0.82		
2251	Eerste TSNSTK	Enkele staaf	L80.6	S235	M16	8.8	3.50	0	223	25.4	0.88	36.5	60.3	38.4	107.1	2.25	0.69		
2252	Eerste TSNSTK	Enkele staaf	L60.6	S235	M16	8.8	2.31	35	197	25.4	0.00	32.1	60.3	38.4	72.6	1.24	0.79		
2253	Eerste TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.71	0	175	25.4	0.43	26.2	60.3	30.3	31.7	0.72	0.97		
2247	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.33	0	137	20.7	0.33	35.7	60.3	30.3	31.7	0.7	0.68		
2250	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.92	53	197	20.7	0.00	22.3	60.3	30.3	31.7	0.7	0.93		
2248	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.83	42	188	20.7	0.00	23.9	60.3	30.3	31.7	0.72	0.86		
2247	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.33	0	137	20.7	0.33	35.7	60.3	30.3	31.7	0.72	0.68		
2246	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.02	0	105	20.7	0.26	46.6	60.3	30.3	31.7	0.7	0.68		
2245	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.52	54	156	20.7	0.00	30.4	60.3	30.3	31.7	0.7	0.68		
2242	Tweede TSNSTK	Enkele staaf	L60.6	S235	M16	8.8	2.15	0	184	20.7	0.54	35.5	60.3	38.4	72.6	1.2	0.58		
2244	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.44	35	148	20.7	0.00	32.6	60.3	30.3	31.7	0.7	0.68		
2243	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.05	0	108	20.7	0.26	45.6	60.3	30.3	31.7	0.72	0.68		
2249	Tussenschot	Enkele staaf	L60.6	S235	M16	8.8	2.51	0	215	20.7	0.63	28.4	60.3	38.4	72.6	1.24	0.73		
2255	Tussenschot	Enkele staaf	L90.8	S235	M16	8.8	3.70	0	210	0.3	0.93	59.0	60.3	51.2	165.9	3.8	0.25		

DNV·GL

Knikverkorters initial construction (afkeur)

Date: 2021-12-10
Author: K H Chan
Version: 1.8

ENS - ZL
HB+0_R_X
Mast: 35

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Net Section Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Notes
2256	Tussenschot	Kruisende staaf halverwege	L60.6	S235	M16	8.8	5.54	0	305	0.3	0.69	14.2	60.3	38.4	72.6	1.2	0.56		
2575	Bovenstuk 1	Enkele staaf	L50.5	S235	M16	8.8	1.86	0	191	10.7	0.47	23.3	60.3	30.3	31.7	0.7	0.65		
2572	Bovenstuk 1	Enkele staaf	L50.5	S235	M16	8.8	1.71	0	176	10.7	0.43	26.1	60.3	30.3	31.7	0.7	0.60		
2571	Bovenstuk 2	Enkele staaf	L50.5	S235	M16	8.8	1.60	0	164	5.6	0.40	28.6	60.3	30.3	31.7	0.7	0.56		
2570	Bovenstuk 2	Enkele staaf	L50.5	S235	M16	8.8	1.41	0	145	5.6	0.35	33.4	60.3	30.3	31.7	0.7	0.49		
5000	Boventraverse	Kniksteun op 0,5L	L60.6	S355	M16	8.8	4.00	0	220	1.5	1.00	25.5	60.3	52.3	98.8	1.9	0.53		

DNV·GL

Knikverkorters adjusted construction (verbouw)

Date: 2021-12-10
Author: K H Chan
Version: 1.8

ENS - ZL

HB+0_R_X
Mast: 35

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness (-)	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Block Tearing Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Mitigation
2037	Broekstuk	Enkele staaf	L50.5	S355	M16	8.8	1.61	71	165	28.4	0.00	32.3	60.3	43.6	51.0	1.08	0.88		Profile exchanged

APPENDIX D
Toetsing blokdeuvels

CALCULATION OF POST INSULATOR LOADS

The following parameters are calculated:

- The forces on the insulator attachment due to wind loading and weight
- The required measurements of the components

The diagram below is a representation of the loads on the insulator:

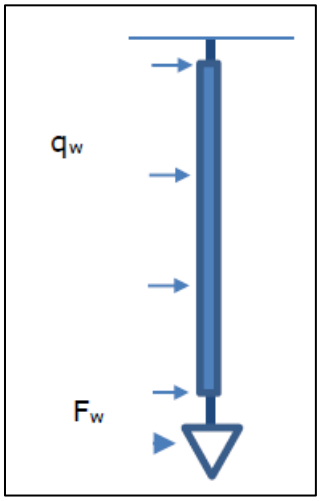


Figure 1: Diagrammatic representation of the loads on the post insulator

Forces on the insulator attachment

Wind pressure based on non-urban terrain in wind zone III at a height of 39,5 m: q_h = 1,07 kN/m^2

Wind load per meter based on an insulator diameter of 0,2 m and a drag factor of 1,2:

q_w = 1,2 x 0,2 x 1,07 = 0,26 kN/m

F_w = 2 x 4 m x 0,26 kN/m = 2,1 kN

Conductor with C_c = 0,9:

F_w based on a supported length of 9 m and a structural factor of 1:

F_w = 9 x 1 x 0,9 x 3 x 0,036 x 1,07 = 0,94 kN

Invoer geleiderbelastingen:

Wind area = 2 x 4 m x 0,2 m = 1,6 m^2

Conductor wind area: 9 m x 3 x 0,036 = 1,0 m^2

Total wind area for geleiderbelasting sheet: 2,6 m^2

Calculation of vertical weight

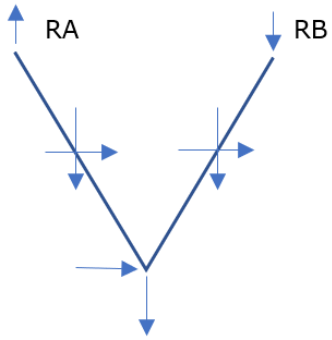
$F_{insulator}$ = 2 x 2,0 kN = 4 kN

$F_{conductor}$ = 9 m x 3 x 0,024 = 0,7 kN

Reaction Force

$\Sigma M_B=0$: -RA x 5 + 4 x 2,5 + 0,7 x 2,5 + 2,1 x 2 + 0,94 x 4 = 0

RA = 19,71 / 5 = 3,9 kN



Relatively small forces, pin connections based short circuit requirement suffices.

Check for bending of beams HEA160

M = 0,6 x 3,9 = 2,34 kNm

M_{Rd} = 51,7 kNm

U.C = 2,34 / 51,7 = 0,1 < 1,0 OK.

Project: ENS-ZL380
Mast: HB+0 R_X (35)

Shear blocks

NEN-EN 1993-1-1 en NEN-EN 1994-1-1

Datum: 2021-11-05
Auteur: TBR
Versie: 1.4

Load				**Results**			
Compression	$F_{Ed,c}$	1738	kN	Compression	U.C.	0.72	< 1,00 OK
Tension	$F_{Ed,t}$	1438	kN	Tension	U.C.	0.64	< 1,00 OK

Main leg

Profile		L250.18	
Steel material		S355	
Cross section		8719	mm^2
Axial capacity	N_{pl}	3095	kN
Width	b	250	mm
Thickness	t	18	mm
Length in concrete		1800	mm

Shear blocks main leg

Width	b	50	mm
Thickness	h	30	mm
Length	L	260	mm
Welds	a	5	mm
c.t.c. separation	s	250	mm
Number for compr.	n_c	12	-
Number for tension	n_t	12	-

Foot plate

Thickness	t	25	mm
Ext. length	m	30	mm
Welds	a	5	mm

Pile

Name		Buispaal	
Diameter		914	mm
Thickness		10	mm
Cross section		28400	mm^2
Steel material		S235	
Capacity		6674	kN
Concrete strength		C20/25	

Shear blocks pile

Width	b	50	mm
Thickness	h	30	mm
Length	L	1300	mm
Welds	a	5	mm
c.t.c. separation	s	450	mm
Number for compr.	n_c	5	-
Number for tension	n_t	5	-

Design value concrete strength

Material factor	γ_c	1.5	
Add. mat. factor	γ_m	1.25	-
f_{cd} =		10.7	N/mm^2

Steel tower stub

Yield strength	f_{yd} =	355	N/mm^2
Tensile strength	f_{ud} =	490	N/mm^2

Capacity shear blocks main leg

A_{f1} =	7800	mm^2
A_{f2} =	23800	mm^2
Slope	1: 5	
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.75	
$f_{jd} = C_A \times f_{cd}$ =	18.6	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	1744	kN
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	1744	kN

Capacity foot plate

k_d =	1.73	-
$f_{jd} = C_A \times f_{cd}$ =	18.5	N/mm^2
$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	63	mm
m* = min(c,m) =	30	mm
Type foot plate	Diagonally cut	
Effective for	Compr. and tension	
$A_{p,c}$ =	36487	mm^2
$F_{Rd,c} = A_{p,druk} \times f_{jd}$ =	674	kN
$A_{p,t}$ =	27768	mm^2
$F_{Rd,t} = A_{p,t} \times f_{jd}$ =	513	kN

Capacities

$F_{rd,c,plate}$ =	674	kN
$F_{rd,blocks,c}$ =	1744	kN
$F_{rd,c} = F_{rd,blck} + F_{rd,footplate}$ =	2418	kN
U.C. compression	0.72	< 1,00 OK
Welds foot plate (see next page)	1212	kN
$F_{rd,t}$ = min. (welds / foot plate) =	513	kN
$F_{rd,blocks,t}$ =	1744	kN
$F_{rd,t} = F_{rd,blck} + F_{rd,footplate}$ =	2257	kN
U.C. tension	0.64	< 1,00 OK
U.C. welds	0.35	< 1,00 OK

Capacity shear blocks pile

A_{f1} =	39000	mm^2
A_{f2} =	117000	mm^2
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.73	-
$f_{jd} = k_d \times f_{cd}$ =	18.5	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	3603	kN
U.C. compression	0.48	< 1,00 OK
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	3603	kN
U.C. tension	0.40	< 1,00 OK
U.C. welds	0.34	< 1,00 OK

"Splitting" of pile

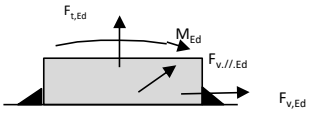
Spread of forces		45	°
Length force flow		1353	mm
Splitting force		531	kN/m
Yield strength wall	f_{yd} =	235	N/mm^2
Capacity tubular pile		4700	kN/m
U.C.		0.11	< 1,00 OK

Project: ENS-ZL380
Mast: HB+0 R_X (35)

Welds of shear blocks of main leg

Out-of-plane loading

Plate			***Welds***		
t =	50	mm	a =	5	mm
Grade	S355		l =	250	mm
f_{yd} =	355	N/mm²	β_w =	0.9	-
f_u =	490	N/mm²	γ_{M2} =	1.25	-



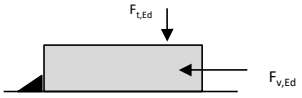
Member forces			***Stress components***		
Factor	1.2		$\sigma_1 = \tau_1 = F_{t,Ed}\sqrt{2} / 4al$ =	0	N/mm²
$F_{t,Ed}$ =	0	kN	$\sigma_1 = \tau_1 = F_{v,Ed}\sqrt{2} / 4al$ =	49	N/mm²
$F_{v,Ed} = F_{rd,c} / n$ =	174	kN		49	N/mm²
$F_{v//,Ed}$ =	0	kN	b* = b + 2/3aV2	54.7	mm
M_{Ed} = 1/2 b / h x $F_{v,Ed}$ =	2.62	kNm	$\sigma_1 = \tau_1 = 0{,}706M_{Ed} / al\ b^*$ =	27	N/mm²
			$\tau_{//} = F_{v//,Ed} / 2al$ =	0	N/mm²
			$\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	153	N/mm²

Check							
$\sigma_{vw,Ed}$ =	153	N/mm²	≤	$f_u / \beta_w\gamma_{M2}$ = 436 N/mm²	U.C. =	0.35	OK
σ_1 =	76	N/mm²	≤	$0{,}9f_u / \gamma_{M2}$ = 353 N/mm²	U.C. =	0.22	OK

Welds of shear blocks of pile

Out-of-plane loading

Plate			***Welds***		
t =	50	mm	a =	5	mm
Grade	S235		l =	1300	mm
f_{yd} =	235	N/mm²	β_w =	0.8	-
f_u =	360	N/mm²	γ_{M2} =	1.25	-



Member forces			***Stress components***		
Factor	1.2		$\sigma_1 = \tau_1 = F_{t,Ed}\sqrt{2} / 2al$ =	14	N/mm²
$F_{t,Ed}$ = 1/2 b / h x $F_{v,Ed}$ =	259	kN	$\sigma_1 = \tau_1 = F_{v,Ed}\sqrt{2} / 2al$ =	47	N/mm²
$F_{v,Ed}$ =	865	kN		61	N/mm²
$F_{v//,Ed}$ =	0	kN			
M_{Ed} =	0.00	kNm			
			$\tau_{//} = F_{v//,Ed} / 2al$ =	0	N/mm²
			$\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	122	N/mm²

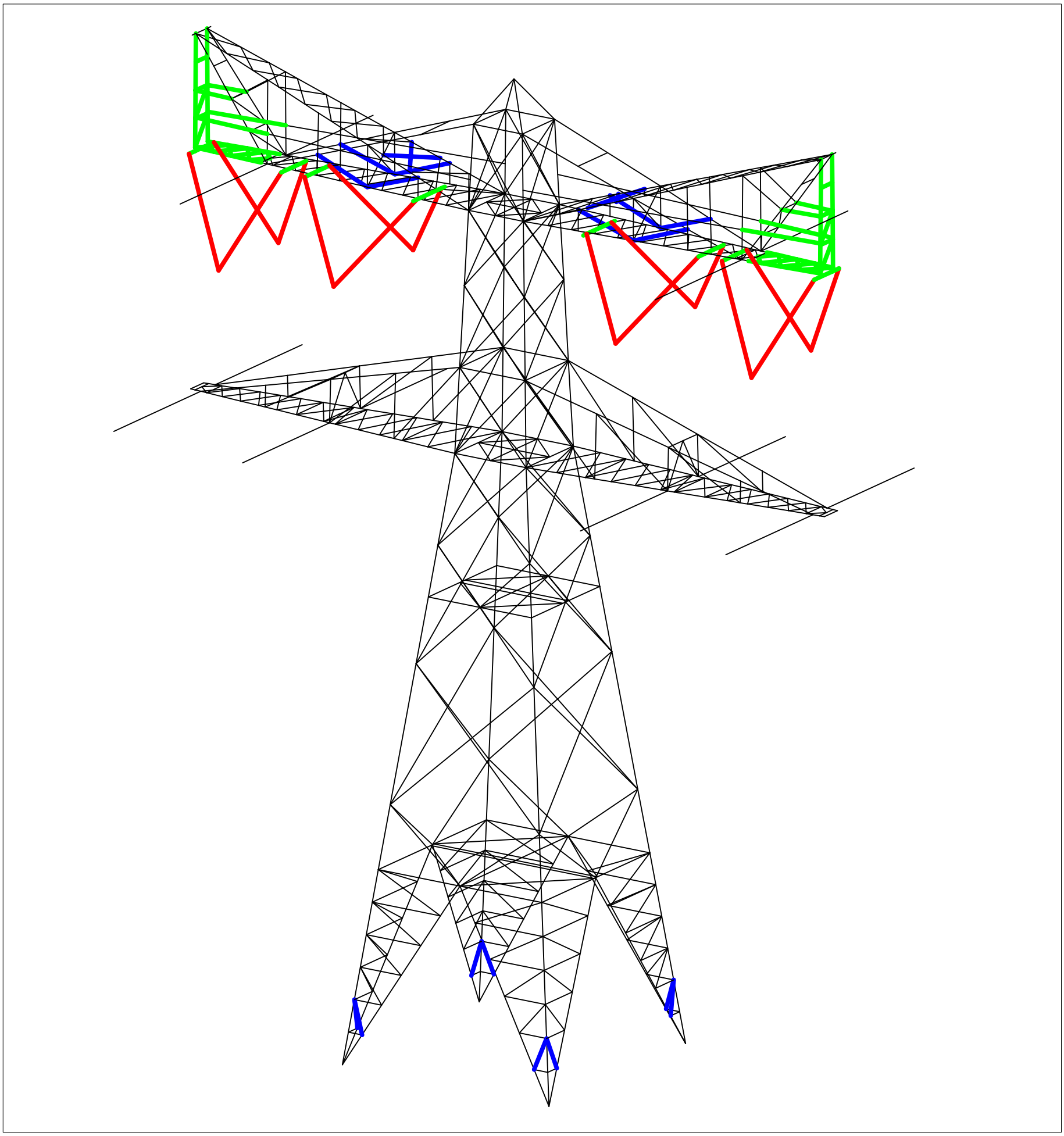
Check							
$\sigma_{vw,Ed}$ =	122	N/mm²	≤	$f_u / \beta_w\gamma_{M2}$ = 360 N/mm²	U.C. =	0.34	OK
σ_1 =	61	N/mm²	≤	$0{,}9f_u / \gamma_{M2}$ = 259 N/mm²	U.C. =	0.24	OK

Welds of foot plate

$f_u / \beta_w\gamma_{M2}$ =		436	N/mm²
Weld size	a =	5	mm
Length	l = 2b+ 2b - t =	964	mm
Capacity	F_{Rd} = a x l x $f_{w,d}$ / √3 =	1212	kN

APPENDIX E
Tekeningen

Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
Pos 2037	EA	L50x5	S235 t=<40	M16-8.8t-NEN2012	EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
426	EA	L50x5	S235 t=<40	M16-8.8t-NEN2012	EA	L70x7	S355 t=<40	M16-8.8t-NEN2012
435	EA	L60x6	S235 t=<40	M16-8.8t-NEN2012	EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
436	EA	L50x5	S235 t=<40	M16-8.8t-NEN2012	EA	L70x7	S355 t=<40	M16-8.8t-NEN2012
490D					EA	L150x14	S355 t=<40	M16-8.8t-NEN2012
469					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
470					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
471					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
472					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
473					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
474					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
442					HEA	HEA160	S355 t=<40	M20-8.8t-NEN2012
443					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
5000					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012



Overview

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5 unless otherwise indicated**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

New profile/insulator
Profile exchanged
New redundant
Bolt exchanged

01	05-11-2021	Phase Transposition
02	10-12-2021	Phase Transposition

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-054

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	10-12-2021	Units:	m	
Checked by:	TBR	10-12-2021	Project no:	10166260	
Approved by:	JHu	10-12-2021	Company:	TenneT	

Description: Modifications overview for mast type HB+0_R_X (Mast 35) page 1 of 3

Revision: 02

Format: A2

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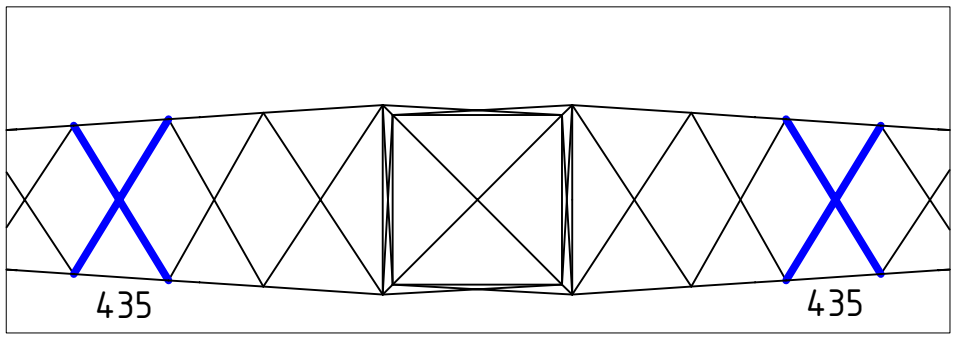
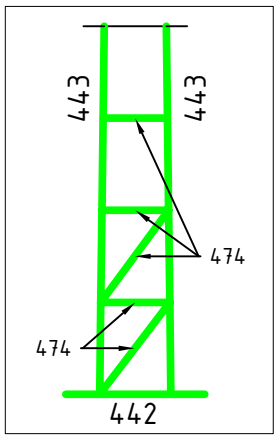
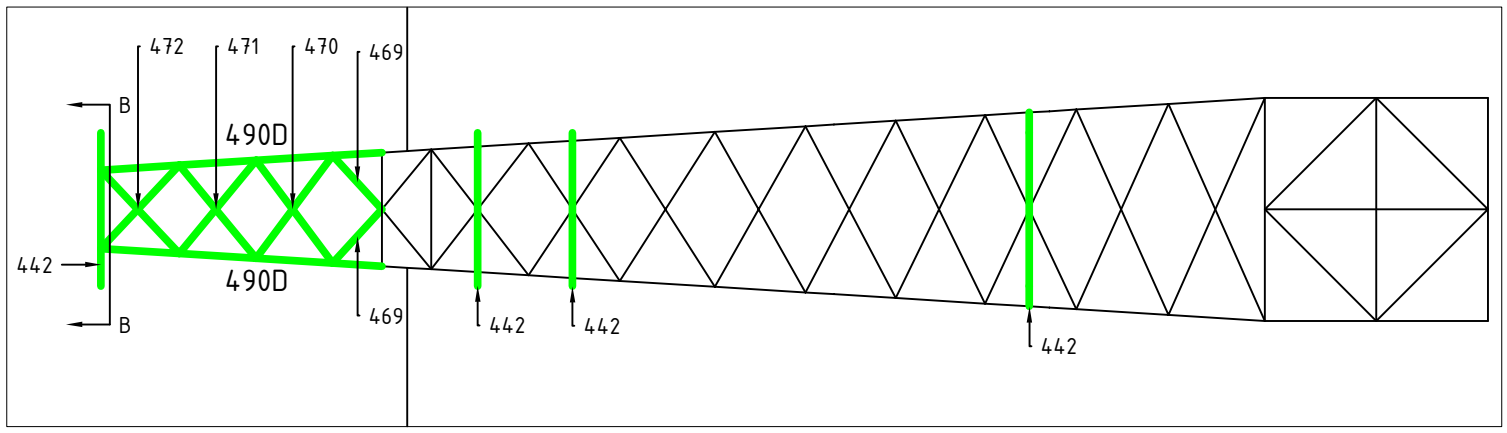


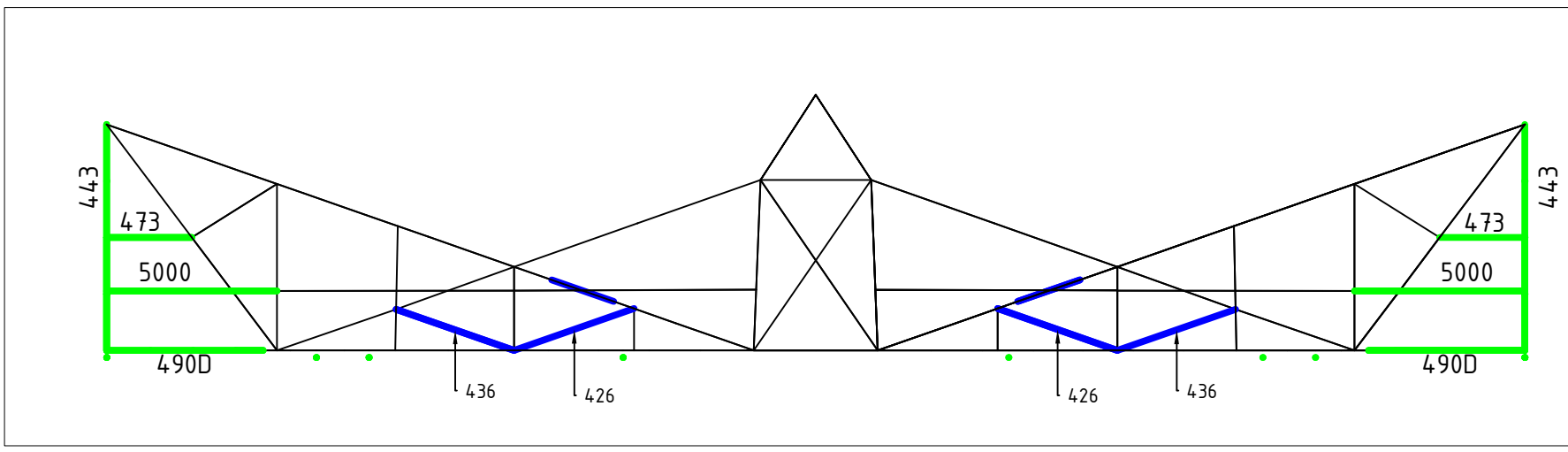
Top View - Upper Crossarm



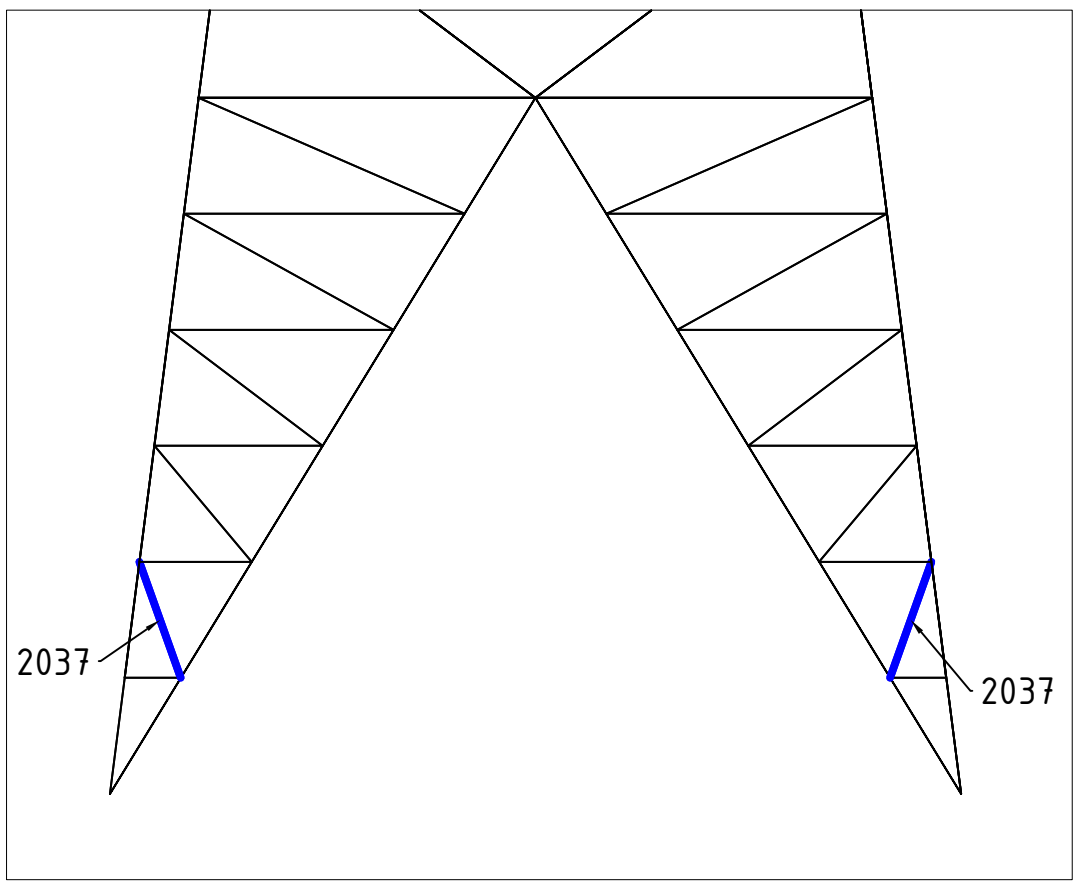
View on Section B



Top View - Lower Part of Upper Crossarm



Front View - Upper Crossarm



Front View - Lower Leg Section

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5 unless otherwise indicated**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Profile exchanged
New redundant
Bolt exchanged

01	05-11-2021	Phase Transposition
02	10-12-2021	Phase Transposition

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-054

Design state:	FINAL		Scale:	-
Drawn by:	KCh	10-12-2021	Units:	m
Checked by:	TBR	10-12-2021	Project no:	10166260
Approved by:	JHu	10-12-2021	Company:	TenneT

Description: Modifications overview for mast type HB+0_R_X (Mast 35) page 2 of 3

Revision: 02

Format: A2

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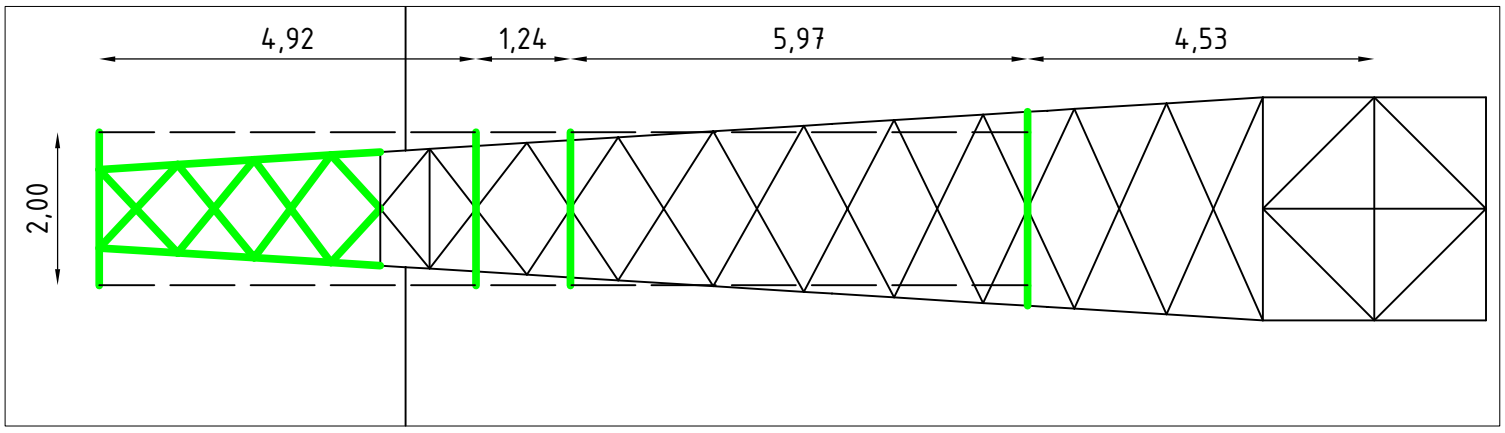
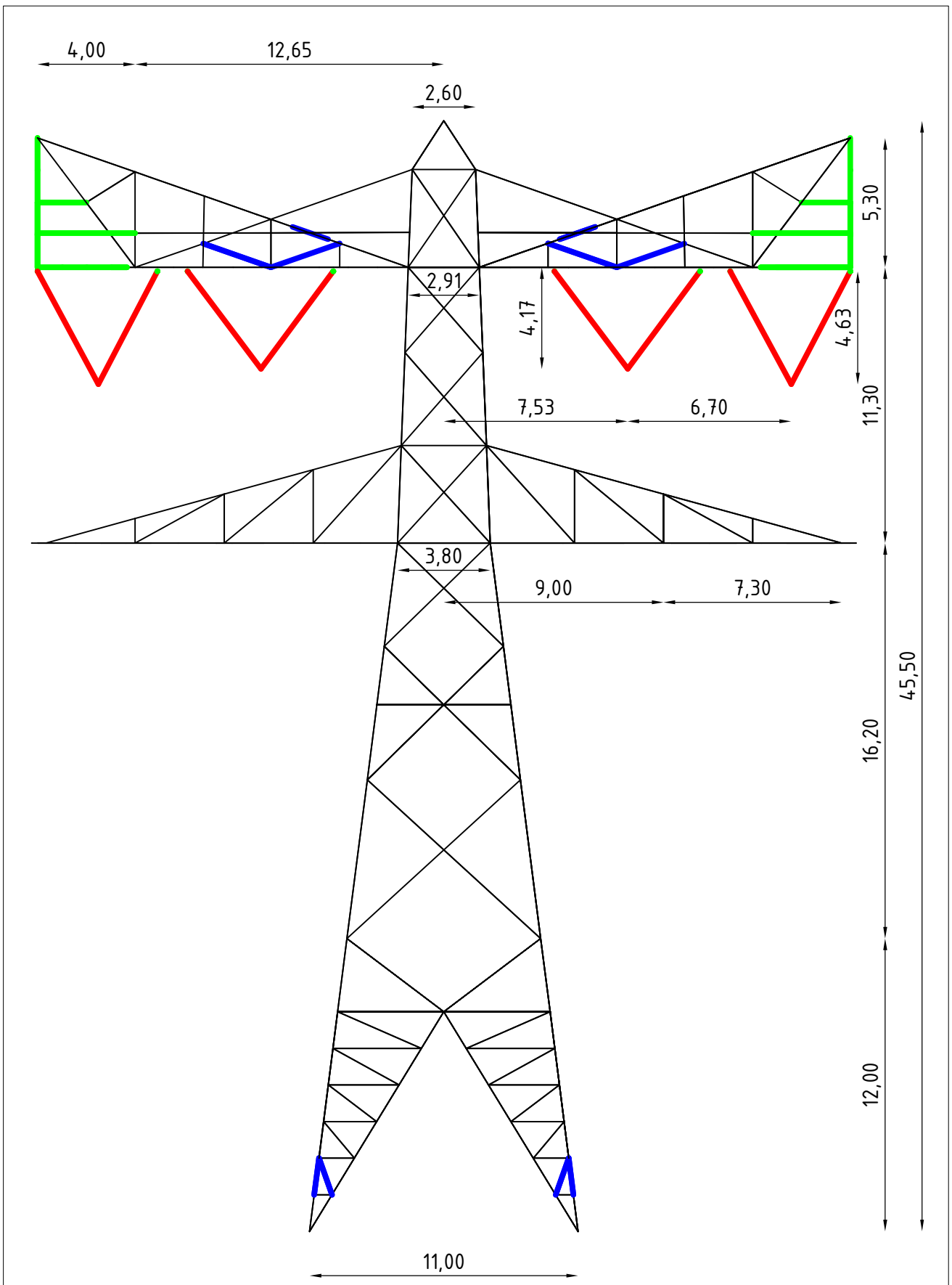
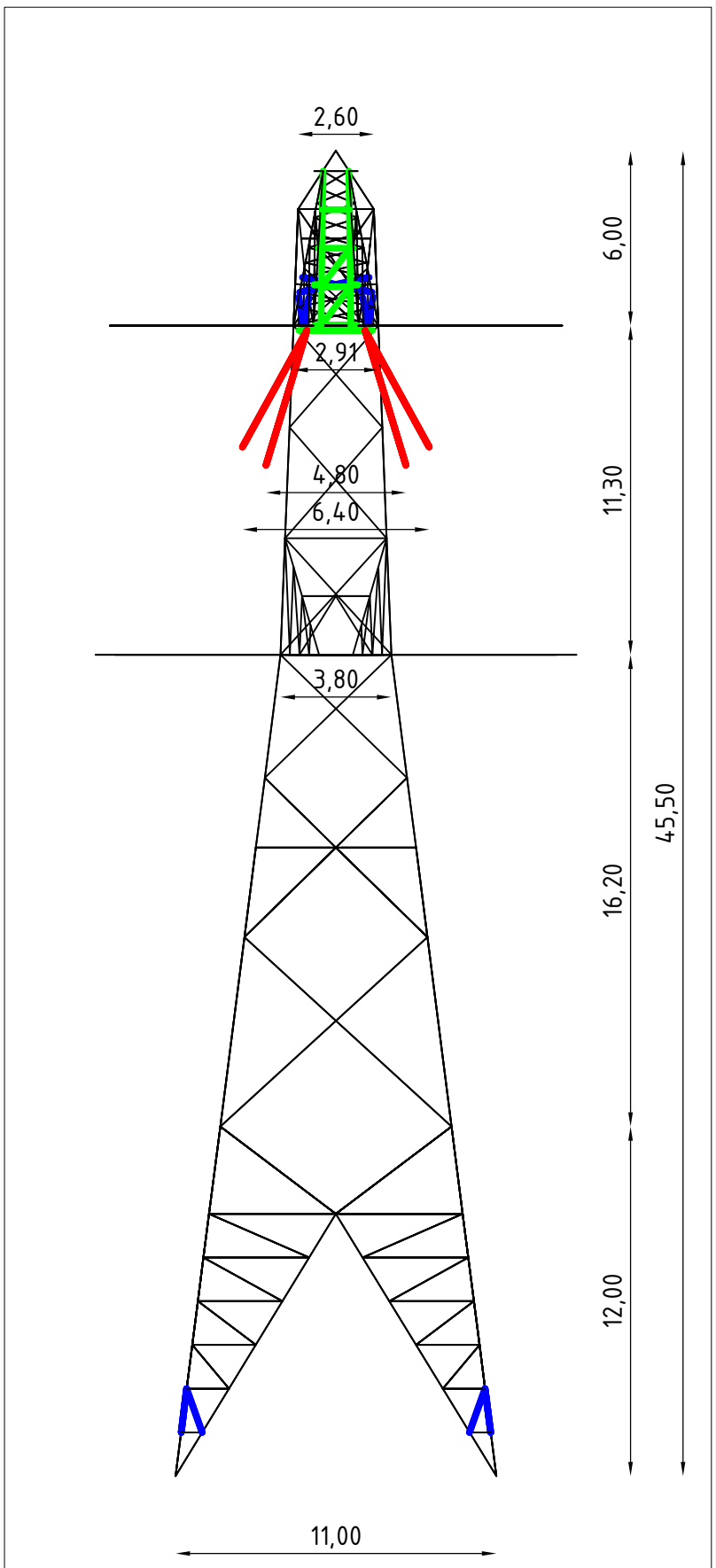


Top View - Lower Part of Upper Crossarm



Front View



Side View

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5 unless otherwise indicated**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Profile exchanged
New redundant
Bolt exchanged

01	05-11-2021	Phase Transposition
02	10-12-2021	Phase Transposition

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-054

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	10-12-2021	Units:	m	
Checked by:	TBR	10-12-2021	Project no:	10166260	
Approved by:	JHu	10-12-2021	Company:	TenneT	

Description: Modifications overview for mast type HB+0_R_X (Mast 35) page 3 of 3

Revision: 02

Format: A2

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TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380

ENS-ZL380 – Rapportage masttype HB+9/R_X

TenneT TSO B.V.

Rapport nr.: 22-0541, Rev. 0
Meridian doc.nr.: 002.515.40 - 1007990
Datum: 2022-04-01

Projectnaam:	Toetsing en herontwerp masten en fundaties BBB380	Energy Systems
Rapport titel:	ENS-ZL380 – Rapportage masttype HB+9/R_X	DNV Netherlands B.V.
Klant:	TenneT TSO B.V.,	Utrechtseweg 310-B50
Contactpersoon klant:	P. v.d. Horst	6812 AR Arnhem
Datum uitgave:	2022-04-01	
Project nr.:	10166260	
Organisatie unit:	TDT	Tel: 026 356 9111
Meridian doc.nr..:	002.515.40 - 1007990	Handelsregister Arnhem 09006404
Rapport nr.:	22-0541, Rev. 0	

Geschreven door:	Beoordeeld door:	Goedgekeurd door:
M.H. Khan	A.J. Börger	C. Schutte

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Rev.	Datum	Reden van uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2022-04-01	Eerste uitgave	M.H. Khan	A.J. Börger	C. Schutte

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Appendix C Toetsing knikverkorters
Appendix D Toetsing blokdeuvels
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1 INLEIDING

1.1 Inleiding

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen zodat er een grotere transportcapaciteit mogelijk wordt gemaakt.

Om die reden is de opdrachtgever (OG) voornemens de bestaande 380 kV-koppelnetring op te waarderen. Het opwaarderen van de bestaande verbindingen valt onder het programma “Beter benutten bestaande 380 kV-ring” en omvat de volgende deelprojecten:

- Opwaardering 380 kV-verbinding Lelystad – Ens (LLS-ENS380)
- Opwaardering 380 kV-verbinding Diemen – Lelystad (DIM-LLS380)
- Opwaardering 380 kV-verbinding Rilland – Zandvliet (RLL-ZVL380)
- Opwaardering 380 kV-verbinding Krimpen aan den IJssel - Geertruidenberg (KIJ-GT380)
- Opwaardering 380 kV-verbinding Ens - Zwolle (ENS-ZL380)
- Opwaardering 380 kV-verbinding Maasbracht - Eindhoven (MBT-EHV380).

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV opdracht verstrekt voor de volgende onderdelen:

1. In eerste fase het opstellen en creëren van:

1.1 E-studie deel 1

1.2 Uitgangspuntenrapporten ten behoeve van de constructieve analyse van masten en fundaties

1.3 Sonderingmodellen

1.4 Fundatiemodellen

1.5 Mastmodellen

2. In tweede fase de uitvoering van de DO-fase bevattende:

2.1 Toetsing conform het uitgangspuntenrapport van de bestaande fundaties

2.2 Globale specificatie van benodigde fundatieversterkingen ten behoeve van aanbesteding

2.3 Toetsing conform het uitgangspuntenrapport van de bestaande masten

2.4 Globale specificatie van benodigde mastversterkingen ten behoeve van aanbesteding

2.5 E-studie deel 2.

1.2 Doel van dit rapport

In dit rapport wordt voor de hoogspanningslijn Ens - Zwolle de controle van de mastconstructie van masttype HB+9/R_X gerapporteerd. Het doel is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de nieuwe ACCC-Warsaw geleider waarmee een hogere capaciteit kan worden gerealiseerd.

Nadat de wijzigingen zijn toegepast dient aantoonbaar geverifieerd te worden dat het systeem voldoet aan de vigerende eisen.

In de defintief-ontwerpfase zijn ten behoeve van de contractvorming Engelstalige rapporten geleverd. Het voorliggende rapport is bedoeld voor vergunningsaanvraag en is inhoudelijk ongewijzigd ten opzichte van de Engelse versie. Om deze reden zijn de bijlagen in dit rapport één op één overgenomen uit de Engelse versie. Hierdoor wijkt het revisienummer van de bijlagen af van het revisienummer van de rapportage.

1.3 Gerelateerde documenten

1.3.1 Verificatie & validatieplan

De door TenneT aangeleverde set met eisen is beoordeeld op relevantie en voor de relevante eisen is aangegeven in welk document wordt aangetoond dat er aan de eis wordt voldaan. De resultaten hiervan zijn opgenomen in het rapport “Verificatie & Validatieplan 380 kV verbinding Ens - Zwolle”.

1.3.2 E-studie deel 1

In de rapportage “ENS-ZL380 - E-studie deel 1” [1] is bepaald welke aanpassingen benodigd zijn om de ACCC-Warsaw geleider toe te passen binnen de verbinding Ens – Zwolle. Mast HB+9/R komt op één locatie voor in ENS-ZL, nummer 65. De constructie wordt aangepast om zo een wisselmast te worden. Deze krijgt dan de naam: HB+9/R_X.

De aanpassingen welke hierboven genoemd zijn, zijn de enige aanpassingen welke relevant zijn voor de structurele analyse in dit rapport. Een complete lijst met aanpassingen met betrekking tot HB+9/R_X is te vinden in “ENS-ZL380 – E-studie deel 1”.

1.3.3 Uitgangspuntendocument

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport “Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” [2].

2 EISEN

In onderstaande Tabel 1 zijn de eisen opgenomen die binnen deze rapportage worden getoetst.

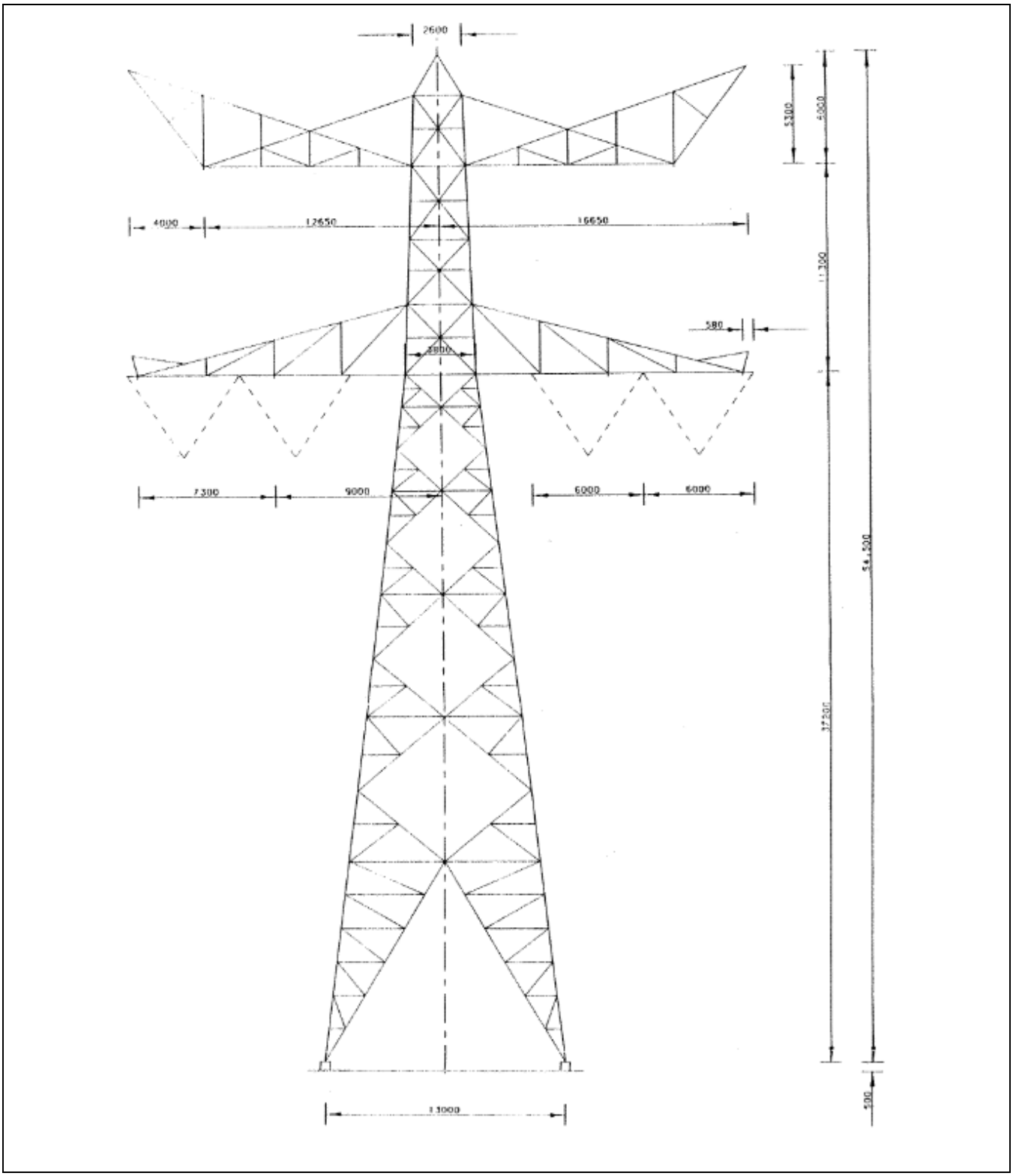
Tabel 1 Relevante eisen

Req. Id	Title	Req. text	Verification
BO Eis: H2.7-6	Omgeving, beperkingsfactoren	Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid.	Tabel 6
PVE.05.001 5.14	Masten	Aanwijzingen t.a.v. klimvoorziening en valbeveiliging: Huidige klimweg blijft gehandhaafd en zal voldoen aan de eisen zoals opgenomen in de NEN 1060:1987. Valbeveiliging is/zal worden uitgevoerd in het type "latch way". Indien staaldelen in de nabijheid (aangrenzend profiel) van de klimweg gewijzigd worden, dient geverifieerd te worden dat de klimvoorziening in overeenstemming is met de NEN 1060:1987.	Tabel 6

3 BEREKENINGEN

3.1 Mastbeeld

Het mastbeeld op basis van de Asset-data is weergegeven in Figuur 1.



Figuur 1 Mastbeeld HB+9/R_X (fasewisseling niet weergegeven)

3.2 Mastenlijst

In deze rapportage wordt masttype HB+9/R_X getoetst. Er is één HB+9/R_X mast, deze valt in windgebied III. De berekening is uitgevoerd voor beide windgebieden. De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven. Er is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde).

Tabel 2 Mastnummers

Tower number	Tower type	Governing tower number	Wind span (m)	Weight span (m)	Height difference back (m)	Height difference ahead (m)
65	HB+9_R_X	65	254	307	-16.7	1.3

3.3 Uitgangspunten berekening

De berekening is uitgevoerd op basis van de uitgangspunten zoals opgenomen in het uitgangspuntenrapport [3]. Hierin is een volledig overzicht opgenomen van de belastingcombinaties en toegepaste belastingfactoren:

Tabel 3 Uitgangspunten berekening

Algemeen	Norm	NEN-EN50341-2-15:2019
	Windgebied	II/III
	Terreincategorie	II (onbebouwde omgeving)
	Reductiefactor cdir	1,00
Situatie initieel	Gevolgklasse	CC2-0
	Betrouwbaarheidsniveau	Afkeur CC2-0
	Referentieperiode	30 jaar
Situatie na aanpassingen	Gevolgklasse	CC2
	Betrouwbaarheidsniveau	Verbouw
	Referentieperiode	50 jaar

3.4 Proces stappen

Het proces van het bepalen van eventueel benodigde verstevigingen bestaat uit de volgende stappen:

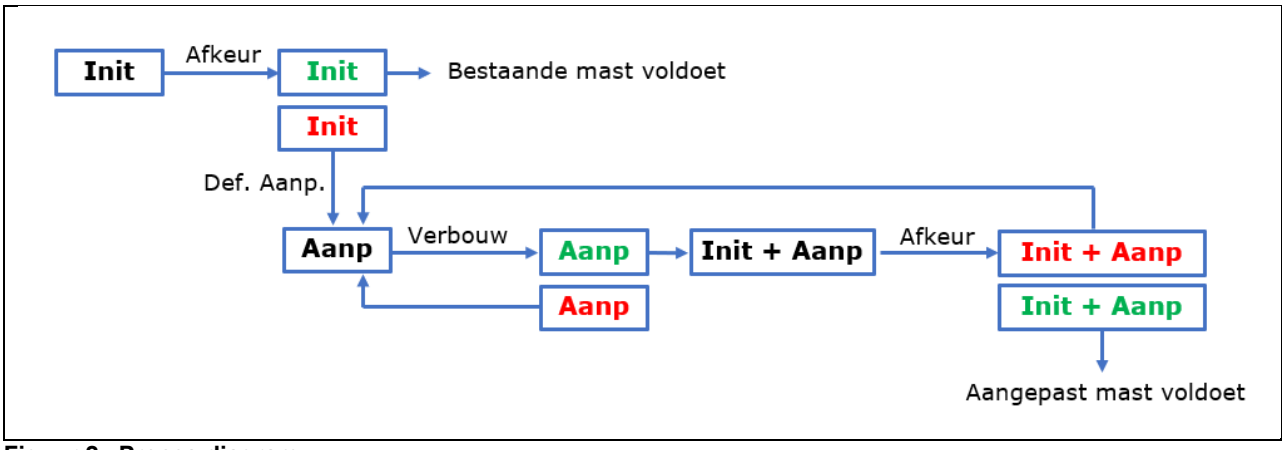
Stap 1: Toets bestaande (Init) mast op Afkeur;

Stap 2: Definiëren benodigde aanpassingen indien initiële mast niet voldoet aan toets op Afkeur (Def. Aanp.);

Stap 3: Het toetsen van (alleen) de uitgewerkte aanpassingen (Aanp) op Verbouw;

Stap 4: Het opnieuw toetsen van de complete mast inclusief aanpassingen (Initi + Aanp) op Afkeur.

Het hierboven omschreven proces is in Figuur 2 weergegeven.



Figuur 2 Proces diagram

3.5 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV. In Appendix A zijn de resultaten van de geleiderbelastingen samengevat.

3.6 Reacties op de fundering

De oplegreacties op de fundering worden ontleend aan de uitvoer van het geleiderbelastingenprogramma, zie ook Appendix A.

3.7 Modellering

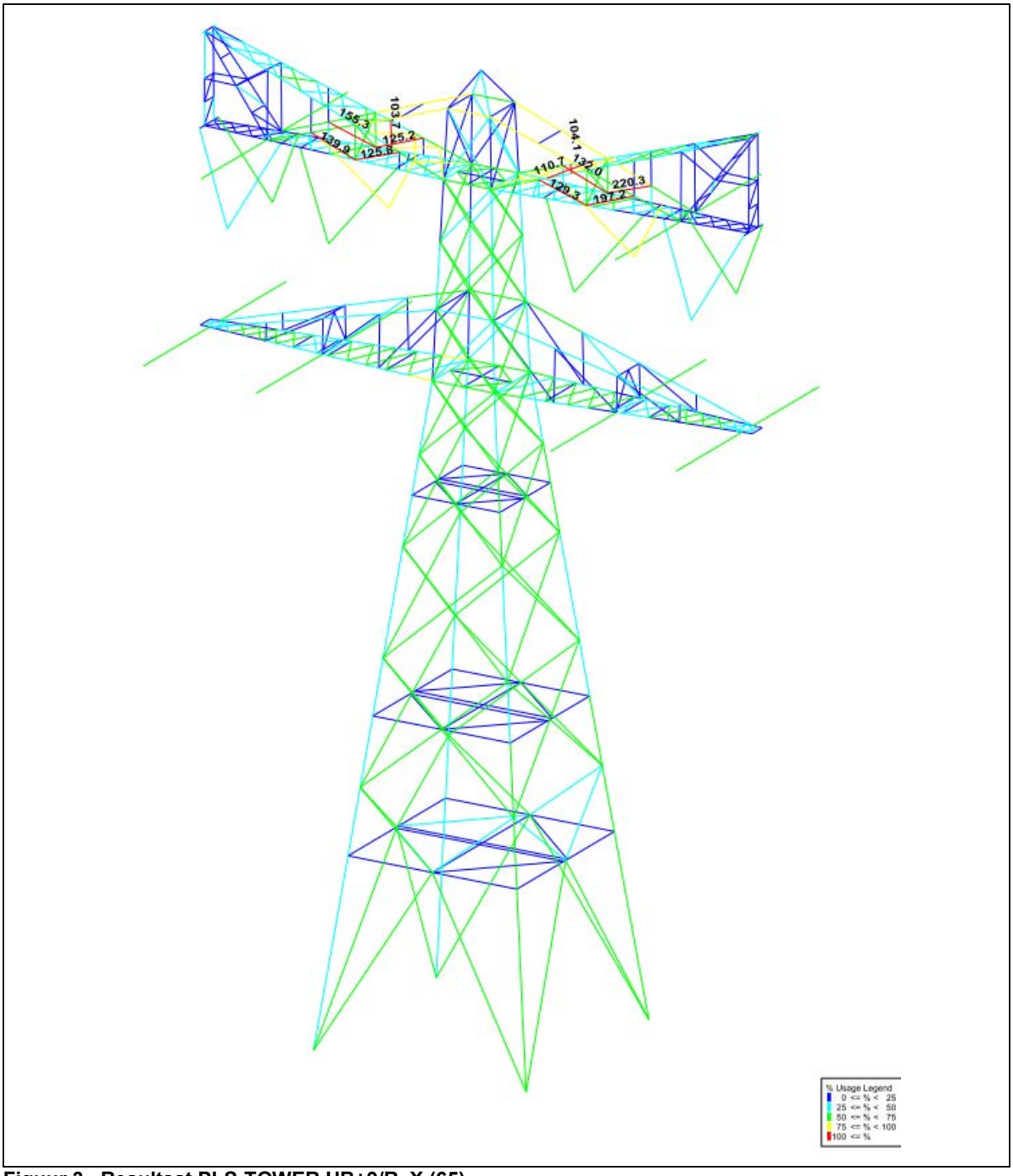
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

De geleiderbelastingen vanuit het geleiderbelastingenprogramma zijn als invoer voor de belastingen gebruikt.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

4 TOETSING MASTCONSTRUCTIE

Het resultaat van de controle van de mastconstructie type HB+9/R_X met belastingen op afkeurniveau is weergegeven in Figuur 3.



Figuur 3 Resultaat PLS-TOWER HB+9/R_X (65)

De diagonalen in één paneel in de boventraverse falen vanwege een te kleine eindafstand van een enkele bout (22 mm).

De toegevoegde verzwaring van de fase omzetting resulteert in een overbelaste knikverkorter in de boventraverse. De hoofdprofielen hebben voldoende capaciteit.

De resultaten van de controles van profielen, knikverkorters en ankers randstijl zijn opgenomen in Tabel 4.

Tabel 4 Samenvatting controle

Controle van	Beoordeling		Referentie
Profielen		Voldoen niet	Figuur 3 Appendix B
Knikverkorters	Voldoen		Appendix C
Blokdeuvels	Voldoen		Appendix D

5 AANPASSINGEN

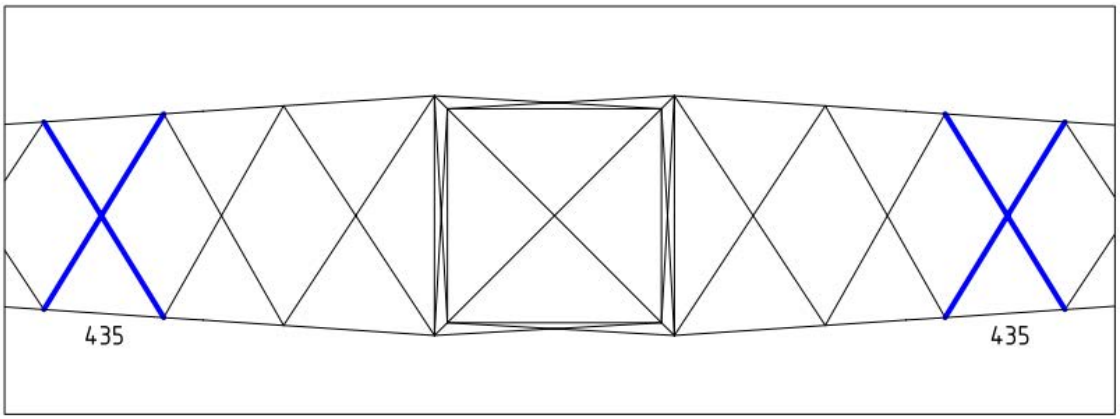
5.1 Inleiding

Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Vervangen van de horizontale diagonalen in de bovenzijde van de boventraverse.
- Vervangen van verschillende verticale verzwaring in de boventraverse.
- Toevoegen van extra profielen om de fasewisseling te ondersteunen.
- Verlengen van de horizontale profielen in de boventraverse.

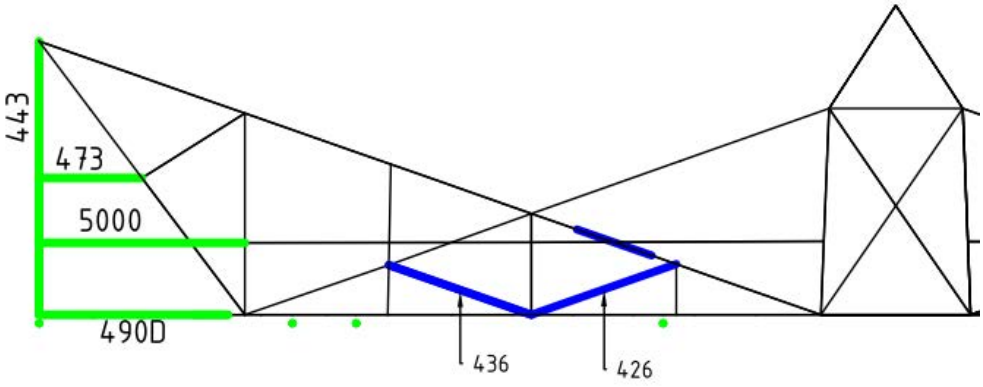
5.2 Aanpassingen

Volgens de resultaten in Appendix B dienen de aanpassingen welke worden toegepast in dit hoofdstuk uitgelicht te worden. In de volgende figuur zijn de horizontale diagonalen welke vervangen dienen te worden weergegeven.

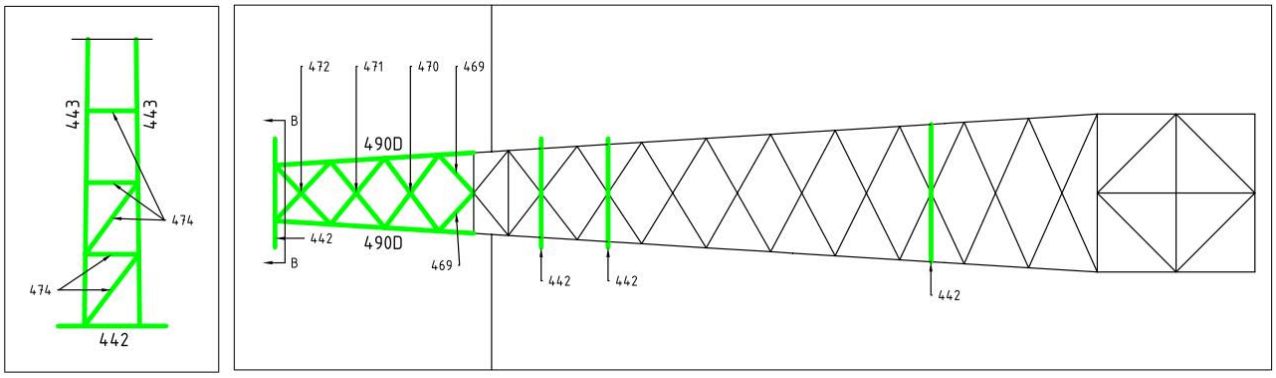


Figuur 4 Bovenaanzicht – Boventraverse

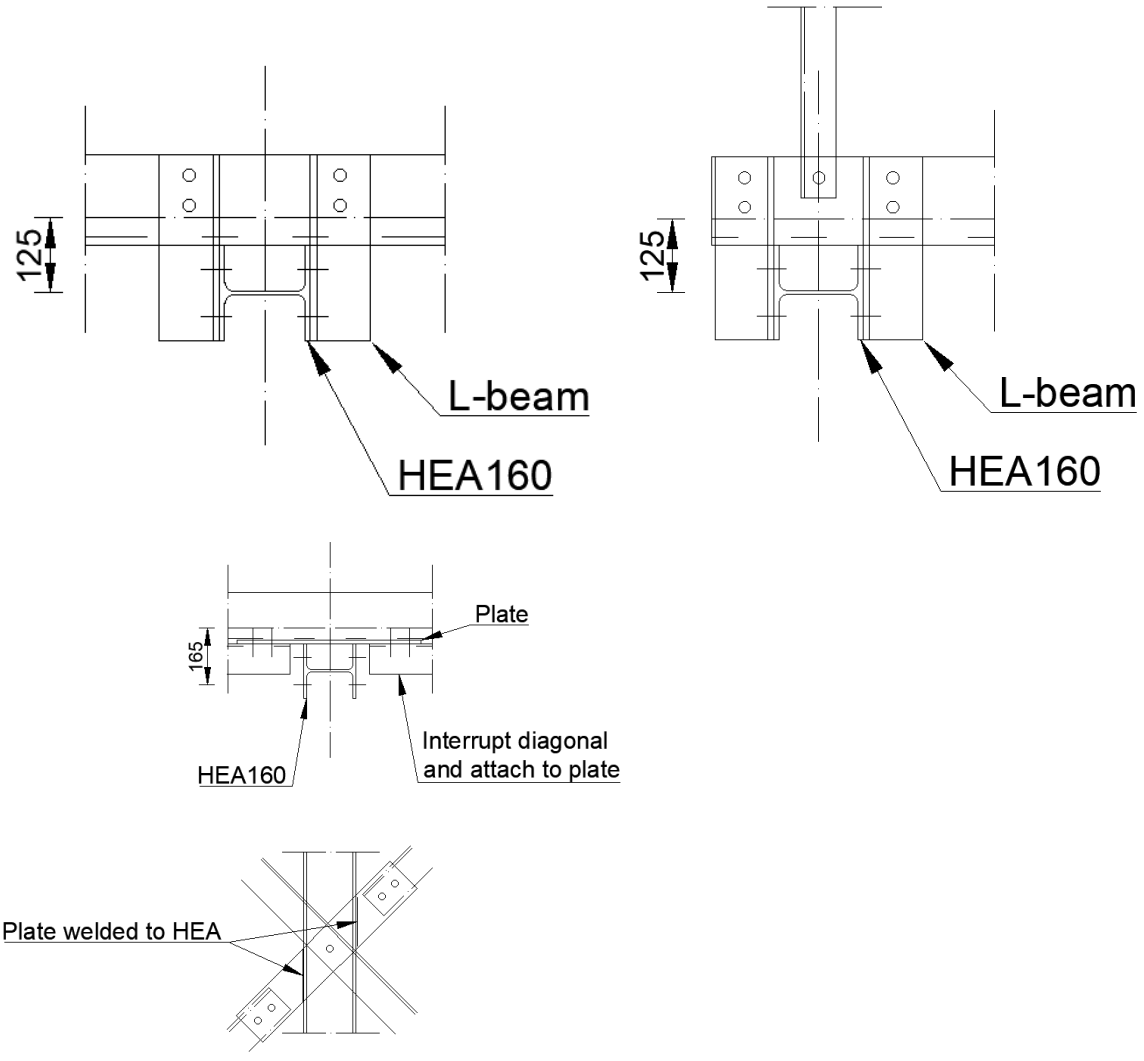
DNV heeft een voorstel voorzien voor de verbinding van de post-isolators welke in figuur 5 en 6 zijn getoond.



Figuur 5 Vooraanzicht – Boventraverse



Figuur 6 bovenaanzicht – Boventraverse



Figuur 7 Principedetails

Meer informatie met betrekking tot de profielmaten en de boutmaten is te vinden in Appendix E. De maten zijn te vinden in Tabel 5. Het gewicht van eventueel benodigde schetsplaten en ander hulpstaal als onderdeel van de verbinding is niet meegenomen.

Tabel 5 Gewichten HB+9/R_X van toegevoegde knikverkorters en uitgewisselde profielen

Group Label	Profile ini.	Material ini.	Bolts ini.	Profile new	Material new	Bolts new	Mitigation	Number	Length (m)	Weight (kg)
435	L60x6	S235	1M16-8.8t	L60x6	S355	1M16-8.8t	Profile exchanged	4	2.83	61.3
426	L50x5	S235	1M16-8.8t	L70x7	S355	1M16-8.8t	Profile exchanged	4	2.98	88.0
436	L50x5	S235	1M16-8.8t	L70x7	S355	1M16-8.8t	Profile exchanged	4	2.96	87.4
490D				L150x14	S355	M20-8.8t	Profile added	4	3.67	463.9
469				L50x5	S355	M16-8.8t	Profile added	4	0.95	14.3
470				L50x5	S355	M16-8.8t	Profile added	4	1.67	25.2
471				L50x5	S355	M16-8.8t	Profile added	4	1.57	23.7
472				L50x5	S355	M16-8.8t	Profile added	4	1.49	22.5
473				L60x6	S355	M16-8.8t	Profile added	4	2.0	43.4
474				L50x5	S355	M16-8.8t	Profile added	10	1.32	49.7
442				HEA160	S355	M20-8.8t	Profile added	8	2.0	486.4
443				L60x6	S355	M16-8.8t	Profile added	4	5.3	114.9
5000				L60x6	S355	M16-8.8t	Profile added	4	4.0	86.7
									146.9	1567.5

5.3 Eisenverificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 6.

Tabel 6 Verificatie eisen

Eis Id	Eis Tekst	Ja	Nee	N.v.t.	toelichting
BO Eis: H2.7-6	Aanpassingen uitvoerbaar?	X			De toe te voegen staalonderdelen zijn met geboute verbindingen te bevestigen. Dit is een bewezen methode.
PVE.05.001 5.14	Staaldelen in nabijheid van klimweg gewijzigd?		X		De wijzigingen in de nabijheid van de klimweg (knikverkorters) zijn in te passen zonder negatieve invloed op de begaanbaarheid.
	klimvoorziening nog in overeenstemming is met de NEN 1060:1987?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.515.40 0825824 - 21-0462 - Verificatie & validatieplan 380kV verbinding Ens - Zwolle”.
[2] „002.515.40 0825812 - 20-1465 - E-studie deel 1 380kV verbinding Ens - Zwolle”.
[3] „002.515.40 0825820 - 20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle”.

APPENDIX A
Geleiderbelastingen

Content

- Starting point p. 2
- Tower construction p. 6
- In between results p. 8
- Loads initial p. 10
- Loads after adjustment p. 15

Data

Norm	NEN-EN50341-2-15:2019
Initial	
Consequence class	CC2-0
Reliability level	Afkeur
Reference period	30 jaar
After adjustment	
Consequence class	CC2
Reliability level	Verbouw
Reference period	50 jaar
Wind zone	III
Wind speed	24.5 m/s
Terrain categorie	II
Reduction factor Cdir	1.00
Ice region	B
Tower type	Hoekmast
Tower height	54.5 m
Max. Span	338.6 m
Line angle	148.1°
Catenary	1760 m
Wind span	254 m
EDS Weight span	340 m
Min. Weight span	320 m
Max. Weight span	425 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-12-10			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype HB+9_R_X

JOB No.	-	DATE	-
DRAWN	-	CHKD	-
DESIGN	-	APPD	-

Document name:

ENS-ZL_HB+9_R_X_65_Report.pdf

Project number:

Project client number:

0.0											

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Conductor loads

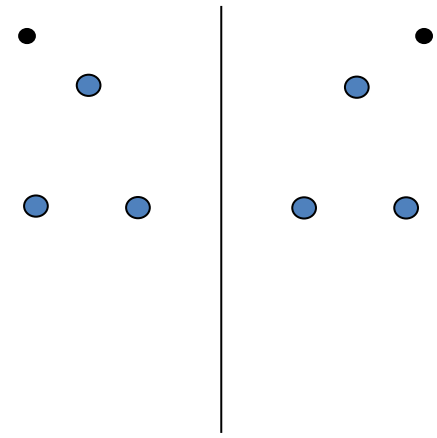
Auteur: TBR
Versie: v11.7

General

Description	HB+9_R_X
Tower type	Hoekmast
Number of circuits	2
Configuration	2-circuit-vlak
Number of earth wires	2

Starting points

Norm	NEN-EN50341-2-15:2019
Consequence class	CC2-0
Reliability level initial	Afkeur CC2-0
Reference period intial	30 jaar
Consequence class modified	CC2
Reliability level modified	Verbouw
Reference period modified	50 jaar
Wind zone	III
Wind speed (m/s)	24.5 m/s
Terrain category	II
Reduction factor c_{dir}	1.00
Ice region phase conductor	B
Ice region earth conductor	B



Configuratie geleiders

Conductors back

Description	Voltage	Conductor Back	Bundle Ba	Ice region	Additional weight	Additional diameter	Catenary P_{back}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Conductors ahead

Description	Voltage	Conductor Ahead	Bundle Ah	Ice region	Additional weight	Additional diameter	Catenary P_{ahead}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Afspanketting	2.00	4.50	1.00
Circuit 2	Afspanketting	2.00	4.50	1.00
Bliksemdraad 1	Vast (Bliksemdraad)	0.10	0.30	0.10
Bliksemdraad 2	Vast (Bliksemdraad)	0.10	0.30	0.10

1. Properties apply to the entire isolator set

Suspension height and position in mast

Circuits	Designation	Number	Suspension height	Attach point	Position in tower Horizontal distance
Circuit 1	10	380ct1f1	37.2 m	37.2 m	-16.3 m
Circuit 1	11	380ct1f2	37.2 m	37.2 m	-9.0 m
Circuit 1	12	380ct1f3	48.5 m	48.5 m	-12.7 m
Circuit 2	21	380ct2f1	37.2 m	37.2 m	16.3 m
Circuit 2	20	380ct2f2	37.2 m	37.2 m	9.0 m
Circuit 2	22	380ct2f3	48.5 m	48.5 m	12.7 m
Bliksemdraad 1	1	bl1	53.5 m	53.8 m	-16.7 m
Bliksemdraad 2	3	bl2	53.5 m	53.8 m	16.7 m

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Height adjustment adjacent masts (wind and weight span adjustment)

	Back	Ahead	
Height increase for wind pressure	0.0 m	0.0 m	(positive: higher)
Height decrease for vertical load	0.0 m	0.0 m	(negative: decrease, more weight span)

Decrease: Niet in 0,9EG-combinaties

Height difference adjacent tower and change of direction with respect to Line direction

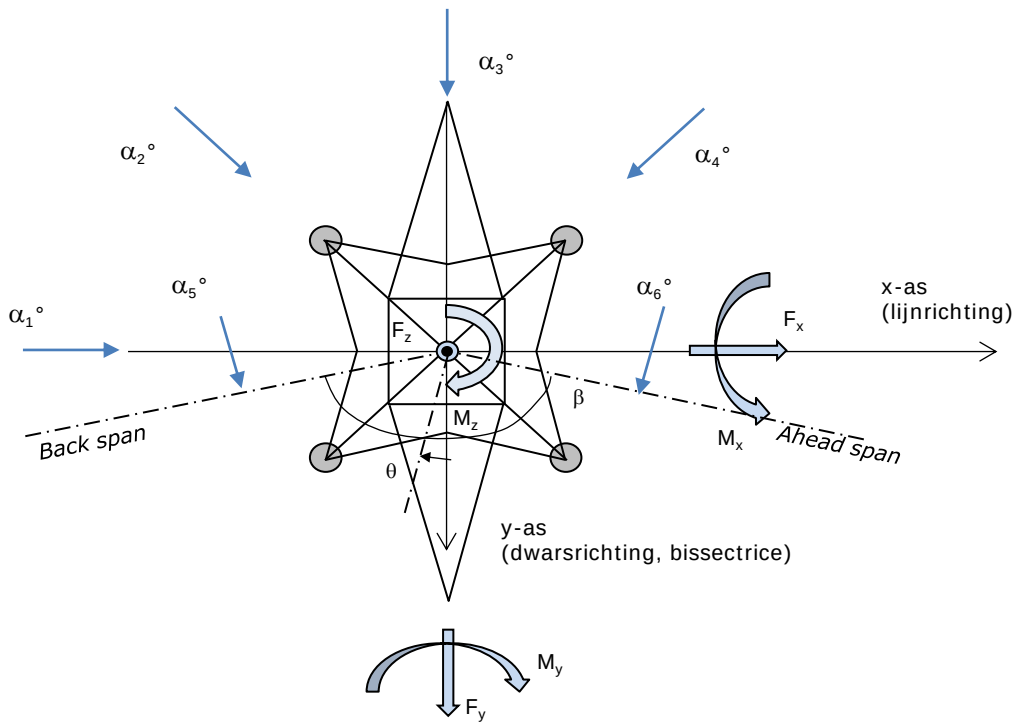
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	-16.7	1.3 m	0.0	0.0 m
Circuit 1	11	380ct1f2	-16.7	1.3 m	0.0	0.0 m
Circuit 1	12	380ct1f3	-16.7	1.3 m	0.0	0.0 m
Circuit 2	21	380ct2f1	-16.7	1.3 m	0.0	0.0 m
Circuit 2	20	380ct2f2	-16.7	1.3 m	0.0	0.0 m
Circuit 2	22	380ct2f3	-16.7	1.3 m	0.0	0.0 m
Bliksemdraad 1	1	bl1	-16.7	1.3 m	0.0	0.0 m
Bliksemdraad 2	3	bl2	-16.7	1.3 m	0.0	0.0 m

Line and tower data

		Back	Ahead	
		338.6	168.5	m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		352.8	327.2	m
Line angle	β	148.1		°
Tower orientation with respect to bi	θ	0		°
Section length		4787	2435	m
Height bottom of tower to ground level		0.5		m
Wind directions considered	α_1	0		°
Wind directions according to:	α_2	45		°
Geleiderbelastingen	α_3	90		°
	α_4	135		°
	α_5	74.05		°
	α_6	105.95		°

Wind directions apply to the main direction of mast construction, not to the bisector.

Windrichtingen en positieve richtingen belastingen



Considered number of wind directions

1a	6
3	6
4	1
6	1
Overig	1

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

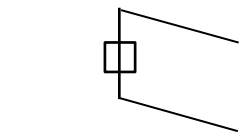
Absence of conductors

		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	1	0
Circuit 1	380ct1f2	1	0	1	0	1	0
Circuit 1	380ct1f3	1	0	1	0	1	0
Circuit 2	380ct2f1	0	1	1	0	1	0
Circuit 2	380ct2f2	0	1	1	0	1	0
Circuit 2	380ct2f3	0	1	1	0	1	0
Bliksemdraad 1	bl1	1	0	1	0	1	0
Bliksemdraad 2	bl2	0	1	1	0	1	0

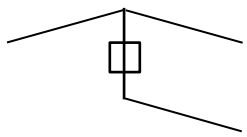
Load situations SPLS

Considered situations SPLS: 1 up to 6, All possible situations

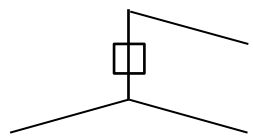
Principle of load situations:



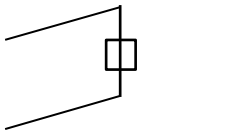
1. Ba All cts



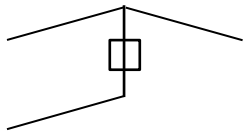
2. Ba ct1



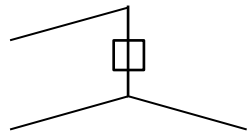
3. Ba ct2



4. Ah All cts



5. Ah ct1

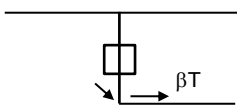


6. Ah ct2

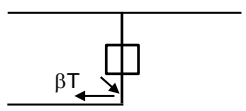
Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1 and 2, all possible situations

Principle of load situations:



1. Ba



2. Ah

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

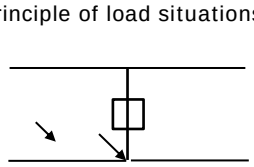
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations are applied in ULS and in every SPLS situation (in case of angle tower).

	Phase	Earth
Line vehicle	3.0 kN	2.0 kN
Concentrated load cross arm	1.0 kN	1.0 kN

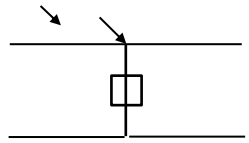
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

Presence line vehicle: Circuit, belasting tegelijk aanwezig in alle geleiders per circuit.

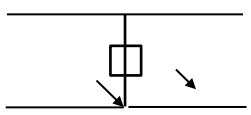
Principle of load situations:



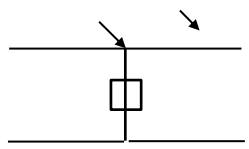
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

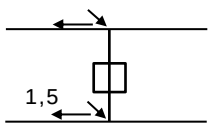
Load situations 8. Galloping as a static load

Conductor		
Suspension tower phase	0.866 W	1.5 W
Suspension tower earth	1.5 EDS	1.5 W
Strain tower phase and earth	1.5 EDS	1.5 W

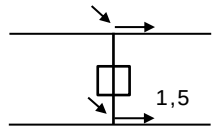
Considered situations galloping 8: None (existing structure)

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principle of load situations:



1. Ba



2. Ah

Load combination 8. Galloping as a dynamic load
Only applies to tension towers
Load consists of EDS tensile load in one of the conductors on one side of the tower
Can be converted by user to fatigue spectrum via the load spectrum of table 4.11 / NL.1

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Tower structure

Properties

Tower type	Hoekmast		
Tower designation	HB+9_R_X		
Base plate w.r.t. ground level	0.5		m
Tower height w.r.t. base plate	54.5		m
Tower self weight	615.0		kN
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	13.00	13.00	m
Inclination of main leg	0.124	0.124	-
Horizontal force factor	1.3	1.3	-

Calculation Wind load

Dynamic factor G_T	1.00 *(Masthoogte < 60 m)*
Wind load diagonally to tower body proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Wind load diagonally on traverse proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Magnification factor diagonal wind to tower body	(1+0,2sin^2(2phi))
Magnification factor diagonal wind to cross arm	(1+0,2sin^2(2phi))
Magnification factor wind parallel to perpendicular to cross a	0.4

Properties mast sections longitudinal direction (front view, yz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	14.60	13.00	9.39	14.60	0.124	163.45	23.86	0.15	3.18
Eerste tussenstuk	28.00	9.39	6.08	13.40	0.124	103.62	16.96	0.16	3.09
Tweede tussenstuk	37.20	6.08	3.80	9.20	0.124	45.43	10.27	0.23	2.82
Bovenstuk 1	45.00	3.80	3.19	7.80	0.039	27.25	6.52	0.24	2.77
Bovenstuk 2	52.50	3.19	2.60	7.50	0.039	21.70	5.14	0.24	2.78
Topstuk	54.50	2.60		2.00		2.60	0.38	0.15	3.17
Ondertraverse	37.20	14.40		4.00		28.80	6.42	0.22	2.83
Boventraverse	48.50	15.19		5.30		40.26	7.96	0.20	2.94

Properties tower sections transversal direction (side view, xz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	14.60	13.00	9.39	14.60	0.124	163.45	23.86	0.15	3.18
Eerste tussenstuk	28.00	9.39	6.08	13.40	0.124	103.62	16.96	0.16	3.09
Tweede tussenstuk	37.20	6.08	3.80	9.20	0.124	45.43	10.27	0.23	2.82
Bovenstuk 1	45.00	3.80	3.19	7.80	0.039	27.25	6.52	0.24	2.77
Bovenstuk 2	52.50	3.19	2.60	7.50	0.039	21.70	5.14	0.24	2.78
Topstuk	54.50	2.60		2.00		2.60	0.38	0.15	3.17
Ondertraverse	37.20	14.40		4.00		28.80	6.42	0.22	2.83
Boventraverse	48.50	15.19		5.30		40.26	7.96	0.20	2.94

Note: Surface transverse direction is reduced in calculation.

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Wind surface feeders telecom installations

Part	A (m^2/m)	Factor	Δh	A_1
Broekstuk				
Eerste tussenstuk				
Tweede tussenstuk				
Bovenstuk 1				
Bovenstuk 2				

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne top			
Antenne o.t.			

Tower section loads longitudinal (x-direction) per wind direction

Description	p_w	F_{x1}	F_{x2}	F_{x3}	F_{x4}	h_{ef}	M_{y1}	M_{y2}	M_{y3}	M_{y4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0.70	53.1	45.1	0.0	-45.1	7.3	388.0	329.2	0.0	-329.2
Eerste tussenstuk	0.89	46.9	39.8	0.0	-39.8	21.3	999.7	848.3	0.0	-848.3
Tweede tussenstuk	1.01	29.3	24.9	0.0	-24.9	32.6	955.1	810.5	0.0	-810.5
Bovenstuk 1	1.08	19.5	16.6	0.0	-16.6	41.1	801.8	680.3	0.0	-680.3
Bovenstuk 2	1.13	16.1	13.7	0.0	-13.7	48.8	784.6	665.7	0.0	-665.7
Topstuk	1.16	1.4	1.2	0.0	-1.2	53.5	74.9	63.6	0.0	-63.6
Ondertraverse	1.06	38.5	22.9	0.0	-22.9	38.5	1484.8	881.9	0.0	-881.9
Boventraverse	1.14	53.2	31.6	0.0	-31.6	50.3	2675.5	1589.2	0.0	-1589.2
Totaal		258.1	195.7	0.0	-195.7		8164.3	5868.6	0.0	-5868.6

Tower section loads transversal (y-direction) per wind direction

Description	p_w	F_{y1}	F_{y2}	F_{y3}	F_{x4}	h_{ef}	M_{x1}	M_{x2}	M_{x3}	M_{x4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0.70	0.0	45.1	53.1	45.1	7.3	0.0	329.2	388.0	329.2
Eerste tussenstuk	0.89	0.0	39.8	46.9	39.8	21.3	0.0	848.3	999.7	848.3
Tweede tussenstuk	1.01	0.0	24.9	29.3	24.9	32.6	0.0	810.5	955.1	810.5
Bovenstuk 1	1.08	0.0	16.6	19.5	16.6	41.1	0.0	680.3	801.8	680.3
Bovenstuk 2	1.13	0.0	13.7	16.1	13.7	48.8	0.0	665.7	784.6	665.7
Topstuk	1.16	0.0	1.2	1.4	1.2	53.5	0.0	63.6	74.9	63.6
Ondertraverse	1.06	0.0	22.9	15.4	22.9	38.5	0.0	881.9	593.9	881.9
Boventraverse	1.14	0.0	31.6	21.3	31.6	50.3	0.0	1589.2	1070.2	1589.2
Total		0.0	195.7	203.1	195.7		0.0	5868.6	5668.2	5868.6

Resulting loads from mast construction incl. Antenna without conductors level foundation (char. Value)

Load / wind direction	F_x	F_y	F_z	M_x	M_y	M_z
	[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
Permanente belasting	0	0	615	0	0	0
Windrichting 0°	258	0	0	0	8164	0
Windrichting 45°	196	196	0	5869	5869	0
Windrichting 90°	0	203	0	5668	0	0
Windrichting 135°	-196	196	0	5869	-5869	0

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Bliksemdraad 1	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05

Conductors ahead

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Bliksemdraad 1	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05

Vertical load back

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	$w_{z,ijs}$ [N/m]	$w_{z,ijs,bundel}$ [N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Bliksemdraad 1	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3

Vertical load ahead

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	[N/m]	[N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Bliksemdraad 1	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3

Insulators

Conductor	$G_{isolator}$ [kN]	Number -	$F_{v,iso}$ [kN]	Length [m]	Wind surf. [m^2]	Wind heigth [m]	Pressure [kN/m^2]	Drag factor [-]	$F_{h,iso}$ [kN]
380ct1f1	2.00	1	2	4.5	1.0	37.70	1.05	1.2	1.26
380ct1f2	2.00	1	2	4.5	1.0	37.70	1.05	1.2	1.26
380ct1f3	2.00	1	2	4.5	1.0	49.00	1.13	1.2	1.36
380ct2f1	2.00	1	2	4.5	1.0	37.70	1.05	1.2	1.26
380ct2f2	2.00	1	2	4.5	1.0	37.70	1.05	1.2	1.26
380ct2f3	2.00	1	2	4.5	1.0	49.00	1.13	1.2	1.36
bl1	0.10	0.5	0.05	0.3	0.1	54.00	1.16	1.2	0.14
bl2	0.10	0.5	0.05	0.3	0.1	54.00	1.16	1.2	0.14

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Wind load back

Conductor	Height wind [m]	Pressure [kN/m^2]	$G_{c\ dwars}$ [-]	$G_{c\ trek}$ [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	23.9	0.93	0.60	0.47	1.12	28.53	52.7	41.7	47.4	94.0	74.3
380ct1f2	23.9	0.93	0.60	0.47	1.12	28.53	52.7	41.7	47.4	94.0	74.3
380ct1f3	35.2	1.03	0.63	0.49	1.09	28.53	60.3	47.6	47.4	110.7	87.3
380ct2f1	23.9	0.93	0.60	0.47	1.12	28.53	52.7	41.7	47.4	94.0	74.3
380ct2f2	23.9	0.93	0.60	0.47	1.12	28.53	52.7	41.7	47.4	94.0	74.3
380ct2f3	35.2	1.03	0.63	0.49	1.09	28.53	60.3	47.6	47.4	110.7	87.3
bl1	41.1	1.08	0.64	0.50	1.20	22.35	18.5	14.6	41.8	34.7	27.3
bl2	41.1	1.08	0.64	0.50	1.20	22.35	18.5	14.6	41.8	34.7	27.3

Wind load ahead

Conductor	Height wind [m]	Pressure [kN/m^2]	G_{c_dwars} [-]	G_{c_trek} [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	37.0	1.05	0.63	0.53	1.08	28.53	61.4	51.1	47.4	112.9	94.0
380ct1f2	37.0	1.05	0.63	0.53	1.08	28.53	61.4	51.1	47.4	112.9	94.0
380ct1f3	48.3	1.13	0.65	0.54	1.06	28.53	66.9	55.6	47.4	125.5	104.3
380ct2f1	37.0	1.05	0.63	0.53	1.08	28.53	61.4	51.1	47.4	112.9	94.0
380ct2f2	37.0	1.05	0.63	0.53	1.08	28.53	61.4	51.1	47.4	112.9	94.0
380ct2f3	48.3	1.13	0.65	0.54	1.06	28.53	66.9	55.6	47.4	125.5	104.3
bl1	53.5	1.16	0.66	0.55	1.18	22.35	20.2	16.8	41.8	38.4	31.9
bl2	53.5	1.16	0.66	0.55	1.18	22.35	20.2	16.8	41.8	38.4	31.9

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class	Afkeur CC2-0
Reference period	30 jaar

ULS (strength)		NEN-EN50341-2-15:2019						
Load case	description	Temp	γ_G	γ_G	γ_Q			γ_a
		°C	$G_{k,mast}$	$G_{k,geleider}$	Q_{pk}	Q_{wk}	Q_{ik}	A_k
ULS 1a	Wind	10°	1.05	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.12	0.00	0.0
ULS 3	Wind+ice	-5°	1.05	1.05	0.00	0.34	0.97	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.05	0.00	0.34	0.97	0.0
ULS 4	Cold+wind	-20°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.05	0.00	0.22	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.05	1.05	1.20	0.22	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 7	Permanent	10°	1.15	1.15	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G	γ_Q			
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.05	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.05	1.05	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.05	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.05	1.05	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.05	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.05	1.05	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.05	1.05	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)								
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	0.94	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.28	0.88	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions	6
Number of load combinations for ULS	54
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5820

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-38.2	38.7	12.6	11.6	7.3	3.1
380ct1f1	-126.7	129.1	42.2	40.6	21.6	8.3
380ct1f2	-126.7	129.1	42.2	40.6	21.6	8.3
380ct1f3	-128.2	130.6	44.2	41.4	21.7	8.3
380ct2f1	-126.7	129.1	42.2	40.6	21.6	8.3
380ct2f2	-126.7	129.1	42.2	40.6	21.6	8.3
380ct2f3	-128.2	130.6	44.2	41.4	21.7	8.3
bl2	-38.2	38.7	12.6	11.6	7.3	3.1
Post 40	0.0	0.0	0.0	0.0	0.0	
Post 41	0.0	0.0	0.0	0.0	0.0	
Post 42	0.0	0.0	0.0	0.0	0.0	
Post 43	0.0	0.0	0.0	0.0	0.0	

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	338.2	364.1	340.4
380ct1f1	324.8	338.7	326.4
380ct1f2	324.8	338.7	326.4
380ct1f3	324.7	338.9	326.4
380ct2f1	324.8	338.7	326.4
380ct2f2	324.8	338.7	326.4
380ct2f3	324.7	338.9	326.4
bl2	338.2	364.1	340.4
Post 40			
Post 41			
Post 42			
Post 43			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	386.5	337.2
380ct1f1	348.1	326.1
380ct1f2	348.1	326.1
380ct1f3	353.7	327.2
380ct2f1	348.1	326.1
380ct2f2	348.1	326.1
380ct2f3	353.7	327.2
bl2	386.5	337.2
Post 40		
Post 41		
Post 42		
Post 43		

Envelop of weight span over all combinations (incl. 0,9 combinations)

For all conductors		Wind / Weight span ratio
Max. weight span	404.4 m	1.595 -
Min. weight span	322.2 m	1.271 -

Project: ENS-ZL
Tower: HB+9_R_X
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Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	38.7	23.2	7.3	-39.9	40.3
380ct1f1	111.8	81.7	21.6	-133.4	135.3
380ct1f2	111.8	81.7	21.6	-133.4	135.3
380ct1f3	113.9	83.7	21.7	-135.2	136.9
380ct2f1	111.8	81.7	21.6	-133.4	135.3
380ct2f2	111.8	81.7	21.6	-133.4	135.3
380ct2f3	113.9	83.7	21.7	-135.2	136.9
bl2	38.7	23.2	7.3	-39.9	40.3
Post 40	2.0	2.0	5.8	0.0	
Post 41	2.0	2.0	5.8	0.0	
Post 42	2.0	2.0	5.8	0.0	
Post 43	2.0	2.0	5.8	0.0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	20.4	5.8	2.8	-21.2	21.2
380ct1f1	78.3	22.4	13.9	-81.5	81.5
380ct1f2	78.3	22.4	13.9	-81.5	81.5
380ct1f3	78.3	22.4	13.9	-81.5	81.5
380ct2f1	78.3	22.4	13.9	-81.5	81.5
380ct2f2	78.3	22.4	13.9	-81.5	81.5
380ct2f3	78.3	22.4	13.9	-81.5	81.5
bl2	20.4	5.8	2.8	-21.2	21.2
Post 40	0.0	0.0	5.0	0.0	
Post 41	0.0	0.0	5.0	0.0	
Post 42	0.0	0.0	5.0	0.0	
Post 43	0.0	0.0	5.0	0.0	

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0.0	0.0
	380ct1f1	0.0	0.0
	380ct1f2	0.0	0.0
	380ct1f3	0.0	0.0
	380ct2f1	0.0	0.0
	380ct2f2	0.0	0.0
	380ct2f3	0.0	0.0
	bl2	0.0	0.0
	Post 40	0.0	
	Post 41	0.0	
	Post 42	0.0	
	Post 43	0.0	

Project: ENS-ZL
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ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		53	527	155	22080	2195	0
ULS 1a_0,9_0		10	307	146	12679	487	-85
ULS 1a_0,9_0,9_90		59	506	135	21257	2446	0
ULS 3_0		-1	462	207	19191	-11	-25
SLS 7		0	292	142	12042	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

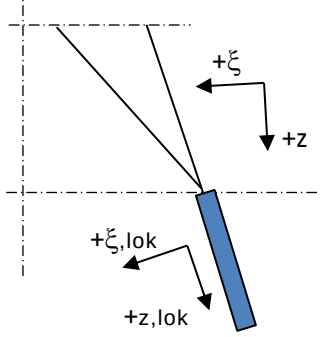
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	53	754	801	28410	2195	0
ULS 1a_0,9_0,9_90	59	733	689	27587	2446	0
SLS 7	0	292	757	12042	0	0

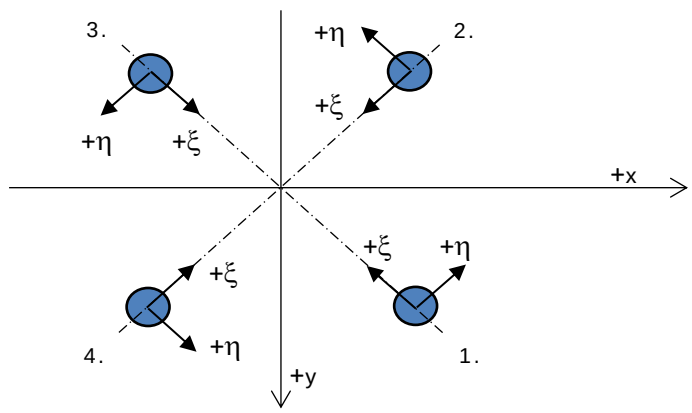
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_90	53	754	706	28442	2195	0
SPLS 3_0 Ba All Cts	756	188	718	7658	30804	-27
SPLS 6a_90 Ah Ct1 Ah Ct2	-175	336	810	13481	-7229	4890
SPLS 3_0,9_105.95 Ba All Cts	716	307	622	11708	30441	8

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_105.95 Ba All Cts	280	294	1799	-10	-406	-91	1827
2	SPLS 3_0 Ba All Cts	171	-172	1070	1	-242	-55	1086
3	SPLS 3_135 Ah All Cts	-152	-149	955	2	-213	-46	969
4	SPLS 3_90 Ah All Cts	-279	291	1779	8	-403	-91	1806

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-91	-90	-582	-1	128	26	-591
2	SPLS 3_0,9_90 Ah All Cts	-219	231	-1408	-8	318	72	-1430
3	SPLS 3_0,9_105.95 Ba All Cts	226	240	-1465	10	330	73	-1488
4	SPLS 3_0,9_0 Ba All Cts	116	-119	-733	-2	166	38	-744

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct1 Ah Ct2	166	-22	443	133	-102	-24	450
2	SPLS 6a_90 Ah Ct1 Ah Ct2	-188	2	-594	132	135	31	-603
3	SPLS 6a_90 Ba Ct2 Ah Ct2	48	244	-908	138	207	48	-922
4	SPLS 6a_90 Ah Ct1 Ba Ct1	-112	306	1306	137	-296	-67	1325

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct2 Ah Ct1	-25	166	426	-135	-100	-26	432
2	SPLS 6a_90 Ah Ct2 Ah Ct1	2	190	-577	-136	133	32	-586
3	SPLS 6a_90 Ah Ct2 Ba Ct2	51	-138	288	-134	-61	-11	292
4	SPLS 6a_90 Ba Ct1 Ah Ct1	-114	-77	105	-135	-26	-8	106

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-91	-90	-582	-1	128	26	-591
2	SPLS 3_0,9_74.05 Ah All Cts	-217	230	-1406	-10	316	70	-1427
3	SPLS 3_0,9_105.95 Ba All Cts	226	240	-1465	10	330	73	-1488
4	SPLS 3_0,9_0 Ba All Cts	116	-119	-733	-2	166	38	-744

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	105	103	652	1	-147	-33	662
2	SLS 7	-44	43	-274	1	61	13	-278
3	SLS 7	44	43	-274	-1	61	13	-278
4	SLS 7	-105	103	652	-1	-147	-33	662

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 3_105.95 Ba All Cts	280	294	1799	-10	-406	-91	1827
Max. tension	SPLS 3_0,9_105.95 Ba All Cts	226	240	-1465	10	330	73	-1488
Max. pos. torsie	SPLS 6a_90 Ba Ct2 Ah Ct2	48	244	-908	138	207	48	-922
Max. neg. torsie	SPLS 6a_90 Ah Ct2 Ah Ct1	2	190	-577	-136	133	32	-586
Comb. tension+torsie	SPLS 3_0,9_105.95 Ba All Cts	226	240	-1465	10	330	73	-1488

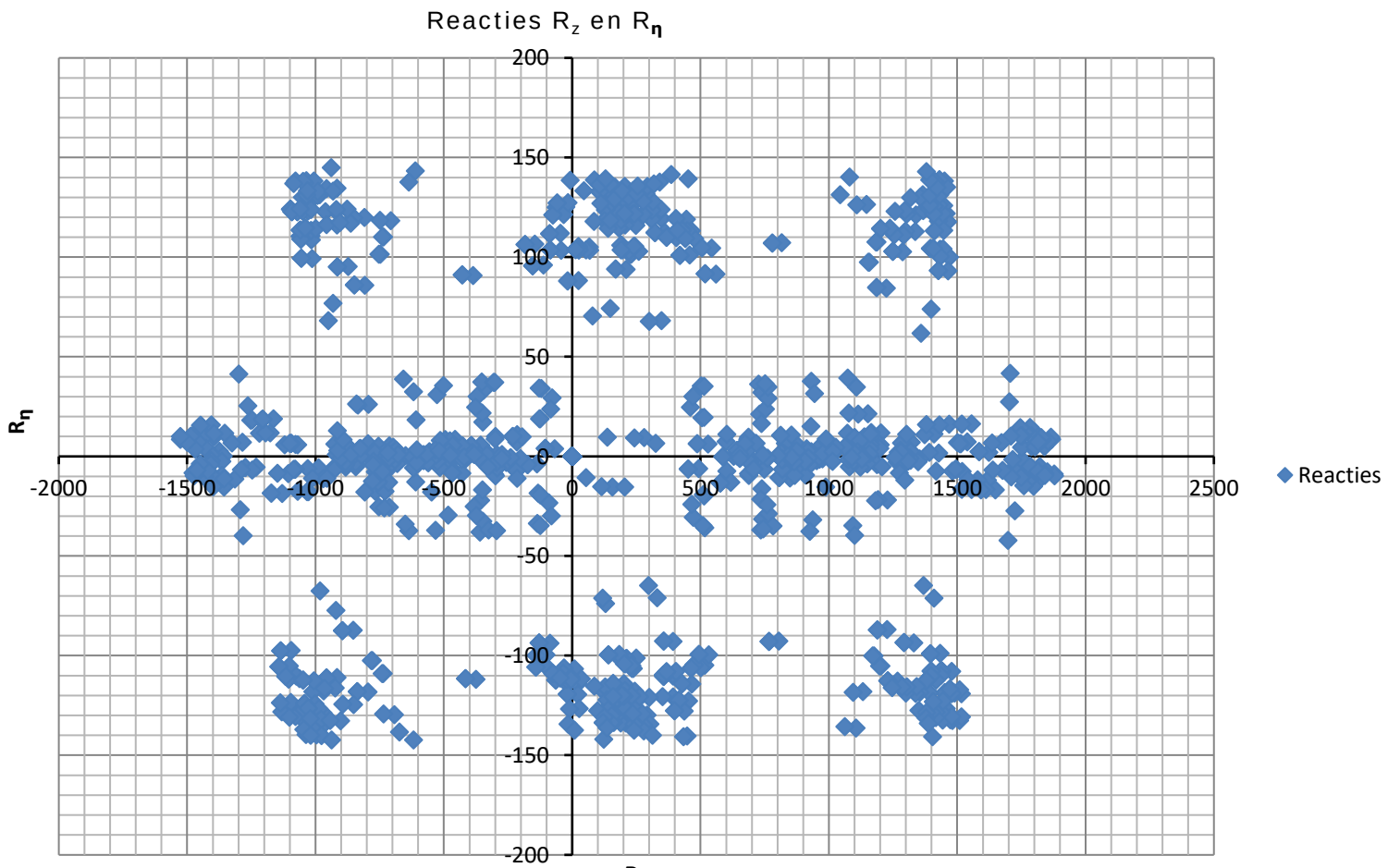
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	105	103	652	1	-147	-33	662
2	SLS 1a_90	-114	125	-710	-7	169	45	-721
3	SLS 1a_90	137	148	-852	8	201	52	-865
4	SLS 1a_0	-44	52	344	6	-68	-8	349

Maximum compression load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_90	198	209	1233	-8	-288	-72	1252
2	SLS 1a_0	20	-6	35	-10	-18	-12	35
3	SLS 7	44	43	-274	-1	61	13	-278
4	SLS 1a_90	-176	186	1091	7	-256	-65	1107

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65



Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class	Verbouw CC2
Reference period	50 jaar

ULS (strength) Load case	description	NEN-EN50341-2-15:2019 Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	γ_a A_k
ULS 1a	Wind	10°	1.15	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.40	0.00	0.0
ULS 3	Wind+ice	-5°	1.15	1.15	0.00	0.42	1.30	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.15	0.00	0.42	1.30	0.0
ULS 4	Cold+wind	-20°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.15	0.00	0.28	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.15	1.15	1.30	0.28	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 7	Permanent	10°	1.30	1.30	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G G_k	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.15	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.15	1.15	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.15	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.15	1.15	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.15	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.15	1.15	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.15	1.15	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	1.00	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.30	1.00	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions	6
Number of load combinations for ULS	54
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5820

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-40.5	40.9	14.8	13.4	7.9	3.3
380ct1f1	-144.3	146.8	48.8	46.7	25.1	9.1
380ct1f2	-144.3	146.8	48.8	46.7	25.1	9.1
380ct1f3	-146.2	148.6	51.8	48.0	25.2	9.1
380ct2f1	-144.3	146.8	48.8	46.7	25.1	9.1
380ct2f2	-144.3	146.8	48.8	46.7	25.1	9.1
380ct2f3	-146.2	148.6	51.8	48.0	25.2	9.1
bl2	-40.5	40.9	14.8	13.4	7.9	3.3
Post 40	0.0	0.0	0.0	0.0	0.0	
Post 41	0.0	0.0	0.0	0.0	0.0	
Post 42	0.0	0.0	0.0	0.0	0.0	
Post 43	0.0	0.0	0.0	0.0	0.0	

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	338.1	364.4	340.4
380ct1f1	324.7	338.8	326.4
380ct1f2	324.7	338.8	326.4
380ct1f3	324.6	339.0	326.4
380ct2f1	324.7	338.8	326.4
380ct2f2	324.7	338.8	326.4
380ct2f3	324.6	339.0	326.4
bl2	338.1	364.4	340.4
Post 40			
Post 41			
Post 42			
Post 43			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	392.1	332.4
380ct1f1	351.6	323.4
380ct1f2	351.6	323.4
380ct1f3	358.1	324.5
380ct2f1	351.6	323.4
380ct2f2	351.6	323.4
380ct2f3	358.1	324.5
bl2	392.1	332.4
Post 40		
Post 41		
Post 42		
Post 43		

Envelop of weight span over all combinations (incl. 0,9 combinations)

For all conductors		Wind / Weight span ratio
Max. weight span	424.9 m	1.676 -
Min. weight span	320.1 m	1.262 -

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	39.6	26.9	7.9	-42.5	42.7
380ct1f1	117.2	94.0	25.1	-152.2	153.9
380ct1f2	117.2	94.0	25.1	-152.2	153.9
380ct1f3	118.6	96.4	25.2	-154.4	156.0
380ct2f1	117.2	94.0	25.1	-152.2	153.9
380ct2f2	117.2	94.0	25.1	-152.2	153.9
380ct2f3	118.6	96.4	25.2	-154.4	156.0
bl2	39.6	26.9	7.9	-42.5	42.7
Post 40	2.5	2.5	6.5	0.0	
Post 41	2.5	2.5	6.5	0.0	
Post 42	2.5	2.5	6.5	0.0	
Post 43	2.5	2.5	6.5	0.0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	20.4	5.8	2.8	-21.2	21.2
380ct1f1	78.3	22.4	13.9	-81.5	81.5
380ct1f2	78.3	22.4	13.9	-81.5	81.5
380ct1f3	78.3	22.4	13.9	-81.5	81.5
380ct2f1	78.3	22.4	13.9	-81.5	81.5
380ct2f2	78.3	22.4	13.9	-81.5	81.5
380ct2f3	78.3	22.4	13.9	-81.5	81.5
bl2	20.4	5.8	2.8	-21.2	21.2
Post 40	0.0	0.0	5.0	0.0	
Post 41	0.0	0.0	5.0	0.0	
Post 42	0.0	0.0	5.0	0.0	
Post 43	0.0	0.0	5.0	0.0	

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0.0	0.0
	380ct1f1	0.0	0.0
	380ct1f2	0.0	0.0
	380ct1f3	0.0	0.0
	380ct2f1	0.0	0.0
	380ct2f2	0.0	0.0
	380ct2f3	0.0	0.0
	bl2	0.0	0.0
	Post 40	0.0	
	Post 41	0.0	
	Post 42	0.0	
	Post 43	0.0	

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		65	613	171	25696	2693	0
ULS 1a_0,9_0		12	330	157	13663	566	-107
ULS 1a_0,9_0,9_90		75	583	138	24526	3100	0
ULS 3_0		-4	524	239	21755	-157	-32
SLS 7		0	292	142	12042	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

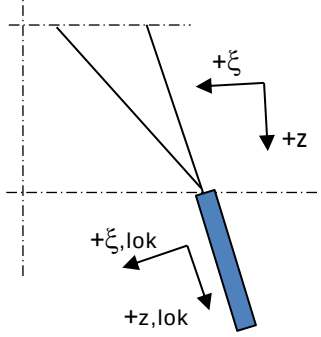
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	65	897	878	33631	2693	0
ULS 1a_0,9_0,9_90	75	867	692	32461	3100	0
SLS 7	0	292	757	12042	0	0

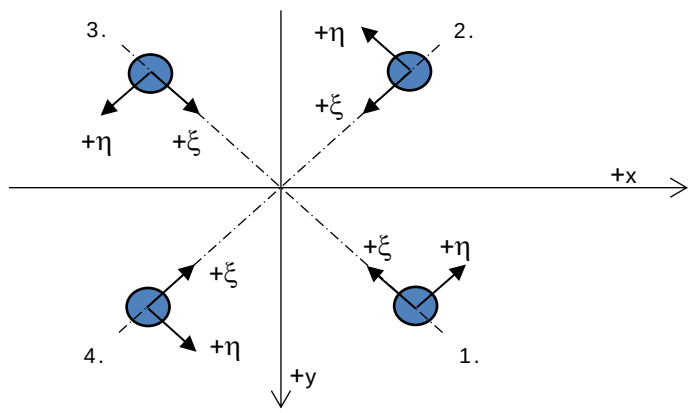
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_90	65	897	719	33686	2693	0
SPLS 3_0 Ba All Cts	793	198	787	8084	32369	-27
SPLS 6a_90 Ah Ct2 Ah Ct1	-197	352	884	13679	-8168	-5110
SPLS 3_0,9_105.95 Ba All Cts	746	316	627	12073	31717	8

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_105.95 Ba All Cts	293	306	1879	-10	-424	-95	1907
2	SPLS 3_0 Ba All Cts	180	-182	1131	1	-256	-58	1148
3	SPLS 3_135 Ah All Cts	-162	-159	1018	2	-227	-49	1033
4	SPLS 3_90 Ah All Cts	-293	305	1868	9	-422	-96	1896

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-98	-97	-624	0	138	29	-634
2	SPLS 3_0,9_90 Ah All Cts	-230	242	-1477	-8	333	75	-1500
3	SPLS 3_0,9_105.95 Ba All Cts	236	250	-1527	10	344	76	-1551
4	SPLS 3_0,9_0 Ba All Cts	122	-126	-775	-3	175	40	-787

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct1 Ah Ct2	172	-25	451	139	-104	-25	458
2	SPLS 6a_90 Ba Ct2 Ah Ct2	-47	-147	341	138	-71	-11	346
3	SPLS 6a_90 Ba Ct2 Ah Ct2	49	254	-939	145	214	50	-953
4	SPLS 6a_90 Ah Ct1 Ba Ct1	-120	322	1380	143	-312	-71	1401

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ba Ct1 Ah Ct1	123	322	1403	-141	-315	-70	1424
2	SPLS 6a_90 Ah Ct2 Ah Ct1	0	201	-619	-142	142	34	-629
3	SPLS 6a_90 Ah Ct2 Ba Ct2	52	-146	312	-140	-67	-12	317
4	SPLS 6a_90 Ba Ct1 Ah Ct1	-122	-79	123	-142	-30	-9	125

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-98	-97	-624	0	138	29	-634
2	SPLS 3_0,9_74.05 Ah All Cts	-227	241	-1473	-10	331	74	-1496
3	SPLS 3_0,9_105.95 Ba All Cts	236	250	-1527	10	344	76	-1551
4	SPLS 3_0,9_0 Ba All Cts	122	-126	-775	-3	175	40	-787

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	105	103	652	1	-147	-33	662
2	SLS 7	-44	43	-274	1	61	13	-278
3	SLS 7	44	43	-274	-1	61	13	-278
4	SLS 7	-105	103	652	-1	-147	-33	662

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 3_105.95 Ba All Cts	293	306	1879	-10	-424	-95	1907
Max. tension	SPLS 3_0,9_105.95 Ba All Cts	236	250	-1527	10	344	76	-1551
Max. pos. torsie	SPLS 6a_90 Ba Ct2 Ah Ct2	49	254	-939	145	214	50	-953
Max. neg. torsie	SPLS 6a_90 Ah Ct2 Ah Ct1	0	201	-619	-142	142	34	-629
Comb. tension+torsie	SPLS 3_0,9_105.95 Ba All Cts	236	250	-1527	10	344	76	-1551

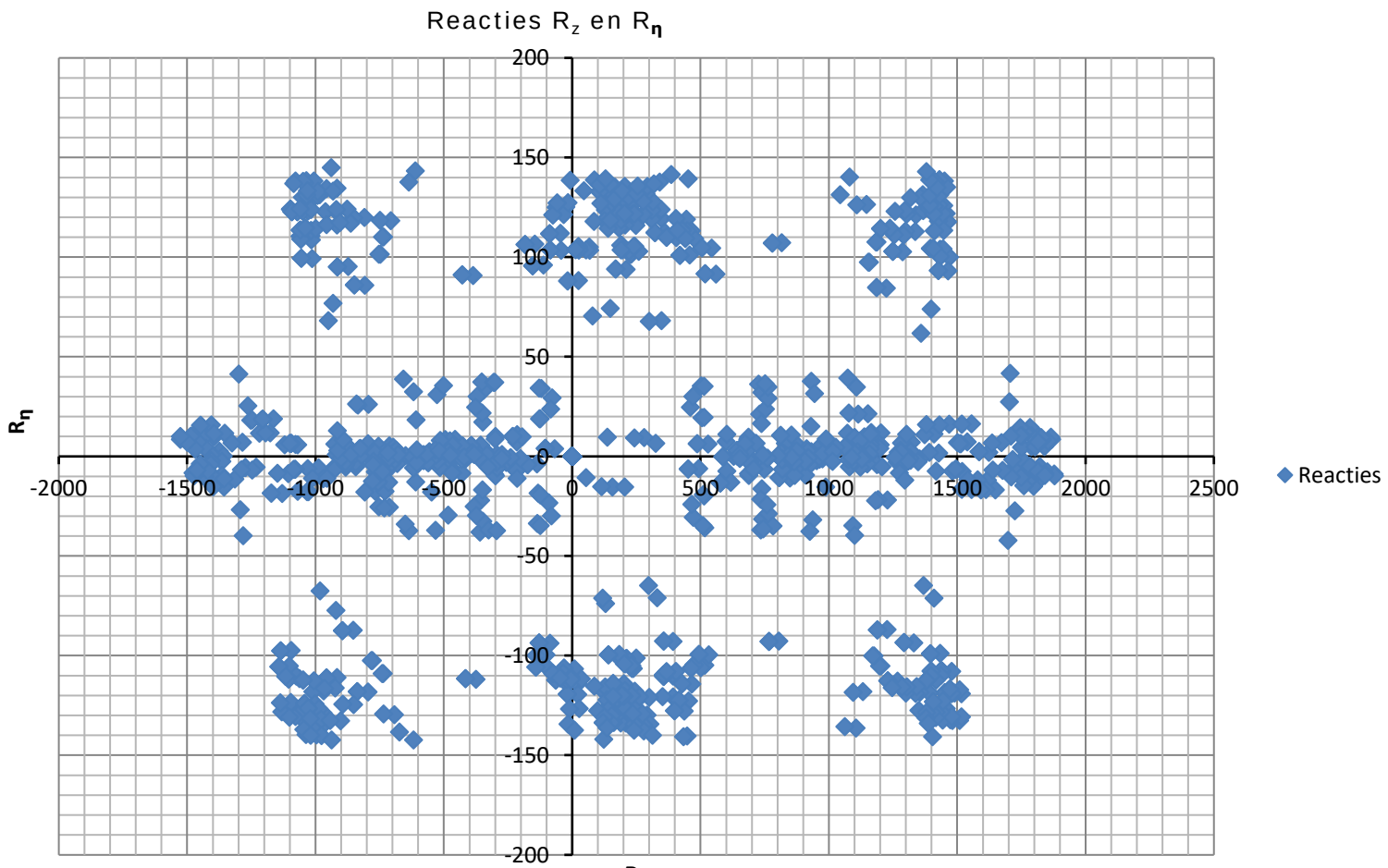
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	105	103	652	1	-147	-33	662
2	SLS 1a_90	-119	130	-740	-8	177	47	-751
3	SLS 1a_90	143	155	-893	8	211	55	-907
4	SLS 1a_0	-40	49	325	7	-63	-6	330

Maximum compression load - SLS

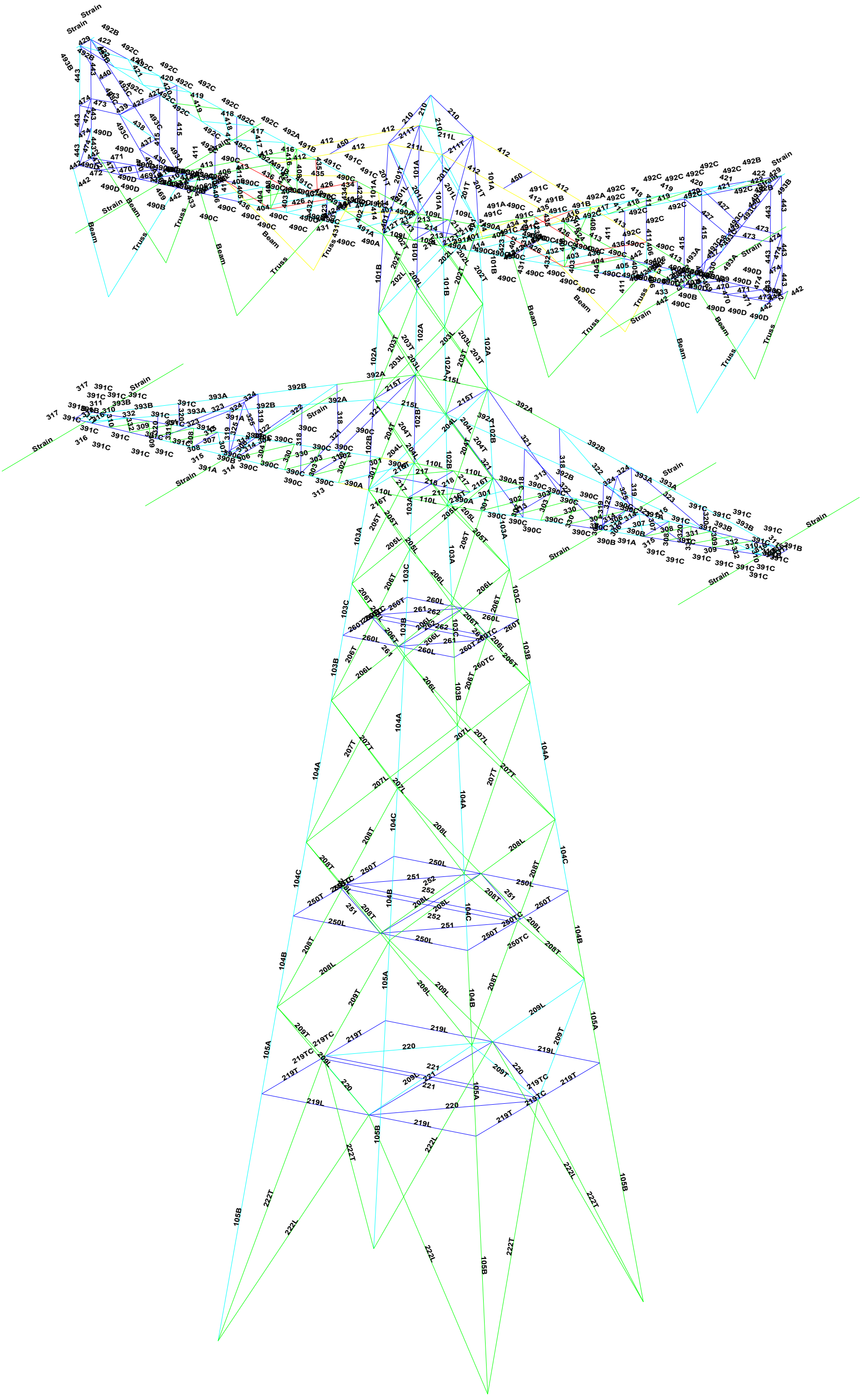
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_90	204	216	1274	-8	-297	-75	1294
2	SLS 1a_0	24	-9	53	-11	-23	-14	54
3	SLS 7	44	43	-274	-1	61	13	-278
4	SLS 1a_90	-181	192	1121	8	-263	-67	1138

Project: ENS-ZL
Tower: HB+9_R_X
Number: 65

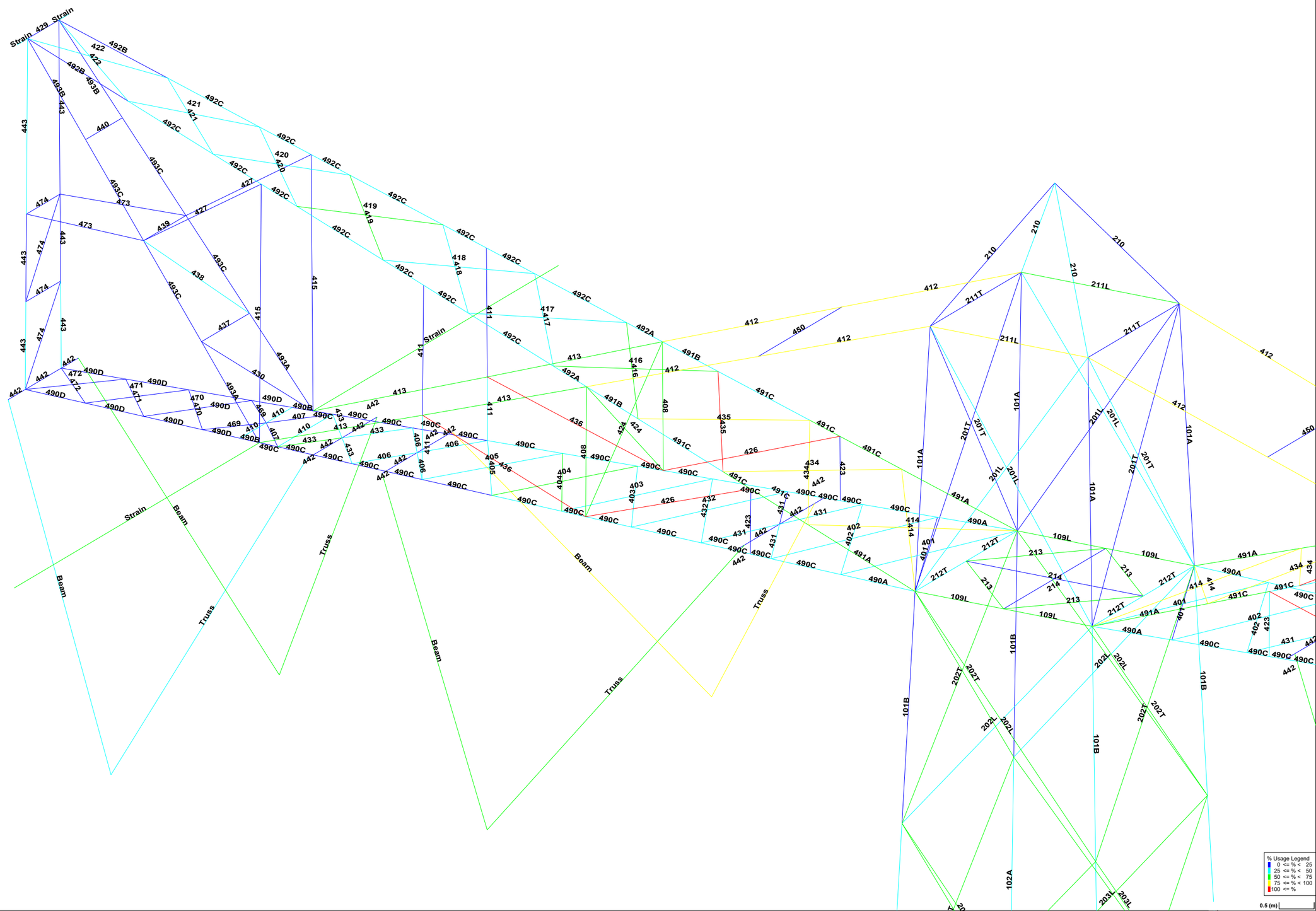


APPENDIX B
Uitvoer PLS-TOWER

DNV GL Nederlands BV, Project: "HB+9_R_X ini"
Tower Version 16.86, 14:15:29 Monday, 15 November, 2021
Undeformed geometry displayed



DNV GL Nederlands BV, Project: "HB+9_R_X ini"
Tower Version 16.86, 14:17:32 Monday, 15 November, 2021
Undeformed geometry displayed



DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 15-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+9 R_X
65

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
101A	Leg	120x120x10	S355	8M24-8.8t	0.50	0.50	0.50	85	-84.6	SPLS 3_90 Ba Ct1	485.4	1074.8	1411.2	0.17		20.8	3_0,9_105.95 Ba All Cts	635.0	1074.8	1326.8	0.03	
101B	Leg	120x120x10	S355	9M24-8.8t	0.50	0.50	0.50	74	-191.3	SPLS 6a_90 Ah All Cts Ba Ct2	557.9	1214.9	1587.6	0.34		150.2	SPLS 3_0,9_90 Ba Ct1	635.0	1214.9	1492.6	0.24	
102A	Leg	160x160x15	S355	8M24-8.8t	0.50	0.50	0.50	60	-481.6	SPLS 3_90 Ah All Cts	1288.7	1084.4	2116.8	0.44		361.5	SPLS 3_0,9_90 Ba All Cts	1372.7	1084.4	1990.2	0.33	
102B	Leg	160x160x15	S355	10M24-8.8t	0.50	0.50	0.50	64	-447.8	SPLS 3_90 Ah All Cts	1252.5	2660.2	2646.0	0.36		330.2	SPLS 3_0,9_90 Ba All Cts	1372.7	2660.2	2397.2	0.24	
103A	Leg	200x200x18	S355	10M24-8.8t	0.26	0.26	0.26	28	-804.4	SPLS 3_90 Ah All Cts	2340.7	2711.0	3175.2	0.34		658.9	SPLS 3_0,9_90 Ba All Cts	2107.6	2711.0	2985.2	0.31	
103B	Leg	200x200x18	S355	15M24-8.8t	0.52	0.52	0.52	39	-1231.3	SPLS 3_90 Ah All Cts	2218.0	4015.7	4762.8	0.56		1010.4	SPLS 3_0,9_90 Ba All Cts	2107.6	4015.7	3297.3	0.48	
103C	Leg	200x200x18	S355		0.52	0.52	0.52	31	-1229.9	SPLS 3_90 Ah All Cts	2310.4	0.0	0.0	0.53		1015.2	SPLS 3_0,9_90 Ba All Cts	2453.1	0.0	0.0	0.41	
104A	Leg	250x250x20	S355	16M24-8.8t	0.26	0.26	0.26	33	-1322.4	SPLS 3_90 Ba All Cts	3202.3	3849.7	5644.8	0.41		1120.8	SPLS 3_0,9_90 Ba All Cts	3055.2	3849.7	5307.1	0.37	
104B	Leg	250x250x20	S355	14M24-8.8t	0.52	0.52	0.52	43	-1584.8	SPLS 3_90 Ba All Cts	3043.9	3463.4	4939.2	0.52		1332.6	SPLS 3_0,9_90 Ba All Cts	3055.2	3463.4	4643.7	0.44	
104C	Leg	250x250x20	S355		0.52	0.52	0.52	34	-1580.2	SPLS 3_90 Ba All Cts	3181.2	0.0	0.0	0.50		1339.8	SPLS 3_0,9_90 Ba All Cts	3443.5	0.0	0.0	0.39	
105A	Leg	250x250x20	S355	15M24-8.8t	0.50	0.50	0.50	39	-1658.6	SPLS 3_90 Ba All Cts	3104.5	3659.9	5292.0	0.53		1365.4	SPLS 3_0,9_90 Ba All Cts	3055.2	3659.9	5292.0	0.45	
105B	Leg	250x250x20	S355	12M24-8.8t	0.17	0.17	0.17	38	-1666.1	SPLS 3_90 Ba All Cts	3126.9	2975.4	4233.6	0.56		1356.6	SPLS 3_0,9_90 Ba All Cts	3055.2	2975.4	3980.3	0.46	
390A	Onderregel eerste dwarsarm	200x200x16	S355	8M24-8.8t	1.00	2.26	1.00	56	-771.9	SPLS 6a_90 Ah Ct1 Ba Ct1	1762.8	920.6	2257.9	0.84		553.8	SPLS 3_0,9_105.95 Ba Ct2	1467.5	920.6	2122.8	0.60	
390B	Onderregel eerste dwarsarm	200x200x16	S355	7M24-8.8t	2.00	###	1.00	59	-415.3	SPLS 6a_90 Ah Ct1 Ba Ct1	1719.3	948.9	1975.7	0.44		289.3	SPLS 3_0,9_105.95 Ba Ct2	1886.8	948.9	1857.5	0.30	
390C	Onderregel eerste dwarsarm	200x200x16	S355		1.00	2.39	1.00	56	-726.7	SPLS 6a_90 Ah Ct1 Ba Ct1	1762.7	0.0	0.0	0.41		508.5	SPLS 3_0,9_105.95 Ba Ct2	2193.9	0.0	0.0	0.23	
391A	Onderregel eerste dwarsarm	160x160x15	S355	7M24-8.8t	1.00	2.36	1.00	75	-385.3	SPLS 6a_90 Ah Ct1 Ba Ct1	1118.1	948.9	1852.2	0.41		257.4	SPLS 3_0,9_105.95 Ba Ct2	1372.7	948.9	1583.1	0.27	
391B	Onderregel eerste dwarsarm	160x160x15	S355		1.00	2.32	1.00	12	-1.7	ULS 3_135	1658.2	0.0	0.0	0.00		0.5	SPLS 3_0,9_135 Ba Ct1	1658.2	0.0	0.0	0.00	
391C	Onderregel eerste dwarsarm	160x160x15	S355		1.00	3.29	1.00	75	-350.8	SPLS 6a_90 Ah Ct1 Ba Ct1	1118.5	0.0	0.0	0.31		219.9	SPLS 3_0,9_105.95 Ba Ct2	1658.2	0.0	0.0	0.13	
490A	Onderregel tweede dwarsarm	150x150x14	S355	10M24-8.8t	2.22	1.00	1.00	62	-466.4	SPLS 6a_90 Ah Ct1 Ba Ct1	1096.6	1228.4	2469.6	0.43		287.7	SPLS 3_0,9_90 Ba Ct2	743.1	1228.4	2321.8	0.39	
490B	Onderregel tweede dwarsarm	150x150x14	S355		1.95	###	1.00	87	-7.8	SPLS 1a_0 Ah Ct1	810.3	0.0	0.0	0.01		15.4	ULS 1a_0,9_0	1425.0	0.0	0.0	0.01	
490C	Onderregel tweede dwarsarm	150x150x14	S355		2.36	1.00	1.00	62	-450.8	SPLS 6a_90 Ah Ct1 Ba Ct1	1096.2	0.0	0.0	0.41		266.4	SPLS 3_0,9_90 Ba Ct2	1425.0	0.0	0.0	0.19	
392A	Bovenregel eerste dwarsarm	100x100x8	S235	4M24-8.8t	2.01	1.00	1.00	247	0.0		62.3	542.2	414.7	0.00		133.4	SPLS 6a_90 Ba Ct1 Ba Ct2	211.1	542.2	368.6	0.63	
392B	Bovenregel eerste dwarsarm	100x100x8	S235	4M20-8.8t	2.00	1.00	1.00	247	0.0		62.3	376.3	345.6	0.00		96.3	SPLS 6a_90 Ba Ct1 Ba Ct2	310.5	376.3	314.2	0.31	
393A	Bovenregel eerste dwarsarm	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	312	-4.4	SPLS 3_0,9_105.95 Ba All Cts	34.3	376.3	345.6	0.13		82.6	SPLS 6a_90 Ba Ct1 Ba Ct2	227.6	376.3	314.2	0.36	
393B	Bovenregel eerste dwarsarm	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	313	-4.3	SPLS 3_0,9_105.95 Ba All Cts	34.3	376.3	345.6	0.13		82.7	SPLS 6a_90 Ba Ct1 Ba Ct2	168.3	376.3	304.4	0.49	
491A	Bovenregel tweede dwarsarm	120x120x10	S355	3M24-8.8t	1.54	1.00	1.00	82	-263.2	SPLS 6a_90 Ah All Cts Ba Ct1	419.0	406.7	529.2	0.65		237.1	SPLS 6a_90 Ah All Cts Ba Ct2	441.0	406.7	493.6	0.58	
491B	Bovenregel tweede dwarsarm	120x120x10	S355	5M24-8.8t	1.64	3.19	1.00	81	-171.7	SPLS 6a_90 Ba Ct1 Ah Ct1	419.2	677.8	882.0	0.41		159.3	SPLS 6a_90 Ah Ct2 Ba Ct2	635.0	677.8	829.2	0.25	
491C	Bovenregel tweede dwarsarm	120x120x10	S355		1.49	2.87	1.00	81	-237.2	SPLS 6a_90 Ba Ct1 Ah Ct1	419.1	0.0	0.0	0.57		216.2	SPLS 6a_90 Ah All Cts Ba Ct2	823.6	0.0	0.0	0.26	
492A	Bovenregel tweede dwarsarm	120x120x10	S355	5M24-8.8t	4.91	2.55	1.00	81	-194.7	SPLS 6a_90 Ah All Cts Ba Ct1	421.9	677.8	882.0	0.46		213.4	SPLS 6a_90 Ah All Cts Ba Ct2	635.0	677.8	829.2	0.34	
492B	Bovenregel tweede dwarsarm	120x120x10	S355	4M24-8.8t	2.32	1.00	1.00	116	-39.0	SPLS 6a_90 Ba All Cts Ah Ct1	294.6	542.2	705.6	0.13		44.0	SPLS 6a_90 Ah All Cts Ba Ct2	635.0	542.2	406.2	0.11	
492C	Bovenregel tweede dwarsarm	120x120x10	S355		1.91	1.00	1.00	80	-177.6	SPLS 6a_90 Ba All Cts Ah Ct1	423.3	0.0	0.0	0.42		193.7	SPLS 6a_90 Ah All Cts Ba Ct2	823.6	0.0	0.0	0.24	
493A	Tussenregel tweede dwarsarm	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-34.3	ULS 5a Ah 22	138.8	188.2	172.8	0.25		3.3	ULS 5a Ah 12	187.5	188.2	172.8	0.02	
493B	Tussenregel tweede dwarsarm	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-27.6	ULS 5a Ah 22	138.8	188.2	172.8	0.20		1.3	SPLS 3_0,9_0 Ba All Cts	168.5	188.2	172.8	0.01	
493C	Tussenregel tweede dwarsarm	90x90x8	S235		2.00	1.00	1.00	121	-33.2	ULS 5a Ah 22	138.8	0.0	0.0	0.24		2.1	ULS 5a Ba 12	326.7	0.0	0.0	0.01	
201L	Diagonaal	100x100x8	S235	2M24-8.8t	0.53	0.53	0.53	131	-69.0	SPLS 3_90 Ba Ct1	150.4	271.1	207.4	0.46		54.8	SPLS 6a_90 Ba Ct1 Ba Ct2	181.4	271.1	189.2	0.30	
201T	Diagonaal	100x100x8	S235	2M24-8.8t	0.53	0.53	0.53	131	-38.8	SPLS 6a_90 Ba Ct1 Ba Ct2	150.4	271.1	207.4	0.26		19.7	SPLS 3_0,9_74.05 Ba Ct1	181.4	271.1	189.2	0.11	
202L	Diagonaal	150x150x18	S235	5M24-8.8t	0.53	0.53	0.53	84	-369.0	SPLS 6a_90 Ah Ct1 Ba Ct1	733.6	677.8	1166.4	0.54		305.4	SPLS 6a_90 Ba Ct2 Ah Ct2	687.5	677.8	901.1	0.45	
202T	Diagonaal	150x150x12	S235	4M24-8.8t	0.53	0.53	0.53	83	-301.3	SPLS 6a_90 Ah Ct1 Ba Ct1	502.8	542.2	622.1	0.60		311.0	SPLS 6a_90 Ba Ct1 Ah Ct1	470.2	542.2	486.8	0.66	
203L	Diagonaal	150x150x12	S235	5M24-8.8t	0.53	0.53	0.53	91	-279.1	SPLS 6a_90 Ba Ct2 Ah Ct2	474.0	677.8	777.6	0.59		335.4	SPLS 6a_90 Ah Ct1 Ba Ct1	470.2	677.8	600.7	0.71	
203T	Diagonaal	150x150x12	S235	4M24-8.8t	0.53	0.53	0.53	91	-283.8	SPLS 6a_90 Ba Ct1 Ah Ct1	474.0	542.2	622.1	0.60		273.9	SPLS 6a_90 Ah Ct1 Ba Ct1	470.2	542.2	486.8	0.58	
204L	Diagonaal	160x160x17	S235	5M24-8.8t	0.53	0.53	0.53	91	-376.5	SPLS 6a_90 Ba Ct1 Ah Ct1	704.3	677.8	1101.6	0.56		325.9	SPLS 6a_90 Ah Ct2 Ba Ct2	704.7	677.8	851.0	0.48	
204T	Diagonaal	150x150x18	S235	4M24-8.8t	0.53	0.53	0.53	98	-329.2	SPLS 6a_90 Ah Ct2 Ba Ct2	656.1	542.2	933.1	0.61		297.6	SPLS 3_0,9_90 Ba Ct1	687.5	542.2	730.1	0.55	
205L	Diagonaal	150x150x18	S355	6M24-8.8t	0.56	0.28	0.28	73	-539.7	SPLS 6a_90 Ah Ct1 Ba Ct1	998.6	810.8	1905.1	0.67		492.5	SPLS 6a_90 Ba Ct2 Ah Ct2	963.7	810.8	1699.3	0.61	
205T	Diagonaal	150x150x18	S355	6M24-8.8t	0.56	0.28	0.28	73	-498.5	SPLS 6a_90 Ah Ct2 Ba Ct2	998.6	810.8	1905.1	0.61		489.2	SPLS 6a_90 Ba Ct1 Ah Ct1	963.7	810.8	1699.3	0.60	
206L	Diagonaal	150x150x12	S355	5M24-8.8t	1.00	0.56	0.56	91	-383.1	SPLS 6a_90 Ba Ct2 Ah Ct2	569.7	677.8	1058.4	0.67		417.3	SPLS 6a_90 Ah Ct1 Ba Ct1	659.1	677.8	948.4	0.63	
206T	Diagonaal	150x150x12	S355	5M24-8.8t	1.00	0.56	0.56	91	-393.1	SPLS 6a_90 Ba Ct1 Ah Ct1	569.7	677.8	1058.4	0.69		388.2	SPLS 6a_90 Ba Ct2 Ah Ct2	659.1	677.8	948.4	0.59	
207L	Diagonaal	160x160x15	S355	4M24-8.8t	0.56	0.28	0.28	106	-329.5	SPLS 6a_90 Ah Ct1 Ba Ct1	655.8	542.2	1058.4	0.61		302.3	SPLS 6a_90 Ba Ct2 Ah Ct2	890.7	542.2	969.6	0.56	
207T	Diagonaal	160x160x15	S355	4M24-8.8t	0.56	0.28	0.28	106	-308.5	SPLS 6a_90 Ah Ct2 Ba Ct2	655.8	542.2	1058.4	0.57		308.5	SPLS 6a_90 Ba Ct1 Ah Ct1	890.7	542.2	969.6	0.57	
208L	Diagonaal	160x160x15	S355	3M24-8.8t	1.00	0.56	0.56	126	-244.5	SPLS 3_0,9_105.95 Ah Ct2	537.0	406.7	793.8	0.60		255.0	SPLS 6a_90 Ah Ct1 Ba Ct1	890.7	406.7	739.0	0.63	
208T	Diagonaal	160x160x15	S355	3M24-8.8t	1.00	0.56	0.56	126	-257.1	SPLS 6a_90 Ba Ct1 Ah Ct1	537.0	406.7	793.8	0.63		238.9	SPLS 6a_90 Ba Ct2 Ah Ct2	890.7	406.7	739.0	0.59	
209L	Diagonaal	160x160x15	S355	3M24-8.8t	1.00	0.50	0.50	123	-213.5	SPLS 6a_90 Ah Ct1 Ba Ct1	549.3	406.7	793.8	0.53		199.9	SPLS 3_0,9_74.05 Ba Ct2	890.7	406.7	739.0	0.49	
209T	Diagonaal	160x160x15	S355	3M24-8.8t	1.00	0.50	0.50	123	-191.8	SPLS 3_0,9_105.95 Ah Ct2	549.3	406.7	793.8	0.47		207.1	SPLS 6a_90 Ba Ct1 Ah Ct1	890.7	406.7	739.0	0.51	
222L	Diagonaal	150x150x12	S355	4M24-8.8t	0.17	0.17	0.17	73	-310.3	SPLS 3_105.95 Ah Ct1	722.6	542.2	846.7	0.57		289.7	ULS 3_0,9_105.95 Ah Ct2	659.1	542.2	763.9	0.53	
222T	Diagonaal	150x150x12	S355	4M24-8.8t	0.17	0.17	0.17	73	-292.0	SPLS 6a_90 Ba Ct2 Ah Ct2	722.6	542.2	846.7	0.54		279.4	SPLS 6a_90 Ba Ct1 Ah Ct1	659.1	542.2	763.9	0.52	
210	Top	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	174	-21.3	SPLS 3_105.95 Ah Ct1	84.7	188.2	172.8	0.25		21.2	SPLS 3_105.95 Ah Ct1	146.3	188.2	157.1	0.14	
211L	Tweede dwarsarm in tower	90x90x8	S235	4M24-8.8t	1.00	1.00	1.00	148	0.0		117.9	542.2	414.7	0.00		143.3	SPLS 6a_90 Ah All Cts Ba Ct2	185.9	542.2	357.1	0.77	
211T	Tweede dwarsarm in tower	70x70x7	S235	1M16-8.8t	1.00	1.00	1.00	191	-4.4	SPLS 6a_90 Ba Ct1 Ba Ct2	45.6	60.3	60.5	0.10		8.0	SPLS 6a_90 Ba Ct1 Ba Ct2	92.7	60.3	52.3	0.15	
109L	Tweede dwarsarm in tower	150x150x14	S355	10M24-8.8t	1.00	2.00	1.00	64	-588.8	SPLS 6a_90 Ah All Cts Ba Ct1	1076.0	1228.4	2469.6	0.55		449.7	3_0,9_105.95 Ba All Cts	743.1	1228.4	2321.8	0.61	
212T	Tweede dwarsarm in tower	120x120x10	S235	6M24-8.8t	1.00	2.00	1.00	79	-124.4	SPLS 6a_90 Ba Ct1 Ba Ct2	328.3	813.3	777.6	0.38		148.2	SPLS 6a_90 Ba Ct1 Ba Ct2	466.6	813.3	731.1	0.32	
213	Tweede dwarsarm in tower	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	87	-181.5	SPLS 6a_90 Ah Ct1 Ba Ct1	325.2	406.7	388.8	0.56		181.4	SPLS 6a_90 Ah Ct1 Ba Ct1	324.0	406.7	359.4	0.56	
214	Tweede dwarsarm in tower	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	150	-0.5	ULS 3_0	31.9	60.3	43.2	0.02		0.5	SPLS 6a_90 Ah Ct2 Ba Ct2	46.1	60.3	32.7	0.01	
215L	Eerste dwarsarm in tower	120x120x10	S235	5M24-8.8t	1.00	1.00	1.00	148	-34.2	SPLS 3_0,9_0 Ba All Cts	196.7	677.8	648.0	0.17		188.8	SPLS 3_135 Ah All Cts	342.3	677.8	609.2	0.55	
215T	Eerste dwarsarm in tower	150x150x12	S235	3M24-8.8t	1.00	1.00	1.00	118	-71.3	ULS 1a_0,9_90	377.5	406.7	466.6	0.19		93.7	ULS 1a_90	512.3	406.7	438.6	0.23	
110L	Eerste dwarsarm in tower	200x200x16	S355	8M24-8.8t	1.00	2.00	1.00	62	-524.7	SPLS 6a_90 Ah All Cts Ba Ct1	1686.0	920.6	2257.9	0.57		399.3	3_0,9_105.95 Ba All Cts	1467.5	920.6	2122.8	0.43	
216T	Eerste dwarsarm in tower	120x120x12	S235	5M24-8.8t	1.00	2.00	1.00	104	-151.4	SPLS 3_0,9_74.05 Ba Ct1	317.5	677.8	777.6	0.48		194.4	SPLS 3_90 Ba Ct1	551.1	677.8	731.1	0.35	
217	Eerste dwarsarm in tower	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	114	-185.9	SPLS 6a_90 Ba Ct1 Ah Ct1	261.1	406.7	388.8	0.71		186.6	SPLS 6a_90 Ba Ct1 Ah Ct1	324.0	406.7	359.4	0.58	
218	Eerste dwarsarm in tower	50x50x7	S235	1M16-8.8t	0.50	0.50	0.50	200	-0.8	ULS 3_74.05	29.9	60.3	60.5	0.03		1.0	ULS 3_74.05	64.5	60.3	45.8	0.02	
219L	Onderstuk in tower	100x100x8	S235	2M16-8.8t	1.00	1.00	1.00	264	-10.4	SPLS 1a_0,9_90 Ba All Cts	58.6	120.6	138.2	0.18		5.7	1a_0,9_74.05 Ba All Cts	245.7	120.6	119.5	0.05	
219T	Onderstuk in tower	100x100x8	S235	2M16-8.8t	1.04	1.00	1.00	254	-8.3	SPLS 1a_0,9_135 Ah Ct2	61.9	120.6	138.2	0.13		6.2	ULS 1a_0,9_45	245.7	120.6	119.5	0.05	
219TC	Onderstuk in tower	100x100x8	S235	5M16-8.8t	###	2.00	1.00	169	-15.5	ULS 1a_45	105.7	301.4	345.6	0.15		13.2	ULS 1a_0,9_45	327.1	301.4	256.0	0.05	
220	Onderstuk in tower	100x100x8	S235	1M20-8.8t	1.00	1.00	1.00	366	-7.6	ULS 1a_135	27.6	94.1	86.4	0.27		6.5	ULS 1a_0,9_45	179.7	94.1	78.5	0.08	
221	Onderstuk in tower	100x100x8	S235	1M20-8.8t	0.50	0.50	0.50	264	-2.4	ULS 1a_0	46.9	94.1	86.4	0.05		0.4	ULS 1a_0,9_0,9_0	179.7	94.1	78.5	0.01	
301	Diagonaal onderregel eerste dwarsarm	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	140	-56.9	SPLS 3_0,9_105.95 Ba All Cts	111.3	188.2	172.8	0.51		63.9	SPLS 3_105.95 Ba All Cts	149.6	188.2	139.6	0.46	
302	Diagonaal onderregel eerste dwarsarm	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	130	-70.6	SPLS 6a_90 Ba Ct2 Ah Ct2	120.9	188.2	172.8	0.58		64.8	SPLS 3_0,9_105.95 Ba Ct1	151.2	188.2	139.6	0.46	
303	Diagonaal onderregel eerste dwarsarm	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	120	-70.0	SPLS 6a_90 Ba All Cts Ah Ct2	131.9	188.2	172.8	0.53		71.2	SPLS 6a_90 Ba All Cts Ah Ct2	149.6	188.2	139.6	0.51	
304	Diagonaal onderregel eerste dwarsarm	90x90x8	S235	2M24-8.8t	0.55	0.55	0.55	93	-88.4	SPLS 6a_90 Ba All Cts Ah Ct2	186.3	271.1	207.4	0.47		89.6	SPLS 6a_90 Ba All Cts Ah Ct2	150.3	271.1	141.8	0.63	
306	Diagonaal onderregel eerste dwarsarm	80x80x8	S235	2M24-8.8t	0.50	0.50	0.50	83	-39.7	SPLS 6a_90 Ba All Cts Ah Ct2	178.6	271.1	207.4	0.22		53.8	SPLS 6a_90 Ba All Cts Ah Ct2	125.9	271.1	162.4	0.43	
307	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	112	-35.8	SPLS 6a_90 Ah All Cts Ba Ct1	107.5	188.2	151.2	0.33		35.0	3_0,9_105.95 Ba All Cts	90.5	188.2	79.7	0.44	
308	Diagonaal onderregel eerste dwarsarm	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	110	-35.1	SPLS 6a_90 Ba All Cts Ah Ct2	80.5	120.6	103.7	0.44		34.5	SPLS 6a_90 Ba All Cts Ah Ct2	67.0	120.6	56.7	0.61	
309	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	79	-47.5	SPLS 6a_90 Ba All Cts Ah Ct2	140.3	188.2	151.2	0.34		48.9	SPLS 6a_90 Ba All Cts Ah Ct2	90.5	188.2	97.1	0.54	
310	Diagonaal onderregel eerste dwarsarm	90x90x8	S235	2M24-8.8t	0.55	0.55	0.55	49	-63.4	SPLS 6a_90 Ba Ct2 Ah Ct2	252.8	271.1	207.4	0.31		62.7	SPLS 6a_90 Ba All Cts Ah Ct2	159.7	271.1	183.4	0.39	
311	Diagonaal onderregel eerste dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	51	-39.5	SPLS 3_0,9_105.95 Ba Ct1	250.3	271.1	207.4	0.19		31.8	SPLS 3_0,9_105.95 Ba Ct1	136.2	271.1	104.6	0.30	
313	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	82	0.0		570.7	188.2	216.0	0.00		3.3	SPLS 6a_90 Ba Ct2 Ba Ct1	766.1	188.2	0.0	0.02	
314	Dwarsligger onderregel eerste dwarsarm	150x150x12	S355		2.00	2.00	2.00	83	0.0		656.2	0.0	0.0	0.00		52.8	ULS 3_90	536.9	271.1	379.9	0.19	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 15-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+9 R_X
65

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
315	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	54	-3.5	ULS 3_0,9_90	689.5	188.2	216.0	0.02		3.4	ULS 5a Ah 11	766.1	188.2	0.0	0.02	
316	Dwarsligger onderregel eerste dwarsarm	150x150x12	S355	2M24-8.8t	2.00	1.00	1.00	24	0.0		1022.5	271.1	423.4	0.00		85.1	ULS 3_105.95	496.7	271.1	191.8	0.44	
317	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	26	-14.0	ULS 3_0,9_90	790.1	188.2	216.0	0.07		0.0		766.1	188.2	0.0	0.00	
318	Verticaal eerste dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	171	-20.8	SPLS 6a_90 Ah Ct2 Ba Ct2	98.1	271.1	207.4	0.21		0.0		159.7	271.1	183.4	0.00	
319	Verticaal eerste dwarsarm	80x80x6#	S235	1M16-8.8t	1.00	1.00	1.00	126	-4.6	SPLS 6a_90 Ah Ct1 Ba Ct1	76.2	60.3	51.8	0.09		0.0		107.1	60.3	44.8	0.00	
320	Verticaal eerste dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	104	-1.1	SPLS 6a_90 Ba Ct2 Ba Ct1	47.2	60.3	43.2	0.03		0.0		46.1	60.3	32.7	0.00	
321	Diagonaal eerste dwarsarm	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	346	0.0		30.1	188.2	172.8	0.00		33.0	ULS 3_105.95	162.8	188.2	157.1	0.21	
322	Diagonaal eerste dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	268	0.0		51.1	271.1	207.4	0.00		46.9	SPLS 6a_90 Ah Ct2 Ba Ct2	136.2	271.1	161.3	0.34	
323	Diagonaal eerste dwarsarm	70x70x7	S235	1M20-8.8t	1.00	1.00	1.00	307	0.0		22.4	94.1	75.6	0.00		15.5	SPLS 6a_90 Ah Ct1 Ba Ct1	84.7	94.1	65.2	0.24	
324	Dwarsligger bovenregel eerste dwarsarm	70x70x7	S235	1M20-8.8t	2.00	1.00	1.00	110	-0.9	ULS 1a_0	93.2	94.1	75.6	0.01		0.8	ULS 1a_0,9_0	84.7	94.1	65.2	0.01	
325	Tussen diagonaal eerste dwarsarm	80x80x8	S235	1M20-8.8t	1.00	1.00	1.00	151	-2.4	ULS 1a_0	81.0	94.1	86.4	0.03		1.6	ULS 1a_0,9_0	133.6	94.1	78.5	0.02	
401	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	126	-23.9	SPLS 1a_0 Ba Ct2	95.8	188.2	151.2	0.25		23.0	SPLS 1a_0,9_0 Ba All Cts	90.5	188.2	91.6	0.25	
402	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	119	-26.0	SPLS 1a_0,9_0 Ba Ct1	101.5	188.2	151.2	0.26		31.0	SPLS 3_0 Ba Ct2	90.5	188.2	100.8	0.34	
403	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	97	-36.0	SPLS 3_0,9_0 Ba Ct1	121.8	188.2	151.2	0.30		36.2	SPLS 3_90 Ba Ct2	90.5	188.2	100.8	0.40	
404	Diagonaal onderregel tweede dwarsarm	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	97	-48.8	SPLS 3_105.95 Ba All Cts	121.5	188.2	151.2	0.40		50.6	SPLS 6a_90 Ba Ct1 Ah Ct1	90.5	188.2	117.6	0.56	
405	Diagonaal onderregel tweede dwarsarm	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	67	-57.9	SPLS 6a_90 Ba Ct1 Ah Ct1	226.0	271.1	207.4	0.28		52.0	SPLS 3_0,9_105.95 Ba All Cts	136.2	271.1	141.8	0.38	
406	Diagonaal onderregel tweede dwarsarm	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	59	-61.4	SPLS 3_105.95 Ba Ct1	239.1	271.1	207.4	0.30		55.7	SPLS 3_105.95 Ba Ct1	144.0	271.1	159.5	0.39	
407	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	2M24-8.8t	1.00	1.00	1.00	65	-35.8	SPLS 6a_90 Ba Ct1 Ah Ct1	203.3	271.1	207.4	0.18		26.1	SPLS 3_0,9_90 Ba Ct1	117.7	271.1	156.0	0.22	
408	Diagonaal onderregel tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	202	-7.7	SPLS 6a_90 Ah All Cts Ba Ct2	21.5	60.3	43.2	0.36		20.1	SPLS 6a_90 Ah All Cts Ba Ct2	46.1	60.3	32.7	0.62	
410	Dwarsligger onderregel tweede dwarsarm	150x150x12	S235	2M24-8.8t	1.00	2.00	1.00	32	0.0		667.4	271.1	311.0	0.00		73.9	ULS 3_0,9_90	365.0	271.1	146.2	0.51	
411		50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	203	-1.8	SPLS 6a_90 Ah Ct1 Ba Ct1	24.2	60.3	43.2	0.07		15.8	SPLS 1a_0 Ah Ct2	46.1	60.3	32.7	0.48	
412	Bovenregel tweede dwarsarm	90x90x8	S235	3M24-8.8t	2.00	2.00	2.00	349	0.0		33.6	406.7	311.0	0.00		181.5	SPLS 6a_90 Ah All Cts Ba Ct2	185.9	542.2	357.1	0.98	
413	Bovenregel tweede dwarsarm	90x90x8	S235	4M20-8.8t	2.00	1.00	1.00	215	0.0		68.3	376.3	345.6	0.00		148.3	SPLS 6a_90 Ba Ct1 Ba Ct2	193.9	376.3	314.2	0.76	
414	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	160	-24.7	SPLS 6a_90 Ah All Cts Ba Ct2	42.5	60.3	51.8	0.58		25.4	SPLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.90	
415	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	334	-2.6	SPLS 1a_105.95 Ba All Cts	14.3	60.3	51.8	0.18		0.0		48.4	60.3	33.7	0.00	
416	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	126	-25.7	SPLS 6a_90 Ah All Cts Ba Ct2	56.3	60.3	51.8	0.50		22.0	SPLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.78	
417	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	118	-10.1	SPLS 6a_90 Ah Ct2 Ba Ct2	59.8	60.3	51.8	0.19		9.7	SPLS 6a_90 Ah Ct2 Ba Ct2	72.6	60.3	28.2	0.35	
418	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	111	-13.9	SPLS 6a_90 Ah All Cts Ba Ct2	63.5	60.3	51.8	0.27		14.5	SPLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.52	
419	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	105	-16.6	SPLS 6a_90 Ah All Cts Ba Ct2	66.8	60.3	51.8	0.32		15.5	SPLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.55	
420	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	97	-18.7	SPLS 6a_90 Ah All Cts Ba Ct2	89.1	120.6	103.7	0.21		19.9	SPLS 6a_90 Ah All Cts Ba Ct2	78.2	120.6	56.3	0.35	
421	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	92	-26.2	SPLS 6a_90 Ah All Cts Ba Ct2	92.9	120.6	103.7	0.28		23.9	SPLS 6a_90 Ah All Cts Ba Ct2	78.2	120.6	56.3	0.43	
422	Diagonaal bovenregel tweede dwarsarm	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	98	-34.7	SPLS 6a_90 Ba Ct1 Ah Ct1	88.8	120.6	103.7	0.39		38.6	SPLS 6a_90 Ah All Cts Ba Ct2	78.2	120.6	76.8	0.50	
423	Verticaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	101	-1.2	ULS 1a_0,9_0	48.1	60.3	43.2	0.03		8.9	ULS 1a_0	46.1	60.3	32.7	0.27	
424	Verticaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	152	-22.8	SPLS 6a_90 Ah All Cts Ba Ct2	31.6	60.3	43.2	0.72		22.8	SPLS 6a_90 Ah All Cts Ba Ct2	46.1	60.3	32.7	0.70	
426	Diagonaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	308	-15.1	SPLS 1a_0 Ah Ct2	11.4	60.3	43.2	1.33	knik	0.1	SPLS 1a_0,9_0 Ah Ct2	46.1	60.3	25.2	0.00	
427	Diagonaal tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	244	0.0		16.4	60.3	43.2	0.00		1.0	ULS 1a_105.95	46.1	60.3	20.5	0.05	
429	Dwarsligger bovenregel tweede dwarsarm	UNP160	S235	3M20-8.8t	1.00	1.00	1.00	47	0.0		409.5	282.2	243.0	0.00		34.6	ULS 3_0,9_90	306.9	282.2	187.2	0.19	
430	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	227	-1.8	SPLS 1a_135 Ba All Cts	18.2	60.3	43.2	0.10		2.9	ULS 1a_0	46.1	60.3	32.7	0.09	
431		70x70x7	S235	2M20-8.8t	1.00	1.00	1.00	106	-34.3	SPLS 1a_0 Ba Ct2	113.0	188.2	151.2	0.30		29.0	SPLS 3_0 Ba Ct2	90.5	188.2	100.8	0.32	
432		70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	108	-31.9	SPLS 3_90 Ba Ct2	111.2	188.2	151.2	0.29		28.9	SPLS 3_0,9_0 Ba Ct1	90.5	188.2	100.8	0.32	
433		90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	62	-64.3	SPLS 6a_90 Ba All Cts Ah Ct2	234.4	271.1	207.4	0.31		70.4	SPLS 3_105.95 Ba Ct1	144.0	271.1	159.5	0.49	
434		60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	141	-26.4	SPLS 6a_90 Ah All Cts Ba Ct2	49.5	60.3	51.8	0.53		25.5	SPLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	0.91	
435		60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	133	-30.3	SPLS 6a_90 Ah All Cts Ba Ct2	52.7	60.3	51.8	0.58		31.2	SPLS 6a_90 Ah All Cts Ba Ct2	72.6	60.3	28.2	1.11	stuik
436		50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	305	-26.0	SPLS 1a_0 Ah Ct2	11.5	60.3	43.2	2.26	knik	2.4	SPLS 1a_0,9_0 Ah Ct1	46.1	60.3	32.7	0.07	
437	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	141	-3.5	SPLS 1a_0 Ah All Cts	34.4	60.3	43.2	0.10		2.6	SPLS 1a_135 Ba All Cts	46.1	60.3	32.7	0.08	
438	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	217	-6.5	SPLS 1a_135 Ba All Cts	19.5	60.3	43.2	0.33		9.5	SPLS 1a_0 Ah All Cts	46.1	60.3	32.7	0.29	
439	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	125	-3.1	SPLS 1a_0 Ah All Cts	39.5	60.3	43.2	0.08		2.1	SPLS 1a_135 Ba All Cts	46.1	60.3	32.7	0.06	
440	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	108	0.0	SPLS 6a_90 Ah Ct2 Ba Ct2	45.3	60.3	43.2	0.00		0.0	ULS 3_0,9_105.95	46.1	60.3	32.7	0.00	
330		80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	111	-78.7	SPLS 6a_90 Ba All Cts Ah Ct2	141.9	188.2	172.8	0.55		76.2	SPLS 6a_90 Ba All Cts Ah Ct2	149.6	188.2	139.6	0.55	
331		60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	100	-41.0	SPLS 6a_90 Ba All Cts Ah Ct2	87.4	120.6	103.7	0.47		40.8	SPLS 6a_90 Ba All Cts Ah Ct2	67.0	120.6	56.7	0.72	
332		70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	73	-55.7	SPLS 6a_90 Ba All Cts Ah Ct2	147.1	188.2	151.2	0.38		52.5	SPLS 6a_90 Ba All Cts Ah Ct2	90.5	188.2	101.5	0.58	
250L		90x90x8	S235	2M16-8.8t	1.00	1.00	1.00	239	-10.9	SPLS 3_0,9_90 Ba All Cts	61.1	120.6	138.2	0.18		7.7	SPLS 1a_0,9_74.05 Ba All Cts	167.5	120.6	119.5	0.06	
250T		90x90x8	S235	2M16-8.8t	1.00	1.00	1.00	225	-7.6	ULS 1a_0,9_74.05	66.6	120.6	138.2	0.11		6.4	ULS 1a_0,9_45	167.5	120.6	119.5	0.05	
250TC		90x90x8	S235		1.00	1.00	1.00	13	-13.3	ULS 1a_45	293.9	0.0	0.0	0.05		11.6	ULS 1a_0,9_45	326.7	0.0	0.0	0.04	
251		90x90x8	S235	1M16-8.8t	1.00	1.00	1.00	328	-5.7	ULS 1a_135	29.6	60.3	69.1	0.19		4.8	ULS 1a_0,9_45	165.9	60.3	59.7	0.08	
252		80x80x8	S235	1M16-8.8t	0.50	0.50	0.50	269	-1.9	ULS 1a_0	36.0	60.3	69.1	0.05		0.4	ULS 1a_0,9_0	142.8	60.3	59.7	0.01	
260L		80x80x6#	S235	2M16-8.8t	1.00	1.00	1.00	169	-11.8	SPLS 3_0,9_90 Ba All Cts	67.4	120.6	103.7	0.17		10.3	SPLS 3_135 Ah All Cts	111.8	120.6	89.6	0.11	
260T		80x80x6#	S235	2M16-8.8t	1.00	1.00	1.00	155	-7.4	ULS 1a_0,9_90	75.3	120.6	103.7	0.10		7.7	ULS 1a_74.05	111.8	120.6	89.6	0.09	
260TC		80x80x6#	S235		1.00	1.00	1.00	14	-9.9	SPLS 1a_0,9_45 Ba Ct1	198.4	0.0	0.0	0.05		10.0	ULS 1a_45	220.9	0.0	0.0	0.05	
261		90x90x8	S235	1M20-8.8t	1.00	1.00	1.00	207	-6.4	SPLS 1a_105.95 Ah Ct1	60.3	94.1	86.4	0.11		5.6	SPLS 1a_0,9_74.05 Ba Ct2	156.7	94.1	69.8	0.08	
262		60x60x6	S235	1M20-8.8t	0.50	0.50	0.50	230	-0.9	SPLS 1a_0 Ah Ct1	25.8	94.1	64.8	0.04		0.3	ULS 1a_0,9_0	65.7	94.1	44.4	0.01	
450		50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	246	-0.1	SPLS 1a_0,9_135 Ba All Cts	16.2	60.3	43.2	0.01		0.2	SPLS 1a_0,9_0 Ba All Cts	46.1	60.3	32.7	0.01	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 15-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+9 R_X
65

Staafgroep	Omschrijving	Profiel	Staalsoort	Bouten	RLX	RLY	RLZ	Slankheid	Druk	Combinatie druk	Knik	Afschuiving	Stuik (druk)	U.C. (druk)	Opm.	Trek	Combinatie trek	Nettodsn.	Afschuif	Stuik (trek)	U.C. (trek)
101A	Leg	120x120x10	S355	8M24-8.8t	0.50	0.50	0.50	85	-84.8	SPLS 3_90 Ba Ct1	485.4	1074.8	1411.2	0.17		20.6	SPLS 3_0,9_105.95 Ba	635.0	1074.8	1326.8	0.03
101B	Leg	120x120x10	S355	9M24-8.8t	0.50	0.50	0.50	74	-191.6	SPLS 6a_90 Ah All Cts	557.9	1214.9	1587.6	0.34		150.0	SPLS 3_0,9_90 Ba Ct1	635.0	1214.9	1492.6	0.24
102A	Leg	160x160x15#	S355	8M24-8.8t	0.50	0.50	0.50	60	-482.1	SPLS 3_90 Ah All Cts	1288.7	1084.4	2116.8	0.44		361.3	SPLS 3_0,9_90 Ba All (	1372.7	1084.4	1990.2	0.33
102B	Leg	160x160x15#	S355	10M24-8.8t	0.50	0.50	0.50	64	-448.1	SPLS 3_90 Ah All Cts	1252.5	2660.2	2646.0	0.36		330.2	SPLS 3_0,9_90 Ba All (	1372.7	2660.2	2397.2	0.24
103A	Leg	200x200x18	S355	10M24-8.8t	0.26	0.26	0.26	28	-804.8	SPLS 3_90 Ah All Cts	2340.7	2711.0	3175.2	0.34		658.9	SPLS 3_0,9_90 Ba All (	2107.6	2711.0	2985.2	0.31
103B	Leg	200x200x18	S355	15M24-8.8t	0.52	0.52	0.52	39	-1231.8	SPLS 3_90 Ah All Cts	2218.0	4015.7	4762.8	0.56		1010.4	SPLS 3_0,9_90 Ba All (	2107.6	4015.7	3297.3	0.48
103C	Leg	200x200x18	S355		0.52	0.52	0.52	31	-1230.5	SPLS 3_90 Ah All Cts	2310.4	0.0	0.0	0.53		1015.2	SPLS 3_0,9_90 Ba All (	2453.1	0.0	0.0	0.41
104A	Leg	250x250x20#	S355	16M24-8.8t	0.26	0.26	0.26	33	-1322.8	SPLS 3_90 Ba All Cts	3202.3	3849.7	5644.8	0.41		1120.8	SPLS 3_0,9_90 Ba All (	3055.2	3849.7	5307.1	0.37
104B	Leg	250x250x20#	S355	14M24-8.8t	0.52	0.52	0.52	43	-1585.4	SPLS 3_90 Ba All Cts	3043.9	3463.4	4939.2	0.52		1332.6	SPLS 3_0,9_90 Ba All (	3055.2	3463.4	4643.7	0.44
104C	Leg	250x250x20#	S355		0.52	0.52	0.52	34	-1580.7	SPLS 3_90 Ba All Cts	3181.2	0.0	0.0	0.50		1339.8	SPLS 3_0,9_90 Ba All (	3443.5	0.0	0.0	0.39
105A	Leg	250x250x20#	S355	15M24-8.8t	0.50	0.50	0.50	39	-1659.1	SPLS 3_90 Ba All Cts	3104.5	3659.9	5292.0	0.53		1365.4	SPLS 3_0,9_90 Ba All (	3055.2	3659.9	5292.0	0.45
105B	Leg	250x250x20#	S355	12M24-8.8t	0.17	0.17	0.17	38	-1666.5	SPLS 3_90 Ba All Cts	3126.9	2975.4	4233.6	0.56		1356.6	SPLS 3_0,9_90 Ba All (	3055.2	2975.4	3980.3	0.46
390A	Onderregel eers	200x200x16	S355	8M24-8.8t	1.00	2.26	1.00	56	-771.9	SPLS 6a_90 Ah Ct1 Ba	1762.8	920.6	2257.9	0.84		553.8	SPLS 3_0,9_105.95 Ba	1467.5	920.6	2122.8	0.60
390B	Onderregel eers	200x200x16	S355	7M24-8.8t	2.00	11.06	1.00	59	-415.3	SPLS 6a_90 Ah Ct1 Ba	1719.3	948.9	1975.7	0.44		289.3	SPLS 3_0,9_105.95 Ba	1886.8	948.9	1857.5	0.30
390C	Onderregel eers	200x200x16	S355		1.00	2.39	1.00	56	-726.7	SPLS 6a_90 Ah Ct1 Ba	1762.7	0.0	0.0	0.41		508.5	SPLS 3_0,9_105.95 Ba	2193.9	0.0	0.0	0.23
391A	Onderregel eers	160x160x15#	S355	7M24-8.8t	1.00	2.36	1.00	75	-385.3	SPLS 6a_90 Ah Ct1 Ba	1118.1	948.9	1852.2	0.41		257.4	SPLS 3_0,9_105.95 Ba	1372.7	948.9	1583.1	0.27
391B	Onderregel eers	160x160x15#	S355		1.00	2.32	1.00	12	-1.7	ULS 3_135	1658.2	0.0	0.0	0.00		0.5	SPLS 3_0,9_135 Ba Ct	1658.2	0.0	0.0	0.00
391C	Onderregel eers	160x160x15#	S355		1.00	3.29	1.00	75	-350.8	SPLS 6a_90 Ah Ct1 Ba	1118.5	0.0	0.0	0.31		219.9	SPLS 3_0,9_105.95 Ba	1658.2	0.0	0.0	0.13
490A	Onderregel twe	150x150x14	S355	10M24-8.8t	2.22	1.00	1.00	62	-466.5	SPLS 6a_90 Ah Ct1 Ba	1096.6	1228.4	2469.6	0.43		287.5	SPLS 3_0,9_90 Ba Ct2	743.1	1228.4	2321.8	0.39
490B	Onderregel twe	150x150x14	S355		1.95	12.10	1.00	87	-7.8	SPLS 1a_0 Ah Ct1	810.3	0.0	0.0	0.01		15.5	ULS 1a_0,9_0	1425.0	0.0	0.0	0.01
490C	Onderregel twe	150x150x14	S355		2.36	1.00	1.00	62	-451.0	SPLS 6a_90 Ah Ct1 Ba	1096.2	0.0	0.0	0.41		266.2	SPLS 3_0,9_90 Ba Ct2	1425.0	0.0	0.0	0.19
392A	Bovenregel eers	100x100x8	S235	4M24-8.8t	2.01	1.00	1.00	247	0.0		62.3	542.2	414.7	0.00		133.4	SPLS 6a_90 Ba Ct1 Ba	211.1	542.2	368.6	0.63
392B	Bovenregel eers	100x100x8	S235	4M20-8.8t	2.00	1.00	1.00	247	0.0		62.3	376.3	345.6	0.00		96.3	SPLS 6a_90 Ba Ct1 Ba	310.5	376.3	314.2	0.31
393A	Bovenregel eers	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	312	-4.4	SPLS 3_0,9_105.95 Ba	34.3	376.3	345.6	0.13		82.6	SPLS 6a_90 Ba Ct1 Ba	227.6	376.3	314.2	0.36
393B	Bovenregel eers	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	313	-4.3	SPLS 3_0,9_105.95 Ba	34.3	376.3	345.6	0.13		82.7	SPLS 6a_90 Ba Ct1 Ba	168.3	376.3	304.4	0.49
491A	Bovenregel twe	120x120x10	S355	3M24-8.8t	1.54	1.00	1.00	82	-263.7	SPLS 6a_90 Ah All Cts	419.0	406.7	529.2	0.65		236.6	SPLS 6a_90 Ah All Cts	441.0	406.7	493.6	0.58
491B	Bovenregel twe	120x120x10	S355	5M24-8.8t	1.64	3.19	1.00	81	-171.6	SPLS 6a_90 Ba Ct1 Ah	419.2	677.8	882.0	0.41		159.3	SPLS 6a_90 Ah Ct2 Ba	635.0	677.8	829.2	0.25
491C	Bovenregel twe	120x120x10	S355		1.49	2.87	1.00	81	-237.7	SPLS 6a_90 Ba Ct1 Ah	419.1	0.0	0.0	0.57		216.2	SPLS 6a_90 Ah All Cts	823.6	0.0	0.0	0.26
492A	Bovenregel twe	120x120x10	S355	5M24-8.8t	4.91	2.55	1.00	81	-194.5	SPLS 6a_90 Ah All Cts	421.9	677.8	882.0	0.46		213.4	SPLS 6a_90 Ah All Cts	635.0	677.8	829.2	0.34
492B	Bovenregel twe	120x120x10	S355	4M24-8.8t	2.32	1.00	1.00	116	-38.8	SPLS 6a_90 Ba All Cts	294.6	542.2	705.6	0.13		44.0	SPLS 6a_90 Ah All Cts	635.0	542.2	406.2	0.11
492C	Bovenregel twe	120x120x10	S355		1.91	1.00	1.00	80	-177.4	SPLS 6a_90 Ba Ah All Cts	423.3	0.0	0.0	0.42		193.7	SPLS 6a_90 Ah All Cts	823.6	0.0	0.0	0.24
493A	Tussenregel twe	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-34.4	ULS 5a Ah 22	138.8	188.2	172.8	0.25		3.1	ULS 5a Ah 12	187.5	188.2	172.8	0.02
493B	Tussenregel twe	90x90x8	S235	2M20-8.8t	2.00	1.00	1.00	121	-27.7	ULS 5a Ah 22	138.8	188.2	172.8	0.20		1.2	SPLS 3_0,9_0 Ba All C	168.5	188.2	172.8	0.01
493C	Tussenregel twe	90x90x8	S235		2.00	1.00	1.00	121	-33.3	ULS 5a Ah 22	138.8	0.0	0.0	0.24		1.9	ULS 5a Ba 12	326.7	0.0	0.0	0.01
201L	Diagonaal	100x100x8	S235	2M24-8.8t	0.53	0.53	0.53	131	-69.0	SPLS 3_90 Ba Ct1	150.4	271.1	207.4	0.46		54.7	SPLS 6a_90 Ba Ct1 Ba	181.4	271.1	189.2	0.30
201T	Diagonaal	100x100x8	S235	2M24-8.8t	0.53	0.53	0.53	131	-38.9	SPLS 6a_90 Ba Ct1 Ba	150.4	271.1	207.4	0.26		19.7	SPLS 3_0,9_74.05 Ba (	181.4	271.1	189.2	0.11
202L	Diagonaal	150x150x18*	S235	5M24-8.8t	0.53	0.53	0.53	84	-369.1	SPLS 6a_90 Ah Ct1 Ba	733.6	677.8	1166.4	0.54		305.3	SPLS 6a_90 Ba Ct2 Ah	687.5	677.8	901.1	0.45
202T	Diagonaal	150x150x12	S235	4M24-8.8t	0.53	0.53	0.53	83	-301.3	SPLS 6a_90 Ah Ct1 Ba	502.8	542.2	622.1	0.60		311.0	SPLS 6a_90 Ba Ct1 Ah	470.2	542.2	486.8	0.66
203L	Diagonaal	150x150x12	S235	5M24-8.8t	0.53	0.53	0.53	91	-279.0	SPLS 6a_90 Ba Ct2 Ah	474.0	677.8	777.6	0.59		335.5	SPLS 6a_90 Ah Ct1 Ba	470.2	677.8	600.7	0.71
203T	Diagonaal	150x150x12	S235	4M24-8.8t	0.53	0.53	0.53	91	-283.8	SPLS 6a_90 Ba Ct1 Ah	474.0	542.2	622.1	0.60		273.9	SPLS 6a_90 Ah Ct1 Ba	470.2	542.2	486.8	0.58
204L	Diagonaal	160x160x17#	S235	5M24-8.8t	0.53	0.53	0.53	91	-376.6	SPLS 6a_90 Ba Ct1 Ah	704.3	677.8	1101.6	0.56		325.8	SPLS 6a_90 Ah Ct2 Ba	704.7	677.8	851.0	0.48
204T	Diagonaal	150x150x18*	S235	4M24-8.8t	0.53	0.53	0.53	98	-329.3	SPLS 6a_90 Ah Ct2 Ba	656.1	542.2	933.1	0.61		297.6	SPLS 3_0,9_90 Ba Ct1	687.5	542.2	730.1	0.55
205L	Diagonaal	150x150x18*	S355	6M24-8.8t	0.56	0.28	0.28	73	-539.8	SPLS 6a_90 Ah Ct1 Ba	998.6	810.8	1905.1	0.67		492.5	SPLS 6a_90 Ba Ct2 Ah	963.7	810.8	1699.3	0.61
205T	Diagonaal	150x150x18*	S355	6M24-8.8t	0.56	0.28	0.28	73	-498.5	SPLS 6a_90 Ah Ct2 Ba	998.6	810.8	1905.1	0.61		489.1	SPLS 6a_90 Ba Ct1 Ah	963.7	810.8	1699.3	0.60
206L	Diagonaal	150x150x12	S355	5M24-8.8t	1.00	0.56	0.56	91	-383.1	SPLS 6a_90 Ba Ct2 Ah	569.7	677.8	1058.4	0.67		417.3	SPLS 6a_90 Ah Ct1 Ba	659.1	677.8	948.4	0.63
206T	Diagonaal	150x150x12	S355	5M24-8.8t	1.00	0.56	0.56	91	-393.1	SPLS 6a_90 Ba Ct1 Ah	569.7	677.8	1058.4	0.69		388.2	SPLS 6a_90 Ba Ct2 Ah	659.1	677.8	948.4	0.59
207L	Diagonaal	160x160x15#	S355	4M24-8.8t	0.56	0.28	0.28	106	-329.5	SPLS 6a_90 Ah Ct1 Ba	655.8	542.2	1058.4	0.61		302.2	SPLS 6a_90 Ba Ct2 Ah	890.7	542.2	969.6	0.56
207T	Diagonaal	160x160x15#	S355	4M24-8.8t	0.56	0.28	0.28	106	-308.5	SPLS 6a_90 Ah Ct2 Ba	655.8	542.2	1058.4	0.57		308.5	SPLS 6a_90 Ba Ct1 Ah	890.7	542.2	969.6	0.57
208L	Diagonaal	160x160x15#	S355	3M24-8.8t	1.00	0.56	0.56	126	-244.5	SPLS 3_0,9_105.95 Ah	537.0	406.7	793.8	0.60		255.1	SPLS 6a_90 Ah Ct1 Ba	890.7	406.7	739.0	0.63
208T	Diagonaal	160x160x15#	S355	3M24-8.8t	1.00	0.56	0.56	126	-257.1	SPLS 6a_90 Ba Ct1 Ah	537.0	406.7	793.8	0.63		238.9	SPLS 6a_90 Ba Ct2 Ah	890.7	406.7	739.0	0.59
209L	Diagonaal	160x160x15#	S355	3M24-8.8t	1.00	0.50	0.50	123	-213.5	SPLS 6a_90 Ah Ct1 Ba	549.3	406.7	793.8	0.53		199.9	SPLS 3_0,9_74.05 Ba (	890.7	406.7	739.0	0.49
209T	Diagonaal	160x160x15#	S355	3M24-8.8t	1.00	0.50	0.50	123	-191.9	SPLS 3_0,9_105.95 Ah	549.3	406.7	793.8	0.47		207.1	SPLS 6a_90 Ba Ct1 Ah	890.7	406.7	739.0	0.51
222L	Diagonaal	150x150x12	S355	4M24-8.8t	0.17	0.17	0.17	73	-310.3	SPLS 3_105.95 Ah Ct1	722.6	542.2	846.7	0.57		289.7	SPLS 3_0,9_105.95 Ah	659.1	542.2	763.9	0.53
222T	Diagonaal	150x150x12	S355	4M24-8.8t	0.17	0.17	0.17	73	-292.0	SPLS 6a_90 Ba Ct2 Ah	722.6	542.2	846.7	0.54		279.4	SPLS 6a_90 Ba Ct1 Ah	659.1	542.2	763.9	0.52
210	Top	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	174	-21.3	SPLS 3_105.95 Ah Ct1	84.7	188.2	172.8	0.25		21.2	SPLS 3_105.95 Ah Ct1	146.3	188.2	157.1	0.14
211L	Tweede dwarsa	90x90x8	S235	4M24-8.8t	1.00	1.00	1.00	148	0.0		117.9	542.2	414.7	0.00		143.8	SPLS 6a_90 Ah All Cts	185.9	542.2	357.1	0.77
211T	Tweede dwarsa	70x70x7	S235	1M16-8.8t	1.00	1.00	1.00	191	-4.4	SPLS 6a_90 Ba Ct1 Ba	45.6	60.3	60.5	0.10		8.0	SPLS 6a_90 Ba Ct1 Ba	92.7	60.3	52.3	0.15
109L	Tweede dwarsa	150x150x14	S355	10M24-8.8t	1.00	2.00	1.00	64	-589.4	SPLS 6a_90 Ah All Cts	1076.0	1228.4	2469.6	0.55		449.1	SPLS 3_0,9_105.95 Ba	743.1	1228.4	2321.8	0.60
212T	Tweede dwarsa	120x120x10	S235	6M24-8.8t	1.00	2.00	1.00	79	-124.3	SPLS 6a_90 Ba Ct1 Ba	328.3	813.3	777.6	0.38		148.3	SPLS 6a_90 Ba Ct1 Ba	466.6	813.3	731.1	0.32
213	Tweede dwarsa	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	87	-181.5	SPLS 6a_90 Ah Ct1 Ba	325.2	406.7	388.8	0.56		181.4	SPLS 6a_90 Ah Ct1 Ba	324.0	406.7	359.4	0.56
214	Tweede dwarsa	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	150	-0.5	ULS 3_0	31.9	60.3	43.2	0.02		0.5	SPLS 6a_90 Ah Ct2 Ba	46.1	60.3	32.7	0.01
215L	Eerste dwarsarr	120x120x10	S235	5M24-8.8t	1.00	1.00	1.00	148	-34.2	SPLS 3_0,9_0 Ba All Cl	196.7	677.8	648.0	0.17		188.9	SPLS 3_135 Ah All Cts	342.3	677.8	609.2	0.55
215T	Eerste dwarsarr	150x150x12	S235	3M24-8.8t	1.00	1.00	1.00	118	-71.4	ULS 1a_0,9_90	377.5	406.7	466.6	0.19		93.8	ULS 1a_90	512.3	406.7	438.6	0.23
110L	Eerste dwarsarr	200x200x16	S355	8M24-8.8t	1.00	2.00	1.00	62	-524.7	SPLS 6a_90 Ah All Cts	1686.0	920.6	2257.9	0.57		399.4	SPLS 3_0,9_105.95 Ba	1467.5	920.6	2122.8	0.43
216T	Eerste dwarsarr	120x120x12	S235	5M24-8.8t	1.00	2.00	1.00	104	-151.4	SPLS 3_0,9_74.05 Ba (	317.5	677.8	777.6	0.48		194.5	SPLS 3_90 Ba Ct1	551.1	677.8	731.1	0.35
217	Eerste dwarsarr	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	114	-185.9	SPLS 6a_90 Ba Ct1 Ah	261.1	406.7	388.8	0.71		186.6	SPLS 6a_90 Ba Ct1 Ah	324.0	406.7	359.4	0.58
218	Eerste dwarsarr	50x50x7	S235	1M16-8.8t	0.50	0.50	0.50	200	-0.8	ULS 3_74.05	29.9	60.3	60.5	0.03		1.0	ULS 3_74.05	64.5	60.3	45.8	0.02
219L	Onderstuk in to	100x100x8	S235	2M16-8.8t	1.00	1.00	1.00	264	-10.4	SPLS 1a_0,9_90 Ba All	58.6	120.6	138.2	0.18		5.7	SPLS 1a_0,9_74.05 Ba	245.7	120.6	119.5	0.05
219T	Onderstuk in to	100x100x8	S235	2M16-8.8t	1.04	1.00	1.00	254	-8.3	SPLS 1a_0,9_135 Ah C	61.9	120.6	138.2	0.13		6.2	ULS 1a_0,9_45	245.7	120.6	119.5	0.05
219TC	Onderstuk in to	100x100x8	S235	5M16-8.8t	28.69	2.00	1.00	169	-15.6	ULS 1a_45	105.7	301.4	345.6	0.15		13.2	ULS 1a_0,9_45	327.1	301.4	256.0	0.05
220	Onderstuk in to	100x100x8	S235	1M20-8.8t	1.00	1.00	1.00	366	-7.6	ULS 1a_135	27.6	94.1	86.4	0.27		6.5	ULS 1a_0,9_45	179.7	94.1	78.5	0.08
221	Onderstuk in to	100x100x8	S235	1M20-8.8t	0.50	0.50	0.50	264	-2.4	ULS 1a_0	46.9	94.1	86.4	0.05		0.4	ULS 1a_0,9_0,9_0	179.7	94.1	78.5	0.01
301	Diagonaal onde	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	140	-56.9	SPLS 3_0,9_105.95 Ba	111.3	188.2	172.8	0.51		63.9	SPLS 3_105.95 Ba All (	149.6	188.2	139.6	0.46
302	Diagonaal onde	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	130	-70.6	SPLS 6a_90 Ba Ct2 Ah	120.9	188.2	172.8	0.58		64.8	SPLS 3_0,9_105.95 Ba	151.2	188.2	139.6	0.46
303	Diagonaal onde	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	120	-70.0	SPLS 6a_90 Ba All Cts	131.9	188.2	172.8	0.53		71.2	SPLS 6a_90 Ba All Cts	149.6	188.2	139.6	0.51
304	Diagonaal onde	90x90x8	S235	2M24-8.8t	0.55	0.55	0.55	93	-88.4	SPLS 6a_90 Ba All Cts	186.3	271.1	207.4	0.47		89.6	SPLS 6a_90 Ba All Cts	150.3	271.1	141.8	0.63
306	Diagonaal onde	80x80x8	S235	2M24-8.8t	0.50	0.50	0.50	83	-39.7	SPLS 6a_90 Ba All Cts	178.6	271.1	207.4	0.22		53.8	SPLS 6a_90 Ba All Cts	125.9	271.1	162.4	0.43
307	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	112	-35.8	SPLS 6a_90 Ah All Cts	107.5	188.2	151.2	0.33		35.0	SPLS 3_0,9_105.95 Ba	90.5	188.2	79.7	0.44
308	Diagonaal onde	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	110	-35.1	SPLS 6a_90 Ba All Cts	80.5	120.6	103.7	0.44		34.5	SPLS 6a_90 Ba All Cts	67.0	120.6	56.7	0.61
309	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	79	-47.5	SPLS 6a_90 Ba All Cts	140.3	188.2	151.2	0.34		48.9	SPLS 6a_90 Ba All Cts	90.5	188.2	97.1	0.54
310	Diagonaal onde	90x90x8	S235	2M24-8.8t	0.55	0.55	0.55	49	-63.4	SPLS 6a_90 Ba Ct2 Ah	252.8	271.1	207.4	0.31		62.7	SPLS 6a_90 Ba All Cts	159.7	271.1	183.4	0.39

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 15-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+9 R_X
65

Staafgroep	Omschrijving	Profiel	Staalsoort	Bouten	RLX	RLY	RLZ	Slankheid	Druk	Combinatie druk	Knik	Afschuiving	Stuik (druk)	U.C. (druk)	Opm.	Trek	Combinatie trek	Nettodsn.	Afschuif	Stuik (trek)	U.C. (trek)
311	Diagonaal onde	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	51	-39.5	SPLS 3_0,9_105.95 Ba	250.3	271.1	207.4	0.19		31.8	SPLS 3_0,9_105.95 Ba	136.2	271.1	104.6	0.30
313	Dwarsligger onc	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	82	0.0		570.7	188.2	216.0	0.00		3.3	SPLS 6a_90 Ba Ct2 Ba	766.1	188.2	0.0	0.02
314	Dwarsligger onc	150x150x12	S355		2.00	2.00	2.00	83	0.0		656.2	0.0	0.0	0.00		52.8	ULS 3_90	536.9	271.1	379.9	0.19
315	Dwarsligger onc	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	54	-3.5	ULS 3_0,9_90	689.5	188.2	216.0	0.02		3.4	ULS 5a Ah 11	766.1	188.2	0.0	0.02
316	Dwarsligger onc	150x150x12	S355	2M24-8.8t	2.00	1.00	1.00	24	0.0		1022.5	271.1	423.4	0.00		85.1	ULS 3_105.95	496.7	271.1	191.8	0.44
317	Dwarsligger onc	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	26	-14.0	ULS 3_0,9_90	790.1	188.2	216.0	0.07		0.0		766.1	188.2	0.0	0.00
318	Verticaal eerste	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	171	-20.8	SPLS 6a_90 Ah Ct2 Ba	98.1	271.1	207.4	0.21		0.0		159.7	271.1	183.4	0.00
319	Verticaal eerste	80x80x6#	S235	1M16-8.8t	1.00	1.00	1.00	126	-4.6	SPLS 6a_90 Ah Ct1 Ba	76.2	60.3	51.8	0.09		0.0		107.1	60.3	44.8	0.00
320	Verticaal eerste	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	104	-1.1	SPLS 6a_90 Ba Ct2 Ba	47.2	60.3	43.2	0.03		0.0		46.1	60.3	32.7	0.00
321	Diagonaal eerst	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	346	0.0		30.1	188.2	172.8	0.00		33.0	ULS 3_105.95	162.8	188.2	157.1	0.21
322	Diagonaal eerst	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	268	0.0		51.1	271.1	207.4	0.00		46.9	SPLS 6a_90 Ah Ct2 Ba	136.2	271.1	161.3	0.34
323	Diagonaal eerst	70x70x7	S235	1M20-8.8t	1.00	1.00	1.00	307	0.0		22.4	94.1	75.6	0.00		15.5	SPLS 6a_90 Ah Ct1 Ba	84.7	94.1	65.2	0.24
324	Dwarsligger bov	70x70x7	S235	1M20-8.8t	2.00	1.00	1.00	110	-0.9	ULS 1a_0	93.2	94.1	75.6	0.01		0.8	ULS 1a_0,9_0	84.7	94.1	65.2	0.01
325	Tussen diagona	80x80x8	S235	1M20-8.8t	1.00	1.00	1.00	151	-2.4	ULS 1a_0	81.0	94.1	86.4	0.03		1.6	ULS 1a_0,9_0	133.6	94.1	78.5	0.02
401	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	126	-23.9	SPLS 1a_0 Ba Ct2	95.8	188.2	151.2	0.25		23.0	SPLS 1a_0,9_0 Ba All (	90.5	188.2	91.6	0.25
402	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	119	-26.0	SPLS 1a_0,9_0 Ba Ct1	101.5	188.2	151.2	0.26		31.0	SPLS 3_0 Ba Ct2	90.5	188.2	100.8	0.34
403	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	97	-36.0	SPLS 3_0 Ba Ct1	121.8	188.2	151.2	0.30		36.2	SPLS 3_90 Ba Ct2	90.5	188.2	100.8	0.40
404	Diagonaal onde	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	97	-48.8	SPLS 3_105.95 Ba All (	121.5	188.2	151.2	0.40		50.6	SPLS 6a_90 Ba Ct1 Ah	90.5	188.2	117.6	0.56
405	Diagonaal onde	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	67	-57.9	SPLS 6a_90 Ba Ct1 Ah	226.0	271.1	207.4	0.28		52.0	SPLS 3_0,9_105.95 Ba	136.2	271.1	141.8	0.38
406	Diagonaal onde	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	59	-61.4	SPLS 3_105.95 Ba Ct1	239.1	271.1	207.4	0.30		55.7	SPLS 3_105.95 Ba Ct1	144.0	271.1	159.5	0.39
407	Diagonaal onde	80x80x8	S235	2M24-8.8t	1.00	1.00	1.00	65	-35.8	SPLS 6a_90 Ba Ct1 Ah	203.3	271.1	207.4	0.18		26.1	SPLS 3_0,9_90 Ba Ct1	117.7	271.1	156.0	0.22
408	Diagonaal onde	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	202	-7.5	SPLS 6a_90 Ah All Cts	21.5	60.3	43.2	0.35		20.2	SPLS 6a_90 Ah All Cts	46.1	60.3	32.7	0.62
410	Dwarsligger onc	150x150x12	S235	2M24-8.8t	1.00	2.00	1.00	32	0.0		667.4	271.1	311.0	0.00		73.9	ULS 3_0,9_90	365.0	271.1	146.2	0.51
411	0	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	203	-1.9	SPLS 6a_90 Ah Ct1 Ba	24.2	60.3	43.2	0.08		16.7	SPLS 1a_0 Ah Ct2	46.1	60.3	32.7	0.51
412	Bovenregel twe	90x90x8	S235	3M24-8.8t	2.00	2.00	2.00	349	0.0		33.6	406.7	311.0	0.00		182.1	SPLS 6a_90 Ah All Cts	185.9	542.2	357.1	0.98
413	Bovenregel twe	90x90x8	S235	4M20-8.8t	2.00	1.00	1.00	215	0.0		68.3	376.3	345.6	0.00		148.9	SPLS 6a_90 Ba Ct1 Ba	193.9	376.3	314.2	0.77
414	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	160	-24.8	SPLS 6a_90 Ah All Cts	42.5	60.3	51.8	0.58		25.4	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.90
415	Diagonaal bove	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	334	-2.6	SPLS 1a_105.95 Ba All	14.3	60.3	51.8	0.18		0.0		48.4	60.3	33.7	0.00
416	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	126	-25.8	SPLS 6a_90 Ah All Cts	56.3	60.3	51.8	0.50		22.0	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.78
417	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	118	-10.1	SPLS 6a_90 Ah Ct2 Ba	59.8	60.3	51.8	0.19		9.7	SPLS 6a_90 Ah Ct2 Ba	72.6	60.3	28.2	0.34
418	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	111	-13.9	SPLS 6a_90 Ah All Cts	63.5	60.3	51.8	0.27		14.5	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.52
419	Diagonaal bove	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	105	-16.6	SPLS 6a_90 Ah All Cts	66.8	60.3	51.8	0.32		15.5	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.55
420	Diagonaal bove	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	97	-18.7	SPLS 6a_90 Ah All Cts	89.1	120.6	103.7	0.21		19.9	SPLS 6a_90 Ah All Cts	78.2	120.6	56.3	0.35
421	Diagonaal bove	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	92	-26.2	SPLS 6a_90 Ah All Cts	92.9	120.6	103.7	0.28		23.9	SPLS 6a_90 Ah All Cts	78.2	120.6	56.3	0.42
422	Diagonaal bove	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	98	-34.7	SPLS 6a_90 Ba Ct1 Ah	88.8	120.6	103.7	0.39		38.7	SPLS 6a_90 Ah All Cts	78.2	120.6	76.8	0.50
423	Verticaal tweed	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	101	-1.1	ULS 1a_0,9_0	48.1	60.3	43.2	0.03		9.4	ULS 1a_0	46.1	60.3	32.7	0.29
424	Verticaal tweed	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	152	-22.8	SPLS 6a_90 Ah All Cts	31.6	60.3	43.2	0.72		22.8	SPLS 6a_90 Ah All Cts	46.1	60.3	32.7	0.70
426	Diagonaal twee	70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	219	-16.1	SPLS 1a_0 Ah Ct2	41.5	60.3	82.3	0.39		0.0	SPLS 1a_0,9_0 Ah Ct2	87.8	60.3	48.1	0.00
427	Diagonaal twee	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	244	0.0		16.4	60.3	43.2	0.00		1.1	ULS 1a_105.95	46.1	60.3	20.5	0.05
429	Dwarsligger bov	UNP160	S235	3M20-8.8t	1.00	1.00	1.00	47	0.0		409.5	282.2	243.0	0.00		34.6	ULS 3_0,9_90	306.9	282.2	187.2	0.19
430	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	227	-1.8	SPLS 1a_135 Ba All Cts	18.2	60.3	43.2	0.10		2.9	ULS 1a_0	46.1	60.3	32.7	0.09
431	0	70x70x7	S235	2M20-8.8t	1.00	1.00	1.00	106	-34.3	SPLS 1a_0 Ba Ct2	113.0	188.2	151.2	0.30		29.1	SPLS 3_0 Ba Ct2	90.5	188.2	100.8	0.32
432	0	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	108	-31.9	SPLS 3_90 Ba Ct2	111.2	188.2	151.2	0.29		28.9	SPLS 1a_0,9_0 Ba Ct1	90.5	188.2	100.8	0.32
433	0	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	62	-64.3	SPLS 6a_90 Ba All Cts	234.4	271.1	207.4	0.31		70.5	SPLS 3_105.95 Ba Ct1	144.0	271.1	159.5	0.49
434	0	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	141	-26.4	SPLS 6a_90 Ah All Cts	49.5	60.3	51.8	0.53		25.5	SPLS 6a_90 Ah All Cts	72.6	60.3	28.2	0.91
435	0	60x60x6	S355	1M16-8.8t	0.55	0.55	0.55	133	-30.3	SPLS 6a_90 Ah All Cts	62.2	60.3	70.6	0.50		31.2	SPLS 6a_90 Ah All Cts	98.8	60.3	38.3	0.81
436	0	70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	218	-27.8	SPLS 1a_0 Ah Ct2	42.0	60.3	82.3	0.66		2.7	SPLS 1a_0,9_0 Ah Ct1	87.8	60.3	62.3	0.05
437	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	141	-3.5	SPLS 1a_0 Ah All Cts	34.4	60.3	43.2	0.10		2.6	SPLS 1a_135 Ba All Cts	46.1	60.3	32.7	0.08
438	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	217	-6.4	SPLS 1a_135 Ba All Cts	19.5	60.3	43.2	0.33		9.5	SPLS 1a_0 Ah All Cts	46.1	60.3	32.7	0.29
439	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	125	-3.1	SPLS 1a_0 Ah All Cts	39.5	60.3	43.2	0.08		2.0	SPLS 1a_135 Ba All Cts	46.1	60.3	32.7	0.06
440	Dwarsligger lad	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	108	0.0	SPLS 6a_90 Ah Ct2 Ba	45.3	60.3	43.2	0.00		0.0	ULS 3_0,9_105.95	46.1	60.3	32.7	0.00
330	0	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	111	-78.7	SPLS 6a_90 Ba All Cts	141.9	188.2	172.8	0.55		76.2	SPLS 6a_90 Ba All Cts	149.6	188.2	139.6	0.55
331	0	60x60x6	S235	2M16-8.8t	0.55	0.55	0.55	100	-41.0	SPLS 6a_90 Ba All Cts	87.4	120.6	103.7	0.47		40.8	SPLS 6a_90 Ba All Cts	67.0	120.6	56.7	0.72
332	0	70x70x7	S235	2M20-8.8t	0.55	0.55	0.55	73	-55.7	SPLS 6a_90 Ba All Cts	147.1	188.2	151.2	0.38		52.5	SPLS 6a_90 Ba All Cts	90.5	188.2	101.5	0.58
250L	0	90x90x8	S235	2M16-8.8t	1.00	1.00	1.00	239	-10.9	SPLS 3_0,9_90 Ba All (	61.1	120.6	138.2	0.18		7.7	SPLS 1a_0,9_74.05 Ba	167.5	120.6	119.5	0.06
250T	0	90x90x8	S235	2M16-8.8t	1.00	1.00	1.00	225	-7.6	ULS 1a_0,9_74.05	66.6	120.6	138.2	0.11		6.5	ULS 1a_0,9_45	167.5	120.6	119.5	0.05
250TC	0	90x90x8	S235		1.00	1.00	1.00	13	-13.3	ULS 1a_45	293.9	0.0	0.0	0.05		11.6	ULS 1a_0,9_45	326.7	0.0	0.0	0.04
251	0	90x90x8	S235	1M16-8.8t	1.00	1.00	1.00	328	-5.7	ULS 1a_135	29.6	60.3	69.1	0.19		4.8	ULS 1a_0,9_45	165.9	60.3	59.7	0.08
252	0	80x80x8	S235	1M16-8.8t	0.50	0.50	0.50	269	-1.9	ULS 1a_0	36.0	60.3	69.1	0.05		0.4	ULS 1a_0,9_0	142.8	60.3	59.7	0.01
260L	0	80x80x6#	S235	2M16-8.8t	1.00	1.00	1.00	169	-11.8	SPLS 3_0,9_90 Ba All (	67.4	120.6	103.7	0.17		10.3	SPLS 3_135 Ah All Cts	111.8	120.6	89.6	0.11
260T	0	80x80x6#	S235	2M16-8.8t	1.00	1.00	1.00	155	-7.4	ULS 1a_0,9_90	75.3	120.6	103.7	0.10		7.7	ULS 1a_74.05	111.8	120.6	89.6	0.09
260TC	0	80x80x6#	S235		1.00	1.00	1.00	14	-9.9	SPLS 1a_0,9_45 Ba Ct	198.4	0.0	0.0	0.05		10.0	ULS 1a_45	220.9	0.0	0.0	0.05
261	0	90x90x8	S235	1M20-8.8t	1.00	1.00	1.00	207	-6.4	SPLS 1a_105.95 Ah Ct	60.3	94.1	86.4	0.11		5.6	SPLS 1a_0,9_74.05 Ba	156.7	94.1	69.8	0.08
262	0	60x60x6	S235	1M20-8.8t	0.50	0.50	0.50	230	-0.9	SPLS 1a_0 Ah Ct1	25.8	94.1	64.8	0.04		0.3	ULS 1a_0,9_0	65.7	94.1	44.4	0.01
450	0	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	246	-0.1	SPLS 1a_0,9_135 Ba A	16.2	60.3	43.2	0.01		0.2	SPLS 1a_0,9_0 Ba All (	46.1	60.3	32.7	0.01
442	442	HEA160	S355	2M20-5.6t	2.00	2.00	2.00	5	-4.7	ULS 1a_0	1198.5	117.6	294.0	0.04		3.8	3.824	SPLS 6a_90 A	1042.7	0.0	0.03
443	443	60x60x6	S235	1M16-8.8t	2.00	1.00	1.00	146	-2.3	ULS 1a_135	50.7	60.3	51.8	0.05		12.4	12.395	ULS 1a_135	72.6	44.8	0.28
490D	490D	150x150x14	S355		1.00	6.20	1.00	87	-11.7	ULS 1a_0	808.6	0.0	0.0	0.01		8.7	8.697	ULS 1a_0,9_(	1425.0	0.0	0.01
469	469	50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	98	-4.5	ULS 1a_0	61.6	60.3	58.8	0.08		3.7	3.728	ULS 1a_0,9_(	51.0	35.0	0.11
470	470	50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	91	-5.9	ULS 1a_0,9_0	66.1	60.3	58.8	0.10		3.9	3.911	ULS 1a_0,9_(	51.0	35.0	0.11
471	471	50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	86	-6.4	ULS 1a_0	69.9	60.3	58.8	0.11		5.0	4.963	ULS 1a_0,9_(	51.0	35.0	0.14
472	472	50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	82	-4.2	SPLS 1a_0 Ah All Cts	73.1	60.3	58.8	0.07		1.2	1.212	ULS 1a_0,9_4	51.0	35.0	0.03
473	473	60x60x6	S355	1M16-8.8t	1.00	1.00	1.00	171	-0.2	ULS 1a_0,9_105.95	44.2	60.3	70.6	0.00		0.2	0.207	ULS 1a_0,9_7	61.2	42.0	0.00
474	474	50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	172	-2.3	ULS 1a_0	30.6	60.3	58.8	0.08		1.8	1.772	ULS 1a_135	51.0	35.0	0.05

DNV·GL

Assessment of groups for strengthened mast (verbouw level)

Date 15-11-21
Author KCh
Version 1.0

ENS-ZL 380
HB+9 R_X
65

Staafgroep	Omschrijving	Profiel	Staalsoort	Bouten	RLX	RLY	RLZ	Slankheid	Druk	Combinatie druk	Knik	Afschuiving	Stuik (druk)	U.C. (druk)	Opm.	Trek	Combinatie trek	Nettodsn.	Afschuif	Stuik (trek)	U.C. (trek)
426	Diagonaal twee	70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	219	-18.2	ULS 1a_0	41.5	60.3	82.3	0.44		1.7	ULS 1a_0,9_0	87.8	60.3	48.1	0.03
435		60x60x6	S355	1M16-8.8t	0.55	0.55	0.55	133	-31.5	SPLS 6a_90 Ah All Cts	62.2	60.3	70.6	0.52		32.4	SPLS 6a_90 Ah All Cts	98.8	60.3	38.3	0.85
436		70x70x7	S355	1M16-8.8t	1.00	1.00	1.00	218	-29.8	SPLS 1a_0 Ah Ct2	42.0	60.3	82.3	0.71		3.1	SPLS 1a_0,9_0 Ah Ct1	87.8	60.3	62.3	0.05
442	Dwarsligger ond	HEA160	S355	2M20-5.6t	2.00	2.00	2.00	5	-5.5	ULS 1a_0	1198.5	117.6	294.0	0.05		4.0	SPLS 6a_90 Ah All Cts	1042.7	117.6	0.0	0.03
443		60x60x6	S235	1M16-8.8t	2.00	1.00	1.00	146	-2.4	ULS 1a_135	50.7	60.3	51.8	0.05		14.5	ULS 1a_45	72.6	60.3	44.8	0.32
490D	Onderregel twee	150x150x14	S355		1.00	6.20	1.00	87	-14.5	ULS 1a_0	808.6	0.0	0.0	0.02		11.2	ULS 1a_0,9_0,9_0	1425.0	0.0	0.0	0.01
469		50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	98	-5.6	ULS 1a_0	61.6	60.3	58.8	0.09		4.7	ULS 1a_0,9_0,9_0	51.0	60.3	35.0	0.13
470		50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	91	-7.2	ULS 1a_0,9_0	66.1	60.3	58.8	0.12		5.1	ULS 1a_0,9_0,9_0	51.0	60.3	35.0	0.15
471		50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	86	-7.9	ULS 1a_0	69.9	60.3	58.8	0.13		6.5	ULS 1a_0,9_0	51.0	60.3	35.0	0.19
472		50x50x5	S355	1M16-8.8t	0.53	0.53	0.53	82	-4.8	ULS 1a_0	73.1	60.3	58.8	0.08		1.5	ULS 1a_45	51.0	60.3	35.0	0.04
473		60x60x6	S355	1M16-8.8t	1.00	1.00	1.00	171	-0.3	ULS 1a_0,9_105.95	44.2	60.3	70.6	0.01		0.3	ULS 1a_0,9_74.05	61.2	60.3	42.0	0.01
474		50x50x5	S355	1M16-8.8t	1.00	1.00	1.00	172	-3.0	ULS 1a_0	30.6	60.3	58.8	0.10		2.3	ULS 1a_135	51.0	60.3	35.0	0.06

APPENDIX C
Toetsing knikverkorters

DNV·GL

Knikverkorters initial construction (afkeur)

Date: 2021-12-13
Author: K H Chan
Version: 1.8

ENS - ZL
HB+9_R_X
Mast: 65

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Net Section Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Notes
9788	Broekstuk	Enkele staaf	L50.5	S235	M16	8.8	0.733	0	75	31.3	0.18	57.3	60.3	35.9	46.1	0.72	0.87		
9787	Broekstuk	Enkele staaf	L60.6	S235	M16	8.8	1.94	71	166	31.3	0.00	40.6	60.3	38.4	72.6	1.24	0.81		
9786	Broekstuk	Enkele staaf	L60.6	S235	M16	8.8	1.59	0	136	31.3	0.40	51.5	60.3	38.4	72.6	1.24	0.81		
9785	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.30	52	146	31.3	0.00	64.1	60.3	38.4	107.1	2.25	0.81		
9784	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.46	0	156	31.3	0.61	59.3	60.3	38.4	107.1	2.25	0.81		
9783	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.89	39	184	31.3	0.00	47.9	60.3	38.4	107.1	2.25	0.81		
9782	Broekstuk	Enkele staaf	L80.8	S235	M16	8.8	3.32	0	213	31.3	0.83	51.3	60.3	51.2	142.8	2.95	0.61		
9781	Broekstuk	Enkele staaf	L80.8	S235	M16	8.8	3.60	30	231	31.3	0.00	45.6	60.3	51.2	142.8	2.95	0.69		
9780	Broekstuk	Enkele staaf	L90.8	S235	M16	8.8	4.18	0	237	31.3	1.04	49.4	60.3	51.2	165.9	3.77	0.63		
9779	Broekstuk	Enkele staaf	L90.8	S235	M16	8.8	4.36	25	247	31.3	0.99	46.4	60.3	51.2	165.9	3.77	0.67		
9778	Broekstuk	Enkele staaf	L80.8	S235	M16	8.8	3.30	30	211	31.3	0.00	51.8	60.3	51.2	142.8	2.95	0.61		
9777	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.53	0	161	31.3	0.63	57.2	60.3	38.4	107.1	2.25	0.81		
9825	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	1.05	0	108	7.2	0.26	45.4	60.3	30.3	31.7	0.72	0.37		
9823	Pootverband	Kniksteun en verticale steur	L50.7	S235	M16	8.8	2.27	0	152	7.2	0.28	33.9	60.3	42.5	44.4	0.68	0.42		
9821	Pootverband	Kniksteun en verticale steur	L80.6	S235	M16	8.8	3.48	0	143	7.2	0.44	51.8	60.3	38.4	107.1	1.77	0.26		
9819	Pootverband	Kniksteun en verticale steur	L80.6	S235	M16	8.8	4.70	0	192	7.2	0.59	36.3	60.3	38.4	107.1	1.77	0.35		
9817	Pootverband	Kniksteun en verticale steur	L90.8	S235	M16	8.8	5.92	0	216	7.2	0.74	46.5	60.3	51.2	165.9	2.87	0.27		
9824	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.14	76	220	7.2	0.00	19.1	60.3	30.3	31.7	0.72	0.38		
9822	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.35	61	241	7.2	0.00	16.6	60.3	30.3	31.7	0.72	0.43		
9820	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.69	50	276	7.2	0.00	13.5	60.3	30.3	31.7	0.72	0.53		
9818	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	3.11	41	319	7.2	0.00	10.7	60.3	30.3	31.7	0.72	0.68		
9816	Pootverband	Enkele staaf	L60.6	S235	M16	8.8	3.52	33	301	7.2	0.00	16.9	60.3	38.4	72.6	1.24	0.43		
9814	Tussenschot	Enkele staaf	L100.8	S235	M16	8.8	5.15	0	262	31.3	1.29	47.4	60.3	51.2	188.9	4.76	0.66		
9811	Tussenschot	Kniksteun en verticale steur	L100.8	S235	M20	8.8	6.92	0	225	0.6	0.87	49.2	94.1	69.8	179.7	3.6	0.25		
9813	Tussenschot	Kruisende staaf halverwege	L100.8	S235	M20	8.8	10.11	0	328	0.6	1.26	28.5	94.1	69.8	179.7	4.76	0.27		
9745	Eerste TSNSTK	Enkele staaf	L60.6	S235	M16	8.8	2.05	0	175	32.0	0.51	37.8	60.3	38.4	72.6	1.24	0.85		
9746	Eerste TSNSTK	Enkele staaf	L80.6	S235	M16	8.8	2.71	47	173	32.0	0.00	52.1	60.3	38.4	107.1	2.25	0.83		
9748	Eerste TSNSTK	Enkele staaf	L80.6	S235	M16	8.8	2.69	38	171	32.0	0.00	52.7	60.3	38.4	107.1	2.25	0.83		
9749	Eerste TSNSTK	Enkele staaf	L60.6	S235	M16	8.8	2.02	0	173	32.0	0.50	38.5	60.3	38.4	72.6	1.24	0.83		
9750	Eerste TSNSTK	Enkele staaf	L50.7	S235	M16	8.8	1.60	0	167	32.0	0.40	38.1	60.3	42.5	44.4	0.98	0.84		
9751	Eerste TSNSTK	Enkele staaf	L80.6	S235	M16	8.8	2.26	51	143	32.0	0.00	65.7	60.3	38.4	107.1	2.2	0.83		
9752	Eerste TSNSTK	Enkele staaf	L80.6	S235	M16	8.8	3.37	0	214	32.0	0.84	38.7	60.3	38.4	107.1	2.2	0.83		
9753	Eerste TSNSTK	Enkele staaf	L80.6	S235	M16	8.8	2.20	35	140	32.0	0.00	67.7	60.3	38.4	107.1	2.25	0.83		
9754	Eerste TSNSTK	Enkele staaf	L50.7	S235	M16	8.8	1.63	0	171	32.0	0.41	37.1	60.3	42.5	44.4	0.98	0.86		
9747	Tussenschot	Enkele staaf	L90.8	S235	M16	8.8	4.03	0	229	32.0	1.01	52.1	60.3	51.2	165.9	3.8	0.63		
9765	Tussenschot	Enkele staaf	L90.8	S235	M16	8.8	5.74	0	325	0.7	1.43	30.0	60.3	51.2	165.9	3.8	0.38		
9764	Tussenschot	Kruisende staaf halverwege	L80.8	S235	M16	8.8	8.55	0	353	0.7	1.07	20.3	60.3	51.2	142.8	3.0	0.36		
9853	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.29	0	133	23.4	0.32	36.8	60.3	30.3	31.7	0.7	0.77		
9857	Tweede TSNSTK	Enkele staaf	L50.7	S235	M16	8.8	1.83	51	191	23.4	0.00	32.0	60.3	42.5	44.4	0.98	0.73		
9856	Tweede TSNSTK	Enkele staaf	L50.7	S235	M16	8.8	1.76	41	184	23.4	0.00	33.5	60.3	42.5	44.4	1.0	0.70		
9852	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.26	0	130	23.4	0.32	37.8	60.3	30.3	31.7	0.7	0.77		

DNV·GL

Knikverkorters initial construction (afkeur)

Date: 2021-12-13
Author: K H Chan
Version: 1.8

ENS - ZL
HB+9_R_X
Mast: 65

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Net Section Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Notes
9851	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	0.98	0	100	23.4	0.24	48.4	60.3	30.3	31.7	0.7	0.77		
9855	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.45	54	149	23.4	0.00	32.2	60.3	30.3	31.7	0.7	0.77		
9848	Tweede TSNSTK	Enkele staaf	L60.6	S235	M16	8.8	2.11	0	181	23.4	0.53	36.3	60.3	38.4	72.6	1.2	0.65		
9854	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.38	36	142	23.4	0.00	34.2	60.3	30.3	31.7	0.72	0.77		
9850	Tweede TSNSTK	Enkele staaf	L50.5	S235	M16	8.8	1.00	0	103	23.4	0.25	47.3	60.3	30.3	31.7	0.7	0.77		
9849	Tussenschot	Enkele staaf	L80.6	S235	M16	8.8	2.53	0	161	23.4	0.63	57.2	60.3	38.4	107.1	2.2	0.61		
9858	Tussenschot	Enkele staaf	L90.8	S235	M20	8.8	3.62	0	205	0.8	0.90	61.1	94.1	69.8	156.7	3.8	0.24		
9860	Tussenschot	Kruisende staaf halverwege	L60.6	S235	M20	8.8	5.53	0	304	0.8	0.69	14.2	94.1	47.5	48.4	1.2	0.56		
8018	Bovenstuk 1	Enkele staaf	L50.5	S235	M16	8.8	1.87	0	192	12.9	0.47	23.2	60.3	30.3	31.7	0.7	0.65		
8020	Bovenstuk 1	Enkele staaf	L50.5	S235	M16	8.8	1.71	0	175	12.9	0.43	26.2	60.3	30.3	31.7	0.7	0.59		
8021	Bovenstuk 2	Enkele staaf	L50.5	S235	M16	8.8	1.61	0	165	5.6	0.40	28.3	60.3	30.3	31.7	0.7	0.56		
8022	Bovenstuk 2	Enkele staaf	L50.5	S235	M16	8.8	1.43	0	147	5.6	0.36	32.8	60.3	30.3	31.7	0.7	0.50		
5000	Boventraverse	Kniksteun op 0,5L	L60.6	S355	M16	8.8	4.00	0	220	1.5	1.00	25.5	60.3	52.3	98.8	1.9	0.53		

APPENDIX D
Toetsing blokdeuvels

CALCULATION OF POST INSULATOR LOADS

The following parameters are calculated:

- The forces on the insulator attachment due to wind loading and weight
- The required measurements of the components

The diagram below is a representation of the loads on the insulator:

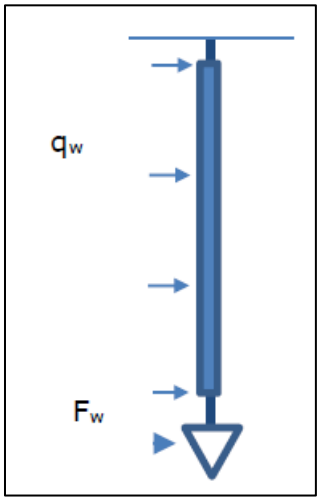


Figure 1: Diagrammatic representation of the loads on the post insulator

Forces on the insulator attachment

Wind pressure based on non-urban terrain in wind zone III at a height of 48,5 m: q_h = 1,13 kN/m^2

Wind load per meter based on an insulator diameter of 0,2 m and a drag factor of 1,2:

q_w = 1,2 x 0,2 x 1,13 = 0,27 kN/m

F_w = 2 x 4 m x 0,27 kN/m = 2,16 kN

Conductor with C_c = 0,9:

F_w based on a supported length of 9 m and a structural factor of 1:

F_w = 9 x 1 x 0,9 x 3 x 0,036 x 1,13 = 0,99 kN

Invoer geleiderbelastingen:

Wind area = 2 x 4 m x 0,2 m = 1,6 m^2

Conductor wind area: 9 m x 3 x 0,036 = 1,0 m^2

Total wind area for geleiderbelasting sheet: 2,6 m^2

Calculation of vertical weight

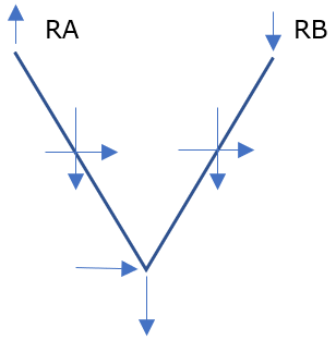
$F_{insulator}$ = 2 x 2,0 kN = 4 kN

$F_{conductor}$ = 9 m x 3 x 0,024 = 0,7 kN

Reaction Force

$\Sigma M_B=0$: -RA x 5 + 4 x 2,5 + 0,7 x 2,5 + 2,1 x 2 + 0,99 x 4 = 0

RA = 19,91 / 5 = 3,98 kN



Relatively small forces, pin connections based short circuit requirement suffices.

Check for bending of beams HEA160

M = 0,6 x 3,98 = 2,39 kNm

M_{Rd} = 51,7 kNm

U.C = 2,39 / 51,7 = 0,1 < 1,0 OK.

Project: ENS-ZL380
Mast: HB+9 R_X (65)

Shear blocks

NEN-EN 1993-1-1 en NEN-EN 1994-1-1

Datum: 2021-11-15
Auteur: TBR
Versie: 1.4

Load				**Results**			
Compression	$F_{Ed,c}$	1821	kN	Compression	U.C.	0.75	< 1,00 OK
Tension	$F_{Ed,t}$	1493	kN	Tension	U.C.	0.66	< 1,00 OK

Main leg

Profile		L250.20	
Steel material		S355	
Cross section		9643	mm^2
Axial capacity	N_{pl}	3423	kN
Width	b	250	mm
Thickness	t	20	mm
Length in concrete		1800	mm

Shear blocks main leg

Width	b	50	mm
Thickness	h	30	mm
Length	L	260	mm
Welds	a	5	mm
c.t.c. separation	s	250	mm
Number for compr.	n_c	12	-
Number for tension	n_t	12	-

Foot plate

Thickness	t	25	mm
Ext. length	m	30	mm
Welds	a	5	mm

Pile

Name		Buispaal	
Diameter		914	mm
Thickness		10	mm
Cross section		28400	mm^2
Steel material		S235	
Capacity		6674	kN
Concrete strength		C20/25	

Shear blocks pile

Width	b	50	mm
Thickness	h	30	mm
Length	L	1300	mm
Welds	a	5	mm
c.t.c. separation	s	360	mm
Number for compr.	n_c	6	-
Number for tension	n_t	6	-

Design value concrete strength

Material factor	γ_c	1.5	
Add. mat. factor	γ_m	1.25	-
f_{cd} =		10.7	N/mm^2

Steel tower stub

Yield strength	f_{yd} =	355	N/mm^2
Tensile strength	f_{ud} =	490	N/mm^2

Capacity shear blocks main leg

A_{f1} =	7800	mm^2
A_{f2} =	23800	mm^2
Slope	1: 5	
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.75	
$f_{jd} = C_A \times f_{cd}$ =	18.6	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	1744	kN
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	1744	kN

Capacity foot plate

k_d =	1.73	-
$f_{jd} = C_A \times f_{cd}$ =	18.5	N/mm^2
$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	63	mm
m* = min(c,m) =	30	mm
Type foot plate	Diagonally cut	
Effective for	Compr. and tension	
$A_{p,c}$ =	37443	mm^2
$F_{Rd,c} = A_{p,druk} \times f_{jd}$ =	692	kN
$A_{p,t}$ =	27800	mm^2
$F_{Rd,t} = A_{p,t} \times f_{jd}$ =	514	kN

Capacities

$F_{rd,c,plate}$ =	692	kN
$F_{rd,blocks,c}$ =	1744	kN
$F_{rd,c} = F_{rd,blck} + F_{rd,footplate}$ =	2436	kN
U.C. compression	0.75	< 1,00 OK
Welds foot plate (see next page)	1207	kN
$F_{rd,t}$ = min. (welds / foot plate) =	514	kN
$F_{rd,blocks,t}$ =	1744	kN
$F_{rd,t} = F_{rd,blck} + F_{rd,footplate}$ =	2258	kN
U.C. tension	0.66	< 1,00 OK
U.C. welds	0.35	< 1,00 OK

Capacity shear blocks pile

A_{f1} =	39000	mm^2
A_{f2} =	117000	mm^2
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.73	-
$f_{jd} = k_d \times f_{cd}$ =	18.5	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	4323	kN
U.C. compression	0.42	< 1,00 OK
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	4323	kN
U.C. tension	0.35	< 1,00 OK
U.C. welds	0.34	< 1,00 OK

"Splitting" of pile

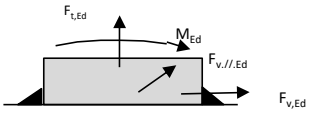
Spread of forces		45	°
Length force flow		1353	mm
Splitting force		552	kN/m
Yield strength wall	f_{yd} =	235	N/mm^2
Capacity tubular pile		4700	kN/m
U.C.		0.12	< 1,00 OK

Project: ENS-ZL380
Mast: HB+9 R_X (65)

Welds of shear blocks of main leg

Out-of-plane loading

Plate			***Welds***		
t =	50	mm	a =	5	mm
Grade	S355		l =	250	mm
f_{yd} =	355	N/mm²	β_w =	0.9	-
f_u =	490	N/mm²	γ_{M2} =	1.25	-



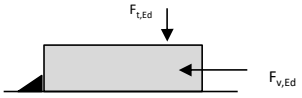
Member forces			***Stress components***		
Factor	1.2		$\sigma_1 = \tau_1 = F_{t,Ed}\sqrt{2} / 4al$ =	0	N/mm²
$F_{t,Ed}$ =	0	kN	$\sigma_1 = \tau_1 = F_{v,Ed}\sqrt{2} / 4al$ =	49	N/mm²
$F_{v,Ed} = F_{rd,c} / n$ =	174	kN		49	N/mm²
$F_{v//,Ed}$ =	0	kN	b* = b + 2/3aV2	54.7	mm
M_{Ed} = 1/2 b / h x $F_{v,Ed}$ =	2.62	kNm	$\sigma_1 = \tau_1 = 0{,}706 M_{Ed} / al\ b^*$ =	27	N/mm²
			$\tau_{//} = F_{v//,Ed} / 2al$ =	0	N/mm²
			$\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	153	N/mm²

Check							
$\sigma_{vw,Ed}$ =	153	N/mm²	≤	$f_u / \beta_w \gamma_{M2}$ =	436 N/mm²	U.C. =	0.35 OK
σ_1 =	76	N/mm²	≤	$0{,}9 f_u / \gamma_{M2}$ =	353 N/mm²	U.C. =	0.22 OK

Welds of shear blocks of pile

Out-of-plane loading

Plate			***Welds***		
t =	50	mm	a =	5	mm
Grade	S235		l =	1300	mm
f_{yd} =	235	N/mm²	β_w =	0.8	-
f_u =	360	N/mm²	γ_{M2} =	1.25	-



Member forces			***Stress components***		
Factor	1.2		$\sigma_1 = \tau_1 = F_{t,Ed}\sqrt{2} / 2al$ =	14	N/mm²
$F_{t,Ed}$ = 1/2 b / h x $F_{v,Ed}$ =	259	kN	$\sigma_1 = \tau_1 = F_{v,Ed}\sqrt{2} / 2al$ =	47	N/mm²
$F_{v,Ed}$ =	865	kN		61	N/mm²
$F_{v//,Ed}$ =	0	kN			
M_{Ed} =	0.00	kNm			
			$\tau_{//} = F_{v//,Ed} / 2al$ =	0	N/mm²
			$\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	122	N/mm²

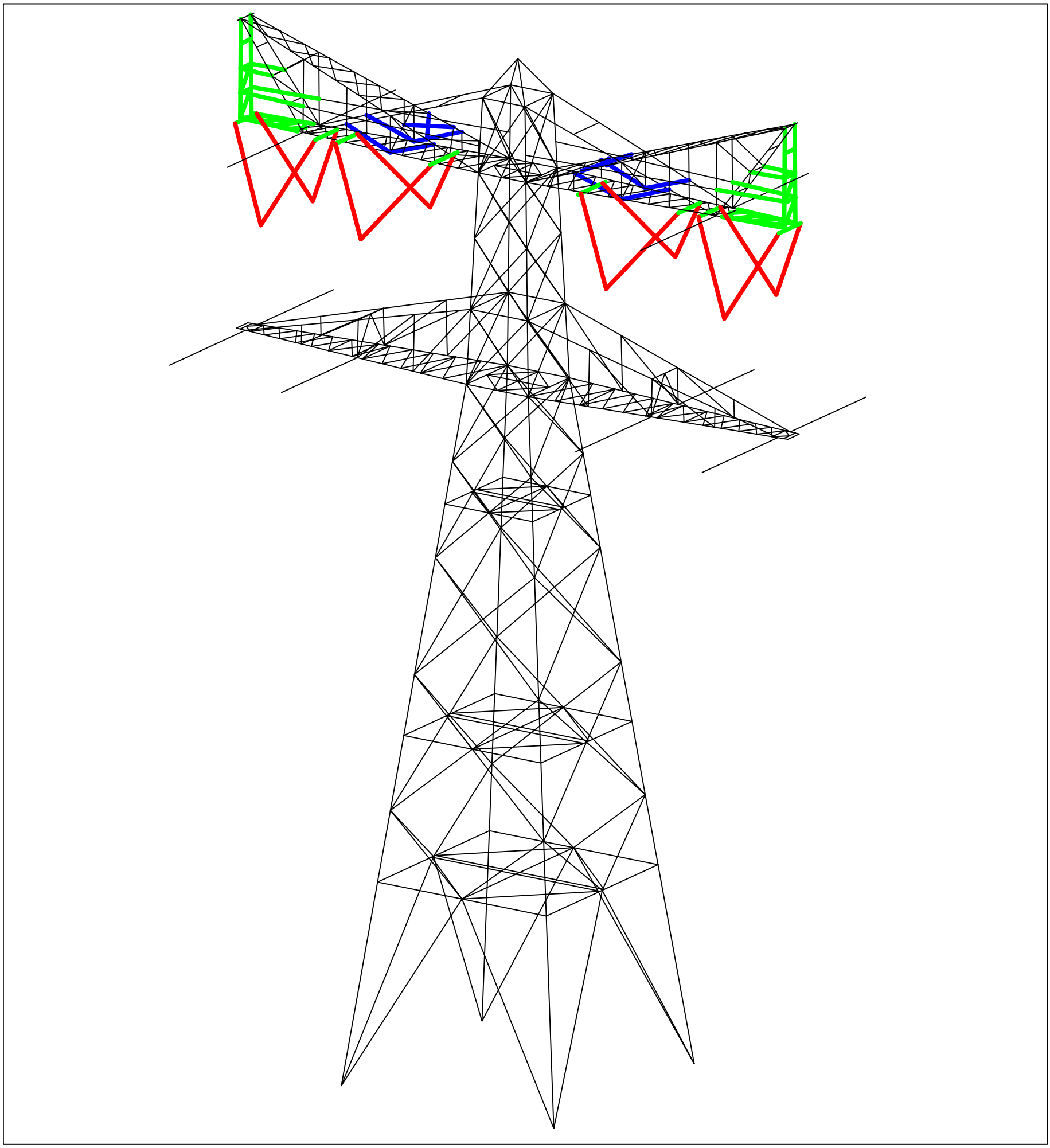
Check							
$\sigma_{vw,Ed}$ =	122	N/mm²	≤	$f_u / \beta_w \gamma_{M2}$ =	360 N/mm²	U.C. =	0.34 OK
σ_1 =	61	N/mm²	≤	$0{,}9 f_u / \gamma_{M2}$ =	259 N/mm²	U.C. =	0.24 OK

Welds of foot plate

$f_u / \beta_w \gamma_{M2}$ =		436	N/mm²
Weld size	a =	5	mm
Length	l = 2b+ 2b - t =	960	mm
Capacity	F_{Rd} = a x l x $f_{w,d}$ / √3 =	1207	kN

APPENDIX E
Tekeningen

Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
426	EA	L50x5	S235 t=<40	M16-8.8t-NEN2012	EA	L70x7	S355 t=<40	M16-8.8t-NEN2012
435	EA	L60x6	S235 t=<40	M16-8.8t-NEN2012	EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
436	EA	L50x5	S235 t=<40	M16-8.8t-NEN2012	EA	L70x7	S355 t=<40	M16-8.8t-NEN2012
490D					EA	L150x14	S355 t=<40	M16-8.8t-NEN2012
469					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
470					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
471					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
472					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
473					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
474					EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
442					HEA	HEA160	S355 t=<40	M20-8.8t-NEN2012
443					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012
5000					EA	L60x6	S355 t=<40	M16-8.8t-NEN2012



Overview

Notes and legend:

- New redundants according to drawing
- Size for new redundants is L50x50x5 unless otherwise indicated
- Other changes according to the table
- All changes are symmetrical unless otherwise indicated
- Material quality t ≤ 16mm S355J0
- Material quality t > 16mm S355J2
- Bolt quality 8.8 rolled

New profile/insulator
Profile exchanged
New redundant
Bolt exchanged

01	15-11-2021	Phase Transposition
02	13-12-2021	Phase Transposition

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-055

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	13-12-2021	Units:	m	
Checked by:	TBR	13-12-2021	Project no:	10166260	
Approved by:	JHu	13-12-2021	Company:	TenneT	

Description: Modifications overview for mast type HB+9_R_X (Mast 65) page 1 of 3

Revision: 02

Format: A2

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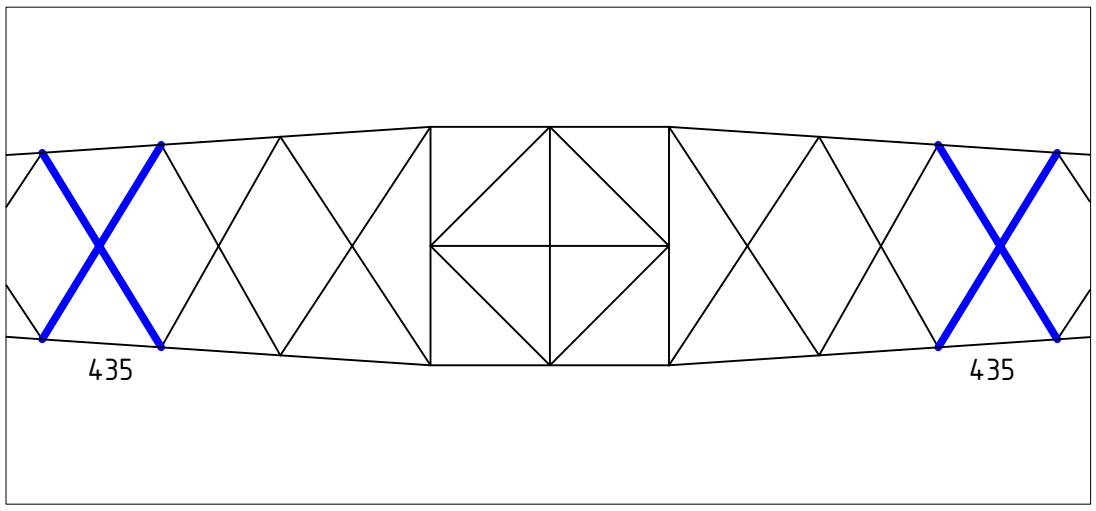
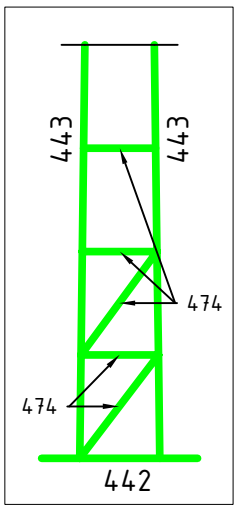
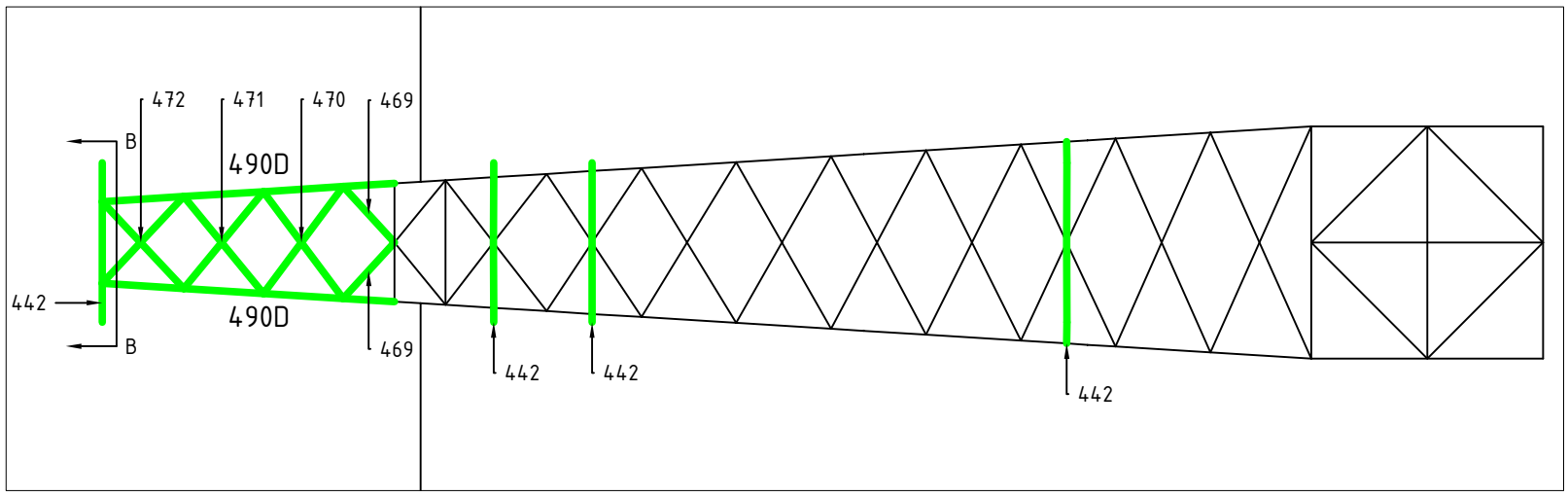


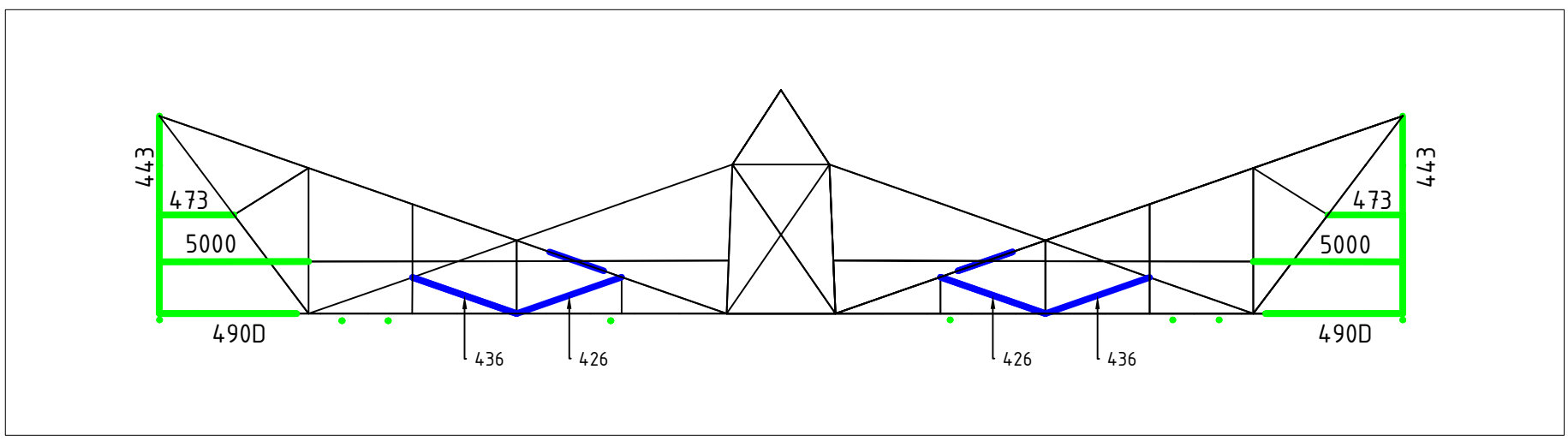
Top View - Upper Crossarm



View on Section B



Top View - Lower Part of Upper Crossarm



Front View - Upper Crossarm

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5 unless otherwise indicated**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

New profile/insulator
Profile exchanged
New redundant
Bolt exchanged

01	15-11-2021	Phase Transposition
02	13-12-2021	Phase Transposition

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-055

Design state:	FINAL	Scale:	-
Drawn by:	KCh 13-12-2021	Units:	m
Checked by:	TBR 13-12-2021	Project no:	10166260
Approved by:	JHu 13-12-2021	Company:	TenneT

Description: Modifications overview for mast type HB+9_R_X (Mast 65) page 2 of 3

Revision: 02

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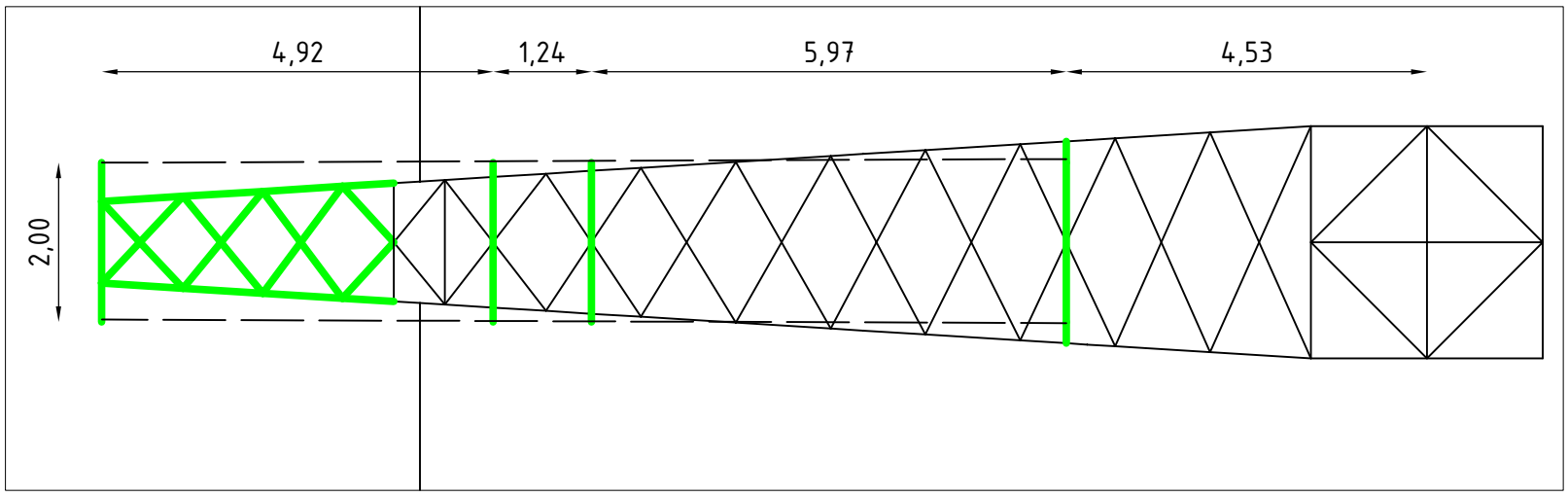
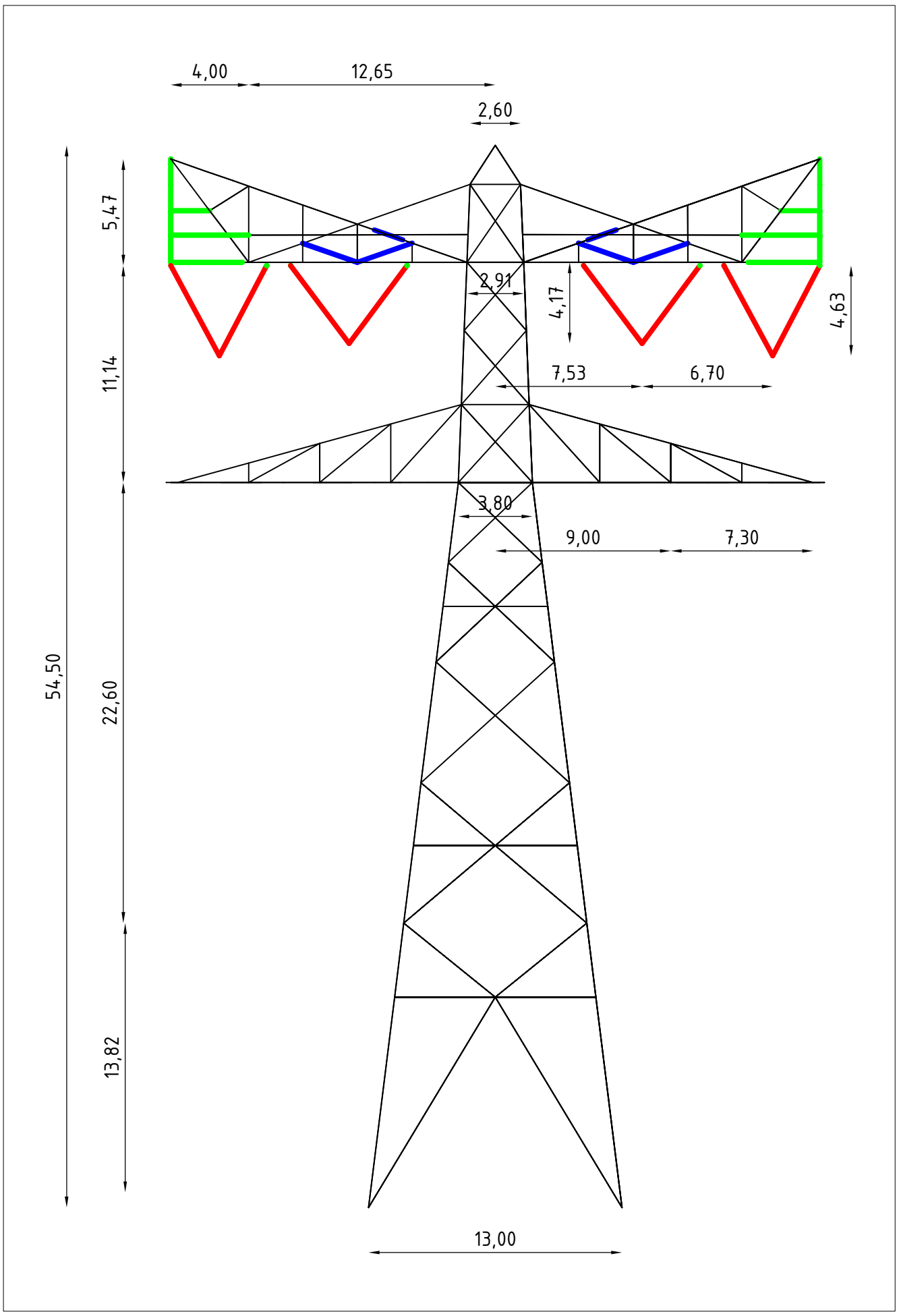
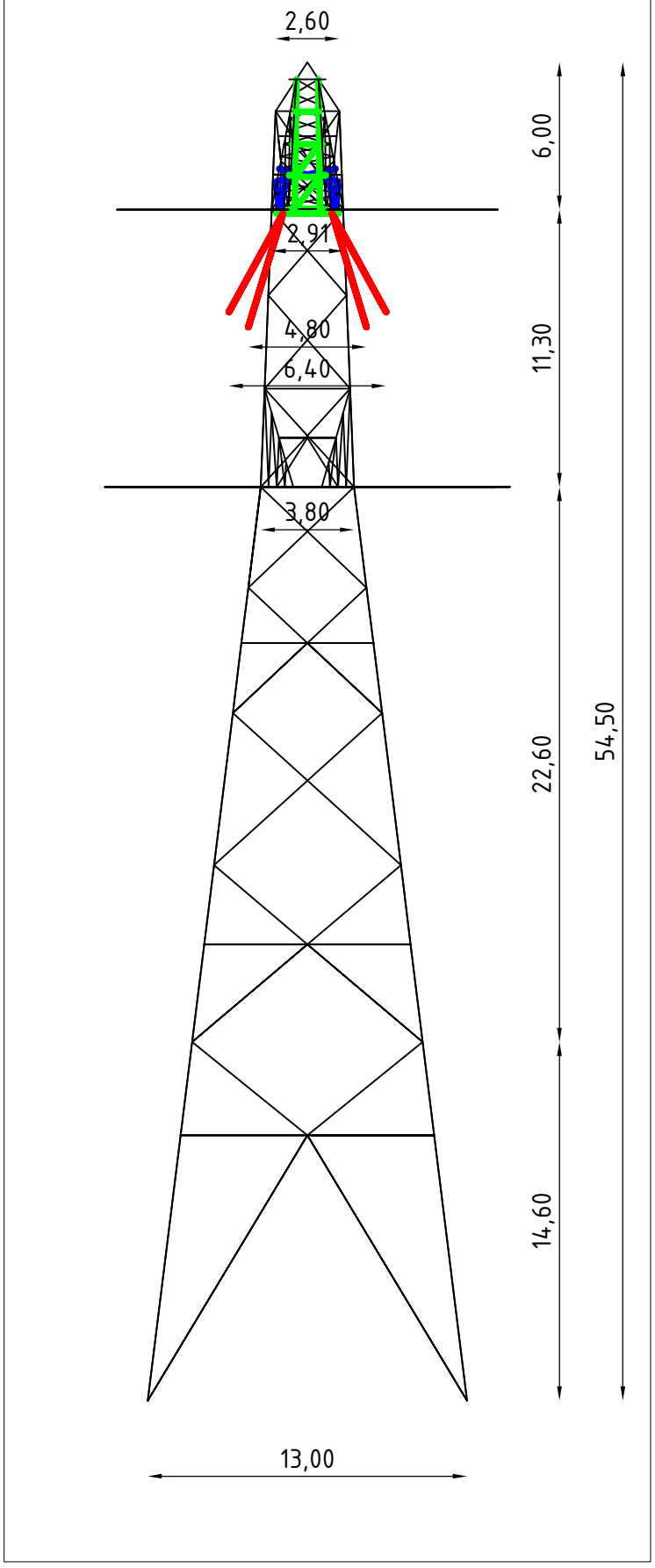


Top View - Lower Part of Upper Crossarm





Front View

Side View

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5 unless otherwise indicated**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Profile exchanged
New redundant
Bolt exchanged

01	15-11-2021	Phase Transposition
02	13-12-2021	Phase Transposition

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-055

Design state:	FINAL		Scale:	-	
Drawn by:	KCh	13-12-2021	Units:	m	
Checked by:	TBR	13-12-2021	Project no:	10166260	
Approved by:	JHu	13-12-2021	Company:	TenneT	

Description: Modifications overview for mast type HB+9_R_X (Mast 65) page 3 of 3

Revision: 02

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TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380

ENS-ZL380 – Rapportage masttype HC-3/RC

TenneT TSO B.V.

Rapport nr.: 22-0511, Rev. 0
Meridian doc.nr.: 002.515.40 - 1007982
Datum: 2022-04-01

Projectnaam:	Toetsing en herontwerp masten en fundaties BBB380	Energy Systems
Rapport titel:	ENS-ZL380 – Rapportage masttype HC-3/RC	DNV Netherlands B.V.
Klant:	TenneT TSO B.V.,	Utrechtseweg 310-B50
Contactpersoon klant:	P. v.d. Horst	6812 AR Arnhem
Datum uitgave:	2022-04-01	
Project nr.:	10166260	
Organisatie unit:	TDT	Tel: 026 356 9111
Meridian doc.nr..:	002.515.40 - 1007982	Handelsregister Arnhem 09006404
Rapport nr.:	22-0511, Rev. 0	

Geschreven door:	Beoordeeld door:	Goedgekeurd door:
M.H. Khan	A.J. Börger	C. Schutte

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Rev.	Datum	Reden van uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2022-04-01	Eerste uitgave	M.H. Khan	A.J. Börger	C. Schutte

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1 INLEIDING

1.1 Inleiding

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen zodat er een grotere transportcapaciteit mogelijk wordt gemaakt.

Om die reden is de opdrachtgever (OG) voornemens de bestaande 380 kV-koppelnetring op te waarderen. Het opwaarderen van de bestaande verbindingen valt onder het programma “Beter benutten bestaande 380 kV-ring” en omvat de volgende deelprojecten:

- Opwaardering 380 kV-verbinding Lelystad – Ens (LLS-ENS380)
- Opwaardering 380 kV-verbinding Diemen – Lelystad (DIM-LLS380)
- Opwaardering 380 kV-verbinding Rilland – Zandvliet (RLL-ZVL380)
- Opwaardering 380 kV-verbinding Krimpen aan den IJssel - Geertruidenberg (KIJ-GT380)
- Opwaardering 380 kV-verbinding Ens - Zwolle (ENS-ZL380)
- Opwaardering 380 kV-verbinding Maasbracht - Eindhoven (MBT-EHV380)

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV opdracht verstrekt voor de volgende onderdelen:

1. In eerste fase het opstellen en creëren van:

1.1 E-studie deel 1

1.2 Uitgangspuntenrapporten ten behoeve van de constructieve analyse van masten en fundaties

1.3 Sonderingmodellen

1.4 Fundatiemodellen

1.5 Mastmodellen

2. In tweede fase de uitvoering van de DO-fase bevattende:

2.1 Toetsing conform het uitgangspuntenrapport van de bestaande fundaties

2.2 Globale specificatie van benodigde fundatieversterkingen ten behoeve van aanbesteding

2.3 Toetsing conform het uitgangspuntenrapport van de bestaande masten

2.4 Globale specificatie van benodigde mastversterkingen ten behoeve van aanbesteding

2.5 E-studie deel 2

1.2 Doel van dit rapport

In dit rapport wordt voor de hoogspanningslijn Ens - Zwolle de controle van de mastconstructie van masttype HC-3/RC gerapporteerd. Het doel is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de nieuwe ACCC-Warsaw geleider waarmee een hogere capaciteit kan worden gerealiseerd.

Nadat de wijzigingen zijn toegepast dient aantoonbaar geverifieerd te worden dat het systeem voldoet aan de vigerende eisen.

In de defintief-ontwerpfase zijn ten behoeve van de contractvorming Engelstalige rapporten geleverd. Het voorliggende rapport is bedoeld voor vergunningsaanvraag en is inhoudelijk ongewijzigd ten opzichte van de Engelse versie. Om deze reden zijn de bijlagen in dit rapport één op één overgenomen uit de Engelse versie. Hierdoor wijkt het revisienummer van de bijlagen af van het revisienummer van de rapportage.

1.3 Gerelateerde documenten

1.3.1 Verificatie & validatieplan

De door TenneT aangeleverde set met eisen is beoordeeld op relevantie en voor de relevante eisen is aangegeven in welk document wordt aangetoond dat er aan de eis wordt voldaan. De resultaten hiervan zijn opgenomen in het rapport “Verificatie & Validatieplan 380 kV verbinding Ens - Zwolle”.

1.3.2 E-studie deel 1

In de rapportage “ENS-ZL380 - E-studie deel 1” [1] is bepaald welke aanpassingen benodigd zijn om de ACCC-Warsaw geleider toe te passen binnen de verbinding Ens – Zwolle.

Uit de E-studie volgen de volgende zaken die relevant zijn voor de constructie van masttype HC-3/RC:

- Toepassen van verticale post-isolators.

1.3.3 Uitgangspuntendocument

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport “Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” [2].

2 EISEN

In onderstaande Tabel 1 zijn de eisen opgenomen die binnen deze rapportage worden getoetst.

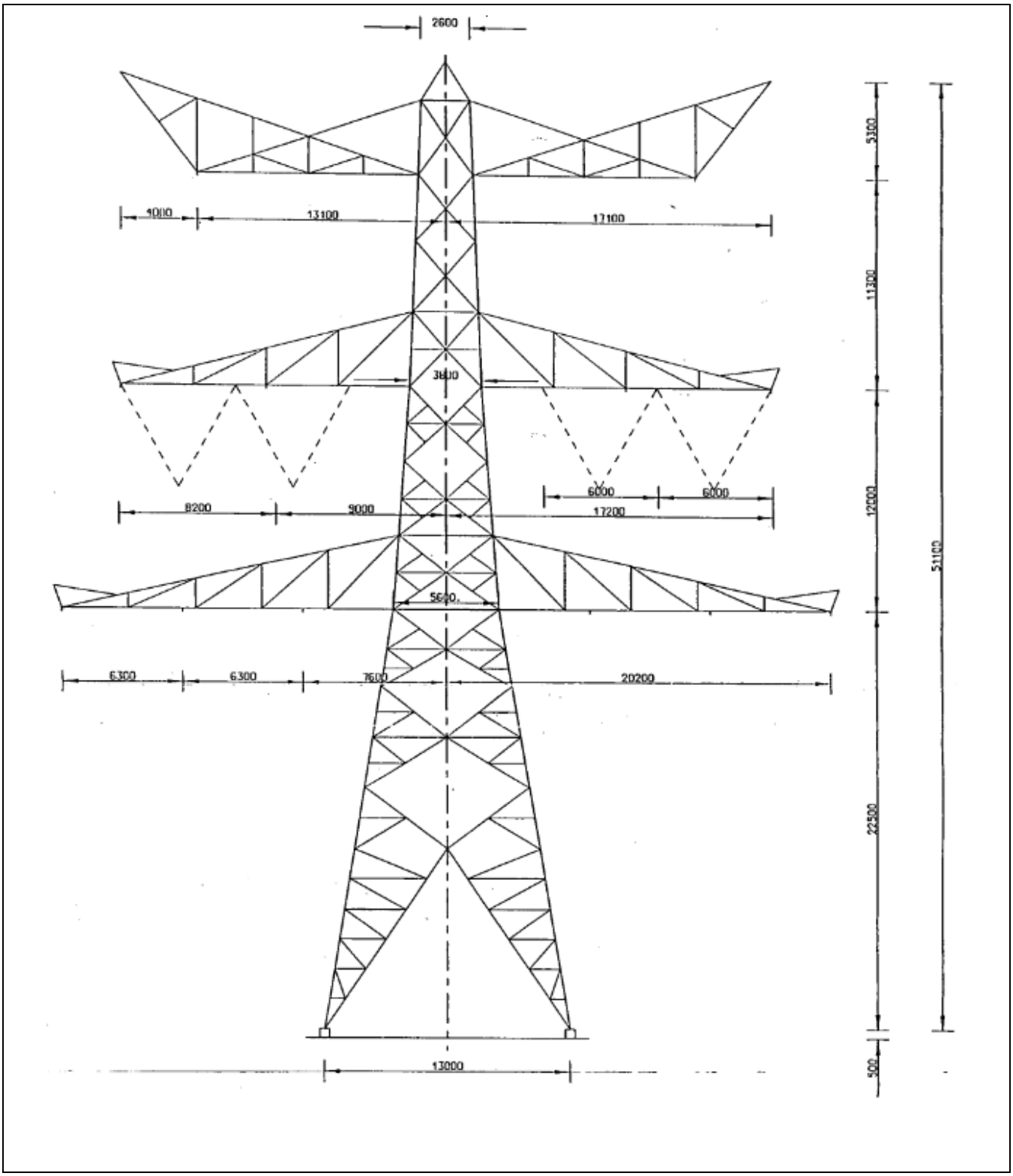
Tabel 1 Relevante eisen

Req. Id	Title	Req. text	Verification
BO Eis: H2.7-6	Omgeving, beperkingsfactoren	Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid.	Tabel 6
PVE.05.001 5.14	Masten	Aanwijzingen t.a.v. klimvoorziening en valbeveiliging: Huidige klimweg blijft gehandhaafd en zal voldoen aan de eisen zoals opgenomen in de NEN 1060:1987. Valbeveiliging is/zal worden uitgevoerd in het type "latch way". Indien staaldelen in de nabijheid (aangrenzend profiel) van de klimweg gewijzigd worden, dient geverifieerd te worden dat de klimvoorziening in overeenstemming is met de NEN 1060:1987.	Tabel 6

3 BEREKENINGEN

3.1 Mastbeeld

Het mastbeeld op basis van de Asset-data is weergegeven in Figuur 1.



Figuur 1 Mastbeeld HC-3/RC

3.2 Mastenlijst

In deze rapportage wordt masttype HC-3/RC getoetst. Er is één HC-3/RC mast welke valt binnen windgebied III. De berekening is uitgevoerd voor windgebied III. De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven. Er is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde).

Tabel 2 Mastnummers

Tower number	Tower type	Governing tower number	Wind span (m)	Weight span (m)	Height difference back (m)	Height difference ahead (m)
73	HC-3_RC	73	297	413	-12.4	-0.8

3.3 Uitgangspunten berekening

De berekening is uitgevoerd op basis van de uitgangspunten zoals opgenomen in het uitgangspuntenrapport [2]. Hierin is een volledig overzicht opgenomen van de belastingcombinaties en toegepaste belastingfactoren.

Tabel 3 Uitgangspunten berekening

Algemeen	Norm	NEN-EN50341-2-15:2019
	Windgebied	II/III
	Terreincategorie	II (onbebouwde omgeving)
	Reductiefactor cdir	1,00
Situatie initieel	Gevolgklasse	CC2-0
	Betrouwbaarheidsniveau	Afkeur CC2-0
	Referentieperiode	30 jaar
Situatie na aanpassingen	Gevolgklasse	CC2
	Betrouwbaarheidsniveau	Verbouw
	Referentieperiode	50 jaar

3.4 Proces stappen

Het proces van het bepalen van eventueel benodigde verstevigingen bestaat uit de volgende stappen:

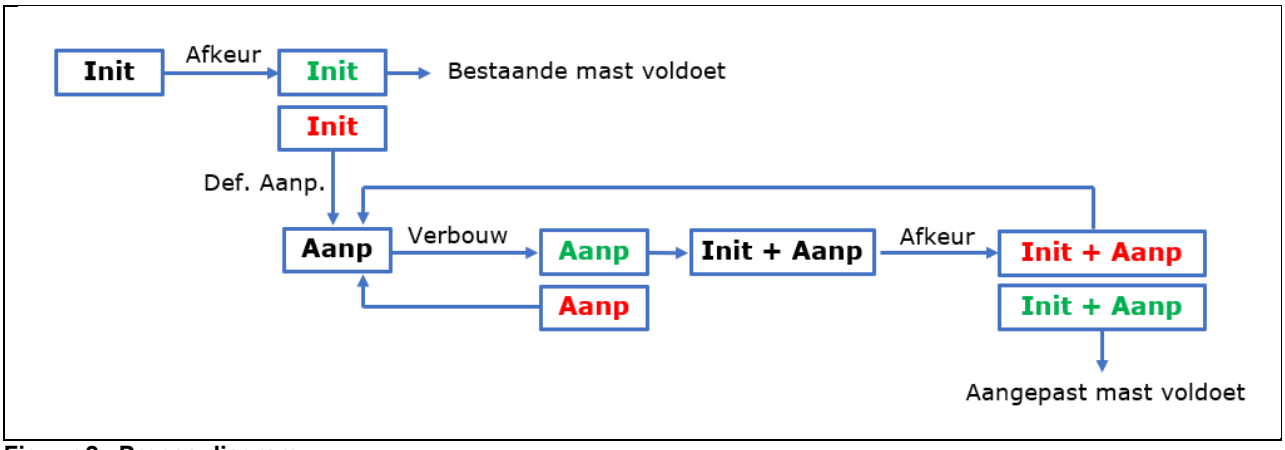
Stap 1: Toets bestaande (Init) mast op Afkeur

Stap 2: Definiëren benodigde aanpassingen indien initiële mast niet voldoet aan toets op Afkeur (Def. Aanp.)

Stap 3: Het toetsen van (alleen) de uitgewerkte aanpassingen (Aanp) op Verbouw

Stap 4: Het opnieuw toetsen van de complete mast inclusief aanpassingen (Initi + Aanp) op Afkeur

Het hierboven omschreven proces is in Figuur 2 weergegeven.



Figuur 2 Proces diagram

3.5 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV. In Appendix A zijn de resultaten van de geleiderbelastingen samengevat.

3.6 Reacties op de fundering

De oplegreacties op de fundering worden ontleend aan de uitvoer van het geleiderbelastingenprogramma, zie ook Appendix A.

3.7 Modellering

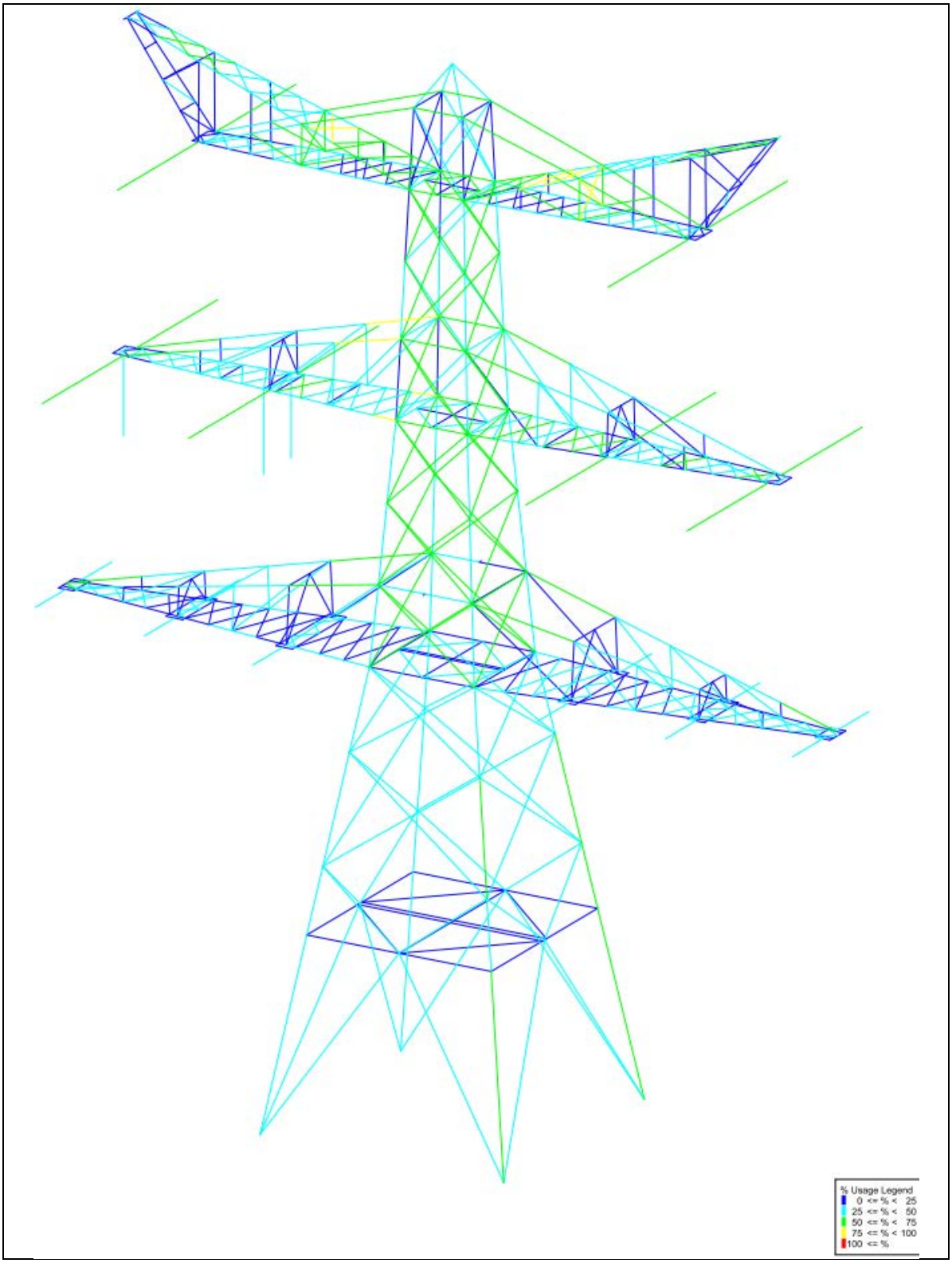
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

De geleiderbelastingen vanuit het geleiderbelastingenprogramma zijn als invoer voor de belastingen gebruikt.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

4 TOETSING MASTCONSTRUCTIE

Het resultaat van de controle van de mastconstructie type HC-3/RC met belastingen op afkeurniveau is weergegeven in Figuur 3.



Figuur 3 Resultaat PLS-TOWER HC-3/RC (73)

De resultaten van de controles van profielen, knikverkorters en ankers randstijl zijn opgenomen in Tabel 4 .

Sommige knikverkorters falen door knik vanwege de overschrijding van het 1% criterium van drukkracht van de randstijl. Daarom moeten de knikverkorters vervangen worden.

Tabel 4 Samenvatting controle

Controle van	Beoordeling		Referentie
Profielen	Voldoen		Appendix B
Knikverkorters		Voldoen niet	Appendix C
Blokdeuvels	Voldoen		Appendix D

5 AANPASSINGEN

5.1 Inleiding

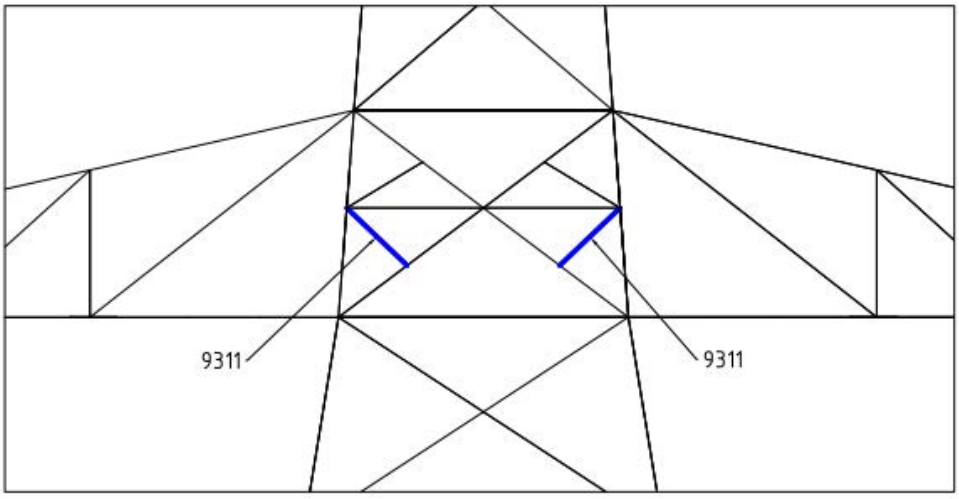
Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Vervangen van verschillende knikverkorters in de onderste randstijl en ter hoogte van de onderste traverse.
- Voorstel voor de verbinding van de ‘post insulator’

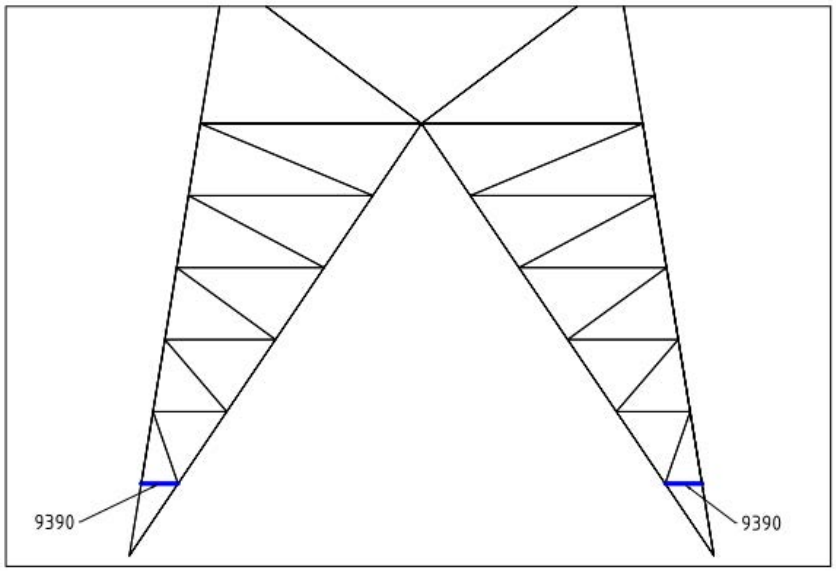
5.2 Aanpassingen

Volgens de resultaten in Appendix B dienen de verbeteringen die worden toegepast in dit hoofdstuk toegelicht te worden.

De knikverkorters welke vervangen dienen te worden zijn in figuur 5 en 6 weergegeven:

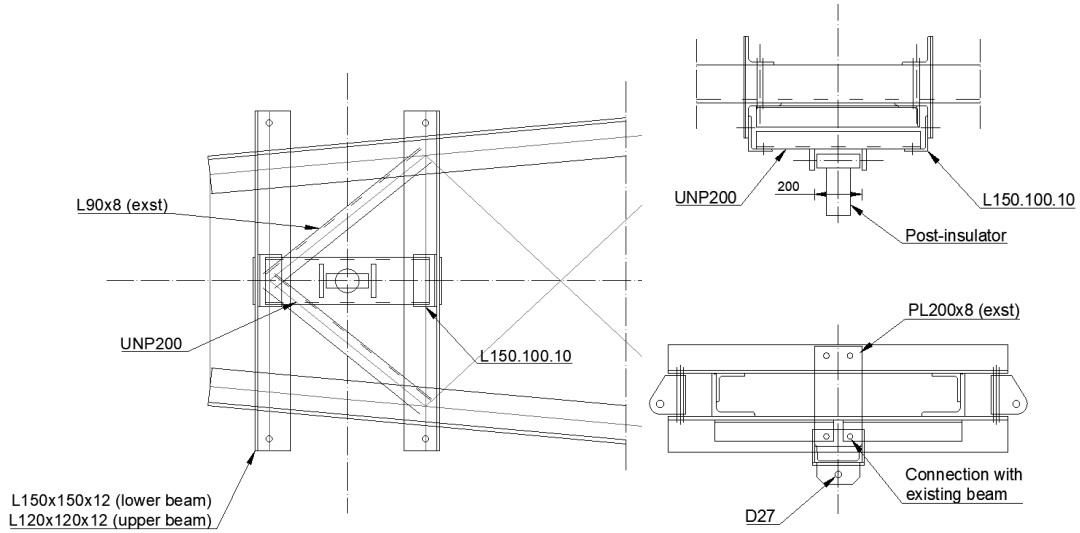


Figuur 4 Vooraanzicht- ter hoogte van de onderste traverse.

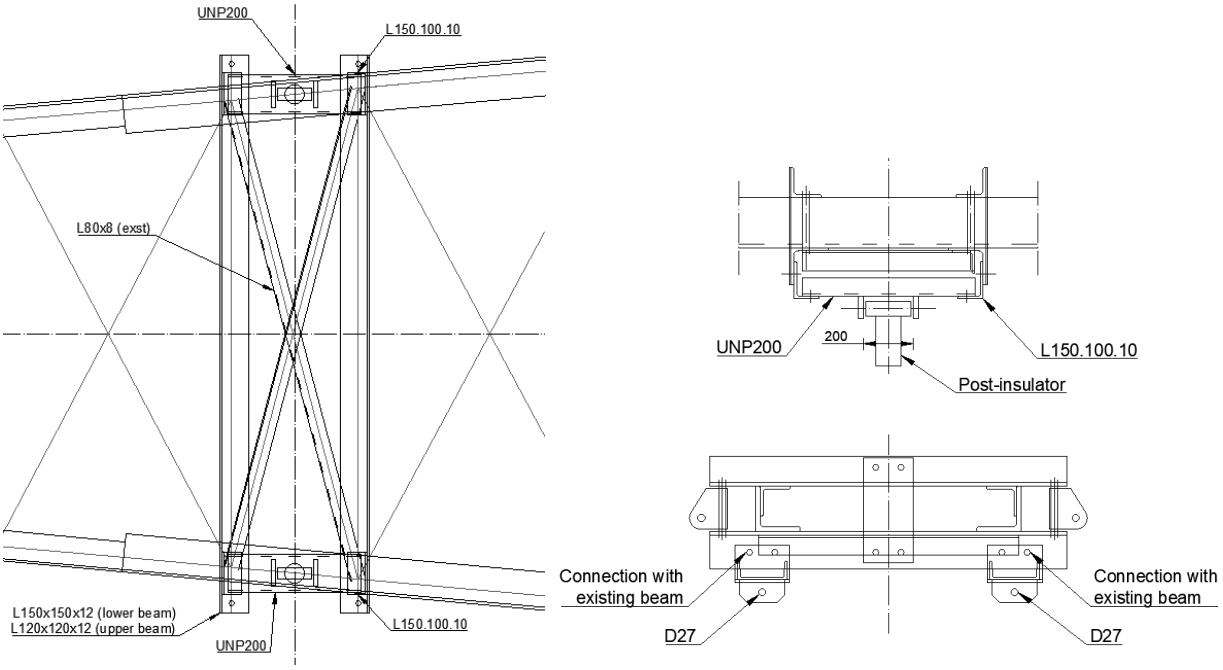


Figuur 5 Vooraanzicht- onderste randstijl

DNV heeft een voorstel voorzien voor de verbinding van de ‘post insulator’ deze zijn weergegeven in figuur 6 en 7.



Figuur 6 Verbinding van de post-isolator aan het einde van de traverse



Figuur 7 Verbinding van de post-isolator in het midden van de traverse

Informatie met betrekking tot de profielmaten en de bout maten is te vinden in Appendix E. Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen is gegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten en ander hulpstaal als onderdeel van de verbinding is niet meegenomen.

Tabel 5 Gewichten HC-3/RC van toegevoegde knikverkorters en uitgewisselde profielen

Group Label	Profile ini.	Material ini.	Bolts ini.	Profile new	Material new	Bolts new	Mitigation	Number	Length (m)	Weight (kg)
Pos 9390	L50.5	S235	1M16-8.8t	**L50.5**	**S355**	**1M16-8.8t**	Profile exchanged	8	0.55	16.9
Pos 9311	L50.5	S235	1M16-8.8t	**L50.5**	**S355**	**1M16-8.8t**	Profile exchanged	8	1.53	47.0
									16.64	63.9

5.3 Eisenverificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 6.

Tabel 6 Verificatie eisen

Eis Id	Eis Tekst	Ja	Nee	N.v.t.	Toelichting
BO Eis: H2.7-6	Aanpassingen uitvoerbaar?	X			De toe te voegen staalonderdelen zijn met geboute verbindingen te bevestigen. Dit is een bewezen methode.
PVE.05.001 5.14	Staaldelen in nabijheid van klimweg gewijzigd?		X		De wijzigingen in de nabijheid van de klimweg (knikverkorters) zijn in te passen zonder negatieve invloed op de begaanbaarheid.
	klimvoorziening nog in overeenstemming is met de NEN 1060:1987?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.515.40 0825824 - 21-0462 - Verificatie & validatieplan 380kV verbinding Ens - Zwolle”.
[2] „002.515.40 0825812 - 20-1465 - E-studie deel 1 380kV verbinding Ens - Zwolle”.
[3] „002.515.40 0825820 - 20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle”.

APPENDIX A
Geleiderbelastingen

Content

- Starting point p. 2
- Tower construction p. 6
- In between results p. 8
- Loads initial p. 10
- Loads after adjustment p. 15

Data

Norm	NEN-EN50341-2-15:2019
Initial	
Consequence class	CC2-0
Reliability level	Afkeur
Reference period	30 jaar
After adjustment	
Consequence class	CC2
Reliability level	Verbouw
Reference period	50 jaar
Wind zone	III
Wind speed	24.5 m/s
Terrain categorie	II
Reduction factor Cdir	1.00
Ice region	B
Tower type	Hoekmast
Tower height	51.8 m
Max. Span	398.4 m
Line angle	124.4°
Catenary	2100 m
Wind span	297 m
EDS Weight span	434 m
Min. Weight span	297 m
Max. Weight span	566 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-01-26			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype HC-3_RC

JOB No.	-	DATE	-
DRAWN	-	CHKD	-
DESIGN	-	APPD	-

Document name:

ENS-ZL_HC-3_RC_73_Report.pdf

Project number:

Project client number:

0.0											

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Conductor loads

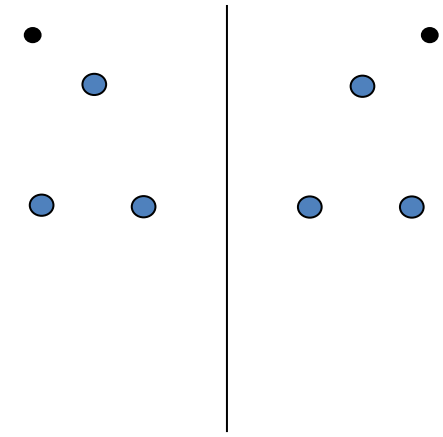
Auteur: TBR
Versie: v11.5

General

Description	HC-3_RC
Tower type	Hoekmast
Number of circuits	4
Configuration	4-circuit-verticaal-vlak
Number of earth wires	3

Starting points

Norm	NEN-EN50341-2-15:2019
Consequence class	CC2-0
Reliability level initial	Afkeur CC2-0
Reference period intial	30 jaar
Consequence class modified	CC2
Reliability level modified	Verbouw
Reference period modified	50 jaar
Wind zone	III
Terrain category	24.5 m/s
Reduction factor c_{dir}	II
Ice region phase conductor	1.00
Ice region earth conductor	B
	B



Configuratie geleiders

Conductors back

Description	Voltage	Conductor Back	Bundle Ba	Ice region	Additional weight	Additional diameter	Catenary P_{back}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 3	110 kV	AAAC IJSSEL	1	B	3 %	3 %	2100
Circuit 4	110 kV	AAAC IJSSEL	1	B	3 %	3 %	2100
Bliksemdraad 1		B232 HAWK	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 3		OPGW 96 Fibral	1	B	3 %	3 %	2100

Conductors ahead

Description	Voltage	Conductor Ahead	Bundle Ah	Ice region	Additional weight	Additional diameter	Catenary P_{ahead}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 3	110 kV	AAAC IJSSEL	1	B	3 %	3 %	2100
Circuit 4	110 kV	AAAC IJSSEL	1	B	3 %	3 %	2100
Bliksemdraad 1		B232 HAWK	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 3		Niet aanwezig	1	B	3 %	3 %	2100

Insulators (1)

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Afspanketting	2.00	4.50	1.00
Circuit 2	Afspanketting	2.00	4.50	1.00
Circuit 3	Afspanketting	1.00	1.59	0.50
Circuit 4	Afspanketting	1.00	1.59	0.50
Bliksemdraad 1	Vast (Bliksemdraad)	0.10	0.30	0.10
Bliksemdraad 2	Vast (Bliksemdraad)	0.10	0.30	0.10
Bliksemdraad 3	Vast (Bliksemdraad)	0.10	0.30	0.10

1. Properties apply to the entire isolator set

Suspension height and position in mast

Circuits	Designation	Number	Suspension height	Attach point	Position in tower (3) Horizontal distance
Circuit 1	10	380ct1f1	34.5 m	34.5 m	-17.2 m
Circuit 1	11	380ct1f2	34.5 m	34.5 m	-9.0 m
Circuit 1	12	380ct1f3	45.8 m	45.8 m	-13.1 m
Circuit 2	21	380ct2f1	34.5 m	34.5 m	17.2 m
Circuit 2	20	380ct2f2	34.5 m	34.5 m	9.0 m
Circuit 2	22	380ct2f3	45.8 m	45.8 m	13.1 m
Circuit 3	30	110ct3f1	22.5 m	22.5 m	-20.2 m
Circuit 3	31	110ct3f2	22.5 m	22.5 m	-13.9 m
Circuit 3	32	110ct3f3	22.5 m	22.5 m	-7.6 m
Circuit 4	42	110ct4f1	22.5 m	22.5 m	20.2 m
Circuit 4	41	110ct4f2	22.5 m	22.5 m	13.9 m
Circuit 4	40	110ct4f3	22.5 m	22.5 m	7.6 m
Bliksemdraad 1	1	bl1	50.8 m	51.1 m	-17.1 m
Bliksemdraad 2	3	bl2	50.8 m	51.1 m	17.1 m
Bliksemdraad 3	2	bl3	26.2 m	26.5 m	0.0 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Height adjustment adjacent masts (wind and weight span adjustment)

	Back	Ahead	
Height increase for wind pressure	0.0 m	0.0 m	(positive: higher)
Height decrease for vertical load	0.0 m	0.0 m	(negative: decrease, more weight span)

Decrease: Niet in 0,9EG-combinaties

Height difference adjacent tower and change of direction with respect to Line direction

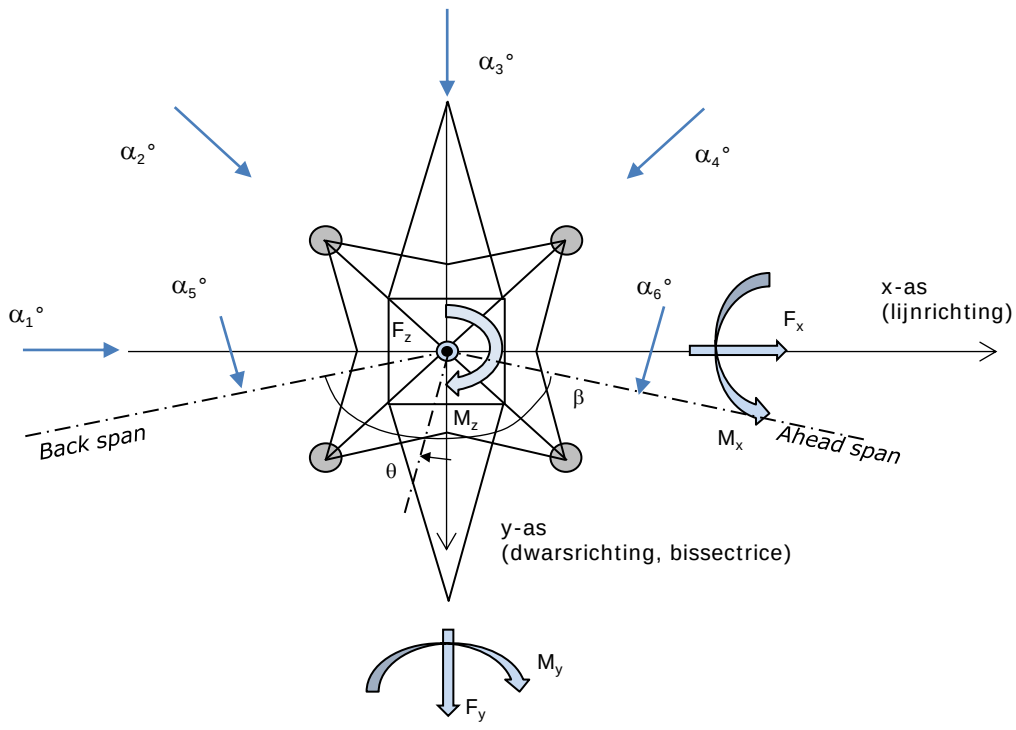
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	-12.4	-0.8 m	0.0	0.0 m
Circuit 1	11	380ct1f2	-12.4	-0.8 m	0.0	0.0 m
Circuit 1	12	380ct1f3	-12.4	-0.8 m	0.0	0.0 m
Circuit 2	21	380ct2f1	-12.4	-0.8 m	0.0	0.0 m
Circuit 2	20	380ct2f2	-12.4	-0.8 m	0.0	0.0 m
Circuit 2	22	380ct2f3	-12.4	-0.8 m	0.0	0.0 m
Circuit 3	30	110ct3f1	0.0	0.0 m	0.0	0.0 m
Circuit 3	31	110ct3f2	0.0	0.0 m	0.0	0.0 m
Circuit 3	32	110ct3f3	0.0	0.0 m	0.0	0.0 m
Circuit 4	42	110ct4f1	0.0	0.0 m	0.0	0.0 m
Circuit 4	41	110ct4f2	0.0	0.0 m	0.0	0.0 m
Circuit 4	40	110ct4f3	0.0	0.0 m	0.0	0.0 m
Bliksemdraad 1	1	bl1	-12.4	-0.8 m	0.0	0.0 m
Bliksemdraad 2	3	bl2	-12.4	-0.8 m	0.0	0.0 m
Bliksemdraad 3	2	bl3	-12.4	-0.8 m	0.0	0.0 m

Line and tower data

		Back	Ahead	
		195.0	398.4	m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		327.2	359.2	m
Line angle	β	124.4		°
Tower orientation with respect to bis	θ	0		°
Section length		2435	3225	m
Height bottom of tower to ground level		0.5		m
Wind directions considered	α_1	0		°
Wind directions according to:	α_2	45		°
Geleiderbelastingen	α_3	90		°
	α_4	135		°
	α_5	62.2		°
	α_6	117.8		°

Wind directions apply to the main direction of mast construction, not to the bisector.

Windrichtingen en positieve richtingen belastingen



Considered number of wind directions

1a	6
3	6
4	1
6	1
Overig	1

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

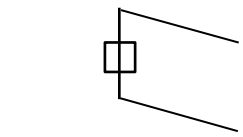
Absence of conductors

		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	1	0
Circuit 1	380ct1f2	1	0	1	0	1	0
Circuit 1	380ct1f3	1	0	1	0	1	0
Circuit 2	380ct2f1	0	1	1	0	1	0
Circuit 2	380ct2f2	0	1	1	0	1	0
Circuit 2	380ct2f3	0	1	1	0	1	0
Circuit 3	110ct3f1	1	0	1	0	1	0
Circuit 3	110ct3f2	1	0	1	0	1	0
Circuit 3	110ct3f3	1	0	1	0	1	0
Circuit 4	110ct4f1	0	1	1	0	1	0
Circuit 4	110ct4f2	0	1	1	0	1	0
Circuit 4	110ct4f3	0	1	1	0	1	0
Bliksemdraad 1	bl1	1	0	1	0	1	0
Bliksemdraad 2	bl2	0	1	1	0	1	0
Bliksemdraad 3	bl3	0	1	1	0	1	0

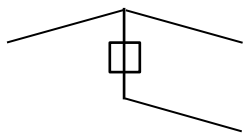
Load situations SPLS

Considered situations SPLS: 1 up to 6, All possible situations

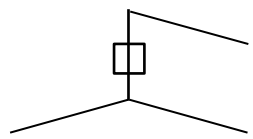
Principle of load situations:



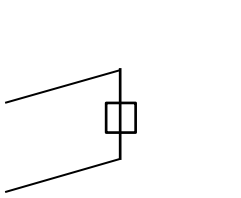
1. Ba All cts



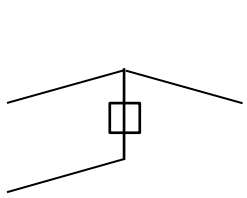
2. Ba ct1



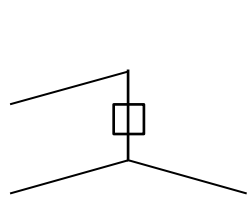
3. Ba ct2



4. Ah All cts



5. Ah ct1

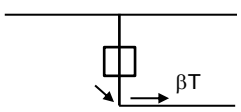


6. Ah ct2

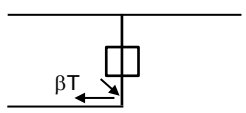
Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1 and 2, all possible situations

Principle of load situations:



1. Ba



2. Ah

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

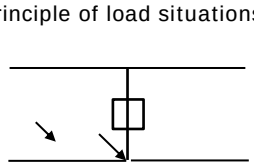
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations are applied in ULS and in every SPLS situation (in case of angle tower).

3.0 kN	2.0 kN
1.0 kN	1.0 kN

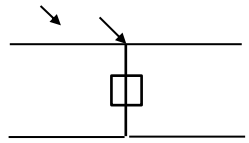
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

Presence line vehicle: Circuit, load present in all conductors of a circuit

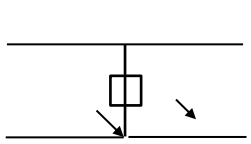
Principle of load situations:



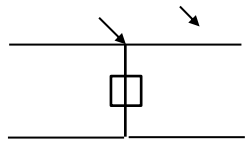
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

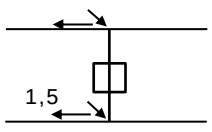
Load situations 8. Galloping as a static load

Conductor		
Suspension tower phase	0.866 W	1.5 W
Suspension tower earth	1.5 EDS	1.5 W
Strain tower phase and earth	1.5 EDS	1.5 W

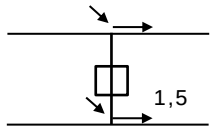
Considered situations galloping 8: None (existing structure)

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principle of load situations:



1. Ba



2. Ah

Load combination 8. Galloping as a dynamic load
Only applies to tension towers
Load consists of EDS tensile load in one of the conductors on one side of the tower
Can be converted by user to fatigue spectrum via the load spectrum of table 4.11 / NL.1

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Tower structure

0.06

Properties

Tower type	Hoekmast		
Tower designation	HC-3_RC		
Base plate w.r.t. ground level	0.5		m
Tower height w.r.t. base plate	51.8		m
Tower self weight	770.0		kN
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	13.00	13.00	m
Inclination of main leg	0.164	0.164	-
Horizontal force factor	1.3	1.3	-

Calculation Wind load

Dynamic factor G_T	1.00 *(Masthoogte < 60 m)*
Wind load diagonally to tower body proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Wind load diagonally on traverse proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Magnification factor diagonal wind to tower body	(1+0,2sin^2(2phi))
Magnification factor diagonal wind to cross arm	(1+0,2sin^2(2phi))
Magnification factor wind parallel to perpendicular to cross a	0.4

Properties mast sections line direction (front view, yz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	12.90	13.00	8.76	12.90	0.164	140.33	22.86	0.16	3.10
Eerste tussenstuk	22.50	8.76	5.60	9.60	0.164	68.91	15.51	0.23	2.82
Tweede tussenstuk	34.50	5.60	3.80	12.00	0.075	56.40	15.91	0.28	2.60
Bovenstuk 1	42.30	3.80	3.19	7.80	0.039	27.25	7.08	0.26	2.68
Bovenstuk 2	49.80	3.19	2.60	7.50	0.039	21.71	5.63	0.26	2.69
Topstuk	51.80	2.60		2.00		2.60	0.40	0.15	3.14
Ondertraverse	22.50	17.40		4.00		34.80	7.60	0.22	2.85
Boventraverse	45.80	15.64		5.30		41.45	7.54	0.18	3.01
Middentraverse	34.50	15.30		4.00		30.60	6.96	0.23	2.81

Properties tower sections transverse direction (side view, xz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	12.90	13.00	8.76	12.90	0.164	140.33	22.86	0.16	3.10
Eerste tussenstuk	22.50	8.76	5.60	9.60	0.164	68.91	15.51	0.23	2.82
Tweede tussenstuk	34.50	5.60	3.80	12.00	0.075	56.40	15.91	0.28	2.60
Bovenstuk 1	42.30	3.80	3.19	7.80	0.039	27.25	7.08	0.26	2.68
Bovenstuk 2	49.80	3.19	2.60	7.50	0.039	21.71	5.63	0.26	2.69
Topstuk	51.80	2.60		2.00		2.60	0.40	0.15	3.14
Ondertraverse	22.50	17.40		4.00		34.80	7.60	0.22	2.85
Boventraverse	45.80	15.64		5.30		41.45	7.54	0.18	3.01
Middentraverse	34.50	15.30		4.00		30.60	6.96	0.23	2.81

Note: Surface transverse direction is reduced in calculation.

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk			
Eerste tussenstuk			
Tweede tussenstuk			
Bovenstuk 1			
Bovenstuk 2			

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne top			
Antenne o.t.			

Tower section loads longitudinal (x-direction) per wind direction

Description	p_w	F_{x1}	F_{x2}	F_{x3}	F_{x4}	h_{ef}	M_{y1}	M_{y2}	M_{y3}	M_{y4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0.70	49.7	42.1	0.0	-42.1	6.5	320.3	271.8	0.0	-271.8
Eerste tussenstuk	0.85	37.0	31.4	0.0	-31.4	17.7	655.4	556.2	0.0	-556.2
Tweede tussenstuk	0.97	40.3	34.2	0.0	-34.2	28.5	1148.3	974.4	0.0	-974.4
Bovenstuk 1	1.06	20.2	17.1	0.0	-17.1	38.4	774.8	657.5	0.0	-657.5
Bovenstuk 2	1.11	16.8	14.3	0.0	-14.3	46.1	773.7	656.5	0.0	-656.5
Topstuk	1.14	1.4	1.2	0.0	-1.2	50.8	72.9	61.9	0.0	-61.9
Ondertraverse	0.93	40.1	23.8	0.0	-23.8	23.8	955.3	567.4	0.0	-567.4
Boventraverse	1.12	50.9	30.2	0.0	-30.2	47.6	2419.5	1437.1	0.0	-1437.1
Middentraverse	1.04	40.7	24.2	0.0	-24.2	35.8	1457.8	865.9	0.0	-865.9
Totaal		297.0	218.5	0.0	-218.5		8578.1	6048.6	0.0	-6048.6

Tower section loads longitudinal (y-direction) per wind direction

Description	p_w	F_{y1}	F_{y2}	F_{y3}	F_{x4}	h_{ef}	M_{x1}	M_{x2}	M_{x3}	M_{x4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0.70	0.0	42.1	49.7	42.1	6.5	0.0	271.8	320.3	271.8
Eerste tussenstuk	0.85	0.0	31.4	37.0	31.4	17.7	0.0	556.2	655.4	556.2
Tweede tussenstuk	0.97	0.0	34.2	40.3	34.2	28.5	0.0	974.4	1148.3	974.4
Bovenstuk 1	1.06	0.0	17.1	20.2	17.1	38.4	0.0	657.5	774.8	657.5
Bovenstuk 2	1.11	0.0	14.3	16.8	14.3	46.1	0.0	656.5	773.7	656.5
Topstuk	1.14	0.0	1.2	1.4	1.2	50.8	0.0	61.9	72.9	61.9
Ondertraverse	0.93	0.0	23.8	16.0	23.8	23.8	0.0	567.4	382.1	567.4
Boventraverse	1.12	0.0	30.2	20.3	30.2	47.6	0.0	1437.1	967.8	1437.1
Middentraverse	1.04	0.0	24.2	16.3	24.2	35.8	0.0	865.9	583.1	865.9
Total		0.0	218.5	218.0	218.5		0.0	6048.6	5678.5	6048.6

Resulting loads from mast construction incl. Antenna without conductors level foundation (char. Value)

Load / wind direction	F_x	F_y	F_z	M_x	M_y	M_z
	[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
Permanente belasting	0	0	770	0	0	0
Windrichting 0°	297	0	0	0	8578	0
Windrichting 45°	219	219	0	6049	6049	0
Windrichting 90°	0	218	0	5679	0	0
Windrichting 135°	-219	219	0	6049	-6049	0

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 3	AAAC IJSSEL	21.8	282.9	8.00	56500	2.30E-05
Circuit 4	AAAC IJSSEL	21.8	282.9	8.00	56500	2.30E-05
Bliksemdraad 1	B232 HAWK	21.8	281.0	9.70	74000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 3	OPGW 96 Fibral	15.8	116.0	4.85	85366	1.72E-05

Conductors ahead

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 2	ACCCZ-Warsaw	27.7	571.0	14.98	62700	1.88E-05
Circuit 3	AAAC IJSSEL	21.8	282.9	8.00	56500	2.30E-05
Circuit 4	AAAC IJSSEL	21.8	282.9	8.00	56500	2.30E-05
Bliksemdraad 1	B232 HAWK	21.8	281.0	9.70	74000	2.30E-05
Bliksemdraad 2	OPGW 226	21.7	264.0	9.80	81000	2.30E-05
Bliksemdraad 3	Niet aanwezig					

Vertical load back

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	$w_{z,ijs}$ [N/m]	$w_{z,ijs,bundel}$ [N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 3	1	3	8.2	B	4+0,2d	8.4	8.4
Circuit 4	1	3	8.2	B	4+0,2d	8.4	8.4
Bliksemdraad 1	1	3	10.0	B	4+0,2d	8.4	8.4
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 3	1	3	5.0	B	4+0,2d	7.2	7.2

Vertical load ahead

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	[N/m]	[N/m]
Circuit 1	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 2	3	3	46.3	B	4+0,2d	9.5	28.6
Circuit 3	1	3	8.2	B	4+0,2d	8.4	8.4
Circuit 4	1	3	8.2	B	4+0,2d	8.4	8.4
Bliksemdraad 1	1	3	10.0	B	4+0,2d	8.4	8.4
Bliksemdraad 2	1	3	10.1	B	4+0,2d	8.3	8.3
Bliksemdraad 3	1	3		B	4+0,2d		

Insulators

Conductor	$G_{isolator}$ [kN]	Number -	$F_{v,iso}$ [kN]	Length [m]	Wind surf. [m^2]	Wind heigth [m]	Pressure [kN/m^2]	Drag factor [-]	$F_{h,iso}$ [kN]
380ct1f1	2.00	1	2	4.5	1.0	35.00	1.03	1.2	1.24
380ct1f2	2.00	1	2	4.5	1.0	35.00	1.03	1.2	1.24
380ct1f3	2.00	1	2	4.5	1.0	46.30	1.11	1.2	1.34
380ct2f1	2.00	1	2	4.5	1.0	35.00	1.03	1.2	1.24
380ct2f2	2.00	1	2	4.5	1.0	35.00	1.03	1.2	1.24
380ct2f3	2.00	1	2	4.5	1.0	46.30	1.11	1.2	1.34
110ct3f1	1.00	1	1	1.6	0.5	23.00	0.92	1.2	0.55
110ct3f2	1.00	1	1	1.6	0.5	23.00	0.92	1.2	0.55
110ct3f3	1.00	1	1	1.6	0.5	23.00	0.92	1.2	0.55
110ct4f1	1.00	1	1	1.6	0.5	23.00	0.92	1.2	0.55
110ct4f2	1.00	1	1	1.6	0.5	23.00	0.92	1.2	0.55
110ct4f3	1.00	1	1	1.6	0.5	23.00	0.92	1.2	0.55
bl1	0.10	0.5	0.05	0.3	0.1	51.30	1.14	1.2	0.14
bl2	0.10	0.5	0.05	0.3	0.1	51.30	1.14	1.2	0.14
bl3	0.10	0.5	0.05	0.3	0.1	26.70	0.96	1.2	0.11

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Wind load back

Conductor	Height wind [m]	Pressure [kN/m^2]	$G_{c\ dwars}$ [-]	$G_{c\ trek}$ [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	27.0	0.96	0.59	0.50	1.11	28.53	53.8	45.9	47.4	96.9	82.5
380ct1f2	27.0	0.96	0.59	0.50	1.11	28.53	53.8	45.9	47.4	96.9	82.5
380ct1f3	38.3	1.06	0.62	0.53	1.08	28.53	60.7	51.6	47.4	112.0	95.3
380ct2f1	27.0	0.96	0.59	0.50	1.11	28.53	53.8	45.9	47.4	96.9	82.5
380ct2f2	27.0	0.96	0.59	0.50	1.11	28.53	53.8	45.9	47.4	96.9	82.5
380ct2f3	38.3	1.06	0.62	0.53	1.08	28.53	60.7	51.6	47.4	112.0	95.3
110ct3f1	21.5	0.90	0.57	0.49	1.20	22.50	13.9	11.8	42.0	25.9	22.1
110ct3f2	21.5	0.90	0.57	0.49	1.20	22.50	13.9	11.8	42.0	25.9	22.1
110ct3f3	21.5	0.90	0.57	0.49	1.20	22.50	13.9	11.8	42.0	25.9	22.1
110ct4f1	21.5	0.90	0.57	0.49	1.20	22.50	13.9	11.8	42.0	25.9	22.1
110ct4f2	21.5	0.90	0.57	0.49	1.20	22.50	13.9	11.8	42.0	25.9	22.1
110ct4f3	21.5	0.90	0.57	0.49	1.20	22.50	13.9	11.8	42.0	25.9	22.1
bl1	43.6	1.10	0.63	0.54	1.19	22.45	18.5	15.8	41.9	34.8	29.6
bl2	43.6	1.10	0.63	0.54	1.20	22.35	18.5	15.7	41.8	34.7	29.5
bl3	19.0	0.86	0.56	0.48	1.20	16.23	9.5	8.1	36.6	21.3	18.2

Wind load ahead

Conductor	Height wind [m]	Pressure [kN/m^2]	G_{c_dwars} [-]	G_{c_trek} [-]	C_c [-]	$d_{additional}$ [mm]	w_y [N/m]	$w_{y,section}$ [N/m]	$D_{ijs,additional}$ [mm]	$w_{y,ijs}$ [N/m]	$w_{y,ijs,section}$ [N/m]
380ct1f1	27.1	0.96	0.59	0.49	1.11	28.53	53.9	44.8	47.4	97.0	80.7
380ct1f2	27.1	0.96	0.59	0.49	1.11	28.53	53.9	44.8	47.4	97.0	80.7
380ct1f3	38.4	1.06	0.62	0.52	1.08	28.53	60.7	50.4	47.4	112.1	93.0
380ct2f1	27.1	0.96	0.59	0.49	1.11	28.53	53.9	44.8	47.4	97.0	80.7
380ct2f2	27.1	0.96	0.59	0.49	1.11	28.53	53.9	44.8	47.4	97.0	80.7
380ct2f3	38.4	1.06	0.62	0.52	1.08	28.53	60.7	50.4	47.4	112.1	93.0
110ct3f1	16.7	0.83	0.55	0.46	1.20	22.50	12.4	10.3	42.0	23.1	19.2
110ct3f2	16.7	0.83	0.55	0.46	1.20	22.50	12.4	10.3	42.0	23.1	19.2
110ct3f3	16.7	0.83	0.55	0.46	1.20	22.50	12.4	10.3	42.0	23.1	19.2
110ct4f1	16.7	0.83	0.55	0.46	1.20	22.50	12.4	10.3	42.0	23.1	19.2
110ct4f2	16.7	0.83	0.55	0.46	1.20	22.50	12.4	10.3	42.0	23.1	19.2
110ct4f3	16.7	0.83	0.55	0.46	1.20	22.50	12.4	10.3	42.0	23.1	19.2
bl1	44.6	1.10	0.63	0.52	1.19	22.45	18.7	15.5	41.9	35.1	29.1
bl2	44.6	1.10	0.63	0.52	1.19	22.35	18.6	15.4	41.8	35.0	29.0
bl3	20.0	0.88	0.57	0.47							

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Conductor loads

Auteur: TBR
Versie: v11.5

Starting points

Consequence class	Afkeur CC2-0
Reference period	30 jaar

ULS (strength) Load case	description	NEN-EN50341-2-15:2019 Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	γ_a A_k
ULS 1a	Wind	10°	1.05	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.05	0.00	1.12	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.12	0.00	0.0
ULS 3	Wind+ice	-5°	1.05	1.05	0.00	0.34	0.97	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.05	0.00	0.34	0.97	0.0
ULS 4	Cold+wind	-20°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.05	0.00	0.22	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.05	1.05	1.20	0.22	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.05	1.05	0.00	0.22	0.00	0.0
ULS 7	Permanent	10°	1.15	1.15	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G G_k	γ_Q Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.05	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.05	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.05	1.05	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.05	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.05	1.05	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.05	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.05	1.05	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.05	1.05	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	0.94	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.28	0.88	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.19	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions	6
Number of load combinations for ULS	72
Number of load combinations for SPLS	246
Number of load combinations for SLS	15
Number of concentrated loads	10989

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-35.1	34.6	18.9	19.8	6.2	6.1
bl2	-35.4	34.9	19.1	19.8	6.3	6.1
380ct1f1	-116.5	115.7	65.5	68.8	18.0	17.6
380ct1f2	-116.5	115.7	65.5	68.8	18.0	17.6
380ct1f3	-117.9	116.9	66.8	70.6	18.1	17.6
380ct2f1	-116.5	115.7	65.5	68.8	18.0	17.6
380ct2f2	-116.5	115.7	65.5	68.8	18.0	17.6
380ct2f3	-117.9	116.9	66.8	70.6	18.1	17.6
Post 1	0.0	0.0	0.0	0.0	0.0	
Post 2	0.0	0.0	0.0	0.0	0.0	
110ct3f1	-36.7	36.3	19.8	19.8	5.2	8.0
110ct3f2	-36.7	36.3	19.8	19.8	5.2	8.0
110ct3f3	-36.7	36.3	19.8	19.8	5.2	8.0
110ct4f1	-36.7	36.3	19.8	19.8	5.2	8.0
110ct4f2	-36.7	36.3	19.8	19.8	5.2	8.0
110ct4f3	-36.7	36.3	19.8	19.8	5.2	8.0
bl3	-23.3	0.0	12.5	0.1	4.9	1.3
Post 3	0.0	0.0	0.0	0.0	0.0	

Min. Weight span (m) Weight span Combinatie1				Max. Weight span (m) Weight span Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7	Geleider	ULS 1a	ULS 3
bl1	437.1	476.1	434.5	bl1	506.4	427.4
bl2	437.1	476.4	434.5	bl2	505.5	427.9
380ct1f1	413.3	434.8	412.1	380ct1f1	448.4	411.5
380ct1f2	413.3	434.8	412.1	380ct1f2	448.4	411.5
380ct1f3	413.6	435.1	412.1	380ct1f3	456.1	413.1
380ct2f1	413.3	434.8	412.1	380ct2f1	448.4	411.5
380ct2f2	413.3	434.8	412.1	380ct2f2	448.4	411.5
380ct2f3	413.6	435.1	412.1	380ct2f3	456.1	413.1
Post 1				Post 1		
Post 2				Post 2		
110ct3f1	296.7	296.7	296.7	110ct3f1	296.7	296.7
110ct3f2	296.7	296.7	296.7	110ct3f2	296.7	296.7
110ct3f3	296.7	296.7	296.7	110ct3f3	296.7	296.7
110ct4f1	296.7	296.7	296.7	110ct4f1	296.7	296.7
110ct4f2	296.7	296.7	296.7	110ct4f2	296.7	296.7
110ct4f3	296.7	296.7	296.7	110ct4f3	296.7	296.7
bl3	231.6	259.5	230.8	bl3	303.8	208.2
Post 3				Post 3		

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	535.2 m	1.804 -
Min. weight span	296.7 m	1.000 -

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	35.1	36.3	6.2	-39.8	39.5
bl2	35.4	36.6	6.3	-40.2	39.8
380ct1f1	102.3	130.2	18.0	-133.6	134.5
380ct1f2	102.3	130.2	18.0	-133.6	134.5
380ct1f3	102.4	132.3	18.1	-135.5	136.3
380ct2f1	102.3	130.2	18.0	-133.6	134.5
380ct2f2	102.3	130.2	18.0	-133.6	134.5
380ct2f3	102.4	132.3	18.1	-135.5	136.3
Post 1	2.1	2.1	3.5	0.0	
Post 2	2.1	2.1	3.5	0.0	
110ct3f1	36.7	30.6	8.0	-41.7	41.3
110ct3f2	36.7	30.6	8.0	-41.7	41.3
110ct3f3	36.7	30.6	8.0	-41.7	41.3
110ct4f1	36.7	30.6	8.0	-41.7	41.3
110ct4f2	36.7	30.6	8.0	-41.7	41.3
110ct4f3	36.7	30.6	8.0	-41.7	41.3
bl3	23.3	12.5	4.9	-26.5	0.0
Post 3	2.1	2.1	3.5	0.0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	18.6	9.8	2.4	-21.0	21.0
bl2	18.8	9.9	2.4	-21.2	21.2
380ct1f1	72.1	38.0	11.7	-81.5	81.5
380ct1f2	72.1	38.0	11.7	-81.5	81.5
380ct1f3	72.1	38.0	11.7	-81.5	81.5
380ct2f1	72.1	38.0	11.7	-81.5	81.5
380ct2f2	72.1	38.0	11.7	-81.5	81.5
380ct2f3	72.1	38.0	11.7	-81.5	81.5
Post 1	0.0	0.0	3.0	0.0	
Post 2	0.0	0.0	3.0	0.0	
110ct3f1	15.3	8.1	2.6	-17.3	17.3
110ct3f2	15.3	8.1	2.6	-17.3	17.3
110ct3f3	15.3	8.1	2.6	-17.3	17.3
110ct4f1	15.3	8.1	2.6	-17.3	17.3
110ct4f2	15.3	8.1	2.6	-17.3	17.3
110ct4f3	15.3	8.1	2.6	-17.3	17.3
bl3	0.0	4.9	1.2	-10.5	0.0
Post 3	0.0	0.0	3.0	0.0	

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0.0	0.0
	bl2	0.0	0.0
	380ct1f1	0.0	0.0
	380ct1f2	0.0	0.0
	380ct1f3	0.0	0.0
	380ct2f1	0.0	0.0
	380ct2f2	0.0	0.0
	380ct2f3	0.0	0.0
	Post 1	0.0	
	Post 2	0.0	
	110ct3f1	0.0	0.0
	110ct3f2	0.0	0.0
	110ct3f3	0.0	0.0
	110ct4f1	0.0	0.0
	110ct4f2	0.0	0.0
	110ct4f3	0.0	0.0
	bl3	0.0	0.0
	Post 3	0.0	

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		-34	911	203	33131	-1066	0
ULS 1a_0,9_0		14	626	193	22732	611	-75
ULS 1a_0,9_0,9_90		-37	866	177	31484	-1158	0
ULS 3_0		1	955	282	34537	190	-23
SLS 7		-9	597	184	21659	-246	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

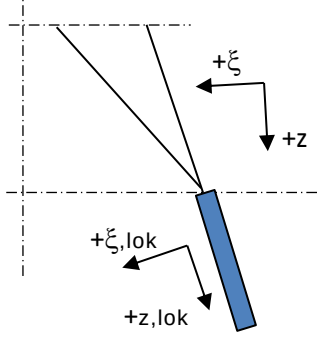
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-34	1155	1011	39473	-1066	0
ULS 1a_0,9_0,9_90	-37	1109	870	37826	-1158	0
SLS 7	-9	597	954	21659	-246	0

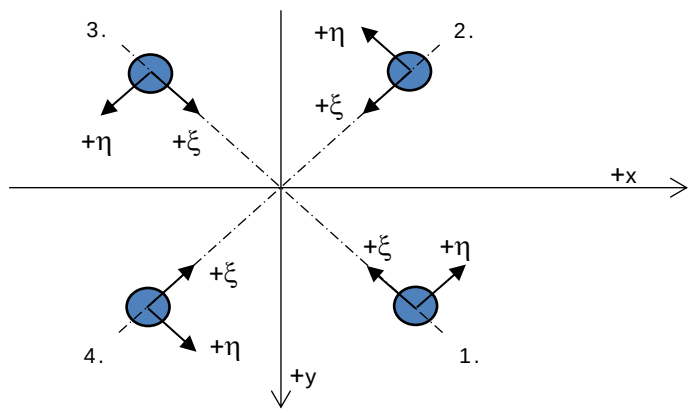
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 3_0,9_117.8	-34	1127	973	40092	-614	10
SPLS 3_0 Ba All Cts	846	381	946	13755	30029	-20
SPLS 3_62.2 Ba Ct1	363	719	994	25793	12936	-5418
SPLS 3_0,9_62.2 Ah All Cts	-769	541	832	18714	-28363	-16

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_117.8 Ba All Cts	393	413	2027	-15	-570	-98	2081
2	SPLS 1a_0 Ba All Cts	171	-210	923	28	-269	-55	947
3	SPLS 3_135 Ah All Cts	-121	-171	724	-35	-207	-38	744
4	SPLS 3_62.2 Ah All Cts	-397	419	2047	15	-577	-101	2102

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-26	-77	-281	36	72	7	-288
2	SPLS 3_0,9_62.2 Ah All Cts	-301	324	-1603	-16	442	70	-1645
3	SPLS 3_0,9_117.8 Ba All Cts	297	319	-1583	15	436	67	-1625
4	SPLS 1a_0,9_0 Ba All Cts	76	-119	-486	-31	138	25	-499

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_117.8 Ah Ct1	262	8	674	179	-191	-34	691
2	SPLS 6a_90 Ba Ct2 Ah Ct2	-126	-123	-11	176	2	-1	-11
3	SPLS 6a_90 Ba Ct2 Ah Ct2	114	315	-1113	142	304	45	-1142
4	SPLS 6a_90 Ah Ct1 Ba Ct1	-239	435	1695	139	-477	-83	1740

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ba Ct1 Ah Ct1	227	423	1638	-139	-459	-78	1681
2	SPLS 6a_90 Ah Ct2 Ba Ct2	-125	327	-1163	-143	320	49	-1194
3	SPLS 6a_90 Ah Ct2 Ba Ct2	119	-129	21	-176	-7	-2	21
4	SPLS 3_0,9_62.2 Ba Ct1	-272	16	714	-181	-204	-38	733

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-26	-77	-281	36	72	7	-288
2	SPLS 3_0,9_90 Ah Ct1	-371	157	-1357	151	373	58	-1393
3	SPLS 3_0,9_117.8 Ba Ct1	361	158	-1348	-143	367	53	-1384
4	SPLS 1a_0,9_0 Ba All Cts	76	-119	-486	-31	138	25	-499

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	227	198	1062	20	-301	-54	1090
2	SLS 7	-129	100	-604	21	162	22	-620
3	SLS 7	125	96	-585	-20	156	20	-601
4	SLS 7	-231	202	1081	-21	-307	-55	1110

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 3_62.2 Ah All Cts	-397	419	2047	15	-577	-101	2102
Max. tension	SPLS 3_0,9_62.2 Ah All Cts	-301	324	-1603	-16	442	70	-1645
Max. pos. torsie	SPLS 3_0,9_117.8 Ah Ct1	262	8	674	179	-191	-34	691
Max. neg. torsie	SPLS 3_0,9_62.2 Ba Ct1	-272	16	714	-181	-204	-38	733
Comb. tension+torsie	SPLS 3_0,9_90 Ah Ct1	-371	157	-1357	151	373	58	-1393

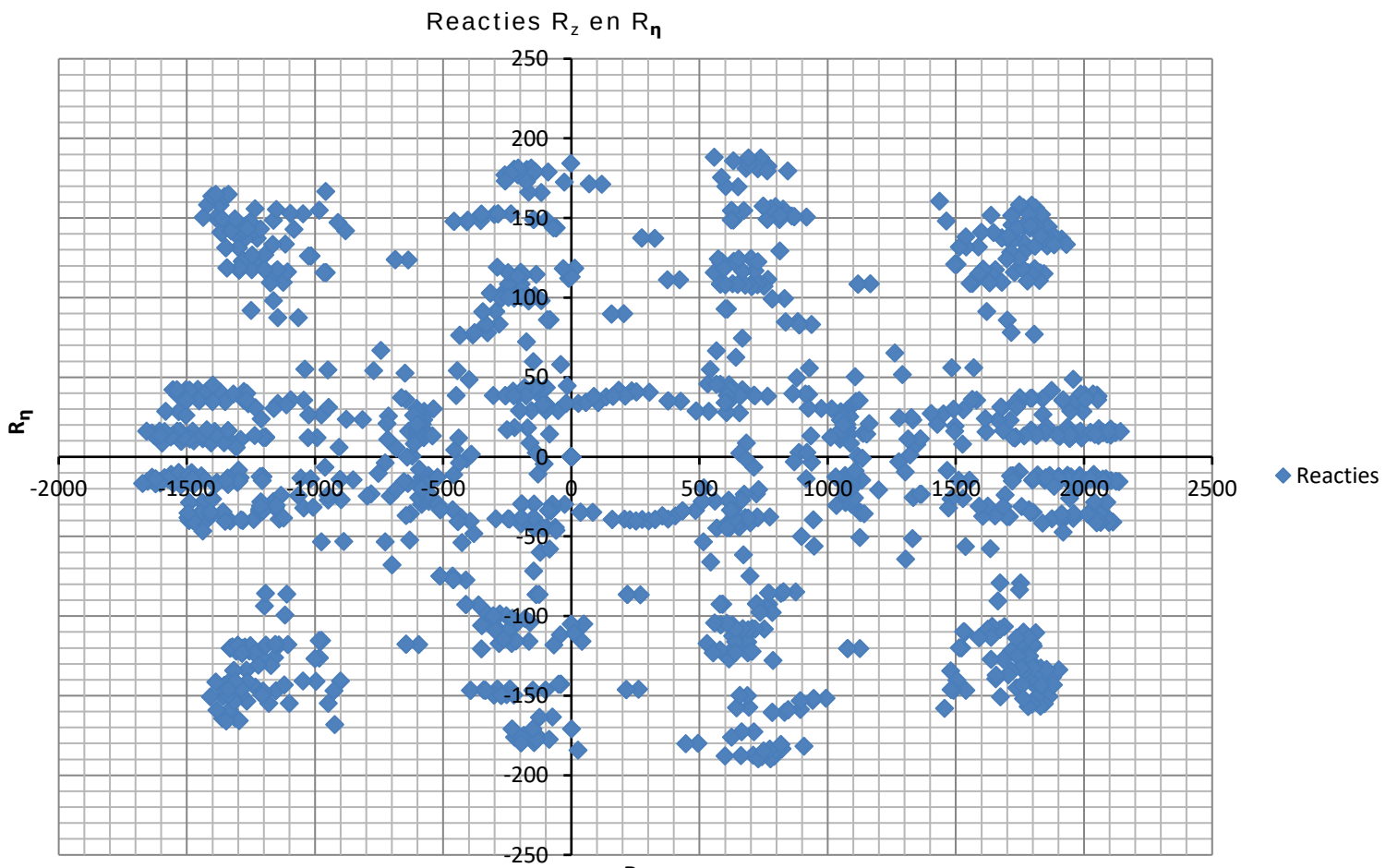
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	227	198	1062	20	-301	-54	1090
2	SLS 3_135	-265	216	-1223	34	340	55	-1256
3	SLS 3_45	251	204	-1162	-33	322	51	-1193
4	SLS 1a_0	-159	130	748	-21	-204	-30	768

Maximum compression load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 3_45	361	316	1681	32	-479	-88	1726
2	SLS 1a_0	-54	30	-271	17	60	-3	-278
3	SLS 7	125	96	-585	-20	156	20	-601
4	SLS 3_135	-375	327	1741	-33	-496	-92	1787

Project: ENS-ZL
Tower: HC-3_RC
Number: 73



Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Conductor loads

Auteur: TBR
Versie: v11.5

Starting points

Consequence class	Verbouw CC2
Reference period	50 jaar

ULS (strength)		NEN-EN50341-2-15:2019						
Load case	description	Temp	γ_G	γ_G	γ_Q			γ_a
		°C	$G_{k,mast}$	$G_{k,geleider}$	Q_{pk}	Q_{wk}	Q_{ik}	A_k
ULS 1a	Wind	10°	1.15	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0.90	1.15	0.00	1.40	0.00	0.0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0.90	0.90	0.00	1.40	0.00	0.0
ULS 3	Wind+ice	-5°	1.15	1.15	0.00	0.42	1.30	0.0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0.90	1.15	0.00	0.42	1.30	0.0
ULS 4	Cold+wind	-20°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0.90	1.15	0.00	0.28	0.00	0.0
ULS 5a	Torsional loads	10°	1.00	1.00	1.00	0.00	0.00	1.0
ULS 5b	Longitudinal loads	10°	1.00	1.00	0.00	0.00	0.00	1.0
ULS 6	Construction + maintenance	5°	1.15	1.15	1.30	0.28	0.00	0.0
ULS 6_0,9	Construction + maintenance	5°	1.15	1.15	0.00	0.28	0.00	0.0
ULS 7	Permanent	10°	1.30	1.30	0.00	0.00	0.00	0.0
ULS 8	Special	10°	1.00	1.00	0.00	0.00	0.00	1.0
SPLS (strength, for angle towers: absence of conductors)				γ_G	γ_Q			
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1.15	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0.90	1.15	0.0	0.78	0.00	0.0
SPLS 3	Wind+ice	-5°	1.15	1.15	0.0	0.36	0.34	0.0
SPLS 3_0,9	Wind+ice 0,9	-5°	0.90	1.15	0.0	0.36	0.34	0.0
SPLS 4	Cold+wind	-20°	1.15	1.15	0.0	0.24	0.00	0.0
SPLS 4_0,9	Cold+wind 0,9	-20°	0.90	1.15	0.0	0.24	0.00	0.0
SPLS 6	Maintenance	5°	1.15	1.15	1.2	0.24	0.0	0.0
SPLS 6_0,9	Maintenance	5°	1.15	1.15	0.0	0.24	0.0	0.0
SLS (deformations, fatigue, EDS)								
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1.00	1.00	0.0	1.00	0.0	0.0
SLS 3	Wind+ice	-5°	1.00	1.00	0.0	0.30	1.00	0.0
SLS 4	Wind	-20°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 6	Maintenance	5°	1.00	1.00	0.0	0.20	0.0	0.0
SLS 7	EDS, no wind	10°	1.00	1.00	0.0	0.00	0.0	0.0

Number of wind directions	6
Number of load combinations for ULS	72
Number of load combinations for SPLS	246
Number of load combinations for SLS	15
Number of concentrated loads	10989

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-37.1	36.6	20.8	23.0	6.7	6.6
bl2	-37.4	37.0	21.0	23.1	6.7	6.6
380ct1f1	-132.3	131.8	74.8	79.3	20.8	20.6
380ct1f2	-132.3	131.8	74.8	79.3	20.8	20.6
380ct1f3	-134.0	133.3	76.4	81.5	20.9	20.6
380ct2f1	-132.3	131.8	74.8	79.3	20.8	20.6
380ct2f2	-132.3	131.8	74.8	79.3	20.8	20.6
380ct2f3	-134.0	133.3	76.4	81.5	20.9	20.6
Post 1	0.0	0.0	0.0	0.0	0.0	
Post 2	0.0	0.0	0.0	0.0	0.0	
110ct3f1	-38.8	38.3	20.9	21.0	5.7	8.7
110ct3f2	-38.8	38.3	20.9	21.0	5.7	8.7
110ct3f3	-38.8	38.3	20.9	21.0	5.7	8.7
110ct4f1	-38.8	38.3	20.9	21.0	5.7	8.7
110ct4f2	-38.8	38.3	20.9	21.0	5.7	8.7
110ct4f3	-38.8	38.3	20.9	21.0	5.7	8.7
bl3	-24.6	0.0	13.2	0.1	5.2	1.4
Post 3	0.0	0.0	0.0	0.0	0.0	

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	437.4	476.4	434.5
bl2	437.3	476.7	434.5
380ct1f1	413.5	435.0	412.1
380ct1f2	413.5	435.0	412.1
380ct1f3	413.8	435.3	412.1
380ct2f1	413.5	435.0	412.1
380ct2f2	413.5	435.0	412.1
380ct2f3	413.8	435.3	412.1
Post 1			
Post 2			
110ct3f1	296.7	296.7	296.7
110ct3f2	296.7	296.7	296.7
110ct3f3	296.7	296.7	296.7
110ct4f1	296.7	296.7	296.7
110ct4f2	296.7	296.7	296.7
110ct4f3	296.7	296.7	296.7
bl3	231.7	259.8	230.8
Post 3			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	514.4	419.2
bl2	513.5	419.8
380ct1f1	453.8	406.8
380ct1f2	453.8	406.8
380ct1f3	462.6	408.4
380ct2f1	453.8	406.8
380ct2f2	453.8	406.8
380ct2f3	462.6	408.4
Post 1		
Post 2		
110ct3f1	296.7	296.7
110ct3f2	296.7	296.7
110ct3f3	296.7	296.7
110ct4f1	296.7	296.7
110ct4f2	296.7	296.7
110ct4f3	296.7	296.7
bl3	311.8	200.1
Post 3		

Envelop of weight span over all combinations (incl. 0,9 combinations)

For all conductors		Wind / Weight span ratio
Max. weight span	566.5 m	1.909 -
Min. weight span	296.7 m	1.000 -

Project: ENS-ZL
Tower: HC-3_RC
Number: 73

Maximum values back + ahead span Maximum tension in conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	36.0	41.3	6.7	-42.1	42.7
bl2	36.3	41.6	6.7	-42.5	43.0
380ct1f1	107.2	149.0	20.8	-151.9	153.6
380ct1f2	107.2	149.0	20.8	-151.9	153.6
380ct1f3	107.3	151.6	20.9	-154.2	155.9
380ct2f1	107.2	149.0	20.8	-151.9	153.6
380ct2f2	107.2	149.0	20.8	-151.9	153.6
380ct2f3	107.3	151.6	20.9	-154.2	155.9
Post 1	2.6	2.6	3.9	0.0	
Post 2	2.6	2.6	3.9	0.0	
110ct3f1	37.4	34.9	8.7	-44.0	43.7
110ct3f2	37.4	34.9	8.7	-44.0	43.7
110ct3f3	37.4	34.9	8.7	-44.0	43.7
110ct4f1	37.4	34.9	8.7	-44.0	43.7
110ct4f2	37.4	34.9	8.7	-44.0	43.7
110ct4f3	37.4	34.9	8.7	-44.0	43.7
bl3	24.6	13.2	5.2	-28.0	0.0
Post 3	2.6	2.6	3.9	0.0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	18.6	9.8	2.4	-21.0	21.0
bl2	18.8	9.9	2.4	-21.2	21.2
380ct1f1	72.1	38.0	11.7	-81.5	81.5
380ct1f2	72.1	38.0	11.7	-81.5	81.5
380ct1f3	72.1	38.0	11.7	-81.5	81.5
380ct2f1	72.1	38.0	11.7	-81.5	81.5
380ct2f2	72.1	38.0	11.7	-81.5	81.5
380ct2f3	72.1	38.0	11.7	-81.5	81.5
Post 1	0.0	0.0	3.0	0.0	
Post 2	0.0	0.0	3.0	0.0	
110ct3f1	15.3	8.1	2.6	-17.3	17.3
110ct3f2	15.3	8.1	2.6	-17.3	17.3
110ct3f3	15.3	8.1	2.6	-17.3	17.3
110ct4f1	15.3	8.1	2.6	-17.3	17.3
110ct4f2	15.3	8.1	2.6	-17.3	17.3
110ct4f3	15.3	8.1	2.6	-17.3	17.3
bl3	0.0	4.9	1.2	-10.5	0.0
Post 3	0.0	0.0	3.0	0.0	

1 Control uplift SLS-wind

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0.0	0.0
	bl2	0.0	0.0
	380ct1f1	0.0	0.0
	380ct1f2	0.0	0.0
	380ct1f3	0.0	0.0
	380ct2f1	0.0	0.0
	380ct2f2	0.0	0.0
	380ct2f3	0.0	0.0
	Post 1	0.0	
	Post 2	0.0	
	110ct3f1	0.0	0.0
	110ct3f2	0.0	0.0
	110ct3f3	0.0	0.0
	110ct4f1	0.0	0.0
	110ct4f2	0.0	0.0
	110ct4f3	0.0	0.0
	bl3	0.0	0.0
	Post 3	0.0	

Project: ENS-ZL
Tower: HC-3_RC
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ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		-39	1042	223	37910	-1206	0
ULS 1a_0,9_0		21	675	210	24518	871	-94
ULS 1a_0,9_0,9_90		-43	976	182	35516	-1353	0
ULS 3_0		8	1082	328	39128	458	-28
SLS 7		-9	597	184	21659	-246	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

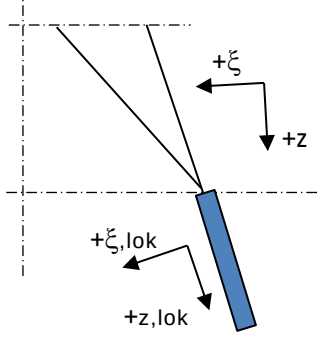
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-39	1347	1109	45860	-1206	0
ULS 1a_0,9_0,9_90	-43	1281	875	43466	-1353	0
SLS 7	-9	597	954	21659	-246	0

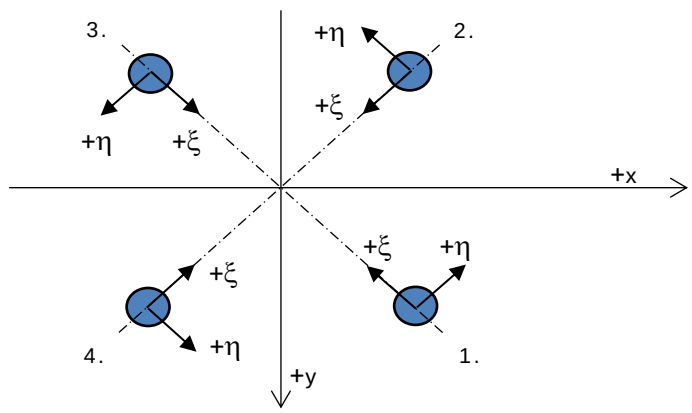
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 3_0,9_117.8	-36	1297	1019	46087	-568	13
SPLS 3_0 Ba All Cts	888	402	1035	14549	31556	-19
SPLS 3_62.2 Ba Ct1	387	749	1085	26945	13823	-5641
SPLS 3_0,9_62.2 Ah All Cts	-803	559	842	19367	-29602	-16

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg





Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_117.8 Ba All Cts	412	433	2125	-15	-598	-103	2182
2	SPLS 1a_0 Ba All Cts	179	-222	974	30	-284	-58	1000
3	SPLS 3_135 Ah All Cts	-129	-183	774	-38	-221	-41	794
4	SPLS 3_62.2 Ah All Cts	-415	438	2141	16	-604	-106	2199

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-29	-83	-305	39	79	8	-313
2	SPLS 3_0,9_62.2 Ah All Cts	-315	338	-1673	-17	462	73	-1718
3	SPLS 3_0,9_117.8 Ba All Cts	311	334	-1657	16	456	71	-1702
4	SPLS 1a_0,9_0 Ba All Cts	79	-126	-512	-33	145	26	-526

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ah Ct1 Ba Ct1	248	-18	557	188	-163	-34	572
2	SPLS 6a_90 Ba Ct2 Ah Ct2	-130	-131	-3	184	-1	-1	-3
3	SPLS 6a_90 Ba Ct2 Ah Ct2	119	329	-1163	149	317	47	-1194
4	SPLS 6a_90 Ah Ct1 Ba Ct1	-253	459	1790	145	-504	-87	1837

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 6a_90 Ba Ct1 Ah Ct1	242	447	1736	-145	-487	-83	1782
2	SPLS 6a_90 Ah Ct2 Ba Ct2	-129	340	-1209	-150	332	51	-1241
3	SPLS 6a_90 Ah Ct2 Ba Ct2	124	-137	26	-184	-9	-3	26
4	SPLS 3_0,9_62.2 Ba Ct1	-281	13	728	-190	-208	-38	748

Project: ENS-ZL
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Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SPLS 3_0,9_135 Ah All Cts	-29	-83	-305	39	79	8	-313
2	SPLS 3_0,9_90 Ah Ct1	-388	164	-1421	158	391	60	-1459
3	SPLS 3_0,9_90 Ba Ct1	381	155	-1384	-159	379	57	-1421
4	SPLS 1a_0,9_0 Ba All Cts	79	-126	-512	-33	145	26	-526

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	227	198	1062	20	-301	-54	1090
2	SLS 7	-129	100	-604	21	162	22	-620
3	SLS 7	125	96	-585	-20	156	20	-601
4	SLS 7	-231	202	1081	-21	-307	-55	1110

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 3_62.2 Ah All Cts	-415	438	2141	16	-604	-106	2199
Max. tension	SPLS 3_0,9_62.2 Ah All Cts	-315	338	-1673	-17	462	73	-1718
Max. pos. torsie	SPLS 6a_90 Ah Ct1 Ba Ct1	248	-18	557	188	-163	-34	572
Max. neg. torsie	SPLS 3_0,9_62.2 Ba Ct1	-281	13	728	-190	-208	-38	748
Comb. tension+torsie	SPLS 3_0,9_90 Ah Ct1	-388	164	-1421	158	391	60	-1459

Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	227	198	1062	20	-301	-54	1090
2	SLS 3_135	-276	226	-1278	36	355	58	-1312
3	SLS 3_45	263	215	-1218	-34	337	54	-1250
4	SLS 1a_0	-155	126	729	-21	-198	-29	749

Maximum compression load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 3_45	374	327	1742	33	-496	-91	1788
2	SLS 1a_0	-50	26	-252	17	54	-5	-258
3	SLS 7	125	96	-585	-20	156	20	-601
4	SLS 3_135	-388	339	1801	-35	-514	-95	1849

Project: ENS-ZL
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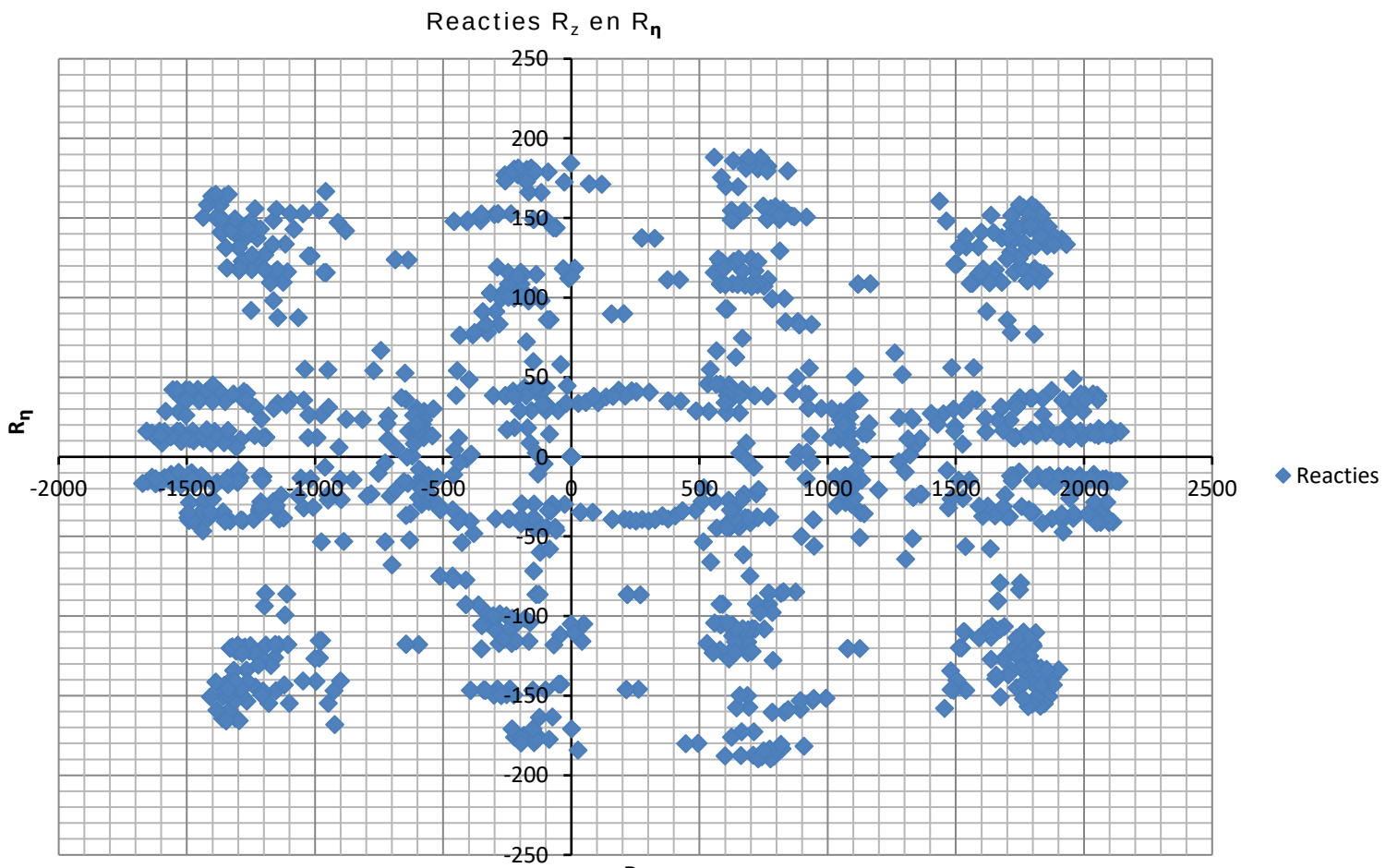
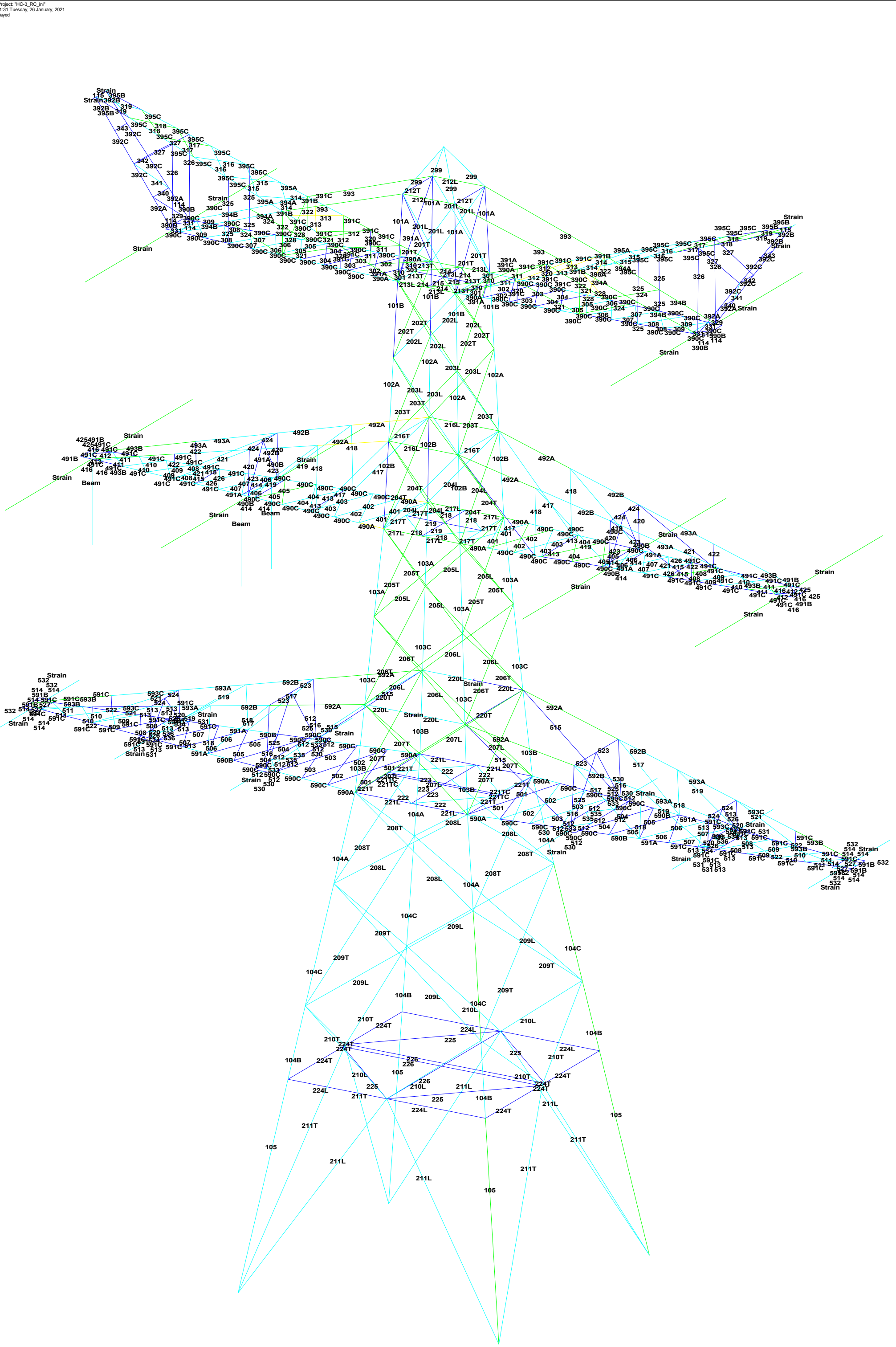


APPENDIX B
Uitvoer PLS-TOWER

DNV GL Nederlands BV, Project: "HC-3_RC_ini"
Tower Version 16.63, 13:51:31 Tuesday, 26 January, 2021
Undeformed geometry displayed



DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 26-01-21
Author MKh
Version 1.0

ENS-ZL 380
HC-3 RC
73

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
299	Mast Top Section 6	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	174	**-22.5**	SPLS 6a_90 Ah Ct1 Ba Ct1	84.7	188.2	172.8	0.27		**22.4**	SPLS 3_0,9_62.2 Ba Ct1	146.3	188.2	157.1	0.15	
101A	Mast Section 5	120x120x12	S355	8M24-8.8t	0.50	0.50	0.50	85	**-90.2**	SPLS 3_117.8 Ba Ct1	572.4	1074.8	1693.4	0.16		**37.3**	SPLS 3_0,9_117.8 Ba All Cts	750.1	1074.8	1592.1	0.05	
101B	Mast Section 5	120x120x12	S355	9M24-8.8t	0.50	0.50	0.50	75	**-197.9**	SPLS 6a_90 Ba Ct1 Ah Ct2	659.0	1214.9	1905.1	0.30		**183.2**	SPLS 3_0,9_90 Ba Ct1	750.1	1214.9	1791.1	0.24	
102A	Mast Section 4	160x160x15#	S355	8M24-8.8t	0.50	0.50	0.50	60	**-487.5**	SPLS 3_62.2 Ah All Cts	1288.7	1084.4	2116.8	0.45		**384.1**	SPLS 3_0,9_117.8 Ba All Cts	1372.7	1084.4	1990.2	0.35	
102B	Mast Section 4	160x160x15#	S355	10M24-8.8t	0.50	0.50	0.50	64	**-463.0**	SPLS 3_117.8 Ba Ct1	1252.5	2655.1	2646.0	0.37		**342.6**	SPLS 3_0,9_117.8 Ba All Cts	1372.7	2655.1	2397.2	0.25	
103A	Mast Section 3	250x250x20#	S355	10M24-8.8t	0.50	0.50	0.50	41	**-912.3**	SPLS 3_117.8 Ba All Cts	3075.6	2558.5	3528.0	0.36		**746.5**	SPLS 3_0,9_117.8 Ba All Cts	3055.2	2558.5	3316.9	0.29	
103C	Mast Section 3	250x250x20#	S355		0.50	0.50	0.50	41	**-1340.5**	SPLS 3_117.8 Ba All Cts	3075.6	0.0	0.0	0.44		**1119.3**	SPLS 3_0,9_117.8 Ba All Cts	3443.5	0.0	0.0	0.33	
103B	Mast Section 2	250x250x20#	S355	16M24-8.8t	0.50	0.50	0.50	41	**-1480.8**	SPLS 3_117.8 Ba All Cts	3075.6	3646.3	5644.8	0.48		**1241.9**	SPLS 3_0,9_117.8 Ba All Cts	3055.2	3646.3	5644.8	0.41	
104A	Mast Section 2	250x250x24#	S355	14M24-8.8t	0.50	0.50	0.50	43	**-1711.3**	SPLS 3_62.2 Ah All Cts	3600.3	3463.4	5927.0	0.49		**1412.1**	SPLS 3_0,9_62.2 Ah All Cts	3614.1	3463.4	5572.4	0.41	
104C	Mast Section 2	250x250x24#	S355		0.26	0.26	0.26	30	**-2011.7**	SPLS 3_62.2 Ah All Cts	3854.9	0.0	0.0	0.52		**1626.9**	SPLS 3_0,9_62.2 Ah All Cts	4079.7	0.0	0.0	0.40	
104B	Mast Section 2	250x250x24#	S355	16M24-8.8t	0.50	0.50	0.50	34	**-1887.4**	SPLS 3_62.2 Ah All Cts	3769.0	3849.7	6773.8	0.50		**1536.4**	SPLS 3_0,9_62.2 Ah All Cts	3614.1	3849.7	6368.5	0.43	
105	Mast Section 1 (Base)	250x250x24#	S355	14M24-8.8t	0.20	0.20	0.20	40	**-1895.1**	SPLS 3_62.2 Ah All Cts	3657.2	3360.6	5927.0	0.56		**1526.7**	SPLS 3_0,9_62.2 Ah All Cts	3614.1	3360.6	5572.4	0.45	
390A	Upper Cross-Arm Lower	150x150x14	S355	8M24-8.8t	1.00	2.27	1.00	64	**-412.3**	SPLS 6a_90 Ah Ct1 Ba Ct1	1069.1	991.8	1975.7	0.42		**266.8**	SPLS 3_0,9_62.2 Ah Ct2	822.4	991.8	1857.5	0.32	
390B	Upper Cross-Arm Lower	150x150x14	S355		1.00	2.00	1.00	15	**0.0**		1425.0	0.0	0.0	0.00		**11.7**	ULS 3_62.2	1425.0	0.0	0.0	0.01	
390C	Upper Cross-Arm Lower	150x150x14	S355		1.00	2.37	1.00	64	**-399.2**	SPLS 6a_90 Ah Ct1 Ba Ct1	1069.0	0.0	0.0	0.37		**252.3**	SPLS 3_0,9_62.2 Ah Ct2	1425.0	0.0	0.0	0.18	
391A	Upper Cross-Arm Upper	120x120x10	S355	6M24-8.8t	1.00	2.03	1.00	85	**-261.8**	SPLS 6a_90 Ah All Cts Ba Ct1	404.3	813.3	1058.4	0.65		**228.4**	SPLS 6a_90 Ah All Cts Ba Ct2	403.8	813.3	823.2	0.57	
391B	Upper Cross-Arm Upper	120x120x10	S355	6M24-8.8t	8.47	4.67	1.00	87	**-159.2**	SPLS 6a_90 Ah Ct1 Ba Ct3	396.4	813.3	1058.4	0.40		**130.5**	SPLS 6a_90 Ah Ct2 Ba Ct4	635.0	813.3	823.2	0.21	
391C	Upper Cross-Arm Upper	120x120x10	S355		1.00	2.13	1.00	85	**-239.9**	SPLS 6a_90 Ah All Cts Ba Ct1	404.6	0.0	0.0	0.59		**205.7**	SPLS 6a_90 Ah All Cts Ba Ct2	823.6	0.0	0.0	0.25	
392A	Upper Cross-Arm Spacer	90x90x8	S235	2M24-8.8t	2.00	1.00	1.00	121	**-26.2**	SPLS 6a_90 Ah Ct1 Ah Ct4	138.8	271.1	207.4	0.19		**13.2**	SPLS 3_0,9_117.8 Ba All Cts	136.2	271.1	156.3	0.10	
392B	Upper Cross-Arm Spacer	90x90x8	S235	2M24-8.8t	2.00	1.00	1.00	121	**-24.0**	SPLS 6a_90 Ah Ct1 Ah Ct4	138.8	271.1	207.4	0.17		**8.7**	SPLS 3_0,9_117.8 Ba All Cts	136.2	271.1	156.3	0.06	
392C	Upper Cross-Arm Spacer	90x90x8	S235		2.00	1.00	1.00	121	**-25.6**	SPLS 6a_90 Ah Ct1 Ah Ct4	138.8	0.0	0.0	0.18		**12.6**	SPLS 3_0,9_117.8 Ba All Cts	326.7	0.0	0.0	0.04	
395A	Upper Cross-Arm Upper	120x120x10	S355	6M24-8.8t	1.27	2.15	1.00	81	**-189.9**	SPLS 6a_90 Ah All Cts Ba Ct1	421.4	813.3	1058.4	0.45		**191.4**	SPLS 6a_90 Ah All Cts Ba Ct2	635.0	813.3	823.2	0.30	
395B	Upper Cross-Arm Upper	120x120x10	S355	4M24-8.8t	1.00	2.31	1.00	115	**-50.0**	SPLS 6a_90 Ah All Cts Ba Ct1	295.6	542.2	705.6	0.17		**36.2**	SPLS 6a_90 Ah All Cts Ba Ct2	635.0	542.2	663.4	0.07	
395C	Upper Cross-Arm Upper	120x120x10	S355		2.84	6.86	1.00	115	**-132.1**	SPLS 6a_90 Ah All Cts Ba Ct1	295.8	0.0	0.0	0.45		**172.8**	SPLS 6a_90 Ah All Cts Ba Ct2	823.6	0.0	0.0	0.21	
393	Upper Cross-Arm Diag Brace	100x100x8	S235	4M24-8.8t	1.00	1.00	1.00	328	**-15.0**	SPLS 3_0,9_117.8 Ba All Cts	41.4	542.2	414.7	0.36		**148.9**	SPLS 6a_90 Ah All Cts Ba Ct2	199.2	542.2	330.3	0.75	
492A	Lower Cross-Arm Lower	90x90x8	S235	4M24-8.8t	1.96	1.00	1.00	274	**0.0**		47.5	542.2	414.7	0.00		**144.3**	ULS 3_0	185.9	542.2	351.3	0.78	
492B	Lower Cross-Arm Lower	90x90x8	S235	4M24-8.8t	2.04	1.00	1.00	274	**0.0**		47.6	542.2	414.7	0.00		**109.6**	ULS 3_0	252.5	542.2	389.9	0.43	
491A	Lower Cross-Arm Lower	160x160x15#	S355	8M24-8.8t	1.00	3.18	1.00	80	**-412.7**	SPLS 6a_90 Ah Ct1 Ba Ct1	1049.8	1084.4	2116.8	0.39		**248.8**	SPLS 6a_90 Ah Ct2 Ba Ct2	1372.7	1084.4	1827.3	0.23	
491B	Lower Cross-Arm Lower	160x160x15#	S355		1.00	2.32	1.00	12	**-1.7**	SPLS 1a_0,9_117.8 Ba Ct1	1658.2	0.0	0.0	0.00		**0.8**	SPLS 3_0,9_0 Ah Ct1	1658.2	0.0	0.0	0.00	
491C	Lower Cross-Arm Lower	160x160x15#	S355		1.00	3.18	1.00	80	**-385.4**	SPLS 6a_90 Ah Ct1 Ba Ct1	1049.8	0.0	0.0	0.37		**221.6**	SPLS 3_0,9_62.2 Ah Ct2	1658.2	0.0	0.0	0.13	
493A	Lower Cross-Arm Upper	90x90x8	S235	4M24-8.8t	2.10	1.00	1.00	310	**0.0**		39.3	542.2	414.7	0.00		**97.9**	ULS 3_0	252.5	542.2	389.9	0.39	
493B	Lower Cross-Arm Upper	90x90x8	S235	3M24-8.8t	1.91	1.00	1.00	310	**0.0**		39.3	406.7	311.0	0.00		**98.0**	ULS 3_0	185.9	406.7	264.5	0.53	
490A	Lower Cross-Arm Upper	200x200x16	S355	9M24-8.8t	1.00	2.73	1.00	58	**-790.5**	SPLS 6a_90 Ah Ct1 Ba Ct1	1742.3	915.0	2540.2	0.86		**518.0**	SPLS 6a_90 Ah Ct2 Ba Ct2	1467.5	915.0	2388.2	0.57	
490B	Lower Cross-Arm Upper	200x200x16	S355	8M24-8.8t	2.00	11.82	1.00	64	**-434.3**	SPLS 6a_90 Ah Ct1 Ba Ct1	1657.7	1078.8	2257.9	0.40		**273.4**	SPLS 6a_90 Ah Ct2 Ba Ct2	1886.8	1078.8	2007.0	0.25	
490C	Lower Cross-Arm Upper	200x200x16	S355		1.00	2.75	1.00	58	**-756.1**	SPLS 6a_90 Ah Ct1 Ba Ct1	1742.3	0.0	0.0	0.43		**481.1**	SPLS 6a_90 Ah Ct2 Ba Ct2	2193.9	0.0	0.0	0.22	
114	Upper Cross-Arm Phase Att Point	150x150x12	S355	2M24-8.8t	1.00	2.00	1.00	32	**0.0**		971.0	271.1	423.4	0.00		**73.2**	ULS 3_62.2	496.7	271.1	191.8	0.38	
115	Upper Cross-Arm EW Att Point	UNP160	S235	4M16-8.8t	1.00	1.00	1.00	47	**0.0**		386.1	236.6	259.2	0.00		**31.2**	ULS 3_0,9_90	456.6	236.6	224.0	0.14	
212L	Mast Section 5 Hrz Brace Trans 1	100x100x8	S235	4M24-8.8t	1.00	1.00	1.00	133	**0.0**		148.9	542.2	414.7	0.00		**106.6**	SPLS 6a_90 Ah Ct1 Ba Ct2	211.1	542.2	362.8	0.51	
212T	Mast Section 5 Hrz Brace Long 1	70x70x7	S235	2M16-8.8t	1.00	1.00	1.00	191	**-5.4**	SPLS 6a_90 Ba Ct1 Ah Ct2	57.0	120.6	121.0	0.09		**7.0**	SPLS 6a_90 Ba Ct1 Ah Ct2	93.8	120.6	94.1	0.07	
201L	Mast Section 5 Diag Brace Trans 1	120x120x10	S235	2M24-8.8t	0.52	0.52	0.52	107	**-82.2**	SPLS 3_117.8 Ba Ct1	276.4	271.1	259.2	0.32		**63.6**	SPLS 6a_90 Ba Ct1 Ba Ct2	278.4	271.1	243.7	0.26	
201T	Mast Section 5 Diag Brace Long 1	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	129	**-38.4**	SPLS 6a_90 Ba Ct1 Ba Ct2	153.5	271.1	207.4	0.25		**25.9**	SPLS 3_0,9_62.2 Ba Ct1	181.4	271.1	189.2	0.14	
213L	Mast Section 5 Hrz Brace Trans 3	150x150x14	S355	8M24-8.8t	1.00	2.00	1.00	64	**-525.6**	SPLS 6a_90 Ah All Cts Ba Ct1	1076.0	991.8	1975.7	0.53		**414.8**	SPLS 3_0,9_62.2 Ah All Cts	822.4	991.8	1857.5	0.50	
213T	Mast Section 5 Hrz Brace Long 3	120x120x10	S235	5M24-8.8t	2.00	1.00	1.00	79	**-121.4**	SPLS 6a_90 Ba Ct1 Ba Ct2	328.3	677.8	648.0	0.37		**132.8**	SPLS 6a_90 Ba Ct1 Ba Ct2	466.6	677.8	559.4	0.28	
214	Mast Section 5 Diaphragm Diag	120x120x10	S235	3M24-8.8t	1.00	1.00	1.00	87	**-170.9**	SPLS 6a_90 Ah Ct1 Ba Ct1	325.2	406.7	388.8	0.53		**170.9**	SPLS 6a_90 Ah Ct1 Ba Ct1	296.6	406.7	302.4	0.58	
215	Mast Section 5 Diaphragm X-Diag	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	150	**-0.2**	ULS 3_0	31.9	60.3	43.2	0.01		**0.1**	SPLS 6a_90 Ah Ct2 Ah Ct1	46.1	60.3	32.7	0.00	
202L	Mast Section 5 X-Diag Trans 3	150x150x18*	S235	5M24-8.8t	0.52	0.52	0.52	82	**-375.9**	SPLS 6a_90 Ah Ct1 Ba Ct1	742.7	677.8	1166.4	0.55		**309.4**	SPLS 6a_90 Ah Ct2 Ba Ct2	687.5	677.8	901.1	0.46	
202T	Mast Section 5 X-Diag Long 3	150x150x18*	S235	4M24-8.8t	0.52	0.52	0.52	82	**-280.7**	SPLS 6a_90 Ah Ct1 Ba Ct1	742.7	542.2	933.1	0.52		**293.1**	SPLS 6a_90 Ah Ct1 Ba Ct1	687.5	542.2	730.1	0.54	
203L	Mast Section 4 X-Diag Trans 1	150x150x18*	S235	5M24-8.8t	0.52	0.52	0.52	90	**-282.8**	SPLS 6a_90 Ah Ct2 Ba Ct2	700.9	677.8	1166.4	0.42		**342.2**	SPLS 6a_90 Ah Ct1 Ba Ct1	687.5	677.8	901.1	0.50	
203T	Mast Section 4 X-Diag Brace Long 1	150x150x12	S235	4M24-8.8t	0.52	0.52	0.52	89	**-266.6**	SPLS 6a_90 Ah Ct1 Ba Ct1	480.6	542.2	622.1	0.55		**255.1**	SPLS 6a_90 Ah Ct1 Ba Ct1	470.2	542.2	486.8	0.54	
216L	Mast Section 4 Hrz Brace Trans 2	120x120x10	S235	5M24-8.8t	1.00	1.00	1.00	148	**-17.2**	SPLS 3_0,9_0 Ba All Cts	196.7	677.8	648.0	0.09		**181.5**	SPLS 3_62.2 Ah All Cts	342.3	677.8	609.2	0.53	
216T	Mast Section 4 Hrz Brace Long 2	150x150x12	S235	3M24-8.8t	1.00	1.00	1.00	118	**-99.4**	ULS 1a_0,9_90	377.5	406.7	466.6	0.26		**129.0**	ULS 3_90	512.3	406.7	438.6	0.32	
204L	Mast Section 4 Diag Brace Trans 3	180x180x16#	S235	5M24-8.8t	0.52	0.52	0.52	80	**-362.1**	SPLS 6a_90 Ah Ct1 Ba Ct1	823.7	677.8	1036.8	0.53		**306.7**	SPLS 6a_90 Ah Ct2 Ba Ct2	760.6	677.8	824.0	0.45	
204T	Mast Section 4 Diag Brace Long 3	150x150x18*	S235	4M24-8.8t	0.52	0.52	0.52	96	**-333.0**	SPLS 6a_90 Ah Ct2 Ba Ct2	666.1	542.2	933.1	0.61		**308.5**	SPLS 3_0,9_62.2 Ba Ct1	687.5	542.2	730.1	0.57	
217L	Mast Section 4 Hrz Brace Trans 4	200x200x16	S355	9M24-8.8t	1.00	2.00	1.00	62	**-519.2**	SPLS 6a_90 Ah All Cts Ba Ct1	1686.0	915.0	2540.2	0.57		**365.1**	SPLS 3_0,9_62.2 Ah All Cts	1467.5	915.0	2388.2	0.40	
217T	Mast Section 4 Hrz Brace Long 4	120x120x12	S235	5M24-8.8t	2.00	1.00	1.00	104	**-156.2**	SPLS 3_0,9_62.2 Ba Ct1	317.5	677.8	777.6	0.49		**190.3**	SPLS 3_62.2 Ba Ct1	551.1	677.8	731.1	0.35	
218	Mast Section 4 Diaphragm Diag	150x150x12	S235	3M24-8.8t	1.00	1.00	1.00	91	**-184.0**	SPLS 6a_90 Ba Ct1 Ah Ct1	473.3	406.7	466.6	0.45		**185.1**	SPLS 6a_90 Ah Ct1 Ba Ct1	498.3	406.7	438.6	0.46	
219	Mast Section 4 Diaphragm X-Diag	50x50x7	S235	1M16-8.8t	0.50	0.50	0.50	200	**-1.5**	ULS 6a_90 Ba Ct1	29.9	60.3	60.5	0.05		**1.6**	ULS 6a_90 Ba Ct1	64.5	60.3	45.8	0.03	
205T	Mast Section 3 Diag Brace Trans 1	150x150x18*	S355	6M24-8.8t	0.55	0.28	0.28	69	**-485.1**	SPLS 6a_90 Ah Ct1 Ba Ct1	1040.8	810.8	1905.1	0.60		**493.3**	SPLS 6a_90 Ah Ct1 Ba Ct1	963.7	810.8	1699.3	0.61	
205L	Mast Section 3 Diag Brace Long 1	150x150x18*	S355	6M24-8.8t	0.55	0.28	0.28	69	**-585.7**	SPLS 6a_90 Ba Ct1 Ah Ct1	1040.8	810.8	1905.1	0.72		**522.4**	SPLS 3_0,9_62.2 Ba Ct2	963.7	810.8	1699.3	0.64	
206L	Mast Section 3 Diag Brace Trans 2	150x150x14	S355	5M24-8.8t	0.55	0.28	0.28	74	**-428.6**	SPLS 3_0,9_62.2 Ba Ct2	780.0	677.8	1234.8	0.63		**476.3**	SPLS 6a_90 Ba Ct1 Ah Ct1	759.4	677.8	1106.5	0.70	
206T	Mast Section 3 Diag Brace Long 2	150x150x14	S355	5M24-8.8t	0.55	0.28	0.28	74	**-402.0**	SPLS 6a_90 Ah Ct1 Ba Ct1	780.0	677.8	1234.8	0.59		**400.4**	SPLS 6a_90 Ah Ct1 Ba Ct1	759.4	677.8	1106.5	0.59	
207L	Mast Section 2 Diag Brace Trans 1	160x160x15#	S355	5M24-8.8t	0.55	0.28	0.28	74	**-443.0**	SPLS 6a_90 Ah Ct1 Ba Ct1	905.4	677.8	1323.0	0.65		**392.1**	SPLS 3_0,9_62.2 Ba Ct2	890.7	677.8	1200.2	0.58	
207T	Mast Section 2 Diag Brace Long 1	160x160x15#	S355	5M24-8.8t	0.55	0.28	0.28	74	**-410.2**	SPLS 6a_90 Ah Ct2 Ba Ct2	905.4	677.8	1323.0	0.61		**396.6**	SPLS 6a_90 Ah Ct1 Ba Ct1	890.7	677.8	1200.2	0.59	
221L	Mast Section 2 Hrz Brace Trans 1	180x180x16#	S355	7M24-8.8t	2.00	1.00	1.00	102	**-173.3**	SPLS 6a_90 Ba Ct1 Ah Ct3	897.5	824.3	1975.7	0.21		**26.6**	SPLS 6a_90 Ba Ct1 Ah Ct3	1291.9	824.3	1857.5	0.03	
221T	Mast Section 2 Hrz Brace Long 1	150x150x12	S235	6M24-8.8t	1.04	1.00	1.00	92	**-67.2**	SPLS 3_0,9_90 Ah Ct1	471.6	813.3	933.1	0.14		**100.4**	ULS 3_117.8	740.3	813.3	877.3	0.14	
221TC	Mast Section 2 Hrz Brace Long 1	150x150x12	S235		28.00	2.00	1.00	61	**-65.8**	ULS 1a_0,9_90	564.9	0.0	0.0	0.12		**100.8**	ULS 3_90	817.8	0.0	0.0	0.12	
222	Mast Section 2 Diaphragm Diag	120x120x12	S235	2M24-8.8t	1.00	1.00	1.00	166	**-57.8**	SPLS 6a_90 Ah Ct1 Ba Ct3	202.4	271.1	311.0	0.29		**58.8**	SPLS 6a_90 Ah Ct1 Ba Ct3	329.5	271.1	292.4	0.22	
223	Mast Section 2 Diaphragm X-Diag	70x70x7	S235	1M24-8.8t	0.50	0.50	0.50	206	**-2.2**	ULS 6a_90 Ba Ct3	41.1	135.6	90.7	0.05		**0.4**	ULS 3_0,9_62.2	76.6	135.6	59.6	0.01	
208L	Mast Section 2 Diag Brace Trans 2	180x180x16#	S355	6M24-8.8t	0.56	0.28	0.28	76	**-385.0**	SPLS 6a_90 Ah Ct1 Ba Ct3	1051.8	810.8	1693.4	0.47		**330.3**	SPLS 3_0,9_62.2 Ba Ct2	1066.1	810.8	1541.8	0.41	
208T	Mast Section 2 Diag Brace Long 2	180x180x16#	S355	6M24-8.8t	0.56	0.28	0.28	76	**-365.1**	SPLS 3_117.8 Ah Ct2	1051.8	810.8	1693.4	0.45		**364.2**	SPLS 3_0,9_117.8 Ah Ct1	1066.1	810.8	1541.8	0.45	
209L	Mast Section 2 Diag Brace Trans 3	180x180x16#	S355	5M24-8.8t	0.56	0.28	0.28	98	**-274.9**	SPLS 3_0,9_62.2 Ba Ct2	842.7	677.8	1411.2	0.41		**315.2**	SPLS 6a_90 Ah Ct1 Ba Ct3	1066.1	677.8	1295.9	0.47	
209T	Mast Section 2 Diag Brace Long 3	180x180x16#	S355	5M24-8.8t	0.56	0.28	0.28	98	**-302.1**	SPLS 3_0,9_117.8 Ah Ct1	842.7	677.8	1411.2	0.45		**303.9**	SPLS 3_117.8 Ah Ct2	1066.1	677.8	1295.9	0.45	
210L	Mast Section 1 Diag Brace Trans 1	180x180x16#	S355	4M24-8.8t	1.00	0.50	0.50	100	**-262.7**	SPLS 6a_90 Ah Ct1 Ba Ct3	824.5	542.2	1129.0	0.48		**223.2**	SPLS 3_0,9_62.2 Ba Ct2	1066.1	542.2	1049.9	0.41	
210T	Mast Section 1 Diag Brace Long 1	180x180x16#	S355	4M24-8.8t	1.00	0.50	0.50	100	**-257.0**	SPLS 3_117.8 Ah Ct2	824.5	542.2	1129.0	0.47		**248.5**	SPLS 3_0,9_117.8 Ah Ct1	1066.1	542.2	1049.9	0.46	
224L	Mast Section 1 Hrz Brace Trans 1	100x100x8	S235	2M24-8.8t	1.00	1.00	1.00	251	**-9.9**	SPLS 3_90 Ah Ct1	63.2	271.1	207.4	0.16		**3.8**	SPLS 1a_0,9_117.8 Ah All Cts	181.4	271.1	189.2	0.02	
224T	Mast Section 1 Hrz Brace Long 1	100x100x8	S235	2M24-8.8t	1.04	1.00	1.00	242	**-10.1**	SPLS 1a_135 Ah Ct2	66.8	271.1	207.4	0.15		**12.5**	ULS 1a_0,9_135	293.9	542.2	389.9	0.04	
225	Mast Section 1 Diaphragm Diag	100x100x8	S235	1M24-8.8t	1.00	1.00	1.00	349	**-7.4**	ULS 1a_62.2	29.9	135.6	103.7	0.25		**6.2**	ULS 1a_0,9_117.8	170.5	135.6	97.5	0.06	
226	Mast Section 1 Diaphragm X-Diag	120x120x10	S235	1M24-8.8t	0.50	0.50	0.50	209	**-2.9**	ULS 1a_0	99.6	135.6	129.6	0.03		**0.0**		270.7	135.6	121.8	0.00	
211L	Mast Section 1 Diag Brace Trans 2	150x150x14	S355	6M24-8.8t	0.17	0.17	0.17	68	**-338.5**	SPLS 3_62.2 Ba Ct1	878.2	810.8	1481.8	0.42		**303.3**	SPLS 3_0,9_62.2 Ba Ct2	759.4	810.8	1321.7	0.40	
211T	Mast Section 1 Diag Brace Long 2	150x150x14	S355	6M24-8.8t	0.17	0.17	0.17	68	**-330.9**	SPLS 3_62.2 Ba Ct2	878.2	810.8	1481.8	0.41		**303.0**	SPLS 3_0,9_117.8 Ah Ct1	759.4	810.8	1321.7	0.40	
301	Upper Cross-Arm Onder X-Diag 1	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	119	**-16.0**	SPLS 3_0,9_0 Ba Ct2	101.1	188.2	151.2	0.16		**15.6**	SPLS 3_0 Ba All Cts	90.5	188.2	101.5	0.17	
302	Upper Cross-Arm Onder X-Diag 2	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	113	**-18.8**	SPLS 3_0,9_0 Ba Ct2	106.4	188.2	151.2	0.18		**19.3**	SPLS 3_0 Ba Ct2	93.0	188.2	101.5	0.21	
303	Upper Cross-Arm Onder X-Diag 3	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	108	**-19.9**	SPLS 3_0 Ba Ct2	111.1	188.2	151.2	0.18		**19.5**	SPLS 3_0,9_0 Ba Ct2	93.0	188.2	101.5	0.21	
304	Upper Cross-Arm Onder X-Diag 4	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	103	**-20.4**	SPLS 3_0,9_62.2 Ah Ct2	115.9	188.2	151.2	0.18		**20.4**	SPLS 3_62.2 Ah Ct2	93.0	188.2	101.5	0.22	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 26-01-21
Author MKh
Version 1.0

ENS-ZL 380
HC-3 RC
73

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
305	Upper Cross-Arm Onder X-Diag 5	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	98	**-27.1**	SPLS 3_62.2 Ah Ct2	120.8	188.2	151.2	0.22		**27.1**	SPLS 3_0,9_62.2 Ah Ct2	94.3	188.2	101.5	0.29	
306	Upper Cross-Arm Onder X-Diag 6	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	93	**-45.6**	SPLS 6a_90 Ah All Cts Ba Ct2	125.8	188.2	151.2	0.36		**45.0**	S 6a_90 Ah All Cts Ba Ct2	95.5	188.2	101.5	0.47	
307	Upper Cross-Arm Onder X-Diag 7	70x70x7	S235	2M20-8.8t	0.52	0.52	0.52	88	**-46.9**	SPLS 6a_90 Ah All Cts Ba Ct2	130.8	188.2	151.2	0.36		**48.0**	S 6a_90 Ah All Cts Ba Ct2	96.7	188.2	116.0	0.50	
308	Upper Cross-Arm Onder X-Diag 8	90x90x8	S235	2M24-8.8t	0.52	0.52	0.52	65	**-54.4**	SPLS 6a_90 Ah All Cts Ba Ct2	230.3	271.1	207.4	0.26		**53.7**	S 6a_90 Ah All Cts Ba Ct2	136.2	271.1	141.8	0.39	
309	Upper Cross-Arm Onder X-Diag 9	90x90x8	S235	2M24-8.8t	0.53	0.53	0.53	63	**-63.7**	SPLS 6a_90 Ah All Cts Ba Ct2	232.0	271.1	207.4	0.31		**60.4**	SPLS 3_0,9_62.2 Ah All Cts	136.2	271.1	161.3	0.44	
310	Upper Cross-Arm Boven X-Diag 1	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	143	**-22.6**	SPLS 6a_90 Ah All Cts Ba Ct2	48.8	60.3	51.8	0.46		**23.4**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.69	
311	Upper Cross-Arm Boven X-Diag 2	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	134	**-26.2**	SPLS 6a_90 Ah All Cts Ba Ct2	52.4	60.3	51.8	0.51		**24.7**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.74	
312	Upper Cross-Arm Boven X-Diag 3	60x60x6	S235	1M16-8.8t	0.52	0.52	0.52	127	**-26.1**	SPLS 6a_90 Ah All Cts Ba Ct2	55.6	60.3	51.8	0.50		**27.7**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.82	
313	Upper Cross-Arm Boven X-Diag 4	60x60x6	S235	1M16-8.8t	0.53	0.53	0.53	123	**-33.6**	SPLS 6a_90 Ah All Cts Ba Ct2	57.7	60.3	51.8	0.65		**31.8**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.95	
314	Upper Cross-Arm Boven X-Diag 5	60x60x6	S235	1M16-8.8t	0.53	0.53	0.53	123	**-16.4**	SPLS 6a_90 Ah All Cts Ba Ct2	57.4	60.3	51.8	0.32		**14.7**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.44	
315	Upper Cross-Arm Boven X-Diag 6	60x60x6	S235	1M16-8.8t	0.54	0.54	0.54	118	**-11.8**	SPLS 6a_90 Ah All Cts Ba Ct2	59.9	60.3	51.8	0.23		**12.3**	SPLS 6a_90 Ah Ct2 Ba Ct2	48.4	60.3	33.7	0.37	
316	Upper Cross-Arm Boven X-Diag 7	60x60x6	S235	1M16-8.8t	0.54	0.54	0.54	111	**-16.2**	SPLS 6a_90 Ah All Cts Ba Ct2	63.6	60.3	51.8	0.31		**15.5**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.46	
317	Upper Cross-Arm Boven X-Diag 8	60x60x6	S235	1M16-8.8t	0.54	0.54	0.54	105	**-18.7**	SPLS 6a_90 Ah All Cts Ba Ct2	67.2	60.3	51.8	0.36		**19.6**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.58	
318	Upper Cross-Arm Boven X-Diag 9	60x60x6	S235	1M16-8.8t	0.55	0.55	0.55	102	**-26.9**	SPLS 6a_90 Ah All Cts Ba Ct2	68.9	60.3	51.8	0.52		**25.0**	S 6a_90 Ah All Cts Ba Ct2	48.4	60.3	33.7	0.74	
319	Upper Cross-Arm Boven X-Diag 10	60x60x6	S235	2M16-8.8t	0.57	0.57	0.57	102	**-33.2**	SPLS 6a_90 Ah All Cts Ba Ct2	86.2	120.6	103.7	0.38		**36.4**	S 6a_90 Ah All Cts Ba Ct2	72.6	120.6	67.3	0.54	
320	Upper Cross-Arm Vertical Brace Trans 1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	103	**-0.1**	ULS 5a Ba 12	47.5	60.3	43.2	0.00		**2.8**	ULS 5a Ba 12	46.1	60.3	32.7	0.08	
321	Upper Cross-Arm Diag Brace Trans 1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	327	**-7.6**	ULS 5a Ba 12	10.3	60.3	43.2	0.74		**0.0**		46.1	60.3	32.7	0.00	
322	Upper Cross-Arm Vertical Brace Trans 2	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	208	**-11.8**	SPLS 6a_90 Ah All Cts Ba Ct2	20.7	60.3	43.2	0.57		**20.5**	S 6a_90 Ah All Cts Ba Ct2	46.1	60.3	32.7	0.63	
394A	Upper Cross-Arm Diag Brace Trans 2	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	246	**0.0**		49.6	376.3	345.6	0.00		**118.6**	SPLS 6a_90 Ah Ct1 Ah Ct2	168.3	376.3	310.2	0.70	
394B	Upper Cross-Arm Diag Brace Trans 2	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	252	**0.0**		47.9	376.3	345.6	0.00		**113.7**	SPLS 6a_90 Ba Ct1 Ba Ct4	168.3	376.3	310.2	0.68	
324	Upper Cross-Arm Diag Brace Trans 3	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	307	**-8.0**	SPLS 6a_90 Ah Ct1 Ba Ct1	11.4	60.3	43.2	0.70		**0.2**	SPLS 3_0,9_62.2 Ah Ct2	46.1	60.3	32.7	0.01	
325	Upper Cross-Arm Vertical Brace Trans 3	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	204	**-2.1**	SPLS 6a_90 Ba Ct1 Ba Ct2	23.9	60.3	43.2	0.09		**3.9**	SPLS 6a_90 Ah Ct2 Ba Ct2	46.1	60.3	32.7	0.12	
326	Upper Cross-Arm Vertical Brace Trans 4	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	337	**-2.9**	SPLS 1a_62.2 Ah All Cts	14.1	60.3	51.8	0.20		**0.0**		48.4	60.3	33.7	0.00	
327	Upper Cross-Arm Diag Brace Trans 4	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	246	**0.0**		16.2	60.3	43.2	0.00		**1.2**	ULS 1a_62.2	46.1	60.3	32.7	0.04	
328	Upper Cross-Arm Internal X-Diag	50x50x5	S235	1M16-8.8t	0.50	0.50	0.50	153	**-24.0**	SPLS 6a_90 Ah All Cts Ba Ct2	31.2	60.3	43.2	0.77		**24.1**	S 6a_90 Ah All Cts Ba Ct2	46.1	60.3	32.7	0.74	
329	Upper Cross-Arm Long Face Diag Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	227	**-2.5**	SPLS 1a_0,9_135 Ba All Cts	18.2	60.3	43.2	0.14		**2.9**	SPLS 1a_0,9_0 Ah All Cts	46.1	60.3	32.7	0.09	
331		80x80x8	S235	2M24-8.8t	1.00	1.00	1.00	66	**-34.1**	SPLS 6a_90 Ah Ct1 Ba Ct1	202.1	271.1	207.4	0.17		**22.7**	SPLS 6a_90 Ah Ct1 Ba Ct1	117.7	271.1	161.3	0.19	
340	Upper Cross-Arm Long Face Diag Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	141	**-3.0**	SPLS 1a_45 Ah All Cts	34.4	60.3	43.2	0.09		**2.9**	SPLS 1a_0,9_135 Ba All Cts	46.1	60.3	32.7	0.09	
341	Upper Cross-Arm Long Face Diag Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	217	**-7.7**	SPLS 3_0,9_135 Ba All Cts	19.5	60.3	43.2	0.40		**8.0**	SPLS 3_0,9_45 Ah All Cts	46.1	60.3	32.7	0.24	
342	Upper Cross-Arm Long Face Diag Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	125	**-2.6**	SPLS 3_0,9_45 Ah All Cts	39.5	60.3	43.2	0.07		**2.5**	SPLS 3_135 Ba All Cts	46.1	60.3	32.7	0.08	
343	Upper Cross-Arm Long Face Diag Brace	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	108	**0.0**	SPLS 6a_90 Ah Ct2 Ba Ct4	45.3	60.3	43.2	0.00		**0.0**	ULS 3_0,9_90	46.1	60.3	32.7	0.00	
401	Mid Cross-Arm Onder X-Diag 1	80x80x8	S235	2M20-8.8t	0.52	0.52	0.52	130	**-49.3**	SPLS 3_0,9_0 Ba Ct1	120.4	188.2	172.8	0.41		**57.3**	S 6a_90 Ba All Cts Ah Ct2	146.3	188.2	157.1	0.39	
402	Mid Cross-Arm Onder X-Diag 2	80x80x8	S235	2M20-8.8t	0.52	0.52	0.52	123	**-66.4**	SPLS 6a_90 Ah Ct2 Ba Ct2	127.7	188.2	172.8	0.52		**61.0**	SPLS 6a_90 Ah Ct2 Ba Ct2	149.6	188.2	157.1	0.41	
403	Mid Cross-Arm Onder X-Diag 3	80x80x8	S235	2M20-8.8t	0.52	0.52	0.52	117	**-64.3**	SPLS 6a_90 Ah All Cts Ba Ct2	135.3	188.2	172.8	0.47		**64.7**	S 6a_90 Ah All Cts Ba Ct2	149.6	188.2	157.1	0.43	
404	Mid Cross-Arm Onder X-Diag 4	80x80x8	S235	2M20-8.8t	0.53	0.53	0.53	114	**-74.5**	SPLS 6a_90 Ah All Cts Ba Ct2	138.7	188.2	172.8	0.54		**70.6**	S 6a_90 Ah All Cts Ba Ct2	151.2	188.2	157.1	0.47	
405	Mid Cross-Arm Onder X-Diag 5	80x80x8	S235	2M20-8.8t	0.53	0.53	0.53	106	**-82.4**	SPLS 6a_90 Ah All Cts Ba Ct2	147.8	188.2	172.8	0.56		**83.6**	S 6a_90 Ah All Cts Ba Ct2	152.9	188.2	157.1	0.55	
406	Mid Cross-Arm Onder X-Diag 6	80x80x8	S235	2M24-8.8t	0.52	0.52	0.52	89	**-37.4**	SPLS 6a_90 Ah All Cts Ba Ct2	170.0	271.1	207.4	0.22		**50.4**	S 6a_90 Ah All Cts Ba Ct2	125.9	271.1	157.0	0.40	
407	Mid Cross-Arm Onder X-Diag 7	60x60x6	S235	2M16-8.8t	0.53	0.53	0.53	123	**-29.3**	SPLS 6a_90 Ah All Cts Ba Ct2	71.7	120.6	103.7	0.41		**29.5**	S 6a_90 Ah All Cts Ba Ct2	73.8	120.6	67.3	0.44	
408	Mid Cross-Arm Onder X-Diag 8	60x60x6	S235	2M16-8.8t	0.53	0.53	0.53	108	**-36.2**	SPLS 6a_90 Ah All Cts Ba Ct2	81.8	120.6	103.7	0.44		**34.5**	S 6a_90 Ah All Cts Ba Ct2	76.0	120.6	67.3	0.51	
409	Mid Cross-Arm Onder X-Diag 9	70x70x7	S235	2M20-8.8t	0.54	0.54	0.54	87	**-43.6**	SPLS 6a_90 Ah All Cts Ba Ct2	131.8	188.2	151.2	0.33		**45.2**	S 6a_90 Ah All Cts Ba Ct2	90.5	188.2	111.4	0.50	
410	Mid Cross-Arm Onder X-Diag 10	80x80x8	S235	2M20-8.8t	0.54	0.54	0.54	70	**-53.8**	SPLS 6a_90 Ah All Cts Ba Ct2	196.2	188.2	172.8	0.31		**52.0**	S 6a_90 Ah All Cts Ba Ct2	121.4	188.2	130.9	0.43	
411	Mid Cross-Arm Onder X-Diag 11	80x80x8	S235	2M20-8.8t	0.55	0.55	0.55	65	**-64.1**	SPLS 6a_90 Ah All Cts Ba Ct2	202.7	188.2	172.8	0.37		**62.2**	S 6a_90 Ah All Cts Ba Ct2	121.4	188.2	134.4	0.51	
412	Mid Cross-Arm Onder X-Diag 12	90x90x8	S235	2M24-8.8t	1.00	1.00	1.00	52	**-36.5**	SPLS 6a_90 Ah Ct1 Ba Ct1	249.5	271.1	207.4	0.18		**30.5**	SPLS 3_0,9_62.2 Ah Ct1	136.2	271.1	161.3	0.22	
413	Mid Cross-Arm Onder X-Diag 13	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	79	**0.0**		583.3	188.2	216.0	0.00		**7.6**	ULS 3_62.2	766.1	188.2	0.0	0.04	
414	Mid Cross-Arm Onder Hrz Brace 1	150x150x12	S355	2M24-8.8t	2.00	2.00	2.00	86	**0.0**		634.5	271.1	423.4	0.00		**48.1**	ULS 3_62.2	536.9	271.1	379.9	0.18	
415	Mid Cross-Arm Onder Hrz Brace 2	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	53	**0.0**		693.2	188.2	216.0	0.00		**6.8**	ULS 3_62.2	766.1	188.2	0.0	0.04	
416	Mid Cross-Arm Onder Hrz Brace 3	150x150x12	S355	2M24-8.8t	1.00	1.00	1.00	42	**0.0**		941.4	271.1	423.4	0.00		**64.0**	ULS 3_0	496.7	271.1	141.1	0.45	
417	Mid Cross-Arm Onder Hrz Brace 4	80x80x6#	S235	2M20-8.8t	1.00	1.00	1.00	343	**0.0**		23.3	188.2	129.6	0.00		**34.3**	ULS 3_0	112.1	188.2	117.8	0.31	
418	Mid Cross-Arm Diag Brace 1	90x90x8	S235	1M24-8.8t	1.00	1.00	1.00	173	**-21.8**	SPLS 6a_90 Ah Ct1 Ba Ct1	77.3	135.6	103.7	0.28		**0.0**		147.5	135.6	97.5	0.00	
419	Mid Cross-Arm Vertical Brace 1	80x80x8	S235	2M20-8.8t	1.00	1.00	1.00	300	**0.0**		38.0	188.2	172.8	0.00		**46.0**	SPLS 6a_90 Ah Ct1 Ba Ct1	146.3	188.2	157.1	0.31	
420	Mid Cross-Arm Diag Brace 2	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	182	**-5.0**	SPLS 1a_0 Ah Ct1	36.0	60.3	51.8	0.14		**0.0**		48.4	60.3	33.7	0.00	
421	Mid Cross-Arm Vertical Brace 2	80x80x6#	S235	1M20-8.8t	1.00	1.00	1.00	280	**0.0**		25.9	94.1	64.8	0.00		**16.4**	SPLS 1a_0 Ah Ct1	100.2	94.1	58.9	0.28	
422	Mid Cross-Arm Diag Brace 3	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	115	**-1.2**	ULS 3_0	42.9	60.3	43.2	0.03		**0.0**		46.1	60.3	32.7	0.00	
423	Mid Cross-Arm Vertical Brace 1	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	256	**-2.6**	ULS 1a_0	15.2	60.3	43.2	0.17		**1.8**	ULS 1a_0,9_0	46.1	60.3	32.7	0.05	
424	Lower Cross-Arm Boven Hrz Brace 1	60x60x6	S235	1M16-8.8t	1.00	2.00	1.00	132	**-1.0**	ULS 1a_0	56.5	60.3	51.8	0.02		**0.8**	ULS 1a_0,9_0,9_0	48.4	60.3	33.7	0.02	
425	Mid Cross-Arm	HEA160	S235	2M20-8.8t	2.00	2.00	2.00	27	**-13.0**	ULS 3_0,9_62.2	786.7	188.2	216.0	0.07		**0.0**		766.1	188.2	0.0	0.00	
426	Mid Cross-Arm Onder X-Diag 7	60x60x6	S235	2M16-8.8t	0.53	0.53	0.53	115	**-32.7**	SPLS 6a_90 Ah All Cts Ba Ct2	77.0	120.6	103.7	0.42		**29.6**	S 6a_90 Ah All Cts Ba Ct2	73.8	120.6	67.3	0.44	
501	Lower Cross-Arm Onder X-Diag 1	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	149	**-28.2**	SPLS 6a_90 Ba Ct1 Ah Ct3	130.5	271.1	207.4	0.22		**32.4**	SPLS 6a_90 Ba Ct2 Ah Ct4	154.6	271.1	141.8	0.23	
502	Lower Cross-Arm Onder X-Diag 2	100x100x8	S235	2M24-8.8t	0.52	0.52	0.52	138	**-37.0**	SPLS 6a_90 Ah Ct2 Ba Ct4	142.5	271.1	207.4	0.26		**29.7**	S 6a_90 Ah All Cts Ba Ct4	154.6	271.1	141.8	0.21	
503	Lower Cross-Arm Onder X-Diag 3	100x100x8	S235	2M24-8.8t	0.53	0.53	0.53	131	**-31.2**	SPLS 6a_90 Ba All Cts Ah Ct4	151.1	271.1	207.4	0.21		**37.9**	SPLS 6a_90 Ah Ct2 Ba Ct4	156.4	271.1	141.8	0.27	
504	Lower Cross-Arm Onder X-Diag 4	80x80x6#	S235	2M20-8.8t	0.53	0.53	0.53	141	**-17.5**	SPLS 6a_90 Ah All Cts Ba Ct4	83.9	188.2	129.6	0.21		**19.0**	S 6a_90 Ah All Cts Ba Ct4	107.0	188.2	91.6	0.21	
505	Lower Cross-Arm Onder X-Diag 5	80x80x6#	S235	2M20-8.8t	0.53	0.53	0.53	130	**-21.0**	SPLS 6a_90 Ah All Cts Ba Ct4	92.3	188.2	129.6	0.23		**20.3**	S 6a_90 Ah All Cts Ba Ct4	107.0	188.2	91.6	0.22	
506	Lower Cross-Arm Onder X-Diag 6	80x80x6#	S235	2M20-8.8t	0.53	0.53	0.53	118	**-23.7**	SPLS 6a_90 Ah All Cts Ba Ct4	102.2	188.2	129.6	0.23		**23.1**	S 6a_90 Ah All Cts Ba Ct4	94.4	188.2	91.6	0.25	
507	Lower Cross-Arm Onder X-Diag 7	80x80x6#	S235	2M20-8.8t	0.54	0.54	0.54	109	**-25.2**	SPLS 6a_90 Ah All Cts Ba Ct4	110.3	188.2	129.6	0.23		**27.2**	S 6a_90 Ah All Cts Ba Ct4	95.6	188.2	91.6	0.30	
508	Lower Cross-Arm Onder X-Diag 8	50x50x5	S235	1M16-8.8t	0.54	0.54	0.54	149	**-9.1**	SPLS 6a_90 Ah All Cts Ba Ct4	32.3	60.3	43.2	0.28		**9.4**	S 6a_90 Ah All Cts Ba Ct4	46.1	60.3	32.7	0.29	
509	Lower Cross-Arm Onder X-Diag 9	50x50x5	S235	1M16-8.8t	0.56	0.56	0.56	135	**-12.2**	SPLS 6a_90 Ah All Cts Ba Ct4	36.2	60.3	43.2	0.34		**11.5**	S 6a_90 Ah All Cts Ba Ct4	46.1	60.3	32.7	0.35	
510	Lower Cross-Arm Onder X-Diag 10	50x50x5	S235	2M16-8.8t	0.56	0.56	0.56	121	**-16.0**	SPLS 6a_90 Ah All Cts Ba Ct4	51.0	120.6	86.4	0.31		**16.6**	S 6a_90 Ah All Cts Ba Ct4	50.2	120.6	65.4	0.33	
511	Lower Cross-Arm Onder X-Diag 11	50x50x7	S235	2M16-8.8t	0.59	0.59	0.59	112	**-22.6**	SPLS 6a_90 Ah All Cts Ba Ct4	75.1	120.6	121.0	0.30		**22.5**	S 6a_90 Ah All Cts Ba Ct4	72.3	120.6	91.5	0.31	
512	Lower Cross-Arm Onder X-Diag 12	100x100x10	S355		1.00	4.00	1.00	138	**-18.1**	SPLS 6a_90 Ah Ct2 Ba Ct4	196.2	0.0	0.0	0.09		**24.0**	SPLS 6a_90 Ah Ct2 Ba Ct3	486.1	120.6	112.4	0.21	
513	Lower Cross-Arm Onder X-Diag 13	100x100x10	S355		1.00	4.00	1.00	81	**-7.8**	SPLS 6a_90 Ah Ct2 Ba Ct4	346.3	0.0	0.0	0.02		**21.0**	SPLS 6a_90 Ah Ct2 Ba Ct4	486.1	120.6	112.4	0.19	
514	Lower Cross-Arm Onder Hrz Brace 1	100x100x10	S355	2M16-8.8t	1.00	1.00	1.00	17	**-0.4**	SPLS 1a_45 Ba All Cts	600.9	120.6	235.2	0.00		**22.2**	SPLS 6a_90 Ah Ct2 Ba Ct3	486.1	120.6	112.4	0.20	
515	Lower Cross-Arm Onder Hrz Brace 2	100x100x8	S235	2M20-8.8t	1.00	1.00	1.00	331	**0.0**		40.7	188.2	172.8	0.00		**39.5**	SPLS 6a_90 Ah Ct2 Ah Ct3	190.7	188.2	157.1	0.25	
516	Lower Cross-Arm Onder Hrz Brace 3	80x80x6#	S235	1M20-8.8t	1.00	1.00	1.00	180	**-11.1**	SPLS 6a_90 Ba All Cts Ah Ct4	49.7	94.1	64.8	0.22		**0.0**		100.2	94.1	58.9	0.00	
517	Lower Cross-Arm Onder Hrz Brace 4	80x80x6#	S235	1M20-8.8t	1.00	1.00	1.00	267	**0.0**		27.8	94.1	64.8	0.00		**20.6**	S 6a_90 Ba All Cts Ah Ct4	100.2	94.1	58.9	0.35	
518	Lower Cross-Arm Diag Brace 1	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	183	**-11.3**	SPLS 6a_90 Ba Ct1 Ah Ct3	35.5	60.3	51.8	0.32		**0.0**		48.4	60.3	33.7	0.00	
519	Lower Cross-Arm Vertical Brace 1	60x60x6	S235	2M16-8.8t	1.00	1.00	1.00	326	**0.0**		18.6	120.6	103.7	0.00		**28.2**	SPLS 6a_90 Ba Ct1 Ah Ct3	78.2	120.6	67.3	0.42	
520	Lower Cross-Arm Diag Brace 2	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	147	**-2.9**	SPLS 6a_90 Ba All Cts Ah Ct3	32.7	60.3	43.2	0.09		**0.0**		46.1	60.3	32.7	0.00	
521	Lower Cross-Arm Vertical Brace 2	60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	297	**0.0**		17.3	60.3	51.8	0.00		**10.9**	S 6a_90 Ba All Cts Ah Ct3	48.4	60.3	33.7	0.32	
522	Lower Cross-Arm Diag Brace 3	50x50x5	S235	1M16-8.8t	1.00	1.00	1.00	74	**-0.8**	SPLS 6a_90 Ah Ct2 Ah Ct3	57.8	60.3	43.2	0.02		**0.0**		46.1	60.3	32.7	0.00	
590A	Middle Cross-Arm Lower	180x180x16#	S355	7M24-8.8t	3.21	1.00	1.00	88	**-371.7**	SPLS 6a_90 Ba Ct1 Ah Ct3	1108.9	824.3	1975.7	0.45		**146.6**	SPLS 6a_90 Ah Ct2 Ba Ct4	1291.9	824.3	1857.5	0.18	
590B	Middle Cross-Arm Lower	180x180x16#	S355	5M24-8.8t	2.25	1.00	1.00	58	**-257.3**	SPLS 6a_90 Ba Ct1 Ah Ct3	1563.7	677.8	1411.2	0.38		**89.6**	SPLS 6a_90 Ah Ct2 Ba Ct4	1661.0	677.8	1326.8	0.13	
590C	Middle Cross-Arm Lower	180x180x16#	S355		3.45	1.00	1.00	88	**-359.5**	SPLS 6a_90 Ba Ct1 Ah Ct3	1109.8	0.0	0.0	0.32		**132.1**	SPLS 6a_90 Ah Ct2 Ba Ct4	1966.7	0.0	0.0	0.07	
591A	Middle Cross-Arm Lower	150x150x12	S355	5M24-8.8t	2.32	1.00	1.00	69	**-229.3**	SPLS 6a_90 Ba Ct1 Ah Ct3	884.5	677.8	1058.4	0.34		**81.6**	SPLS 6a_90 Ah Ct2 Ba Ct4	1007.6	677.8	995.1	0.12	
591B	Middle Cross-Arm Lower	150x150x12	S355		1.00	2.11	1.00	18	**-20.1**	SPLS 6a_90 Ah All Cts Ba Ct3	1232.5	0.0	0.0	0.02		**4.4**	S 6a_90 Ba All Cts Ah Ct3	1235.4	0.0	0.0	0.00	
591C	Middle Cross-Arm Lower	150x150x12	S355		2.30	1.00	1.00	69	**-212.2**	SPLS 6a_90 Ba Ct1 Ah Ct3	884.6	0.0	0.0	0.24		**60.8**	SPLS 6a_90 Ah Ct2 Ba Ct4	1235.4	0.0	0.0	0.05	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 26-01-21
Author MKh
Version 1.0

ENS-ZL 380
HC-3 RC
73

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	Compression	Load Case (Compression)	Buckling	Shear (Comp)	Bearing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	Shear (Tens)	Bearing (Tens)	U.C. (Tens)	Exceedance (Tens)
592A	Middle Cross-Arm Lower	80x80x8	S235	4M20-8.8t	1.00	1.00	1.00	337	**0.0**		31.3	376.3	345.6	0.00		**96.9**	PLS 6a_90 Ah Ct1 Ah Ct4	168.3	376.3	310.2	0.58	
592B	Middle Cross-Arm Lower	80x80x8	S235	4M20-8.8t	2.00	1.00	1.00	267	**0.0**		43.8	376.3	345.6	0.00		**81.6**	PLS 6a_90 Ah Ct1 Ah Ct4	227.6	376.3	314.2	0.36	
593A	Middle Cross-Arm Lower	80x80x6#	S235	4M20-8.8t	2.00	1.00	1.00	263	**0.0**		34.3	376.3	259.2	0.00		**64.2**	PLS 6a_90 Ba Ct2 Ah Ct3	175.2	376.3	235.6	0.37	
593B	Middle Cross-Arm Lower	80x80x6#	S235	2M20-8.8t	2.00	1.00	1.00	263	**0.0**		34.3	188.2	129.6	0.00		**58.2**	PLS 6a_90 Ba Ct2 Ah Ct3	112.1	188.2	117.8	0.52	
593C	Middle Cross-Arm Lower	80x80x6#	S235		2.00	1.00	1.00	263	**0.0**		34.3	0.0	0.0	0.00		**58.1**	PLS 6a_90 Ba Ct2 Ah Ct3	220.9	0.0	0.0	0.26	
523	Lower Cross-Arm Diag Brace 3	80x80x6#	S235	1M20-8.8t	2.00	1.00	1.00	155	**-0.6**	ULS 1a_0	64.4	94.1	64.8	0.01		**0.4**	ULS 1a_0,9_0	100.2	94.1	52.4	0.01	
524	Lower Cross-Arm Diag Brace 3	60x60x6	S235	1M16-8.8t	2.00	1.00	1.00	130	**-0.7**	ULS 1a_0	57.8	60.3	51.8	0.01		**0.5**	ULS 1a_0,9_0,9_0	72.6	60.3	44.8	0.01	
525	Lower Cross-Arm Diag Brace 3	70x70x7	S235	1M16-8.8t	1.00	1.00	1.00	262	**-1.4**	ULS 1a_0	28.6	60.3	60.5	0.05		**0.7**	ULS 1a_0,9_0	92.7	60.3	52.3	0.01	
526	Lower Cross-Arm Diag Brace 3	50x50x7	S235	1M16-8.8t	1.00	1.00	1.00	203	**-1.5**	ULS 1a_0	29.3	60.3	60.5	0.05		**0.8**	ULS 1a_0,9_0,9_0	64.5	60.3	45.8	0.02	
220T	Lower Cross-Arm Diag Brace 3	150x150x12	S235	5M24-8.8t	1.00	1.00	1.00	169	**-101.3**	ULS 3_0,9_90	248.3	666.5	777.6	0.41		**117.5**	ULS 3_90	582.5	666.5	731.1	0.20	
220L	Lower Cross-Arm Diag Brace 3	150x150x12	S235	5M24-8.8t	2.00	2.00	2.00	169	**-23.8**	SPLS 3_0,9_0 Ba All Cts	248.3	666.5	777.6	0.10		**151.4**	S 6a_90 Ba All Cts Ah Ct3	582.5	666.5	731.1	0.26	
527		60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	81	**-18.8**	SPLS 6a_90 Ah Ct1 Ba Ct3	80.1	60.3	51.8	0.36		**18.6**	PLS 6a_90 Ah Ct1 Ba Ct3	48.4	60.3	33.7	0.55	
530	koker*	200x100x10	S235	2M16-8.8t	1.75	1.75	1.75	41	**-5.7**	SPLS 6a_90 Ba Ct1 Ah Ct3	614.0	120.6	172.8	0.05		**23.1**	PLS 6a_90 Ah Ct1 Ba Ct4	584.6	120.6	75.4	0.31	
531	koker*	200x100x10	S235	2M16-8.8t	2.08	2.08	2.08	41	**-6.0**	SPLS 6a_90 Ba Ct1 Ah Ct3	614.1	120.6	172.8	0.05		**24.5**	PLS 6a_90 Ah Ct1 Ba Ct4	636.5	120.6	75.4	0.33	
532	koker*	200x100x10	S235	2M16-8.8t	2.00	2.00	2.00	39	**-4.8**	ULS 1a_117.8	620.8	120.6	172.8	0.04		**24.8**	PLS 6a_90 Ah Ct2 Ba Ct4	584.6	120.6	75.4	0.33	
533		60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	126	**-17.2**	SPLS 6a_90 Ah Ct1 Ba Ct3	56.2	60.3	51.8	0.33		**16.8**	PLS 6a_90 Ah Ct1 Ba Ct3	48.4	60.3	33.7	0.50	
534		60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	99	**-14.4**	SPLS 6a_90 Ah Ct1 Ba Ct3	70.4	60.3	51.8	0.28		**13.8**	PLS 6a_90 Ah Ct1 Ba Ct3	48.4	60.3	33.7	0.41	
535		60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	118	**-16.1**	SPLS 6a_90 Ah Ct1 Ba Ct3	60.2	60.3	51.8	0.31		**16.1**	PLS 6a_90 Ah Ct1 Ba Ct3	48.4	60.3	33.7	0.48	
536		60x60x6	S235	1M16-8.8t	1.00	1.00	1.00	93	**-13.0**	SPLS 6a_90 Ah All Cts Ba Ct3	74.1	60.3	51.8	0.25		**12.7**	S 6a_90 Ah All Cts Ba Ct3	48.4	60.3	33.7	0.38	

APPENDIX C
Toetsing knikverkorters

Knikverkorters initial construction (afkeur)

Date: 2022-02-23
Author: M H Khan
Version: 1.8

ENS - ZL
HC-3_RC
Mast: 73

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Net Section Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Notes
9390	Broekstuk	Enkele staaf	L50.5	S235	M16	8.8	0.55	0	57	**37.7**	**0.14**	62.5	60.3	35.9	46.1	0.72	1.05	Bearing	
9389	Broekstuk	Enkele staaf	L60.6	S235	M16	8.8	1.73	62	148	**37.7**	**0.00**	46.8	60.3	38.4	72.6	1.24	0.98		
9388	Broekstuk	Enkele staaf	L50.7	S235	M16	8.8	1.51	0	158	**37.7**	**0.38**	41.1	60.3	42.5	44.4	0.98	0.92		
9387	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.07	52	132	**37.7**	**0.00**	72.3	60.3	38.4	107.1	2.25	0.98		
9386	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.33	0	148	**37.7**	**0.58**	63.2	60.3	38.4	107.1	2.25	0.98		
9385	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.64	38	168	**37.7**	**0.00**	54.1	60.3	38.4	107.1	2.25	0.98		
9384	Broekstuk	Enkele staaf	L80.8	S235	M16	8.8	3.15	0	202	**37.7**	**0.79**	55.2	60.3	51.2	142.8	2.95	0.74		
9383	Broekstuk	Enkele staaf	L80.8	S235	M16	8.8	3.32	29	213	**37.7**	**0.73**	51.2	60.3	51.2	142.8	2.95	0.74		
9382	Broekstuk	Enkele staaf	L90.8	S235	M16	8.8	3.97	0	225	**37.7**	**0.99**	53.3	60.3	51.2	165.9	3.77	0.74		
9381	Broekstuk	Enkele staaf	L90.8	S235	M16	8.8	3.78	24	214	**37.7**	**0.86**	57.4	60.3	51.2	165.9	3.77	0.74		
9395	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	0.99	0	102	**8.8**	**0.25**	47.7	60.3	30.3	31.7	0.72	0.35		
9394	Pootverband	Kniksteun en verticale steur	L50.7	S235	M16	8.8	2.16	0	145	**8.8**	**0.27**	35.7	60.3	42.5	44.4	0.68	0.40		
9393	Pootverband	Kniksteun en verticale steur	L80.6	S235	M16	8.8	3.33	0	136	**8.8**	**0.42**	54.4	60.3	38.4	107.1	1.77	0.25		
9392	Pootverband	Kniksteun en verticale steur	L80.6	S235	M16	8.8	4.49	0	184	**8.8**	**0.56**	38.5	60.3	38.4	107.1	1.77	0.33		
9391	Pootverband	Kniksteun en verticale steur	L90.8	S235	M16	8.8	5.66	0	206	**8.8**	**0.71**	49.4	60.3	51.2	165.9	2.87	0.26		
9380	Tussenschot	Kniksteun en verticale steur	L100.8	S235	M24	8.8	6.62	0	215	**0.7**	**0.83**	52.1	135.6	88.6	170.5	3.63	0.24		
9376	Tussenschot	Kruisende staaf halverwege	L120.10	S235	M24	8.8	9.68	0	263	**0.7**	**1.21**	59.1	135.6	110.8	270.7	8.49	0.14		
9400	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	1.98	87	203	**8.8**	**0.00**	21.4	60.3	30.3	31.7	0.72	0.41		
9399	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.18	60	224	**8.8**	**0.00**	18.6	60.3	30.3	31.7	0.72	0.47		
9398	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.51	48	258	**8.8**	**0.00**	15.0	60.3	30.3	31.7	0.72	0.59		
9397	Pootverband	Enkele staaf	L50.5	S235	M16	8.8	2.92	40	300	**8.8**	**0.00**	11.8	60.3	30.3	31.7	0.72	0.74		
9396	Pootverband	Enkele staaf	L60.6	S235	M16	8.8	3.33	32	284	**8.8**	**0.00**	18.5	60.3	38.4	72.6	1.24	0.47		
9566	Broekstuk	Enkele staaf	L80.8	S235	M16	8.8	2.92	36	187	**37.7**	**0.00**	61.5	60.3	51.2	142.8	2.95	0.74		
9565	Broekstuk	Enkele staaf	L80.6	S235	M16	8.8	2.37	0	150	**37.7**	**0.59**	62.1	60.3	44.8	107.1	2.2	0.84		
9563	1e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	1.84	0	157	**38.6**	**0.46**	43.4	60.3	41.3	48.4	1.24	0.93		
9562	1e tussenstuk	Enkele staaf	L80.6	S235	M16	8.8	2.26	44	144	**38.6**	**0.00**	65.5	60.3	44.8	107.1	2.25	0.86		
9561	1e tussenstuk	Enkele staaf	L90.8	S235	M16	8.8	3.88	0	220	**38.6**	**0.97**	55.1	60.3	51.2	165.9	3.77	0.75		
9560	1e tussenstuk	Enkele staaf	L80.6	S235	M16	8.8	2.32	31	148	**38.6**	**0.00**	63.5	60.3	44.8	107.1	2.25	0.86		
9559	1e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	1.84	0	157	**38.6**	**0.46**	43.4	60.3	41.3	48.4	1.24	0.93		
9557	1e tussenstuk	Enkele staaf	L50.7	S235	M16	8.8	1.45	0	151	**38.6**	**0.36**	43.2	60.3	42.5	44.4	0.98	0.91		
9556	1e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	1.75	42	150	**38.6**	**0.00**	46.1	60.3	41.3	48.4	1.2	0.93		
9555	1e tussenstuk	Enkele staaf	L80.6	S235	M16	8.8	3.10	0	197	**38.6**	**0.78**	43.4	60.3	44.8	107.1	2.2	0.89		
9554	1e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	1.82	30	156	**38.6**	**0.39**	43.9	60.3	41.3	48.4	1.24	0.93		
9311	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.53	40	157	**9.1**	**0.00**	30.2	60.3	35.9	46.1	0.72	0.30		
9310	2e tussenstuk	Enkele staaf	L80.6	S235	M16	8.8	2.64	0	168	**30.8**	**0.66**	54.2	60.3	38.4	107.1	2.2	0.80		
9598	2e tussenstuk	Enkele staaf	L50.7	S235	M16	8.8	1.57	32	163	**30.8**	**0.00**	39.3	60.3	42.5	44.4	0.98	0.78		
9313	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.49	43	153	**30.8**	**0.00**	31.2	60.3	32.2	31.7	0.72	0.99		
9309	2e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	2.33	0	200	**30.8**	**0.58**	31.6	60.3	38.4	72.6	1.2	0.97		
9314	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.45	35	149	**30.8**	**0.00**	32.3	60.3	32.2	31.7	0.7	0.97		
9315	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.41	48	145	**30.8**	**0.00**	33.4	60.3	32.2	31.7	0.7	0.97		

Knikverkorters initial construction (afkeur)

Date: 2022-02-23
Author: M H Khan
Version: 1.8

ENS - ZL
HC-3_RC
Mast: 73

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Net Section Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Notes
9597	2e tussenstuk	Enkele staaf	L60.6	S235	M16	8.8	2.03	0	173	**30.8**	**0.51**	38.3	60.3	38.4	72.6	1.2	0.80		
9316	2e tussenstuk	Enkele staaf	L50.5	S235	M16	8.8	1.33	38	137	**30.8**	**0.00**	35.7	60.3	32.2	31.7	0.7	0.97		
8018	Bovenstuk 1	Enkele staaf	L50.5	S235	M16	8.8	1.86	0	191	**12.9**	**0.47**	23.3	60.3	30.3	31.7	0.7	0.65		
8020	Bovenstuk 1	Enkele staaf	L50.5	S235	M16	8.8	1.71	0	175	**12.9**	**0.43**	26.2	60.3	30.3	31.7	0.7	0.59		
8021	Bovenstuk 2	Enkele staaf	L50.5	S235	M16	8.8	1.61	0	165	**6.6**	**0.40**	28.3	60.3	30.3	31.7	0.7	0.56		
8022	Bovenstuk 2	Enkele staaf	L50.5	S235	M16	8.8	1.43	0	147	**6.6**	**0.36**	32.8	60.3	30.3	31.7	0.7	0.50		

Knikverkorters adjusted construction (verbouw)

Date: 2022-02-23
Author: M H Khan
Version: 1.8

ENS - ZL
HC-3_RC
Mast: 73

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness (-)	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Block Tearing Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Mitigation
9390	Broekstuk	Enkele staaf	L50.5	**S355**	M16	8.8	0.55	0	57	**37.7**	**0.18**	89.0	60.3	43.6	51.0	1.08	0.87		Profile exchanged

APPENDIX D
Toetsing blokdeuvels

CALCULATION OF POST INSULATOR LOADS

The following parameters are calculated:

- The forces on the insulator attachment due to wind loading and weight
- The required measurements of the components

The diagram below is a representation of the loads on the insulator:

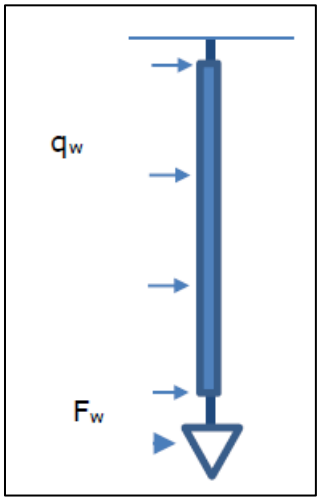


Figure 1: Diagrammatic representation of the loads on the post insulator

1. Forces on the insulator attachment

Wind pressure based on non-urban terrain in wind zone III at a height of 34.5 m: q_h = 1.03 kN/m^2

Wind load per meter based on an insulator diameter of 0.2 m and a drag factor of 1.2:

q_w = 1.2 x 0.2 x 1.03 = 0.25 kN/m

Then calculate F_w based on a supported length of 9 m, a dragfactor of 0,9 and a structural factor of 1,0:

F_w = 9 x 0.9 x 1.0 x 3 x 0.036 x 1.03 = 0.90 kN

Calculate the moment based on the wind loading and the point load:

M_w = 0.5 x 0.24 x 4^2 + 4 x 0.90 = 5.52 kNm

Design values:

M_{ED} = 1.4 x 5.52 = 7.7 kNm

V_{ED} = 1.4 x (0.90 + 3.5 x 0.24) = 2.44 kN

2. Assessment of the pin

The figure below is a sketch of the insulator attachment mechanism indicating the location of the pin.

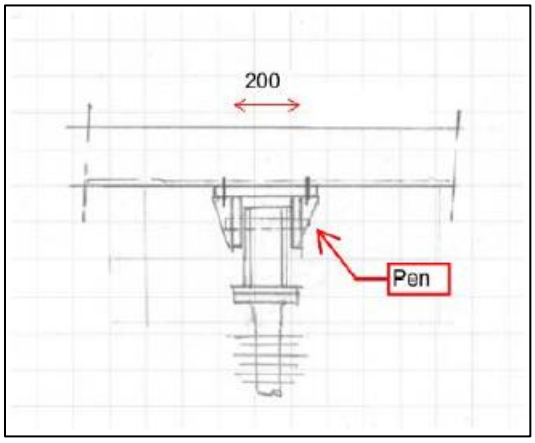


Figure 2: Post insulator attachment mechanism

Calculation of the shear force on the pin:

Assuming a total vertical weight of 5 kN and an attachment fit of 200 mm:

F_V = 7.7 /0.2 + 5/2 = 41 kN

Using a pin with a diameter of 25 mm is sufficient; see the attached spreadsheet calculation at the end of this appendix. A minimum flange thickness of 15 mm is required.

3. Console thickness

This will be determined in the subsequent design phases.

4. Attachment to the crossarm

The figure below depicts the additional members required for attachment to the crossarm.

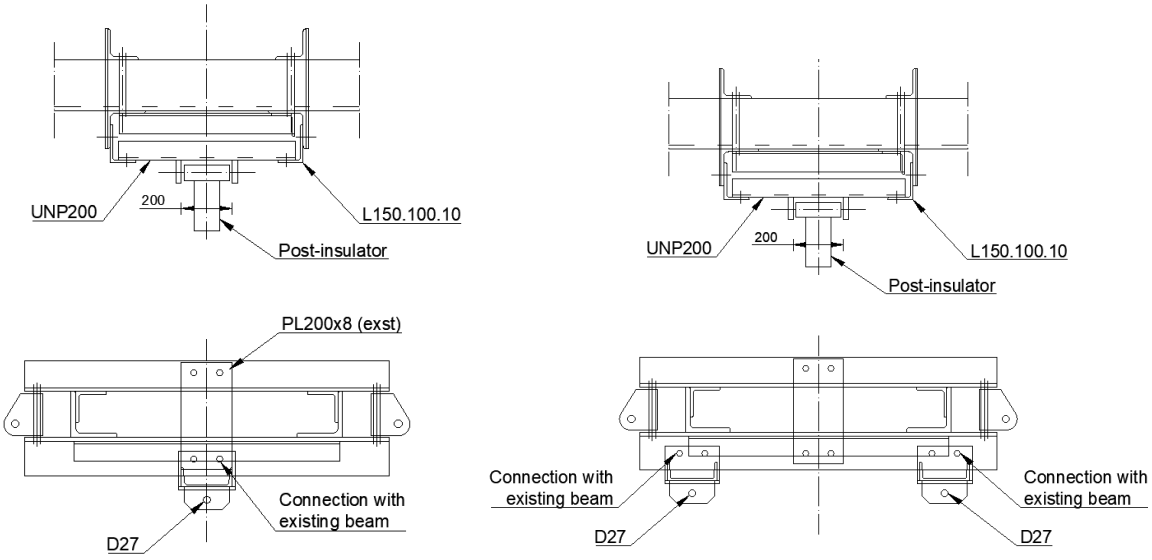


Figure 3: Overview of the new members required for attachment

M = 0.5 x 7.7 + 0.25 x 5 x 0.66 = 4.67 kNm

Proposition: 1 x UNP200: M_{rd} = 26900 x 355 = 9.55 kNm

U.C. = 4.67/ 9.55 = 0.49 < 1 OK

Project: BBB - ENS-ZL
Mast: HC-3 RC

DNV·GL

Pen-gatverbinding

Datum: 2021-01-27
Auteur: MKh
Versie: 1.3

Onderwerp	**Post Insulator Attachment**	Toetsing sterkte	0.56 < 1,0 OK

Input

Dikte	15	mm
Gat	27	mm
Pendiameter	25	mm
Ringdikte	5	mm
Eindafstand	40	mm
Randafstand	35	mm
Staalsoort	S235	
Kwaliteit pen	8.8	

Belasting

F_{Ed} = 41.0 kN

$\gamma_{m0,staal}$	1.20
$\gamma_{m0,pen}$	1.00
γ_{m2}	1.25
$\gamma_{m6,ser}$	1.00

Toetsing

Afstanden

Randafstand	OK
Eindafstand	OK
Dikte	OK

Sterkte-eisen

Afschuifsterkte pen	0.22	< 1,0 OK
Buigsterkte pen	0.56	< 1,0 OK
Combinatie M + V	0.36	< 1,0 OK
Stuik plaat	0.37	< 1,0 OK

Berekeningen

Controle eind- en randafstand

Aan de eisen van óf A óf B moet voldaan worden

Type A

Rand	$a > F_{Ed}\,\gamma_{m0} / 2tf_y + 2\,d0/3$ =	25 mm	OK
Eind	$c > F_{Ed}\,\gamma_{m0} / 2tf_y + d0/3$ =	16 mm	OK

Type B

Min. eindafstand	$e > 1{,}6d_0$ =	43 mm	Niet OK
Min. randafstand	$e > 1{,}25d_0$ =	34 mm	OK
Min. dikte	$t > 0{,}7\sqrt{(F_{Ed}\,\gamma_{m0} / f_y)}$ =	10 mm	OK

Pen

A =	491	mm^2
W_{el} =	1534	mm^2

Excentriciteit

e = (132-102)+t_{clip}/2 = 20 mm

Materiaalsterktes

$f_y = \min(f_{y,staal}, f_{yp})$ =	235	N/mm^2
f_{yp} =	640	N/mm^2
f_{up} =	800	N/mm^2
$f_{y,staal}$	235	N/mm^2
$f_{t,staal}$	360	N/mm^2

Afschuiving

$F_{v,Rd} = 0{,}6A\,f_{up} / \gamma_{m2}$ = 188 kN

U.C. 0.22 < 1,0 OK

Stuik

$F_{b,Rd} = 1{,}5\,t\,d\,f_y / \gamma_{m0}$ = 110 kN

U.C. 0.37 < 1,0 OK

Buigweerstand

$M_{Ed} = F_{Ed}\,e$ = 0.82 kNm

$M_{Rd} = 1{,}5\,W_{el}\,f_{yp} / \gamma_{m0}$ = 1.47 kNm

U.C. = 0.56 < 1,0 OK

$(M_{Ed} / M_{Rd})2 + (F_{v,Ed} / F_{v,Rd})^2$ = 0.36 < 1,0 OK

Project: ENS-ZL380
Mast: HC-3 RC (73)

Shear blocks

NEN-EN 1993-1-1 en NEN-EN 1994-1-1

Datum: 2021-01-26
Auteur: TBR
Versie: 1.4

Load				***Results***			
Compression	$F_{Ed,c}$	**2102**	kN	Compression	U.C.	0.79	< 1,00 OK
Tension	$F_{Ed,t}$	**1645**	kN	Tension	U.C.	0.65	< 1,00 OK

Main leg

Profile		**L250.24**	
Steel material		S355	
Cross section		11467	mm^2
Axial capacity	N_{pl}	4071	kN
Width	b	250	mm
Thickness	t	24	mm
Length in concrete		2000	mm

Shear blocks main leg

Width	b	50	mm
Thickness	h	30	mm
Length	L	260	mm
Welds	a	5	mm
c.t.c. separation	s	250	mm
Number for compr.	n_c	14	-
Number for tension	n_t	14	-

Foot plate

Thickness	t	25	mm
Ext. length	m	30	mm
Welds	a	6	mm

Pile

Name		Buispaal	
Diameter		559	mm
Thickness		10	mm
Cross section		17241	mm^2
Steel material		S235	
Capacity		4052	kN
Concrete strength		C20/25	

Shear blocks pile

Width	b	50	mm
Thickness	h	30	mm
Length	L	1200	mm
Welds	a	5	mm
c.t.c. separation	s	500	mm
Number for compr.	n_c	4	-
Number for tension	n_t	4	-

Design value concrete strength

Material factor	γ_c	1.5	
Add. mat. factor	γ_m	1.25	-
f_{cd} =		10.7	N/mm^2

Steel tower stub

Yield strength	f_{yd} =	355	N/mm^2
Tensile strength	f_{ud} =	490	N/mm^2

Capacity shear blocks main leg

A_{f1} =	7800	mm^2
A_{f2} =	23800	mm^2
Slope	1: 5	
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.75	
$f_{jd} = C_A \times f_{cd}$ =	18.6	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	2035	kN
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	2035	kN

Capacity foot plate

k_d =	1.73	-
$f_{jd} = C_A \times f_{cd}$ =	18.5	N/mm^2
$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	63	mm
m* = min(c,m) =	30	mm
Type foot plate	Diagonally cut	
Effective for	Compr. and tension	
$A_{p,c}$ =	39379	mm^2
$F_{Rd,c} = A_{p,druk} \times f_{jd}$ =	728	kN
$A_{p,t}$ =	27912	mm^2
$F_{Rd,t} = A_{p,t} \times f_{jd}$ =	516	kN

Capacities

$F_{rd,c,plate}$ =	728	kN
$F_{rd,blocks,c}$ =	2035	kN
$F_{rd,c} = F_{rd,blck} + F_{rd,footplate}$ =	**2762**	kN
U.C. compression	0.76	< 1,00 OK
Welds foot plate (see next page)	1436	kN
$F_{rd,t}$ = min. (welds / foot plate) =	516	kN
$F_{rd,blocks,t}$ =	2035	kN
$F_{rd,t} = F_{rd,blck} + F_{rd,footplate}$ =	**2550**	kN
U.C. tension	0.65	< 1,00 OK
U.C. welds	0.35	< 1,00 OK

Capacity shear blocks pile

A_{f1} =	36000	mm^2
A_{f2} =	108000	mm^2
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1.73	-
$f_{jd} = k_d \times f_{cd}$ =	18.5	N/mm^2
$F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ =	**2660**	kN
U.C. compression	0.79	< 1,00 OK
$F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ =	**2660**	kN
U.C. tension	0.62	< 1,00 OK
U.C. welds	0.34	< 1,00 OK

"Splitting" of pile

Spread of forces	45	°
Length force flow	1731	mm
Splitting force	475	kN/m
Yield strength wall f_{yd} =	235	N/mm^2
Capacity tubular pile	4700	kN/m
U.C.	0.10	< 1,00 OK

Project: ENS-ZL380
Mast: HC-3 RC (73)

Welds of shear blocks of main leg

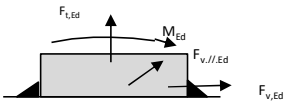
Out-of-plane loading

Plate

t =	50	mm
Grade	S355	
f_{yd} =	355	N/mm²
f_u =	490	N/mm²

Welds

a =	5	mm
l =	250	mm
β_w =	0.9	-
γ_{M2} =	1.25	-



Member forces

Factor	1.2	
$F_{t,Ed}$ =	**0**	kN
$F_{v,Ed} = F_{rd,c} / n$ =	**174**	kN
$F_{v//,Ed}$ =	**0**	kN
$M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ =	**2.62**	kNm

Stress components

$\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ =	0	N/mm²
$\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ =	49	N/mm²
	49	N/mm²
$b^* = b + 2/3a\sqrt{2}$	54.7	mm
$\sigma_1 = \tau_1 = 0{,}706 M_{Ed} / al\ b^*$ =	27	N/mm²
$\tau_{//} = F_{vl,Ed} / 2al$ =	0	N/mm²
$\sigma_{w,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	153	N/mm²

Check

$\sigma_{vw,Ed}$ =	153	N/mm²	≤	$f_u / \beta_w \gamma_{M2}$ =	436	N/mm²	U.C. = **0.35** OK
σ_1 =	76	N/mm²	≤	$0{,}9 f_u / \gamma_{M2}$ =	353	N/mm²	U.C. = **0.22** OK

Welds of shear blocks of pile

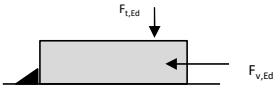
Out-of-plane loading

Plate

t =	50	mm
Grade	S235	
f_{yd} =	235	N/mm²
f_u =	360	N/mm²

Welds

a =	5	mm
l =	1200	mm
β_w =	0.8	-
γ_{M2} =	1.25	-



Member forces

Factor	1.2	
$F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ =	**239**	kN
$F_{v,Ed}$ =	**798**	kN
$F_{v//,Ed}$ =	**0**	kN
M_{Ed} =	**0.00**	kNm

Stress components

$\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ =	14	N/mm²
$\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ =	47	N/mm²
	61	N/mm²
$\tau_{//} = F_{vl,Ed} / 2al$ =	0	N/mm²
$\sigma_{w,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ =	122	N/mm²

Check

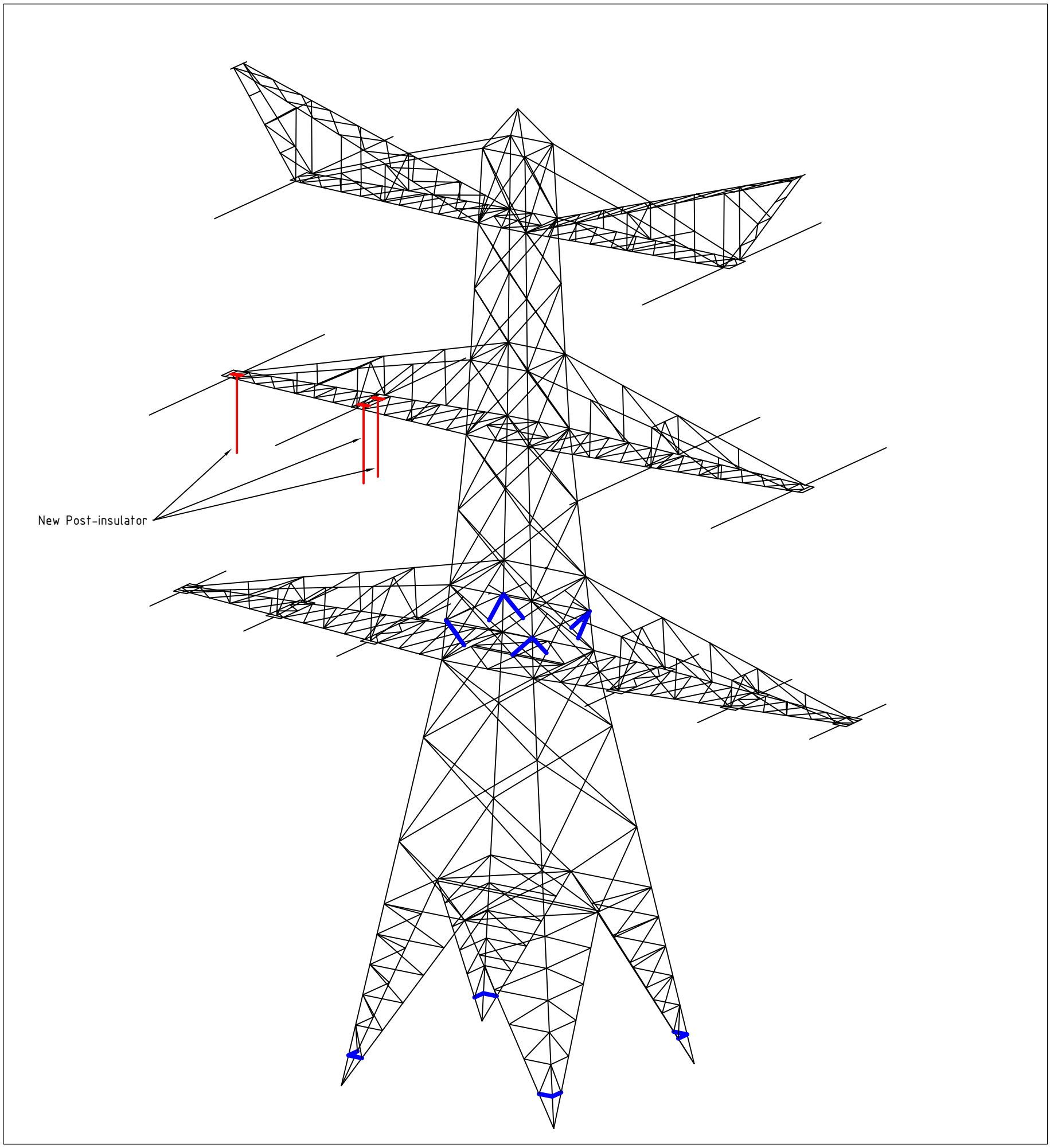
$\sigma_{vw,Ed}$ =	122	N/mm²	≤	$f_u / \beta_w \gamma_{M2}$ =	360	N/mm²	U.C. = **0.34** OK
σ_1 =	61	N/mm²	≤	$0{,}9 f_u / \gamma_{M2}$ =	259	N/mm²	U.C. = **0.24** OK

Welds of foot plate

$f_u / \beta_w \gamma_{M2}$ =		436	N/mm²
Weld size	a =	6	mm
Length	l = 2b+ 2b - t =	952	mm
Capacity	$F_{Rd} = a \times l \times f_{w,d} / \sqrt{3}$ =	**1436**	kN

APPENDIX E
Tekeningen

Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
Pos 9390	EA	L50x5	S235 t=<40	M16-8.8t-NEN2012	EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
Pos 9311	EA	L50x5	S235 t=<40	M16-8.8t-NEN2012	EA	L50x5	S355 t=<40	M16-8.8t-NEN2012
BR1 & BR2					EA	L100x10	S355 t=<40	M24-8.8t-NEN2012



Overview

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

New profile/insulator
Profile exchanged
New redundant
Bolt exchanged

00	27-1-2021	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-056

Design state:	FINAL	Scale:	-
Drawn by:	MuK 27-1-2021	Units:	m
Checked by:	TBR 27-1-2021	Project no:	10166260
Approved by:	JHu 27-1-2021	Company:	TenneT

Description: Modifications overview for mast type HC-3_RC (Mast 73) page 1 of 3

Revision: 00

Format: A2

DNV GL Energy & Sustainability, Utrechtseweg 310, 6812 AR Arnhem, tel: +31 26 3 56 91 11, www.dnvgl.com

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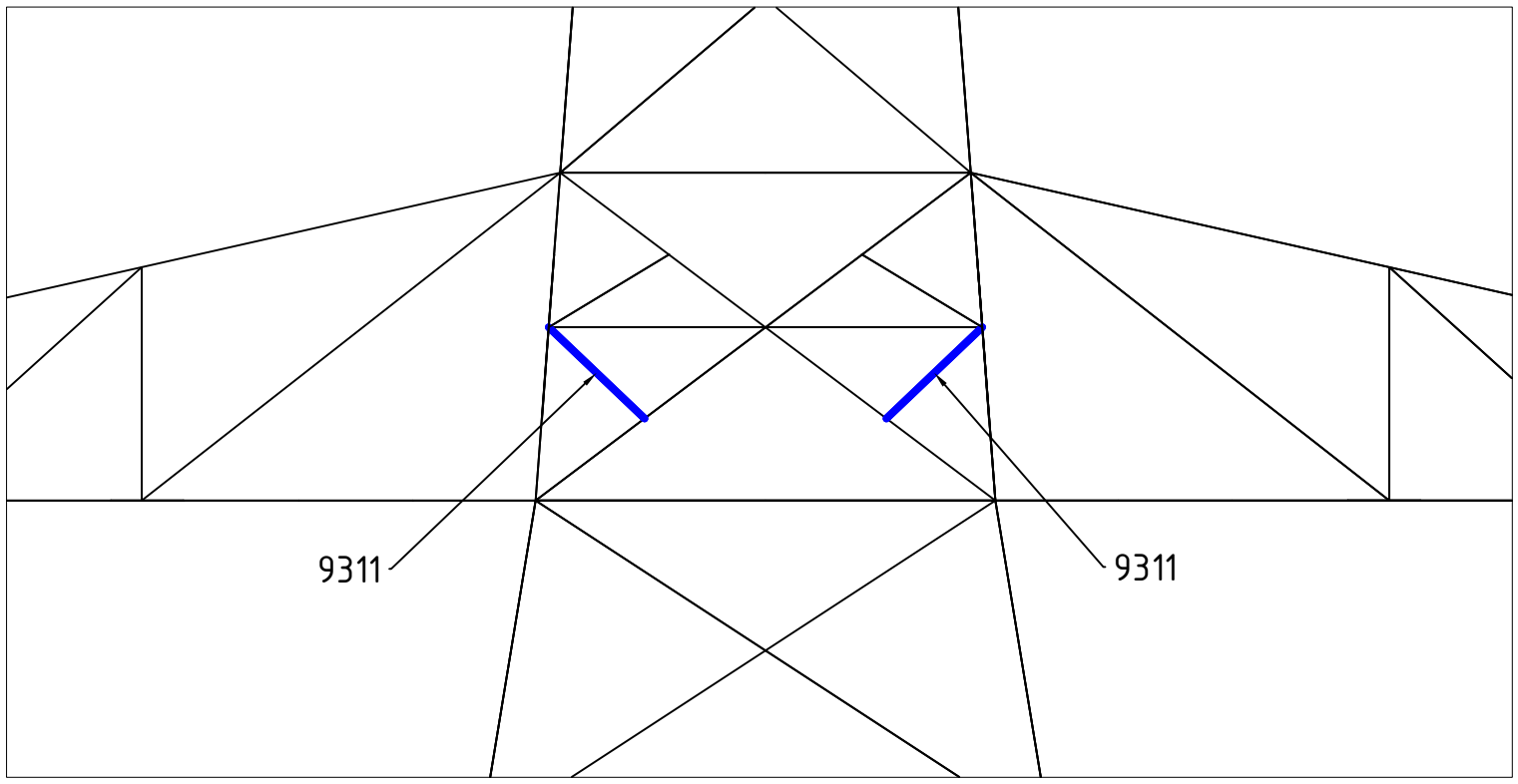
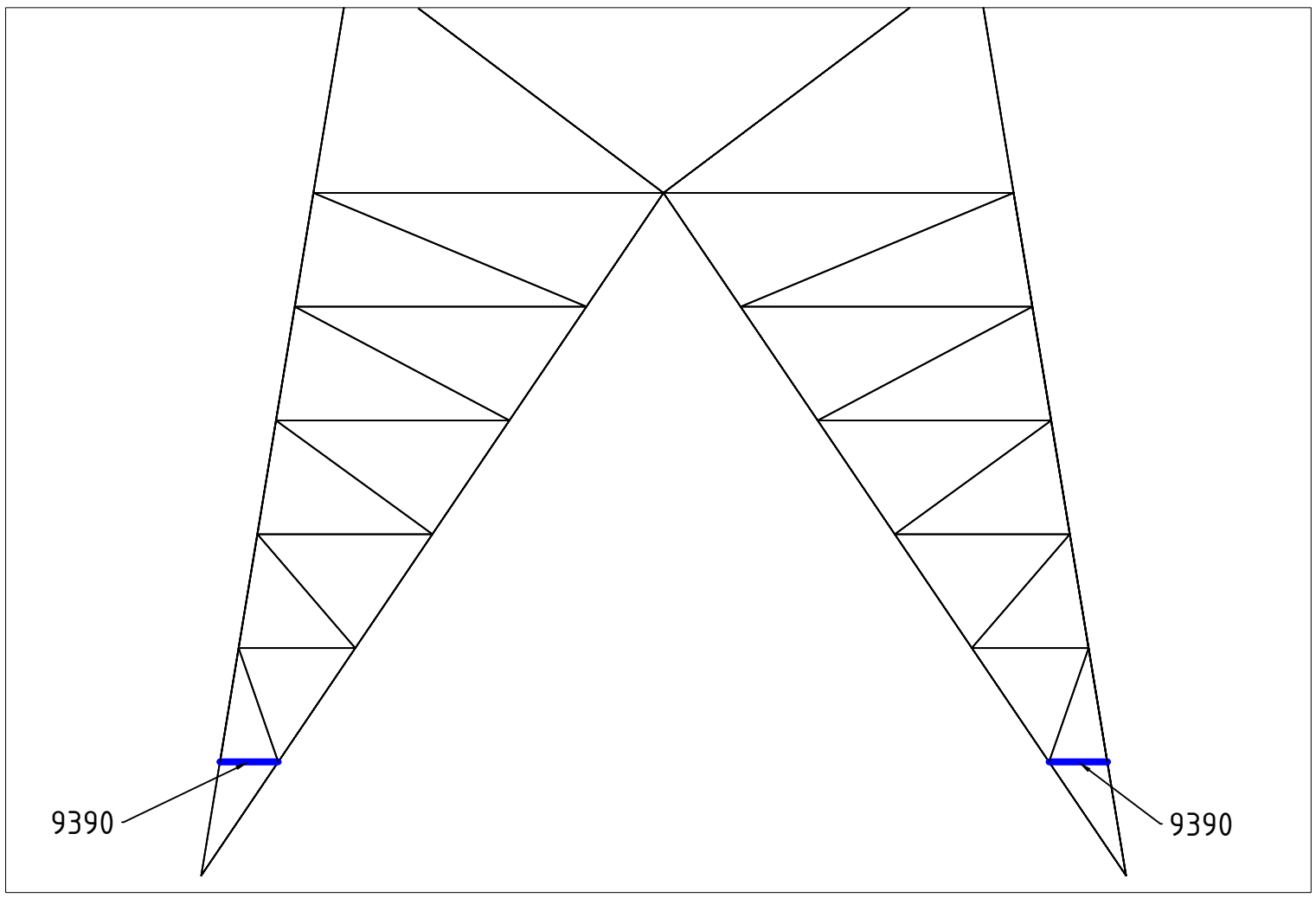


Front View - Lower Crossarm



Front View - Lower Leg Section

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Profile exchanged
New redundant
Bolt exchanged

00	27-1-2021	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-056

Design state:	FINAL	Scale:	-
Drawn by:	MuK 27-1-2021	Units:	m
Checked by:	TBR 27-1-2021	Project no:	10166260
Approved by:	JHu 27-1-2021	Company:	TenneT

Description: Modifications overview for mast type HC-3_RC (Mast 73) page 2 of 3

Revision: 00

Format: A2

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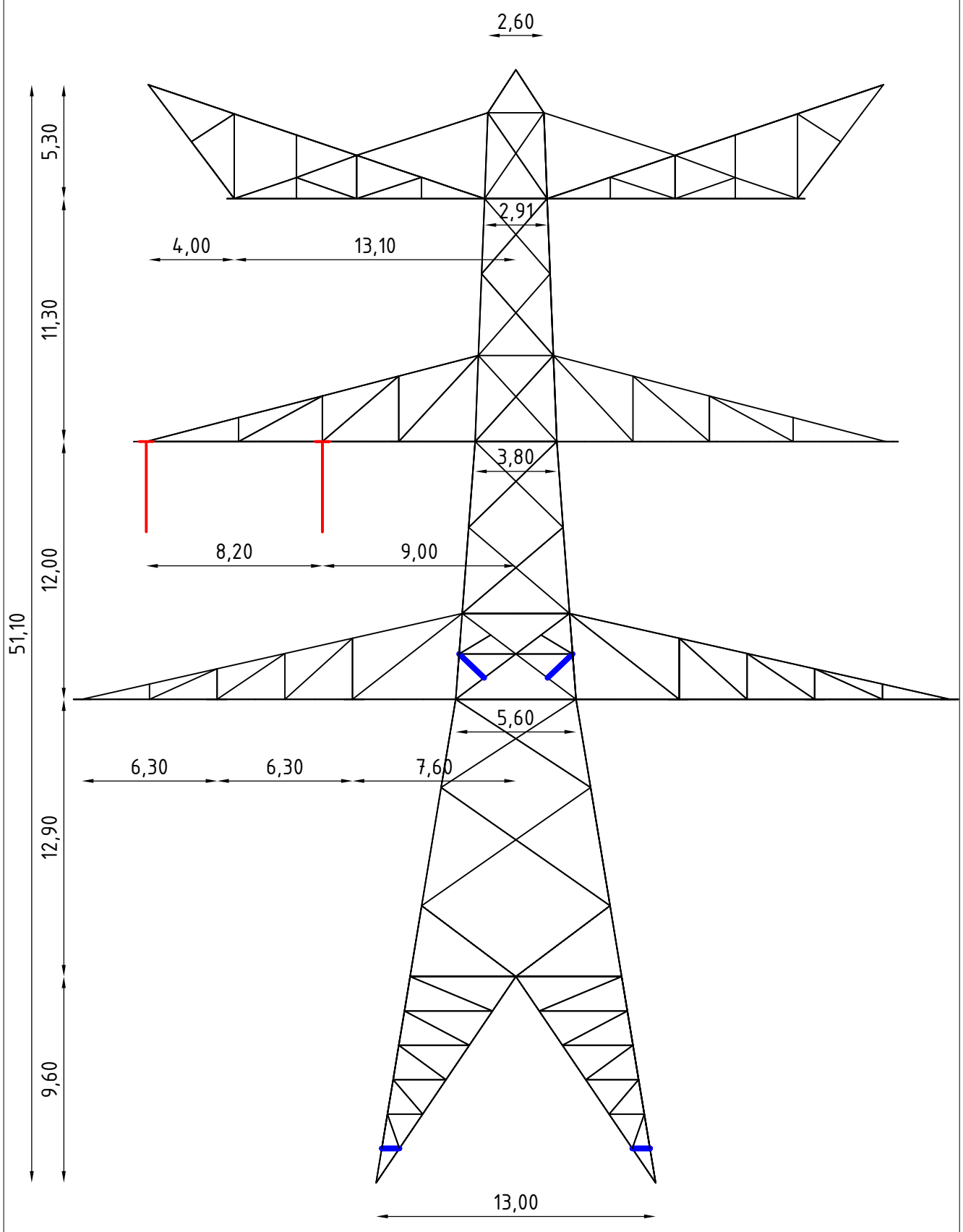
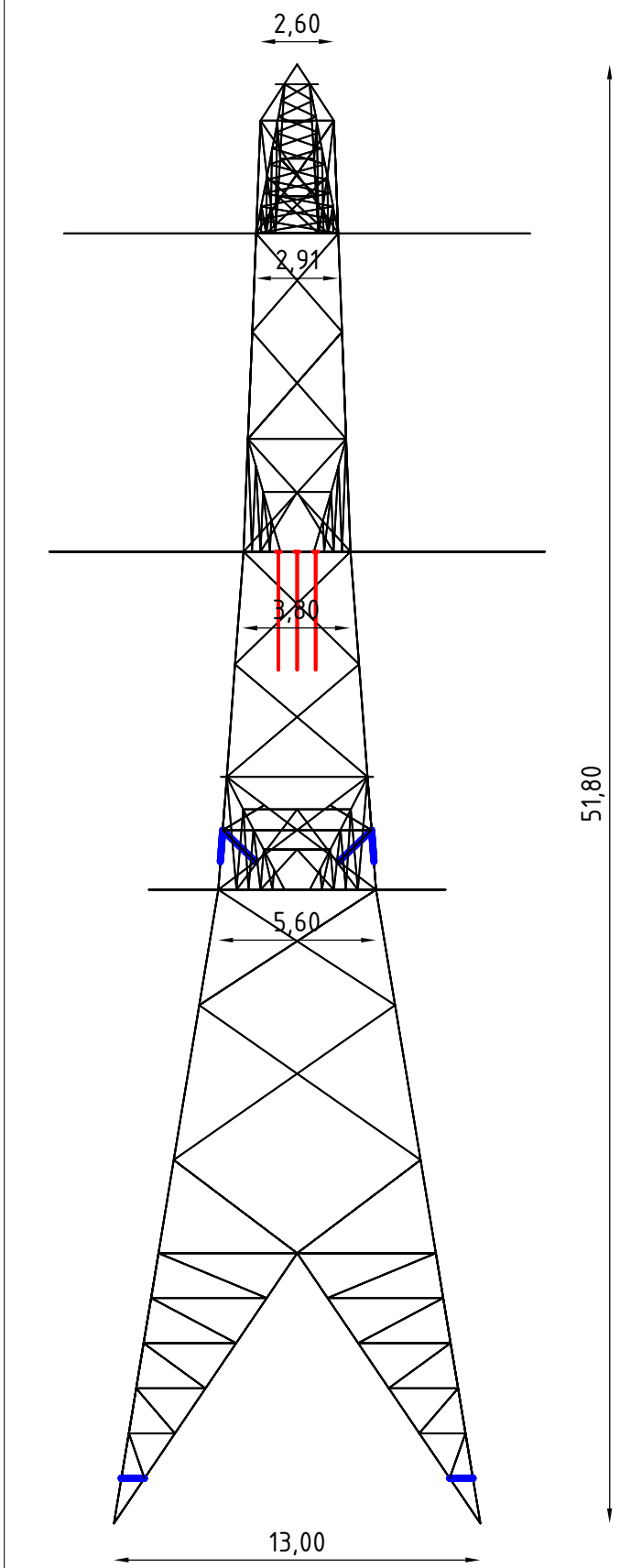


Front View



Side View

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is L50x50x5**
- **Other changes according to the table**
- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

Profile exchanged
New redundant
Bolt exchanged

00	27-1-2021	Version 1.0

DNV·GL

Projectname: Mast constructions ENS - ZL 380 kV

Third angle projection:

Drawing no.: 10166260-056

Design state:	FINAL		Scale:	-
Drawn by:	MuK	27-1-2021	Units:	m
Checked by:	TBR	27-1-2021	Project no:	10166260
Approved by:	JHu	27-1-2021	Company:	TenneT

Description: Modifications overview for mast type HC-3_RC (Mast 73) page 3 of 3

Revision: 00

Format: A2

DNV GL Energy & Sustainability, Utrechtseweg 310, 6812 AR Arnhem, tel: +31 26 3 56 91 11, www.dnvgl.com

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DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

Bijlage 5

Gegevens UO per masttype

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-02800**

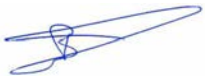
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994434**

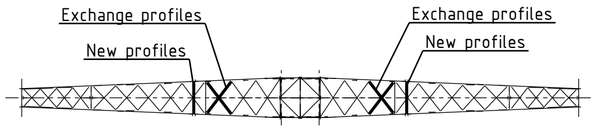
Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype S-6_R, Mast 28 - Overzichtstekeningen**

	Naam	Functie	Handtekening	Datum
Opgesteld	Rogier Hol	Tekenaar		10-03-2022
Validatie Aafjes	Niels Verhaar	System Engineer		10-03-2022
Vrijgegeven	Bart Aafjes	Projectleider		10-03-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	10-03-2022	1e versie ter review



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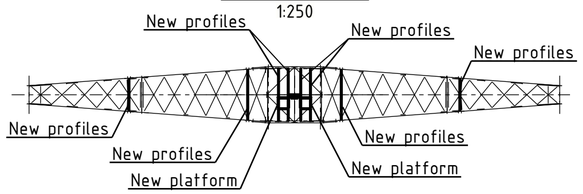

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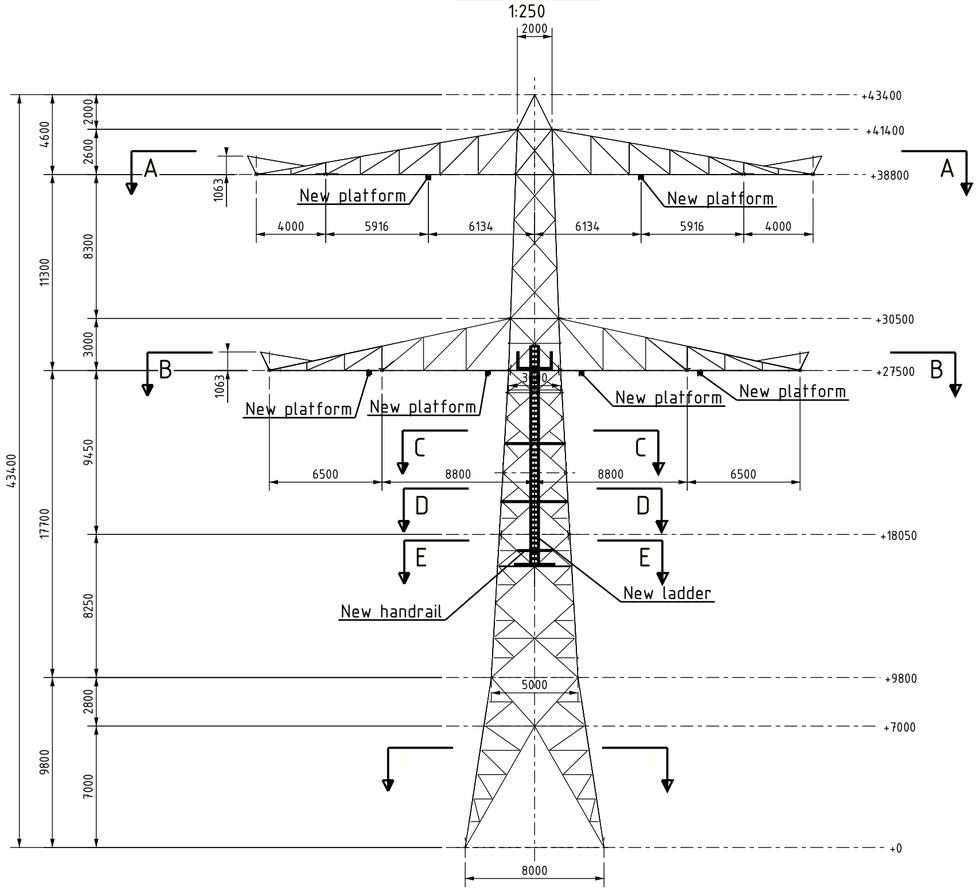

Transverse face
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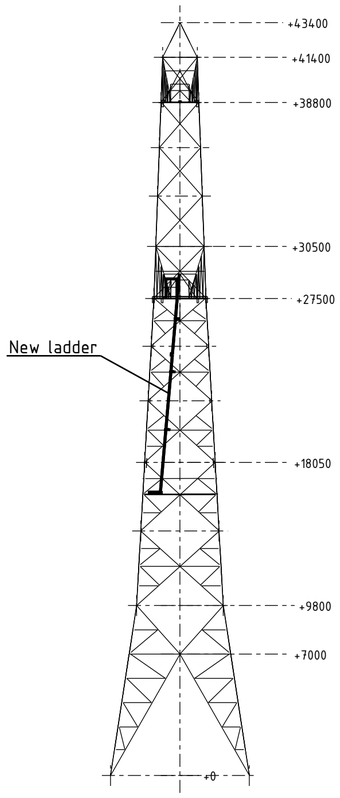

Longitudinal face
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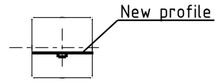

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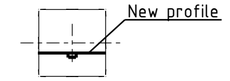

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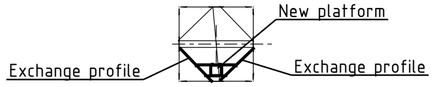

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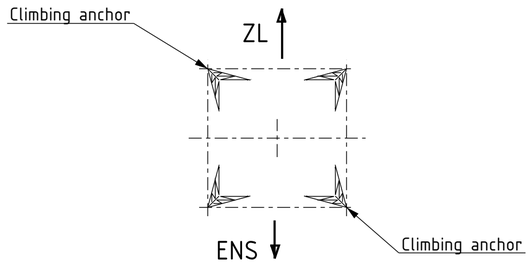

Section
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All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

Unless otherwise specified:
- It has drawn on the right side.
- Material quality S355J0 (t<=16mm), S355J2 (16<t<=40mm)
- All bended profiles and plates "HOT BENDING".
- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 - HDG oversized
Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle
Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:250	594x420

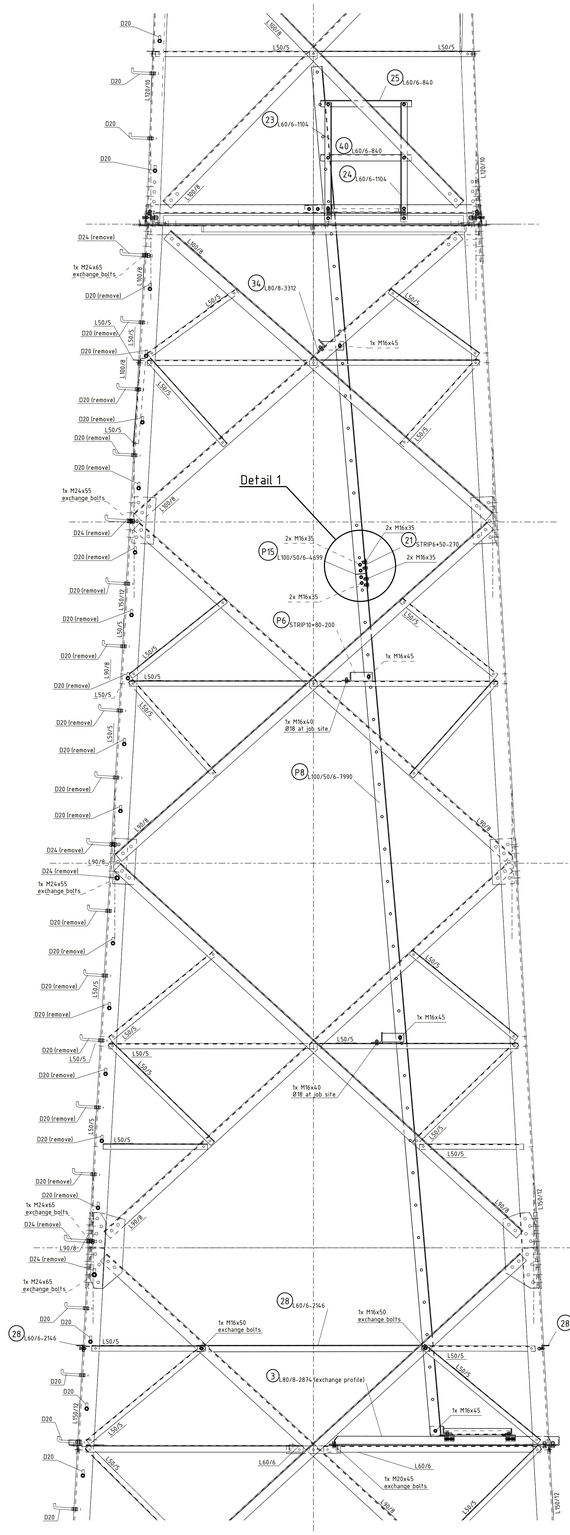
Relatie

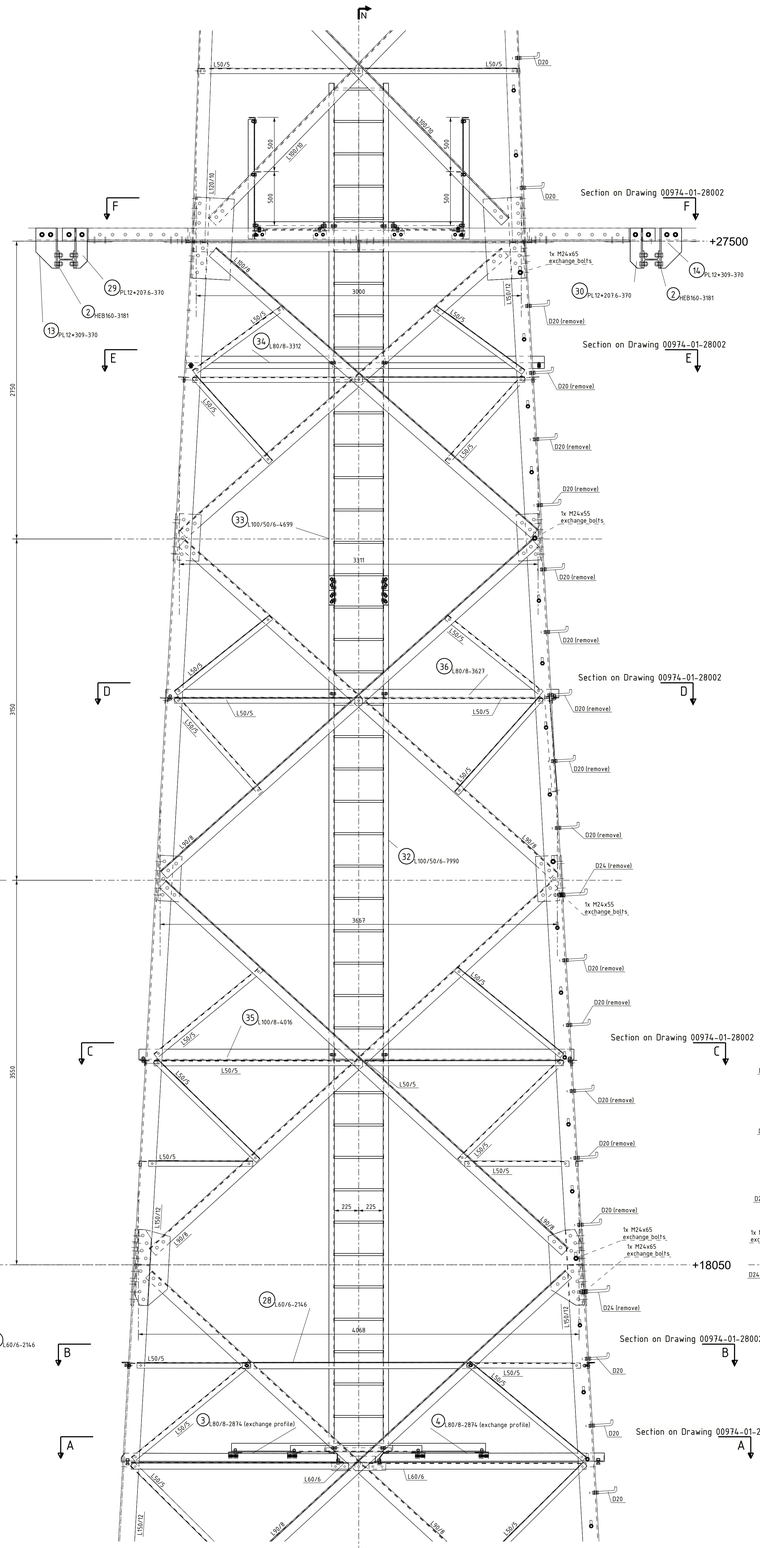
Oud Tekeningnummer:

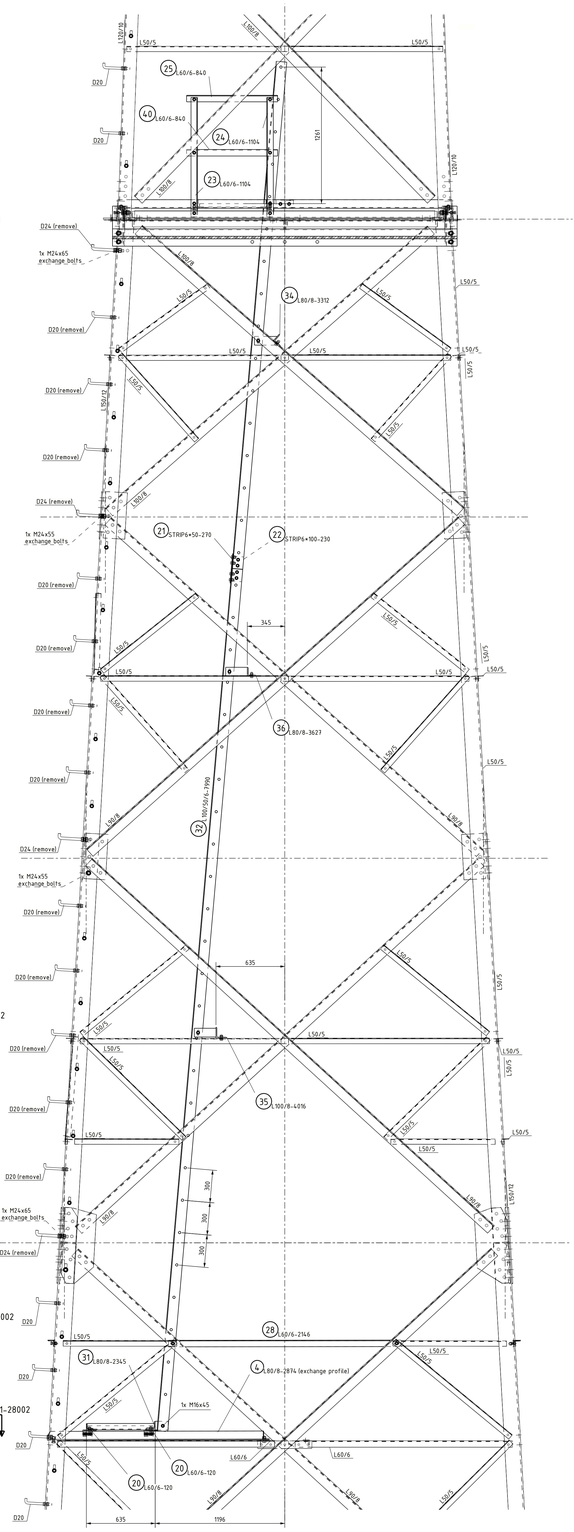
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Masttype S-6_R, Mast 28 - Overzicht
Documentnummer:	00974-01-28001

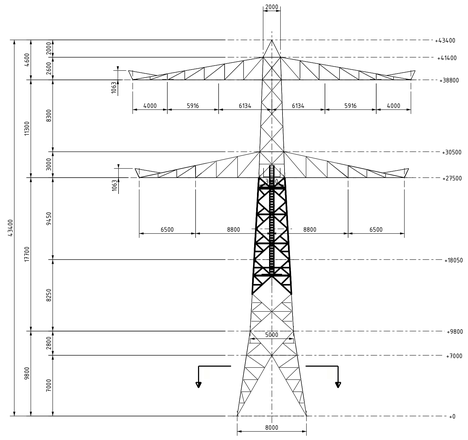
TenneT Taking power further

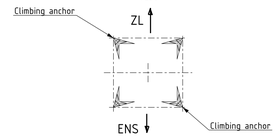
Tekla Structures

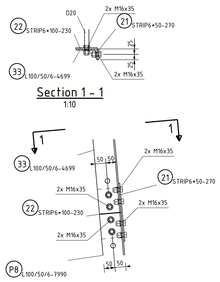












All components of manufacture and finishing according to implementation of TenneT specifications below:
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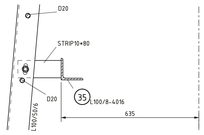
Project					Werknaam	
Opwaarderen 380 kV verbinding Ens - Zwolle					Voortopig	
Rev.	Datum revisie	Beschrijving revisie	Getekend	Gecon. tu-Delft	Gcheck	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aalfjes b.v.		1:10 1:20	A0

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentsoort	Constructietekening
Ref. Tekeningnummer	Object ID	ENS-ZL380
	Beschrijving	Masttype S-6_R, Mast 28 - Tussenstuk
	Documenthoofdnr.	00974-01-28002

TenneT taking power further

Tekla Structures



Section C1 – C1
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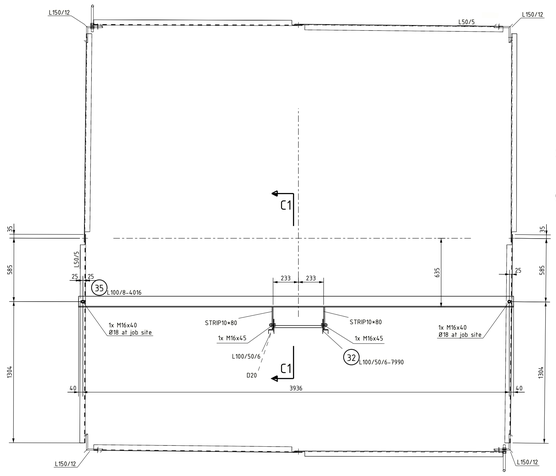

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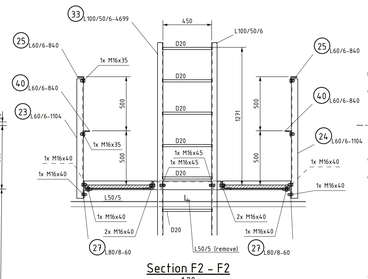

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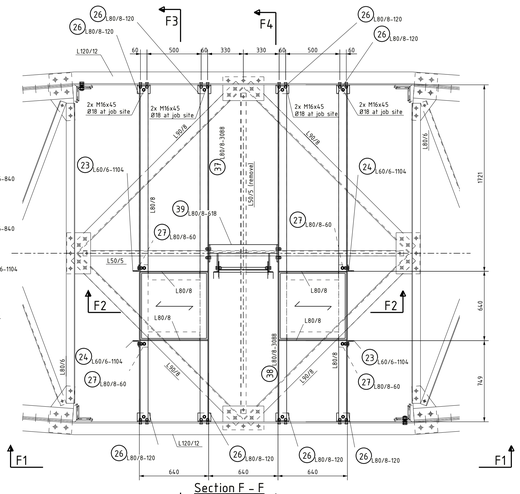
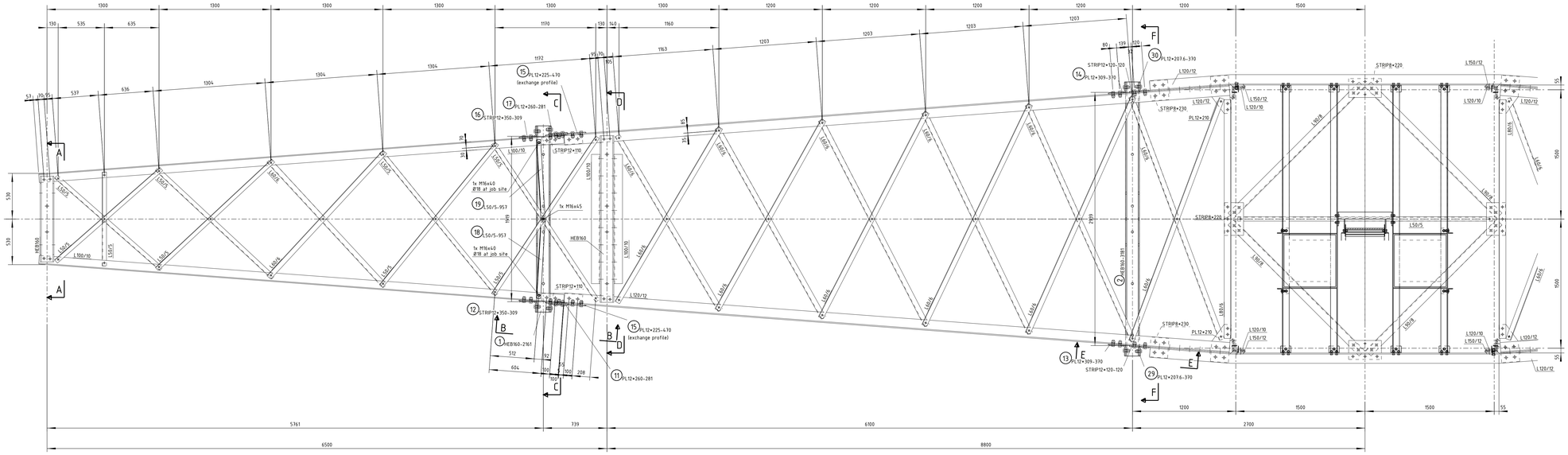
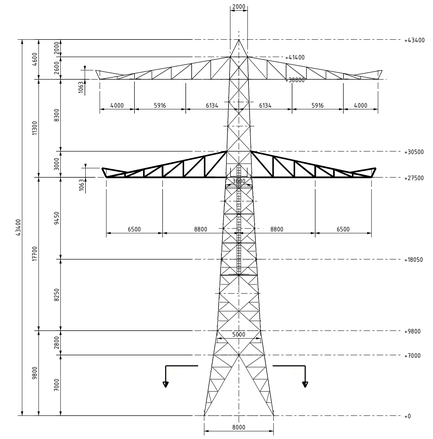

F3
F4
26 L80/8-120
L120/12
60
500
60
330
330
60
500
60
2x M16x45 Ø18 at job site
L80/8
L80/8-3088
L50/5 (remove)
L80/8
L80/8
L80/8



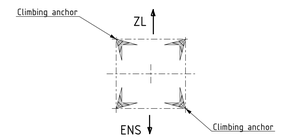
Bottom surface upper cross arm

Left side drawn, right side mirrord 1:20



Transverse face

1:250



Section

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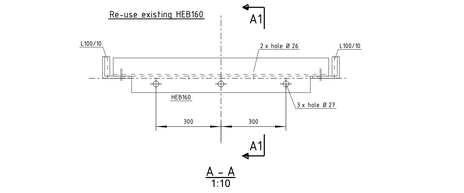

A – A

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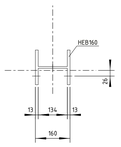

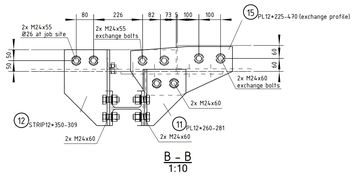

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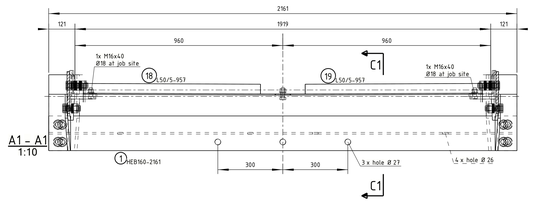
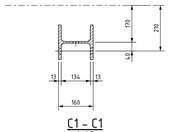


C – C

1:10



C1 – C1

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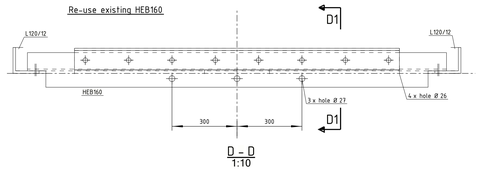

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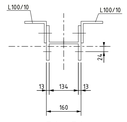

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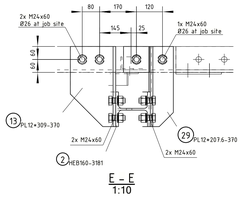

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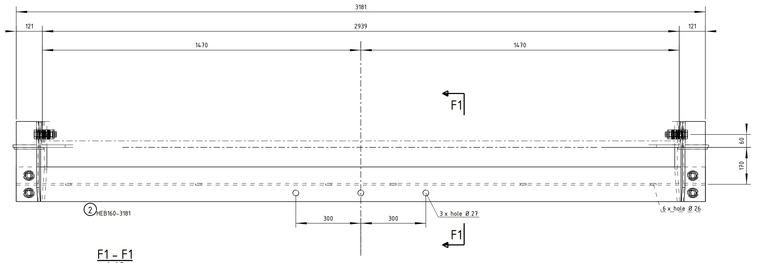
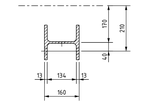


F1 – F1

1:10

F – F

1:10



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- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
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Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 – HDG oversized
Nuts	: Quality 8 – HDG oversized
Washers	: St. –HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimun 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

Project: Opwaarderen 380 kV verbinding Ens – Zwolle				Tekeningstatus: Voorlopig	
No.	Datum revisie	Beschrijving revisie	Getekend: Ing. bureau Aafjes b.v.	Datum As-Built:	Schaal: 1:10 1:20 Format: A0
0.1	10.03.2022	1e versie ter review			

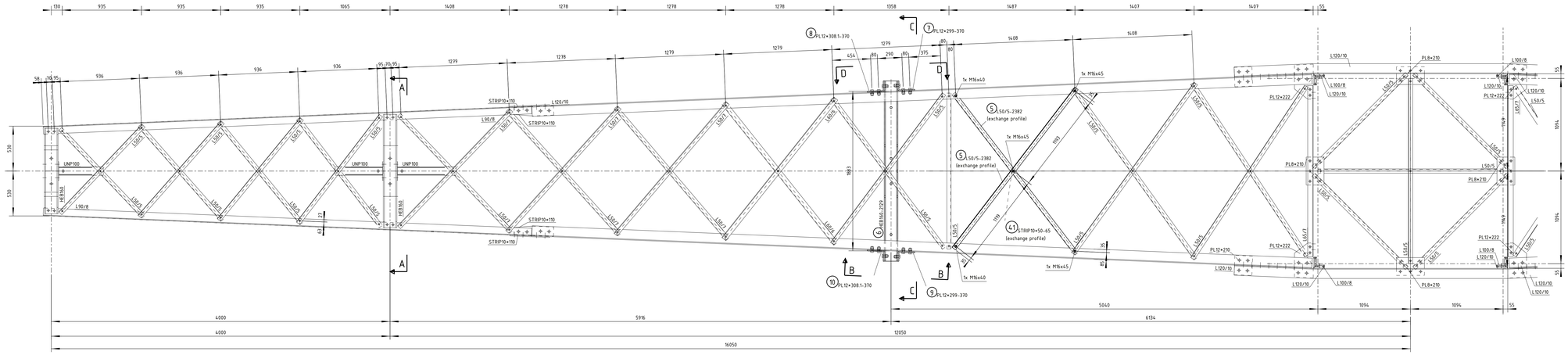
Revisie:

Ref. tekeningnummer:

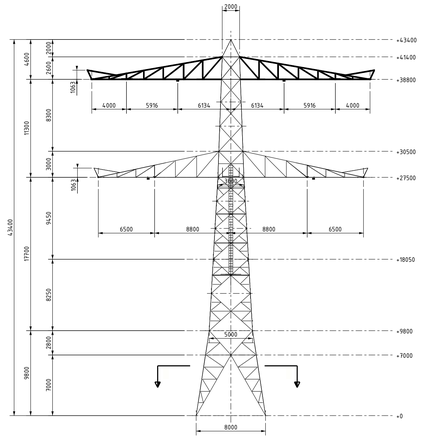
Thema:	Verbinding
Categorie:	Algemeen
Documentsoort:	Constructietekening
Object ID:	ENS-ZL380
Beschrijving:	Mastitype S-6_R, Mast 28 - Ondertraverse
Documentnummer:	00974-01-28004

TenneT taking power further

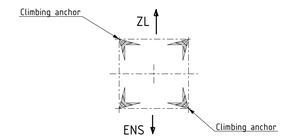
Tekla Structures



Bottom surface lower cross arm
Left side drawn, right side mirrord 1:20



Transverse face
1:250



Section
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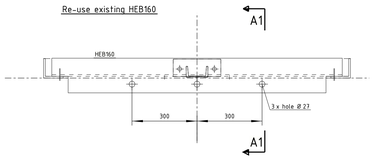
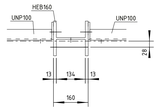
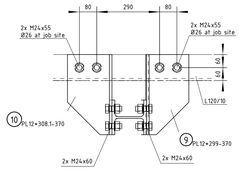


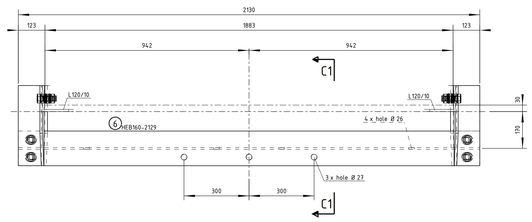
Section A - A
1:10



Section A1 - A1
1:10



Section B - B
1:10



Section C - C
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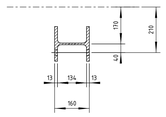

Section C1 - C1
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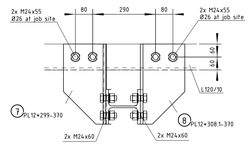


Section D - D
1:10

All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

Unless otherwise specified:
- It has drawn on the right side.
- Material quality S355J0 (t=16mm), S355J2 (16+t=40mm)
- All bended profiles and plates "HOT BENDING".
- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 - HDG oversized
Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

Opwaarderen 380 kV verbinding Ens - Zwolle					Voorlopig		
Rev.	Datum revisie	Beschrijving revisie	Gehaald	Datum Ko-Bolt	Schaal		Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	1:20	A0

Relatie	Tekst	Verbinding
	Lengte	Algemeen
	Documentsoort	Constructietekening
Ref. Tekeningnummer:	Object ID	ENS-ZL380
	Beschrijving	Masttype S-6_R, Mast 28 - Boventraverse
TENNET Taking power further	Documentnummer	00974-01-280045

Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-02810**

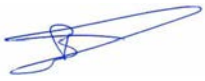
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994435**

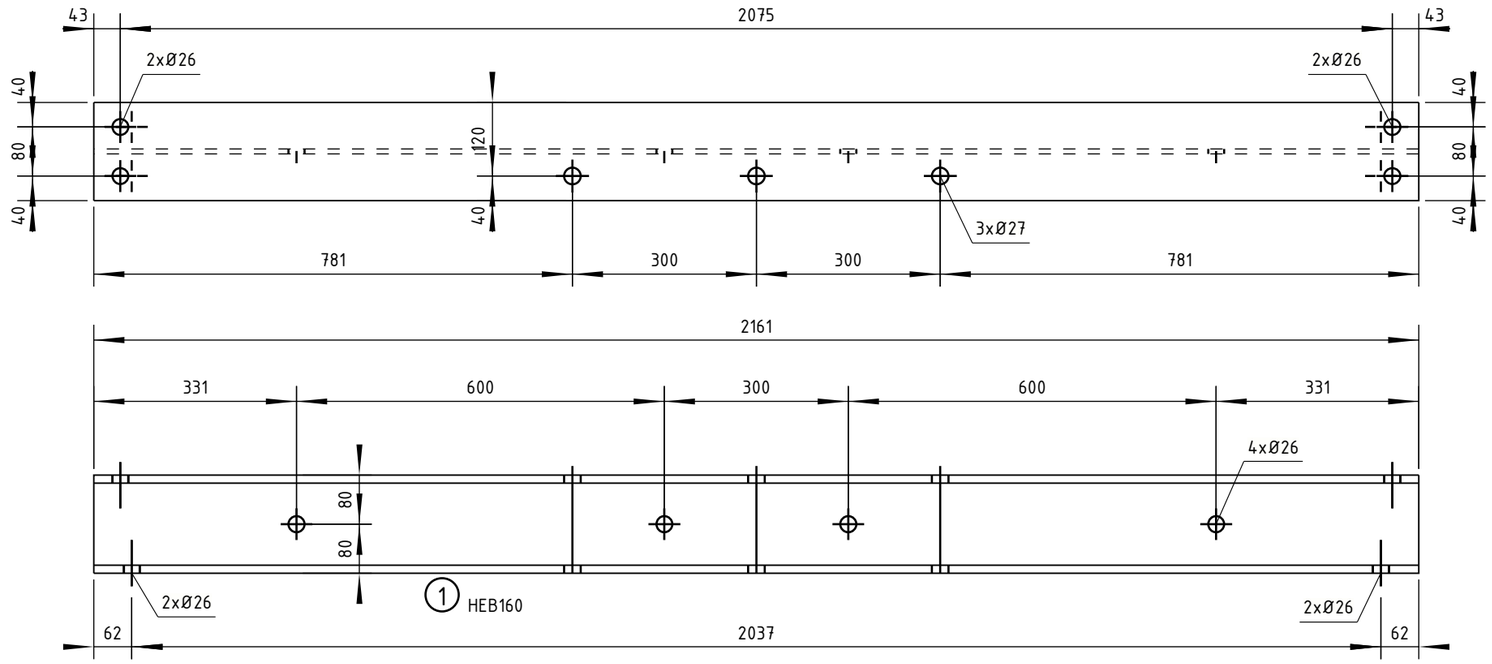
Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype S-6_R, Mast 28- Onderdeeltekeningen**

	Naam	Functie	Handtekening	Datum
Opgesteld	Rogier Hol	Tekenaar		10-03-2022
Validatie Aafjes	Niels Verhaar	System Engineer		10-03-2022
Vrijgegeven	Bart Aafjes	Projectleider		10-03-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	10-03-2022	1e versie ter review



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Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [1]
Documentnummer:	

TenneT Taking power further

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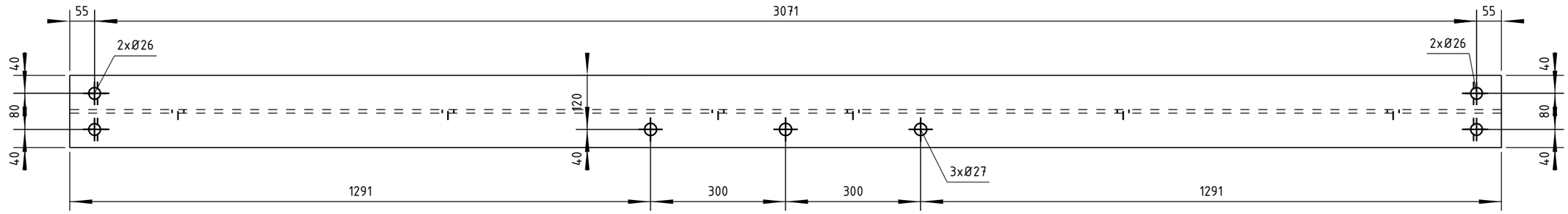

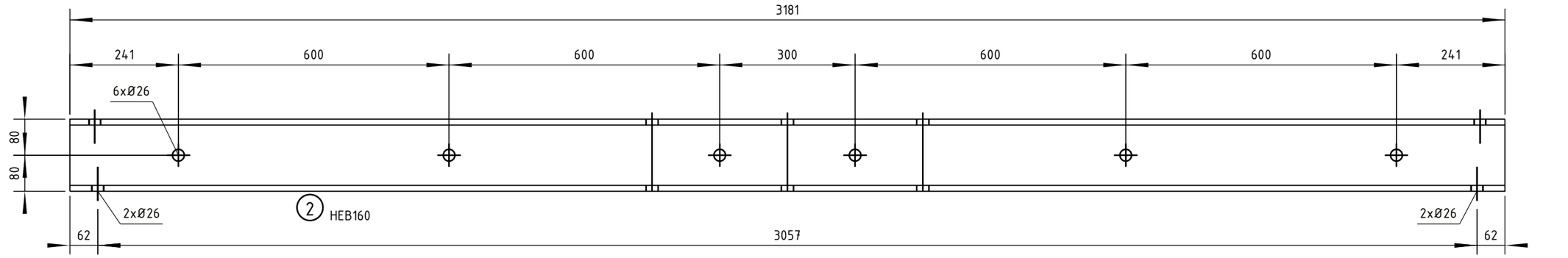

② HEB160

2	HEB160	2	S355J0	3181	2.93
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [2]
TenneT Taking power further	Documentnummer:	

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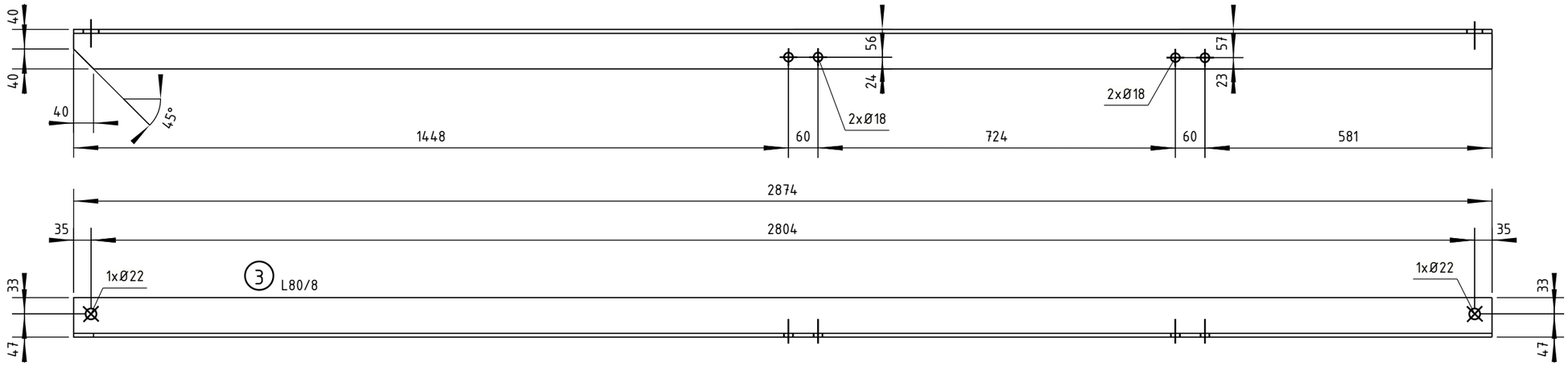

Pos	Profile	Number	Grade	Length	Area (m^2)
3	L80/8	1	S355J0	2874	0.92

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380
TenneT Taking power further	Omschrijving:	Te vervangen staal - onderdeel [3]
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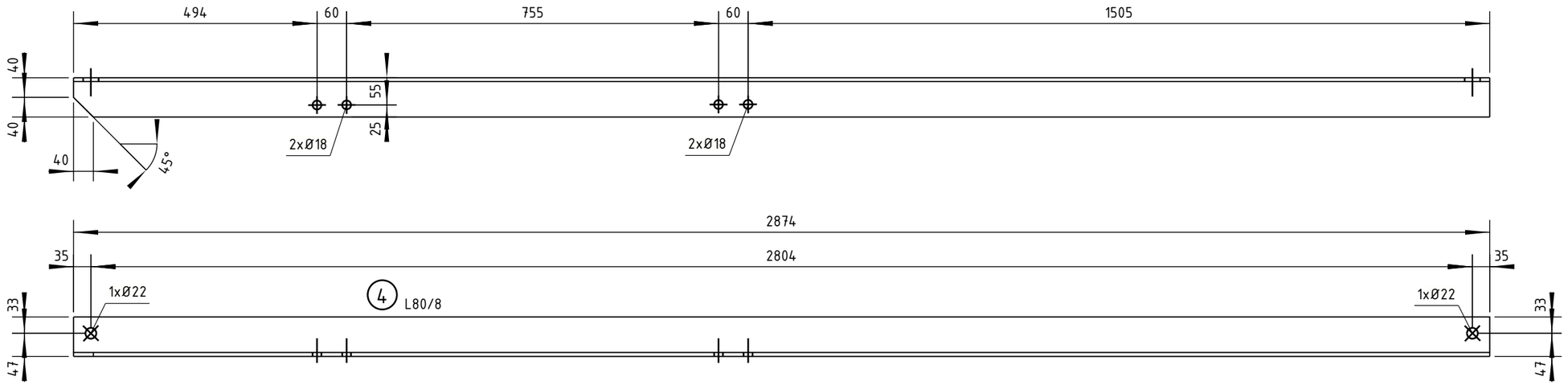


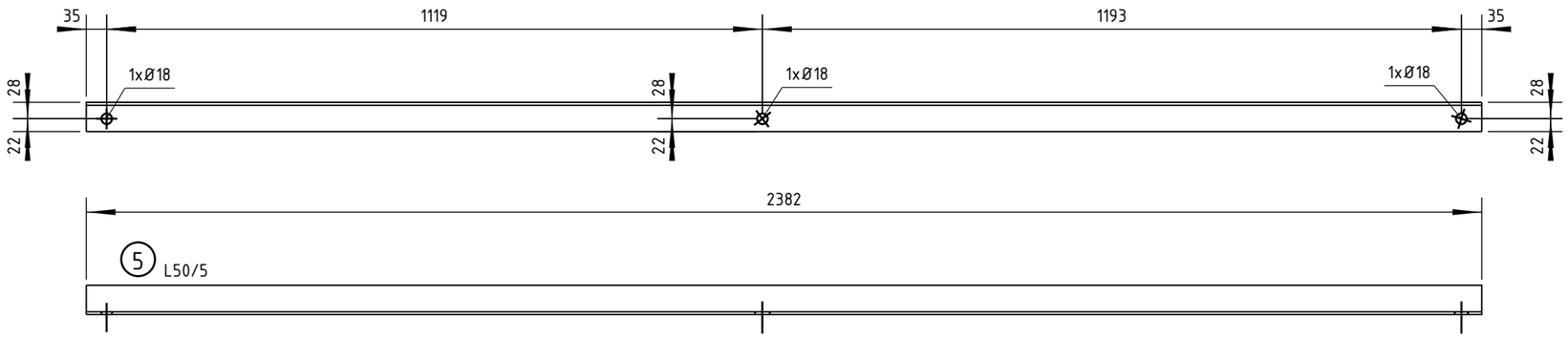
Pos	Profile	Number	Grade	Length	Area (m^2)
4	L80/8	1	S355J0	2874	0.92

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Oud tekeningnummer:	
Omschrijving:	Te vervangen staal - onderdeel [4]
Documentnummer:	

TenneT Taking power further

Tekla Structures



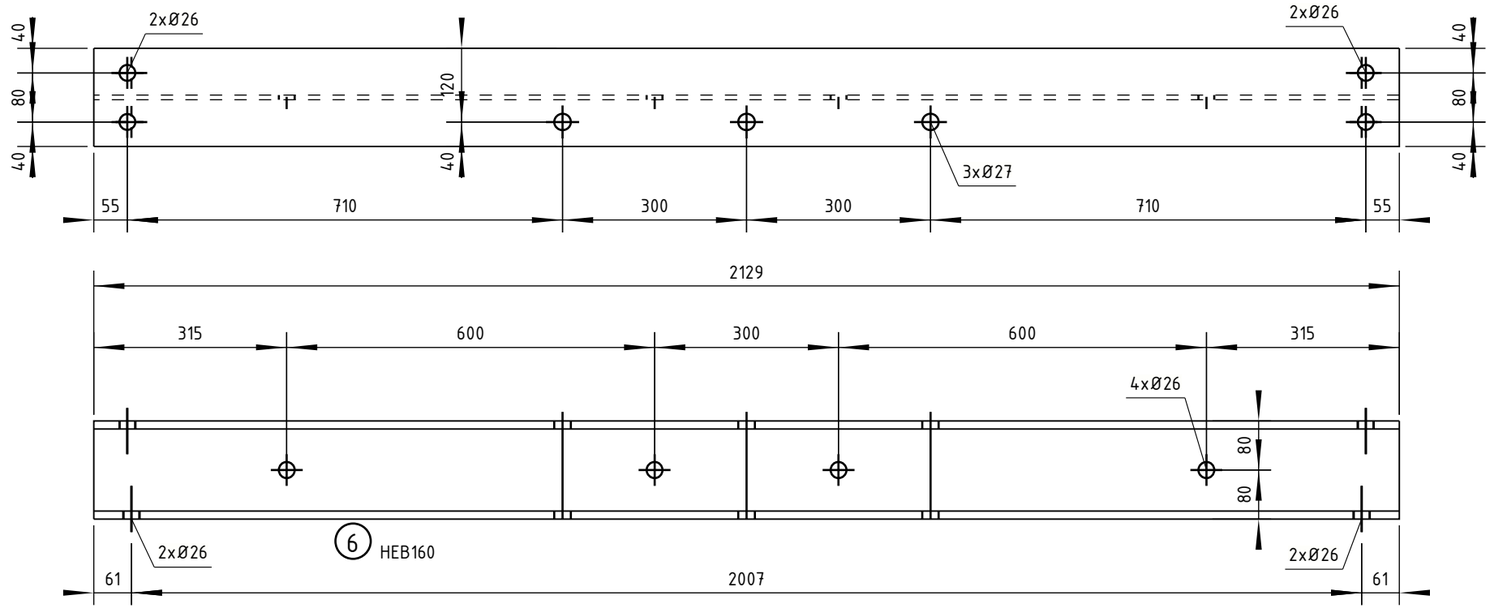
Pos	Profile	Number	Grade	Length	Area (m^2)
5	L50/5	4	S355J0	2382	0.48

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Oud tekeningnummer:	
Omschrijving:	Te vervangen staal - onderdeel [5]
Documentnummer:	

TenneT Taking power further

Tekla Structures



6	HEB160	2	S355J0	2129	1.96
Pos	Profile	Number	Grade	Length	Area (m²)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [6]
TenneT Taking power further	Documentnummer:	

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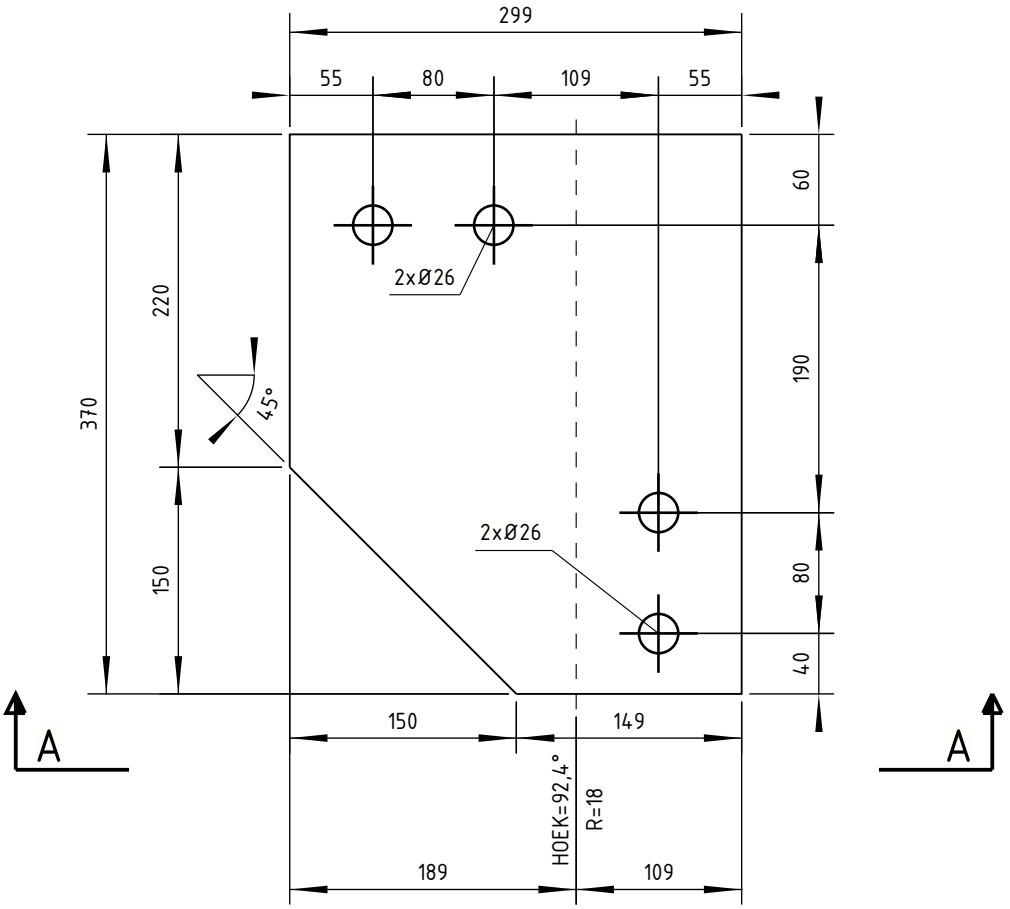

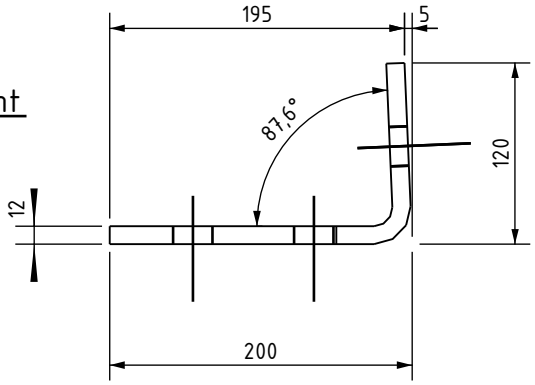

Hot bent

A – A

1:5

Pos	Profile	Number	Grade	Length	Area (m^2)
7	PL12*299	2	S355J0	370	0.21

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
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TenneT Taking power further

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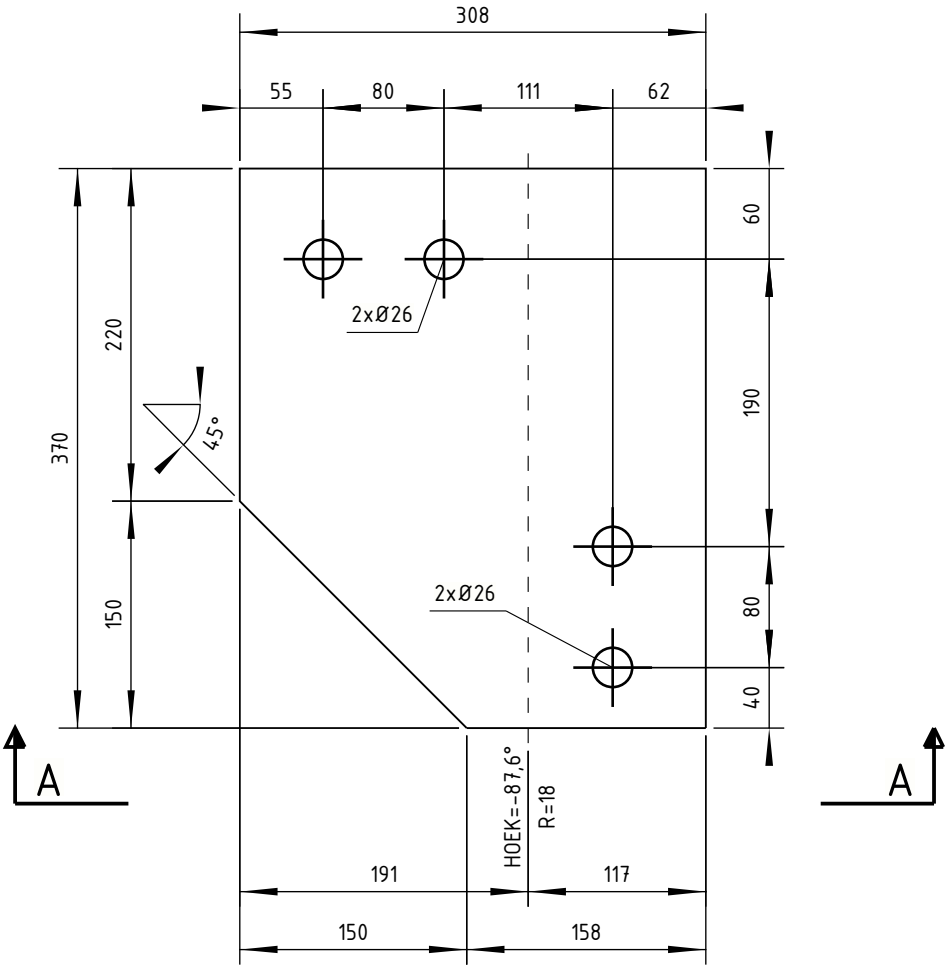

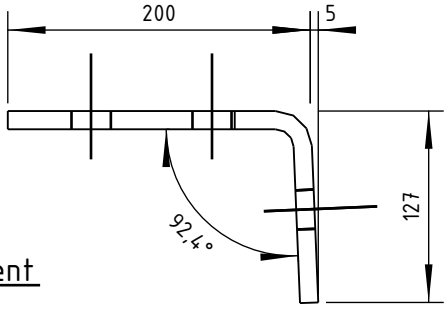

Hot bent

A – A
1:5

Pos	Profile	Number	Grade	Length	Area (m^2)
8	PL12*308.1	2	S355J0	370	0.22

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
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Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [8]
	Documentnummer:	

TenneT Taking power further

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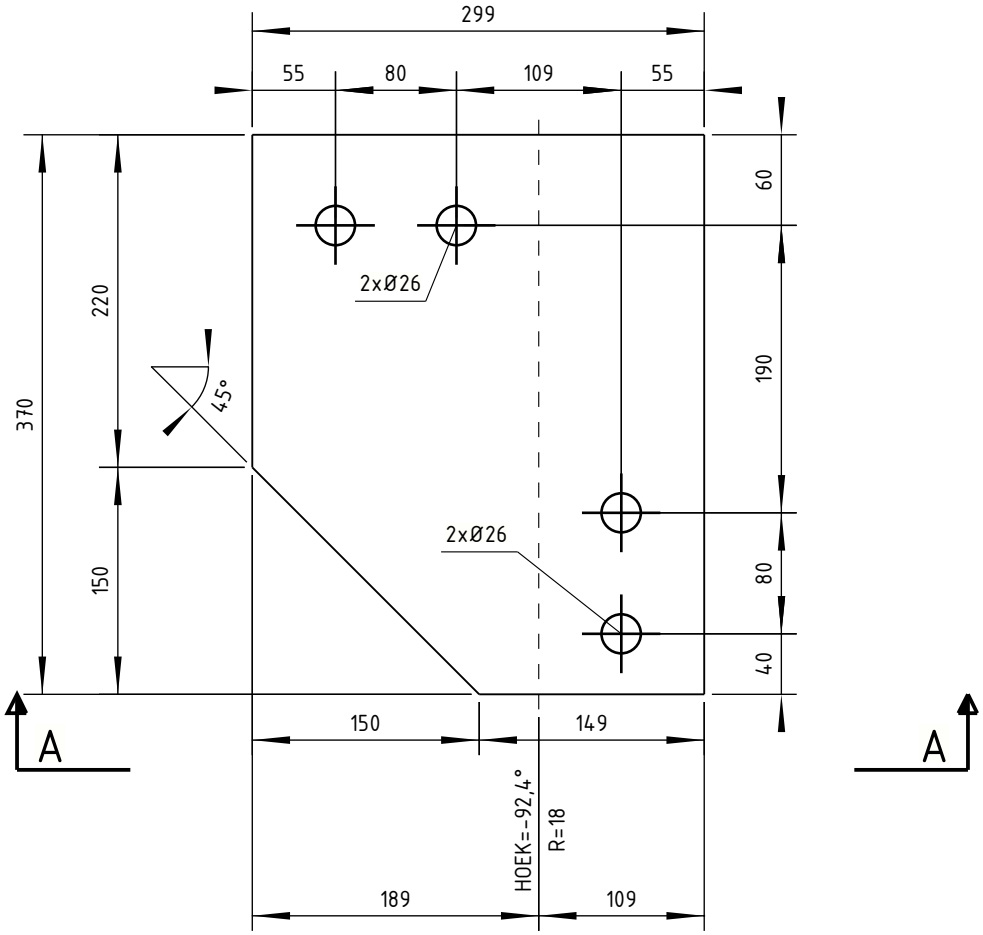
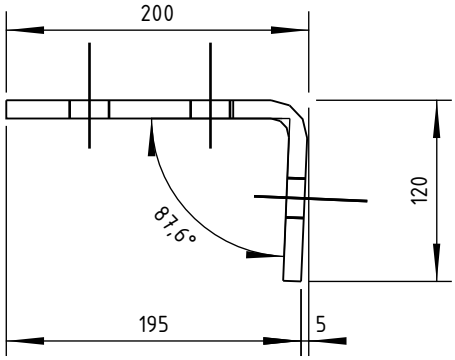




Hot bent

A - A
1:5

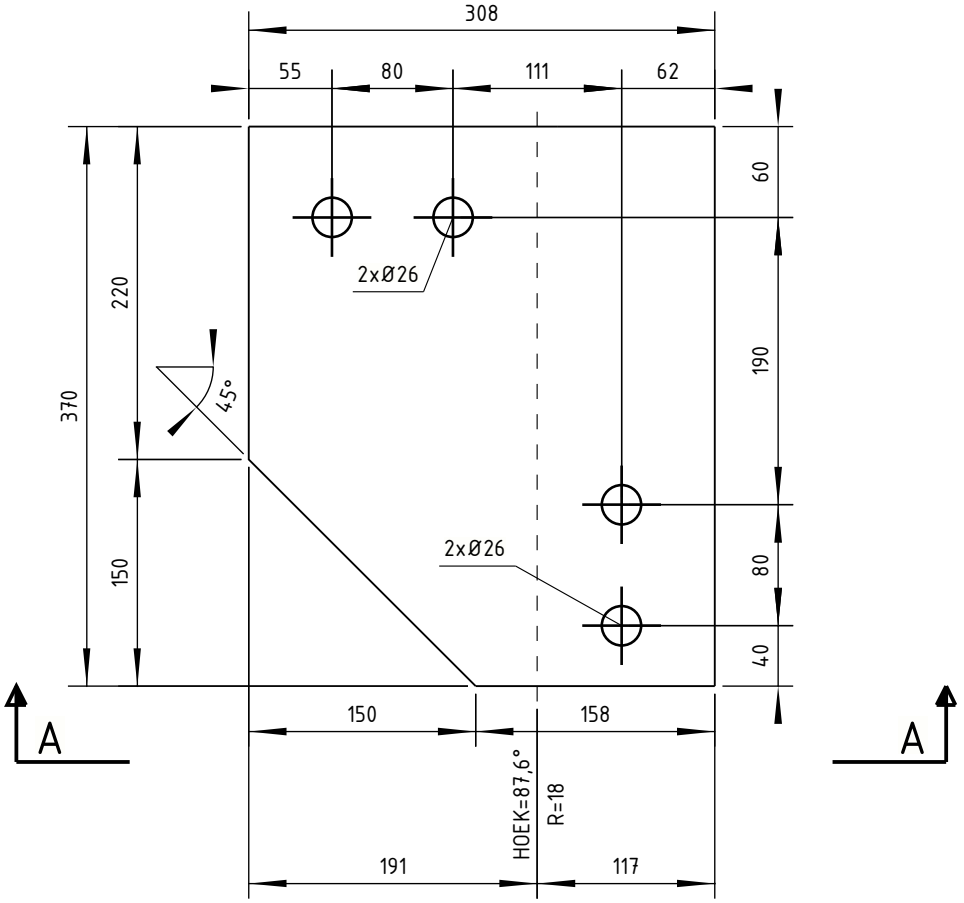
Pos	Profile	Number	Grade	Length	Area (m^2)
9	PL12*299	2	S355J0	370	0.21

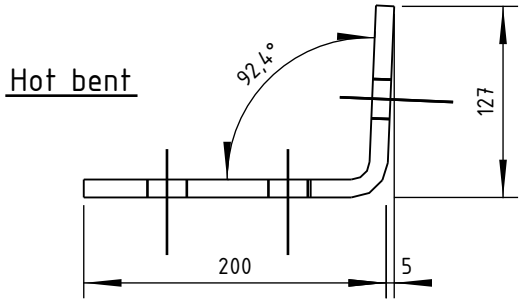
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [9]
Documentnummer:	

TenneT Taking power further

Tekla Structures





A – A
1:5

10	PL12*308.1	2	S355J0	370	0.22
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
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Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [10]
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TenneT Taking power further

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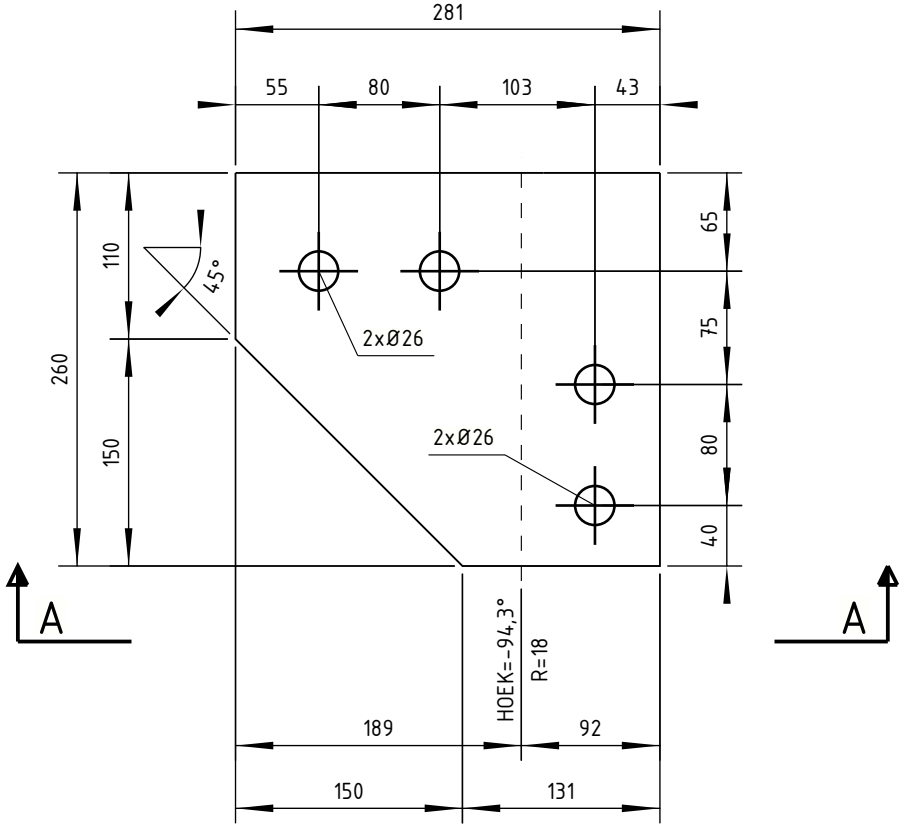

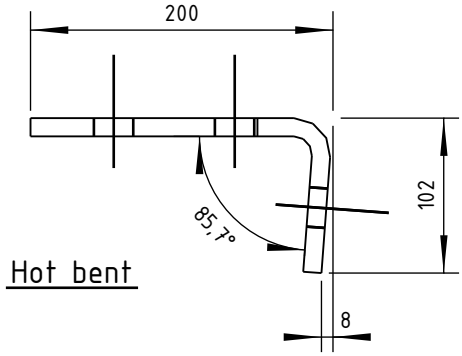

Hot bent

A – A
1:5

Pos	Profile	Number	Grade	Length	Area (m^2)
11	PL12*260	2	S355J0	281	0.14

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
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Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [11]
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TenneT Taking power further

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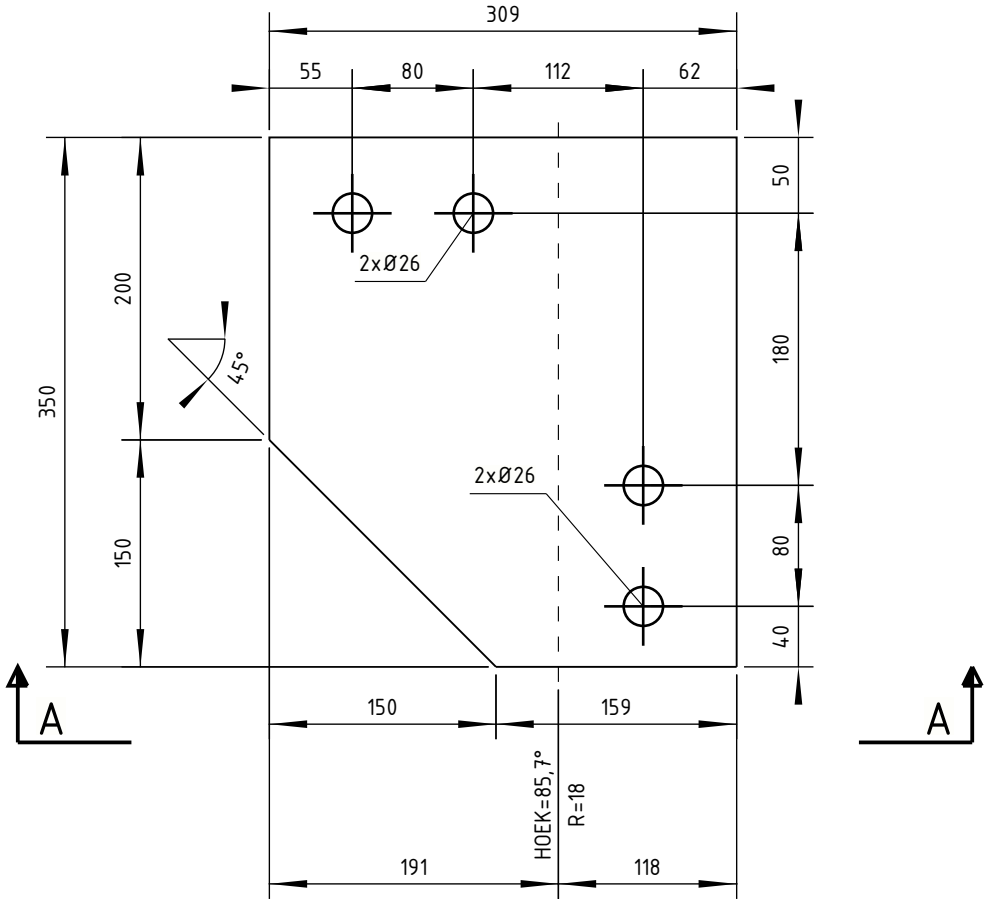
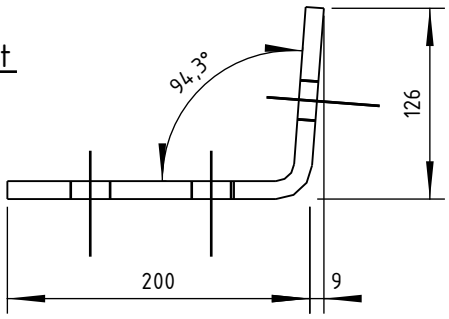


Hot bent



A – A
1:5

12	STRIP12*350	2	S355J0	309	0.21
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
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TenneT Taking power further

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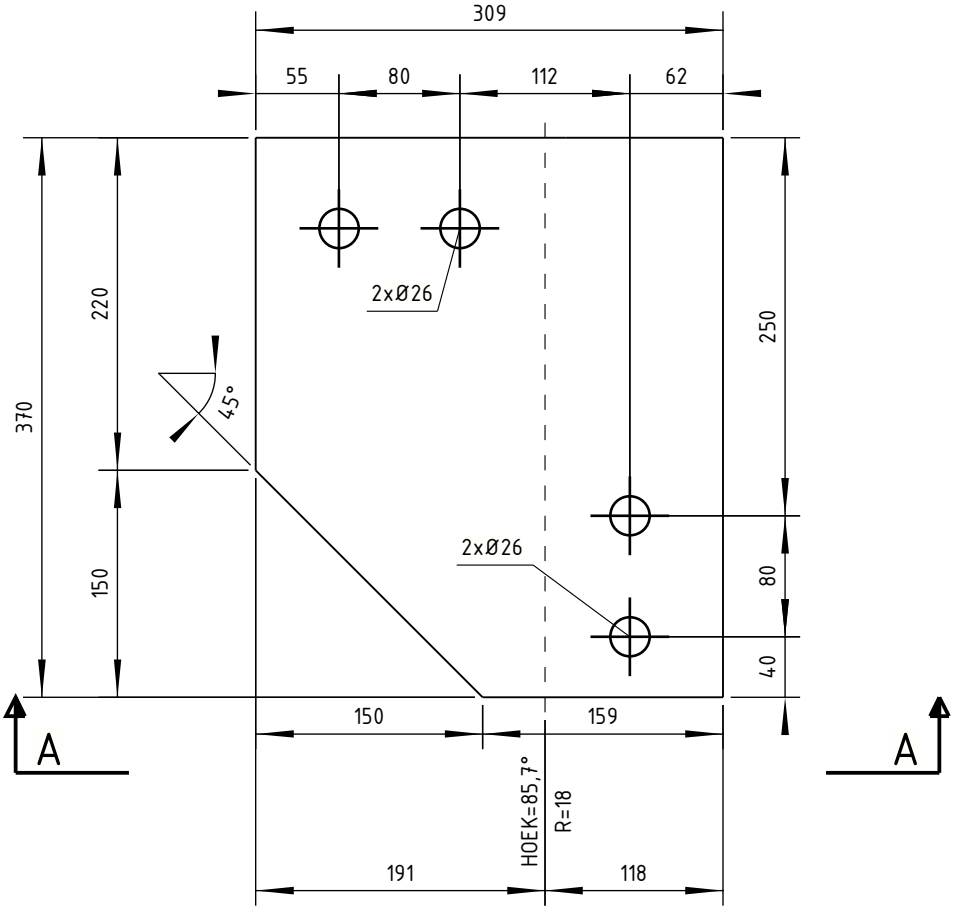

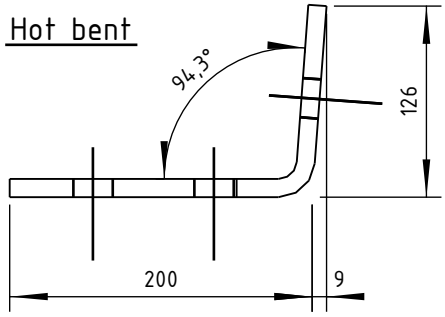

A – A
1:5

13	PL12*309	2	S355J0	370	0.22
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
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TenneT Taking power further

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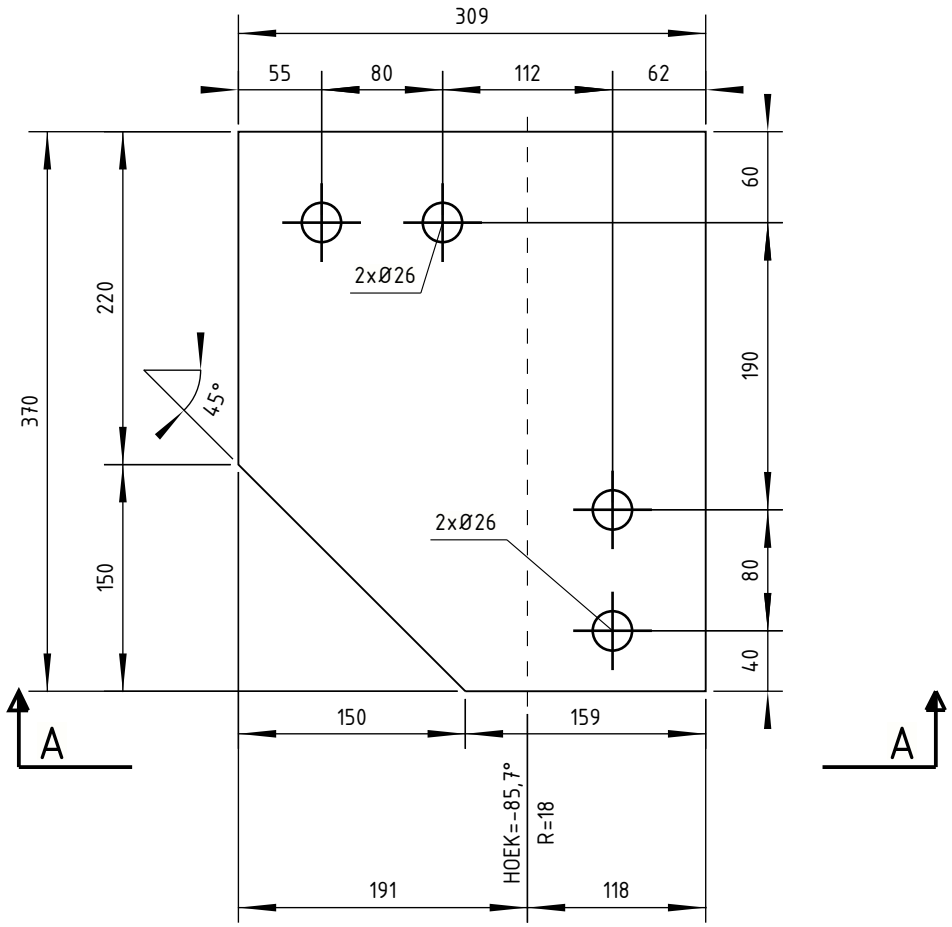
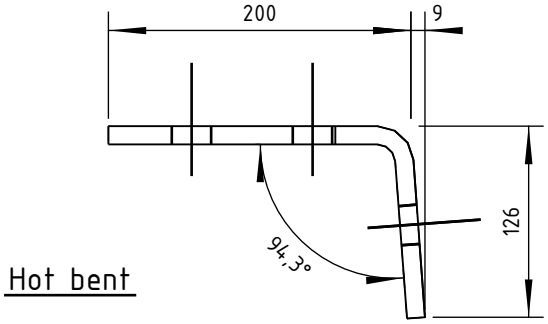




Hot bent

A - A
1:5

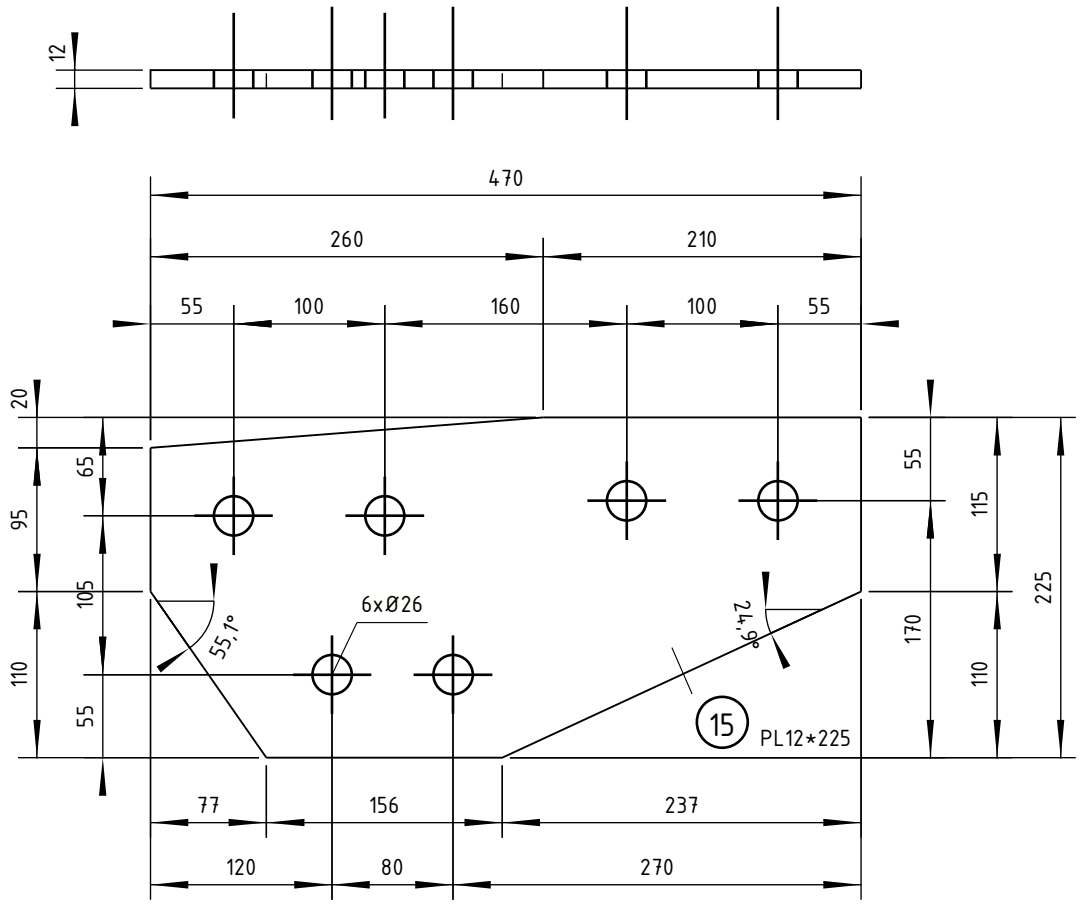
Pos	Profile	Number	Grade	Length	Area (m^2)
14	PL12*309	2	S355J0	370	0.22

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	**Datum revisie**	**Omschrijving revisie**	**Getekend**	**Datum As-Built**	**Schaal**	**Formaat**
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [14]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



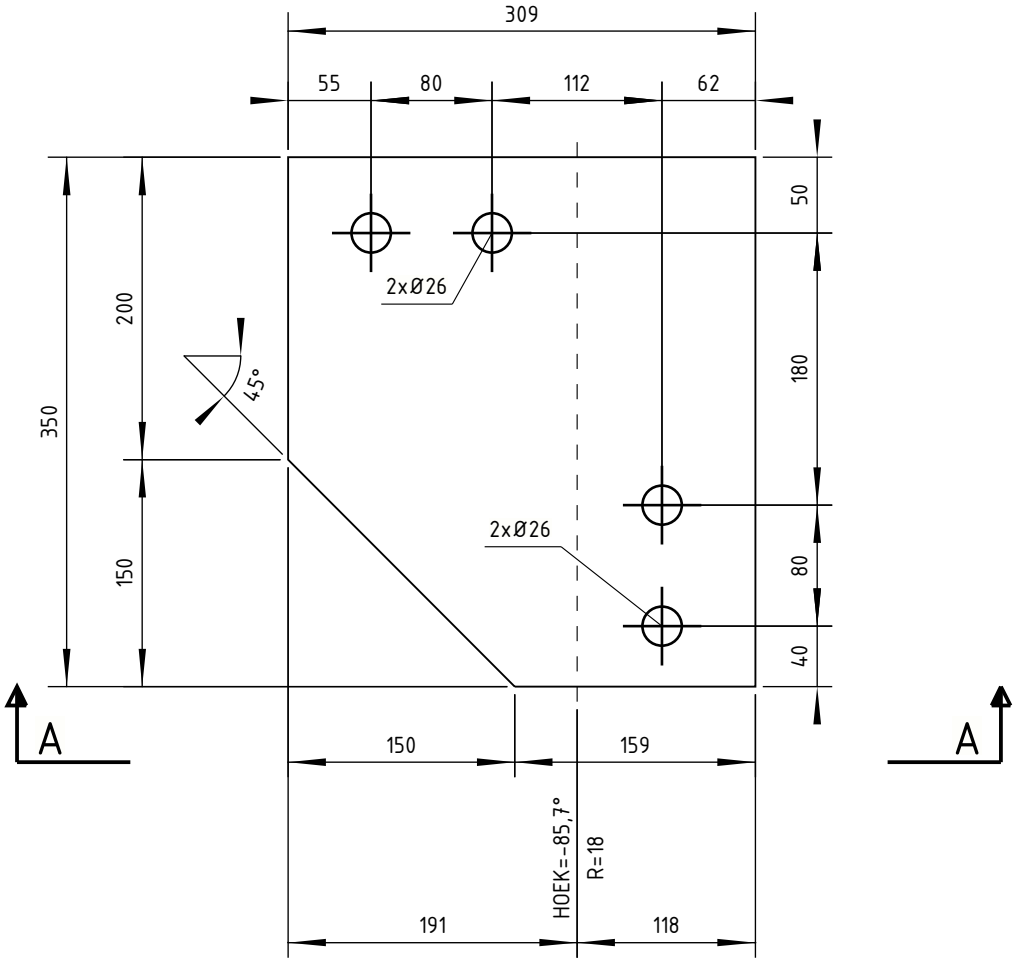
15	PL12*225	4	S355J0	470	0.19
Pos	Profile	Number	Grade	Length	Area (m^2)

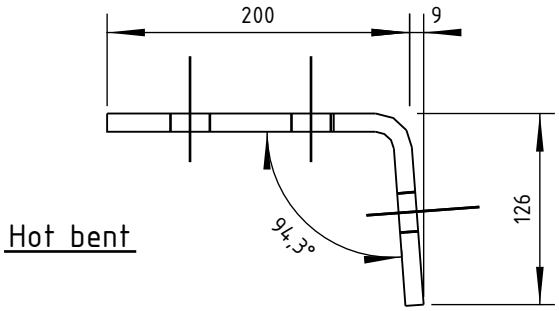
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [15]
	Documentnummer:	

TenneT Taking power further

Tekla Structures





Hot bent

A - A
1:5

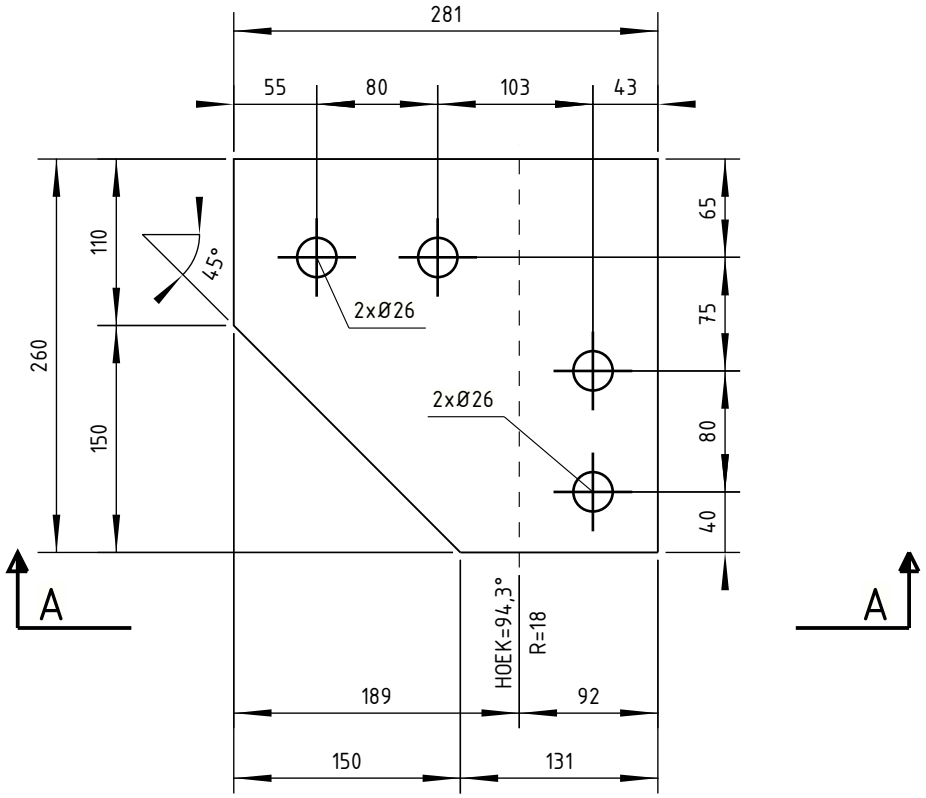
Pos	Profile	Number	Grade	Length	Area (m^2)
16	STRIP12*350	2	S355J0	309	0.21

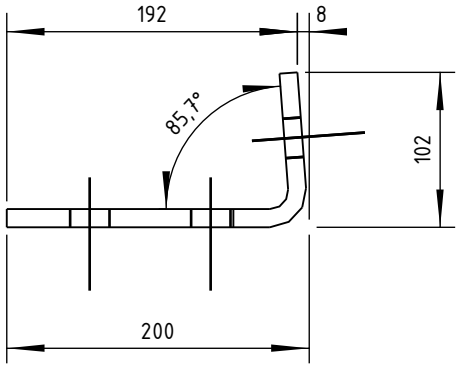
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [16]
Documentnummer:	

TenneT Taking power further

Tekla Structures





Hot bent

A – A
1:5

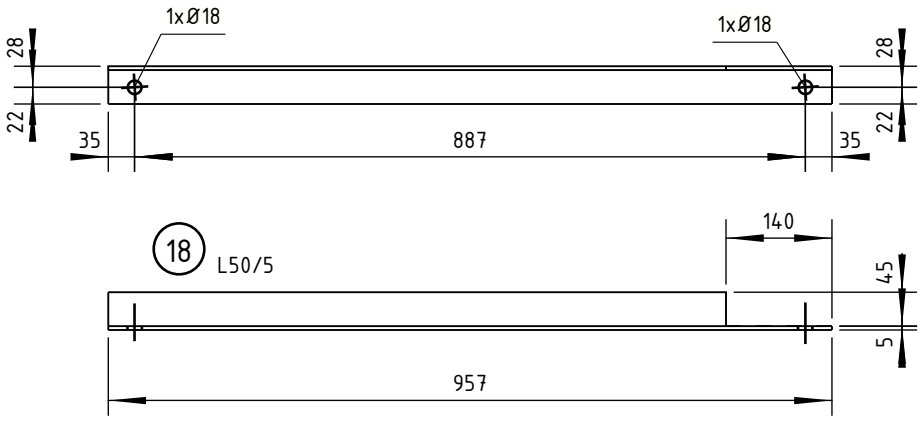
Pos	Profile	Number	Grade	Length	Area (m^2)
17	PL12*260	2	S355J0	281	0.14

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [17]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



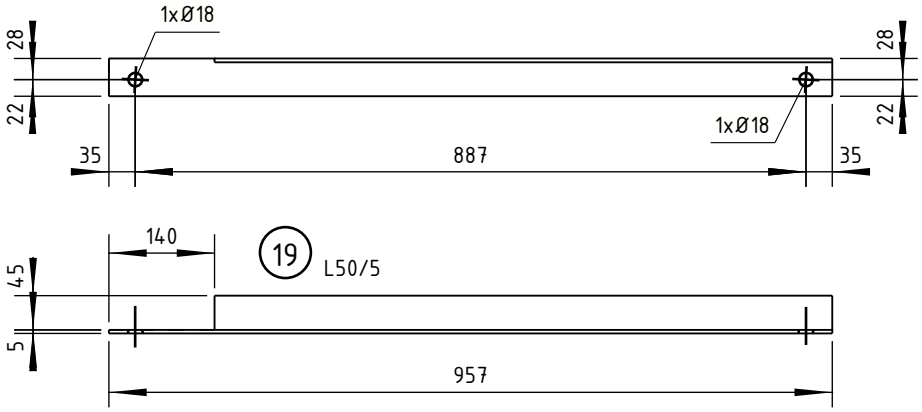
18	L50/5	2	S355J0	957	0.19
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [18]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



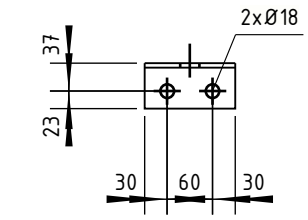
19	L50/5	2	S355J0	957	0.19
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

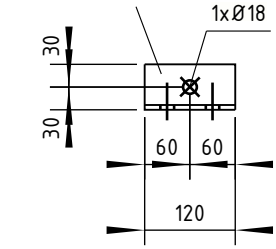
Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [19]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



20 L60/6



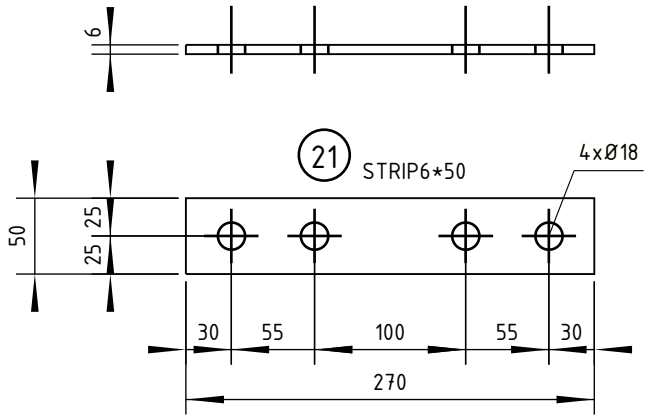
Pos	Profile	Number	Grade	Length	Area (m^2)
20	L60/6	4	S355J0	120	0.03

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [20]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



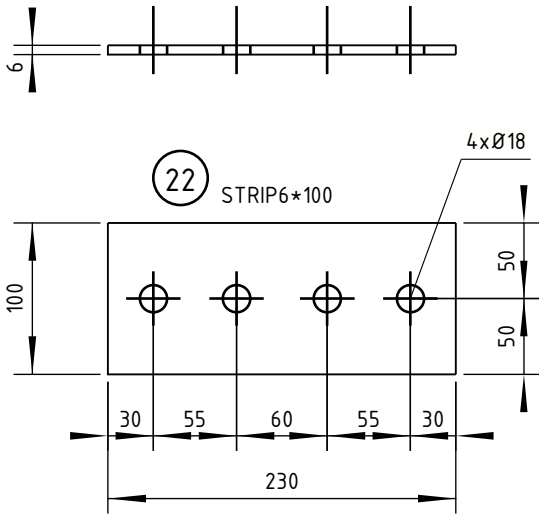
Pos	Profile	Number	Grade	Length	Area (m^2)
21	STRIP6*50	2	S355J0	270	0.03

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [21]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



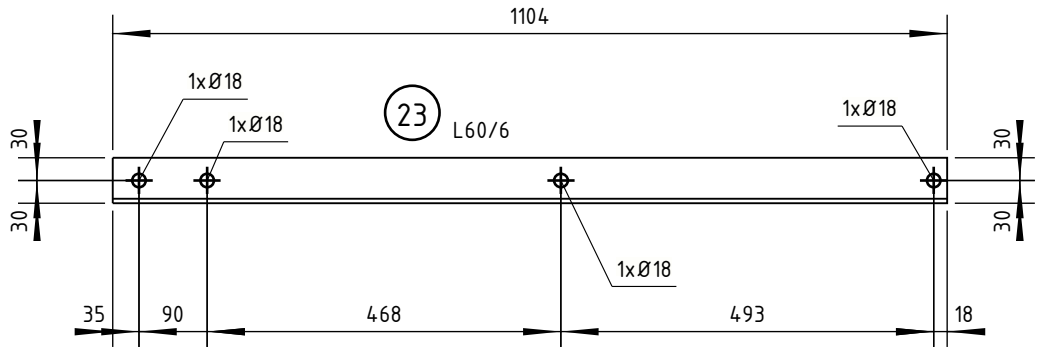
22	STRIP6*100	2	S355J0	230	0.05
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [22]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



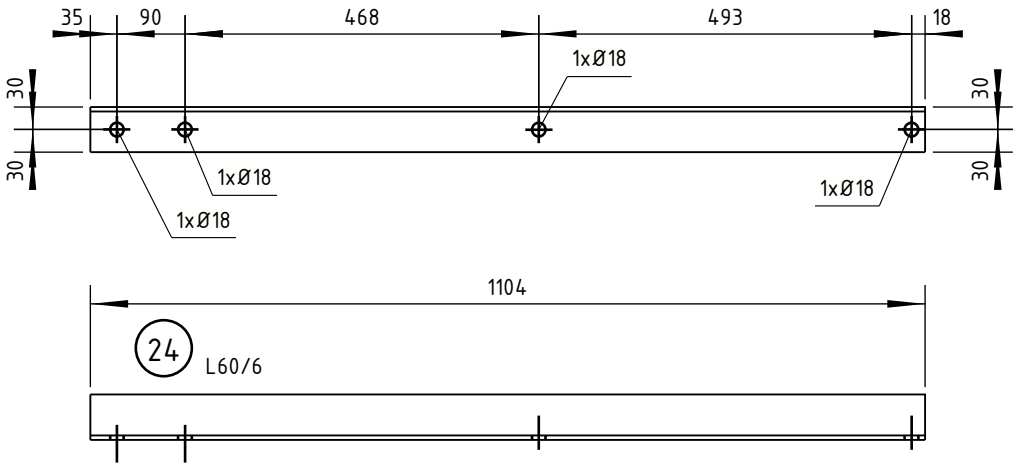
23	L60/6	2	S355J0	1104	0.26
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [23]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



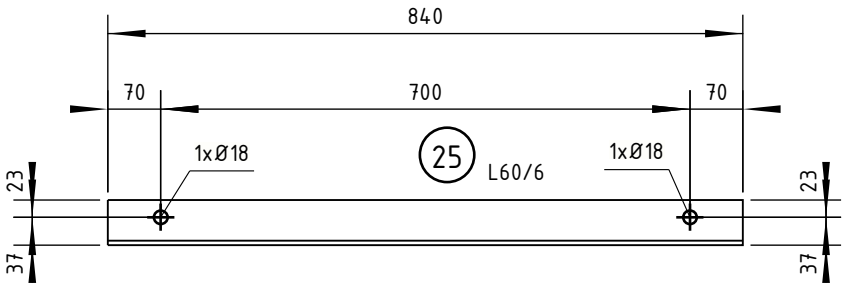
Pos	Profile	Number	Grade	Length	Area (m^2)
24	L60/6	2	S355J0	1104	0.26

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [24]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



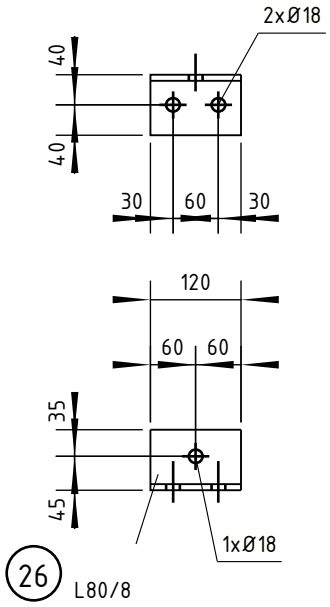
Pos	Profile	Number	Grade	Length	Area (m^2)
25	L60/6	2	S355J0	840	0.20

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [25]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



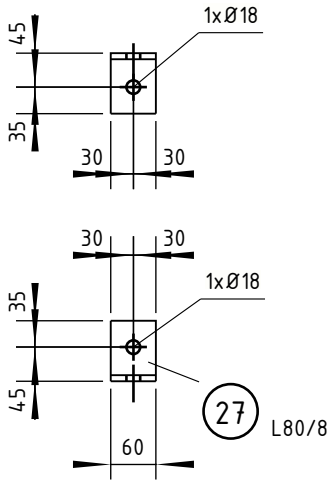
Pos	Profile	Number	Grade	Length	Area (m^2)
26	L80/8	8	S355J0	120	0.04

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [26]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



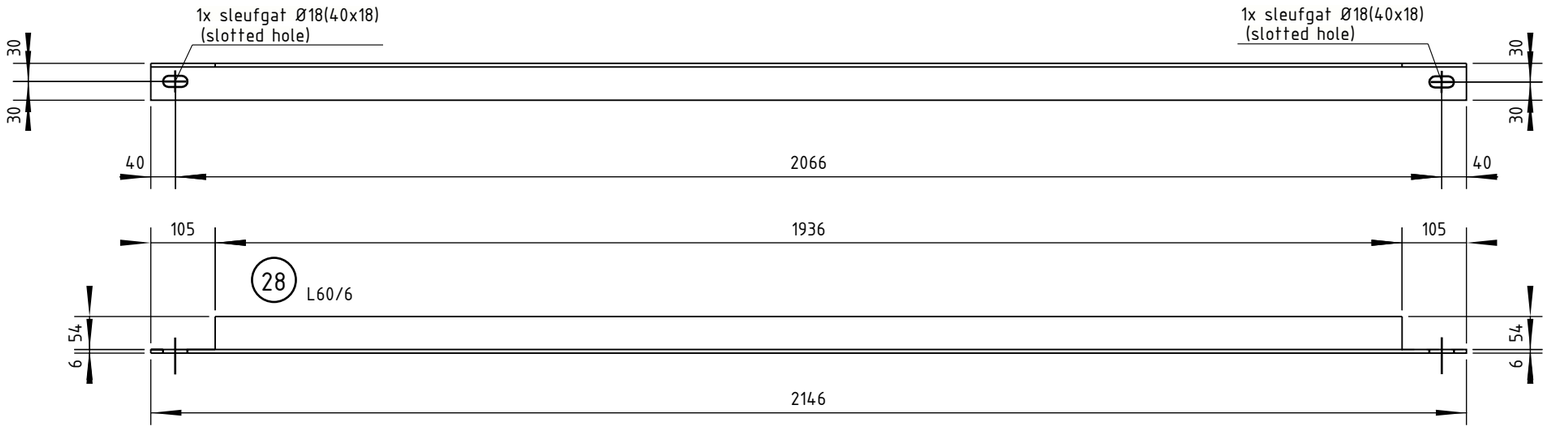
27	L80/8	4	S355J0	60	0.02
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [27]
	Documentnummer:	

TenneT Taking power further

Tekla Structures

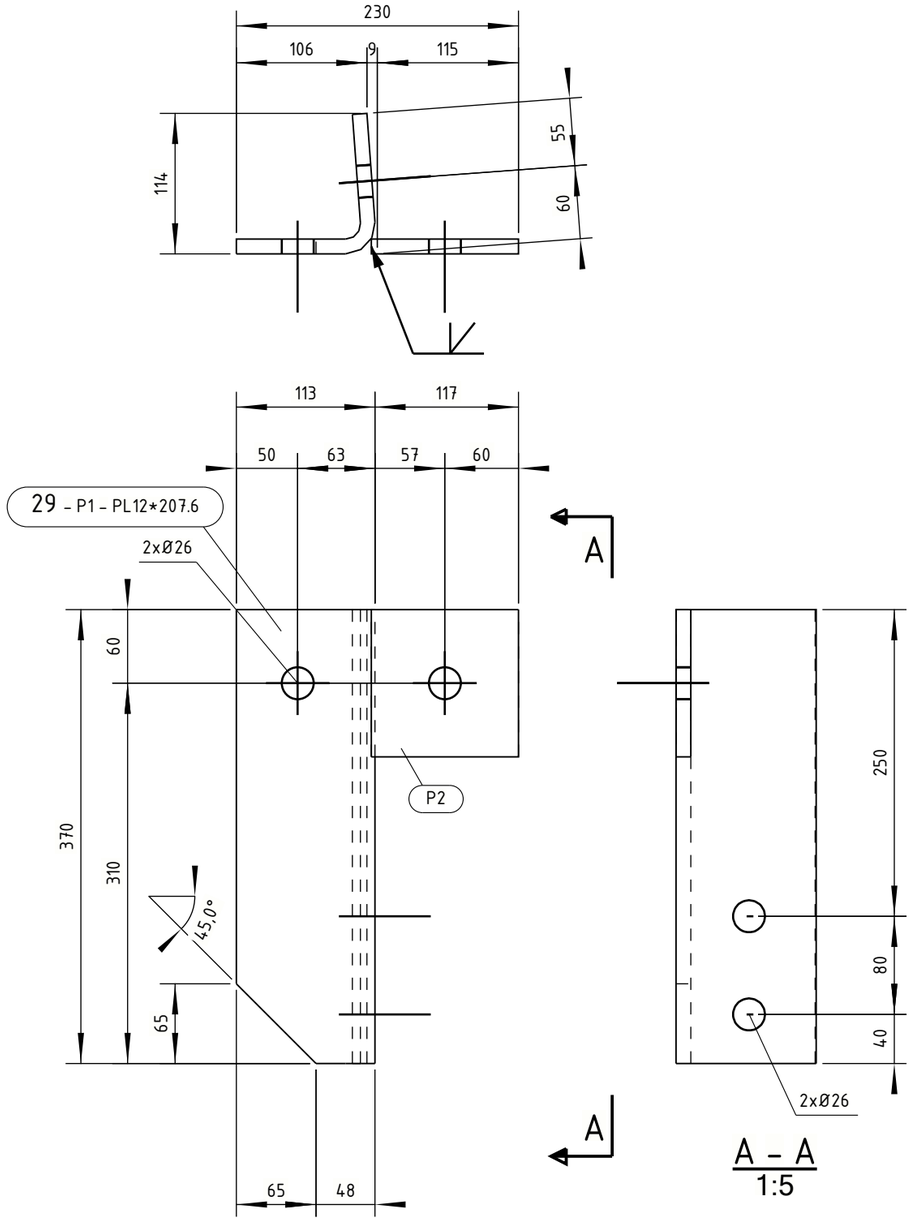


28	L60/6	4	S355J0	2146	0.52
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380
	Omschrijving:	Nieuw staal - onderdeel [28]
	Documentnummer:	

Tekla Structures



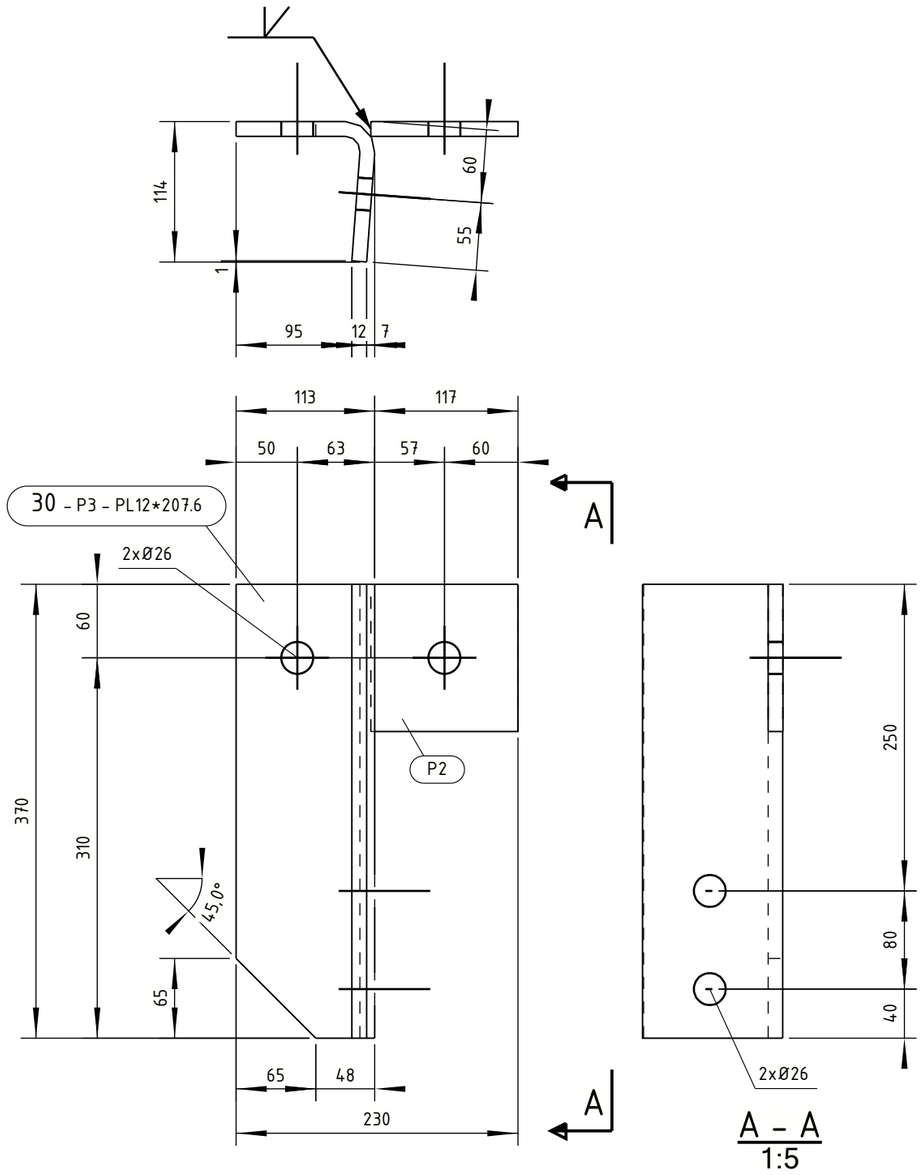
ASSEMBLY						
Mark: 29			length (mm): 230		Number: 2	
Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P1	PL12*207.6	S355J0	1	370	7.1	0.16
P2	STRIP12*120	S355J0	1	120	1.4	0.03
				Total of one mark	8.5	0.20

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [29]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



ASSEMBLY

Mark: 30 length (mm): 230 Number: 2

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P2	STRIP12*120	S355J0	1	120	1.4	0.03
P3	PL12*207.6	S355J0	1	370	7.1	0.16
				Total of one mark	8.5	0.20

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5 / A3

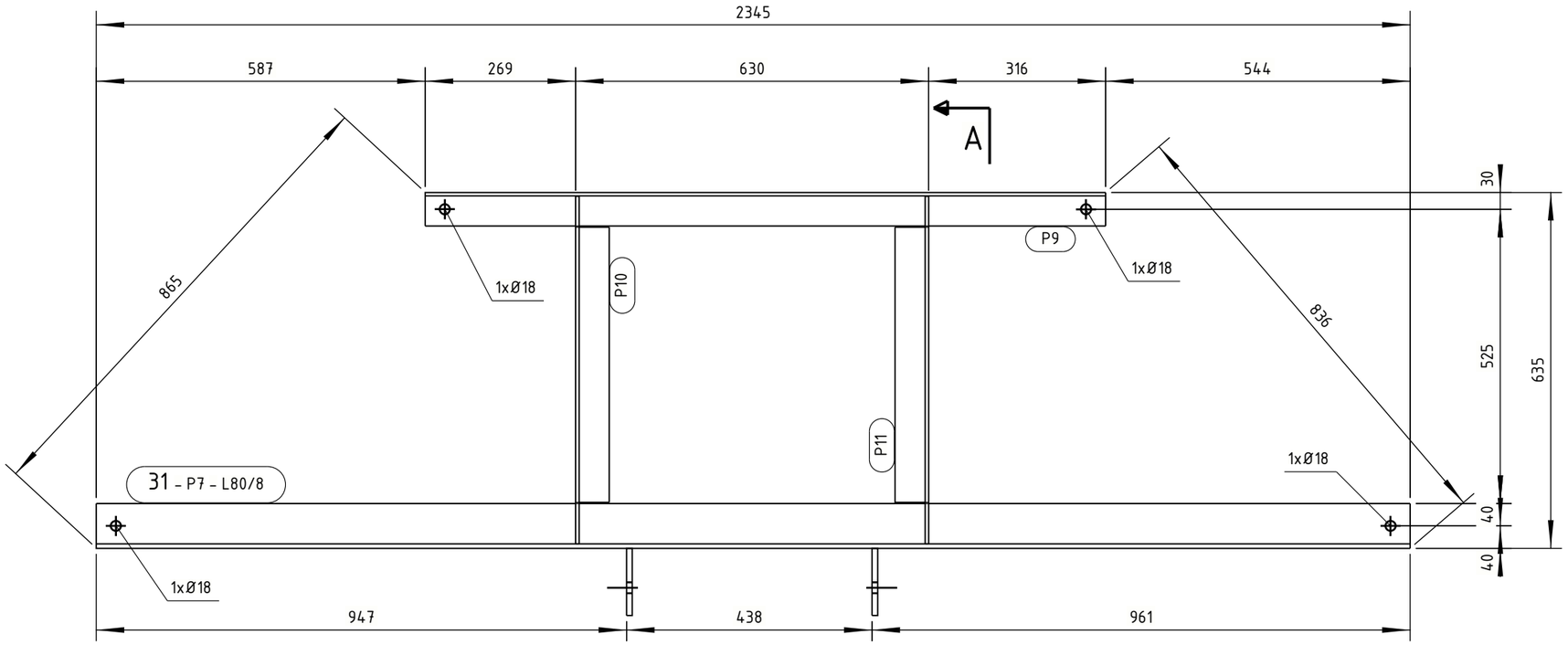
Relatie

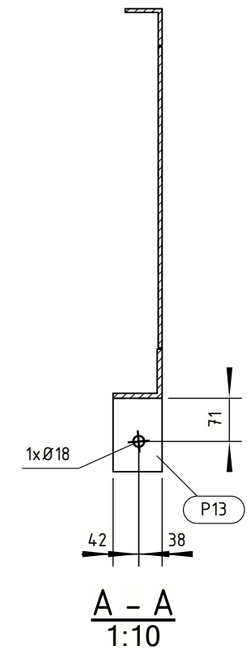
Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [30]
Documentnummer:	

TenneT Taking power further

Tekla Structures





A - A
1:10

A

Welds a=4, all round

ASSEMBLY
Mark: 31 length (mm): 2345 Number: 1

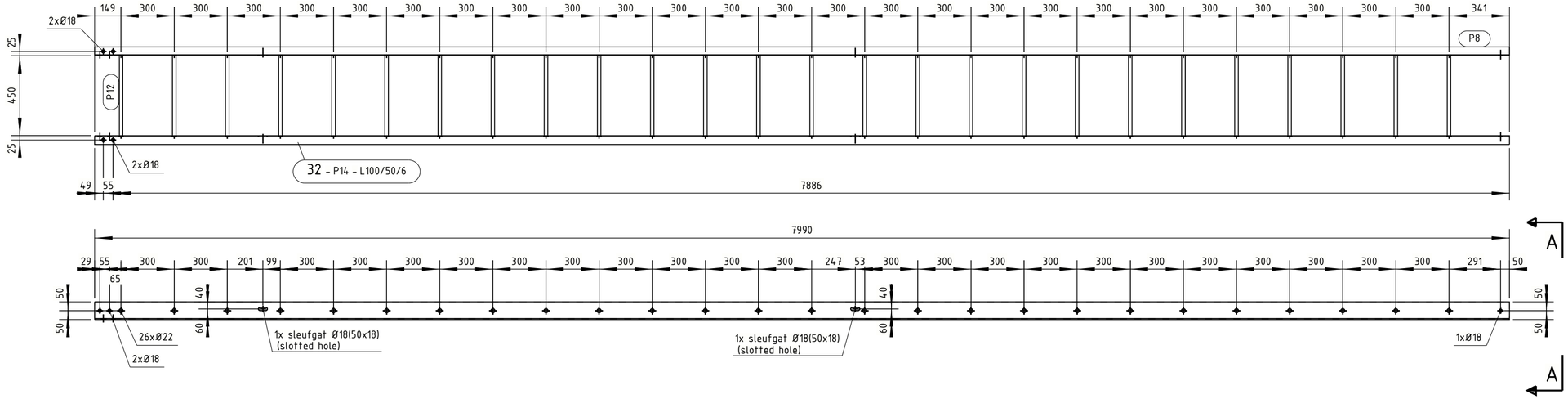
Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P7	L80/8	S355J0	1	2345	23.0	0.75
P9	L60/6	S355J0	1	1215	6.7	0.29
P10	L60/6	S355J0	1	620	3.4	0.15
P11	L60/6	S355J0	1	620	3.4	0.15
P13	STRIP10*80	S355J0	2	120	1.5	0.05
				Total of one mark	38.1	1.39

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [31]
	Documentnummer:	

tennet Taking power further

Tekla Structures



Welds a=4, all round

ASSEMBLY

Mark: 32 length (mm): 7990 Number: 1

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P8	L100/50/6	S355J0	1	7990	55.2	2.40
P12	D20	S355J2	26	456	26.8	0.74
P14	L100/50/6	S355J0	1	7990	55.2	2.40
				Total of one mark	137.3	5.53

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:20	594x420

Relatie

Oud tekeningnummer:

Thema: Verbinding

Categorie: Algemeen

Documentcode: Constructietekening

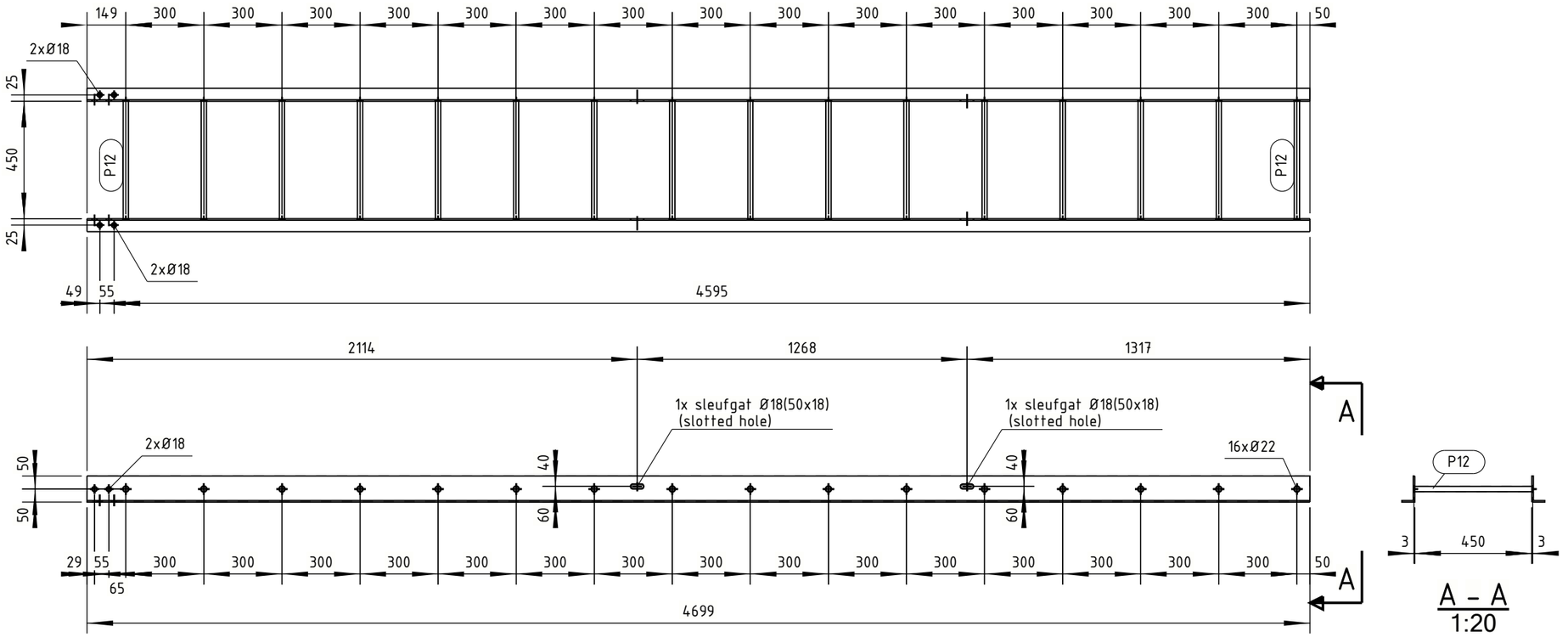
Object ID: ENS-ZL380

Omschrijving: Nieuw staal - onderdeel [32]

Documentnummer:

TenneT Taking power further

Tekla Structures



A – A
1:20

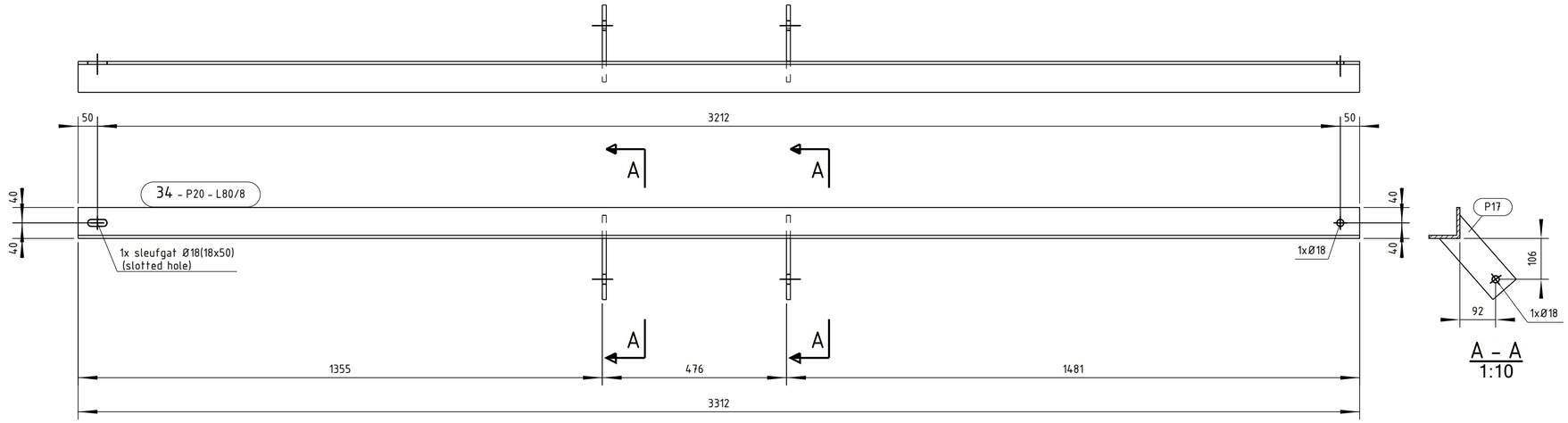
Welds a=4, all round

ASSEMBLY						
Mark: 33			length (mm): 4699		Number: 1	
Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P12	D20	S355J2	16	456	16.5	0.46
P15	L100/50/6	S355J0	1	4699	32.5	1.41
P16	L100/50/6	S355J0	1	4699	32.5	1.41
				Total of one mark	81.5	3.28

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens – Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:20	A3

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380
TenneT Taking power further	Omschrijving:	Nieuw staal – onderdeel [33]
	Documentnummer:	

Tekla Structures



A - A
1:10

ASSEMBLY
Mark: 34 length (mm): 3312 Number: 1

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P17	STRIP10*80	S355J0	2	220	2.5	0.08
P20	L80/8	S355J0	1	3312	32.5	1.06
				Total of one mark	35.0	1.13

Naam				Tekeningstatus
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built / Schaal / Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.	1:10 / 594x420

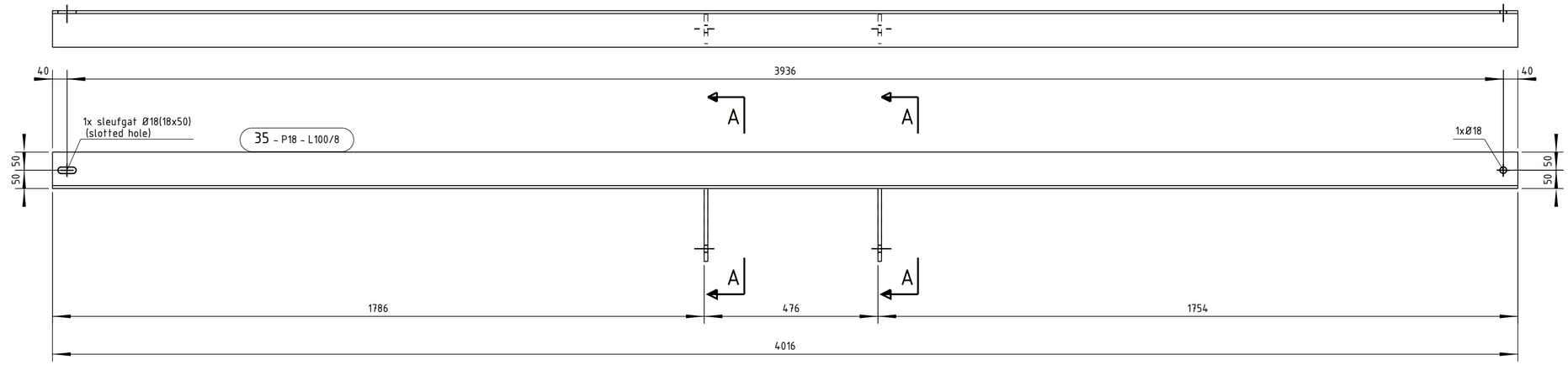
Relatie

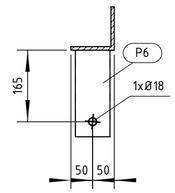
Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [34]
Documentnummer:	

TenneT Taking power further

Tekla Structures





A - A
1:10

Welds a=4, all round

ASSEMBLY
Mark: 35 length (mm): 4016 Number: 1

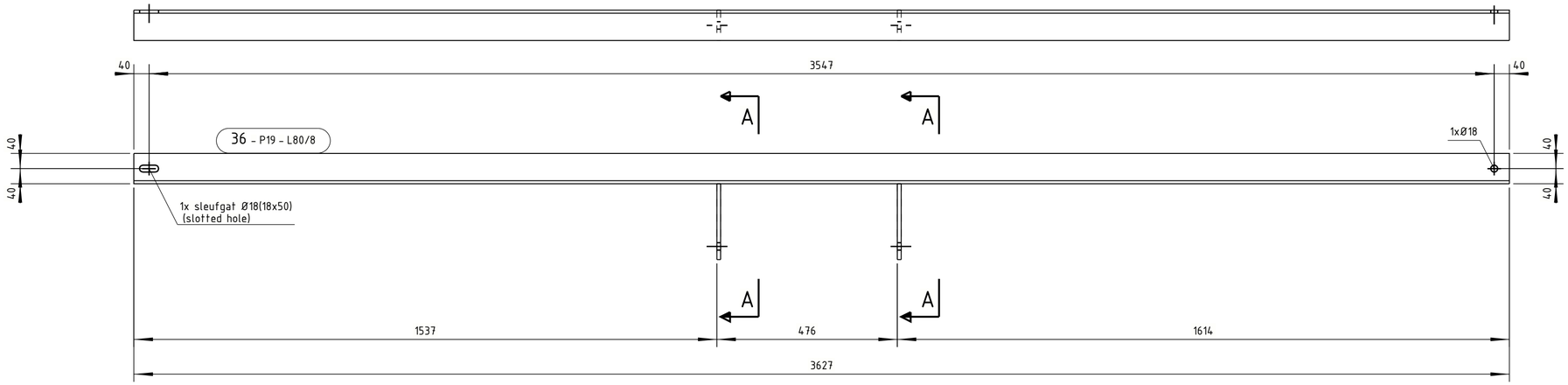
Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P6	STRIP10*80	S355J0	2	200	2.6	0.08
P18	L100/8	S355J0	1	4016	49.8	1.61
				Total of one mark	52.4	1.68

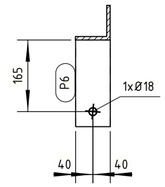
Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie	
Oud tekeningnummer:	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [35]
Documentnummer:	

TenneT Taking power further

Tekla Structures





A - A
1:10

Welds a=4, all round

ASSEMBLY
Mark: 36 length (mm): 3627 Number: 1

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P6	STRIP10*80	S355J0	2	200	2.6	0.08
P19	L80/8	S355J0	1	3627	35.6	1.16
				Total of one mark	38.1	1.24

Naam				Tekeningstatus
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built / Schaal / Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.	1:10 / 594x420

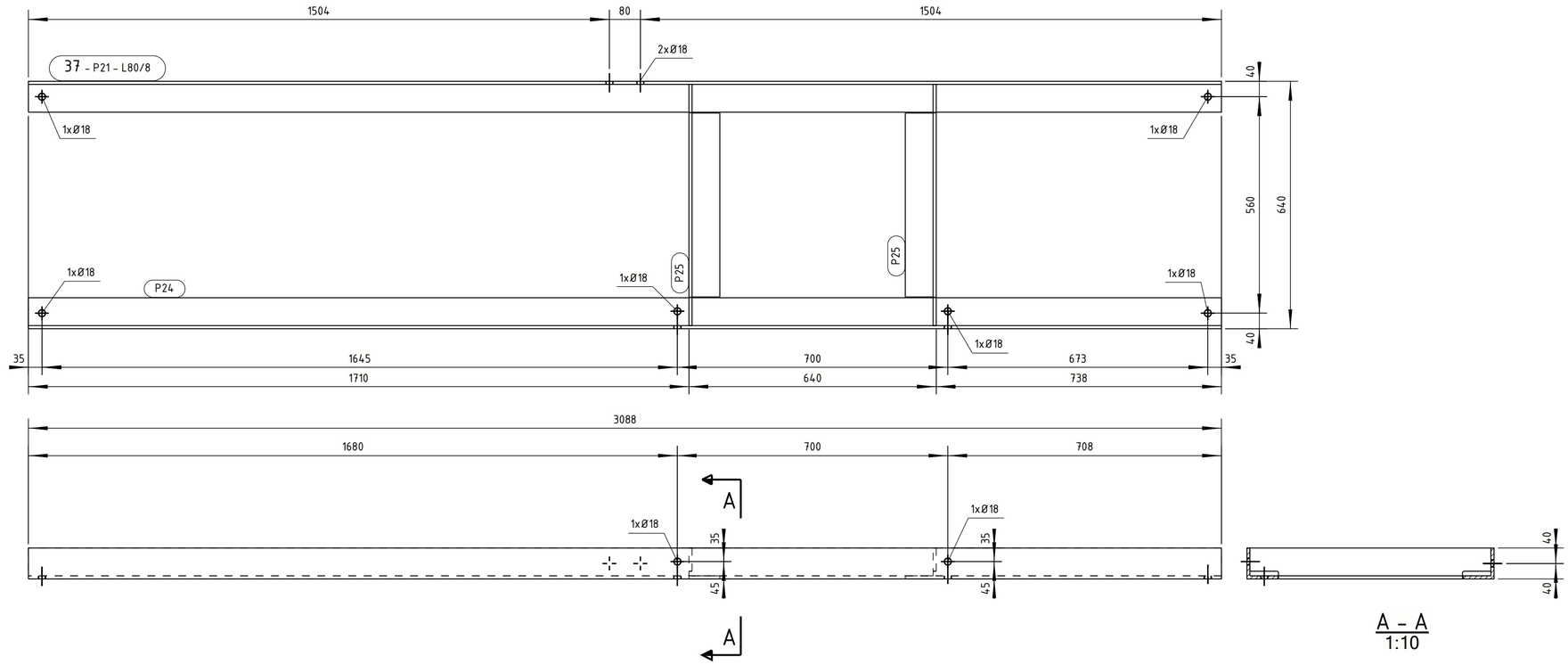
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [36]
Documentnummer:	

TenneT Taking power further

Tekla Structures



A - A
1:10

Welds a=4, all round

ASSEMBLY
Mark: 37 length (mm): 3088 Number: 1

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P21	L80/8	S355J0	1	3088	30.3	0.99
P24	L80/8	S355J0	1	3088	30.3	0.99
P25	L80/8	S355J0	2	624	12.2	0.40
				Total of one mark	72.8	2.38

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle
Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

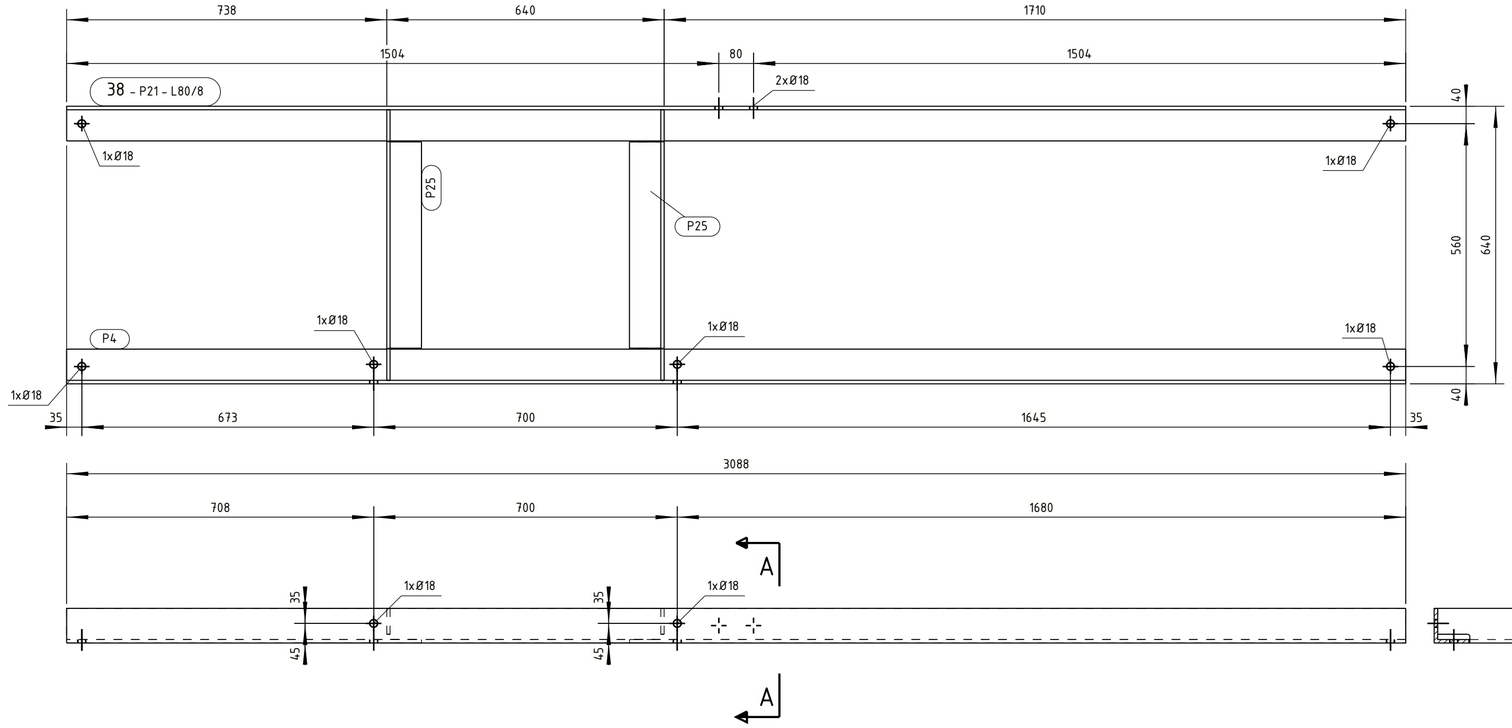
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [37]
Documentnummer:	

TenneT Taking power further

Tekla Structures



A - A
1:10

Welds a=4, all round

ASSEMBLY
Mark: 38 length (mm): 3088 Number: 1

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P4	L80/8	S355J0	1	3088	30.3	0.99
P21	L80/8	S355J0	1	3088	30.3	0.99
P25	L80/8	S355J0	2	624	12.2	0.40
				Total of one mark	72.8	2.38

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle
Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

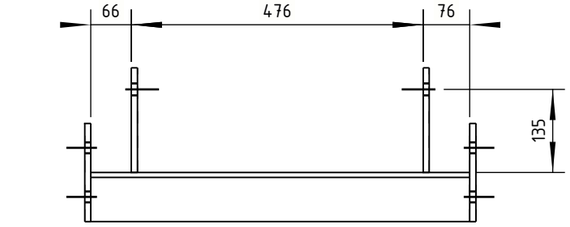
Relatie

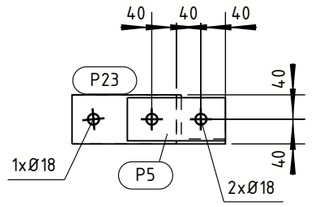
Oud tekeningnummer:

TenneT Taking power further

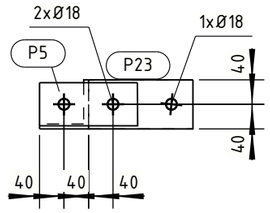
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [38]
Documentnummer:	

Tekla Structures





A - A
1:10



B - B
1:10

Welds a=4, all round

ASSEMBLY
Mark: 39 length (mm): 638 Number: 1

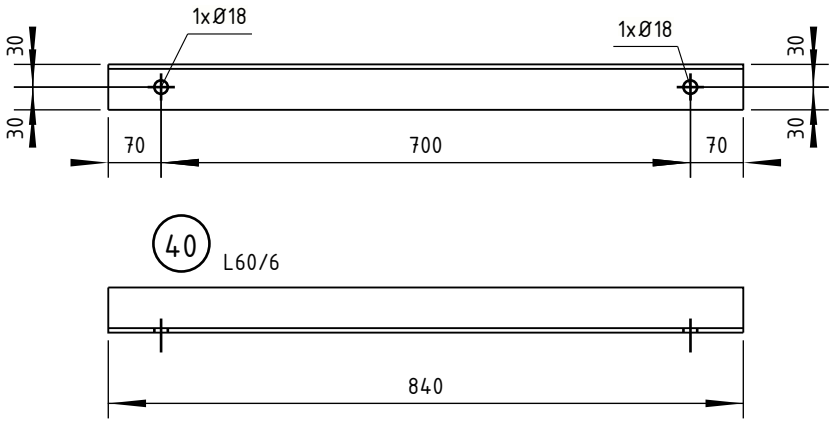
Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P5	STRIP10*70	S355J0	2	160	1.8	0.05
P22	L80/8	S355J0	1	618	6.1	0.20
P23	STRIP10*80	S355J0	2	170	2.2	0.06
				Total of one mark	10.0	0.32

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [39]
Documentnummer:	

TenneT Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m^2)
40	L60/6	2	S355J0	840	0.20

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

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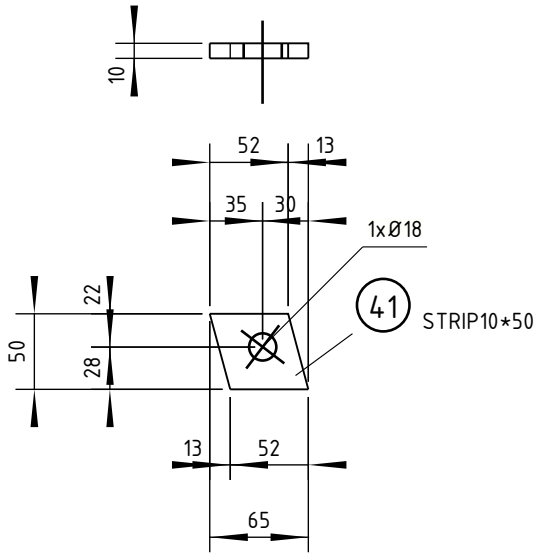
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [40]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



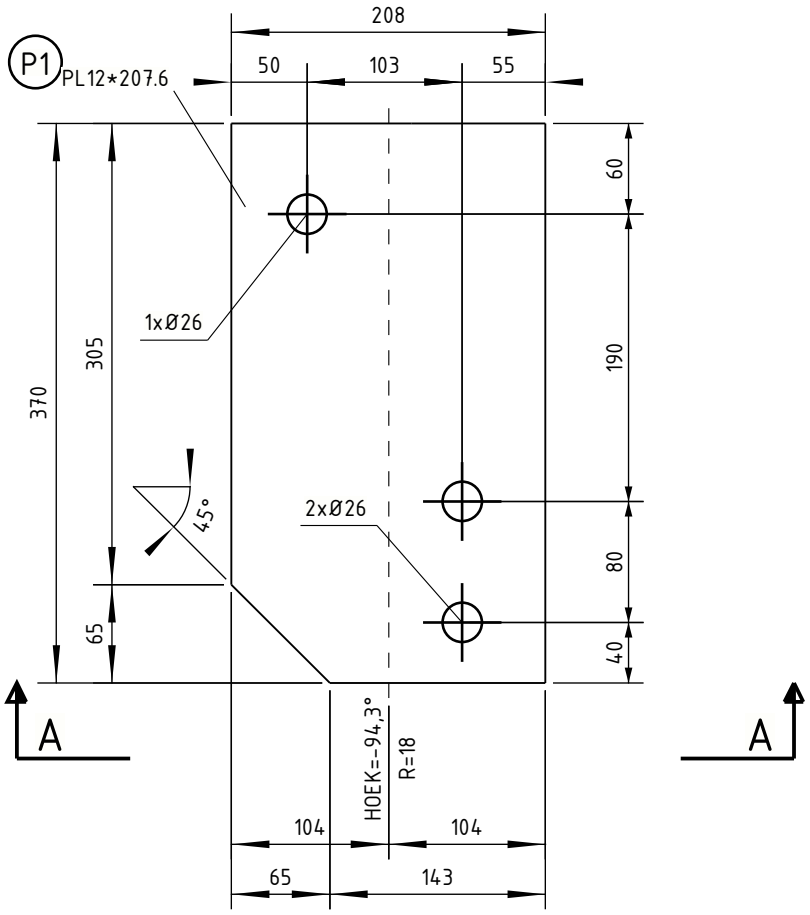
Pos	Profile	Number	Grade	Length	Area (m^2)
41	STRIP10*50	2	S355J0	65	0.01

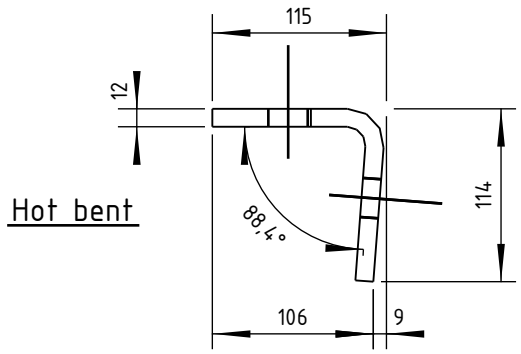
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [41]
	Documentnummer:	

TenneT Taking power further

Tekla Structures





Hot bent

Doorsnede A - A
1:5

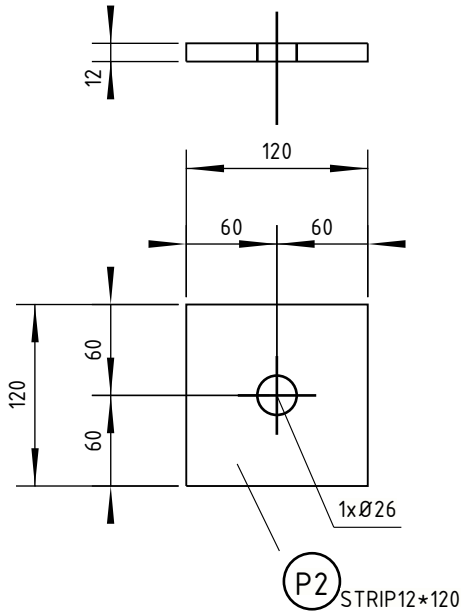
Pos	Profile	Number	Grade	Length	Area (m^2)
P1	PL12*207.6	2	S355J0	370	0.16

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P1]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



P2	STRIP12*120	4	S355J0	120	0.03
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

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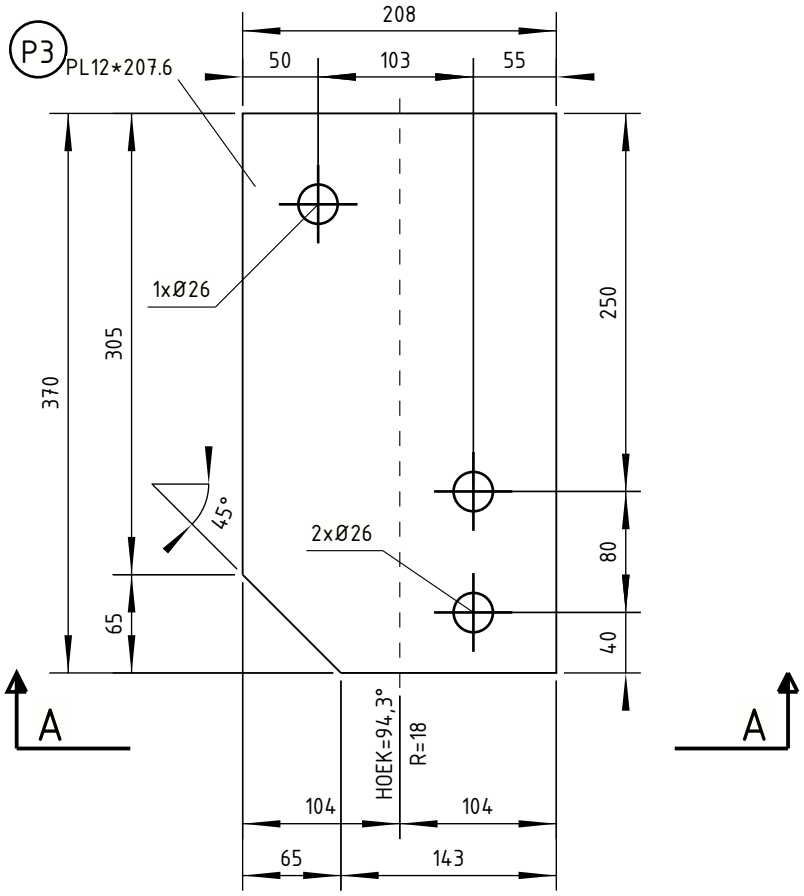
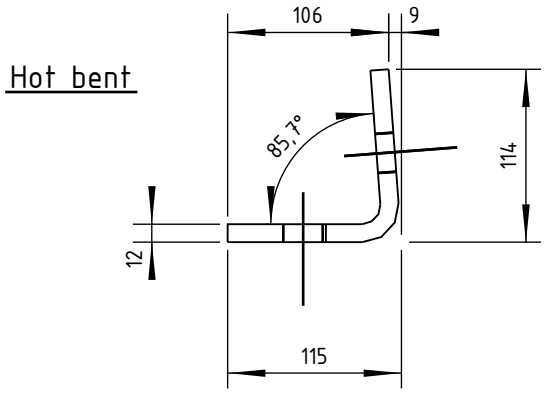
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P2]
	Documentnummer:	

TenneT Taking power further

Tekla Structures





Doorsnede A - A

1:5

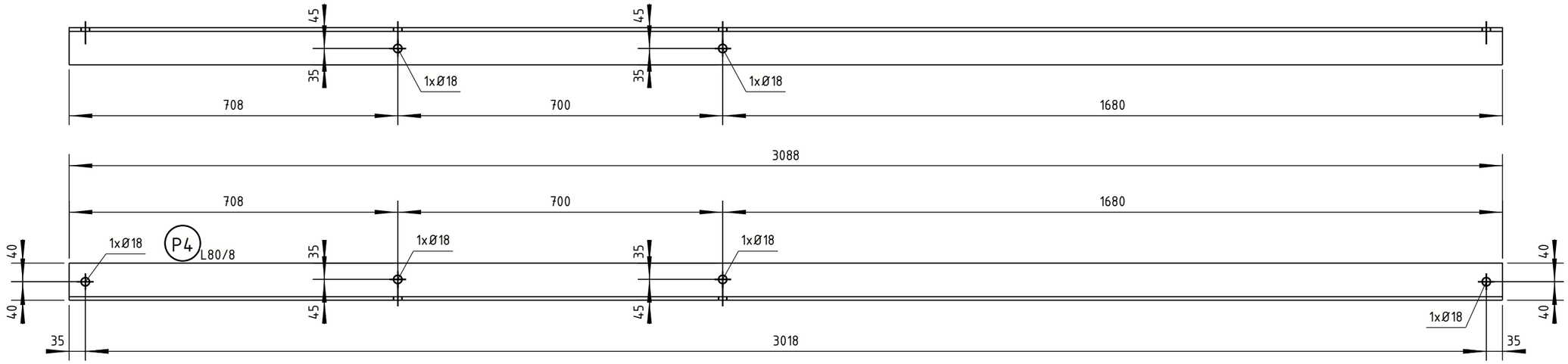
Pos	Profile	Number	Grade	Length	Area (m^2)
P3	PL12*207.6	2	S355J0	370	0.16

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [P3]
Documentnummer:	

TenneT Taking power further

Tekla Structures

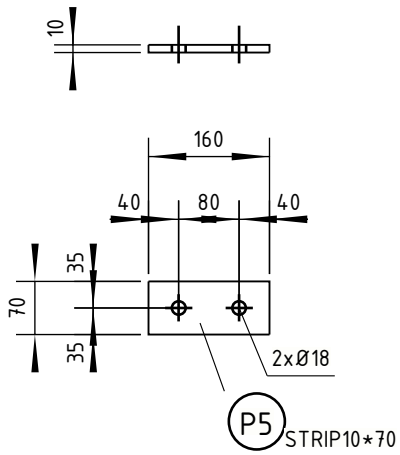


P4	L80/8	1	S355J0	3088	0.99
Pos	Profile	Number	Grade	Length	Area (m²)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P4]
TenneT Taking power further	Documentnummer:	

Tekla Structures



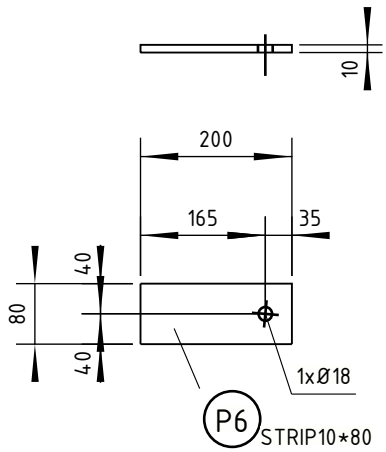
P5	STRIP10*70	2	S355J0	160	0.03
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P5]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



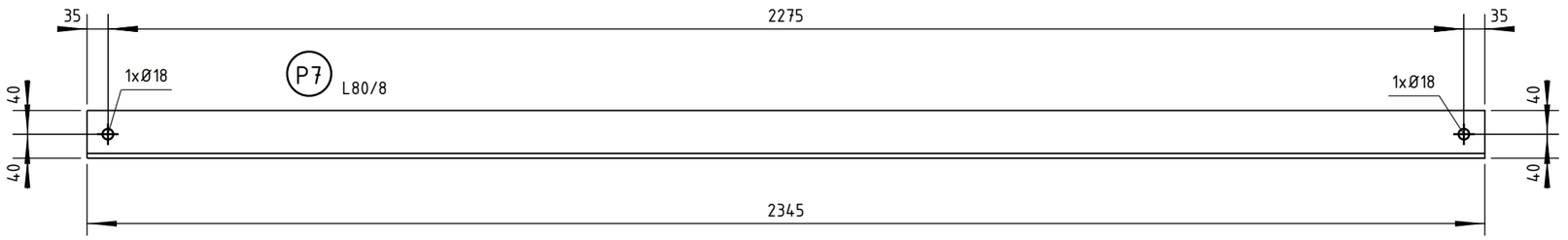
P6	STRIP10*80	4	S355J0	200	0.04
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P6]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



P7	L80/8	1	S355J0	2345	0.75
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

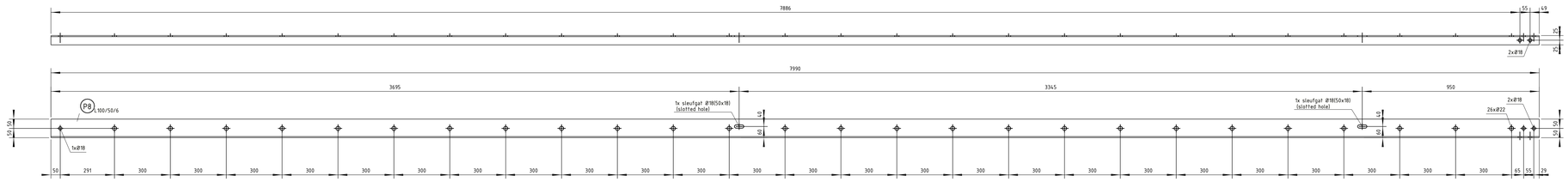
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [P7]
Documentnummer:	

TenneT Taking power further

Tekla Structures



P8	L100/50/6	1	S355J0	7990	2.40
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Werkingsfase: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Gerekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aspjes b.v.		1:10	A0

Relatie

Uit tekeningnummer:

Thema: Verbinding

Categorie: Algemeen

Documentcode: Constructietekening

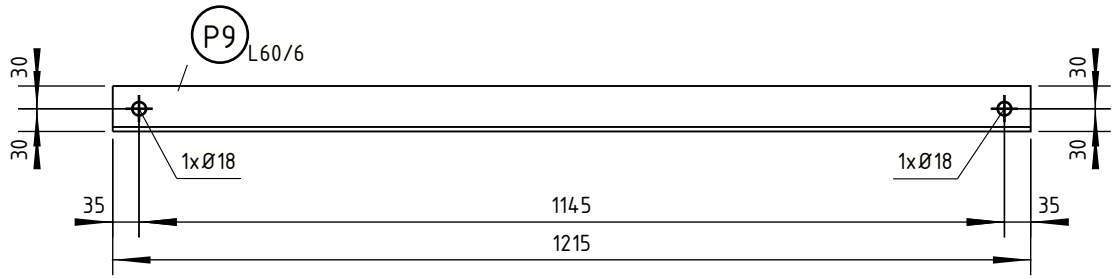
Object ID: ENS-ZL380

Omschrijving: Nieuw staal - onderdeel [P8]

Documentnummer:

TenneT taking power further

Tekla Structures



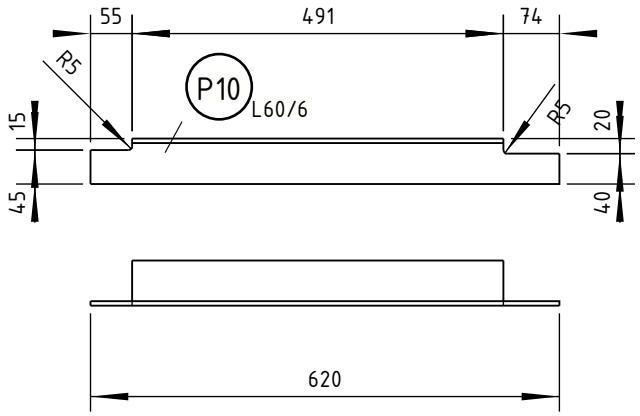
P9	L60/6	1	S355J0	1215	0.29
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P9]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



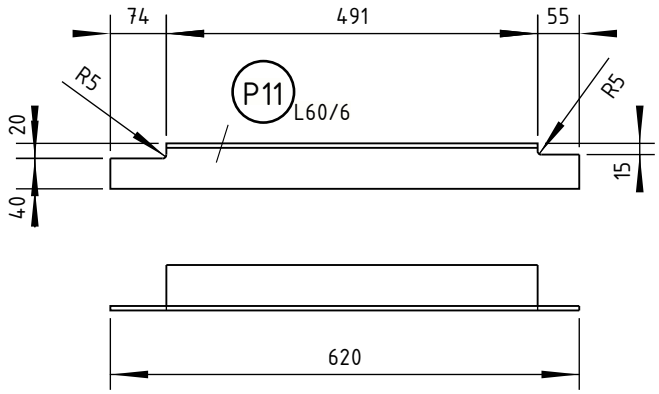
P10	L60/6	1	S355J0	620	0.15
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P10]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



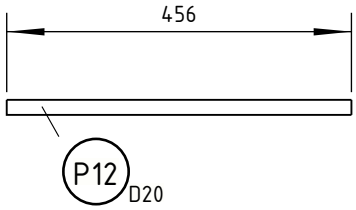
P11	L60/6	1	S355J0	620	0.15
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P11]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



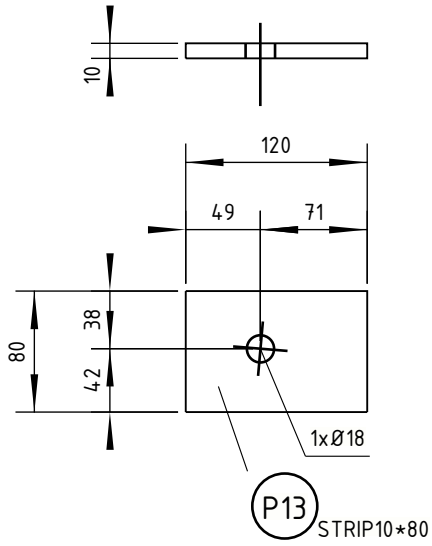
P12	D20	42	S355J2	456	0.03
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P12]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



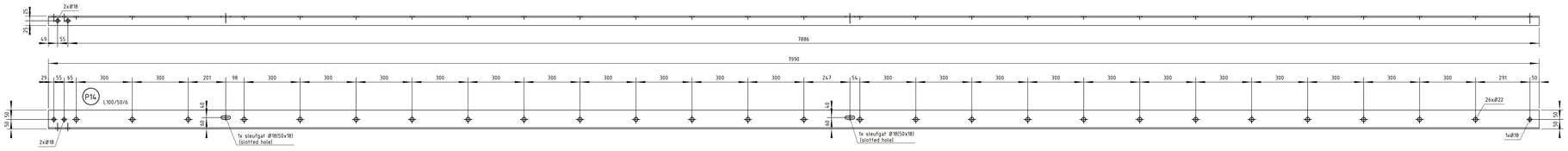
P13	STRIP10*80	2	S355J0	120	0.02
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P13]
	Documentnummer:	

TenneT Taking power further

Tekla Structures

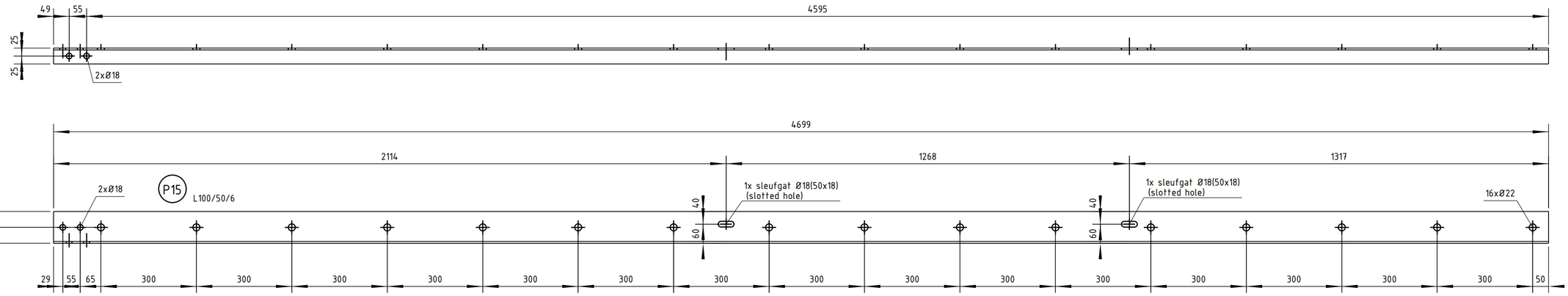


P14	L100/50/6	1	S355J0	7990	2.40
Pos	Profile	Number	Grade	Length	Area (m²)

Naam: Opwaarderen 380 kV verbinding Ens – Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aalfjes b.v.		1:10	A0
Relatie:			Thema: Verbinding			
			Categorie: Algemeen			
			Documentcode: Constructietekening			
Oud tekeningnummer:			Object ID: ENS-ZL380			
			Omschrijving: Nieuw staal - onderdeel [P14]			
			Documentnummer:			

TENNET taking power further

Tekla Structures



P15	L100/50/6	1	S355J0	4699	1.41
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

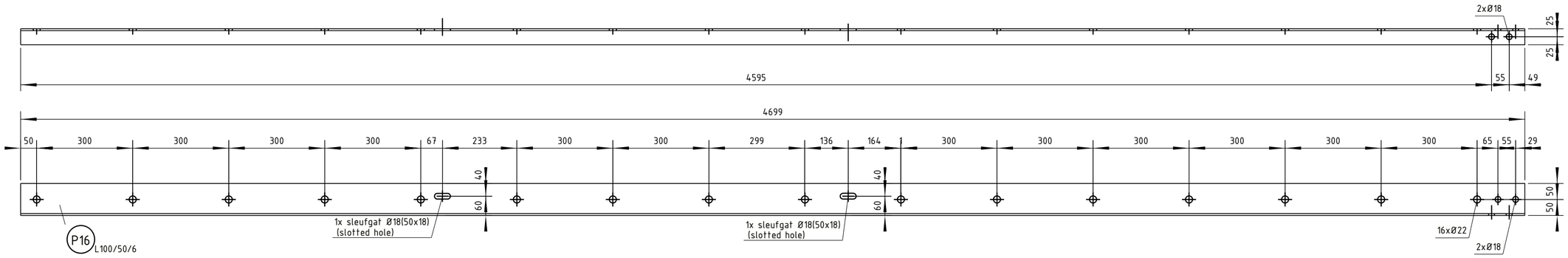
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [P15]
Documentnummer:	

TenneT Taking power further

Tekla Structures



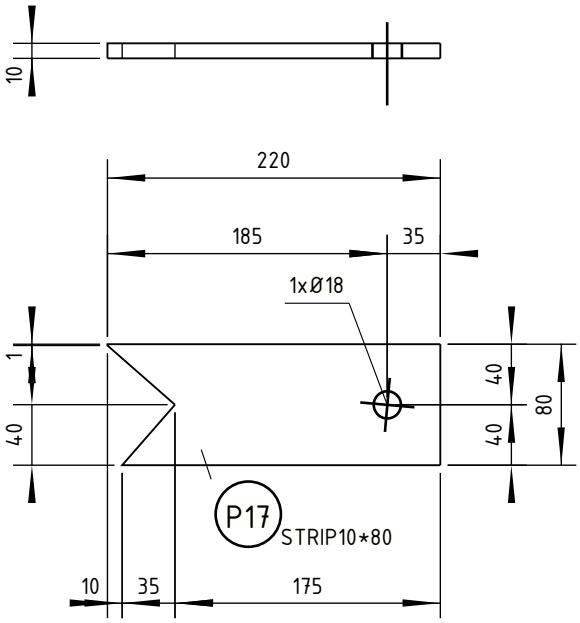
P16	L100/50/6	1	S355J0	4699	1.41
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built / Schaal / Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.	1:10 / 594x420

Relatie	
Oud tekeningnummer:	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [P16]
Documentnummer:	

TenneT Taking power further

Tekla Structures



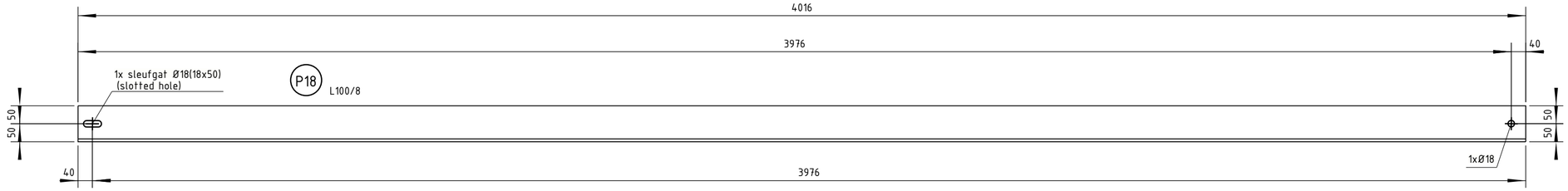
Pos	Profile	Number	Grade	Length	Area (m^2)
P17	STRIP10*80	2	S355J0	220	0.04

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P17]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



P18	L100/8	1	S355J0	4016	1.61
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

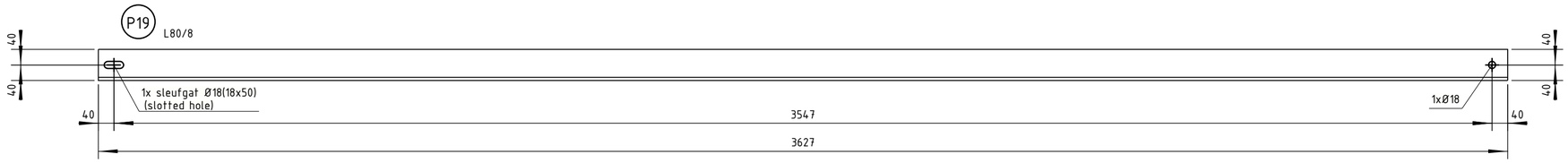
Object ID: ENS-ZL380

Omschrijving: Nieuw staal - onderdeel [P18]

Documentnummer:

TenneT Taking power further

Tekla Structures

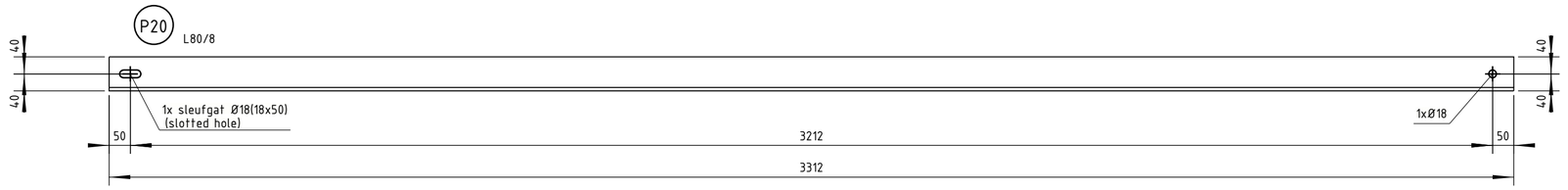


P19	L80/8	1	S355J0	3627	1.16
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus	
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380
	Omschrijving:	Nieuw staal - onderdeel [P19]
TenneT Taking power further	Documentnummer:	

Tekla Structures

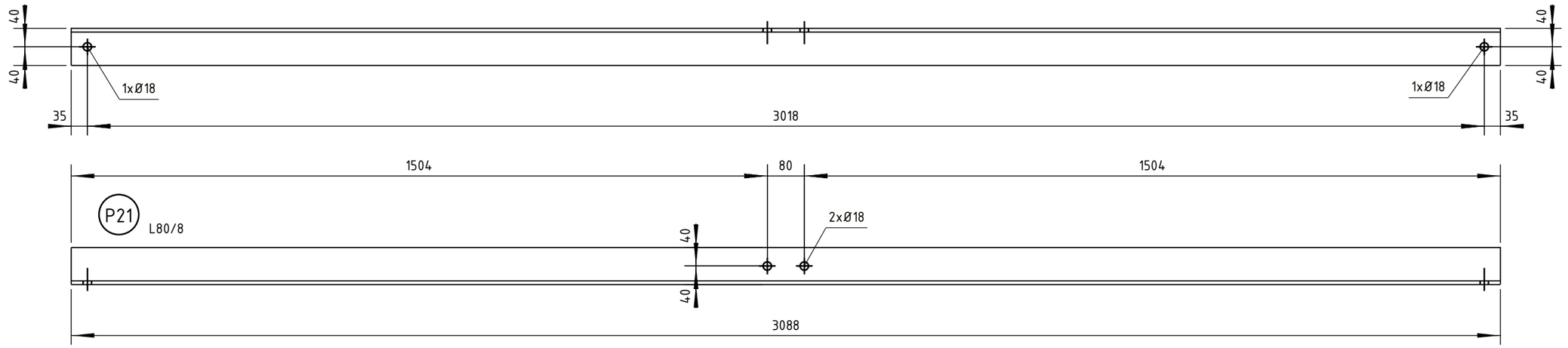


P20	L80/8	1	S355J0	3312	1.06
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus	
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380
	Omschrijving:	Nieuw staal - onderdeel [P20]
TenneT Taking power further	Documentnummer:	

Tekla Structures



P21	L80/8	2	S355J0	3088	0.99
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

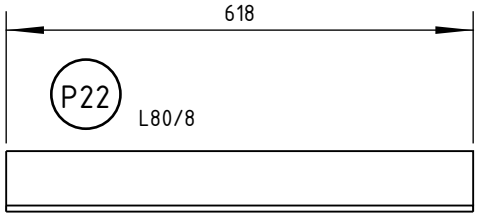
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380
Omschrijving:	Nieuw staal - onderdeel [P21]
Documentnummer:	

tennet Taking power further

Tekla Structures



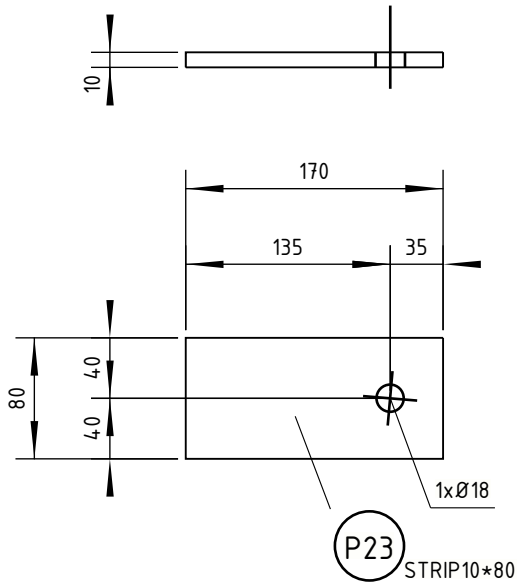
Pos	Profile	Number	Grade	Length	Area (m^2)
P22	L80/8	1	S355J0	618	0.20

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P22]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



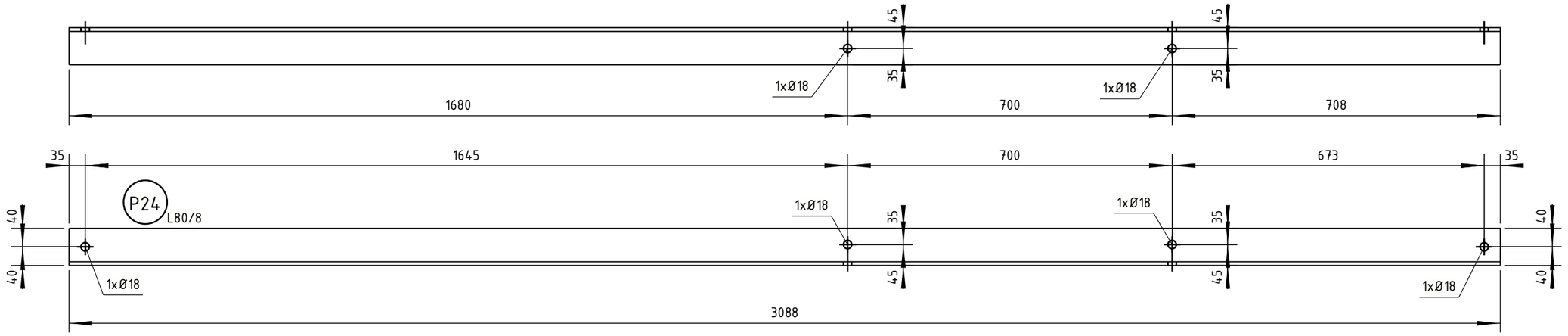
P23	STRIP10*80	2	S355J0	170	0.03
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P23]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



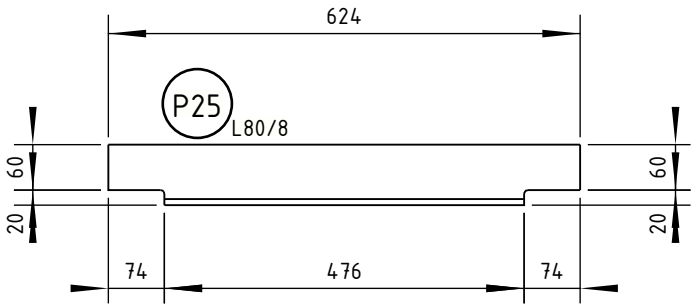
P24	L80/8	1	S355J0	3088	0.99
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P24]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



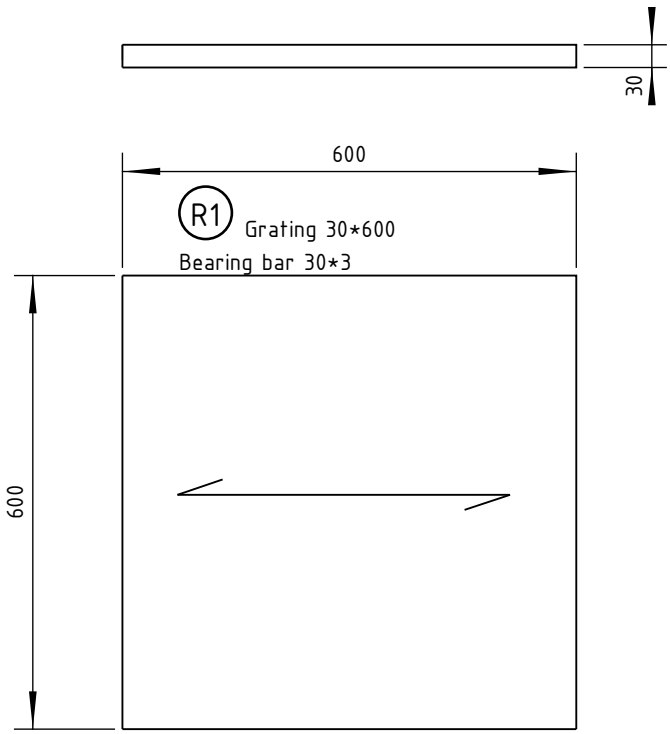
P25	L80/8	4	S355J0	624	0.20
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P25]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m^2)
R1	PL30*600	3	S235JR	600	0.79

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	10.03.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [R1]
	Documentnummer:	

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Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-02820**

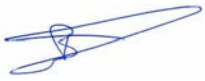
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994436**

Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype S-6_R, Mast 28 - Lijsten**

	Naam	Functie	Handtekening	Datum
Opgesteld	Rogier Hol	Tekenaar		10-03-2022
Validatie Aafjes	Niels Verhaar	System Engineer		10-03-2022
Vrijgegeven	Bart Aafjes	Projectleider		10-03-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	10-03-2022	1e versie ter review

BOUTEN-, MOEREN-, RINGENLIJST Pagina: 1

ENS-ZL380 Datum: 09.03.2022
Masttype S-6_R
t.b.v. Mast 28

Naam	Type	Kwal.	Aantal
BOUT-M16*35	4017	8.8	26
BOUT-M16*40	4017	8.8	46
BOUT-M16*45	4017	8.8	36
BOUT-M16*50	4014	8.8	8
BOUT-M20*45	4017	8.8	4
BOUT-M24*55	4017	8.8	38
BOUT-M24*60	4017	8.8	80
BOUT-M24*65	4017	8.8	6
MOER-M16	4032		116
MOER-M20	4032		4
MOER-M24	4032		124
RING-M16	7091		16
RING-M16	7091		116
RING-M20	7091		4
RING-M24	7091		124

MATERIAALLIJST Pagina: 1

ENS-ZL380 Datum: 09.03.2022
Masttype S-6_R
t.b.v. Mast 28

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
D20	P12	S355J2	42	456	0.03	1.0
				19152	1.20	43.3
HEB160	1	S355J0	2	2161	1.99	93.8
HEB160	2	S355J0	2	3181	2.93	138.1
HEB160	6	S355J0	2	2129	1.96	92.4
				14943	13.75	648.5
L50/5	5	S355J0	4	2382	0.48	9.2
L50/5	18	S355J0	2	957	0.19	3.7
L50/5	19	S355J0	2	957	0.19	3.7
				13358	2.67	51.3
L60/6	20	S355J0	4	120	0.03	0.7
L60/6	23	S355J0	2	1104	0.26	6.1
L60/6	24	S355J0	2	1104	0.26	6.1
L60/6	25	S355J0	2	840	0.20	4.6
L60/6	28	S355J0	4	2146	0.52	11.9
L60/6	40	S355J0	2	840	0.20	4.6
L60/6	P9	S355J0	1	1215	0.29	6.7
L60/6	P10	S355J0	1	620	0.15	3.4
L60/6	P11	S355J0	1	620	0.15	3.4
				19294	4.63	106.6
L80/8	3	S355J0	1	2874	0.92	28.2
L80/8	4	S355J0	1	2874	0.92	28.2
L80/8	26	S355J0	8	120	0.04	1.2
L80/8	27	S355J0	4	60	0.02	0.6
L80/8	P4	S355J0	1	3088	0.99	30.3
L80/8	P7	S355J0	1	2345	0.75	23.0
L80/8	P19	S355J0	1	3627	1.16	35.6
L80/8	P20	S355J0	1	3312	1.06	32.5
L80/8	P21	S355J0	2	3088	0.99	30.3
L80/8	P22	S355J0	1	618	0.20	6.1
L80/8	P24	S355J0	1	3088	0.99	30.3
L80/8	P25	S355J0	4	624	0.20	6.1
				31698	10.14	310.9
L100/8	P18	S355J0	1	4016	1.61	49.8
				4016	1.61	49.8
L100/50/6	P8	S355J0	1	7990	2.40	55.2
L100/50/6	P14	S355J0	1	7990	2.40	55.2

ENS-ZL380 Datum: 09.03.2022
Masttype S-6_R
t.b.v. Mast 28

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
L100/50/6	P15	S355J0	1	4699	1.41	32.5
L100/50/6	P16	S355J0	1	4699	1.41	32.5
				25378	7.61	175.4
PL12*207.6	P1	S355J0	2	370	0.16	7.1
PL12*207.6	P3	S355J0	2	370	0.16	7.1
				1480	0.65	28.5
PL12*225	15	S355J0	4	470	0.19	8.2
				1880	0.75	33.0
PL12*260	11	S355J0	2	281	0.14	5.9
PL12*260	17	S355J0	2	281	0.14	5.9
				1122	0.54	23.5
PL12*299	7	S355J0	2	370	0.21	9.5
PL12*299	9	S355J0	2	370	0.21	9.5
				1480	0.85	38.0
PL12*308.1	8	S355J0	2	370	0.22	9.8
PL12*308.1	10	S355J0	2	370	0.22	9.8
				1480	0.88	39.3
PL12*309	13	S355J0	2	370	0.22	9.9
PL12*309	14	S355J0	2	370	0.22	9.9
				1480	0.88	39.4
PL30*600	R1	S235JR	3	600	0.79	86.4
				1800	2.38	259.2
STRIP6*50	21	S355J0	2	270	0.03	0.6
				540	0.06	1.3
STRIP6*100	22	S355J0	2	230	0.05	1.1
				460	0.10	2.2
STRIP10*50	41	S355JO	2	65	0.01	0.2

ENS-ZL380 Datum: 09.03.2022
Masttype S-6_R
t.b.v. Mast 28

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
				130	0.01	0.4
STRIP10*70	P5	S355J0	2	160	0.03	0.9
				320	0.05	1.8
STRIP10*80	P6	S355J0	4	200	0.04	1.3
STRIP10*80	P13	S355J0	2	120	0.02	0.8
STRIP10*80	P17	S355J0	2	220	0.04	1.3
STRIP10*80	P23	S355J0	2	170	0.03	1.1
				1821	0.34	11.3
STRIP12*120	P2	S355J0	4	120	0.03	1.4
				480	0.14	5.5
STRIP12*350	12	S355J0	2	309	0.21	9.3
STRIP12*350	16	S355J0	2	309	0.21	9.3
				1236	0.83	37.1
			Totaal:		50.08	1906.5

TEKLA STRUCTURES MERKENLIJST Pagina: 1

ENS-ZL380 Datum: 09.03.2022
Masttype S-6_R
t.b.v. Mast 28

Merk	Aantal	Profiel	Lengte	Opp.(m2)	Gewicht (kg)
1	2	HEB160	2161	1.99	93.8
2	2	HEB160	3181	2.93	138.1
3	1	L80/8	2874	0.92	28.2
4	1	L80/8	2874	0.92	28.2
5	4	L50/5	2382	0.48	9.2
6	2	HEB160	2129	1.96	92.4
7	2	PL12*299	199	0.21	9.5
8	2	PL12*308.1	205	0.22	9.8
9	2	PL12*299	199	0.21	9.5
10	2	PL12*308.1	205	0.22	9.8
11	2	PL12*260	198	0.14	5.9
12	2	STRIP12*350	209	0.21	9.3
13	2	PL12*309	209	0.22	9.9
14	2	PL12*309	209	0.22	9.9
15	4	PL12*225	470	0.19	8.2
16	2	STRIP12*350	209	0.21	9.3
17	2	PL12*260	198	0.14	5.9
18	2	L50/5	957	0.19	3.7
19	2	L50/5	957	0.19	3.7
20	4	L60/6	120	0.03	0.7
21	2	STRIP6*50	270	0.03	0.6
22	2	STRIP6*100	230	0.05	1.1
23	2	L60/6	1104	0.26	6.1
24	2	L60/6	1104	0.26	6.1
25	2	L60/6	840	0.20	4.6
26	8	L80/8	120	0.04	1.2
27	4	L80/8	60	0.02	0.6
28	4	L60/6	2146	0.52	11.9
29	2	PL12*207.6	230	0.20	8.5
30	2	PL12*207.6	230	0.20	8.5
31	1	L80/8	2345	1.39	38.1
32	1	L100/50/6	7990	5.53	137.3
33	1	L100/50/6	4699	3.28	81.5
34	1	L80/8	3312	1.13	35.0
35	1	L100/8	4016	1.68	52.4
36	1	L80/8	3627	1.24	38.1
37	1	L80/8	3088	2.38	72.8
38	1	L80/8	3088	2.38	72.8
39	1	L80/8	638	0.32	10.0
40	2	L60/6	840	0.20	4.6
41	2	STRIP10*50	65	0.01	0.2
R1	3	PL30*600	600	0.79	86.4
Totaal	90	merk(en)		50.08	1906.5

Masttype: Masttype S-6_R Mast 28
Opwaarderen 380 kV verbinding Ens - Zwolle

Tekening omschrijving	Tekeningnummer	Rev.	Datum	Tek.	formaat
Masttype S-6_R, Mast 28 - Overzicht	00974-01-02801	0.1	10.03.2022	A2	594x420
Masttype S-6_R, Mast 28 - Tussenstuk	00974-01-02802	0.1	10.03.2022	A0	1189x841
Masttype S-6_R, Mast 28 - Tussenstuk bordes en ladder	00974-01-02803	0.1	10.03.2022	A0	1189x841
Masttype S-6_R, Mast 28 - Ondertraverse	00974-01-02804	0.1	10.03.2022	A0	1189x841
Masttype S-6_R, Mast 28 - Boventraverse	00974-01-02805	0.1	10.03.2022	A0	1189x841
S-6_R, Mast 28 - Onderdeeltekeningen	00974-01-02810	0.1	10.03.2022	A2/A3/A4	

Lijsten	Documentnummer		Datum
bouten-moeren-ringenlijst	00974-01-02820	0.1	09.03.2022
materiaallijst	00974-01-02820	0.1	09.03.2022
merkenlijst	00974-01-02820	0.1	09.03.2022
Documentenlijst	00974-01-02820	0.1	09.03.2022

Detailberekeningen	Documentnummer		Datum
Masttype S-6-R, Mast 28	00974-01-02830	0.1	10.03.2022

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

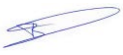
"REVIEW AND RE-DESIGN TOWERS BBB380"

ENS-ZL380 – Tower S-6_R Mast 28

TenneT TSO B.V.

Detail Calculation

Projectnummer Aafjes:	**21-187**
Documentnummer:	**00974-01-02830**
Projectnummer TenneT:	**002.515**
Meridian nummer:	**002.515.40 0994437**
Opdrachtgever:	**TenneT**
Project:	**Opwaardering ENS-ZL380**
Onderdeel:	**S-3_R Mast 28 - Detailberekeningen**

					
1e versie ter review	G. Pieper	R.Hol	B. Aafjes	10-03-2022	0.1
	Author	Checked	Approved	date	revision

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5.1.1 Connections 16

1 Introduction

This report contains the detail calculations of the reinforcements of towertype S-6/R windzone III.

It concerns tower number: Tower 28

To increase the future capacity of electricity transmission, it is necessary to upgrade the transmission grid by building new and modifying existing high voltage connections.

It is for this reason the client (OG) intends to upgrade part the existing 380kV grid. This upgrading is part of the program “Beter Benutten Bestaande 380kV” and consists of the following subprojects:

- Upgrading of the 380 kV-connection Lelystad – Ens (LLS-ENS380).
- Upgrading of the 380 kV-connection Diemen – Lelystad (DIM-LLS380).
- Upgrading of the 380 kV-connection Rilland – Zandvliet (RLL-ZVL380).
- Upgrading of the 380 kV-connection Krimpen aan de IJssel – Geertruidenberg (KIJ-GT380).
- Upgrading of the 380 kV-connection Ens – Zwolle (ENS-ZL380).
- Upgrading of the 380 kV-connection Maasbracht – Eindhoven (MBT-EHV380).

DNV GL has calculated the existing tower for the new situation on behalf of Tennet. On the instructions of DNV GL, the reinforcements mainly consist of the exchange of bolts and profiles and the reinforcement of profiles and the application of redundant members.

DNV GL has tested the profiles and bolts. In this report only the detail calculations are made of the specified reinforcements (bolts are specified by DNV GL).

2 General Data

2.1 Principal constructor

DNV GL – Energy

2.2 Principal calculation and related documents

- ENS-ZL380 – Tower S-6/R
  Reportnr.: 20-1505 Rev 1
  Date: 2021-03-23

- Uitgangspuntenrapport 380kV verbinding Ens – Zwolle
  Reportnr.: 20-1245 Rev.3
  Date: 2021-06-09

2.3 Material- and bolt quality

Materials excisting construction

	Signification 1969	Current startingpoint
Steeltype	St.37	S235JR
	St.52	S355JO
Bolt quality	bolt class 8.8	8.8 rolled thread
Concrete quality	K225	Min. C16/20
Reinforcing steel	Qr24, Qr40	B220, B400

Materials modified construction

Steeltype	S355JO ($t \leqq 16$ mm)
	S355J2 ($16 < t \leqq 40$ mm)
Bolt quality	8.8 rolled thread

2.4 Applicable standards

Mainly used:
- NEN-EN 1993-1-8+C2 :2011/NB:2011 nl

Also used:
- NEN-EN 50341-2-15: 2019
- NEN-EN 8700: 2011
- NEN-EN 8701: 2011
- Eurocode reeks

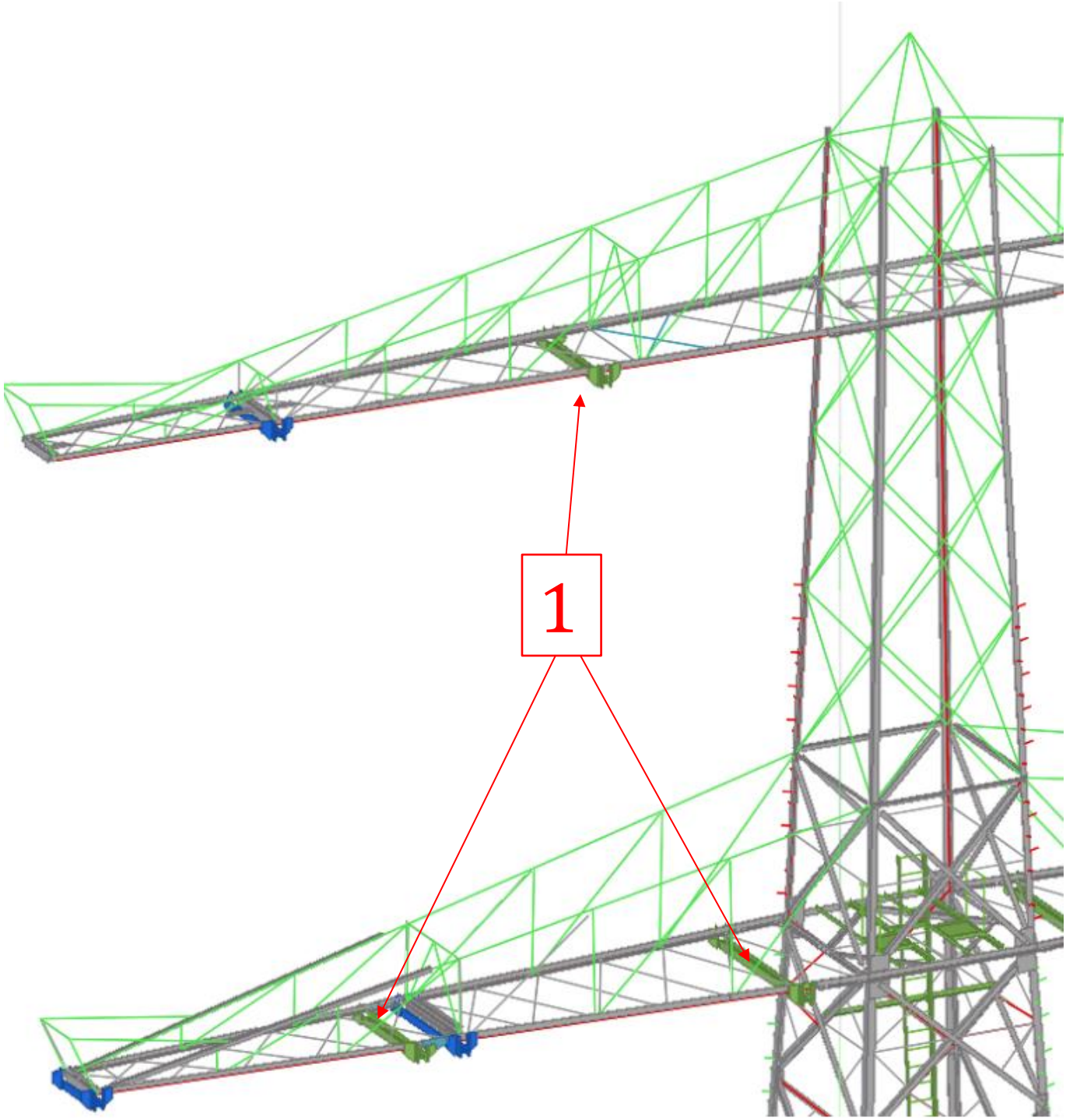
2.5 Tennet specifications

- SPE. 05. 346. v 2.0 algemene specificatie stalen masten

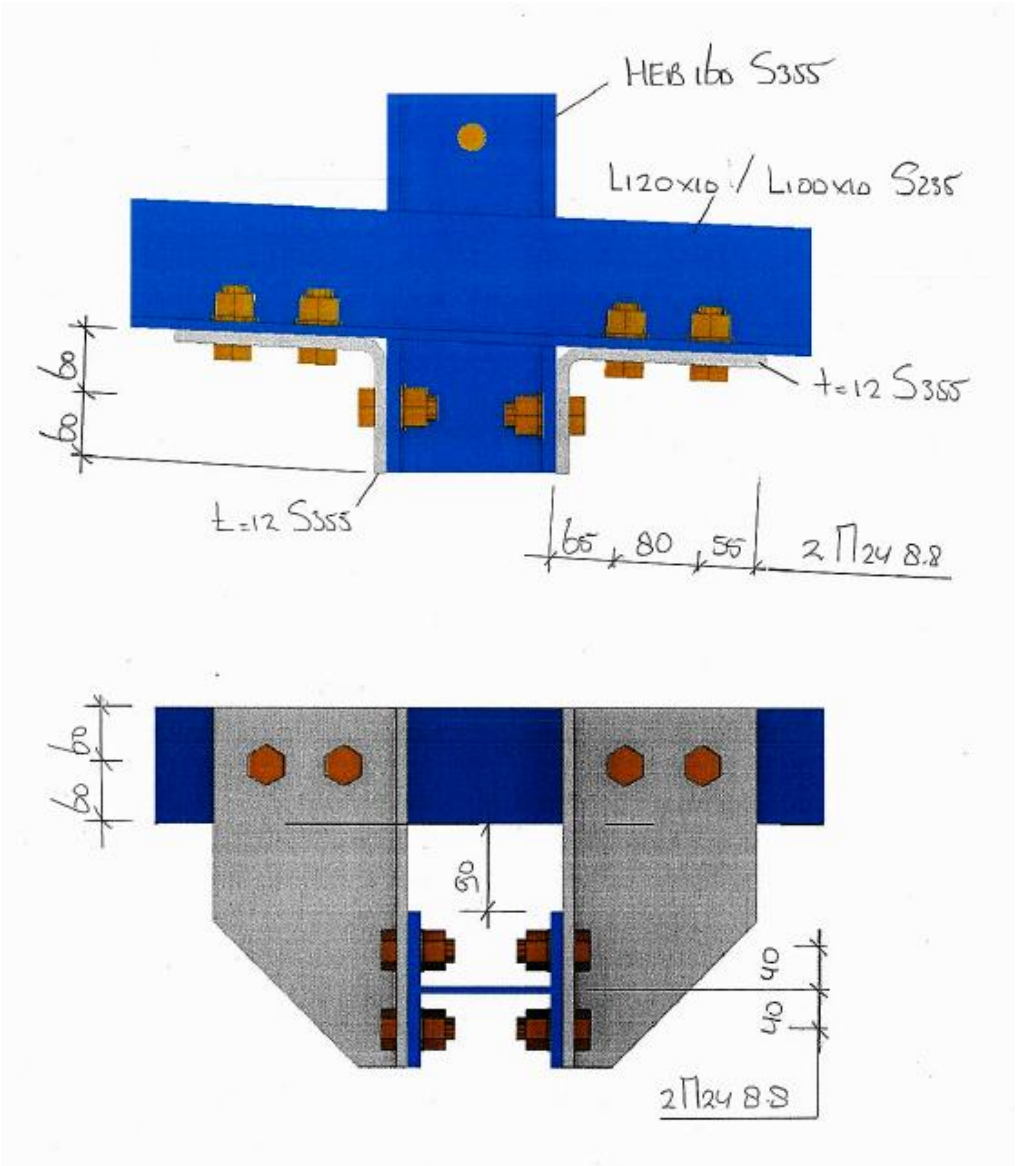
3 Calculations

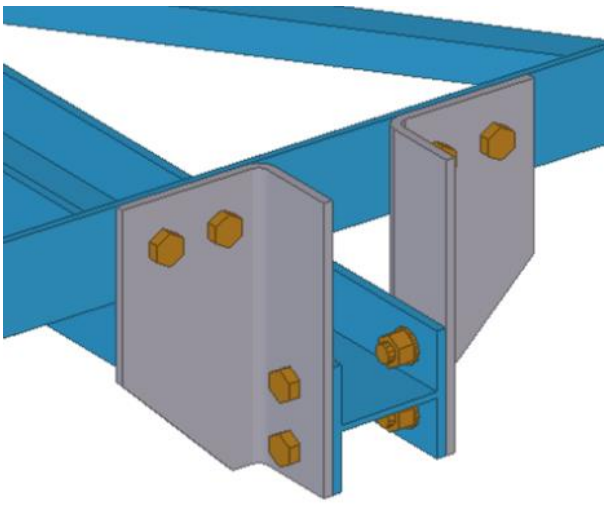
3.1 Connections

3.1.1 Overview



3.1.2 Detail 1


HEB 160 S355
L120x10 / L100x10 S235
t=12 S355
t=12 S355
60
60
65
80
55
2 M24 8.8
60
60
90
40
40
2 M24 8.8



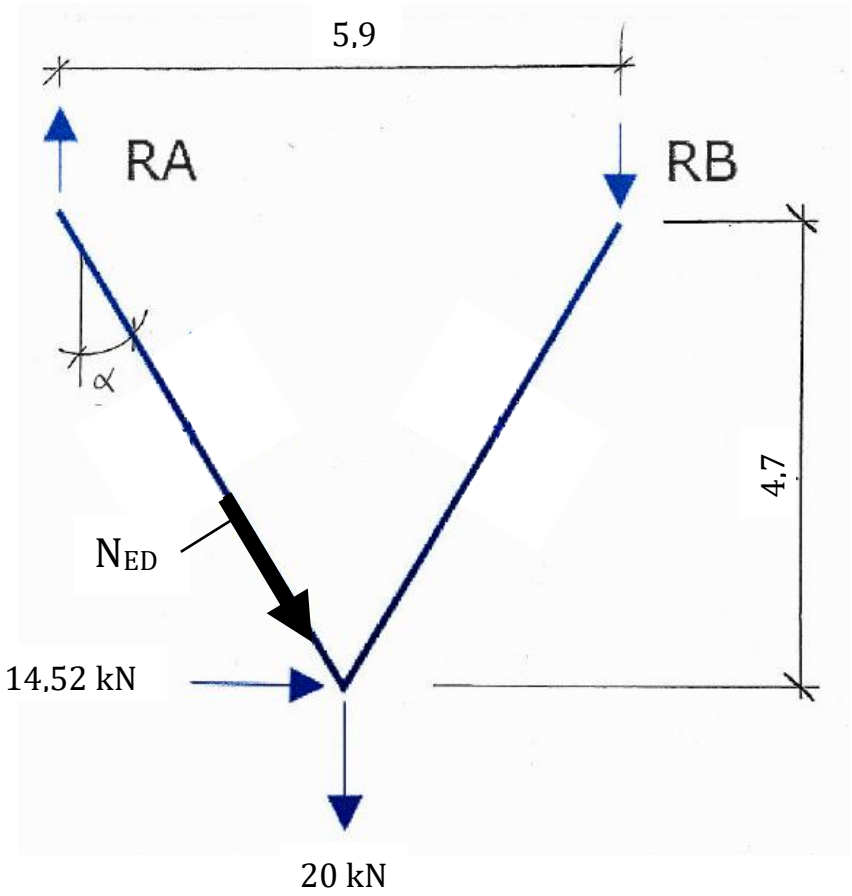
3.1.3 Loads

Loads from report:

ENS-ZL380 – Tower S-6/R

Report nr.: 20-1505 Rev 1
Date: 2021-03-23

Page 125



$$RA = \frac{14{,}52 \text{ x } 4{,}7 + 20 \text{ x } 2{,}95}{5{,}9} = 21{,}56 \text{ kN}$$

$\alpha = 32°$

$N_{ED} = 21{,}56 / \cos 32° = 25{,}43 \text{ kN}$

3.1.4 Calculation

3.1.4.1 IDEA calculation

Project data

Project name	ENS-ZL380 S-6_R mast 28
Project number	21-187
Author	G.P.
Description	Detail 1
Date	3/8/2022
Design code	EN

Material

Steel	S 355, S 235

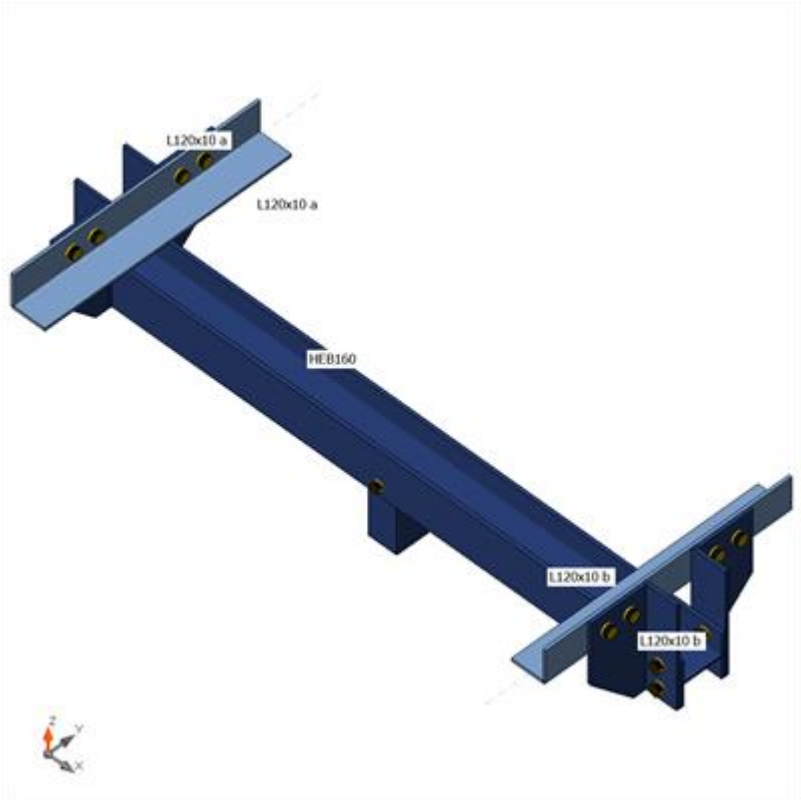
Project item Detail 1

Design

Name	Detail 1
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
Dummy	5 - CHS40,3	90.0	58.0	0.0	0	0	-61	Node
L120x10 a	6 - L120/10	-90.0	0.0	0.0	0	-912	203	Bolts
L120x10 b	6 - L120/10	90.0	0.0	0.0	0	-912	203	Bolts



Cross-sections

Name	Material
5 - CHS40,3	S 355
6 - L120/10	S 235
1 - HEB160	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M20 8.8	M20 8.8	20	800.0	314
M24 8.8	M24 8.8	24	800.0	452

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	Dummy	26.0	0.0	0.0	0.0	0.0	0.0
	L120x10 a	6.9	0.0	5.5	0.0	-1.1	0.0
	L120x10 a	0.0	0.0	5.5	0.0	-1.1	0.0
	L120x10 b	0.0	0.0	5.5	0.0	1.1	0.0
	L120x10 b	-6.9	0.0	5.5	0.0	1.1	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	29.7 < 100%	OK
Buckling	38.61	

Plates

Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
Dummy	S 355	3.0	LE1	98.6	0.0	0.0	OK
L120x10 a-bfl 1	S 235	10.0	LE1	88.6	0.0	0.0	OK
L120x10 a-w 1	S 235	10.0	LE1	129.0	0.0	4.2	OK
L120x10 b-bfl 1	S 235	10.0	LE1	82.9	0.0	0.0	OK
L120x10 b-w 1	S 235	10.0	LE1	117.2	0.0	4.2	OK
HEB160-bfl 1	S 355	13.0	LE1	100.0	0.0	5.9	OK
HEB160-tfl 1	S 355	13.0	LE1	203.3	0.0	7.3	OK
HEB160-w 1	S 355	8.0	LE1	62.6	0.0	0.0	OK
Dummy	S 355 - 1	134.0	LE1	8.0	0.0	7.3	OK
SP10	S 355	12.0	LE1	13.5	0.0	3.1	OK
SP11	S 355	12.0	LE1	57.6	0.0	4.0	OK
SP8	S 355	12.0	LE1	95.2	0.0	4.5	OK
SP12	S 355	12.0	LE1	61.7	0.0	4.2	OK
SP6	S 355	12.0	LE1	48.4	0.0	3.5	OK
SP7	S 355	12.0	LE1	14.5	0.0	3.2	OK
SP13	S 355	12.0	LE1	59.8	0.0	4.2	OK
SP14	S 355	12.0	LE1	96.3	0.0	4.3	OK

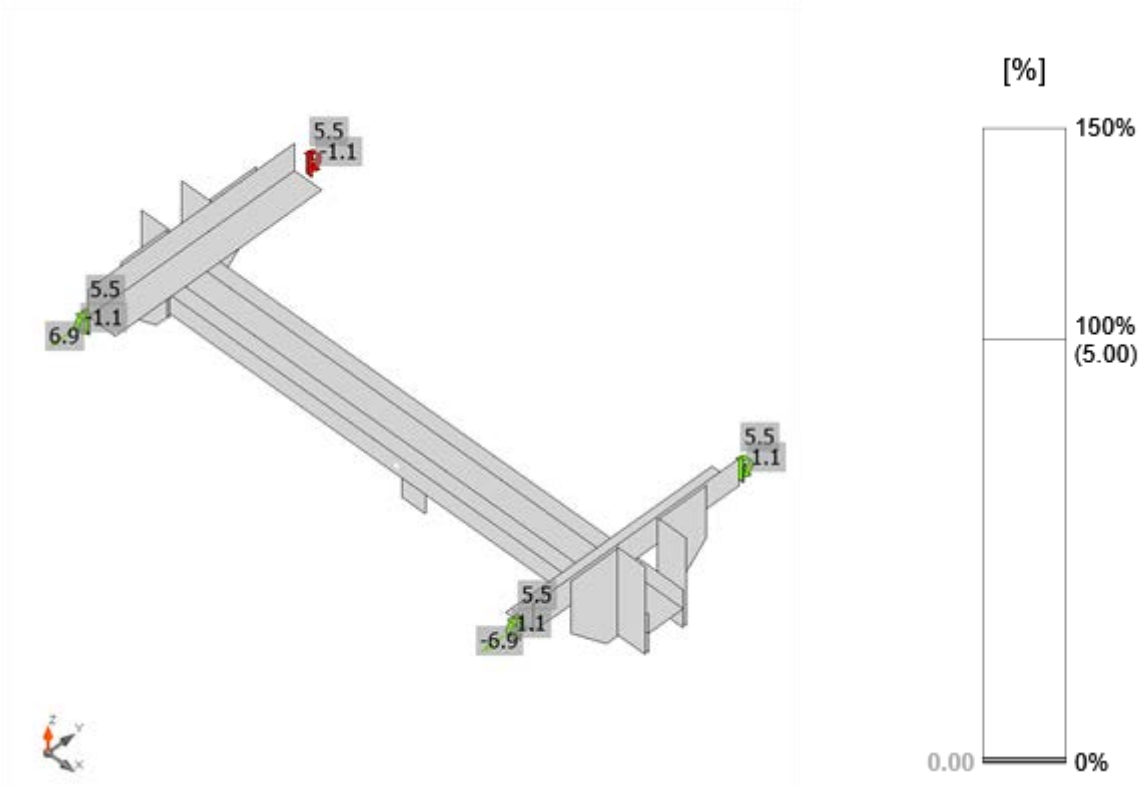
Design data

Material	f_y [MPa]	ε_{lim} [%]
S 355	355.0	5.0
S 235	235.0	5.0
S 355 - 1	335.0	5.0

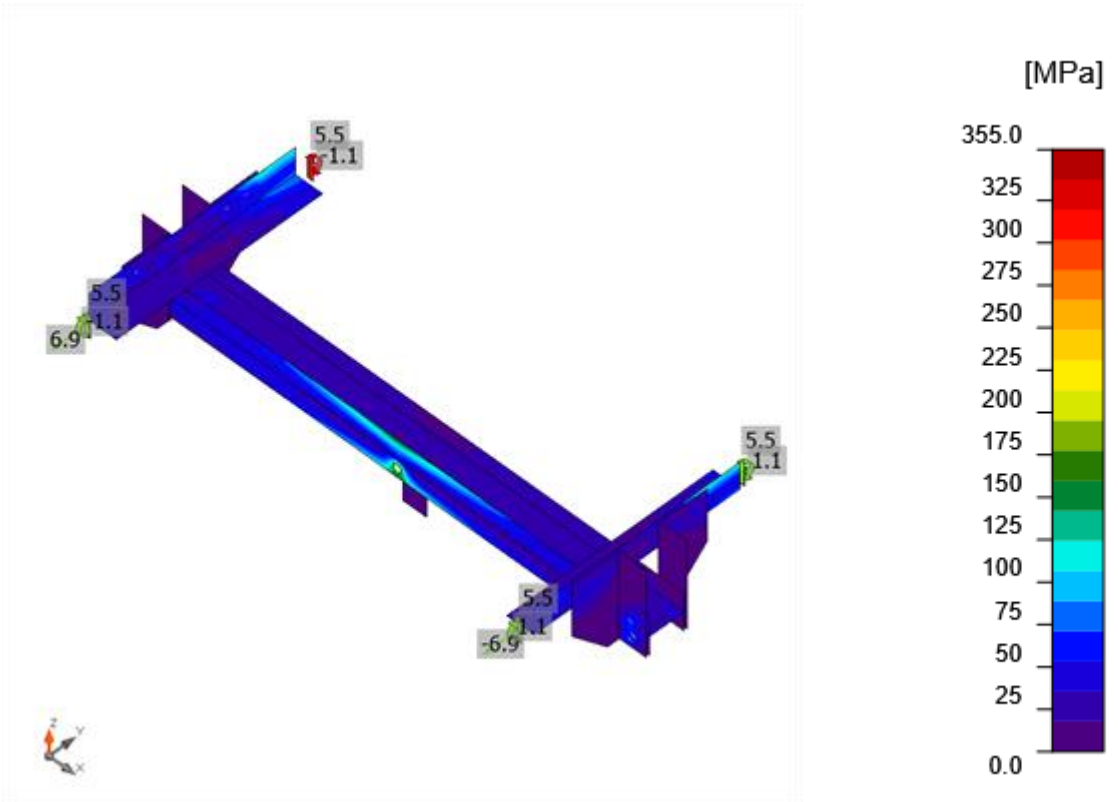
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

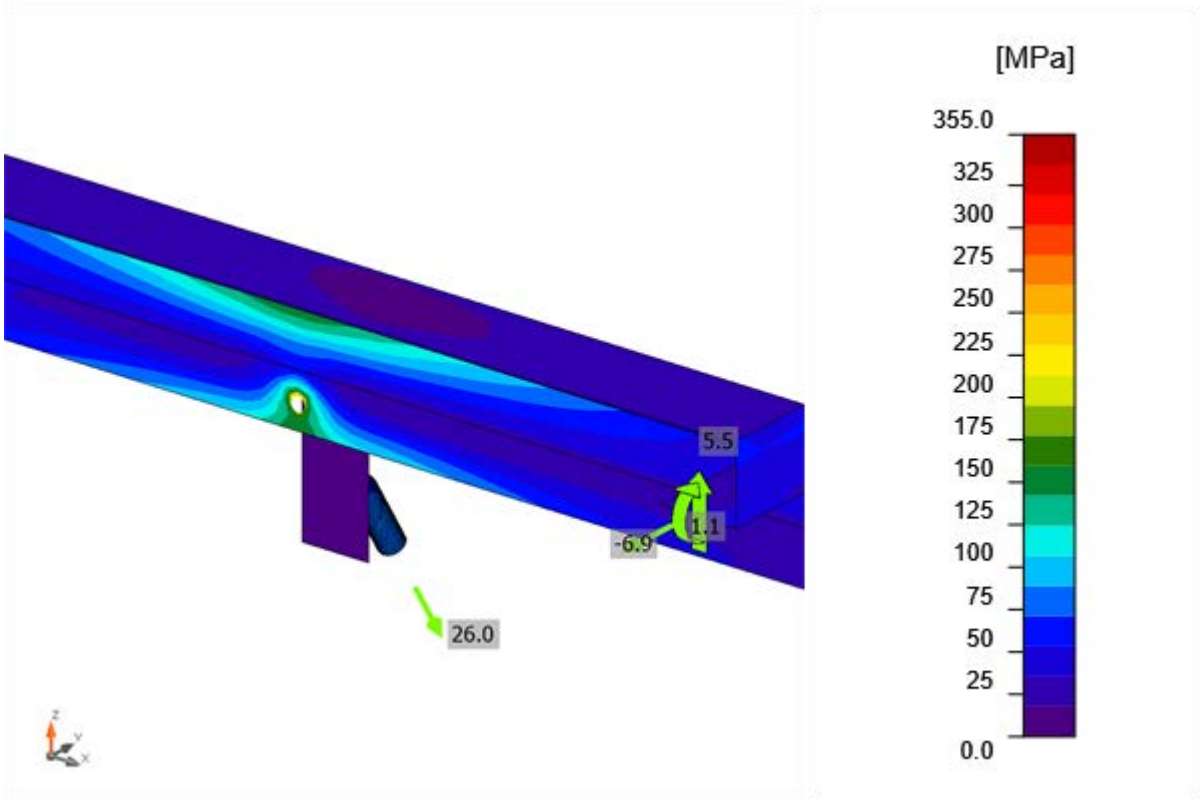
Overall check, LE1



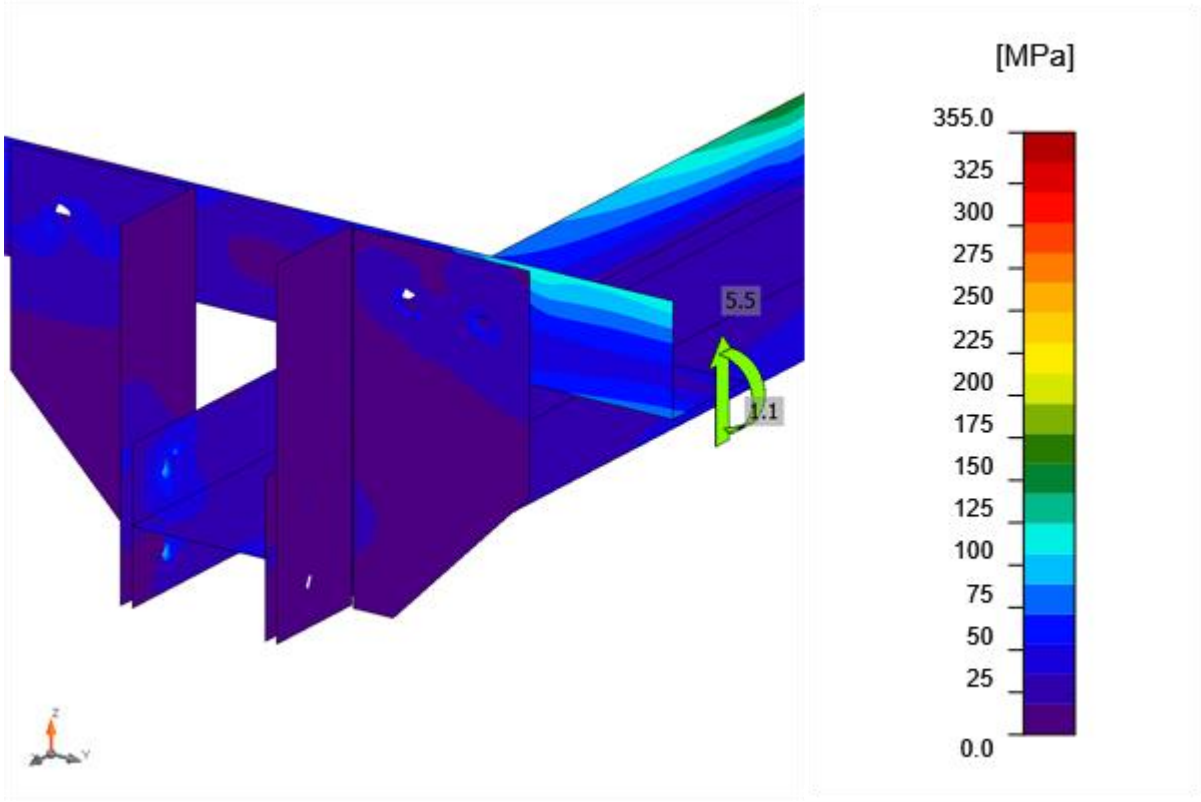
Strain check, LE1



Equivalent stress, LE1

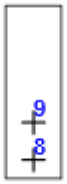


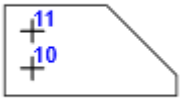
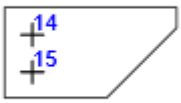
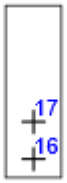
Equivalent stress, LE1



Equivalent stress, LE1

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M20 8.8 - 1	LE1	18.3	19.2	13.0	135.1	20.4	29.7	OK
	B2	M24 8.8 - 2	LE1	6.4	6.4	3.2	122.1	5.2	7.0	OK
	B3	M24 8.8 - 2	LE1	7.0	5.7	3.4	132.6	4.3	6.6	OK
	B6	M24 8.8 - 2	LE1	2.3	4.8	1.1	122.6	3.9	4.3	OK
	B7	M24 8.8 - 2	LE1	5.9	6.9	2.9	122.1	5.7	7.2	OK
	B4	M24 8.8 - 3	LE1	1.3	1.1	0.6	196.1	0.8	1.3	OK
	B5	M24 8.8 - 3	LE1	0.9	0.4	0.4	156.8	0.3	0.6	OK
	B12	M24 8.8 - 3	LE1	1.3	1.1	0.6	185.9	0.8	1.2	OK
	B13	M24 8.8 - 3	LE1	1.1	0.5	0.5	156.8	0.4	0.7	OK
	B8	M24 8.8 - 3	LE1	9.5	13.3	4.7	185.7	9.8	13.2	OK
	B9	M24 8.8 - 3	LE1	7.9	14.6	3.9	198.3	10.8	13.5	OK

	B10	M24 8.8 - 2	LE1	5.8	6.4	2.8	122.1	5.2	6.7	OK
	B11	M24 8.8 - 2	LE1	6.2	5.5	3.0	132.6	4.1	6.2	OK
	B14	M24 8.8 - 2	LE1	1.9	4.6	0.9	122.9	3.8	4.1	OK
	B15	M24 8.8 - 2	LE1	5.5	6.9	2.7	122.1	5.6	7.0	OK
	B16	M24 8.8 - 3	LE1	9.1	12.7	4.5	184.5	9.4	12.6	OK
	B17	M24 8.8 - 3	LE1	8.9	13.9	4.4	196.9	10.3	13.4	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M20 8.8 - 1	141.1	302.6	94.1
M24 8.8 - 2	203.3	206.3	135.6
M24 8.8 - 3	203.3	336.9	135.6

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Buckling

Loads	Shape	Factor [-]
LE1	1	38.61
	2	38.95
	3	47.63
	4	48.05
	5	55.79
	6	56.31

Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

4 Summary U.C. 's

4.1.1 Connections

Detail 1

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	29.7 < 100%	OK
Buckling	38.61	

5 Conclusion

5.1.1 Connections

Connection has sufficient strength.

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-03500**

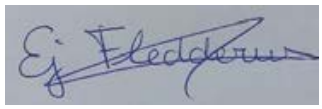
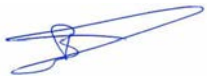
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994400**

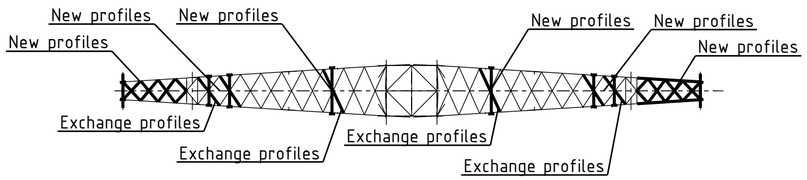
Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype HB+0_R_X, Mast 35 - Overzichtstekeningen**

	Naam	Functie	Handtekening	Datum
Opgesteld	Erik-Jan Fledderus	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review



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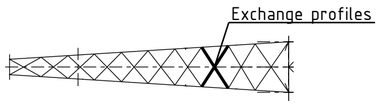

Section B – B
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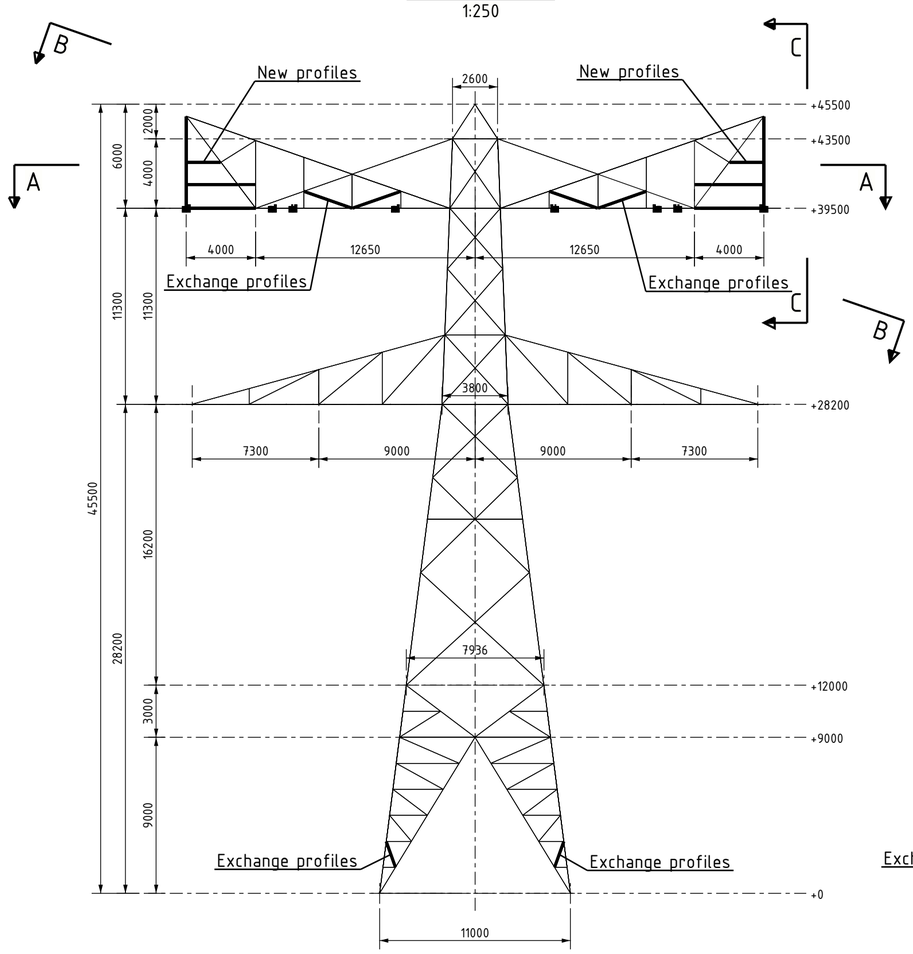

Transverse face
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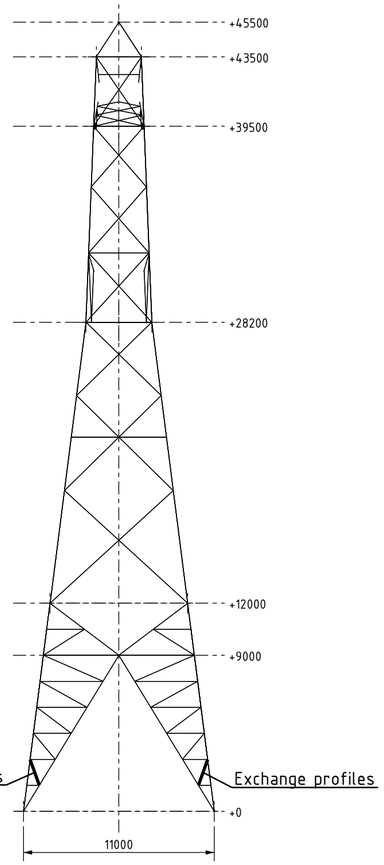

Longitudinal face
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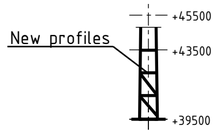

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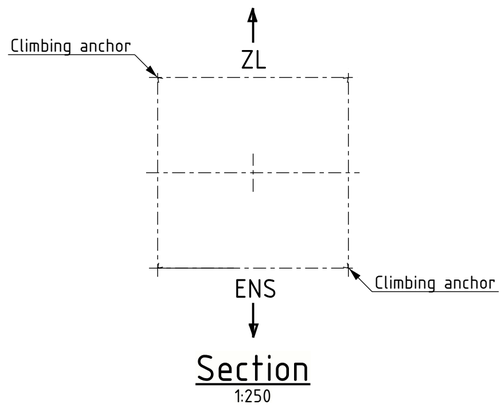

Section
1:250

All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

Unless otherwise specified:
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- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 - HDG oversized
Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

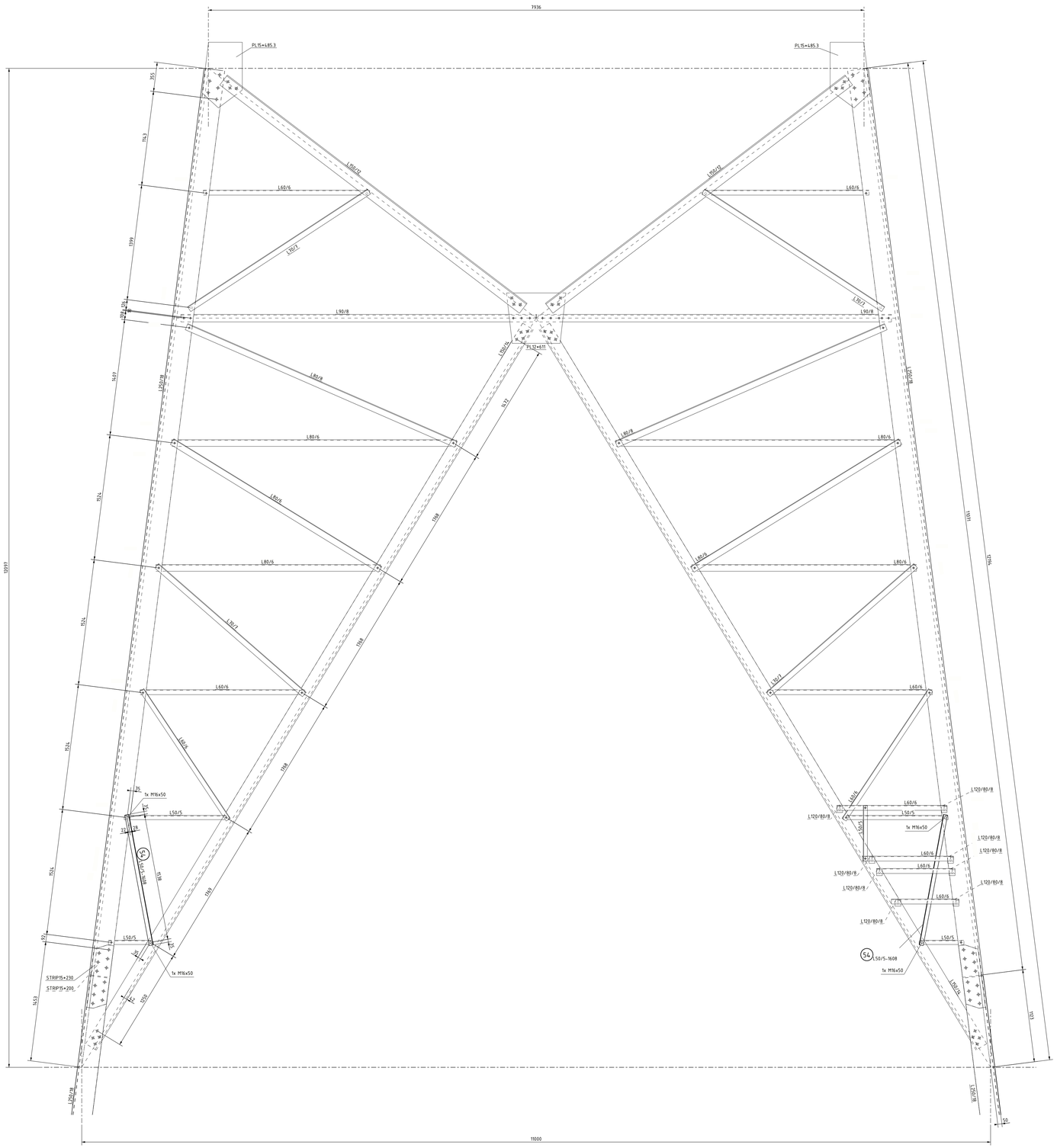
Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:250	594x420

Relatie	
Oud Tekeningnummer:	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Omschrijving:	Masttype HB+0_R_X, Mast 35 - Overzicht
Documentnummer:	00974-01-03501

TenneT Taking power further

Tekla Structures

Apply to all sides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PL15+L85.3
355
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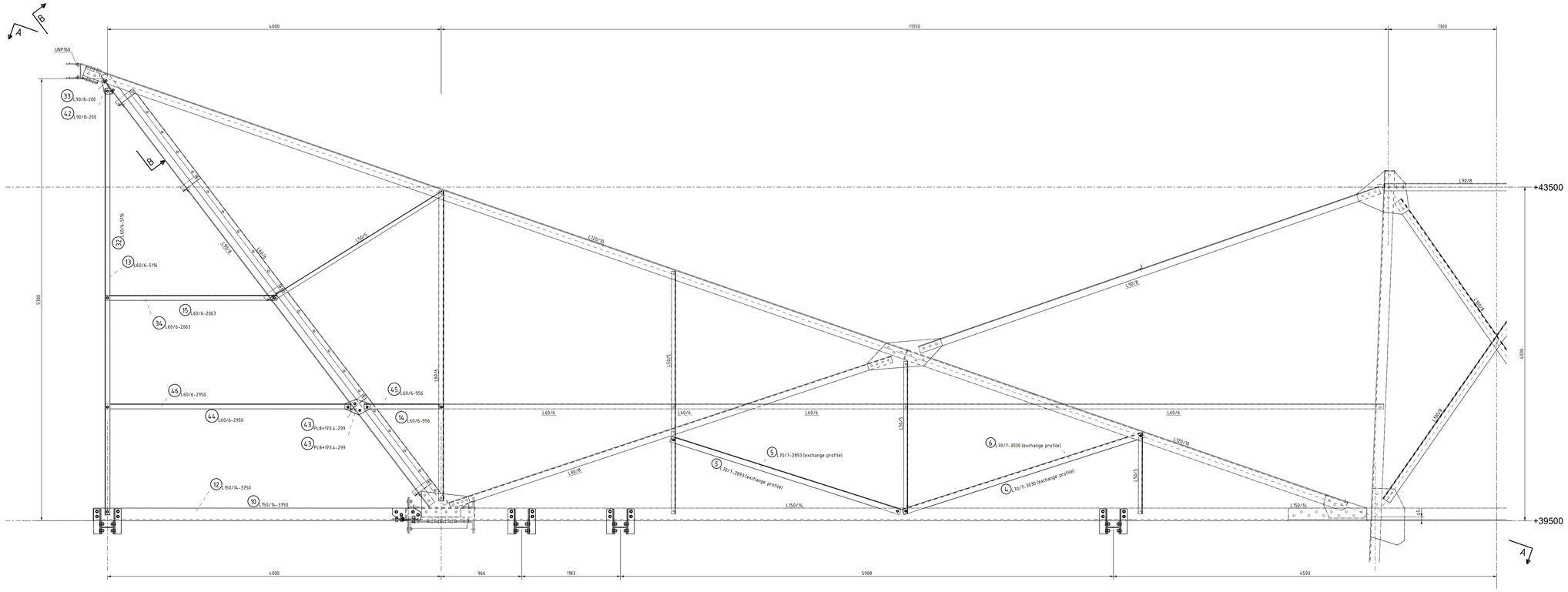
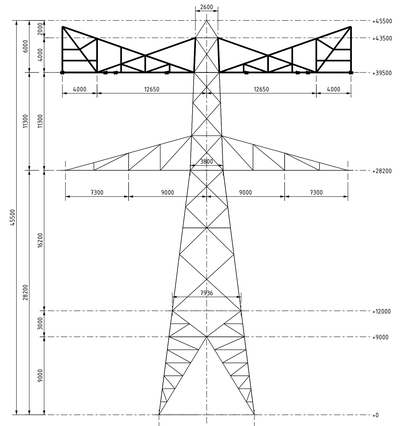
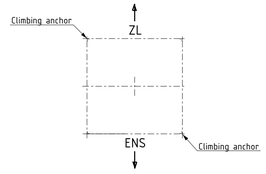


Front Face Upper Cross Arm
1:20



Transverse face
1:250



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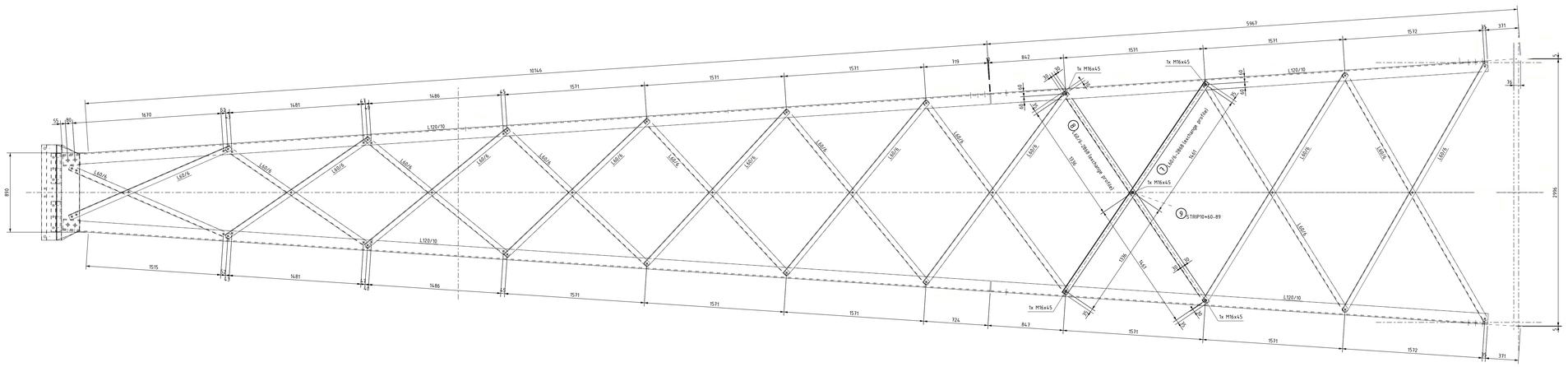

Section A - A
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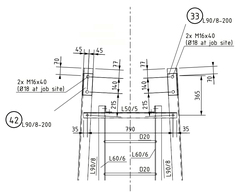

Section B - B
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All components of manufacture and finishing according to implementation of TenneT specifications below:
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- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

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Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

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Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
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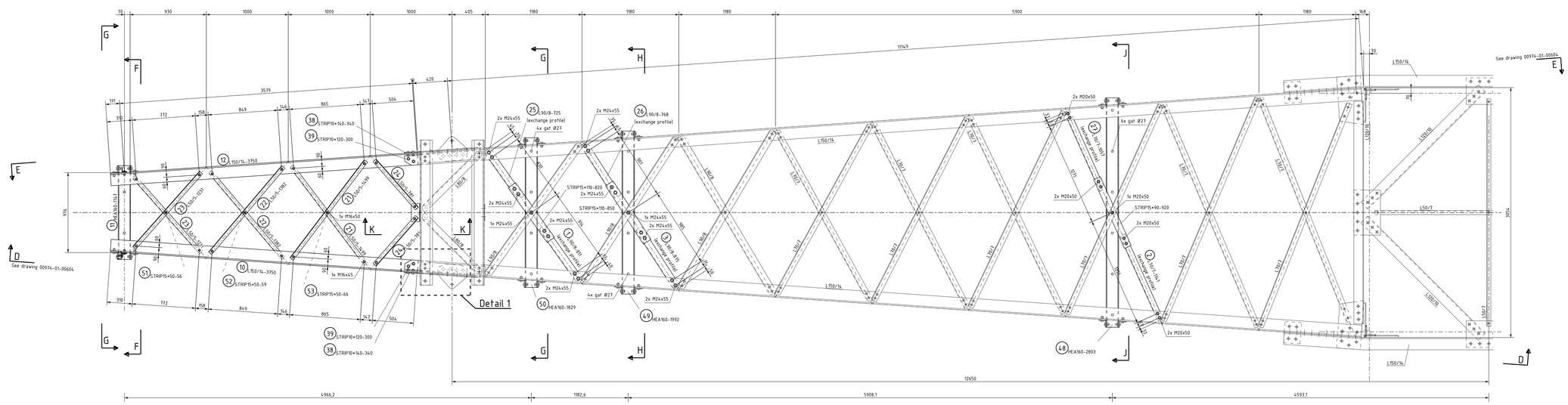
- If a profile needs to be replaced, always use new bolts.

See also drawing 00974-01-00603 and 00974-01-00604

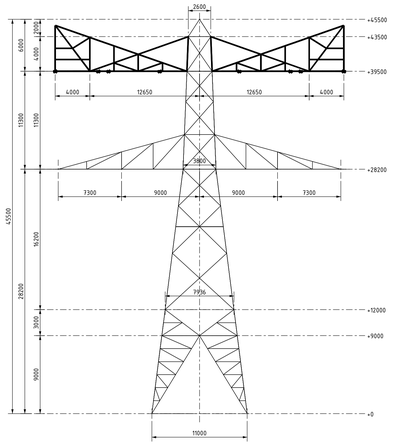
Opwaarderen 380 kV verbinding Ens - Zwolle				Vaststelling: Voorlopig		
Rev.	Datum revisie	Beschrijving revisie	Getekend	Datum Ao-Bolt	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:20 1:250	A0

Relatie	Tekening	Verbinding
	Categorie	Algemeen
	Documentsoort	Constructietekening
Ref. Tekeningnummer:	Object ID	ENS-ZL380 HB+0_R_X Mast 35
TenneT taking power further	Beschrijving	Masttype HB+0_R_X, Mast 35 - Ondertraverse Bovenvlak
	Documentnummer	00974-01-03503

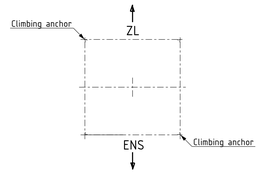
Tekla Structures



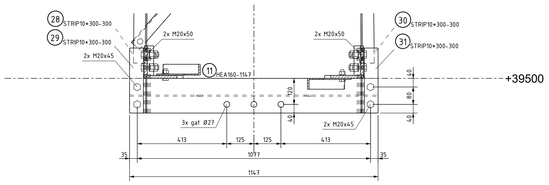
Bottom Surface Upper Cross Arm
1:20



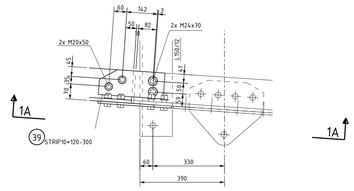
Transverse face
1:250



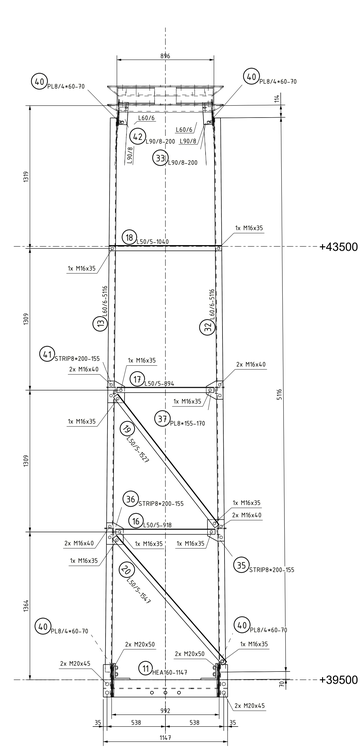
Section
1:250



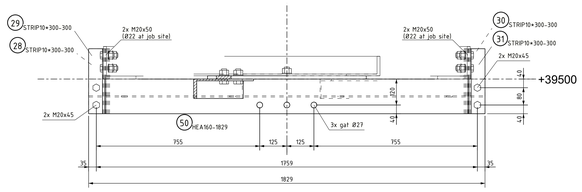
Section F - F
1:10



Detail 1
1:10



Section G - G
1:20



Section G - G
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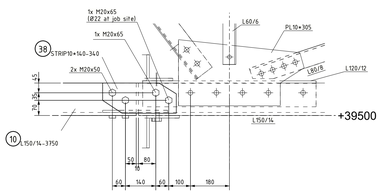
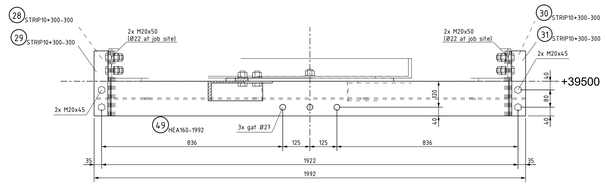
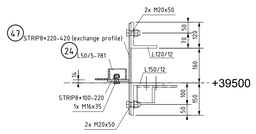


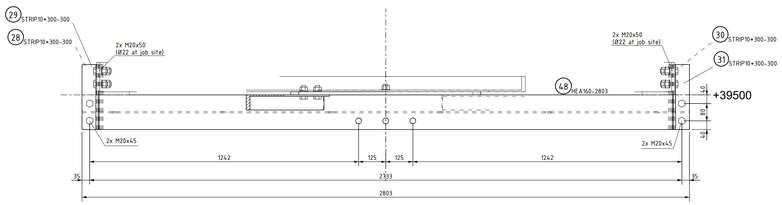
Section 1A - 1A
1:10



Section H - H
1:10



K - K
1:10



Section J - J
1:10

All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
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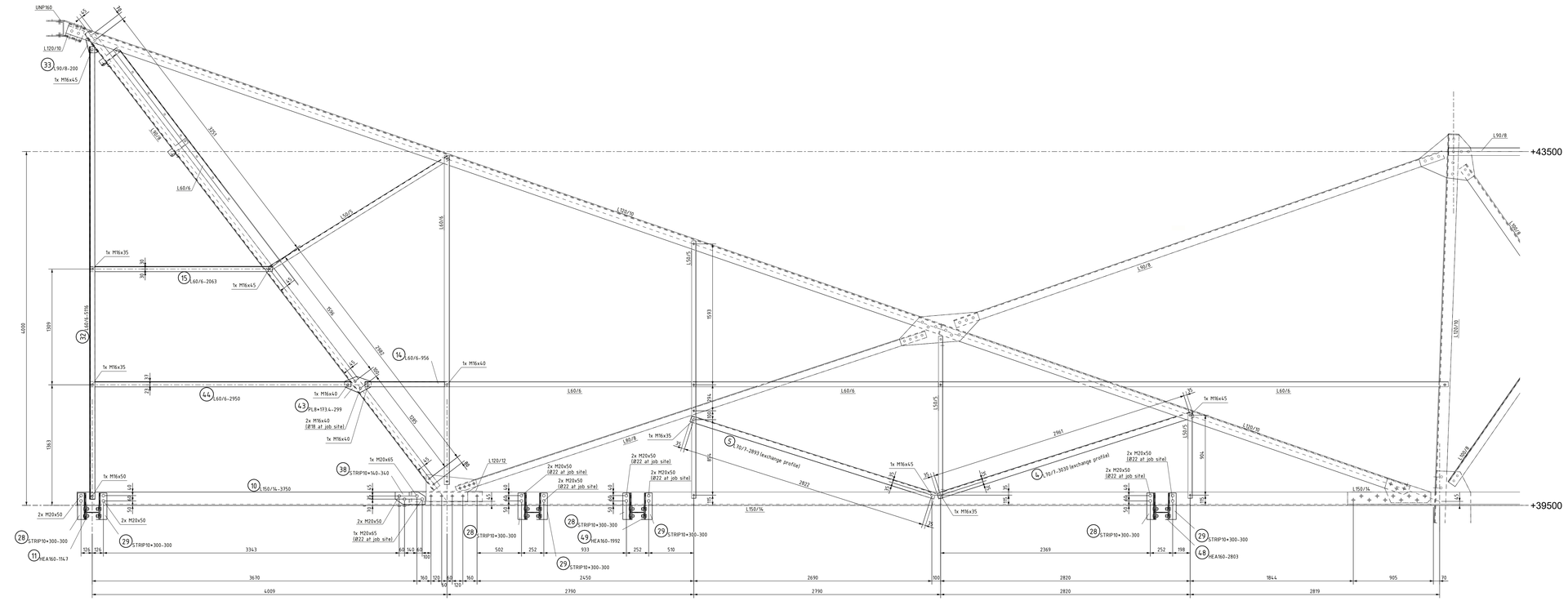
See also drawing 00974-01-00602 and 00974-01-00604

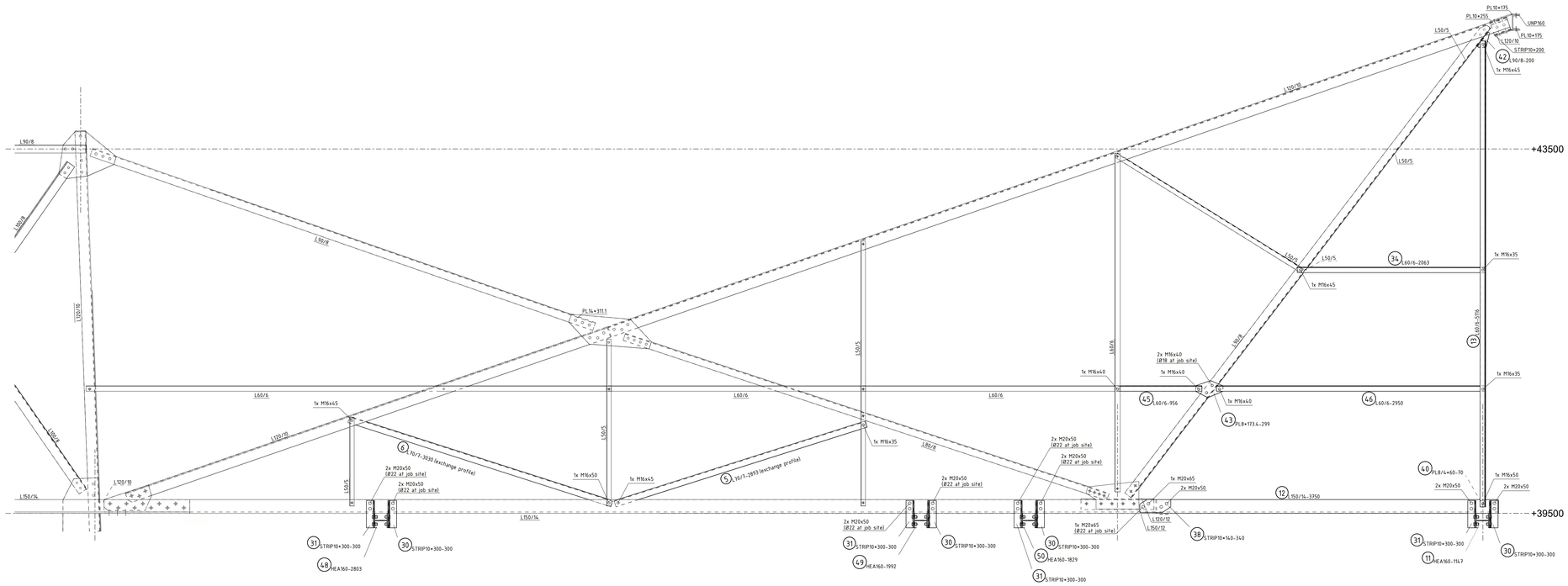
Opwaarderen 380 kV verbinding Ens - Zwolle				Vooriopig		
Rev.	Datum revisie	Beschrijving revisie	Getekend	Datum Ao-Bolt	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 1:20	A0

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentsoort	Constructietekening
Ind. tekeningnummer	Object ID	ENS-ZL380 HB+0_R_X Mast 35
	Beschrijving	Masttype HB+0_R_X, Mast 35 - Boventraverse Onderviak
TenneT Taking power further	Documentnummer	00974-01-03504

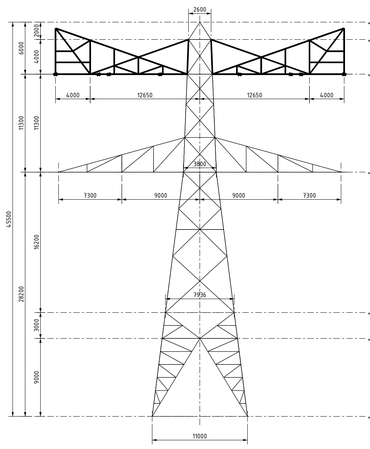
Tekla Structures



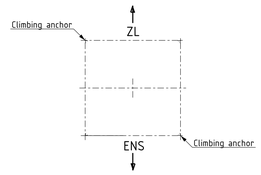
Section D - D
1:20



Section E - E
1:20



Transverse face
1:250



Section
1:250

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- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
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- Material quality S355J0 (t=16mm), S355J2 (16+t=40mm)
- All bended profiles and plates "HOT BENDING".
- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 - HDG oversized
Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

See also drawing 00974-01-00602 and 00974-01-00603

Rev.	Datum revisie	Beschrijving revisie	Getekend	Datum Ao-Bolt	Schaal	Formaat
++	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:20 1:250	A0

Relatie

Ref. Tekeningnummer:

Tekeningstatus: Voorlopig

Titel: Verbinding

Categorie: Algemeen

Documentsoort: Constructietekening

Object ID: ENS-ZL380 HB+0_R_X Mast 35

Beschrijving: Masttype HB+0_R_X, Mast 35 - Boventraverse Zijaanzichten

Documentnummer: 00974-01-03505

TenneT taking power further

Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-033510**

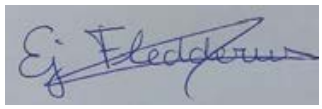
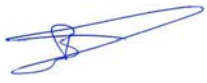
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994401**

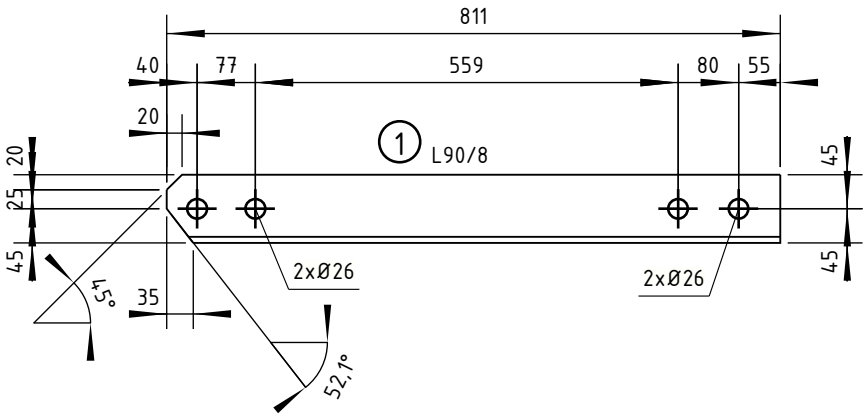
Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype HB+0_R_X, Mast 35 - Onderdeeltekeningen**

	Naam	Functie	Handtekening	Datum
Opgesteld	Erik Jan Fledderus	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review



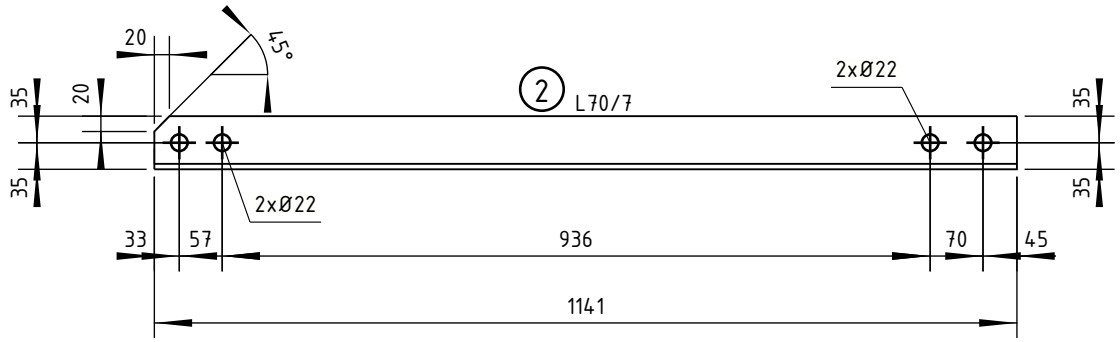
1	L90/8	2	S355J0	811	0.29
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [1]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



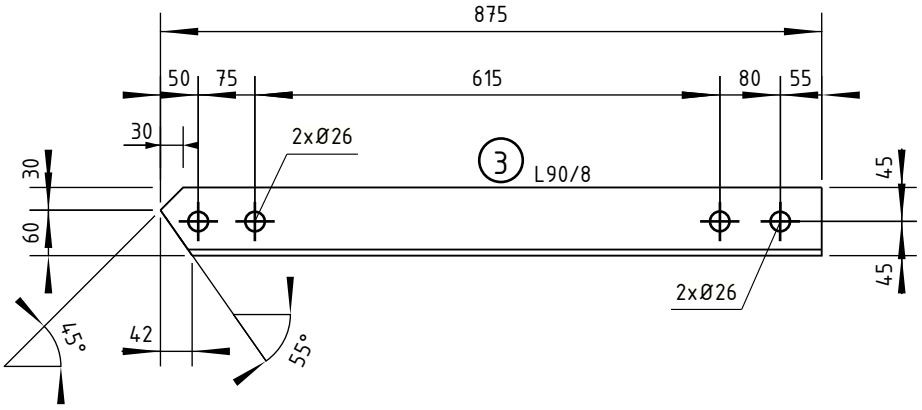
2	L70/7	2	S355J0	1141	0.32
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [2]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



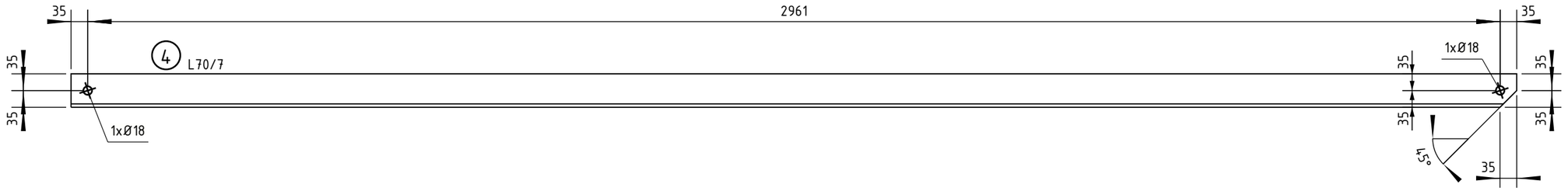
3	L90/8	2	S355J0	875	0.31
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [3]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



4	L70/7	2	S355J0	3030	0.85
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [4]
TenneT Taking power further	Documentnummer:	

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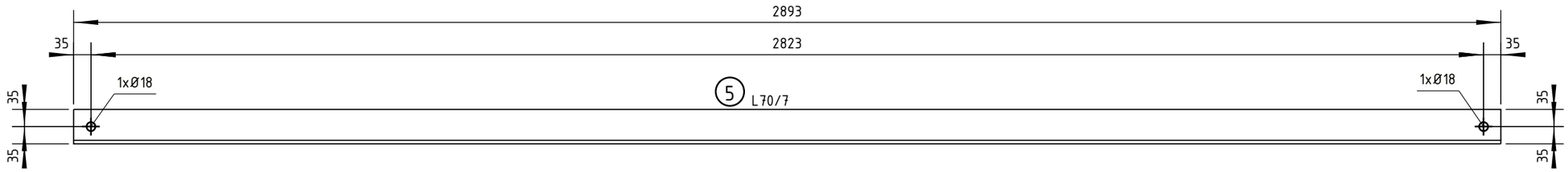

Pos	Profile	Number	Grade	Length	Area (m^2)
5	L70/7	4	S355J0	2893	0.81

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [5]
TenneT Taking power further	Documentnummer:	

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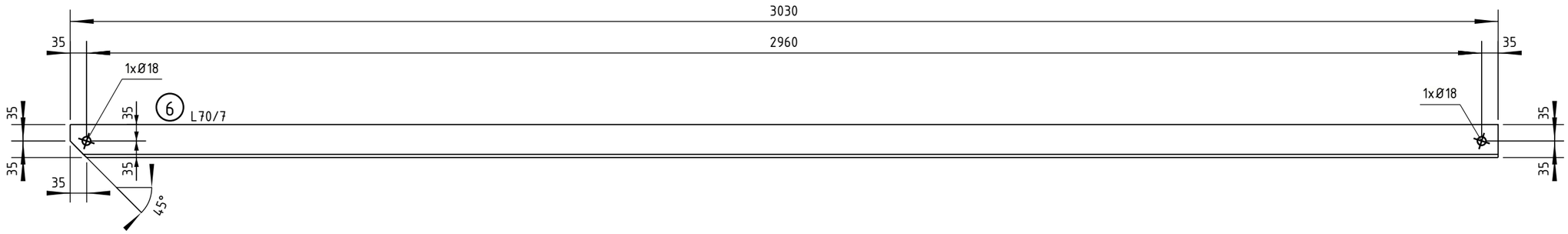

6	L70/7	2	S355J0	3030	0.85
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [6]
TenneT Taking power further	Documentnummer:	

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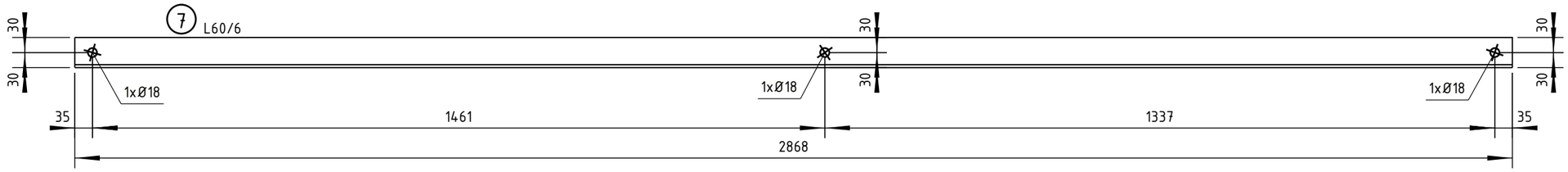


Pos	Profile	Number	Grade	Length	Area (m²)
7	L60/6	2	S355J0	2868	0.69

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

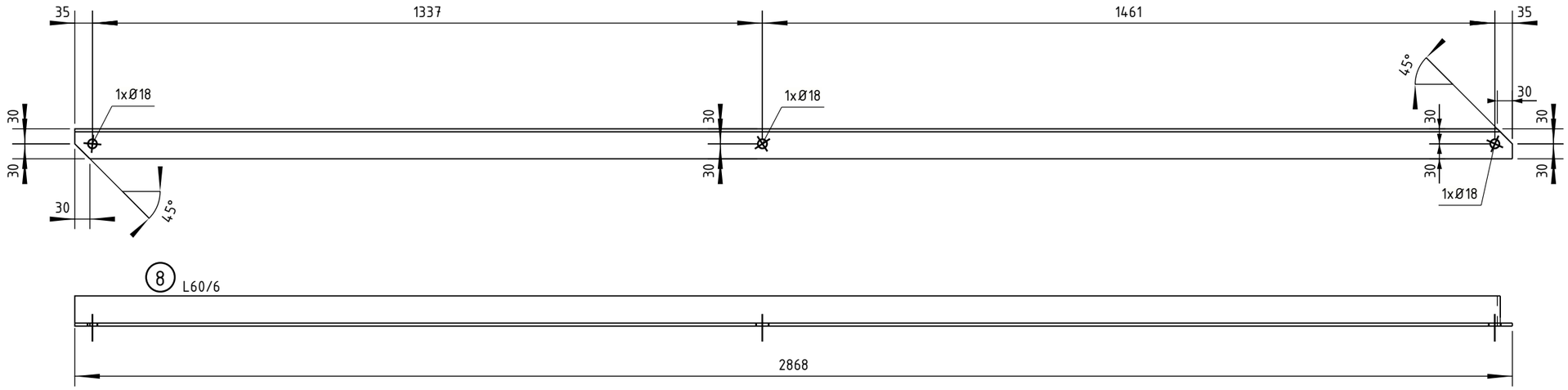
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Omschrijving:	Te vervangen staal - onderdeel [7]
Documentnummer:	

TenneT Taking power further

Tekla Structures



8	L60/6	2	S355J0	2868	0.69
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
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TenneT Taking power further	Documentnummer:	

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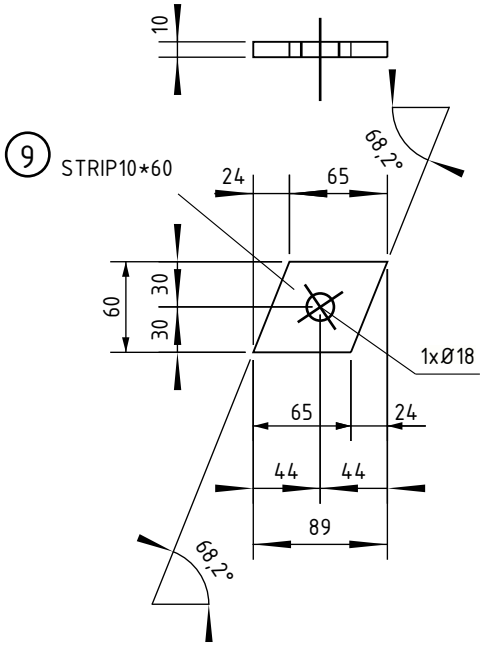
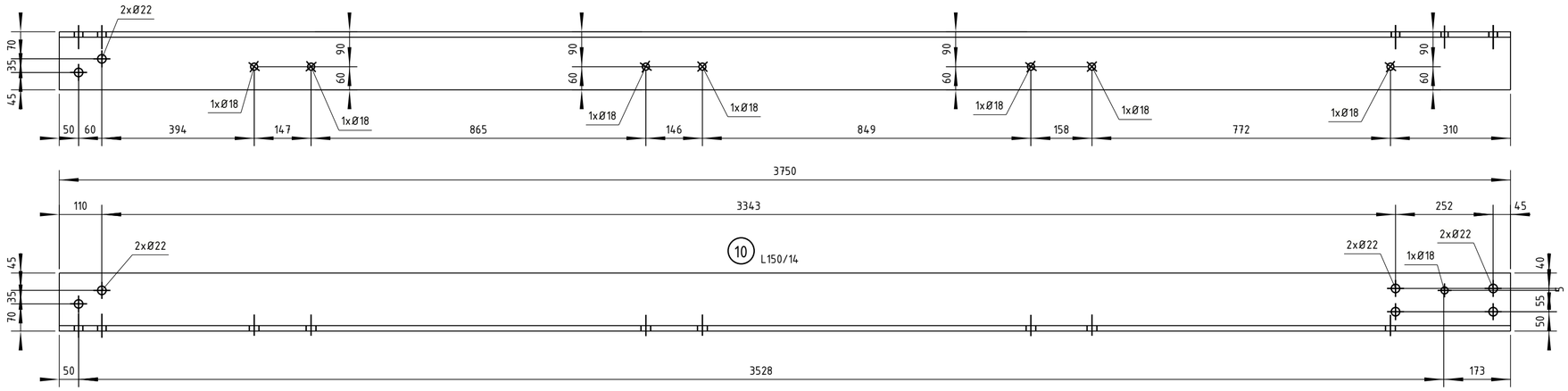


9	STRIP10*60	2	S355J0	89	0.01
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [9]
TenneT Taking power further	Documentnummer:	

Tekla Structures



10	L150/14	2	S355J0	3750	2.25
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

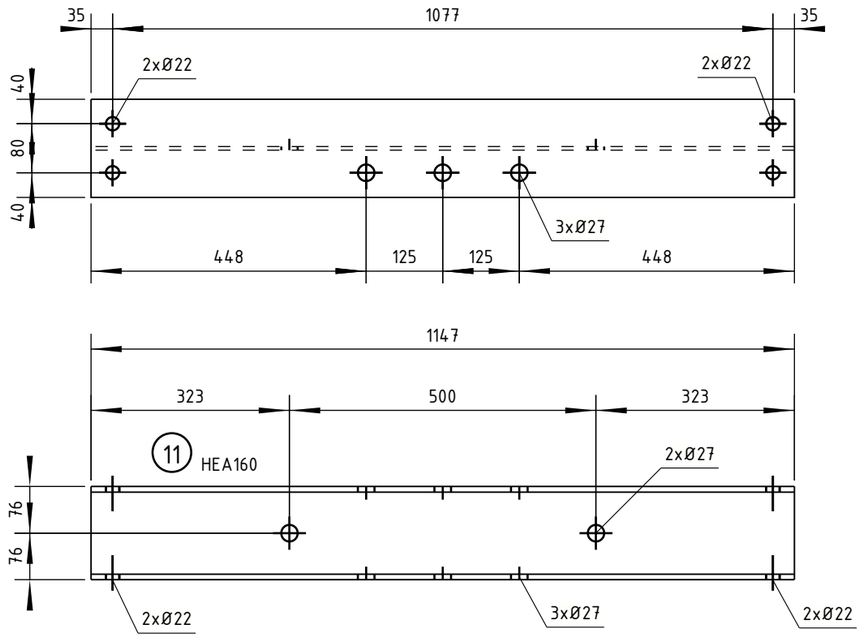
Object ID: ENS-ZL380 HB+0_R_X Mast 35

Omschrijving: Nieuw staal - onderdeel [10]

Documentnummer:

TenneT Taking power further

Tekla Structures



11	HEA160	2	S355J0	1147	1.04
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [11]
TenneT Taking power further	Documentnummer:	

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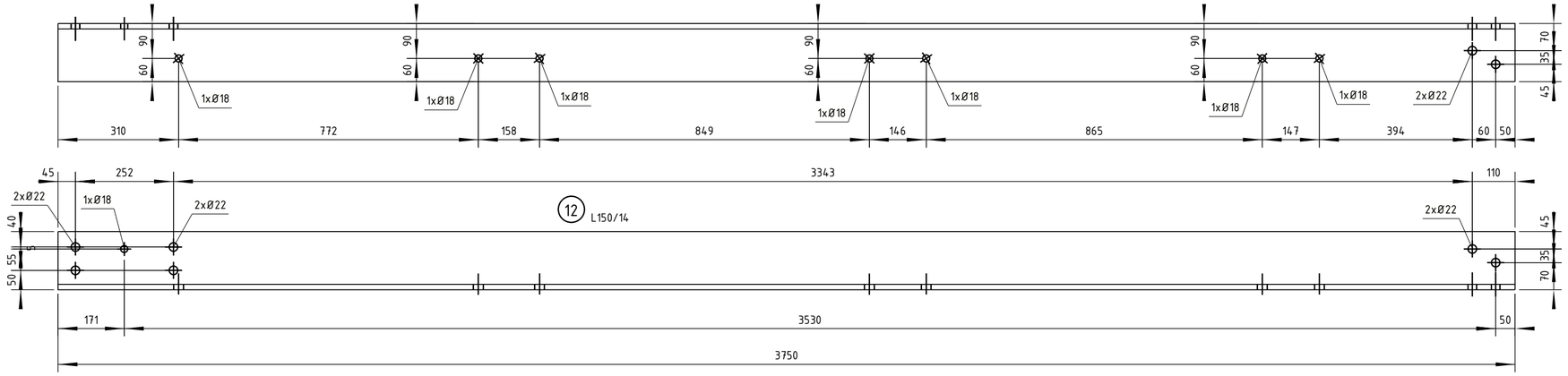


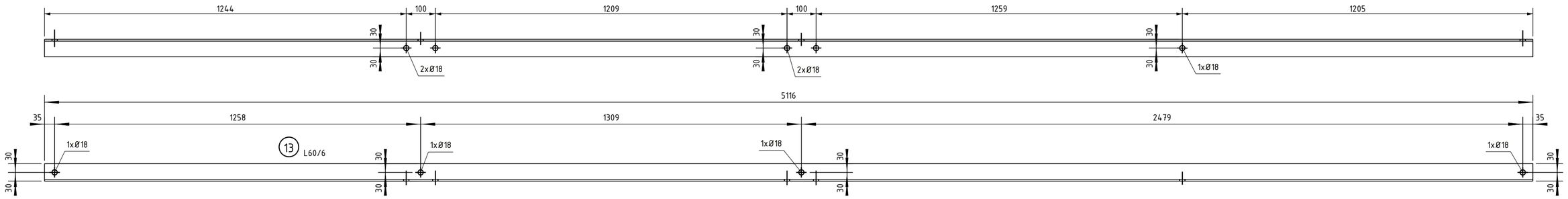
12	L150/14	2	S355J0	3750	2.25
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [12]
Documentnummer:	

TenneT Taking power further

Tekla Structures



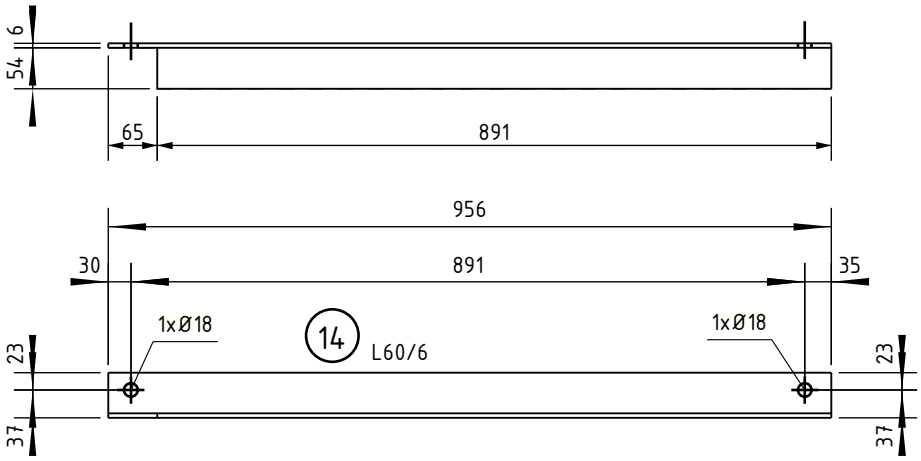
13	L60/6	2	S355J0	5116	1.23
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus	
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie	
Oud tekeningnummer:	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Omschrijving:	Nieuw staal - onderdeel [13]
Documentnummer:	

TenneT Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m^2)
14	L60/6	2	S355J0	956	0.23

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
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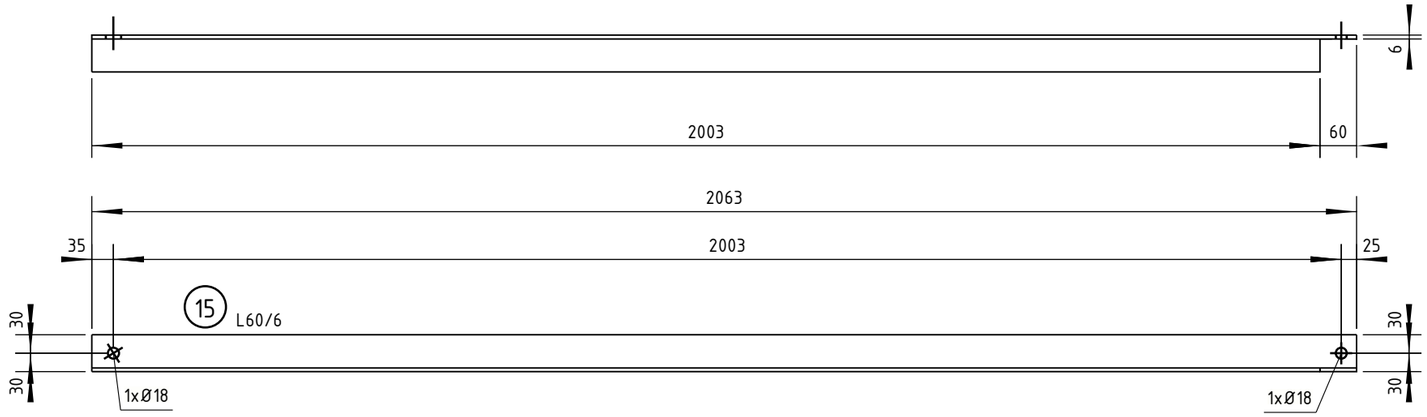
	Documentnummer:	

TenneT Taking power further

Tekla Structures



15	L60/6	2	S355J0	2063	0.50
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380 HB+0_R_X Mast 35
tennet Taking power further	Omschrijving:	Nieuw staal - onderdeel [15]
	Documentnummer:	

Tekla Structures

16	L50/5	2	S355J0	918	0.18
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [16]
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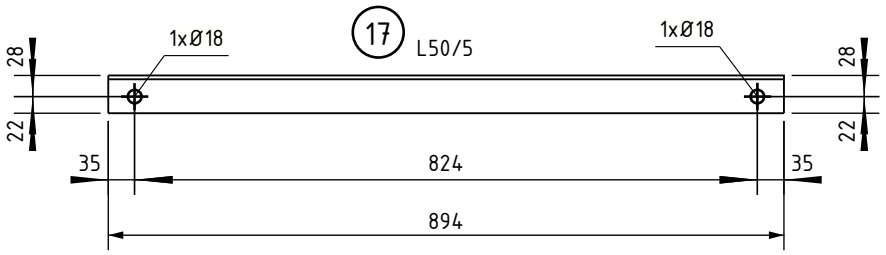
Taking power further

Tekla Structures



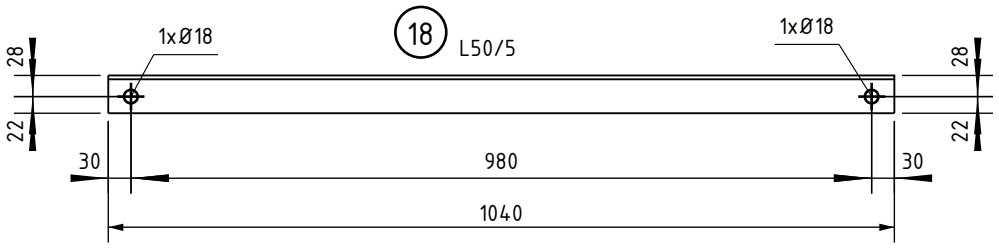
17	L50/5	2	S355J0	894	0.18
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [17]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



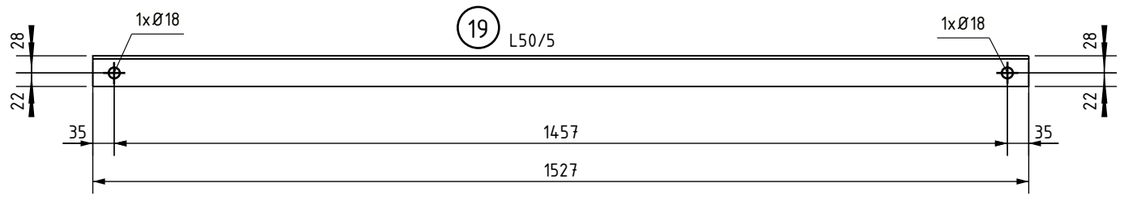
Pos	Profile	Number	Grade	Length	Area (m^2)
18	L50/5	2	S355J0	1040	0.21

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [18]
Documentnummer:	

TenneT Taking power further

Tekla Structures

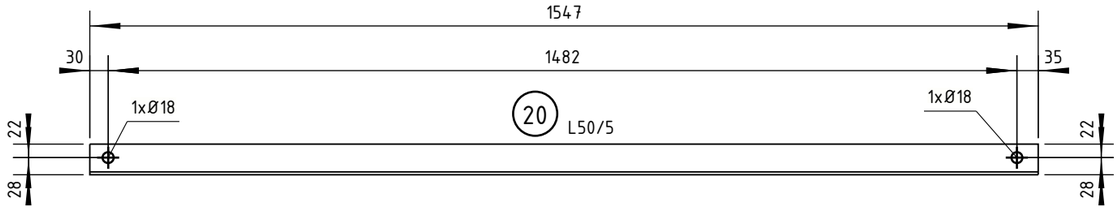


19	L50/5	2	S355J0	1527	0.31
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [19]
TenneT Taking power further	Documentnummer:	

Tekla Structures



20	L50/5	2	S355J0	1547	0.31
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

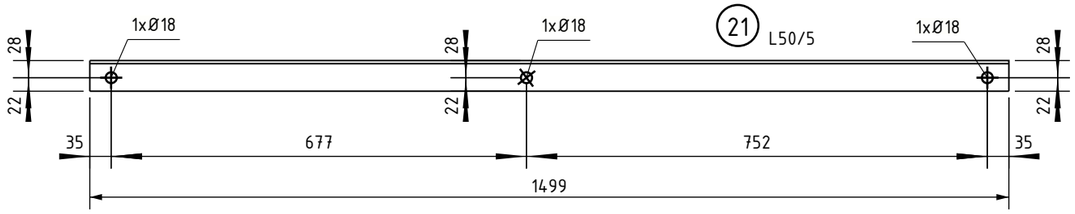
Object ID: ENS-ZL380 HB+0_R_X Mast 35

Omschrijving: Nieuw staal - onderdeel [20]

Documentnummer:

TenneT Taking power further

Tekla Structures

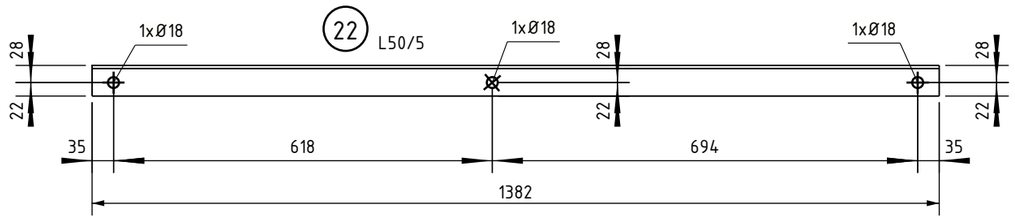


21	L50/5	4	S355J0	1499	0.30
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [21]
TenneT Taking power further	Documentnummer:	

Tekla Structures

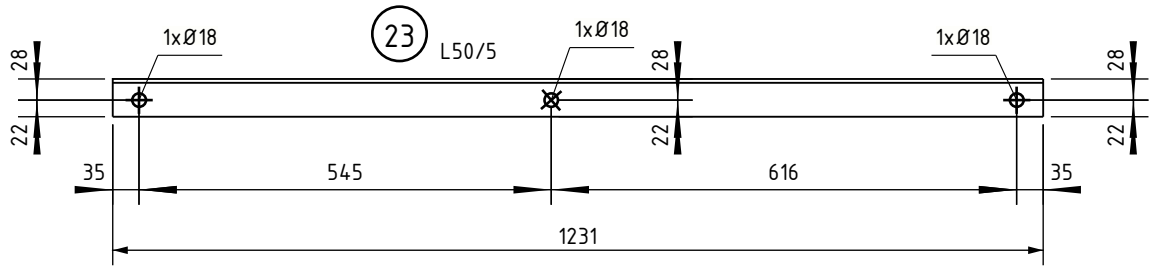


22	L50/5	4	S355J0	1382	0.28
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [22]
TenneT Taking power further	Documentnummer:	

Tekla Structures



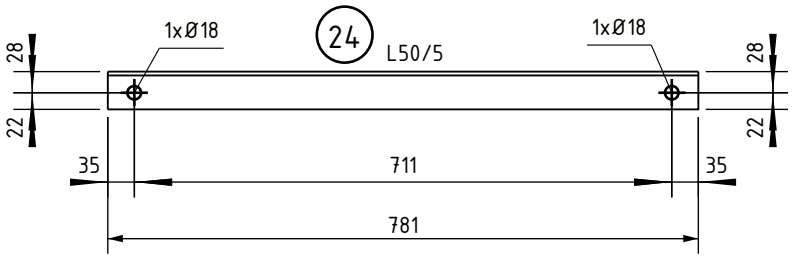
23	L50/5	4	S355J0	1231	0.25
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [23]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



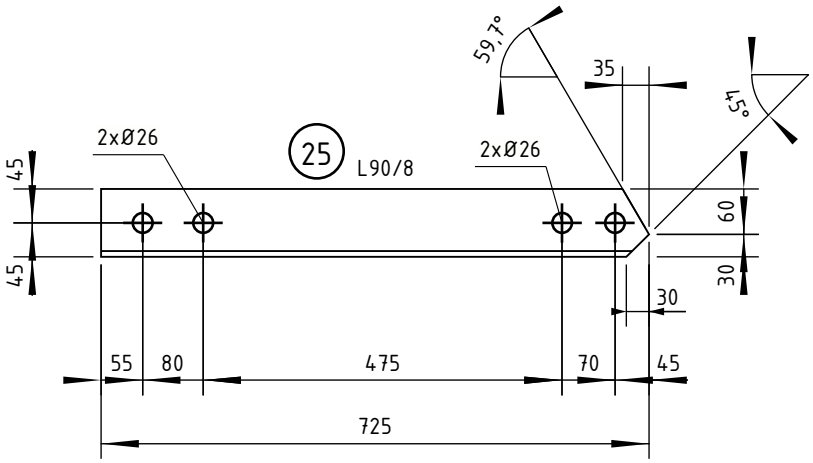
24	L50/5	4	S355J0	781	0.16
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [24]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



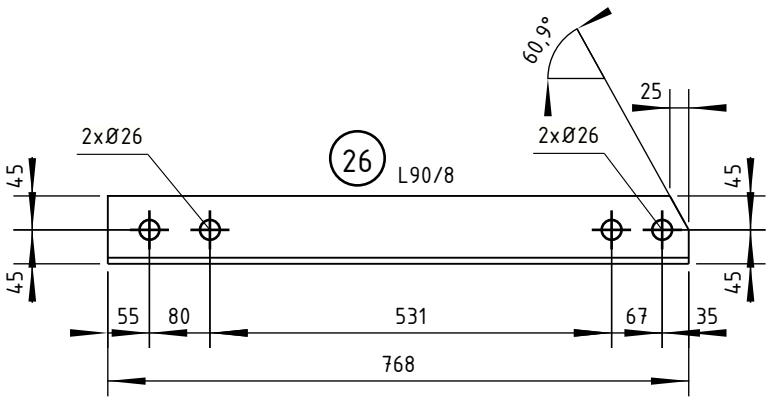
Pos	Profile	Number	Grade	Length	Area (m^2)
25	L90/8	2	S355J0	725	0.26

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Te vervangen staal - onderdeel [25]
Documentnummer:	

TenneT Taking power further

Tekla Structures



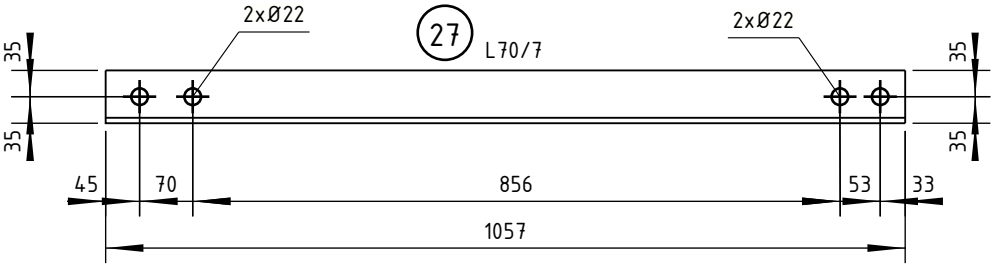
Pos	Profile	Number	Grade	Length	Area (m^2)
26	L90/8	2	S355J0	768	0.28

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [26]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



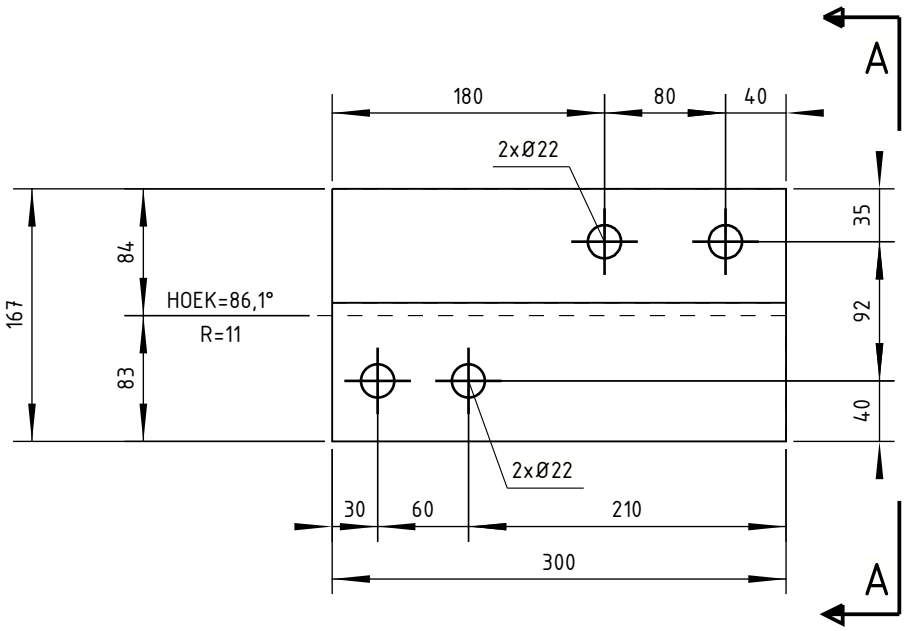
27	L70/7	2	S355J0	1057	0.30
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

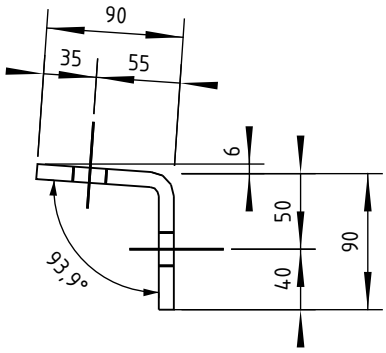
Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [27]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



hot bend



A – A
1:5

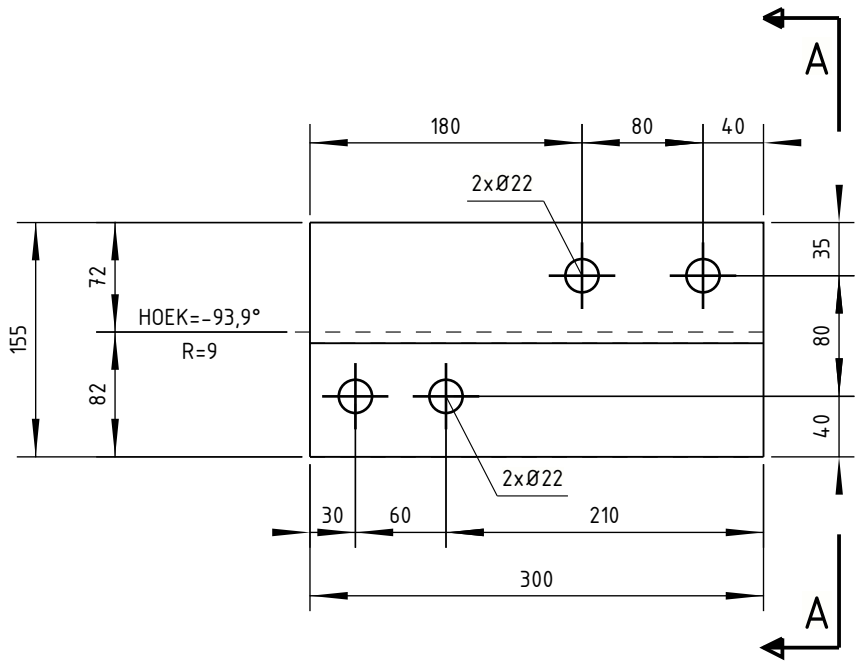
Pos	Profile	Number	Grade	Length	Area (m^2)
28	STRIP10*300	8	S355J0	300	0.11

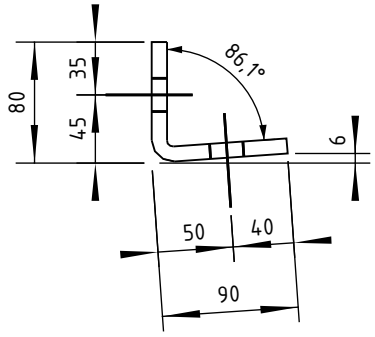
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [28]
Documentnummer:	

TenneT Taking power further

Tekla Structures





hot bend

A - A
1:5

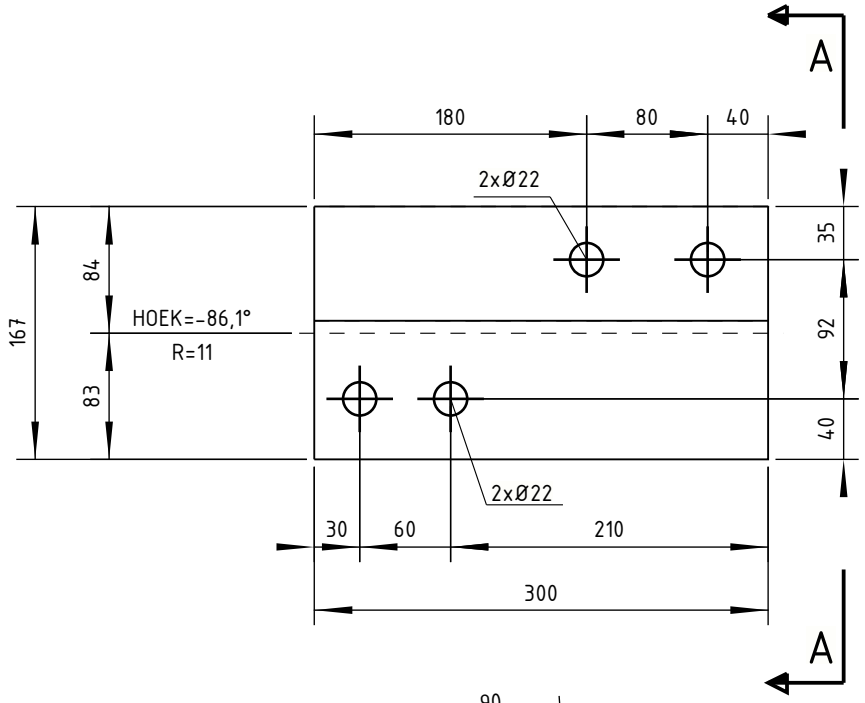
Pos	Profile	Number	Grade	Length	Area (m^2)
29	STRIP10*300	8	S355J0	300	0.10

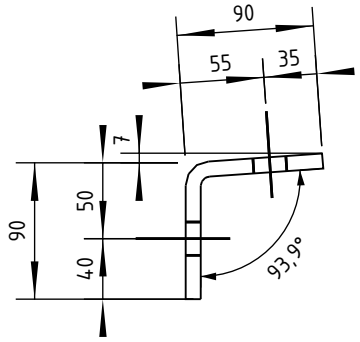
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [29]
Documentnummer:	

TenneT Taking power further

Tekla Structures





hot bend

A - A
1:5

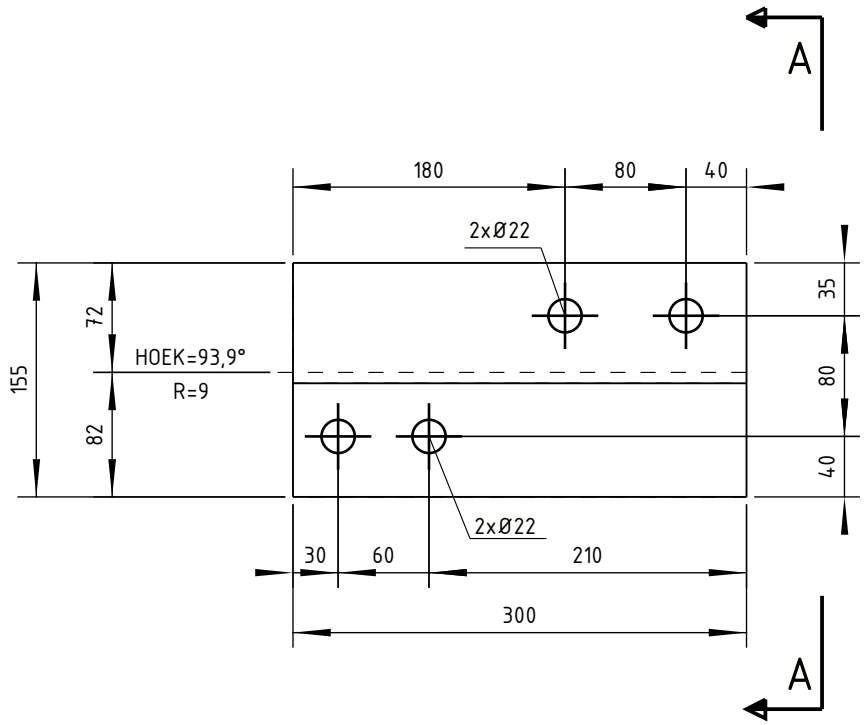
Pos	Profile	Number	Grade	Length	Area (m^2)
30	STRIP10*300	8	S355J0	300	0.11

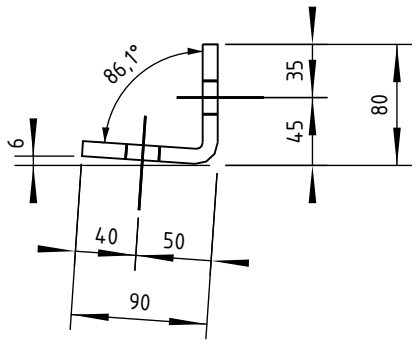
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [30]
	Documentnummer:	

TenneT Taking power further

Tekla Structures





hot bend

A - A
1:5

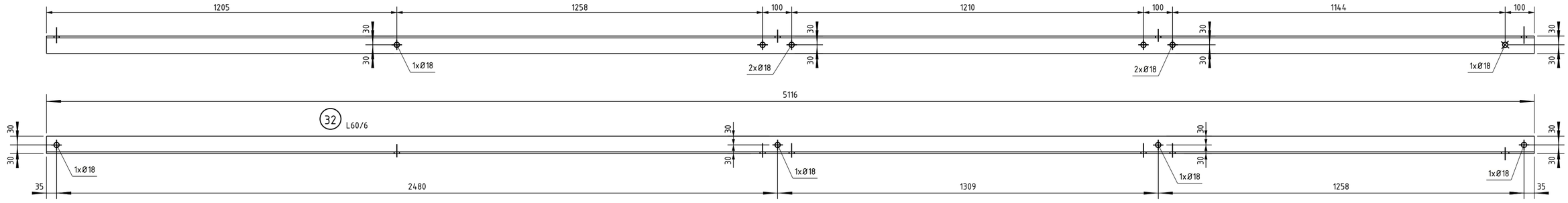
Pos	Profile	Number	Grade	Length	Area (m^2)
31	STRIP10*300	8	S355J0	300	0.10

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [31]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



32	L60/6	2	S355J0	5116	1.23
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

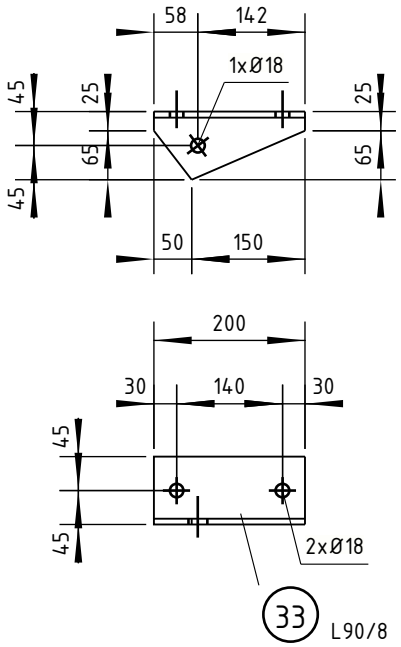
Object ID: ENS-ZL380 HB+0_R_X Mast 35

Omschrijving: Nieuw staal - onderdeel [32]

Documentnummer:

TenneT Taking power further

Tekla Structures



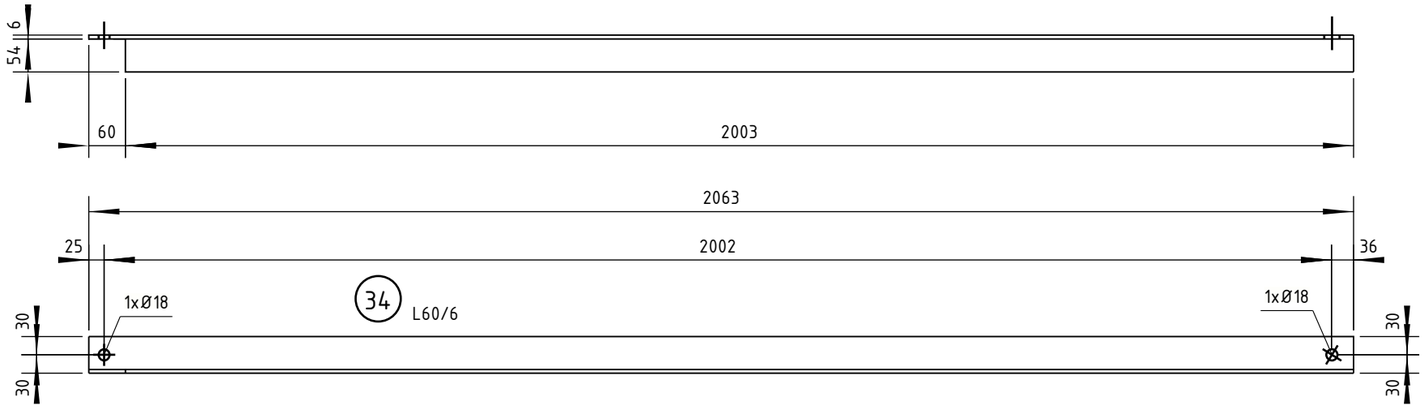
33	L90/8	2	S355J0	200	0.07
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [33]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



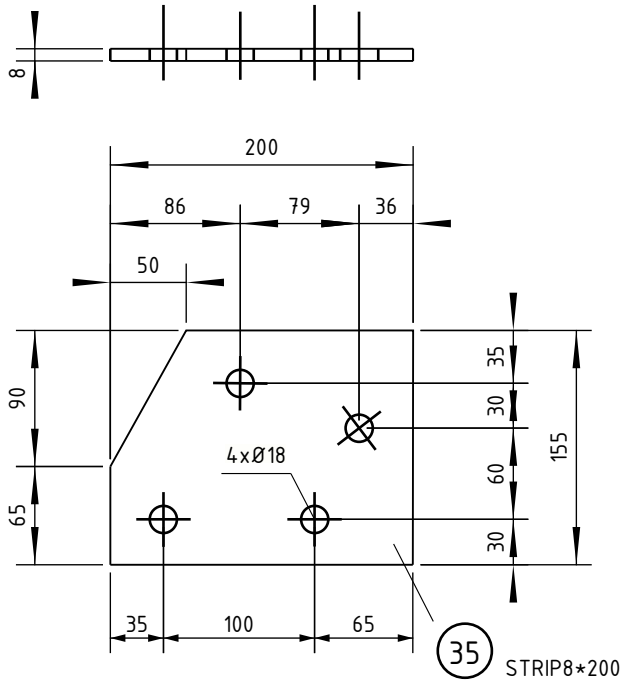
Pos	Profile	Number	Grade	Length	Area (m²)
34	L60/6	2	S355J0	2063	0.50

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [34]
Documentnummer:	

tennet
Taking power further

Tekla Structures



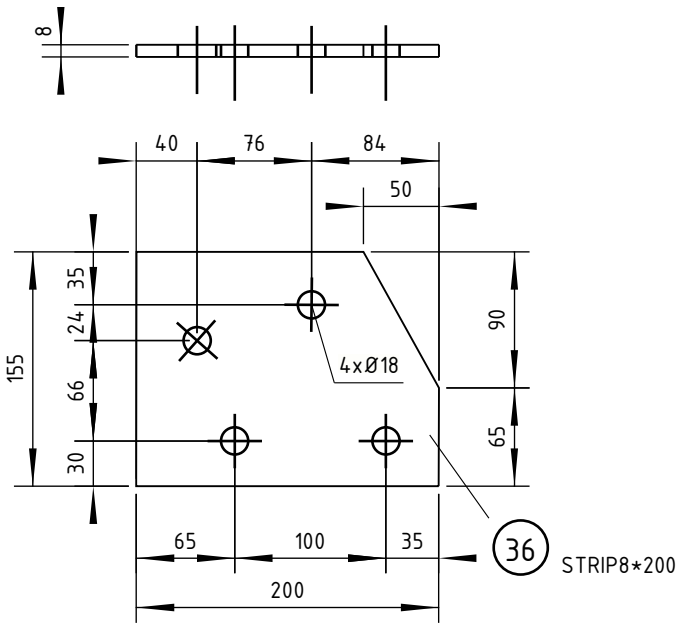
Pos	Profile	Number	Grade	Length	Area (m^2)
35	STRIP8*200	2	S355J0	155	0.06

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [35]
Documentnummer:	

TenneT Taking power further

Tekla Structures



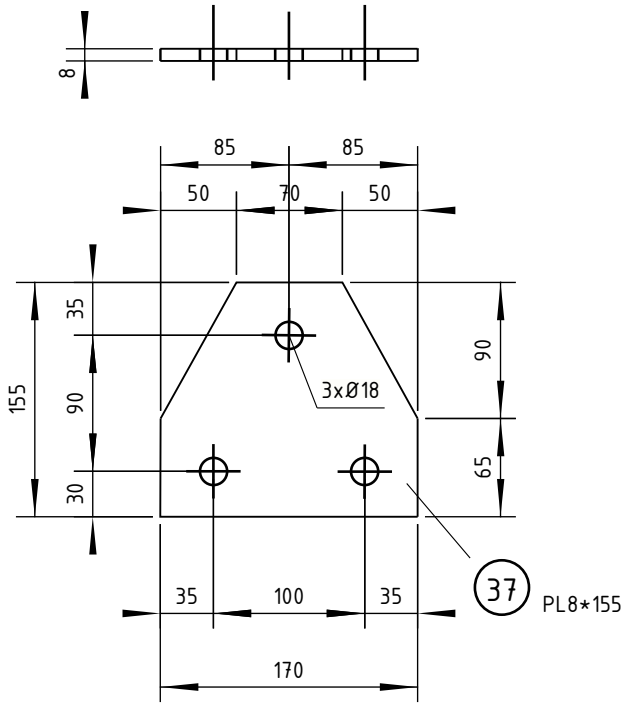
Pos	Profile	Number	Grade	Length	Area (m^2)
36	STRIP8*200	2	S355J0	155	0.06

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [36]
Documentnummer:	

TenneT Taking power further

Tekla Structures



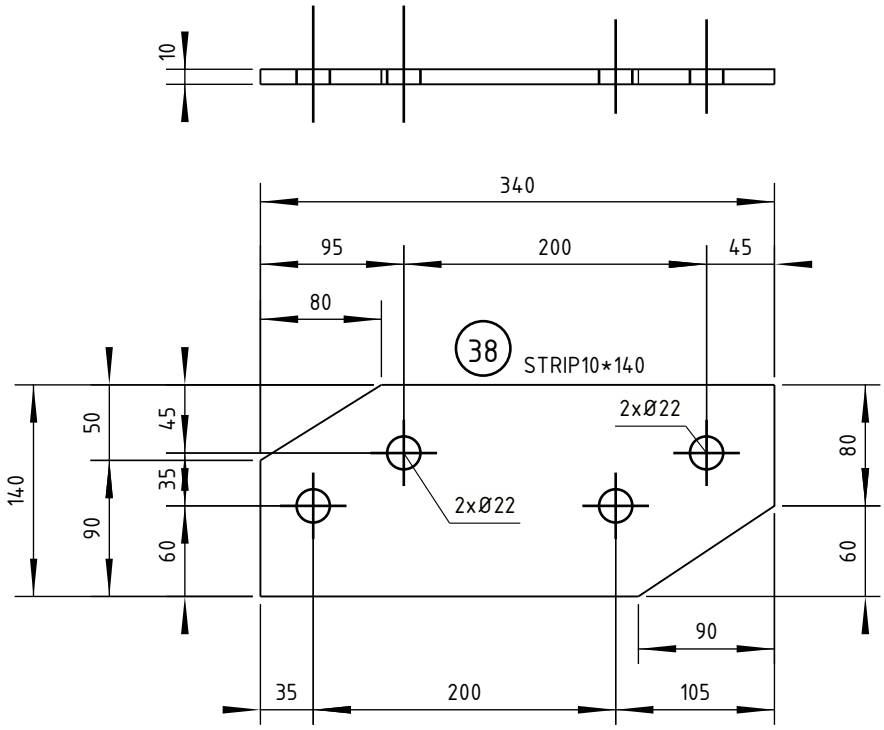
37	PL8*155	2	S355J0	170	0.05
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [37]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



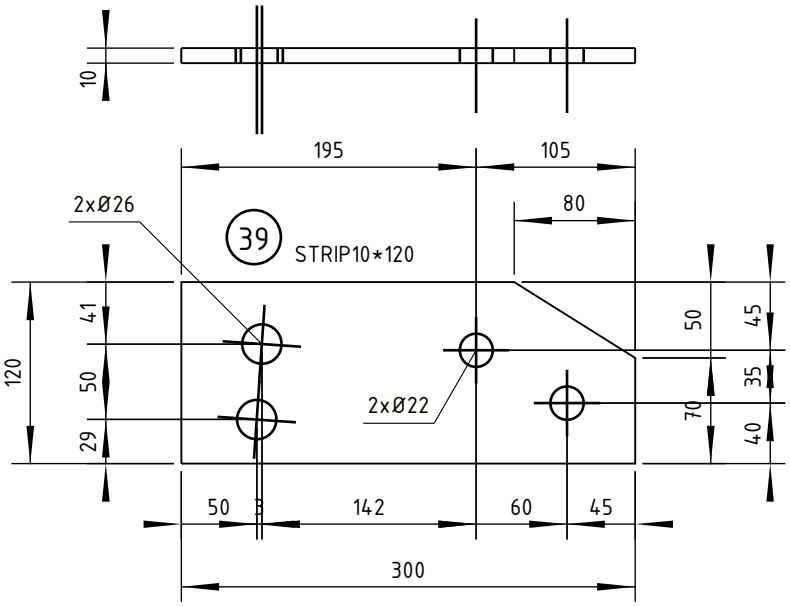
38	STRIP10*140	4	S355J0	340	0.09
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [38]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



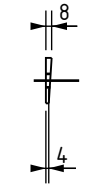
39	STRIP10*120	4	S355J0	300	0.08
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

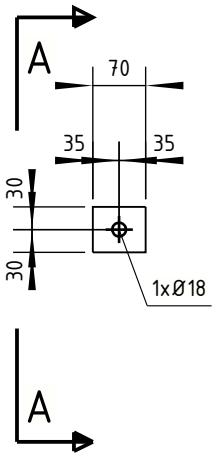
Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [39]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



A – A
1:10



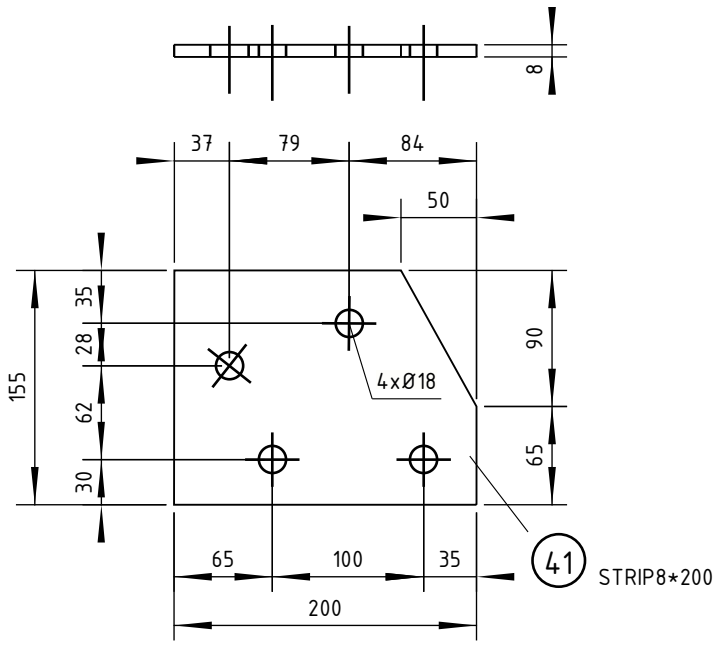
Pos	Profile	Number	Grade	Length	Area (m^2)
40	PL8/4*60	8	S355J0	70	0.00

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [40]
Documentnummer:	

TenneT Taking power further

Tekla Structures



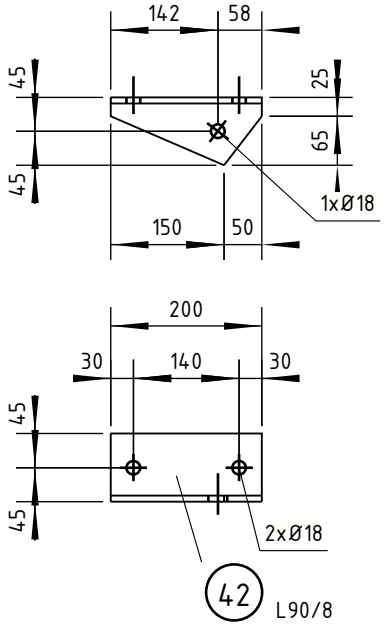
41	STRIP8*200	2	S355J0	155	0.06
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [41]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



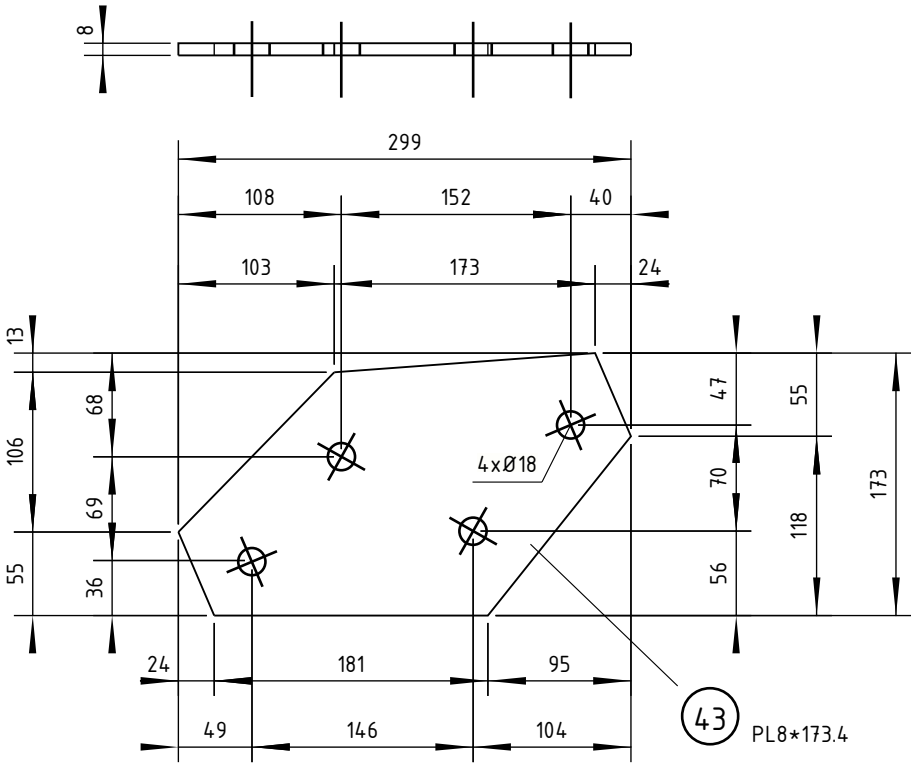
42	L90/8	2	S355J0	200	0.07
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [42]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



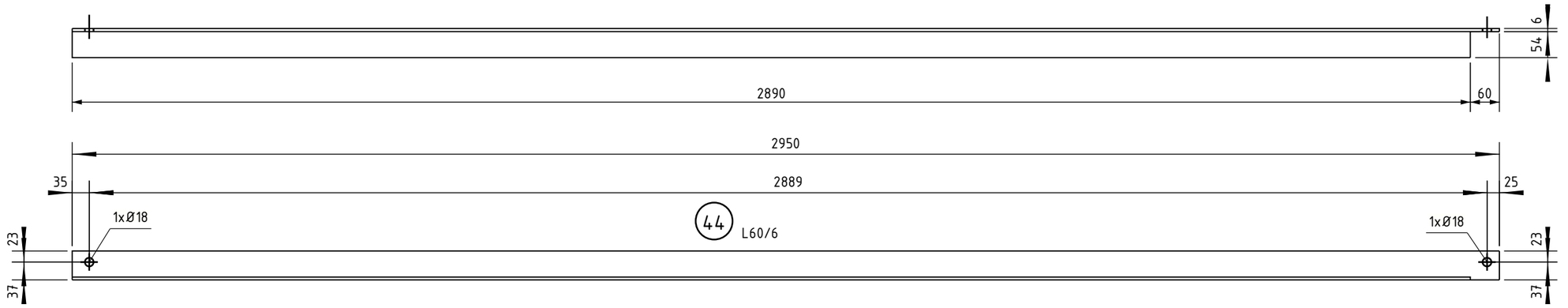
43	PL8*173.4	4	S355J0	299	0.08
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [43]
	Documentnummer:	

tennet
Taking power further

Tekla Structures

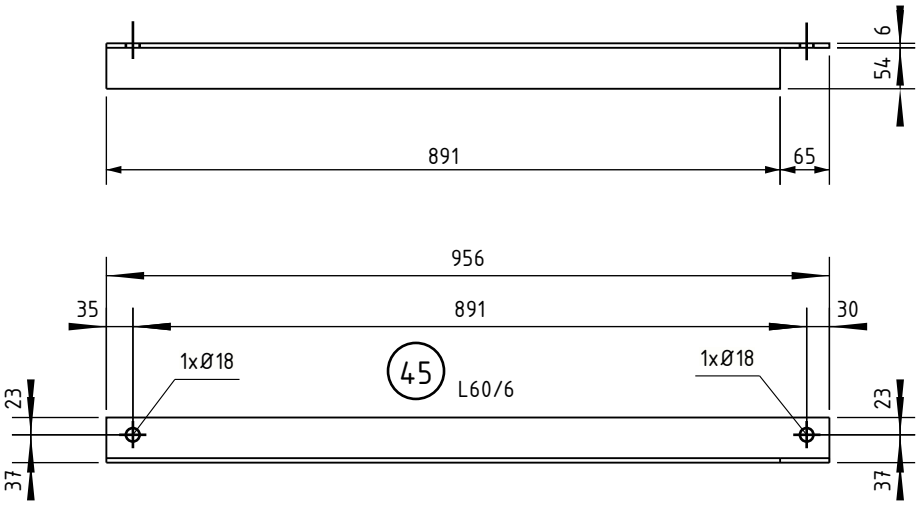


44	L60/6	2	S355J0	2950	0.71
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [44]
TenneT Taking power further	Documentnummer:	

Tekla Structures



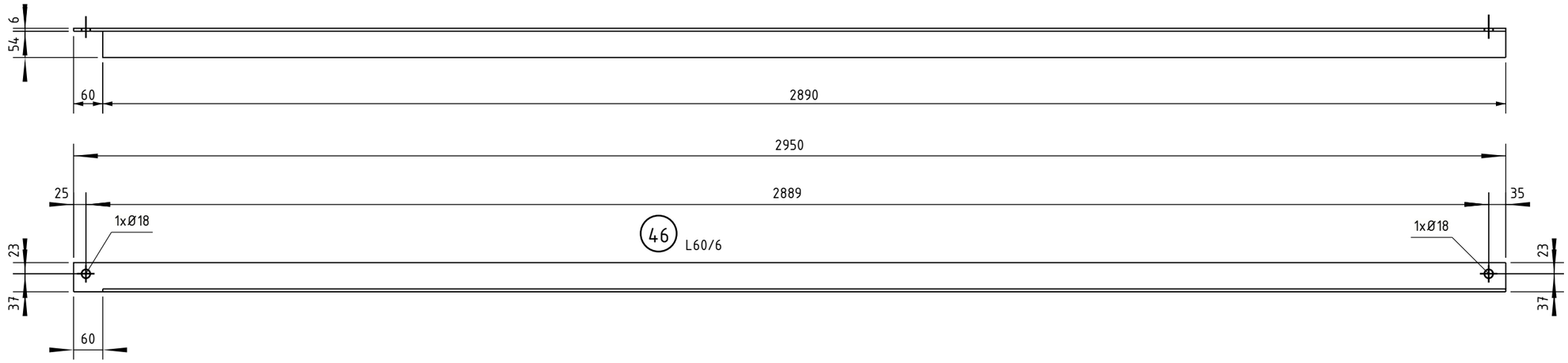
Pos	Profile	Number	Grade	Length	Area (m^2)
45	L60/6	2	S355J0	956	0.23

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [45]
Documentnummer:	

TenneT Taking power further

Tekla Structures

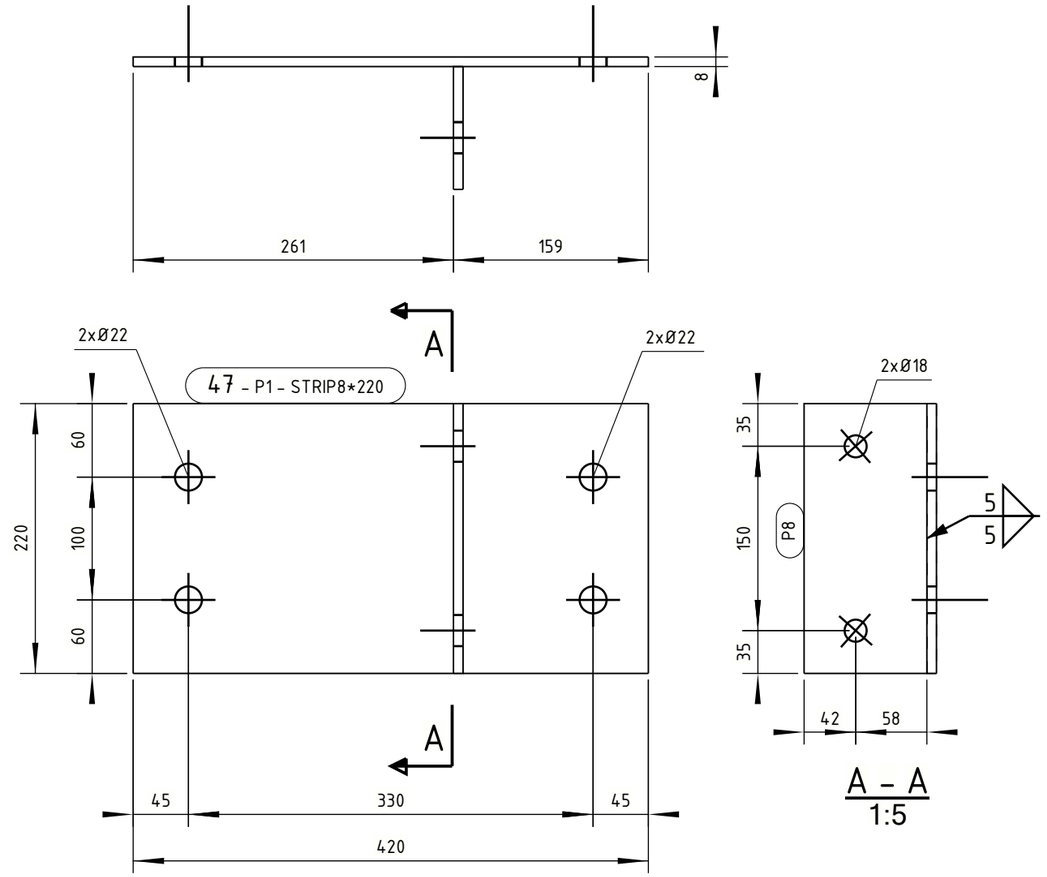


46	L60/6	2	S355J0	2950	0.71
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [46]
TenneT Taking power further	Documentnummer:	

Tekla Structures



ASSEMBLY

Mark: 47 length (mm): 420 Number: 2

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P1	STRIP8*220	S355J0	1	420	5.9	0.20
P8	STRIP8*100	S355J0	1	220	1.4	0.05
				Total of one mark	7.3	0.24

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5 / A3

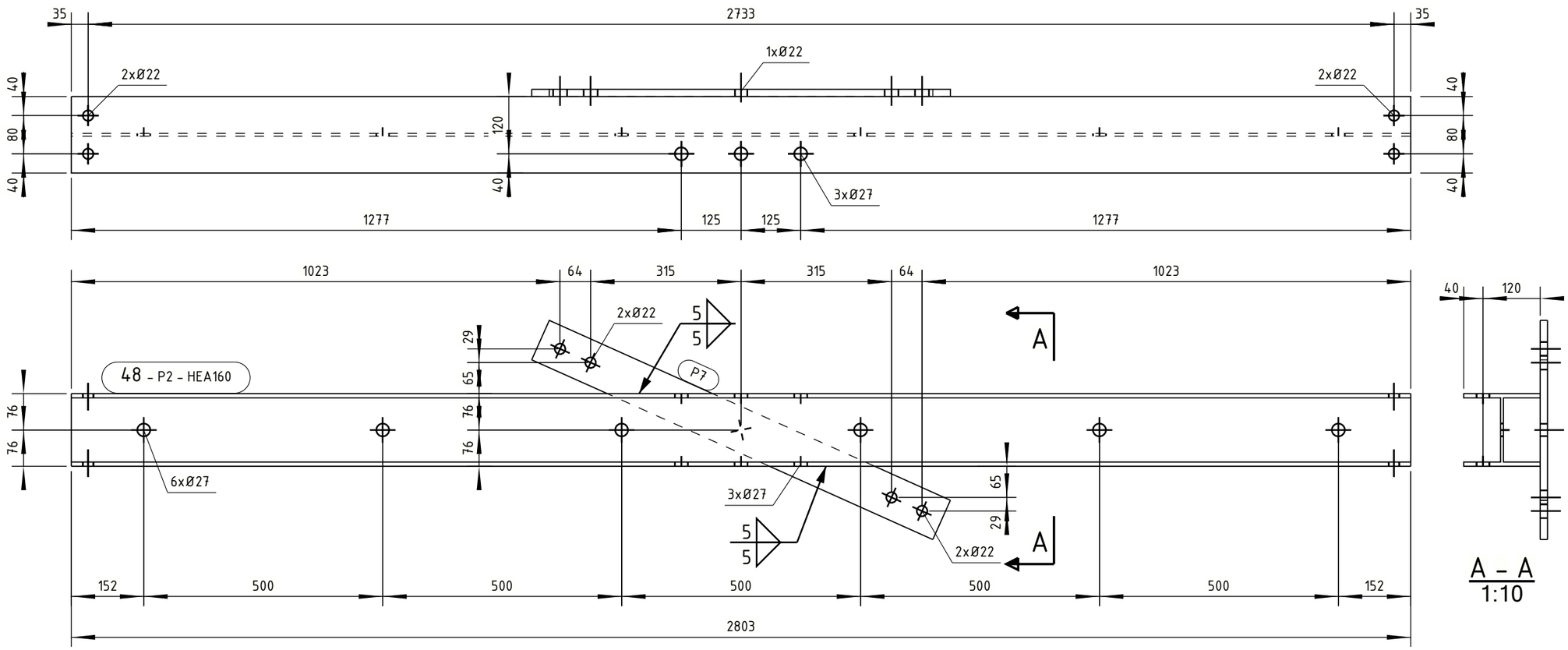
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Omschrijving:	Te vervangen staal - onderdeel [47]
Documentnummer:	

TenneT Taking power further

Tekla Structures



A - A
1:10

ASSEMBLY
Mark: 48 length (mm): 2803 Number: 2

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P2	HEA160	S355J0	1	2803	86.9	2.54
P7	STRIP15*90	S355J0	1	920	9.9	0.20
				Total of one mark	96.9	2.74

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

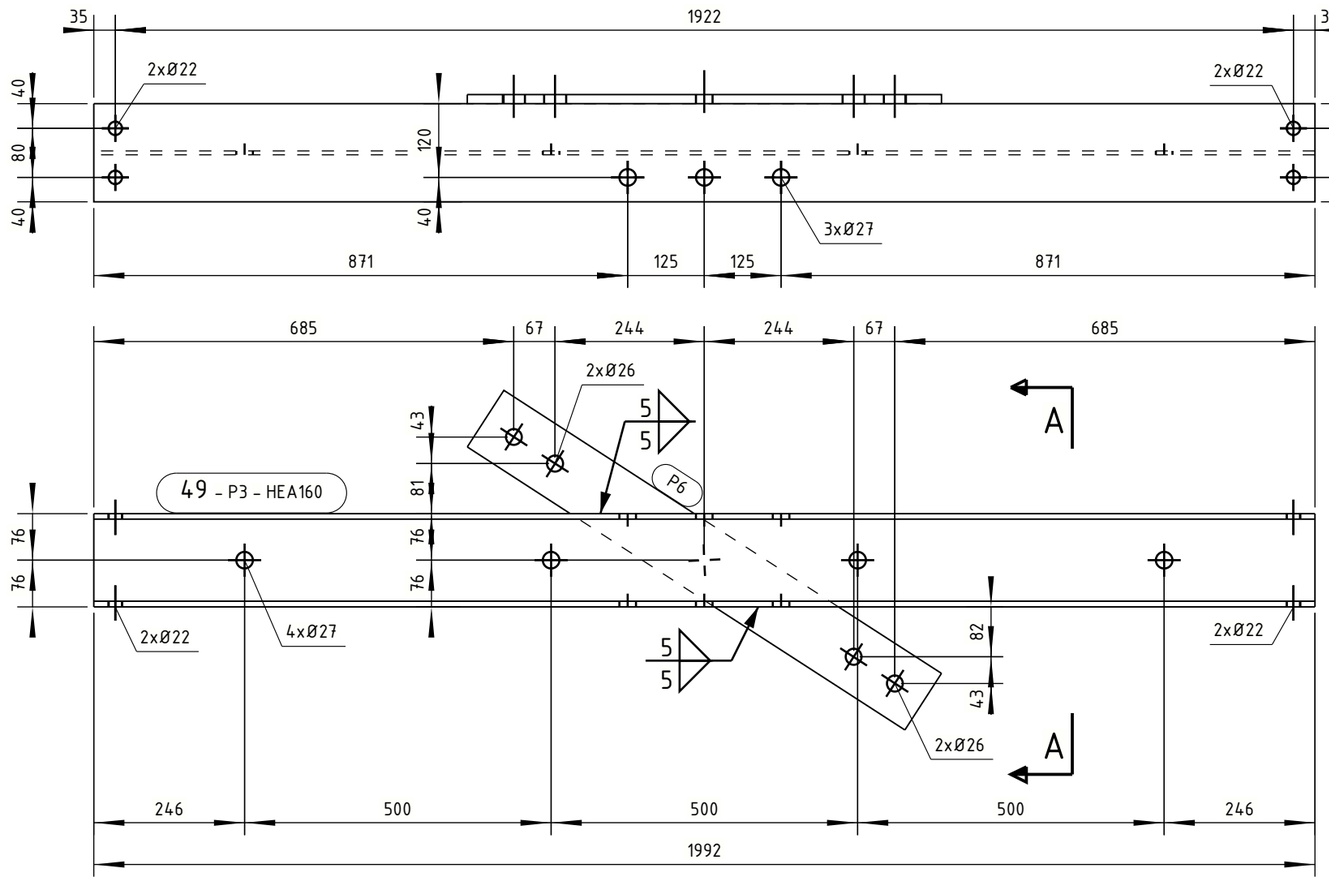
Relatie

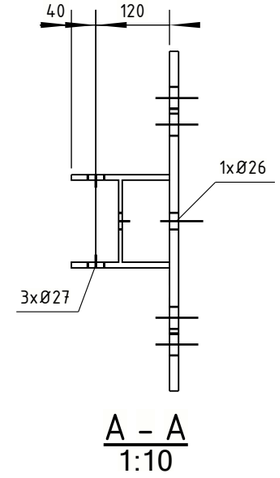
Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Omschrijving:	Nieuw staal - onderdeel [48]
Documentnummer:	

TenneT Taking power further

Tekla Structures





A - A
1:10

ASSEMBLY
Mark: 49 length (mm): 1992 Number: 2

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P3	HEA160	S355J0	1	1992	61.8	1.80
P6	STRIP15*110	S355J0	1	850	11.2	0.22
				Total of one mark	73.0	2.02

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

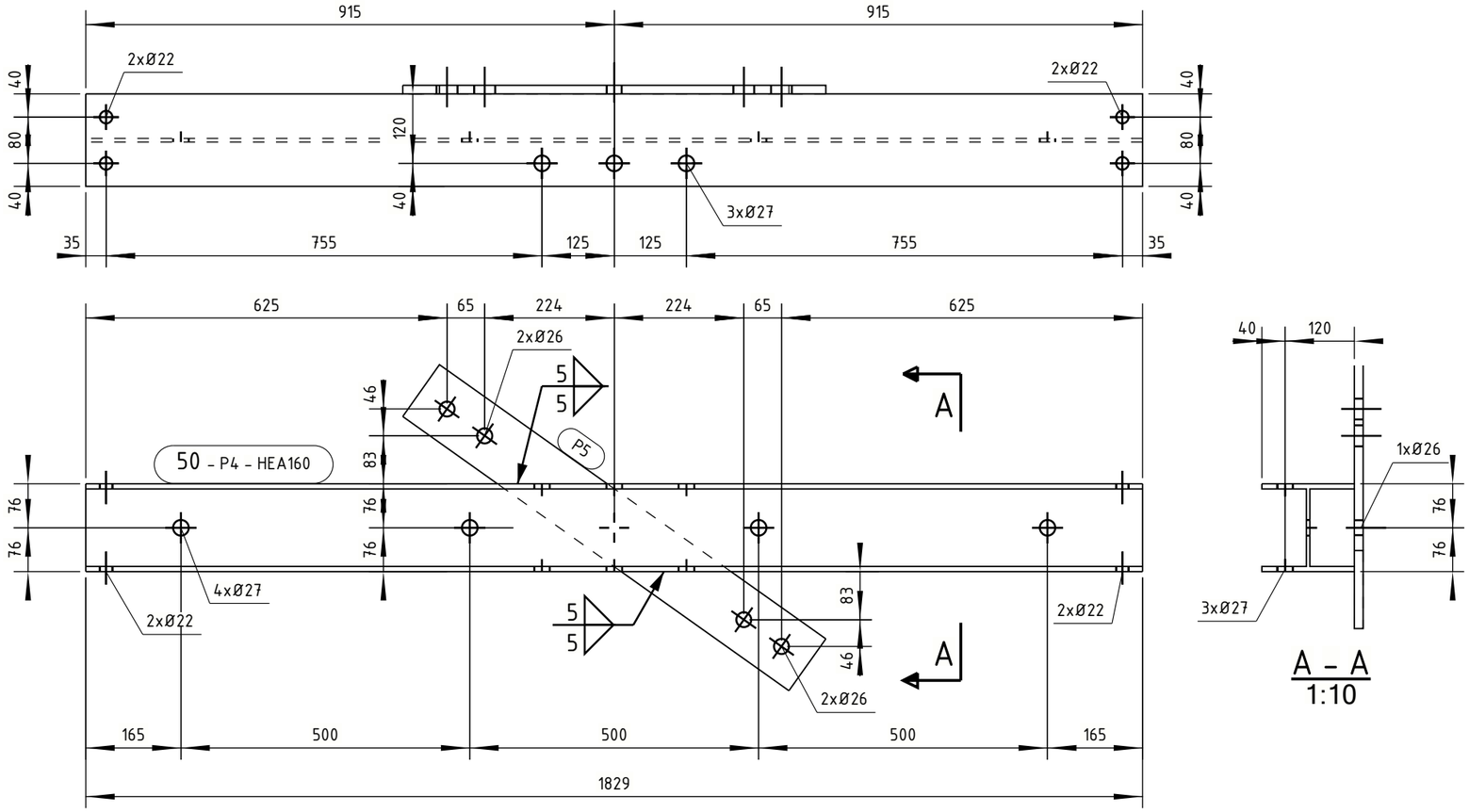
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Omschrijving:	Nieuw staal - onderdeel [49]
Documentnummer:	

TenneT Taking power further

Tekla Structures



A - A
1:10

ASSEMBLY
Mark: 50 length (mm): 1829 Number: 2

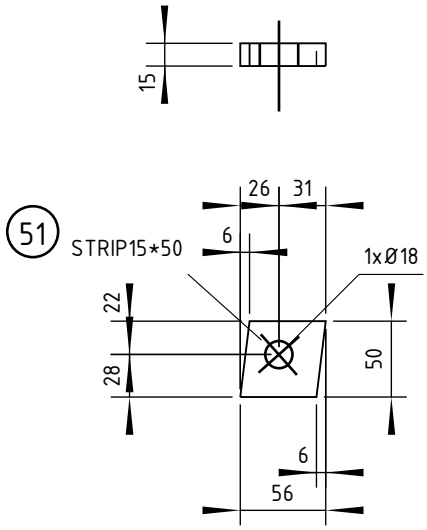
Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P4	HEA160	S355J0	1	1829	56.7	1.66
P5	STRIP15*110	S355J0	1	820	10.8	0.21
				Total of one mark	67.6	1.87

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [50]
Documentnummer:	

TenneT Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m^2)
51	STRIP15*50	2	S355J0	56	0.01

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

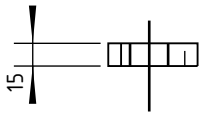
Object ID: ENS-ZL380 HB+0_R_X Mast 35

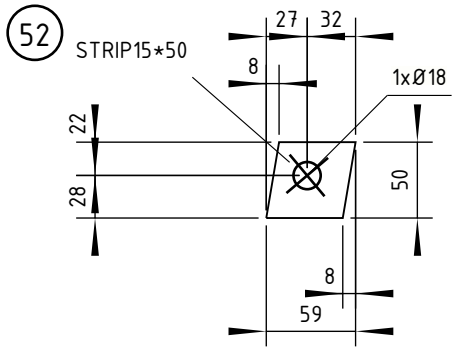
Omschrijving: Nieuw staal - onderdeel [51]

Documentnummer:

TenneT Taking power further

Tekla Structures





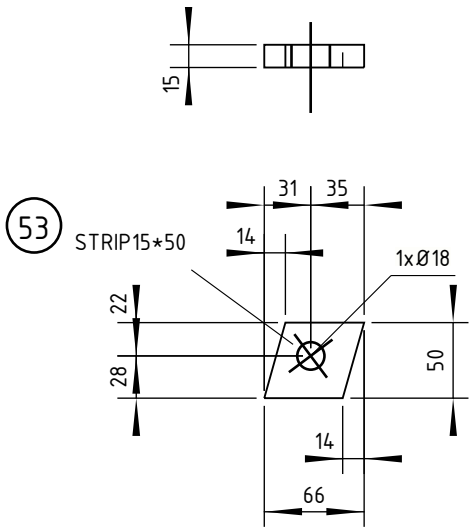
52	STRIP15*50	2	S355J0	59	0.01
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [52]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



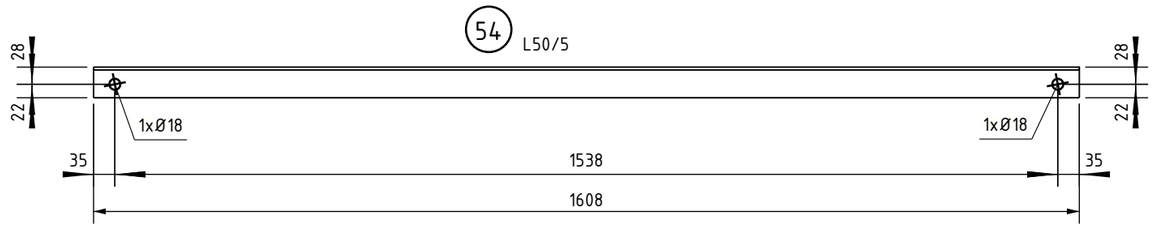
53	STRIP15*50	2	S355J0	66	0.01
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [53]
	Documentnummer:	

tennet Taking power further

Tekla Structures

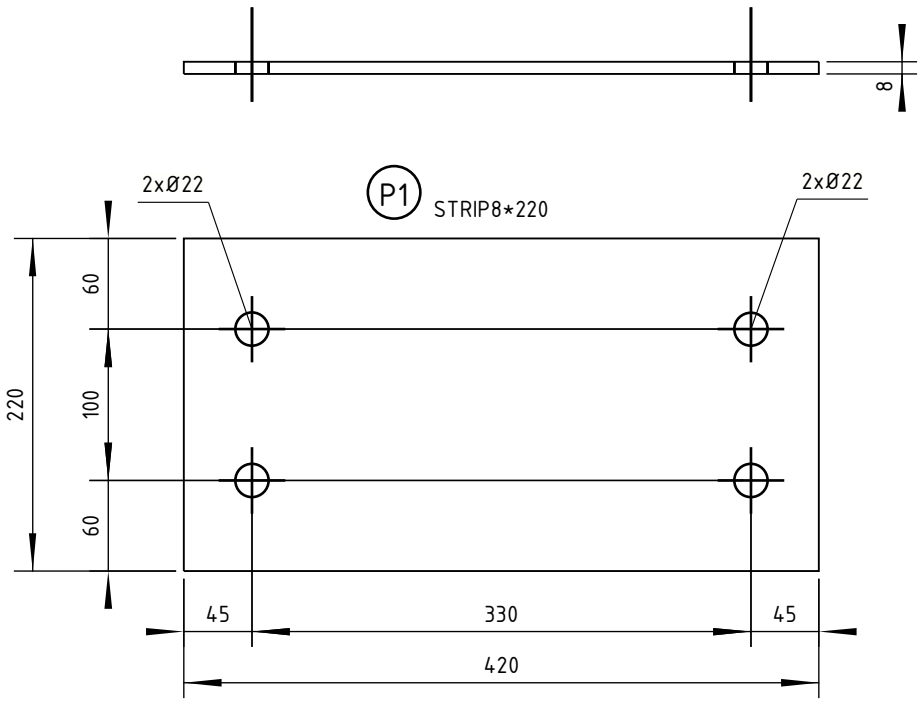


54	L50/5	8	S355J0	1608	0.32
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle						
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [54]
TenneT Taking power further	Documentnummer:	

Tekla Structures



P1	STRIP8*220	2	S355J0	420	0.20
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [P1]
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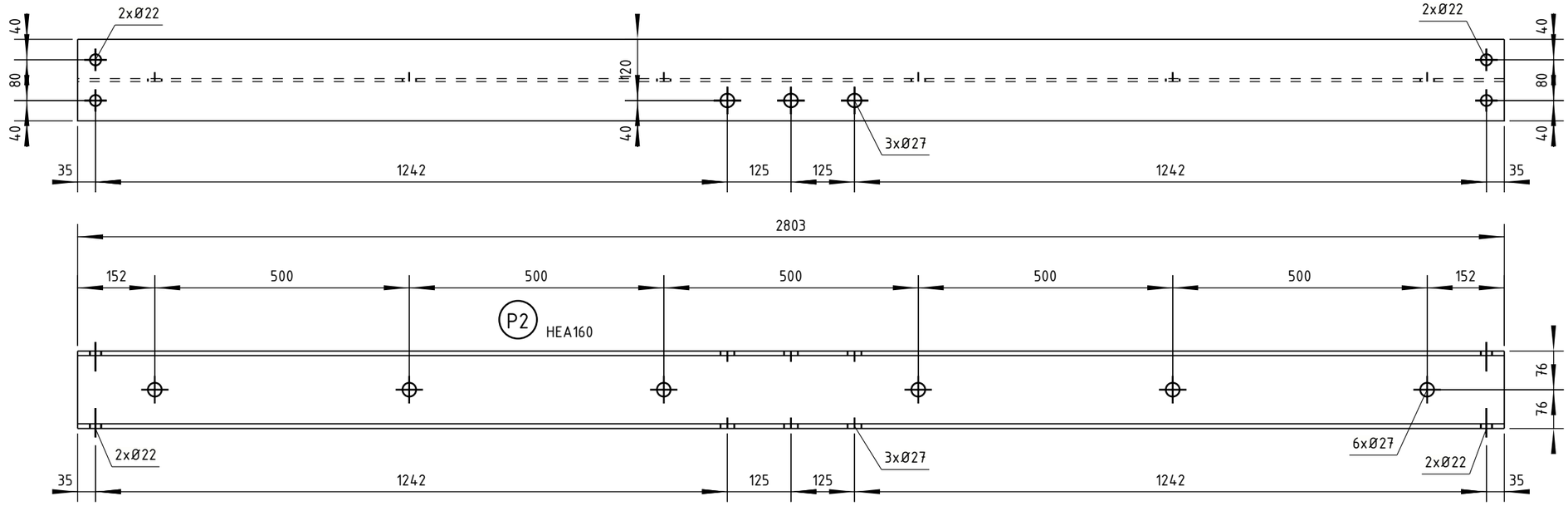
tennet
Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m²)
P2	HEA160	2	S355J0	2803	2.54

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P2]
TenneT Taking power further	Documentnummer:	

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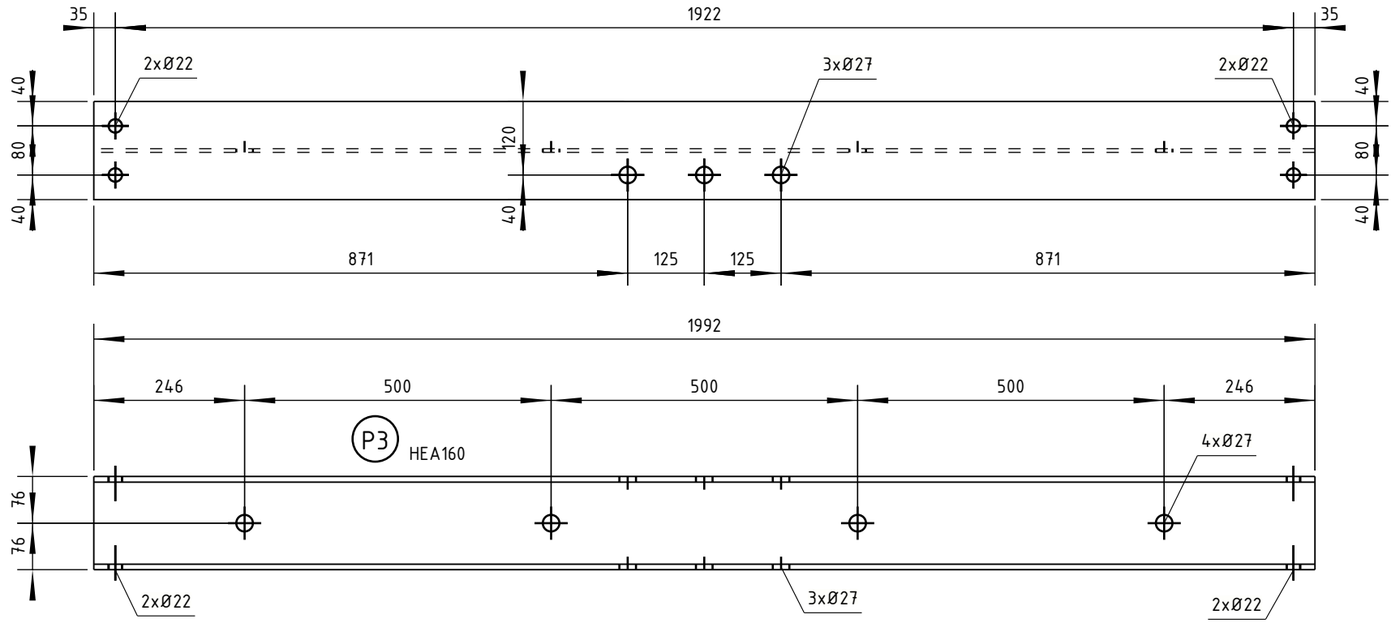
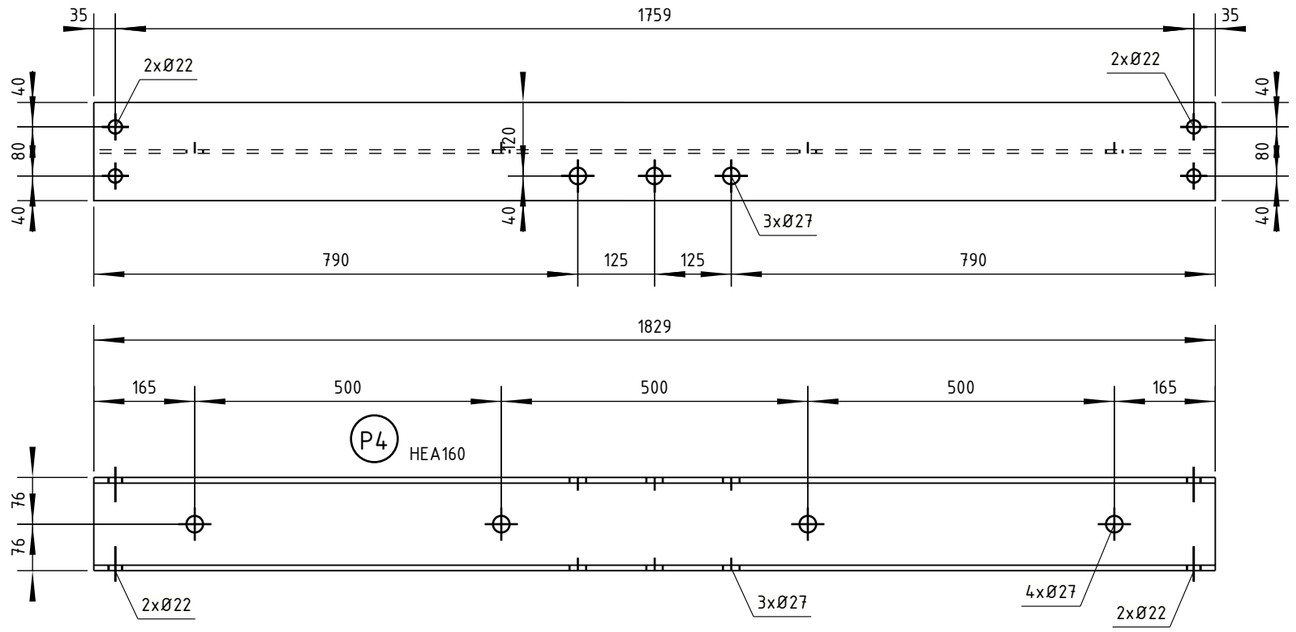


P3	HEA160	2	S355J0	1992	1.80
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380 HB+0_R_X Mast 35
TenneT Taking power further	Omschrijving:	Nieuw staal - onderdeel [P3]
	Documentnummer:	

Tekla Structures



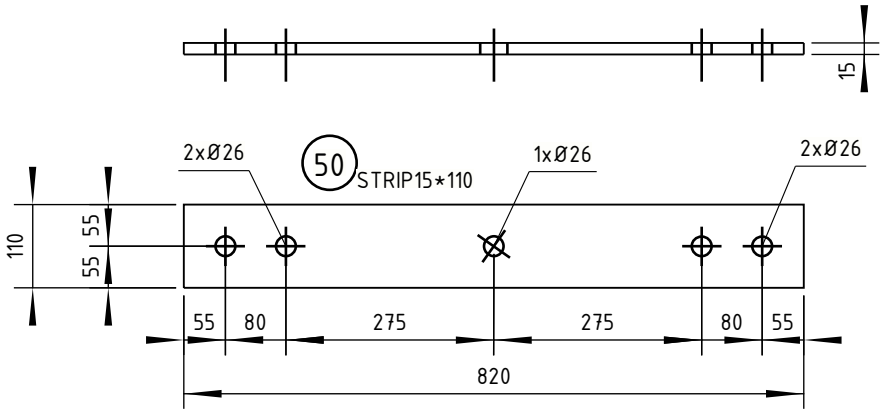
P4	HEA160	2	S355J0	1829	1.66
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [P4]
Documentnummer:	

TenneT Taking power further

Tekla Structures



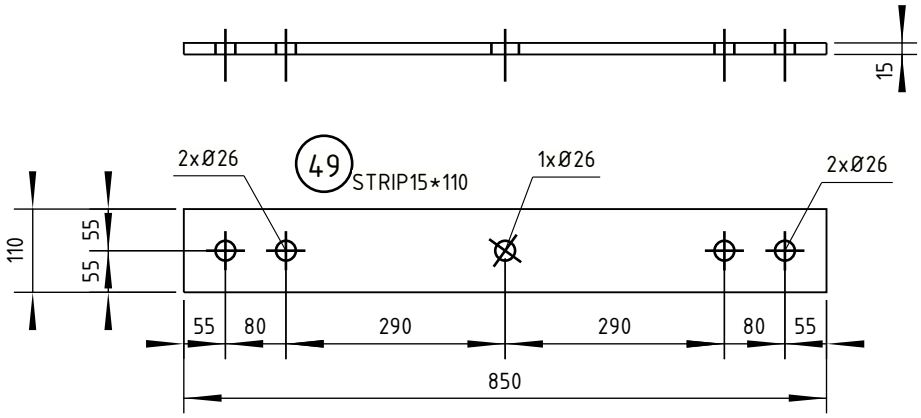
P5	STRIP15*110	2	S355J0	820	0.21
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P5]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



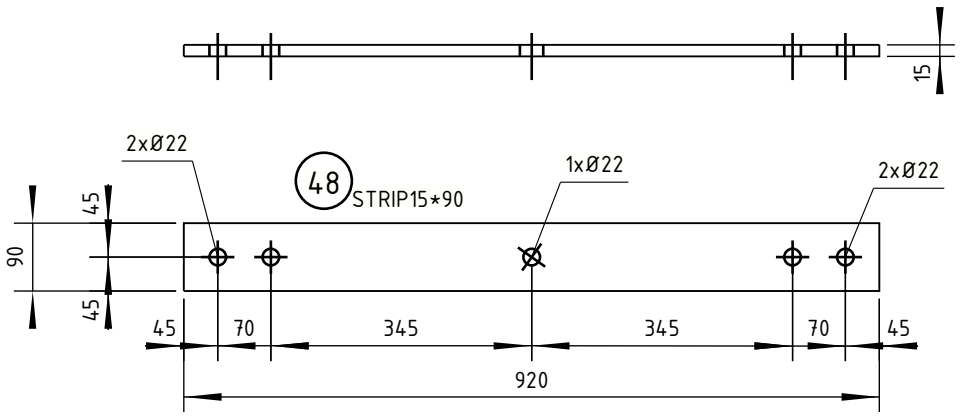
P6	STRIP15*110	2	S355J0	850	0.22
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P6]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



P7	STRIP15*90	2	S355J0	920	0.20
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P7]
	Documentnummer:	

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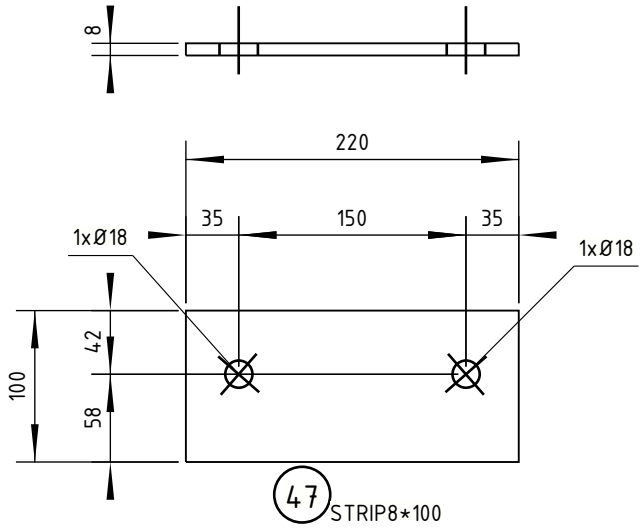
Tekla Structures



P8	STRIP8*100	2	S355J0	220	0.05
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
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Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+0_R_X Mast 35
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [P8]
	Documentnummer:	

TenneT Taking power further

Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-03520**

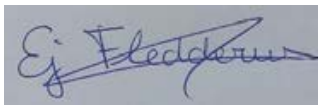
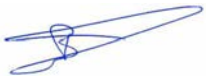
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994402**

Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype HB+0_R_X, Mast 35 - Lijsten**

	Naam	Functie	Handtekening	Datum
Opgesteld	Rogier Hol	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review

BOUTEN-, MOEREN-, RINGENLIJST Pagina: 1

ENS-ZL380 Datum: 13.02.2022
Masttype HB+0_R_X
t.b.v. mast 35

Naam	Type	Kwal.	Aantal
BOUT-M16*35	4017	8.8	38
BOUT-M16*40	4017	8.8	44
BOUT-M16*45	4017	8.8	54
BOUT-M16*50	4014	8.8	28
BOUT-M20*45	4017	8.8	64
BOUT-M20*50	4017	8.8	106
BOUT-M20*65	4014	8.8	8
BOUT-M24*55	4017	8.8	36
BOUT-M24*70	4014	8.8	8
MOER-M16	4032		164
MOER-M20	4032		178
MOER-M24	4032		44
RING-M16	7091		164
RING-M20	7091		178
RING-M24	7091		44

MATERIAALLIJST Pagina: 1

ENS-ZL380 Datum: 13.02.2022
Masttype HB+0_R_X
t.b.v. mast 35

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
HEA160	11	S355J0	2	1147	1.04	35.6
HEA160	P2	S355J0	2	2803	2.54	86.9
HEA160	P3	S355J0	2	1992	1.80	61.8
HEA160	P4	S355J0	2	1829	1.66	56.7
				15542	14.08	482.0
L50/5	16	S355J0	2	918	0.18	3.5
L50/5	17	S355J0	2	894	0.18	3.4
L50/5	18	S355J0	2	1040	0.21	4.0
L50/5	19	S355J0	2	1527	0.31	5.9
L50/5	20	S355J0	2	1547	0.31	5.9
L50/5	21	S355J0	4	1499	0.30	5.8
L50/5	22	S355J0	4	1382	0.28	5.3
L50/5	23	S355J0	4	1231	0.25	4.7
L50/5	24	S355J0	4	781	0.16	3.0
L50/5	54	S355J0	8	1608	0.32	6.2
				44283	8.86	170.1
L60/6	7	S355J0	2	2868	0.69	15.8
L60/6	8	S355J0	2	2868	0.69	15.8
L60/6	13	S355J0	2	5116	1.23	28.3
L60/6	14	S355J0	2	956	0.23	5.3
L60/6	15	S355J0	2	2063	0.50	11.4
L60/6	32	S355J0	2	5116	1.23	28.3
L60/6	34	S355J0	2	2063	0.50	11.4
L60/6	44	S355J0	2	2950	0.71	16.3
L60/6	45	S355J0	2	956	0.23	5.3
L60/6	46	S355J0	2	2950	0.71	16.3
				55812	13.39	308.4
L70/7	2	S355J0	2	1141	0.32	8.6
L70/7	4	S355J0	2	3030	0.85	22.8
L70/7	5	S355J0	4	2893	0.81	21.7
L70/7	6	S355J0	2	3030	0.85	22.8
L70/7	27	S355J0	2	1057	0.30	7.9
				28091	7.87	211.2
L90/8	1	S355J0	2	811	0.29	8.7
L90/8	3	S355J0	2	875	0.31	9.3
L90/8	25	S355J0	2	725	0.26	7.7
L90/8	26	S355J0	2	768	0.28	8.4
L90/8	33	S355J0	2	200	0.07	1.8
L90/8	42	S355J0	2	200	0.07	1.8

ENS-ZL380 Datum: 13.02.2022
Masttype HB+0_R_X
t.b.v. mast 35

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
				7158	2.58	75.5
L150/14	10	S355J0	2	3750	2.25	120.1
L150/14	12	S355J0	2	3750	2.25	120.1
				15002	9.00	480.5
PL8*155	37	S355J0	2	170	0.05	1.4
				340	0.10	2.8
PL8*173.4	43	S355J0	4	299	0.08	2.4
				1197	0.32	9.5
PL8/4*60	40	S355J0	8	70	0.00	0.2
				560	0.00	1.6
STRIP8*100	P8	S355J0	2	220	0.05	1.4
				440	0.10	2.8
STRIP8*200	35	S355J0	2	155	0.06	1.8
STRIP8*200	36	S355J0	2	155	0.06	1.8
STRIP8*200	41	S355J0	2	155	0.06	1.8
				930	0.38	11.0
STRIP8*220	P1	S355J0	2	420	0.20	5.9
				840	0.39	11.8
STRIP10*60	9	S355J0	2	89	0.01	0.3
				177	0.02	0.6
STRIP10*120	39	S355J0	4	300	0.08	2.7
				1200	0.30	10.9
STRIP10*140	38	S355J0	4	340	0.09	3.4
				1360	0.38	13.7
STRIP10*300	28	S355J0	8	300	0.11	4.0
STRIP10*300	29	S355J0	8	300	0.10	3.7
STRIP10*300	30	S355J0	8	300	0.11	4.0

ENS-ZL380 Datum: 13.02.2022
Masttype HB+0_R_X
t.b.v. mast 35

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
STRIP10*300	31	S355J0	8	300	0.10	3.7
				9600	3.38	123.0
STRIP15*50	51	S355J0	2	56	0.01	0.3
STRIP15*50	52	S355J0	2	59	0.01	0.3
STRIP15*50	53	S355J0	2	66	0.01	0.3
				363	0.05	1.8
STRIP15*90	P7	S355J0	2	920	0.20	9.9
				1840	0.39	19.9
STRIP15*110	P5	S355J0	2	820	0.21	10.8
STRIP15*110	P6	S355J0	2	850	0.22	11.2
				3340	0.85	44.1
				Totaal:	62.43	1981.5

TEKLA STRUCTURES MERKENLIJST Pagina: 1

ENS-ZL380 Datum: 13.02.2022
Masttype HB+0_R_X
t.b.v. mast 35

Merk	Aantal	Profiel	Lengte	Opp.(m2)	Gewicht (kg)
1	2	L90/8	811	0.29	8.7
2	2	L70/7	1141	0.32	8.6
3	2	L90/8	875	0.31	9.3
4	2	L70/7	3030	0.85	22.8
5	4	L70/7	2893	0.81	21.7
6	2	L70/7	3030	0.85	22.8
7	2	L60/6	2868	0.69	15.8
8	2	L60/6	2868	0.69	15.8
9	2	STRIP10*60	89	0.01	0.3
10	2	L150/14	3750	2.25	120.1
11	2	HEA160	1147	1.04	35.6
12	2	L150/14	3750	2.25	120.1
13	2	L60/6	5116	1.23	28.3
14	2	L60/6	956	0.23	5.3
15	2	L60/6	2063	0.50	11.4
16	2	L50/5	918	0.18	3.5
17	2	L50/5	894	0.18	3.4
18	2	L50/5	1040	0.21	4.0
19	2	L50/5	1527	0.31	5.9
20	2	L50/5	1547	0.31	5.9
21	4	L50/5	1499	0.30	5.8
22	4	L50/5	1382	0.28	5.3
23	4	L50/5	1231	0.25	4.7
24	4	L50/5	781	0.16	3.0
25	2	L90/8	725	0.26	7.7
26	2	L90/8	768	0.28	8.4
27	2	L70/7	1057	0.30	7.9
28	8	STRIP10*300	300	0.11	4.0
29	8	STRIP10*300	300	0.10	3.7
30	8	STRIP10*300	300	0.11	4.0
31	8	STRIP10*300	300	0.10	3.7
32	2	L60/6	5116	1.23	28.3
33	2	L90/8	200	0.07	1.8
34	2	L60/6	2063	0.50	11.4
35	2	STRIP8*200	155	0.06	1.8
36	2	STRIP8*200	155	0.06	1.8
37	2	PL8*155	155	0.05	1.4
38	4	STRIP10*140	340	0.09	3.4
39	4	STRIP10*120	300	0.08	2.7
40	8	PL8/4*60	70	0.00	0.2
41	2	STRIP8*200	155	0.06	1.8
42	2	L90/8	200	0.07	1.8
43	4	PL8*173.4	300	0.08	2.4
44	2	L60/6	2950	0.71	16.3
45	2	L60/6	956	0.23	5.3
46	2	L60/6	2950	0.71	16.3
47	2	STRIP8*220	420	0.24	7.3
48	2	HEA160	2803	2.74	96.9
49	2	HEA160	1992	2.02	73.0

ENS-ZL380 Datum: 13.02.2022
Masttype HB+0_R_X
t.b.v. mast 35

Merk	Aantal	Profiel	Lengte	Opp.(m2)	Gewicht (kg)
50	2	HEA160	1829	1.87	67.6
51	2	STRIP15*50	56	0.01	0.3
52	2	STRIP15*50	59	0.01	0.3
53	2	STRIP15*50	66	0.01	0.3
54	8	L50/5	1608	0.32	6.2
Totaal	160	merk(en)		62.43	1981.5

Masttype: Masttype HB+0_R_X, Mast 35
Opwaarderen 380 kV verbinding Ens - Zwolle

Tekening omschrijving	Tekeningnummer	Rev.	Datum	Tek.	formaat
Masttype HB+0_R_X, Mast 35 - Overzicht	00974-01-03501	0.1	18.02.2022	A2	594x420
Masttype HB+0_R_X, Mast 35 - Broekstuk	00974-01-03502	0.1	18.02.2022	A0	1189x841
Masttype HB+0_R_X, Mast 35 - Ondertraverse Bovenvlak	00974-01-06503	0.1	18.02.2022	A0	1189x841
Masttype HB+0_R_X, Mast 35 - Boventraverse Ondervlak	00974-01-03504	0.1	18.02.2022	A0	1189x841
Masttype HB+0_R_X, Mast 35 - Boventraverse Zijaanzichten	00974-01-03505	0.1	18.02.2022	A0	1189x841
HB+0_R_X, Mast 35 - Onderdeeltekeningen	00974-01-03510	0.1	18.02.2022	A2/A3/A4	

Lijsten	Documentnummer		Datum
bouten-moeren-ringenlijst	00974-01-03520	0.1	14.02.2022
materiaallijst	00974-01-03520	0.1	14.02.2022
merkenlijst	00974-01-03520	0.1	14.02.2022
Documentenlijst	00974-01-03520	0.1	18.02.2022

Detailberekeningen	Documentnummer		Datum
Masttype HB+0_R_X, Mast 35	00974-01-03530	0.1	18.02.2022

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

"REVIEW AND RE-DESIGN TOWERS BBB380"

ENS-ZL380 – Tower HB+0_R_X Mast 35

TenneT TSO B.V.

Detail Calculation

Projectnummer Aafjes:	**21-187**
Documentnummer:	**00974-01-03530**
Projectnummer TenneT:	**002.515**
Meridian nummer:	**002.515.40 0994403**
Opdrachtgever:	**TenneT**
Project:	**Opwaardering ENS-ZL380**
Onderdeel:	**HB+0_R_X Mast 35 - Detailberekeningen**

1e versie ter review	G. Pieper	R.Hol	B. Aafjes	18-02-2022	0.1
	Author	Checked	Approved	date	revision

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1 Introduction

This report contains the detail calculations of the reinforcements of towertype HB+0/R_X windzone III.

It concerns tower number: Tower 35

To increase the future capacity of electricity transmission, it is necessary to upgrade the transmission grid by building new and modifying existing high voltage connections.

It is for this reason the client (OG) intends to upgrade part the existing 380kV grid. This upgrading is part of the program “Beter Benutten Bestaande 380kV” and consists of the following subprojects:

- Upgrading of the 380 kV-connection Lelystad – Ens (LLS-ENS380).
- Upgrading of the 380 kV-connection Diemen – Lelystad (DIM-LLS380).
- Upgrading of the 380 kV-connection Rilland – Zandvliet (RLL-ZVL380).
- Upgrading of the 380 kV-connection Krimpen aan de IJssel – Geertruidenberg (KIJ-GT380).
- Upgrading of the 380 kV-connection Ens – Zwolle (ENS-ZL380).
- Upgrading of the 380 kV-connection Maasbracht – Eindhoven (MBT-EHV380).

DNV GL has calculated the existing tower for the new situation on behalf of Tennet. On the instructions of DNV GL, the reinforcements mainly consist of the exchange of bolts and profiles and the reinforcement of profiles and the application of redundant members.

DNV GL has tested the profiles and bolts. In this report only the detail calculations are made of the specified reinforcements (bolts are specified by DNV GL).

2 General Data

2.1 Principal constructor

DNV GL – Energy

2.2 Principal calculation and related documents

- ENS-ZL380 – Tower HB+0/R_X
  Reportnr.: 21-0135 Rev 3
  Date: 2021-12-20

- Uitgangspuntenrapport 380kV verbinding Ens – Zwolle
  Reportnr.: 20-1245 Rev.3
  Date: 2021-06-09

2.3 Material- and bolt quality

Materials excisting construction

	Signification 1969	Current startingpoint
Steeltype	St.37	S235JR
	St.52	S355JO
Bolt quality	bolt class 8.8	8.8 rolled thread
Concrete quality	K225	Min. C16/20
Reinforcing steel	Qr24, Qr40	B220, B400

Materials modified construction

Steeltype	S355JO ($t \leqq 16$ mm)
	S355J2 ($16 < t \leqq 40$ mm)
Bolt quality	8.8 rolled thread

2.4 Applicable standards

Mainly used:
- NEN-EN 1993-1-8+C2 :2011/NB:2011 nl

Also used:
- NEN-EN 50341-2-15: 2019
- NEN-EN 8700: 2011
- NEN-EN 8701: 2011
- Eurocode reeks

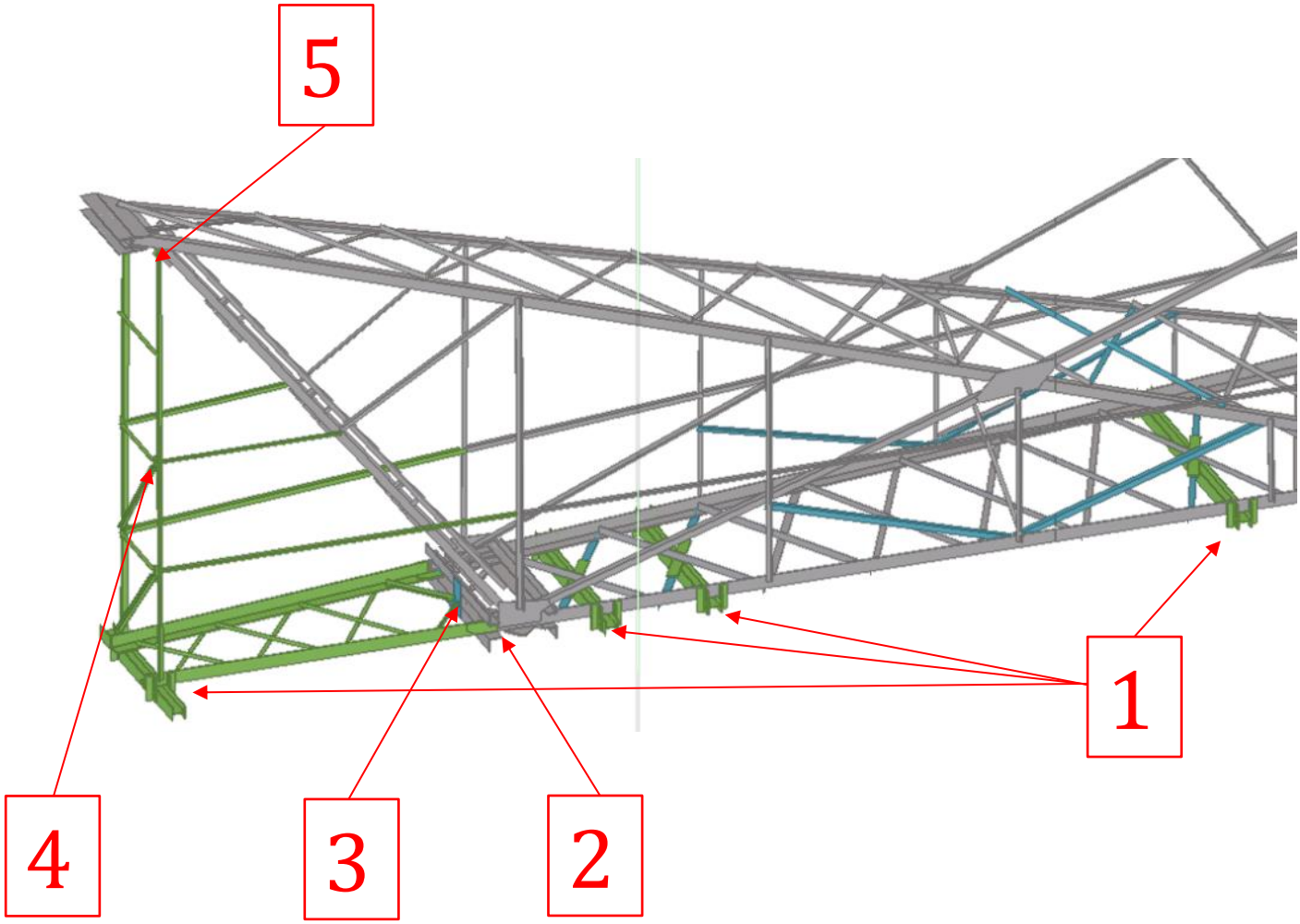
2.5 Tennet specifications

- SPE. 05. 346. v 2.0 algemene specificatie stalen masten

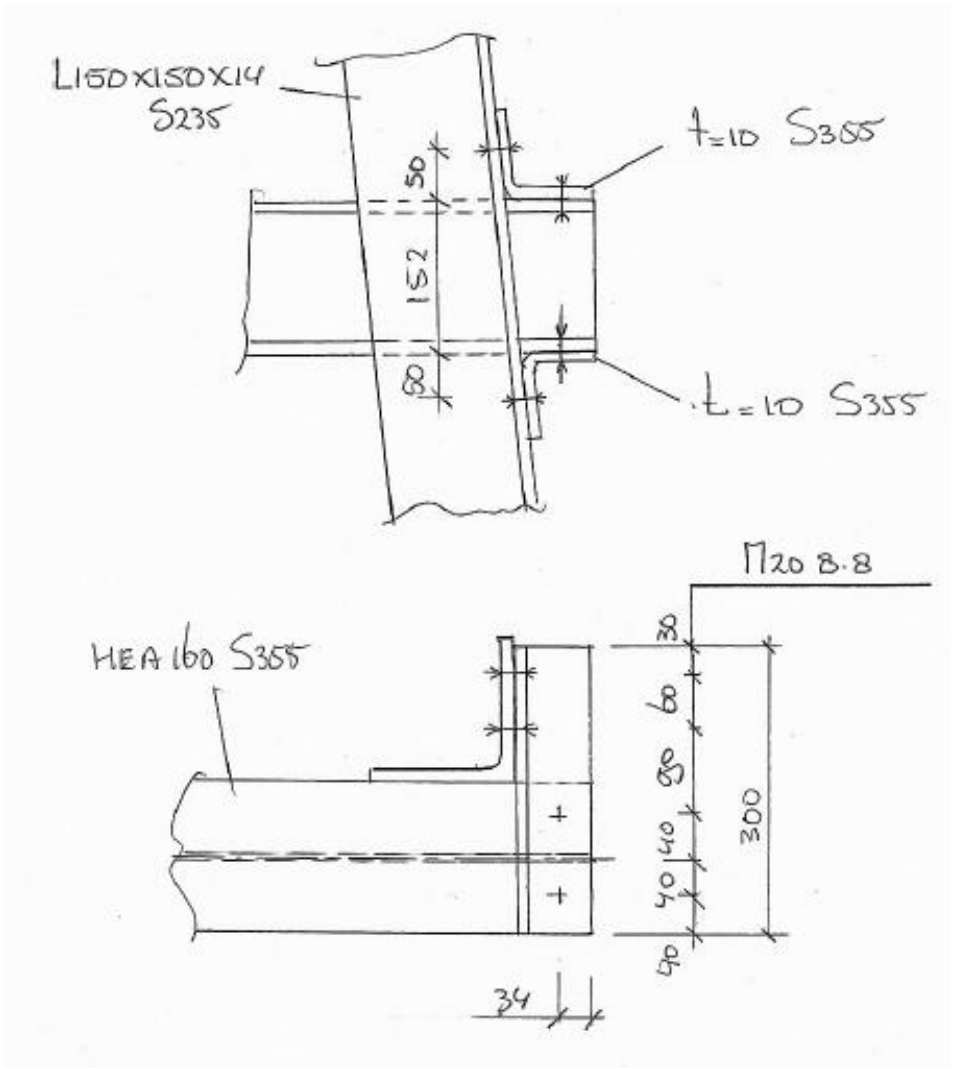
3 Calculations

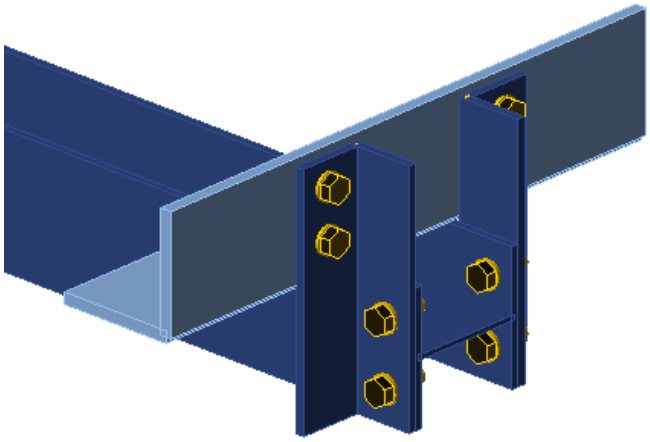
3.1 Connections

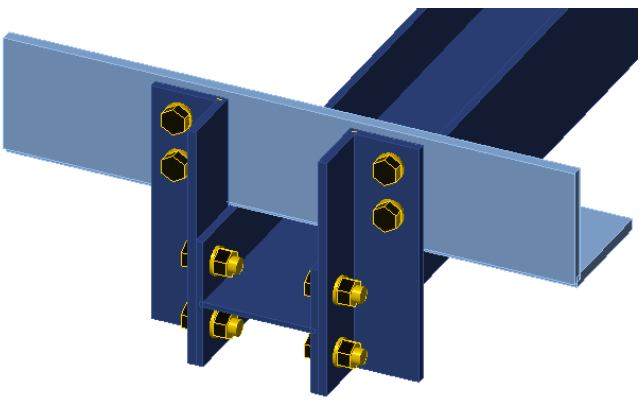
3.1.1 Overview



3.1.2 Detail 1


L150X150X14
S235
t=10 S355
50
152
80
t=10 S355
M20 8.8
HEA 160 S355
30
60
80
40
40
90
300
34





3.1.3 Loads

Loads from report:

ENS-ZL380 – Tower HB+0/R_X

Report nr.: 21-0135 Rev 3
Date: 2021-12-20

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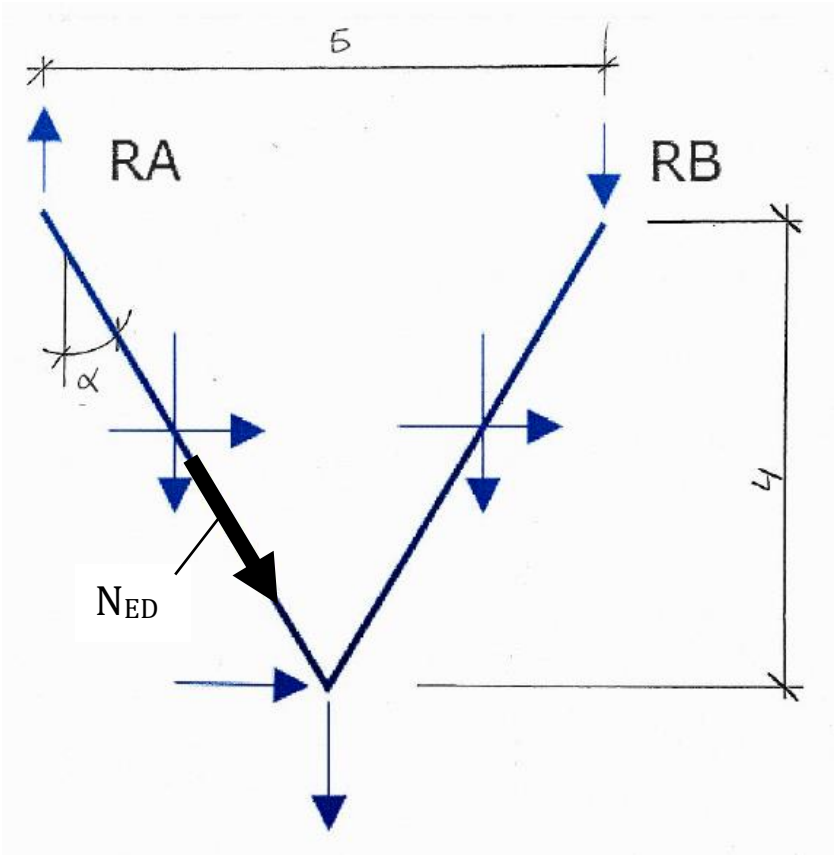


RA = 3,9 kN

$\alpha = 32°$

N_{ED} = 1,5 x 3,9 / cos 32° = 7 kN

V_{ED}

3.1.4 Calculation

3.1.4.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+0_R_X mast 35
Project number	21-187
Author	G.P.
Description	Detail 1
Date	2/17/2022
Design code	EN

Material

Steel	S 355, S 235

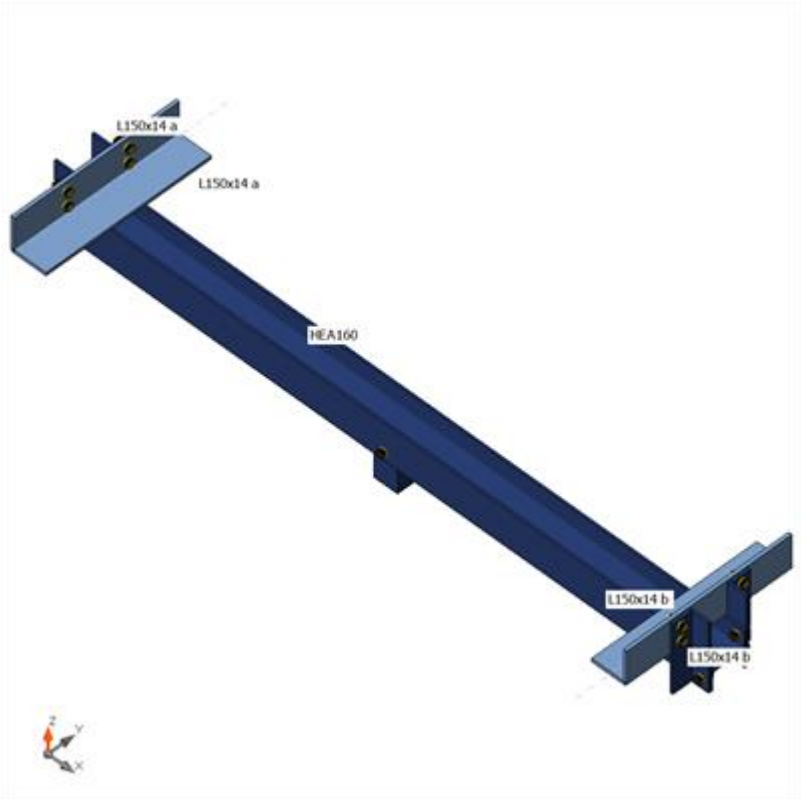
Project item Detail 1

Design

Name	Detail 1
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
Dummy	5 - CHS40,3	90.0	58.0	0.0	0	0	-25	Node
L150x14 a	3 - L150x14(L150)	-90.0	0.0	0.0	0	-1275	122	Bolts
L150x14 b	3 - L150x14(L150)	90.0	0.0	0.0	0	-1275	122	Bolts



Cross-sections

Name	Material
5 - CHS40,3	S 355
3 - L150x14(L150)	S 235
1 - HEA160	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M20 8.8	M20 8.8	20	800.0	314

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	Dummy	7.0	0.0	0.0	0.0	0.0	0.0
	L150x14 a	1.9	0.0	1.5	0.0	-0.2	0.0
	L150x14 a	0.0	0.0	1.5	0.0	-0.2	0.0
	L150x14 b	0.0	0.0	1.5	0.0	0.2	0.0
	L150x14 b	-1.9	0.0	1.5	0.0	0.2	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	6.0 < 100%	OK
Buckling	43.12	

Plates

Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
Dummy	S 355	3.0	LE1	27.1	0.0	0.0	OK
L150x14 a-bfl 1	S 235	14.0	LE1	11.0	0.0	0.0	OK
L150x14 a-w 1	S 235	14.0	LE1	20.7	0.0	4.5	OK
L150x14 b-bfl 1	S 235	14.0	LE1	7.8	0.0	0.0	OK
L150x14 b-w 1	S 235	14.0	LE1	15.0	0.0	3.6	OK
HEA160-bfl 1	S 355	9.0	LE1	59.9	0.0	1.9	OK
HEA160-tfl 1	S 355	9.0	LE1	75.1	0.0	1.7	OK
HEA160-w 1	S 355	6.0	LE1	27.5	0.0	0.0	OK
SP1	S 355	10.0	LE1	8.7	0.0	1.4	OK
SP2	S 355	10.0	LE1	25.4	0.0	3.6	OK
SP3	S 355	10.0	LE1	28.9	0.0	1.7	OK
SP4	S 355	10.0	LE1	17.7	0.0	1.1	OK
SP5	S 355	10.0	LE1	10.3	0.0	1.4	OK
SP6	S 355	10.0	LE1	32.4	0.0	4.5	OK
SP7	S 355	10.0	LE1	32.9	0.0	1.5	OK
SP8	S 355	10.0	LE1	19.9	0.0	2.1	OK
SP9	S 355 - 1	134.0	LE1	1.8	0.0	1.9	OK

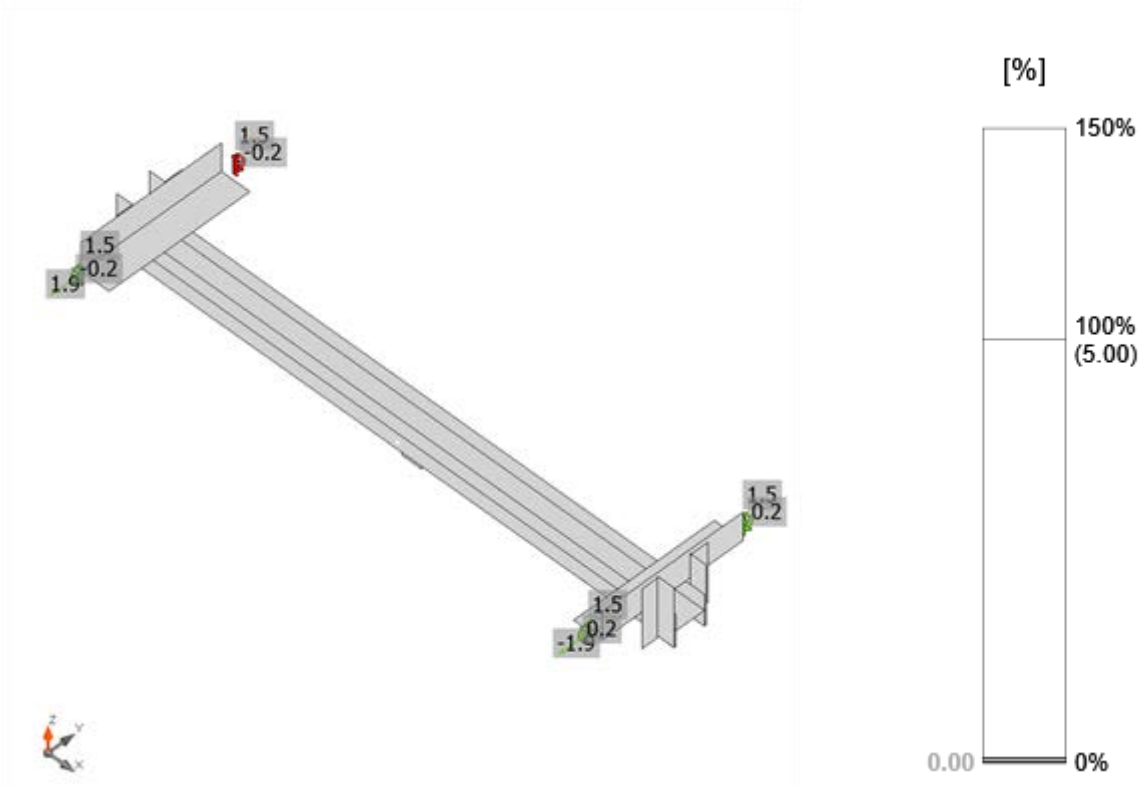
Design data

Material	f_y [MPa]	ε_{lim} [%]
S 355	355.0	5.0
S 235	235.0	5.0
S 355 - 1	335.0	5.0

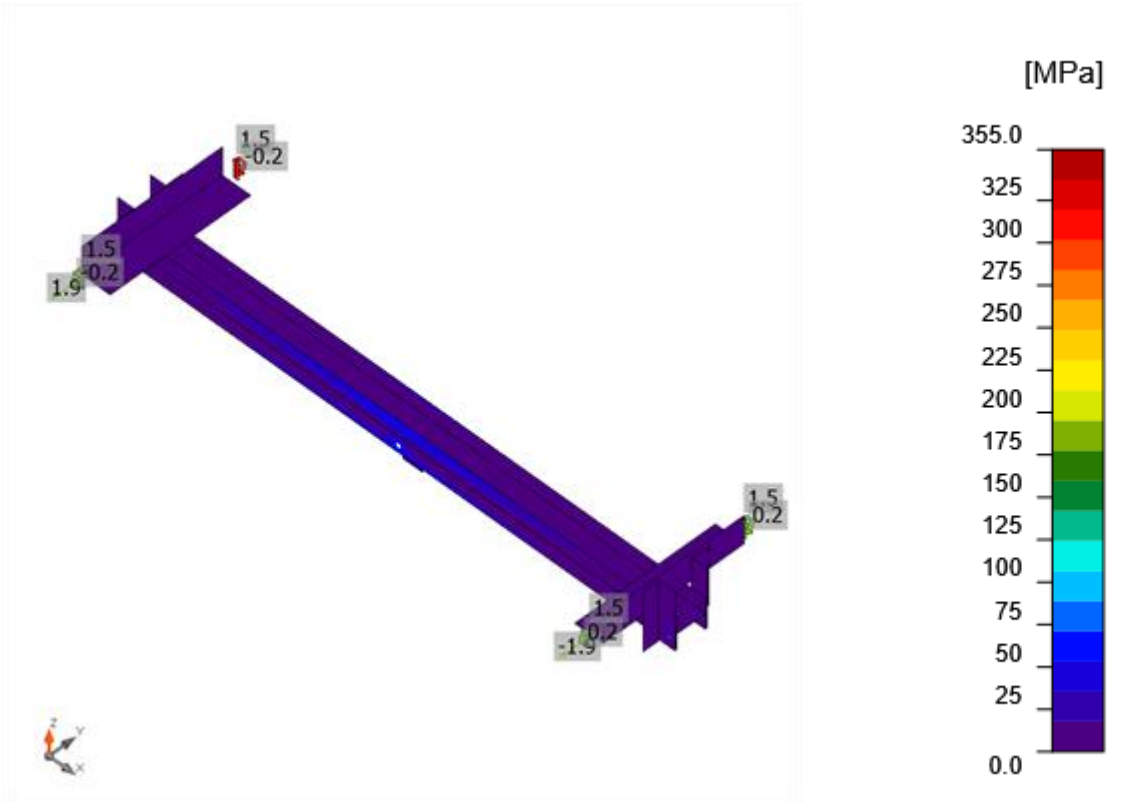
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

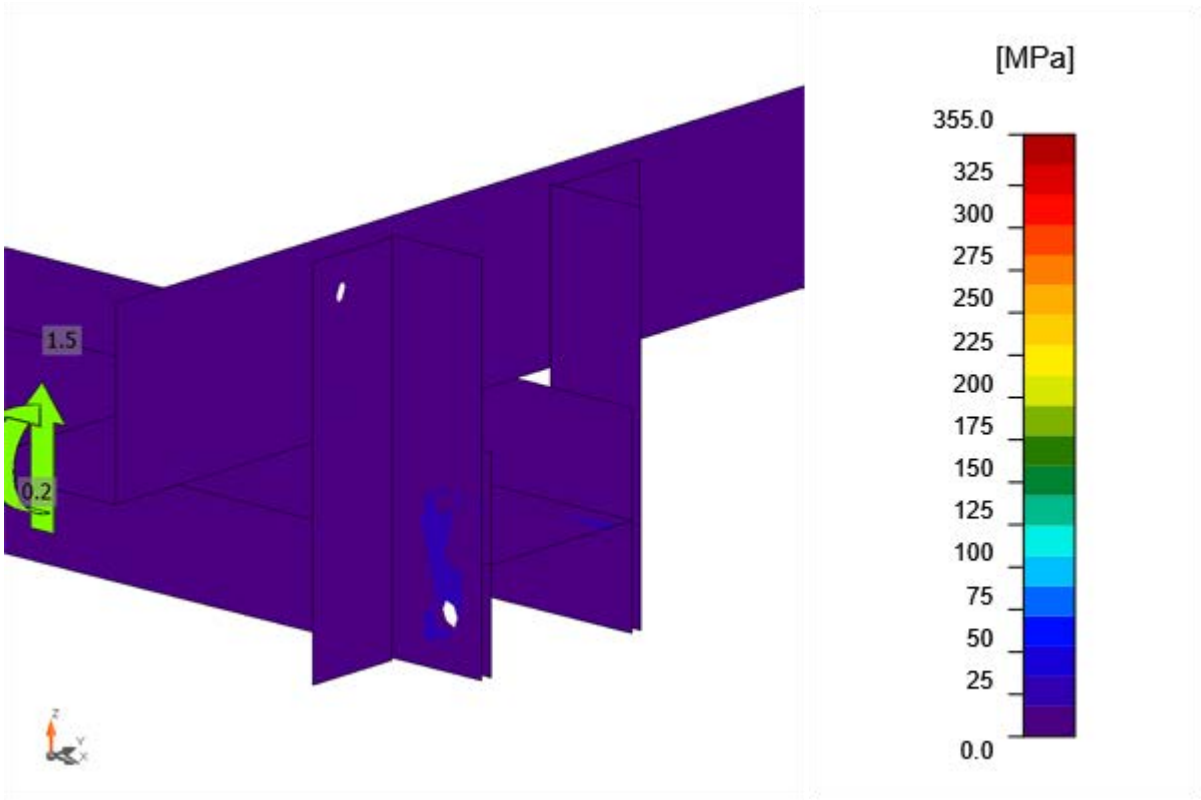
Overall check, LE1



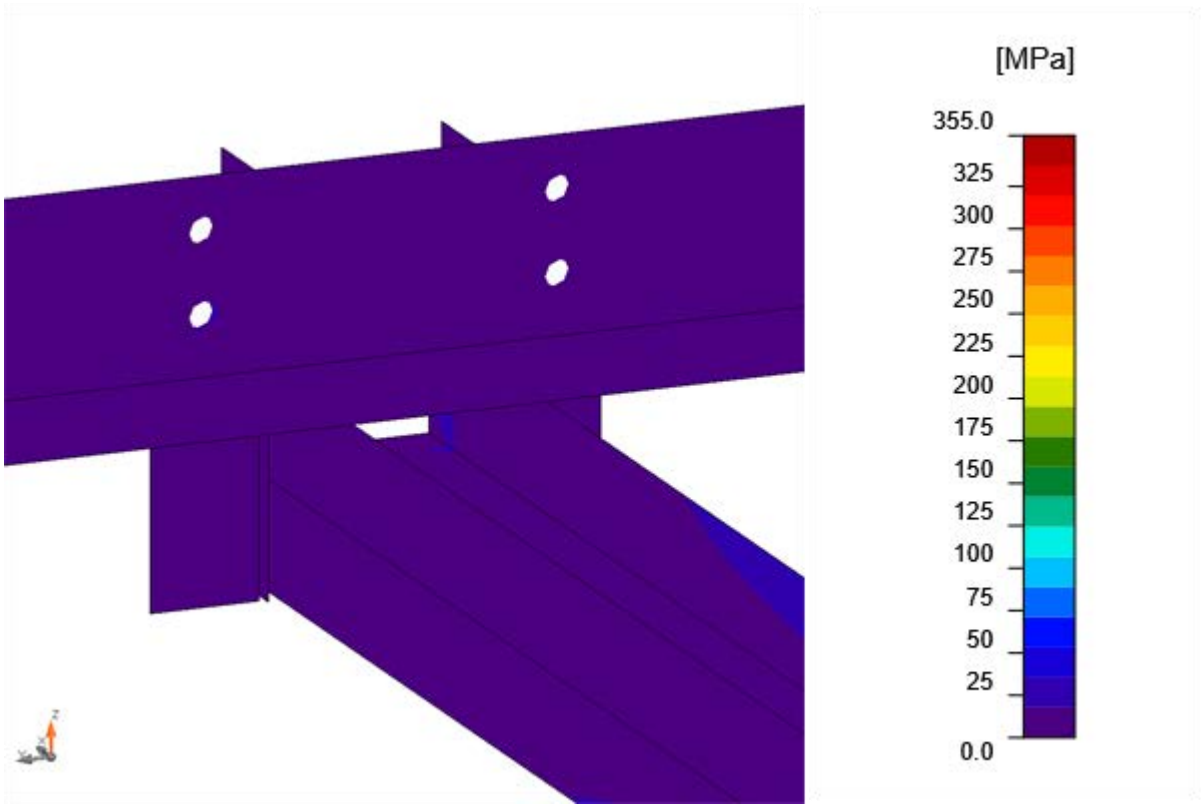
Strain check, LE1



Equivalent stress, LE1

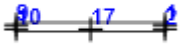
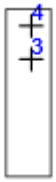


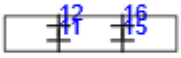
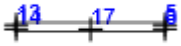
Equivalent stress, LE1



Equivalent stress, LE1

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M20 8.8 - 1	LE1	0.5	0.6	0.4	89.9	0.7	0.9	OK
	B2	M20 8.8 - 1	LE1	0.5	0.9	0.3	98.0	1.0	1.3	OK
	B9	M20 8.8 - 1	LE1	0.4	0.6	0.3	89.5	0.6	0.8	OK
	B10	M20 8.8 - 1	LE1	0.5	1.0	0.4	98.0	1.1	1.4	OK
	B3	M20 8.8 - 2	LE1	2.6	1.9	1.8	113.2	2.0	3.3	OK
	B4	M20 8.8 - 2	LE1	0.1	1.4	0.1	88.1	1.6	1.6	OK
	B5	M20 8.8 - 1	LE1	2.4	3.2	1.7	88.2	3.6	4.6	OK
	B6	M20 8.8 - 1	LE1	2.0	2.7	1.4	98.0	2.9	3.9	OK
	B7	M20 8.8 - 2	LE1	1.0	2.2	0.7	104.0	2.4	2.8	OK
	B8	M20 8.8 - 2	LE1	0.3	1.2	0.2	75.9	1.6	1.4	OK

	B11	M20 8.8 - 2	LE1	3.3	1.9	2.3	113.2	2.0	3.7	OK
	B12	M20 8.8 - 2	LE1	0.1	1.4	0.1	88.1	1.6	1.6	OK
	B15	M20 8.8 - 2	LE1	1.2	2.3	0.8	104.0	2.5	3.1	OK
	B16	M20 8.8 - 2	LE1	0.4	1.3	0.3	75.6	1.7	1.6	OK
	B13	M20 8.8 - 1	LE1	2.1	3.8	1.5	88.2	4.3	5.1	OK
	B14	M20 8.8 - 1	LE1	2.2	3.2	1.5	98.0	3.4	4.5	OK
	B17	M20 8.8 - 1	LE1	3.8	3.8	2.7	93.5	4.1	6.0	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M20 8.8 - 1	141.1	209.5	94.1
M20 8.8 - 2	141.1	232.8	94.1

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

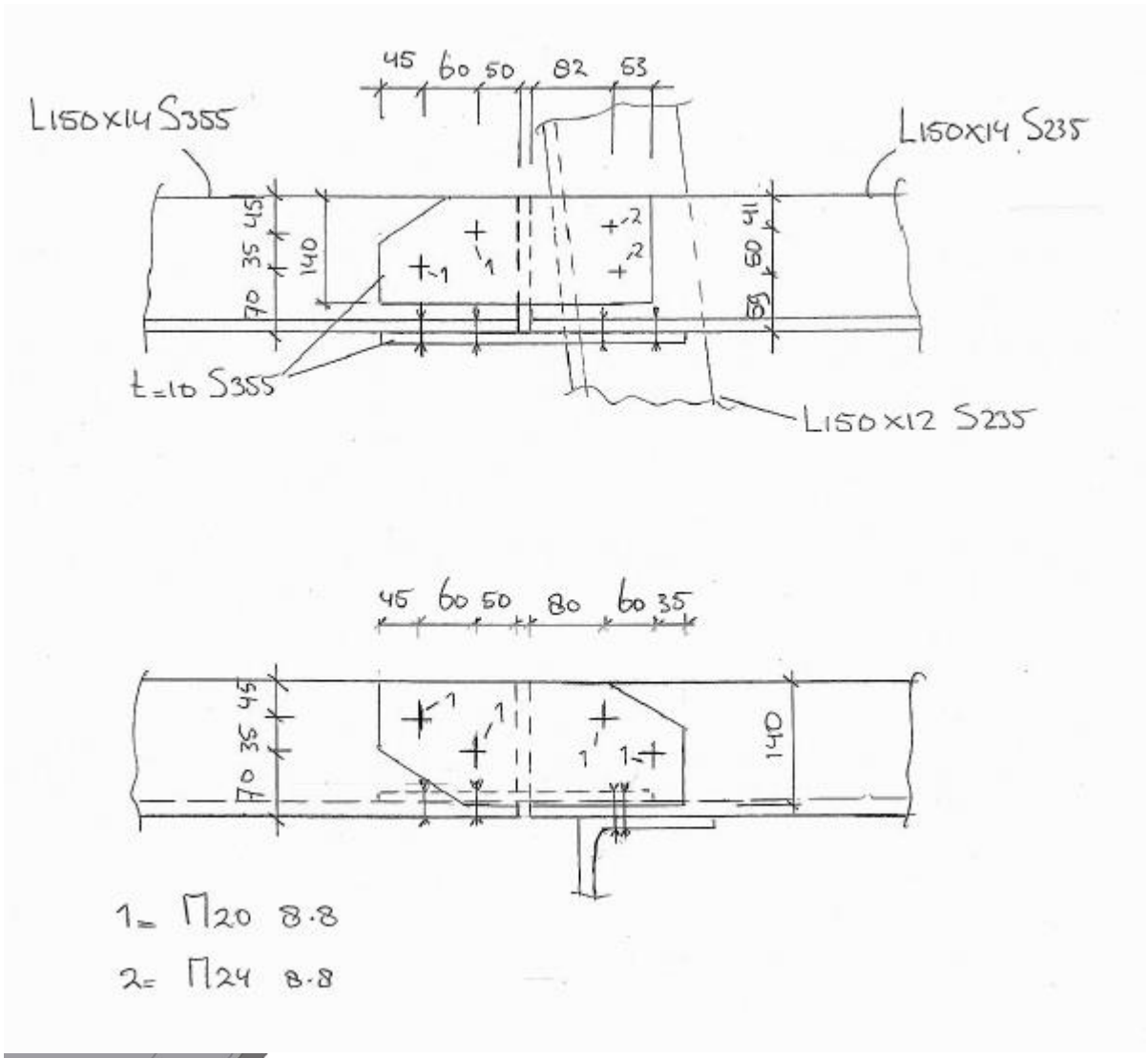
Buckling

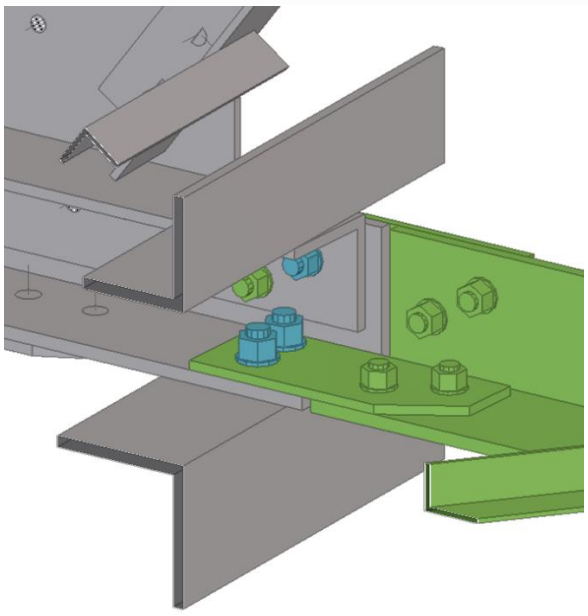
Loads	Shape	Factor [-]
LE1	1	43.12
	2	43.55
	3	50.80
	4	51.17
	5	57.40
	6	57.87

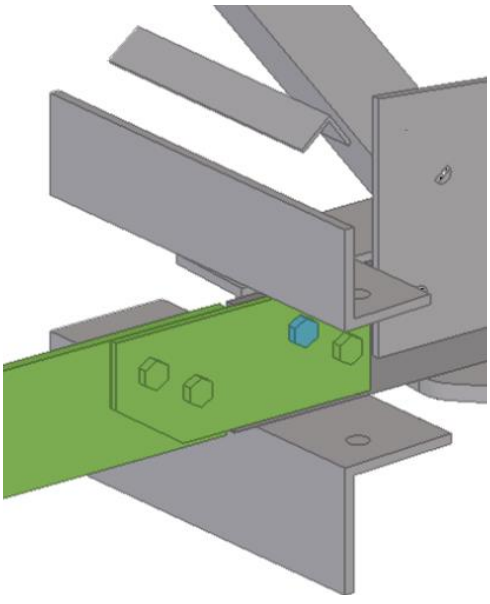
Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

3.1.5 Detail 2


45 60 50 82 53
L150x14 S355
L150x14 S235
45 35 70
140
41 60 53
t=10 S355
L150x12 S235
45 60 50 80 60 35
45 35 70
140
1= M20 8.8
2= M24 8.8





3.1.6 Loads

Loads from report:

ENS-ZL380 – Tower HB+0/R_X

Report nr.: 21-0135 Rev 3
Date: 2021-12-20

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Member: 490D L150x150x14 S355

N_{ED} = -13,7 kN compression N_{ED} = 10,6 kN tension

3.1.7 Calculation

3.1.7.1 Check Bolts

L150x150x14: Fd in one flange $= \frac{13,7}{2} = 6,9$ kN

Bolt M20 8.8

U.C. $= \frac{\text{FvEd}}{\text{FvRd}} = \frac{6,9}{2\text{x}94} = 0,04 < 1$ O.K.

$F_{bearing}$ max $= 6,9$ kN

PL 10x140 S355

$e_1 = 35$ mm

$e_2 = 45$ mm

$p_1 = 60$ mm

$k_1 = 2,8 \text{ x } \frac{45}{22} - 1,7 = 4 \rightarrow k_1 = 2,5$

$\alpha_b = \frac{35}{3\text{x}22} - 0,53$

$F_{b,Rd} = \frac{2,5 \text{ x } 0,53 \text{ x } 490 \text{ x } 20 \text{ x } 10}{1,25} = 104$ kN

U.C. $= \frac{\text{Fb,Ed}}{\text{Fb,Rd}} = \frac{6,9}{2\text{x}104} = 0,04 < 1$ O.K.

3.1.7.2 Check plate

PL 140 x 10 S355

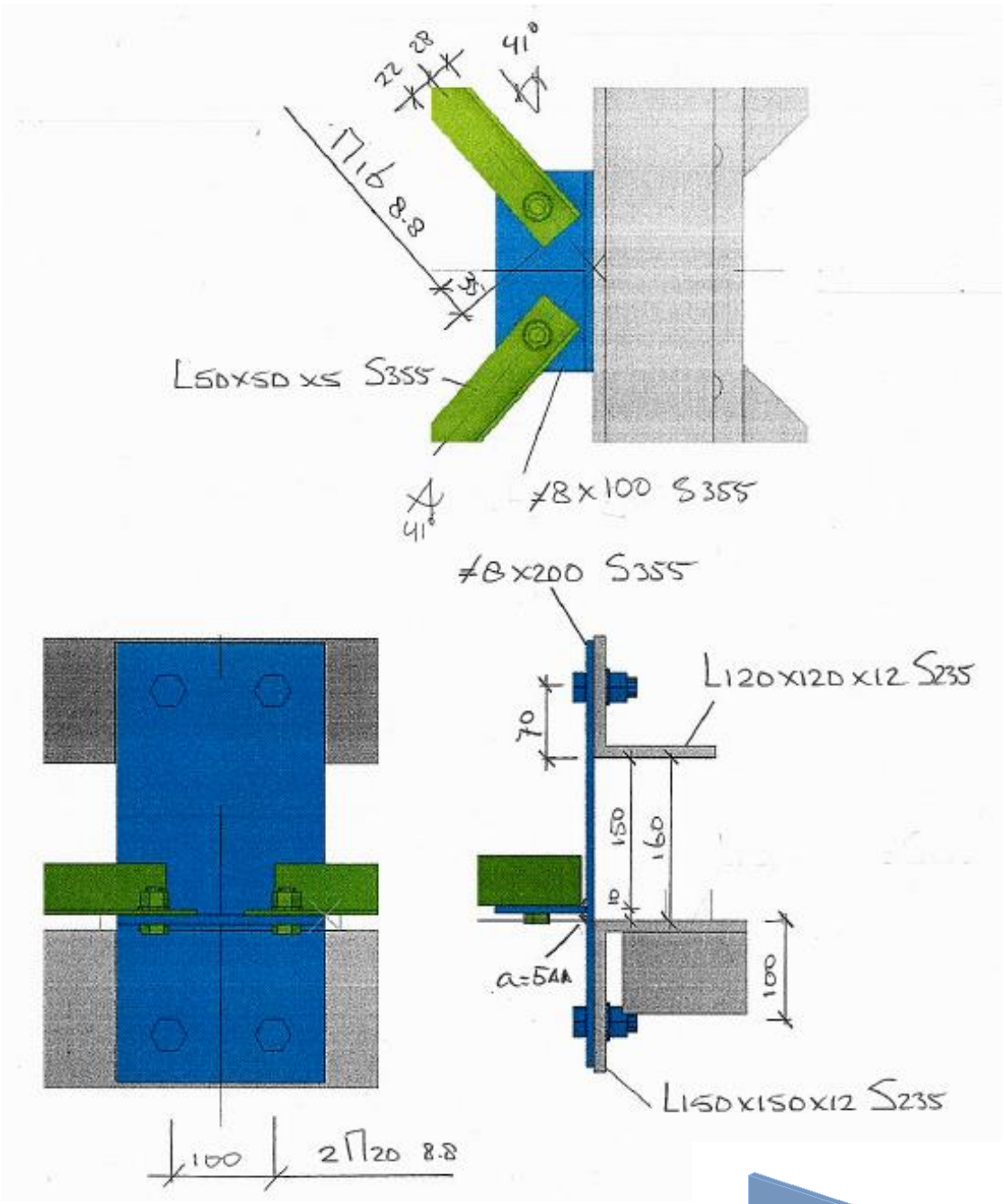
Fd =6,9 kN

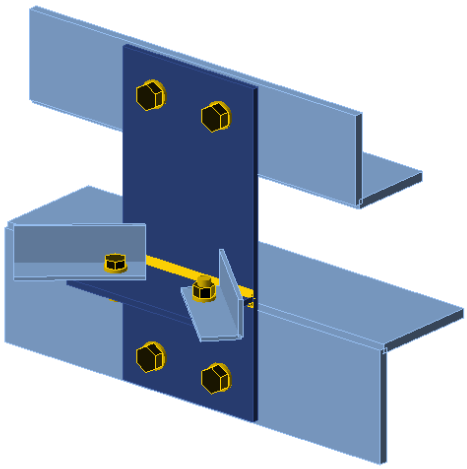
$$N_{u,Rd} = \frac{0,9 \text{ x Anett x fu}}{\Upsilon m2} \qquad A_{nett} = 1400 - (2 \text{ x } 10 \text{ x } 26) = 880 \text{ mm}^2$$

$$= \frac{0,9 \text{ x } 880 \text{ x } 490}{1,25} = 310 \text{ kN}$$

$$\text{U.C.} = \frac{FEd}{Nu,Rd} = \frac{6,9}{310} = 0,02 < 1 \text{ O.K.}$$

3.1.8 Detail 3


41°
22
28
M16 8.8
35
L50x50x5 S355
≠8x100 S355
41°
≠8x200 S355
L120x120x12 S235
70
150
160
10
a=5AA
100
L150x150x12 S235
100
2M20 8.8



3.1.9 Loads

Loads from report:

ENS-ZL380 – Tower HB+0/R_X

Report nr.: 21-0135 Rev 3
Date: 2021-12-20

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Member: 469 L50x50x5 S355

N_{ED} = -5,3 kN compression N_{ED} = 4,3 kN tension

3.1.10 Calculation

3.1.10.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+0_R_X mast 35
Project number	21-187
Author	G.P.
Description	Detail 3
Date	17/2/2022
Design code	EN

Material

Steel	S 355, S 235

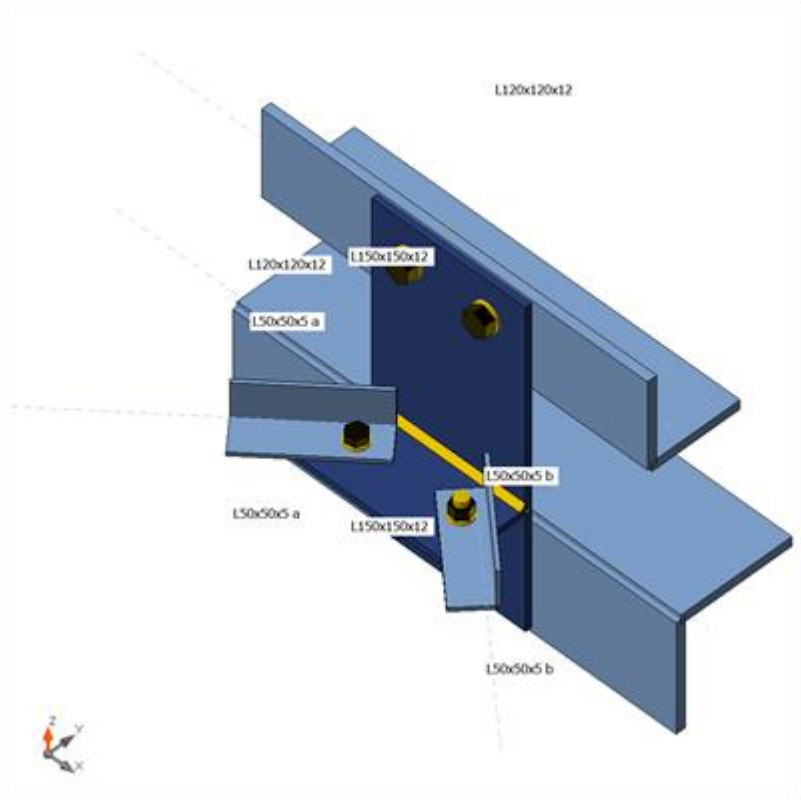
Project item Detail 3

Design

Name	Detail 3
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in	X [mm]
L150x150x12	3 - HFLeq150x150x12	0.0	0.0	-90.0	0	70	41	Node	0
L50x50x5 a	5 - HFLeq50x50x5	-139.0	0.0	0.0	55	-14	0	Bolts	35
L120x120x12	4 - HFLeq120x120x12	0.0	0.0	0.0	0	34	165	Node	0
L50x50x5 b	5 - HFLeq50x50x5	-41.0	0.0	90.0	55	0	-14	Bolts	35



Cross-sections

Name	Material
3 - HFLeq150x150x12	S 235
5 - HFLeq50x50x5	S 355
4 - HFLeq120x120x12	S 235

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M16 8.8	M16 8.8	16	800.0	201
M20 8.8	M20 8.8	20	800.0	314

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	L150x150x12	0.0	0.0	-1.2	0.0	0.0	0.0
	L150x150x12	-2.7	0.0	-1.2	0.0	0.1	0.0
	L50x50x5 a	-5.3	0.0	0.0	0.0	0.0	0.0
	L120x120x12	-1.3	-0.6	0.0	0.0	0.0	0.0
	L120x120x12	0.0	-0.6	0.0	0.0	0.0	0.0
	L50x50x5 b	0.0	0.0	0.0	0.0	0.0	0.0
LE2	L150x150x12	0.0	0.0	0.9	0.0	0.0	0.0
	L150x150x12	2.2	0.0	0.9	0.0	-0.1	0.0
	L50x50x5 a	4.3	0.0	0.0	0.0	0.0	0.0

	L120x120x12	1.0	0.5	0.0	0.0	0.0	0.0
	L120x120x12	0.0	0.5	0.0	0.0	0.0	0.0
	L50x50x5 b	0.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	12.3 < 100%	OK
Welds	4.9 < 100%	OK
Buckling	82.58	

Plates

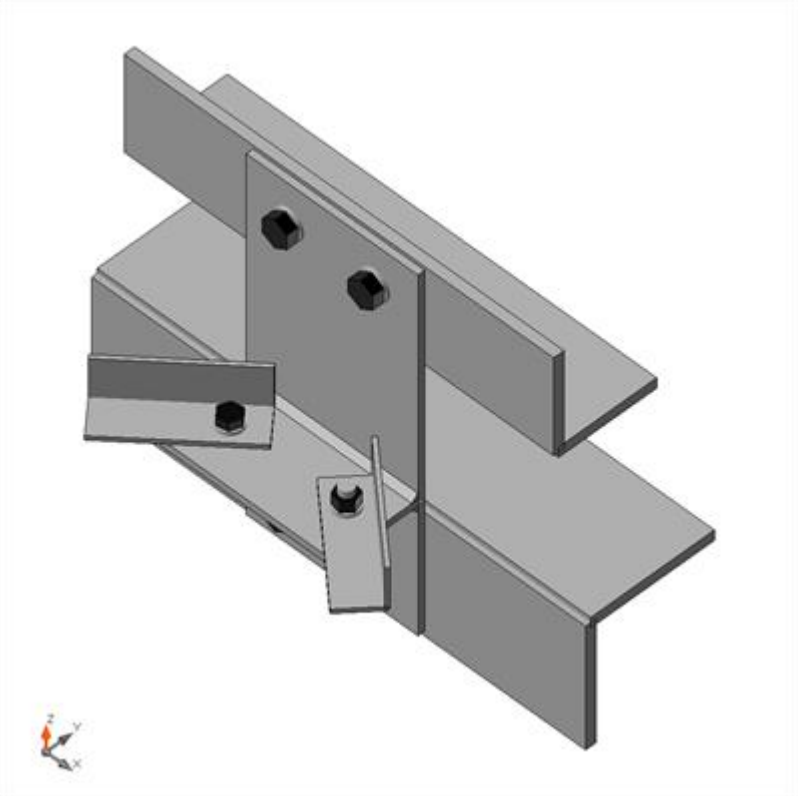
Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
L150x150x12-bfl 1	S 235	12.0	LE2	22.8	0.0	3.0	OK
L150x150x12-w 1	S 235	12.0	LE2	9.3	0.0	0.0	OK
L50x50x5 a-bfl 1	S 355	5.0	LE1	79.0	0.0	26.1	OK
L50x50x5 a-w 1	S 355	5.0	LE1	48.6	0.0	0.0	OK
L120x120x12-bfl 1	S 235	12.0	LE1	5.0	0.0	0.0	OK
L120x120x12-w 1	S 235	12.0	LE2	12.9	0.0	2.0	OK
L50x50x5 b-bfl 1	S 355	5.0	LE1	59.7	0.0	0.0	OK
L50x50x5 b-w 1	S 355	5.0	LE1	61.2	0.0	25.9	OK
SP1	S 355	8.0	LE1	100.1	0.0	3.5	OK
SP2	S 355	8.0	LE1	71.4	0.0	26.1	OK

Design data

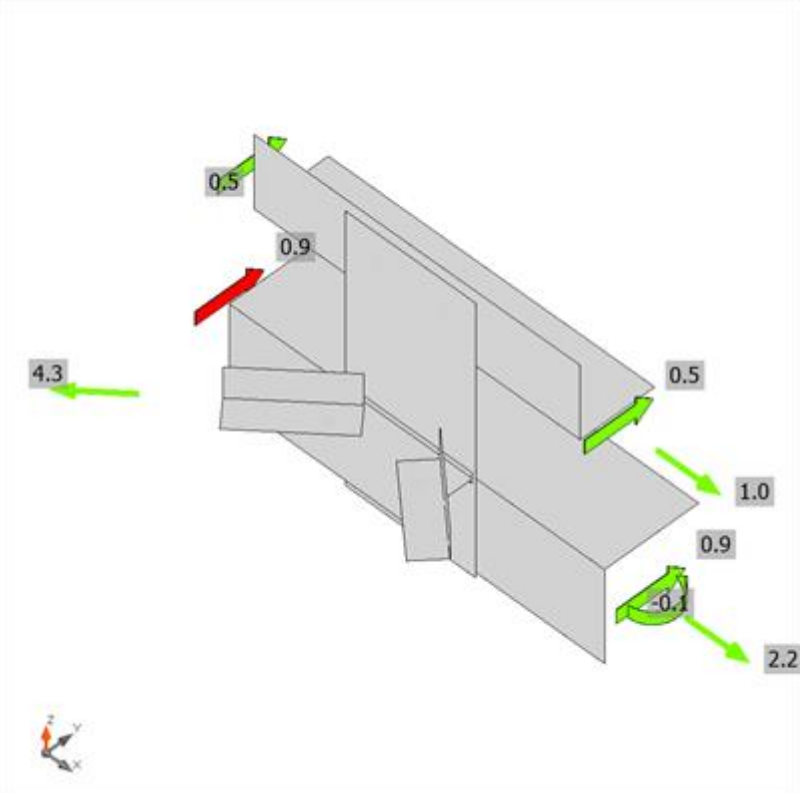
Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0
S 355	355.0	5.0

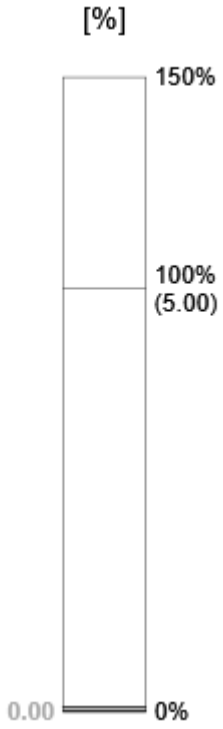
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

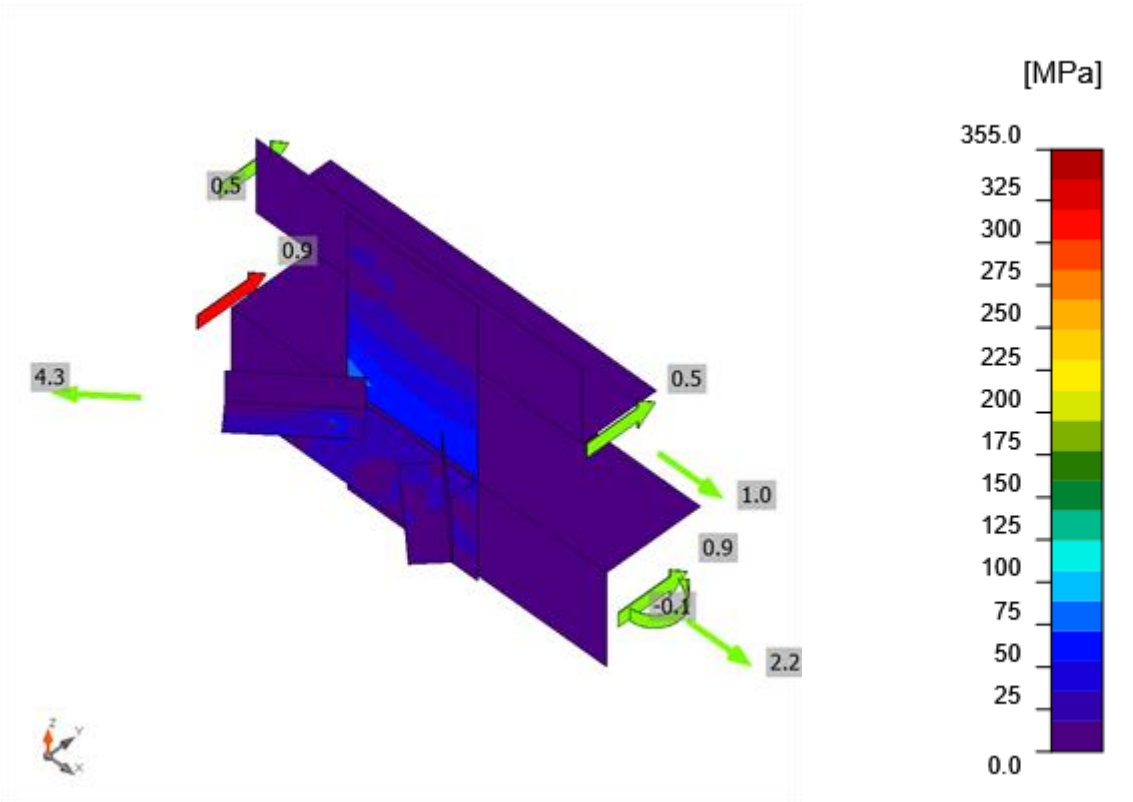


Overall check, LE2

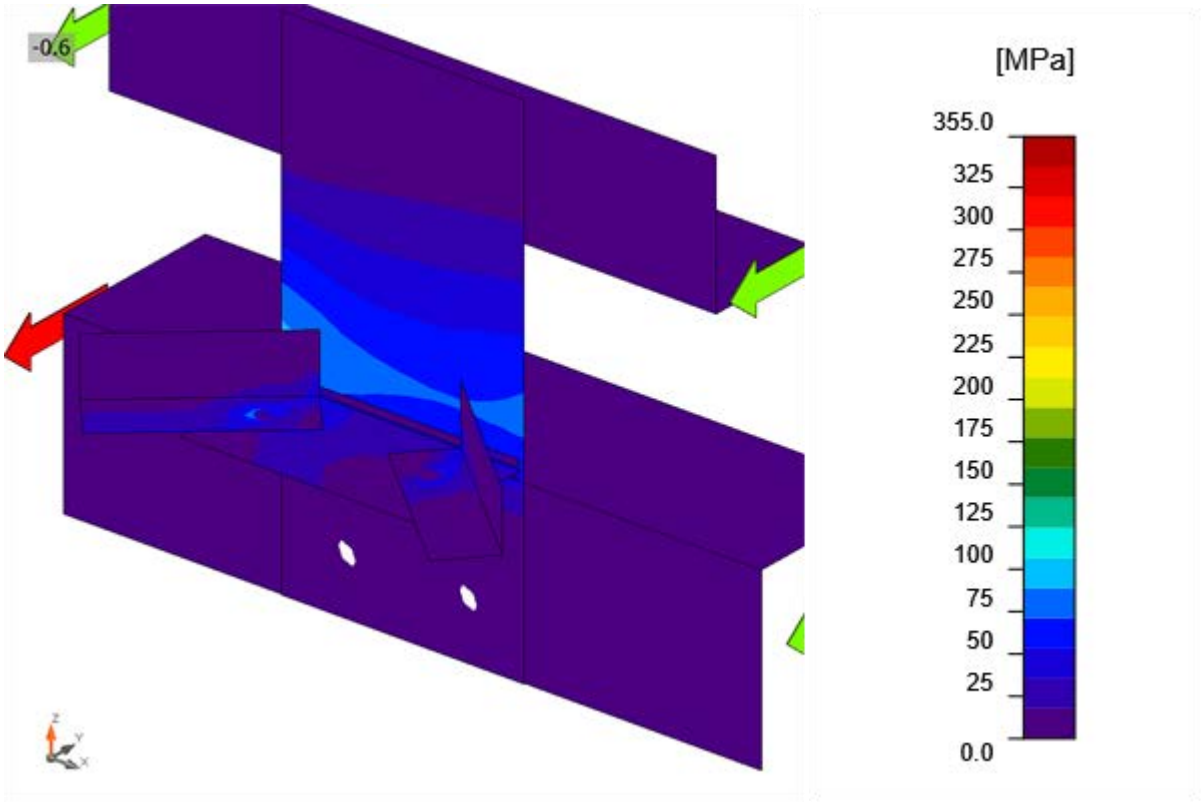




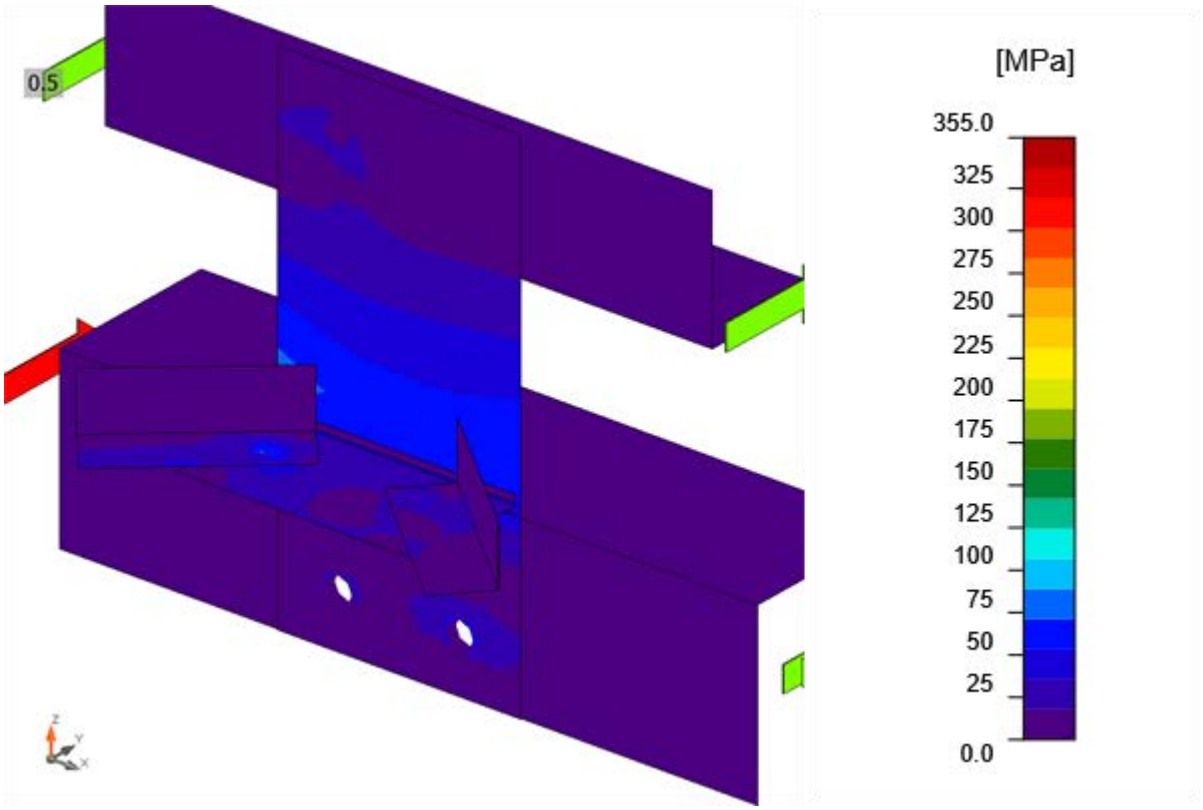
Strain check, LE2



Equivalent stress, LE2

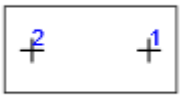


Equivalent stress, LE1



Equivalent stress, LE2

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M16 8.8 - 1	LE1	3.4	0.0	3.8	22.2	0.0	2.7	OK
	B2	M16 8.8 - 1	LE2	2.7	4.3	3.0	34.9	12.3	9.3	OK
	B3	M20 8.8 - 2	LE2	2.8	0.6	2.0	144.1	0.7	2.1	OK
	B4	M20 8.8 - 2	LE2	0.8	0.6	0.5	119.5	0.6	1.0	OK
	B5	M20 8.8 - 2	LE2	2.4	1.3	1.7	141.8	1.4	2.6	OK
	B6	M20 8.8 - 2	LE2	3.9	1.4	2.7	117.1	1.5	3.5	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M16 8.8 - 1	90.4	92.4	60.3

M20 8.8 - 2	141.1	186.2	94.1

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	Ut [%]	Ut_c [%]	Status
SP1	SP2	◢5.0◣	200	LE2	18.1	0.0	9.3	4.9	7.5	4.2	2.6	OK
		◢5.0◣	200	LE2	21.5	0.0	-11.1	-2.2	10.4	4.9	2.6	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 355	0.90	435.6	352.8

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Buckling

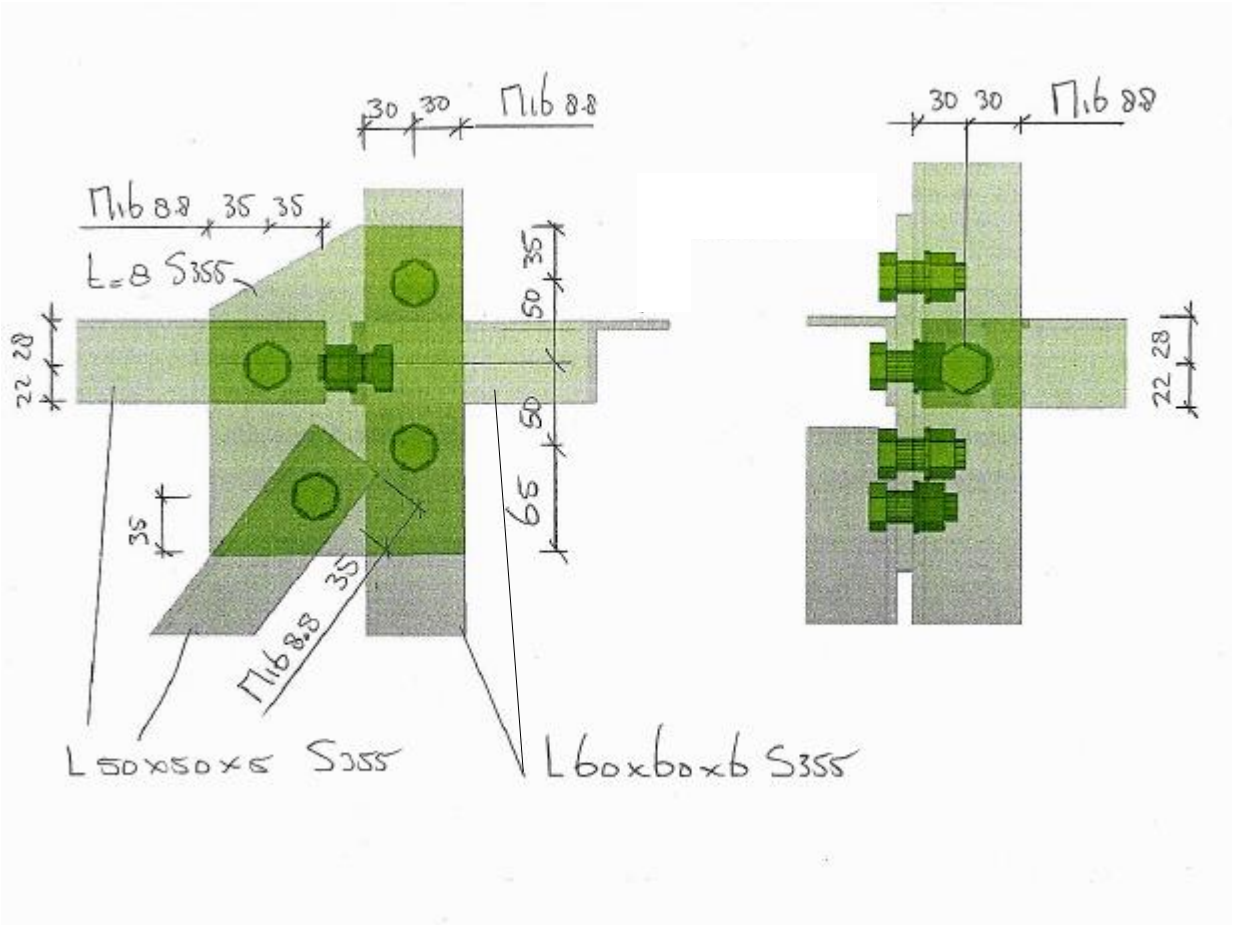
Loads	Shape	Factor [-]
LE1	1	82.58
	2	108.66
	3	159.97
	4	198.87
	5	224.36
	6	255.95
LE2	1	372.29
	2	1067.62

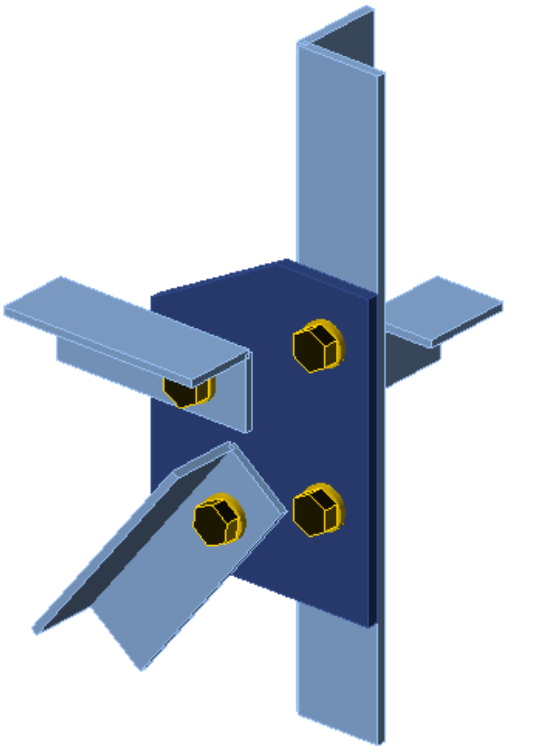
	3	1506.70
	4	1518.59
	5	1930.02
	6	1993.30

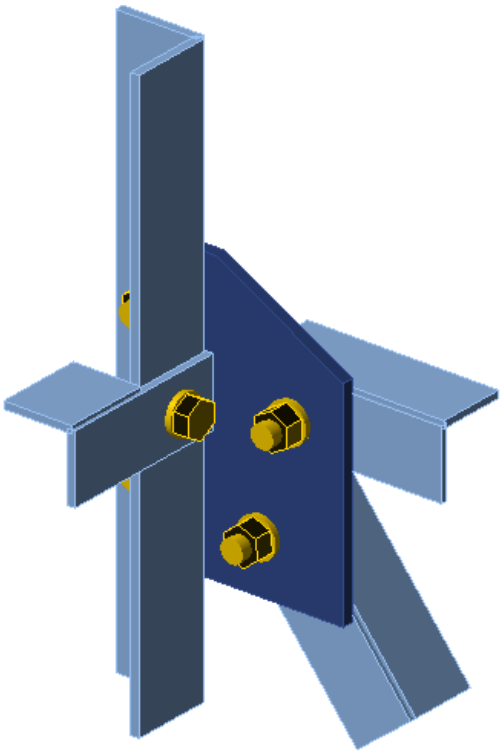
Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

3.1.11 Detail 4







3.1.12 Loads

Loads from report:

ENS-ZL380 – Tower HB+0/R_X

Report nr.: 21-0135 Rev 3
Date: 2021-12-20

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Member: 474	L50x50x5	S355
N_{ED} = -2,8 kN compression		N_{ED} = 2,3 kN tension
Member: 473	L60x60x6	S355
N_{ED} = -0,2 kN compression		N_{ED} = 0,2 kN tension

Page 44

Member: 443	L60x60x6	S355
N_{ED} = -1,1 kN compression		N_{ED} = 14,3 kN tension

3.1.13 Calculation

3.1.13.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+0_R_X mast 35
Project number	21-187
Author	G.P.
Description	Detail 4
Date	2/17/2022
Design code	EN

Material

Steel	S 355

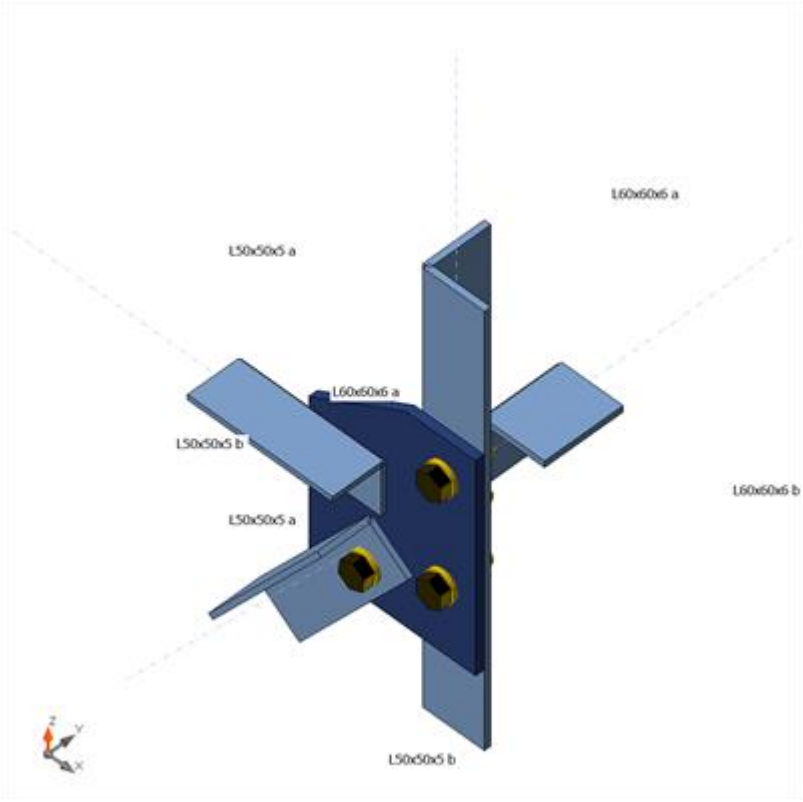
Project item Detail 4

Design

Name	Detail 4
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
L60x60x6 a	4 - HFLeq60x60x6	0.0	90.0	0.0	0	0	0	Node
L50x50x5 a	5 - HFLeq50x50x5	180.0	0.0	-90.0	40	0	39	Node
L50x50x5 b	5 - HFLeq50x50x5	180.0	52.0	-90.0	70	0	39	Node
L60x60x6 b	4 - HFLeq60x60x6	90.0	0.0	180.0	-15	-6	0	Node



Cross-sections

Name	Material
4 - HFLeq60x60x6	S 355
5 - HFLeq50x50x5	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M16 8.8	M16 8.8	16	800.0	201

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	L60x60x6 a	-1.8	0.0	0.0	0.0	0.0	-0.1
	L50x50x5 a	-1.4	0.0	0.0	0.0	0.0	0.0
	L50x50x5 b	2.3	0.0	0.0	0.0	0.0	0.0
	L60x60x6 a	0.0	0.0	0.0	0.0	0.0	0.0
	L60x60x6 b	0.0	0.0	0.0	0.0	0.0	0.0
LE2	L60x60x6 a	2.2	0.0	0.0	0.0	0.0	0.1
	L50x50x5 a	1.7	0.0	0.0	0.0	0.0	0.0
	L50x50x5 b	-2.8	0.0	0.0	0.0	0.0	0.0
	L60x60x6 a	0.0	0.0	0.0	0.0	0.0	0.0
	L60x60x6 b	0.0	0.0	0.0	0.0	0.0	0.0

LE3	L60x60x6 a	0.0	-0.1	0.0	0.0	0.0	0.0
	L50x50x5 a	0.0	0.0	0.0	0.0	0.0	0.0
	L50x50x5 b	0.0	0.0	0.0	0.0	0.0	0.0
	L60x60x6 a	0.0	-0.1	0.0	0.0	0.0	0.0
	L60x60x6 b	0.2	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	6.6 < 100%	OK
Buckling	191.04	

Plates

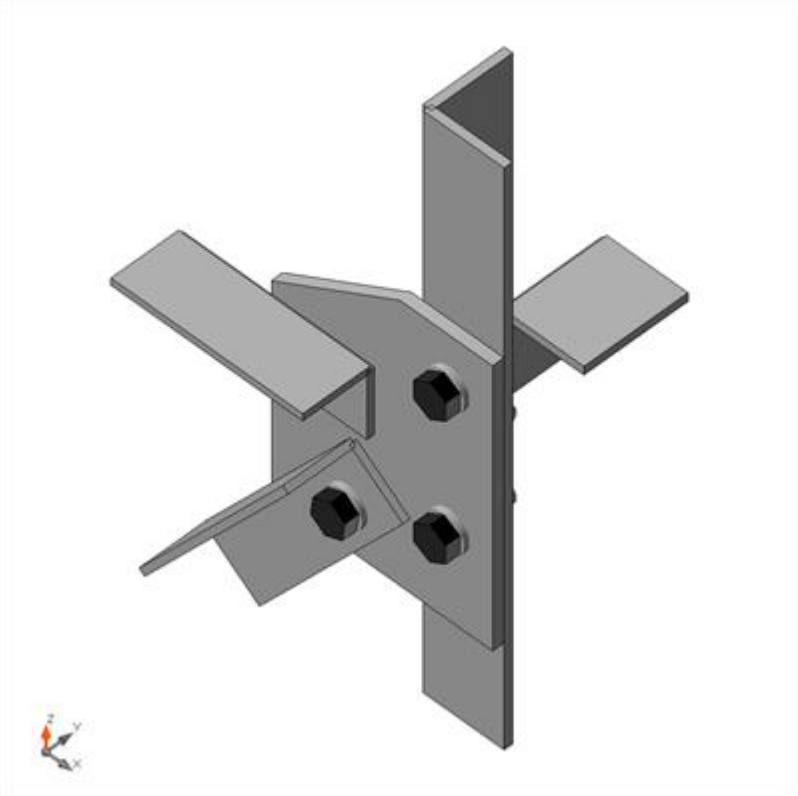
Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
L60x60x6 a-bfl 1	6.0	LE1	18.4	0.0	3.9	OK
L60x60x6 a-w 1	6.0	LE2	26.5	0.0	1.2	OK
L50x50x5 a-bfl 1	5.0	LE2	22.4	0.0	0.7	OK
L50x50x5 a-w 1	5.0	LE1	3.8	0.0	0.0	OK
L50x50x5 b-bfl 1	5.0	LE2	32.3	0.0	2.3	OK
L50x50x5 b-w 1	5.0	LE2	5.6	0.0	0.0	OK
L60x60x6 b-bfl 1	6.0	LE1	4.5	0.0	0.0	OK
L60x60x6 b-w 1	6.0	LE1	4.9	0.0	0.2	OK
SP1	8.0	LE2	23.2	0.0	2.3	OK

Design data

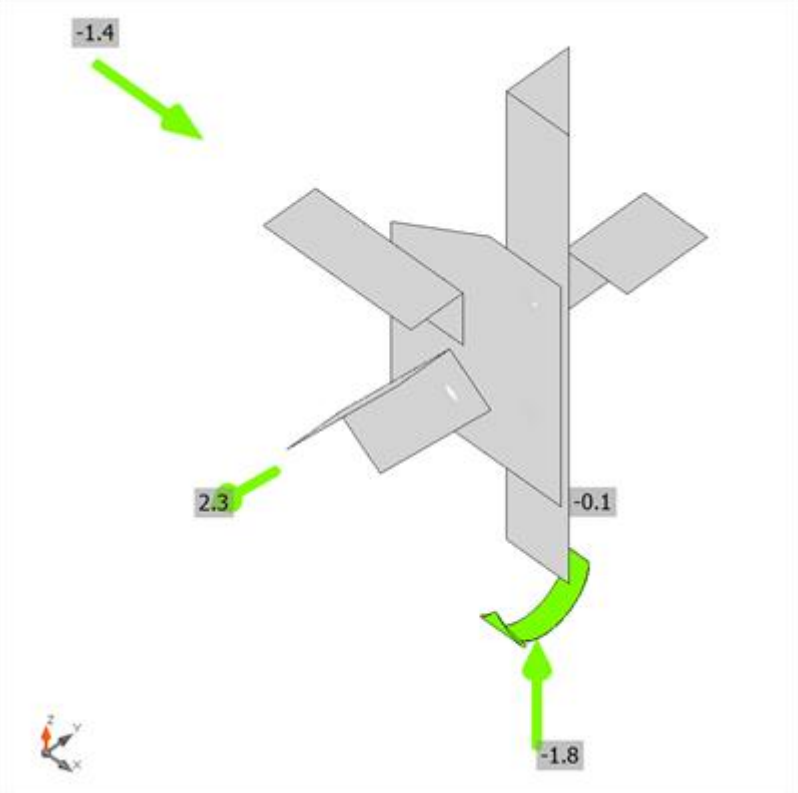
Material	f_y [MPa]	ε_{lim} [%]
S 355	355.0	5.0

Symbol explanation

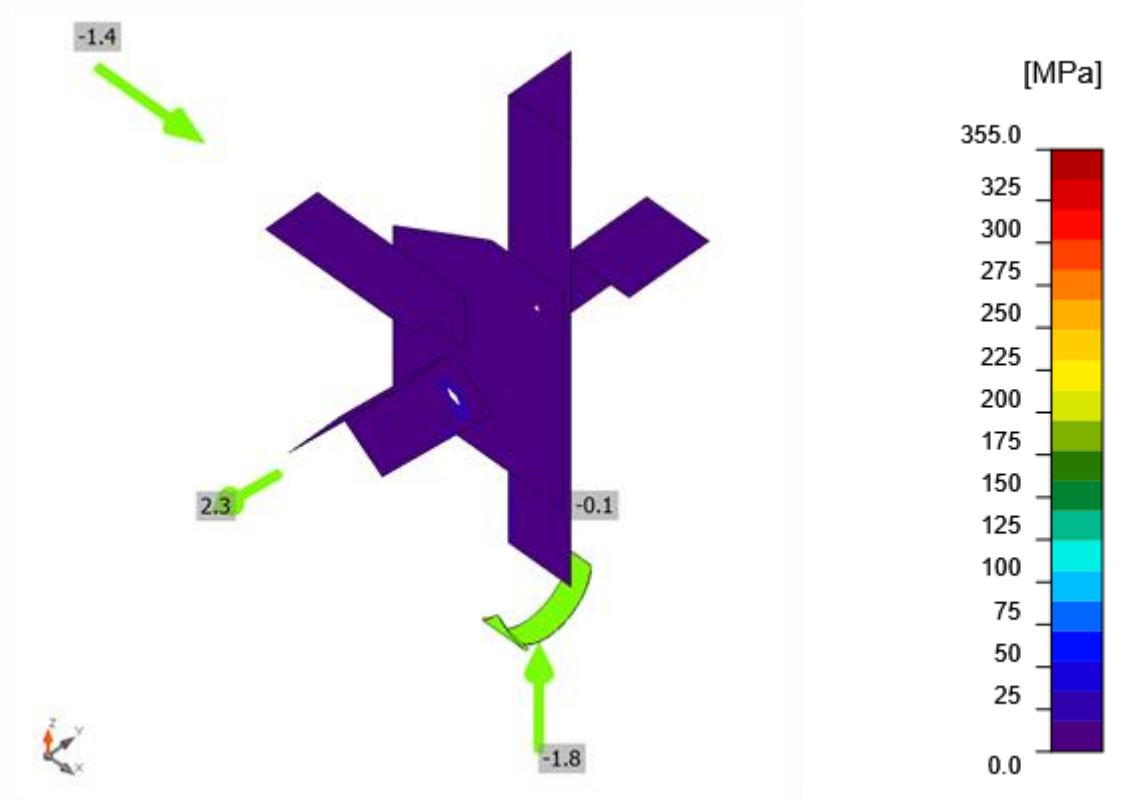
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain



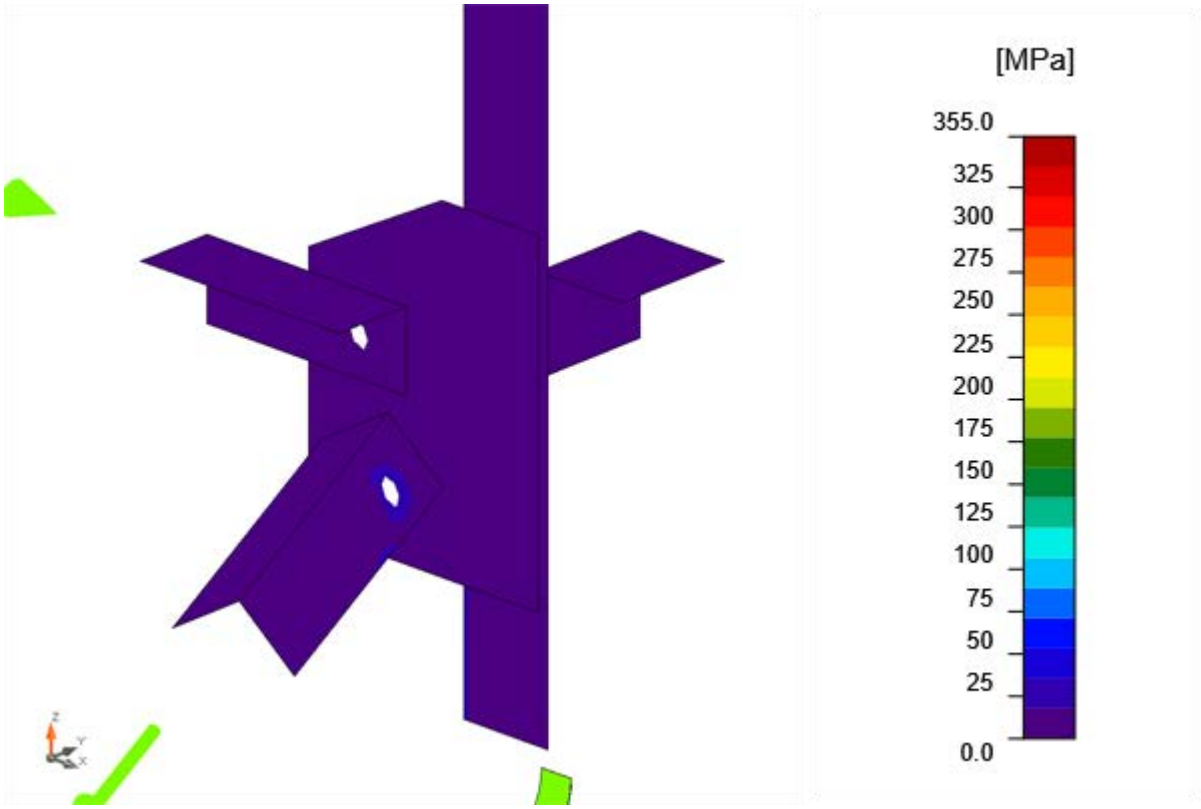
Overall check, LE1



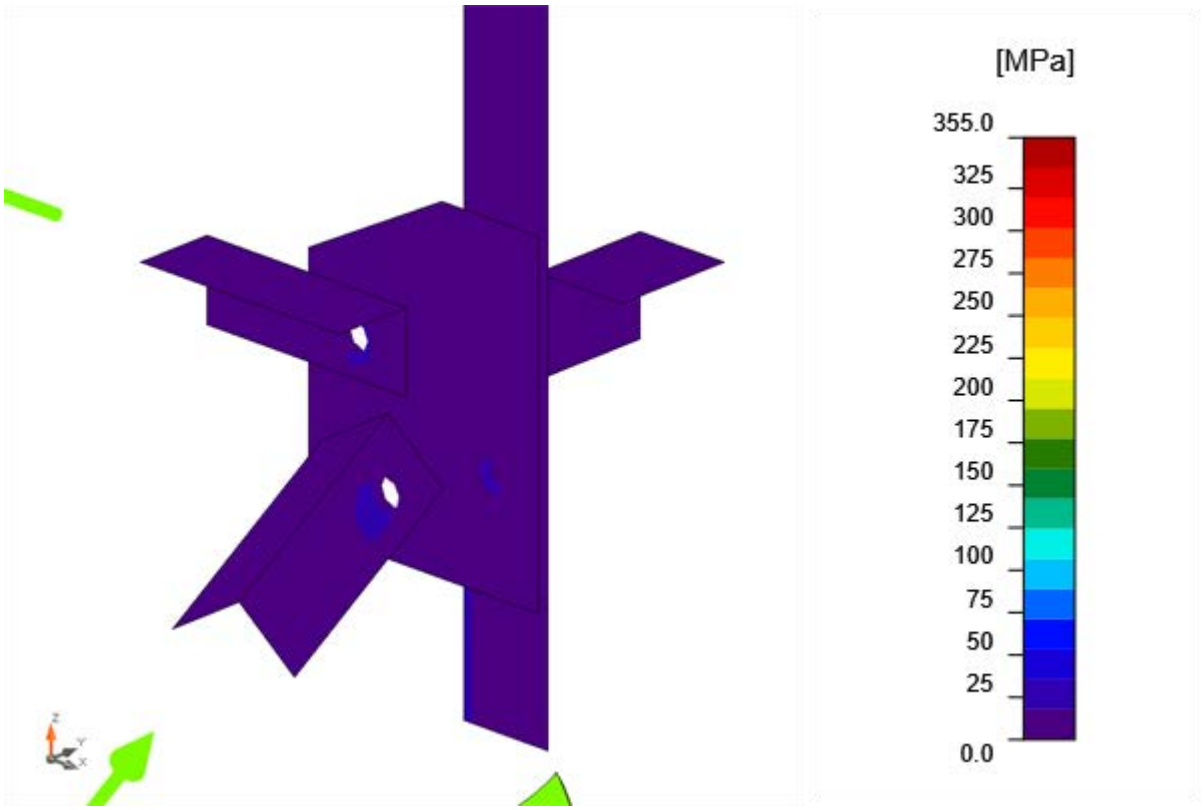
Strain check, LE1



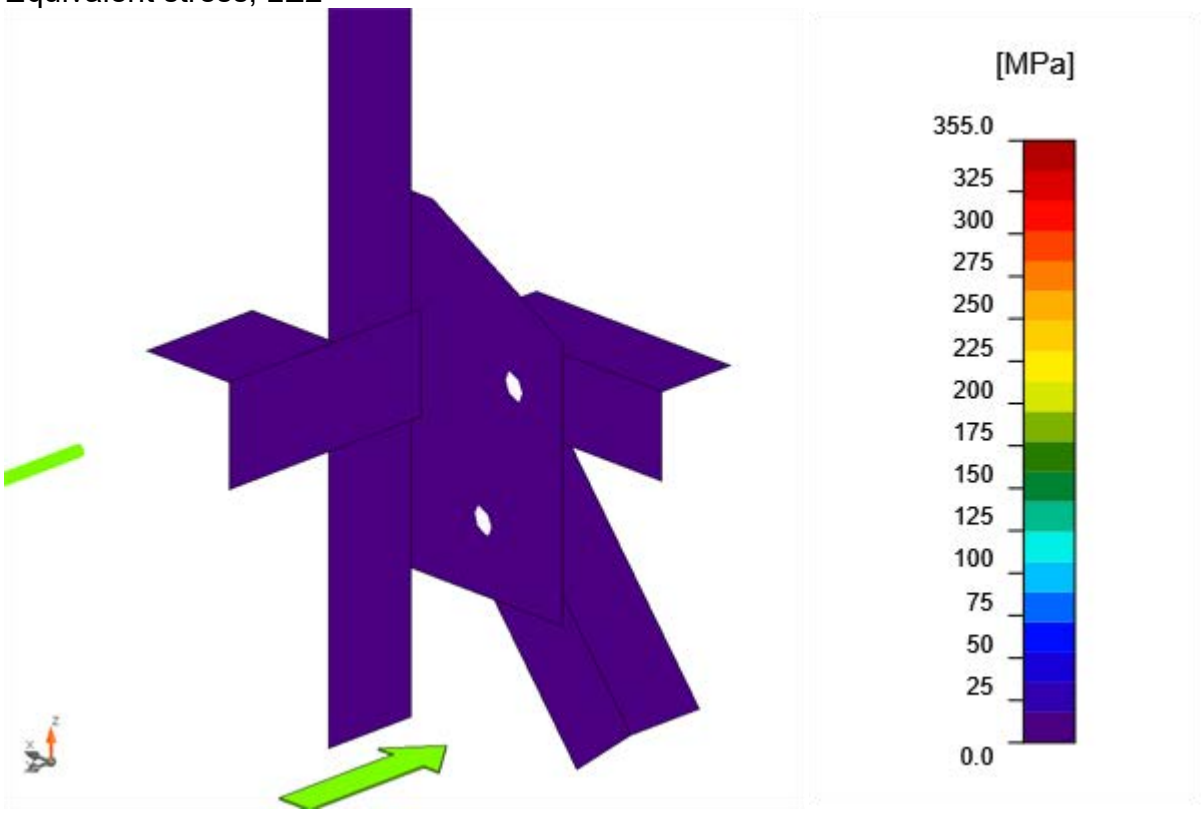
Equivalent stress, LE1



Equivalent stress, LE1



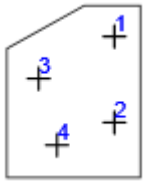
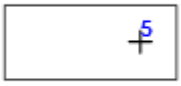
Equivalent stress, LE2



Equivalent stress, LE3

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status

	B1	M16 8.8 - 1	LE2	0.1	1.1	0.1	84.8	1.8	1.9	OK
	B2	M16 8.8 - 1	LE2	1.0	1.2	1.1	78.7	1.9	2.7	OK
	B3	M16 8.8 - 2	LE2	0.5	1.7	0.5	34.9	4.9	3.2	OK
	B4	M16 8.8 - 2	LE1	0.8	2.3	0.9	34.9	6.6	4.5	OK
	B5	M16 8.8 - 1	LE3	0.1	0.2	0.1	48.8	0.4	0.4	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M16 8.8 - 1	90.4	110.8	60.3
M16 8.8 - 2	90.4	92.4	60.3

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Buckling

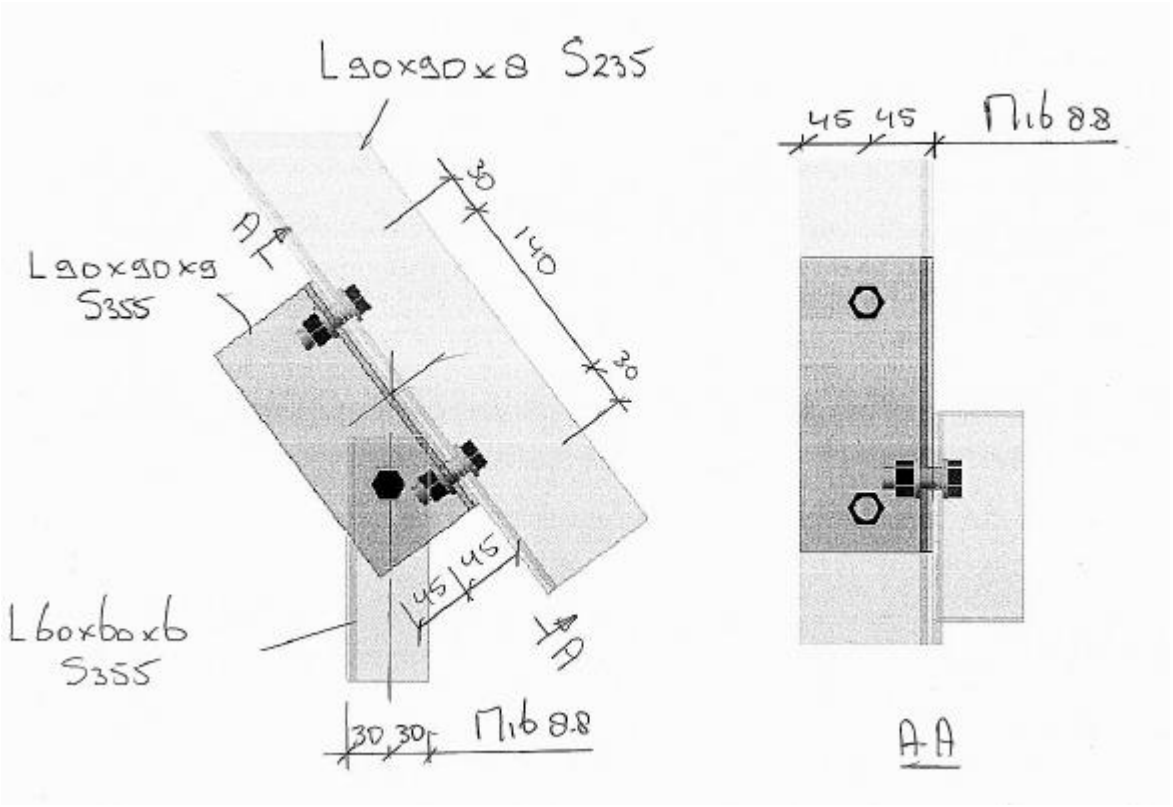
Loads	Shape	Factor [-]
LE1	1	437.06
	2	566.31
	3	598.50
	4	618.48
	5	960.23
	6	1122.82

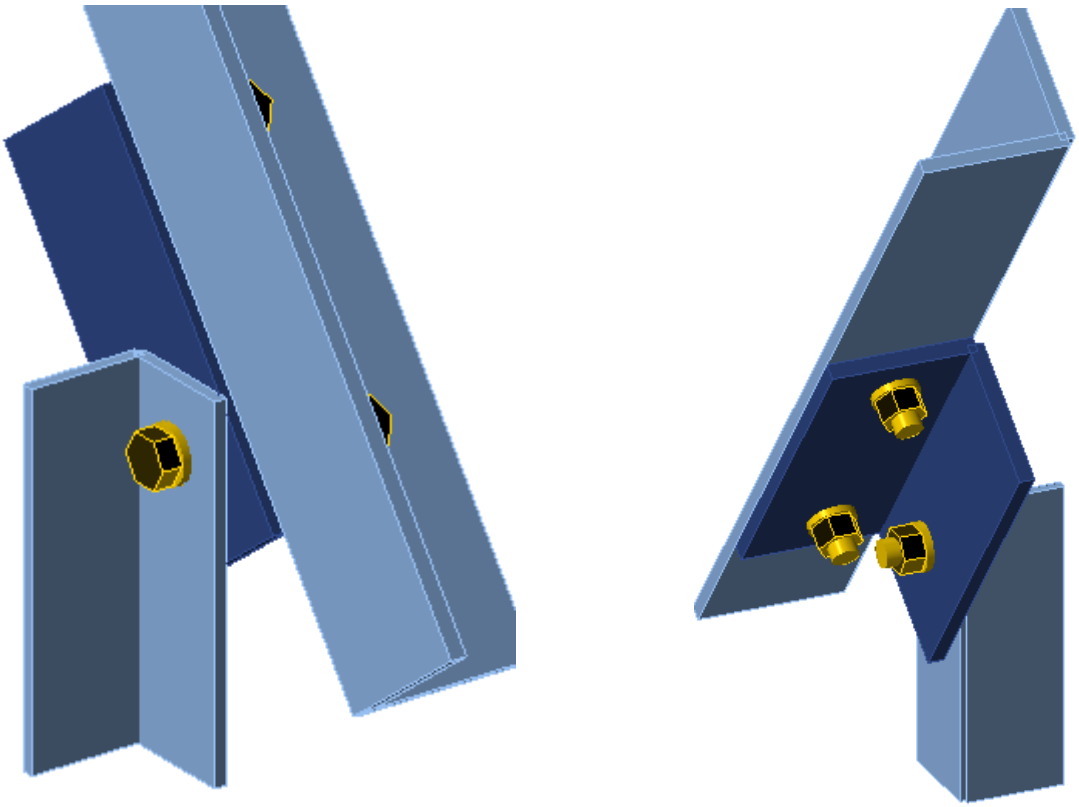
LE2	1	191.04
	2	201.68
	3	211.20
	4	215.76
	5	292.83
	6	300.26
LE3	1	1011.51
	2	1128.40
	3	1249.73
	4	1370.44
	5	2040.58
	6	2246.71

Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_C	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

3.1.14 Detail 5





3.1.15 Loads

Loads from report:

ENS-ZL380 – Tower HB+0/R_X

Report nr.: 21-0135 Rev 3
Date: 2021-12-20

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Member: 443 L60x60x6 S355

N_{ED} = -1,1 kN compression N_{ED} = 14,3 kN tension

3.1.16 Calculation

3.1.16.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+0_R_X mast 35
Project number	21-187
Author	G.P.
Description	Detail 5
Date	2/17/2022
Design code	EN

Material

Steel	S 355, S 235

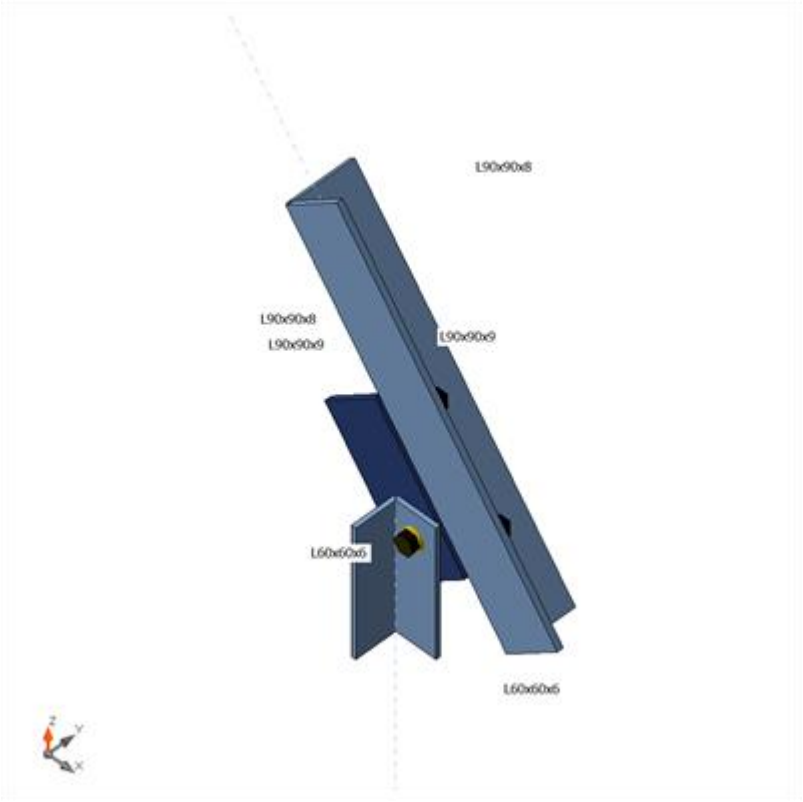
Project item Detail 5

Design

Name	Detail 5
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in	X [mm]
L90x90x8	3 - H90/90/8	0.0	53.0	0.0	0	0	0	Node	0
L60x60x6	4 - HFLeq60x60x6	0.0	90.0	90.0	99	0	42	Bolts	35



Cross-sections

Name	Material
3 - H90/90/8	S 235
4 - HFLeq60x60x6	S 355
5 - HFLeq90x90x9	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M16 8.8	M16 8.8	16	800.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	L60x60x6	14.3	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	27.9 < 100%	OK
Buckling	99.51	

Plates

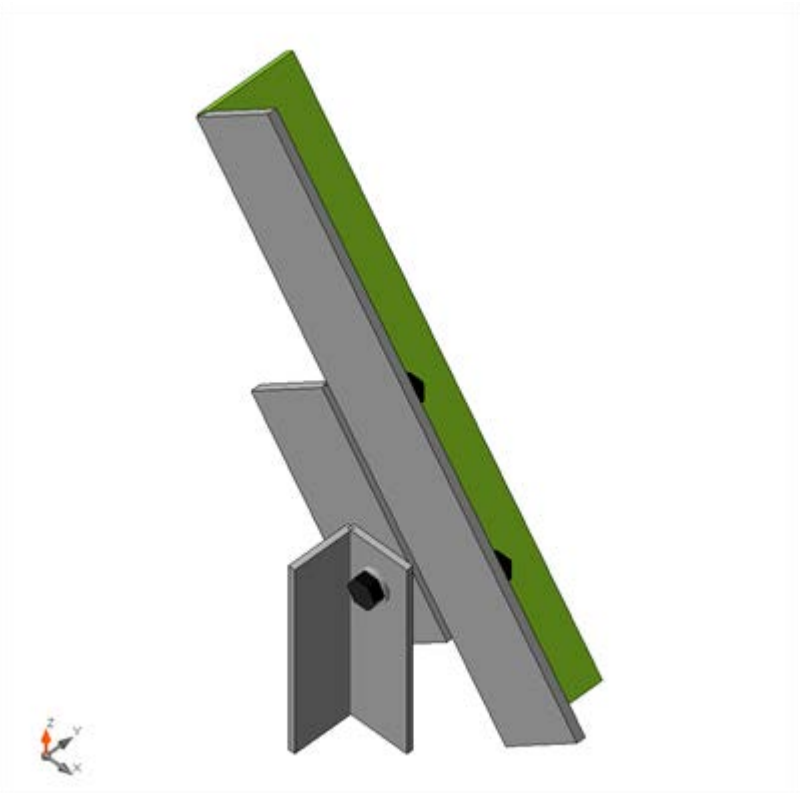
Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
L90x90x8-bfl 1	S 235	8.0	LE1	194.6	0.0	17.6	OK
L90x90x8-w 1	S 235	8.0	LE1	79.3	0.0	0.0	OK
L60x60x6-bfl 1	S 355	6.0	LE1	187.9	0.0	32.7	OK
L60x60x6-w 1	S 355	6.0	LE1	111.6	0.0	0.0	OK
L90x90x9-bfl 1	S 355	9.0	LE1	91.6	0.0	32.7	OK
L90x90x9-w 1	S 355	9.0	LE1	204.9	0.0	17.6	OK

Design data

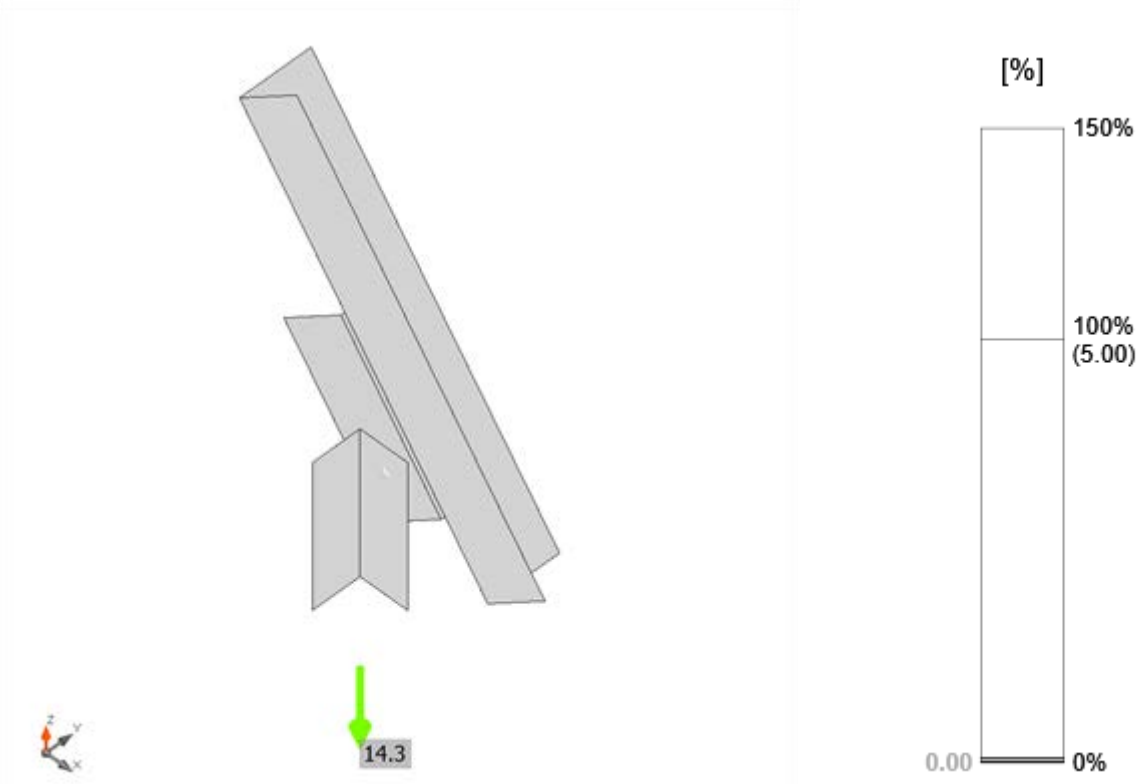
Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0
S 355	355.0	5.0

Symbol explanation

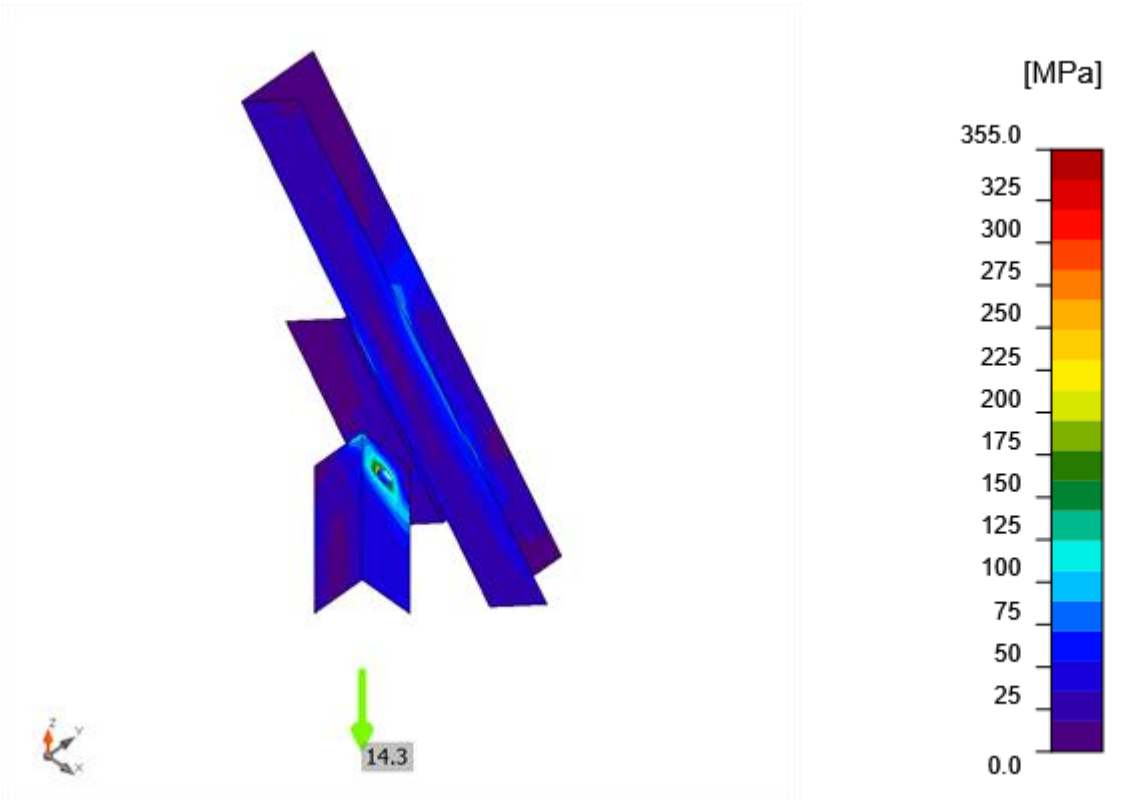
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain



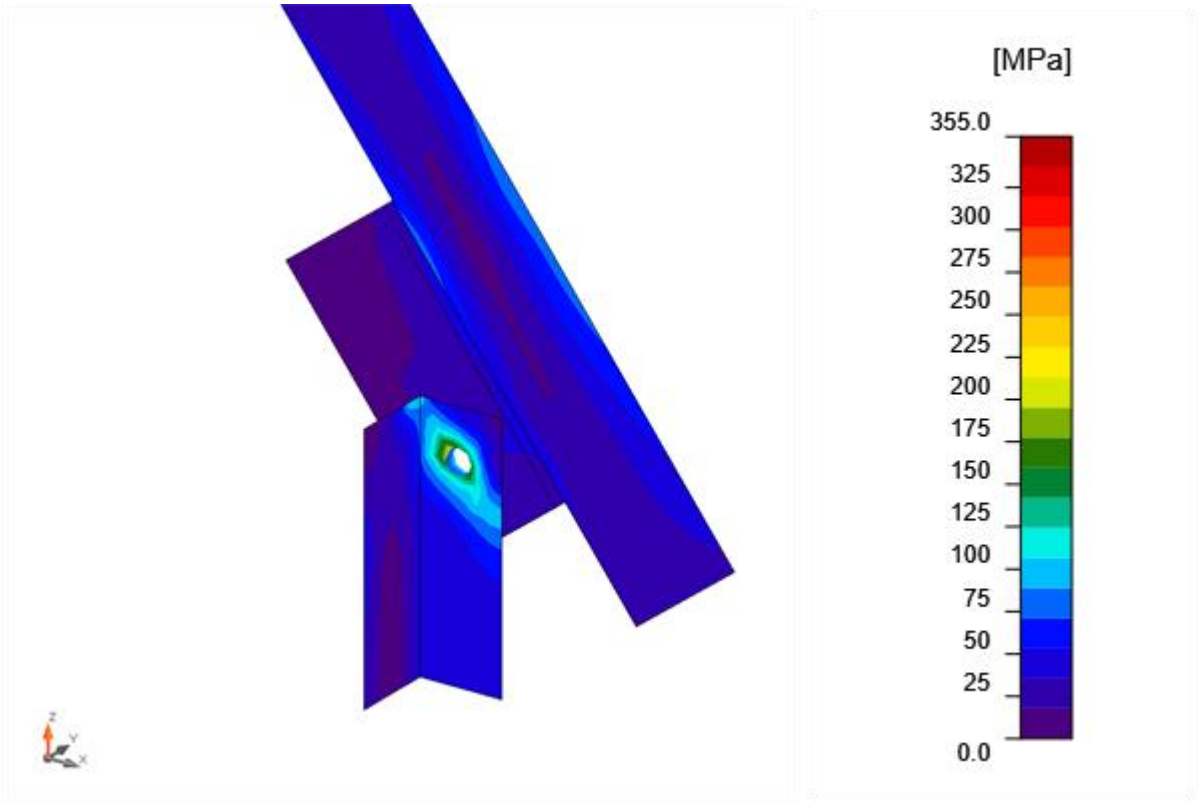
Overall check, LE1



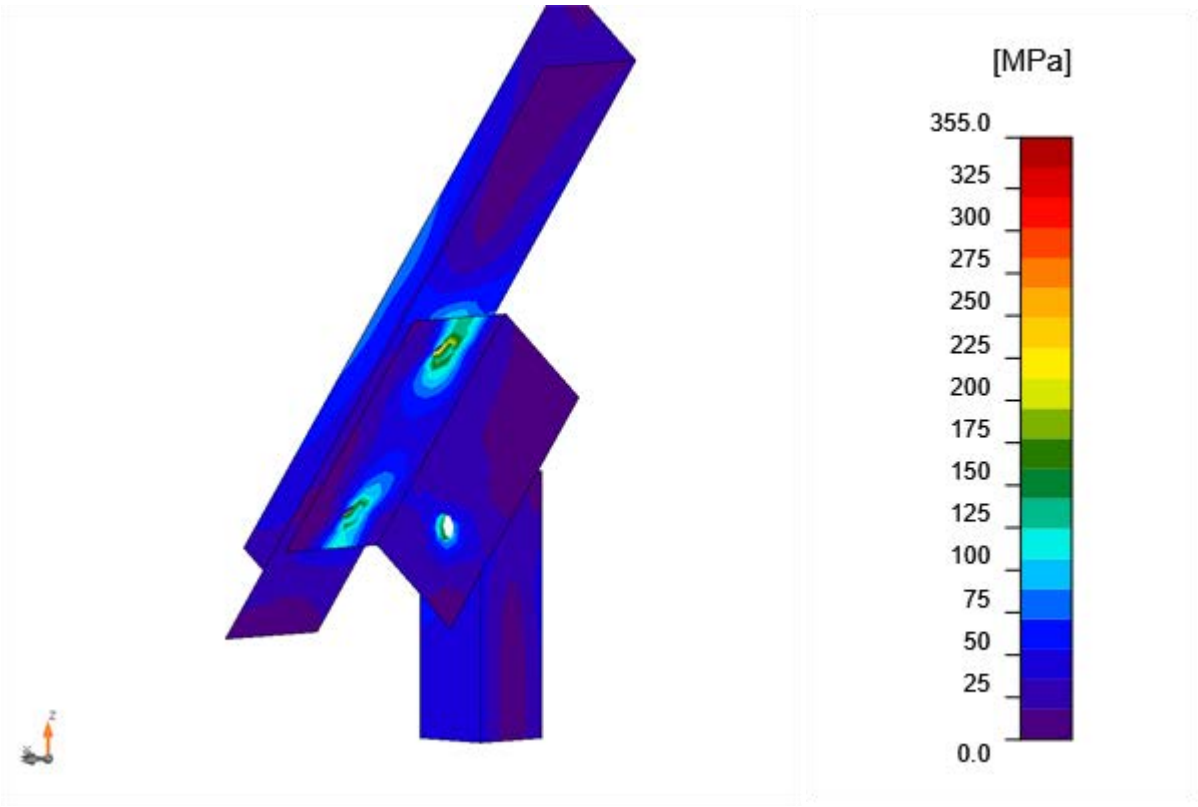
Strain check, LE1



Equivalent stress, LE1



Equivalent stress, LE1



Equivalent stress, LE1

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M16 8.8 - 1	LE1	5.3	14.3	5.9	60.5	23.7	27.9	OK
	B2	M16 8.8 - 2	LE1	13.8	6.3	15.3	86.9	10.5	21.4	OK
	B3	M16 8.8 - 2	LE1	16.4	6.8	18.1	78.4	11.3	24.3	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M16 8.8 - 1	90.4	110.8	60.3
M16 8.8 - 2	90.4	108.6	60.3

Symbol explanation

$F_{t,Rd}$ Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$ Tension force

$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Buckling

Loads	Shape	Factor [-]
LE1	1	99.51
	2	107.16
	3	109.09
	4	111.16
	5	172.39
	6	188.25

Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_C	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

4 Summary U.C. 's

4.1.1 Connections

Detail 1

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	6.0 < 100%	OK
Buckling	43.12	

Detail 2

Bolts: U.C. = 0,04

Plate: U.C. = 0,02

Detail 3

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	12.3 < 100%	OK
Welds	4.9 < 100%	OK
Buckling	82.58	

Detail 4

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	6.6 < 100%	OK
Buckling	191.04	

Detail 5

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	27.9 < 100%	OK
Buckling	99.51	

5 Conclusion

5.1.1 Connections

All connections have sufficient strength.

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-06500**

Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994404**

Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype HB+9_R_X, Mast 65 - Overzichtstekeningen**

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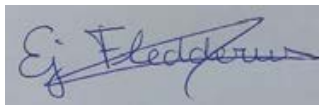
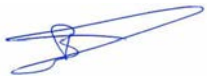
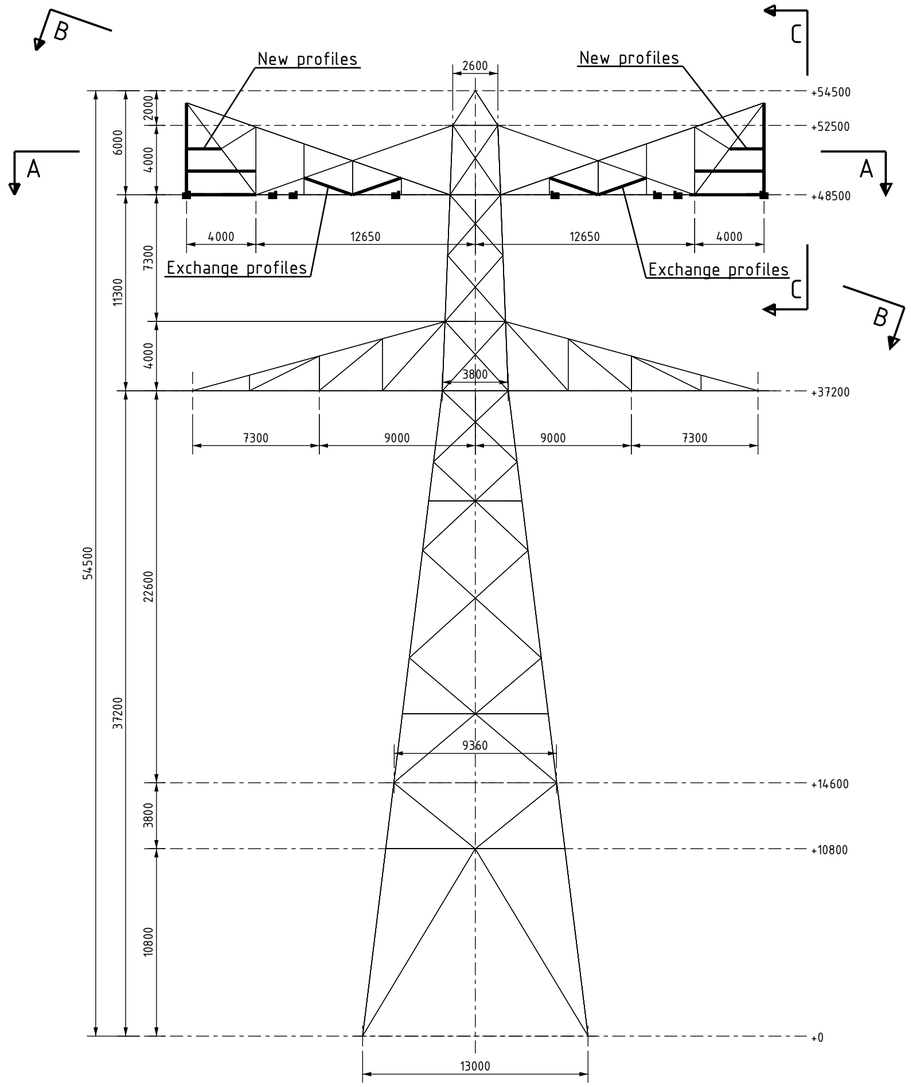
Opgesteld	Erik-Jan Fledderus	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review



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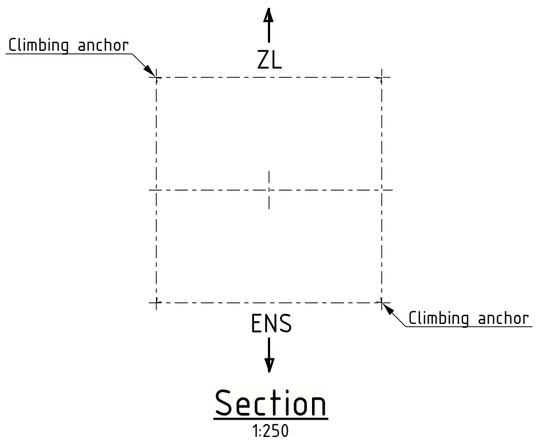

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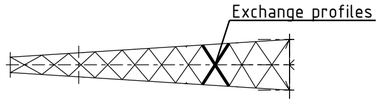

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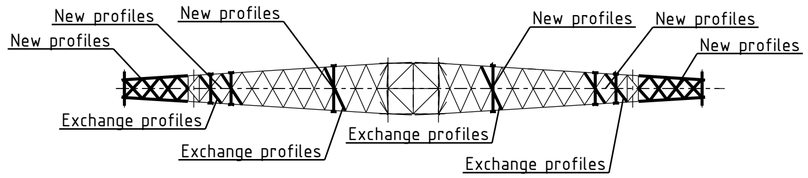

Section A – A
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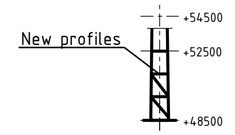


Section C – C
1:250

All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

Unless otherwise specified:
- It has drawn on the right side.
- Material quality S355J0 (t<=16mm), S355J2 (16<t<=40mm)
- All bended profiles and plates "HOT BENDING".
- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 - HDG oversized
Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle
Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:250	594x420

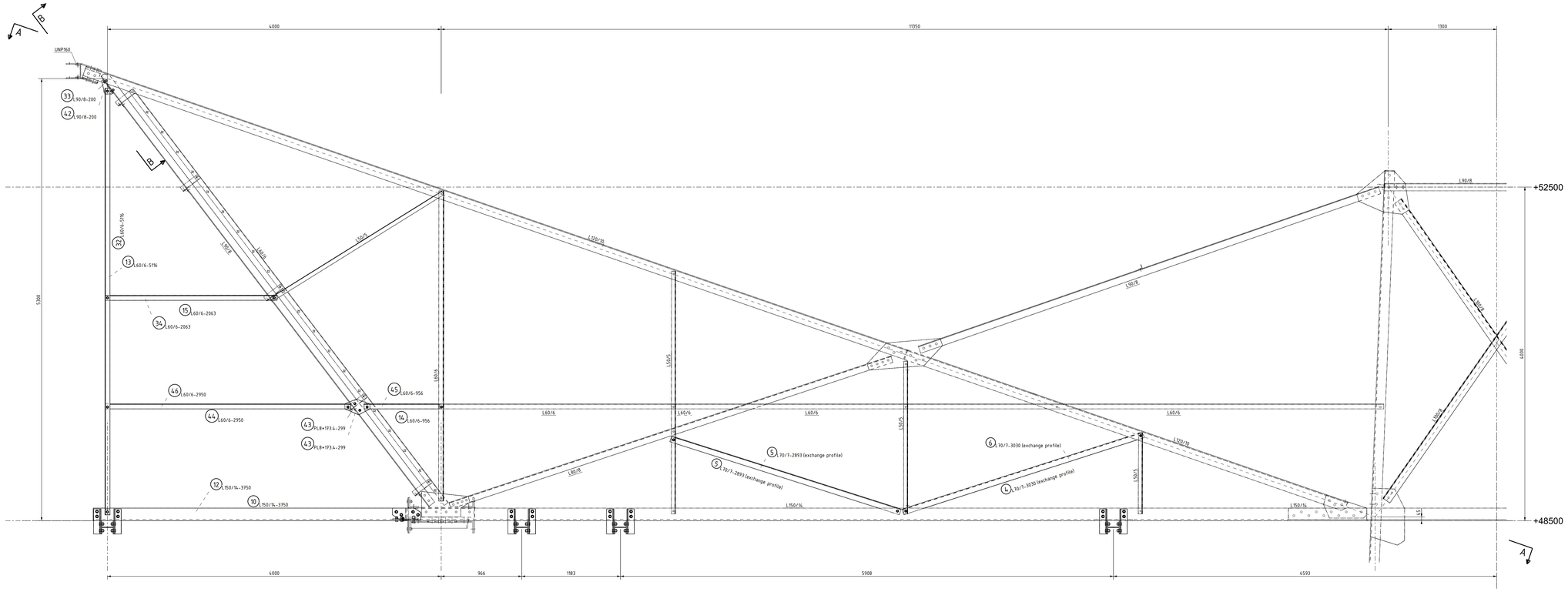
Relatie

Oud Tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Omschrijving:	Masttype HB+9_R_X, Mast 65 - Overzicht
Documentnummer:	00974-01-06501

TenneT Taking power further

Tekla Structures



Front Face Upper Cross Arm
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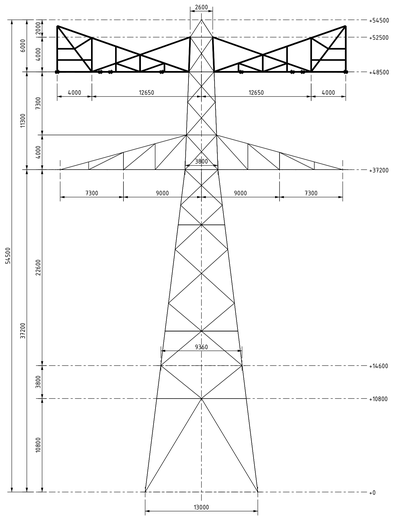

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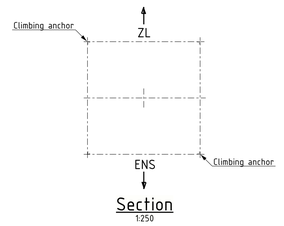

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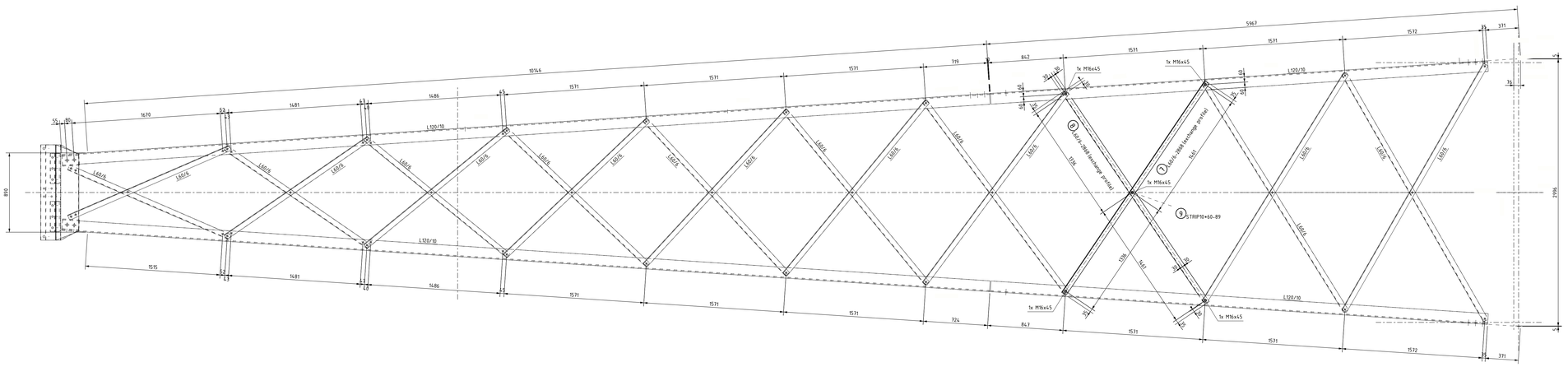
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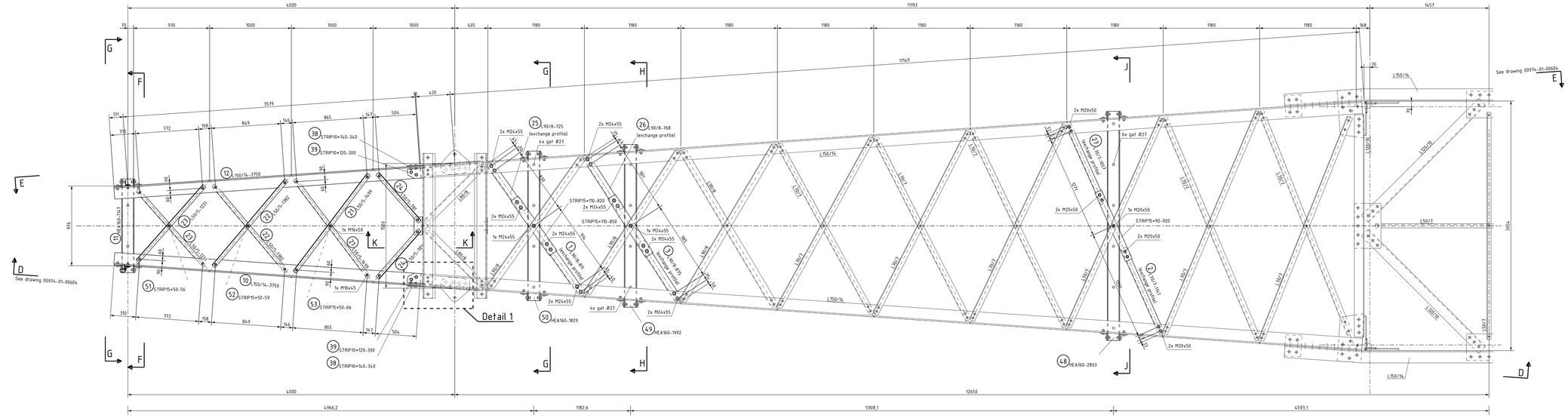

Bottom Surface Upper Cross Arm
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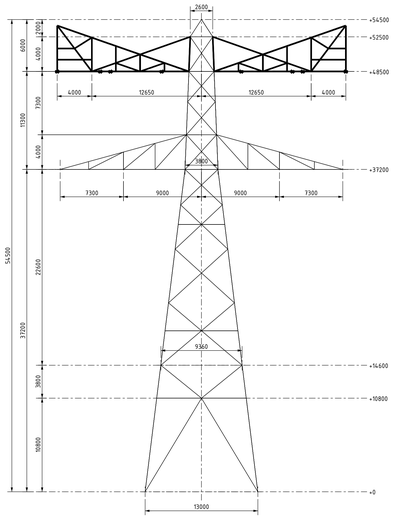

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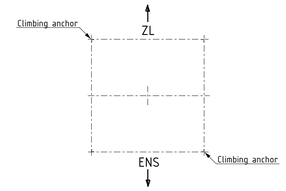

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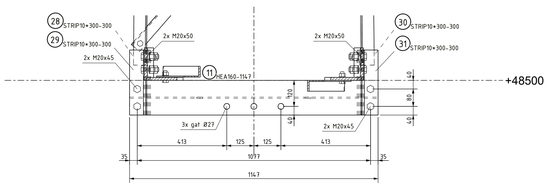

Section F - F
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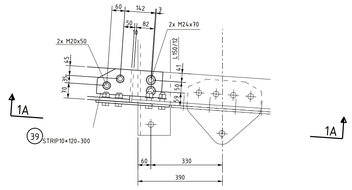

Detail 1
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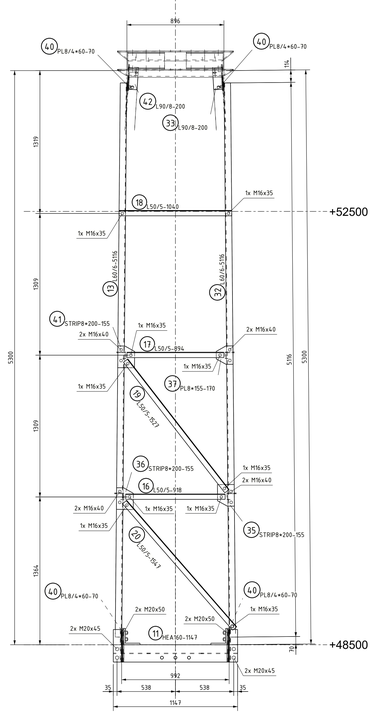
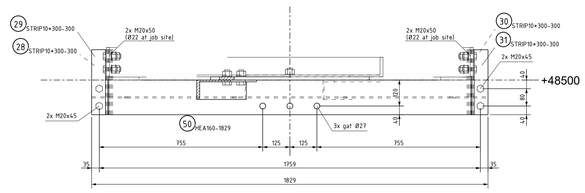


Section G - G
1:20



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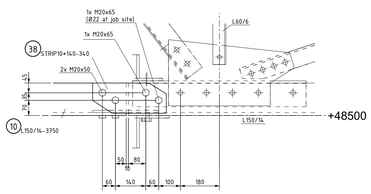

Section 1A - 1A
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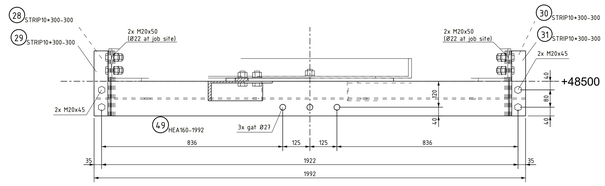

Section H - H
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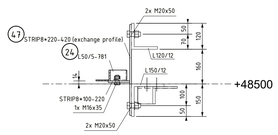

K - K
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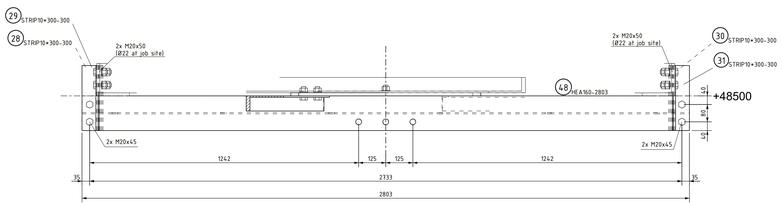


Section J - J
1:10

All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

Unless otherwise specified:
- It has drawn on the right side.
- Material quality S355J0 (t=16mm), S355J2 (16=t=40mm)
- All bended profiles and plates "HOT BENDING".
- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 - HDG oversized
Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

See also drawing 00974-01-00602 and 00974-01-00604

Rev.	Datum revisie	Beschrijving revisie	Getekend	Datum Ao-Bolt	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 1:20	A0

Opwaarderen 380 kV verbinding Ens - Zwolle

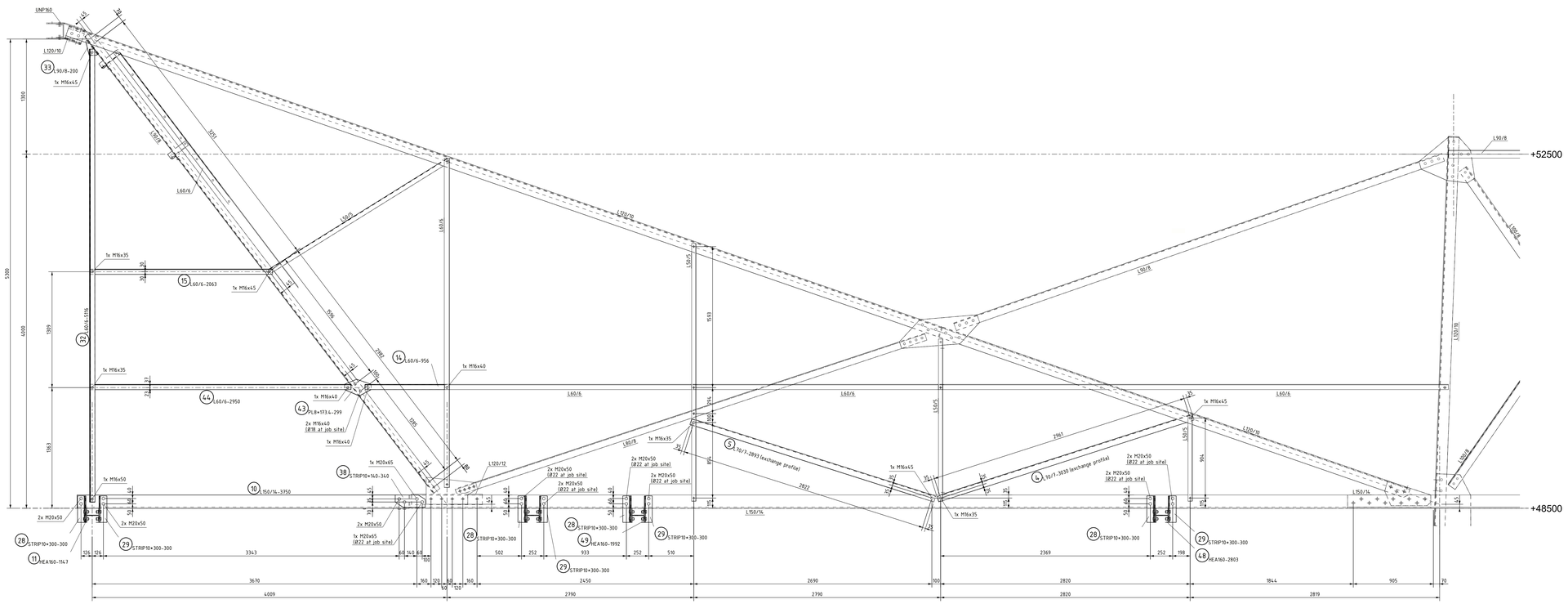
Vooriopig

Relatie

Thema: Verbinding
Categorie: Algemeen
Documentsoort: Constructietekening
Object ID: ENS-ZL380 HB+9_R_X Mast 65
Beschrijving: Masttype HB+9_R_X, Mast 65 - Boventraverse Ondervlak
Documentnummer: 00974-01-06503

TenneT taking power further

Teka Structures



Section D - D
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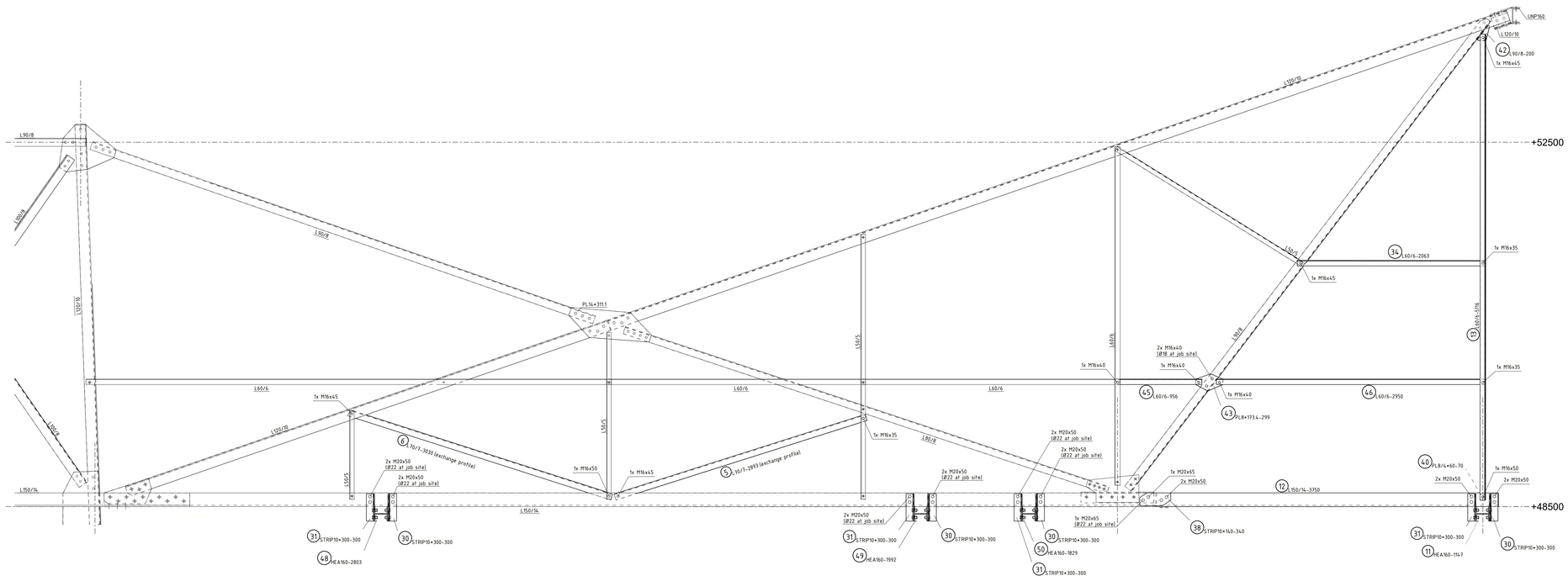

Section E - E
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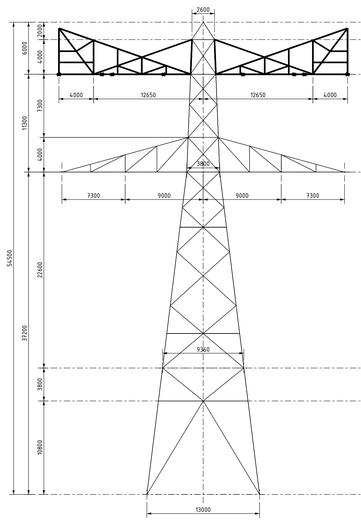
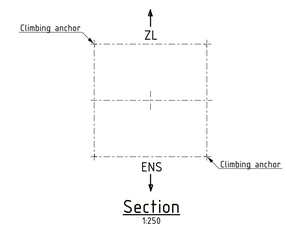


Transverse face
1:250



Section
1:250

All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring.

Unless otherwise specified:
- If has drawn on the right side.
- Material quality S355J0 (t<=16mm), S355J2 (16<t<=40mm)
- All bended profiles and plates "HOT BENDING".
- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 – HDG oversized
Nuts	: Quality 8 – HDG oversized
Washers	: St. –HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

See also drawing 00974-01-00602 and 00974-01-00603

Project: Opwaarderen 380 kV verbinding Ens – Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Beschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
++	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:20 1:250 A0
Kopiëhe:			Thema: Verbinding		
			Categorie: Algemeen		
			Documentsoort: Constructietekening		
Stuff Tekeningnummer:			Object ID: ENS-ZL380 HB+9_R_X Mast 65		
			Beschrijving: Masttype HB+9_R_X Mast 65 - Bovenaanzicht en Zijaanzichten		
TenneT taking power further			Documentnummer: 00974-01-00504		

Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-06510**

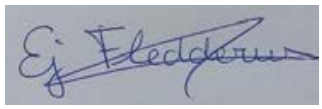
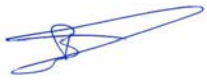
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994405**

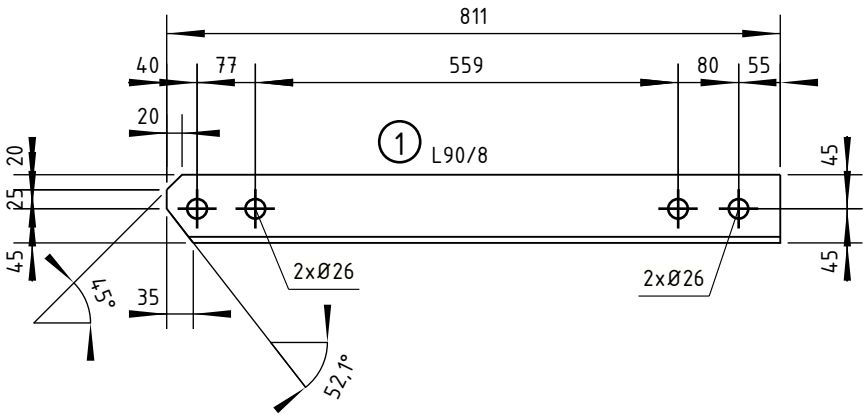
Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype HB+9_R_X, Mast 65 - Onderdeeltekeningen**

	Naam	Functie	Handtekening	Datum
Opgesteld	Erik Jan Fledderus	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review



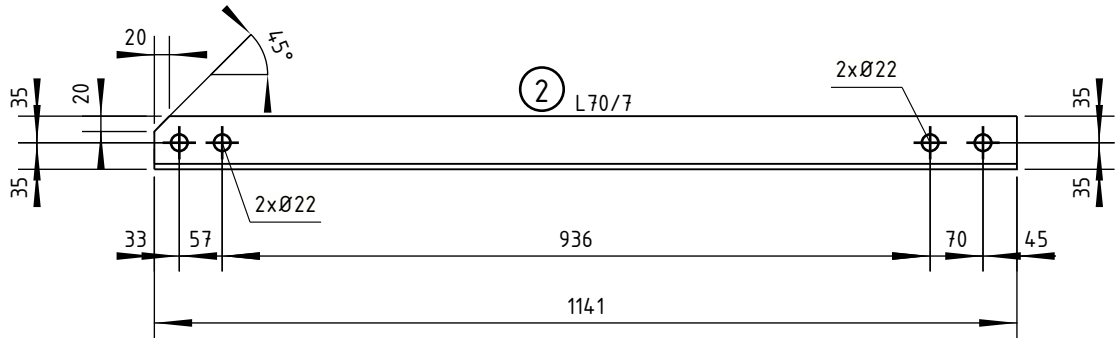
1	L90/8	2	S355J0	811	0.29
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [1]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



2	L70/7	2	S355J0	1141	0.32
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
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	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [2]
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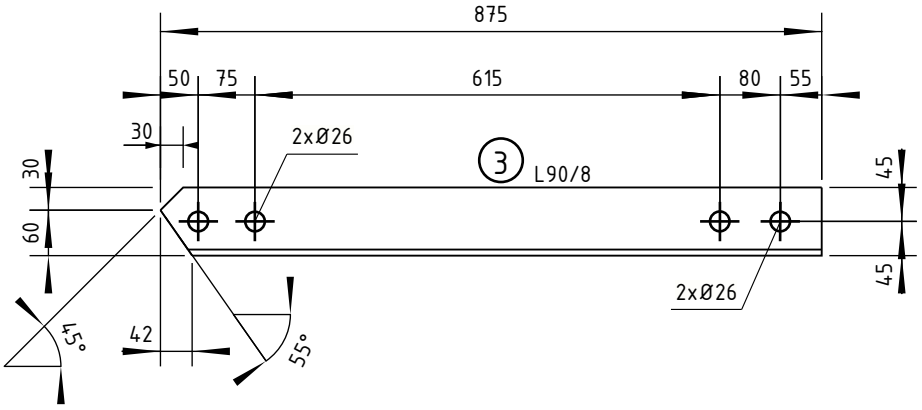
TenneT Taking power further

Tekla Structures



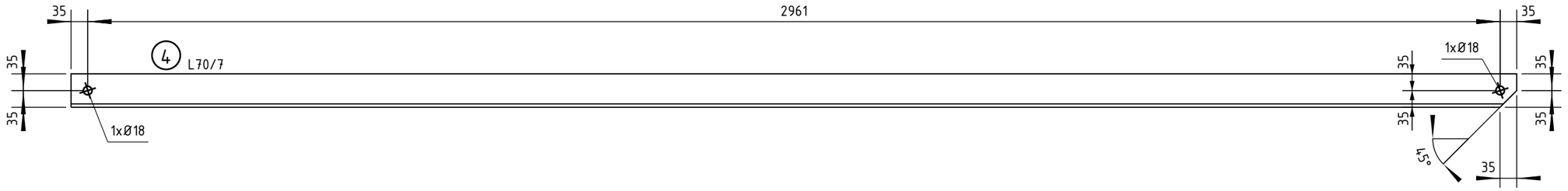
3	L90/8	2	S355J0	875	0.31
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [3]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m²)
4	L70/7	2	S355J0	3030	0.85

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	
Omschrijving:	Te vervangen staal - onderdeel [4]
Documentnummer:	

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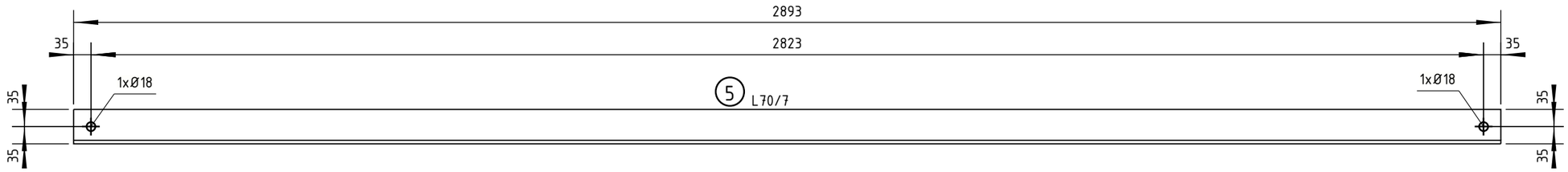
Tekla Structures

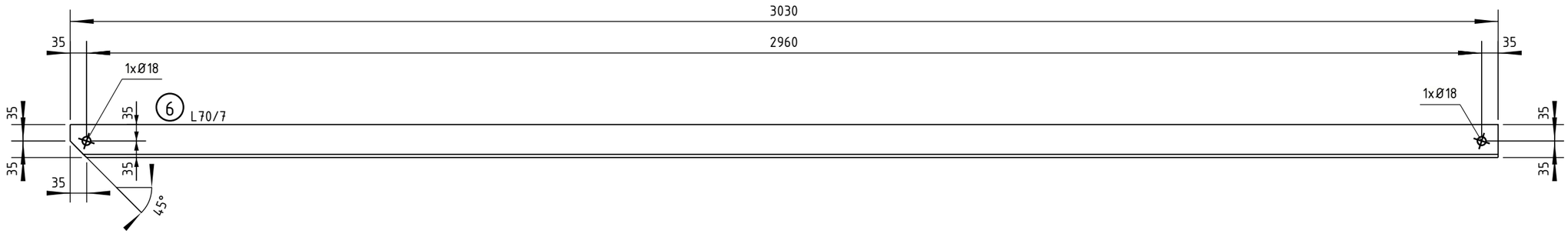


Pos	Profile	Number	Grade	Length	Area (m^2)
5	L70/7	4	S355J0	2893	0.81

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [5]
TenneT Taking power further	Documentnummer:	

Tekla Structures



6	L70/7	2	S355J0	3030	0.85
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [6]
TenneT Taking power further	Documentnummer:	

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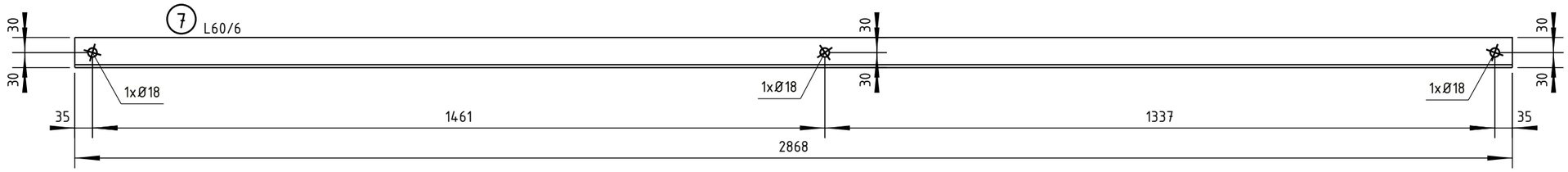


Pos	Profile	Number	Grade	Length	Area (m²)
7	L60/6	2	S355J0	2868	0.69

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

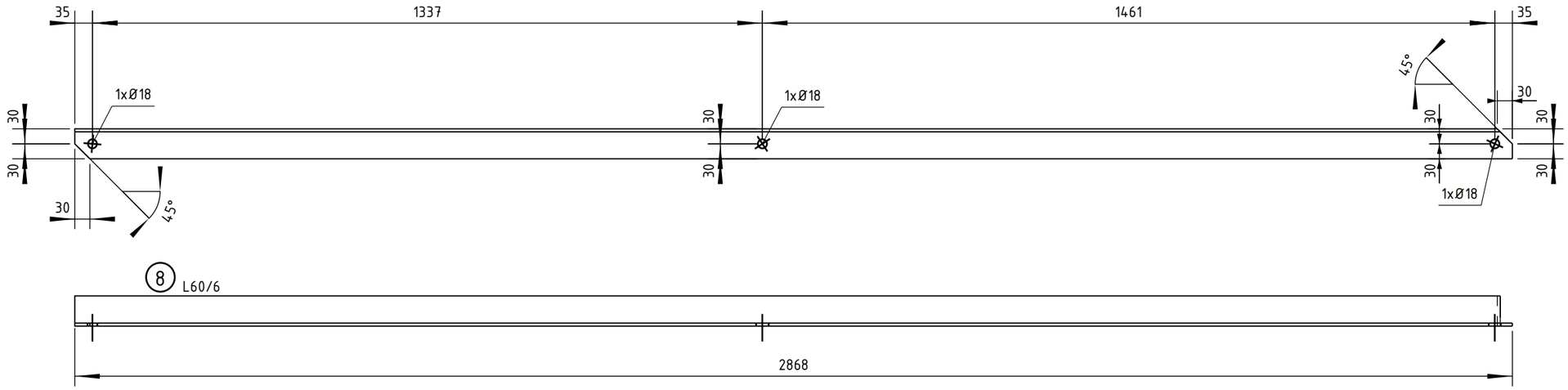
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Omschrijving:	Te vervangen staal - onderdeel [7]
Documentnummer:	

TenneT Taking power further

Tekla Structures



8	L60/6	2	S355J0	2868	0.69
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
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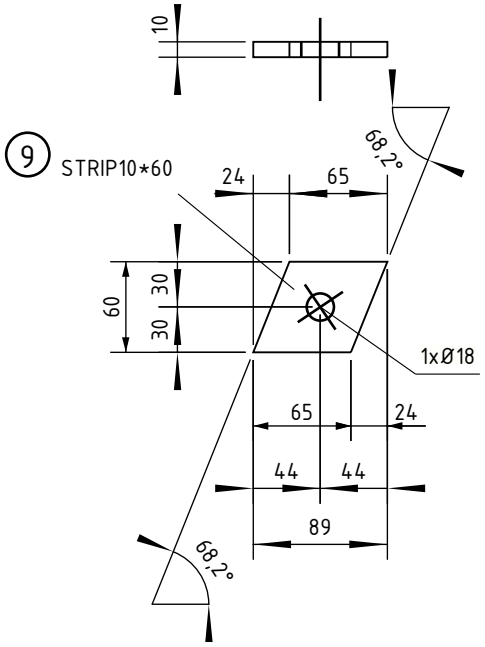
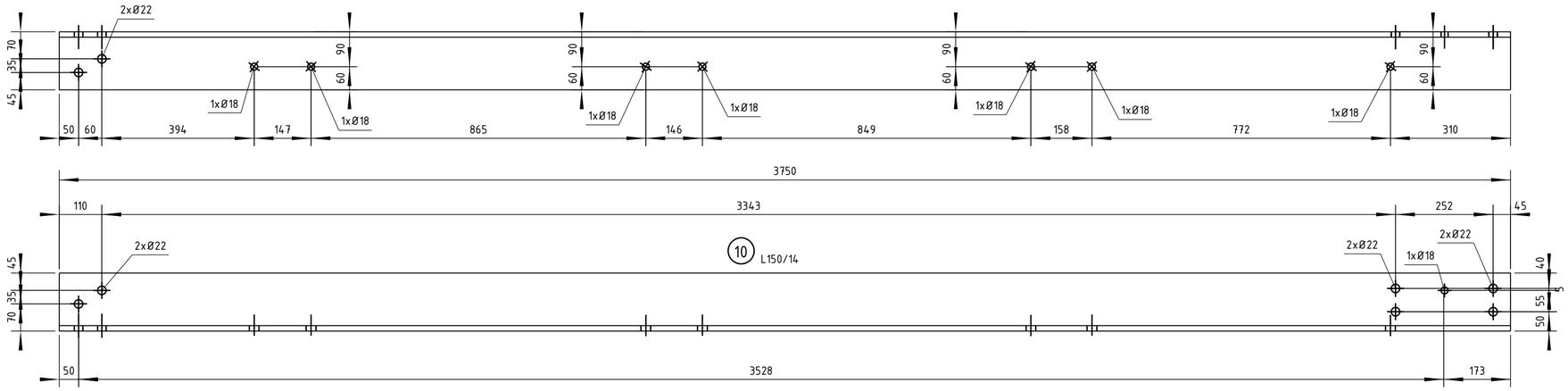


9	STRIP10*60	2	S355J0	89	0.01
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [9]
TenneT Taking power further	Documentnummer:	

Tekla Structures



10	L150/14	2	S355J0	3750	2.25
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

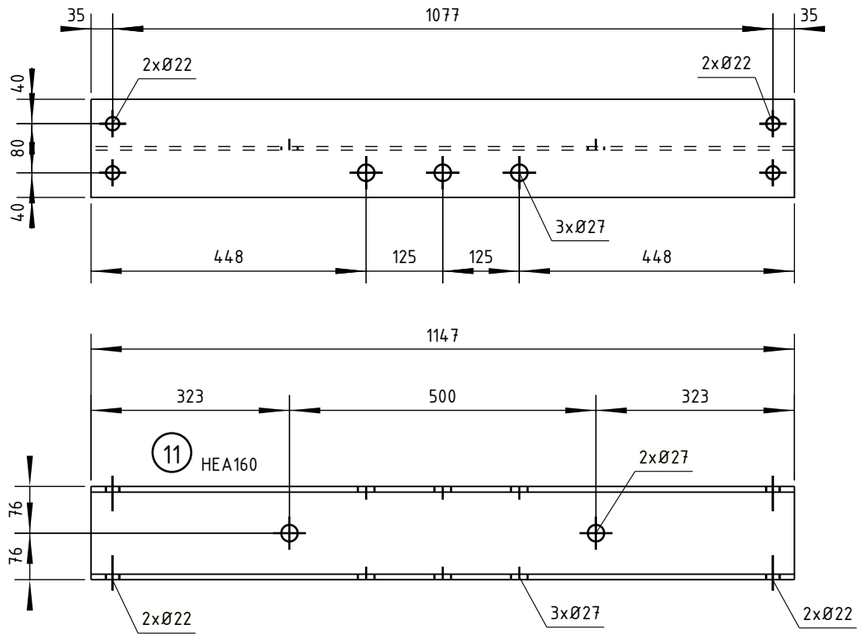
Object ID: ENS-ZL380 HB+9_R_X Mast 65

Omschrijving: Nieuw staal - onderdeel [10]

Documentnummer:

TenneT Taking power further

Tekla Structures



11	HEA160	2	S355J0	1147	1.04
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
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TenneT Taking power further	Documentnummer:	

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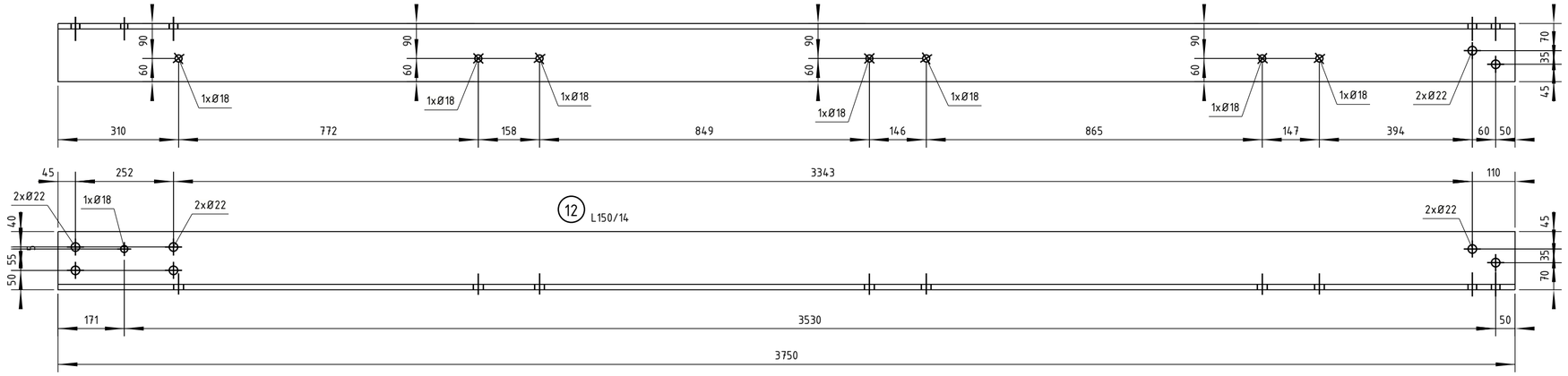

12	L150/14	2	S355J0	3750	2.25
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
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Omschrijving:	Nieuw staal - onderdeel [12]
Documentnummer:	

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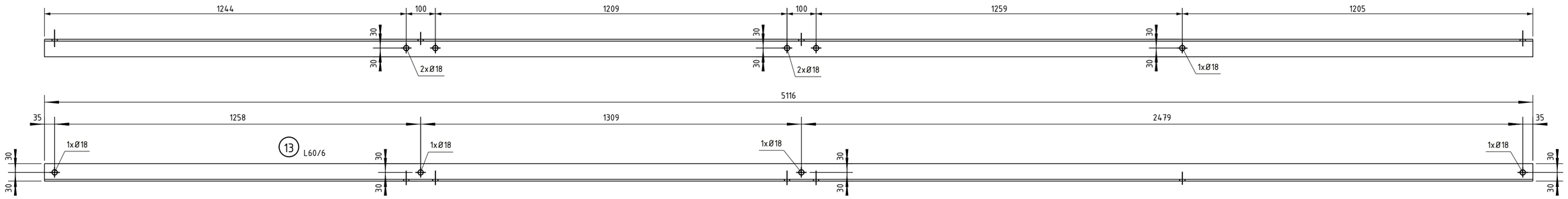

13	L60/6	2	S355J0	5116	1.23
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus	
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie	
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Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
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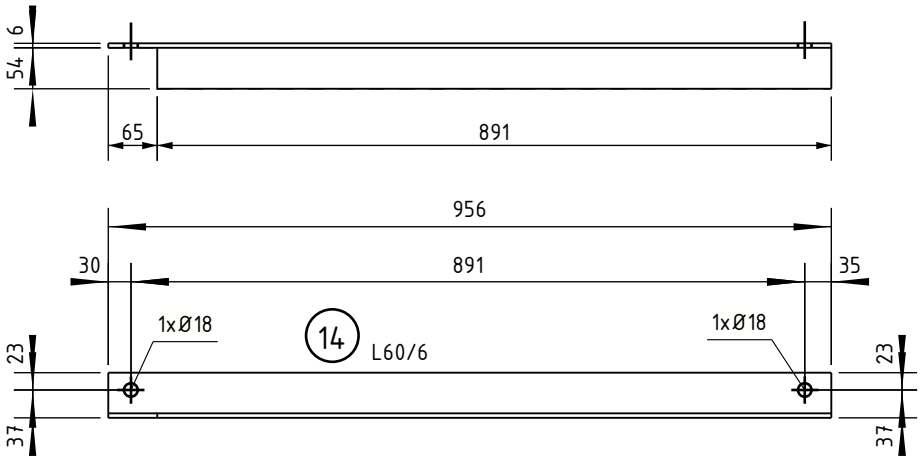
Omschrijving:	Nieuw staal - onderdeel [13]
Documentnummer:	

TenneT Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m^2)
14	L60/6	2	S355J0	956	0.23

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
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Taking power further

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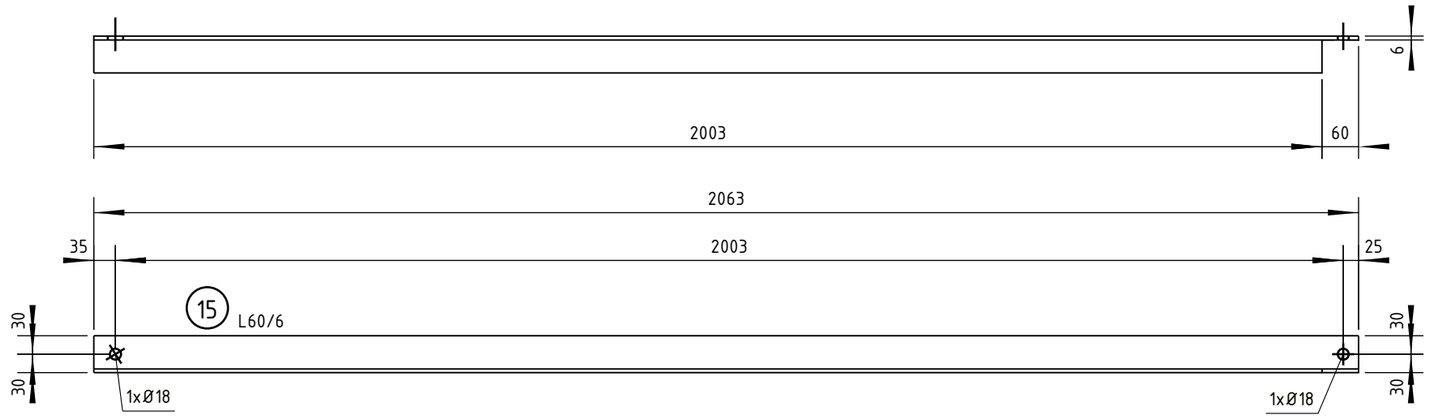

15	L60/6	2	S355J0	2063	0.50
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
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Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [15]
TenneT Taking power further	Documentnummer:	

Tekla Structures

16	L50/5	2	S355J0	918	0.18
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
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Relatie	Thema	Verbinding
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	Documentcode	Constructietekening
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Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [16]
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Taking power further

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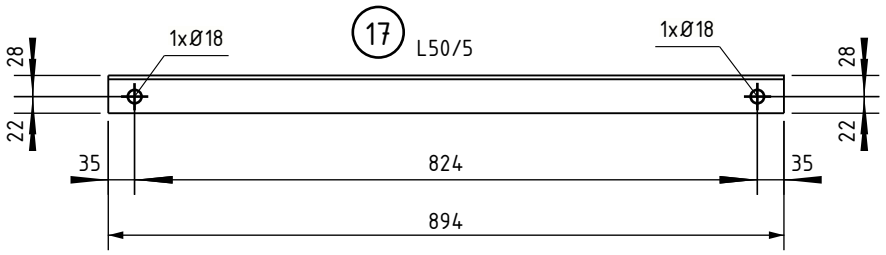

17	L50/5	2	S355J0	894	0.18
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
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	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [17]
	Documentnummer:	

tennet
Taking power further

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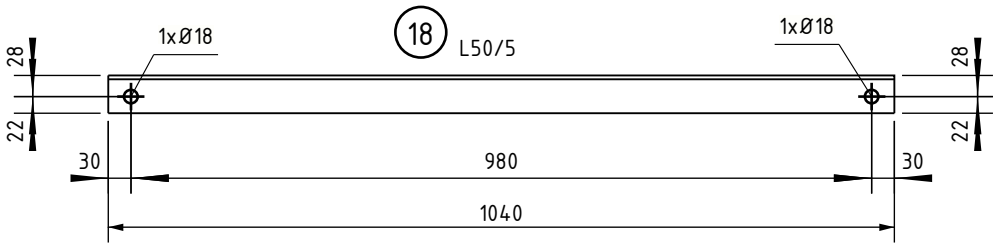

18	L50/5	2	S355J0	1040	0.21
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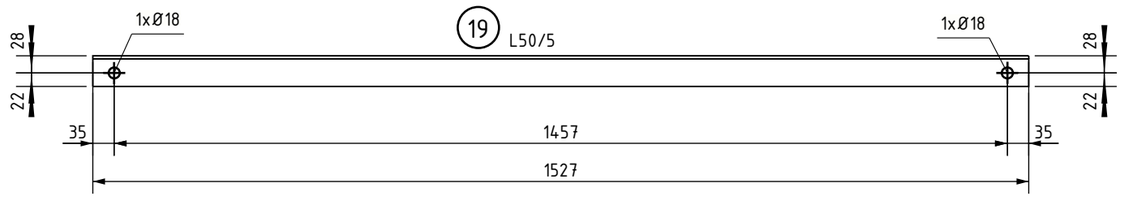
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [18]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



19	L50/5	2	S355J0	1527	0.31
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

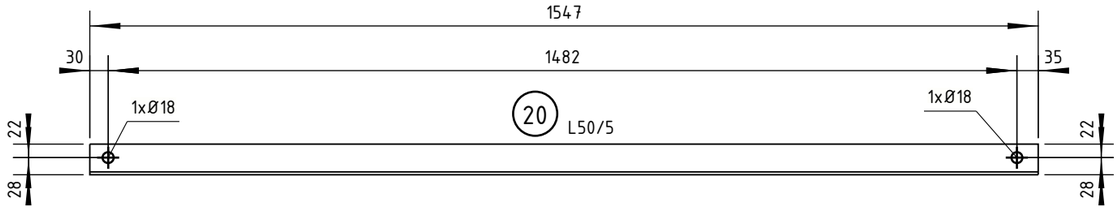
Relatie

Oud tekeningnummer:

TenneT Taking power further

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Omschrijving:	Nieuw staal - onderdeel [19]
Documentnummer:	

Tekla Structures

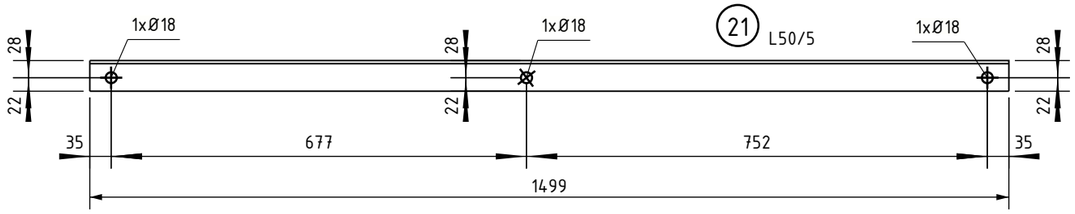


Pos	Profile	Number	Grade	Length	Area (m^2)
20	L50/5	2	S355J0	1547	0.31

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [20]
TenneT Taking power further	Documentnummer:	

Tekla Structures

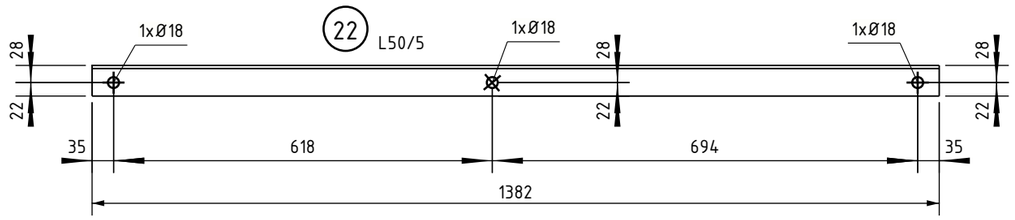


21	L50/5	4	S355J0	1499	0.30
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [21]
TenneT Taking power further	Documentnummer:	

Tekla Structures

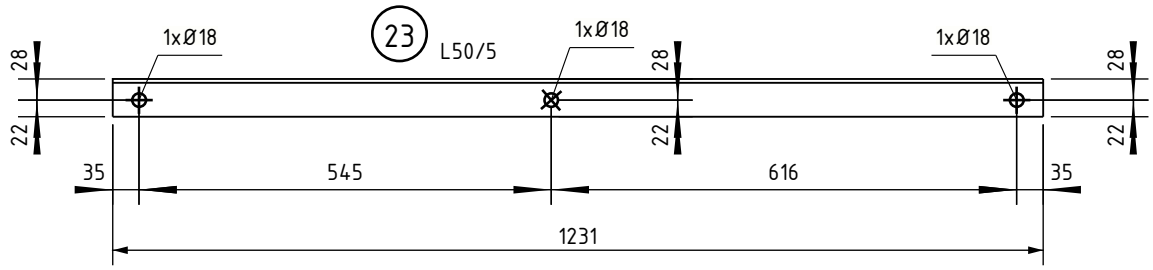


22	L50/5	4	S355J0	1382	0.28
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [22]
TenneT Taking power further	Documentnummer:	

Tekla Structures



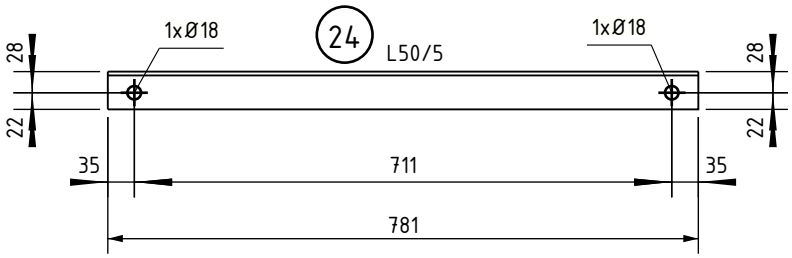
23	L50/5	4	S355J0	1231	0.25
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [23]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



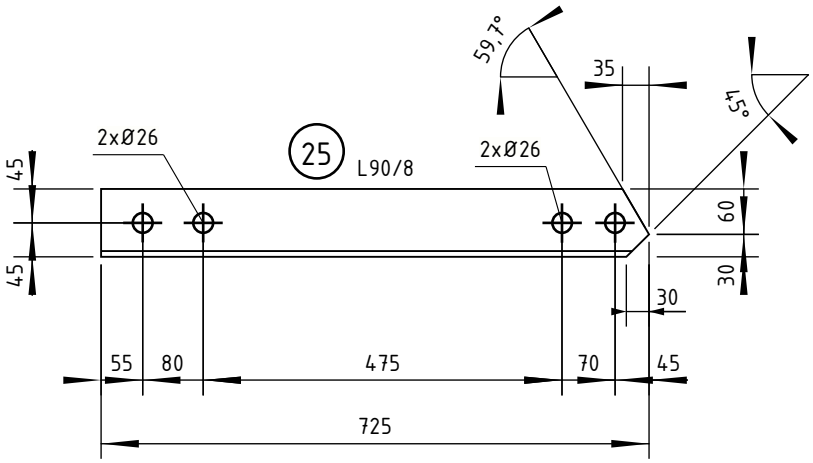
24	L50/5	4	S355J0	781	0.16
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [24]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



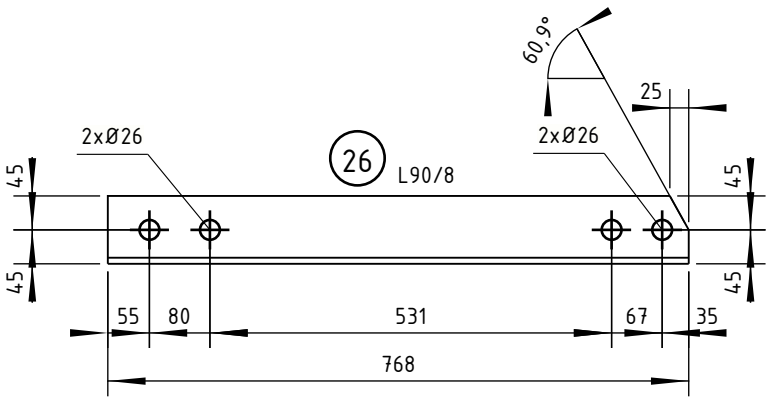
25	L90/8	2	S355J0	725	0.26
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [25]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



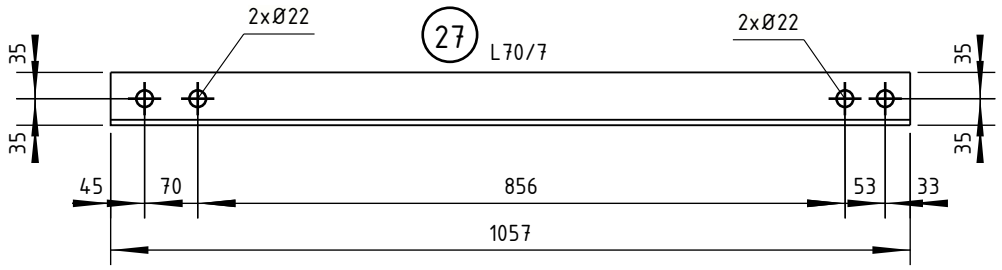
Pos	Profile	Number	Grade	Length	Area (m^2)
26	L90/8	2	S355J0	768	0.28

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [26]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



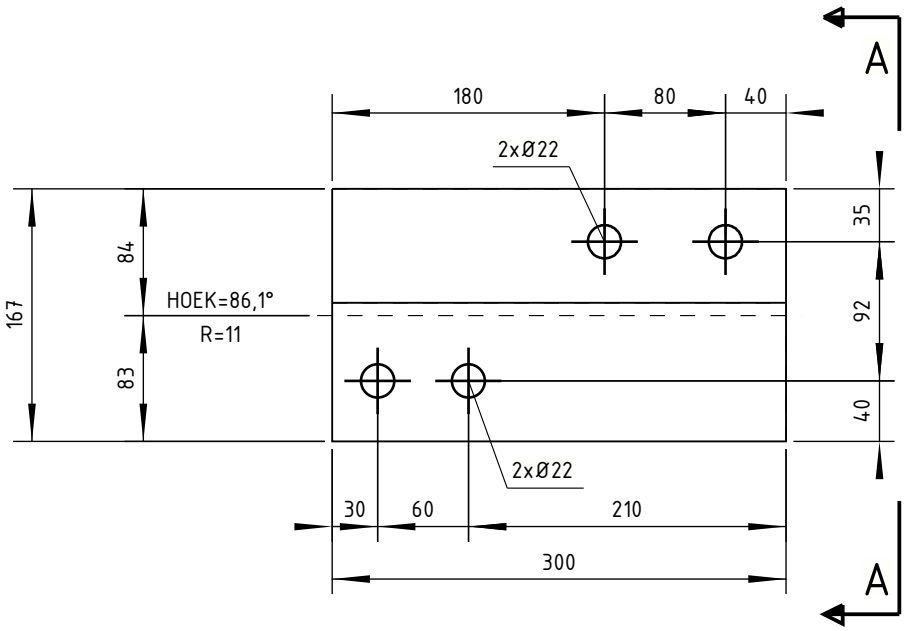
27	L70/7	2	S355J0	1057	0.30
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

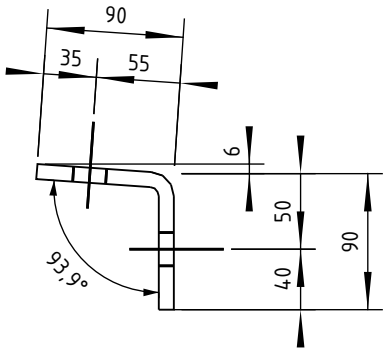
Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [27]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



hot bend



A – A
1:5

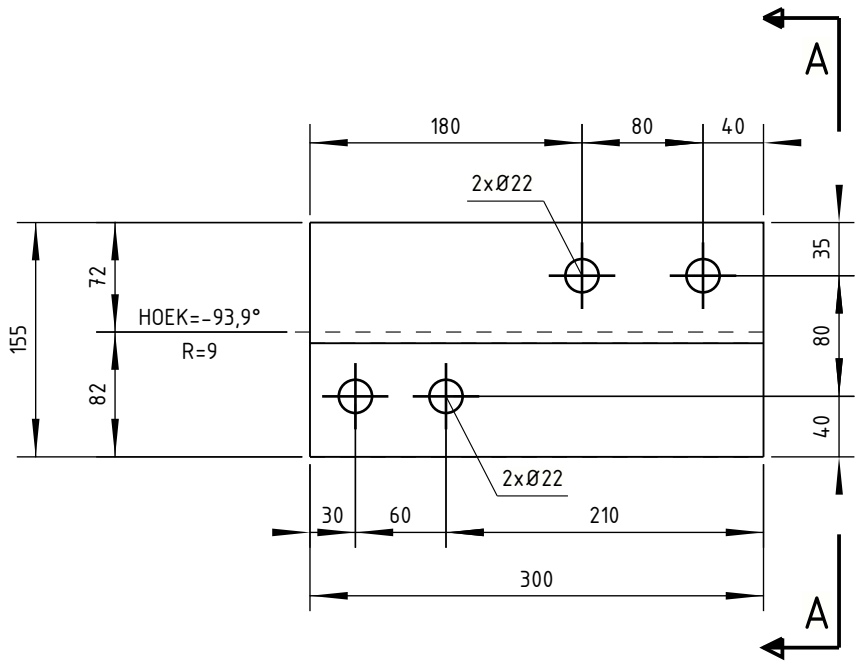
Pos	Profile	Number	Grade	Length	Area (m^2)
28	STRIP10*300	8	S355J0	300	0.11

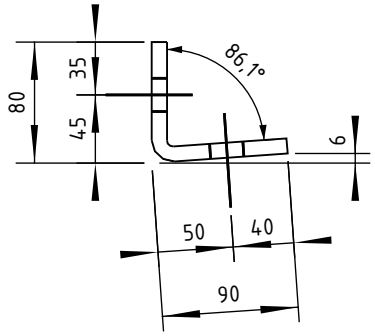
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [28]
Documentnummer:	

TenneT Taking power further

Tekla Structures





hot bend

A - A
1:5

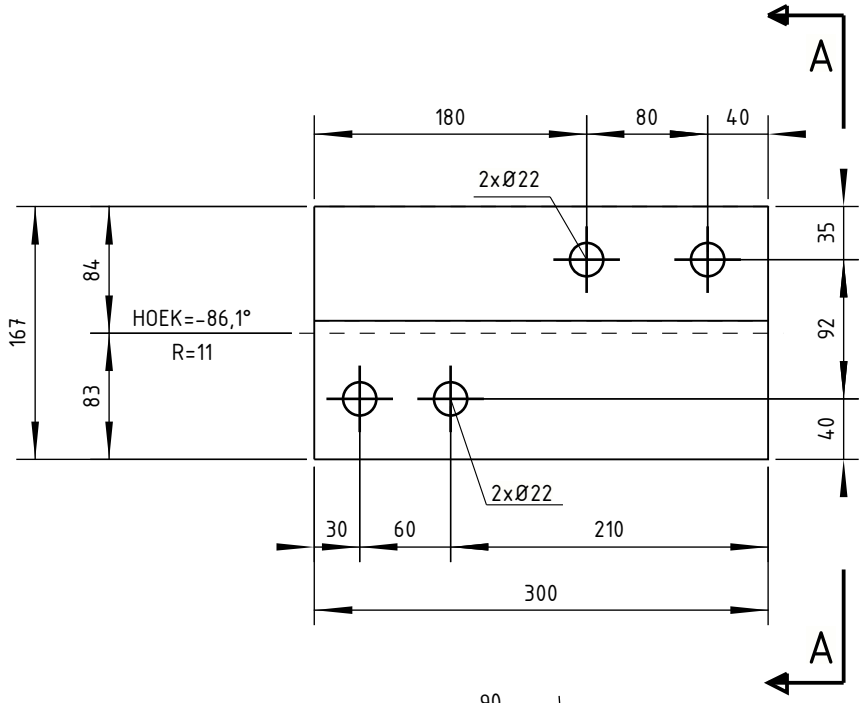
Pos	Profile	Number	Grade	Length	Area (m^2)
29	STRIP10*300	8	S355J0	300	0.10

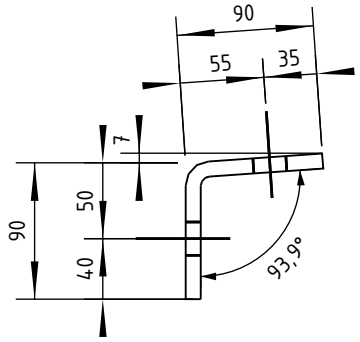
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [29]
	Documentnummer:	

TenneT Taking power further

Tekla Structures





hot bend

A - A
1:5

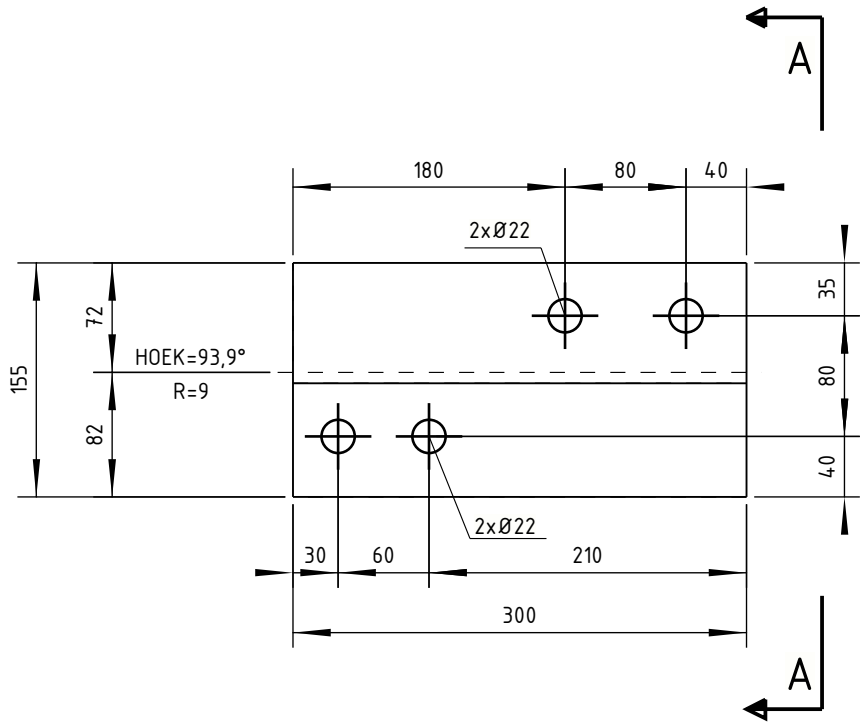
Pos	Profile	Number	Grade	Length	Area (m^2)
30	STRIP10*300	8	S355J0	300	0.11

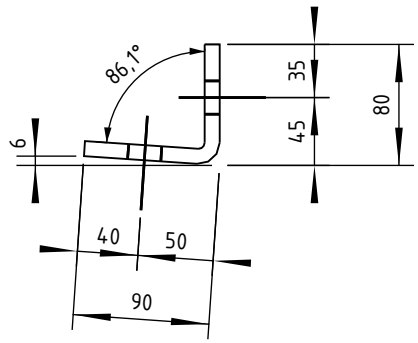
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [30]
	Documentnummer:	

TenneT Taking power further

Tekla Structures





hot bend

A - A
1:5

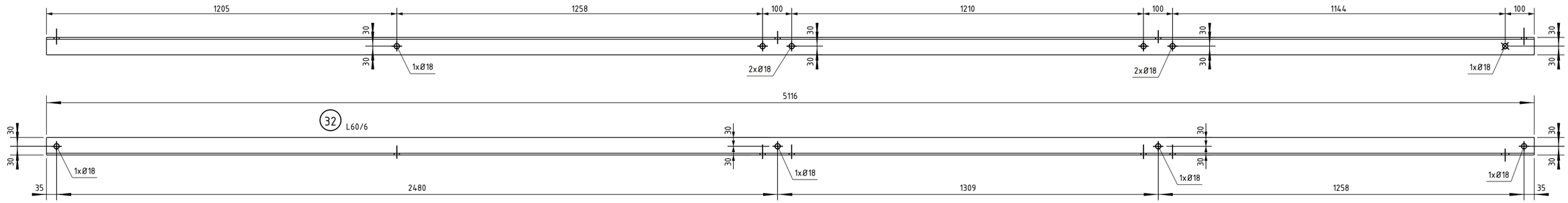
Pos	Profile	Number	Grade	Length	Area (m^2)
31	STRIP10*300	8	S355J0	300	0.10

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie		
	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [31]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



32	L60/6	2	S355J0	5116	1.23
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	594x420

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

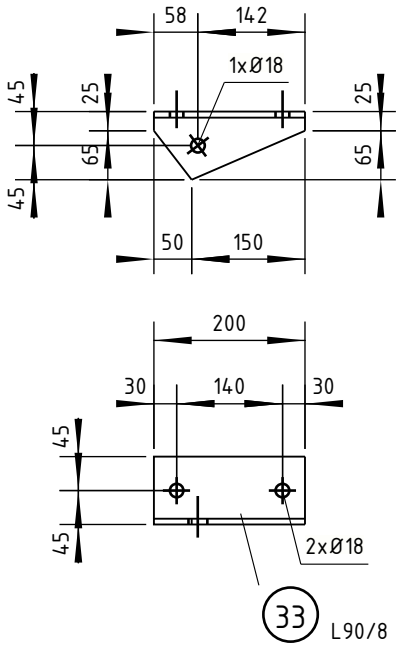
Object ID: ENS-ZL380 HB+9_R_X Mast 65

Omschrijving: Nieuw staal - onderdeel [32]

Documentnummer:

TenneT Taking power further

Tekla Structures



33	L90/8	2	S355J0	200	0.07
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [33]
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TenneT Taking power further

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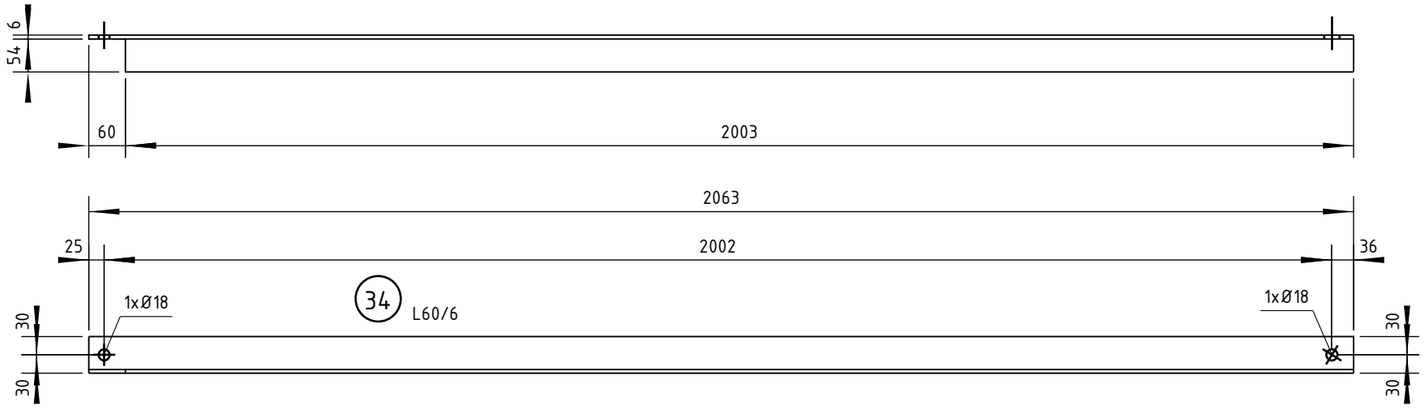

34	L60/6	2	S355J0	2063	0.50
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [34]
TenneT Taking power further	Documentnummer:	

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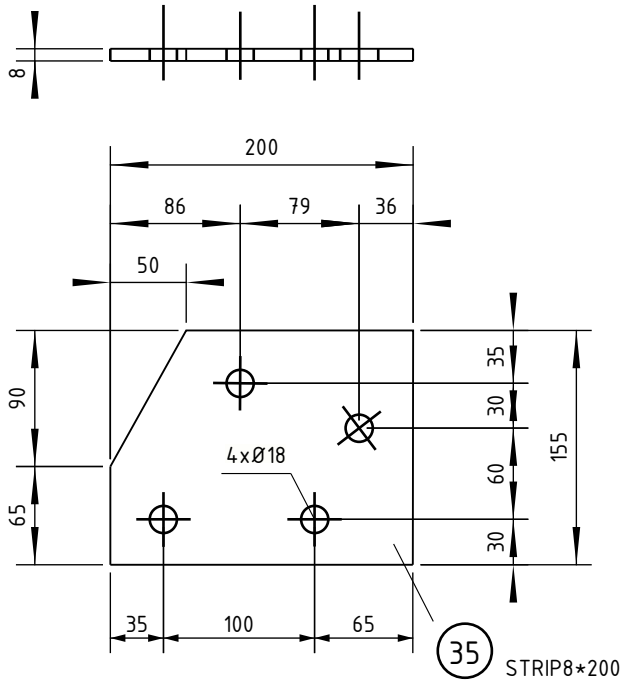


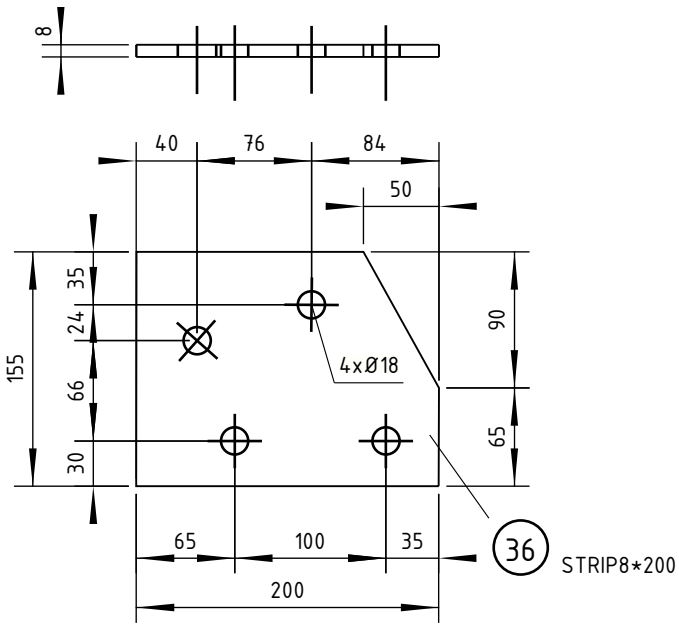
Pos	Profile	Number	Grade	Length	Area (m^2)
35	STRIP8*200	2	S355J0	155	0.06

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [35]
Documentnummer:	

TenneT Taking power further

Tekla Structures



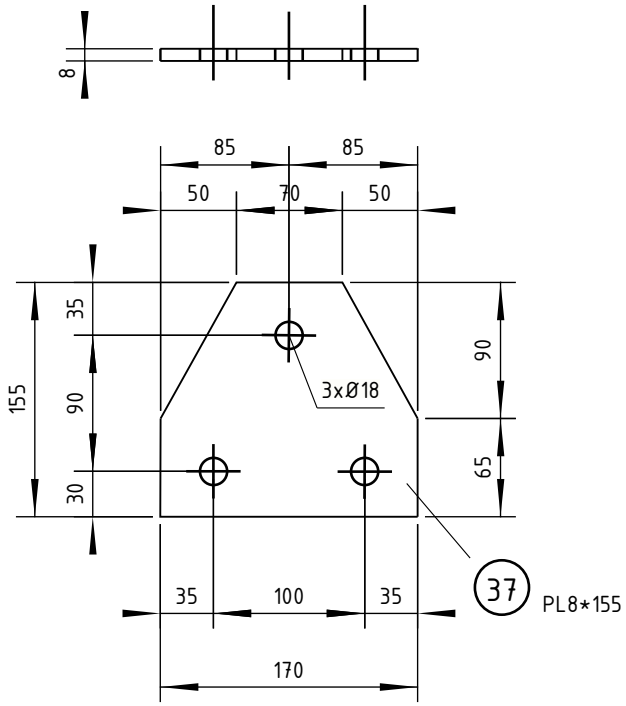
Pos	Profile	Number	Grade	Length	Area (m^2)
36	STRIP8*200	2	S355J0	155	0.06

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [36]
Documentnummer:	

TenneT Taking power further

Tekla Structures



37	PL8*155	2	S355J0	170	0.05
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [37]
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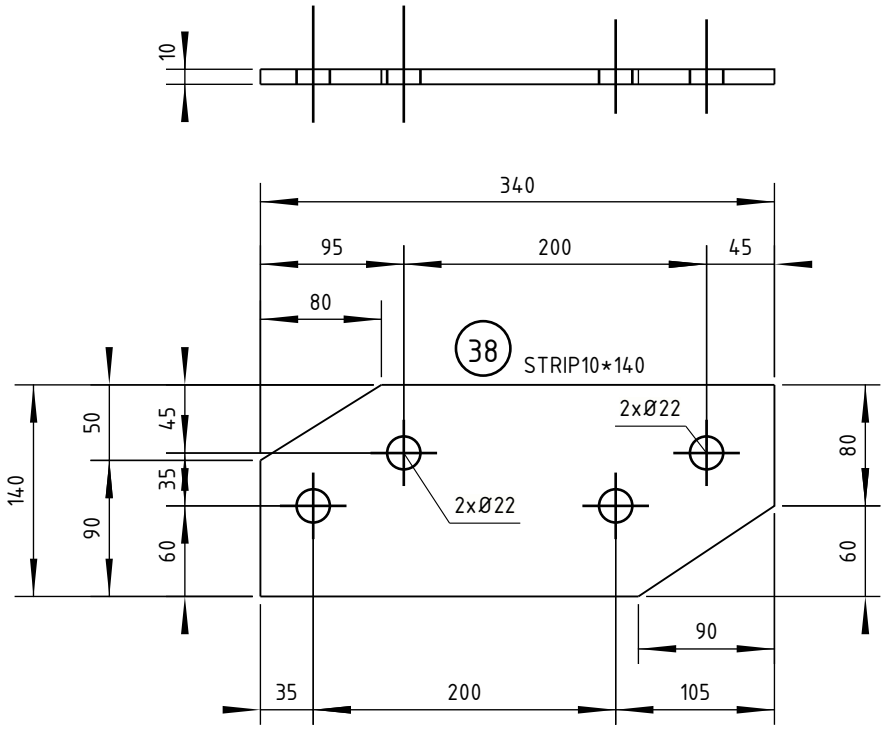
TenneT Taking power further

Tekla Structures



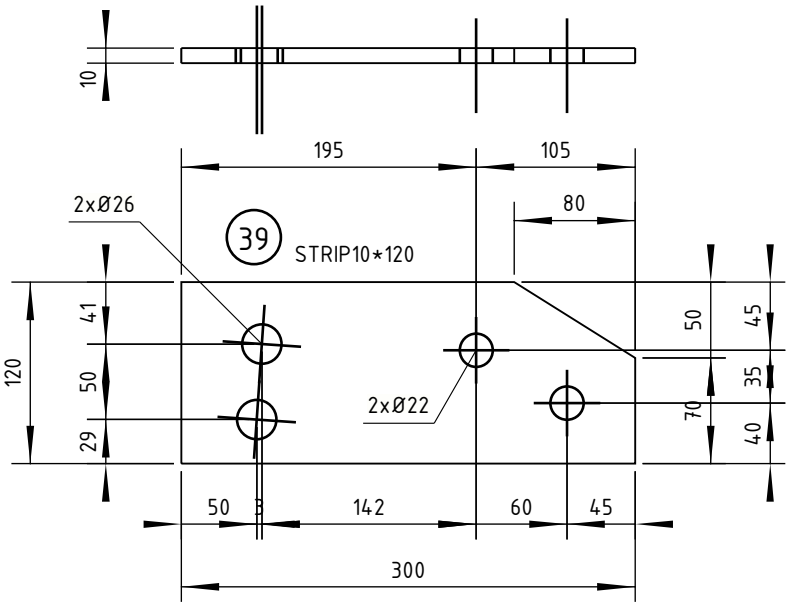
Pos	Profile	Number	Grade	Length	Area (m^2)
38	STRIP10*140	4	S355J0	340	0.09

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [38]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



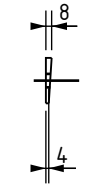
39	STRIP10*120	4	S355J0	300	0.08
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

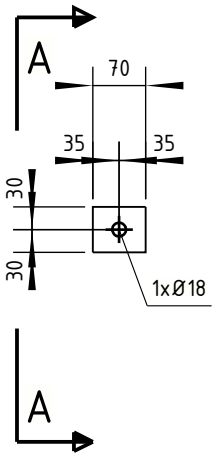
Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [39]
	Documentnummer:	

tennet Taking power further

Tekla Structures



A – A
1:10



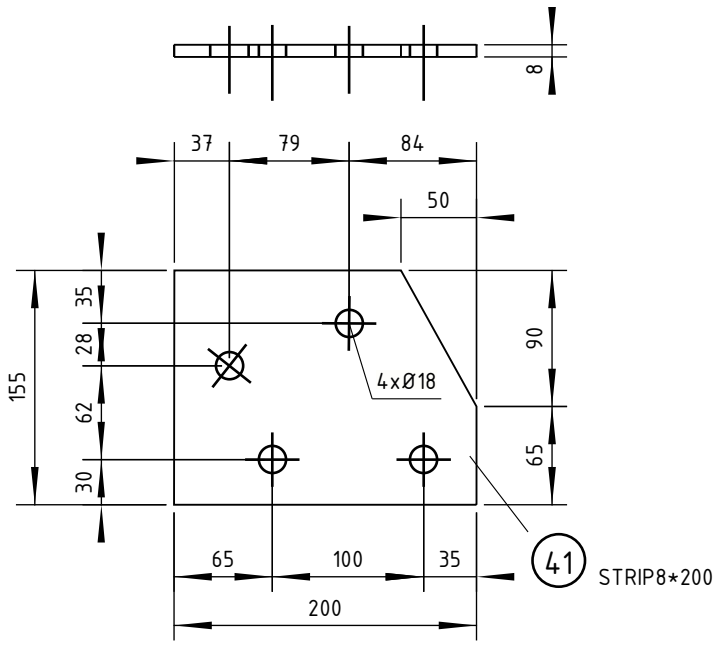
Pos	Profile	Number	Grade	Length	Area (m^2)
40	PL8/4*60	8	S355J0	70	0.00

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [40]
Documentnummer:	

TenneT Taking power further

Tekla Structures



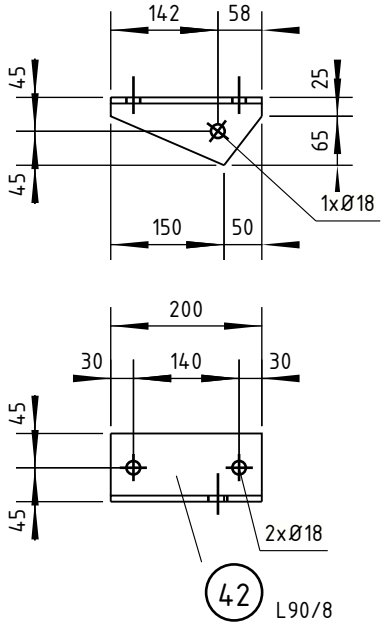
41	STRIP8*200	2	S355J0	155	0.06
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [41]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



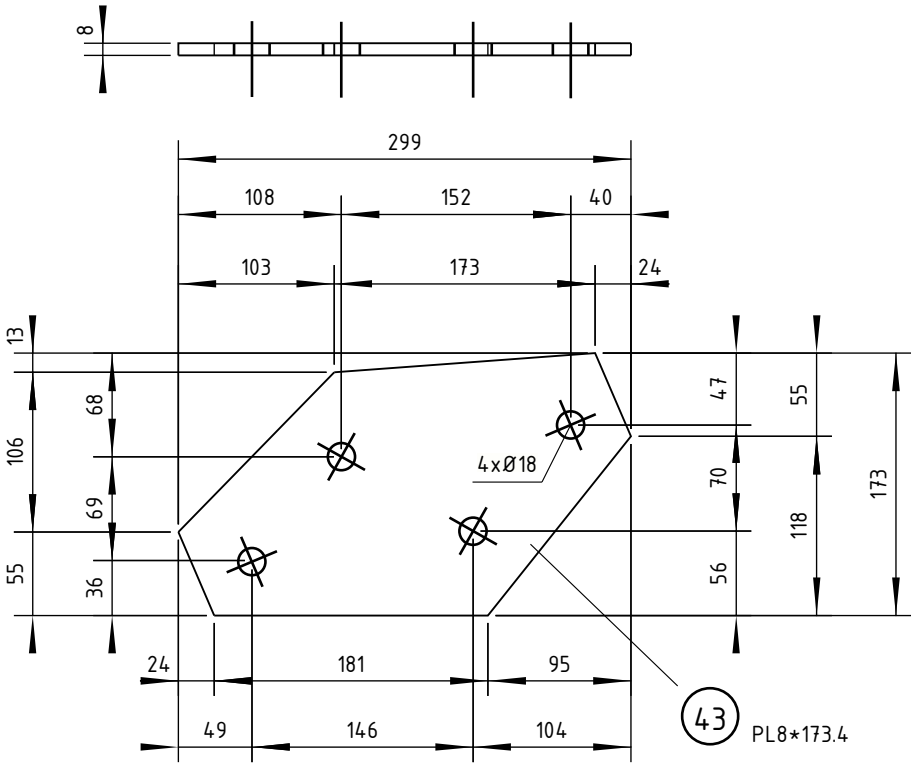
Pos	Profile	Number	Grade	Length	Area (m^2)
42	L90/8	2	S355J0	200	0.07

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	
Omschrijving:	Nieuw staal - onderdeel [42]
Documentnummer:	

TenneT Taking power further

Tekla Structures



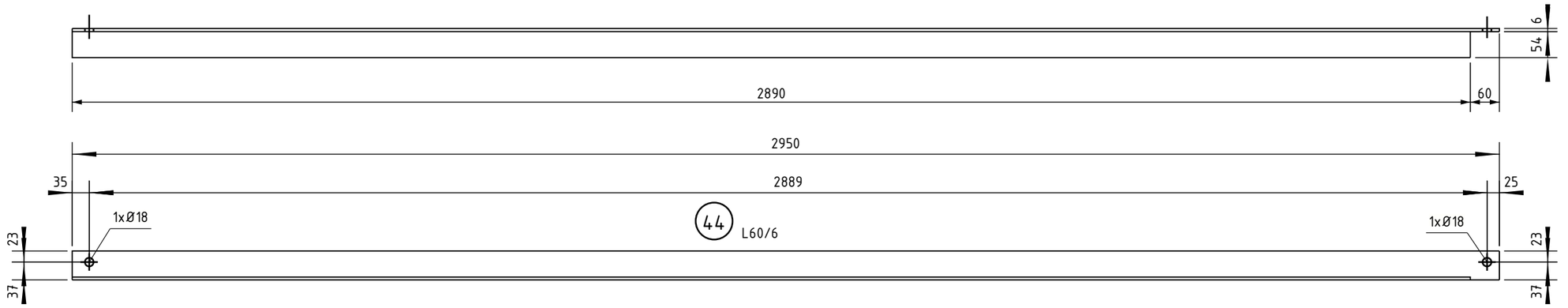
43	PL8*173.4	4	S355J0	299	0.08
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [43]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



44	L60/6	2	S355J0	2950	0.71
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

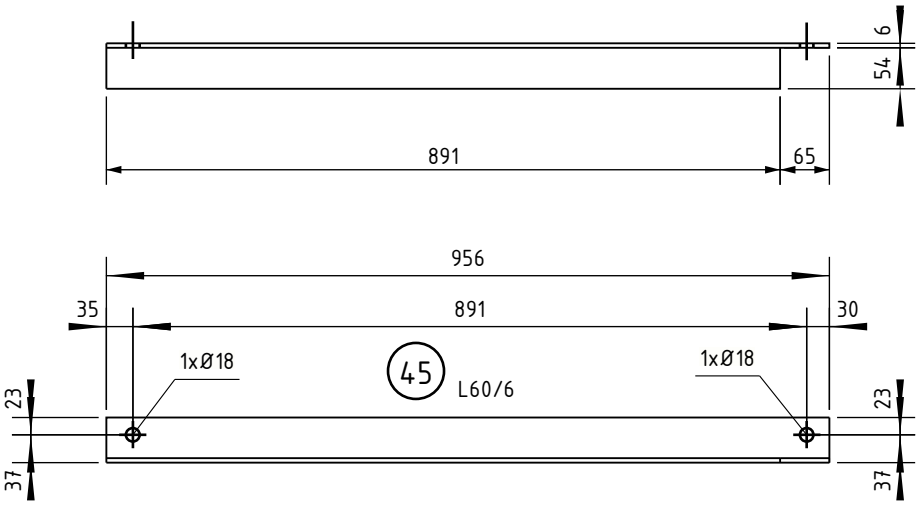
Object ID: ENS-ZL380 HB+9_R_X Mast 65

Omschrijving: Nieuw staal - onderdeel [44]

Documentnummer:

TenneT Taking power further

Tekla Structures



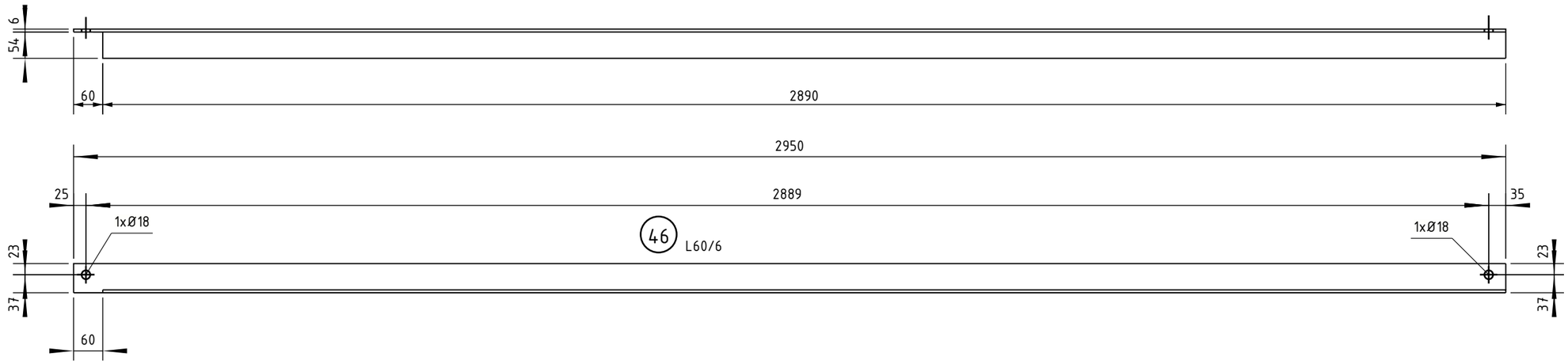
Pos	Profile	Number	Grade	Length	Area (m^2)
45	L60/6	2	S355J0	956	0.23

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [45]
	Documentnummer:	

tennet
Taking power further

Tekla Structures

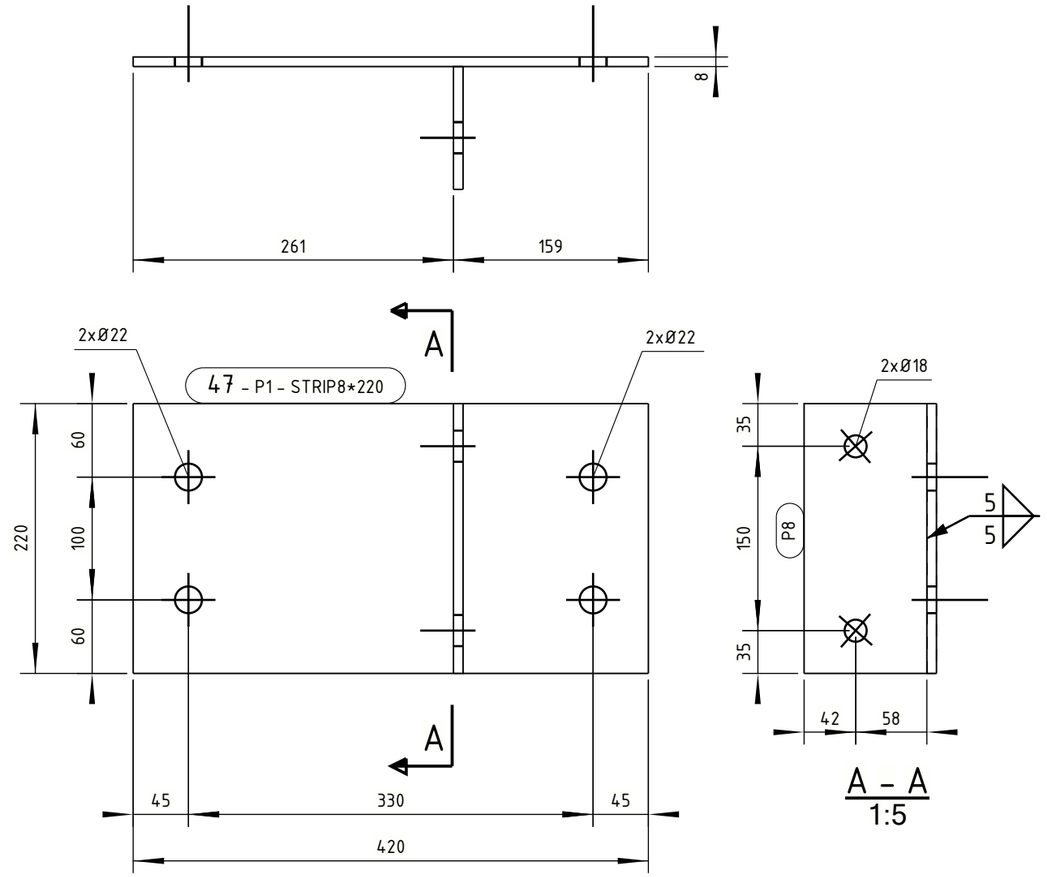


46	L60/6	2	S355J0	2950	0.71
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [46]
TenneT Taking power further	Documentnummer:	

Tekla Structures



ASSEMBLY

Mark: 47 length (mm): 420 Number: 2

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P1	STRIP8*220	S355J0	1	420	5.9	0.20
P8	STRIP8*100	S355J0	1	220	1.4	0.05
				Total of one mark	7.3	0.24

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5 / A3

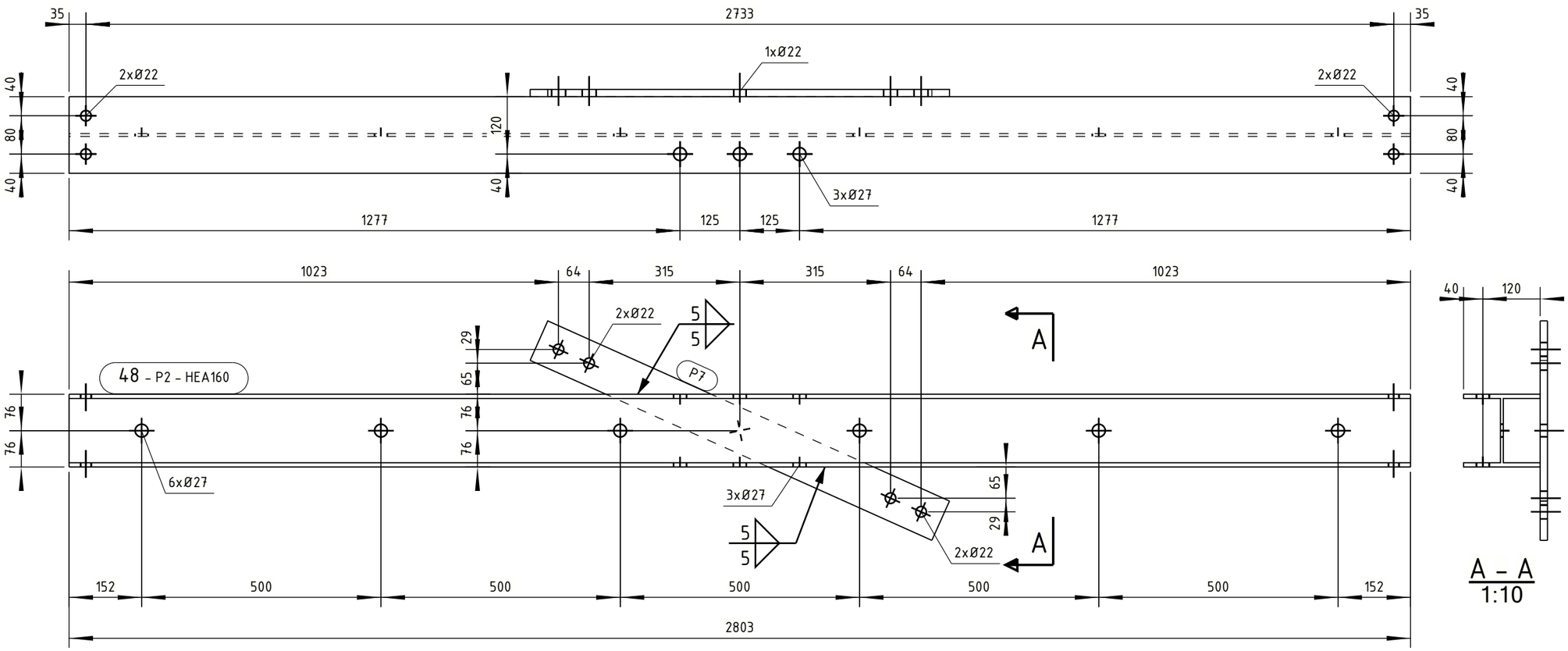
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Omschrijving:	Te vervangen staal - onderdeel [47]
Documentnummer:	

TenneT Taking power further

Tekla Structures



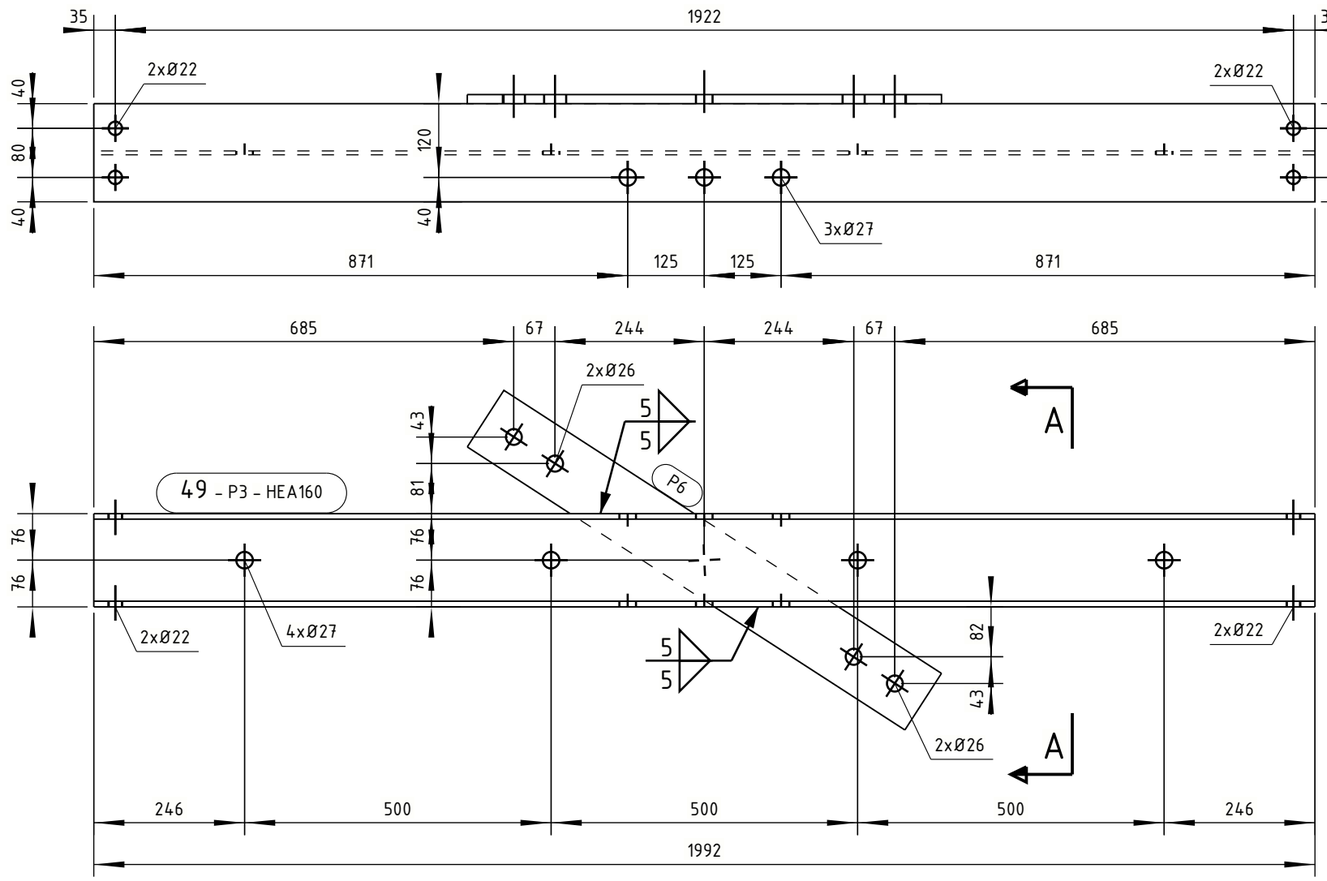
ASSEMBLY						
Mark: 48			length (mm): 2803		Number: 2	
Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P2	HEA160	S355J0	1	2803	86.9	2.54
P7	STRIP15*90	S355J0	1	920	9.9	0.20
				Total of one mark	96.9	2.74

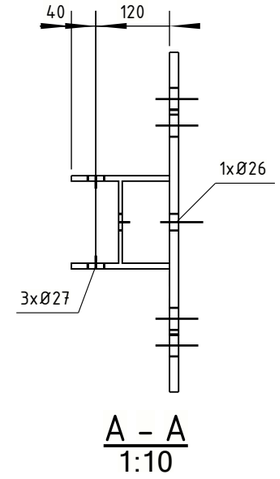
Naam: Opwaarderen 380 kV verbinding Ens - Zwolle					Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Oud tekeningnummer:	
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Omschrijving:	Nieuw staal - onderdeel [48]
Documentnummer:	

TenneT Taking power further

Tekla Structures





A - A
1:10

ASSEMBLY
Mark: 49 length (mm): 1992 Number: 2

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P3	HEA160	S355J0	1	1992	61.8	1.80
P6	STRIP15*110	S355J0	1	850	11.2	0.22
				Total of one mark	73.0	2.02

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

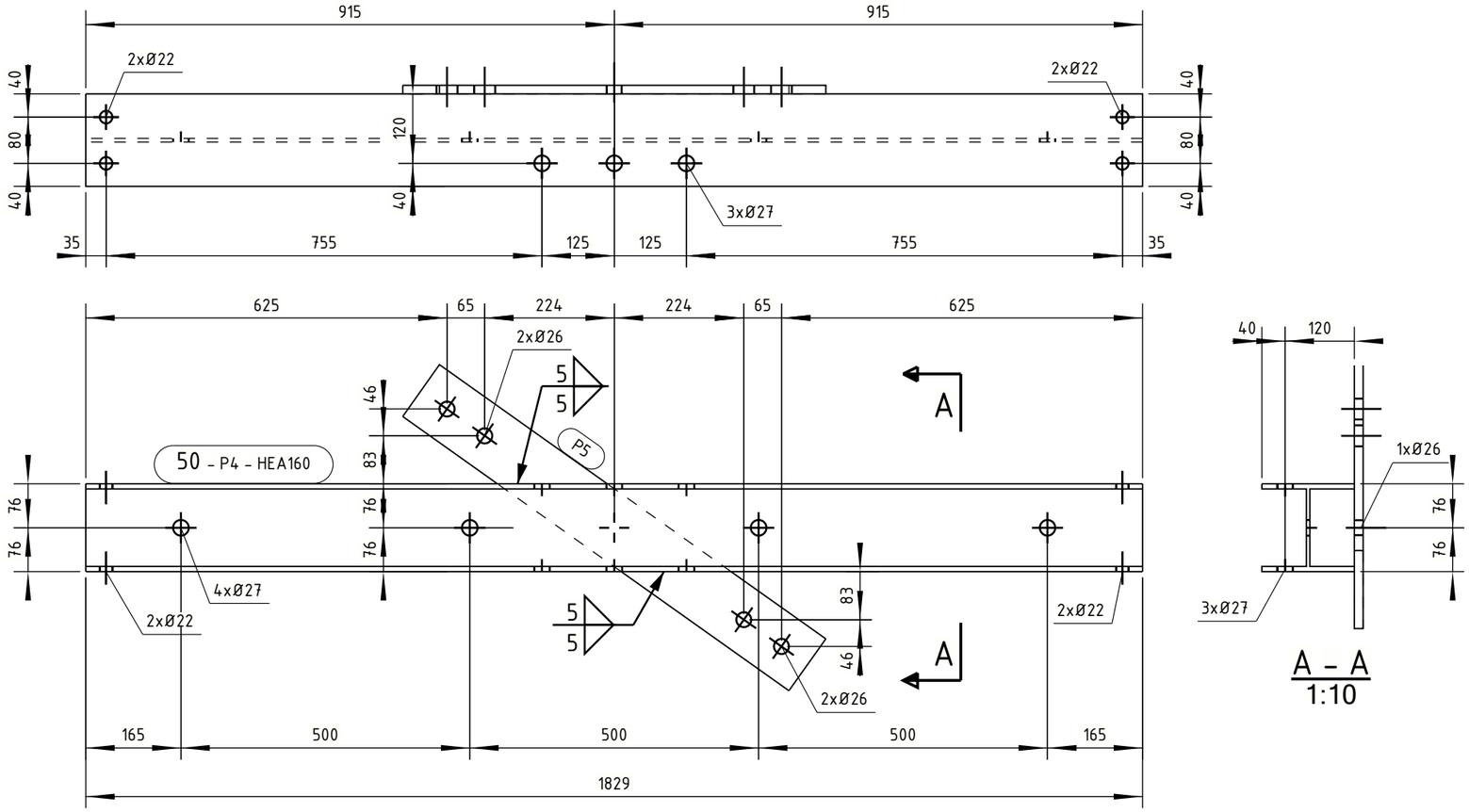
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Omschrijving:	Nieuw staal - onderdeel [49]
Documentnummer:	

TenneT Taking power further

Tekla Structures



A - A
1:10

ASSEMBLY
Mark: 50 length (mm): 1829 Number: 2

Pos	Profile	Grade	Number	Length (mm)	Weight (kg)	Area (m^2)
P4	HEA160	S355J0	1	1829	56.7	1.66
P5	STRIP15*110	S355J0	1	820	10.8	0.21
				Total of one mark	67.6	1.87

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

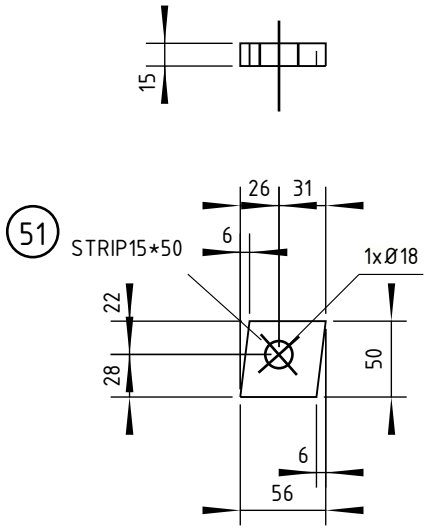
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 HB+9_R_X Mast 65
Omschrijving:	Nieuw staal - onderdeel [50]
Documentnummer:	

TenneT Taking power further

Tekla Structures



Pos	Profile	Number	Grade	Length	Area (m^2)
51	STRIP15*50	2	S355J0	56	0.01

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

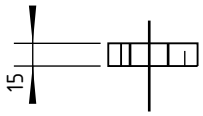
Object ID: ENS-ZL380 HB+9_R_X Mast 65

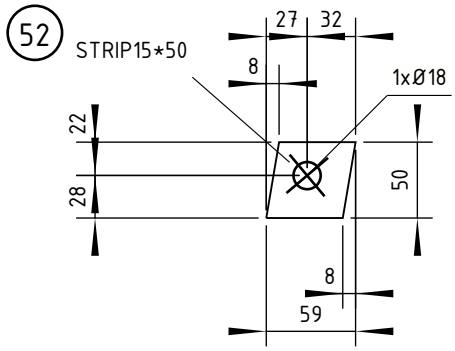
Omschrijving: Nieuw staal - onderdeel [51]

Documentnummer:

TenneT Taking power further

Tekla Structures





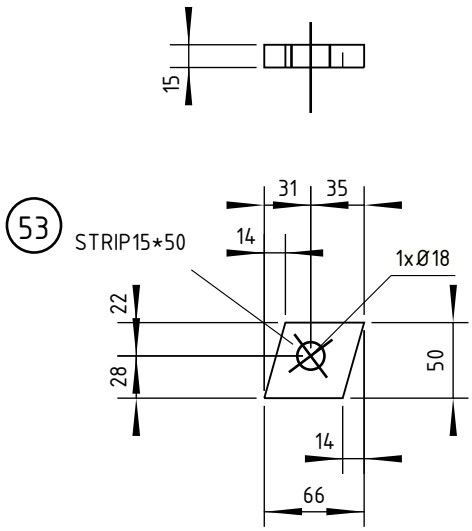
52	STRIP15*50	2	S355J0	59	0.01
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [52]
	Documentnummer:	

tennet
Taking power further

Tekla Structures



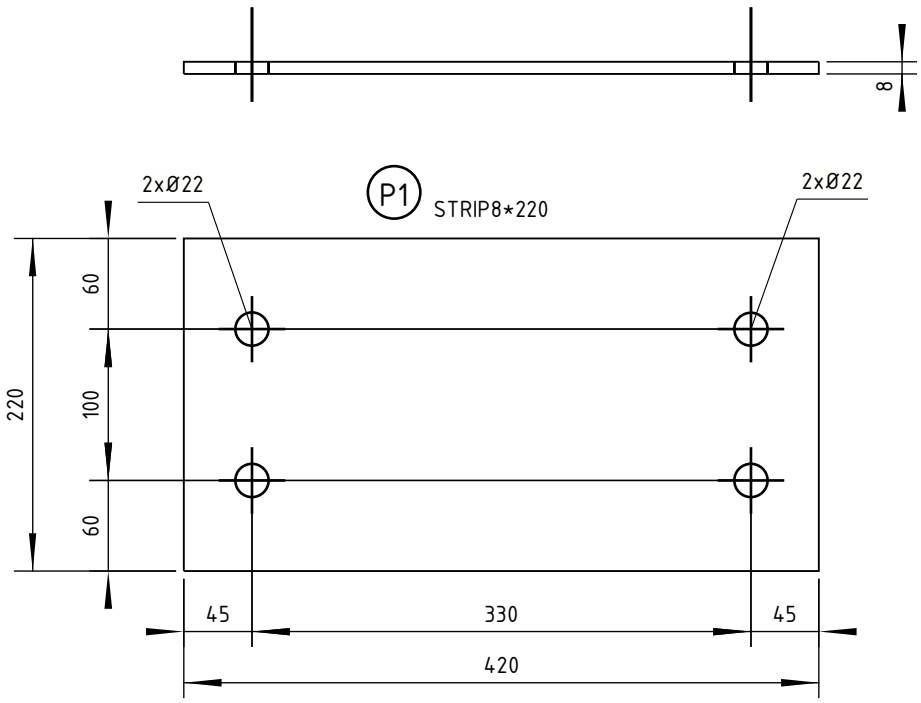
53	STRIP15*50	2	S355J0	66	0.01
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [53]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



P1	STRIP8*220	2	S355J0	420	0.20
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [P1]
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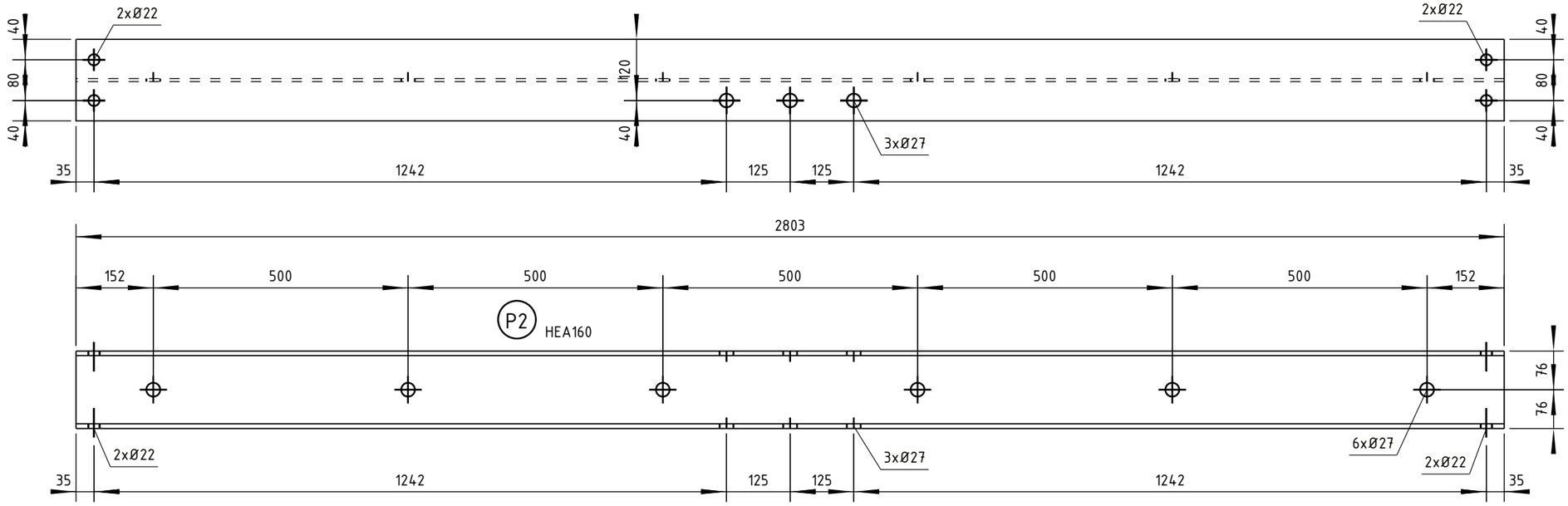
tennet
Taking power further

Tekla Structures

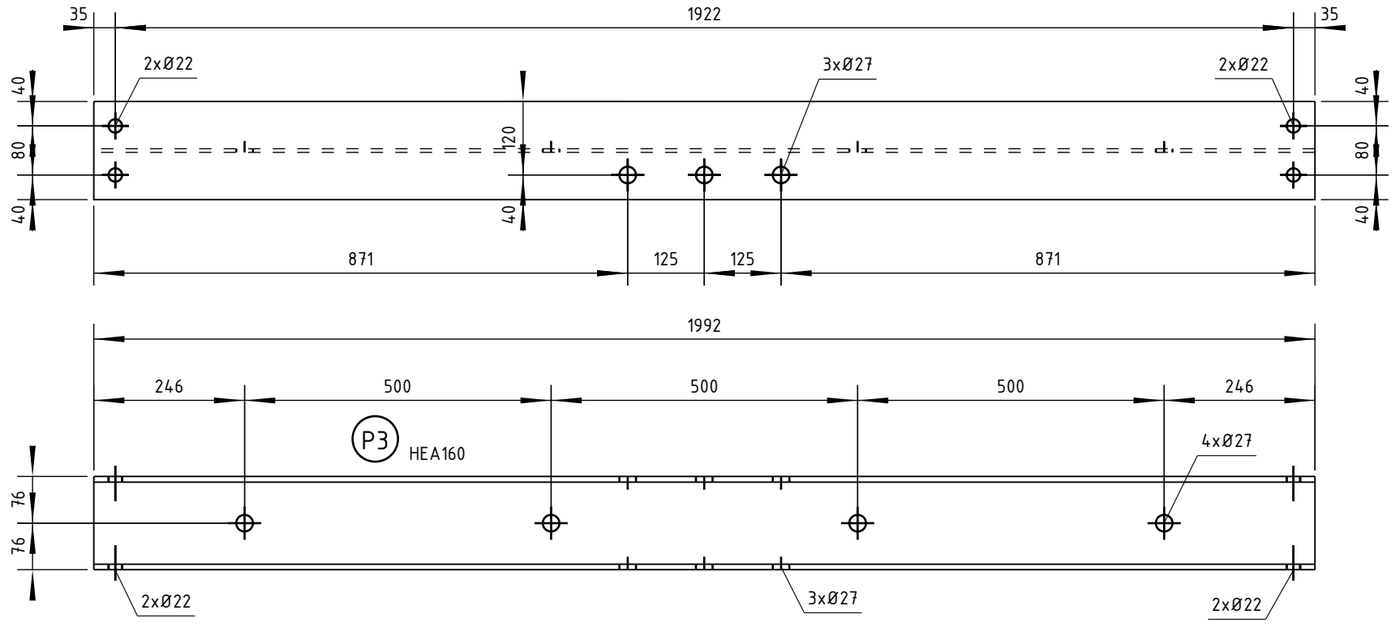


P2	HEA160	2	S355J0	2803	2.54
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 / A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P2]
TenneT Taking power further	Documentnummer:	

Tekla Structures

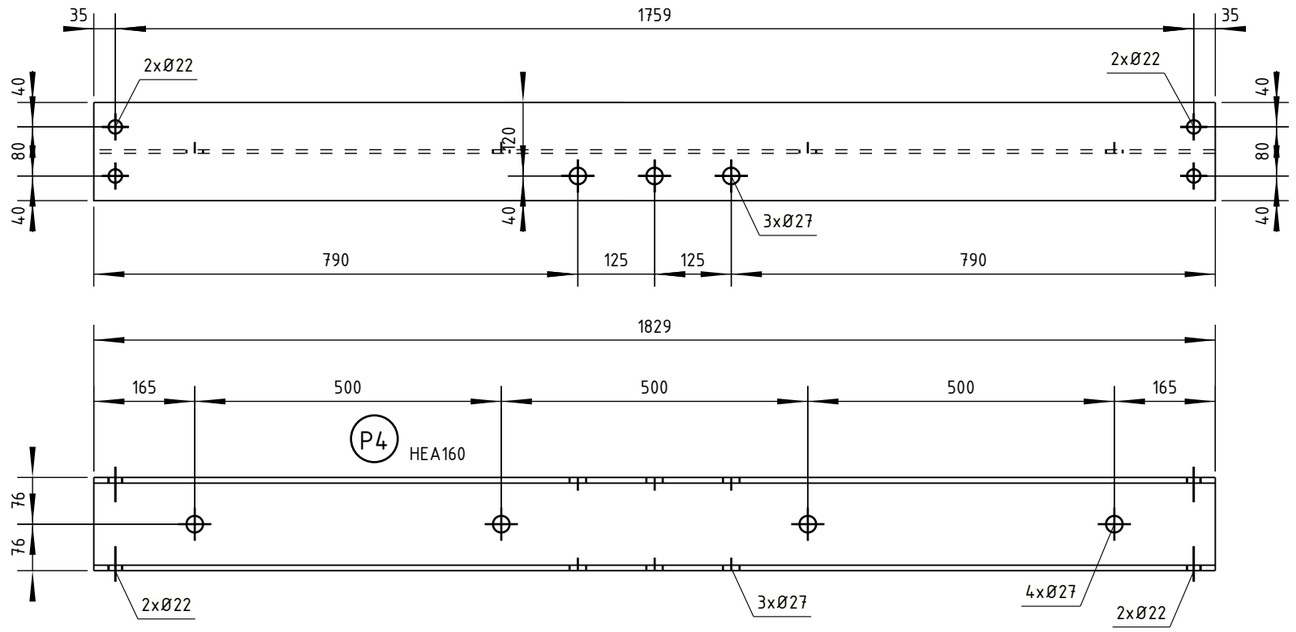


P3	HEA160	2	S355J0	1992	1.80
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
Oud tekeningnummer:	Object ID	ENS-ZL380 HB+9_R_X Mast 65
TenneT Taking power further	Omschrijving:	Nieuw staal - onderdeel [P3]
	Documentnummer:	

Tekla Structures



P4	HEA160	2	S355J0	1829	1.66
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle

Tekeningstatus: Voorlopig

Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening

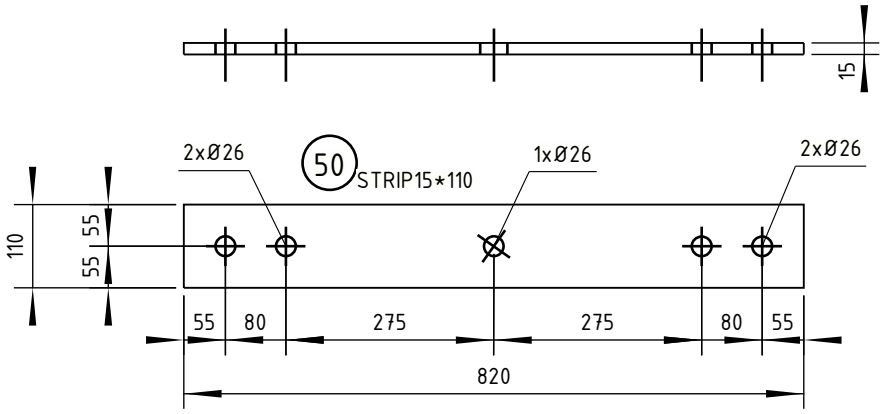
Object ID: ENS-ZL380 HB+9_R_X Mast 65

Omschrijving: Nieuw staal - onderdeel [P4]

Documentnummer:

TenneT Taking power further

Tekla Structures



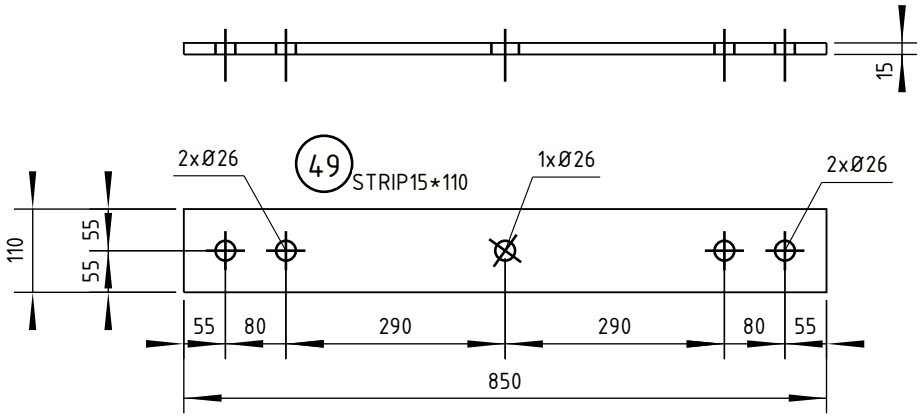
P5	STRIP15*110	2	S355J0	820	0.21
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P5]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



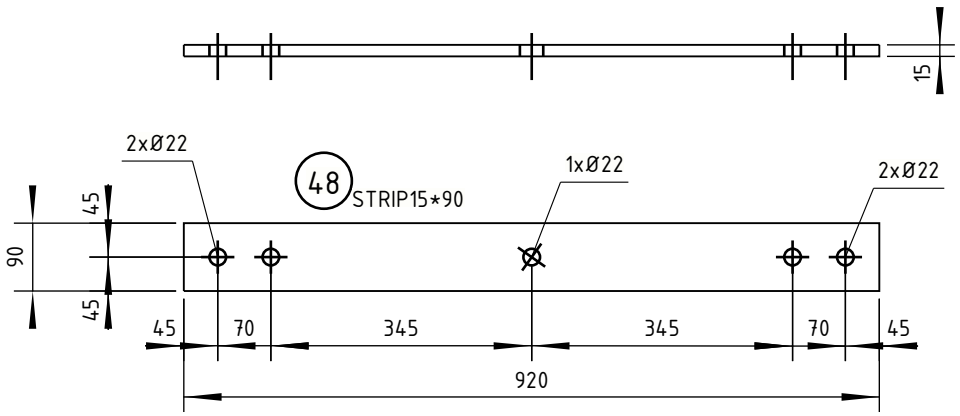
P6	STRIP15*110	2	S355J0	850	0.22
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P6]
	Documentnummer:	

TenneT Taking power further

Tekla Structures



P7	STRIP15*90	2	S355J0	920	0.20
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P7]
	Documentnummer:	

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Taking power further

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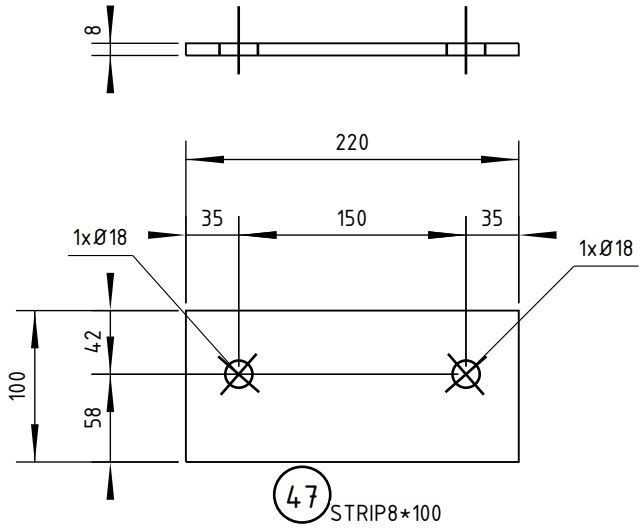

P8	STRIP8*100	2	S355J0	220	0.05
Pos	Profile	Number	Grade	Length	Area (m^2)

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
**	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 HB+9_R_X Mast 65
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [P8]
	Documentnummer:	

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Taking power further

Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-06520**

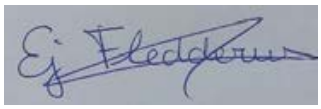
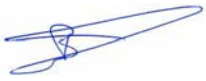
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994406**

Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **Masttype HB+9_R_X, Mast 65 - Lijsten**

	Naam	Functie	Handtekening	Datum
Opgesteld	Rogier Hol	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review

BOUTEN-, MOEREN-, RINGENLIJST Pagina: 1

ENS-ZL380 Datum: 13.02.2022
Masttype HB+9_R_X
t.b.v. mast 65

Naam	Type	Kwal.	Aantal
BOUT-M16*35	4017	8.8	38
BOUT-M16*40	4017	8.8	44
BOUT-M16*45	4017	8.8	54
BOUT-M16*50	4014	8.8	12
BOUT-M20*45	4017	8.8	64
BOUT-M20*50	4017	8.8	106
BOUT-M20*65	4014	8.8	8
BOUT-M24*55	4017	8.8	36
BOUT-M24*70	4014	8.8	8
MOER-M16	4032		148
MOER-M20	4032		178
MOER-M24	4032		44
RING-M16	7091		148
RING-M20	7091		178
RING-M24	7091		44

MATERIAALLIJST Pagina: 1

ENS-ZL380 Datum: 13.02.2022
Masttype HB+9_R_X
t.b.v. mast 65

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
HEA160	11	S355J0	2	1147	1.04	35.6
HEA160	P2	S355J0	2	2803	2.54	86.9
HEA160	P3	S355J0	2	1992	1.80	61.8
HEA160	P4	S355J0	2	1829	1.66	56.7
				15542	14.08	482.0
L50/5	16	S355J0	2	918	0.18	3.5
L50/5	17	S355J0	2	894	0.18	3.4
L50/5	18	S355J0	2	1040	0.21	4.0
L50/5	19	S355J0	2	1527	0.31	5.9
L50/5	20	S355J0	2	1547	0.31	5.9
L50/5	21	S355J0	4	1499	0.30	5.8
L50/5	22	S355J0	4	1382	0.28	5.3
L50/5	23	S355J0	4	1231	0.25	4.7
L50/5	24	S355J0	4	781	0.16	3.0
				31419	6.28	120.7
L60/6	7	S355J0	2	2868	0.69	15.8
L60/6	8	S355J0	2	2868	0.69	15.8
L60/6	13	S355J0	2	5116	1.23	28.3
L60/6	14	S355J0	2	956	0.23	5.3
L60/6	15	S355J0	2	2063	0.50	11.4
L60/6	32	S355J0	2	5116	1.23	28.3
L60/6	34	S355J0	2	2063	0.50	11.4
L60/6	44	S355J0	2	2950	0.71	16.3
L60/6	45	S355J0	2	956	0.23	5.3
L60/6	46	S355J0	2	2950	0.71	16.3
				55812	13.39	308.4
L70/7	2	S355J0	2	1141	0.32	8.6
L70/7	4	S355J0	2	3030	0.85	22.8
L70/7	5	S355J0	4	2893	0.81	21.7
L70/7	6	S355J0	2	3030	0.85	22.8
L70/7	27	S355J0	2	1057	0.30	7.9
				28091	7.87	211.2
L90/8	1	S355J0	2	811	0.29	8.7
L90/8	3	S355J0	2	875	0.31	9.3
L90/8	25	S355J0	2	725	0.26	7.7
L90/8	26	S355J0	2	768	0.28	8.4
L90/8	33	S355J0	2	200	0.07	1.8
L90/8	42	S355J0	2	200	0.07	1.8
				7158	2.58	75.5

ENS-ZL380 Datum: 13.02.2022
Masttype HB+9_R_X
t.b.v. mast 65

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
L150/14	10	S355J0	2	3750	2.25	120.1
L150/14	12	S355J0	2	3750	2.25	120.1
				15002	9.00	480.5
PL8*155	37	S355J0	2	170	0.05	1.4
				340	0.10	2.8
PL8*173.4	43	S355J0	4	299	0.08	2.4
				1197	0.32	9.5
PL8/4*60	40	S355J0	8	70	0.00	0.2
				560	0.00	1.6
STRIP8*100	P8	S355J0	2	220	0.05	1.4
				440	0.10	2.8
STRIP8*200	35	S355J0	2	155	0.06	1.8
STRIP8*200	36	S355J0	2	155	0.06	1.8
STRIP8*200	41	S355J0	2	155	0.06	1.8
				930	0.38	11.0
STRIP8*220	P1	S355J0	2	420	0.20	5.9
				840	0.39	11.8
STRIP10*60	9	S355J0	2	89	0.01	0.3
				177	0.02	0.6
STRIP10*120	39	S355J0	4	300	0.08	2.7
				1200	0.30	10.9
STRIP10*140	38	S355J0	4	340	0.09	3.4
				1360	0.38	13.7
STRIP10*300	28	S355J0	8	300	0.11	4.0
STRIP10*300	29	S355J0	8	300	0.10	3.7
STRIP10*300	30	S355J0	8	300	0.11	4.0
STRIP10*300	31	S355J0	8	300	0.10	3.7

ENS-ZL380 Datum: 13.02.2022
Masttype HB+9_R_X
t.b.v. mast 65

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
				9600	3.38	123.0
STRIP15*50	51	S355J0	2	56	0.01	0.3
STRIP15*50	52	S355J0	2	59	0.01	0.3
STRIP15*50	53	S355J0	2	66	0.01	0.3
				363	0.05	1.8
STRIP15*90	P7	S355J0	2	920	0.20	9.9
				1840	0.39	19.9
STRIP15*110	P5	S355J0	2	820	0.21	10.8
STRIP15*110	P6	S355J0	2	850	0.22	11.2
				3340	0.85	44.1
			Totaal:		59.86	1932.1

TEKLA STRUCTURES MERKENLIJST Pagina: 1

ENS-ZL380 Datum: 13.02.2022
Masttype HB+9_R_X
t.b.v. mast 65

Merk	Aantal	Profiel	Lengte	Opp.(m2)	Gewicht (kg)
1	2	L90/8	811	0.29	8.7
2	2	L70/7	1141	0.32	8.6
3	2	L90/8	875	0.31	9.3
4	2	L70/7	3030	0.85	22.8
5	4	L70/7	2893	0.81	21.7
6	2	L70/7	3030	0.85	22.8
7	2	L60/6	2868	0.69	15.8
8	2	L60/6	2868	0.69	15.8
9	2	STRIP10*60	89	0.01	0.3
10	2	L150/14	3750	2.25	120.1
11	2	HEA160	1147	1.04	35.6
12	2	L150/14	3750	2.25	120.1
13	2	L60/6	5116	1.23	28.3
14	2	L60/6	956	0.23	5.3
15	2	L60/6	2063	0.50	11.4
16	2	L50/5	918	0.18	3.5
17	2	L50/5	894	0.18	3.4
18	2	L50/5	1040	0.21	4.0
19	2	L50/5	1527	0.31	5.9
20	2	L50/5	1547	0.31	5.9
21	4	L50/5	1499	0.30	5.8
22	4	L50/5	1382	0.28	5.3
23	4	L50/5	1231	0.25	4.7
24	4	L50/5	781	0.16	3.0
25	2	L90/8	725	0.26	7.7
26	2	L90/8	768	0.28	8.4
27	2	L70/7	1057	0.30	7.9
28	8	STRIP10*300	300	0.11	4.0
29	8	STRIP10*300	300	0.10	3.7
30	8	STRIP10*300	300	0.11	4.0
31	8	STRIP10*300	300	0.10	3.7
32	2	L60/6	5116	1.23	28.3
33	2	L90/8	200	0.07	1.8
34	2	L60/6	2063	0.50	11.4
35	2	STRIP8*200	155	0.06	1.8
36	2	STRIP8*200	155	0.06	1.8
37	2	PL8*155	155	0.05	1.4
38	4	STRIP10*140	340	0.09	3.4
39	4	STRIP10*120	300	0.08	2.7
40	8	PL8/4*60	70	0.00	0.2
41	2	STRIP8*200	155	0.06	1.8
42	2	L90/8	200	0.07	1.8
43	4	PL8*173.4	300	0.08	2.4
44	2	L60/6	2950	0.71	16.3
45	2	L60/6	956	0.23	5.3
46	2	L60/6	2950	0.71	16.3
47	2	STRIP8*220	420	0.24	7.3
48	2	HEA160	2803	2.74	96.9
49	2	HEA160	1992	2.02	73.0

ENS-ZL380 Datum: 13.02.2022
Masttype HB+9_R_X
t.b.v. mast 65

Merk	Aantal	Profiel	Lengte	Opp.(m2)	Gewicht (kg)
50	2	HEA160	1829	1.87	67.6
51	2	STRIP15*50	56	0.01	0.3
52	2	STRIP15*50	59	0.01	0.3
53	2	STRIP15*50	66	0.01	0.3
Totaal	152	merk(en)		59.86	1932.1

Masttype: Masttype HB+9_R_X, Mast 65
Opwaarderen 380 kV verbinding Ens - Zwolle

Tekening omschrijving	Tekeningnummer	Rev.	Datum	Tek.	formaat
Masttype HB+9_R_X, Mast 65 - Overzicht	00974-01-06501	0.1	18.02.2022	A2	594x420
Masttype HB+9_R_X, Mast 65 - Ondertraverse Bovenvlak	00974-01-06502	0.1	18.02.2022	A0	1189x841
Masttype HB+9_R_X, Mast 65 - Boventraverse Ondervlak	00974-01-06503	0.1	18.02.2022	A0	1189x841
Masttype HB+9_R_X, Mast 65 - Boventraverse Zijaanzichten	00974-01-06504	0.1	18.02.2022	A0	1189x841
HB+9_R_X, Mast 65 - Onderdeeltekeningen	00974-01-06510	0.1	18.02.2022	A2/A3/A4	

Lijsten	Documentnummer		Datum
bouten-moeren-ringenlijst	00974-01-06520	0.1a	14.02.2022
materiaallijst	00974-01-06520	0.1a	14.02.2022
merkenlijst	00974-01-06520	0.1a	14.02.2022
Documentenlijst	00974-01-06520	0.1	18.02.2022

Detailberekeningen	Documentnummer		Datum
Masttype HB+9_R_X, Mast 65	00974-01-06530	0.1	18.02.2022

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

"REVIEW AND RE-DESIGN TOWERS BBB380"

ENS-ZL380 – Tower HB+9_R_X Mast 65

TenneT TSO B.V.

Detail Calculation

Projectnummer Aafjes:	**21-187**
Documentnummer:	**00974-01-06530**
Projectnummer TenneT:	**002.515**
Meridian nummer:	**002.515.40 0994407**
Opdrachtgever:	**TenneT**
Project:	**Opwaardering ENS-ZL380**
Onderdeel:	**HB+9_R_X Mast 65 - Detailberekeningen**

1e versie ter review	G. Pieper	R.Hol	B. Aafjes	17-02-2022	0.1a
	Author	Checked	Approved	date	revision

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5.1.1 Connections 50

1 Introduction

This report contains the detail calculations of the reinforcements of towertype HB+9/R_X windzone III.

It concerns tower number: Tower 65

To increase the future capacity of electricity transmission, it is necessary to upgrade the transmission grid by building new and modifying existing high voltage connections.

It is for this reason the client (OG) intends to upgrade part the existing 380kV grid. This upgrading is part of the program “Beter Benutten Bestaande 380kV” and consists of the following subprojects:

- Upgrading of the 380 kV-connection Lelystad – Ens (LLS-ENS380).
- Upgrading of the 380 kV-connection Diemen – Lelystad (DIM-LLS380).
- Upgrading of the 380 kV-connection Rilland – Zandvliet (RLL-ZVL380).
- Upgrading of the 380 kV-connection Krimpen aan de IJssel – Geertruidenberg (KIJ-GT380).
- Upgrading of the 380 kV-connection Ens – Zwolle (ENS-ZL380).
- Upgrading of the 380 kV-connection Maasbracht – Eindhoven (MBT-EHV380).

DNV GL has calculated the existing tower for the new situation on behalf of Tennet. On the instructions of DNV GL, the reinforcements mainly consist of the exchange of bolts and profiles and the reinforcement of profiles and the application of redundant members.

DNV GL has tested the profiles and bolts. In this report only the detail calculations are made of the specified reinforcements (bolts are specified by DNV GL).

2 General Data

2.1 Principal constructor

DNV GL – Energy

2.2 Principal calculation and related documents

- ENS-ZL380 – Tower HB+9/R_X
  Reportnr.: 21-0180 Rev 3
  Date: 2021-12-20

- Uitgangspuntenrapport 380kV verbinding Ens – Zwolle
  Reportnr.: 20-1245 Rev.3
  Date: 2021-06-09

2.3 Material- and bolt quality

Materials excisting construction

	Signification 1969	Current startingpoint
Steeltype	St.37	S235JR
	St.52	S355JO
Bolt quality	bolt class 8.8	8.8 rolled thread
Concrete quality	K225	Min. C16/20
Reinforcing steel	Qr24, Qr40	B220, B400

Materials modified construction

Steeltype	S355JO ($t \leqq 16$ mm)
	S355J2 ($16 < t \leqq 40$ mm)
Bolt quality	8.8 rolled thread

2.4 Applicable standards

Mainly used:
- NEN-EN 1993-1-8+C2 :2011/NB:2011 nl

Also used:
- NEN-EN 50341-2-15: 2019
- NEN-EN 8700: 2011
- NEN-EN 8701: 2011
- Eurocode reeks

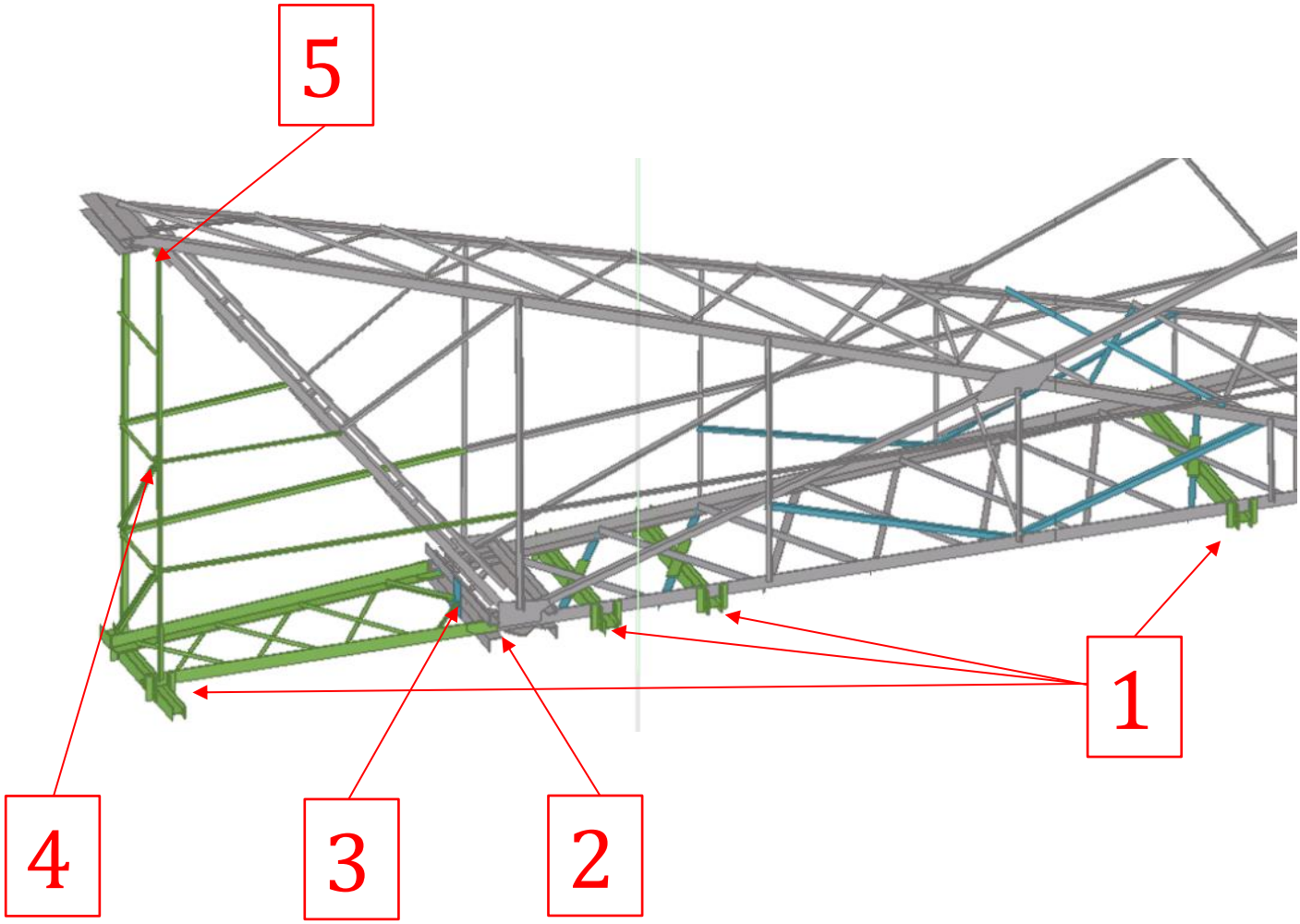
2.5 Tennet specifications

- SPE. 05. 346. v 2.0 algemene specificatie stalen masten

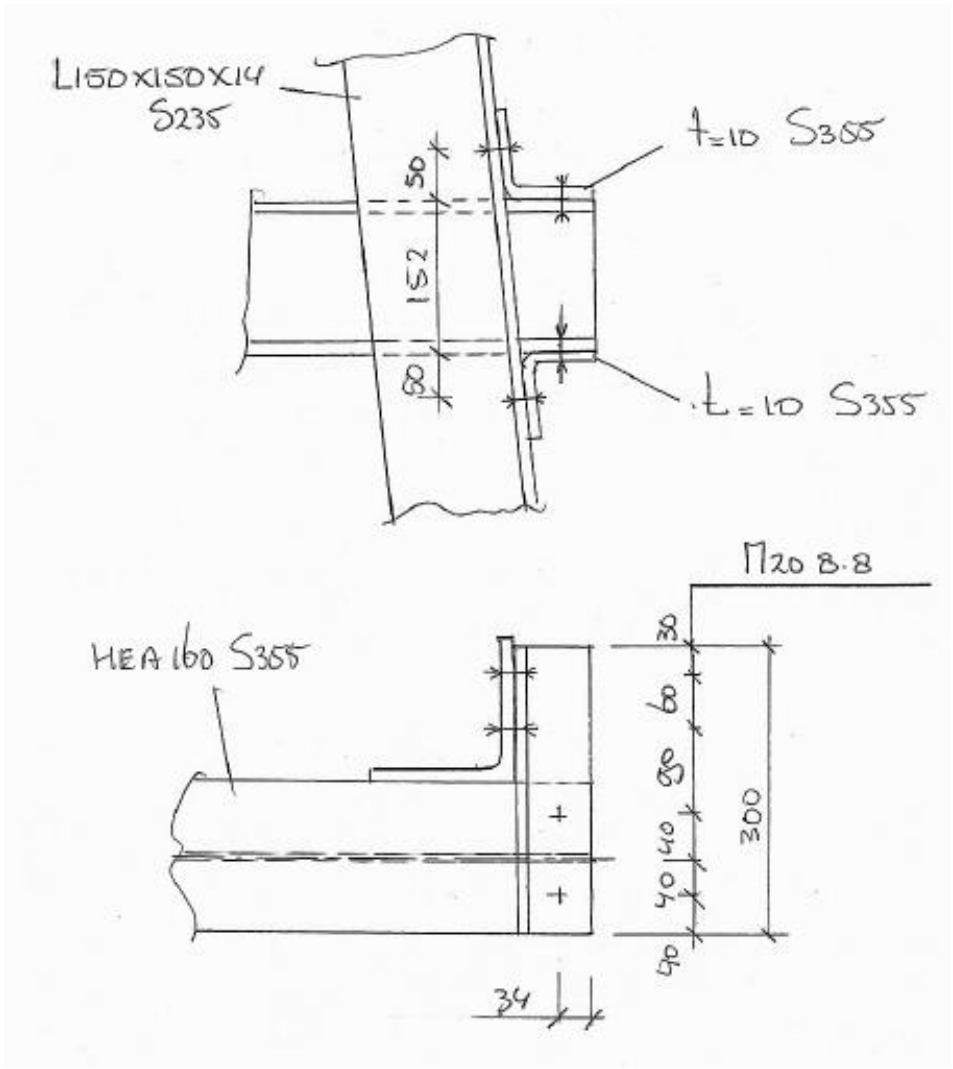
3 Calculations

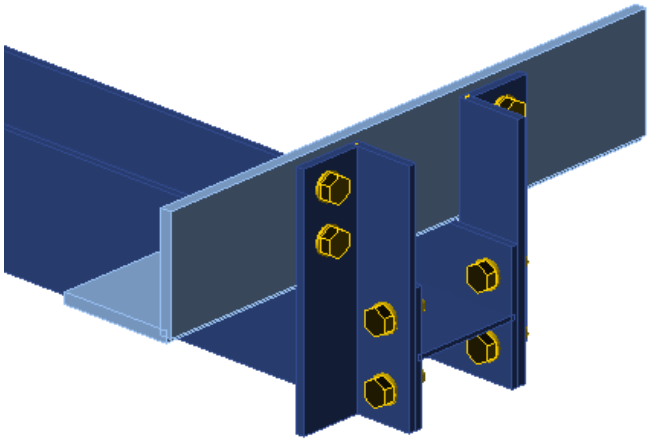
3.1 Connections

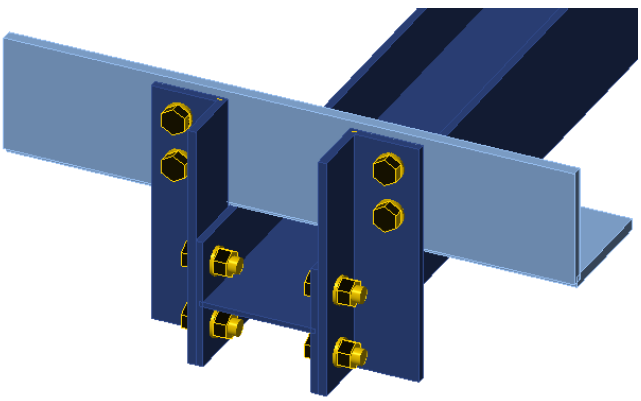
3.1.1 Overview



3.1.2 Detail 1


L150X150X14
S235
t=10 S355
50
152
80
t=10 S355
M20 8.8
HEA 160 S355
30
60
80
40
40
90
300
34





3.1.3 Loads

Loads from report:

ENS-ZL380 – Tower HB+9/R_X

Report nr.: 21-0180 Rev 3
Date: 2021-12-20

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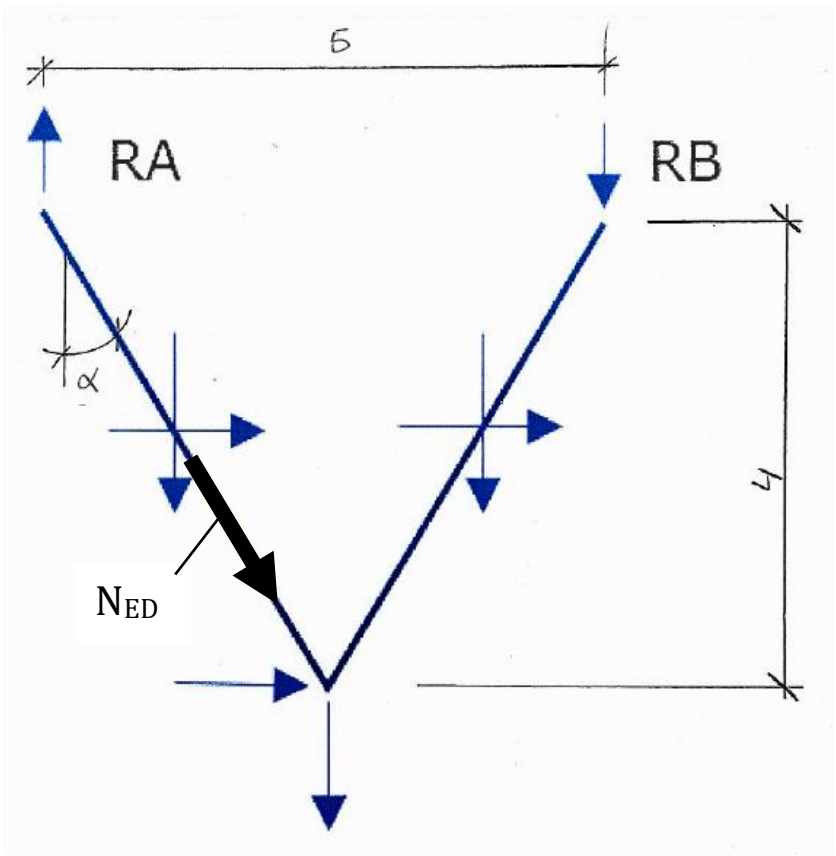


RA = 3,98 kN

$\alpha = 32°$

N_{ED} = 1,5 x 3,98 / cos 32° = 7 kN

V_{ED}

3.1.4 Calculation

3.1.4.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+9_R_X mast 65
Project number	21-187
Author	G.P.
Description	Detail 1
Date	2/17/2022
Design code	EN

Material

Steel	S 355, S 235

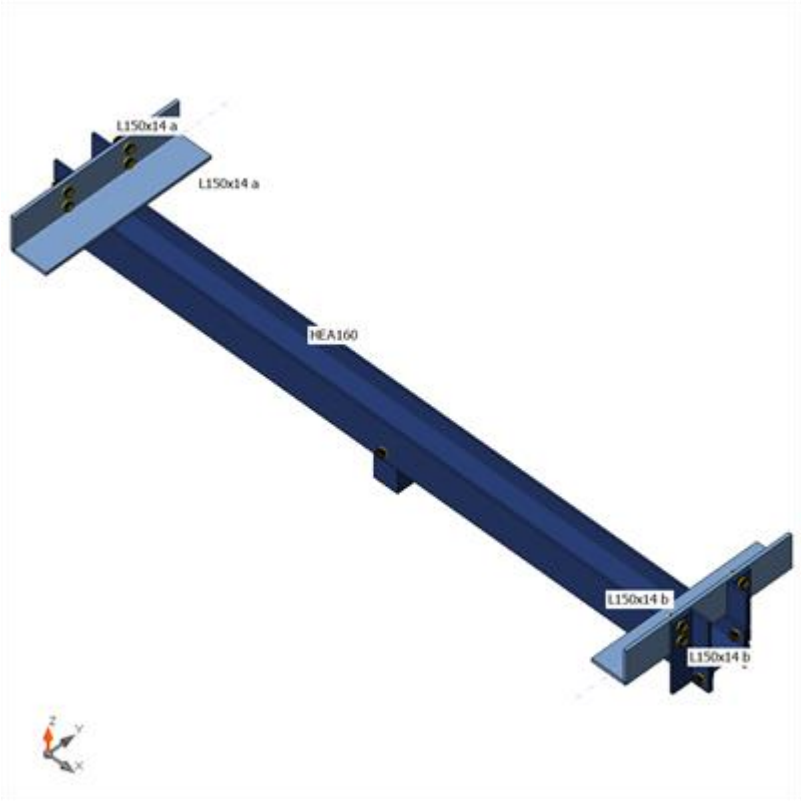
Project item Detail 1

Design

Name	Detail 1
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
Dummy	5 - CHS40,3	90.0	58.0	0.0	0	0	-25	Node
L150x14 a	3 - L150x14(L150)	-90.0	0.0	0.0	0	-1275	122	Bolts
L150x14 b	3 - L150x14(L150)	90.0	0.0	0.0	0	-1275	122	Bolts



Cross-sections

Name	Material
5 - CHS40,3	S 355
3 - L150x14(L150)	S 235
1 - HEA160	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M20 8.8	M20 8.8	20	800.0	314

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	Dummy	7.0	0.0	0.0	0.0	0.0	0.0
	L150x14 a	1.9	0.0	1.5	0.0	-0.2	0.0
	L150x14 a	0.0	0.0	1.5	0.0	-0.2	0.0
	L150x14 b	0.0	0.0	1.5	0.0	0.2	0.0
	L150x14 b	-1.9	0.0	1.5	0.0	0.2	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	6.0 < 100%	OK
Buckling	43.12	

Plates

Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
Dummy	S 355	3.0	LE1	27.1	0.0	0.0	OK
L150x14 a-bfl 1	S 235	14.0	LE1	11.0	0.0	0.0	OK
L150x14 a-w 1	S 235	14.0	LE1	20.7	0.0	4.5	OK
L150x14 b-bfl 1	S 235	14.0	LE1	7.8	0.0	0.0	OK
L150x14 b-w 1	S 235	14.0	LE1	15.0	0.0	3.6	OK
HEA160-bfl 1	S 355	9.0	LE1	59.9	0.0	1.9	OK
HEA160-tfl 1	S 355	9.0	LE1	75.1	0.0	1.7	OK
HEA160-w 1	S 355	6.0	LE1	27.5	0.0	0.0	OK
SP1	S 355	10.0	LE1	8.7	0.0	1.4	OK
SP2	S 355	10.0	LE1	25.4	0.0	3.6	OK
SP3	S 355	10.0	LE1	28.9	0.0	1.7	OK
SP4	S 355	10.0	LE1	17.7	0.0	1.1	OK
SP5	S 355	10.0	LE1	10.3	0.0	1.4	OK
SP6	S 355	10.0	LE1	32.4	0.0	4.5	OK
SP7	S 355	10.0	LE1	32.9	0.0	1.5	OK
SP8	S 355	10.0	LE1	19.9	0.0	2.1	OK
SP9	S 355 - 1	134.0	LE1	1.8	0.0	1.9	OK

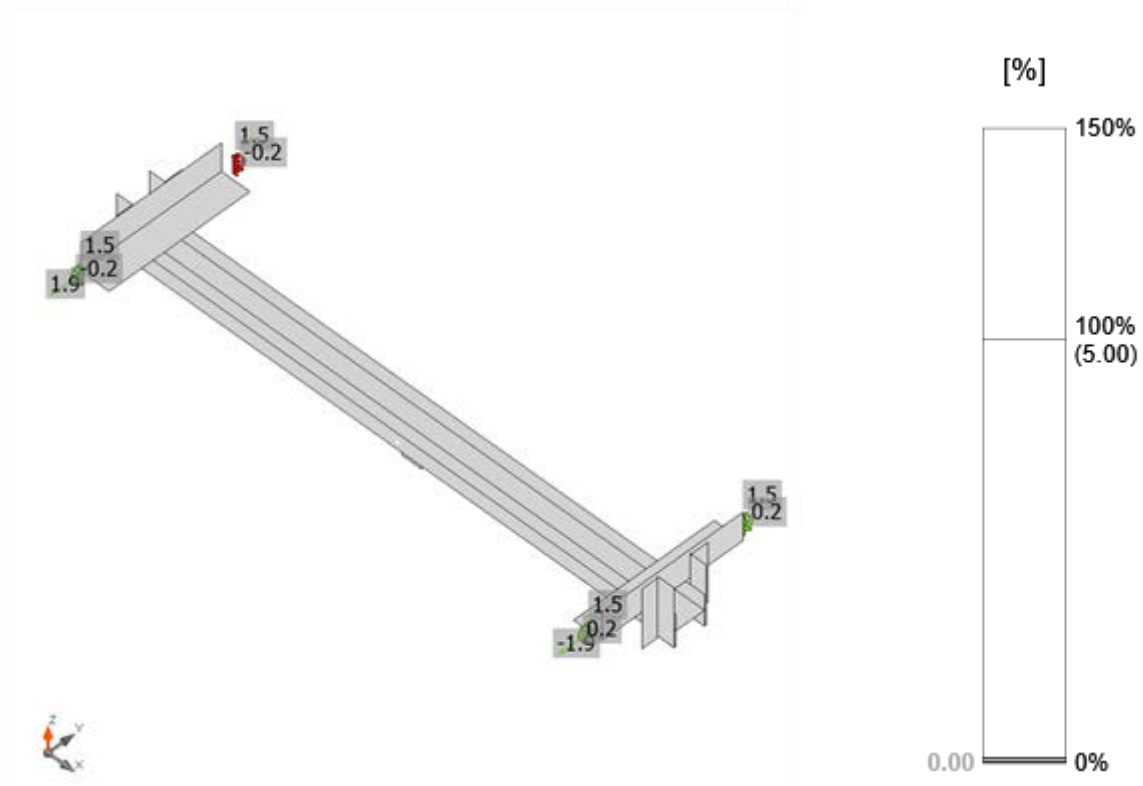
Design data

Material	f_y [MPa]	ε_{lim} [%]
S 355	355.0	5.0
S 235	235.0	5.0
S 355 - 1	335.0	5.0

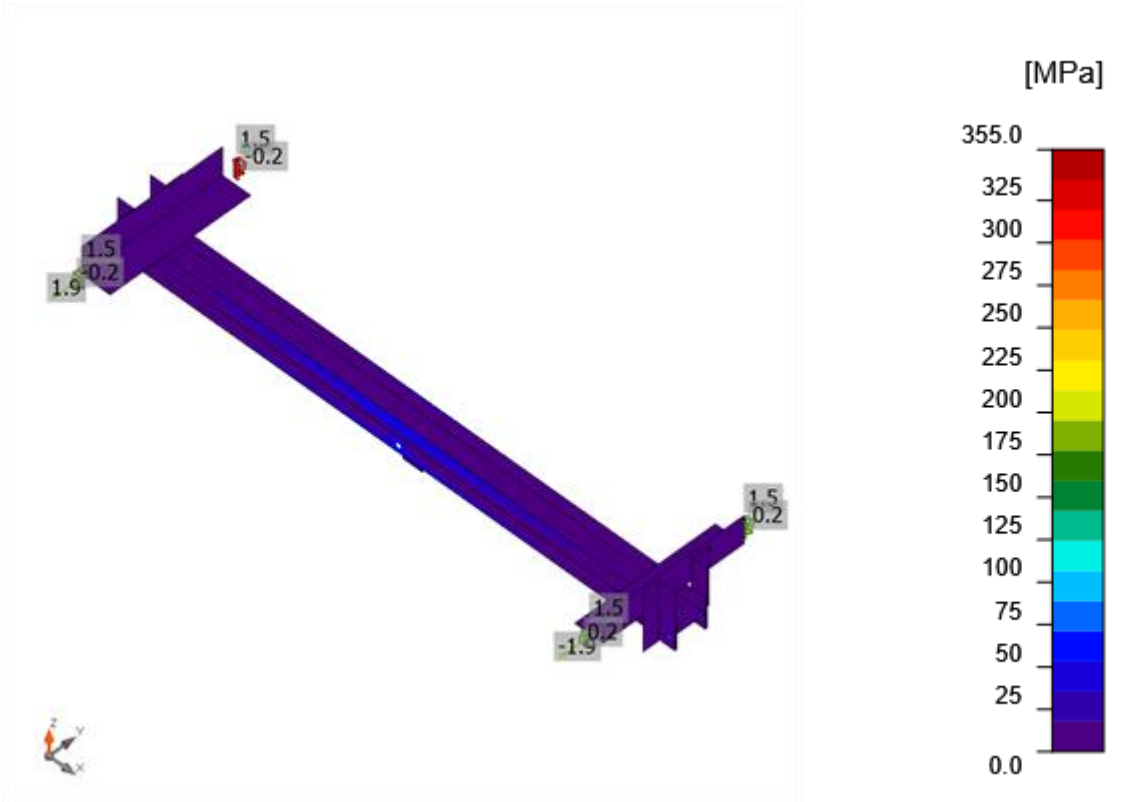
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

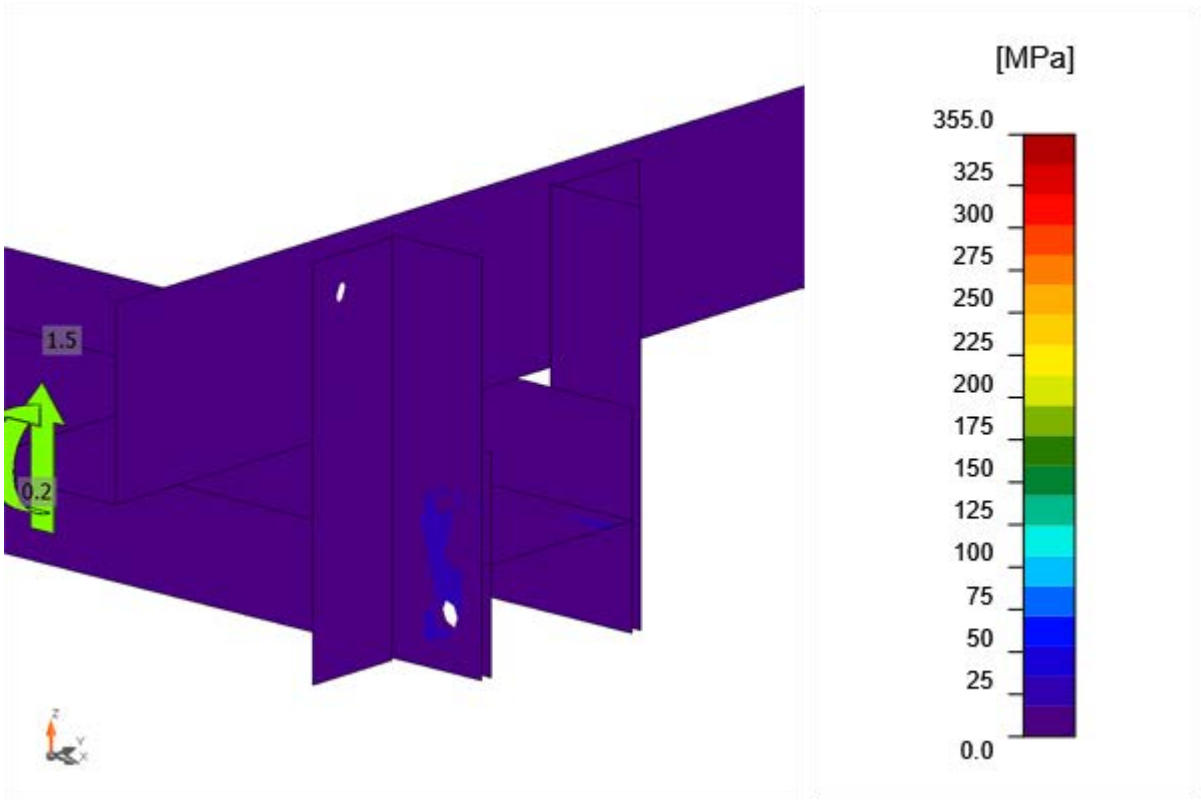
Overall check, LE1



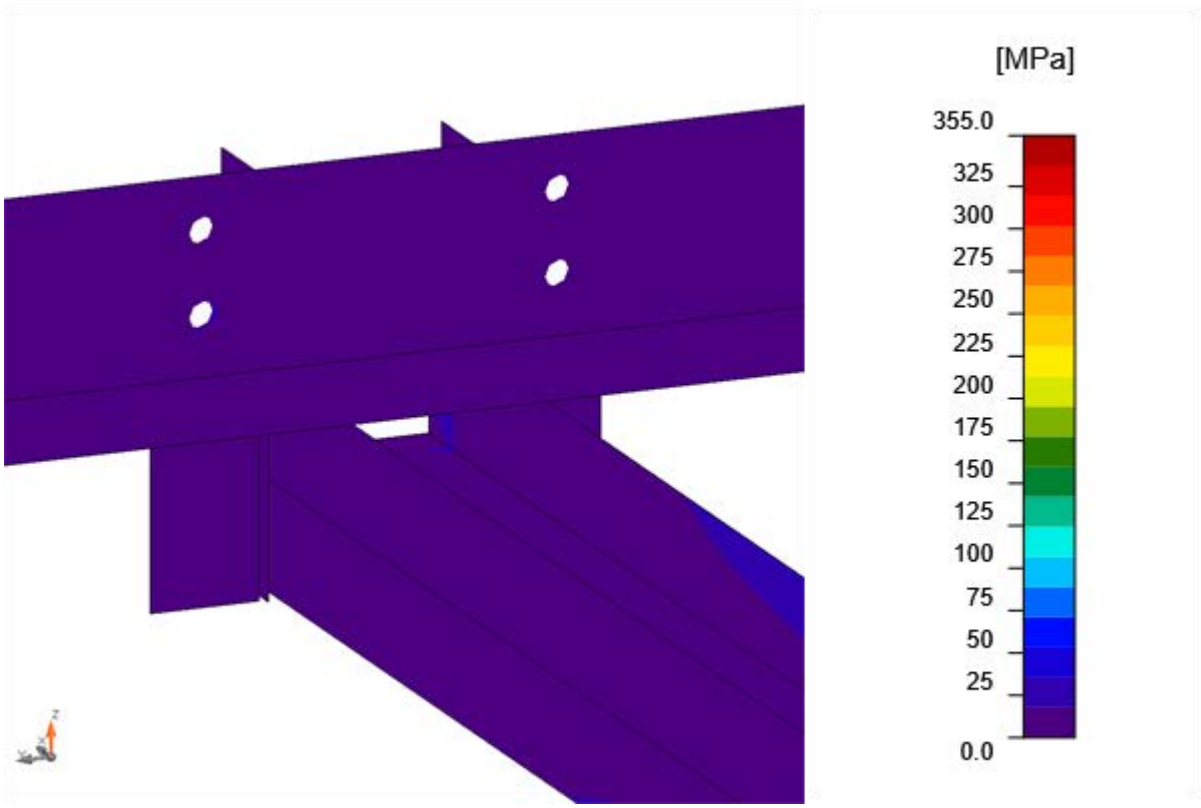
Strain check, LE1



Equivalent stress, LE1

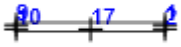
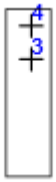


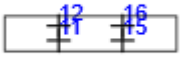
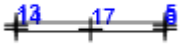
Equivalent stress, LE1



Equivalent stress, LE1

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M20 8.8 - 1	LE1	0.5	0.6	0.4	89.9	0.7	0.9	OK
	B2	M20 8.8 - 1	LE1	0.5	0.9	0.3	98.0	1.0	1.3	OK
	B9	M20 8.8 - 1	LE1	0.4	0.6	0.3	89.5	0.6	0.8	OK
	B10	M20 8.8 - 1	LE1	0.5	1.0	0.4	98.0	1.1	1.4	OK
	B3	M20 8.8 - 2	LE1	2.6	1.9	1.8	113.2	2.0	3.3	OK
	B4	M20 8.8 - 2	LE1	0.1	1.4	0.1	88.1	1.6	1.6	OK
	B5	M20 8.8 - 1	LE1	2.4	3.2	1.7	88.2	3.6	4.6	OK
	B6	M20 8.8 - 1	LE1	2.0	2.7	1.4	98.0	2.9	3.9	OK
	B7	M20 8.8 - 2	LE1	1.0	2.2	0.7	104.0	2.4	2.8	OK
	B8	M20 8.8 - 2	LE1	0.3	1.2	0.2	75.9	1.6	1.4	OK

	B11	M20 8.8 - 2	LE1	3.3	1.9	2.3	113.2	2.0	3.7	OK
	B12	M20 8.8 - 2	LE1	0.1	1.4	0.1	88.1	1.6	1.6	OK
	B15	M20 8.8 - 2	LE1	1.2	2.3	0.8	104.0	2.5	3.1	OK
	B16	M20 8.8 - 2	LE1	0.4	1.3	0.3	75.6	1.7	1.6	OK
	B13	M20 8.8 - 1	LE1	2.1	3.8	1.5	88.2	4.3	5.1	OK
	B14	M20 8.8 - 1	LE1	2.2	3.2	1.5	98.0	3.4	4.5	OK
	B17	M20 8.8 - 1	LE1	3.8	3.8	2.7	93.5	4.1	6.0	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M20 8.8 - 1	141.1	209.5	94.1
M20 8.8 - 2	141.1	232.8	94.1

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

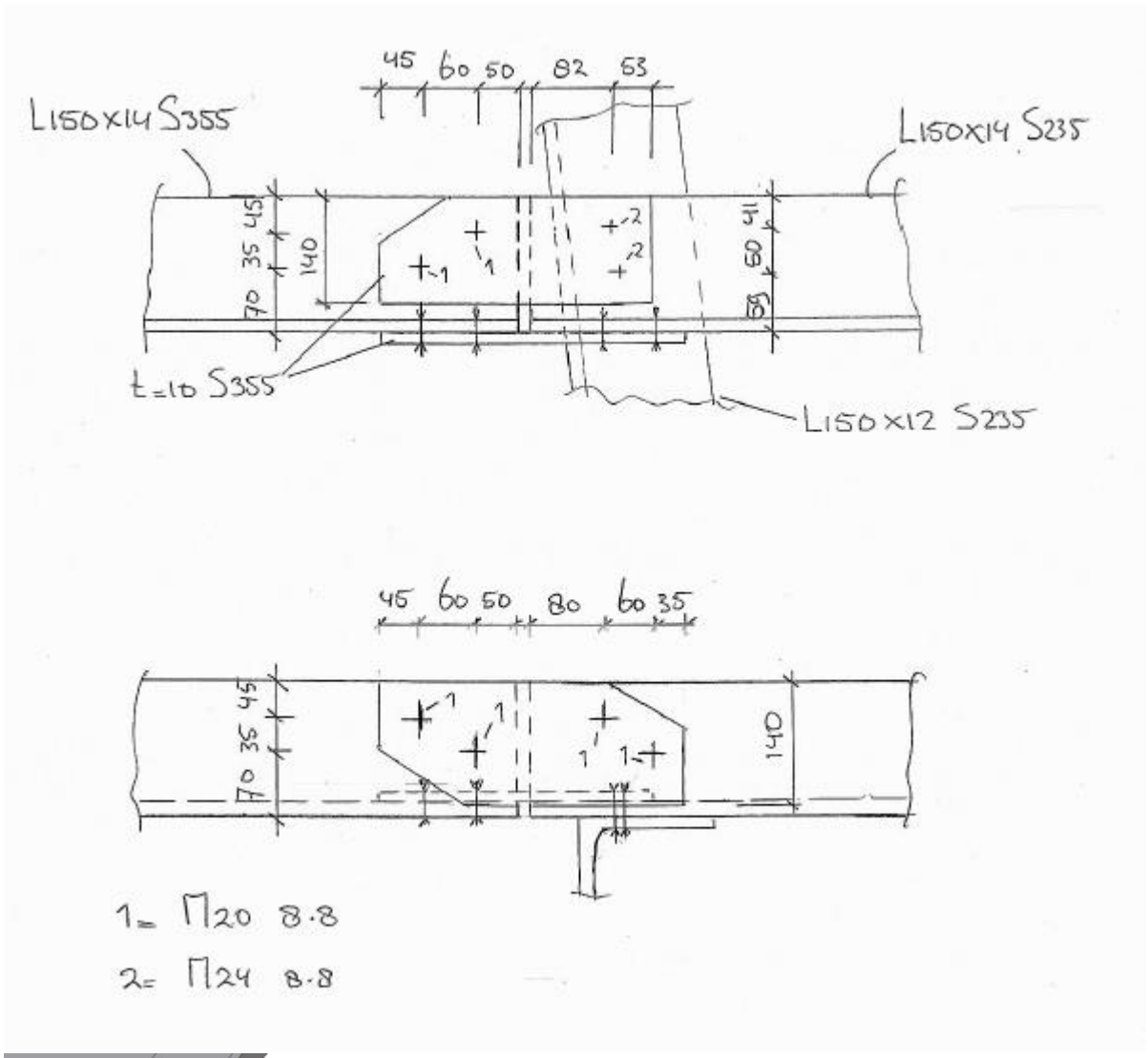
Buckling

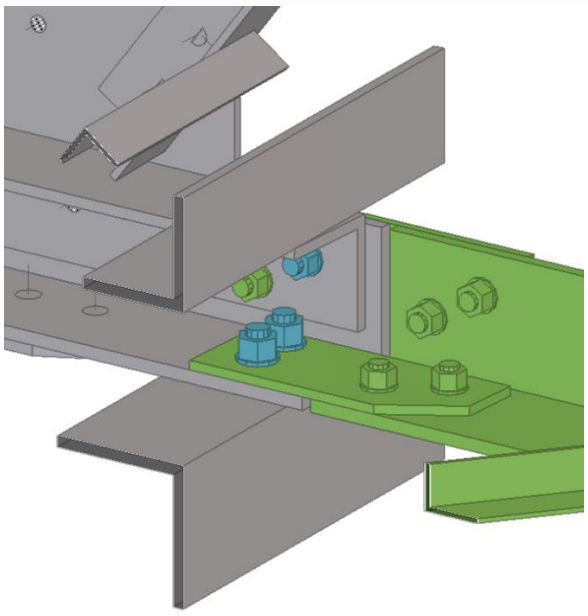
Loads	Shape	Factor [-]
LE1	1	43.12
	2	43.55
	3	50.80
	4	51.17
	5	57.40
	6	57.87

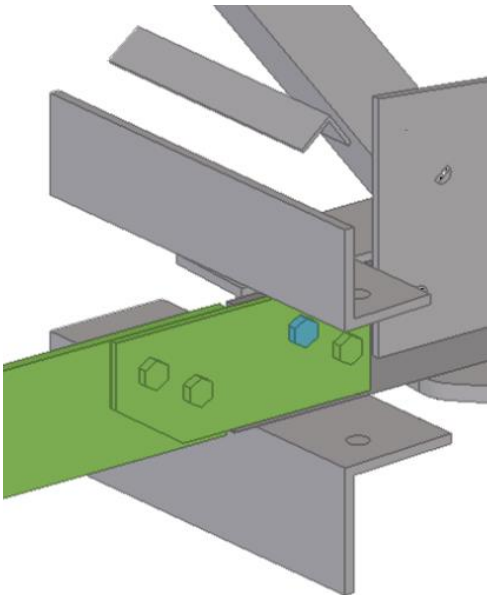
Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

3.1.5 Detail 2


45 60 50 82 53
L150x14 S355
L150x14 S235
45 35 70
140
41 60 53
t=10 S355
L150x12 S235
45 60 50 80 60 35
45 35 70
140
1= M20 8.8
2= M24 8.8





3.1.6 Loads

Loads from report:

ENS-ZL380 – Tower HB+9/R_X

Report nr.: 21-0180 Rev 3
Date: 2021-12-20

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Member: 490D L150x150x14 S355

N_{ED} = -14,5 kN compression N_{ED} = 11,2 kN tension

3.1.7 Calculation

3.1.7.1 Check Bolts

L150x150x14: Fd in one flange $= \frac{14,5}{2} = 7,25$ kN

Bolt M20 8.8

U.C. $= \frac{\text{FvEd}}{\text{FvRd}} = \frac{7,25}{2\text{x}94} = 0,04 < 1$ O.K.

$F_{bearing}$ max $= 7,25$ kN

PL 10x140 S355

$e_1 = 35$ mm

$e_2 = 45$ mm

$p_1 = 60$ mm

$k_1 = 2,8 \text{ x } \frac{45}{22} - 1,7 = 4 \rightarrow k_1 = 2,5$

$\alpha_b = \frac{35}{3\text{x}22} - 0,53$

$F_{b,Rd} = \frac{2,5 \text{ x } 0,53 \text{ x } 490 \text{ x } 20 \text{ x } 10}{1,25} = 104$ kN

U.C. $= \frac{\text{Fb,Ed}}{\text{Fb,Rd}} = \frac{7,25}{2\text{x}104} = 0,04 < 1$ O.K.

3.1.7.2 Check plate

PL 140 x 10 S355

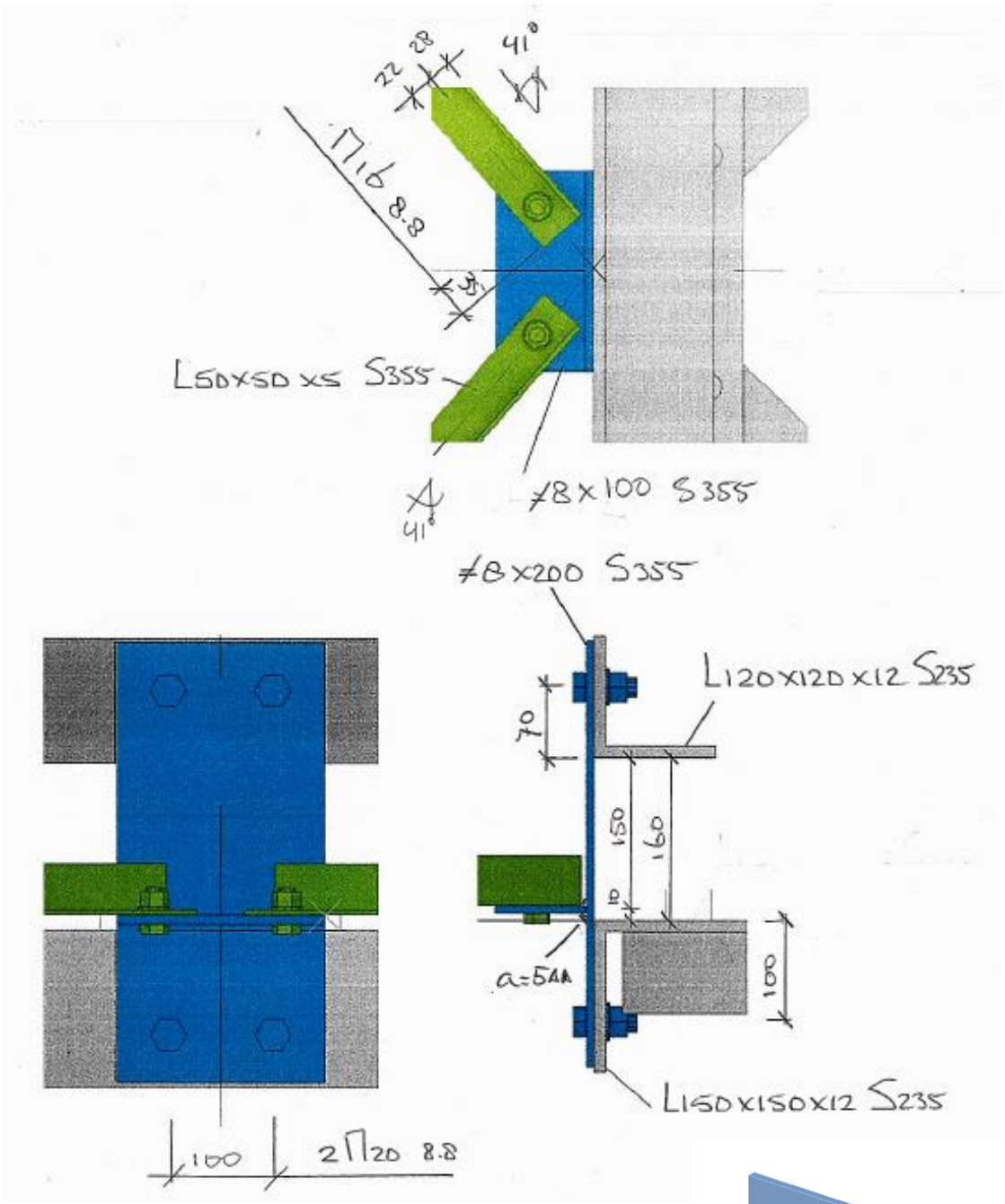
Fd =7,25 kN

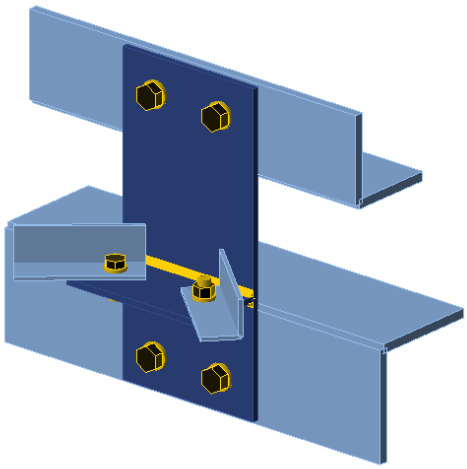
$$N_{u,Rd} = \frac{0,9 \text{ x Anett x fu}}{\Upsilon m2} \qquad A_{nett} = 1400 - (2 \text{ x } 10 \text{ x } 26) = 880 \text{ mm}^2$$

$$= \frac{0,9 \text{ x } 880 \text{ x } 490}{1,25} = 310 \text{ kN}$$

$$\text{U.C.} = \frac{FEd}{Nu,Rd} = \frac{7,25}{310} = 0,02 < 1 \quad \text{O.K.}$$

3.1.8 Detail 3


41°
22
28
M16 8.8
35
L50x50x5 S355
≠8x100 S355
41°
≠8x200 S355
L120x120x12 S235
70
150
160
10
a=5AA
100
L150x150x12 S235
100
2M20 8.8



3.1.9 Loads

Loads from report:

ENS-ZL380 – Tower HB+9/R_X

Report nr.: 21-0180 Rev 3
Date: 2021-12-20

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Member: 469 L50x50x5 S355

N_{ED} = -5,6 kN compression N_{ED} = 4,7 kN tension

3.1.10 Calculation

3.1.10.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+9_R_X mast 65
Project number	21-187
Author	G.P.
Description	Detail 3
Date	2/17/2022
Design code	EN

Material

Steel	S 355, S 235

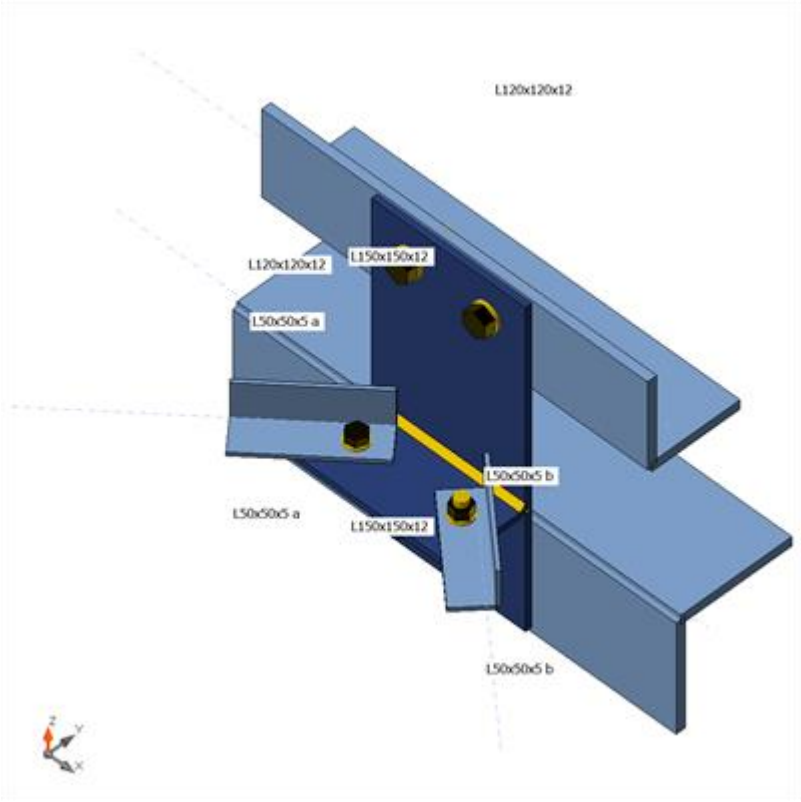
Project item Detail 3

Design

Name	Detail 3
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in	X [mm]
L150x150x12	3 - HFLeq150x150x12	0.0	0.0	-90.0	0	70	41	Node	0
L50x50x5 a	5 - HFLeq50x50x5	-139.0	0.0	0.0	55	-14	0	Bolts	35
L120x120x12	4 - HFLeq120x120x12	0.0	0.0	0.0	0	34	165	Node	0
L50x50x5 b	5 - HFLeq50x50x5	-41.0	0.0	90.0	55	0	-14	Bolts	35



Cross-sections

Name	Material
3 - HFLeq150x150x12	S 235
5 - HFLeq50x50x5	S 355
4 - HFLeq120x120x12	S 235

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M16 8.8	M16 8.8	16	800.0	201
M20 8.8	M20 8.8	20	800.0	314

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	L150x150x12	0.0	0.0	-1.3	0.0	0.0	0.0
	L150x150x12	-2.8	0.0	-1.3	0.0	0.1	0.0
	L50x50x5 a	-5.6	0.0	0.0	0.0	0.0	0.0
	L120x120x12	-1.4	-0.6	0.0	0.0	0.0	0.0
	L120x120x12	0.0	-0.6	0.0	0.0	0.0	0.0
	L50x50x5 b	0.0	0.0	0.0	0.0	0.0	0.0
LE2	L150x150x12	0.0	0.0	0.9	0.0	0.0	0.0
	L150x150x12	2.2	0.0	0.9	0.0	-0.1	0.0
	L50x50x5 a	4.3	0.0	0.0	0.0	0.0	0.0

	L120x120x12	1.0	0.5	0.0	0.0	0.0	0.0
	L120x120x12	0.0	0.5	0.0	0.0	0.0	0.0
	L50x50x5 b	0.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	12.3 < 100%	OK
Welds	4.9 < 100%	OK
Buckling	78.39	

Plates

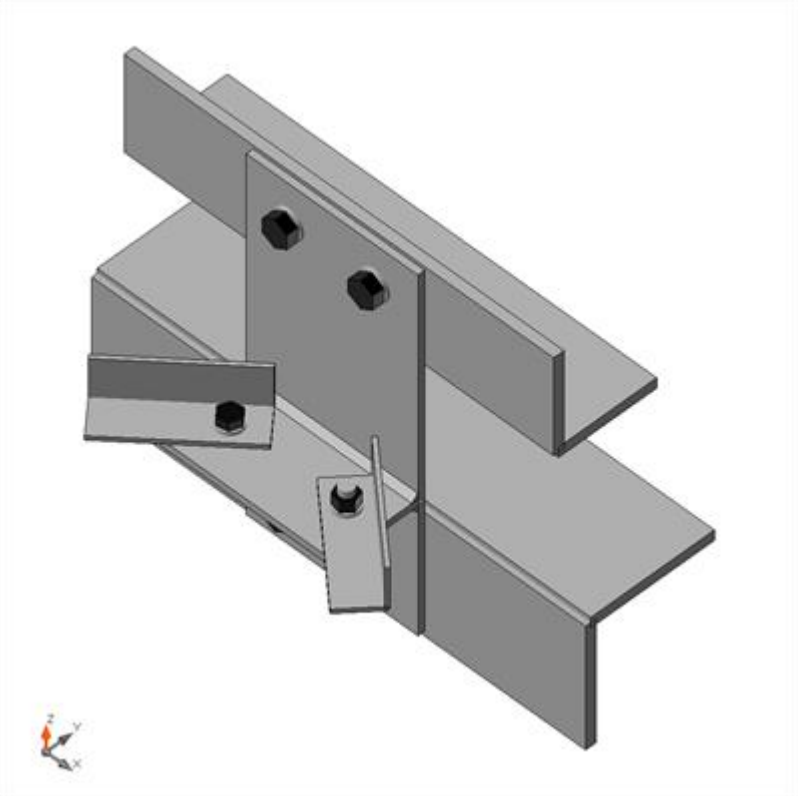
Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
L150x150x12-bfl 1	S 235	12.0	LE2	22.8	0.0	3.0	OK
L150x150x12-w 1	S 235	12.0	LE2	9.3	0.0	0.0	OK
L50x50x5 a-bfl 1	S 355	5.0	LE1	82.1	0.0	26.3	OK
L50x50x5 a-w 1	S 355	5.0	LE1	48.6	0.0	0.0	OK
L120x120x12-bfl 1	S 235	12.0	LE1	5.2	0.0	0.0	OK
L120x120x12-w 1	S 235	12.0	LE2	12.9	0.0	2.0	OK
L50x50x5 b-bfl 1	S 355	5.0	LE1	59.4	0.0	0.0	OK
L50x50x5 b-w 1	S 355	5.0	LE1	60.8	0.0	25.7	OK
SP1	S 355	8.0	LE1	103.8	0.0	3.8	OK
SP2	S 355	8.0	LE1	73.4	0.0	26.3	OK

Design data

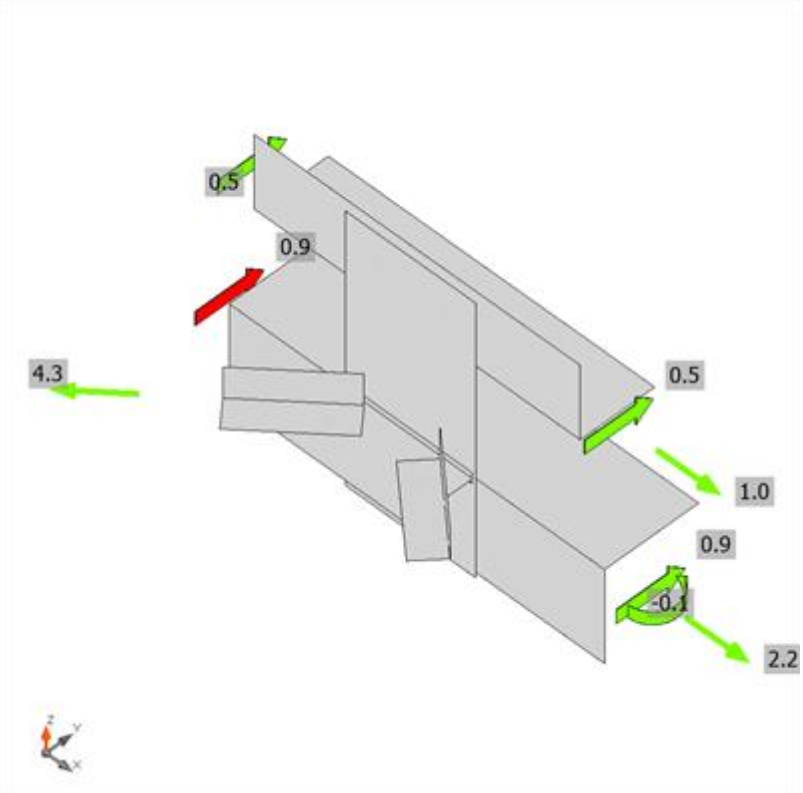
Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0
S 355	355.0	5.0

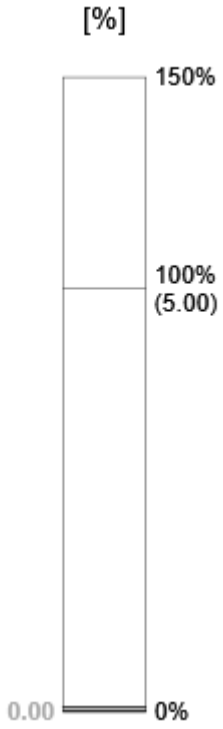
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

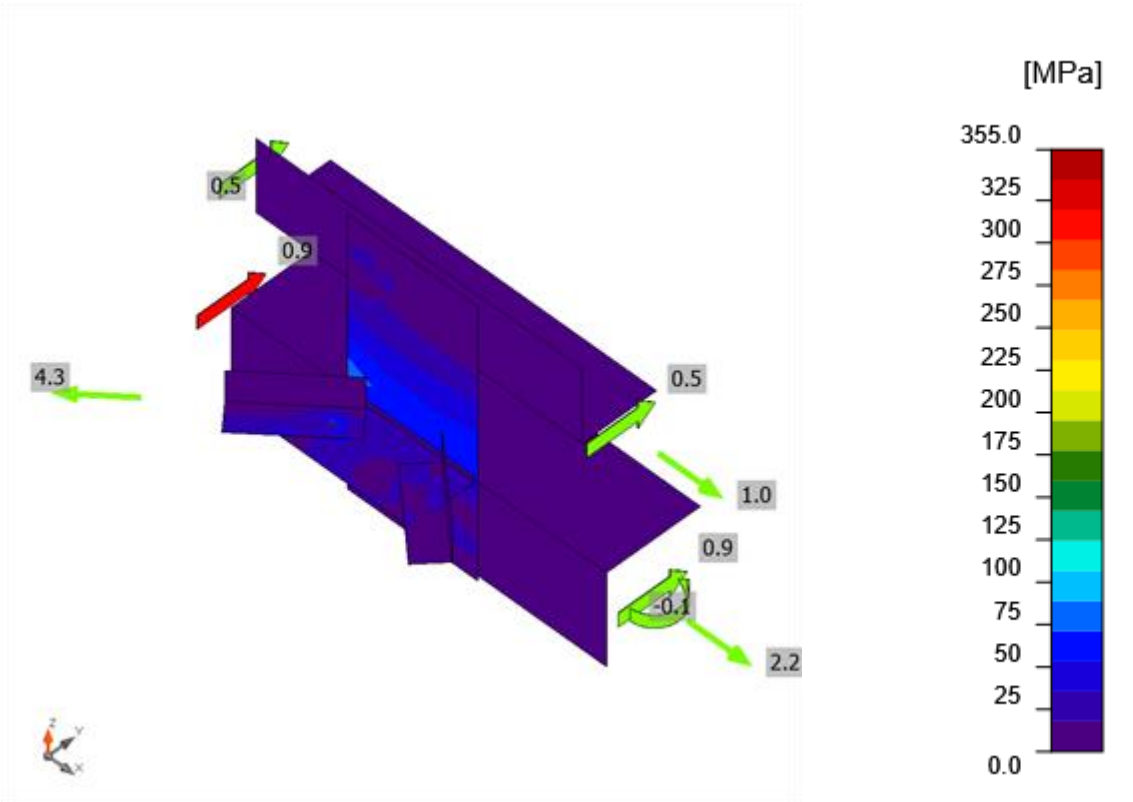


Overall check, LE2

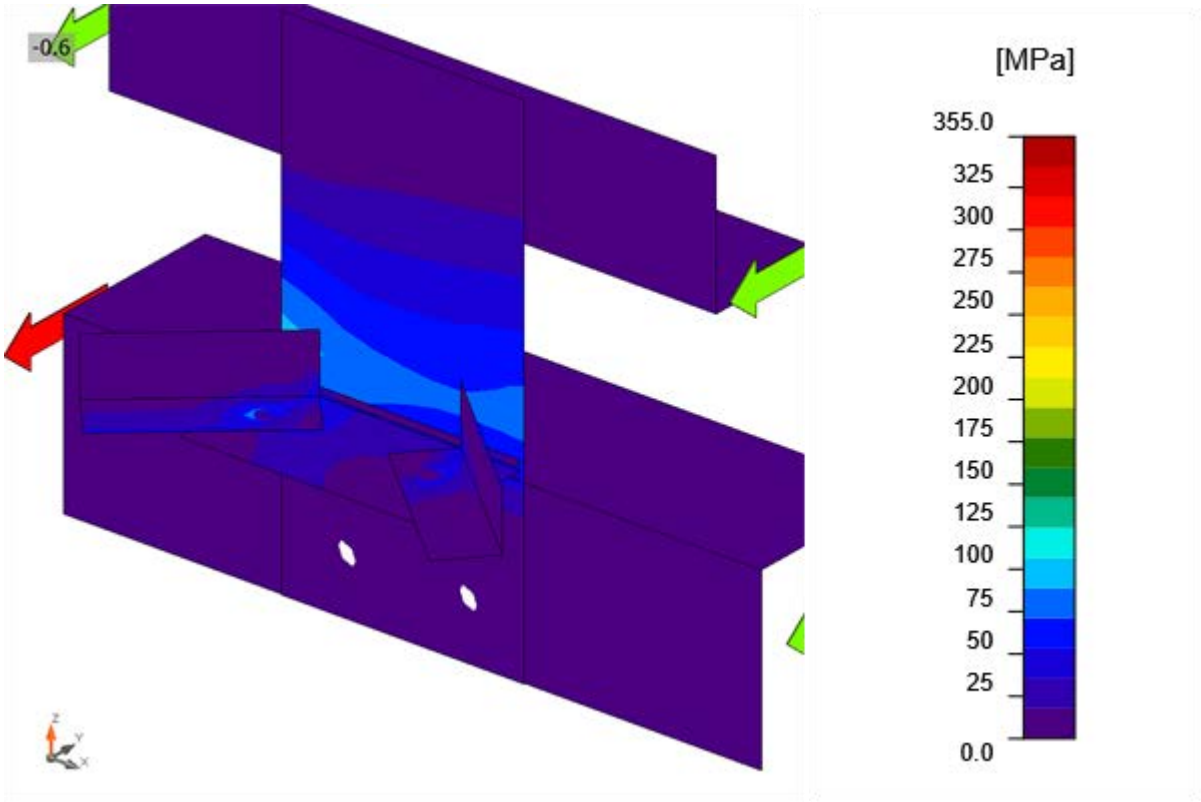




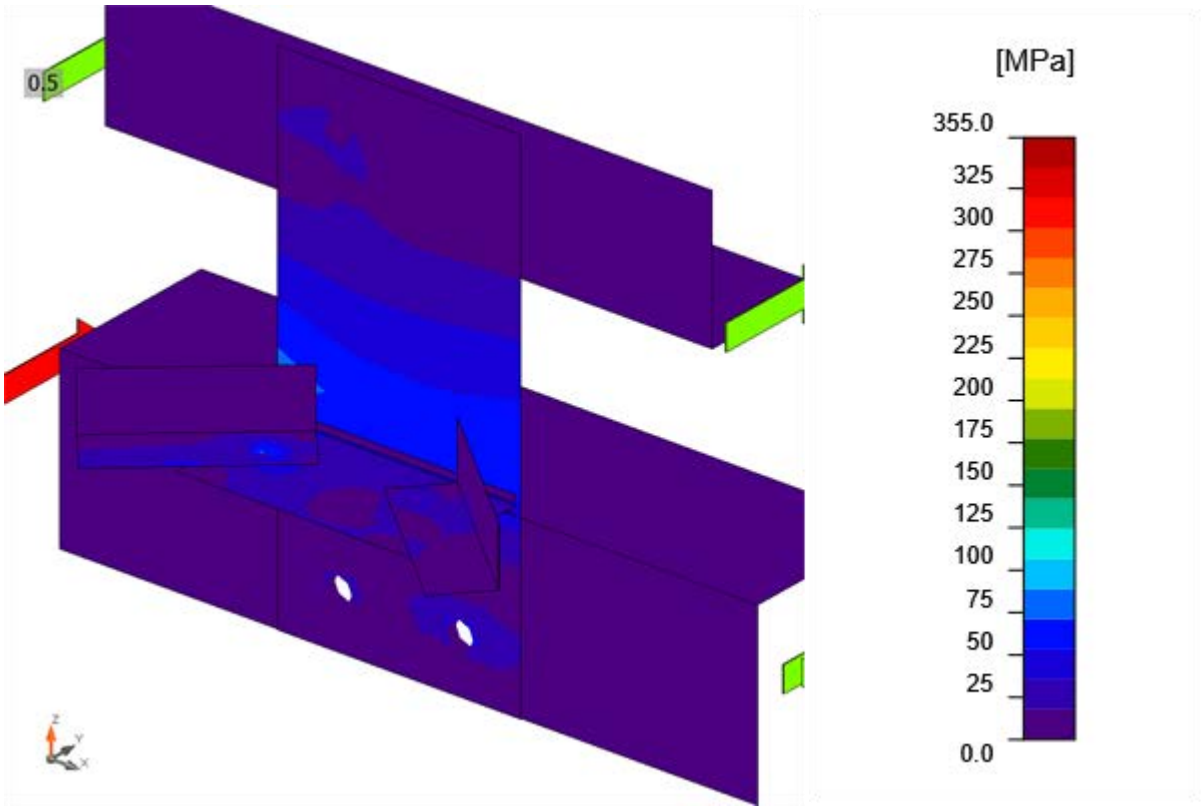
Strain check, LE2



Equivalent stress, LE2

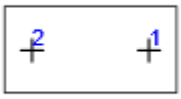


Equivalent stress, LE1



Equivalent stress, LE2

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M16 8.8 - 1	LE1	3.4	0.0	3.8	22.4	0.0	2.7	OK
	B2	M16 8.8 - 1	LE2	2.7	4.3	3.0	34.9	12.3	9.3	OK
	B3	M20 8.8 - 2	LE2	2.8	0.6	2.0	144.1	0.7	2.1	OK
	B4	M20 8.8 - 2	LE2	0.8	0.6	0.5	119.5	0.6	1.0	OK
	B5	M20 8.8 - 2	LE2	2.4	1.3	1.7	141.8	1.4	2.6	OK
	B6	M20 8.8 - 2	LE2	3.9	1.4	2.7	117.1	1.5	3.5	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M16 8.8 - 1	90.4	92.4	60.3

M20 8.8 - 2	141.1	186.2	94.1

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	Ut [%]	Ut_c [%]	Status
SP1	SP2	◢5.0◣	200	LE2	18.1	0.0	9.3	4.9	7.5	4.2	2.6	OK
		◢5.0◣	200	LE2	21.5	0.0	-11.1	-2.2	10.4	4.9	2.6	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 355	0.90	435.6	352.8

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Buckling

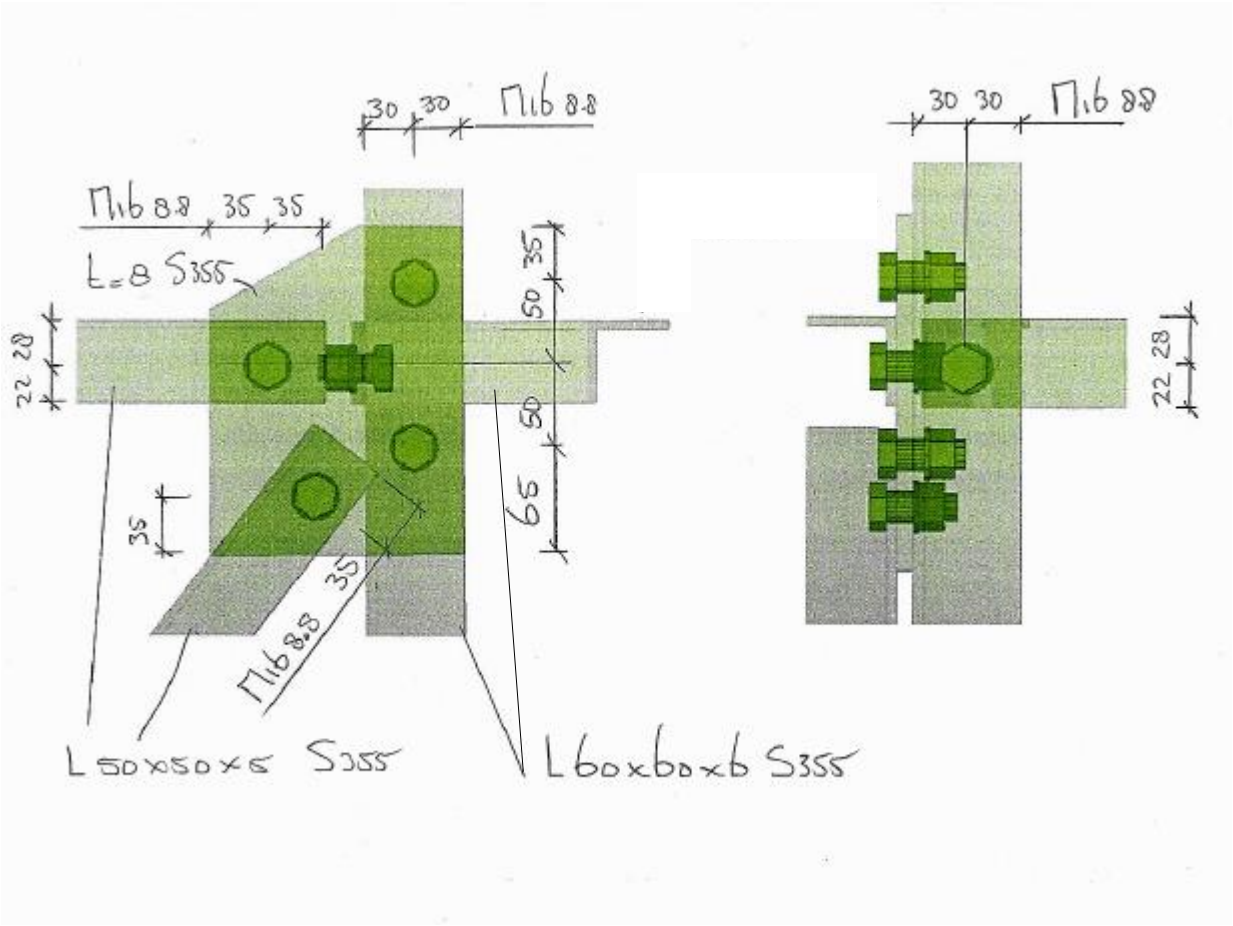
Loads	Shape	Factor [-]
LE1	1	78.39
	2	102.89
	3	151.79
	4	188.39
	5	225.98
	6	250.22
LE2	1	372.29
	2	1067.62

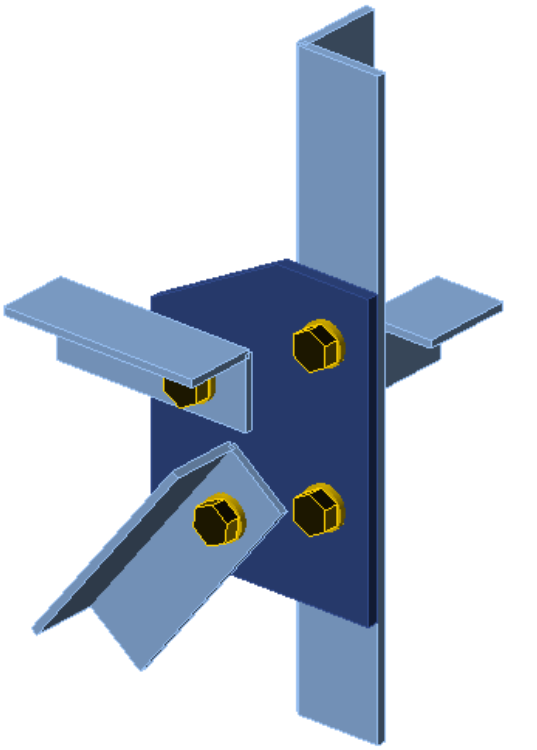
	3	1506.70
	4	1518.59
	5	1930.02
	6	1993.30

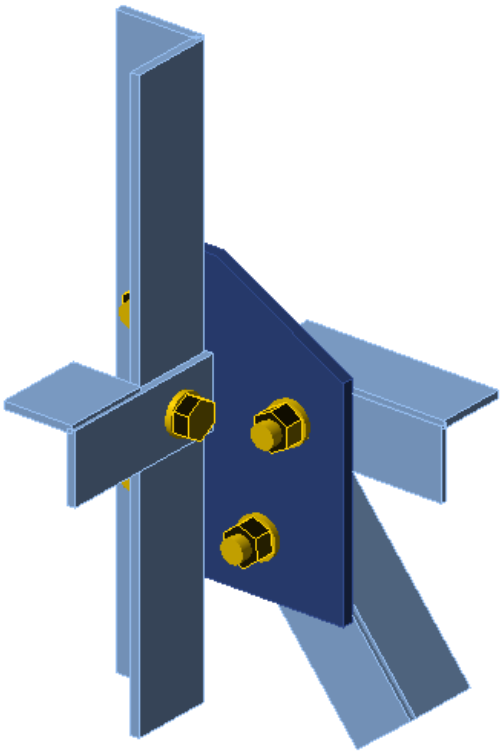
Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_{C}	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

3.1.11 Detail 4







3.1.12 Loads

Loads from report:

ENS-ZL380 – Tower HB+9/R_X

Report nr.: 21-0180 Rev 3
Date: 2021-12-20

Page 44

Member: 474	L50x50x5	S355
N_{ED} = -3 kN compression		N_{ED} = 2,3 kN tension
Member: 473	L60x60x6	S355
N_{ED} = -0,3 kN compression		N_{ED} = 0,3 kN tension

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Member: 443	L60x60x6	S355
N_{ED} = -2,4 kN compression		N_{ED} = 14,5 kN tension

3.1.13 Calculation

3.1.13.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+9_R_X mast 65
Project number	21-187
Author	G.P.
Description	Detail 4
Date	2/17/2022
Design code	EN

Material

Steel	S 355

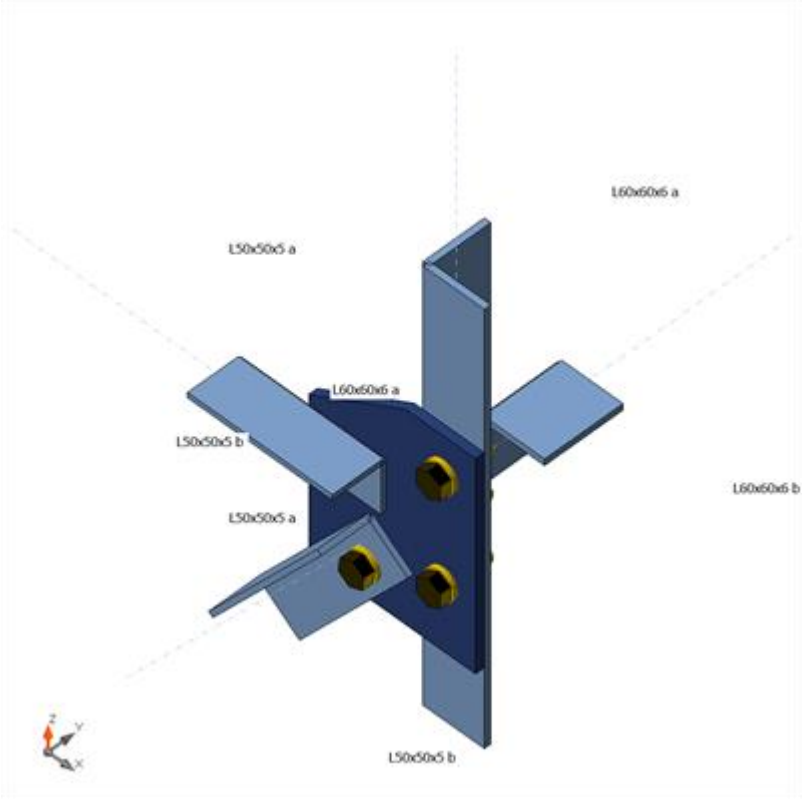
Project item Detail 4

Design

Name	Detail 4
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
L60x60x6 a	4 - HFLeq60x60x6	0.0	90.0	0.0	0	0	0	Node
L50x50x5 a	5 - HFLeq50x50x5	180.0	0.0	-90.0	40	0	39	Node
L50x50x5 b	5 - HFLeq50x50x5	180.0	52.0	-90.0	70	0	39	Node
L60x60x6 b	4 - HFLeq60x60x6	90.0	0.0	180.0	-15	-6	0	Node



Cross-sections

Name	Material
4 - HFLeq60x60x6	S 355
5 - HFLeq50x50x5	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M16 8.8	M16 8.8	16	800.0	201

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	L60x60x6 a	-2.4	0.0	0.0	0.0	0.0	-0.1
	L50x50x5 a	-1.8	0.0	0.0	0.0	0.0	0.0
	L50x50x5 b	3.0	0.0	0.0	0.0	0.0	0.0
	L60x60x6 a	0.0	0.0	0.0	0.0	0.0	0.0
	L60x60x6 b	0.0	0.0	0.0	0.0	0.0	0.0
LE2	L60x60x6 a	1.8	0.0	0.0	0.0	0.0	0.1
	L50x50x5 a	1.4	0.0	0.0	0.0	0.0	0.0
	L50x50x5 b	-2.3	0.0	0.0	0.0	0.0	0.0
	L60x60x6 a	0.0	0.0	0.0	0.0	0.0	0.0
	L60x60x6 b	0.0	0.0	0.0	0.0	0.0	0.0

LE3	L60x60x6 a	0.0	-0.2	0.0	0.0	0.0	0.0
	L50x50x5 a	0.0	0.0	0.0	0.0	0.0	0.0
	L50x50x5 b	0.0	0.0	0.0	0.0	0.0	0.0
	L60x60x6 a	0.0	-0.2	0.0	0.0	0.0	0.0
	L60x60x6 b	0.3	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	8.6 < 100%	OK
Buckling	189.92	

Plates

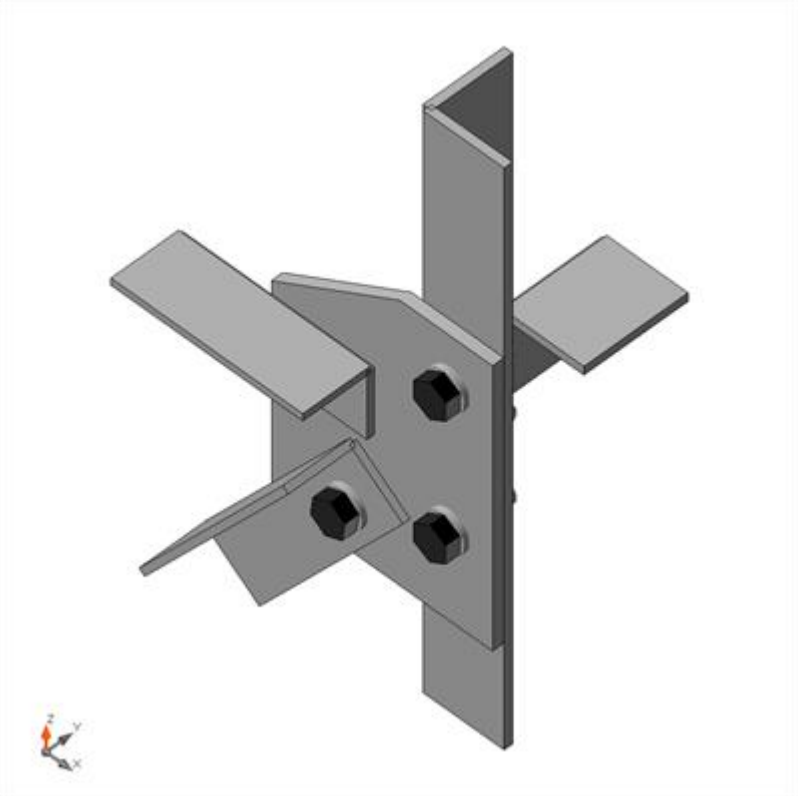
Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
L60x60x6 a-bfl 1	6.0	LE2	18.4	0.0	0.7	OK
L60x60x6 a-w 1	6.0	LE2	24.8	0.0	1.1	OK
L50x50x5 a-bfl 1	5.0	LE1	19.5	0.0	0.6	OK
L50x50x5 a-w 1	5.0	LE1	3.3	0.0	0.0	OK
L50x50x5 b-bfl 1	5.0	LE1	35.5	0.0	1.4	OK
L50x50x5 b-w 1	5.0	LE1	5.2	0.0	0.0	OK
L60x60x6 b-bfl 1	6.0	LE1	4.6	0.0	0.0	OK
L60x60x6 b-w 1	6.0	LE3	5.3	0.0	0.3	OK
SP1	8.0	LE1	26.9	0.0	4.5	OK

Design data

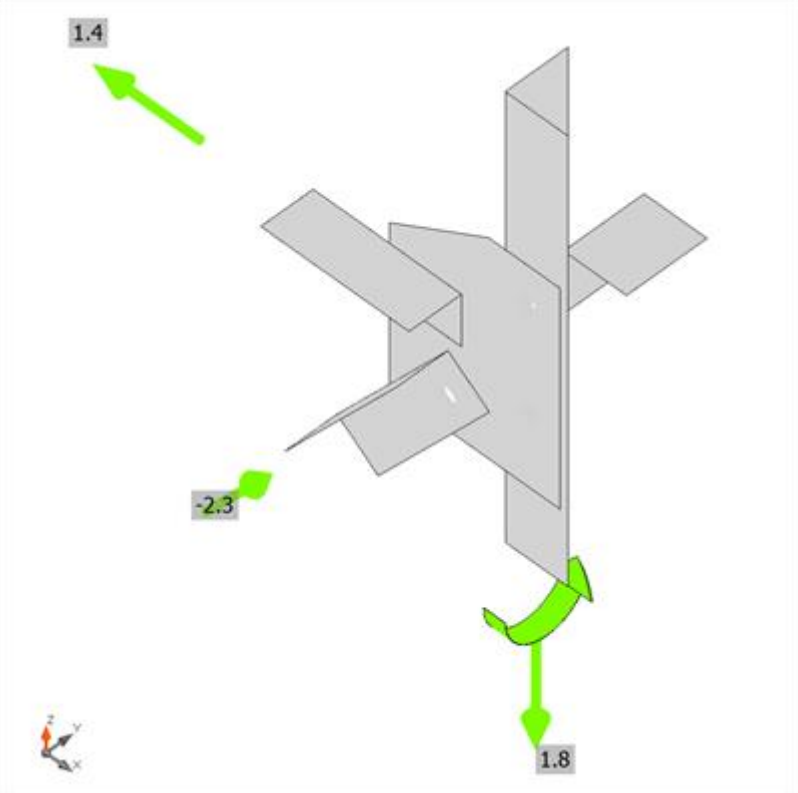
Material	f_y [MPa]	ε_{lim} [%]
S 355	355.0	5.0

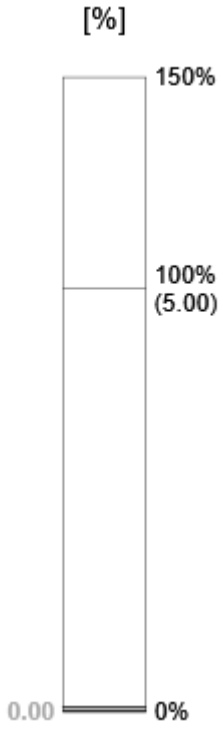
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

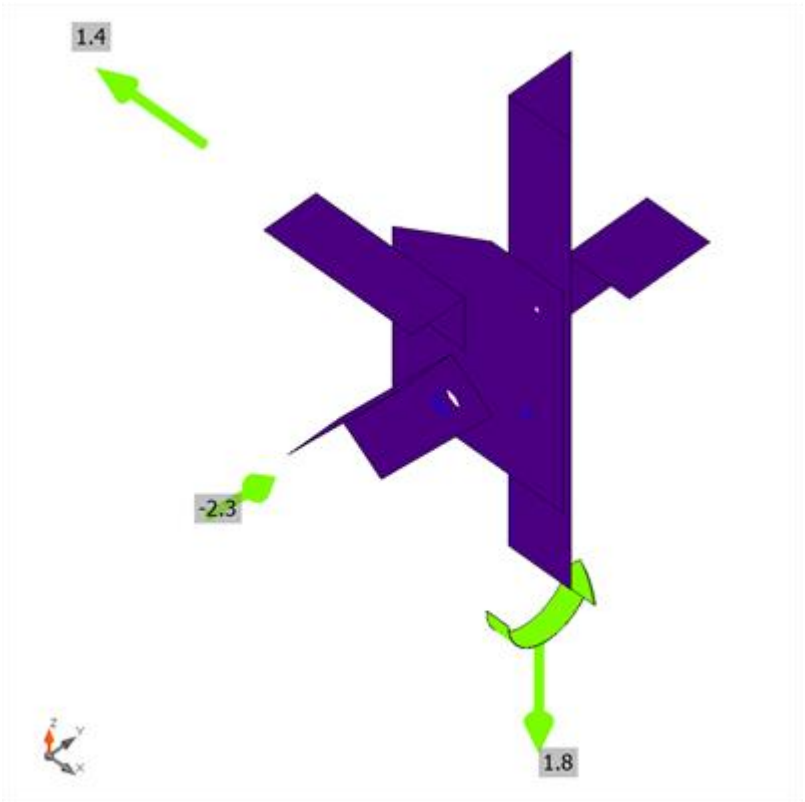


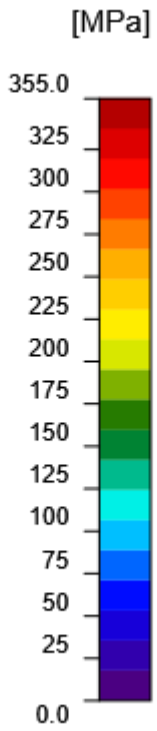
Overall check, LE2



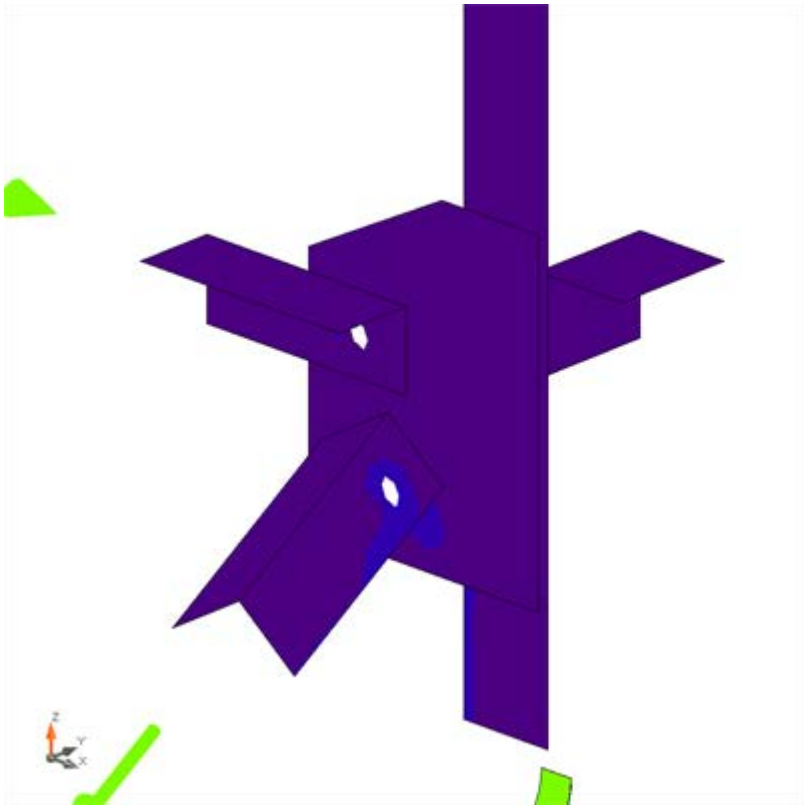


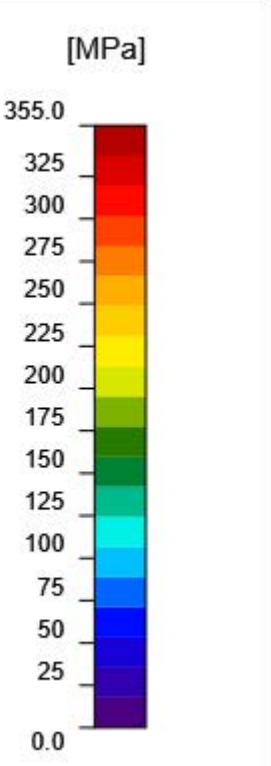
Strain check, LE2



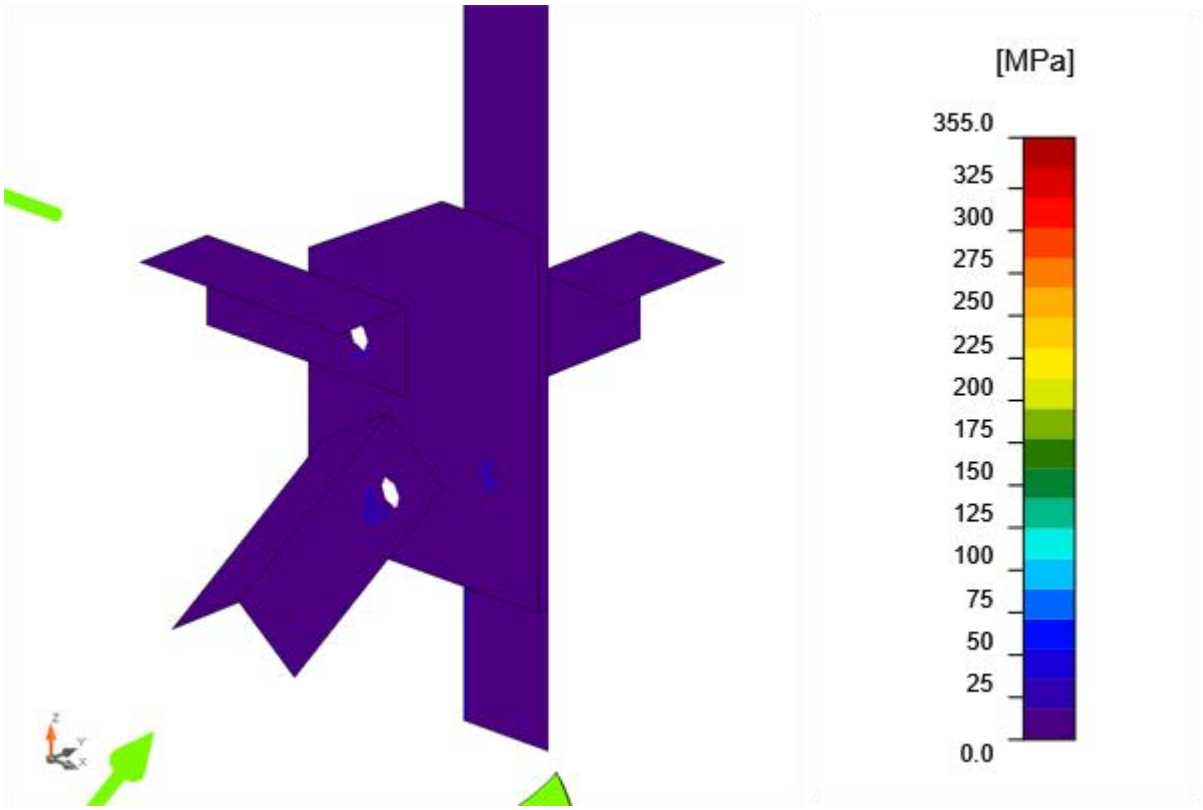


Equivalent stress, LE2

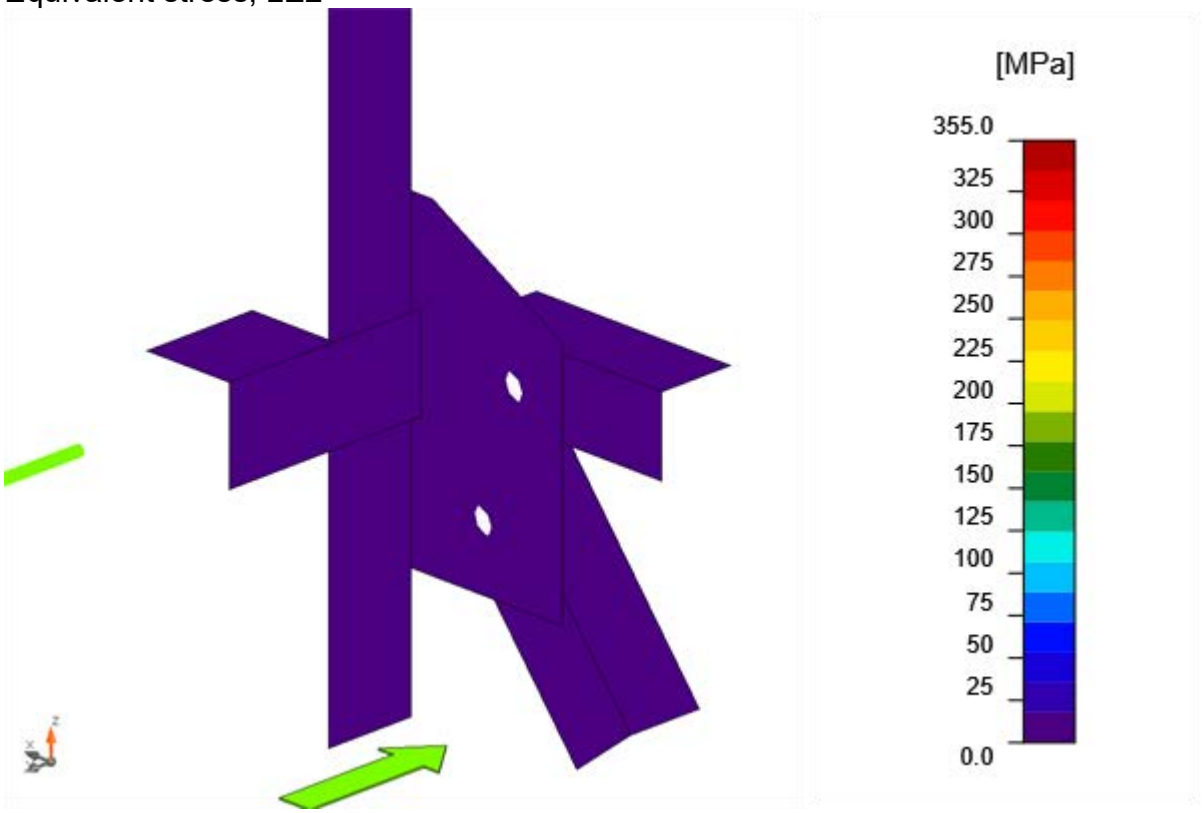




Equivalent stress, LE1



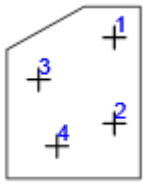
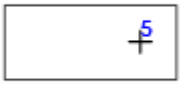
Equivalent stress, LE2



Equivalent stress, LE3

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status

	B1	M16 8.8 - 1	LE1	0.4	1.1	0.4	74.2	1.8	2.2	OK
	B2	M16 8.8 - 1	LE1	0.5	1.3	0.5	89.6	2.1	2.5	OK
	B3	M16 8.8 - 2	LE2	0.4	1.4	0.5	34.9	4.0	2.7	OK
	B4	M16 8.8 - 2	LE1	0.9	3.0	1.0	34.9	8.6	5.7	OK
	B5	M16 8.8 - 1	LE3	0.1	0.3	0.1	48.8	0.6	0.6	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M16 8.8 - 1	90.4	110.8	60.3
M16 8.8 - 2	90.4	92.4	60.3

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Buckling

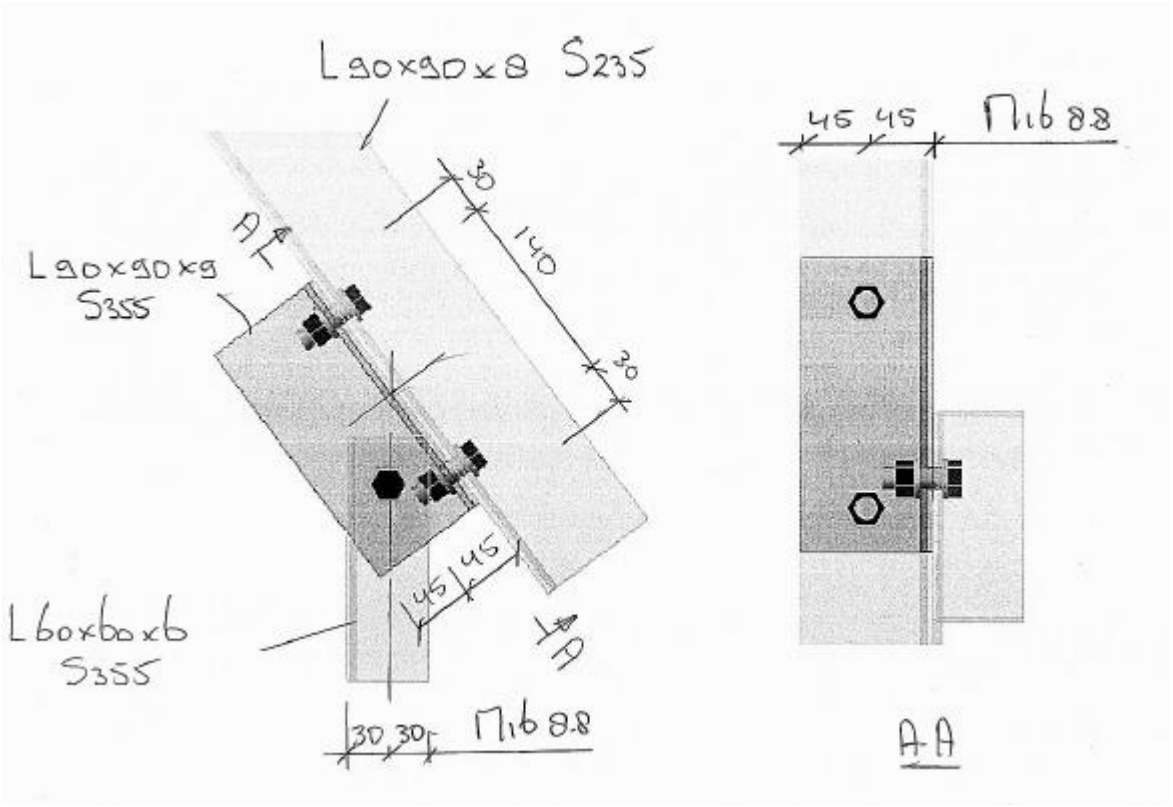
Loads	Shape	Factor [-]
LE1	1	318.96
	2	426.64
	3	449.40
	4	481.51
	5	740.60
	6	908.45

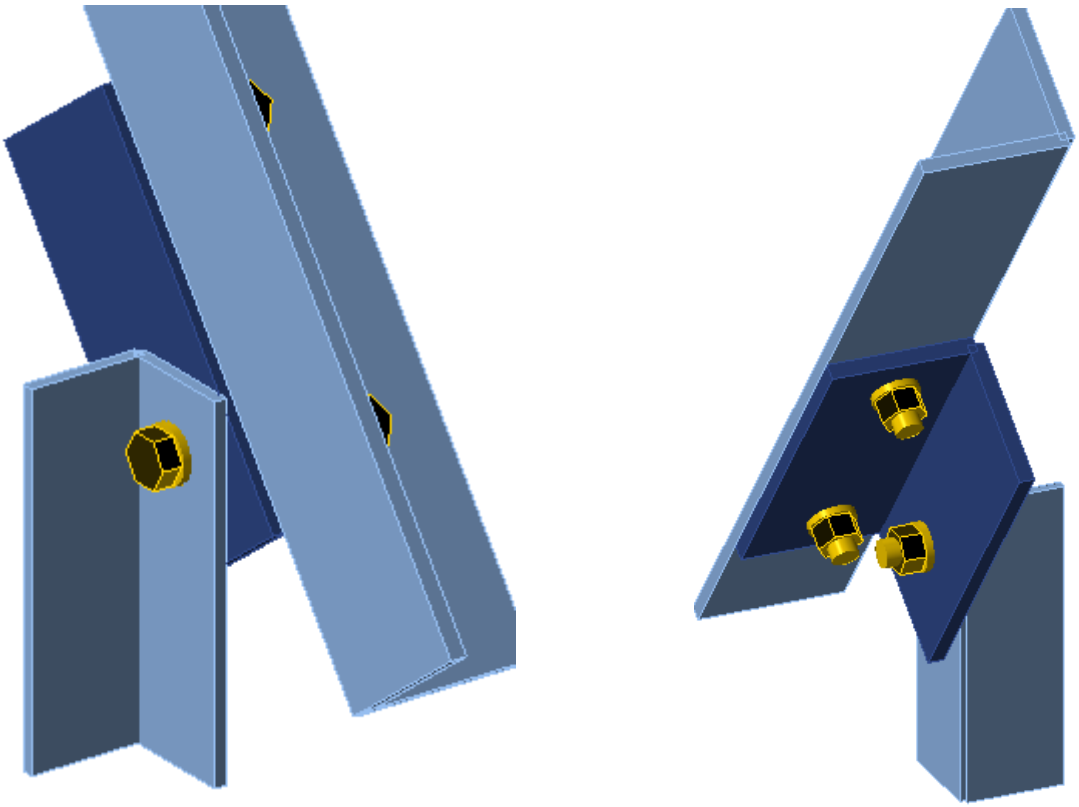
LE2	1	189.92
	2	192.71
	3	203.81
	4	251.62
	5	254.43
	6	279.66
LE3	1	674.34
	2	752.26
	3	833.15
	4	913.63
	5	1360.39
	6	1497.81

Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_C	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

3.1.14 Detail 5





3.1.15 Loads

Loads from report:

ENS-ZL380 – Tower HB+9/R_X

Report nr.: 21-0180 Rev 3
Date: 2021-12-20

Page 44

Member: 443 L60x60x6 S355

N_{ED} = -2,4 kN compression N_{ED} = 14,5 kN tension

3.1.16 Calculation

3.1.16.1 IDEA calculation

Project data

Project name	ENS-ZL380 HB+9_R_X mast 65
Project number	21-187
Author	G.P.
Description	Detail 5
Date	2/17/2022
Design code	EN

Material

Steel	S 355, S 235

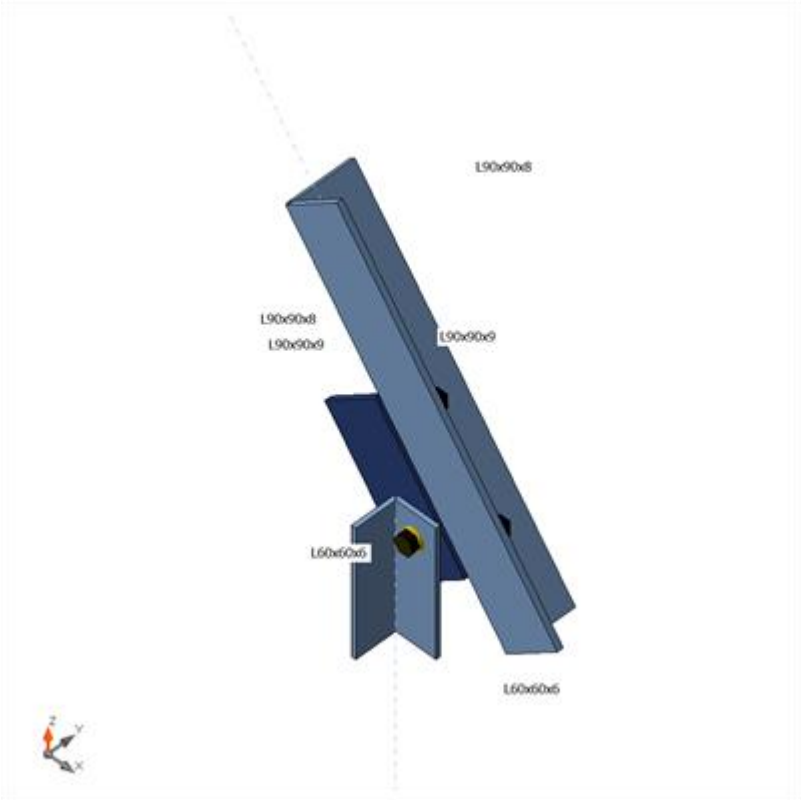
Project item Detail 5

Design

Name	Detail 5
Description	
Analysis	Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in	X [mm]
L90x90x8	3 - H90/90/8	0.0	53.0	0.0	0	0	0	Node	0
L60x60x6	4 - HFLeq60x60x6	0.0	90.0	90.0	99	0	42	Bolts	35



Cross-sections

Name	Material
3 - H90/90/8	S 235
4 - HFLeq60x60x6	S 355
5 - HFLeq90x90x9	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M16 8.8	M16 8.8	16	800.0	201

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	L60x60x6	14.5	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	28.3 < 100%	OK
Buckling	98.14	

Plates

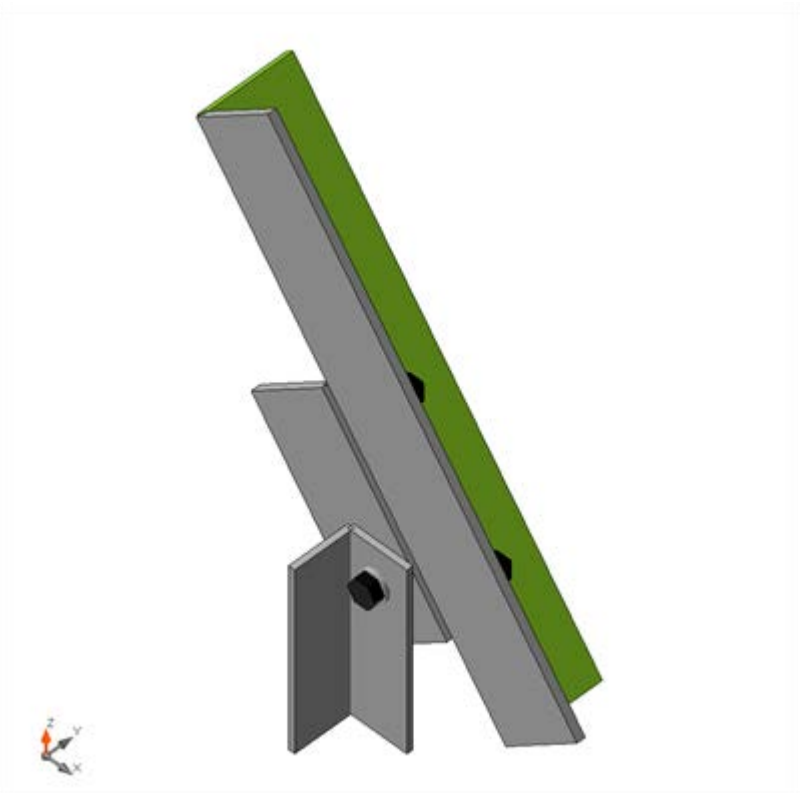
Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
L90x90x8-bfl 1	S 235	8.0	LE1	196.6	0.0	17.9	OK
L90x90x8-w 1	S 235	8.0	LE1	80.4	0.0	0.0	OK
L60x60x6-bfl 1	S 355	6.0	LE1	190.5	0.0	33.2	OK
L60x60x6-w 1	S 355	6.0	LE1	113.2	0.0	0.0	OK
L90x90x9-bfl 1	S 355	9.0	LE1	92.9	0.0	33.2	OK
L90x90x9-w 1	S 355	9.0	LE1	207.8	0.0	17.9	OK

Design data

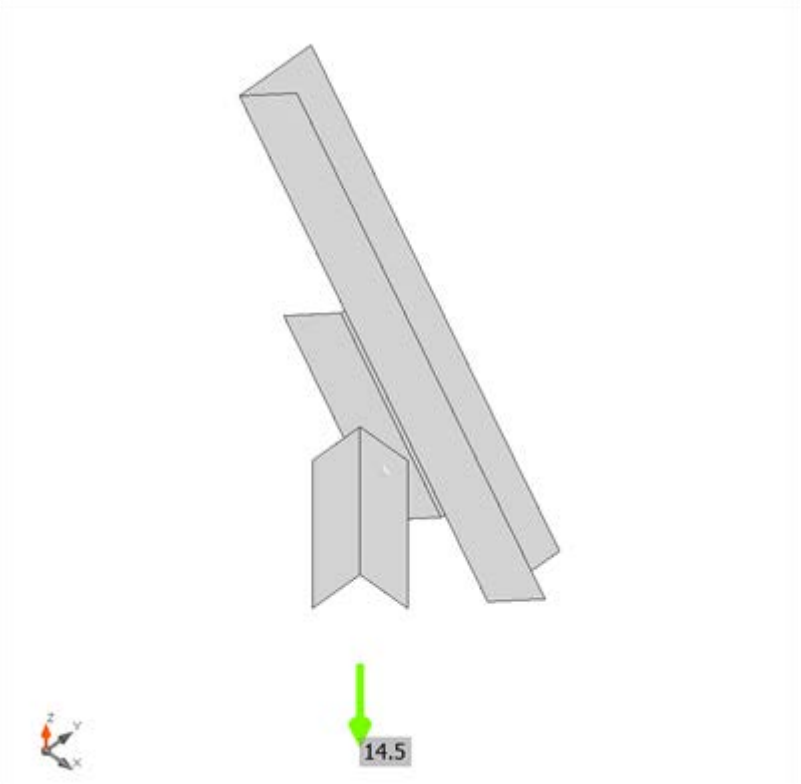
Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0
S 355	355.0	5.0

Symbol explanation

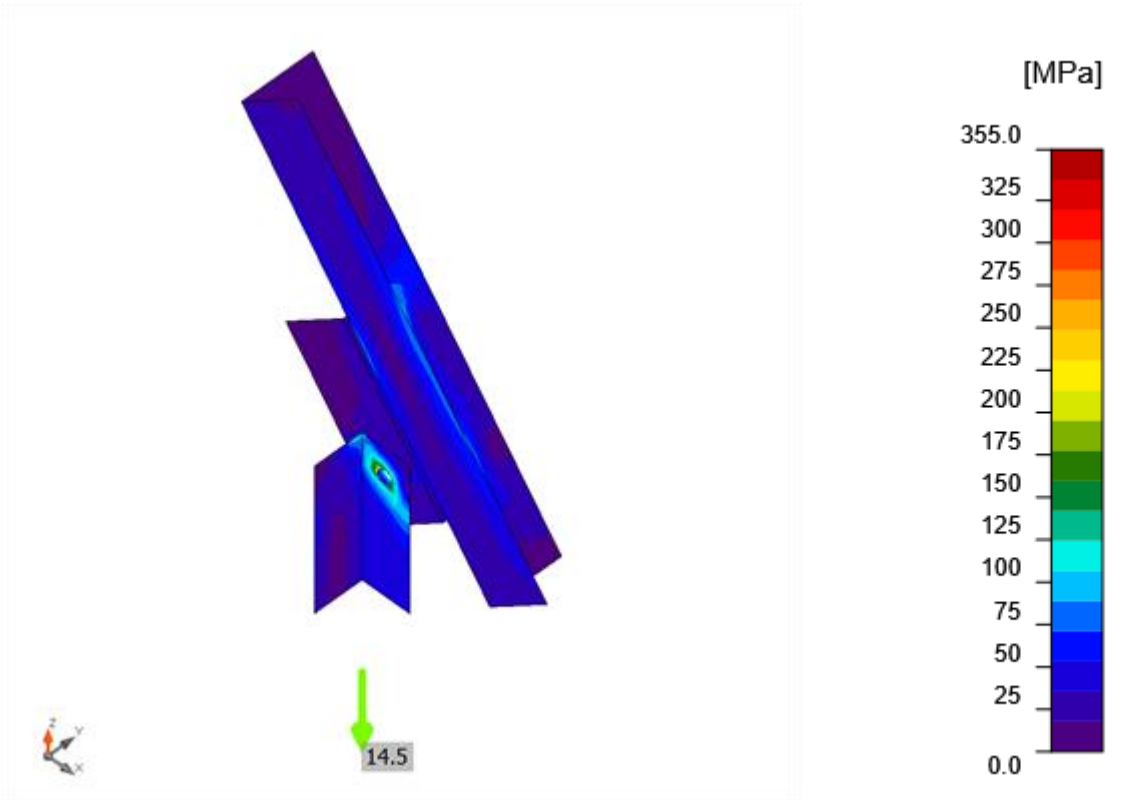
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain



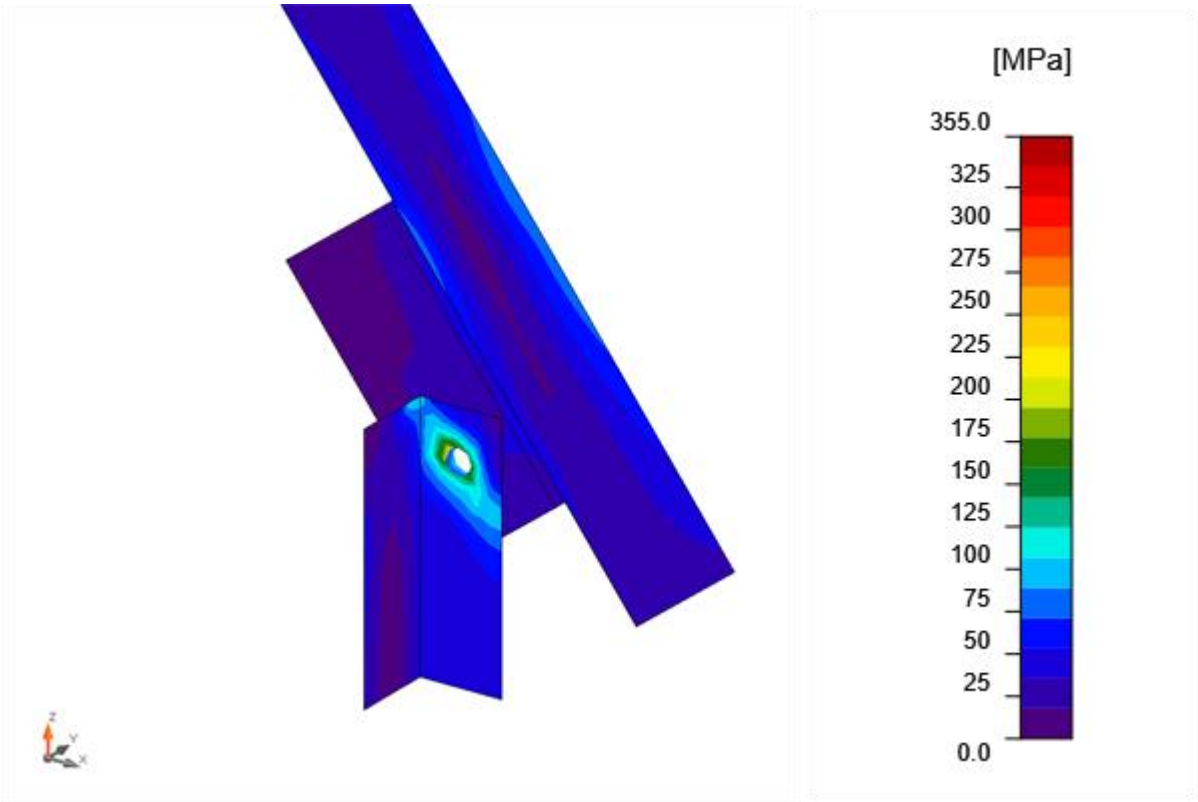
Overall check, LE1



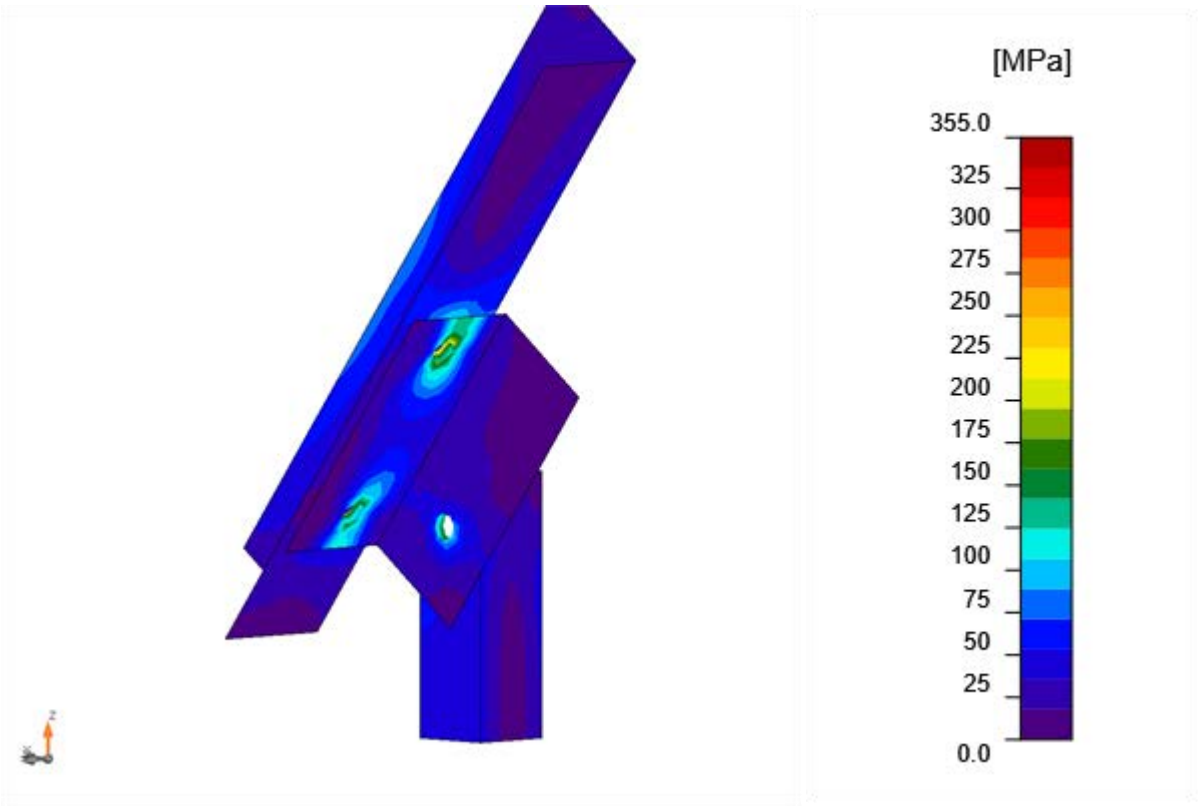
Strain check, LE1



Equivalent stress, LE1



Equivalent stress, LE1



Equivalent stress, LE1

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M16 8.8 - 1	LE1	5.4	14.5	5.9	60.5	24.1	28.3	OK
	B2	M16 8.8 - 2	LE1	14.0	6.4	15.5	86.9	10.7	21.7	OK
	B3	M16 8.8 - 2	LE1	16.6	6.9	18.4	78.4	11.5	24.6	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M16 8.8 - 1	90.4	110.8	60.3
M16 8.8 - 2	90.4	108.6	60.3

Symbol explanation

$F_{t,Rd}$ Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$ Tension force

$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Buckling

Loads	Shape	Factor [-]
LE1	1	98.14
	2	105.68
	3	107.58
	4	109.62
	5	170.01
	6	185.65

Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_C	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1
Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

4 Summary U.C. 's

4.1.1 Connections

Detail 1

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	6.0 < 100%	OK
Buckling	43.12	

Detail 2

Bolts: U.C. = 0,04

Plate: U.C. = 0,02

Detail 3

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	12.3 < 100%	OK
Welds	4.9 < 100%	OK
Buckling	78.39	

Detail 4

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	8.6 < 100%	OK
Buckling	189.92	

Detail 5

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	28.3 < 100%	OK
Buckling	98.14	

5 Conclusion

5.1.1 Connections

All connections have sufficient strength.

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-07300**

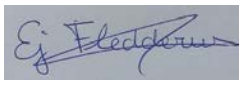
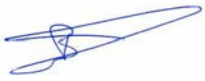
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994424**

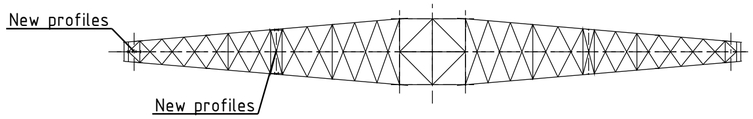
Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **HC-3_RC Mast 73 - Overzichtstekeningen**

	Naam	Functie	Handtekening	Datum
Opgesteld	Erik Jan Fledderus	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review



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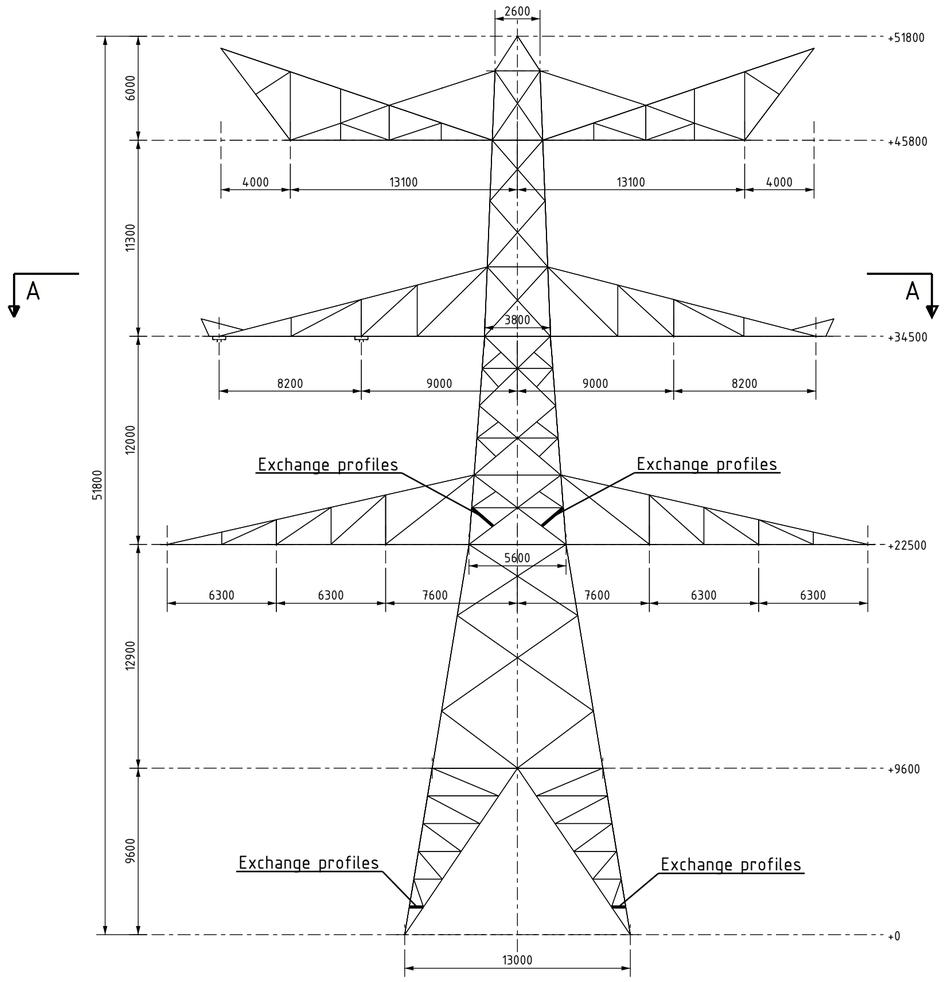

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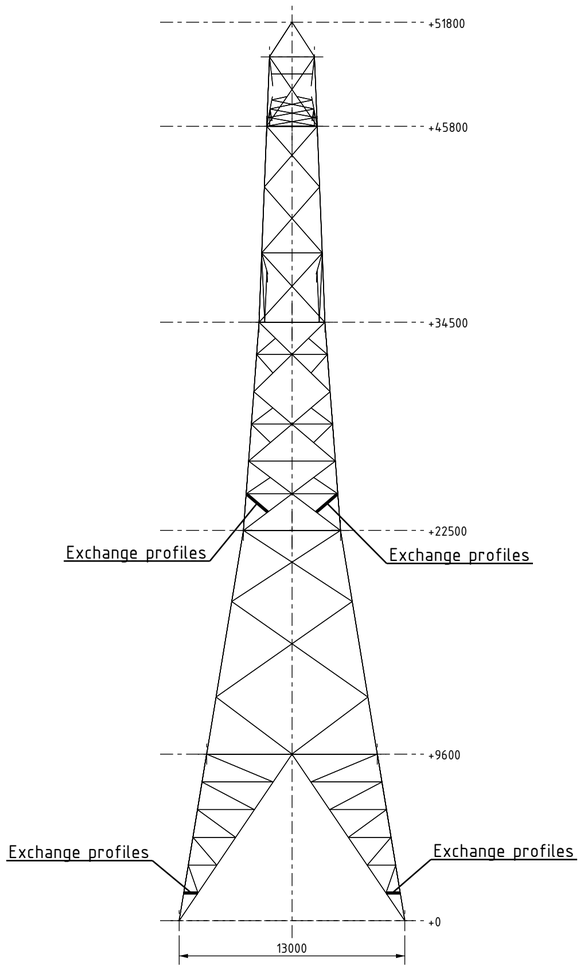

Longitudinal face
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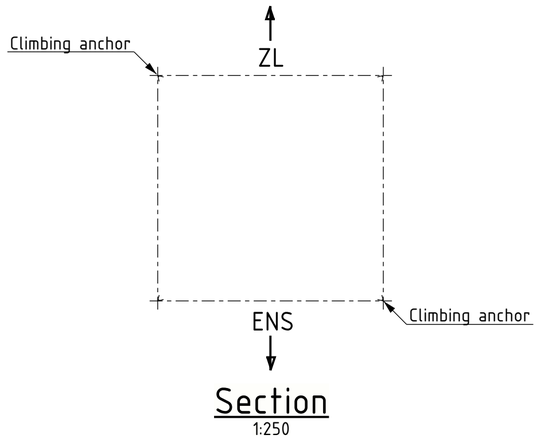

Section
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All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

Unless otherwise specified:
- It has drawn on the right side.
- Material quality S355J0 (t<=16mm), S355J2 (16<t<=40mm)
- All bended profiles and plates "HOT BENDING".
- Hot-dip galvanization according to NEN-EN-ISO 1461.
- Treat any damage of the zinc layer on the existing profiles due to drilling/grinding for corrosion protection.

Norms for connection components:

Bolts	ISO 4014
Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

Quality of connection components:

Bolts	: Quality 8.8 - HDG oversized
Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

- Place a washer under each nut.
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

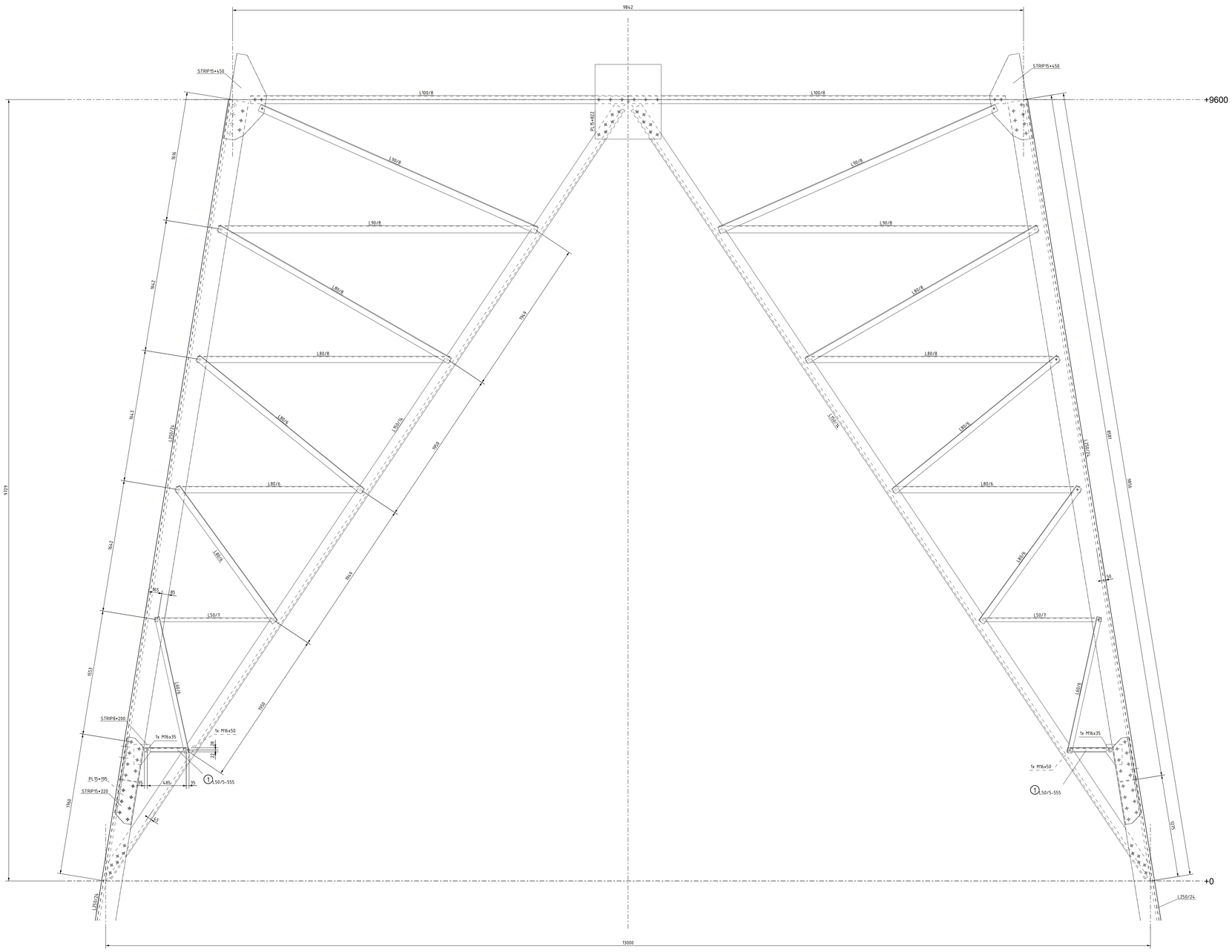
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:250	A2

Relatie	
Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Oud tekeningnummer:	
Omschrijving:	Masttype HC-3 RC, Mast 73 - Overzicht
Documentnummer:	00974-01-07301

TenneT Taking power further

Tekla Structures

Apply to all sides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STRIP15×450
L100/8
L100/8
+9600
PL15×492
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L80/8
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STRIP15×220
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L50/5-555
+0
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966
9642
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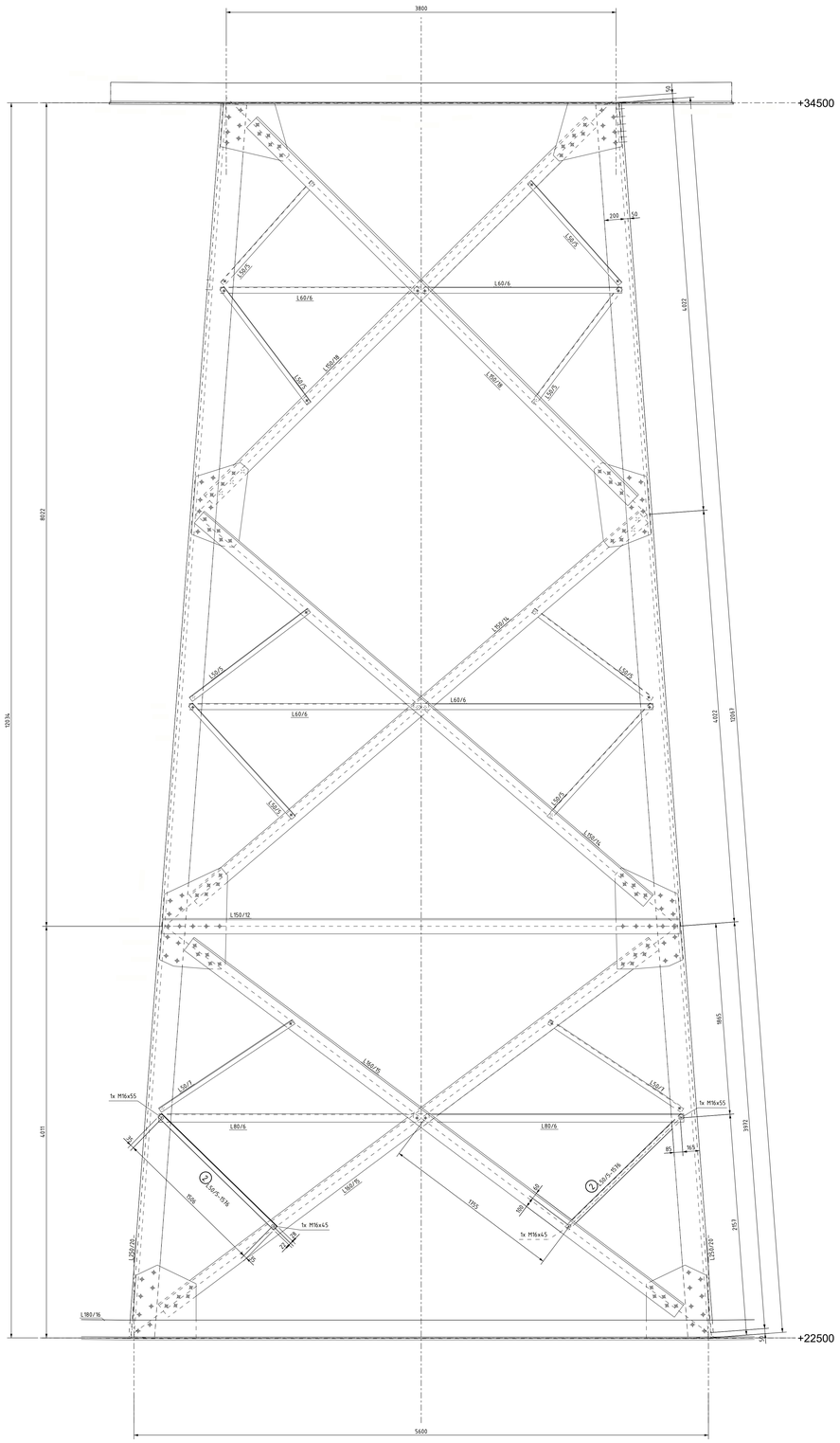
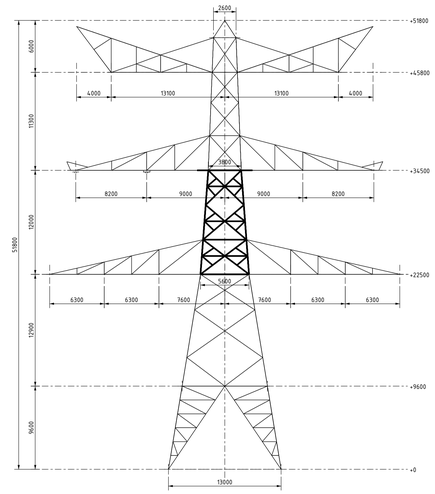
1929
1929

Apply to all sides



Side Face Second Middle Part
1:20



Transverse face
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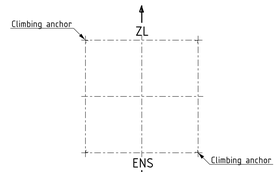

Section
1:250

All components of manufacture and finishing according to implementation of TenneT specifications below:
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- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

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Nuts	ISO 4032
Washers	ISO 7091
Welds	NEN-EN 15607

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Nuts	: Quality 8 - HDG oversized
Washers	: St. -HDG oversized

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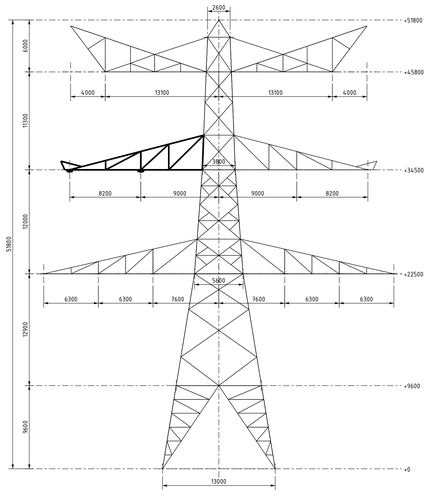
- Length of bolts after mounting must be minimum 1 thread and maximum 4 threads.
- If a profile needs to be replaced, always use new bolts.

Opwaarderen 380 kV verbinding Ens - Zwolle				Vaststelling Voorlopig		
Rev.	Datum revisie	Beschrijving revisie	Getekend	Datum Ko-Bolt	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:20 1:250	A0

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentsoort	Constructietekening
Ind. Tekeningnummer	Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
	Beschrijving	Masttype HC-3 RC, Mast 73 - 2e Tussenstuk
TenneT Taking power further	Documentnummer	00974-01-07303

Tekla Structures



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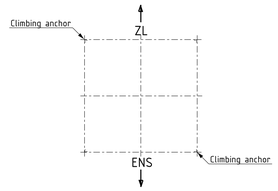

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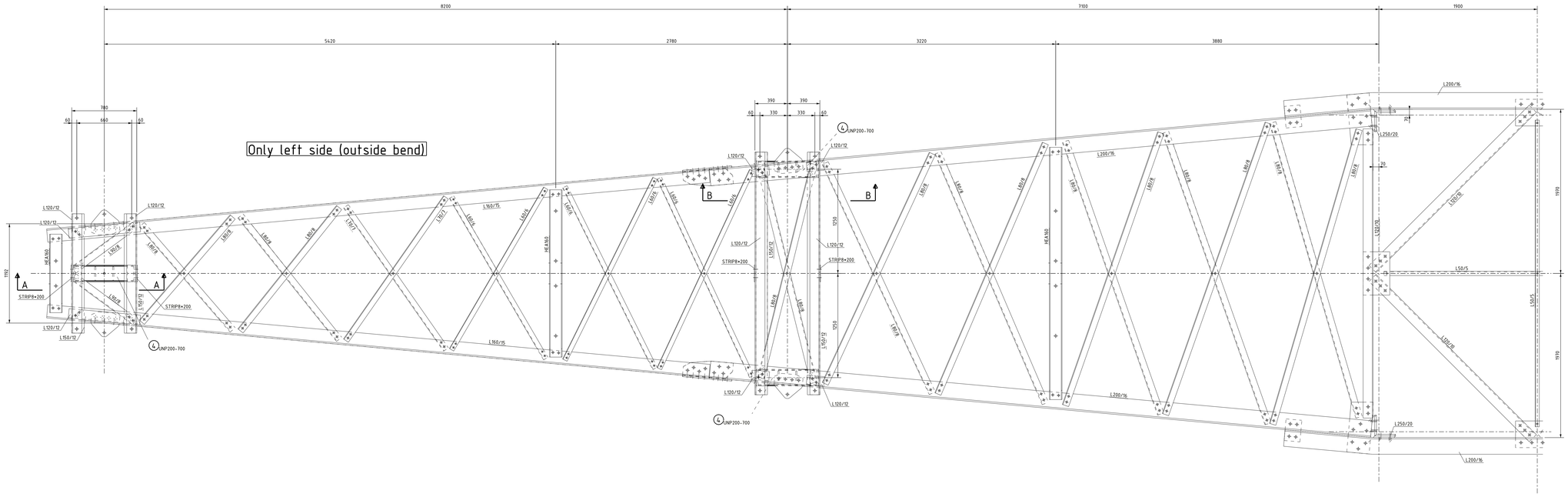

Bottom Surface Middle Cross Arm
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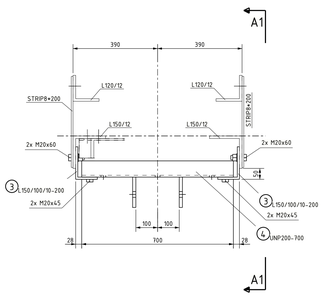
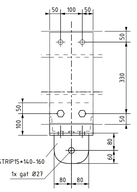


Section A - A
1:10



Section A1 - A1
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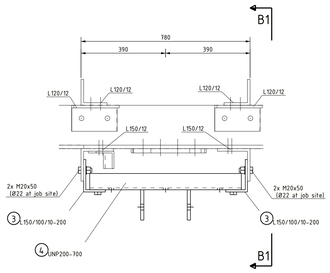

Section B - B
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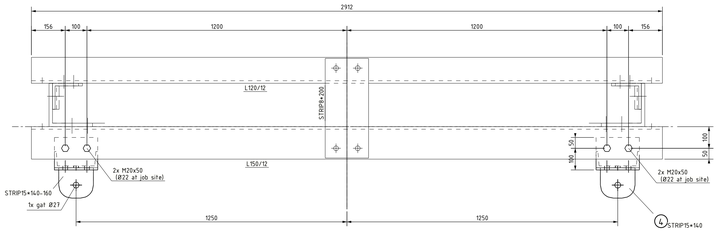

Section B1 - B1
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All components of manufacture and finishing according to implementation of TenneT specifications below:
- SPE.05.312 V2.0 Algemene specificatie transport montage staalconstructies HS-stations, HS-lijnen
- SPE.05.346 V2.0 Algemene specificatie stalen HS masten
- SPE.00.905 V1.3 Conservering Mastverzwaring

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Bolts	ISO 4014
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Welds	NEN-EN 15607

Quality of connection components:

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Washers	: St. -HDG oversized

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- If a profile needs to be replaced, always use new bolts.

Rev.	Datum revisie	Beschrijving revisie	Gehaald	Datum As-Built	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10 1:20	A0

Relatie

Ind. Tekeningnummer

TenneT Taking power further

Thema	Verbinding
Categorie	Algemeen
Documentsoort	Constructietekening
Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Beschrijving	Masttype HC-3 RC, Mast 73 - Middentraverse
Documentnummer	00974-01-07304

Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-07310**

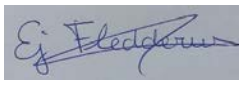
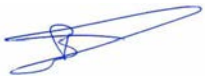
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994425**

Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **HC-3_RC Mast 73 - Onderdeeltekeningen**

	Naam	Functie	Handtekening	Datum
Opgesteld	Erik Jan Fledderus	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
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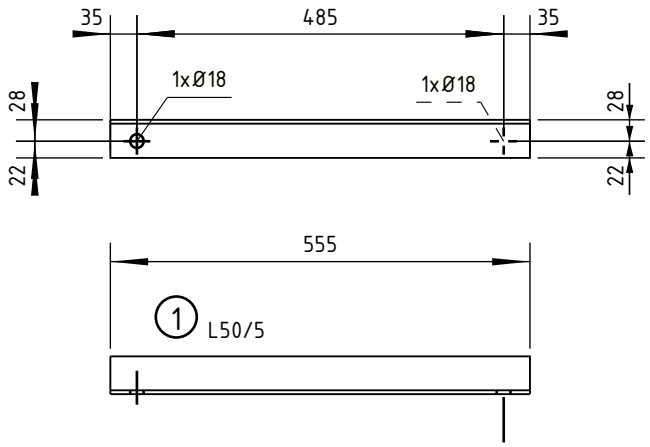


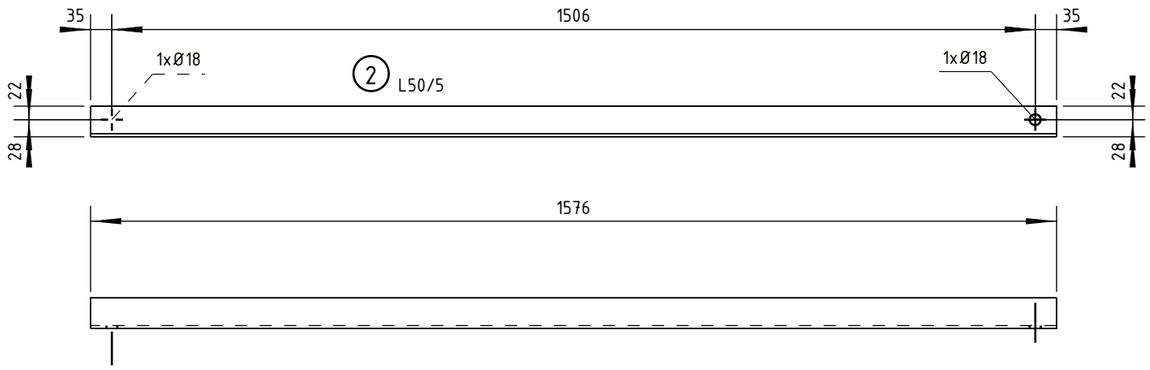
Pos	Profiel	Aantal	Materiaal	Lengte
1	L50/5	8	S355J0	555

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [1]
	Documentnummer:	

tennet
Taking power further

Tekla Structures

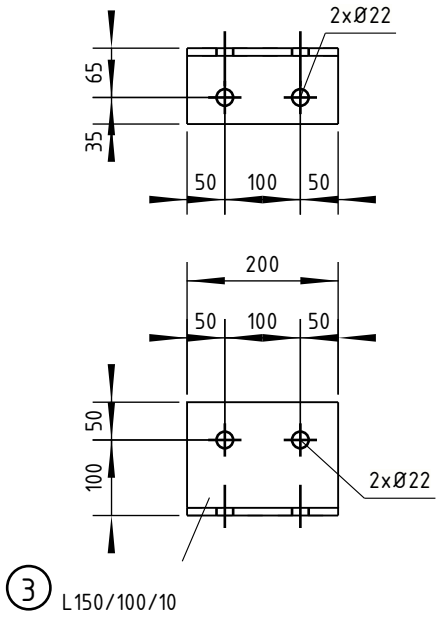


2	L50/5	8	S355J0	1576
Pos	Profiel	Aantal	Materiaal	Lengte

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	A3

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Oud tekeningnummer:	Omschrijving:	Te vervangen staal - onderdeel [2]
TenneT Taking power further	Documentnummer:	

Tekla Structures



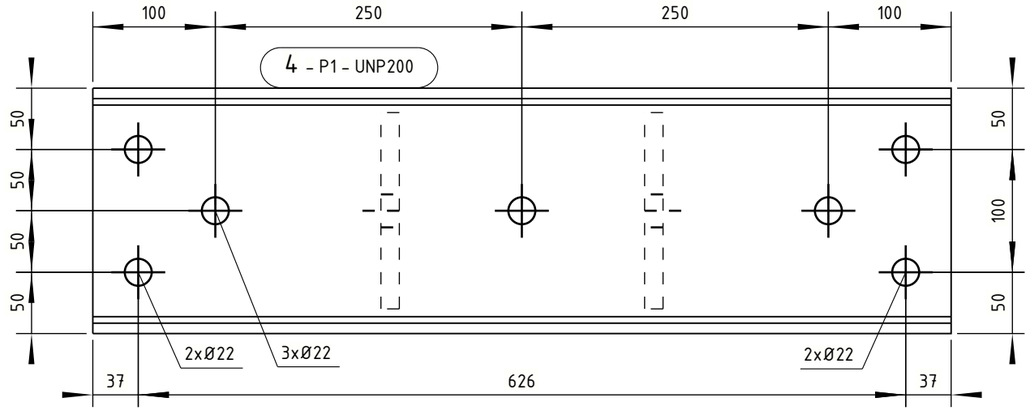
3	L150/100/10	6	S355J0	200
Pos	Profiel	Aantal	Materiaal	Lengte

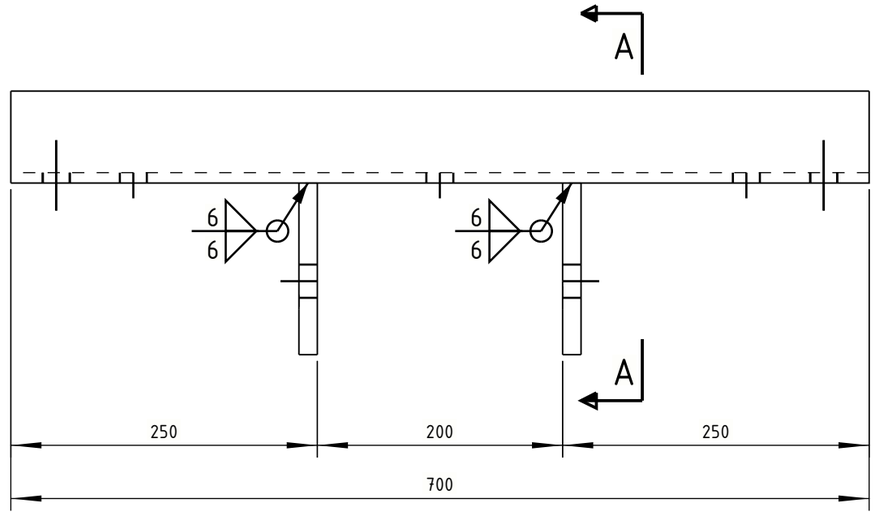
Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

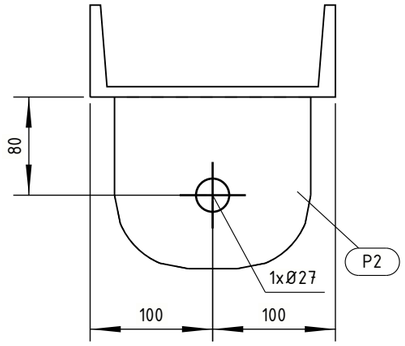
Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [3]
	Documentnummer:	

TenneT Taking power further

Tekla Structures







A - A
1:5

MERKENPOSLIJST 4

Merk: 4 lengte (mm): 700 Aantal: 3

Pos	Profiel	Materiaal	Aantal	Lengte (mm)	Gewicht (kg)
P1	UNP200	S355J0	1	700	18.0
P2	STRIP15*140	S355J0	2	160	5.0
				Totaal per merk	23.0

Naam: Opwaarderen 380 kV verbinding Ens - Zwolle				Tekeningstatus: Voorlopig	
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal / Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5 / A3

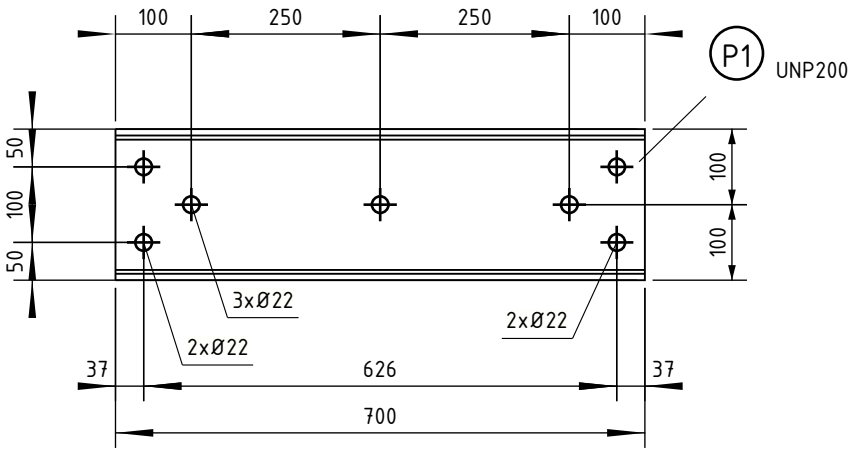
Relatie

Oud tekeningnummer:

Thema	Verbinding
Categorie	Algemeen
Documentcode	Constructietekening
Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Omschrijving:	Nieuw staal - onderdeel [4]
Documentnummer:	

TenneT Taking power further

Tekla Structures



P1	UNP200	3	S355J0	700
Pos	Profiel	Aantal	Materiaal	Lengte

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:10	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P1]
	Documentnummer:	

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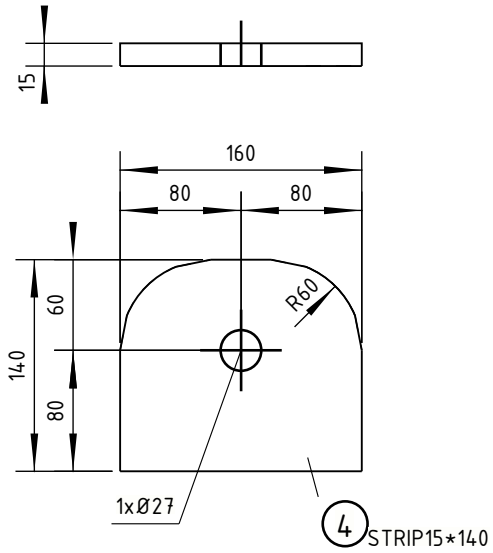
Taking power further

Tekla Structures



Pos	Profiel	Aantal	Materiaal	Lengte
P2	STRIP15*140	6	S355J0	160

Naam				Tekeningstatus		
Opwaarderen 380 kV verbinding Ens - Zwolle				Voorlopig		
Rev.	Datum revisie	Omschrijving revisie	Getekend	Datum As-Built	Schaal	Formaat
0.1	18.02.2022	1e versie ter review	Ing. bureau Aafjes b.v.		1:5	210x297

Relatie	Thema	Verbinding
	Categorie	Algemeen
	Documentcode	Constructietekening
	Object ID	ENS-ZL380 Masttype HC-3 RC, Mast 73
Oud tekeningnummer:	Omschrijving:	Nieuw staal - onderdeel [P2]
	Documentnummer:	

tennet Taking power further

Tekla Structures

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

Projectnummer Aafjes: **21-187**

Documentnummer: **00974-01-07320**

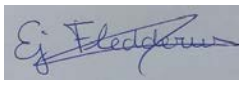
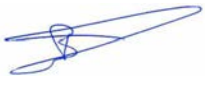
Projectnummer TenneT: **002.515**

Meridian nummer: **002.515.40 0994426**

Opdrachtgever: **TenneT**

Project: **Opwaardering ENS-ZL380**

Onderdeel: **HC-3_RC Mast 73 - Lijsten**

	Naam	Functie	Handtekening	Datum
Opgesteld	Erik Jan Fledderus	Tekenaar		18-02-2022
Validatie Aafjes	Niels Verhaar	System Engineer		18-02-2022
Vrijgegeven	Bart Aafjes	Projectleider		18-02-2022

Revisie	Documentstatus	Datum	Reden van uitgifte
0.1	Voorlopig	18-02-2022	1e versie ter review

BOUTEN-, MOEREN-, RINGENLIJST Pagina: 1

ENS-ZL380 Datum: 15.02.2022
Masttype Masttype HC-3 RC
t.b.v. mast 73

Naam	Type	Kwal.	Aantal
BOUT-M16*35	4017	8.8	8
BOUT-M16*45	4017	8.8	8
BOUT-M16*50	4014	8.8	8
BOUT-M16*55	4014	8.8	8
BOUT-M20*45	4017	8.8	12
BOUT-M20*50	4017	8.8	8
BOUT-M20*60	4017	8.8	4
MOER-M16	4032		32
MOER-M20	4032		24
RING-M16	7091		32
RING-M20	7091		24

MATERIAALLIJST Pagina: 1

ENS-ZL380 Datum: 15.02.2022
Masttype Masttype HC-3 RC
t.b.v. mast 73

Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp.(m2)	Gewicht(kg)
L50/5	1	S355J0	8	555	0.11	2.1
L50/5	2	S355J0	8	1576	0.32	6.1
				17048	3.41	65.5
L150/100/10	3	S355J0	6	200	0.10	3.8
				1200	0.60	23.0
STRIP15*140	P2	S355J0	6	160	0.05	2.5
				960	0.30	14.9
UNP200	P1	S355J0	3	700	0.46	18.0
				2100	1.39	54.1
				Totaal:	5.69	157.5

TEKLA STRUCTURES MERKENLIJST Pagina: 1

ENS-ZL380 Datum: 15.02.2022
Masttype Masttype HC-3 RC
t.b.v. mast 73

Merk	Aantal	Profiel	Lengte	Opp.(m2)	Gewicht (kg)
1	8	L50/5	555	0.11	2.1
2	8	L50/5	1576	0.32	6.1
3	6	L150/100/10	200	0.10	3.8
4	3	UNP200	700	0.56	23.0
Totaal	25	merk(en)		5.69	157.5

Masttype: HC-3_RC Mast 73
Opwaarderen 380 kV verbinding Ens - Zwolle

Tekening omschrijving	Tekeningnummer	Rev.	Datum	Tek.	formaat
Masttype HC-3 RC, Mast 73 - Overzicht	00974-01-07301	0.1	18.02.2022	A2	594x420
Masttype HC-3 RC, Mast 73 - Broekstuk	00974-01-07302	0.1	18.02.2022	A0	1189x841
Masttype HC-3 RC, Mast 73 - 2e Tussenstuk	00974-01-07303	0.1	18.02.2022	A0	1189x841
Masttype HC-3 RC, Mast 73 - Middentraverse	00974-01-07304	0.1	18.02.2022	A0	1189x841
HC-3 RC, Mast 10 - Onderdeeltekeningen	00974-01-07305	0.1	18.02.2022	A3/A4	

Lijsten	Documentnummer		Datum
bouten-moeren-ringenlijst	00974-01-017320	0.1	14.02.2022
materiaallijst	00974-01-017320	0.1	14.02.2022
merkenlijst	00974-01-017320	0.1	14.02.2022
Documentenlijst	00974-01-017320	0.1	18.02.2022

Detailberekeningen	Documentnummer		Datum
HC-3_RC, Mast 73	00974-01-07330	0.1	18.02.2022

Ingenieursbureau
Aafjes b.v.

Ohmstraat 1
8013 PZ Zwolle
T. 038-460 88 60
M. info@jaapaafje

"REVIEW AND RE-DESIGN TOWERS BBB380"

ENS-ZL380 – Tower HC-3/RC

TenneT TSO B.V.

Detail Calculation

Projectnummer Aafjes:	**21-187**
Documentnummer:	**00974-01-07330**
Projectnummer TenneT:	**002.515**
Meridian nummer:	**002.515.40 0994427**
Opdrachtgever:	**TenneT**
Project:	**Opwaardering ENS-ZL380**
Onderdeel:	**HC-3_RC Mast 73 - Detailberekeningen**

1e versie ter review	G. Pieper	R.Hol	B. Aafjes	18-02-2022	0.1
	Author	Checked	Approved	date	revision

Content

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2 General Data....4
2.1 Principal constructor....4
2.2 Principal calculation and related documents....4
2.3 Material- and bolt quality....4
2.4 Applicable standards....4
2.5 Tennet specifications....4
3 Calculations....5
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3.1.1 Overview....5
3.1.2 Detail 1....6
3.1.3 Loads....8
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3.1.5 Detail 2....17
4 Summary U.C. 's....18
4.1.1 Connection of post insulators to the lower crossarm....18
5 Conclusion....19
5.1.1 Connection of post insulators to the lower crossarm....19

1 Introduction

This report contains the detail calculations of the reinforcements of towertype HB-3/RC windzone III.

It concerns tower number: Tower 73

To increase the future capacity of electricity transmission, it is necessary to upgrade the transmission grid by building new and modifying existing high voltage connections.

It is for this reason the client (OG) intends to upgrade part the existing 380kV grid. This upgrading is part of the program “Beter Benutten Bestaande 380kV” and consists of the following subprojects:

- Upgrading of the 380 kV-connection Lelystad – Ens (LLS-ENS380).
- Upgrading of the 380 kV-connection Diemen – Lelystad (DIM-LLS380).
- Upgrading of the 380 kV-connection Rilland – Zandvliet (RLL-ZVL380).
- Upgrading of the 380 kV-connection Krimpen aan de IJssel – Geertruidenberg (KIJ-GT380).
- Upgrading of the 380 kV-connection Ens – Zwolle (ENS-ZL380).
- Upgrading of the 380 kV-connection Maasbracht – Eindhoven (MBT-EHV380).

DNV GL has calculated the existing tower for the new situation on behalf of Tennet. On the instructions of DNV GL, the reinforcements mainly consist of the exchange of bolts and profiles and the reinforcement of profiles and the application of redundant members.

DNV GL has tested the profiles and bolts. In this report only the detail calculations are made of the specified reinforcements (bolts are specified by DNV GL).

2 General Data

2.1 Principal constructor

DNV GL – Energy

2.2 Principal calculation and related documents

- ENS-ZL380 – Tower HC-3/RC
  Reportnr.: 21-0181 Rev 1
  Date: 2021-03-23

- Uitgangspuntenrapport 380kV verbinding Ens – Zwolle
  Reportnr.: 20-1245 Rev.3
  Date: 2021-06-09

2.3 Material- and bolt quality

Materials excisting construction

	Signification 1969	Current startingpoint
Steeltype	St.37	S235JR
	St.52	S355JO
Bolt quality	bolt class 5	5.6 rolled thread
Concrete quality	K225	Min. C16/20
Reinforcing steel	Qr24, Qr40	B220, B400

Materials modified construction

Steeltype	S355JO ($t \leqq 16$ mm)
	S355J2 ($16 < t \leqq 40$ mm)
Bolt quality	8.8 rolled thread

2.4 Applicable standards

Mainly used:
- NEN-EN 1993-1-8+C2 :2011/NB:2011 nl

Also used:
- NEN-EN 50341-2-15: 2019
- NEN-EN 8700: 2011
- NEN-EN 8701: 2011
- Eurocode reeks

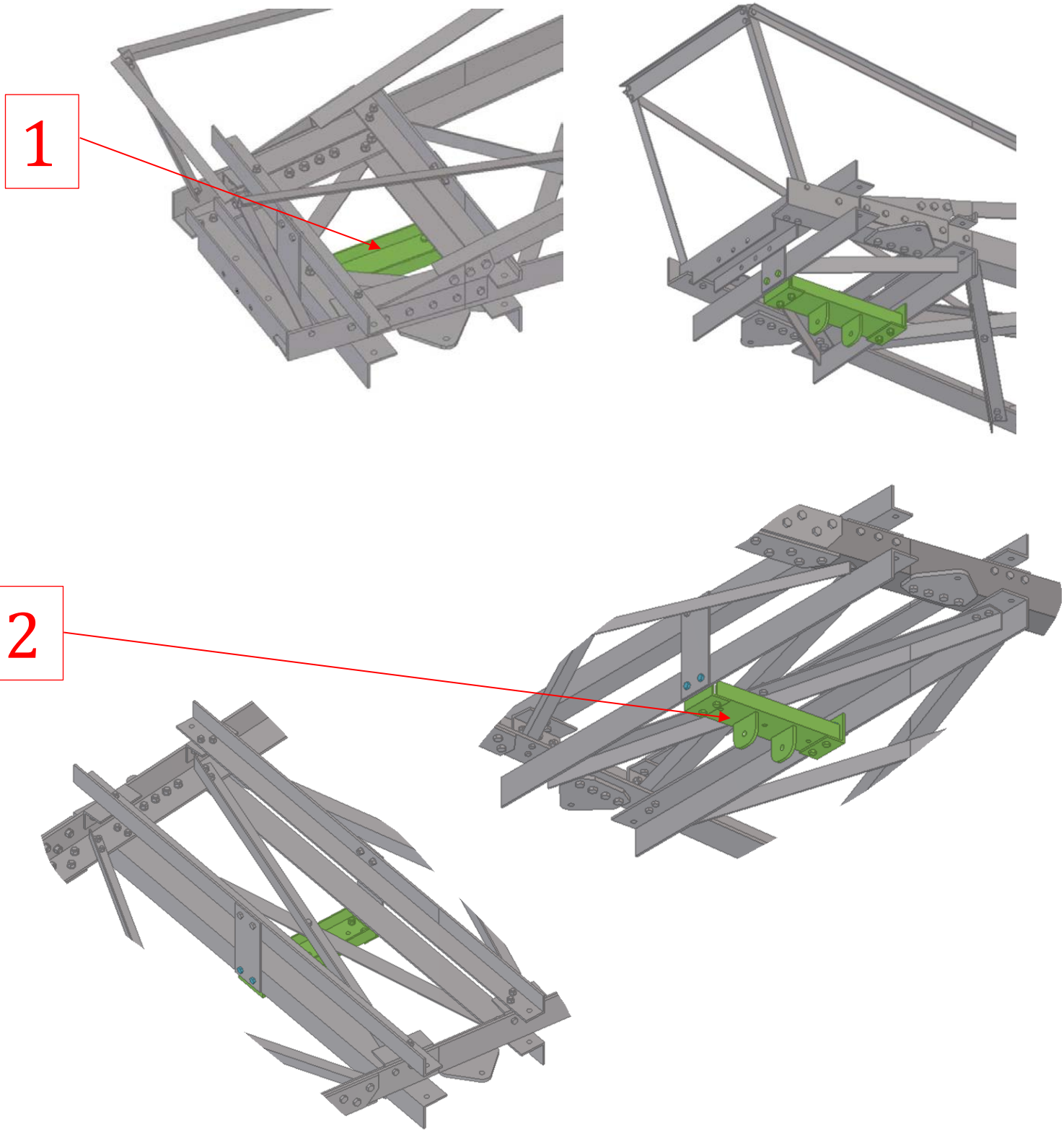
2.5 Tennet specifications

- SPE. 05. 346. v 2.0 algemene specificatie stalen masten

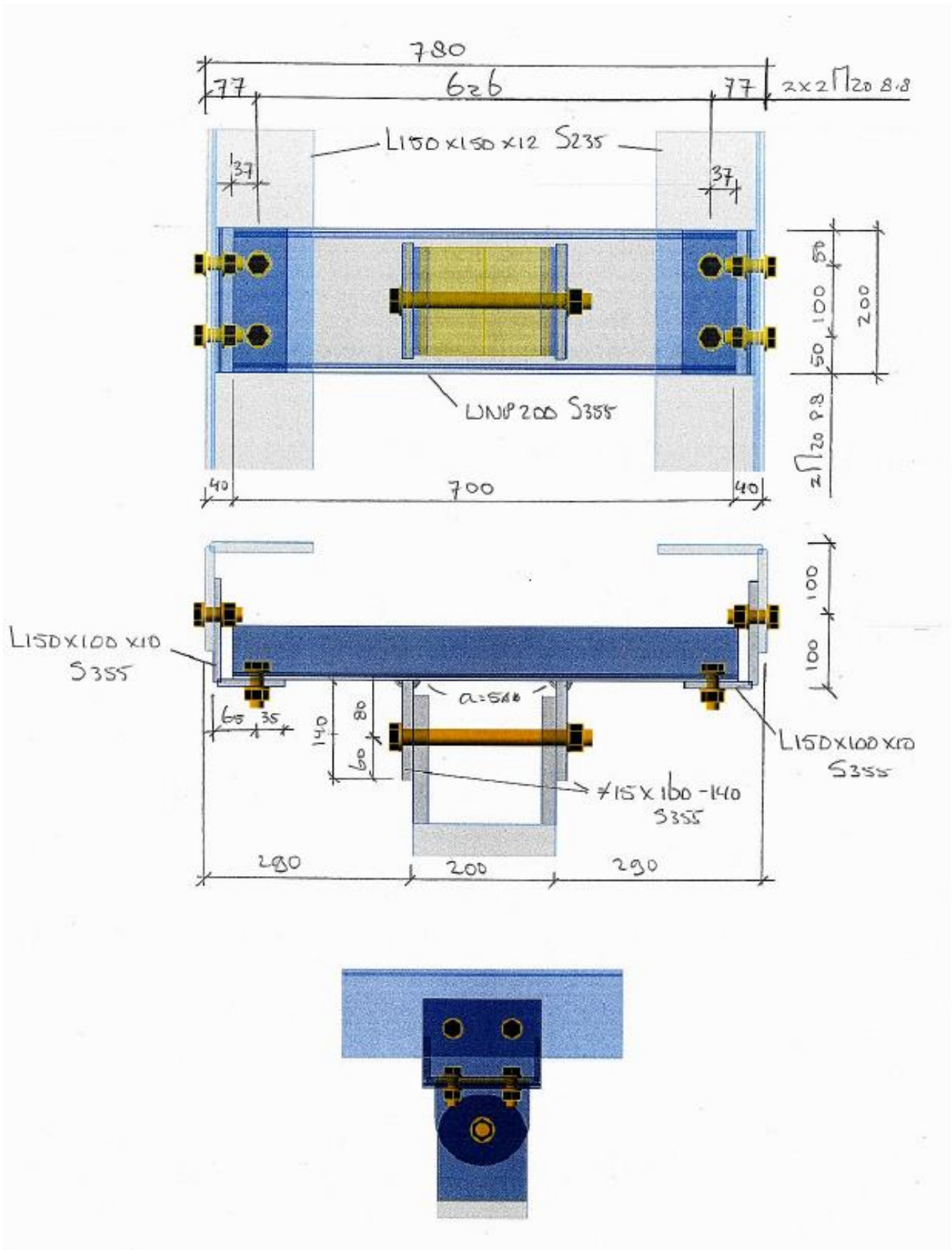
3 Calculations

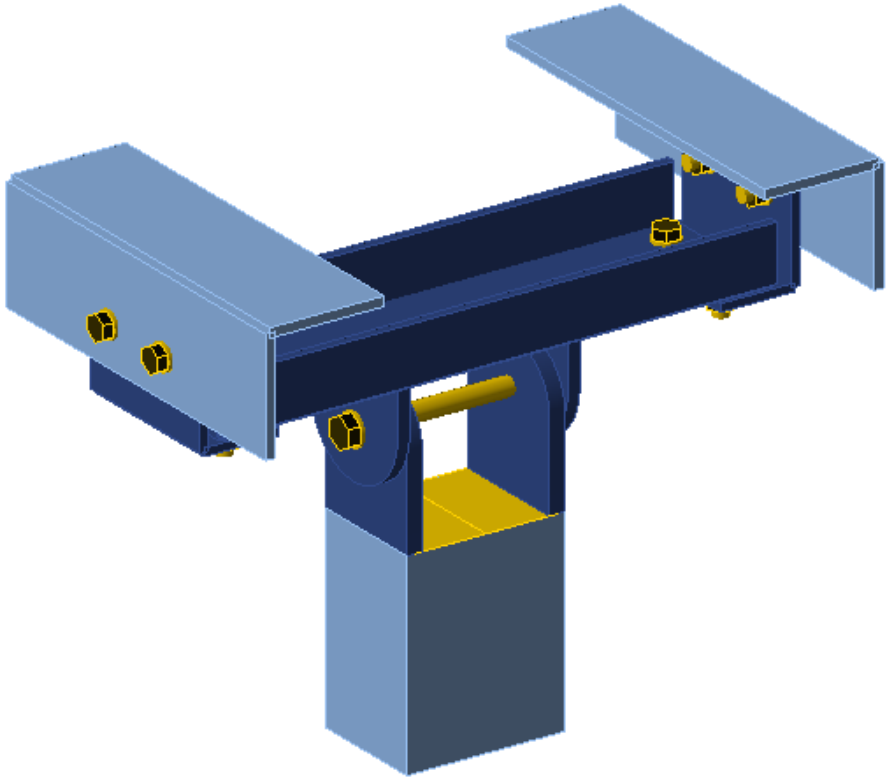
3.1 Connection of post insulators to the lower crossarm

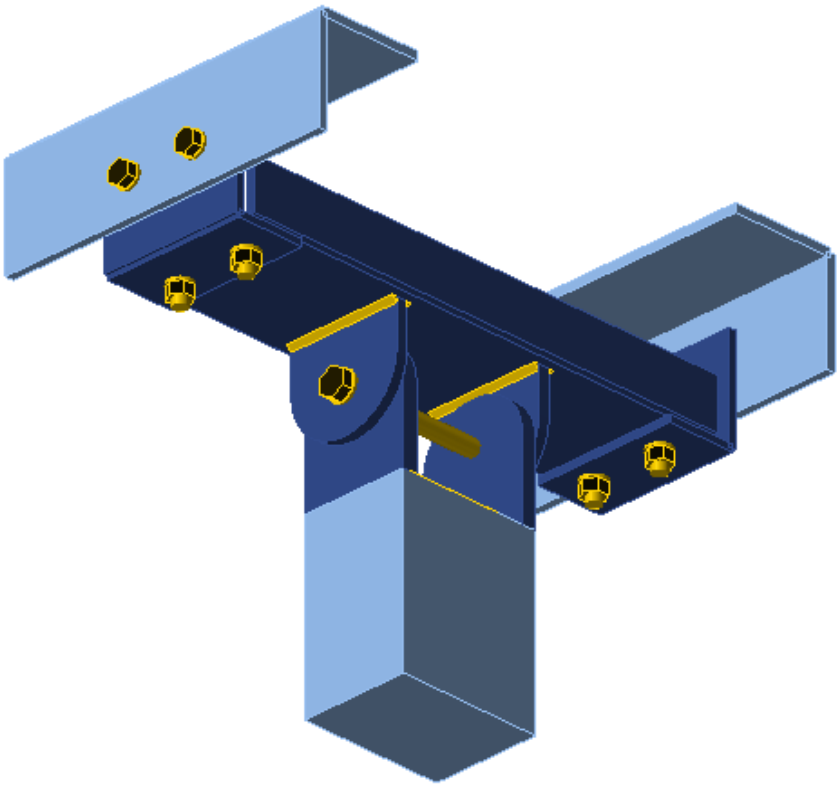
3.1.1 Overview



3.1.2 Detail 1


780
77
626
77
2x2 M20 8.8
L150x150x12 S235
37
37
50
100
50
200
UNP 200 S355
2 M20 8.8
40
700
40
100
100
L150x100x10
S355
65
35
140
80
60
a=5x6
L150x100x10
S355
≠15x180-140
S355
290
200
290





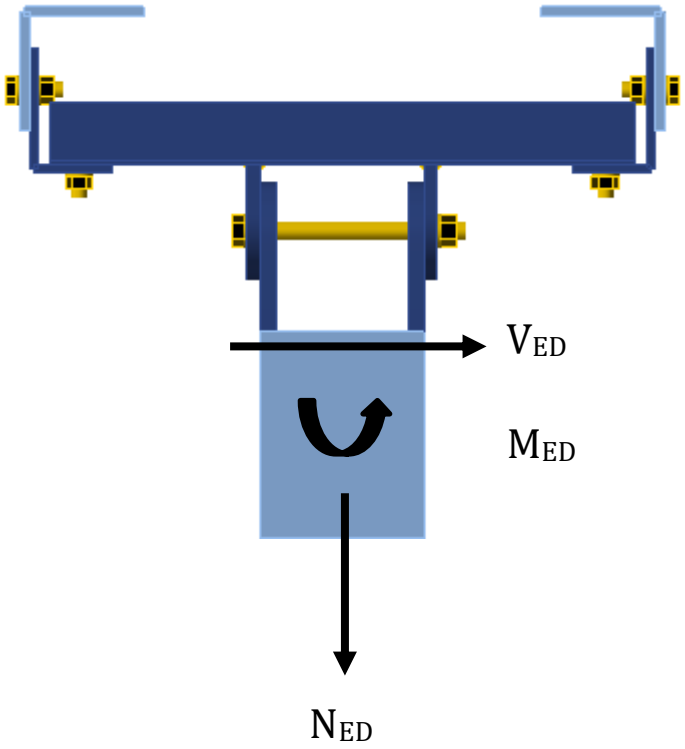
3.1.3 Loads

Loads from report:

ENS-ZL380 – Tower HC-3/R

Report nr.: 21-0085 Rev 1
Date: 2021-03-23

Page 46 / 47



$V_{ED} = 2{,}44$ kN

$M_{ED} = 7{,}7$ kNm

$N_{ED} = 5$ kN

3.1.4 Calculation

3.1.4.1 IDEA calculation

Project data

Project name	ENS-ZL380 HC-3/RC Tower 73
Project number	21-187
Author	G.P.
Description	Detail 1
Date	2/17/2022
Design code	EN

Material

Steel	S 235, S 355

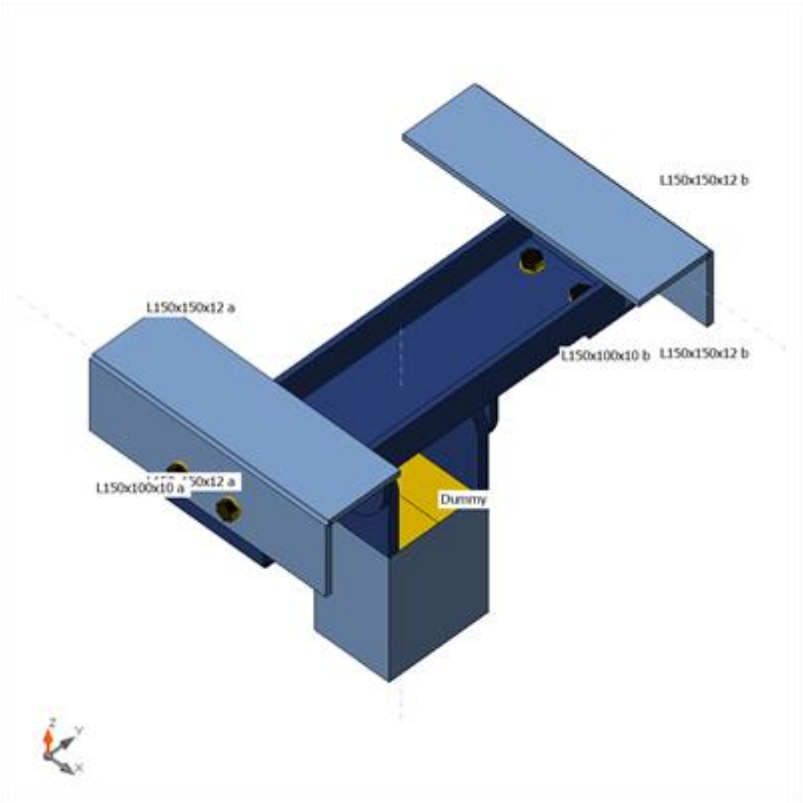
Project item Detail 1

Design

Name	Detail 1
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
L150x150x12 a	3 - HFLeq150x150x12	0.0	0.0	-90.0	0	0	-349	Node
L150x150x12 b	3 - HFLeq150x150x12	180.0	0.0	-90.0	0	0	-349	Bolts
Dummy	5 - Plaat 200, 150	0.0	90.0	90.0	0	0	0	Node



Cross-sections

Name	Material
3 - HFLeq150x150x12	S 235
5 - Plaat 200, 150	S 355
10 - UNP200	S 355
9 - HFLue150x100x10	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M24 8.8	M24 8.8	24	800.0	452
M20 8.8	M20 8.8	20	800.0	314

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	L150x150x12 a	0.0	-6.8	-0.6	0.0	0.0	0.0
	L150x150x12 a	0.0	-6.8	-0.6	0.0	0.0	0.0
	L150x150x12 b	0.0	4.3	0.6	0.0	0.0	0.0
	L150x150x12 b	0.0	4.3	0.6	0.0	0.0	0.0
	Dummy	5.0	0.0	-2.4	0.0	7.7	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	28.5 < 100%	OK
Welds	96.8 < 100%	OK
Buckling	89.11	

Plates

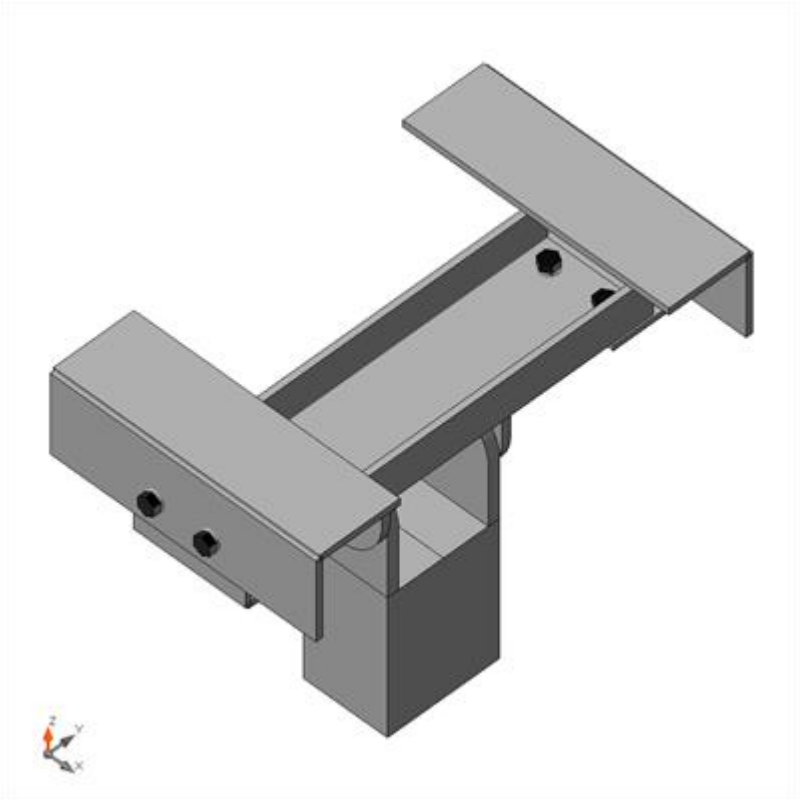
Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
L150x150x12 a-bfl 1	S 235	12.0	LE1	105.3	0.0	12.0	OK
L150x150x12 a-w 1	S 235	12.0	LE1	28.4	0.0	0.0	OK
L150x150x12 b-bfl 1	S 235	12.0	LE1	44.9	0.0	5.4	OK
L150x150x12 b-w 1	S 235	12.0	LE1	18.1	0.0	0.0	OK
Dummy-bfl 1	S 355	200.0	LE1	7.3	0.0	0.0	OK
UNP200-bfl 1	S 355 - 1	11.5	LE1	88.6	0.0	0.0	OK
UNP200-tfl 1	S 355 - 1	11.5	LE1	88.5	0.0	0.0	OK
UNP200-w 1	S 355 - 1	8.5	LE1	119.4	0.0	24.0	OK
L150x100x10 a-bfl 1	S 355 - 1	10.0	LE1	114.9	0.0	24.0	OK
L150x100x10 a-w 1	S 355 - 1	10.0	LE1	184.1	0.0	12.0	OK
L150x100x10 b-bfl 1	S 355 - 1	10.0	LE1	91.5	0.0	7.8	OK
L150x100x10 b-w 1	S 355 - 1	10.0	LE1	117.4	0.0	5.4	OK
SP2	S 355 - 1	15.0	LE1	125.3	0.0	17.7	OK
SP1	S 355 - 1	15.0	LE1	149.9	0.0	10.4	OK
dummy1	S 355 - 1	20.0	LE1	61.4	0.0	17.7	OK
dummy2	S 355 - 1	20.0	LE1	79.7	0.0	10.4	OK

Design data

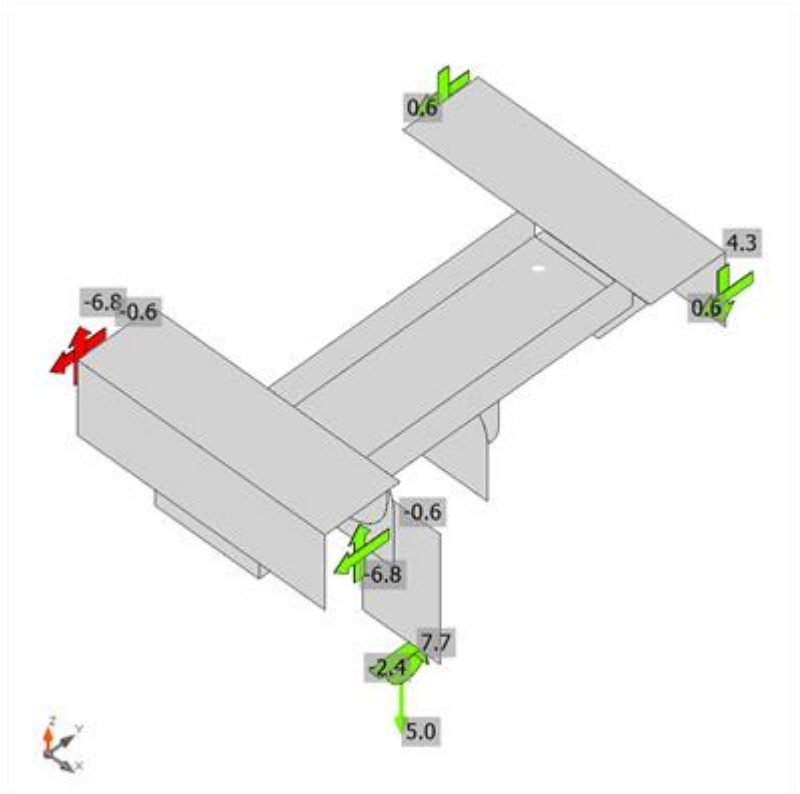
Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0
S 355	335.0	5.0
S 355 - 1	355.0	5.0

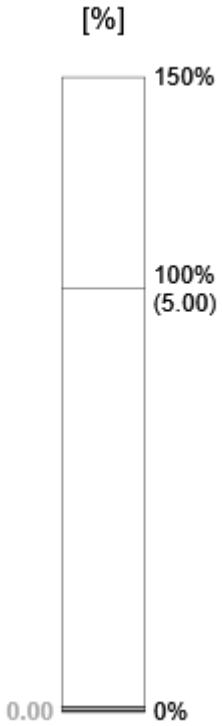
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

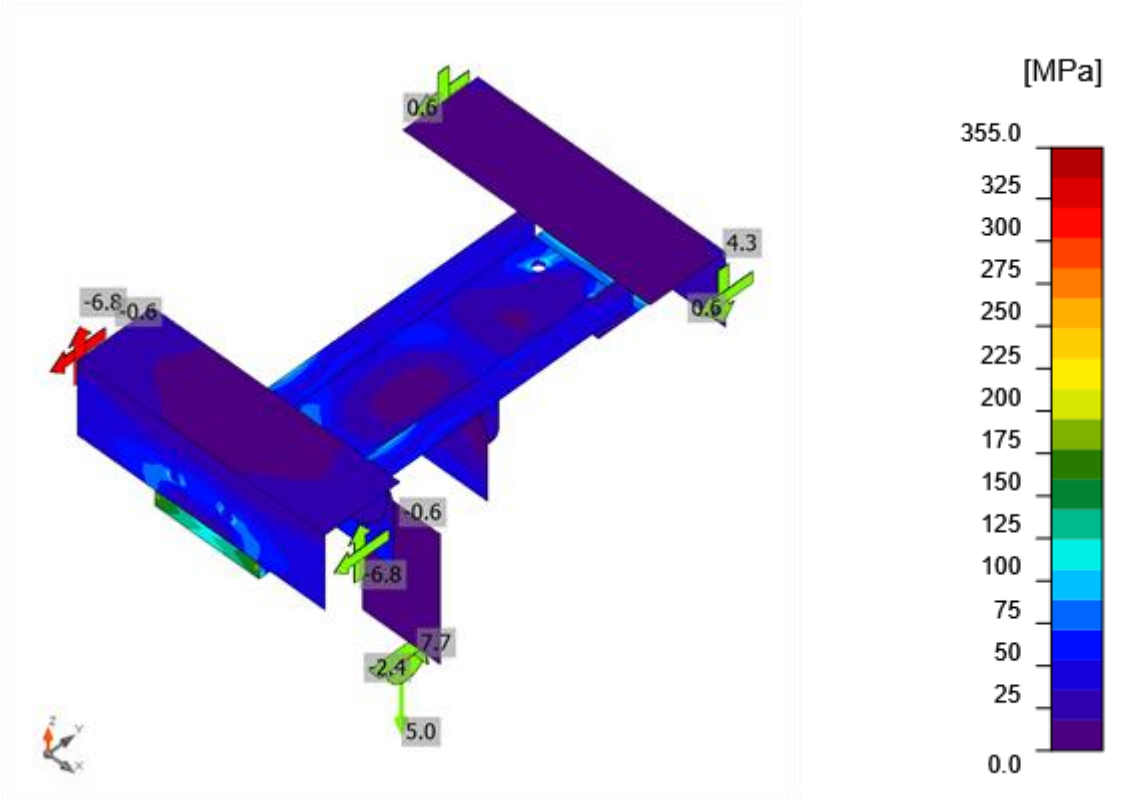


Overall check, LE1

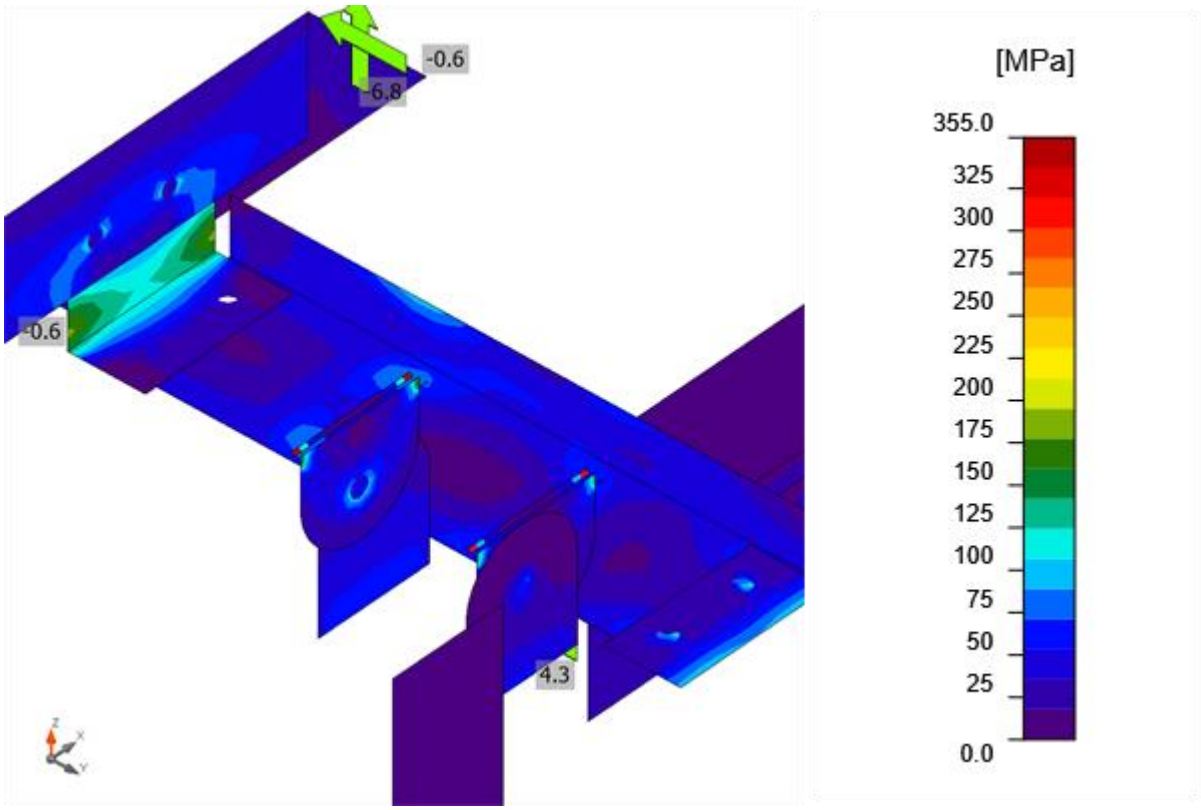




Strain check, LE1

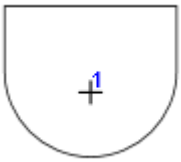
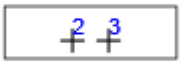
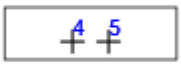
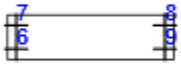


Equivalent stress, LE1



Equivalent stress, LE1

Bolts

	Name	Grade	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	M24 8.8 - 1	LE1	5.7	35.9	2.8	271.1	26.5	28.5	OK
	B2	M20 8.8 - 2	LE1	6.5	4.3	4.6	172.8	4.5	7.8	OK
	B3	M20 8.8 - 2	LE1	6.5	4.3	4.6	172.8	4.5	7.8	OK
	B4	M20 8.8 - 2	LE1	6.5	6.8	4.6	130.3	7.2	10.5	OK
	B5	M20 8.8 - 2	LE1	6.5	6.8	4.6	130.3	7.2	10.5	OK
	B6	M20 8.8 - 3	LE1	11.8	1.0	8.4	149.5	1.1	7.1	OK
	B7	M20 8.8 - 3	LE1	11.8	1.0	8.4	149.5	1.1	7.1	OK
	B8	M20 8.8 - 3	LE1	0.3	0.9	0.2	97.0	0.9	1.1	OK
	B9	M20 8.8 - 3	LE1	0.3	0.9	0.2	97.0	0.9	1.1	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M24 8.8 - 1	203.3	421.2	135.6
M20 8.8 - 2	141.1	205.2	94.1
M20 8.8 - 3	141.1	197.8	94.1

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear

Welds (Plastic redistribution)

Item	Edge	Material	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	Ut [%]	Ut_c [%]	Status
Dummy-bfl 1	dummy1	S 235	20.0	150	LE1								OK
Dummy-bfl 1	dummy2	S 235	20.0	150	LE1								OK
UNP200-w 1	SP1	S 355	◢5.0◣	160	LE1	421.7	0.0	143.3	189.3	128.9	96.8	19.0	OK
		S 355	◢5.0◣	160	LE1	383.3	0.0	109.7	-171.9	-124.1	88.0	18.9	OK
UNP200-w 1	SP2	S 355	◢5.0◣	160	LE1	304.9	0.0	-89.2	-137.4	-97.2	70.0	15.1	OK
		S 355	◢5.0◣	160	LE1	336.6	0.0	-111.5	151.5	103.2	77.3	15.9	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	0.80	360.0	259.2
S 355	0.90	435.6	352.8

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Buckling

Loads	Shape	Factor [-]
LE1	1	89.11
	2	89.27
	3	95.57
	4	97.46
	5	158.32
	6	165.74

Code settings

Item	Value	Unit	Reference
γ_{M0}	1.00	-	EN 1993-1-1: 6.1
γ_{M1}	1.00	-	EN 1993-1-1: 6.1
γ_{M2}	1.25	-	EN 1993-1-1: 6.1
γ_{M3}	1.25	-	EN 1993-1-8: 2.2
γ_C	1.50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1.20	-	EN 1992-4: Table 4.1

Joint coefficient βj	0.67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0.10	-	
Friction coefficient - concrete	0.25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0.30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0.05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2.20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1.20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance check	Both		EN 1992-4: 7.2.1.4 and 7.2.2.5
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		EN 1992-4
Local deformation check	No		CIDECT DG 1, 3 - 1.1
Local deformation limit	0.03	-	CIDECT DG 1, 3 - 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints
Braced system	No		EN 1993-1-8: 5.2.2.5

3.1.5 Detail 2

Detail 2 is equal to detail 1.

Loads detail 2 are equal to detail 1.

Check connection is the same as detail 1.

4 Summary U.C. 's

4.1.1 Connection of post insulators to the lower crossarm

Detail 1

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	28.5 < 100%	OK
Welds	96.8 < 100%	OK
Buckling	89.11	

5 Conclusion

5.1.1 Connection of post insulators to the lower crossarm

Both connections have sufficient strength.

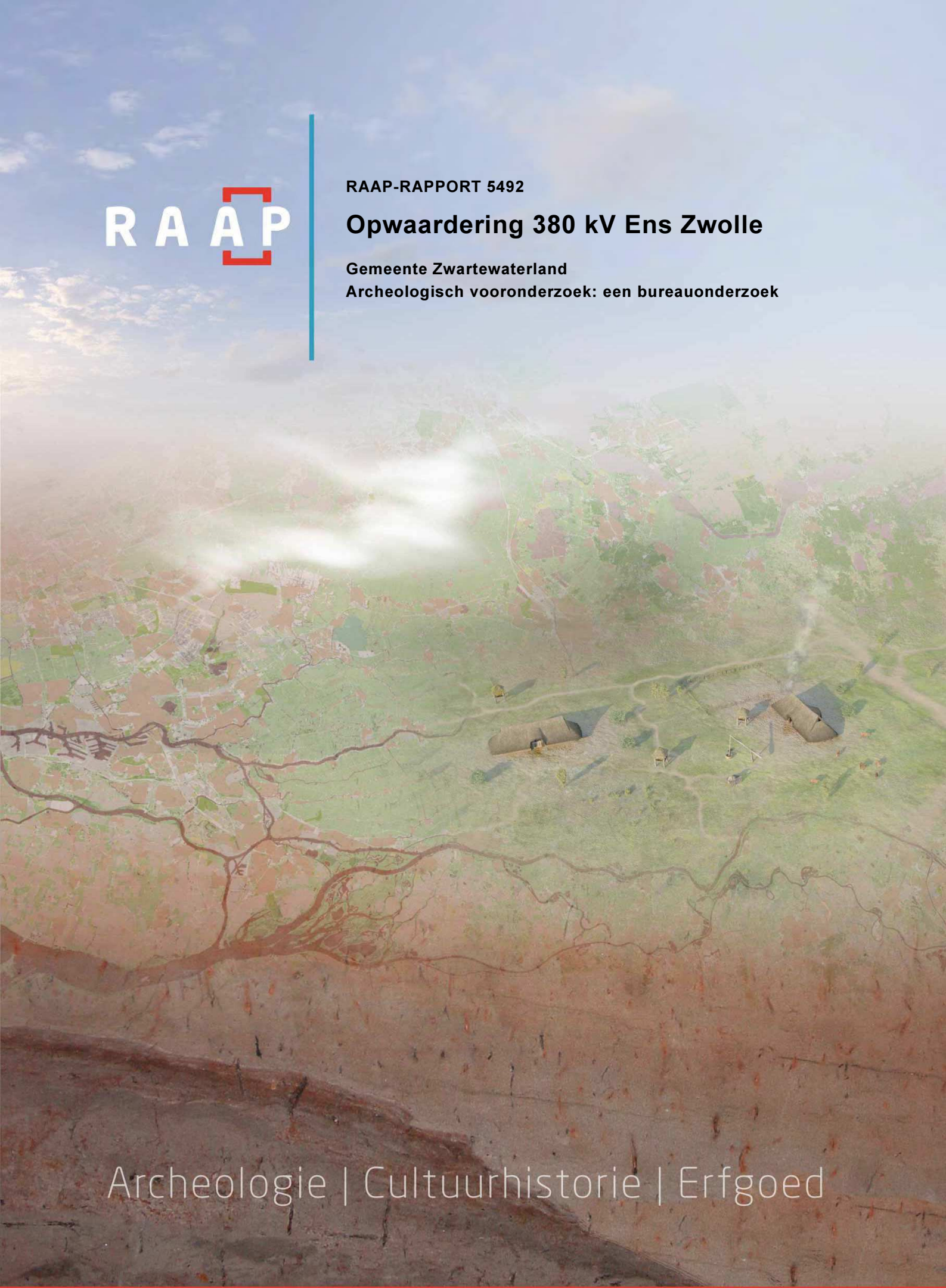
Bijlage 6

Archeologisch onderzoek

RAAP-RAPPORT 5492

Opwaardering 380 kV Ens Zwolle

Gemeente Zwartewaterland
Archeologisch vooronderzoek: een bureauonderzoek



Archeologie | Cultuurhistorie | Erfgoed

Colofon

Titel: Opwaardering 380 kV Ens Zwolle, gemeente Zwartewaterland; archeologisch vooronderzoek: een bureauonderzoek

Versie: 13-12-2021

Auteur: H.B.G. Scholte Lubberink & E. Witmer (met een bijdrage van W. Groenendijk)

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RAAP
Leeuwenveldseweg 5b
1382 LV Weesp
Postbus 5069
1380 GB Weesp

Telefoon: 0294-491 500
E-mail: raap@raap.nl
Website: www.raap.nl

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Samenvatting

In opdracht van Arcadis heeft RAAP van 19-10-2021 tot 19-11-2021 een archeologisch vooronderzoek in de vorm van een bureauonderzoek uitgevoerd voor het plangebied Onderzoeksgebied Opwaardering 380 kV Ens Zwolle in de gemeente Zwartewaterland. Het onderzoek vond plaats in het kader van een omgevingsvergunning. Verspreid binnen het plangebied worden bouwwegen en werkterreinen aangelegd en weer verwijderd, waarna het terrein cultuurtechnisch wordt hersteld. Bij een deel van de hoogspanningsmasten wordt de fundering versterkt. De exacte omvang en diepte van de ingrepen is vooralsnog onbekend.

Binnen specifieke delen van het onderzoeksgebied is sprake van archeologisch waardevolle of zeer waardevolle gebieden met een hoge of zeer hoge trefkans op het aantreffen van archeologische resten. In de polder Mastenbroek gaat het uitsluitend om verhoogde woonplaatsen/huisterpen en de locatie van een windmolen uit de late middeleeuwen en nieuwe tijd: de Lutterzijlmolen. De locatie van de voormalige windmolen wordt doorsneden door een geplande bouwweg. Op de andere locaties zijn geen ingrepen gepland. Verder is in Mastenbroek de kans op het aantreffen van archeologische resten buiten de huisterpen, anders dan losse vondsten, relatief klein. Een uitzondering vormen mogelijk enkele gebieden met door holocene afzettingen afgedekt dekzandreliëf tussen de Nieuwe Wetering en het Zwarte Water.

Het enige gebied met een grotere aaneengesloten zone met archeologisch waardevolle of zeer waardevolle gebieden is de buurtschap Holten. Hier snijdt het onderzoeksgebied hoge rivierduinen en dekzandruggen/koppen waar archeologische resten vanaf de prehistorie verwacht worden. In de nabijheid van een relatief groot aantal historische erven worden archeologische resten van voorgangers uit de late middeleeuwen en/of nieuwe tijd verwacht. Ter hoogte van het voormalige erve De Hovenier (direct ten noorden van Verkavelingsweg 7) bevindt zich een hoogspanningsmast op het voormalige erf. Bij werkzaamheden kunnen daar archeologische resten aan het daglicht komen.

In de veen- en broekgebieden ten zuidoosten van Holten is de kans op archeologische resten, anders dan losse vondsten, zeer klein.

In de buurtschap Holten zijn op basis van historische bronnen resten van verdedigingswerken (loopgraven) en gevechts-/wapenopstellingen uit de Tweede Wereldoorlog te verwachten. Op meerdere plaatsen wordt het tracé van een loopgraaf gesneden door een geplande werkweg of is een hoogspanningsmast naast een loopgraaf geplaatst. Deze locaties hebben een verhoogde kans op het aantreffen van resten uit de tweede wereldoorlog. Hier moet men tevens beducht zijn voor de aanwezigheid van Ontplofbare Oorlogsresten (OO). NB! De op de overzichtskaart aangegeven loopgraven zijn bij benadering, dat wil zeggen op tientallen meters nauwkeurig. De exacte locatie moet nog worden vastgesteld.

In de laaggelegen veen- en broekgebieden ten (zuid)oosten van Holten is de kans op de aanwezigheid van archeologische resten (zeer) gering. Langs de randen het onderzoeksgebied liggen (resten van) een aantal eendenkooien. Deze vallen echter niet samen met geplande ingrepen.

Op basis van de resultaten van het onderzoek blijkt dat in het plangebied (mogelijk) archeologische resten bedreigd worden door de voorgenomen bodemingrepen (bijlage 10), met name ter hoogte van de voormalige Lutterzijlmolen. Daarom wordt geadviseerd om op deze locatie de plannen zodanig aan

te passen (graafwerkzaamheden tot een minimum beperken) en om mitigerende maatregelen te treffen (bijvoorbeeld gebruik van rijplaten voor bouwwegen), zodat verstoring wordt voorkomen/tot een minimum wordt beperkt.

Indien en waar dit het geval is, en indien mitigerende maatregelen of planaanpassing niet mogelijk zijn, wordt aanbevolen in het kader van de bestaande planvorming vervolgstappen uit het proces van de Archeologische Monumentenzorg (AMZ) te nemen in de vorm van een inventariserend archeologisch booronderzoek om de diepteligging en kwetsbaarheid van archeologische resten vast te stellen.

In zones met dekzandreliëf op een geringe diepte in de polder Mastenbroek en in archeologisch (zeer) waardevol gebied in de buurschap Holten wordt archeologisch vervolgonderzoek aanbevolen om een beter beeld te krijgen van de (kans op de) aan- of afwezigheid van archeologische resten. Hierbij moet in eerste instantie geacht worden aan een verkennend of inventariserend booronderzoek op locaties waar binnen die zones ingrepen zijn gepland.

Op en rond de locaties van de bij benadering gelokaliseerde gevechtsstellingen en loopgraven in de buurtschap Holten is een onderzoek naar ontplofbare oorlogsresten noodzakelijk.

Voor de overige delen van het plangebied gelden binnen de gemeente Zwartewaterland geen planologische beperkingen. In deze delen van het plangebied wordt in het kader van dit onderzoek geen vervolgonderzoek aanbevolen. Indien bij de uitvoering van de werkzaamheden onverwacht archeologische resten worden aangetroffen, dan is conform artikel 5.10 van de Erfgoedwet aanmelding van de desbetreffende vondsten bij de Minister van Onderwijs, Cultuur en Wetenschap c.q. de Rijksdienst voor het Cultureel Erfgoed verplicht (vondstmelding via ARCHIS).

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Figuur 1. Aanduiding onderzoeksgebied. Inzet: ligging in Nederland (ster).

1 Inleiding

1.1 Kader

Aanleiding

In opdracht van Arcadis heeft RAAP van 19-10-2021 tot 19-11-2021 een archeologisch vooronderzoek in de vorm van een bureauonderzoek uitgevoerd voor het plangebied Onderzoeksgebied Opwaardering 380 kV Ens Zwolle in de gemeente Zwartewaterland (figuur 1 en bijlage 5). Het onderzoek vond plaats in het kader van een omgevingsvergunning. Voor de tracédelen binnen gemeenten Noordoostpolder, Kampen en Zwolle wordt verwezen naar RAAP-rapporten 5490, 5491 en 5493.[1]

Voor de opwaardering van de bestaande 380 kV verbinding Ens-Zwolle moeten diverse werkzaamheden worden uitgevoerd. In de basis betreft dit het ophangen van nieuwe geleiders met een hogere transportcapaciteit dan de huidige geleiders. De nieuwe geleiders zijn qua omvang en aantal gelijk aan de bestaande, maar kunnen meer stroom transporteren doordat ze hogere temperaturen kunnen weerstaan zonder te ver door te gaan hangen. De huidige hoogspanningsverbinding is bovendien inmiddels bijna 35 jaar oud. Om deze reden worden ook andere onderdelen, zoals de isolatorkettingen en bliksemdraden als levensduurverlengende activiteit vervangen. Daarnaast worden de masten opnieuw constructief beschouwd en moet bij een aantal masten de fundering en/of het mastlichaam versterkt worden.

In de kaartbijlagen bij deze rapportage zijn de locaties van ingrepen/werkzaamheden weergegeven waarvan eventueel schade aan archeologische resten zijn te verwachten. Het gebruik van bestaande (verharde) wegen is bij de beoordeling van de effecten en in het kaartbeeld achterwege gelaten.

Het doel van het archeologisch onderzoek is in eerste instantie het opstellen van een bureauonderzoek (KNA-protocol 4001) met een gespecificeerde archeologische verwachting. Op basis daarvan wordt een selectieadvies opgesteld. Dit advies kan zijn geen vervolgonderzoek uit te voeren (indien geen archeologische waarden worden verwacht) of wel een vervolgonderzoek uit te voeren indien archeologische waarden worden verwacht die mogelijk worden verstoord. Uitgangspunt hierbij is dat het onderzoek gericht is op de ontgraving rond masten waarvan de fundering versterkt wordt en indien cultuurtechnisch herstel bij werkterreinen, lierplaatsen en bouwwegen archeologische waarden kan raken.

Juridisch en beleidskader

Het uitgangspunt voor dit onderzoek wordt gevormd door het wettelijk en beleidsmatig kader voor de ruimtelijke ordening en monumentenzorg. De gemeente is de bevoegde overheid die een besluit zal nemen over hoe om te gaan met de eventueel aanwezige archeologische waarden.

Op de archeologische verwachtingskaart van de gemeente Zwartewaterland zijn binnen het onderzoeksgebied vier zones met een verschillende archeologische verwachting onderscheiden.[2] Een 0% gebied is archeologisch leeg. Van een 10% gebied is de archeologische waarde onbekend, in deze gebieden wordt proefonderzoek aanbevolen. Een 50% gebied is archeologisch waardevol met een hoge

[1] Scholte Lubberink 2021a en b; Witmer 2021.
[2] Clevis, Klomp & Kranenborg 2009.

archeologische verwachting waar bij ingrepen een inventariserend veldonderzoek dient plaats te vinden. Een 90% gebied is zeer waardevol de vondstkans is bijna 100%, bij ingrepen is een opgraving noodzakelijk.

Op basis van deze verwachtingen is in het bestemmingsplan buitengebied van de gemeente Zwartewaterland (vastgesteld 10-10-2013) aan 50%- en 90%-gebieden een dubbelbestemming Archeologie toegekend.[3] Hiervan bevinden er zich verscheidene binnen het onderzoeksgebied. Het beleid voor deze dubbelbestemming schrijft voor dat er bij bodemingrepen groter dan 100 m^2 en dieper dan 50 cm -mv een archeologisch onderzoek dient te worden uitgevoerd. De geplande ingrepen zijn groter dan de vrijstellingsgrens. Een archeologische onderbouwing met betrekking tot de eventuele aanwezigheid van archeologische waarden is daarom verplicht conform het vigerend beleid.

Kwaliteitsborging

De werkzaamheden zijn uitgevoerd onder certificaat BRL4000, conform artikel 5.4 van de Erfgoedwet. Het onderzoek is uitgevoerd volgens de normen van de archeologische beroepsgroep. De Kwaliteitsnorm Nederlandse Archeologie (KNA, versie 4.1), beheerd door de Stichting Infrastructuur Kwaliteitsborging Bodembeheer (SIKB; www.sikb.nl), is door de minister aangewezen als norm.

RAAP is gecertificeerd voor de protocollen 4001 Programma van Eisen, 4002 Bureauonderzoek, 4003 Inventariserend veldonderzoek (landbodems), onderdelen proefsleuven en overig, alsmede 4004 Opgraven (landbodems).

Zie bijlage 1 voor de dateringen van de in dit rapport genoemde archeologische perioden.

[3] NL.IMRO.1896.BP0035-VS01.

1.2 Administratieve gegevens

Type onderzoek	Bureauonderzoek
Opdrachtgever	Arcadis
Bevoegde overheid	Gemeente Zwartewaterland
Plaats	Zwartewaterland
Gemeente	Zwartewaterland
Provincie	Overijssel
Centrumcoördinaten (X/Y)	201.556/509.336
Toponiem	380 kV Ens-Zwolle
Oppervlakte onderzoeksgebied	639 ha
Afbakening onderzoeksgebied	Tijdens onderhavig onderzoek is het plangebied inclusief een zone van 200 m rondom het plangebied onderzocht.
Onderzoeksperiode	19-10-2021-19-11-2021
Uitvoerder	RAAP Oost
Projectleider	H.B.G. Scholte Lubberink
Projectmedewerkers	E. Witmer
RAAP-projectcode	ZWEN
ARCHIS-onderzoeksmeldingsnummer	5129133100
Beheer en plaats documentatie	Raap Oost-Nederland.

Tabel 1. Administratieve gegevens.

1.3 Doel- en vraagstelling

De doelstelling van het archeologisch vooronderzoek is het vaststellen van de archeologische waarde van het terrein, dan wel de archeologische vindplaats. Daartoe wordt informatie verzameld over bekende en verwachte archeologische resten teneinde een gespecificeerde archeologische verwachting op te stellen. Hiertoe is een aantal onderzoeksvragen geformuleerd:

- Hoe ziet de geo(morfo)logische en/of bodemkundige opbouw van het plangebied eruit?
- Welke gegevens met betrekking tot archeologische complexen in en rond plangebied zijn reeds bekend?
- Wat was het historisch landgebruik van het plangebied en wat is het landgebruik nu en wat is de invloed daarvan op de (verwachte) archeologie en (bodem)gaafheid?
- Wat is de gespecificeerde verwachting ten aanzien van nog onbekende archeologische waarden in het gebied? En wat zijn hiervan de prospectiekenmerken?

Algemeen

- Wat is de invloed van de toekomstige inrichting op eventuele archeologische resten?
- Op welke wijze kan bij de planvorming met archeologische resten worden omgegaan?
- Met de inzet van welke zoekmethoden kunnen verwachte resten systematisch opgespoord worden (zoeksleuven, booronderzoek, veldkartering, geofysisch etc.)?

2 Bureauonderzoek

2.1 Methode

Het bureauonderzoek dient ervoor om – op basis van verschillende bronnen – inzicht te krijgen in de genese van het landschap, de bodemopbouw en de sporen die het menselijk gebruik in de loop van de tijd heeft achtergelaten. Met behulp van deze gegevens wordt een gespecificeerde archeologische verwachting opgesteld.

Naast de conform de KNA verplichte bronnen is door de gebiedsexperts van RAAP een beredeneerde keuze gemaakt uit betrouwbare bronnen die voor de archeologische verwachting relevante informatie bevatten (zie bijlage 2 voor de motivering). Daarvoor is gebruik gemaakt van de landelijk en voor RAAP digitaal beschikbare archieven. Voor de beschrijving van de historische situatie is gebruik gemaakt van hiervoor relevante informatiedragers. Voor de actuele metadata van de verzamelde gegevens (gemeente, plaats, etc.) wordt verwezen naar het van toepassing zijnde data-archief.

2.2 Aardkundige situatie (bijlage 7)

De geologische ondergrond van de gemeente Zwartewaterland is onderdeel van een in noordoostelijke richting hellend dekzandplateau dat door riviergeulen is versneden. Plaatselijk zijn op dit plateau hogere zandkoppen opgestoven die tegenwoordig nog boven het maaiveld uitsteken. Door de stijging van de zee- en grondwaterspiegel gedurende het holoceen is het dekzandplateau vernat, waarna sprake was van veengroei. In de polder Mastenbroek nam de veengroei omstreeks 1600 voor Chr. een aanvang en zette zich voort tot rond het begin van onze jaartelling. Het uitgestrekte veengebied werd toentertijd ontwaterd door geulen die tegenwoordig nog in het landschap zichtbaar zijn. Op de best ontwaterde delen kwam een moerasbos tot ontwikkeling. In drogere periodes zijn vanuit drooggevallen rivierbeddingen duinen opgestoven op de oostoever van de Vecht. Rond het begin van de vroege middeleeuwen nam de waterafvoer via de IJssel toe. De regelmatig buiten zijn oevers tredende rivier heeft op het veen in Mastenbroek circa een halve meter klei afgezet. Ten oosten van het Zwartewater ontbreekt een dergelijk kleidek, of is hooguit sprake van een dun dek, en ligt veen of dekzand vrijwel aan de oppervlakte (bijlage 7).[4]

In geomorfologisch opzicht bestaat de polder Mastenbroek grotendeels uit een ontgonnen veenvlakte (met een dun kleidek) die nabij de Vecht/Zwartewater is beïnvloed door (afzettingen van) deze rivier. Op de hoge oostoever van het Zwartewater bevinden zich rivierduinen en dekzandwelvingen die de overgang vormen naar laaggelegen veen- broekgebieden ten oosten daarvan (bijlage 7).

De geologische en geomorfologische situatie weerspiegeld zich in de bodemgesteldheid. In Mastenbroek worden hoofdzakelijk weide- en waardveengronden aangetroffen met een dun dek van zavel en klei en al dan niet met zand binnen 120 cm -mv. Langs de meandergordel van de Vecht is het kleidek dikker en is sprake van drechtvaaggronden. Waar veen ontbreekt binnen 80 cm -mv wordt gesproken van poldervaaggronden. Uit de rivierbedding opgestoven riverduinen en door de rivier afgezette plateaus van grove rivierzanden zijn geclassificeerd als vlakvaagronden. In de veengebieden ten oosten van de Vecht is sprake van koopveen-, weideveen- en waardveengronden al dan niet met

[4] Clevis, Klomp & Kranenborg 2009, 34-36.

een dun dek van rivierklei. Op de overgang naar de hogere rivierduingronden liggen moerige podzolgronden (bijlage 7).

Geologische situatie (Weerts et al., 2006)	Mastenbroek: Formatie van Echteld/Formatie van Nieuwkoop op Formatie van Boxtel; rivierklei en-zand met inschakelingen van veen op zand. meandergordel Zwartewater: Laagpakket van Singraven; beekzand en -leem. hoge oostoever Zwartewater: Laagpakket van Wierden; dekzand. veen- en broekgebied: Formatie van Boxtel met een dek van het laagpakket van Wierden; fluvioperiglaciale afzettingen (leem en zand) met een zanddek. Formatie van Nieuwkoop; veen.
Geomorfologische situatie (Koomen & Maas, 2004)	Mastenbroek: getij-riviermonding (B73); rivierkomvlakte (M46); rivierkom- en oeverwalachtige vlakte (M48); vlakte van ten dele verspoelde dekzanden of lössen (M53); ontgonnen veenvlakte (M81); laagte zonder randwal (N51); restgeul (R43); overloop of crevassegeul (R44). meandergordel Zwartewater: doorbraak waaier (G41); meanderruggen en -geulen (L42); welvingen in rivierafzettingen (L43); vlakte van rivierafzettingen (M45); rivierkomvlakte (M46); rivierkom- en oeverwalachtige vlakte (M48); restgeul (R43); hoge oostoever Zwartewater: rivierduin (B57); dekzandwelvingen (L51). veen- en broekgebied: ontgonnen veenvlakte (M81); vlakte van ten dele verspoelde dekzanden of lössen (M53).
Ouderdom geomorfologische structuur	laat-pleistoceen (diepere geologische ondergrond) tot holoceen (meandergordel Vecht en veenvlakten)
Bodemkundige situatie	Mastenbroek: overslaggronden (AO); waardveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen (kVc);

	weideveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen- (pVc) of waardveengronden (kVz) op zand, beginnend ondieper dan 120 cm; meandergordel Zwartewater: kalkarme poldervaaggronden (Mn82C); drechtvaaggronden (Mv41C); vlakvaaggronden, grof zand (Zn30). hoge oostoever Zwartewater: vlakvaaggronden, grof zand (Zn30). veen- en broekgebied: koopveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen (hVc); waardveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen (pVc); waardveengronden (kVz) op zand, beginnend ondieper dan 120 cm moerige podzolgronden met een zavel- of een kleidek en een moerige tussenlaag (kWp); weideveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen (pVc).
Verwachte diepteligging van archeologisch relevante lagen	vlak onder het maaiveld op huisterpen, rivierduinen en dekzandreliëf. Op rivierduinen eventueel afgedekt door een cultuurdek of een laag veen langs de randen.

Tabel 2. Overzicht van geraadpleegde geologische, geomorfologische en bodemkundige kenmerken.

2.3 Archeologische gegevens

Gemeentelijk archeologiebeleid (bijlage 6)

Bestemmingsplan buitengebied (NL.IMRO.1896.BP0035-VS01; vastgesteld 10-10-2013)	In het bestemmingsplan buitengebied van de gemeente Zwartewaterland is aan diverse delen van het onderzoeksgebied een dubbelbestemming Archeologie toegekend. Het beleid voor deze dubbelbestemming schrijft voor dat er bij bodemingrepen groter dan 100 m^2 en dieper dan 50 cm -mv een archeologisch onderzoek dient te worden uitgevoerd. De geplande ingrepen zijn groter dan de vrijstellingsgrens. Een archeologische onderbouwing met betrekking tot de eventuele aanwezigheid van archeologische waarden is daarom verplicht conform het vigerend beleid.
Gemeentelijke archeologische verwachtingskaart (Clevis, Klomp & Kranenborg 2009)	Op de gemeentelijke verwachtingskaart zijn vier zones met een verschillende archeologische verwachting onderscheiden. Een 0% gebied is archeologisch leeg. Van een 10% gebied is de archeologische waarde onbekend, in deze gebieden wordt proefonderzoek aanbevolen. Een 50% gebied is archeologisch waardevol met een hoge archeologische verwachting waar bij ingrepen een inventariserend veldonderzoek dient plaats te vinden. Een 90% gebied is zeer waardevol de vondstkans is bijna 100%, bij ingrepen is een opgraving noodzakelijk.

Tabel 3. Overzicht van het geldende archeologiebeleid en achterliggende verwachtingskaart.

In het '10%-gebied' in de polder Mastenbroek blijken zich volgens een gedetailleerde bodemkaart zones met dekzandreliëf op een geringe diepte beneden het maaiveld te bevinden.[5] Deze zones met een verhoogde kans op de aanwezigheid van archeologische resten zijn aan kaartbeeld van de gemeentelijke verwachtingskaart toegevoegd (bijlage 8).

Terreinen met een archeologische waarde en vondstmeldingen (bijlage 8)

Op de Archeologische Monumentenkaart (AMK) zijn in de gemeente Zwartewaterland verscheidene waardevolle archeologische terreinen aangeduid. Het zijn zonder uitzondering huisterpen in de polder Mastenbroek die als 'terrein van hoge archeologische waarde' zijn aangemerkt. Aangezien de AMK sinds 2014 niet meer wordt bijgewerkt en de begrenzing van de weergegeven terreinen veelal niet overeenkomt met de gemeentelijke archeologische verwachtingskaart, is besloten om de AMK-terreinen binnen onderhavig onderzoek niet af te beelden. De op de AMK aangegeven huisterpen zijn verwerkt in de gemeentelijke archeologische verwachtingskaart en hebben een dubbelbestemming - waarde archeologie in de vigerende bestemmingsplannen.

Verder is in Archis 3 één vondstmelding in het onderzoeksgebied opgenomen (tabel 4). De bekende vindplaats heeft geen relatie met de hierboven beschreven landschappelijke kenmerken. Het gaat om vondsten op een op de geomorfologische kaart en op historische kaarten aangeduide huisterp: De Werf.

Zaakidentificatienr.	Ligging	Complex	Datering	Materiaal	Diepte	Verzamelwijze
3086938100	aan westelijke voet van huisterp De Werf	huisterp	late middeleeuwen-nieuwe tijd	keramiek	maaiveld	enkele stuks roodbakkend aardewerk gevonden in persbult

Tabel 4. Overzicht van de bekende archeologische monumenten en archeologische vondstlocaties in en rond het plangebied.

Eerder in de omgeving uitgevoerd onderzoek volgens ARCHIS3 (bijlage 8)

Zaakidentificatienummer	**Aard**	**Opmerking**
4627606100	bureauonderzoek	zie bijlage 3 (Paré & Boon 2018)
4677162100	booronderzoek	zie bijlage 3 (Brongers 2019);
4868144100	bureau- en booronderzoek	zie bijlage 3 (Koeman 2020a)
4874105100	bureauonderzoek	zie bijlage 3 (Koeman 2020b)
4903687100	geofysisch onderzoek	zie bijlage 3 (Van den Oever 2021)

Tabel 5. Overzicht van eerder archeologisch onderzoek in en rond het plangebied.

Bekende archeologische gegevens uit andere bronnen (bijlage 8)

In het uiterste noorden van het onderzoeksgebied, langs de omstreeks 1364 aangelegde Kamperzeedijk, is sprake van een oude woonplaats. Hier wordt al vroeg melding gemaakt van herberg 'Het Witte Schaap'. Op de archeologische verwachtingskaart van Zwartewaterland staat de locatie daarvan als archeologisch zeer waardevol aangeduid (90%) en het omliggende terrein als archeologisch waardevol (50%; verwachtingskaart Zwartewaterland no. 332).[6]

[5] Bles, Groot Obbink & Rutten 1970.
[6] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 332.

Langs de Oude en de Nieuwe Wetering liggen oude bewoningslinten in de polder Mastenbroek. Drie van de huisterpen in deze linten, die niet ouder zijn dan de veertiende eeuw, valt binnen het onderzoeksgebied. De betreffende terpen zijn op de archeologische verwachtingskaart van Zwartewaterland als archeologisch zeer waardevol aangeduid (90%; verwachtingskaart Zwartewaterland no. 354 en 355).[7]

Langs de N331 Zwolle-Hasselt ligt de huisplaats van het voormalige erf Milligen. De exacte ouderdom is onbekend (verwachtingskaart Zwartewaterland no. 353).[8]

Langs de Zwolse dijk uit 1364 is sprake van een strook verspreide lintbebouwing. De boerderijen zijn vernieuwd in de late achttiende en in de negentiende eeuw (verwachtingskaart Zwartewaterland no. 351).[9]

Op een rivierduin oostelijk van de Vecht ligt de oude bewoningskern Holten. In dit gebied worden resten uit het mesolithicum en de bronstijd verwacht. In de dertiende eeuw zijn daarna weer mensen in dit gebied komen wonen (verwachtingskaart Zwartewaterland no. 325).[10]

Aan de oostzijde van de buurtschap Holten ligt een gebied met moerige podzolgronden. In dit gebied komt een aantal pleistocene zandopduikingen voor. Op één daarvan zijn vuurstenen artefacten uit het mesolithicum gevonden (verwachtingskaart Zwartewaterland no. 326).[11]

2.4 Cultuurhistorische gegevens (bijlage 8)

Op basis van historische kaarten kan inzicht worden verkregen in het historisch gebruik van een gebied van na de late middeleeuwen tot begin 20e eeuw. In die periode was men veel meer dan nu gebonden aan de (on)mogelijkheden die het natuurlijke landschap bood voor bewoning en andere vormen van landgebruik. Het historisch gebruik zegt daarmee iets over de archeologische potentie van het gebied. Daarnaast kan het informatie leveren over eventuele bodemverstoringen die in het verleden hebben plaatsgevonden.

Op historische kaarten staan in het onderzoeksgebied diverse oude woonplaatsen en andere cultuurhistorische elementen aangegeven. Een groot deel daarvan bestaat uit terpen die voor het merendeel al op de archeologische verwachtingskaart zijn aangeduid. Een deel ontbreekt daarop.

Aan de Kamperzeedijk, In het uiterste noorden van het onderzoeksgebied wordt al vroeg melding gemaakt van herberg ‘Het Witte Schaap’ (zie hierboven).[12] Ten oosten daarvan staat op de kadastrale minuut van 1811-1832 een historisch erf aangeven: G. Netjes (figuur 3). Niet ver ten zuiden daarvan bij de Lutterzijl, bevond zich een windmolen (watermolen), de zogenaamde Lutterzijlmolen (figuur 4). Op 23 september 1819 vond de aanbesteding plaats van de bouw van de molen bij de Lutterzijl. Uit het bestek dat nog is bewaard gebleven, kunnen we vaststellen dat de fundering uit 192 palen bestond van 7,85 m lengte. Voor het ophijsen van het 400 kilo zware heiblok waren dertig mannen nodig. Op de palen werd een rooster gelegd van zware balken, met daarop een vloer van ca. 8 cm dikke brede planken. Onder de funderingsvloer werden drie houten damwanden aangebracht, die moesten voorkomen dat het van hoog naar laag stromend grondwater de molen op den duur zou ondermijnen.

[7] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 354.
[8] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 353.
[9] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 351.
[10] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 325.
[11] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 326.
[12] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 322.

Daarop kwam de 5,8 m hoge stenen opgemetselde veldmuur, met daarop het achtkant. Het scheprad van bijna 6 m middellijn met 47 cm brede schoepen kon bij één omwenteling 6650 liter water uitslaan. De molen werd op 10 november 1821 opgeleverd en is omstreeks 1857 vervangen door een stoomgemaal.[13] Op de kadastrale minuut van 1832 staat ten zuiden van de molen een boerderij of woning aangegeven (E. Voerman; figuur 4). De locatie van de voormalige molen wordt doorsneden door een bouwweg.

Op de kadastrale minuut uit 1811-1832 zijn verder binnen het onderzoek verscheidene boerderijen / oude erven aangegeven. Langs de Oude Wetering in de polder Mastenbroek vallen twee huisterpen met de erven Werkel en Van de Vegte binnen het onderzoeksgebied (figuur 5). Aan de Nieuwe Wetering is een huisterp met erve Nijboer aangegeven (figuur 6). Iets oostelijker op dezelfde kavel ligt nog een huisterp met boerderij: De Werf (figuur 7).

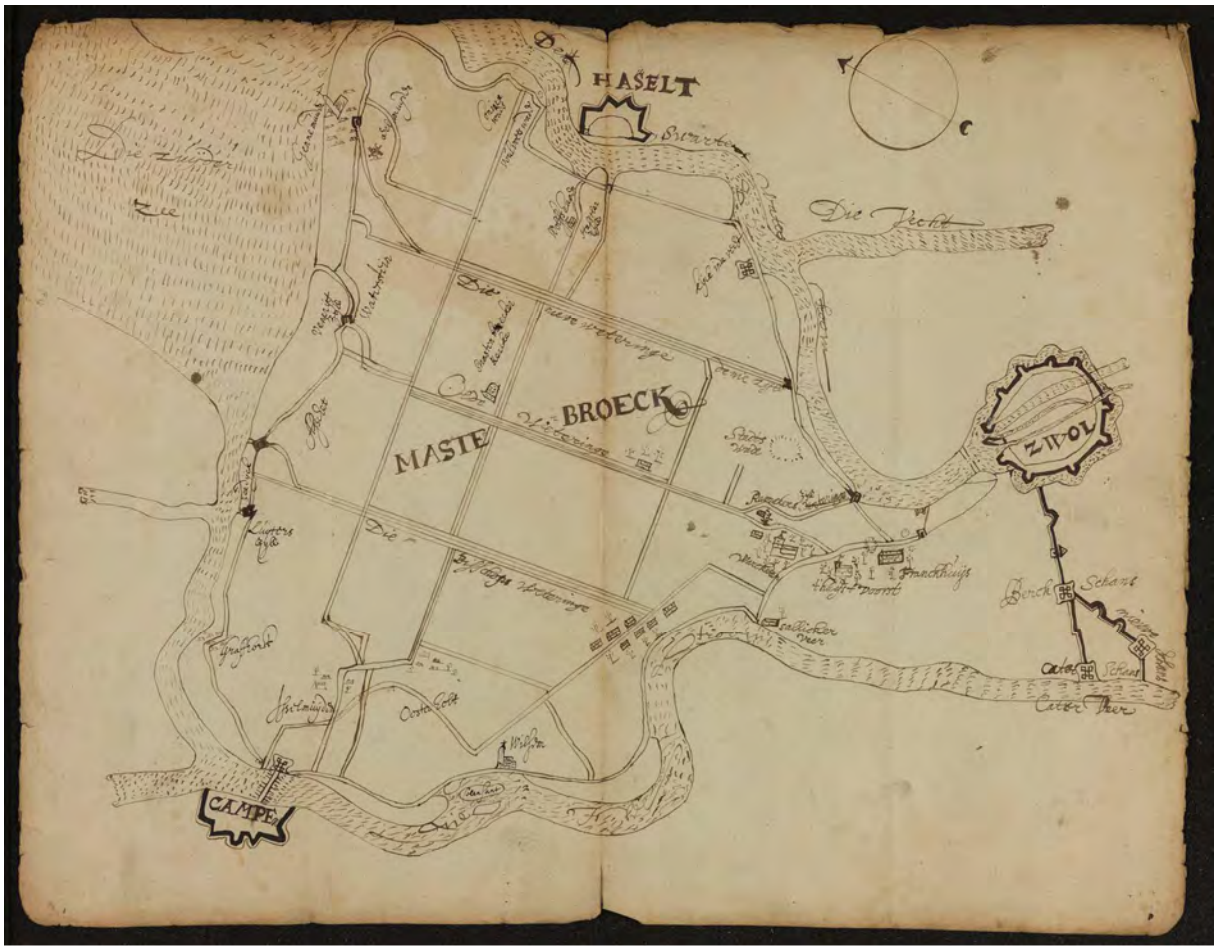
Nog twee historische erven, erve Heimich en een naamloos erf, zijn op de kadastrale minuut van 1811-1832 aangegeven aan de westzijde van de Zwolsedijk langs het Zwartewater (figuur 8).

Het merendeel van de historische erven ligt ter plaatse van de buurtschap Holten op de oostoever van het Zwartewater, waar er acht zijn geconcentreerd binnen de grenzen van het onderzoeksgebied tussen de Gennerdijk en de Verkavelingsweg. De plaats van één daarvan, erve De Hovenier, valt samen met de locatie van een hoogspanningsmast (figuur 9). De buurtschap Holten is vanaf de dertiende eeuw bewoond.[14]

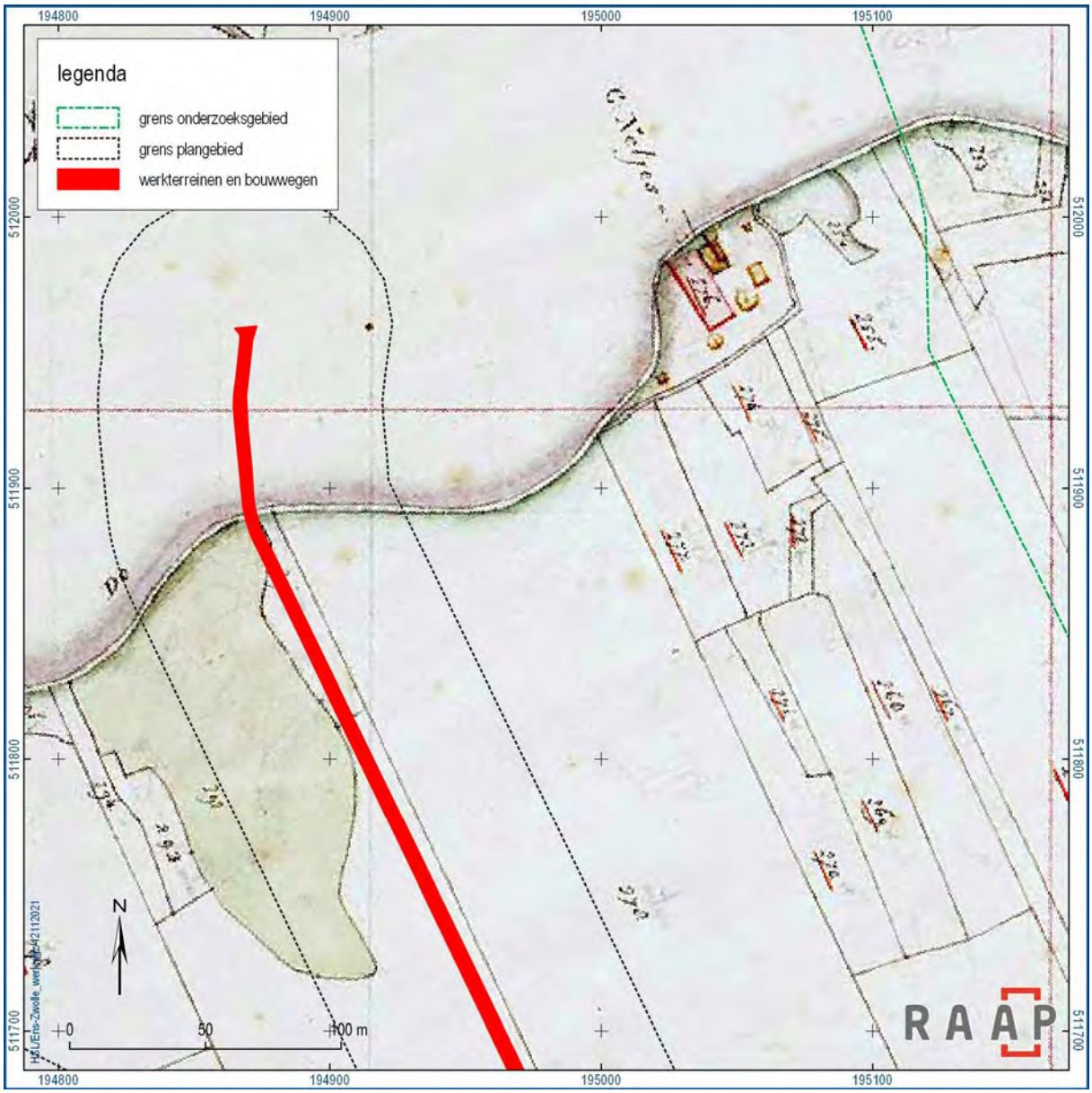
In de broek- en veengebieden ten oosten en zuidoosten daarvan bevinden zich geen historische erven, maar bevonden zich langs de uiterste randen van het onderzoeksgebied drie eendenkooien (bijlage 8). Geen daarvan valt samen met geplande ingrepen.

Binnen de grenzen van het onderzoeksgebied bevinden zich geen bouwkundige monumenten.

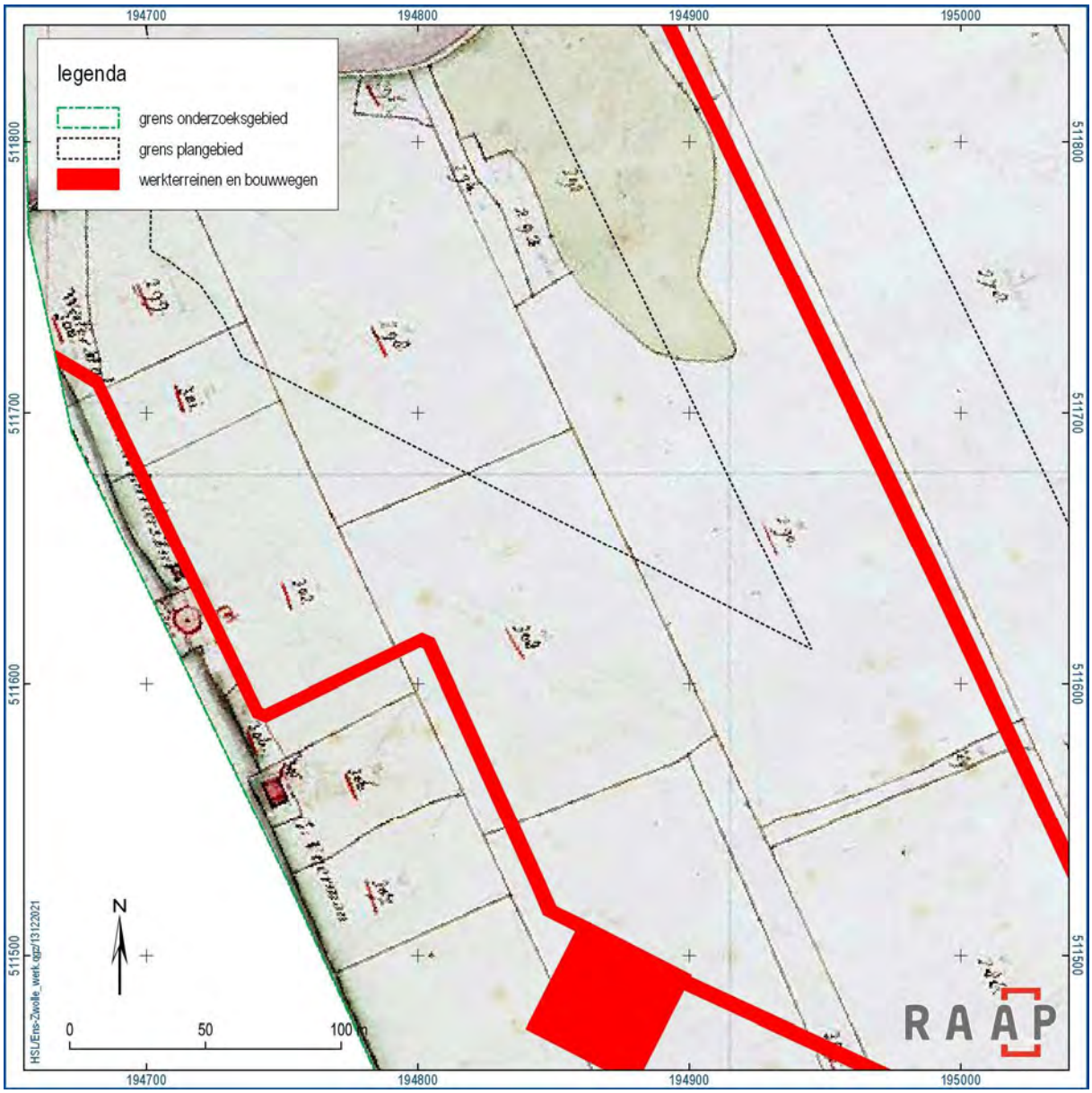
[13] https://www.molendatabase.org/molendb.php?step=details&nummer=12323; Van der Heide & Pereboom 1995.
[14] Clevis, Klomp & Kranenborg 2009, gebiedsnummer 325.



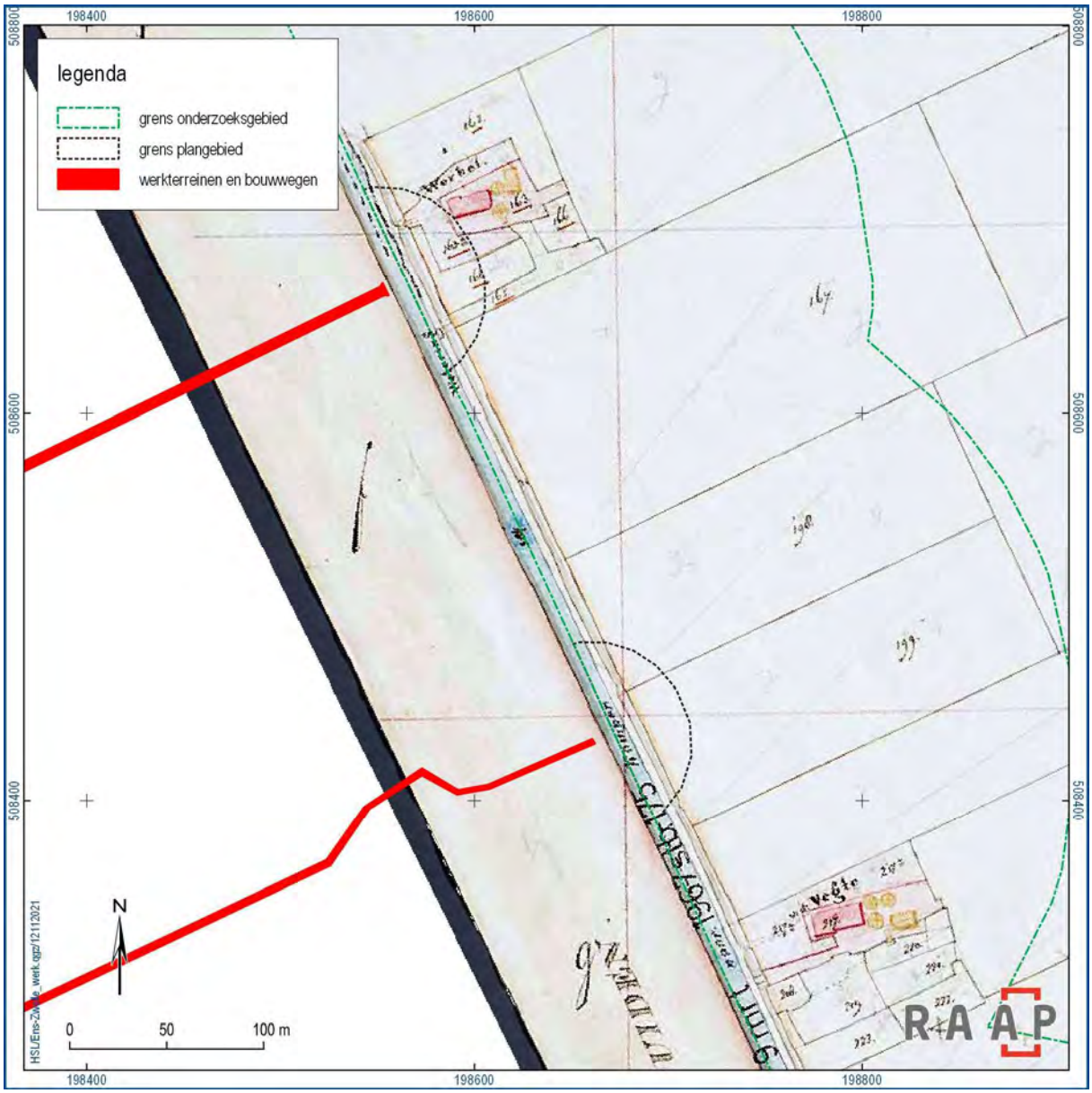
Figuur 2. Caerte van Mastenbroeck (ca. 1660) met de waterlopen en omliggende plaatsen (collectie Overijssel; 5803-KD000202).



Figuur 3. Erve G. Netjes ten zuiden van de Kamperzeedijk aangegeven op de kadastrale minuut van 1811-1832.



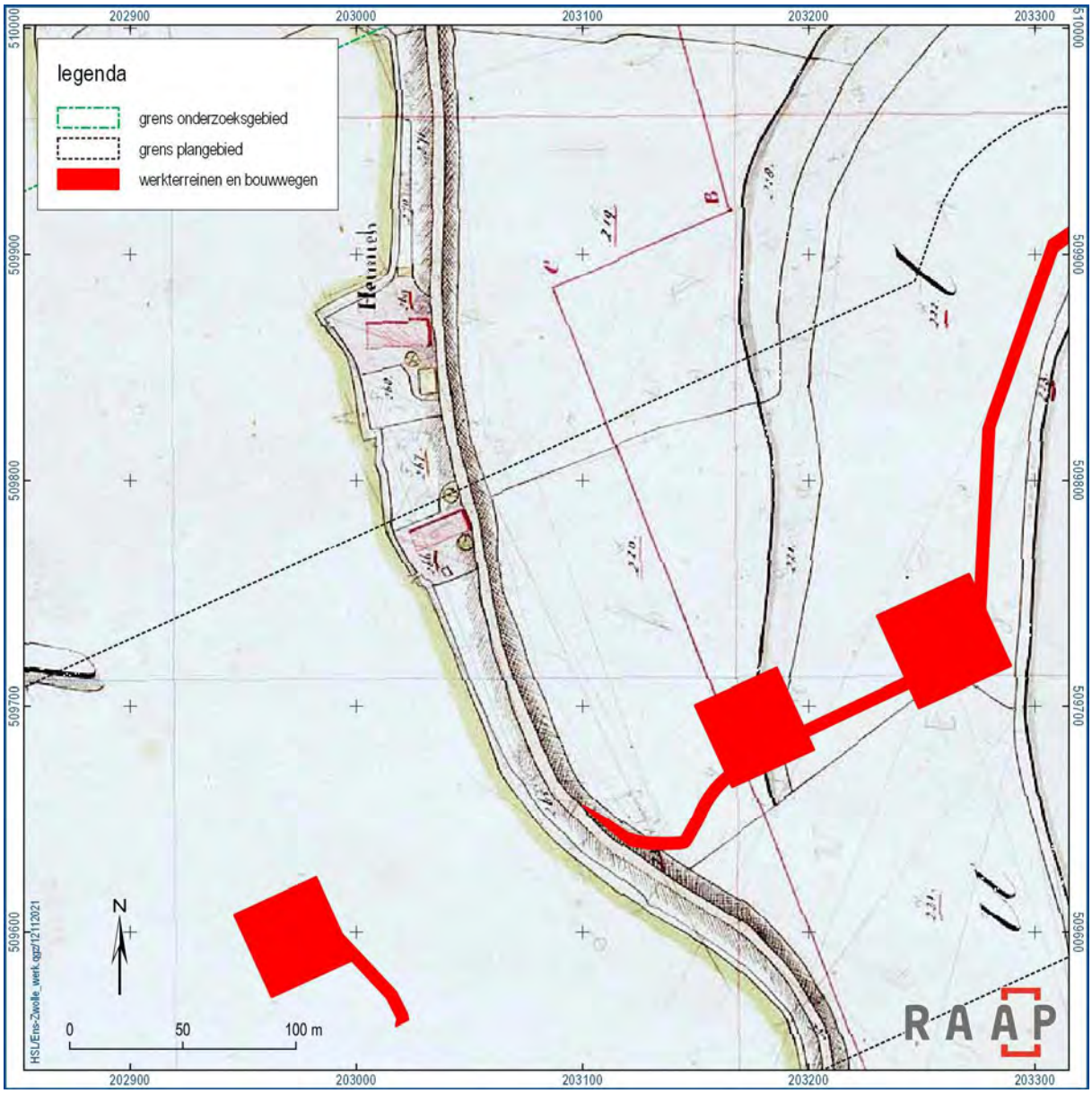
Figuur 4. Kadastrale minuut van 1811-1832 met de Lutterzijlmolen en een ten zuiden daarvan gelegen huisplaats (E. Voerman).



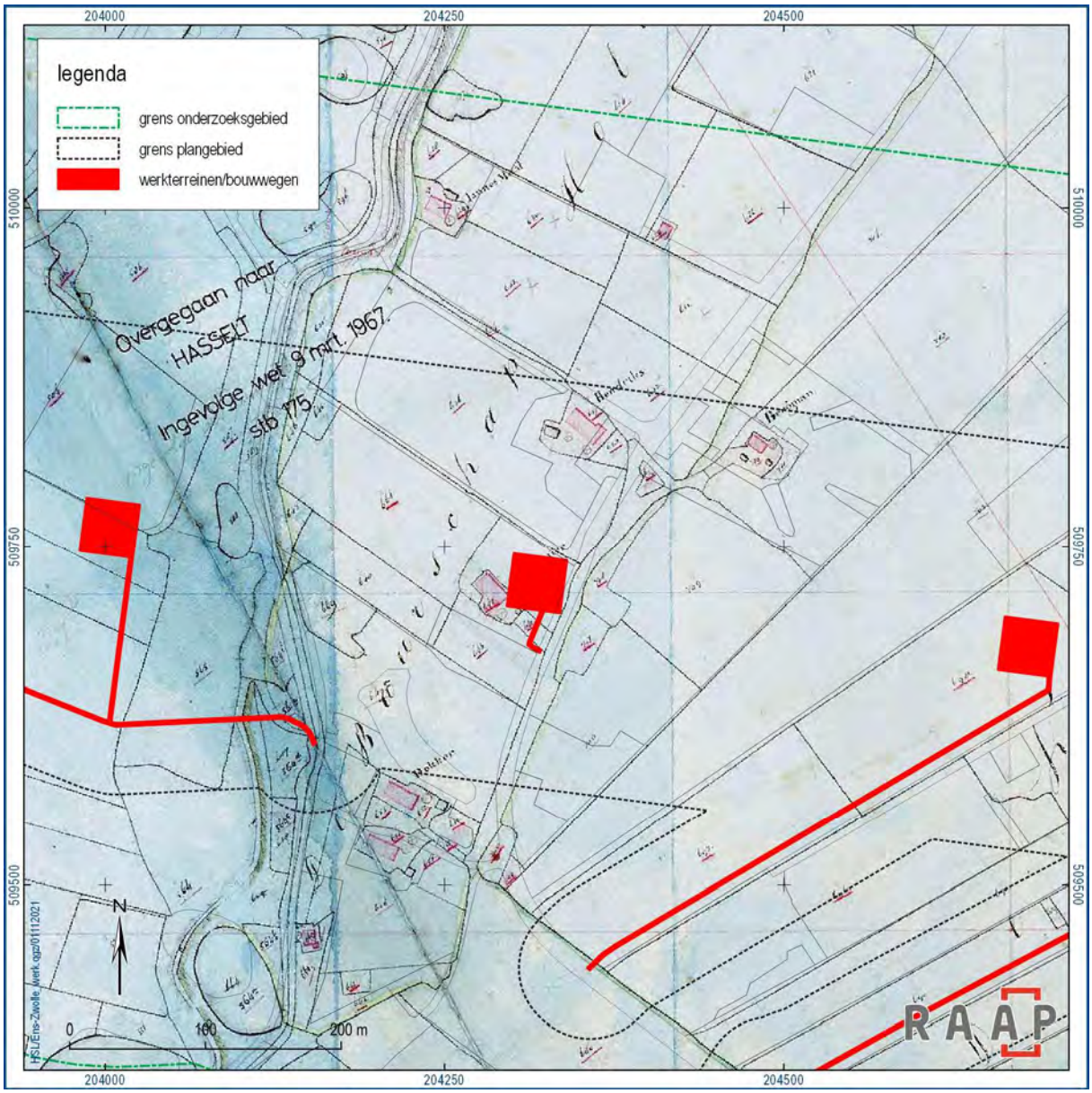
Figuur 5. Kadastrale minuut van 1811-1832 met de erven Werkel en De Vegte aan de Oude Wetering.

Figuur 6. Erve Nijboer aan de Nieuwe Wetering in de polder Mastenbroek op de kadastrale minuut van 1811-1832.

Figuur 7. Huisplaats De Werf op de kadastrale minuut van 1811-1832.



Figuur 8. Erve Heimich en een naamloos erf langs de Zwolsedijk op de kadastrale minuut van 1811-1832.



Figuur 9. Historische erven ter hoogte van de buurtschap Holten op de kadastrale minuut van 1811-1832.

Resten uit de Tweede Wereldoorlog (Wouter Groenendijk, Arcadis; bijlage 9)

Binnen het traject Zwolle-Ens is er een gebied te vinden met een verwachting op archeologische resten uit de Tweede Wereldoorlog ter hoogte van de buurtschap Holten op de oostoever van het Zwartewater. Deze behoren tot de verdedigingswerken langs de Gennerdijk, nabij Hasselt (figuur 10 en figuur 11).

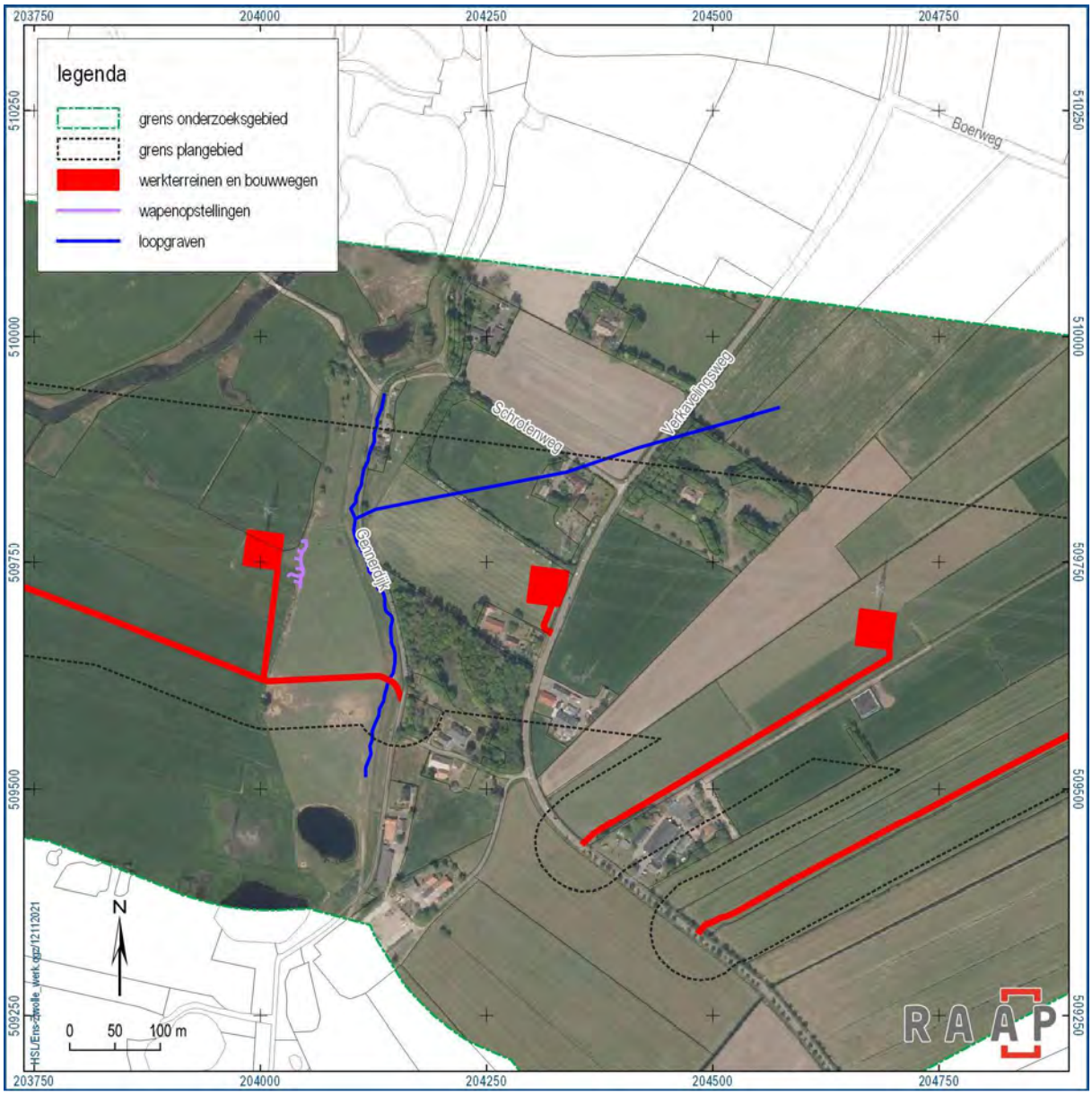
Op het luchtfotomateriaal van 6 oktober 1944 (luchtfotonummer 3090) zijn enkele loopgraven en wapenopstellingen (mitrailleursnesten) waargenomen. De identiteit van de op het luchtfotomateriaal waargenomen objecten kon worden bevestigd middels het beschikbare kaartmateriaal (Defence Overprint), waarop overigens meer loopgraven zijn aangeduid dan op de bestudeerde luchtfoto's (figuur 12).

Figuur 10. RAF-luchtfoto van 6 oktober 1944 met daarop aangegeven loopgraven op de Gennerdijk ter hoogte van Holten en een gevechtsstelling (rode pijlen) ten westen daarvan (fotonummer:3090_Hasselt_1944).

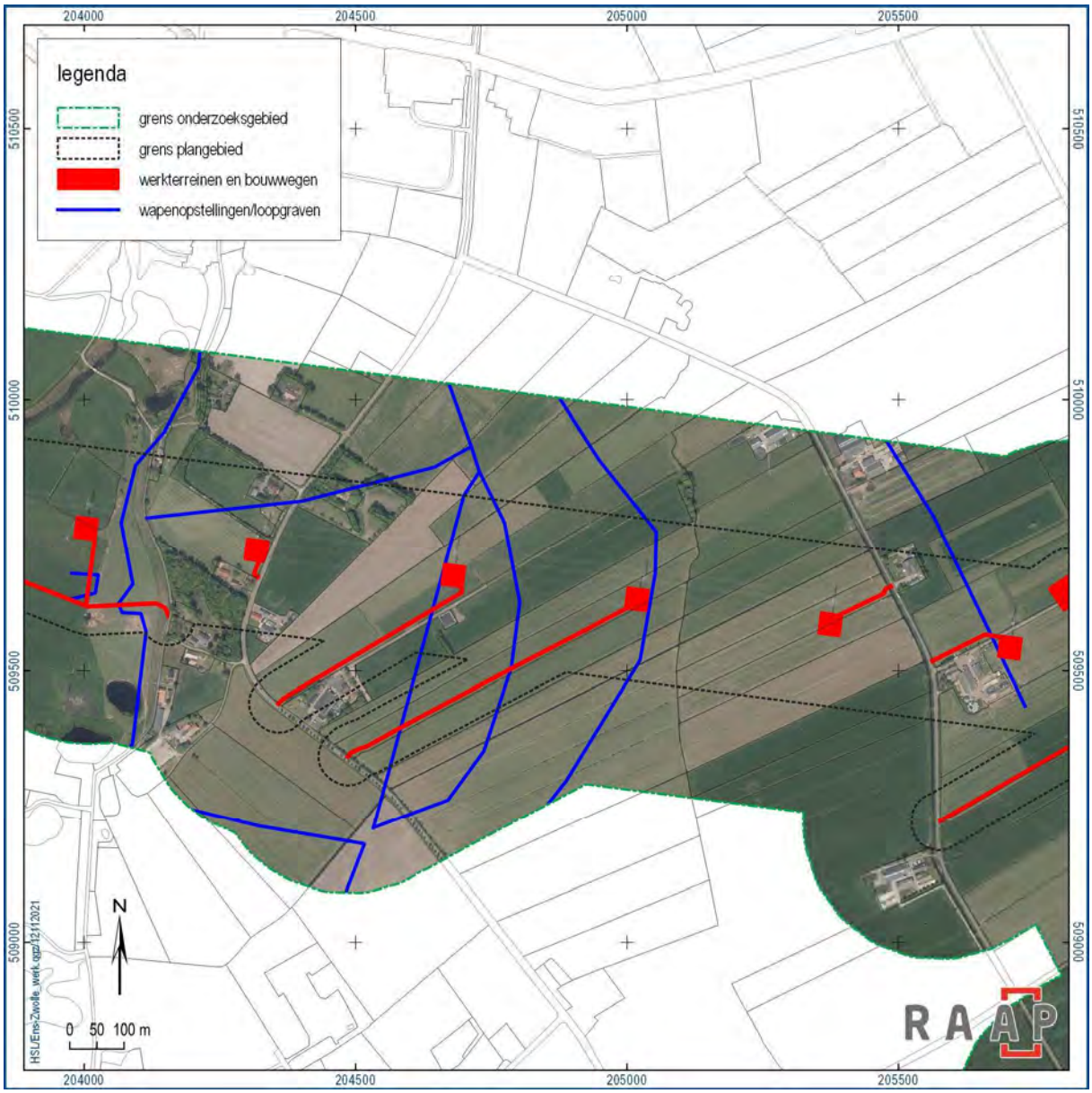
De Duitsers zijn in september 1944 begonnen met het aanleggen van deze werken, door middel van dwangarbeiders o.l.v. de Organisation Todt, om te voorkomen dat de geallieerden gemakkelijk via het westelijke deel van Nederland zouden kunnen oprukken. Vanuit die gedachte zijn ook linies in Drenthe aangelegd, die weer aansloten op linies in Overijssel en zo verder. Uiteindelijk zijn die verdedigingswerken nooit gebruikt, in ieder geval niet tijdens gevechten tussen geallieerde en Duitse troepen. Desondanks zijn de loopgraven en stellingen wel verdacht vanuit het NGE-vooronderzoek, met als reden dat het vaak voorkwam dat er materieel werd achtergelaten in verdedigingswerken of bij het

opruimen in de gegraven stellingen werd gedumpt. De gebieden zijn daarom afgebakend op achtergelaten OO. Het is dus wel mogelijk om nog materieel aan te treffen, maar de kans is m.i. een stuk kleiner dan elders waar in de frontgebieden hard is gevochten (bijv. Arnhem, Nijmegen etc., waar met regelmaat in dit soort stellingen OO worden aangetroffen). De werken blijven verdacht.

De loopgraven, verbindingsgraven en mitrailleursnesten zijn archeologisch gezien interessant en bevinden zich mogelijk nog in de bodem. De locaties van meerdere hoogspanningsmasten lijken samen te vallen met loopgraven. De op figuur 11 en de overzichtskaart (bijlage 9) aangegeven loopgraven zijn echter bij benadering, dat wil zeggen op tientallen meters nauwkeurig. De exacte locatie moet nog worden vastgesteld. Wees bij graafwerkzaamheden altijd voorbereid op NGE-resten.



Figuur 11. De ligging van loopgraven en een gevechtsstelling afgeleid van luchtfoto's uit de Tweede Wereldoorlog.



Figuur 12. Ligging van loopgraven en gevechtsstellingen (bij benadering) ter hoogte van de buurtschap Holten (dikke zwarte lijnen), gebaseerd op de Defence Overprint uit 1944/45.

2.5 Huidige situatie

Aan de hand van actuele gegevens van recente luchtfoto's, Google Street View zijn de onderstaande zaken over de huidige situatie te melden (bijlage 5).

Huidig grondgebruik	agrarisch (vooral grasland)
Hoogteligging maaiveld	tussen 2,5 m -NAP en 1,5 m NAP
Grondwatertrap of -stand	IIb tot VI; gemiddeld hoogste grondwaterstand 25-40 cm, gemiddeld laagste grondwaterstand 50-80 cm -mv tot gemiddeld hoogste grondwaterstand 40-80 cm, gemiddeld laagste grondwaterstand > 120 cm -mv
Milieutechnische condities	ter plaatse van de mastlocaties en werkterreinen zal milieuhygiënisch onderzoek verricht worden
Aanwezige constructies (funderingen, kelders e.d.)	onbekend

Tabel 6. Overzicht van de huidige situatie van het plangebied.

2.6 Toekomstige situatie

Uit aangeleverde informatie van de opdrachtgever is het volgende gebleken over de toekomstige situatie:

Aard	er worden bouwwegen en werkterreinen aangelegd en weer verwijderd, waarna het terrein cultuurtechnisch wordt hersteld. Bij een deel van de hoogspanningsmasten wordt de fundering versterkt
Omvang en diepte	de exacte omvang en diepte van de ingrepen is vooralsnog onbekend
Invloed op maaiveld en grondwater	er worden bouwwegen en werkterreinen aangelegd en weer verwijderd, waarna het terrein cultuurtechnisch wordt hersteld.
Toekomstig gebruik	agrarisch en hoogspanningsmasten

Tabel 7. De toekomstige situatie.

3 Gespecificeerde archeologische verwachting

Op basis van de tijdens het bureauonderzoek verzamelde gegevens is een gespecificeerde archeologische verwachting opgesteld. Deze geeft inzicht in de aard en de ouderdom (inclusief omvang en uiterlijke kenmerken), (diepte)ligging, en gaafheid van eventueel aanwezige archeologische resten.

Aard en ouderdom

Prehistorie, Romeinse tijd en vroege middeleeuwen
In de steentijd (paleolithicum t/m neolithicum) leefden de mensen voornamelijk van de jacht, visvangst en het verzamelen van eetbare planten en vruchten. Deze zogenaamde jager-verzamelaars trokken door het landschap en verbleven alleen tijdelijk op een plek. Meestal ging het hierbij om droge plekken (zandruggen of koppen) in of aan de rand van water of waterrijke gebieden, waar zich veel wild bevond en eetbare planten groeiden. Met de introductie van de landbouw (vanaf het neolithicum) werd de mate waarin gronden geschikt waren om te beakkeren een steeds belangrijker factor in de locatiekeuze van de mensen. De eerste akkergronden werden aangelegd op de van nature vruchtbaarste gronden, die bovendien goed ontwaterd moesten zijn.

Het onderzoeksgebied in de gemeente Zwartewaterland bestaat voor het grootste deel uit (voormalige) laaggelegen veen- en broekgebieden. Gebieden die in het verre verleden weinig aantrekkelijk waren voor bewoning. De enige locatie waar bewoningssporen en andere resten uit de prehistorie, Romeinse tijd en vroege middeleeuwen verwacht mogen worden is de hoge oostoever van het Zwartewater ter hoogte van de buurtschap Holten. Hier bevinden zich droge(re) rivierduinen, dekzandruggen en -koppen. Op deze hoger gelegen delen van het landschap kunnen resten van kampementen uit de steentijd en nederzettingen, grafvelden en agrarische structuren uit de periode van de bronstijd tot en met de vroege middeleeuwen verwacht worden.

Late middeleeuwen/nieuwe tijd
Na de drooglegging en ontginning van Mastenbroek vanaf omstreeks 1364 werd de polder al vrij snel bewoond. Bewoning bevond zich in de vorm van lintbebouwing op/langs de dijken (o.a. Kamperzeedijk, Gennerdijk) en langs de weteringen (o.a. de Oude en Nieuwe Wetering). Over het algemeen ging het om bewoning op verhoogde woonplaatsen/huisterpen. Deze zijn in het huidige landschap nog zichtbaar. Op elke terp stond een boerderij met bijgebouwen.
Ter hoogte van de buurtschap Holten was sprake van verspreide bebouwing op een rivierduin. De exacte ouderdom van deze erven is onbekend, maar aangenomen mag worden dat (een deel daarvan) al vanaf de veertiende eeuw aanwezig waren. In de nabijheid van de locaties van historische erven moet derhalve rekening gehouden worden met resten (paalsporen, kuilen, greppels) van oudere voorgangers.

Tweede Wereldoorlog
Ter hoogte van de buurtschap Holten op de oostoever van het Zwartewater zijn verder resten uit de

Tweede Wereldoorlog te verwachten. Deze behoren tot de verdedigingswerken langs de Gennerdijk, nabij Hasselt. Het gaat om loopgraven en gevechtsstellingen/wapenopstellingen (mitrailleursnesten).

Diepteligging

Afhankelijk van de aan- of afwezigheid van een afdekkende laag (veen, een stuifzanddek of een plaggendek) kunnen deze resten vlak onder de moderne bouwvoor of dieper dan circa 50 cm -mv voorkomen, bijvoorbeeld ter hoogte van de buurtschap Holten. Op terpen in de polder Mastenbroek zullen archeologische resten zich direct onder het huidige maaiveld kunnen manifesteren en zich tot enkele meters diep in de ondergrond kunnen bevinden. Het formaat van deze vindplaatsen varieert van enkele vierkante meters voor de kampementen tot meer dan een ha voor de nederzettingen uit latere perioden. Resten uit de tweede wereldoorlog worden direct onder het huidige maaiveld verwacht.

Fysieke kwaliteit

De conservering van eventuele archeologische resten is sterk afhankelijk van de aan- of afwezigheid van een afdekkende laag (veen, een stuifzanddek of een plaggendek). Waar resten zijn afgedekt, is de conservering doorgaans beter dan wanneer deze zich direct onder het maaiveld bevinden. Op de hoge en droge rivierduinen en dekzandruggen bij Holten zal de conservering van organisch materiaal (in onverbrande toestand) matig tot slecht zijn. Op de van kleiig materiaal opgeworpen huisterpen in de polder Mastenbroek zal de kwaliteit van eventuele archeologische resten (van organisch materiaal) goed zijn. Hierbij moet wel in acht genomen worden dat ondiep gelegen resten hier verstoord kunnen zijn door latere bebouwing.

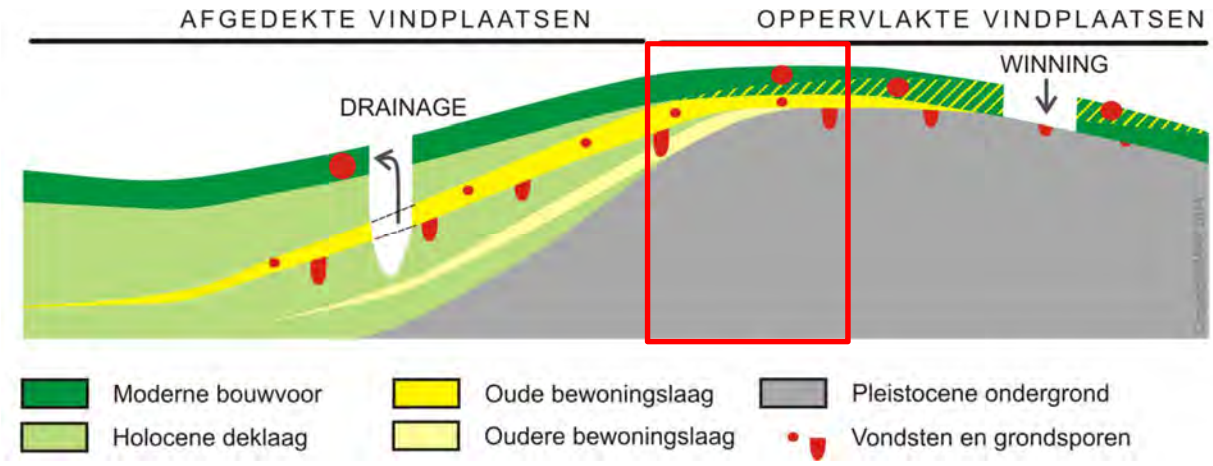
Overzicht

De archeologische verwachting en de verschillende deelaspecten daarvan, zoals hiervoor beschreven, zijn samengevat in tabel 8. Daarnaast zijn de prospectiekenmerken met betrekking tot de verwachte archeologische resten in figuur 13 schematisch verbeeld.

Archeologische periode	Complextype	Omvang	Kenmerken	Diepte-ligging	Gaafheid
steentijd	kampementen, nederzettingen, graven	enkele tientallen vierkante meters	afvallaag met vuurstenen en stenen artefacten, verbrand en (eventueel) onverbrand bot, met daaronder grondsporen (kuilen, paalsporen, haarden, graven etc.).	direct onder de moderne bouw of onder een dunne, afdekkende laag (veen, stuifzand, cultuurdek)	matig tot goed
bronstijd - vroege middeleeuwen	nederzettingen, grafvelden, agrarische structuren	één tot enkele hectares	paalsporen van gebouwen, (afval)kuilen, waterputten, greppels en graven. Bij afgedekte vindplaatsen kan op het	direct onder de moderne bouw of onder een dunne, afdekkende laag (veen,	matig tot goed

Archeologische periode	Complextype	Omvang	Kenmerken	Diepte-ligging	Gaafheid
			sporenniveau een afvallaag resteren.	stuifzand, cultuurdek	
middeleeuwen - nieuwe tijd	huisterpen, nederzettingen en agrarische structuren	tot enkele hectares	paalsporen van gebouwen, (afval)kuilen, waterputten en greppels	direct onder het huidige maaiveld of afgedekt door een cultuurdek dieper dan 50 cm -mv	matig tot goed
Tweede Wereldoorlog	loopgraven en wapenopstellingen	lineaire en vlakelementen, tientallen tot honderden vierkante meters	loopgraven en kuilen	direct onder het huidige maaiveld	matig tot goed

Tabel 8. Samenvatting van de gespecificeerde archeologische verwachting voor het plangebied.



Figuur 13. Diagram voor archeologische vondst- en spoorcomplexen. Rode kader: aanduiding van de situatie in het plangebied.

4 Conclusies en advies

4.1 Conclusie

Op grond van de onderzoeksresultaten en onder verwijzing naar de doelstellingen, kunnen de volgende uitspraken worden gedaan (bijlage 10):

Binnen specifieke delen van het onderzoeksgebied is sprake van archeologisch waardevolle of zeer waardevolle gebieden met een hoge of zeer hoge trefkans op het aantreffen van archeologische resten. In de polder Mastenbroek gaat het uitsluitend om verhoogde woonplaatsen/huisterpen en de locatie van een windmolen uit de late middeleeuwen en nieuwe tijd: de Lutterzijlmolen. De locatie van de voormalige windmolen wordt doorsneden door een geplande bouwweg. Op de andere locaties zijn geen ingrepen gepland. Verder is in Mastenbroek de kans op het aantreffen van archeologische resten buiten de huisterpen, anders dan losse vondsten, relatief klein. Een uitzondering vormen mogelijk enkele gebieden met door holocene afzettingen afgedekt dekzandreliëf tussen de Nieuwe Wetering en het Zwarte Water.

Het enige gebied met een grotere aaneengesloten zone met archeologisch waardevolle of zeer waardevolle gebieden is de buurtschap Holten. Hier snijdt het onderzoeksgebied hoge rivierduinen en dekzandruggen/koppen waar archeologische resten vanaf de prehistorie verwacht worden. In de nabijheid van een relatief groot aantal historische erven worden archeologische resten van voorgangers uit de late middeleeuwen en/of nieuwe tijd verwacht. Ter hoogte van het voormalige erve De Hovenier (direct ten noorden van Verkavelingsweg 7) bevindt zich een hoogspanningsmast op het voormalige erf. Bij werkzaamheden kunnen daar archeologische resten aan het daglicht komen. In de veen- en broekgebieden ten zuidoosten van Holten is de kans op archeologische resten, anders dan losse vondsten, zeer klein.

In de buurtschap Holten zijn op basis van historische bronnen resten van verdedigingswerken (loopgraven) en gevechts-/wapenopstellingen uit de Tweede Wereldoorlog te verwachten. Op meerdere plaatsen wordt het tracé van een loopgraaf gesneden door een geplande werkweg of is een hoogspanningsmast naast een loopgraaf geplaatst. Deze locaties hebben een verhoogde kans op het aantreffen van resten uit de tweede wereldoorlog. Hier moet men tevens beducht zijn voor de aanwezigheid van Ontplofbare Oorlogsresten (OO). NB! De op de overzichtskaart aangegeven loopgraven zijn bij benadering, dat wil zeggen op tientallen meters nauwkeurig. De exacte locatie moet nog worden vastgesteld.

In de laaggelegen veen- en broekgebieden ten (zuid)oosten van Holten is de kans op de aanwezigheid van archeologische resten (zeer) gering. Langs de randen het onderzoeksgebied liggen (resten van) een aantal eendenkooien. Deze vallen echter niet samen met geplande ingrepen.

4.2 Advies

Op basis van de resultaten van het onderzoek blijkt dat in het plangebied (mogelijk) archeologische resten bedreigd worden door de voorgenomen bodemingrepen (bijlage 10), met name ter hoogte van de voormalige Lutterzijlmolen. Daarom wordt geadviseerd om op deze locatie de plannen zodanig aan te passen (graafwerkzaamheden tot een minimum beperken) en om mitigerende maatregelen te treffen

(bijvoorbeeld gebruik van rijplaten voor bouwwegen), zodat verstoring wordt voorkomen/tot een minimum wordt beperkt.

Indien en waar dit het geval is, en indien mitigerende maatregelen of planaanpassing niet mogelijk zijn, wordt aanbevolen in het kader van de bestaande planvorming vervolgstappen uit het proces van de Archeologische Monumentenzorg (AMZ) te nemen in de vorm van een inventariserend archeologisch booronderzoek om de diepteligging en kwetsbaarheid van archeologische resten vast te stellen.

In zones met dekzandreliëf op een geringe diepte in de polder Mastenbroek en in archeologisch (zeer) waardevol gebied in de buurschap Holten wordt archeologisch vervolgonderzoek aanbevolen om een beter beeld te krijgen van de (kans op de) aan- of afwezigheid van archeologische resten. Hierbij moet in eerste instantie geacht worden aan een verkennend of inventariserend booronderzoek op locaties waar binnen die zones ingrepen zijn gepland.

Op en rond de locaties van de bij benadering gelokaliseerde gevechtsstellingen en loopgraven in de buurtschap Holten is een onderzoek naar ontplofbare oorlogsresten noodzakelijk.

Voor de overige delen van het plangebied gelden binnen de gemeente Zwartewaterland geen planologische beperkingen. In deze delen van het plangebied wordt in het kader van dit onderzoek geen vervolgonderzoek aanbevolen. Indien bij de uitvoering van de werkzaamheden onverwacht archeologische resten worden aangetroffen, dan is conform artikel 5.10 van de Erfgoedwet aanmelding van de desbetreffende vondsten bij de Minister van Onderwijs, Cultuur en Wetenschap c.q. de Rijksdienst voor het Cultureel Erfgoed verplicht (vondstmelding via ARCHIS).

4.3 Tot slot

Dit rapport geeft (selectie)adviezen. Het is aan de bevoegde overheid, de gemeente Zwartewaterland, deze al dan niet over te nemen in de vorm van een (selectie)besluit.

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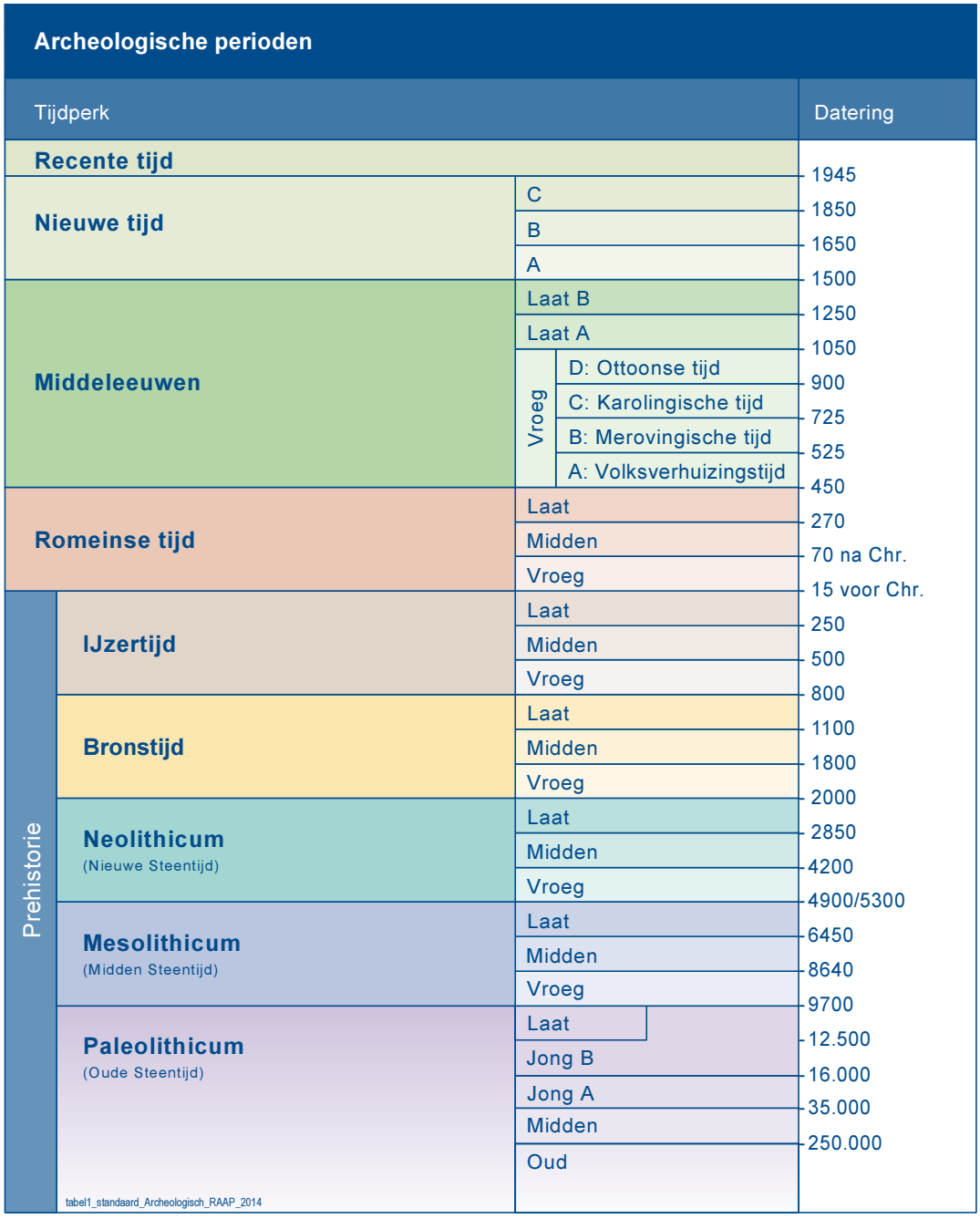
Bijlage 1. Tijdschaal



Bijlage 2. Motivatie geraadpleegde bronnen

LS03 en LS04, motivatie voor de keuze van de geraadpleegde bronnen (+ indien van toepassing)

Bron	Geraadpleegd en afgebeeld/beschreven	Geraadpleegd, niet afgebeeld	Niet beschikbaar voor dit plan-/onderzoeksgebied	Bevat geen (nieuwe) relevante informatie	Opmerking
Bodemkaart van NL	x				
Geologische kaart van NL	x				
Geomorfologische kaart van NL	x				
Gedetailleerde bodemkaarten	x				
Actueel Hoogtebestand Nederland	x				
Lucht- en satellietfoto's	x				
Topografische kaart van Nederland	x				
Oud(st)e kadasterkaarten	x				
Historische kaarten van Nederland	x				
Archeologische en cultuurhistorische rapportages	x				
AMK				x	
ARCHIS	x				
Literatuur (arch./aardwet.)		x			
Gemeentelijke waarden- of verwachtingskaart	x				

Bijlage 3. Onderzoeksmeldingen

Zaakidentificatie:	**2003431100**
Zaaktype:	Registratie niet-rapportplichtige onderzoeksmelding
Voorafgaand onderzoek:	-
Archis2 Onderzoeksmeldingsnr:	1205
Naam onderzoek:	-
Eigen kenmerk project:	-
Verwerving:	verwervingswijze niet te bepalen
Uitvoerder:	gemeente Zwolle
Bevoegd gezag:	particulier
Provincie:	Overijssel
Gemeente:	Zwartewaterland
Plaats:	Zwolle
Toponiem:	Schellerhoek/Oud Deventerstr.Weg
X coördinaat:	203800
Y coördinaat:	510000
Startdatum veldwerk:	01-11-1994
Verwachte einddatum veldwerk:	01-11-1994
Meldingsdatum:	01-11-1994
(Eerste) Bevindingen:	Noodopgraving wegens bouw woningen; Onduidelijk of de opgraving op de in ARCHIS aangegeven locatie is uitgevoerd. Het toponiem komt daar niet mee overeen. Schellerhoek is een buurt in Zwolle. Mogelijk is hier een foutieve coördinaat ingevoerd.
Status zaak:	Onderzoek afgemeld op 26-05-2015

Zaakidentificatie:	**4627606100**
Zaaktype:	Registratie niet-rapportplichtige onderzoeksmelding
Voorafgaand onderzoek:	-
Archis2 Onderzoeksmeldingsnr:	-
Naam onderzoek:	Onderhoud N760
Eigen kenmerk project:	360999
Verwerving:	archeologisch: bureauonderzoek
Uitvoerder:	Sweco
Bevoegd gezag:	gemeente
Provincie:	Overijssel
Gemeente:	Zwartewaterland
Plaats:	Genemuiden
Toponiem:	-
X coördinaat:	195348
Y coördinaat:	512080
Startdatum veldwerk:	13-08-2018
Verwachte einddatum veldwerk:	12-08-2019
Meldingsdatum:	10-08-2018
(Eerste) Bevindingen:	In opdracht van de provincie Overijssel heeft Sweco Nederland B.V. een archeologisch bureauonderzoek uitgevoerd naar de locatie N760 tussen IJsselmuiden en Genemuiden, respectievelijk gemeenten Kampen en Zwartewaterland. De aanleiding voor dit onderzoek is gepland onderhoud aan de N760 (provinciale weg tussen IJsselmuiden en Genemuiden). Het betreft groot onderhoud van een bestaande weg. Langs twee zones binnen het tracé zijn plannen om het fietspad te verbreden. Hier zullen mogelijk bodemingrepen tot 90 cm diep plaatsvinden. Het vervangen van al bestaand asfalt zal naar verwachting geen ingrijpende gevolgen voor het bodemarchief hebben. Het plangebied bevindt zich op en langs een Zuiderzeedijk, waarlangs meerdere terpen gevestigd zijn. De bevolking begon zich in de Middeleeuwen te beschermen tegen overstromingen, door het aanleggen van dijken langs de Zuiderzee. Aan het begin waren dit nog lokale, ‘losliggende’ dijken, maar al gauw werden deze met elkaar verbonden tot een aaneengesloten dijkenstelsel. Op basis van de geplande ingrepen en de landschappelijke en archeologische waarden van het gebied kunnen drie verwachtingszones worden onderscheiden: Deelgebied Nieuwe Gemaal: Hier valt het fietspad samen met een parallelweg die volgens historische kaarten ter hoogte van het originele dijklichaam ligt. Bodemingrepen kunnen hier archeologische waarden treffen die in verband staan met bewoning vanaf de Late Middeleeuwen tot aan de Nieuwe Tijd. Deelgebied West: Hier kruist het tracé een archeologisch monument die geïdentificeerd is als ‘terp,’ en bestaat de verwachting dat de geplande ingrepen archeologische waarden treffen die in verband staan met bewoning vanaf de Late Middeleeuwen tot aan de Nieuwe Tijd. Deelgebied Chr. Basisschool: Hier worden mogelijk hoog gelegen pleistocene gronden (verwachtte diepteligging 1 m -mv) geraakt, daar waar een vermoedelijke rivierduin aanwezig is. Hier kunnen archeologische waarden worden aangetroffen daterend vanaf het Paleolithicum tot het Neolithicum. Uit de periode tussen het Laat-Neolithicum tot de Late Middeleeuwen kunnen sporen aanwezig zijn die samenhangen met het sporadisch bezoeken van deze hoger gelegen locatie. Op basis van de resultaten van het bureauonderzoek wordt voor deelgebieden West en Chr. Basisschool geadviseerd om een karterend booronderzoek uit te laten voeren. Voor het deelgebied Nieuwe Gemaal wordt geadviseerd een verkennend booronderzoek te laten uit voeren. Op basis van dit booronderzoek en de uiteindelijk geplande werkzaamheden op deze locatie, kan een advies voor eventueel noodzakelijk archeologisch vervolgonderzoek worden opgesteld.
Status zaak:	Onderzoek afgemeld op 19-09-2021
Literatuur:	Paré & Boon 2018

Zaakidentificatie:	**4677162100**
Zaaktype:	Registratie rapportplichtige onderzoeksmelding
Voorafgaand onderzoek:	-
Archis2-onderzoeksmeldingsnr:	-
Naam onderzoek:	Zwolsedijk 1
Eigen kenmerk project:	2019-03/04
Verwerving:	archeologisch: boring
Uitvoerder:	De Steekproef
Bevoegd gezag:	gemeente
Provincie:	Overijssel
Gemeente:	Zwartewaterland
Plaats:	Hasselt
Toponiem:	-
X coördinaat:	203363
Y coördinaat:	509361
Startdatum veldwerk:	08-03-2019
Verwachte einddatum veldwerk:	08-03-2019
Meldingsdatum:	01-03-2019
Omschrijving:	-
Status zaak:	Onderzoek afgemeld op 30-10-2019
(Eerste) Bevindingen:	In verband met de geplande bouw van een woning met schuur is een archeologisch onderzoek uitgevoerd aan de Zwolsedijk 1 te Hasselt, gemeente Zwartewaterland, provincie Overijssel. Tijdens het veldonderzoek zijn zes boringen geplaatst om de opbouw en gaafheid van de bodem te bepalen. De gemiddelde boordichtheid is twintig boringen per hectare. Plangebied Zwolsedijk 1 ligt in de uiterwaard van de rivier Zwarte Water. Tijdens de middeleeuwen reikten de kwelders van het Almere en later de Zuiderzee tot aan het gebied. Het boerderij-erf sluit aan op de zomerdijk die over de westelijke oever van een voormalige rivierloop ligt. De dichtstbij bekende archeologische waarde is een laat-middeleeuwse huisterp. Op de kadastrale kaart van 1811-1832 staat een kleine boerderij, die mogelijk al dezelfde was die er nu staat. Tussen 1893 en 1933 is de voormalige riviergeul die dicht langs het plangebied liep gedempt. Ook lijkt toen het gebied noordelijk van het plangebied te zijn afgegraven. De verhoging waar de boerderij op staat is in één keer aangelegd met grof zand. Aangezien een boerderij op de kadasterkaart van 1811-1832 staat, is dit waarschijnlijk gebeurd aan het begin van de negentiende eeuw of eerder. De ophoging op het noordwestelijke deel van het erf is recenter, waarschijnlijk uit de twintigste eeuw. Bij het onderzoek zijn twee scherven aardewerk en een steel en een kop van een kleipijp gevonden. De vondsten dateren van omstreeks de negentiende eeuw. Het onderzoek heeft geen eenduidig middeleeuwse vondsten opgeleverd of afvallagen, stukken bot of dergelijke. Er is geen vervolgonderzoek aanbevolen.
Literatuur:	Brongers 2019

Zaakidentificatie:	**4874105100**
Zaaktype:	Registratie niet-rapportplichtige onderzoeksmelding
Voorafgaand onderzoek:	-
Archis2 Onderzoeksmeldingsnr:	-
Naam onderzoek:	KRW Zwarte Water - deelproject Oeveroptimalisatie - deelgebied E
Eigen kenmerk project:	19632
Verwerving:	archeologisch: bureauonderzoek
Uitvoerder:	KSP Archeologie
Bevoegd gezag:	gemeente
Provincie:	Overijssel
Gemeente:	Zwartewaterland
Plaats:	Hasselt
Toponiem:	-
X coördinaat:	203691
Y coördinaat:	509795
Startdatum veldwerk:	13-07-2020
Verwachte einddatum veldwerk:	13-07-2020
Meldingsdatum:	02-07-2020
Omschrijving:	
Status zaak:	Onderzoek afgemeld op 27-01-2021
(Eerste) bevindingen:	KSP Archeologie heeft een archeologisch bureauonderzoek uitgevoerd voor het project KRW Zwarte Water 2022 – deelproject Oeveroptimalisaties (gemeente Zwartewaterland). Het onderzoek is uitgevoerd in het kader van de voorbereiding van het uitvoeringsbesluit MIRT3. Het doel van het archeologische bureauonderzoek was het opstellen van een gespecificeerde archeologische verwachting voor het plangebied. De kans om scheepswrakken en andere watergerelateerde vondsten aan te treffen, geldt voor de oevertrajecten die ter plaatse van de voormalige vaargeul van het Zwarte Water liggen. Losse vondsten van prehistorische vindplaatsen kunnen ter plaatse van de getij-oeverwallen en in de riviervlakte worden aangetroffen. Er zijn geen aanwijzingen dat ter plaatse van de oevertrajecten rivierduinen of pleistocene welvingen in de ondergrond liggen, die een verhoogde kans geven op een vindplaats in de prehistorie. Tot slot zijn er oevertrajecten of kansrijke zijwateren gepland op locaties waar de bodem door menselijk ingrijpen is verstoord en de kans op archeologische resten daardoor zeer laag is. Vanwege de lage trefkans en geringe omvang van vondstlocaties geeft aanvullend veldonderzoek door middel van boringen, proefsleuven weinig zekerheid om losse vondsten op voorhand uit te sluiten en het risico daarmee te beperken. Bovendien is het uitgangspunt dat de werkzaamheden vanaf het water plaatsvinden binnen de huidige oevertaluds. Daarom adviseert KSP Archeologie geen vervolgonderzoek voor de oevertrajecten.
Literatuur:	Koeman 2020b

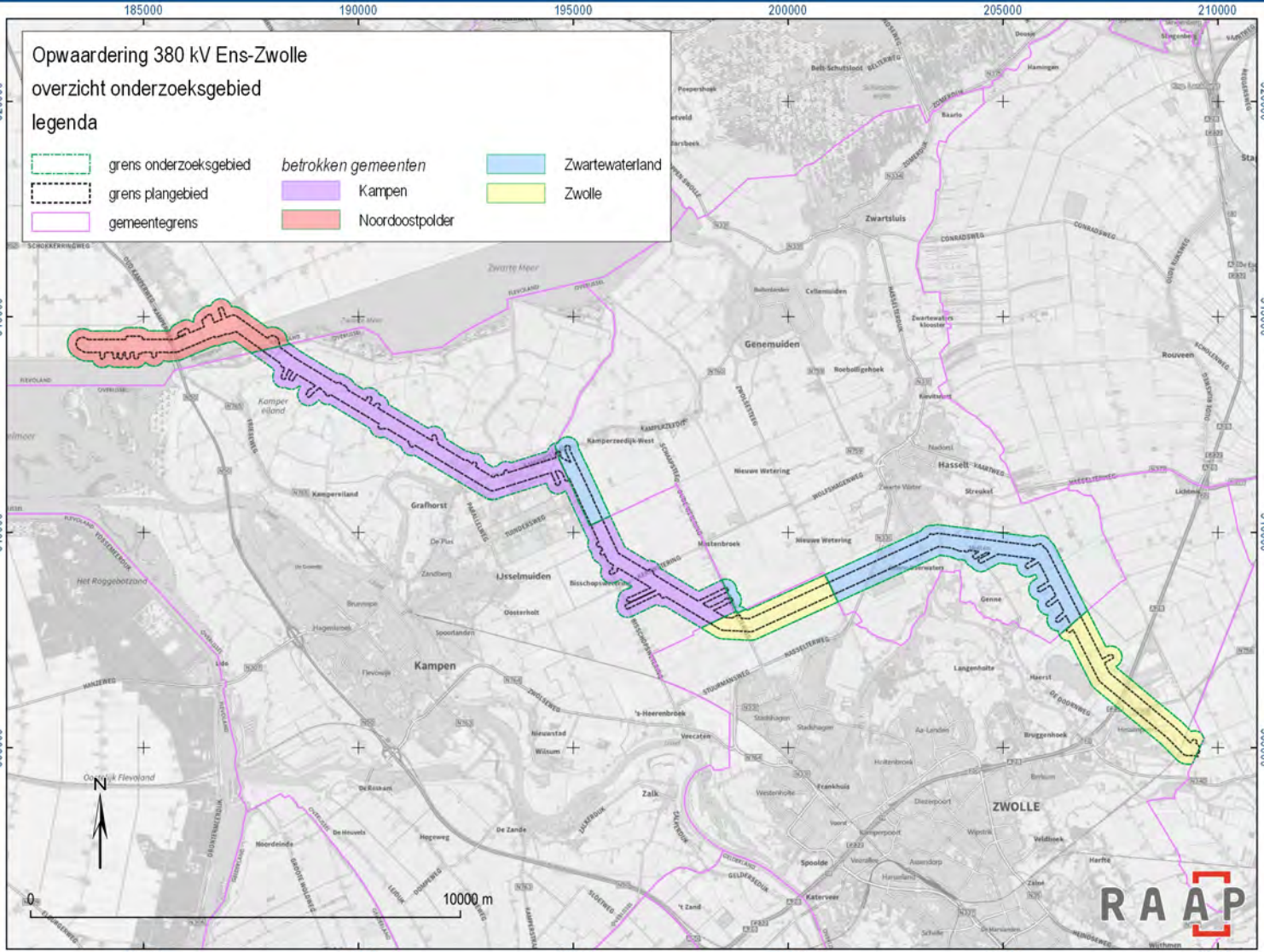
Zaakidentificatie:	**4868144100**
Zaaktype:	Registratie niet-rapportplichtige onderzoeksmelding
Voorafgaand onderzoek:	-
Archis2 Onderzoeksmeldingsnr:	-
Naam onderzoek:	KRW Zwarte Water - deelproject Nevengeul Genne Overwater
Eigen kenmerk project:	19632
Verwerving:	archeologisch: bureauonderzoek en booronderzoek
Uitvoerder:	KSP Archeologie
Bevoegd gezag:	gemeente
Provincie:	Overijssel
Gemeente:	Zwartewaterland
Plaats:	Hasselt
Toponiem:	-
X coördinaat:	203301
Y coördinaat:	509708
Startdatum veldwerk:	15-06-2020
Verwachte einddatum veldwerk:	15-06-2020
Meldingsdatum:	10-06-2020
Omschrijving:	-
Status zaak:	Onderzoek afgemeld op 24-09-2020
Eerste bevindingen:	KSP Archeologie heeft een archeologisch bureauonderzoek uitgevoerd voor het project KRW Zwarte Water 2022 – deelproject Nevengeul Genne Overwater (gemeente Zwartewaterland). Het onderzoek is uitgevoerd in het kader van de voorbereiding van het uitvoeringsbesluit MIRT3. Het doel van het archeologische bureauonderzoek was het opstellen van een gespecificeerde archeologische verwachting voor het plangebied. Op basis van de landschappelijke ligging binnen de actieve riviervlakte/uiterwaard van het Zwarte Water is aan het plangebied een zeer lage verwachting toegekend voor bewoningssporen uit het Laat-Paleolithicum tot en met de Late Middeleeuwen. Specifiek voor de restgeulen binnen het plangebied en met name de centraal gelegen voormalige vaargeul geldt een verwachting op resten de gerelateerd zijn aan de scheepvaart, waaronder scheepswrakken, maar ook kleinere objecten en houten structuren. Halverwege de 18e eeuw is in het zuidelijke deel van plangebied een constructie aangelegd om het Zwarte Water tijdelijk te kunnen afdammen als onderdeel van de IJssellinie. De constructie is eind 19e eeuw gesloopt en in 1913 zouden de laatste restanten zijn opgeruimd. Mogelijk dat er nog wel diepe funderingsresten in de bodem zijn achtergebleven. Voor deze locatie geldt daarom een hoge verwachting op restanten van deze constructie en bijbehorende dijk/dam. Vervolgens kan op basis van de resultaten van het geofysisch onderzoek een gericht proefsleuvenonderzoek worden uitgevoerd op bepaalde locaties om vast te stellen of daadwerkelijk archeologische resten in de bodem aanwezig zijn en zo ja, wat de aard en omvang daarvan is. Voor dit proefsleuvenonderzoek is een Programma van Eisen (PvE) noodzakelijk dat is goedgekeurd door de bevoegde overheid. De rietzone wordt deels in de voormalige vaargeul en deels binnen het voormalige rietland aangelegd. De voormalige geul is geselecteerd voor vervolgonderzoek (zie vorige alinea) en voor het voormalige rietland geldt een zeer lage archeologische verwachting. Ook voor de locatie van het ooibos dat grotendeels op de hoger gelegen meanderrug wordt aangelegd, geldt een zeer lage archeologische verwachting en wordt geen vervolgonderzoek geadviseerd.
Literatuur:	Koeman 2020a

Zaakidentificatie:	**4903687100**
Zaaktype:	Registratie niet-rapportplichtige onderzoeksmelding
Voorafgaand onderzoek:	-
Archis2 Onderzoeksmeldingsnr:	-
Naam onderzoek:	KRW Zwarte Water 2022. Deelproject Nevengeul Genne Overwater.
Eigen kenmerk project:	19632
Verwerving:	archeologisch: geofysisch onderzoek
Uitvoerder:	KSP Archeologie
Bevoegd gezag:	gemeente
Provincie:	Overijssel
Gemeente:	Zwartewaterland
Plaats:	Hasselt
Toponiem:	-
X coördinaat:	203318
Y coördinaat:	509676
Startdatum veldwerk:	22-10-2020
Verwachte einddatum veldwerk:	05-11-2020
Meldingsdatum:	14-10-2020
Omschrijving:	-
Status zaak:	Onderzoek afgemeld op 27-01-2021
Eerste bevindingen:	Veldwerk kon in centrale en noordelijke deel niet uitgevoerd worden Op basis van het geofysisch onderzoek zijn twee locaties aan te wijzen waar zich in de bodem binnen een diepte van 1,5 meter mogelijk restanten van de voormalige afsluitende constructie in de vaargeul zijn terug te vinden. Om vast te stellen of het daadwerkelijk restanten van de constructie betreft en zo ja, de aard en omvang daarvan te bepalen, is een karterend en waarderend archeologisch onderzoek nodig. Omdat het hoofdzakelijk om resten bakstenen en grondsporen gaat, wordt een proefsleuvenonderzoek geadviseerd. Een groot deel van de nevengeul kon vanwege de terreinomstandigheden niet worden onderzocht. Hier kan het risico op het aantreffen van scheepswrakken en andere watergerelateerde objecten niet worden verlaagd. De opdrachtgever zal in overleg met het bevoegd gezag afspraken maken hoe hiermee tijdens de uitvoeringsfase moet worden omgegaan.
Literatuur:	Van den Oever 2021

Bijlage 4. Vondstmeldingen

Zaakidentificatie:	**3086938100**
Zaaktype:	Registratie archeologische vondstmelding
Voorafgaand onderzoek:	-
Archis2 Waarnemingsnr:	12917
Naam onderzoek:	-
Verwerving:	niet-archeologisch
Vinder:	-
Provincie:	Overijssel
Gemeente:	Zwartewaterland
Plaats:	Genne
Toponiem:	De Werf
X coördinaat:	202800
Y coördinaat:	509380
Vondstdatum:	02-07-1973
Meldingsdatum:	01-01-9999
Omschrijving:	-
Status zaak:	Vondstmelding afgemeld op 27-06-2015
(Eerste) bevindingen:	Enkele stuks roodbakkend aardewerk gevonden in persbult aan westelijke voet van huisterp. Ter plaatse bevindt zich een kleidek op veen. Datering: Nieuwe tijd vroeg - Nieuwe tijd midden.
Literatuur:	-

Bijlage 5. Huidige situatie



Opwaardering 380 kV Ens-Zwolle
overzicht onderzoeksgebied
legenda
grens onderzoeksgebied
grens plangebied
gemeentegrens
betrokken gemeenten
Kampen
Noordoostpolder
Zwartewaterland
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Genemuiden
Hasselt
Kampen
IJsselmuiden
Grafhorst
Zwolle
Zalk
Spoolde
Katerveer
Zwarte Meer
Kamper eiland
Het Roggebotzand
Oostelijk Flevoland
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10000 m
RAAP

Opwaardering 380 kV Ens-Zwolle
huidige situatie (luchtfoto) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
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Opwaardering 380 kV Ens-Zwolle
huidige situatie (luchtfoto) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
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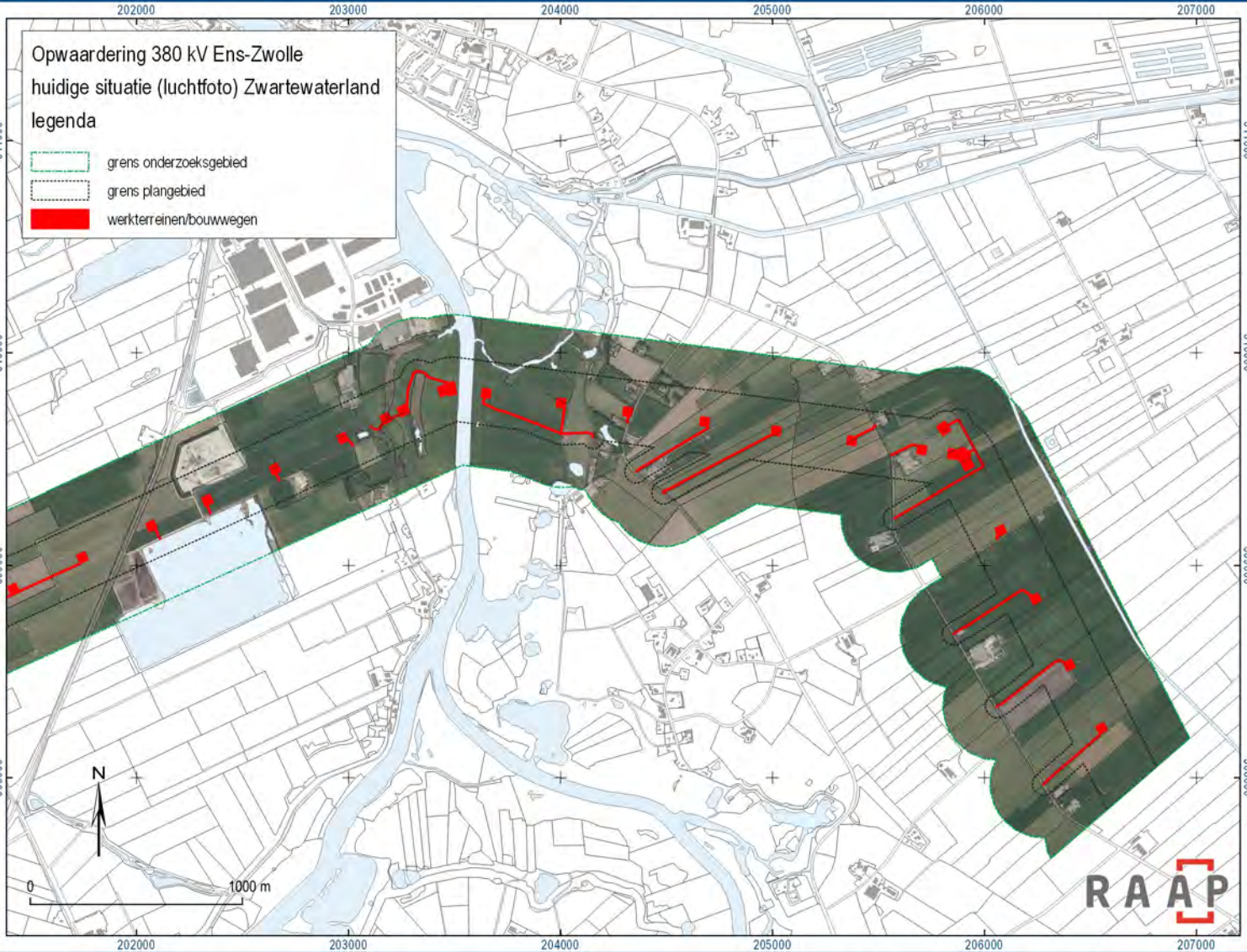
Opwaardering 380 kV Ens-Zwolle
huidige situatie (luchtfoto) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
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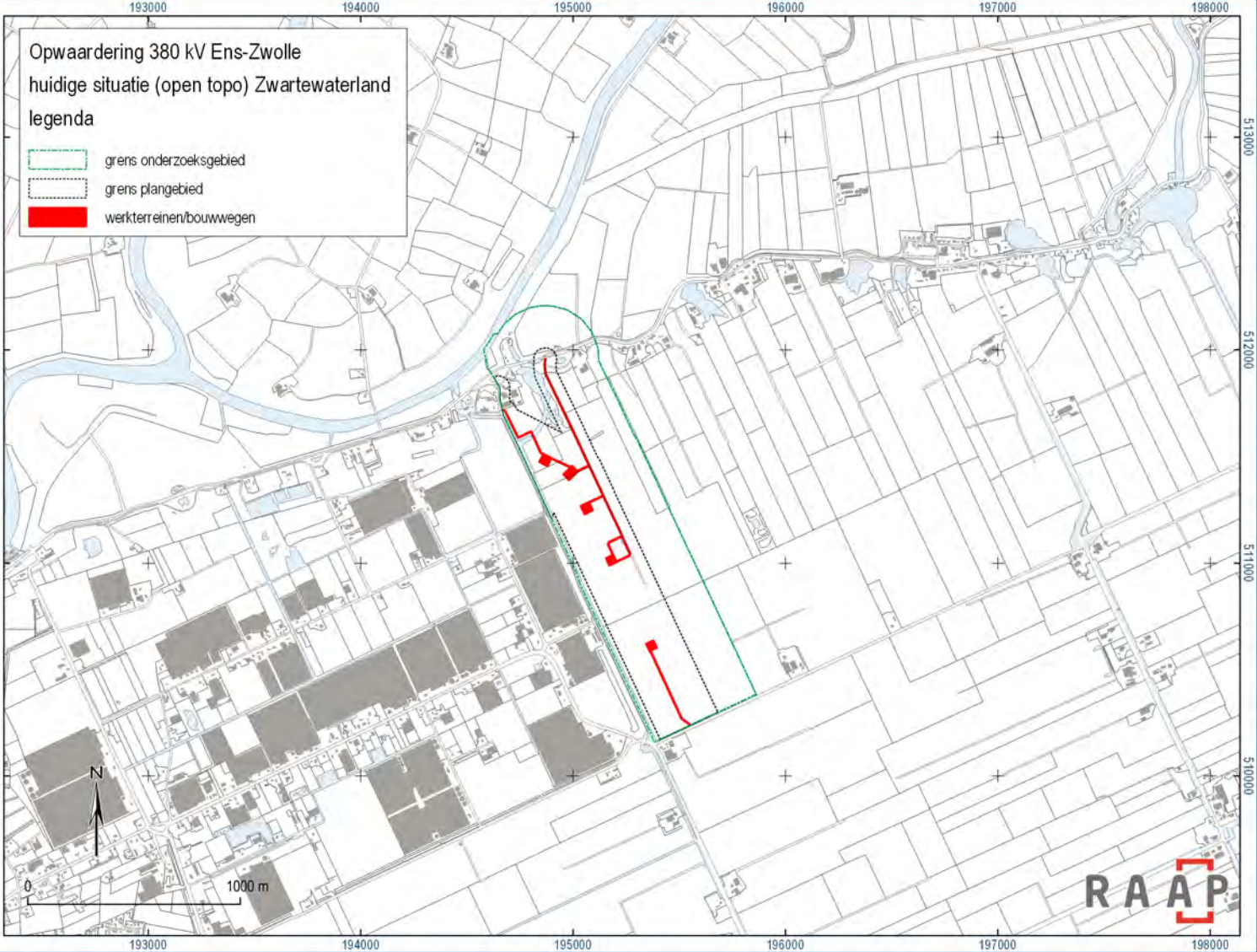
Opwaardering 380 kV Ens-Zwolle
huidige situatie (open topo) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
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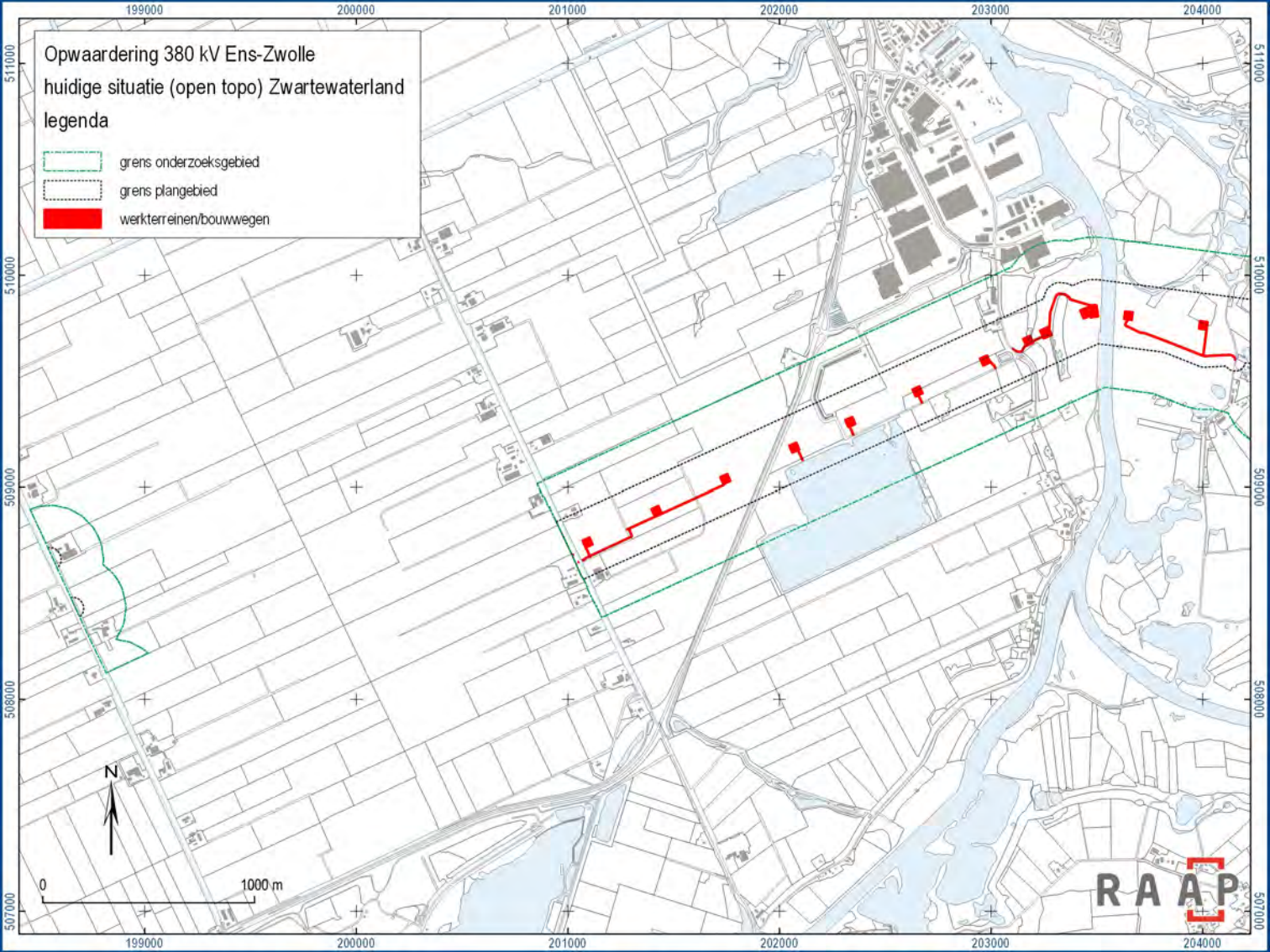
RAAP


Opwaardering 380 kV Ens-Zwolle
huidige situatie (open topo) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
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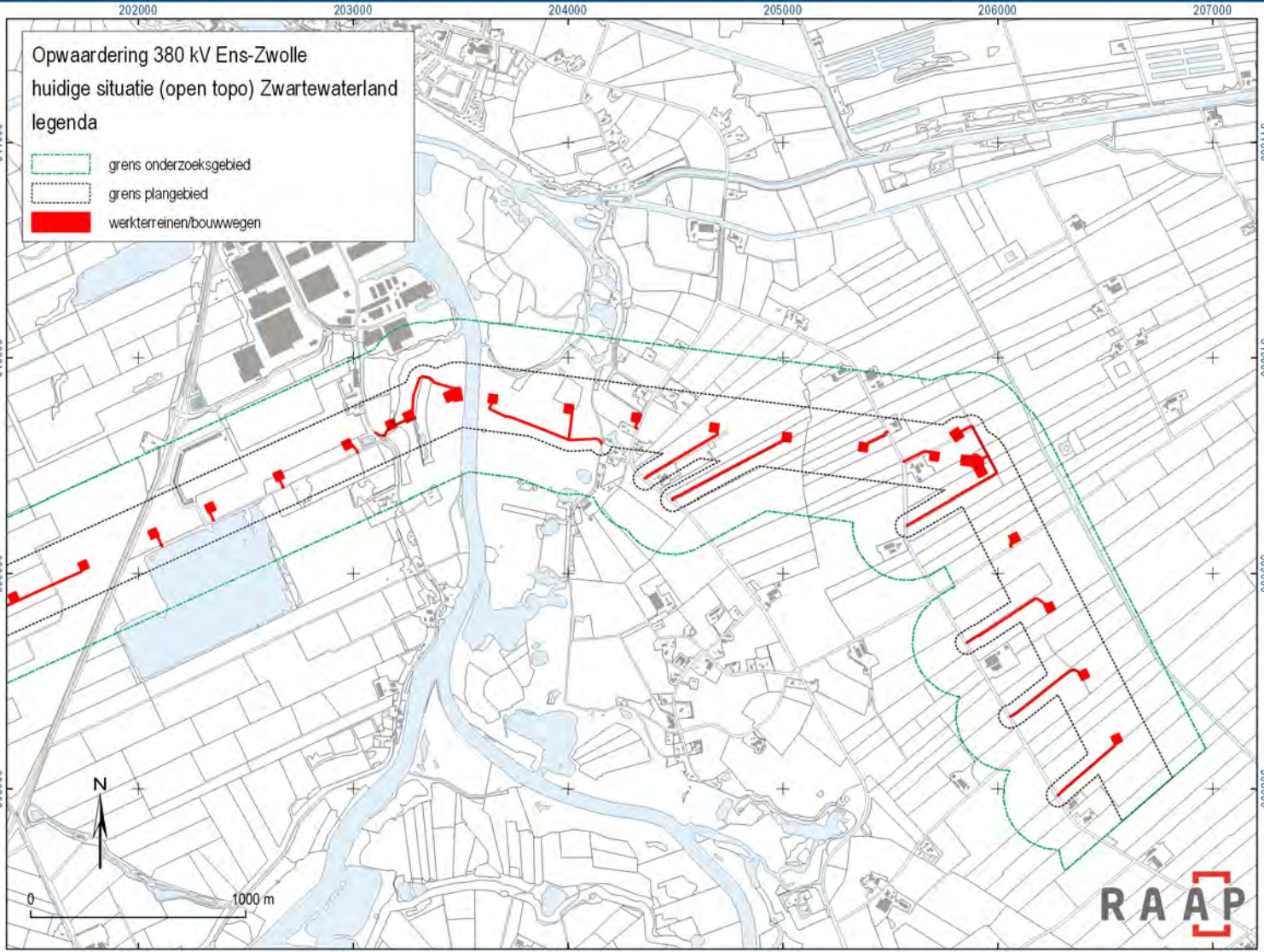
Opwaardering 380 kV Ens-Zwolle
huidige situatie (open topo) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
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Opwaardering 380 kV Ens-Zwolle
maaiveldhoogte Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
AHN3_grid_5dm
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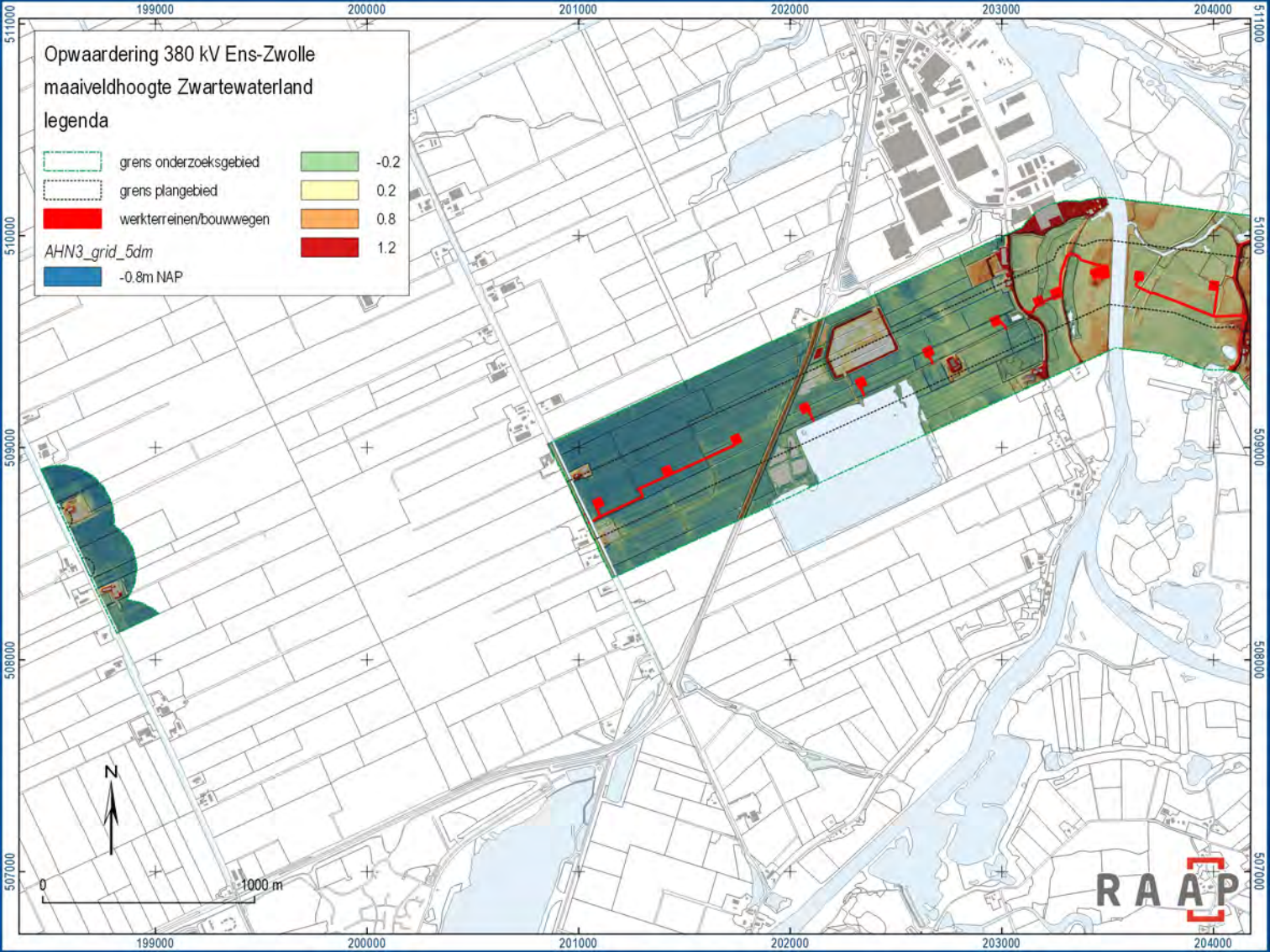
Opwaardering 380 kV Ens-Zwolle
maaiveldhoogte Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
AHN3_grid_5dm
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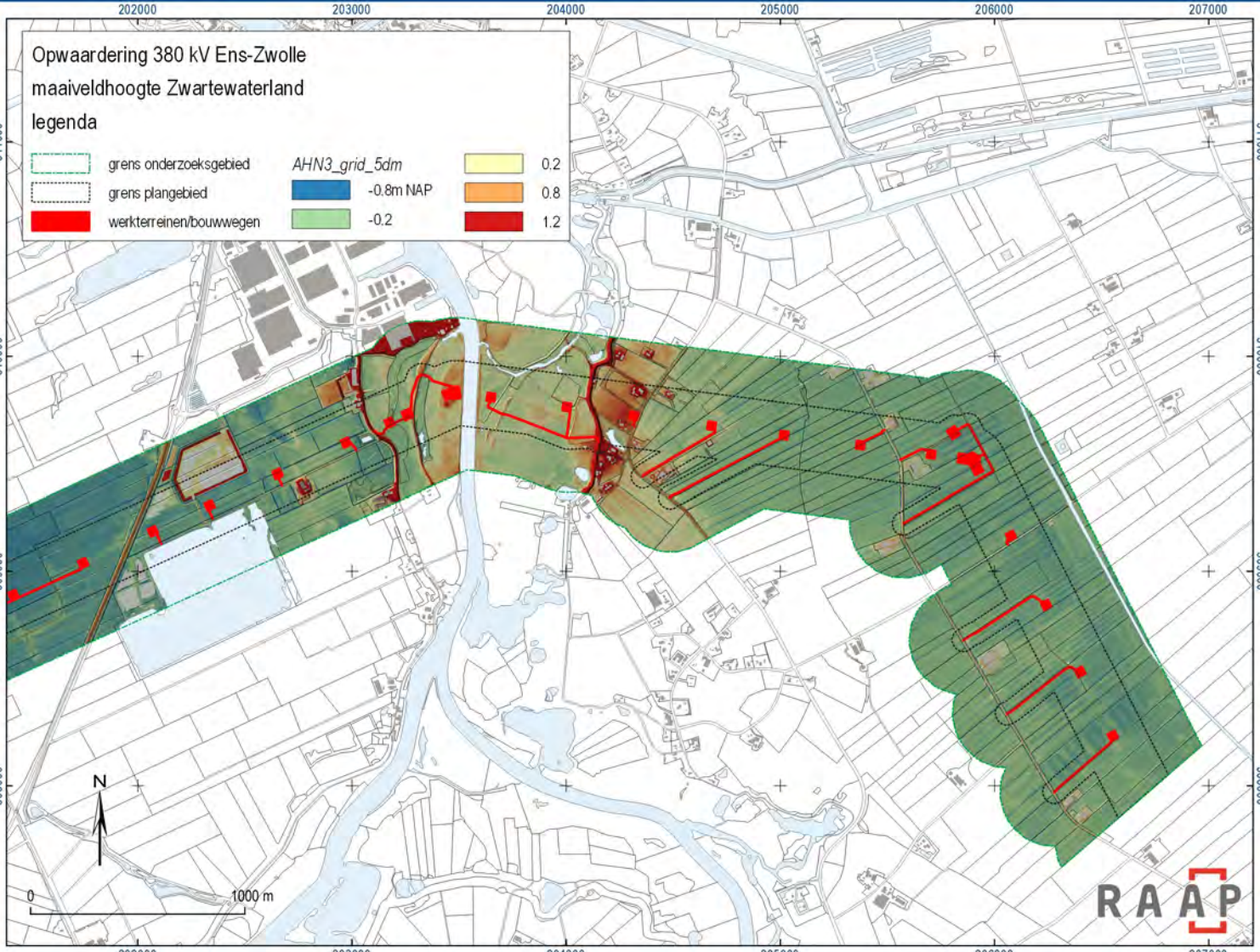
RAAP


Opwaardering 380 kV Ens-Zwolle
maaiveldhoogte Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
AHN3_grid_5dm
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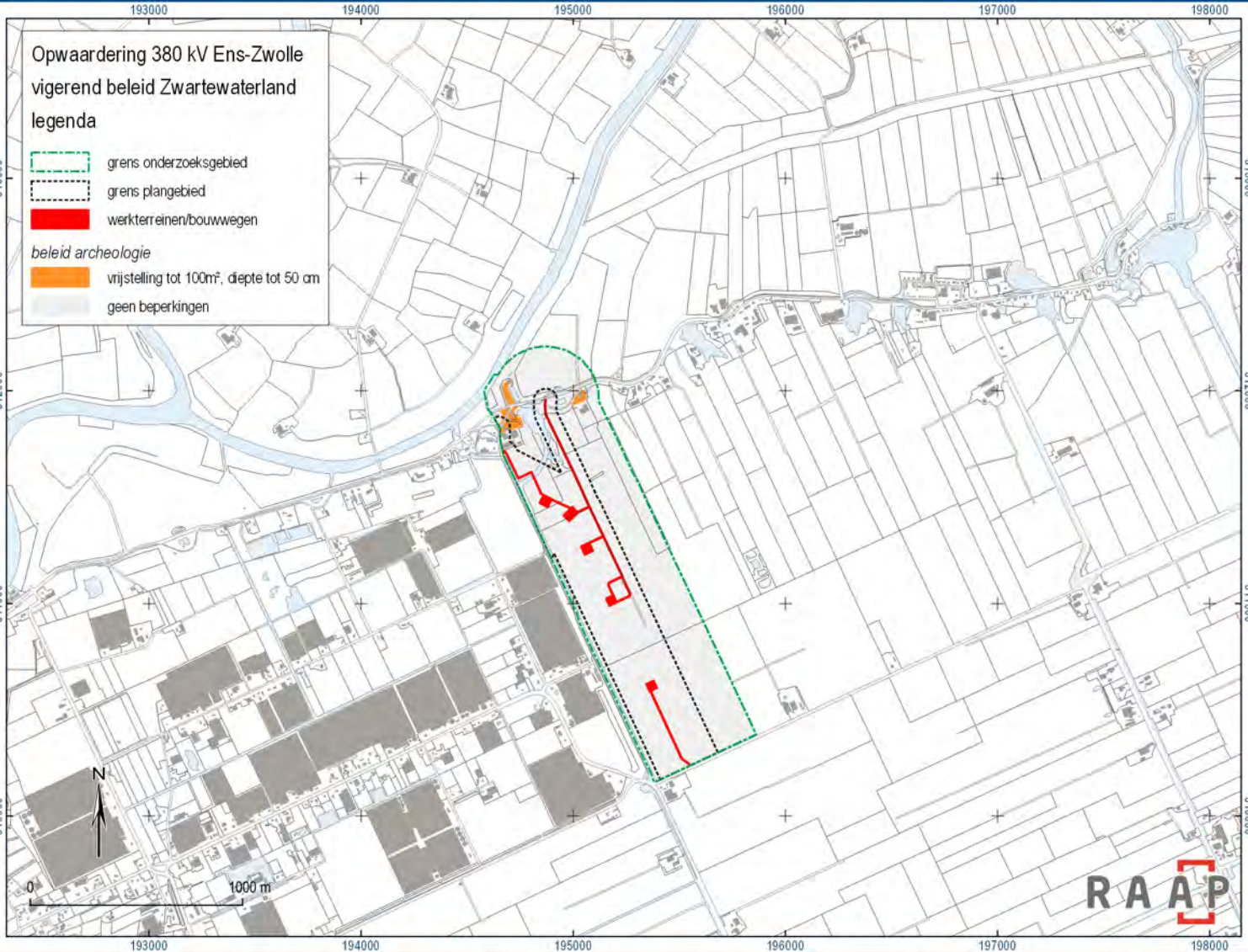
RAAP

Bijlage 6. Vigerend beleid


Opwaardering 380 kV Ens-Zwolle
vigerend beleid Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
beleid archeologie
vrijstelling tot 100m², diepte tot 50 cm
geen beperkingen
193000
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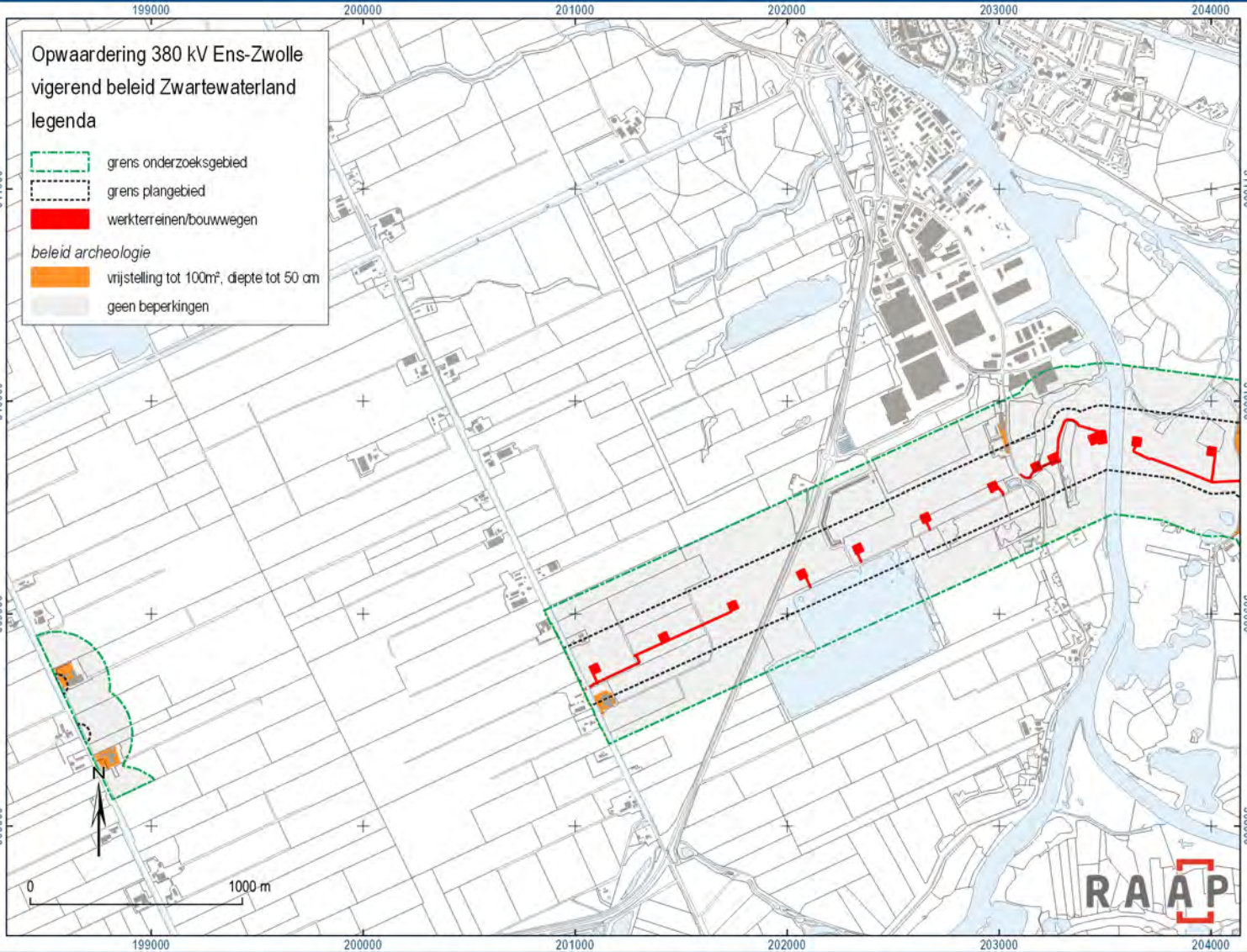
Opwaardering 380 kV Ens-Zwolle
vigerend beleid Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
beleid archeologie
vrijstelling tot 100m², diepte tot 50 cm
geen beperkingen
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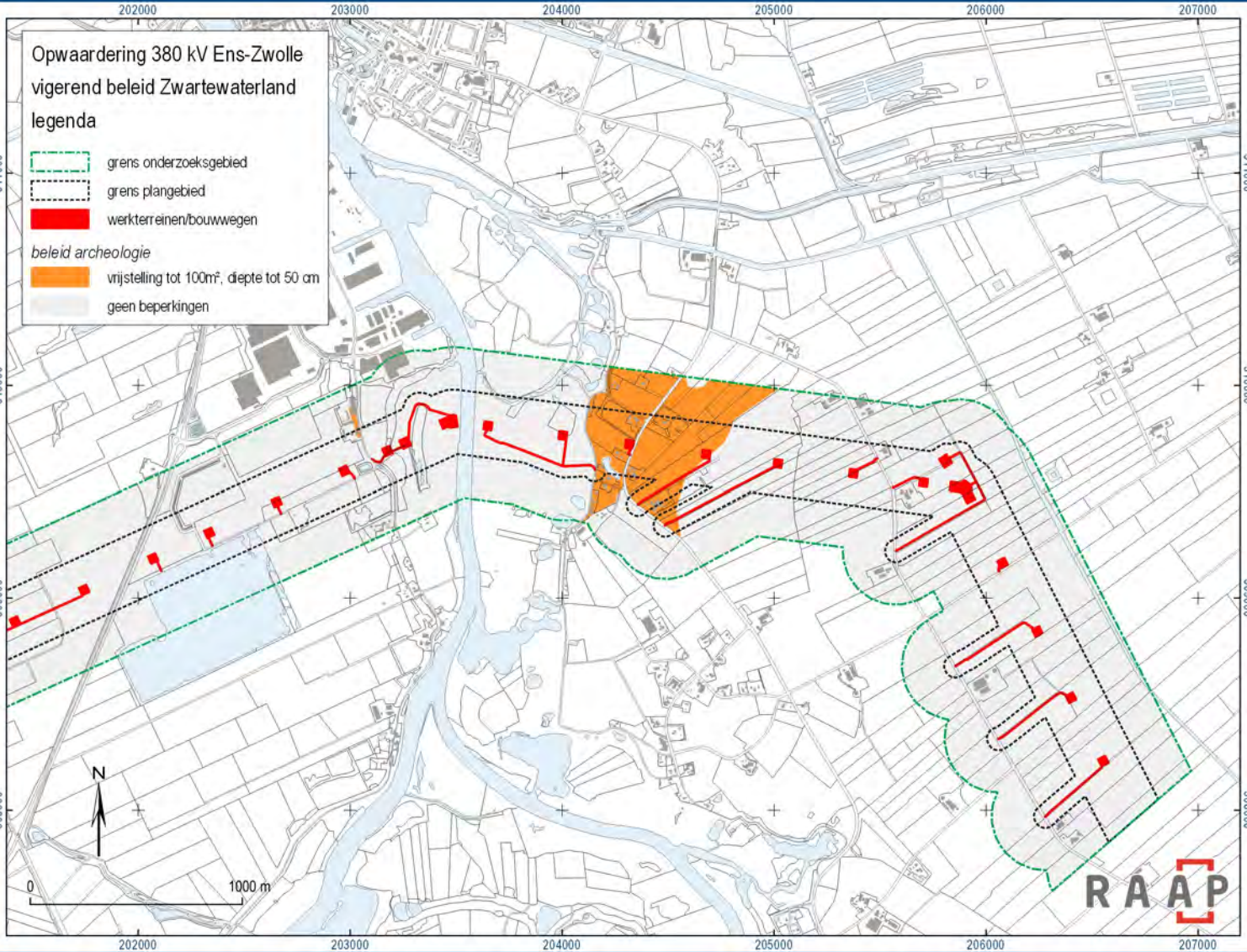
RAAP


Opwaardering 380 kV Ens-Zwolle
vigerend beleid Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
beleid archeologie
vrijstelling tot 100m², diepte tot 50 cm
geen beperkingen
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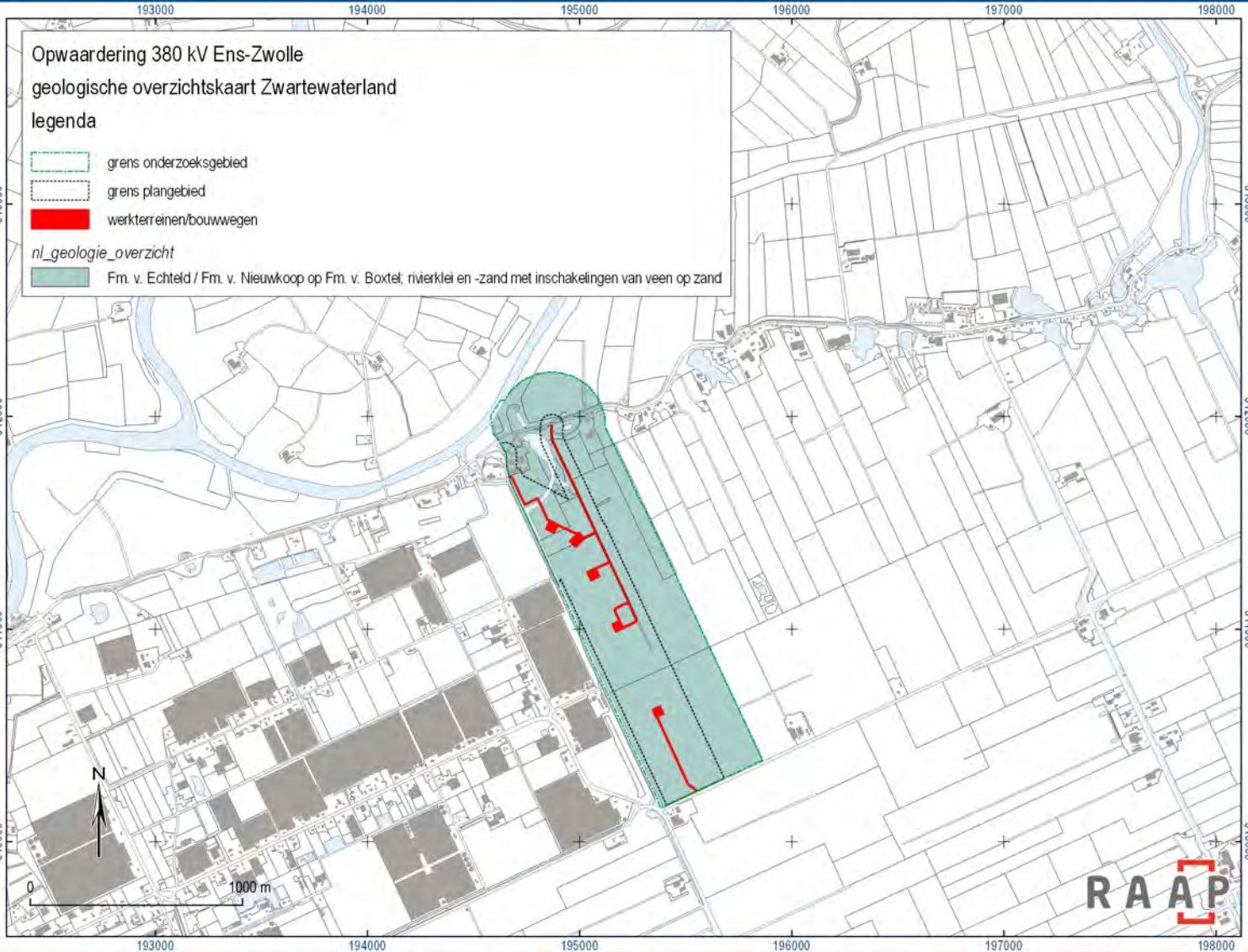
Bijlage 7. Landschap


Opwaardering 380 kV Ens-Zwolle
geologische overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
nl_geologie_overzicht
Fm. v. Echteld / Fm. v. Nieuwkoop op Fm. v. Boxtel; rivierklei en -zand met inschakelingen van veen op zand
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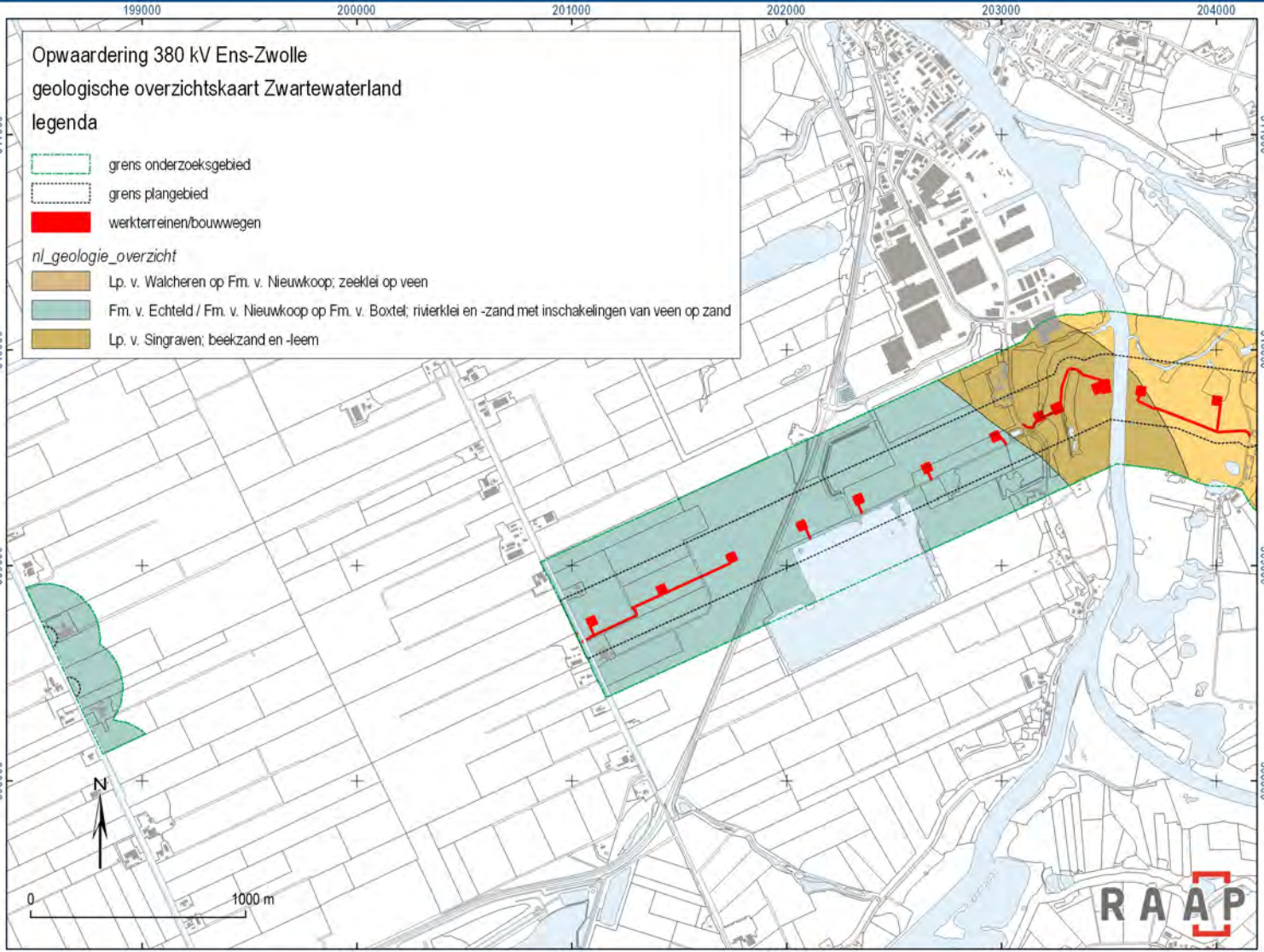
Opwaardering 380 kV Ens-Zwolle
geologische overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
nl_geologie_overzicht
Lp. v. Walcheren op Fm. v. Nieuwkoop; zeeklei op veen
Fm. v. Echteld / Fm. v. Nieuwkoop op Fm. v. Boxtel; rivierklei en -zand met inschakelingen van veen op zand
Lp. v. Singraven; beekzand en -leem
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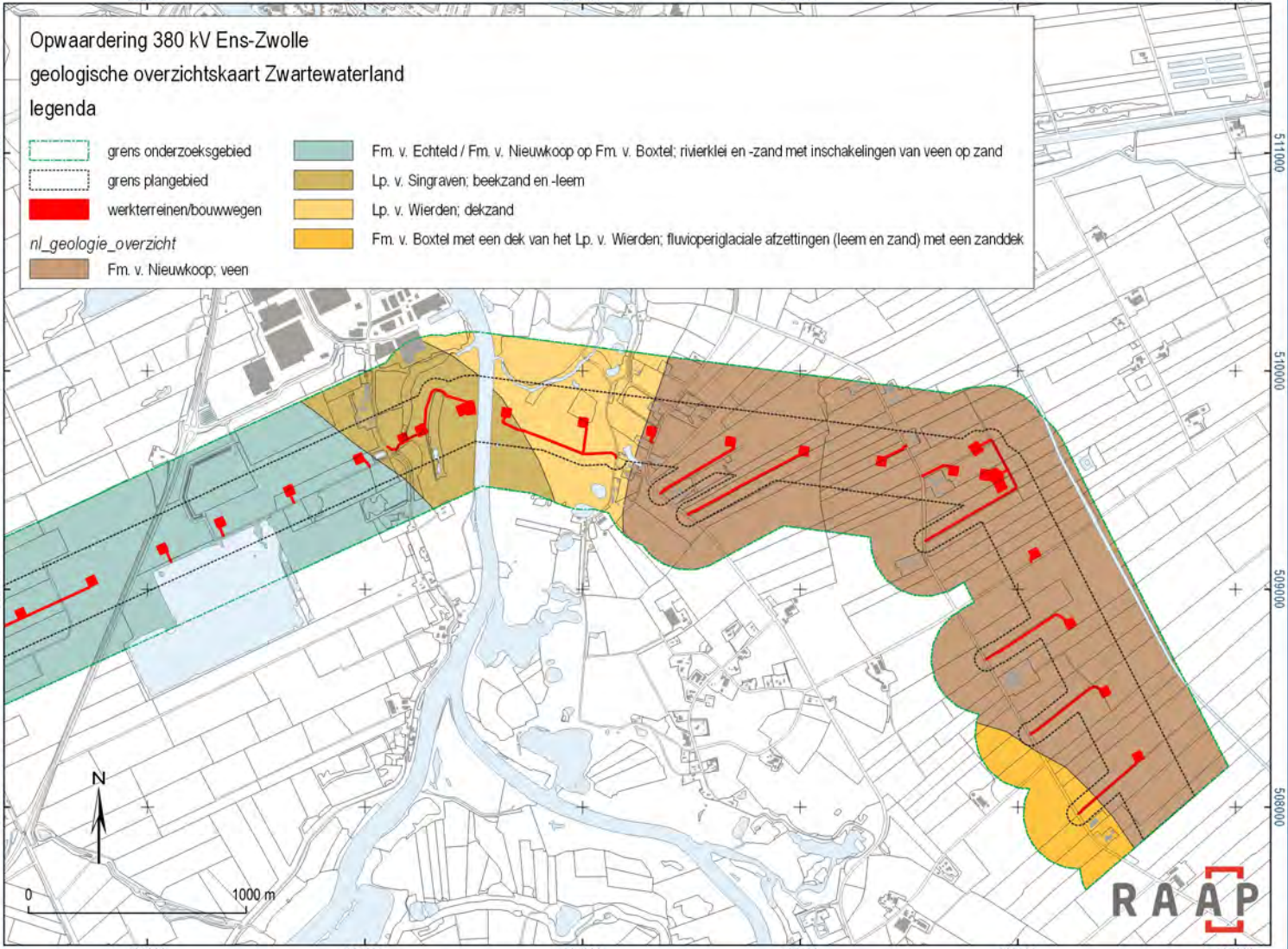
1000 m
RAAP


Opwaardering 380 kV Ens-Zwolle
geologische overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
nl_geologie_overzicht
Fm. v. Nieuwkoop; veen
Fm. v. Echteld / Fm. v. Nieuwkoop op Fm. v. Boxtel; rivierklei en -zand met inschakelingen van veen op zand
Lp. v. Singraven; beekzand en -leem
Lp. v. Wierden; dekzand
Fm. v. Boxtel met een dek van het Lp. v. Wierden; fluvioperiglaciale afzettingen (leem en zand) met een zanddek
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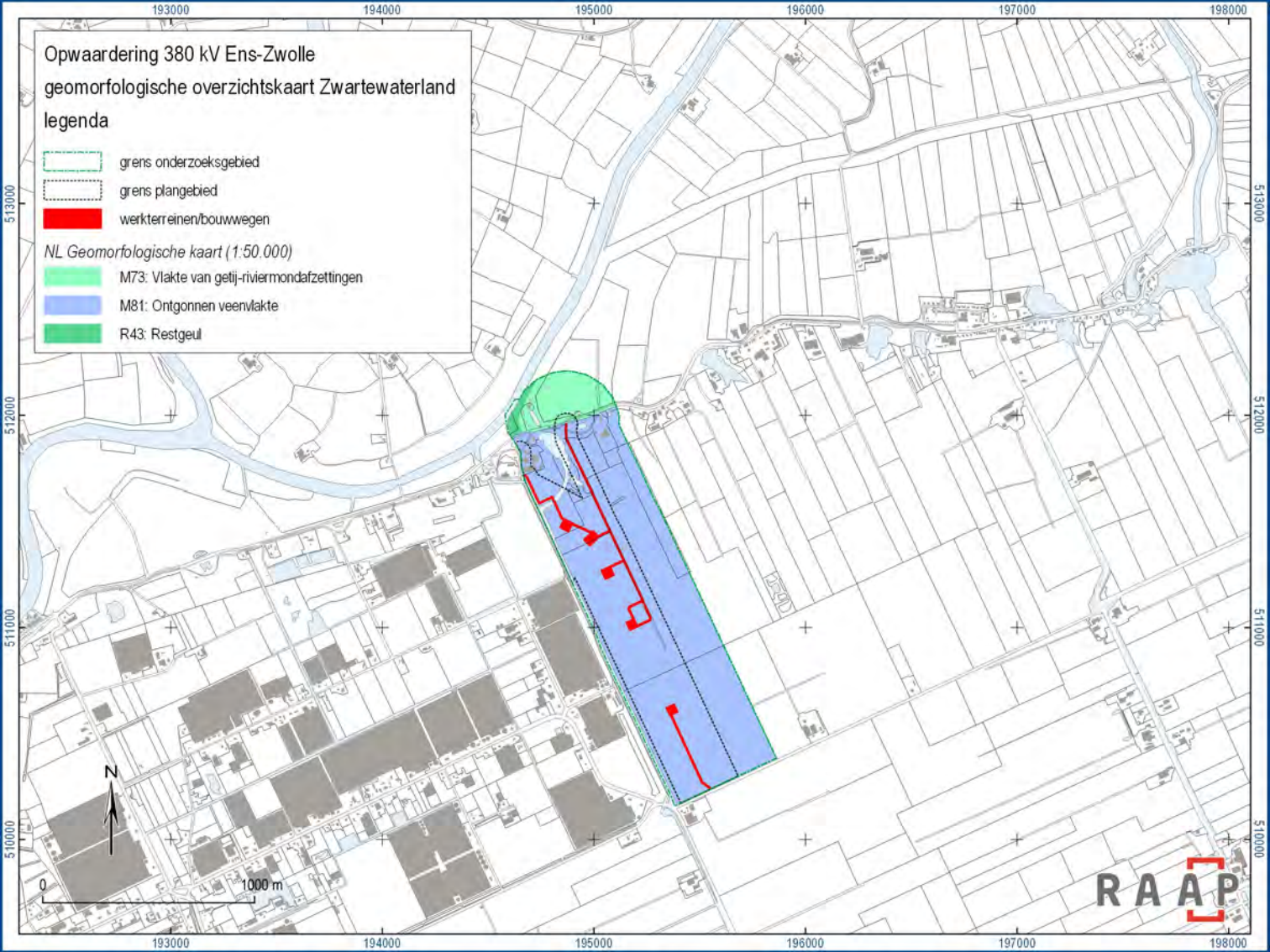
Opwaardering 380 kV Ens-Zwolle
geomorfologische overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
NL Geomorfologische kaart (1:50.000)
M73: Vlakte van getij-riviermondafzettingen
M81: Ontgonnen veenvlakte
R43: Restgeul
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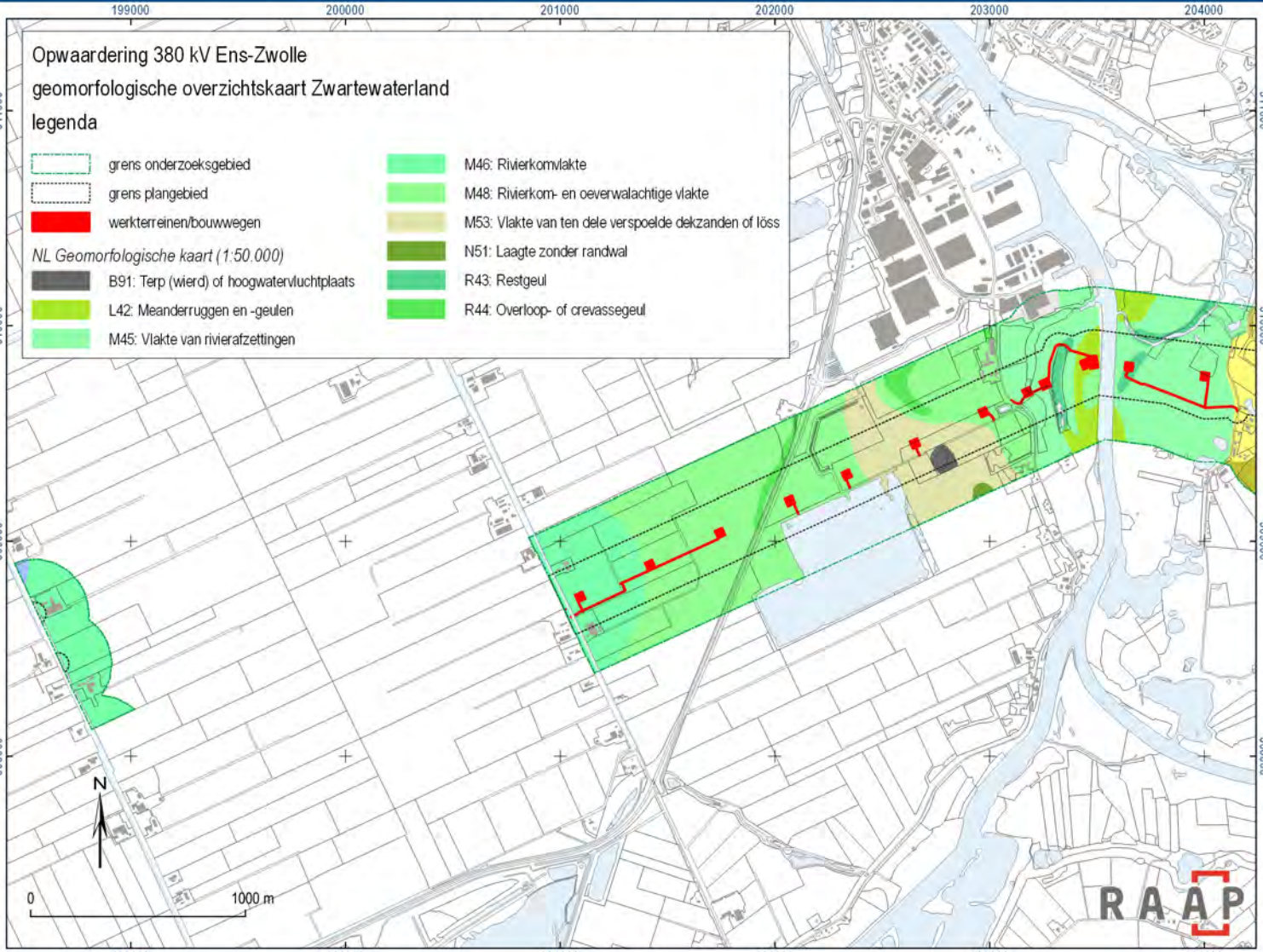
RAAP


Opwaardering 380 kV Ens-Zwolle
geomorfologische overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
NL Geomorfologische kaart (1:50.000)
B91: Terp (wierd) of hoogwatervluchtplaats
L42: Meanderruggen en -geulen
M45: Vlakte van rivierafzettingen
M46: Rivierkomvlakte
M48: Rivierkom- en oeverwalachtige vlakte
M53: Vlakte van ten dele verspoelde dekzanden of löss
N51: Laagte zonder randwal
R43: Restgeul
R44: Overloop- of crevassegeul
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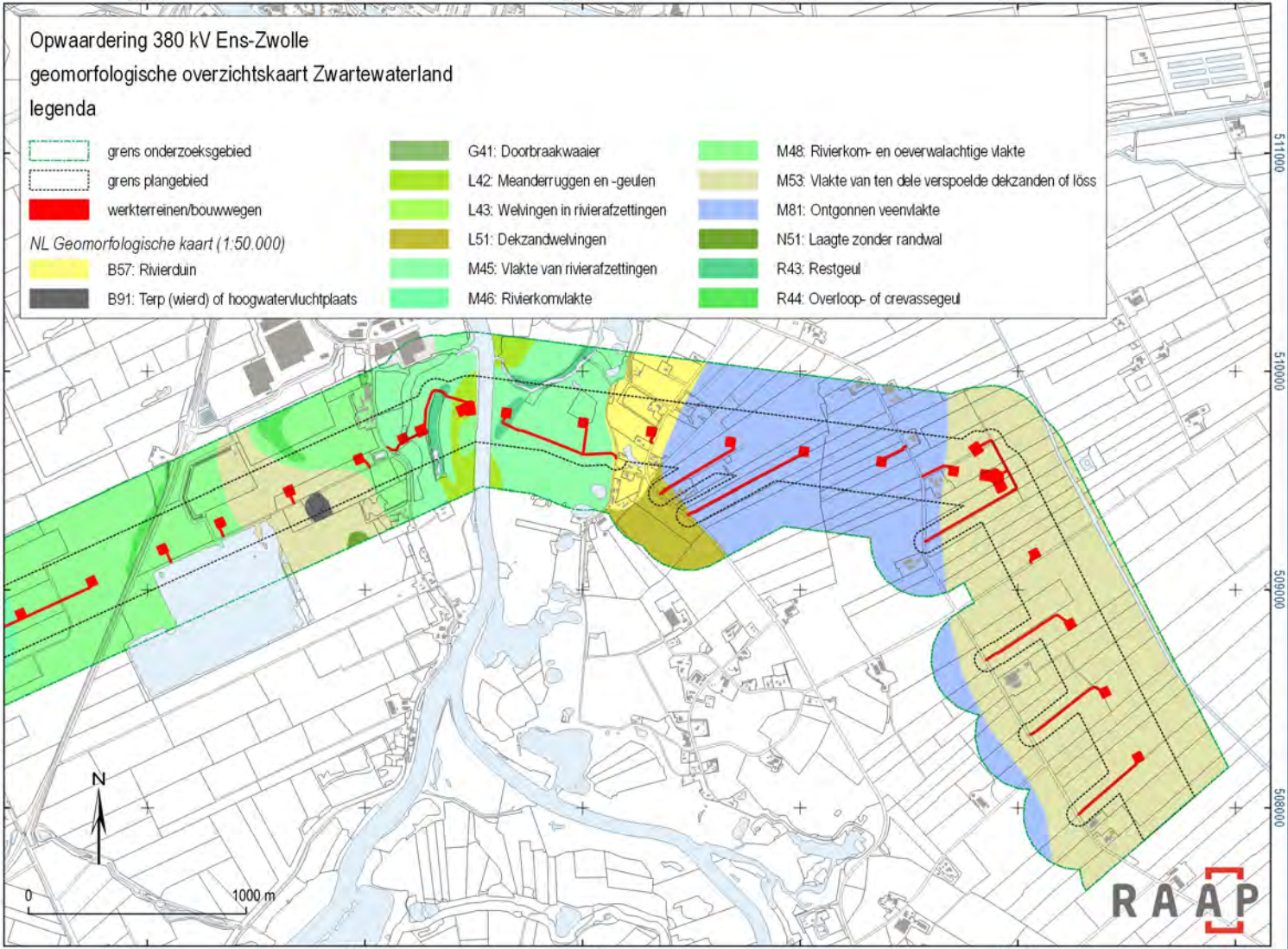
RAAP


Opwaardering 380 kV Ens-Zwolle
geomorfologische overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
NL Geomorfologische kaart (1:50.000)
B57: Rivierduin
B91: Terp (wierd) of hoogwatervluchtplaats
G41: Doorbraakwaaier
L42: Meanderruggen en -geulen
L43: Welvingen in rivierafzettingen
L51: Dekzandwelvingen
M45: Vlakte van rivierafzettingen
M46: Rivierkomvlakte
M48: Rivierkom- en oeverwalachtige vlakte
M53: Vlakte van ten dele verspoelde dekzanden of löss
M81: Ontgonnen veenvlakte
N51: Laagte zonder randwal
R43: Restgeul
R44: Overloop- of crevassegeul
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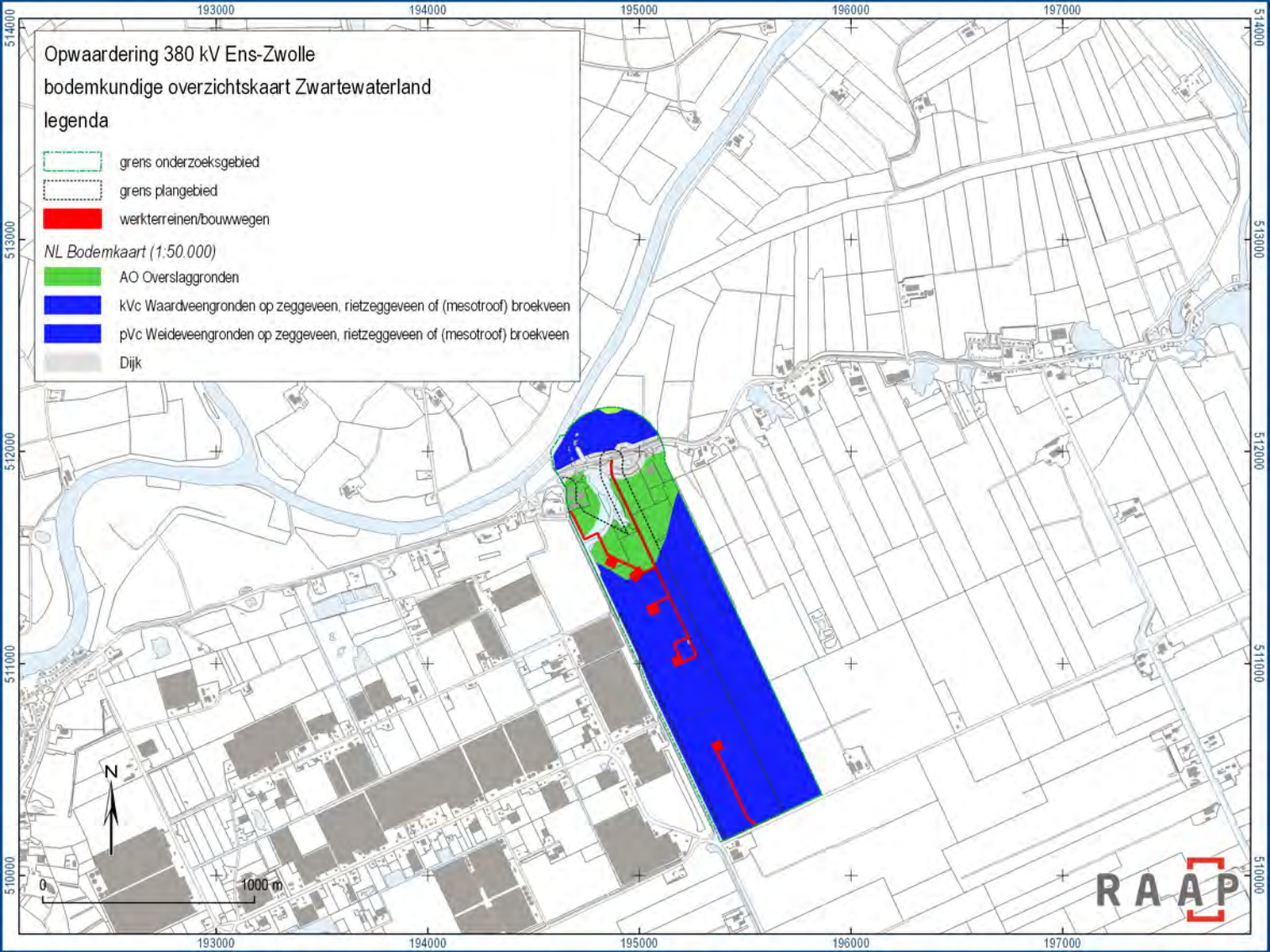
Opwaardering 380 kV Ens-Zwolle
bodemkundige overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
NL Bodemkaart (1:50.000)
AO Overslaggronden
kVc Waardveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen
pVc Weideveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen
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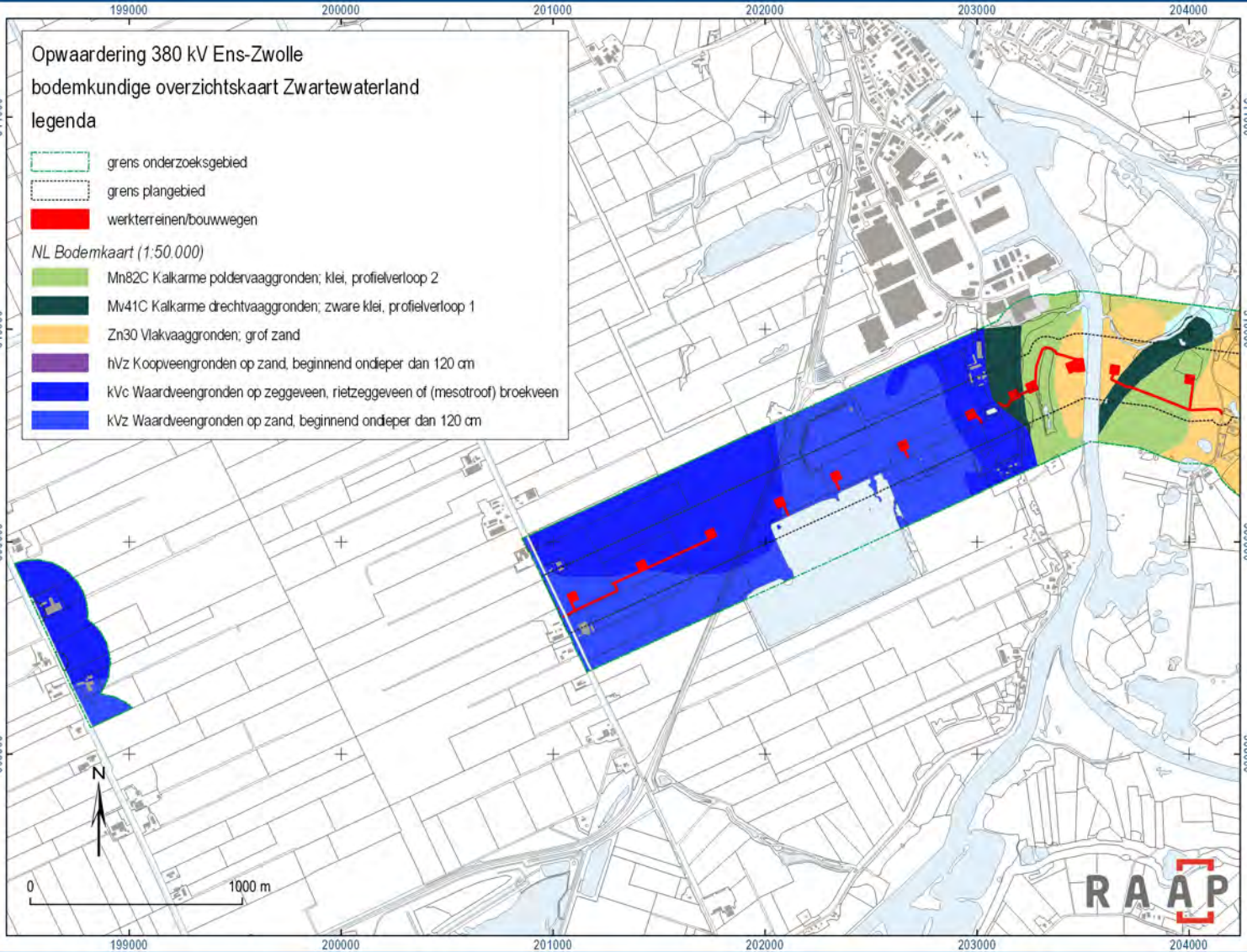
Opwaardering 380 kV Ens-Zwolle
bodemkundige overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
NL Bodemkaart (1:50.000)
Mn82C Kalkarme poldervaaggronden; klei, profielverloop 2
Mv41C Kalkarme drechtvaaggronden; zware klei, profielverloop 1
Zn30 Vlakvaaggronden; grof zand
hVz Koopveengronden op zand, beginnend ondieper dan 120 cm
kVc Waardveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen
kVz Waardveengronden op zand, beginnend ondieper dan 120 cm
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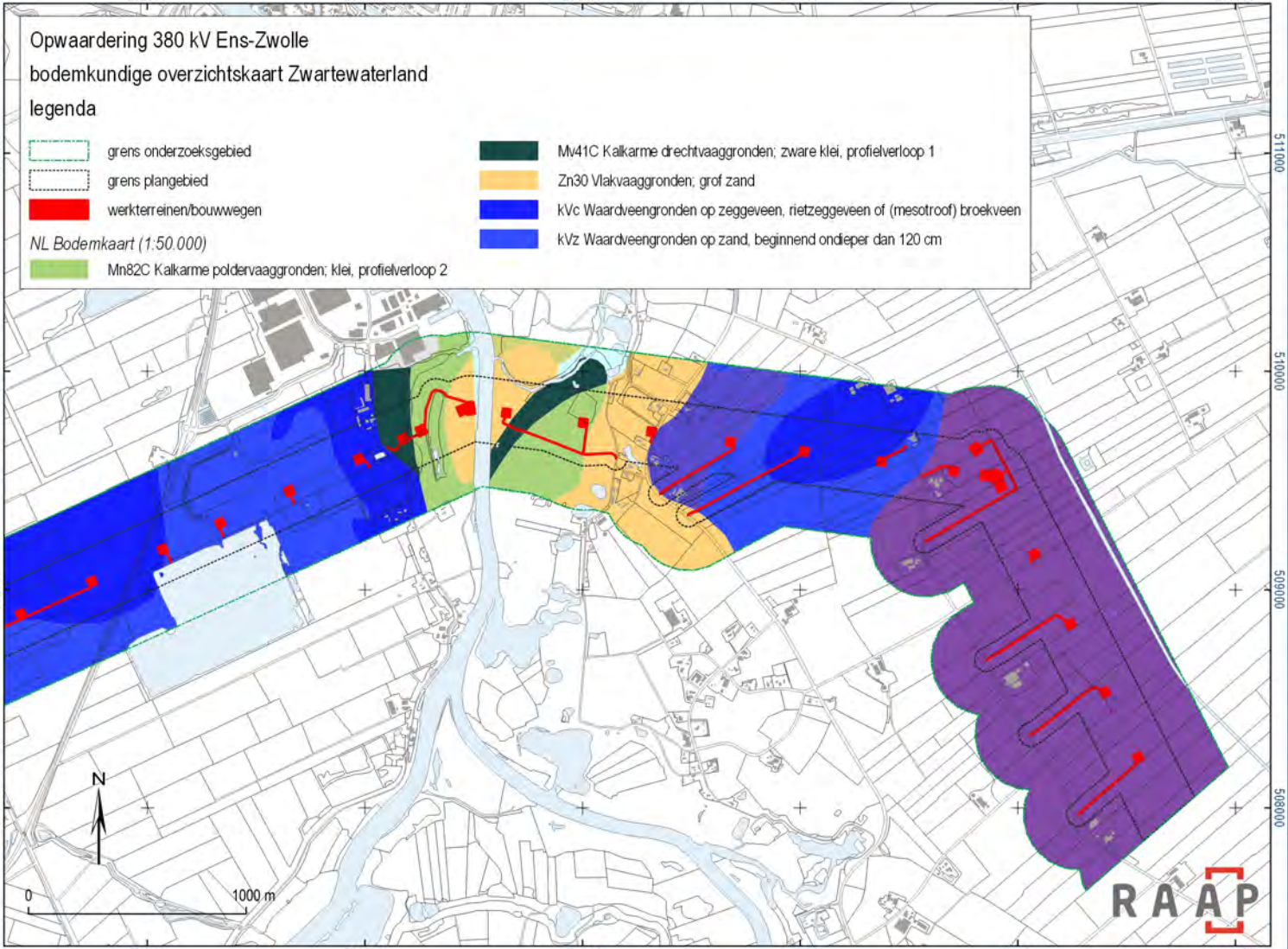
RAAP


Opwaardering 380 kV Ens-Zwolle
bodemkundige overzichtskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
NL Bodemkaart (1:50.000)
Mn82C Kalkarme poldervaaggronden; klei, profielverloop 2
Mv41C Kalkarme drechtvaaggronden; zware klei, profielverloop 1
Zn30 Vlakvaaggronden; grof zand
kVc Waardveengronden op zeggeveen, rietzeggeveen of (mesotroof) broekveen
kVz Waardveengronden op zand, beginnend ondieper dan 120 cm
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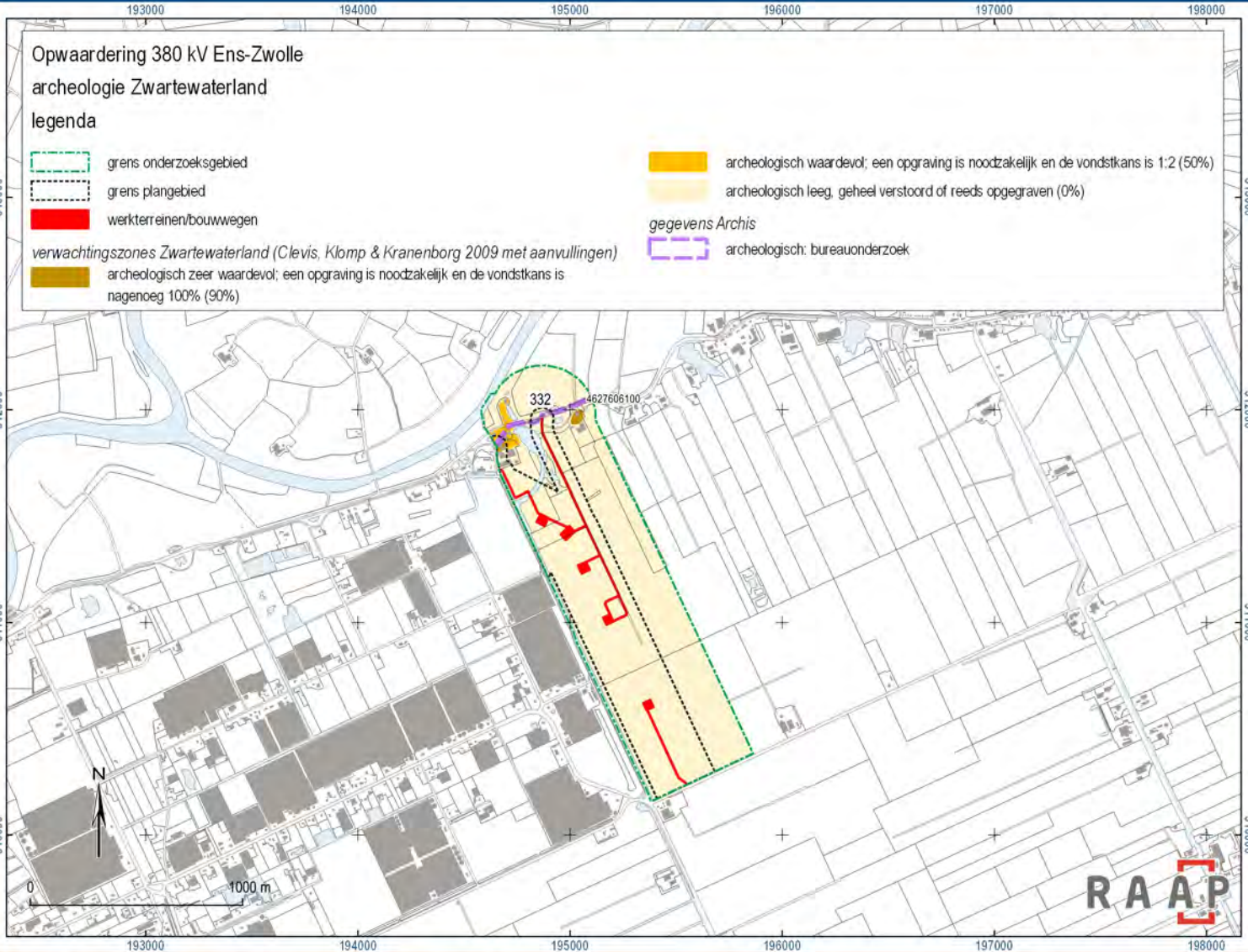
RAAP

Bijlage 8. Archeologie en cultuurhistorie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Opwaardering 380 kV Ens-Zwolle
archeologie Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
verwachtingszones Zwartewaterland (Clevis, Klomp & Kranenborg 2009 met aanvullingen)
archeologisch zeer waardevol; een opgraving is noodzakelijk en de vondstkans is nagenoeg 100% (90%)
archeologisch waardevol; een opgraving is noodzakelijk en de vondstkans is 1:2 (50%)
archeologisch leeg, geheel verstoord of reeds opgegraven (0%)
gegevens Archis
archeologisch: bureauonderzoek
332
4627606100
N
0
1000 m
RAAP

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Opwaardering 380 kV Ens-Zwolle
archeologie Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
verwachtingszones Zwartewaterland (Clevis, Klomp & Kranenborg 2009 met aanvullingen)
archeologisch zeer waardevol; een opgraving is noodzakelijk en de vondstkans is nagenoeg 100% (90%)
huisterp uit de late middeleeuwen en nieuwe tijd met zeer hoge archeologische verwachting
archeologisch waardevol; een opgraving is noodzakelijk en de vondstkans is 1:2 (50%)
archeologische waarde onbekend; kans op archeologische resten gering (10%)
archeologische waarde onbekend (10%); zones met dekzandreliëf op geringe diepte onder het maaiveld, verhoogde kans op archeologische resten
archeologisch leeg, geheel verstoord of reeds opgegraven (0%)
gegevens Archis
archeologisch: bureauonderzoek
archeologisch: booronderzoek/veldkartering
overig onderzoek
351
353
354
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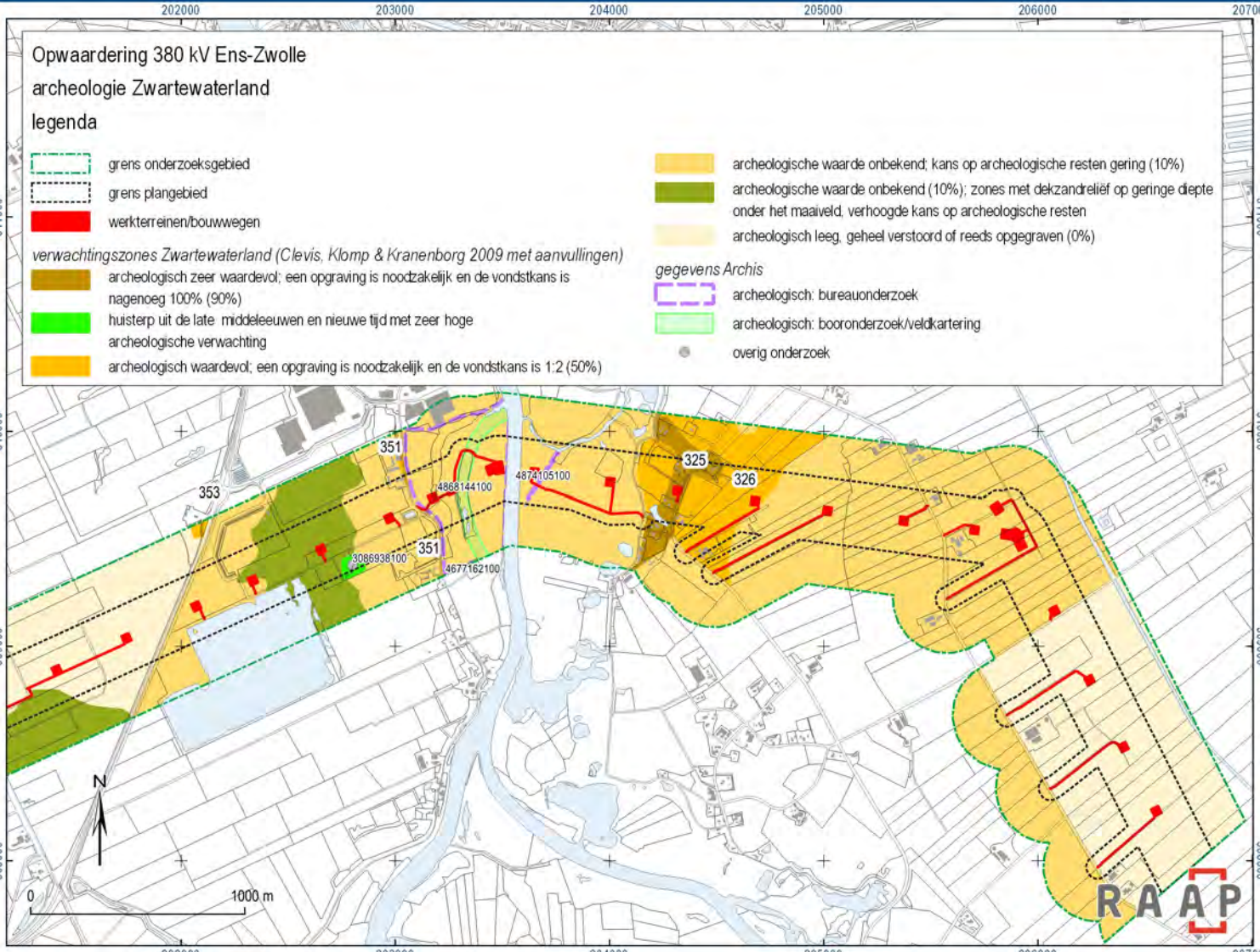
1000 m
RAAP


Opwaardering 380 kV Ens-Zwolle
archeologie Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
verwachtingszones Zwartewaterland (Clevis, Klomp & Kranenborg 2009 met aanvullingen)
archeologisch zeer waardevol; een opgraving is noodzakelijk en de vondstkans is nagenoeg 100% (90%)
huisterp uit de late middeleeuwen en nieuwe tijd met zeer hoge archeologische verwachting
archeologisch waardevol; een opgraving is noodzakelijk en de vondstkans is 1:2 (50%)
archeologische waarde onbekend; kans op archeologische resten gering (10%)
archeologische waarde onbekend (10%); zones met dekzandreliëf op geringe diepte onder het maaiveld, verhoogde kans op archeologische resten
archeologisch leeg, geheel verstoord of reeds opgegraven (0%)
gegevens Archis
archeologisch: bureauonderzoek
archeologisch: booronderzoek/veldkartering
overig onderzoek
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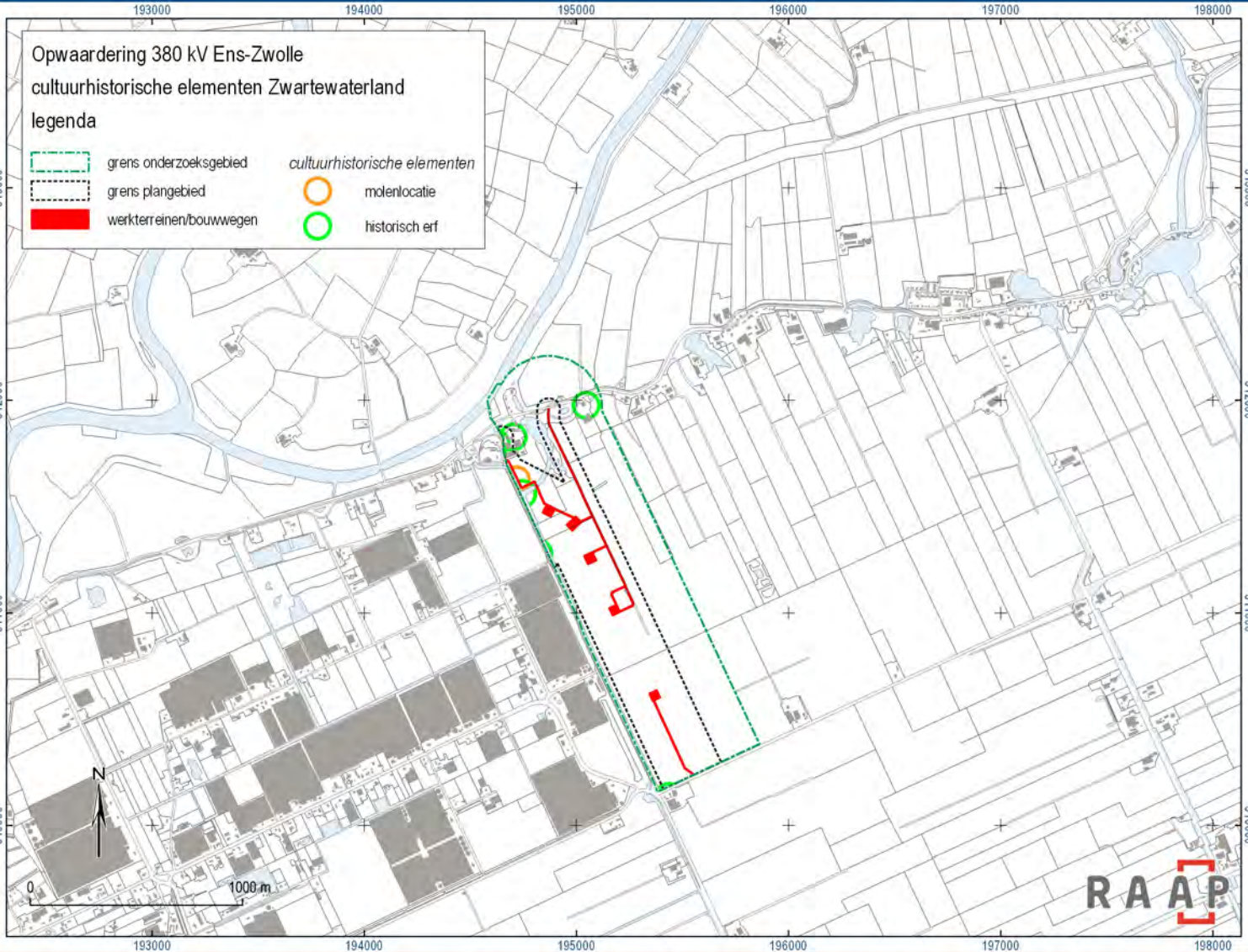
Opwaardering 380 kV Ens-Zwolle
cultuurhistorische elementen Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
cultuurhistorische elementen
molenlocatie
historisch erf
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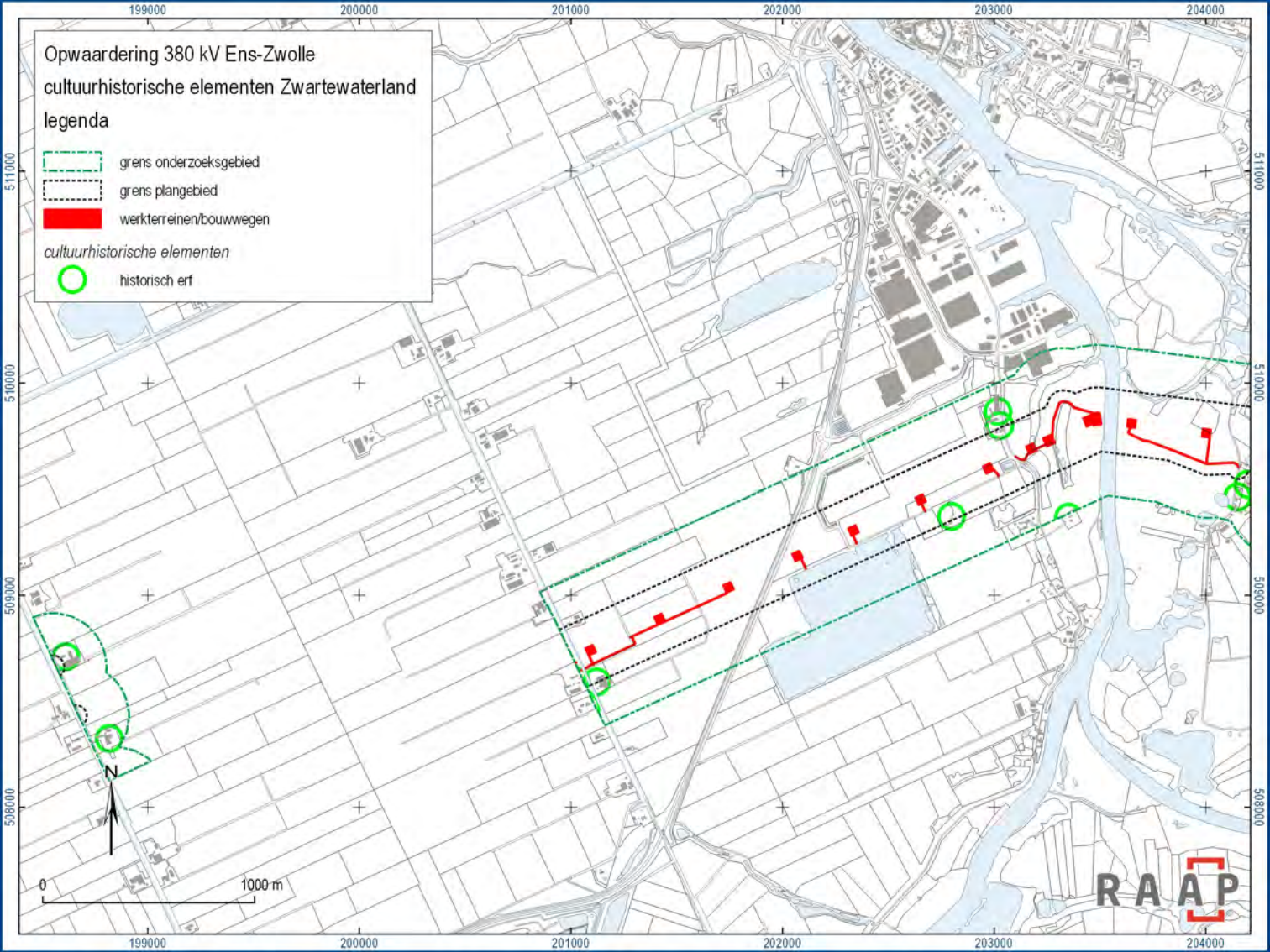
Opwaardering 380 kV Ens-Zwolle
cultuurhistorische elementen Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
cultuurhistorische elementen
historisch erf
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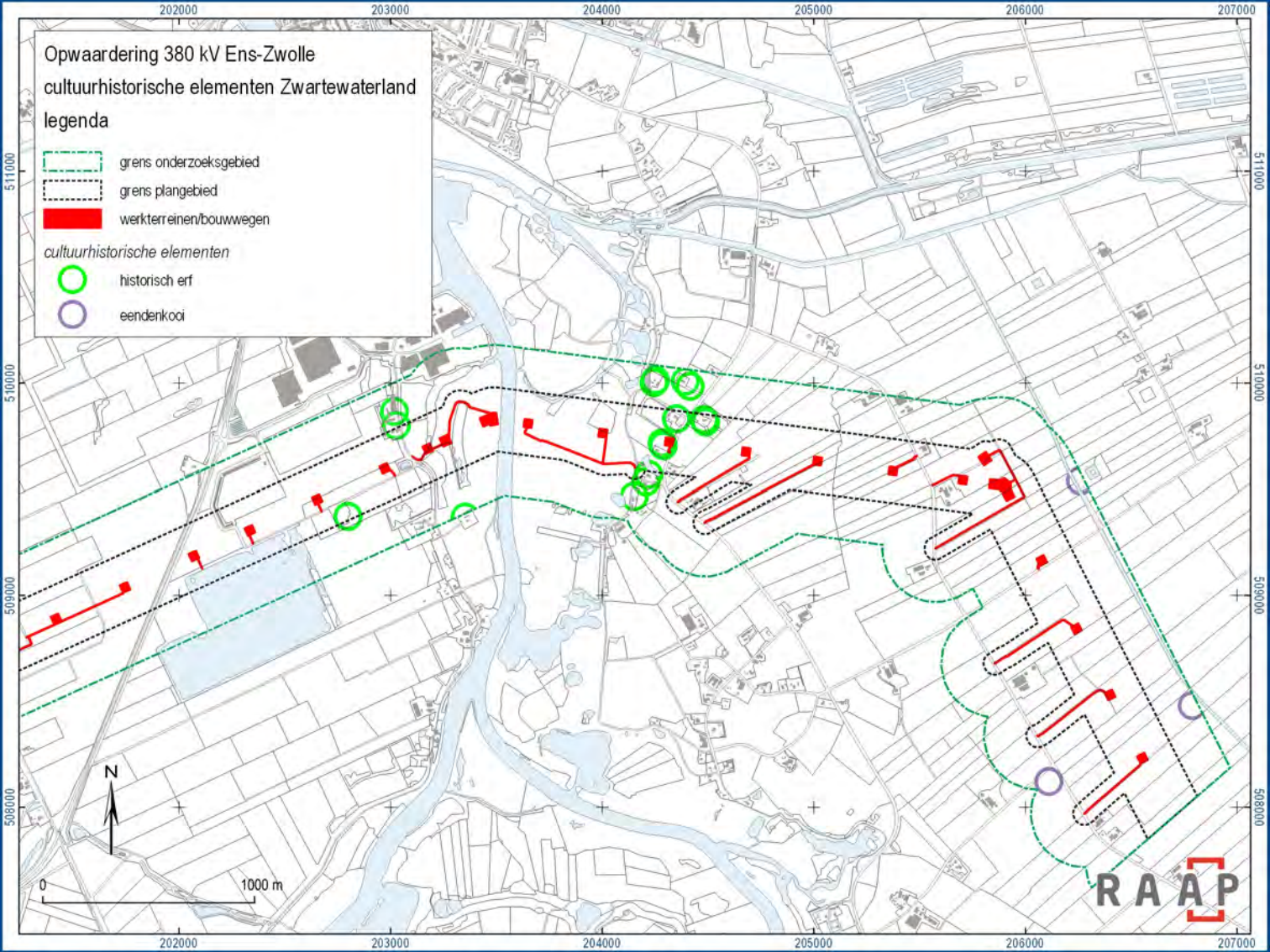
Opwaardering 380 kV Ens-Zwolle
cultuurhistorische elementen Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
cultuurhistorische elementen
historisch erf
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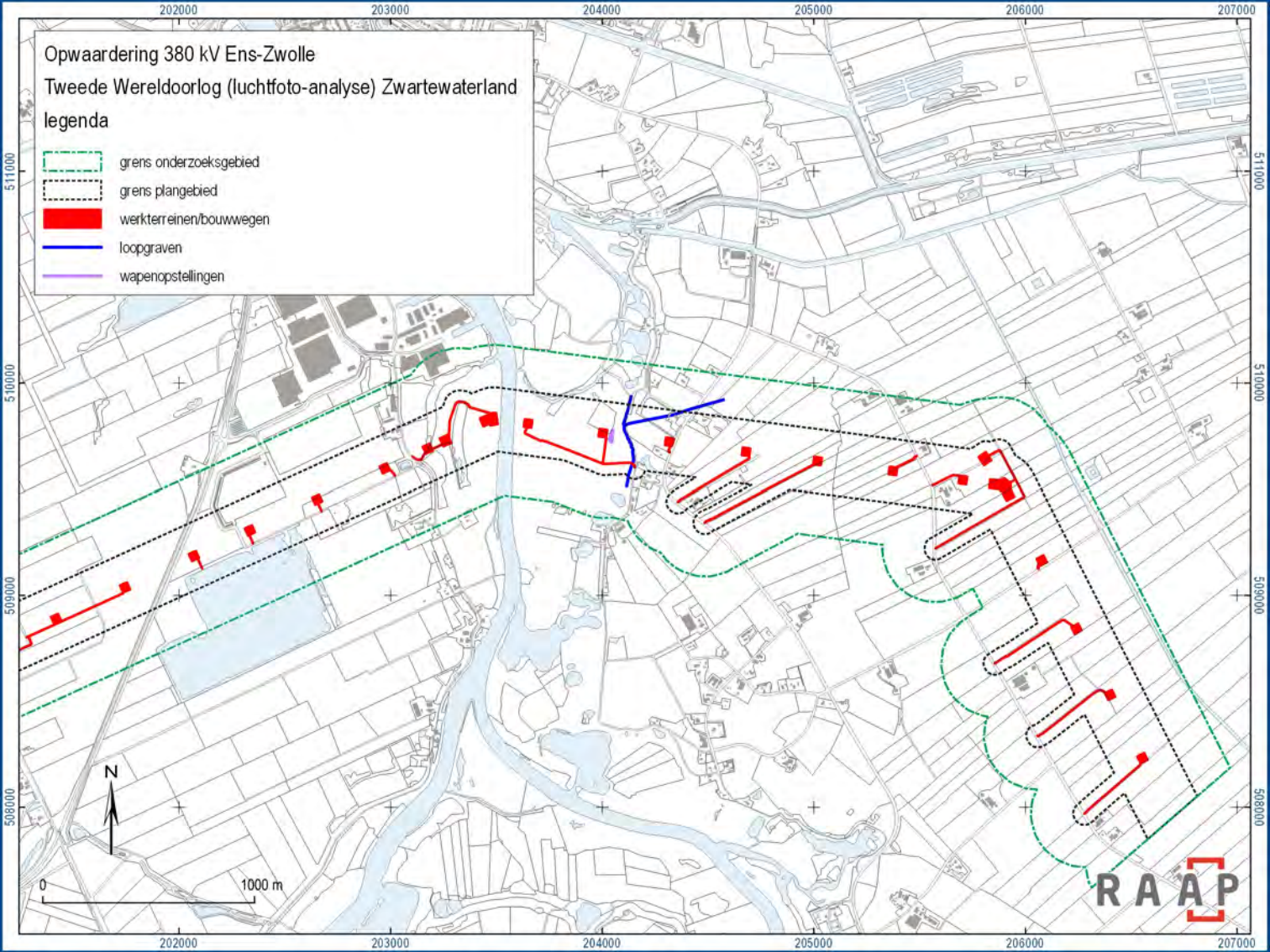
RAAP

Bijlage 9. Tweede Wereldoorlog


Opwaardering 380 kV Ens-Zwolle
Tweede Wereldoorlog (luchtfoto-analyse) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
loopgraven
wapenopstellingen
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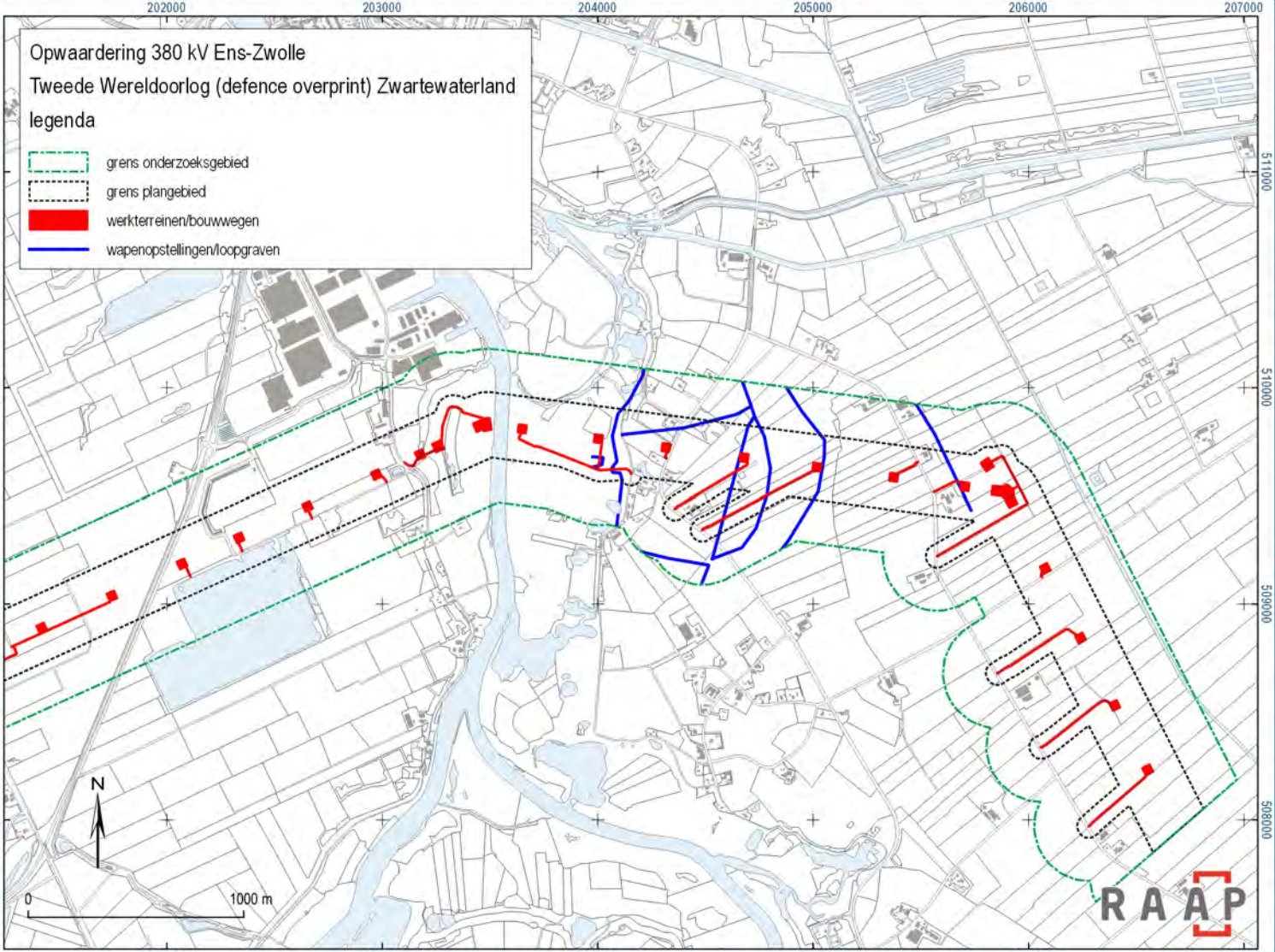
Opwaardering 380 kV Ens-Zwolle
Tweede Wereldoorlog (defence overprint) Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
wapenopstellingen/loopgraven
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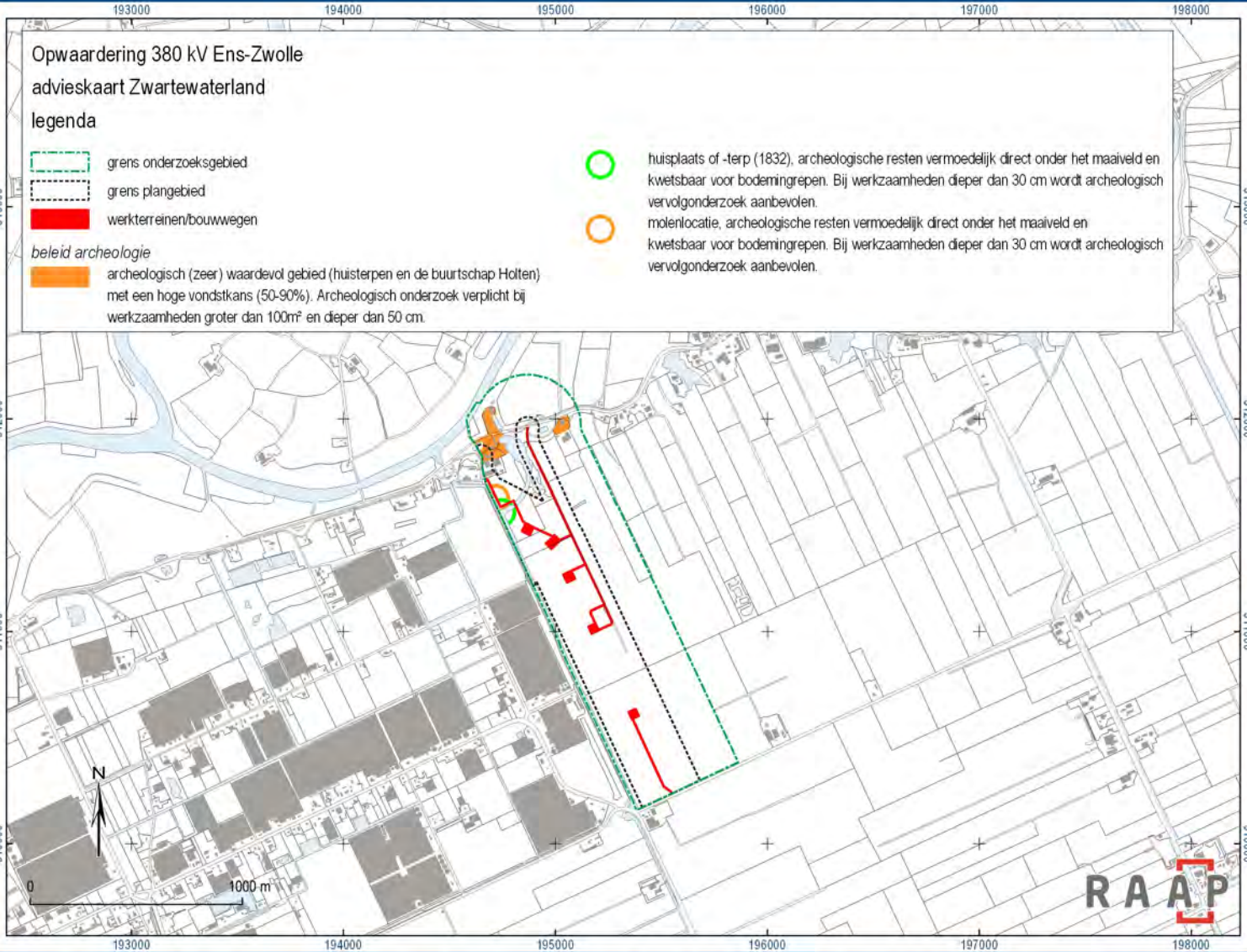
1000 m
RAAP

Bijlage 10. Advies


Opwaardering 380 kV Ens-Zwolle
advieskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
beleid archeologie
archeologisch (zeer) waardevol gebied (huisterpen en de buurtschap Holten) met een hoge vondstkans (50-90%). Archeologisch onderzoek verplicht bij werkzaamheden groter dan 100m² en dieper dan 50 cm.
huisplaats of -terp (1832), archeologische resten vermoedelijk direct onder het maaiveld en kwetsbaar voor bodemingrepen. Bij werkzaamheden dieper dan 30 cm wordt archeologisch vervolgonderzoek aanbevolen.
molenlocatie, archeologische resten vermoedelijk direct onder het maaiveld en kwetsbaar voor bodemingrepen. Bij werkzaamheden dieper dan 30 cm wordt archeologisch vervolgonderzoek aanbevolen.
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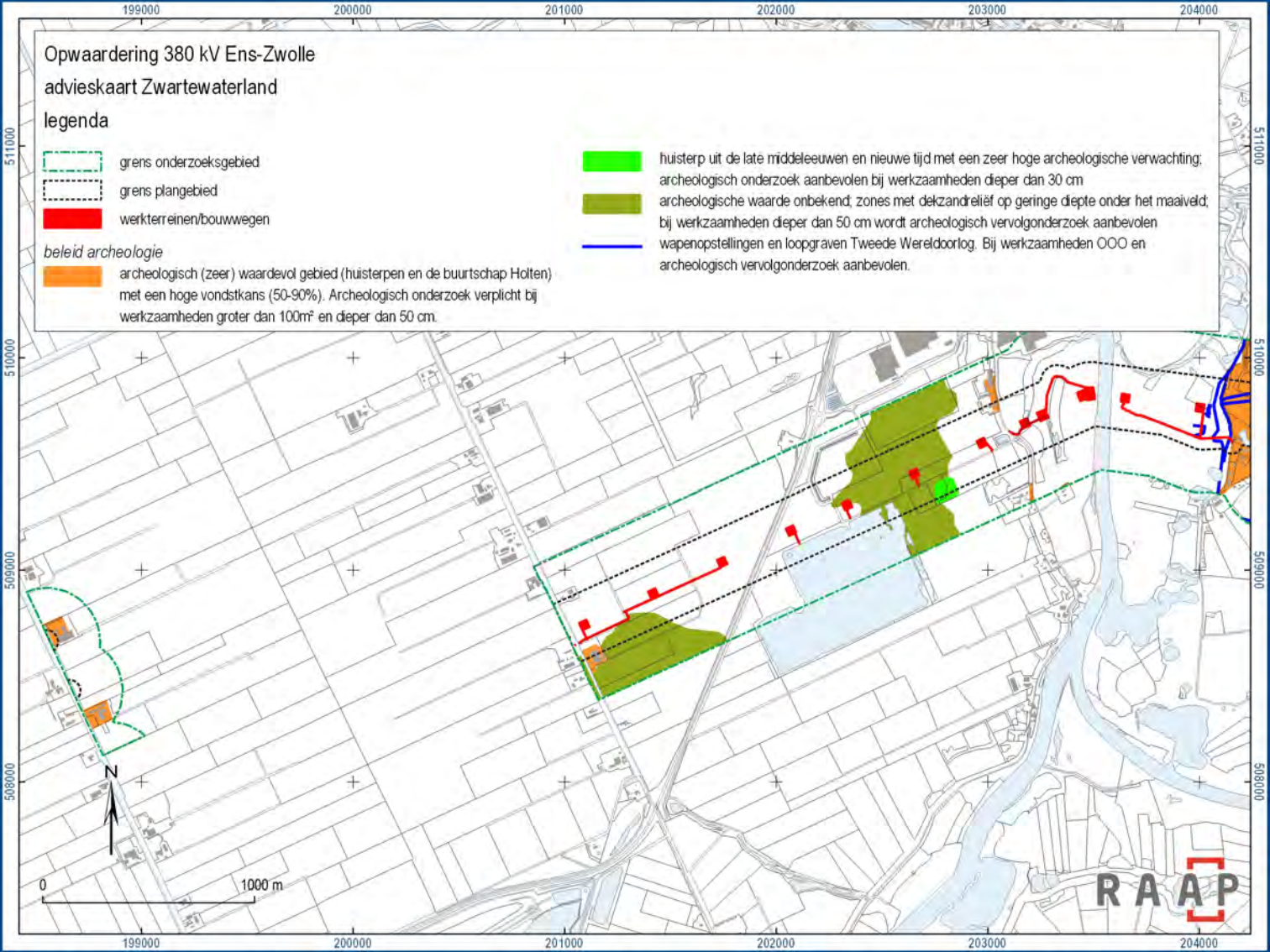
Opwaardering 380 kV Ens-Zwolle
advieskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
beleid archeologie
archeologisch (zeer) waardevol gebied (huisterpen en de buurtschap Holten) met een hoge vondstkans (50-90%). Archeologisch onderzoek verplicht bij werkzaamheden groter dan 100m² en dieper dan 50 cm.
huisterp uit de late middeleeuwen en nieuwe tijd met een zeer hoge archeologische verwachting; archeologisch onderzoek aanbevolen bij werkzaamheden dieper dan 30 cm
archeologische waarde onbekend; zones met dekzandreliëf op geringe diepte onder het maaiveld; bij werkzaamheden dieper dan 50 cm wordt archeologisch vervolgonderzoek aanbevolen
wapenopstellingen en loopgraven Tweede Wereldoorlog. Bij werkzaamheden OOO en archeologisch vervolgonderzoek aanbevolen.
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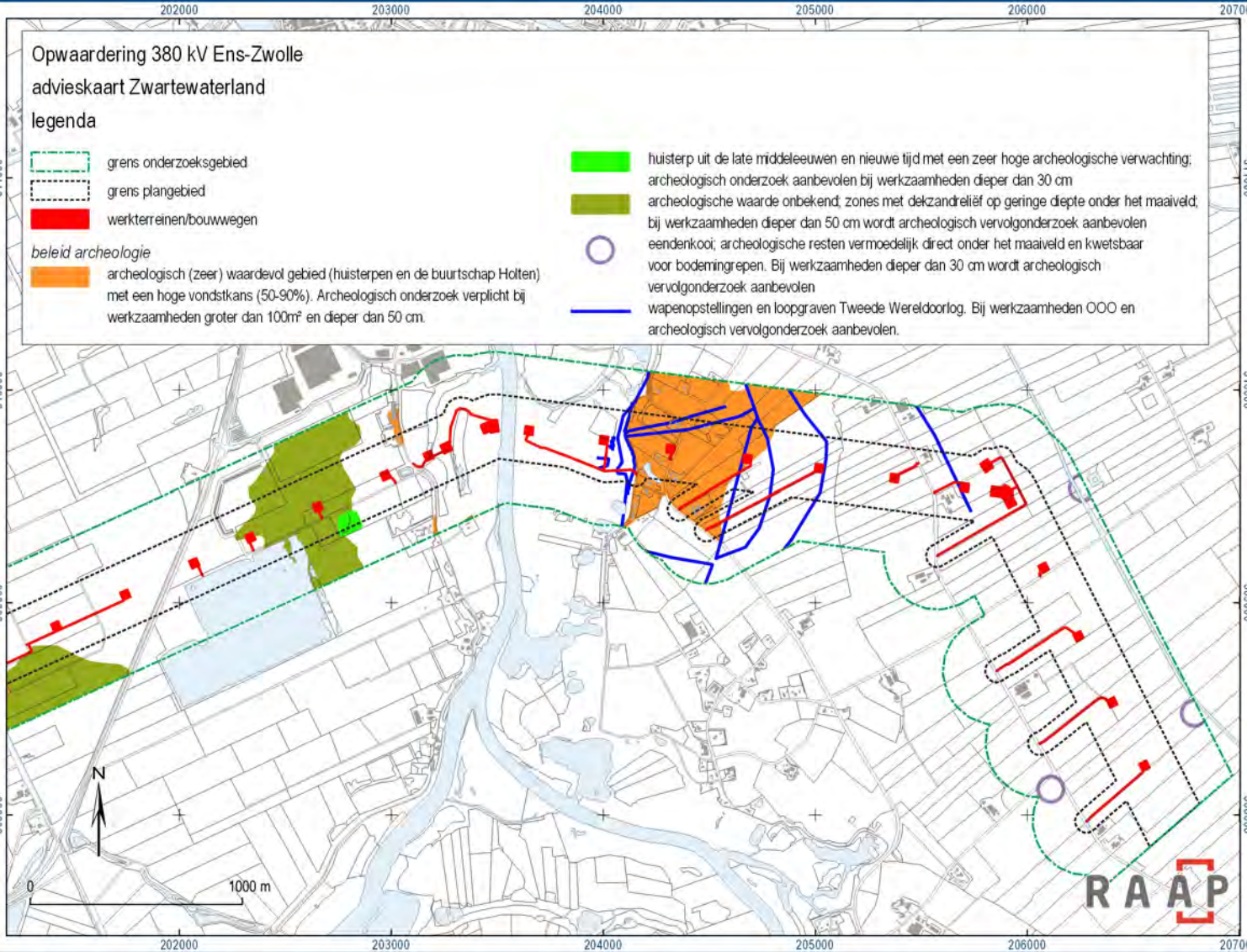
Opwaardering 380 kV Ens-Zwolle
advieskaart Zwartewaterland
legenda
grens onderzoeksgebied
grens plangebied
werkterreinen/bouwwegen
beleid archeologie
archeologisch (zeer) waardevol gebied (huisterpen en de buurtschap Holten) met een hoge vondstkans (50-90%). Archeologisch onderzoek verplicht bij werkzaamheden groter dan 100m² en dieper dan 50 cm.
huisterp uit de late middeleeuwen en nieuwe tijd met een zeer hoge archeologische verwachting; archeologisch onderzoek aanbevolen bij werkzaamheden dieper dan 30 cm
archeologische waarde onbekend; zones met dekzandreliëf op geringe diepte onder het maaiveld; bij werkzaamheden dieper dan 50 cm wordt archeologisch vervolgonderzoek aanbevolen
eendenkooi; archeologische resten vermoedelijk direct onder het maaiveld en kwetsbaar voor bodemingrepen. Bij werkzaamheden dieper dan 30 cm wordt archeologisch vervolgonderzoek aanbevolen
wapenopstellingen en loopgraven Tweede Wereldoorlog. Bij werkzaamheden OOO en archeologisch vervolgonderzoek aanbevolen.
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RAAP

Bijlage 7

Natuuronderzoek, verkennend

Rapport

Projectnummer: 375014
Referentienummer: NL21-648800269-11542
Datum: 02-12-2021

Verkennend natuuronderzoek opwaardering 380 kV Ens - Zwolle

Oriënterend natuuronderzoek in het kader van de wet- en regelgeving voor natuur

Status definitief

Opdrachtgever:
TenneT TSO BV
Utrechtseweg 310
6812 AR ARNHEM

Sweco
Rozenburglaan 11
9727 DL Groningen
Postbus 7057
9701 JB Groningen

T +31 88 811 66 00
www.sweco.nl

Sweco Nederland B.V.
Groningen
Handelsregister 30129769
Statutair gevestigd te De Bilt

Rietje Klous
Adviseur Ecologie en Milieu

M +31 6 20 13 47 40

Verantwoording

Titel	Verkennend natuuronderzoek opwaardering 380 kV Ens - Zwolle
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Auteur	Rietje Klous & Germ Zeephat
E-mailadres	rietje.klous@sweco.nl
Gecontroleerd door	Germ Zeephat
Paraaf gecontroleerd	
Goedgekeurd door	Tim Verver
Paraaf goedgekeurd	

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1 Inleiding

1.1 Aanleiding

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen zodat er een grotere transportcapaciteit mogelijk wordt gemaakt. Om die reden is TenneT voornemens de bestaande landelijke 380 kV-ring, de 'ruggengraat' van het landelijk hoogspanningsnet, op te waarderen (programma Beter Benutten Bestaande 380 kV). Binnen het betreffende programma valt ook het deelproject Opwaardering 380 kV-verbinding Ens - Zwolle.

1.2 Kader van het onderzoek

We toetsen de voorgenomen werkzaamheden aan de wet- en regelgeving voor natuur binnen de volgende kaders:

- Wet natuurbescherming:
  - Natura 2000-gebieden;
  - Soorten.
- Provinciaal beleid
  - Natuurnetwerk Nederland (NNN);
  - eventueel gebieden buiten het NNN.

Het verkennend natuuronderzoek is erop gericht een eerste inzicht te krijgen in de mogelijke effecten op beschermde natuurwaarden in en om het projectgebied en de mogelijke vervolgstappen die moeten worden genomen met betrekking tot aanvullend veldonderzoek, nader effectonderzoek en nadere procedures. Het verkennend onderzoek is de eerste stap in de procedure. Afhankelijk van het resultaat, moeten de navolgende stappen al dan niet worden doorlopen. Welke stappen dit zijn, staat beschreven in de effectenanalyse en conclusie van elk hoofdstuk. De resultaten van eventuele vervolgonderzoeken zijn, voor zover al uitgevoerd in deze rapportage verwerkt.

1.3 Ligging en beschrijving plangebied

De scope van de werkzaamheden betreft de bestaande 380 kV hoogspanningsverbinding tussen Zwolle en Ens (figuur 1.1). Onderdeel van de scope zijn 91 mastlocaties, werkterreinen, lierlocaties en aanrijroutes behorend bij de op te waarderen hoogspanningsmasten van het tracé Ens - Zwolle.

Figuur 1.1 De 380 Kv-verbinding Ens-Zwolle (in rood, Ens en Zwolle omcirkeld)

1.4 Voorgenomen ontwikkelingen

Voor de opwaardering van de bestaande 380 kV-verbinding Zwolle-Ens moeten diverse werkzaamheden worden uitgevoerd. In de basis betreft dit het ophangen van nieuwe geleiders met een hogere transportcapaciteit dan de huidige geleiders. De nieuwe geleiders zijn qua omvang en aantal gelijk aan de bestaande maar kunnen meer stroom transporteren doordat ze hogere temperaturen kunnen weerstaan zonder te ver door te gaan hangen. De huidige hoogspanningsverbinding is bovendien inmiddels bijna 35 jaar oud. Om deze reden worden ook andere onderdelen, zoals de isolatorkettingen en bliksemdraden als levensduur verlengende activiteit vervangen. Daarnaast zijn de masten constructief beschouwd en moet bij een aantal masten de fundering versterkt worden.

2 Wet natuurbescherming: Natura 2000-gebieden

2.1 Toetsingskader

Bescherming van Natura 2000-gebieden vindt plaats op grond van de Wet natuurbescherming. Onder Natura 2000-gebieden vallen de gebieden die op grond van de Europese Vogelrichtlijn en/of Habitatrichtlijn zijn aangewezen. De essentie van het beschermingsregime voor deze gebieden is dat de duurzame instandhouding van soorten en habitats binnen de Europese Unie wordt gewaarborgd. Daarbij zijn instandhoudingsdoelstellingen geformuleerd voor natuurlijke habitats en/of soorten. Dit kunnen behoudsdoelstellingen zijn voor habitats en leefgebieden van soorten die zich al op het gewenste niveau (kwalitatief en kwantitatief) bevinden of uitbreidings- of verbeterdoelstellingen voor habitats en leefgebieden van soorten die zich nog niet op het gewenste niveau bevinden.

Om dit toetsbaar te maken, kent de Wet natuurbescherming (Wnb) een goedkeuringsvereiste voor plannen die significante gevolgen voor de betreffende gebieden zouden kunnen hebben (artikel 2.7, eerste lid, Wnb), en een vergunningsplicht voor projecten en andere handelingen die (significant) negatieve gevolgen voor de betreffende gebieden zouden kunnen hebben (artikel 2.7, tweede lid, Wnb). De goedkeuring of de vergunning wordt alleen verleend wanneer voldoende zeker is dat de instandhoudingsdoelstellingen voor het betreffende Natura 2000-gebied niet in het geding zijn. Wanneer significante gevolgen voor Natura 2000-gebieden op grond van een passende beoordeling niet kunnen worden uitgesloten, kan alleen goedkeuring aan het plan of een vergunning voor het project worden verleend indien de ADC-toets met succes doorlopen kan worden (artikel 2.8, vierde lid, Wnb). Dat betekent dat het project nodig is omwille van een dwingende reden van groot openbaar belang, er geen alternatief mag zijn met minder grote effecten op Natura 2000 en de nodige compenserende maatregelen worden getroffen.

In de navolgende paragrafen is beoordeeld of er effecten op kunnen treden op Natura 2000-gebieden en zo ja, wat de benodigde vervolgstappen zijn.

2.2 Inventarisatie

Voor de inventarisatie van Natura 2000-gebieden is gebruik gemaakt van de Natura 2000-kaart van het ministerie van LNV. Het plangebied ligt grotendeels buiten de begrenzing van Natura 2000-gebieden. De dichtstbijzijnde Natura-2000 gebieden Zwarte meer, Ketelmeer & Vossemeer (HR- en VR-gebied), Rijntakken (HR- en VR-gebied) en Uiterwaarden Zwarte Water en Vecht (HR en VR-gebied) liggen allen binnen enkele km van een deel van het tracé. Een aantal masten ligt binnen of zeer nabij een Natura 2000-gebied (Zwarte meer en Uiterwaarden Zwarte Water en Vecht). In tabel 2.1 is een overzicht van deze afstanden gegeven. In figuur 2.1 is de globale ligging van het tracé ten opzichte van de Natura 2000-gebieden te zien. Op iets grotere afstand liggen HR-gebied Olde Maten & Veerslootslanden (minimaal 3,8 km) en HR en VR-gebied De Wieden (minimaal 6 km).

Tabel 2.1 Afstand van het plangebied tot Natura 2000-gebieden

Natura-2000 gebied	Mast nr.	Afstand
Zwarte meer	12	0 m
	13	35 m
	11	50 m
	6- 10	200 m
Ketelmeer & Vossemeer	1 – 6a	350 m
Rijntakken	49 - 50	3 km
Uiterwaarden Zwarte Water en Vecht	64 - 67	0 m
	63	120 m
	68	150 m

Figuur 2.1 Ligging van het tracé ten opzichte van Natura 2000-gebieden Globaal van links naar rechts: Ketelmeer & Vossemeer (K) Zwarte meer (Z), Rijntakken (R), Uiterwaarden Zwarte Water en Vecht, De Wieden (W) en Olde Maten & Veerslootslanden (O) (transparant groen met blauwe letter).

2.3 Analyse van de mogelijke effecten

2.3.1 Natura 2000-gebied Zwarte meer

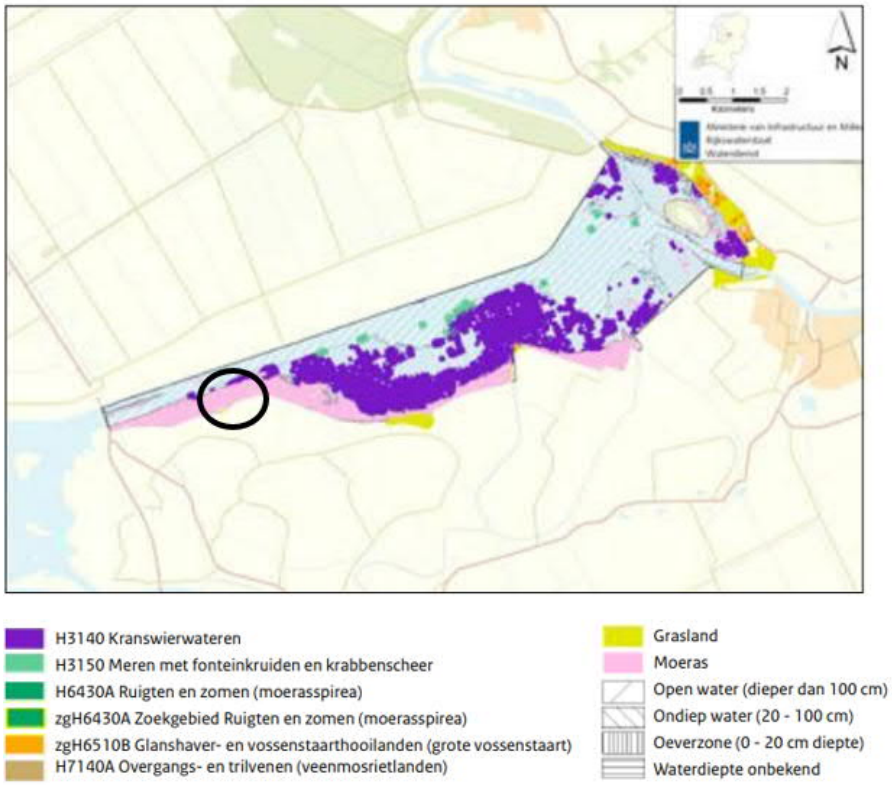
Oppervlakteverlies en versnippering
Mast 12 bevindt zich binnen de begrenzing van Natura 2000-gebied Zwarte meer en is deels gelegen in habtattype H3140 Kranswierwateren en deels in moeras (zie afbeelding 2.2). Omdat de mast vanwege het rietmoeras rondom niet bereikbaar is met materieel, is het nodig om voorafgaande aan de werkzaamheden aan de mast een zandpad aan te leggen. Hierdoor kan mogelijk een deel van het habitattype H3140 Kranswierwateren verloren gaan. Met uitzondering van het aan te leggen pad wordt het werkgebied weer in de oorspronkelijke staat terug gebracht. Van het gedeelte waar het pad wordt aangelegd dient onderzocht te worden of (significant) negatieve effecten op het aangewezen habittatype kunnen optreden.

Verstoring
Verstoring van verstoringsgevoelige dieren door beweging, geluid, trilling en licht gedurende de realisatiefase en gebruiksfase reikt tot maximaal enkele honderden meters ver. De masten 6 t/m 13 bevinden zich op een afstand van nul tot 200 m van Natura 2000 gebied Zwarte meer en staan niet in het water. Verstoring op de aangewezen vissen kan worden uitgesloten, er van uitgaande dat geen trillingen plaatsvinden. Wel kan verstoring van meervleermuis, broedvogels en niet-broedvogels plaatsvinden.

Door de werkzaamheden overdag uit te voeren en geen gebruik te maken van kunstlicht worden negatieve effecten op meervleermuis voorkomen.
Voor de broedvogels geldt dat deze voornamelijk de aanwezige rietvelden zullen gebruiken als broedplaats. Om negatieve effecten op deze soorten te voorkomen dienen de

werkzaamheden buiten het broedseizoen plaats te vinden. In een aanvullende toets moet worden vastgesteld of ook (potentieel) broedgebied verloren gaat door de aanleg van het zandpad.

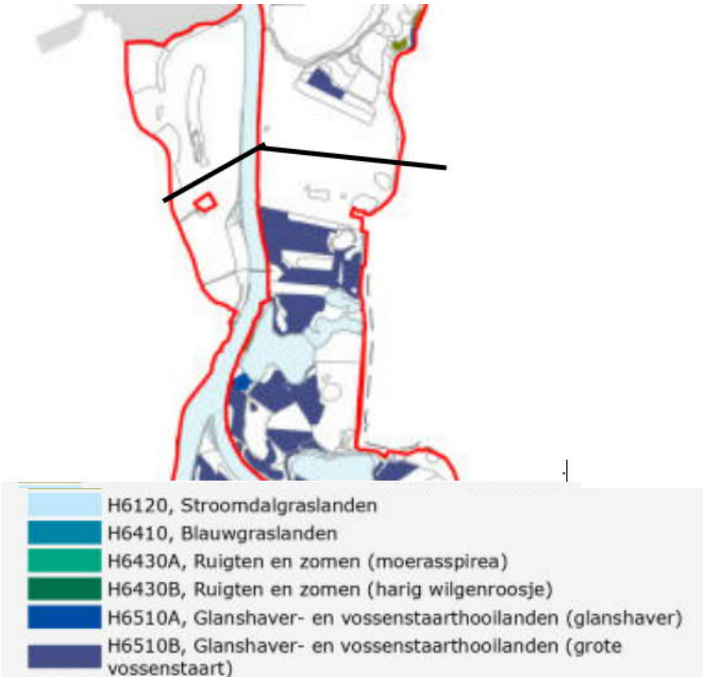
Verstoring van niet-broedvogels in een klein deel van Natura 2000-gebied Zwarte meer is niet geheel uit te sluiten. Maar omdat de werkzaamheden tijdelijk zijn is er geen sprake van structurele verstoring dat verlies van leefgebied tot gevolg kan hebben. Bij mogelijke verstoring is aan de oostzijde van het plangebied een groot areaal aan geschikt gebied aanwezig, waar rustende vogels gebruik van kunnen maken als tijdelijk alternatief. De omvang van de verstoring ten opzichte van de omvang van het Natura 2000-gebied is erg beperkt. Hierdoor zullen de werkzaamheden waarschijnlijk niet leiden tot significant negatieve effecten op de niet-broedvogels, zeker als de werkzaamheden zoveel mogelijk uitgevoerd worden buiten de kwetsbare periodes (broedseizoen en winterrustseizoen). Maar om uit te sluiten dat significant negatieve effecten op de instandhoudingsdoelen van de niet-broedvogels optreden een aanvullende toets te worden uitgevoerd.



Afbeelding 2.2: habitattypenkaart Natura 2000-gebied Zwarte meer met plangebied zwart omcirkeld.

2.3.2 Natura 2000-gebied Uiterwaarden Zwarte water en Vecht

Oppervlakteverlies en versnippering
De masten 64 t/m 67 bevinden zich binnen de begrenzing van Natura 2000-gebied. Voor deze masten geldt dat na de werkzaamheden de oorspronkelijke situatie weer is hersteld. Rond de masten 64 t/m 67 is bovendien geen habitattype aangewezen (zie afbeelding 2.3). Er is geen sprake van versnippering en oppervlakteverlies ten gevolge van de werkzaamheden.



Afbeelding 2.3: Habitattypenkaart Uiterwaarden Zwarte water en Vecht met het hoogspanningstracé zwart ingetekend.

Verstoring

De masten 64, 65, 66 en 67 bevinden zich binnen de begrenzing van Natura 2000-gebied Uiterwaarden Zwarte water en Vecht en mast 63 en 68 bevinden zich op ruim 100 m afstand van de begrenzing van dit gebied. Tussen de begrenzing van het Natura 2000-gebied en deze masten ligt een weg vanwaar uit structurele verstoring plaatsvindt op het Natura 2000-gebied.
De habitatrichtlijnsoorten, een 4-tal vissoorten (bittervoorn, grote modderkruiper, kleine modderkruiper en rivierdonderpad) zullen geen negatieve effecten ondervinden van de werkzaamheden, aangezien niet in open water wordt gewerkt en geen trillingen ontstaan die negatief effect kunnen veroorzaken.

Wel kan mogelijk verstoring ontstaan voor broedvogels en niet-broedvogels. Om verstoring van broedvogels tegen te gaan wordt gewerkt buiten het broedseizoen (halverwege maart tot halverwege augustus). Verstoring van niet-broedvogels kan niet geheel worden uitgesloten. Maar omdat de werkzaamheden aan de vier masten binnen de begrenzing tijdelijk zijn, is er waarschijnlijk geen sprake van structurele verstoring en daardoor geen verlies van leefgebied. Er is nabij het plangebied een groot areaal aan graslanden, uiterwaarden en rietmoeras aanwezig, dat als alternatief kan dienen, voor rustende of foeragerende vogels. Het mogelijk verstoorde areaal rond de masten in het plangebied is dermate klein ten opzichte van de omvang van het Natura 2000-gebied dat de werkzaamheden waarschijnlijk niet zullen leiden tot significant negatieve effecten op de niet-broedvogels, uitgaande van uitvoering van de werkzaamheden buiten de kwetsbare periodes (broedseizoen en winterrustseizoen).
Voor de masten 63 en 68 die buiten de begrenzing van het Natura 2000-gebied staan geldt bovendien dat de tussen de masten en het Natura 2000-gebied aanwezige weg al zorgt voor een zeker geluidsniveau dat door de werkzaamheden niet permanent zal worden overstegen. De aanvullende verstoring ten gevolge van de werkzaamheden aan de masten 63 en 68 is naar verwachting gering en zal waarschijnlijk niet tot significant negatieve effecten leiden op niet-broedvogels.

Om uit te kunnen sluiten of significant negatieve effecten op de instandhoudingsdoelen van de niet-broedvogels optreden dient een aanvullende toets te worden uitgevoerd

2.3.3 Stikstofdepositie

Bij de uitvoering van de werkzaamheden wordt gebruik gemaakt van verschillend materieel dat gepaard gaat met stikstofemissie, zoals kranen en lierwagens. Stikstofdepositie als gevolg van de inzet van werktuigen is naar verwachting erg beperkt, gezien de tijdelijke aard van de werkzaamheden. Per 1 juli 2021 voorziet de Wet stikstofreductie en natuurverbetering in een partiële vrijstelling van de vergunningplicht voor stikstofemissies afkomstig van bouw- en sloopwerkzaamheden. De werkzaamheden aan de masten kunnen conform de huidige wetgeving vanaf die datum buiten beschouwing worden gelaten voor de beoordeling van de vergunningplicht. In de nieuwe situatie vindt geen stikstofuitstoot plaats.

2.4 Conclusie

Voor de werkzaamheden bij mast 12 dient een nadere toets uitgevoerd te worden om vast te stellen of de aanleg van het zandpad om de mast te bereiken leidt tot significant negatieve effecten op aangewezen habitattypen, broedareaal voor de aangewezen broedvogels en verstoring van niet-broedvogels.

Voor alle masten in of nabij de Natura 2000-gebieden Zwarte meer en Uiterwaarden Zwarte water en Vecht is het uitgangspunt dat de werkzaamheden uitgevoerd worden buiten het broedseizoen. Voor mogelijk significante verstoring van niet-broedvogels in deze Natura 2000-gebieden een aanvullende toets te worden uitgevoerd om uit te kunnen sluiten of significant negatieve effecten op de instandhoudingsdoelen van de niet-broedvogels optreden.

3 Wet natuurbescherming: soortenbescherming

3.1 Toetsingskader

In de Wet natuurbescherming (Wnb) is de soortenbescherming in Nederland geregeld. Hierbij worden drie verschillende beschermingsregimes gehanteerd waaraan verschillende verbodsbepalingen zijn gekoppeld:

Soorten Vogelrichtlijn (artikel 3.1 e.v.):

- lid 1) Het is verboden opzettelijk van nature in Nederland in het wild levende vogels van soorten als bedoeld in artikel 1 van de Vogelrichtlijn te doden of te vangen;
- lid 2) Het is verboden opzettelijk nesten, rustplaatsen en eieren van vogels als bedoeld in het eerste lid te vernielen of te beschadigen, of nesten van vogels weg te nemen;
- lid 3) Het is verboden eieren van vogels als bedoeld in het eerste lid te rapen en deze onder zich te hebben;
- lid 4) Het is verboden vogels als bedoeld in het eerste lid opzettelijk te storen;
- lid 5) Het verbod, bedoeld in het vierde lid, is niet van toepassing indien de storing niet van wezenlijke invloed is op de staat van instandhouding van de desbetreffende vogelsoort.

Soorten Habitatrichtlijn (artikel 3.5 e.v.):

- lid 1) Het is verboden in het wild levende dieren van soorten, genoemd in bijlage IV, onderdeel a, bij de Habitatrichtlijn, bijlage II bij het Verdrag van Bern of bijlage I bij het Verdrag van Bonn, in hun natuurlijk verspreidingsgebied opzettelijk te doden of te vangen;
- lid 2) Het is verboden dieren als bedoeld in het eerste lid opzettelijk te verstoren;
- lid 3) Het is verboden eieren van dieren als bedoeld in het eerste lid in de natuur opzettelijk te vernielen of te rapen;
- lid 4) Het is verboden de voortplantingsplaatsen of rustplaatsen van dieren als bedoeld in het eerste lid te beschadigen of te vernielen;
- lid 5) Het is verboden planten van soorten, genoemd in bijlage IV, onderdeel b, bij de Habitatrichtlijn of bijlage I bij het Verdrag van Bern, in hun natuurlijke verspreidings-gebied opzettelijk te plukken en te verzamelen, af te snijden, te ontwortelen of te vernielen.

Andere soorten (artikel 3.10 e.v.):

- lid 1) Onverminderd artikel 3.5, eerste, vierde en vijfde lid, is het verboden:
  - onderdeel a. in het wild levende zoogdieren, amfibieën, reptielen, vissen, dagvlinders, libellen en kevers van de soorten, genoemd in de bijlage, onderdeel A, bij deze wet, opzettelijk te doden of te vangen;
  - onderdeel b. de voortplantingsplaatsen of rustplaatsen van dieren als bedoeld in onderdeel a opzettelijk te beschadigen of te vernielen, of
  - onderdeel c. vaatplanten van de soorten, genoemd in de bijlage, onderdeel B, bij deze wet, in hun natuurlijke verspreidingsgebied opzettelijk te plukken en te verzamelen, af te snijden, te ontwortelen of te vernielen.

Voor *Vogelrichtlijn- en Habitatrichtlijnsoorten* geldt dat voortplantings- en rustplaatsen (inclusief functionele leefomgeving) van beschermde soorten niet opzettelijk verstoord of vernietigd mogen worden en dat exemplaren van beschermde soorten niet opzettelijk mogen worden gedood of verwond.
Voor *Andere soorten* geldt dat voortplantingsplaatsen en rustplaatsen (inclusief functionele leefomgeving) van beschermde soorten niet (opzettelijk) vernietigd mogen worden en dat exemplaren van beschermde soorten niet (opzettelijk) mogen worden gedood of verwond.

Verbodsbepalingen ten aanzien van de verstoring zijn niet van toepassing op deze soorten. Ten aanzien van de andere beschermde soorten geldt dat het bevoegd gezag (provincies c.q. ministerie van LNV) de vrijheid hebben om soorten binnen deze categorie vrij te stellen van de verbodsbepalingen uit artikel 3.10 Wet Natuurbescherming.

Voor beschermde soorten die niet zijn vrijgesteld en de voorgenomen activiteiten strijdig zijn met de bepalingen in de wet, geldt een ontheffingsplicht. Een ontheffing kan alleen worden verleend, indien de gunstige staat van instandhouding niet in het geding is. Voor vogels geldt in afwijking hierop dat voor verstoring geen ontheffing nodig is, indien de gunstige staat van instandhouding niet in het geding is. Het is mogelijk om ten aanzien van Andere soorten te werken volgens een goedgekeurde gedragscode die is afgestemd op de Wnb, mits de voorgenomen activiteit als zodanig in de gedragscode is beschreven. Er is dan geen ontheffingsplicht van toepassing.

Naast bepalingen voor specifiek aangewezen soorten geldt krachtens artikel 1.11 (lid 1 & 2) van de Wet natuurbescherming, de algemene zorgplicht voor alle in het wild levende dieren en planten alsmede voor hun directe leefomgeving. Via deze wet wordt eenieder medeverantwoordelijk gesteld voor de zorg en bescherming van flora en fauna.

3.2 Methode

De inventarisatie betreft een onderzoek naar de actueel en potentieel voorkomende beschermde soorten in het tracé. Hierbij maken we onderscheid tussen het bronnenonderzoek en een verkennend veldbezoek. Tijdens het laatste vindt tevens een habitatgeschiktheidsbeoordeling plaats.

<u>Bronnenonderzoek</u>
Het bronnenonderzoek heeft als doel een overzicht te verkrijgen van de beschikbare informatie met betrekking tot het voorkomen van beschermde soorten in het plangebied en omgeving. Hiervoor zijn de volgende bronnen gebruikt:

- landelijke (digitale) verspreidingsatlassen (waaronder de NDFF, periode 2016-2021);
- regionale verspreidingsatlassen.

<u>Habitatgeschiktheidsbeoordeling</u>
Op basis van een oriënterend veldbezoek is de geschiktheid van biotopen voor beschermde soorten beoordeeld. Deze beoordeling brengt samen met het bronnenonderzoek de beschermde soorten(groepen) in beeld die in het tracé (kunnen) voorkomen. De veldbezoeken hebben plaats gevonden in november en december 2020 en zijn uitgevoerd door Rietje Klous en Germ Zeephat, beide deskundig ecologen van Sweco. Uitgangspunt bij de inventarisatie is geweest dat, waar mogelijk de omliggende sloten intact blijven en de werkzaamheden vanaf de droge percelen worden uitgevoerd. In enkele gevallen kan, bijvoorbeeld ten behoeve van een tijdelijke bouwweg, een tijdelijke dam met duiker nodig zijn. Voor deze gevallen wordt vooraf beoordeeld of nader onderzoek nodig is of dat werken volgens voorgeschreven maatregelen (ecologisch werkprotocol) afdoende is.

<u>Analyse en toetsing van mogelijke effecten</u>
Op basis van het bronnenonderzoek en de habitatgeschiktheidsbeoordeling wordt een inschatting gemaakt in hoeverre de te verwachten soort(groepen)en en/of het geschikte biotoop beïnvloed wordt door de voorgenomen activiteit. Hieruit wordt duidelijk voor welke soort(groepen) er nader (veld)onderzoek en eventueel ontheffingsplicht in kader van de Wnb noodzakelijk is. Het onderzoek beperkt zich tot op grond van de Wnb beschermde planten- en diersoorten. Niet-beschermde Rode lijst-soorten die in het plangebied (kunnen) voorkomen zoals diverse soorten paddenstoelen en vaatplanten worden niet in het onderzoek betrokken, omdat deze soorten niet relevant zijn voor toetsing aan de Wnb.

Leeswijzer resultaten

Om de resultaten overzichtelijk te maken en de leesbaarheid te bewaren zijn de resultaten van het onderdeel soortenbescherming in paragraaf 3.2 weergegeven in een tabel (3.1). in de tabel wordt per locatie aangegeven:

- wat het ecotoop is,
- of er waarnemingen bekend zijn van beschermde soorten,
- of deze, of andere, beschermde soorten hier te verwachten zijn aan de hand van het aanwezige ecotoop en,
- of er nader onderzoek noodzakelijk is naar de aanwezigheid van deze soorten (betreffende masten zijn rood gemarkeerd).

Uitgevoerd aanvullend onderzoek is beschreven in paragraaf 3.4.

In de tabel zijn ook lierlocaties vermeld. Omdat de lierlocaties in het door TenneT aangeleverde mastenboek ongenummerd zijn, zijn ze vermeld bij het dichtstbijzijnde mastnummer.

Binnen de scope van het verkennend onderzoek vallen ook de toegangswegen naar de mast- en lierlocaties. Resultaten hiervan worden meegenomen in de beoordeling van de locaties zelf en worden niet apart beschreven.

De aangeleverde werkvlakken vallen in een aantal gevallen over een sloot of moerasgebied heen. Uitgangspunt hierbij is dat de werkzaamheden zoveel mogelijk uitgevoerd zullen worden vanaf de droge percelen rondom de hoogspanningsmast. Als dit niet kan en een tijdelijke demping moet plaatsvinden, wordt vooraf beoordeeld of nader onderzoek nodig is of dat werken volgens voorgeschreven maatregelen (ecologisch werkprotocol) afdoende is.

3.3 Resultaten

Tabel 3.1 Resultaten veld-en bronnenonderzoek masten- en lierlocaties (in rood de masten waar een nest is aangetroffen)

Locatie	Ecotoop	Veldwaarnemingen	Nader onderzoek	Bekende waarnemingen	Geschikt habitat
Mast 1+lier	Grasland + Akkerland	-	Nee	Gewone- ruige- en kleine dwergvleermuis, rosse vleermuis, bever, otter. Boomvalk, buizerd, gierzwaluw, havik, huismus, kerkuil, ransuil, roek, sperwer, rugstreeppad, grote modderkruiper	Vleermuizen, vogels
Mast 2	Agrarisch grasland	Slechtvalk	Nee		
Mast 3	Akkerland	Nest, 2e traverse noordzijde	Ja, gebruik nest		
Mast 4	Akkerland	-	Nee		
Mast 5	Akkerland	Buizerd	Nee		
Mast 5a+lier	Verruigd grasland	Nest, 2e traverse zuidzijde	Ja, gebruik nest		
Mast 6a+lier	Gemaaid grasland	-	Nee		
Mast 7	Agrarisch grasland	-	Nee		
Mast 8	Agrarisch grasland	Slechtvalk	Nee		
Mast 9+lier	Agrarisch grasland	-	Nee		
Mast 10	Agrarisch grasland	-	Nee		
Mast 11+lier	Agrarisch grasland	-	Nee		
Mast 12	Ruigte, boschages en riet	Aalscholvers aanwezig, zie ook 3.4.2	Nee	Vleermuizen. Wezel, bunzing, bever, otter, woelrat, boomvalk, buizerd, havik, kerkuil, ooievaar, ransuil, roek, slechtvalk.	Vleermuizen, vogels, poelkikker, otter (uitsluitend bij mast 12 en 27)
Mast 13+lier	Agrarisch grasland	-	Nee		
Mast 14+lier	Agrarisch grasland	-	Nee		
Mast 15+lier	Agrarisch grasland	-	Nee		
Mast 16	Agrarisch grasland	-	Nee		
Mast 17	Agrarisch grasland/ ruigte	Nest, 2e traverse zuidzijde	Ja, gebruik nest		
Mast 18	Agrarisch grasland	Nest, 1e traverse noordoostzijde	Ja, gebruik nest		
Mast 19	Agrarisch grasland	-	Nee		
Mast 20	Agrarisch grasland & riet	-	Nee		
Mast 21	Agrarisch grasland	-	Nee		
Mast 22	Agrarisch grasland	-	Nee		
Mast 23	Agrarisch grasland	Nest, 2e traverse zuidzijde	Ja, gebruik nest		
Mast 24	Agrarisch grasland	-	Nee		

Mast 25	Agrarisch grasland	-	Nee		
Mast 26	Akkerland	-	Nee		
Mast 27	Graskade nabij rietoever	Aalscholver aanwezig	Nee[1]		
Mast 28	Agrarisch grasland	-	Nee		
Mast 29+lier	Agrarisch akker- en grasland	-	Nee		
Mast 30+lier	Grasland en nat rietland	-	Nee	Vleermuizen. Bunzing, otter, woelrat. Boomvalk, buizerd, grote gele kwikstaart, havik, huismus, ooievaar slechtvalk, rugstreeppad	Vleermuizen, vogels, amfibieën
Mast 31	Grasland omringd door bomen	Nest, traverse noordzijde	Ja, gebruik nest		
Mast 32	Schapenweide	-	Nee		
Mast 33+lier	Nat agrarisch grasland	-	Nee		
Mast 34 +lier	Ruigte (voedselrijk)	Nest, 2e traverse zuidzijde	Ja, gebruik nest		
Mast 35+lier	Akkerland	-	Nee	Vleermuizen, woelrat, wezel, hermelijn, boomvalk, buizerd, gierzwaluw, grote gele kwikstaart, havik, huismus, kerkuil, ooievaar, roek, slechtvalk, sperwer, wespendief	Vleermuizen, vogels
Mast 36	Agrarisch grasland	-	Nee		
Mast 37	Agrarisch grasland	-	Nee		
Mast 38	Agrarisch grasland	Nest, 2e traverse noordoostzijde	Ja, gebruik nest		
Mast 39	Agrarisch grasland	-	Nee		
Mast 40	Agrarisch grasland	-	Nee		
Mast 41+lier	Agrarisch grasland	-	Nee		
Mast 42	Agrarisch grasland	-	Nee		
Mast 43	Agrarisch grasland	-	Nee		
Mast 44	Agrarisch grasland	-	Nee		
Mast 45	Agrarisch grasland				
Mast 46	Agrarisch grasand	-	Nee		
Mast 47	Agrarisch grasland	Werkterrein over sloot	Nee		
Mast 48+lier	Agrarisch grasland	Aanrijroute tussen 48 en 49 passeert 3x landbouwsloot	Nee		
Mast 49+lier	Agrarisch grasland	Aanrijroute tussen 48 en 49 passeert 3x landbouwsloot	Nee	Vleermuizen, wezel, hermelijn, buizerd, gierzwaluw, grote gele kwikstaart, huismus, ooievaar,	Vleermuizen, vogels, waterspitsmuis
Mast 50+lier	Agrarisch grasland	Nest, 2e traverse zuidzijde	Ja, gebruik nest		
Mast 51+lier	Begroeide landbouw sloot	Mast over sloot	Nee[1]		

Mast 52	Mast over sloot	Voedselrijke landbouw sloot	Nee[1]	ransuil, roek slechtvalk, sperwer, torenvalk, steenarend	
Mast 53	Agrarisch grasland	-	Nee		
Mast 54	Agrarisch grasland	-	Nee		
Mast 55	Agrarisch grasland	-	Nee		
Madt 56	Agrarisch grasland	-	Nee		
Mast 57	Agrarisch grasland	-	Nee		
Mast 58	Akkerland (mais)	-	Nee		
Mast 59	Agrarisch grasland	-	Nee		
Werkroute 59	Sloot/dam	Aanrijroute over/door weg en sloot. Maar ook aanrijroute via andere kant over particulier pad	Nee[1]		
Mast 60	Agrarisch grasland.	aanrijroute over/door sloot	Nee[1]		
Mast 61	Agrarisch grasland Grasdam over sloot	-	Nee		
Mast 62	Verruigd grasland	-	Nee		
Mast 63	Grasland met riet en ruigte	Toegang via bestaande weg en via dam grasland in	Nee		
Mast 64+lier	Grasland, riet, bosschages, dunne bomen	Geen nesten of holtes aanwezig	Nee		
Mast 65	Agrarisch grasland	Aanrijroute door riet en over sloot	Nee[1]	Vleermuizen, wezel, hermelijn, otter. Boerenzwaluw, buizerd, huismus, huiszwaluw, kerkuil, ooievaar, slechtvalk, sperwer, torenvalk, zeearend.	Vleermuizen, vogels. amfibieën (mast 66, 67), otter (mast 66, 67)
Mast 66+lier	Grasland, sloot	Werkterrein valt over sloot Binnen verspreidingsgebied poelkikker en otter. Geen otterverblijf aangetroffen.	Nee[1]		
Mast 67	Grasland, sloot	Werkterrein valt over sloot.Binnen verspreidingsgebied poelkikker en otter. Geen otterverblijf aangetroffen	Nee[1]		
Mast 68	Agrarisch grasland	-	Nee		
Mast 69	Agrarisch grasland	-	Nee		
Mast 70	Agrarisch grasland	-	Nee		
Mast 71	Grasland, sloot	Mast over sloot	Nee[1]		
Mast 72+lier	Agrarisch grasland	-	Nee		

Mast 73+lier	Agrarisch grasland	-	Nee	Vleermuizen, bunzing, steenmarter, otter, egel. Boerenzwaluw, boomvalk, buizerd, havik, huismus, huiszwaluw, roek, ooievaar, slechtvalk, sperwer, torenvalk, zwarte wouw	Vleermuizen, vogels
Mast 74	Agrarisch grasland	-	Nee		
Mast 75	Agrarisch grasland	-	Nee		
Mast 76	Agrarisch grasland	-	Nee		
Mast 77	Agrarisch grasland	Kraaien nabij mast	Nee		
Mast 78	Agrarisch grasland	-	Nee		
Mast 79	Agrarisch grasland	-	Nee		
Mast 80	Agrarisch grasland	Nest, 2e traverse noordoostzijde	Ja, gebruik nest		
Mast 81	Agrarisch grasland	-	Nee		
Mast 82+lier	Grasland, bosschage, landbouwsloot	-	Nee		
Mast 83+lier	Agrarisch grasland	-	Nee	Vleermuizen. Grote modderkruiper, beekrombout. Boerenzwaluw, boomvalk, buizerd, havik, huismus, ,roek, ooievaar, slechtvalk, sperwer, torenvalk.	Vleermuizen, vogels, amfibieën (mast 88), otter (mast 88)
Mast 84	Hoog gras, riet	Mogelijk nest	Ja, gebruik nest		
Mast 85	Grasland met schapen	-	Nee		
Mast 86	Grasland	-	Nee		
Mast 87	Grasland en graspad	-	Nee		
Mast 88+lier	Gras, ruigte, bosschage	Nest, 2e traverse noordoostzijde	Ja, gebruik nest		
Werkroute	Zandberm, sloot met brede oeverzone	Geen beschermde soorten. In sloot mogelijk amfibieën. Binnen verspreidingsgebied poelkikker en otter. Geen otterverblijf aangetroffen.	Nee[1]		
Mast 89+lier	Grasland	-	Nee		
Mast 90+lier	Grasland	-	Nee		

[1] *In de leeswijzer is het uitgangspunt opgenomen dat de werkzaamheden (zoveel mogelijk) uitgevoerd zullen worden vanaf de droge percelen rondom de hoogspanningsmast.*

3.4 Resultaten aanvullend onderzoek

3.4.1 Aanvullend onderzoek nesten

Van een aantal vogelsoorten zijn binnen de wet natuurbescherming de nesten niet alleen beschermd als er gebroed wordt, maar zijn deze nestplaatsen jaarrond beschermd. Dit is met name voor soorten die niet zelf een nest (kunnen) bouwen, of afhankelijk zijn van bebouwing (zoals hoogspanningsmasten). De soorten waarvan de nesten jaarrond beschermd zijn, mogelijk in een hoogspanningsmast aangetroffen kunnen worden en voor kunnen komen binnen het plangebied zijn: slechtvalk, boomvalk, buizerd, havik, ransuil, sperwer, ekster en torenvalk.
In onderstaande tabel 3.2 is een overzicht gegeven van alle aangetroffen nesten in de hoogspanningsmasten. Deze nesten zijn, afhankelijk van het gebruik, mogelijk jaarrond beschermd. Als jaarrond beschermde nesten door de werkzaamheden worden geschaad, vindt overtreding van de Wet natuurbescherming plaats. De traverse nummering is overgenomen uit de methodiek van Tennet en begint bij de bovenste traverse met 1.

Om voor de nesten in de masten vermeldt in tabel 3.2 te achterhalen of deze in gebruik zijn als jaarrond beschermd nest, is aanvullend onderzoek uitgevoerd. Dit onderzoek bestond uit 4 rondes in de periode april t/m juni 2021 conform de protocollen die vanuit de overheid hiervoor zijn opgesteld. De resultaten zijn samengevat in tabel 3.2 en de uitgebreide resultaten per ronde zijn opgenomen in Bijlage 1.

Tabel 3.2 Traverse waar te onderzoeken nest is aangetroffen en een samenvatting van het resultaat

Mastnummer	Traverse	Zijde	Samenvatting 4 rondes
3	2e traverse	Noord	Geen nest meer aanwezig
5	2e traverse	Zuid	Kraai (niet jaarrond beschermd)
17	2e traverse	Zuid	Kraai (niet jaarrond beschermd)
18	1e traverse	Noord-oost	Kraai (niet jaarrond beschermd)
23	2e traverse	Zuid	Geen nest meer aanwezig
31	2e traverse	Noord	Geen nest meer aanwezig
34	2e traverse	Zuid	Nest 4 rondes niet in gebruik
38	2e traverse	Noord-oost	Nest 4 rondes niet in gebruik
50	2e traverse	Zuid	In gebruik door slechtvalk
80	2e traverse	Noord-oost	Nest 4 rondes niet in gebruik
84	1e traverse	Midden mast	Geen nest meer aanwezig
88	2e traverse	Noord-oost	Nest 4 rondes niet in gebruik

3.4.2 Aanvullend onderzoek mast 12

Mast 12 staat in moerasgebied staat en was niet zonder meer bereikbaar. Omdat de mast nabij de oever van het Zwarte meer staat en is omringd door Natura 2000-gebied was het van belang om hier wel aanvullend een veldonderzoek te doen. Op 22 april 2021 is samen met Koops grondmechanica een veldbezoek aan mast 12 gebracht.
Een luchtfoto van deze locatie is weergegeven in afbeelding 3.1. Binnen het werkgebied van mast 12 kunnen potentieel vleermuizen, vogels, wezel, bunzing, bever, otter, woelrat en poelkikker (telmee.nl) aanwezig zijn.
Tijdens het veldbezoek zijn geen (jaarrond beschermde) nesten direct langs de werkstrook en/ of onder de mast aangetroffen. Wel waren er grote aantallen van diverse soorten vogels aanwezig in het gebied. Als het gebied binnen het broedseizoen wordt betreden met machines valt verstoring van broedvogels niet uit te sluiten. Door het dichte rietland zijn nesten, van met name kleinere zangvogels, binnen de verstoringsafstand niet uit te sluiten.

Onder de mast was vooral ruigte aanwezig in de vorm van brandnetels en braam. Onder de mast op het verhoogde deel waren holen te zien. Op basis van de predatiesporen, uitwerpselen, gebiedseigenschappen en de vorm van de holen, wordt aangenomen dat dit van een vos is. De vos is nationaal beschermd, maar door de provincie vrijgesteld. Onder de hoogspanningsmast naast (oostelijk van) mast 12 zijn diverse knaagsporen van bever aangetroffen. Er is geen burcht waargenomen, dus waarschijnlijk wordt dit deel van het rietland gebruikt om te foerageren.

3.5 Toetsing soortenbescherming

Uit de tabel met resultaten van het bronnen- en veldonderzoek blijkt dat bij het grootste deel van masten geen negatieve effecten op beschermde soorten zijn te verwachten. Er zijn bij de meeste masten geen beschermde verblijfplaatsen aangetroffen en geen beschermde planten en als de zorgplicht in acht wordt genomen zijn negatieve effecten uitgesloten.

Bij de masten 27, 30, 34, 51, 52, 59, 60, 65, 66, 67, 71 en 88/89 valt het werkgebied en /of de toerit deels in rietoevers of sloten. Uitgaande van het voornemen de masten zoveel mogelijk over land te benaderen worden geen negatieve effecten op soorten die in de sloten voorkomen verwacht. Mocht het plaatselijk toch noodzakelijk zijn een sloot (deels) te dempen of anderzins te beïnvloeden, dient alsnog beoordeeld te worden of sprake kan zijn van negatieve effecten, en dienen mogelijk maatregelen te worden genomen om negatieve effecten te voorkomen. Voorbeelden hiervan zijn: werken buiten het voortplantingseizoen van amfibien en vissen, het vooraf kaal maken, het een kant op werken etc. Voor in riet broedende vogels geldt dat buiten het broedseizoen wordt gewerkt. Waar en wanneer maatregelen nodig zijn zal worden opgenomen in een ecologisch werkprotcol.

Bij mast 12 is het onvermijdelijk om het rietmoeras te betreden. Er zijn echter geen beschermde rust en verblijfplaatsen en jaarrond beschermde nesten aanwezig. Wel wordt het gebied rond mast 12 gebruikt door vos, bever en broedvogels. Voor vos geldt dat deze is vrijgesteld in de provincie Overijssel. Bever gebruikt de omgeving als foerageergebied en dit is in ruime mate aanwezig. Bovendien komt het plangebied na de werkzaamheden weer in de oude situatie beschikbaar. Tijdens de werkzaamheden kan bever het plangebied gemakkelijk mijden en geldt, voor alle soorten, de zorgplicht. Dit houdt in dat dieren de gelegenheid moet worden geboden het plangebied tijdens de werkzaamheden te verlaten Negatieve effecten op bever en andere soorten worden niet verwacht. Voor vogels worden negatieve effecten voorkomen door buiten het broedseizoen de werkzaamheden te verrichten.

In de masten 3, 5, 17, 18, 23, 31, 34, 38, 50, 80, 84 en 88 zijn in 2020 nesten waargenomen die mogelijk jaarrond beschermd zijn. Deze zijn in het voorjaar 2021 nader onderzocht en in één van de masten, mast 50 blijkt een jaarrond beschermd nest aanwezig te zijn dat in gebruik is door een slechtvalk. De overige nesten zijn of niet meer aanwezig of niet in gebruik door een juridisch zwaarder beschermde vogelsoort. Als het nest in mast 50 door de werkzaamheden verloren kan gaan, beschadigd wordt of wordt verstoord, dient ontheffing aangevraagd te worden bij het bevoegd gezag (provincie). Aan de ontheffingsaanvraag dient een activiteitenplan ter grondslag te liggen waarin de werkzaamheden zijn beschreven (inclusief planning en periode), de mitigerende maatregelen en het maatschappelijke belang van de ingreep. Als de werkzaamheden na het broedseizien van 2022 gaan plaatsvinden dient opnieuw onderzocht te worden of in de masten jaarrond beschermde nesten in gebruik zijn.

Afbeelding 3.1: Bovenaanzicht van mast 12 in Natura 2000-gebied Zwarte meer.

Gedragscode/zorgplicht
In acht neming van de zorgplicht geldt voor de werkzaamheden bij alle masten. Dit houdt in dat voor een aantal soortgroepen mitigerende maatregelen genomen dienen te worden. In deze paragraaf worden de mitigerende maatregelen ten behoeve van de zorgplicht per soortgroep toegelicht.

Vogels
Het werk dient buiten het broedseizoen plaats te vinden. Het broedseizoen loopt globaal van halverwege maart tot begin augustus afhankelijk van de vogelsoort. Als werken binnen het broedseizoen niet te vermijden is dient voorafgaand aan de werkzaamheden een inspectie uitgevoerd te worden door een deskundig ecoloog, naar de aanwezigheid van broedende vogels binnen het plangebied. Als deze aanwezig zijn, dient gewacht te worden met het uitvoeren van de werkzaamheden tot de jongen uitgevlogen zijn. Om te voorkomen dat vogels gaan broeden binnen het plangebied kan voorafgaand aan het broedseizoen in de directe omgeving van het plangebied ruigte te worden verwijderd, gras kort gemaaid, werkzaamheden (inclusief de verstoring) voorafgaand aan het broedseizoen op te starten of voorafgaand aan het broedseizoen verstoring aan te brengen binnen het plangebied.

Vleermuizen
Om verstoring van migrerende, foeragerende of overvliegende vleermuizen te voorkomen dient in de actieve periode (maart tot en met oktober) geen gebruik gemaakt te worden van kunstlicht. Er wordt gewerkt tussen zonsopkomst en zonsondergang. Indien niet gewerkt kan worden zonder kunstlicht (bijvoorbeeld bij slecht weer vanwege de veiligheid) dient dit zo afgesteld te zijn dat deze geen omliggende bosschages of gebouwen kunnen beschijnen.

Amfibieën
Daar waar gewerkt wordt in oevers dient de voortplantingsperiode gemeden te worden. Deze periode loopt van april tot en met augustus. Indien niet te vermijden is om in deze periode werk uit te voeren zullen de werkzaamheden zo uitgevoerd moeten worden dat mogelijk aanwezige amfibieën geen hinder ondervinden. Bij aanwezigheid moeten de dieren de gelegenheid worden geboden het plangebied te kunnen verlaten.

Zoogdieren
De werkzaamheden dienen op dusdanige wijze uitgevoerd te worden dat mogelijk aanwezige dieren het plangebied ongestoord kunnen verlaten. Dit betekend veelal één kant op werken, naar de richting van geschikt habitat (ruigte).

Draadslachtoffers
Het optreden van een stijging van het aantal draadslachtoffers door de werkzaamheden wordt uitgesloten omdat de configuratie van de lijnen niet verandert ten opzichte van de huidige configuratie. Verder worden over de gehele verbinging varkenskrullen aangebracht. De bliksemdraden en de nieuwe geleiders komen op dezelfde positie te hangen als in de huidige situatie. Het type geleider is wel verschillend in materiaal, maar de omvang (diameter) is gelijk. Dat het verschil in het materiaal van de geleider niet leidt tot een hogere aanvaringskans, wordt hieronder nader onderbouwd.
Het materiaal bepaalt de maximale temperatuur (weerstandsafhankelijk) die in de geleider mag optreden. Dit bepaalt de maximale doorhang van de geleider en de maximale transportcapaciteit van de hoogspanningsverbinding. De nieuwe geleider heeft een maximaal toelaatbare temperatuur van 175 graden Celsius, waar de huidige geleider een temperatuur heeft van 70 graden Celsius. Hierdoor kan er dus ook meer stroom over de nieuwe geleider. Een toename van stroom doet de geleiders lichtelijk uitzetten, waardoor de doorhang zeer beperkt toeneemt bij de toepassing van dit nieuwe type geleider (wat uiteraard ook samenhangt met de omgevingstemperatuur). De huidige geleider, type ACSR 48/7, heeft een maximaal toelaatbare geleidertemperatuur van 70 graden Celsius en zet dan 16,51 meter uit over een nominale veldlengte van 400 meter. De toekomstige geleider, type ACCCZ Midal, heeft een maximaal toelaatbare geleidertemperatuur van 175 graden Celsius, en zet dan 16,71 meter uit over een nominale veldlengte van 400 meter. Dit betekent dat bij een maximale belasting een extra uitzetting in de lengte van 20 centimeter over 400 meter (0,0005 centimeter per meter) ten opzichte van de huidige situatie. In praktijk zal dit echter zelden gebeuren, omdat slechts zelden de maximale transportcapaciteit wordt gebruikt.
Bij dezelfde transportcapaciteit heeft de nieuwe geleider minder uitzetting per meter dan de huidige geleider. De nieuwe geleiders vertonen daardoor minder variatie in doorhang ten opzichte van de huidige geleiders. Verschillen in doorhang zijn dusdanig klein dat hier niet gesproken kan worden over een veranderende configuratie of positionering van de geleiders. Een negatief effect zoals het verwonden of doden van vogels door de incidenteel hogere geleidertemperaturen is uitgesloten. In de huidige situatie kan de temperatuur van de geleiders al oplopen tot 70 graden Celsius, ongeschikt voor vogels om op te rusten. Ook bij hogere temperaturen zijn vogels in staat om dit aan te voelen en niet te landen of direct weer los te laten.

3.6 Conclusie
Op de meeste soortgroepen treden ten gevolge van de werkzaamheden geen negatieve effecten op. Het uitgangspunt is hierbij dat gewerkt wordt buiten het broedseizoen en dat de werkzaamheden (zoveel mogelijk) uitgevoerd zullen worden vanaf de droge percelen rondom de hoogspanningsmast. Als wel sloten worden vergraven of (deels) gedempt zal voor betreffende locatie mogelijke vervolgonderzoek moeten worden verricht. Van de in

2020 in de masten waargenomen mogelijk jaarrond beschermde nesten is er in 2021 één in gebruik gebleken door slechtvalk. Dit nest is daarmee jaarrond beschermd en als door de werkzaamheden beschadiging van dit nest niet kan worden uitgesloten, dient ontheffing te worden aangevraagd. Als de werkzaamheden pas na het broedseizoen 2022 worden utigevoerd, moet opnieuw onderzoek naar mogelijk aarrond beschermde nesten in alle masten worden gedaan.

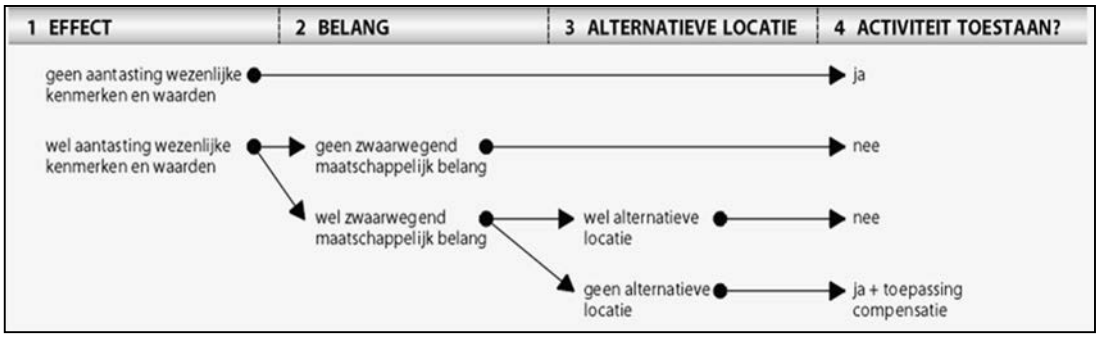
4 Provinciaal natuurbeleid

4.1 Toetsingskader

Het beleidskader van de overheid dat niet in wetgeving is vastgelegd, bestaat uit:

- Provinciaal beleid:
  - Natuurnetwerk Nederland (NNN): Flevoland en Overijssel.

De afweging voor ingrepen in het NNN gaat volgens het 'nee, tenzij-principe'. In figuur 4.1 is dit stapsgewijs weergegeven. Ingrepen met een significant negatieve invloed op de wezenlijke kenmerken en waarden mogen niet plaatsvinden, tenzij er sprake is van een zwaarwegend maatschappelijk belang en indien er geen alternatieven zijn. Indien bij een ingreep schade wordt aangericht aan een NNN-gebied, dient dit in ieder geval gemitigeerd te worden. De resteffecten aan verlies van kwaliteit en/of oppervlakte dient te worden gecompenseerd. Daarnaast kan salderen van positieve en negatieve effecten op het NNN uitkomst bieden om projecten in het NNN te realiseren.

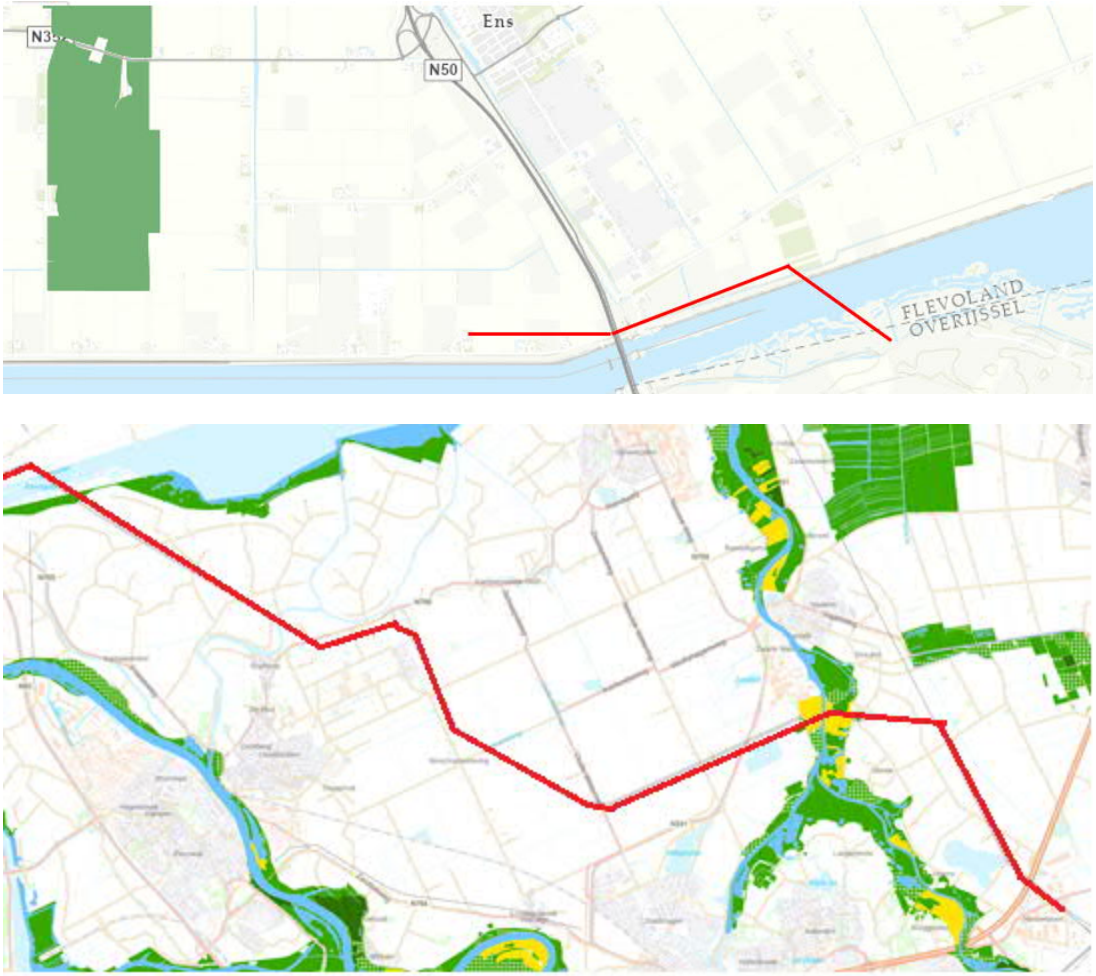


Figuur 4.1 Het 'nee, tenzij'-principe van het compensatiebeginsel.

Het verkennend natuuronderzoek geeft inzicht in de ligging van NNN-gebieden in de omgeving van het tracé en de noodzaak voor het doorlopen van 'nee, tenzij'-procedure. Een 'nee, tenzij'-toets behoeft alleen te worden doorlopen, indien er sprake is van een RO-procedure met betrekking tot wijziging van de bestemming van het plangebied. In provincie Flevoland zijn ook effecten vanuit externe werking op het NNN van toepassing, in de provincie Overijssel niet.

4.2 Inventarisatie

Op twee plaatsen in Overijssel doorsnijdt het tracé gebieden die zijn aangewezen als NNN. Betreffende gebieden liggen tevens binnen Natura 2000-gebied (Zwarte meer en Uiterwaarden Zwarte Water en Vecht). Op beide locaties wordt de oorspronkelijke situatie weer hersteld. De ligging van het tracé ten opzichte van de NNN gebieden is weergegeven in figuur 4.2.



Figuur 4.2 De ligging van het tracé (in rood) ten opzichte van Natuurnetwerk Nederland. Boven Flevoland en onder Overijssel (groen is NNN, geel is uitwerkingsgebied ontwikkelopgave Natura 2000).

4.3 Analyse van de mogelijke effecten

Op twee plaatsen doorsnijdt het tracé het NNN Overijssel. Omdat de oorspronkelijke situatie wordt hersteld is er geen sprake van negatieve effecten op de kernwaarden van NNN. In Flevoland liggen de masten buiten NNN. In Flevoland dient ook externe werking te worden getoetst. Daarvan is echter geen sprake omdat er geen bestemmingswijziging met bijbehorende RO-procedure gaat plaatsvinden Er is hierdoor geen noodzaak tot een nadere beschouwing van de effecten in de vorm van een ‘Nee, tenzij’-toets en er zijn geen belemmeringen vanuit provinciaal beleid.

4.4 Conclusie

Er is met de voorgenomen ontwikkeling geen sprake van een RO-procedure met betrekking tot het wijzigen van bestemmingen binnen het tracé. Er is hierdoor geen noodzaak tot een nadere beschouwing van de effecten in de vorm van een ‘Nee, tenzij’-toets en er zijn geen belemmeringen vanuit provinciaal beleid.

5 Conclusies

Op basis van het verkennend natuuronderzoek en het aanvullend onderzoek wordt het volgende geconcludeerd:

Gebiedsbescherming
Voor de werkzaamheden bij mast 12 dient een nadere toets uitgevoerd te worden om vast te stellen of de aanleg van het zandpad om de mast te bereiken leidt tot significant negatieve effecten op aangewezen habitattypen, broedareaal voor de aangewezen broedvogels en verstoring van niet-broedvogels. Er wordt bij alle masten buiten het broedseizoen gewerkt zodat verstoring van aangewezen broedvogels niet aan de orde is. Ook voor de werkzaamheden aan alle andere masten in of nabij de Natura 2000-gebieden Zwarte meer en Uiterwaarden Zwarte water en Vecht is het uitgangspunt dat geen verstoring op aangewezen broedvogels plaatsvindt. Om mogelijk significant negatieve effecten door verstoring van niet-broedvogels in beide Natura 2000-gebieden uit te kunnen sluiten dient aanvullende toets te worden uitgevoerd.

Soortenbescherming
Op de meeste soortgroepen treden ten gevolge van de werkzaamheden geen negatieve effecten op. Het uitgangspunt is hierbij dat gewerkt wordt buiten het broedseizoen en dat de werkzaamheden (zoveel mogelijk) uitgevoerd zullen worden vanaf de droge percelen rondom de hoogspanningsmast. Als wel sloten worden vergraven of (deels) gedempt dient te worden beoordeeld of voor betreffende locatie vervolgonderzoek nodig is of dat werken volgens voorgeschreven maatregelen (ecologisch werkprotocol) afdoende is. Van de in 2020 in de masten waargenomen mogelijk jaarrond beschermde nesten is er in 2021 één in gebruik gebleken door slechtvalk. Dit nest is daarmee jaarrond beschermd en als door de werkzaamheden beschadiging van dit nest niet kan worden uitgesloten, dient ontheffing te worden aangevraagd. Omdat de werkzaamheden pas na het broedseizoen 2022 worden utigevoerd, wordt in 2022 opnieuw onderzoek naar mogelijk jaarrond beschermde nesten in alle masten uitgevoerd.

Natuurnetwerk Nederland
Er is met de voorgenomen ontwikkeling geen sprake van een RO-procedure met betrekking tot het wijzigen van bestemmingen binnen het tracé. Er is hierdoor geen noodzaak tot een nadere beschouwing van de effecten in de vorm van een ‘Nee, tenzij’-toets en er zijn geen belemmeringen vanuit provinciaal beleid.

Bijlage 1 Resultaten aanvullend nestonderzoek

Nr.	Datum	Bevindingen 1e ronde	Opmerking	Bevindingen 2e ronde 27-5-2021	Opmerking	Bevindingen 3e ronde 08-06-2021	Opmerking	Bevindingen 4e ronde 24-6-2021	vervolg
3	22-4-2021	Nest niet teruggevonden	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	geen
5a	22-4-2021	Gebruik door kraai	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	geen
17	22-4-2021	Gebruik door kraai	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	geen
18	22-4-2021	Gebruik door kraai	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	geen
23	22-4-2021	Niet in gebruik	Veldbezoek continueren	nest niet teruggevonden	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	geen
31	22-4-2021	Niet in gebruik	Veldbezoek continueren	nest niet teruggevonden	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	geen
34	22-4-2021	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	niet in gebruik	geen
38	22-4-2021	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	niet in gebruik	geen
50	7-5-2021	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	Gebruik door slechtvalk	Geen vervolg nodig	nvt	Mogelijk ontheffing nodig
80	7-5-2021	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	niet in gebruik	geen
84	7-5-2021	Nest niet teruggevonden	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	Geen vervolg nodig	nvt	geen
88	7-5-2021	Niet in gebruik	Veldbezoek continueren	Niet in gebruik	Veldbezoek continueren	Niet in gebruik, wel kraai in mast	Veldbezoek continueren	niet in gebruik	geen

Voor de nesten die niet in gebruik waren gedurende de 4 inventarisatierondes geldt in de meeste gevallen dat het nest geen volledige opbouw heeft en mogelijk deels verwaait is.

Bijlage 8

Natuuronderzoek, voortoets

Voortoets werkzaamheden aan hoogspanningsmasten tracé Zwolle-Ens

Beoordeling van de gevolgen van de voorgenomen activiteit(en) op Natura 2000-gebieden

SWECO

Verantwoording

Titel:	Voortoets werkzaamheden aan hoogspanningsmasten tracé Zwolle-Ens
Onderwerp:	Voortoets
Projectnummer:	51002704
Klant:	TenneT TSO BV
Referentienummer:	NL22-648800269-19681
Versie:	D1
Datum:	31-03-2022
Auteur:	Rietje Klous
E-mailadres:	Rietje.klous@sweco.nl
Gecontroleerd door:	Germ Zeephat
Paraaf gecontroleerd:	
Vrijgegeven door:	Tim Verver
Paraaf vrijgegeven:	

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1 Inleiding

1.1 Aanleiding

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspannings-verbindingen aan te passen zodat er een grotere transportcapaciteit mogelijk wordt gemaakt. Om die reden is TenneT voornemens de bestaande landelijke 380 kV-ring, de 'ruggengraat' van het landelijk hoogspanningsnet, op te waarderen (programma Beter Benutten Bestaande 380 kV). Binnen het betreffende programma valt ook het deelproject Opwaardering 380 kV-verbinding Ens – Zwolle. Een aantal van deze masten ligt in of nabij Natura 2000-gebied Zwarte meer of Uiterwaarden Zwarte Water en Vecht. Om vast te kunnen stellen of de geplande werkzaamheden aan deze masten leiden tot negatieve effecten op de instandhoudingsdoelstellingen van deze Natura 2000-gebieden is voorliggende voortoets opgesteld.

1.1 Werkzaamheden

De werkzaamheden betreffen het opwaarderen van de masten, het aanpassen van de geleiders. Bij een aantal masten moet ook de fundering worden aangepast worden. Van de masten binnen Natura 2000-gebied is mast 64 de enige waarvan zowel de geleiders worden vervangen, aanpassingen in de mast plaatsvinden en waar de fundering wordt aangepast. In hoofdstuk 2 worden de werkzaamheden verder toegelicht samen met de ligging van het plangebied ten opzichte van de omliggende Natura 2000-gebieden.

1.2 Doel voorliggend rapport

Dit rapport geeft inzicht in de aanwezigheid van wettelijk en beleidsmatig beschermde natuurwaarden in de Natura 2000-gebieden (Zwarte meer en Uiterwaarden zwarte water en Vecht) binnen de invloedssfeer van de werkzaamheden bij de masten 6 t/m 13 en 63 t/m 68. Het rapport gaat in verstorende effecten die de werkzaamheden kunnen hebben op de aangewezen niet-broedvogels. Beoordeeld is of significante effecten kunnen worden uitgesloten.
Overige effecten zijn in eerder onderzoek uitgesloten. In het verkennend natuur onderzoek (Sweco, ref NL21-648800269-11542, december 2021) zijn negatieve effecten op habitattypen en habitatsoorten van Uiterwaarden Zwarte Water en Vecht al uitgesloten en voor Zwarte meer is dit uitgesloten in een voortoets (opgesteld voor de aanleg van een onverhard toegangspad, Sweco , ref NL22-648800269-18292). Effecten op aangewezen broedvogels zijn niet aan de orde omdat de werkzaamheden in Natura 2000-gebied buiten het broedseizoen worden uitgevoerd.

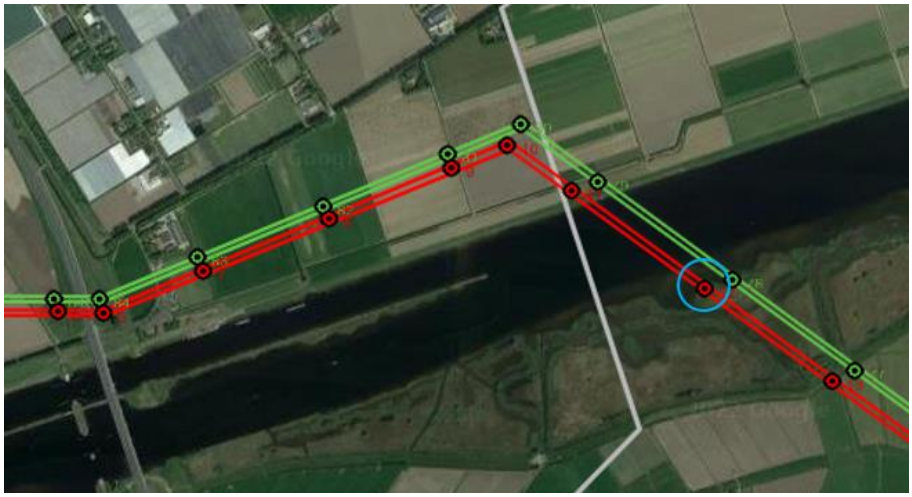
1.3 Leeswijzer

In het voorliggend rapport zijn in hoofdstuk 1 de aanleiding en doelstelling omschreven. Een beschrijving van het planvoornemen volgt in hoofdstuk 2. Vervolgens is het wettelijk kader in hoofdstuk 3 nader toegelicht. Hoofdstuk 4 behandelt de afbakening van effectindicatoren en hoofdstuk 5 de toetsing hiervan. In hoofdstuk 6 staan de conclusies.

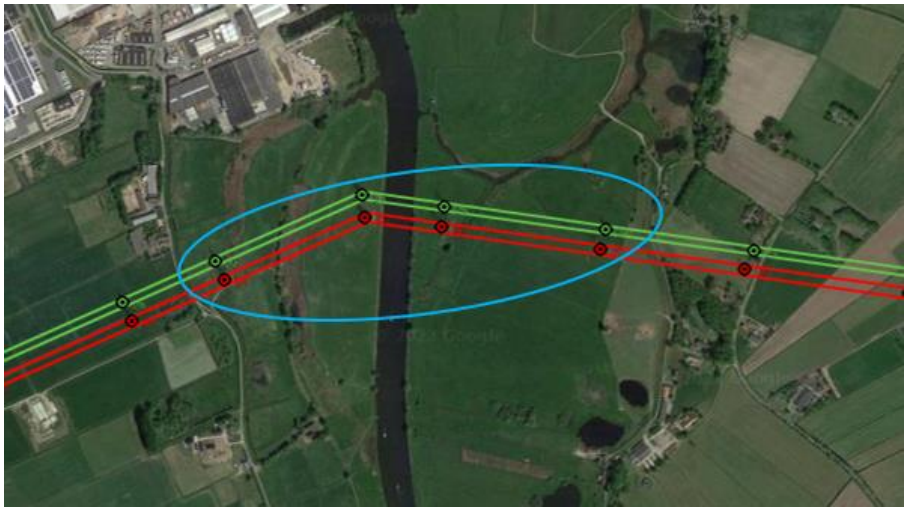
2 Plangebied en werkzaamheden

2.1 Ligging en begrenzing plangebied

De masten 6 t/m 13 en 63 t/m 68 vormen het plangebied dat binnen Natura 2000-gebieden ligt. De masten 6 t/m 13 liggen binnen of nabij de begrenzing van Natura 2000-gebied Zwarte meer. De masten 63 t/m 68 liggen binnen of nabij de begrenzing van Natura 2000-gebied Uiterwaarden Zwarte Water en Vecht (zie figuur 2.1).



Figuur 2.1 Ligging masten 6 t/m 13 (rood) plangebied binnen (blauw omcirkeld) en nabij Zwarte meer.

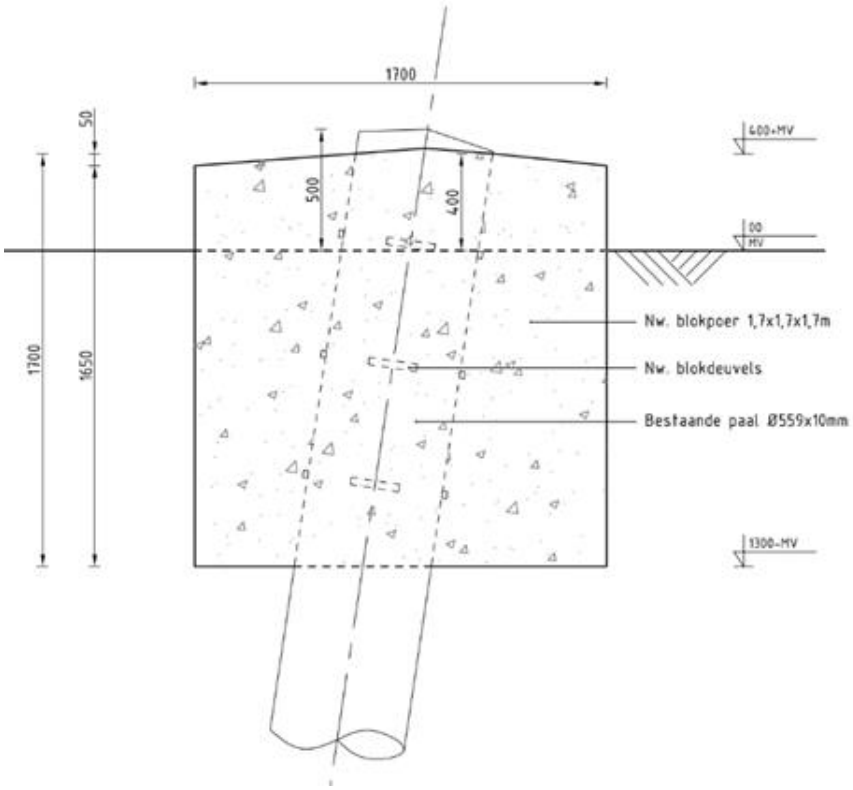


Figuur 2.2 Ligging masten 63 t/m 68 (rood) binnen (blauw omcirkeld) en nabij Uiterwaarden Zwarte Water en Vecht.

2.2 Werkzaamheden

De beoogd uit te voeren werkzaamheden betreffen:

- Aanpassen mast: bij aanpassing van de masten worden stalen profielen/bouten vervangen. Het te gebruiken materieel bestaat uit een hoogwerker en een wagen om materiaal aan te voeren. In het geval dat een mast moeilijker bereikbaar is (zoals mast 12) zal het materieel beperkt blijven tot een tractor met platte kar. Er wordt dan in de mast geklommen en benodigde materialen worden opgehesen. Duur van deze werkzaamheden betreft enkele werkdagen per mast.
- Lierlocaties: op tussenliggende lierlocaties worden de geleiders binnen de vakken getrokken (deel tussen twee hoek/trekmasten). De lierlocaties zijn enkele weken aanwezig, maar het lieren zelf neemt een paar dagen in beslag;
- Aanpassen fundering: bij mast 64 wordt naast de mast en de geleiders ook de fundering aangepast (zie figuur 2.3). De werkzaamheden bestaan uit het aanbrengen van een extra klomp beton per poer. Er komen geen palen bij. Er zal ca 1 dag een graafmachine werkzaam zijn, daarna een paar dagen mensen die een bekisting maken waarna de kist wordt gestort. Tenslotte wordt er gedurende enkele uren een kraan ingezet ter afwerking. Totale duur 5 werkdagen verspreid over 2 weken.



Figuur 2.3 Doorsnede fundatieversterking

2.3 Doelstelling Zwarte meer en Uiterwaarden Zwarte Water en vecht

In deze voortoets worden alleen de Natura 2000-gebieden beschouwd die binnen de verstoringsafstand van de geplande werkzaamheden liggen. Negatieve effecten op instandhoudingsdoelstellingen van Natura 200-gebieden die verder dan enkele honderenden meters af liggen, kunnen gezien de beperkte duur en intensiteit van de werkzaamheden op voorhand worden uitgesloten.

Verder wordt alleen getoetst op de instandhoudingsdoelstellingen van niet-broedvogels omdat de doelstellingen van overige soorten/habitattypen reeds zijn getoetst en negatieve effecten zijn uitgesloten.

De aangewezen niet-broedvogels voor Zwarte meer staan in tabel 2.1 en die voor Uiterwaarden Zwarte Water en Vecht in tabel 2.2.

Tabel 2.1.Niet broedvogels Natura 2000-gebied Zwarte Meer met instandhoudingsdoelstelling en functie

Soort		LSVI[2]	doelstelling Opp	kwal	Functie[3]
A005	**Fuut**	-	=	=	**foer**
A017	Aalscholver	+	=	=	foer
A034	Lepelaar	+	=	=	foer
A037	Kleine zwaan	--	=	=	Slaaprust/foer
A041	kolgans	+	=	=	Slaaprust foer
A043	Grauwe gans	+	=	=	Slaaprust foer
A050	Smient	-	=	=	slaaprust
A051	Krakeend	+	=	=	Foer
A052	Wintertaling	+	=	=	Foer
A054	Pijlstaart	+	=	=	Foer
A056	Slobeend	+	=	=	Foer
A059	Tafeleend	--	=	=	Foer
A061	Kuifeend	-	=	=	Foer
A125	Meerkoet	-	=	=	Foer
A156	Grutto	--	=	=	slaaprust
A197	Zwarte stern	--	=	=	Foer
A702	Toendrarietgans	+	=	=	slaaprust

Tabel 2.2. Niet broedvogels Natura 2000-gebied Uiterwaarden Zwarte Water en Vecht met instandhoudingsdoelstelling en functie

Soort		LSVI[2]	doelstelling[1] opp	kwal	Functie[3]
A037	Kleine zwaan	--	=	=	foer
A041	kolgans	+	=(<)	=	foer
A050	Smient	-	=(<)	=	Slaaprust foer
A054	Pijlstaart	+	=	=	Foer
A056	Slobeend	+	=	=	Foer
A125	Meerkoet	-	=	=	Foer
A156	Grutto	--	=	=	Slaaprust foer

[1] doelstelling:
Broedvogels, niet-broedvogels: doelstelling voor leefgebied en/of omvang populatie
= behoud
> uitbreiding

[2] LSVI landelijke staat van instandhouding

\+ gunstig
\- matig ongunstig
-- zeer ongunstig

[3] functie foer = foerageergebied, slaaprust = slaap of rustplaatsen

3 Wettelijk kader

3.1 Wet natuurbescherming: onderdeel Natura 2000-gebieden

De Wet natuurbescherming heeft als doel het beschermen van Natura 2000-gebieden (Vogel- en Habitatrichtlijn) in Nederland. Projecten die, gelet op de instandhoudingsdoelen, leiden tot significante verstoring van kwalificerende soorten of verslechtering van habitats (van soorten), zijn in beginsel niet toegestaan (zonder vergunning).

Bij toetsing aan Natura 2000 doelstellingen kunnen de volgende stappen aan de orde zijn:

- Geen nader onderzoek: effecten kunnen op voorhand en zonder enig nader onderzoek worden uitgesloten (er zijn geen Natura 2000-gebieden in de omgeving aanwezig die beïnvloed kunnen worden door de werkzaamheden).
- Voortoets: effecten kunnen niet op voorhand en zonder enig onderzoek worden uitgesloten.
- Passende beoordeling: significantie van effecten kan op basis van de Voortoets niet worden uitgesloten en mitigerende maatregelen zijn nodig effect te voorkomen.
- ADC-toets: indien aantasting van de natuurlijke kenmerken van het gebied niet kan worden uitgesloten. Aangetoond dient te worden dat er geen alternatieven zijn met minder effecten, er sprake is dwingende redenen van groot openbaar belang en in compensatie is voorzien.

De voorliggende studie richt zich op de vraag: ‘Wat zijn de effecten van de werkzaamheden op de kwalificerende niet-broedvogelsoorten en wat zijn de gevolgen voor de instandhoudingsdoelstellingen?’ Indien significante verstoring of significante verslechtering van het Natura 2000-gebied niet is uit te sluiten, is een vergunning noodzakelijk op grond van artikel 2.7 Wet natuurbescherming. Indien significante effecten in relatie tot de instandhoudingsdoelstellingen niet zijn uit te sluiten kan een vergunning alleen verleend worden indien voldaan wordt aan de ADC-criteria.

3.2 Algemeen kader instandhoudingsdoelstellingen

De effecten van de ingreep worden getoetst aan de instandhoudingsdoelstellingen die gelden voor de niet-broedvogelsoorten en de waarvoor de Natura 2000-gebieden Zwarte meer en Uiterwaarden Zwarte Water en Vecht zijn aangewezen. Daarbij wordt onderscheid gemaakt tussen een significante verslechtering van de kwaliteit van habitattypen en habitats van soorten en een significante verstoring van soorten conform artikel 2.7 lid 2 Wet natuurbescherming.

3.3 Significantie

Voor het begrip significantie bestaat geen juridische (of ecologische) definitie. De Europese Commissie laat de interpretatie van dit begrip over aan de lidstaten. Tot op heden wordt in de jurisprudentie teruggegrepen op een uitspraak van het Europese Hof van Justitie uit 2004.

In het Kokkelvisserij-arrest is significantie door het Europese Hof van Justitie als volgt omschreven:

‘Een plan of project dat niet direct verband houdt met of nodig is voor het beheer van een gebied moet worden beschouwd als een plan of project dat significante gevolgen kan hebben voor het betrokken gebied, wanneer de instandhoudingsdoelstellingen daarvan in gevaar dreigen te komen.’ Ook het ministerie van LNV neemt de instandhoudingsdoelen als referentie voor het bepalen van significante effecten; ‘indien als gevolg van een ingreep de toekomstige oppervlakte habitat of leefgebied, aantal van een soort dan wel kwaliteit van een habitat lager zal worden dan zoals bedoeld in de instandhoudingsdoelstelling, dan kan sprake zijn van significante gevolgen’ (Steunpunt Natura 2000, 2010).

4 Afbakening effectindicatoren Natura 2000

4.1 Relevante effecttypen

Voor de effectanalyse is het van belang om eerst de relevante storingsfactoren in beeld te brengen die de werkzaamheden met zich meebrengen. Het gaat hierbij alleen om tijdelijke effecten voor de Natura 2000-gebieden binnen de reikwijdte van het effect. De werkzaamheden aan de masten zijn per mast relatief beperkt en kortdurend (enkele dagen en bij mast 64 iets langer). De reikwijdte beperkt zich tot het Natura 2000-gebied Zwarte meer voor de masten 6 t/m 13 en tot het Natura 2000-gebied Uiterwaarden Zwarte Water en Vecht voor de masten 63 t/m 68.

De mogelijke significante effectindicatoren van de geplande werkzaamheden op het Natura 2000-gebied zijn uitgewerkt aan de hand van de zogenoemde ‘effectenindicator’ (LNV, 2014).

De effectenindicator is een instrument om een eerste indruk te kunnen geven van de mogelijk optredende effecten bij een specifieke activiteit. De effectenindicator biedt een selectie aan activiteiten (zoals woningbouw, recreatie, etc.). Hierbij zijn de gangbare effecten vanuit de geselecteerde activiteit in relatie gebracht met de gevoeligheid van de aangewezen habitats en soorten voor de betreffende effecten. De meest passende activiteit die gekozen kan worden is ‘weg’. De masten worden voor het onderhoud bereikt via aanrijroutes (mogelijk met rijplaten) op het maaiveld. Omdat een weg intensiever is dan een tijdelijke betreding betreft het een worst case. De volgende effectindicatoren zijn van toepassing:

- Oppervlakteverlies en versnippering.
- Verontreiniging.
- Verdroging.
- Verstoring door licht, geluid en trillingen.
- Optische verstoring.
- Verstoring door mechanische effecten.
- Vermesting en verzuring door stikstofdepositie.

Per effectindicator is in de navolgende paragrafen een korte omschrijving opgenomen.

4.2 Ruimtebeslag en versnippering

Verlies van oppervlakte kan leiden tot verkleining en in sommige gevallen ook tot versnippering van het leefgebied van kwalificerende soorten. Een kleiner gebied heeft bovendien meer te lijden van randinvloeden: vaak is de kwaliteit van het leefmilieu aan de rand minder goed dan in het centrum van het gebied. Op deze manier leidt verlies van oppervlakte mogelijk ook tot een grotere gevoeligheid voor bijvoorbeeld verdroging, verzuring of vermesting (Broekmeyer et al, 2005).

Er is geen sprake van versnippering en oppervlakteverlies door de tijdelijke werkzaamheden aan de masten.

4.3 Verontreiniging

De werkzaamheden aan de masten veroorzaken geen verontreiniging en effecten door verontreiniging zijn daarom niet aan de orde. Verontreiniging heeft namelijk betrekking op afstroming van water (‘run-off’) met daarin bijvoorbeeld zware metalen, organische stoffen of strooizout. Deze stoffen kunnen een negatief effect hebben op habitattypen en (leefgebieden van) kwalificerende soorten op een zeer korte afstand tot de bron.

4.4 Verdroging

De werkzaamheden aan de masten hebben geen invloed op de waterhuishouding in het plangebied en omgeving. Effecten door verdroging zijn niet aan de orde. De waterhuishouding op regionale schaal, bijvoorbeeld van verschillende beeksystemen, werkt door in de aanvoer van grondwater naar diverse gebieden en de kwaliteit daarvan. Dit kan leiden tot verdroging en als gevolg daarvan tot verzuring. Verzuring treedt op door een vergrote invloed van regenwater in de wortelzone, ten koste van het meer gebufferde grondwater.

4.5 Verstoring door licht, geluid en trillingen

Door lichtverstoring bestaat de kans dat kwalificerende soorten een verlicht gebied gaan ontwijken waardoor het leefgebied afneemt. Lichthinder op fauna kan doorgaans tot honderden meters van de bron meetbaar zijn (Molenaar, 2003) en in uitzonderlijke gevallen leiden tot effecten op 1.000 meter afstand van leefgebieden (Arcadis, 2014).

De werkzaamheden voor de aanleg en ook het gebruik vinden plaats bij daglicht en er wordt geen kunstlicht gebruikt. Verstoring door licht is niet aan de orde. Bij de werkzaamheden aan de masten en funderingen worden geen heipalen gezet. De werkzaamheden worden voornamelijk uitgevoerd door relatief licht materieel zoals een kraan, vrachtwagen en hoogwerker. Het gebruikte materieel veroorzaakt geen tot nauwelijks trillingen die niet verder reiken dan het werkgebied. Verstoring door trillingen is niet aan de orde.

Verstoring van geluid kan optreden door onnatuurlijke geluidsbronnen. Deze verstoring kan tijdelijk of permanent zijn. Permanent zoals geluid van bijvoorbeeld wegverkeer dan wel tijdelijk zoals geluidsbelasting tijdens de realisatiefase. Geluid is een hoorbare trilling, gekenmerkt door geluidsdruk en frequentie. Geluid kan de vocale communicatie maskeren en op korte afstand voor schrikreacties zorgen voor soorten. Met name broedvogels zijn gevoelig en de effecten kunnen tot op grotere afstand doorwerken. Trillingen en geluid kunnen vooral ontstaan bij zwaardere werkzaamheden zoals bijvoorbeeld heien.

Voor de niet-broedvogels moeten de mogelijke effecten door de tijdelijke geluidverstoring nader worden beschouwd.

4.6 Optische verstoring

Met optische verstoring wordt bedoeld een toename van het aantal mensen of verkeersbewegingen door de aanleg van de benodigde infrastructuur waardoor de druk op Natura 2000-gebieden toeneemt. Optische verstoring kan optreden door de aanwezigheid en/of beweging van mensen dan wel voorwerpen die niet thuishoren in het natuurlijke systeem.

Volgens Arcadis (2014) kunnen in uiterste gevallen nog effecten optreden tot een afstand van 1.200 meter voor kwalificerende visueel verstoringsgevoelige soorten (met name vogels) bij een zeer intensieve uitloop van menselijke activiteiten en zonder enige tussenliggende afscherming.

Door de werkzaamheden zal de menselijke aanwezigheid tijdelijk toenemen. Voor de aangewezen niet-broedvogels zijn negatieve effecten op de instandhoudingsdoelstellingen niet op voorhand uit te sluiten en worden in hoofdstuk 5 mogelijke effecten nader beschouwd.

4.7 Verstoring door mechanische effecten

Onder mechanische effecten vallen verstoring door betreding, golfslag, luchtwervelingen etc. die optreden ten gevolge van menselijke activiteiten. De oorzaken en gevolgen zijn bij deze storende factor zeer divers.

De werkzaamheden aan de masten zijn niet zodanig intensief dat hierdoor mechanische effecten zijn te verwachten. Dit geldt ook voor het aanbrengen van beton bij mast 64. Negatieve effecten door verstoring door mechanische effecten zijn niet aan de orde.

4.8 Verzuring en vermesting door stikstofdepositie

Als er stoffen in het milieu terecht komen die leiden tot het zuurder worden van de lucht, neerslag, bodem, oppervlaktewater of grondwater spreken we van verzuring. Dit leidt tot een directe of indirecte afname van de buffercapaciteit (het neutralisatievermogen) van bodem of water. Op termijn resulteert dit proces in een daling van de zuurgraad. Hierdoor zullen voor verzuring gevoelige soorten verdwijnen, wat kan resulteren in een verandering van het habitattype en daarmee mogelijk het verdwijnen van typische (dier)soorten. Vermesting betreft elke extra aanvoer van voedingsstoffen, met name stikstof en fosfaat. Het kan gaan om aanvoer door de lucht (droge en natte neerslag van ammoniak en stikstofoxiden) of nitraat- en fosfaataanvoer door het oppervlaktewater. Ook verhoogde mineralisatie, dat wil zeggen de omzetting van plantenresten en humus tot voedingsstoffen en CO_2, leidt tot vermesting.

De werkzaamheden leiden tot een geringe extra stikstofuitstoot. Per 1 juli 2021 is echter de Wet stikstofreductie natuurverbetering in werking is getreden en geldt er een partiële vrijstelling voor de bouwsector, waardoor de stikstofemissies (en de bijhorende stikstofdepositie) in de aanlegfase niet meer leiden tot een vergunningplicht op grond van de Wet natuurbescherming. Stikstof uitstoot in de eindfase is niet aan de orde. De werkzaamheden vallen onder een eenmalige tijdelijke activiteit ten behoeve van de opwaardering van het hoogspanningstracé. In de nieuwe situatie zal de stikstofuitstoot en depositie niet toenemen. De werkzaamheden vallen hiermee onder de partiele vrijstelling. Deze vrijstelling is echter nog niet juridisch houdbaar gebleken. Hier schuilt dus een risico. Door toch voor de werkzaamheden een Aeriusberekening uit te voeren kan hier indien nodig later op worden terug gegrepen. Negatieve effecten door stikstofdepositie hoeven niet te worden getoetst.

5 Effectbeoordeling Natura 2000

5.1 Effectbeoordeling

In dit hoofdstuk zijn de mogelijke effecten beschreven op de instandhoudingsdoelen van habitattypen en kwalificerende soorten van Natura 2000-gebied Zwarte meer. De hoofdvraag hierbij is of significante verslechtering op de doelen van kwalificerende soorten, en significante verslechtering van habitattypen en habitats van soorten (leefgebied), op voorhand zijn uitgesloten.

In de onderstaande paragrafen worden de effectindicatoren behandeld die in hoofdstuk 4 als relevant en nader te toetsen zijn beoordeeld. Bepaald wordt in hoeverre significante effecten op de geformuleerde instandhoudingsdoelstellingen optreden.

Voor de onderstaande effectindicatoren is in hoofdstuk 4 geconcludeerd dat geen nadere toetsing nodig is:

- Oppervlakteverlies en versnippering
- Verontreiniging.
- Verdroging.
- Verstoring door licht en trillingen.
- Verstoring door mechanische effecten.
- Verzuring en vermesting door stikstofdepositie.

Mogelijke effecten van verstoring door geluid en optische verstoring worden in paragraaf 5.2 getoetst.

5.2 Verstoring door geluid en optische verstoring

De werkzaamheden per mast en per lierlocatie duren enkele dagen. Bij mast 64 is dat iets langer (max. 5 werkdagen, verdeeld over 2 weken). Er wordt niet gelijktijdig aan alle masten gewerkt waardoor het verstoorde oppervlakte zich elke keer beperkt tot de omgeving van één mast/lierlocatie.

Voor de niet-broedvogels kunnen effecten van verstoring door geluid en optische verstoring niet worden uitgesloten. Voor alle aangewezen niet-broedvogels geldt voor zowel kwaliteit als omvang van het leefgebied een behoudsdoelstelling.

In tabel 5.1 en 5.2 is voor respectievelijk de Natura 2000-gebieden Zwarte meer en Uiterwaarden Zwarte Water en Vecht een overzicht opgenomen van de aangewezen niet-broedvogels en hun staat van instandhouding, de doelstelling en de huidige aantallen. Vervolgens vindt per soort een toetsing plaats. Voor de waarnemingen per soort is gebruik gemaakt van NDFF (2017-2022).

Tabel 5.1. Niet broedvogels Natura 2000-gebied Zwarte Meer met instandhoudingsdoelstelling en huidige aantallen. De aantallen betreffen seizoensgemiddelden. Aantallen in rood zijn aantallen onder instandhoudingsdoelstelling

			doelstelling			Draagkracht		Huidig[3]	
Soort		**LSVI[2]**	Opp	kwal	Functie[4]	Aantal paren	Aantal vogels	aantal paren	aantal vogels
A005	**Fuut**	**-**	**=**	**=**	**foer**		**170**		**103**
A017	Aalscholver	+	=	=	foer		330		263
A034	Lepelaar	+	=	=	foer		3		2
A037	Kleine zwaan	--	=	=	Slaaprust /foer		2		0
A041	kolgans	+	=	=	Slaaprust foer		740		343
A043	Grauwe gans	+	=	=	Slaaprust foer		630		822
A050	Smient	-	=	=	slaaprust		1.300		610
A051	Krakeend	+	=	=	Foer		90		1123
A052	Wintertaling	+	=	=	Foer		470		71
A054	Pijlstaart	+	=	=	Foer		10		1
A056	Slobeend	+	=	=	Foer		10		13
A059	Tafeleend	--	=	=	Foer		240		69
A061	Kuifeend	-	=	=	Foer		1.700		1464
A125	Meerkoet	-	=	=	Foer		1.800		1.521
A156	Grutto	--	=	=	slaaprust		Behoud		583
A197	Zwarte stern	--	=	=	Foer		10 (max)		1
A702	Toendrarietgans	+	=	=	slaaprust		behoud		1030[1]

Tabel 5.2. Niet broedvogels Natura 2000-gebied Uiterwaarden Zwarte Water en Vecht met instandhoudingsdoelstelling en huidige aantallen. De aantallen betreffen seizoensgemiddelden. Aantallen in rood zijn aantallen onder instandhoudingsdoelstelling

		LSVI[2]	**doelstelling[1]**			**draagkracht**		**Huidige aantallen[3]**	
Soort			**opp**	**kwal**	**Functie[4]**	**aantal paren**	**aantal vogels**	**Aantal paren**	**Aantal vogels**
A037	Kleine zwaan	--	=	=	foer		4		1
A041	kolgans	+	=(<)	=	foer		2.100		1265
A050	Smient	-	=(<)	=	Slaaprust foer		570		368
A054	Pijlstaart	+	=	=	Foer		20		1
A056	Slobeend	+	=	=	Foer		10		8
A125	Meerkoet	-	=	=	Foer		320		193
A156	Grutto	--	=	=	Slaaprust foer		80		10

[1] doelstelling:
Broedvogels, niet-broedvogels: doelstelling voor leefgebied en/of omvang populatie
= behoud
> uitbreiding

[2] LSVI landelijke staat van instandhouding

+ gunstig
- matig ongunstig
-- zeer ongunstig

[3] * huidige aantallen betreffen het gemiddelde van seizoenen 2015 t/m 2019 voor broedvogels, en seizoenen 2014/2015 t/m 2018/2019 voor niet-broedvogels (Bron:Sovon)

[4] functie foer = foerageergebied, slaaprust = slaap of rustplaatsen

Fuut

De aantallen voor fuut liggen beneden het instandhoudingsdoel voor Zwarte Meer en de landelijke staat van instandhouding is matig ongunstig. Fuut komt jaarrond verspreid voor in het hele Zwarte Meer. Buiten de broedperiode is de fuut beperkt gevoelig voor verstoring (Platteeuw and Henkens 1997, Platteeuw

and Beekman 1994). De territoria liggen in het rietmoeras langs de gehele zuidoever van het Zwarte meer, ook nabij mast 12. De overige masten liggen buiten de verstoringsafstand van het foerageergebied. Bij de werkzaamheden aan mast 12 kan verstoring optreden op fuut, maar er zijn voldoende uitwijkmogelijkheden waar geen verstoring door de werkzaamheden optreedt (zie figuur 5.1). Omdat slechts een gering deel van het totale beschikbare foerageergebied (tot mogelijk 1 kortdurend wordt verstoord en er eenvoudig uitgeweken kan worden naar alternatief foerageergebied, zijn significant negatieve effecten van verstoring door de werkzaamheden op het instandhoudingsdoel van fuut uitgesloten.

Figuur 5.1 Ligging werkgebied (masten 12 en 13) met globale verstoringsgrens binnen alternatief foerageergebied

Aalscholver

De aalscholver komt jaarrond verspreid voor in het gebied Zwarte Meer. In of nabij de masten binnen Natura 2000-gebieden zijn geen aalscholverkolonies waargenomen. Het aantal aalscholvers (263) bevindt zich momenteel beneden het instandhoudingsdoel van Zwarte Meer (330). Buiten de broedperiode is de aalscholver beperkt gevoelig voor verstoring. Bovendien maken ze gebruik van een groot foerageergebied. Wanneer er wel verstoring optreedt, wijken foeragerende aalscholvers daarbij uit om elders te foerageren, zonder dat daar meetbare effecten op voedselinname waarneembaar zijn (Madsen et al. 1992). Omdat door de werkzaamheden aan de masten slechts een klein deel van het aanwezige foerageergebied van de aalscholver verstoord kan worden, er eenvoudig kan worden uitgeweken naar alternatief foerageergebied en de landelijke staat van instandhouding gunstig is, worden significant negatieve effecten op de aalscholver uitgesloten.

Lepelaar

Lepelaar is meer dan 1 km oostelijk en meer dan 2 km westelijk van mast 12 foeragerend waargenomen langs de oever van het Zwarte Meer. De gebieden in Zwarte Meer zijn aangewezen als foerageergebied. Lepelaars zijn ook buiten de broedtijd gevoelig voor verstoring en kiezen voor weinig verstoorde foerageergebieden. Concrete verstoringsafstanden zijn weinig bekend, wel genoemd wordt een gemiddelde verstoringsafstand van 113 m voor wandelaars (Krijgsveld, Smits, and van der Winden 2008). Het aantal lepelaars (2) bevindt zich momenteel iets beneden het instandhoudingsdoel van Zwarte Meer (3). Van het in Zwarte Meer aanwezige foerageergebied ligt slechts een klein deel mogelijk binnen de verstoringsafstand van lepelaar (zie figuur 5.1). Daarnaast is de landelijke staat van instandhouding gunstig. De verstoring door de kortdurende werkzaamheden aan de dichtstbijzijnde masten 12 en 13 hebben geen significant negatieve effecten voor lepelaar tot gevolg.

Kleine zwaan

In het Zwarte Meer zijn in de omgeving van de masten weinig waarnemingen van foeragerende kleine zwanen bekend. In en in de omgeving van Uiterwaarden Zwarte Water en Vecht wordt kleine zwaan veel meer waargenomen. De soort foerageert op het water maar ook op graslanden en akkers. De waarnemingen die er zijn, zijn verspreid over het gebied. Omdat de werkzaamheden per mast plaatsvinden en zo steeds slechts een klein deel van het aanwezige foerageergebied van de kleine zwaan verstoord kan worden, kan er eenvoudig worden uitgeweken naar alternatief foerageergebied (zie figuren 5.1 en 5.2).

Het aantal kleine zwanen bevindt zich momenteel voor beide Natura 2000-gebieden beneden het instandhoudingsdoel en de landelijke staat van instandhouding is zeer ongunstig. Maar omdat beurtelings slechts een zeer klein deel van mogelijk foerageergebied van kleine zwaan wordt verstoord, kunnen significant negatieve effecten van de verstoring door de werkzaamheden worden uitgesloten.

Figuur 5.2 De ligging van de masten in het agrarisch gebied met blauw omcirkelde de masten nabij Natura 2000-gebied Zwarte meer en groen nabij Uiterwaarden Zwarte Water en Vecht

Kolgans

De kolgans is van oktober tot maart aanwezig in Nederland, vooral in open agrarische gebieden. Langs de noordoever van het Zwarte Meer (Flevoland) worden door Sovon en NEM (Netwerk Ecologische Monitoring) diverse tellingen gedaan. Op deze locaties, maar ook langs de zuid- en oostoever van het Zwarte Meer zijn veel kolganzen waargenomen. Het aantal kolganzen bevindt zich momenteel beneden het instandhoudingsdoel van Zwarte Meer en Uiterwaarden Zwarte Water en Vecht, maar de landelijke staat van instandhouding is gunstig. De werkzaamheden aan de masten zijn plaatselijk (per mast) en tijdelijk. De kolganzen die mogelijk foerageren in het agrarische gebied waar de masten zich bevinden, zullen omdat het agrarisch gebied hier omvangrijk is, altijd voldoende alternatief in de directe omgeving hebben (zie figuur 5.2). Significant negatieve effecten van de verstoring door de werkzaamheden aan de masten kunnen worden uitgesloten.

Grauwe gans

De grauwe gans komt jaarrond voor in Nederland, maar de piek ligt in de winter. In het gehele gebied Zwarte Meer komt de soort voor, vooral in de oeverzone. Het aantal grauwe ganzen bevindt zich momenteel boven het instandhoudingsdoel van Zwarte Meer en ook de landelijke staat van instandhouding is goed. De grauwe gans is vergeleken met andere ganzensoorten relatief beperkt gevoelig voor verstoring. Grauwe gans kan in geval van verstoring eenvoudig uitwijken naar alternatieve foerageergebieden. Omdat door de werkzaamheden per mast slechts een beperkt oppervlakte tijdelijk verstoord kan worden zijn significant negatieve effecten van verstoring door de werkzaamheden op de grauwe gans uitgesloten.

Smient

De smient komt verspreid voor in het Zwarte Meer en is vooral aanwezig tussen november en maart. Het aantal smienten bevindt zich momenteel beneden het instandhoudingsdoel van vooral Zwarte Meer maar ook van Zwarte Water en Vecht. Voor beide gebieden is de functie rust- en slaapgebied en dat is voor smient met name overdag en op het water. De landelijke staat van instandhouding is matig ongunstig. Vergeleken met andere grasland-gebonden soorten is de smient is relatief gevoelig voor verstoring (Kleyheeg and van den Bremer 2018, Madsen 1998). Bij verstoring zullen de smienten het verstoorde gebied mijden om elders te rusten of foerageren wanneer uitwijkmogelijkheden aanwezig zijn (Kleyheeg and van den Bremer 2018). Omdat de smient vooral overdag rust en de werkzaamheden overdag plaatsvinden, kan verstoring van de rustgebieden aan de orde zijn bij werk aan de masten nabij water. Dit betreft slechts enkele masten (11,12, 65 en 66) waardoor voldoende niet verstoorde rustplaatsen overblijven (zie figuren 5.1 en 5.2). Het leidt ook niet direct tot verlies van voedselgebied, omdat dit ‘s nachts onverstoord is. Omdat per mast wordt gewerkt en steeds een beperkt oppervlakte (gedurende enkele dagen) wordt verstoord kan smient voor rustplaatsen ook gemakkelijk uitwijken naar onverstoorde locaties op korte afstand. Er zijn veel graslanden waar gefoerageerd kan worden aanwezig in de omgeving van de masten waar gewerkt gaat worden. Significant negatieve effecten van de verstoring door de werkzaamheden op de instandhoudingsdoelstellingen voor smient kunnen worden uitgesloten.

Krakeend

Krakeend komt verspreid voor in de omgeving van de masten en is het hele jaar aanwezig, maar het meest in de winter. Hoewel de krakeend verstoord kan worden door bijvoorbeeld waterrecreatie, is de soort de afgelopen jaren sterk in aantal toegenomen ondanks de eveneens toegenomen waterrecreatie. Verder komt de krakeend steeds vaker voor binnen de stedelijke omgeving wat ook wijst op een beperkte gevoeligheid voor verstoring. Het aantal krakeenden bevindt zich momenteel ruim boven het instandhoudingsdoel van Zwarte Meer en ook de landelijke staat van instandhouding is goed. Op basis van de aanwezigheid van krakeend langs de gehele zuidkant van het Zwarte meer lijkt het erop dat er voldoende uitwijkmogelijkheden aanwezig zijn. Bovendien wordt door de werkzaamheden slechts tijdelijk en per mast een gebied rond deze mast verstoord. Significant negatieve effecten van de verstoring door de werkzaamheden op de instandhoudingsdoelstellingen voor de krakeend kunnen worden uitgesloten.

Wintertaling

Wintertaling komt verspreid voor langs de noord- en zuidoever van het Zwarte Meer. Wintertaling is het gehele jaar in Nederland aanwezig, maar de aantallen zijn het hoogst van september t/m november. Wintertaling is gevoelig voor verstoring door water- en oeverrecreatie. Het aantal wintertalingen bevindt zich momenteel ruim beneden het instandhoudingsdoel van Zwarte Meer, maar de landelijke staat van instandhouding is goed. De foerageergebieden bevinden zich in en rond de wateren waar wintertaling verblijft. Bij de werkzaamheden aan mast 12 kan verstoring optreden op wintertaling, maar er zijn voldoende uitwijkmogelijkheden (zie figuur 5.1) waar geen verstoring door de werkzaamheden optreedt. Omdat slechts een gering deel van het totale beschikbare foerageergebied kortdurend wordt verstoord en er eenvoudig uitgeweken kan worden naar alternatief foerageergebied, zijn significant negatieve effecten van verstoring door de werkzaamheden op het instandhoudingsdoel van wintertaling uitgesloten.

Pijlstaart

Pijlstaart komt verspreid voor langs de zuidoever van het Zwarte Meer en ook langs de noordoostoevers. Pijlstaart is het gehele jaar in Nederland aanwezig, maar de aantallen zijn het hoogst van oktober t/m februari. Pijlstaart foerageert voornamelijk ’s nachts, waardoor geschikte foerageergebieden niet worden verstoord door de werkzaamheden. Bovendien zijn er langs de hele Zwarte Meer kust geschikte alternatieven waarnaar uitgeweken kan worden (zie figuur 5.1). Het aantal pijlstaarten bevindt zich momenteel onder het instandhoudingsdoel van Zwarte Meer en Zwarte Water en Vecht, maar de landelijke staat van instandhouding is goed. Vanwege het ’s nachts foerageren worden de foerageergebieden door de werkzaamheden niet verstoord. Significant negatieve effecten op de instandhoudings-doelstellingen van pijlstaart zijn uitgesloten.

Slobeend

Slobeend komt gedurende het gehele jaar verspreid voor langs de zuid- en noord oever van het Zwarte Meer. Slobeend foerageert bij voorkeur in ondiepere en beschutte wateren en is vooral gevoelig voor waterrecreatie. Nabij mast 12 ligt geschikt foerageerwater, maar ook in de directe omgeving, buiten de verstoringsafstand van het werk aan mast 12 is geschikt foerageergebied aanwezig (zie figuur 5.1). Voor Uiterwaarden Zwarte Water en Vecht liggen de geschikte foerageergebieden buiten de verstoringsafstand. Het aantal slobeenden bevindt zich momenteel boven het instandhoudingsdoel van Zwarte Meer en iets beneden dat van Uiterwaarden Zwarte Water en Vecht. Bovendien is de landelijke staat van instandhouding goed. Significant negatieve effecten van verstoring door de kortdurende werkzaamheden, uitgevoerd op een beperkt oppervlakte per dag, op de instandhoudingsdoelstellingen voor de slobeend kunnen daarom worden uitgesloten.

Tafeleend

Tafeleend komt gedurende het gehele jaar verspreid voor langs de zuid- en noordoevers van het Zwarte Meer. Tafeleend bevindt zich overdag op beschutte rustplaatsen, langs de oeverzone en eilandjes, terwijl er ’s nachts veelal op meerdere kilometers afstand van de rustplaatsen en vooral op het open water gefoerageerd wordt op waterplanten en macrofauna. Tafeleend is zeer gevoelig voor waterrecreatie.

De dichtstbijzijnde mast bij rustplaatsen is mast 12, maar omdat de hele oeverzone geschikt is als rustplaats kan tijdens de kortdurende (enkele dagen) werkzaamheden bij mast 12 worden uitgeweken naar de directe omgeving (zie figuur 5.1). De foerageergebieden worden niet verstoord omdat het werk overdag plaatsvindt. Het aantal tafeleenden bevindt zich momenteel beneden het instandhoudingsdoel van Zwarte Meer, en ook is de landelijke staat van instandhouding zeer ongunstig. De kortdurende en zeer plaatselijke (alleen mast 12 bevindt zich in rustgebied) werkzaamheden leiden niet tot significant negatieve effecten van verstoring op de instandhoudingsdoelstellingen van tafeleend.

Kuifeend

Kuifeend komt gedurende het gehele jaar verspreid voor langs de zuid- en noordoostoevers van het Zwarte Meer. Kuifeend bevindt zich overdag vaak op de rustplaatsen, terwijl er met name ’s nachts veelal op meerdere kilometers afstand van de rustplaatsen en vooral op het open water gefoerageerd wordt op driehoeksmosselen en andere macrofauna. Kuifeend is gevoelig voor waterrecreatie, maar ook recreatie op oevers kan verstorend werken. De dichtstbijzijnde mast bij rustplaatsen is mast 12, maar omdat de hele oeverzone geschikt is als rustplaats kan tijdens de kortdurende (enkele dagen) werkzaamheden bij mast 12 worden uitgeweken naar de directe omgeving (zie figuur 5.1). De foerageergebieden worden niet verstoord omdat het werk overdag plaatsvindt. Het aantal kuifeenden (1464) bevindt zich momenteel beneden het instandhoudingsdoel van Zwarte Meer (1700) en de landelijke staat van instandhouding is matig ongunstig. De kortdurende en zeer plaatselijke (alleen mast 12 bevindt zich in rustgebied) werkzaamheden leiden niet tot significant negatieve effecten van verstoring op de instandhoudingsdoelstellingen van kuifeend omdat de soort niet erg verstoringsgevoelig is, de foerageergebieden op beperkte afstand liggen, er voldoende uitwijkmogelijkheden zijn en foerageren vooral ’s nachts plaatsvindt.

Meerkoet

De meerkoet komt jaarrond verspreid voor in het Zwarte Meer. Zowel nabij mast 12 als bij mast 13 zijn territoria aanwezig. Voor Uiterwaarden Zwarte Water en Vecht geldt dat de masten buiten de verstoringsafstand van de territoria liggen. De vluchtafstanden bij water- en oeverrecreatie zijn ongeveer 50 m en de maximale verstoringsafstand is ongeveer 130 m. Meerkoet is daarmee beperkt gevoelig voor verstoring en komt dan ook veelvuldig voor binnen de stedelijke omgeving en gebieden met veel waterrecreatie (Platteeuw and Beekman 1994). Het aantal meerkoeten bevindt zich momenteel beneden het instandhoudingsdoel van Zwarte Meer en Uiterwaarden Zwarte Water en Vecht en de landelijke staat van instandhouding is matig ongunstig Vanwege de beperkte verstoringsgevoeligheid, de korte duur, het werken per mast en de alternatieve foerageerlocaties nabij mast 12 en 13 (zie figuur 5.1) worden significant negatieve effecten van de werkzaamheden aan de masten voor de meerkoet uitgesloten.

Grutto

Grutto is waargenomen in de omgeving van de masten bij beide Natura 2000-gebieden. Er bevinden zich slaapplaatsen op een beperkt aantal km afstand van het plangebied (Meetnet NEM, via NDFF). Slaapplaatsen worden niet verstoord omdat overdag wordt gewerkt.

Voor foerageergebieden kan gemakkelijk worden uitgeweken omdat per mast wordt gewerkt en het verstoorde oppervlakte daarom zowel beperkt als tijdelijk is. De landelijke staat van instandhouding is zeer ongunstig, maar het aantal grutto's (583) bevindt zich momenteel boven het instandhoudingsdoel van Zwarte Meer (behoud) en beneden dat van Uiterwaarden Zwarte Water en Vecht (aantal 10, doel 80). Vanwege de korte duur en het beperkte oppervlak van verstoring en daarmee de uitwijkmogelijkheden bij foerageren worden significant negatieve effecten door de werkzaamheden op de instandhoudingsdoelstellingen voor grutto uitgesloten.

Zwarte stern

Zwarte stern is niet in de omgeving van de masten waargenomen. Het aantal zwarte sterns in Zwarte Meer (1) ligt beneden het instandhoudingsdoel (10) De landelijke staat van instandhouding is zeer ongunstig. Op basis van de afstand van de waargenomen zwarte sterns tot het plangebied, de gemiddelde verstoringsgevoeligheid van de soort en de uitwijkmogelijkheden naar alternatief geschikt foerageergebied worden significant negatieve effecten van de van de beoogd uit te voeren werkzaamheden op de instandhoudingsdoelstellingen voor de zwarte stern uitgesloten.

Toendrarietgans

Toendrarietgans verblijft van oktober tot maart in Nederland en komt verspreid op het land langs de oevers van het Zwarte Meer voor. Dit betreffen echter losse waarnemingen. De soort slaapt op water, maar zal dan niet worden verstoord omdat overdag wordt gewerkt. Foerageren gebeurt op akkers en graslanden die in de wijde omgeving van de masten aanwezig zijn. Gedurende het werk aan een mast is er voldoende alternatief niet verstoord foerageergebied beschikbaar (zie figuur 5.2). Het aantal toendrarietganzen bevindt zich momenteel boven het instandhoudingsdoel van Zwarte Meer en ook de landelijke staat van instandhouding is gunstig. Significant negatieve effecten van werkzaamheden aan de masten op de instandhoudingsdoelstellingen voor toendrarietgans worden uitgesloten.

Voor alle niet-broedvogels kunnen negatieve effecten, en zeker significant negatieve effecten door optische verstoring en verstoring door geluid worden uitgesloten.

6 Conclusie

Uit de voortoets gericht op niet-broedvogels is gebleken dat de per mastlocatie kortdurende werkzaamheden niet leidt tot effecten op de instandhoudingsdoelstellingen van Natura 2000-gebied Zwarte meer en Uiterwaarden Zwarte Water en Vecht.

Er is geen sprake van effecten van:

- Oppervlakteverlies en versnippering.
- Verontreiniging.
- Verdroging.
- Verstoring door licht en trillingen.
- Verstoring door mechanische effecten.
- Verzuring en vermesting door stikstofdepositie.

De volgende mogelijke effecten zijn nader getoetst:

- Verstoring door geluid.
- Optische verstoring.

Uit de effectbeoordeling is gebleken dat de werkzaamheden aan de masten niet zal leiden tot significant negatieve effecten op de instandhoudingsdoelstellingen van niet-broedvogels. Deze conclusie dient te worden besproken met het bevoegd gezag (LNV).

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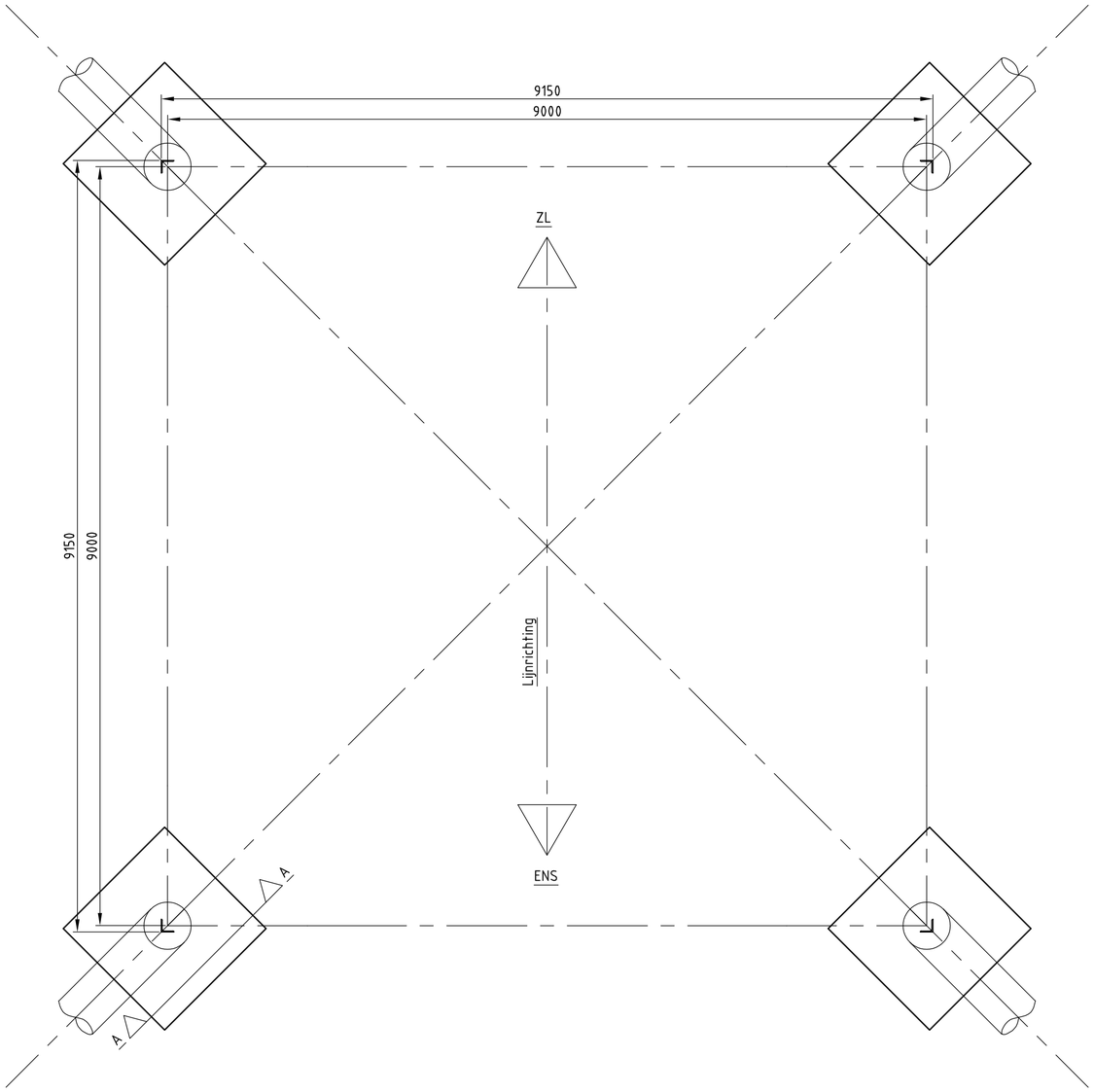
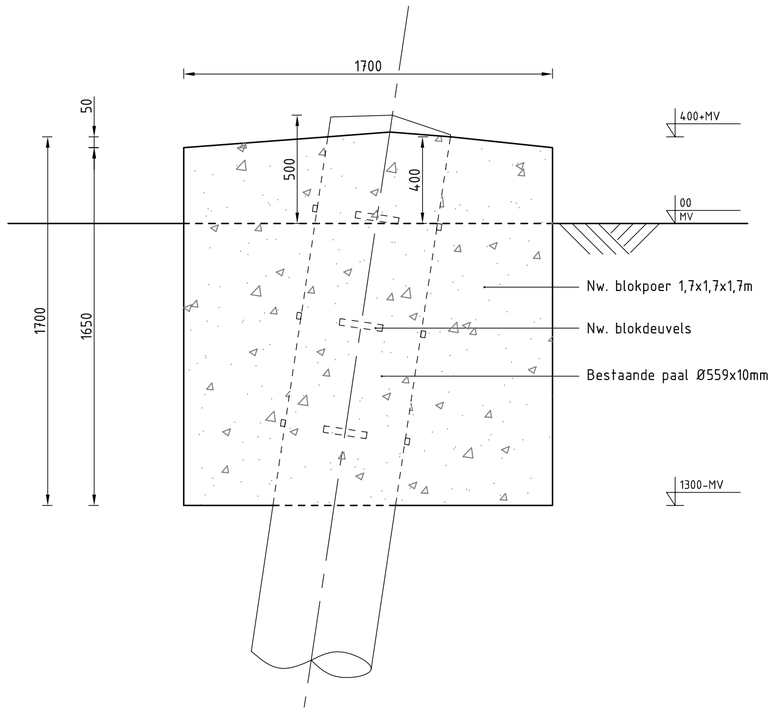


Bovenaanzicht fundatie
Schaal 1:50



Doorsnede A-A fundatieversterking
Schaal 1:20

Opmerkingen:
- Alle maatvoering in mm
- Alle hoogtemaatvoering in mm t.o.v. maaiveld
- Maatvoering indicatief weergegeven t.b.v. vergunningsaanvraag

- Conservering verwijderen van het gedeelte van de paal dat wordt opgenomen in de poer
- Aardingsvoorzieningen zijn niet weergegeven op tekening
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0	14-02-2022	Fundatieversterking
Revisie	Datum	Omschrijving

DNV

Projectnaam: BBB380 modeleren funderingen

Projectie:

Tekening nummer: 10166262-032-300

Blad: 001 Van: 001

Status: DRAFT	Schaal: 1:50 , 1:20	Omschrijving: Verbinding ENS-ZL380 Principetekening fundatieversterking Mast 44, 45 & 48	Revisie: 0
Datum: 14-02-2022	Units: mm		Formaat: A2
Getekend: DMR	Ref.nr.: 002.515.40 0993357		
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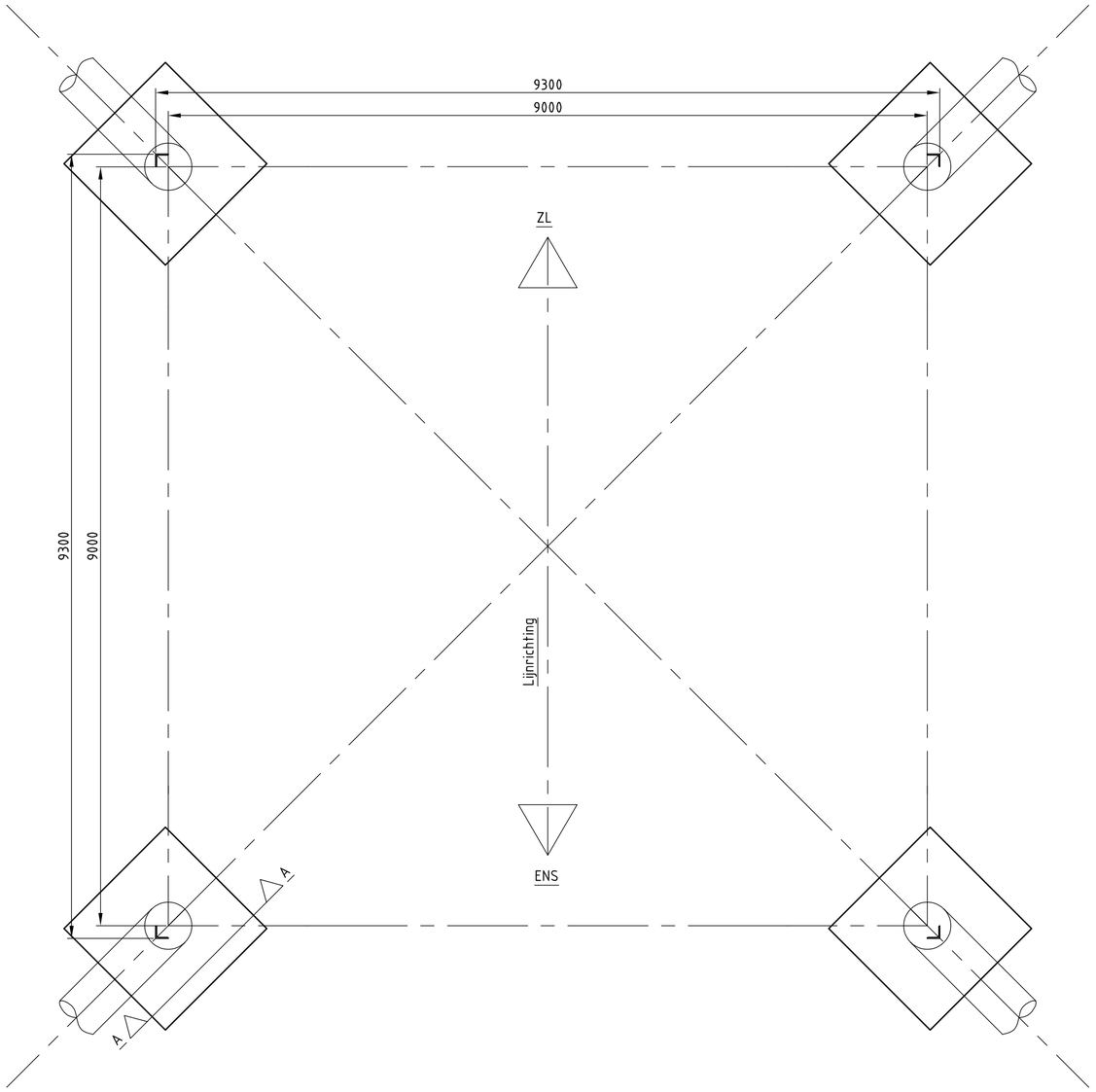

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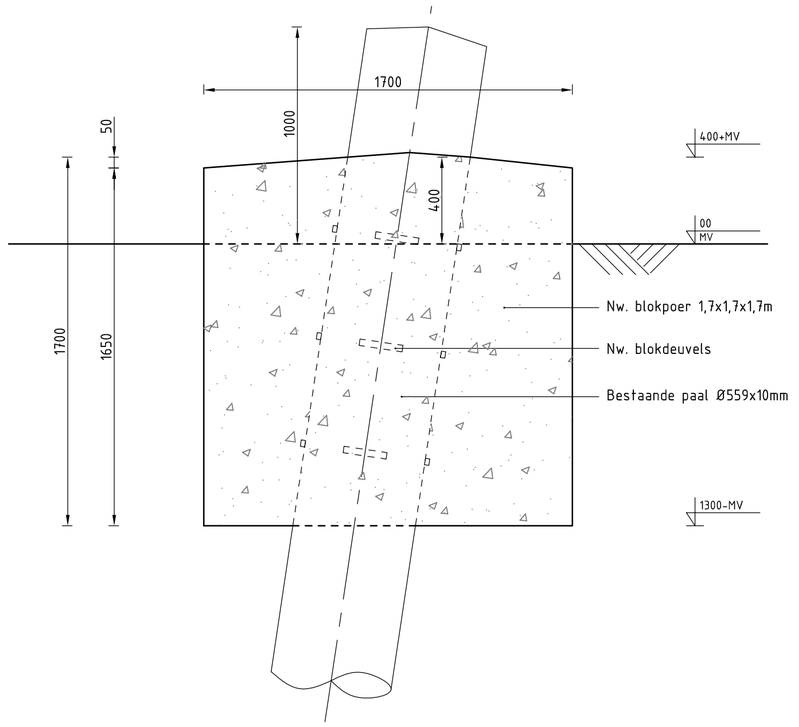

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Opmerkingen:
- Alle maatvoering in mm
- Alle hoogtemaatvoering in mm t.o.v. maaiveld
- Maatvoering indicatief weergegeven t.b.v. vergunningsaanvraag

- Conservering verwijderen van het gedeelte van de paal dat wordt opgenomen in de poer
- Aardingsvoorzieningen zijn niet weergegeven op tekening
- Aantal en afmetingen nieuwe blokdeuvels n.t.b.

- Ontwerp volgens rapportage DNV 21-1501 Rev.1 (Meridian 002.515.40 0825809)

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Revisie	Datum	Omschrijving

DNV

Projectnaam: BBB380 modeleren funderingen

Projectie:

Tekening nummer: 10166262-032-301

Blad: 001 Van: 001

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Getekend: DMR	Ref.nr.: 002.515.40 0993357		
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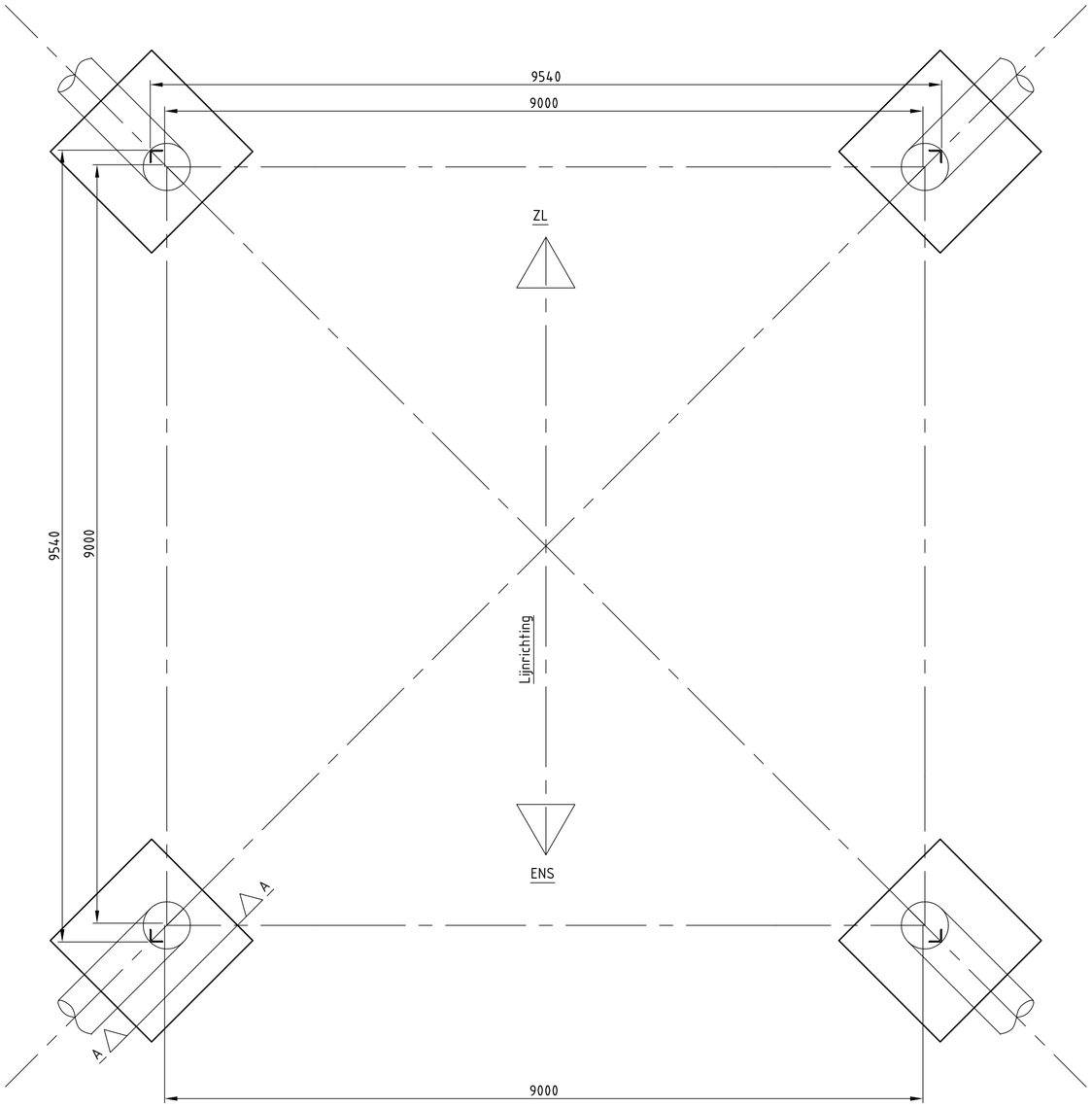
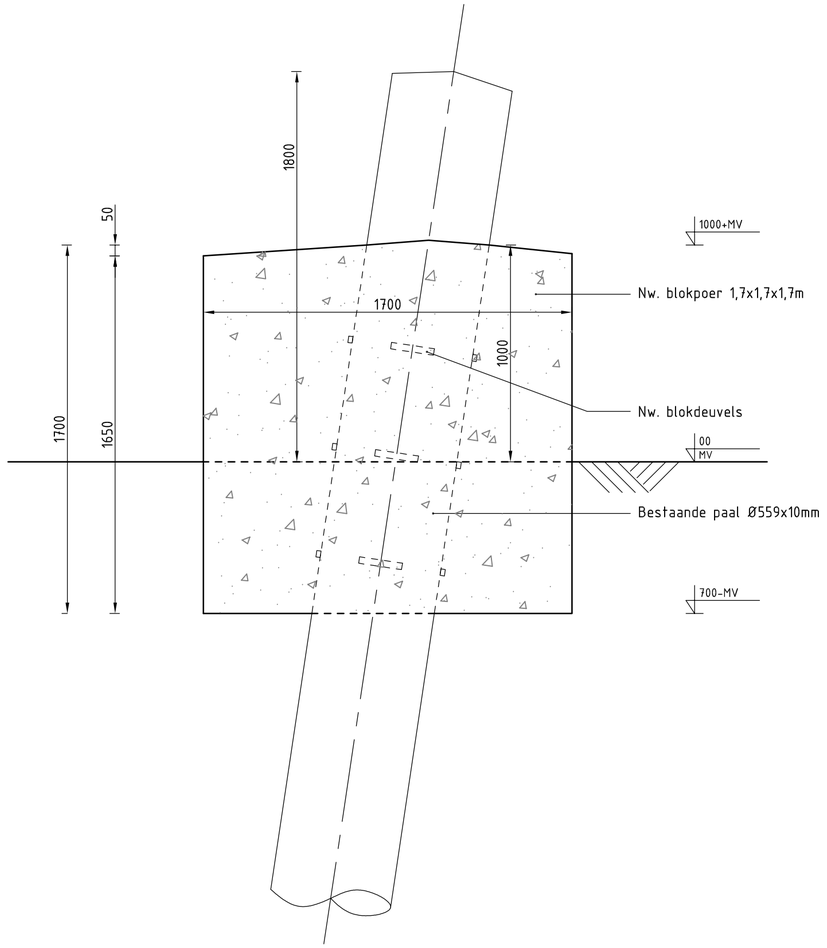


Bovenaanzicht fundatie
Schaal 1:50



Doorsnede A-A fundatieversterking
Schaal 1:20

Opmerkingen:
- Alle maatvoering in mm
- Alle hoogtemaatvoering in mm t.o.v. maaiveld
- Maatvoering indicatief weergegeven t.b.v. vergunningsaanvraag

- Conservering verwijderen van het gedeelte van de paal dat wordt opgenomen in de poer
- Aardingsvoorzieningen zijn niet weergegeven op tekening
- Aantal en afmetingen nieuwe blokdeuvels n.t.b.

- Ontwerp volgens rapportage DNV 21-1501 Rev.1 (Meridian 002.515.40 0825809)

0	14-02-2022	Fundatieversterking
Revisie	Datum	Omschrijving

DNV

Projectnaam:
BBB380 modeleren funderingen

Projectie:

Tekening nummer:
10166262-032-302

Blad: 001 Van: 001

Status: DRAFT	Schaal: 1:50 , 1:20	Omschrijving: Verbinding ENS-ZL380 Principetekening fundatieversterking Mast 64	Revisie: 0
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Getekend: DMR	Ref.nr.: 002.515.40 0993357		
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Funderingen: Berekeningen DO

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"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

ENS-ZL380 – Rapportage fundaties: eenpaalsfunderingen

TenneT TSO B.V.

Meridian doc.nr.: 002.515.40 0825809
Rapport nr.: 21-1501, Rev. 1
Datum: 2022-01-06

Projectnaam:	“Toetsing en herontwerp masten en fundaties BBB380”	Energy Systems
Rapport titel:	ENS-ZL380 – Rapportage fundaties: eenpaalsfunderingen	DNV Netherlands B.V. Utrechtseweg 310-B50
Klant:	TenneT TSO B.V.,	6812 AR Arnhem
Contactpersoon klant:	P. van der Horst	
Datum uitgave:	2022-01-06	
Project nr.:	10166262	Tel: 026 356 9111
Organisatie unit:	TDT	Handelsregister Arnhem 09006404
Meridian doc.nr.:	002.515.40 0825809	
Rapport nr.:	21-1501, Rev. 1	

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	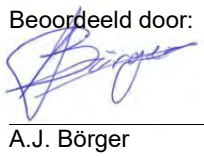	
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1	2022-01-06	RFA-commentaar & aangepaste belastingen fasewisseling verwerkt	M. Rekers	A.J. Börger	J. Huisman

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Appendix H Fundatiebelastingen

1 INLEIDING

1.1 Introductie

Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen zodat er een grotere transportcapaciteit mogelijk wordt gemaakt. Om die reden is de opdrachtgever (OG) voornemens de bestaande 380 kV-koppelnetring op te waarderen. Het opwaarderen van de bestaande verbindingen valt onder het programma “Beter benutten bestaande 380 kV-ring” en omvat de volgende deelprojecten:

1. Opwaardering 380 kV-verbinding Diemen – Lelystad (DIM-LLS380)
2. Opwaardering 380 kV-verbinding Lelystad – Ens (LLS-ENS380)
3. Opwaardering 380 kV-verbinding Rilland – Zandvliet (RLL-ZVL380)
4. Opwaardering 380 kV-verbinding Krimpen aan den IJssel - Geertruidenberg (KIJ-GT380)
5. Opwaardering 380 kV-verbinding Ens - Zwolle (ENS-ZL380)
6. Opwaardering 380 kV-verbinding Maasbracht - Eindhoven (MBT-EHV380)

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV opdracht verstrekt voor de volgende onderdelen:

1. In eerste fase het opstellen en creëren van:

1.1 E-studie deel 1

1.2 Uitgangspuntenrapporten ten behoeve van de constructieve analyse van masten en fundaties

1.3 Sonderingmodellen

1.4 Fundatiemodellen

1.5 Mastmodellen

2. In tweede fase de uitvoering van de DO-fase bevattende:

2.1 Toetsing conform het uitgangspuntenrapport van de bestaande fundaties

2.2 Specificatie van benodigde fundatieversterkingen ten behoeve van aanbesteding

2.3 Toetsing conform het uitgangspuntenrapport van de bestaande masten

2.4 Specificatie van benodigde mastversterkingen ten behoeve van aanbesteding

2.5 E-studie deel 2

De toetsing van de bestaande fundaties (fase 2.1) is vanwege de omvang verdeeld over drie rapportages. De onderverdeling is gemaakt op basis van het type fundatie. In het eerste deel zijn de masten opgenomen met een eenpaalsfundering, in het tweede deel zijn de masten opgenomen met een meerpaalsfundering en in het derde deel de fundatie van de portalen.

Dit voorliggende rapport betreft het eerste deel.

In Tabel 1-1 is de lijst met mastlocaties weergegeven, in Figuur 1-1 het geografische overzicht.

Figuur 1-1 Geografische ligging ENS-ZL380 met hoekmastnummers

Tabel 1-1 Mastlocaties

Gemeente	Mastnummer	Masttype	X-coördinaat [m]	Y-coördinaat [m]
Noordoostpolder	1	EC-3_R	183670,2	514320,0
Noordoostpolder	2	S-3 R	184098,2	514320,9
Noordoostpolder	3	S-3 R	184473,2	514321,7
Noordoostpolder	4	S-3 R	184913,2	514322,7
Noordoostpolder	5	S-3 R	185306,6	514323,5
Noordoostpolder	5A	S+6_R	185596,6	514324,1
Noordoostpolder	6	HB-3_R_X	185746,6	514324,5
Noordoostpolder	7	S+0 R	186081,0	514465,3
Noordoostpolder	8	S+0 R	186495,7	514639,9
Noordoostpolder	9	S+0 R	186902,8	514811,2
Noordoostpolder	11	S+30_R	187302,1	514734,5
Kampen	12	S+30_R	187748,8	514413,8
Kampen	13	S+0 R	188175,5	514107,5
Kampen	14	HA-3_R	188473,9	513893,3
Kampen	15	S-3 R	188739,7	513733,8
Kampen	16	S-3 R	189094,7	513520,7
Kampen	17	S-3 R	189354,8	513364,6
Kampen	18	S-3 R	189695,4	513160,2
Kampen	19	S-6 R	189996,8	512979,3
Kampen	20	S-6 R	190290,7	512803,0
Kampen	21	S-6 R	190598,9	512618,0
Kampen	22	S-6 R	190899,4	512437,6
Kampen	23	S-6 R	191218,6	512246,1
Kampen	24	S-6 R	191483,8	512086,9
Kampen	25	S-6 R	191767,1	511916,9
Kampen	27	S+12_R	192351,8	511566,0
Kampen	28	S-6 R	192600,6	511416,7
Kampen	29	S-6 R	192862,3	511259,6
Kampen	31	S-3 R	193456,7	511212,5
Kampen	32	S+0 R	193800,2	511320,0
Kampen	33	S+0 R	194243,8	511459,0
Kampen	34	HC-3_R	194661,3	511589,7
Zwartewaterland	35	HB+0_R_X	194988,7	511421,9
Zwartewaterland	36	S-3 R	195180,2	511014,5
Zwartewaterland	37	S-3 R	195369,4	510611,8
Kampen	38	S+0 R	195559,2	510207,9
Kampen	39	S-3 R	195754,1	509793,2
Kampen	41	S-6 R	196121,4	509303,6
Kampen	42	S-6 R	196426,5	509120,6
Kampen	43	S-6 R	196721,4	508943,6
Kampen	44	S-6 R	197021,4	508763,6

Gemeente	Mastnummer	Masttype	X-coördinaat [m]	Y-coördinaat [m]
Kampen	45	S-6 R	197321,6	508583,5
Kampen	46	S-6 R	197609,2	508410,9
Kampen	47	S-6 R	197903,6	508234,3
Kampen	48	S-6 R	198196,1	508058,8
Zwolle	49	HB-3_R	198498,1	507877,6
Zwolle	50	S-6 R	198814,6	507861,4
Zwolle	51	HB-3_R	199129,1	507845,3
Zwolle	52	S-6 R	199464,8	507998,3
Zwolle	53	S-6 R	199790,5	508146,9
Zwolle	54	S-6 R	200116,3	508295,4
Zwolle	55	S-3 R	200343,8	508399,1
Zwolle	56	S-3 R	200718,6	508570,0
Zwartewaterland	57	S-3 R	201093,3	508740,9
Zwartewaterland	58	S-6 R	201419,0	508889,4
Zwartewaterland	59	S-6 R	201744,7	509037,9
Zwartewaterland	60	S-6 R	202070,3	509186,4
Zwartewaterland	61	S-6 R	202335,1	509307,1
Zwartewaterland	62	S-6 R	202653,0	509452,1
Zwartewaterland	63	S-6 R	202972,4	509597,7
Zwartewaterland	64	S-6 R	203176,0	509690,6
Zwartewaterland	65	HB+9_R_X	203484,0	509831,0
Zwartewaterland	66	S+12_R	203651,1	509809,4
Zwartewaterland	67	S+0 R	204003,3	509763,7
Zwartewaterland	68	S-6 R	204318,1	509722,8
Zwartewaterland	69	S-6 R	204679,9	509675,9
Zwartewaterland	70	S-6 R	205019,3	509631,9
Zwartewaterland	71	S-6 R	205374,2	509585,8
Zwartewaterland	72	S-6 R	205705,2	509542,9
Zwartewaterland	75	S-6 RC	206242,3	508842,0
Zwartewaterland	76	S-6 RC	206400,8	508530,4
Zwartewaterland	77	S-6 RC	206559,2	508219,2
Zwolle	78	S-6 RC	206718,4	507906,2
Zwolle	79	S-6 RC	206878,9	507590,7
Zwolle	80	S-6 RC	207039,3	507275,4
Zwolle	81	S-6 RC	207199,9	506959,8
Zwolle	83	S-6 RC	207619,4	506428,3
Zwolle	84	S-3 RC	207888,6	506204,3
Zwolle	85	S-6 RC	208144,1	505991,7
Zwolle	86	S-6 RC	208399,3	505779,4
Zwolle	87	S-6 RC	208668,5	505555,4
Zwolle	89	S+15_R	209247,1	505015,4
Zwolle	90	EC-3_R	209295,1	504966,5

1.2 Doelstelling en scope van dit rapport

In de verbinding ENS-ZL380 wordt de bestaande driebundel AMS460-geleider vervangen door een driebundel ACCC-“Warsaw”-geleider. Het doel van deze studie is om te bepalen of de in dit rapport beschreven mastfundaties voldoen onder de belastingen die ontstaan bij toepassing van de nieuwe Warsaw geleider. De nieuwe geleider is zodanig gekozen dat belastingen in principe niet toenemen in de nieuwe situatie ten opzichte van de bestaande geleider.

Bij de beoordeling van de constructieve veiligheid van bestaande constructies is NEN 8700 aangewezen door het Bouwbesluit. Uitgangspunt is het afkeurniveau met een referentieperiode van 30 jaar. Indien blijkt dat de fundatie niet voldoet aan het afkeurniveau worden aanpassingen bepaald op basis van het verbouwniveau met een referentieperiode van 50 jaar.

Nadat de wijzigingen zijn toegepast dient aantoonbaar geverifieerd te worden dat het systeem voldoet aan de vigerende eisen.

1.3 Relatie overige documenten

1.3.1 Verificatie & validatie plan

De door TenneT aangeleverde set met eisen is beoordeeld op relevantie en voor de relevantie eisen is aangegeven in welk document wordt aangetoond dat er aan de eis wordt voldaan. De resultaten hiervan zijn opgenomen in het rapport “21-0462 - Verificatie & validatieplan 380kV verbinding Ens - Zwolle” /3/.

1.3.2 E-studie deel 1

In de rapportage “20-1465 - ENS-ZL380 – E-studie Deel 1” /2/ is bepaald welke aanpassingen benodigd zijn om de ACCC-Warsaw geleider toe te passen binnen de verbinding Ens - Zwolle. Voor de steunmasten die behandeld worden in deze rapportage zijn er geen relevante aanpassingen anders dan nieuwe isolatoren en geleiders.

1.3.3 Uitgangspuntenrapport

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport “20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” /1/.

1.3.4 Rapportages masten

De belastingen op basis waarvan de fundaties worden doorgerekend komen voort uit de mastrapportages:

1. 20-1505 - ENS-ZL380 – Tower S-6 Report /4/
2. 20-1574 - ENS-ZL380 – Tower S-6 RC Report /5/
3. 20-1537 - ENS-ZL380 – Tower S-3 Report /6/
4. 20-1815 - ENS-ZL380 – Tower S-3 RC Report /7/
5. 20-1595 - ENS-ZL380 – Tower S+0/R Report /8/
6. 20-1785 - ENS-ZL380 – Tower S+6 R Report /9/
7. 20-1642 - ENS-ZL380 – Tower S+12 R Report /10/
8. 20-1725 - ENS-ZL380 – Tower S+15 R Report /11/
9. 20-1688 - ENS-ZL380 – Tower S+30 R Report /12/
10. 21-0055 - ENS-ZL380 – Tower HA-3/R Report /13/
11. 21-0050 - ENS-ZL380 – Tower HB-3/R Report /14/
12. 21-0135 - ENS-ZL380 – Tower HB+0/R Report /15/
13. 21-0180 - ENS-ZL380 – Tower HB+9/R Report /16/
14. 21-0181 - ENS-ZL380 – Tower HC-3/RC Report /17/
15. 21-0093 - ENS-ZL380 – Tower EC-3/R Report /18/

2 UITGANGSPUNTEN

2.1 Normen

De volgende normen zijn gehanteerd bij het opstellen van dit rapport:

- NEN 8700:2011, “Grondslagen voor de constructieve beoordeling van bestaande bouw en het constructief ontwerp ten behoeve van verbouw” /19/;
- NEN-EN 1997-1-C1+A1:2016/NB:2016 nl, “Geotechnisch – Algemeen” /20/;
- NEN 8707:2019, “Geotechnisch ontwerp - Beoordeling van de constructieve veiligheid van een bestaand bouwwerk” /21/.

2.2 TenneT-specificaties

Voor de van toepassing zijnde TenneT-specificaties wordt verwezen naar Appendix A van het uitgangspuntenrapport behorend bij dit project; “20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” /1/.

2.3 Gebruikte gegevens

Zie de tabel in Appendix I van “20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” /1/.

2.4 Sonderingen

De berekeningen in deze rapportage zijn deels gebaseerd op de mechanische sonderingen die beschikbaar zijn gekomen vanuit de bouwperiode en deels op nieuw uitgevoerde elektrische sonderingen.

Voor het doel van het toetsen van de bestaande paalfunderingen is het op basis van NEN 8707 mogelijk om bestaande mechanische sonderingen te gebruiken. Voor de basistype masten is één sondering per mast beschikbaar. Voor hogere masten met vergrote pootspreiding, is per hoekpunt een sondering beschikbaar. Er zijn geen nieuwe sonderingen gemaakt bij alle masten waar op basis van verkennende berekeningen geen versterkingen worden verwacht. Voor deze masten wordt de bestaande sondering als uitgangspunt genomen voor de toetsing. Dit geldt voor mast 5A, 15 t/m 18, 20 t/m 22, 25, 31, 36 t/m 39, 41, 55, 66, 70, 75 t/m 78, 80 en 83.

Mast 12 betreft een uitzondering. Op basis van de verkennende berekeningen zou het voor deze locatie wenselijk zijn nieuwe sonderingen te maken. Echter is deze mast dermate slecht bereikbaar, dat er wordt afgezien van het uitvoeren van nieuwe sonderingen. Voor nadere verklaring wordt verwezen naar hoofdstuk 5.1.1.

Voor alle overige masten wordt de draagkracht van de bestaande en nieuwe palen berekend op basis van nieuw uitgevoerde elektrische sonderingen, zoals vereist op basis van het Bouwbesluit 2012. Bestaande sonderingen worden hierbij buiten beschouwing gelaten. Op twee mastlocaties (mast 69 en mast 82) was het uitvoeren van nieuwe sonderingen nog niet mogelijk, voor deze locaties worden vooralsnog bestaande sonderingen gebruikt.

2.5 Software

Tabel 2-1 Software

Onderwerp	Software	Versie
Geotechnische berekeningen	Technosoft paalfunderingen	V6.70
Constructieve analyse	AxisVM	X6 1k
Algemene berekeningen	Excel	2016

2.6 Materialen

Voor de controle van de bestaande mastconstructies gebouwd in 1988 geldt Tabel 2-2.

Tabel 2-2 Materialen bestaande constructie

	Aanduiding '88	Huidig uitgangspunt
Staalsoort	Fe360	S235JR
	Fe510	S355J0
Boutkwaliteit	8.8	8.8, gerolde draad
Betonkwaliteit	B25	Min. C16/20
Wapeningsstaal	FeB220, FeB400, FeB500	B220, B400, B500

Voor de controle van de fundering in de nieuwe situatie geldt voor aan te brengen versterkingen als minimale kwaliteit:

Tabel 2-3 Materialen nieuwe constructie

	Aanduiding
Staalsoort	S355J0 (t≤16 mm)
	S355J2 (16<t≤40 mm)
Betonkwaliteit	C30/37
Wapeningstaal	B500

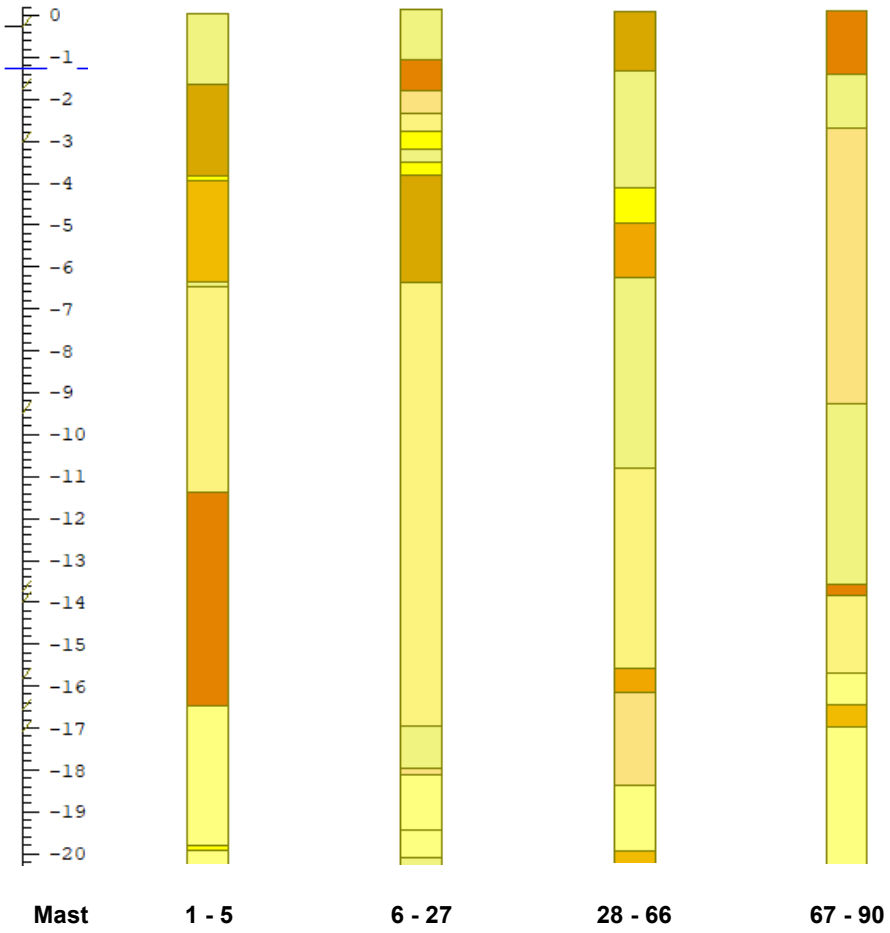
2.7 Beschrijving grondopbouw

In onderstaande voorbeelden (zie Figuur 2-1) is de bodemopbouw opgenomen. Voor het beschrijven van de grondopbouw maken we gebruik van de nieuw uitgevoerde sonderingen.

Met een grove beschouwing kan de grondopbouw geclusterd worden in vier delen:

- Mast 1 – 5: slappe grondlagen tot ca. 6 m – MV, dan een zandpakket van ca. 5 m, vervolgens nog een slappe laag van ca. 5 m en daarna zand;
- Mast 6 – 27: slappe grondlagen tot ca. 6 m – MV en daarna zand;
- Mast 28 – 66: slappe grondlagen tot ca. 2m – MV, daarna zand met een teruggang (van kleiig zand) tussen de 5 m – MV en 10 m – MV en verder zand;
- Mast 66 – 90: slappe grondlagen tot ca. 1 m – MV en daarna zand;

De pakking van de zandlagen is over het algemeen tussen los en matig, maar er zijn ook locaties met dicht gepakte lagen. In de diepere lagen komen soms nog verstorende lagen voor, maar de laagdikte van deze grondlagen is over het algemeen beperkt tot maximaal 1 m.



Figuur 2-1 Grondopbouw

2.8 Uitgangspunten geotechniek

2.8.1 Paalklassefactoren

Met de 2016-versie van de Nationale Bijlage van de norm voor Geotechniek, de NEN-EN 1997-1 /20/, zijn per 1 januari 2017 de paalklassefactoren volgens tabel 7.c verlaagd. Deze verlaagde factoren gelden echter niet voor bestaande paalfunderingen; via NEN 8700 /19/ wordt nog naar de NEN-EN 1997-1 /20/ van voor 2016 normatief verwezen. Daardoor hoeven de gereduceerde waarden niet te zijn toegepast bij de toetsing van de funderingen in de bestaande situatie. Bij de controle van nieuw aan te brengen palen wordt de reductie wel in rekening gebracht.

2.8.2 Uitgangspunt hoogte fundatie

Voor het bepalen van de hoogtes van bovenkant fundatie en van het maaiveld zijn aanvullende hoogtemetingen[1] uitgevoerd. Deze hoogtemetingen worden gebruikt als uitgangspunt voor het bepalen van het paalpuntniveau ten opzichte van NAP. In Appendix E wordt nader ingegaan op de bepaling van het paalpuntniveau.

[1] De hoogtemetingen zijn uitgevoerd door Arcadis en vastgelegd in een DWG-bestand genaamd “1258201001 versie 28 juni 2021”.

2.8.3 Aanname kleef cohesieve lagen

In de berekeningen wordt de weerstand van de cohesieve lagen boven de draagkrachtige zandlaag meegenomen. Volgens opmerking (b) van 7.6.3.3 (8) van NEN-EN 1997-1 is de schachtwrijving tot 50% gereduceerd. Negatieve kleef is gerekend over de hoogte van de cohesieve laag en de grondlagen daarboven.

2.8.4 Sonderingen per locatie

De sonderingen uit de bouwperiode bevatten één sondering per locatie. De precieze positie is niet bekend, aangenomen wordt dat dit in het centrum van de mastpositie was. Met een afmeting van circa 10x10 m voor de pootspreiding wordt op basis van NEN 8707 voldaan aan het benodigde aantal sonderingen.

In het geval van nieuw uit te voeren sonderingen benodigd voor nieuwe funderingen zal het dekkingsgebied van de sonderingen een afmeting bestrijken van 25x25 m onder de voorwaarde dat $\Delta R_{c,cal} \leq 0{,}3R_{c,cal}$ volgens 3.2.3 opmerking (a) van NEN-EN 1997-1. Met twee sonderingen per locatie om een mast met pootsprei van circa 10 m, vallen alle hoeken onder het dekkingsgebied van beide sonderingen. Indien variatie groter is, dan valt iedere hoek onder tenminste één sondering.

2.8.5 Ksi-factoren

De factoren ksi3 en ksi4 worden toegepast bij de bepaling van de karakteristieke weerstand van een paal. De waarden zijn afhankelijk van de aard van de constructie en het aantal beschikbare sonderingen. De ksi-factoren zijn ontleend aan NEN-EN 1997-1:2016, bijlage A, tabel 10. Per mastlocatie zijn maximaal zes sonderingen beschikbaar. De eenpaalsfunderingen vallen onder “niet-stijf”.

Tabel 2-4 Ksi-factoren niet-stijf bouwwerk

Aantal sonderingen	1	2	3	4	5	7	10
ksi3	1,39	1,32	1,30	1,28	1,28	1,27	1,25
ksi4	1,39	1,32	1,30	1,03	1,03	1,01	1,00

Indien bij sterk wisselende resultaten uit de verschillende sonderingen per mastlocatie niet voldaan wordt aan de eis van de variatiecoëfficiënt (NEN-EN 1997-1, opmerking in bijlage A), dan wordt de ksi-factor gekozen op basis van één sondering. De capaciteit wordt gebaseerd op de minst gunstige sondering.

2.8.6 Materiaalfactor $\gamma_{m,var,qc}$

Een belangrijke parameter die de berekende draagkracht reduceert is de partiele factor $\gamma_{m,var,qc}$ volgens NEN-EN 1997-1 artikel 7.6.3.3 (8) opmerking (d). Voor een paal die een wisselende belasting ondergaat tussen trek- en druk treedt een vermindering op van de schuifweerstand. Afhankelijk van de verhouding tussen uiterste trek- en drukkracht in de SLS is de $\gamma_{m,var,qc}$ tussen de 1,0 en 1,5.

$$\gamma_{m;var;q_c} = 1 + 0{,}25 \cdot \frac{F_{t;max;rep} - F_{t;min;rep}}{F_{t;max;rep}} \text{ en } \gamma_{m;var;q_c} \leq 1{,}5$$

Voor steunmasten met variatie waarbij de maximale drukbelasting minimaal gelijk is aan de trekbelasting levert de formule de waarde van 1,50 op. Deze waarde is gebruikt in de controle van bestaande en nieuwe palen.

2.9 Duurzaamheid

2.9.1 Bestaande betonpoeren

Alle berekeningen zijn opgesteld met het uitgangspunt dat door voldoende onderhoud geen achteruitgang is opgetreden. Dit uitgangspunt wordt ondersteund door het inspectierapport Bejan Bouw & BetonTechniek b.v., rapportnummer 200152A-001 v2.1. Daarin wordt onderstaande eindconclusie geschreven:

"*De poeren met stalen buizen hebben een restlevensduur van minimaal 50 jaar. Om de corrosie van de stalen delen te stoppen, dienen de stalen oppervlakken periodiek te worden voorzien van nieuwe conservering.*

De betonnen poeren hebben eveneens een restlevensduur van minimaal 50 jaar. Om deze restlevensduur te kunnen bereiken dienen de poeren voldoende te worden beschermd tegen indringing van carbonatatie. Om de kans op indringing van carbonatatie en carbonatatie geïnitieerde wapeningscorrosie te verkleinen adviseren wij om de betonconservering periodiek te vervangen."

De betonsterkteklasse is ook geverifieerd aan de hand van cilinderdrukproeven. De minimaal gevonden karakteristieke druksterkte is 65,7 MPa en is veel hoger dan de aangenomen karakteristieke druksterkte van 20 MPa (C20/25). Dit betreft daarmee een veilige aanname. Voor resultaten, zie inspectierapport.

2.9.2 Nieuwe betonpoeren

De duurzaamheid van de nieuwe betonpoeren wordt geborgd door het toepassen van voldoende betondekking op het betonstaal. Conform TenneT-specificatie betreft dit een minimale betondekking van 40mm.

2.10 Staaldikte funderingspalen

Voor het dimensioneren van stalen palen dient volgens TenneT-specificatie 04.009 rekening te worden gehouden met afname van staaldikte op basis van NEN 1993-5. Dit komt overeen met de CUR-aanbeveling 166 voor damwanden. Op dit moment is nog geen milieukundig onderzoek beschikbaar waaruit de agressiviteit van het grondwater (pH-waarde) kan worden afgeleid, de palen bevinden zich mogelijk in deels in zuurdere veengrond. De invloed van het zoutgehalte in het grondwater is gering[2].

Voor de nieuwe palen wordt uitgegaan van enkelzijdige afroesting op basis van zure bodem, hetgeen leidt tot een afname van 1,75 mm na 50 jaar. Bij minimaal 10 mm dikte moet de U.C. voor nieuwe palen beneden de (10-1,75)/10 = 0,83 blijven.

Voor bestaande palen wordt uitgegaan van een dikteverlies na 35+50 jaar op basis van zure bodem. Het dikteverlies is gelijk aan: 85 / 50 x 1,75 mm/50 jaar = 3,0 mm. Bij een initiële dikte van 10 mm voor de buispaal betekent dat de U.C. beneden de (10-3,0)/10 = 0,70 moet blijven. De keuze voor enkelzijdig volgt uit het gegeven dat de stalen palen deels gevuld zijn met beton en een gelaste gietstalen punt hebben.

Tabel 9.2. Aantasting (mm) van damwanden in bodem en ophogingen met of zonder grondwater (per blootgestelde zijde) *).

Beoogde levensduur (jaar)	5 ***)	25 ***)	50	75	100
Ongeroerde, schone bodem	0,00	0,30	0,60	0,90	1,20
Verontreinigde bodem, geroerde grond	0,15	0,75	1,50	2,25	3,00
Zure bodem (veen, moeras)	0,20	1,00	1,75	2,50	3,25
Onverdichte grond (klei, zand) **)	0,18	0,70	1,20	1,70	2,20
Onverdicht, agressief ophoogmateriaal (bodemas, slakken, sintels)	0,50	2,00	3,25	4,50	5,75

Figuur 2-2 Tabel 9.2 uit CUR 166

[2] Deltares, rapport 1209030, Corrosie van stalen damwandplanken in de grond;

2.11 Vermoeiing

De funderingen worden belast door vakwerkmasten. Deze zijn vanwege de aard van de constructie niet gevoelig voor vortex shedding of andere opslingeringen door wind. De wisselende belasting van wind is een quasi-statische belasting. Dit is vastgelegd in 7.3.10 van NEN-EN 50341-1:2013. Toetsing op vermoeiing door galloping, voor zover al relevant voor funderingen, is voor bestaande constructies niet vereist op basis NEN 8701.

2.12 Omgeving

De voorgestelde versterkingsoplossingen met betonpoeren vereisen ruimte buiten de huidige mastvoeten. Een gedetailleerde studie naar eventuele obstakels valt buiten de scope van deze rapportage, echter lijken er voor de betreffende masten geen obstakels aanwezig te zijn.

2.13 Aarding

Uitwerking van aardingsvoorzieningen vallen buiten de scope van deze rapportage. In de UO-fase dient de aarding in de betonpoeren te worden ontworpen op basis van de van toepassing zijnde TenneT-specificaties.

3 BESTAANDE FUNDATIES

In deze paragraaf worden de specifieke mechanische en geotechnische uitgangspunten behorend bij de aanwezige palen en fundaties beschreven die onderdeel zijn van deze rapportage. In alle gevallen betreft het een stalen buispaal met een gesloten voet of een groutinjectiepaal, alleen mast 5A vormt een uitzondering met een schroefinjectiepaal.

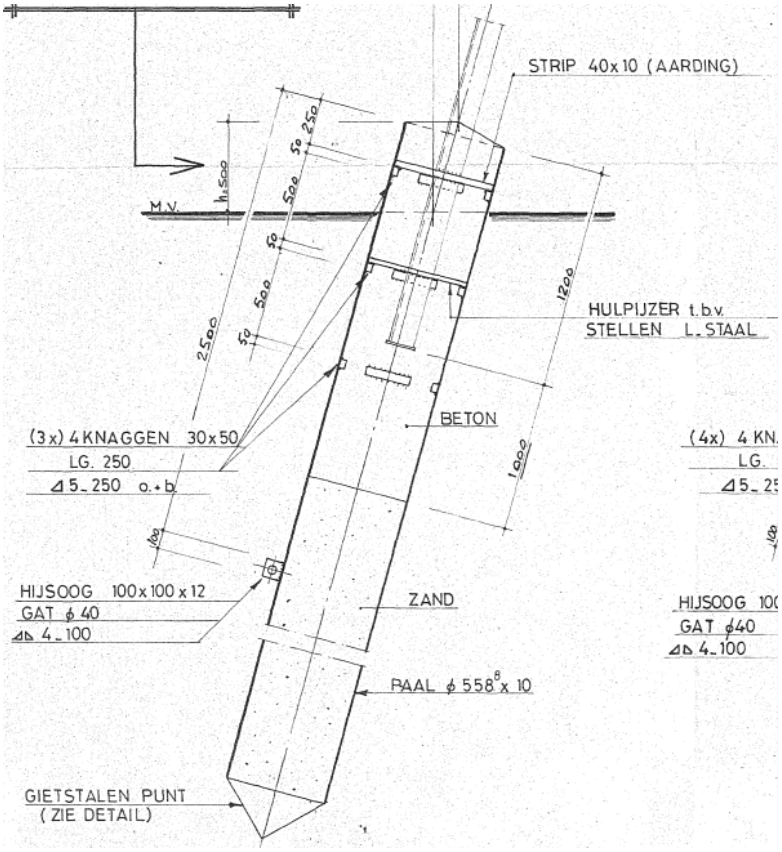
3.1 Ontbrekende gegevens

De as-built gegevens van de fundaties zijn compleet.

3.2 Poerfunderingen

3.2.1 Buispalen met punt

Het meest voorkomende type is de geheide, stalen buispaal met punt. Het betreft een stalen buis Ø559x10 mm. De buis is over de bovenste 2 m á 3 m gevuld met beton en verder met zand. Een principedetail van de funderingspaal is weergegeven in Figuur 3-1. De theoretische positie van de bovenkant van de paal ten opzichte van maaiveld is 1,8 m voor mast 64 en 67, 1,0 m voor mast 60 t/m 63 en 0,5 m voor alle overige masten. In werkelijkheid blijken deze maten te variëren per locatie (zie Appendix B).

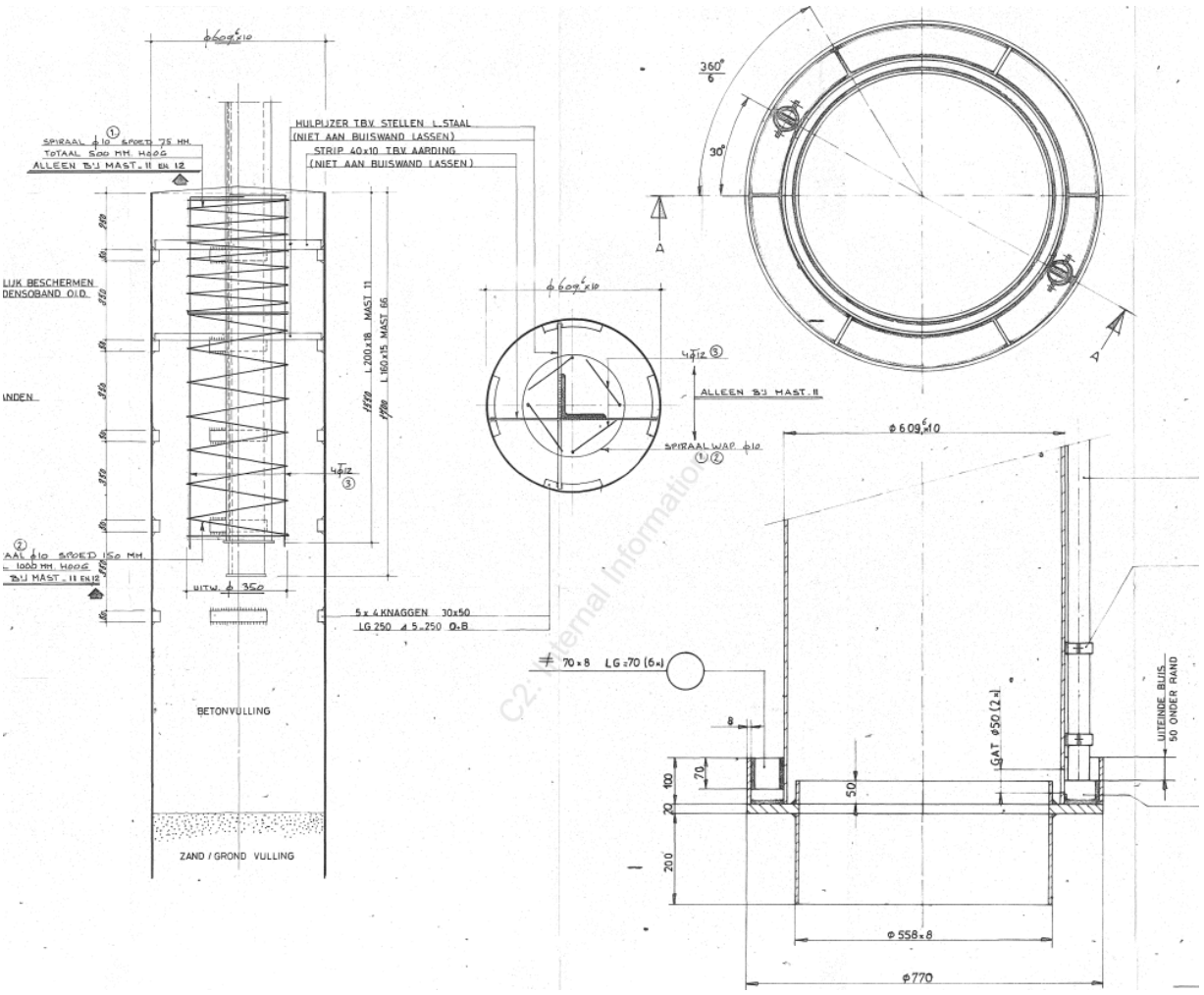


Figuur 3-1 Gesloten stalen buispaal met punt

3.2.2 Groutinjectiepalen

Als alternatief voor de buispaal met punt is er op verschillende locaties gebruik gemaakt van groutinjectiepalen. De buis is over de bovenste 2 m á 3 m gevuld met beton. Een principedetail van de funderingspaal is weergegeven in Figuur 3-2. De theoretische positie van de bovenkant van de paal ten opzichte van maaiveld is 1,8 m voor mast 65 en 66, 0,9m voor mast 12 en 27 en 0,5 m voor alle overige masten. In werkelijkheid blijken deze maten te variëren per locatie (zie Appendix B). Er komen drie afmetingen voor:

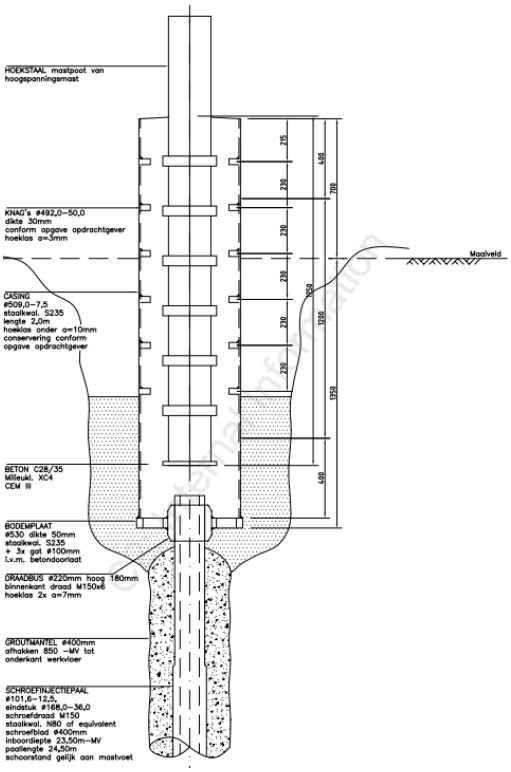
- Ø770/610x10 mm;
- Ø871/711x10 mm;
- Ø1075/914x10 mm.



Figuur 3-2 Groutinjectiepalen

3.2.3 Schroefinjectiepaal

Mast 5A vormt een uitzondering, bij deze mast is een schroefinjectiepaal toegepast. Het betreft een stalen buis Ø101,6x12,5 mm met een groutmantel Ø400 mm. De stalen buis verloopt aan het eind naar een Ø168,0x36,0 mm. De schroefinjectiepaal loopt tot ca. 1,35m onder maaiveld en is middels een schroefkoppeling verlengd door een met beton gevulde stalen casing Ø509,0x7,5 mm tot ca. 0,7 m boven maaiveld. Een principedetail van de funderingspaal is weergegeven in Figuur 3-3.



Figuur 3-3 Schroefinjectiepaal

3.3 Geotechnische eigenschappen paaltypes

In Tabel 3-1 zijn de geotechnische eigenschappen op basis van NEN-EN 1997-1 samengevat waarmee de berekeningen worden uitgevoerd. De mechanische eigenschappen van de paaltypes zijn gebaseerd op archiefgegevens. Voor gebruik in het programma is een diameter ingevoerd met equivalente paalomtrek als de werkelijke paal. In Appendix E zijn de eigenschappen samengevat.

Tabel 3-1 Geotechnische eigenschappen palen

	BP 559x10	GI-paal 770/610	GI-paal 871/711	GI-paal 1075/914	SI-paal 400
Paaltype	Geheide stalen buis met punt	Geheide stalen buis met groutinjectie	Geheide stalen buis met groutinjectie	Geheide stalen buis met groutinjectie	In de grond gevormde geschroefde paal met groutinjectie
Diameter (m)	0,559	0,77	0,871	1,075	0,4
Factor α_s	0,010	0,014	0,014	0,014	0,009
Factor α_t	0,007	0,012	0,012	0,012	0,009
Factor α_p	1,0	1,0	1,0	1,0	0,9
Factor β	1,0	1,0	1,0	1,0	1,0

4 AANPAK TOETSINGEN FUNDERINGEN

In dit hoofdstuk is een toelichting op de methode gegeven waarmee de bestaande paalfunderingen zijn getoetst. De toetsing van de palen heeft ten eerste plaatsgevonden op basis van het verticale draagvermogen. Dat wil zeggen de maximale trek- of drukbelasting die opneembaar is. Ten tweede is beoordeeld of de palen in staat zijn om de horizontale belastingen af te dragen.

4.1 Verticaal draagvermogen

4.1.1 Belastingen

De fundatiebelastingen van de mastconstructies zijn opgenomen in Appendix H. Deze zijn ontleend aan de rapporten betreffende de mastconstructies. De belastingen van de maatgevende masten uit een groep van gelijke masttypes zijn als uitgangspunt gebruikt.

Voor mast 45, 47, 61 en 64 (masttype S-6) zijn locatiespecifieke belastingen gebruikt op basis van de lijnconfiguratie ter plaatse. Deze masten hebben geen hoogteverschil ten opzichte van de twee naastgelegen masten, waardoor er een lagere belasting optreedt dan bij het “standaard” masttype S-6. De uitvoer van het geleiderbelastingenprogramma van DNV is toegevoegd aan Appendix H. De belastingcombinatie met maximale trek of maximale drukbelasting is gerekend. Bij de steunmasten uit deze rapportage is dit in alle gevallen de overhoekse wind.

Het gewicht van de paal wordt door het programma automatisch bepaald, waarbij de invloed van het grondwater wordt meegenomen.

4.1.2 Invoer TS paalfunderingen

De sonderingen zijn in digitaal formaat omgezet voor gebruik in het programma Technosoft Paalfunderingen. Aan de hand van de sonderingen en de beschikbare boringen is een grondprofiel geconstrueerd. De gebieden waarin negatieve en positieve schachtwrijving optreedt worden ingesteld per sondering. Positieve wrijving wordt bij controle van drukbelasting enkel ontleend aan de draagkrachtige zandlaag.

Alle in deze rapportage opgenomen masten uit de hoogspanningslijn zijn in één uitvoer opgenomen, zie Appendix E. Er is een uitvoer voor druk en een uitvoer voor trek gegenereerd, voor bestaande palen en indien van toepassing voor nieuwe palen. De sondeergrafieken zijn in de uitvoer van de bestaande palen op trek voor de controleerbaarheid opgenomen.

De resultaten uit de berekeningen van het programma zijn vervolgens ten behoeve van de toetsing in een tabel met belastingen ingevoerd. Zie hiervoor Appendix C. De samenvatting hiervan in de vorm van unity-checks is opgenomen in de rapporttekst.

Bij mast 14 en 49 zijn vanwege verschillende paalpuntniveaus aan de binnen- en buitenzijde van de bocht twee berekeningen uitgevoerd.

4.2 Horizontaal draagvermogen

Aan de hand van een 1D-stavenmodel in Axis VM is het horizontale draagvermogen getoetst. Hierbij is getoetst op de optredende spanningen in de buispaal en horizontale vervormingen op basis van maximale trekbelasting, maximale drukbelasting en torsiebelasting.

Voor verdere omschrijving, zie Appendix G.

5 RESULTATEN TOETSING INITIËLE SITUATIE

In dit hoofdstuk worden de resultaten van de toetsingsberekeningen gepresenteerd. De gehele tabel met toetsingsresultaat op trek- en drukbelasting is terug te vinden in Appendix C. In dit hoofdstuk is de samenvatting per funderingstype opgenomen. Het resultaat wordt gevormd door de getalswaarde van de “unity-check”. Indien deze kleiner of gelijk aan 1,00 is, voldoet de constructie ten aanzien van het betreffende betrouwbaarheidsniveau.

De berekeningen zijn gerangschikt naar oplopend mastnummer en naar funderingstype.

5.1 Toetsing fundaties

Zie Tabel 5-1 voor de resultaten van de toetsing van de masten met enkelpaalsfunderingen. De palen van steunmast 44, 45, 48, 61 en 64 hebben onvoldoende capaciteit op trek, maar wel voldoende capaciteit op druk. Alle andere masten hebben voldoende capaciteit op trek en druk.

Tabel 5-1 Toetsing fundaties ENS-ZL380

Mast	Masttype	Poertype	Paaltype	U.C. Trek	U.C. Druk
1	EC-3_R	1-paals - 914	GI-paal 1075/914	0,53	0,27
2	S-3 R	1-paals - 559	BP 559x10	0,87	0,70
3	S-3 R	1-paals - 559	BP 559x10	0,77	0,27
4	S-3 R	1-paals - 559	BP 559x10	0,85	0,55
5	S-3 R	1-paals - 559	BP 559x10	0,89	0,35
5A	S+6_R	1-paals - 509 + omstort	SI-paal 400	0,65	0,35
6	HB-3_R_X	1-paals - 914	GI-paal 1075/914	0,45	0,19
7	S+0 R	1-paals - 559	BP 559x10	0,83	0,34
8	S+0 R	1-paals - 559	BP 559x10	0,82	0,29
9	S+0 R	1-paals - 559	BP 559x10	0,87	0,46
11	S+30_R	1-paals - 610	GI-paal 770/610	0,72	0,41
12	S+30_R	1-paals - 610 +900	GI-paal 770/610	0,99	0,53
13	S+0 R	1-paals - 559	BP 559x10	0,89	0,31
14-I	HA-3_R	1-paals - 914	GI-paal 1075/914	0,51	0,21
14-II	HA-3_R	1-paals - 914	GI-paal 1075/914	0,47	0,20
15	S-3 R	1-paals - 559	BP 559x10	0,85	0,30
16	S-3 R	1-paals - 559	BP 559x10	0,86	0,21
17	S-3 R	1-paals - 559	BP 559x10	0,81	0,22
18	S-3 R	1-paals - 559	BP 559x10	0,88	0,25
19	S-6 R	1-paals - 559	BP 559x10	0,81	0,22
20	S-6 R	1-paals - 559	BP 559x10	0,68	0,19
21	S-6 R	1-paals - 559	BP 559x10	0,69	0,22
22	S-6 R	1-paals - 559	BP 559x10	0,74	0,29
23	S-6 R	1-paals - 559	BP 559x10	0,65	0,20
24	S-6 R	1-paals - 559	BP 559x10	0,56	0,22
25	S-6 R	1-paals - 559	BP 559x10	0,65	0,19
27	S+12_R	1-paals - 610 +900	GI-paal 770/610	0,39	0,23
28	S-6 R	1-paals - 559	BP 559x10	0,92	0,32
29	S-6 R	1-paals - 559	BP 559x10	0,68	0,19
31	S-3 R	1-paals - 559	BP 559x10	0,71	0,19
32	S+0 R	1-paals - 559	BP 559x10	0,84	0,30
33	S+0 R	1-paals - 559	BP 559x10	0,95	0,32
34	HC-3_R	1-paals - 914	GI-paal 1075/914	0,61	0,17
35	HB+0_R_X	1-paals - 914	GI-paal 1075/914	0,60	0,14
36	S-3 R	1-paals - 559	BP 559x10	0,74	0,27
37	S-3 R	1-paals - 559	BP 559x10	0,72	0,21
38	S+0 R	1-paals - 559	BP 559x10	0,77	0,30
39	S-3 R	1-paals - 559	BP 559x10	0,71	0,32
41	S-6 R	1-paals - 559	BP 559x10	0,85	0,19
42	S-6 R	1-paals - 559	BP 559x10	0,96	0,34
43	S-6 R	1-paals - 559	BP 559x10	0,94	0,23
44	S-6 R	1-paals - 559	BP 559x10	1,08	0,22
45	S-6 R	1-paals - 559	BP 559x10	1,06	0,40

Mast	Masttype	Poertype	Paaltype	U.C. Trek	U.C. Druk
46	S-6 R	1-paals - 559	BP 559x10	0,61	0,22
47	S-6 R	1-paals - 559	BP 559x10	1,00	0,38
48	S-6 R	1-paals - 559	BP 559x10	1,07	0,25
49-I	HB-3_R	1-paals - 914	GI-paal 1075/914	0,92	0,24
49-II	HB-3_R	1-paals - 914	GI-paal 1075/914	0,67	0,15
50	S-6 R	1-paals - 559	BP 559x10	0,91	0,22
51	HB-3_R	1-paals - 914	GI-paal 1075/914	0,61	0,32
52	S-6 R	1-paals - 559	BP 559x10	0,81	0,23
53	S-6 R	1-paals - 559	BP 559x10	0,90	0,27
54	S-6 R	1-paals - 559	BP 559x10	0,98	0,28
55	S-3 R	1-paals - 559	BP 559x10	0,72	0,25
56	S-3 R	1-paals - 559	BP 559x10	0,87	0,23
57	S-3 R	1-paals - 559	BP 559x10	0,99	0,41
58	S-6 R	1-paals - 559	BP 559x10	0,83	0,27
59	S-6 R	1-paals - 559	BP 559x10	0,87	0,22
60	S-6 R	1-paals - 559 +1000	BP 559x10	0,96	0,23
61	S-6 R	1-paals - 559 +1000	BP 559x10	1,06	0,24
62	S-6 R	1-paals - 559 +1000	BP 559x10	0,98	0,23
63	S-6 R	1-paals - 559 +1000	BP 559x10	0,94	0,44
64	S-6 R	1-paals - 559 +1800	BP 559x10	1,02	0,25
65	HB+9_R_X	1-paals - 914 +1800	GI-paal 1075/914	0,60	0,19
66	S+12_R	1-paals - 610 +1800	GI-paal 770/610	0,59	0,27
67	S+0 R	1-paals - 559 +1800	BP 559x10	0,98	0,39
68	S-6 R	1-paals - 559	BP 559x10	0,96	0,42
69	S-6 R	1-paals - 559	BP 559x10	0,91	0,25
70	S-6 R	1-paals - 559	BP 559x10	0,76	0,19
71	S-6 R	1-paals - 559	BP 559x10	0,81	0,19
72	S-6 R	1-paals - 559	BP 559x10	0,60	0,18
75	S-6 RC	1-paals - 559	BP 559x10	0,59	0,29
76	S-6 RC	1-paals - 559	BP 559x10	0,69	0,23
77	S-6 RC	1-paals - 559	BP 559x10	0,77	0,23
78	S-6 RC	1-paals - 559	BP 559x10	0,76	0,24
79	S-6 RC	1-paals - 559	BP 559x10	0,76	0,24
80	S-6 RC	1-paals - 559	BP 559x10	0,82	0,23
81	S-6 RC	1-paals - 559	BP 559x10	0,87	0,29
83	S-6 RC	1-paals - 559	BP 559x10	0,78	0,29
84	S-3 RC	1-paals - 559	BP 559x10	0,79	0,30
85	S-6 RC	1-paals - 559	BP 559x10	0,90	0,26
86	S-6 RC	1-paals - 559	BP 559x10	0,87	0,30
87	S-6 RC	1-paals - 559	BP 559x10	0,89	0,30
89	S+15_R	1-paals - 711	GI-paal 871/711	0,39	0,18
90	EC-3_R	1-paals - 914	GI-paal 1075/914	0,52	0,14

5.1.1 Mast 12

De sondering die gebruikt is voor mast 12 is onvoldoende diep en de uitnutting op trek is ca. 1,0. Om deze redenen is het wenselijk om nieuwe sonderingen te maken. Echter is de bereikbaarheid van deze mastlocatie slecht en is ervoor gekozen geen nieuwe sonderingen te maken. Dit wordt beoordeeld als acceptabel, omdat:

- Het schachtdraagvermogen op druk is voldoende om de belasting te dragen (voor het puntdraagvermogen is voor het deel dat de sondering te ondiep was is een conuswaarde van 5MPa aangehouden);
- Sonderingen bij naastgelegen mast 13 geven geen aanleiding om te denken dat er onder of rond de paalpunt een slappe laag aanwezig is. Ook lijkt de bestaande sondering van mast over de grondlagen tot aan de paalpunt redelijk op de sondering van mast 13.

5.2 Horizontaal draagvermogen

Uit berekening blijkt dat alle palen de horizontale belasting af kunnen dragen naar de ondergrond. Voor berekening, zie Appendix G.

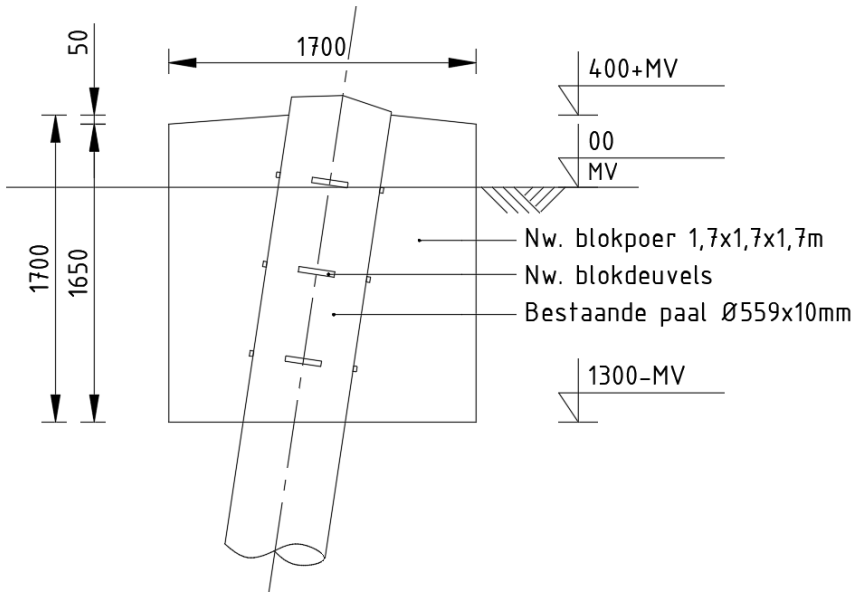
6 VERSTERKINGSVOORSTEL

In dit hoofdstuk wordt een versterkingsvoorstel gegeven, waarmee bereikt kan worden dat de funderingen voldoen aan de eisen.

6.1 Ballastverzwaring

De optredende overschrijding van het trekdraagvermogen is in alle gevallen beperkt. Het maximum wordt gevonden bij mast 44 en bedraagt 30 kN. Het is goed mogelijk om deze relatief kleine overschrijding te compenseren met extra gewicht aan de paal in de vorm van een betonpoer. De beschikbare restcapaciteit op het drukdraagvermogen laat deze ballastverzwaring ook toe. Bij het uitwerken van dit voorstel zal er uitgegaan worden van de belastingen op basis van het afkeurniveau van NEN 8700 /19/.

De aanhechting van de nieuwe poer aan de bestaande paal kan bestaan uit een aantal nieuw aan de paal gelaste blokdeuvels. De conservering van het gedeelte van de paal dat wordt opgenomen in de poer moet hiervoor worden verwijderd. Vanuit duurzaamheidsoogpunt wordt er geadviseerd het gedeelte van de paal op de overgang tussen staal en beton te metalliseren.



Figuur 6-1 Voorstel ballastverzwaring

6.2 Aanpak berekening

Bij het berekenen van het gewicht van de nieuwe poer worden de volgende aannamen gedaan:

- Inhoud van de nieuwe poer wordt verminderd met inhoud van de gedeelte paal dat in de poer wordt gestort (effectief blijft er ca. 85% van het poer gewicht over);
- Conservatief wordt aangehouden dat de nieuwe poer volledig onder water kan staan;
- Streven is om ca. 5% restcapaciteit over te houden van het trekdraagvermogen na aanbrengen van de poer.

7 TOETSING VERSTERKTE FUNDATIES

7.1 Toetsing palen

In deze paragraaf wordt de toetsing van de bestaande palen met nieuw aangebrachte poeren beschreven. De bestaande palen zijn zowel op trek als op druk gecontroleerd, waarbij de belasting is gehanteerd op basis van het afkeurniveau.

Uit berekening blijkt dat alle paalfunderingen na versterking voldoen.

Tabel 7-1 Toetsing versterkte fundaties ENS-ZL380

Mast	Masttype	Poertype nieuw	Paaltype versterking	U.C. nieuw	U.C. nieuw
44	S-6 R	1-paals - 559 + poer	BP 559x10	0,95	0,26
45	S-6 R	1-paals - 559 + poer	BP 559x10	0,93	0,48
48	S-6 R	1-paals - 559 + poer	BP 559x10	0,95	0,31
61	S-6 R	1-paals - 559 + 1000 + poer	BP 559x10	0,94	0,29
64	S-6 R	1-paals - 559 + 1800 + poer	BP 559x10	0,90	0,30

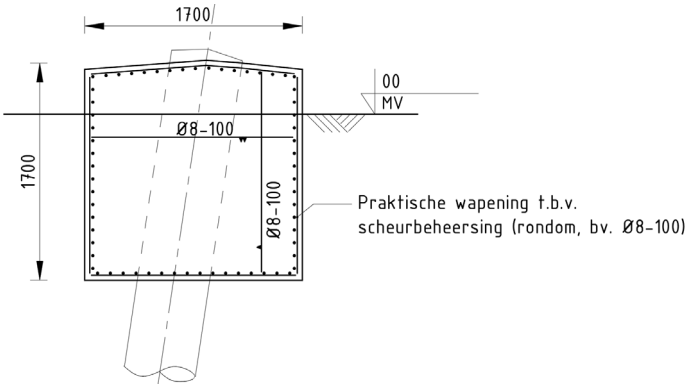
7.2 Controle horizontale krachtsafdracht

Wat betreft de horizontale afdracht is er geen wijziging aan het systeem. Er wordt geen rekening gehouden met de extra horizontale weerstand die de poer wellicht teweegbrengt. Voor controle, zie hoofdstuk 5.2 en Appendix G.

Uit berekening blijkt dat de paalkoppen maximaal 4,6 mm extra horizontaal vervormen na aanbrengen van de poeren. Dit wordt beoordeeld als een acceptabele vervorming. Bij toetsing van de vervormingen is deze extra vervorming ook meegenomen.

7.3 Wapening poeren

De poeren hebben geen dragende functie behalve voor hun eigen gewicht. Geadviseerd wordt om de poeren rondom te voorzien van een praktische wapening voor scheurbeheersing, bijvoorbeeld Ø8-100 rondom.



Figuur 7-1 Principe wapening

8 CONCLUSIES

Als onderdeel van het opwaarderingsproject van de 380kV hoogspanningsverbinding Ens – Zwolle zijn de bestaande funderingen getoetst aan het afkeurniveau voor bestaande bouw volgens NEN 8700 /19/. Daarbij zijn de palen gecontroleerd ten aanzien van de aanwezige capaciteit op trek-, druk- en horizontale belasting. Voor fundaties die niet voldoen is een versterking uitgewerkt. De toetsing van de fundaties is verdeeld over drie rapporten. In dit eerste deel worden de enkelpaalsfunderingen getoetst. In het tweede deel worden meerpaalsfundaties getoetst en in het derde deel de fundaties van de portalen.

De berekeningen zijn deels uitgevoerd op basis van sonderingen die beschikbaar zijn vanuit de bouwperiode van de verbinding en deels op nieuw uitgevoerde sonderingen. Op basis van NEN8707 zijn de sonderingen van uit de bouwperiode bruikbaar voor toetsing van de bestaande funderingen.

Voor toetsing van mast 5A, 12, 15 t/m 18, 20 t/m 22, 25, 31, 36 t/m 39, 41, 55, 66, 70, 75 t/m 78, 80 en 83 zijn bestaande sonderingen gebruikt. Voor alle overige masten wordt de draagkracht van de bestaande palen berekend op basis van nieuw uitgevoerde elektrische sonderingen. Bestaande sonderingen worden hierbij buiten beschouwing gelaten. Op twee mastlocaties (mast 69 en mast 71) was het uitvoeren van nieuwe sonderingen nog niet mogelijk, voor deze locaties worden vooralsnog bestaande sonderingen gebruikt.

Mast 12 betreft een uitzondering. Op basis van de berekeningen zou het voor deze locatie wenselijk zijn nieuwe sonderingen te maken. Echter is deze mast dermate slecht bereikbaar, dat er wordt afgezien van het uitvoeren van nieuwe sonderingen. Dit wordt beoordeeld als acceptabel, omdat het schachtdraagvermogen op druk voldoende is om de belasting te dragen en de sonderingen bij naastgelegen mast 13 geen aanleiding geven om te denken dat er onder of rond de paalpunt een slappe grondlaag aanwezig is.

8.1 Toetsing bestaande fundering afkeurniveau

De palen van steunmast 44, 45, 48, 61 en 64 hebben onvoldoende capaciteit op trek, maar wel voldoende capaciteit op druk. Alle andere masten hebben voldoende capaciteit op trek en druk.

8.2 Versterkingen

Voor de fundaties die niet voldoen is een versterkingsvoorstel uitgewerkt. In al deze gevallen betreft de versterking een ballastverzwaring in de vorm van een betonnen poer van 1,7 m x 1,7 m x 1,7 m. De bestaande palen zullen worden opgenomen in deze poeren. Voor aanhechting dienen blokdeuvels op de bestaande palen gelast te worden.

Verder dienen er aardingsvoorzieningen te worden aangebracht in de nieuwe poeren (buiten scope van dit rapport).

9 REFERENTIES

/1/ 002.515.40 0825820 - 20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle

/2/ 002.515.40 0825812 - 20-1465 - ENS-ZL380 – E-studie Deel 1

/3/ 002.515.40 0825824 - 21-0462 - Verificatie & validatieplan 380kV verbinding Ens - Zwolle

/4/ 002.515.40 0825868 - 20-1505 - ENS-ZL380 – Tower S-6 Report

/5/ 002.515.40 0825870 - 20-1574 - ENS-ZL380 – Tower S-6 RC Report

/6/ 002.515.40 0825864 - 20-1537 - ENS-ZL380 – Tower S-3 Report

/7/ 002.515.40 0825866 - 20-1815 - ENS-ZL380 – Tower S-3 RC Report

/8/ 002.515.40 0825853 - 20-1595 - ENS-ZL380 – Tower S+0/R Report

/9/ 002.515.40 0825862 - 20-1785 - ENS-ZL380 – Tower S+6 R Report

/10/ 002.515.40 0825855 - 20-1642 - ENS-ZL380 – Tower S+12 R Report

/11/ 002.515.40 0825858 - 20-1725 - ENS-ZL380 – Tower S+15 R Report

/12/ 002.515.40 0825860 - 20-1688 - ENS-ZL380 – Tower S+30 R Report

/13/ 002.515.40 0825834 - 21-0055 - ENS-ZL380 – Tower HA-3/R Report

/14/ 002.515.40 0825842 - 21-0050 - ENS-ZL380 – Tower HB-3/R Report

/15/ 002.515.40 0825838 - 21-0135 - ENS-ZL380 – Tower HB+0/R Report

/16/ 002.515.40 0825840 - 21-0180 - ENS-ZL380 – Tower HB+9/R Report

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/18/ 002.515.40 0825832 - 21-0093 - ENS-ZL380 – Tower EC-3/R Report

/19/ NEN 8700:2011 - Belastingen voor bestaande bouw

/20/ NEN 1997-1: Eurocode 7: Geotechnisch ontwerp - Deel 1: Algemene regels

/21/ NEN 8707:2019 - Geotechnisch ontwerp - Beoordeling van de constructieve veiligheid van een bestaand bouwwerk

APPENDIX A
Asset-gegevens

Hiervoor wordt verwezen naar het uitgangspuntendocument “20-1245 - Uitgangspuntenrapport 380kV verbinding Ens - Zwolle” /1/.

APPENDIX B
Gegevens funderingen

Paalgegevens, bestaand

Mastnr.	Masttype	Aantal palen	Paaltype	Paallengte [m]	Paal boven (oud) maaiveld [m]	Paalpuntniveau t.o.v. (oud) MV [m] (1)	Huidig maaiveld t.o.v. NAP [m]	Bovenkant fundatie t.o.v. NAP [m]	Paal tov. bk. fundatie [m]	Paalpuntniveau t.o.v. NAP [m]
1	EC-3_R	1	GI-paal 1075/914	19,50	0,50	-18,89	-1,13	-0,52	0,00	-20,02
2	S-3 R	1	BP 559x10	16,40	0,50	-15,84	-1,26	-0,71	0,00	-17,11
3	S-3 R	1	BP 559x10	17,00	0,50	-16,39	-1,19	-0,59	0,00	-17,59
4	S-3 R	1	BP 559x10	17,65	0,50	-17,08	-1,04	-0,47	0,00	-18,12
5	S-3 R	1	BP 559x10	18,50	0,50	-18,11	-0,82	-0,43	0,00	-18,93
5A	S+6_R	1	SI-paal 400	21,50	-2,00	-23,50	-0,83	-0,15	2,70	-24,35
6	HB-3_R_X	1	GI-paal 1075/914	20,35	0,50	-20,10	-0,73	-0,48	0,00	-20,83
7	S+0 R	1	BP 559x10	15,90	0,50	-15,46	-0,67	-0,23	0,00	-16,13
8	S+0 R	1	BP 559x10	18,00	0,50	-17,47	-0,71	-0,18	0,00	-18,18
9	S+0 R	1	BP 559x10	16,50	0,50	-16,11	-0,54	-0,15	0,00	-16,65
11	S+30_R	1	GI-paal 770/610	20,35	0,50	-20,00	2,87	3,22	0,00	-17,13
12	S+30_R	1	GI-paal 770/610	19,70	0,90	-19,61	1,45	1,55	0,00	-18,15
13	S+0 R	1	BP 559x10	14,95	0,50	-14,36	0,01	0,60	0,00	-14,35
14-I	HA-3_R	1	GI-paal 1075/914	18,95	0,50	-18,42	-0,32	0,22	0,00	-18,73
14-II	HA-3_R	1	GI-paal 1075/914	20,20	0,50	-19,67	-0,32	0,22	0,00	-19,98
15	S-3 R	1	BP 559x10	15,55	0,50	-14,91	0,24	0,89	0,00	-14,66
16	S-3 R	1	BP 559x10	16,90	0,50	-16,24	-0,23	0,44	0,00	-16,46
17	S-3 R	1	BP 559x10	18,40	0,50	-17,88	-0,21	0,31	0,00	-18,09
18	S-3 R	1	BP 559x10	17,20	0,50	-16,73	0,53	1,00	0,00	-16,20
19	S-6 R	1	BP 559x10	14,75	0,50	-14,16	0,33	0,92	0,00	-13,83
20	S-6 R	1	BP 559x10	16,50	0,50	-16,01	0,04	0,53	0,00	-15,97
21	S-6 R	1	BP 559x10	14,70	0,50	-14,14	0,04	0,60	0,00	-14,10
22	S-6 R	1	BP 559x10	16,25	0,50	-15,71	-0,09	0,44	0,00	-15,81
23	S-6 R	1	BP 559x10	15,65	0,50	-15,06	0,18	0,78	0,00	-14,87
24	S-6 R	1	BP 559x10	17,95	0,50	-17,31	-0,06	0,58	0,00	-17,37
25	S-6 R	1	BP 559x10	16,15	0,50	-15,58	-0,11	0,47	0,00	-15,68
27	S+12_R	1	GI-paal 770/610	20,20	0,90	-19,13	0,15	1,22	0,00	-18,98
28	S-6 R	1	BP 559x10	16,35	0,50	-15,54	-1,51	-0,70	0,00	-17,05
29	S-6 R	1	BP 559x10	17,45	0,50	-16,66	-1,82	-1,04	0,00	-18,49
31	S-3 R	1	BP 559x10	15,70	0,50	-15,08	-2,89	-2,27	0,00	-17,97
32	S+0 R	1	BP 559x10	15,85	0,50	-15,21	-2,79	-2,16	0,00	-18,01
33	S+0 R	1	BP 559x10	16,15	0,50	-15,52	-2,68	-2,05	0,00	-18,20
34	HC-3_R	1	GI-paal 1075/914	20,00	0,50	-19,15	-2,47	-1,62	0,00	-21,62
35	HB+0_R_X	1	GI-paal 1075/914	19,10	0,50	-18,27	-1,81	-0,98	0,00	-20,08
36	S-3 R	1	BP 559x10	15,10	0,50	-14,01	-2,08	-0,98	0,00	-16,08
37	S-3 R	1	BP 559x10	16,10	0,50	-14,84	-2,21	-0,95	0,00	-17,05
38	S+0 R	1	BP 559x10	16,60	0,50	-15,73	-1,37	-0,51	0,00	-17,11

Paalgegevens, bestaand

Mastnr.	Masttype	Aantal palen	Paaltype	Paallengte [m]	Paal boven (oud) maaiveld [m]	Paalpuntniveau t.o.v. (oud) MV [m] (1)	Huidig maaiveld t.o.v. NAP [m]	Bovenkant fundatie t.o.v. NAP [m]	Paal tov. bk. fundatie [m]	Paalpuntniveau t.o.v. NAP [m]
39	S-3 R	1	BP 559x10	15,65	0,50	-14,65	-1,59	-0,60	0,00	-16,25
41	S-6 R	1	BP 559x10	13,60	0,50	-12,72	-1,37	-0,49	0,00	-14,09
42	S-6 R	1	BP 559x10	12,90	0,50	-12,15	-1,07	-0,32	0,00	-13,22
43	S-6 R	1	BP 559x10	12,95	0,50	-12,31	-0,97	-0,33	0,00	-13,28
44	S-6 R	1	BP 559x10	13,50	0,50	-12,77	-0,84	-0,11	0,00	-13,61
45	S-6 R	1	BP 559x10	12,50	0,50	-11,65	-0,89	-0,04	0,00	-12,54
46	S-6 R	1	BP 559x10	16,45	0,50	-15,55	-0,94	-0,04	0,00	-16,49
47	S-6 R	1	BP 559x10	13,50	0,50	-12,69	-0,81	0,01	0,00	-13,49
48	S-6 R	1	BP 559x10	12,75	0,50	-12,04	-0,69	0,02	0,00	-12,73
49-I	HB-3_R	1	GI-paal 1075/914	15,50	0,50	-14,86	-0,62	0,02	0,00	-15,48
49-II	HB-3_R	1	GI-paal 1075/914	18,00	0,50	-17,36	-0,62	0,02	0,00	-17,98
50	S-6 R	1	BP 559x10	14,50	0,50	-13,99	-0,48	0,03	0,00	-14,47
51	HB-3_R	1	GI-paal 1075/914	21,15	0,50	-20,54	-0,64	-0,03	0,00	-21,18
52	S-6 R	1	BP 559x10	14,45	0,50	-13,77	-0,66	0,02	0,00	-14,43
53	S-6 R	1	BP 559x10	12,65	0,50	-11,97	-0,69	-0,01	0,00	-12,66
54	S-6 R	1	BP 559x10	12,65	0,50	-11,98	-0,65	0,02	0,00	-12,63
55	S-3 R	1	BP 559x10	14,65	0,50	-14,01	-0,57	0,07	0,00	-14,58
56	S-3 R	1	BP 559x10	14,05	0,50	-13,36	-0,63	0,06	0,00	-13,99
57	S-3 R	1	BP 559x10	13,55	0,50	-12,77	-0,68	0,10	0,00	-13,45
58	S-6 R	1	BP 559x10	13,65	0,50	-12,98	-0,59	0,08	0,00	-13,57
59	S-6 R	1	BP 559x10	12,70	0,50	-12,22	-0,38	0,10	0,00	-12,60
60	S-6 R	1	BP 559x10	12,40	1,00	-11,33	-0,36	0,71	0,00	-11,69
61	S-6 R	1	BP 559x10	13,35	1,00	-12,31	-0,30	0,74	0,00	-12,61
62	S-6 R	1	BP 559x10	13,00	1,00	-11,99	-0,05	0,96	0,00	-12,04
63	S-6 R	1	BP 559x10	12,35	1,00	-11,26	-0,31	0,78	0,00	-11,57
64	S-6 R	1	BP 559x10	14,45	1,80	-12,67	-0,10	1,67	0,00	-12,78
65	HB+9_R_X	1	GI-paal 1075/914	21,50	1,80	-19,58	0,71	2,63	0,00	-18,87
66	S+12_R	1	GI-paal 770/610	16,20	1,80	-14,44	-0,12	1,64	0,00	-14,56
67	S+0 R	1	BP 559x10	15,70	1,80	-13,92	-0,06	1,72	0,00	-13,98
68	S-6 R	1	BP 559x10	14,80	0,50	-14,40	0,88	1,28	0,00	-13,52
69	S-6 R	1	BP 559x10	15,30	0,50	-14,75	-0,05	0,50	0,00	-14,80
70	S-6 R	1	BP 559x10	15,55	0,50	-14,98	-0,14	0,43	0,00	-15,12
71	S-6 R	1	BP 559x10	15,10	0,50	-14,44	-0,34	0,32	0,00	-14,78
72	S-6 R	1	BP 559x10	17,05	0,50	-16,55	-0,17	0,33	0,00	-16,72
75	S-6 RC	1	BP 559x10	17,25	0,50	-16,74	-0,23	0,28	0,00	-16,97
76	S-6 RC	1	BP 559x10	16,00	0,50	-15,48	-0,24	0,28	0,00	-15,72
77	S-6 RC	1	BP 559x10	16,00	0,50	-15,49	-0,08	0,43	0,00	-15,57
78	S-6 RC	1	BP 559x10	15,20	0,50	-14,76	-0,14	0,30	0,00	-14,90
79	S-6 RC	1	BP 559x10	15,80	0,50	-15,40	-0,11	0,29	0,00	-15,51
80	S-6 RC	1	BP 559x10	15,30	0,50	-14,82	-0,13	0,35	0,00	-14,95
81	S-6 RC	1	BP 559x10	14,85	0,50	-14,46	-0,02	0,37	0,00	-14,48

Paalgegevens, bestaand

Mastnr.	Masttype	Aantal palen	Paaltype	Paallengte [m]	Paal boven (oud) maaiveld [m]	Paalpuntniveau t.o.v. (oud) MV [m] (1)	Huidig maaiveld t.o.v. NAP [m]	Bovenkant fundatie t.o.v. NAP [m]	Paal tov. bk. fundatie [m]	Paalpuntniveau t.o.v. NAP [m]
83	S-6 RC	1	BP 559x10	15,00	0,50	-14,61	0,15	0,54	0,00	-14,46
84	S-3 RC	1	BP 559x10	17,45	0,50	-17,36	0,56	0,65	0,00	-16,80
85	S-6 RC	1	BP 559x10	12,85	0,50	-12,48	0,57	0,94	0,00	-11,91
86	S-6 RC	1	BP 559x10	12,60	0,50	-12,61	0,73	0,72	0,00	-11,88
87	S-6 RC	1	BP 559x10	13,50	0,50	-13,47	0,64	0,66	0,00	-12,84
89	S+15_R	1	GI-paal 871/711	15,05	0,50	-14,67	0,44	0,82	0,00	-14,23

Alleen mast 5A heeft een omstorting onder maaiveld, welke als bestaande poer is meegenomen in de berekeningen.

Poergegevens, bestaand

Mastnr.	Masttype	Poertype	L [m]	b [m]2	h [m]	Bovenkant poer tov. NAP [m]	Bovenkant poer tov MV [m] (1)	Onderkant poer tov. MV [m]	Volume. onder GWS [m]	Volume poer [m^3]	EG_{poer} [kN]
5A	S+6_R	1-paals - 509 + omstort	1,00	1,00	1,20	-0,15	-0,80	-2,00	1,50	1,50	36

Mast 44, 45, 48, 61 en 64 worden voorzien van een nieuwe poer. De paalgegevens blijven ongewijzigd.

Poergegevens, nieuw

Mastnr.	Masttype	Poertype	L [m]	b [m]2	h [m]	Bovenkant poer tov. NAP [m]	Bovenkant poer tov MV	Onderkant poer tov. MV	Volume poer [m^3]	EG_{poer} [kN]
44	S-6 R	1-paals - 559 + poer	1,70	1,70	1,70	-0,11	0,40	-1,30	4,18	100
45	S-6 R	1-paals - 559 + poer	1,70	1,70	1,70	-0,04	0,40	-1,30	4,18	100
48	S-6 R	1-paals - 559 + poer	1,70	1,70	1,70	0,02	0,40	-1,30	4,18	100
61	S-6 R	1-paals - 559 + 1000 + poer	1,70	1,70	1,70	0,74	0,40	-1,30	4,18	100
64	S-6 R	1-paals - 559 + 1800 + poer	1,70	1,70	1,70	1,67	0,40	-1,30	4,18	100

APPENDIX C
Toetsing bestaande constructie

Toetsing funderingen op trekbelasting, initiële situatie

Mast	Masttype	Poertype	Paaltype	$F_{Ed,mast}$ [kN]	Aantal palen per randstijl	Effectiviteit palen	$F_{poer,d}$ [kN]	$F_{Ed,paal}$ [kN]	$F_{R,d,trek}$ [kN]	U.C.
1	EC-3_R	1-paals - 914	GI-paal 1075/914	-1173	1	100%	0	1173	2200	0,53
2	S-3 R	1-paals - 559	BP 559x10	-470	1	100%	0	470	538	0,87
3	S-3 R	1-paals - 559	BP 559x10	-470	1	100%	0	470	609	0,77
4	S-3 R	1-paals - 559	BP 559x10	-470	1	100%	0	470	556	0,85
5	S-3 R	1-paals - 559	BP 559x10	-470	1	100%	0	470	531	0,89
5A	S+6_R	1-paals - 509 + omstort	SI-paal 400	-611	1	100%	17	594	918	0,65
6	HB-3_R_X	1-paals - 914	GI-paal 1075/914	-1337	1	100%	0	1337	2967	0,45
7	S+0 R	1-paals - 559	BP 559x10	-538	1	100%	0	538	645	0,83
8	S+0 R	1-paals - 559	BP 559x10	-538	1	100%	0	538	654	0,82
9	S+0 R	1-paals - 559	BP 559x10	-538	1	100%	0	538	619	0,87
11	S+30_R	1-paals - 610	GI-paal 770/610	-1049	1	100%	0	1049	1459	0,72
12	S+30_R	1-paals - 610 +900	GI-paal 770/610	-1049	1	100%	0	1049	1064	0,99
13	S+0 R	1-paals - 559	BP 559x10	-515	1	100%	0	515	576	0,89
14-I	HA-3_R	1-paals - 914	GI-paal 1075/914	-1183	1	100%	0	1183	2317	0,51
14-II	HA-3_R	1-paals - 914	GI-paal 1075/914	-1183	1	100%	0	1183	2511	0,47
15	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	526	0,85
16	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	523	0,86
17	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	555	0,81
18	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	510	0,88
19	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	522	0,81
20	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	623	0,68
21	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	616	0,69
22	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	578	0,74
23	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	651	0,65
24	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	755	0,56
25	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	651	0,65
27	S+12_R	1-paals - 610 +900	GI-paal 770/610	-643	1	100%	0	643	1661	0,39
28	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	461	0,92
29	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	626	0,68
31	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	636	0,71
32	S+0 R	1-paals - 559	BP 559x10	-515	1	100%	0	515	610	0,84
33	S+0 R	1-paals - 559	BP 559x10	-515	1	100%	0	515	543	0,95
34	HC-3_R	1-paals - 914	GI-paal 1075/914	-1487	1	100%	0	1487	2425	0,61
35	HB+0_R_X	1-paals - 914	GI-paal 1075/914	-1433	1	100%	0	1433	2377	0,60
36	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	603	0,74
37	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	624	0,72
38	S+0 R	1-paals - 559	BP 559x10	-515	1	100%	0	515	669	0,77
39	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	632	0,71
41	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	500	0,85
42	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	441	0,96
43	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	450	0,94
44	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	395	1,08
45	S-6 R	1-paals - 559	BP 559x10	-418	1	100%	0	418	396	1,06
46	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	698	0,61
47	S-6 R	1-paals - 559	BP 559x10	-418	1	100%	0	418	418	1,00
48	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	398	1,07
49-I	HB-3_R	1-paals - 914	GI-paal 1075/914	-1394	1	100%	0	1394	1514	0,92
49-II	HB-3_R	1-paals - 914	GI-paal 1075/914	-1394	1	100%	0	1394	2074	0,67
50	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	466	0,91
51	HB-3_R	1-paals - 914	GI-paal 1075/914	-1394	1	100%	0	1394	2301	0,61
52	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	524	0,81
53	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	471	0,90
54	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	435	0,98
55	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	621	0,72
56	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	514	0,87
57	S-3 R	1-paals - 559	BP 559x10	-449	1	100%	0	449	455	0,99
58	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	514	0,83
59	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	487	0,87
60	S-6 R	1-paals - 559 +1000	BP 559x10	-425	1	100%	0	425	443	0,96
61	S-6 R	1-paals - 559 +1000	BP 559x10	-418	1	100%	0	418	395	1,06
62	S-6 R	1-paals - 559 +1000	BP 559x10	-425	1	100%	0	425	432	0,98
63	S-6 R	1-paals - 559 +1000	BP 559x10	-425	1	100%	0	425	451	0,94

Toetsing funderingen op trekbelasting, initiële situatie

Mast	Masttype	Poertype	Paaltype	$F_{Ed,mast}$ [kN]	Aantal palen per randstijl	Effectiviteit palen	$F_{poer,d}$ [kN]	$F_{Ed,paal}$ [kN]	$F_{R,d,trek}$ [kN]	U.C.
64	S-6 R	1-paals - 559 +1800	BP 559x10	-418	1	100%	0	418	410	1,02
65	HB+9_R_X	1-paals - 914 +1800	GI-paal 1075/914	-1488	1	100%	0	1488	2478	0,60
66	S+12_R	1-paals - 610 +1800	GI-paal 770/610	-643	1	100%	0	643	1089	0,59
67	S+0 R	1-paals - 559 +1800	BP 559x10	-515	1	100%	0	515	525	0,98
68	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	444	0,96
69	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	469	0,91
70	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	556	0,76
71	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	524	0,81
72	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	0	425	712	0,60
75	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	884	0,59
76	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	758	0,69
77	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	676	0,77
78	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	680	0,76
79	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	684	0,76
80	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	634	0,82
81	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	600	0,87
83	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	667	0,78
84	S-3 RC	1-paals - 559	BP 559x10	-628	1	100%	0	628	790	0,79
85	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	577	0,90
86	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	594	0,87
87	S-6 RC	1-paals - 559	BP 559x10	-519	1	100%	0	519	585	0,89
89	S+15_R	1-paals - 711	GI-paal 871/711	-625	1	100%	0	625	1609	0,39
90	EC-3_R	1-paals - 914	GI-paal 1075/914	-1470	1	1	0	1470	2814	0,52

Toetsing funderingen op drukbelasting, initiële situatie

Mast	Masttype	Poertype	Paaltype	$F_{Ed,mast}$ [kN]	Aantal palen per randstijl	Effectiviteit palen	$F_{poer,d}$ [kN]	$F_{Ed,paal}$ [kN]	$F_{R,d,druk}$ [kN]	U.C.
1	EC-3_R	1-paals - 914	GI-paal 1075/914	1457	1	100%	0	1457	5326	0,27
2	S-3 R	1-paals - 559	BP 559x10	638	1	100%	0	638	917	0,70
3	S-3 R	1-paals - 559	BP 559x10	638	1	100%	0	638	2353	0,27
4	S-3 R	1-paals - 559	BP 559x10	638	1	100%	0	638	1170	0,55
5	S-3 R	1-paals - 559	BP 559x10	638	1	100%	0	638	1810	0,35
5A	S+6_R	1-paals - 509 + omstort	SI-paal 400	822	1	100%	43	865	2473	0,35
6	HB-3_R_X	1-paals - 914	GI-paal 1075/914	1604	1	100%	0	1604	8533	0,19
7	S+0 R	1-paals - 559	BP 559x10	729	1	100%	0	729	2165	0,34
8	S+0 R	1-paals - 559	BP 559x10	729	1	100%	0	729	2502	0,29
9	S+0 R	1-paals - 559	BP 559x10	729	1	100%	0	729	1600	0,46
11	S+30_R	1-paals - 610	GI-paal 770/610	1436	1	100%	0	1436	3496	0,41
12	S+30_R	1-paals - 610 +900	GI-paal 770/610	1436	1	100%	0	1436	2722	0,53
13	S+0 R	1-paals - 559	BP 559x10	709	1	100%	0	709	2264	0,31
14-I	HA-3_R	1-paals - 914	GI-paal 1075/914	1441	1	100%	0	1441	6817	0,21
14-II	HA-3_R	1-paals - 914	GI-paal 1075/914	1441	1	100%	0	1441	7259	0,20
15	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	2124	0,30
16	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	3025	0,21
17	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	2880	0,22
18	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	2503	0,25
19	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2619	0,22
20	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	3144	0,19
21	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2610	0,22
22	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2045	0,29
23	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2906	0,20
24	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2631	0,22
25	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	3099	0,19
27	S+12_R	1-paals - 610 +900	GI-paal 770/610	871	1	100%	0	871	3812	0,23
28	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	1820	0,32
29	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	3075	0,19
31	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	3368	0,19
32	S+0 R	1-paals - 559	BP 559x10	709	1	100%	0	709	2398	0,30
33	S+0 R	1-paals - 559	BP 559x10	709	1	100%	0	709	2211	0,32
34	HC-3_R	1-paals - 914	GI-paal 1075/914	1764	1	100%	0	1764	10316	0,17
35	HB+0_R_X	1-paals - 914	GI-paal 1075/914	1743	1	100%	0	1743	12087	0,14
36	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	2323	0,27
37	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	2957	0,21
38	S+0 R	1-paals - 559	BP 559x10	709	1	100%	0	709	2375	0,30
39	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	1937	0,32
41	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2998	0,19
42	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	1727	0,34
43	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2577	0,23
44	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2699	0,22
45	S-6 R	1-paals - 559	BP 559x10	575	1	100%	0	575	1454	0,40
46	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2650	0,22
47	S-6 R	1-paals - 559	BP 559x10	575	1	100%	0	575	1494	0,38
48	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2296	0,25
49-I	HB-3_R	1-paals - 914	GI-paal 1075/914	1660	1	100%	0	1660	7042	0,24
49-II	HB-3_R	1-paals - 914	GI-paal 1075/914	1660	1	100%	0	1660	10729	0,15
50	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2609	0,22
51	HB-3_R	1-paals - 914	GI-paal 1075/914	1660	1	100%	0	1660	5235	0,32
52	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2558	0,23
53	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2128	0,27
54	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2104	0,28
55	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	2552	0,25
56	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	2737	0,23
57	S-3 R	1-paals - 559	BP 559x10	628	1	100%	0	628	1526	0,41
58	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2168	0,27
59	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2657	0,22
60	S-6 R	1-paals - 559 +1000	BP 559x10	584	1	100%	0	584	2596	0,23
61	S-6 R	1-paals - 559 +1000	BP 559x10	575	1	100%	0	575	2377	0,24
62	S-6 R	1-paals - 559 +1000	BP 559x10	584	1	100%	0	584	2524	0,23
63	S-6 R	1-paals - 559 +1000	BP 559x10	584	1	100%	0	584	1342	0,44
64	S-6 R	1-paals - 559 +1800	BP 559x10	575	1	100%	0	575	2341	0,25
65	HB+9_R_X	1-paals - 914 +1800	GI-paal 1075/914	1827	1	100%	0	1827	9860	0,19
66	S+12_R	1-paals - 610 +1800	GI-paal 770/610	871	1	100%	0	871	3263	0,27
67	S+0 R	1-paals - 559 +1800	BP 559x10	709	1	100%	0	709	1833	0,39
68	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	1404	0,42

Toetsing funderingen op drukbelasting, initiële situatie

Mast	Masttype	Poertype	Paaltype	$F_{Ed,mast}$ [kN]	Aantal palen per randstijl	Effectiviteit palen	$F_{poer,d}$ [kN]	$F_{Ed,paal}$ [kN]	$F_{R,d,druk}$ [kN]	U.C.
69	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	2366	0,25
70	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	3106	0,19
71	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	3069	0,19
72	S-6 R	1-paals - 559	BP 559x10	584	1	100%	0	584	3317	0,18
75	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	2438	0,29
76	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	3108	0,23
77	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	3085	0,23
78	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	2954	0,24
79	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	3032	0,24
80	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	3104	0,23
81	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	2473	0,29
83	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	2496	0,29
84	S-3 RC	1-paals - 559	BP 559x10	875	1	100%	0	875	2927	0,30
85	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	2720	0,26
86	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	2407	0,30
87	S-6 RC	1-paals - 559	BP 559x10	716	1	100%	0	716	2420	0,30
89	S+15_R	1-paals - 711	GI-paal 871/711	925	1	100%	0	925	5245	0,18
90	EC-3_R	1-paals - 914	GI-paal 1075/914	1617	1	1	0	1617	11319	0,14

APPENDIX D

Toetsing versterkte constructie

Toetsing funderingen op trekbelasting, verbouwniveau 50 jaar

Mast	Masttype	Poertype bestaand	Paaltype	$F_{Ed,mast}$ [kN]	Aantal palen per randstijl	Effectiviteit palen	$F_{R,d,trek}$ [kN]	Poertype nieuw	Tekort [kN]	Aantal nieuwe palen	Effectiviteit nw.palen	$F_{poer,nw,d}$ [kN]	$F_{rd,benodigd}$ [kN]	Maximale $F_{r,d}$ [kN]	$F_{r,d,nieuw}$ [kN]	U.C. nieuw
44	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	395	1-paals - 559 + poer	-18	1	100%	48	-377	0	395	0,95
45	S-6 R	1-paals - 559	BP 559x10	-418	1	100%	396	1-paals - 559 + poer	-26	1	100%	48	-370	0	396	0,93
48	S-6 R	1-paals - 559	BP 559x10	-425	1	100%	398	1-paals - 559 + poer	-21	1	100%	48	-377	0	398	0,95
61	S-6 R	1-paals - 559 +1000	BP 559x10	-418	1	100%	395	1-paals - 559 + 1000 + poer	-25	1	100%	48	-370	0	395	0,94
64	S-6 R	1-paals - 559 +1800	BP 559x10	-418	1	100%	410	1-paals - 559 + 1800 + poer	-40	1	100%	48	-370	0	410	0,90

Toetsing funderingen op drukbelasting, verbouwniveau 50 jaar

Mast	Masttype	Poertype bestaand	Paaltype	$F_{Ed,mast}$ [kN]	Aantal palen per randstijl	Effectieviteit	$F_{R,d,druk}$ [kN]	Poertype versterking	$F_{poer,nw,d}$ [kN]	Aantal nw. palen	Tekort (kN)	Effectiviteit nw. palen	$F_{rd,benodigd}$ [kN]	Minimale $F_{r,d}$ [kN]	$F_{r,d,nieuw}$ [kN]	U.C. nieuw
44	S-6 R	1-paals - 559	BP 559x10	584	1	100%	2699	1-paals - 559 + poer	120	1	0	100%	705	0	2699	0,26
45	S-6 R	1-paals - 559	BP 559x10	575	1	100%	1454	1-paals - 559 + poer	120	1	0	100%	695	0	1454	0,48
48	S-6 R	1-paals - 559	BP 559x10	584	1	100%	2296	1-paals - 559 + poer	120	1	0	100%	705	0	2296	0,31
61	S-6 R	1-paals - 559 +1000	BP 559x10	575	1	100%	2377	1-paals - 559 + 1000 + poer	120	1	0	100%	695	0	2377	0,29
64	S-6 R	1-paals - 559 +1800	BP 559x10	575	1	100%	2341	1-paals - 559 + 1800 + poer	120	1	0	100%	695	0	2341	0,30

APPENDIX E
Technosoft uitvoer paalfunderingen

Ondergebracht in separate bijlagen:

- Beoordeling hoogtemetingen;
- Uitvoer TS paalfunderingen deel 1 – afkeur trekpalen – nieuwe sonderingen;
- Uitvoer TS paalfunderingen deel 2 – afkeur trekpalen – oude sonderingen;
- Uitvoer TS paalfunderingen deel 3 – afkeur drukpalen – nieuwe sonderingen;
- Uitvoer TS paalfunderingen deel 4 – afkeur drukpalen – oude sonderingen.

Beoordeling hoogtemetingen

Voor de beoordeling van de fundaties van de masten in de hoogspanningsverbinding ENS-ZL380 zijn hoogtemetingen uitgevoerd. Bij deze metingen zijn alle masten ingemeten. Deze hoogtemetingen (i.c.m. de beschikbare archiefgegevens) worden gebruikt om een zo betrouwbaar mogelijk paalpuntniveau te bepalen, waarmee uiteindelijk het paaldraagvermogen wordt berekend.

De hoogtemetingen zijn gedaan met GPS op basis van rijkscoördinaten en de volgende onderdelen zijn ingemeten:

- Vier hoekpunten van bovenzijde van de bestaande poeren, inclusief N.A.P. meting van de hoekpunten;
- Bestaande maaiveldhoogten rondom de poeren.

De hoogtemetingen zijn aangeleverd in DWG-formaat in een bestand genaamd “1258201001 versie 28 juni 2021”. Uit analyse van de hoogtemetingen bleken een aantal ontbrekende metingen en ook een paar afwijkende/opvallende metingen. De belangrijkste punten zijn:

- Uit de data blijkt dat bij verschillende masten het hoogteverschil tussen de verschillende meetpunten op één poer behoorlijk groot (maximaal gevonden waarde was 0,48m) kunnen zijn;
- Bij verschillende masten wordt er een onderling hoogteverschil tussen de poeren gevonden die groter is dan 0,2m (maximaal gevonden waarde was 0,64m).

Na overleg met uitvoerende partij bleken de volgende mogelijke factoren voor afwijkende waarden:

- Standaardafwijking GPS-meting is +/- 2cm;
- De masten storen op het GPS-signaal, waardoor er verschillen en afwijkingen kunnen ontstaan;
- Er wordt gemeten met een meetstok die handmatig waterpas gehouden moet worden.

Uiteindelijk zijn de metingen beoordeeld op betrouwbaarheid en zijn de betreffende metingen die niet betrouwbaar leken uitgesloten. Eventueel ontbrekende metingen zijn ook verwaarloosd. Als laatste is er nog een vergelijking gemaakt met de LIDAR-data, waardoor er uiteindelijk een voldoende betrouwbare hoogtebepaling heeft kunnen plaatsvinden.

Op de volgende pagina worden de uitgesloten metingen nog nader omschreven.

1 - Opvallendheden - algemeen	Actie na terugkoppeling 18-8

1.1 Mast 12

Twee van de vier poeren ingemeten

1.2 Mast 13

Eén van de poeren staat op een afwijkende plek, wat kan hier de oorzaak van zijn? En is deze hoogtemeting betrouwbaar?

Metingen van afwijkende poer verwaarloosd

1.3 Mast 34

Drie van de vier poeren ingemeten

1.4 Mast 72

Drie van de vier poeren ingemeten

1.5 Verschillende masten

Uit de data blijkt dat bij verschillende masten het hoogteverschil tussen de verschillende meetpunten op één poer behoorlijk groot kunnen zijn. Mast 36 en mast 65 springen het meest in het oog met een maximaal hoogteverschil van 0,48m. Onderstaand zijn de meetgevens van de betreffende poer bij mast 36 weergegeven. Op basis van de vier metingen is niet te zeggen dat er één meting heel erg afwijkt en de andere drie dicht bij elkaar liggen. Is er een verklaring te geven voor deze grote verschillen? En wordt er met het gemiddelde van deze punten wel de juiste poerhoogte gevonden?

3-1	3-2	3-3	3-4	3-min	3-max	3-gem	3-delta
-0,72	-1,04	-0,98	-0,56	-1,04	-0,56	-0,82	0,48

De positionering va[illegible]
goed, echter is de tussenafstand wel aan de grote
kant, de poer is als het goed is ca. 0,56m.

Grote afwijkingen (d.w.z. goter dan 0,2m) zijn gevonden bij de masten: 5, 6, 14, 16, 25, 27, 29, 36, 39, 49, 50, 51, 53, 65, 89 & 90.

Niet aangepast i.v.m. logisch gemiddelde: 5, 14, 16, 27, 29, 39, 49, 50, 51, 53, 89, 90
Gehele poer verwaarloosd: 6(3), 36(3)
Niet gewijzigd, nader onderzoek: 25
Afwijkend: 65 (poer 3 min. verwaarloosd en poer 4 min en max verwaarloosd)

In sommige gevallen was het duidelijk dat één meetpunt de grote delta veroorzaakte, in deze gevallen zijn deze metingen niet meegenomen bij het bepalen van de hoogte. Betreft metingen bij mast: 5, 8, 13, 17, 20, 21, 27, 31, 32, 35, 42, 60, 61, 64, 83 & 90

2 - Afwijkende hoogtemaatvoering - poerhoogte	
2.1 Mast 8	
De meest zuidelijke poer staat op 0,43m+NAP, terwijl de overige drie op gemiddeld 0,18m-NAP staan. Een delta van ca. 0,6m, kan dit een meetfout zijn?	Metingen van afwijkende poer verwaarloosd
2.2 Mast 13	
De poer op een afwijkende positie staat op 0,9m+NAP, terwijl de overige op ca. 0,6m+NAP staan. Een delta van ca. 0,3m, kan dit te maken hebben met de afwijkende positie van de poer?	Metingen van afwijkende poer verwaarloosd
2.3 Mast 25	
De maximale delta tussen twee poeren is 0,27m, bij deze mast lijkt het er echter niet op dat er één afwijkende poer is. Locatiebezoek zou verheldering kunnen opleveren.	
2.4 Mast 42	
De meest westelijke poer staat op 0,56m-NAP, terwijl de overige drie op gemiddeld 0,30m-NAP staan. Een delta van ca. 0,25m, kan dit een meetfout zijn?	Metingen van afwijkende poer verwaarloosd
2.5 Overige masten	
Overige masten met een delta tussen de verschillende poeren groter dan 1/100·pootsprei zijn: 5, 5A, 9, 17, 18, 24, 29, 32, 36, 38, 47, 51, 63, 64, 71, 76, 79, 83, 86 & 90	Max. toelaatbare delta aangepast van 1/100·pootsprei naar 1/100·pootsprei + 0,05m (o.b.v. max. toelaatbare afwijking). Zes masten blijven over: 5A, 18, 25, 32, 38 en 86 5A: minimale meting poer 1 verwaarloosd (deze enkele meting verstoorde het gemiddelde) 32: Poer 1 verwaarloosd (deze poer lag als enige ruim onder het gemiddelde) 38: Poer 4 verwaarloosd (lag als enige bijna 0,2m onder LIDAR meting) 18, 25, 86: blijken met gemiddelde allemaal in de buurt te liggen van LIDAR gegevens (allemaal -0,04m), dus deze meting lijkt (gemiddeld) in orde

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 00 P-ENS-09 (excl 5A).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m^3]	$\gamma_{sat;k;1}$ [kN/m^3]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m^3]	$\gamma_{sat;k;2}$ [kN/m^3]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
15	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: 1-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.14 Grondwaterstand [m] : -2.14

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.14	-2.59	Leem - Zwak zandig - Vast	1.0	50.0		
2	-2.59	-3.61	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-3.61	-4.59	Leem - Zwak zandig - Vast	1.0	50.0		
4	-4.59	-7.77	Klei - Zwak zandig - Slap	1.0	50.0		
5	-7.77	-9.03	Zand - Schoon - Los	1.0	100.0		
6	-9.03	-9.17	Leem - Zwak zandig - Vast	1.0	50.0		
7	-9.17	-9.45	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-9.45	-10.11	Klei - Zwak zandig - Slap	1.0	50.0		
9	-10.11	-15.86	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-15.86	-16.14	Zand - Schoon - Los	1.0	100.0		
11	-16.14	-17.38	Zand - Schoon - Vast	1.0	100.0		
12	-17.38	-18.88	Zand - Schoon - Matig	1.0	100.0		
13	-18.88	-19.66	Zand - Schoon - Los	1.0	100.0		
14	-19.66	-20.59	Leem - Zwak zandig - Vast	1.0	50.0		
15	-20.59	-29.41	Zand - Schoon - Los	1.0	100.0		
16	-29.41	-31.14	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 1-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.18 Grondwaterstand [m] : -2.18

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.18	-1.69	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.69	-2.33	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-2.33	-3.55	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-3.55	-3.79	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-3.79	-4.55	Klei - Zwak zandig - Matig	1.0	50.0		
6	-4.55	-4.81	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-4.81	-7.25	Klei - Organisch - Matig	1.0	50.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
8	-7.25	-7.73	Zand - Schoon - Los	1.0	100.0		
9	-7.73	-8.11	Klei - Organisch - Matig	1.0	50.0		
10	-8.11	-15.71	Zand - Schoon - Los	1.0	100.0		
11	-15.71	-16.80	Zand - Schoon - Vast	1.0	100.0		
12	-16.80	-17.38	Zand - Schoon - Matig	1.0	100.0		
13	-17.38	-29.97	Zand - Zwak siltig - Kleiig	1.0	100.0		
14	-29.97	-30.53	Zand - Schoon - Vast	1.0	100.0		
15	-30.53	-31.19	Zand - Schoon - Los	1.0	100.0		

BODEMPROFIELGEGEVENS: 1-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.09 Grondwaterstand [m] : -2.09

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.09	-1.74	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.74	-3.46	Zand - Schoon - Los	1.0	100.0		
3	-3.46	-4.04	Leem - Zwak zandig - Vast	1.0	50.0		
4	-4.04	-4.16	Zand - Schoon - Los	1.0	100.0		
5	-4.16	-4.44	Leem - Zwak zandig - Vast	1.0	50.0		
6	-4.44	-7.32	Klei - Organisch - Matig	1.0	50.0		
7	-7.32	-8.42	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-8.42	-9.44	Klei - Zwak zandig - Matig	1.0	50.0		
9	-9.44	-11.78	Zand - Schoon - Matig	1.0	100.0		
10	-11.78	-15.84	Zand - Zwak siltig - Kleiig	1.0	100.0		
11	-15.84	-17.04	Zand - Schoon - Vast	1.0	100.0		
12	-17.04	-20.44	Zand - Schoon - Matig	1.0	100.0		
13	-20.44	-23.12	Zand - Schoon - Los	1.0	100.0		
14	-23.12	-31.17	Zand - Zwak siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 1-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.14 Grondwaterstand [m] : -2.14

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.14	-2.35	Leem - Zwak zandig - Vast	1.0	50.0		
2	-2.35	-3.49	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-3.49	-4.21	Klei - Schoon - Matig	1.0	50.0		
4	-4.21	-4.59	Leem - Zwak zandig - Vast	1.0	50.0		
5	-4.59	-4.85	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-4.85	-8.45	Klei - Organisch - Matig	1.0	50.0		
7	-8.45	-10.83	Zand - Schoon - Matig	1.0	100.0		
8	-10.83	-11.60	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-11.60	-17.51	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-17.51	-18.21	Leem - Zwak zandig - Vast	1.0	50.0		
11	-18.21	-19.05	Klei - Zwak zandig - Vast	1.0	50.0		
12	-19.05	-28.09	Zand - Sterk siltig - Kleiig	1.0	100.0		
13	-28.09	-29.59	Zand - Schoon - Los	1.0	100.0		
14	-29.59	-31.26	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 2-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.20 Grondwaterstand [m] : -2.20

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.20	-3.15	Zand - Sterk siltig - Kleiig	1.0	100.0		
2	-3.15	-3.59	Leem - Zwak zandig - Vast	1.0	50.0		
3	-3.59	-4.47	Klei - Zwak zandig - Matig	1.0	50.0		
4	-4.47	-4.85	Zand - Schoon - Los	1.0	100.0		
5	-4.85	-6.77	Klei - Zwak zandig - Slap	1.0	50.0		
6	-6.77	-10.85	Zand - Schoon - Vast	1.0	100.0		
7	-10.85	-11.11	Zand - Schoon - Los	1.0	100.0		
8	-11.11	-13.50	Klei - Zwak zandig - Matig	1.0	50.0		
9	-13.50	-14.35	Leem - Zwak zandig - Vast	1.0	50.0		
10	-14.35	-20.09	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-20.09	-20.55	Zand - Schoon - Los	1.0	100.0		
12	-20.55	-21.47	Leem - Zwak zandig - Vast	1.0	50.0		
13	-21.47	-23.57	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-23.57	-24.01	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
15	-24.01	-28.06	Zand - Sterk siltig - Kleiig	1.0	100.0		
16	-28.06	-28.62	Zand - Schoon - Vast	1.0	100.0		
17	-28.62	-31.25	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 2-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.13 Grondwaterstand [m] : -2.13

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.13	-2.56	Leem - Zwak zandig - Vast	1.0	50.0		
2	-2.56	-4.52	Klei - Zwak zandig - Matig	1.0	50.0		
3	-4.52	-4.76	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-4.76	-6.86	Klei - Zwak zandig - Slap	1.0	50.0		
5	-6.86	-8.06	Zand - Schoon - Los	1.0	100.0		
6	-8.06	-13.21	Zand - Schoon - Matig	1.0	100.0		
7	-13.21	-13.61	Leem - Zwak zandig - Vast	1.0	50.0		
8	-13.61	-17.03	Klei - Schoon - Matig	1.0	50.0		
9	-17.03	-21.06	Zand - Sterk siltig - Kleiig	1.0	100.0		
10	-21.06	-21.54	Leem - Zwak zandig - Vast	1.0	50.0		
11	-21.54	-24.14	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-24.14	-28.16	Zand - Schoon - Matig	1.0	100.0		
13	-28.16	-30.81	Zand - Schoon - Vast	1.0	100.0		
14	-30.81	-31.21	Zand - Zwak siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 3-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.24 Grondwaterstand [m] : -2.24

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.24	-1.85	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.85	-2.83	Klei - Zwak zandig - Slap	1.0	50.0		
3	-2.83	-3.41	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-3.41	-4.17	Leem - Zwak zandig - Vast	1.0	50.0		
5	-4.17	-6.35	Klei - Zwak zandig - Matig	1.0	50.0		
6	-6.35	-6.59	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-6.59	-7.27	Klei - Organisch - Matig	1.0	50.0		
8	-7.27	-11.17	Zand - Schoon - Los	1.0	100.0		
9	-11.17	-13.85	Zand - Schoon - Matig	1.0	100.0		
10	-13.85	-15.37	Klei - Zwak zandig - Matig	1.0	50.0		
11	-15.37	-16.91	Zand - Schoon - Vast	1.0	100.0		
12	-16.91	-17.50	Zand - Schoon - Matig	1.0	100.0		
13	-17.50	-18.50	Zand - Schoon - Vast	1.0	100.0		
14	-18.50	-19.82	Zand - Schoon - Matig	1.0	100.0		
15	-19.82	-20.48	Leem - Zwak zandig - Vast	1.0	50.0		
16	-20.48	-21.12	Zand - Schoon - Matig	1.0	100.0		
17	-21.12	-22.22	Zand - Schoon - Los	1.0	100.0		
18	-22.22	-31.26	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 3-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.25 Grondwaterstand [m] : -2.25

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.25	-3.40	Zand - Sterk siltig - Kleiig	1.0	100.0		
2	-3.40	-4.34	Klei - Schoon - Vast	1.0	50.0		
3	-4.34	-6.18	Klei - Schoon - Matig	1.0	50.0		
4	-6.18	-6.82	Zand - Schoon - Los	1.0	100.0		
5	-6.82	-7.18	Klei - Zwak zandig - Slap	1.0	50.0		
6	-7.18	-9.20	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-9.20	-14.76	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-14.76	-15.54	Klei - Zwak zandig - Vast	1.0	50.0		
9	-15.54	-20.23	Zand - Schoon - Vast	1.0	100.0		
10	-20.23	-23.34	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-23.34	-24.48	Zand - Schoon - Vast	1.0	100.0		
12	-24.48	-31.26	Zand - Zwak siltig - Kleiig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 4-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.05 Grondwaterstand [m] : -2.05

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.05	-2.22	Leem - Zwak zandig - Vast	1.0	50.0		
2	-2.22	-2.48	Klei - Schoon - Matig	1.0	50.0		
3	-2.48	-3.14	Leem - Zwak zandig - Vast	1.0	50.0		
4	-3.14	-4.00	Zand - Schoon - Los	1.0	100.0		
5	-4.00	-4.38	Klei - Zwak zandig - Vast	1.0	50.0		
6	-4.38	-4.88	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-4.88	-9.33	Klei - Zwak zandig - Slap	1.0	50.0		
8	-9.33	-10.03	Zand - Schoon - Los	1.0	100.0		
9	-10.03	-10.43	Leem - Zwak zandig - Vast	1.0	50.0		
10	-10.43	-12.73	Zand - Schoon - Matig	1.0	100.0		
11	-12.73	-16.31	Klei - Zwak zandig - Slap	1.0	50.0		
12	-16.31	-18.64	Zand - Zwak siltig - Kleiig	1.0	100.0		
13	-18.64	-19.04	Leem - Zwak zandig - Vast	1.0	50.0		
14	-19.04	-31.11	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 4-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.06 Grondwaterstand [m] : -2.06

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.06	-2.09	Leem - Zwak zandig - Vast	1.0	50.0		
2	-2.09	-2.45	Klei - Zwak zandig - Slap	1.0	50.0		
3	-2.45	-2.87	Zand - Schoon - Los	1.0	100.0		
4	-2.87	-3.31	Leem - Zwak zandig - Vast	1.0	50.0		
5	-3.31	-4.35	Zand - Schoon - Los	1.0	100.0		
6	-4.35	-4.61	Leem - Zwak zandig - Vast	1.0	50.0		
7	-4.61	-4.97	Zand - Schoon - Los	1.0	100.0		
8	-4.97	-9.55	Klei - Zwak zandig - Slap	1.0	50.0		
9	-9.55	-9.97	Leem - Zwak zandig - Vast	1.0	50.0		
10	-9.97	-10.67	Klei - Schoon - Matig	1.0	50.0		
11	-10.67	-13.13	Zand - Schoon - Los	1.0	100.0		
12	-13.13	-16.35	Klei - Zwak zandig - Slap	1.0	50.0		
13	-16.35	-20.65	Zand - Zwak siltig - Kleiig	1.0	100.0		
14	-20.65	-22.24	Zand - Schoon - Vast	1.0	100.0		
15	-22.24	-26.06	Zand - Schoon - Matig	1.0	100.0		
16	-26.06	-26.58	Leem - Zwak zandig - Vast	1.0	50.0		
17	-26.58	-31.19	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 5-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.95 Grondwaterstand [m] : -1.95

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.95	-2.58	Zand - Schoon - Los	1.0	100.0		
2	-2.58	-4.64	Klei - Zwak zandig - Slap	1.0	50.0		
3	-4.64	-4.76	Leem - Zwak zandig - Vast	1.0	50.0		
4	-4.76	-7.06	Klei - Schoon - Vast	1.0	50.0		
5	-7.06	-7.18	Zand - Schoon - Los	1.0	100.0		
6	-7.18	-11.86	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-11.86	-16.74	Klei - Schoon - Matig	1.0	50.0		
8	-16.74	-19.92	Zand - Schoon - Vast	1.0	100.0		
9	-19.92	-20.06	Leem - Zwak zandig - Vast	1.0	50.0		
10	-20.06	-21.12	Zand - Schoon - Vast	1.0	100.0		
11	-21.12	-22.68	Zand - Schoon - Matig	1.0	100.0		
12	-22.68	-22.92	Zand - Schoon - Los	1.0	100.0		
13	-22.92	-31.13	Zand - Schoon - Matig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 5-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.85 Grondwaterstand [m] : -1.85

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.85	-1.98	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.98	-7.02	Klei - Schoon - Matig	1.0	50.0		
3	-7.02	-8.38	Zand - Schoon - Los	1.0	100.0		
4	-8.38	-8.92	Leem - Zwak zandig - Vast	1.0	50.0		
5	-8.92	-11.20	Zand - Schoon - Matig	1.0	100.0		
6	-11.20	-12.92	Zand - Schoon - Los	1.0	100.0		
7	-12.92	-18.12	Klei - Zwak zandig - Matig	1.0	50.0		
8	-18.12	-18.74	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-18.74	-19.12	Zand - Schoon - Los	1.0	100.0		
10	-19.12	-22.18	Zand - Schoon - Vast	1.0	100.0		
11	-22.18	-24.00	Zand - Schoon - Los	1.0	100.0		
12	-24.00	-25.22	Zand - Zwak siltig - Kleiig	1.0	100.0		
13	-25.22	-30.99	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 6-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.85 Grondwaterstand [m] : -1.85

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.85	-2.32	Leem - Zwak zandig - Vast	1.0	50.0		
2	-2.32	-4.26	Klei - Zwak zandig - Matig	1.0	50.0		
3	-4.26	-4.70	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-4.70	-7.28	Klei - Schoon - Matig	1.0	50.0		
5	-7.28	-8.28	Zand - Schoon - Matig	1.0	100.0		
6	-8.28	-9.10	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-9.10	-16.22	Zand - Schoon - Matig	1.0	100.0		
8	-16.22	-22.77	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-22.77	-24.73	Zand - Schoon - Matig	1.0	100.0		
10	-24.73	-25.69	Leem - Zwak zandig - Vast	1.0	50.0		
11	-25.69	-25.97	Klei - Schoon - Vast	1.0	50.0		
12	-25.97	-30.92	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 7-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.75 Grondwaterstand [m] : -1.75

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.75	-1.90	Zand - Schoon - Los	1.0	100.0		
2	-1.90	-2.60	Klei - Schoon - Matig	1.0	50.0		
3	-2.60	-3.14	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-3.14	-3.52	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-3.52	-3.96	Leem - Zwak zandig - Vast	1.0	50.0		
6	-3.96	-4.24	Zand - Schoon - Los	1.0	100.0		
7	-4.24	-4.54	Leem - Zwak zandig - Vast	1.0	50.0		
8	-4.54	-7.02	Klei - Zwak zandig - Slap	1.0	50.0		
9	-7.02	-17.17	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-17.17	-18.15	Zand - Schoon - Los	1.0	100.0		
11	-18.15	-18.29	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-18.29	-19.57	Zand - Schoon - Vast	1.0	100.0		
13	-19.57	-20.21	Zand - Schoon - Matig	1.0	100.0		
14	-20.21	-25.01	Zand - Schoon - Los	1.0	100.0		
15	-25.01	-25.59	Leem - Zwak zandig - Vast	1.0	50.0		
16	-25.59	-30.70	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 8-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.70 Grondwaterstand [m] : -1.70

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.70	-2.45	Zand - Schoon - Los	1.0	100.0		
2	-2.45	-3.79	Klei - Organisch - Matig	1.0	50.0		
3	-3.79	-4.81	Zand - Schoon - Los	1.0	100.0		
4	-4.81	-7.35	Klei - Zwak zandig - Slap	1.0	50.0		
5	-7.35	-20.91	Zand - Schoon - Los	1.0	100.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
6	-20.91	-21.47	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-21.47	-22.25	Klei - Zwak zandig - Vast	1.0	50.0		
8	-22.25	-23.00	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-23.00	-23.28	Klei - Zwak zandig - Matig	1.0	50.0		
10	-23.28	-25.90	Zand - Schoon - Vast	1.0	100.0		
11	-25.90	-26.66	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-26.66	-27.45	Leem - Zwak zandig - Vast	1.0	50.0		
13	-27.45	-27.83	Zand - Schoon - Matig	1.0	100.0		
14	-27.83	-28.15	Leem - Zwak zandig - Vast	1.0	50.0		
15	-28.15	-29.24	Zand - Schoon - Matig	1.0	100.0		
16	-29.24	-30.61	Klei - Schoon - Vast	1.0	50.0		

BODEMPROFIELGEGEVENS: 9-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.49 Grondwaterstand [m] : -1.49

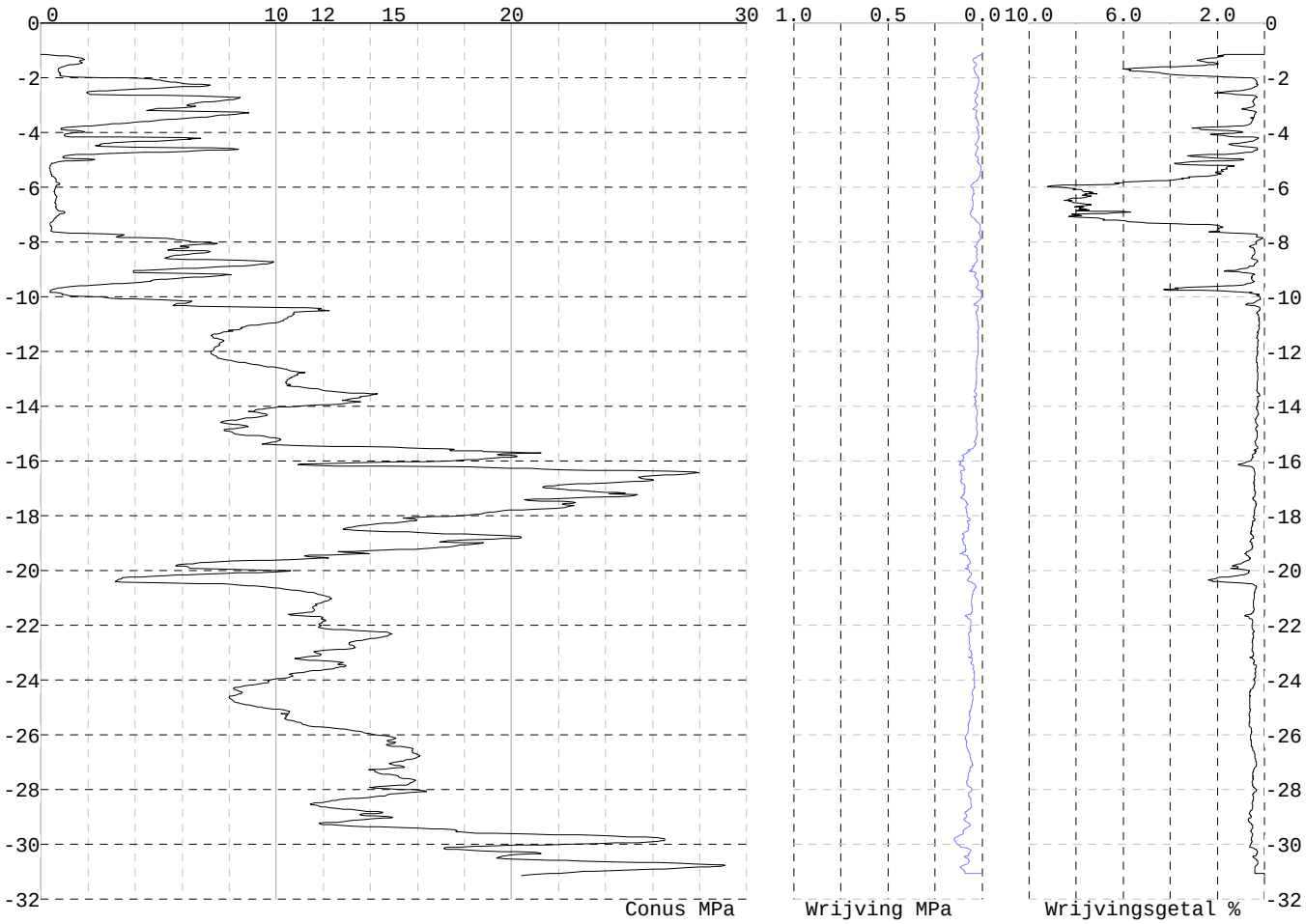
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.49	-1.60	Zand - Schoon - Los	1.0	100.0		
2	-1.60	-4.60	Klei - Zwak zandig - Slap	1.0	50.0		
3	-4.60	-5.61	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-5.61	-6.09	Klei - Zwak zandig - Vast	1.0	50.0		
5	-6.09	-9.19	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-9.19	-9.99	Leem - Zwak zandig - Vast	1.0	50.0		
7	-9.99	-10.93	Zand - Schoon - Los	1.0	100.0		
8	-10.93	-11.77	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-11.77	-12.11	Leem - Zwak zandig - Vast	1.0	50.0		
10	-12.11	-16.99	Zand - Zwak siltig - Kleiig	1.0	100.0		
11	-16.99	-17.99	Klei - Zwak zandig - Matig	1.0	50.0		
12	-17.99	-18.89	Zand - Schoon - Los	1.0	100.0		
13	-18.89	-30.59	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 1-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.14 Bodemprofiel: 1-1
Traject negatieve kleef : -1.14 tot -7.60 [m]
Traject positieve kleef : -9.80 tot -31.15 [m]

Project :
Onderdeel :

SONDERINGSGEGEVENS GRAFIEK: 1-1

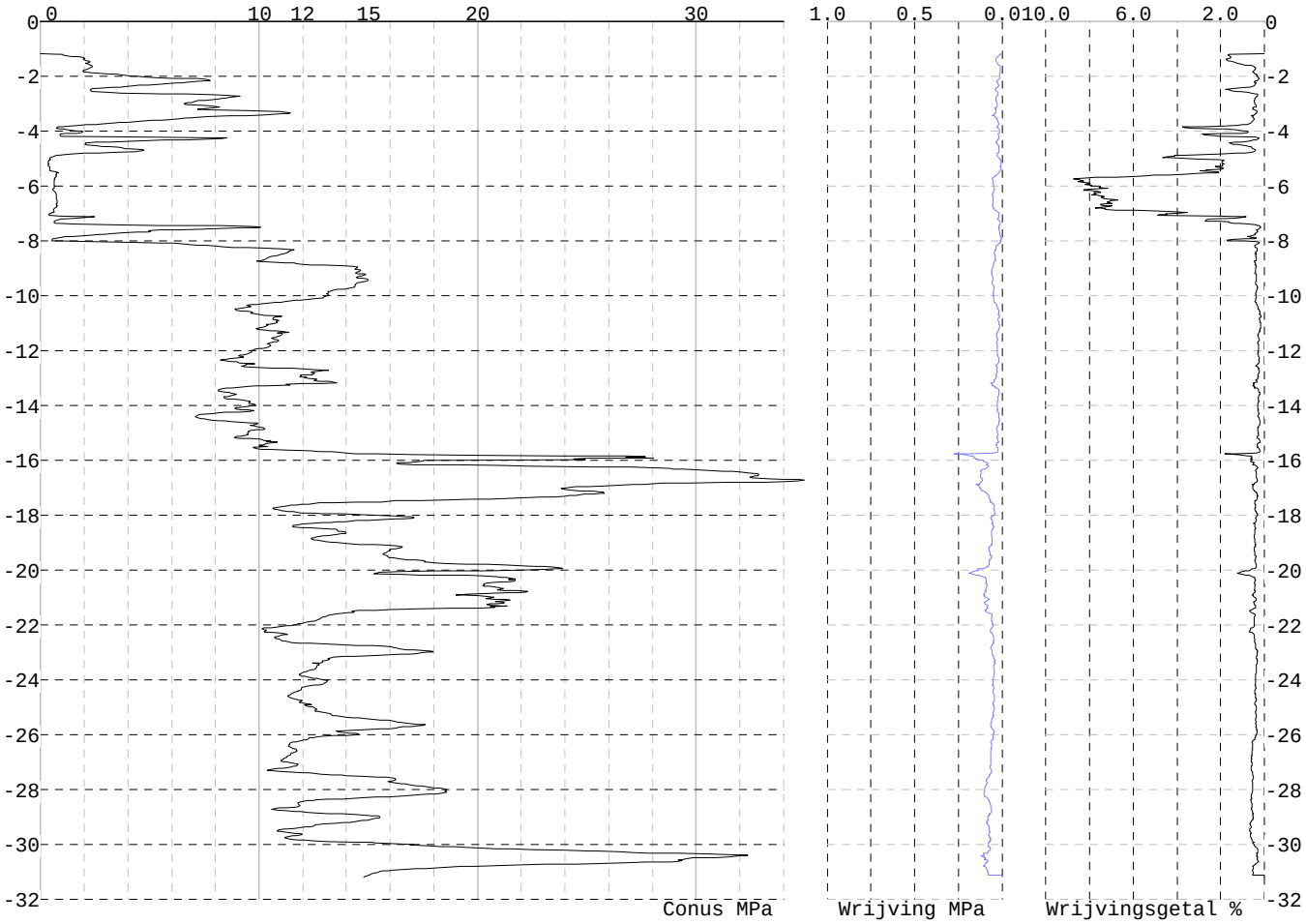


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 1-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.18 Bodemprofiel: 1-2
Traject negatieve kleef : -1.18 tot -6.30 [m]
Traject positieve kleef : -8.10 tot -31.20 [m]

SONDERINGSGEGEVENS GRAFIEK: 1-2

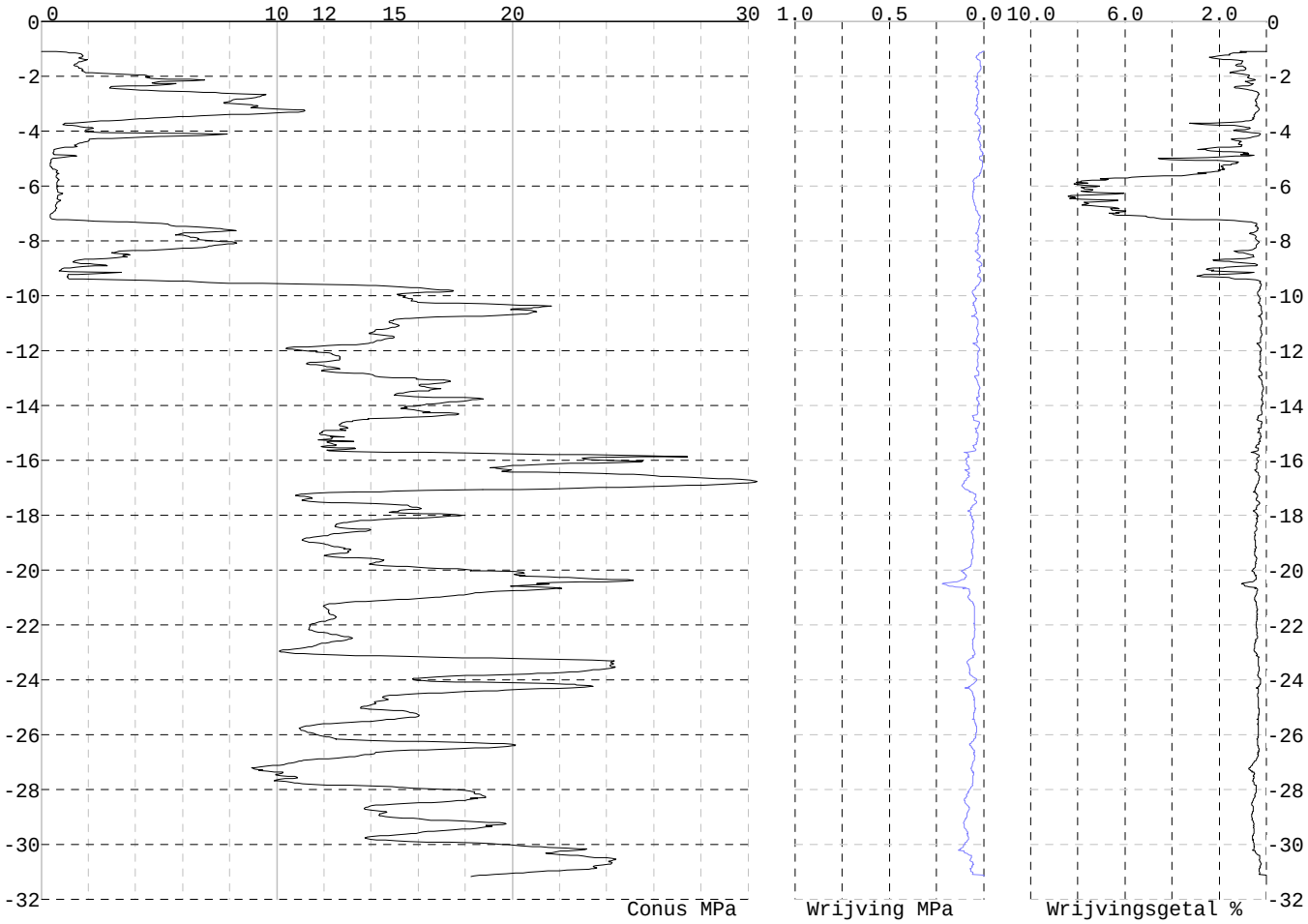


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 1-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.09 Bodemprofiel: 1-3
Traject negatieve kleef : -1.09 tot -7.20 [m]
Traject positieve kleef : -9.30 tot -31.18 [m]

SONDERINGSGEGEVENS GRAFIEK: 1-3

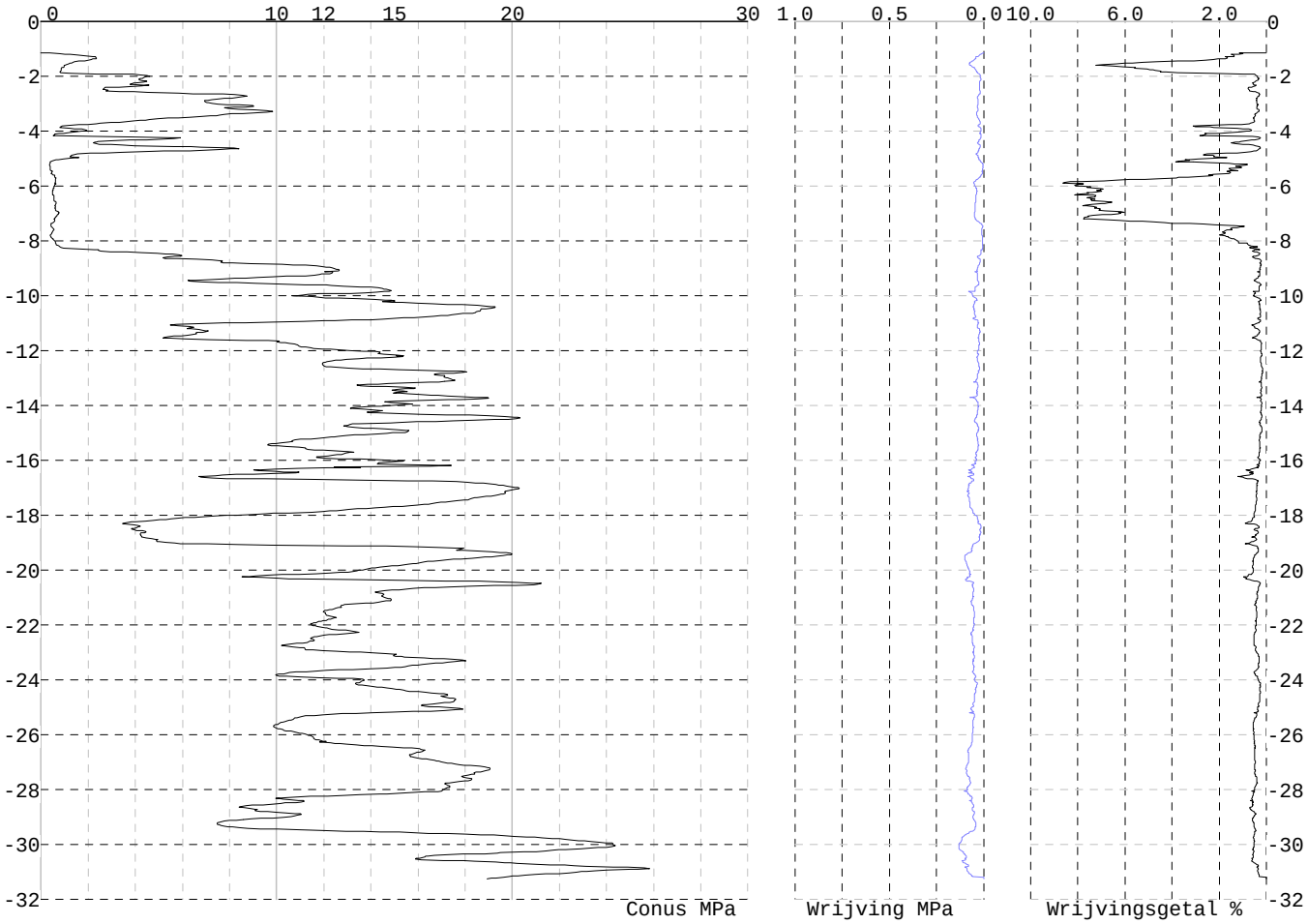


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 1-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.14 Bodemprofiel: 1-4
Traject negatieve kleef : -1.14 tot -8.10 [m]
Traject positieve kleef : -8.10 tot -31.27 [m]

SONDERINGSGEGEVENS GRAFIEK: 1-4

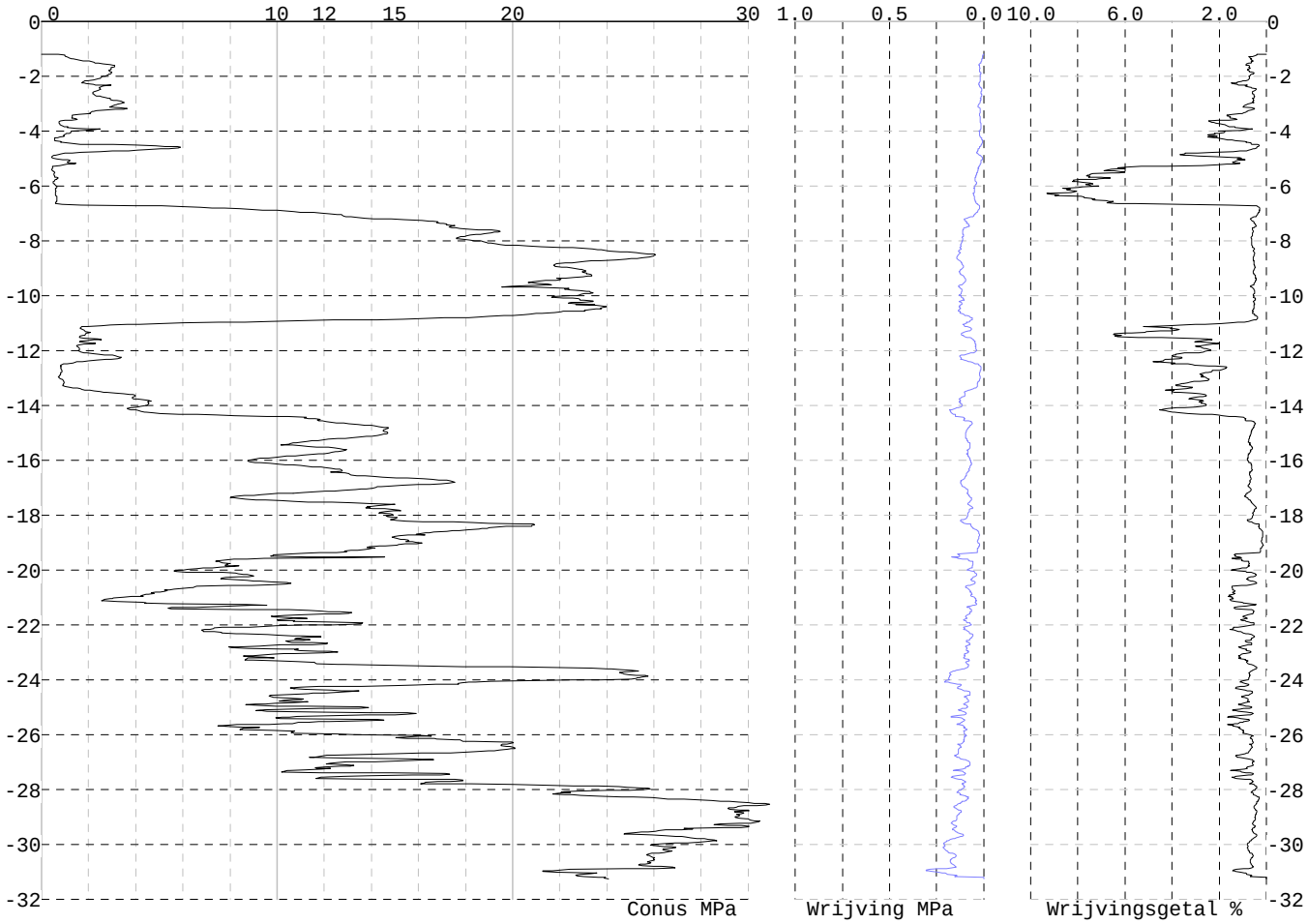


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 2-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.20 Bodemprofiel: 2-1
Traject negatieve kleef : -1.20 tot -6.70 [m]
Traject positieve kleef : -13.30 tot -31.26 [m]

SONDERINGSGEGEVENS GRAFIEK: 2-1

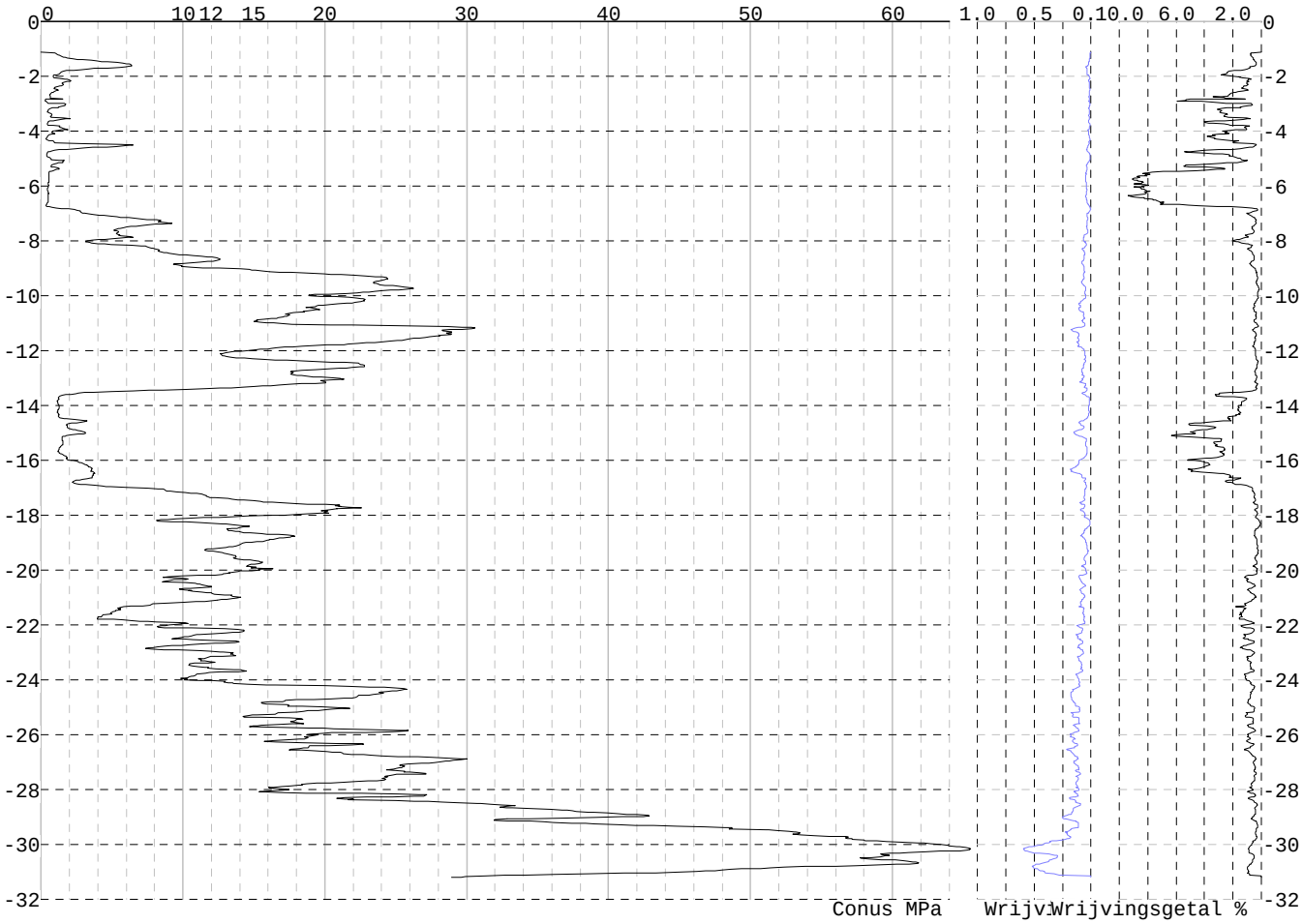


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 2-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.13 Bodemprofiel: 2-2
Traject negatieve kleef : -1.13 tot -6.60 [m]
Traject positieve kleef : -16.80 tot -31.22 [m]

SONDERINGSGEGEVENS GRAFIEK: 2-2

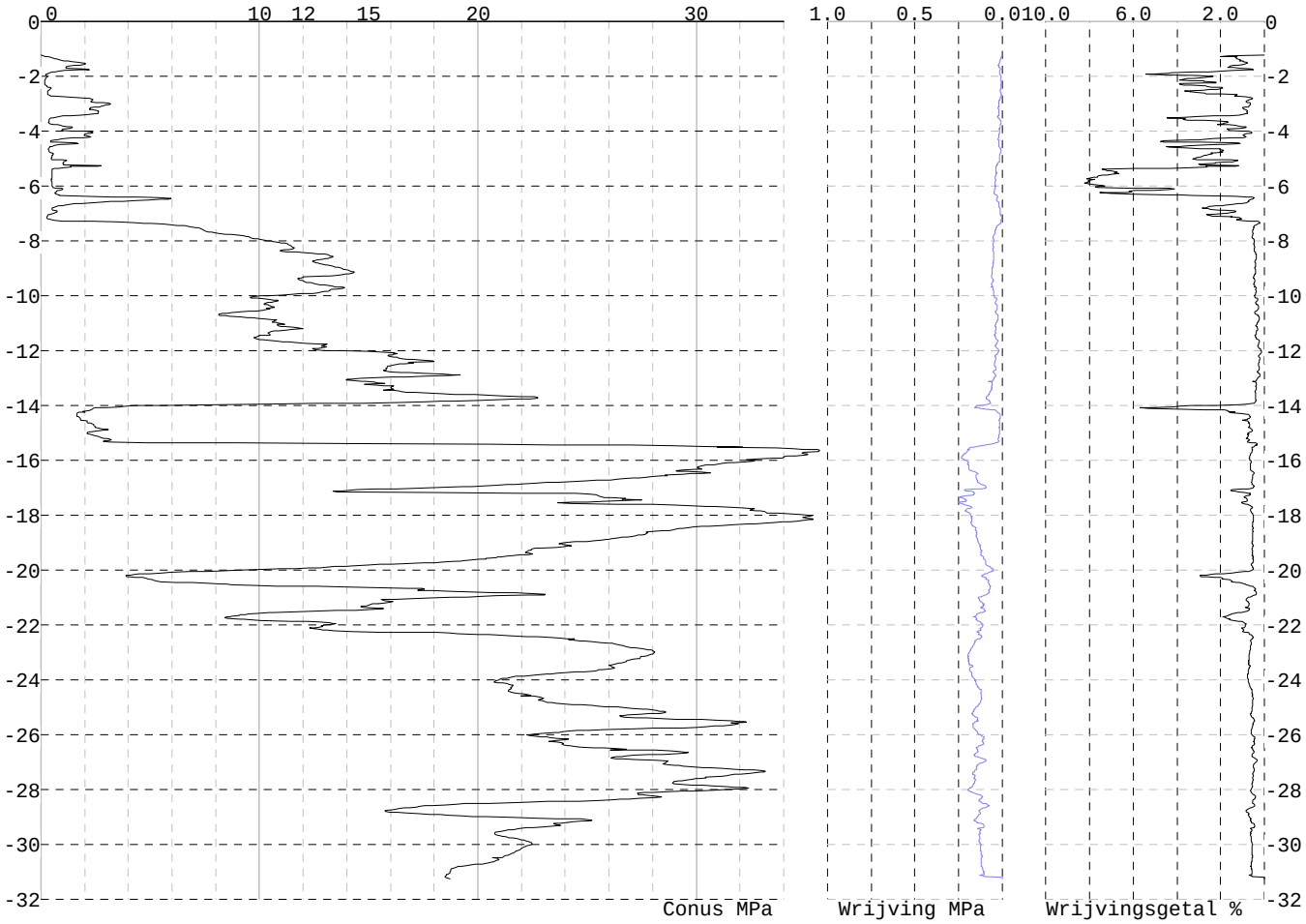


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 3-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.24 Bodemprofiel: 3-1
Traject negatieve kleef : -1.24 tot -7.20 [m]
Traject positieve kleef : -15.40 tot -31.27 [m]

SONDERINGSGEGEVENS GRAFIEK: 3-1

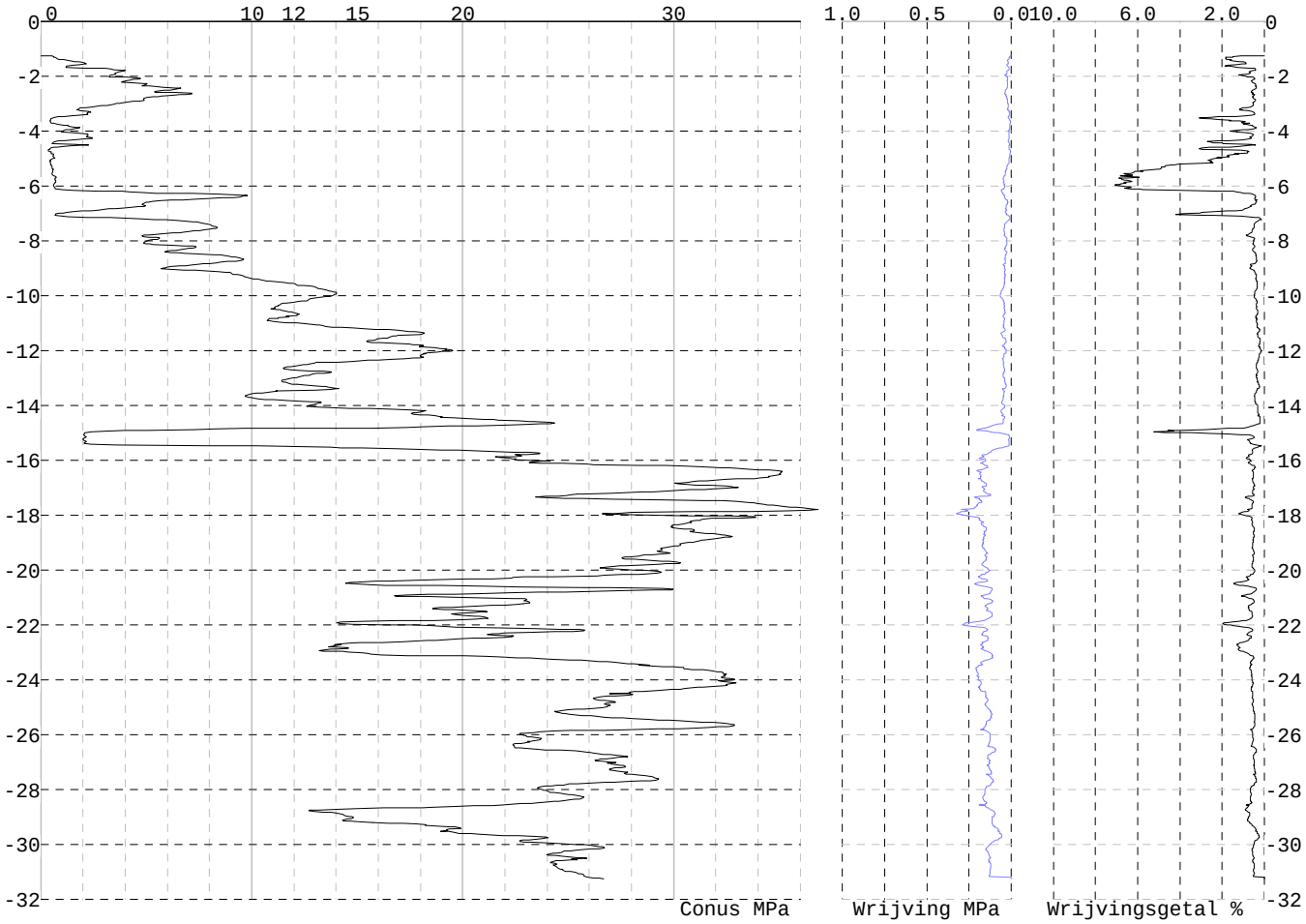


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 3-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.25 Bodemprofiel: 3-2
Traject negatieve kleef : -1.25 tot -6.10 [m]
Traject positieve kleef : -15.60 tot -31.27 [m]

SONDERINGSGEGEVENS GRAFIEK: 3-2

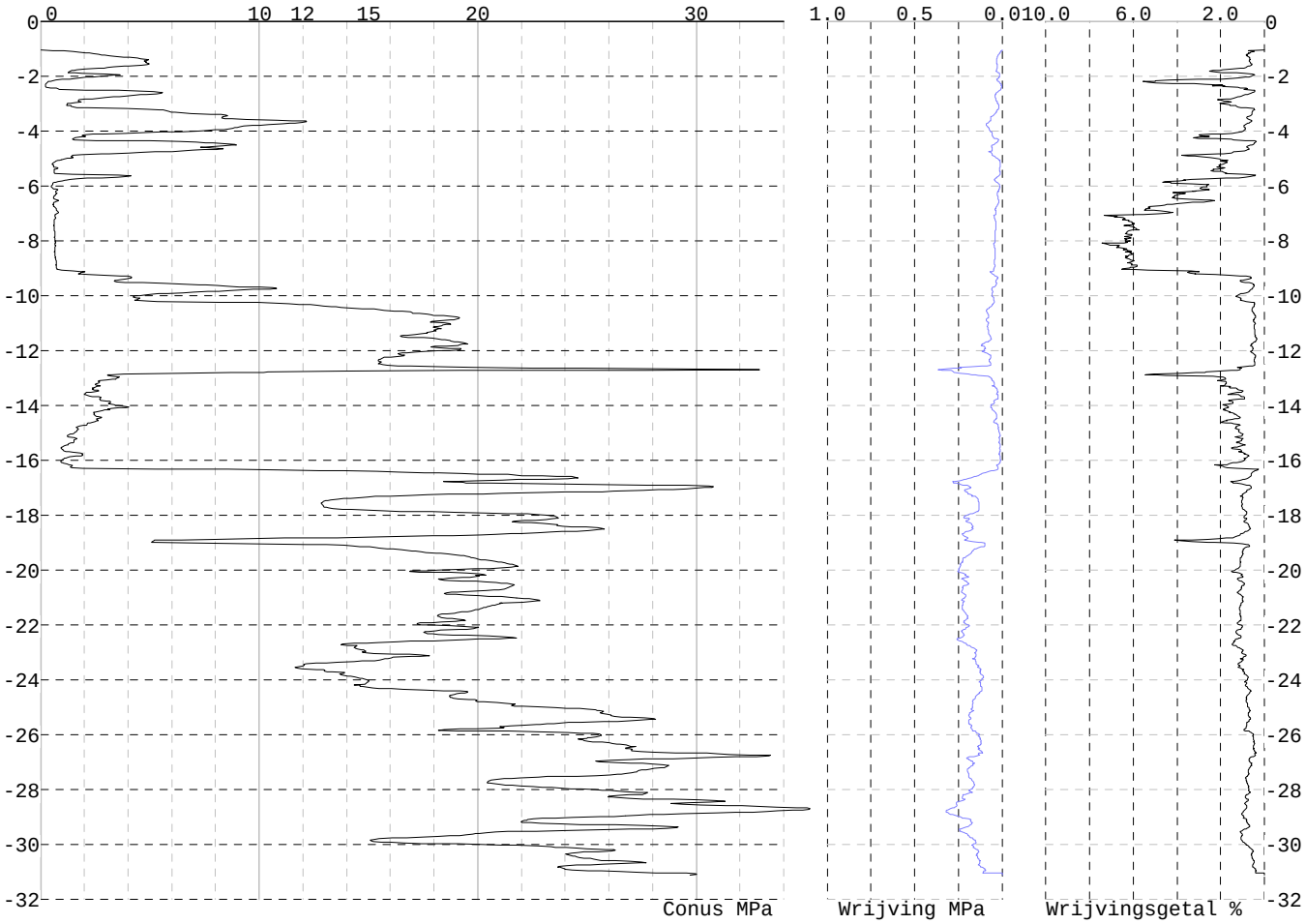


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 4-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.05 Bodemprofiel: 4-1
Traject negatieve kleef : -1.05 tot -9.00 [m]
Traject positieve kleef : -16.20 tot -31.12 [m]

SONDERINGSGEGEVENS GRAFIEK: 4-1

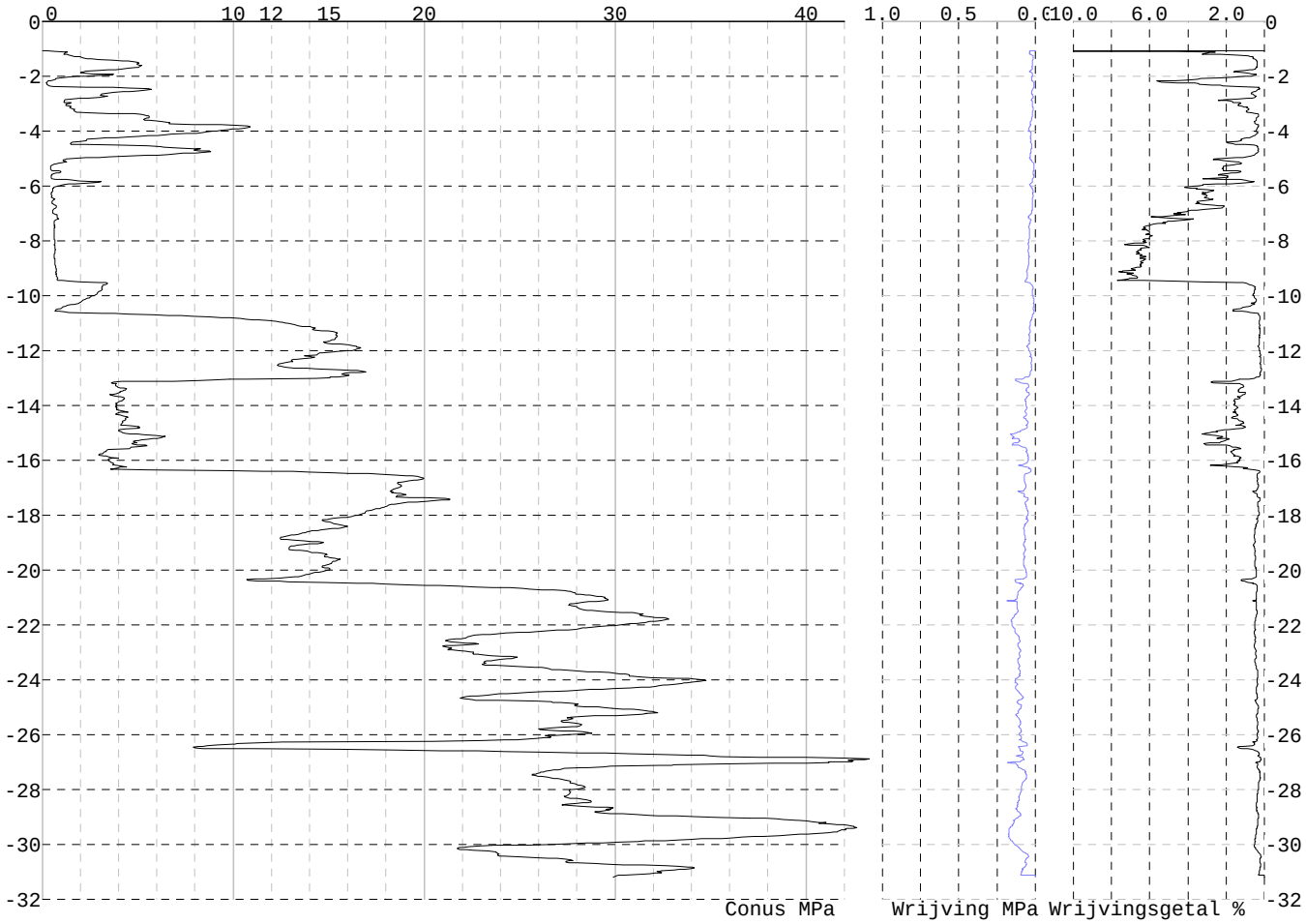


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 4-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.06 Bodemprofiel: 4-2
Traject negatieve kleef : -1.06 tot -10.60 [m]
Traject positieve kleef : -16.20 tot -31.20 [m]

SONDERINGSGEGEVENS GRAFIEK: 4-2

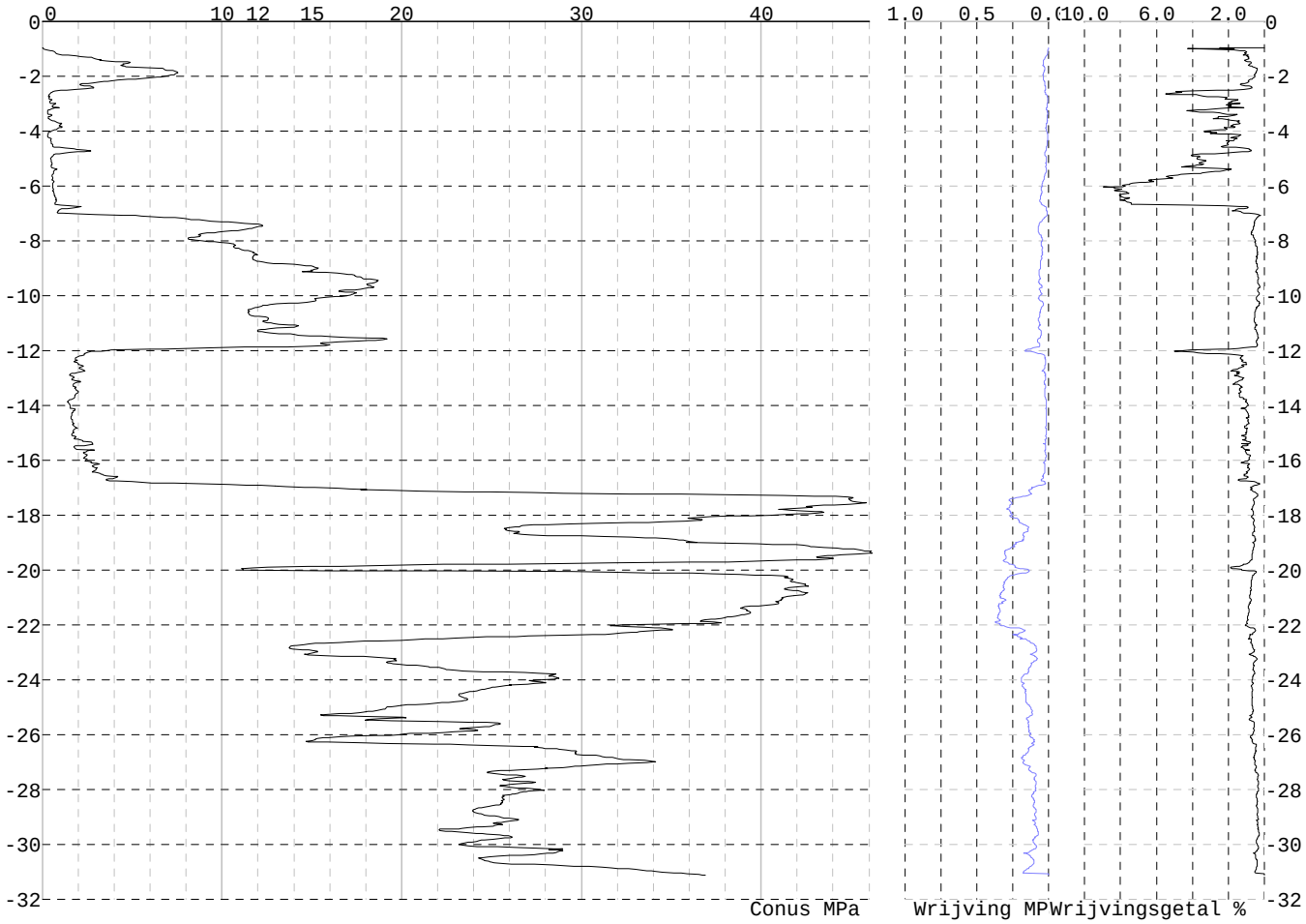


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 5-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.95 Bodemprofiel: 5-1
Traject negatieve kleef : -0.95 tot -7.00 [m]
Traject positieve kleef : -16.70 tot -31.14 [m]

SONDERINGSGEGEVENS GRAFIEK: 5-1

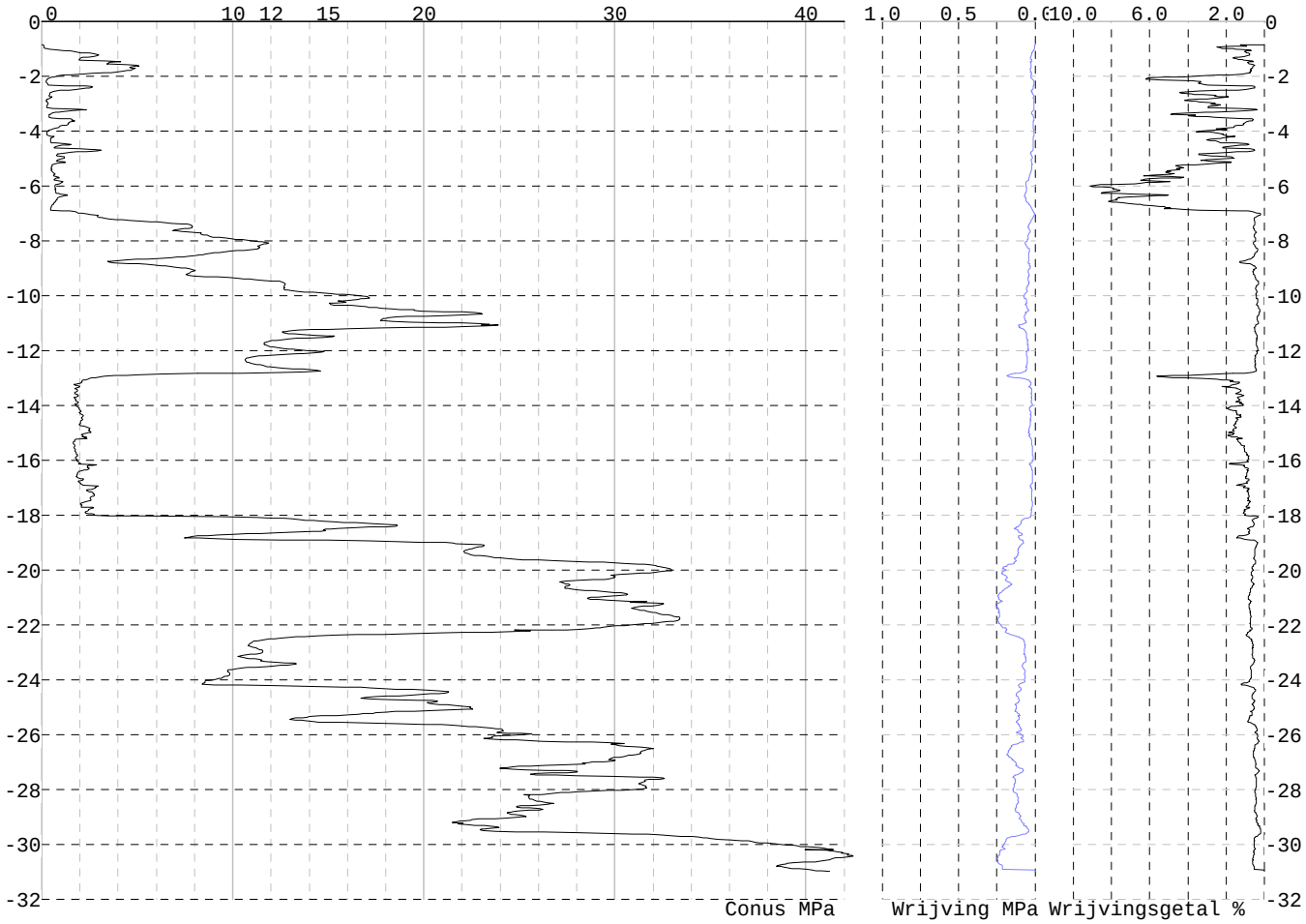


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 5-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.85 Bodemprofiel: 5-2
Traject negatieve kleef : -0.85 tot -6.80 [m]
Traject positieve kleef : -18.10 tot -31.00 [m]

SONDERINGSGEGEVENS GRAFIEK: 5-2

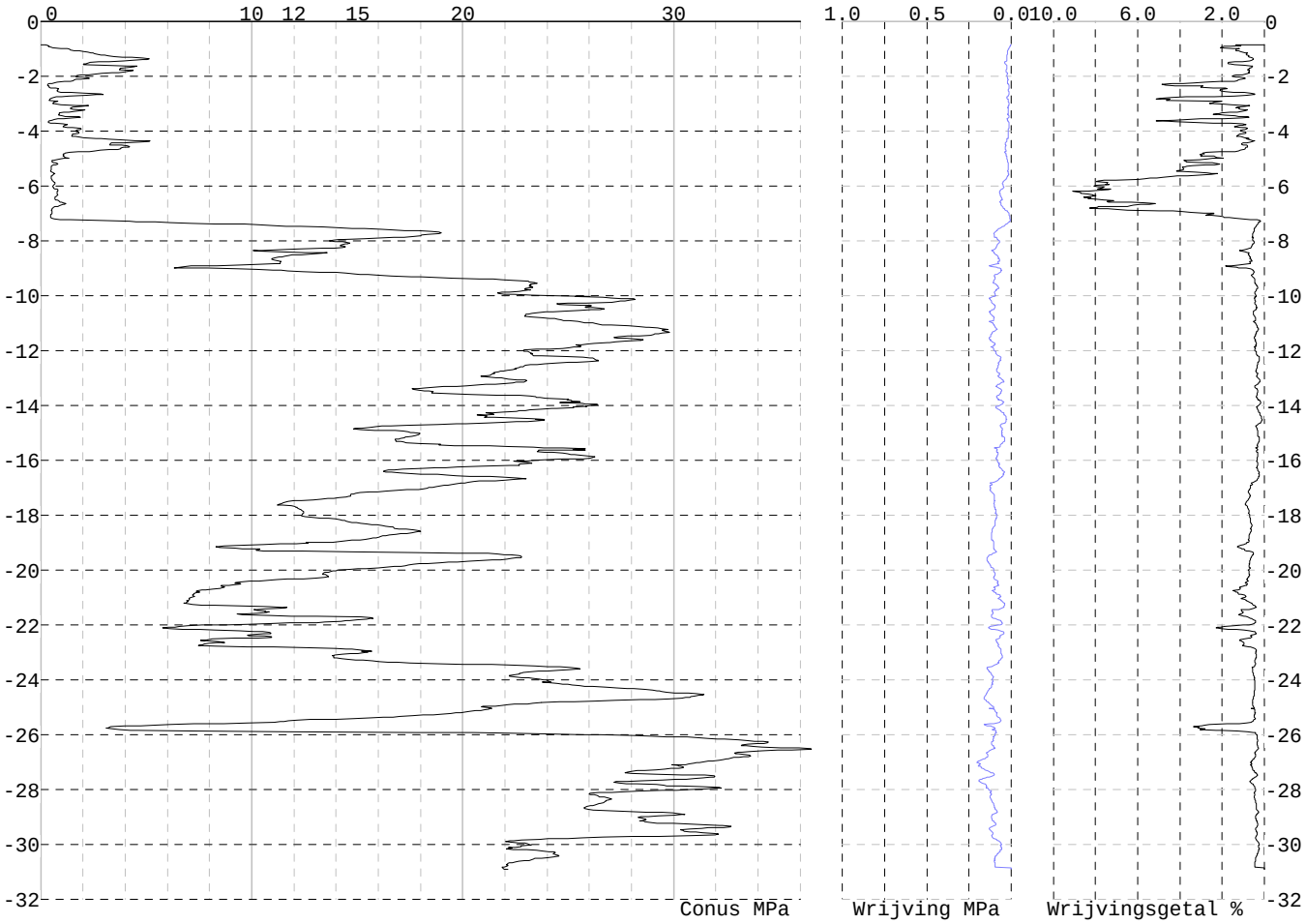


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 6-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.85 Bodemprofiel: 6-1
Traject negatieve kleef : -0.85 tot -7.30 [m]
Traject positieve kleef : -7.30 tot -30.93 [m]

SONDERINGSGEGEVENS GRAFIEK: 6-1

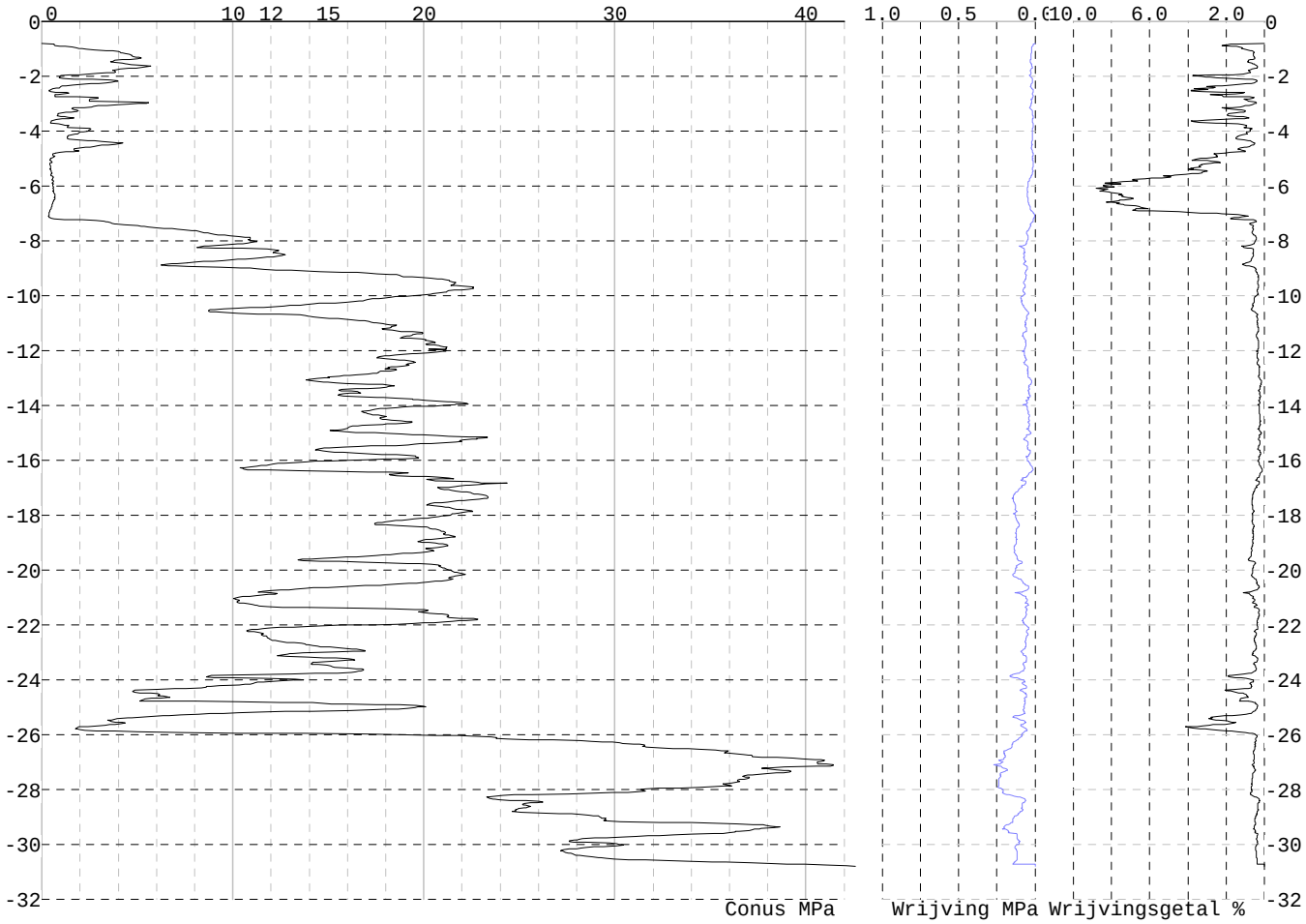


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 6-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.81 Bodemprofiel: 6-1
Traject negatieve kleef : -0.81 tot -7.10 [m]
Traject positieve kleef : -7.10 tot -30.80 [m]

SONDERINGSGEGEVENS GRAFIEK: 6-2

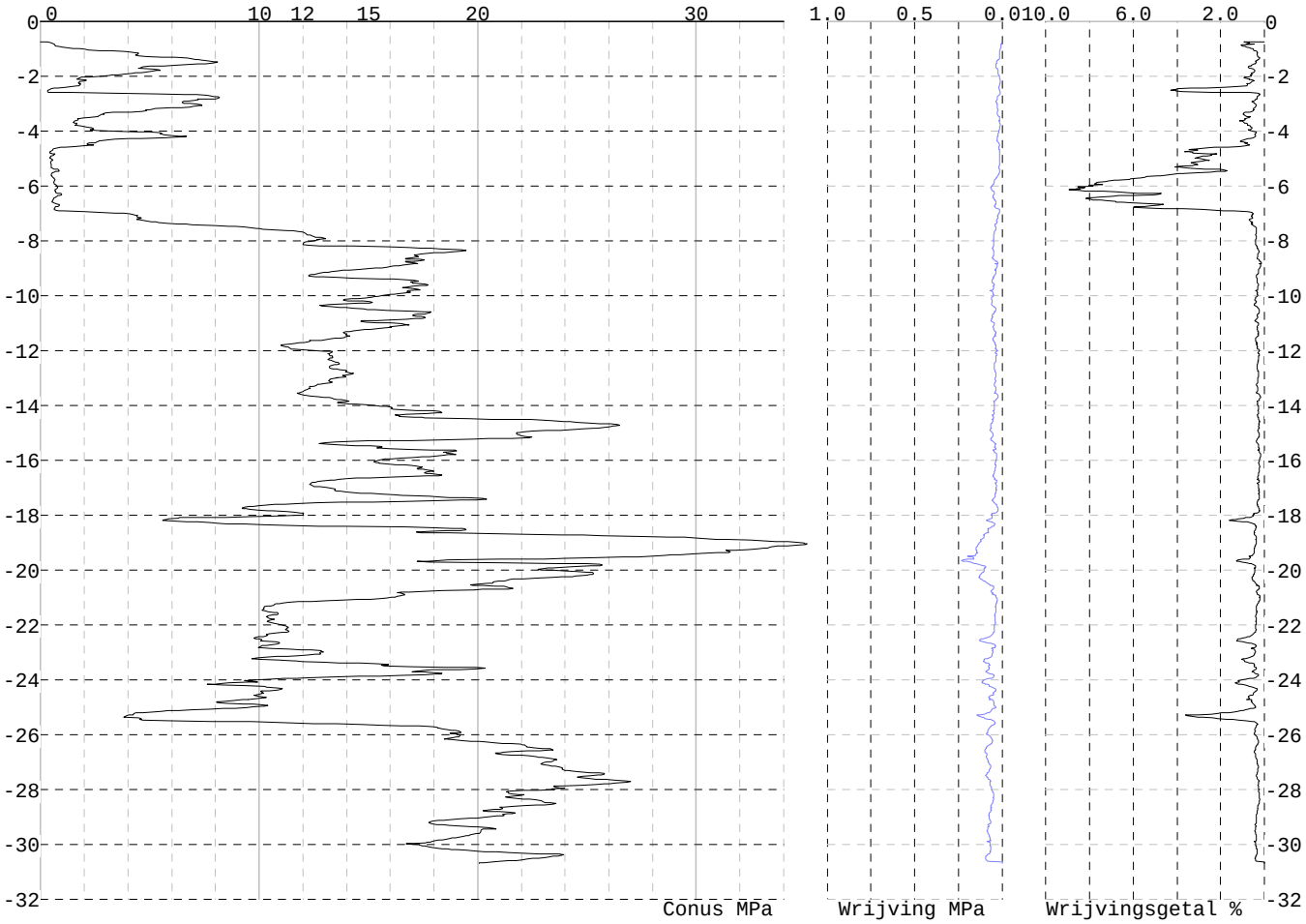


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 7-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.75 Bodemprofiel: 7-1
Traject negatieve kleef : -0.75 tot -6.90 [m]
Traject positieve kleef : -6.90 tot -30.71 [m]

SONDERINGSGEGEVENS GRAFIEK: 7-1

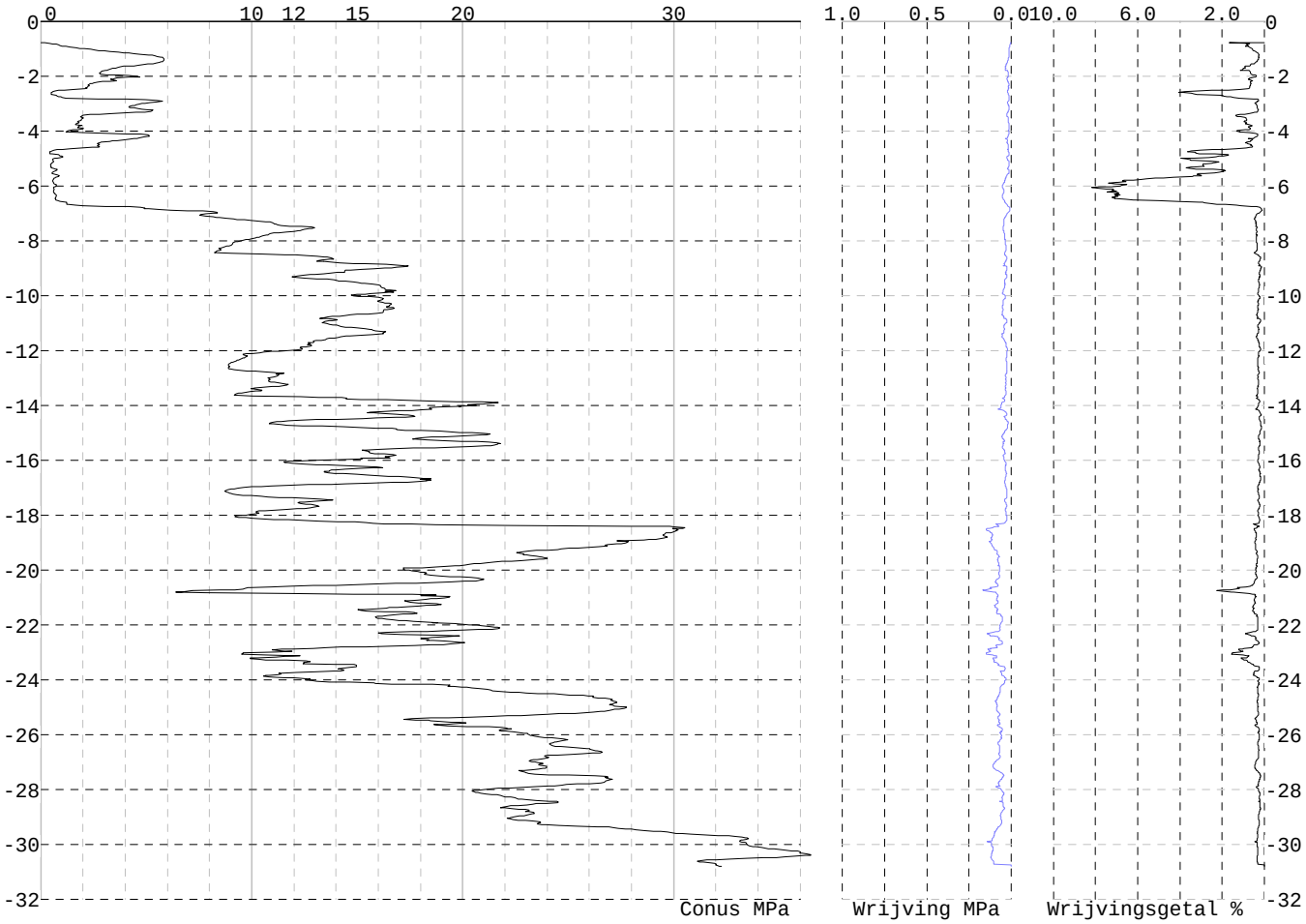


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 7-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.77 Bodemprofiel: 7-1
Traject negatieve kleef : -0.77 tot -6.70 [m]
Traject positieve kleef : -6.70 tot -30.82 [m]

SONDERINGSGEGEVENS GRAFIEK: 7-2

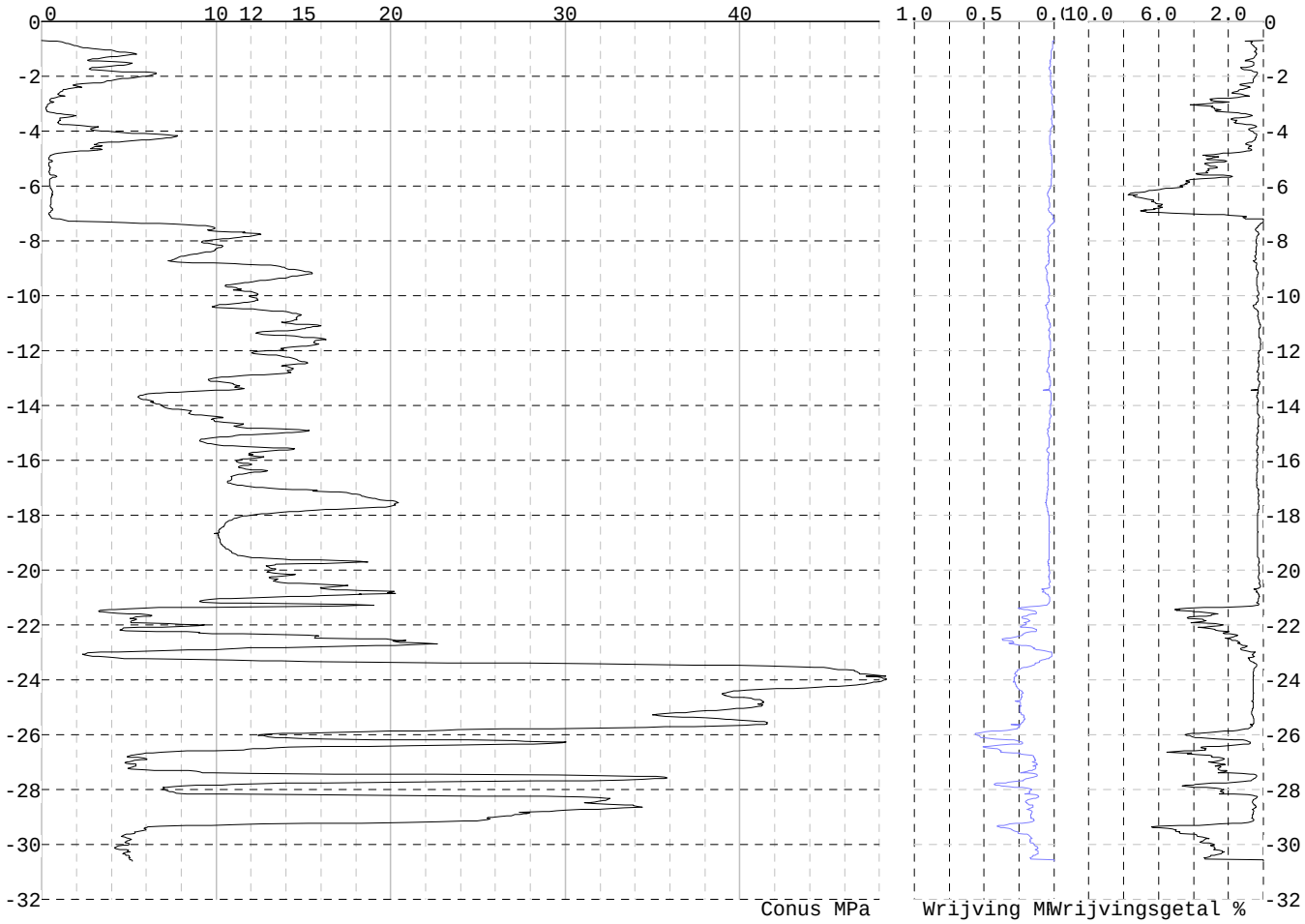


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 8-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.70 Bodemprofiel: 8-1
Traject negatieve kleef : -0.70 tot -7.20 [m]
Traject positieve kleef : -7.20 tot -30.62 [m]

SONDERINGSGEGEVENS GRAFIEK: 8-1

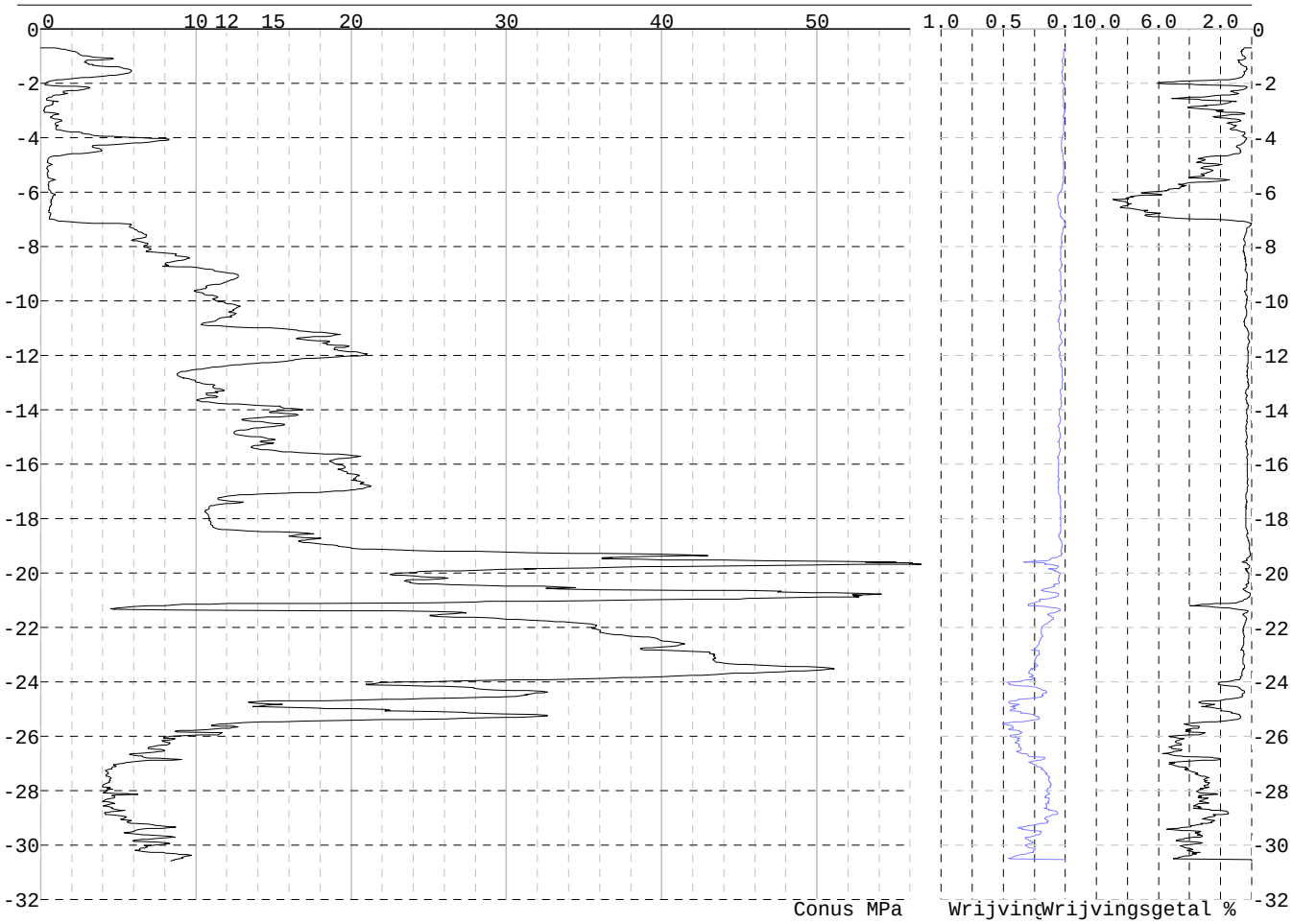


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 8-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.69 Bodemprofiel: 8-1
Traject negatieve kleef : -0.69 tot -7.10 [m]
Traject positieve kleef : -7.10 tot -30.60 [m]

SONDERINGSGEGEVENS GRAFIEK: 8-2

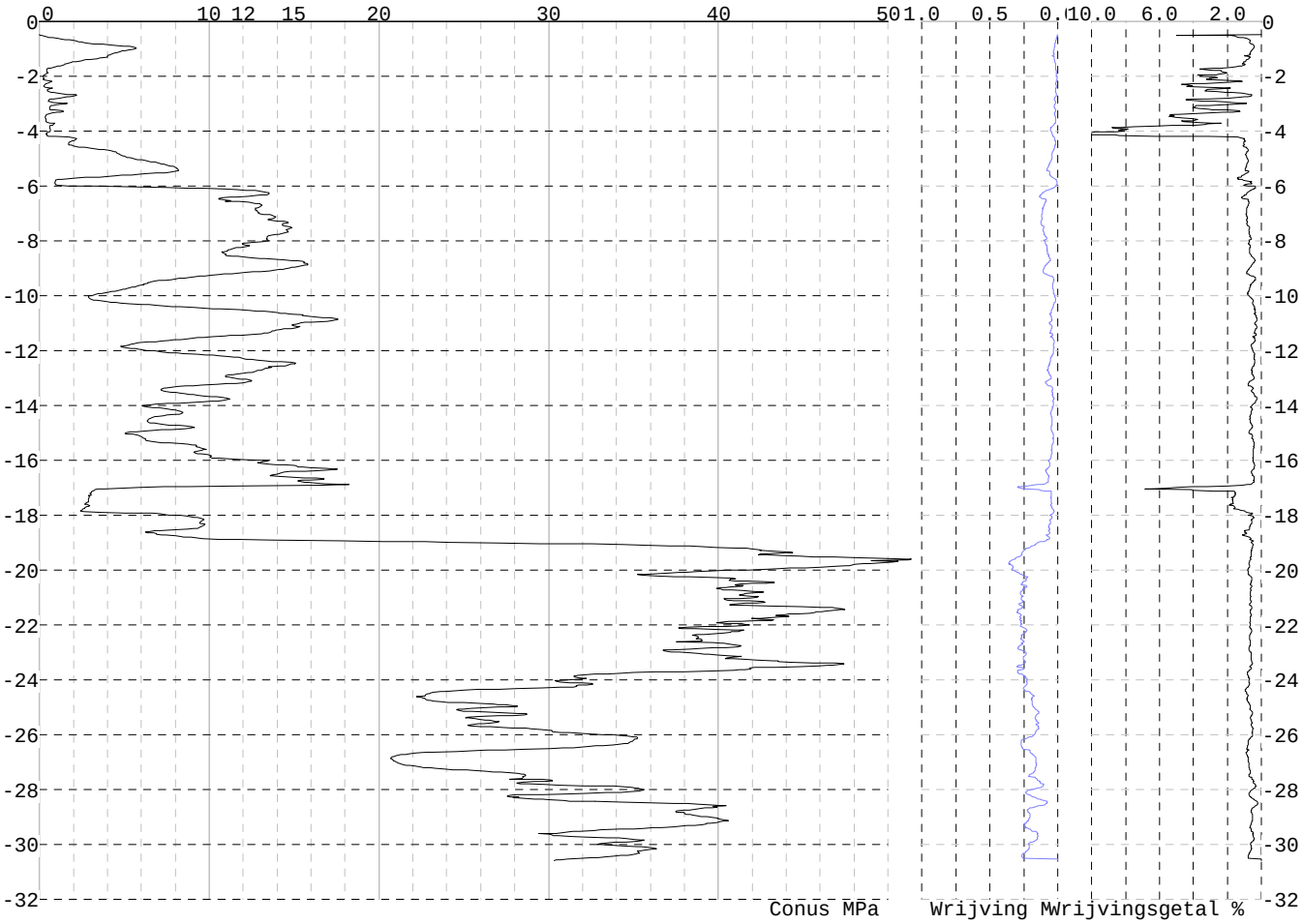


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 9-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.49 Bodemprofiel: 9-1
Traject negatieve kleef : -0.49 tot -4.20 [m]
Traject positieve kleef : -4.20 tot -30.60 [m]

SONDERINGSGEGEVENS GRAFIEK: 9-1

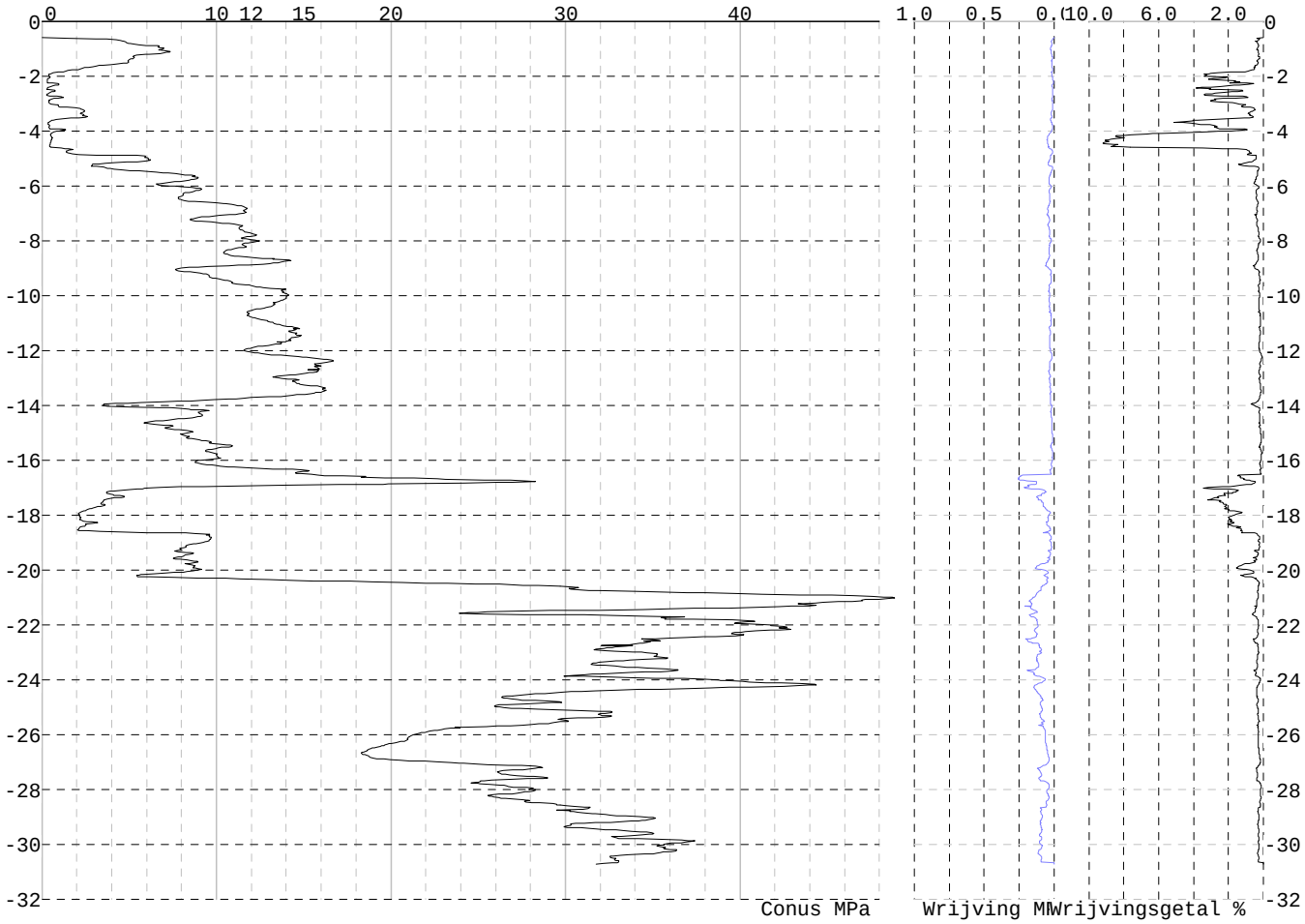


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 9-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.60 Bodemprofiel: 9-1
Traject negatieve kleef : -0.60 tot -4.70 [m]
Traject positieve kleef : -4.70 tot -30.73 [m]

SONDERINGSGEGEVENS GRAFIEK: 9-2



REKENGEGEVENS Mast 1

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 1-1, 1-2, 1-3, 1-4
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.52
Paalpuntniveau : N.A.P. -20.02
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 1 (n=1)

Project :
Onderdeel :

Sondering : 1-1
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.02	-20.02	223.9	2200.4	2200.4	0.0	0.00

Sondering : 1-2
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.02	-20.02	224.2	2503.5	2503.5	0.0	0.00

Sondering : 1-3
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.02	-20.02	223.4	2631.1	2631.1	0.0	0.00

Sondering : 1-4
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.02	-20.02	223.9	2300.2	2300.2	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 1 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
1-1	-1.14	-20.02	2200.4	2200.4	2200.4
1-2	-1.18	-20.02	2503.5	2503.5	2503.5
1-3	-1.09	-20.02	2631.1	2631.1	2631.1
1-4	-1.14	-20.02	2300.2	2300.2	2300.2

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 1 (van 4 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=4)}$: 1.28
Correlatiefactor $\xi_{4min(n=4)}$: 1.03

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.28				
1-1	-1.14	-20.02	223.9	2370.2
1-2	-1.18	-20.02	223.9	2699.4
1-3	-1.09	-20.02	223.9	2838.0
1-4	-1.14	-20.02	223.9	2478.7
		-20.02	$R_{t;cal;gem}$	2596.6
met ξ_4(min) = 1.03				
1-1	-1.14	-20.02	223.9	2891.2
1-2	-1.18	-20.02	223.9	3300.2
1-3	-1.09	-20.02	223.9	3472.6
1-4	-1.14	-20.02	223.9	3026.0
		-20.02	$R_{t;cal;min}$	2891.2

Totaal resultaten Mast 1 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
1-1 1-2 1-3 1-4

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-20.02 $R_{t;d}$ = min.{ 2596.6; 2891.2}= 2596.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-20.02	2596.6	2596.6	0.0	2596.6	0.00

REKENGEGEVENS Mast 2

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 2-1, 2-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.71
Paalpuntniveau : N.A.P. -17.11
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

RESULTATEN Mast 2 (n=1)

Sondering : 2-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.11	-17.11	51.2	552.8	552.8	0.0	0.00

Sondering : 2-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.11	-17.11	51.1	513.1	513.1	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 2 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
2-1	-1.20	-17.11	552.8	552.8	552.8
2-2	-1.13	-17.11	513.1	513.1	513.1

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 2 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
2-1	-1.20	-17.11	51.2	579.4
2-2	-1.13	-17.11	51.2	537.6
		-17.11	$R_{t;cal;gem}$	558.5
met ξ_4(min) = 1.32				
2-1	-1.20	-17.11	51.2	579.4
2-2	-1.13	-17.11	51.2	537.6
		-17.11	$R_{t;cal;min}$	537.6

Totaal resultaten Mast 2 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
2-1 2-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-17.11	$R_{t;d}$ = min.{ 558.5; 537.6}= 537.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.11	537.6	537.6	0.0	537.6	0.00

REKENGEGEVENS Mast 3

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 3-1, 3-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.59
Paalpuntniveau : N.A.P. -17.59
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 3 (n=1)

Project :
Onderdeel :

Sondering : 3-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.59	-17.59	53.4	609.8	609.8	0.0	0.00

Sondering : 3-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.59	-17.59	53.4	643.7	643.7	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 3 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
3-1	-1.24	-17.59	609.8	609.8	609.8
3-2	-1.25	-17.59	643.7	643.7	643.7

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 3 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
3-1	-1.24	-17.59	53.4	639.3
3-2	-1.25	-17.59	53.4	675.0
		-17.59	$R_{t;cal;gem}$	657.1
met ξ_4(min) = 1.32				
3-1	-1.24	-17.59	53.4	639.3
3-2	-1.25	-17.59	53.4	675.0
		-17.59	$R_{t;cal;min}$	639.3

Totaal resultaten Mast 3 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
3-1 3-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-17.59 $R_{t;d}$ = min.{ 657.1; 639.3}= 639.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.59	639.3	639.3	0.0	639.3	0.00

REKENGEGEVENS Mast 4

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 4-1, 4-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.47
Paalpuntniveau : N.A.P. -18.12
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 4 (n=1)

Project :
Onderdeel :

Sondering : 4-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.12	-18.12	55.1	531.1	531.1	0.0	0.00

Sondering : 4-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.12	-18.12	55.1	538.1	538.1	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 4 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
4-1	-1.05	-18.12	531.1	531.1	531.1
4-2	-1.06	-18.12	538.1	538.1	538.1

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 4 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
4-1	-1.05	-18.12	55.1	556.4
4-2	-1.06	-18.12	55.1	563.7
		-18.12	$R_{t;cal;gem}$	560.1
met ξ_4(min) = 1.32				
4-1	-1.05	-18.12	55.1	556.4
4-2	-1.06	-18.12	55.1	563.7
		-18.12	$R_{t;cal;min}$	556.4

Totaal resultaten Mast 4 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
4-1 4-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-18.12 $R_{t;d}$ = min.{ 560.1; 556.4}= 556.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.12	556.4	556.4	0.0	556.4	0.00

REKENGEGEVENS Mast 5

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 5-1, 5-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.43
Paalpuntniveau : N.A.P. -18.93
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 5 (n=1)

Project :
Onderdeel :

Sondering : 5-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.93	-18.93	57.4	567.0	567.0	0.0	0.00

Sondering : 5-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.93	-18.93	57.1	507.6	507.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 5 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
5-1	-0.95	-18.93	567.0	567.0	567.0
5-2	-0.85	-18.93	507.6	507.6	507.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 5 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
5-1	-0.95	-18.93	57.4	594.1
5-2	-0.85	-18.93	57.4	531.4
		-18.93	$R_{t;cal;gem}$	562.7
met ξ_4(min) = 1.32				
5-1	-0.95	-18.93	57.4	594.1
5-2	-0.85	-18.93	57.4	531.4
		-18.93	$R_{t;cal;min}$	531.4

Totaal resultaten Mast 5 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
5-1 5-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-18.93 $R_{t;d}$ = min.{ 562.7; 531.4}= 531.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.93	531.4	531.4	0.0	531.4	0.00

REKENGEGEVENS Mast 6

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 6-1, 6-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.48
Paalpuntniveau : N.A.P. -20.83
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 6 (n=1)

Project :
Onderdeel :

Sondering : 6-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.83	-20.83	230.7	2968.0	2968.0	0.0	0.00

Sondering : 6-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.83	-20.83	230.7	3038.4	3038.4	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 6 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
6-1	-0.85	-20.83	2968.0	2968.0	2968.0
6-2	-0.81	-20.83	3038.4	3038.4	3038.4

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 6 (van 2 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
6-1	-0.85	-20.83	230.7	3113.1
6-2	-0.81	-20.83	230.7	3187.3
		-20.83	$R_{t;cal;gem}$	3150.2
met ξ_4(min) = 1.32				
6-1	-0.85	-20.83	230.7	3113.1
6-2	-0.81	-20.83	230.7	3187.3
		-20.83	$R_{t;cal;min}$	3113.1

Totaal resultaten Mast 6 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
6-1 6-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]: -20.83 $R_{t;d}$ = min.{ 3150.2; 3113.1}= 3113.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-20.83	3113.1	3113.1	0.0	3113.1	0.00

REKENGEGEVENS Mast 7

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 7-1, 7-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.23
Paalpuntniveau : N.A.P. -16.13
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 7 (n=1)

Project :
Onderdeel :

Sondering : 7-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.13	-16.13	49.8	621.7	621.7	0.0	0.00

Sondering : 7-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.13	-16.13	49.8	614.9	614.9	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 7 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
7-1	-0.75	-16.13	621.7	621.7	621.7
7-2	-0.77	-16.13	614.9	614.9	614.9

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 7 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
7-1	-0.75	-16.13	49.8	652.0
7-2	-0.77	-16.13	49.8	644.8
		-16.13	$R_{t;cal;gem}$	648.4
met ξ_4(min) = 1.32				
7-1	-0.75	-16.13	49.8	652.0
7-2	-0.77	-16.13	49.8	644.8
		-16.13	$R_{t;cal;min}$	644.8

Totaal resultaten Mast 7 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
7-1 7-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.13	$R_{t;d}$ = min.{ 648.4; 644.8}= 644.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.13	644.8	644.8	0.0	644.8	0.00

REKENGEGEVENS Mast 8

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 8-1, 8-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.18
Paalpuntniveau : N.A.P. -18.18
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 8 (n=1)

Project :
Onderdeel :

Sondering : 8-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.18	-18.18	55.9	623.9	623.9	0.0	0.00

Sondering : 8-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.18	-18.18	55.9	672.5	672.5	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 8 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
8-1	-0.70	-18.18	623.9	623.9	623.9
8-2	-0.69	-18.18	672.5	672.5	672.5

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 8 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
8-1	-0.70	-18.18	55.9	654.0
8-2	-0.69	-18.18	55.9	705.2
		-18.18	$R_{t;cal;gem}$	679.6
met ξ_4(min) = 1.32				
8-1	-0.70	-18.18	55.9	654.0
8-2	-0.69	-18.18	55.9	705.2
		-18.18	$R_{t;cal;min}$	654.0

Totaal resultaten Mast 8 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
8-1 8-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-18.18 $R_{t;d}$ = min.{ 679.6; 654.0}= 654.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.18	654.0	654.0	0.0	654.0	0.00

REKENGEGEVENS Mast 9

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 9-1, 9-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.15
Paalpuntniveau : N.A.P. -16.65
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 9 (n=1)

Project :
Onderdeel :

Sondering : 9-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.65	-16.65	51.1	590.1	590.1	0.0	0.00

Sondering : 9-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.65	-16.65	51.1	671.7	671.7	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 9 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
9-1	-0.49	-16.65	590.1	590.1	590.1
9-2	-0.60	-16.65	671.7	671.7	671.7

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 9 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
9-1	-0.49	-16.65	51.1	618.7
9-2	-0.60	-16.65	51.1	704.6
		-16.65	$R_{t;cal;gem}$	661.7
met ξ_4(min) = 1.32				
9-1	-0.49	-16.65	51.1	618.7
9-2	-0.60	-16.65	51.1	704.6
		-16.65	$R_{t;cal;min}$	618.7

Totaal resultaten Mast 9 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
9-1 9-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.65	$R_{t;d}$ = min.{ 661.7; 618.7}= 618.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.65	618.7	618.7	0.0	618.7	0.00

PAALGEGEVENS BP 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project :
Onderdeel :

PAALGEGEVENS GI 914_1075

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 1.075
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{t;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 1	Mast 2	Mast 3	Mast 4	Mast 5
1-1	-1.14	-20.02	2200				
1-2	-1.18	-20.02	2503				
1-3	-1.09	-20.02	2631				
1-4	-1.14	-20.02	2300				
2-1	-1.20	-17.11		552			
2-2	-1.13	-17.11		513			
3-1	-1.24	-17.59			609		
3-2	-1.25	-17.59			643		
4-1	-1.05	-18.12				531	
4-2	-1.06	-18.12				538	
5-1	-0.95	-18.93					567
5-2	-0.85	-18.93					507

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 6	Mast 7	Mast 8	Mast 9
6-1	-0.85	-20.83	2967			
6-2	-0.81	-20.83	3038			
7-1	-0.75	-16.13		621		
7-2	-0.77	-16.13		614		
8-1	-0.70	-18.18			623	
8-2	-0.69	-18.18			672	
9-1	-0.49	-16.65				590
9-2	-0.60	-16.65				671

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 10-19 (10 11 12 13 14 19).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
9	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
10	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
11	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
12	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
13	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
14	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
15	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00

BODEMPROFIELGEGEVENS: 10-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.50 Grondwaterstand [m] : -1.50

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.50	-1.97	Zand - Schoon - Los	1.0	100.0		
2	-1.97	-3.65	Leem - Zwak zandig - Vast	1.0	50.0		
3	-3.65	-4.15	Klei - Schoon - Matig	1.0	50.0		
4	-4.15	-5.18	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-5.18	-6.26	Klei - Zwak zandig - Slap	1.0	50.0		
6	-6.26	-6.66	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-6.66	-9.92	Zand - Schoon - Vast	1.0	100.0		
8	-9.92	-13.73	Zand - Schoon - Matig	1.0	100.0		
9	-13.73	-14.43	Zand - Schoon - Los	1.0	100.0		
10	-14.43	-15.49	Zand - Schoon - Vast	1.0	100.0		
11	-15.49	-15.75	Zand - Schoon - Los	1.0	100.0		
12	-15.75	-16.63	Klei - Zwak zandig - Matig	1.0	50.0		
13	-16.63	-17.85	Leem - Zwak zandig - Vast	1.0	50.0		
14	-17.85	-18.87	Zand - Schoon - Los	1.0	100.0		
15	-18.87	-25.10	Zand - Schoon - Matig	1.0	100.0		
16	-25.10	-29.64	Zand - Schoon - Vast	1.0	100.0		
17	-29.64	-30.52	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 11-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 2.70 Grondwaterstand [m] : 1.70

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	2.70	1.91	Leem - Zwak zandig - Vast	1.0	50.0		
2	1.91	-0.79	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-0.79	-1.05	Klei - Zwak zandig - Matig	1.0	50.0		
4	-1.05	-2.41	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-2.41	-3.33	Klei - Schoon - Matig	1.0	50.0		
6	-3.33	-4.31	Leem - Zwak zandig - Vast	1.0	50.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
7	-4.31	-6.11	Klei - Zwak zandig - Slap	1.0	50.0		
8	-6.11	-6.89	Zand - Schoon - Matig	1.0	100.0		
9	-6.89	-7.27	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-7.27	-7.65	Zand - Schoon - Los	1.0	100.0		
11	-7.65	-8.81	Zand - Schoon - Matig	1.0	100.0		
12	-8.81	-10.09	Zand - Zwak siltig - Kleiig	1.0	100.0		
13	-10.09	-12.57	Zand - Schoon - Los	1.0	100.0		
14	-12.57	-14.99	Leem - Zwak zandig - Vast	1.0	50.0		
15	-14.99	-18.50	Zand - Sterk siltig - Kleiig	1.0	100.0		
16	-18.50	-19.38	Zand - Schoon - Los	1.0	100.0		
17	-19.38	-27.43	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 13-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.08 Grondwaterstand [m] : -0.92

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.08	-0.43	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.43	-1.87	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-1.87	-3.03	Klei - Zwak zandig - Vast	1.0	50.0		
4	-3.03	-3.91	Klei - Organisch - Matig	1.0	50.0		
5	-3.91	-5.37	Zand - Schoon - Los	1.0	100.0		
6	-5.37	-6.35	Klei - Zwak zandig - Vast	1.0	50.0		
7	-6.35	-12.67	Zand - Schoon - Los	1.0	100.0		
8	-12.67	-13.05	Klei - Zwak zandig - Slap	1.0	50.0		
9	-13.05	-24.08	Zand - Schoon - Matig	1.0	100.0		
10	-24.08	-24.46	Zand - Schoon - Los	1.0	100.0		
11	-24.46	-29.93	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 14-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.25 Grondwaterstand [m] : -1.25

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.25	-2.48	Leem - Zwak zandig - Vast	1.0	50.0		
2	-2.48	-4.24	Klei - Organisch - Matig	1.0	50.0		
3	-4.24	-11.86	Zand - Schoon - Los	1.0	100.0		
4	-11.86	-14.86	Zand - Schoon - Matig	1.0	100.0		
5	-14.86	-16.16	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-16.16	-20.41	Zand - Schoon - Matig	1.0	100.0		
7	-20.41	-20.89	Leem - Zwak zandig - Vast	1.0	50.0		
8	-20.89	-22.23	Zand - Schoon - Vast	1.0	100.0		
9	-22.23	-23.09	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-23.09	-24.17	Leem - Zwak zandig - Vast	1.0	50.0		
11	-24.17	-25.79	Zand - Schoon - Los	1.0	100.0		
12	-25.79	-30.37	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 19-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.40 Grondwaterstand [m] : -0.60

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.40	-0.29	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.29	-2.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-2.21	-3.13	Leem - Zwak zandig - Vast	1.0	50.0		
4	-3.13	-5.51	Klei - Zwak zandig - Slap	1.0	50.0		
5	-5.51	-8.03	Zand - Schoon - Matig	1.0	100.0		
6	-8.03	-13.19	Zand - Schoon - Los	1.0	100.0		
7	-13.19	-14.05	Zand - Schoon - Vast	1.0	100.0		
8	-14.05	-14.61	Zand - Schoon - Matig	1.0	100.0		
9	-14.61	-20.05	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-20.05	-21.16	Zand - Schoon - Matig	1.0	100.0		
11	-21.16	-29.74	Zand - Sterk siltig - Kleiig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: Bodemprofiel 15

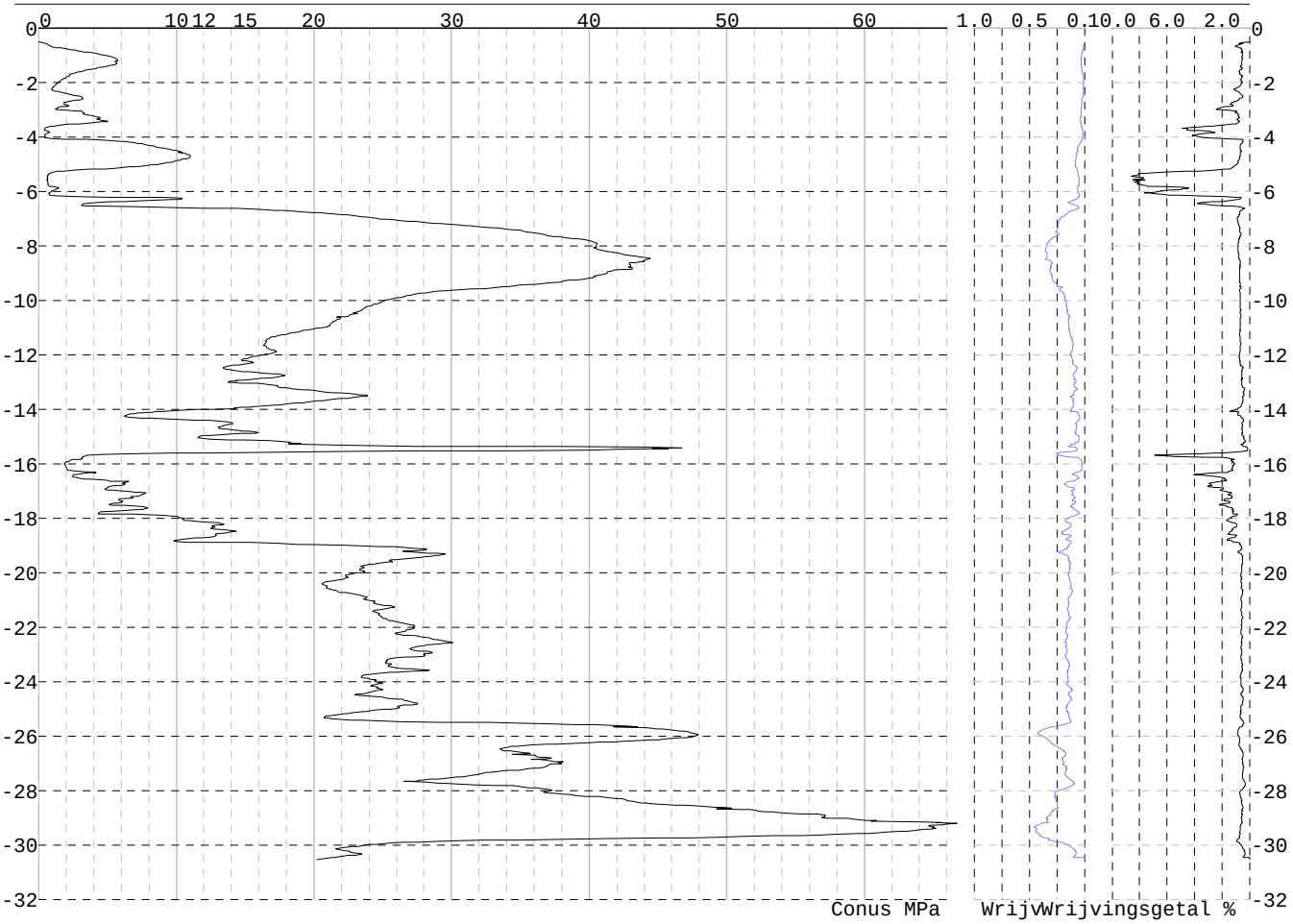
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 3.25 Grondwaterstand [m] : 2.25

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	3.25	2.00	Klei - Zwak zandig - Matig	1.0	50.0		
2	2.00	0.50	Zand - Schoon - Matig	1.0	100.0		
3	0.50	-0.50	Leem - Zwak zandig - Matig	1.0	50.0		
4	-0.50	-1.00	Klei - Zwak zandig - Matig	1.0	50.0		
5	-1.00	-2.50	Zand - Schoon - Matig	1.0	100.0		
6	-2.50	-4.00	Leem - Zwak zandig - Matig	1.0	50.0		
7	-4.00	-6.00	Klei - Zwak zandig - Matig	1.0	50.0		
8	-6.00	-14.50	Zand - Schoon - Matig	1.0	100.0		
9	-14.50	-19.00	Leem - Zwak zandig - Matig	1.0	50.0		
10	-19.00	-40.00	Zand - Schoon - Matig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 10-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.50 Bodemprofiel: 10-1
Traject negatieve kleef : -0.50 tot -6.20 [m]
Traject positieve kleef : -6.20 tot -30.53 [m]

SONDERINGSGEGEVENS GRAFIEK: 10-1

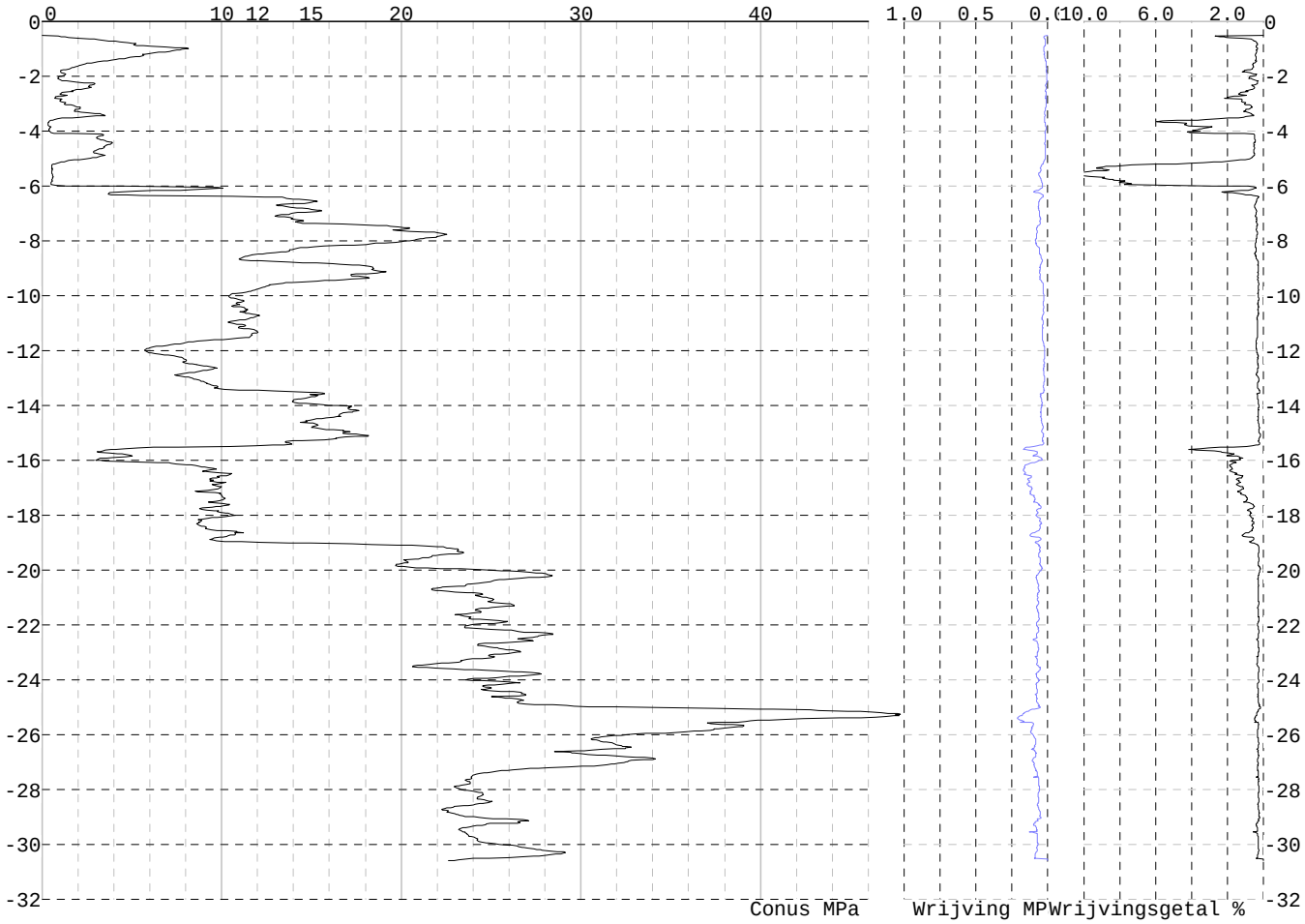


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 10-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.52 Bodemprofiel: 10-1
Traject negatieve kleef : -0.52 tot -5.90 [m]
Traject positieve kleef : -5.90 tot -30.61 [m]

SONDERINGSGEGEVENS GRAFIEK: 10-2

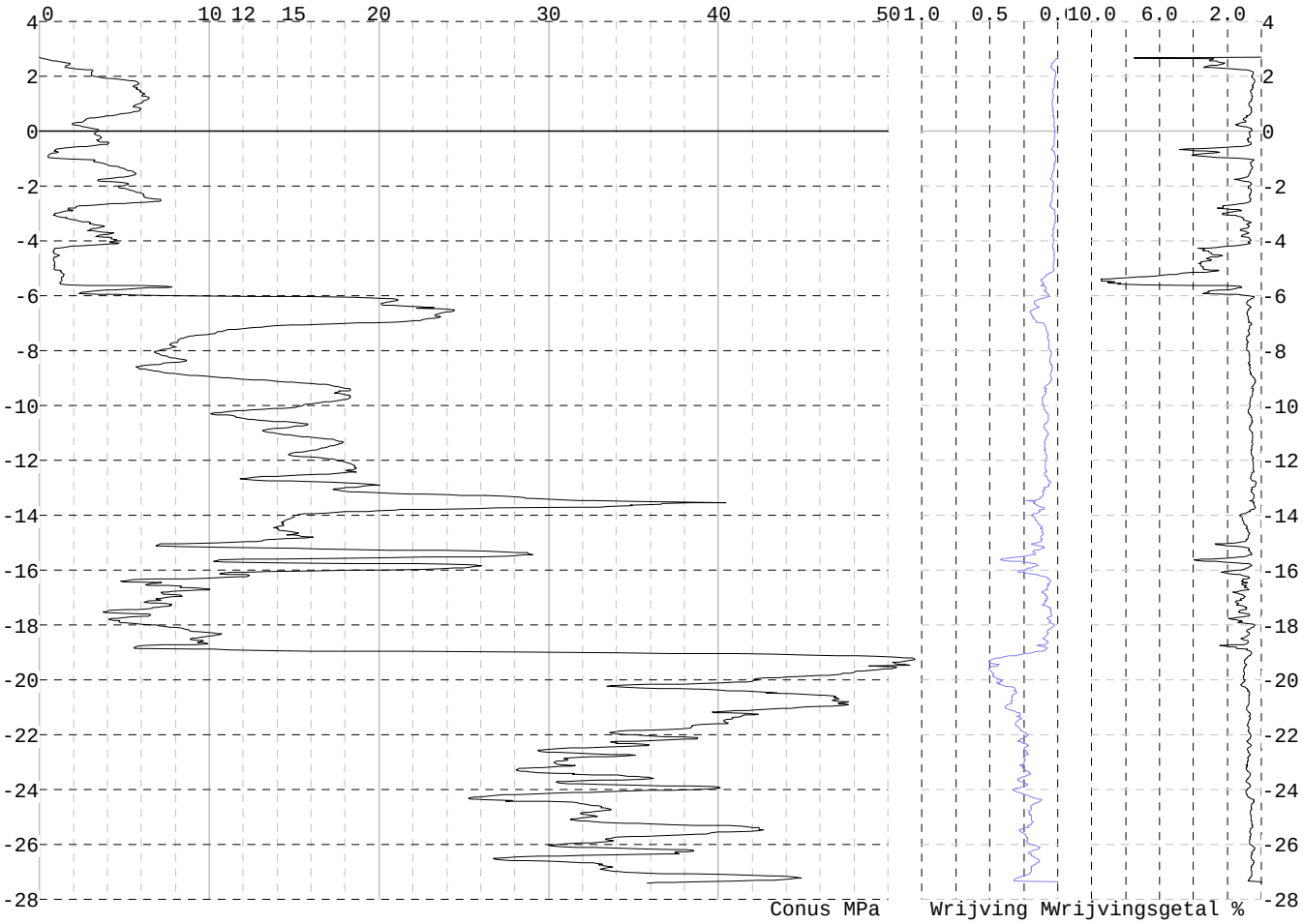


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 11-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 2.68 Bodemprofiel: Bodemprofiel 15
Traject negatieve kleef : 2.68 tot -4.90 [m]
Traject positieve kleef : -6.00 tot -27.43 [m]

SONDERINGSGEGEVENS GRAFIEK: 11-1

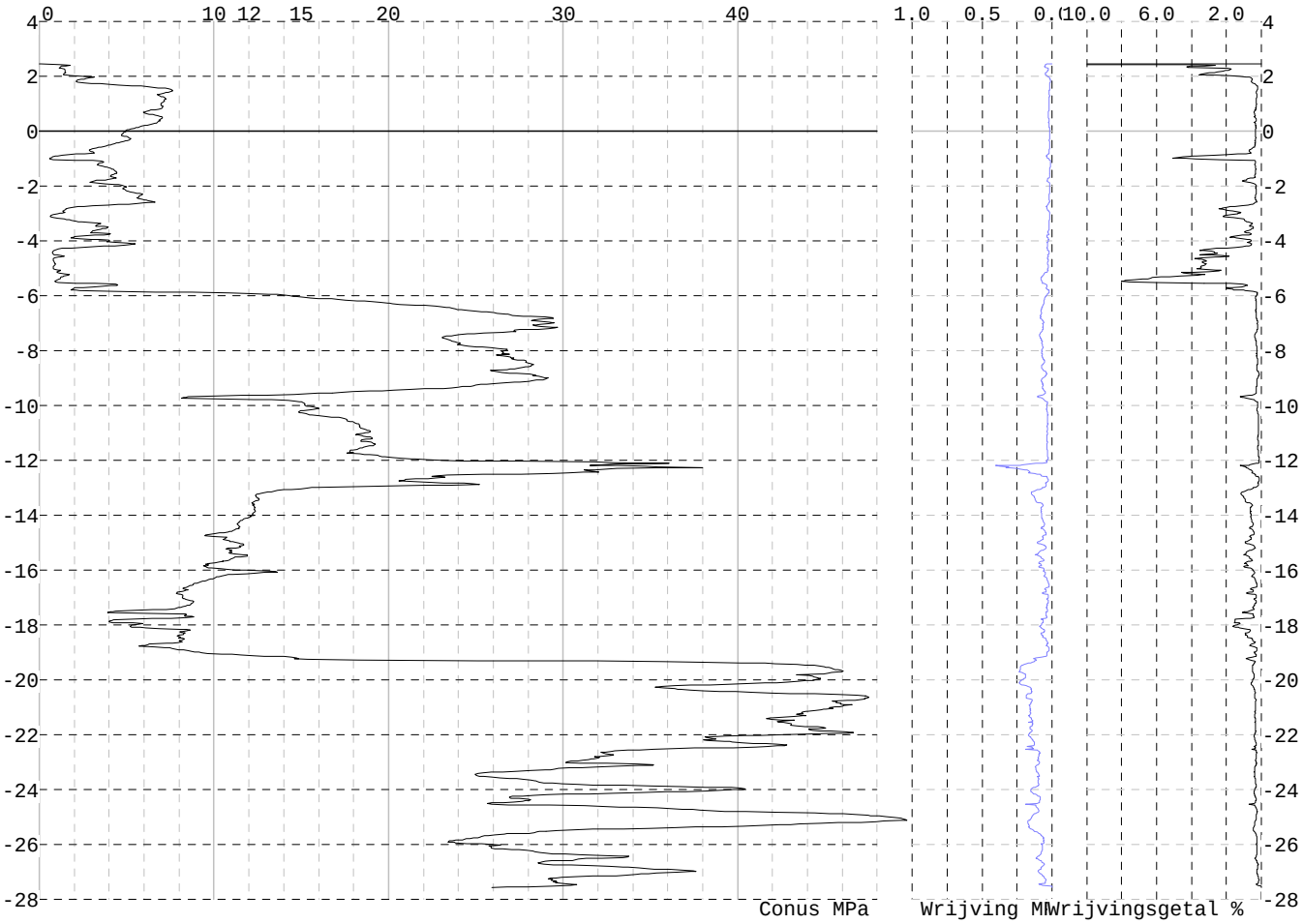


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 11-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 2.45 Bodemprofiel: Bodemprofiel 15
Traject negatieve kleef : 2.45 tot -4.90 [m]
Traject positieve kleef : -5.80 tot -27.59 [m]

SONDERINGSGEGEVENS GRAFIEK: 11-2

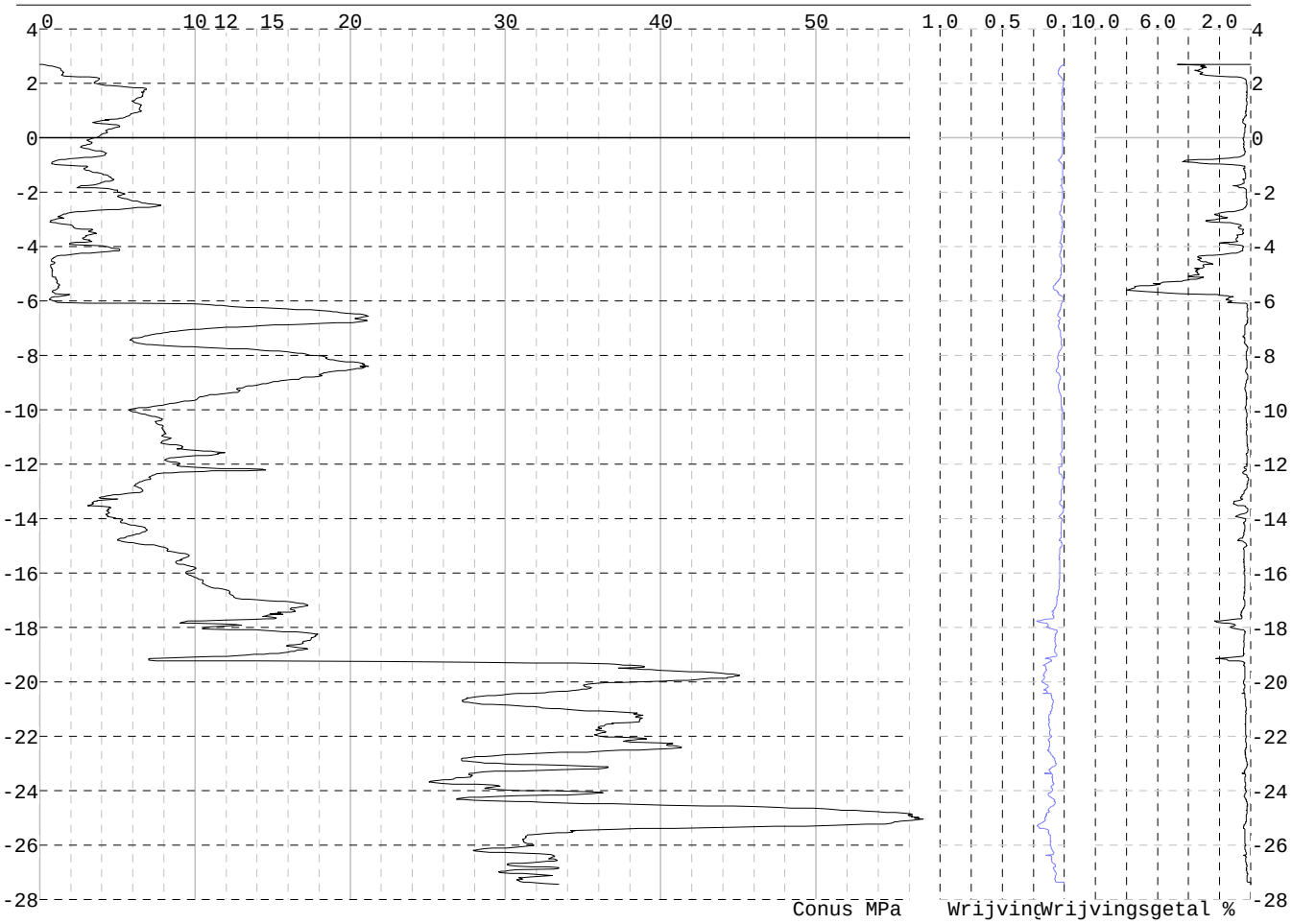


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 11-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 2.70 Bodemprofiel: Bodemprofiel 15
Traject negatieve kleef : 2.70 tot -4.90 [m]
Traject positieve kleef : -6.00 tot -27.44 [m]

SONDERINGSGEGEVENS GRAFIEK: 11-3

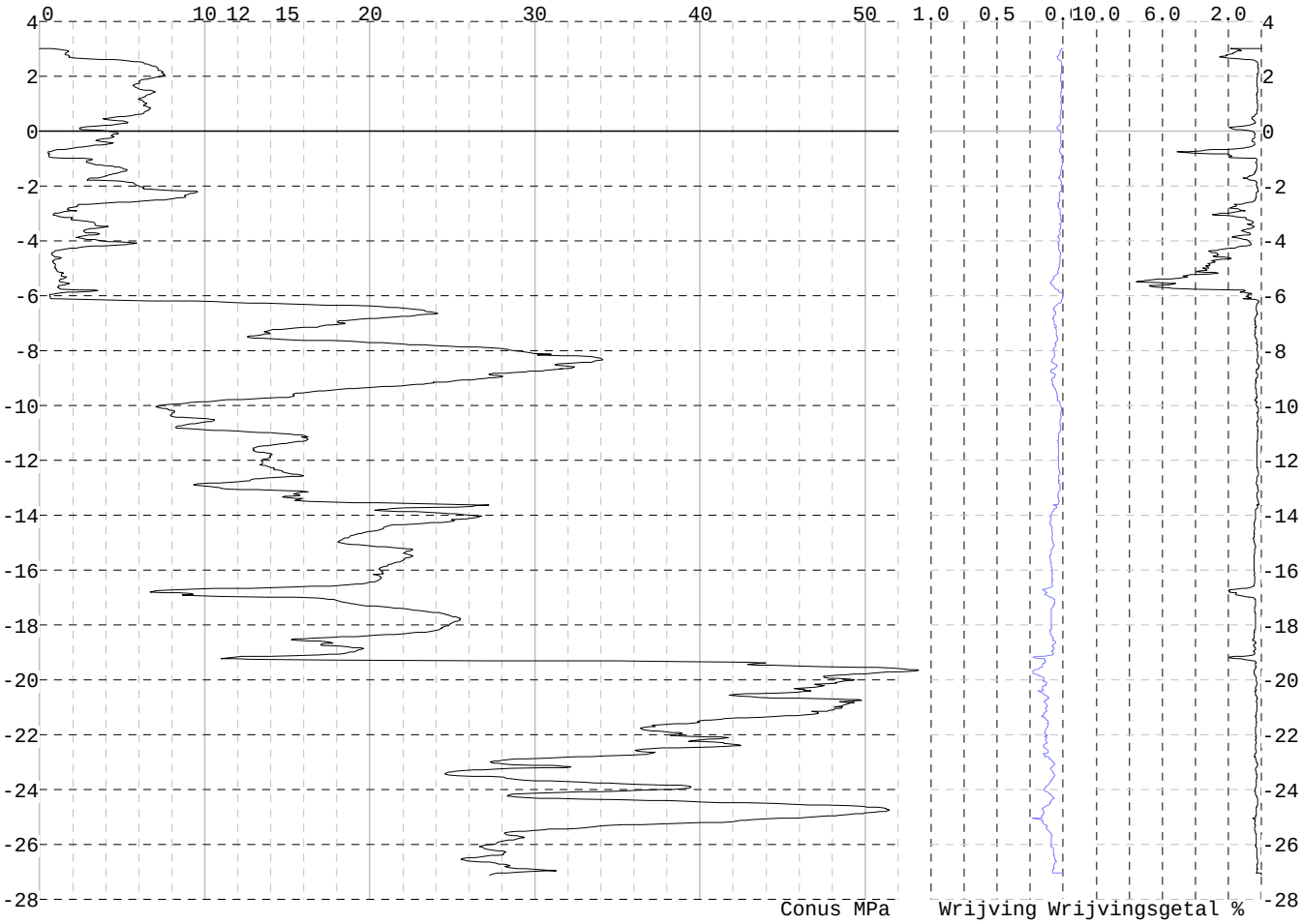


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 11-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 3.01 Bodemprofiel: Bodemprofiel 15
Traject negatieve kleef : 3.01 tot -5.00 [m]
Traject positieve kleef : -6.00 tot -27.12 [m]

SONDERINGSGEGEVENS GRAFIEK: 11-4

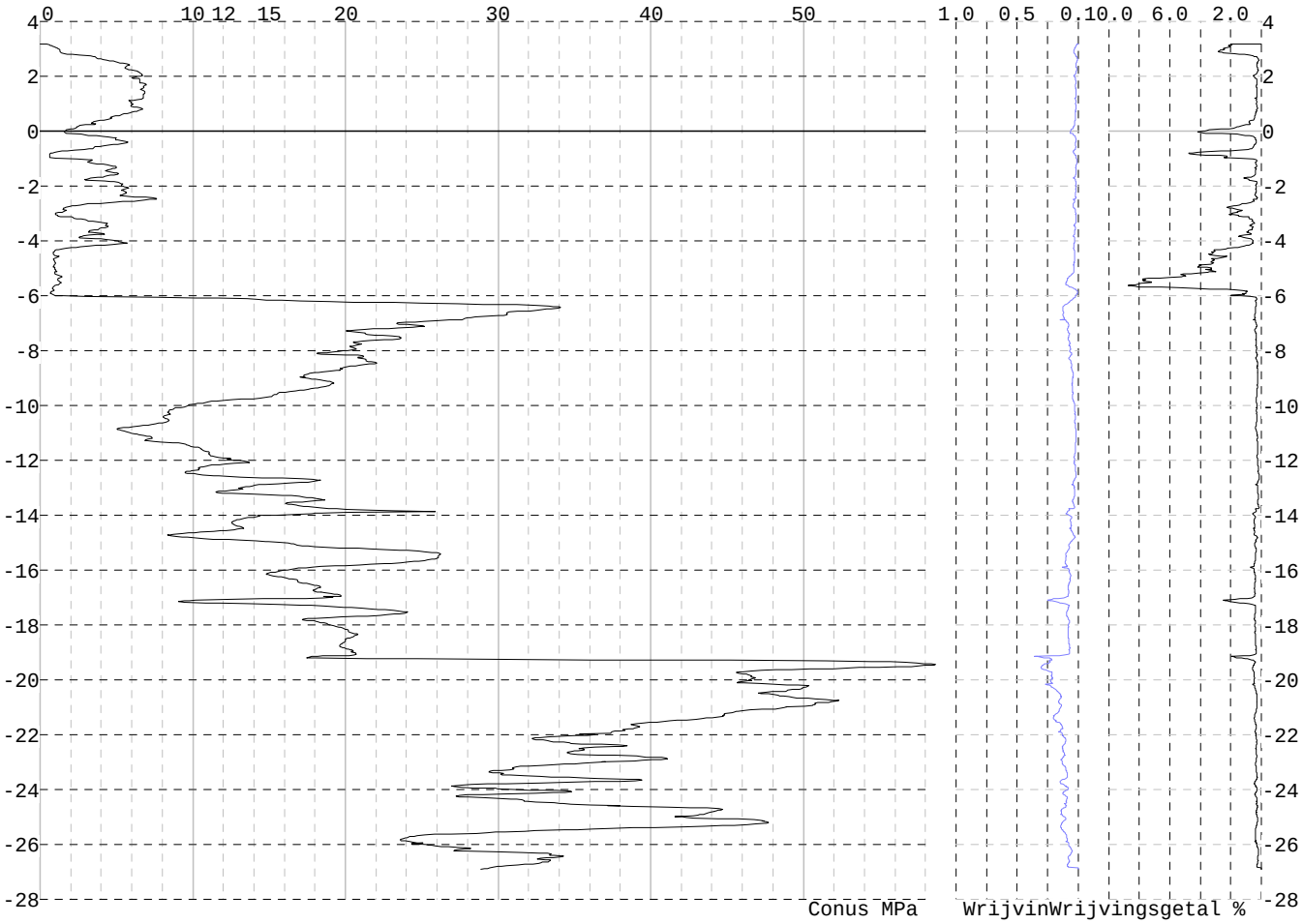


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 11-5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 3.18 Bodemprofiel: Bodemprofiel 15
Traject negatieve kleef : 3.18 tot -5.00 [m]
Traject positieve kleef : -6.00 tot -26.92 [m]

SONDERINGSGEGEVENS GRAFIEK: 11-5

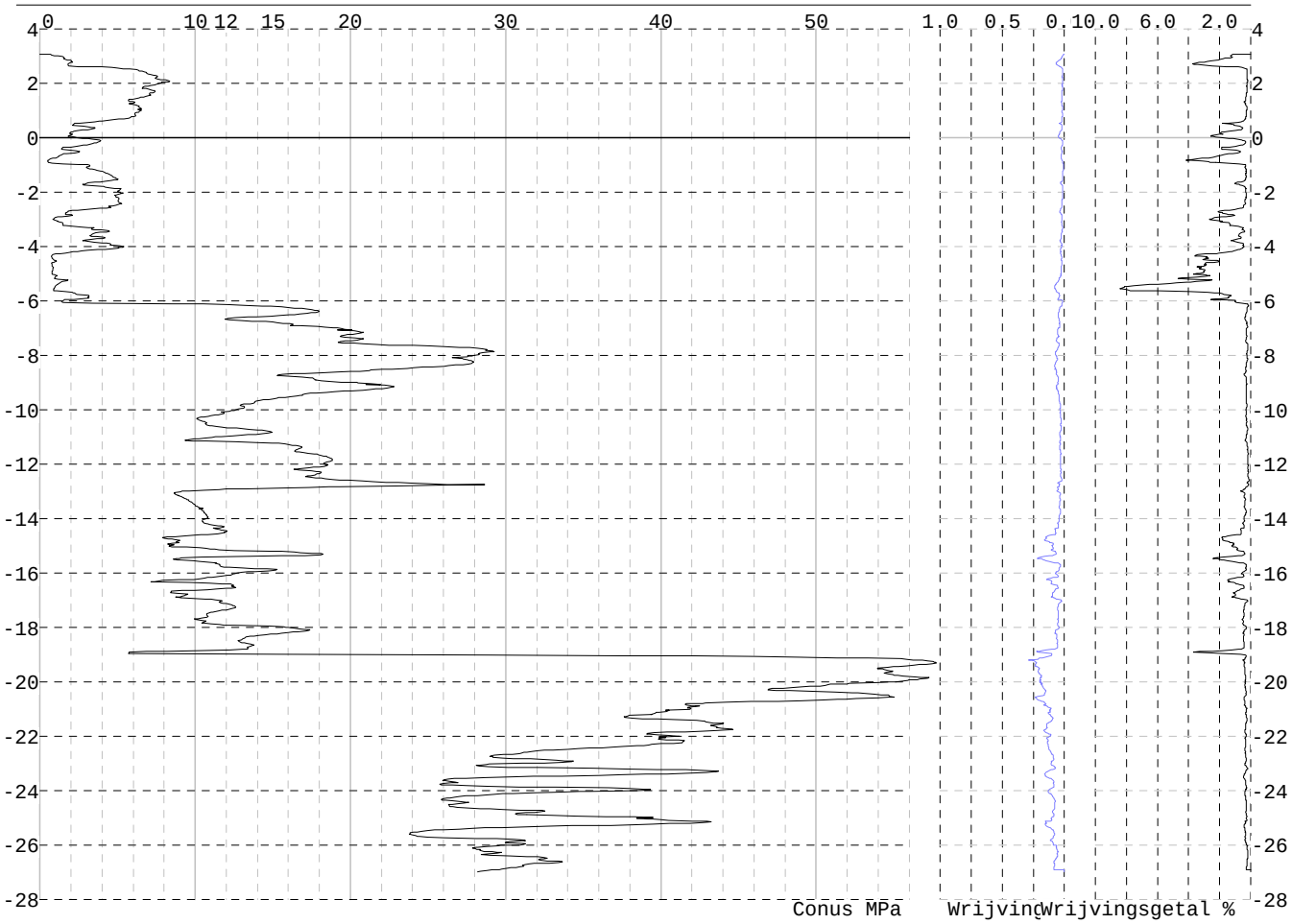


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 11-6

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 3.07 Bodemprofiel: Bodemprofiel 15
Traject negatieve kleef : 3.07 tot -5.00 [m]
Traject positieve kleef : -5.90 tot -26.99 [m]

SONDERINGSGEGEVENS GRAFIEK: 11-6

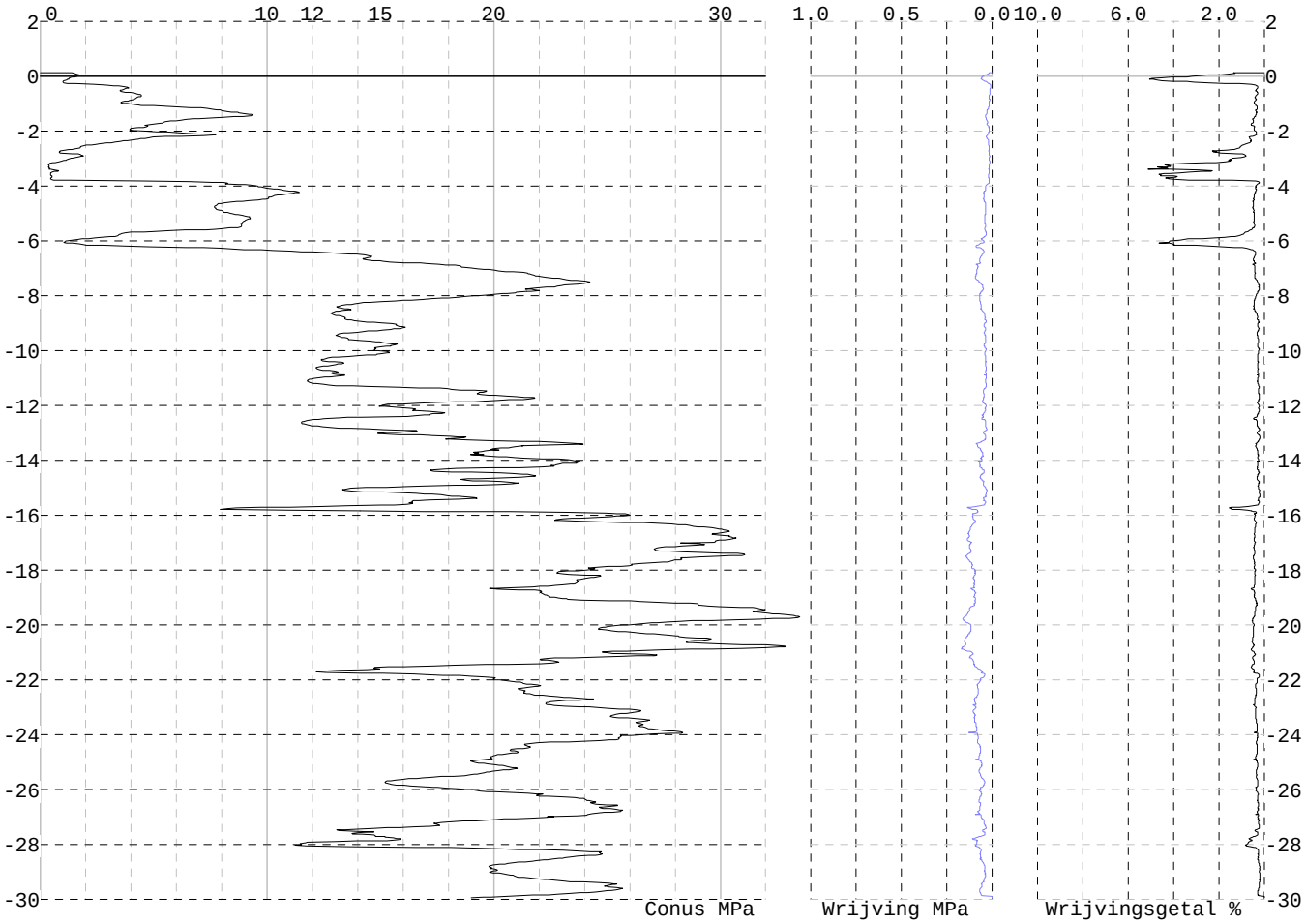


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 13-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.13 Bodemprofiel: 13-2
Traject negatieve kleef : 0.13 tot -3.80 [m]
Traject positieve kleef : -3.80 tot -29.96 [m]

SONDERINGSGEGEVENS GRAFIEK: 13-1

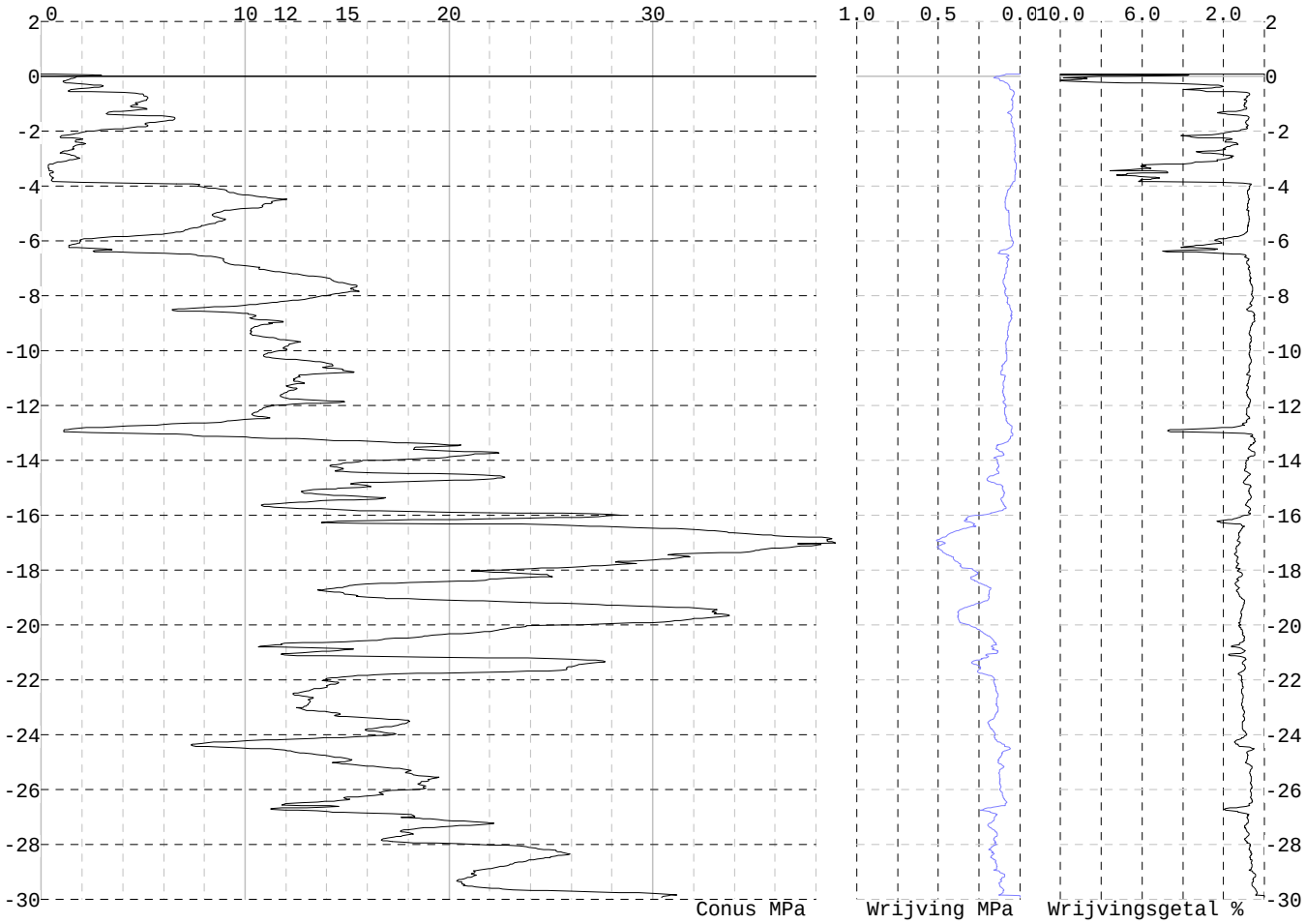


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 13-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.08 Bodemprofiel: 13-2
Traject negatieve kleef : 0.08 tot -4.00 [m]
Traject positieve kleef : -4.00 tot -29.94 [m]

SONDERINGSGEGEVENS GRAFIEK: 13-2

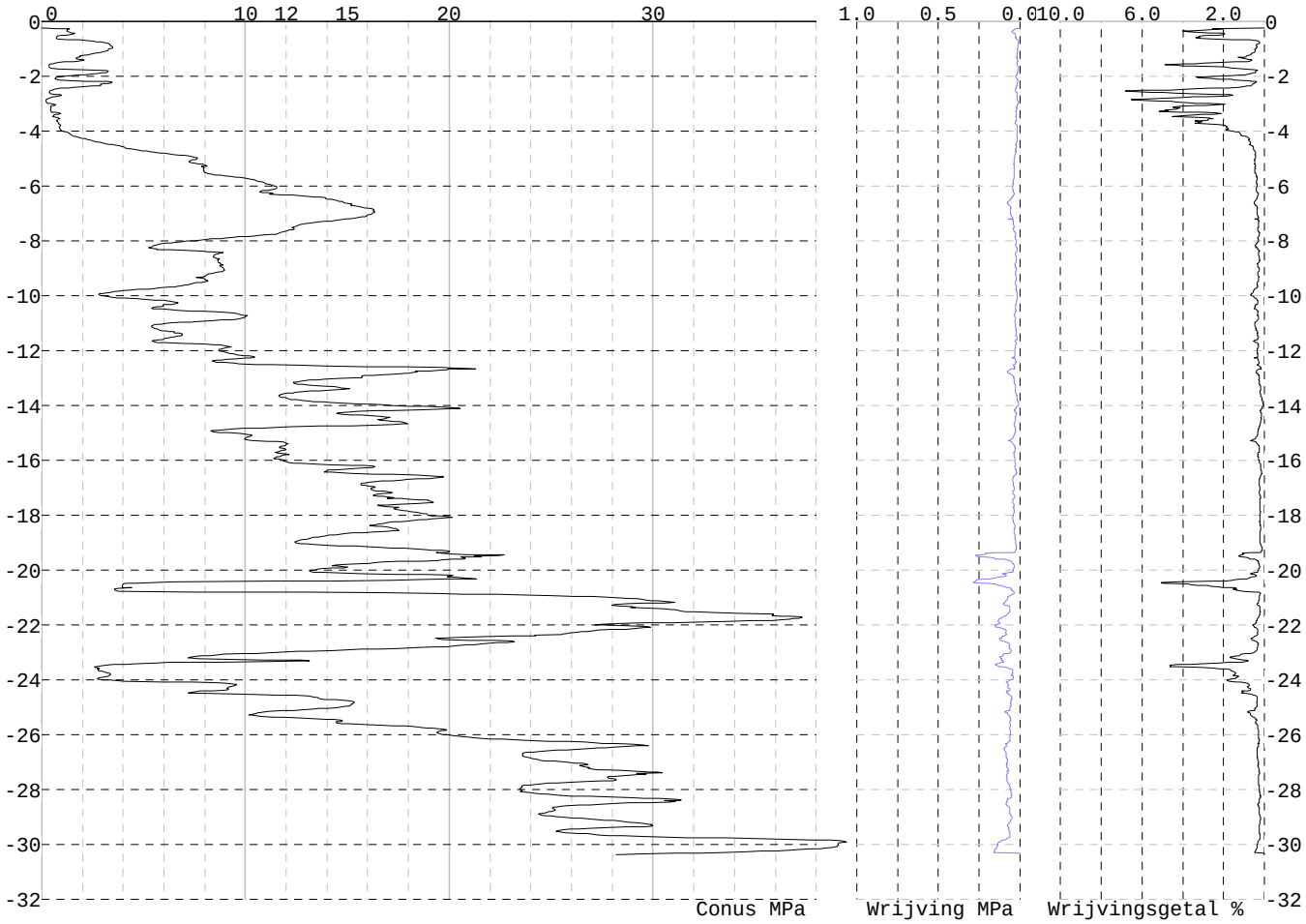


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 14-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.25 Bodemprofiel: 14-1
Traject negatieve kleef : -0.25 tot -4.40 [m]
Traject positieve kleef : -4.40 tot -30.38 [m]

SONDERINGSGEGEVENS GRAFIEK: 14-1

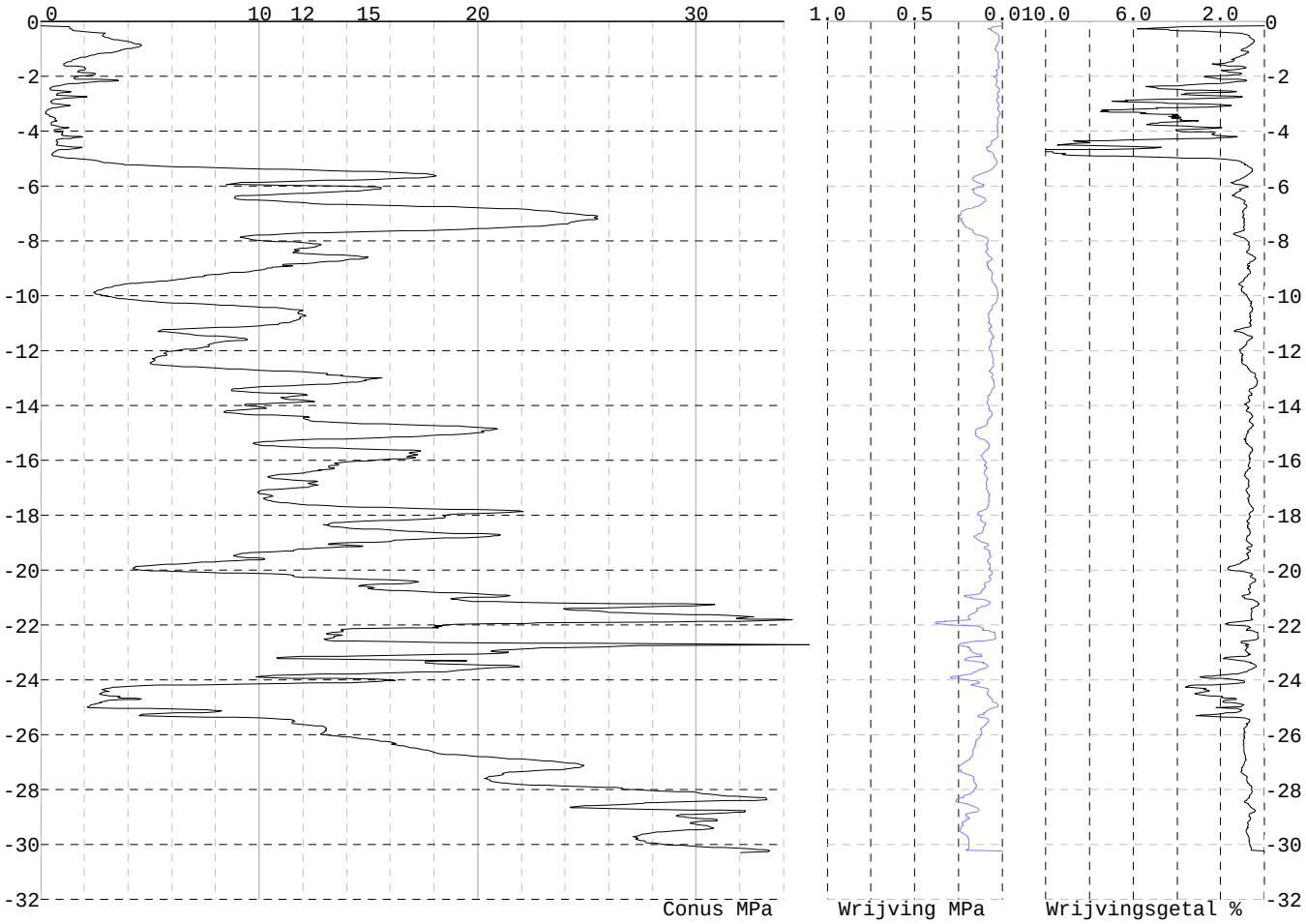


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 14-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.17 Bodemprofiel: 14-1
Traject negatieve kleef : -0.17 tot -5.10 [m]
Traject positieve kleef : -5.10 tot -30.31 [m]

SONDERINGSGEGEVENS GRAFIEK: 14-2

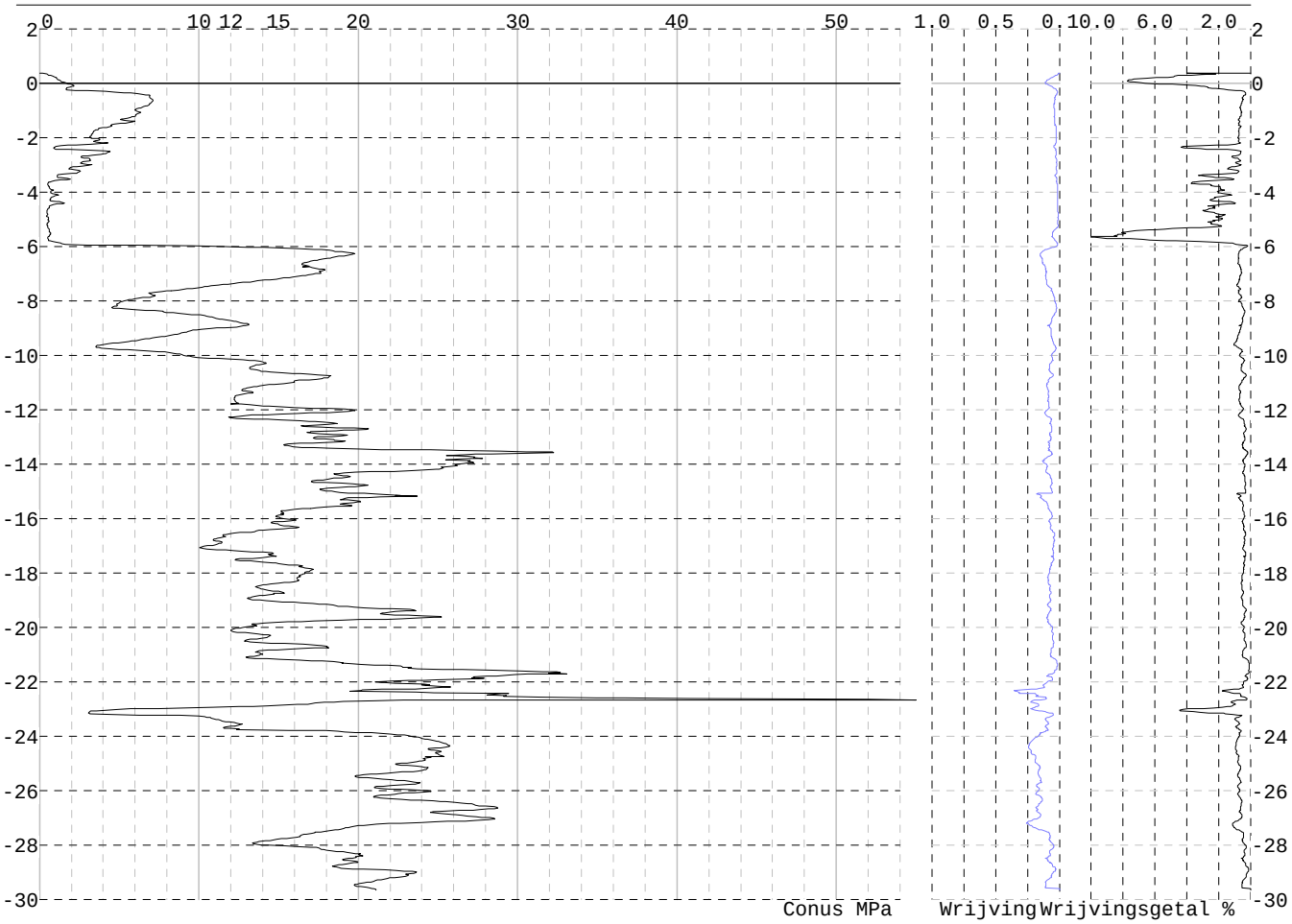


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 19-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.37 Bodemprofiel: 19-2
Traject negatieve kleef : 0.37 tot -6.00 [m]
Traject positieve kleef : -6.00 tot -29.66 [m]

SONDERINGSGEGEVENS GRAFIEK: 19-1

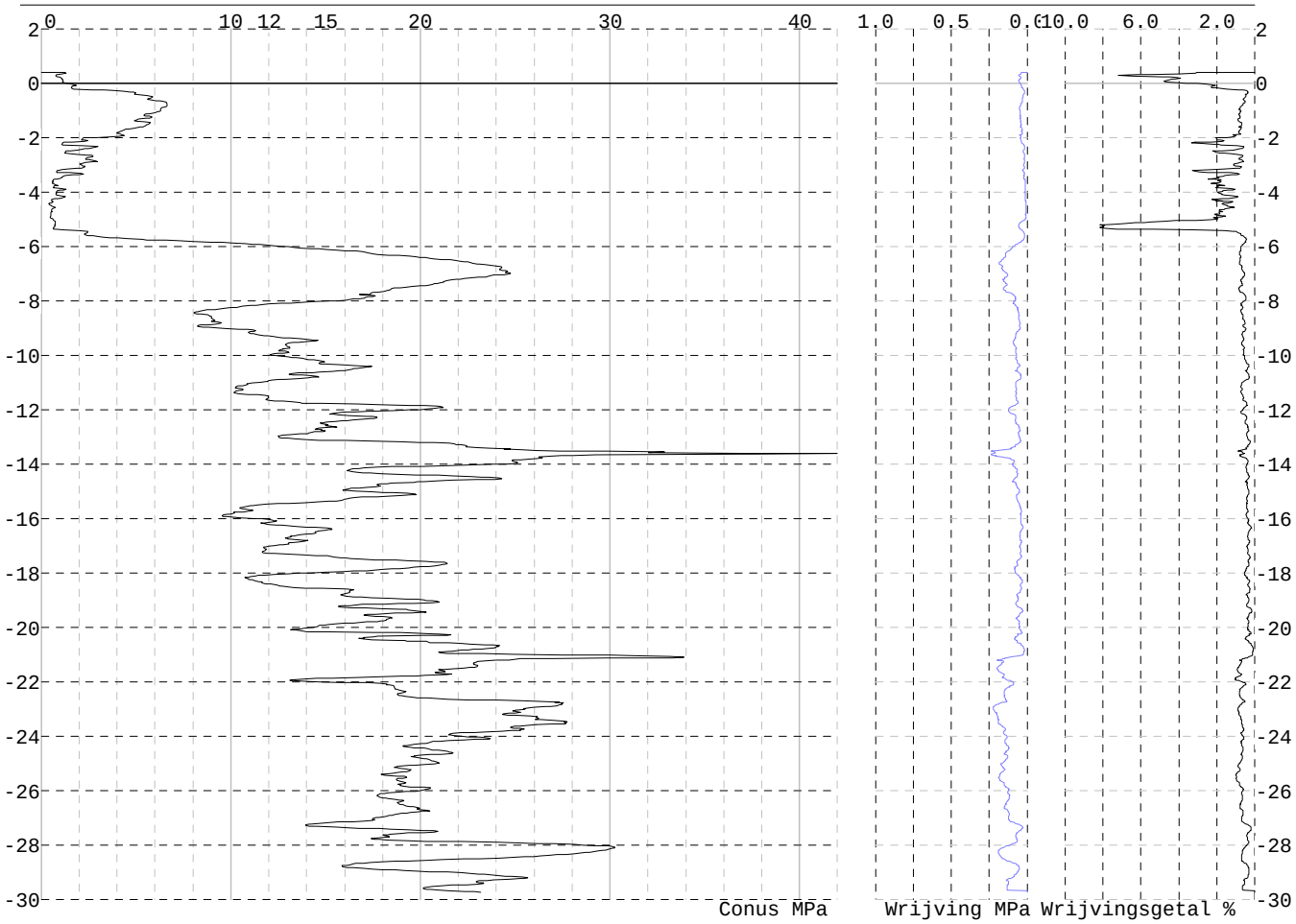


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 19-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.40 Bodemprofiel: 19-2
Traject negatieve kleef : 0.40 tot -5.50 [m]
Traject positieve kleef : -5.50 tot -29.75 [m]

SONDERINGSGEGEVENS GRAFIEK: 19-2



REKENGEGEVENS Mast 11

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 11-1, 11-2, 11-3, 11-4, 11-5, 11-6
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 6
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.27
Factor $\xi_{4\ (min)}$: 1.01
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 610_770
Niveau paalkop [m] : N.A.P. 3.22
Paalpuntniveau : N.A.P. -17.13
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 11 (n=1)

Project :
Onderdeel :

Sondering : 11-1
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.13	-17.13	116.5	1824.2	1824.2	0.0	0.00

Sondering : 11-2
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.13	-17.13	116.5	1975.9	1975.9	0.0	0.00

Sondering : 11-3
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.13	-17.13	116.5	1459.0	1459.0	0.0	0.00

Sondering : 11-4
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.13	-17.13	116.5	1972.6	1972.6	0.0	0.00

Sondering : 11-5
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.13	-17.13	116.5	1918.1	1918.1	0.0	0.00

Sondering : 11-6
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.13	-17.13	116.5	1847.8	1847.8	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 11 (n=1)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
11-1	2.68	-17.13	1824.2	1824.2	1824.2
11-2	2.45	-17.13	1975.9	1975.9	1975.9
11-3	2.70	-17.13	1459.0	1459.0	1459.0
11-4	3.01	-17.13	1972.6	1972.6	1972.6
11-5	3.18	-17.13	1918.1	1918.1	1918.1
11-6	3.07	-17.13	1847.8	1847.8	1847.8

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 11 (van 6 sonderingen)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=6)}$: 1.27
Correlatiefactor $\xi_{4min(n=6)}$: 1.01

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.27				
11-1	2.68	-17.13	116.5	1985.6
11-2	2.45	-17.13	116.5	2151.6
11-3	2.70	-17.13	116.5	1585.9
11-4	3.01	-17.13	116.5	2147.9
11-5	3.18	-17.13	116.5	2088.3
11-6	3.07	-17.13	116.5	2011.3
		-17.13	$R_{t;cal;gem}$	1995.1
met ξ_4(min) = 1.01				
11-1	2.68	-17.13	116.5	2466.7
11-2	2.45	-17.13	116.5	2675.5
11-3	2.70	-17.13	116.5	1964.1
11-4	3.01	-17.13	116.5	2670.9
11-5	3.18	-17.13	116.5	2595.9
11-6	3.07	-17.13	116.5	2499.1
		-17.13	$R_{t;cal;min}$	1964.1

Totaal resultaten Mast 11 (van 6 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 6) : 1.27
Correlatiefactor ξ_{4min} (n= 6) : 1.01

gebaseerd op sonderingen:
11-1 11-2 11-3 11-4 11-5 11-6

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]: -17.13 $R_{t;d}$ = min.{ 1995.1; 1964.1}= 1964.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.13	1964.1	1964.1	0.0	1964.1	0.00

Project :
Onderdeel :

REKENGEGEVENS Mast 13

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 13-1, 13-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.60
Paalpuntniveau : N.A.P. -14.35
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 13 (n=1)

Sondering : 13-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.35	-14.35	47.1	731.7	731.7	0.0	0.00

Sondering : 13-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.35	-14.35	47.1	576.3	576.3	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 13 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
13-1	0.13	-14.35	731.7	731.7	731.7
13-2	0.08	-14.35	576.3	576.3	576.3

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 13 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
13-1	0.13	-14.35	47.1	768.0
13-2	0.08	-14.35	47.1	604.4
		-14.35	$R_{t;cal;gem}$	686.2
met ξ_4(min) = 1.32				
13-1	0.13	-14.35	47.1	768.0
13-2	0.08	-14.35	47.1	604.4
		-14.35	$R_{t;cal;min}$	604.4

Totaal resultaten Mast 13 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
13-1 13-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.35	$R_{t;d}$ = min.{ 686.2; 604.4}= 604.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.35	604.4	604.4	0.0	604.4	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-14.35	2	686.20	16.9

Project :
Onderdeel :

REKENGEGEVENS Mast 14-I

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 14-1, 14-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.22
Paalpuntniveau : N.A.P. -18.73
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 14-I (n=1)

Sondering : 14-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.73	-18.73	216.6	2435.1	2435.1	0.0	0.00

Sondering : 14-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.73	-18.73	216.6	2317.4	2317.4	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 14-I (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
14-1	-0.25	-18.73	2435.1	2435.1	2435.1
14-2	-0.17	-18.73	2317.4	2317.4	2317.4

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 14-I (van 2 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
14-1	-0.25	-18.73	216.6	2552.7
14-2	-0.17	-18.73	216.6	2428.8
		-18.73	$R_{t;cal;gem}$	2490.7
met ξ_4(min) = 1.32				
14-1	-0.25	-18.73	216.6	2552.7
14-2	-0.17	-18.73	216.6	2428.8
		-18.73	$R_{t;cal;min}$	2428.8

Totaal resultaten Mast 14-I (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
14-1 14-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-18.73	$R_{t;d}$ = min.{ 2490.7; 2428.8}= 2428.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.73	2428.8	2428.8	0.0	2428.8	0.00

REKENGEGEVENS Mast 14-II

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 14-1, 14-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.22
Paalpuntniveau : N.A.P. -19.98
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 14-II (n=1)

Project :
Onderdeel :

Sondering : 14-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-19.98	-19.98	230.0	2684.3	2684.3	0.0	0.00

Sondering : 14-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-19.98	-19.98	230.0	2511.9	2511.9	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 14-II (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
14-1	-0.25	-19.98	2684.3	2684.3	2684.3
14-2	-0.17	-19.98	2511.9	2511.9	2511.9

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 14-II (van 2 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
14-1	-0.25	-19.98	230.0	2814.5
14-2	-0.17	-19.98	230.0	2632.9
		-19.98	$R_{t;cal;gem}$	2723.7
met ξ_4(min) = 1.32				
14-1	-0.25	-19.98	230.0	2814.5
14-2	-0.17	-19.98	230.0	2632.9
		-19.98	$R_{t;cal;min}$	2632.9

Totaal resultaten Mast 14-II (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
14-1 14-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]: -19.98 $R_{t;d}$ = min.{ 2723.7; 2632.9}= 2632.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-19.98	2632.9	2632.9	0.0	2632.9	0.00

REKENGEGEVENS Mast 19

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 19-1, 19-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.92
Paalpuntniveau : N.A.P. -13.83
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 19 (n=1)

Project :
Onderdeel :

Sondering : 19-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.83	-13.83	46.5	522.9	522.9	0.0	0.00

Sondering : 19-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.83	-13.83	46.5	569.9	569.9	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 19 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
19-1	0.37	-13.83	522.9	522.9	522.9
19-2	0.40	-13.83	569.9	569.9	569.9

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 19 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
19-1	0.37	-13.83	46.5	548.1
19-2	0.40	-13.83	46.5	597.7
		-13.83	$R_{t;cal;gem}$	572.9
met ξ_4(min) = 1.32				
19-1	0.37	-13.83	46.5	548.1
19-2	0.40	-13.83	46.5	597.7
		-13.83	$R_{t;cal;min}$	548.1

Totaal resultaten Mast 19 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
19-1 19-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-13.83 $R_{t;d}$ = min.{ 572.9; 548.1}= 548.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.83	548.1	548.1	0.0	548.1	0.00

PAALGEGEVENS BP 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project :
Onderdeel :

PAALGEGEVENS GI 610_770

Type	: Stalen profiel (geheid, grout)
Wijze van installeren	: Heien
Diameter [m]	: 0.770
Elasticiteitsmodulus [N/mm²]	: 20000
Factor α_s (tabel 7.c EC 7.1)	: 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	: 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	: 1.00
Paalvoetvormfactor β	: 1.00
Type lastzakkingsdiagram	: Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	: 0.75
Groutomhulling	: JA

PAALGEGEVENS GI 914_1075

Type	: Stalen profiel (geheid, grout)
Wijze van installeren	: Heien
Diameter [m]	: 1.075
Elasticiteitsmodulus [N/mm²]	: 20000
Factor α_s (tabel 7.c EC 7.1)	: 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	: 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	: 1.00
Paalvoetvormfactor β	: 1.00
Type lastzakkingsdiagram	: Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	: 0.75
Groutomhulling	: JA

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 11	Mast 13	Mast 14-I	Mast 14-I	Mast 19
11-1	2.68	-17.13	1824				
11-2	2.45	-17.13	1975				
11-3	2.70	-17.13	1459				
11-4	3.01	-17.13	1972				
11-5	3.18	-17.13	1918				
11-6	3.07	-17.13	1847				
13-1	0.13	-14.35		731			
13-2	0.08	-14.35		576			
14-1	-0.25	-18.73			2435		
		-19.98				2684	
14-2	-0.17	-18.73			2317		
		-19.98				2511	
19-1	0.37	-13.83					522
19-2	0.40	-13.83					569

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 20-29 (23 24 27 28 29).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Slap	13.00	13.00	15.00	15.00	15.00	15.00
15	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00

BODEMPROFIELGEGEVENS: 23-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.34 Grondwaterstand [m] : -0.66

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.34	-1.17	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.17	-5.01	Klei - Zwak zandig - Matig	1.0	50.0		
3	-5.01	-7.09	Zand - Schoon - Matig	1.0	100.0		
4	-7.09	-7.71	Zand - Schoon - Los	1.0	100.0		
5	-7.71	-13.27	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-13.27	-14.19	Zand - Schoon - Vast	1.0	100.0		
7	-14.19	-19.62	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-19.62	-27.91	Zand - Schoon - Vast	1.0	100.0		
9	-27.91	-29.79	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 24-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.02 Grondwaterstand [m] : -0.98

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.02	-1.93	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.93	-2.33	Klei - Zwak zandig - Vast	1.0	50.0		
3	-2.33	-5.13	Klei - Schoon - Matig	1.0	50.0		
4	-5.13	-7.91	Zand - Schoon - Matig	1.0	100.0		
5	-7.91	-9.07	Zand - Schoon - Los	1.0	100.0		
6	-9.07	-19.00	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-19.00	-19.67	Leem - Zwak zandig - Vast	1.0	50.0		
8	-19.67	-20.17	Klei - Schoon - Matig	1.0	50.0		
9	-20.17	-21.30	Zand - Schoon - Los	1.0	100.0		
10	-21.30	-23.10	Zand - Schoon - Vast	1.0	100.0		
11	-23.10	-24.17	Klei - Schoon - Matig	1.0	50.0		
12	-24.17	-24.63	Zand - Schoon - Los	1.0	100.0		
13	-24.63	-24.87	Klei - Schoon - Matig	1.0	50.0		
14	-24.87	-28.33	Zand - Sterk siltig - Kleiig	1.0	100.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
15	-28.33	-29.99	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 27-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.34 Grondwaterstand [m] : -0.66

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.34	-0.61	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.61	-2.01	Klei - Schoon - Matig	1.0	50.0		
3	-2.01	-3.17	Leem - Zwak zandig - Vast	1.0	50.0		
4	-3.17	-4.81	Klei - Organisch - Matig	1.0	50.0		
5	-4.81	-7.25	Zand - Schoon - Los	1.0	100.0		
6	-7.25	-8.50	Leem - Zwak zandig - Vast	1.0	50.0		
7	-8.50	-11.04	Zand - Schoon - Matig	1.0	100.0		
8	-11.04	-11.68	Zand - Schoon - Los	1.0	100.0		
9	-11.68	-11.96	Leem - Zwak zandig - Vast	1.0	50.0		
10	-11.96	-12.60	Zand - Schoon - Los	1.0	100.0		
11	-12.60	-14.78	Zand - Schoon - Vast	1.0	100.0		
12	-14.78	-20.04	Zand - Schoon - Matig	1.0	100.0		
13	-20.04	-22.04	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-22.04	-29.80	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 27-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.43 Grondwaterstand [m] : -0.57

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.43	-2.50	Klei - Zwak zandig - Slap	1.0	50.0		
2	-2.50	-4.14	Zand - Schoon - Los	1.0	100.0		
3	-4.14	-4.74	Klei - Schoon - Matig	1.0	50.0		
4	-4.74	-5.36	Zand - Schoon - Los	1.0	100.0		
5	-5.36	-6.64	Zand - Schoon - Vast	1.0	100.0		
6	-6.64	-9.18	Zand - Schoon - Los	1.0	100.0		
7	-9.18	-10.48	Leem - Zwak zandig - Vast	1.0	50.0		
8	-10.48	-11.52	Klei - Schoon - Matig	1.0	50.0		
9	-11.52	-15.40	Zand - Schoon - Los	1.0	100.0		
10	-15.40	-19.22	Zand - Schoon - Matig	1.0	100.0		
11	-19.22	-20.74	Zand - Zwak siltig - Kleiig	1.0	100.0		
12	-20.74	-21.30	Leem - Zwak zandig - Vast	1.0	50.0		
13	-21.30	-22.40	Klei - Zwak zandig - Matig	1.0	50.0		
14	-22.40	-27.13	Zand - Sterk siltig - Kleiig	1.0	100.0		
15	-27.13	-29.75	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 28-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.38 Grondwaterstand [m] : -2.38

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.38	-4.63	Klei - Organisch - Matig	1.0	50.0		
2	-4.63	-7.81	Zand - Schoon - Los	1.0	100.0		
3	-7.81	-8.35	Klei - Zwak zandig - Vast	1.0	50.0		
4	-8.35	-8.91	Leem - Zwak zandig - Vast	1.0	50.0		
5	-8.91	-9.93	Zand - Schoon - Los	1.0	100.0		
6	-9.93	-10.77	Klei - Schoon - Matig	1.0	50.0		
7	-10.77	-18.85	Zand - Schoon - Los	1.0	100.0		
8	-18.85	-31.47	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 29-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.85 Grondwaterstand [m] : -2.85

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.85	-4.44	Klei - Organisch - Slap	1.0	50.0		
2	-4.44	-6.82	Zand - Schoon - Los	1.0	100.0		
3	-6.82	-7.56	Leem - Zwak zandig - Vast	1.0	50.0		
4	-7.56	-8.10	Klei - Schoon - Matig	1.0	50.0		

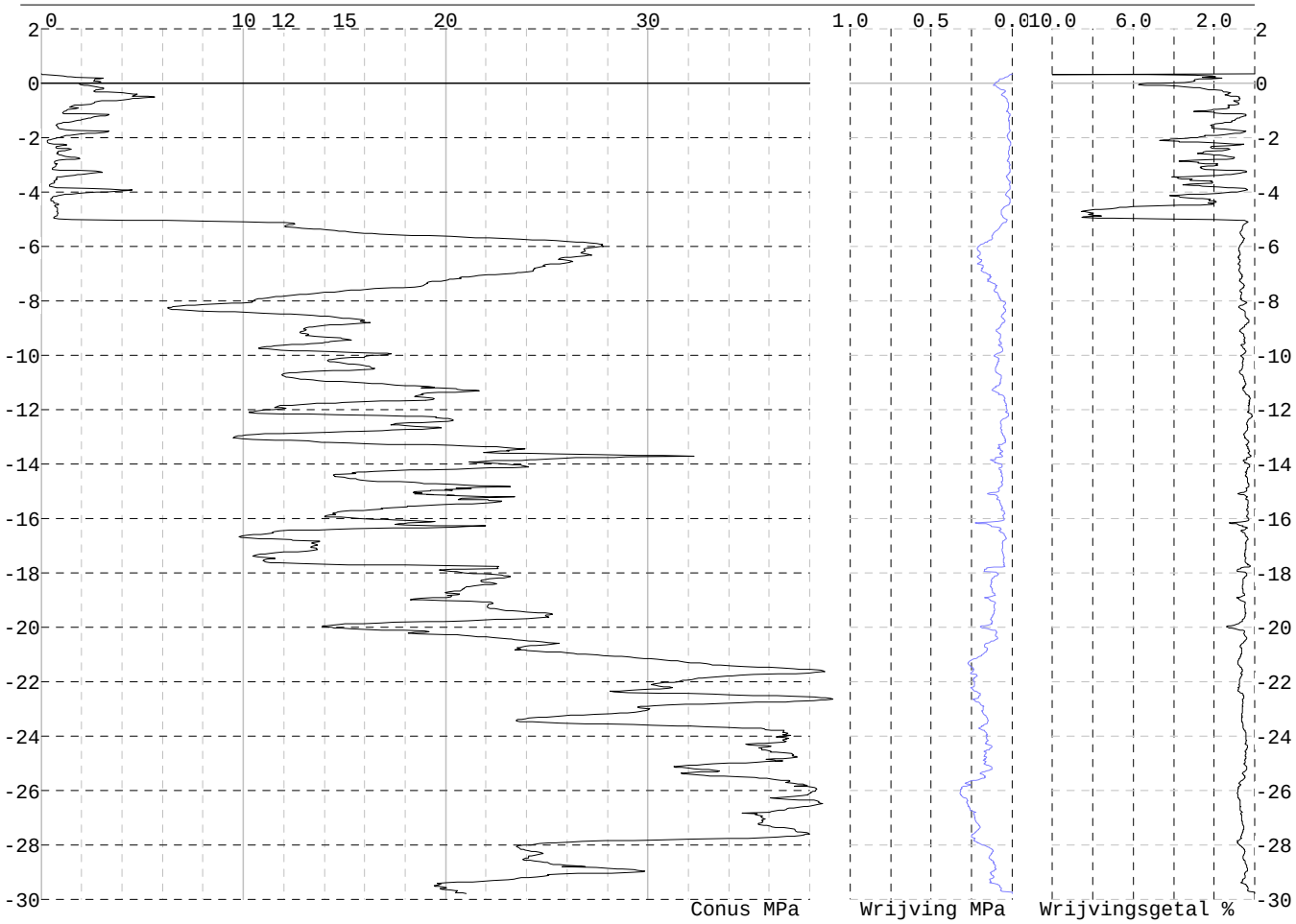
Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
5	-8.10	-9.44	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-9.44	-10.56	Klei - Zwak zandig - Vast	1.0	50.0		
7	-10.56	-13.54	Zand - Schoon - Los	1.0	100.0		
8	-13.54	-19.94	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-19.94	-27.67	Zand - Schoon - Vast	1.0	100.0		
10	-27.67	-31.86	Zand - Schoon - Matig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 23-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.34 Bodemprofiel: 23-1
Traject negatieve kleef : 0.34 tot -5.00 [m]
Traject positieve kleef : -5.00 tot -29.80 [m]

SONDERINGSGEGEVENS GRAFIEK: 23-1

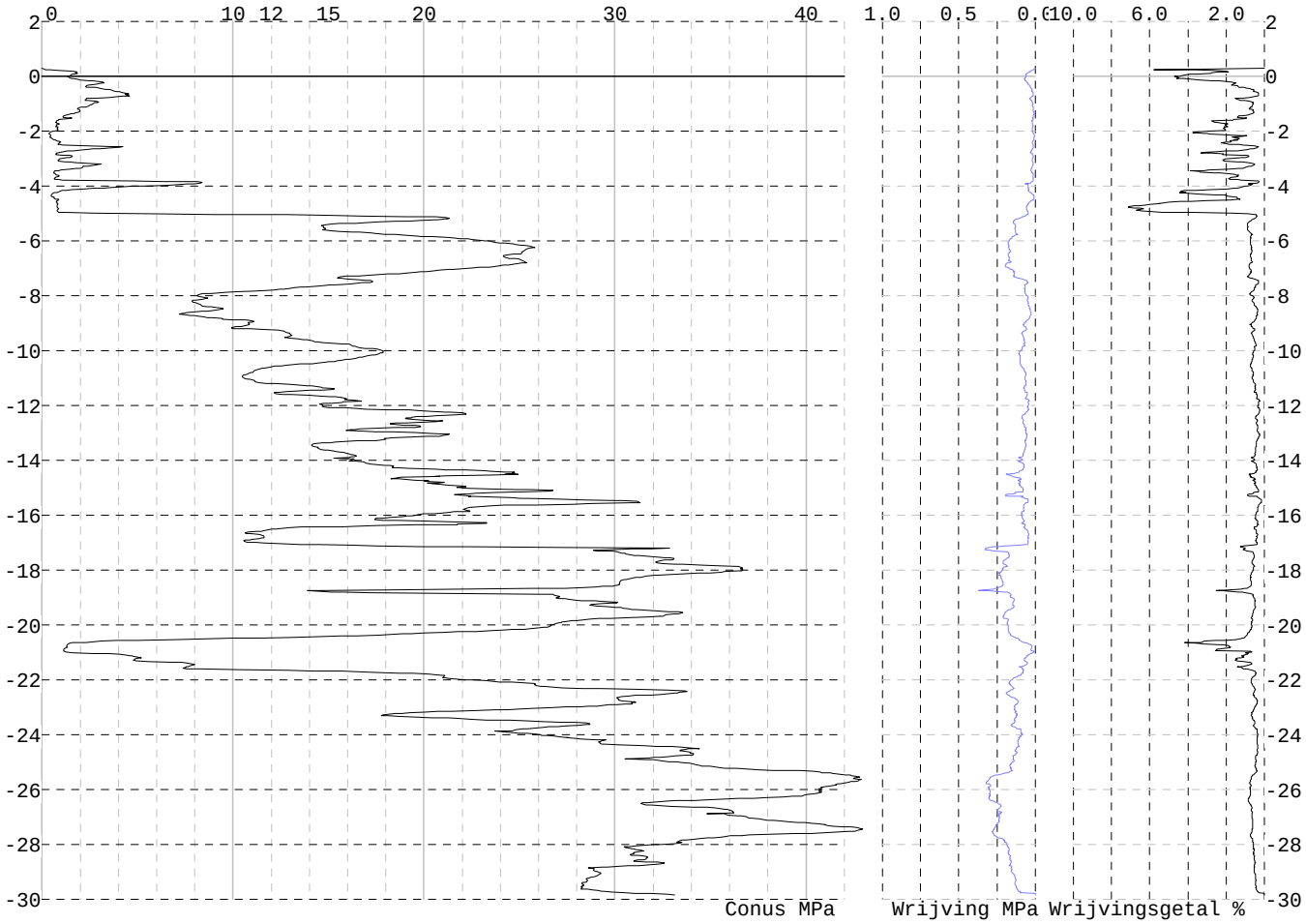


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 23-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.28 Bodemprofiel: 23-1
Traject negatieve kleef : 0.28 tot -5.00 [m]
Traject positieve kleef : -5.00 tot -29.85 [m]

SONDERINGSGEGEVENS GRAFIEK: 23-2

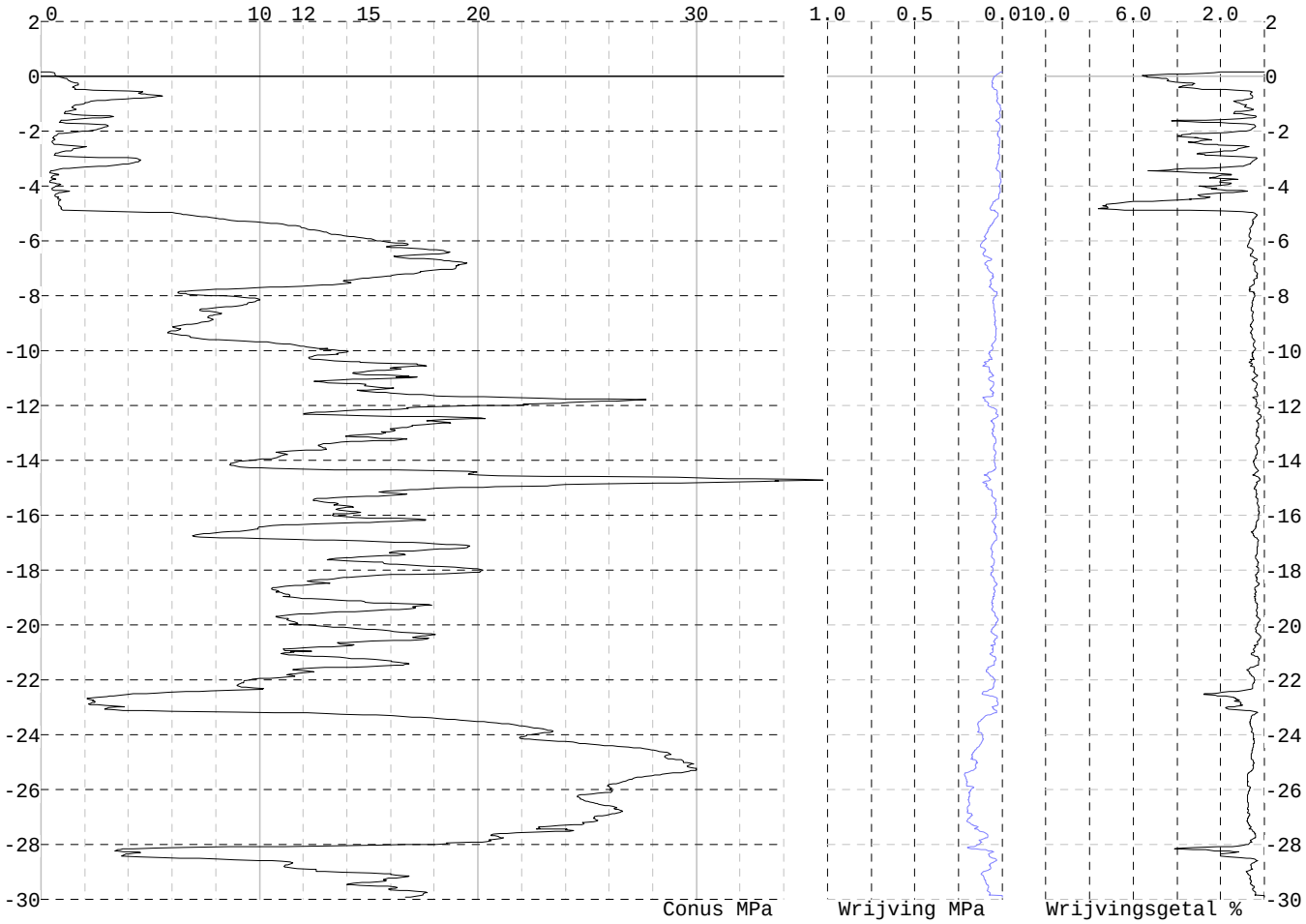


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 24-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.16 Bodemprofiel: 24-2
Traject negatieve kleef : 0.16 tot -4.80 [m]
Traject positieve kleef : -4.80 tot -29.94 [m]

SONDERINGSGEGEVENS GRAFIEK: 24-1

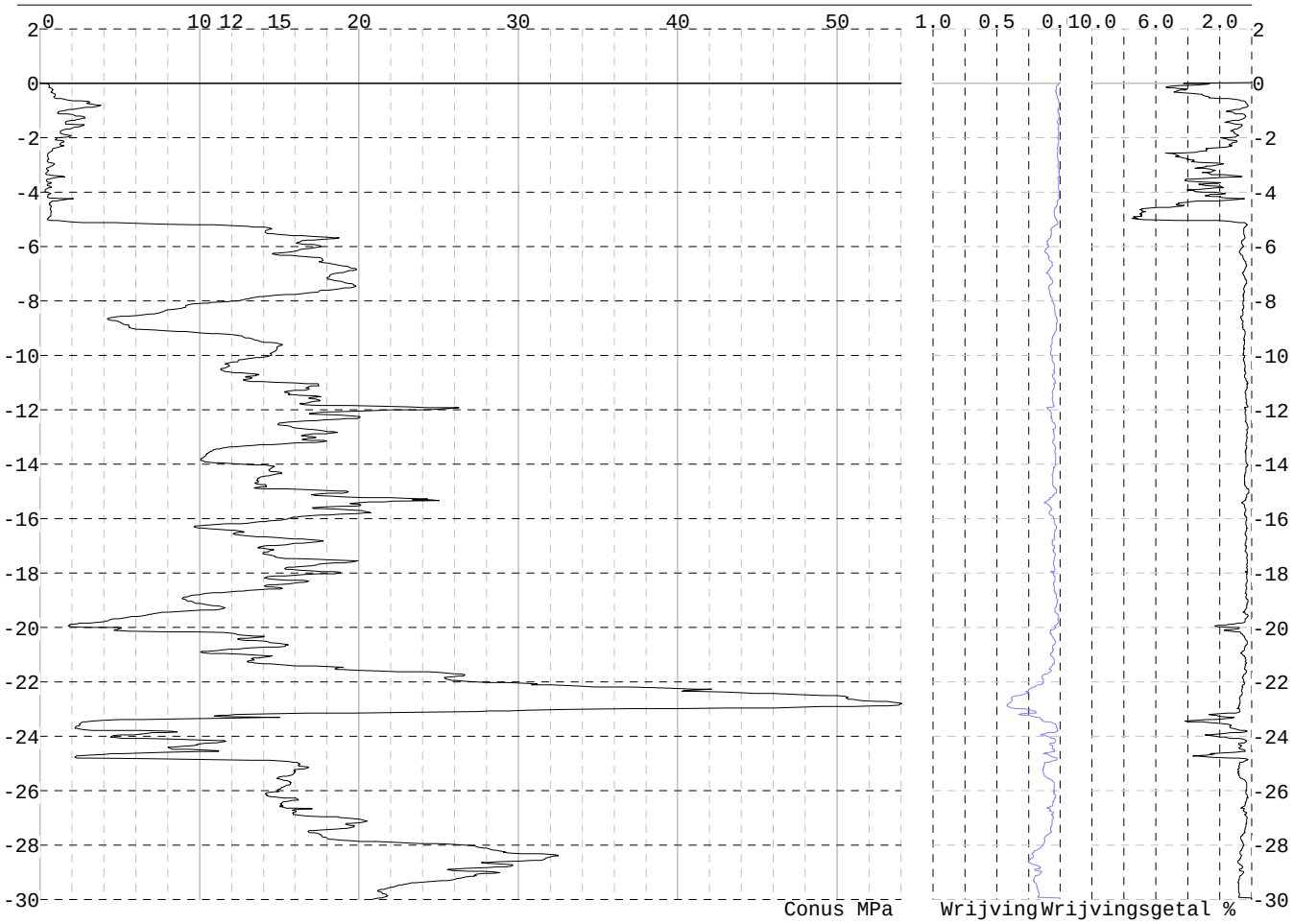


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 24-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.02 Bodemprofiel: 24-2
Traject negatieve kleef : 0.02 tot -5.00 [m]
Traject positieve kleef : -5.00 tot -30.00 [m]

SONDERINGSGEGEVENS GRAFIEK: 24-2

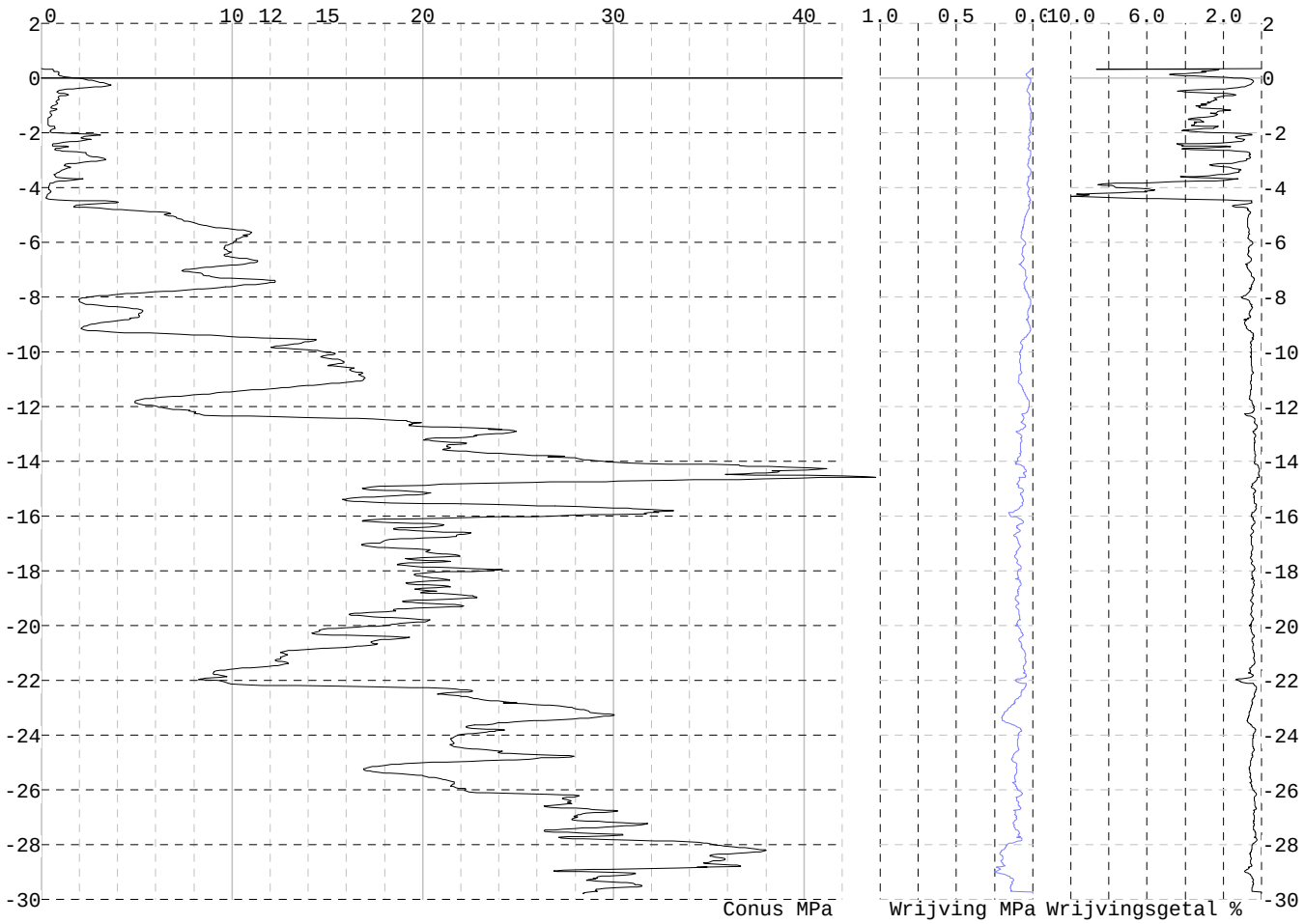


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 27-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.34 Bodemprofiel: 27-1
Traject negatieve kleef : 0.34 tot -4.50 [m]
Traject positieve kleef : -4.50 tot -29.81 [m]

SONDERINGSGEGEVENS GRAFIEK: 27-1

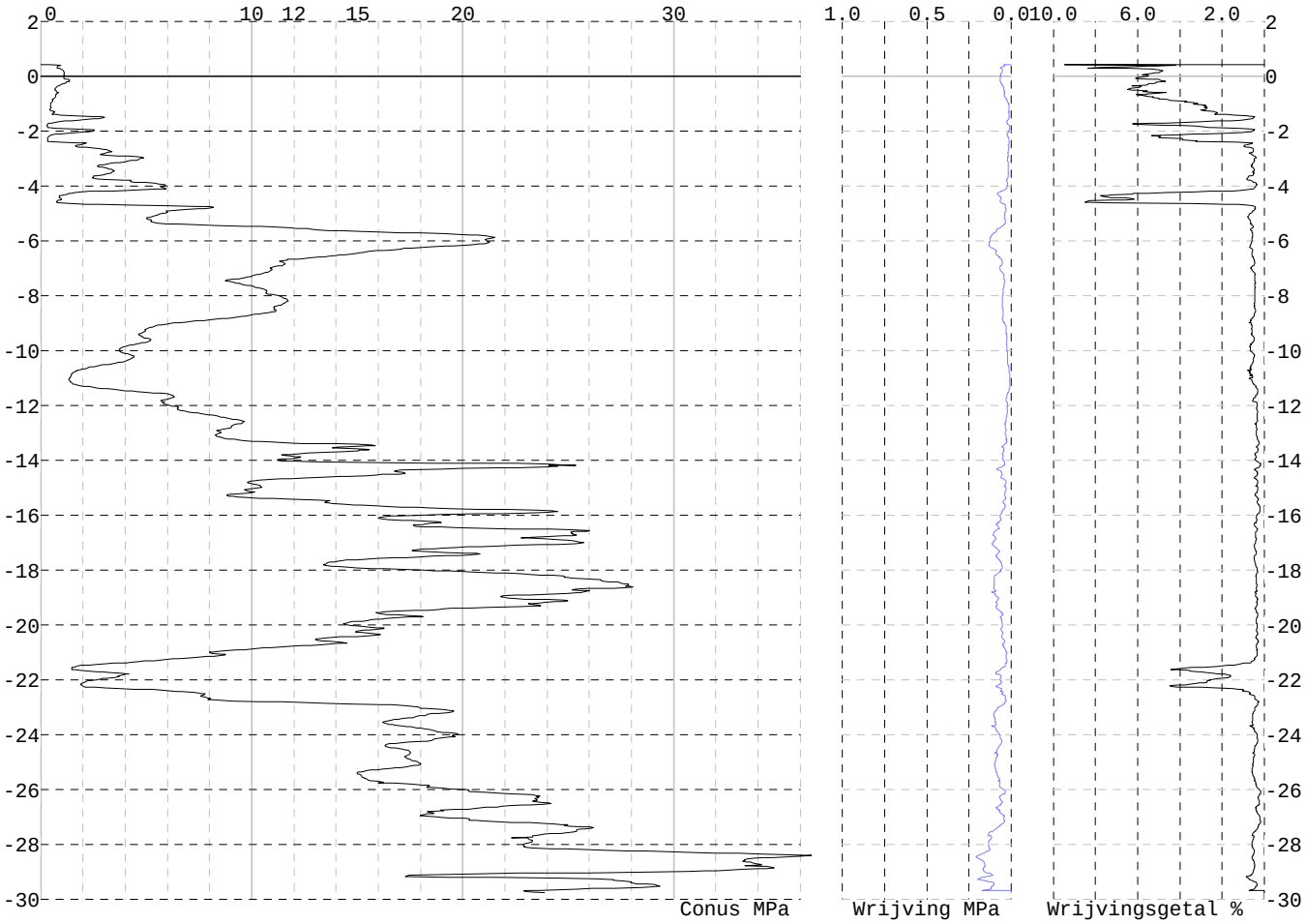


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 27-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.43 Bodemprofiel: 27-2
Traject negatieve kleef : 0.43 tot -4.70 [m]
Traject positieve kleef : -4.70 tot -29.76 [m]

SONDERINGSGEGEVENS GRAFIEK: 27-2

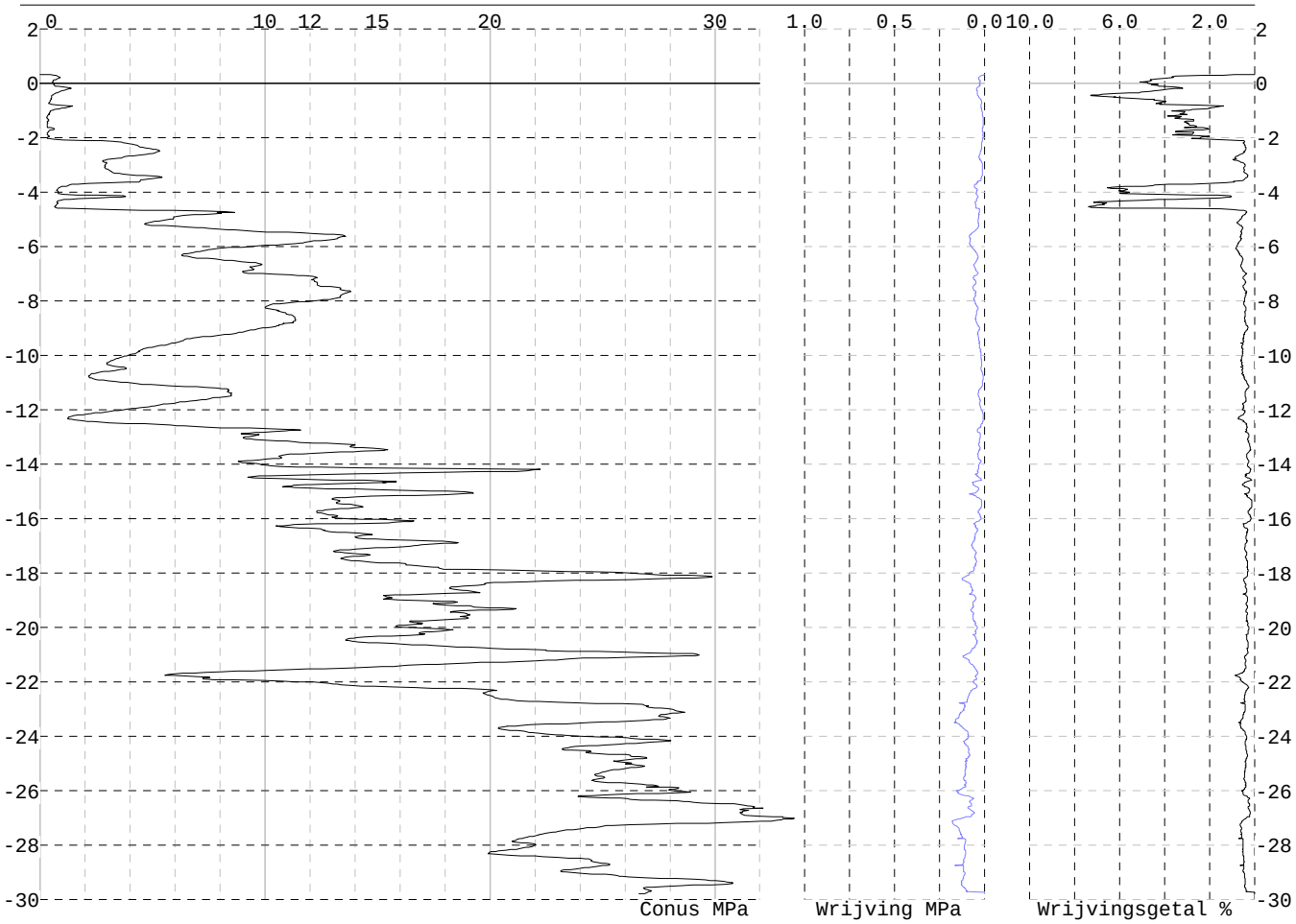


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 27-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.33 Bodemprofiel: 27-2
Traject negatieve kleef : 0.33 tot -4.80 [m]
Traject positieve kleef : -4.80 tot -29.81 [m]

SONDERINGSGEGEVENS GRAFIEK: 27-3

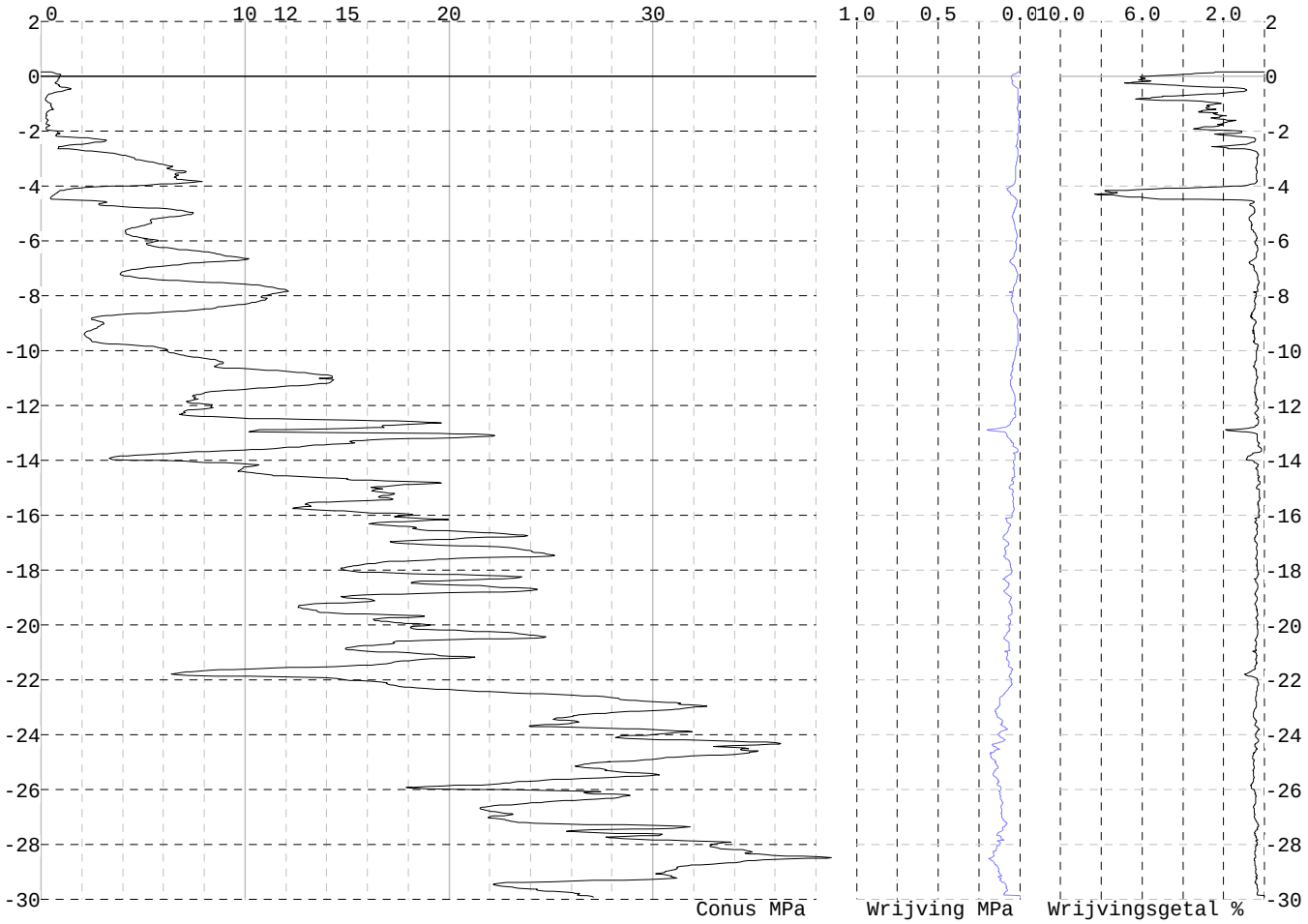


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 27-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.16 Bodemprofiel: 27-2
Traject negatieve kleef : 0.16 tot -4.50 [m]
Traject positieve kleef : -4.50 tot -29.92 [m]

SONDERINGSGEGEVENS GRAFIEK: 27-4

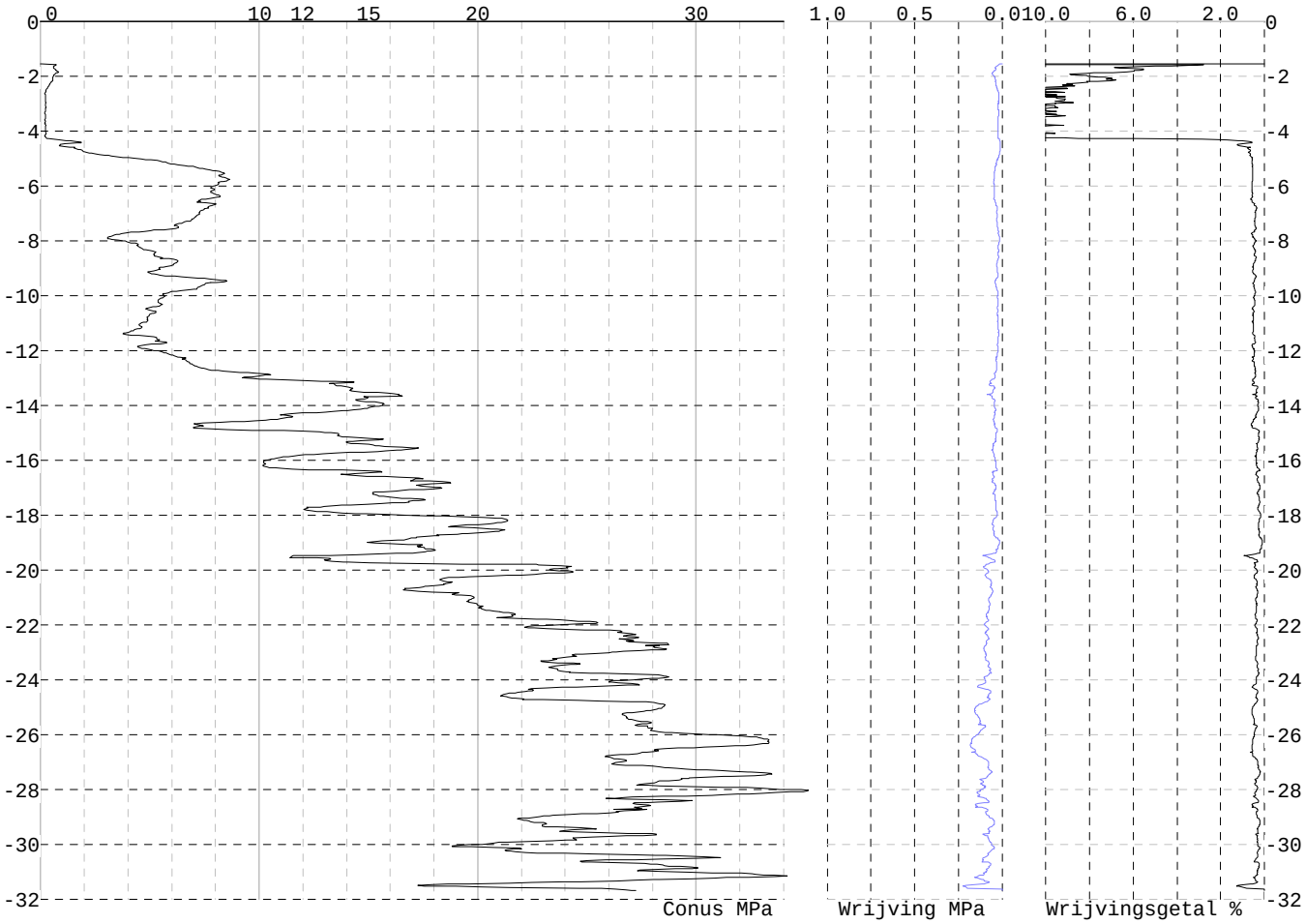


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 28-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.55 Bodemprofiel: 28-2
Traject negatieve kleef : -1.55 tot -4.40 [m]
Traject positieve kleef : -4.40 tot -31.70 [m]

SONDERINGSGEGEVENS GRAFIEK: 28-1

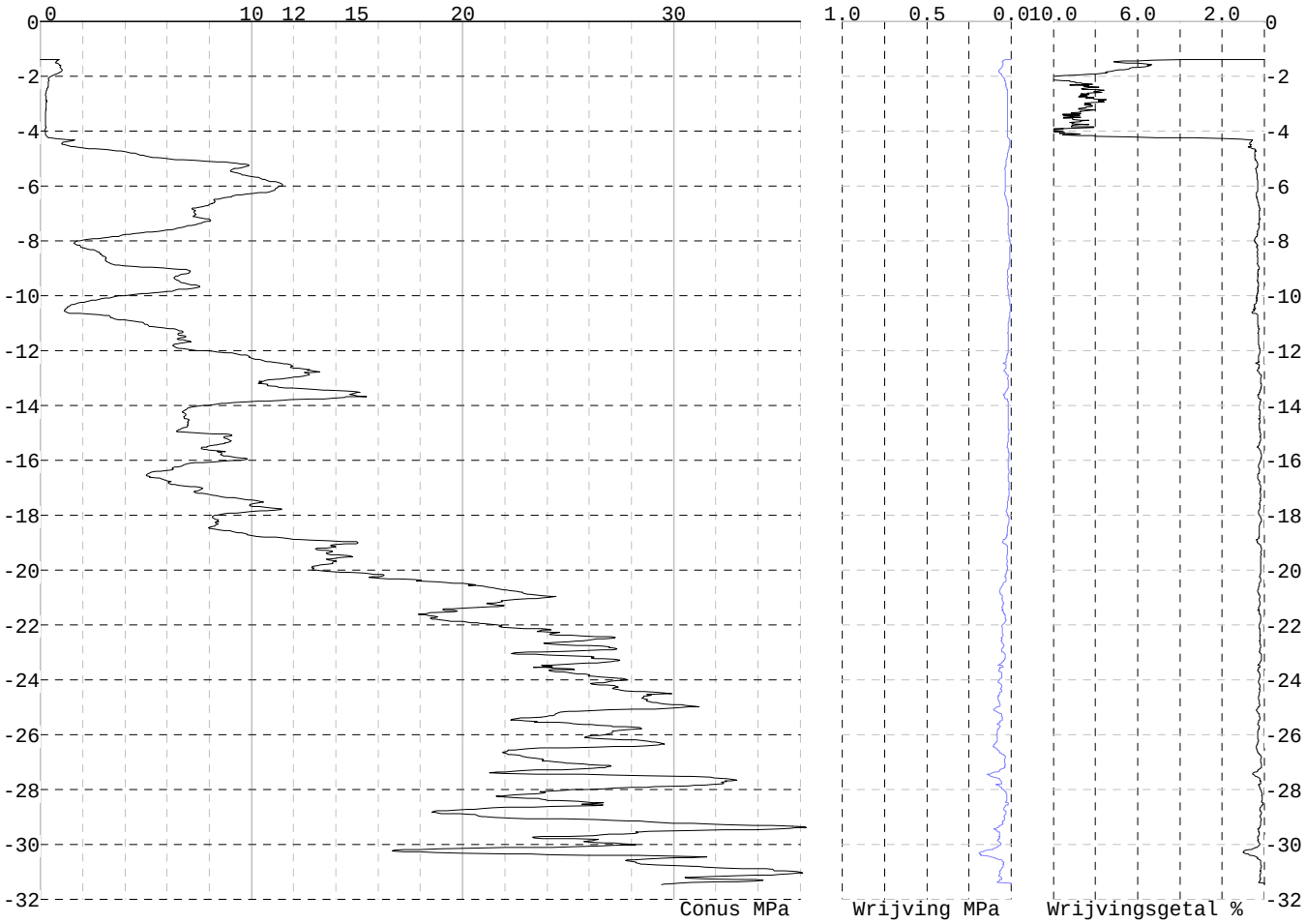


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 28-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.38 Bodemprofiel: 28-2
Traject negatieve kleef : -1.38 tot -4.50 [m]
Traject positieve kleef : -4.50 tot -31.48 [m]

SONDERINGSGEGEVENS GRAFIEK: 28-2

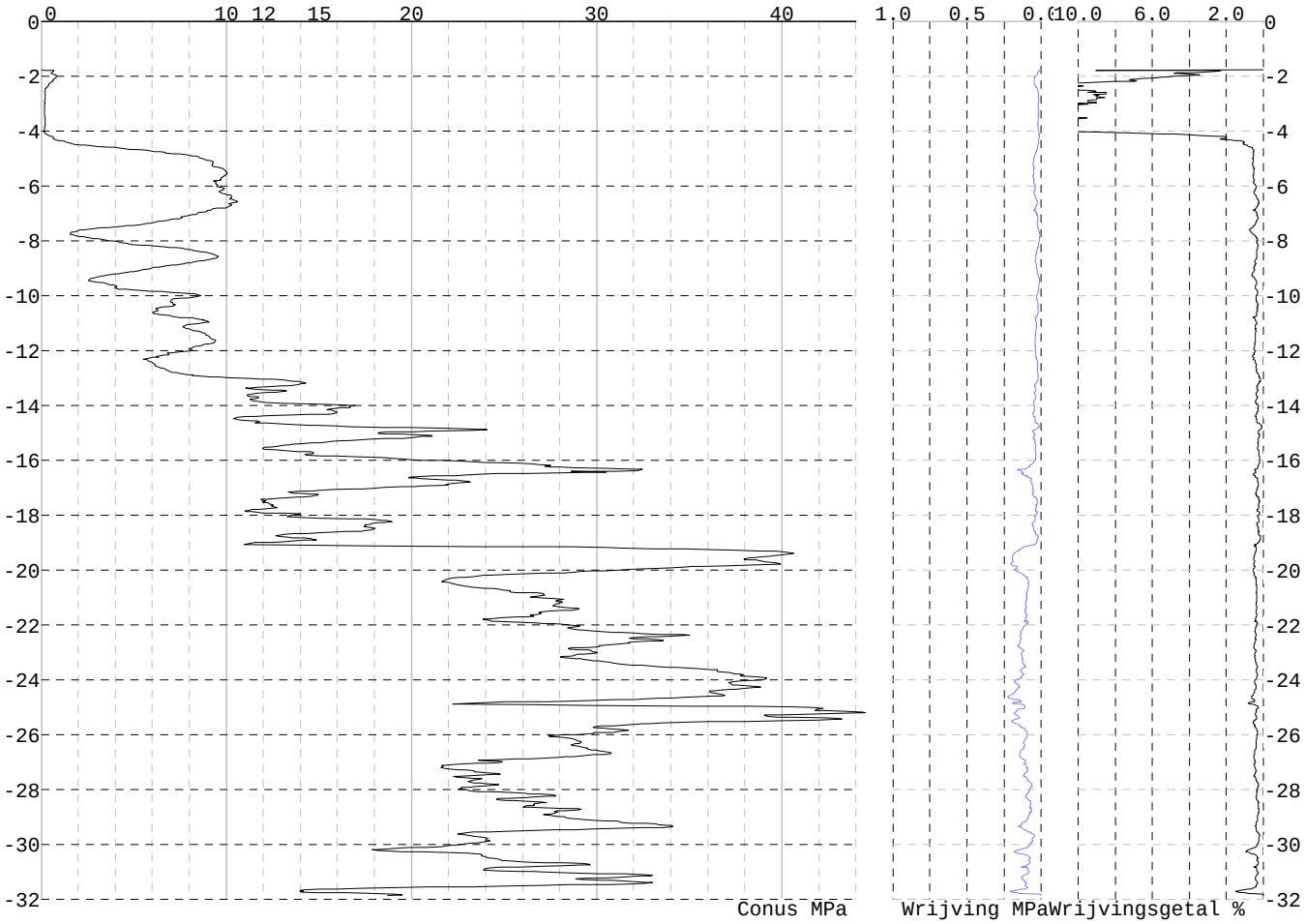


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 29-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.77 Bodemprofiel: 29-2
Traject negatieve kleef : -1.77 tot -4.30 [m]
Traject positieve kleef : -4.30 tot -31.88 [m]

SONDERINGSGEGEVENS GRAFIEK: 29-1

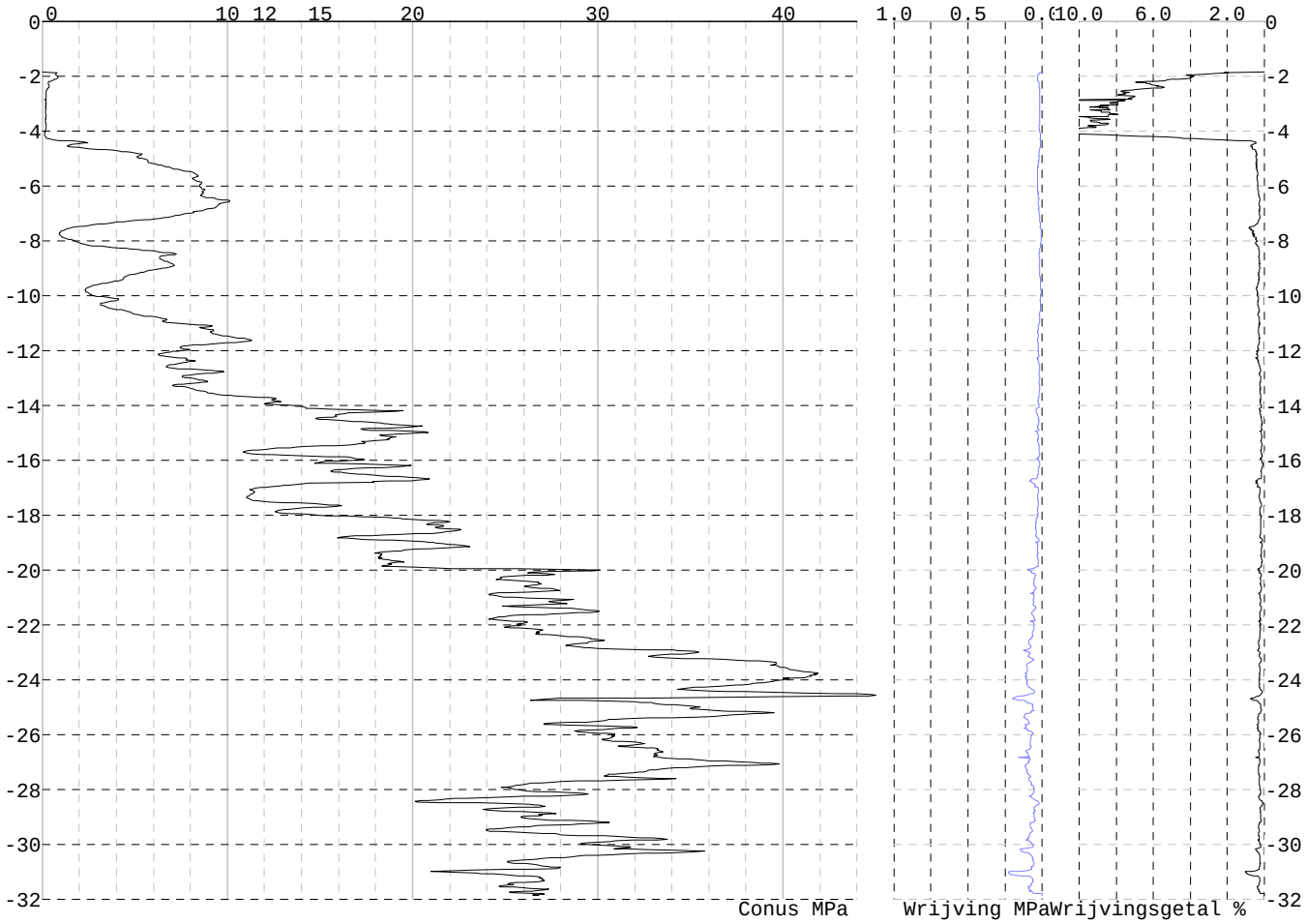


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 29-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.85 Bodemprofiel: 29-2
Traject negatieve kleef : -1.85 tot -4.30 [m]
Traject positieve kleef : -4.30 tot -31.87 [m]

SONDERINGSGEGEVENS GRAFIEK: 29-2



REKENGEGEVENS Mast 23

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 23-1, 23-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.78
Paalpuntniveau : N.A.P. -14.87
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 23 (n=1)

Project :
Onderdeel :

Sondering : 23-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.87	-14.87	48.9	651.1	651.1	0.0	0.00

Sondering : 23-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.87	-14.87	48.9	678.2	678.2	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 23 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
23-1	0.34	-14.87	651.1	651.1	651.1
23-2	0.28	-14.87	678.2	678.2	678.2

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 23 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
23-1	0.34	-14.87	48.9	683.0
23-2	0.28	-14.87	48.9	711.6
		-14.87	$R_{t;cal;gem}$	697.3
met ξ_4(min) = 1.32				
23-1	0.34	-14.87	48.9	683.0
23-2	0.28	-14.87	48.9	711.6
		-14.87	$R_{t;cal;min}$	683.0

Totaal resultaten Mast 23 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
23-1 23-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.87	$R_{t;d}$ = min.{ 697.3; 683.0}= 683.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.87	683.0	683.0	0.0	683.0	0.00

REKENGEGEVENS Mast 24

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 24-1, 24-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.58
Paalpuntniveau : N.A.P. -17.37
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 24 (n=1)

Project :
Onderdeel :

Sondering : 24-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.37	-17.37	55.9	755.9	755.9	0.0	0.00

Sondering : 24-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.37	-17.37	55.9	786.3	786.3	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 24 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
24-1	0.16	-17.37	755.9	755.9	755.9
24-2	0.02	-17.37	786.3	786.3	786.3

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 24 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
24-1	0.16	-17.37	55.9	793.1
24-2	0.02	-17.37	55.9	825.1
		-17.37	$R_{t;cal;gem}$	809.1
met ξ_4(min) = 1.32				
24-1	0.16	-17.37	55.9	793.1
24-2	0.02	-17.37	55.9	825.1
		-17.37	$R_{t;cal;min}$	793.1

Totaal resultaten Mast 24 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
24-1 24-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-17.37	$R_{t;d}$ = min.{ 809.1; 793.1}= 793.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.37	793.1	793.1	0.0	793.1	0.00

REKENGEGEVENS Mast 27

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 27-1, 27-2, 27-3, 27-4
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 610_770
Niveau paalkop [m] : N.A.P. 1.22
Paalpuntniveau : N.A.P. -18.95
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 27 (n=1)

Project :
Onderdeel :

Sondering : 27-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.95	-18.95	119.8	1897.1	1897.1	0.0	0.00

Sondering : 27-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.95	-18.95	119.3	1690.3	1690.3	0.0	0.00

Sondering : 27-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.95	-18.95	119.3	1661.2	1661.2	0.0	0.00

Sondering : 27-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.95	-18.95	119.3	1687.1	1687.1	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 27 (n=1)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
27-1	0.34	-18.95	1897.1	1897.1	1897.1
27-2	0.43	-18.95	1690.3	1690.3	1690.3
27-3	0.33	-18.95	1661.2	1661.2	1661.2
27-4	0.16	-18.95	1687.1	1687.1	1687.1

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 27 (van 4 sonderingen)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=4)}$: 1.28
Correlatiefactor $\xi_{4min(n=4)}$: 1.03

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.28				
27-1	0.34	-18.95	119.8	2049.8
27-2	0.43	-18.95	119.8	1825.3
27-3	0.33	-18.95	119.8	1793.7
27-4	0.16	-18.95	119.8	1821.8
		-18.95	$R_{t;cal;gem}$	1872.7
met ξ_4(min) = 1.03				
27-1	0.34	-18.95	119.8	2518.3
27-2	0.43	-18.95	119.8	2239.4
27-3	0.33	-18.95	119.8	2200.2
27-4	0.16	-18.95	119.8	2235.0
		-18.95	$R_{t;cal;min}$	2200.2

Totaal resultaten Mast 27 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
27-1 27-2 27-3 27-4

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]: -18.95 $R_{t;d}$ = min.{ 1872.7; 2200.2}= 1872.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.95	1872.7	1872.7	0.0	1872.7	0.00

REKENGEGEVENS Mast 28

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 28-1, 28-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.70
Paalpuntniveau : N.A.P. -17.05
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

RESULTATEN Mast 28 (n=1)

Sondering : 28-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.05	-17.05	51.5	537.7	537.7	0.0	0.00

Sondering : 28-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.05	-17.05	51.5	461.2	461.2	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 28 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
28-1	-1.55	-17.05	537.7	537.7	537.7
28-2	-1.38	-17.05	461.2	461.2	461.2

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 28 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
28-1	-1.55	-17.05	51.5	563.5
28-2	-1.38	-17.05	51.5	482.9
		-17.05	$R_{t;cal;gem}$	523.2
met ξ_4(min) = 1.32				
28-1	-1.55	-17.05	51.5	563.5
28-2	-1.38	-17.05	51.5	482.9
		-17.05	$R_{t;cal;min}$	482.9

Totaal resultaten Mast 28 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
28-1 28-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-17.05 $R_{t;d}$ = min.{ 523.2; 482.9}= 482.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.05	482.9	482.9	0.0	482.9	0.00

REKENGEGEVENS Mast 29

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 29-1, 29-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -1.04
Paalpuntniveau : N.A.P. -18.49
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 29 (n=1)

Project :
Onderdeel :

Sondering : 29-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.49	-18.49	55.1	692.5	692.5	0.0	0.00

Sondering : 29-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.49	-18.49	55.1	626.0	626.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 29 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
29-1	-1.77	-18.49	692.5	692.5	692.5
29-2	-1.85	-18.49	626.0	626.0	626.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 29 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
29-1	-1.77	-18.49	55.1	726.3
29-2	-1.85	-18.49	55.1	656.3
		-18.49	$R_{t;cal;gem}$	691.3
met ξ_4(min) = 1.32				
29-1	-1.77	-18.49	55.1	726.3
29-2	-1.85	-18.49	55.1	656.3
		-18.49	$R_{t;cal;min}$	656.3

Totaal resultaten Mast 29 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
29-1 29-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-18.49 $R_{t;d}$ = min.{ 691.3; 656.3}= 656.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.49	656.3	656.3	0.0	656.3	0.00

PAALGEGEVENS BP 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project :
Onderdeel :

PAALGEGEVENS GI 610_770

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 0.770
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 23	Mast 24	Mast 27	Mast 28	Mast 29
23-1	0.34	-14.87	651				
23-2	0.28	-14.87	678				
24-1	0.16	-17.37		755			
24-2	0.02	-17.37		786			
27-1	0.34	-18.95			1897		
27-2	0.43	-18.95			1690		
27-3	0.33	-18.95			1661		
27-4	0.16	-18.95			1687		
28-1	-1.55	-17.05				537	
28-2	-1.38	-17.05				461	
29-1	-1.77	-18.49					692
29-2	-1.85	-18.49					626

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 30-39 (30 32 33 34 35).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m^3]	$\gamma_{sat;k;1}$ [kN/m^3]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m^3]	$\gamma_{sat;k;2}$ [kN/m^3]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
15	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00
16	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: 30-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.87 Grondwaterstand [m] : -3.87

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.87	-4.36	Klei - Zwak zandig - Slap	1.0	50.0		
2	-4.36	-7.16	Zand - Schoon - Los	1.0	100.0		
3	-7.16	-8.22	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-8.22	-17.08	Zand - Schoon - Los	1.0	100.0		
5	-17.08	-20.87	Zand - Schoon - Vast	1.0	100.0		
6	-20.87	-22.95	Zand - Schoon - Matig	1.0	100.0		
7	-22.95	-27.09	Zand - Schoon - Vast	1.0	100.0		
8	-27.09	-31.06	Zand - Schoon - Matig	1.0	100.0		
9	-31.06	-33.00	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 33-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.69 Grondwaterstand [m] : -3.69

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.69	-3.90	Klei - Zwak zandig - Slap	1.0	50.0		
2	-3.90	-6.32	Zand - Schoon - Los	1.0	100.0		
3	-6.32	-7.05	Leem - Zwak zandig - Vast	1.0	50.0		
4	-7.05	-8.17	Klei - Zwak zandig - Matig	1.0	50.0		
5	-8.17	-12.09	Zand - Schoon - Los	1.0	100.0		
6	-12.09	-16.20	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-16.20	-16.72	Klei - Zwak zandig - Matig	1.0	50.0		
8	-16.72	-18.62	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-18.62	-19.98	Zand - Schoon - Matig	1.0	100.0		
10	-19.98	-20.38	Klei - Schoon - Vast	1.0	50.0		
11	-20.38	-32.67	Zand - Schoon - Matig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 35-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.85 Grondwaterstand [m] : -2.85

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.85	-3.58	Klei - Organisch - Matig	1.0	50.0		
2	-3.58	-6.03	Zand - Schoon - Los	1.0	100.0		
3	-6.03	-6.39	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-6.39	-10.09	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-10.09	-12.87	Zand - Schoon - Los	1.0	100.0		
6	-12.87	-15.99	Zand - Schoon - Matig	1.0	100.0		
7	-15.99	-16.70	Leem - Zwak zandig - Vast	1.0	50.0		
8	-16.70	-17.13	Klei - Zwak zandig - Matig	1.0	50.0		
9	-17.13	-18.70	Zand - Schoon - Matig	1.0	100.0		
10	-18.70	-31.86	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 35-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.82 Grondwaterstand [m] : -2.82

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.82	-3.55	Klei - Zwak zandig - Slap	1.0	50.0		
2	-3.55	-3.83	Leem - Zwak zandig - Vast	1.0	50.0		
3	-3.83	-11.11	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-11.11	-14.43	Zand - Schoon - Los	1.0	100.0		
5	-14.43	-14.64	Leem - Zwak zandig - Vast	1.0	50.0		
6	-14.64	-15.54	Zand - Schoon - Matig	1.0	100.0		
7	-15.54	-16.38	Leem - Zwak zandig - Vast	1.0	50.0		
8	-16.38	-16.74	Klei - Schoon - Matig	1.0	50.0		
9	-16.74	-28.57	Zand - Schoon - Vast	1.0	100.0		
10	-28.57	-30.15	Zand - Schoon - Los	1.0	100.0		
11	-30.15	-31.96	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 32-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.84 Grondwaterstand [m] : -3.84

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.84	-4.16	Veen - Matig voorbelast - Matig	1.0	0.0		
2	-4.16	-5.34	Zand - Schoon - Los	1.0	100.0		
3	-5.34	-7.62	Zand - Schoon - Matig	1.0	100.0		
4	-7.62	-10.36	Zand - Schoon - Los	1.0	100.0		
5	-10.36	-19.18	Zand - Schoon - Vast	1.0	100.0		
6	-19.18	-21.87	Zand - Schoon - Matig	1.0	100.0		
7	-21.87	-32.98	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 32-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.77 Grondwaterstand [m] : -3.77

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.77	-4.05	Veen - Matig voorbelast - Matig	1.0	0.0		
2	-4.05	-4.79	Zand - Schoon - Matig	1.0	100.0		
3	-4.79	-9.09	Zand - Schoon - Vast	1.0	100.0		
4	-9.09	-9.93	Zand - Schoon - Los	1.0	100.0		
5	-9.93	-14.00	Zand - Schoon - Matig	1.0	100.0		
6	-14.00	-16.50	Zand - Schoon - Vast	1.0	100.0		
7	-16.50	-17.49	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-17.49	-32.75	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 34-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.38 Grondwaterstand [m] : -3.38

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.38	-3.80	Veen - Niet voorbelast - Slap	1.0	0.0		
2	-3.80	-4.10	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-4.10	-13.00	Zand - Schoon - Matig	1.0	100.0		
4	-13.00	-20.34	Zand - Schoon - Vast	1.0	100.0		
5	-20.34	-20.74	Klei - Zwak zandig - Vast	1.0	50.0		
6	-20.74	-32.36	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 34-2

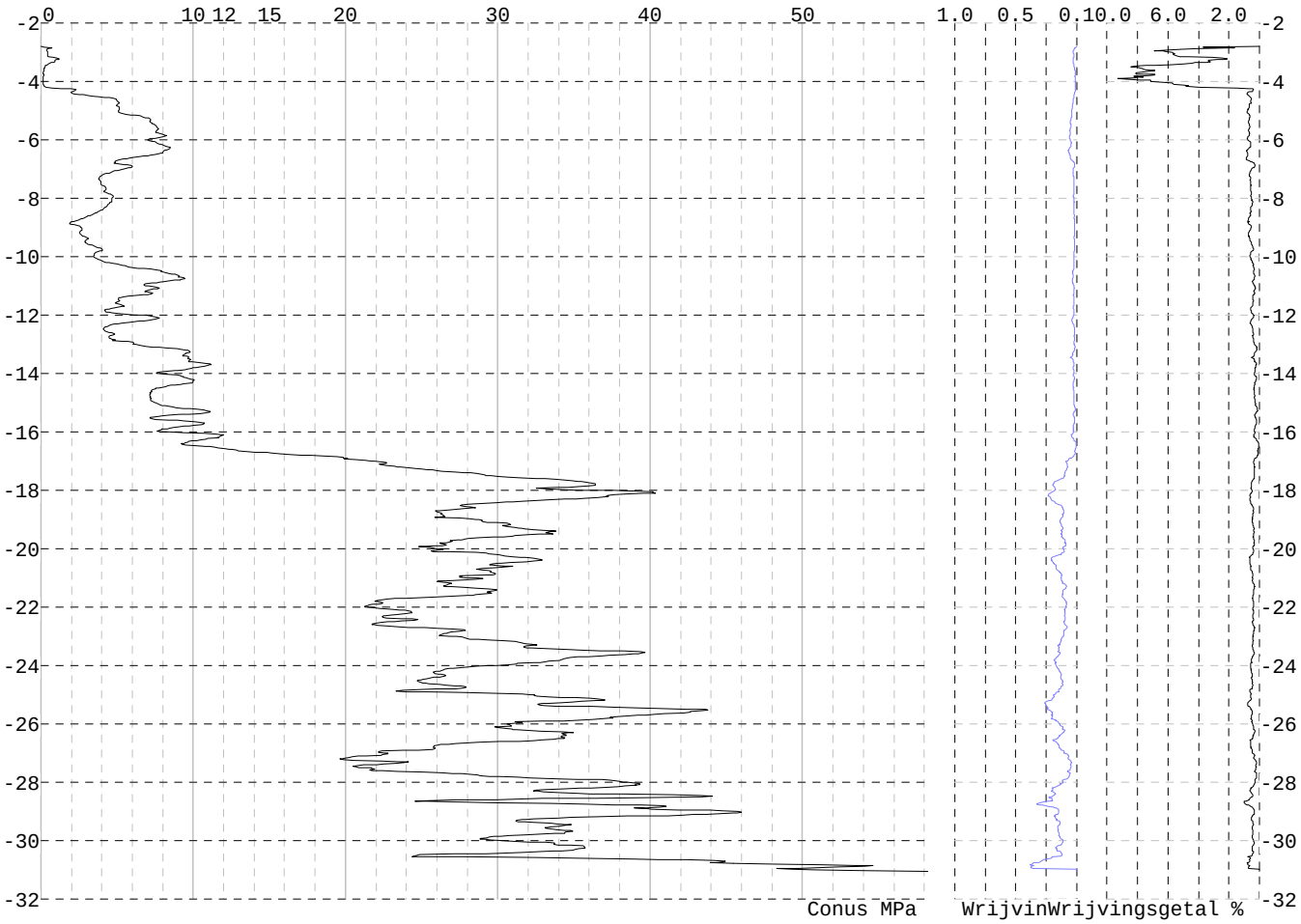
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.48 Grondwaterstand [m] : -3.48

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.48	-3.96	Veen - Matig voorbelast - Matig	1.0	0.0		
2	-3.96	-10.10	Zand - Schoon - Los	1.0	100.0		
3	-10.10	-10.96	Zand - Schoon - Matig	1.0	100.0		
4	-10.96	-31.51	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 30-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.81 Bodemprofiel: 30-2
Traject negatieve kleef : -2.81 tot -4.60 [m]
Traject positieve kleef : -4.60 tot -31.05 [m]

SONDERINGSGEGEVENS GRAFIEK: 30-1

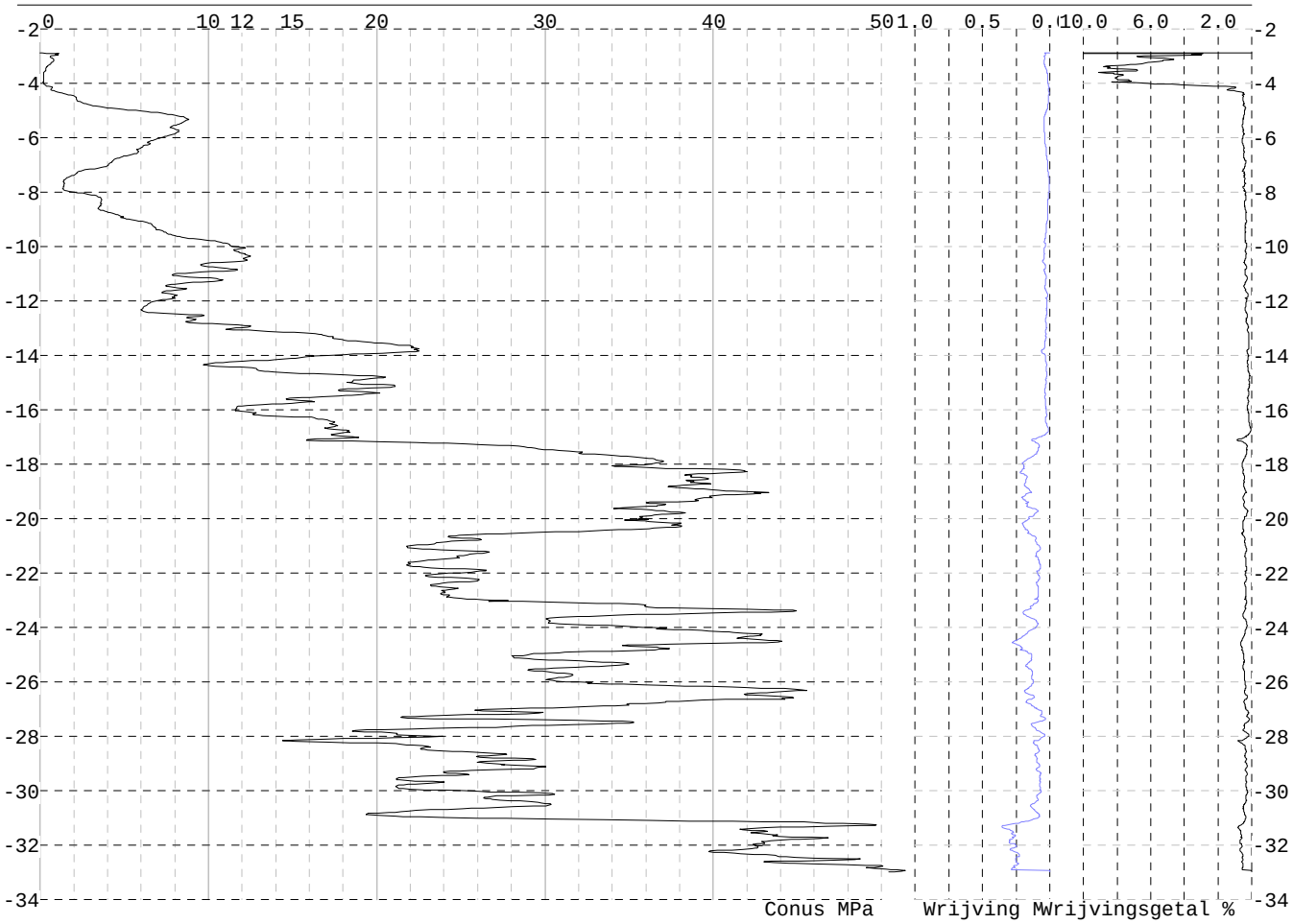


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 30-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.87 Bodemprofiel: 30-2
Traject negatieve kleef : -2.87 tot -4.40 [m]
Traject positieve kleef : -4.40 tot -33.01 [m]

SONDERINGSGEGEVENS GRAFIEK: 30-2

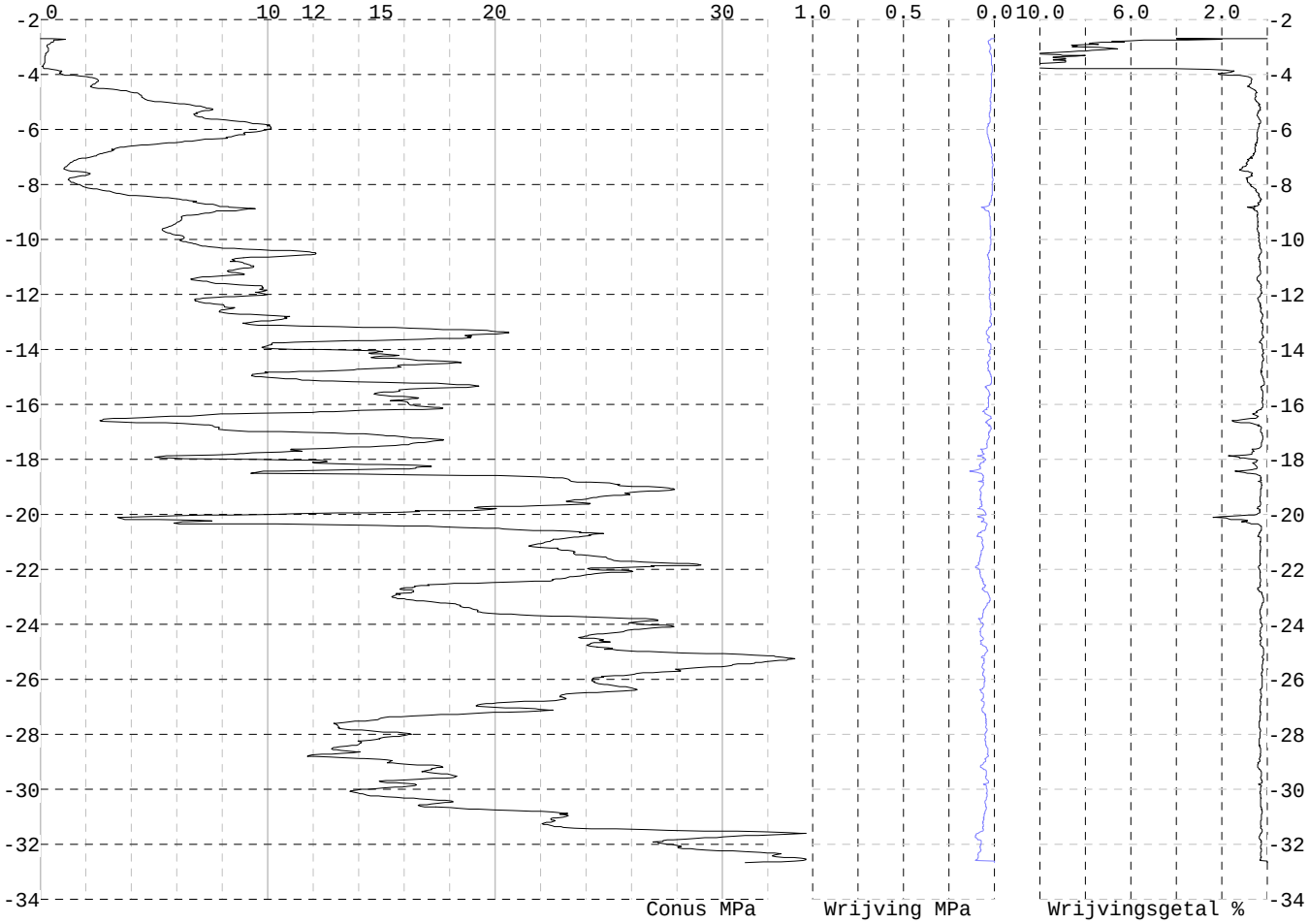


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 33-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.69 Bodemprofiel: 33-1
Traject negatieve kleef : -2.69 tot -4.00 [m]
Traject positieve kleef : -4.00 tot -32.68 [m]

SONDERINGSGEGEVENS GRAFIEK: 33-1

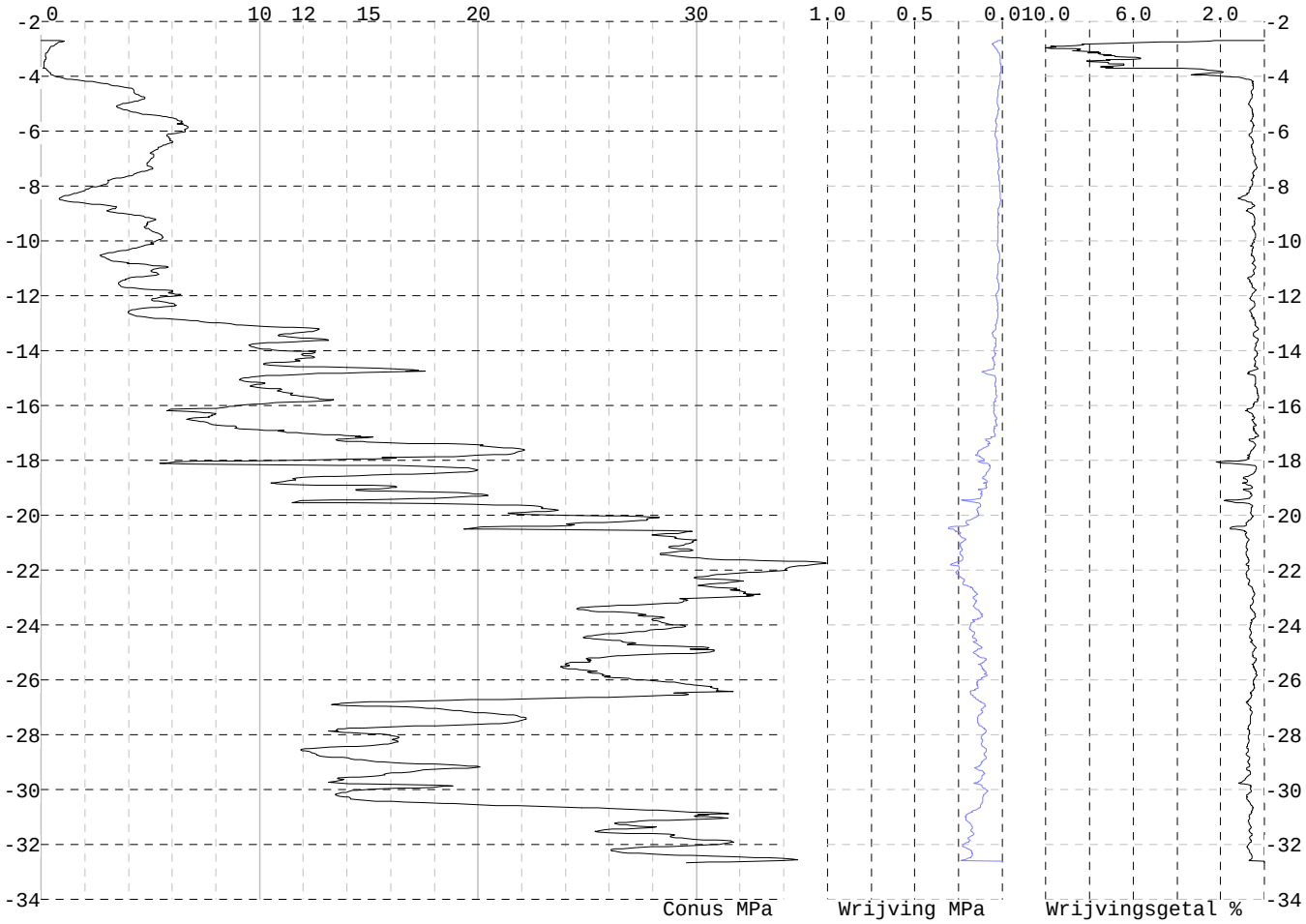


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 33-2A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.69 Bodemprofiel: 33-1
Traject negatieve kleef : -2.69 tot -4.40 [m]
Traject positieve kleef : -4.40 tot -32.68 [m]

SONDERINGSGEGEVENS GRAFIEK: 33-2A

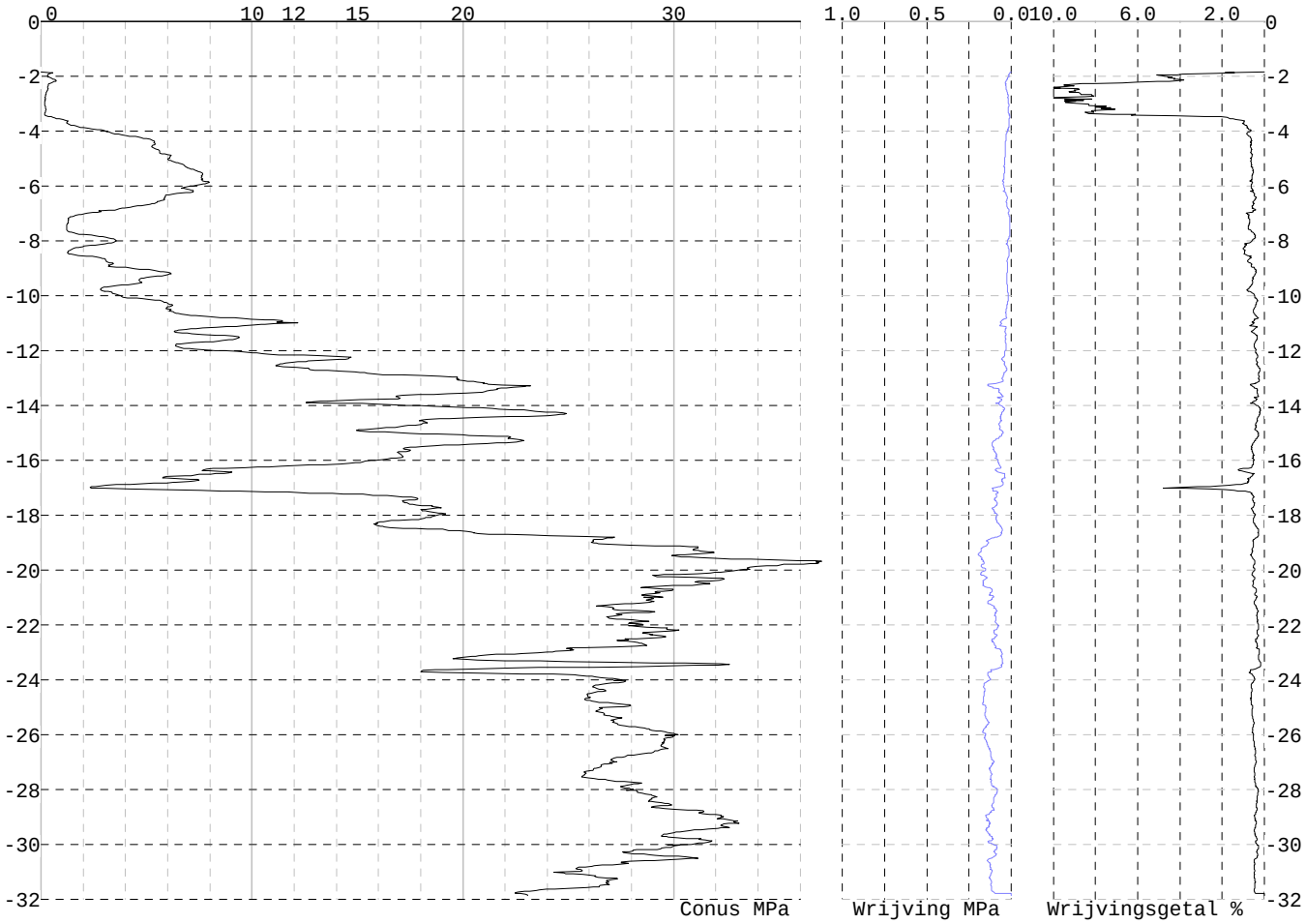


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 35-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.85 Bodemprofiel: 35-1
Traject negatieve kleef : -1.85 tot -3.70 [m]
Traject positieve kleef : -3.70 tot -31.87 [m]

SONDERINGSGEGEVENS GRAFIEK: 35-1

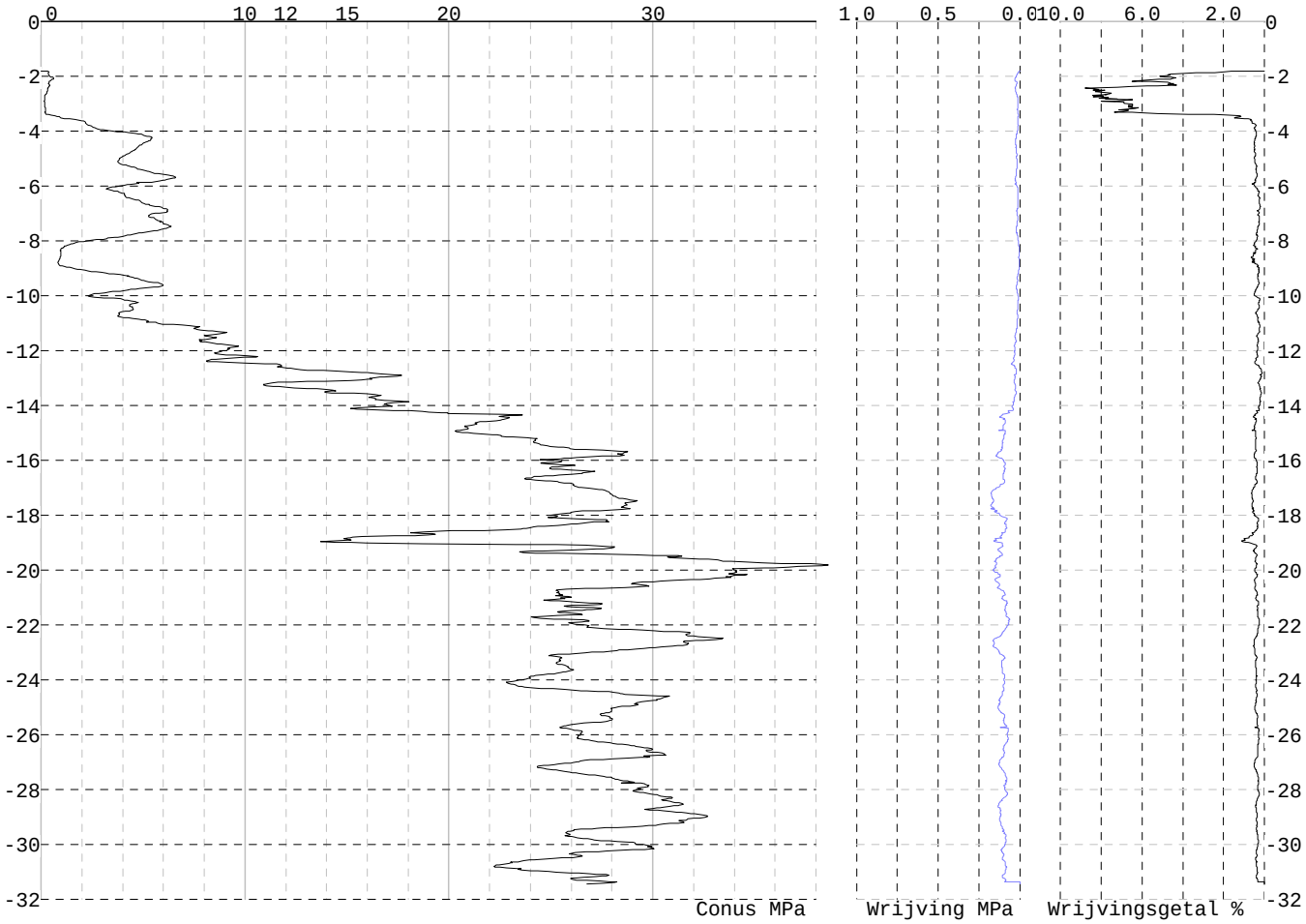


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 35-2A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.81 Bodemprofiel: 35-3
Traject negatieve kleef : -1.81 tot -3.80 [m]
Traject positieve kleef : -3.80 tot -31.44 [m]

SONDERINGSGEGEVENS GRAFIEK: 35-2A

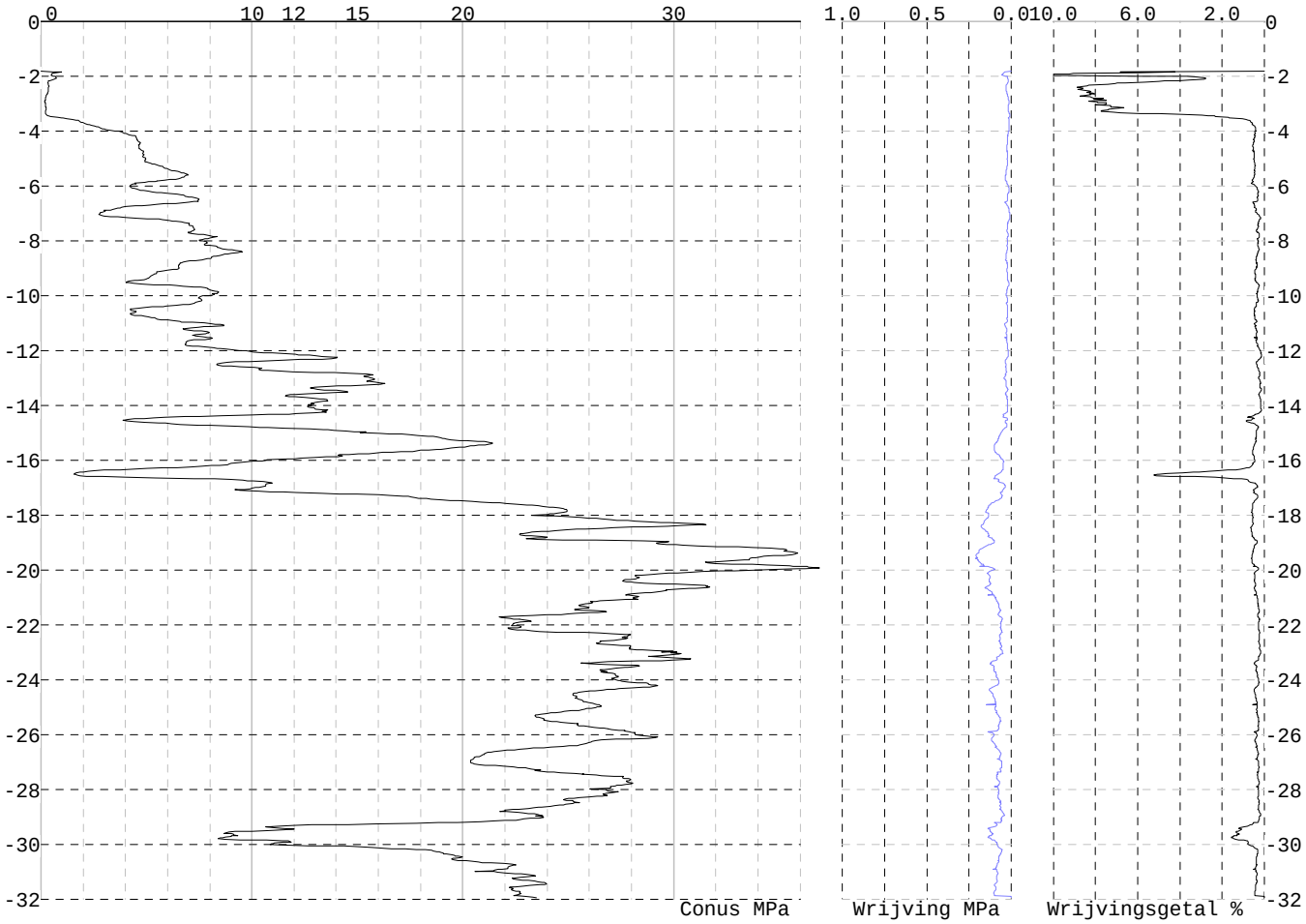


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 35-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.82 Bodemprofiel: 35-3
Traject negatieve kleef : -1.82 tot -3.80 [m]
Traject positieve kleef : -3.80 tot -31.97 [m]

SONDERINGSGEGEVENS GRAFIEK: 35-3

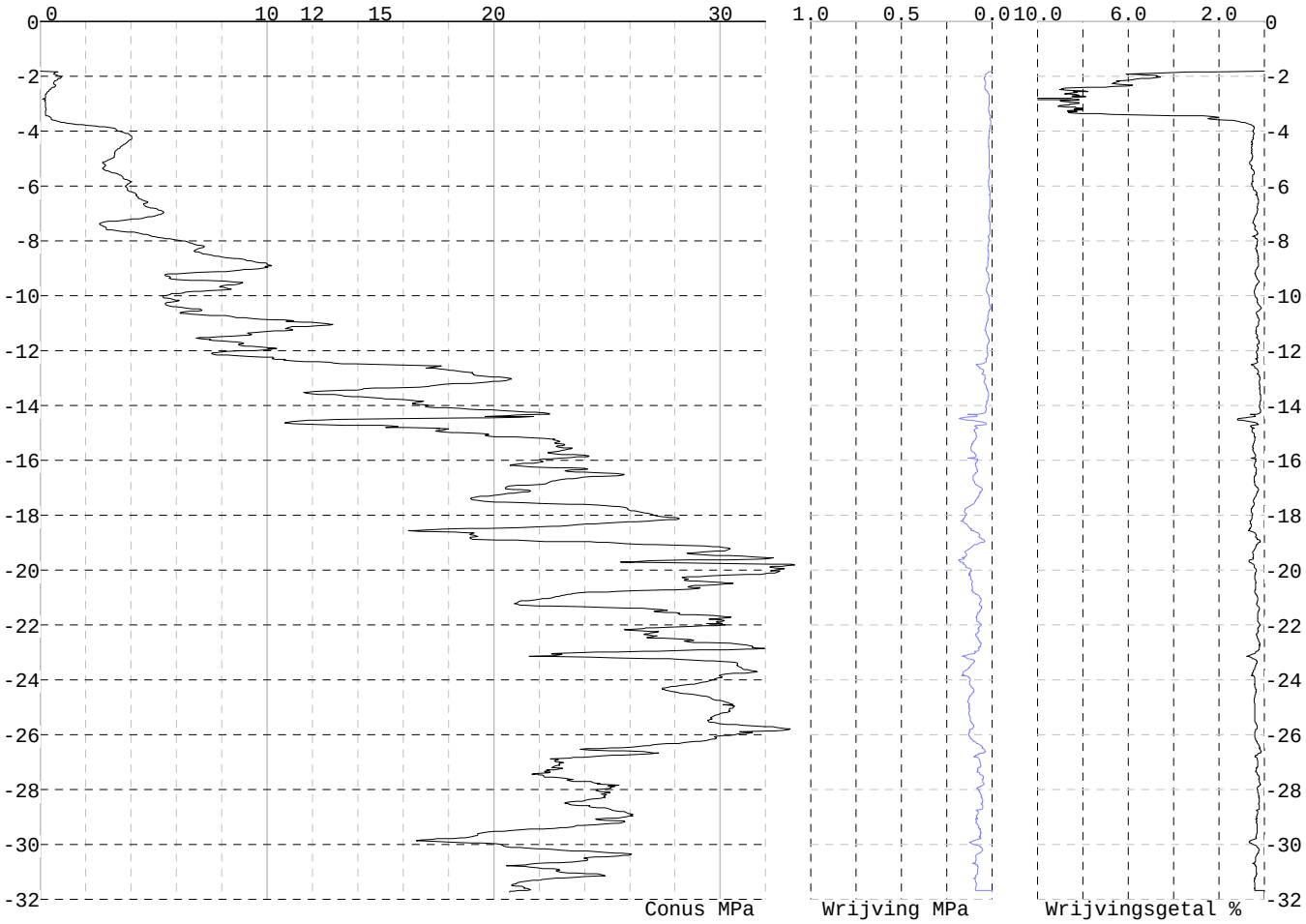


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 35-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.82 Bodemprofiel: 35-1
Traject negatieve kleef : -1.82 tot -3.90 [m]
Traject positieve kleef : -3.90 tot -31.75 [m]

SONDERINGSGEGEVENS GRAFIEK: 35-4

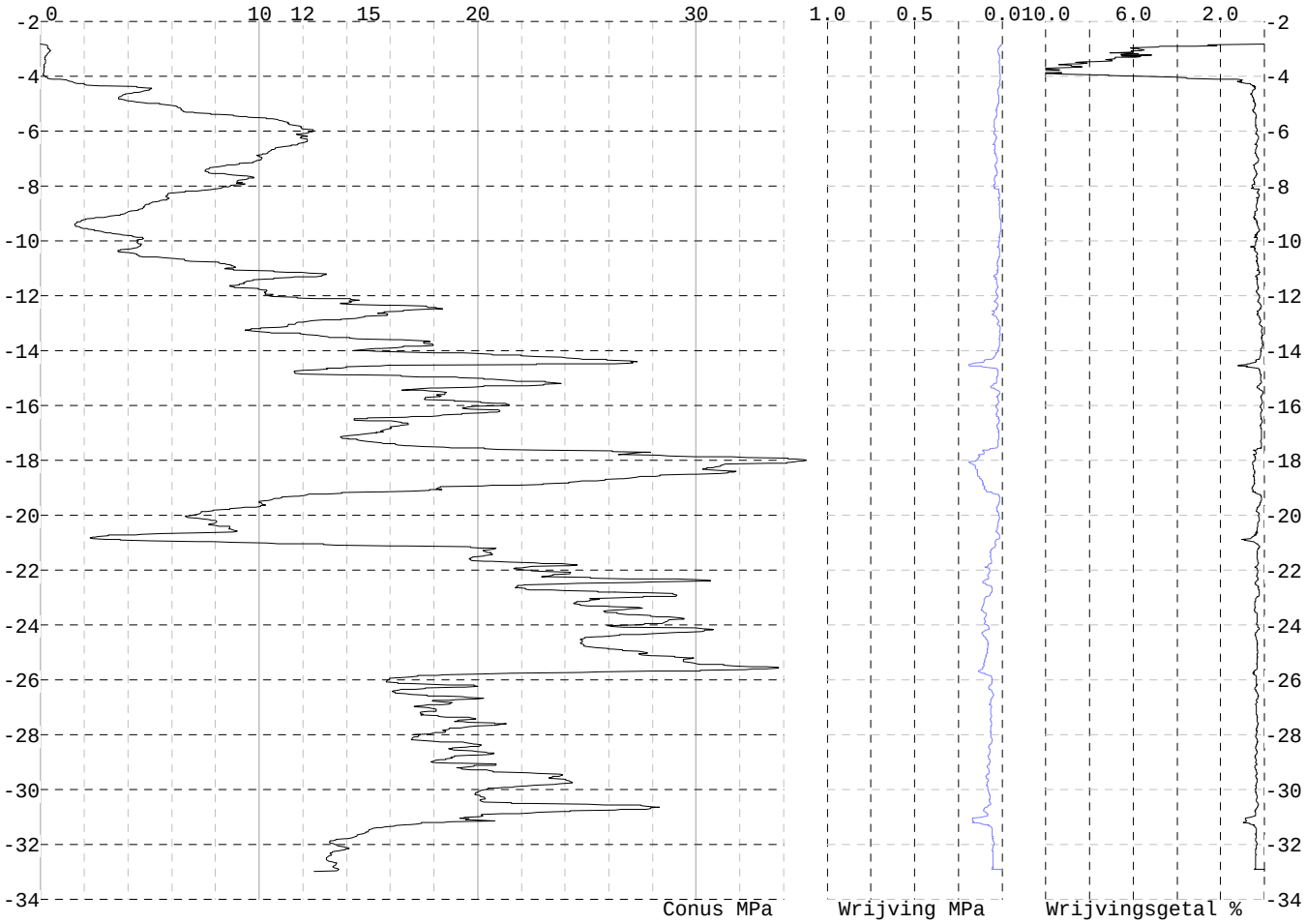


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 32-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.84 Bodemprofiel: 32-1
Traject negatieve kleef : -2.84 tot -4.00 [m]
Traject positieve kleef : -9.50 tot -32.98 [m]

SONDERINGSGEGEVENS GRAFIEK: 32-1

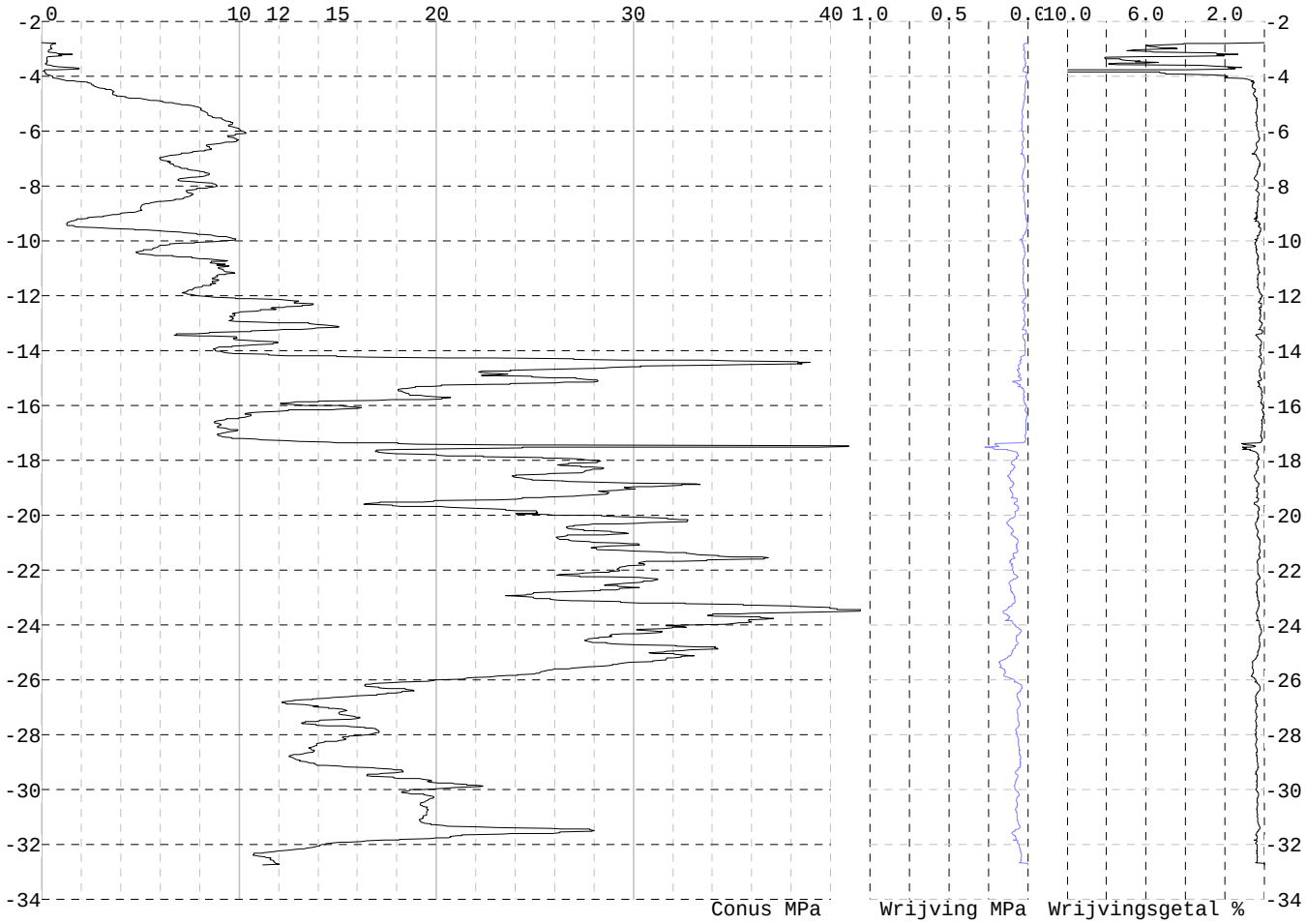


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 32-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.77 Bodemprofiel: 32-2
Traject negatieve kleef : -2.77 tot -4.00 [m]
Traject positieve kleef : -9.50 tot -32.75 [m]

SONDERINGSGEGEVENS GRAFIEK: 32-2

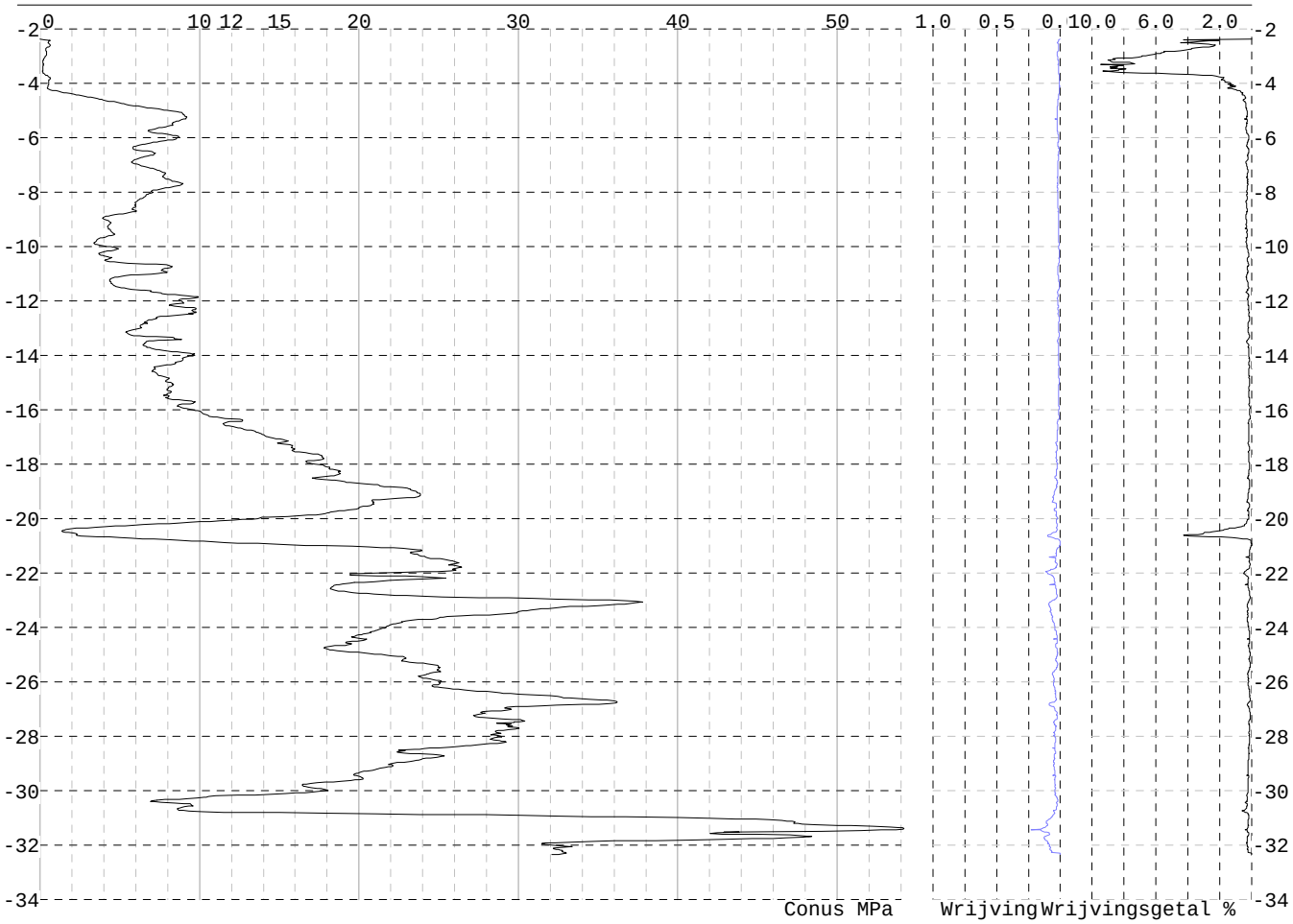


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 34-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.38 Bodemprofiel: 34-1
Traject negatieve kleef : -2.38 tot -4.25 [m]
Traject positieve kleef : -4.25 tot -32.36 [m]

SONDERINGSGEGEVENS GRAFIEK: 34-1

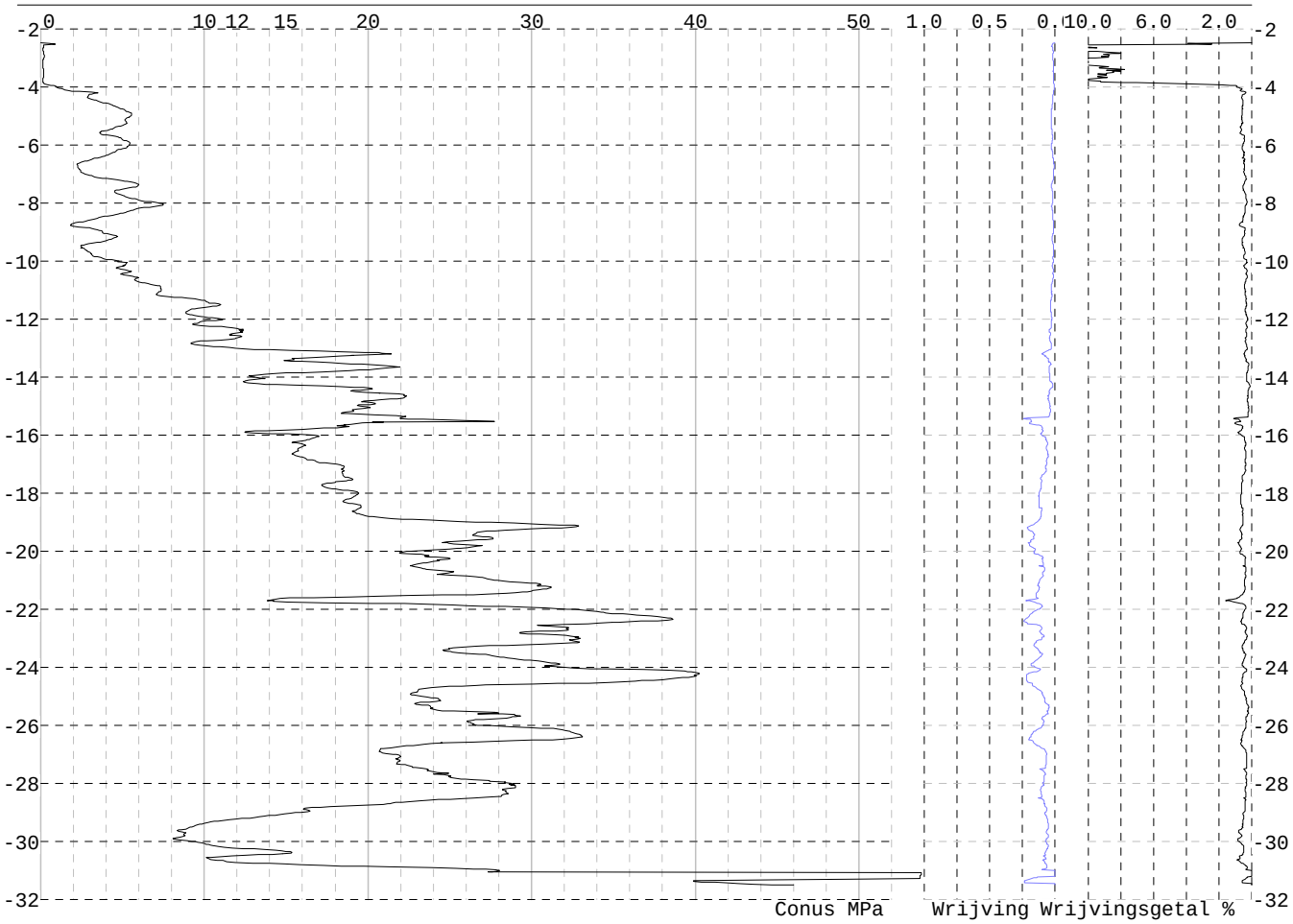


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 34-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.48 Bodemprofiel: 34-2
Traject negatieve kleef : -2.48 tot -4.00 [m]
Traject positieve kleef : -4.00 tot -31.51 [m]

SONDERINGSGEGEVENS GRAFIEK: 34-2



REKENGEGEVENS Mast 32

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 32-1, 32-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -2.16
Paalpuntniveau : N.A.P. -18.01
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 32 (n=1)

Project :
Onderdeel :

Sondering : 32-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.01	-18.01	50.1	660.5	660.5	0.0	0.00

Sondering : 32-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.01	-18.01	49.9	610.3	610.3	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 32 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
32-1	-2.84	-18.01	660.5	660.5	660.5
32-2	-2.77	-18.01	610.3	610.3	610.3

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 32 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
32-1	-2.84	-18.01	50.1	692.9
32-2	-2.77	-18.01	50.1	640.0
		-18.01	$R_{t;cal;gem}$	666.5
met ξ_4(min) = 1.32				
32-1	-2.84	-18.01	50.1	692.9
32-2	-2.77	-18.01	50.1	640.0
		-18.01	$R_{t;cal;min}$	640.0

Totaal resultaten Mast 32 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
32-1 32-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-18.01 $R_{t;d}$ = min.{ 666.5; 640.0}= 640.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.01	640.0	640.0	0.0	640.0	0.00

REKENGEGEVENS Mast 33

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 33-1, 33-2A
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -2.05
Paalpuntniveau : N.A.P. -18.20
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 33 (n=1)

Project :
Onderdeel :

Sondering : 33-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.20	-18.20	50.9	582.2	582.2	0.0	0.00

Sondering : 33-2A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.20	-18.20	50.9	518.6	518.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 33 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
33-1	-2.69	-18.20	582.2	582.2	582.2
33-2A	-2.69	-18.20	518.6	518.6	518.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 33 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
33-1	-2.69	-18.20	50.9	610.4
33-2A	-2.69	-18.20	50.9	543.4
		-18.20	$R_{t;cal;gem}$	576.9
met ξ_4(min) = 1.32				
33-1	-2.69	-18.20	50.9	610.4
33-2A	-2.69	-18.20	50.9	543.4
		-18.20	$R_{t;cal;min}$	543.4

Totaal resultaten Mast 33 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
33-1 33-2A

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-18.20 $R_{t;d}$ = min.{ 576.9; 543.4}= 543.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.20	543.4	543.4	0.0	543.4	0.00

REKENGEGEVENS Mast 34

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 34-1, 34-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -1.62
Paalpuntniveau : N.A.P. -21.62
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 34 (n=1)

Project :
Onderdeel :

Sondering : 34-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-21.62	-21.62	230.5	2425.8	2425.8	0.0	0.00

Sondering : 34-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-21.62	-21.62	231.4	2778.1	2778.1	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 34 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
34-1	-2.38	-21.62	2425.8	2425.8	2425.8
34-2	-2.48	-21.62	2778.1	2778.1	2778.1

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 34 (van 2 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
34-1	-2.38	-21.62	230.5	2542.2
34-2	-2.48	-21.62	230.5	2913.2
		-21.62	$R_{t;cal;gem}$	2727.7
met ξ_4(min) = 1.32				
34-1	-2.38	-21.62	230.5	2542.2
34-2	-2.48	-21.62	230.5	2913.2
		-21.62	$R_{t;cal;min}$	2542.2

Totaal resultaten Mast 34 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
34-1 34-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-21.62	$R_{t;d}$ = min.{ 2727.7; 2542.2}= 2542.2

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-21.62	2542.2	2542.2	0.0	2542.2	0.00

REKENGEGEVENS Mast 35

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 35-1, 35-2A, 35-3, 35-4
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.98
Paalpuntniveau : N.A.P. -20.08
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 35 (n=1)

Project :
Onderdeel :

Sondering : 35-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.08	-20.08	221.8	2428.5	2428.5	0.0	0.00

Sondering : 35-2A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.08	-20.08	221.6	2464.2	2464.2	0.0	0.00

Sondering : 35-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.08	-20.08	221.6	2377.7	2377.7	0.0	0.00

Sondering : 35-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-20.08	-20.08	221.8	2578.6	2578.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 35 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
35-1	-1.85	-20.08	2428.5	2428.5	2428.5
35-2A	-1.81	-20.08	2464.2	2464.2	2464.2
35-3	-1.82	-20.08	2377.7	2377.7	2377.7
35-4	-1.82	-20.08	2578.6	2578.6	2578.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 35 (van 4 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=4)}$: 1.28
Correlatiefactor $\xi_{4min(n=4)}$: 1.03

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.28				
35-1	-1.85	-20.08	221.8	2618.1
35-2A	-1.81	-20.08	221.8	2656.9
35-3	-1.82	-20.08	221.8	2563.0
35-4	-1.82	-20.08	221.8	2781.1
		-20.08	$R_{t;cal;gem}$	2654.8
met ξ_4(min) = 1.03				
35-1	-1.85	-20.08	221.8	3199.7
35-2A	-1.81	-20.08	221.8	3248.0
35-3	-1.82	-20.08	221.8	3131.3
35-4	-1.82	-20.08	221.8	3402.3
		-20.08	$R_{t;cal;min}$	3131.3

Totaal resultaten Mast 35 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
35-1 35-2A 35-3 35-4

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]: -20.08 $R_{t;d}$ = min.{ 2654.8; 3131.3}= 2654.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-20.08	2654.8	2654.8	0.0	2654.8	0.00

PAALGEGEVENS GI 609_750

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 0.750
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

Project :
Onderdeel :

PAALGEGEVENS BP 559x10

Type	: Stalen buispaal (gesloten)
Wijze van installeren	: Heien
Diameter [m]	: 0.559
Elasticiteitsmodulus [N/mm²]	: 20000
Factor α_s (tabel 7.c EC 7.1)	: 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	: 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	: 1.00
Paalvoetvormfactor β	: 1.00
Type lastzakkingsdiagram	: Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	: 0.75
Groutomhulling	: NEE

PAALGEGEVENS GI 914_1075

Type	: Stalen profiel (geheid, grout)
Wijze van installeren	: Heien
Diameter [m]	: 1.075
Elasticiteitsmodulus [N/mm²]	: 20000
Factor α_s (tabel 7.c EC 7.1)	: 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	: 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	: 1.00
Paalvoetvormfactor β	: 1.00
Type lastzakkingsdiagram	: Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	: 0.75
Groutomhulling	: JA

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 32	Mast 33	Mast 34	Mast 35
33-1	-2.69	-18.20		582		
33-2A	-2.69	-18.20		518		
35-1	-1.85	-20.08				2428
35-2A	-1.81	-20.08				2464
35-3	-1.82	-20.08				2377
35-4	-1.82	-20.08				2578
32-1	-2.84	-18.01	660			
32-2	-2.77	-18.01	610			
34-1	-2.38	-21.62			2425	
34-2	-2.48	-21.62			2778	

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 40-49 (excl 41).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
15	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: 40-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.30 Grondwaterstand [m] : -2.30

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.30	-2.97	Klei - Schoon - Matig	1.0	50.0		
2	-2.97	-5.90	Zand - Schoon - Los	1.0	100.0		
3	-5.90	-11.47	Zand - Schoon - Los	1.0	100.0		
4	-11.47	-12.49	Zand - Schoon - Matig	1.0	100.0		
5	-12.49	-15.87	Zand - Schoon - Los	1.0	100.0		
6	-15.87	-16.88	Klei - Schoon - Vast	1.0	50.0		
7	-16.88	-17.16	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-17.16	-17.64	Klei - Zwak zandig - Vast	1.0	50.0		
9	-17.64	-25.82	Zand - Schoon - Matig	1.0	100.0		
10	-25.82	-27.68	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-27.68	-31.27	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 42-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.10 Grondwaterstand [m] : -2.10

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.10	-2.73	Klei - Organisch - Matig	1.0	50.0		
2	-2.73	-12.93	Zand - Schoon - Los	1.0	100.0		
3	-12.93	-14.00	Zand - Schoon - Matig	1.0	100.0		
4	-14.00	-15.15	Zand - Schoon - Los	1.0	100.0		
5	-15.15	-15.83	Leem - Zwak zandig - Vast	1.0	50.0		
6	-15.83	-16.73	Klei - Zwak zandig - Vast	1.0	50.0		
7	-16.73	-26.16	Zand - Schoon - Matig	1.0	100.0		
8	-26.16	-26.54	Zand - Schoon - Los	1.0	100.0		
9	-26.54	-27.19	Klei - Schoon - Vast	1.0	50.0		
10	-27.19	-30.66	Zand - Schoon - Los	1.0	100.0		
11	-30.66	-31.26	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 42-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.67 Grondwaterstand [m] : -0.33

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.67	-0.76	Klei - Organisch - Matig	1.0	50.0		
2	-0.76	-3.90	Zand - Schoon - Los	1.0	100.0		
3	-3.90	-4.92	Klei - Zwak zandig - Vast	1.0	50.0		
4	-4.92	-14.57	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-14.57	-15.13	Klei - Schoon - Vast	1.0	50.0		
6	-15.13	-24.12	Zand - Schoon - Matig	1.0	100.0		
7	-24.12	-29.49	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 43-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.01 Grondwaterstand [m] : -2.01

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.01	-2.66	Klei - Organisch - Matig	1.0	50.0		
2	-2.66	-7.83	Zand - Schoon - Los	1.0	100.0		
3	-7.83	-9.01	Leem - Zwak zandig - Vast	1.0	50.0		
4	-9.01	-12.07	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-12.07	-15.11	Zand - Schoon - Matig	1.0	100.0		
6	-15.11	-20.31	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-20.31	-27.50	Zand - Schoon - Matig	1.0	100.0		
8	-27.50	-30.32	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-30.32	-31.17	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 44-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.80 Grondwaterstand [m] : -1.80

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.80	-2.15	Klei - Zwak zandig - Slap	1.0	50.0		
2	-2.15	-5.36	Zand - Schoon - Los	1.0	100.0		
3	-5.36	-10.97	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-10.97	-12.99	Zand - Schoon - Los	1.0	100.0		
5	-12.99	-27.50	Zand - Schoon - Matig	1.0	100.0		
6	-27.50	-30.88	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 45-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.85 Grondwaterstand [m] : -1.85

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.85	-2.20	Klei - Organisch - Matig	1.0	50.0		
2	-2.20	-8.11	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-8.11	-13.71	Zand - Schoon - Los	1.0	100.0		
4	-13.71	-13.97	Klei - Schoon - Vast	1.0	50.0		
5	-13.97	-14.71	Zand - Schoon - Matig	1.0	100.0		
6	-14.71	-15.39	Zand - Schoon - Los	1.0	100.0		
7	-15.39	-15.79	Zand - Schoon - Matig	1.0	100.0		
8	-15.79	-16.17	Zand - Schoon - Los	1.0	100.0		
9	-16.17	-16.43	Klei - Zwak zandig - Vast	1.0	50.0		
10	-16.43	-19.01	Zand - Schoon - Matig	1.0	100.0		
11	-19.01	-25.34	Zand - Schoon - Vast	1.0	100.0		
12	-25.34	-27.76	Zand - Schoon - Matig	1.0	100.0		
13	-27.76	-29.76	Zand - Schoon - Los	1.0	100.0		
14	-29.76	-31.02	Zand - Sterk siltig - Kleiig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 46-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.82 Grondwaterstand [m] : -1.82

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.82	-2.27	Klei - Organisch - Matig	1.0	50.0		
2	-2.27	-8.96	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-8.96	-9.71	Zand - Schoon - Los	1.0	100.0		
4	-9.71	-10.11	Klei - Zwak zandig - Vast	1.0	50.0		
5	-10.11	-30.91	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 47-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.71 Grondwaterstand [m] : -1.71

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.71	-2.18	Klei - Organisch - Matig	1.0	50.0		
2	-2.18	-13.13	Zand - Schoon - Los	1.0	100.0		
3	-13.13	-13.54	Klei - Zwak zandig - Matig	1.0	50.0		
4	-13.54	-17.00	Zand - Schoon - Los	1.0	100.0		
5	-17.00	-24.90	Zand - Schoon - Matig	1.0	100.0		
6	-24.90	-25.34	Leem - Zwak zandig - Vast	1.0	50.0		
7	-25.34	-28.56	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-28.56	-30.52	Zand - Schoon - Los	1.0	100.0		
9	-30.52	-30.92	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 48-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.63 Grondwaterstand [m] : -1.63

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.63	-1.90	Klei - Zwak zandig - Slap	1.0	50.0		
2	-1.90	-11.01	Zand - Schoon - Los	1.0	100.0		
3	-11.01	-15.00	Zand - Schoon - Matig	1.0	100.0		
4	-15.00	-16.04	Zand - Schoon - Los	1.0	100.0		
5	-16.04	-16.80	Klei - Schoon - Matig	1.0	50.0		
6	-16.80	-25.64	Zand - Schoon - Matig	1.0	100.0		
7	-25.64	-29.78	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-29.78	-30.57	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 49-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.50 Grondwaterstand [m] : -1.50

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.50	-1.71	Klei - Zwak zandig - Slap	1.0	50.0		
2	-1.71	-1.83	Leem - Zwak zandig - Vast	1.0	50.0		
3	-1.83	-8.59	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-8.59	-10.56	Zand - Schoon - Los	1.0	100.0		
5	-10.56	-11.58	Klei - Zwak zandig - Matig	1.0	50.0		
6	-11.58	-15.43	Zand - Schoon - Los	1.0	100.0		
7	-15.43	-25.00	Zand - Schoon - Matig	1.0	100.0		
8	-25.00	-26.90	Zand - Schoon - Los	1.0	100.0		
9	-26.90	-29.62	Zand - Schoon - Matig	1.0	100.0		
10	-29.62	-30.51	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 49-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.54 Grondwaterstand [m] : -1.54

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.54	-1.85	Klei - Zwak zandig - Slap	1.0	50.0		
2	-1.85	-5.03	Zand - Schoon - Los	1.0	100.0		
3	-5.03	-7.61	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-7.61	-10.52	Zand - Schoon - Los	1.0	100.0		
5	-10.52	-12.18	Zand - Schoon - Matig	1.0	100.0		
6	-12.18	-13.94	Zand - Schoon - Los	1.0	100.0		

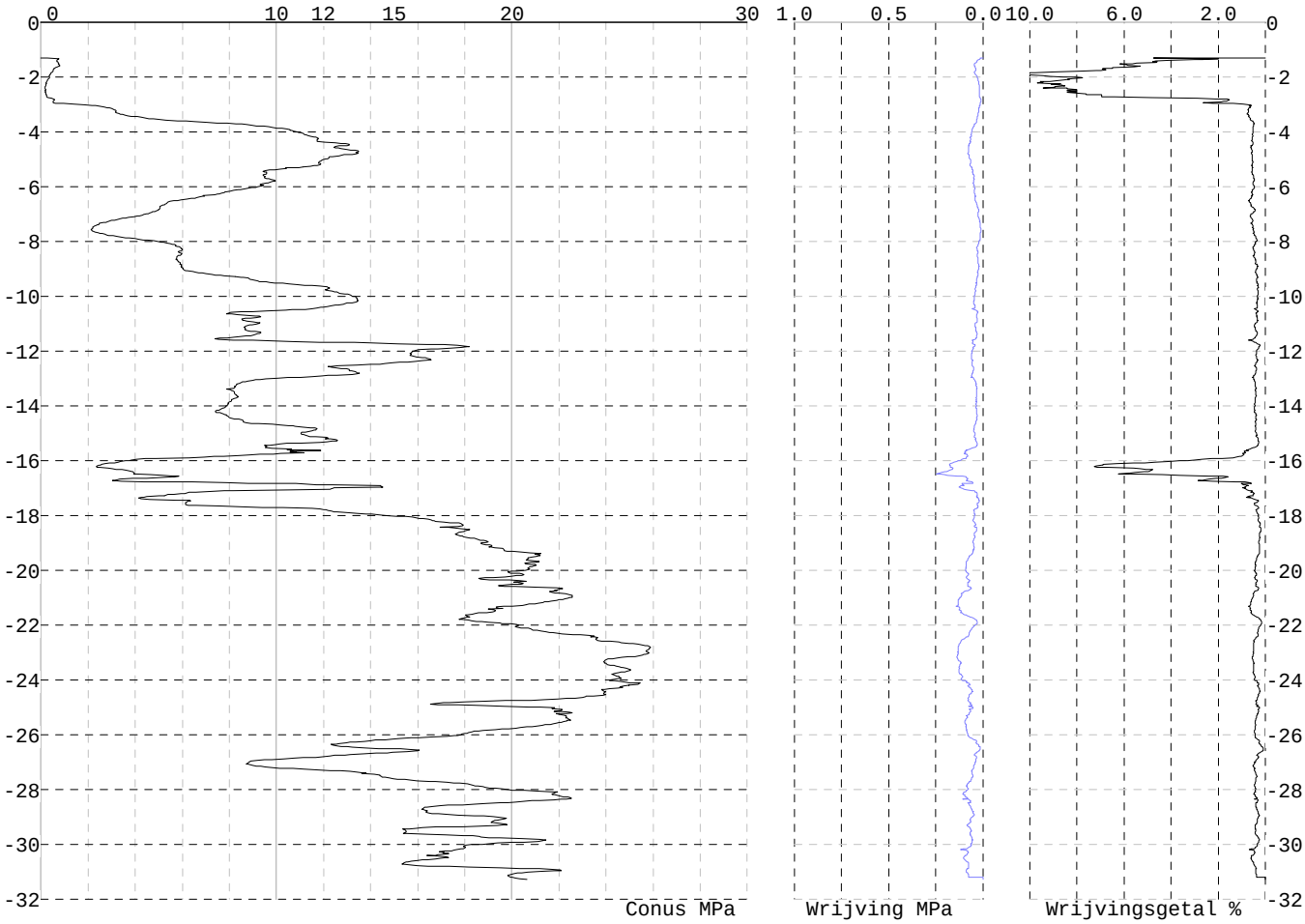
Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
7	-13.94	-14.45	Klei - Zwak zandig - Vast	1.0	50.0		
8	-14.45	-15.79	Zand - Schoon - Matig	1.0	100.0		
9	-15.79	-16.18	Leem - Zwak zandig - Vast	1.0	50.0		
10	-16.18	-25.01	Zand - Schoon - Matig	1.0	100.0		
11	-25.01	-26.95	Zand - Schoon - Los	1.0	100.0		
12	-26.95	-30.58	Zand - Schoon - Matig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 40-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.30 Bodemprofiel: 40-1
Traject negatieve kleef : -1.30 tot -3.10 [m]
Traject positieve kleef : -3.10 tot -31.28 [m]

SONDERINGSGEGEVENS GRAFIEK: 40-1

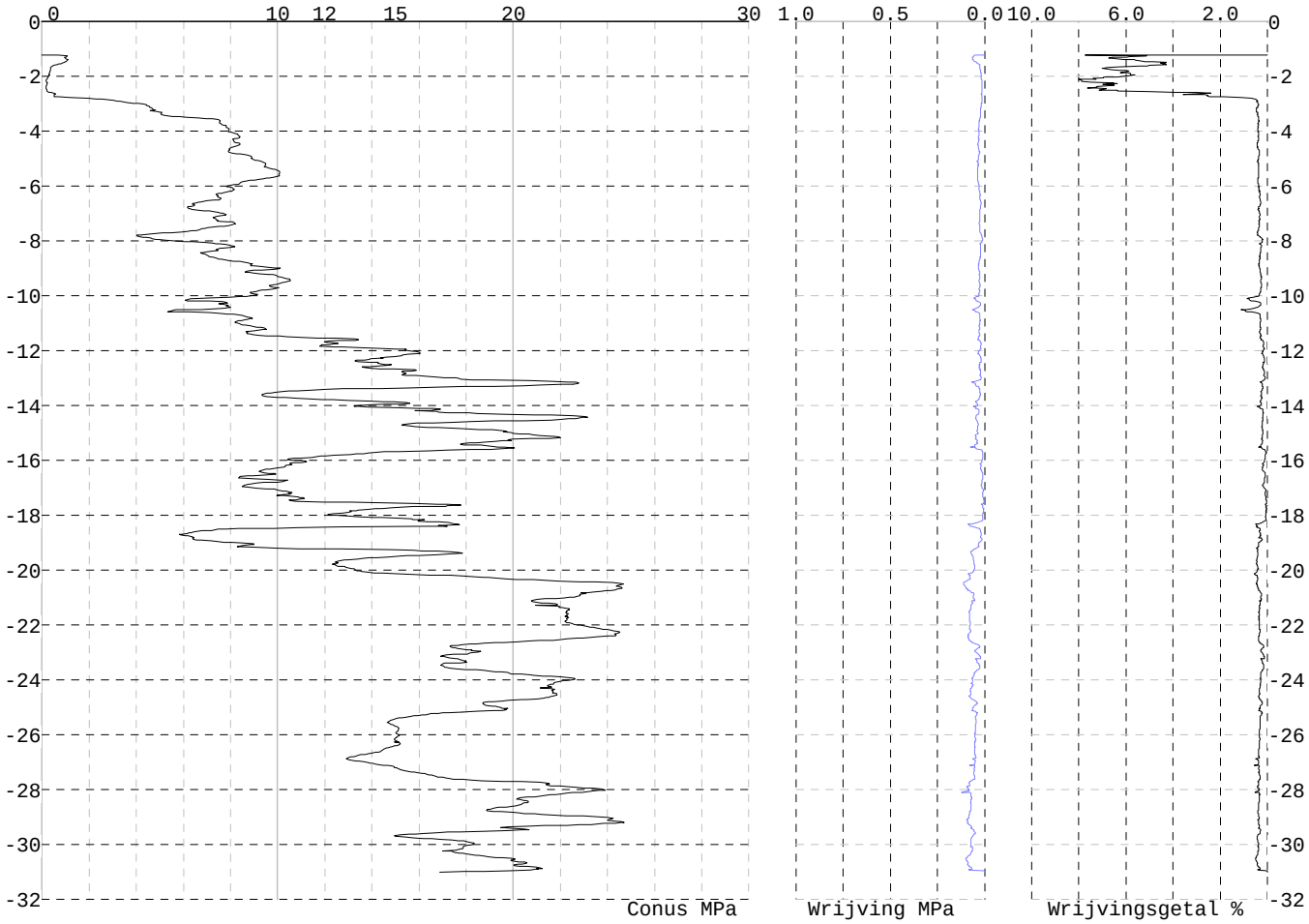


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 40-2A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.23 Bodemprofiel: 40-1
Traject negatieve kleef : -1.23 tot -2.80 [m]
Traject positieve kleef : -2.80 tot -31.03 [m]

SONDERINGSGEGEVENS GRAFIEK: 40-2A

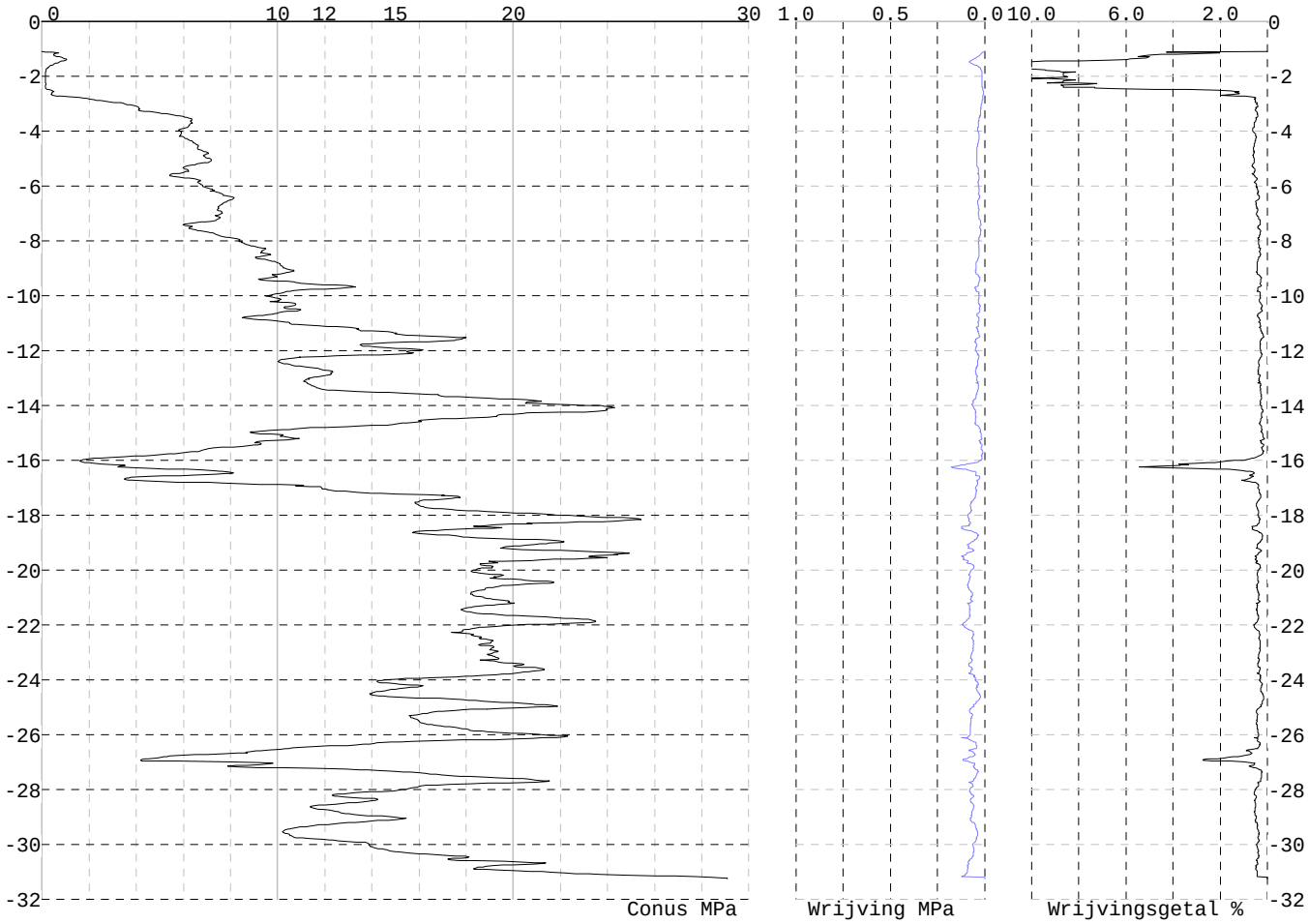


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 42-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.10 Bodemprofiel: 42-1
Traject negatieve kleef : -1.10 tot -2.70 [m]
Traject positieve kleef : -2.70 tot -31.27 [m]

SONDERINGSGEGEVENS GRAFIEK: 42-1

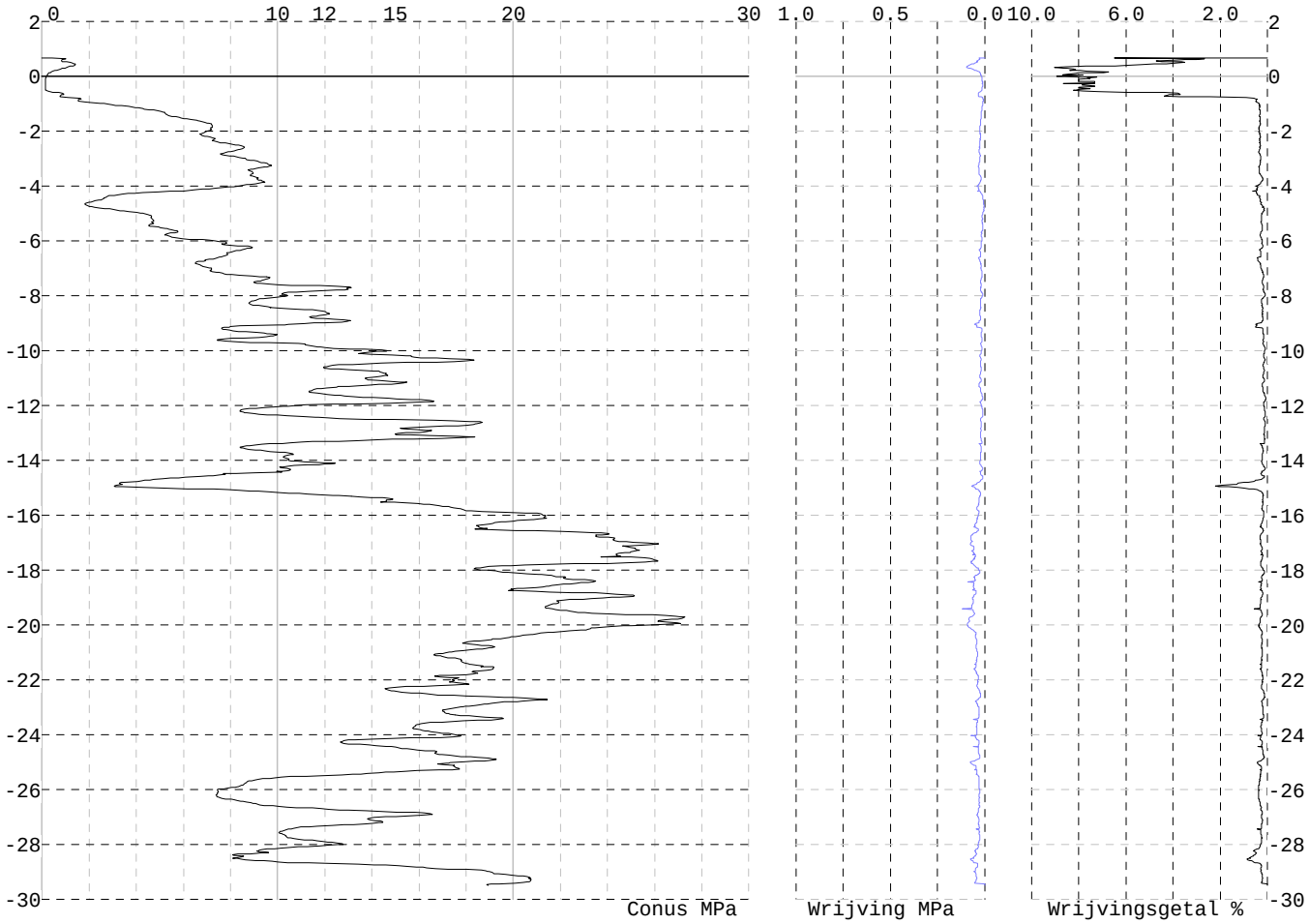


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 42-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.67 Bodemprofiel: 42-2
Traject negatieve kleef : 0.67 tot -0.90 [m]
Traject positieve kleef : -0.90 tot -29.50 [m]

SONDERINGSGEGEVENS GRAFIEK: 42-2

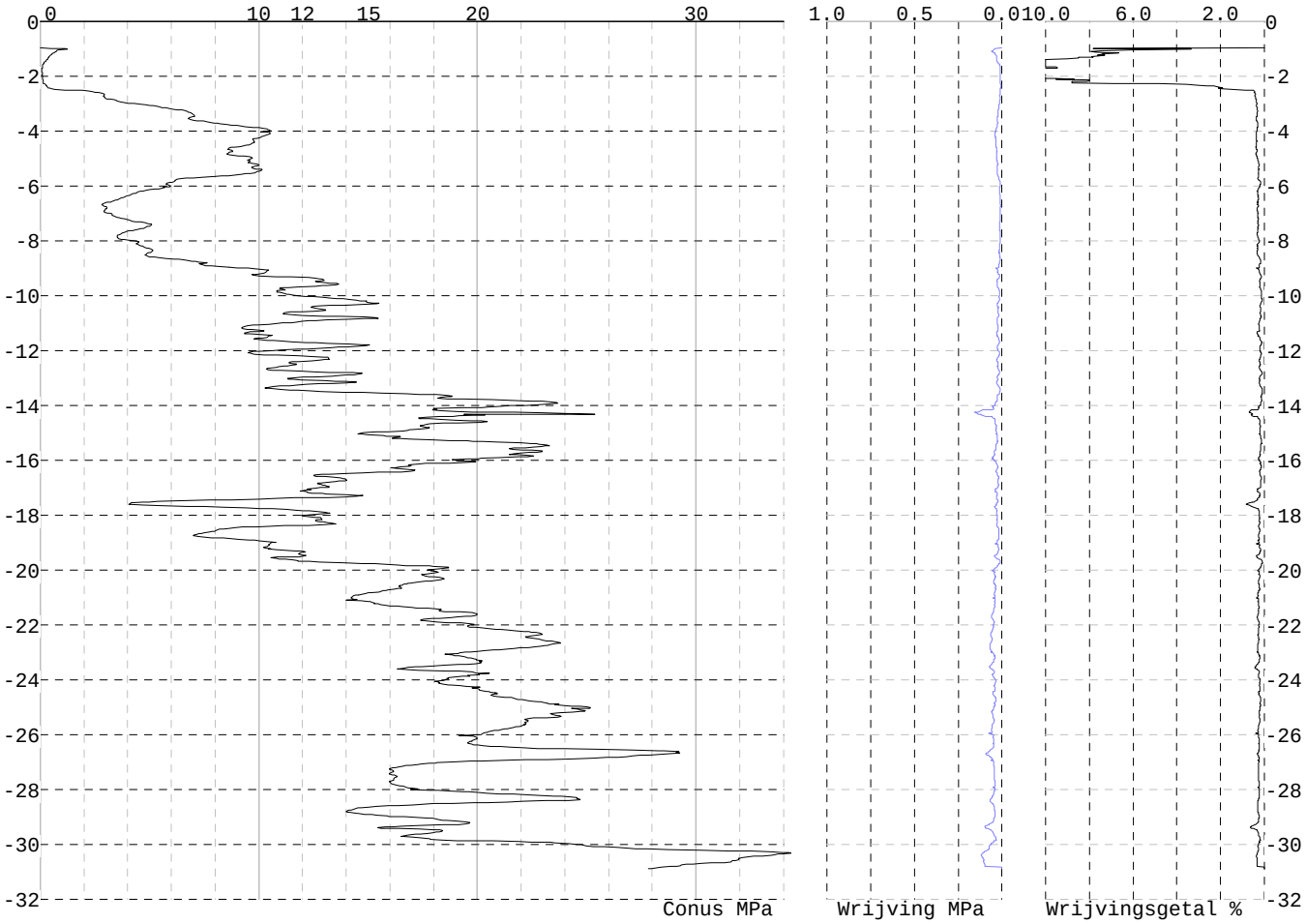


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 43-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.97 Bodemprofiel: 43-2
Traject negatieve kleef : -0.97 tot -2.50 [m]
Traject positieve kleef : -2.50 tot -30.90 [m]

SONDERINGSGEGEVENS GRAFIEK: 43-1

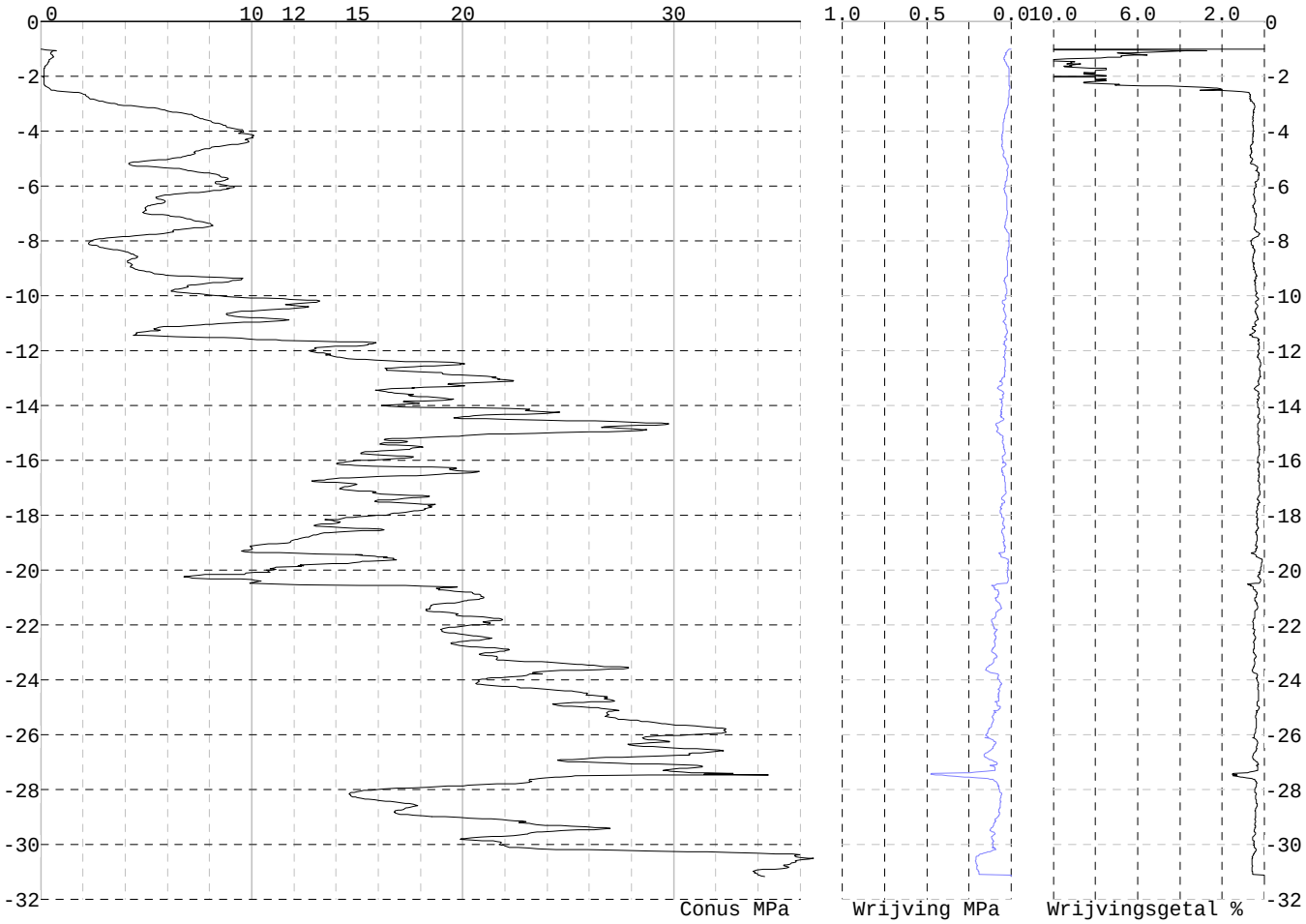


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 43-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.01 Bodemprofiel: 43-2
Traject negatieve kleef : -1.01 tot -2.80 [m]
Traject positieve kleef : -2.80 tot -31.18 [m]

SONDERINGSGEGEVENS GRAFIEK: 43-2

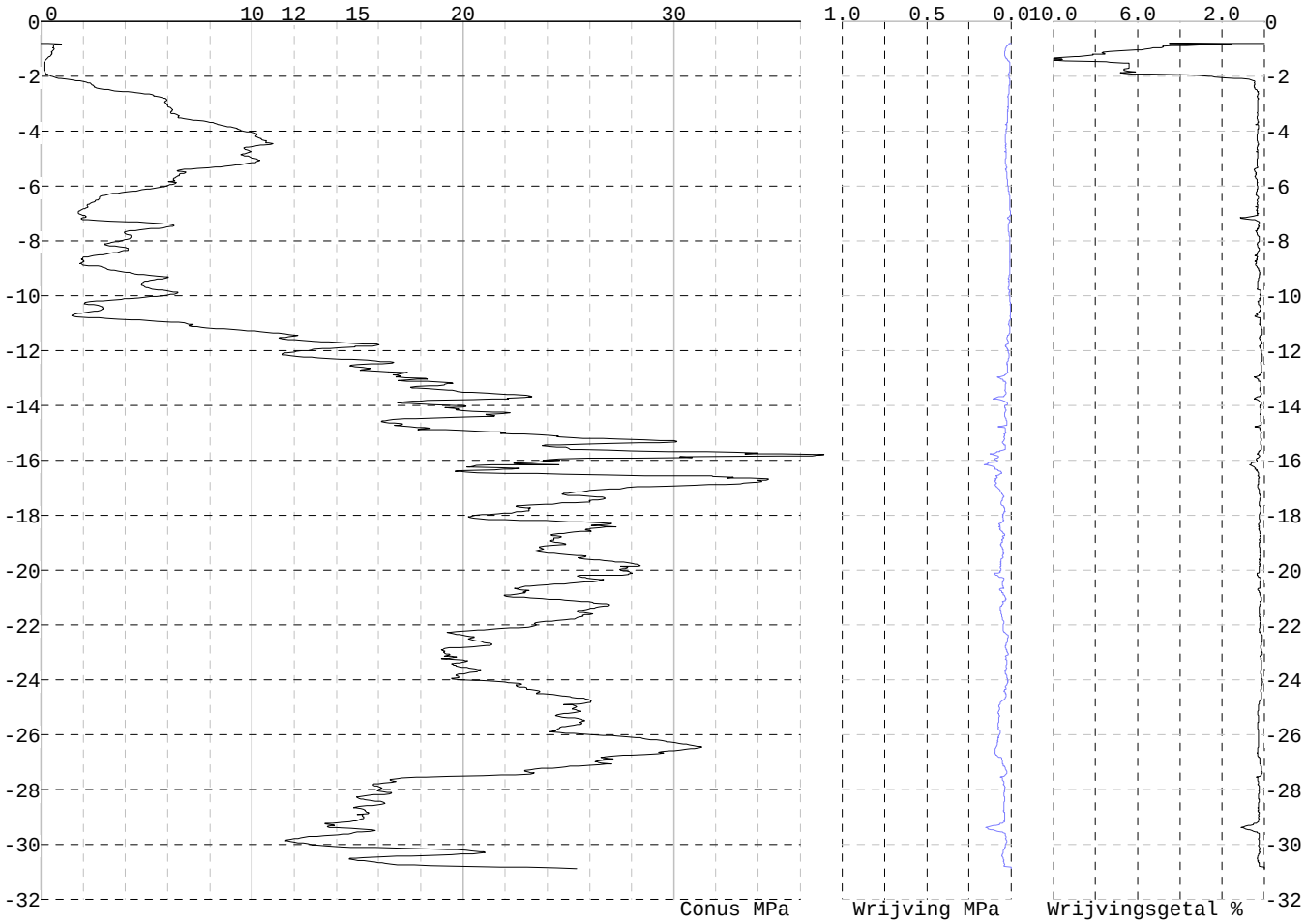


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 44-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.80 Bodemprofiel: 44-1
Traject negatieve kleef : -0.80 tot -2.40 [m]
Traject positieve kleef : -2.40 tot -30.89 [m]

SONDERINGSGEGEVENS GRAFIEK: 44-1

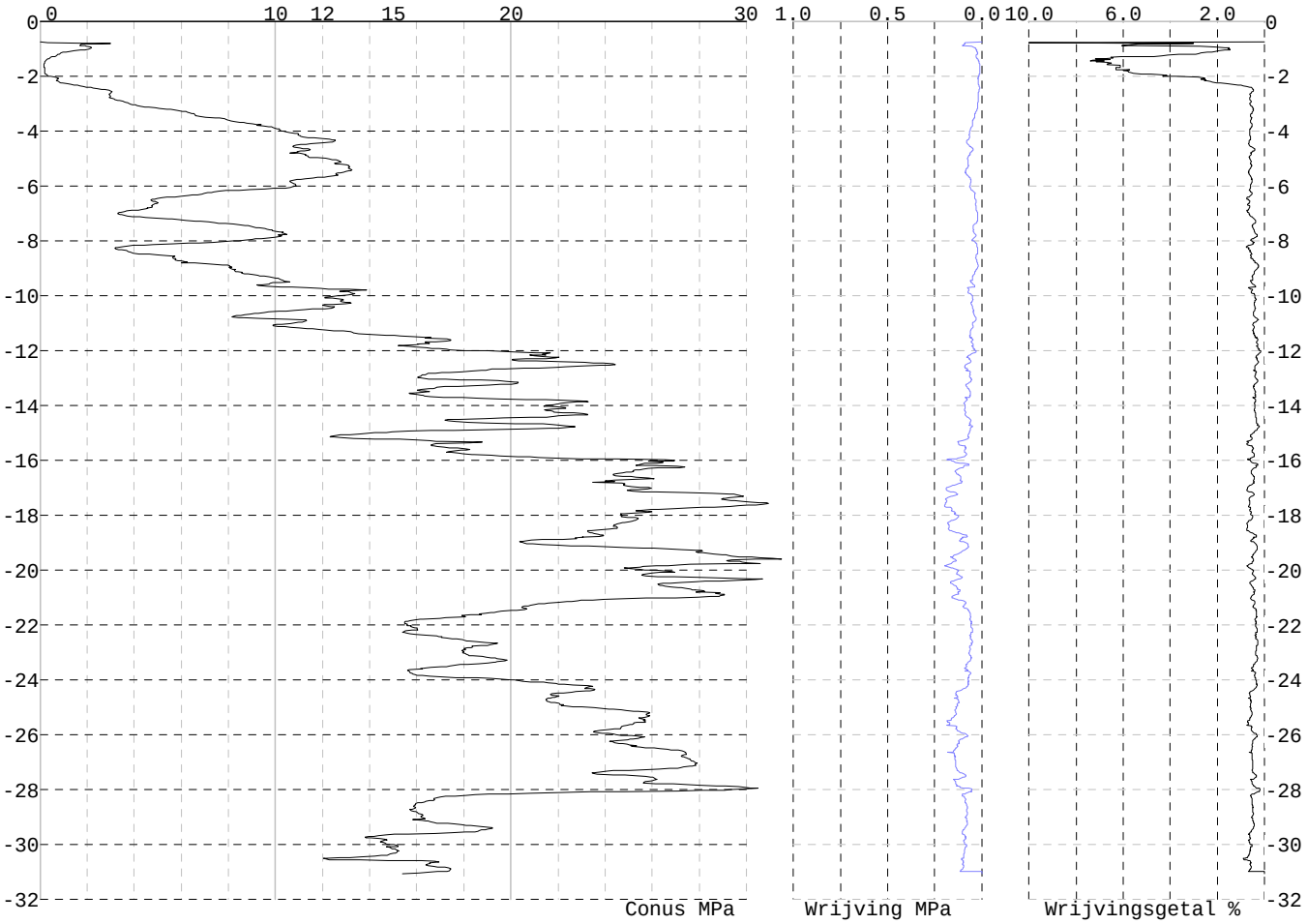


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 44-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.76 Bodemprofiel: 44-1
Traject negatieve kleef : -0.76 tot -2.60 [m]
Traject positieve kleef : -2.60 tot -31.07 [m]

SONDERINGSGEGEVENS GRAFIEK: 44-2

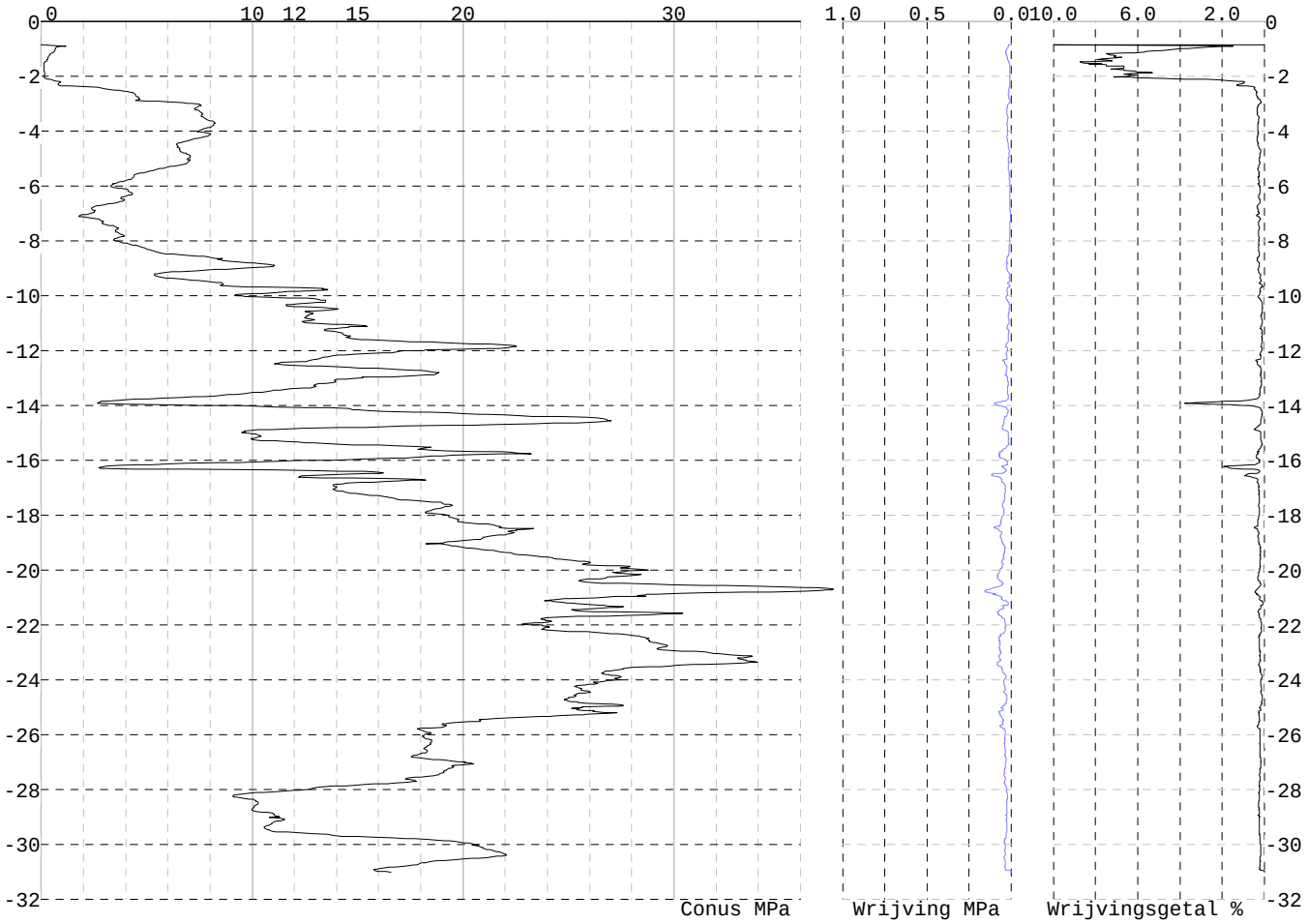


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 45-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.85 Bodemprofiel: 45-1
Traject negatieve kleef : -0.85 tot -2.70 [m]
Traject positieve kleef : -2.70 tot -31.03 [m]

SONDERINGSGEGEVENS GRAFIEK: 45-1

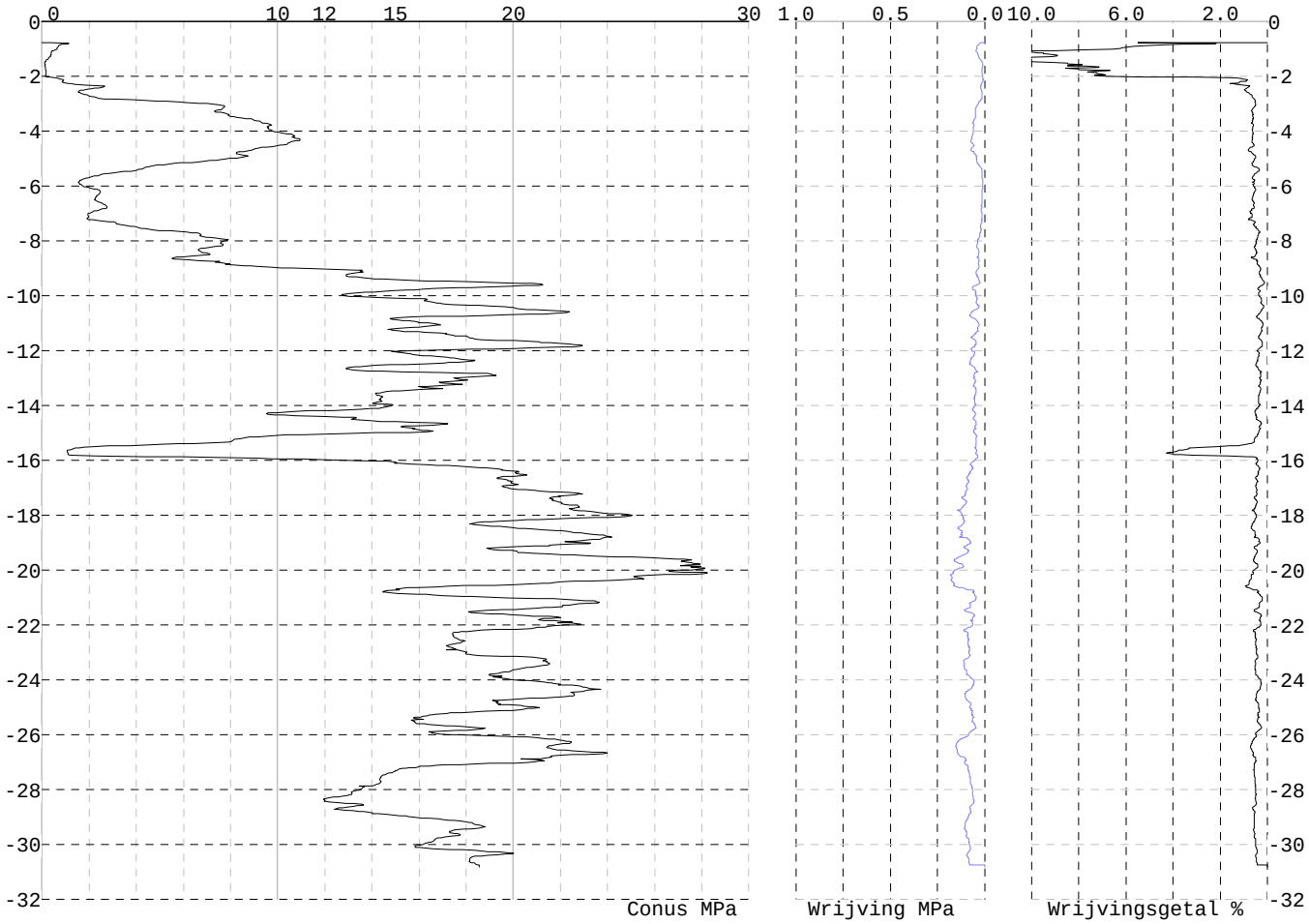


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 45-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.77 Bodemprofiel: 45-1
Traject negatieve kleef : -0.77 tot -2.60 [m]
Traject positieve kleef : -2.60 tot -30.83 [m]

SONDERINGSGEGEVENS GRAFIEK: 45-2

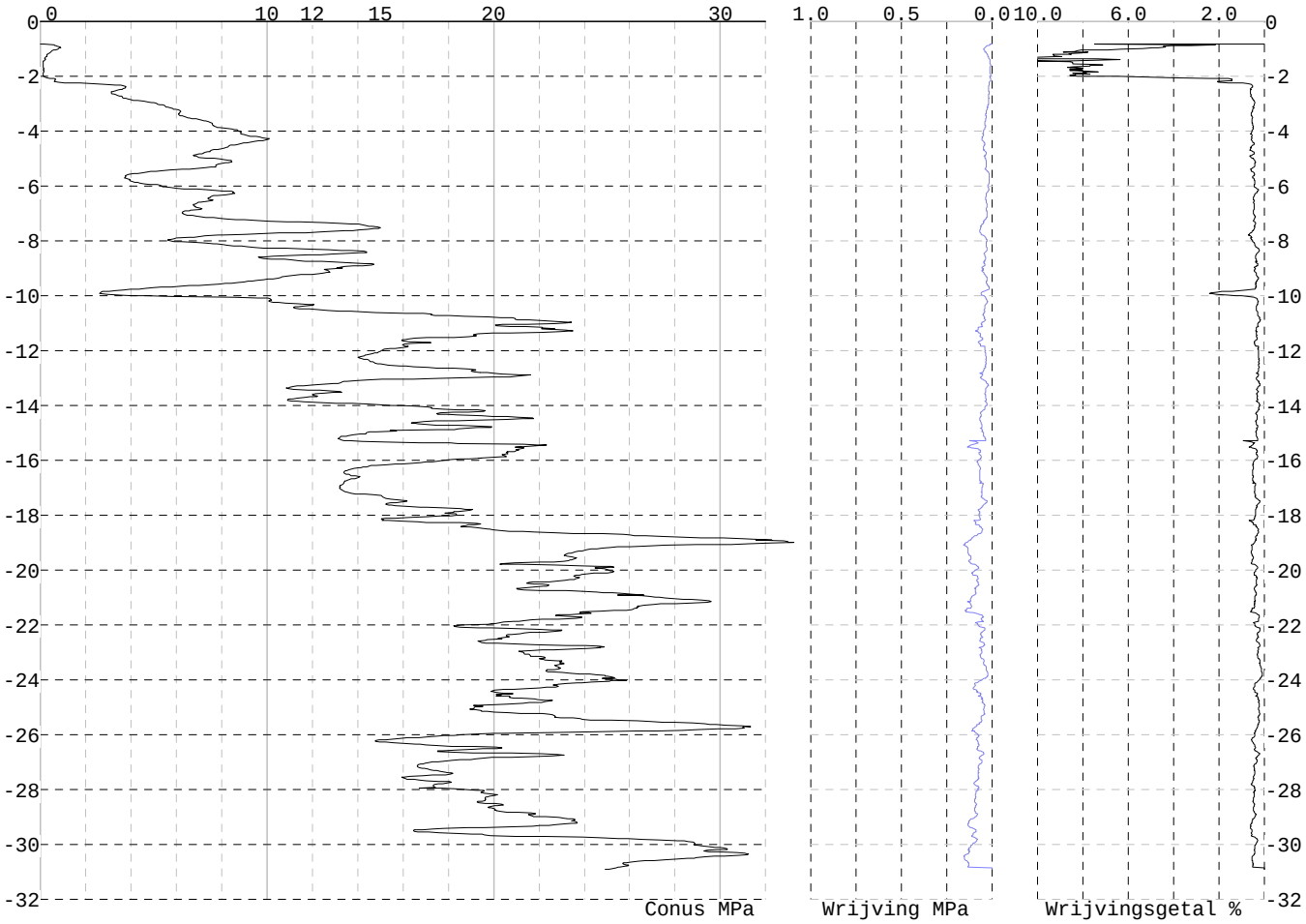


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 46-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.82 Bodemprofiel: 46-1
Traject negatieve kleef : -0.82 tot -2.30 [m]
Traject positieve kleef : -2.30 tot -30.92 [m]

SONDERINGSGEGEVENS GRAFIEK: 46-1

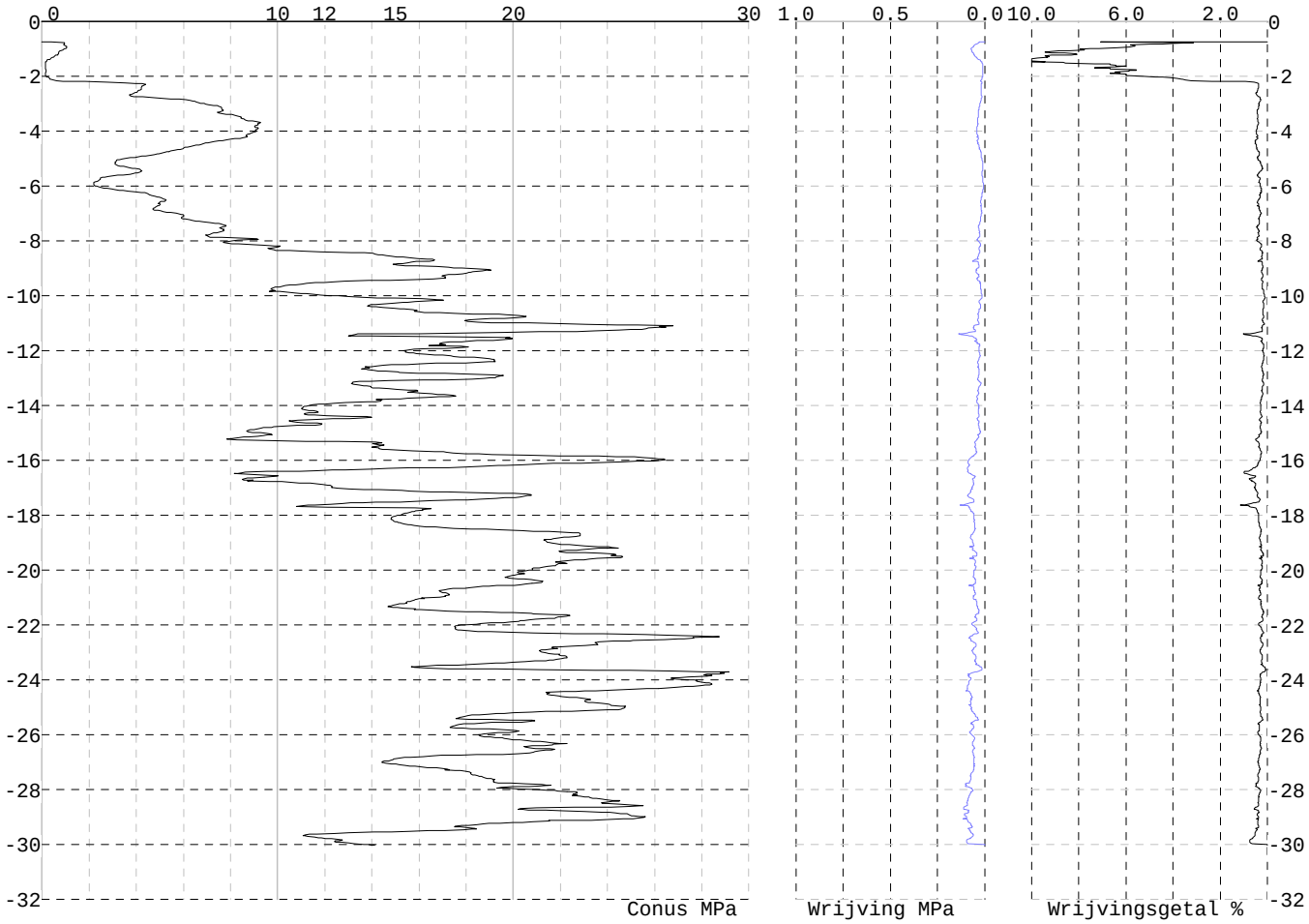


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 46-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.75 Bodemprofiel: 46-1
Traject negatieve kleef : -0.75 tot -2.30 [m]
Traject positieve kleef : -2.30 tot -30.05 [m]

SONDERINGSGEGEVENS GRAFIEK: 46-2

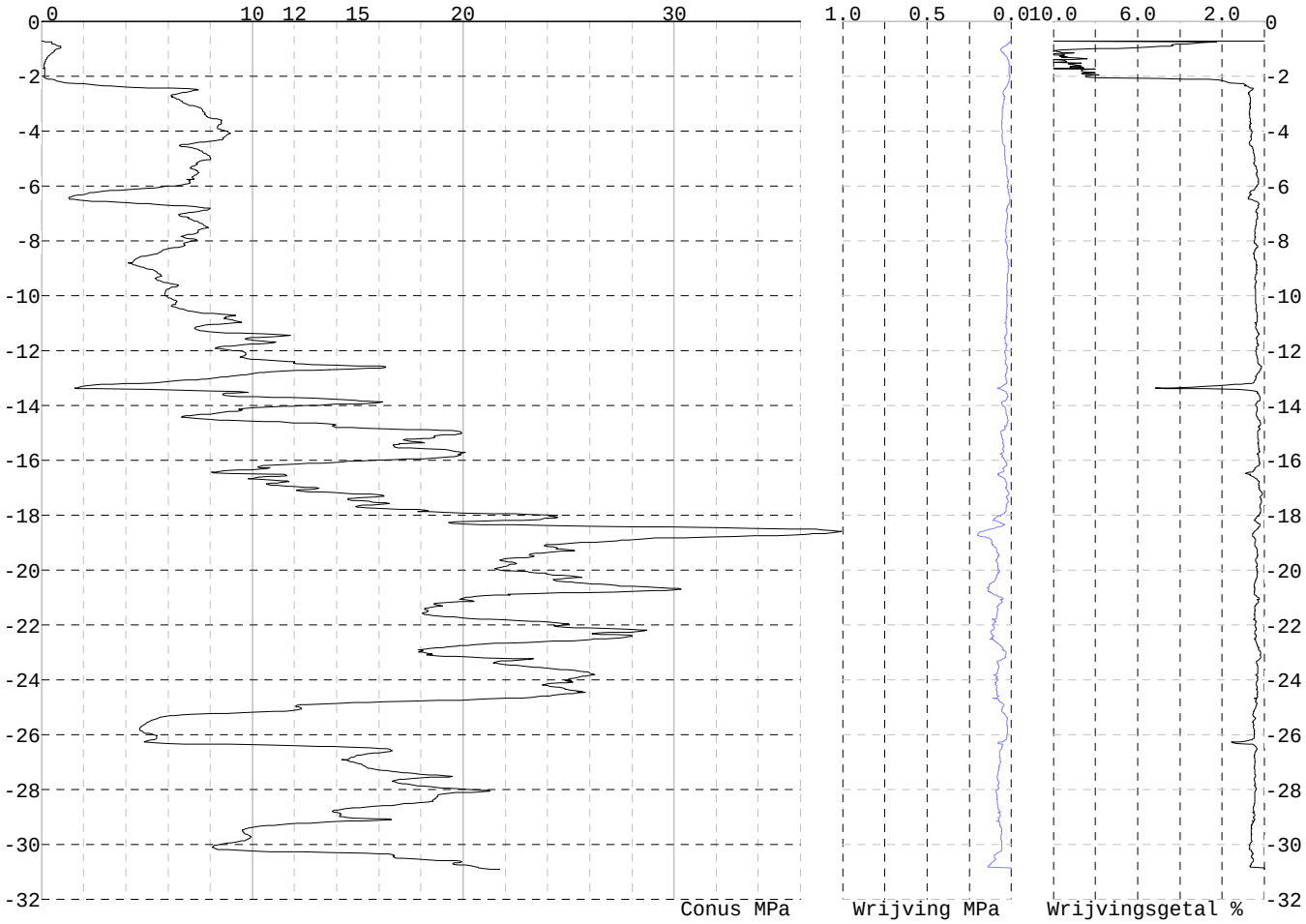


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 47-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.71 Bodemprofiel: 47-1
Traject negatieve kleef : -0.71 tot -2.60 [m]
Traject positieve kleef : -2.60 tot -30.93 [m]

SONDERINGSGEGEVENS GRAFIEK: 47-1

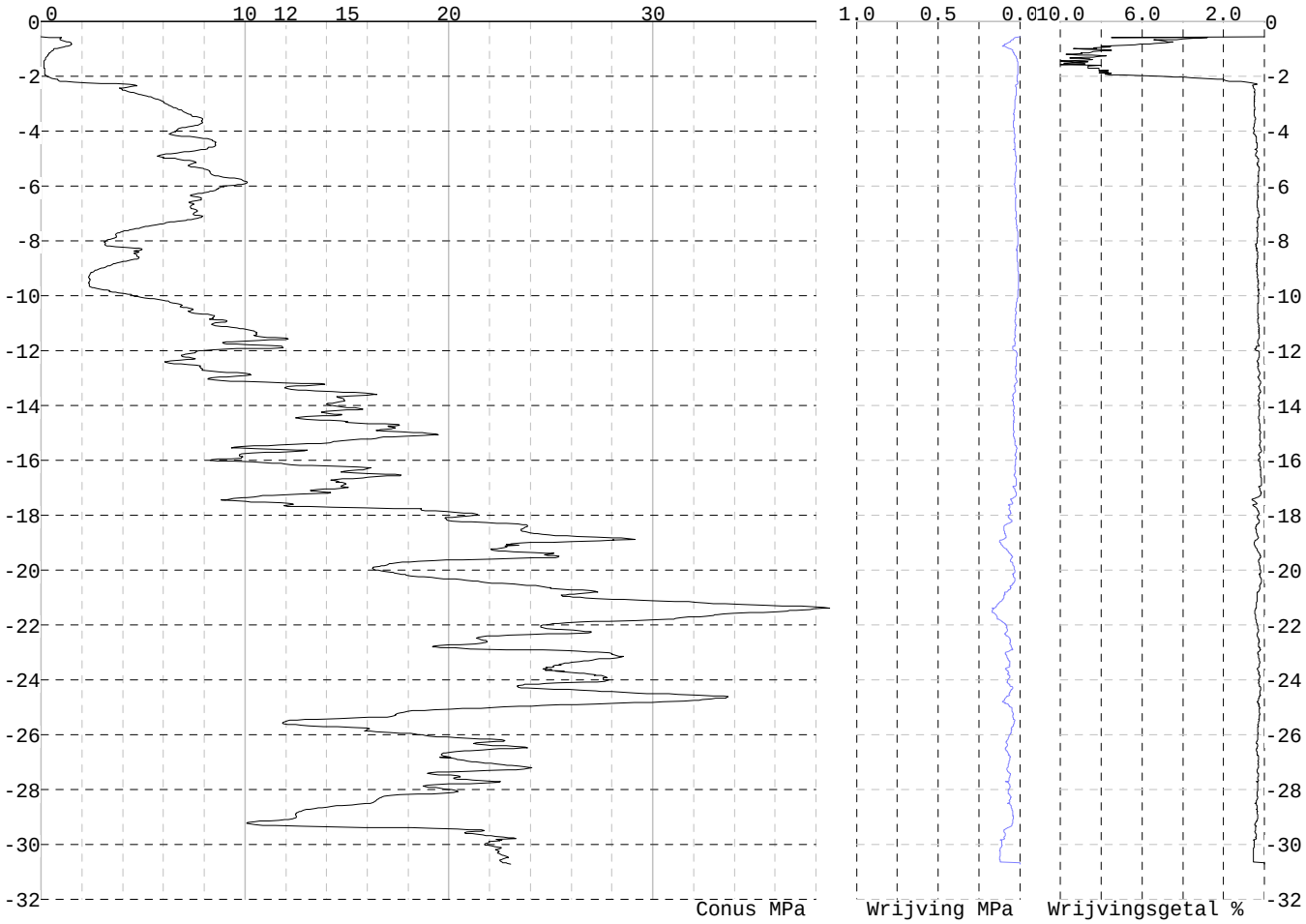


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 47-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.57 Bodemprofiel: 47-1
Traject negatieve kleef : -0.57 tot -2.30 [m]
Traject positieve kleef : -2.30 tot -30.73 [m]

SONDERINGSGEGEVENS GRAFIEK: 47-2

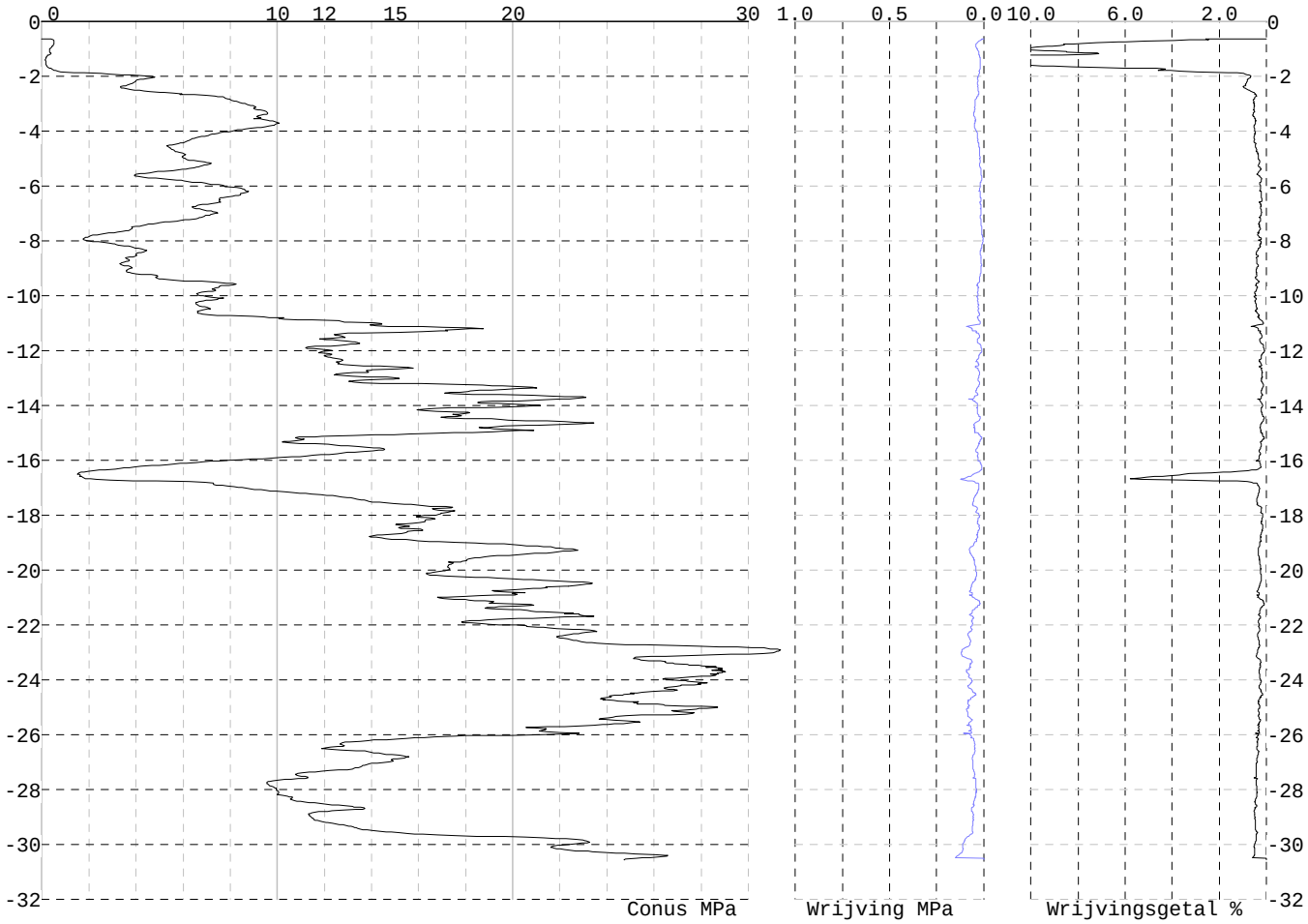


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 48-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.63 Bodemprofiel: 48-1
Traject negatieve kleef : -0.63 tot -2.00 [m]
Traject positieve kleef : -2.00 tot -30.58 [m]

SONDERINGSGEGEVENS GRAFIEK: 48-1

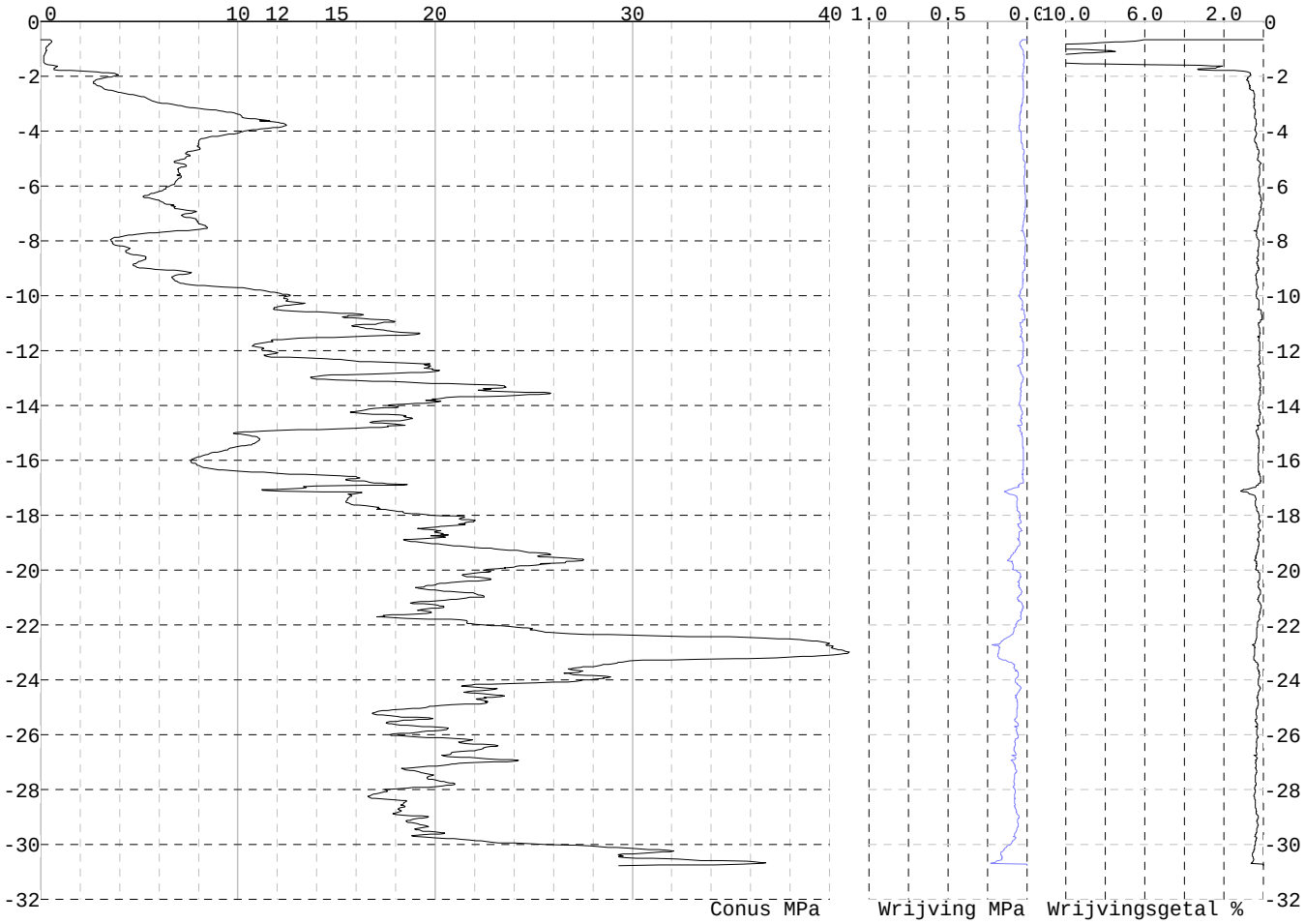


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 48-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.67 Bodemprofiel: 48-1
Traject negatieve kleef : -0.67 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.79 [m]

SONDERINGSGEGEVENS GRAFIEK: 48-2

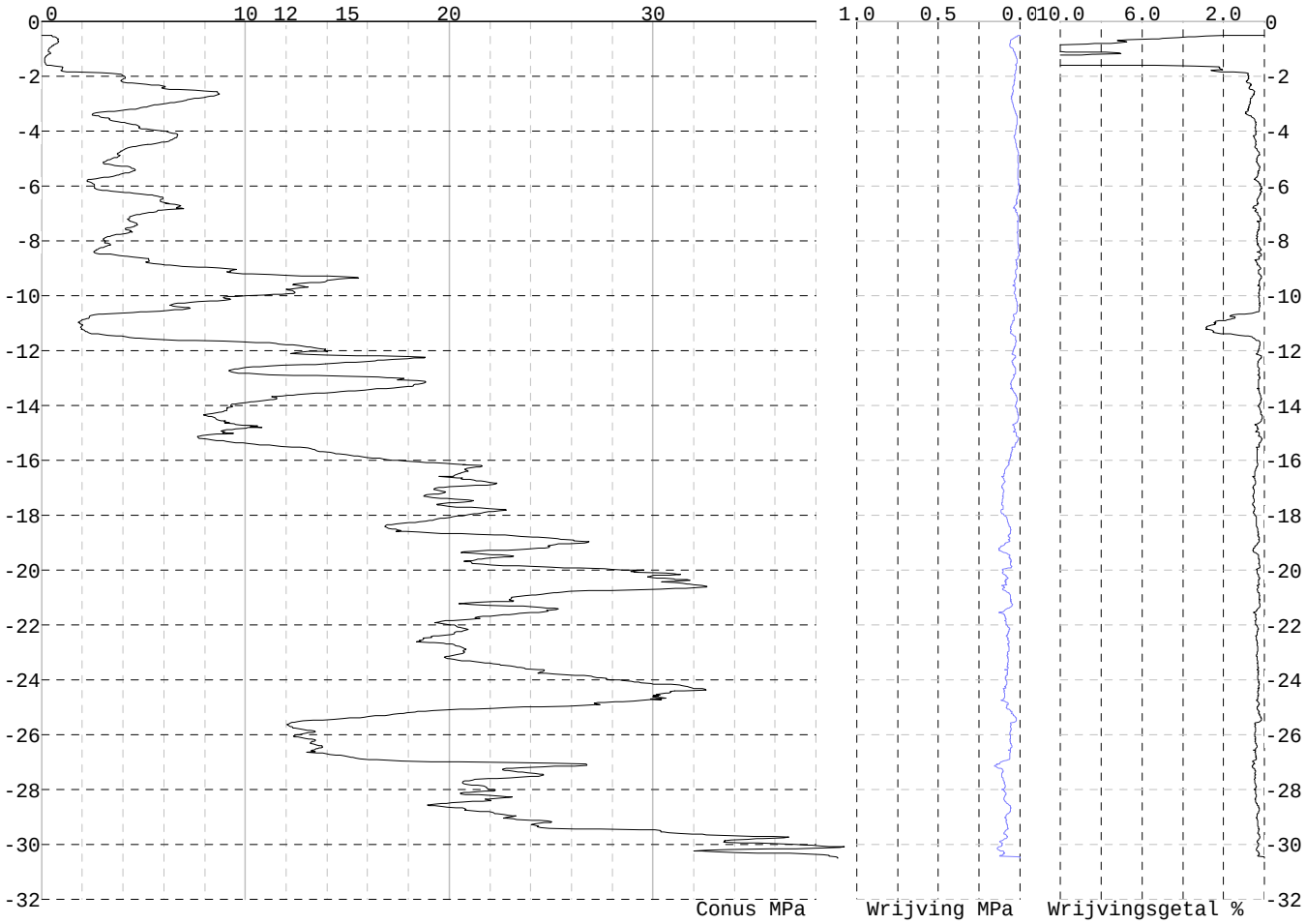


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 49-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.50 Bodemprofiel: 49-1
Traject negatieve kleef : -0.50 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.52 [m]

SONDERINGSGEGEVENS GRAFIEK: 49-1

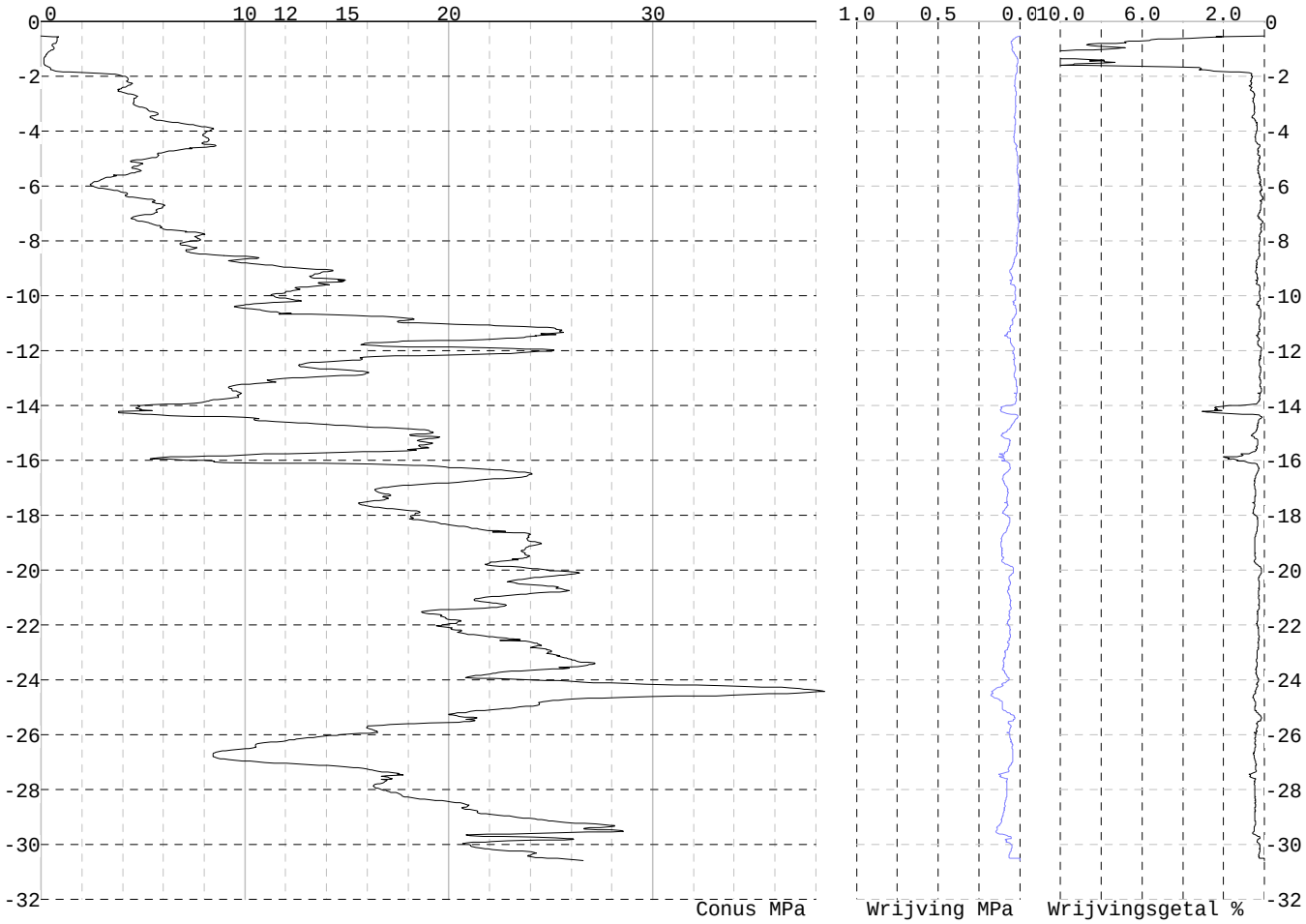


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 49-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.54 Bodemprofiel: 49-2
Traject negatieve kleef : -0.54 tot -2.20 [m]
Traject positieve kleef : -2.20 tot -30.59 [m]

SONDERINGSGEGEVENS GRAFIEK: 49-2



REKENGEGEVENS Mast 42

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 42-1, 42-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.32
Paalpuntniveau : N.A.P. -13.28
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 42 (n=1)

Project :
Onderdeel :

Sondering : 42-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.28	-13.28	42.0	442.0	442.0	0.0	0.00

Sondering : 42-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.28	-13.28	37.6	518.6	518.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 42 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
42-1	-1.10	-13.28	442.0	442.0	442.0
42-2	0.67	-13.28	518.6	518.6	518.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 42 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
42-1	-1.10	-13.28	42.0	463.2
42-2	0.67	-13.28	42.0	544.1
		-13.28	$R_{t;cal;gem}$	503.6
met ξ_4(min) = 1.32				
42-1	-1.10	-13.28	42.0	463.2
42-2	0.67	-13.28	42.0	544.1
		-13.28	$R_{t;cal;min}$	463.2

Totaal resultaten Mast 42 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
42-1 42-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-13.28 $R_{t;d}$ = min.{ 503.6; 463.2}= 463.2

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.28	463.2	463.2	0.0	463.2	0.00

REKENGEGEVENS Mast 43

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 43-1, 43-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.33
Paalpuntniveau : N.A.P. -13.28
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 43 (n=1)

Project :
Onderdeel :

Sondering : 43-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.28	-13.28	41.7	453.9	453.9	0.0	0.00

Sondering : 43-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.28	-13.28	41.7	429.5	429.5	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 43 (n=1)

Uitgangspunten

- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
43-1	-0.97	-13.28	453.9	453.9	453.9
43-2	-1.01	-13.28	429.5	429.5	429.5

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 43 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
43-1	-0.97	-13.28	41.7	475.8
43-2	-1.01	-13.28	41.7	450.0
		-13.28	$R_{t;cal;gem}$	462.9
met ξ_4(min) = 1.32				
43-1	-0.97	-13.28	41.7	475.8
43-2	-1.01	-13.28	41.7	450.0
		-13.28	$R_{t;cal;min}$	450.0

Totaal resultaten Mast 43 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
43-1 43-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-13.28 $R_{t;d}$ = min.{ 462.9; 450.0}= 450.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.28	450.0	450.0	0.0	450.0	0.00

REKENGEGEVENS Mast 44

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 44-1, 44-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.11
Paalpuntniveau : N.A.P. -13.61
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 44 (n=1)

Project :
Onderdeel :

Sondering : 44-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.61	-13.61	43.3	396.0	396.0	0.0	0.00

Sondering : 44-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.61	-13.61	43.3	527.8	527.8	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 44 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
44-1	-0.80	-13.61	396.0	396.0	396.0
44-2	-0.76	-13.61	527.8	527.8	527.8

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 44 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
44-1	-0.80	-13.61	43.3	414.7
44-2	-0.76	-13.61	43.3	553.5
		-13.61	$R_{t;cal;gem}$	484.1
met ξ_4(min) = 1.32				
44-1	-0.80	-13.61	43.3	414.7
44-2	-0.76	-13.61	43.3	553.5
		-13.61	$R_{t;cal;min}$	414.7

Totaal resultaten Mast 44 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
44-1 44-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-13.61	$R_{t;d}$ = min.{ 484.1; 414.7}= 414.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.61	414.7	414.7	0.0	414.7	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-13.61	2	484.09	20.3

Project :
Onderdeel :

REKENGEGEVENS Mast 45

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 45-1, 45-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.04
Paalpuntniveau : N.A.P. -12.54
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 45 (n=1)

Sondering : 45-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.54	-12.54	40.7	378.5	378.5	0.0	0.00

Sondering : 45-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.54	-12.54	40.7	426.8	426.8	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 45 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
45-1	-0.85	-12.54	378.5	378.5	378.5
45-2	-0.77	-12.54	426.8	426.8	426.8

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 45 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
45-1	-0.85	-12.54	40.7	396.4
45-2	-0.77	-12.54	40.7	447.2
		-12.54	$R_{t;cal;gem}$	421.8
met ξ_4(min) = 1.32				
45-1	-0.85	-12.54	40.7	396.4
45-2	-0.77	-12.54	40.7	447.2
		-12.54	$R_{t;cal;min}$	396.4

Totaal resultaten Mast 45 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
45-1 45-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-12.54	$R_{t;d}$ = min.{ 421.8; 396.4}= 396.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.54	396.4	396.4	0.0	396.4	0.00

REKENGEGEVENS Mast 46

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 46-1, 46-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.04
Paalpuntniveau : N.A.P. -16.49
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 46 (n=1)

Project :
Onderdeel :

Sondering : 46-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.49	-16.49	52.1	708.2	708.2	0.0	0.00

Sondering : 46-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.49	-16.49	52.1	698.7	698.7	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 46 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
46-1	-0.82	-16.49	708.2	708.2	708.2
46-2	-0.75	-16.49	698.7	698.7	698.7

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 46 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
46-1	-0.82	-16.49	52.1	743.0
46-2	-0.75	-16.49	52.1	732.9
		-16.49	$R_{t;cal;gem}$	738.0
met ξ_4(min) = 1.32				
46-1	-0.82	-16.49	52.1	743.0
46-2	-0.75	-16.49	52.1	732.9
		-16.49	$R_{t;cal;min}$	732.9

Totaal resultaten Mast 46 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
46-1 46-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.49	$R_{t;d}$ = min.{ 738.0; 732.9}= 732.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.49	732.9	732.9	0.0	732.9	0.00

REKENGEGEVENS Mast 47

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 47-1, 47-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.01
Paalpuntniveau : N.A.P. -13.49
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 47 (n=1)

Project :
Onderdeel :

Sondering : 47-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.49	-13.49	43.4	398.9	398.9	0.0	0.00

Sondering : 47-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.49	-13.49	43.4	403.2	403.2	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 47 (n=1)

Uitgangspunten

- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
47-1	-0.71	-13.49	398.9	398.9	398.9
47-2	-0.57	-13.49	403.2	403.2	403.2

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 47 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
47-1	-0.71	-13.49	43.4	417.7
47-2	-0.57	-13.49	43.4	422.3
		-13.49	$R_{t;cal;gem}$	420.0
met ξ_4(min) = 1.32				
47-1	-0.71	-13.49	43.4	417.7
47-2	-0.57	-13.49	43.4	422.3
		-13.49	$R_{t;cal;min}$	417.7

Totaal resultaten Mast 47 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
47-1 47-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-13.49 $R_{t;d}$ = min.{ 420.0; 417.7}= 417.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.49	417.7	417.7	0.0	417.7	0.00

REKENGEGEVENS Mast 48

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 48-1, 48-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.21
Paalpuntniveau : N.A.P. -12.73
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 48 (n=1)

Project :
Onderdeel :

Sondering : 48-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.73	-12.73	39.8	379.6	379.6	0.0	0.00

Sondering : 48-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.73	-12.73	39.8	434.5	434.5	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 48 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
48-1	-0.63	-12.73	379.6	379.6	379.6
48-2	-0.67	-12.73	434.5	434.5	434.5

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 48 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
48-1	-0.63	-12.73	39.8	397.6
48-2	-0.67	-12.73	39.8	455.5
		-12.73	$R_{t;cal;gem}$	426.6
met ξ_4(min) = 1.32				
48-1	-0.63	-12.73	39.8	397.6
48-2	-0.67	-12.73	39.8	455.5
		-12.73	$R_{t;cal;min}$	397.6

Totaal resultaten Mast 48 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
48-1 48-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-12.73	$R_{t;d}$ = min.{ 426.6; 397.6}= 397.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.73	397.6	397.6	0.0	397.6	0.00

REKENGEGEVENS Mast 49-I

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 49-1, 49-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -15.48
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 49-I (n=1)

Project :
Onderdeel :

Sondering : 49-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.48	-15.48	180.1	1514.6	1514.6	0.0	0.00

Sondering : 49-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.48	-15.48	180.4	1935.0	1935.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 49-I (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
49-1	-0.50	-15.48	1514.6	1514.6	1514.6
49-2	-0.54	-15.48	1935.0	1935.0	1935.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 49-I (van 2 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
49-1	-0.50	-15.48	180.1	1585.4
49-2	-0.54	-15.48	180.1	2028.0
		-15.48	$R_{t;cal;gem}$	1806.7
met ξ_4(min) = 1.32				
49-1	-0.50	-15.48	180.1	1585.4
49-2	-0.54	-15.48	180.1	2028.0
		-15.48	$R_{t;cal;min}$	1585.4

Totaal resultaten Mast 49-I (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
49-1 49-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-15.48	$R_{t;d}$ = min.{ 1806.7; 1585.4}= 1585.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.48	1585.4	1585.4	0.0	1585.4	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-15.48	2	1806.72	17.3

Project :
Onderdeel :

REKENGEGEVENS Mast 49-II

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 49-1, 49-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -17.98
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 49-II (n=1)

Sondering : 49-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.98	-17.98	206.9	2074.6	2074.6	0.0	0.00

Sondering : 49-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.98	-17.98	207.2	2466.0	2466.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 49-II (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
49-1	-0.50	-17.98	2074.6	2074.6	2074.6
49-2	-0.54	-17.98	2466.0	2466.0	2466.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 49-II (van 2 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
49-1	-0.50	-17.98	206.9	2173.7
49-2	-0.54	-17.98	206.9	2585.8
		-17.98	$R_{t;cal;gem}$	2379.7
met ξ_4(min) = 1.32				
49-1	-0.50	-17.98	206.9	2173.7
49-2	-0.54	-17.98	206.9	2585.8
		-17.98	$R_{t;cal;min}$	2173.7

Totaal resultaten Mast 49-II (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
49-1 49-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-17.98	$R_{t;d}$ = min.{ 2379.7; 2173.7}= 2173.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.98	2173.7	2173.7	0.0	2173.7	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-17.98	2	2379.74	12.2

Project :
Onderdeel :

PAALGEGEVENS GI 609_750

Type	:	Stalen profiel (geheid, grout)
Wijze van installeren	:	Heien
Diameter [m]	:	0.750
Elasticiteitsmodulus [N/mm²]	:	20000
Factor α_s (tabel 7.c EC 7.1)	:	0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	:	0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	:	1.00
Paalvoetvormfactor β	:	1.00
Type lastzakkingsdiagram	:	Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	:	0.75
Groutomhulling	:	JA

PAALGEGEVENS BP 559x10

Type	:	Stalen buispaal (gesloten)
Wijze van installeren	:	Heien
Diameter [m]	:	0.559
Elasticiteitsmodulus [N/mm²]	:	20000
Factor α_s (tabel 7.c EC 7.1)	:	0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	:	0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	:	1.00
Paalvoetvormfactor β	:	1.00
Type lastzakkingsdiagram	:	Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	:	0.75
Groutomhulling	:	NEE

PAALGEGEVENS GI 914_1075

Type	:	Stalen profiel (geheid, grout)
Wijze van installeren	:	Heien
Diameter [m]	:	1.075
Elasticiteitsmodulus [N/mm²]	:	20000
Factor α_s (tabel 7.c EC 7.1)	:	0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	:	0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	:	1.00
Paalvoetvormfactor β	:	1.00
Type lastzakkingsdiagram	:	Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	:	0.75
Groutomhulling	:	JA

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 42	Mast 43	Mast 44	Mast 45	Mast 46
42-1	-1.10	-13.28	441				
42-2	0.67	-13.28	518				
43-1	-0.97	-13.28		453			
43-2	-1.01	-13.28		429			
44-1	-0.80	-13.61			395		
44-2	-0.76	-13.61			527		
45-1	-0.85	-12.54				378	
45-2	-0.77	-12.54				426	
46-1	-0.82	-16.49					708
46-2	-0.75	-16.49					698

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 47	Mast 48	Mast 49-I	Mast 49-I
47-1	-0.71	-13.49	398			
47-2	-0.57	-13.49	403			
48-1	-0.63	-12.73		379		
48-2	-0.67	-12.73		434		
49-1	-0.50	-15.48			1514	
		-17.98				2074
49-2	-0.54	-15.48			1934	
		-17.98				2466

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 50-59 (excl 55).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
15	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: 50-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.46 Grondwaterstand [m] : -1.46

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.46	-1.93	Klei - Zwak zandig - Slap	1.0	50.0		
2	-1.93	-4.27	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-4.27	-4.99	Klei - Zwak zandig - Matig	1.0	50.0		
4	-4.99	-13.19	Zand - Schoon - Los	1.0	100.0		
5	-13.19	-15.11	Zand - Schoon - Matig	1.0	100.0		
6	-15.11	-18.36	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-18.36	-22.80	Zand - Schoon - Vast	1.0	100.0		
8	-22.80	-23.73	Leem - Zwak zandig - Vast	1.0	50.0		
9	-23.73	-25.58	Zand - Schoon - Vast	1.0	100.0		
10	-25.58	-30.57	Zand - Zwak siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 51-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.70 Grondwaterstand [m] : -1.70

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.70	-1.75	Klei - Zwak zandig - Slap	1.0	50.0		
2	-1.75	-7.45	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-7.45	-9.75	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-9.75	-12.11	Zand - Schoon - Los	1.0	100.0		
5	-12.11	-13.33	Klei - Schoon - Matig	1.0	50.0		
6	-13.33	-13.59	Zand - Schoon - Los	1.0	100.0		
7	-13.59	-16.25	Klei - Zwak zandig - Matig	1.0	50.0		
8	-16.25	-16.97	Zand - Schoon - Vast	1.0	100.0		
9	-16.97	-17.33	Zand - Schoon - Los	1.0	100.0		
10	-17.33	-18.47	Klei - Zwak zandig - Slap	1.0	50.0		
11	-18.47	-21.87	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-21.87	-23.02	Klei - Zwak zandig - Slap	1.0	50.0		
13	-23.02	-24.26	Zand - Schoon - Vast	1.0	100.0		
14	-24.26	-25.46	Zand - Schoon - Los	1.0	100.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
15	-25.46	-30.93	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 52-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.62 Grondwaterstand [m] : -1.62

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.62	-1.47	Klei - Zwak zandig - Matig	1.0	50.0		
2	-1.47	-4.09	Zand - Schoon - Los	1.0	100.0		
3	-4.09	-6.57	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-6.57	-7.57	Klei - Schoon - Vast	1.0	50.0		
5	-7.57	-16.60	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-16.60	-23.14	Zand - Schoon - Vast	1.0	100.0		
7	-23.14	-27.63	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-27.63	-29.51	Zand - Schoon - Vast	1.0	100.0		
9	-29.51	-30.65	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 53-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.67 Grondwaterstand [m] : -1.67

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.67	-1.52	Veen - Matig voorbelast - Matig	1.0	50.0		
2	-1.52	-3.30	Zand - Schoon - Los	1.0	100.0		
3	-3.30	-4.50	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-4.50	-5.46	Klei - Zwak zandig - Vast	1.0	50.0		
5	-5.46	-14.68	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-14.68	-24.19	Zand - Schoon - Vast	1.0	100.0		
7	-24.19	-25.32	Zand - Schoon - Los	1.0	100.0		
8	-25.32	-27.89	Zand - Schoon - Vast	1.0	100.0		
9	-27.89	-29.17	Zand - Schoon - Matig	1.0	100.0		
10	-29.17	-30.64	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 54-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.71 Grondwaterstand [m] : -1.71

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.71	-1.64	Klei - Schoon - Matig	1.0	50.0		
2	-1.64	-4.10	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-4.10	-7.86	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-7.86	-9.96	Zand - Schoon - Los	1.0	100.0		
5	-9.96	-12.63	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-12.63	-14.29	Zand - Schoon - Los	1.0	100.0		
7	-14.29	-14.89	Zand - Schoon - Matig	1.0	100.0		
8	-14.89	-19.84	Zand - Schoon - Vast	1.0	100.0		
9	-19.84	-20.38	Leem - Zwak zandig - Vast	1.0	50.0		
10	-20.38	-26.59	Zand - Schoon - Matig	1.0	100.0		
11	-26.59	-30.74	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 56-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.55 Grondwaterstand [m] : -1.55

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.55	-1.74	Klei - Schoon - Matig	1.0	50.0		
2	-1.74	-7.06	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-7.06	-13.45	Zand - Schoon - Los	1.0	100.0		
4	-13.45	-17.06	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-17.06	-20.00	Zand - Schoon - Los	1.0	100.0		
6	-20.00	-20.33	Leem - Zwak zandig - Vast	1.0	50.0		
7	-20.33	-22.92	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-22.92	-25.55	Zand - Schoon - Matig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 56-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.72 Grondwaterstand [m] : -1.72

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.72	-1.77	Klei - Schoon - Matig	1.0	50.0		
2	-1.77	-6.29	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-6.29	-9.37	Zand - Schoon - Los	1.0	100.0		
4	-9.37	-10.69	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-10.69	-17.08	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-17.08	-18.50	Zand - Schoon - Los	1.0	100.0		
7	-18.50	-20.24	Klei - Schoon - Matig	1.0	50.0		
8	-20.24	-22.62	Zand - Schoon - Los	1.0	100.0		
9	-22.62	-29.15	Zand - Schoon - Vast	1.0	100.0		
10	-29.15	-30.02	Zand - Schoon - Matig	1.0	100.0		
11	-30.02	-30.69	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 57-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.54 Grondwaterstand [m] : -1.54

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.54	-1.71	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.71	-9.47	Zand - Schoon - Los	1.0	100.0		
3	-9.47	-10.15	Klei - Zwak zandig - Vast	1.0	50.0		
4	-10.15	-10.39	Leem - Zwak zandig - Vast	1.0	50.0		
5	-10.39	-10.79	Klei - Zwak zandig - Matig	1.0	50.0		
6	-10.79	-11.75	Klei - Schoon - Vast	1.0	50.0		
7	-11.75	-13.04	Klei - Zwak zandig - Vast	1.0	50.0		
8	-13.04	-13.74	Zand - Schoon - Vast	1.0	100.0		
9	-13.74	-15.02	Zand - Sterk siltig - Kleiig	1.0	100.0		
10	-15.02	-15.42	Klei - Zwak zandig - Matig	1.0	50.0		
11	-15.42	-23.19	Zand - Schoon - Matig	1.0	100.0		
12	-23.19	-23.85	Zand - Schoon - Los	1.0	100.0		
13	-23.85	-24.31	Klei - Schoon - Vast	1.0	50.0		
14	-24.31	-30.68	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 57-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.63 Grondwaterstand [m] : -1.63

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.63	-1.90	Klei - Organisch - Matig	1.0	50.0		
2	-1.90	-8.48	Zand - Schoon - Los	1.0	100.0		
3	-8.48	-26.09	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-26.09	-30.10	Zand - Schoon - Matig	1.0	100.0		
5	-30.10	-30.57	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 58-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.82 Grondwaterstand [m] : -1.82

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.82	-1.85	Klei - Schoon - Matig	1.0	50.0		
2	-1.85	-6.69	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-6.69	-10.80	Zand - Schoon - Los	1.0	100.0		
4	-10.80	-11.35	Leem - Zwak zandig - Vast	1.0	50.0		
5	-11.35	-15.11	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-15.11	-17.40	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-17.40	-19.81	Zand - Schoon - Vast	1.0	100.0		
8	-19.81	-21.65	Zand - Schoon - Los	1.0	100.0		
9	-21.65	-24.71	Zand - Schoon - Matig	1.0	100.0		
10	-24.71	-25.17	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-25.17	-25.56	Leem - Zwak zandig - Vast	1.0	50.0		
12	-25.56	-30.81	Zand - Schoon - Matig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 58-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.69 Grondwaterstand [m] : -1.69

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.69	-1.88	Klei - Schoon - Matig	1.0	50.0		
2	-1.88	-2.44	Zand - Schoon - Los	1.0	100.0		
3	-2.44	-4.38	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-4.38	-5.14	Klei - Schoon - Matig	1.0	50.0		
5	-5.14	-9.58	Zand - Schoon - Los	1.0	100.0		
6	-9.58	-11.50	Klei - Zwak zandig - Vast	1.0	50.0		
7	-11.50	-19.80	Zand - Schoon - Matig	1.0	100.0		
8	-19.80	-24.89	Zand - Schoon - Los	1.0	100.0		
9	-24.89	-26.26	Zand - Sterk siltig - Kleiig	1.0	100.0		
10	-26.26	-26.82	Zand - Schoon - Los	1.0	100.0		
11	-26.82	-30.69	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 59-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.40 Grondwaterstand [m] : -1.40

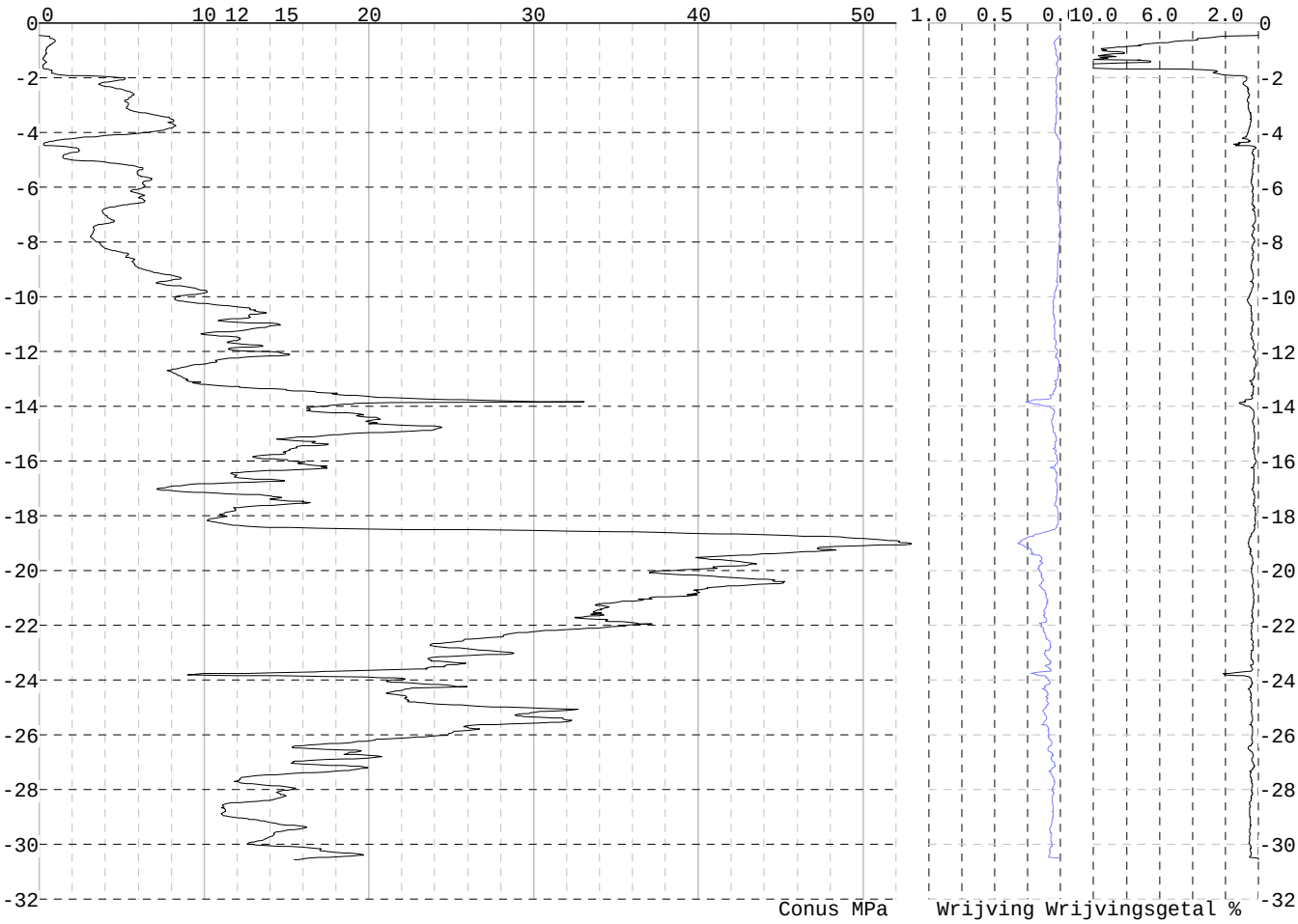
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.40	-1.99	Klei - Organisch - Matig	1.0	50.0		
2	-1.99	-4.03	Zand - Schoon - Los	1.0	100.0		
3	-4.03	-5.73	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-5.73	-10.11	Zand - Schoon - Los	1.0	100.0		
5	-10.11	-11.17	Zand - Schoon - Matig	1.0	100.0		
6	-11.17	-11.62	Leem - Zwak zandig - Vast	1.0	50.0		
7	-11.62	-23.08	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-23.08	-26.11	Zand - Schoon - Matig	1.0	100.0		
9	-26.11	-30.30	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 50-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.46 Bodemprofiel: 50-1
Traject negatieve kleef : -0.46 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.58 [m]

Project :
Onderdeel :

SONDERINGSGEGEVENS GRAFIEK: 50-1

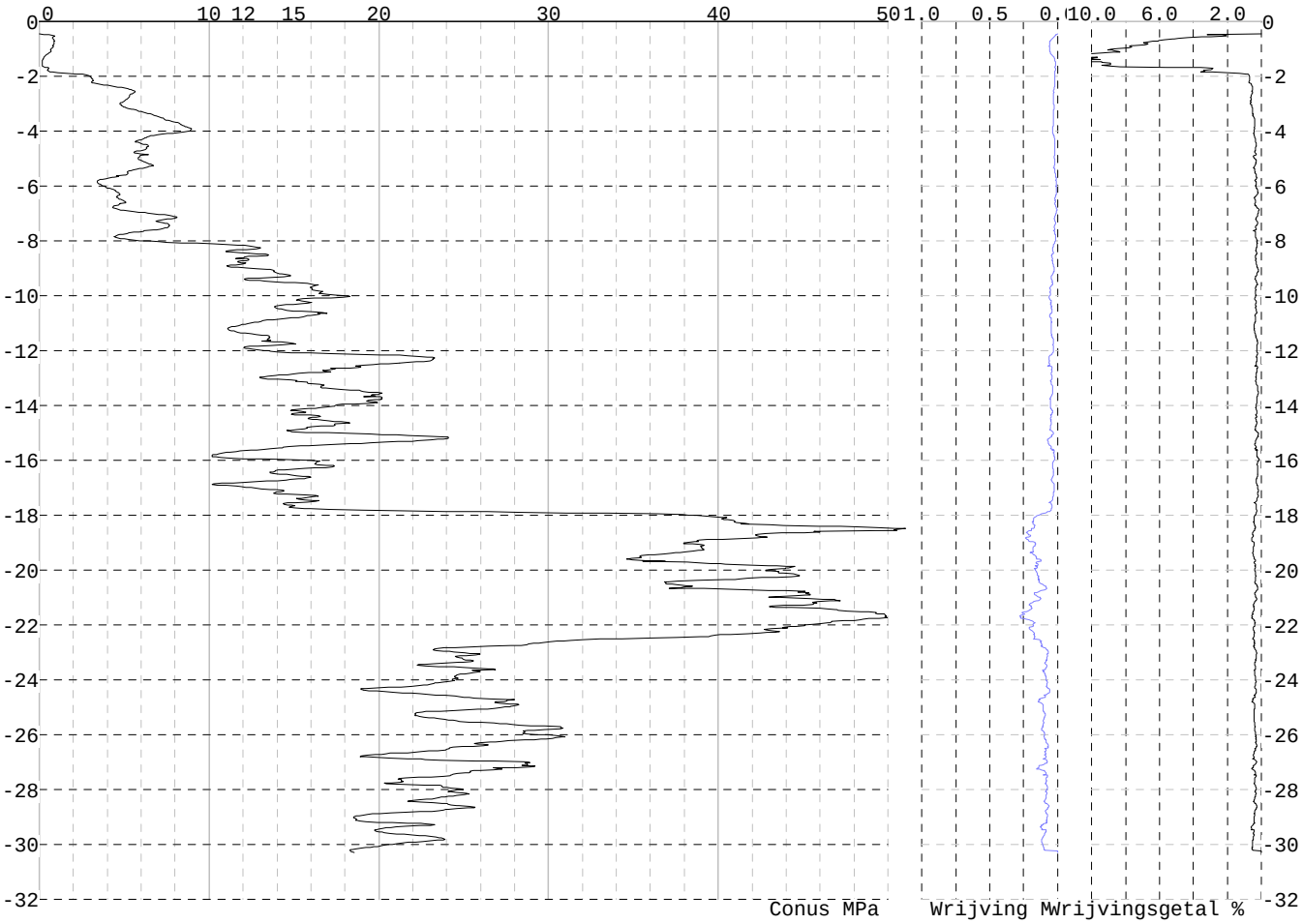


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 50-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.46 Bodemprofiel: 50-1
Traject negatieve kleef : -0.46 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.31 [m]

SONDERINGSGEGEVENS GRAFIEK: 50-2

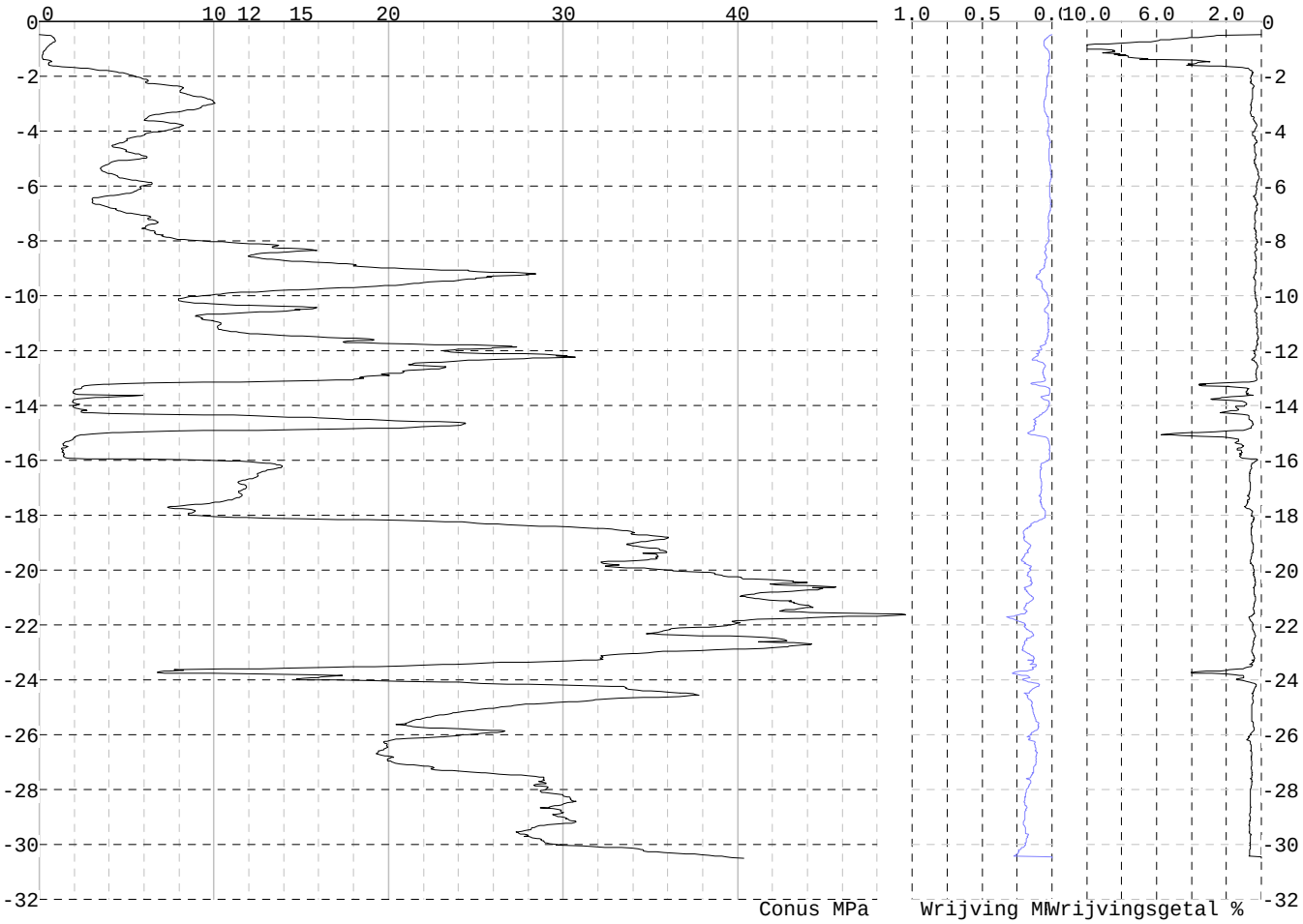


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 51-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.49 Bodemprofiel: 51-2
Traject negatieve kleef : -0.49 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.53 [m]

SONDERINGSGEGEVENS GRAFIEK: 51-1

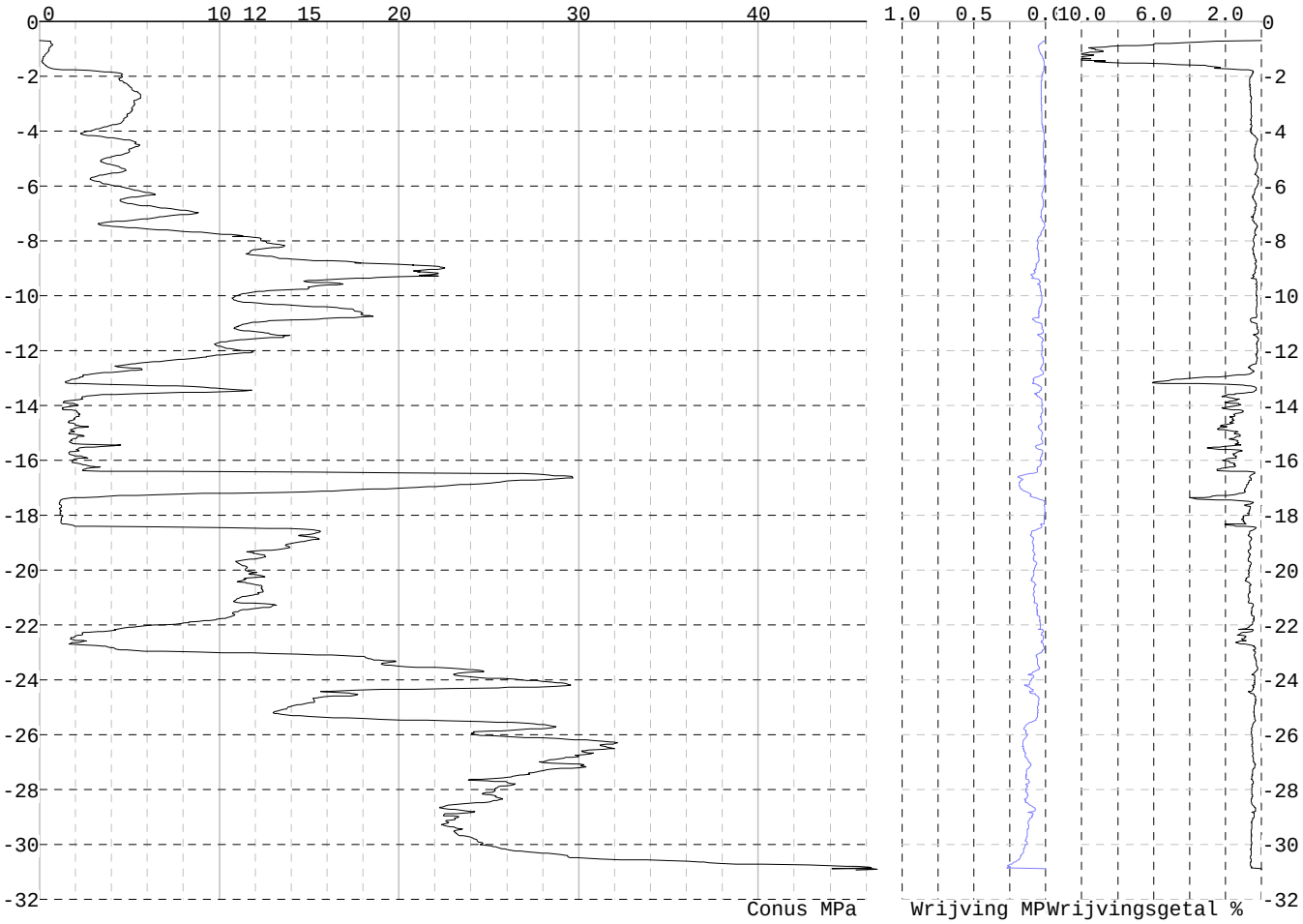


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 51-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.70 Bodemprofiel: 51-2
Traject negatieve kleef : -0.70 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.94 [m]

SONDERINGSGEGEVENS GRAFIEK: 51-2

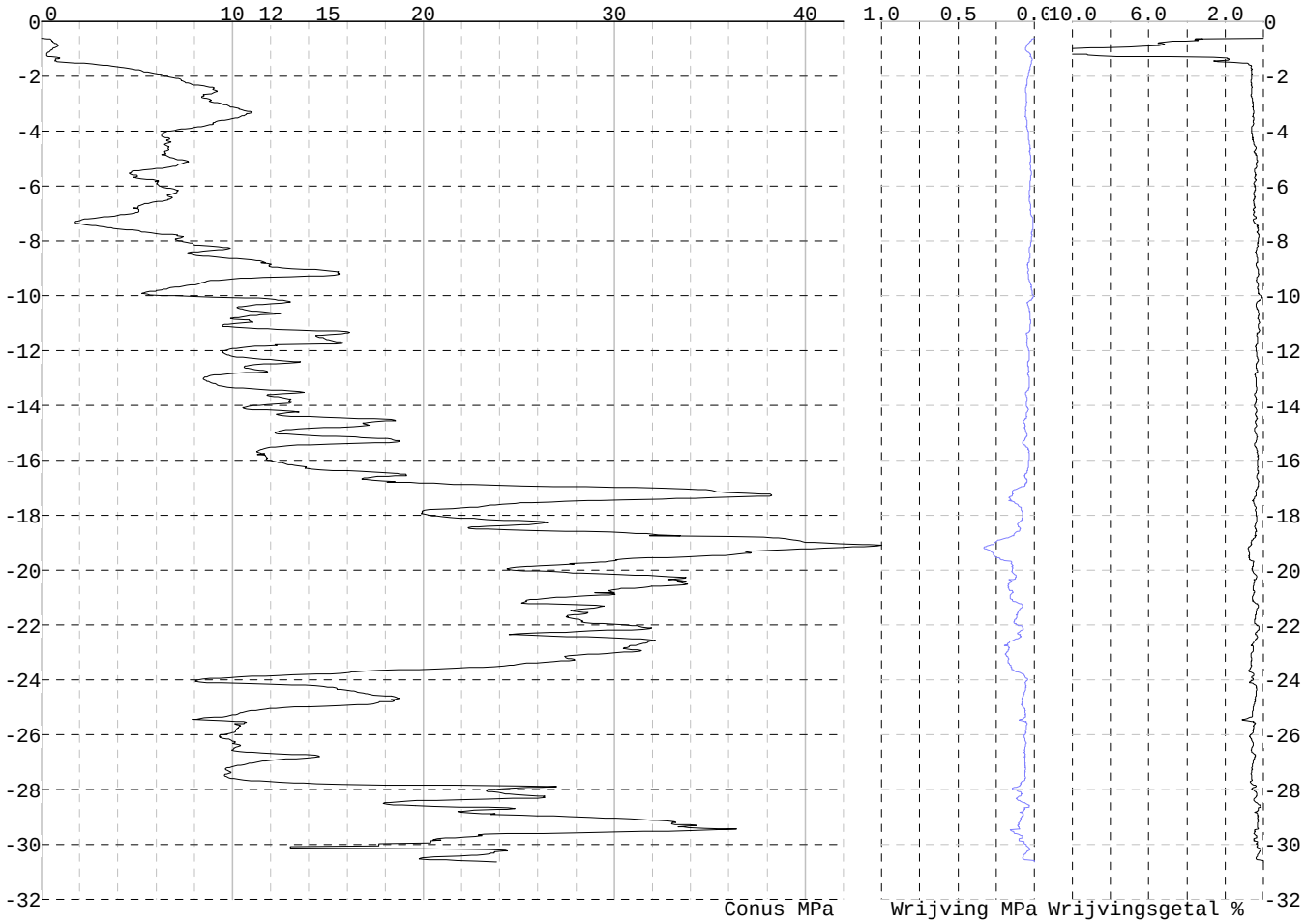


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 52-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.62 Bodemprofiel: 52-1
Traject negatieve kleef : -0.62 tot -1.60 [m]
Traject positieve kleef : -1.60 tot -30.66 [m]

SONDERINGSGEGEVENS GRAFIEK: 52-1

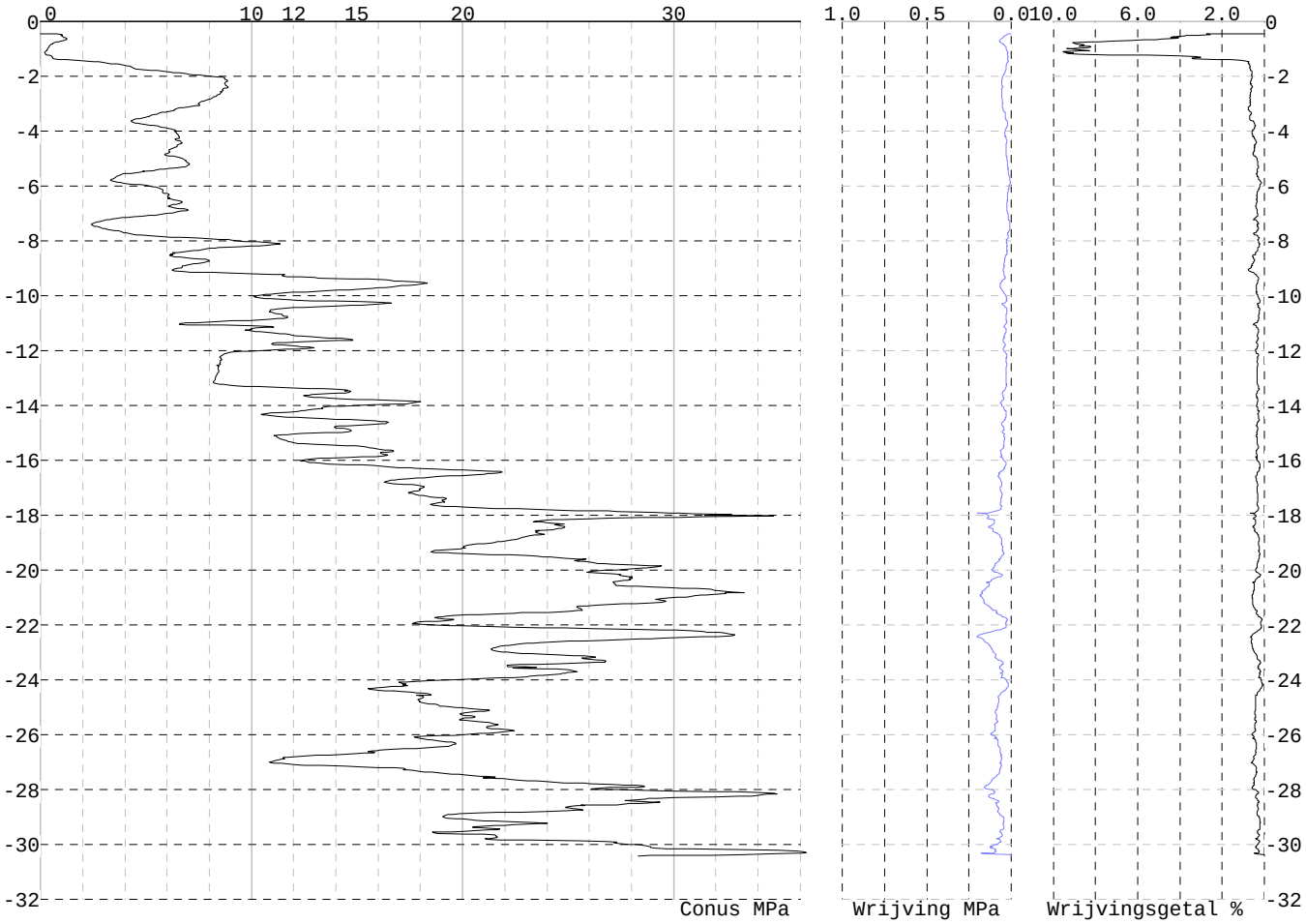


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 52-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.45 Bodemprofiel: 52-1
Traject negatieve kleef : -0.45 tot -1.50 [m]
Traject positieve kleef : -1.50 tot -30.44 [m]

SONDERINGSGEGEVENS GRAFIEK: 52-2

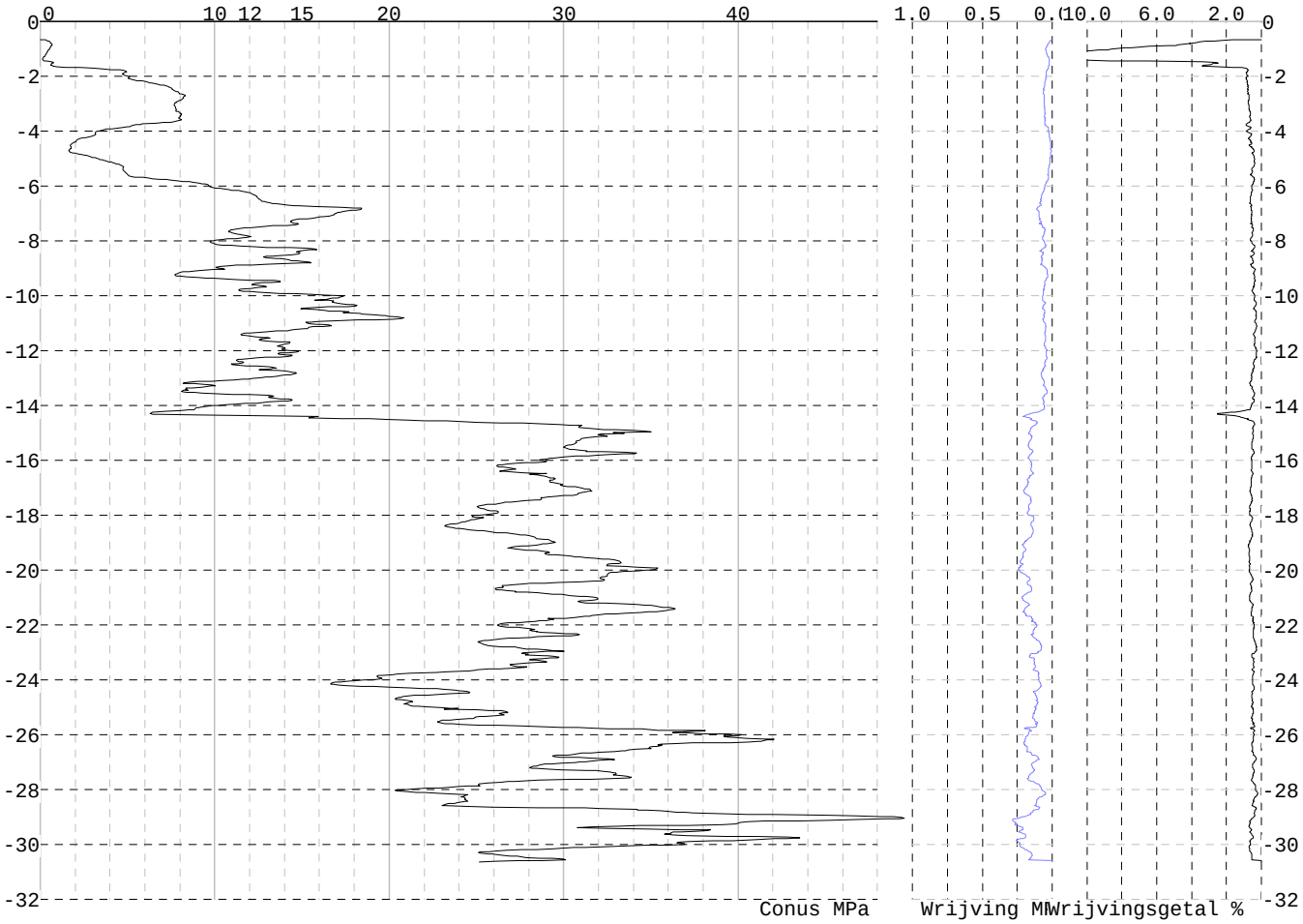


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 53-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.66 Bodemprofiel: 53-2
Traject negatieve kleef : -0.66 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.65 [m]

SONDERINGSGEGEVENS GRAFIEK: 53-1

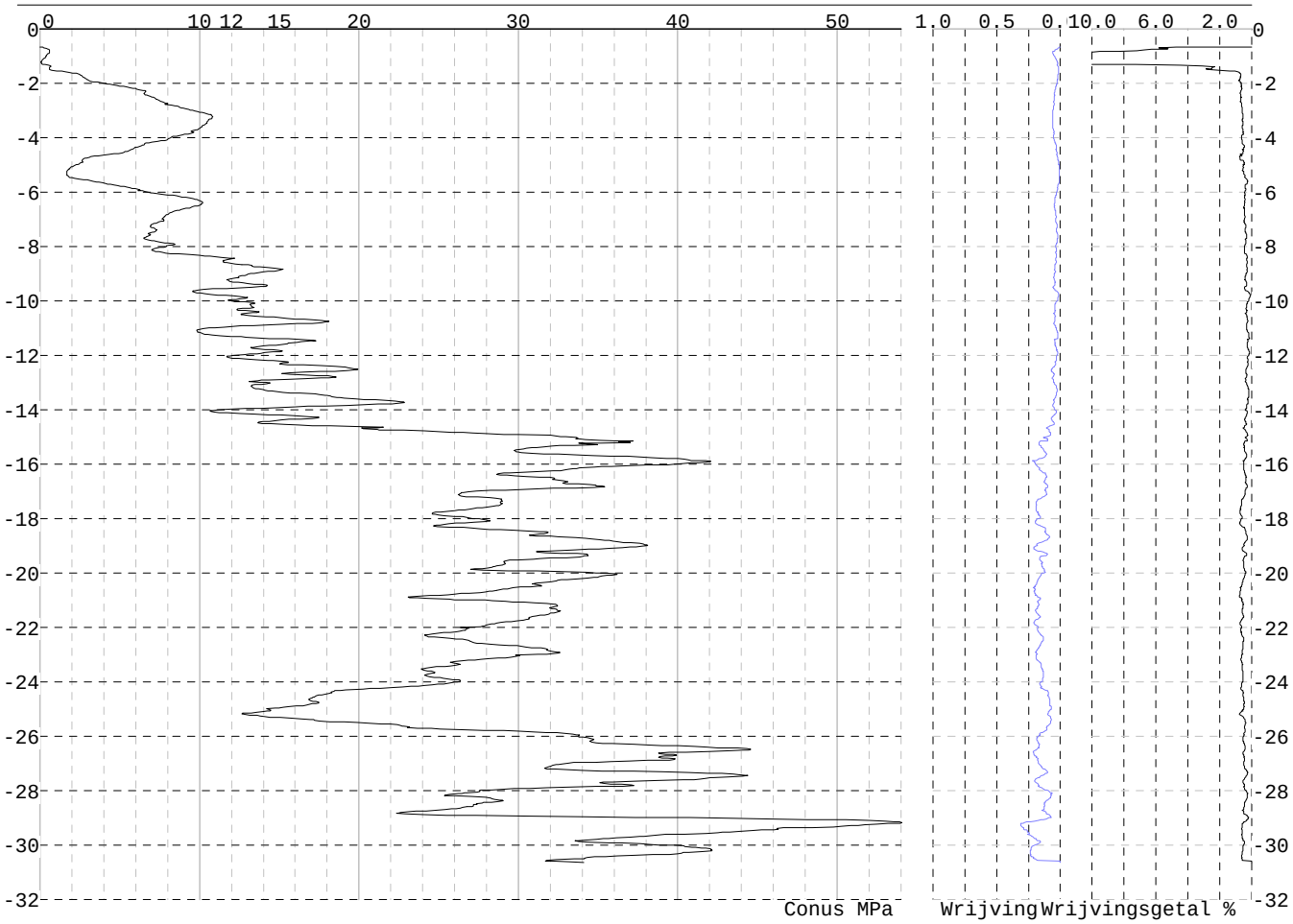


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 53-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.67 Bodemprofiel: 53-2
Traject negatieve kleef : -0.67 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.65 [m]

SONDERINGSGEGEVENS GRAFIEK: 53-2

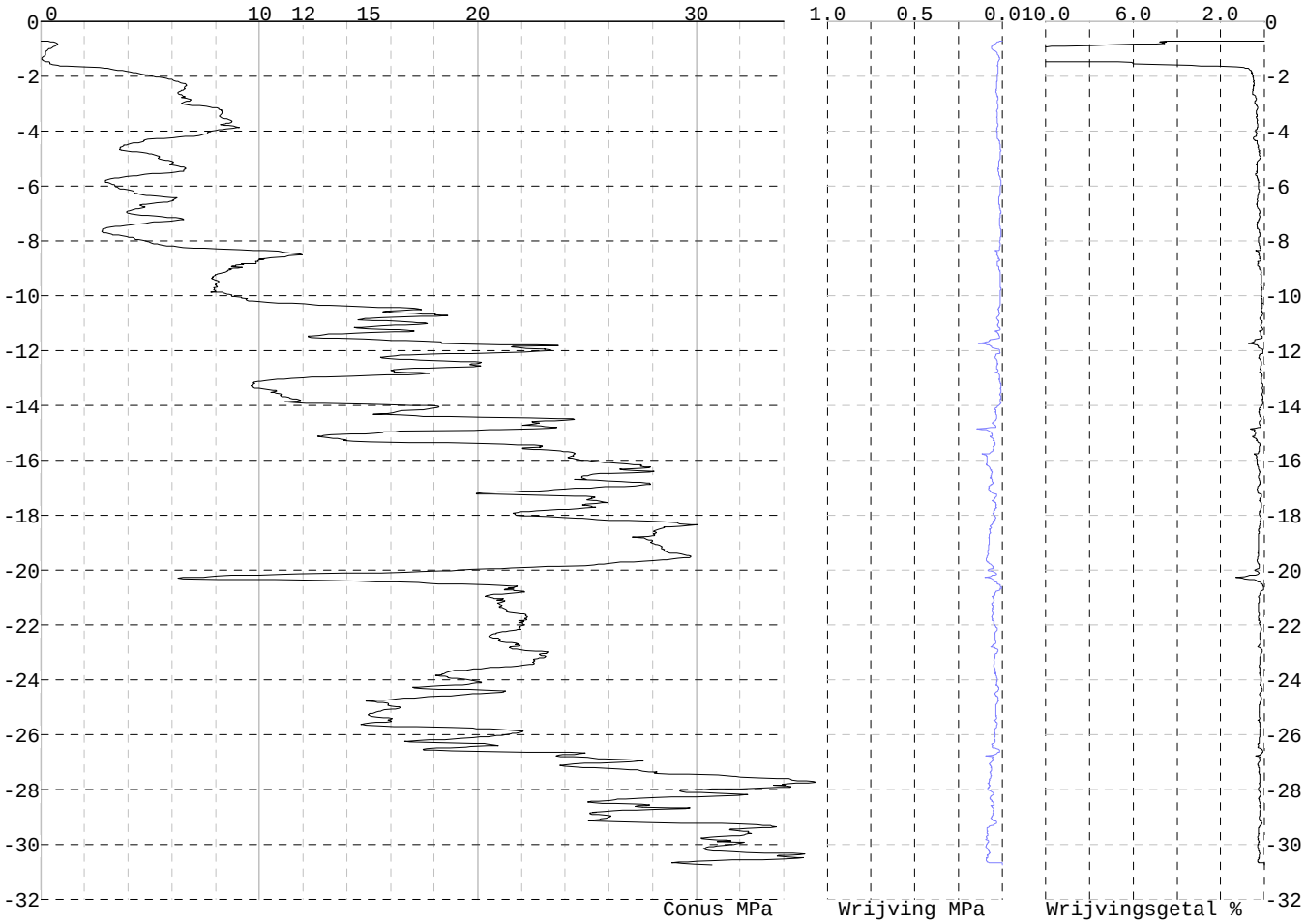


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 54-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.71 Bodemprofiel: 54-1
Traject negatieve kleef : -0.71 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.75 [m]

SONDERINGSGEGEVENS GRAFIEK: 54-1

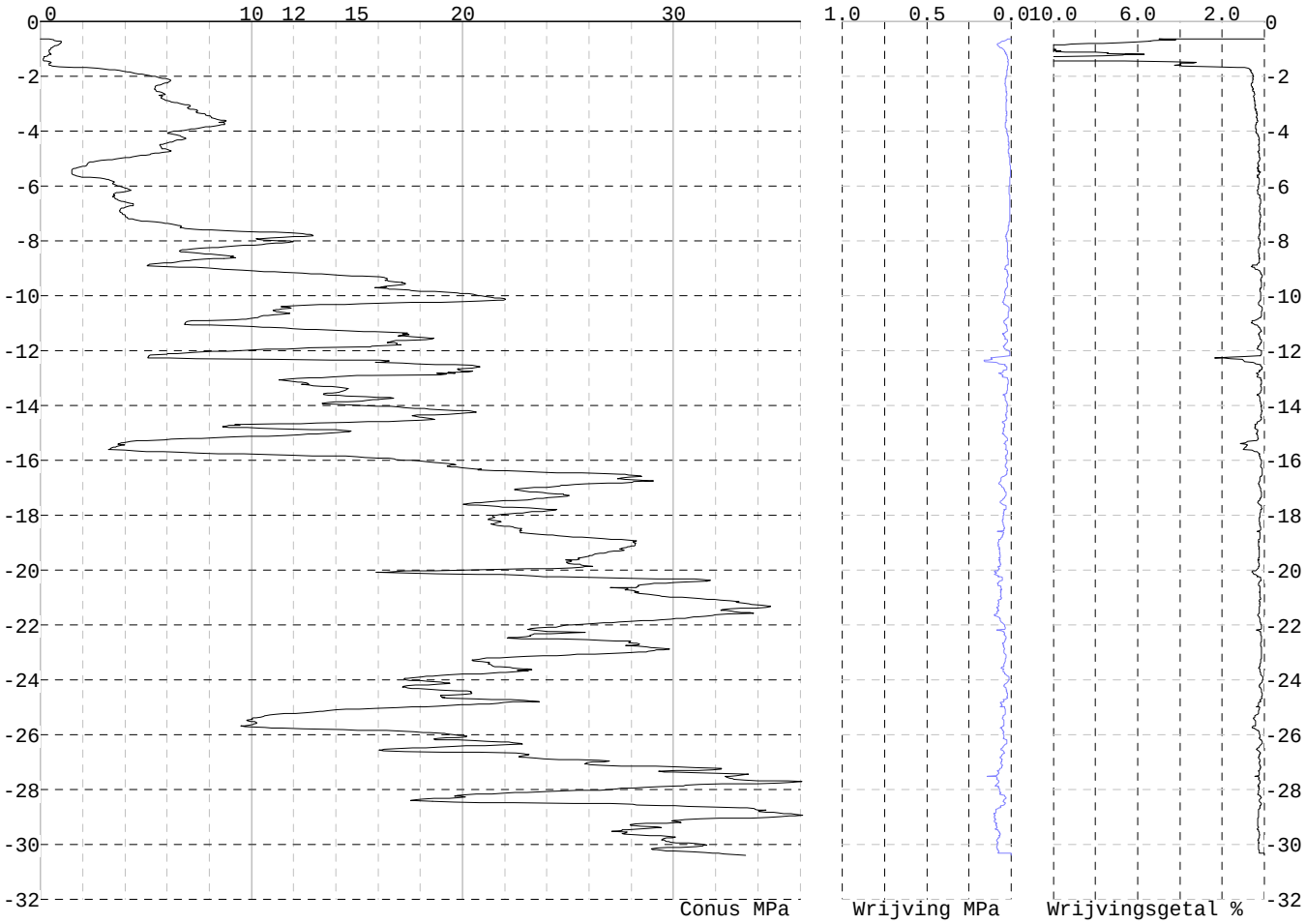


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 54-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.64 Bodemprofiel: 54-1
Traject negatieve kleef : -0.64 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.40 [m]

SONDERINGSGEGEVENS GRAFIEK: 54-2

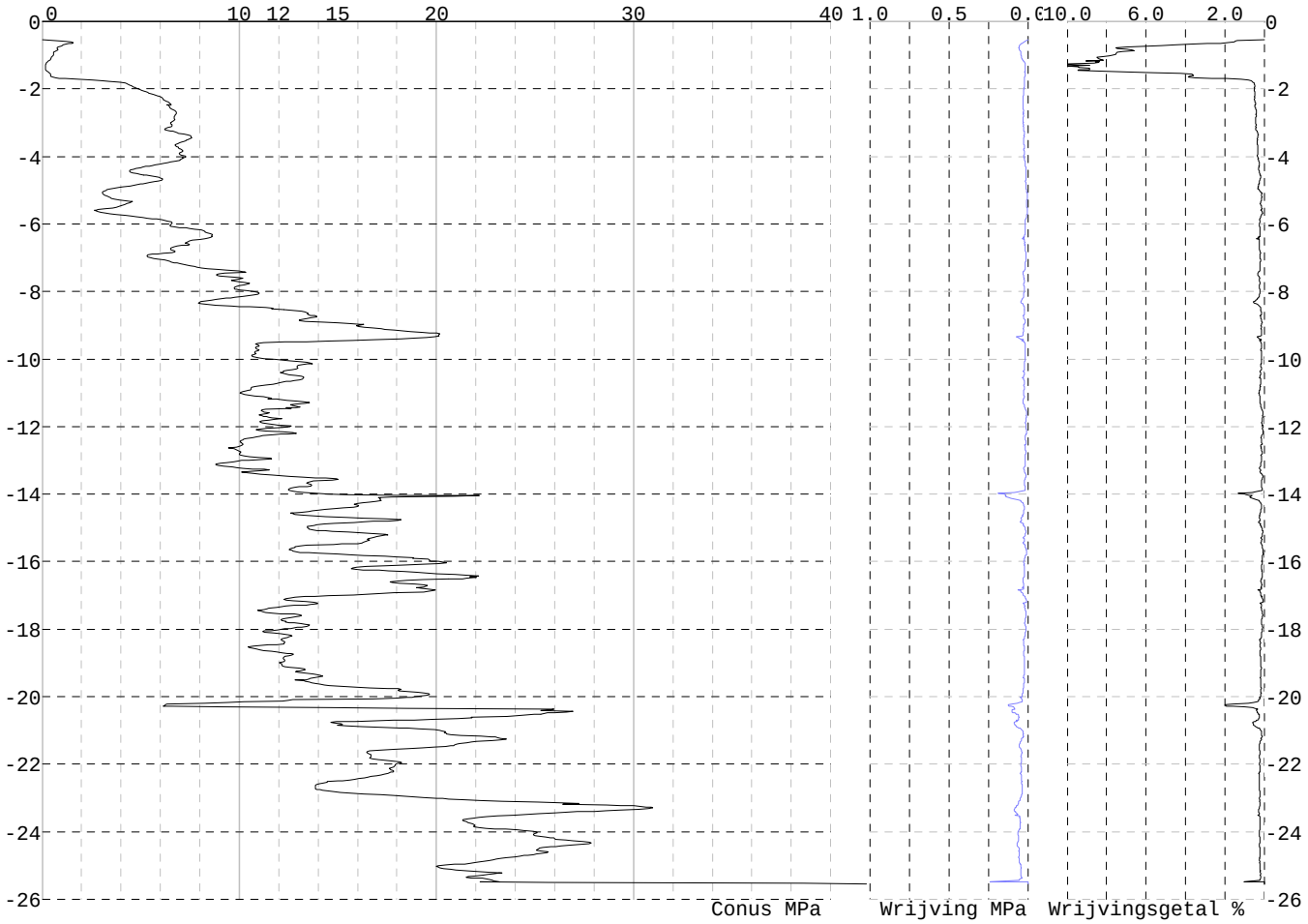


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 56-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.55 Bodemprofiel: 56-1
Traject negatieve kleef : -0.55 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -25.56 [m]

SONDERINGSGEGEVENS GRAFIEK: 56-1

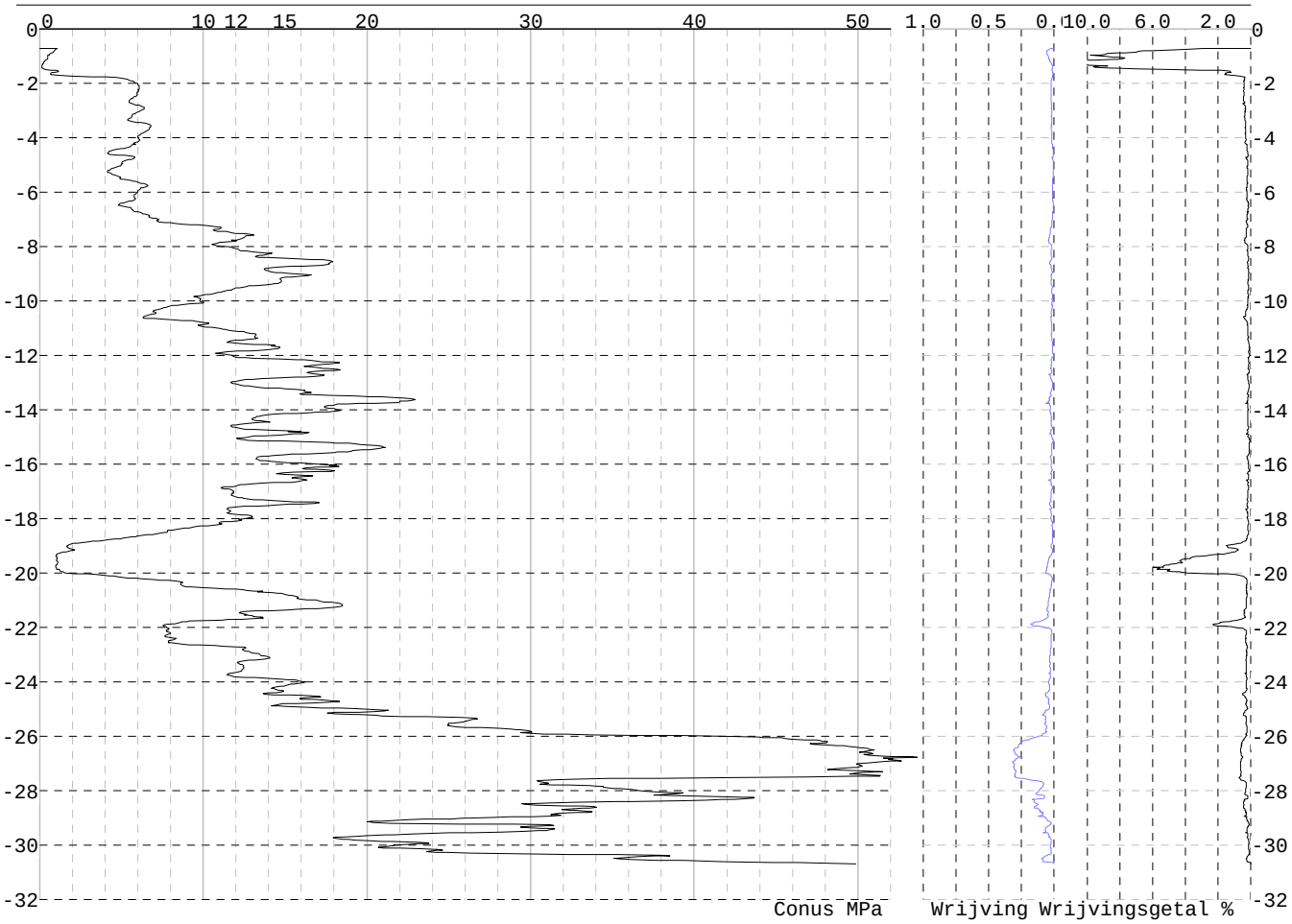


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 56-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.72 Bodemprofiel: 56-2
Traject negatieve kleef : -0.72 tot -1.90 [m]
Traject positieve kleef : -1.90 tot -30.70 [m]

SONDERINGSGEGEVENS GRAFIEK: 56-2

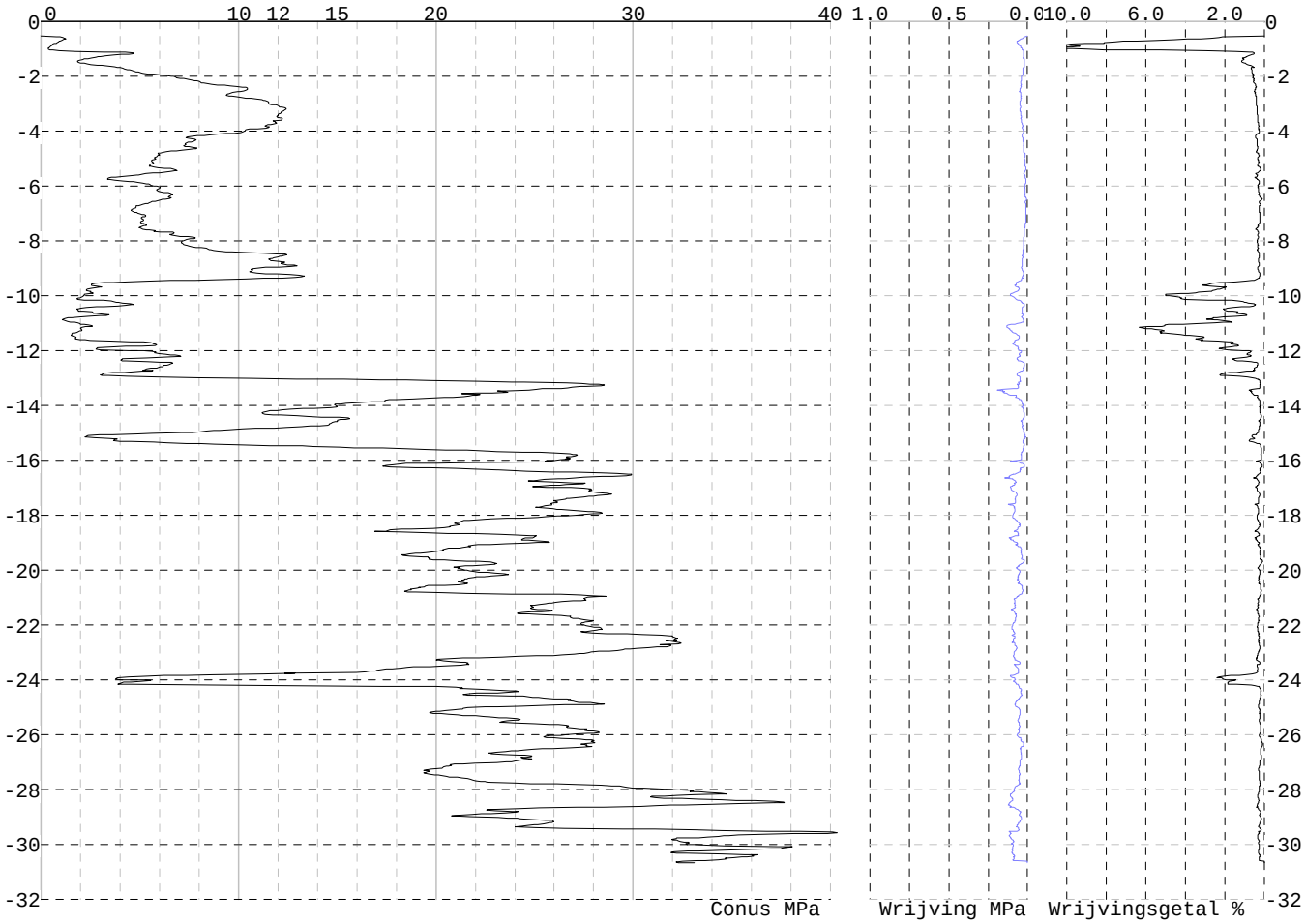


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 57-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.54 Bodemprofiel: 57-1
Traject negatieve kleef : -0.54 tot -1.60 [m]
Traject positieve kleef : -1.60 tot -30.69 [m]

SONDERINGSGEGEVENS GRAFIEK: 57-1

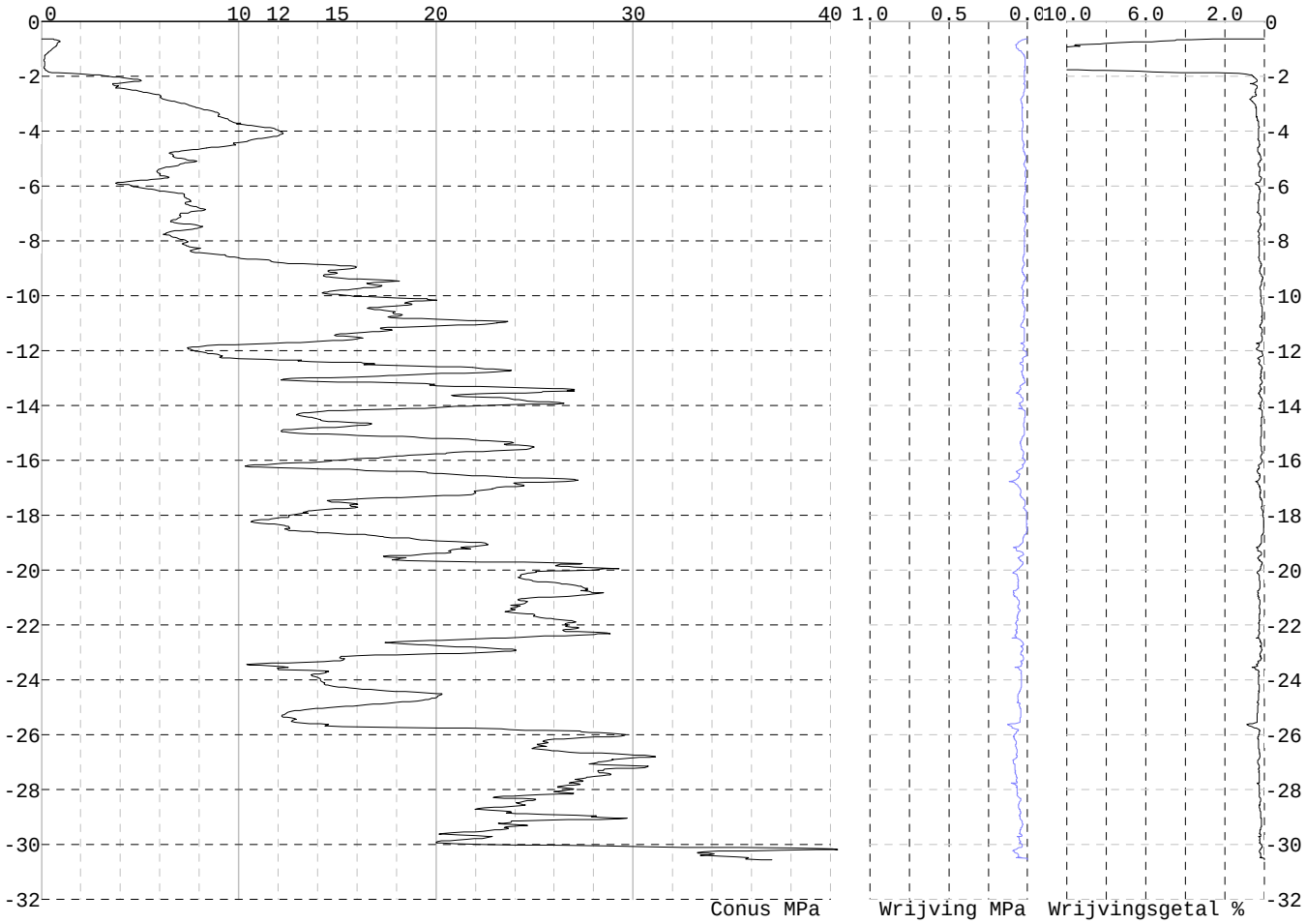


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 57-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.63 Bodemprofiel: 57-2
Traject negatieve kleef : -0.63 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.58 [m]

SONDERINGSGEGEVENS GRAFIEK: 57-2

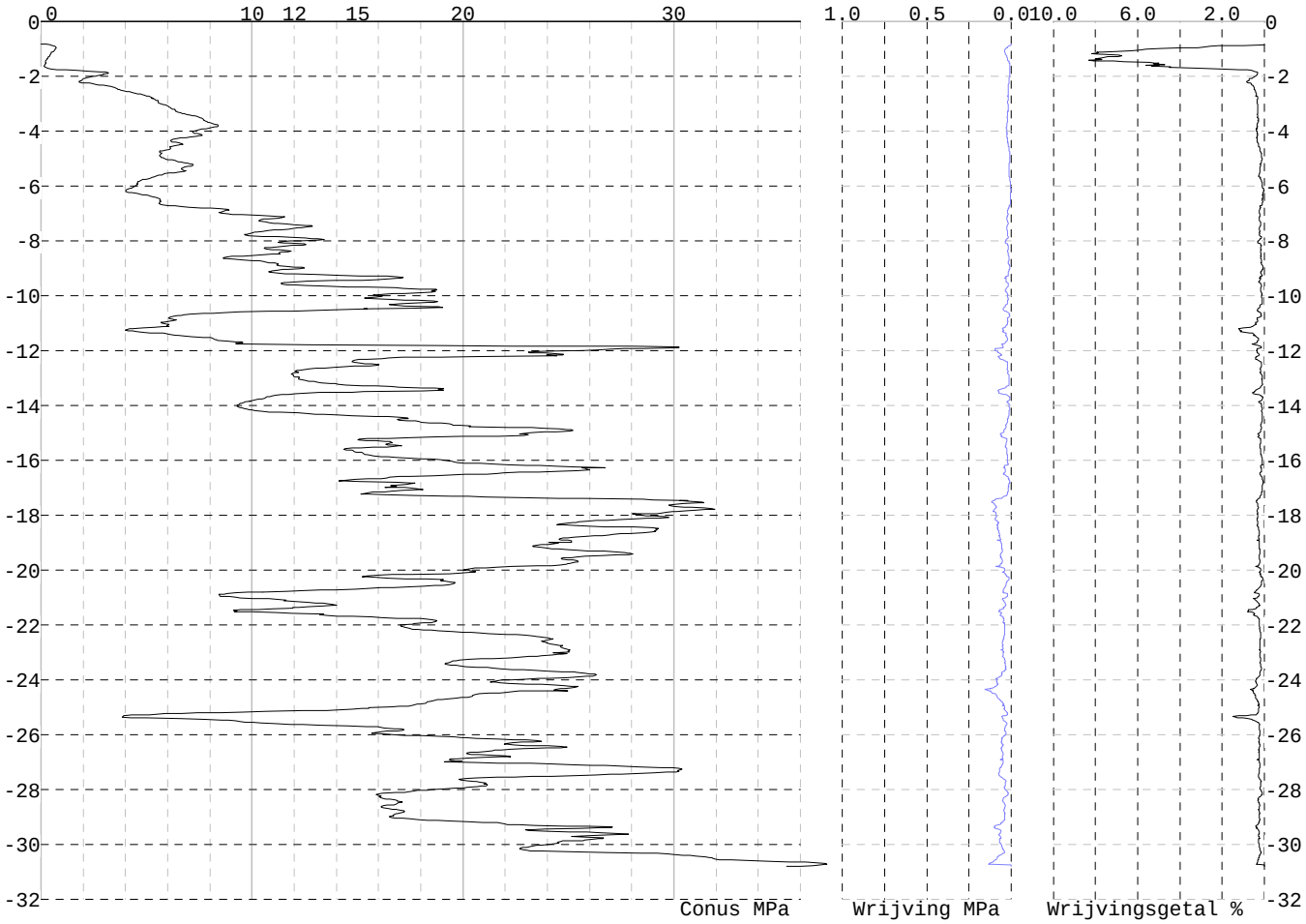


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 58-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.82 Bodemprofiel: 58-1
Traject negatieve kleef : -0.82 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.82 [m]

SONDERINGSGEGEVENS GRAFIEK: 58-1

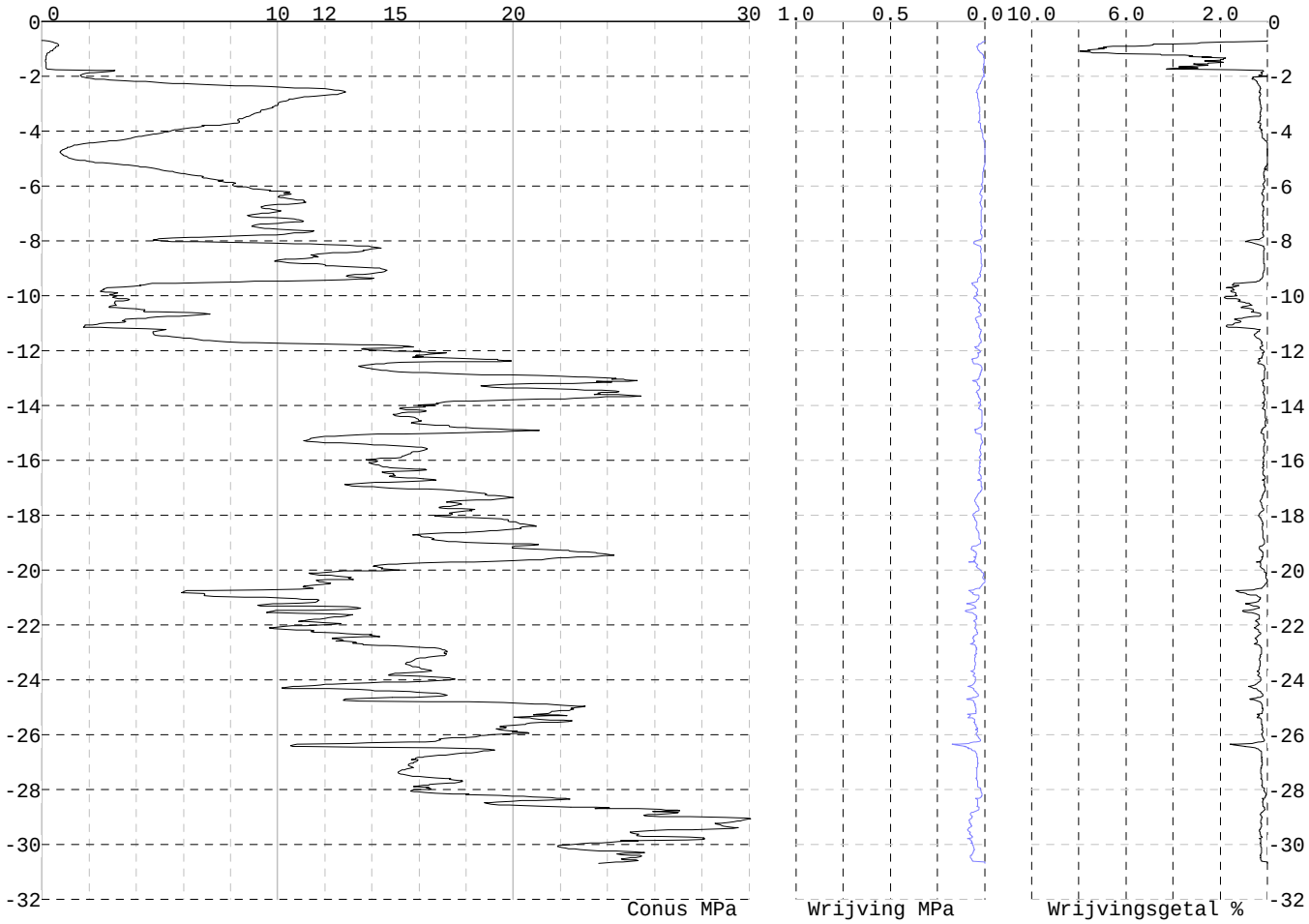


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 58-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.69 Bodemprofiel: 58-2
Traject negatieve kleef : -0.69 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.70 [m]

SONDERINGSGEGEVENS GRAFIEK: 58-2

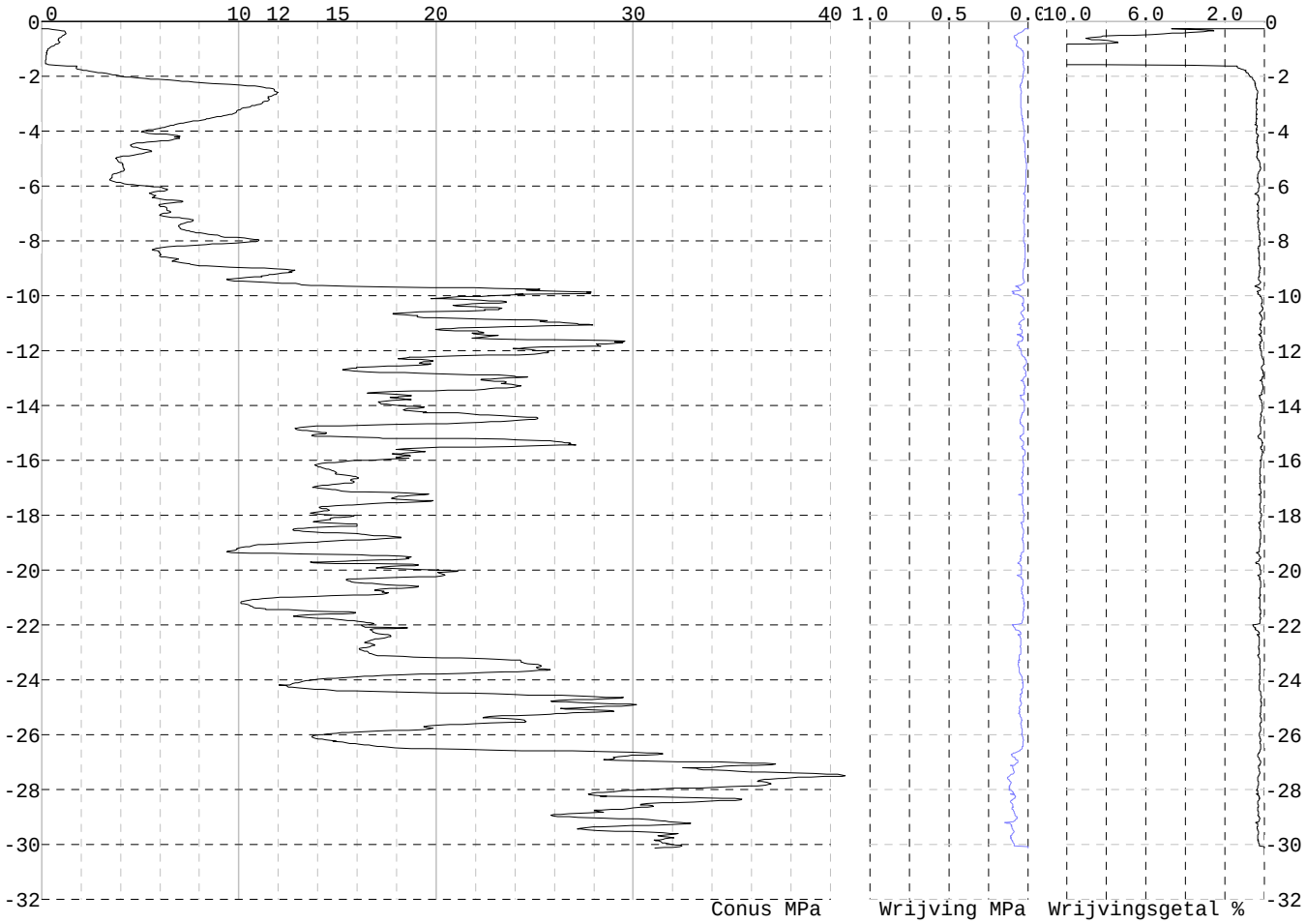


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 59-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.27 Bodemprofiel: 59-2
Traject negatieve kleef : -0.27 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.15 [m]

SONDERINGSGEGEVENS GRAFIEK: 59-1

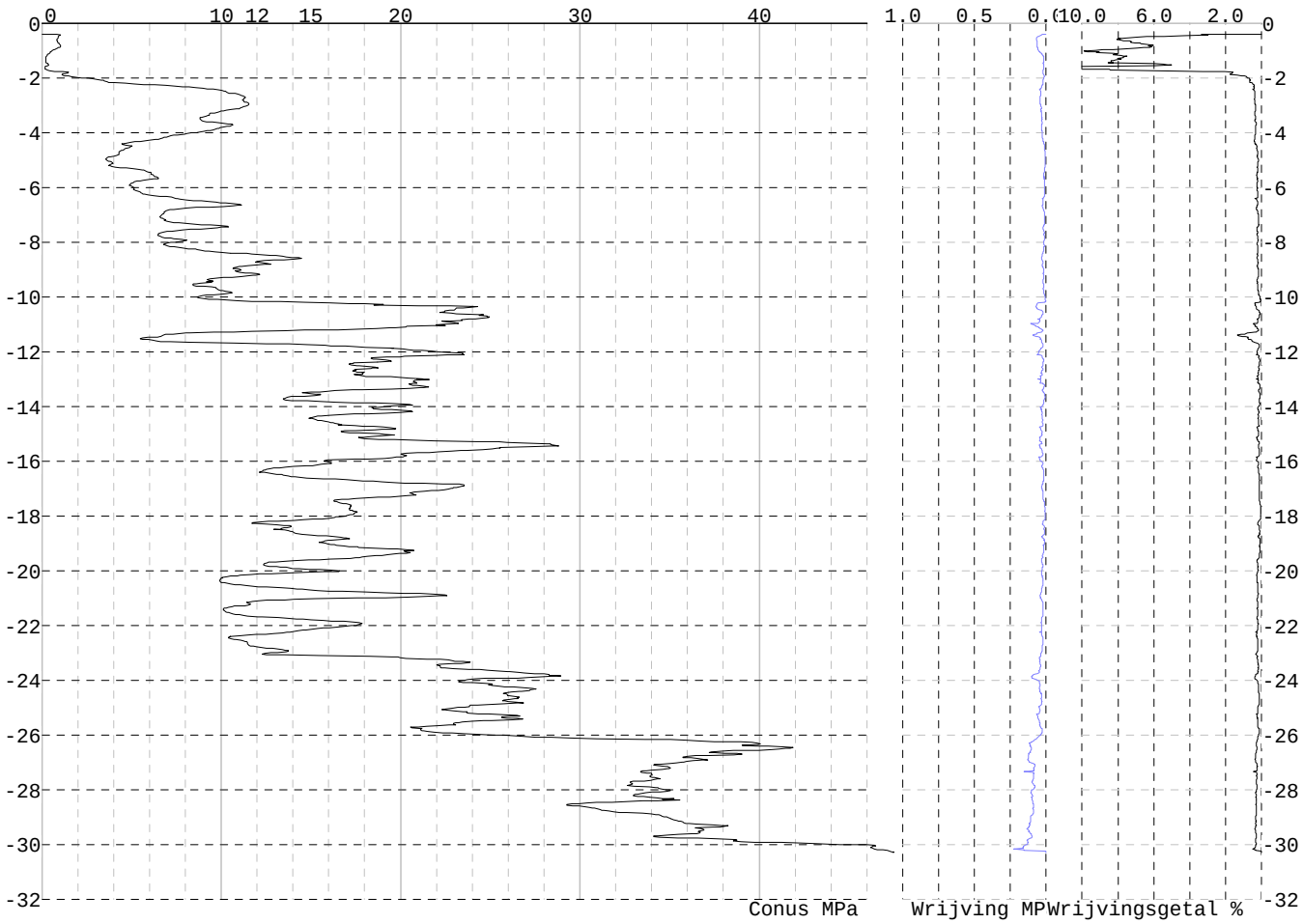


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 59-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.40 Bodemprofiel: 59-2
Traject negatieve kleef : -0.40 tot -2.00 [m]
Traject positieve kleef : -2.00 tot -30.31 [m]

SONDERINGSGEGEVENS GRAFIEK: 59-2



REKENGEGEVENS Mast 50

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 50-1, 50-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.03
Paalpuntniveau : N.A.P. -14.47
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 50 (n=1)

Project :
Onderdeel :

Sondering : 50-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.47	-14.47	45.7	466.6	466.6	0.0	0.00

Sondering : 50-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.47	-14.47	45.7	590.0	590.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 50 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
50-1	-0.46	-14.47	466.6	466.6	466.6
50-2	-0.46	-14.47	590.0	590.0	590.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 50 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
50-1	-0.46	-14.47	45.7	489.0
50-2	-0.46	-14.47	45.7	618.9
		-14.47	$R_{t;cal;gem}$	553.9
met ξ_4(min) = 1.32				
50-1	-0.46	-14.47	45.7	489.0
50-2	-0.46	-14.47	45.7	618.9
		-14.47	$R_{t;cal;min}$	489.0

Totaal resultaten Mast 50 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
50-1 50-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.47	$R_{t;d}$ = min.{ 553.9; 489.0}= 489.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.47	489.0	489.0	0.0	489.0	0.00 *

*** WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)**

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-14.47	2	553.94	16.6

Project :
Onderdeel :

REKENGEGEVENS Mast 51

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 51-1, 51-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.03
Paalpuntniveau : N.A.P. -21.18
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 51 (n=1)

Sondering : 51-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-21.18	-21.18	242.0	3085.0	3085.0	0.0	0.00

Sondering : 51-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-21.18	-21.18	242.0	2301.5	2301.5	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 51 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
51-1	-0.49	-21.18	3085.0	3085.0	3085.0
51-2	-0.70	-21.18	2301.5	2301.5	2301.5

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 51 (van 2 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
51-1	-0.49	-21.18	242.0	3235.8
51-2	-0.70	-21.18	242.0	2410.8
		-21.18	$R_{t;cal;gem}$	2823.3
met ξ_4(min) = 1.32				
51-1	-0.49	-21.18	242.0	3235.8
51-2	-0.70	-21.18	242.0	2410.8
		-21.18	$R_{t;cal;min}$	2410.8

Totaal resultaten Mast 51 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
51-1 51-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-21.18	$R_{t;d}$ = min.{ 2823.3; 2410.8}= 2410.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-21.18	2410.8	2410.8	0.0	2410.8	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-21.18	2	2823.26	20.7

Project :
Onderdeel :

REKENGEGEVENS Mast 52

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 52-1, 52-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -14.43
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 52 (n=1)

Sondering : 52-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.43	-14.43	45.9	545.0	545.0	0.0	0.00

Sondering : 52-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.43	-14.43	45.9	524.1	524.1	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 52 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
52-1	-0.62	-14.43	545.0	545.0	545.0
52-2	-0.45	-14.43	524.1	524.1	524.1

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 52 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
52-1	-0.62	-14.43	45.9	571.5
52-2	-0.45	-14.43	45.9	549.4
		-14.43	$R_{t;cal;gem}$	560.5
met ξ_4(min) = 1.32				
52-1	-0.62	-14.43	45.9	571.5
52-2	-0.45	-14.43	45.9	549.4
		-14.43	$R_{t;cal;min}$	549.4

Totaal resultaten Mast 52 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
52-1 52-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-14.43 $R_{t;d}$ = min.{ 560.5; 549.4}= 549.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.43	549.4	549.4	0.0	549.4	0.00

REKENGEGEVENS Mast 53

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 53-1, 53-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.01
Paalpuntniveau : N.A.P. -12.66
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 53 (n=1)

Project :
Onderdeel :

Sondering : 53-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.66	-12.66	40.8	514.9	514.9	0.0	0.00

Sondering : 53-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.66	-12.66	40.8	471.3	471.3	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 53 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
53-1	-0.66	-12.66	514.9	514.9	514.9
53-2	-0.67	-12.66	471.3	471.3	471.3

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 53 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
53-1	-0.66	-12.66	40.8	540.0
53-2	-0.67	-12.66	40.8	494.1
		-12.66	$R_{t;cal;gem}$	517.1
met ξ_4(min) = 1.32				
53-1	-0.66	-12.66	40.8	540.0
53-2	-0.67	-12.66	40.8	494.1
		-12.66	$R_{t;cal;min}$	494.1

Totaal resultaten Mast 53 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
53-1 53-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-12.66 $R_{t;d}$ = min.{ 517.1; 494.1}= 494.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.66	494.1	494.1	0.0	494.1	0.00

REKENGEGEVENS Mast 54

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 54-1, 54-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -12.63
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 54 (n=1)

Project :
Onderdeel :

Sondering : 54-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.63	-12.63	40.9	425.8	425.8	0.0	0.00

Sondering : 54-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.63	-12.63	40.9	414.8	414.8	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 54 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
54-1	-0.71	-12.63	425.8	425.8	425.8
54-2	-0.64	-12.63	414.8	414.8	414.8

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 54 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
54-1	-0.71	-12.63	40.9	446.2
54-2	-0.64	-12.63	40.9	434.6
		-12.63	$R_{t;cal;gem}$	440.4
met ξ_4(min) = 1.32				
54-1	-0.71	-12.63	40.9	446.2
54-2	-0.64	-12.63	40.9	434.6
		-12.63	$R_{t;cal;min}$	434.6

Totaal resultaten Mast 54 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
54-1 54-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-12.63	$R_{t;d}$ = min.{ 440.4; 434.6}= 434.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.63	434.6	434.6	0.0	434.6	0.00

REKENGEGEVENS Mast 56

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 56-1, 56-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.06
Paalpuntniveau : N.A.P. -13.99
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 56 (n=1)

Project :
Onderdeel :

Sondering : 56-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.99	-13.99	44.7	514.2	514.2	0.0	0.00

Sondering : 56-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.99	-13.99	45.1	532.6	532.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 56 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
56-1	-0.55	-13.99	514.2	514.2	514.2
56-2	-0.72	-13.99	532.6	532.6	532.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 56 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
56-1	-0.55	-13.99	44.7	539.1
56-2	-0.72	-13.99	44.7	558.4
		-13.99	$R_{t;cal;gem}$	548.7
met ξ_4(min) = 1.32				
56-1	-0.55	-13.99	44.7	539.1
56-2	-0.72	-13.99	44.7	558.4
		-13.99	$R_{t;cal;min}$	539.1

Totaal resultaten Mast 56 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
56-1 56-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-13.99	$R_{t;d}$ = min.{ 548.7; 539.1}= 539.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.99	539.1	539.1	0.0	539.1	0.00

REKENGEGEVENS Mast 57

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 57-1, 57-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.10
Paalpuntniveau : N.A.P. -13.45
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 57 (n=1)

Project :
Onderdeel :

Sondering : 57-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.45	-13.45	43.3	455.2	455.2	0.0	0.00

Sondering : 57-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.45	-13.45	43.5	541.4	541.4	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 57 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
57-1	-0.54	-13.45	455.2	455.2	455.2
57-2	-0.63	-13.45	541.4	541.4	541.4

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 57 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
57-1	-0.54	-13.45	43.3	477.0
57-2	-0.63	-13.45	43.3	567.8
		-13.45	$R_{t;cal;gem}$	522.4
met ξ_4(min) = 1.32				
57-1	-0.54	-13.45	43.3	477.0
57-2	-0.63	-13.45	43.3	567.8
		-13.45	$R_{t;cal;min}$	477.0

Totaal resultaten Mast 57 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
57-1 57-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-13.45	$R_{t;d}$ = min.{ 522.4; 477.0}= 477.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.45	477.0	477.0	0.0	477.0	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-13.45	2	522.40	12.3

Project :
Onderdeel :

REKENGEGEVENS Mast 58

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 58-1, 58-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.08
Paalpuntniveau : N.A.P. -13.57
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 58 (n=1)

Sondering : 58-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.57	-13.57	44.3	490.2	490.2	0.0	0.00

Sondering : 58-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.57	-13.57	43.9	505.6	505.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 58 (n=1)

Uitgangspunten

- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
58-1	-0.82	-13.57	490.2	490.2	490.2
58-2	-0.69	-13.57	505.6	505.6	505.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 58 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
58-1	-0.82	-13.57	44.3	513.9
58-2	-0.69	-13.57	44.3	530.0
		-13.57	$R_{t;cal;gem}$	521.9
met ξ_4(min) = 1.32				
58-1	-0.82	-13.57	44.3	513.9
58-2	-0.69	-13.57	44.3	530.0
		-13.57	$R_{t;cal;min}$	513.9

Totaal resultaten Mast 58 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
58-1 58-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-13.57 $R_{t;d}$ = min.{ 521.9; 513.9}= 513.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.57	513.9	513.9	0.0	513.9	0.00

REKENGEGEVENS Mast 59

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 59-1, 59-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.10
Paalpuntniveau : N.A.P. -12.60
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 59 (n=1)

Project :
Onderdeel :

Sondering : 59-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.60	-12.60	40.5	512.8	512.8	0.0	0.00

Sondering : 59-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.60	-12.60	40.5	487.2	487.2	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 59 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
59-1	-0.27	-12.60	512.8	512.8	512.8
59-2	-0.40	-12.60	487.2	487.2	487.2

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 59 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
59-1	-0.27	-12.60	40.5	537.9
59-2	-0.40	-12.60	40.5	510.9
		-12.60	$R_{t;cal;gem}$	524.4
met ξ_4(min) = 1.32				
59-1	-0.27	-12.60	40.5	537.9
59-2	-0.40	-12.60	40.5	510.9
		-12.60	$R_{t;cal;min}$	510.9

Totaal resultaten Mast 59 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
59-1 59-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-12.60	$R_{t;d}$ = min.{ 524.4; 510.9}= 510.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.60	510.9	510.9	0.0	510.9	0.00

PAALGEGEVENS BP 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project :
Onderdeel :

PAALGEGEVENS GI 914_1075

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 1.075
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{t;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 50	Mast 51	Mast 52	Mast 53	Mast 54
50-1	-0.46	-14.47	466				
50-2	-0.46	-14.47	590				
51-1	-0.49	-21.18		3084			
51-2	-0.70	-21.18		2301			
52-1	-0.62	-14.43			545		
52-2	-0.45	-14.43			524		
53-1	-0.66	-12.66				514	
53-2	-0.67	-12.66				471	
54-1	-0.71	-12.63					425
54-2	-0.64	-12.63					414

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 56	Mast 57	Mast 58	Mast 59
56-1	-0.55	-13.99	514			
56-2	-0.72	-13.99	532			
57-1	-0.54	-13.45		455		
57-2	-0.63	-13.45		541		
58-1	-0.82	-13.57			490	
58-2	-0.69	-13.57			505	
59-1	-0.27	-12.60				512
59-2	-0.40	-12.60				487

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 60-69 (excl 66).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Sterk zandig	18.00	18.00	27.50	20.00	20.00	32.50
15	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00

BODEMPROFIELGEGEVENS: 60-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.17 Grondwaterstand [m] : -1.17

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.17	-1.82	Klei - Schoon - Matig	1.0	50.0		
2	-1.82	-5.05	Zand - Schoon - Los	1.0	100.0		
3	-5.05	-5.87	Leem - Zwak zandig - Vast	1.0	50.0		
4	-5.87	-10.17	Zand - Schoon - Los	1.0	100.0		
5	-10.17	-11.27	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-11.27	-13.45	Zand - Schoon - Vast	1.0	100.0		
7	-13.45	-14.45	Zand - Schoon - Matig	1.0	100.0		
8	-14.45	-15.45	Zand - Schoon - Los	1.0	100.0		
9	-15.45	-15.71	Leem - Zwak zandig - Vast	1.0	50.0		
10	-15.71	-18.82	Zand - Schoon - Matig	1.0	100.0		
11	-18.82	-19.24	Zand - Schoon - Vast	1.0	100.0		
12	-19.24	-20.02	Zand - Schoon - Matig	1.0	100.0		
13	-20.02	-23.55	Zand - Zwak siltig - Kleiig	1.0	100.0		
14	-23.55	-28.45	Zand - Schoon - Matig	1.0	100.0		
15	-28.45	-30.25	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 60-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.27 Grondwaterstand [m] : -1.27

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.27	-1.98	Klei - Organisch - Matig	1.0	50.0		
2	-1.98	-3.64	Zand - Schoon - Los	1.0	100.0		
3	-3.64	-5.08	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-5.08	-5.68	Klei - Zwak zandig - Vast	1.0	50.0		
5	-5.68	-10.03	Zand - Schoon - Los	1.0	100.0		
6	-10.03	-24.87	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-24.87	-30.31	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 61-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.40 Grondwaterstand [m] : -1.40

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.40	-1.59	Klei - Schoon - Matig	1.0	50.0		
2	-1.59	-3.14	Zand - Schoon - Los	1.0	100.0		
3	-3.14	-4.06	Klei - Zwak zandig - Vast	1.0	50.0		
4	-4.06	-11.17	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-11.17	-13.89	Zand - Schoon - Matig	1.0	100.0		
6	-13.89	-14.17	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-14.17	-15.55	Zand - Schoon - Matig	1.0	100.0		
8	-15.55	-16.82	Zand - Schoon - Los	1.0	100.0		
9	-16.82	-18.34	Zand - Schoon - Vast	1.0	100.0		
10	-18.34	-20.38	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-20.38	-22.70	Zand - Schoon - Matig	1.0	100.0		
12	-22.70	-23.55	Zand - Sterk siltig - Kleiig	1.0	100.0		
13	-23.55	-23.99	Klei - Zwak zandig - Vast	1.0	50.0		
14	-23.99	-25.05	Zand - Schoon - Matig	1.0	100.0		
15	-25.05	-29.39	Zand - Schoon - Vast	1.0	100.0		
16	-29.39	-30.50	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 62-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.03 Grondwaterstand [m] : -1.03

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.03	-0.96	Klei - Organisch - Matig	1.0	50.0		
2	-0.96	-1.88	Leem - Zwak zandig - Vast	1.0	50.0		
3	-1.88	-3.61	Zand - Schoon - Los	1.0	100.0		
4	-3.61	-5.09	Klei - Zwak zandig - Matig	1.0	50.0		
5	-5.09	-8.97	Zand - Schoon - Los	1.0	100.0		
6	-8.97	-10.45	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-10.45	-12.83	Zand - Schoon - Vast	1.0	100.0		
8	-12.83	-14.58	Zand - Schoon - Matig	1.0	100.0		
9	-14.58	-15.50	Zand - Schoon - Vast	1.0	100.0		
10	-15.50	-16.40	Zand - Schoon - Matig	1.0	100.0		
11	-16.40	-21.28	Zand - Zwak siltig - Kleiig	1.0	100.0		
12	-21.28	-26.09	Zand - Schoon - Matig	1.0	100.0		
13	-26.09	-27.05	Zand - Schoon - Los	1.0	100.0		
14	-27.05	-28.67	Zand - Schoon - Vast	1.0	100.0		
15	-28.67	-30.19	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 62-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.15 Grondwaterstand [m] : -1.15

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.15	-1.64	Klei - Schoon - Matig	1.0	50.0		
2	-1.64	-3.78	Zand - Schoon - Los	1.0	100.0		
3	-3.78	-7.78	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-7.78	-11.08	Zand - Schoon - Los	1.0	100.0		
5	-11.08	-12.70	Zand - Schoon - Vast	1.0	100.0		
6	-12.70	-13.34	Zand - Schoon - Los	1.0	100.0		
7	-13.34	-14.25	Zand - Schoon - Matig	1.0	100.0		
8	-14.25	-14.76	Zand - Schoon - Los	1.0	100.0		
9	-14.76	-17.21	Zand - Schoon - Matig	1.0	100.0		
10	-17.21	-17.67	Zand - Schoon - Los	1.0	100.0		
11	-17.67	-24.77	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-24.77	-27.09	Zand - Schoon - Los	1.0	100.0		
13	-27.09	-29.81	Zand - Schoon - Vast	1.0	100.0		
14	-29.81	-30.21	Zand - Schoon - Los	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 63-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.27 Grondwaterstand [m] : -1.27

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.27	-1.90	Klei - Organisch - Matig	1.0	50.0		
2	-1.90	-3.63	Zand - Schoon - Los	1.0	100.0		
3	-3.63	-4.13	Leem - Zwak zandig - Vast	1.0	50.0		
4	-4.13	-5.05	Zand - Schoon - Los	1.0	100.0		
5	-5.05	-6.89	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-6.89	-10.33	Zand - Schoon - Los	1.0	100.0		
7	-10.33	-12.79	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-12.79	-15.25	Zand - Schoon - Vast	1.0	100.0		
9	-15.25	-17.63	Zand - Schoon - Matig	1.0	100.0		
10	-17.63	-18.30	Klei - Schoon - Vast	1.0	50.0		
11	-18.30	-26.22	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-26.22	-30.32	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 63-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.36 Grondwaterstand [m] : -1.36

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.36	-1.89	Klei - Zwak zandig - Slap	1.0	50.0		
2	-1.89	-3.95	Zand - Schoon - Los	1.0	100.0		
3	-3.95	-4.51	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-4.51	-7.63	Zand - Schoon - Los	1.0	100.0		
5	-7.63	-10.68	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-10.68	-11.11	Leem - Zwak zandig - Vast	1.0	50.0		
7	-11.11	-12.66	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-12.66	-13.36	Leem - Zwak zandig - Vast	1.0	50.0		
9	-13.36	-14.13	Klei - Schoon - Matig	1.0	50.0		
10	-14.13	-14.59	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-14.59	-15.11	Klei - Schoon - Matig	1.0	50.0		
12	-15.11	-27.51	Zand - Schoon - Matig	1.0	100.0		
13	-27.51	-29.83	Zand - Schoon - Vast	1.0	100.0		
14	-29.83	-30.13	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 64-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.06 Grondwaterstand [m] : -1.06

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.06	-1.67	Klei - Organisch - Matig	1.0	50.0		
2	-1.67	-4.38	Zand - Schoon - Los	1.0	100.0		
3	-4.38	-9.44	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-9.44	-26.00	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-26.00	-30.12	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 64-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.36 Grondwaterstand [m] : -1.36

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.36	-1.23	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.23	-3.57	Klei - Organisch - Matig	1.0	50.0		
3	-3.57	-9.75	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-9.75	-10.45	Zand - Schoon - Matig	1.0	100.0		
5	-10.45	-12.35	Zand - Schoon - Los	1.0	100.0		
6	-12.35	-15.43	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-15.43	-16.63	Zand - Schoon - Los	1.0	100.0		
8	-16.63	-17.37	Zand - Schoon - Vast	1.0	100.0		
9	-17.37	-18.24	Zand - Schoon - Matig	1.0	100.0		
10	-18.24	-22.08	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-22.08	-22.66	Zand - Schoon - Los	1.0	100.0		
12	-22.66	-24.91	Zand - Sterk siltig - Kleiig	1.0	100.0		
13	-24.91	-26.74	Zand - Schoon - Los	1.0	100.0		
14	-26.74	-28.52	Zand - Schoon - Vast	1.0	100.0		
15	-28.52	-28.97	Leem - Zwak zandig - Vast	1.0	50.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
16	-28.97	-30.42	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 65-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.80 Grondwaterstand [m] : -0.20

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.80	0.33	Leem - Zwak zandig - Vast	1.0	50.0		
2	0.33	-5.56	Klei - Zwak zandig - Matig	1.0	50.0		
3	-5.56	-6.00	Leem - Zwak zandig - Vast	1.0	50.0		
4	-6.00	-10.00	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-10.00	-10.50	Zand - Schoon - Matig	1.0	100.0		
6	-10.50	-11.64	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-11.64	-12.78	Zand - Schoon - Matig	1.0	100.0		
8	-12.78	-13.80	Leem - Zwak zandig - Vast	1.0	50.0		
9	-13.80	-14.42	Zand - Schoon - Los	1.0	100.0		
10	-14.42	-15.08	Leem - Zwak zandig - Vast	1.0	50.0		
11	-15.08	-16.68	Zand - Schoon - Los	1.0	100.0		
12	-16.68	-22.93	Zand - Schoon - Matig	1.0	100.0		
13	-22.93	-29.23	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 65-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.85 Grondwaterstand [m] : -0.15

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.85	0.48	Leem - Zwak zandig - Vast	1.0	50.0		
2	0.48	-0.18	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-0.18	-3.96	Klei - Zwak zandig - Matig	1.0	50.0		
4	-3.96	-4.42	Leem - Zwak zandig - Vast	1.0	50.0		
5	-4.42	-6.00	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-6.00	-6.52	Klei - Schoon - Matig	1.0	50.0		
7	-6.52	-6.90	Leem - Zwak zandig - Vast	1.0	50.0		
8	-6.90	-10.02	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-10.02	-11.90	Zand - Schoon - Matig	1.0	100.0		
10	-11.90	-12.30	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-12.30	-13.58	Zand - Schoon - Matig	1.0	100.0		
12	-13.58	-15.60	Zand - Schoon - Los	1.0	100.0		
13	-15.60	-17.30	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-17.30	-20.00	Zand - Schoon - Matig	1.0	100.0		
15	-20.00	-24.24	Zand - Sterk siltig - Kleiig	1.0	100.0		
16	-24.24	-29.16	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 67-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.32 Grondwaterstand [m] : -1.32

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.32	-1.11	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.11	-13.34	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-13.34	-14.02	Zand - Schoon - Matig	1.0	100.0		
4	-14.02	-14.70	Leem - Zwak zandig - Vast	1.0	50.0		
5	-14.70	-15.75	Zand - Schoon - Los	1.0	100.0		
6	-15.75	-16.32	Leem - Zwak zandig - Vast	1.0	50.0		
7	-16.32	-19.88	Zand - Schoon - Matig	1.0	100.0		
8	-19.88	-21.18	Zand - Schoon - Los	1.0	100.0		
9	-21.18	-23.06	Zand - Sterk siltig - Kleiig	1.0	100.0		
10	-23.06	-27.39	Zand - Schoon - Vast	1.0	100.0		
11	-27.39	-28.33	Zand - Schoon - Matig	1.0	100.0		
12	-28.33	-30.39	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 68-2

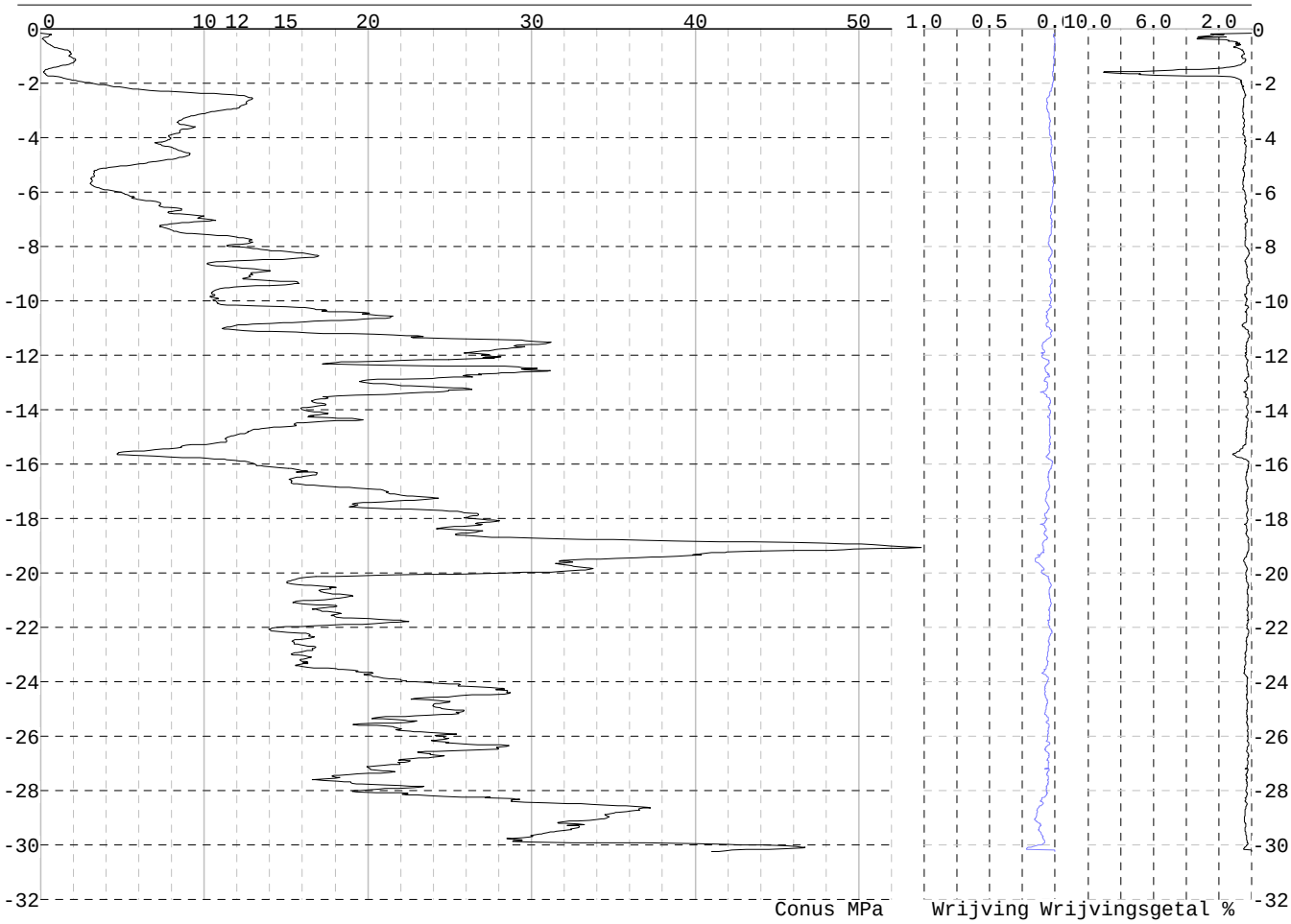
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.82 Grondwaterstand [m] : -0.18

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.82	0.43	Leem - Zwak zandig - Vast	1.0	50.0		
2	0.43	-1.23	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-1.23	-3.05	Zand - Schoon - Los	1.0	100.0		
4	-3.05	-3.43	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-3.43	-4.81	Klei - Schoon - Matig	1.0	50.0		
6	-4.81	-10.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-10.21	-12.71	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-12.71	-13.01	Leem - Zwak zandig - Vast	1.0	50.0		
9	-13.01	-14.15	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-14.15	-14.87	Klei - Sterk zandig	1.0	50.0		
11	-14.87	-17.23	Zand - Zwak siltig - Kleiig	1.0	100.0		
12	-17.23	-17.88	Zand - Schoon - Matig	1.0	100.0		
13	-17.88	-25.02	Zand - Schoon - Los	1.0	100.0		
14	-25.02	-27.25	Zand - Schoon - Matig	1.0	100.0		
15	-27.25	-29.20	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 60-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.17 Bodemprofiel: 60-1
Traject negatieve kleef : -0.17 tot -2.10 [m]
Traject positieve kleef : -2.10 tot -30.25 [m]

SONDERINGSGEGEVENS GRAFIEK: 60-1

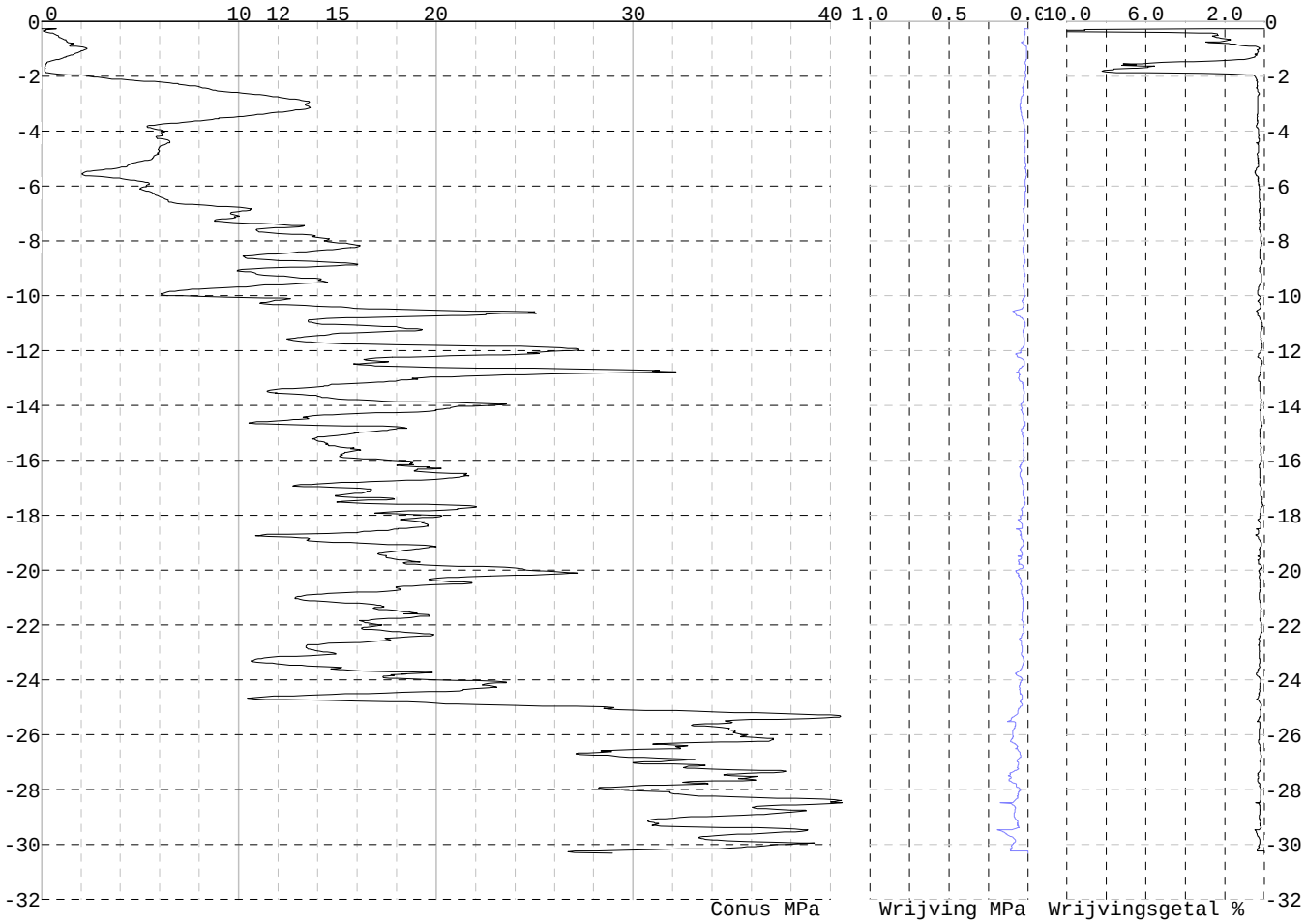


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 60-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.27 Bodemprofiel: 60-2
Traject negatieve kleef : -0.27 tot -2.20 [m]
Traject positieve kleef : -2.20 tot -30.32 [m]

SONDERINGSGEGEVENS GRAFIEK: 60-2

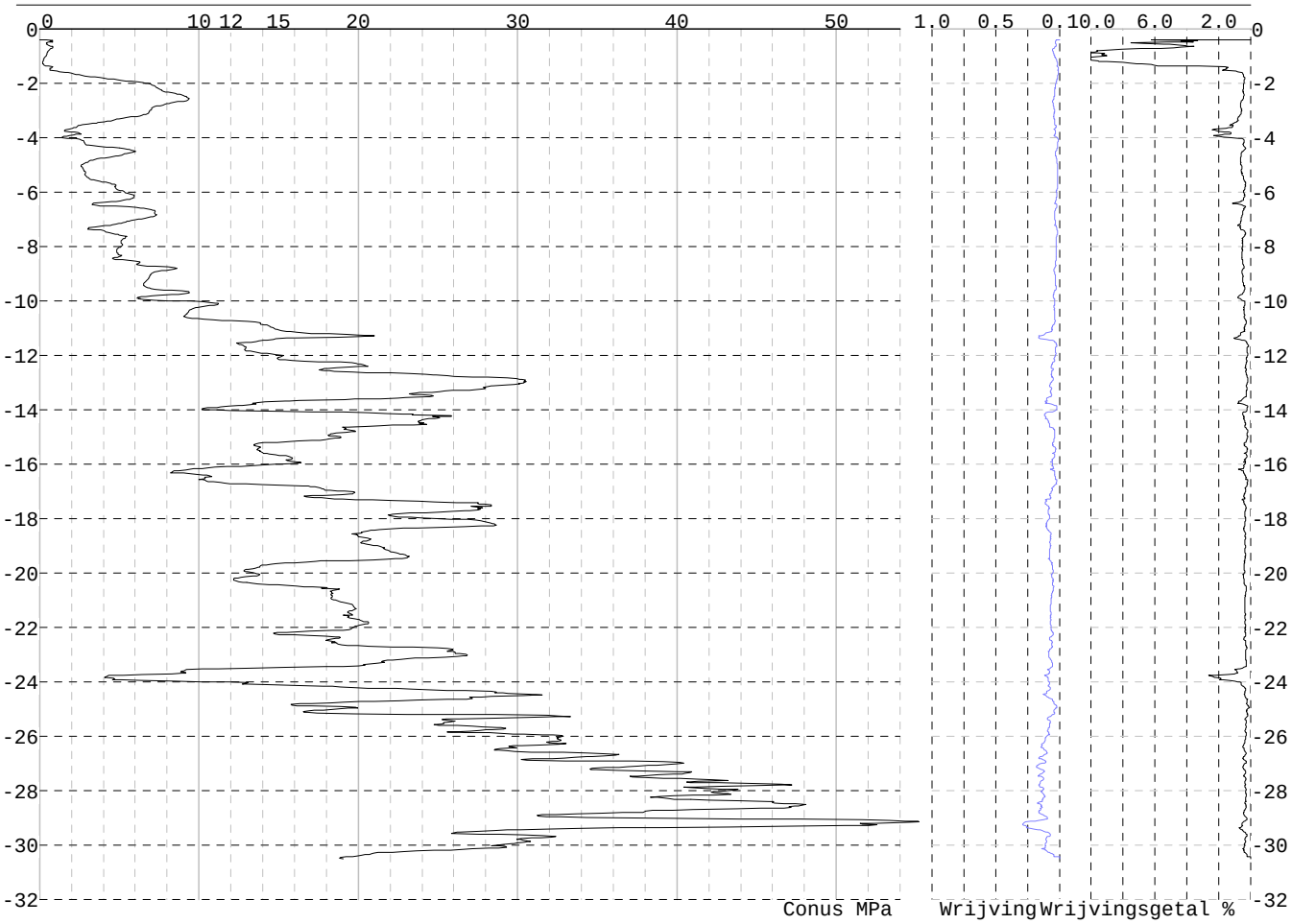


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 61-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.40 Bodemprofiel: 61-1
Traject negatieve kleef : -0.40 tot -4.30 [m]
Traject positieve kleef : -4.30 tot -30.51 [m]

SONDERINGSGEGEVENS GRAFIEK: 61-1

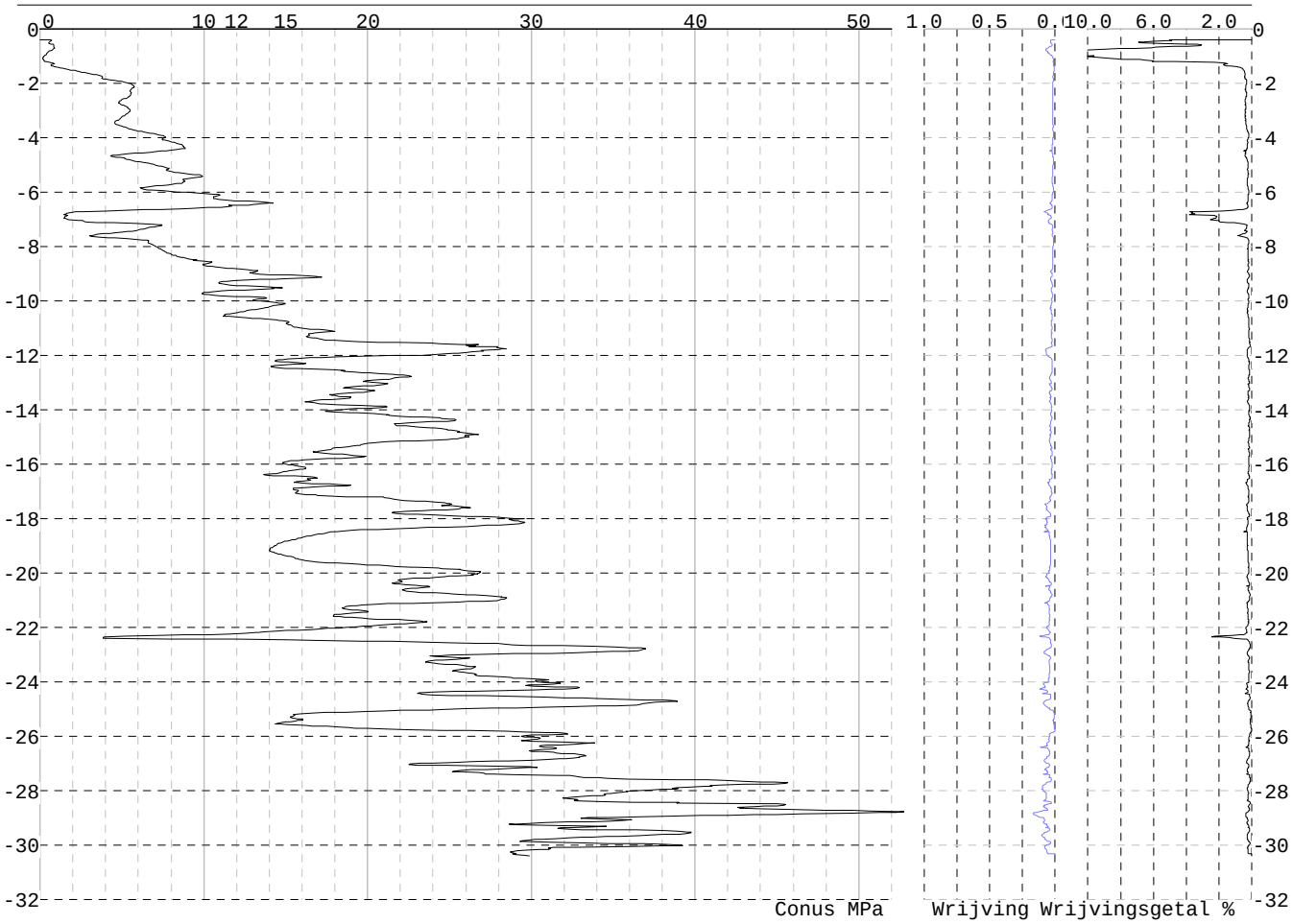


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 61-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.40 Bodemprofiel: 61-1
Traject negatieve kleef : -0.40 tot -1.60 [m]
Traject positieve kleef : -1.60 tot -30.40 [m]

SONDERINGSGEGEVENS GRAFIEK: 61-2

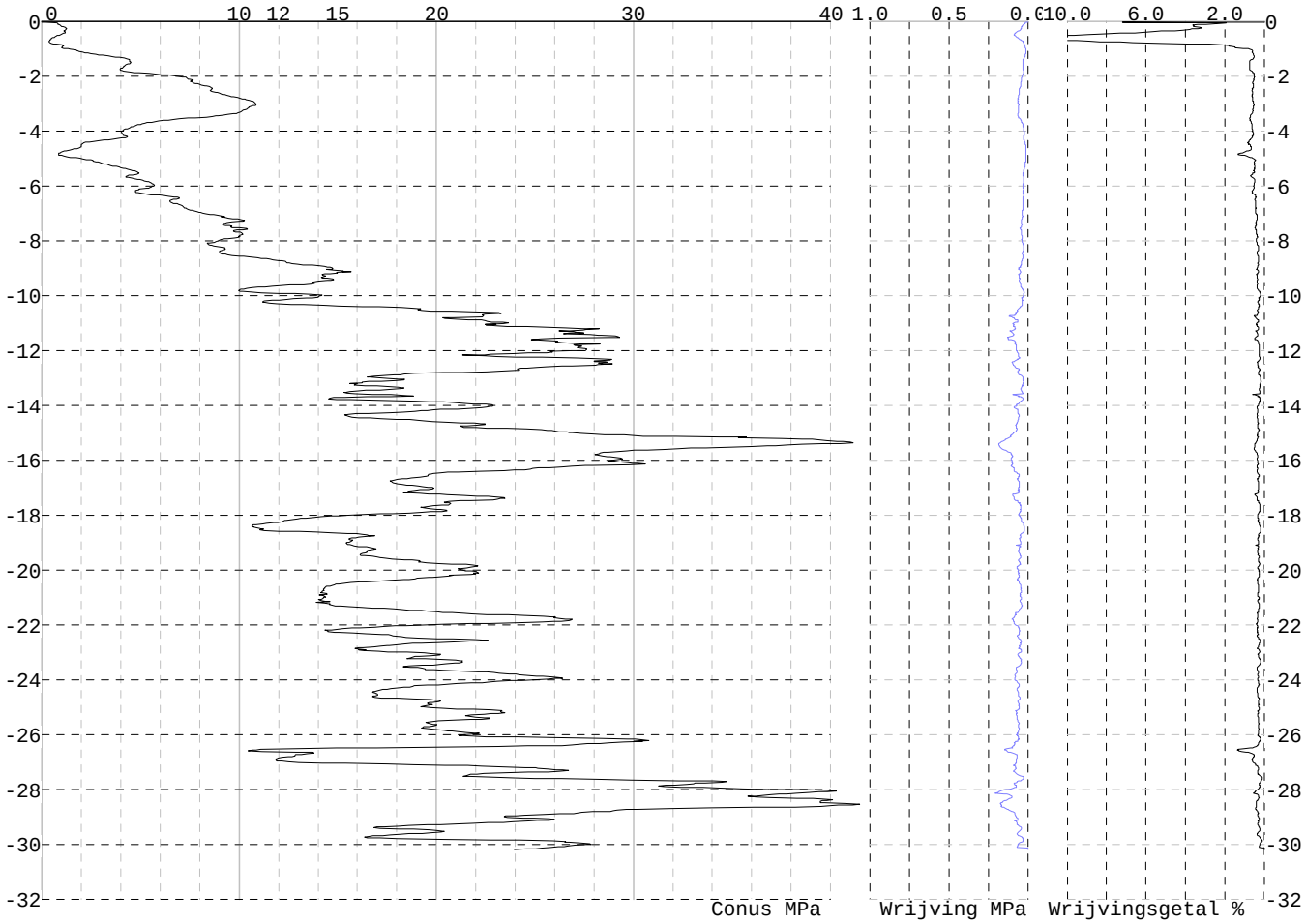


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 62-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.03 Bodemprofiel: 62-1
Traject negatieve kleef : -0.03 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.20 [m]

SONDERINGSGEGEVENS GRAFIEK: 62-1

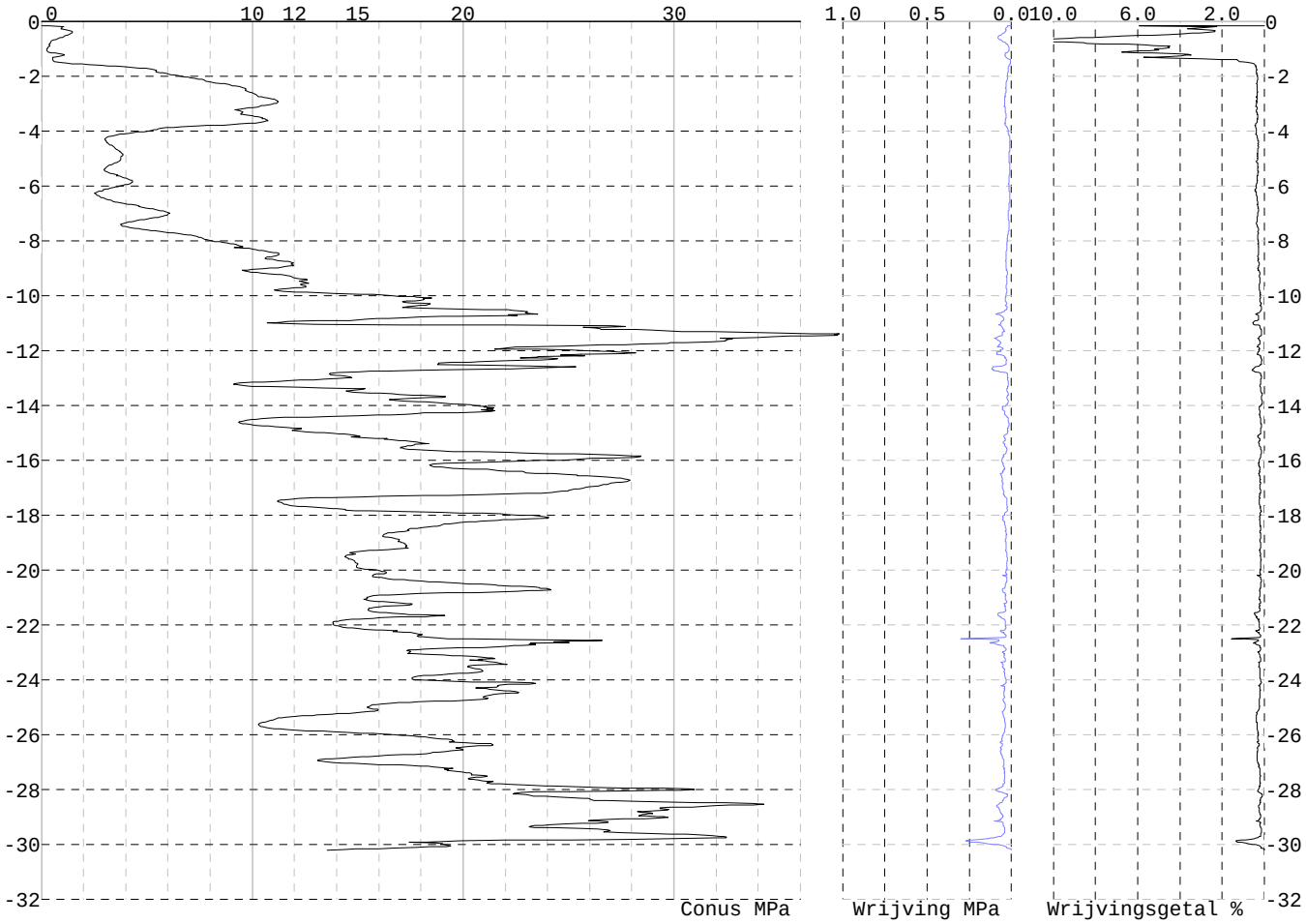


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 62-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.15 Bodemprofiel: 62-2
Traject negatieve kleef : -0.15 tot -1.50 [m]
Traject positieve kleef : -1.50 tot -30.22 [m]

SONDERINGSGEGEVENS GRAFIEK: 62-2

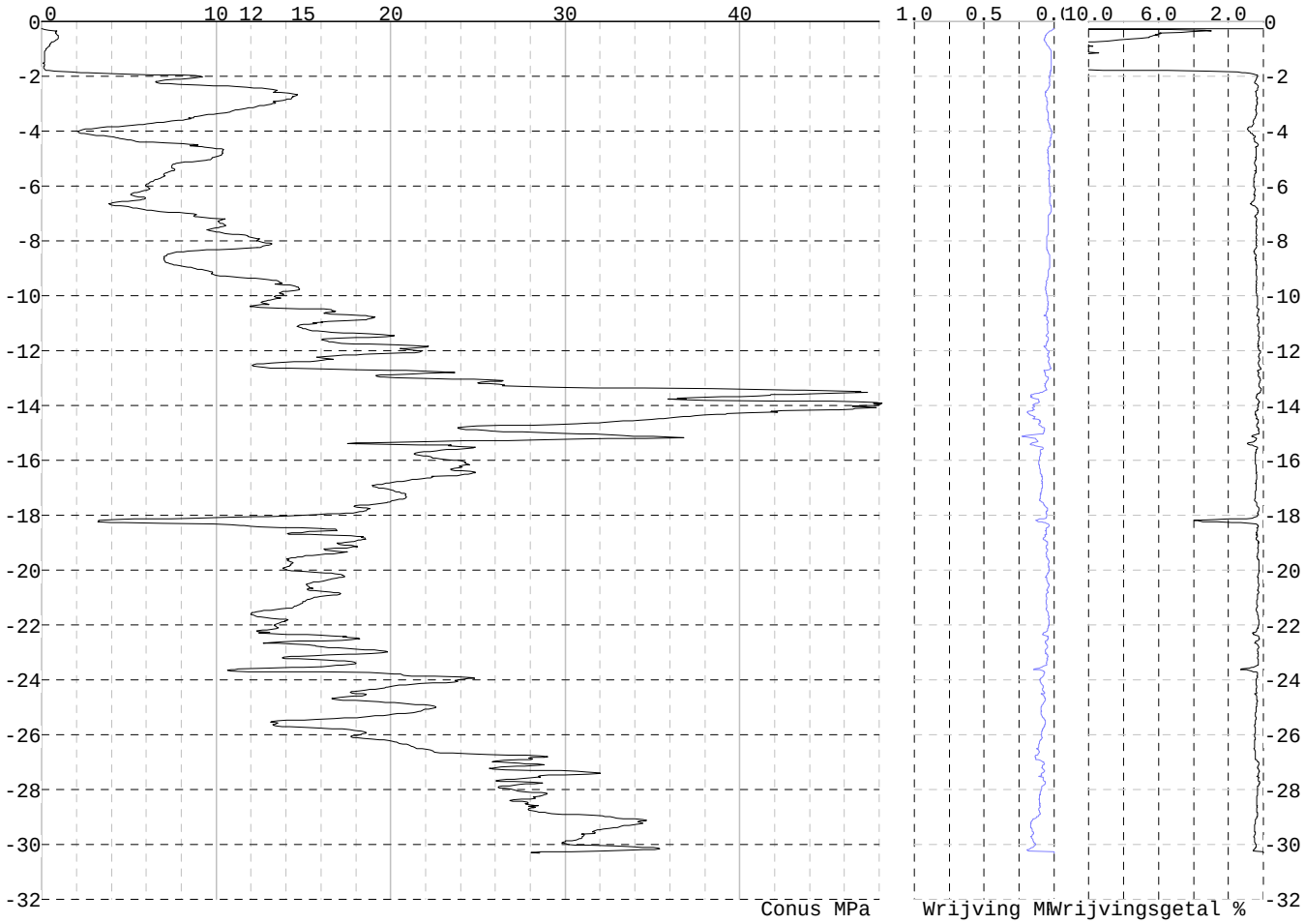


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 63-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.27 Bodemprofiel: 63-1
Traject negatieve kleef : -0.27 tot -2.00 [m]
Traject positieve kleef : -2.00 tot -30.33 [m]

SONDERINGSGEGEVENS GRAFIEK: 63-1

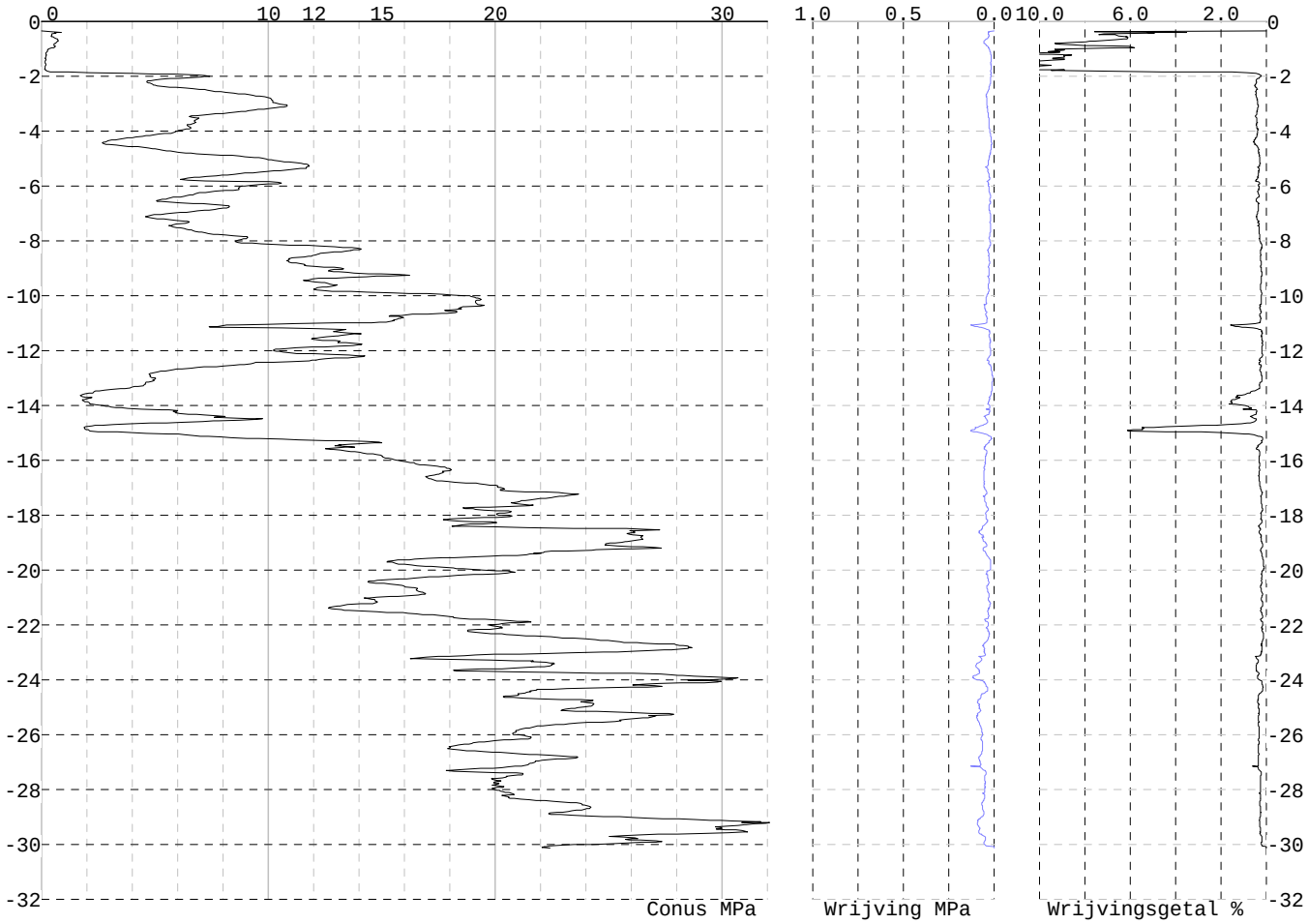


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 63-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.36 Bodemprofiel: 63-2
Traject negatieve kleef : -0.36 tot -2.00 [m]
Traject positieve kleef : -2.00 tot -30.14 [m]

SONDERINGSGEGEVENS GRAFIEK: 63-2

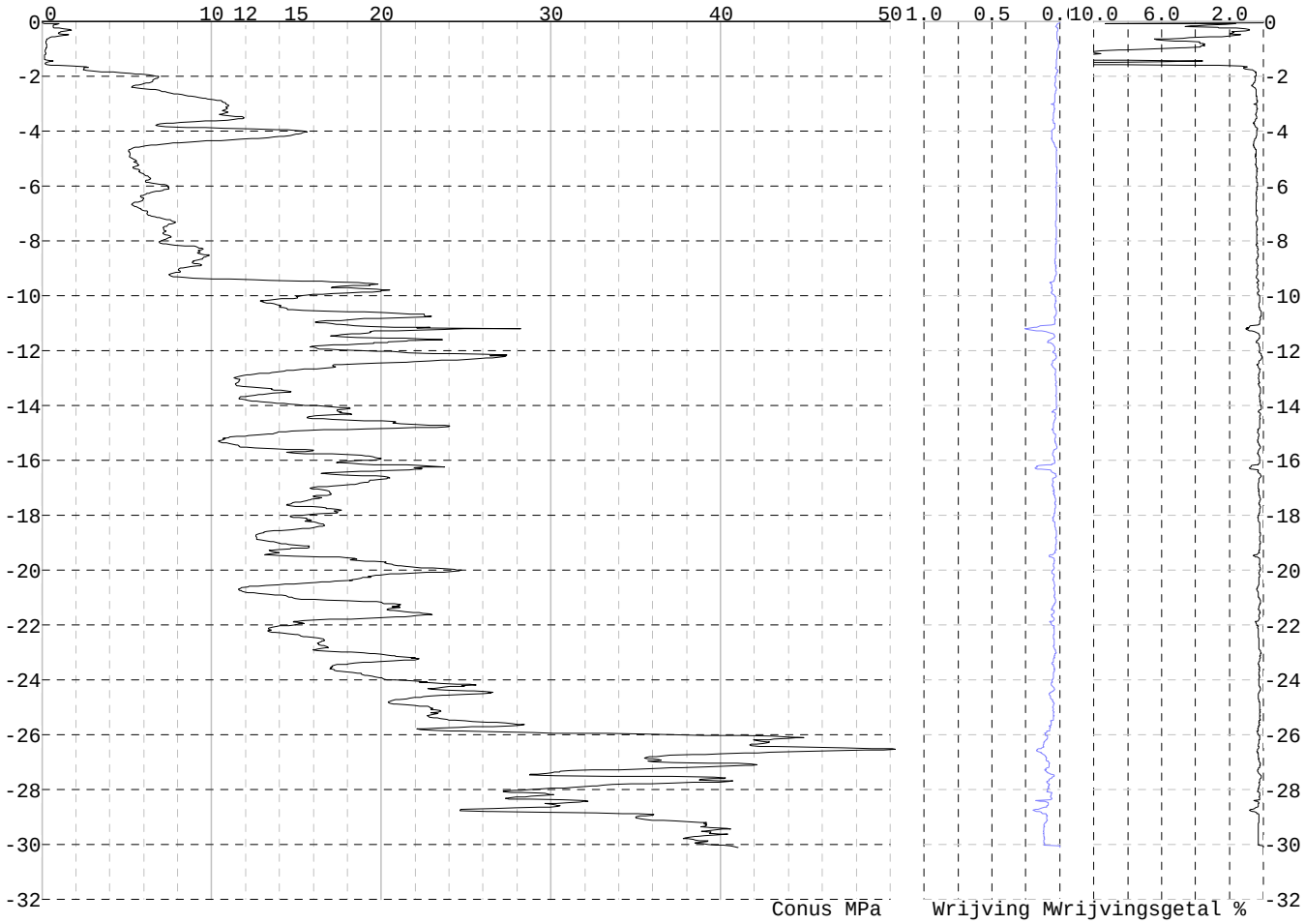


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 64-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.06 Bodemprofiel: 64-1
Traject negatieve kleef : -0.06 tot -1.90 [m]
Traject positieve kleef : -1.90 tot -30.13 [m]

SONDERINGSGEGEVENS GRAFIEK: 64-1

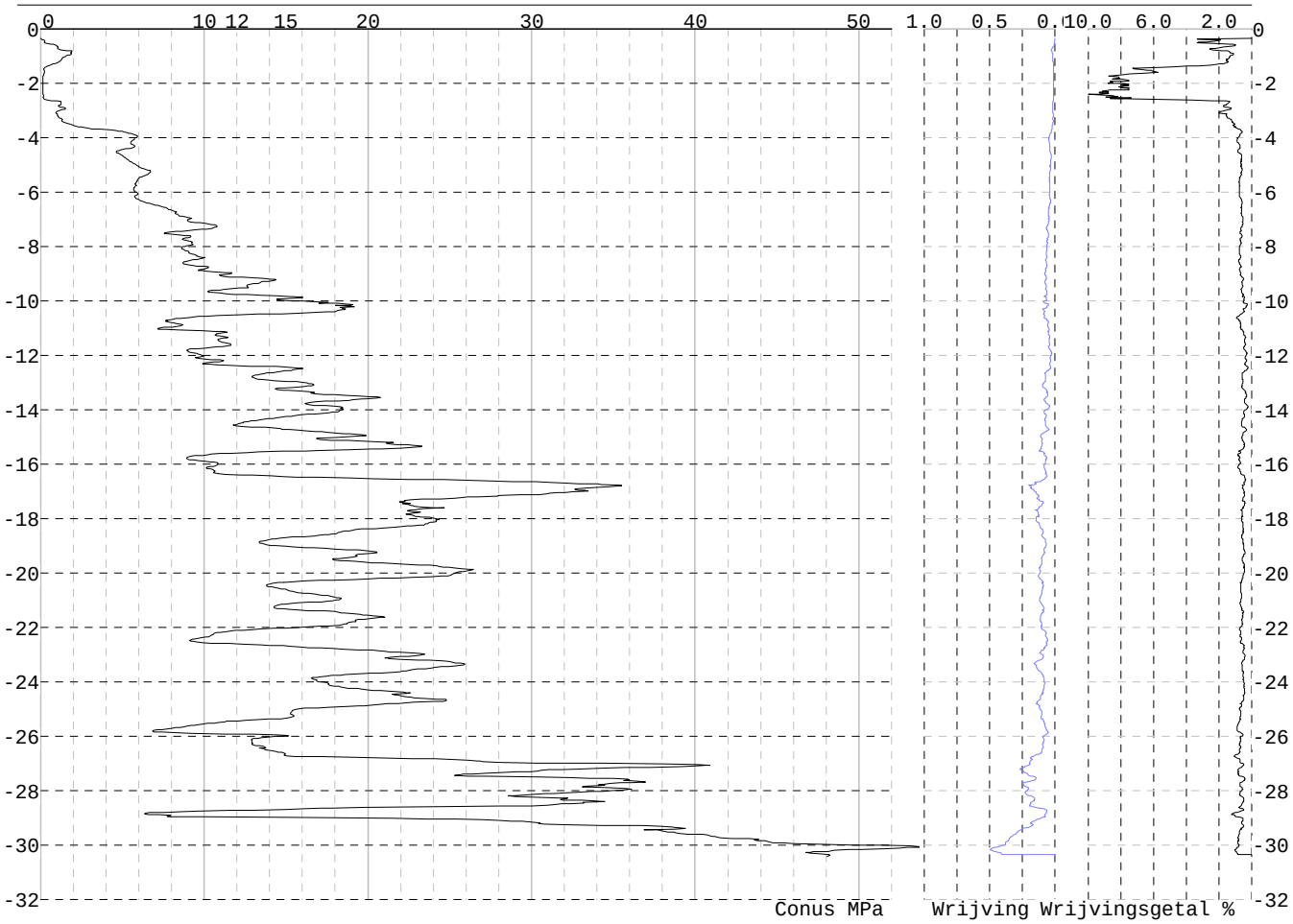


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 64-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.36 Bodemprofiel: 64-2
Traject negatieve kleef : -0.36 tot -4.10 [m]
Traject positieve kleef : -4.10 tot -30.43 [m]

SONDERINGSGEGEVENS GRAFIEK: 64-2

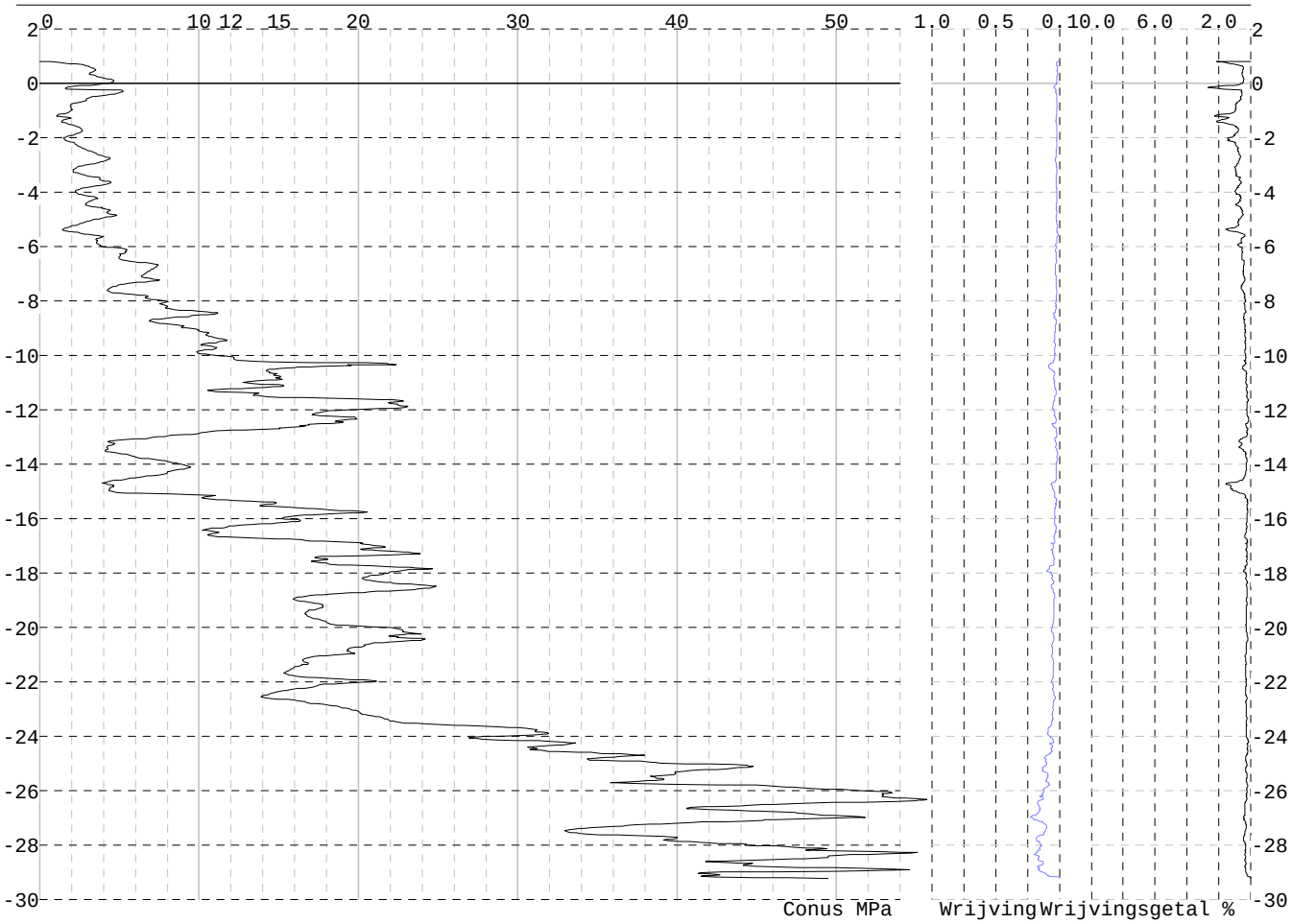


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 65-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.80 Bodemprofiel: 65-1
Traject negatieve kleef : 0.80 tot -5.60 [m]
Traject positieve kleef : -5.60 tot -29.25 [m]

SONDERINGSGEGEVENS GRAFIEK: 65-1

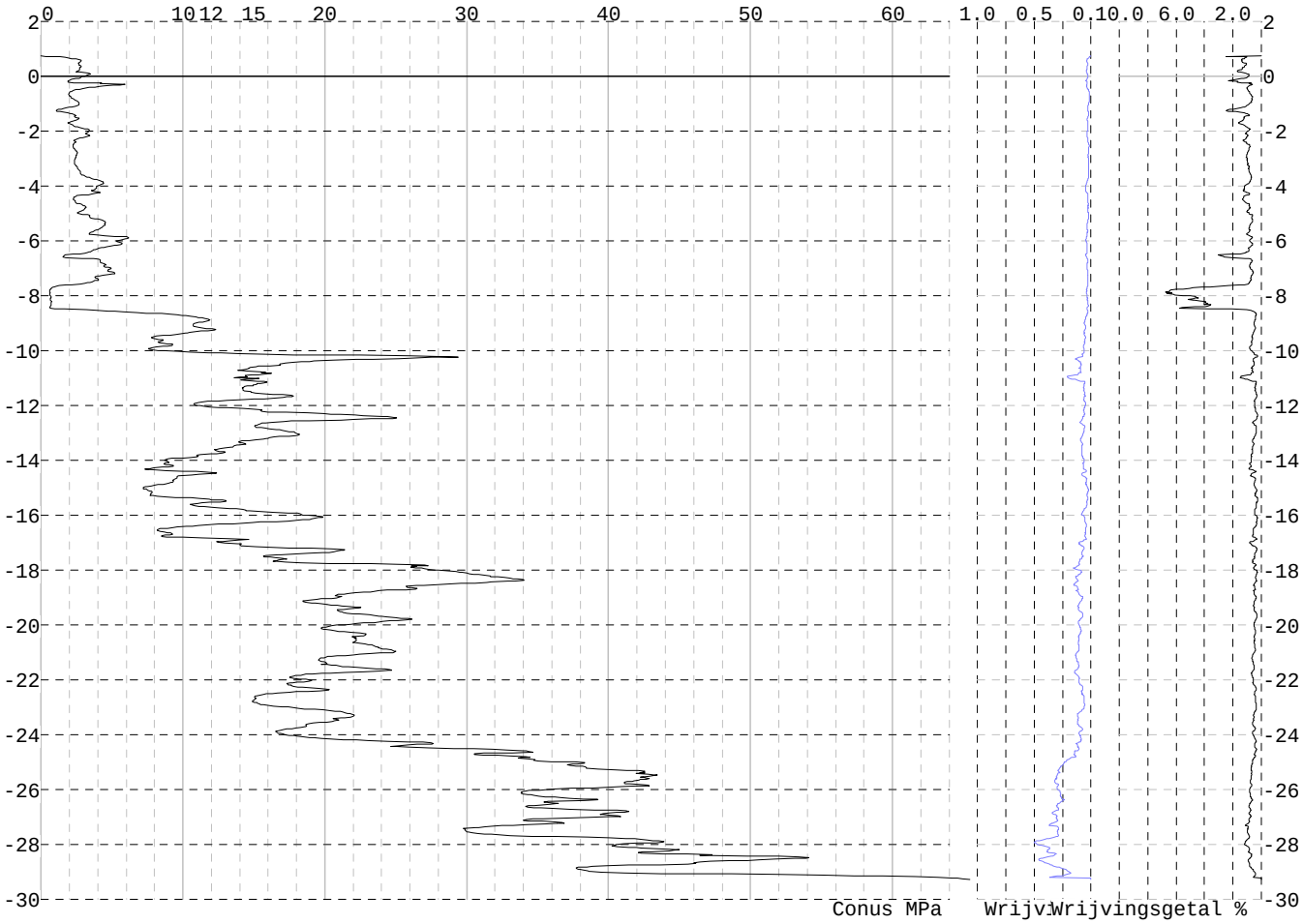


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 65-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.74 Bodemprofiel: 65-1
Traject negatieve kleef : 0.74 tot -6.60 [m]
Traject positieve kleef : -6.60 tot -29.29 [m]

SONDERINGSGEGEVENS GRAFIEK: 65-2

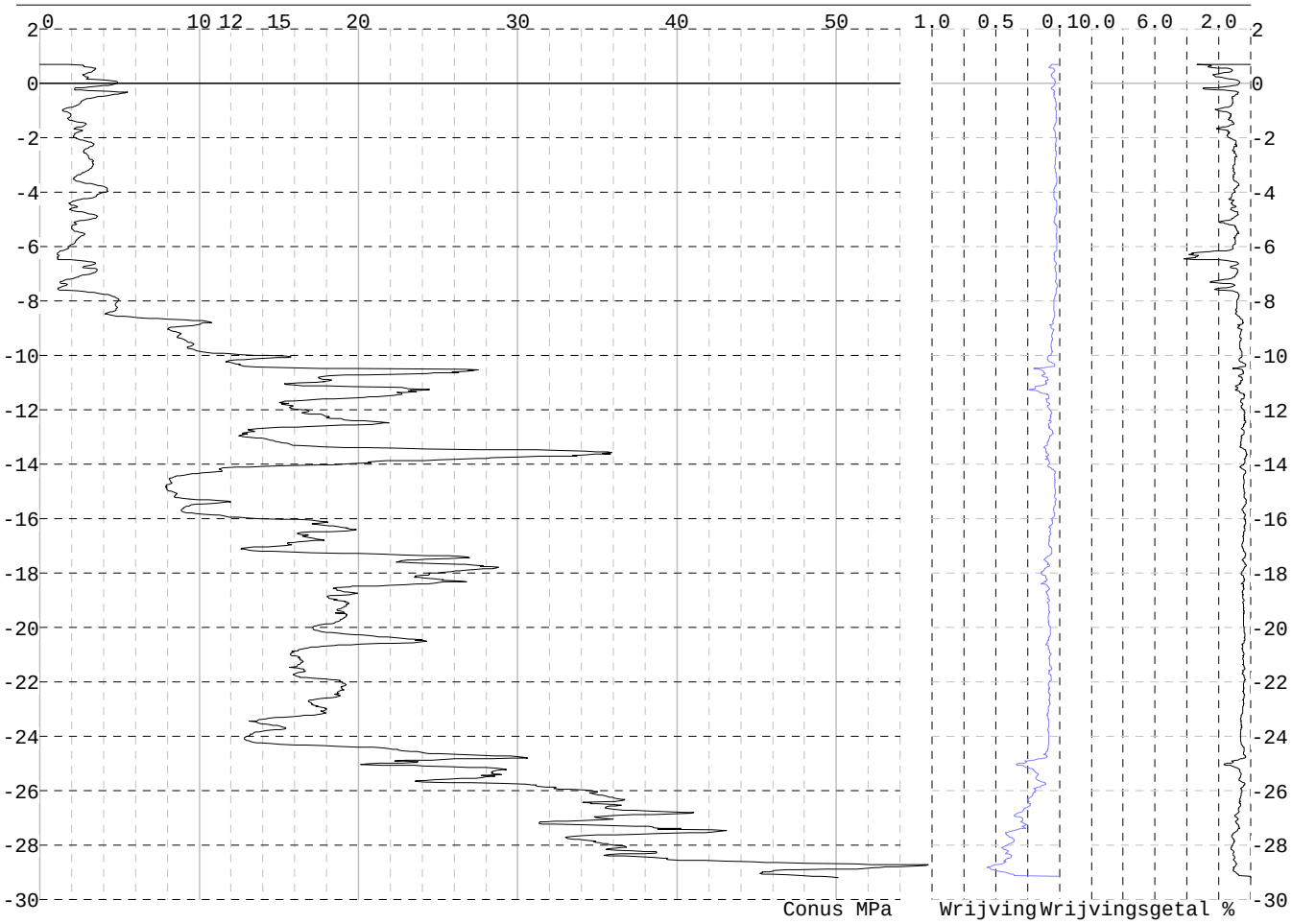


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 65-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.70 Bodemprofiel: 65-4
Traject negatieve kleef : 0.70 tot -6.70 [m]
Traject positieve kleef : -6.70 tot -29.21 [m]

SONDERINGSGEGEVENS GRAFIEK: 65-3

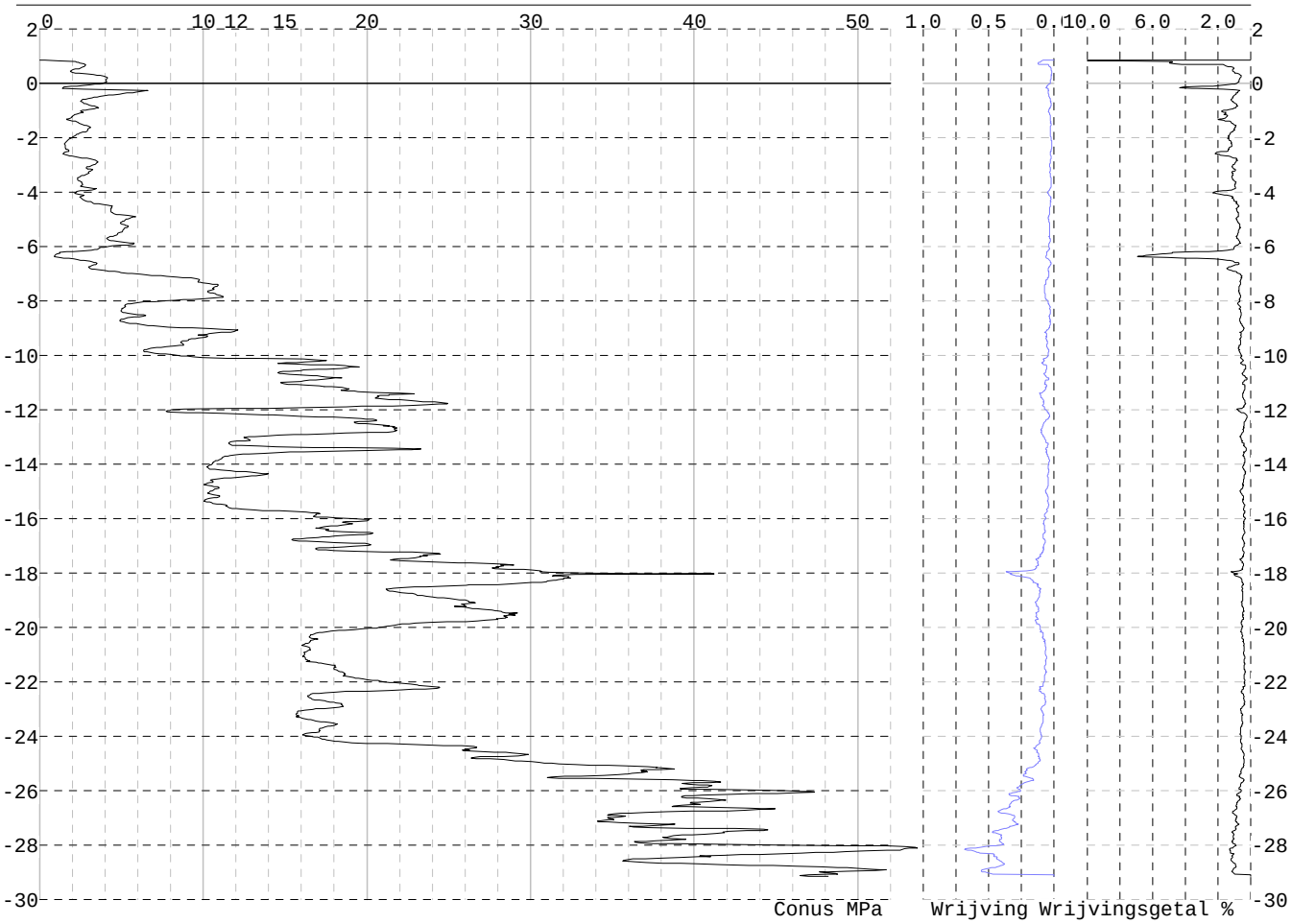


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 65-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.85 Bodemprofiel: 65-4
Traject negatieve kleef : 0.85 tot -6.80 [m]
Traject positieve kleef : -6.80 tot -29.17 [m]

SONDERINGSGEGEVENS GRAFIEK: 65-4

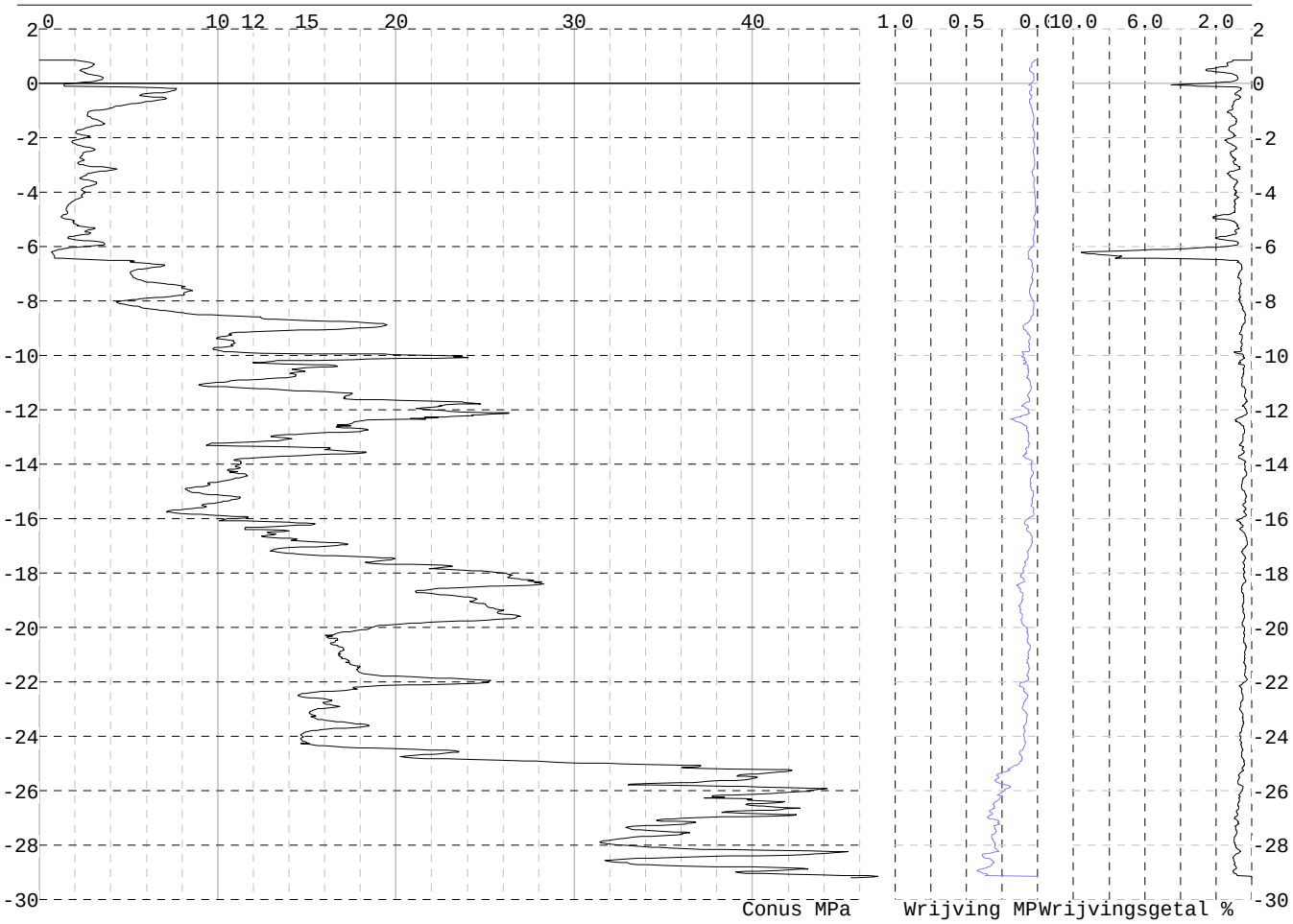


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 65-5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.85 Bodemprofiel: 65-1
Traject negatieve kleef : 0.85 tot -6.60 [m]
Traject positieve kleef : -6.60 tot -29.22 [m]

SONDERINGSGEGEVENS GRAFIEK: 65-5

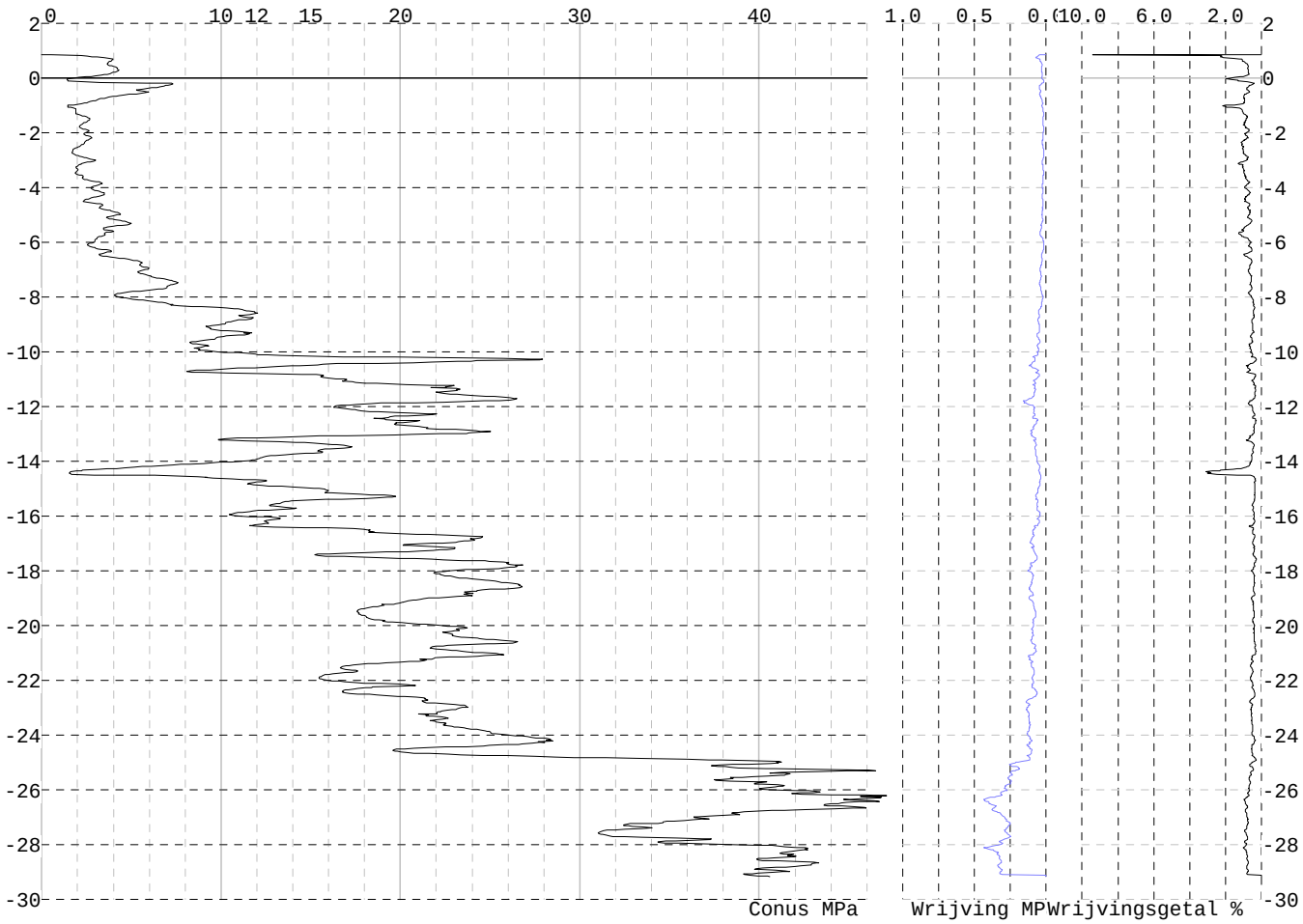


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 65-6A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.85 Bodemprofiel: 65-1
Traject negatieve kleef : 0.85 tot -4.40 [m]
Traject positieve kleef : -4.40 tot -29.19 [m]

SONDERINGSGEGEVENS GRAFIEK: 65-6A

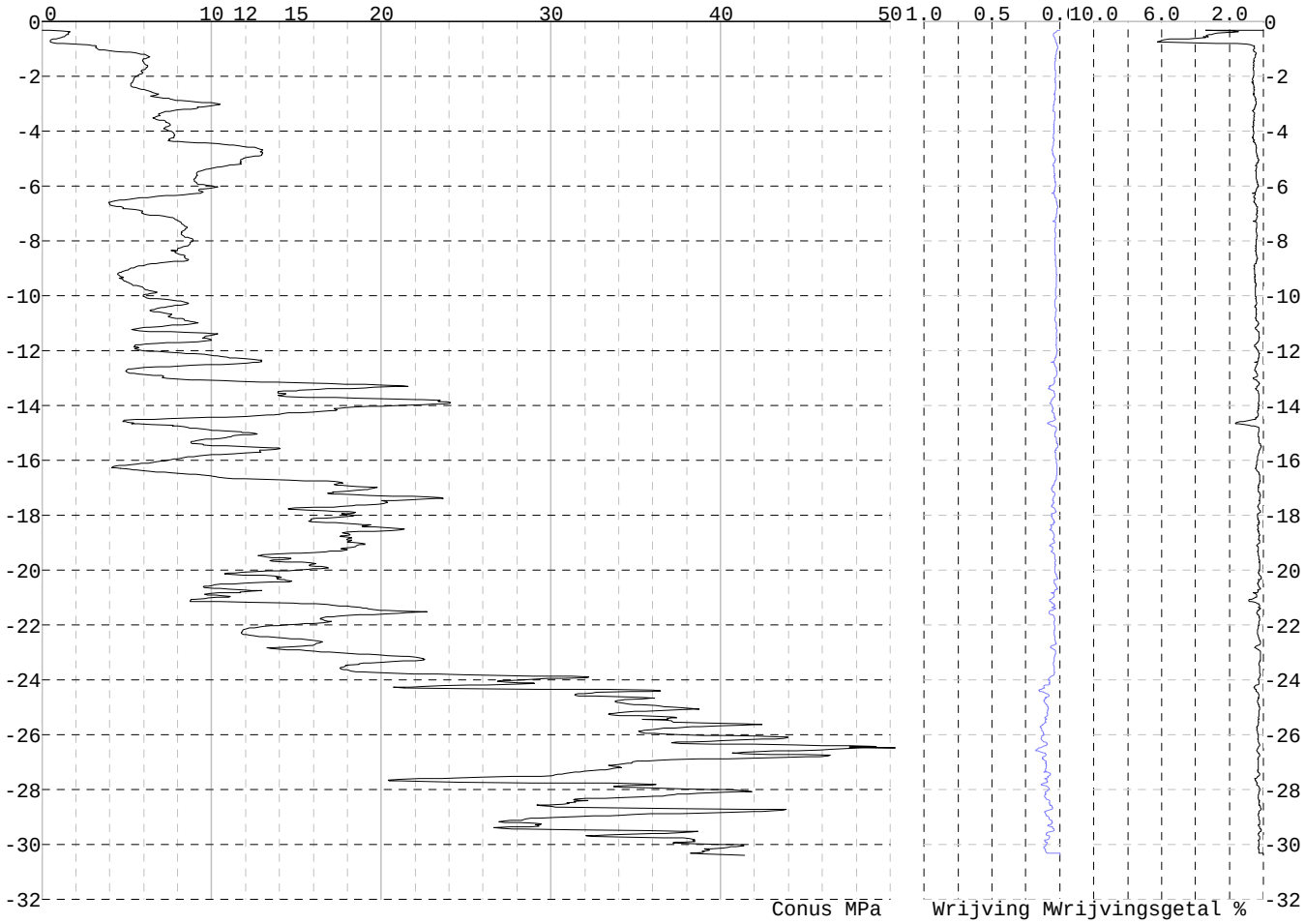


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 67-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.32 Bodemprofiel: 67-1
Traject negatieve kleef : -0.32 tot -1.40 [m]
Traject positieve kleef : -1.40 tot -30.40 [m]

SONDERINGSGEGEVENS GRAFIEK: 67-1

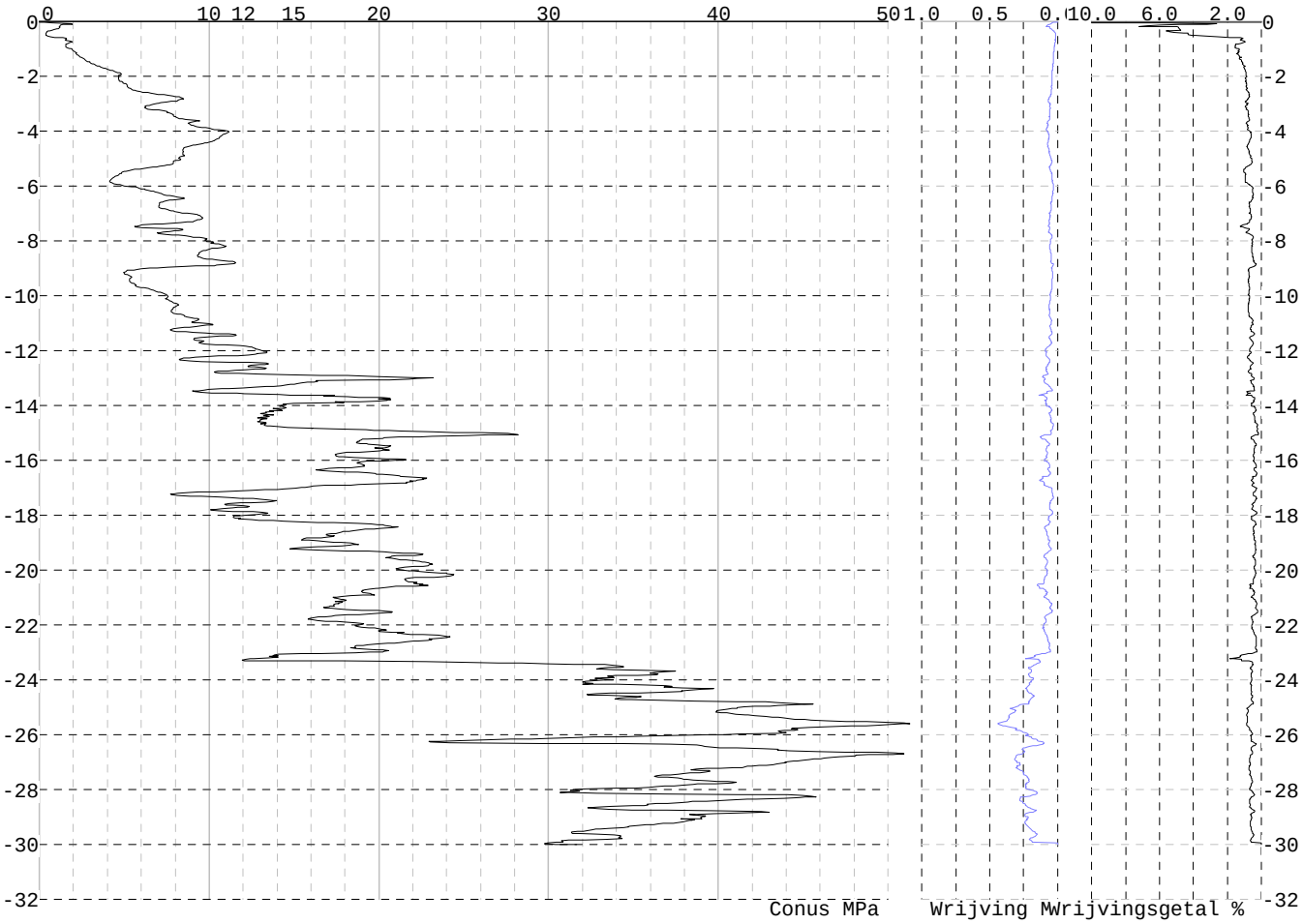


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 67-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.03 Bodemprofiel: 67-1
Traject negatieve kleef : -0.03 tot -2.40 [m]
Traject positieve kleef : -2.40 tot -30.02 [m]

SONDERINGSGEGEVENS GRAFIEK: 67-2

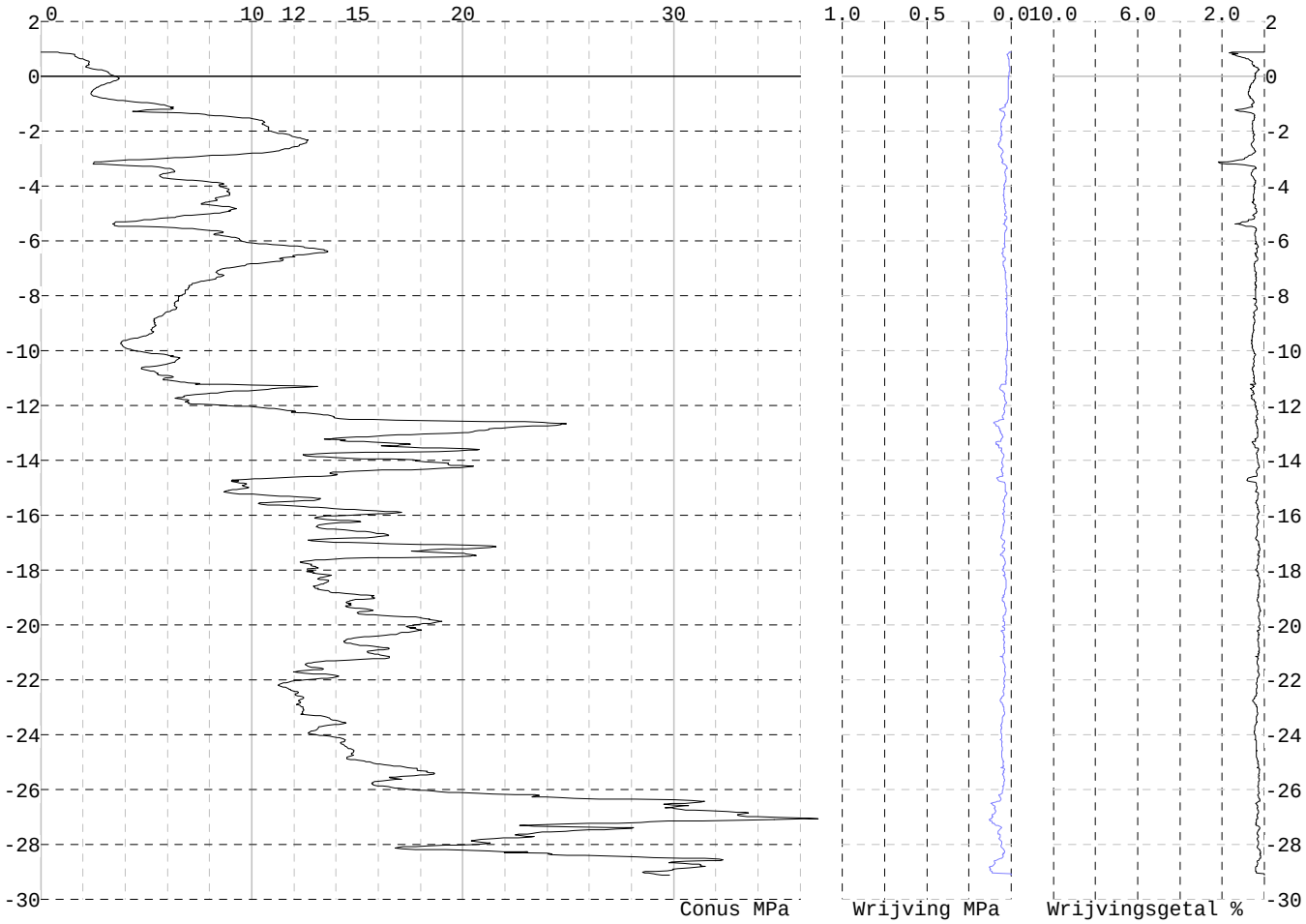


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 68-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.88 Bodemprofiel: 68-2
Traject negatieve kleef : 0.88 tot -5.50 [m]
Traject positieve kleef : -5.50 tot -29.15 [m]

SONDERINGSGEGEVENS GRAFIEK: 68-1

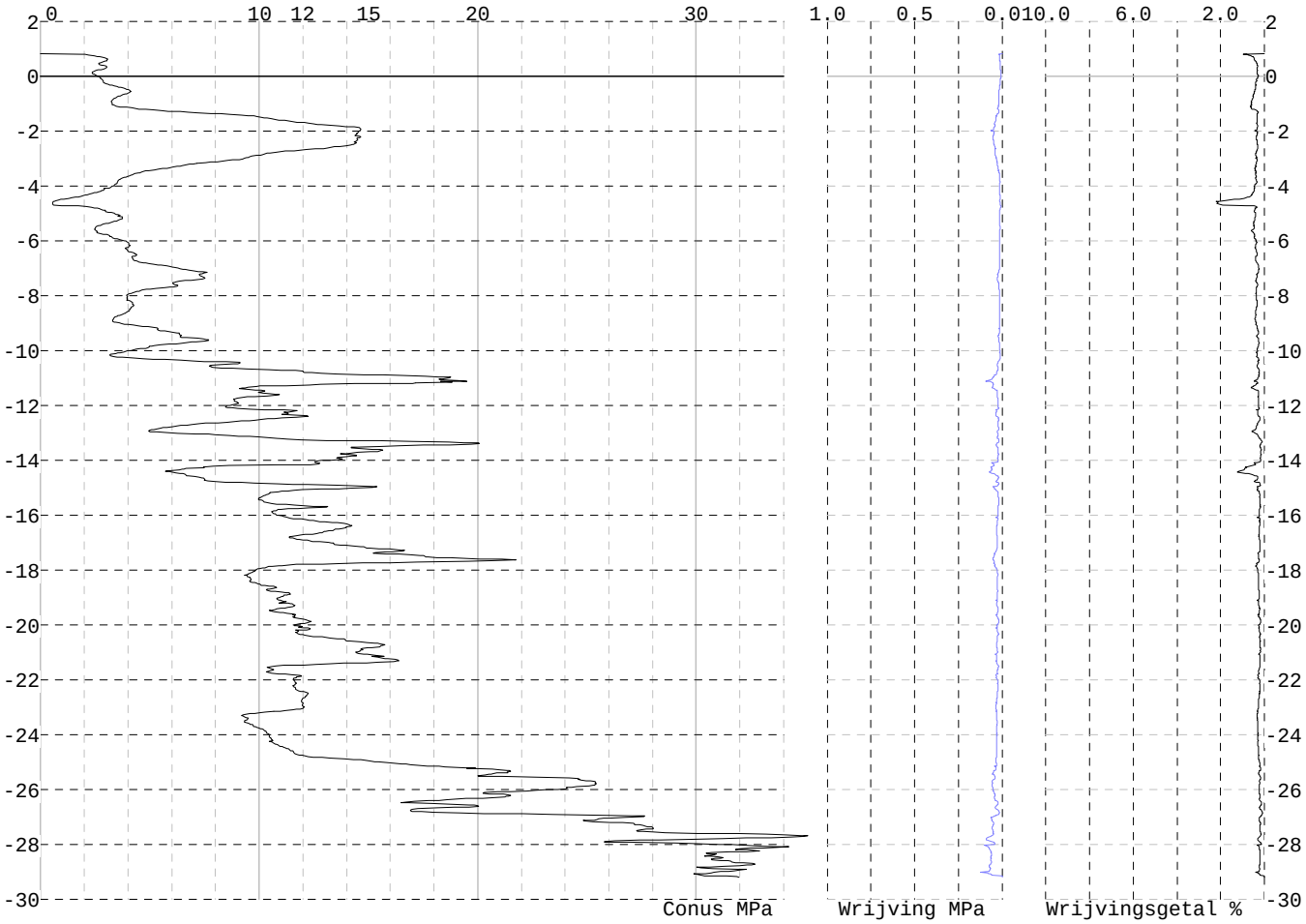


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 68-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.82 Bodemprofiel: 68-2
Traject negatieve kleef : 0.82 tot -4.80 [m]
Traject positieve kleef : -4.80 tot -29.21 [m]

SONDERINGSGEGEVENS GRAFIEK: 68-2



REKENGEGEVENS Mast 60

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 60-1, 60-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.71
Paalpuntniveau : N.A.P. -11.69
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 60 (n=1)

Project :
Onderdeel :

Sondering : 60-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.69	-11.69	40.6	457.8	457.8	0.0	0.00

Sondering : 60-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.69	-11.69	40.8	444.0	444.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 60 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
60-1	-0.17	-11.69	457.8	457.8	457.8
60-2	-0.27	-11.69	444.0	444.0	444.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 60 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
60-1	-0.17	-11.69	40.6	479.9
60-2	-0.27	-11.69	40.6	465.3
		-11.69	$R_{t;cal;gem}$	472.6
met ξ_4(min) = 1.32				
60-1	-0.17	-11.69	40.6	479.9
60-2	-0.27	-11.69	40.6	465.3
		-11.69	$R_{t;cal;min}$	465.3

Totaal resultaten Mast 60 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
60-1 60-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-11.69 $R_{t;d}$ = min.{ 472.6; 465.3}= 465.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-11.69	465.3	465.3	0.0	465.3	0.00

REKENGEGEVENS Mast 61

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 61-1, 61-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.74
Paalpuntniveau : N.A.P. -12.61
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 61 (n=1)

Project :
Onderdeel :

Sondering : 61-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.61	-12.61	44.0	395.0	395.0	0.0	0.00

Sondering : 61-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.61	-12.61	44.0	503.5	503.5	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 61 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
61-1	-0.40	-12.61	395.0	395.0	395.0
61-2	-0.40	-12.61	503.5	503.5	503.5

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 61 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
61-1	-0.40	-12.61	44.0	413.6
61-2	-0.40	-12.61	44.0	527.9
		-12.61	$R_{t;cal;gem}$	470.8
met ξ_4(min) = 1.32				
61-1	-0.40	-12.61	44.0	413.6
61-2	-0.40	-12.61	44.0	527.9
		-12.61	$R_{t;cal;min}$	413.6

Totaal resultaten Mast 61 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
61-1 61-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-12.61	$R_{t;d}$ = min.{ 470.8; 413.6}= 413.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.61	413.6	413.6	0.0	413.6	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-12.61	2	470.78	17.2

Project :
Onderdeel :

REKENGEGEVENS Mast 62

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 62-1, 62-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.96
Paalpuntniveau : N.A.P. -12.04
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 62 (n=1)

Sondering : 62-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.04	-12.04	42.6	485.3	485.3	0.0	0.00

Sondering : 62-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.04	-12.04	42.9	432.6	432.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 62 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
62-1	-0.03	-12.04	485.3	485.3	485.3
62-2	-0.15	-12.04	432.6	432.6	432.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 62 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
62-1	-0.03	-12.04	42.6	508.7
62-2	-0.15	-12.04	42.6	453.3
		-12.04	$R_{t;cal;gem}$	481.0
met ξ_4(min) = 1.32				
62-1	-0.03	-12.04	42.6	508.7
62-2	-0.15	-12.04	42.6	453.3
		-12.04	$R_{t;cal;min}$	453.3

Totaal resultaten Mast 62 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
62-1 62-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-12.04	$R_{t;d}$ = min.{ 481.0; 453.3}= 453.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.04	453.3	453.3	0.0	453.3	0.00

REKENGEGEVENS Mast 63

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 63-1, 63-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.78
Paalpuntniveau : N.A.P. -11.57
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 63 (n=1)

Project :
Onderdeel :

Sondering : 63-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.57	-11.57	40.9	451.8	451.8	0.0	0.00

Sondering : 63-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.57	-11.57	41.1	451.7	451.7	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 63 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
63-1	-0.27	-11.57	451.8	451.8	451.8
63-2	-0.36	-11.57	451.7	451.7	451.7

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 63 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
63-1	-0.27	-11.57	40.9	473.6
63-2	-0.36	-11.57	40.9	473.5
		-11.57	$R_{t;cal;gem}$	473.6
met ξ_4(min) = 1.32				
63-1	-0.27	-11.57	40.9	473.6
63-2	-0.36	-11.57	40.9	473.5
		-11.57	$R_{t;cal;min}$	473.5

Totaal resultaten Mast 63 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
63-1 63-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-11.57 $R_{t;d}$ = min.{ 473.6; 473.5}= 473.5

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-11.57	473.5	473.5	0.0	473.5	0.00

REKENGEGEVENS Mast 64

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 64-1, 64-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 1.67
Paalpuntniveau : N.A.P. -12.78
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 64 (n=1)

Project :
Onderdeel :

Sondering : 64-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.78	-12.78	48.6	519.2	519.2	0.0	0.00

Sondering : 64-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.78	-12.78	49.3	410.8	410.8	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 64 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
64-1	-0.06	-12.78	519.2	519.2	519.2
64-2	-0.36	-12.78	410.8	410.8	410.8

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 64 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
64-1	-0.06	-12.78	48.6	544.1
64-2	-0.36	-12.78	48.6	430.0
		-12.78	$R_{t;cal;gem}$	487.0
met ξ_4(min) = 1.32				
64-1	-0.06	-12.78	48.6	544.1
64-2	-0.36	-12.78	48.6	430.0
		-12.78	$R_{t;cal;min}$	430.0

Totaal resultaten Mast 64 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
64-1 64-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-12.78	$R_{t;d}$ = min.{ 487.0; 430.0}= 430.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.78	430.0	430.0	0.0	430.0	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-12.78	2	487.05	16.6

Project :
Onderdeel :

REKENGEGEVENS Mast 65

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 65-1, 65-2, 65-3, 65-4, 65-5, 65-6A
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 6
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.27
Factor $\xi_{4\ (min)}$: 1.01
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 2.63
Paalpuntniveau : N.A.P. -18.87
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 65 (n=1)

Sondering : 65-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.87	-18.87	256.3	2478.7	2478.7	0.0	0.00

Sondering : 65-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.87	-18.87	256.3	2484.1	2484.1	0.0	0.00

Sondering : 65-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.87	-18.87	255.9	2522.2	2522.2	0.0	0.00

Sondering : 65-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.87	-18.87	255.9	2649.9	2649.9	0.0	0.00

Sondering : 65-5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.87	-18.87	256.3	2600.3	2600.3	0.0	0.00

Sondering : 65-6A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.87	-18.87	256.3	2649.8	2649.8	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 65 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
65-1	0.80	-18.87	2478.7	2478.7	2478.7
65-2	0.74	-18.87	2484.1	2484.1	2484.1
65-3	0.70	-18.87	2522.2	2522.2	2522.2
65-4	0.85	-18.87	2649.9	2649.9	2649.9
65-5	0.85	-18.87	2600.3	2600.3	2600.3
65-6A	0.85	-18.87	2649.8	2649.8	2649.8

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 65 (van 6 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=6)}$: 1.27
Correlatiefactor $\xi_{4min(n=6)}$: 1.01

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.27				
65-1	0.80	-18.87	256.3	2688.7
65-2	0.74	-18.87	256.3	2694.6
65-3	0.70	-18.87	256.3	2736.4
65-4	0.85	-18.87	256.3	2876.1
65-5	0.85	-18.87	256.3	2821.8
65-6A	0.85	-18.87	256.3	2876.0
		-18.87	$R_{t;cal;gem}$	2782.2
met ξ_4(min) = 1.01				
65-1	0.80	-18.87	256.3	3314.9
65-2	0.74	-18.87	256.3	3322.2
65-3	0.70	-18.87	256.3	3374.9
65-4	0.85	-18.87	256.3	3550.6
65-5	0.85	-18.87	256.3	3482.2
65-6A	0.85	-18.87	256.3	3550.4
		-18.87	$R_{t;cal;min}$	3314.9

Totaal resultaten Mast 65 (van 6 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 6) : 1.27
Correlatiefactor ξ_{4min} (n= 6) : 1.01

gebaseerd op sonderingen:
65-1 65-2 65-3 65-4 65-5 65-6A

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]: -18.87 $R_{t;d}$ = min.{ 2782.2; 3314.9}= 2782.2

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.87	2782.2	2782.2	0.0	2782.2	0.00

Project :
Onderdeel :

REKENGEGEVENS Mast 67

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 67-1, 67-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 1.72
Paalpuntniveau : N.A.P. -13.98
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 67 (n=1)

Sondering : 67-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.98	-13.98	53.0	500.8	500.8	0.0	0.00

Sondering : 67-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.98	-13.98	53.0	512.7	512.7	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 67 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
67-1	-0.32	-13.98	500.8	500.8	500.8
67-2	-0.03	-13.98	512.7	512.7	512.7

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 67 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
67-1	-0.32	-13.98	53.0	524.6
67-2	-0.03	-13.98	53.0	537.1
		-13.98	$R_{t;cal;gem}$	530.8
met ξ_4(min) = 1.32				
67-1	-0.32	-13.98	53.0	524.6
67-2	-0.03	-13.98	53.0	537.1
		-13.98	$R_{t;cal;min}$	524.6

Totaal resultaten Mast 67 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
67-1 67-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-13.98	$R_{t;d}$ = min.{ 530.8; 524.6}= 524.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.98	524.6	524.6	0.0	524.6	0.00

REKENGEGEVENS Mast 68

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 68-1, 68-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 1.28
Paalpuntniveau : N.A.P. -13.52
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 68 (n=1)

Project :
Onderdeel :

Sondering : 68-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.52	-13.52	46.5	578.2	578.2	0.0	0.00

Sondering : 68-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-13.52	-13.52	46.5	445.0	445.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 68 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
68-1	0.88	-13.52	578.2	578.2	578.2
68-2	0.82	-13.52	445.0	445.0	445.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 68 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
68-1	0.88	-13.52	46.5	606.4
68-2	0.82	-13.52	46.5	466.1
		-13.52	$R_{t;cal;gem}$	536.2
met ξ_4(min) = 1.32				
68-1	0.88	-13.52	46.5	606.4
68-2	0.82	-13.52	46.5	466.1
		-13.52	$R_{t;cal;min}$	466.1

Totaal resultaten Mast 68 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
68-1 68-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-13.52 $R_{t;d}$ = min.{ 536.2; 466.1}= 466.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-13.52	466.1	466.1	0.0	466.1	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-13.52	2	536.25	18.5

Project :
Onderdeel :

PAALGEGEVENS BP 559x10

Type	: Stalen buispaal (gesloten)
Wijze van installeren	: Heien
Diameter [m]	: 0.559
Elasticiteitsmodulus [N/mm²]	: 20000
Factor α_s (tabel 7.c EC 7.1)	: 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	: 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	: 1.00
Paalvoetvormfactor β	: 1.00
Type lastzakkingsdiagram	: Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	: 0.75
Groutomhulling	: NEE

PAALGEGEVENS GI 914_1075

Type	: Stalen profiel (geheid, grout)
Wijze van installeren	: Heien
Diameter [m]	: 1.075
Elasticiteitsmodulus [N/mm²]	: 20000
Factor α_s (tabel 7.c EC 7.1)	: 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1)	: 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p	: 1.00
Paalvoetvormfactor β	: 1.00
Type lastzakkingsdiagram	: Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$	: 0.75
Groutomhulling	: JA

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 60	Mast 61	Mast 62	Mast 63	Mast 64
60-1	-0.17	-11.69	457				
60-2	-0.27	-11.69	443				
61-1	-0.40	-12.61		395			
61-2	-0.40	-12.61		503			
62-1	-0.03	-12.04			485		
62-2	-0.15	-12.04			432		
63-1	-0.27	-11.57				451	
63-2	-0.36	-11.57				451	
64-1	-0.06	-12.78					519
64-2	-0.36	-12.78					410

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{t;netto;d}$ [kN]		
sondering	niveau	niveau	Mast 65	Mast 67	Mast 68
65-1	0.80	-18.87	2478		
65-2	0.74	-18.87	2484		
65-3	0.70	-18.87	2522		
65-4	0.85	-18.87	2649		
65-5	0.85	-18.87	2600		
65-6A	0.85	-18.87	2649		
67-1	-0.32	-13.98		500	
67-2	-0.03	-13.98		512	
68-1	0.88	-13.52			578
68-2	0.82	-13.52			444

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 70-79 (71 72 73 79).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Leem - Sterk zandig	19.00	19.00	27.50	20.00	20.00	35.00
10	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
11	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
12	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
13	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
14	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
15	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
16	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: 72-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.19 Grondwaterstand [m] : -1.19

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.19	-1.28	Klei - Schoon - Matig	1.0	50.0		
2	-1.28	-7.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-7.21	-8.67	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-8.67	-9.25	Zand - Schoon - Los	1.0	100.0		
5	-9.25	-9.89	Leem - Zwak zandig - Vast	1.0	50.0		
6	-9.89	-16.77	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-16.77	-23.10	Zand - Schoon - Matig	1.0	100.0		
8	-23.10	-24.10	Zand - Schoon - Los	1.0	100.0		
9	-24.10	-25.04	Zand - Schoon - Matig	1.0	100.0		
10	-25.04	-26.00	Klei - Schoon - Vast	1.0	50.0		
11	-26.00	-30.20	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 72-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.32 Grondwaterstand [m] : -1.32

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.32	-1.45	Klei - Schoon - Matig	1.0	50.0		
2	-1.45	-7.65	Zand - Schoon - Los	1.0	100.0		
3	-7.65	-12.96	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-12.96	-14.04	Zand - Schoon - Los	1.0	100.0		
5	-14.04	-21.09	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-21.09	-22.09	Zand - Schoon - Los	1.0	100.0		
7	-22.09	-23.20	Zand - Schoon - Matig	1.0	100.0		
8	-23.20	-23.46	Leem - Sterk zandig	1.0	50.0		
9	-23.46	-30.39	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 73-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.25 Grondwaterstand [m] : -1.25

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.25	-1.76	Klei - Schoon - Matig	1.0	50.0		
2	-1.76	-3.00	Zand - Schoon - Los	1.0	100.0		
3	-3.00	-9.47	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-9.47	-13.72	Zand - Schoon - Los	1.0	100.0		
5	-13.72	-14.00	Klei - Schoon - Matig	1.0	50.0		
6	-14.00	-15.80	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-15.80	-16.54	Zand - Schoon - Matig	1.0	100.0		
8	-16.54	-17.06	Klei - Schoon - Vast	1.0	50.0		
9	-17.06	-24.05	Zand - Schoon - Matig	1.0	100.0		
10	-24.05	-27.51	Zand - Schoon - Vast	1.0	100.0		
11	-27.51	-30.17	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 73-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.23 Grondwaterstand [m] : -1.23

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.23	-0.78	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.78	-2.26	Klei - Organisch - Matig	1.0	50.0		
3	-2.26	-13.23	Zand - Schoon - Los	1.0	100.0		
4	-13.23	-13.67	Zand - Schoon - Vast	1.0	100.0		
5	-13.67	-15.73	Zand - Schoon - Los	1.0	100.0		
6	-15.73	-20.36	Zand - Schoon - Matig	1.0	100.0		
7	-20.36	-22.35	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-22.35	-23.74	Zand - Schoon - Vast	1.0	100.0		
9	-23.74	-24.63	Zand - Schoon - Los	1.0	100.0		
10	-24.63	-30.18	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 73-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.23 Grondwaterstand [m] : -1.23

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.23	-0.64	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.64	-2.12	Klei - Schoon - Matig	1.0	50.0		
3	-2.12	-6.40	Zand - Schoon - Los	1.0	100.0		
4	-6.40	-8.10	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-8.10	-8.58	Zand - Schoon - Matig	1.0	100.0		
6	-8.58	-10.95	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-10.95	-12.51	Zand - Schoon - Matig	1.0	100.0		
8	-12.51	-13.35	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-13.35	-13.99	Zand - Schoon - Los	1.0	100.0		
10	-13.99	-14.61	Leem - Zwak zandig - Vast	1.0	50.0		
11	-14.61	-17.01	Zand - Schoon - Los	1.0	100.0		
12	-17.01	-18.25	Zand - Schoon - Matig	1.0	100.0		
13	-18.25	-20.39	Zand - Zwak siltig - Kleiig	1.0	100.0		
14	-20.39	-21.95	Zand - Schoon - Los	1.0	100.0		
15	-21.95	-25.50	Zand - Zwak siltig - Kleiig	1.0	100.0		
16	-25.50	-28.58	Zand - Schoon - Matig	1.0	100.0		
17	-28.58	-30.34	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 79-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.30 Grondwaterstand [m] : -1.30

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.30	-1.20	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.20	-1.91	Zand - Schoon - Los	1.0	100.0		
3	-1.91	-2.89	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-2.89	-9.91	Zand - Schoon - Los	1.0	100.0		
5	-9.91	-10.97	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-10.97	-17.29	Zand - Schoon - Los	1.0	100.0		
7	-17.29	-19.12	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-19.12	-20.08	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
9	-20.08	-20.75	Zand - Schoon - Los	1.0	100.0		
10	-20.75	-21.45	Leem - Zwak zandig - Vast	1.0	50.0		
11	-21.45	-23.49	Zand - Schoon - Vast	1.0	100.0		
12	-23.49	-24.26	Zand - Schoon - Los	1.0	100.0		
13	-24.26	-24.40	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-24.40	-30.44	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 71-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.27 Grondwaterstand [m] : -2.27

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.27	-2.21	Klei - Organisch - Matig	1.0	50.0		
2	-2.21	-2.33	Veen - Matig voorbelast - Matig	1.0	0.0		
3	-2.33	-2.63	Klei - Organisch - Matig	1.0	50.0		
4	-2.63	-2.75	Klei - Zwak zandig - Vast	1.0	50.0		
5	-2.75	-7.09	Zand - Schoon - Matig	1.0	100.0		
6	-7.09	-31.27	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 71-1A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.29 Grondwaterstand [m] : -2.29

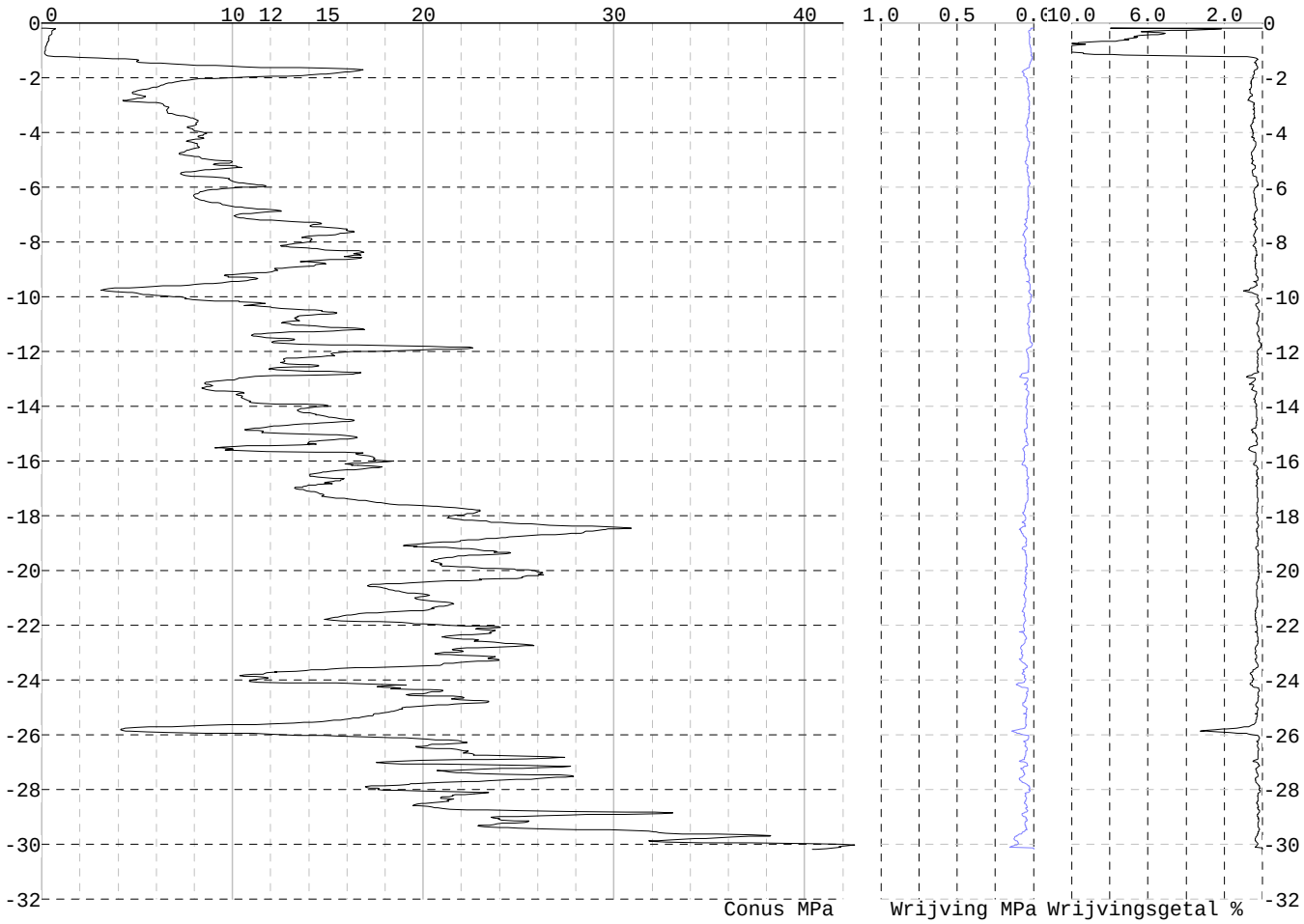
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.29	-2.67	Klei - Organisch - Matig	1.0	50.0		
2	-2.67	-2.79	Klei - Zwak zandig - Vast	1.0	50.0		
3	-2.79	-3.69	Zand - Schoon - Matig	1.0	100.0		
4	-3.69	-6.80	Zand - Schoon - Vast	1.0	100.0		
5	-6.80	-8.36	Zand - Schoon - Matig	1.0	100.0		
6	-8.36	-31.24	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 72-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.19 Bodemprofiel: 72-1
Traject negatieve kleef : -0.19 tot -1.30 [m]
Traject positieve kleef : -1.30 tot -30.21 [m]

Project :
Onderdeel :

SONDERINGSGEGEVENS GRAFIEK: 72-1

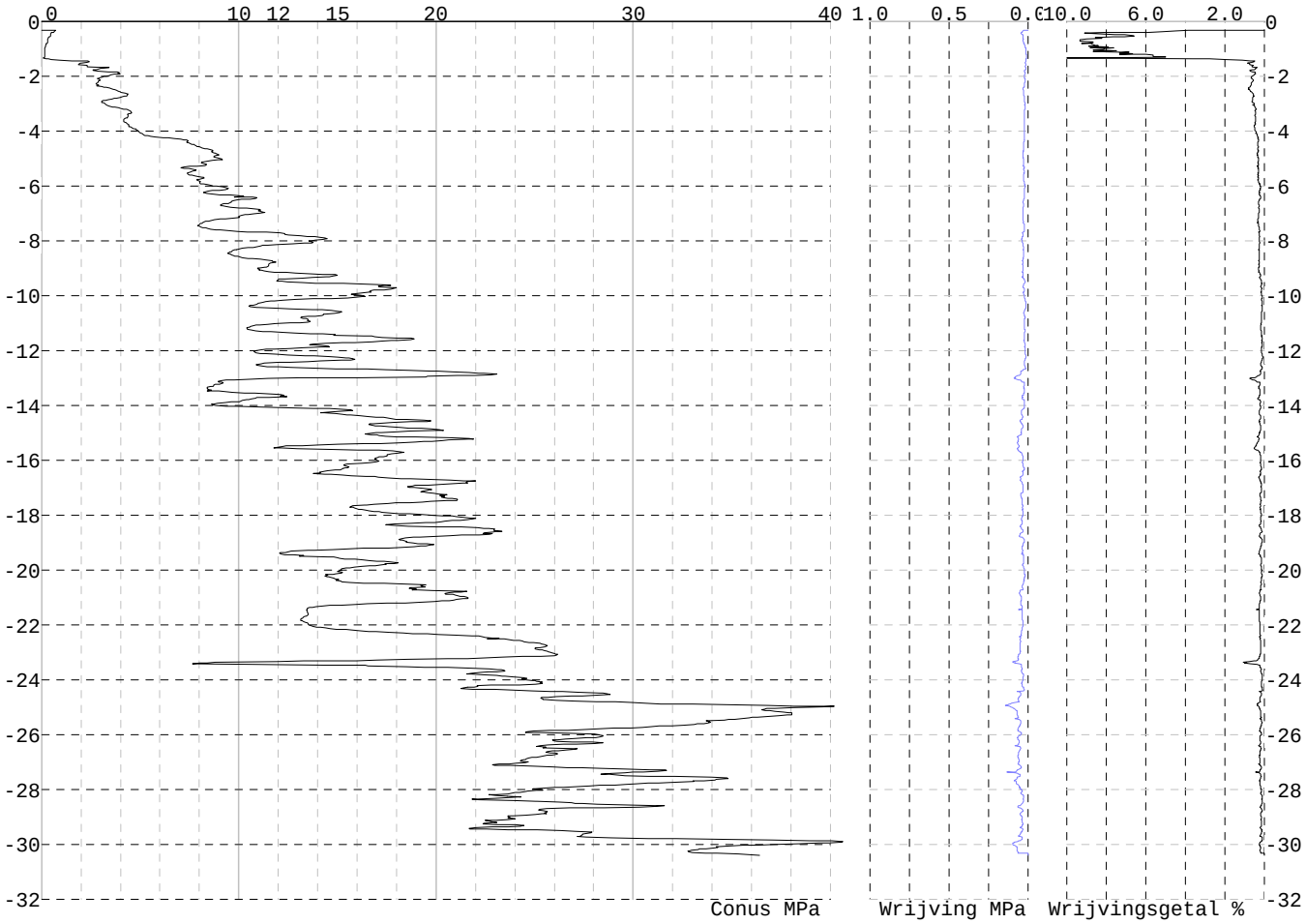


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 72-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.32 Bodemprofiel: 72-2
Traject negatieve kleef : -0.32 tot -1.50 [m]
Traject positieve kleef : -1.50 tot -30.40 [m]

SONDERINGSGEGEVENS GRAFIEK: 72-2

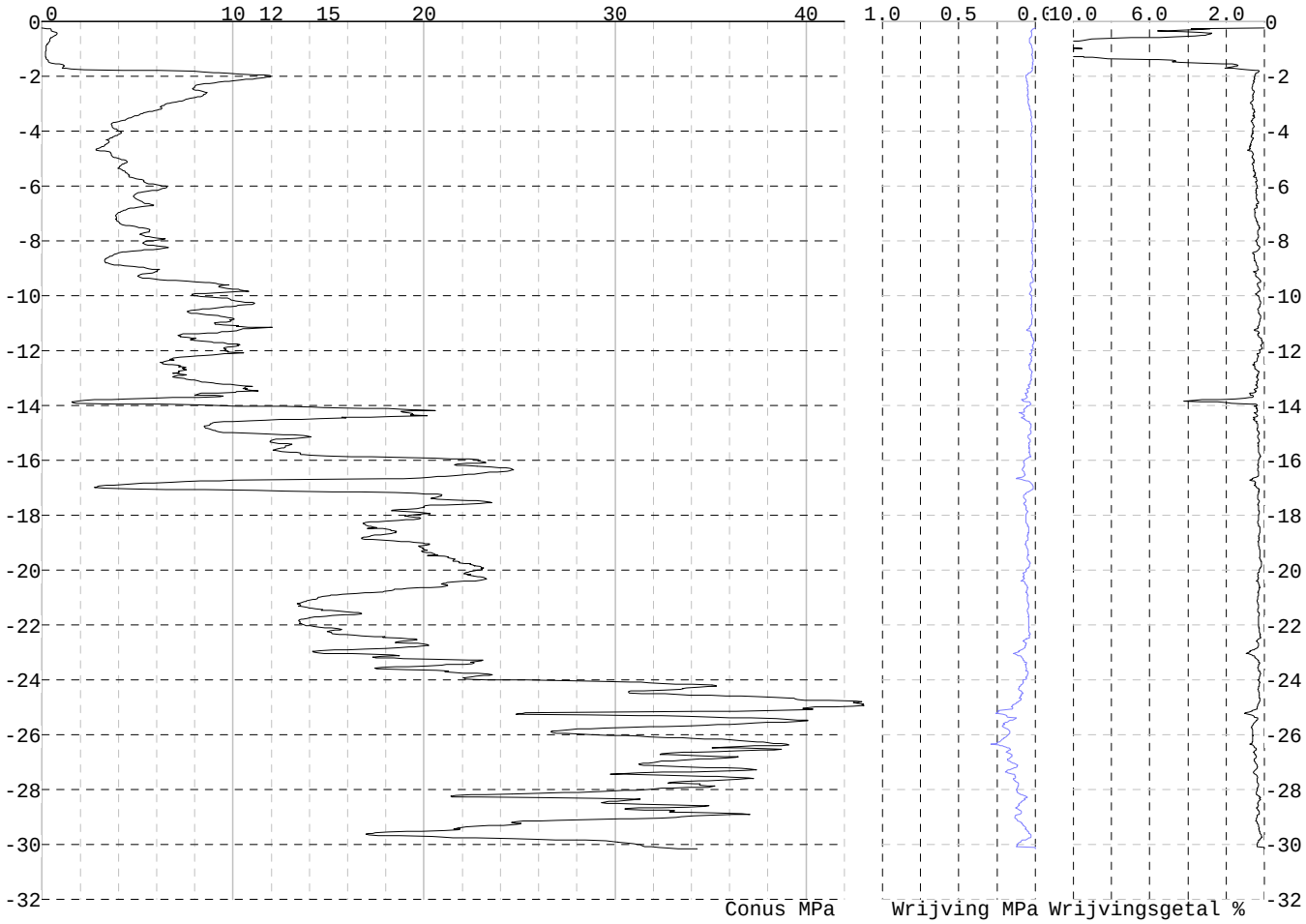


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 73-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.25 Bodemprofiel: 73-1
Traject negatieve kleef : -0.25 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.18 [m]

SONDERINGSGEGEVENS GRAFIEK: 73-1

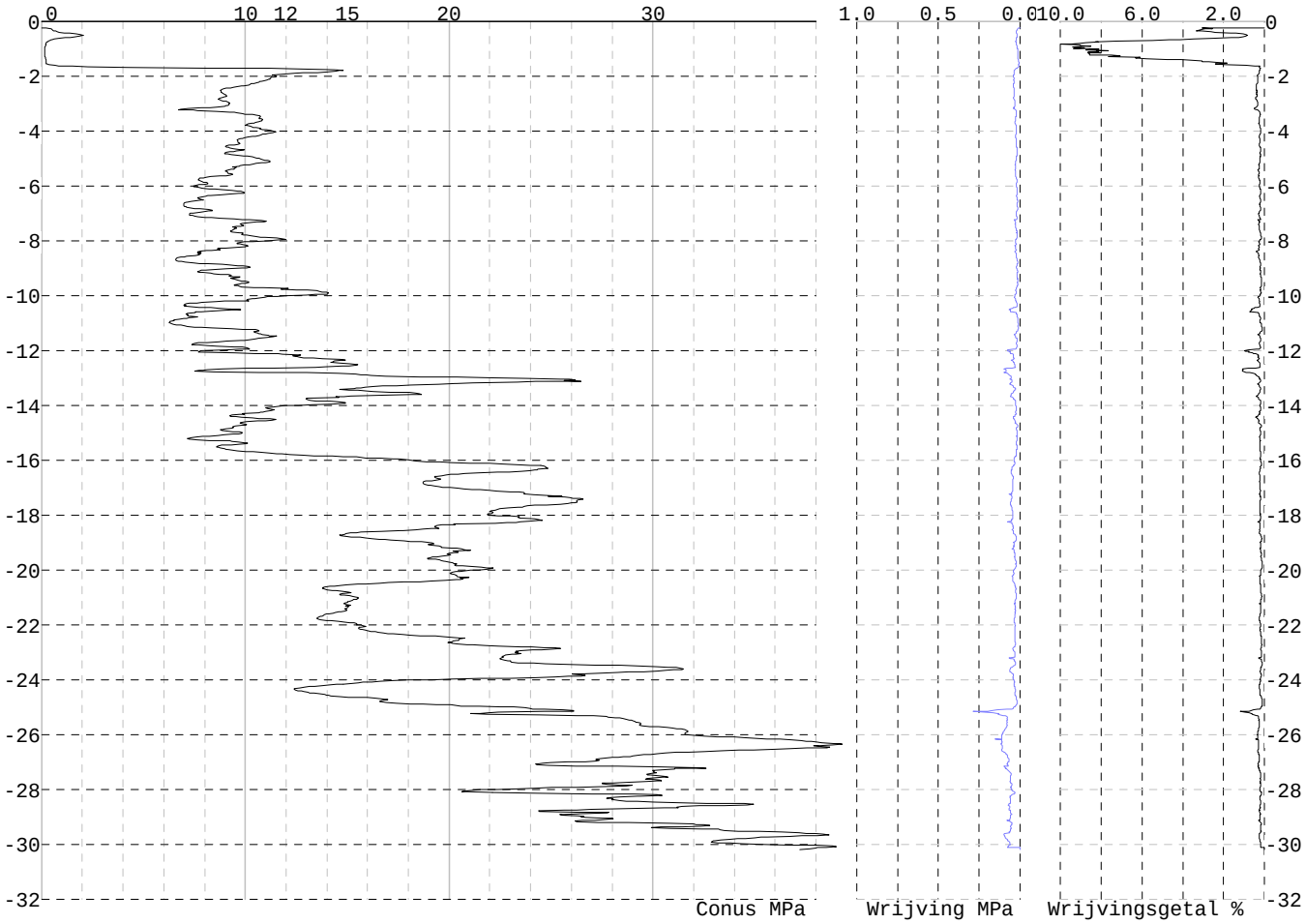


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 73-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.23 Bodemprofiel: 73-2
Traject negatieve kleef : -0.23 tot -1.70 [m]
Traject positieve kleef : -1.70 tot -30.19 [m]

SONDERINGSGEGEVENS GRAFIEK: 73-2

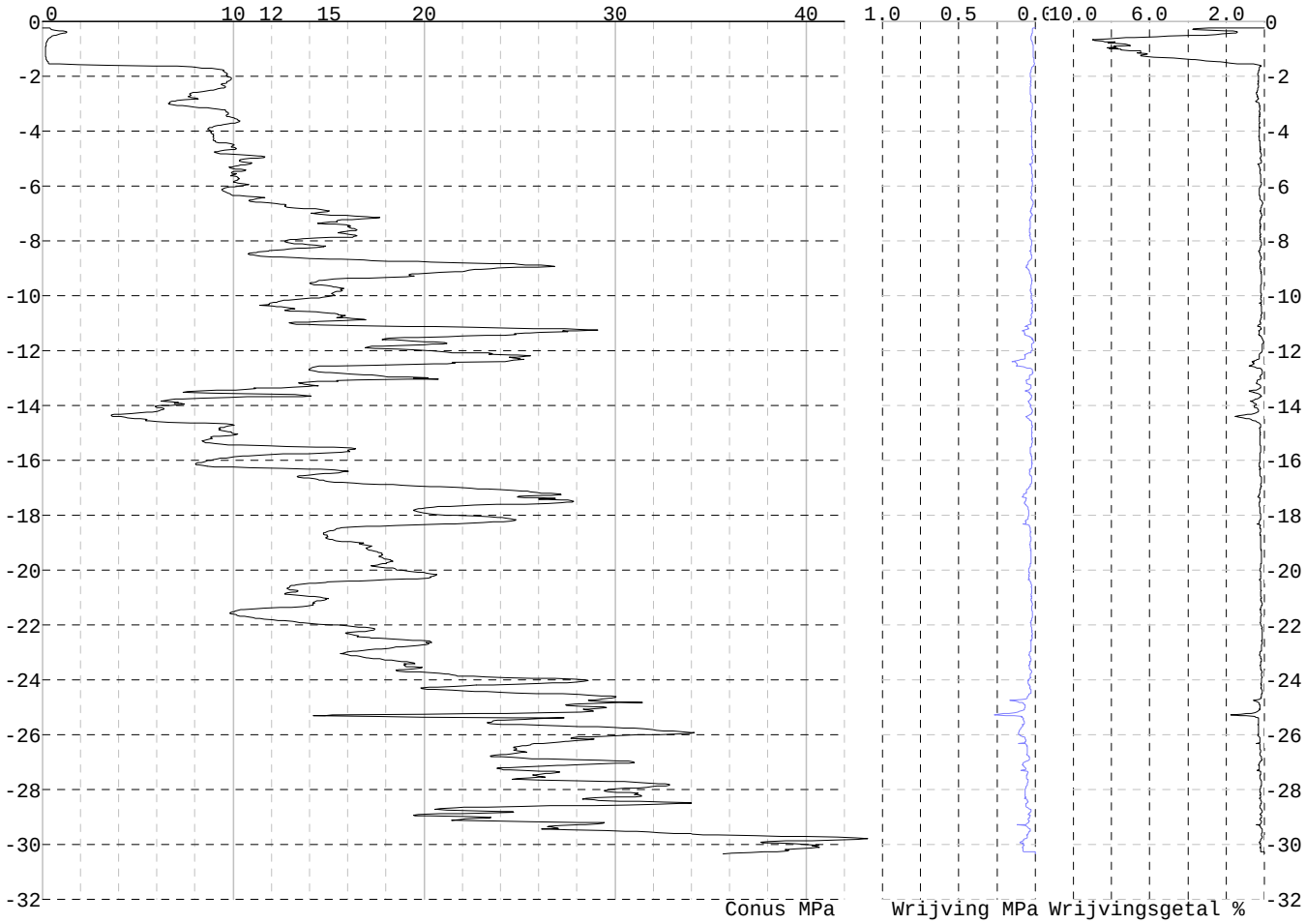


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 73-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.23 Bodemprofiel: 73-3
Traject negatieve kleef : -0.23 tot -1.70 [m]
Traject positieve kleef : -1.70 tot -30.35 [m]

SONDERINGSGEGEVENS GRAFIEK: 73-3

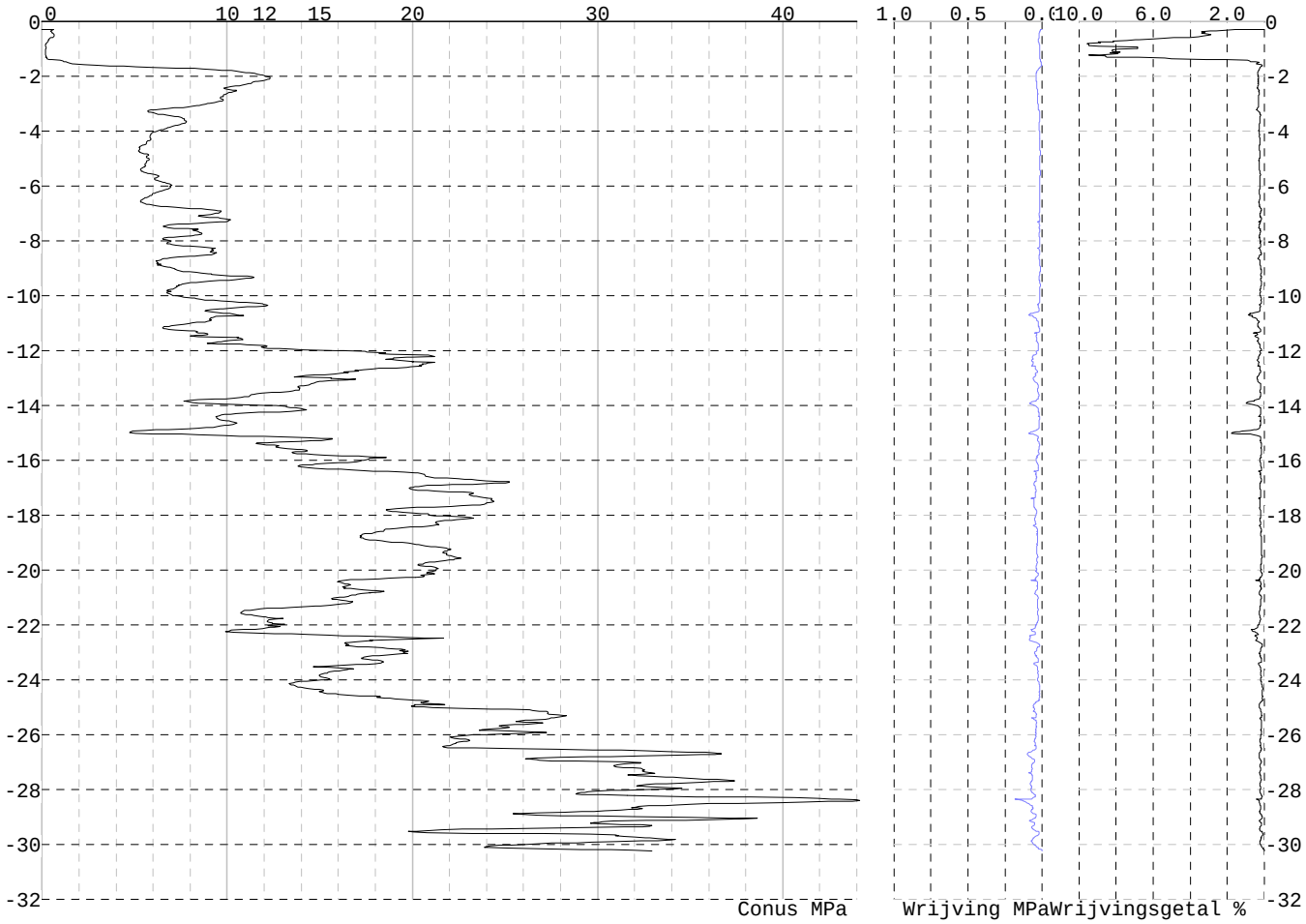


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 73-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.29 Bodemprofiel: 73-1
Traject negatieve kleef : -0.29 tot -1.60 [m]
Traject positieve kleef : -1.60 tot -30.25 [m]

SONDERINGSGEGEVENS GRAFIEK: 73-4

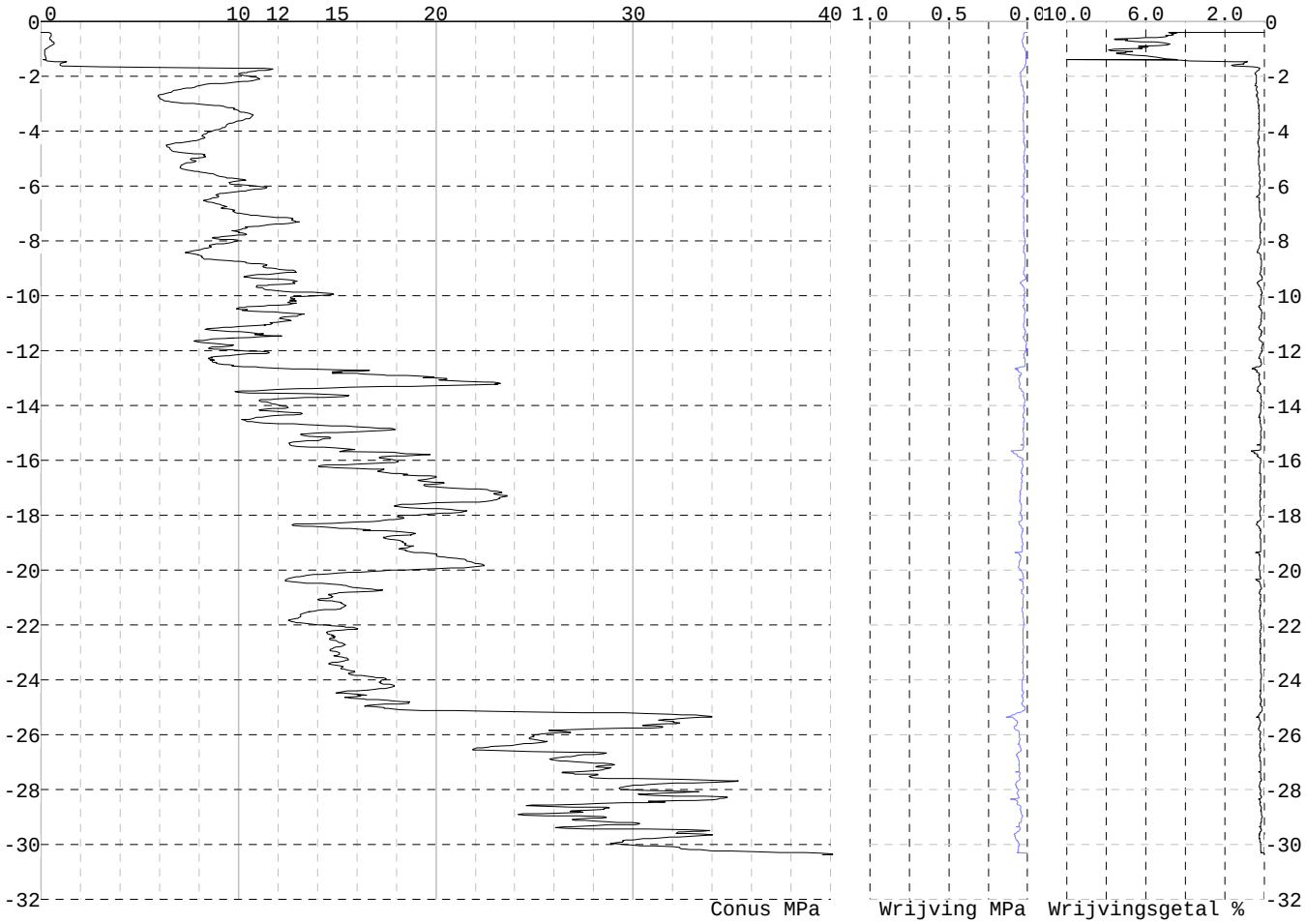


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 73-5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.39 Bodemprofiel: 73-2
Traject negatieve kleef : -0.39 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.40 [m]

SONDERINGSGEGEVENS GRAFIEK: 73-5

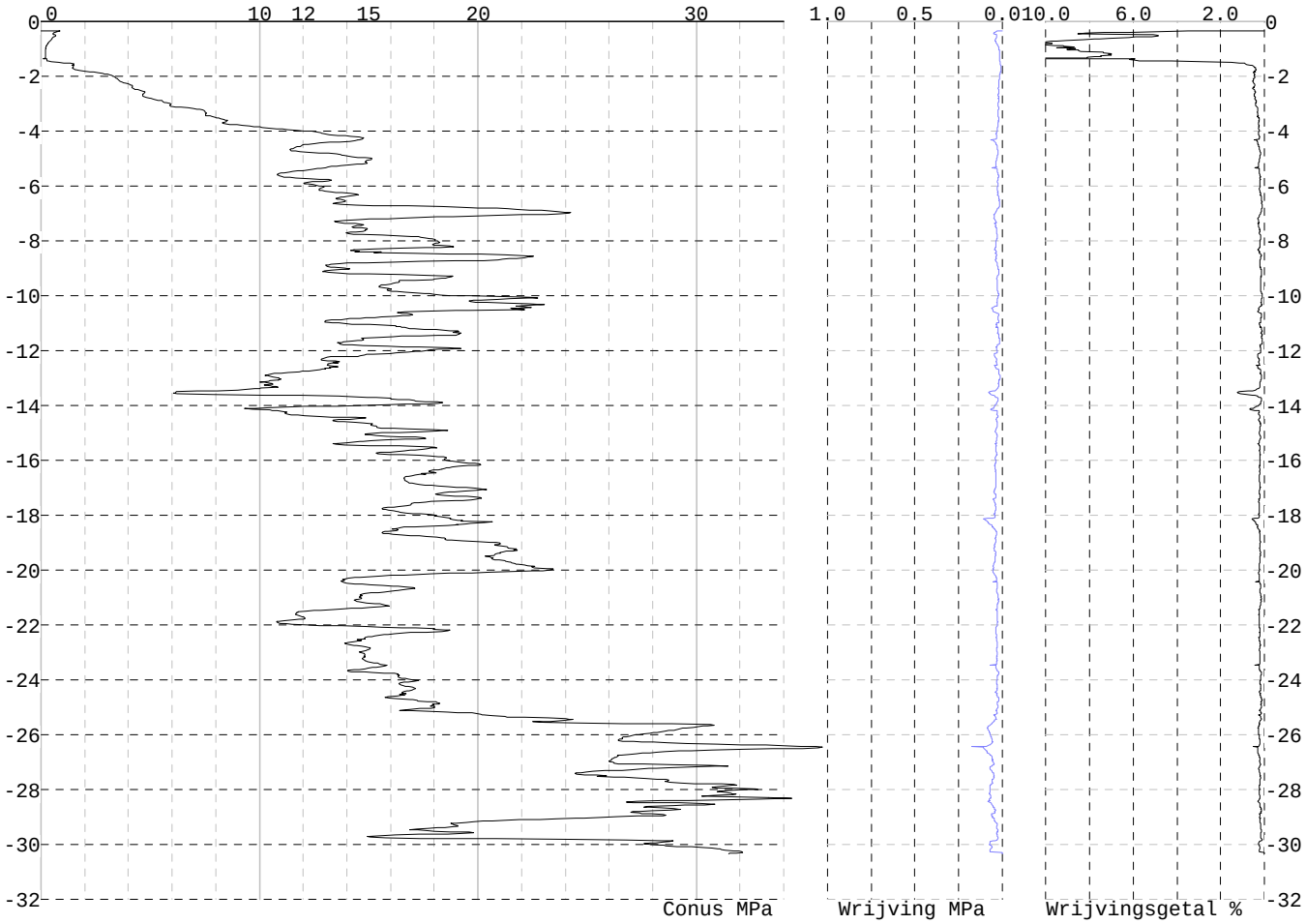


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 73-6

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.34 Bodemprofiel: 73-1
Traject negatieve kleef : -0.34 tot -1.80 [m]
Traject positieve kleef : -1.80 tot -30.36 [m]

SONDERINGSGEGEVENS GRAFIEK: 73-6

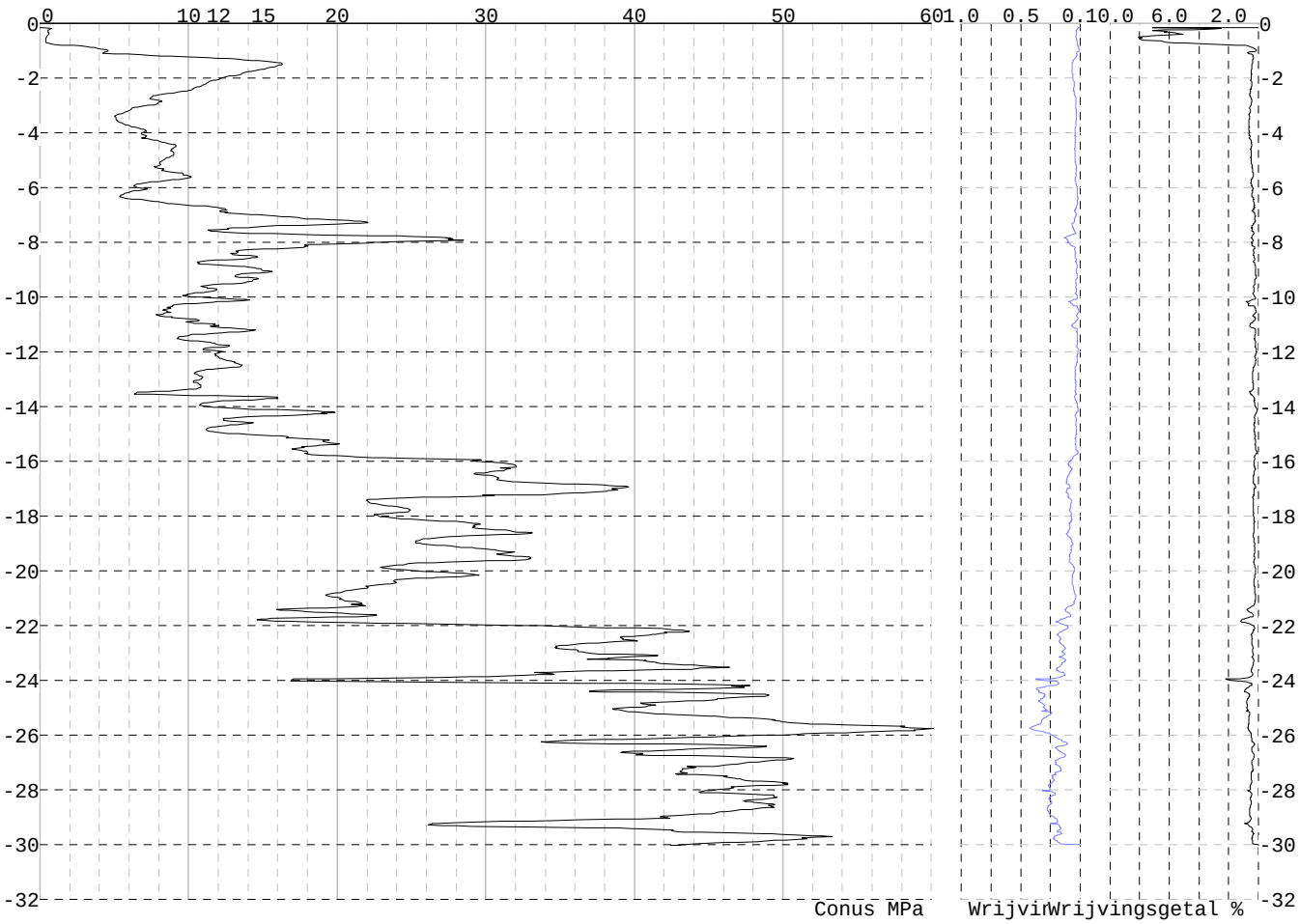


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 79-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.16 Bodemprofiel: 79-2
Traject negatieve kleef : -0.16 tot -1.10 [m]
Traject positieve kleef : -1.10 tot -30.05 [m]

SONDERINGSGEGEVENS GRAFIEK: 79-1

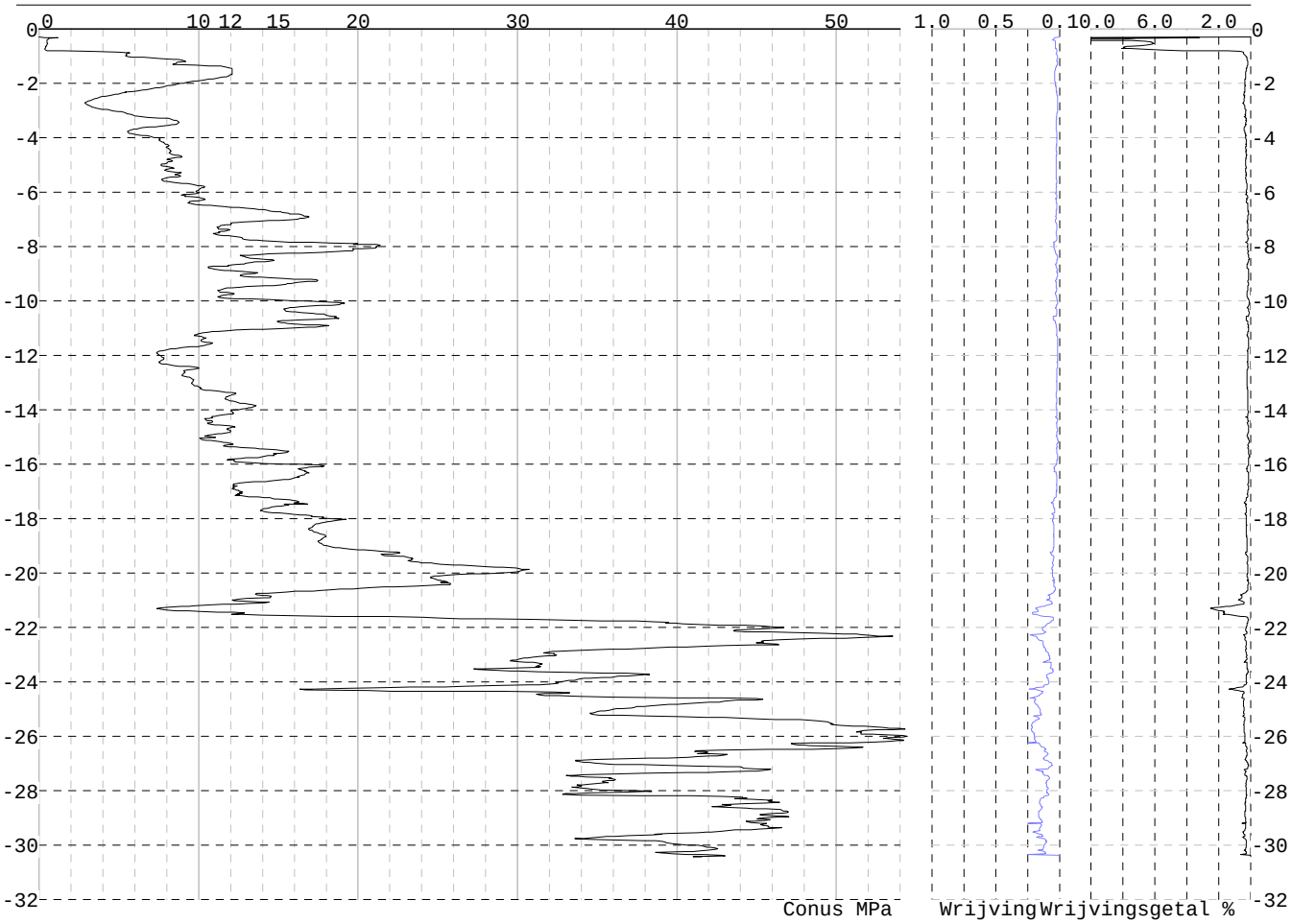


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 79-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.30 Bodemprofiel: 79-2
Traject negatieve kleef : -0.30 tot -1.20 [m]
Traject positieve kleef : -1.20 tot -30.45 [m]

SONDERINGSGEGEVENS GRAFIEK: 79-2

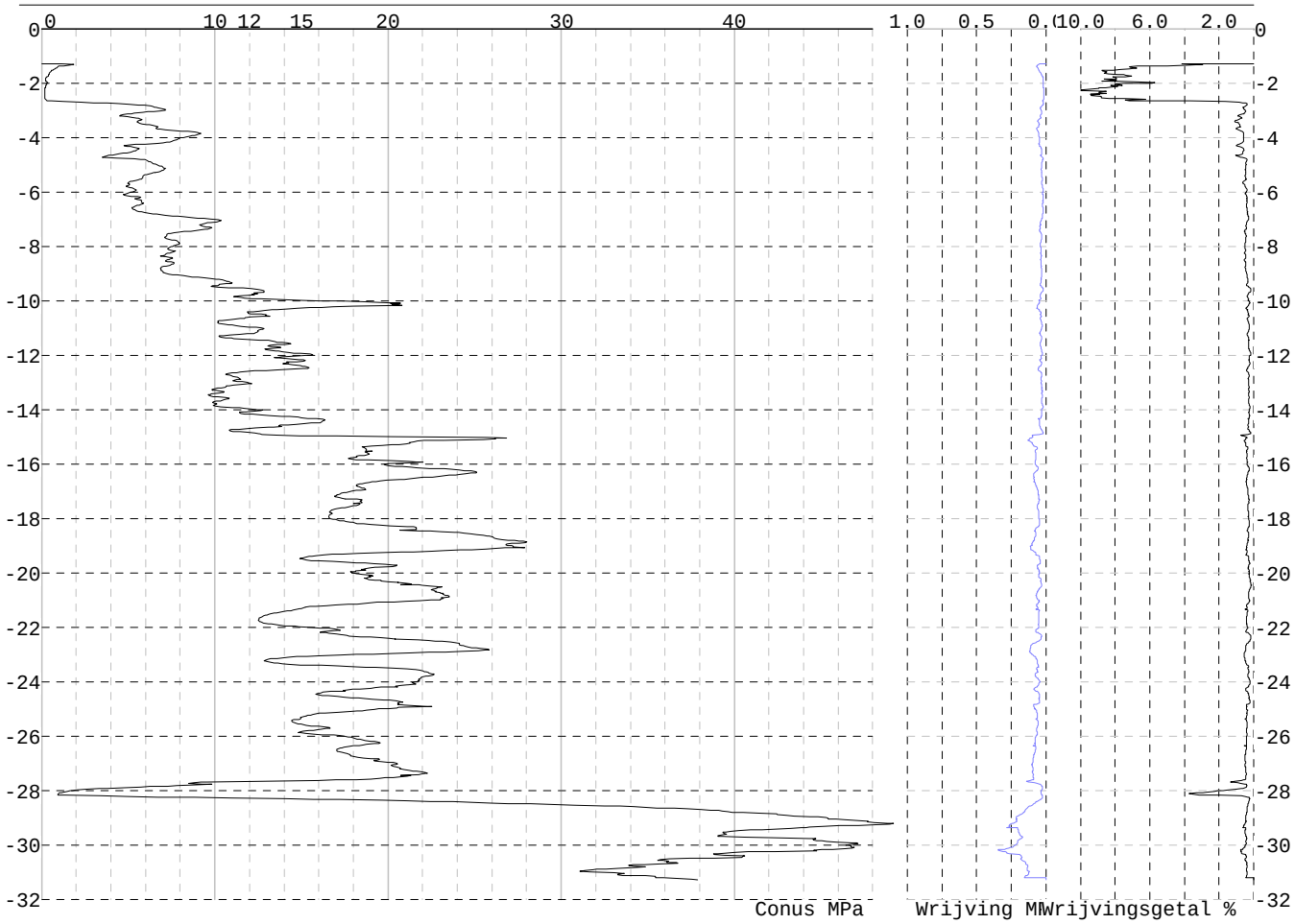


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 71-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.27 Bodemprofiel: 71-2
Traject negatieve kleef : -1.27 tot -2.75 [m]
Traject positieve kleef : -2.75 tot -31.27 [m]

SONDERINGSGEGEVENS GRAFIEK: 71-2

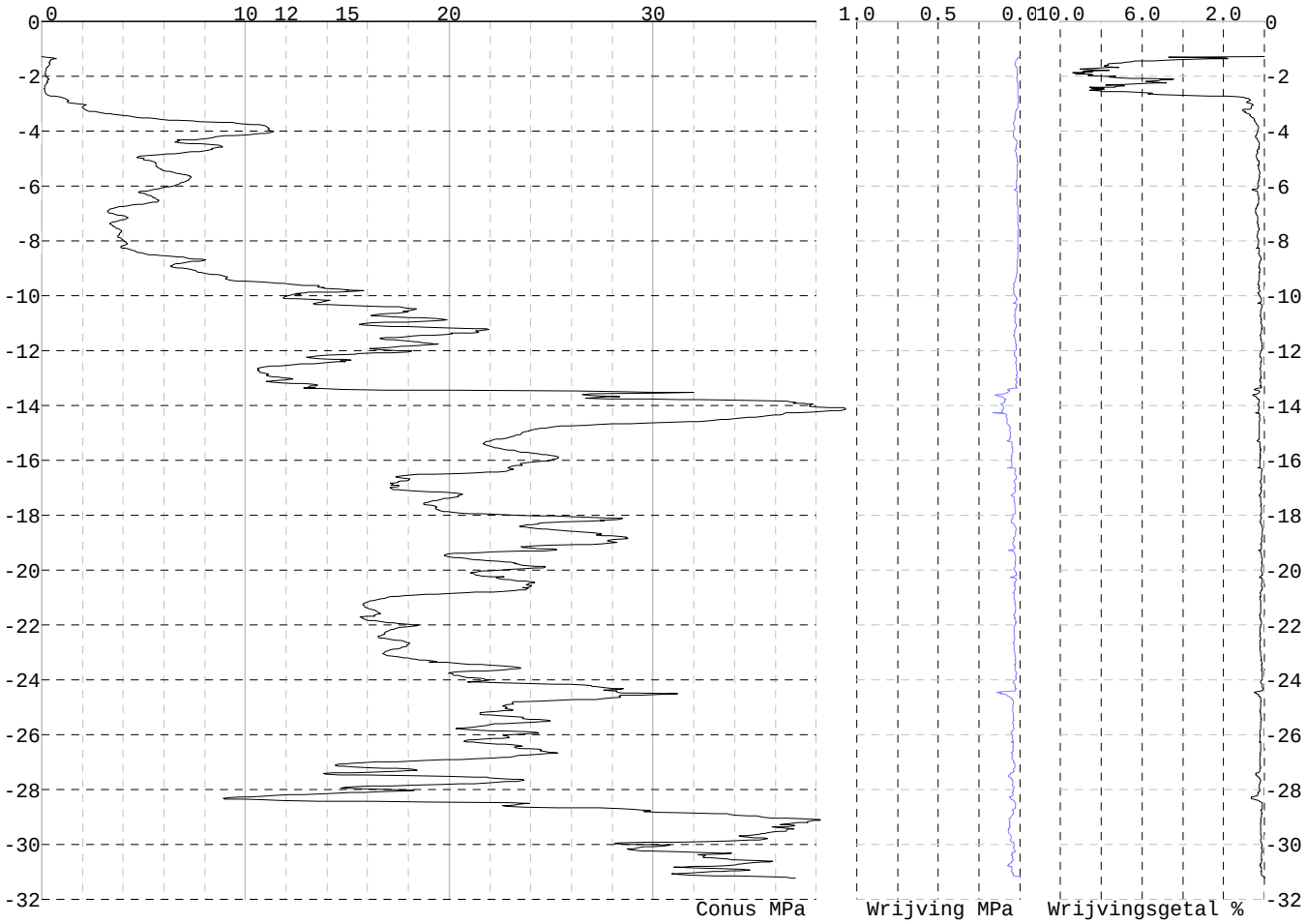


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 71-1A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.29 Bodemprofiel: 71-1A
Traject negatieve kleef : -1.29 tot -2.75 [m]
Traject positieve kleef : -2.75 tot -31.24 [m]

SONDERINGSGEGEVENS GRAFIEK: 71-1A



REKENGEGEVENS Mast 71

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 71-2, 71-1A
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.32
Paalpuntniveau : N.A.P. -14.78
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 71 (n=1)

Project :
Onderdeel :

Sondering : 71-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.78	-14.78	50.2	524.7	524.7	0.0	0.00

Sondering : 71-1A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.78	-14.78	50.2	541.0	541.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 71 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
71-2	-1.27	-14.78	524.7	524.7	524.7
71-1A	-1.29	-14.78	541.0	541.0	541.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 71 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
71-2	-1.27	-14.78	50.2	549.8
71-1A	-1.29	-14.78	50.2	567.0
		-14.78	$R_{t;cal;gem}$	558.4
met ξ_4(min) = 1.32				
71-2	-1.27	-14.78	50.2	549.8
71-1A	-1.29	-14.78	50.2	567.0
		-14.78	$R_{t;cal;min}$	549.8

Totaal resultaten Mast 71 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
71-2 71-1A

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-14.78 $R_{t;d}$ = min.{ 558.4; 549.8}= 549.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.78	549.8	549.8	0.0	549.8	0.00

REKENGEGEVENS Mast 72

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 72-1, 72-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.33
Paalpuntniveau : N.A.P. -16.72
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 72 (n=1)

Project :
Onderdeel :

Sondering : 72-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.72	-16.72	53.2	764.2	764.2	0.0	0.00

Sondering : 72-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.72	-16.72	53.5	712.0	712.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 72 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
72-1	-0.19	-16.72	764.2	764.2	764.2
72-2	-0.32	-16.72	712.0	712.0	712.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 72 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
72-1	-0.19	-16.72	53.2	801.9
72-2	-0.32	-16.72	53.2	746.9
		-16.72	$R_{t;cal;gem}$	774.4
met ξ_4(min) = 1.32				
72-1	-0.19	-16.72	53.2	801.9
72-2	-0.32	-16.72	53.2	746.9
		-16.72	$R_{t;cal;min}$	746.9

Totaal resultaten Mast 72 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
72-1 72-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.72	$R_{t;d}$ = min.{ 774.4; 746.9}= 746.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.72	746.9	746.9	0.0	746.9	0.00

REKENGEGEVENS Mast 79

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 79-1, 79-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.29
Paalpuntniveau : N.A.P. -15.51
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 79 (n=1)

Project :
Onderdeel :

Sondering : 79-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.51	-15.51	49.7	699.6	699.6	0.0	0.00

Sondering : 79-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.51	-15.51	49.7	684.8	684.8	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 79 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
79-1	-0.16	-15.51	699.6	699.6	699.6
79-2	-0.30	-15.51	684.8	684.8	684.8

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 79 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
79-1	-0.16	-15.51	49.7	734.0
79-2	-0.30	-15.51	49.7	718.5
		-15.51	$R_{t;cal;gem}$	726.3
met ξ_4(min) = 1.32				
79-1	-0.16	-15.51	49.7	734.0
79-2	-0.30	-15.51	49.7	718.5
		-15.51	$R_{t;cal;min}$	718.5

Totaal resultaten Mast 79 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
79-1 79-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-15.51 $R_{t;d}$ = min.{ 726.3; 718.5}= 718.5

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.51	718.5	718.5	0.0	718.5	0.00

PAALGEGEVENS BP 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 71	Mast 72	Mast 79
72-1	-0.19	-16.72		764	
72-2	-0.32	-16.72		712	
79-1	-0.16	-15.51			699
79-2	-0.30	-15.51			684
71-2	-1.27	-14.78	524		
71-1A	-1.29	-14.78	540		

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 80-89 (81 82 84 85 86 87 89).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
9	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
10	Leem - Sterk zandig	19.00	19.00	27.50	20.00	20.00	35.00
11	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
12	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
13	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
14	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
15	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
16	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00

BODEMPROFIELGEGEVENS: 81-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.12 Grondwaterstand [m] : -1.12

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.12	-1.00	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.00	-10.37	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-10.37	-11.95	Zand - Schoon - Matig	1.0	100.0		
4	-11.95	-12.25	Zand - Schoon - Vast	1.0	100.0		
5	-12.25	-17.93	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-17.93	-19.60	Zand - Schoon - Matig	1.0	100.0		
7	-19.60	-25.14	Zand - Schoon - Vast	1.0	100.0		
8	-25.14	-26.12	Zand - Schoon - Los	1.0	100.0		
9	-26.12	-30.08	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: 81-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.06 Grondwaterstand [m] : -1.06

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.06	-0.87	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.87	-8.19	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-8.19	-9.25	Zand - Schoon - Vast	1.0	100.0		
4	-9.25	-9.87	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-9.87	-10.73	Zand - Schoon - Los	1.0	100.0		
6	-10.73	-12.13	Zand - Schoon - Vast	1.0	100.0		
7	-12.13	-12.53	Leem - Zwak zandig - Vast	1.0	50.0		
8	-12.53	-18.18	Zand - Schoon - Los	1.0	100.0		
9	-18.18	-20.56	Zand - Schoon - Vast	1.0	100.0		
10	-20.56	-22.91	Zand - Schoon - Los	1.0	100.0		
11	-22.91	-29.57	Zand - Schoon - Vast	1.0	100.0		
12	-29.57	-30.05	Zand - Schoon - Matig	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 84-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.50 Grondwaterstand [m] : -0.50

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.50	-0.79	Klei - Schoon - Matig	1.0	50.0		
2	-0.79	-1.93	Zand - Schoon - Matig	1.0	100.0		
3	-1.93	-2.43	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-2.43	-4.76	Leem - Zwak zandig - Matig	1.0	50.0		
5	-4.76	-8.92	Zand - Schoon - Los	1.0	100.0		
6	-8.92	-16.05	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-16.05	-18.95	Zand - Schoon - Los	1.0	100.0		
8	-18.95	-29.72	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 85-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.57 Grondwaterstand [m] : -0.43

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.57	-0.22	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.22	-2.22	Zand - Schoon - Los	1.0	100.0		
3	-2.22	-3.40	Leem - Zwak zandig - Vast	1.0	50.0		
4	-3.40	-8.94	Zand - Schoon - Los	1.0	100.0		
5	-8.94	-11.18	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-11.18	-12.58	Zand - Schoon - Vast	1.0	100.0		
7	-12.58	-16.01	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-16.01	-17.31	Klei - Zwak zandig - Matig	1.0	50.0		
9	-17.31	-29.58	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: 86-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.61 Grondwaterstand [m] : -0.39

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.61	-0.38	Klei - Schoon - Vast	1.0	50.0		
2	-0.38	-1.52	Zand - Schoon - Matig	1.0	100.0		
3	-1.52	-2.10	Zand - Schoon - Los	1.0	100.0		
4	-2.10	-2.48	Leem - Zwak zandig - Vast	1.0	50.0		
5	-2.48	-5.03	Zand - Schoon - Los	1.0	100.0		
6	-5.03	-10.71	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-10.71	-11.65	Zand - Schoon - Matig	1.0	100.0		
8	-11.65	-16.99	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-16.99	-17.55	Zand - Schoon - Matig	1.0	100.0		
10	-17.55	-18.25	Zand - Schoon - Los	1.0	100.0		
11	-18.25	-20.13	Zand - Schoon - Vast	1.0	100.0		
12	-20.13	-20.87	Zand - Schoon - Los	1.0	100.0		
13	-20.87	-21.71	Zand - Schoon - Matig	1.0	100.0		
14	-21.71	-22.73	Zand - Schoon - Vast	1.0	100.0		
15	-22.73	-22.96	Zand - Schoon - Los	1.0	100.0		
16	-22.96	-23.40	Klei - Schoon - Matig	1.0	50.0		
17	-23.40	-28.44	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: 87-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.64 Grondwaterstand [m] : -0.36

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.64	-0.49	Klei - Schoon - Vast	1.0	50.0		
2	-0.49	-12.96	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-12.96	-13.42	Leem - Sterk zandig	1.0	50.0		
4	-13.42	-14.20	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-14.20	-18.00	Zand - Schoon - Los	1.0	100.0		
6	-18.00	-19.36	Zand - Schoon - Vast	1.0	100.0		
7	-19.36	-23.23	Zand - Schoon - Matig	1.0	100.0		
8	-23.23	-29.42	Zand - Schoon - Vast	1.0	100.0		

Project :
Onderdeel :

BODEMPROFIELGEGEVENS: 89-3

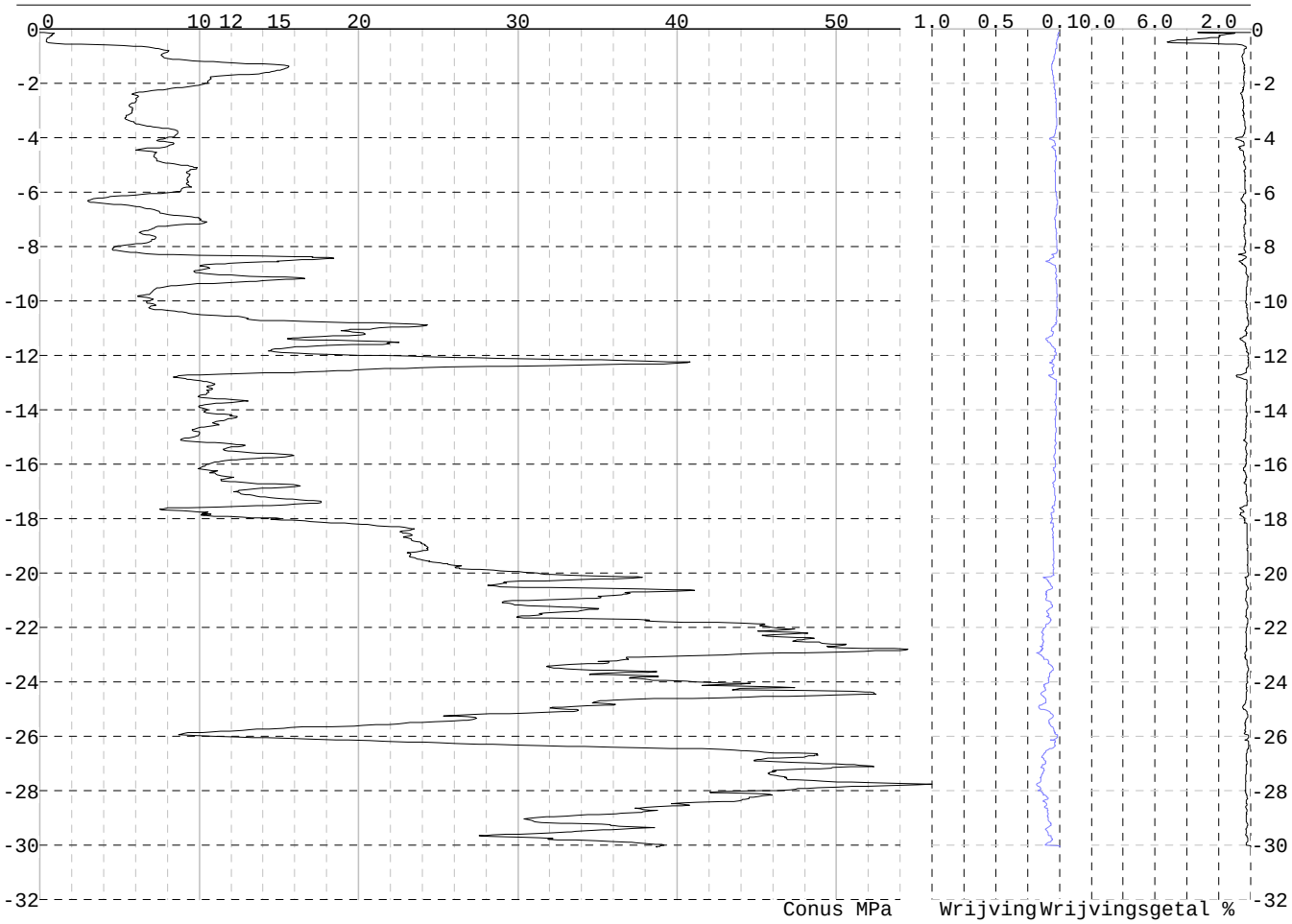
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.42 Grondwaterstand [m] : -0.58

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.42	-0.11	Leem - Zwak zandig - Matig	1.0	50.0		
2	-0.11	-4.47	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-4.47	-11.12	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-11.12	-13.28	Klei - Schoon - Matig	1.0	50.0		
5	-13.28	-14.16	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-14.16	-15.10	Zand - Schoon - Matig	1.0	100.0		
7	-15.10	-15.53	Leem - Sterk zandig	1.0	50.0		
8	-15.53	-23.63	Zand - Schoon - Matig	1.0	100.0		
9	-23.63	-24.88	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-24.88	-28.29	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-28.29	-28.53	Zand - Schoon - Vast	1.0	100.0		
12	-28.53	-29.06	Klei - Schoon - Vast	1.0	50.0		
13	-29.06	-29.52	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 81-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.12 Bodemprofiel: 81-1
Traject negatieve kleef : -0.12 tot -0.90 [m]
Traject positieve kleef : -0.90 tot -30.09 [m]

SONDERINGSGEGEVENS GRAFIEK: 81-1

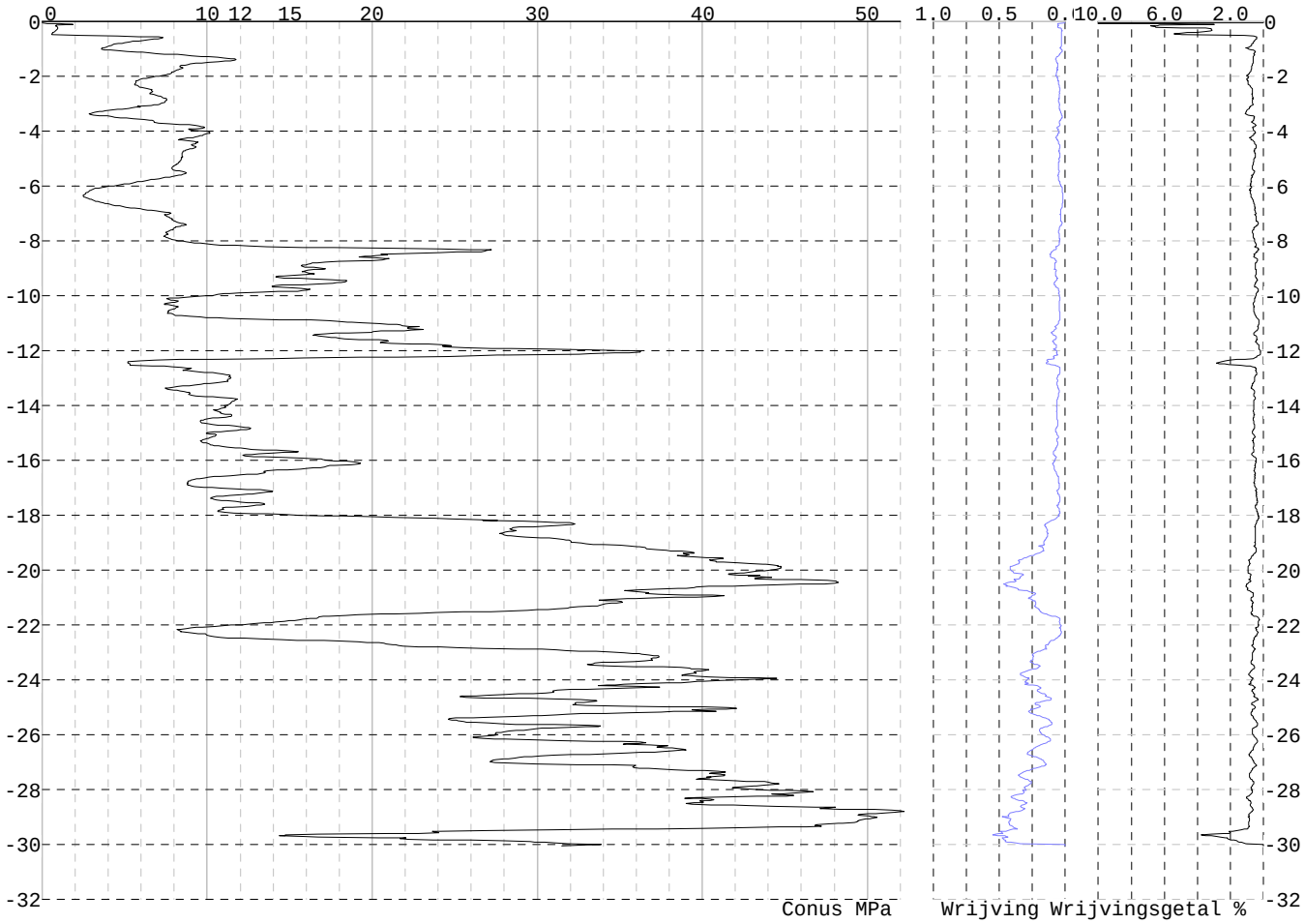


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 81-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.06 Bodemprofiel: 81-2
Traject negatieve kleef : -0.06 tot -0.90 [m]
Traject positieve kleef : -0.90 tot -30.06 [m]

SONDERINGSGEGEVENS GRAFIEK: 81-2

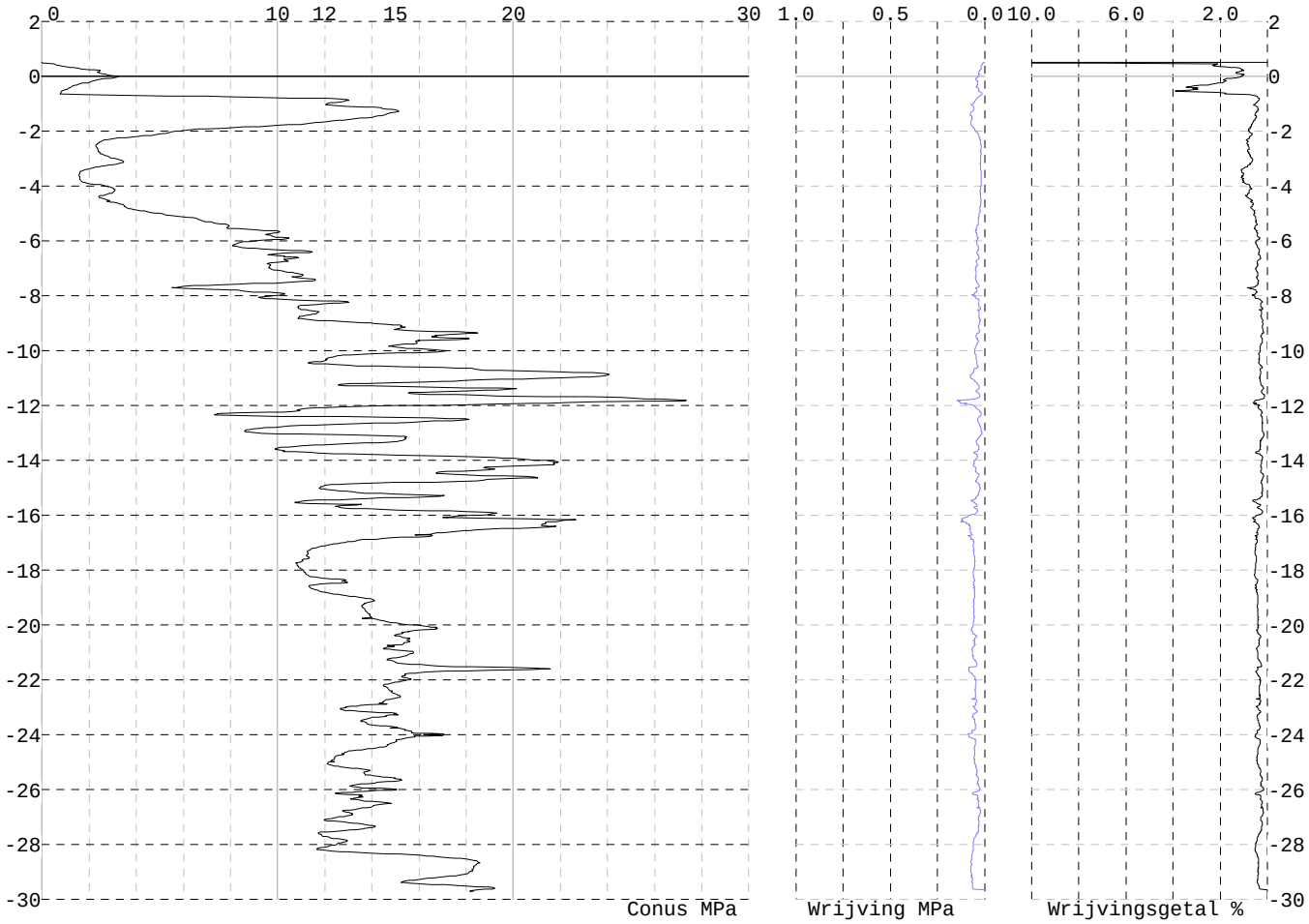


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 84-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.50 Bodemprofiel: 84-1
Traject negatieve kleef : 0.50 tot -3.80 [m]
Traject positieve kleef : -3.80 tot -29.73 [m]

SONDERINGSGEGEVENS GRAFIEK: 84-1

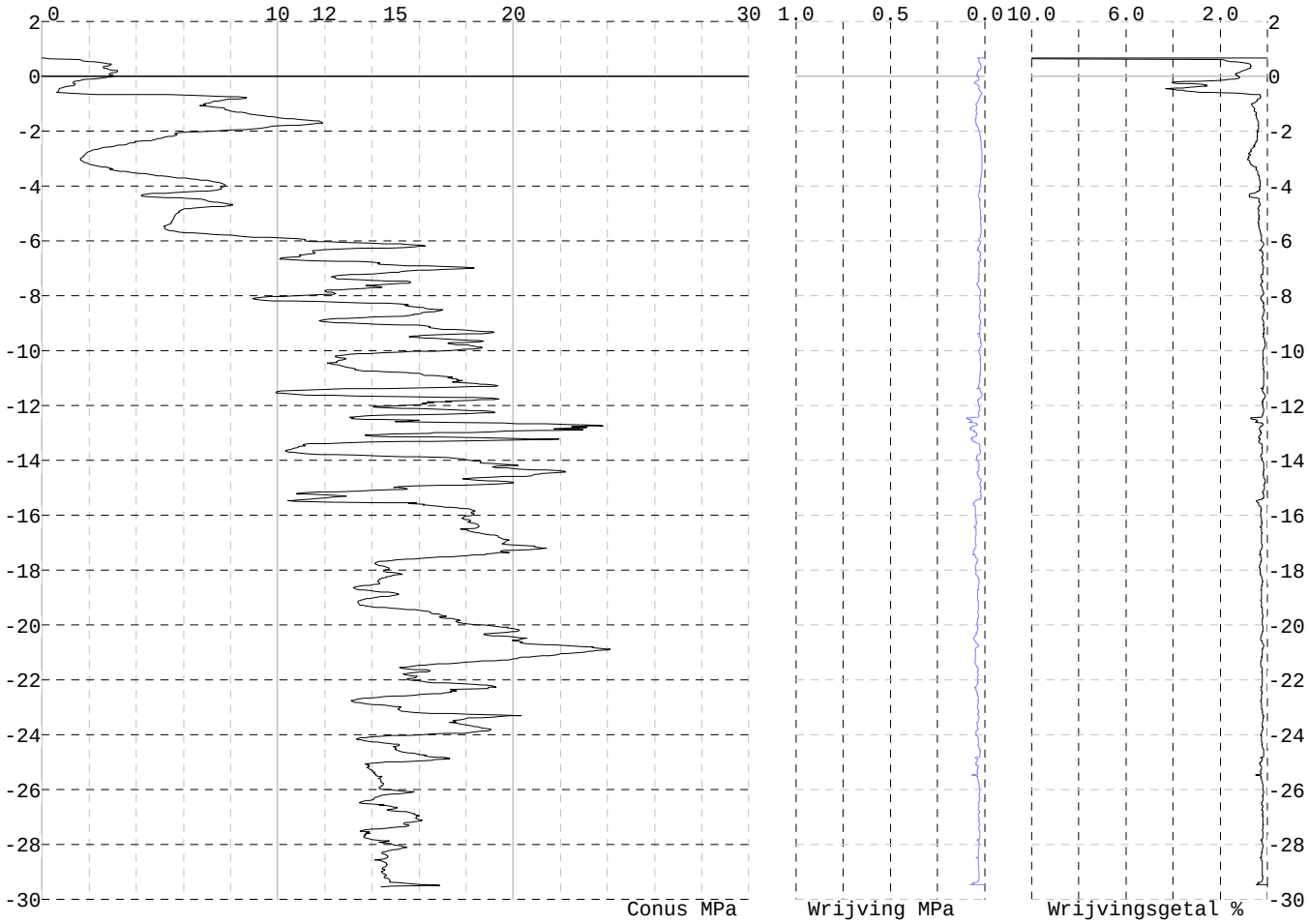


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 84-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.67 Bodemprofiel: 84-1
Traject negatieve kleef : 0.67 tot -3.20 [m]
Traject positieve kleef : -3.20 tot -29.55 [m]

SONDERINGSGEGEVENS GRAFIEK: 84-2

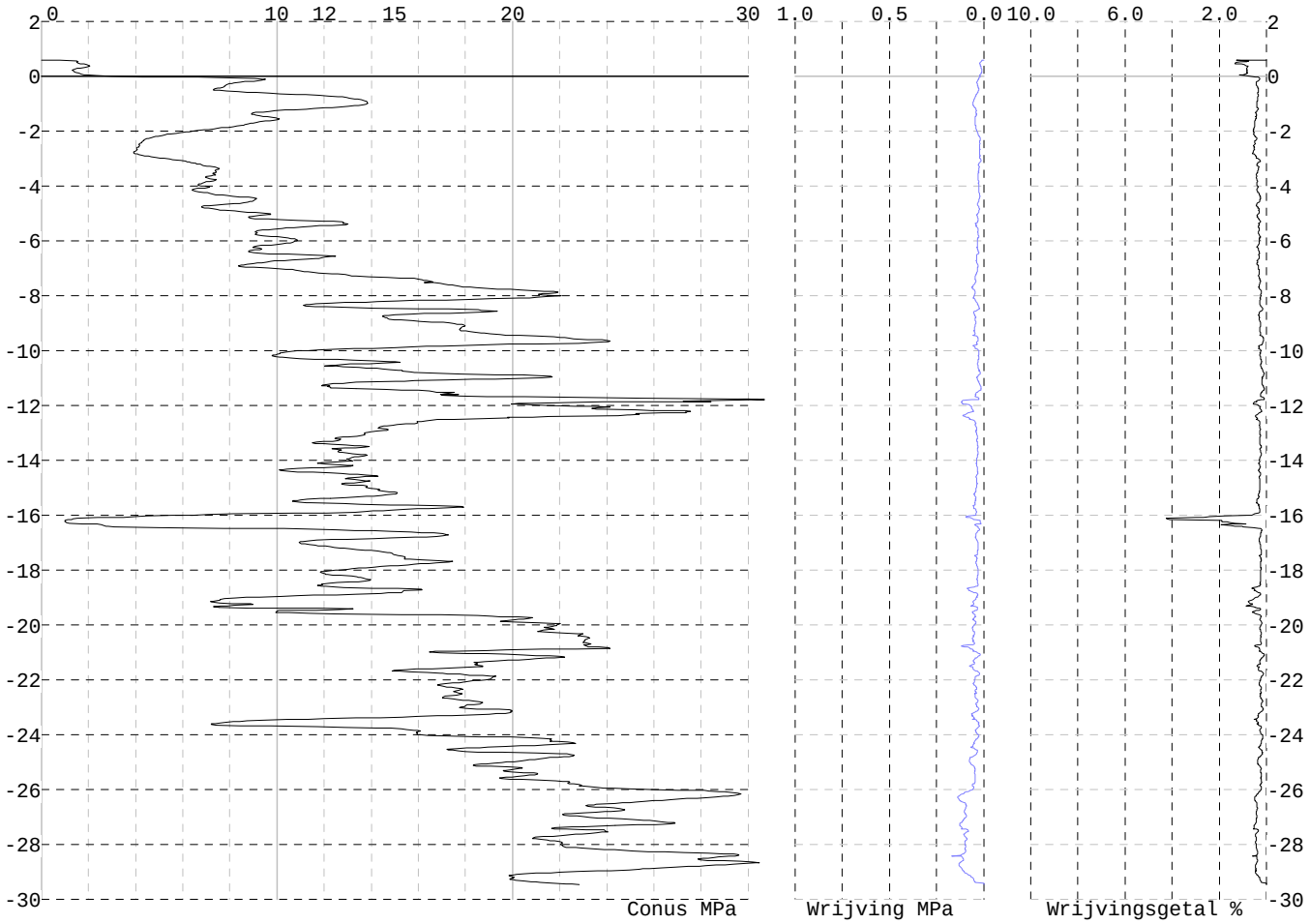


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 85-1A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.59 Bodemprofiel: 85-2
Traject negatieve kleef : 0.59 tot -3.00 [m]
Traject positieve kleef : -3.00 tot -29.48 [m]

SONDERINGSGEGEVENS GRAFIEK: 85-1A

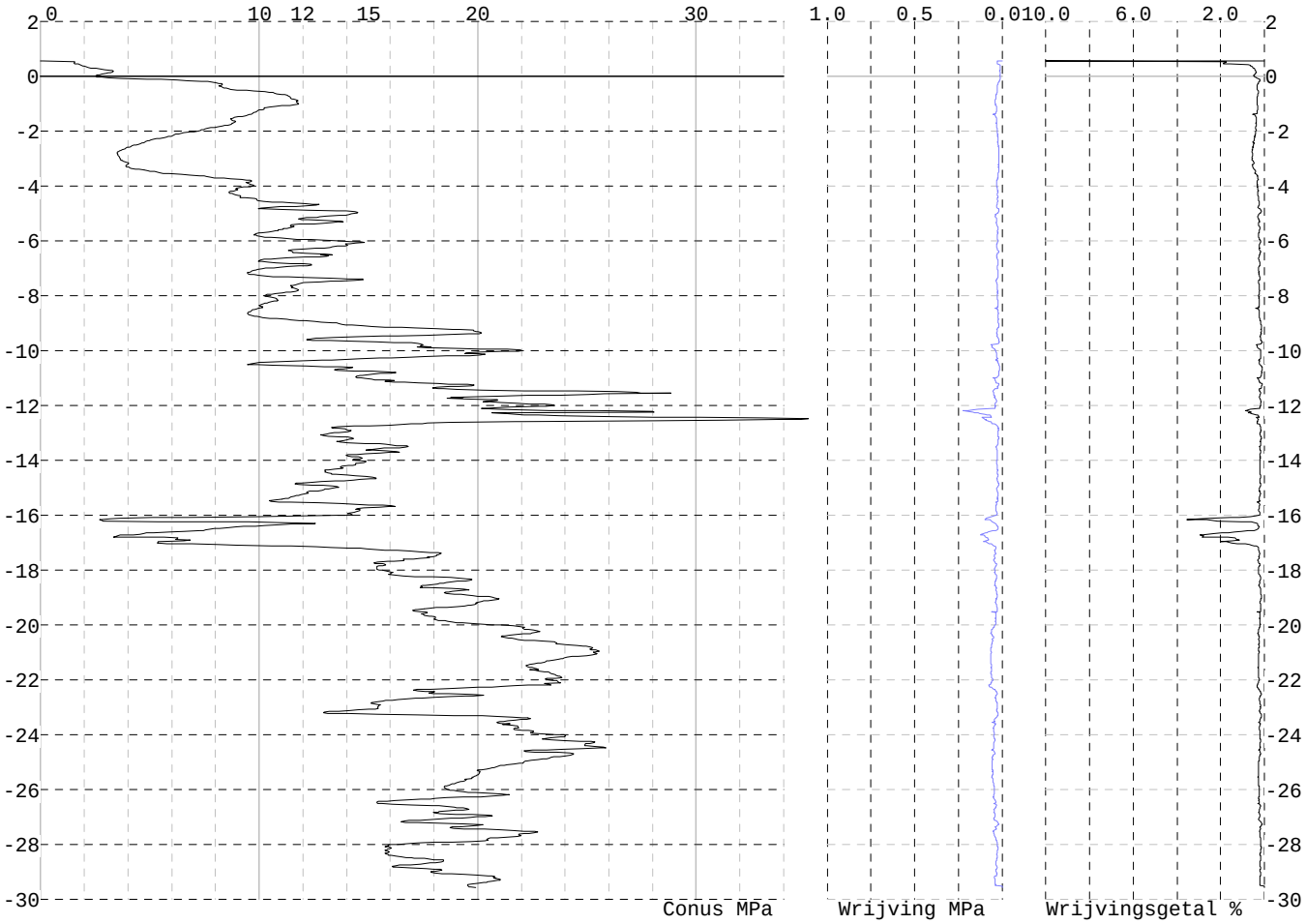


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 85-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.57 Bodemprofiel: 85-2
Traject negatieve kleef : 0.57 tot -3.50 [m]
Traject positieve kleef : -3.50 tot -29.59 [m]

SONDERINGSGEGEVENS GRAFIEK: 85-2

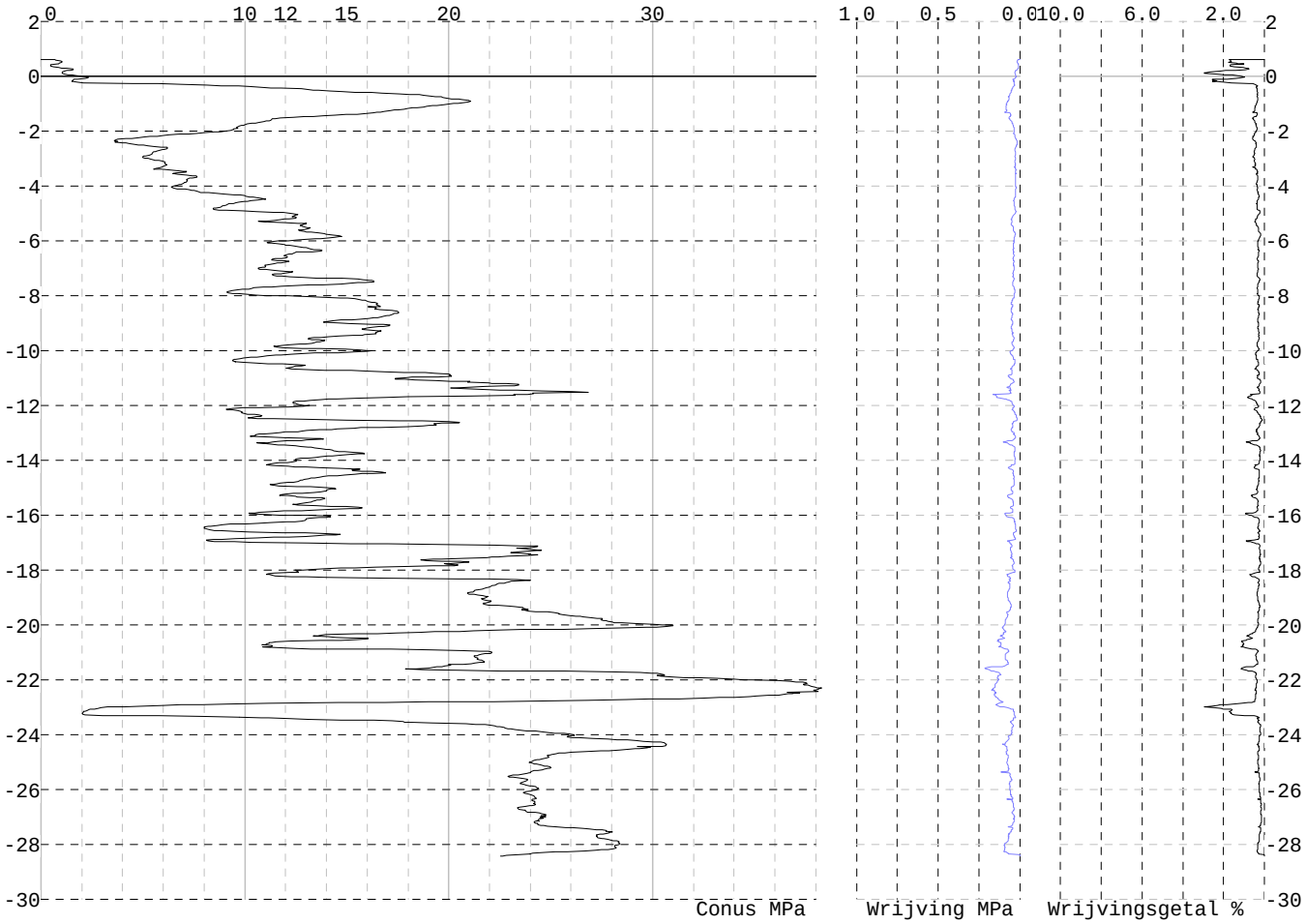


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 86-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.61 Bodemprofiel: 86-1
Traject negatieve kleef : 0.61 tot -2.40 [m]
Traject positieve kleef : -2.40 tot -28.45 [m]

SONDERINGSGEGEVENS GRAFIEK: 86-1

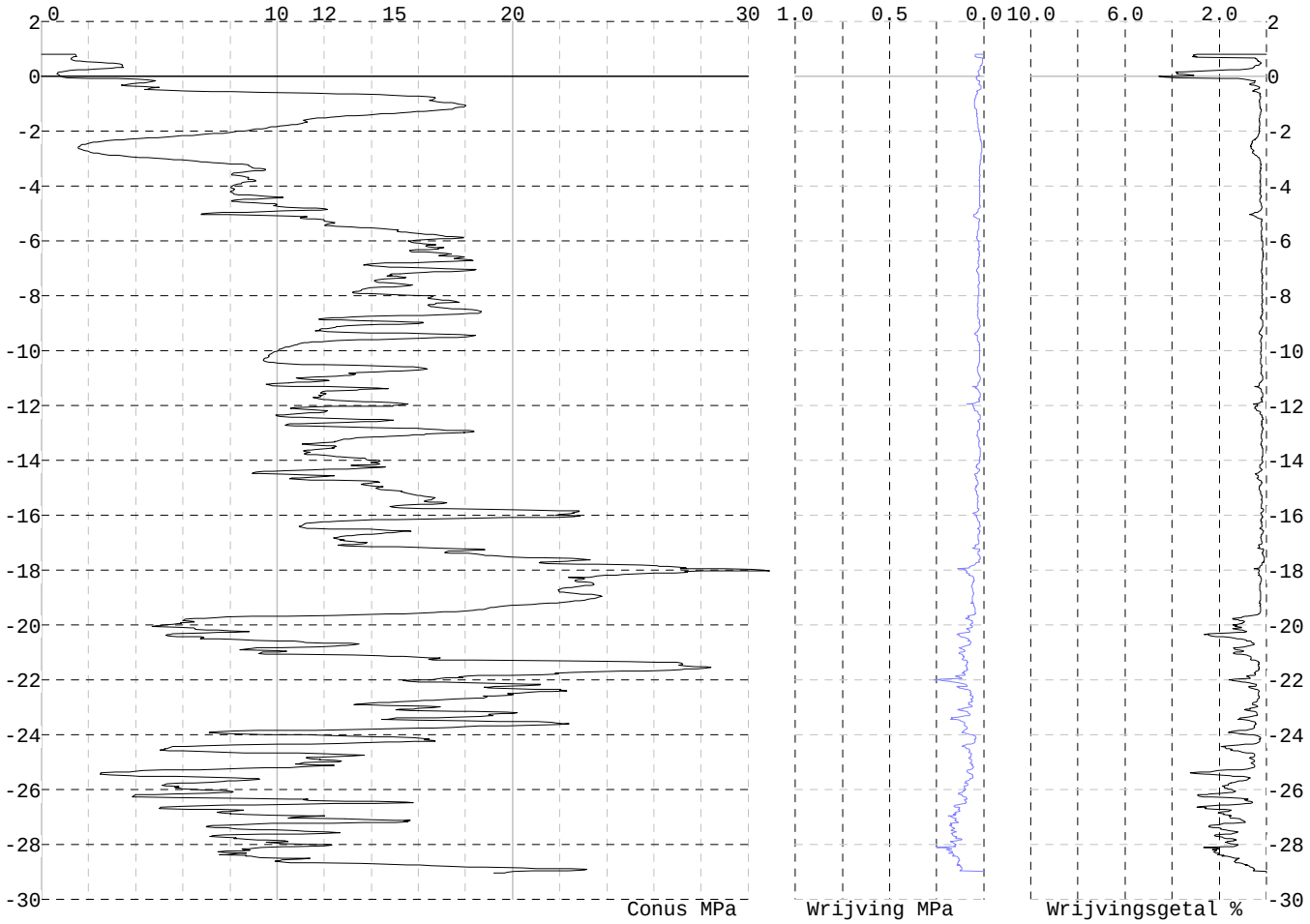


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 86-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.80 Bodemprofiel: 86-1
Traject negatieve kleef : 0.80 tot -2.70 [m]
Traject positieve kleef : -2.70 tot -29.06 [m]

SONDERINGSGEGEVENS GRAFIEK: 86-2

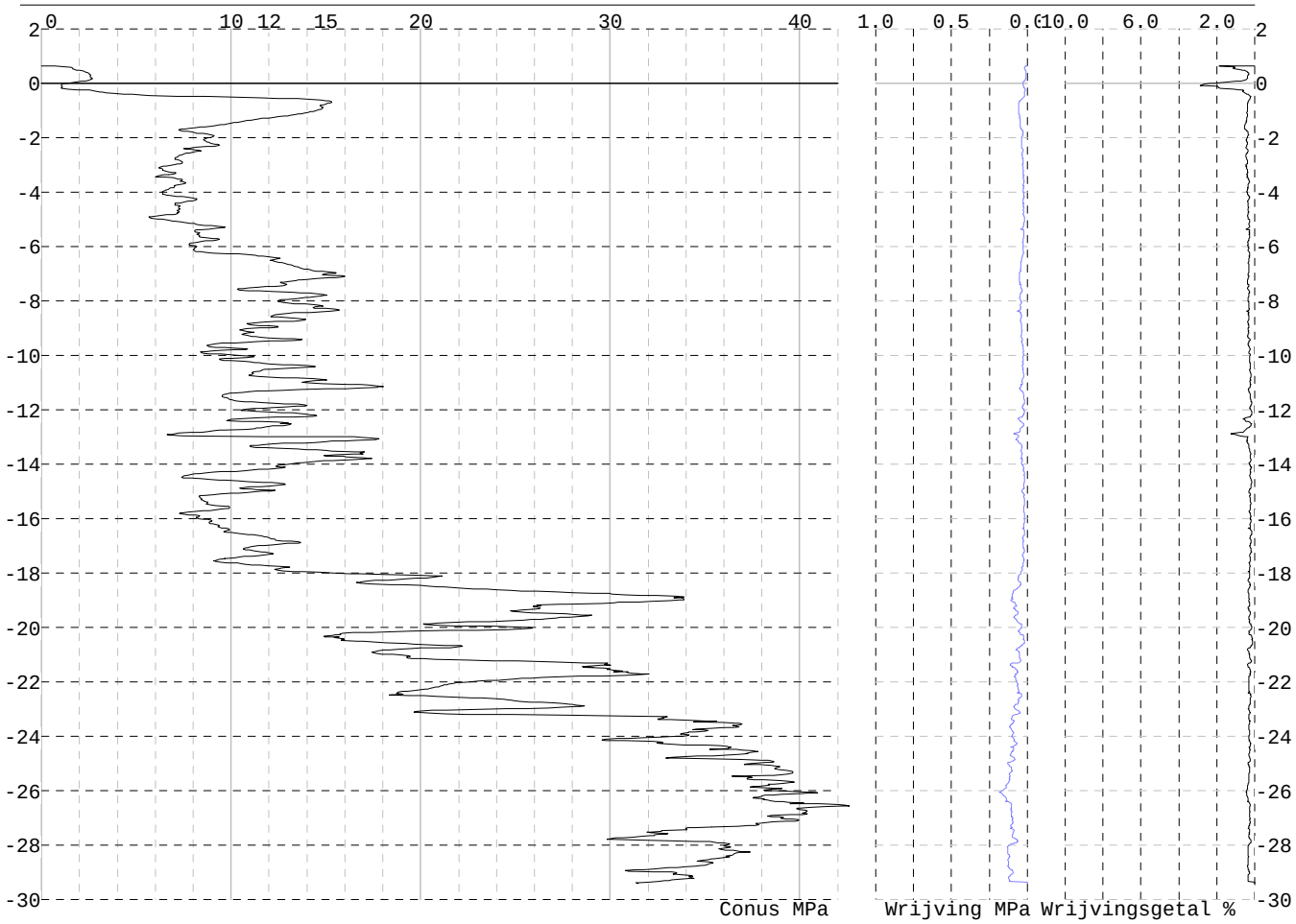


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 87-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.64 Bodemprofiel: 87-1
Traject negatieve kleef : 0.64 tot -0.60 [m]
Traject positieve kleef : -0.60 tot -29.43 [m]

SONDERINGSGEGEVENS GRAFIEK: 87-1

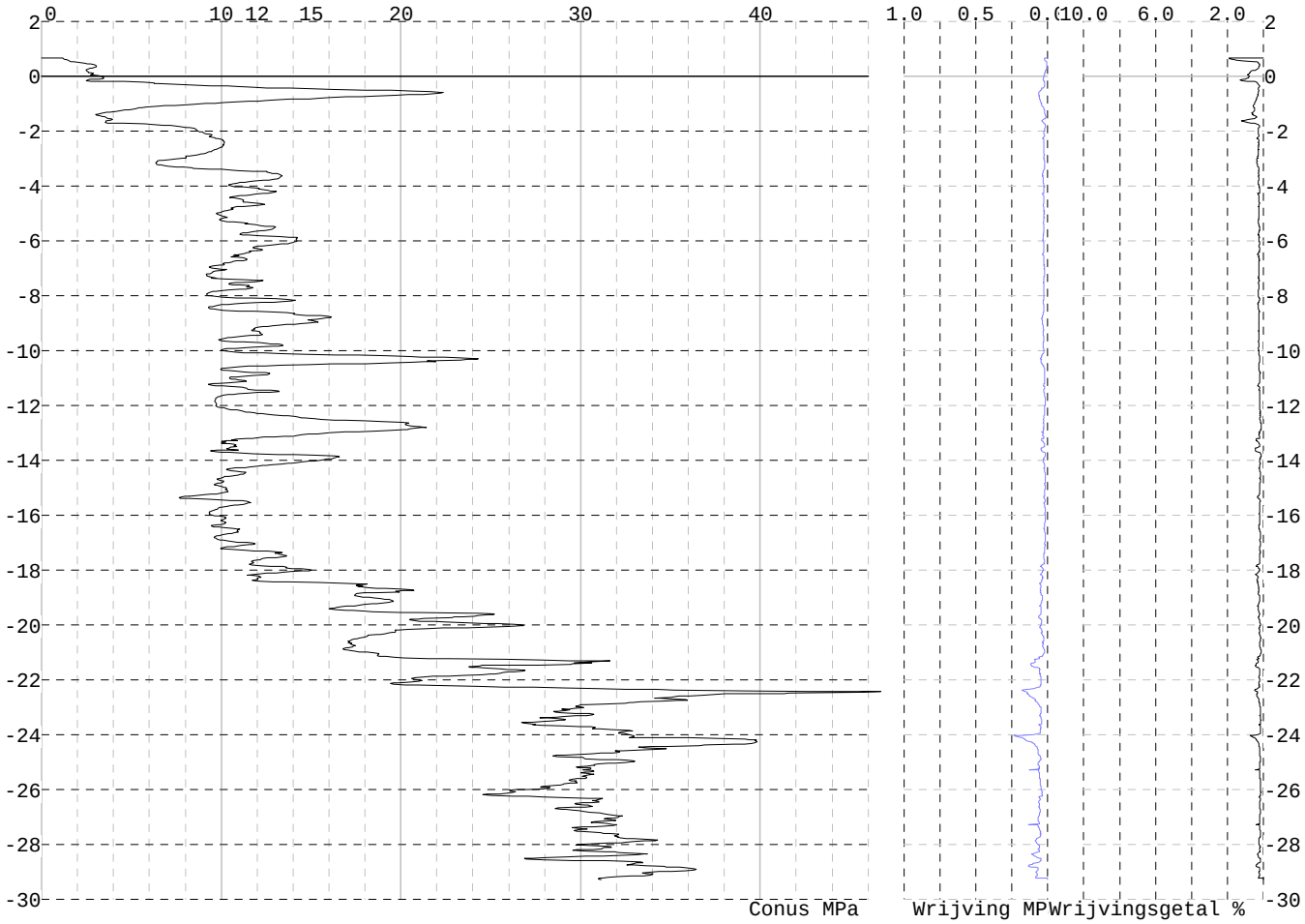


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 87-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.67 Bodemprofiel: 87-1
Traject negatieve kleef : 0.67 tot -1.90 [m]
Traject positieve kleef : -1.90 tot -29.31 [m]

SONDERINGSGEGEVENS GRAFIEK: 87-2

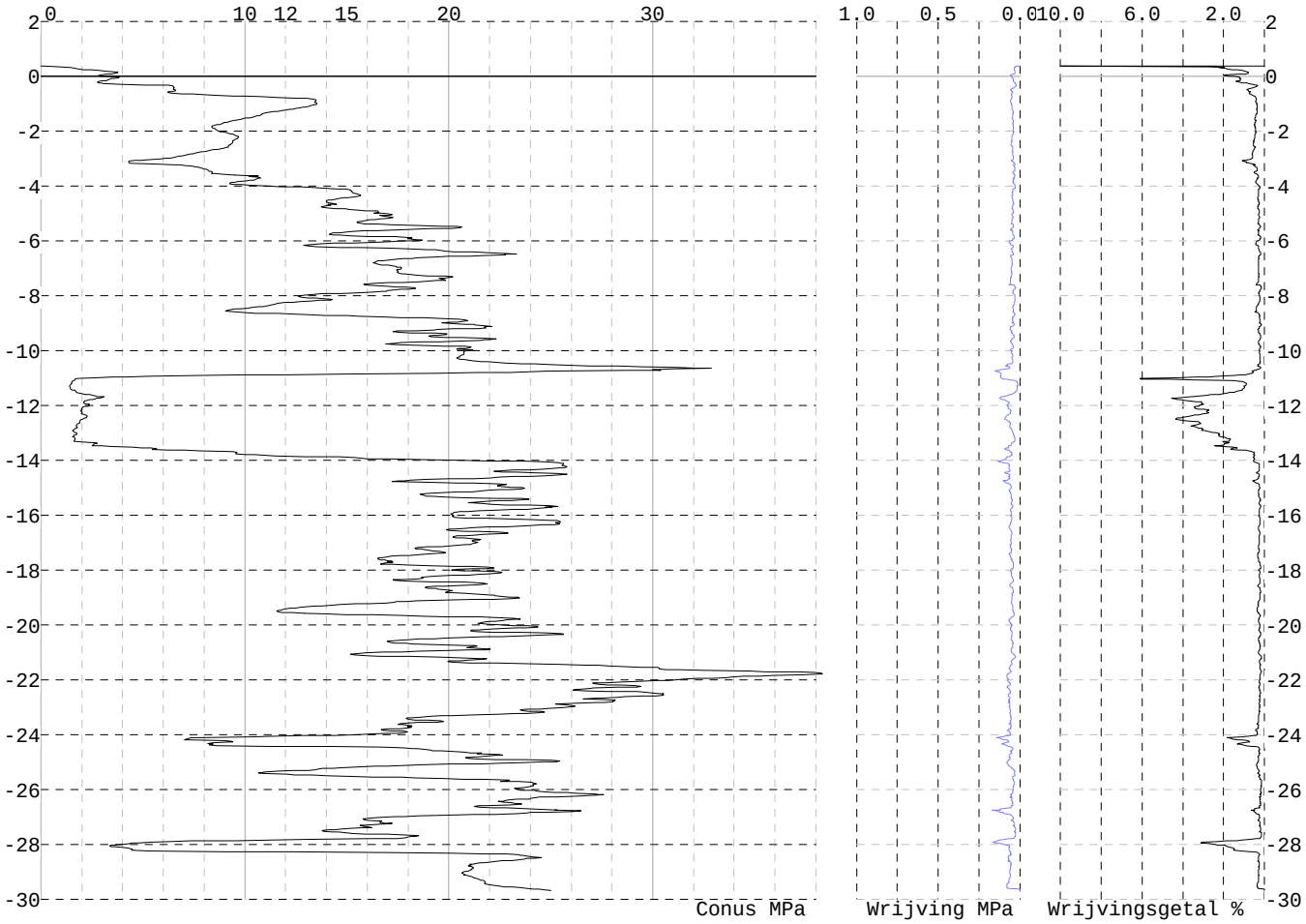


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 89-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.38 Bodemprofiel: 89-3
Traject negatieve kleef : 0.38 tot -3.20 [m]
Traject positieve kleef : -3.20 tot -29.68 [m]

SONDERINGSGEGEVENS GRAFIEK: 89-1

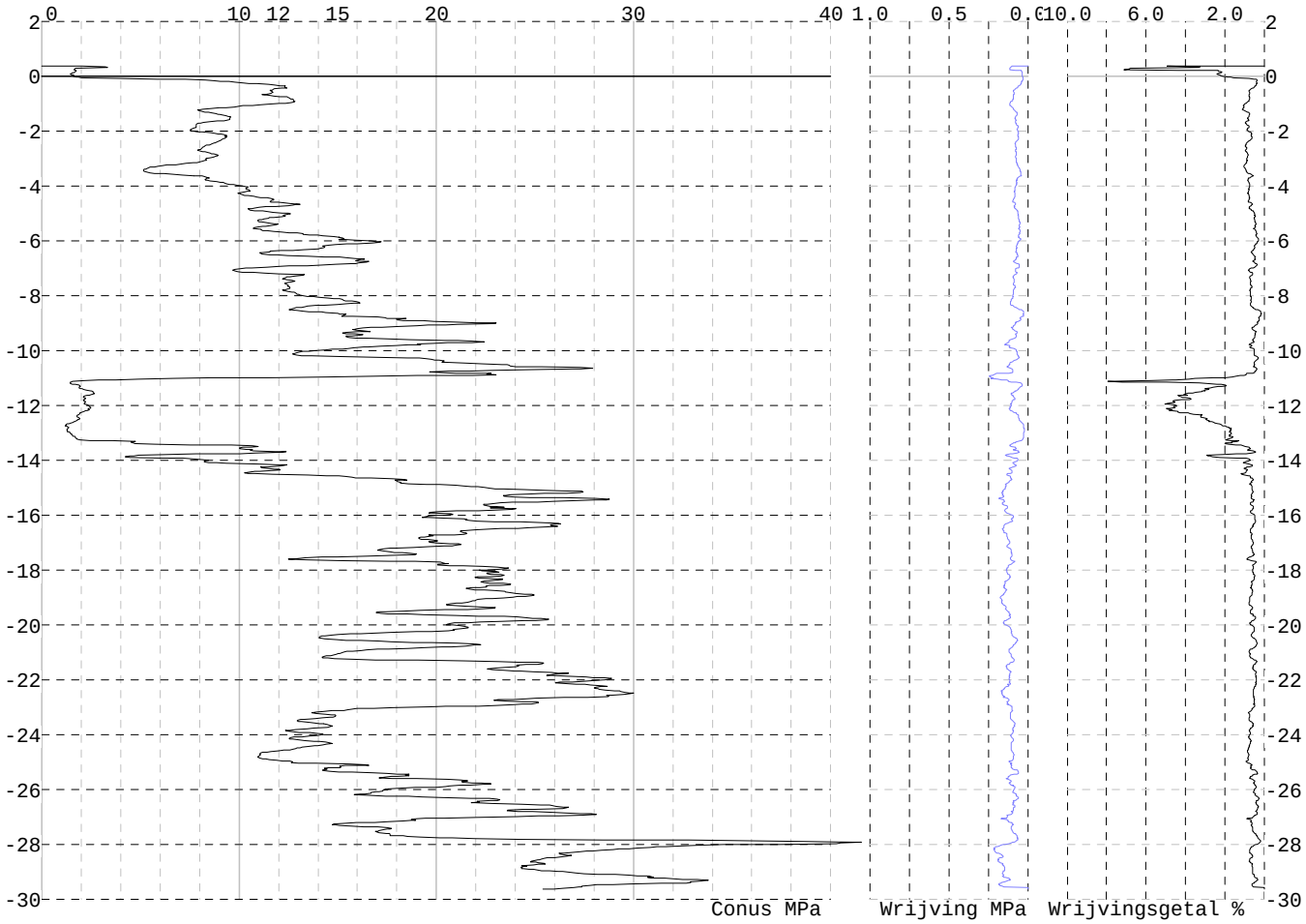


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 89-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.37 Bodemprofiel: 89-3
Traject negatieve kleef : 0.37 tot -0.20 [m]
Traject positieve kleef : -0.20 tot -29.65 [m]

SONDERINGSGEGEVENS GRAFIEK: 89-2

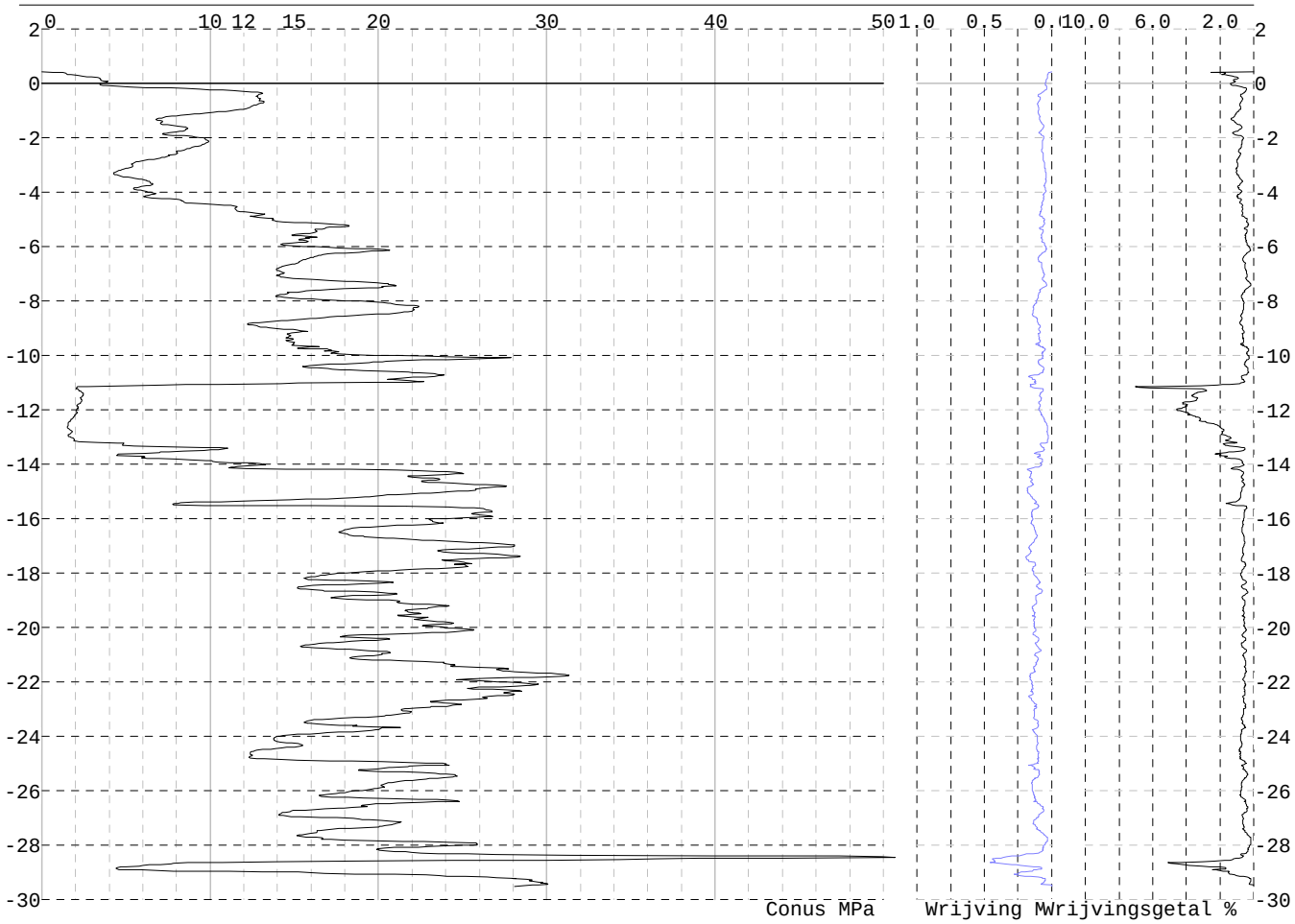


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 89-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.42 Bodemprofiel: 89-3
Traject negatieve kleef : 0.42 tot -3.50 [m]
Traject positieve kleef : -3.50 tot -29.53 [m]

SONDERINGSGEGEVENS GRAFIEK: 89-3

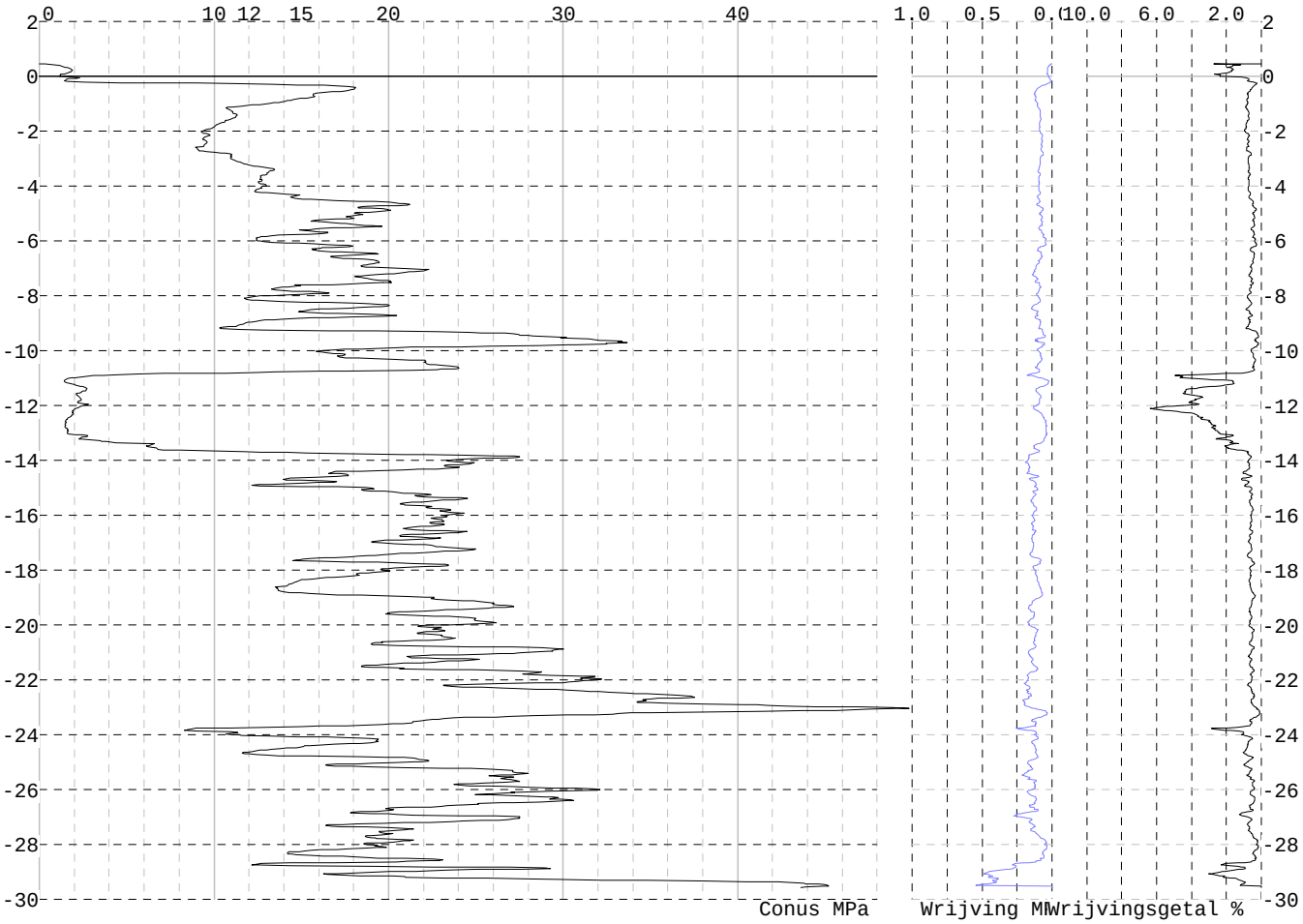


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 89-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.46 Bodemprofiel: 89-3
Traject negatieve kleef : 0.46 tot -0.30 [m]
Traject positieve kleef : -0.30 tot -29.58 [m]

SONDERINGSGEGEVENS GRAFIEK: 89-4



REKENGEGEVENS Mast 81

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 81-1, 81-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.37
Paalpuntniveau : N.A.P. -14.48
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 81 (n=1)

Project :
Onderdeel :

Sondering : 81-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.48	-14.48	46.7	600.5	600.5	0.0	0.00

Sondering : 81-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.48	-14.48	46.6	615.6	615.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 81 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
81-1	-0.12	-14.48	600.5	600.5	600.5
81-2	-0.06	-14.48	615.6	615.6	615.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 81 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
81-1	-0.12	-14.48	46.7	629.9
81-2	-0.06	-14.48	46.7	645.8
		-14.48	$R_{t;cal;gem}$	637.8
met ξ_4(min) = 1.32				
81-1	-0.12	-14.48	46.7	629.9
81-2	-0.06	-14.48	46.7	645.8
		-14.48	$R_{t;cal;min}$	629.9

Totaal resultaten Mast 81 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
81-1 81-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.48	$R_{t;d}$ = min.{ 637.8; 629.9}= 629.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.48	629.9	629.9	0.0	629.9	0.00

REKENGEGEVENS Mast 84

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 84-1, 84-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.65
Paalpuntniveau : N.A.P. -16.80
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 84 (n=1)

Project :
Onderdeel :

Sondering : 84-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.80	-16.80	53.4	790.7	790.7	0.0	0.00

Sondering : 84-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.80	-16.80	53.4	855.0	855.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 84 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
84-1	0.50	-16.80	790.7	790.7	790.7
84-2	0.67	-16.80	855.0	855.0	855.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 84 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
84-1	0.50	-16.80	53.4	829.8
84-2	0.67	-16.80	53.4	897.6
		-16.80	$R_{t;cal;gem}$	863.7
met ξ_4(min) = 1.32				
84-1	0.50	-16.80	53.4	829.8
84-2	0.67	-16.80	53.4	897.6
		-16.80	$R_{t;cal;min}$	829.8

Totaal resultaten Mast 84 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
84-1 84-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-16.80 $R_{t;d}$ = min.{ 863.7; 829.8}= 829.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.80	829.8	829.8	0.0	829.8	0.00

REKENGEGEVENS Mast 85

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 85-1A, 85-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.94
Paalpuntniveau : N.A.P. -11.91
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 85 (n=1)

Project :
Onderdeel :

Sondering : 85-1A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.91	-11.91	40.6	585.5	585.5	0.0	0.00

Sondering : 85-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.91	-11.91	40.6	577.5	577.5	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 85 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
85-1A	0.59	-11.91	585.5	585.5	585.5
85-2	0.57	-11.91	577.5	577.5	577.5

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 85 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
85-1A	0.59	-11.91	40.6	614.4
85-2	0.57	-11.91	40.6	606.0
		-11.91	$R_{t;cal;gem}$	610.2
met ξ_4(min) = 1.32				
85-1A	0.59	-11.91	40.6	614.4
85-2	0.57	-11.91	40.6	606.0
		-11.91	$R_{t;cal;min}$	606.0

Totaal resultaten Mast 85 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
85-1A 85-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-11.91	$R_{t;d}$ = min.{ 610.2; 606.0}= 606.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-11.91	606.0	606.0	0.0	606.0	0.00

REKENGEGEVENS Mast 86

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 86-1, 86-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.72
Paalpuntniveau : N.A.P. -11.88
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 86 (n=1)

Project :
Onderdeel :

Sondering : 86-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.88	-11.88	39.3	602.8	602.8	0.0	0.00

Sondering : 86-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.88	-11.88	39.3	594.6	594.6	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 86 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
86-1	0.61	-11.88	602.8	602.8	602.8
86-2	0.80	-11.88	594.6	594.6	594.6

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 86 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
86-1	0.61	-11.88	39.3	632.6
86-2	0.80	-11.88	39.3	624.1
		-11.88	$R_{t;cal;gem}$	628.3
met ξ_4(min) = 1.32				
86-1	0.61	-11.88	39.3	632.6
86-2	0.80	-11.88	39.3	624.1
		-11.88	$R_{t;cal;min}$	624.1

Totaal resultaten Mast 86 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
86-1 86-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-11.88 $R_{t;d}$ = min.{ 628.3; 624.1}= 624.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-11.88	624.1	624.1	0.0	624.1	0.00

REKENGEGEVENS Mast 87

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 87-1, 87-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.66
Paalpuntniveau : N.A.P. -12.84
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 87 (n=1)

Project :
Onderdeel :

Sondering : 87-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.84	-12.84	41.7	585.6	585.6	0.0	0.00

Sondering : 87-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-12.84	-12.84	41.7	620.4	620.4	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 87 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
87-1	0.64	-12.84	585.6	585.6	585.6
87-2	0.67	-12.84	620.4	620.4	620.4

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 87 (van 2 sonderingen)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
87-1	0.64	-12.84	41.7	614.4
87-2	0.67	-12.84	41.7	651.1
		-12.84	$R_{t;cal;gem}$	632.8
met ξ_4(min) = 1.32				
87-1	0.64	-12.84	41.7	614.4
87-2	0.67	-12.84	41.7	651.1
		-12.84	$R_{t;cal;min}$	614.4

Totaal resultaten Mast 87 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
87-1 87-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-12.84 $R_{t;d}$ = min.{ 632.8; 614.4}= 614.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-12.84	614.4	614.4	0.0	614.4	0.00

REKENGEGEVENS Mast 89

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 89-1, 89-2, 89-3, 89-4
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 711_871
Niveau paalkop [m] : N.A.P. 0.82
Paalpuntniveau : N.A.P. -14.23
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 89 (n=1)

Project :
Onderdeel :

Sondering : 89-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.23	-14.23	114.3	1780.4	1780.4	0.0	0.00

Sondering : 89-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.23	-14.23	114.3	1609.5	1609.5	0.0	0.00

Sondering : 89-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.23	-14.23	114.3	1708.7	1708.7	0.0	0.00

Sondering : 89-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.23	-14.23	114.3	1862.9	1862.9	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 89 (n=1)

Uitgangspunten
- paal : GI 711_871
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 871 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
89-1	0.38	-14.23	1780.4	1780.4	1780.4
89-2	0.37	-14.23	1609.5	1609.5	1609.5
89-3	0.42	-14.23	1708.7	1708.7	1708.7
89-4	0.46	-14.23	1862.9	1862.9	1862.9

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 89 (van 4 sonderingen)

Uitgangspunten
- paal : GI 711_871
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 871 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=4)}$: 1.28
Correlatiefactor $\xi_{4min(n=4)}$: 1.03

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.28				
89-1	0.38	-14.23	114.3	1923.6
89-2	0.37	-14.23	114.3	1738.0
89-3	0.42	-14.23	114.3	1845.7
89-4	0.46	-14.23	114.3	2013.1
		-14.23	$R_{t;cal;gem}$	1880.1
met ξ_4(min) = 1.03				
89-1	0.38	-14.23	114.3	2362.8
89-2	0.37	-14.23	114.3	2132.1
89-3	0.42	-14.23	114.3	2265.9
89-4	0.46	-14.23	114.3	2474.0
		-14.23	$R_{t;cal;min}$	2132.1

Totaal resultaten Mast 89 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
89-1 89-2 89-3 89-4

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.23	$R_{t;d}$ = min.{ 1880.1; 2132.1}= 1880.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.23	1880.1	1880.1	0.0	1880.1	0.00

PAALGEGEVENS BP 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project :
Onderdeel :

PAALGEGEVENS GI 711_871

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 0.871
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{t;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 81	Mast 84	Mast 85	Mast 86	Mast 87
81-1	-0.12	-14.48	600				
81-2	-0.06	-14.48	615				
84-1	0.50	-16.80		790			
84-2	0.67	-16.80		855			
85-1A	0.59	-11.91			585		
85-2	0.57	-11.91			577		
86-1	0.61	-11.88				602	
86-2	0.80	-11.88				594	
87-1	0.64	-12.84					585
87-2	0.67	-12.84					620

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 89
89-1	0.38	-14.23	1780
89-2	0.37	-14.23	1609
89-3	0.42	-14.23	1708
89-4	0.46	-14.23	1862

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 90-P-ZL.pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
12	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50

BODEMPROFIELGEGEVENS: 90-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.45 Grondwaterstand [m] : -0.55

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.45	-0.25	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.25	-2.79	Zand - Schoon - Los	1.0	100.0		
3	-2.79	-4.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-4.21	-8.38	Zand - Schoon - Los	1.0	100.0		
5	-8.38	-10.89	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-10.89	-12.84	Klei - Schoon - Matig	1.0	50.0		
7	-12.84	-14.12	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-14.12	-15.18	Zand - Schoon - Vast	1.0	100.0		
9	-15.18	-15.71	Leem - Zwak zandig - Vast	1.0	50.0		
10	-15.71	-23.46	Zand - Schoon - Matig	1.0	100.0		
11	-23.46	-23.83	Klei - Schoon - Matig	1.0	50.0		
12	-23.83	-24.98	Zand - Sterk siltig - Kleiig	1.0	100.0		
13	-24.98	-25.46	Zand - Schoon - Vast	1.0	100.0		
14	-25.46	-28.62	Zand - Sterk siltig - Kleiig	1.0	100.0		
15	-28.62	-28.89	Zand - Schoon - Vast	1.0	100.0		
16	-28.89	-29.61	Zand - Schoon - Los	1.0	100.0		

BODEMPROFIELGEGEVENS: 90-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.44 Grondwaterstand [m] : -0.56

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.44	-0.50	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.50	-1.61	Zand - Schoon - Matig	1.0	100.0		
3	-1.61	-5.27	Zand - Schoon - Los	1.0	100.0		
4	-5.27	-9.55	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-9.55	-10.21	Klei - Schoon - Vast	1.0	50.0		
6	-10.21	-11.01	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-11.01	-13.46	Klei - Schoon - Matig	1.0	50.0		
8	-13.46	-21.45	Zand - Schoon - Matig	1.0	100.0		
9	-21.45	-22.49	Zand - Schoon - Vast	1.0	100.0		
10	-22.49	-24.44	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-24.44	-24.90	Leem - Zwak zandig - Vast	1.0	50.0		

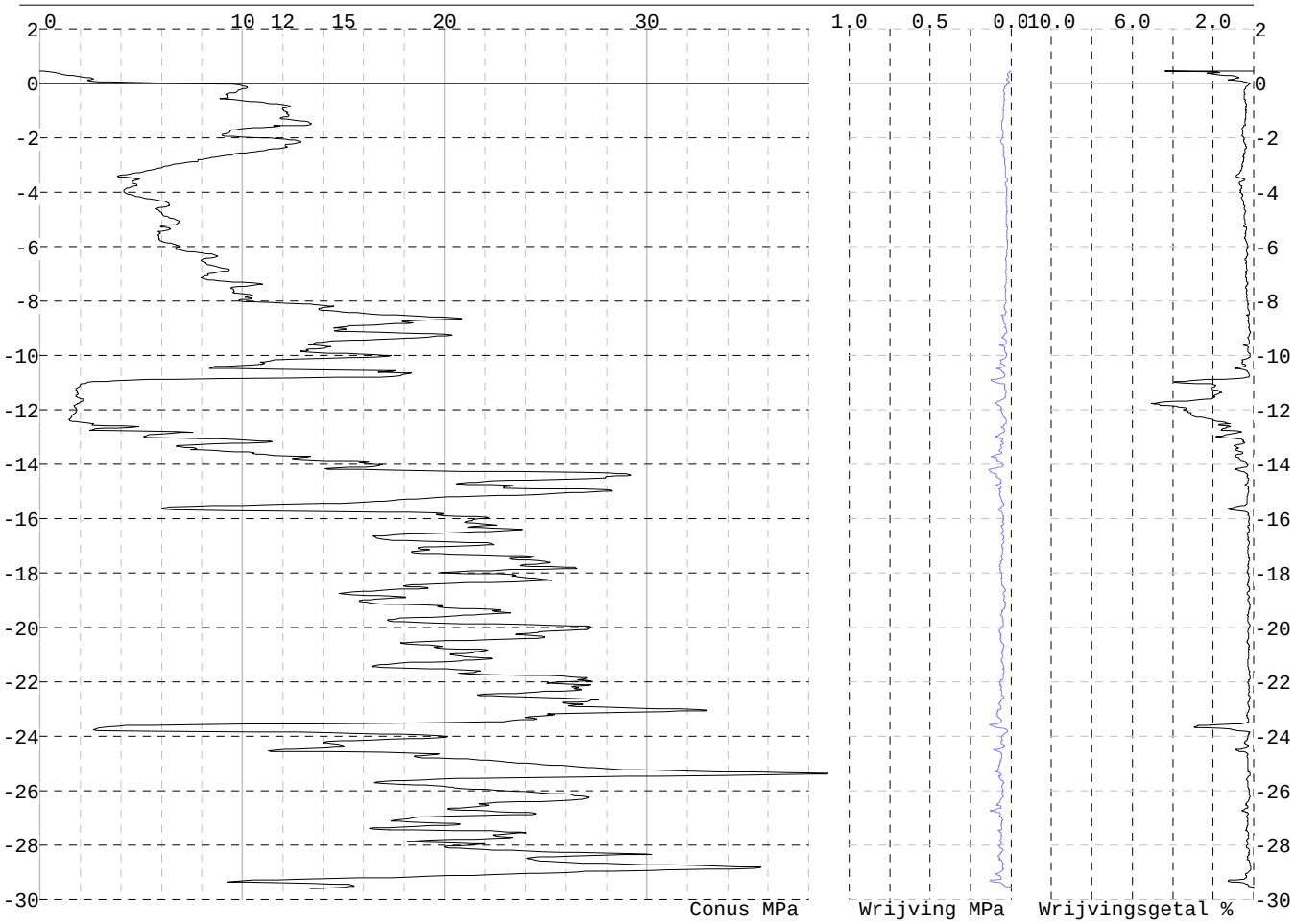
Project :
Onderdeel :

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
12	-24.90	-25.91	Zand - Schoon - Vast	1.0	100.0		
13	-25.91	-28.75	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-28.75	-29.65	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: 90-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.45 Bodemprofiel: 90-1
Traject negatieve kleef : 0.45 tot -0.30 [m]
Traject positieve kleef : -0.30 tot -29.62 [m]

SONDERINGSGEGEVENS GRAFIEK: 90-1

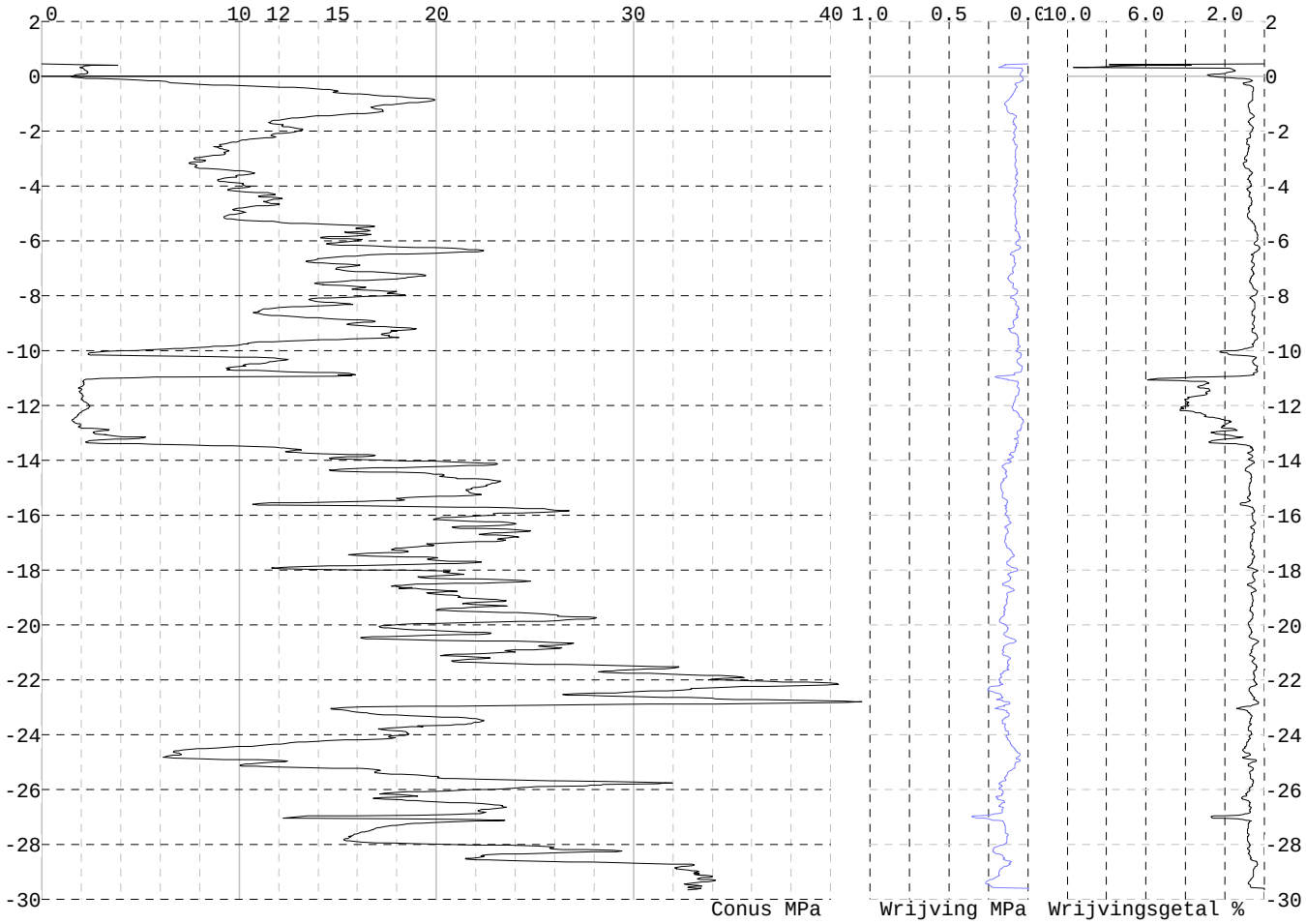


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 90-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.44 Bodemprofiel: 90-2
Traject negatieve kleef : 0.44 tot -0.60 [m]
Traject positieve kleef : -0.60 tot -29.66 [m]

SONDERINGSGEGEVENS GRAFIEK: 90-2

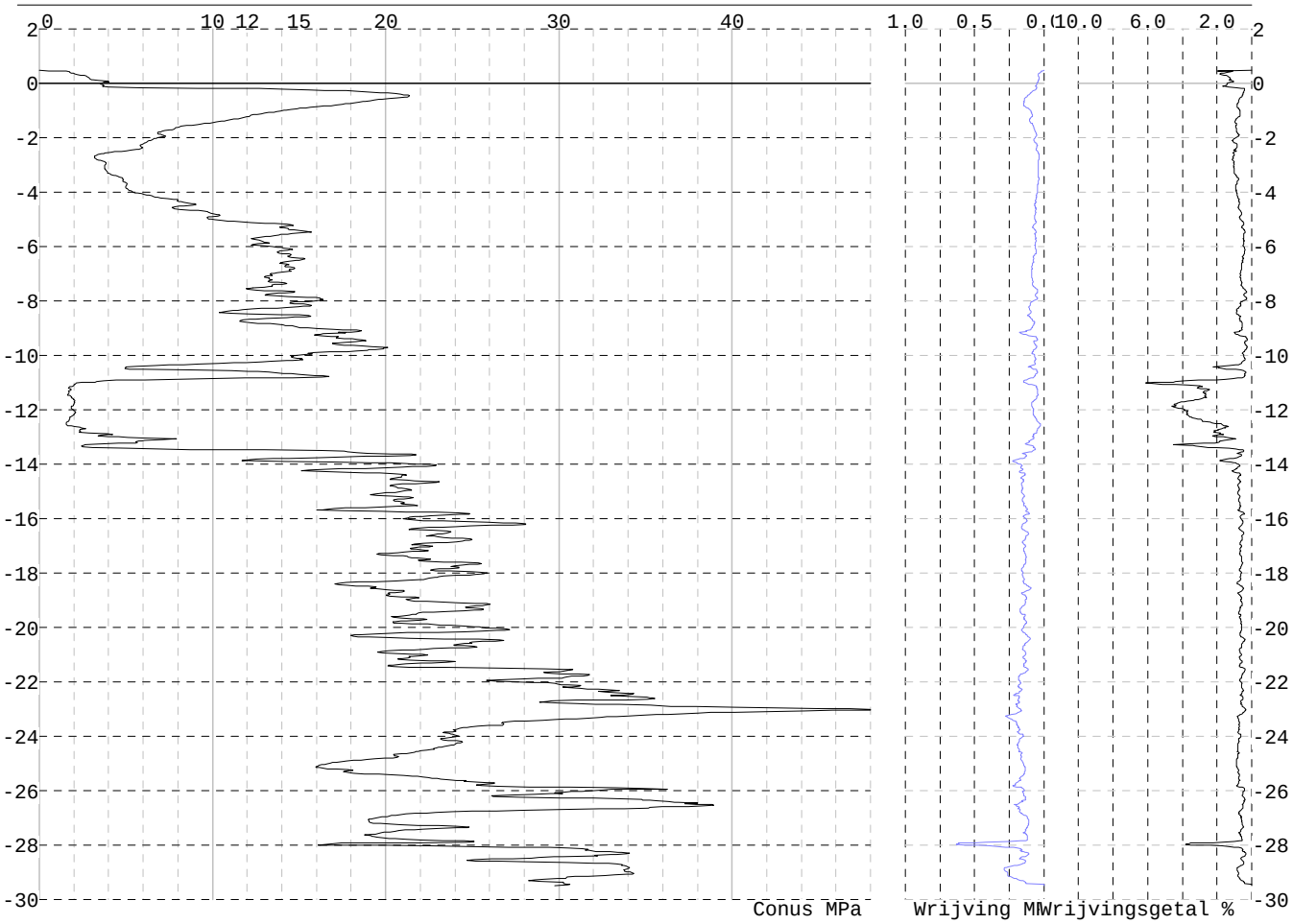


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 90-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.47 Bodemprofiel: 90-2
Traject negatieve kleef : 0.47 tot -0.30 [m]
Traject positieve kleef : -0.30 tot -29.50 [m]

SONDERINGSGEGEVENS GRAFIEK: 90-3

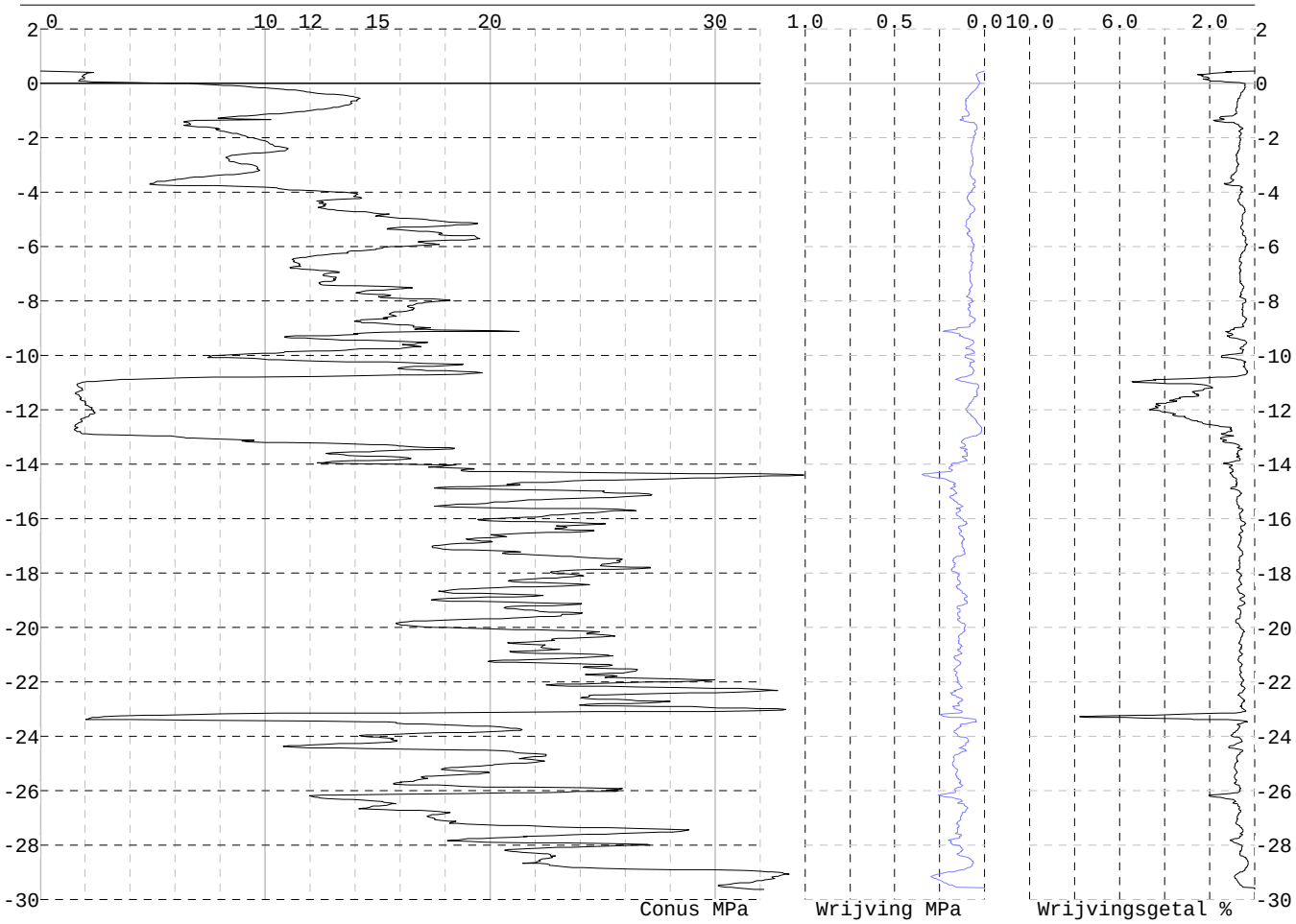


Project :
Onderdeel :

SONDERINGSGEGEVENS ALGEMEEN: 90-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.44 Bodemprofiel: 90-1
Traject negatieve kleef : 0.44 tot -1.50 [m]
Traject positieve kleef : -1.50 tot -29.65 [m]

SONDERINGSGEGEVENS GRAFIEK: 90-4



REKENGEGEVENS Mast 90

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : 90-1, 90-2, 90-3, 90-4
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.89
Paalpuntniveau : N.A.P. -18.51
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 90 (n=1)

Project :
Onderdeel :

Sondering : 90-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.51	-18.51	221.2	2814.1	2814.1	0.0	0.00

Sondering : 90-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.51	-18.51	221.3	3144.3	3144.3	0.0	0.00

Sondering : 90-3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.51	-18.51	221.3	2984.5	2984.5	0.0	0.00

Sondering : 90-4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.51	-18.51	221.2	3171.0	3171.0	0.0	0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 90 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
90-1	0.45	-18.51	2814.1	2814.1	2814.1
90-2	0.44	-18.51	3144.3	3144.3	3144.3
90-3	0.47	-18.51	2984.5	2984.5	2984.5
90-4	0.44	-18.51	3171.0	3171.0	3171.0

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 90 (van 4 sonderingen)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=4)}$: 1.28
Correlatiefactor $\xi_{4min(n=4)}$: 1.03

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.28				
90-1	0.45	-18.51	221.2	3036.9
90-2	0.44	-18.51	221.2	3395.5
90-3	0.47	-18.51	221.2	3221.9
90-4	0.44	-18.51	221.2	3424.5
		-18.51	$R_{t;cal;gem}$	3269.7
met ξ_4(min) = 1.03				
90-1	0.45	-18.51	221.2	3720.3
90-2	0.44	-18.51	221.2	4165.9
90-3	0.47	-18.51	221.2	3950.2
90-4	0.44	-18.51	221.2	4202.0
		-18.51	$R_{t;cal;min}$	3720.3

Totaal resultaten Mast 90 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
90-1 90-2 90-3 90-4

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-18.51	$R_{t;d}$ = min.{ 3269.7; 3720.3}= 3269.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.51	3269.7	3269.7	0.0	3269.7	0.00

PAALGEGEVENS GI 914_1075

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 1.075
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 90
90-1	0.45	-18.51	2814
90-2	0.44	-18.51	3144
90-3	0.47	-18.51	2984
90-4	0.44	-18.51	3170

Project : ENS-ZL380
Onderdeel : Masten 1-8

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 1-8
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL 1-8 (5A).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
9	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
10	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
11	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
12	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
13	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
14	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
15	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
16	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00
17	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 5A-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.93 Grondwaterstand [m] : -1.93

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.93	-6.85	Klei - Schoon - Matig	1.0	50.0		
2	-6.85	-9.05	Leem - Zwak zandig - Matig	1.0	50.0		
3	-9.05	-14.25	Zand - Schoon - Matig	1.0	100.0		
4	-14.25	-16.25	Klei - Schoon - Matig	1.0	50.0		
5	-16.25	-17.35	Zand - Schoon - Matig	1.0	100.0		
6	-17.35	-17.65	Leem - Zwak zandig - Matig	1.0	50.0		
7	-17.65	-31.95	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 5A-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.91 Grondwaterstand [m] : -1.91

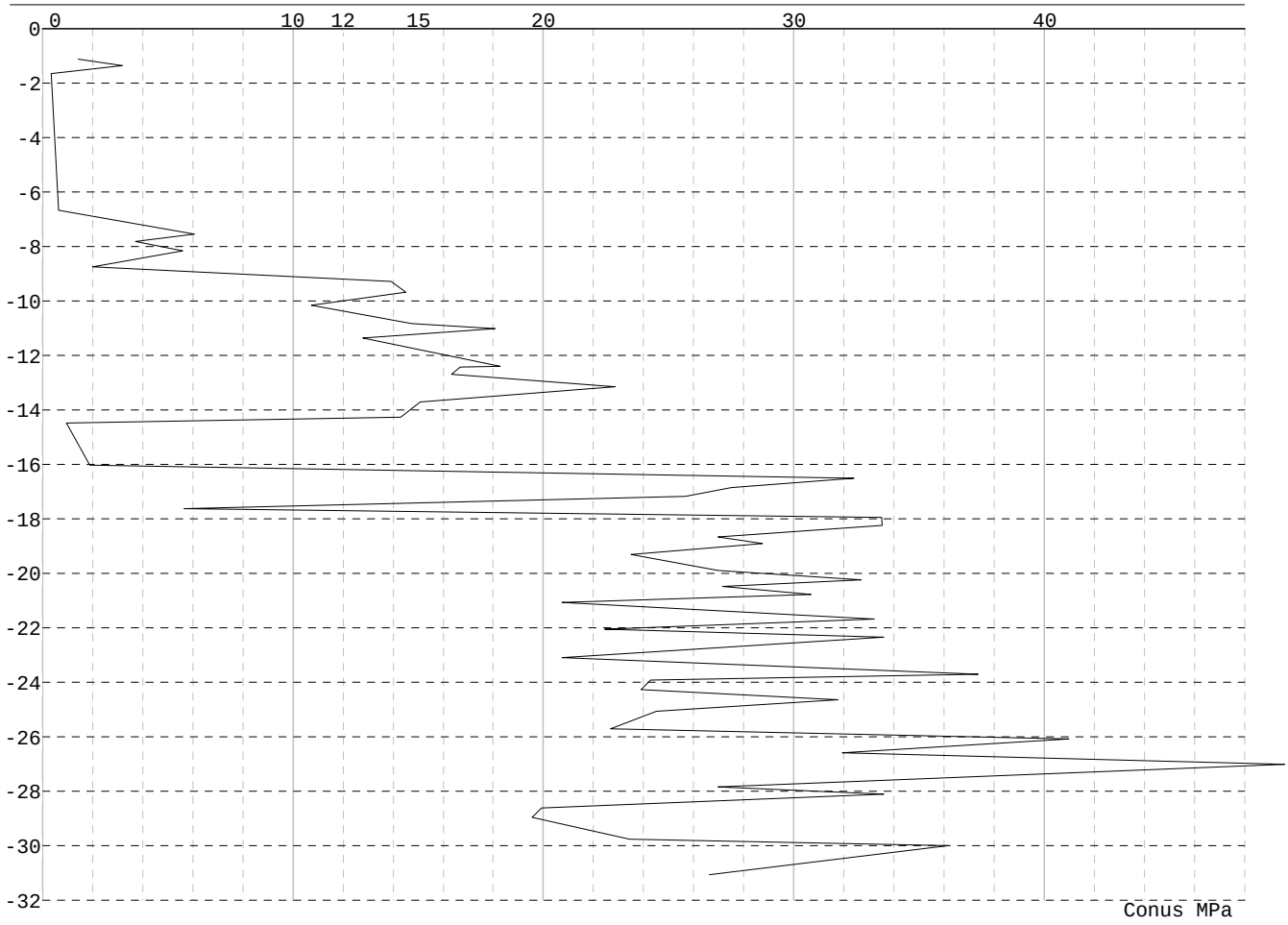
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.91	-7.13	Klei - Schoon - Matig	1.0	50.0		
2	-7.13	-8.63	Leem - Zwak zandig - Matig	1.0	50.0		
3	-8.63	-16.43	Zand - Schoon - Matig	1.0	100.0		
4	-16.43	-18.63	Klei - Schoon - Matig	1.0	50.0		
5	-18.63	-30.85	Zand - Schoon - Matig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 5A-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.93 Bodemprofiel: Son 5A-1
Traject negatieve kleef : -1.13 tot -5.10 [m]
Traject positieve kleef : -8.90 tot -31.07 [m]

Project : ENS-ZL380
Onderdeel : Masten 1-8

SONDERINGSGEGEVENS GRAFIEK: Son 5A-1

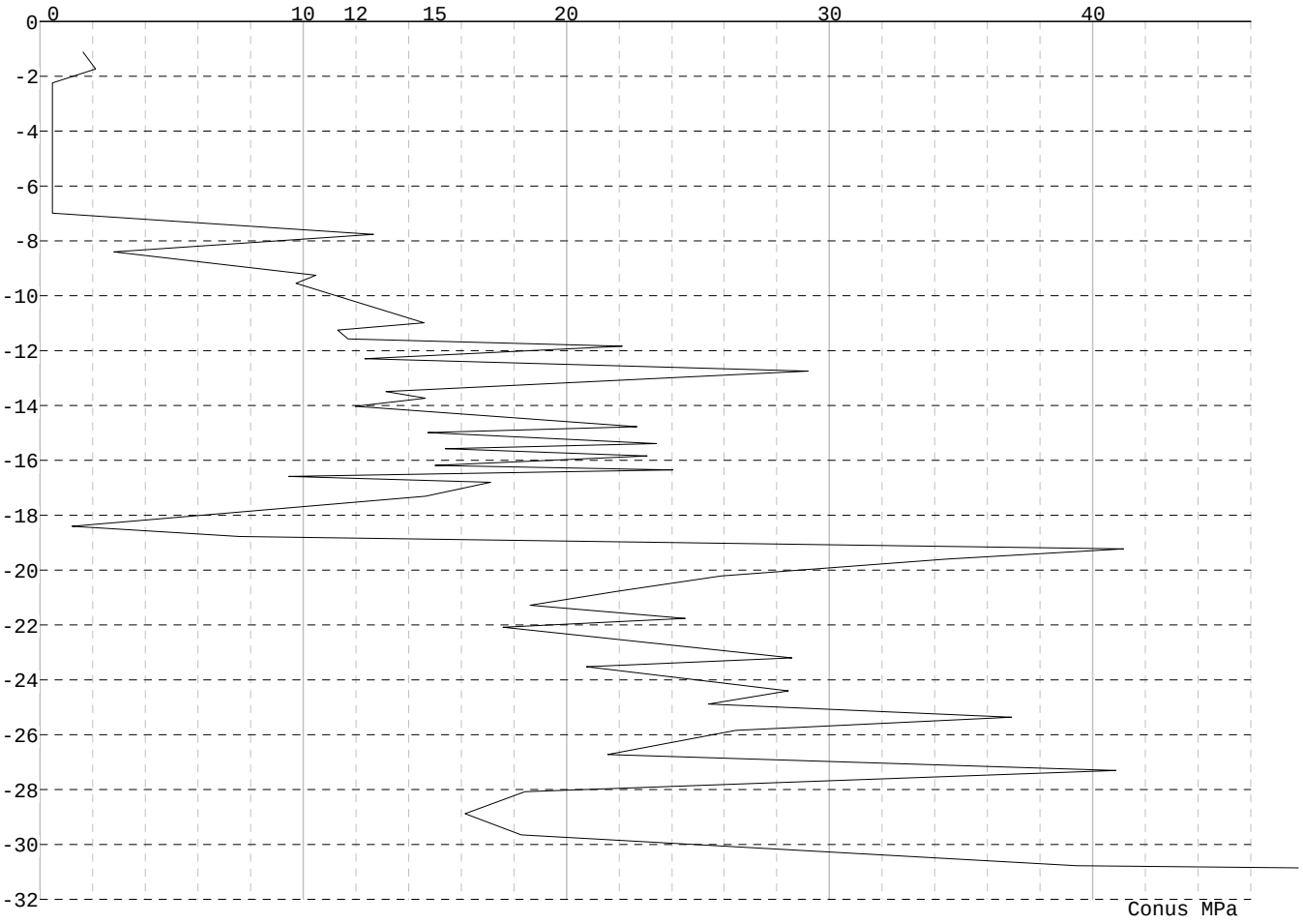


Project : ENS-ZL380
Onderdeel : Masten 1-8

SONDERINGSGEGEVENS ALGEMEEN: Son 5A-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.91 Bodemprofiel: Son 5A-2
Traject negatieve kleef : -1.12 tot -5.00 [m]
Traject positieve kleef : -8.60 tot -30.85 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 5A-2



Project : ENS-ZL380
Onderdeel : Masten 1-8

REKENGEGEVENS Mast 5A

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 5A-1, Son 5A-2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : SI 400mm
Niveau paalkop [m] : N.A.P. -2.85
Paalpuntniveau : N.A.P. -24.35
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 5A (n=1)

Sondering : Son 5A-1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-24.35	-24.35	31.9	918.1	918.1	0.0	0.00

Sondering : Son 5A-2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-24.35	-24.35	31.9	987.8	987.8	0.0	0.00

Project : ENS-ZL380
Onderdeel : Masten 1-8

SAMENVATTINGSTABEL Mast 5A (n=1)

Uitgangspunten
- paal : SI 400mm
- paaltype : In de grond gevormde geschroefde paal; groutinjectie
- schachtafmeting : 400 mm

Paalklassefactor α_p : 0.90
Factor α_t (tabel 7.c EC 7.1) : 0.0090 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 5A-1	-0.93	-24.35	918.1	918.1	918.1
Son 5A-2	-0.91	-24.35	987.8	987.8	987.8

Project : ENS-ZL380
Onderdeel : Masten 1-8

SAMENVATTINGSTABEL Mast 5A (van 2 sonderingen)

Uitgangspunten
- paal : SI 400mm
- paaltype : In de grond gevormde geschroefde paal; groutinjectie
- schachtafmeting : 400 mm
Paalklassefactor α_p : 0.90
Factor α_t (tabel 7.c EC 7.1) : 0.0090 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
Son 5A-1	-0.93	-24.35	31.9	965.1
Son 5A-2	-0.91	-24.35	31.9	1038.5
		-24.35	$R_{t;cal;gem}$	1001.8
met ξ_4(min) = 1.32				
Son 5A-1	-0.93	-24.35	31.9	965.1
Son 5A-2	-0.91	-24.35	31.9	1038.5
		-24.35	$R_{t;cal;min}$	965.1

Totaal resultaten Mast 5A (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 5A-1 Son 5A-2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-24.35	$R_{t;d}$ = min.{ 1001.8; 965.1}= 965.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-24.35	965.1	965.1	0.0	965.1	0.00

PAALGEGEVENS SI 400mm

Type : In de grond gevormde geschroefde paal; groutinjectie
Wijze van installeren : Boren
Wijze van terugwinnen : n.v.t.
Diameter [m] : 0.400
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.009 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0090 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 0.90
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 1.00
Groutomhulling : JA

Project : ENS-ZL380
Onderdeel : Masten 1-8

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 5A
Son 5A-1	-0.93	-24.35	918
Son 5A-2	-0.91	-24.35	987

Project : ENS-ZL380
Onderdeel : Masten 9-19

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 9-19
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\Nog te ontvangen\ENS-ZL380 9-19 (12).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
9	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
10	Klei - Schoon - Slap	14.00	14.00	17.50	17.00	17.00	17.50
11	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
12	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
13	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
14	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
15	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
16	Klei - Organisch - Slap	13.00	13.00	15.00	15.00	15.00	15.00
17	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
18	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00
19	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 12B (2)

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.00 Grondwaterstand [m] : -1.00

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.00	-0.45	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.45	-0.60	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-0.60	-0.80	Klei - Zwak zandig - Matig	1.0	50.0		
4	-0.80	-1.14	Zand - Schoon - Matig	1.0	100.0		
5	-1.14	-1.40	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-1.40	-1.78	Zand - Schoon - Los	1.0	100.0		
7	-1.78	-2.04	Klei - Zwak zandig - Vast	1.0	50.0		
8	-2.04	-2.23	Grind - Sterk siltig - Los	1.0	0.0		
9	-2.23	-2.35	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-2.35	-2.84	Klei - Zwak zandig - Slap	1.0	50.0		
11	-2.84	-2.96	Leem - Zwak zandig - Vast	1.0	50.0		
12	-2.96	-3.38	Klei - Zwak zandig - Vast	1.0	50.0		
13	-3.38	-3.80	Klei - Organisch - Matig	1.0	50.0		
14	-3.80	-4.40	Veen - Matig voorbelast - Matig	1.0	0.0		
15	-4.40	-4.59	Klei - Zwak zandig - Slap	1.0	50.0		
16	-4.59	-5.01	Klei - Schoon - Matig	1.0	50.0		
17	-5.01	-5.46	Klei - Zwak zandig - Slap	1.0	50.0		
18	-5.46	-6.46	Zand - Schoon - Matig	1.0	100.0		
19	-6.46	-6.84	Zand - Zwak siltig - Kleiig	1.0	100.0		
20	-6.84	-7.25	Zand - Schoon - Matig	1.0	100.0		
21	-7.25	-7.78	Zand - Schoon - Los	1.0	100.0		
22	-7.78	-8.53	Zand - Schoon - Matig	1.0	100.0		
23	-8.53	-9.40	Grind - Sterk siltig - Los	1.0	0.0		
24	-9.40	-10.00	Zand - Schoon - Matig	1.0	100.0		
25	-10.00	-10.19	Zand - Zwak siltig - Kleiig	1.0	100.0		
26	-10.19	-10.32	Grind - Sterk siltig - Los	1.0	0.0		
27	-10.32	-10.67	Zand - Sterk siltig - Kleiig	1.0	100.0		

Project : ENS-ZL380
Onderdeel : Masten 9-19

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
28	-10.67	-10.86	Zand - Zwak siltig - Kleiig	1.0	100.0		
29	-10.86	-11.18	Grind - Sterk siltig - Los	1.0	0.0		
30	-11.18	-11.72	Zand - Zwak siltig - Kleiig	1.0	100.0		
31	-11.72	-11.94	Zand - Schoon - Matig	1.0	100.0		
32	-11.94	-12.35	Leem - Zwak zandig - Vast	1.0	50.0		
33	-12.35	-12.56	Zand - Schoon - Los	1.0	100.0		
34	-12.56	-13.37	Klei - Zwak zandig - Slap	1.0	50.0		
35	-13.37	-14.00	Zand - Schoon - Los	1.0	100.0		
36	-14.00	-14.19	Leem - Zwak zandig - Vast	1.0	50.0		
37	-14.19	-14.98	Zand - Schoon - Vast	1.0	100.0		
38	-14.98	-16.99	Grind - Zwak siltig - Vast	1.0	0.0		
39	-16.99	-17.02	Zand - Schoon - Matig	1.0	100.0		
40	-17.02	-17.18	Grind - Zwak siltig - Vast	1.0	0.0		
41	-17.18	-25.00	Leem - Zwak zandig - Vast	1.0	50.0		

BODEMPROFIELGEGEVENS: Son 12A v3.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.75 Grondwaterstand [m] : -0.25

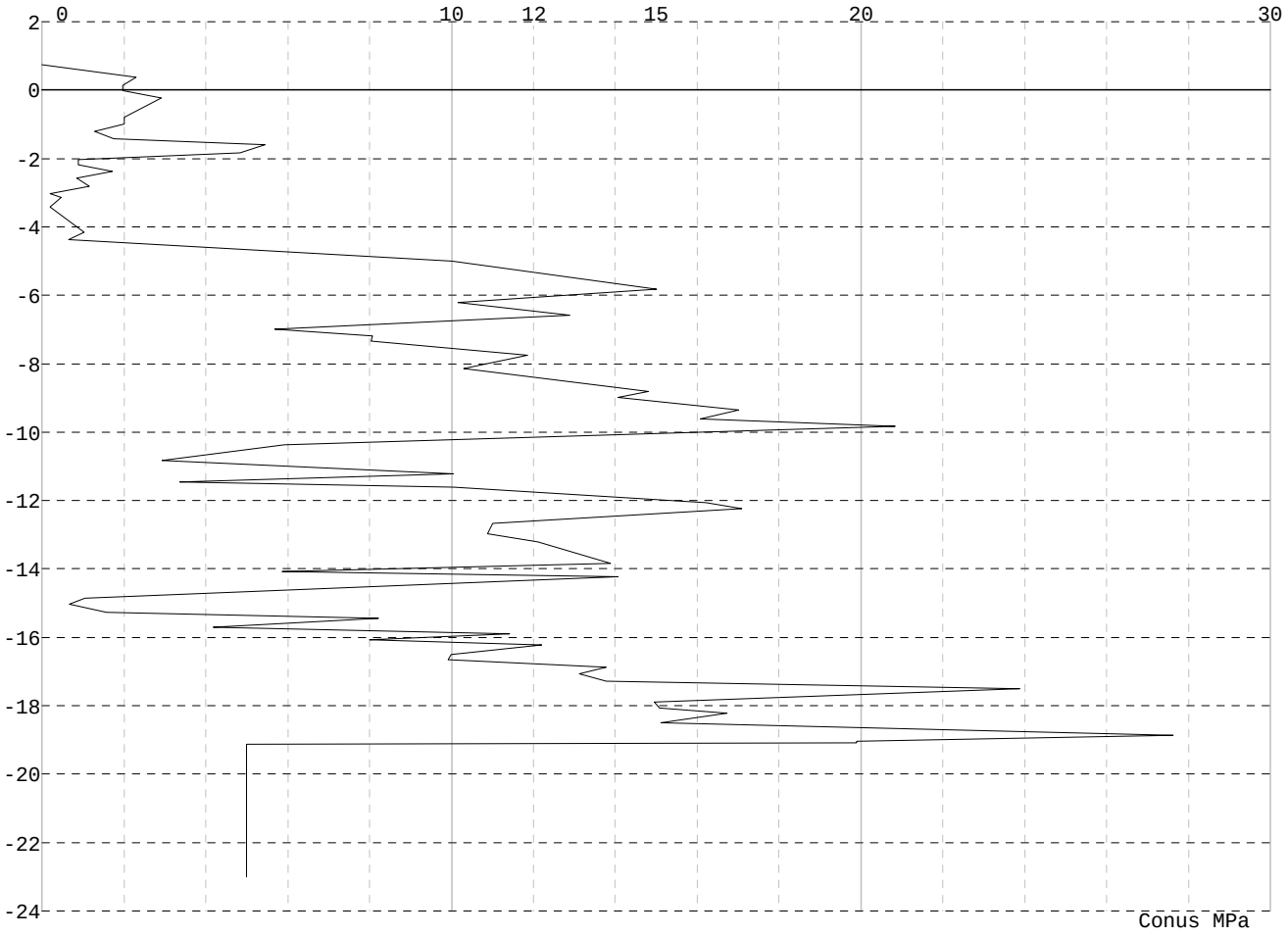
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.75	0.38	Zand - Schoon - Matig	1.0	100.0		
2	0.38	0.14	Grind - Sterk siltig - Los	1.0	50.0		
3	0.14	-0.02	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-0.02	-0.23	Grind - Sterk siltig - Los	1.0	50.0		
5	-0.23	-0.98	Zand - Schoon - Los	1.0	100.0		
6	-0.98	-1.42	Leem - Zwak zandig - Vast	1.0	50.0		
7	-1.42	-1.59	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-1.59	-1.83	Grind - Sterk siltig - Los	1.0	50.0		
9	-1.83	-2.19	Klei - Zwak zandig - Matig	1.0	50.0		
10	-2.19	-2.38	Leem - Zwak zandig - Vast	1.0	50.0		
11	-2.38	-2.58	Klei - Zwak zandig - Matig	1.0	50.0		
12	-2.58	-2.80	Klei - Schoon - Vast	1.0	50.0		
13	-2.80	-3.42	Veen - Matig voorbelast - Matig	1.0	50.0		
14	-3.42	-4.16	Klei - Zwak zandig - Matig	1.0	50.0		
15	-4.16	-4.36	Klei - Zwak zandig - Slap	1.0	50.0		
16	-4.36	-5.83	Zand - Schoon - Matig	1.0	100.0		
17	-5.83	-6.21	Zand - Zwak siltig - Kleiig	1.0	100.0		
18	-6.21	-6.58	Zand - Schoon - Matig	1.0	100.0		
19	-6.58	-6.99	Zand - Schoon - Los	1.0	100.0		
20	-6.99	-7.33	Zand - Sterk siltig - Kleiig	1.0	100.0		
21	-7.33	-7.75	Zand - Zwak siltig - Kleiig	1.0	100.0		
22	-7.75	-8.14	Grind - Sterk siltig - Los	1.0	50.0		
23	-8.14	-8.82	Zand - Schoon - Matig	1.0	100.0		
24	-8.82	-8.99	Zand - Zwak siltig - Kleiig	1.0	100.0		
25	-8.99	-9.84	Zand - Schoon - Matig	1.0	100.0		
26	-9.84	-10.38	Zand - Schoon - Los	1.0	100.0		
27	-10.38	-10.83	Klei - Zwak zandig - Vast	1.0	50.0		
28	-10.83	-11.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
29	-11.21	-11.46	Klei - Zwak zandig - Vast	1.0	50.0		
30	-11.46	-11.61	Zand - Sterk siltig - Kleiig	1.0	100.0		
31	-11.61	-12.24	Zand - Zwak siltig - Kleiig	1.0	100.0		
32	-12.24	-13.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
33	-13.21	-13.84	Grind - Sterk siltig - Los	1.0	50.0		
34	-13.84	-14.07	Leem - Zwak zandig - Vast	1.0	50.0		
35	-14.07	-14.23	Grind - Sterk siltig - Los	1.0	50.0		
36	-14.23	-14.86	Klei - Zwak zandig - Slap	1.0	50.0		
37	-14.86	-15.04	Veen - Matig voorbelast - Matig	1.0	50.0		
38	-15.04	-15.26	Klei - Schoon - Matig	1.0	50.0		
39	-15.26	-15.45	Zand - Schoon - Los	1.0	100.0		
40	-15.45	-15.71	Klei - Zwak zandig - Vast	1.0	50.0		
41	-15.71	-16.06	Zand - Schoon - Los	1.0	100.0		
42	-16.06	-16.23	Zand - Sterk siltig - Kleiig	1.0	100.0		
43	-16.23	-16.65	Zand - Schoon - Los	1.0	100.0		
44	-16.65	-17.28	Zand - Sterk siltig - Kleiig	1.0	100.0		
45	-17.28	-17.51	Zand - Schoon - Matig	1.0	100.0		
46	-17.51	-18.07	Zand - Sterk siltig - Kleiig	1.0	100.0		
47	-18.07	-18.22	Grind - Sterk siltig - Los	1.0	50.0		
48	-18.22	-18.49	Zand - Sterk siltig - Kleiig	1.0	100.0		
49	-18.49	-18.87	Zand - Schoon - Matig	1.0	100.0		
50	-18.87	-19.03	Zand - Zwak siltig - Kleiig	1.0	100.0		
51	-19.03	-23.00	Zand - Schoon - Matig	1.0	100.0		

Project : ENS-ZL380
Onderdeel : Masten 9-19

SONDERINGSGEGEVENS ALGEMEEN: Son 12A v3.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.75 Bodemprofiel: Son 12A v3.0
Traject negatieve kleef : 0.75 tot -4.50 [m]
Traject positieve kleef : -4.50 tot -19.22 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 12A v3.0

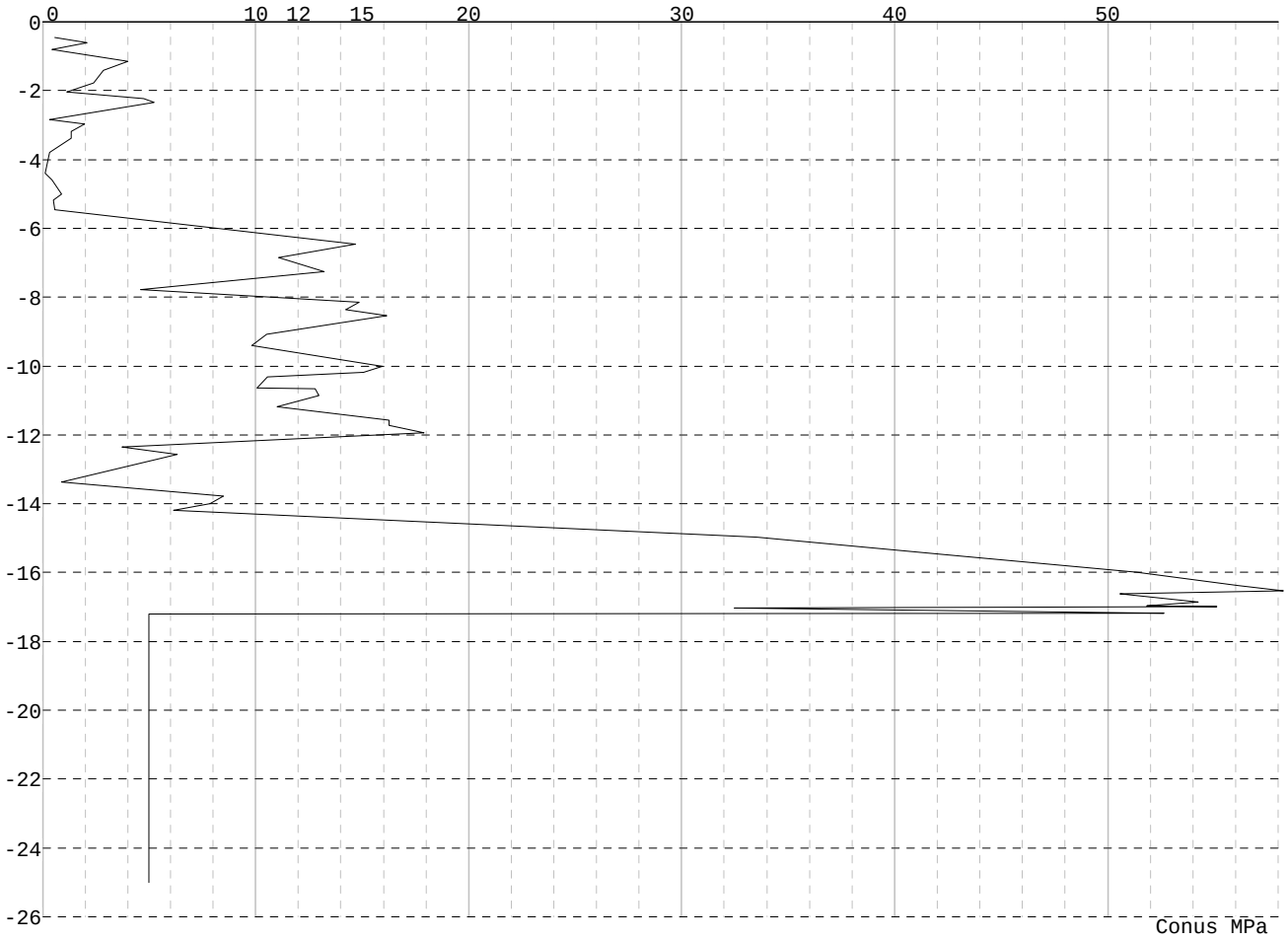


Project : ENS-ZL380
Onderdeel : Masten 9-19

SONDERINGSGEGEVENS ALGEMEEN: Son 12B v2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.00 Bodemprofiel: Son 12B (2)
Traject negatieve kleef : -0.45 tot -5.60 [m]
Traject positieve kleef : -5.60 tot -25.00 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 12B v2



REKENGEGEVENS Mast 12

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 12A v3.0, Son 12B v2
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 610_770
Niveau paalkop [m] : N.A.P. 1.55
Paalpuntniveau : N.A.P. -18.15
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 12 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 9-19

Sondering : Son 12A v3.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.15	-18.15	116.8	1517.0	1517.0	0.0	0.00

Sondering : Son 12B v2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.15	-18.15	120.3	1064.6	1064.6	0.0	0.00

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 12 (n=1)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 12A v3.0	0.75	-18.15	1517.0	1517.0	1517.0
Son 12B v2	0.00	-18.15	1064.6	1064.6	1064.6

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 12 (van 2 sonderingen)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
Son 12A v3.0	0.75	-18.15	116.8	1591.2
Son 12B v2	0.00	-18.15	116.8	1114.6
		-18.15	$R_{t;cal;gem}$	1352.9
met ξ_4(min) = 1.32				
Son 12A v3.0	0.75	-18.15	116.8	1591.2
Son 12B v2	0.00	-18.15	116.8	1114.6
		-18.15	$R_{t;cal;min}$	1114.6

Totaal resultaten Mast 12 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 12A v3.0 Son 12B v2

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-18.15	$R_{t;d}$ = min.{ 1352.9; 1114.6}= 1114.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.15	1114.6	1114.6	0.0	1114.6	0.00 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{t;cal;gem}$ [kN]	Var.coëff. [%]
-18.15	2	1352.93	24.9

Project : ENS-ZL380
Onderdeel : Masten 9-19

PAALGEGEVENS GI 610_770

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 0.770
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 12
Son 12A v3.0	0.75	-18.15	1516
Son 12B v2	0.00	-18.15	1064

Project : ENS-ZL380
Onderdeel : Masten 9-19

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 9-19
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 9-19 (15 16 17 18).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
9	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
10	Klei - Schoon - Slap	14.00	14.00	17.50	17.00	17.00	17.50
11	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
12	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
13	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
14	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
15	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
16	Klei - Organisch - Slap	13.00	13.00	15.00	15.00	15.00	15.00
17	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
18	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00
19	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 15

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.55 Grondwaterstand [m] : -0.45

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.55	0.14	Zand - Sterk siltig - Kleiig	1.0	100.0		
2	0.14	-0.17	Klei - Zwak zandig - Matig	1.0	50.0		
3	-0.17	-0.47	Klei - Schoon - Matig	1.0	50.0		
4	-0.47	-0.81	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-0.81	-0.99	Zand - Schoon - Los	1.0	100.0		
6	-0.99	-1.25	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-1.25	-1.51	Zand - Schoon - Los	1.0	100.0		
8	-1.51	-1.99	Veen - Niet voorbelast - Slap	1.0	0.0		
9	-1.99	-2.29	Klei - Zwak zandig - Matig	1.0	50.0		
10	-2.29	-2.42	Klei - Schoon - Matig	1.0	50.0		
11	-2.42	-3.25	Veen - Matig voorbelast - Matig	1.0	0.0		
12	-3.25	-4.60	Zand - Schoon - Matig	1.0	100.0		
13	-4.60	-4.66	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-4.66	-4.92	Zand - Schoon - Los	1.0	100.0		
15	-4.92	-5.18	Zand - Sterk siltig - Kleiig	1.0	100.0		
16	-5.18	-5.75	Zand - Schoon - Los	1.0	100.0		
17	-5.75	-6.12	Grind - Sterk siltig - Los	1.0	0.0		
18	-6.12	-6.55	Zand - Zwak siltig - Kleiig	1.0	100.0		
19	-6.55	-6.73	Grind - Sterk siltig - Los	1.0	0.0		
20	-6.73	-7.35	Zand - Schoon - Matig	1.0	100.0		
21	-7.35	-7.84	Zand - Zwak siltig - Kleiig	1.0	100.0		
22	-7.84	-8.21	Zand - Schoon - Los	1.0	100.0		
23	-8.21	-8.67	Grind - Sterk siltig - Los	1.0	0.0		
24	-8.67	-9.53	Zand - Zwak siltig - Kleiig	1.0	100.0		
25	-9.53	-10.21	Leem - Zwak zandig - Vast	1.0	50.0		
26	-10.21	-10.62	Grind - Sterk siltig - Los	1.0	0.0		
27	-10.62	-10.93	Zand - Sterk siltig - Kleiig	1.0	100.0		
28	-10.93	-11.15	Zand - Schoon - Los	1.0	100.0		

Project : ENS-ZL380
Onderdeel : Masten 9-19

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
29	-11.15	-11.39	Grind - Sterk siltig - Los	1.0	0.0		
30	-11.39	-11.88	Zand - Schoon - Los	1.0	100.0		
31	-11.88	-12.19	Zand - Schoon - Matig	1.0	100.0		
32	-12.19	-13.16	Zand - Zwak siltig - Kleiig	1.0	100.0		
33	-13.16	-13.83	Zand - Schoon - Matig	1.0	100.0		
34	-13.83	-14.64	Zand - Sterk siltig - Kleiig	1.0	100.0		
35	-14.64	-14.97	Grind - Sterk siltig - Los	1.0	50.0		
36	-14.97	-15.21	Zand - Zwak siltig - Kleiig	1.0	100.0		
37	-15.21	-15.58	Grind - Sterk siltig - Los	1.0	0.0		
38	-15.58	-16.00	Zand - Schoon - Los	1.0	100.0		
39	-16.00	-16.27	Leem - Zwak zandig - Vast	1.0	50.0		
40	-16.27	-16.75	Grind - Sterk siltig - Los	1.0	0.0		
41	-16.75	-17.15	Zand - Sterk siltig - Kleiig	1.0	100.0		
42	-17.15	-17.56	Zand - Schoon - Los	1.0	100.0		
43	-17.56	-18.10	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 16

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.20 Grondwaterstand [m] : -1.20

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.20	-0.69	Zand - Zwak siltig - Kleiig	1.0	100.0		
2	-0.69	-1.32	Zand - Schoon - Matig	1.0	100.0		
3	-1.32	-1.45	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-1.45	-2.03	Zand - Schoon - Los	1.0	100.0		
5	-2.03	-2.44	Klei - Schoon - Matig	1.0	50.0		
6	-2.44	-2.51	Zand - Schoon - Los	1.0	100.0		
7	-2.51	-2.70	Klei - Zwak zandig - Matig	1.0	50.0		
8	-2.70	-3.00	Leem - Zwak zandig - Vast	1.0	50.0		
9	-3.00	-3.48	Klei - Zwak zandig - Matig	1.0	50.0		
10	-3.48	-3.98	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-3.98	-4.27	Klei - Zwak zandig - Slap	1.0	50.0		
12	-4.27	-4.57	Klei - Schoon - Matig	1.0	50.0		
13	-4.57	-5.01	Klei - Organisch - Matig	1.0	50.0		
14	-5.01	-5.25	Zand - Schoon - Los	1.0	100.0		
15	-5.25	-5.65	Leem - Zwak zandig - Vast	1.0	50.0		
16	-5.65	-6.29	Zand - Schoon - Matig	1.0	100.0		
17	-6.29	-7.09	Grind - Sterk siltig - Los	1.0	0.0		
18	-7.09	-7.43	Zand - Zwak siltig - Kleiig	1.0	100.0		
19	-7.43	-8.11	Zand - Sterk siltig - Kleiig	1.0	100.0		
20	-8.11	-8.50	Zand - Zwak siltig - Kleiig	1.0	100.0		
21	-8.50	-9.44	Leem - Zwak zandig - Vast	1.0	50.0		
22	-9.44	-10.04	Grind - Sterk siltig - Los	1.0	0.0		
23	-10.04	-10.33	Zand - Schoon - Los	1.0	100.0		
24	-10.33	-10.78	Leem - Zwak zandig - Vast	1.0	50.0		
25	-10.78	-12.28	Zand - Sterk siltig - Kleiig	1.0	100.0		
26	-12.28	-12.78	Leem - Zwak zandig - Vast	1.0	50.0		
27	-12.78	-13.48	Zand - Sterk siltig - Kleiig	1.0	100.0		
28	-13.48	-13.68	Grind - Sterk siltig - Los	1.0	0.0		
29	-13.68	-14.01	Zand - Sterk siltig - Kleiig	1.0	100.0		
30	-14.01	-14.64	Zand - Schoon - Matig	1.0	100.0		
31	-14.64	-15.08	Grind - Sterk siltig - Los	1.0	0.0		
32	-15.08	-15.32	Zand - Zwak siltig - Kleiig	1.0	100.0		
33	-15.32	-15.53	Zand - Sterk siltig - Kleiig	1.0	100.0		
34	-15.53	-16.46	Zand - Schoon - Matig	1.0	100.0		
35	-16.46	-16.70	Zand - Zwak siltig - Kleiig	1.0	100.0		
36	-16.70	-17.15	Zand - Schoon - Matig	1.0	100.0		
37	-17.15	-18.11	Grind - Sterk siltig - Los	1.0	0.0		
38	-18.11	-18.45	Zand - Schoon - Matig	1.0	100.0		
39	-18.45	-18.89	Grind - Sterk siltig - Los	1.0	0.0		
40	-18.89	-19.13	Zand - Schoon - Matig	1.0	100.0		
41	-19.13	-20.24	Zand - Schoon - Los	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 17

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.10 Grondwaterstand [m] : -1.10

Project : ENS-ZL380
Onderdeel : Masten 9-19

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.10	-0.55	Zand - Schoon - Vast	1.0	100.0		
2	-0.55	-1.42	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-1.42	-1.69	Klei - Zwak zandig - Matig	1.0	50.0		
4	-1.69	-2.29	Klei - Zwak zandig - Slap	1.0	50.0		
5	-2.29	-2.81	Leem - Zwak zandig - Vast	1.0	50.0		
6	-2.81	-3.07	Klei - Zwak zandig - Matig	1.0	50.0		
7	-3.07	-3.23	Zand - Schoon - Los	1.0	100.0		
8	-3.23	-3.93	Klei - Zwak zandig - Slap	1.0	50.0		
9	-3.93	-4.24	Klei - Schoon - Matig	1.0	50.0		
10	-4.24	-4.44	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-4.44	-4.97	Klei - Schoon - Matig	1.0	50.0		
12	-4.97	-5.53	Klei - Zwak zandig - Slap	1.0	50.0		
13	-5.53	-5.75	Klei - Schoon - Matig	1.0	50.0		
14	-5.75	-6.90	Grind - Zwak siltig - Vast	1.0	0.0		
15	-6.90	-8.02	Zand - Zwak siltig - Kleiig	1.0	100.0		
16	-8.02	-8.41	Grind - Sterk siltig - Los	1.0	0.0		
17	-8.41	-8.59	Zand - Schoon - Los	1.0	100.0		
18	-8.59	-9.01	Zand - Zwak siltig - Kleiig	1.0	100.0		
19	-9.01	-9.45	Zand - Schoon - Los	1.0	100.0		
20	-9.45	-10.13	Zand - Zwak siltig - Kleiig	1.0	100.0		
21	-10.13	-10.57	Zand - Sterk siltig - Kleiig	1.0	100.0		
22	-10.57	-10.88	Leem - Zwak zandig - Vast	1.0	50.0		
23	-10.88	-11.22	Zand - Sterk siltig - Kleiig	1.0	100.0		
24	-11.22	-11.44	Zand - Schoon - Los	1.0	100.0		
25	-11.44	-11.73	Grind - Sterk siltig - Los	1.0	0.0		
26	-11.73	-12.04	Zand - Schoon - Los	1.0	100.0		
27	-12.04	-12.55	Zand - Zwak siltig - Kleiig	1.0	100.0		
28	-12.55	-12.85	Zand - Schoon - Matig	1.0	100.0		
29	-12.85	-13.15	Grind - Sterk siltig - Los	1.0	0.0		
30	-13.15	-13.50	Zand - Zwak siltig - Kleiig	1.0	100.0		
31	-13.50	-14.19	Grind - Sterk siltig - Los	1.0	0.0		
32	-14.19	-14.50	Zand - Sterk siltig - Kleiig	1.0	100.0		
33	-14.50	-14.67	Grind - Sterk siltig - Los	1.0	0.0		
34	-14.67	-15.32	Zand - Schoon - Los	1.0	100.0		
35	-15.32	-15.69	Zand - Schoon - Matig	1.0	100.0		
36	-15.69	-16.00	Zand - Sterk siltig - Kleiig	1.0	100.0		
37	-16.00	-16.43	Grind - Sterk siltig - Los	1.0	0.0		
38	-16.43	-16.74	Zand - Sterk siltig - Kleiig	1.0	100.0		
39	-16.74	-17.16	Zand - Schoon - Matig	1.0	100.0		
40	-17.16	-17.31	Zand - Sterk siltig - Kleiig	1.0	100.0		
41	-17.31	-17.52	Grind - Sterk siltig - Los	1.0	0.0		
42	-17.52	-18.09	Zand - Sterk siltig - Kleiig	1.0	100.0		
43	-18.09	-18.84	Zand - Zwak siltig - Kleiig	1.0	100.0		
44	-18.84	-19.07	Grind - Sterk siltig - Los	1.0	0.0		
45	-19.07	-19.54	Zand - Zwak siltig - Kleiig	1.0	100.0		
46	-19.54	-20.54	Zand - Schoon - Matig	1.0	100.0		
47	-20.54	-21.00	Zand - Schoon - Los	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 18

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.20 Grondwaterstand [m] : -0.80

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.20	-0.21	Zand - Schoon - Los	1.0	100.0		
2	-0.21	-0.56	Klei - Schoon - Vast	1.0	50.0		
3	-0.56	-0.99	Zand - Schoon - Matig	1.0	100.0		
4	-0.99	-1.38	Zand - Schoon - Los	1.0	100.0		
5	-1.38	-1.85	Klei - Zwak zandig - Vast	1.0	50.0		
6	-1.85	-2.19	Zand - Schoon - Los	1.0	100.0		
7	-2.19	-2.58	Leem - Zwak zandig - Vast	1.0	50.0		
8	-2.58	-3.01	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-3.01	-6.02	Klei - Zwak zandig - Slap	1.0	50.0		
10	-6.02	-6.28	Zand - Schoon - Los	1.0	100.0		
11	-6.28	-6.53	Leem - Zwak zandig - Vast	1.0	50.0		
12	-6.53	-6.71	Zand - Schoon - Los	1.0	100.0		
13	-6.71	-7.35	Leem - Zwak zandig - Vast	1.0	50.0		
14	-7.35	-7.91	Grind - Sterk siltig - Los	1.0	0.0		
15	-7.91	-8.42	Zand - Schoon - Los	1.0	100.0		
16	-8.42	-8.77	Zand - Schoon - Matig	1.0	100.0		
17	-8.77	-8.98	Zand - Zwak siltig - Kleiig	1.0	100.0		
18	-8.98	-9.11	Zand - Schoon - Matig	1.0	100.0		
19	-9.11	-9.63	Zand - Zwak siltig - Kleiig	1.0	100.0		

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Onderdeel : Masten 9-19

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
20	-9.63	-9.97	Grind - Sterk siltig - Los	1.0	0.0		
21	-9.97	-10.53	Zand - Sterk siltig - Kleiig	1.0	100.0		
22	-10.53	-10.96	Zand - Schoon - Los	1.0	100.0		
23	-10.96	-11.09	Grind - Sterk siltig - Los	1.0	0.0		
24	-11.09	-11.56	Zand - Schoon - Los	1.0	100.0		
25	-11.56	-12.21	Zand - Zwak siltig - Kleiig	1.0	100.0		
26	-12.21	-12.55	Grind - Sterk siltig - Los	1.0	0.0		
27	-12.55	-12.68	Zand - Zwak siltig - Kleiig	1.0	100.0		
28	-12.68	-13.54	Zand - Sterk siltig - Kleiig	1.0	100.0		
29	-13.54	-13.97	Zand - Schoon - Matig	1.0	100.0		
30	-13.97	-14.61	Zand - Zwak siltig - Kleiig	1.0	100.0		
31	-14.61	-14.70	Zand - Schoon - Matig	1.0	100.0		
32	-14.70	-15.34	Zand - Schoon - Los	1.0	100.0		
33	-15.34	-15.60	Zand - Zwak siltig - Kleiig	1.0	100.0		
34	-15.60	-15.99	Zand - Sterk siltig - Kleiig	1.0	100.0		
35	-15.99	-16.16	Grind - Sterk siltig - Los	1.0	0.0		
36	-16.16	-16.46	Zand - Sterk siltig - Kleiig	1.0	100.0		
37	-16.46	-16.89	Grind - Sterk siltig - Los	1.0	0.0		
38	-16.89	-17.32	Zand - Zwak siltig - Kleiig	1.0	100.0		
39	-17.32	-18.05	Grind - Sterk siltig - Los	1.0	0.0		
40	-18.05	-18.27	Zand - Schoon - Matig	1.0	100.0		
41	-18.27	-18.78	Grind - Sterk siltig - Los	1.0	0.0		
42	-18.78	-18.95	Zand - Zwak siltig - Kleiig	1.0	100.0		
43	-18.95	-19.64	Zand - Sterk siltig - Kleiig	1.0	100.0		
44	-19.64	-19.81	Zand - Zwak siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 19

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.00 Grondwaterstand [m] : -1.00

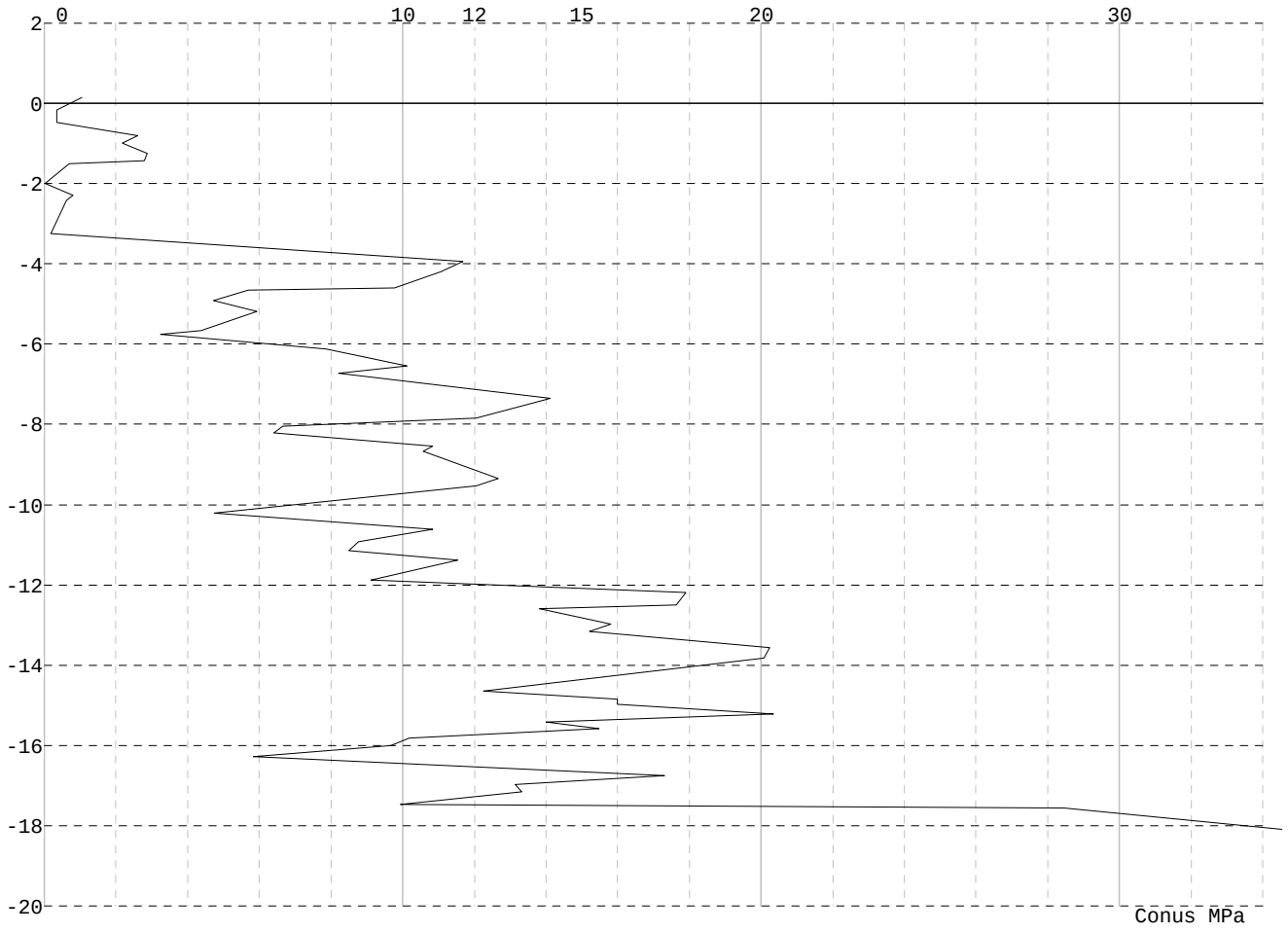
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.00	-0.42	Zand - Zwak siltig - Kleiig	1.0	100.0		
2	-0.42	-0.59	Zand - Schoon - Matig	1.0	100.0		
3	-0.59	-0.85	Grind - Sterk siltig - Los	1.0	50.0		
4	-0.85	-1.06	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-1.06	-1.45	Grind - Sterk siltig - Los	1.0	50.0		
6	-1.45	-1.67	Leem - Zwak zandig - Vast	1.0	50.0		
7	-1.67	-1.84	Zand - Schoon - Los	1.0	100.0		
8	-1.84	-1.98	Leem - Zwak zandig - Vast	1.0	50.0		
9	-1.98	-2.24	Klei - Zwak zandig - Vast	1.0	50.0		
10	-2.24	-2.71	Klei - Schoon - Matig	1.0	50.0		
11	-2.71	-2.96	Zand - Schoon - Los	1.0	100.0		
12	-2.96	-3.44	Klei - Schoon - Matig	1.0	50.0		
13	-3.44	-4.18	Klei - Zwak zandig - Slap	1.0	50.0		
14	-4.18	-4.56	Klei - Zwak zandig - Vast	1.0	50.0		
15	-4.56	-4.78	Veen - Matig voorbelast - Matig	1.0	0.0		
16	-4.78	-5.47	Klei - Schoon - Matig	1.0	50.0		
17	-5.47	-5.73	Klei - Zwak zandig - Slap	1.0	50.0		
18	-5.73	-7.17	Zand - Schoon - Matig	1.0	100.0		
19	-7.17	-7.75	Zand - Zwak siltig - Kleiig	1.0	100.0		
20	-7.75	-8.34	Zand - Schoon - Los	1.0	100.0		
21	-8.34	-8.47	Leem - Zwak zandig - Vast	1.0	50.0		
22	-8.47	-9.64	Zand - Zwak siltig - Kleiig	1.0	100.0		
23	-9.64	-10.03	Grind - Sterk siltig - Los	1.0	50.0		
24	-10.03	-10.41	Zand - Zwak siltig - Kleiig	1.0	100.0		
25	-10.41	-11.11	Zand - Schoon - Matig	1.0	100.0		
26	-11.11	-11.55	Zand - Sterk siltig - Kleiig	1.0	100.0		
27	-11.55	-12.03	Zand - Schoon - Matig	1.0	100.0		
28	-12.03	-13.04	Grind - Sterk siltig - Los	1.0	50.0		
29	-13.04	-13.10	Zand - Sterk siltig - Kleiig	1.0	100.0		
30	-13.10	-14.64	Zand - Schoon - Matig	1.0	100.0		
31	-14.64	-15.02	Zand - Schoon - Vast	1.0	100.0		
32	-15.02	-15.38	Zand - Schoon - Matig	1.0	100.0		
33	-15.38	-16.67	Zand - Sterk siltig - Kleiig	1.0	100.0		
34	-16.67	-16.90	Zand - Zwak siltig - Kleiig	1.0	100.0		
35	-16.90	-18.00	Zand - Sterk siltig - Kleiig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 15

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.55 Bodemprofiel: Son 15
Traject negatieve kleef : 0.14 tot -1.70 [m]
Traject positieve kleef : -3.40 tot -18.10 [m]

Project : ENS-ZL380
Onderdeel : Masten 9-19

SONDERINGSGEGEVENS GRAFIEK: Son 15

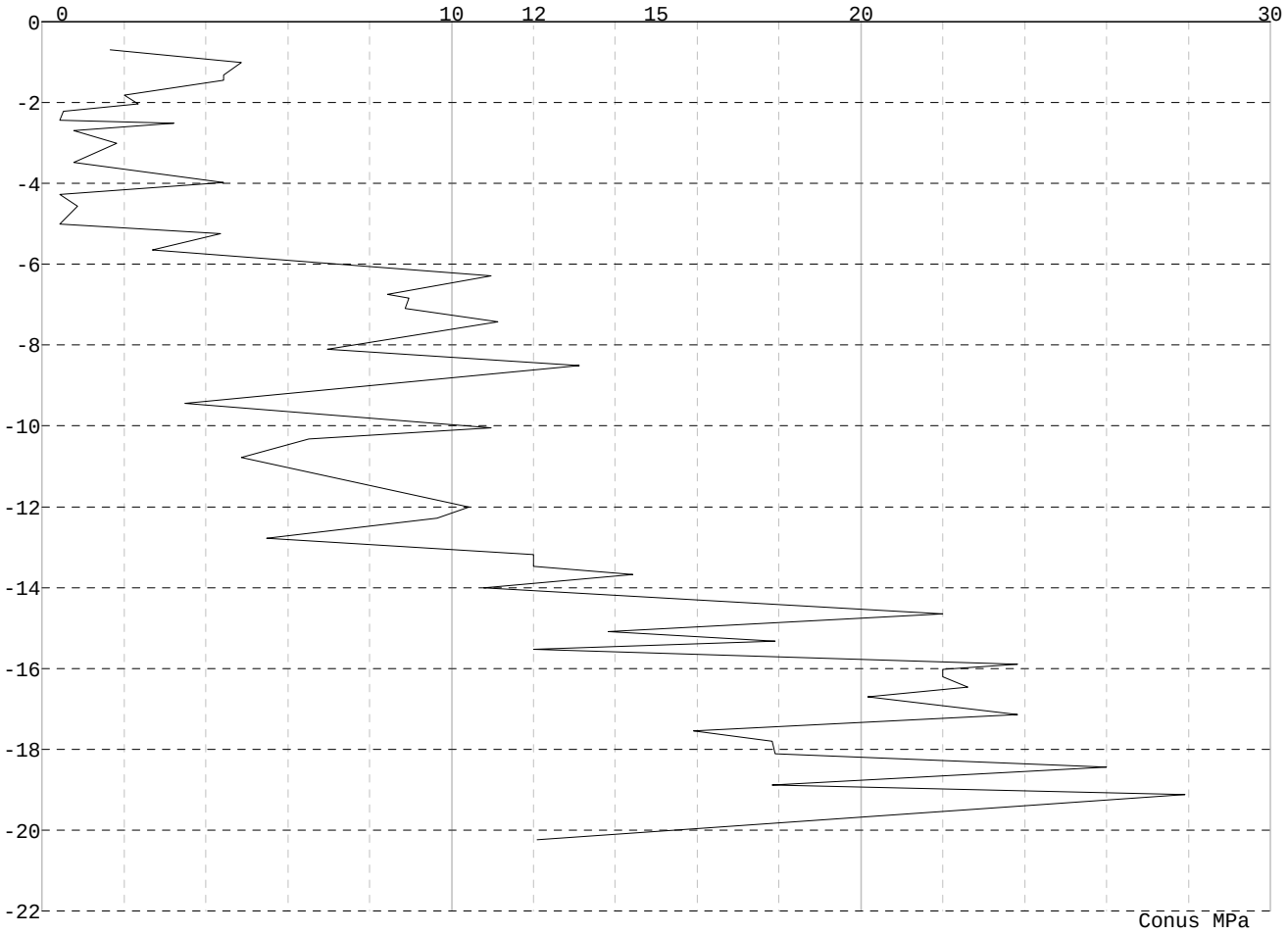


Project : ENS-ZL380
Onderdeel : Masten 9-19

SONDERINGSGEGEVENS ALGEMEEN: Son 16

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.20 Bodemprofiel: Son 16
Traject negatieve kleef : -0.69 tot -2.90 [m]
Traject positieve kleef : -5.00 tot -20.24 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 16

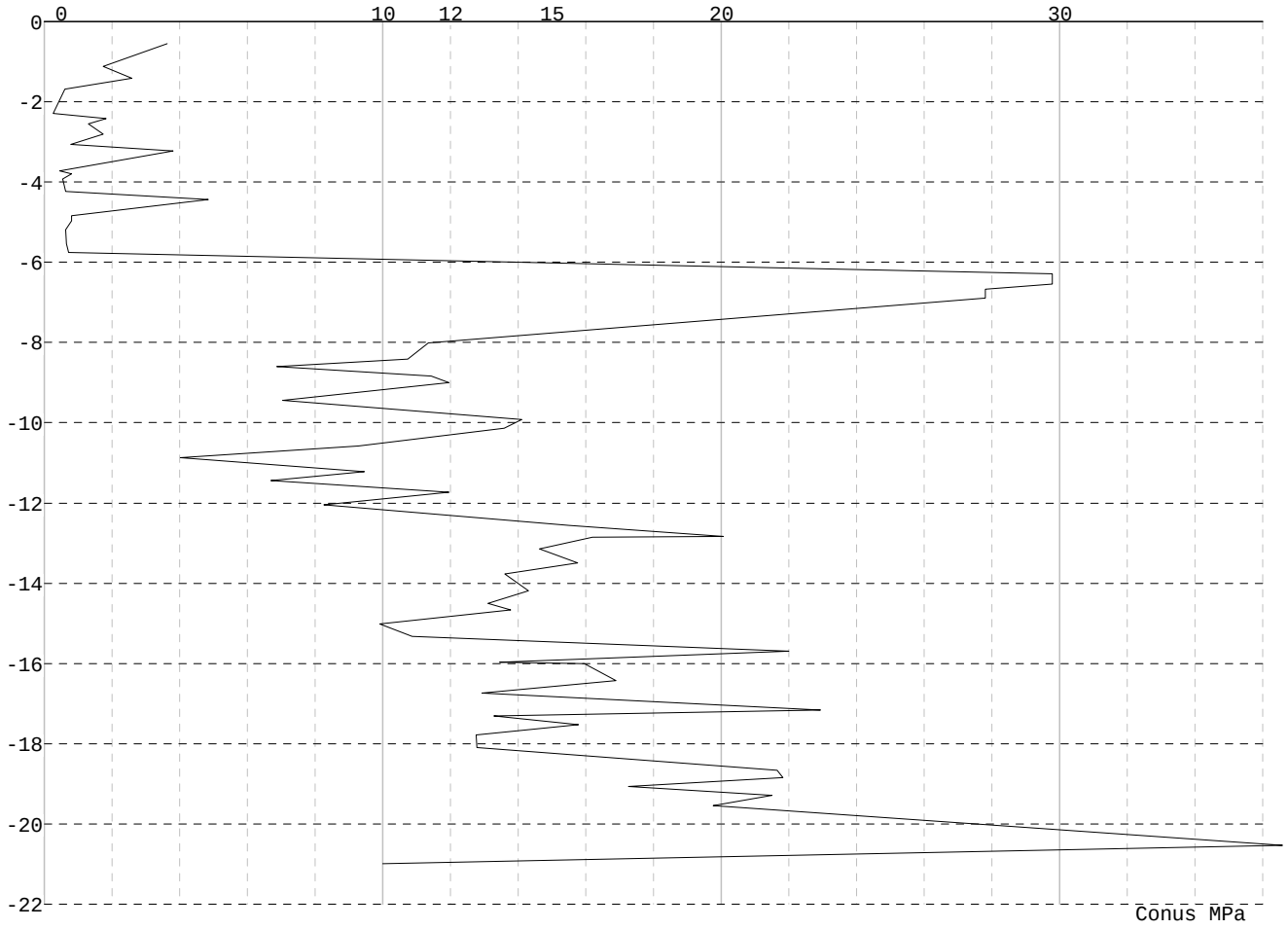


Project : ENS-ZL380
Onderdeel : Masten 9-19

SONDERINGSGEGEVENS ALGEMEEN: Son 17

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.10 Bodemprofiel: Son 17
Traject negatieve kleef : -0.55 tot -3.15 [m]
Traject positieve kleef : -5.80 tot -21.00 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 17

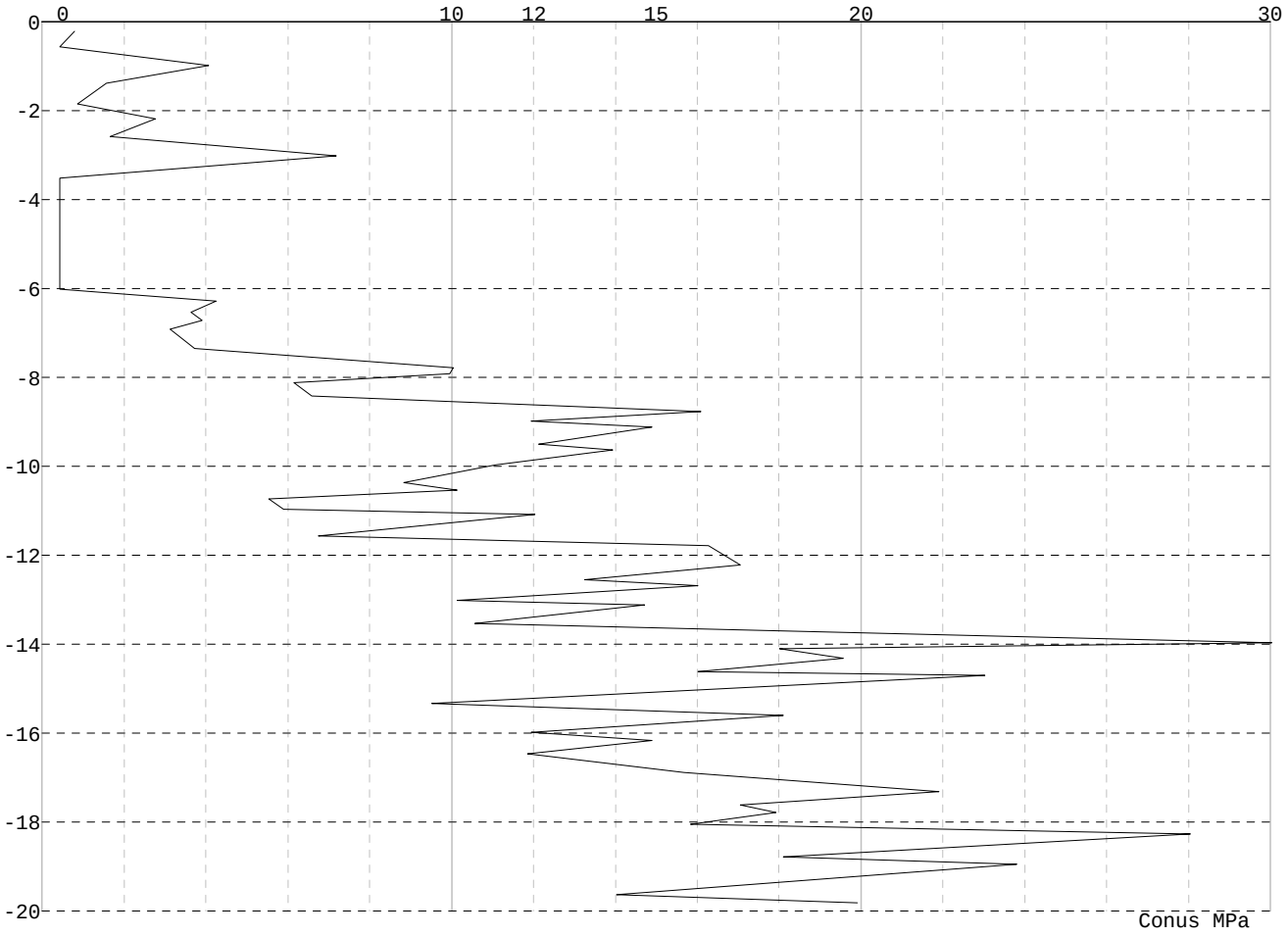


Project : ENS-ZL380
Onderdeel : Masten 9-19

SONDERINGSGEGEVENS ALGEMEEN: Son 18

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.20 Bodemprofiel: Son 18
Traject negatieve kleef : -0.22 tot -3.15 [m]
Traject positieve kleef : -6.10 tot -19.81 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 18



Project : ENS-ZL380
Onderdeel : Masten 9-19

REKENGEGEVENS Mast 15

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 15
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.89
Paalpuntniveau : N.A.P. -14.66
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 15 (n=1)

Sondering : Son 15

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.66	-14.66	48.4	526.3	526.3	0.0	0.00

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 15 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 15	0.55	-14.66	526.3	526.3	526.3

Totaal resultaten Mast 15 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 15

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.66	$R_{t;d}$ = min.{ 526.3; 526.3}= 526.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.66	526.3	526.3	0.0	526.3	0.00

REKENGEGEVENS Mast 16

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 16
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.44
Paalpuntniveau : N.A.P. -16.46
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 16 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 9-19

Sondering : Son 16

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.46	-16.46	53.0	523.9	523.9	0.0	0.00

SAMENVATTINGSTABEL Mast 16 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 16	-0.20	-16.46	523.9	523.9	523.9

Totaal resultaten Mast 16 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 16

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.46	$R_{t;d}$ = min.{ 523.9; 523.9}= 523.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.46	523.9	523.9	0.0	523.9	0.00

REKENGEGEVENS Mast 17

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 17
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.31
Paalpuntniveau : N.A.P. -18.09
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 17 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 9-19

Sondering : Son 17

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-18.09	-18.09	56.8	555.8	555.8	0.0	0.00

SAMENVATTINGSTABEL Mast 17 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 17	-0.10	-18.09	555.8	555.8	555.8

Totaal resultaten Mast 17 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 17

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-18.09	$R_{t;d}$ = min.{ 555.8; 555.8}= 555.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-18.09	555.8	555.8	0.0	555.8	0.00

REKENGEGEVENS Mast 18

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 18
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 1.00
Paalpuntniveau : N.A.P. -16.20
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 18 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 9-19

Sondering : Son 18

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.20	-16.20	54.3	510.9	510.9	0.0	0.00

SAMENVATTINGSTABEL Mast 18 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 18	0.20	-16.20	510.9	510.9	510.9

Totaal resultaten Mast 18 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 18

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.20	$R_{t;d}$ = min.{ 510.9; 510.9}= 510.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.20	510.9	510.9	0.0	510.9	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : ENS-ZL380
Onderdeel : Masten 9-19

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 15	Mast 16	Mast 17	Mast 18
Son 15	0.55	-14.66	526			
Son 16	-0.20	-16.46		523		
Son 17	-0.10	-18.09			555	
Son 18	0.20	-16.20				510

Project : ENS-ZL380
Onderdeel : Masten 20-29

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 20-29
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 20-29 (20 21 22 25 26).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m^3]	$\gamma_{sat;k;1}$ [kN/m^3]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m^3]	$\gamma_{sat;k;2}$ [kN/m^3]	$\varphi'_{k;2}$ [°]
1	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
2	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
3	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
4	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
5	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
6	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
7	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
8	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
9	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
10	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
11	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
12	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
13	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 20

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.00 Grondwaterstand [m] : -1.00

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.00	-0.87	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.87	-5.16	Klei - Zwak zandig - Slap	1.0	50.0		
3	-5.16	-8.24	Zand - Schoon - Matig	1.0	100.0		
4	-8.24	-8.70	Leem - Zwak zandig - Vast	1.0	50.0		
5	-8.70	-9.13	Grind - Sterk siltig - Los	1.0	0.0		
6	-9.13	-9.70	Leem - Zwak zandig - Vast	1.0	50.0		
7	-9.70	-10.80	Zand - Schoon - Matig	1.0	100.0		
8	-10.80	-18.70	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 21

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.20 Grondwaterstand [m] : -0.80

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.20	-3.08	Zand - Zwak siltig - Kleiig	1.0	100.0		
2	-3.08	-5.21	Klei - Organisch - Matig	1.0	50.0		
3	-5.21	-8.23	Zand - Schoon - Matig	1.0	100.0		
4	-8.23	-8.65	Zand - Schoon - Los	1.0	100.0		
5	-8.65	-9.60	Zand - Schoon - Matig	1.0	100.0		
6	-9.60	-10.49	Zand - Schoon - Vast	1.0	100.0		
7	-10.49	-11.29	Zand - Schoon - Matig	1.0	100.0		
8	-11.29	-11.95	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-11.95	-12.82	Zand - Schoon - Matig	1.0	100.0		
10	-12.82	-13.17	Klei - Schoon - Matig	1.0	50.0		
11	-13.17	-13.73	Zand - Schoon - Vast	1.0	100.0		
12	-13.73	-16.33	Zand - Schoon - Matig	1.0	100.0		
13	-16.33	-19.72	Zand - Schoon - Vast	1.0	100.0		

Project : ENS-ZL380
Onderdeel : Masten 20-29

BODEMPROFIELGEGEVENS: Son 22

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.25 Grondwaterstand [m] : -0.75

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.25	-4.38	Klei - Zwak zandig - Slap	1.0	50.0		
2	-4.38	-6.20	Zand - Schoon - Matig	1.0	100.0		
3	-6.20	-7.28	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-7.28	-9.28	Klei - Zwak zandig - Matig	1.0	50.0		
5	-9.28	-11.36	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-11.36	-16.08	Zand - Schoon - Matig	1.0	100.0		
7	-16.08	-16.43	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-16.43	-16.73	Zand - Schoon - Vast	1.0	100.0		
9	-16.73	-17.12	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-17.12	-17.51	Zand - Schoon - Vast	1.0	100.0		
11	-17.51	-19.99	Klei - Organisch - Matig	1.0	50.0		

BODEMPROFIELGEGEVENS: Son 25

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.10 Grondwaterstand [m] : -1.10

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.10	-4.59	Klei - Zwak zandig - Matig	1.0	50.0		
2	-4.59	-7.08	Zand - Schoon - Matig	1.0	100.0		
3	-7.08	-9.13	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-9.13	-10.94	Zand - Schoon - Matig	1.0	100.0		
5	-10.94	-12.18	Zand - Schoon - Los	1.0	100.0		
6	-12.18	-14.76	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-14.76	-15.73	Zand - Schoon - Vast	1.0	100.0		
8	-15.73	-16.72	Zand - Schoon - Los	1.0	100.0		
9	-16.72	-17.75	Zand - Schoon - Vast	1.0	100.0		
10	-17.75	-18.29	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-18.29	-19.40	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 26

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.10 Grondwaterstand [m] : -0.90

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.10	-6.24	Zand - Sterk siltig - Kleiig	1.0	100.0		
2	-6.24	-11.61	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-11.61	-12.00	Klei - Schoon - Matig	1.0	50.0		
4	-12.00	-13.54	Zand - Schoon - Los	1.0	100.0		
5	-13.54	-16.88	Zand - Schoon - Matig	1.0	100.0		
6	-16.88	-17.79	Zand - Schoon - Los	1.0	100.0		
7	-17.79	-20.10	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 20

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.00 Bodemprofiel: Son 20
Traject negatieve kleef : -0.44 tot -2.80 [m]
Traject positieve kleef : -5.20 tot -18.69 [m]

Project : ENS-ZL380
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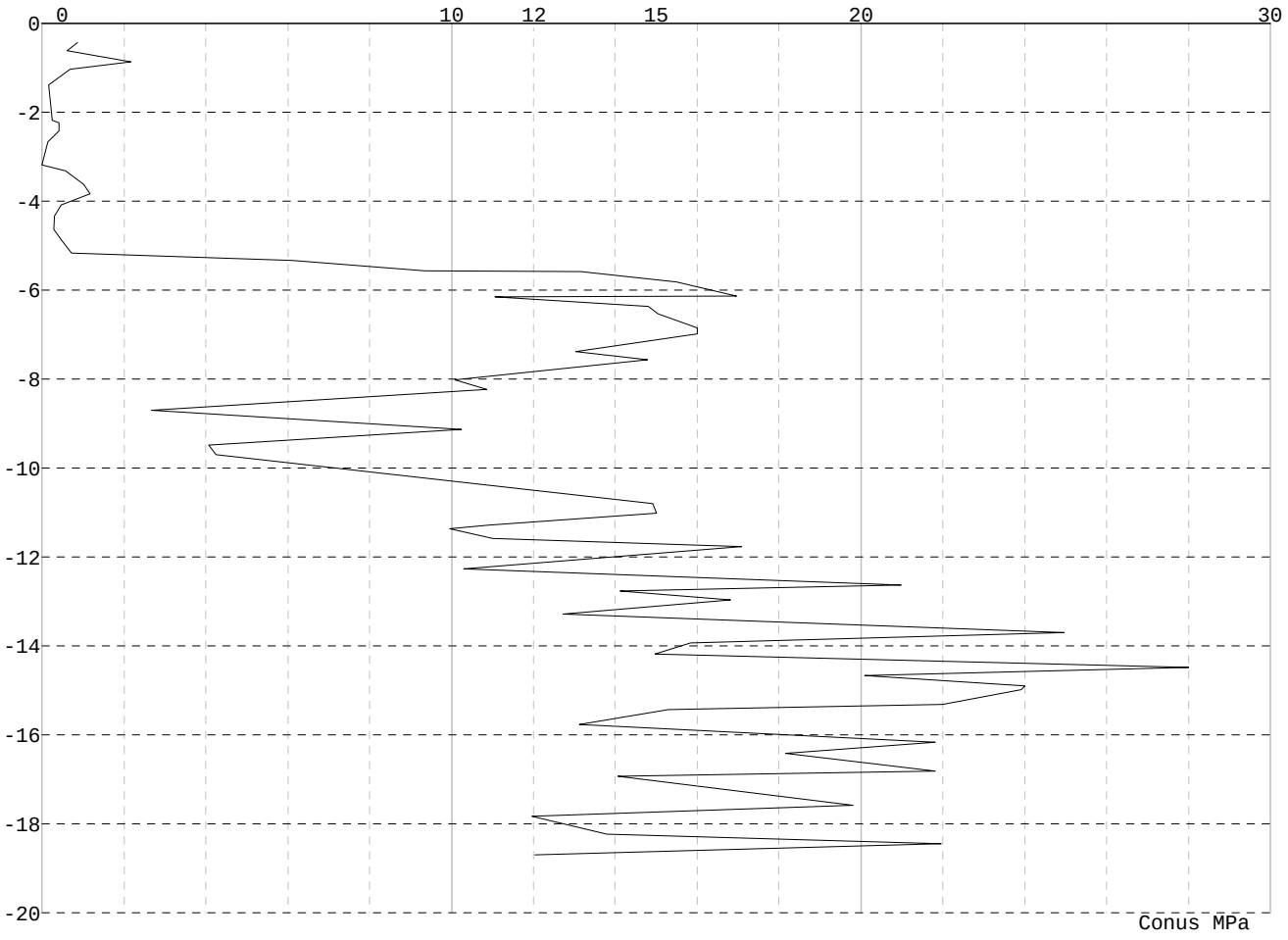
SONDERINGSGEGEVENS GRAFIEK: Son 20

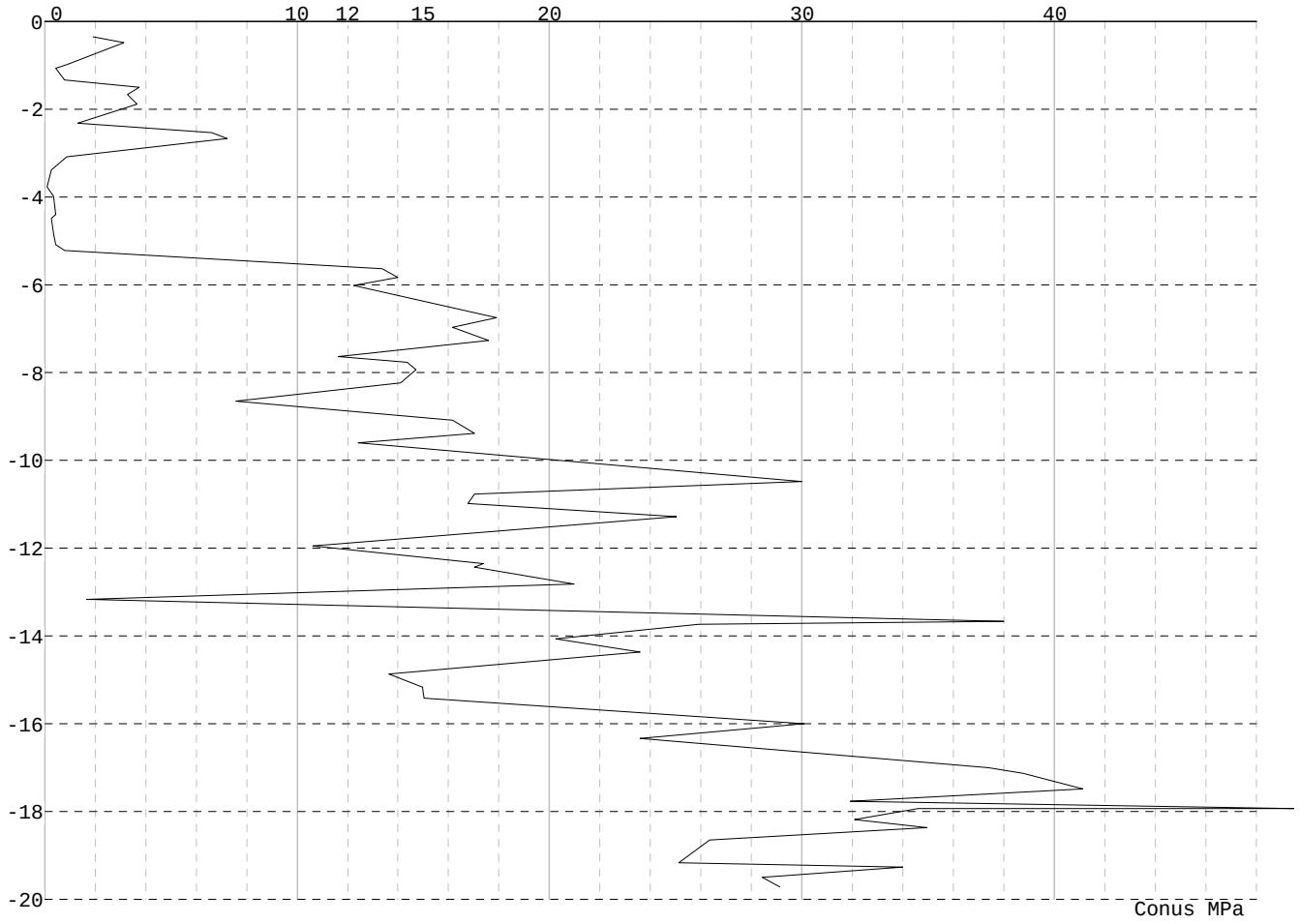


Project : ENS-ZL380
Onderdeel : Masten 20-29

SONDERINGSGEGEVENS ALGEMEEN: Son 21

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.20 Bodemprofiel: Son 21
Traject negatieve kleef : -3.10 tot -4.20 [m]
Traject positieve kleef : -5.30 tot -19.72 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 21

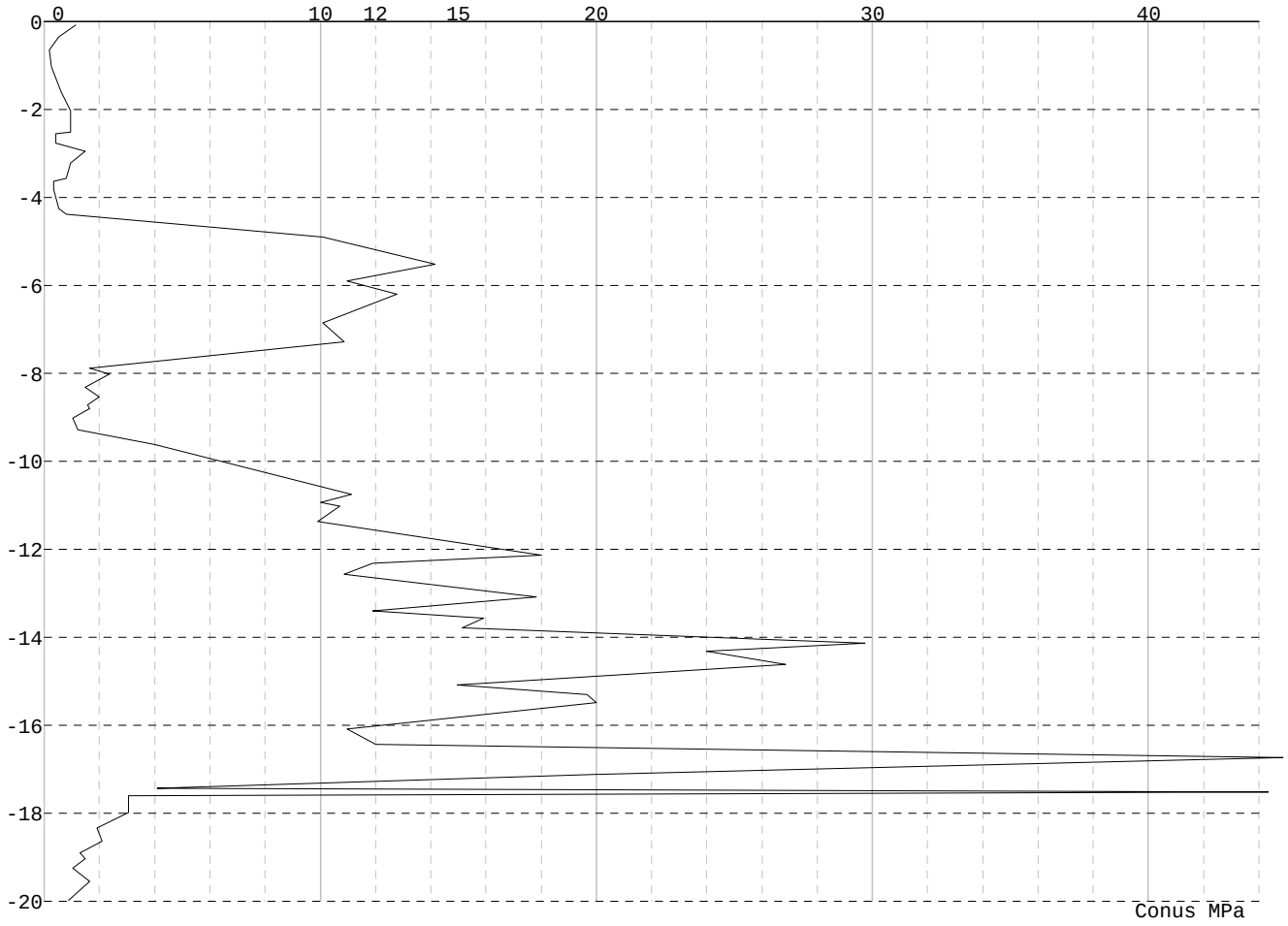


Project : ENS-ZL380
Onderdeel : Masten 20-29

SONDERINGSGEGEVENS ALGEMEEN: Son 22

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.25 Bodemprofiel: Son 22
Traject negatieve kleef : -0.09 tot -2.30 [m]
Traject positieve kleef : -4.50 tot -19.99 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 22

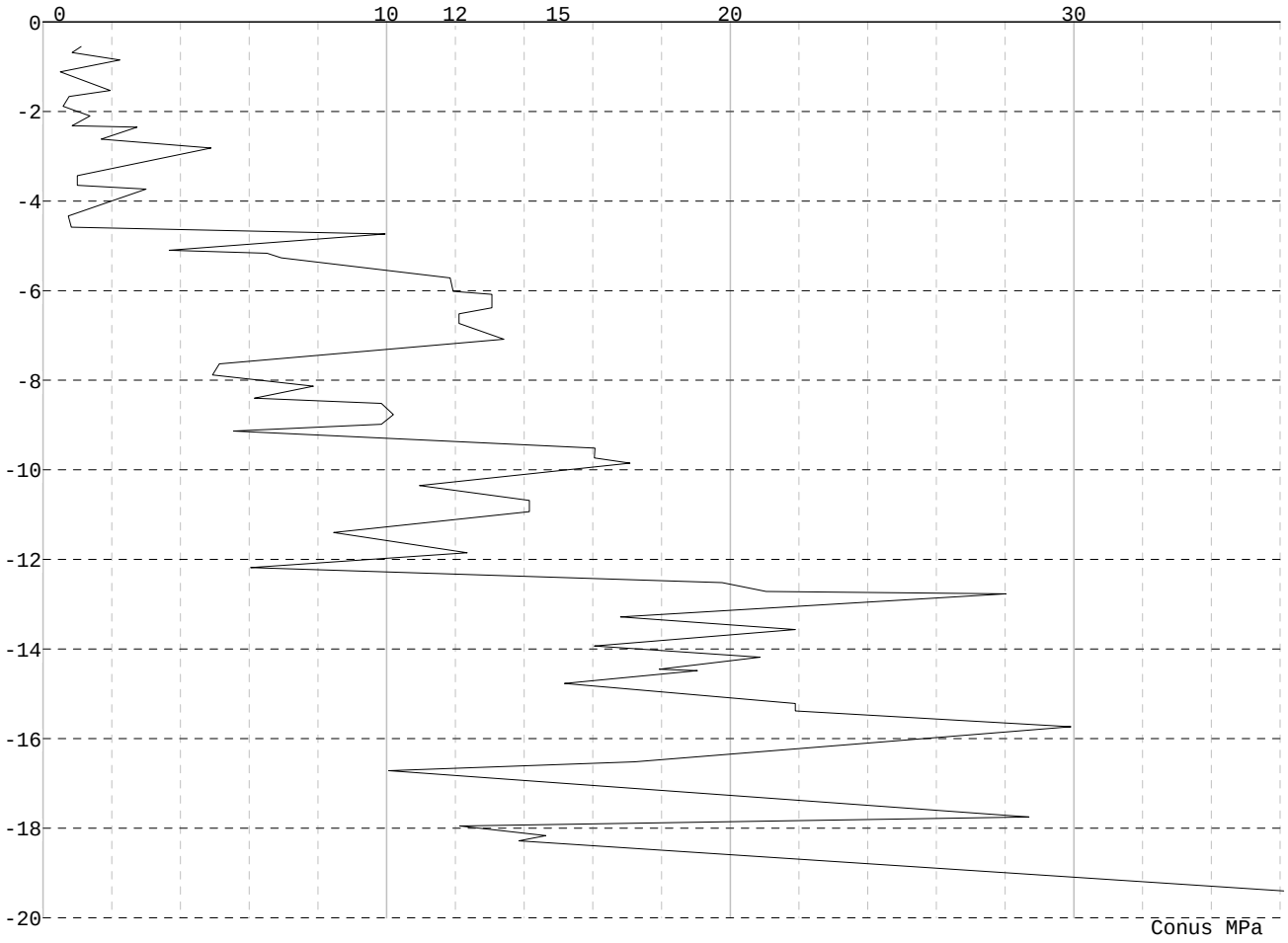


Project : ENS-ZL380
Onderdeel : Masten 20-29

SONDERINGSGEGEVENS ALGEMEEN: Son 25

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.10 Bodemprofiel: Son 25
Traject negatieve kleef : -0.55 tot -2.60 [m]
Traject positieve kleef : -4.60 tot -19.40 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 25

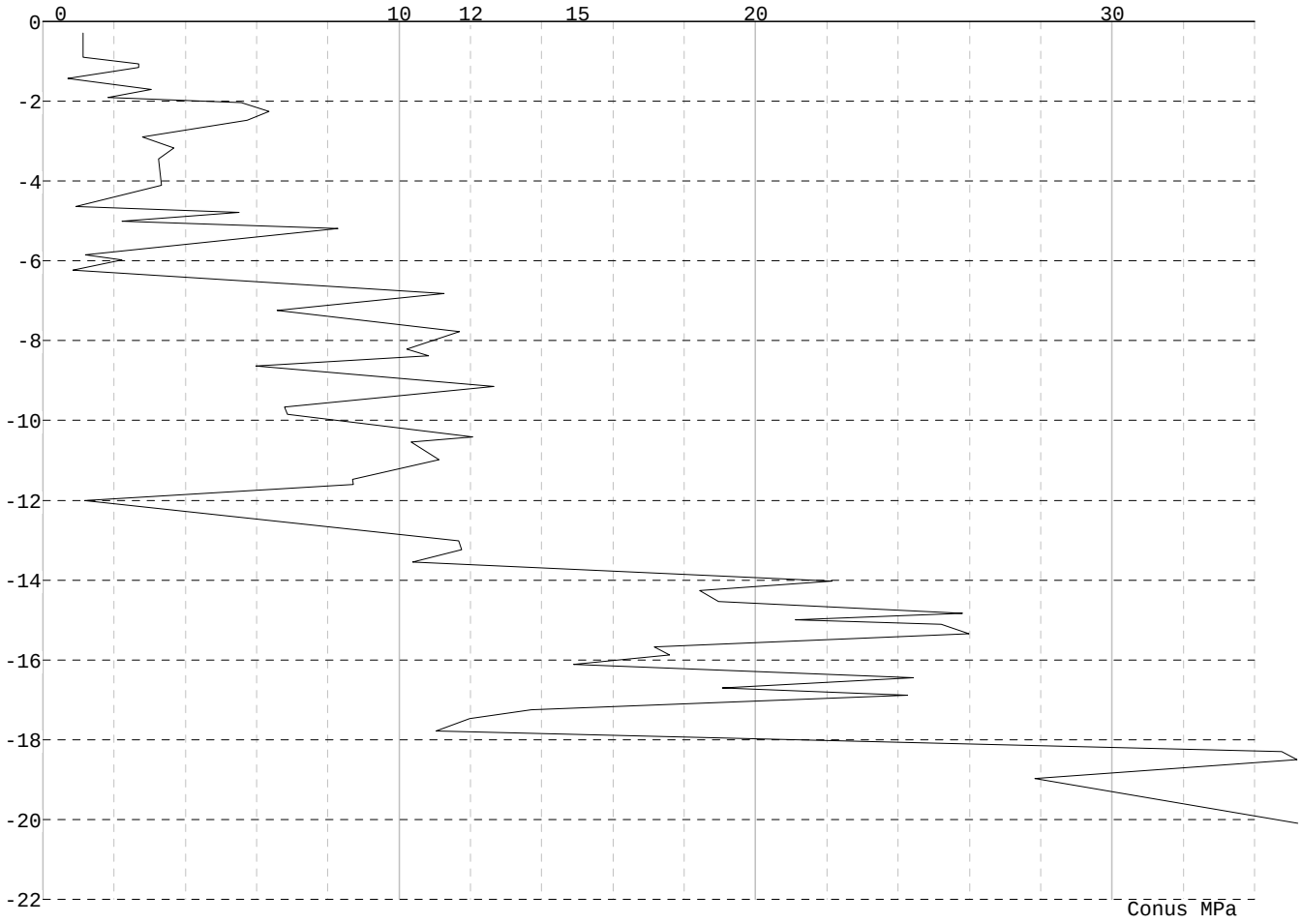


Project : ENS-ZL380
Onderdeel : Masten 20-29

SONDERINGSGEGEVENS ALGEMEEN: Son 26

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.10 Bodemprofiel: Son 26
Traject negatieve kleef : -0.30 tot -0.30 [m]
Traject positieve kleef : -6.20 tot -20.60 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 26



Project : ENS-ZL380
Onderdeel : Masten 20-29

REKENGEGEVENS Mast 20

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 20
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.53
Paalpuntniveau : N.A.P. -15.97
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 20 (n=1)

Sondering : Son 20

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.97	-15.97	51.6	623.3	623.3	0.0	0.00

Project : ENS-ZL380
Onderdeel : Masten 20-29

SAMENVATTINGSTABEL Mast 20 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 20	0.00	-15.97	623.3	623.3	623.3

Totaal resultaten Mast 20 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 20

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-15.97	$R_{t;d}$ = min.{ 623.3; 623.3}= 623.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.97	623.3	623.3	0.0	623.3	0.00

REKENGEGEVENS Mast 21

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 21
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.60
Paalpuntniveau : N.A.P. -14.10
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 21 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 20-29

Sondering : Son 21

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.10	-14.10	46.1	616.2	616.2	0.0	0.00

SAMENVATTINGSTABEL Mast 21 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 21	0.20	-14.10	616.2	616.2	616.2

Totaal resultaten Mast 21 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 21

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.10	$R_{t;d}$ = min.{ 616.2; 616.2}= 616.2

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.10	616.2	616.2	0.0	616.2	0.00

REKENGEGEVENS Mast 22

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 22
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.44
Paalpuntniveau : N.A.P. -15.81
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 22 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 20-29

Sondering : Son 22

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.81	-15.81	50.1	578.9	578.9	0.0	0.00

SAMENVATTINGSTABEL Mast 22 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 22	0.25	-15.81	578.9	578.9	578.9

Totaal resultaten Mast 22 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 22

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-15.81	$R_{t;d}$ = min.{ 578.9; 578.9}= 578.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.81	578.9	578.9	0.0	578.9	0.00

REKENGEGEVENS Mast 25

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 25
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.47
Paalpuntniveau : N.A.P. -15.68
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 25 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 20-29

Sondering : Son 25

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.68	-15.68	50.7	651.6	651.6	0.0	0.00

SAMENVATTINGSTABEL Mast 25 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 25	-0.10	-15.68	651.6	651.6	651.6

Totaal resultaten Mast 25 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 25

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-15.68	$R_{t;d}$ = min.{ 651.6; 651.6}= 651.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.68	651.6	651.6	0.0	651.6	0.00

REKENGEGEVENS Mast 26

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 26
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.63
Paalpuntniveau : N.A.P. -14.97
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 26 (n=1)

Project : ENS-ZL380
Onderdeel : Masten 20-29

Sondering : Son 26

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.97	-14.97	49.0	506.6	506.6	0.0	0.00

SAMENVATTINGSTABEL Mast 26 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 26	0.10	-14.97	506.6	506.6	506.6

Totaal resultaten Mast 26 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 26

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.97	$R_{t;d}$ = min.{ 506.6; 506.6}= 506.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.97	506.6	506.6	0.0	506.6	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : ENS-ZL380
Onderdeel : Masten 20-29

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{t;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 20	Mast 21	Mast 22	Mast 25	Mast 26
Son 20	0.00	-15.97	623				
Son 21	0.20	-14.10		616			
Son 22	0.25	-15.81			578		
Son 25	-0.10	-15.68				651	
Son 26	0.10	-14.97					506

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 30-39 (31 36 37 38 39).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m^3]	$\gamma_{sat;k;1}$ [kN/m^3]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m^3]	$\gamma_{sat;k;2}$ [kN/m^3]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
15	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 31

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.30 Grondwaterstand [m] : -3.30

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.30	-3.36	Klei - Schoon - Matig	1.0	5.0		
2	-3.36	-7.84	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-7.84	-8.10	Klei - Schoon - Matig	1.0	5.0		
4	-8.10	-9.83	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-9.83	-12.41	Zand - Schoon - Los	1.0	100.0		
6	-12.41	-15.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-15.21	-18.28	Zand - Schoon - Matig	1.0	100.0		
8	-18.28	-19.70	Zand - Schoon - Vast	1.0	100.0		
9	-19.70	-20.26	Zand - Zwak siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 36

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.40 Grondwaterstand [m] : -2.40

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.40	-3.42	Klei - Schoon - Matig	1.0	50.0		
2	-3.42	-10.11	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-10.11	-11.19	Zand - Schoon - Los	1.0	100.0		
4	-11.19	-13.06	Zand - Schoon - Matig	1.0	100.0		
5	-13.06	-13.62	Zand - Schoon - Vast	1.0	100.0		
6	-13.62	-13.90	Zand - Schoon - Matig	1.0	100.0		
7	-13.90	-14.21	Zand - Schoon - Vast	1.0	100.0		
8	-14.21	-18.05	Zand - Schoon - Matig	1.0	100.0		
9	-18.05	-19.08	Zand - Schoon - Los	1.0	100.0		
10	-19.08	-25.70	Zand - Schoon - Vast	1.0	100.0		

Project : BBB
Onderdeel : ENS-ZL380

BODEMPROFIELGEGEVENS: Son 37

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -1.40 Grondwaterstand [m] : -2.40

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-1.40	-3.63	Klei - Zwak zandig - Slap	1.0	50.0		
2	-3.63	-5.99	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-5.99	-6.81	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-6.81	-8.18	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-8.18	-11.48	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-11.48	-12.17	Zand - Schoon - Los	1.0	100.0		
7	-12.17	-12.96	Zand - Schoon - Vast	1.0	100.0		
8	-12.96	-13.20	Zand - Schoon - Matig	1.0	100.0		
9	-13.20	-13.98	Zand - Schoon - Vast	1.0	100.0		
10	-13.98	-18.54	Zand - Schoon - Matig	1.0	100.0		
11	-18.54	-22.81	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 38

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.90 Grondwaterstand [m] : -1.90

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.90	-3.21	Veen - Matig voorbelast - Matig	1.0	0.0		
2	-3.21	-8.36	Zand - Schoon - Los	1.0	100.0		
3	-8.36	-9.26	Klei - Schoon - Vast	1.0	50.0		
4	-9.26	-10.46	Zand - Schoon - Los	1.0	100.0		
5	-10.46	-13.46	Zand - Schoon - Matig	1.0	100.0		
6	-13.46	-13.89	Grind - Zwak siltig - Vast	1.0	0.0		
7	-13.89	-15.39	Zand - Sterk siltig - Kleiig	1.0	100.0		
8	-15.39	-15.86	Zand - Schoon - Matig	1.0	100.0		
9	-15.86	-17.14	Zand - Schoon - Los	1.0	100.0		
10	-17.14	-21.77	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.86 Grondwaterstand [m] : -1.86

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.86	-2.71	Klei - Zwak zandig - Matig	1.0	50.0		
2	-2.71	-5.43	Zand - Schoon - Los	1.0	100.0		
3	-5.43	-6.91	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-6.91	-7.43	Klei - Zwak zandig - Matig	1.0	50.0		
5	-7.43	-8.53	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-8.53	-14.36	Zand - Schoon - Los	1.0	100.0		
7	-14.36	-15.07	Zand - Schoon - Matig	1.0	100.0		
8	-15.07	-20.14	Zand - Schoon - Los	1.0	100.0		
9	-20.14	-21.18	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 33 (2)

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -2.45 Grondwaterstand [m] : -3.45

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-2.45	-2.89	Zand - Schoon - Los	1.0	100.0		
2	-2.89	-3.19	Klei - Schoon - Matig	1.0	50.0		
3	-3.19	-3.88	Klei - Zwak zandig - Slap	1.0	50.0		
4	-3.88	-4.19	Leem - Zwak zandig - Vast	1.0	50.0		
5	-4.19	-4.75	Zand - Schoon - Los	1.0	100.0		
6	-4.75	-5.01	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-5.01	-5.62	Grind - Sterk siltig - Los	1.0	0.0		
8	-5.62	-7.09	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-7.09	-7.55	Klei - Schoon - Vast	1.0	50.0		
10	-7.55	-8.02	Klei - Schoon - Matig	1.0	50.0		
11	-8.02	-8.61	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-8.61	-9.00	Grind - Sterk siltig - Los	1.0	0.0		
13	-9.00	-10.15	Zand - Schoon - Los	1.0	100.0		
14	-10.15	-10.72	Zand - Sterk siltig - Kleiig	1.0	100.0		
15	-10.72	-10.99	Grind - Sterk siltig - Los	1.0	0.0		
16	-10.99	-11.19	Zand - Schoon - Los	1.0	100.0		

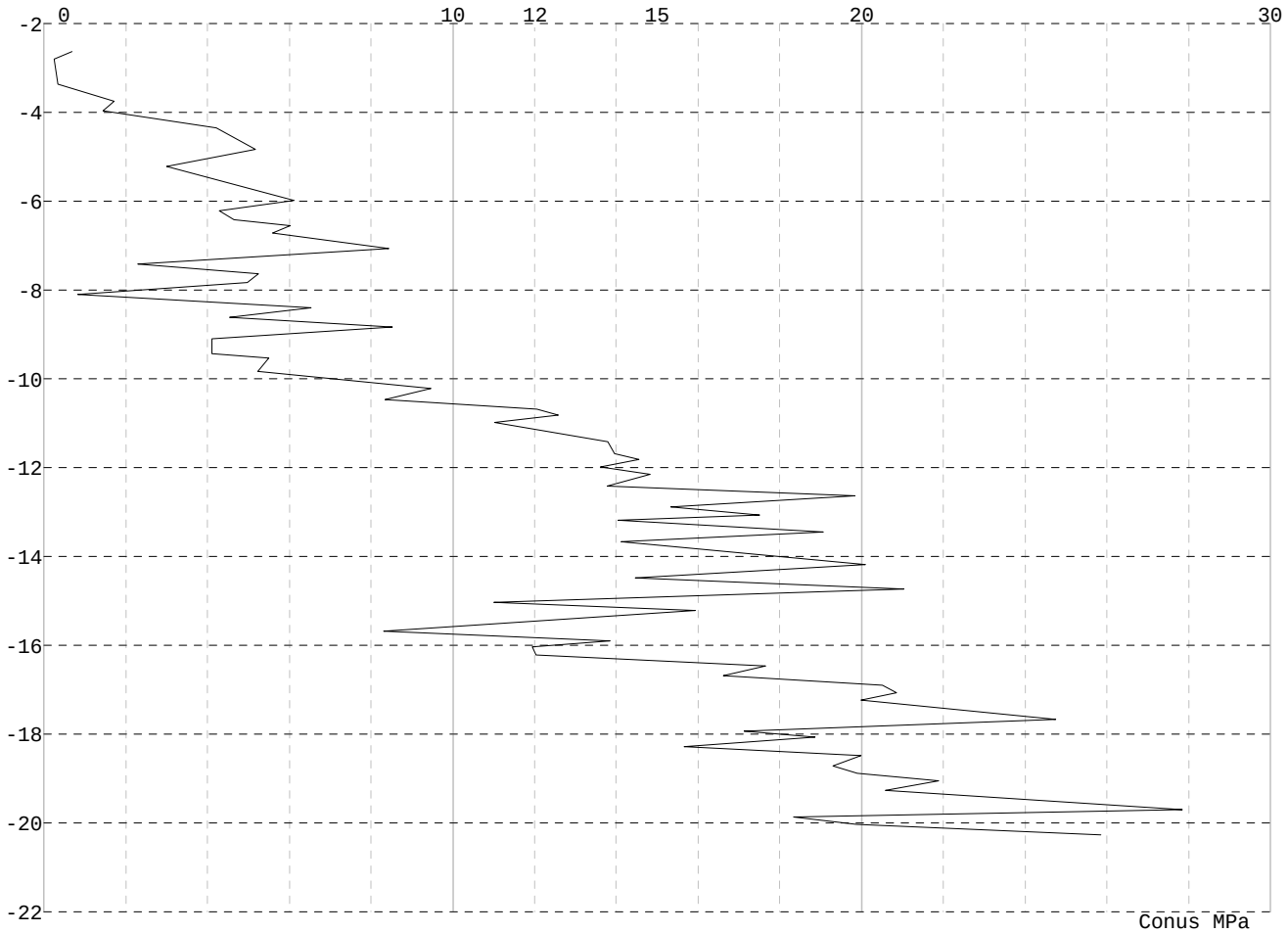
Project : BBB
Onderdeel : ENS-ZL380

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
17	-11.19	-11.59	Zand - Sterk siltig - Kleiig	1.0	100.0		
18	-11.59	-11.84	Zand - Schoon - Los	1.0	100.0		
19	-11.84	-11.98	Zand - Sterk siltig - Kleiig	1.0	100.0		
20	-11.98	-12.79	Zand - Schoon - Los	1.0	100.0		
21	-12.79	-12.94	Grind - Sterk siltig - Los	1.0	0.0		
22	-12.94	-13.20	Zand - Zwak siltig - Kleiig	1.0	100.0		
23	-13.20	-13.41	Zand - Sterk siltig - Kleiig	1.0	100.0		
24	-13.41	-14.09	Zand - Schoon - Matig	1.0	100.0		
25	-14.09	-14.19	Grind - Sterk siltig - Los	1.0	0.0		
26	-14.19	-14.37	Zand - Zwak siltig - Kleiig	1.0	100.0		
27	-14.37	-14.58	Zand - Sterk siltig - Kleiig	1.0	100.0		
28	-14.58	-14.76	Grind - Sterk siltig - Los	1.0	0.0		
29	-14.76	-14.96	Zand - Sterk siltig - Kleiig	1.0	100.0		
30	-14.96	-15.17	Zand - Schoon - Matig	1.0	100.0		
31	-15.17	-15.79	Grind - Sterk siltig - Los	1.0	0.0		
32	-15.79	-15.98	Zand - Schoon - Los	1.0	100.0		
33	-15.98	-16.52	Zand - Sterk siltig - Kleiig	1.0	100.0		
34	-16.52	-16.92	Grind - Sterk siltig - Los	1.0	0.0		
35	-16.92	-17.50	Zand - Sterk siltig - Kleiig	1.0	100.0		
36	-17.50	-17.74	Leem - Zwak zandig - Vast	1.0	50.0		
37	-17.74	-18.48	Zand - Zwak siltig - Kleiig	1.0	100.0		
38	-18.48	-18.82	Leem - Zwak zandig - Vast	1.0	50.0		
39	-18.82	-19.03	Grind - Sterk siltig - Los	1.0	0.0		
40	-19.03	-19.40	Zand - Zwak siltig - Kleiig	1.0	100.0		
41	-19.40	-19.86	Grind - Sterk siltig - Los	1.0	0.0		
42	-19.86	-20.18	Zand - Schoon - Los	1.0	100.0		
43	-20.18	-21.44	Zand - Schoon - Matig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 31

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -2.30 Bodemprofiel: Son 31
Traject negatieve kleef : -2.63 tot -2.63 [m]
Traject positieve kleef : -3.40 tot -20.26 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 31

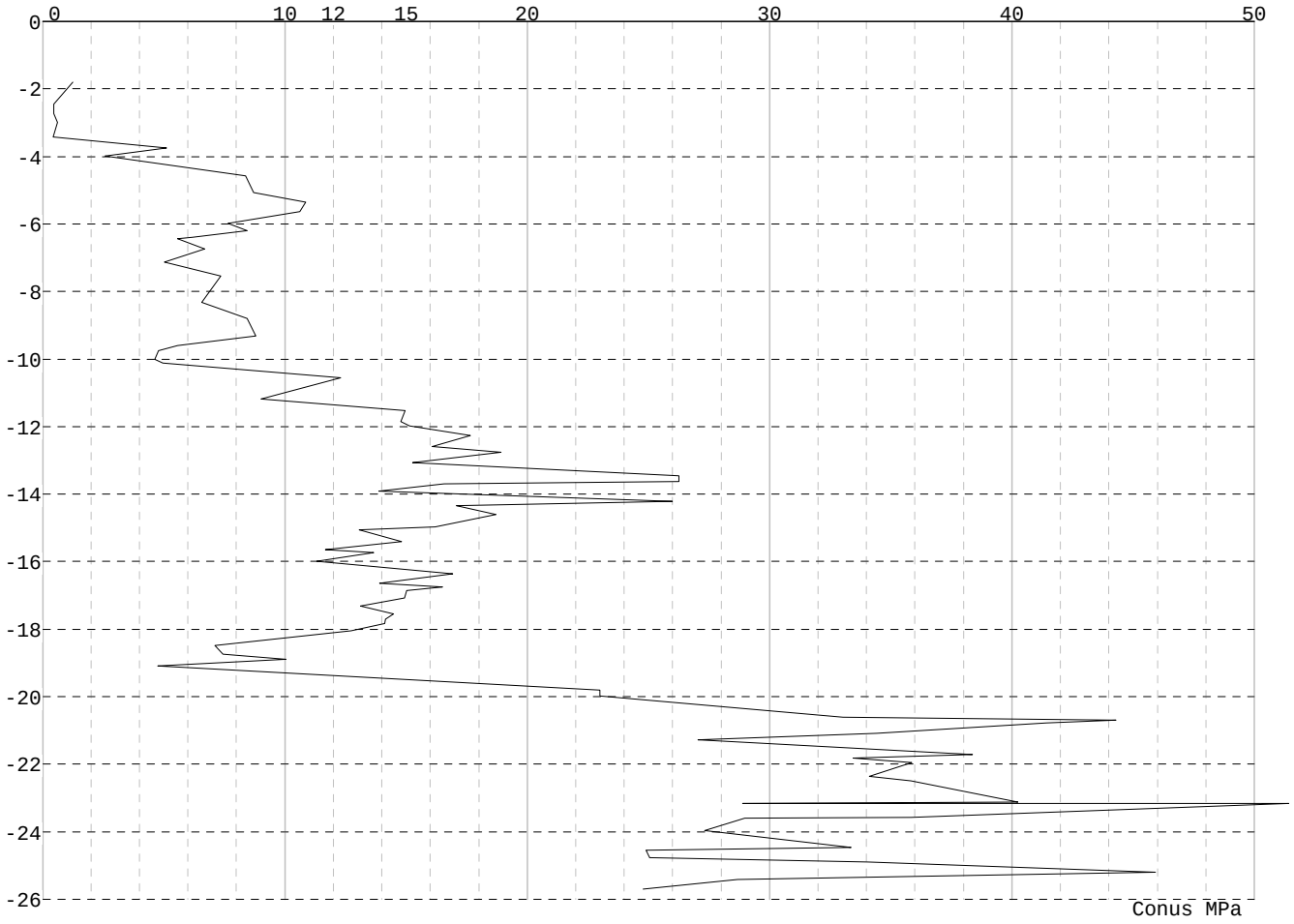


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 36

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.40 Bodemprofiel: Son 36
Traject negatieve kleef : -1.80 tot -3.50 [m]
Traject positieve kleef : -10.00 tot -25.70 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 36

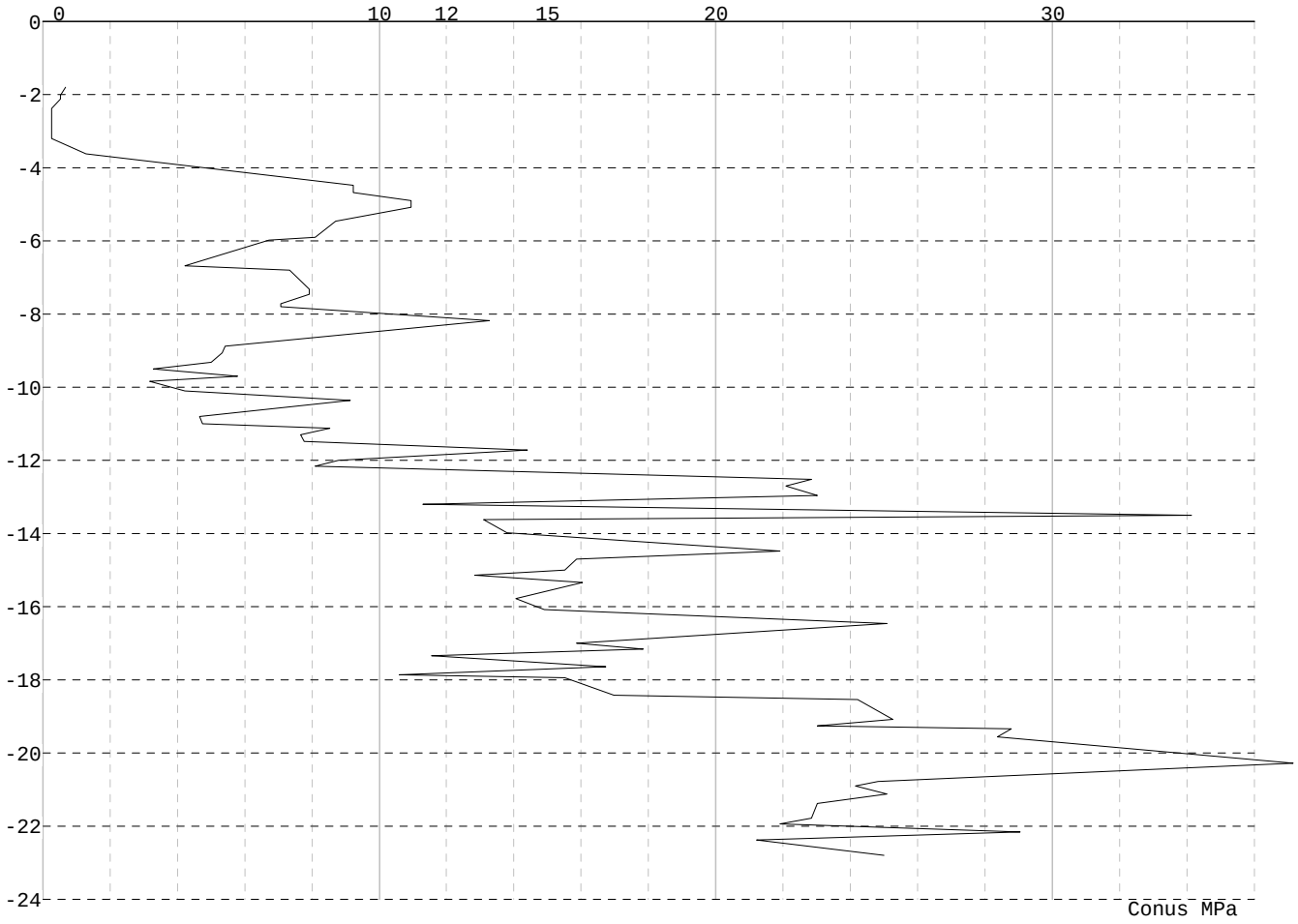


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 37

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -1.40 Bodemprofiel: Son 37
Traject negatieve kleef : -1.81 tot -2.70 [m]
Traject positieve kleef : -3.60 tot -22.81 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 37

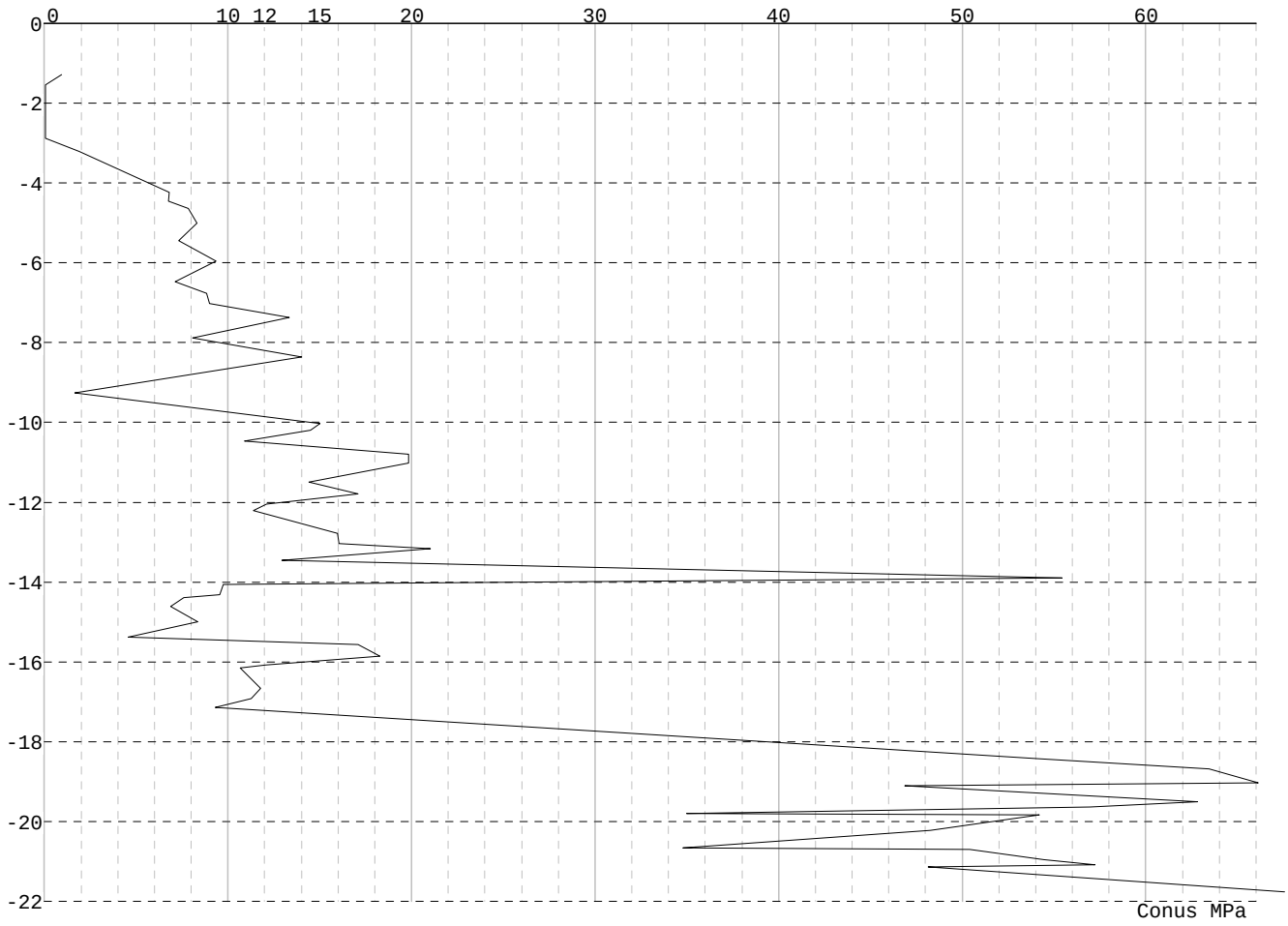


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 38

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.90 Bodemprofiel: Son 38
Traject negatieve kleef : -1.29 tot -3.10 [m]
Traject positieve kleef : -9.30 tot -21.77 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 38

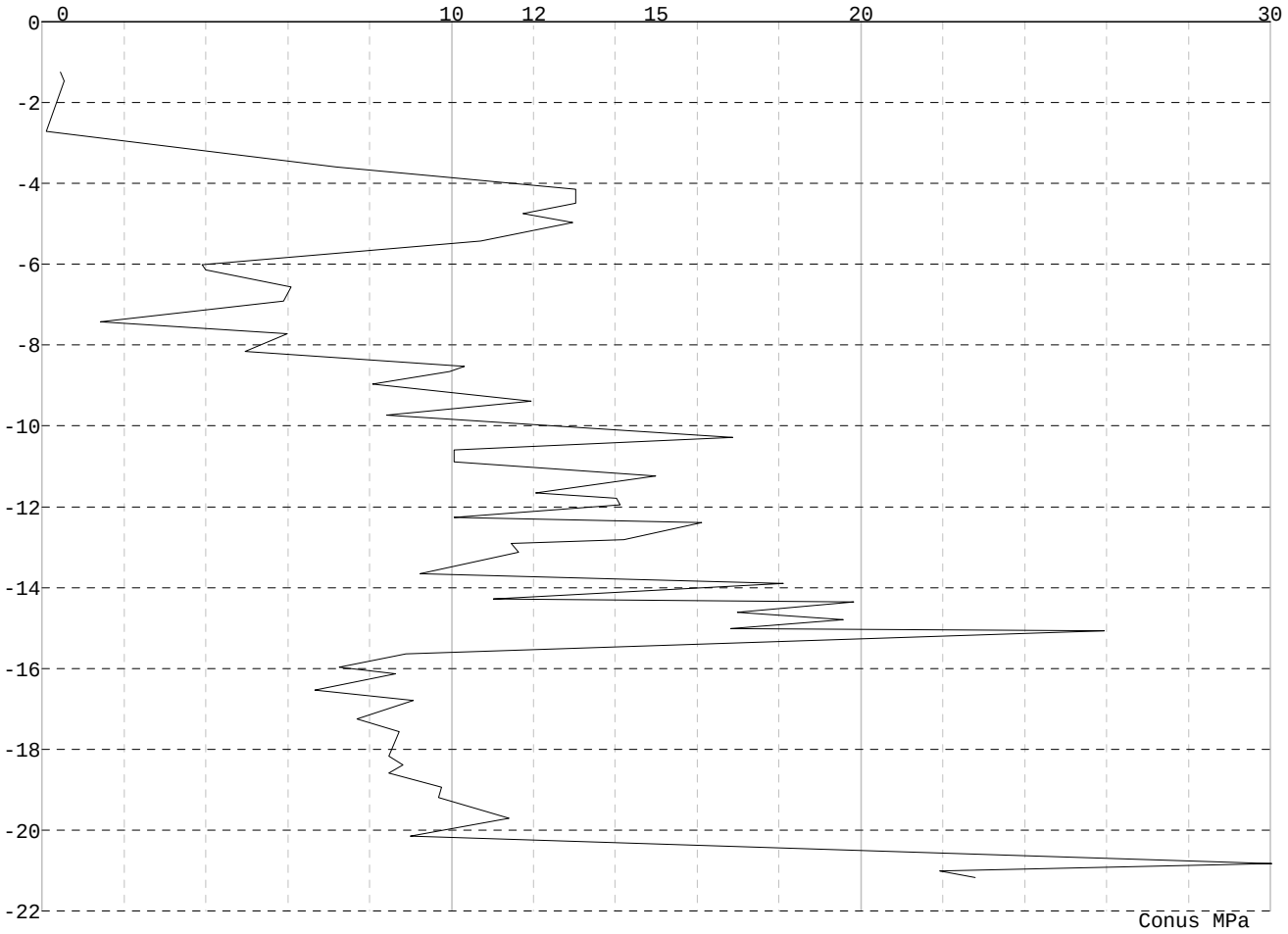


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.86 Bodemprofiel: Son 39
Traject negatieve kleef : -1.25 tot -2.80 [m]
Traject positieve kleef : -7.50 tot -21.18 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 39



REKENGEGEVENS Mast 31

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 31
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -2.27
Paalpuntniveau : N.A.P. -17.97
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 31 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 31

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.97	-17.97	48.1	636.9	636.9	0.0	0.00

SAMENVATTINGSTABEL Mast 31 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 31	-2.30	-17.97	636.9	636.9	636.9

Totaal resultaten Mast 31 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 31

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-17.97	$R_{t;d}$ = min.{ 636.9; 636.9}= 636.9

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.97	636.9	636.9	0.0	636.9	0.00

REKENGEGEVENS Mast 36

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 36
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.98
Paalpuntniveau : N.A.P. -16.08
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 36 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 36

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.08	-16.08	47.3	603.1	603.1	0.0	0.00

SAMENVATTINGSTABEL Mast 36 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 36	-1.40	-16.08	603.1	603.1	603.1

Totaal resultaten Mast 36 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 36

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.08	$R_{t;d}$ = min.{ 603.1; 603.1}= 603.1

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.08	603.1	603.1	0.0	603.1	0.00

REKENGEGEVENS Mast 37

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 37
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.95
Paalpuntniveau : N.A.P. -17.05
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 37 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 37

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.05	-17.05	50.3	625.0	625.0	0.0	0.00

SAMENVATTINGSTABEL Mast 37 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 37	-1.40	-17.05	625.0	625.0	625.0

Totaal resultaten Mast 37 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 37

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-17.05	$R_{t;d}$ = min.{ 625.0; 625.0}= 625.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.05	625.0	625.0	0.0	625.0	0.00

REKENGEGEVENS Mast 38

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 38
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.51
Paalpuntniveau : N.A.P. -17.11
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 38 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 38

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-17.11	-17.11	51.6	669.7	669.7	0.0	0.00

SAMENVATTINGSTABEL Mast 38 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 38	-0.90	-17.11	669.7	669.7	669.7

Totaal resultaten Mast 38 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 38

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-17.11	$R_{t;d}$ = min.{ 669.7; 669.7}= 669.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-17.11	669.7	669.7	0.0	669.7	0.00

REKENGEGEVENS Mast 39

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 39
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.60
Paalpuntniveau : N.A.P. -16.25
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 39 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.25	-16.25	48.5	632.6	632.6	0.0	0.00

SAMENVATTINGSTABEL Mast 39 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 39	-0.86	-16.25	632.6	632.6	632.6

Totaal resultaten Mast 39 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 39

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.25	$R_{t;d}$ = min.{ 632.6; 632.6}= 632.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.25	632.6	632.6	0.0	632.6	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 31	Mast 36	Mast 37	Mast 38	Mast 39
Son 31	-2.30	-17.97	636				
Son 36	-1.40	-16.08		603			
Son 37	-1.40	-17.05			624		
Son 38	-0.90	-17.11				669	
Son 39	-0.86	-16.25					632

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 40-49 (41).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Matig	18.00	20.00	35.00	19.00	21.00	37.50
2	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
3	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
4	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
5	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
6	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
7	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
8	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
9	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
10	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
11	Klei - Schoon - Slap	14.00	14.00	17.50	17.00	17.00	17.50
12	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
13	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
14	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
15	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
16	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
17	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
18	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00
19	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 41

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.90 Grondwaterstand [m] : -1.90

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.90	-2.72	Klei - Zwak zandig - Slap	1.0	50.0		
2	-2.72	-10.21	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-10.21	-16.30	Zand - Schoon - Matig	1.0	100.0		
4	-16.30	-17.50	Zand - Schoon - Los	1.0	100.0		
5	-17.50	-17.96	Zand - Schoon - Vast	1.0	100.0		
6	-17.96	-18.41	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-18.41	-19.24	Zand - Schoon - Vast	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 41 (2)

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.90 Grondwaterstand [m] : -1.90

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.90	-1.34	Zand - Schoon - Los	1.0	100.0		
2	-1.34	-1.64	Veen - Niet voorbelast - Slap	1.0	0.0		
3	-1.64	-1.85	Klei - Zwak zandig - Slap	1.0	50.0		
4	-1.85	-2.28	Veen - Niet voorbelast - Slap	1.0	0.0		
5	-2.28	-2.72	Klei - Schoon - Matig	1.0	50.0		
6	-2.72	-3.03	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-3.03	-3.24	Zand - Schoon - Los	1.0	100.0		
8	-3.24	-3.47	Zand - Schoon - Matig	1.0	100.0		
9	-3.47	-3.60	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-3.60	-4.83	Zand - Schoon - Matig	1.0	100.0		
11	-4.83	-5.67	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-5.67	-6.63	Zand - Zwak siltig - Kleiig	1.0	100.0		
13	-6.63	-7.26	Leem - Zwak zandig - Vast	1.0	50.0		

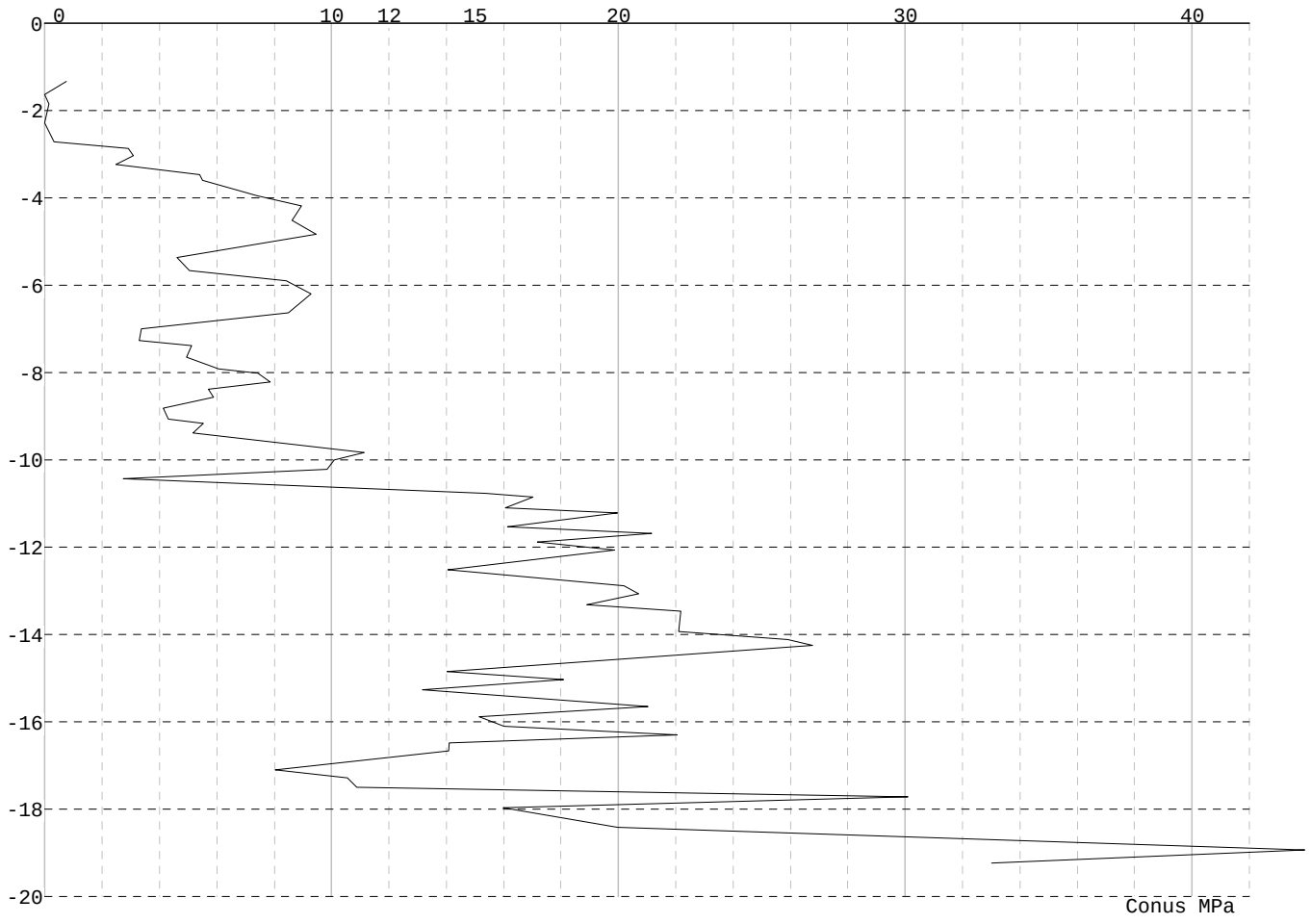
Project : BBB
Onderdeel : ENS-ZL380

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
14	-7.26	-7.91	Zand - Schoon - Los	1.0	100.0		
15	-7.91	-8.22	Zand - Sterk siltig - Kleiig	1.0	100.0		
16	-8.22	-8.56	Zand - Schoon - Los	1.0	100.0		
17	-8.56	-9.07	Leem - Zwak zandig - Vast	1.0	50.0		
18	-9.07	-9.38	Zand - Schoon - Los	1.0	100.0		
19	-9.38	-9.83	Zand - Zwak siltig - Kleiig	1.0	100.0		
20	-9.83	-10.21	Grind - Sterk siltig - Los	1.0	0.0		
21	-10.21	-10.44	Klei - Zwak zandig - Vast	1.0	50.0		
22	-10.44	-12.07	Zand - Schoon - Matig	1.0	100.0		
23	-12.07	-12.52	Zand - Zwak siltig - Kleiig	1.0	100.0		
24	-12.52	-14.25	Zand - Schoon - Matig	1.0	100.0		
25	-14.25	-14.85	Grind - Sterk siltig - Los	1.0	0.0		
26	-14.85	-15.04	Zand - Zwak siltig - Kleiig	1.0	100.0		
27	-15.04	-15.27	Zand - Sterk siltig - Kleiig	1.0	100.0		
28	-15.27	-15.65	Zand - Schoon - Matig	1.0	100.0		
29	-15.65	-16.10	Grind - Sterk siltig - Los	1.0	0.0		
30	-16.10	-16.30	Zand - Schoon - Matig	1.0	100.0		
31	-16.30	-16.48	Grind - Sterk siltig - Los	1.0	0.0		
32	-16.48	-16.66	Zand - Sterk siltig - Kleiig	1.0	100.0		
33	-16.66	-17.50	Zand - Schoon - Los	1.0	100.0		
34	-17.50	-17.72	Zand - Schoon - Matig	1.0	100.0		
35	-17.72	-17.96	Grind - Sterk siltig - Los	1.0	0.0		
36	-17.96	-18.41	Zand - Zwak siltig - Kleiig	1.0	100.0		
37	-18.41	-18.94	Zand - Schoon - Vast	1.0	100.0		
38	-18.94	-19.24	Zand - Schoon - Matig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 41

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.90 Bodemprofiel: Son 41 (2)
Traject negatieve kleef : -1.34 tot -2.10 [m]
Traject positieve kleef : -2.80 tot -19.24 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 41



Project : BBB
Onderdeel : ENS-ZL380

REKENGEGEVENS Mast 41

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 41
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.49
Paalpuntniveau : N.A.P. -14.09
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 41 (n=1)

Sondering : Son 41

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.09	-14.09	42.9	500.8	500.8	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 41 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 41	-0.90	-14.09	500.8	500.8	500.8

Totaal resultaten Mast 41 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 41

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.09	$R_{t;d}$ = min.{ 500.8; 500.8}= 500.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.09	500.8	500.8	0.0	500.8	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 41
Son 41	-0.90	-14.09	500

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 50-59 (55).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Matig	18.00	20.00	35.00	19.00	21.00	37.50
2	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
3	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
4	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
5	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
6	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
7	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
8	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
9	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
10	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
11	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
12	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
13	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
14	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
15	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
16	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 55

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.35 Grondwaterstand [m] : -1.35

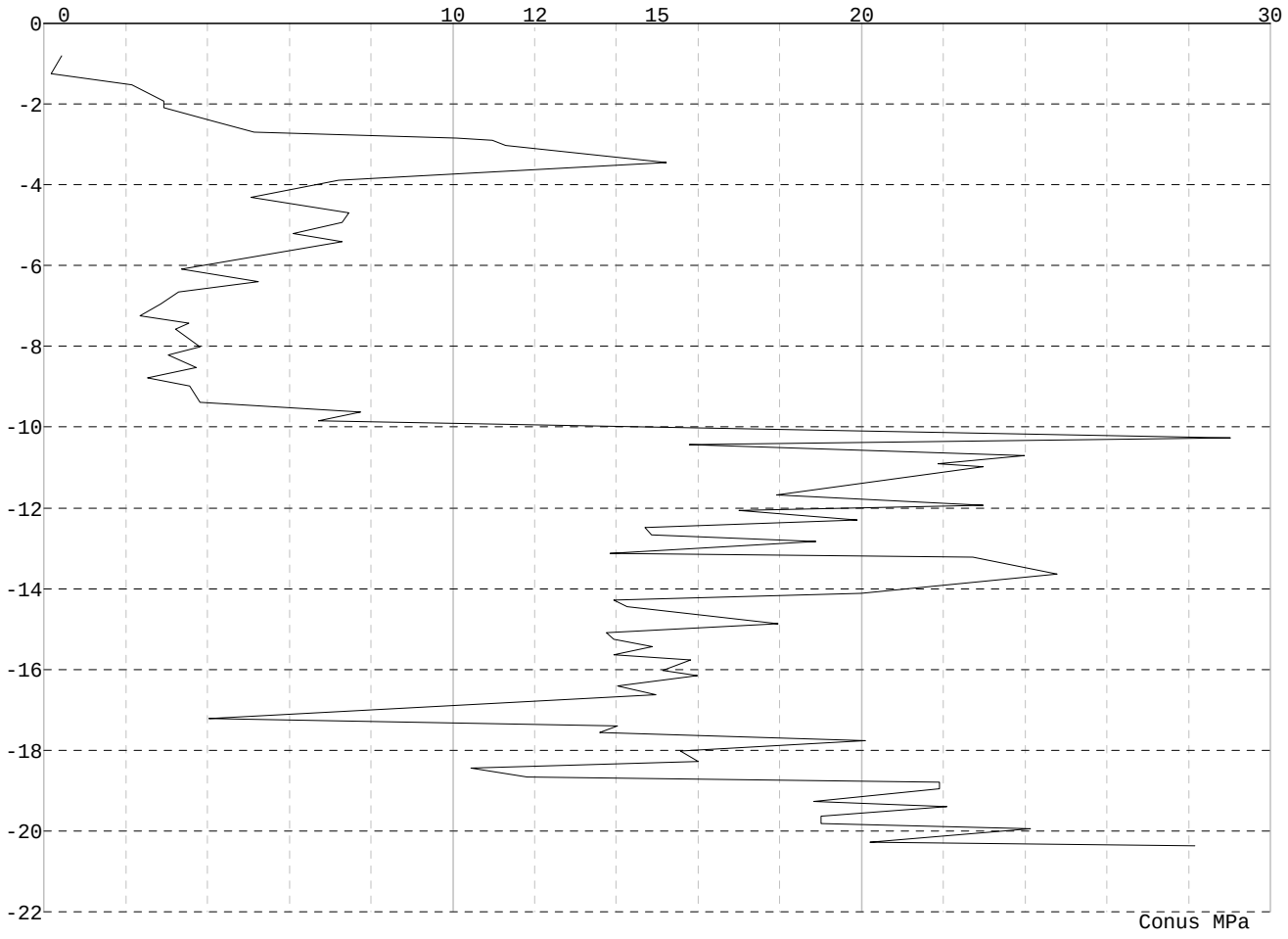
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.35	-1.24	Klei - Zwak zandig - Slap	1.0	50.0		
2	-1.24	-2.09	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-2.09	-3.45	Zand - Schoon - Matig	1.0	100.0		
4	-3.45	-5.41	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-5.41	-9.38	Klei - Zwak zandig - Vast	1.0	50.0		
6	-9.38	-9.84	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-9.84	-10.27	Zand - Schoon - Vast	1.0	100.0		
8	-10.27	-13.21	Zand - Schoon - Matig	1.0	100.0		
9	-13.21	-13.64	Zand - Schoon - Vast	1.0	100.0		
10	-13.64	-16.62	Zand - Zwak siltig - Kleiig	1.0	100.0		
11	-16.62	-17.22	Klei - Zwak zandig - Vast	1.0	50.0		
12	-17.22	-18.96	Zand - Zwak siltig - Kleiig	1.0	100.0		
13	-18.96	-20.37	Zand - Schoon - Matig	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 55

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.35 Bodemprofiel: Son 55
Traject negatieve kleef : -0.81 tot -1.30 [m]
Traject positieve kleef : -9.30 tot -20.37 [m]

Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS GRAFIEK: Son 55



Project : BBB
Onderdeel : ENS-ZL380

REKENGEGEVENS Mast 55

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 55
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.07
Paalpuntniveau : N.A.P. -14.58
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 55 (n=1)

Sondering : Son 55

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.58	-14.58	46.0	621.6	621.6	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 55 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 55	-0.35	-14.58	621.6	621.6	621.6

Totaal resultaten Mast 55 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 55

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.58	$R_{t;d}$ = min.{ 621.6; 621.6}= 621.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.58	621.6	621.6	0.0	621.6	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 55
Son 55	-0.35	-14.58	621

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 60-69 (66).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
15	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 66

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.10 Grondwaterstand [m] : -1.10

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.10	-3.68	Klei - Schoon - Vast	1.0	50.0		
2	-3.68	-4.82	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-4.82	-5.73	Leem - Zwak zandig - Vast	1.0	50.0		
4	-5.73	-6.51	Klei - Zwak zandig - Vast	1.0	50.0		
5	-6.51	-9.83	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-9.83	-12.67	Zand - Schoon - Matig	1.0	100.0		
7	-12.67	-13.62	Zand - Schoon - Los	1.0	100.0		
8	-13.62	-13.92	Zand - Schoon - Vast	1.0	100.0		
9	-13.92	-14.22	Klei - Zwak zandig - Matig	1.0	50.0		
10	-14.22	-17.22	Zand - Zwak siltig - Kleiig	1.0	100.0		
11	-17.22	-18.49	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 66B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.10 Grondwaterstand [m] : -1.10

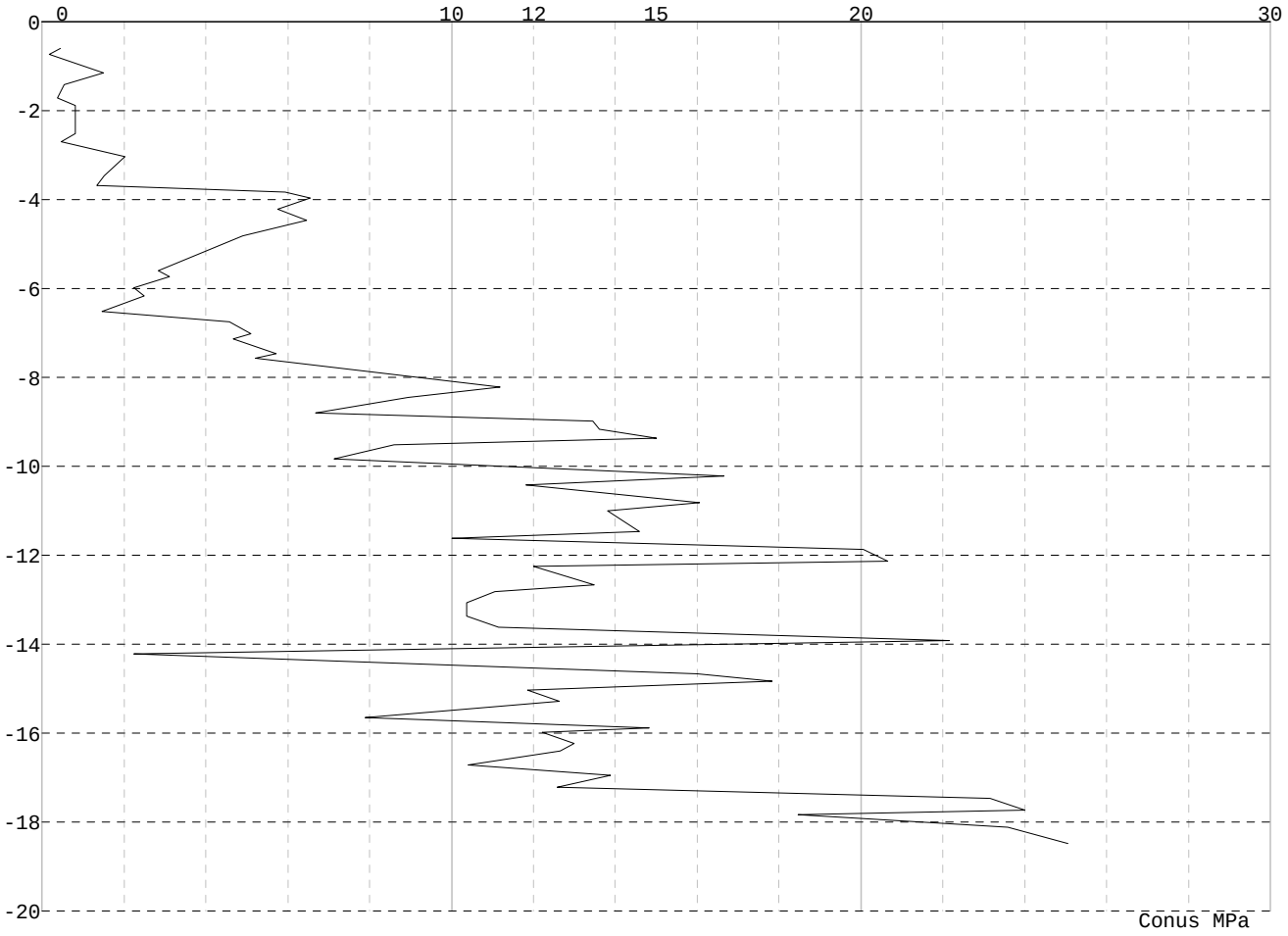
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.10	-5.23	Klei - Schoon - Matig	1.0	50.0		
2	-5.23	-6.13	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-6.13	-6.42	Klei - Zwak zandig - Matig	1.0	50.0		
4	-6.42	-11.47	Zand - Schoon - Los	1.0	100.0		
5	-11.47	-13.83	Zand - Schoon - Matig	1.0	100.0		
6	-13.83	-13.98	Grind - Zwak siltig - Vast	1.0	0.0		
7	-13.98	-15.04	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-15.04	-17.00	Zand - Schoon - Matig	1.0	100.0		
9	-17.00	-17.23	Zand - Schoon - Los	1.0	100.0		
10	-17.23	-19.98	Zand - Zwak siltig - Kleiig	1.0	100.0		

Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 66

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.10 Bodemprofiel: Son 66
Traject negatieve kleef : -0.60 tot -3.70 [m]
Traject positieve kleef : -6.50 tot -18.49 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 66

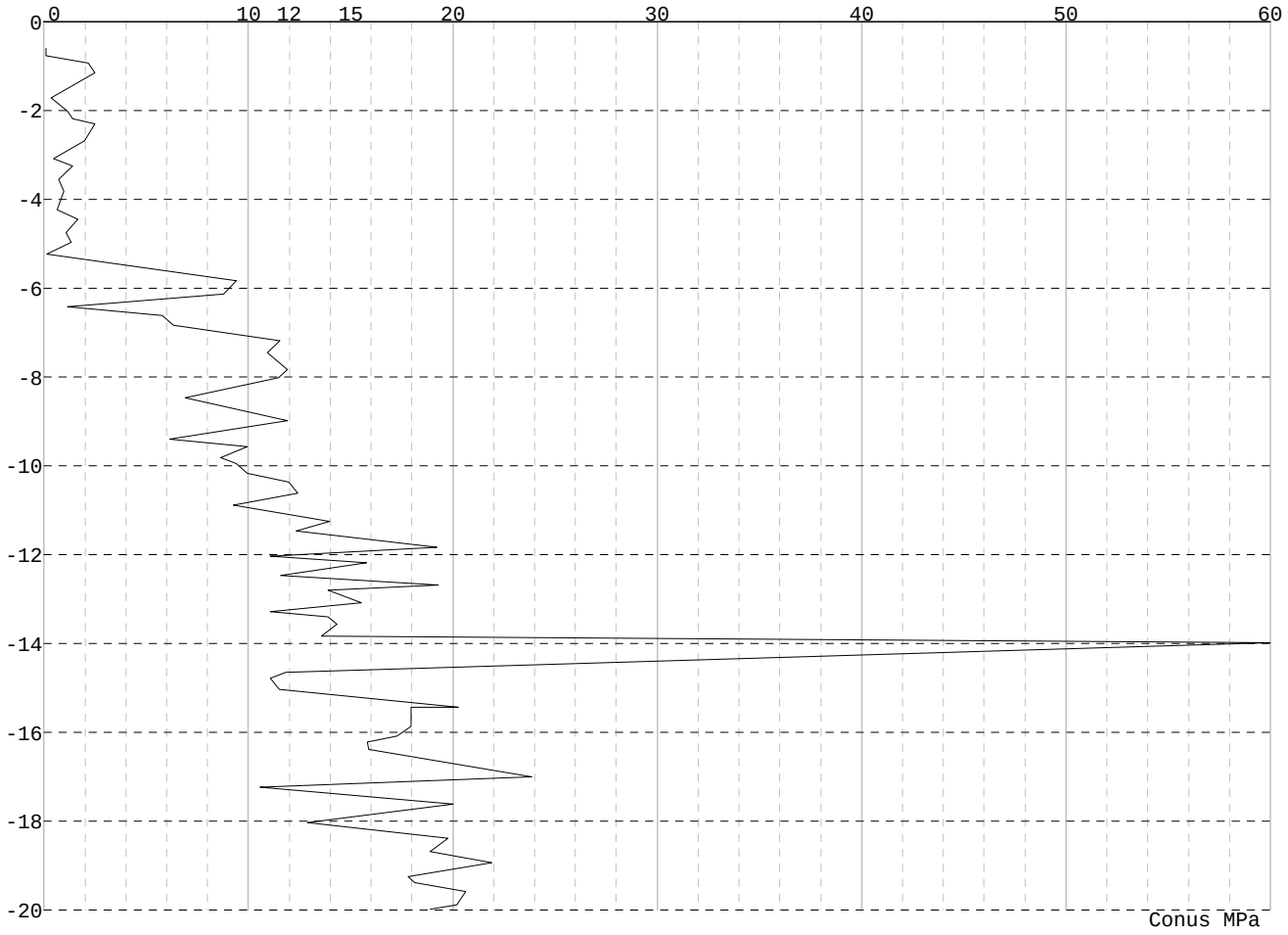


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 66B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.10 Bodemprofiel: Son 66B
Traject negatieve kleef : -0.60 tot -3.00 [m]
Traject positieve kleef : -6.40 tot -19.98 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 66B



Project : BBB
Onderdeel : ENS-ZL380

REKENGEGEVENS Mast 66

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 66, Son 66B
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 609_770
Niveau paalkop [m] : N.A.P. 1.64
Paalpuntniveau : N.A.P. -14.56
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 66 (n=1)

Sondering : Son 66

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.56	-14.56	101.9	1089.4	1089.4	0.0	0.00

Sondering : Son 66B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.56	-14.56	101.9	1105.5	1105.5	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 66 (n=1)

Uitgangspunten
- paal : GI 609_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 66	-0.10	-14.56	1089.4	1089.4	1089.4
Son 66B	-0.10	-14.56	1105.5	1105.5	1105.5

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 66 (van 2 sonderingen)

Uitgangspunten
- paal : GI 609_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
Son 66	-0.10	-14.56	101.9	1141.7
Son 66B	-0.10	-14.56	101.9	1158.7
		-14.56	$R_{t;cal;gem}$	1150.2
met ξ_4(min) = 1.32				
Son 66	-0.10	-14.56	101.9	1141.7
Son 66B	-0.10	-14.56	101.9	1158.7
		-14.56	$R_{t;cal;min}$	1141.7

Totaal resultaten Mast 66 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 66 Son 66B

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.56	$R_{t;d}$ = min.{ 1150.2; 1141.7}= 1141.7

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.56	1141.7	1141.7	0.0	1141.7	0.00

PAALGEGEVENS GI 609_770

Type : Stalen profiel (geheid, grout)
Wijze van installeren : Heien
Diameter [m] : 0.770
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0120 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : JA

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 66
Son 66	-0.10	-14.56	1089
Son 66B	-0.10	-14.56	1105

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\Nog te ontvangen\ENS-ZL380 60-69 (69).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
4	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
5	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
6	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
7	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
8	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
9	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
10	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
11	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
12	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
13	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
14	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
15	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 69

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.20 Grondwaterstand [m] : -1.20

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.20	-1.55	Leem - Zwak zandig - Vast	1.0	50.0		
2	-1.55	-6.74	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-6.74	-7.45	Zand - Schoon - Matig	1.0	100.0		
4	-7.45	-9.67	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-9.67	-10.00	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-10.00	-11.50	Zand - Schoon - Matig	1.0	100.0		
7	-11.50	-12.30	Klei - Schoon - Vast	1.0	50.0		
8	-12.30	-14.55	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-14.55	-15.59	Zand - Schoon - Vast	1.0	100.0		
10	-15.59	-17.38	Zand - Schoon - Matig	1.0	100.0		
11	-17.38	-18.30	Zand - Schoon - Los	1.0	100.0		
12	-18.30	-20.28	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 69 (2)

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.20 Grondwaterstand [m] : -1.20

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.20	-0.60	Leem - Zwak zandig - Vast	1.0	50.0		
2	-0.60	-1.16	Zand - Zwak siltig - Kleiig	1.0	100.0		
3	-1.16	-1.55	Zand - Schoon - Los	1.0	100.0		
4	-1.55	-2.80	Zand - Zwak siltig - Kleiig	1.0	100.0		
5	-2.80	-3.06	Grind - Sterk siltig - Los	1.0	0.0		
6	-3.06	-3.97	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-3.97	-4.83	Zand - Schoon - Los	1.0	100.0		
8	-4.83	-5.09	Leem - Zwak zandig - Vast	1.0	50.0		
9	-5.09	-5.43	Grind - Sterk siltig - Los	1.0	0.0		
10	-5.43	-5.56	Zand - Schoon - Los	1.0	100.0		
11	-5.56	-6.25	Grind - Sterk siltig - Los	1.0	0.0		

Project : BBB
Onderdeel : ENS-ZL380

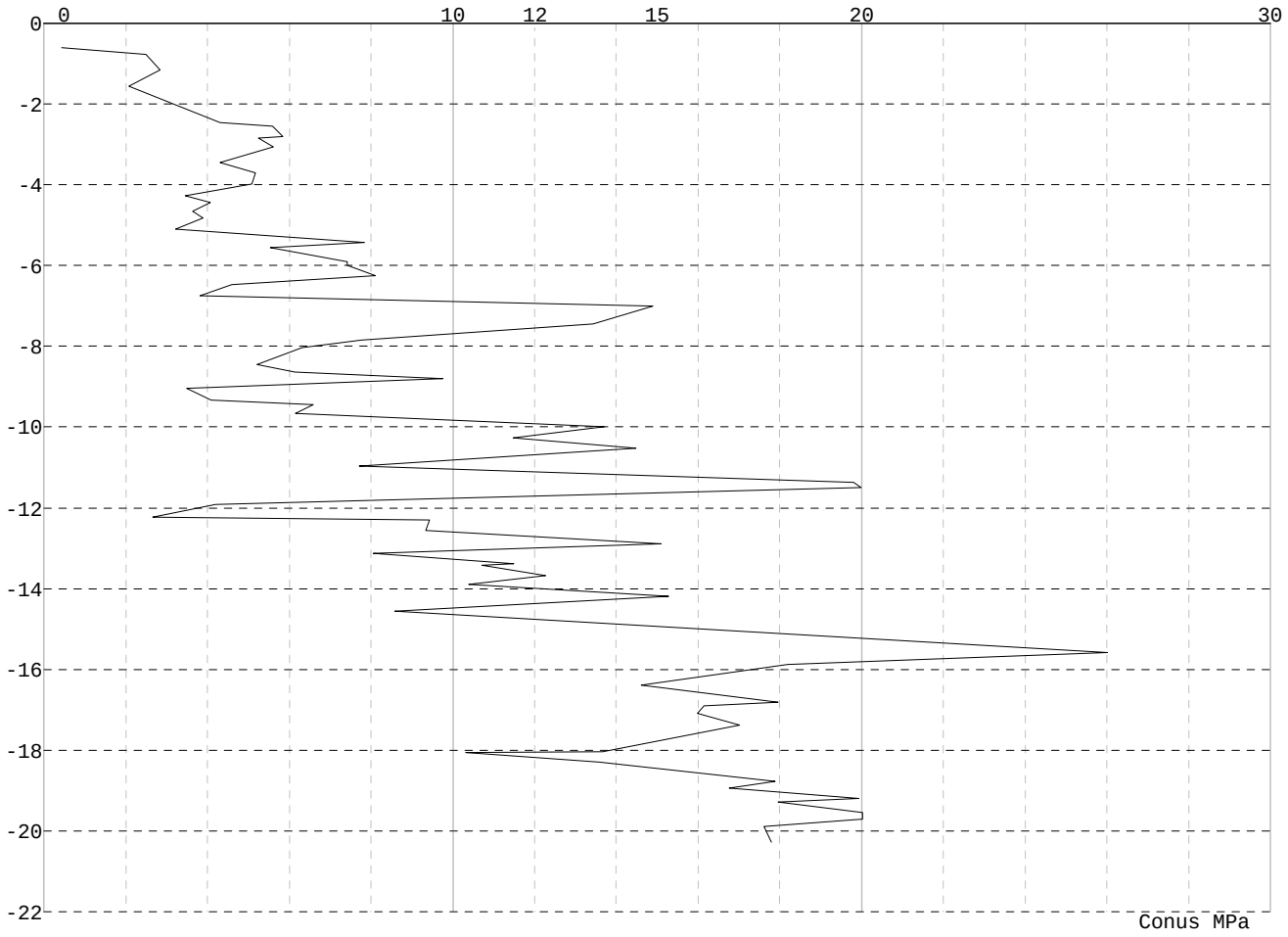
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
12	-6.25	-6.47	Zand - Schoon - Los	1.0	100.0		
13	-6.47	-6.74	Leem - Zwak zandig - Vast	1.0	50.0		
14	-6.74	-7.45	Zand - Schoon - Matig	1.0	100.0		
15	-7.45	-7.85	Zand - Sterk siltig - Kleiig	1.0	100.0		
16	-7.85	-8.63	Zand - Schoon - Los	1.0	100.0		
17	-8.63	-8.80	Grind - Sterk siltig - Los	1.0	0.0		
18	-8.80	-9.33	Leem - Zwak zandig - Vast	1.0	50.0		
19	-9.33	-9.67	Zand - Schoon - Los	1.0	100.0		
20	-9.67	-10.00	Zand - Zwak siltig - Kleiig	1.0	100.0		
21	-10.00	-10.26	Grind - Sterk siltig - Los	1.0	0.0		
22	-10.26	-10.52	Zand - Zwak siltig - Kleiig	1.0	100.0		
23	-10.52	-10.96	Zand - Schoon - Los	1.0	100.0		
24	-10.96	-11.50	Zand - Schoon - Matig	1.0	100.0		
25	-11.50	-11.92	Leem - Zwak zandig - Vast	1.0	50.0		
26	-11.92	-12.30	Klei - Schoon - Vast	1.0	50.0		
27	-12.30	-12.56	Zand - Schoon - Los	1.0	100.0		
28	-12.56	-12.89	Zand - Zwak siltig - Kleiig	1.0	100.0		
29	-12.89	-13.12	Zand - Schoon - Los	1.0	100.0		
30	-13.12	-13.68	Zand - Sterk siltig - Kleiig	1.0	100.0		
31	-13.68	-13.90	Zand - Schoon - Los	1.0	100.0		
32	-13.90	-14.19	Grind - Sterk siltig - Los	1.0	0.0		
33	-14.19	-14.55	Zand - Schoon - Los	1.0	100.0		
34	-14.55	-15.59	Zand - Schoon - Matig	1.0	100.0		
35	-15.59	-15.87	Zand - Zwak siltig - Kleiig	1.0	100.0		
36	-15.87	-16.39	Grind - Sterk siltig - Los	1.0	0.0		
37	-16.39	-16.91	Zand - Zwak siltig - Kleiig	1.0	100.0		
38	-16.91	-17.38	Grind - Sterk siltig - Los	1.0	0.0		
39	-17.38	-18.30	Zand - Sterk siltig - Kleiig	1.0	100.0		
40	-18.30	-18.94	Grind - Sterk siltig - Los	1.0	0.0		
41	-18.94	-19.71	Zand - Zwak siltig - Kleiig	1.0	100.0		
42	-19.71	-20.28	Grind - Sterk siltig - Los	1.0	0.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 69

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.20 Bodemprofiel: Son 69 (2)
Traject negatieve kleef : -0.60 tot -0.60 [m]
Traject positieve kleef : -1.60 tot -20.28 [m]

Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS GRAFIEK: Son 69



Project : BBB
Onderdeel : ENS-ZL380

REKENGEGEVENS Mast 69

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 69
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.50
Paalpuntniveau : N.A.P. -14.80
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 69 (n=1)

Sondering : Son 69

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.80	-14.80	48.5	470.0	470.0	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 69 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 69	-0.20	-14.80	470.0	470.0	470.0

Totaal resultaten Mast 69 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 69

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.80	$R_{t;d}$ = min.{ 470.0; 470.0}= 470.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.80	470.0	470.0	0.0	470.0	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 69
Son 69	-0.20	-14.80	469

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 70-79 (70 74 75 76 77 78).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m^3]	$\gamma_{sat;k;1}$ [kN/m^3]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m^3]	$\gamma_{sat;k;2}$ [kN/m^3]	$\varphi'_{k;2}$ [°]
1	Grind - Sterk siltig - Matig	19.00	21.00	32.50	20.00	22.00	35.00
2	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
3	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
4	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
5	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
6	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
7	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
8	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
9	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
10	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
11	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
12	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
13	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
14	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00
15	Veen - Matig voorbelast - Matig	12.00	12.00	15.00	13.00	13.00	15.00

BODEMPROFIELGEGEVENS: Son 70

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.20 Grondwaterstand [m] : -1.20

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.20	-1.56	Veen - Matig voorbelast - Matig	1.0	0.0		
2	-1.56	-7.54	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-7.54	-7.97	Klei - Zwak zandig - Matig	1.0	50.0		
4	-7.97	-8.75	Leem - Zwak zandig - Vast	1.0	50.0		
5	-8.75	-11.33	Zand - Schoon - Los	1.0	100.0		
6	-11.33	-19.35	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 74

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.35 Grondwaterstand [m] : -1.35

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.35	-1.55	Klei - Organisch - Matig	1.0	50.0		
2	-1.55	-5.58	Zand - Schoon - Los	1.0	100.0		
3	-5.58	-8.46	Zand - Zwak siltig - Kleiig	1.0	100.0		
4	-8.46	-10.13	Zand - Schoon - Matig	1.0	100.0		
5	-10.13	-11.91	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-11.91	-15.49	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-15.49	-16.42	Klei - Organisch - Matig	1.0	50.0		
8	-16.42	-17.27	Zand - Schoon - Vast	1.0	100.0		
9	-17.27	-18.03	Zand - Sterk siltig - Kleiig	1.0	100.0		
10	-18.03	-19.04	Zand - Schoon - Los	1.0	100.0		
11	-19.04	-19.57	Zand - Zwak siltig - Kleiig	1.0	100.0		

Project : BBB
Onderdeel : ENS-ZL380

BODEMPROFIELGEGEVENS: Son 75

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.25 Grondwaterstand [m] : -1.25

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.25	-0.82	Zand - Zwak siltig - Kleiig	1.0	100.0		
2	-0.82	-1.60	Klei - Schoon - Matig	1.0	50.0		
3	-1.60	-5.30	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-5.30	-7.49	Zand - Schoon - Matig	1.0	100.0		
5	-7.49	-10.50	Zand - Zwak siltig - Kleiig	1.0	100.0		
6	-10.50	-11.52	Zand - Schoon - Los	1.0	100.0		
7	-11.52	-11.90	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-11.90	-14.28	Zand - Schoon - Matig	1.0	100.0		
9	-14.28	-15.06	Zand - Schoon - Los	1.0	100.0		
10	-15.06	-15.87	Zand - Schoon - Matig	1.0	100.0		
11	-15.87	-16.79	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-16.79	-17.49	Zand - Schoon - Los	1.0	100.0		
13	-17.49	-17.67	Zand - Schoon - Vast	1.0	100.0		
14	-17.67	-18.64	Zand - Schoon - Matig	1.0	100.0		
15	-18.64	-19.46	Klei - Schoon - Matig	1.0	50.0		
16	-19.46	-20.14	Grind - Sterk siltig - Matig	1.0	0.0		

BODEMPROFIELGEGEVENS: Son 76

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.25 Grondwaterstand [m] : -1.25

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.25	-0.99	Klei - Zwak zandig - Slap	1.0	50.0		
2	-0.99	-2.51	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-2.51	-3.20	Klei - Zwak zandig - Vast	1.0	50.0		
4	-3.20	-4.37	Zand - Schoon - Los	1.0	100.0		
5	-4.37	-5.06	Klei - Zwak zandig - Matig	1.0	50.0		
6	-5.06	-5.84	Zand - Schoon - Los	1.0	100.0		
7	-5.84	-13.10	Zand - Schoon - Matig	1.0	100.0		
8	-13.10	-14.57	Zand - Schoon - Los	1.0	100.0		
9	-14.57	-15.22	Klei - Zwak zandig - Vast	1.0	50.0		
10	-15.22	-15.95	Zand - Schoon - Vast	1.0	100.0		
11	-15.95	-16.95	Zand - Schoon - Matig	1.0	100.0		
12	-16.95	-17.38	Zand - Schoon - Vast	1.0	100.0		
13	-17.38	-17.77	Zand - Zwak siltig - Kleiig	1.0	100.0		
14	-17.77	-19.41	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 77

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.00 Grondwaterstand [m] : -1.00

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.00	-2.41	Zand - Sterk siltig - Kleiig	1.0	100.0		
2	-2.41	-3.22	Klei - Zwak zandig - Matig	1.0	50.0		
3	-3.22	-5.37	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-5.37	-5.80	Zand - Schoon - Matig	1.0	100.0		
5	-5.80	-6.62	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-6.62	-6.88	Veen - Matig voorbelast - Matig	1.0	0.0		
7	-6.88	-8.17	Zand - Schoon - Los	1.0	100.0		
8	-8.17	-8.81	Zand - Schoon - Matig	1.0	100.0		
9	-8.81	-12.12	Zand - Schoon - Los	1.0	100.0		
10	-12.12	-13.15	Zand - Schoon - Vast	1.0	100.0		
11	-13.15	-14.05	Zand - Sterk siltig - Kleiig	1.0	100.0		
12	-14.05	-15.82	Zand - Zwak siltig - Kleiig	1.0	100.0		
13	-15.82	-16.93	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-16.93	-17.23	Zand - Schoon - Matig	1.0	100.0		
15	-17.23	-18.61	Zand - Schoon - Los	1.0	100.0		
16	-18.61	-19.13	Zand - Zwak siltig - Kleiig	1.0	100.0		

Project : BBB
Onderdeel : ENS-ZL380

BODEMPROFIELGEGEVENS: Son 78

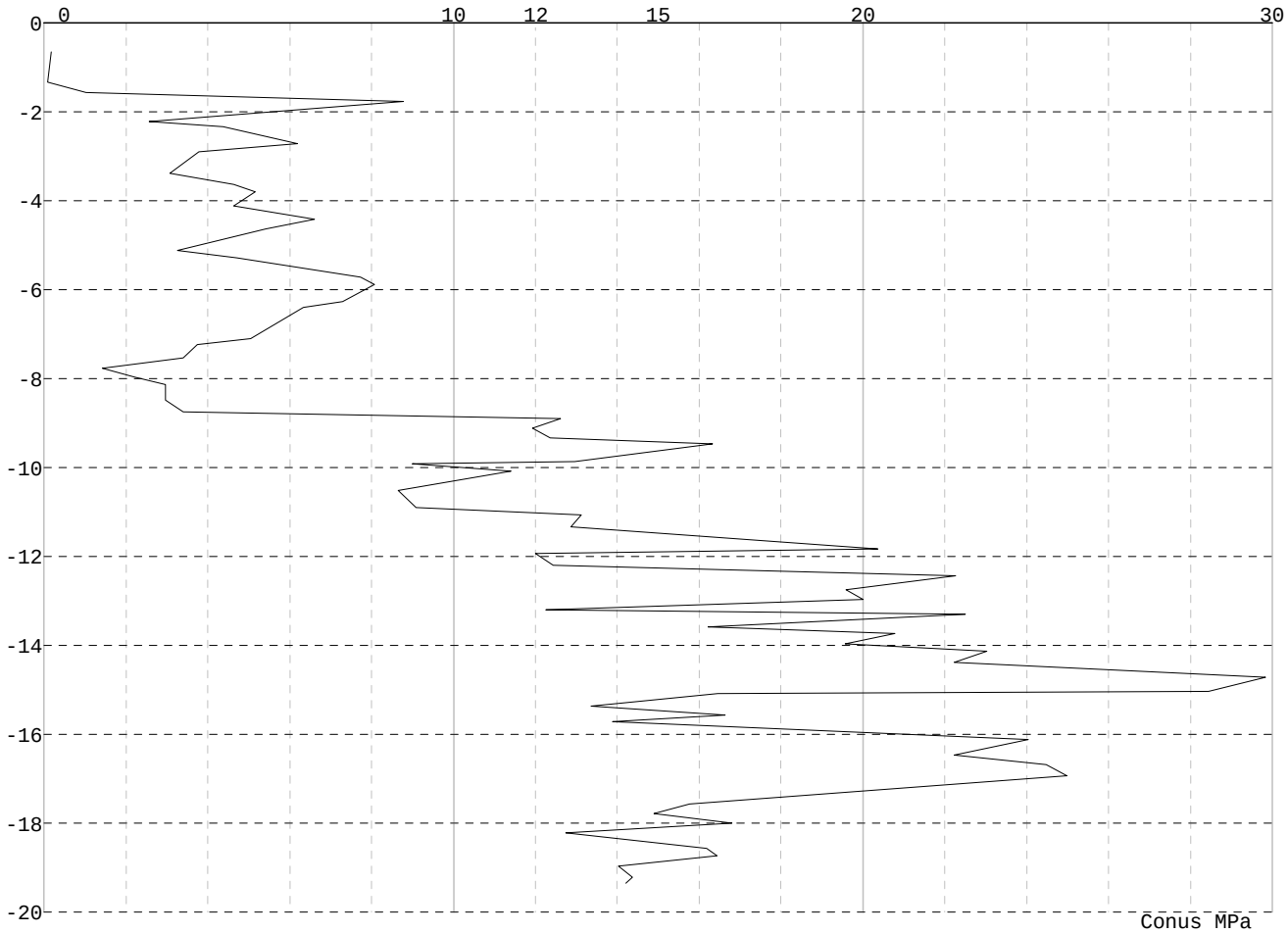
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : -0.30 Grondwaterstand [m] : -1.30

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	-0.30	-1.65	Zand - Schoon - Matig	1.0	100.0		
2	-1.65	-4.81	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-4.81	-5.63	Klei - Zwak zandig - Matig	1.0	50.0		
4	-5.63	-8.43	Zand - Schoon - Matig	1.0	100.0		
5	-8.43	-9.82	Zand - Schoon - Vast	1.0	100.0		
6	-9.82	-16.42	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-16.42	-17.21	Zand - Schoon - Los	1.0	100.0		
8	-17.21	-18.54	Zand - Schoon - Vast	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 70

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.20 Bodemprofiel: Son 70
Traject negatieve kleef : -0.65 tot -0.65 [m]
Traject positieve kleef : -1.60 tot -19.35 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 70

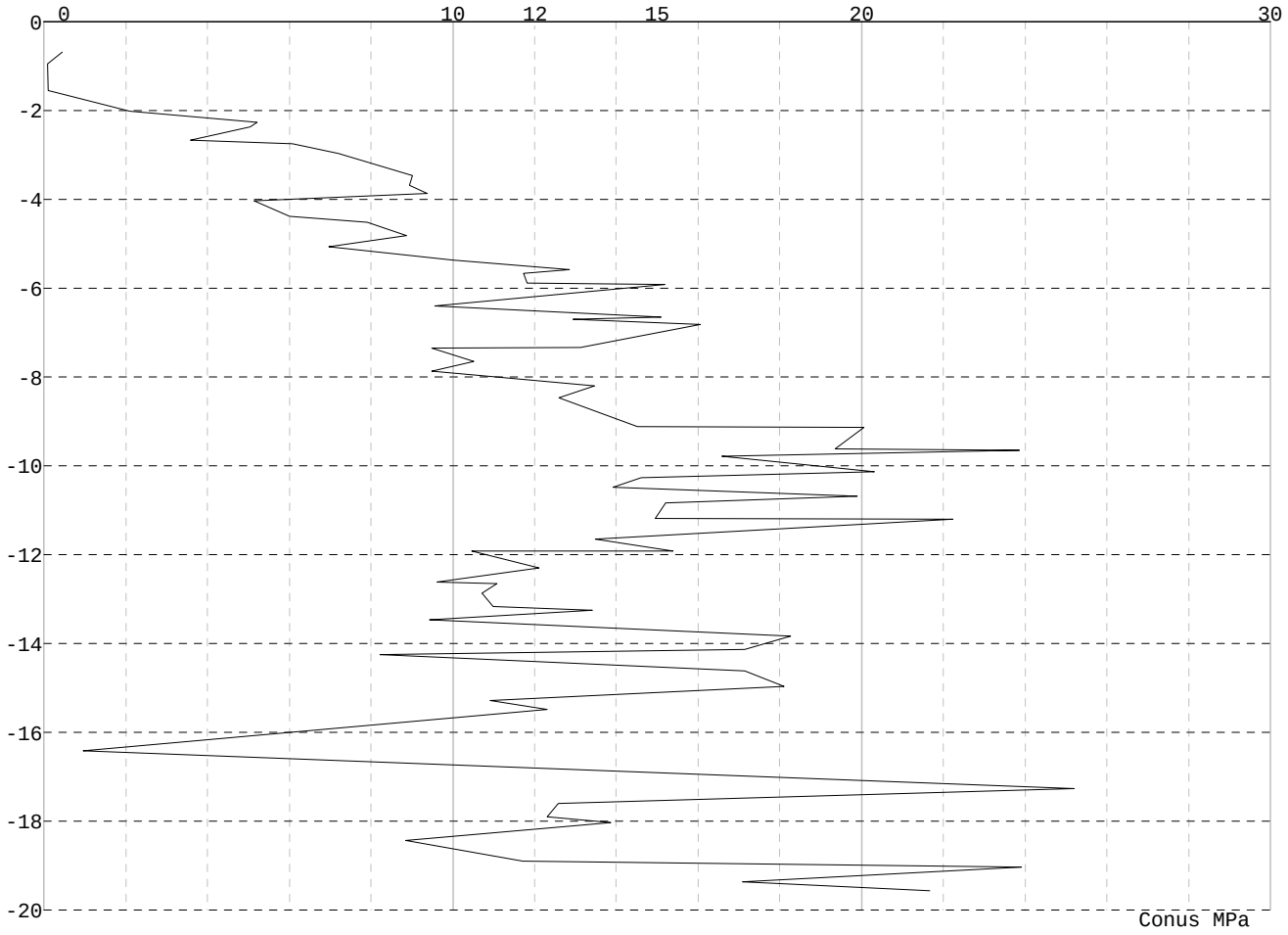


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 74

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.35 Bodemprofiel: Son 74
Traject negatieve kleef : -0.69 tot -0.70 [m]
Traject positieve kleef : -1.60 tot -19.57 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 74

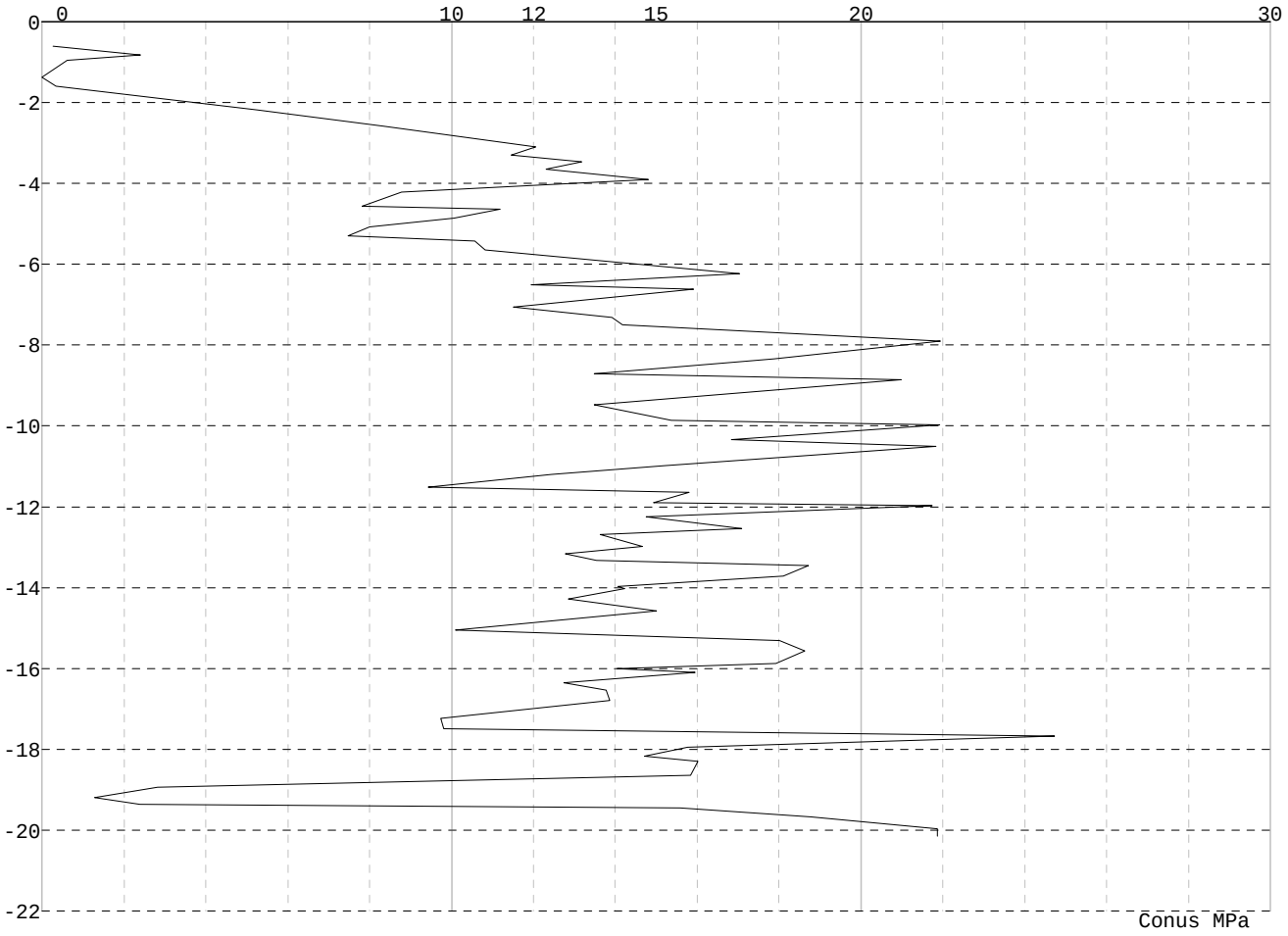


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 75

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.25 Bodemprofiel: Son 75
Traject negatieve kleef : -0.61 tot -0.61 [m]
Traject positieve kleef : -1.60 tot -20.14 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 75

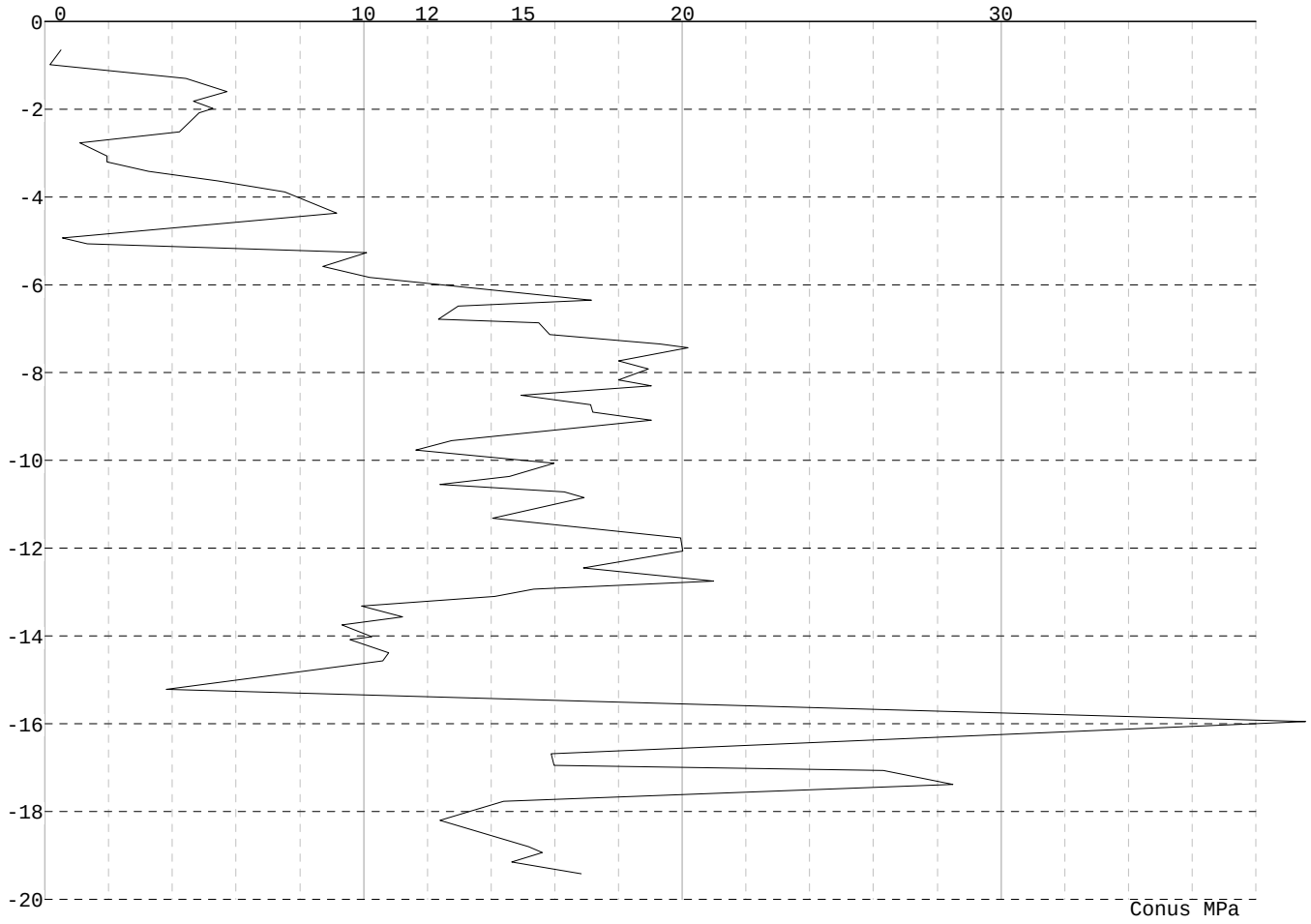


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 76

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.25 Bodemprofiel: Son 76
Traject negatieve kleef : -0.65 tot -0.65 [m]
Traject positieve kleef : -5.10 tot -19.41 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 76

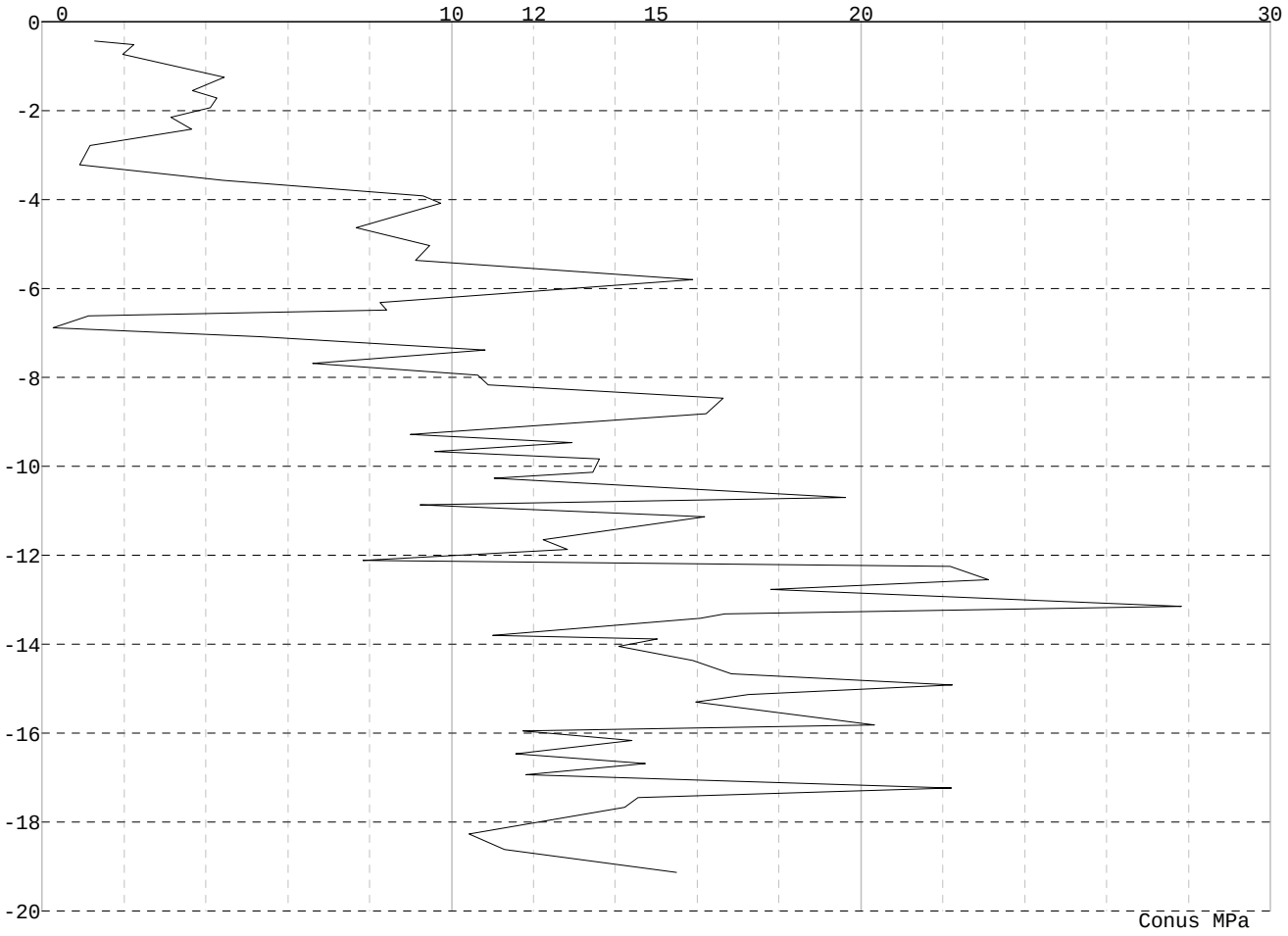


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 77

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.00 Bodemprofiel: Son 77
Traject negatieve kleef : -0.43 tot -0.43 [m]
Traject positieve kleef : -3.20 tot -19.13 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 77

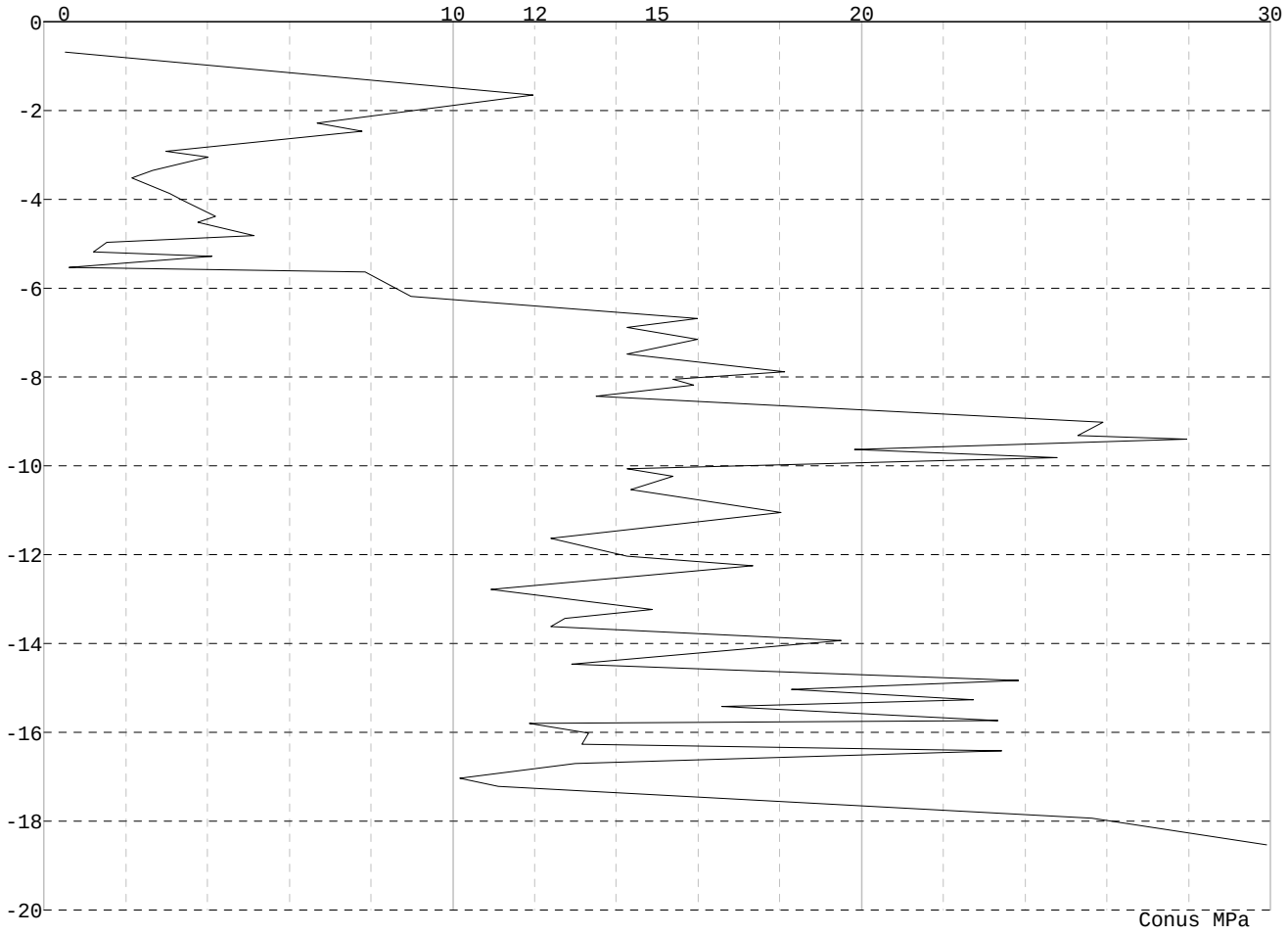


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 78

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : -0.30 Bodemprofiel: Son 78
Traject negatieve kleef : -0.69 tot -0.70 [m]
Traject positieve kleef : -5.50 tot -18.53 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 78



Project : BBB
Onderdeel : ENS-ZL380

REKENGEGEVENS Mast 70

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 70
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.43
Paalpuntniveau : N.A.P. -15.12
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 70 (n=1)

Sondering : Son 70

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.12	-15.12	49.1	556.5	556.5	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 70 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 70	-0.20	-15.12	556.5	556.5	556.5

Totaal resultaten Mast 70 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 70

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-15.12	$R_{t;d}$ = min.{ 556.5; 556.5}= 556.5

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.12	556.5	556.5	0.0	556.5	0.00

REKENGEGEVENS Mast 74

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 74
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.03
Paalpuntniveau : N.A.P. -11.72
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 74 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 74
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-11.72	-11.72	37.5	506.2	506.2	0.0	0.00

SAMENVATTINGSTABEL Mast 74 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 74	-0.35	-11.72	506.2	506.2	506.2

Totaal resultaten Mast 74 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 74

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-11.72	$R_{t;d}$ = min.{ 506.2; 506.2}= 506.2

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-11.72	506.2	506.2	0.0	506.2	0.00

REKENGEGEVENS Mast 75

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 75
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.28
Paalpuntniveau : N.A.P. -16.97
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 75 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 75

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.97	-16.97	53.8	884.6	884.6	0.0	0.00

SAMENVATTINGSTABEL Mast 75 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 75	-0.25	-16.97	884.6	884.6	884.6

Totaal resultaten Mast 75 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 75

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-16.97	$R_{t;d}$ = min.{ 884.6; 884.6}= 884.6

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.97	884.6	884.6	0.0	884.6	0.00

REKENGEGEVENS Mast 76

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 76
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.28
Paalpuntniveau : N.A.P. -15.72
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 76 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 76

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.72	-15.72	50.2	758.5	758.5	0.0	0.00

SAMENVATTINGSTABEL Mast 76 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 76	-0.25	-15.72	758.5	758.5	758.5

Totaal resultaten Mast 76 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 76

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-15.72	$R_{t;d}$ = min.{ 758.5; 758.5}= 758.5

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.72	758.5	758.5	0.0	758.5	0.00

REKENGEGEVENS Mast 77

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 77
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.43
Paalpuntniveau : N.A.P. -15.57
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 77 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 77

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.57	-15.57	49.9	676.8	676.8	0.0	0.00

SAMENVATTINGSTABEL Mast 77 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 77	0.00	-15.57	676.8	676.8	676.8

Totaal resultaten Mast 77 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 77

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-15.57	$R_{t;d}$ = min.{ 676.8; 676.8}= 676.8

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.57	676.8	676.8	0.0	676.8	0.00

REKENGEGEVENS Mast 78

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 78
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.30
Paalpuntniveau : N.A.P. -14.90
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 78 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 78

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.90	-14.90	48.0	680.4	680.4	0.0	0.00

SAMENVATTINGSTABEL Mast 78 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 78	-0.30	-14.90	680.4	680.4	680.4

Totaal resultaten Mast 78 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 78

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.90	$R_{t;d}$ = min.{ 680.4; 680.4}= 680.4

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.90	680.4	680.4	0.0	680.4	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 70	Mast 74	Mast 75	Mast 76	Mast 77
Son 70	-0.20	-15.12	556				
Son 74	-0.35	-11.72		506			
Son 75	-0.25	-16.97			884		
Son 76	-0.25	-15.72				758	
Son 77	0.00	-15.57					676

Project : BBB
Onderdeel : ENS-ZL380

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 78
Son 78	-0.30	-14.90	680

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 80-90 (80 83 88).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m³]	$\gamma_{sat;k;1}$ [kN/m³]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m³]	$\gamma_{sat;k;2}$ [kN/m³]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Grind - Sterk siltig - Matig	19.00	21.00	32.50	20.00	22.00	35.00
4	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
5	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
6	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
7	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
8	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
9	Leem - Zwak zandig - Slap	19.00	19.00	27.50	20.00	20.00	30.00
10	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
11	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
12	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
13	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
14	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
15	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
16	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
17	Klei - Sterk zandig	18.00	18.00	27.50	20.00	20.00	32.50
18	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
19	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00

BODEMPROFIELGEGEVENS: Son 80

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.05 Grondwaterstand [m] : -0.95

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.05	-1.45	Zand - Schoon - Matig	1.0	100.0		
2	-1.45	-8.69	Zand - Sterk siltig - Kleiig	1.0	100.0		
3	-8.69	-9.79	Zand - Schoon - Matig	1.0	100.0		
4	-9.79	-12.09	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-12.09	-14.68	Zand - Schoon - Matig	1.0	100.0		
6	-14.68	-15.39	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-15.39	-15.45	Grind - Zwak siltig - Vast	1.0	0.0		
8	-15.45	-18.25	Zand - Sterk siltig - Kleiig	1.0	100.0		
9	-18.25	-19.00	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 83

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.00 Grondwaterstand [m] : -1.00

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.00	-0.60	Klei - Zwak zandig - Vast	1.0	50.0		
2	-0.60	-1.52	Zand - Schoon - Matig	1.0	100.0		
3	-1.52	-5.55	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-5.55	-6.54	Zand - Schoon - Los	1.0	100.0		
5	-6.54	-7.24	Leem - Zwak zandig - Vast	1.0	50.0		
6	-7.24	-7.94	Zand - Schoon - Matig	1.0	100.0		
7	-7.94	-8.89	Zand - Schoon - Los	1.0	100.0		
8	-8.89	-11.03	Zand - Schoon - Matig	1.0	100.0		
9	-11.03	-12.12	Klei - Schoon - Vast	1.0	50.0		
10	-12.12	-12.82	Zand - Sterk siltig - Kleiig	1.0	100.0		
11	-12.82	-14.76	Zand - Zwak siltig - Kleiig	1.0	100.0		

Project : BBB
Onderdeel : ENS-ZL380

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
12	-14.76	-15.34	Zand - Schoon - Matig	1.0	100.0		
13	-15.34	-18.05	Zand - Zwak siltig - Kleiig	1.0	100.0		
14	-18.05	-18.79	Zand - Schoon - Los	1.0	100.0		
15	-18.79	-18.96	Zand - Sterk siltig - Kleiig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 88A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.35 Grondwaterstand [m] : -0.65

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.35	-1.10	Zand - Schoon - Matig	1.0	100.0		
2	-1.10	-2.12	Zand - Schoon - Los	1.0	100.0		
3	-2.12	-2.93	Leem - Zwak zandig - Vast	1.0	50.0		
4	-2.93	-8.20	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-8.20	-8.99	Zand - Schoon - Matig	1.0	100.0		
6	-8.99	-9.61	Zand - Sterk siltig - Kleiig	1.0	100.0		
7	-9.61	-10.03	Zand - Schoon - Vast	1.0	100.0		
8	-10.03	-18.40	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-18.40	-19.70	Klei - Organisch - Matig	1.0	50.0		
10	-19.70	-20.76	Zand - Schoon - Matig	1.0	100.0		
11	-20.76	-21.36	Klei - Zwak zandig - Vast	1.0	50.0		
12	-21.36	-21.89	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 88B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.35 Grondwaterstand [m] : -0.65

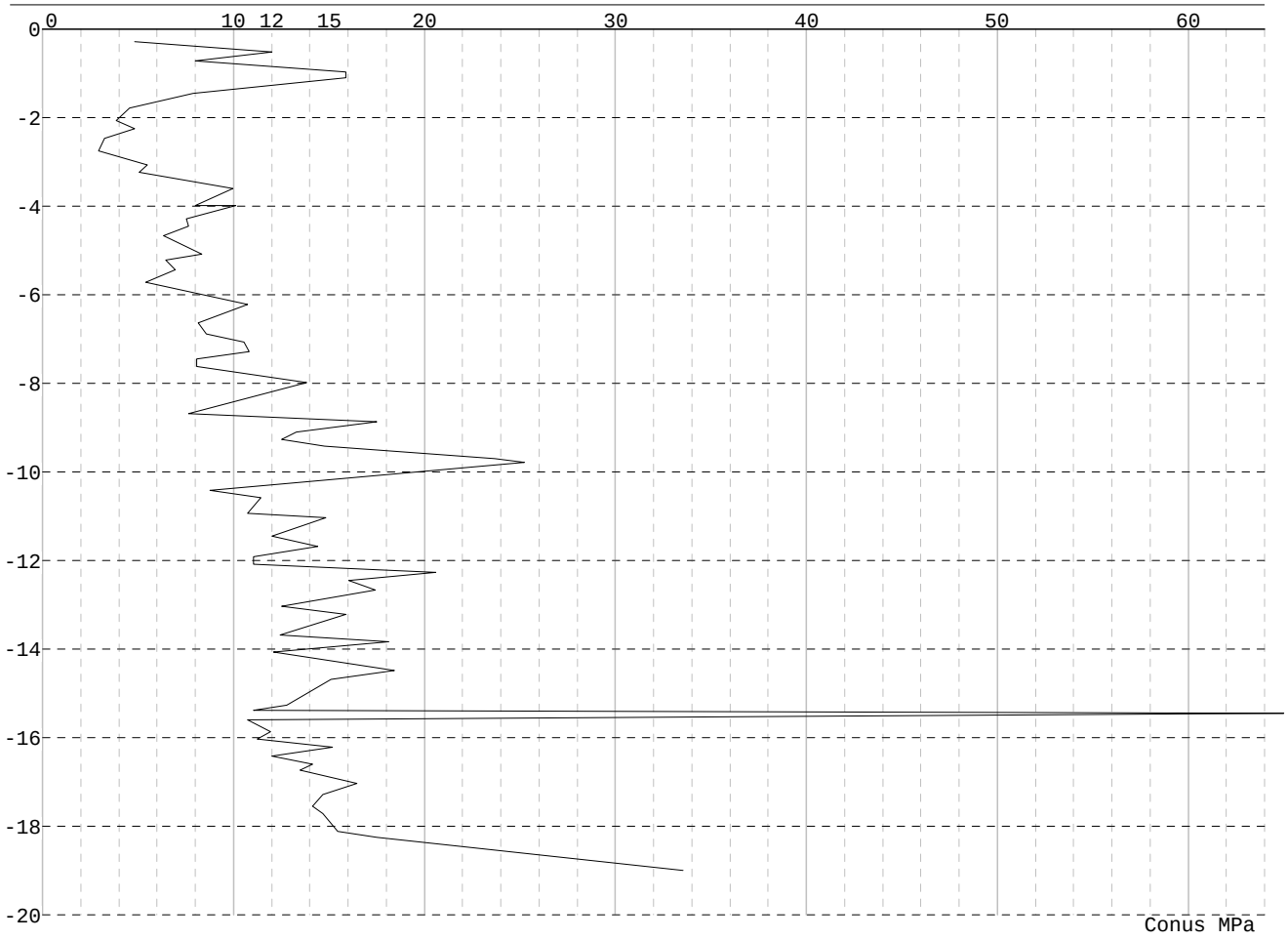
Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.35	-1.58	Zand - Schoon - Matig	1.0	100.0		
2	-1.58	-2.59	Leem - Zwak zandig - Vast	1.0	50.0		
3	-2.59	-3.08	Zand - Schoon - Los	1.0	100.0		
4	-3.08	-7.94	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-7.94	-8.39	Zand - Schoon - Vast	1.0	100.0		
6	-8.39	-11.21	Zand - Schoon - Los	1.0	100.0		
7	-11.21	-12.95	Zand - Schoon - Vast	1.0	100.0		
8	-12.95	-13.74	Zand - Zwak siltig - Kleiig	1.0	100.0		
9	-13.74	-16.34	Zand - Sterk siltig - Kleiig	1.0	100.0		
10	-16.34	-17.40	Zand - Schoon - Matig	1.0	100.0		
11	-17.40	-18.61	Zand - Schoon - Los	1.0	100.0		
12	-18.61	-19.16	Zand - Schoon - Matig	1.0	100.0		
13	-19.16	-20.66	Klei - Zwak zandig - Slap	1.0	50.0		
14	-20.66	-21.08	Zand - Schoon - Vast	1.0	100.0		
15	-21.08	-21.77	Zand - Schoon - Matig	1.0	100.0		
16	-21.77	-21.95	Grind - Zwak siltig - Vast	1.0	0.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 80

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.05 Bodemprofiel: Son 80
Traject negatieve kleef : -0.20 tot -0.20 [m]
Traject positieve kleef : -0.20 tot -19.00 [m]

Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS GRAFIEK: Son 80

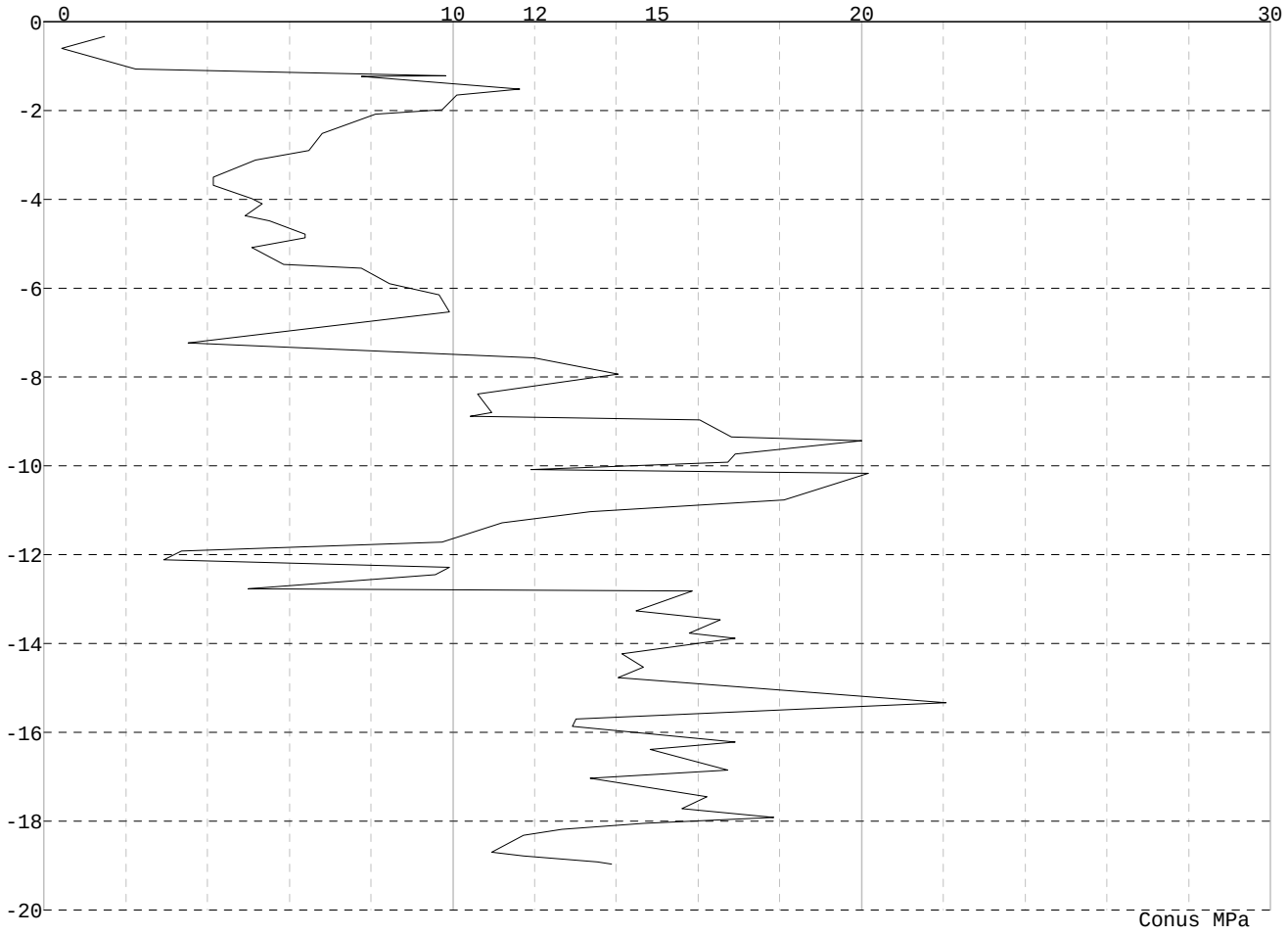


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 83

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.00 Bodemprofiel: Son 83
Traject negatieve kleef : -0.34 tot -0.34 [m]
Traject positieve kleef : -7.20 tot -18.96 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 83

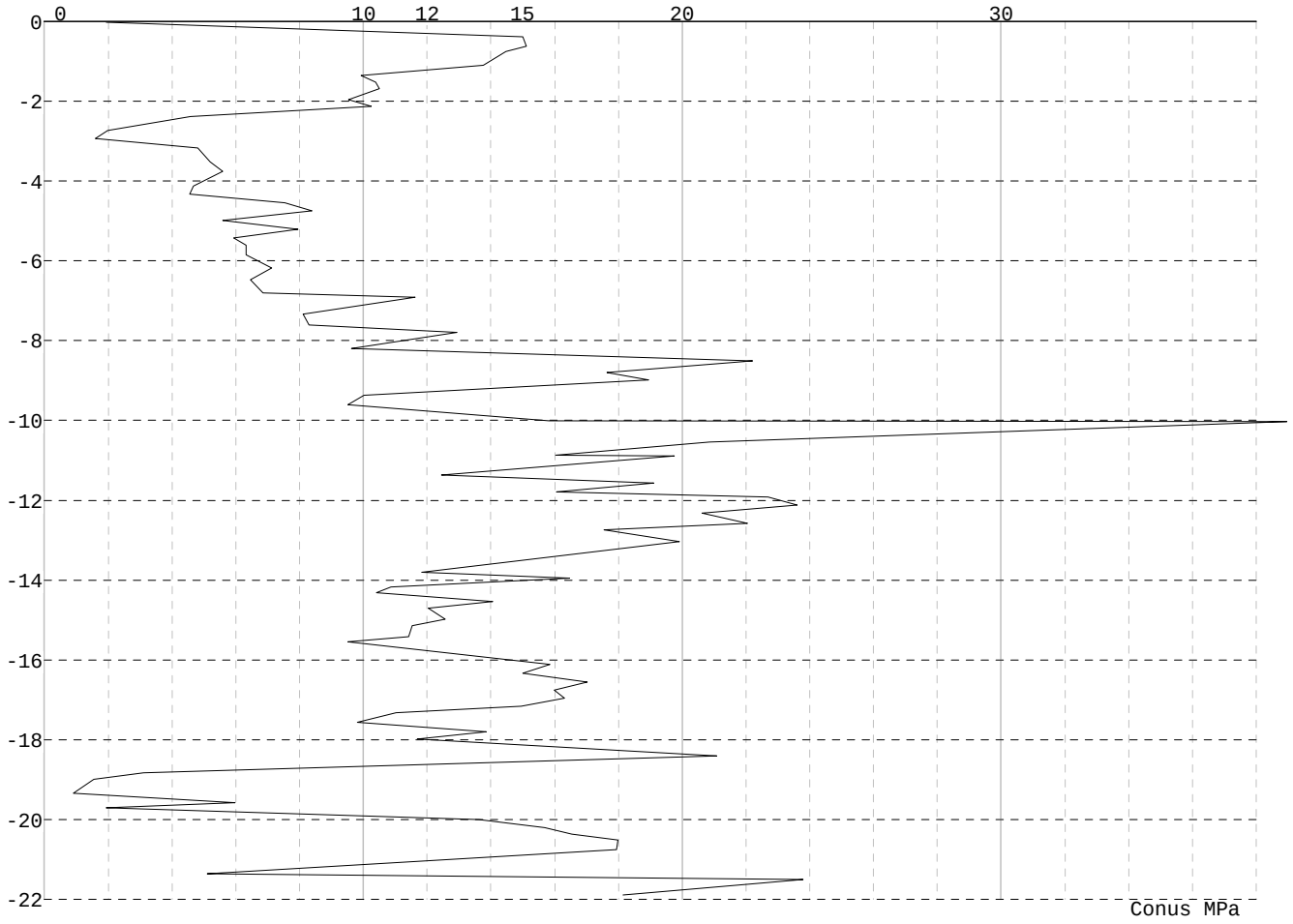


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 88A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.35 Bodemprofiel: Son 88A
Traject negatieve kleef : -0.10 tot -0.10 [m]
Traject positieve kleef : -2.90 tot -21.89 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 88A

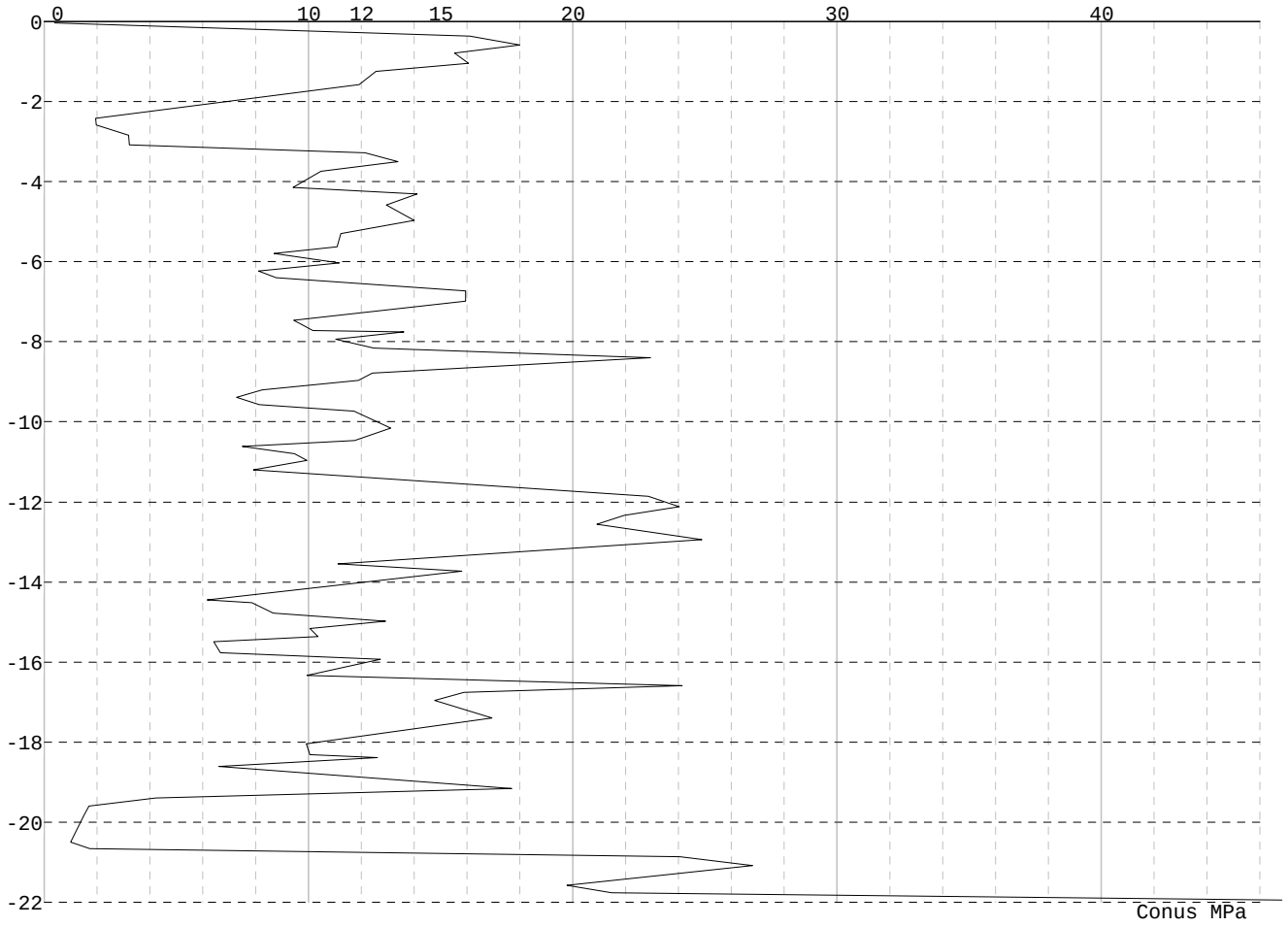


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 88B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.35 Bodemprofiel: Son 88B
Traject negatieve kleef : -0.03 tot -0.10 [m]
Traject positieve kleef : -3.10 tot -21.95 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 88B



Project : BBB
Onderdeel : ENS-ZL380

REKENGEGEVENS Mast 80

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 80
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.35
Paalpuntniveau : N.A.P. -14.95
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 80 (n=1)

Sondering : Son 80

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.95	-14.95	47.6	635.0	635.0	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 80 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 80	0.05	-14.95	635.0	635.0	635.0

Totaal resultaten Mast 80 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 80

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.95	$R_{t;d}$ = min.{ 635.0; 635.0}= 635.0

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.95	635.0	635.0	0.0	635.0	0.00

REKENGEGEVENS Mast 83

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 83
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.54
Paalpuntniveau : N.A.P. -14.46
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 83 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 83

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.46	-14.46	47.3	667.3	667.3	0.0	0.00

SAMENVATTINGSTABEL Mast 83 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 83	0.00	-14.46	667.3	667.3	667.3

Totaal resultaten Mast 83 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 83

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]	
-14.46	$R_{t;d}$ = min.{ 667.3; 667.3}= 667.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.46	667.3	667.3	0.0	667.3	0.00

REKENGEGEVENS Mast 88

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 88A, Son 88B
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.68
Paalpuntniveau : N.A.P. -14.32
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 88 (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 88A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.32	-14.32	46.8	657.8	657.8	0.0	0.00

Sondering : Son 88B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-14.32	-14.32	46.8	710.1	710.1	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 88 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 88A	0.35	-14.32	657.8	657.8	657.8
Son 88B	0.35	-14.32	710.1	710.1	710.1

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 88 (van 2 sonderingen)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
Son 88A	0.35	-14.32	46.8	690.2
Son 88B	0.35	-14.32	46.8	745.3
		-14.32	$R_{t;cal;gem}$	717.8
met ξ_4(min) = 1.32				
Son 88A	0.35	-14.32	46.8	690.2
Son 88B	0.35	-14.32	46.8	745.3
		-14.32	$R_{t;cal;min}$	690.2

Totaal resultaten Mast 88 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 88A Son 88B

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-14.32 $R_{t;d}$ = min.{ 717.8; 690.2}= 690.2

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-14.32	690.2	690.2	0.0	690.2	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{t;netto;d}$ [kN] Mast 80	Mast 83	Mast 88
Son 80	0.05	-14.95	634		
Son 83	0.00	-14.46		667	
Son 88A	0.35	-14.32			657
Son 88B	0.35	-14.32			710

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\Nog te ontvangen\ENS-ZL380 80-90 (82).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

GRONDSOORTEN

Nr.	Omschrijving	$\gamma_{k;1}$ [kN/m^3]	$\gamma_{sat;k;1}$ [kN/m^3]	$\varphi'_{k;1}$ [°]	$\gamma_{k;2}$ [kN/m^3]	$\gamma_{sat;k;2}$ [kN/m^3]	$\varphi'_{k;2}$ [°]
1	Grind - Zwak siltig - Vast	19.00	21.00	37.50	20.00	22.00	40.00
2	Grind - Sterk siltig - Los	18.00	20.00	30.00	19.00	21.00	32.50
3	Grind - Sterk siltig - Matig	19.00	21.00	32.50	20.00	22.00	35.00
4	Zand - Schoon - Los	17.00	19.00	30.00	18.00	20.00	32.50
5	Zand - Schoon - Matig	18.00	20.00	32.50	19.00	21.00	35.00
6	Zand - Schoon - Vast	19.00	21.00	35.00	20.00	22.00	40.00
7	Zand - Zwak siltig - Kleiig	18.00	20.00	27.00	19.00	21.00	32.50
8	Zand - Sterk siltig - Kleiig	18.00	20.00	25.00	19.00	21.00	30.00
9	Leem - Zwak zandig - Slap	19.00	19.00	27.50	20.00	20.00	30.00
10	Leem - Zwak zandig - Matig	20.00	20.00	27.50	21.00	21.00	32.50
11	Leem - Zwak zandig - Vast	21.00	21.00	27.50	22.00	22.00	35.00
12	Klei - Schoon - Matig	17.00	17.00	17.50	19.00	19.00	17.50
13	Klei - Schoon - Vast	19.00	19.00	17.50	20.00	20.00	25.00
14	Klei - Zwak zandig - Slap	15.00	15.00	22.50	18.00	18.00	22.50
15	Klei - Zwak zandig - Matig	18.00	18.00	22.50	20.00	20.00	22.50
16	Klei - Zwak zandig - Vast	20.00	20.00	22.50	21.00	21.00	27.50
17	Klei - Sterk zandig	18.00	18.00	27.50	20.00	20.00	32.50
18	Klei - Organisch - Matig	15.00	15.00	15.00	16.00	16.00	15.00
19	Veen - Niet voorbelast - Slap	10.00	10.00	15.00	12.00	12.00	15.00

BODEMPROFIELGEGEVENS: Son 82A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.05 Grondwaterstand [m] : -0.95

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.05	-2.15	Klei - Organisch - Matig	1.0	50.0		
2	-2.15	-2.31	Zand - Schoon - Matig	1.0	100.0		
3	-2.31	-2.92	Zand - Sterk siltig - Kleiig	1.0	100.0		
4	-2.92	-4.27	Klei - Zwak zandig - Matig	1.0	50.0		
5	-4.27	-7.79	Zand - Sterk siltig - Kleiig	1.0	100.0		
6	-7.79	-8.94	Zand - Zwak siltig - Kleiig	1.0	100.0		
7	-8.94	-9.63	Zand - Schoon - Vast	1.0	100.0		
8	-9.63	-10.03	Zand - Schoon - Los	1.0	100.0		
9	-10.03	-11.86	Zand - Zwak siltig - Kleiig	1.0	100.0		
10	-11.86	-12.00	Zand - Schoon - Vast	1.0	100.0		
11	-12.00	-15.09	Zand - Schoon - Matig	1.0	100.0		
12	-15.09	-15.61	Leem - Zwak zandig - Vast	1.0	50.0		
13	-15.61	-20.00	Zand - Schoon - Matig	1.0	100.0		

BODEMPROFIELGEGEVENS: Son 82B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
d50-reductie is meegenomen overeenkomstig NEN-EN 9997 art. 7.6.2.3 (i)
Hoogte maaiveld [m] : 0.05 Grondwaterstand [m] : -0.95

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
1	0.05	-1.42	Zand - Schoon - Matig	1.0	100.0		
2	-1.42	-2.18	Zand - Schoon - Los	1.0	100.0		
3	-2.18	-4.01	Klei - Zwak zandig - Matig	1.0	50.0		
4	-4.01	-4.29	Zand - Sterk siltig - Kleiig	1.0	100.0		
5	-4.29	-4.53	Klei - Schoon - Vast	1.0	50.0		
6	-4.53	-8.35	Zand - Sterk siltig - Kleiig	1.0	100.0		

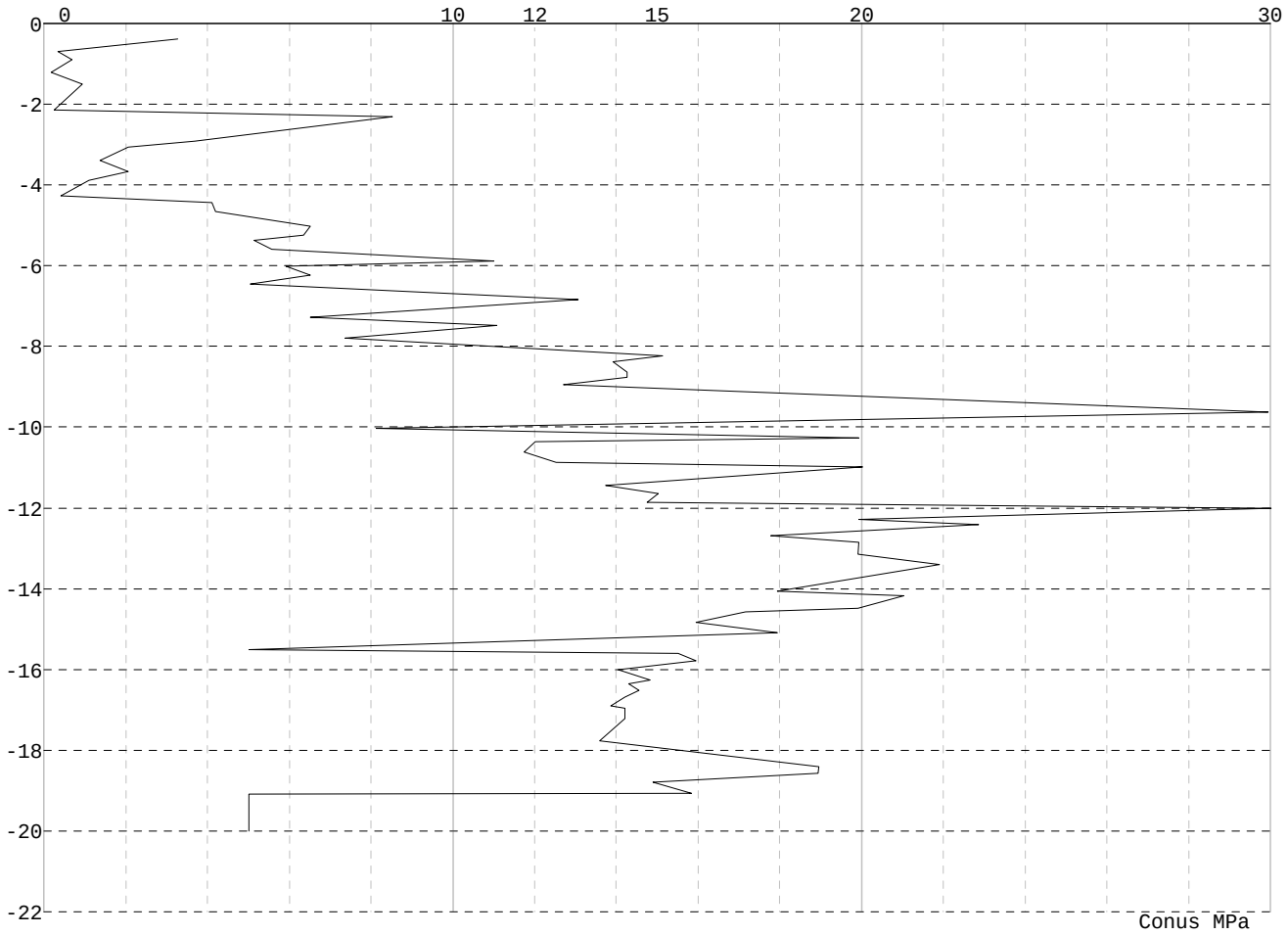
Project : BBB
Onderdeel : ENS-ZL380

Laag	Van [m]	Tot [m]	Omschrijving	OCR	Aandeel pos. kleef [%]	α_s	d_{50} [mm]
7	-8.35	-9.48	Zand - Zwak siltig - Kleiig	1.0	100.0		
8	-9.48	-10.23	Zand - Schoon - Matig	1.0	100.0		
9	-10.23	-11.13	Zand - Schoon - Los	1.0	100.0		
10	-11.13	-11.71	Zand - Schoon - Matig	1.0	100.0		
11	-11.71	-12.78	Zand - Zwak siltig - Kleiig	1.0	100.0		
12	-12.78	-15.81	Zand - Schoon - Vast	1.0	100.0		
13	-15.81	-17.08	Zand - Sterk siltig - Kleiig	1.0	100.0		
14	-17.08	-20.00	Zand - Schoon - Los	1.0	100.0		

SONDERINGSGEGEVENS ALGEMEEN: Son 82A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.05 Bodemprofiel: Son 82A
Traject negatieve kleef : -0.38 tot -2.20 [m]
Traject positieve kleef : -4.30 tot -20.00 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 82A

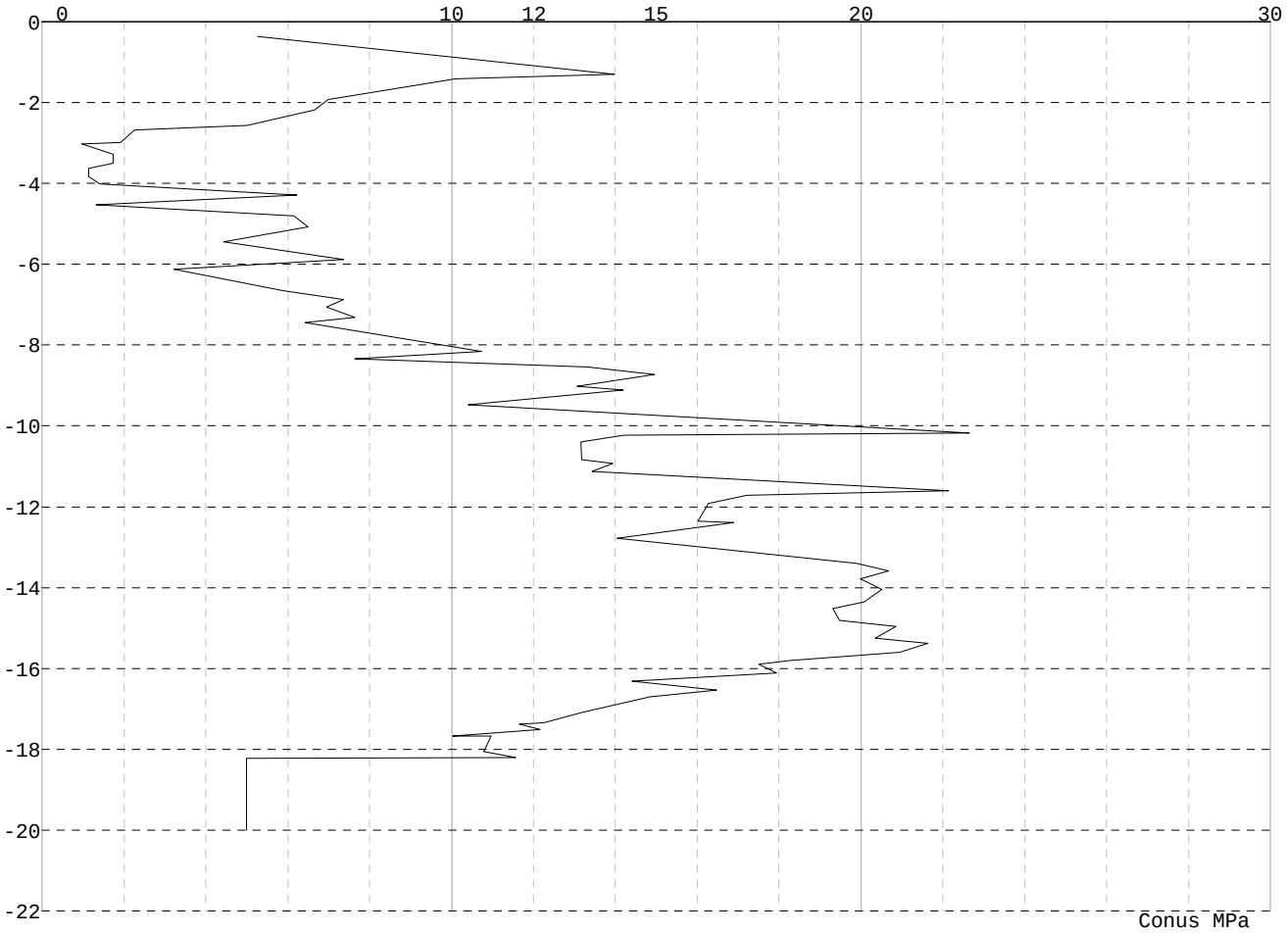


Project : BBB
Onderdeel : ENS-ZL380

SONDERINGSGEGEVENS ALGEMEEN: Son 82B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.
Hoogte maaiveld [m] : 0.05 Bodemprofiel: Son 82B
Traject negatieve kleef : -0.37 tot -0.37 [m]
Traject positieve kleef : -4.60 tot -20.00 [m]

SONDERINGSGEGEVENS GRAFIEK: Son 82B



Project : BBB
Onderdeel : ENS-ZL380

REKENGEGEVENS Mast 82-I

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 82A, Son 82B
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.27
Paalpuntniveau : N.A.P. -16.89
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 82-I (n=1)

Sondering : Son 82A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.89	-16.89	52.8	761.9	761.9	0.0	0.00

Sondering : Son 82B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-16.89	-16.89	52.8	768.3	768.3	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 82-I (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 82A	0.05	-16.89	761.9	761.9	761.9
Son 82B	0.05	-16.89	768.3	768.3	768.3

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 82-I (van 2 sonderingen)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
Son 82A	0.05	-16.89	52.8	799.5
Son 82B	0.05	-16.89	52.8	806.2
		-16.89	$R_{t;cal;gem}$	802.9
met ξ_4(min) = 1.32				
Son 82A	0.05	-16.89	52.8	799.5
Son 82B	0.05	-16.89	52.8	806.2
		-16.89	$R_{t;cal;min}$	799.5

Totaal resultaten Mast 82-I (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 82A Son 82B

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-16.89 $R_{t;d}$ = min.{ 802.9; 799.5}= 799.5

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-16.89	799.5	799.5	0.0	799.5	0.00

REKENGEGEVENS Mast 82-II

Berekening : Controlerend
Rekenmethode : Trekpalen volgens NEN-EN 1997-1, art. 7.6.3
Sondering(en) : Son 82A, Son 82B
Let op: trekcapaciteit t.p.v. negatief kleeftraject is meegerekend.

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.35
$\gamma_{m;var;qc}$: 1.50
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.27
Paalpuntniveau : N.A.P. -15.39
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
Bovenbel. [kN/m²] : 0.00

RESULTATEN Mast 82-II (n=1)

Project : BBB
Onderdeel : ENS-ZL380

Sondering : Son 82A

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.39	-15.39	48.4	664.6	664.6	0.0	0.00

Sondering : Son 82B

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	Effectief inheiniveau [m]	E.G. paal [kN]	$R_{t;cal;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	U.C.
-15.39	-15.39	48.4	667.4	667.4	0.0	0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 82-II (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{t;cal}$ [kN]	Rekenwaarden $R_{t;d}$ [kN]	$R_{t;netto;d}$ [kN]
Son 82A	0.05	-15.39	664.6	664.6	664.6
Son 82B	0.05	-15.39	667.4	667.4	667.4

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 82-II (van 2 sonderingen)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3gem(n=2)}$: 1.32
Correlatiefactor $\xi_{4min(n=2)}$: 1.32

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen E.G. paal [kN]	$R_{t;cal}$ [kN]
met ξ_3(gem) = 1.32				
Son 82A	0.05	-15.39	48.4	697.3
Son 82B	0.05	-15.39	48.4	700.2
		-15.39	$R_{t;cal;gem}$	698.8
met ξ_4(min) = 1.32				
Son 82A	0.05	-15.39	48.4	697.3
Son 82B	0.05	-15.39	48.4	700.2
		-15.39	$R_{t;cal;min}$	697.3

Totaal resultaten Mast 82-II (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 82A Son 82B

$R_{t;d}$ = min.{ $R_{t;cal;gem}$; $R_{t;cal;min}$ } (7.17) *)

Inheiniveau [m]

-15.39 $R_{t;d}$ = min.{ 698.8; 697.3}= 697.3

*) Bij de trekpaalberekening zijn factoren ξ_3 en ξ_4 al bij de berekening van de conusweerstand $q_{c;z;d}$ in rekening gebracht, evenals factor $\gamma_{s;t}$. Dat is conform de opmerkingen in art. 7.6.3.3 (3) en (4).

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{t;k}$ [kN]	$R_{t;d}$ [kN]	$F_{t;tot;1}$ [kN]	$R_{t;netto;d}$ [kN]	U.C.
-15.39	697.3	697.3	0.0	697.3	0.00

PAALGEGEVENS 559x10

Type : Stalen buispaal (gesloten)
Wijze van installeren : Heien
Diameter [m] : 0.559
Elasticiteitsmodulus [N/mm²] : 20000
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Factor α_t (tabel 7.c EC 7.1) : 0.0070 (zandlagen; voor kleilagen zie tabel 7.d)
Paalklassefactor α_p : 1.00
Paalvoetvormfactor β : 1.00
Type lastzakkingsdiagram : Grondverdringende paal
Verm.factor * $\varphi'_{j;k}$: 0.75
Groutomhulling : NEE

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN TREKPALEN (n=1)

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{t;netto;d}$ [kN]	
sondering	niveau	niveau	Mast 82-I	Mast 82-I
Son 82A	0.05	-15.39		664
		-16.89	761	
Son 82B	0.05	-15.39		667
		-16.89	768	

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 00 P-ENS-09 (excl 5A).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 1

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 1-1, 1-2, 1-3, 1-4

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.52
Paalpuntniveau : N.A.P. -20.02

$E_{d;1}$	[kN] : 0.00		$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15		$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00				

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 1 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
1-1	-1.14	-20.02	4378.8	4916.7	9295.5	5572.8	-246.0	5326.9
1-2	-1.18	-20.02	9984.1	6149.3	16133.4	9672.3	-153.3	9519.0
1-3	-1.09	-20.02	10269.6	6262.5	16532.1	9911.3	-202.1	9709.2
1-4	-1.14	-20.02	7139.6	5667.0	12806.6	7677.8	-261.4	7416.4

Totaal resultaten Mast 1 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
1-1 1-2 1-3 1-4

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-20.02	$R_{c;k}$ = min.{(13691.9/ 1.28);(9295.5/ 1.03)}= 9024.7

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-20.02	9024.7	7520.6	-261.4	-261.4	7259.2	0.03	-0.3	-0.3 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-20.02	4	13691.90	24.6

REKENGEGEVENS Mast 2

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 2-1, 2-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.71
Paalpuntniveau : N.A.P. -17.11
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 2 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
2-1	-1.20	-17.11	1827.9	614.0	2441.9	1463.9	-88.0	1375.9
2-2	-1.13	-17.11	1649.9	35.8	1685.7	1010.6	-92.8	917.8

Totaal resultaten Mast 2 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
2-1 2-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.11	$R_{c;k}$ = min.{(2063.8/ 1.32);(1685.7/ 1.32)}= 1277.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.11	1277.0	1064.2	-92.8	-92.8	971.4	0.09	-0.6	-0.6 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-17.11	2	2063.78	25.9

REKENGEGEVENS Mast 3

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 3-1, 3-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.59
Paalpuntniveau : N.A.P. -17.59
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 3 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
3-1	-1.24	-17.59	3528.3	572.0	4100.4	2458.3	-104.7	2353.5
3-2	-1.25	-17.59	3681.3	524.2	4205.5	2521.3	-69.8	2451.5

Totaal resultaten Mast 3 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
3-1 3-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.59	$R_{c;k}$ = min.{(4153.0/ 1.32);(4100.4/ 1.32)}= 3106.3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.59	3106.3	2588.6	-104.7	-104.7	2483.9	0.04	-0.5	-0.5

REKENGEGEVENS Mast 4

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 4-1, 4-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.47
Paalpuntniveau : N.A.P. -18.12
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 4 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
4-1	-1.05	-18.12	1845.4	401.9	2247.3	1347.3	-177.1	1170.2
4-2	-1.06	-18.12	2276.2	472.7	2748.9	1648.0	-238.2	1409.9

Totaal resultaten Mast 4 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
4-1 4-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.12	$R_{c;k} = \min.\{(2498.1/ 1.32);(2247.3/ 1.32)\}= 1702.5$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.12	1702.5	1418.7	-238.2	-238.2	1180.6	0.17	-1.3	-1.2 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-18.12	2	2498.11	14.2

REKENGEGEVENS Mast 5

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 5-1, 5-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.43
Paalpuntniveau : N.A.P. -18.93
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 5 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
5-1	-0.95	-18.93	3681.3	550.2	4231.6	2536.9	-94.1	2442.8
5-2	-0.85	-18.93	3030.1	160.6	3190.7	1912.9	-102.3	1810.6

Totaal resultaten Mast 5 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
5-1 5-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.93	$R_{c;k}$ = min.{(3711.1/ 1.32);(3190.7/ 1.32)}= 2417.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.93	2417.2	2014.3	-102.3	-102.3	1912.1	0.05	-0.6	-0.5 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-18.93	2	3711.14	19.8

REKENGEGEVENS Mast 6

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 6-1, 6-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.48
Paalpuntniveau : N.A.P. -20.83
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 6 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
6-1	-0.85	-20.83	6141.5	8491.8	14633.3	8772.9	-239.4	8533.5
6-2	-0.81	-20.83	6232.5	8546.3	14778.8	8860.2	-227.3	8632.9

Totaal resultaten Mast 6 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
6-1 6-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-20.83	$R_{c;k}$ = min.{(14706.0/ 1.32);(14633.3/ 1.32)}=11085.8

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-20.83	11085.8	9238.2	-239.4	-239.4	8998.7	0.03	-0.2	-0.2

REKENGEGEVENS Mast 7

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 7-1, 7-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.23
Paalpuntniveau : N.A.P. -16.13
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 7 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
7-1	-0.75	-16.13	1863.5	1920.5	3783.9	2268.5	-103.3	2165.3
7-2	-0.77	-16.13	2398.4	1851.6	4250.0	2547.9	-97.5	2450.4

Totaal resultaten Mast 7 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
7-1 7-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.13	$R_{c;k} = \min.\{(4016.9/ 1.32);(3783.9/ 1.32)\}= 2866.6$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.13	2866.6	2388.8	-103.3	-103.3	2285.6	0.04	-0.4	-0.3

REKENGEGEVENS Mast 8

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 8-1, 8-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.18
Paalpuntniveau : N.A.P. -18.18
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 8 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
8-1	-0.70	-18.18	2381.9	1962.6	4344.6	2604.7	-101.7	2502.9
8-2	-0.69	-18.18	2877.3	2165.8	5043.2	3023.5	-99.0	2924.5

Totaal resultaten Mast 8 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
8-1 8-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.18	$R_{c;k}$ = min.{(4693.9/ 1.32);(4344.6/ 1.32)}= 3291.3

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.18	3291.3	2742.8	-101.7	-101.7	2641.1	0.04	-0.4	-0.3

REKENGEGEVENS Mast 9

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 9-1, 9-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.15
Paalpuntniveau : N.A.P. -16.65
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 9 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
9-1	-0.49	-16.65	825.0	1909.3	2734.4	1639.3	-38.5	1600.8
9-2	-0.60	-16.65	755.5	2095.6	2851.2	1709.3	-47.7	1661.7

Totaal resultaten Mast 9 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
9-1 9-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.65	$R_{c;k} = \min.\{(2792.8/ 1.32);(2734.4/ 1.32)\}= 2071.5$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.65	2071.5	1726.2	-47.7	-47.7	1678.6	0.03	-0.2	-0.2

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 1	Mast 2	Mast 3	Mast 4	Mast 5
1-1	-1.14	-20.02	5326				
1-2	-1.18	-20.02	9519				
1-3	-1.09	-20.02	9709				
1-4	-1.14	-20.02	7416				
2-1	-1.20	-17.11		1375			
2-2	-1.13	-17.11		917			
3-1	-1.24	-17.59			2353		
3-2	-1.25	-17.59			2451		
4-1	-1.05	-18.12				1170	
4-2	-1.06	-18.12				1409	
5-1	-0.95	-18.93					2442
5-2	-0.85	-18.93					1810

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 6	Mast 7	Mast 8	Mast 9
6-1	-0.85	-20.83	8533			
6-2	-0.81	-20.83	8632			
7-1	-0.75	-16.13		2165		
7-2	-0.77	-16.13		2450		
8-1	-0.70	-18.18			2502	
8-2	-0.69	-18.18			2924	
9-1	-0.49	-16.65				1600
9-2	-0.60	-16.65				1661

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 10-19 (10 11 12 13 14 19).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 11

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 11-1, 11-2, 11-3, 11-4, 11-5, 11-6

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 6
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.27
Factor $\xi_{4\ (min)}$: 1.01
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 610_770
Niveau paalkop [m] : N.A.P. 3.22
Paalpuntniveau : N.A.P. -17.13

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 11 (n=1)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
11-1	2.68	-17.13	2003.1	4259.0	6262.2	3754.3	-258.0	3496.2
11-2	2.45	-17.13	2174.7	4911.4	7086.1	4248.3	-256.1	3992.1
11-3	2.70	-17.13	3670.2	3200.6	6870.8	4119.2	-258.2	3861.0
11-4	3.01	-17.13	5271.8	4671.1	9942.9	5961.0	-265.6	5695.4
11-5	3.18	-17.13	6091.7	4548.7	10640.4	6379.1	-265.9	6113.2
11-6	3.07	-17.13	3442.8	4443.8	7886.6	4728.2	-265.7	4462.5

Totaal resultaten Mast 11 (van 6 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 6) : 1.27
Correlatiefactor ξ_{4min} (n= 6) : 1.01

gebaseerd op sonderingen:
11-1 11-2 11-3 11-4 11-5 11-6

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.13	$R_{c;k} = \min.\{(8114.8/ 1.27);(6262.2/ 1.01)\}= 6200.2$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.13	6200.2	5166.8	-265.9	-265.9	4900.9	0.05	-0.6	-0.6 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-17.13	6	8114.82	21.9

REKENGEGEVENS Mast 13

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 13-1, 13-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.60
Paalpuntniveau : N.A.P. -14.35
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 13 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
13-1	0.13	-14.35	2510.1	2250.0	4760.1	2853.8	-50.2	2803.6
13-2	0.08	-14.35	2110.6	1756.7	3867.3	2318.5	-54.4	2264.1

Totaal resultaten Mast 13 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
13-1 13-2

$R_{c;k}$ = min.{ $R_{c;cal;gem}/\xi_3$; $R_{c;cal;min}/\xi_4$ } (7.8)

Inheiniveau [m]	
-14.35	$R_{c;k}$ = min.{(4313.7/ 1.32);(3867.3/ 1.32)}= 2929.8

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.35	2929.8	2441.5	-54.4	-54.4	2387.1	0.02	-0.2	-0.2 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-14.35	2	4313.69	14.6

REKENGEGEVENS Mast 14-I

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 14-1, 14-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.22
Paalpuntniveau : N.A.P. -18.73
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 14-I (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
14-1	-0.25	-18.73	5690.8	6607.8	12298.7	7373.3	-111.2	7262.1
14-2	-0.17	-18.73	5400.5	6210.2	11610.7	6960.8	-143.0	6817.9

Totaal resultaten Mast 14-I (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
14-1 14-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.73	$R_{c;k}$ = min.{(11954.7/ 1.32);(11610.7/ 1.32)}= 8796.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.73	8796.0	7330.0	-143.0	-143.0	7187.0	0.02	-0.1	-0.1

REKENGEGEVENS Mast 14-II

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 14-1, 14-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.22
Paalpuntniveau : N.A.P. -19.98
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 14-II (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
14-1	-0.25	-19.98	4982.1	7312.4	12294.6	7370.8	-111.2	7259.6
14-2	-0.17	-19.98	6420.8	6752.8	13173.6	7897.8	-143.0	7754.8

Totaal resultaten Mast 14-II (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
14-1 14-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-19.98	$R_{c;k}$ = min.{(12734.1/ 1.32);(12294.6/ 1.32)}= 9314.1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-19.98	9314.1	7761.7	-143.0	-143.0	7618.7	0.02	-0.2	-0.1

REKENGEGEVENS Mast 19

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 19-1, 19-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.92
Paalpuntniveau : N.A.P. -13.83
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 19 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
19-1	0.37	-13.83	3573.9	1521.4	5095.3	3054.8	-122.5	2932.3
19-2	0.40	-13.83	2791.8	1755.4	4547.2	2726.1	-106.8	2619.4

Totaal resultaten Mast 19 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
19-1 19-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.83	$R_{c;k} = \min.\{(4821.3/ 1.32);(4547.2/ 1.32)\}= 3444.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.83	3444.8	2870.7	-122.5	-122.5	2748.2	0.04	-0.4	-0.4

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 11	Mast 13	Mast 14-I	Mast 14-I	Mast 19
11-1	2.68	-17.13	3496				
11-2	2.45	-17.13	3992				
11-3	2.70	-17.13	3861				
11-4	3.01	-17.13	5695				
11-5	3.18	-17.13	6113				
11-6	3.07	-17.13	4462				
13-1	0.13	-14.35		2803			
13-2	0.08	-14.35		2264			
14-1	-0.25	-18.73			7262		
		-19.98				7259	
14-2	-0.17	-18.73			6817		
		-19.98				7754	
19-1	0.37	-13.83					2932
19-2	0.40	-13.83					2619

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 20-29 (23 24 27 28 29).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 23

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 23-1, 23-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.78
Paalpuntniveau : N.A.P. -14.87

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 23 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
23-1	0.34	-14.87	2824.3	2175.4	4999.7	2997.4	-90.6	2906.9
23-2	0.28	-14.87	3143.6	2183.4	5327.0	3193.6	-90.6	3103.1

Totaal resultaten Mast 23 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
23-1 23-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.87	$R_{c;k}$ = min.{(5163.3/ 1.32);(4999.7/ 1.32)}= 3787.7

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.87	3787.7	3156.4	-90.6	-90.6	3065.8	0.03	-0.3	-0.3

REKENGEGEVENS Mast 24

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 24-1, 24-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.58
Paalpuntniveau : N.A.P. -17.37
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 24 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
24-1	0.16	-17.37	2441.0	2414.7	4855.7	2911.1	-77.4	2833.7
24-2	0.02	-17.37	1895.3	2630.8	4526.1	2713.5	-82.0	2631.4

Totaal resultaten Mast 24 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
24-1 24-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.37	$R_{c;k} = \min.\{(4690.9/ 1.32);(4526.1/ 1.32)\}= 3428.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.37	3428.8	2857.4	-82.0	-82.0	2775.3	0.03	-0.3	-0.3

REKENGEGEVENS Mast 27

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 27-1, 27-2, 27-3, 27-4

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 610_770
Niveau paalkop [m] : N.A.P. 1.22
Paalpuntniveau : N.A.P. -18.95
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 27 (n=1)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
27-1	0.34	-18.95	4679.8	5455.3	10135.1	6076.2	-102.1	5974.1
27-2	0.43	-18.95	1963.2	4552.8	6516.0	3906.5	-94.5	3812.0
27-3	0.33	-18.95	3943.7	4405.1	8348.7	5005.2	-97.8	4907.4
27-4	0.16	-18.95	4022.1	4450.0	8472.1	5079.2	-87.6	4991.6

Totaal resultaten Mast 27 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
27-1 27-2 27-3 27-4

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.95	$R_{c;k}$ = min.{(8368.0/ 1.28);(6516.0/ 1.03)}= 6326.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.95	6326.2	5271.9	-102.1	-102.1	5169.8	0.02	-0.2	-0.2 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-18.95	4	8367.99	17.7

REKENGEGEVENS Mast 28

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 28-1, 28-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.70
Paalpuntniveau : N.A.P. -17.05
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 28 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
28-1	-1.55	-17.05	2753.1	1695.0	4448.1	2666.7	-23.0	2643.8
28-2	-1.38	-17.05	1631.9	1444.6	3076.6	1844.5	-24.3	1820.1

Totaal resultaten Mast 28 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
28-1 28-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.05	$R_{c;k}$ = min.{(3762.3/ 1.32);(3076.6/ 1.32)}= 2330.7

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.05	2330.7	1942.3	-24.3	-24.3	1917.9	0.01	-0.1	-0.1 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-17.05	2	3762.34	25.8

REKENGEGEVENS Mast 29

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 29-1, 29-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -1.04
Paalpuntniveau : N.A.P. -18.49
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 29 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
29-1	-1.77	-18.49	2876.9	2278.8	5155.6	3090.9	-15.4	3075.5
29-2	-1.85	-18.49	3615.9	2037.6	5653.5	3389.4	-15.1	3374.3

Totaal resultaten Mast 29 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
29-1 29-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.49	$R_{c;k} = \min.\{(5404.6/ 1.32);(5155.6/ 1.32)\}= 3905.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.49	3905.8	3254.8	-15.4	-15.4	3239.4	0.00	-0.0	-0.0

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 23	Mast 24	Mast 27	Mast 28	Mast 29
23-1	0.34	-14.87	2906				
23-2	0.28	-14.87	3103				
24-1	0.16	-17.37		2833			
24-2	0.02	-17.37		2631			
27-1	0.34	-18.95			5974		
27-2	0.43	-18.95			3812		
27-3	0.33	-18.95			4907		
27-4	0.16	-18.95			4991		
28-1	-1.55	-17.05				2643	
28-2	-1.38	-17.05				1820	
29-1	-1.77	-18.49					3075
29-2	-1.85	-18.49					3374

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 30-39 (30 32 33 34 35).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 32

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 32-1, 32-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -2.16
Paalpuntniveau : N.A.P. -18.01

$E_{d;1}$	[kN] : 0.00		$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15		$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00				

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 32 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
32-1	-2.84	-18.01	2344.4	1661.9	4006.3	2401.9	-3.8	2398.1
32-2	-2.77	-18.01	3681.3	1536.9	5218.2	3128.4	-4.2	3124.2

Totaal resultaten Mast 32 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
32-1 32-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.01	$R_{c;k} = \min.\{(4612.3/ 1.32);(4006.3/ 1.32)\}= 3035.1$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.01	3035.1	2529.2	-4.2	-4.2	2525.0	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-18.01	2	4612.26	18.6

REKENGEGEVENS Mast 33

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 33-1, 33-2A

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -2.05
Paalpuntniveau : N.A.P. -18.20
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 33 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
33-1	-2.69	-18.20	1795.9	1904.6	3700.5	2218.5	-6.6	2212.0
33-2A	-2.69	-18.20	2254.5	1621.9	3876.4	2324.0	-10.6	2313.4

Totaal resultaten Mast 33 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
33-1 33-2A

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.20	$R_{c;k}$ = min.{(3788.5/ 1.32);(3700.5/ 1.32)}= 2803.4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.20	2803.4	2336.2	-10.6	-10.6	2325.6	0.00	-0.0	-0.0

REKENGEGEVENS Mast 34

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 34-1, 34-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -1.62
Paalpuntniveau : N.A.P. -21.62
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 34 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
34-1	-2.38	-21.62	10533.7	6700.4	17234.1	10332.2	-15.3	10316.9
34-2	-2.48	-21.62	13614.4	8014.2	21628.6	12966.8	-11.5	12955.2

Totaal resultaten Mast 34 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
34-1 34-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-21.62	$R_{c;k}$ = min.{(19431.3/ 1.32);(17234.1/ 1.32)}=13056.1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-21.62	13056.1	10880.1	-15.3	-15.3	10864.8	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-21.62	2	19431.35	16.0

REKENGEGEVENS Mast 35

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 35-1, 35-2A, 35-3, 35-4

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.98
Paalpuntniveau : N.A.P. -20.08
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 35 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
35-1	-1.85	-20.08	13614.4	6718.0	20332.4	12189.7	-20.1	12169.6
35-2A	-1.81	-20.08	13614.4	6886.7	20501.1	12290.8	-26.2	12264.6
35-3	-1.82	-20.08	13614.4	6591.5	20205.9	12113.8	-26.2	12087.7
35-4	-1.82	-20.08	13614.4	7254.1	20868.5	12511.1	-24.1	12487.0

Totaal resultaten Mast 35 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
35-1 35-2A 35-3 35-4

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-20.08	$R_{c;k} = \min.\{(20477.0/ 1.28);(20205.9/ 1.03)\}=15997.6$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-20.08	15997.6	13331.4	-26.2	-26.2	13305.1	0.00	-0.0	-0.0

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 32	Mast 33	Mast 34	Mast 35
33-1	-2.69	-18.20		2211		
33-2A	-2.69	-18.20		2313		
35-1	-1.85	-20.08				12169
35-2A	-1.81	-20.08				12264
35-3	-1.82	-20.08				12087
35-4	-1.82	-20.08				12486
32-1	-2.84	-18.01	2398			
32-2	-2.77	-18.01	3124			
34-1	-2.38	-21.62			10316	
34-2	-2.48	-21.62			12955	

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 40-49 (excl 41).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 42

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 42-1, 42-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.32
Paalpuntniveau : N.A.P. -13.28

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 42 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
42-1	-1.10	-13.28	2398.9	1447.5	3846.4	2306.0	-8.2	2297.8
42-2	0.67	-13.28	1101.5	1786.9	2888.4	1731.6	-4.5	1727.1

Totaal resultaten Mast 42 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
42-1 42-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.28	$R_{c;k}$ = min.{(3367.4/ 1.32);(2888.4/ 1.32)}= 2188.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.28	2188.2	1823.5	-8.2	-8.2	1815.3	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-13.28	2	3367.38	20.1

REKENGEGEVENS Mast 43

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 43-1, 43-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.33
Paalpuntniveau : N.A.P. -13.28
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 43 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
43-1	-0.97	-13.28	2837.0	1475.2	4312.2	2585.3	-7.4	2577.9
43-2	-1.01	-13.28	3096.5	1389.1	4485.6	2689.2	-9.9	2679.3

Totaal resultaten Mast 43 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
43-1 43-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.28	$R_{c;k}$ = min.{(4398.9/ 1.32);(4312.2/ 1.32)}= 3266.8

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.28	3266.8	2722.4	-9.9	-9.9	2712.5	0.00	-0.0	-0.0

REKENGEGEVENS Mast 44

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 44-1, 44-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.11
Paalpuntniveau : N.A.P. -13.61
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 44 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
44-1	-0.80	-13.61	3224.7	1293.0	4517.7	2708.5	-9.4	2699.1
44-2	-0.76	-13.61	3260.1	1787.7	5047.8	3026.2	-11.6	3014.6

Totaal resultaten Mast 44 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
44-1 44-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.61	$R_{c;k}$ = min.{(4782.7/ 1.32);(4517.7/ 1.32)}= 3422.5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.61	3422.5	2852.1	-11.6	-11.6	2840.4	0.00	-0.0	-0.0

REKENGEGEVENS Mast 45

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 45-1, 45-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.04
Paalpuntniveau : N.A.P. -12.54
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 45 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
45-1	-0.85	-12.54	1235.4	1208.1	2443.5	1464.9	-10.7	1454.2
45-2	-0.77	-12.54	2601.4	1389.5	3990.8	2392.6	-10.0	2382.6

Totaal resultaten Mast 45 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
45-1 45-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.54	$R_{c;k}$ = min.{(3217.2/ 1.32);(2443.5/ 1.32)}= 1851.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.54	1851.2	1542.6	-10.7	-10.7	1531.9	0.01	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-12.54	2	3217.19	34.0

REKENGEGEVENS Mast 46

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 46-1, 46-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.04
Paalpuntniveau : N.A.P. -16.49
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 46 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
46-1	-0.82	-16.49	3137.2	2392.4	5529.7	3315.1	-7.2	3308.0
46-2	-0.75	-16.49	2133.6	2299.3	4432.9	2657.6	-7.4	2650.2

Totaal resultaten Mast 46 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
46-1 46-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.49	$R_{c;k}$ = min.{(4981.3/ 1.32);(4432.9/ 1.32)}= 3358.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.49	3358.2	2798.5	-7.4	-7.4	2791.1	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-16.49	2	4981.28	15.6

REKENGEGEVENS Mast 47

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 47-1, 47-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.01
Paalpuntniveau : N.A.P. -13.49
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 47 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
47-1	-0.71	-13.49	1261.2	1250.1	2511.3	1505.6	-11.0	1494.6
47-2	-0.57	-13.49	2216.5	1260.1	3476.7	2084.3	-8.6	2075.7

Totaal resultaten Mast 47 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
47-1 47-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.49	$R_{c;k}$ = min.{(2994.0/ 1.32);(2511.3/ 1.32)}= 1902.5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.49	1902.5	1585.4	-11.0	-11.0	1574.4	0.01	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-13.49	2	2993.97	22.8

REKENGEGEVENS Mast 48

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 48-1, 48-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.21
Paalpuntniveau : N.A.P. -12.73
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 48 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
48-1	-0.63	-12.73	2604.6	1238.7	3843.3	2304.1	-7.1	2297.0
48-2	-0.67	-12.73	2870.0	1418.3	4288.3	2570.9	-8.1	2562.8

Totaal resultaten Mast 48 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
48-1 48-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.73	$R_{c;k} = \min.\{(4065.8/ 1.32);(3843.3/ 1.32)\}= 2911.6$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.73	2911.6	2426.3	-8.1	-8.1	2418.2	0.00	-0.0	-0.0

REKENGEGEVENS Mast 49-I

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 49-1, 49-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -15.48
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 49-I (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
49-1	-0.50	-15.48	9406.6	3985.7	13392.3	8029.0	-18.3	8010.7
49-2	-0.54	-15.48	6548.3	5230.8	11779.1	7061.8	-19.2	7042.6

Totaal resultaten Mast 49-I (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
49-1 49-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.48	$R_{c;k}$ = min.{(12585.7/ 1.32);(11779.1/ 1.32)}= 8923.6

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.48	8923.6	7436.3	-19.2	-19.2	7417.1	0.00	-0.0	-0.0

REKENGEGEVENS Mast 49-II

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 49-1, 49-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -17.98
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 49-II (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
49-1	-0.50	-17.98	12216.8	5710.9	17927.8	10748.1	-18.3	10729.8
49-2	-0.54	-17.98	12350.2	6816.2	19166.4	11490.7	-19.2	11471.5

Totaal resultaten Mast 49-II (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
49-1 49-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.98	$R_{c;k} = \min.\{(18547.1/ 1.32);(17927.8/ 1.32)\}=13581.6$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.98	13581.6	11318.0	-19.2	-19.2	11298.8	0.00	-0.0	-0.0

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 42	Mast 43	Mast 44	Mast 45	Mast 46
42-1	-1.10	-13.28	2297				
42-2	0.67	-13.28	1727				
43-1	-0.97	-13.28		2577			
43-2	-1.01	-13.28		2679			
44-1	-0.80	-13.61			2699		
44-2	-0.76	-13.61			3014		
45-1	-0.85	-12.54				1454	
45-2	-0.77	-12.54				2382	
46-1	-0.82	-16.49					3307
46-2	-0.75	-16.49					2650

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]			
sondering	niveau	niveau	Mast 47	Mast 48	Mast 49-I	Mast 49-I
47-1	-0.71	-13.49	1494			
47-2	-0.57	-13.49	2075			
48-1	-0.63	-12.73		2296		
48-2	-0.67	-12.73		2562		
49-1	-0.50	-15.48			8010	
		-17.98				10729
49-2	-0.54	-15.48			7042	
		-17.98				11471

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 50-59 (excl 55).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 50

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 50-1, 50-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.03
Paalpuntniveau : N.A.P. -14.47

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 50 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
50-1	-0.46	-14.47	2833.8	1535.9	4369.7	2619.7	-9.7	2610.0
50-2	-0.46	-14.47	2903.8	1954.3	4858.1	2912.5	-9.7	2902.8

Totaal resultaten Mast 50 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
50-1 50-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.47	$R_{c;k} = \min.\{(4613.9/ 1.32);(4369.7/ 1.32)\}= 3310.4$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.47	3310.4	2758.6	-9.7	-9.7	2748.9	0.00	-0.0	-0.0

REKENGEGEVENS Mast 51

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 51-1, 51-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. -0.03
Paalpuntniveau : N.A.P. -21.18
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 51 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
51-1	-0.49	-21.18	11877.3	8568.0	20445.3	12257.4	-10.8	12246.6
51-2	-0.70	-21.18	2541.1	6206.4	8747.6	5244.3	-9.2	5235.2

Totaal resultaten Mast 51 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
51-1 51-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-21.18	$R_{c;k}$ = min.{(14596.4/ 1.32);(8747.6/ 1.32)}= 6626.9

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-21.18	6626.9	5522.4	-10.8	-10.8	5511.7	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-21.18	2	14596.42	56.7

REKENGEGEVENS Mast 52

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 52-1, 52-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -14.43
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 52 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
52-1	-0.62	-14.43	2690.9	1810.2	4501.2	2698.6	-4.2	2694.3
52-2	-0.45	-14.43	2545.9	1728.0	4273.8	2562.2	-4.0	2558.2

Totaal resultaten Mast 52 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
52-1 52-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.43	$R_{c;k}$ = min.{(4387.5/ 1.32);(4273.8/ 1.32)}= 3237.7

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.43	3237.7	2698.1	-4.2	-4.2	2693.9	0.00	-0.0	-0.0

REKENGEGEVENS Mast 53

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 53-1, 53-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. -0.01
Paalpuntniveau : N.A.P. -12.66
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 53 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
53-1	-0.66	-12.66	1826.2	1729.8	3556.0	2131.9	-3.7	2128.2
53-2	-0.67	-12.66	2888.2	1581.6	4469.8	2679.8	-3.7	2676.1

Totaal resultaten Mast 53 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
53-1 53-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.66	$R_{c;k} = \min.\{(4012.9/ 1.32);(3556.0/ 1.32)\}= 2694.0$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.66	2694.0	2245.0	-3.7	-3.7	2241.3	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-12.66	2	4012.94	16.1

REKENGEGEVENS Mast 54

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 54-1, 54-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.02
Paalpuntniveau : N.A.P. -12.63
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 54 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
54-1	-0.71	-12.63	2452.1	1397.2	3849.3	2307.8	-4.9	2302.8
54-2	-0.64	-12.63	2146.7	1372.0	3518.6	2109.5	-5.2	2104.3

Totaal resultaten Mast 54 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
54-1 54-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.63	$R_{c;k}$ = min.{(3684.0/ 1.32);(3518.6/ 1.32)}= 2665.6

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.63	2665.6	2221.4	-5.2	-5.2	2216.1	0.00	-0.0	-0.0

REKENGEGEVENS Mast 56

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 56-1, 56-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.06
Paalpuntniveau : N.A.P. -13.99
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 56 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
56-1	-0.55	-13.99	2861.3	1729.8	4591.1	2752.5	-6.4	2746.1
56-2	-0.72	-13.99	2797.9	1778.7	4576.5	2743.7	-5.7	2738.0

Totaal resultaten Mast 56 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
56-1 56-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.99	$R_{c;k}$ = min.{(4583.8/ 1.32);(4576.5/ 1.32)}= 3467.1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.99	3467.1	2889.2	-6.4	-6.4	2882.8	0.00	-0.0	-0.0

REKENGEGEVENS Mast 57

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 57-1, 57-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.10
Paalpuntniveau : N.A.P. -13.45
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 57 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
57-1	-0.54	-13.45	1155.7	1400.0	2555.7	1532.2	-5.8	1526.5
57-2	-0.63	-13.45	2930.6	1841.7	4772.3	2861.1	-7.1	2854.0

Totaal resultaten Mast 57 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
57-1 57-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.45	$R_{c;k}$ = min.{(3664.0/ 1.32);(2555.7/ 1.32)}= 1936.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.45	1936.2	1613.5	-7.1	-7.1	1606.3	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-13.45	2	3664.03	42.8

REKENGEGEVENS Mast 58

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 58-1, 58-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.08
Paalpuntniveau : N.A.P. -13.57
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 58 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
58-1	-0.82	-13.57	1990.5	1638.1	3628.7	2175.5	-6.7	2168.8
58-2	-0.69	-13.57	2467.5	1633.9	4101.4	2458.8	-7.9	2450.9

Totaal resultaten Mast 58 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
58-1 58-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.57	$R_{c;k}$ = min.{(3865.0/ 1.32);(3628.7/ 1.32)}= 2749.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.57	2749.0	2290.8	-7.9	-7.9	2282.9	0.00	-0.0	-0.0

REKENGEGEVENS Mast 59

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 59-1, 59-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.10
Paalpuntniveau : N.A.P. -12.60
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 59 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
59-1	-0.27	-12.60	3397.2	1716.8	5114.0	3065.9	-7.0	3059.0
59-2	-0.40	-12.60	2819.4	1626.9	4446.3	2665.6	-8.2	2657.4

Totaal resultaten Mast 59 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
59-1 59-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.60	$R_{c;k} = \min.\{(4780.1/ 1.32);(4446.3/ 1.32)\}= 3368.4$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.60	3368.4	2807.0	-8.2	-8.2	2798.8	0.00	-0.0	-0.0

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 50	Mast 51	Mast 52	Mast 53	Mast 54
50-1	-0.46	-14.47	2609				
50-2	-0.46	-14.47	2902				
51-1	-0.49	-21.18		12246			
51-2	-0.70	-21.18		5235			
52-1	-0.62	-14.43			2694		
52-2	-0.45	-14.43			2558		
53-1	-0.66	-12.66				2128	
53-2	-0.67	-12.66				2676	
54-1	-0.71	-12.63					2302
54-2	-0.64	-12.63					2104

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 56	Mast 57	Mast 58	Mast 59
56-1	-0.55	-13.99	2746			
56-2	-0.72	-13.99	2737			
57-1	-0.54	-13.45		1526		
57-2	-0.63	-13.45		2853		
58-1	-0.82	-13.57			2168	
58-2	-0.69	-13.57			2450	
59-1	-0.27	-12.60				3058
59-2	-0.40	-12.60				2657

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 60-69 (excl 66).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 60

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 60-1, 60-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.71
Paalpuntniveau : N.A.P. -11.69

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 60 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
60-1	-0.17	-11.69	3681.3	1522.3	5203.6	3119.7	-13.7	3106.0
60-2	-0.27	-11.69	2891.5	1458.2	4349.7	2607.7	-11.2	2596.5

Totaal resultaten Mast 60 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
60-1 60-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-11.69	$R_{c;k}$ = min.{(4776.6/ 1.32);(4349.7/ 1.32)}= 3295.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-11.69	3295.2	2746.0	-13.7	-13.7	2732.3	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-11.69	2	4776.62	12.6

REKENGEGEVENS Mast 61

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 61-1, 61-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.74
Paalpuntniveau : N.A.P. -12.61
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 61 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
61-1	-0.40	-12.61	3024.1	1019.7	4043.8	2424.4	-46.9	2377.5
61-2	-0.40	-12.61	3670.2	1664.3	5334.5	3198.2	-5.9	3192.2

Totaal resultaten Mast 61 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
61-1 61-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.61	$R_{c;k}$ = min.{(4689.2/ 1.32);(4043.8/ 1.32)}= 3063.5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.61	3063.5	2552.9	-46.9	-46.9	2506.0	0.02	-0.1	-0.2 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-12.61	2	4689.17	19.5

REKENGEGEVENS Mast 62

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 62-1, 62-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.96
Paalpuntniveau : N.A.P. -12.04
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 62 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
62-1	-0.03	-12.04	3587.4	1553.9	5141.3	3082.3	-11.1	3071.2
62-2	-0.15	-12.04	2792.9	1431.0	4223.9	2532.3	-7.3	2525.0

Totaal resultaten Mast 62 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
62-1 62-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.04	$R_{c;k}$ = min.{(4682.6/ 1.32);(4223.9/ 1.32)}= 3199.9

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.04	3199.9	2666.6	-11.1	-11.1	2655.5	0.00	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-12.04	2	4682.56	13.9

REKENGEGEVENS Mast 63

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 63-1, 63-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.78
Paalpuntniveau : N.A.P. -11.57
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 63 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
63-1	-0.27	-11.57	3002.1	1494.5	4496.6	2695.8	-9.4	2686.5
63-2	-0.36	-11.57	776.4	1478.4	2254.7	1351.8	-9.7	1342.0

Totaal resultaten Mast 63 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
63-1 63-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-11.57	$R_{c;k}$ = min.{(3375.7/ 1.32);(2254.7/ 1.32)}= 1708.1

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-11.57	1708.1	1423.4	-9.7	-9.7	1413.7	0.01	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-11.57	2	3375.67	47.0

REKENGEGEVENS Mast 64

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 64-1, 64-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 1.67
Paalpuntniveau : N.A.P. -12.78
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 64 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
64-1	-0.06	-12.78	2704.8	1730.6	4435.4	2659.1	-10.4	2648.7
64-2	-0.36	-12.78	2714.9	1259.2	3974.1	2382.6	-40.8	2341.8

Totaal resultaten Mast 64 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
64-1 64-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.78	$R_{c;k}$ = min.{(4204.8/ 1.32);(3974.1/ 1.32)}= 3010.7

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.78	3010.7	2508.9	-40.8	-40.8	2468.1	0.02	-0.1	-0.1

REKENGEGEVENS Mast 65

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 65-1, 65-2, 65-3, 65-4, 65-5, 65-6A

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 6
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.27
Factor $\xi_{4\ (min)}$: 1.01
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 2.63
Paalpuntniveau : N.A.P. -18.87
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 65 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
65-1	0.80	-18.87	10749.9	6078.4	16828.3	10088.9	-227.9	9861.0
65-2	0.74	-18.87	12210.3	5687.0	17897.3	10729.8	-297.7	10432.1
65-3	0.70	-18.87	12327.5	6048.5	18376.0	11016.8	-307.2	10709.6
65-4	0.85	-18.87	13412.6	6347.5	19760.2	11846.6	-315.3	11531.3
65-5	0.85	-18.87	11918.7	6291.4	18210.1	10917.3	-298.0	10619.3
65-6A	0.85	-18.87	11609.5	6732.8	18342.2	10996.5	-158.1	10838.4

Totaal resultaten Mast 65 (van 6 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 6) : 1.27
Correlatiefactor ξ_{4min} (n= 6) : 1.01

gebaseerd op sonderingen:
65-1 65-2 65-3 65-4 65-5 65-6A

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.87	$R_{c;k}$ = min.{(18235.7/ 1.27);(16828.3/ 1.01)}=14358.8

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.87	14358.8	11965.7	-315.3	-315.3	11650.3	0.03	-0.4	-0.4

REKENGEGEVENS Mast 67

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 67-1, 67-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 1.72
Paalpuntniveau : N.A.P. -13.98
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 67 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
67-1	-0.32	-13.98	1449.0	1619.6	3068.6	1839.7	-5.8	1833.9
67-2	-0.03	-13.98	2670.5	1607.7	4278.1	2564.8	-19.1	2545.7

Totaal resultaten Mast 67 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
67-1 67-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.98	$R_{c;k}$ = min.{(3673.4/ 1.32);(3068.6/ 1.32)}= 2324.7

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.98	2324.7	1937.2	-19.1	-19.1	1918.1	0.01	-0.1	-0.1 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-13.98	2	3673.37	23.3

REKENGEGEVENS Mast 68

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 68-1, 68-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 1.28
Paalpuntniveau : N.A.P. -13.52
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 68 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
68-1	0.88	-13.52	2169.7	1081.0	3250.7	1948.9	-115.8	1833.0
68-2	0.82	-13.52	1586.3	912.6	2498.9	1498.2	-94.1	1404.0

Totaal resultaten Mast 68 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
68-1 68-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-13.52	$R_{c;k} = \min.\{(2874.8/ 1.32);(2498.9/ 1.32)\}= 1893.1$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-13.52	1893.1	1577.6	-115.8	-115.8	1461.8	0.07	-0.4	-0.4 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-13.52	2	2874.81	18.5

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 60	Mast 61	Mast 62	Mast 63	Mast 64
60-1	-0.17	-11.69	3106				
60-2	-0.27	-11.69	2596				
61-1	-0.40	-12.61		2377			
61-2	-0.40	-12.61		3192			
62-1	-0.03	-12.04			3071		
62-2	-0.15	-12.04			2524		
63-1	-0.27	-11.57				2686	
63-2	-0.36	-11.57				1342	
64-1	-0.06	-12.78					2648
64-2	-0.36	-12.78					2341

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]		
sondering	niveau	niveau	Mast 65	Mast 67	Mast 68
65-1	0.80	-18.87	9860		
65-2	0.74	-18.87	10432		
65-3	0.70	-18.87	10709		
65-4	0.85	-18.87	11531		
65-5	0.85	-18.87	10619		
65-6A	0.85	-18.87	10838		
67-1	-0.32	-13.98		1833	
67-2	-0.03	-13.98		2545	
68-1	0.88	-13.52			1833
68-2	0.82	-13.52			1404

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 70-79 (71 72 73 79).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 71

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 71-2, 71-1A

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.32
Paalpuntniveau : N.A.P. -14.78

$E_{d;1}$	[kN] : 0.00		$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15		$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00				

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 71 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
71-2	-1.27	-14.78	3392.3	1740.2	5132.4	3077.0	-7.1	3069.9
71-1A	-1.29	-14.78	3681.3	1842.9	5524.2	3311.9	-7.0	3304.9

Totaal resultaten Mast 71 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
71-2 71-1A

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.78	$R_{c;k} = \min.\{(5328.3/ 1.32);(5132.4/ 1.32)\}= 3888.2$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.78	3888.2	3240.2	-7.1	-7.1	3233.1	0.00	-0.0	-0.0

REKENGEGEVENS Mast 72

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 72-1, 72-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.33
Paalpuntniveau : N.A.P. -16.72
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 72 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
72-1	-0.19	-16.72	2910.1	2631.9	5542.0	3322.5	-5.1	3317.4
72-2	-0.32	-16.72	3493.4	2467.9	5961.3	3573.9	-5.7	3568.2

Totaal resultaten Mast 72 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
72-1 72-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.72	$R_{c;k}$ = min.{(5751.7/ 1.32);(5542.0/ 1.32)}= 4198.5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.72	4198.5	3498.7	-5.7	-5.7	3493.0	0.00	-0.0	-0.0

REKENGEGEVENS Mast 79

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 79-1, 79-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.29
Paalpuntniveau : N.A.P. -15.51
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 79 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
79-1	-0.16	-15.51	3429.4	2447.8	5877.2	3523.5	-3.9	3519.7
79-2	-0.30	-15.51	2712.7	2352.2	5064.9	3036.5	-4.2	3032.4

Totaal resultaten Mast 79 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
79-1 79-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.51	$R_{c;k} = \min.\{(5471.1/ 1.32);(5064.9/ 1.32)\}= 3837.1$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.51	3837.1	3197.5	-4.2	-4.2	3193.4	0.00	-0.0	-0.0

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 71	Mast 72	Mast 79
72-1	-0.19	-16.72		3317	
72-2	-0.32	-16.72		3568	
79-1	-0.16	-15.51			3519
79-2	-0.30	-15.51			3032
71-2	-1.27	-14.78	3069		
71-1A	-1.29	-14.78	3304		

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 80-89 (81 82 84 85 86 87 89).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 81

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 81-1, 81-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.37
Paalpuntniveau : N.A.P. -14.48

$E_{d;1}$	[kN] : 0.00		$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15		$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00				

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 81 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
81-1	-0.12	-14.48	2184.2	2063.1	4247.3	2546.4	-3.1	2543.2
81-2	-0.06	-14.48	2049.8	2082.8	4132.6	2477.6	-3.6	2474.0

Totaal resultaten Mast 81 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
81-1 81-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.48	$R_{c;k} = \min.\{(4189.9/ 1.32);(4132.6/ 1.32)\}= 3130.7$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.48	3130.7	2608.9	-3.6	-3.6	2605.3	0.00	-0.0	-0.0

REKENGEGEVENS Mast 84

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 84-1, 84-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.65
Paalpuntniveau : N.A.P. -16.80
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 84 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
84-1	0.50	-16.80	2642.9	2334.7	4977.6	2984.2	-57.2	2927.0
84-2	0.67	-16.80	3183.5	2673.5	5857.0	3511.4	-44.3	3467.1

Totaal resultaten Mast 84 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
84-1 84-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.80	$R_{c;k} = \min.\{(5417.3/ 1.32);(4977.6/ 1.32)\}= 3770.9$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.80	3770.9	3142.5	-57.2	-57.2	3085.3	0.02	-0.2	-0.2

REKENGEGEVENS Mast 85

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 85-1A, 85-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.94
Paalpuntniveau : N.A.P. -11.91
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 85 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
85-1A	0.59	-11.91	2979.7	1632.0	4611.7	2764.8	-44.6	2720.2
85-2	0.57	-11.91	3203.6	1599.1	4802.7	2879.3	-56.4	2822.9

Totaal resultaten Mast 85 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
85-1A 85-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-11.91	$R_{c;k} = \min.\{(4707.2/ 1.32);(4611.7/ 1.32)\}= 3493.7$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-11.91	3493.7	2911.4	-56.4	-56.4	2855.0	0.02	-0.2	-0.2

REKENGEGEVENS Mast 86

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 86-1, 86-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.72
Paalpuntniveau : N.A.P. -11.88
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 86 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
86-1	0.61	-11.88	2359.6	1709.8	4069.4	2439.7	-32.0	2407.7
86-2	0.80	-11.88	2532.4	1697.9	4230.3	2536.1	-38.3	2497.9

Totaal resultaten Mast 86 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
86-1 86-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-11.88	$R_{c;k}$ = min.{(4149.8/ 1.32);(4069.4/ 1.32)}= 3082.9

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-11.88	3082.9	2569.1	-38.3	-38.3	2530.8	0.01	-0.1	-0.1

REKENGEGEVENS Mast 87

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 87-1, 87-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : BP 559x10
Niveau paalkop [m] : N.A.P. 0.66
Paalpuntniveau : N.A.P. -12.84
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 87 (n=1)

Uitgangspunten
- paal : BP 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
87-1	0.64	-12.84	2054.1	1994.4	4048.5	2427.1	-6.6	2420.5
87-2	0.67	-12.84	2479.9	1923.6	4403.4	2640.0	-23.6	2616.3

Totaal resultaten Mast 87 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
87-1 87-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-12.84	$R_{c;k}$ = min.{(4226.0/ 1.32);(4048.5/ 1.32)}= 3067.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-12.84	3067.0	2555.9	-23.6	-23.6	2532.2	0.01	-0.1	-0.1

REKENGEGEVENS Mast 89

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 89-1, 89-2, 89-3, 89-4

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 711_871
Niveau paalkop [m] : N.A.P. 0.82
Paalpuntniveau : N.A.P. -14.23
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 89 (n=1)

Uitgangspunten
- paal : GI 711_871
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 871 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
89-1	0.38	-14.23	6428.7	4302.3	10731.0	6433.4	-68.8	6364.6
89-2	0.37	-14.23	4706.7	4725.2	9432.0	5654.7	-2.7	5651.9
89-3	0.42	-14.23	4973.0	3908.3	8881.2	5324.5	-79.2	5245.3
89-4	0.46	-14.23	5144.0	5482.4	10626.4	6370.7	-3.9	6366.9

Totaal resultaten Mast 89 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
89-1 89-2 89-3 89-4

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.23	$R_{c;k}$ = min.{(9917.6/ 1.28);(8881.2/ 1.03)}= 7748.2

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.23	7748.2	6456.8	-79.2	-79.2	6377.6	0.01	-0.1	-0.1

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 81	Mast 84	Mast 85	Mast 86	Mast 87
81-1	-0.12	-14.48	2543				
81-2	-0.06	-14.48	2473				
84-1	0.50	-16.80		2927			
84-2	0.67	-16.80		3467			
85-1A	0.59	-11.91			2720		
85-2	0.57	-11.91			2822		
86-1	0.61	-11.88				2407	
86-2	0.80	-11.88				2497	
87-1	0.64	-12.84					2420
87-2	0.67	-12.84					2616

Project :
Onderdeel :

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 89
89-1	0.38	-14.23	6364
89-2	0.37	-14.23	5651
89-3	0.42	-14.23	5245
89-4	0.46	-14.23	6366

Project :
Onderdeel :

ALGEMENE GEGEVENS

Project :
Onderdeel :
Datum : 19-07-2021
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\ENS-ZL380 Mast 90-P-ZL.pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 90

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : 90-1, 90-2, 90-3, 90-4

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 4
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.28
Factor $\xi_{4\ (min)}$: 1.03
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 914_1075
Niveau paalkop [m] : N.A.P. 0.89
Paalpuntniveau : N.A.P. -18.51

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project :
Onderdeel :

SAMENVATTINGSTABEL Mast 90 (n=1)

Uitgangspunten
- paal : GI 914_1075
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 1075 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
90-1	0.45	-18.51	10847.7	8041.9	18889.6	11324.7	-5.5	11319.2
90-2	0.44	-18.51	11968.7	8930.4	20899.1	12529.4	-10.5	12518.9
90-3	0.47	-18.51	13614.4	8695.8	22310.2	13375.4	-5.6	13369.8
90-4	0.44	-18.51	12788.4	8694.4	21482.8	12879.4	-29.9	12849.5

Totaal resultaten Mast 90 (van 4 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 4) : 1.28
Correlatiefactor ξ_{4min} (n= 4) : 1.03

gebaseerd op sonderingen:
90-1 90-2 90-3 90-4

$R_{c;k}$ = min.{ $R_{c;cal;gem}/\xi_3$; $R_{c;cal;min}/\xi_4$ } (7.8)

Inheiniveau [m]	
-18.51	$R_{c;k}$ = min.{(20895.4/ 1.28);(18889.6/ 1.03)}=16324.5

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.51	16324.5	13603.8	-29.9	-29.9	13573.9	0.00	-0.0	-0.0

Project :
Onderdeel :

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 90
90-1	0.45	-18.51	11319
90-2	0.44	-18.51	12518
90-3	0.47	-18.51	13369
90-4	0.44	-18.51	12849

Project : ENS-ZL380
Onderdeel : Masten 1-8

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 1-8
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL 1-8 (5A).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 5A

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 5A-1, Son 5A-2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : SI 400mm
Niveau paalkop [m] : N.A.P. -2.85
Paalpuntniveau : N.A.P. -24.35

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : ENS-ZL380
Onderdeel : Masten 1-8

SAMENVATTINGSTABEL Mast 5A (n=1)

Uitgangspunten
- paal : SI 400mm
- paaltype : In de grond gevormde geschroefde paal; groutinjectie
- schachtafmeting : 400 mm

Paalklassefactor α_p : 0.90
Factor α_s (tabel 7.c EC 7.1) : 0.009 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 5A-1	-0.93	-24.35	1885.0	2284.5	4169.5	2499.7	-26.4	2473.2
Son 5A-2	-0.91	-24.35	1885.0	2458.5	4343.4	2604.0	-25.1	2578.9

Totaal resultaten Mast 5A (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 5A-1 Son 5A-2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-24.35	$R_{c;k} = \min.\{(4256.5/ 1.32);(4169.5/ 1.32)\}= 3158.7$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-24.35	3158.7	2632.2	-26.4	-26.4	2605.8	0.01	-0.2	-0.2

Project : ENS-ZL380
Onderdeel : Masten 1-8

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 5A
Son 5A-1	-0.93	-24.35	2473
Son 5A-2	-0.91	-24.35	2578

Project : ENS-ZL380
Onderdeel : Masten 9-19

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 9-19
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\Nog te ontvangen\ENS-ZL380 9-19 (12).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 12

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 12A v3.0, Son 12B v2

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 610_770
Niveau paalkop [m] : N.A.P. 1.55
Paalpuntniveau : N.A.P. -18.15

$E_{d;1}$	[kN] : 0.00		$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15		$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00				

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 12 (n=1)

Uitgangspunten
- paal : GI 610_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 12A v3.0	0.75	-18.15	2309.9	4175.2	6485.1	3887.9	-109.2	3778.7
Son 12B v2	0.00	-18.15	2097.1	2646.6	4743.7	2843.9	-121.4	2722.5

Totaal resultaten Mast 12 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 12A v3.0 Son 12B v2

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.15	$R_{c;k}$ = min.{(5614.4/ 1.32);(4743.7/ 1.32)}= 3593.7

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.15	3593.7	2994.8	-121.4	-121.4	2873.3	0.04	-0.3	-0.3 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-18.15	2	5614.38	21.9

Project : ENS-ZL380
Onderdeel : Masten 9-19

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 12
Son 12A v3.0	0.75	-18.15	3778
Son 12B v2	0.00	-18.15	2722

Project : ENS-ZL380
Onderdeel : Masten 9-19

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 9-19
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 9-19 (15 16 17 18).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 15

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 15

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.89
Paalpuntniveau : N.A.P. -14.66

$E_{d;1}$	[kN] : 0.00		$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15		$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00				

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 15 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 15	0.55	-14.66	1907.5	1666.3	3573.8	2142.6	-17.7	2124.9

Totaal resultaten Mast 15 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 15

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.66	$R_{c;k} = \min.\{(3573.8/ 1.39);(3573.8/ 1.39)\}= 2571.1$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.66	2571.1	2142.6	-17.7	-17.7	2124.9	0.01	-0.1	-0.0

REKENGEGEVENS Mast 16

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 16

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.44
Paalpuntniveau : N.A.P. -16.46
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 16 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 16	-0.20	-16.46	3583.3	1502.4	5085.8	3049.0	-24.0	3025.0

Totaal resultaten Mast 16 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 16

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.46	$R_{c;k} = \min.\{(5085.8/ 1.39);(5085.8/ 1.39)\}= 3658.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.46	3658.8	3049.0	-24.0	-24.0	3025.0	0.01	-0.1	-0.1

REKENGEGEVENS Mast 17

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 17

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.31
Paalpuntniveau : N.A.P. -18.09
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 17 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 17	-0.10	-18.09	3187.8	1668.7	4856.4	2911.5	-30.6	2881.0

Totaal resultaten Mast 17 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 17

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-18.09	$R_{c;k} = \min.\{(4856.4/ 1.39);(4856.4/ 1.39)\}= 3493.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-18.09	3493.8	2911.5	-30.6	-30.6	2881.0	0.01	-0.1	-0.1

REKENGEGEVENS Mast 18

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 18

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 1.00
Paalpuntniveau : N.A.P. -16.20
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : ENS-ZL380
Onderdeel : Masten 9-19

SAMENVATTINGSTABEL Mast 18 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 18	0.20	-16.20	2754.0	1483.0	4237.0	2540.1	-36.3	2503.9

Totaal resultaten Mast 18 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 18

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.20	$R_{c;k} = \min.\{(4237.0/ 1.39);(4237.0/ 1.39)\}= 3048.2$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.20	3048.2	2540.1	-36.3	-36.3	2503.9	0.01	-0.1	-0.1

Project : ENS-ZL380
Onderdeel : Masten 9-19

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]			
sondering	niveau	niveau	Mast 15	Mast 16	Mast 17	Mast 18
Son 15	0.55	-14.66	2124			
Son 16	-0.20	-16.46		3025		
Son 17	-0.10	-18.09			2880	
Son 18	0.20	-16.20				2503

Project : ENS-ZL380
Onderdeel : Masten 20-29

ALGEMENE GEGEVENS

Project : ENS-ZL380
Onderdeel : Masten 20-29
Datum : 27-01-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 20-29 (20 21 22 25 26).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 20

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 20

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.53
Paalpuntniveau : N.A.P. -15.97

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : ENS-ZL380
Onderdeel : Masten 20-29

SAMENVATTINGSTABEL Mast 20 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 20	0.00	-15.97	3237.1	2052.4	5289.5	3171.2	-26.7	3144.4

Totaal resultaten Mast 20 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 20

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.97	$R_{c;k} = \min.\{(5289.5/ 1.39);(5289.5/ 1.39)\}= 3805.4$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.97	3805.4	3171.2	-26.7	-26.7	3144.4	0.01	-0.1	-0.1

REKENGEGEVENS Mast 21

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 21

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.60
Paalpuntniveau : N.A.P. -14.10
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : ENS-ZL380
Onderdeel : Masten 20-29

SAMENVATTINGSTABEL Mast 21 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 21	0.20	-14.10	2426.8	1965.1	4391.9	2633.0	-22.9	2610.1

Totaal resultaten Mast 21 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 21

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.10	$R_{c;k} = \min.\{(4391.9/ 1.39);(4391.9/ 1.39)\}= 3159.6$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.10	3159.6	2633.0	-22.9	-22.9	2610.1	0.01	-0.1	-0.1

REKENGEGEVENS Mast 22

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 22

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.44
Paalpuntniveau : N.A.P. -15.81
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : ENS-ZL380
Onderdeel : Masten 20-29

SAMENVATTINGSTABEL Mast 22 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm
Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 22	0.25	-15.81	1564.3	1881.6	3445.9	2065.9	-20.0	2045.9

Totaal resultaten Mast 22 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 22

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.81	$R_{c;k} = \min.\{(3445.9/ 1.39);(3445.9/ 1.39)\}= 2479.1$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.81	2479.1	2065.9	-20.0	-20.0	2045.9	0.01	-0.1	-0.1

REKENGEGEVENS Mast 25

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 25

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.47
Paalpuntniveau : N.A.P. -15.68
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : ENS-ZL380
Onderdeel : Masten 20-29

SAMENVATTINGSTABEL Mast 25 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 25	-0.10	-15.68	3088.7	2117.0	5205.7	3120.9	-21.6	3099.3

Totaal resultaten Mast 25 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 25

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.68	$R_{c;k} = \min.\{(5205.7/ 1.39);(5205.7/ 1.39)\}= 3745.1$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.68	3745.1	3120.9	-21.6	-21.6	3099.3	0.01	-0.1	-0.1

REKENGEGEVENS Mast 26

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 26

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.63
Paalpuntniveau : N.A.P. -14.97
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : ENS-ZL380
Onderdeel : Masten 20-29

SAMENVATTINGSTABEL Mast 26 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 26	0.10	-14.97	3132.3	1394.9	4527.2	2714.1	-0.0	2714.1

Totaal resultaten Mast 26 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 26

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.97	$R_{c;k} = \min.\{(4527.2/ 1.39);(4527.2/ 1.39)\} = 3257.0$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.97	3257.0	2714.1	-0.0	-0.0	2714.1	0.00	-0.0	-0.0

Project : ENS-ZL380
Onderdeel : Masten 20-29

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 20	Mast 21	Mast 22	Mast 25	Mast 26
Son 20	0.00	-15.97	3144				
Son 21	0.20	-14.10		2610			
Son 22	0.25	-15.81			2045		
Son 25	-0.10	-15.68				3099	
Son 26	0.10	-14.97					2714

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 30-39 (31 36 37 38 39).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 31

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 31

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -2.27
Paalpuntniveau : N.A.P. -17.97

$E_{d;1}$	[kN] :	0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] :	0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] :	0.00			

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 31 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm
Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 31	-2.30	-17.97	3445.4	2172.8	5618.2	3368.2	0.0	3368.2

Totaal resultaten Mast 31 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 31

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.97	$R_{c;k} = \min.\{(5618.2/ 1.39);(5618.2/ 1.39)\}= 4041.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.97	4041.8	3368.2	0.0	0.0	3368.2	0.00	-0.0	-0.0

REKENGEGEVENS Mast 36

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 36

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.98
Paalpuntniveau : N.A.P. -16.08
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 36 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 36	-1.40	-16.08	2585.7	1315.5	3901.2	2338.8	-15.1	2323.8

Totaal resultaten Mast 36 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 36

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.08	$R_{c;k} = \min.\{(3901.2/ 1.39);(3901.2/ 1.39)\}= 2806.6$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.08	2806.6	2338.8	-15.1	-15.1	2323.8	0.01	-0.0	-0.0

REKENGEGEVENS Mast 37

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 37

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.95
Paalpuntniveau : N.A.P. -17.05
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 37 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 37	-1.40	-17.05	2844.7	2098.1	4942.8	2963.3	-5.8	2957.5

Totaal resultaten Mast 37 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 37

$R_{c;k}$ = min.{ $R_{c;cal;gem}/\xi_3$; $R_{c;cal;min}/\xi_4$ } (7.8)

Inheiniveau [m]	
-17.05	$R_{c;k}$ = min.{(4942.8/ 1.39);(4942.8/ 1.39)}= 3556.0

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.05	3556.0	2963.3	-5.8	-5.8	2957.5	0.00	-0.0	-0.0

REKENGEGEVENS Mast 38

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 38

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.51
Paalpuntniveau : N.A.P. -17.11
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 38 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm
Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 38	-0.90	-17.11	2632.9	1346.7	3979.6	2385.9	-10.2	2375.6

Totaal resultaten Mast 38 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 38

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-17.11	$R_{c;k} = \min.\{(3979.6/ 1.39);(3979.6/ 1.39)\}= 2863.0$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-17.11	2863.0	2385.9	-10.2	-10.2	2375.6	0.00	-0.0	-0.0

REKENGEGEVENS Mast 39

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 39

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.60
Paalpuntniveau : N.A.P. -16.25
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 39 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 39	-0.86	-16.25	1681.3	1573.5	3254.7	1951.3	-13.9	1937.3

Totaal resultaten Mast 39 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 39

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.25	$R_{c;k} = \min.\{(3254.7/ 1.39);(3254.7/ 1.39)\}= 2341.5$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.25	2341.5	1951.3	-13.9	-13.9	1937.3	0.01	-0.0	-0.0

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 31	Mast 36	Mast 37	Mast 38	Mast 39
Son 31	-2.30	-17.97	3368				
Son 36	-1.40	-16.08		2323			
Son 37	-1.40	-17.05			2957		
Son 38	-0.90	-17.11				2375	
Son 39	-0.86	-16.25					1937

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 40-49 (41).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 41

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 41

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. -0.49
Paalpuntniveau : N.A.P. -14.09

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 41 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 41	-0.90	-14.09	3333.8	1674.6	5008.4	3002.7	-4.3	2998.4

Totaal resultaten Mast 41 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 41

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.09	$R_{c;k} = \min.\{(5008.4/ 1.39);(5008.4/ 1.39)\}= 3603.2$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.09	3603.2	3002.7	-4.3	-4.3	2998.4	0.00	-0.0	-0.0

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 41
Son 41	-0.90	-14.09	2998

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 50-59 (55).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 55

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 55

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.07
Paalpuntniveau : N.A.P. -14.58

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 55 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 55	-0.35	-14.58	3017.2	1245.1	4262.2	2555.3	-2.7	2552.6

Totaal resultaten Mast 55 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 55

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.58	$R_{c;k} = \min.\{(4262.2/ 1.39);(4262.2/ 1.39)\}= 3066.4$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.58	3066.4	2555.3	-2.7	-2.7	2552.6	0.00	-0.0	-0.0

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 55
Son 55	-0.35	-14.58	2552

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 60-69 (66).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 66

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 66, Son 66B

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : GI 609_770
Niveau paalkop [m] : N.A.P. 1.64
Paalpuntniveau : N.A.P. -14.56

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 66 (n=1)

Uitgangspunten
- paal : GI 609_770
- paaltype : Stalen profiel (geheid, grout)
- schachtafmeting : 770 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.014 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 66	-0.10	-14.56	3007.3	2529.6	5536.9	3319.5	-56.4	3263.1
Son 66B	-0.10	-14.56	4985.6	2689.7	7675.3	4601.5	-36.0	4565.5

Totaal resultaten Mast 66 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 66 Son 66B

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.56	$R_{c;k} = \min.\{(6606.1/ 1.32);(5536.9/ 1.32)\}= 4194.7$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.56	4194.7	3495.5	-56.4	-56.4	3439.1	0.02	-0.1	-0.1 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-14.56	2	6606.13	22.9

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 66
Son 66	-0.10	-14.56	3263
Son 66B	-0.10	-14.56	4565

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\Nog te ontvangen\ENS-ZL380 60-69 (69).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 69

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 69

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.50
Paalpuntniveau : N.A.P. -14.80

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 69 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 69	-0.20	-14.80	2508.8	1438.7	3947.5	2366.6	0.0	2366.6

Totaal resultaten Mast 69 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 69

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.80	$R_{c;k} = \min.\{(3947.5/ 1.39);(3947.5/ 1.39)\}= 2839.9$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.80	2839.9	2366.6	0.0	0.0	2366.6	0.00	-0.0	-0.0

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 69
Son 69	-0.20	-14.80	2366

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 70-79 (70 74 75 76 77 78).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 70

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 70

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.43
Paalpuntniveau : N.A.P. -15.12

$E_{d;1}$	[kN] : 0.00		$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15		$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00				

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 70 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 70	-0.20	-15.12	3273.2	1908.1	5181.3	3106.3	0.0	3106.3

Totaal resultaten Mast 70 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 70

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.12	$R_{c;k} = \min.\{(5181.3/ 1.39);(5181.3/ 1.39)\}= 3727.6$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.12	3727.6	3106.3	0.0	0.0	3106.3	0.00	-0.0	-0.0

REKENGEGEVENS Mast 74

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 74

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.03
Paalpuntniveau : N.A.P. -11.72
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 74 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 74	-0.35	-11.72	2441.5	1741.0	4182.5	2507.5	-0.0	2507.5

Totaal resultaten Mast 74 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 74

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-11.72	$R_{c;k} = \min.\{(4182.5/ 1.39);(4182.5/ 1.39)\}= 3009.0$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-11.72	3009.0	2507.5	-0.0	-0.0	2507.5	0.00	-0.0	-0.0

REKENGEGEVENS Mast 75

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 75

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.28
Paalpuntniveau : N.A.P. -16.97
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 75 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 75	-0.25	-16.97	1012.5	3055.0	4067.4	2438.5	0.0	2438.5

Totaal resultaten Mast 75 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 75

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.97	$R_{c;k} = \min.\{(4067.4/ 1.39);(4067.4/ 1.39)\}= 2926.2$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.97	2926.2	2438.5	0.0	0.0	2438.5	0.00	-0.0	-0.0

REKENGEGEVENS Mast 76

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 76

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.28
Paalpuntniveau : N.A.P. -15.72
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 76 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 76	-0.25	-15.72	2900.2	2285.5	5185.7	3109.0	0.0	3109.0

Totaal resultaten Mast 76 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 76

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.72	$R_{c;k} = \min.\{(5185.7/ 1.39);(5185.7/ 1.39)\}= 3730.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.72	3730.8	3109.0	0.0	0.0	3109.0	0.00	-0.0	-0.0

REKENGEGEVENS Mast 77

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 77

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.43
Paalpuntniveau : N.A.P. -15.57
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 77 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 77	0.00	-15.57	2894.2	2253.2	5147.4	3086.0	0.0	3086.0

Totaal resultaten Mast 77 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 77

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.57	$R_{c;k} = \min.\{(5147.4/ 1.39);(5147.4/ 1.39)\}= 3703.2$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.57	3703.2	3086.0	0.0	0.0	3086.0	0.00	-0.0	-0.0

REKENGEGEVENS Mast 78

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 78

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.30
Paalpuntniveau : N.A.P. -14.90
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 78 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 78	-0.30	-14.90	2882.6	2044.9	4927.4	2954.1	-0.0	2954.0

Totaal resultaten Mast 78 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 78

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.90	$R_{c;k} = \min.\{(4927.4/ 1.39);(4927.4/ 1.39)\}= 3544.9$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.90	3544.9	2954.1	-0.0	-0.0	2954.0	0.00	-0.0	-0.0

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	$R_{c;netto;d}$ [kN]				
sondering	niveau	niveau	Mast 70	Mast 74	Mast 75	Mast 76	Mast 77
Son 70	-0.20	-15.12	3106				
Son 74	-0.35	-11.72		2507			
Son 75	-0.25	-16.97			2438		
Son 76	-0.25	-15.72				3108	
Son 77	0.00	-15.57					3085

Project : BBB
Onderdeel : ENS-ZL380

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 78
Son 78	-0.30	-14.90	2954

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Bestaande sonderingen\ENS-ZL380 80-90 (80 83 88).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 80

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 80

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.35
Paalpuntniveau : N.A.P. -14.95

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 80 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 80	0.05	-14.95	2830.9	2347.9	5178.8	3104.8	0.0	3104.8

Totaal resultaten Mast 80 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 80

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.95	$R_{c;k} = \min.\{(5178.8/ 1.39);(5178.8/ 1.39)\}= 3725.8$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.95	3725.8	3104.8	0.0	0.0	3104.8	0.00	-0.0	-0.0

REKENGEGEVENS Mast 83

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 83

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 1
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.39
Factor $\xi_{4\ (min)}$: 1.39
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.54
Paalpuntniveau : N.A.P. -14.46
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 83 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 83	0.00	-14.46	2664.4	1499.6	4164.0	2496.4	0.0	2496.4

Totaal resultaten Mast 83 (van 1 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 1) : 1.39
Correlatiefactor ξ_{4min} (n= 1) : 1.39

gebaseerd op sonderingen:
Son 83

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.46	$R_{c;k} = \min.\{(4164.0/ 1.39);(4164.0/ 1.39)\}= 2995.7$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.46	2995.7	2496.4	0.0	0.0	2496.4	0.00	-0.0	-0.0

REKENGEGEVENS Mast 88

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 88A, Son 88B

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.68
Paalpuntniveau : N.A.P. -14.32
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 88 (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 88A	0.35	-14.32	2488.1	2001.6	4489.7	2691.6	0.0	2691.6
Son 88B	0.35	-14.32	1670.5	2164.1	3834.6	2298.9	-0.2	2298.7

Totaal resultaten Mast 88 (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 88A Son 88B

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-14.32	$R_{c;k} = \min.\{(4162.2/ 1.32);(3834.6/ 1.32)\}= 2905.0$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-14.32	2905.0	2420.9	-0.2	-0.2	2420.6	0.00	-0.0	-0.0

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 80	Mast 83	Mast 88
Son 80	0.05	-14.95	3104		
Son 83	0.00	-14.46		2496	
Son 88A	0.35	-14.32			2691
Son 88B	0.35	-14.32			2298

Project : BBB
Onderdeel : ENS-ZL380

ALGEMENE GEGEVENS

Project : BBB
Onderdeel : ENS-ZL380
Datum : 18-02-2020
Bestand : \\Arh7001.verit.dnv.com\projects\EANL_Projects\10166262 - BBB modelleren funderingen 380 kV\02 Content\03 Calculations\Technosoft Paalfunderingen\ENS-ZL380\DO\Nieuwe sonderingen\Nog te ontvangen\ENS-ZL380 80-90 (82).pvw
Berekeningstype : Verticaal belaste paal
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Toegepaste normen volgens Eurocode met Nederlandse NB

Geotechniek	EN 1997-1:2004	AC:2009	
	NEN-EN 1997-1:2005	C1+A1:2013	NB:2016
	NEN 9997-1:2016	C2:2017	

REKENGEGEVENS Mast 82-I

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 82A, Son 82B

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.27
Paalpuntniveau : N.A.P. -16.89

$E_{d;1}$	[kN] : 0.00	$E_{d;2}$	[kN] :	0.00
$s_{req;1}$	[m] : 0.15	$s_{req;2}$	[m] :	0.05
Bovenbel.	[kN/m²] : 0.00			

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 82-I (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm
Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	Bezwijkdraagvermogen $R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	Rekenwaarden $R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 82A	0.05	-16.89	1869.6	2483.8	4353.3	2609.9	-13.7	2596.2
Son 82B	0.05	-16.89	1474.5	2414.4	3888.8	2331.4	0.0	2331.4

Totaal resultaten Mast 82-I (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 82A Son 82B

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-16.89	$R_{c;k} = \min.\{(4121.1/ 1.32);(3888.8/ 1.32)\}= 2946.1$

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-16.89	2946.1	2455.1	-13.7	-13.7	2441.4	0.01	-0.0	-0.0

REKENGEGEVENS Mast 82-II

Berekening : Controlerend
Rekenmethode : Drukpalen volgens NEN-EN 1997-1, art. 7.6.2
Sondering(en) : Son 82A, Son 82B

Stijf bouwwerk : NEE
Paalgroep : NEE
Aantal sonderingen : 2
Factor $\xi_{3\ (n=1)}$: 1.39
Factor $\xi_{3\ (gem)}$: 1.32
Factor $\xi_{4\ (min)}$: 1.32
Weerstandsfactor γ_R : 1.20
$\gamma_{f;nk}$: 1.0
$R_{s;cal;max;i}$ begrenzen op 0.75 * $R_{b;cal;max;i}$: NEE
UGT draagvermogen zonder negatieve kleef : NEE

Paal : 559x10
Niveau paalkop [m] : N.A.P. 0.27
Paalpuntniveau : N.A.P. -15.39
$E_{d;1}$ [kN] : 0.00 $E_{d;2}$ [kN] : 0.00
$s_{req;1}$ [m] : 0.15 $s_{req;2}$ [m] : 0.05
Bovenbel. [kN/m²] : 0.00

Project : BBB
Onderdeel : ENS-ZL380

SAMENVATTINGSTABEL Mast 82-II (n=1)

Uitgangspunten
- paal : 559x10
- paaltype : Stalen buispaal (gesloten)
- schachtafmeting : 559 mm

Paalklassefactor α_p : 1.00
Factor α_s (tabel 7.c EC 7.1) : 0.010 (zandlagen; voor kleilagen zie tabel 7.d)
Correlatiefactor $\xi_{3(n=1)}$: 1.39

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

	maaiveld	paalpunt	Bezwijkdraagvermogen			Rekenwaarden		
sondering	niveau	niveau	$R_{b;cal}$ [kN]	$R_{s;cal}$ [kN]	$R_{c;cal}$ [kN]	$R_{c;d}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]
Son 82A	0.05	-15.39	2002.9	2161.0	4163.9	2496.3	-13.7	2482.6
Son 82B	0.05	-15.39	2919.4	2043.1	4962.5	2975.1	0.0	2975.1

Totaal resultaten Mast 82-II (van 2 sonderingen)

Uitgangspunten
Correlatiefactor ξ_{3gem} (n= 2) : 1.32
Correlatiefactor ξ_{4min} (n= 2) : 1.32

gebaseerd op sonderingen:
Son 82A Son 82B

$R_{c;k} = \min.\{ R_{c;cal;gem}/\xi_3; R_{c;cal;min}/\xi_4 \}$ (7.8)

Inheiniveau [m]	
-15.39	$R_{c;k}$ = min.{(4563.2/ 1.32);(4163.9/ 1.32)}= 3154.4

Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

Inheiniveau [m]	$R_{c;k}$ [kN]	$R_{c;d}$ [kN]	$F_{c;tot;1}$ [kN]	$F_{nk;d}$ [kN]	$R_{c;netto;d}$ [kN]	U.C.	$s_{1;1}$ [mm]	$s_{1;2}$ [mm]
-15.39	3154.4	2628.7	-13.7	-13.7	2615.0	0.01	-0.0	-0.0 *

* WAARSCHUWING n.a.v. NEN-NA 1997-1 art. A.3.3.3 1)

Bij toepassing van de waarden van ξ_1, ξ_2, ξ_3 en ξ_4 van de tabellen A.9 en A.10 mag de variatiecoëfficiënt van de draagkracht van palen in een groep, bepaald volgens de verschillende voor deze groep geldende sonderingen, niet groter zijn dan 12%. Deze variatiecoëfficiënt van 12% geeft bij een kans van onderschrijding van 5% een minimumdraagkracht groter dan 80% van het gemiddelde.

Inheiniveau [m]	Aantal [-]	$R_{c;cal;gem}$ [kN]	Var.coëff. [%]
-15.39	2	4563.19	12.4

Project : BBB
Onderdeel : ENS-ZL380

OVERZICHT NETTO DRAAGVERMOGEN DRUKPALEN

Netto paaldraagvermogen(s) zijn naar beneden toe afgerond op: 1.0 kN nauwkeurig
Alle niveaus/hoogtes/peilmaten zijn t.o.v.: N.A.P.

sondering	maaiveld niveau	paalpunt niveau	$R_{c;netto;d}$ [kN] Mast 82-I	Mast 82-I
Son 82A	0.05	-15.39		2482
		-16.89	2596	
Son 82B	0.05	-15.39		2975
		-16.89	2331	

APPENDIX F
Betonberekeningen

Deze bijlage is niet van toepassing voor dit rapport.

APPENDIX G
Horizontale belastingen

Appendix G – Horizontale belastingen

1 INTRODUCTIE

Alle enkelpaalsfunderingen bestaan uit een met zand gevulde stalen buis die 0,5m, 1,0m of 1,8m boven maaiveld uitsteekt. De kop van de paal wordt belast door een trek- of drukkracht in combinatie met een horizontale belasting. Deze horizontale belasting wordt via druk op de buiswand afgedragen aan de bovenste grondlagen.

Middels een 1D-staven model wordt berekend hoe de kracht wordt afgedragen, welke spanningen daarbij in de buis optreden en wat de paalkopverplaatsing is. In de komende subhoofdstukken de uitgangspunten van de grondsoorten, materialen, geometrie en belasting omschreven.

1.1 Modellen

De volgende paaltypen worden getoetst in het model:

- Ø559x10mm, schoorstand 4,75:1;
- Ø610x10mm of Ø711/10, schoorstand 4,75:1;
- Ø914x10mm, schoorstand 5,5:1.

Allen modellen zijn opgenomen in één Axis VM-model.

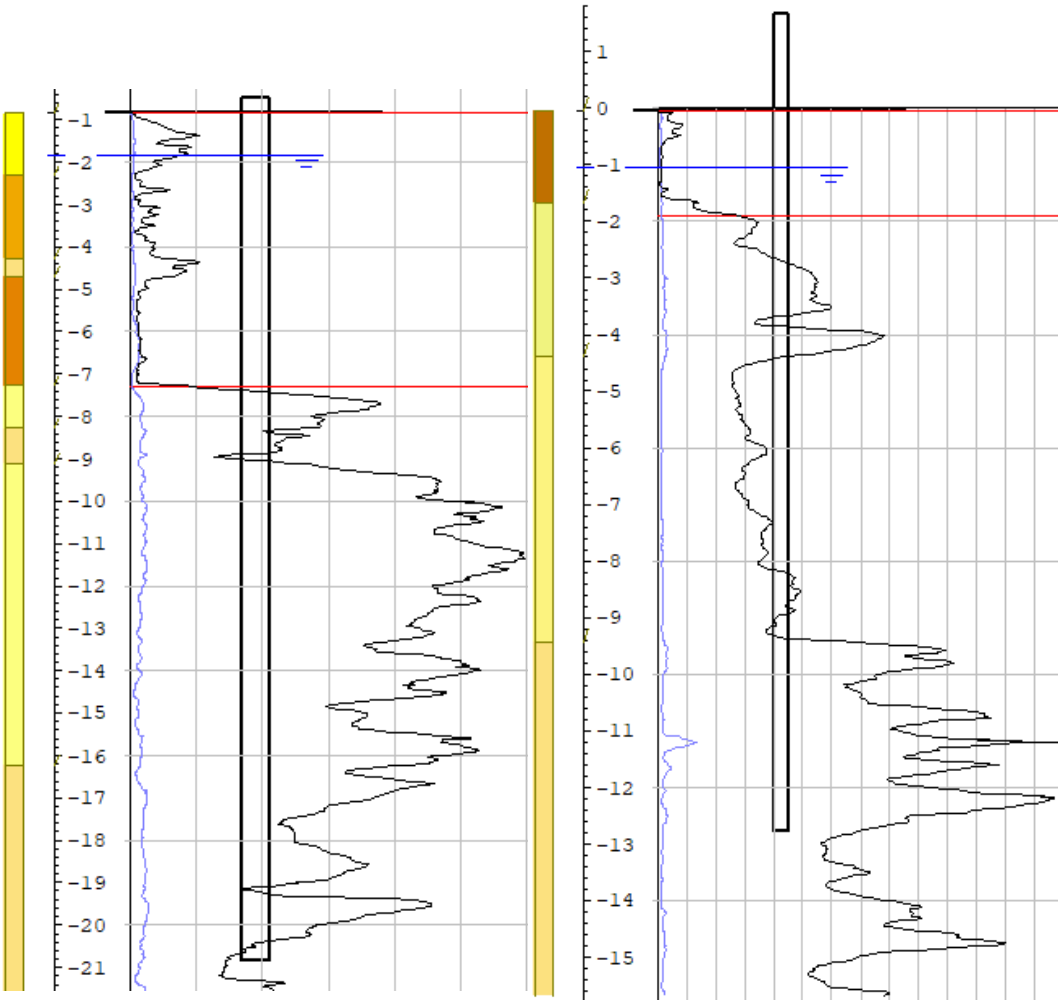
1.2 Modelvorming

De 1D-staven worden voorzien van een verende lijnoplegging met veerkarakteristieken die bij de betreffende grondsoort horen. De veerwaarde van de grondsoort is bepaald aan de hand van CUR166 “Damwandconstructies”. Bij de vertaling van deze veerwaarde naar een lijnoplegging wordt rekening gehouden met de schelpfactor volgens CUR228 “Horizontaal belaste palen”.

Kwa grondgelaagdheid zijn er voor de toetsing van de horizontale afdracht twee interessante situaties:

- Situatie 1: ter plaatse van mast 1 tot en met 5 zijn er slappe grondlagen tot ca. 6 m – MV aanwezig, dan een zandpakket van ca. 5 m, vervolgens nog een slappe laag van ca. 5 m en daarna zand. Echter zitten er in de bovenste lagen nog welk wat steungevende zandlagen;
- Situatie 2: ter plaatse van mast 60 tot en met 67 zijn er slappe grondlagen tot ca. 2m – MV aanwezig, daarna zand met een teruggang (van kleiig zand) tussen de 5 m – MV en 10 m – MV en verder zand. Daar komt echter bij dat er een aantal palen ca. 1,8m boven maaiveld staan. De ongesteunde lengte wordt daardoor ca. 4m.

Door de steunende laag die aanwezig is in situatie 1, wordt situatie 2 als maatgevend beschouwd en beoordeeld in deze bijlage.



Figuur 1 Grondgelaagdheid situatie 1 en situatie 2

1.2.1 Belastingen

De maatgevende belastingen zijn opgenomen in onderstaande tabel en overgenomen uit Appendix H.

Tabel 1 Belastingen

Type	Paal	Mast	R_x [kN]	R_y [kN]	R_z [kN]
Trek	Ø559	S-3_RC	99,4	92,9	-618,8
	Ø610/711	S+30_R	173,7	160,1	-1033,3
	Ø914	HB+9_R_X	226,1	240,1	-1465,5
Druk	Ø559	S-3_RC	137,9	131,3	862,2
	Ø610/711	S+30_R	235,8	222,2	1414,2
	Ø914	HB+9_R_X	280,0	293,6	1799,3
Torsie	Ø559	S-6_R	32,3	37,6	-24,2
	Ø610/711	S+12_R	32,3	-29,6	-16,8
	Ø914	HA-3_R	-128,3	126,7	-16,8

Het eigen gewicht van de nieuwe poer is 100,2kN.

1.2.2 Veerwaarden

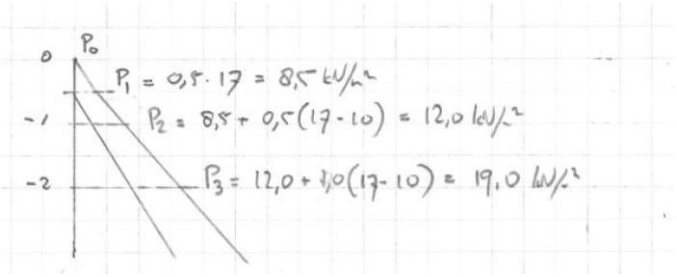
In Tabel 2 zijn de veerwaarden van veen, klei en zand opgenomen. Rekening wordt gehouden met lage, gemiddelde en hoge veerwaarden.

Tabel 2 Veerwaarden

Paal	Grond	k_h [kN/m^3]	schelp [-]	Diameter [m]	Gem. [kN/m]	Laag [kN/m]	Hoog [kN/m]
Ø559	Veen	1500	1,2	0,559	1006	711	1423
	Klei	3000	1,3	0,559	2180	1542	3083
	Zand	15000	2	0,559	16770	11858	23716
Ø610	Veen	1500	1,2	0,61	1098	776	1553
	Klei	3000	1,3	0,61	2379	1682	3364
	Zand	15000	2	0,61	18300	12940	25880
Ø914	Veen	1500	1,2	0,914	1645	1163	2327
	Klei	3000	1,3	0,914	3565	2521	5041
	Zand	15000	2	0,914	27420	19389	38778

1.2.3 Maximale gronddruk

In de bovenste grondlagen kan er slechts beperkte gronddruk worden opgenomen, gebaseerd op de maximale passieve gronddruk. In het model wordt de maximale oplegdruk van de lijnoplegging beperkt, wordt de eerste meter van de grond onder maaiveld niet voorzien van een bedding en wordt GWS aangenomen op 0,5m - maaiveld. De dichtheid van de grond is voor veen en klei genomen op 17kN/m^3 en voor zand op 18kN/m^3.



Figuur 2 Voorbeeld opbouw passieve gronddruk

De passieve gronddrukfactor is voor veen en klei aangenomen op 2 en voor zand op 3. In Tabel 3 zijn de maximale gronddrukken per meter grondlaag opgenomen tot 3m of 4m onder maaiveld.

Tabel 3 Maximale gronddruk

Paal	Grond	Niveau [m]	p [kN/m^3]	k_{pa} [kN/m^3]	schelp [-]	Diameter [m]	Max. druk [kN]
Ø559		0	0				
	Klei/veen	-1	12	2	1,2	0,559	8,0
		-2	19	2	1,2	0,559	20,8
	Zand	-3	27	3	2	0,559	77,1
		dieper					
Ø610		0	0				
	Klei/veen	-1	12	2	1,2	0,61	8,8
		-2	19	2	1,2	0,61	22,7
	Zand	-3	27	3	2	0,61	84,2
		dieper					
Ø914		0	0				
	Klei/veen	-1	12	2	1,2	0,914	13,2
		-2	19	2	1,2	0,914	34,0
		-3	27	3	2	0,914	126,1
	Zand	-4	35	3	2	0,914	170,0
		dieper					

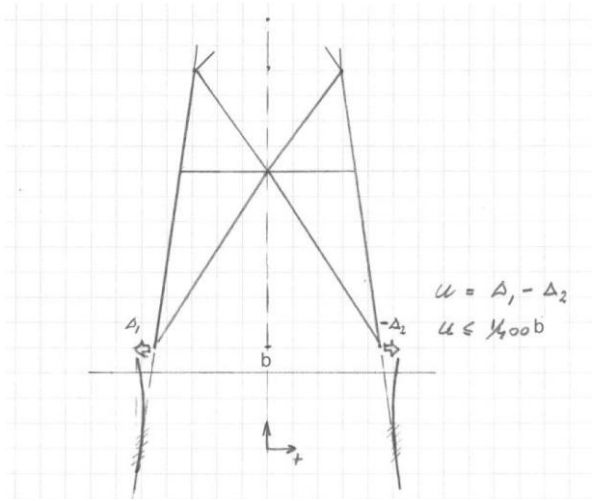
1.2.4 Toetsing

De palen worden op de volgende punten getoetst:

- Maximale spanning in de buis. Voor bestaande palen wordt uitgegaan van een dikteverlies na 35+50 jaar op basis van ongeroerde schone bodem. Het dikteverlies is gelijk aan: 85 / 50 x 0,6 mm/50 jaar = 1,0 mm. Bij een initiële dikte van 10 mm voor de kokerpaal betekent dat de U.C. beneden de (10-1,0)/10 = 0,90 moet blijven;
- Horizontale verplaatsing van maximaal 1/400·b. Deze eis is conform TenneT-specificatie “paalfunderingen” en wordt in principe alleen gehanteerd voor nieuwe constructies.

  Deze verplaatsingseisen worden gesteld aan karakteristieke belastingen. De gehanteerde belastingen zijn uit ULS of SpLS. De verplaatsingen die gevonden worden moeten dus nog worden gedeeld door de belastingfactor, hier wordt een factor van 1,25 voor aangehouden. Voor steunmasten worden de torsiebelastingen al berekend zonder belastingfactor. Hiervoor wordt de factor van 1,25 dus niet gehanteerd.

  Bij belasting door torsie bewegen de palen in principe in dezelfde richting, daardoor wordt er theoretisch altijd aan de eis voldaan. Als beginpunt wordt 1/400·b aangehouden. Bij beoordeling van de bestaande palen wordt een kleine overschrijding als acceptabel gezien.



Figuur 3 Toelaatbare horizontale verplaatsing

Tabel 4 Toelaatbare horizontale verplaatsing per paaltype

Mast	Paal	Pootsprei [m]	basiseis [-]	Max. u [mm]	Factor 1 [-]	Factor 2 [-]	Eis [mm]
S-6	Ø559	8,0	1/400	20	1,0	0,5	10
S+12	Ø610/711	10,75	1/400	26,9	1,0	0,5	13,5
HA-3	Ø914	10,0	1/400	25	1,25	0,5	15,6

2 RESULTATEN

In dit hoofdstuk zijn de resultaten per paaltype opgenomen. Voor volledige berekening en resultaten, zie uitvoerrapport van Axis-VM vanaf volgende pagina.

2.1 Ø559

In Tabel 5 zijn de resultaten samengevat van de palen Ø559mm, de palen voldoen.

Tabel 5 Resultaten palen Ø559

Palen Ø559	Berekend	Toelaatbaar		UC	
Spanning	113	235	MPa	0,48	OK
Verplaatsing e_x/e_y, excl. torsie	6,3	10	mm		OK
Verplaatsing e_x/e_y, incl. torsie	25,4		mm		Acceptabel

2.2 Ø610/711

In Tabel 6 zijn de resultaten samengevat van de palen Ø610/711mm, de palen voldoen.

Tabel 6 Resultaten palen Ø610

Palen Ø610	Berekend	Toelaatbaar		UC	
Spanning	110	235	MPa	0,46	OK
Verplaatsing e_x/e_y, excl. torsie	11,9	13,5	mm		OK
Verplaatsing e_x/e_y, incl. torsie	13,4		mm		Acceptabel

2.3 Ø914

In Tabel 7 zijn de resultaten samengevat van de palen Ø914mm, de palen voldoen.

Tabel 7 Resultaten palen Ø914

Palen Ø914	Berekend	Toelaatbaar		UC	
Spanning	128	235	MPa	0,54	OK
Verplaatsing e_x/e_y, excl. torsie	11,9	15,6	mm		OK
Verplaatsing e_x/e_y, incl. torsie	24,9		mm		Acceptabel

Project:

Constructeur: DNV GL - Energy

AxisVM X6 R1o-hf1 · Geregistreerd aan DNV GL - Energy

1-paal v1.axs

Rapport

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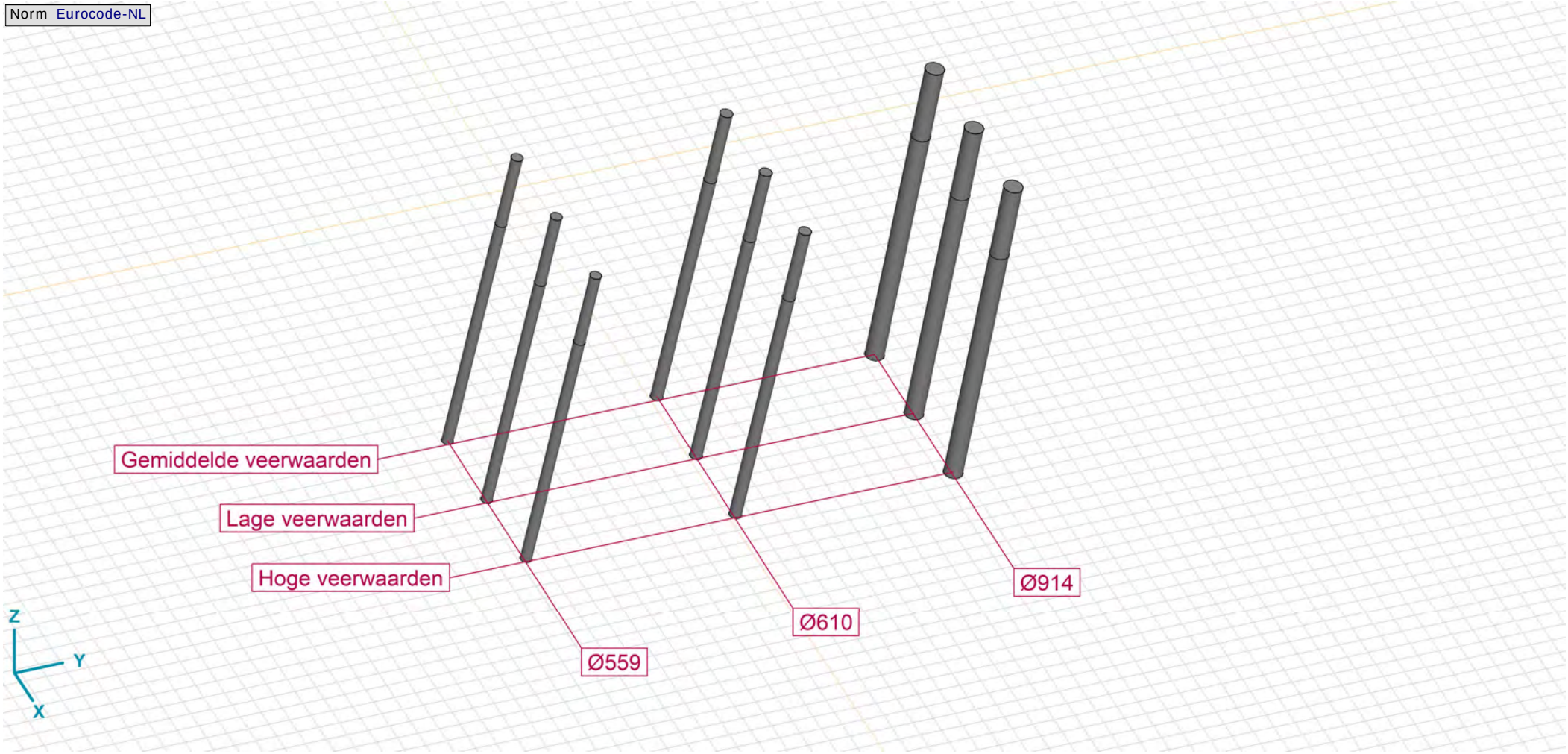
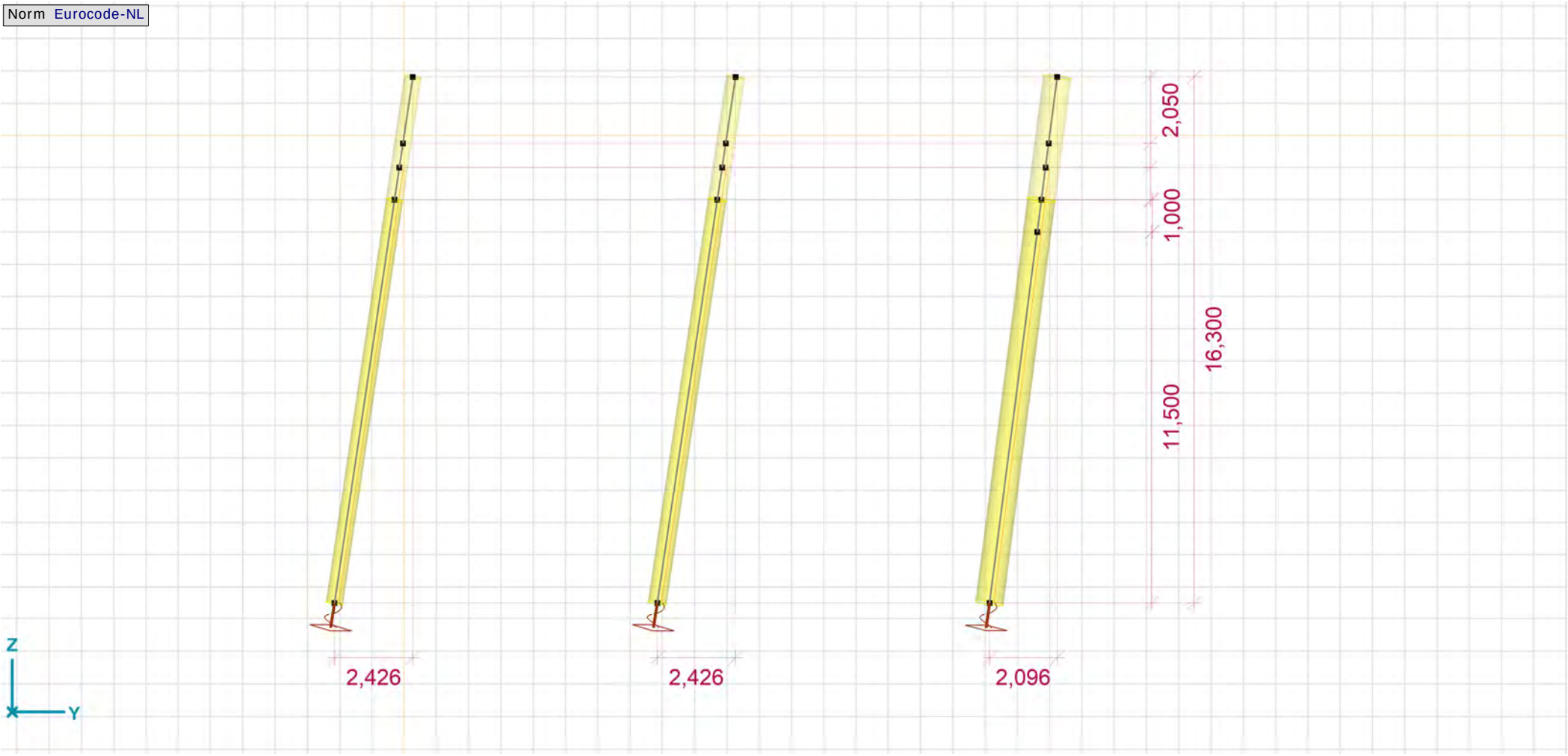
Ø914 - Knoopverplaatsingen [Non-lin., Omhullende (Alle UGT), Geselecteerd]	18
[II], Non-lin., Omhullende (Alle UGT), Onmiddellijke doorbuiging, eX, Lijnen	19
Knoopverplaatsingen [Non-lin., POER [1] (1,000)]	20
[II], Non-lin., POER [1] (1,000), Onmiddellijke doorbuiging, eX, Lijnen	21
Staafspanningen [Non-lin., Omhullende (Alle UGT)]	22
[II], Non-lin., Omhullende (Alle UGT), Onmiddellijke doorbuiging, Sominmax, Lijnen (gevuld)	23
Interne krachten lijnoplegging [Non-lin., Omhullende (Alle UGT)]	24
[II], Non-lin., Omhullende (Alle UGT), Onmiddellijke doorbuiging, Rz (lijnopp.), Lijnen (gevuld)	27

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**



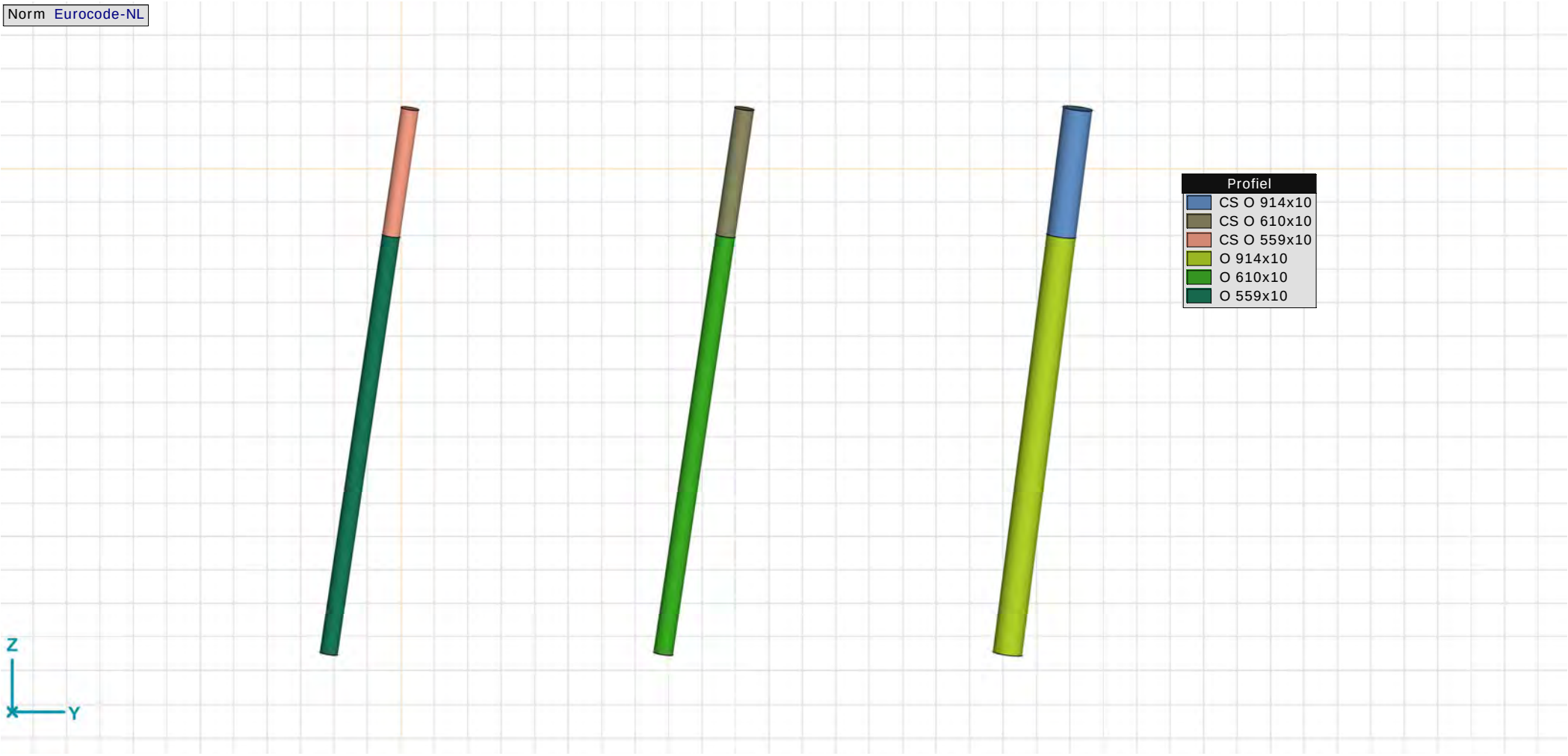
Overzicht 3D-model

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**



Zijaanzicht met maatvoering

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**



Profielen

Materialen

	Naam	Type	Nationale norm	Materiaalnorm	Model	E_x [N/mm^2]	E_y [N/mm^2]	ν	α_T [1/°C]	ρ [kg/m^3]	Materiaal kleur	Contour kleur	Structuur	P_1
1	S 235	Staal	Eurocode-NL	10025-2	Lineair	210000	210000	0,30	1,2E-5	7850			Steel	f_y[N/mm^2] = 235,00
2	C20/25	Beton	Eurocode-NL	EN 206	Lineair	30000	30000	0,20	1E-5	2500			Concrete A	f_{ck}[N/mm^2] = 20,00

	Naam	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}
1	S 235	f_u[N/mm^2] = 360,00	f_y^*[N/mm^2] = 215,00	f_u^*[N/mm^2] = 360,00										
2	C20/25	γ_c= 1,500	α_{cc}= 1,00	ϕ_t= 2,00										

Naam: Materiaalnaam; **Type:** Type materiaal; **Model:** Materiaal model; **E_x:** Elasticiteitsmodulus in lokale x richting; **E_y:** Elasticiteitsmodulus in lokale y richting; **ν:** Poisson's verhouding; **α_T:** Warmteuitzettingscoëfficiënt; **ρ:** Dichtheid; **Materiaal kleur:** Materiaalkleur; **Contour kleur:** Contourkleur; **P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}:** Ontwerpparameter;

Profielen

	Naam	Tekening	Productie	Vorm	Buitenste materiaal	Vulling	h [mm]	b [mm]	tw [mm]	tf [mm]	r_1 [mm]	r_2 [mm]	r_3 [mm]	Ax [mm^2]	Ay [mm^2]	Az [mm^2]
1	O 559x10		Gewalst	Buis			559,0	559,0	10,0	10,0	0	0	0	17243,84	8626,67	8626,69
2	CS O 559x10		Ander	Met beton gevulde stalen buis	S 235	C20/25	559,0	559,0	10,0	10,0	0	0	0	49833,60	38888,59	38888,61

	Naam	Ix [mm^4]	Iy [mm^4]	Iz [mm^4]	Iyz [mm^4]	I_1 [mm^4]	I_2 [mm^4]	α [°]	Iω [mm^6]	$W_{1,el,t}$ [mm^3]	$W_{1,el,b}$ [mm^3]	$W_{2,el,t}$ [mm^3]	$W_{2,el,b}$ [mm^3]	$W_{1,pl}$ [mm^3]	$W_{2,pl}$ [mm^3]
1	O 559x10	1,3E+09	6,5E+08	6,5E+08	0	6,5E+08	6,5E+08	0	0	2324678,0	2324678,0	2324678,0	2324678,0	3013425,0	3013445,0
2	CS O 559x10	2,6E+09	1,2E+09	1,2E+09	0	1,2E+09	1,2E+09	0	0	0	0	0	0	0	0

	Naam	i_y [mm]	i_z [mm]	Hy [mm]	Hz [mm]	y_G [mm]	z_G [mm]	y_s [mm]	z_s [mm]	β_y [mm]	β_z [mm]	β_w []	S.p.
1	O 559x10	194,1	194,1	559,0	559,0	279,5	279,5	0	0	0	0	0	5
2	CS O 559x10	157,8	157,8	559,0	559,0	279,5	279,5	0	0	0	0	0	5

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

Profielen

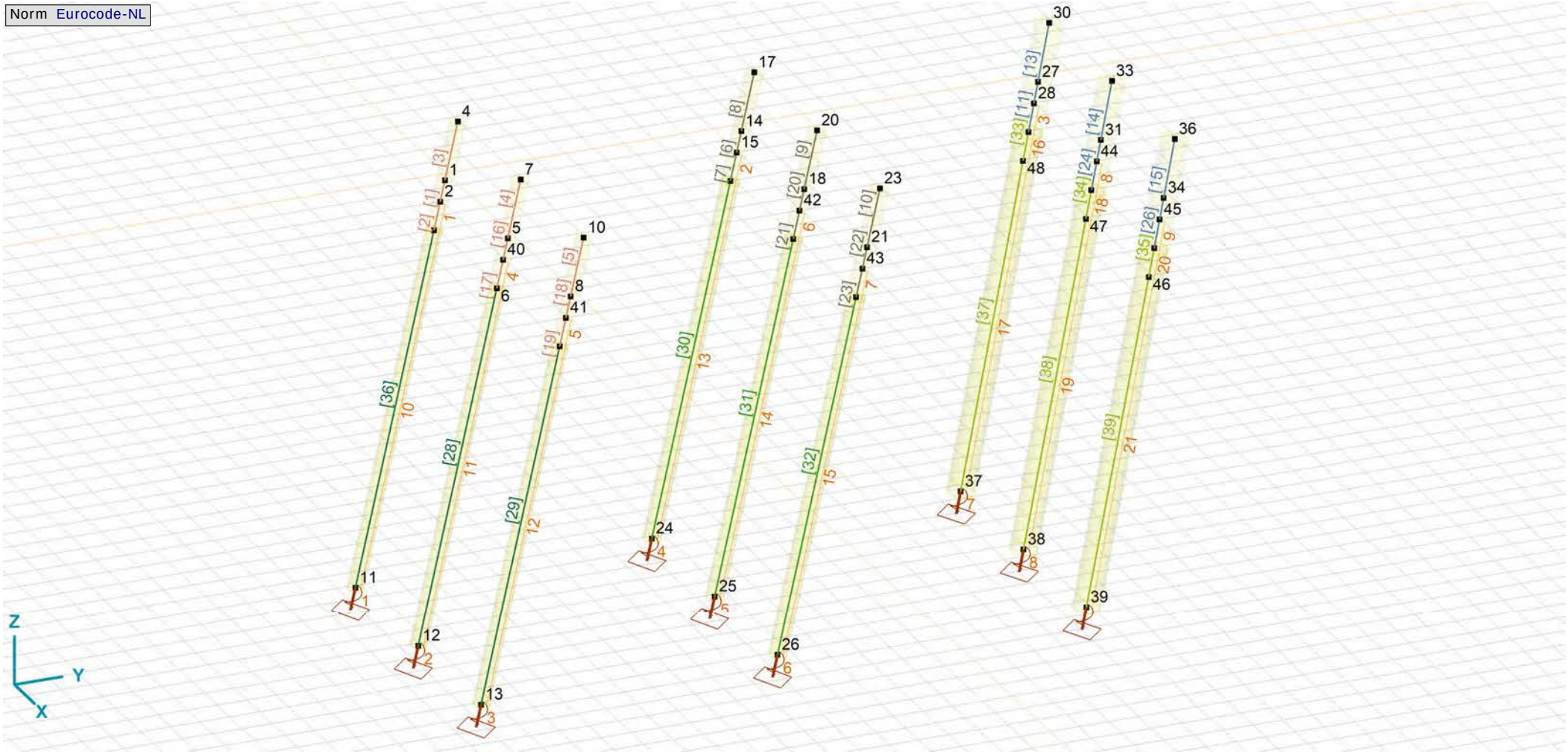
	Naam	Tekening	Productie	Vorm	Buitenste materiaal	Vulling	h [mm]	b [mm]	tw [mm]	tf [mm]	r_1 [mm]	r_2 [mm]	r_3 [mm]	Ax [mm^2]	Ay [mm^2]	Az [mm^2]
3	O 610x10		Gewalst	Buis			610,0	610,0	10,0	10,0	0	0	0	18845,73	9427,14	9427,23
4	CS O 610x10		Ander	Met beton gevulde stalen buis	S 235	C20/25	610,0	610,0	10,0	10,0	0	0	0	57894,52	45686,74	45686,82
5	O 914x10		Gewalst	Buis			914,0	914,0	10,0	10,0	0	0	0	28394,23	14199,71	14200,02
6	CS O 914x10		Ander	Met beton gevulde stalen buis	S 235	C20/25	914,0	914,0	10,0	10,0	0	0	0	118050,10	97451,58	97451,89

	Naam	Ix [mm^4]	Iy [mm^4]	Iz [mm^4]	Iyz [mm^4]	I_1 [mm^4]	I_2 [mm^4]	α [°]	Iω [mm^6]	$W_{1,el,t}$ [mm^3]	$W_{1,el,b}$ [mm^3]	$W_{2,el,t}$ [mm^3]	$W_{2,el,b}$ [mm^3]	$W_{1,pl}$ [mm^3]	$W_{2,pl}$ [mm^3]
3	O 610x10	1,7E+09	8,5E+08	8,5E+08	0	8,5E+08	8,5E+08	0	0	2780725,0	2780725,0	2780725,0	2780725,0	3599237,0	3599260,0
4	CS O 610x10	3,5E+09	1,7E+09	1,7E+09	0	1,7E+09	1,7E+09	0	0	0	0	0	0	0	0
5	O 914x10	5,8E+09	2,9E+09	2,9E+09	0	2,9E+09	2,9E+09	0	0	6346375,0	6346375,0	6346375,0	6346375,0	8170004,0	8170058,0
6	CS O 914x10	1,6E+10	7,4E+09	7,4E+09	0	7,4E+09	7,4E+09	0	0	0	0	0	0	0	0

	Naam	i_y [mm]	i_z [mm]	Hy [mm]	Hz [mm]	y_G [mm]	z_G [mm]	y_s [mm]	z_s [mm]	β_y [mm]	β_z [mm]	β_w []	S.p.
3	O 610x10	212,1	212,1	610,0	610,0	305,0	305,0	0	0	0	0	0	5
4	CS O 610x10	171,2	171,2	610,0	610,0	305,0	305,0	0	0	0	0	0	5
5	O 914x10	319,6	319,6	914,0	914,0	457,0	457,0	0	0	0	0	0	5
6	CS O 914x10	250,0	250,0	914,0	914,0	457,0	457,0	0	0	0	0	0	5

Naam: Doorsnede naam; **Productie:** Productieproces; **Vorm:** Profiel; **h:** Doorsnede hoogte; **b:** Doorsnede breedte; **tw:** Lijfdikte; **tf:** Flensdikte; **r_1, r_2, r_3:** Afrondingswaarde; **Ax:** Doorsnede-oppervlak; **Ay, Az:** Afschuivingsoppervlak; **Ix:** Torsietraagheidsmoment; **Iy, Iz:** Buigtraagheidsmoment; **Iyz:** Centrifugaal traagheidsmoment; **I_1, I_2:** Hoofdbuigtraagheidsmoment; **α:** Hoofdrichtingen; **Iω:** Krommingsconstante; **$W_{1,el,t}$, $W_{1,el,b}$, $W_{2,el,t}$, $W_{2,el,b}$:** Elastisch weerstandsmoment; **$W_{1,pl}$, $W_{2,pl}$:** Plastisch weerstandsmoment; **i_y, i_z:** Traagheidsstraal; **Hy:** Afmeting in lokale Y-richting; **Hz:** Afmeting in lokale Z-richting; **y_G:** Y-coördinaat van het zwaartepunt; **z_G:** Z-coördinaat van het zwaartepunt; **y_s:** Y-coördinaat van het afschuivingsmiddelpunt (torsie); **z_s:** Z-coördinaat van het afschuivingsmiddelpunt (torsie); **β_y, β_z, β_w:** Wagner's coëfficiënt; **S.p.:** Spanningspunten;

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**



Overzicht knopen, staven en opleggingen

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

Knopen

	X [m]	Y [m]	Z [m]
1	−0,037	−0,037	−0,250
2	−0,148	−0,148	−1,000
3	−0,298	−0,298	−2,000
4	0,268	0,268	1,800
5	4,963	−0,037	−0,250
6	4,702	−0,298	−2,000
7	5,268	0,268	1,800
8	9,963	−0,037	−0,250
9	9,702	−0,298	−2,000
10	10,268	0,268	1,800
11	−2,159	−2,159	−14,500
12	2,841	−2,159	−14,500
13	7,841	−2,159	−14,500
14	−0,037	9,963	−0,250
15	−0,148	9,852	−1,000
16	−0,298	9,702	−2,000
17	0,268	10,268	1,800
18	4,963	9,963	−0,250
19	4,702	9,702	−2,000
20	5,268	10,268	1,800
21	9,963	9,963	−0,250
22	9,702	9,702	−2,000
23	10,268	10,268	1,800
24	−2,159	7,841	−14,500
25	2,841	7,841	−14,500
26	7,841	7,841	−14,500
27	−0,032	19,968	−0,250
28	−0,129	19,871	−1,000
29	−0,257	19,743	−2,000
30	0,231	20,231	1,800
31	4,968	19,968	−0,250
32	4,743	19,743	−2,000
33	5,231	20,231	1,800
34	9,968	19,968	−0,250
35	9,743	19,743	−2,000
36	10,231	20,231	1,800
37	−1,864	18,136	−14,500
38	3,136	18,136	−14,500
39	8,136	18,136	−14,500
40	4,852	−0,148	−1,000
41	9,852	−0,148	−1,000
42	4,852	9,852	−1,000
43	9,852	9,852	−1,000
44	4,871	19,871	−1,000
45	9,871	19,871	−1,000
46	9,614	19,614	−3,000
47	4,614	19,614	−3,000
48	−0,386	19,614	−3,000

Staven

	Start-punt	Eind-punt	Lengte	Lokaal X	Materiaal	Doorsnede
1	1	2	0,766	i - j	S 235	2
2	2	3	1,022	i - j	S 235	2
3	4	1	2,095	j - i	S 235	2
4	7	5	2,095	j - i	S 235	2
5	10	8	2,095	j - i	S 235	2
6	14	15	0,766	i - j	S 235	4
7	15	16	1,022	i - j	S 235	4
8	17	14	2,095	j - i	S 235	4
9	20	18	2,095	j - i	S 235	4
10	23	21	2,095	j - i	S 235	4
11	27	28	0,762	i - j	S 235	6
12	28	29	1,016	i - j	S 235	6
13	30	27	2,084	j - i	S 235	6
14	33	31	2,084	j - i	S 235	6
15	36	34	2,084	j - i	S 235	6
16	5	40	0,766	i - j	S 235	2
17	40	6	1,022	j - i	S 235	2
18	8	41	0,766	i - j	S 235	2
19	41	9	1,022	j - i	S 235	2
20	18	42	0,766	i - j	S 235	4
21	42	19	1,022	j - i	S 235	4
22	21	43	0,766	i - j	S 235	4
23	43	22	1,022	j - i	S 235	4
24	31	44	0,762	i - j	S 235	6
25	44	32	1,016	j - i	S 235	6
26	34	45	0,762	i - j	S 235	6
27	45	35	1,016	j - i	S 235	6
28	12	6	12,774	j - i	S 235	1
29	13	9	12,774	j - i	S 235	1
30	24	16	12,774	j - i	S 235	3
31	25	19	12,774	j - i	S 235	3
32	26	22	12,774	j - i	S 235	3
33	29	48	1,016	i - j	S 235	5
34	32	47	1,016	i - j	S 235	5
35	35	46	1,016	i - j	S 235	5
36	11	3	12,774	j - i	S 235	1
37	37	48	11,689	i - j	S 235	5
38	38	47	11,689	i - j	S 235	5
39	39	46	11,689	i - j	S 235	5

Lengte: Elementlengte; **Lokaal X:** Lokale X-richting;

Knoopopleggingen

	Knoop	*X [m]*	*Y [m]*	*Z [m]*	*Type*	*Ref. elem.*	*K_x [kN/m]*	*K_y [kN/m]*	*K_{xx} [kNm/rad]*
1	11	−2,159	−2,159	−14,500	Staaf r.	Staaf 591	100000	–	1E+10
2	12	2,841	−2,159	−14,500	Staaf r.	Staaf 253	100000	–	1E+10
3	13	7,841	−2,159	−14,500	Staaf r.	Staaf 317	100000	–	1E+10
4	24	−2,159	7,841	−14,500	Staaf r.	Staaf 381	100000	–	1E+10
5	25	2,841	7,841	−14,500	Staaf r.	Staaf 445	100000	–	1E+10
6	26	7,841	7,841	−14,500	Staaf r.	Staaf 509	100000	–	1E+10
7	37	−1,864	18,136	−14,500	Staaf r.	Staaf 592	100000	–	1E+10
8	38	3,136	18,136	−14,500	Staaf r.	Staaf 651	100000	–	1E+10
9	39	8,136	18,136	−14,500	Staaf r.	Staaf 710	100000	–	1E+10

Knoop: Ondersteunde knoop; **Type:** Opleggingstype; **Ref. elem.:** Referentie-element; **K_x, K_y, K_{xx}:** Initiële stijfheid;

Lijnopleggingen

	Lijn	*Type*	*Ref. elem.*	*Ry [kN/m/m]*	*Rz [kN/m/m]*	*NL(y)*	*NL(z)*	*F(y) [kN/m]*	*F(z) [kN/m]*
		Staaf r.							
1	Staaf 2	Staaf r.		1006	1006	Symmetrisch	Symmetrisch	20,800	20,800
2	Staaf 7	Staaf r.		1098	1098	Symmetrisch	Symmetrisch	22,700	22,700
3	Staaf 12	Staaf r.		1645	1645	Symmetrisch	Symmetrisch	34,000	34,000
4	Staaf 17	Staaf r.		711	711	Symmetrisch	Symmetrisch	20,800	20,800
5	Staaf 19	Staaf r.		1423	1423	Symmetrisch	Symmetrisch	20,800	20,800
6	Staaf 21	Staaf r.		776	776	Symmetrisch	Symmetrisch	22,700	22,700
7	Staaf 23	Staaf r.		1553	1553	Symmetrisch	Symmetrisch	22,700	22,700
8	Staaf 25	Staaf r.		1163	1163	Symmetrisch	Symmetrisch	34,000	34,000
9	Staaf 27	Staaf r.		2327	2327	Symmetrisch	Symmetrisch	34,000	34,000
11	Staaf 28	Staaf r.		11858	11858	Symmetrisch	Symmetrisch	77,100	77,100
12	Staaf 29	Staaf r.		23716	23716	Symmetrisch	Symmetrisch	77,100	77,100
13	Staaf 30	Staaf r.		18300	18300	Symmetrisch	Symmetrisch	84,200	84,200
14	Staaf 31	Staaf r.		12940	12940	Symmetrisch	Symmetrisch	84,200	84,200
15	Staaf 32	Staaf r.		25880	25880	Symmetrisch	Symmetrisch	84,200	84,200
16	Staaf 33	Staaf r.		27420	27420	Symmetrisch	Symmetrisch	126,100	126,100
18	Staaf 34	Staaf r.		19389	19389	Symmetrisch	Symmetrisch	126,100	126,100
20	Staaf 35	Staaf r.		38778	38778	Symmetrisch	Symmetrisch	126,100	126,100
10	Staaf 36	Staaf r.		16770	16770	Symmetrisch	Symmetrisch	77,100	77,100
17	Staaf 37	Staaf r.		27420	27420	Symmetrisch	Symmetrisch	170,000	170,000
19	Staaf 38	Staaf r.		19389	19389	Symmetrisch	Symmetrisch	170,000	170,000
21	Staaf 39	Staaf r.		38778	38778	Symmetrisch	Symmetrisch	170,000	170,000

Lijn: Ondersteund lijnelement; **Type:** Opleggingstype; **Ref. elem.:** Referentie-element; **Ry, Rz:** Verplaatsingsstijfheid; **NL(y), NL(z):** Niet-lineaire parameters; **F(y):** Weerstand in Y-richting; **F(z):** Weerstand in Z-richting;

Belastinggevallen

	Naam	*Groep*	*Groepstype*
1	EG	---	---
2	POER	---	---
3	Trek	---	---
4	Druk	---	---
5	Torsie	---	---

Naam: Naam belastinggeval; **Groep:** Belastinggroep; **Groepstype:** Belastinggroep type;

EG: Staaf eigen gewicht

	Σ [kg]
1–768	58020,197
Totaal	**58020,197**

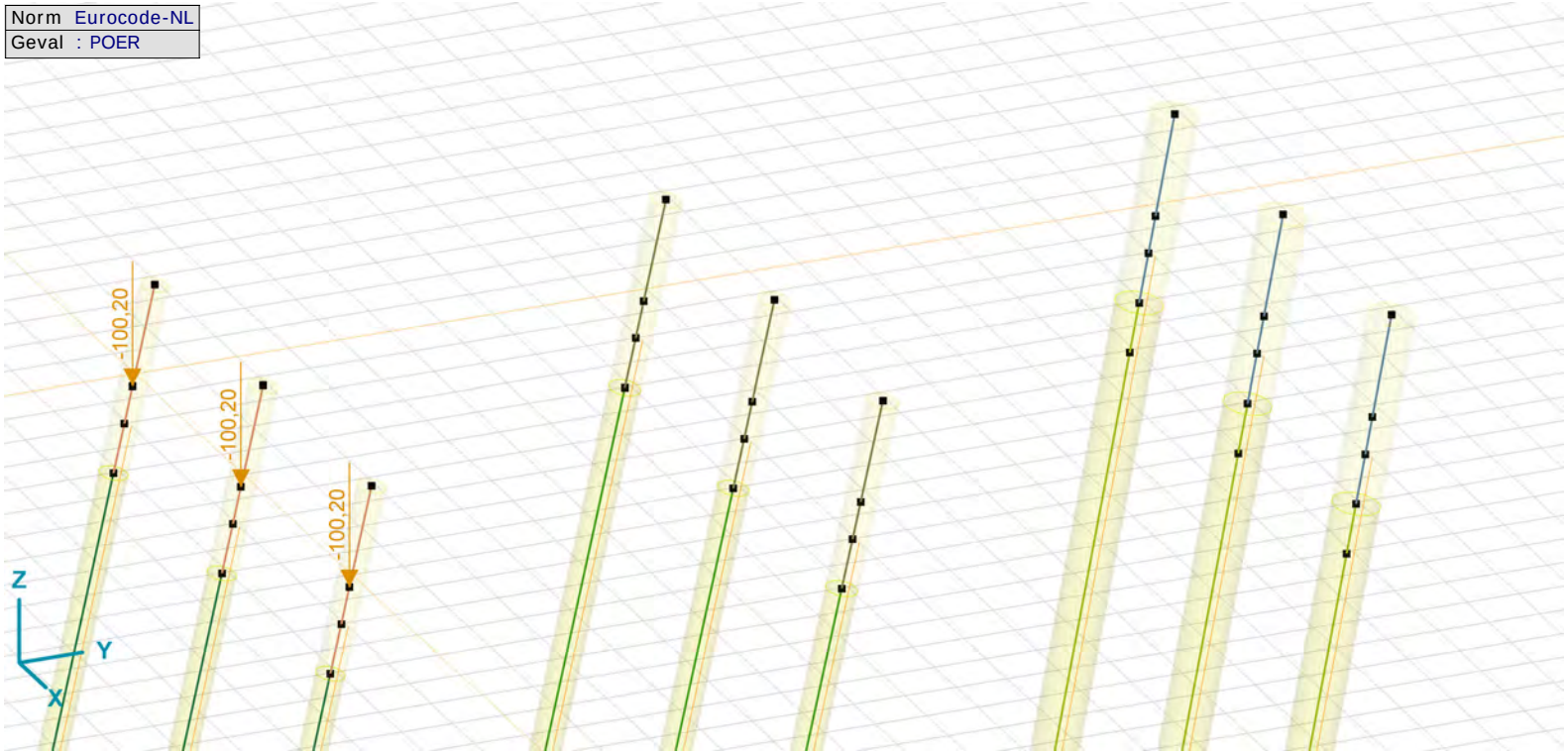
Σ: Totale massa;

POER: Knoopbelastingen

	Richting	*Fx [kN]*	*Fy [kN]*	*Fz [kN]*	*Mx [kNm]*	*My [kNm]*	*Mz [kNm]*
1	Globaal	0	0	−100,20	0	0	0
5	Globaal	0	0	−100,20	0	0	0
8	Globaal	0	0	−100,20	0	0	0

Fx, Fy, Fz: Belastingkracht component; **Mx, My, Mz:** Belastingsmoment component;

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

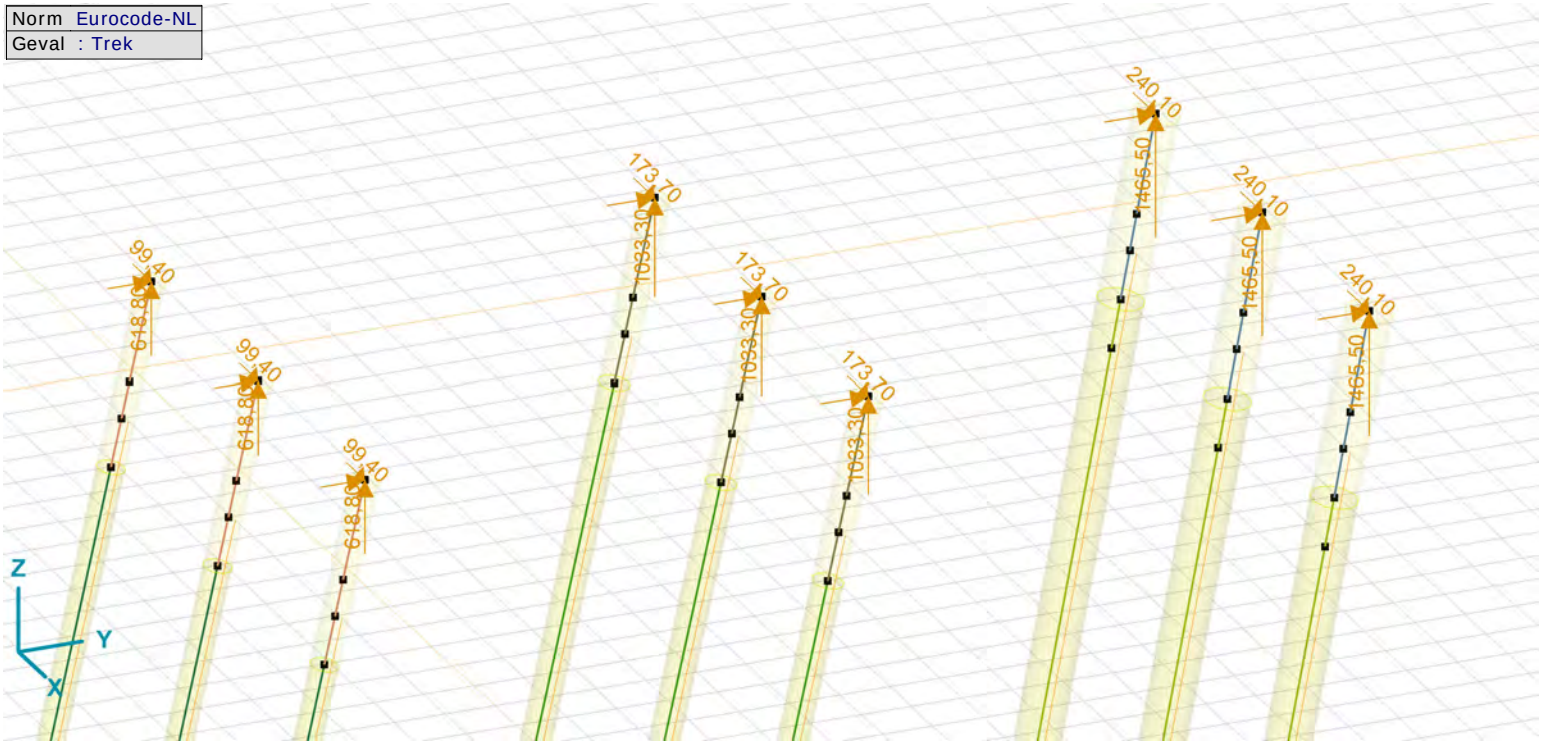


POER

Trek: Knoopbelastingen

	Richting	*Fx [kN]*	*Fy [kN]*	*Fz [kN]*	*Mx [kNm]*	*My [kNm]*	*Mz [kNm]*
4	Globaal	99,40	92,90	618,80	0	0	0
7	Globaal	99,40	92,90	618,80	0	0	0
10	Globaal	99,40	92,90	618,80	0	0	0
17	Globaal	173,70	160,10	1033,30	0	0	0
20	Globaal	173,70	160,10	1033,30	0	0	0
23	Globaal	173,70	160,10	1033,30	0	0	0
30	Globaal	240,10	226,10	1465,50	0	0	0
33	Globaal	240,10	226,10	1465,50	0	0	0
36	Globaal	240,10	226,10	1465,50	0	0	0

Fx, Fy, Fz: Belastingkracht component; **Mx, My, Mz:** Belastingsmoment component;



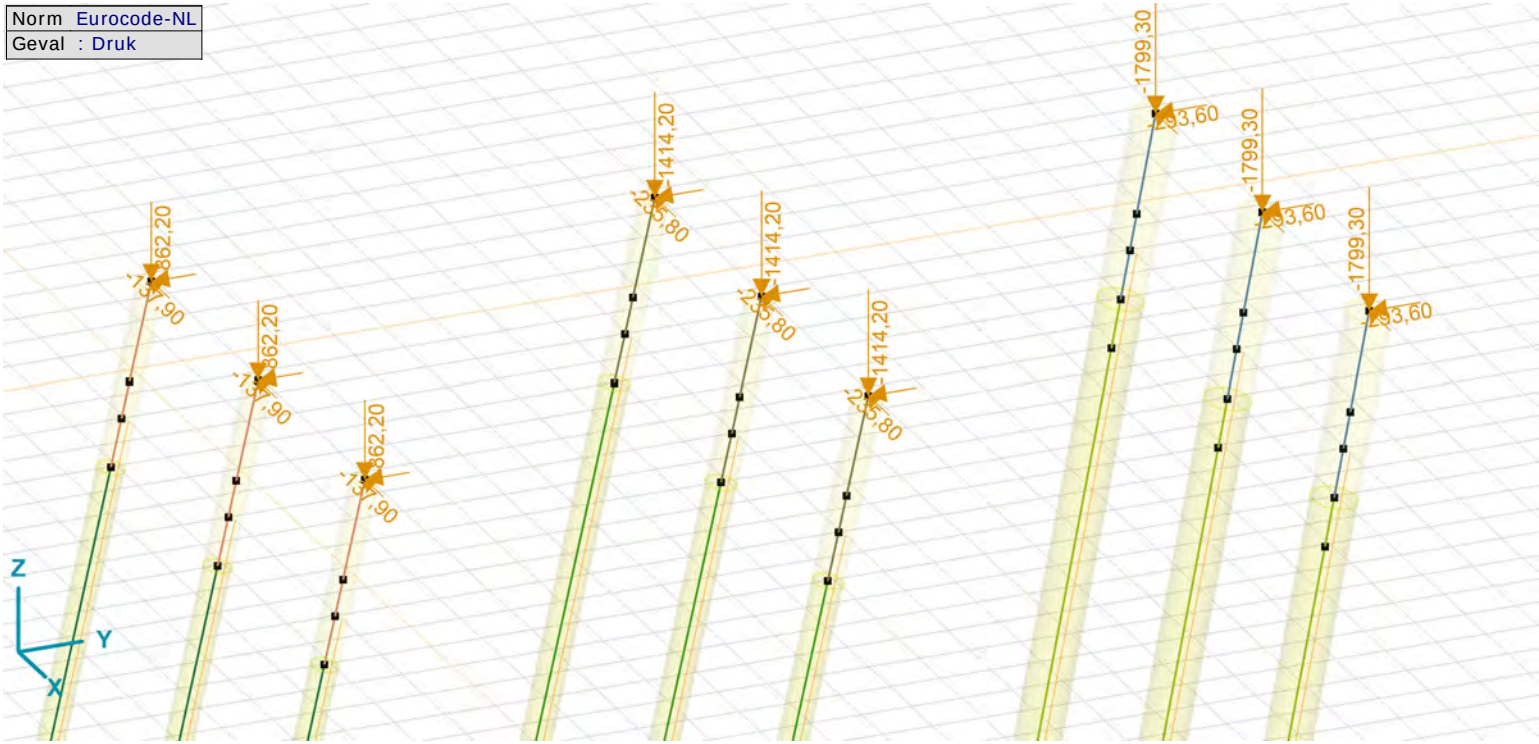
Trek

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

Druk: Knoopbelastingen

	Richting	*Fx [kN]*	*Fy [kN]*	*Fz [kN]*	*Mx [kNm]*	*My [kNm]*	*Mz [kNm]*
4	Globaal	−137,90	−131,30	−862,20	0	0	0
7	Globaal	−137,90	−131,30	−862,20	0	0	0
10	Globaal	−137,90	−131,30	−862,20	0	0	0
17	Globaal	−235,80	−222,20	−1414,20	0	0	0
20	Globaal	−235,80	−222,20	−1414,20	0	0	0
23	Globaal	−235,80	−222,20	−1414,20	0	0	0
30	Globaal	−280,00	−293,60	−1799,30	0	0	0
33	Globaal	−280,00	−293,60	−1799,30	0	0	0
36	Globaal	−280,00	−293,60	−1799,30	0	0	0

Fx, Fy, Fz: Belastingkracht component; **Mx, My, Mz:** Belastingsmoment component;



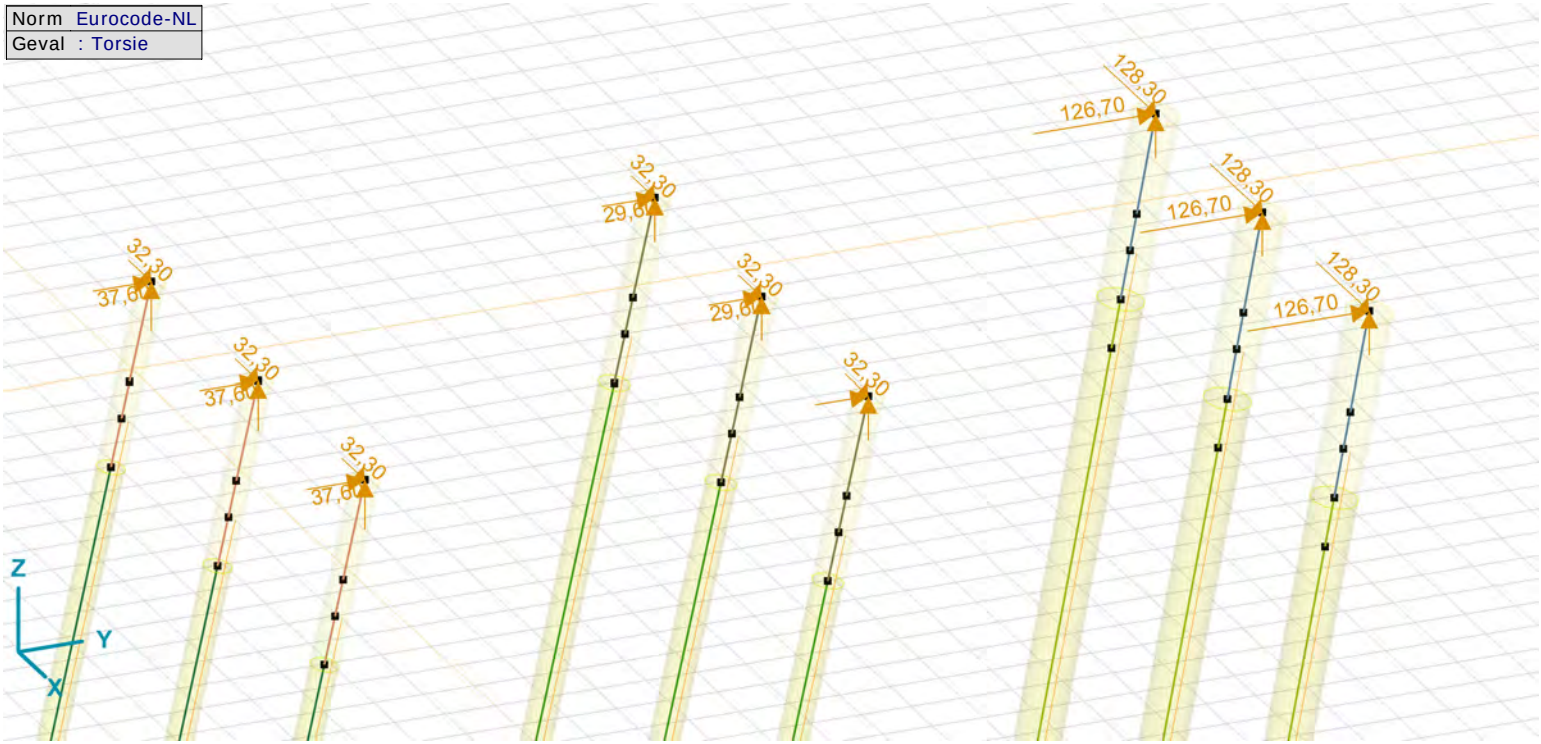
Druk

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

Torsie: Knoopbelastingen

	Richting	*Fx [kN]*	*Fy [kN]*	*Fz [kN]*	*Mx [kNm]*	*My [kNm]*	*Mz [kNm]*
4	Globaal	32,30	37,60	24,20	0	0	0
7	Globaal	32,30	37,60	24,20	0	0	0
10	Globaal	32,30	37,60	24,20	0	0	0
17	Globaal	32,30	29,60	16,80	0	0	0
20	Globaal	32,30	29,60	16,80	0	0	0
23	Globaal	32,30	29,60	16,80	0	0	0
30	Globaal	128,30	126,70	16,80	0	0	0
33	Globaal	128,30	126,70	16,80	0	0	0
36	Globaal	128,30	126,70	16,80	0	0	0

Fx, Fy, Fz: Belastingkracht component; **Mx, My, Mz:** Belastingsmoment component;



Torsie

Gebruiker gedefinieerde belastingcombinaties uit belastinggevallen

	Naam	*Type*	*EG*	*POER*	*Trek*	*Druk*	*Torsie*	*Commentaar*
1	Co #1 - trek	UGT	1,20	0	1,00	0	0	
2	Co #2 - druk	UGT	1,20	0	0	1,00	0	
3	Co #3 - trek+poer	UGT	1,20	1,20	1,00	0	0	
4	Co #4 - druk+poer	UGT	1,20	1,20	0	1,00	0	
5	Co #6 - alleen poer	UGT	0	1,00	0	0	0	
6	Co #6 - torsie	UGT	1,20	0	0	0	1,00	
7	Co #7 - torsie + poer	UGT	1,20	1,20	0	0	1,00	

Naam: Naam belastingcombinatie; **Type:** Type belastingcombinatie; **EG, POER, Trek, Druk, Torsie:** Factor;

Alle paaltypen - alleen trek - Knoopverplaatsingen [Non-lin., Co #1 - trek [1] (1,000), Geselecteerd]

	eX [mm]	*eY [mm]*	*eZ [mm]*	*eR [mm]*	*fX [rad]*	*fY [rad]*	*fZ [rad]*	*fR [rad]*
4	6,331	2,952	6,935	9,843	−0,00037	0,00109	−0,00011	0,00116
17	11,542	5,803	11,322	17,178	−0,00082	0,00201	−0,00018	0,00218
30	11,485	9,190	14,721	20,810	−0,00134	0,00176	−0,00005	0,00221

eX: Verplaatsing in X-richting; **eY:** Verplaatsing in Y-richting; **eZ:** Verplaatsing in Z-richting; **eR:** Resulterende verplaatsing; **fX:** Rotatie in X-richting; **fY:** Rotatie in Y-richting; **fZ:** Rotatie in Z-richting; **fR:** Resulterende rotatie;

Alle paaltypen - alleen druk - Knoopverplaatsingen [Non-lin., Co #2 - druk [1] (1,000), Geselecteerd]

	eX [mm]	*eY [mm]*	*eZ [mm]*	*eR [mm]*	*fX [rad]*	*fY [rad]*	*fZ [rad]*	*fR [rad]*
4	−5,280	−1,848	−12,161	13,386	0,00004	−0,00077	0,00011	0,00078
17	−11,921	−6,182	−18,154	22,581	0,00075	−0,00194	0,00018	0,00208
30	−9,639	−11,868	−21,612	26,473	0,00171	−0,00129	−0,00005	0,00214

eX: Verplaatsing in X-richting; **eY:** Verplaatsing in Y-richting; **eZ:** Verplaatsing in Z-richting; **eR:** Resulterende verplaatsing; **fX:** Rotatie in X-richting; **fY:** Rotatie in Y-richting; **fZ:** Rotatie in Z-richting; **fR:** Resulterende rotatie;

Ø559 - Knoopverplaatsingen [Non-lin., Omhullende (Alle UGT), Geselecteerd]

Ext.	*C*	*min. max.*	*Geval*	*eX [mm]*	*eY [mm]*	*eZ [mm]*	*eR [mm]*	*fX [rad]*	*fY [rad]*	*fZ [rad]*	*fR [rad]*
4	eX	min	Co #2 - druk [1] (1,000)	**−5,280**	−1,848	−12,161	13,386	0,00004	−0,00077	0,00011	0,00078
4		max	Co #7 - torsie + poer [1] (1,000)	**22,686**	25,441	−9,012	35,258	−0,00534	0,00476	0,00009	0,00715
4	eY	min	Co #2 - druk [1] (1,000)	−5,280	**−1,848**	−12,161	13,386	0,00004	−0,00077	0,00011	0,00078
4		max	Co #7 - torsie + poer [1] (1,000)	22,686	**25,441**	−9,012	35,258	−0,00534	0,00476	0,00009	0,00715
4	eZ	min	Co #4 - druk+poer [1] (1,000)	−0,542	2,890	**−15,219**	15,500	−0,00092	0,00019	0,00011	0,00095
4		max	Co #1 - trek [1] (1,000)	6,331	2,952	**6,935**	9,843	−0,00037	0,00109	−0,00011	0,00116
4	eR	min	Co #1 - trek [1] (1,000)	6,331	2,952	6,935	**9,843**	−0,00037	0,00109	−0,00011	0,00116
4		max	Co #7 - torsie + poer [1] (1,000)	22,686	25,441	−9,012	**35,258**	−0,00534	0,00476	0,00009	0,00715

C: Extreme component; **min. max.:** Extreme type; **Geval:** Belastinggeval van de extreme; **eX:** Verplaatsing in X-richting; **eY:** Verplaatsing in Y-richting; **eZ:** Verplaatsing in Z-richting; **eR:** Resulterende verplaatsing; **fX:** Rotatie in X-richting; **fY:** Rotatie in Y-richting; **fZ:** Rotatie in Z-richting; **fR:** Resulterende rotatie;

Ø610 - Knoopverplaatsingen [Non-lin., Omhullende (Alle UGT), Geselecteerd]

Ext.	*C*	*min. max.*	*Geval*	*eX [mm]*	*eY [mm]*	*eZ [mm]*	*eR [mm]*	*fX [rad]*	*fY [rad]*	*fZ [rad]*	*fR [rad]*
17	eX	min	Co #2 - druk [1] (1,000)	**−11,921**	−6,182	−18,154	22,581	0,00075	−0,00194	0,00018	0,00208
17		max	Co #6 - torsie [1] (1,000)	**13,404**	12,264	−4,235	18,655	−0,00263	0,00287	−0,00004	0,00389
17	eY	min	Co #2 - druk [1] (1,000)	−11,921	**−6,182**	−18,154	22,581	0,00075	−0,00194	0,00018	0,00208
17		max	Co #6 - torsie [1] (1,000)	13,404	**12,264**	−4,235	18,655	−0,00263	0,00287	−0,00004	0,00389
17	eZ	min	Co #2 - druk [1] (1,000)	−11,921	−6,182	**−18,154**	22,581	0,00075	−0,00194	0,00018	0,00208
17		max	Co #1 - trek [1] (1,000)	11,542	5,803	**11,322**	17,178	−0,00082	0,00201	−0,00018	0,00218
17	eR	min	Co #1 - trek [1] (1,000)	11,542	5,803	11,322	**17,178**	−0,00082	0,00201	−0,00018	0,00218
17		max	Co #2 - druk [1] (1,000)	−11,921	−6,182	−18,154	**22,581**	0,00075	−0,00194	0,00018	0,00208

C: Extreme component; **min. max.:** Extreme type; **Geval:** Belastinggeval van de extreme; **eX:** Verplaatsing in X-richting; **eY:** Verplaatsing in Y-richting; **eZ:** Verplaatsing in Z-richting; **eR:** Resulterende verplaatsing; **fX:** Rotatie in X-richting; **fY:** Rotatie in Y-richting; **fZ:** Rotatie in Z-richting; **fR:** Resulterende rotatie;

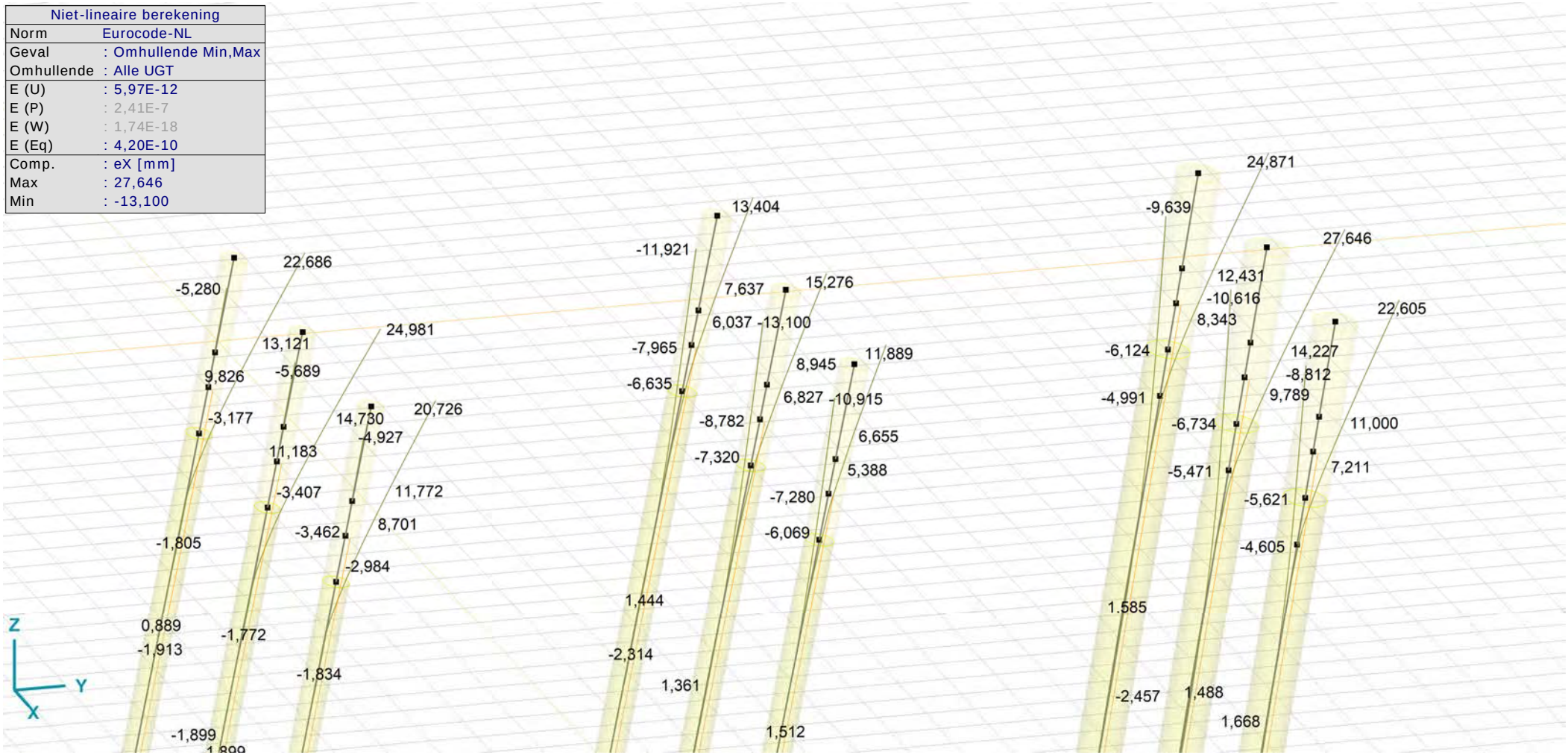
Ø914 - Knoopverplaatsingen [Non-lin., Omhullende (Alle UGT), Geselecteerd]

Ext.	*C*	*min. max.*	*Geval*	*eX [mm]*	*eY [mm]*	*eZ [mm]*	*eR [mm]*	*fX [rad]*	*fY [rad]*	*fZ [rad]*	*fR [rad]*
30	eX	min	Co #2 - druk [1] (1,000)	**−9,639**	−11,868	−21,612	26,473	0,00171	−0,00129	−0,00005	0,00214
30		max	Co #6 - torsie [1] (1,000)	**24,871**	24,609	−7,116	35,705	−0,00450	0,00455	−0,00001	0,00640
30	eY	min	Co #2 - druk [1] (1,000)	−9,639	**−11,868**	−21,612	26,473	0,00171	−0,00129	−0,00005	0,00214
30		max	Co #6 - torsie [1] (1,000)	24,871	**24,609**	−7,116	35,705	−0,00450	0,00455	−0,00001	0,00640
30	eZ	min	Co #2 - druk [1] (1,000)	−9,639	−11,868	**−21,612**	26,473	0,00171	−0,00129	−0,00005	0,00214
30		max	Co #1 - trek [1] (1,000)	11,485	9,190	**14,721**	20,810	−0,00134	0,00176	−0,00005	0,00221
30	eR	min	Co #1 - trek [1] (1,000)	11,485	9,190	14,721	**20,810**	−0,00134	0,00176	−0,00005	0,00221
30		max	Co #6 - torsie [1] (1,000)	24,871	24,609	−7,116	**35,705**	−0,00450	0,00455	−0,00001	0,00640

C: Extreme component; **min. max.:** Extreme type; **Geval:** Belastinggeval van de extreme; **eX:** Verplaatsing in X-richting; **eY:** Verplaatsing in Y-richting; **eZ:** Verplaatsing in Z-richting; **eR:** Resulterende verplaatsing; **fX:** Rotatie in X-richting; **fY:** Rotatie in Y-richting; **fZ:** Rotatie in Z-richting; **fR:** Resulterende rotatie;

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

Niet-lineaire berekening	
Norm	Eurocode-NL
Geval	: Omhullende Min,Max
Omhullende	: Alle UGT
E (U)	: 5,97E-12
E (P)	: 2,41E-7
E (W)	: 1,74E-18
E (Eq)	: 4,20E-10
Comp.	: eX [mm]
Max	: 27,646
Min	: -13,100



[II], Non-lin., Omhullende (Alle UGT), Onmiddellijke doorbuiging, eX, Lijnen

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

Knoopverplaatsingen [Non-lin., POER [1] (1,000)]

Ext.	*eX [mm]*	*eY [mm]*	*eZ [mm]*	*eR [mm]*	*fX [rad]*	*fY [rad]*	*fZ [rad]*	*fR [rad]*
10	**3,380**	3,380	−2,379	5,339	−0,00071	0,00071	0	0,00101
7	**4,628**	4,628	−2,750	7,099	−0,00090	0,00090	0	0,00127
10	3,380	**3,380**	−2,379	5,339	−0,00071	0,00071	0	0,00101
7	4,628	**4,628**	−2,750	7,099	−0,00090	0,00090	0	0,00127
7	4,628	4,628	**−2,750**	7,099	−0,00090	0,00090	0	0,00127
10	3,380	3,380	**−2,379**	5,339	−0,00071	0,00071	0	0,00101
10	3,380	3,380	−2,379	**5,339**	−0,00071	0,00071	0	0,00101
7	4,628	4,628	−2,750	**7,099**	−0,00090	0,00090	0	0,00127

eX: Verplaatsing in X-richting; **eY:** Verplaatsing in Y-richting; **eZ:** Verplaatsing in Z-richting; **eR:** Resulterende verplaatsing; **fX:** Rotatie in X-richting; **fY:** Rotatie in Y-richting; **fZ:** Rotatie in Z-richting; **fR:** Resulterende rotatie;

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

Niet-lineaire berekening	
Norm	Eurocode-NL
Geval	: POER [1] (1,000)
E (U)	: 5,97E-12
E (P)	: 2,41E-7
E (W)	: 1,74E-18
E (Eq)	: 4,20E-10
Comp.	: eX [mm]
Max	: 4,628
Min	: -0,333

[II], Non-lin., POER [1] (1,000), Onmiddellijke doorbuiging, eX, Lijnen

Staafspanningen [Non-lin., Omhullende (Alle UGT)]

Ext.	Prof.	Doorsnede naam	C	min. max.	Geval	Pos. [m]	Knoop	S;x;min [N/mm²]	S;x;max [N/mm²]	Vmin [N/mm²]	Vmax [N/mm²]	Somin [N/mm²]	Somax [N/mm²]
3	2	CS O 559x10	Somin	min	Co #6 - alleen poer [1] (1,000)	1,904	(57)	0	0	0	0	**0**	0
30	3	O 610x10		max	Co #2 - druk [1] (1,000)	0	(24)	−80,10	−80,10	0	0,01	**80,10**	80,10
31	3	O 610x10		max	Co #2 - druk [1] (1,000)	0	(25)	−80,10	−80,10	0	0,01	**80,10**	80,10
32	3	O 610x10		max	Co #2 - druk [1] (1,000)	0	(26)	−80,10	−80,10	0	0	**80,10**	80,10
6	4	CS O 610x10	Somax	min	Co #6 - alleen poer [1] (1,000)	0	(14)	0	0	0	0	0	**0**
38	5	O 914x10		max	Co #6 - torsie [1] (1,000)	11,490	(719)	−127,60	125,17	0	0,30	0,71	**127,60**

Ext.	Prof.	Doorsnede naam	C	min. max.	Geval	Pos. [m]	Knoop	V;y;gem [N/mm²]	V;z;gem [N/mm²]
3	2	CS O 559x10	Somin	min	Co #6 - alleen poer [1] (1,000)	1,904	(57)	0	0
30	3	O 610x10		max	Co #2 - druk [1] (1,000)	0	(24)	0	0
31	3	O 610x10		max	Co #2 - druk [1] (1,000)	0	(25)	0	0,01
32	3	O 610x10		max	Co #2 - druk [1] (1,000)	0	(26)	0	0
6	4	CS O 610x10	Somax	min	Co #6 - alleen poer [1] (1,000)	0	(14)	0	0
38	5	O 914x10		max	Co #6 - torsie [1] (1,000)	11,490	(719)	0,01	0,15

Prof.: Profiel; **C:** Extreme component; **min. max.:** Extreme type; **Geval:** Belastinggeval van de extreme; **Pos.:** Lokale X-positie van de doorsnede op de staaf; **S;x;min:** Doorsnede minimum normaalspanning; **S;x;max:** Doorsnede maximum normaalspanning; **Vmin:** Doorsnede minimum afschuifspanning; **Vmax:** Doorsnede maximum afschuifspanning; **Somin:** Doorsnede minimum Von Mises spanning; **Somax:** Doorsnede maximum Von Mises spanning; **V;y;gem:** Afschuifspanning in lokale Y-richting; **V;z;gem:** Afschuifspanning in lokale Z-richting;

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**

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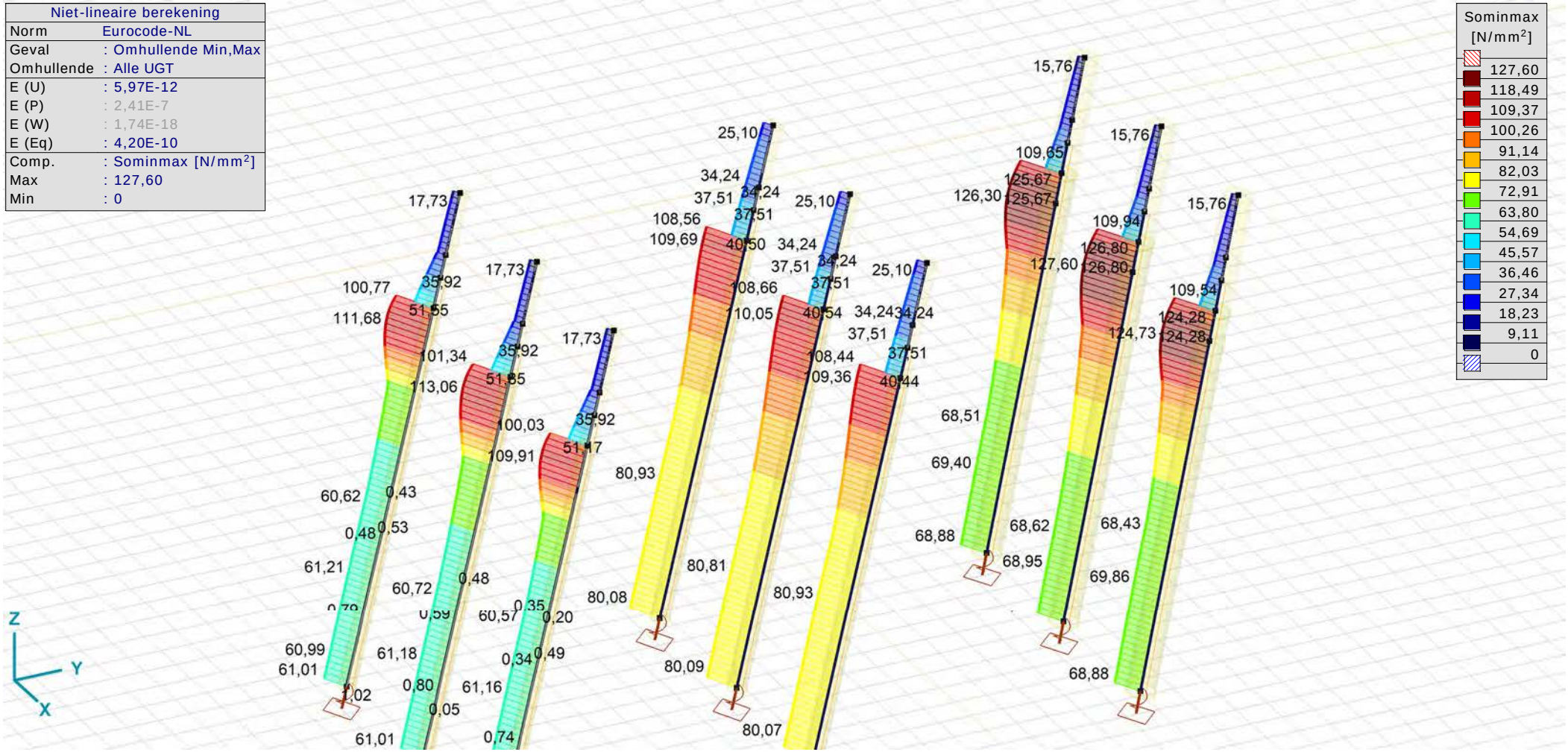
Niet-lineaire berekening	
Norm	Eurocode-NL
Geval	: Omhullende Min,Max
Omhullende	: Alle UGT
E (U)	: 5,97E-12
E (P)	: 2,41E-7
E (W)	: 1,74E-18
E (Eq)	: 4,20E-10
Comp.	: Sominmax [N/mm²]
Max	: 127,60
Min	: 0



[II], Non-lin., Omhullende (Alle UGT), Onmiddellijke doorbuiging, Sominmax, Lijnen (gevuld)

Interne krachten lijnoplegging [Non-lin., Omhullende (Alle UGT)]

	Lijn	*Type*	*C*	*min. max.*	*Geval*	*Knoop*	*Pos. [m]*	*Ry [kN/m]*	*Rz [kN/m]*
1		Staaf r.	Ry	min	Co #2 - druk [1] (1,000)	2	0	**−1,001**	0,892
				max	Co #1 - trek [1] (1,000)	2	0	**0,986**	−2,138
			Rz	min	Co #7 - torsie + poer [1] (1,000)	2	0	−0,804	**−15,493**
				max	Co #2 - druk [1] (1,000)	2	0	−1,001	**0,892**
2	Staaf 7	Staaf r.	Ry	min	Co #2 - druk [1] (1,000)	15	0	**−1,880**	3,946
				max	Co #1 - trek [1] (1,000)	15	0	**1,880**	−4,553
			Rz	min	Co #6 - torsie [1] (1,000)	15	0	0,373	**−8,727**
				max	Co #2 - druk [1] (1,000)	15	0	−1,880	**3,946**
3	Staaf 12	Staaf r.	Ry	min	Co #6 - alleen poer [1] (1,000)	28	0	**0**	0
				max	Co #1 - trek [1] (1,000)	128	0,169	**1,199**	−8,785
			Rz	min	Co #6 - torsie [1] (1,000)	128	0,169	0,137	**−27,821**
				max	Co #2 - druk [1] (1,000)	128	0,169	1,165	**8,097**
4	Staaf 17	Staaf r.	Ry	min	Co #2 - druk [1] (1,000)	40	0	**−0,839**	0,733
				max	Co #1 - trek [1] (1,000)	40	0	**0,826**	−1,811
			Rz	min	Co #7 - torsie + poer [1] (1,000)	40	0	−0,674	**−12,453**
				max	Co #2 - druk [1] (1,000)	40	0	−0,839	**0,733**
5	Staaf 19	Staaf r.	Ry	min	Co #2 - druk [1] (1,000)	41	0	**−1,197**	1,089
				max	Co #1 - trek [1] (1,000)	41	0	**1,179**	−2,533
			Rz	min	Co #7 - torsie + poer [1] (1,000)	41	0	−0,962	**−19,422**
				max	Co #2 - druk [1] (1,000)	41	0	−1,197	**1,089**
6	Staaf 21	Staaf r.	Ry	min	Co #2 - druk [1] (1,000)	42	0	**−1,580**	3,300
				max	Co #1 - trek [1] (1,000)	42	0	**1,580**	−3,847
			Rz	min	Co #6 - torsie [1] (1,000)	42	0	0,314	**−7,352**
				max	Co #2 - druk [1] (1,000)	42	0	−1,580	**3,300**
7	Staaf 23	Staaf r.	Ry	min	Co #2 - druk [1] (1,000)	43	0	**−2,245**	4,733
				max	Co #1 - trek [1] (1,000)	43	0	**2,245**	−5,408
			Rz	min	Co #6 - torsie [1] (1,000)	43	0	0,446	**−10,486**
				max	Co #2 - druk [1] (1,000)	43	0	−2,245	**4,733**
8	Staaf 25	Staaf r.	Ry	min	Co #6 - alleen poer [1] (1,000)	44	0	**0**	0
				max	Co #1 - trek [1] (1,000)	202	0,169	**1,022**	−7,513
			Rz	min	Co #6 - torsie [1] (1,000)	202	0,169	0,117	**−22,553**
				max	Co #2 - druk [1] (1,000)	202	0,169	0,993	**6,881**

Interne krachten lijnoplegging [Non-lin., Omhullende (Alle UGT)]

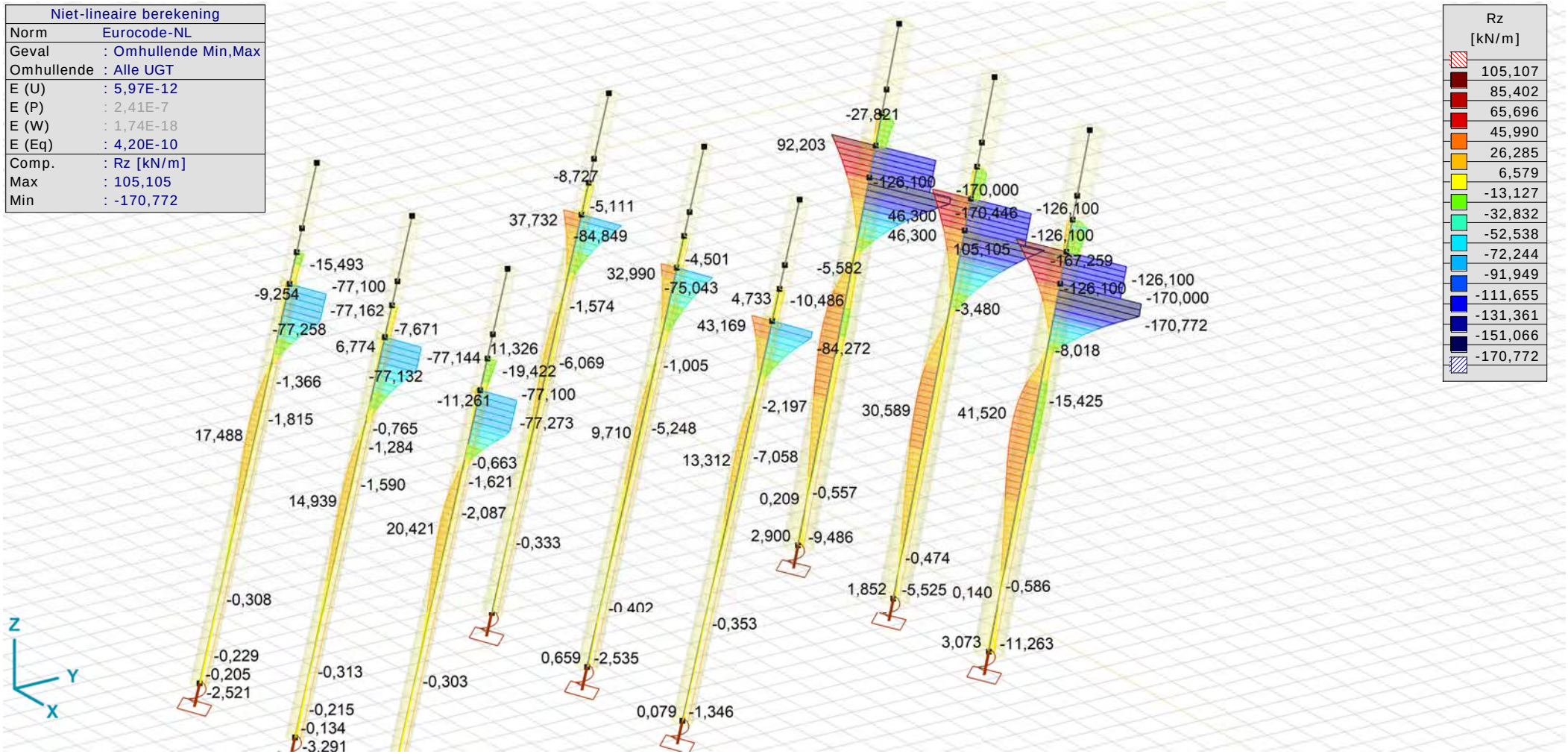
	Lijn	*Type*	*C*	*min. max.*	*Geval*	*Knoop*	*Pos. [m]*	*Ry [kN/m]*	*Rz [kN/m]*
9	Staaf 27	Staaf r.	Ry	min	Co #6 - alleen poer [1] (1,000)	45	0	**0**	0
				max	Co #1 - trek [1] (1,000)	210	0,169	**1,411**	−10,307
			Rz	min	Co #6 - torsie [1] (1,000)	210	0,169	0,161	**−33,936**
				max	Co #2 - druk [1] (1,000)	210	0,169	1,371	**9,557**
10	Staaf 36	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	3	12,774	**−9,298**	−20,920
				max	Co #2 - druk [1] (1,000)	3	12,774	**9,441**	7,890
			Rz	min	Co #7 - torsie + poer [1] (1,000)	544	11,976	3,958	**−77,258**
				max	Co #7 - torsie + poer [1] (1,000)	563	8,183	−1,067	**17,488**
11	Staaf 28	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	6	12,774	**−8,171**	−18,540
				max	Co #2 - druk [1] (1,000)	6	12,774	**8,297**	6,774
			Rz	min	Co #6 - torsie [1] (1,000)	6	12,774	6,662	**−77,144**
				max	Co #7 - torsie + poer [1] (1,000)	235	7,784	−0,920	**14,939**
12	Staaf 29	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	9	12,774	**−10,583**	−23,622
				max	Co #2 - druk [1] (1,000)	9	12,774	**10,745**	9,179
			Rz	min	Co #6 - torsie [1] (1,000)	275	12,375	6,182	**−77,273**
				max	Co #7 - torsie + poer [1] (1,000)	294	8,583	−1,247	**20,421**
13	Staaf 30	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	16	12,774	**−18,196**	−44,938
				max	Co #2 - druk [1] (1,000)	16	12,774	**18,196**	37,732
			Rz	min	Co #6 - torsie [1] (1,000)	16	12,774	−3,613	**−84,849**
				max	Co #2 - druk [1] (1,000)	16	12,774	18,196	**37,732**
14	Staaf 31	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	19	12,774	**−15,996**	−39,674
				max	Co #2 - druk [1] (1,000)	19	12,774	**15,996**	32,990
			Rz	min	Co #6 - torsie [1] (1,000)	19	12,774	−3,176	**−75,043**
				max	Co #2 - druk [1] (1,000)	19	12,774	15,996	**32,990**
15	Staaf 32	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	22	12,774	**−20,710**	−50,937
				max	Co #2 - druk [1] (1,000)	22	12,774	**20,710**	43,169
			Rz	min	Co #6 - torsie [1] (1,000)	463	12,574	−3,535	**−84,272**
				max	Co #2 - druk [1] (1,000)	22	12,774	20,710	**43,169**
16	Staaf 33	Staaf r.	Ry	min	Co #6 - alleen poer [1] (1,000)	29	0	**0**	0
				max	Co #1 - trek [1] (1,000)	29	0	**13,760**	−101,512
			Rz	min	Co #6 - torsie [1] (1,000)	29	0	1,573	**−126,100**
				max	Co #2 - druk [1] (1,000)	29	0	13,367	**92,203**

Interne krachten lijnoplegging [Non-lin., Omhullende (Alle UGT)]

	Lijn	*Type*	*C*	*min. max.*	*Geval*	*Knoop*	*Pos. [m]*	*Ry [kN/m]*	*Rz [kN/m]*
17	Staaf 37	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	48	11,689	**−7,474**	−55,969
				max	Co #1 - trek [1] (1,000)	639	7,132	**1,857**	12,741
			Rz	min	Co #6 - torsie [1] (1,000)	661	11,490	−0,739	**−170,446**
				max	Co #2 - druk [1] (1,000)	48	11,689	−7,260	**49,248**
18	Staaf 34	Staaf r.	Ry	min	Co #6 - alleen poer [1] (1,000)	32	0	**0**	0
				max	Co #1 - trek [1] (1,000)	32	0	**12,113**	−89,603
			Rz	min	Co #6 - torsie [1] (1,000)	32	0	1,384	**−126,100**
				max	Co #2 - druk [1] (1,000)	32	0	11,767	**80,921**
19	Staaf 38	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	47	11,689	**−7,037**	−52,770
				max	Co #1 - trek [1] (1,000)	694	6,538	**1,606**	10,979
			Rz	min	Co #6 - torsie [1] (1,000)	47	11,689	−0,804	**−167,259**
				max	Co #2 - druk [1] (1,000)	47	11,689	−6,836	**46,300**
20	Staaf 35	Staaf r.	Ry	min	Co #6 - alleen poer [1] (1,000)	35	0	**0**	0
				max	Co #1 - trek [1] (1,000)	35	0	**15,640**	−115,082
			Rz	min	Co #6 - torsie [1] (1,000)	35	0	1,787	**−126,100**
				max	Co #2 - druk [1] (1,000)	35	0	15,194	**105,105**
21	Staaf 39	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	46	11,689	**−7,862**	−58,820
				max	Co #1 - trek [1] (1,000)	757	7,528	**2,146**	14,791
			Rz	min	Co #6 - torsie [1] (1,000)	776	11,292	−0,633	**−170,772**
				max	Co #2 - druk [1] (1,000)	46	11,689	−7,637	**51,862**
Ext.									
15	Staaf 32	Staaf r.	Ry	min	Co #1 - trek [1] (1,000)	22	12,774	**−20,710**	−50,937
15	Staaf 32	Staaf r.		max	Co #2 - druk [1] (1,000)	22	12,774	**20,710**	43,169
21	Staaf 39	Staaf r.	Rz	min	Co #6 - torsie [1] (1,000)	776	11,292	−0,633	**−170,772**
20	Staaf 35	Staaf r.		max	Co #2 - druk [1] (1,000)	35	0	15,194	**105,105**

Lijn: Ondersteund lijnelement; **Type:** Opleggingstype; **C:** Extreme component; **min. max.:** Extreme type; **Geval:** Belastinggeval van de extreme; **Pos.:** Lokale X-positie van de doorsnede op de staaf; **Ry:** Y-component opleggingsreactiekracht; **Rz:** Z-component opleggingsreactiekracht;

Project:
Constructeur: DNV GL - Energy
Model: **1-paal v1.axs**



[II], Non-lin., Omhullende (Alle UGT), Onmiddellijke doorbuiging, Rz (lijnopp.), Lijnen (gevuld)

APPENDIX H
Fundatiebelastingen

Project: Ens - Zwolle
Uitgangspunt: Initiële situatie
Datum: 13-12-2021

Betreft Trekbelasting
Richting Globale assenstelsel

Mastnummer	Masttype	Verticaal trek [kN]	Xi-richting [kN]	Eta-richting [kN]	Betrouwbaarheidsniveau	Bijbehorende loadcase
1	EC-3_R	-1148,7	-214,6	-221,5	Afkeur CC2-0	ULS 1a_0,9_255
4	S-3 R	-461,0	82,8	73,2	Afkeur CC2-0	ULS 1a_0,9_0,9_45
5A	S+6_R	-598,6	104,8	94,1	Afkeur CC2	ULS 1a_0,9_0,9_45
6	HB-3_R_X	-1316,9	-216,4	217,5	Afkeur CC2-0	SPLS 3_0,9_78.65 Ah All Cts
8	S+0 R	-527,5	92,1	79,3	Afkeur CC2-0	ULS 1a_0,9_0,9_45
12	S+30_R	-1033,3	173,7	160,1	Afkeur CC2-0	ULS 1a_0,9_0,9_45
14	HA-3_R	-1165,1	-192,2	194,9	Afkeur CC2-0	SPLS 1a_0,9_92.35 Ah All Cts
22	S-6 R	-415,5	75,9	65,2	Afkeur CC2-0	ULS 1a_0,9_0,9_45
27	S+12_R	-628,4	113,0	97,3	Afkeur CC2-0	ULS 1a_0,9_0,9_45
34	HC-3_R	-1465,2	238,6	241,7	Afkeur CC2-0	SPLS 3_0,9_112,25 Ba All Cts
35	HB+0_R_X	-1410,5	-232,2	239,5	Afkeur CC2-0	SPLS 3_0,9_71.15 Ah All Cts
36	S-3 R	-439,9	79,0	69,3	Afkeur CC2-0	ULS 1a_0,9_0,9_45
38	S+0 R	-505,0	88,2	75,6	Afkeur CC2-0	ULS 1a_0,9_0,9_45
40	HB-3_R	-1373,4	-224,8	224,7	Afkeur CC2-0	SPLS 3_0,9_73.05 Ah All Cts
45	S-6 R	-408,7	74,5	64,4	Afkeur CC2-0	ULS 1a_0,9_0,9_45
65	HB+9_R_X	-1465,5	226,1	240,1	Afkeur CC2-0	SPLS 3_0,9_105.95 Ba All Cts
74	S-3 RC	-618,8	99,4	92,9	Afkeur CC2-0	ULS 1a_0,9_0,9_45
80	S-6 RC	-511,3	83,9	78,7	Afkeur CC2-0	ULS 1a_0,9_0,9_45
89	S+15_R	-615,0	-98,7	89,0	Afkeur CC2-0	ULS 1a_0,9_0,9_135
90	EC-3_R	-1444,6	261,0	-276,6	Afkeur CC2-0	ULS 1a_0,9_246.2

Project: Ens - Zwolle
Uitgangspunt: Initiële situatie
Datum: 13-12-2021

Betreft Drukbelasting
Richting Globale assenstelsel

Mastnummer	Masttype	Verticaal druk [kN]	Xi-richting [kN]	Eta-richting [kN]	Betrouwbaarheidsniveau	Bijbehorende loadcase
1	EC-3_R	1427,3	-263,4	-276,4	Afkeur CC2-0	ULS 1a_255
4	S-3 R	625,3	113,3	103,7	Afkeur CC2-0	ULS 1a_45
5A	S+6_R	804,5	144,3	133,6	Afkeur CC2	ULS 1a_45
6	HB-3_R_X	1579,9	259,0	259,7	Afkeur CC2-0	SPLS 3_90 Ba All Cts
8	S+0 R	714,9	126,9	114,2	Afkeur CC2-0	ULS 1a_45
12	S+30_R	1414,2	235,8	222,2	Afkeur CC2-0	ULS 1a_45
14	HA-3_R	1419,2	-233,6	231,1	Afkeur CC2-0	SPLS 3_92.35 Ah All Cts
22	S-6 R	571,0	106,8	96,1	Afkeur CC2-0	ULS 1a_45
27	S+12_R	851,0	157,5	141,8	Afkeur CC2-0	ULS 1a_45
34	HC-3_R	1738,2	282,6	285,1	Afkeur CC2-0	SPLS 3_112,25 Ba All Cts
35	HB+0_R_X	1715,5	-283,2	290,0	Afkeur CC2-0	SPLS 3_71.15 Ah All Cts
36	S-3 R	615,9	111,7	102,0	Afkeur CC2-0	ULS 1a_45
38	S+0 R	695,2	123,5	110,9	Afkeur CC2-0	ULS 1a_45
40	HB-3_R	1635,1	-266,4	266,8	Afkeur CC2-0	SPLS 3_73.05 Ah All Cts
45	S-6 R	561,9	105,0	94,9	Afkeur CC2-0	ULS 1a_45
65	HB+9_R_X	1799,3	280,0	293,6	Afkeur CC2-0	SPLS 3_105.95 Ba All Cts
74	S-3 RC	862,2	137,9	131,3	Afkeur CC2-0	ULS 1a_45
80	S-6 RC	705,0	115,5	110,2	Afkeur CC2-0	ULS 1a_45
89	S+15_R	909,5	-148,5	138,7	Afkeur CC2-0	ULS 1a_135
90	EC-3_R	1590,2	289,7	-302,2	Afkeur CC2-0	ULS 1a_246.2

Project: Ens - Zwolle
Uitgangspunt: Initiële situatie
Datum: 13-12-2021

Betreft Trekbelasting
Richting Lokale assenstelsel

Mastnummer	Masttype	Verticaal trek [kN]	Xi-richting [kN]	Eta-richting [kN]	Betrouwbaarheidsniveau	Bijbehorende loadcase
1	EC-3_R	-1171,9	308,4	4,8	Afkeur CC2-0	ULS 1a_0,9_255
4	S-3 R	-470,3	110,2	-6,8	Afkeur CC2-0	ULS 1a_0,9_0,9_45
5A	S+6_R	-611,5	140,6	-7,6	Afkeur CC2	ULS 1a_0,9_0,9_45
6	HB-3_R_X	-1336,6	306,8	-0,8	Afkeur CC2-0	SPLS 3_0,9_78.65 Ah All Cts
8	S+0 R	-538,2	121,2	-9,0	Afkeur CC2-0	ULS 1a_0,9_0,9_45
12	S+30_R	-1049,4	236,0	-9,6	Afkeur CC2-0	ULS 1a_0,9_0,9_45
14	HA-3_R	-1182,6	273,7	-1,9	Afkeur CC2-0	SPLS 1a_0,9_92.35 Ah All Cts
22	S-6 R	-425,1	99,7	-7,6	Afkeur CC2-0	ULS 1a_0,9_0,9_45
27	S+12_R	-643,0	148,7	-11,1	Afkeur CC2-0	ULS 1a_0,9_0,9_45
34	HC-3_R	-1487,2	339,6	2,2	Afkeur CC2-0	SPLS 3_0,9_112,25 Ba All Cts
35	HB+0_R_X	-1433,3	333,5	-5,2	Afkeur CC2-0	SPLS 3_0,9_71.15 Ah All Cts
36	S-3 R	-448,8	104,9	-6,8	Afkeur CC2-0	ULS 1a_0,9_0,9_45
38	S+0 R	-515,2	115,8	-8,9	Afkeur CC2-0	ULS 1a_0,9_0,9_45
40	HB-3_R	-1394,0	317,9	0,1	Afkeur CC2-0	SPLS 3_0,9_73.05 Ah All Cts
45	S-6 R	-418,2	98,2	-7,1	Afkeur CC2-0	ULS 1a_0,9_0,9_45
65	HB+9_R_X	-1487,7	329,6	9,9	Afkeur CC2-0	SPLS 3_0,9_105.95 Ba All Cts
74	S-3 RC	-627,9	136,0	-4,6	Afkeur CC2-0	ULS 1a_0,9_0,9_45
80	S-6 RC	-519,3	114,9	-3,7	Afkeur CC2-0	ULS 1a_0,9_0,9_45
89	S+15_R	-625,4	132,7	6,9	Afkeur CC2-0	ULS 1a_0,9_0,9_135
90	EC-3_R	-1473,8	380,1	-11,0	Afkeur CC2-0	ULS 1a_0,9_246.2

Project: Ens - Zwolle
Uitgangspunt: Initiële situatie
Datum: 13-12-2021

Betreft Drukbelasting
Richting Lokale assenstelsel

Mastnummer	Masttype	Verticaal druk [kN]	Xi-richting [kN]	Eta-richting [kN]	Betrouwbaarheidsniveau	Bijbehorende loadcase
1	EC-3_R	1456,1	-381,7	-9,2	Afkeur CC2-0	ULS 1a_255
4	S-3 R	638,0	-153,4	6,8	Afkeur CC2-0	ULS 1a_45
5A	S+6_R	821,8	-196,5	7,6	Afkeur CC2	ULS 1a_45
6	HB-3_R_X	1603,7	-366,8	-0,4	Afkeur CC2-0	SPLS 3_90 Ba All Cts
8	S+0 R	729,4	-170,4	9,0	Afkeur CC2-0	ULS 1a_45
12	S+30_R	1436,3	-323,9	9,6	Afkeur CC2-0	ULS 1a_45
14	HA-3_R	1440,5	-328,5	-1,8	Afkeur CC2-0	SPLS 3_92.35 Ah All Cts
22	S-6 R	584,3	-143,5	7,6	Afkeur CC2-0	ULS 1a_45
27	S+12_R	870,9	-211,6	11,1	Afkeur CC2-0	ULS 1a_45
34	HC-3_R	1764,3	-401,4	-1,7	Afkeur CC2-0	SPLS 3_112,25 Ba All Cts
35	HB+0_R_X	1743,3	-405,3	4,8	Afkeur CC2-0	SPLS 3_71.15 Ah All Cts
36	S-3 R	628,3	-151,1	6,8	Afkeur CC2-0	ULS 1a_45
38	S+0 R	709,3	-165,8	8,9	Afkeur CC2-0	ULS 1a_45
40	HB-3_R	1659,7	-377,0	0,3	Afkeur CC2-0	SPLS 3_73.05 Ah All Cts
45	S-6 R	574,9	-141,3	7,1	Afkeur CC2-0	ULS 1a_45
65	HB+9_R_X	1826,6	-405,7	-9,6	Afkeur CC2-0	SPLS 3_105.95 Ba All Cts
74	S-3 RC	874,9	-190,4	4,6	Afkeur CC2-0	ULS 1a_45
80	S-6 RC	716,0	-159,6	3,7	Afkeur CC2-0	ULS 1a_45
89	S+15_R	924,7	-203,1	-6,9	Afkeur CC2-0	ULS 1a_135
90	EC-3_R	1622,3	-418,5	8,9	Afkeur CC2-0	ULS 1a_246.2

Project: Ens - Zwolle
Uitgangspunt: Initiële situatie
Datum: 13-12-2021

Betreft Torsiebelasting hoekmasten
Richting Lokale assenstelsel

Mastnummer	Masttype	Verticaal trek [kN]	Xi-richting [kN]	Eta-richting [kN]	Betrouwbaarheidsniveau	Bijbehorende loadcase
1	EC-3_R	-1171,9	308,4	4,8	Afkeur CC2-0	ULS 1a_0,9_255
6	HB-3_R_X	-918,0	210,0	168,3	Afkeur CC2-0	SPLS 3_0,9_90 Ah Ct1
14	HA-3_R	-1182,6	273,7	-1,9	Afkeur CC2-0	SPLS 1a_0,9_92.35 Ah All Cts
34	HC-3_R	-1225,3	277,0	-150,1	Afkeur CC2-0	SPLS 3_0,9_112,25 Ba Ct1
35	HB+0_R_X	-1128,5	260,0	136,1	Afkeur CC2-0	SPLS 3_0,9_71.15 Ah Ct1
40	HB-3_R	-1036,2	235,4	-161,5	Afkeur CC2-0	SPLS 3_0,9_90 Ba Ct1
65	HB+9_R_X	-1487,7	329,6	9,9	Afkeur CC2-0	SPLS 3_0,9_105.95 Ba All Cts
90	EC-3_R	-1334,0	339,4	80,7	Afkeur CC2-0	SPLS 3_0,9_246.2 Ba Ct2

Project: Ens - Zwolle
Uitgangspunt: Initiële situatie
Datum: 13-12-2021

Betreft Torsiebelasting steunmasten
Richting Lokale assenstelsel

Mastnummer	Masttype	Verticaal trek [kN]	Xi-richting [kN]	Eta-richting [kN]	Betrouwbaarheidsniveau	Bijbehorende loadcase
4	S-3 R	-235,1	55,1	43,3	Afkeur CC2-0	ULS 5a Ba 21
5A	S+6_R	-305,7	70,3	44,9	Afkeur CC2	ULS 5a Ba 21
8	S+0 R	-269,1	60,6	46,1	Afkeur CC2-0	ULS 5a Ah 10
12	S+30_R	-524,7	118,0	29,3	Afkeur CC2-0	ULS 5a Ah 10
22	S-6 R	-212,5	49,9	49,5	Afkeur CC2-0	ULS 5a Ah 10
27	S+12_R	-321,5	74,3	43,8	Afkeur CC2-0	ULS 5a Ah 10
36	S-3 R	-224,4	52,4	43,4	Afkeur CC2-0	ULS 5a Ah 10
38	S+0 R	-257,6	57,9	46,2	Afkeur CC2-0	ULS 5a Ah 10
45	S-6 R	-209,1	49,1	49,4	Afkeur CC2-0	ULS 5a Ba 21
74	S-3 RC	-313,9	68,0	40,7	Afkeur CC2-0	ULS 5a Ah 10
80	S-6 RC	-259,6	57,5	41,2	Afkeur CC2-0	ULS 5a Ah 10
89	S+15_R	-312,7	66,3	41,3	Afkeur CC2-0	ULS 5a Ah 10

Content

- Starting point p. 2
- Tower construction p. 6
- In between results p. 8
- Loads initial p. 10
- Loads after adjustment p. 15

Data

Norm	NEN-EN50341-2-15:2019
Initial	
Consequence class	CC2-0
Reliability level	Afkeur
Reference period	30 jaar
After adjustment	
Consequence class	CC2
Reliability level	Verbouw
Reference period	50 jaar
Wind zone	III
Wind speed	24,5 m/s
Terrain categorie	II
Reduction factor Cdir	1,00
Ice region	B
Tower type	Steunmast
Tower height	43,4 m
Max. Span	350,1 m
Line angle	180°
Catenary	1760 m
Wind span	343 m
EDS Weight span	343 m
Min. Weight span	343 m
Max. Weight span	343 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-08-30			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype S-6 R

JOB No.	-	DATE	-
DRAWN	-	CHKD	-
DESIGN	-	APPD	-

Document name:

ENS-ZL_S-6 R_45_Report.pdf

Project number:

Project client number:

0.0											

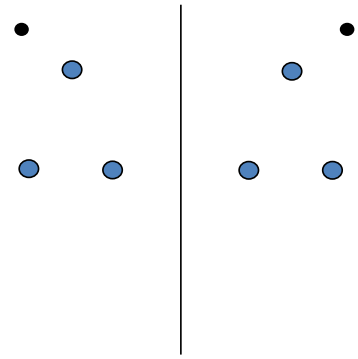
Project: ENS-ZL
Tower: S-6 R
Number: 45

Conductor loads

Auteur: TBR
Versie: v11.7

General

Description	S-6 R
Tower type	Steunmast
Number of circuits	2
Configuration	2-circuit-donau
Number of earth wires	2



Configuratie geleiders

Starting points

Norm	NEN-EN50341-2-15:2019
Consequence class	CC2-0
Reliability level initial	Afkeur CC2-0
Reference period intial	30 jaar
Consequence class modified	CC2
Reliability level modified	Verbouw
Reference period modified	50 jaar
Wind zone	III
Wind speed (m/s)	24,5 m/s
Terrain category	II
Reduction factor c_{dir}	1,00
Ice region phase conductor	B
Ice region earth conductor	B

Conductors back

Description	Voltage	Conductor Back	Bundle Ba	Ice region	Additional weight	Additional diameter	Catenary P_{back}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Conductors ahead

Description	Voltage	Conductor Ahead	Bundle Ah	Ice region	Additional weight	Additional diameter	Catenary P_{ahead}
Circuit 1	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	3 %	3 %	1760
Bliksemdraad 1		OPGW 226	1	B	3 %	3 %	2100
Bliksemdraad 2		OPGW 226	1	B	3 %	3 %	2100

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Halfverankering	2,00	4,50	1,00
Circuit 2	Halfverankering	2,00	4,50	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,30	0,10
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,30	0,10

1. Properties apply to the entire isolator set

Suspension height and position in mast

Circuits	Designation	Number	Suspension height	Attach point	Position in tower Horizontal distance
Circuit 1	10	380ct1f1	23,0 m	27,5 m	-15,3 m
Circuit 1	11	380ct1f2	23,0 m	27,5 m	-8,8 m
Circuit 1	12	380ct1f3	34,3 m	38,8 m	-12,1 m
Circuit 2	21	380ct2f1	23,0 m	27,5 m	15,3 m
Circuit 2	20	380ct2f2	23,0 m	27,5 m	8,8 m
Circuit 2	22	380ct2f3	34,3 m	38,8 m	12,1 m
Bliksemdraad 1	1	bl1	38,5 m	38,8 m	-16,0 m
Bliksemdraad 2	3	bl2	38,5 m	38,8 m	16,0 m

Project: ENS-ZL
Tower: S-6 R
Number: 45

Height adjustment adjacent masts (wind and weight span adjustment)

	Back	Ahead	
Height increase for wind pressure	0,0 m	0,0 m	(positive: higher)
Height decrease for vertical load	0,0 m	0,0 m	(negative: decrease, more weight span)

Decrease: Niet in 0,9EG-combinaties

Height difference adjacent tower and change of direction with respect to Line direction

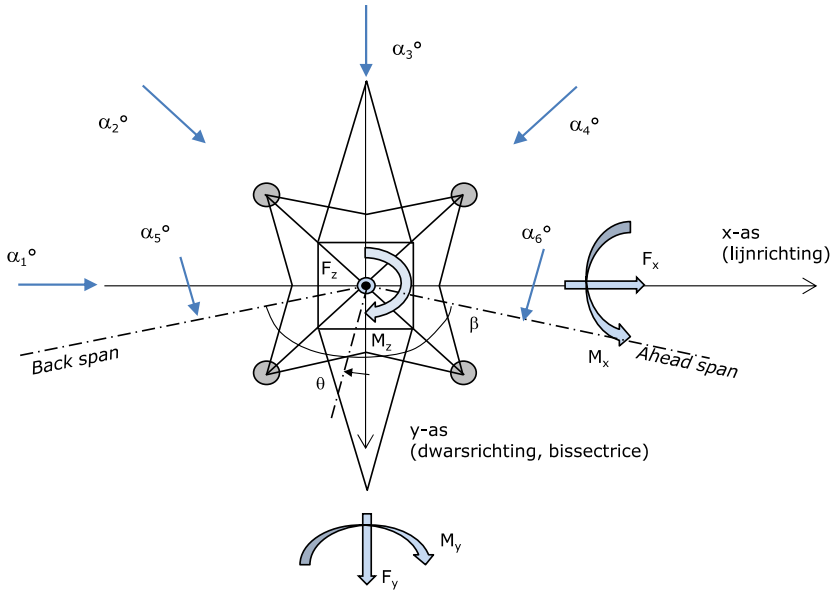
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	0,0	0,0 m	0,0	0,0 m
Circuit 1	11	380ct1f2	0,0	0,0 m	0,0	0,0 m
Circuit 1	12	380ct1f3	0,0	0,0 m	0,0	0,0 m
Circuit 2	21	380ct2f1	0,0	0,0 m	0,0	0,0 m
Circuit 2	20	380ct2f2	0,0	0,0 m	0,0	0,0 m
Circuit 2	22	380ct2f3	0,0	0,0 m	0,0	0,0 m
Bliksemdraad 1	1	bl1	0,0	0,0 m	0,0	0,0 m
Bliksemdraad 2	3	bl2	0,0	0,0 m	0,0	0,0 m

Line and tower data

		Back	Ahead
		350,1	335,3 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		341,3	341,3 m
Line angle	β	180 °	
Tower orientation with respect to bi	θ	0 °	
Section length		5379	5379 m
Height bottom of tower to ground level		0,5 m	
Wind directions considered	α_1	0 °	
Wind directions according to:	α_2	45 °	
Geleiderbelastingen	α_3	90 °	
	α_4	135 °	
	α_5	- °	
	α_6	- °	

Wind directions apply to the main direction of mast construction, not to the bisector.

Windrichtingen en positieve richtingen belastingen



Considered number of wind directions

1a	4
3	4
4	1
6	1
Overig	1

Project: ENS-ZL
Tower: S-6 R
Number: 45

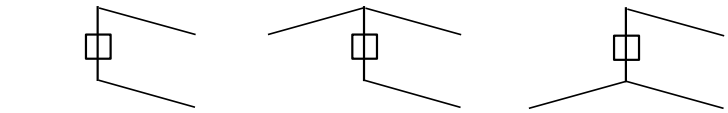
Absence of conductors

		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	0,8	0
Circuit 1	380ct1f2	1	0	1	0	0,8	0
Circuit 1	380ct1f3	1	0	1	0	0,8	0
Circuit 2	380ct2f1	0	1	1	0	0,8	0
Circuit 2	380ct2f2	0	1	1	0	0,8	0
Circuit 2	380ct2f3	0	1	1	0	0,8	0
Bliksemdraad 1	bl1	1	0	1	0	1	0
Bliksemdraad 2	bl2	0	1	1	0	1	0

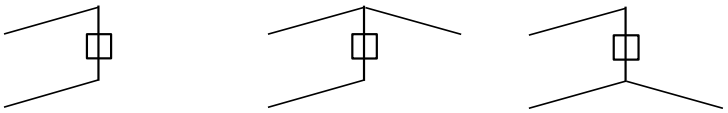
Load situations SPLS

Considered situations SPLS: SPLS for suspension tower not applicable

Principle of load situations:



1. Ba All cts
2. Ba ct1
3. Ba ct2



4. Ah All cts
5. Ah ct1
6. Ah ct2

Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1 and 2, all possible situations

Principle of load situations:

1. Ba
2. Ah

Project: ENS-ZL
Tower: S-6 R
Number: 45

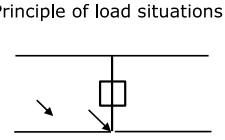
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations are applied in ULS and in every SPLS situation (in case of angle tower).

	Phase	Earth
Line vehicle	3,0 kN	2,0 kN
Concentrated load cross arm	1,0 kN	1,0 kN

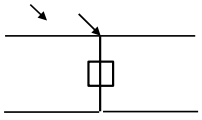
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

Presence line vehicle: Circuit, belasting tegelijk aanwezig in alle geleiders per circuit.

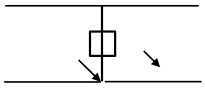
Principle of load situations:



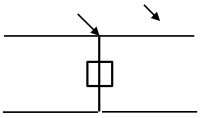
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

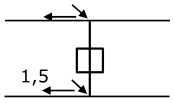
Load situations 8. Galloping as a static load

Conductor		
Suspension tower phase	0,866 W	1,5 W
Suspension tower earth	1,5 EDS	1,5 W
Strain tower phase and earth	1,5 EDS	1,5 W

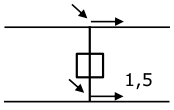
Considered situations galloping 8: None (existing structure)

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principle of load situations:



1. Ba



2. Ah

Load combination 8. Galloping as a dynamic load
Only applies to tension towers
Load consists of EDS tensile load in one of the conductors on one side of the tower
Can be converted by user to fatigue spectrum via the load spectrum of table 4.11 / NL.1

Project: ENS-ZL
Tower: S-6 R
Number: 45

Tower structure

Properties

Tower type	Steunmast		
Tower designation	S-6 R		
Base plate w.r.t. ground level	0,5	m	
Tower height w.r.t. base plate	43,4	m	
Tower self weight	200,0	kN	
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	8,00	8,00	m
Inclination of main leg	0,153	0,153	-
Horizontal force factor	1,3	1,3	-

Calculation Wind load

Dynamic factor G_T	1,00 *(Masthoogte < 60 m)*
Wind load diagonally to tower body proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Wind load diagonally on traverse proportional to:	(A1C1sin^2(phi)+A2C2cos^2(phi))
Magnification factor diagonal wind to tower body	(1+0,2sin^2(2phi))
Magnification factor diagonal wind to cross arm	(1+0,2sin^2(2phi))
Magnification factor wind parallel to perpendicular to cross a	0,4

Properties mast sections longitudinal direction (front view, yz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	9,80	8,00	5,00	9,80	0,153	63,70	8,48	0,13	3,24
Eerste tussenstuk	18,05	5,00	4,07	8,25	0,056	37,41	6,27	0,17	3,08
Tweede tussenstuk	27,50	4,07	3,00	9,45	0,057	33,40	6,78	0,20	2,92
Bovenstuk 1	33,40	3,00	2,58	5,90	0,036	16,45	3,83	0,23	2,79
Bovenstuk 2	41,40	2,58	2,00	8,00	0,036	18,30	4,44	0,24	2,75
Topstuk	43,40	2,00		2,00		2,00	0,38	0,19	2,97
Ondertraverse	27,50	13,80		3,00		20,70	4,66	0,22	2,82
Boventraverse	38,80	15,00		2,60		19,50	4,82	0,25	2,73

Properties tower sections transversal direction (side view, xz plane)

Description	h [m]	b_1 [m]	b_2 [m]	Δh [m]	Δ_x [m]	A_0 [m^2]	A_1 [m^2]	$\chi = A_1/A_0$ [-]	C_t
Broekstuk	9,80	8,00	5,00	9,80	0,153	63,70	8,48	0,13	3,24
Eerste tussenstuk	18,05	5,00	4,07	8,25	0,056	37,41	6,27	0,17	3,08
Tweede tussenstuk	27,50	4,07	3,00	9,45	0,057	33,40	6,78	0,20	2,92
Bovenstuk 1	33,40	3,00	2,58	5,90	0,036	16,45	3,83	0,23	2,79
Bovenstuk 2	41,40	2,58	2,00	8,00	0,036	18,30	4,44	0,24	2,75
Topstuk	43,40	2,00		2,00		2,00	0,38	0,19	2,97
Ondertraverse	27,50	13,80		3,00		20,70	4,66	0,22	2,82
Boventraverse	38,80	15,00		2,60		19,50	4,82	0,25	2,73

Note: Surface transverse direction is reduced in calculation.

Project: ENS-ZL
Tower: S-6 R
Number: 45

Wind surface feeders telecom installations

Part	A (m^2/m)	Factor	Δh	A_1
Broekstuk				
Eerste tussenstuk				
Tweede tussenstuk				
Bovenstuk 1				
Bovenstuk 2				

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne top			
Antenne o.t.			

Tower section loads longitudinal (x-direction) per wind direction

Description	p_w	F_{x1}	F_{x2}	F_{x3}	F_{x4}	h_{ef}	M_{y1}	M_{y2}	M_{y3}	M_{y4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0,70	19,3	16,3	0,0	-16,3	4,9	94,4	80,1	0,0	-80,1
Eerste tussenstuk	0,78	15,1	12,8	0,0	-12,8	13,9	210,4	178,5	0,0	-178,5
Tweede tussenstuk	0,91	18,1	15,3	0,0	-15,3	22,8	411,1	348,9	0,0	-348,9
Bovenstuk 1	1,00	10,7	9,0	0,0	-9,0	30,5	324,7	275,5	0,0	-275,5
Bovenstuk 2	1,05	12,8	10,9	0,0	-10,9	37,4	480,3	407,5	0,0	-407,5
Topstuk	1,09	1,2	1,0	0,0	-1,0	42,4	52,1	44,2	0,0	-44,2
Ondertraverse	0,97	25,6	15,2	0,0	-15,2	28,5	730,1	433,7	0,0	-433,7
Boventraverse	1,07	28,1	16,7	0,0	-16,7	39,7	1116,0	662,9	0,0	-662,9
Totaal		130,9	97,4	0,0	-97,4		3419,1	2431,3	0,0	-2431,3

Tower section loads transversal (y-direction) per wind direction

Description	p_w	F_{y1}	F_{y2}	F_{y3}	F_{x4}	h_{ef}	M_{x1}	M_{x2}	M_{x3}	M_{x4}
	[kN/m^2]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk	0,70	0,0	16,3	19,3	16,3	4,9	0,0	80,1	94,4	80,1
Eerste tussenstuk	0,78	0,0	12,8	15,1	12,8	13,9	0,0	178,5	210,4	178,5
Tweede tussenstuk	0,91	0,0	15,3	18,1	15,3	22,8	0,0	348,9	411,1	348,9
Bovenstuk 1	1,00	0,0	9,0	10,7	9,0	30,5	0,0	275,5	324,7	275,5
Bovenstuk 2	1,05	0,0	10,9	12,8	10,9	37,4	0,0	407,5	480,3	407,5
Topstuk	1,09	0,0	1,0	1,2	1,0	42,4	0,0	44,2	52,1	44,2
Ondertraverse	0,97	0,0	15,2	10,2	15,2	28,5	0,0	433,7	292,0	433,7
Boventraverse	1,07	0,0	16,7	11,3	16,7	39,7	0,0	662,9	446,4	662,9
Total		0,0	97,4	98,7	97,4		0,0	2431,3	2311,4	2431,3

Resulting loads from mast construction incl. Antenna without conductors level foundation (char. Value)

Load / wind direction	F_x	F_y	F_z	M_x	M_y	M_z
	[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
Permanente belasting	0	0	200	0	0	0
Windrichting 0°	131	0	0	0	3419	0
Windrichting 45°	97	97	0	2431	2431	0
Windrichting 90°	0	99	0	2311	0	0
Windrichting 135°	-97	97	0	2431	-2431	0

Project: ENS-ZL
Tower: S-6 R
Number: 45

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Circuit 2	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Bliksemdraad 1	OPGW 226	21,7	264,0	9,80	81000	2,30E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Conductors ahead

Circuit	Geleider	Diameter [mm]	A [mm^2]	G [N/m]	E [N/mm^2]	αT [-]
Circuit 1	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Circuit 2	ACCCZ-Warsaw	27,7	571,0	14,98	62700	1,88E-05
Bliksemdraad 1	OPGW 226	21,7	264,0	9,80	81000	2,30E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Vertical load back

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	$w_{z,ijs}$ [N/m]	$w_{z,ijs,bundel}$ [N/m]
Circuit 1	3	3	46,3	B	4+0,2d	9,5	28,6
Circuit 2	3	3	46,3	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	3	10,1	B	4+0,2d	8,3	8,3
Bliksemdraad 2	1	3	10,1	B	4+0,2d	8,3	8,3

Vertical load ahead

Circuit	Bundle [-]	Additional [%]	$w_{z,G}$ [N/m]	Ice region	Formula	[N/m]	[N/m]
Circuit 1	3	3	46,3	B	4+0,2d	9,5	28,6
Circuit 2	3	3	46,3	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	3	10,1	B	4+0,2d	8,3	8,3
Bliksemdraad 2	1	3	10,1	B	4+0,2d	8,3	8,3

Insulators

Conductor	$G_{isolator}$ [kN]	Number -	$F_{v,iso}$ [kN]	Length [m]	Wind surf. [m^2]	Wind heigth [m]	Pressure [kN/m^2]	Drag factor [-]	$F_{h,iso}$ [kN]
380ct1f1	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct1f2	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct1f3	2,00	1	2	4,5	1,0	37,05	1,05	1,2	1,26
380ct2f1	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct2f2	2,00	1	2	4,5	1,0	25,75	0,95	1,2	1,14
380ct2f3	2,00	1	2	4,5	1,0	37,05	1,05	1,2	1,26
bl1	0,10	1	0,1	0,3	0,1	39,15	1,06	1,2	0,13
bl2	0,10	1	0,1	0,3	0,1	39,15	1,06	1,2	0,13

Project: ENS-ZL
Tower: S-6 R
Number: 45

Wind load back

Conductor	Height wind	Pressure	G_{c_dwars}	G_{c_trek}	C_c	$d_{additional}$	w_y	$w_{y,section}$	$D_{ijs,additional}$	$w_{y,ijs}$	$w_{y,ijs,section}$
	[m]	[kN/m^2]	[-]	[-]	[-]	[mm]	[N/m]	[N/m]	[mm]	[N/m]	[N/m]
380ct1f1	17,7	0,85	0,55	0,45	1,14	28,53	45,1	36,9	47,4	78,8	64,6
380ct1f2	17,7	0,85	0,55	0,45	1,14	28,53	45,1	36,9	47,4	78,8	64,6
380ct1f3	29,0	0,98	0,59	0,48	1,10	28,53	54,1	44,2	47,4	97,9	80,0
380ct2f1	17,7	0,85	0,55	0,45	1,14	28,53	45,1	36,9	47,4	78,8	64,6
380ct2f2	17,7	0,85	0,55	0,45	1,14	28,53	45,1	36,9	47,4	78,8	64,6
380ct2f3	29,0	0,98	0,59	0,48	1,10	28,53	54,1	44,2	47,4	97,9	80,0
bl1	34,1	1,02	0,60	0,49	1,20	22,35	16,5	13,4	41,8	30,9	25,2
bl2	34,1	1,02	0,60	0,49	1,20	22,35	16,5	13,4	41,8	30,9	25,2

Wind load ahead

Conductor	Height wind	Pressure	G_{c_dwars}	G_{c_trek}	C_c	$d_{additional}$	w_y	$w_{y,section}$	$D_{ijs,additional}$	$w_{y,ijs}$	$w_{y,ijs,section}$
	[m]	[kN/m^2]	[-]	[-]	[-]	[mm]	[N/m]	[N/m]	[mm]	[N/m]	[N/m]
380ct1f1	18,2	0,85	0,55	0,45	1,14	28,53	45,6	37,3	47,4	79,8	65,4
380ct1f2	18,2	0,85	0,55	0,45	1,14	28,53	45,6	37,3	47,4	79,8	65,4
380ct1f3	29,5	0,98	0,59	0,48	1,10	28,53	54,5	44,5	47,4	98,6	80,5
380ct2f1	18,2	0,85	0,55	0,45	1,14	28,53	45,6	37,3	47,4	79,8	65,4
380ct2f2	18,2	0,85	0,55	0,45	1,14	28,53	45,6	37,3	47,4	79,8	65,4
380ct2f3	29,5	0,98	0,59	0,48	1,10	28,53	54,5	44,5	47,4	98,6	80,5
bl1	34,5	1,03	0,60	0,49	1,20	22,35	16,6	13,5	41,8	31,0	25,3
bl2	34,5	1,03	0,60	0,49	1,20	22,35	16,6	13,5	41,8	31,0	25,3

Project: ENS-ZL
Tower: S-6 R
Number: 45

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class	Afkeur CC2-0
Reference period	30 jaar

ULS (strength)		**NEN-EN50341-2-15:2019**						
Load case	description	Temp	γ_G	γ_G		γ_Q		γ_a
		°C	$G_{k,mast}$	$G_{k,geleider}$	Q_{pk}	Q_{wk}	Q_{ik}	A_k
ULS 1a	Wind	10°	1,05	1,05	0,00	1,12	0,00	0,0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0,90	1,05	0,00	1,12	0,00	0,0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0,90	0,90	0,00	1,12	0,00	0,0
ULS 3	Wind+ice	-5°	1,05	1,05	0,00	0,34	0,97	0,0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0,90	1,05	0,00	0,34	0,97	0,0
ULS 4	Cold+wind	-20°	1,05	1,05	0,00	0,22	0,00	0,0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0,90	1,05	0,00	0,22	0,00	0,0
ULS 5a	Torsional loads	10°	1,00	1,00	1,00	0,00	0,00	1,0
ULS 5b	Longitudinal loads	10°	1,00	1,00	0,00	0,00	0,00	1,0
ULS 6	Construction + maintenance	5°	1,05	1,05	1,20	0,22	0,00	0,0
ULS 6_0,9	Construction + maintenance	5°	1,05	1,05	0,00	0,22	0,00	0,0
ULS 7	Permanent	10°	1,15	1,15	0,00	0,00	0,00	0,0
ULS 8	Special	10°	1,00	1,00	0,00	0,00	0,00	1,0
SPLS	(strength, for angle towers: absence of conductors)			γ_G	γ_Q			
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1,05	1,05	0,0	0,78	0,00	0,0
SPLS 1a_0,9	Wind 0,9	10°	0,90	1,05	0,0	0,78	0,00	0,0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0,90	1,05	0,0	0,78	0,00	0,0
SPLS 3	Wind+ice	-5°	1,05	1,05	0,0	0,36	0,34	0,0
SPLS 3_0,9	Wind+ice 0,9	-5°	0,90	1,05	0,0	0,36	0,34	0,0
SPLS 4	Cold+wind	-20°	1,05	1,05	0,0	0,24	0,00	0,0
SPLS 4_0,9	Cold+wind 0,9	-20°	0,90	1,05	0,0	0,24	0,00	0,0
SPLS 6	Maintenance	5°	1,05	1,05	1,2	0,24	0,0	0,0
SPLS 6_0,9	Maintenance	5°	1,05	1,05	0,0	0,24	0,0	0,0
SLS	(deformations, fatigue, EDS)			G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1,00	1,00	0,0	0,94	0,0	0,0
SLS 3	Wind+ice	-5°	1,00	1,00	0,0	0,28	0,88	0,0
SLS 4	Wind	-20°	1,00	1,00	0,0	0,19	0,0	0,0
SLS 6	Maintenance	5°	1,00	1,00	0,0	0,19	0,0	0,0
SLS 7	EDS, no wind	10°	1,00	1,00	0,0	0,00	0,0	0,0

Number of wind directions	4
Number of load combinations for ULS	44
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	440

Project: ENS-ZL
Tower: S-6 R
Number: 45

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-36,9	36,9	3,3	3,2	5,0	4,8
380ct1f1	-131,9	131,9	9,4	9,2	14,4	13,8
380ct1f2	-131,9	131,9	9,4	9,2	14,4	13,8
380ct1f3	-133,8	133,8	11,3	10,9	14,4	13,8
380ct2f1	-131,9	131,9	9,4	9,2	14,4	13,8
380ct2f2	-131,9	131,9	9,4	9,2	14,4	13,8
380ct2f3	-133,8	133,8	11,3	10,9	14,4	13,8
bl2	-36,9	36,9	3,3	3,2	5,0	4,8

Min. Weight span (m)

Weight span	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	342,7	342,7	342,7
380ct1f1	342,7	342,7	342,7
380ct1f2	342,7	342,7	342,7
380ct1f3	342,7	342,7	342,7
380ct2f1	342,7	342,7	342,7
380ct2f2	342,7	342,7	342,7
380ct2f3	342,7	342,7	342,7
bl2	342,7	342,7	342,7

Max. Weight span (m)

Weight span	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	342,7	342,7
380ct1f1	342,7	342,7
380ct1f2	342,7	342,7
380ct1f3	342,7	342,7
380ct2f1	342,7	342,7
380ct2f2	342,7	342,7
380ct2f3	342,7	342,7
bl2	342,7	342,7

Envelop of weight span over all combinations (incl. 0,9 combinations)		
For all conductors		Wind / Weight span ratio
Max. weight span	342,7 m	1,000 -
Min. weight span	342,7 m	1,000 -

Project: ENS-ZL
Tower: S-6 R
Number: 45

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	21,2	6,5	7,4	-40,1	40,1
380ct1f1	65,2	18,6	28,2	-131,9	132,0
380ct1f2	65,2	18,6	28,2	-131,9	132,0
380ct1f3	65,2	22,2	28,2	-133,8	133,9
380ct2f1	65,2	18,6	28,2	-131,9	132,0
380ct2f2	65,2	18,6	28,2	-131,9	132,0
380ct2f3	65,2	22,2	28,2	-133,8	133,9
bl2	21,2	6,5	7,4	-40,1	40,1

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	3,6	-21,2	21,2
380ct1f1	0,0	0,0	17,9	-81,5	81,5
380ct1f2	0,0	0,0	17,9	-81,5	81,5
380ct1f3	0,0	0,0	17,9	-81,5	81,5
380ct2f1	0,0	0,0	17,9	-81,5	81,5
380ct2f2	0,0	0,0	17,9	-81,5	81,5
380ct2f3	0,0	0,0	17,9	-81,5	81,5
bl2	0,0	0,0	3,6	-21,2	21,2

1 **Control uplift SLS-wind**

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	1,8	1,7
	380ct1f1	9,1	8,8
	380ct1f2	9,1	8,8
	380ct1f3	9,1	8,8
	380ct2f1	9,1	8,8
	380ct2f2	9,1	8,8
	380ct2f3	9,1	8,8
	bl2	1,8	1,7

Project: ENS-ZL
Tower: S-6 R
Number: 45

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		0	132	120	4270	0	0
ULS 1a_0,9_90		0	132	120	4270	0	0
ULS 3_90		0	69	182	2230	0	0
ULS 3_0,9_90		0	69	182	2230	0	0
SLS 7		0	0	114	0	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

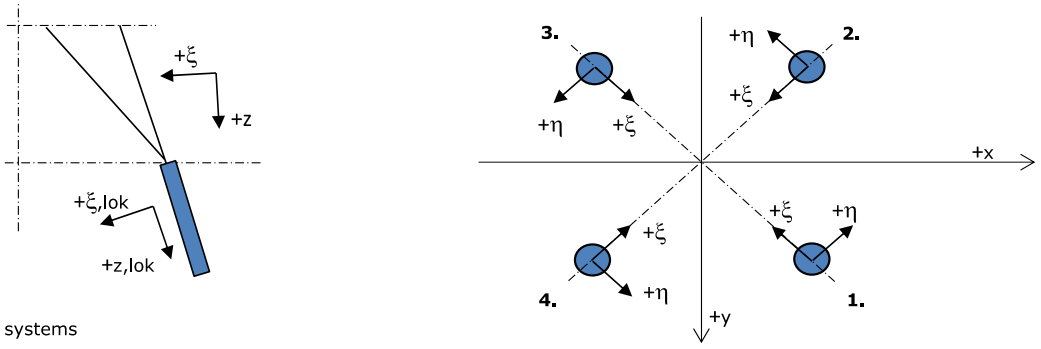
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	242	330	6851	0	0
ULS 3_90	0	102	392	3004	0	0
SLS 7	0	0	314	0	0	0

Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	242	330	**6851**	0	0
ULS 1a_0	148	0	330	0	**3891**	0
ULS 5a Ba 10	65	0	314	124	1792	**-997**
ULS 1a_45	110	176	330	**4904**	**2767**	0

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg



Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 1a_45	105	95	**562**	7	-141	-20	575
2	ULS 1a_0	54	-65	**326**	8	-84	-13	333
3	ULS 5a Ah 22	-9	-72	**243**	-45	-57	-4	248
4	ULS 1a_135	-105	95	**562**	-7	-141	-20	575

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 22	-26	9	**-85**	-25	12	-6	-87
2	ULS 1a_0,9_0,9_135	-75	64	**-409**	7	98	10	-418
3	ULS 1a_0,9_0,9_45	75	64	**-409**	-7	98	10	-418
4	ULS 1a_0,9_0,9_0	23	-34	**-172**	-8	41	3	-176

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 10	32	-38	-26	**49**	4	-2	-27
2	ULS 5a Ba 21	2	-69	198	**47**	-50	-8	203
3	ULS 5a Ba 21	-32	38	-26	**49**	4	-1	-26
4	ULS 5a Ah 10	-2	69	198	**47**	-50	-8	203

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ba 10	2	69	198	**-47**	-50	-8	203
2	ULS 5a Ah 21	32	38	-26	**-49**	4	-2	-27
3	ULS 5a Ah 21	-2	-69	198	**-47**	-50	-8	203
4	ULS 5a Ba 10	-32	-38	-26	**-49**	4	-1	-26

Project: ENS-ZL
Tower: S-6 R
Number: 45

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 12	25	-40	**-74**	**46**	11	-5	-75
2	ULS 1a_0,9_0,9_135	-75	64	**-409**	**7**	98	10	-418
3	ULS 1a_0,9_0,9_45	75	64	**-409**	**-7**	98	10	-418
4	ULS 5a Ba 12	-25	-40	**-73**	**-46**	11	-5	-75

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	79	0	-22	-5	80
2	SLS 7	16	-16	79	0	-22	-5	80
3	SLS 7	-16	-16	79	0	-22	-5	80
4	SLS 7	-16	16	79	0	-22	-5	80

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_45	105	95	**562**	7	-141	-20	575
Max. tension	ULS 1a_0,9_0,9_45	75	64	**-409**	-7	98	10	-418
Max. pos. torsie	ULS 5a Ba 21	-32	38	-26	**49**	4	-1	-26
Max. neg. torsie	ULS 5a Ba 10	-32	-38	-26	**-49**	4	-1	-26
Comb. tension+torsie	ULS 1a_45	75	64	**-409**	**-7**	98	10	-418

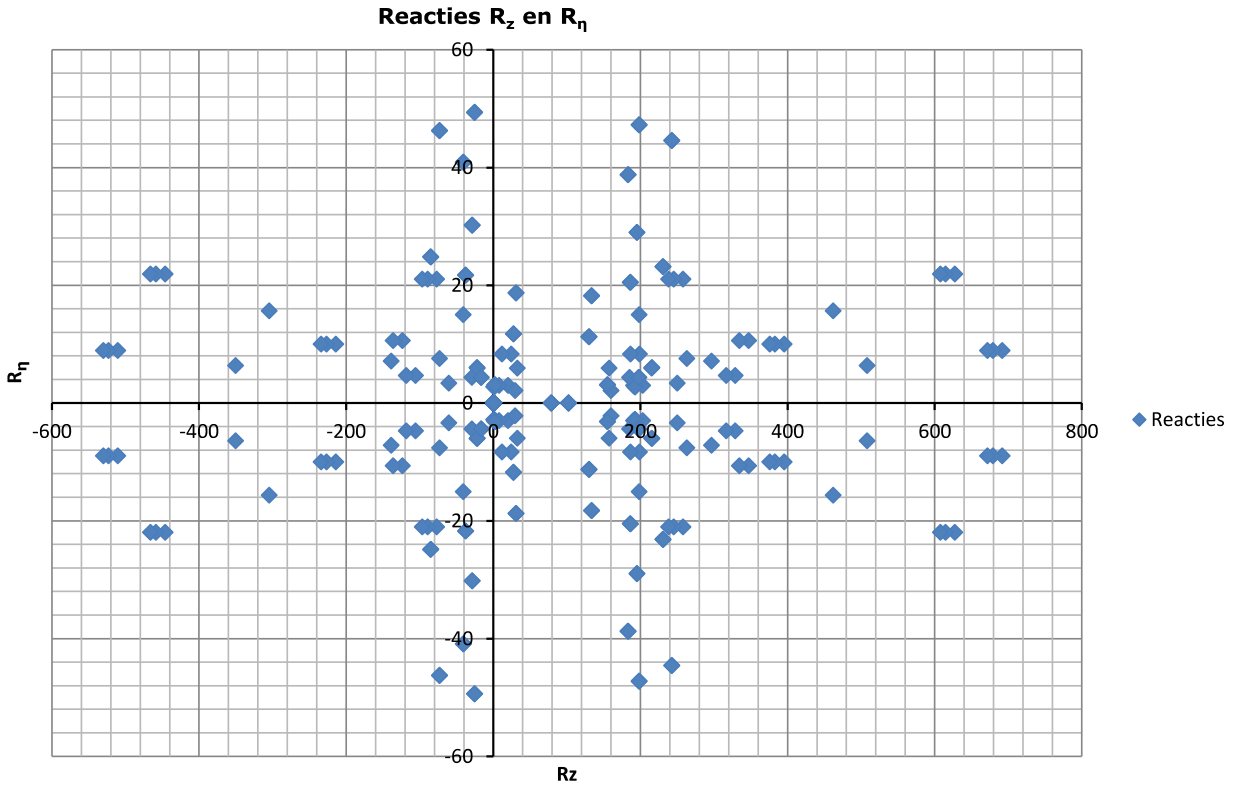
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	**79**	0	-22	-5	80
2	SLS 1a_135	-59	51	**-326**	6	78	7	-334
3	SLS 1a_45	59	51	**-326**	-6	78	7	-334
4	SLS 1a_0	16	-25	**-127**	-7	29	1	-130

Maximum compression load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	90	82	**484**	6	-122	-17	495
2	SLS 1a_0	47	-57	**284**	7	-73	-12	291
3	SLS 7	-16	-16	**79**	0	-22	-5	80
4	SLS 1a_135	-90	82	**484**	-6	-122	-17	495

Project: ENS-ZL
Tower: S-6 R
Number: 45



Project: ENS-ZL
Tower: S-6 R
Number: 45

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class	Verbouw CC2
Reference period	50 jaar

ULS (strength)		**NEN-EN50341-2-15:2019**						
Load case	description	Temp	γ_G	γ_G		γ_Q		γ_a
		°C	$G_{k,mast}$	$G_{k,geleider}$	Q_{pk}	Q_{wk}	Q_{ik}	A_k
ULS 1a	Wind	10°	1,15	1,15	0,00	1,40	0,00	0,0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0,90	1,15	0,00	1,40	0,00	0,0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0,90	0,90	0,00	1,40	0,00	0,0
ULS 3	Wind+ice	-5°	1,15	1,15	0,00	0,42	1,30	0,0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0,90	1,15	0,00	0,42	1,30	0,0
ULS 4	Cold+wind	-20°	1,15	1,15	0,00	0,28	0,00	0,0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0,90	1,15	0,00	0,28	0,00	0,0
ULS 5a	Torsional loads	10°	1,00	1,00	1,00	0,00	0,00	1,0
ULS 5b	Longitudinal loads	10°	1,00	1,00	0,00	0,00	0,00	1,0
ULS 6	Construction + maintenance	5°	1,15	1,15	1,30	0,28	0,00	0,0
ULS 6_0,9	Construction + maintenance	5°	1,15	1,15	0,00	0,28	0,00	0,0
ULS 7	Permanent	10°	1,30	1,30	0,00	0,00	0,00	0,0
ULS 8	Special	10°	1,00	1,00	0,00	0,00	0,00	1,0
SPLS	(strength, for angle towers: absence of conductors)			γ_G	γ_Q			
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SPLS 1a	Wind	10°	1,15	1,15	0,0	0,78	0,00	0,0
SPLS 1a_0,9	Wind 0,9	10°	0,90	1,15	0,0	0,78	0,00	0,0
SPLS 1a_0,9_0,9	Wind 0,9	10°	0,90	1,15	0,0	0,78	0,00	0,0
SPLS 3	Wind+ice	-5°	1,15	1,15	0,0	0,36	0,34	0,0
SPLS 3_0,9	Wind+ice 0,9	-5°	0,90	1,15	0,0	0,36	0,34	0,0
SPLS 4	Cold+wind	-20°	1,15	1,15	0,0	0,24	0,00	0,0
SPLS 4_0,9	Cold+wind 0,9	-20°	0,90	1,15	0,0	0,24	0,00	0,0
SPLS 6	Maintenance	5°	1,15	1,15	1,2	0,24	0,0	0,0
SPLS 6_0,9	Maintenance	5°	1,15	1,15	0,0	0,24	0,0	0,0
SLS	(deformations, fatigue, EDS)							
				G_k	Q_{pk}	Q_{wk}	Q_{ik}	A_k
SLS 1a	Wind	10°	1,00	1,00	0,0	1,00	0,0	0,0
SLS 3	Wind+ice	-5°	1,00	1,00	0,0	0,30	1,00	0,0
SLS 4	Wind	-20°	1,00	1,00	0,0	0,20	0,0	0,0
SLS 6	Maintenance	5°	1,00	1,00	0,0	0,20	0,0	0,0
SLS 7	EDS, no wind	10°	1,00	1,00	0,0	0,00	0,0	0,0

Number of wind directions	4
Number of load combinations for ULS	44
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	440

Project: ENS-ZL
Tower: S-6 R
Number: 45

Summary table - Conductor loads

The four tables below show:
- The maximum conductor load in the global axis system, split into proportion of back and ahead span
- The combined conductor load (Ba+Ah) in the global axis system with the maximum tensile force in the local axes. Components Fx and Fy as absolute values
- The everyday (EDS) values of the combined conductor loads (Ba+Ah) with corresponding tensile forces
- Check for uplift, where a negative value indicates uplift

Note: Maximum values for Fx, Fy and Fz do not necessarily belong to the same load combination.

Maximum values for back and ahead span

Geleider	Fx_ba [kN]	Fx_ah [kN]	Fy_ba [kN]	Fy_ah [kN]	Fz_ba [kN]	Fz_ah [kN]
bl1	-41,7	41,7	4,1	4,0	5,4	5,2
380ct1f1	-150,1	150,1	11,8	11,5	17,0	16,3
380ct1f2	-150,1	150,1	11,8	11,5	17,0	16,3
380ct1f3	-152,4	152,4	14,1	13,7	17,0	16,3
380ct2f1	-150,1	150,1	11,8	11,5	17,0	16,3
380ct2f2	-150,1	150,1	11,8	11,5	17,0	16,3
380ct2f3	-152,4	152,4	14,1	13,7	17,0	16,3
bl2	-41,7	41,7	4,1	4,0	5,4	5,2

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	342,7	342,7	342,7
380ct1f1	342,7	342,7	342,7
380ct1f2	342,7	342,7	342,7
380ct1f3	342,7	342,7	342,7
380ct2f1	342,7	342,7	342,7
380ct2f2	342,7	342,7	342,7
380ct2f3	342,7	342,7	342,7
bl2	342,7	342,7	342,7

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	342,7	342,7
380ct1f1	342,7	342,7
380ct1f2	342,7	342,7
380ct1f3	342,7	342,7
380ct2f1	342,7	342,7
380ct2f2	342,7	342,7
380ct2f3	342,7	342,7
bl2	342,7	342,7

Envelop of weight span over all combinations (incl. 0,9 combinations)		
For all conductors		Wind / Weight span ratio
Max. weight span	342,7 m	1,000 -
Min. weight span	342,7 m	1,000 -

Project: ENS-ZL
Tower: S-6 R
Number: 45

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	21,2	8,1	8,1	-42,4	42,4
380ct1f1	65,2	23,3	33,3	-150,0	150,1
380ct1f2	65,2	23,3	33,3	-150,0	150,1
380ct1f3	65,2	27,8	33,3	-152,4	152,5
380ct2f1	65,2	23,3	33,3	-150,0	150,1
380ct2f2	65,2	23,3	33,3	-150,0	150,1
380ct2f3	65,2	27,8	33,3	-152,4	152,5
bl2	21,2	8,1	8,1	-42,4	42,4

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	3,6	-21,2	21,2
380ct1f1	0,0	0,0	17,9	-81,5	81,5
380ct1f2	0,0	0,0	17,9	-81,5	81,5
380ct1f3	0,0	0,0	17,9	-81,5	81,5
380ct2f1	0,0	0,0	17,9	-81,5	81,5
380ct2f2	0,0	0,0	17,9	-81,5	81,5
380ct2f3	0,0	0,0	17,9	-81,5	81,5
bl2	0,0	0,0	3,6	-21,2	21,2

1 **Control uplift SLS-wind**

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	1,8	1,7
	380ct1f1	9,1	8,8
	380ct1f2	9,1	8,8
	380ct1f3	9,1	8,8
	380ct2f1	9,1	8,8
	380ct2f2	9,1	8,8
	380ct2f3	9,1	8,8
	bl2	1,8	1,7

Project: ENS-ZL
Tower: S-6 R
Number: 45

ULS foundation loads for LC 1 and 3, wind purpendicular to the line or bisector and EDS, from conductors

Combination	Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90		0	165	131	5353	0	0
ULS 1a_0,9_90		0	165	131	5353	0	0
ULS 3_90		0	86	215	2795	0	0
ULS 3_0,9_90		0	86	215	2795	0	0
SLS 7		0	0	114	0	0	0

ULS foundation loads, LC 1 and 3, wind purpendicular to the line or bisector and EDS, total conductors and tower

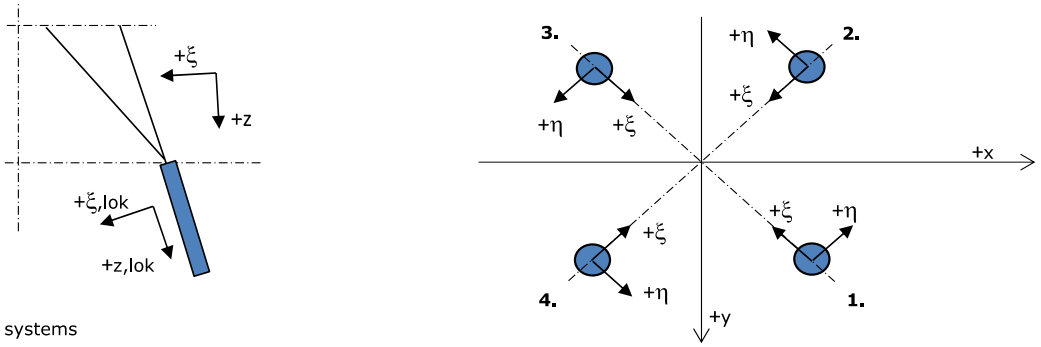
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	303	361	8589	0	0
ULS 3_90	0	127	445	3766	0	0
SLS 7	0	0	314	0	0	0

Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_0,9_90	0	303	283	**8589**	0	0
ULS 1a_0	186	0	361	0	**4878**	0
ULS 5a Ba 10	65	0	314	124	1792	**-997**
ULS 1a_45	138	221	361	**6148**	**3469**	0

Note: Largest values can appear in multiple combinations, one combination is displayed.

Support reactions per leg



Axis systems

Maximum compression load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 1a_45	129	116	**691**	9	-174	-24	707
2	ULS 1a_0	65	-79	**395**	10	-101	-16	404
3	ULS 5a Ah 22	-9	-72	**243**	-45	-57	-4	248
4	ULS 1a_135	-129	116	**691**	-9	-174	-24	707

Maximum tension load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 22	-26	9	**-85**	-25	12	-6	-87
2	ULS 1a_0,9_0,9_135	-97	84	**-530**	9	128	13	-543
3	ULS 1a_0,9_0,9_45	97	84	**-530**	-9	128	13	-543
4	ULS 1a_0,9_0,9_0	32	-47	**-234**	-10	56	5	-240

Maximum torsional load (positive)

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 10	32	-38	-26	**49**	4	-2	-27
2	ULS 5a Ba 21	2	-69	198	**47**	-50	-8	203
3	ULS 5a Ba 21	-32	38	-26	**49**	4	-1	-26
4	ULS 5a Ah 10	-2	69	198	**47**	-50	-8	203

Maximum torsional load (negative)

Index Index	Combination Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ba 10	2	69	198	**-47**	-50	-8	203
2	ULS 5a Ah 21	32	38	-26	**-49**	4	-2	-27
3	ULS 5a Ah 21	-2	-69	198	**-47**	-50	-8	203
4	ULS 5a Ba 10	-32	-38	-26	**-49**	4	-1	-26

Project: ENS-ZL
Tower: S-6 R
Number: 45

Combination Ftensile+Fhor

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	ULS 5a Ah 12	25	-40	**-74**	**46**	11	-5	-75
2	ULS 1a_0,9_0,9_135	-97	84	**-530**	**9**	128	13	-543
3	ULS 1a_0,9_0,9_45	97	84	**-530**	**-9**	128	13	-543
4	ULS 1a_0,9_0,9_0	32	-47	**-234**	**-10**	56	5	-240

Permanent load

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	79	0	-22	-5	80
2	SLS 7	16	-16	79	0	-22	-5	80
3	SLS 7	-16	-16	79	0	-22	-5	80
4	SLS 7	-16	16	79	0	-22	-5	80

Envelope of load combinations for all of the legs

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_45	129	116	**691**	9	-174	-24	707
Max. tension	ULS 1a_0,9_0,9_45	97	84	**-530**	-9	128	13	-543
Max. pos. torsie	ULS 5a Ba 21	-32	38	-26	**49**	4	-1	-26
Max. neg. torsie	ULS 5a Ba 10	-32	-38	-26	**-49**	4	-1	-26
Comb. tension+torsie	ULS 1a_45	97	84	**-530**	**-9**	128	13	-543

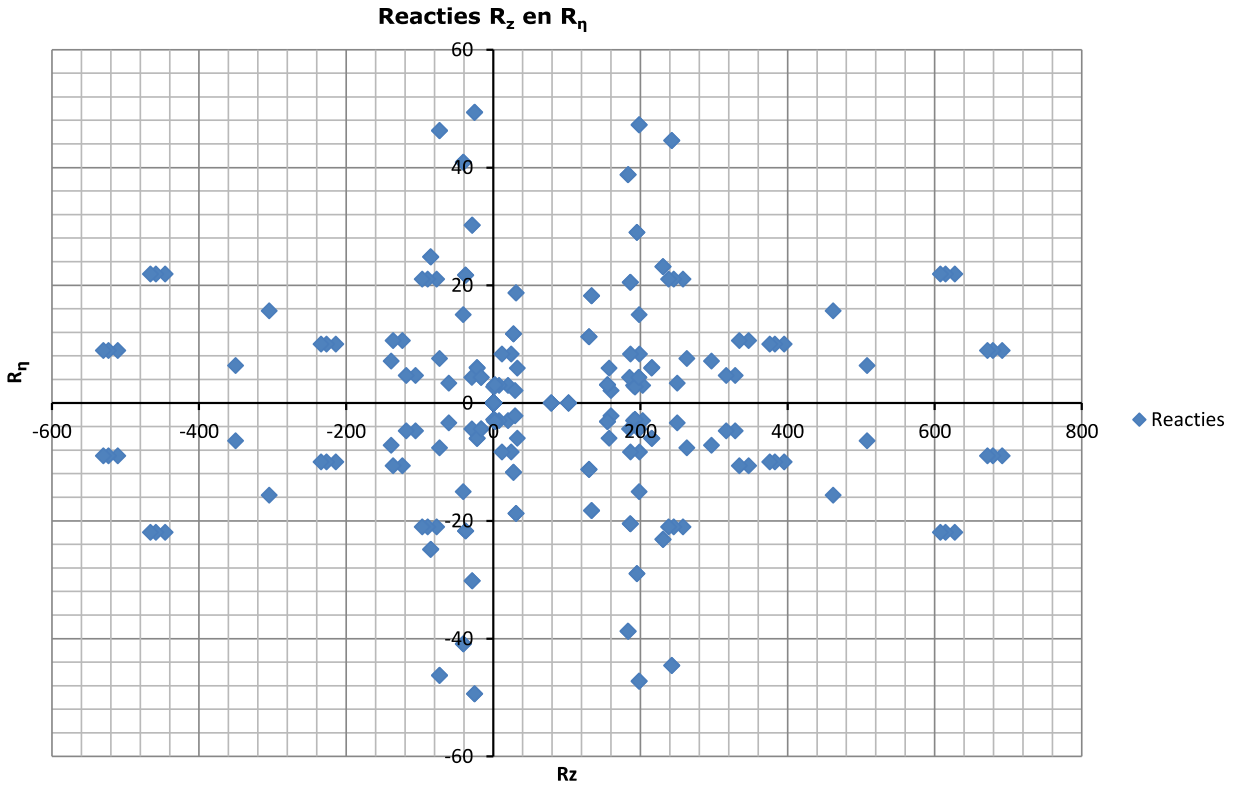
Maximum tension load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 7	16	16	**79**	0	-22	-5	80
2	SLS 1a_135	-64	55	**-351**	6	84	8	-359
3	SLS 1a_45	64	55	**-351**	-6	84	8	-359
4	SLS 1a_0	18	-28	**-139**	-7	32	2	-142

Maximum compression load - SLS

Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	95	86	**508**	6	-128	-18	520
2	SLS 1a_0	49	-59	**296**	7	-76	-12	303
3	SLS 7	-16	-16	**79**	0	-22	-5	80
4	SLS 1a_135	-95	86	**508**	-6	-128	-18	520

Project: ENS-ZL
Tower: S-6 R
Number: 45



About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

Bijlage 11

Funderingen: Milieukundig bodemonderzoek

Verkennend bodemonderzoek opwaardering 380kV Ens-Zwolle

Mast 61
Opdrachtgever: TenneT

25 maart 2022

Contactpersoon

SIMON VAN DEN BOSSE
Projectmanager

Arcadis Nederland B.V.
Postbus 63
9400 AB Assen
Nederland

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Colofon 24

1 Inleiding

In opdracht van TenneT heeft Arcadis Nederland B.V. een verkennend bodemonderzoek uitgevoerd. Dit ten behoeve van het project Opwaardering tracé Ens-Zwolle 380 kV. Het milieukundig bodemonderzoek is uitgevoerd ter plaatse van mast 61.

In bijlage A is een regionale ligging en een overzichtstekening opgenomen met weergave van de uitgevoerde werkzaamheden.

Aanleiding van het onderzoek
Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen voor een grotere transportcapaciteit. Om die reden gaat TenneT de bestaande landelijke 380kV-ring, de 'ruggengraat' van het landelijk hoogspanningsnet, opwaarderen (programma Beter Benutten Bestaande 380 kV). Binnen dit programma valt ook het deelproject Opwaardering 380kV-verbinding Ens-Zwolle (ENS-ZL380).

Voor de opwaardering van deze verbinding moeten diverse werkzaamheden worden uitgevoerd. In de basis betreft dit het ophangen van nieuwe geleiders met een hogere transportcapaciteit dan de huidige geleiders. De nieuwe geleiders zijn in omvang en aantal gelijk aan de bestaande maar kunnen meer stroom transporteren doordat ze hogere temperaturen kunnen weerstaan zonder te ver door te hangen. De huidige hoogspanningsverbinding is bovendien bijna 35 jaar oud. Om deze reden worden ook andere onderdelen, zoals de isolatorkettingen en bliksemdraden als levensduur verlengende activiteit vervangen. Daarnaast worden de masten opnieuw constructief beschouwd en moet bij een aantal masten de fundering en of het mastlichaam versterkt worden.

Doelstelling van het onderzoek

Voor het ontwerp van de mastlichamen en fundaties (Definitieve Ontwerp), de bouwwegen en de vergunningaanvraag zijn verschillende veld- en bodemonderzoeken nodig.

Het doel van het bodemonderzoek is het vaststellen of ter plaatse van de graaflocatie sprake is van bodemverontreiniging en zo ja, of deze een belemmering vormt voor de voorgenomen werkzaamheden.

Het bodemonderzoek is niet gericht op het vaststellen van de mogelijkheden voor hergebruik van (eventueel) in een later stadium af te voeren grond. Op hergebruik van grond is het Besluit bodemkwaliteit van toepassing. Voor bodemonderzoek dat in het kader van grondverzet wordt uitgevoerd gelden andere onderzoeksprotocollen. Wel zijn de onderzoeksresultaten indicatief getoetst aan het Besluit bodemkwaliteit. Het doel daarvan is om een indicatie te krijgen over de mogelijkheden om eventueel vrijkomende grond te hergebruiken

Werkwijze

Bij elke activiteit waar grondroering in de bodem wordt voorzien, is het uitvoeren van het vooronderzoek naar de milieuhygiënische kwaliteit van de bodem noodzakelijk volgens NEN 5725[1]. Het bodemonderzoek is uitgevoerd conform de BRL SIKB 2000 en conform de richtlijnen uit de NEN 5725 en de NEN 5740[2].

In de NEN 5720 zijn, afhankelijk van de onderzoeksstrategie en -inspanning, richtlijnen gegeven voor de aantallen te verrichten boringen en te analyseren waterbodemmonsters als functie van de oppervlakte of de lengte van de te onderzoeken (deel)locatie. Op basis van de verkregen informatie uit het vooronderzoek is gekozen voor de strategie Lintvormig, met een normale onderzoeksinspanning.

[1]Vooronderzoek landbodem conform NEN 5725:2017 NL (Bodem - Landbodem Strategie voor het uitvoeren van milieuhygiënisch vooronderzoek)
[2] Bodem – Landbodem – Strategie voor het uitvoeren van verkennend bodemonderzoek – Onderzoek naar de milieuhygiënische kwaliteit van bodem en grond.

Afbakening

Landbodem

De oorspronkelijk opdracht bestond uit landbodemonderzoek ter plaatse van 15 masten:

- 121 boringen tot 0,5 m -mv. (deze worden gecombineerd met de cultuurtechnische boringen);
- 30 boringen tot 2,0 m -mv. (deze worden gecombineerd met de cultuurtechnische boringen);
- 30 analyses bovengrond op standaardpakket;
- 15 analyses ondergrond op standaardpakket;
- Bemonstering van 30 peilbuizen;
- Analyse van 15 grondwatermonsters.

Waterbodemonderzoek

- Waar bouwwegen sloten/watergangen kruisen en
- Op plaatsen waar een werkterrein of lierlocatie op of over watergang geprojecteerd is

Na gunning werd duidelijk dat in plaats van bij 15, bij slechts 5 masten de fundering moet worden verstevigd. Dit betreft de masten 44-45-48-61 en 64. Dit houdt in dat enkel bij de 5 genoemde masten graafwerkzaamheden in de grond zullen plaatsvinden. Bovendien zijn nieuwe versies van het mastenboek verschenen, hetgeen invloed heeft gehad op de aantallen te verrichte boringen, sonderingen, waterbodemonderzoeken en dergelijke.

Leeswijzer

De resultaten van het vooronderzoek zijn beschreven in hoofdstuk 2. Hoofdstuk 3 beschrijft de uitvoering en resultaten van het bodemonderzoek. Hoofdstuk 4 beschrijft de conclusies en advies.

Disclaimer

Hoewel het bodemonderzoek op zorgvuldige wijze is voorbereid en uitgevoerd, kan niet worden uitgesloten dat er in werkelijkheid afwijkingen optreden ten opzichte van de in dit rapport gepresenteerde resultaten. Immers, elk bodemonderzoek is gebaseerd op het nemen van een aantal steekproeven, welke representatief worden geacht voor het onderzochte gebied, maar waarbij (lokale) afwijkingen niet volledig kunnen worden uitgesloten.

2 Vooronderzoek conform NEN 5725

Het verkennend milieukundig bodemonderzoek is voorafgegaan door een vooronderzoek volgens NEN 5725:2017, aanleiding G “Opstellen hypothese over de bodemkwaliteit bij tijdelijke uitplaatsing en bij overig projectmatig grondverzet ten behoeve van het inschatten van arbeidshygiënische risico’s”. Ter beantwoording van de onderzoeksvragen behorende bij aanleiding G is informatie verzameld over relevante onderzoeksaspecten. Het vooronderzoek is uitgevoerd om relevante informatie te verzamelen om onderbouwde antwoorden te formuleren op de onderzoeksvragen, welke van toepassing zijn op aanleiding G.

Op basis van de resultaten uit het vooronderzoek wordt een onderzoekshypothese geformuleerd. Afhankelijk van eventuele aanwijzingen over de aanwezigheid van een bodemverontreiniging wordt een locatie geclassificeerd als ‘verdacht’ of ‘onverdacht’. Op basis van deze classificatie wordt een hypothese geformuleerd, welke vervolgens aan de hand van de onderzoeksresultaten wordt getoetst. Bij een onderzoek op een ‘onverdachte’ locatie wordt de hypothese getoetst dat er geen verontreiniging aanwezig is, bij een onderzoek van een verdachte locatie wordt de hypothese getoetst dat wel een (specifieke) verontreiniging aanwezig is.

2.1 Onderzoekslocatie en -grenzen

De ligging van de onderzoekslocatie is weergegeven in bijlage A. Het perceel staat kadastraal bekend als gemeente Hasselt, sectie G, nummer 986.

2.2 Geraadpleegde bronnen

Tijdens het vooronderzoek zijn de volgende bronnen geraadpleegd. Dit zijn minimaal de gebruikelijke bronnen die geraadpleegd worden voor een vooronderzoek in Nederland.

- De opdrachtgever (TenneT);
- De website www.google.nl/maps en Streetview. Hiermee is een digitale terreininspectie uitgevoerd;
- De website www.bodemloket.nl;
- De website www.topotijdreis.nl; voor het raadplegen van historisch kaartmateriaal;
- De Bodemkwaliteitskaarten van gemeente Zwartewaterland, omgevingsdienst IJsselland;
- Dinoloket, voor informatie over de bodemopbouw en geohydrologische informatie;
- De website van de provincie Overijssel voor het opvragen en raadplegen van relevante bodemonderzoeksdocumenten.
- Terreininspectie digitaal uitgevoerd en voorafgaand aan het veldwerk.

2.3 Bekende bodemkwaliteitsgegevens

2.3.1 Bodemopbouw en geohydrologie

De maaiveldhoogte ter plaatse van de onderzoekslocatie is circa -0,4 m NAP. De bodem ter plaatse van de onderzoekslocatie bestaat uit zand en klei. De freatische grondwaterstand bevindt zich op een diepte van 0,7 m-mv.

2.3.2 Bodemkwaliteitskaart

Voor het algemeen beeld van de lokale bodemkwaliteit is de bodemkwaliteitskaart van de gemeente geraadpleegd. Binnen de bodemkwaliteitskaart is geen aandacht besteed aan PFAS verdachte/onverdachte gebieden. Op basis van de bodemkwaliteitskaart kan de bodemkwaliteit van de onderzoekslocatie als volgt worden beschreven:

- Kwaliteit bovengrond : Landbouw/natuur
- Kwaliteit ondergrond : Landbouw/natuur

Voor de onderzoekslocatie is geen asbestkansenkaart aanwezig.

Waterbodems zijn uitgesloten van de bodemkwaliteitskaart.

2.3.3 Gebruik en beïnvloeding van de onderzoekslocatie

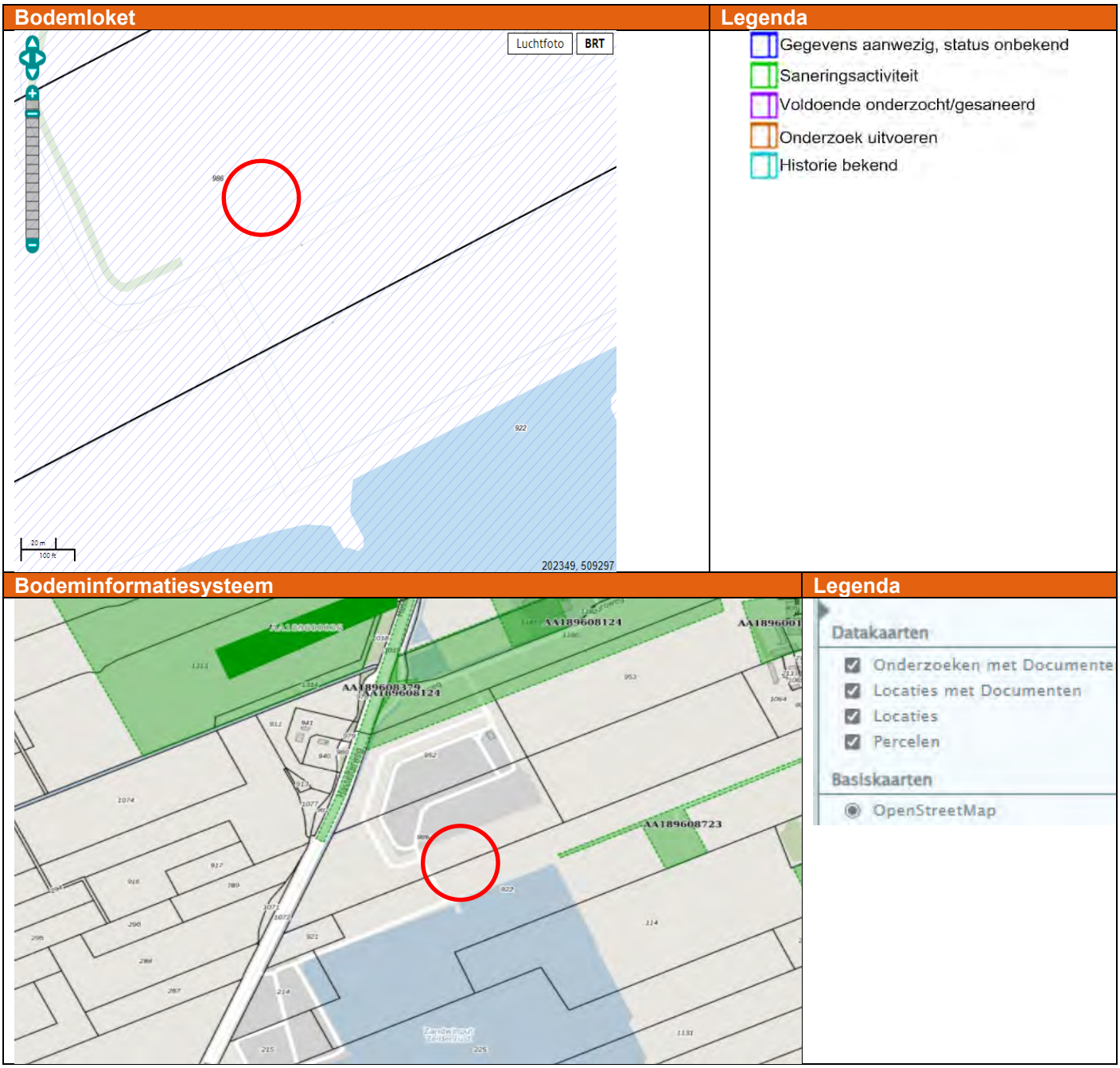
Uit het historisch kaartmateriaal (zie figuren) blijkt dat de omgeving van de onderzoekslocatie een agrarische bestemming heeft. De structuur van watergangen is nagenoeg ongewijzigd, totdat in het begin van de 21e eeuw de zandwinning is ontwikkeld.

Figuur 1 Uitsneden historisch kaartmateriaal (onderzoekslocatie met oranje gemarkeerd)

2.3.4 Verwachting ten aanzien van de bodemkwaliteit

2.3.4.1 Beschikbare bodeminformatie

In onderstaande afbeeldingen is de beschikbare bodeminformatie te zien ten opzichte van de onderzoekslocatie.



Figuur 2 Uitsneden kaartmateriaal (onderzoekslocatie met rood gemarkeerd)

De voor de locatie beschikbare rapporten en documenten zijn samengevat in tabel 1.

Tabel 1: Overzicht beschikbare rapporten en documenten

Bron	Datum	Titel document/rapport	Kenmerk	Opsteller
☐ TenneT	-	-	-	-
☐ Bodemloket	-	-	-	-
☐ Bodeminformatiesysteem	-	-	-	-
Toelichting tabel: ☐ Er zijn geen bodemonderzoeksgegevens bekend ter plaatse van de onderzoekslocatie ☒ Er zijn bodemonderzoeksgegevens bekend ter plaatse van de onderzoekslocatie				

2.3.4.2 Verdachte activiteiten

In tabel 2 is een overzicht weergegeven met de historische informatie uit de verschillende bronnen. Hieruit kan worden afgeleid dat er geen verdachte activiteiten bekend zijn ter plaatse van de onderzoekslocatie.

Tabel 2: Overzicht met verdachte (bedrijfs)activiteiten nabij de onderzoekslocatie

Verdachte (bedrijfs)activiteiten	UBI- code	Toelichting
Nabij de onderzoekslocatie zijn geen verdachte (bedrijfs)activiteiten bekend.	-	-

2.3.4.3 Asbest

Uit het vooronderzoek blijkt op basis van de beschikbare gegevens geen aanleiding voor een verdenking voor de aanwezigheid van een bodemverontreiniging met asbest.

2.3.4.4 PFAS

In relatie tot de te hanteren onderzoeksstrategie dient in het vooronderzoek beoordeeld te worden of de locatie door de ligging verdacht is op het voorkomen van gehalten aan PFAS (bijvoorbeeld nabij bronlocaties). De gemeente heeft op de bodemkwaliteitskaart PFAS niet toegevoegd als een kritische parameter.

In december 2021 is het meest recente handelingskader voor hergebruik van PFAS-houdende grond en baggerspecie aangepast en van kracht. In dit handelingskader zijn diverse toepassingsnormen voor het toepassen van grond en baggerspecie op de landbodem en in oppervlaktewater vastgesteld. Uit het handelingskader volgt de noodzaak tot onderzoek naar PFAS in geval van bodemtoepassingen of afvoer van bodemmateriaal naar een erkende verwerker. Dit is niet van toepassing indien er sprake is van tijdelijk uitplaatsen van grond. Bij het tijdelijk uitplaatsen van grond verandert de algemene bodemkwaliteit op de betreffende locatie, niet.

Gezien de voorgenomen werkzaamheden, het tijdelijk uitplaatsen van grond, behoeft met het bodemonderzoek, PFAS niet te worden geanalyseerd.

2.3.4.5 Terreininspectie

Voorafgaand aan de uitvoering van het bodemonderzoek is een terreininspectie uitgevoerd. Tijdens de terreininspectie zijn ter plaatse van de onderzoekslocatie geen waarnemingen gedaan die wijzen op de aanwezigheid van bodemverontreiniging.

2.4 Conclusies vooronderzoek en hypothese

- Binnen het onderzoeksgebied zijn geen bodemonderzoeksgegevens bekend.
- Er is geen sprake (geweest) van activiteiten waarbij de bodem kan zijn verontreinigd.
- De onderzoekslocatie is niet verdacht op het voorkomen van verontreiniging met asbest in de bodem. Indien tijdens de uitvoering van het bodemonderzoek asbestverdachte materialen, puinhoudende grond welke als asbestverdacht kan worden aangemerkt of puinlagen worden aangetroffen dient asbestonderzoek (conform NEN 5707 of NEN 5897) te worden uitgevoerd.
- PFAS in grond behoeft niet te worden onderzocht, aangezien geen aan- of afvoer van grond zal plaatsvinden.
- Op basis van de bodemkwaliteitskaart worden geen verontreinigingen verwacht.

De locatie wordt onderzocht conform de NEN richtlijn bij onverdachte locaties (strategie ONV).

3 Resultaten

3.1 Kwaliteitsborging

De genoemde werkzaamheden zijn uitgevoerd in overeenstemming met de regelgeving die bekend is onder de naam KWALIBO (dat staat voor kwaliteitsborging bij bodemintermediairs). De beschrijving van de kwaliteitsborging en wijze van uitvoering is opgenomen in bijlage F.

3.2 Uitgevoerde werkzaamheden

In tabel 3 is het uitgevoerde onderzoeksprogramma weergegeven. Voorafgaand aan de werkzaamheden is een graafmelding uitgevoerd.

Tabel 3: Uitgevoerde onderzoeksprogramma

	Aantal	Omschrijving veldwerk	Aantal	Omschrijving analyses
Grond				
	8	Boring tot 0,5 m-mv	2	NEN 5740 STAP GR *
	4	Boring tot 1,2 m-mv	2	Regionaal Waterbodempakket *
	2	Boring tot 2,0 m-mv		
	1	Boring tot 3,2 m-mv		
	1	Boring tot 4,0 m-mv		
	20	Waterbodemsteken		
Grondwater				
	-	Boring met peilbuis	1	NEN 5740 STAP GW **
	2	Bemonsteren grondwater en oppervlaktewater	2	Lozingspakket ***
	2	Meten grondwaterstand, pH, EC en NTU		

Toelichting tabel:

* STAP GR + Regionaal Waterbodempakket: (Standaardpakket grond): droge stof, lutumgehalte, organisch stofgehalte, barium (Ba), cadmium (Cd), kobalt (Co), koper (Cu), kwik (Hg), molybdeen (Mo), nikkel (Ni), lood (Pb), zink (Zn), minerale olie (GC) (C10-C40), PAK (10 VROM), PCB (7) inclusief structuur-pakket (organische stof/lutum) en voorbehandeling AS3000.
** STAP GW (Standaardpakket grondwater): barium (Ba), cadmium (Cd), kobalt (Co), koper (Cu), kwik (Hg), molybdeen (Mo), nikkel (Ni), lood (Pb), zink (Zn), aromaten (BTEXN), styreen, VOCl (11) en vinylchloride, 1,1-dichlooretheen, 1,1- dichloorpropaan, 1,2-dichloorpropaan,1,3-dichloorpropaan, bromoform en minerale olie (GC) (C10-C40), inclusief voorbehandeling AS3000.

*** Lozingspakket: onopgeloste bestanddelen, ijzer, sulfaat, ammonium, chloride, fosfaat

pH = zuurgraad; EC = elektrische geleidbaarheid; NTU= maat voor het meten van de troebelheid van het grondwater.

Bij de bemonsteringen op de locatie is de vrijkomende grond beoordeeld op de bodemkundige samenstelling. Daarnaast is gelet op het voorkomen van puin, slakken, kolengruis en dergelijke en op afwijkingen van kleur, die kunnen duiden op de aanwezigheid van bodemverontreiniging. De grond uit de boringen is met behulp van de oliedetectiepan beoordeeld op de aanwezigheid van olieachtige en oppervlakte-actieve stoffen. De boorprofielen zijn opgenomen in bijlage B. De opgeboorde grond van elke boring is per bodemlaag van maximaal 0,5 m bemonsterd. Indien de bodemopbouw en de veldwaarnemingen daar aanleiding toe gaven, is een kleiner monstertraject gekozen.

De peilbuizen zijn in een eerder stadium geplaatst. Na een wachttijd van meerdere weken is het grondwater uit de peilbuis bemonsterd. De periode van 1 week is minimaal noodzakelijk om het evenwicht tussen grond en grondwater te laten herstellen. Voorafgaande aan de bemonstering zijn de zuurgraad (pH), het elektrisch geleidingsvermogen (EC) en de troebelheid (NTU) van het opgepompte grondwater bepaald. Daarnaast is het oppervlaktewater bemonsterd en geanalyseerd op lozingsparameters.

3.3 Bodemopbouw

De bodem bestaat voornamelijk uit klei op veen. Plaatselijk is in de ondergrond een laag zand aanwezig. De waterbodem bestaat uit slib op zand.

3.4 Veldwaarnemingen

Er zijn geen bodemvreemde materialen aangetroffen. Het grondwater is aanwezig op een diepte van circa 0,70 m-mv.

Tabel 4 Meetgegevens grondwater

Peilbuis	Filterstelling (m-mv)	Grondwaterstand	pH (-)	EC (µS/cm)	Troebelheid (NTU)
61-1Hb	1,90 – 2,90	0,70	6,04	920	1,2

Toelichting tabel:
pH : Zuurgraad
EC : Elektrisch geleidingsvermogen
NTU : Afkorting van Nephelometric Turbidity Unit, is een maat voor de troebelheid (Turbidity) van een vloeistof. *Indien de NTU-waarde >10, is er sprake van een troebel watermonster. Dit kan de analyseresultaten hebben beïnvloed. Er is als gevolg van de lage troebelheid geen beïnvloeding van de analyseresultaten te verwachten.

3.5 Analyseresultaten

De analyseresultaten zijn getoetst aan de achtergrond / streef- en interventiewaarden uit de Circulaire bodemsanering 2013 en het Besluit bodemkwaliteit en weergegeven in onderstaande tabellen. De (getoetste) analysecertificaten zijn opgenomen bijlage C en D. Een toelichting op het toetsingskader is opgenomen in bijlage E.

Tabel 5 Analyseresultaten grond

Analyse code	Deelmonsters	Diepte (m-mv)	> AW (index)	> I (index)	Klasse Bbk (indicatief)
61-MM-BG01	61-HB01-1, 61-HB07-1, 61-HB08-1, 61-HB13-1	0,00 - 0,40	-	-	Altijd toepasbaar
61-MM-OG01	61-HB06-3, 61-HB09-3	0,90 - 1,30	-	-	Altijd toepasbaar

Toelichting tabel:
- : Geen verhoogde waarden gemeten
>AW : Gehalten groter dan de achtergrondwaarde
>I : Gehalten groter dan de interventiewaarde
Index : (GSSD-AW) / (I-AW)
GSSD : Gestandaardiseerde meetwaarde
Bbk : Besluit bodemkwaliteit

Tabel 6 Analyseresultaten waterbodem

Analysecode	Deelmonsters	Diepte (m-mv)	> AW (index)	Toepassen op of in Landbodem	Verspreiden op aangrenzende perceel
61-MM-WB01	61-WB01-1, 61-WB02-1, 61-WB03-1, 61-WB04-1, 61-WB05-1, 61-WB06-1, 61-WB07-1, 61-WB08-1, 61-WB09-1, 61-WB10-1	0,20 - 0,70	-	Altijd toepasbaar	Verspreidbaar
61-MM-WB02	61-WB11-1, 61-WB12-1, 61-WB13-1, 61-WB14-1, 61-WB15-1, 61-WB16-1, 61-WB17-1, 61-WB18-1, 61-WB19-1, 61-WB20-1	0,20 - 0,70	-	Altijd toepasbaar	Verspreidbaar

Toelichting tabel:
- : Geen verhoogde waarden gemeten
>AW : Gehalten groter dan de achtergrondwaarde
Index : (GSSD-AW) / (I-AW)
GSSD : Gestandaardiseerde meetwaarde

Tabel 7 Analyseresultaten grondwater

Peilbuis	Filterstelling (m-mv)	Datum monstername	> S (index)	> I (index)
61-1HB	1,90 – 2,90	23 november 2021	Barium (0,10)	-

Toelichting tabel:
- : Geen verhoogde waarden gemeten
>S : Gehalten groter dan de streefwaarde
>I : Gehalten groter dan de interventiewaarde
Index : (GSSD-S) / (I-S)
GSSD : Gestandaardiseerde meetwaarde

3.6 Interpretatie resultaten

Grond

In zowel de bovengrond als de ondergrond als de waterbodem zijn geen verontreinigingen aangetoond. Dit komt overeen met de bevindingen vanuit het vooronderzoek.

Grondwater

In het grondwater is een licht verhoogde concentratie barium aangetoond. Er is geen directe aanleiding gevonden voor deze verhoogde concentraties. Deze parameter wordt vaker in verhoogde concentraties aangetoond, zonder dat daarvoor een reden voor is. Het betreft hier een van nature verhoogde concentratie,

Waterbodem

De waterbodem is niet verontreinigd met de geanalyseerde parameters.

4 Conclusies

Milieuhygiënische kwaliteit grond, grondwater en waterbodem

Uit de resultaten van het bodemonderzoek blijkt het volgende.

- Tijdens het terreinbezoek en tijdens het uitvoeren van het bodemonderzoek zijn geen (asbest)verdachte materialen waargenomen of andere waarnemingen (puin) gedaan die kunnen duiden op de aanwezigheid van asbest of bodemverontreiniging
- In de boven- (0,0-0,4 m-mv) en de ondergrond (0,9-1,3 m-mv) zijn geen verhoogde gehalten aangetoond.
- Het slib uit de waterbodem is niet verontreinigd, is altijd toepasbaar en vrij verspreidbaar over de aangrenzende percelen.
- In het grondwater is een licht verhoogde concentratie barium aangetoond.

Procedures in het kader van de Wet bodembescherming

- De onderzoeksresultaten geven geen aanleiding tot het uitvoeren van vervolgonderzoek.
- In het kader van de Wet bodembescherming en de toekomstige Omgevingswet zijn voor de uitvoering van de geplande werkzaamheden in de bodem geen meldingen noodzakelijk.
- De milieuhygiënische kwaliteit van de bodem en de waterbodem vormen geen belemmering voor de geplande werkzaamheden.

Veiligheidsklasse

De te hanteren voorlopige veiligheidsklasse is bepaald volgens de systematiek uit de CROW-publicatie 400 (werken in en met verontreinigde bodem) . Bij de uitvoering van de werkzaamheden dienen de bij deze veiligheidsklasse behorende maatregelen te worden toegepast, zoals beschreven in de CROW-publicatie 400. De bepaling van de definitieve veiligheidsklasse dient te worden getoetst door een veiligheidskundige van de aannemer.

Uit de bepaling volgt ‘geen veiligheidsklasse van toepassing’. Voor de werkzaamheden die in de bodem worden uitgevoerd zijn de maatregelen volgens de Basishygiëne van toepassing.

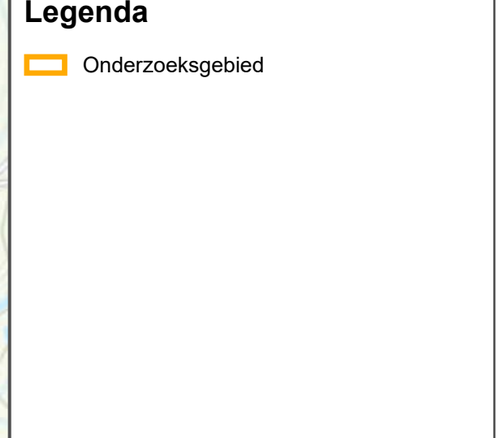
Bijlage A – Tekeningen

TenneT ENS-ZL

Overzichtstekening

Legenda

Onderzoeksgebied



OPDRACHTGEVER: Tennet

ZAAKNUMMER: 30073259

ARCADIS Design & Consultancy for natural and built assets

datum: 10/6/2021
schaal (A3): 1:10,000

0 100 200 300 400 500 m

N

Cultuurtechnisch en milieukundig onderzoek

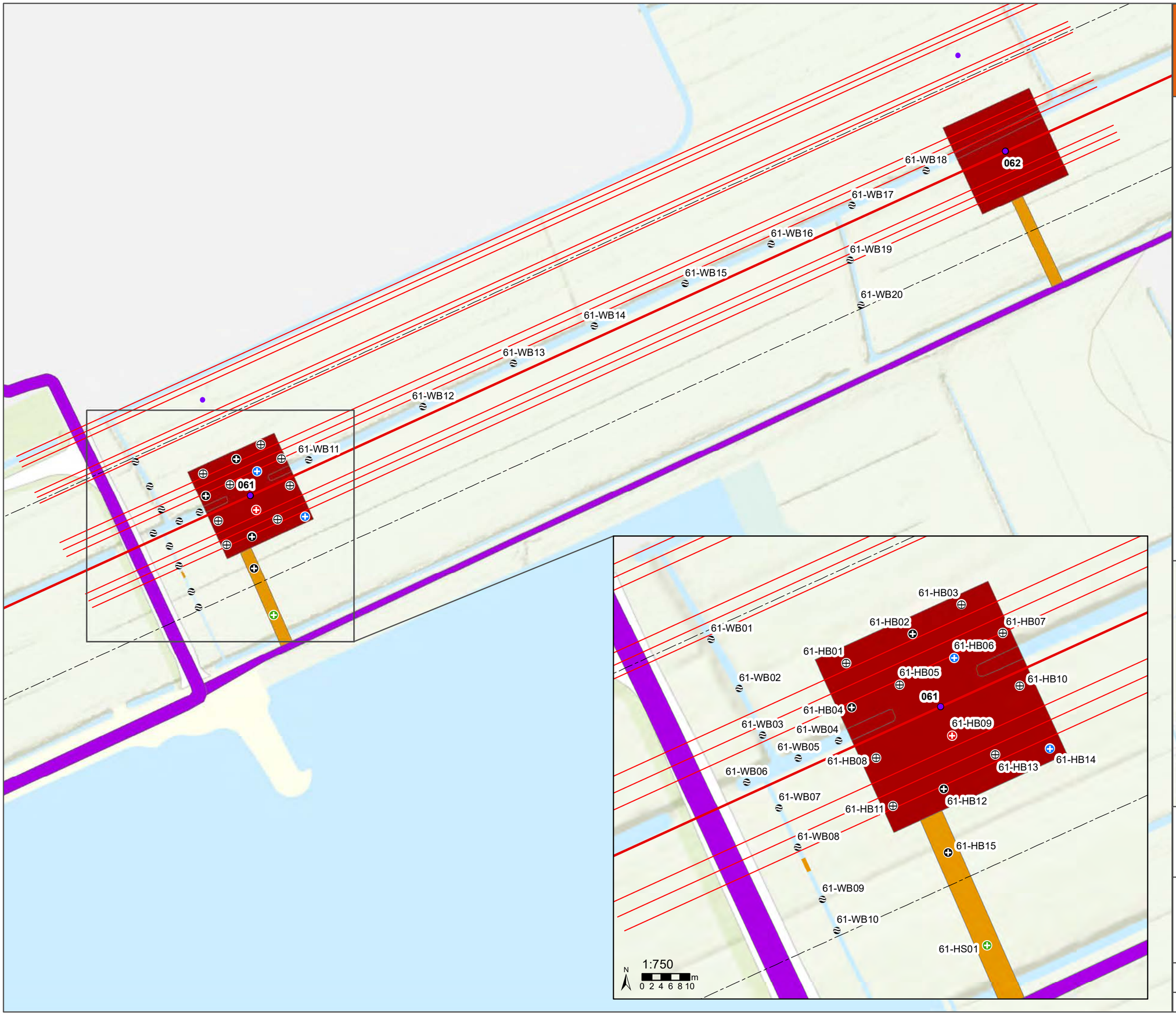
Mast 61

Legenda

- Boring tot 0,5 m-mv
- Boring tot 1,20 m-mv
- Boring tot 2,0 m-mv
- Handsondering tot 3,00 m-mv
- Boring tot 4,00 m-mv
- Boring tot waterbodem
- Masten
- 380 kV
- Zakelijk rechtstrook
- Aan te leggen dijk (rijbaan)
- Bestaande weg / verharding benutten
- Lierlocatie
- Ruimtereservering aanrijroute (nat weer)
- Ruimtereservering aanrijroute (onderzoek)
- Ruimtereservering aanrijroute (rijbaan)
- Ruimtereservering aanrijroute (rijbaan) (optie)
- Werkterrein

KLIC

- KL-MS-N
- KL-HS-N



opdrachtgever: TenneT

ARCADIS Design & Consultancy for natural and built assets

datum:	12-11-2021
schaal (A3):	1:1.500
status:	definitief
tekenaar:	George Alion
projectleider:	Simon van den Bosse
goedgekeurd:	Andries Faber
GIS bestand:	Geoinformatie\TenneT_30073259_20211112.mxd
PDF bestand:	Tekeningen\TenneT_30073259 _20211112.pdf

N 0 10 20 30 40 50 m

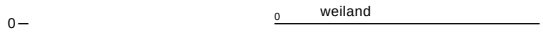
projectnummer	tekening	versie
30073259	4	1

Bijlage B – Boorprofiel(en)

Boring: 61-1HB

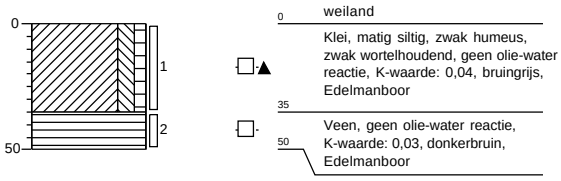
Datum: 23-11-2021

Boormeester: Marcel la Crois



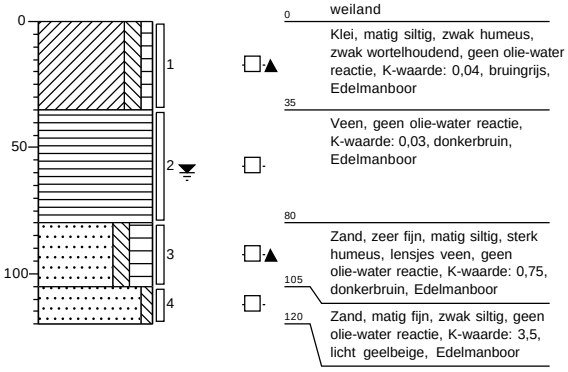
Boring: 61-HB01

Datum: 23-11-2021
X: 202315,16
Y: 509316,38
Boormeester: Marcel la Crois



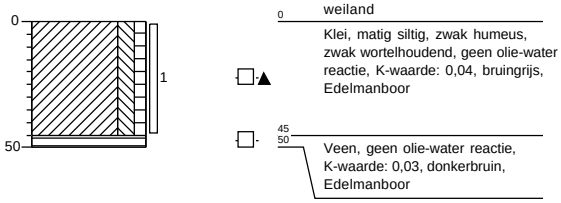
Boring: 61-HB02

Datum: 23-11-2021
X: 202329,17
Y: 509322,49
Boormeester: Marcel la Crois



Boring: 61-HB03

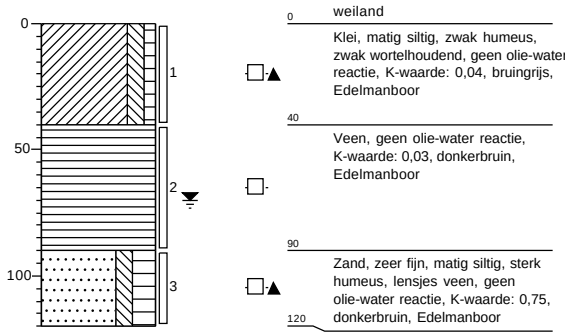
Datum: 23-11-2021
X: 202339,51
Y: 509328,67
Boormeester: Marcel la Crois



ARCADIS Design & Consultancy for natural and built assets

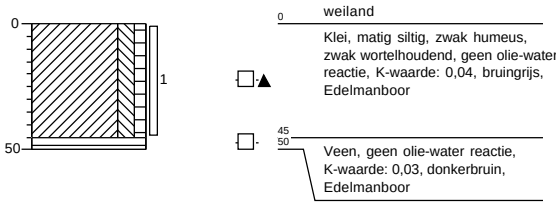
Boring: 61-HB04

Datum: 23-11-2021
X: 202316,37
Y: 509307,04
Boormeester: Marcel la Crois



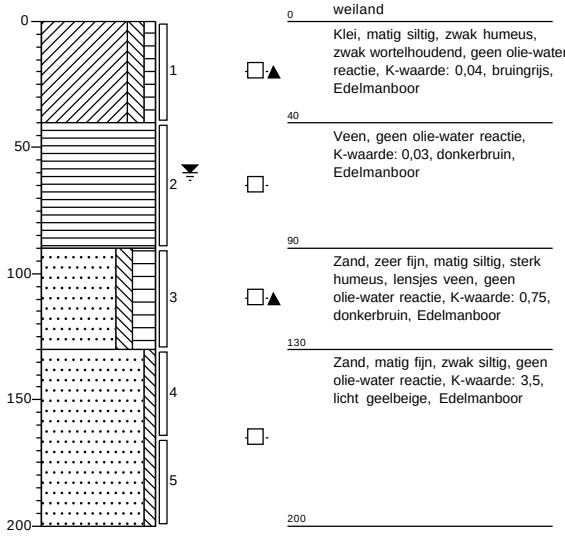
Boring: 61-HB05

Datum: 23-11-2021
X: 202326,45
Y: 509311,72
Boormeester: Marcel la Crois



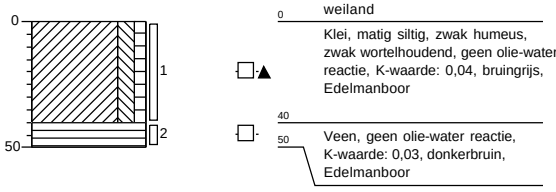
Boring: 61-HB06

Datum: 23-11-2021
X: 202337,95
Y: 509317,43
Boormeester: Marcel la Crois



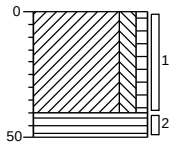
Boring: 61-HB07

Datum: 23-11-2021
X: 202348,18
Y: 509322,65
Boormeester: Marcel la Crois



Boring: 61-HB08

Datum: 23-11-2021
X: 202321,48
Y: 509296,44
Boormeester: Marcel la Crois



0 weiland

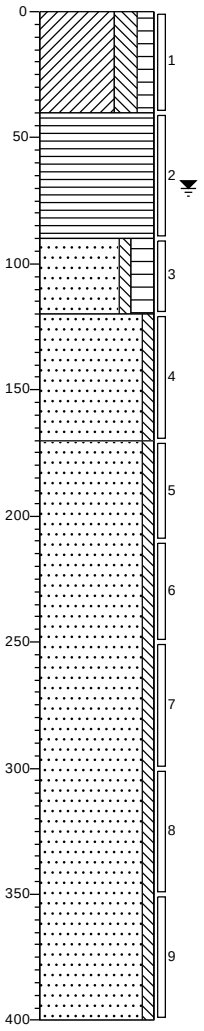
Klei, matig siltig, zwak humeus, zwak wortelhoudend, geen olie-water reactie, K-waarde: 0,04, bruingrijs, Edelmanboor

40

50 Veen, geen olie-water reactie, K-waarde: 0,03, donkerbruin, Edelmanboor

Boring: 61-HB09

Datum: 23-11-2021
X: 202337,28
Y: 509300,83
Boormeester: Marcel la Crois



0 weiland

Klei, sterk siltig, matig humeus, zwak wortelhoudend, geen olie-water reactie, K-waarde: 0,04, donkerbruin, Edelmanboor

40

Veen, zwak zandhoudend, geen olie-water reactie, K-waarde: 0,08, donkerbruin, Edelmanboor

90

Zand, matig fijn, zwak siltig, sterk humeus, geen olie-water reactie, donkerbruin, Edelmanboor

120

Zand, matig fijn, zwak siltig, geen olie-water reactie, K-waarde: 3,5, lichtbeige, Edelmanboor

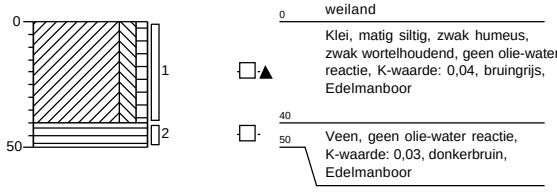
170

Zand, matig fijn, zwak siltig, geen olie-water reactie, K-waarde: 5, licht beigegrijs, Zuigerboor

400

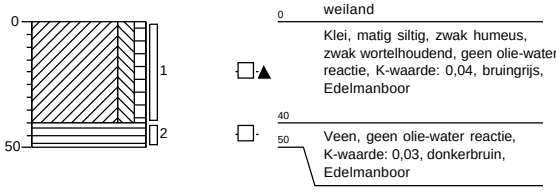
Boring: 61-HB10

Datum: 23-11-2021
X: 202351,73
Y: 509311,51
Boormeester: Marcel la Crois



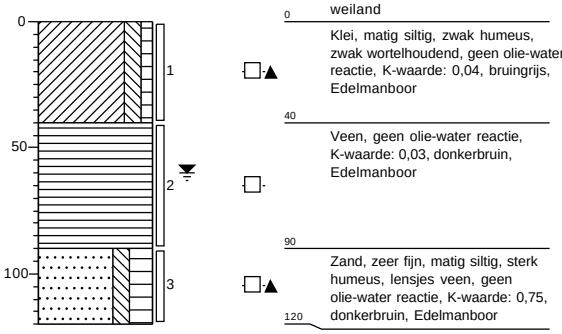
Boring: 61-HB11

Datum: 23-11-2021
X: 202325,07
Y: 509286,28
Boormeester: Marcel la Crois



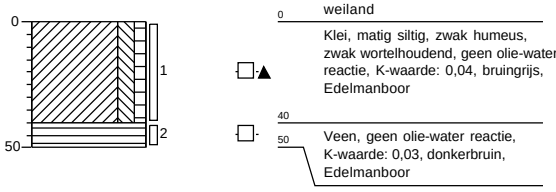
Boring: 61-HB12

Datum: 23-11-2021
X: 202335,76
Y: 509289,90
Boormeester: Marcel la Crois



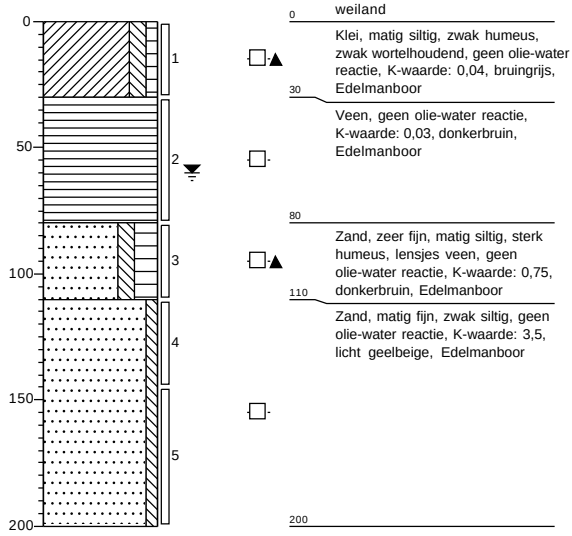
Boring: 61-HB13

Datum: 23-11-2021
X: 202346,57
Y: 509297,13
Boormeester: Marcel la Crois



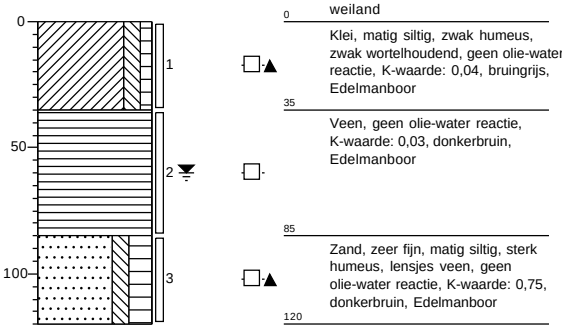
Boring: 61-HB14

Datum: 23-11-2021
X: 202358,08
Y: 509298,30
Boormeester: Marcel la Crois



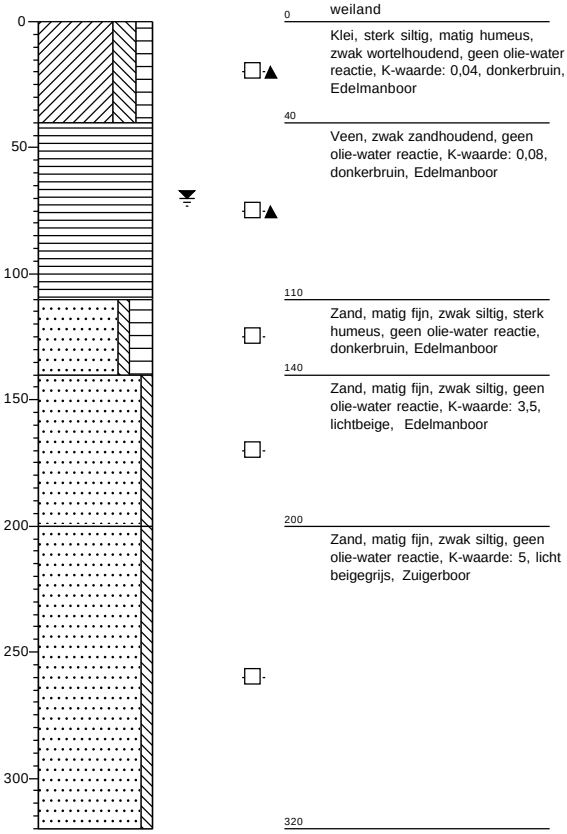
Boring: 61-HB15

Datum: 23-11-2021
X: 202336,63
Y: 509276,46
Boormeester: Marcel la Crois



Boring: 61-HS01

Datum: 23-11-2021
X: 202344,89
Y: 509256,81
Boormeester: Marcel la Crois



0 weiland

Klei, sterk siltig, matig humeus, zwak wortelhoudend, geen olie-water reactie, K-waarde: 0,04, donkerbruin, Edelmanboor

40

Veen, zwak zandhoudend, geen olie-water reactie, K-waarde: 0,08, donkerbruin, Edelmanboor

110

Zand, matig fijn, zwak siltig, sterk humeus, geen olie-water reactie, donkerbruin, Edelmanboor

140

Zand, matig fijn, zwak siltig, geen olie-water reactie, K-waarde: 3,5, lichtbeige, Edelmanboor

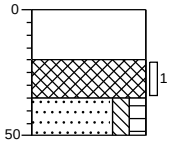
200

Zand, matig fijn, zwak siltig, geen olie-water reactie, K-waarde: 5, licht beigegrijs, Zuigerboor

320

Boring: 61-WB01

Datum: 23-11-2021
X: 202288,49
Y: 509320,18
Boormeester: Marcel la Crois



0 waterspiegel

Zuigerboor

20

Slib, donker zwartgrijs, Zuigerboor

35

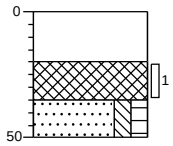
Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor

50

ARCADIS Design & Consultancy for natural and built assets

Boring: 61-WB02

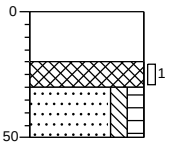
Datum: 23-11-2021
X: 202292,90
Y: 509312,28
Boormeester: Marcel la Crois



0	waterspiegel
	Zuigerboor
20	
	Slib, donker zwartgrijs, Zuigerboor
35	
	Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor
50	

Boring: 61-WB03

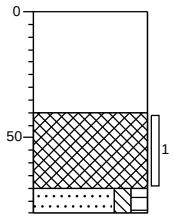
Datum: 23-11-2021
X: 202298,56
Y: 509301,76
Boormeester: Marcel la Crois



0	waterspiegel
	Zuigerboor
20	
30	Slib, donker zwartgrijs, Zuigerboor
	Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor
50	

Boring: 61-WB04

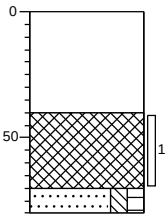
Datum: 23-11-2021
X: 202323,46
Y: 509303,49
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
40 Slib, donker zwartgrijs, Zuigerboor
70
80 Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor

Boring: 61-WB05

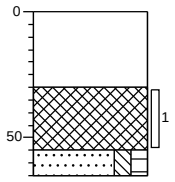
Datum: 23-11-2021
X: 202316,59
Y: 509300,23
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
40 Slib, donker zwartgrijs, Zuigerboor
70
80 Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor

Boring: 61-WB06

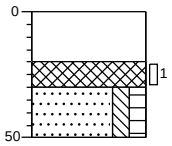
Datum: 23-11-2021
X: 202301,33
Y: 509292,99
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
30
Slib, donker zwartgrijs, Zuigerboor
55
65 Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor

Boring: 61-WB07

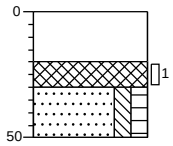
Datum: 23-11-2021
X: 202304,28
Y: 509279,61
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
20
30 Slib, donker zwartgrijs, Zuigerboor
Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor
50

Boring: 61-WB08

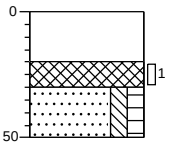
Datum: 23-11-2021
X: 202306,28
Y: 509275,31
Boormeester: Marcel la Crois



0	waterspiegel
	Zuigerboor
20	
30	Slib, donker zwartgrijs, Zuigerboor
	Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor
50	

Boring: 61-WB09

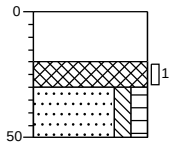
Datum: 23-11-2021
X: 202310,39
Y: 509267,52
Boormeester: Marcel la Crois



0	waterspiegel
	Zuigerboor
20	
30	Slib, donker zwartgrijs, Zuigerboor
	Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor
50	

Boring: 61-WB10

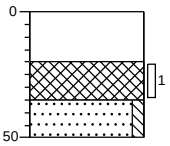
Datum: 23-11-2021
X: 202318,13
Y: 509251,11
Boormeester: Marcel la Crois



0	waterspiegel
	Zuigerboor
20	
30	Slib, donker zwartgrijs, Zuigerboor
	Zand, zeer fijn, matig siltig, matig humeus, donkerbruin, Zuigerboor
50	

Boring: 61-WB11

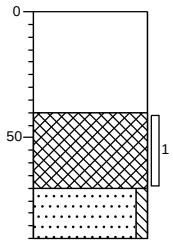
Datum: 23-11-2021
X: 202346,51
Y: 509314,70
Boormeester: Marcel la Crois



0	waterspiegel
	Zuigerboor
20	
	Slib, donker zwartgrijs, Zuigerboor
35	
	Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
50	

Boring: 61-WB12

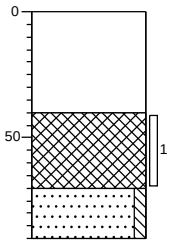
Datum: 23-11-2021
X: 202370,05
Y: 509324,91
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
40
Slib, donker zwartgrijs, Zuigerboor
70
Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
90

Boring: 61-WB13

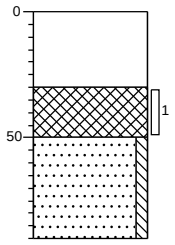
Datum: 23-11-2021
X: 202407,31
Y: 509343,14
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
40
Slib, donker zwartgrijs, Zuigerboor
70
Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
90

Boring: 61-WB14

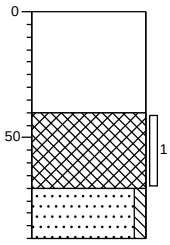
Datum: 23-11-2021
X: 202457,31
Y: 509367,27
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
30
Slib, donker zwartgrijs, Zuigerboor
50
Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
90

Boring: 61-WB15

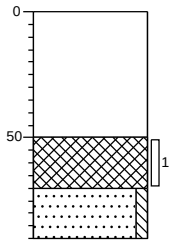
Datum: 23-11-2021
X: 202509,98
Y: 509391,25
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
40
Slib, donker zwartgrijs, Zuigerboor
70
Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
90

Boring: 61-WB16

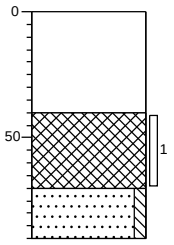
Datum: 23-11-2021
X: 202572,69
Y: 509420,46
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
50 Slib, donker zwartgrijs, Zuigerboor
70 Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
90

Boring: 61-WB17

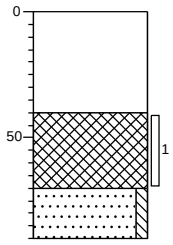
Datum: 23-11-2021
X: 202597,72
Y: 509432,11
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
40 Slib, donker zwartgrijs, Zuigerboor
70 Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
90

Boring: 61-WB18

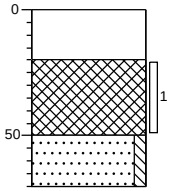
Datum: 23-11-2021
X: 202634,72
Y: 509450,19
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
40
Slib, donker zwartgrijs, Zuigerboor
70
Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
90

Boring: 61-WB19

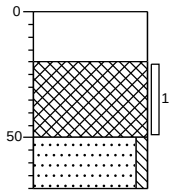
Datum: 23-11-2021
X: 202585,81
Y: 509411,99
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
20
Slib, donker zwartgrijs, Zuigerboor
50
Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
70

Boring: 61-WB20

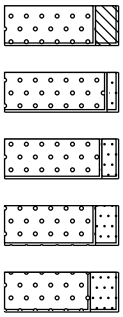
Datum: 23-11-2021
X: 202591,72
Y: 509387,32
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
20
Slib, donker zwartgrijs, Zuigerboor
50
Zand, zeer fijn, zwak siltig, lichtbeige, Zuigerboor
70

Legenda (conform NEN 5104)

grind



Grind, siltig

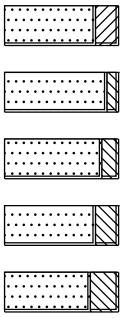
Grind, zwak zandig

Grind, matig zandig

Grind, sterk zandig

Grind, uiterst zandig

zand



Zand, kleïig

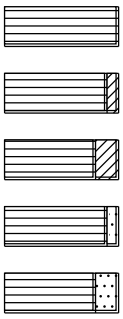
Zand, zwak siltig

Zand, matig siltig

Zand, sterk siltig

Zand, uiterst siltig

veen



Veen, mineraalarm

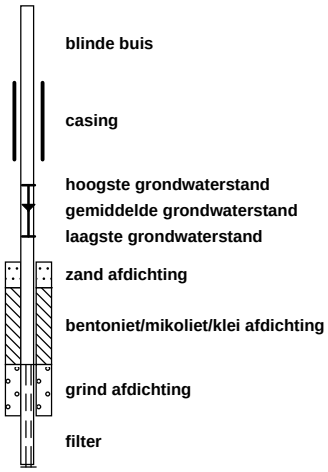
Veen, zwak kleïig

Veen, sterk kleïig

Veen, zwak zandig

Veen, sterk zandig

peilbuis



blinde buis

casing

hoogste grondwaterstand
gemiddelde grondwaterstand
laagste grondwaterstand

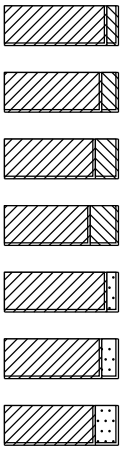
zand afdichting

bentoniet/mikoliet/klei afdichting

grind afdichting

filter

klei



Klei, zwak siltig

Klei, matig siltig

Klei, sterk siltig

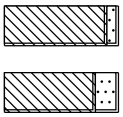
Klei, uiterst siltig

Klei, zwak zandig

Klei, matig zandig

Klei, sterk zandig

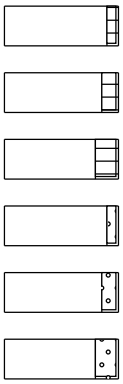
leem



Leem, zwak zandig

Leem, sterk zandig

overige toevoegingen



zwak humeus

matig humeus

sterk humeus

zwak grindig

matig grindig

sterk grindig

geur

- geen geur
- zwakke geur
- matige geur
- sterke geur
- uiterste geur

olie

- geen olie-water reactie
- zwakke olie-water reactie
- matige olie-water reactie
- sterke olie-water reactie
- uiterste olie-water reactie

p.i.d.-waarde

- >0
- >1
- >10
- >100
- >1000
- >10000

monsters

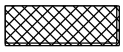
geroerd monster

ongeroerd monster

volumering

overig

- bijzonder bestanddeel
- Gemiddeld hoogste grondwaterstand
- grondwaterstand
- Gemiddeld laagste grondwaterstand



slib

water

Bijlage C – Analysecertificaten

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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A. Faber
Postbus 161
6800 AD Arnhem

Datum	29.11.2021
Relatienr	35006104
Opdrachtnr.	1103647

ANALYSERAPPORT

***Opdracht* 1103647 Water**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	24.11.21

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen U met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB
TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1103647 Water**

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
816932	61-1HB	23.11.2021	
816933	64-1HB (175-275)	23.11.2021	

		Eenheid	816932 61-1HB	816933 64-1HB (175-275)
Metalen (AS3000)				
S	Barium (Ba)	µg/l	**110**	**37**
S	Cadmium (Cd)	µg/l	**<0,20**	**<0,20**
S	Kobalt (Co)	µg/l	**<2,0**	**<2,0**
S	Koper (Cu)	µg/l	**<2,0**	**<2,0**
S	Kwik (Hg)	µg/l	**<0,05**	**<0,05**
S	Lood (Pb)	µg/l	**<2,0**	**<2,0**
S	Molybdeen (Mo)	µg/l	**<2,0**	**<2,0**
S	Nikkel (Ni)	µg/l	**<3,0**	**<3,0**
S	Zink (Zn)	µg/l	**<10**	**<10**
Aromaten (AS3000)				
S	Benzeen	µg/l	**<0,20**	**<0,20**
S	Tolueen	µg/l	**<0,20**	**<0,20**
S	Ethylbenzeen	µg/l	**<0,20**	**<0,20**
S	*m,p-Xyleen*	µg/l	**<0,20**	**<0,20**
S	*ortho-Xyleen*	µg/l	**<0,10**	**<0,10**
S	**Som Xylenen (Factor 0,7)**	µg/l	**0,21** #)	**0,21** #)
S	Naftaleen	µg/l	**<0,020**	**<0,020**
S	Styreen	µg/l	**<0,20**	**<0,20**
Chloorhoudende koolwaterstoffen (AS3000)				
S	Dichloormethaan	µg/l	**<0,20**	**<0,20**
S	Trichloormethaan (Chloroform)	µg/l	**<0,20**	**<0,20**
S	Tetrachloormethaan (Tetra)	µg/l	**<0,10**	**<0,10**
S	1,1-Dichloorethaan	µg/l	**<0,20**	**<0,20**
S	1,2-Dichloorethaan	µg/l	**<0,20**	**<0,20**
S	1,1,1-Trichloorethaan	µg/l	**<0,10**	**<0,10**
S	1,1,2-Trichloorethaan	µg/l	**<0,10**	**0,12**
S	Vinylchloride	µg/l	**<0,20**	**<0,20**
S	*1,1-Dichlooretheen*	µg/l	**<0,10**	**<0,10**
S	*Cis-1,2-Dichlooretheen*	µg/l	**<0,10**	**<0,10**
S	*trans-1,2-Dichlooretheen*	µg/l	**<0,10**	**<0,10**
S	**Som cis/trans-1,2-Dichlooretheen (Factor 0,7)**	µg/l	**0,14** #)	**0,14** #)
S	**Som Dichlooretheen (Factor 0,7)**	µg/l	**0,21** #)	**0,21** #)
S	Trichlooretheen (Tri)	µg/l	**<0,20**	**<0,20**
S	Tetrachlooretheen (Per)	µg/l	**<0,10**	**<0,10**

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht 1103647 Water

		Eenheid	816932 61-1HB	816933 64-1HB (175-275)
Chloorhoudende koolwaterstoffen (AS3000)				
S	*1,1-Dichloorpropaan*	µg/l	**<0,20**	**<0,20**
S	*1,2-Dichloorpropaan*	µg/l	**<0,20**	**<0,20**
S	*1,3-Dichloorpropaan*	µg/l	**<0,20**	**<0,20**
S	**Som Dichloorpropanen (Factor 0,7)**	µg/l	**0,42** #)	**0,42** #)
Broomhoudende koolwaterstoffen				
S	Tribroommethaan (bromoform)	µg/l	**<0,20**	**<0,60** m)
Minerale olie (AS3000)				
S	Koolwaterstoffractie C10-C40	µg/l	**<50**	**<50**
	Koolwaterstoffractie C10-C12	µg/l	**<10** *)	**<10** *)
	Koolwaterstoffractie C12-C16	µg/l	**<10** *)	**<10** *)
	Koolwaterstoffractie C16-C20	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C20-C24	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C24-C28	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C28-C32	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C32-C36	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C36-C40	µg/l	**<5,0** *)	**<5,0** *)

m) De rapportagegrens is verhoogd, omdat door matrixeffecten, resp. co-elutie een kwantificering bemoeilijkt wordt.

S) Erkend volgens AS SIKB 3000

Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. ?? Die Mindestleistungskriterien der angewandten Verfahren beruhen bezüglich der Messunsicherheit in der Regel auf der Richtlinie 2009/90/EG der Europäischen Kommission.

Begin van de analyses: 25.11.2021
Einde van de analyses: 29.11.2021

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Toegepaste methoden

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	25.11.2021
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	29.11.2021
AL-West Opdrachtnummer	1103647		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
816932	A10200928018		23.11.21	23.11.21
816932	A11300190866		23.11.21	23.11.21
816932	A20500091547		23.11.21	23.11.21
816933	A10200928027		23.11.21	23.11.21
816933	A11300190862		23.11.21	23.11.21
816933	A20500091544		23.11.21	23.11.21

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

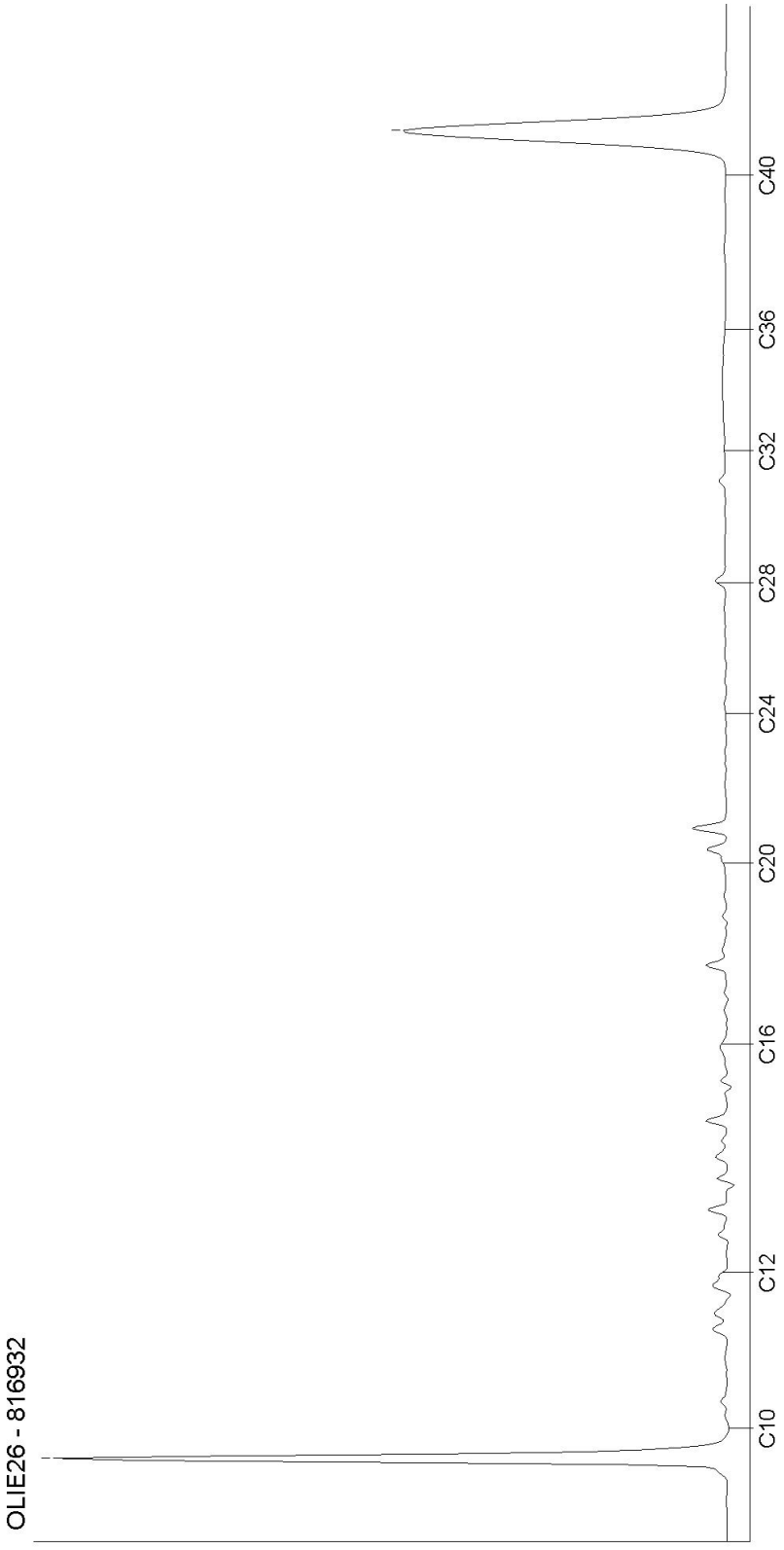
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1103647, Analysis No. 816932, created at 29.11.2021 10:07:52

Monster beschrijving: 61-1HB



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VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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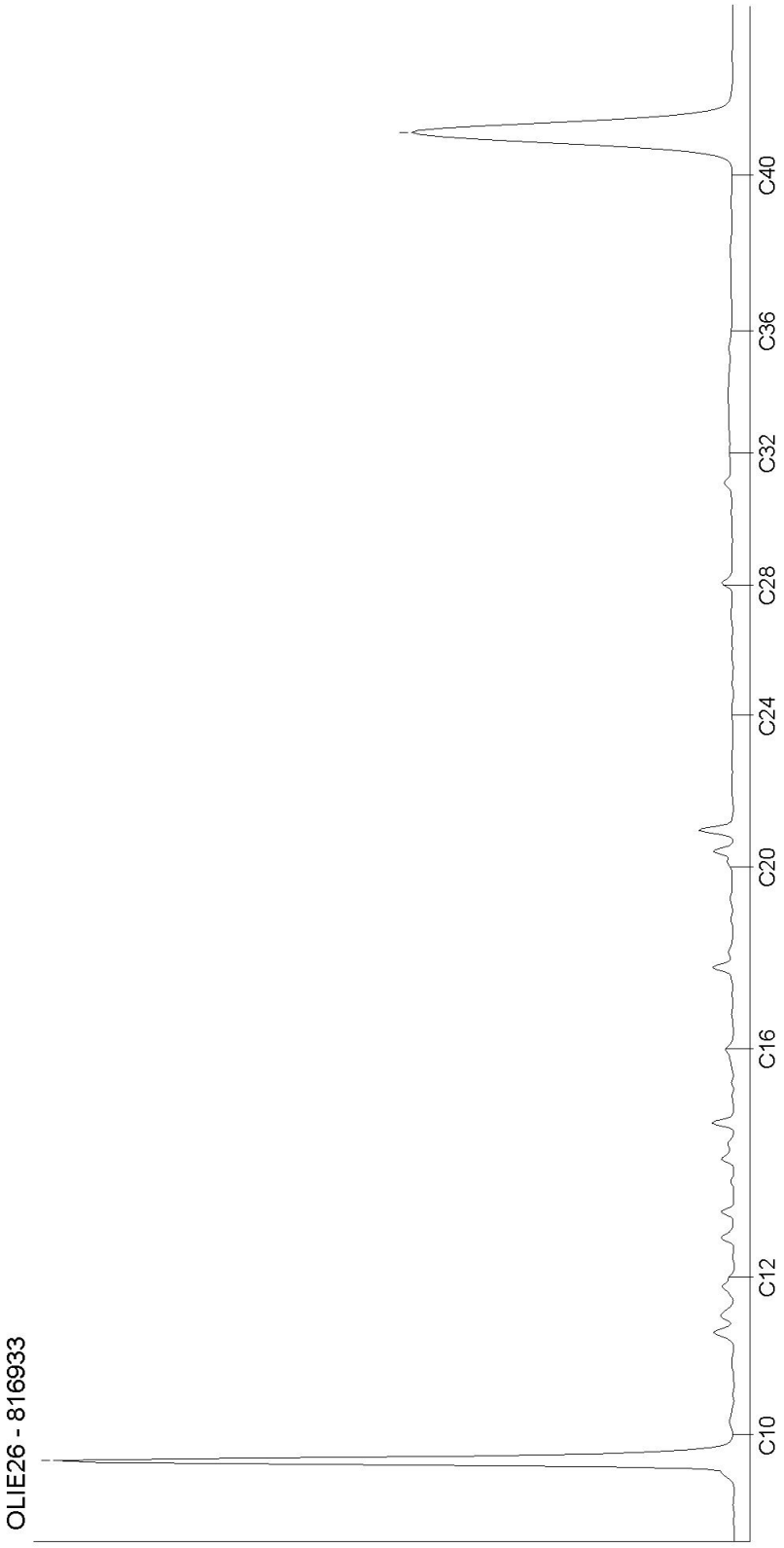
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1103647, Analysis No. 816933, created at 29.11.2021 10:07:52

Monster beschrijving: 64-1HB (175-275)



Kamer van Koophandel
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Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
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e-Mail: info@al-west.nl, www.al-west.nl

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A. Faber
Postbus 161
6800 AD Arnhem

Datum	16.02.2022
Relatienr	35006104
Opdrachtnr.	1127979

ANALYSERAPPORT

Opdracht **1127979 Water**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	15.02.22

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Let op: alleen de algemene voorwaarden van AL-West gedeponeerd bij de KvK te Deventer, zijn van toepassing.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen erop u met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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DOC-13-17854476-NL-P1

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1127979 Water**

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
156943	48-1HB-wamo-1-1 48-1HB-wamo (20	14.02.2022	

	Eenheid	**156943** 48-1HB-wamo-1-1 48-1HB-wamo (200-300)
Klassiek Chemische Analyses		
Onopgeloste bestanddelen	mg/l	**27**

De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Begin van de analyses: 15.02.2022
Einde van de analyses: 16.02.2022

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Toegepaste methoden

conform NEN-EN 872 : Onopgeloste bestanddelen

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) " .

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	15.02.2022
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	16.02.2022
AL-West Opdrachtnummer	1127979		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
156943	A70100041501		14.02.22	15.02.22

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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A. Faber
Postbus 161
6800 AD Arnhem

Datum	10.03.2022
Relatienr	35006104
Opdrachtnr.	1134952

ANALYSERAPPORT

Opdracht **1134952** Water

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	08.03.22

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Let op: alleen de algemene voorwaarden van AL-West gedeponeerd bij de KvK te Deventer, zijn van toepassing.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen erop u met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1134952** Water

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
193865	44-PB01-1-1 44-PB01 (170-270)	07.03.2022	
193866	61PB01-1-1 61PB01 (180-280)	07.03.2022	
193867	64PB01-1-1 64PB01 (400-500)	07.03.2022	

		Eenheid	193865 44-PB01-1-1 44-PB01 (170-270)	193866 61PB01-1-1 61PB01 (180-280)	193867 64PB01-1-1 64PB01 (400-500)
Klassiek Chemische Analyses					
S	pH		**6,3**	**7,1**	**6,8**
	Ammonium (als N)	mg/l	**4,3**	**2,3**	**2,2**
S	Chloride (Cl)	mg/l	**51**	**65**	**<50**
S	Sulfaat (SO4)	mg/l	**240**	**<30**	**<30**
	totaal fosfor (P)	mg/l	**0,07**	**0,19**	**1,3**
	Onopgeloste bestanddelen	mg/l	**75**	**94**	**150**
Metalen					
	IJzer (Fe)	µg/l	**7500**	**8800**	**32000**

S) Erkend volgens AS SIKB 3000
Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Analyse chloride (Cl): Bromide (gehalte boven 30 mg/l) en sulfide storen de bepaling van chloride en worden als chloride meebepaald.

Begin van de analyses: 08.03.2022
Einde van de analyses: 10.03.2022

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Toegepaste methoden

conform NEN-EN 872 : Onopgeloste bestanddelen
Conform NEN-EN-ISO 17294-2 (2004) : IJzer (Fe)
conform NEN-ISO 15923-1 : Ammonium (als N)
Gelijkwaardig aan NEN-EN-ISO 15681-2 : totaal fosfor (P)
Protocollen AS 3100 : pH Chloride (Cl) Sulfaat (SO4)

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) " .

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Bijlage bij Opdrachtnr. 1134952

CONSERVERING, CONSERVERINGSTERMIJN EN VERPAKKING

Er zijn verschillen met de richtlijnen geconstateerd die mogelijk de betrouwbaarheid van de analyseresultaten beïnvloeden. De conserveringstermijn is voor volgende analyse overschreden:

pH	193865, 193866, 193867

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	08.03.2022
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	10.03.2022
AL-West Opdrachtnummer	1134952		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
193865	A10200963715		07.03.22	07.03.22
193865	A10700080022		07.03.22	07.03.22
193865	A11300184654		07.03.22	07.03.22
193865	A20300508909		07.03.22	07.03.22
193865	A20500146630		07.03.22	07.03.22
193865	A20800562507		07.03.22	07.03.22
193865	A21000006810		07.03.22	07.03.22
193865	A70100041473		07.03.22	07.03.22
193866	A10200963734		07.03.22	07.03.22
193866	A10700080036		07.03.22	07.03.22
193866	A11300184661		07.03.22	07.03.22
193866	A20300508910		07.03.22	07.03.22
193866	A20500146653		07.03.22	07.03.22
193866	A20800562538		07.03.22	07.03.22
193866	A21000006826		07.03.22	07.03.22
193866	A70100041480		07.03.22	07.03.22
193867	A10200963706		07.03.22	07.03.22
193867	A10700080035		07.03.22	07.03.22
193867	A11300184662		07.03.22	07.03.22
193867	A20300508902		07.03.22	07.03.22
193867	A20500146646		07.03.22	07.03.22
193867	A20800562544		07.03.22	07.03.22
193867	A21000006825		07.03.22	07.03.22
193867	A70100041516		07.03.22	07.03.22

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

DOC-13-18003358-NL-P1

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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ARCADIS NEDERLAND BV
S. van den Bosse
Postbus 161
6800 AD Arnhem

Datum	16.03.2022
Relatienr	35006104
Opdrachtnr.	1135118

ANALYSERAPPORT

Opdracht **1135118** Water

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 Opwaardering 380kv verbinding Ens-Zwolle 30073259/01
Opdrachtacceptatie	11.03.22

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Let op: alleen de algemene voorwaarden van AL-West gedeponeerd bij de KvK te Deventer, zijn van toepassing.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen erop u met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1135118** Water

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
194727	44-PB01-1-1	07.03.2022	
194728	61PB01-1-1	07.03.2022	
194729	64PB01-1-1	07.03.2022	

		Eenheid	194727 44-PB01-1-1	194728 61PB01-1-1	194729 64PB01-1-1
Klassiek Chemische Analyses					
	Ammonium (als N)	mg/l	**4,4**	**2,3**	**2,3**
S	Chloride (Cl)	mg/l	**53**	**67**	**<50**
S	Sulfaat (SO4)	mg/l	**240**	**<30**	**<30**
	Onopgeloste bestanddelen (NEN 6621)	mg/l	**157** *)	**618** *)	**335** *)
Metalen					
	IJzer (Fe)	µg/l	**7400**	**8900**	**35000**
Metalen (AS3000)					
S	Barium (Ba)	µg/l	**130**	**37**	**79**
S	Cadmium (Cd)	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Kobalt (Co)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Koper (Cu)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Kwik (Hg)	µg/l	**<0,050**	**<0,050**	**<0,050**
S	Lood (Pb)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Molybdeen (Mo)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Nikkel (Ni)	µg/l	**<3,0**	**<3,0**	**<3,0**
S	Zink (Zn)	µg/l	**<10**	**<10**	**<10**
Aromaten (AS3000)					
S	Benzeen	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Tolueen	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Ethylbenzeen	µg/l	**<0,20**	**<0,20**	**<0,20**
S	*m,p-Xyleen*	µg/l	**0,55**	**0,26**	**0,25**
S	*ortho-Xyleen*	µg/l	**0,15**	**<0,10**	**0,12**
S	**Som Xylenen (Factor 0,7)**	µg/l	**0,70**	**0,33** #)	**0,37**
S	Naftaleen	µg/l	**<0,020**	**<0,020**	**<0,020**
S	Styreen	µg/l	**<0,20**	**<0,20**	**<0,20**
Chloorhoudende koolwaterstoffen (AS3000)					
S	Dichloormethaan	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Trichloormethaan (Chloroform)	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Tetrachloormethaan (Tetra)	µg/l	**<0,10**	**<0,10**	**<0,10**
S	1,1-Dichloorethaan	µg/l	**<0,20**	**<0,20**	**<0,20**
S	1,2-Dichloorethaan	µg/l	**<0,20**	**<0,20**	**<0,20**
S	1,1,1-Trichloorethaan	µg/l	**<0,10**	**<0,10**	**<0,10**
S	1,1,2-Trichloorethaan	µg/l	**<0,10**	**<0,10**	**<0,10**
S	Vinylchloride	µg/l	**<0,20**	**<0,20**	**<0,20**

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1135118** Water

		Eenheid	194727 44-PB01-1-1		194728 61PB01-1-1		194729 64PB01-1-1	
Chloorhoudende koolwaterstoffen (AS3000)								
S	*1,1-Dichlooretheen*	µg/l	**<0,10**		**<0,10**		**<0,10**	
S	*Cis-1,2-Dichlooretheen*	µg/l	**<0,10**		**<0,10**		**<0,10**	
S	*trans-1,2-Dichlooretheen*	µg/l	**<0,10**		**<0,10**		**<0,10**	
S	**Som cis/trans-1,2-Dichlooretheen (Factor 0,7)**	µg/l	**0,14**	#)	**0,14**	#)	**0,14**	#)
S	**Som Dichlooretheen (Factor 0,7)**	µg/l	**0,21**	#)	**0,21**	#)	**0,21**	#)
S	Trichlooretheen (Tri)	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	Tetrachlooretheen (Per)	µg/l	**0,21**		**1,7**		**0,25**	
S	*1,1-Dichloorpropaan*	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	*1,2-Dichloorpropaan*	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	*1,3-Dichloorpropaan*	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	**Som Dichloorpropanen (Factor 0,7)**	µg/l	**0,42**	#)	**0,42**	#)	**0,42**	#)
Broomhoudende koolwaterstoffen								
S	Tribroommethaan (bromoform)	µg/l	**<0,20**		**<0,20**		**<0,20**	
Minerale olie (AS3000)								
S	Koolwaterstoffractie C10-C40	µg/l	**<50**		**<50**		**<50**	
	Koolwaterstoffractie C10-C12	µg/l	**<10**	*)	**<10**	*)	**<10**	*)
	Koolwaterstoffractie C12-C16	µg/l	**<10**	*)	**<10**	*)	**<10**	*)
	Koolwaterstoffractie C16-C20	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C20-C24	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C24-C28	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C28-C32	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C32-C36	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C36-C40	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
Overig onderzoek								
	Ortho-Fosfaat (o-PO4)	mg/l	**0,039**		**0,53**		**0,57**	

#) Bij deze som zijn resultaten "<rapportagegrens" vermenigvuldigd met 0,7.

S) Erkend volgens AS SIKB 3000

Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Analyse chloride (Cl): Bromide (gehalte boven 30 mg/l) en sulfide storen de bepaling van chloride en worden als chloride meebepaald.

Analyse ortho fosfaat: een gehalte aan silicaat hoger dan 5 mg/l kan een storing veroorzaken op het gehalte van ortho fosfaat.

Begin van de analyses: 11.03.2022
Einde van de analyses: 16.03.2022

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

DOC-13-18033950-NL-P3

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1135118** Water

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Toegepaste methoden

conform NEN 6621 (1992) *): Onopgeloste bestanddelen (NEN 6621)

Conform NEN-EN-ISO 17294-2 (2004) : IJzer (Fe)

conform NEN-ISO 15923-1 : Ammonium (als N) Ortho-Fosfaat (o-PO4)

eigen methode *): Koolwaterstoffractie C10-C12 Koolwaterstoffractie C12-C16 Koolwaterstoffractie C16-C20 Koolwaterstoffractie C20-C24 Koolwaterstoffractie C24-C28 Koolwaterstoffractie C28-C32 Koolwaterstoffractie C32-C36 Koolwaterstoffractie C36-C40

Protocollen AS 3100 : Chloride (Cl) Sulfaat (SO4) Barium (Ba) Cadmium (Cd) Kobalt (Co) Koper (Cu) Kwik (Hg) Lood (Pb) Molybdeen (Mo) Nikkel (Ni) Zink (Zn) Dichloormethaan Tribroommethaan (bromoform) Benzeen Trichloormethaan (Chloroform) Tetrachloormethaan (Tetra) Tolueen Ethylbenzeen 1,1-Dichloorethaan m,p-Xyleen ortho-Xyleen 1,2-Dichloorethaan Som Xylenen (Factor 0,7) Naftaleen Styreen 1,1,1-Trichloorethaan 1,1,2-Trichloorethaan Vinylchloride 1,1-Dichlooretheen Cis-1,2-Dichlooretheen trans-1,2-Dichlooretheen Som cis/trans-1,2-Dichlooretheen (Factor 0,7) Som Dichlooretheen (Factor 0,7) Trichlooretheen (Tri) Tetrachlooretheen (Per) 1,1-Dichloorpropaan 1,2-Dichloorpropaan 1,3-Dichloorpropaan Som Dichloorpropanen (Factor 0,7) Koolwaterstoffractie C10-C40

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
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Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Bijlage bij Opdrachtnr. 1135118

CONSERVERING, CONSERVERINGSTERMIJN EN VERPAKKING

Er zijn verschillen met de richtlijnen geconstateerd die mogelijk de betrouwbaarheid van de analyseresultaten beïnvloeden. De conserveringstermijn is voor volgende analyse overschreden:

Onopgeloste bestanddelen (NEN 6621)	194727, 194728, 194729
Naftaleen	194727, 194728, 194729
1,2-Dichloorpropaan	194727, 194728, 194729
1,1,1-Trichloorethaan	194727, 194728, 194729
Trichlooretheen (Tri)	194727, 194728, 194729
Tetrachlooretheen (Per)	194727, 194728, 194729
m,p-Xyleen	194727, 194728, 194729
1,3-Dichloorpropaan	194727, 194728, 194729
Dichloormethaan	194727, 194728, 194729
1,1-Dichloorpropaan	194727, 194728, 194729
1,1-Dichlooretheen	194727, 194728, 194729
Vinylchloride	194727, 194728, 194729
Kwik (Hg)	194727, 194728, 194729
Ethylbenzeen	194727, 194728, 194729
ortho-Xyleen	194727, 194728, 194729
Tribroommethaan (bromoform)	194727, 194728, 194729
Tetrachloormethaan (Tetra)	194727, 194728, 194729
1,1,2-Trichloorethaan	194727, 194728, 194729
Styreen	194727, 194728, 194729
Cis-1,2-Dichlooretheen	194727, 194728, 194729
1,2-Dichloorethaan	194727, 194728, 194729
trans-1,2-Dichlooretheen	194727, 194728, 194729
Benzeen	194727, 194728, 194729
1,1-Dichloorethaan	194727, 194728, 194729
Tolueen	194727, 194728, 194729
Trichloormethaan (Chloroform)	194727, 194728, 194729

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259	Begin van de analyses:	11.03.2022
Projectnaam	Opwaardering 380kv verbinding Ens-Zwolle	Einde van de analyses:	16.03.2022

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
194727	A10200963715		07.03.22	07.03.22
194727	A10700080022		07.03.22	07.03.22
194727	A11300184654		07.03.22	07.03.22
194727	A20300508909		07.03.22	07.03.22
194727	A20500146630		07.03.22	07.03.22
194727	A20800562507		07.03.22	07.03.22
194727	A21000006810		07.03.22	07.03.22
194727	A70100041473		07.03.22	07.03.22
194728	A10200963734		07.03.22	07.03.22
194728	A10700080036		07.03.22	07.03.22
194728	A11300184661		07.03.22	07.03.22
194728	A20300508910		07.03.22	07.03.22
194728	A20500146653		07.03.22	07.03.22
194728	A20800562538		07.03.22	07.03.22
194728	A21000006826		07.03.22	07.03.22
194728	A70100041480		07.03.22	07.03.22
194729	A10200963706		07.03.22	07.03.22
194729	A10700080035		07.03.22	07.03.22
194729	A11300184662		07.03.22	07.03.22
194729	A20300508902		07.03.22	07.03.22
194729	A20500146646		07.03.22	07.03.22
194729	A20800562544		07.03.22	07.03.22
194729	A21000006825		07.03.22	07.03.22
194729	A70100041516		07.03.22	07.03.22

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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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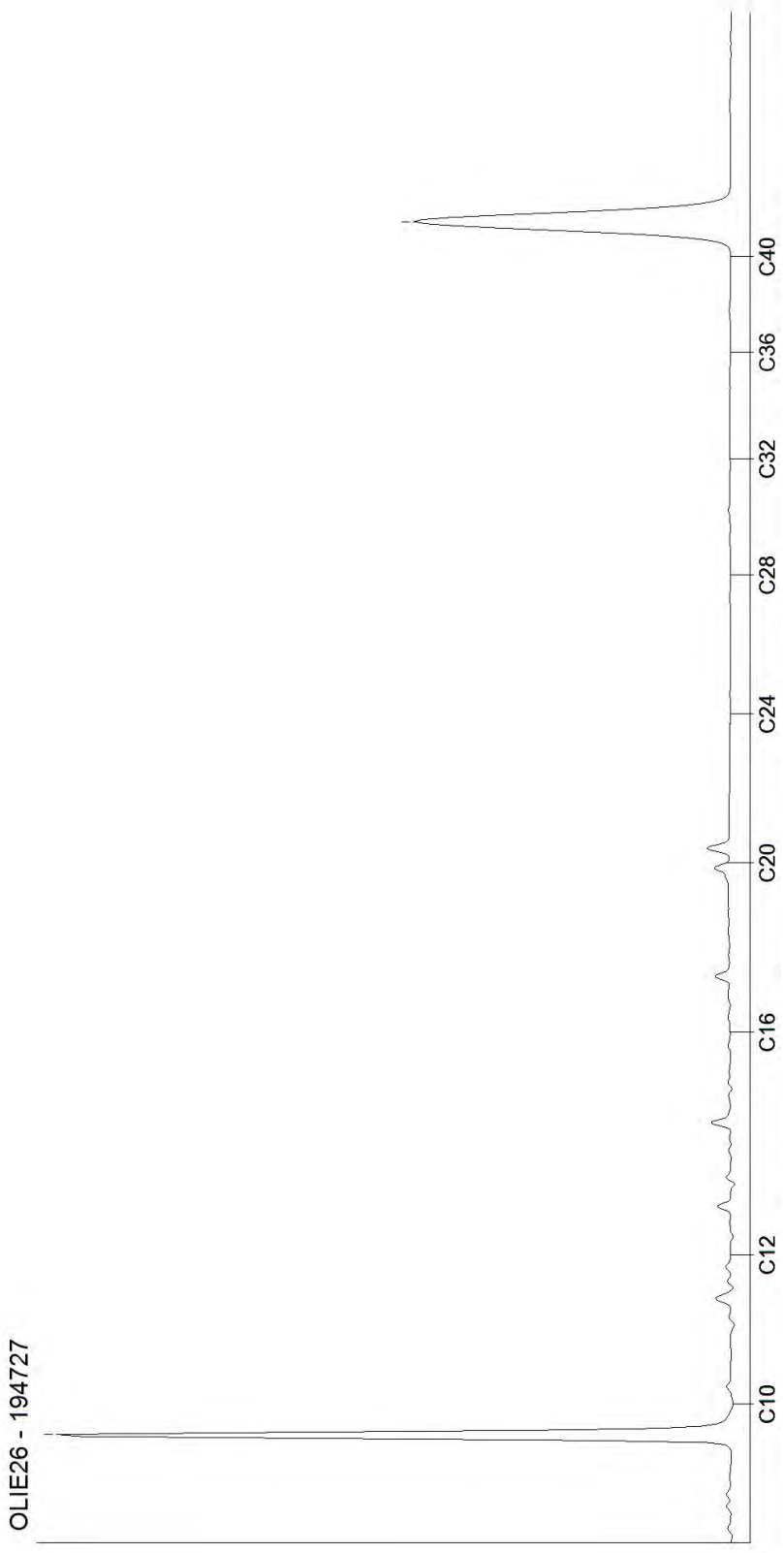
AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1135118, Analysis No. 194727, created at 15.03.2022 13:57:56

Monster beschrijving: 44-PB01-1-1



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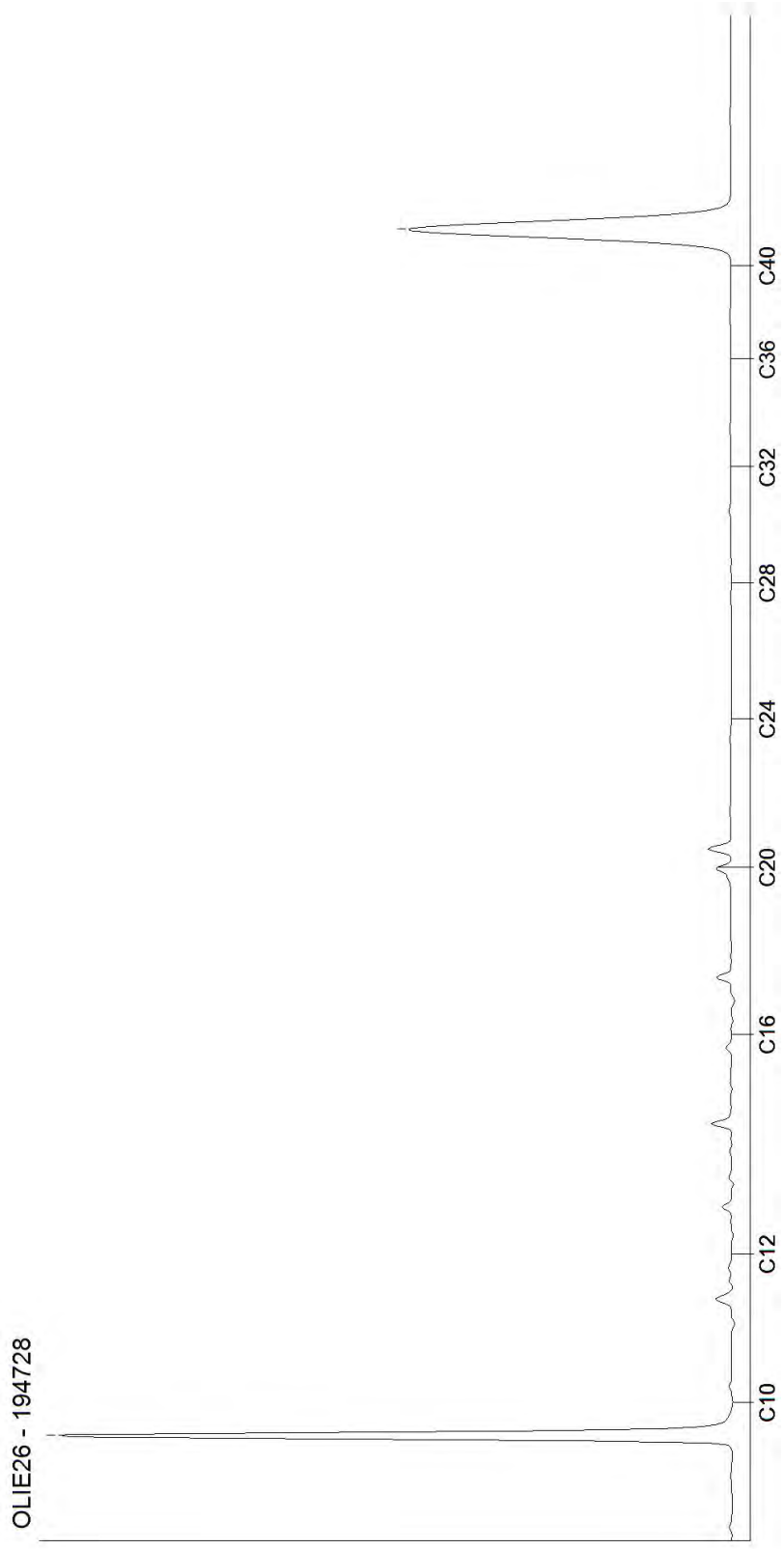
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1135118, Analysis No. 194728, created at 15.03.2022 13:57:56

Monster beschrijving: 61PB01-1-1



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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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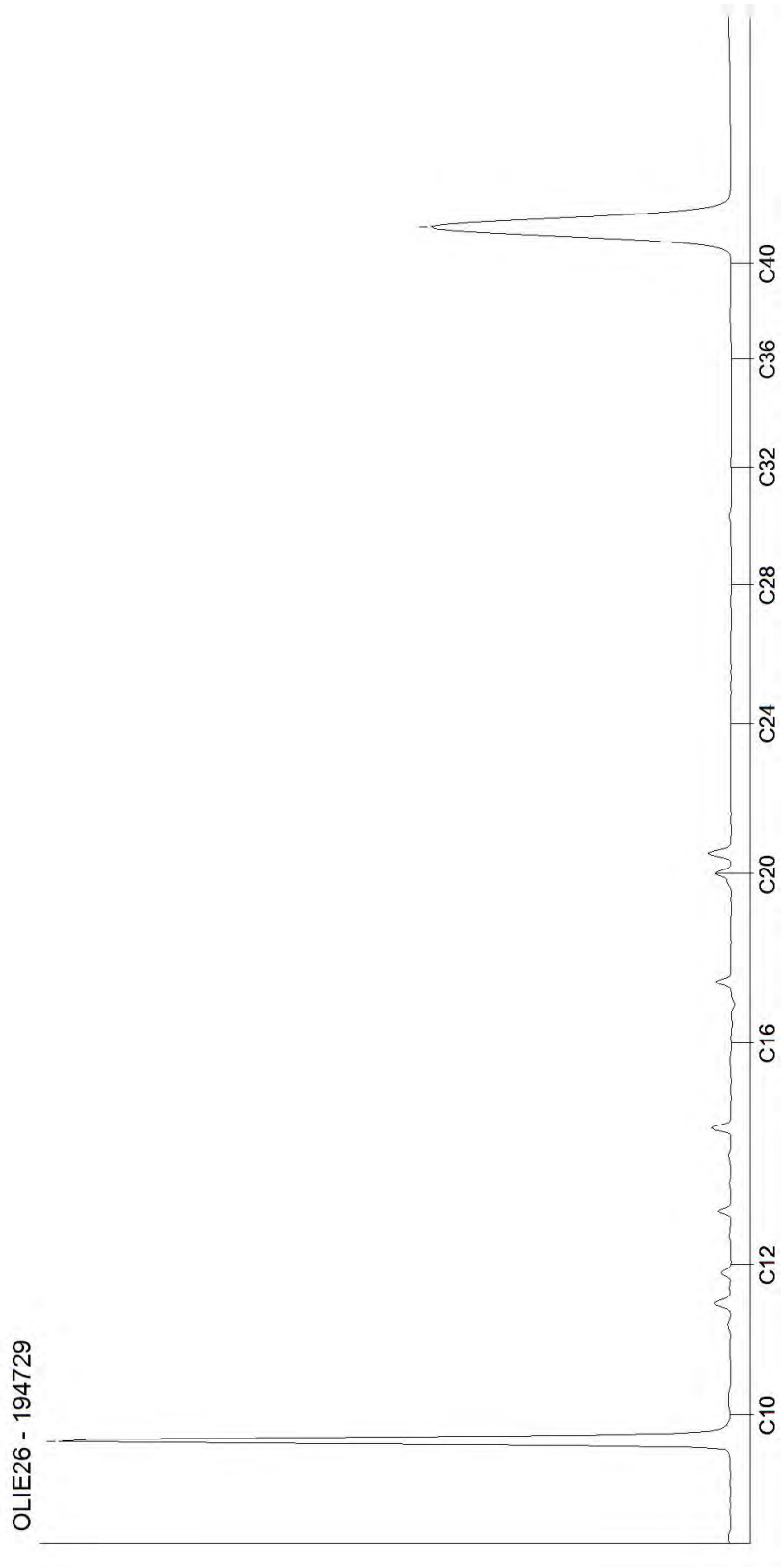
AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1135118, Analysis No. 194729, created at 15.03.2022 13:57:56

Monster beschrijving: 64PB01-1-1



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NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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ARCADIS NEDERLAND BV
A. Faber
Postbus 161
6800 AD Arnhem

Datum	30.11.2021
Relatienr	35006104
Opdrachtnr.	1104073

ANALYSERAPPORT

***Opdracht* 1104073 Waterbodem**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	25.11.21

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen U met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104073 Waterbodem**

Monsternr.	*Monstername*	*Monster beschrijving*
819440	23.11.2021	61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-W
819441	23.11.2021	61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-W
819442	22.11.2021	64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-W

		Eenheid	819440 61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-WB08 (20-30) 61-WB09 (20-30) 61-WB10 (20-30)	819441 61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-WB18 (40-70) 61-WB19 (20-50) 61-WB20 (20-50)	819442 64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-WB08 (30-50) 64-WB09 (30-50) 64-WB10 (30-50)
Algemene monstervoorbehandeling					
S	Voorbehandeling waterbodem		++	++	++
S	Droge stof	%	37,6	35,6	23,1
Fracties (sedigraaf)					
S	Fraktie <2µm (lutum)	% Ds	16	8,0	9,3
	Fractie < 16 µm	% Ds	25 *)	14 *)	18 *)
Klassiek Chemische Analyses					
S	Organische stof, na lutum correctie	% Ds	18,9 x)	16,4 x)	22,3 x)
Voorbehandeling metalen analyse					
S	Koningswater ontsluiting		++	++	++
Metalen (AS3200)					
S	Barium (Ba)	mg/kg Ds	72	140	65
S	Cadmium (Cd)	mg/kg Ds	0,2	0,3	1,2
S	Kobalt (Co)	mg/kg Ds	3,8	5,0	14
S	Koper (Cu)	mg/kg Ds	9,8	14	22
S	Kwik (Hg)	mg/kg Ds	<0,05	<0,05	<0,05
S	Lood (Pb)	mg/kg Ds	12	20	44
S	Molybdeen (Mo)	mg/kg Ds	<1,5	<1,5	<1,5
S	Nikkel (Ni)	mg/kg Ds	11	15	26
S	Zink (Zn)	mg/kg Ds	40	66	170
PAK (AS3200)					
S	*Anthraceen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Benzo(a)anthraceen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,27
S	*Benzo-(a)-Pyreen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Benzo(ghi)peryleen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Benzo(k)fluorantheen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Chryseen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,36
S	*Fenanthreen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Fluorantheen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,56
S	*Indeno-(1,2,3-c,d)pyreen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,29
S	*Naftaleen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	**Som PAK (VROM) (Factor 0,7)**	mg/kg Ds	1,4 #)	1,4 #)	3,6 #)
Minerale olie (AS3000/AS3200)					
S	Koolwaterstoffractie C10-C40	mg/kg Ds	<110 ts)	<110 ts)	<180 ts)
	Koolwaterstoffractie C10-C12	mg/kg Ds	<9 ts) *)	<9 ts) *)	<15 ts) *)

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104073 Waterbodem**

		Eenheid	819440 61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-WB08 (20-30) 61-WB09 (20-30) 61-WB10 (20-30)	819441 61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-WB18 (40-70) 61-WB19 (20-50) 61-WB20 (20-50)	819442 64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-WB08 (30-50) 64-WB09 (30-50) 64-WB10 (30-50)
Minerale olie (AS3000/AS3200)					
	Koolwaterstoffractie C12-C16	mg/kg Ds	**<9** *ts) *)	**<9** *ts) *)	**<15** *ts) *)
	Koolwaterstoffractie C16-C20	mg/kg Ds	**<12** *ts) *)	**<12** *ts) *)	**<20** *ts) *)
	Koolwaterstoffractie C20-C24	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
	Koolwaterstoffractie C24-C28	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
	Koolwaterstoffractie C28-C32	mg/kg Ds	**13** *)	**21** *)	**30** *)
	Koolwaterstoffractie C32-C36	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
	Koolwaterstoffractie C36-C40	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
Polychloorbifenylen (AS3200)					
S	*PCB 28*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 52*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 101*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 118*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 138*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 153*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 180*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	**Som PCB (7 Ballschmiter) (Factor 0,7)**	mg/kg Ds	**0,0049** #)	**0,0049** #)	**0,0049** #)

x) Gehaltes beneden de rapportagegrens zijn niet mee inbegrepen.
#) Bij deze som zijn resultaten "<rapportagegrens" vermenigvuldigd met 0,7.
ts) De rapportagegrens is verhoogd vanwege het lage droge stofgehalte.
S) Erkend volgens AS SIKB 3000
Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Het analyseresultaat van PCB 138 is mogelijk overschat vanwege co-elutie met PCB 163

Begin van de analyses: 25.11.2021
Einde van de analyses: 30.11.2021

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104073 Waterbodem**

Toegepaste methoden

conform Protocollen AS 3200 : Organische stof, na lutum correctie Voorbehandeling waterbodem Barium (Ba) Cadmium (Cd) Kobalt (Co) Koper (Cu) Kwik (Hg) Lood (Pb) Molybdeen (Mo) Nikkel (Ni) Zink (Zn) Koolwaterstoffractie C10-C40 Anthraceen Benzo(a)anthraceen Benzo-(a)-Pyreen Benzo(ghi)peryleen Benzo(k)fluorantheen Chryseen Fenanthreen Fluorantheen Indeno-(1,2,3-c,d)pyreen Naftaleen Som PAK (VROM) (Factor 0,7) Fraktie <2µm (lutum) PCB 28 PCB 52 PCB 101 PCB 118 PCB 138 PCB 153 PCB 180 Som PCB (7 Ballschmiter) (Factor 0,7)

conformNEN-EN12880; AS3000, AS3200; NEN-EN15934 : Droge stof

eigen methode *) **:** Koolwaterstoffractie C10-C12 Koolwaterstoffractie C12-C16 Koolwaterstoffractie C16-C20 Koolwaterstoffractie C20-C24 Koolwaterstoffractie C24-C28 Koolwaterstoffractie C28-C32 Koolwaterstoffractie C32-C36 Koolwaterstoffractie C36-C40 Fractie < 16 µm

Protocollen AS 3000 / Protocollen AS 3200 : Koningswater ontsluiting

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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kwaliteitswaarborg bodembeheer SIKB

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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	25.11.2021
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	30.11.2021
AL-West Opdrachtnummer	1104073		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
819440	AG3917859P	1	23.11.21	24.11.21
819440	AG3917860H	1	23.11.21	24.11.21
819440	AG3917861I	1	23.11.21	24.11.21
819440	AG3917862J	1	23.11.21	24.11.21
819440	AG3917863K	1	23.11.21	24.11.21
819440	AG3917864L	1	23.11.21	24.11.21
819440	AG3917865M	1	23.11.21	24.11.21
819440	AG3917866N	1	23.11.21	24.11.21
819440	AG3917867O	1	23.11.21	24.11.21
819440	AG3917868P	1	23.11.21	24.11.21
819441	AG3917869Q	1	23.11.21	24.11.21
819441	AG3917870I	1	23.11.21	24.11.21
819441	AG3918519J	1	23.11.21	24.11.21
819441	AG3918520B	1	23.11.21	24.11.21
819441	AG3918521C	1	23.11.21	24.11.21
819441	AG3918522D	1	23.11.21	24.11.21
819441	AG3918523E	1	23.11.21	24.11.21
819441	AG3918524F	1	23.11.21	24.11.21
819441	AG3918525G	1	23.11.21	24.11.21
819441	AG3918526H	1	23.11.21	24.11.21
819442	0407924BB	1	22.11.21	22.11.21
819442	0407933BB	1	22.11.21	22.11.21
819442	0407957BB	1	22.11.21	22.11.21
819442	0407966BB	1	22.11.21	22.11.21
819442	0408171BB	1	22.11.21	22.11.21
819442	0408173BB	1	22.11.21	22.11.21
819442	0408175BB	1	22.11.21	22.11.21
819442	0408178BB	1	22.11.21	22.11.21
819442	0408181BB	1	22.11.21	22.11.21
819442	0408184BB	1	22.11.21	22.11.21

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VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

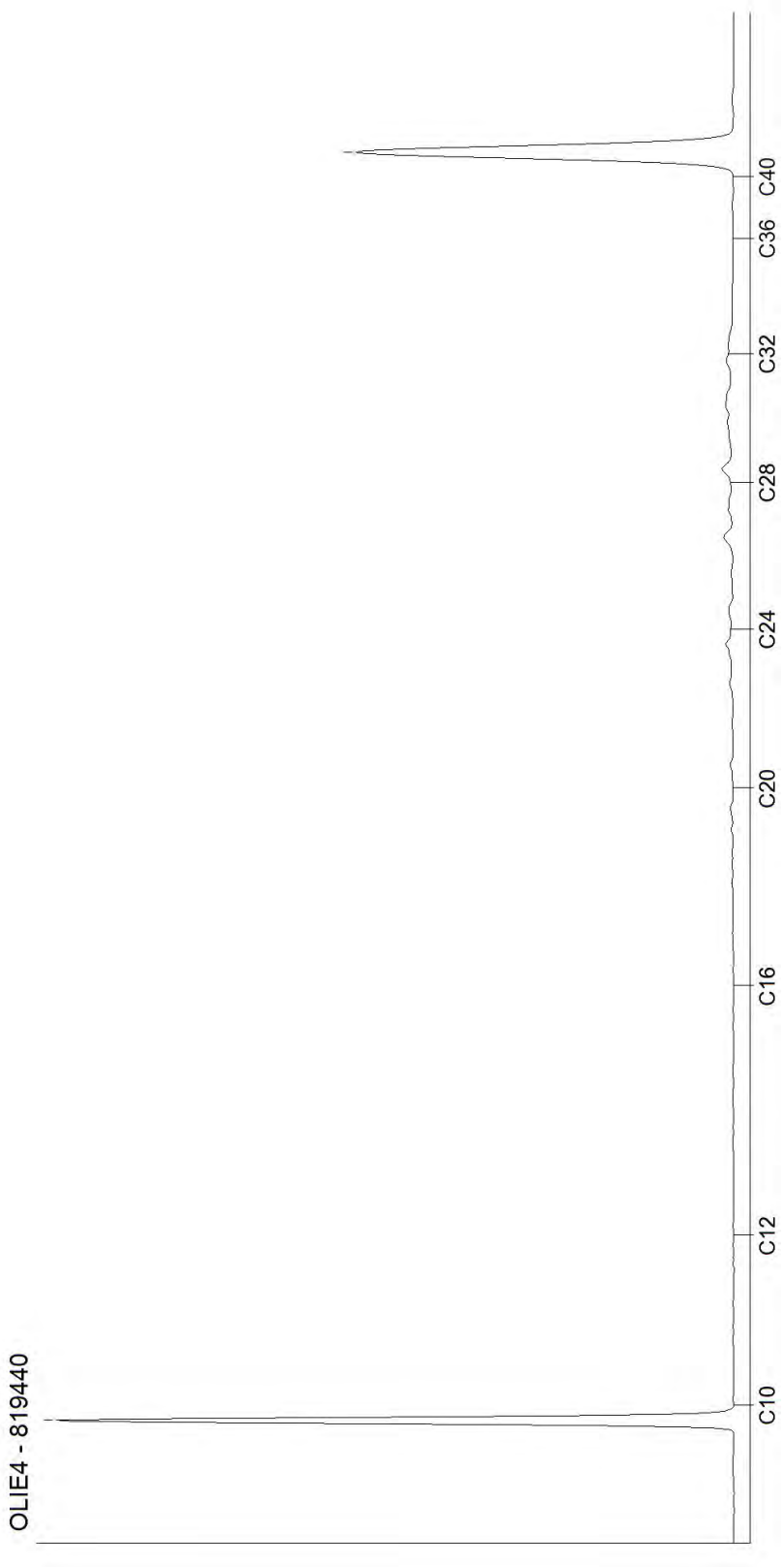
DOC-13-17412342-NL-P1

AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104073, Analysis No. 819440, created at 29.11.2021 13:17:55

Monster beschrijving: 61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-WB08 (20-30) 61-WB09 (20-30) 61-WB10 (20-30)



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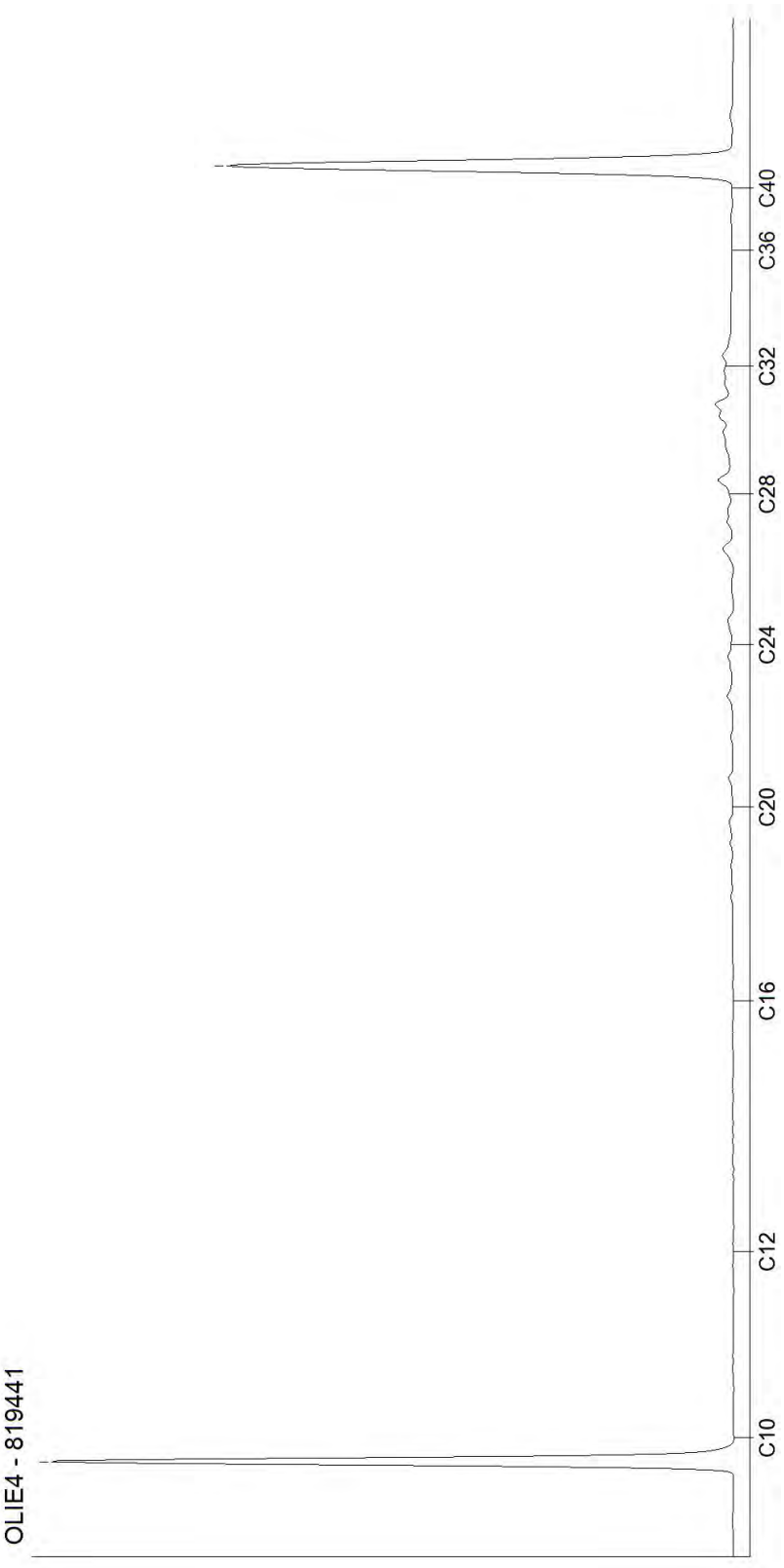
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104073, Analysis No. 819441, created at 29.11.2021 14:05:44

Monster beschrijving: 61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-WB18 (40-70) 61-WB19 (20-50) 61-WB20 (20-50)



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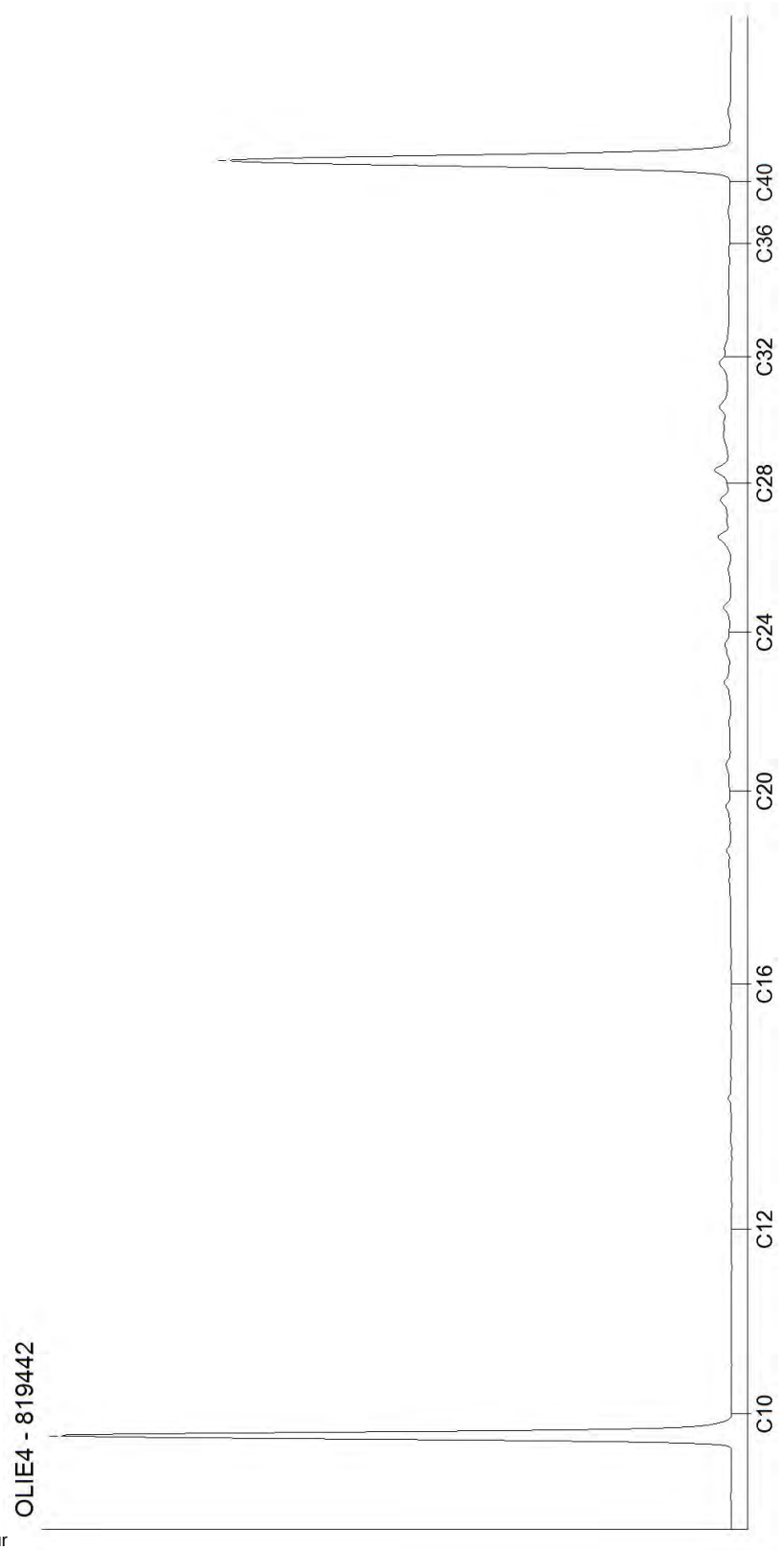
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104073, Analysis No. 819442, created at 29.11.2021 14:05:44

Monster beschrijving: 64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-WB08 (30-50) 64-WB09 (30-50) 64-WB10 (30-50)



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Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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ARCADIS NEDERLAND BV
A. Faber
Postbus 161
6800 AD Arnhem

Datum	30.11.2021
Relatienr	35006104
Opdrachtnr.	1104111

ANALYSERAPPORT

***Opdracht* 1104111 Bodem / Eluaat**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	25.11.21

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen U met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
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Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB
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AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht 1104111 Bodem / Eluaat

Monsternr.	*Monstername*	*Monster beschrijving*
819668	23.11.2021	61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)
819669	23.11.2021	61-HB06 (90-130) 61-HB09 (90-120)
819670	22.11.2021	64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)
819671	22.11.2021	64-HB07 (80-120) 64-HB12 (150-200)

		Eenheid	819668 61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)	819669 61-HB06 (90-130) 61-HB09 (90-120)	819670 64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)	819671 64-HB07 (80-120) 64-HB12 (150-200)
Algemene monstervoorbehandeling						
S	Voorbehandeling conform AS3000		++	++	++	++
S	Droge stof	%	66,1	78,1	61,8	76,6
S	IJzer (Fe2O3)	% Ds	<5,0	<5,0	<5,0	<5,0
Fracties (sedigraaf)						
S	Fractie < 2 µm	% Ds	47	1,2	24	4,4
Klassiek Chemische Analyses						
S	Organische stof	% Ds	10,7 x)	4,9 x)	12,3 x)	0,7 x)
Voorbehandeling metalen analyse						
S	Koningswater ontsluiting		++	++	++	++
Metalen (AS3000)						
S	Barium (Ba)	mg/kg Ds	290	<20	130	<20
S	Cadmium (Cd)	mg/kg Ds	<0,20	<0,20	0,40	<0,20
S	Kobalt (Co)	mg/kg Ds	16	<3,0	6,9	<3,0
S	Koper (Cu)	mg/kg Ds	26	<5,0	16	<5,0
S	Kwik (Hg)	mg/kg Ds	0,08	<0,05	0,14	<0,05
S	Lood (Pb)	mg/kg Ds	39	<10	44	<10
S	Molybdeen (Mo)	mg/kg Ds	<1,5	<1,5	<1,5	<1,5
S	Nikkel (AS3000)	mg/kg Ds	53	<4,0	24	4,6
S	Zink (Zn)	mg/kg Ds	100	<20	94	<20
PAK (AS3000)						
S	*Anthraceen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo(a)anthraceen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo-(a)-Pyreen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo(ghi)peryleen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo(k)fluorantheen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Chryseen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Fenanthreen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Fluorantheen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Indeno-(1,2,3-c,d)pyreen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Naftaleen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	**Som PAK (VROM) (Factor 0,7)**	mg/kg Ds	0,35 #)	0,35 #)	0,35 #)	0,35 #)
Minerale olie (AS3000/AS3200)						
S	Koolwaterstoffractie C10-C40	mg/kg Ds	<35	<35	<35	<35
	Koolwaterstoffractie C10-C12	mg/kg Ds	<3 *)	<3 *)	<3 *)	<3 *)

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104111 Bodem / Eluaat**

		Eenheid	819668 61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)		819669 61-HB06 (90-130) 61-HB09 (90-120)		819670 64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)		819671 64-HB07 (80-120) 64-HB12 (150-200)	
Minerale olie (AS3000/AS3200)										
	Koolwaterstoffractie C12-C16	mg/kg Ds	**<3**	*)	**<3**	*)	**<3**	*)	**5**	*)
	Koolwaterstoffractie C16-C20	mg/kg Ds	**<4**	*)	**<4**	*)	**<4**	*)	**<4**	*)
	Koolwaterstoffractie C20-C24	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
	Koolwaterstoffractie C24-C28	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
	Koolwaterstoffractie C28-C32	mg/kg Ds	**<5**	*)	**14**	*)	**9**	*)	**<5**	*)
	Koolwaterstoffractie C32-C36	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
	Koolwaterstoffractie C36-C40	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
Polychloorbifenylen (AS3000)										
S	*PCB 28*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 52*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 101*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 118*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 138*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 153*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 180*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	**Som PCB (7 Ballschmiter) (Factor 0,7)**	mg/kg Ds	**0,0049**	#)	**0,0049**	#)	**0,0049**	#)	**0,0049**	#)

x) Gehaltes beneden de rapportagegrens zijn niet mee inbegrepen.
#) Bij deze som zijn resultaten "<rapportagegrens" vermenigvuldigd met 0,7.
S) Erkend volgens AS SIKB 3000
Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Het analyseresultaat van PCB 138 is mogelijk overschat vanwege co-elutie met PCB 163
Het organische stof gehalte wordt gecorrigeerd voor het lutum gehalte, als geen lutum bepaald is wordt gecorrigeerd als ware het lutum gehalte 5,4%

Begin van de analyses: 25.11.2021
Einde van de analyses: 30.11.2021

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht 1104111 Bodem / Eluaat

Toegepaste methoden

conform Protocollen AS 3000 : Organische stof Voorbehandeling conform AS3000 Barium (Ba) Cadmium (Cd) Kobalt (Co) Koper (Cu) Kwik (Hg) Lood (Pb) Molybdeen (Mo) Nikkel (AS3000) Zink (Zn) Koolwaterstoffractie C10-C40 Anthraceen Benzo(a)anthraceen Benzo-(a)-Pyreen Benzo(ghi)peryleen Benzo(k)fluorantheen Chryseen Fenanthreen Fluorantheen Indeno-(1,2,3-c,d)pyreen Naftaleen Som PAK (VROM) (Factor 0,7) PCB 28 PCB 52 PCB 101 PCB 118 PCB 138 PCB 153 PCB 180 Som PCB (7 Ballschmiter) (Factor 0,7)

conformNEN-EN12880; AS3000, AS3200; NEN-EN15934 : Droge stof

eigen methode *) **:** Koolwaterstoffractie C10-C12 Koolwaterstoffractie C12-C16 Koolwaterstoffractie C16-C20 Koolwaterstoffractie C20-C24 Koolwaterstoffractie C24-C28 Koolwaterstoffractie C28-C32 Koolwaterstoffractie C32-C36 Koolwaterstoffractie C36-C40

Gelijkwaardig aan NEN 5739 : IJzer (Fe2O3)

Protocollen AS 3000 / Protocollen AS 3200 : Koningswater ontsluiting Fractie < 2 µm

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	25.11.2021
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	30.11.2021
AL-West Opdrachtnummer	1104111		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
819668	AG31809116	1	23.11.21	24.11.21
819668	AG3180925B	1	23.11.21	24.11.21
819668	AG3180926C	1	23.11.21	24.11.21
819668	AG31815427	1	23.11.21	24.11.21
819669	AG2403140/	3	23.11.21	24.11.21
819669	AG31815539	3	23.11.21	24.11.21
819670	AG3483843G	1	22.11.21	22.11.21
819670	AG3483846J	1	22.11.21	22.11.21
819670	AG3835562F	1	22.11.21	22.11.21
819670	AG3835565I	1	22.11.21	22.11.21
819671	AG2403150+	4	22.11.21	22.11.21
819671	AG3483832E	5	22.11.21	22.11.21

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VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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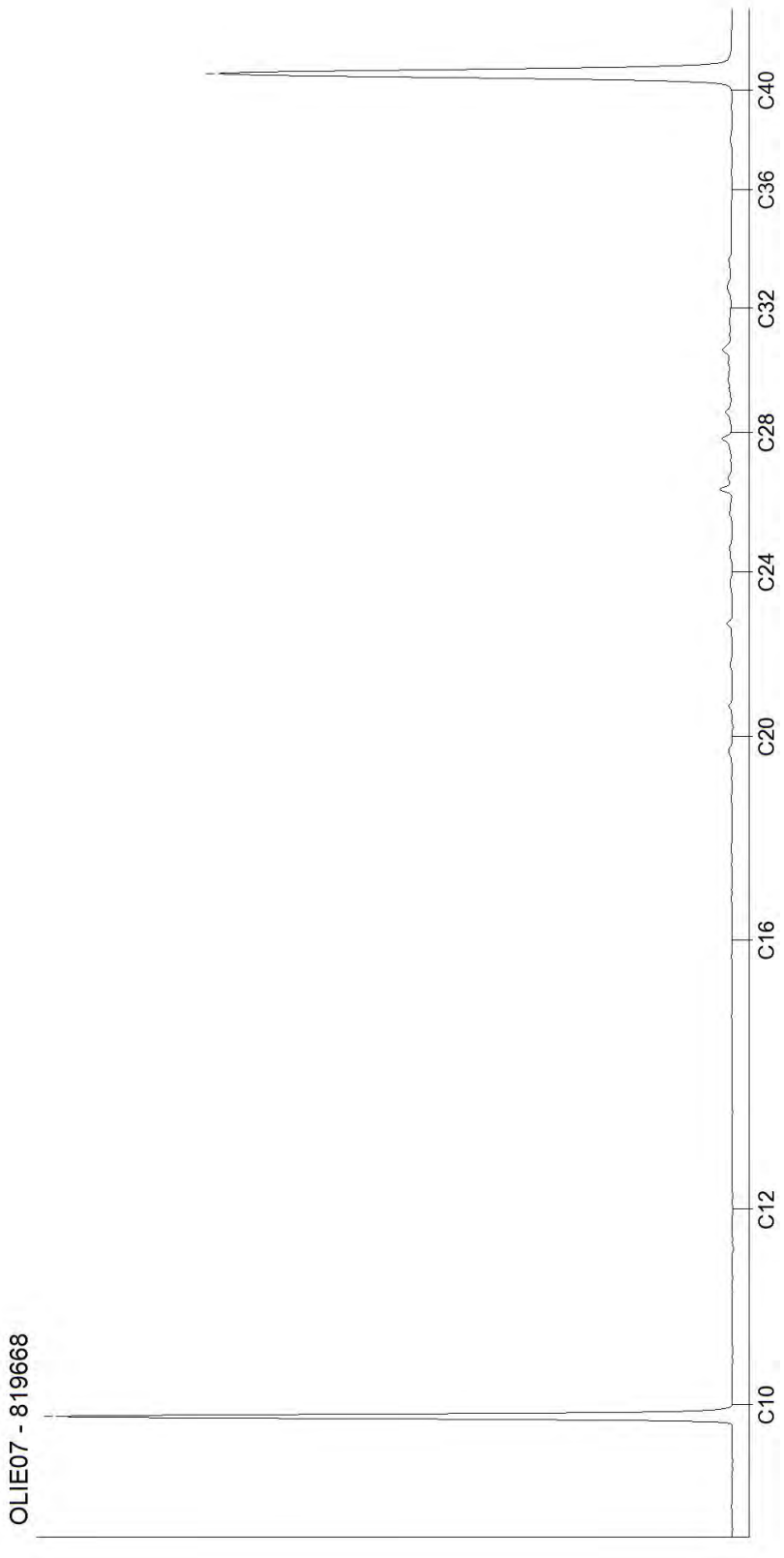
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819668, created at 30.11.2021 08:18:03

Monster beschrijving: 61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)



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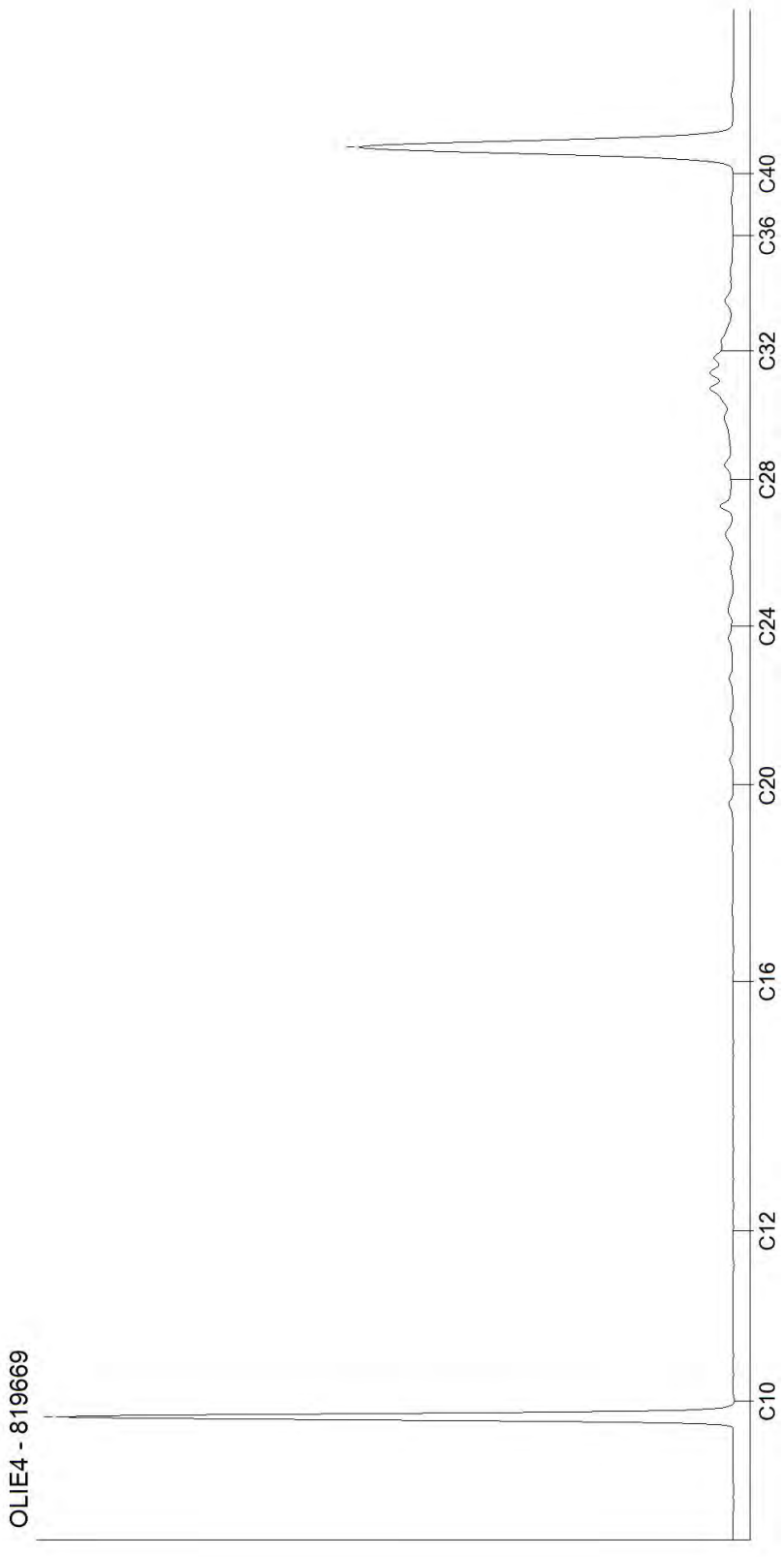
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819669, created at 30.11.2021 07:35:15

Monster beschrijving: 61-HB06 (90-130) 61-HB09 (90-120)



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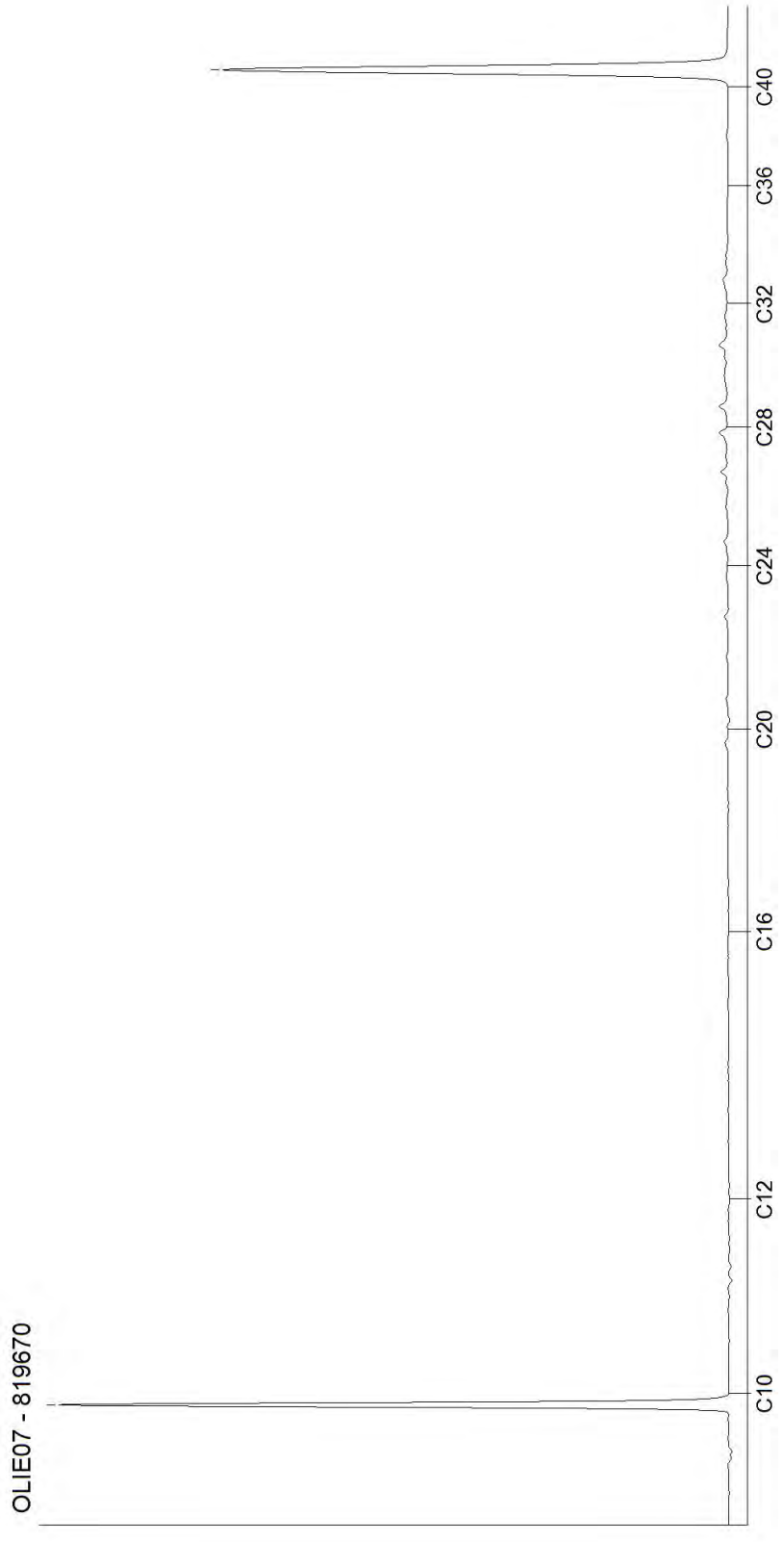
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819670, created at 30.11.2021 08:18:03

Monster beschrijving: 64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)



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Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
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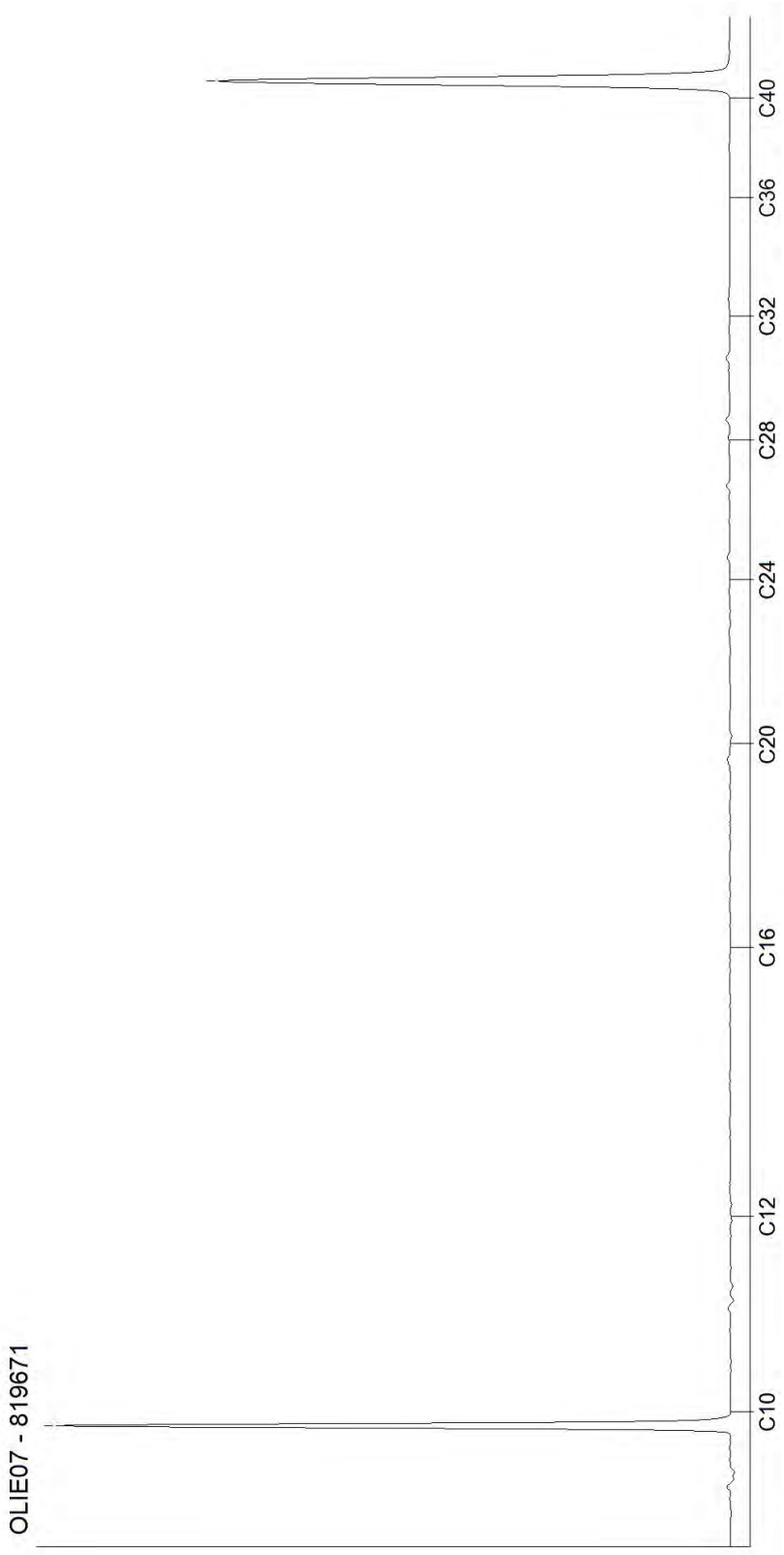
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819671, created at 30.11.2021 08:18:03

Monster beschrijving: 64-HB07 (80-120) 64-HB12 (150-200)



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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

Bijlage D – Toetsingsresultaten

Tabel 1: Gemeten concentraties in grondwater met beoordeling conform de Wet Bodembescherming

Watermonster		61PB01-1-1		
Datum		7-3-2022		
Filterdiepte (m -mv)		1,90 - 2,90		
Datum van toetsing		18-3-2022		
Monsterconclusie		Voldoet aan Streefwaarde		
Monstermelding 1				
Monstermelding 2				
Monstermelding 3				
		Meetw	**GSSD**	**Index**
METALEN				
IJzer	µg/l	8800	8800 (6)	
OVERIG				
pH	-	7,1		
Ptot (fosfor totaal)	mg/l	0,19		
Onopgeloste stoffen	mg/l	94	94 (6)	
ANORGANISCHE VERBINDINGEN				
Ammonium (als N)	mg/l	2,3	2,3 (6)	
Chloride	mg/l	65	65	
Sulfaat (als SO4)	mg/l	<30	<21 (6)	

--------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Streefwaarde
8,88	: > Streefwaarde
8,88	: > Interventiewaarde
>T	: Groter dan Tussenwaarde
11	: Enkele parameters ontbreken in de berekening van de somfractie
14	: Streefwaarde ontbreekt zorgplicht van toepassing
2	: Enkele parameters ontbreken in de som
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde
Index	: (GSSD - S) / (I - S)

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 2: Normwaarden conform de Wet Bodembescherming

		S	S Diep	Indicatief	I
ANORGANISCHE VERBINDINGEN					
Chloride	µg/l	100000			

Tabel 1: Gemeten gehalten in grond met beoordeling conform de Wet Bodembescherming

Grondmonster		61-MM-BG01			61-MM-OG01			61-MM-WB01		
Certificaatcode		1104111			1104111			1104073		
Boring(en)		61-HB01, 61-HB07, 61-HB08, 61-HB13			61-HB06, 61-HB09			61-WB01, 61-WB02, 61-WB03, 61-WB04, 61-WB05, 61-WB06, 61-WB07, 61-WB08, 61-WB09, 61-WB10		
Traject (m -mv)		0,00 - 0,40			0,90 - 1,30			0,20 - 0,70		
Humus	% ds	10,70			4,90			18,90		
Lutum	% ds	47,0			1,20			16,00		
Datum van toetsing		9-12-2021			9-12-2021			9-12-2021		
Monsterconclusie		Voldoet aan Achtergrondwaarde			Voldoet aan Achtergrondwaarde			Voldoet aan Achtergrondwaarde		
		Meetw	**GSSD**	**Index**	**Meetw**	**GSSD**	**Index**	**Meetw**	**GSSD**	**Index**
METALEN										
Barium	mg/kg ds	290	170 (6)		<20	<54 (6)		72	101 (6)	
Cadmium	mg/kg ds	<0,2	<0,1	-0,04	<0,2	<0,2	-0,03	0,2	0,2	-0,03
Kobalt	mg/kg ds	16	9	-0,03	<3	<7	-0,04	3,8	5,3	-0,06
Koper	mg/kg ds	26	19	-0,14	<5	<7	-0,22	9,8	9,8	-0,2
Kwik	mg/kg ds	0,08	0,06	-0	<0,05	<0,05	-0	<0,05	<0,04	-0
Nikkel	mg/kg ds	53	33	-0,04	<4	<8	-0,41	11	15	-0,31
Molybdeen	mg/kg ds	<1,5	<1,1	-0	<1,5	<1,1	-0	<1,5	<1,1	-0
Lood	mg/kg ds	39	31	-0,04	<10	<10	-0,08	12	12	-0,08
Zink	mg/kg ds	100	68	-0,12	<20	<31	-0,19	40	44	-0,16
IJzer	% ds	<5	4 (6)		<5	4 (6)				
PAK										
Naftaleen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Anthraceen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Fenanthreen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Fluorantheen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Chryseen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Benzo(a)anthraceen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Benzo(a)pyreen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Benzo(k)fluorantheen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Indeno-(1,2,3-c,d)pyreen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
Benzo(g,h,i)peryleen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,2	0,1 (41)	
PAK 10 VROM	mg/kg ds	0,35	<0,33	-0,03	0,35	<0,35	-0,03	1,4	0,7	-0,02
GECHLOREERDE KOOLWATERSTOFFEN										
PCB 28	mg/kg ds	<0,001	<0,001		<0,001	<0,001		<0,001	<0,000	
PCB 52	mg/kg ds	<0,001	<0,001		<0,001	<0,001		<0,001	<0,000	
PCB 101	mg/kg ds	<0,001	<0,001		<0,001	<0,001		<0,001	<0,000	
PCB 118	mg/kg ds	<0,001	<0,001		<0,001	<0,001		<0,001	<0,000	
PCB 138	mg/kg ds	<0,001	<0,001		<0,001	<0,001		<0,001	<0,000	
PCB 153	mg/kg ds	<0,001	<0,001		<0,001	<0,001		<0,001	<0,000	
PCB 180	mg/kg ds	<0,001	<0,001		<0,001	<0,001		<0,001	<0,000	
PCB (som 7)	mg/kg ds	0,0049	<0,0046	-0,02	0,0049	<0,0100	-0,01	0,0049	<0,0026	-0,02
OVERIGE (ORGANISCHE) VERBINDINGEN										
Minerale olie C10 - C12	mg/kg ds	<3	2 (6)		<3	4 (6)		<9	3 (6)	
Minerale olie C12 - C16	mg/kg ds	<3	2 (6)		<3	4 (6)		<9	3 (6)	
Minerale olie C16 - C20	mg/kg ds	<4	3 (6)		<4	6 (6)		<12	4 (6)	
Minerale olie C20 - C24	mg/kg ds	<5	3 (6)		<5	7 (6)		<15	6 (6)	
Minerale olie C24 - C28	mg/kg ds	<5	3 (6)		<5	7 (6)		<15	6 (6)	
Minerale olie C28 - C32	mg/kg ds	<5	3 (6)		14	29 (6)		13	7 (6)	
Minerale olie C32 - C36	mg/kg ds	<5	3 (6)		<5	7 (6)		<15	6 (6)	
Minerale olie C36 - C40	mg/kg ds	<5	3 (6)		<5	7 (6)		<15	6 (6)	
Minerale olie C10 - C40	mg/kg ds	<35	<23	-0,03	<35	<50	-0,03	<110	41 (41)	-0,03
OVERIG										
Droge stof	%	66,1	66,1 (6)		78,1	78,1 (6)		37,6	37,6 (6)	
Lutum	%	47			1,2			16		
Organische stof (humus)	% ds	10,7			4,9			18,9		
Korrelfractie < 16 µm	%							25		

Tabel 2: Gemeten gehalten in grond met beoordeling conform de Wet Bodembescherming

Grondmonster		61-MM-WB02		
Certificaatcode		1104073		
Boring(en)		61-WB11, 61-WB12, 61-WB13, 61-WB14, 61-WB15, 61-WB16, 61-WB17, 61-WB18, 61-WB19, 61-WB20		
Traject (m -mv)		0,20 - 0,70		
Humus	% ds	16,40		
Lutum	% ds	8,00		
Datum van toetsing		9-12-2021		
Monsterconclusie		Voldoet aan Achtergrondwaarde		
		Meetw	**GSSD**	**Index**
METALEN				
Barium	mg/kg ds	140	310 (6)	
Cadmium	mg/kg ds	0,3	0,3	-0,02
Kobalt	mg/kg ds	5	11	-0,03
Koper	mg/kg ds	14	17	-0,15
Kwik	mg/kg ds	<0,05	<0,04	-0
Nikkel	mg/kg ds	15	29	-0,09
Molybdeen	mg/kg ds	<1,5	<1,1	-0
Lood	mg/kg ds	20	23	-0,06
Zink	mg/kg ds	66	94	-0,08
IJzer	% ds			
PAK				
Naftaleen	mg/kg ds	<0,2	0,1 (41)	
Anthraceen	mg/kg ds	<0,2	0,1 (41)	
Fenanthreen	mg/kg ds	<0,2	0,1 (41)	
Fluorantheen	mg/kg ds	<0,2	0,1 (41)	
Chryseen	mg/kg ds	<0,2	0,1 (41)	
Benzo(a)anthraceen	mg/kg ds	<0,2	0,1 (41)	
Benzo(a)pyreen	mg/kg ds	<0,2	0,1 (41)	
Benzo(k)fluorantheen	mg/kg ds	<0,2	0,1 (41)	
Indeno-(1,2,3-c,d)pyreen	mg/kg ds	<0,2	0,1 (41)	
Benzo(g,h,i)peryleen	mg/kg ds	<0,2	0,1 (41)	
PAK 10 VROM	mg/kg ds	1,4	0,9	-0,02
GECHLOREERDE KOOLWATERSTOFFEN				
PCB 28	mg/kg ds	<0,001	<0,000	
PCB 52	mg/kg ds	<0,001	<0,000	
PCB 101	mg/kg ds	<0,001	<0,000	
PCB 118	mg/kg ds	<0,001	<0,000	
PCB 138	mg/kg ds	<0,001	<0,000	
PCB 153	mg/kg ds	<0,001	<0,000	
PCB 180	mg/kg ds	<0,001	<0,000	
PCB (som 7)	mg/kg ds	0,0049	<0,0030	-0,02
OVERIGE (ORGANISCHE) VERBINDINGEN				
Minerale olie C10 - C12	mg/kg ds	<9	4 (6)	
Minerale olie C12 - C16	mg/kg ds	<9	4 (6)	
Minerale olie C16 - C20	mg/kg ds	<12	5 (6)	
Minerale olie C20 - C24	mg/kg ds	<15	6 (6)	
Minerale olie C24 - C28	mg/kg ds	<15	6 (6)	
Minerale olie C28 - C32	mg/kg ds	21	13 (6)	
Minerale olie C32 - C36	mg/kg ds	<15	6 (6)	
Minerale olie C36 - C40	mg/kg ds	<15	6 (6)	
Minerale olie C10 - C40	mg/kg ds	<110	47 (41)	-0,03
OVERIG				
Droge stof	%	35,6	35,6 (6)	
Lutum	%	8		
Organische stof (humus)	% ds	16,4		
Korrelfractie < 16 µm	%	14		

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Achtergrondwaarde
<=T	: Kleiner of gelijk aan Tussenwaarde
8,88	: <= Interventiewaarde
8,88	: > Interventiewaarde
38	: Bij antropogene bron: > voormalige interventiewaarde
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde
Index	: (GSSD - AW) / (I - AW)

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 3: Normwaarden conform de Wet Bodembescherming

		AW	WO	IND	I
METALEN					
Cadmium	mg/kg ds	0,6	1,2	4,3	13
Kobalt	mg/kg ds	15	35	190	190
Koper	mg/kg ds	40	54	190	190
Kwik	mg/kg ds	0,15	0,83	4,8	36
Nikkel	mg/kg ds	35	39	100	100
Molybdeen	mg/kg ds	1,5	88	190	190
Lood	mg/kg ds	50	210	530	530
Zink	mg/kg ds	140	200	720	720
PAK					
PAK 10 VROM	mg/kg ds	1,5	6,8	40	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB (som 7)	mg/kg ds	0,02	0,04	0,5	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds	190	190	500	5000

Tabel 4: Gemeten concentraties in grondwater met beoordeling conform de Wet Bodembescherming

Watermonster		61-1HB-1-1		
Datum		23-11-2021		
Filterdiepte (m -mv)		-		
Datum van toetsing		9-12-2021		
Monsterconclusie		Overschrijding Streefwaarde		
		Meetw	**GSSD**	**Index**
METALEN				
Barium	µg/l	*110*	*110*	*0,1*
Cadmium	µg/l	<0,2	<0,1	-0,05
Kobalt	µg/l	<2	<1	-0,23
Koper	µg/l	<2	<1	-0,23
Kwik	µg/l	<0,05	<0,04	-0,06
Nikkel	µg/l	<3	<2	-0,22
Molybdeen	µg/l	<2	<1	-0,01
Lood	µg/l	<2	<1	-0,23
Zink	µg/l	<10	<7	-0,08
IJzer	µg/l	5100	5100 (6)	
PAK				
Naftaleen	µg/l	<0,02	<0,01	0
PAK 10 VROM	-		<0,00020 (11)	
GECHLOREERDE KOOLWATERSTOFFEN				
1,1-Dichloorpropaan	µg/l	<0,2	<0,1	
1,3-Dichloorpropaan	µg/l	<0,2	<0,1	
Tribroommethaan (bromoform)	µg/l	<0,2	<0,1 (14)	
Tetrachloormethaan (Tetra)	µg/l	<0,1	<0,1	0,01
1,1-Dichloorethaan	µg/l	<0,2	<0,1	-0,01
1,2-Dichloorethaan	µg/l	<0,2	<0,1	-0,02
1,2-Dichloorpropaan	µg/l	<0,2	<0,1	
1,1,1-Trichloorethaan	µg/l	<0,1	<0,1	0
1,1,2-Trichloorethaan	µg/l	<0,1	<0,1	0
Trichlooretheen (Tri)	µg/l	<0,2	<0,1	-0,05
Tetrachlooretheen (Per)	µg/l	<0,1	<0,1	0
Vinylchloride	µg/l	<0,2	<0,1	0,03
Dichloormethaan	µg/l	<0,2	<0,1	0
Trichloormethaan (Chloroform)	µg/l	<0,2	<0,1	-0,01
cis + trans-1,2-Dichlooretheen	µg/l	0,21	<0,14	0,01
1,1-Dichlooretheen	µg/l	<0,1	<0,1	0,01
cis-1,2-Dichlooretheen	µg/l	<0,1	<0,1	
trans-1,2-Dichlooretheen	µg/l	<0,1	<0,1	
Dichloorpropaan	µg/l		<0,42	-0
AROMATISCHE VERBINDINGEN				
Styreen (Vinylbenzeen)	µg/l	<0,2	<0,1	-0,02
Benzeen	µg/l	<0,2	<0,1	-0
Ethylbenzeen	µg/l	<0,2	<0,1	-0,03
Tolueen	µg/l	<0,2	<0,1	-0,01
Xylenen (som)	µg/l	0,21	<0,21	0
meta-/para-Xyleen (som)	µg/l	<0,2	<0,1	
ortho-Xyleen	µg/l	<0,1	<0,1	
Som 16 Aromatische oplosmiddelen	µg/l		<0,77 (2,14)	
OVERIGE (ORGANISCHE) VERBINDINGEN				
Minerale olie C10 - C12	µg/l	<10	7 (6)	
Minerale olie C12 - C16	µg/l	<10	7 (6)	
Minerale olie C16 - C20	µg/l	<5	4 (6)	

Watermonster		61-1HB-1-1		
Datum		23-11-2021		
Filterdiepte (m -mv)		-		
Datum van toetsing		9-12-2021		
Monsterconclusie		Overschrijding Streefwaarde		
Minerale olie C20 - C24	µg/l	<5	4 (6)	
Minerale olie C24 - C28	µg/l	<5	4 (6)	
Minerale olie C28 - C32	µg/l	<5	4 (6)	
Minerale olie C32 - C36	µg/l	<5	4 (6)	
Minerale olie C36 - C40	µg/l	<5	4 (6)	
Minerale olie C10 - C40	µg/l	<50	<35	-0,03
OVERIG				
som dichloorpropaan-isomeren	µg/l	0,42		
ANORGANISCHE VERBINDINGEN				
Ammonium (als N)	mg/l	1,5	1,5 (6)	
Chloride	mg/l	81	81	
Sulfaat (als SO4)	mg/l	51	51 (6)	

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Streefwaarde
8,88	: > Streefwaarde
8,88	: > Interventiewaarde
>T	: Groter dan Tussenwaarde
11	: Enkele parameters ontbreken in de berekening van de somfractie
14	: Streefwaarde ontbreekt zorgplicht van toepassing
2	: Enkele parameters ontbreken in de som
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde
Index	: (GSSD - S) / (I - S)

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 5: Normwaarden conform de Wet Bodembescherming

		S	S Diep	Indicatief	I
METALEN					
Barium	µg/l	50	200		625
Cadmium	µg/l	0,4	0,06		6
Kobalt	µg/l	20	0,7		100
Koper	µg/l	15	1,3		75
Kwik	µg/l	0,05	0,01		0,3
Nikkel	µg/l	15	2,1		75
Molybdeen	µg/l	5	3,6		300
Lood	µg/l	15	1,7		75
Zink	µg/l	65	24		800
PAK					
Naftaleen	µg/l	0,01			70
GECHLOREERDE KOOLWATERSTOFFEN					
Tribroommethaan (bromoform)	µg/l				630
Tetrachloormethaan (Tetra)	µg/l	0,01			10
1,1-Dichloorethaan	µg/l	7			900
1,2-Dichloorethaan	µg/l	7			400
1,1,1-Trichloorethaan	µg/l	0,01			300
1,1,2-Trichloorethaan	µg/l	0,01			130
Trichlooretheen (Tri)	µg/l	24			500
Tetrachlooretheen (Per)	µg/l	0,01			40
Vinylchloride	µg/l	0,01			5
Dichloormethaan	µg/l	0,01			1000
Trichloormethaan (Chloroform)	µg/l	6			400
cis + trans-1,2-Dichlooretheen	µg/l	0,01			20
1,1-Dichlooretheen	µg/l	0,01			10
Dichloorpropaan	µg/l	0,8			80
AROMATISCHE VERBINDINGEN					
Styreen (Vinylbenzeen)	µg/l	6			300
Benzeen	µg/l	0,2			30
Ethylbenzeen	µg/l	4			150
Tolueen	µg/l	7			1000
Xylenen (som)	µg/l	0,2			70
Som 16 Aromatische oplosmiddelen	µg/l			150	
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	µg/l	50			600
ANORGANISCHE VERBINDINGEN					
Chloride	µg/l	100000			

Tabel 1: Samenstellingwaarden en toetsing voor waterbodem conform Besluit Bodemkwaliteit

Analysemonster	61-MM-WB01						
Certificaatcode	1104073						
Datum	23-11-2021						
Traject (cm-mv)	20-70						
Humus (% ds)	18,9						
Lutum (% ds)	16						
Datum van toetsing	21-3-2022						
Bodemklasse monster			Altijd toepasbaar	Altijd toepasbaar	Verspreidbaar	Verspreidbaar	Verspreidbaar
			T1	T3	T5	T6	T7
METALEN							
Barium	72	mg/kg ds	-------	-------		-------	-------
Cadmium	0,2	mg/kg ds	<=AW	<=AW	<=MW_AW	<=MW_AW	<=MW_AW
Kobalt	3,8	mg/kg ds	<=AW	<=AW		<=MW_AW	
Koper	9,8	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Kwik	< 0,05	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Nikkel	11	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Molybdeen	< 1,5	mg/kg ds	<=AW	<=AW		<=MW_AW	
Lood	12	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Zink	40	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
PAK							
Naftaleen	< 0,2	mg/kg ds					
Anthraceen	< 0,2	mg/kg ds					
Fenanthreen	< 0,2	mg/kg ds					
Fluorantheen	< 0,2	mg/kg ds					
Chryseen	< 0,2	mg/kg ds					
Benzo(a)anthraceen	< 0,2	mg/kg ds					
Benzo(a)pyreen	< 0,2	mg/kg ds					
Benzo(k)fluorantheen	< 0,2	mg/kg ds					
Indeno-(1,2,3-c,d)pyreen	< 0,2	mg/kg ds					
Benzo(g,h,i)peryleen	< 0,2	mg/kg ds					
PAK 10 VROM	1,4	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
GECHLOREERDE KOOLWATERSTOFFEN							
PCB 28	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 52	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 101	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 118	< 0,001	mg/kg ds		<=AW		<=MW_AW	

Analysemonster	61-MM-WB01						
Certificaatcode	1104073						
Datum	23-11-2021						
Traject (cm-mv)	20-70						
Humus (% ds)	18,9						
Lutum (% ds)	16						
Datum van toetsing	21-3-2022						
Bodemklasse monster			Altijd toepasbaar	Altijd toepasbaar	Verspreidbaar	Verspreidbaar	Verspreidbaar
PCB 138	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 153	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 180	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB (som 7)	0,0049	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
OVERIGE (ORGANISCHE) VERBINDINGEN							
Minerale olie C10 - C12	< 9	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C12 - C16	< 9	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C16 - C20	< 12	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C20 - C24	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C24 - C28	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C28 - C32	13	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C32 - C36	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C36 - C40	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C10 - C40	< 110	mg/kg ds	<=AW	<=AW	<=MW_AW	<=MW_AW	<=MW_AW
OVERIG							
Droge stof	37,6	%	-------	-------	-------	-------	-------
Lutum	16	%					
Organische stof (humus)	18,9	% ds					
Korrelfractie < 16 µm	25	%					
meersoorten PAF organische verbindingen		%			<=MW_AW		
meersoorten PAF metalen		%			<=MW_AW		

Tabel 2: Samenstellingwaarden en toetsing voor waterbodem conform Besluit Bodemkwaliteit

Analysemonster	61-MM-WB02						
Certificaatcode	1104073						
Datum	23-11-2021						
Traject (cm-mv)	20-70						
Humus (% ds)	16,4						
Lutum (% ds)	8						
Datum van toetsing	21-3-2022						
Bodemklasse monster			Altijd toepasbaar	Altijd toepasbaar	Verspreidbaar	Verspreidbaar	Verspreidbaar
			T1	T3	T5	T6	T7
METALEN							
Barium	140	mg/kg	-------	-------		-------	-------

Analysemonster	61-MM-WB02						
Certificaatcode	1104073						
Datum	23-11-2021						
Traject (cm-mv)	20-70						
Humus (% ds)	16,4						
Lutum (% ds)	8						
Datum van toetsing	21-3-2022						
Bodemklasse monster			Altijd toepasbaar	Altijd toepasbaar	Verspreidbaar	Verspreidbaar	Verspreidbaar
		ds					
Cadmium	0,3	mg/kg ds	<=AW	<=AW	<=MW_AW	<=MW_AW	<=MW_AW
Kobalt	5	mg/kg ds	<=AW	<=AW		<=MW_AW	
Koper	14	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Kwik	< 0,05	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Nikkel	15	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Molybdeen	< 1,5	mg/kg ds	<=AW	<=AW		<=MW_AW	
Lood	20	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Zink	66	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
PAK							
Naftaleen	< 0,2	mg/kg ds					
Anthraceen	< 0,2	mg/kg ds					
Fenanthreen	< 0,2	mg/kg ds					
Fluorantheen	< 0,2	mg/kg ds					
Chryseen	< 0,2	mg/kg ds					
Benzo(a)anthraceen	< 0,2	mg/kg ds					
Benzo(a)pyreen	< 0,2	mg/kg ds					
Benzo(k)fluorantheen	< 0,2	mg/kg ds					
Indeno-(1,2,3-c,d)pyreen	< 0,2	mg/kg ds					
Benzo(g,h,i)peryleen	< 0,2	mg/kg ds					
PAK 10 VROM	1,4	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
GECHLOREERDE KOOLWATERSTOFFEN							
PCB 28	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 52	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 101	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 118	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 138	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 153	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 180	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB (som 7)	0,0049	mg/kg	<=AW	<=AW		<=MW_AW	<=MW_AW

Analysemonster	61-MM-WB02						
Certificaatcode	1104073						
Datum	23-11-2021						
Traject (cm-mv)	20-70						
Humus (% ds)	16,4						
Lutum (% ds)	8						
Datum van toetsing	21-3-2022						
Bodemklasse monster			Altijd toepasbaar	Altijd toepasbaar	Verspreidbaar	Verspreidbaar	Verspreidbaar
		ds					
OVERIGE (ORGANISCHE) VERBINDINGEN							
Minerale olie C10 - C12	< 9	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C12 - C16	< 9	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C16 - C20	< 12	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C20 - C24	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C24 - C28	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C28 - C32	21	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C32 - C36	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C36 - C40	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C10 - C40	< 110	mg/kg ds	<=AW	<=AW	<=MW_AW	<=MW_AW	<=MW_AW
OVERIG							
Droge stof	35,6	%	-------	-------	-------	-------	-------
Lutum	8	%					
Organische stof (humus)	16,4	% ds					
Korrelfractie < 16 µm	14	%					
meersoorten PAF organische verbindingen		%			<=MW_AW		
meersoorten PAF metalen		%			<=MW_AW		

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Achtergrondwaarde
8,88	: A
8,88	: B
8,88	: Nooit toepasbaar
38	: Bij antropogene bron: > voormalige interventiewaarde
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	@ verhoogde rapportagegrens
GSSD	@ Gestandaardiseerde meetwaarde

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 3: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T1)

		AW	WO	IND	I
METALEN					
Cadmium	mg/kg ds	0,6	1,2	4,3	13
Kobalt	mg/kg ds	15	35	190	190
Koper	mg/kg ds	40	54	190	190

		AW	WO	IND	I
Kwik	mg/kg ds	0,15	0,83	4,8	36
Nikkel	mg/kg ds	35	39	100	100
Molybdeen	mg/kg ds	1,5	88	190	190
Lood	mg/kg ds	50	210	530	530
Zink	mg/kg ds	140	200	720	720
PAK					
PAK 10 VROM	mg/kg ds	1,5	6,8	40	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB (som 7)	mg/kg ds	0,02	0,04	0,5	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds	190	190	500	5000

Tabel 4: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T3)

		ETW	AW	A	B
METALEN					
Cadmium	mg/kg ds	4,3	0,6	4	14
Kobalt	mg/kg ds	130	15	25	240
Koper	mg/kg ds	113	40	96	190
Kwik	mg/kg ds	4,8	0,15	1,2	10
Nikkel	mg/kg ds	100	35	50	210
Molybdeen	mg/kg ds	105	1,5	5	200
Lood	mg/kg ds	308	50	138	580
Zink	mg/kg ds	430	140	563	2000
PAK					
PAK 10 VROM	mg/kg ds		1,5	9	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB 28	mg/kg ds		0,0015	0,014	
PCB 52	mg/kg ds		0,002	0,015	
PCB 101	mg/kg ds		0,0015	0,023	
PCB 118	mg/kg ds		0,0045	0,016	
PCB 138	mg/kg ds		0,004	0,027	
PCB 153	mg/kg ds		0,0035	0,033	
PCB 180	mg/kg ds		0,0025	0,018	
PCB (som 7)	mg/kg ds		0,02	0,139	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds		190	1250	5000

Tabel 5: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T5)

		AW	MW per	I
METALEN				
Cadmium	mg/kg ds	0,6	7,5	13
Kobalt	mg/kg ds	15		190
Koper	mg/kg ds	40		190
Kwik	mg/kg ds	0,15		36
Nikkel	mg/kg ds	35		100
Molybdeen	mg/kg ds	1,5		190
Lood	mg/kg ds	50		530
Zink	mg/kg ds	140		720
PAK				
PAK 10 VROM	mg/kg ds	1,5		40

		AW	MW per	I
GECHLOREERDE KOOLWATERSTOFFEN				
PCB (som 7)	mg/kg ds	0,02		1
OVERIGE (ORGANISCHE) VERBINDINGEN				
Minerale olie C10 - C40	mg/kg ds	190	3000	5000

Tabel 6: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T6)

		AW	MW zoet	IW
METALEN				
Cadmium	mg/kg ds	0,6	4	14
Kobalt	mg/kg ds	15	25	240
Koper	mg/kg ds	40	96	190
Kwik	mg/kg ds	0,15	1,2	10
Nikkel	mg/kg ds	35	50	210
Molybdeen	mg/kg ds	1,5	5	200
Lood	mg/kg ds	50	138	580
Zink	mg/kg ds	140	563	2000
PAK				
PAK 10 VROM	mg/kg ds	1,5	9	40
GECHLOREERDE KOOLWATERSTOFFEN				
PCB 28	mg/kg ds	0,0015	0,014	
PCB 52	mg/kg ds	0,002	0,015	
PCB 101	mg/kg ds	0,0015	0,023	
PCB 118	mg/kg ds	0,0045	0,016	
PCB 138	mg/kg ds	0,004	0,027	
PCB 153	mg/kg ds	0,0035	0,033	
PCB 180	mg/kg ds	0,0025	0,018	
PCB (som 7)	mg/kg ds	0,02	0,139	1
OVERIGE (ORGANISCHE) VERBINDINGEN				
Minerale olie C10 - C40	mg/kg ds	190	1250	5000

Tabel 7: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T7)

		MW zout	IW
METALEN			
Cadmium	mg/kg ds	4	14
Kobalt	mg/kg ds		240
Koper	mg/kg ds	60	190
Kwik	mg/kg ds	1,2	10
Nikkel	mg/kg ds	45	210
Molybdeen	mg/kg ds		200
Lood	mg/kg ds	110	580
Zink	mg/kg ds	365	2000
PAK			
PAK 10 VROM	mg/kg ds	8	40
GECHLOREERDE KOOLWATERSTOFFEN			
PCB (som 7)	mg/kg ds	0,1	1
OVERIGE (ORGANISCHE) VERBINDINGEN			
Minerale olie C10 - C40	mg/kg ds	1250	5000

Tabel 1: Samenstellingwaarden en toetsing voor grond conform Besluit Bodemkwaliteit

Grondmonster		61-MM-BG01		61-MM-OG01		61-MM-WB01	
Grondsoort		Klei		Zand		Slib	
Zintuiglijke bijmengingen		zwak wortelhoudend, geen olie-water reactie		lensjes veen, geen olie-water reactie			
Humus (% ds)		10,70		4,90		18,90	
Lutum (% ds)		47,0		1,20		16,00	
Datum van toetsing		9-12-2021		9-12-2021		9-12-2021	
Monster getoetst als		partij		partij		partij	
Bodemklasse monster		Altijd toepasbaar		Altijd toepasbaar		Altijd toepasbaar	
		Meetw	**GSSD**	**Meetw**	**GSSD**	**Meetw**	**GSSD**
METALEN							
Barium	mg/kg ds	290	170 (6)	<20	<54 (6)	72	101 (6)
Cadmium	mg/kg ds	<0,2	<0,1	<0,2	<0,2	0,2	0,2
Kobalt	mg/kg ds	16	9	<3	<7	3,8	5,3
Koper	mg/kg ds	26	19	<5	<7	9,8	9,8
Kwik	mg/kg ds	0,08	0,06	<0,05	<0,05	<0,05	<0,04
Nikkel	mg/kg ds	53	33	<4	<8	11	15
Molybdeen	mg/kg ds	<1,5	<1,1	<1,5	<1,1	<1,5	<1,1
Lood	mg/kg ds	39	31	<10	<10	12	12
Zink	mg/kg ds	100	68	<20	<31	40	44
IJzer	% ds	<5	4 (6)	<5	4 (6)		
PAK							
Naftaleen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Anthraceen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Fenanthreen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Fluorantheen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Chryseen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Benzo(a)anthraceen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Benzo(a)pyreen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Benzo(k)fluorantheen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Indeno-(1,2,3-c,d)pyreen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
Benzo(g,h,i)peryleen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,2	0,1 (41)
PAK 10 VROM	mg/kg ds	0,35	<0,33	0,35	<0,35	1,4	0,7
GECHLOREERDE KOOLWATERSTOFFEN							
PCB 28	mg/kg ds	<0,001	<0,001	<0,001	<0,001	<0,001	<0,000
PCB 52	mg/kg ds	<0,001	<0,001	<0,001	<0,001	<0,001	<0,000
PCB 101	mg/kg ds	<0,001	<0,001	<0,001	<0,001	<0,001	<0,000
PCB 118	mg/kg ds	<0,001	<0,001	<0,001	<0,001	<0,001	<0,000
PCB 138	mg/kg ds	<0,001	<0,001	<0,001	<0,001	<0,001	<0,000
PCB 153	mg/kg ds	<0,001	<0,001	<0,001	<0,001	<0,001	<0,000
PCB 180	mg/kg ds	<0,001	<0,001	<0,001	<0,001	<0,001	<0,000
PCB (som 7)	mg/kg ds	0,0049	<0,0046	0,0049	<0,0100	0,0049	<0,0026
OVERIGE (ORGANISCHE) VERBINDINGEN							
Minerale olie C10 - C12	mg/kg ds	<3	2 (6)	<3	4 (6)	<9	3 (6)
Minerale olie C12 - C16	mg/kg ds	<3	2 (6)	<3	4 (6)	<9	3 (6)
Minerale olie C16 - C20	mg/kg ds	<4	3 (6)	<4	6 (6)	<12	4 (6)
Minerale olie C20 - C24	mg/kg ds	<5	3 (6)	<5	7 (6)	<15	6 (6)
Minerale olie C24 - C28	mg/kg ds	<5	3 (6)	<5	7 (6)	<15	6 (6)
Minerale olie C28 - C32	mg/kg ds	<5	3 (6)	14	29 (6)	13	7 (6)
Minerale olie C32 - C36	mg/kg ds	<5	3 (6)	<5	7 (6)	<15	6 (6)
Minerale olie C36 - C40	mg/kg ds	<5	3 (6)	<5	7 (6)	<15	6 (6)
Minerale olie C10 - C40	mg/kg ds	<35	<23	<35	<50	<110	41 (41)
OVERIG							
Droge stof	%	66,1	66,1 (6)	78,1	78,1 (6)	37,6	37,6 (6)
Lutum	%	47		1,2		16	
Organische stof (humus)	% ds	10,7		4,9		18,9	
Korrelfractie < 16 µm	%					25	

Tabel 2: Samenstellingwaarden en toetsing voor grond conform Besluit Bodemkwaliteit

Grondmonster		61-MM-WB02	
Grondsoort		Slib	
Zintuiglijke bijmengingen			
Humus (% ds)		16,40	
Lutum (% ds)		8,00	
Datum van toetsing		9-12-2021	
Monster getoetst als		partij	
Bodemklasse monster		Altijd toepasbaar	
Samenstelling monster			
Monstermelding 1			
Monstermelding 2			
Monstermelding 3			
		Meetw	**GSSD**
METALEN			
Barium	mg/kg ds	140	310 (6)
Cadmium	mg/kg ds	0,3	0,3
Kobalt	mg/kg ds	5	11
Koper	mg/kg ds	14	17
Kwik	mg/kg ds	<0,05	<0,04
Nikkel	mg/kg ds	15	29
Molybdeen	mg/kg ds	<1,5	<1,1
Lood	mg/kg ds	20	23
Zink	mg/kg ds	66	94
IJzer	% ds		
PAK			
Naftaleen	mg/kg ds	<0,2	0,1 (41)
Anthraceen	mg/kg ds	<0,2	0,1 (41)
Fenanthreen	mg/kg ds	<0,2	0,1 (41)
Fluorantheen	mg/kg ds	<0,2	0,1 (41)
Chryseen	mg/kg ds	<0,2	0,1 (41)
Benzo(a)anthraceen	mg/kg ds	<0,2	0,1 (41)
Benzo(a)pyreen	mg/kg ds	<0,2	0,1 (41)
Benzo(k)fluorantheen	mg/kg ds	<0,2	0,1 (41)
Indeno-(1,2,3-c,d)pyreen	mg/kg ds	<0,2	0,1 (41)
Benzo(g,h,i)peryleen	mg/kg ds	<0,2	0,1 (41)
PAK 10 VROM	mg/kg ds	1,4	0,9
GECHLOREERDE KOOLWATERSTOFFEN			
PCB 28	mg/kg ds	<0,001	<0,000
PCB 52	mg/kg ds	<0,001	<0,000
PCB 101	mg/kg ds	<0,001	<0,000
PCB 118	mg/kg ds	<0,001	<0,000
PCB 138	mg/kg ds	<0,001	<0,000
PCB 153	mg/kg ds	<0,001	<0,000
PCB 180	mg/kg ds	<0,001	<0,000
PCB (som 7)	mg/kg ds	0,0049	<0,0030
OVERIGE (ORGANISCHE) VERBINDINGEN			
Minerale olie C10 - C12	mg/kg ds	<9	4 (6)
Minerale olie C12 - C16	mg/kg ds	<9	4 (6)
Minerale olie C16 - C20	mg/kg ds	<12	5 (6)
Minerale olie C20 - C24	mg/kg ds	<15	6 (6)
Minerale olie C24 - C28	mg/kg ds	<15	6 (6)
Minerale olie C28 - C32	mg/kg ds	21	13 (6)
Minerale olie C32 - C36	mg/kg ds	<15	6 (6)
Minerale olie C36 - C40	mg/kg ds	<15	6 (6)
Minerale olie C10 - C40	mg/kg ds	<110	47 (41)
OVERIG			
Droge stof	%	35,6	35,6 (6)
Lutum	%	8	
Organische stof (humus)	% ds	16,4	
Korrelfractie < 16 µm	%	14	

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Achtergrondwaarde
8,88	: Wonen
8,88	: Industrie
8,88	: <= Interventiewaarde
8,88	: Niet Toepasbaar > IW
38	: Bij antropogene bron: > voormalige interventiewaarde
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 3: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit

		AW	WO	IND	I
METALEN					
Cadmium	mg/kg ds	0,6	1,2	4,3	13
Kobalt	mg/kg ds	15	35	190	190
Koper	mg/kg ds	40	54	190	190
Kwik	mg/kg ds	0,15	0,83	4,8	36
Nikkel	mg/kg ds	35	39	100	100
Molybdeen	mg/kg ds	1,5	88	190	190
Lood	mg/kg ds	50	210	530	530
Zink	mg/kg ds	140	200	720	720
PAK					
PAK 10 VROM	mg/kg ds	1,5	6,8	40	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB (som 7)	mg/kg ds	0,02	0,04	0,5	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds	190	190	500	5000

Bijlage E – Toelichting toetsingskader

MATE VAN BODEMVERONTREINIGING
Toetsing van de analyseresultaten van grond- en grondwater heeft plaatsgevonden aan de hand van het toetsingskader zoals gedefinieerd in de Circulaire bodemsanering per 1 juli 2013 en de Regeling bodemkwaliteit van 13 december 2007. Onderstaande toetswaarden worden gehanteerd om de mate van bodemverontreiniging weer te geven:

Bij toetsing van de grond zijn de gehalten teruggerekend naar de standaard middels de percentages humus (10%) en lutum (25%). De gecorrigeerde gehalten zijn getoetst aan de van toepassing zijnde normen.

Interventiewaarden (I)
De interventiewaarden bodemsanering geven het concentratieniveau voor verontreinigingen in grond en grondwater aan waarboven ernstige vermindering of dreigende vermindering optreedt van de functionele eigenschappen die de bodem heeft voor mens, plant en dier. Bij gehalten boven de interventiewaarde is mogelijk sprake van (een geval van) ernstige verontreiniging en is er mogelijk een saneringsnoodzaak.

Streefwaarden grondwater (S)
De streefwaarden gelden als referentiewaarden en hebben betrekking op de in de natuur voorkomende achtergrondwaarden in het grondwater of op detectiegrenzen bij stoffen die niet in natuurlijk milieu voorkomen.

Achtergrondwaarden grond (AW)
De achtergrondwaarden gelden als referentiewaarden waar relatief onbelaste gebieden (natuur en landbouwgebieden) voor 95 % aan voldoen. Grond die aan de AW voldoet is blijvend geschikt voor alle bodemfuncties (waaronder moestuin, natuur en landbouw).

Per 1 november 2013 dient toetsing plaats te vinden via de landelijke toetsingsmodule van de Rijksoverheid genaamd BoToVa. Conform de Circulaire bodemsanering per 1 juli 2013 en de Regeling bodemkwaliteit van 13 december 2007 worden de gemeten gehalten voor grond gecorrigeerd naar een standaardbodem (25% lutum en 10% organische stof). Hierna wordt getoetst aan de hierboven genoemde toetswaarden. De toetsing geeft weer of sprake is van een overschrijding van deze toetswaarden. Om de mate van bodemverontreiniging aan te geven wordt de volgende terminologie gebruikt:

- Niet verontreinigd: Index ≤ 0,0 (gehalte ≤ AW (achtergrondwaarde) / S (streefwaarde)
- Licht verontreinigd: Index > 0,0 ≤ 1,0 (AW / S < gehalte ≤ I (interventiewaarde))
- Sterk verontreinigd: Index > 1,0 (gehalte > I)

Geval van ernstige bodemverontreiniging
Er is sprake van een ernstig geval van bodemverontreiniging indien voor één of meerdere stoffen de gemiddelde gemeten concentratie van 25 m^3 bodemvolume in het geval van grondverontreiniging, of in 100 m^3 bodemvolume in het geval van grondwaterverontreiniging, hoger is dan de interventiewaarde voor landbodems.

Voor ernstige bodemverontreinigingen die ontstaan zijn vóór 1987, dient middels een risicobeoordeling te worden vastgesteld of sanering al dan niet spoedig uitgevoerd dient te worden (Circulaire bodemsanering 2009).

TOETSING VAN ASBEST IN GROND/PUIN
De landelijke norm voor asbest in grond, bodem en puingranulaat is vastgesteld op 100 mg/kg d.s. gemeten (serpentijnconcentratie vermeerderd met tienmaal de amfiboolconcentratie) zoals vastgesteld in de Circulaire bodemsanering 2013. Grond en/of puin met een (gemeten) concentratie asbest boven de norm van 100 mg/kg d.s. wordt beoordeeld als ‘’verontreinigd met asbest’’. Grond en/of puin met een (gemeten) concentratie aan asbest lager dan de interventiewaarde of restconcentratienorm wordt als ‘’niet verontreinigd’’ beoordeeld.

TOEPASSEN VAN GROND EN TOEPASSEN EN VERSPREIDEN VAN BAGGERSPECIE
Op het toepassen van grond en het toepassen en verspreiden van baggerspecie is de Regeling bodemkwaliteit van 13 december 2007 van toepassing. Daarin kunnen lokale (water)bodembeheerders kiezen tussen generiek en gebiedspecifiek beleid.

Gebiedspecifiek beleid
Met het gebiedspecifiek beleid kunnen lokale (water)bodembeheerders zelf kwaliteitsnormen vaststellen. Als randvoorwaarden geldt dat sprake moet zijn van stand still op gebiedsniveau. De normen in het gebiedspecifiek kader worden lokale Maximale waarden genoemd.

Generiek beleid
Binnen het generieke (landelijke) beleid is het toetsingskader gebaseerd op een klassenindeling voor kwaliteit en functie. Uitgangspunt bij het toepassen van grond en het toepassen en verspreiden van baggerspecie binnen het generieke kader is, dat de kwaliteit moet aansluiten bij de functie van de (water)bodem en dat de lokale (water)bodemkwaliteit op klasse niveau niet mag verslechteren en waar mogelijk verbetert.

Landbodem
Binnen het generieke kader zijn voor het toepassen op landbodem vier kwaliteitsklassen onderscheiden:

- Vrij toepasbaar

Een partij grond is vrij toepasbaar wanneer deze voldoet aan de achtergrondwaarden. Daarnaast wordt een partij grond als “vrij toepasbaar” geclassificeerd als bij meting van 7-16 parameters de rekenkundig gemiddelde gehalten van maximaal twee stoffen verhoogd zijn ten opzichte van de achtergrondwaarden, met een maximum van tweemaal de achtergrondwaarden.

- Bodemkwaliteitsklasse wonen

Een partij grond wordt als “wonen” geclassificeerd als geen van de gemeten gehalten de maximale waarden wonen overschrijden, maar wel één of meer gehalten meer dan tweemaal de achtergrondwaarden overschrijden en/of drie of meer gemeten gehalten de achtergrondwaarden overschrijden.

- Bodemkwaliteitsklasse industrie

Een partij grond wordt als “industrie” geclassificeerd als één of meer van de gemeten gehalten de maximale waarden wonen overschrijden, maar de maximale waarden industrie niet worden overschreden.

- Niet toepasbaar

Een partij grond is niet toepasbaar wanneer één of meer van de gemeten gehalten de maximale waarden industrie overschrijden.

Bijlage F – Kwaliteitsborging

Dit onderzoek is uitgevoerd conform de eisen uit de KWALIBO-regeling; KWALIBO staat voor 'Kwaliteitsborging bij bodemintermediairs'. Arcadis Nederland B.V. is gecertificeerd volgens het procescertificaat 'Veldwerk bij milieuhygiënisch bodem- en waterbodemonderzoek'. Het veldwerk is uitgevoerd door Poelsema Veldwerk Bureau conform de BRL SIKB 2000 en de onderliggende protocollen 2001, 2002 en 2003. Het milieukundig veldwerk is onafhankelijk van de opdrachtgever uitgevoerd; voor de onafhankelijkheidsverklaring van de betrokken erkende milieutechnici zie bijlage G.

Het laboratoriumonderzoek is uitgevoerd door een door de Raad van Accreditatie geaccrediteerd en conform AS SIKB 3000 gecertificeerd laboratorium. Indien mogelijk zijn de analyses uitgevoerd conform AS SIKB 3000 en de onderliggende relevante protocollen. Dergelijke protocollen zijn echter niet voor alle stoffen opgesteld, en derhalve zijn niet alle analyses conform AS SIKB 3000 uit te voeren. Op de analysecertificaten in bijlage C staat per parameter aangegeven of de gehanteerde analysemethode erkend is volgens AS SIKB 3000.

Dit rapport draagt het keurmerk 'kwaliteitswaarborg bodembeheer SIKB'. Tijdens het uitgevoerde onderzoek is namelijk niet op kritieke punten afgeweken van de gehanteerde certificatieschema's, richtlijnen of normen.

Afwijkingen						
Van toepassing zijnde BRL	Onderwerp	Juiste wijze volgens BRL/NEN	Omschrijving afwijking	Motivatie	Risico	Conclusie
Conserverings-methoden en -termijnen voor milieumonsters, protocol 3001, tabel 2 (grond en waterbodem).	Conserverings-termijn.	De conserverings-termijn voor de desbetreffende parameter bedraagt minder dagen dan hetgeen nu tussen monstername en analyse heeft gezeten.	De conserverings-termijn is overschreden voor analyse van diverse monsters.	De monsters zijn gekoeld en donker opgeslagen geweest ten tijde van transport en opslag bij zowel het veldwerkwerkbureau als bij het laboratorium. De analyses zijn uitgevoerd nadat alle monsters waren verzameld.	Wegens mogelijke afbraak van de stoffen, wordt de concentratie mogelijk onderschat.	Niet-kritiek, omdat op basis van het vooronderzoek geen verontreinigingen worden verwacht en bij omliggende mastlocaties de waarden in dezelfde orde van grootte zijn vastgesteld.

In geval van BRL-gerelateerde klachten kunt u (de opdrachtgever) zich wenden tot ons (de certificaathouder) en, zo nodig, tot onze certificatie-instelling SGS Intron Certificatie B.V.

Bijlage G – Onafhankelijkheidsverklaring

Verklaring uitgevoerd conform BRL 2000 en in onafhankelijkheid van de opdrachtgever.*				
Opmerking en/of afwijkingen t.o.v BRL2000/P2002	Nee: ☑	Ja, reden:		
Functie:		Naam:	Paraaf:	Datum veldwerk:
Veldwerker (ervaren)		M. La Crois		22-11-21 tm 09-03-22
Veldwerker in opleiding			nvt	
Assistent			nvt	
* Verklaart hiermee tevens de opdracht; materiaal en benodigde apparatuur en hulpmiddelen enz. gecontroleerd te hebben.				

Colofon

VERKENNEND BODEMONDERZOEK OPWAARDERING 380KV ENS-ZWOLLE
MAST 61

KLANT
Opdrachtgever: TenneT

AUTEUR
Andries Faber

PROJECTNUMMER
30073259

ONZE REFERENTIE
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DATUM
25 maart 2022

STATUS
Concept

GECONTROLEERD DOOR	VRIJGEGEVEN DOOR
Chris Jansonius Senior Specialist Bodemonderzoek en -sanering	Simon van den Bosse Projectmanager

Over Arcadis

Arcadis is een toonaangevend wereldwijd ontwerp- en consultancybureau voor de natuurlijke en gebouwde omgeving. Wij maken het verschil voor onze klanten en de maatschappij met doeltreffende, duurzame en digitale oplossingen. Met 27.000 mensen in meer dan 70 landen genereerden we in 2020 een omzet van €3,3 miljard. Wij ondersteunen UN-Habitat met kennis en expertise om leefomstandigheden te verbeteren in gebieden getroffen door de gevolgen van de klimaatverandering.

www.arcadis.com

Arcadis Nederland B.V.

Postbus 63
9400 AB Assen
Nederland

T +31 (0)88 4261 261

Arcadis. Improving quality of life

Verkennend bodemonderzoek opwaardering 380kV Ens-Zwolle

Mast 64
Opdrachtgever: TenneT

25 maart 2022

Contactpersoon

SIMON VAN DEN BOSSE
Projectmanager

Arcadis Nederland B.V.
Postbus 63
9400 AB Assen
Nederland

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1 Inleiding

In opdracht van TenneT heeft Arcadis Nederland B.V. een verkennend bodemonderzoek uitgevoerd. Dit ten behoeve van het project Opwaardering tracé Ens-Zwolle 380 kV. Het milieukundig bodemonderzoek is uitgevoerd ter plaatse van mast 64.

In bijlage A is een regionale ligging en een overzichtstekening opgenomen met weergave van de uitgevoerde werkzaamheden.

Aanleiding van het onderzoek
Om in de toekomst meer elektriciteit te kunnen transporteren is het noodzakelijk om naast de nieuwbouw van verbindingen bestaande hoogspanningsverbindingen aan te passen voor een grotere transportcapaciteit. Om die reden gaat TenneT de bestaande landelijke 380kV-ring, de 'ruggengraat' van het landelijk hoogspanningsnet, opwaarderen (programma Beter Benutten Bestaande 380 kV). Binnen dit programma valt ook het deelproject Opwaardering 380kV-verbinding Ens-Zwolle (ENS-ZL380).

Voor de opwaardering van deze verbinding moeten diverse werkzaamheden worden uitgevoerd. In de basis betreft dit het ophangen van nieuwe geleiders met een hogere transportcapaciteit dan de huidige geleiders. De nieuwe geleiders zijn in omvang en aantal gelijk aan de bestaande maar kunnen meer stroom transporteren doordat ze hogere temperaturen kunnen weerstaan zonder te ver door te hangen. De huidige hoogspanningsverbinding is bovendien bijna 35 jaar oud. Om deze reden worden ook andere onderdelen, zoals de isolatorkettingen en bliksemdraden als levensduur verlengende activiteit vervangen. Daarnaast worden de masten opnieuw constructief beschouwd en moet bij een aantal masten de fundering en of het mastlichaam versterkt worden.

Doelstelling van het onderzoek

Voor het ontwerp van de mastlichamen en fundaties (Definitieve Ontwerp), de bouwwegen en de vergunningaanvraag zijn verschillende veld- en bodemonderzoeken nodig.

Het doel van het bodemonderzoek is het vaststellen of ter plaatse van de graaflocatie sprake is van bodemverontreiniging en zo ja, of deze een belemmering vormt voor de voorgenomen werkzaamheden.

Op basis van de milieuhygiënische kwaliteit van de bodem wordt advies gegeven over:
- de veiligheidsklasse(n) behorende bij de graafwerkzaamheden;
- welke meldingen, vergunningen en/of processturing en certificeringen, vanuit de Wet bodembescherming (Wbb) en het Besluit Bodemkwaliteit (Bbk) en/of Omgevingswet, noodzakelijk zijn;

Het bodemonderzoek is niet gericht op het vaststellen van de mogelijkheden voor hergebruik van (eventueel) in een later stadium af te voeren grond. Op hergebruik van grond is het Besluit bodemkwaliteit van toepassing. Voor bodemonderzoek dat in het kader van grondverzet wordt uitgevoerd gelden andere onderzoeksprotocollen. Wel zijn de onderzoeksresultaten indicatief getoetst aan het Besluit bodemkwaliteit. Het doel daarvan is om een indicatie te krijgen over de mogelijkheden om eventueel vrijkomende grond te hergebruiken

Werkwijze

Bij elke activiteit waar grondroering in de bodem wordt voorzien, is het uitvoeren van het vooronderzoek naar de milieuhygiënische kwaliteit van de bodem noodzakelijk volgens NEN 5725[1]. Het bodemonderzoek is uitgevoerd conform de BRL SIKB 2000 en conform de richtlijnen uit de NEN 5725 en de NEN 5740[2].

In de NEN 5720 zijn, afhankelijk van de onderzoeksstrategie en -inspanning, richtlijnen gegeven voor de aantallen te verrichten boringen en te analyseren waterbodemmonsters als functie van de oppervlakte of de lengte van de te

[1]Vooronderzoek landbodem conform NEN 5725:2017 NL (Bodem - Landbodem Strategie voor het uitvoeren van milieuhygiënisch vooronderzoek)
[2] Bodem – Landbodem – Strategie voor het uitvoeren van verkennend bodemonderzoek – Onderzoek naar de milieuhygiënische kwaliteit van bodem en grond.

onderzoeken (deel)locatie. Op basis van de verkregen informatie uit het vooronderzoek is gekozen voor de strategie Lintvormig, met een normale onderzoeksinspanning.

Afbakening

Landbodem

De oorspronkelijk opdracht bestond uit landbodemonderzoek ter plaatse van 15 masten:

- 121 boringen tot 0,5 m -mv. (deze worden gecombineerd met de cultuurtechnische boringen);
- 30 boringen tot 2,0 m -mv. (deze worden gecombineerd met de cultuurtechnische boringen);
- 30 analyses bovengrond op standaardpakket;
- 15 analyses ondergrond op standaardpakket;
- Bemonstering van 30 peilbuizen;
- Analyse van 15 grondwatermonsters.

Waterbodemonderzoek

- Waar bouwwegen sloten/watergangen kruisen en
- Op plaatsen waar een werkterrein of lierlocatie op of over watergang geprojecteerd is

Na gunning werd duidelijk dat in plaats van bij 15, bij slechts 5 masten de fundering moet worden verstevigd. Dit betreft de masten 44-45-48-61 en 64. Dit houdt in dat enkel bij de 5 genoemde masten graafwerkzaamheden in de grond zullen plaatsvinden. Bovendien zijn nieuwe versies van het zogenaamde mastenboek verschenen, hetgeen invloed heeft gehad op de aantallen te verrichte boringen, sonderingen, waterbodemonderzoeken en dergelijke.

Leeswijzer

De resultaten van het vooronderzoek zijn beschreven in hoofdstuk 2. Hoofdstuk 3 beschrijft de uitvoering en resultaten van het bodemonderzoek. Hoofdstuk 4 beschrijft de conclusies en advies.

Disclaimer

Hoewel het bodemonderzoek op zorgvuldige wijze is voorbereid en uitgevoerd, kan niet worden uitgesloten dat er in werkelijkheid afwijkingen optreden ten opzichte van de in dit rapport gepresenteerde resultaten. Immers, elk bodemonderzoek is gebaseerd op het nemen van een aantal steekproeven, welke representatief worden geacht voor het onderzochte gebied, maar waarbij (lokale) afwijkingen niet volledig kunnen worden uitgesloten.

2 Vooronderzoek conform NEN 5725

Het verkennend milieukundig bodemonderzoek is voorafgegaan door een vooronderzoek volgens NEN 5725:2017, aanleiding G “Opstellen hypothese over de bodemkwaliteit bij tijdelijke uitplaatsing en bij overig projectmatig grondverzet ten behoeve van het inschatten van arbeidshygiënische risico’s”. Ter beantwoording van de onderzoeksvragen behorende bij aanleiding G is informatie verzameld over relevante onderzoeksaspecten. Het vooronderzoek is uitgevoerd om relevante informatie te verzamelen om onderbouwde antwoorden te formuleren op de onderzoeksvragen, welke van toepassing zijn op aanleiding G.

Op basis van de resultaten uit het vooronderzoek wordt een onderzoekshypothese geformuleerd. Afhankelijk van eventuele aanwijzingen over de aanwezigheid van een bodemverontreiniging wordt een locatie geclassificeerd als ‘verdacht’ of ‘onverdacht’. Op basis van deze classificatie wordt een hypothese geformuleerd, welke vervolgens aan de hand van de onderzoeksresultaten wordt getoetst. Bij een onderzoek op een ‘onverdachte’ locatie wordt de hypothese getoetst dat er geen verontreiniging aanwezig is, bij een onderzoek van een verdachte locatie wordt de hypothese getoetst dat wel een (specifieke) verontreiniging aanwezig is.

2.1 Onderzoekslocatie en -grenzen

De ligging van de onderzoekslocatie is weergegeven in bijlage A. Het perceel staat kadastraal bekend als gemeente IJsselmuiden, sectie M, nummer 345.

2.2 Geraadpleegde bronnen

Tijdens het vooronderzoek zijn de volgende bronnen geraadpleegd. Dit zijn minimaal de gebruikelijke bronnen die geraadpleegd worden voor een vooronderzoek in Nederland.

- De opdrachtgever (TenneT);
- De website www.google.nl/maps en Streetview. Hiermee is een digitale terreininspectie uitgevoerd;
- De website www.bodemloket.nl;
- De website www.topotijdreis.nl; voor het raadplegen van historisch kaartmateriaal;
- De Bodemkwaliteitskaarten van gemeente Zwartewaterland, omgevingsdienst IJsselland;
- Dinoloket, voor informatie over de bodemopbouw en geohydrologische informatie;
- De website van de provincie Overijssel voor het opvragen en raadplegen van relevante bodemonderzoeksdocumenten.
- Terreininspectie digitaal uitgevoerd en voorafgaand aan het veldwerk.

2.3 Bekende bodemkwaliteitsgegevens

2.3.1 Bodemopbouw en geohydrologie

De maaiveldhoogte ter plaatse van de onderzoekslocatie is circa -0,2 m NAP. De bodem ter plaatse van de onderzoekslocatie bestaat uit zand en klei. De freatische grondwaterstand bevindt zich op een diepte van 2,0 m-mv.

2.3.2 Bodemkwaliteitskaart

Voor het algemeen beeld van de lokale bodemkwaliteit is de bodemkwaliteitskaart van de gemeente geraadpleegd. Binnen de bodemkwaliteitskaart is geen aandacht besteed aan PFAS verdachte/onverdachte gebieden. Op basis van de bodemkwaliteitskaart kan de bodemkwaliteit van de onderzoekslocatie als volgt worden beschreven:

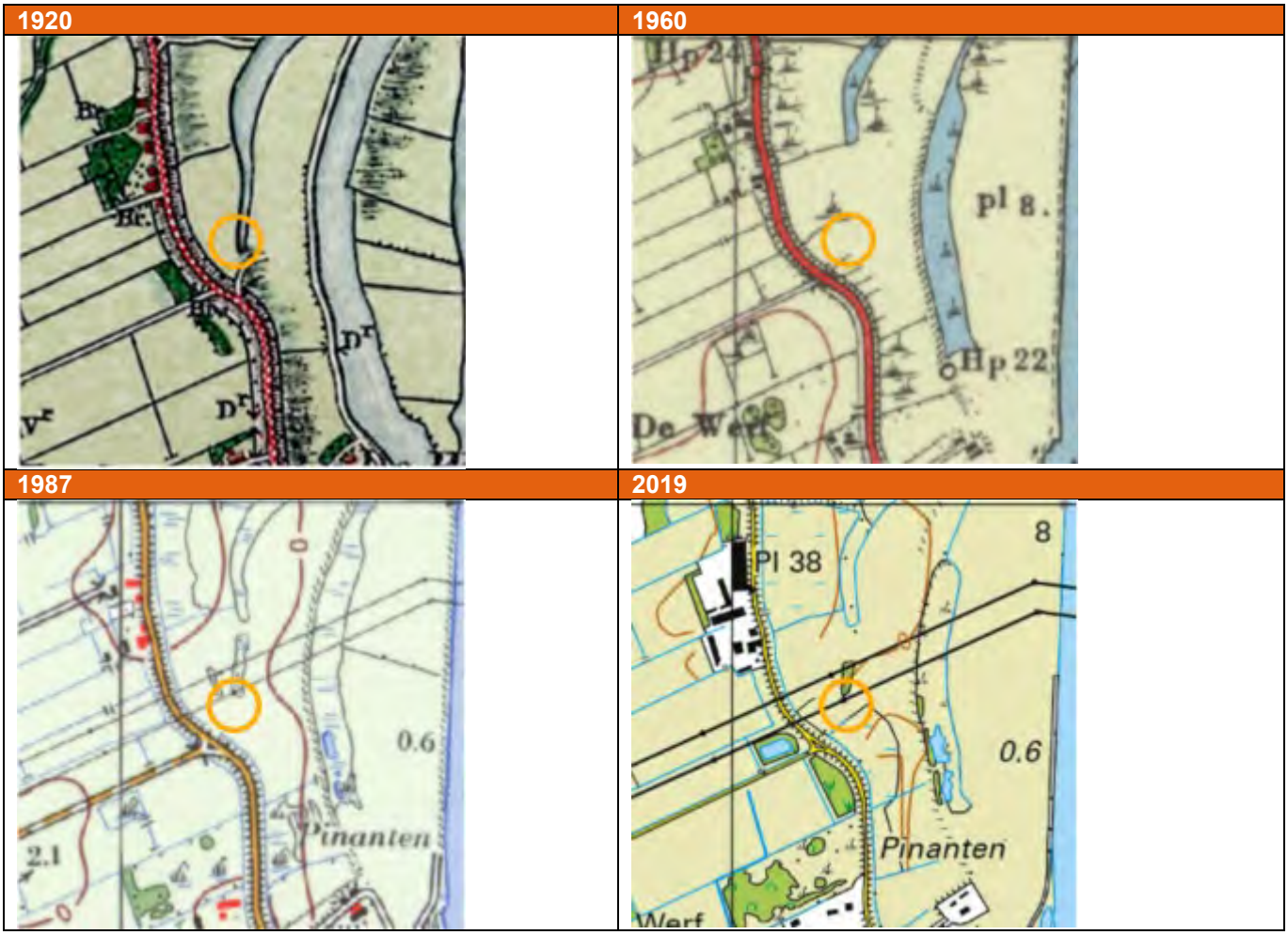
- Kwaliteit bovengrond : Landbouw/natuur
- Kwaliteit ondergrond : Landbouw/natuur

Voor de onderzoekslocatie is geen asbestkansenkaart aanwezig.

Waterbodems zijn uitgesloten van de bodemkwaliteitskaart.

2.3.3 Gebruik en beïnvloeding van de onderzoekslocatie

Uit het historisch kaartmateriaal (zie figuren) blijkt dat de omgeving van de onderzoekslocatie een agrarische bestemming heeft. De structuur van watergangen is nagenoeg ongewijzigd.



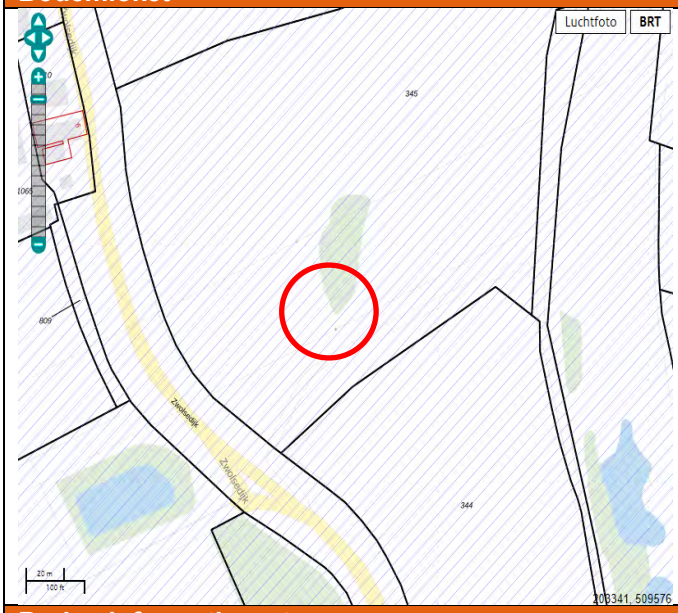
Figuur 1 Uitsneden historisch kaartmateriaal (onderzoekslocatie met oranje gemarkeerd)

2.3.4 Verwachting ten aanzien van de bodemkwaliteit

2.3.4.1 Beschikbare bodeminformatie

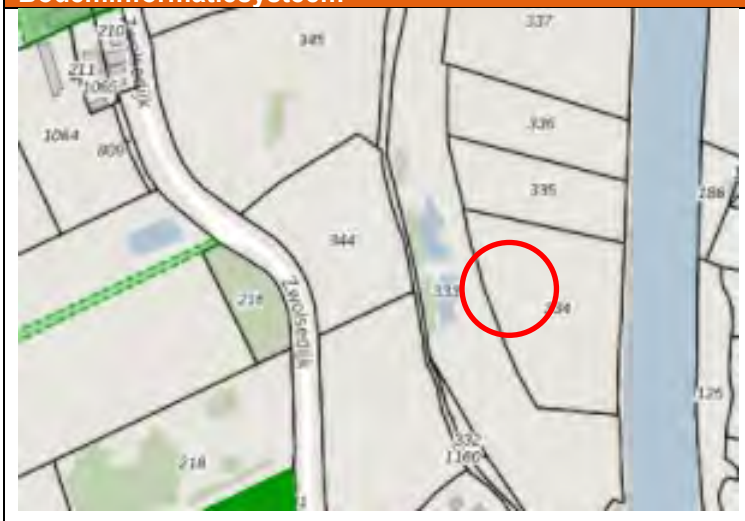
In onderstaande afbeeldingen is de beschikbare bodeminformatie te zien ten opzichte van de onderzoekslocatie.

Bodemloket



Legenda

Bodeminformatiesysteem



Legenda

Figuur 2 Uitsneden kaartmateriaal (onderzoekslocatie met rood gemarkeerd)

De voor de locatie beschikbare rapporten en documenten zijn samengevat in tabel 1. Hieruit kan worden afgeleid dat er geen bodeminformatie ter plaatse van de onderzoekslocatie beschikbaar is.

Tabel 1: Overzicht beschikbare rapporten en documenten

Bron	Datum	Titel document/rapport	Kenmerk	Opsteller
☐ TenneT	-	-	-	-
☐ Bodemloket	-	-	-	-
☐ Bodeminformatiesysteem	-	-	-	-

Toelichting tabel:
☐ Er zijn geen bodemonderzoeksgegevens bekend ter plaatse van de onderzoekslocatie
☒ Er zijn bodemonderzoeksgegevens bekend ter plaatse van de onderzoekslocatie

2.3.4.2 Verdachte activiteiten

In tabel 2 is een overzicht weergegeven met de historische informatie uit de verschillende bronnen.

Tabel 2: Overzicht met verdachte (bedrijfs)activiteiten nabij de onderzoekslocatie

Verdachte (bedrijfs)activiteiten	UBI- code	Toelichting
Nabij de onderzoekslocatie zijn geen verdachte (bedrijfs)activiteiten bekend.	-	-

2.3.4.3 Asbest

Uit het vooronderzoek blijkt op basis van de beschikbare gegevens geen aanleiding voor een verdenking voor de aanwezigheid van een bodemverontreiniging met asbest.

2.3.4.4 PFAS

In relatie tot de te hanteren onderzoeksstrategie dient in het vooronderzoek beoordeeld te worden of de locatie door de ligging verdacht is op het voorkomen van gehalten aan PFAS (bijvoorbeeld nabij bronlocaties). De gemeente heeft op de bodemkwaliteitskaart PFAS niet toegevoegd als een kritische parameter.

In december 2021 is het meest recente handelingskader voor hergebruik van PFAS-houdende grond en baggerspecie aangepast en van kracht. In dit handelingskader zijn diverse toepassingsnormen voor het toepassen van grond en baggerspecie op de landbodem en in oppervlaktewater vastgesteld. Uit het handelingskader volgt de noodzaak tot onderzoek naar PFAS in geval van bodemtoepassingen of afvoer van bodemmateriaal naar een erkende verwerker. Dit is niet van toepassing indien er sprake is van tijdelijk uitplaatsen van grond. Bij het tijdelijk uitplaatsen van grond verandert de algemene bodemkwaliteit op de betreffende locatie, niet.

Gezien de voorgenomen werkzaamheden, het tijdelijk uitplaatsen van grond, behoeft met het bodemonderzoek, PFAS niet te worden geanalyseerd.

2.3.4.5 Terreininspectie

Voorafgaand aan de uitvoering van het bodemonderzoek is een terreininspectie uitgevoerd. Tijdens de terreininspectie zijn ter plaatse van de onderzoekslocatie geen waarnemingen gedaan die wijzen op de aanwezigheid van bodemverontreiniging.

2.4 Conclusies vooronderzoek en hypothese

- Binnen het onderzoeksgebied zijn geen bodemonderzoeksgegevens bekend.
- Er is geen sprake (geweest) van activiteiten waarbij de bodem kan zijn verontreinigd.
- De onderzoekslocatie is niet verdacht op het voorkomen van verontreiniging met asbest in de bodem. Indien tijdens de uitvoering van het bodemonderzoek asbestverdachte materialen, puinhoudende grond welke als asbestverdacht kan worden aangemerkt of puinlagen worden aangetroffen dient asbestonderzoek (conform NEN 5707 of NEN 5897) te worden uitgevoerd.
- PFAS in grond behoeft niet te worden onderzocht, aangezien geen aan- of afvoer van grond zal plaatsvinden.
- Op basis van de bodemkwaliteitskaart worden geen verontreinigingen verwacht.

De locatie wordt onderzocht conform de NEN richtlijn bij onverdachte locaties (strategie ONV).

3 Resultaten

3.1 Kwaliteitsborging

De genoemde werkzaamheden zijn uitgevoerd in overeenstemming met de regelgeving die bekend is onder de naam KWALIBO (dat staat voor kwaliteitsborging bij bodemintermediairs). De beschrijving van de kwaliteitsborging en wijze van uitvoering is opgenomen in bijlage F.

3.2 Uitgevoerde werkzaamheden

In tabel 3 is het uitgevoerde onderzoeksprogramma weergegeven. Voorafgaand aan de werkzaamheden is bij het kadaster in het kader van de Wibon een graafmelding uitgevoerd.

Tabel 3: Uitgevoerde onderzoeksprogramma

	Aantal	Omschrijving veldwerk	Aantal	Omschrijving analyses
Grond				
	7	Boring tot 0,5 m-mv	2	NEN 5740 STAP GR *
	8	Boring tot 1,2 m-mv	1	Regionaal Waterbodempakket *
	3	Boring tot 1,5 m-mv		
	2	Boring tot 2,0 m-mv		
	1	Boring tot 3,0 m-mv		
	2	Boring tot 3,2 m-mv		
	1	Boring tot 4,0 m-mv		
	10	Waterbodemsteken		
Grondwater				
	-	Boring met peilbuis	2	NEN 5740 STAP GW **
	2	Bemonsteren grondwater en oppervlaktewater	2	Lozingspakket ***
	2	Meten grondwaterstand, pH, EC en NTU		
Toelichting tabel:				
* STAP GR + Regionaal Waterbodempakket: droge stof, lutumgehalte, organisch stofgehalte, barium (Ba), cadmium (Cd), kobalt (Co), koper (Cu), kwik (Hg), molybdeen (Mo), nikkel (Ni), lood (Pb), zink (Zn), minerale olie (GC) (C10-C40), PAK (10 VROM), PCB (7) inclusief structuur-pakket (humus/lutum) en voorbehandeling AS3000. ** STAP GW (Standaardpakket grondwater): barium (Ba), cadmium (Cd), kobalt (Co), koper (Cu), kwik (Hg), molybdeen (Mo), nikkel (Ni), lood (Pb), zink (Zn), aromaten (BTEXN), styreen, VOCl (11) en vinylchloride, 1,1-dichlooretheen, 1,1- dichloorpropaan, 1,2-dichloorpropaan,1,3-dichloorpropaan, bromoform en minerale olie (GC) (C10-C40), inclusief voorbehandeling AS3000. *** Lozingspakket: onopgeloste bestanddelen, ijzer, sulfaat, ammonium, chloride, fosfaat pH = zuurgraad; EC = elektrische geleidbaarheid; NTU= maat voor het meten van de troebelheid van het grondwater.				

Bij de bemonsteringen op de locatie is de vrijkomende grond beoordeeld op de bodemkundige samenstelling. Daarnaast is gelet op het voorkomen van puin, slakken, kolengruis en dergelijke en op afwijkingen van kleur, die kunnen duiden op de aanwezigheid van bodemverontreiniging. De grond uit de boringen is met behulp van de oliedetectiepan beoordeeld op de aanwezigheid van olieachtige en oppervlakte-actieve stoffen. De boorprofielen zijn opgenomen in bijlage B. De opgeboorde grond van elke boring is per bodemlaag van maximaal 0,5 m bemonsterd. Indien de bodemopbouw en de veldwaarnemingen daar aanleiding toe gaven, is een kleiner monstertraject gekozen.

De peilbuizen zijn in een eerder stadium geplaatst. Na een wachttijd van meerdere weken is het grondwater uit de peilbuis bemonsterd. De periode van 1 week is minimaal noodzakelijk om het evenwicht tussen grond en grondwater te laten herstellen. Voorafgaande aan de bemonstering zijn de zuurgraad (pH), het elektrisch geleidingsvermogen (EC) en de troebelheid (NTU) van het opgepompte grondwater bepaald. Daarnaast is het oppervlaktewater bemonsterd en geanalyseerd op lozingsparameters.

3.3 Bodemopbouw

De bodem bestaat voornamelijk uit klei op veen. Plaatselijk is in de ondergrond een laag zand aanwezig. De waterbodem bestaat uit slib op veen of slib op zand.

3.4 Veldwaarnemingen

Er zijn geen bodemvreemde materialen aangetroffen.

3.5 Veldmetingen

Tabel 4 Meetgegevens grondwater

Peilbuis	Filterstelling (m-mv)	Grondwaterstand	pH (-)	EC (µS/cm	Troebelheid (NTU)
64-1HB	1,75 - 2,75	0,74 m-mv	6,1	690	8,71

Toelichting tabel:
pH : Zuurgraad
EC : Elektrisch geleidingsvermogen
NTU : Afkorting van Nephelometric Turbidity Unit, is een maat voor de troebelheid (Turbidity) van een vloeistof. *Indien de NTU-waarde >10, is er sprake van een troebel watermonster. Het grondwater was niet troebel (<10 NTU). Er is als gevolg van de lage troebelheid geen beïnvloeding van de analyseresultaten te verwachten.

3.6 Analyseresultaten

De analyseresultaten zijn getoetst aan de achtergrond / streef- en interventiewaarden uit de Circulaire bodemsanering 2013 en het Besluit bodemkwaliteit en weergegeven in onderstaande tabellen. De (getoetste) analysecertificaten zijn opgenomen bijlage C en D. Een toelichting op het toetsingskader is opgenomen in bijlage E.

Tabel 5 Analyseresultaten grond

Analyse code	Deelmonsters	Diepte (m-mv)	> AW (index)	> I (index)	Klasse Bbk (indicatief)
64-MM-BG01	64-HB05-1, 64-HB10-1, 64-HB11-1, 64-HB16-1	0,00 - 0,50	-	-	Altijd toepasbaar
64-MM-OG01	64-HB07-4, 64-HB12-5	0,80 - 2,00	-	-	Altijd toepasbaar

Toelichting tabel:
- : Geen verhoogde waarden gemeten
>AW : Gehalten groter dan de achtergrondwaarde
>I : Gehalten groter dan de interventiewaarde
Index : (GSSD-AW) / (I-AW)
GSSD : Gestandaardiseerde meetwaarde
Bbk : Besluit bodemkwaliteit

Tabel 6 Analyseresultaten waterbodem

Analysecode	Deelmonsters	Diepte (m-mv)	> AW (index)	Toepassen op of in Landbodem	Verspreiden op aangrenzende perceel
64-MM-WB01	64-WB01-1, 64-WB02-1, 64-WB03-1, 64-WB04-1, 64-WB05-1, 64-WB06-1, 64-WB07-1, 64-WB08-1, 64-WB09-1, 64-WB10-1	0,15 - 0,50	Cd (0,03), Co (0,07), Ni (0,19), PAK VROM (0,00), Zn (0,13)	Industrie	Verspreidbaar

Toelichting tabel:
- : Geen verhoogde waarden gemeten
>AW : Gehalten groter dan de achtergrondwaarde
Index : (GSSD-AW) / (I-AW)
GSSD : Gestandaardiseerde meetwaarde

Tabel 7 Analyseresultaten grondwater

Peilbuis	Filterstelling (m-mv)	Datum monstername	> S (index)	> I (index)
64-1HB	1,75 - 2,75	23 november 2021	112TCA (0,00)	-

Toelichting tabel:
- : Geen verhoogde waarden gemeten
>S : Gehalten groter dan de streefwaarde
>I : Gehalten groter dan de interventiewaarde
Index : (GSSD-S) / (I-S)
GSSD : Gestandaardiseerde meetwaarde
112TCA : Trichloorethaan

3.7 Interpretatie resultaten

Grond

In zowel de bovengrond (0,0-0,5) als de ondergrond (0,8-2,0) zijn geen verhoogde gehalten aangetoond. Dit komt overeen met de bevindingen vanuit het vooronderzoek.

Grondwater

In het grondwater is een licht verhoogd gehalte trichloorethaan aangetoond (0,12 µg/l, streefwaarde = 0,10 µg/l). Er is geen directe aanleiding gevonden voor deze verhoogde concentratie. Er hoeft hier geen nadere aandacht aan te worden besteed,

Waterbodem

De waterbodem bevat een licht verhoogd gehalte zware metalen (cadmium, kobalt, nikkel, zink) en PAK.

4 Conclusies

Milieuhygiënische kwaliteit grond, grondwater en waterbodem

Uit de resultaten van het bodemonderzoek blijkt het volgende.

- Tijdens het terreinbezoek en tijdens het uitvoeren van het bodemonderzoek zijn geen (asbest)verdachte materialen waargenomen of andere waarnemingen (puin) gedaan die kunnen duiden op de aanwezigheid van asbest of bodemverontreiniging.
- In zowel de boven- (0,0-0,5 m-mv) als de ondergrond (0,8-2,0 m-mv) zijn geen van de onderzochte parameters in verhoogde gehalten aangetoond en is altijd toepasbaar.
- Het onderzochte slib voldoet maximaal aan de klasse Industrie. Het slib uit de waterbodem mag worden verspreid op het aangrenzende perceel. Bij hergebruik van het slib elders geldt dat deze alleen als klasse industrie mag worden toegepast.
- In het grondwater is een licht verhoogde concentratie trichloorethaan aangetoond.

Procedures in het kader van de Wet bodembescherming

- De onderzoeksresultaten geven geen aanleiding tot het uitvoeren van vervolgonderzoek.
- In het kader van de Wet bodembescherming en de toekomstige Omgevingswet zijn voor de uitvoering van de geplande werkzaamheden in de bodem geen meldingen noodzakelijk.
- De milieuhygiënische kwaliteit van de bodem en de waterbodem vormen geen belemmering voor de geplande werkzaamheden.

Veiligheidsklasse

De te hanteren voorlopige veiligheidsklasse is bepaald volgens de systematiek uit de CROW-publicatie 400 (werken in en met verontreinigde bodem) . Bij de uitvoering van de werkzaamheden dienen de bij deze veiligheidsklasse behorende maatregelen te worden toegepast, zoals beschreven in de CROW-publicatie 400. De bepaling van de definitieve veiligheidsklasse dient te worden getoetst door een veiligheidskundige van de aannemer.

Uit de bepaling volgt ‘geen veiligheidsklasse van toepassing’. Voor de werkzaamheden die in de bodem worden uitgevoerd zijn de maatregelen volgens de Basishygiëne van toepassing.

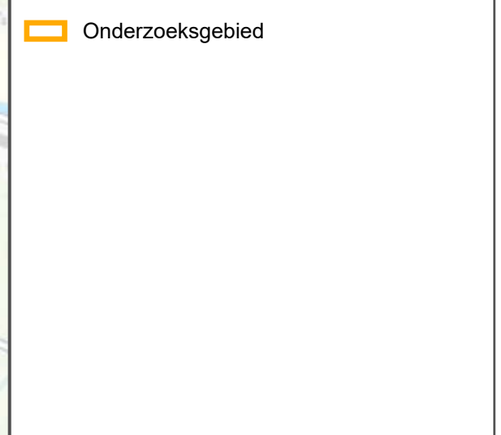
Bijlage A – Tekeningen

TenneT ENS-ZL

Overzichtstekening

Legenda

Onderzoeksgebied



OPDRACHTGEVER:	Tennet
ZAAKNUMMER:	30073259

ARCADIS Design & Consultancy for natural and built assets

datum: 10/6/2021
schaal (A3): 1:10,000

0 100 200 300 400 500 m

N

Cultuurtechnisch en milieukundig onderzoek

Mast 64

Legenda

- Boring tot 0,5 m-mv
- Boring tot 1,20 m-mv
- Boring tot 2,0 m-mv
- Handsondering tot 3,00 m-mv
- Boring tot 4,00 m-mv
- Masten
- 380 kV
- Zakelijk rechtstrook
- Aan te leggen dijk (rijbaan)
- Bestaande weg / verharding benutten
- Lierlocatie
- Ruimtereservering aanrijroute (nat weer)
- Ruimtereservering aanrijroute (onderzoek)
- Ruimtereservering aanrijroute (rijbaan)
- Ruimtereservering aanrijroute (rijbaan) (optie)
- Werkterrein

KLIC

- KL-MS-N
- KL-HS-N

opdrachtgever: TenneT

ARCADIS Design & Consultancy for natural and built assets

datum:	12-11-2021
schaal (A3):	1:750
status:	definitief
tekenaar:	George Alion
projectleider:	Simon van den Bosse
goedgekeurd:	Andries Faber
GIS bestand:	Geoinformatie\TenneT_30073259_20211112.mxd
PDF bestand:	Tekeningen\TenneT_30073259 _20211112.pdf

N

0 5 10 15 20 25 m

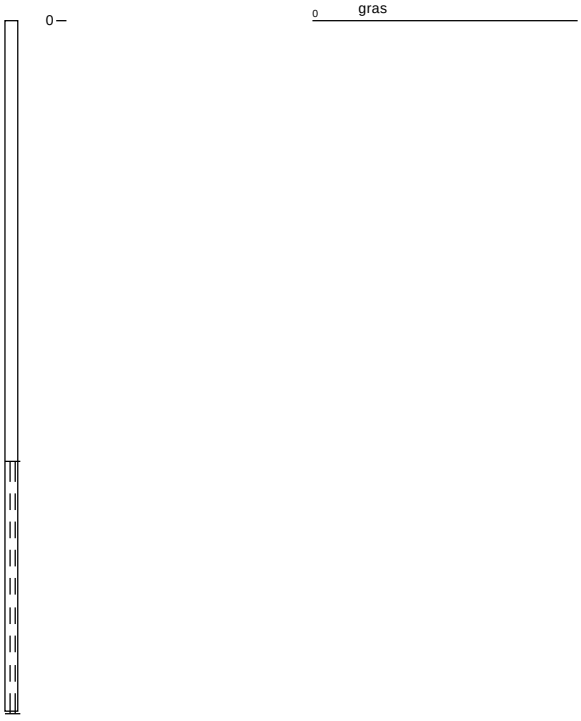
projectnummer	tekening	versie
30073259	5	1

Bijlage B – Boorprofiel(en)

Boring: 64-1HB (bestaande peilbuis)

Datum: 23-11-2021

Boormeester: Marcel la Crois



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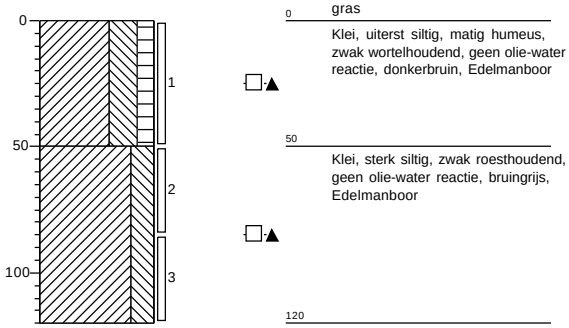

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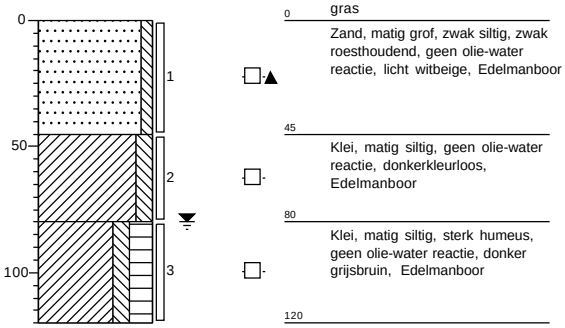

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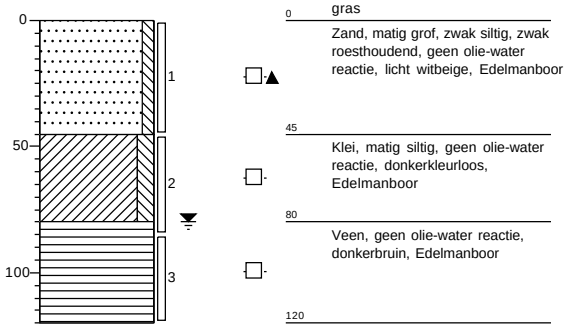

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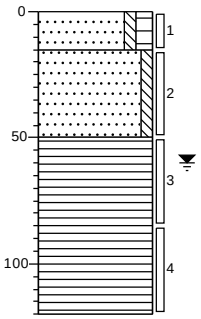

0 gras
15 Zand, matig fijn, zwak siltig, matig humeus, zwak wortelhoudend, geen olie-water reactie, donkerbruin, Edelmanboor
50 Zand, matig grof, zwak siltig, matig roesthoudend, geen olie-water reactie, licht bruinbeige, Edelmanboor
Veen, geen olie-water reactie, donkerbruin, Edelmanboor
120

Boring: 64-HB05

Datum: 22-11-2021
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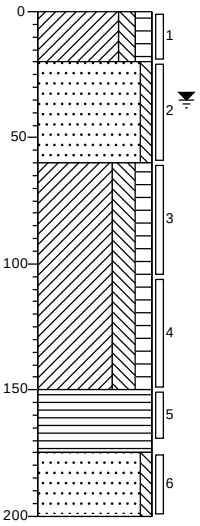

0 gras
20 Klei, matig siltig, matig humeus, geen olie-water reactie, grijsbruin, Edelmanboor
Zand, matig grof, zwak siltig, geen olie-water reactie, grijswit, Edelmanboor
60 Klei, sterk siltig, matig humeus, geen olie-water reactie, K-waarde: 0,04, Edelmanboor
150 Veen, geen olie-water reactie, K-waarde: 0,02, donkerbruin, Edelmanboor
175 Zand, zeer fijn, zwak siltig, geen olie-water reactie, K-waarde: 3, licht grijswit, Edelmanboor
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Boring: 64-HB06

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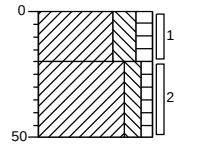

0 gras
20 Klei, sterk siltig, matig humeus, zwak wortelhoudend, geen olie-water reactie, donkerbruin, Edelmanboor
50 Klei, matig siltig, zwak humeus, zwak wortelhoudend, geen olie-water reactie, donker bruingrijs, Edelmanboor

Boring: 64-HB07

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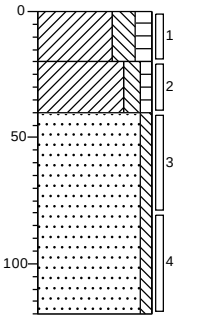

0 gras
20 Klei, sterk siltig, matig humeus, zwak wortelhoudend, geen olie-water reactie, donkerbruin, Edelmanboor
40 Klei, matig siltig, zwak humeus, zwak wortelhoudend, geen olie-water reactie, donker bruingrijs, Edelmanboor
Zand, matig fijn, zwak siltig, lensjes klei, geen olie-water reactie, neutraalgrijs, Edelmanboor
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Boring: 64-HB08

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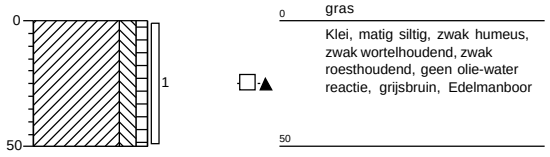

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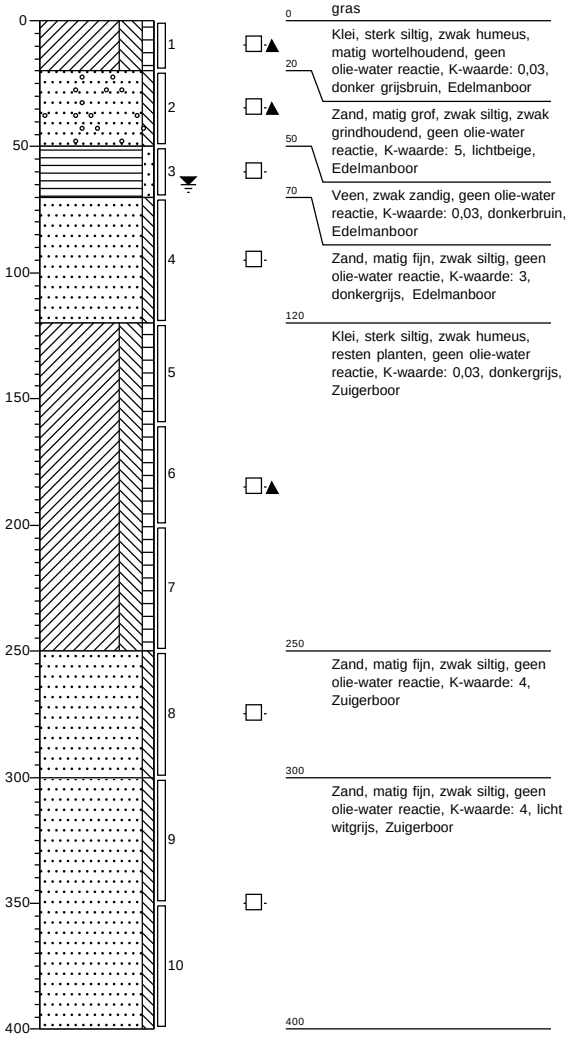

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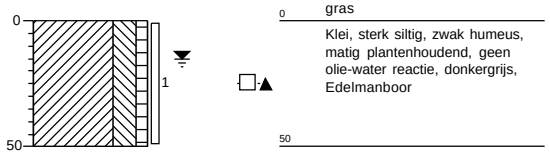

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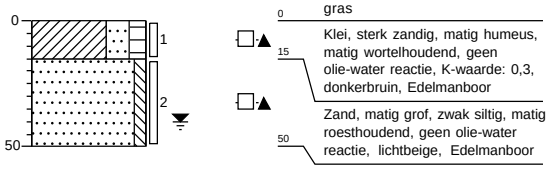

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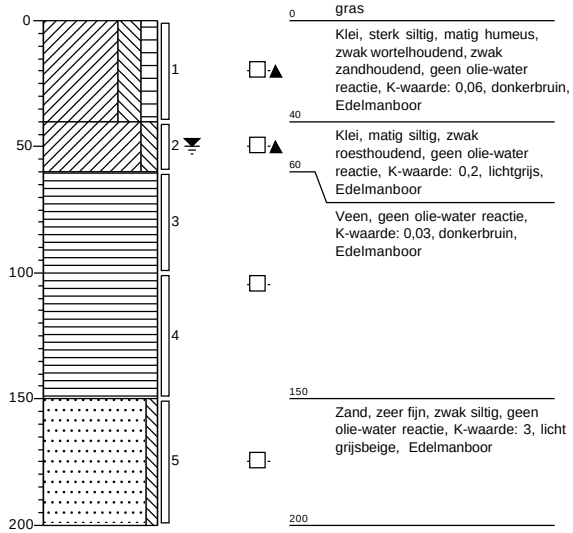

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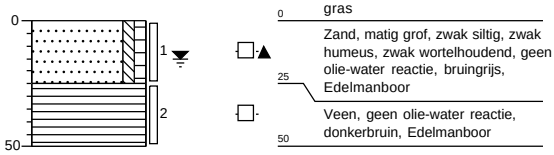

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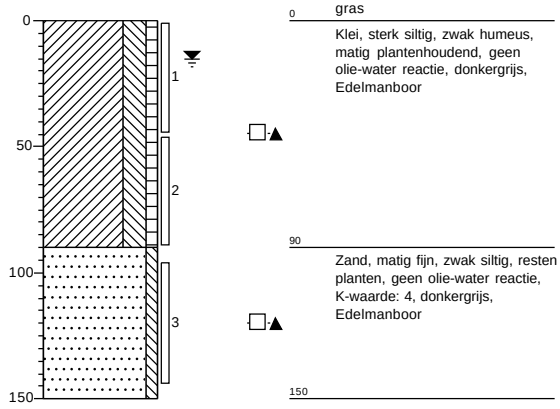

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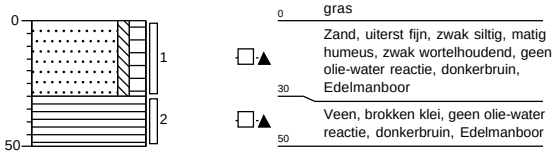

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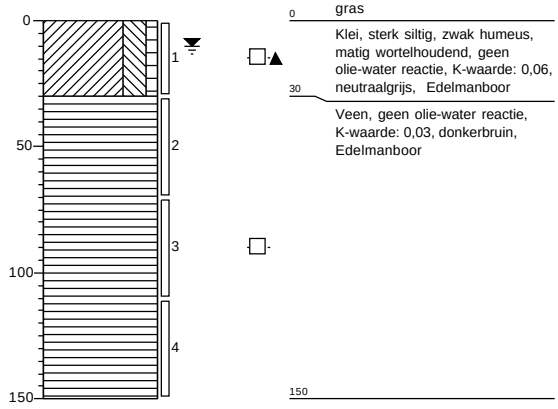

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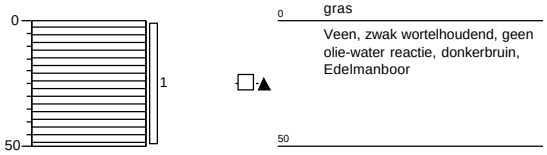

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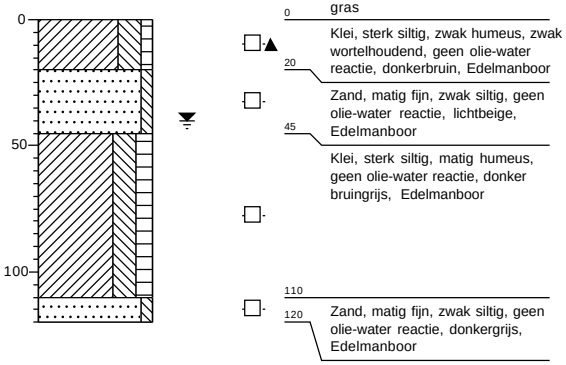

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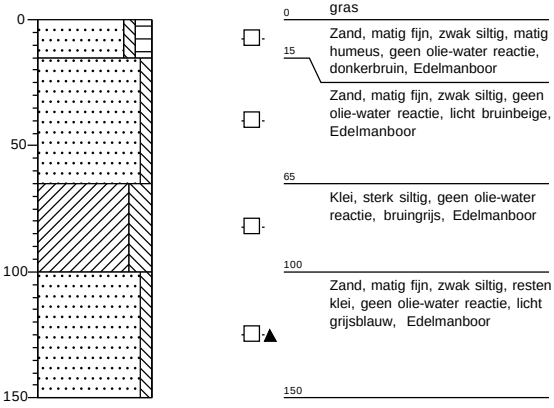

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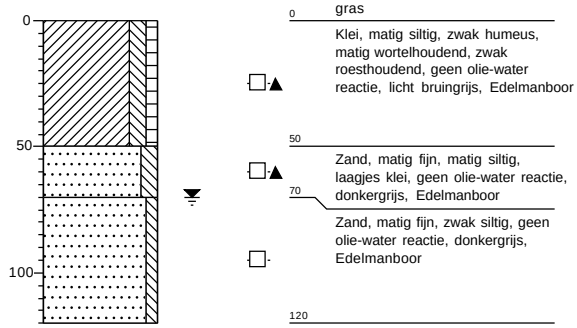

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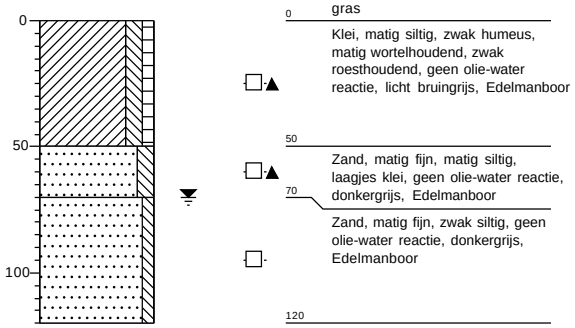
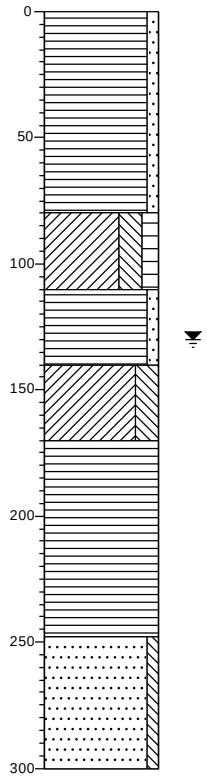
Y: 509748,84
Boormeester: Marcel la Crois



Boring: 64-HS01

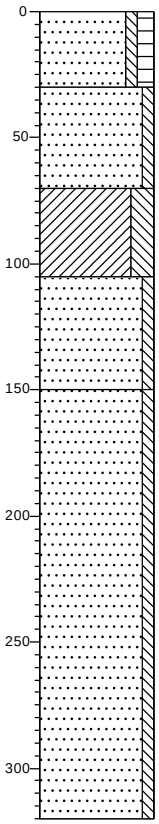
Datum: 23-11-2021
X: 203132,81
Y: 509638,97
Boormeester: Marcel la Crois



0 gras
Veen, zwak zandig, brokken klei, donkerbruin, Edelmanboor
80
Klei, sterk siltig, matig humeus, bruingrijs, Edelmanboor
110
Veen, zwak zandig, donkerbruin, Edelmanboor
140
Klei, sterk siltig, lensjes zand, donker bruinkleurloos, Edelmanboor
170
Veen, donkerbruin, Edelmanboor
248
Zand, matig fijn, zwak siltig, lichtgrijs, Edelmanboor
300

Boring: 64-HS02

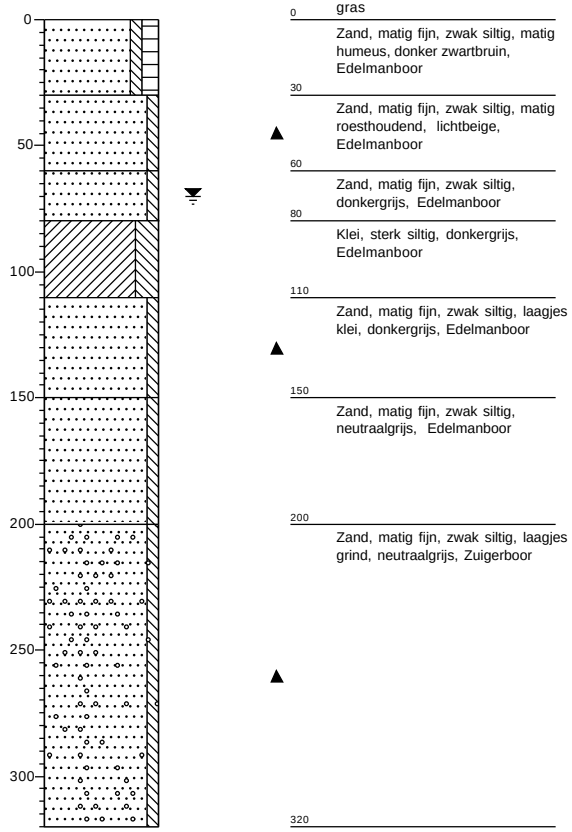
Datum: 23-11-2021
X: 203209,06
Y: 509693,91
Boormeester: Marcel la Crois



0 gras
Zand, zeer fijn, zwak siltig, matig humeus, donker zwartbruin, Edelmanboor
30
Zand, matig fijn, zwak siltig, zwak roesthoudend, lichtbeige, Edelmanboor
70
Klei, sterk siltig, donkergrijs, Edelmanboor
105
Zand, matig fijn, zwak siltig, lensjes klei, donkergrijs, Edelmanboor
150
Zand, matig fijn, zwak siltig, neutraalgrijs, Zuigerboor
320

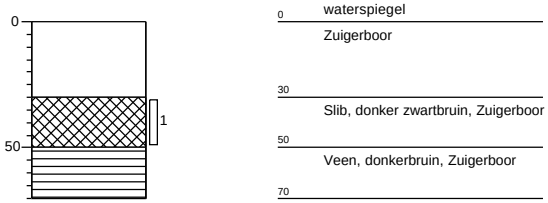
Boring: 64-HS03

Datum: 23-11-2021
X: 203234,59
Y: 509706,02
Boormeester: Marcel la Crois



Boring: 64-WB01

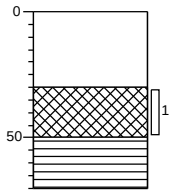
Datum: 22-11-2021
X: 203091,68
Y: 509687,55
Boormeester: Marcel la Crois

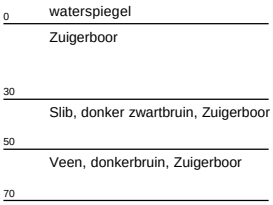


ARCADIS Design & Consultancy for natural and built assets

Boring: 64-WB02

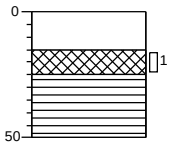
Datum: 22-11-2021
X: 203095,76
Y: 509680,18
Boormeester: Marcel la Crois

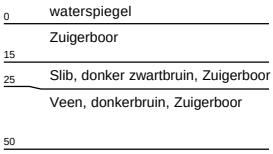




Boring: 64-WB03

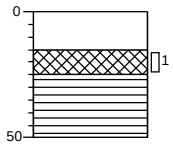
Datum: 22-11-2021
X: 203126,32
Y: 509692,05
Boormeester: Marcel la Crois

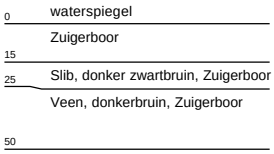




Boring: 64-WB04

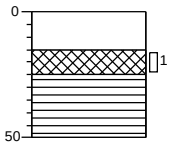
Datum: 22-11-2021
X: 203117,65
Y: 509685,11
Boormeester: Marcel la Crois

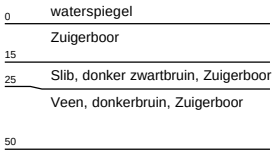




Boring: 64-WB05

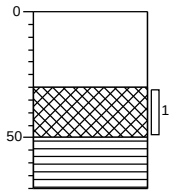
Datum: 22-11-2021
X: 203109,52
Y: 509678,31
Boormeester: Marcel la Crois

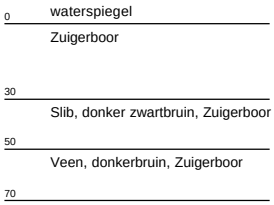




Boring: 64-WB06

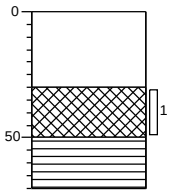
Datum: 22-11-2021
X: 203103,06
Y: 509672,30
Boormeester: Marcel la Crois

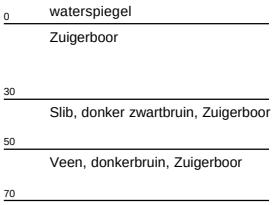




Boring: 64-WB07

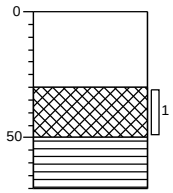
Datum: 22-11-2021
X: 203109,33
Y: 509662,55
Boormeester: Marcel la Crois

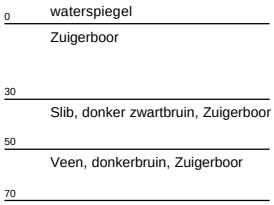




Boring: 64-WB08

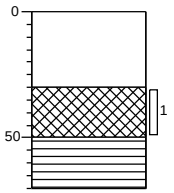
Datum: 22-11-2021
X: 203116,85
Y: 509656,08
Boormeester: Marcel la Crois

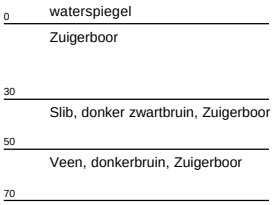




Boring: 64-WB09

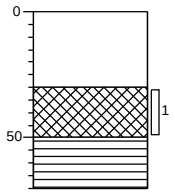
Datum: 22-11-2021
X: 203129,70
Y: 509646,75
Boormeester: Marcel la Crois





Boring: 64-WB10

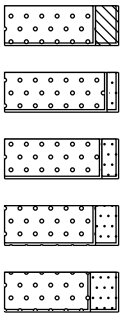
Datum: 22-11-2021
X: 203137,46
Y: 509641,07
Boormeester: Marcel la Crois



0 waterspiegel
Zuigerboor
30
Slib, donker zwartbruin, Zuigerboor
50
Veen, donkerbruin, Zuigerboor
70

Legenda (conform NEN 5104)

grind



Grind, siltig

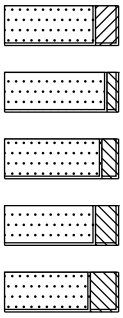
Grind, zwak zandig

Grind, matig zandig

Grind, sterk zandig

Grind, uiterst zandig

zand



Zand, kleïig

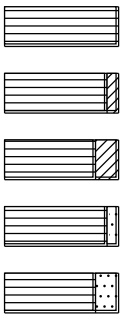
Zand, zwak siltig

Zand, matig siltig

Zand, sterk siltig

Zand, uiterst siltig

veen



Veen, mineraalarm

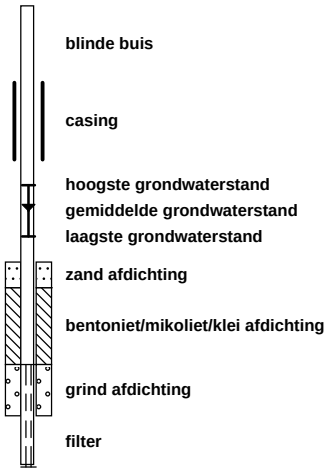
Veen, zwak kleïig

Veen, sterk kleïig

Veen, zwak zandig

Veen, sterk zandig

peilbuis



blinde buis

casing

hoogste grondwaterstand
gemiddelde grondwaterstand
laagste grondwaterstand

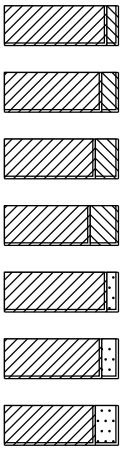
zand afdichting

bentoniet/mikoliet/klei afdichting

grind afdichting

filter

klei



Klei, zwak siltig

Klei, matig siltig

Klei, sterk siltig

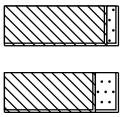
Klei, uiterst siltig

Klei, zwak zandig

Klei, matig zandig

Klei, sterk zandig

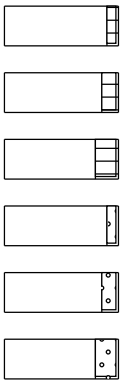
leem



Leem, zwak zandig

Leem, sterk zandig

overige toevoegingen



zwak humeus

matig humeus

sterk humeus

zwak grindig

matig grindig

sterk grindig

geur

- geen geur
- zwakke geur
- matige geur
- sterke geur
- uiterste geur

olie

- geen olie-water reactie
- zwakke olie-water reactie
- matige olie-water reactie
- sterke olie-water reactie
- uiterste olie-water reactie

p.i.d.-waarde

- >0
- >1
- >10
- >100
- >1000
- >10000

monsters

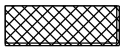
geroerd monster

ongeroerd monster

volumering

overig

- bijzonder bestanddeel
- Gemiddeld hoogste grondwaterstand
- grondwaterstand
- Gemiddeld laagste grondwaterstand



slib

water

Bijlage C – Analysecertificaten

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

AGROLAB GROUP
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ARCADIS NEDERLAND BV
A. Faber
Postbus 161
6800 AD Arnhem

Datum	29.11.2021
Relatienr	35006104
Opdrachtnr.	1103647

ANALYSERAPPORT

***Opdracht* 1103647 Water**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	24.11.21

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen U met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB
TESTING RvA L 005

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Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1103647 Water**

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
816932	61-1HB	23.11.2021	
816933	64-1HB (175-275)	23.11.2021	

		Eenheid	816932 61-1HB	816933 64-1HB (175-275)
Metalen (AS3000)				
S	Barium (Ba)	µg/l	**110**	**37**
S	Cadmium (Cd)	µg/l	**<0,20**	**<0,20**
S	Kobalt (Co)	µg/l	**<2,0**	**<2,0**
S	Koper (Cu)	µg/l	**<2,0**	**<2,0**
S	Kwik (Hg)	µg/l	**<0,05**	**<0,05**
S	Lood (Pb)	µg/l	**<2,0**	**<2,0**
S	Molybdeen (Mo)	µg/l	**<2,0**	**<2,0**
S	Nikkel (Ni)	µg/l	**<3,0**	**<3,0**
S	Zink (Zn)	µg/l	**<10**	**<10**
Aromaten (AS3000)				
S	Benzeen	µg/l	**<0,20**	**<0,20**
S	Tolueen	µg/l	**<0,20**	**<0,20**
S	Ethylbenzeen	µg/l	**<0,20**	**<0,20**
S	*m,p-Xyleen*	µg/l	**<0,20**	**<0,20**
S	*ortho-Xyleen*	µg/l	**<0,10**	**<0,10**
S	**Som Xylenen (Factor 0,7)**	µg/l	**0,21** #)	**0,21** #)
S	Naftaleen	µg/l	**<0,020**	**<0,020**
S	Styreen	µg/l	**<0,20**	**<0,20**
Chloorhoudende koolwaterstoffen (AS3000)				
S	Dichloormethaan	µg/l	**<0,20**	**<0,20**
S	Trichloormethaan (Chloroform)	µg/l	**<0,20**	**<0,20**
S	Tetrachloormethaan (Tetra)	µg/l	**<0,10**	**<0,10**
S	1,1-Dichloorethaan	µg/l	**<0,20**	**<0,20**
S	1,2-Dichloorethaan	µg/l	**<0,20**	**<0,20**
S	1,1,1-Trichloorethaan	µg/l	**<0,10**	**<0,10**
S	1,1,2-Trichloorethaan	µg/l	**<0,10**	**0,12**
S	Vinylchloride	µg/l	**<0,20**	**<0,20**
S	*1,1-Dichlooretheen*	µg/l	**<0,10**	**<0,10**
S	*Cis-1,2-Dichlooretheen*	µg/l	**<0,10**	**<0,10**
S	*trans-1,2-Dichlooretheen*	µg/l	**<0,10**	**<0,10**
S	**Som cis/trans-1,2-Dichlooretheen (Factor 0,7)**	µg/l	**0,14** #)	**0,14** #)
S	**Som Dichlooretheen (Factor 0,7)**	µg/l	**0,21** #)	**0,21** #)
S	Trichlooretheen (Tri)	µg/l	**<0,20**	**<0,20**
S	Tetrachlooretheen (Per)	µg/l	**<0,10**	**<0,10**

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
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kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

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e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht 1103647 Water

		Eenheid	816932 61-1HB	816933 64-1HB (175-275)
Chloorhoudende koolwaterstoffen (AS3000)				
S	*1,1-Dichloorpropaan*	µg/l	**<0,20**	**<0,20**
S	*1,2-Dichloorpropaan*	µg/l	**<0,20**	**<0,20**
S	*1,3-Dichloorpropaan*	µg/l	**<0,20**	**<0,20**
S	**Som Dichloorpropanen (Factor 0,7)**	µg/l	**0,42** #)	**0,42** #)
Broomhoudende koolwaterstoffen				
S	Tribroommethaan (bromoform)	µg/l	**<0,20**	**<0,60** m)
Minerale olie (AS3000)				
S	Koolwaterstoffractie C10-C40	µg/l	**<50**	**<50**
	Koolwaterstoffractie C10-C12	µg/l	**<10** *)	**<10** *)
	Koolwaterstoffractie C12-C16	µg/l	**<10** *)	**<10** *)
	Koolwaterstoffractie C16-C20	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C20-C24	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C24-C28	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C28-C32	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C32-C36	µg/l	**<5,0** *)	**<5,0** *)
	Koolwaterstoffractie C36-C40	µg/l	**<5,0** *)	**<5,0** *)

m) De rapportagegrens is verhoogd, omdat door matrixeffecten, resp. co-elutie een kwantificering bemoeilijkt wordt.

S) Erkend volgens AS SIKB 3000

Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. ?? Die Mindestleistungskriterien der angewandten Verfahren beruhen bezüglich der Messunsicherheit in der Regel auf der Richtlinie 2009/90/EG der Europäischen Kommission.

Begin van de analyses: 25.11.2021
Einde van de analyses: 29.11.2021

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Toegepaste methoden

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	25.11.2021
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	29.11.2021
AL-West Opdrachtnummer	1103647		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
816932	A10200928018		23.11.21	23.11.21
816932	A11300190866		23.11.21	23.11.21
816932	A20500091547		23.11.21	23.11.21
816933	A10200928027		23.11.21	23.11.21
816933	A11300190862		23.11.21	23.11.21
816933	A20500091544		23.11.21	23.11.21

Kamer van Koophandel Nr. 08110898
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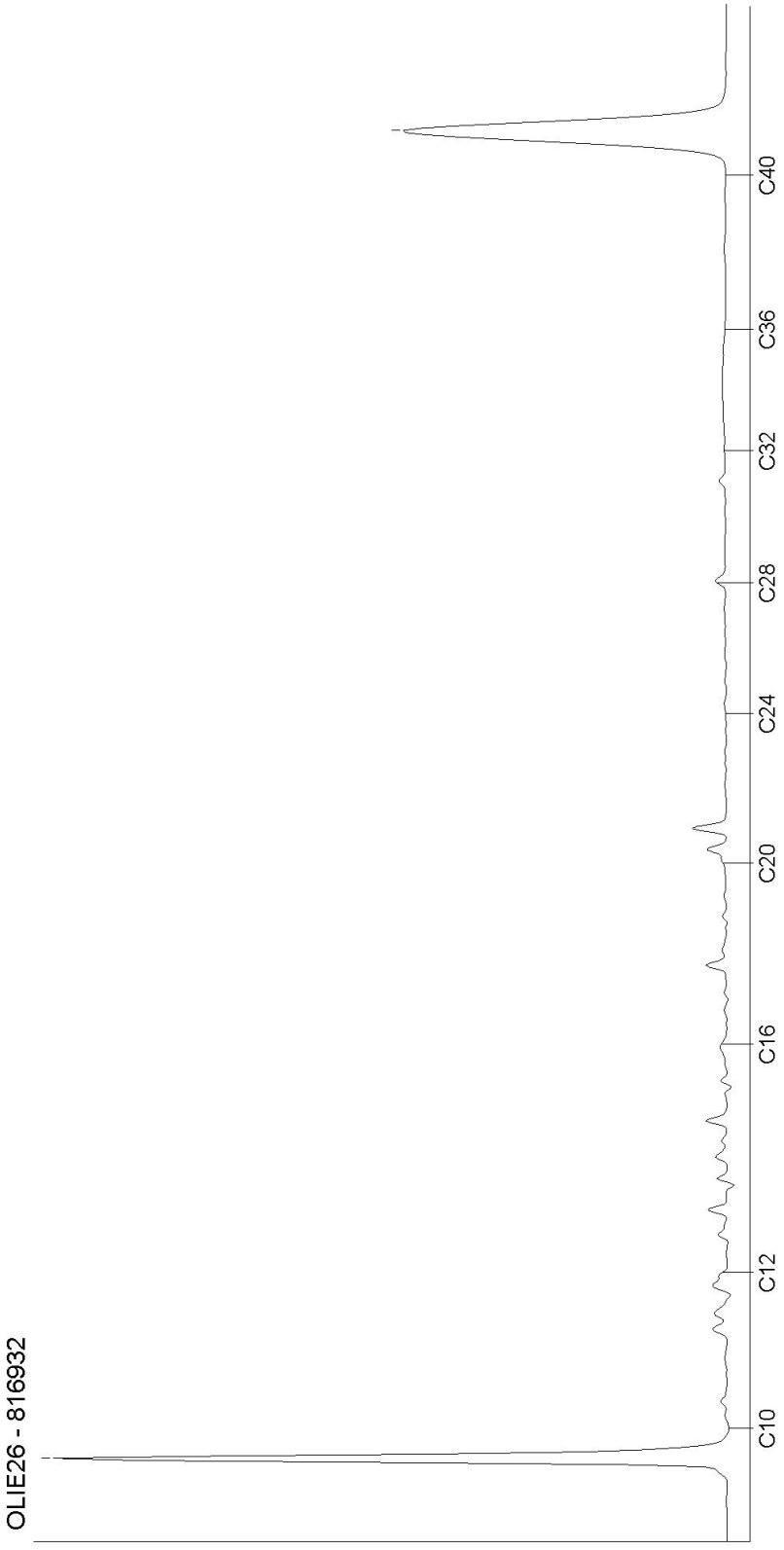
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1103647, Analysis No. 816932, created at 29.11.2021 10:07:52

Monster beschrijving: 61-1HB



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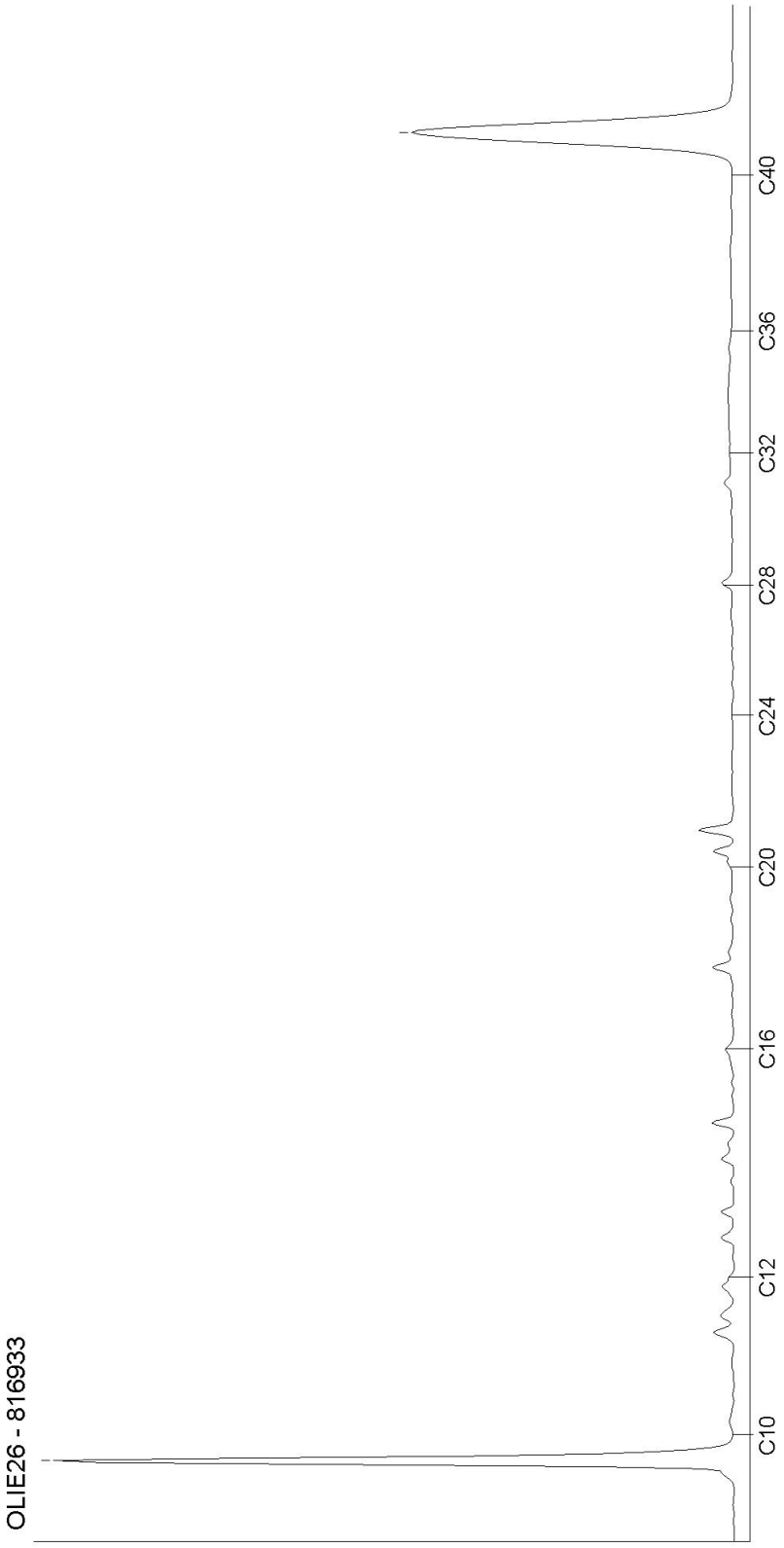
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1103647, Analysis No. 816933, created at 29.11.2021 10:07:52

Monster beschrijving: 64-1HB (175-275)



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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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ARCADIS NEDERLAND BV
A. Faber
Postbus 161
6800 AD Arnhem

Datum	16.02.2022
Relatienr	35006104
Opdrachtnr.	1127979

ANALYSERAPPORT

Opdracht **1127979 Water**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	15.02.22

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Let op: alleen de algemene voorwaarden van AL-West gedeponeerd bij de KvK te Deventer, zijn van toepassing.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen erop u met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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RvA L 005

DOC-13-17854476-NL-P1

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1127979 Water**

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
156943	48-1HB-wamo-1-1 48-1HB-wamo (20	14.02.2022	

	Eenheid	**156943** 48-1HB-wamo-1-1 48-1HB-wamo (200-300)
Klassiek Chemische Analyses		
Onopgeloste bestanddelen	mg/l	**27**

De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Begin van de analyses: 15.02.2022
Einde van de analyses: 16.02.2022

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Toegepaste methoden

conform NEN-EN 872 : Onopgeloste bestanddelen

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) " .

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ppa. Marc van Gelder
Dr. Paul Wimmer

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RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	15.02.2022
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	16.02.2022
AL-West Opdrachtnummer	1127979		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
156943	A70100041501		14.02.22	15.02.22

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Nr. 08110898
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NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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A. Faber
Postbus 161
6800 AD Arnhem

Datum	10.03.2022
Relatienr	35006104
Opdrachtnr.	1134952

ANALYSERAPPORT

Opdracht **1134952** Water

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	08.03.22

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Let op: alleen de algemene voorwaarden van AL-West gedeponeerd bij de KvK te Deventer, zijn van toepassing.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen erop u met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1134952** Water

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
193865	44-PB01-1-1 44-PB01 (170-270)	07.03.2022	
193866	61PB01-1-1 61PB01 (180-280)	07.03.2022	
193867	64PB01-1-1 64PB01 (400-500)	07.03.2022	

		Eenheid	193865 44-PB01-1-1 44-PB01 (170-270)	193866 61PB01-1-1 61PB01 (180-280)	193867 64PB01-1-1 64PB01 (400-500)
Klassiek Chemische Analyses					
S	pH		**6,3**	**7,1**	**6,8**
	Ammonium (als N)	mg/l	**4,3**	**2,3**	**2,2**
S	Chloride (Cl)	mg/l	**51**	**65**	**<50**
S	Sulfaat (SO4)	mg/l	**240**	**<30**	**<30**
	totaal fosfor (P)	mg/l	**0,07**	**0,19**	**1,3**
	Onopgeloste bestanddelen	mg/l	**75**	**94**	**150**
Metalen					
	IJzer (Fe)	µg/l	**7500**	**8800**	**32000**

S) Erkend volgens AS SIKB 3000
Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Analyse chloride (Cl): Bromide (gehalte boven 30 mg/l) en sulfide storen de bepaling van chloride en worden als chloride meebepaald.

Begin van de analyses: 08.03.2022
Einde van de analyses: 10.03.2022

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Toegepaste methoden

conform NEN-EN 872 : Onopgeloste bestanddelen
Conform NEN-EN-ISO 17294-2 (2004) : IJzer (Fe)
conform NEN-ISO 15923-1 : Ammonium (als N)
Gelijkwaardig aan NEN-EN-ISO 15681-2 : totaal fosfor (P)
Protocollen AS 3100 : pH Chloride (Cl) Sulfaat (SO4)

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) " .

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Bijlage bij Opdrachtnr. 1134952

CONSERVERING, CONSERVERINGSTERMIJN EN VERPAKKING

Er zijn verschillen met de richtlijnen geconstateerd die mogelijk de betrouwbaarheid van de analyseresultaten beïnvloeden. De conserveringstermijn is voor volgende analyse overschreden:

pH	193865, 193866, 193867

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	08.03.2022
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	10.03.2022
AL-West Opdrachtnummer	1134952		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
193865	A10200963715		07.03.22	07.03.22
193865	A10700080022		07.03.22	07.03.22
193865	A11300184654		07.03.22	07.03.22
193865	A20300508909		07.03.22	07.03.22
193865	A20500146630		07.03.22	07.03.22
193865	A20800562507		07.03.22	07.03.22
193865	A21000006810		07.03.22	07.03.22
193865	A70100041473		07.03.22	07.03.22
193866	A10200963734		07.03.22	07.03.22
193866	A10700080036		07.03.22	07.03.22
193866	A11300184661		07.03.22	07.03.22
193866	A20300508910		07.03.22	07.03.22
193866	A20500146653		07.03.22	07.03.22
193866	A20800562538		07.03.22	07.03.22
193866	A21000006826		07.03.22	07.03.22
193866	A70100041480		07.03.22	07.03.22
193867	A10200963706		07.03.22	07.03.22
193867	A10700080035		07.03.22	07.03.22
193867	A11300184662		07.03.22	07.03.22
193867	A20300508902		07.03.22	07.03.22
193867	A20500146646		07.03.22	07.03.22
193867	A20800562544		07.03.22	07.03.22
193867	A21000006825		07.03.22	07.03.22
193867	A70100041516		07.03.22	07.03.22

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

DOC-13-18003358-NL-P1

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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ARCADIS NEDERLAND BV
S. van den Bosse
Postbus 161
6800 AD Arnhem

Datum	16.03.2022
Relatienr	35006104
Opdrachtnr.	1135118

ANALYSERAPPORT

Opdracht **1135118** Water

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 Opwaardering 380kv verbinding Ens-Zwolle 30073259/01
Opdrachtacceptatie	11.03.22

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Let op: alleen de algemene voorwaarden van AL-West gedeponeerd bij de KvK te Deventer, zijn van toepassing.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen erop u met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. 31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1135118** Water

Monsternr.	*Monster beschrijving*	*Monstername*	*Monsternamepunt*
194727	44-PB01-1-1	07.03.2022	
194728	61PB01-1-1	07.03.2022	
194729	64PB01-1-1	07.03.2022	

		Eenheid	194727 44-PB01-1-1	194728 61PB01-1-1	194729 64PB01-1-1
Klassiek Chemische Analyses					
	Ammonium (als N)	mg/l	**4,4**	**2,3**	**2,3**
S	Chloride (Cl)	mg/l	**53**	**67**	**<50**
S	Sulfaat (SO4)	mg/l	**240**	**<30**	**<30**
	Onopgeloste bestanddelen (NEN 6621)	mg/l	**157** *)	**618** *)	**335** *)
Metalen					
	IJzer (Fe)	µg/l	**7400**	**8900**	**35000**
Metalen (AS3000)					
S	Barium (Ba)	µg/l	**130**	**37**	**79**
S	Cadmium (Cd)	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Kobalt (Co)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Koper (Cu)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Kwik (Hg)	µg/l	**<0,050**	**<0,050**	**<0,050**
S	Lood (Pb)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Molybdeen (Mo)	µg/l	**<2,0**	**<2,0**	**<2,0**
S	Nikkel (Ni)	µg/l	**<3,0**	**<3,0**	**<3,0**
S	Zink (Zn)	µg/l	**<10**	**<10**	**<10**
Aromaten (AS3000)					
S	Benzeen	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Tolueen	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Ethylbenzeen	µg/l	**<0,20**	**<0,20**	**<0,20**
S	*m,p-Xyleen*	µg/l	**0,55**	**0,26**	**0,25**
S	*ortho-Xyleen*	µg/l	**0,15**	**<0,10**	**0,12**
S	**Som Xylenen (Factor 0,7)**	µg/l	**0,70**	**0,33** #)	**0,37**
S	Naftaleen	µg/l	**<0,020**	**<0,020**	**<0,020**
S	Styreen	µg/l	**<0,20**	**<0,20**	**<0,20**
Chloorhoudende koolwaterstoffen (AS3000)					
S	Dichloormethaan	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Trichloormethaan (Chloroform)	µg/l	**<0,20**	**<0,20**	**<0,20**
S	Tetrachloormethaan (Tetra)	µg/l	**<0,10**	**<0,10**	**<0,10**
S	1,1-Dichloorethaan	µg/l	**<0,20**	**<0,20**	**<0,20**
S	1,2-Dichloorethaan	µg/l	**<0,20**	**<0,20**	**<0,20**
S	1,1,1-Trichloorethaan	µg/l	**<0,10**	**<0,10**	**<0,10**
S	1,1,2-Trichloorethaan	µg/l	**<0,10**	**<0,10**	**<0,10**
S	Vinylchloride	µg/l	**<0,20**	**<0,20**	**<0,20**

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1135118** Water

		Eenheid	194727 44-PB01-1-1		194728 61PB01-1-1		194729 64PB01-1-1	
Chloorhoudende koolwaterstoffen (AS3000)								
S	*1,1-Dichlooretheen*	µg/l	**<0,10**		**<0,10**		**<0,10**	
S	*Cis-1,2-Dichlooretheen*	µg/l	**<0,10**		**<0,10**		**<0,10**	
S	*trans-1,2-Dichlooretheen*	µg/l	**<0,10**		**<0,10**		**<0,10**	
S	**Som cis/trans-1,2-Dichlooretheen (Factor 0,7)**	µg/l	**0,14**	#)	**0,14**	#)	**0,14**	#)
S	**Som Dichlooretheen (Factor 0,7)**	µg/l	**0,21**	#)	**0,21**	#)	**0,21**	#)
S	Trichlooretheen (Tri)	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	Tetrachlooretheen (Per)	µg/l	**0,21**		**1,7**		**0,25**	
S	*1,1-Dichloorpropaan*	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	*1,2-Dichloorpropaan*	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	*1,3-Dichloorpropaan*	µg/l	**<0,20**		**<0,20**		**<0,20**	
S	**Som Dichloorpropanen (Factor 0,7)**	µg/l	**0,42**	#)	**0,42**	#)	**0,42**	#)
Broomhoudende koolwaterstoffen								
S	Tribroommethaan (bromoform)	µg/l	**<0,20**		**<0,20**		**<0,20**	
Minerale olie (AS3000)								
S	Koolwaterstoffractie C10-C40	µg/l	**<50**		**<50**		**<50**	
	Koolwaterstoffractie C10-C12	µg/l	**<10**	*)	**<10**	*)	**<10**	*)
	Koolwaterstoffractie C12-C16	µg/l	**<10**	*)	**<10**	*)	**<10**	*)
	Koolwaterstoffractie C16-C20	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C20-C24	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C24-C28	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C28-C32	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C32-C36	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
	Koolwaterstoffractie C36-C40	µg/l	**<5,0**	*)	**<5,0**	*)	**<5,0**	*)
Overig onderzoek								
	Ortho-Fosfaat (o-PO4)	mg/l	**0,039**		**0,53**		**0,57**	

#) Bij deze som zijn resultaten "<rapportagegrens" vermenigvuldigd met 0,7.

S) Erkend volgens AS SIKB 3000

Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Analyse chloride (Cl): Bromide (gehalte boven 30 mg/l) en sulfide storen de bepaling van chloride en worden als chloride meebepaald.

Analyse ortho fosfaat: een gehalte aan silicaat hoger dan 5 mg/l kan een storing veroorzaken op het gehalte van ortho fosfaat.

Begin van de analyses: 11.03.2022
Einde van de analyses: 16.03.2022

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

DOC-13-18033950-NL-P3

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1135118** Water

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Klantenservice

Toegepaste methoden

conform NEN 6621 (1992) *): Onopgeloste bestanddelen (NEN 6621)

Conform NEN-EN-ISO 17294-2 (2004) : IJzer (Fe)

conform NEN-ISO 15923-1 : Ammonium (als N) Ortho-Fosfaat (o-PO4)

eigen methode *): Koolwaterstoffractie C10-C12 Koolwaterstoffractie C12-C16 Koolwaterstoffractie C16-C20 Koolwaterstoffractie C20-C24 Koolwaterstoffractie C24-C28 Koolwaterstoffractie C28-C32 Koolwaterstoffractie C32-C36 Koolwaterstoffractie C36-C40

Protocollen AS 3100 : Chloride (Cl) Sulfaat (SO4) Barium (Ba) Cadmium (Cd) Kobalt (Co) Koper (Cu) Kwik (Hg) Lood (Pb) Molybdeen (Mo) Nikkel (Ni) Zink (Zn) Dichloormethaan Tribroommethaan (bromoform) Benzeen Trichloormethaan (Chloroform) Tetrachloormethaan (Tetra) Tolueen Ethylbenzeen 1,1-Dichloorethaan m,p-Xyleen ortho-Xyleen 1,2-Dichloorethaan Som Xylenen (Factor 0,7) Naftaleen Styreen 1,1,1-Trichloorethaan 1,1,2-Trichloorethaan Vinylchloride 1,1-Dichlooretheen Cis-1,2-Dichlooretheen trans-1,2-Dichlooretheen Som cis/trans-1,2-Dichlooretheen (Factor 0,7) Som Dichlooretheen (Factor 0,7) Trichlooretheen (Tri) Tetrachlooretheen (Per) 1,1-Dichloorpropaan 1,2-Dichloorpropaan 1,3-Dichloorpropaan Som Dichloorpropanen (Factor 0,7) Koolwaterstoffractie C10-C40

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Bijlage bij Opdrachtnr. 1135118

CONSERVERING, CONSERVERINGSTERMIJN EN VERPAKKING

Er zijn verschillen met de richtlijnen geconstateerd die mogelijk de betrouwbaarheid van de analyseresultaten beïnvloeden. De conserveringstermijn is voor volgende analyse overschreden:

Onopgeloste bestanddelen (NEN 6621)	194727, 194728, 194729
Naftaleen	194727, 194728, 194729
1,2-Dichloorpropaan	194727, 194728, 194729
1,1,1-Trichloorethaan	194727, 194728, 194729
Trichlooretheen (Tri)	194727, 194728, 194729
Tetrachlooretheen (Per)	194727, 194728, 194729
m,p-Xyleen	194727, 194728, 194729
1,3-Dichloorpropaan	194727, 194728, 194729
Dichloormethaan	194727, 194728, 194729
1,1-Dichloorpropaan	194727, 194728, 194729
1,1-Dichlooretheen	194727, 194728, 194729
Vinylchloride	194727, 194728, 194729
Kwik (Hg)	194727, 194728, 194729
Ethylbenzeen	194727, 194728, 194729
ortho-Xyleen	194727, 194728, 194729
Tribroommethaan (bromoform)	194727, 194728, 194729
Tetrachloormethaan (Tetra)	194727, 194728, 194729
1,1,2-Trichloorethaan	194727, 194728, 194729
Styreen	194727, 194728, 194729
Cis-1,2-Dichlooretheen	194727, 194728, 194729
1,2-Dichloorethaan	194727, 194728, 194729
trans-1,2-Dichlooretheen	194727, 194728, 194729
Benzeen	194727, 194728, 194729
1,1-Dichloorethaan	194727, 194728, 194729
Tolueen	194727, 194728, 194729
Trichloormethaan (Chloroform)	194727, 194728, 194729

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259	Begin van de analyses:	11.03.2022
Projectnaam	Opwaardering 380kv verbinding Ens-Zwolle	Einde van de analyses:	16.03.2022

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
194727	A10200963715		07.03.22	07.03.22
194727	A10700080022		07.03.22	07.03.22
194727	A11300184654		07.03.22	07.03.22
194727	A20300508909		07.03.22	07.03.22
194727	A20500146630		07.03.22	07.03.22
194727	A20800562507		07.03.22	07.03.22
194727	A21000006810		07.03.22	07.03.22
194727	A70100041473		07.03.22	07.03.22
194728	A10200963734		07.03.22	07.03.22
194728	A10700080036		07.03.22	07.03.22
194728	A11300184661		07.03.22	07.03.22
194728	A20300508910		07.03.22	07.03.22
194728	A20500146653		07.03.22	07.03.22
194728	A20800562538		07.03.22	07.03.22
194728	A21000006826		07.03.22	07.03.22
194728	A70100041480		07.03.22	07.03.22
194729	A10200963706		07.03.22	07.03.22
194729	A10700080035		07.03.22	07.03.22
194729	A11300184662		07.03.22	07.03.22
194729	A20300508902		07.03.22	07.03.22
194729	A20500146646		07.03.22	07.03.22
194729	A20800562544		07.03.22	07.03.22
194729	A21000006825		07.03.22	07.03.22
194729	A70100041516		07.03.22	07.03.22

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Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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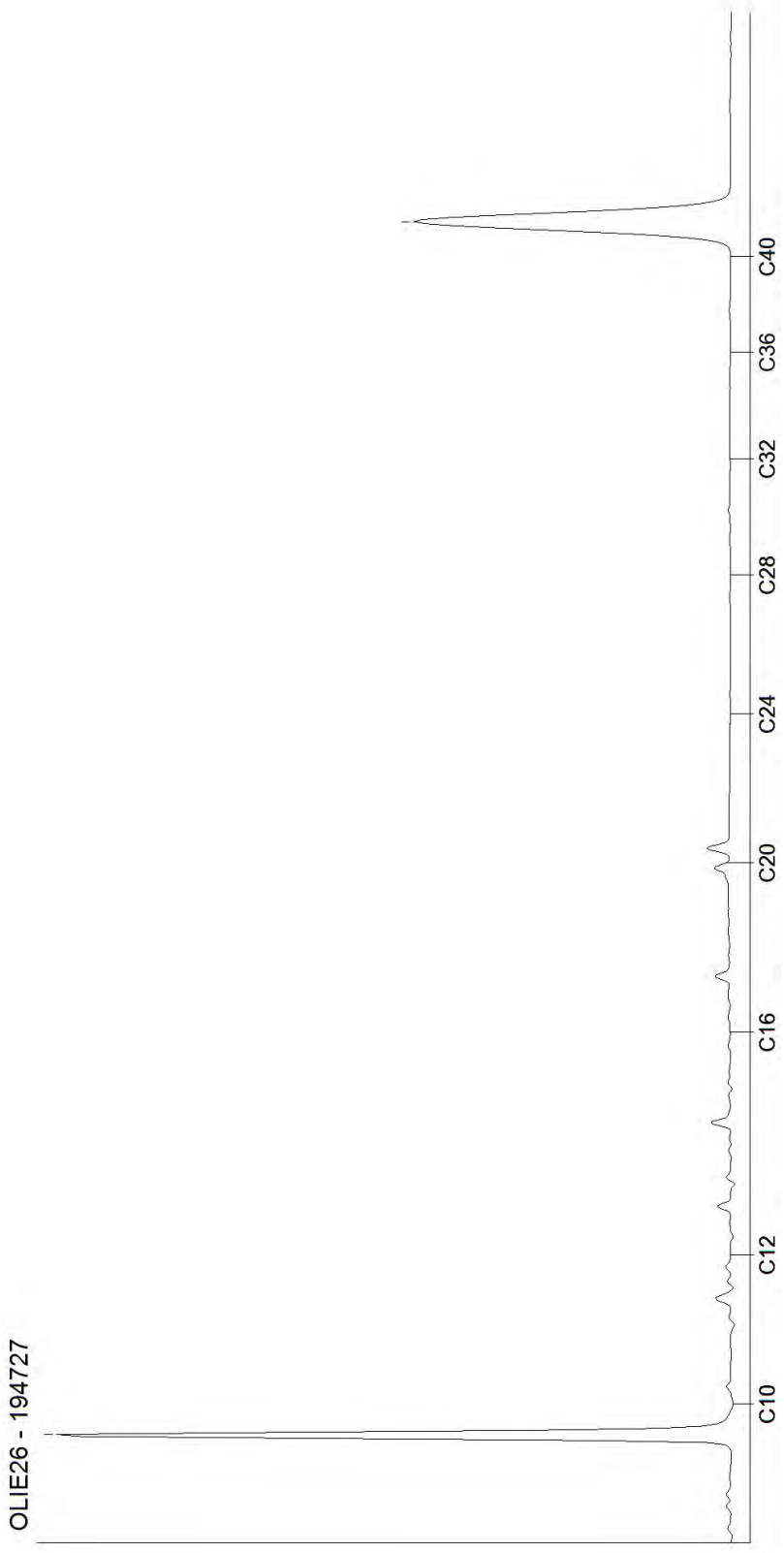
AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1135118, Analysis No. 194727, created at 15.03.2022 13:57:56

Monster beschrijving: 44-PB01-1-1



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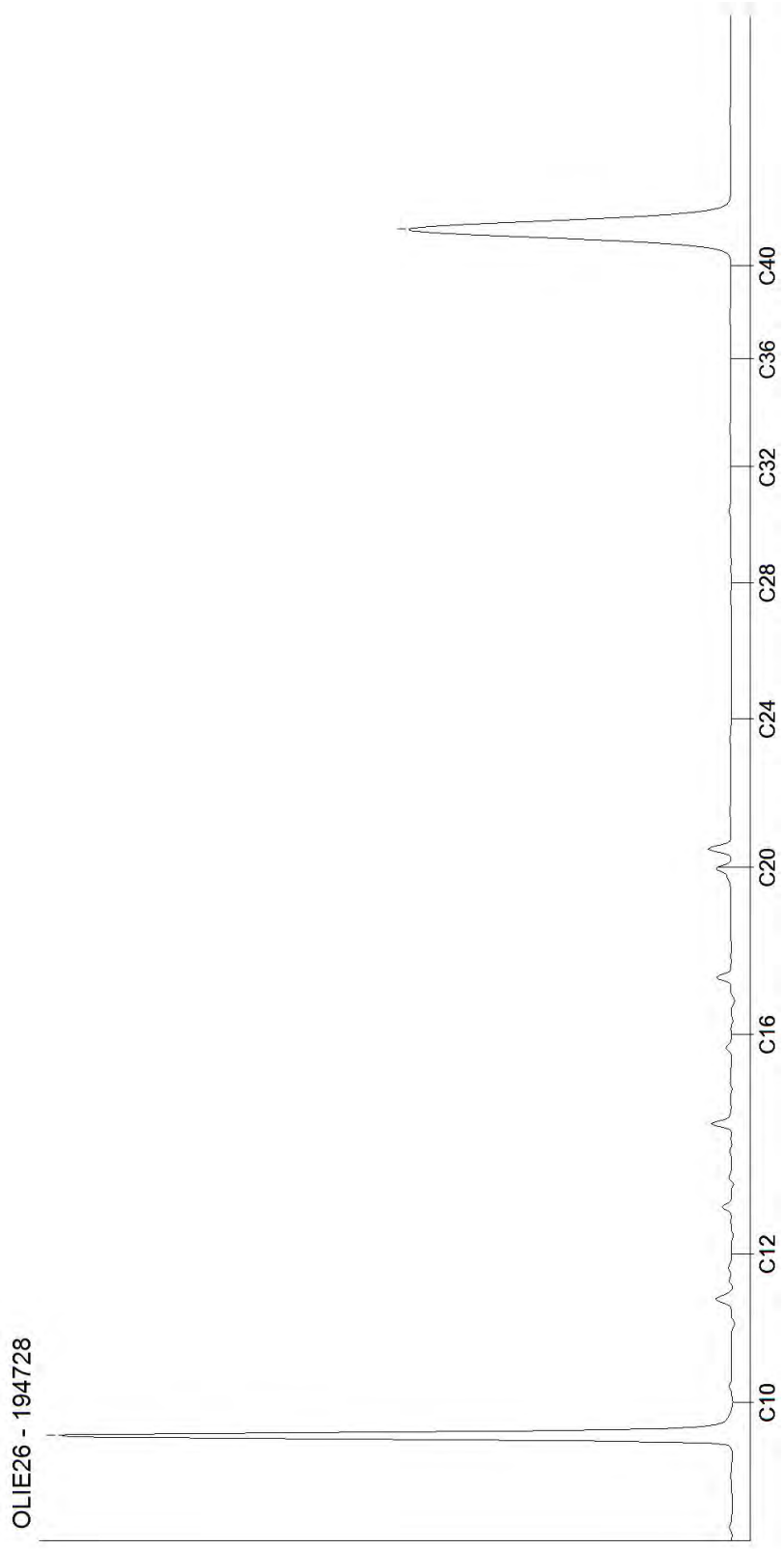
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1135118, Analysis No. 194728, created at 15.03.2022 13:57:56

Monster beschrijving: 61PB01-1-1



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VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

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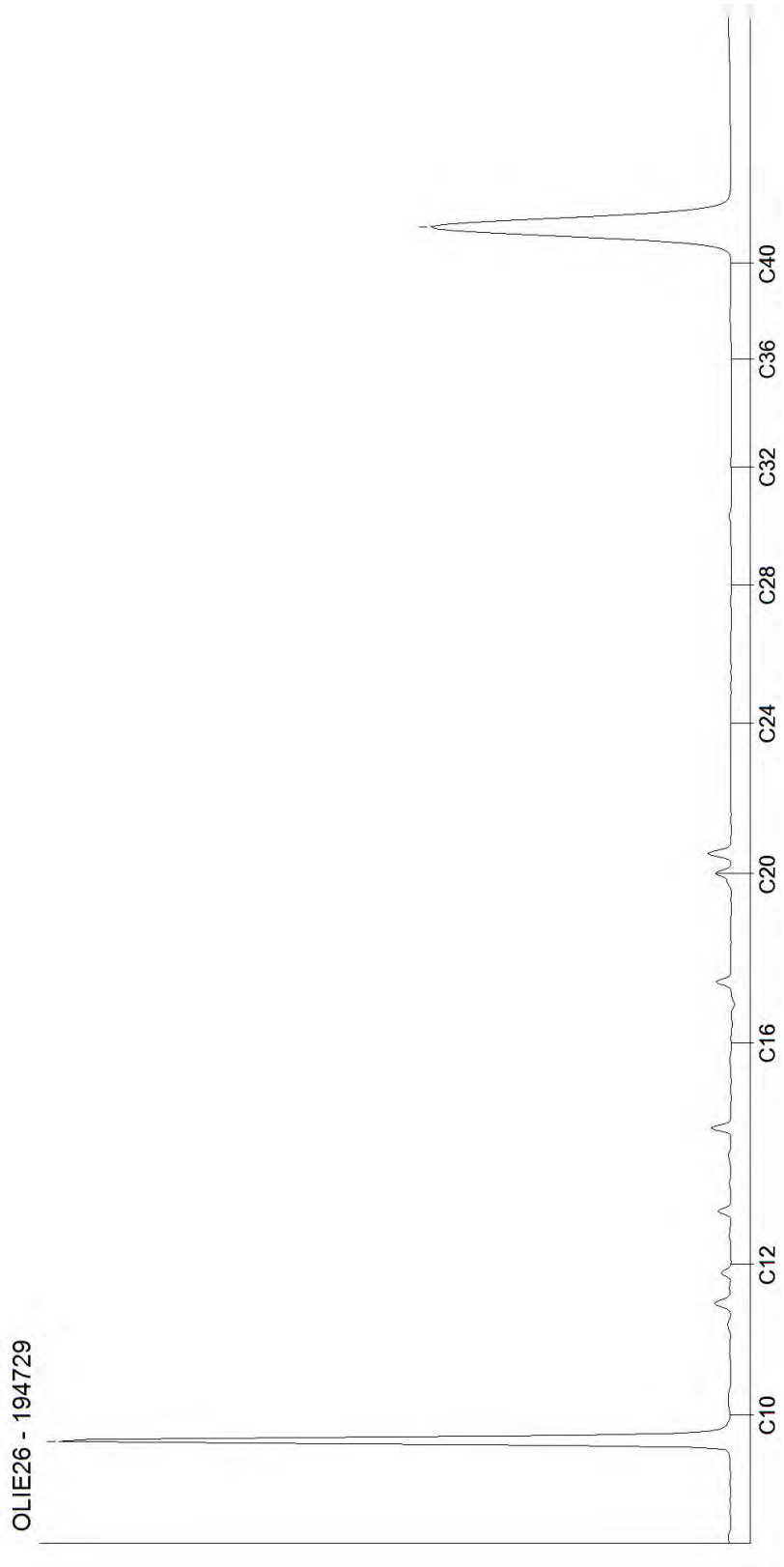
AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1135118, Analysis No. 194729, created at 15.03.2022 13:57:56

Monster beschrijving: 64PB01-1-1



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VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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ARCADIS NEDERLAND BV
A. Faber
Postbus 161
6800 AD Arnhem

Datum	30.11.2021
Relatienr	35006104
Opdrachtnr.	1104073

ANALYSERAPPORT

***Opdracht* 1104073 Waterbodem**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	25.11.21

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen U met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104073 Waterbodem**

Monsternr.	*Monstername*	*Monster beschrijving*
819440	23.11.2021	61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-W
819441	23.11.2021	61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-W
819442	22.11.2021	64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-W

		Eenheid	819440 61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-WB08 (20-30) 61-WB09 (20-30) 61-WB10 (20-30)	819441 61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-WB18 (40-70) 61-WB19 (20-50) 61-WB20 (20-50)	819442 64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-WB08 (30-50) 64-WB09 (30-50) 64-WB10 (30-50)
Algemene monstervoorbehandeling					
S	Voorbehandeling waterbodem		++	++	++
S	Droge stof	%	37,6	35,6	23,1
Fracties (sedigraaf)					
S	Fraktie <2µm (lutum)	% Ds	16	8,0	9,3
	Fractie < 16 µm	% Ds	25 *)	14 *)	18 *)
Klassiek Chemische Analyses					
S	Organische stof, na lutum correctie	% Ds	18,9 x)	16,4 x)	22,3 x)
Voorbehandeling metalen analyse					
S	Koningswater ontsluiting		++	++	++
Metalen (AS3200)					
S	Barium (Ba)	mg/kg Ds	72	140	65
S	Cadmium (Cd)	mg/kg Ds	0,2	0,3	1,2
S	Kobalt (Co)	mg/kg Ds	3,8	5,0	14
S	Koper (Cu)	mg/kg Ds	9,8	14	22
S	Kwik (Hg)	mg/kg Ds	<0,05	<0,05	<0,05
S	Lood (Pb)	mg/kg Ds	12	20	44
S	Molybdeen (Mo)	mg/kg Ds	<1,5	<1,5	<1,5
S	Nikkel (Ni)	mg/kg Ds	11	15	26
S	Zink (Zn)	mg/kg Ds	40	66	170
PAK (AS3200)					
S	*Anthraceen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Benzo(a)anthraceen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,27
S	*Benzo-(a)-Pyreen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Benzo(ghi)peryleen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Benzo(k)fluorantheen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Chryseen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,36
S	*Fenanthreen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	*Fluorantheen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,56
S	*Indeno-(1,2,3-c,d)pyreen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	0,29
S	*Naftaleen*	mg/kg Ds	<0,20 ts)	<0,20 ts)	<0,50 ts)
S	**Som PAK (VROM) (Factor 0,7)**	mg/kg Ds	1,4 #)	1,4 #)	3,6 #)
Minerale olie (AS3000/AS3200)					
S	Koolwaterstoffractie C10-C40	mg/kg Ds	<110 ts)	<110 ts)	<180 ts)
	Koolwaterstoffractie C10-C12	mg/kg Ds	<9 ts) *)	<9 ts) *)	<15 ts) *)

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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Directeur
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kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

DOC-13-17412276-NL-P2

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104073 Waterbodem**

		Eenheid	819440 61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-WB08 (20-30) 61-WB09 (20-30) 61-WB10 (20-30)	819441 61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-WB18 (40-70) 61-WB19 (20-50) 61-WB20 (20-50)	819442 64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-WB08 (30-50) 64-WB09 (30-50) 64-WB10 (30-50)
Minerale olie (AS3000/AS3200)					
	Koolwaterstoffractie C12-C16	mg/kg Ds	**<9** *ts) *)	**<9** *ts) *)	**<15** *ts) *)
	Koolwaterstoffractie C16-C20	mg/kg Ds	**<12** *ts) *)	**<12** *ts) *)	**<20** *ts) *)
	Koolwaterstoffractie C20-C24	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
	Koolwaterstoffractie C24-C28	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
	Koolwaterstoffractie C28-C32	mg/kg Ds	**13** *)	**21** *)	**30** *)
	Koolwaterstoffractie C32-C36	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
	Koolwaterstoffractie C36-C40	mg/kg Ds	**<15** *ts) *)	**<15** *ts) *)	**<25** *ts) *)
Polychloorbifenylen (AS3200)					
S	*PCB 28*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 52*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 101*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 118*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 138*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 153*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	*PCB 180*	mg/kg Ds	**<0,0010**	**<0,0010**	**<0,0010**
S	**Som PCB (7 Ballschmiter) (Factor 0,7)**	mg/kg Ds	**0,0049** #)	**0,0049** #)	**0,0049** #)

x) Gehaltes beneden de rapportagegrens zijn niet mee inbegrepen.
#) Bij deze som zijn resultaten "<rapportagegrens" vermenigvuldigd met 0,7.
ts) De rapportagegrens is verhoogd vanwege het lage droge stofgehalte.
S) Erkend volgens AS SIKB 3000
Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Het analyseresultaat van PCB 138 is mogelijk overschat vanwege co-elutie met PCB 163

Begin van de analyses: 25.11.2021
Einde van de analyses: 30.11.2021

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01
Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104073 Waterbodem**

Toegepaste methoden

conform Protocollen AS 3200 : Organische stof, na lutum correctie Voorbehandeling waterbodem Barium (Ba) Cadmium (Cd) Kobalt (Co) Koper (Cu) Kwik (Hg) Lood (Pb) Molybdeen (Mo) Nikkel (Ni) Zink (Zn) Koolwaterstoffractie C10-C40 Anthraceen Benzo(a)anthraceen Benzo-(a)-Pyreen Benzo(ghi)peryleen Benzo(k)fluorantheen Chryseen Fenanthreen Fluorantheen Indeno-(1,2,3-c,d)pyreen Naftaleen Som PAK (VROM) (Factor 0,7) Fraktie <2µm (lutum) PCB 28 PCB 52 PCB 101 PCB 118 PCB 138 PCB 153 PCB 180 Som PCB (7 Ballschmiter) (Factor 0,7)

conformNEN-EN12880; AS3000, AS3200; NEN-EN15934 : Droge stof

eigen methode *) **:** Koolwaterstoffractie C10-C12 Koolwaterstoffractie C12-C16 Koolwaterstoffractie C16-C20 Koolwaterstoffractie C20-C24 Koolwaterstoffractie C24-C28 Koolwaterstoffractie C28-C32 Koolwaterstoffractie C32-C36 Koolwaterstoffractie C36-C40 Fractie < 16 µm

Protocollen AS 3000 / Protocollen AS 3200 : Koningswater ontsluiting

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	25.11.2021
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	30.11.2021
AL-West Opdrachtnummer	1104073		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
819440	AG3917859P	1	23.11.21	24.11.21
819440	AG3917860H	1	23.11.21	24.11.21
819440	AG3917861I	1	23.11.21	24.11.21
819440	AG3917862J	1	23.11.21	24.11.21
819440	AG3917863K	1	23.11.21	24.11.21
819440	AG3917864L	1	23.11.21	24.11.21
819440	AG3917865M	1	23.11.21	24.11.21
819440	AG3917866N	1	23.11.21	24.11.21
819440	AG3917867O	1	23.11.21	24.11.21
819440	AG3917868P	1	23.11.21	24.11.21
819441	AG3917869Q	1	23.11.21	24.11.21
819441	AG3917870I	1	23.11.21	24.11.21
819441	AG3918519J	1	23.11.21	24.11.21
819441	AG3918520B	1	23.11.21	24.11.21
819441	AG3918521C	1	23.11.21	24.11.21
819441	AG3918522D	1	23.11.21	24.11.21
819441	AG3918523E	1	23.11.21	24.11.21
819441	AG3918524F	1	23.11.21	24.11.21
819441	AG3918525G	1	23.11.21	24.11.21
819441	AG3918526H	1	23.11.21	24.11.21
819442	0407924BB	1	22.11.21	22.11.21
819442	0407933BB	1	22.11.21	22.11.21
819442	0407957BB	1	22.11.21	22.11.21
819442	0407966BB	1	22.11.21	22.11.21
819442	0408171BB	1	22.11.21	22.11.21
819442	0408173BB	1	22.11.21	22.11.21
819442	0408175BB	1	22.11.21	22.11.21
819442	0408178BB	1	22.11.21	22.11.21
819442	0408181BB	1	22.11.21	22.11.21
819442	0408184BB	1	22.11.21	22.11.21

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

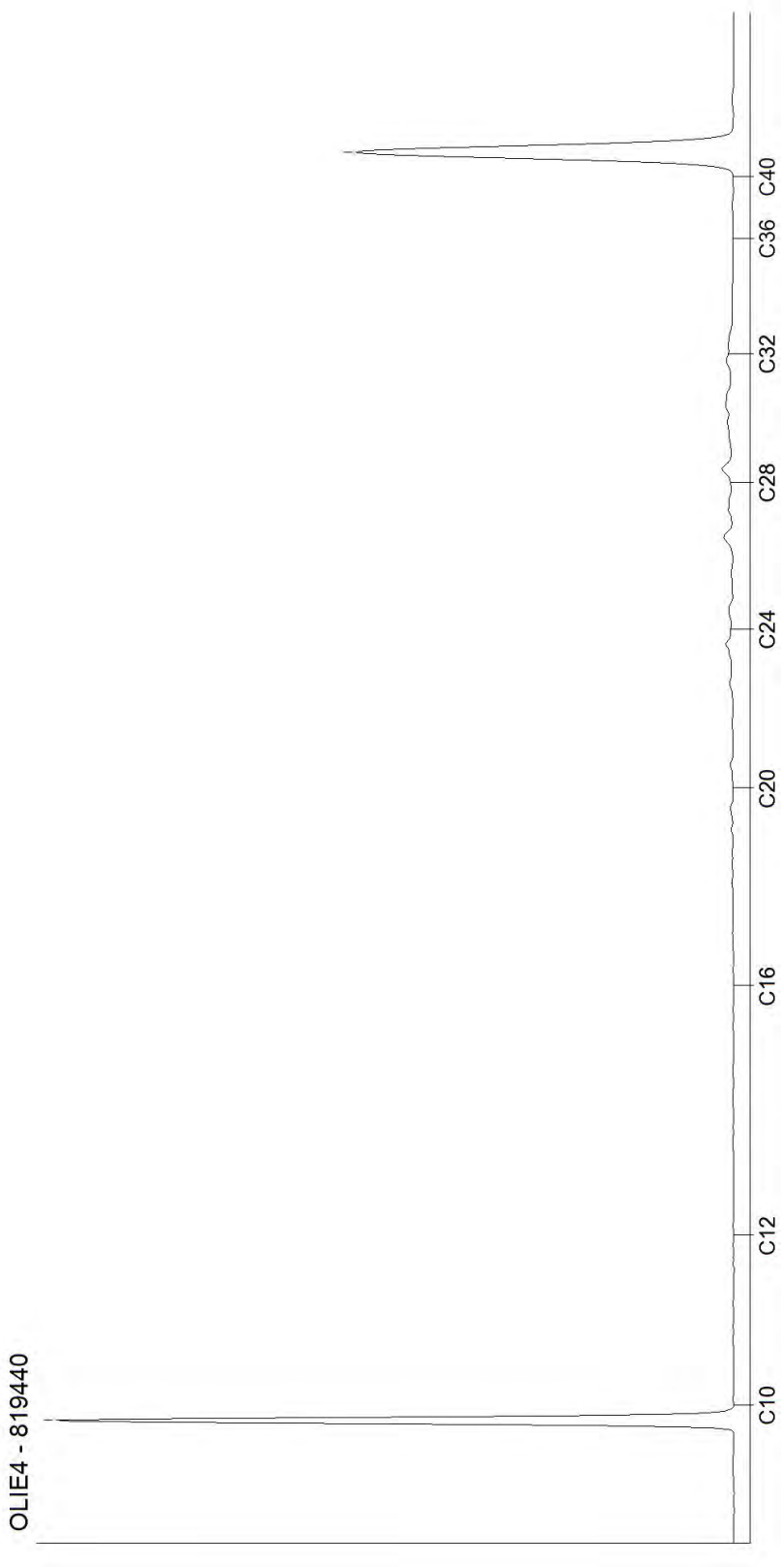
DOC-13-17412342-NL-P1

AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104073, Analysis No. 819440, created at 29.11.2021 13:17:55

Monster beschrijving: 61-WB01 (20-35) 61-WB02 (20-35) 61-WB03 (20-30) 61-WB04 (40-70) 61-WB05 (40-70) 61-WB06 (30-55) 61-WB07 (20-30) 61-WB08 (20-30) 61-WB09 (20-30) 61-WB10 (20-30)



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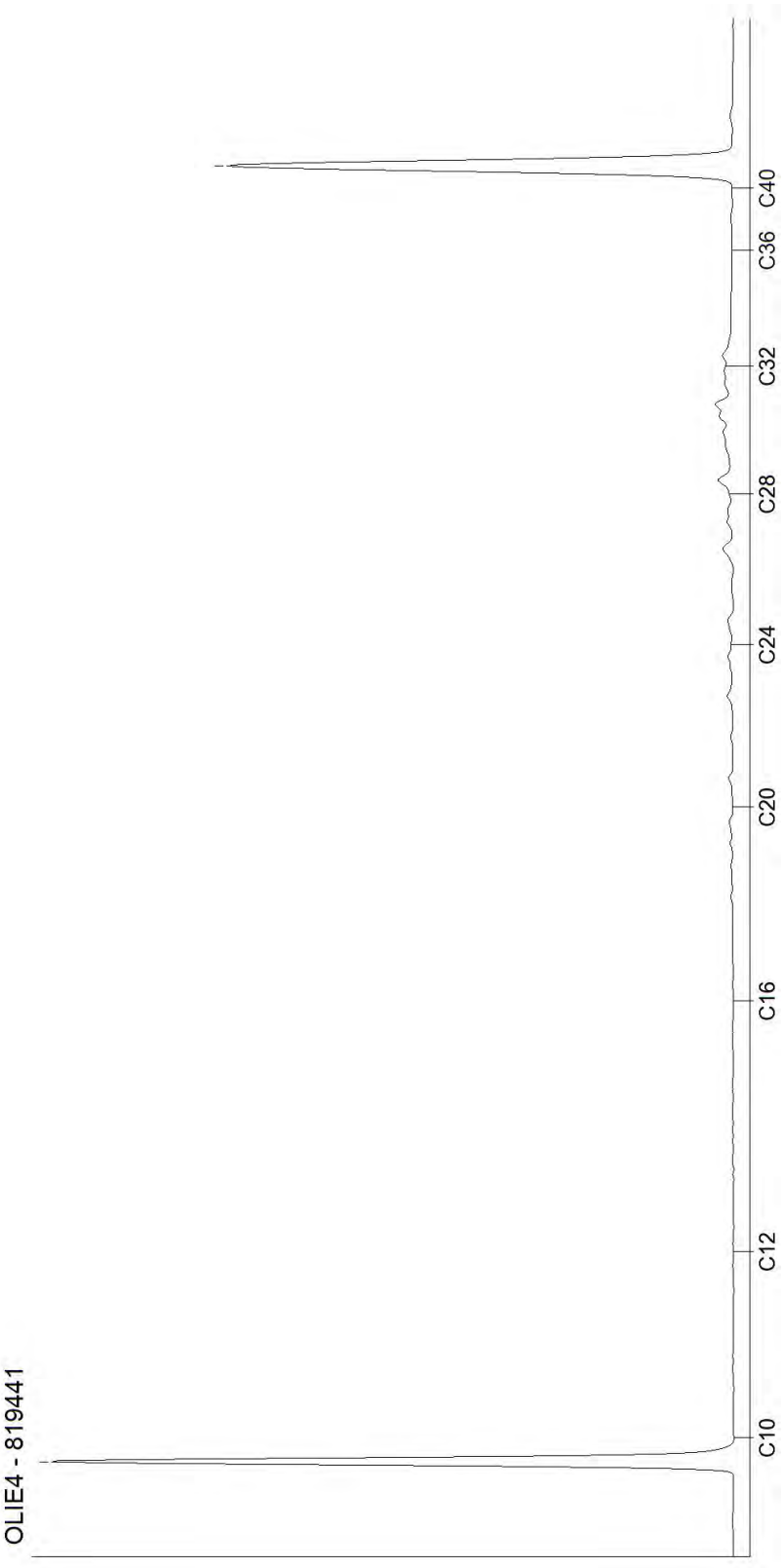
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104073, Analysis No. 819441, created at 29.11.2021 14:05:44

Monster beschrijving: 61-WB11 (20-35) 61-WB12 (40-70) 61-WB13 (40-70) 61-WB14 (30-50) 61-WB15 (40-70) 61-WB16 (50-70) 61-WB17 (40-70) 61-WB18 (40-70) 61-WB19 (20-50) 61-WB20 (20-50)



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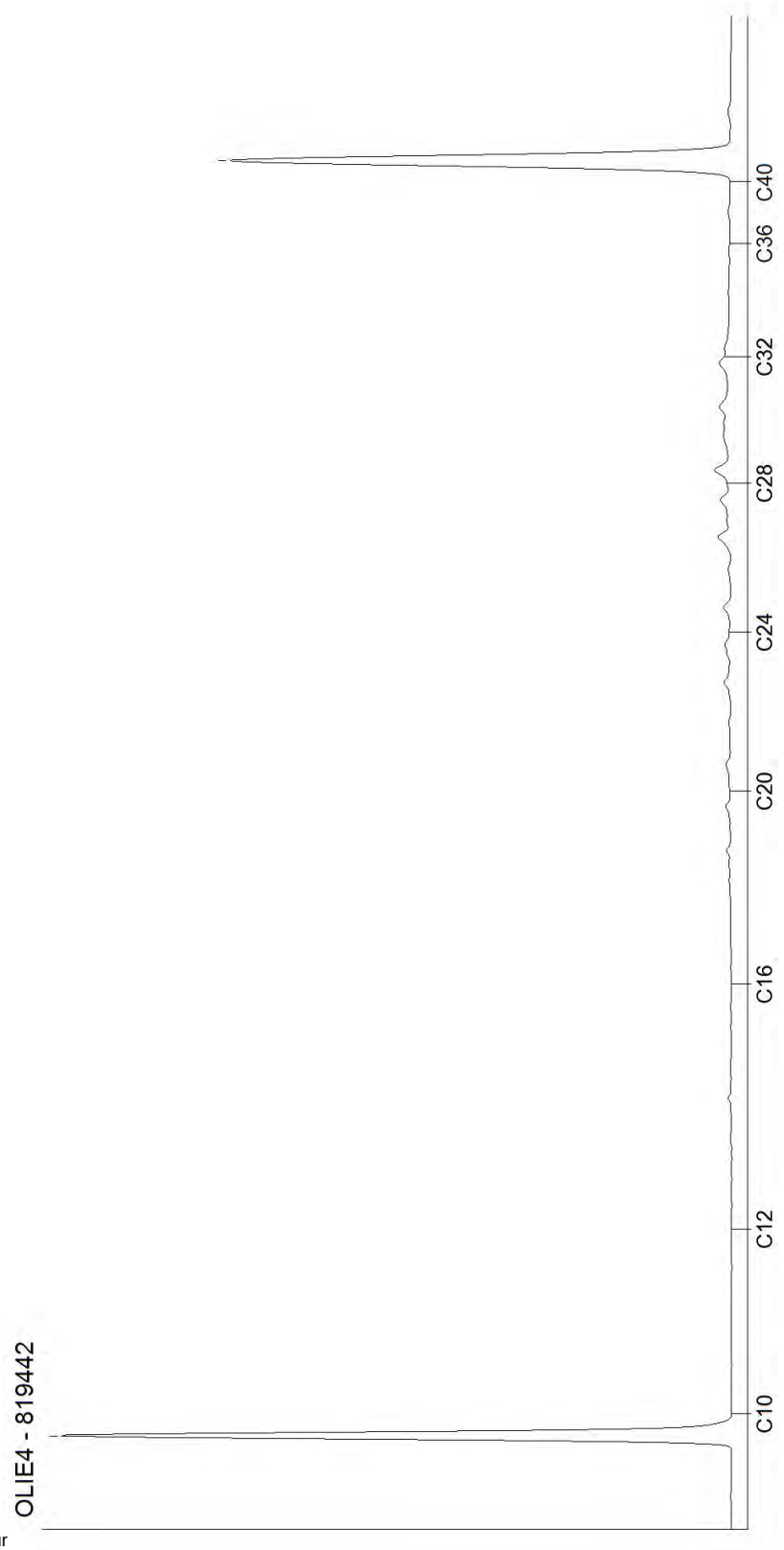
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104073, Analysis No. 819442, created at 29.11.2021 14:05:44

Monster beschrijving: 64-WB01 (30-50) 64-WB02 (30-50) 64-WB03 (15-25) 64-WB04 (15-25) 64-WB05 (15-25) 64-WB06 (30-50) 64-WB07 (30-50) 64-WB08 (30-50) 64-WB09 (30-50) 64-WB10 (30-50)



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NL 811132559 B01

Directeur
ppa. Marc van Gelder
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AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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ARCADIS NEDERLAND BV
A. Faber
Postbus 161
6800 AD Arnhem

Datum	30.11.2021
Relatienr	35006104
Opdrachtnr.	1104111

ANALYSERAPPORT

***Opdracht* 1104111 Bodem / Eluaat**

Opdrachtgever	35006104 ARCADIS NEDERLAND BV
Uw referentie	30073259 FASE II Mastentrace Zwolle - Ens 30073259/01
Opdrachtacceptatie	25.11.21

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.

De analyses zijn, tenzij anders vermeld, uitgevoerd overeenkomstig onze erkenning voor de werkzaamheid "Analyse voor milieuhygiënisch bodemonderzoek" van het Besluit Bodemkwaliteit.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen U met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
Klantenservice

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

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kwaliteitswaarborg bodembeheer SIKB
TESTING RvA L 005

AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht 1104111 Bodem / Eluaat

Monsternr.	*Monstername*	*Monster beschrijving*
819668	23.11.2021	61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)
819669	23.11.2021	61-HB06 (90-130) 61-HB09 (90-120)
819670	22.11.2021	64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)
819671	22.11.2021	64-HB07 (80-120) 64-HB12 (150-200)

		Eenheid	819668 61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)	819669 61-HB06 (90-130) 61-HB09 (90-120)	819670 64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)	819671 64-HB07 (80-120) 64-HB12 (150-200)
Algemene monstervoorbehandeling						
S	Voorbehandeling conform AS3000		++	++	++	++
S	Droge stof	%	66,1	78,1	61,8	76,6
S	IJzer (Fe2O3)	% Ds	<5,0	<5,0	<5,0	<5,0
Fracties (sedigraaf)						
S	Fractie < 2 µm	% Ds	47	1,2	24	4,4
Klassiek Chemische Analyses						
S	Organische stof	% Ds	10,7 x)	4,9 x)	12,3 x)	0,7 x)
Voorbehandeling metalen analyse						
S	Koningswater ontsluiting		++	++	++	++
Metalen (AS3000)						
S	Barium (Ba)	mg/kg Ds	290	<20	130	<20
S	Cadmium (Cd)	mg/kg Ds	<0,20	<0,20	0,40	<0,20
S	Kobalt (Co)	mg/kg Ds	16	<3,0	6,9	<3,0
S	Koper (Cu)	mg/kg Ds	26	<5,0	16	<5,0
S	Kwik (Hg)	mg/kg Ds	0,08	<0,05	0,14	<0,05
S	Lood (Pb)	mg/kg Ds	39	<10	44	<10
S	Molybdeen (Mo)	mg/kg Ds	<1,5	<1,5	<1,5	<1,5
S	Nikkel (AS3000)	mg/kg Ds	53	<4,0	24	4,6
S	Zink (Zn)	mg/kg Ds	100	<20	94	<20
PAK (AS3000)						
S	*Anthraceen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo(a)anthraceen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo-(a)-Pyreen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo(ghi)peryleen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Benzo(k)fluorantheen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Chryseen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Fenanthreen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Fluorantheen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Indeno-(1,2,3-c,d)pyreen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	*Naftaleen*	mg/kg Ds	<0,050	<0,050	<0,050	<0,050
S	**Som PAK (VROM) (Factor 0,7)**	mg/kg Ds	0,35 #)	0,35 #)	0,35 #)	0,35 #)
Minerale olie (AS3000/AS3200)						
S	Koolwaterstoffractie C10-C40	mg/kg Ds	<35	<35	<35	<35
	Koolwaterstoffractie C10-C12	mg/kg Ds	<3 *)	<3 *)	<3 *)	<3 *)

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING
RvA L 005

DOC-13-17410036-NL-P2

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

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Opdracht **1104111 Bodem / Eluaat**

		Eenheid	819668 61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)		819669 61-HB06 (90-130) 61-HB09 (90-120)		819670 64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)		819671 64-HB07 (80-120) 64-HB12 (150-200)	
Minerale olie (AS3000/AS3200)										
	Koolwaterstoffractie C12-C16	mg/kg Ds	**<3**	*)	**<3**	*)	**<3**	*)	**5**	*)
	Koolwaterstoffractie C16-C20	mg/kg Ds	**<4**	*)	**<4**	*)	**<4**	*)	**<4**	*)
	Koolwaterstoffractie C20-C24	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
	Koolwaterstoffractie C24-C28	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
	Koolwaterstoffractie C28-C32	mg/kg Ds	**<5**	*)	**14**	*)	**9**	*)	**<5**	*)
	Koolwaterstoffractie C32-C36	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
	Koolwaterstoffractie C36-C40	mg/kg Ds	**<5**	*)	**<5**	*)	**<5**	*)	**<5**	*)
Polychloorbifenylen (AS3000)										
S	*PCB 28*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 52*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 101*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 118*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 138*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 153*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	*PCB 180*	mg/kg Ds	**<0,0010**		**<0,0010**		**<0,0010**		**<0,0010**	
S	**Som PCB (7 Ballschmiter) (Factor 0,7)**	mg/kg Ds	**0,0049**	#)	**0,0049**	#)	**0,0049**	#)	**0,0049**	#)

x) Gehaltes beneden de rapportagegrens zijn niet mee inbegrepen.
#) Bij deze som zijn resultaten "<rapportagegrens" vermenigvuldigd met 0,7.
S) Erkend volgens AS SIKB 3000
Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens.
De parameter-specifieke analytische meetonzekerheid en informatie over de berekeningsmethode zijn op aanvraag beschikbaar, indien de gerapporteerde resultaten boven de parameterspecifieke rapportagegrens liggen. De minimale prestatiecriteria van de toegepaste methoden met betrekking tot de meetonzekerheid zijn in het algemeen gebaseerd op Richtlijn 2009/90/EG van de Europese Commissie.

Het analyseresultaat van PCB 138 is mogelijk overschat vanwege co-elutie met PCB 163
Het organische stof gehalte wordt gecorrigeerd voor het lutum gehalte, als geen lutum bepaald is wordt gecorrigeerd als ware het lutum gehalte 5,4%

Begin van de analyses: 25.11.2021
Einde van de analyses: 30.11.2021

De resultaten hebben uitsluitend betrekking op de geanalyseerde monsters. In gevallen waarin het testlaboratorium niet verantwoordelijk was voor de bemonstering, gelden de gerapporteerde resultaten voor de monsters zoals zij zijn ontvangen. .

AL-West B.V. Dhr. Rudie Leuverink, Tel. +31/570788112
Klantenservice

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kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
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Opdracht 1104111 Bodem / Eluaat

Toegepaste methoden

conform Protocollen AS 3000 : Organische stof Voorbehandeling conform AS3000 Barium (Ba) Cadmium (Cd) Kobalt (Co) Koper (Cu) Kwik (Hg) Lood (Pb) Molybdeen (Mo) Nikkel (AS3000) Zink (Zn) Koolwaterstoffractie C10-C40 Anthraceen Benzo(a)anthraceen Benzo-(a)-Pyreen Benzo(ghi)peryleen Benzo(k)fluorantheen Chryseen Fenanthreen Fluorantheen Indeno-(1,2,3-c,d)pyreen Naftaleen Som PAK (VROM) (Factor 0,7) PCB 28 PCB 52 PCB 101 PCB 118 PCB 138 PCB 153 PCB 180 Som PCB (7 Ballschmiter) (Factor 0,7)

conformNEN-EN12880; AS3000, AS3200; NEN-EN15934 : Droge stof

eigen methode *) **:** Koolwaterstoffractie C10-C12 Koolwaterstoffractie C12-C16 Koolwaterstoffractie C16-C20 Koolwaterstoffractie C20-C24 Koolwaterstoffractie C24-C28 Koolwaterstoffractie C28-C32 Koolwaterstoffractie C32-C36 Koolwaterstoffractie C36-C40

Gelijkwaardig aan NEN 5739 : IJzer (Fe2O3)

Protocollen AS 3000 / Protocollen AS 3200 : Koningswater ontsluiting Fractie < 2 µm

Parameters uitgevoerd door AL-West BV zijn geaccrediteerd volgens EN ISO/IEC 17025:2017. Alleen niet-geaccrediteerde en/of uitbestede parameters zijn gemarkeerd met het symbool " *) ".

Kamer van Koophandel Nr. 08110898
VAT/BTW-ID-Nr.: NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

kwaliteitswaarborg bodembeheer SIKB

TESTING RvA L 005

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

Projectnummer	30073259 FASE II	Begin van de analyses:	25.11.2021
Projectnaam	Mastentrace Zwolle - Ens	Einde van de analyses:	30.11.2021
AL-West Opdrachtnummer	1104111		

Monstergegevens

Monsternr.	Barcode	Boornummer	Monstername	Aanlevering
819668	AG31809116	1	23.11.21	24.11.21
819668	AG3180925B	1	23.11.21	24.11.21
819668	AG3180926C	1	23.11.21	24.11.21
819668	AG31815427	1	23.11.21	24.11.21
819669	AG2403140/	3	23.11.21	24.11.21
819669	AG31815539	3	23.11.21	24.11.21
819670	AG3483843G	1	22.11.21	22.11.21
819670	AG3483846J	1	22.11.21	22.11.21
819670	AG3835562F	1	22.11.21	22.11.21
819670	AG3835565I	1	22.11.21	22.11.21
819671	AG2403150+	4	22.11.21	22.11.21
819671	AG3483832E	5	22.11.21	22.11.21

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Dr. Paul Wimmer

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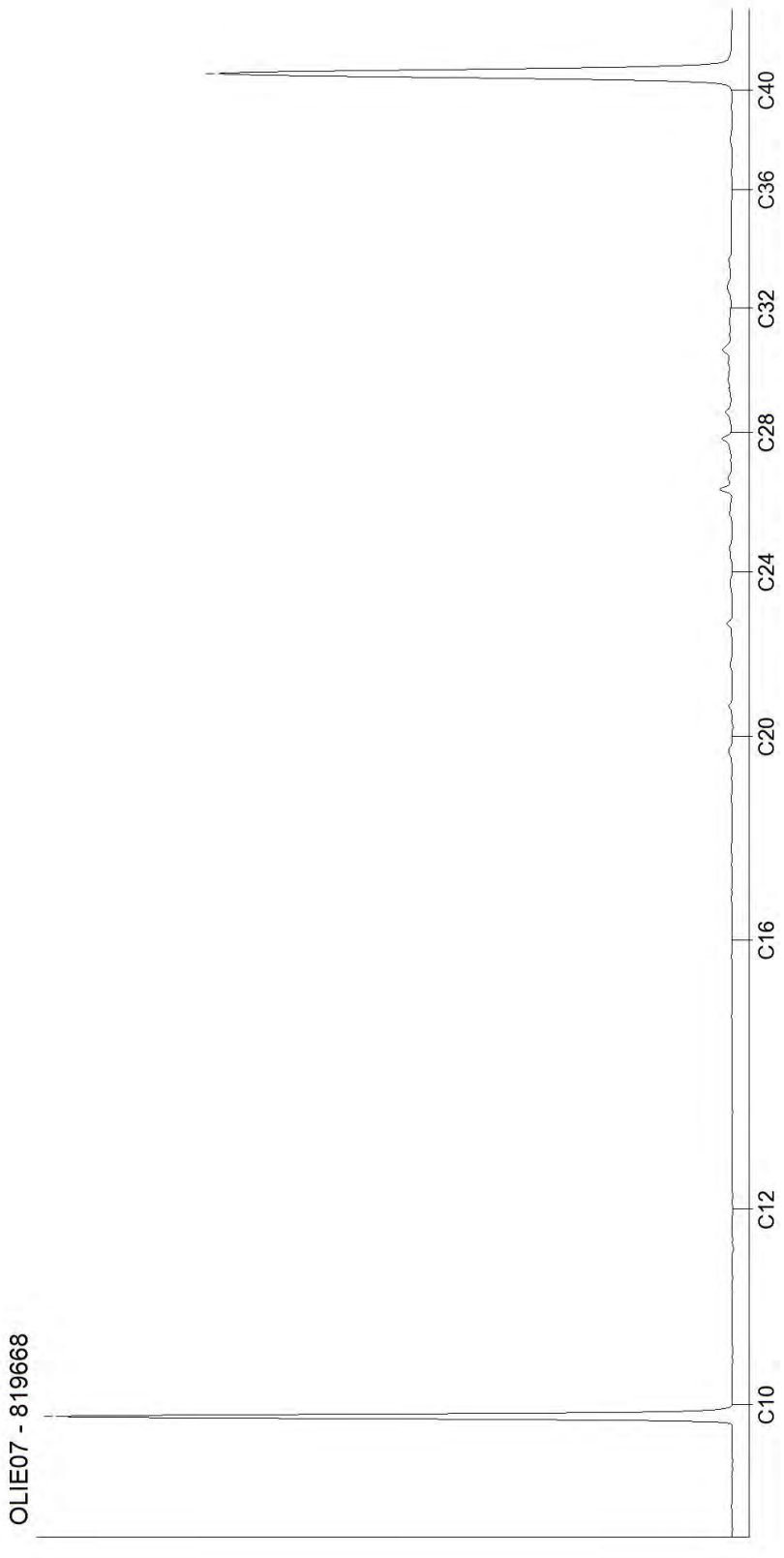
AL-West B.V.

Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819668, created at 30.11.2021 08:18:03

Monster beschrijving: 61-HB01 (0-35) 61-HB07 (0-40) 61-HB08 (0-40) 61-HB13 (0-40)



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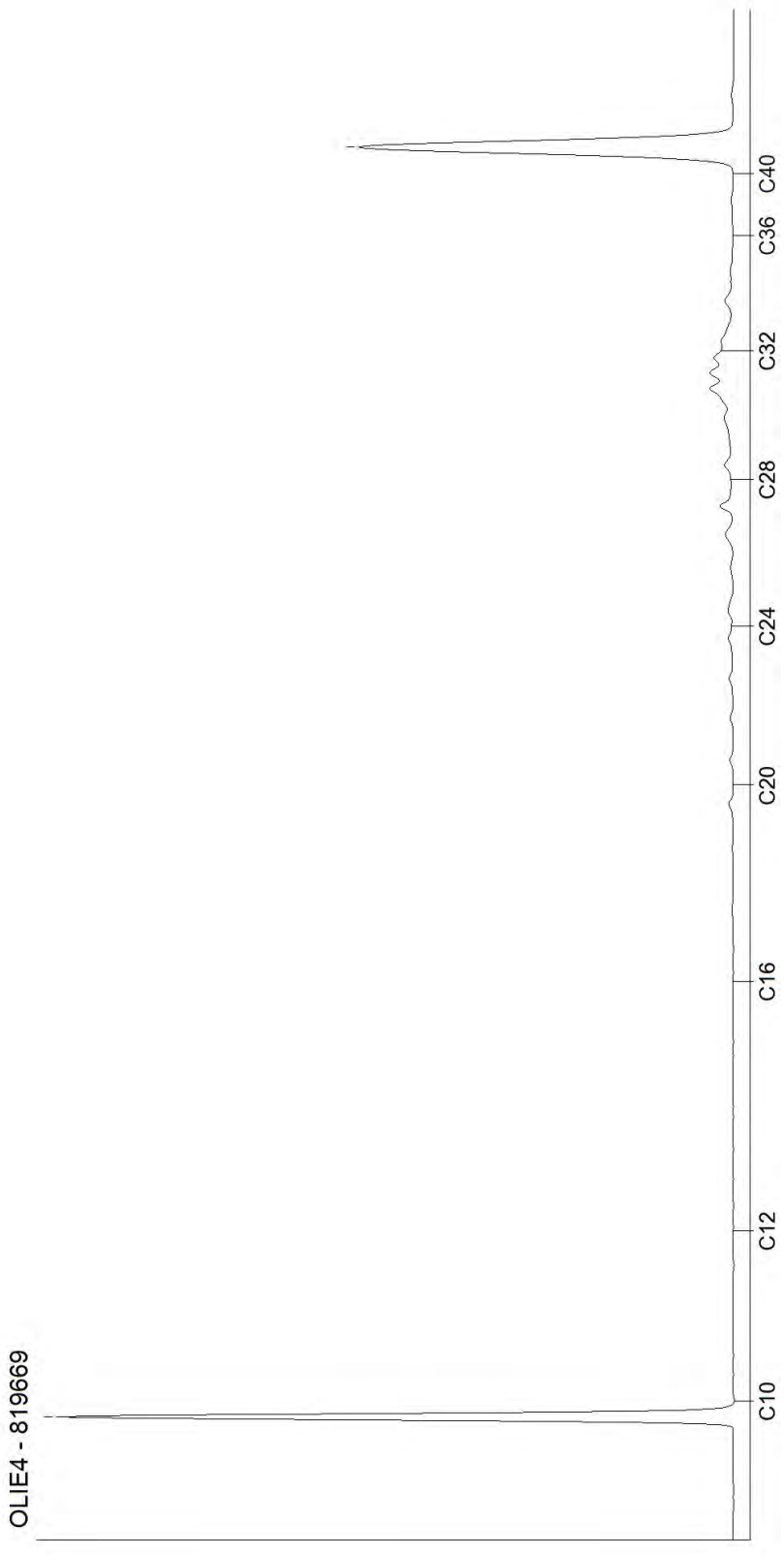
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819669, created at 30.11.2021 07:35:15

Monster beschrijving: 61-HB06 (90-130) 61-HB09 (90-120)



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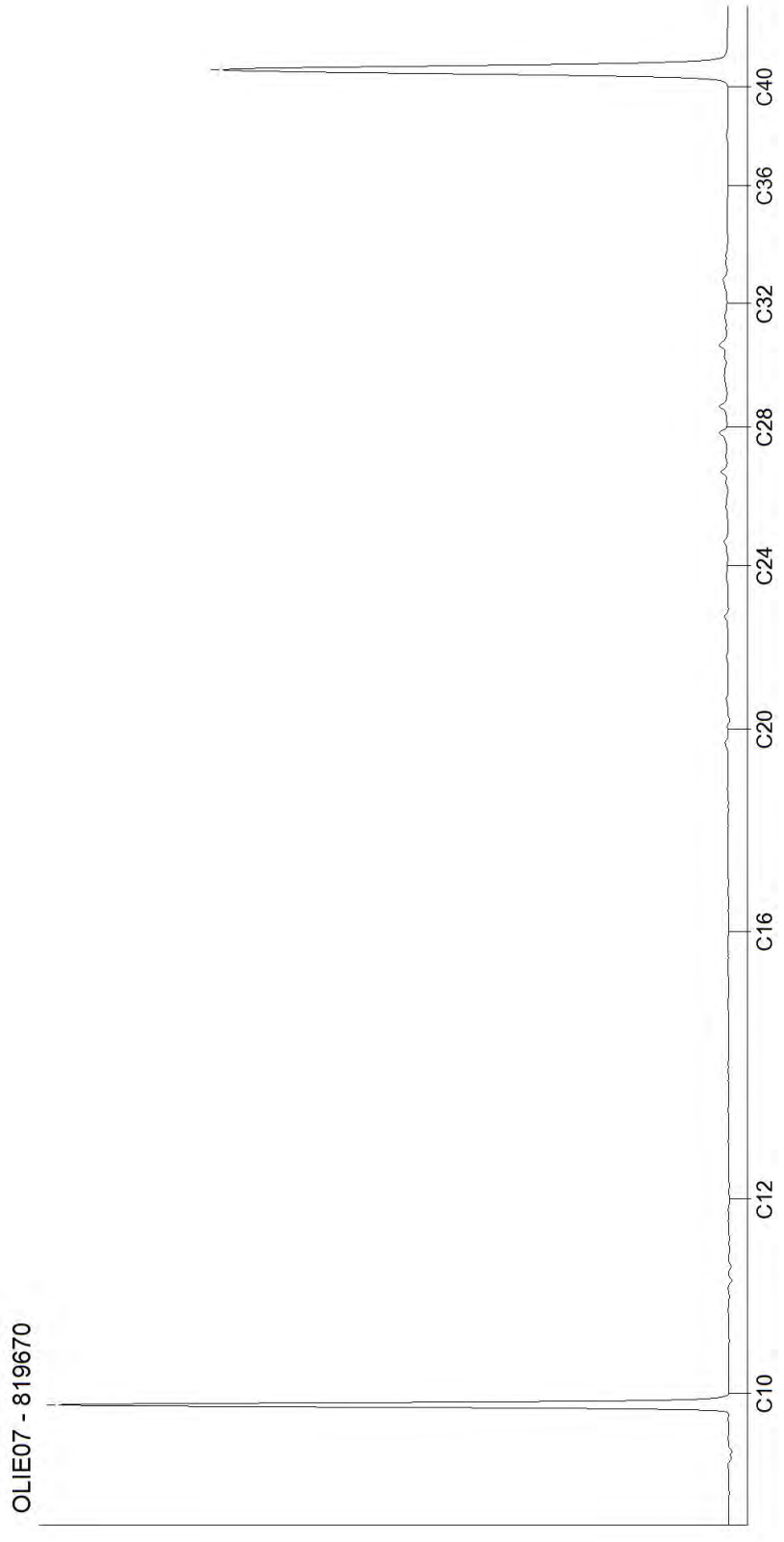
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819670, created at 30.11.2021 08:18:03

Monster beschrijving: 64-HB05 (0-20) 64-HB10 (0-50) 64-HB11 (0-15) 64-HB16 (0-30)



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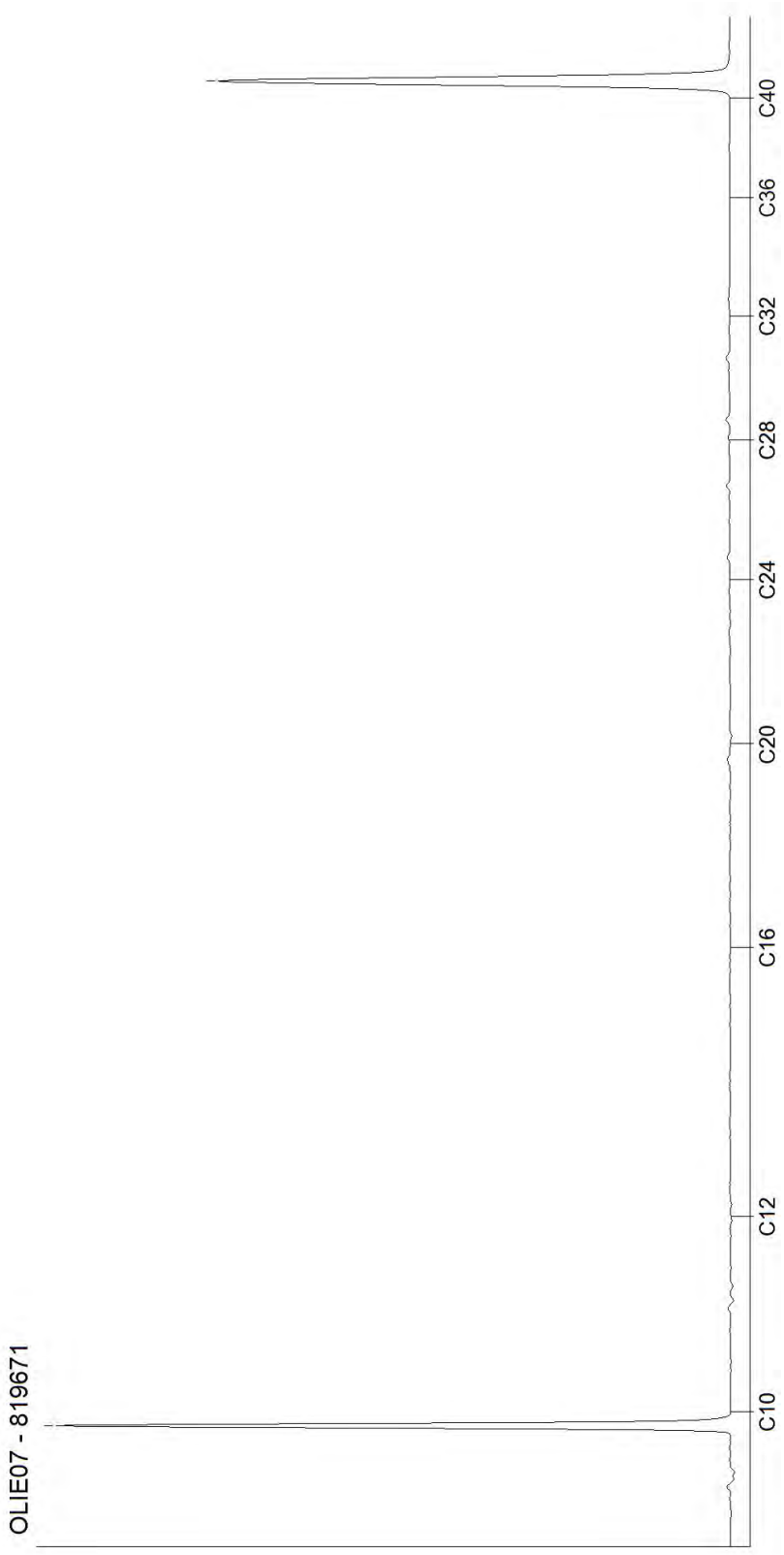
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

AL-West B.V.
Dortmundstraat 16B, 7418 BH Deventer, the Netherlands
Tel. +31(0)570 788110
e-Mail: info@al-west.nl, www.al-west.nl

CHROMATOGRAM for Order No. 1104111, Analysis No. 819671, created at 30.11.2021 08:18:03

Monster beschrijving: 64-HB07 (80-120) 64-HB12 (150-200)



Kamer van Koophandel
Nr. 08110898
VAT/BTW-ID-Nr.:
NL 811132559 B01

Directeur
ppa. Marc van Gelder
Dr. Paul Wimmer

Bijlage D – Toetsingsresultaten

Tabel 1: Gemeten gehalten in grond met beoordeling conform de Wet Bodembescherming

Grondmonster		64-MM-BG01			64-MM-OG01			64-MM-WB01		
Certificaatcode		1104111			1104111			1104073		
Boring(en)		64-HB05, 64-HB10, 64-HB11, 64-HB16			64-HB07, 64-HB12			64-WB01, 64-WB02, 64-WB03, 64-WB04, 64-WB05, 64-WB06, 64-WB07, 64-WB08, 64-WB09, 64-WB10		
Traject (m -mv)		0,00 - 0,50			0,80 - 2,00			0,15 - 0,50		
Humus	% ds	12,30			0,70			22,3		
Lutum	% ds	24,0			4,40			9,30		
Datum van toetsing		9-12-2021			9-12-2021			9-12-2021		
Monsterconclusie		Voldoet aan Achtergrondwaarde			Voldoet aan Achtergrondwaarde			Overschrijding Achtergrondwaarde		
		Meetw	**GSSD**	**Index**	**Meetw**	**GSSD**	**Index**	**Meetw**	**GSSD**	**Index**
METALEN										
Barium	mg/kg ds	130	134 (6)		<20	<42 (6)		65	132 (6)	
Cadmium	mg/kg ds	0,4	0,4	-0,02	<0,2	<0,2	-0,03	*1,2*	*1,0*	*0,03*
Kobalt	mg/kg ds	6,9	7,1	-0,05	<3	<6	-0,05	*14*	*27*	*0,07*
Koper	mg/kg ds	16	16	-0,16	<5	<7	-0,22	22	23	-0,11
Kwik	mg/kg ds	0,14	0,14	-0	<0,05	<0,05	-0	<0,05	<0,04	-0
Nikkel	mg/kg ds	24	25	-0,16	4,6	11,2	-0,37	*26*	*47*	*0,19*
Molybdeen	mg/kg ds	<1,5	<1,1	-0	<1,5	<1,1	-0	<1,5	<1,1	-0
Lood	mg/kg ds	44	43	-0,01	<10	<11	-0,08	44	46	-0,01
Zink	mg/kg ds	94	94	-0,08	<20	<30	-0,19	*170*	*214*	*0,13*
IJzer	% ds	<5	4 (6)		<5	4 (6)				
PAK										
Naftaleen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,5	0,2 (41)	
Anthraceen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,5	0,2 (41)	
Fenanthreen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,5	0,2 (41)	
Fluorantheen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		0,56	0,25	
Chryseen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		0,36	0,16	
Benzo(a)anthraceen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		0,27	0,12	
Benzo(a)pyreen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,5	0,2 (41)	
Benzo(k)fluorantheen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,5	0,2 (41)	
Indeno-(1,2,3-c,d)pyreen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		0,29	0,13	
Benzo(g,h,i)peryleen	mg/kg ds	<0,05	<0,03		<0,05	<0,04		<0,5	0,2 (41)	
PAK 10 VROM	mg/kg ds	0,35	<0,28	-0,03	0,35	<0,35	-0,03	*3,6*	*1,6*	*0*
GECHLOREERDE KOOLWATERSTOFFEN										
PCB 28	mg/kg ds	<0,001	<0,001		<0,001	<0,004		<0,001	<0,000	
PCB 52	mg/kg ds	<0,001	<0,001		<0,001	<0,004		<0,001	<0,000	
PCB 101	mg/kg ds	<0,001	<0,001		<0,001	<0,004		<0,001	<0,000	
PCB 118	mg/kg ds	<0,001	<0,001		<0,001	<0,004		<0,001	<0,000	
PCB 138	mg/kg ds	<0,001	<0,001		<0,001	<0,004		<0,001	<0,000	
PCB 153	mg/kg ds	<0,001	<0,001		<0,001	<0,004		<0,001	<0,000	
PCB 180	mg/kg ds	<0,001	<0,001		<0,001	<0,004		<0,001	<0,000	
PCB (som 7)	mg/kg ds	0,0049	<0,0040	-0,02	0,0049	<0,0245	0	0,0049	<0,0022	-0,02
OVERIGE (ORGANISCHE) VERBINDINGEN										
Minerale olie C10 - C12	mg/kg ds	<3	2 (6)		<3	11 (6)		<15	5 (6)	
Minerale olie C12 - C16	mg/kg ds	<3	2 (6)		5	25 (6)		<15	5 (6)	
Minerale olie C16 - C20	mg/kg ds	<4	2 (6)		<4	14 (6)		<20	6 (6)	
Minerale olie C20 - C24	mg/kg ds	<5	3 (6)		<5	18 (6)		<25	8 (6)	
Minerale olie C24 - C28	mg/kg ds	<5	3 (6)		<5	18 (6)		<25	8 (6)	
Minerale olie C28 - C32	mg/kg ds	9	7 (6)		<5	18 (6)		30	13 (6)	
Minerale olie C32 - C36	mg/kg ds	<5	3 (6)		<5	18 (6)		<25	8 (6)	
Minerale olie C36 - C40	mg/kg ds	<5	3 (6)		<5	18 (6)		<25	8 (6)	
Minerale olie C10 - C40	mg/kg ds	<35	<20	-0,04	<35	<123	-0,01	<180	57 (41)	-0,03
OVERIG										
Droge stof	%	61,8	61,8 (6)		76,6	76,6 (6)		23,1	23,1 (6)	
Lutum	%	24			4,4			9,3		
Organische stof (humus)	% ds	12,3			0,7			22,3		
Korrelfractie < 16 µm	%							18		

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Achtergrondwaarde
<=T	: Kleiner of gelijk aan Tussenwaarde
8,88	: <= Interventiewaarde
8,88	: > Interventiewaarde
38	: Bij antropogene bron: > voormalige interventiewaarde
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde
Index	: (GSSD - AW) / (I - AW)

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 2: Normwaarden conform de Wet Bodembescherming

		AW	WO	IND	I
METALEN					
Cadmium	mg/kg ds	0,6	1,2	4,3	13
Kobalt	mg/kg ds	15	35	190	190
Koper	mg/kg ds	40	54	190	190
Kwik	mg/kg ds	0,15	0,83	4,8	36
Nikkel	mg/kg ds	35	39	100	100
Molybdeen	mg/kg ds	1,5	88	190	190
Lood	mg/kg ds	50	210	530	530
Zink	mg/kg ds	140	200	720	720
PAK					
PAK 10 VROM	mg/kg ds	1,5	6,8	40	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB (som 7)	mg/kg ds	0,02	0,04	0,5	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds	190	190	500	5000

Tabel 1: Gemeten concentraties in grondwater met beoordeling conform de Wet Bodembescherming

Watermonster		64PB01-1-1		
Datum		7-3-2022		
Filterdiepte (m -mv)		1,40 - 2,40		
Datum van toetsing		18-3-2022		
Monsterconclusie		Voldoet aan Streefwaarde		
Monstermelding 1				
Monstermelding 2				
Monstermelding 3				
		Meetw	**GSSD**	**Index**
METALEN				
IJzer	µg/l	32000	32000 (6)	
OVERIG				
pH	-	6,8		
Ptot (fosfor totaal)	mg/l	1,3		
Onopgeloste stoffen	mg/l	150	150 (6)	
ANORGANISCHE VERBINDINGEN				
Ammonium (als N)	mg/l	2,2	2,2 (6)	
Chloride	mg/l	<50	<35	
Sulfaat (als SO4)	mg/l	<30	<21 (6)	

--------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Streefwaarde
8,88	: > Streefwaarde
8,88	: > Interventiewaarde
>T	: Groter dan Tussenwaarde
11	: Enkele parameters ontbreken in de berekening van de somfractie
14	: Streefwaarde ontbreekt zorgplicht van toepassing
2	: Enkele parameters ontbreken in de som
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde
Index	: (GSSD - S) / (I - S)

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 2: Normwaarden conform de Wet Bodembescherming

		S	S Diep	Indicatief	I
ANORGANISCHE VERBINDINGEN					
Chloride	µg/l	100000			

Tabel 3: Gemeten concentraties in grondwater met beoordeling conform de Wet Bodembescherming

Watermonster		64-1HB-1-1		
Datum		23-11-2021		
Filterdiepte (m -mv)		1,75 - 2,75		
Datum van toetsing		9-12-2021		
Monsterconclusie		Overschrijding Streefwaarde		
		Meetw	**GSSD**	**Index**
METALEN				
Barium	µg/l	37	37	-0,02
Cadmium	µg/l	<0,2	<0,1	-0,05
Kobalt	µg/l	<2	<1	-0,23
Koper	µg/l	<2	<1	-0,23
Kwik	µg/l	<0,05	<0,04	-0,06
Nikkel	µg/l	<3	<2	-0,22
Molybdeen	µg/l	<2	<1	-0,01
Lood	µg/l	<2	<1	-0,23
Zink	µg/l	<10	<7	-0,08
IJzer	µg/l	1800	1800 (6)	
PAK				
Naftaleen	µg/l	<0,02	<0,01	0
PAK 10 VROM	-		<0,00020 (11)	
GECHLOREERDE KOOLWATERSTOFFEN				
1,1-Dichloorpropaan	µg/l	<0,2	<0,1	
1,3-Dichloorpropaan	µg/l	<0,2	<0,1	
Tribroommethaan (bromoform)	µg/l	<0,6	0,4 (41,14)	
Tetrachloormethaan (Tetra)	µg/l	<0,1	<0,1	0,01
1,1-Dichloorethaan	µg/l	<0,2	<0,1	-0,01
1,2-Dichloorethaan	µg/l	<0,2	<0,1	-0,02
1,2-Dichloorpropaan	µg/l	<0,2	<0,1	
1,1,1-Trichloorethaan	µg/l	<0,1	<0,1	0
1,1,2-Trichloorethaan	µg/l	*0,12*	*0,12*	*0*
Trichlooretheen (Tri)	µg/l	<0,2	<0,1	-0,05
Tetrachlooretheen (Per)	µg/l	<0,1	<0,1	0
Vinylchloride	µg/l	<0,2	<0,1	0,03
Dichloormethaan	µg/l	<0,2	<0,1	0
Trichloormethaan (Chloroform)	µg/l	<0,2	<0,1	-0,01
cis + trans-1,2-Dichlooretheen	µg/l	0,21	<0,14	0,01
1,1-Dichlooretheen	µg/l	<0,1	<0,1	0,01
cis-1,2-Dichlooretheen	µg/l	<0,1	<0,1	
trans-1,2-Dichlooretheen	µg/l	<0,1	<0,1	
Dichloorpropaan	µg/l		<0,42	-0
AROMATISCHE VERBINDINGEN				
Styreen (Vinylbenzeen)	µg/l	<0,2	<0,1	-0,02
Benzeen	µg/l	<0,2	<0,1	-0
Ethylbenzeen	µg/l	<0,2	<0,1	-0,03
Tolueen	µg/l	<0,2	<0,1	-0,01
Xylenen (som)	µg/l	0,21	<0,21	0
meta-/para-Xyleen (som)	µg/l	<0,2	<0,1	
ortho-Xyleen	µg/l	<0,1	<0,1	
Som 16 Aromatische oplosmiddelen	µg/l		<0,77 (2,14)	
OVERIGE (ORGANISCHE) VERBINDINGEN				
Minerale olie C10 - C12	µg/l	<10	7 (6)	
Minerale olie C12 - C16	µg/l	<10	7 (6)	
Minerale olie C16 - C20	µg/l	<5	4 (6)	

Watermonster		64-1HB-1-1		
Datum		23-11-2021		
Filterdiepte (m -mv)		1,75 - 2,75		
Datum van toetsing		9-12-2021		
Monsterconclusie		Overschrijding Streefwaarde		
Minerale olie C20 - C24	µg/l	<5	4 (6)	
Minerale olie C24 - C28	µg/l	<5	4 (6)	
Minerale olie C28 - C32	µg/l	<5	4 (6)	
Minerale olie C32 - C36	µg/l	<5	4 (6)	
Minerale olie C36 - C40	µg/l	<5	4 (6)	
Minerale olie C10 - C40	µg/l	<50	<35	-0,03
OVERIG				
som dichloorpropaan-isomeren	µg/l	0,42		
ANORGANISCHE VERBINDINGEN				
Ammonium (als N)	mg/l	0,1	0,1 (6)	
Chloride	mg/l	<50	<35	
Sulfaat (als SO4)	mg/l	<30	<21 (6)	

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Streefwaarde
8,88	: > Streefwaarde
8,88	: > Interventiewaarde
>T	: Groter dan Tussenwaarde
11	: Enkele parameters ontbreken in de berekening van de somfractie
14	: Streefwaarde ontbreekt zorgplicht van toepassing
2	: Enkele parameters ontbreken in de som
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde
Index	: (GSSD - S) / (I - S)

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 4: Normwaarden conform de Wet Bodembescherming

		S	S Diep	Indicatief	I
METALEN					
Barium	µg/l	50	200		625
Cadmium	µg/l	0,4	0,06		6
Kobalt	µg/l	20	0,7		100
Koper	µg/l	15	1,3		75
Kwik	µg/l	0,05	0,01		0,3
Nikkel	µg/l	15	2,1		75
Molybdeen	µg/l	5	3,6		300
Lood	µg/l	15	1,7		75
Zink	µg/l	65	24		800
PAK					
Naftaleen	µg/l	0,01			70
GECHLOREERDE KOOLWATERSTOFFEN					
Tribroommethaan (bromoform)	µg/l				630
Tetrachloormethaan (Tetra)	µg/l	0,01			10
1,1-Dichloorethaan	µg/l	7			900
1,2-Dichloorethaan	µg/l	7			400
1,1,1-Trichloorethaan	µg/l	0,01			300
1,1,2-Trichloorethaan	µg/l	0,01			130
Trichlooretheen (Tri)	µg/l	24			500
Tetrachlooretheen (Per)	µg/l	0,01			40
Vinylchloride	µg/l	0,01			5
Dichloormethaan	µg/l	0,01			1000
Trichloormethaan (Chloroform)	µg/l	6			400
cis + trans-1,2-Dichlooretheen	µg/l	0,01			20
1,1-Dichlooretheen	µg/l	0,01			10
Dichloorpropaan	µg/l	0,8			80
AROMATISCHE VERBINDINGEN					
Styreen (Vinylbenzeen)	µg/l	6			300
Benzeen	µg/l	0,2			30
Ethylbenzeen	µg/l	4			150
Tolueen	µg/l	7			1000
Xylenen (som)	µg/l	0,2			70
Som 16 Aromatische oplosmiddelen	µg/l			150	
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	µg/l	50			600
ANORGANISCHE VERBINDINGEN					
Chloride	µg/l	100000			

Tabel 1: Samenstellingwaarden en toetsing voor waterbodem conform Besluit Bodemkwaliteit

Analysemonster	64-MM-WB01						
Certificaatcode	1104073						
Datum	22-11-2021						
Traject (cm-mv)	15-50						
Humus (% ds)	22,3						
Lutum (% ds)	9,3						
Datum van toetsing	21-3-2022						
Bodemklasse monster			Klasse industrie	Klasse B	Verspreidbaar	Niet verspreidbaar	Verspreidbaar
			T1	T3	T5	T6	T7
METALEN							
Barium	65	mg/kg ds	-------	-------		-------	-------
Cadmium	1,2	mg/kg ds	<=*WO*	<*A*	<=MW_AW	<=MW_AW	<=MW_AW
Kobalt	14	mg/kg ds	<=*WO*	<B		>MW_AW	
Koper	22	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Kwik	< 0,05	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Nikkel	26	mg/kg ds	<=*IND*	<*A*		<=MW_AW	<=MW_AW
Molybdeen	< 1,5	mg/kg ds	<=AW	<=AW		<=MW_AW	
Lood	44	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
Zink	170	mg/kg ds	<=*IND*	<*A*		<=MW_AW	<=MW_AW
PAK							
Naftaleen	< 0,5	mg/kg ds					
Anthraceen	< 0,5	mg/kg ds					
Fenanthreen	< 0,5	mg/kg ds					
Fluorantheen	0,56	mg/kg ds					
Chryseen	0,36	mg/kg ds					
Benzo(a)anthraceen	0,27	mg/kg ds					
Benzo(a)pyreen	< 0,5	mg/kg ds					
Benzo(k)fluorantheen	< 0,5	mg/kg ds					
Indeno-(1,2,3-c,d)pyreen	0,29	mg/kg ds					
Benzo(g,h,i)peryleen	< 0,5	mg/kg ds					
PAK 10 VROM	3,6	mg/kg ds	<=*WO*	<*A*		<=MW_AW	<=MW_AW
GECHLOREERDE KOOLWATERSTOFFEN							
PCB 28	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 52	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 101	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 118	< 0,001	mg/kg ds		<=AW		<=MW_AW	

Analysemonster	64-MM-WB01						
Certificaatcode	1104073						
Datum	22-11-2021						
Traject (cm-mv)	15-50						
Humus (% ds)	22,3						
Lutum (% ds)	9,3						
Datum van toetsing	21-3-2022						
Bodemklasse monster			Klasse industrie	Klasse B	Verspreidbaar	Niet verspreidbaar	Verspreidbaar
PCB 138	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 153	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB 180	< 0,001	mg/kg ds		<=AW		<=MW_AW	
PCB (som 7)	0,0049	mg/kg ds	<=AW	<=AW		<=MW_AW	<=MW_AW
OVERIGE (ORGANISCHE) VERBINDINGEN							
Minerale olie C10 - C12	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C12 - C16	< 15	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C16 - C20	< 20	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C20 - C24	< 25	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C24 - C28	< 25	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C28 - C32	30	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C32 - C36	< 25	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C36 - C40	< 25	mg/kg ds	-------	-------	-------	-------	-------
Minerale olie C10 - C40	< 180	mg/kg ds	<=AW	<=AW	<=MW_AW	<=MW_AW	<=MW_AW
OVERIG							
Droge stof	23,1	%	-------	-------	-------	-------	-------
Lutum	9,3	%					
Organische stof (humus)	22,3	% ds					
Korrelfractie < 16 µm	18	%					
meersoorten PAF organische verbindingen		%			<=MW_AW		
meersoorten PAF metalen		%			<=MW_AW		

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Achtergrondwaarde
8,88	: A
8,88	: B
8,88	: Nooit toepasbaar
38	: Bij antropogene bron: > voormalige interventiewaarde
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	@ verhoogde rapportagegrens
GSSD	@ Gestandaardiseerde meetwaarde

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 2: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T1)

		AW	WO	IND	I
METALEN					
Cadmium	mg/kg ds	0,6	1,2	4,3	13
Kobalt	mg/kg ds	15	35	190	190
Koper	mg/kg ds	40	54	190	190
Kwik	mg/kg ds	0,15	0,83	4,8	36
Nikkel	mg/kg ds	35	39	100	100
Molybdeen	mg/kg ds	1,5	88	190	190
Lood	mg/kg ds	50	210	530	530
Zink	mg/kg ds	140	200	720	720
PAK					
PAK 10 VROM	mg/kg ds	1,5	6,8	40	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB (som 7)	mg/kg ds	0,02	0,04	0,5	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds	190	190	500	5000

Tabel 3: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T3)

		ETW	AW	A	B
METALEN					
Cadmium	mg/kg ds	4,3	0,6	4	14
Kobalt	mg/kg ds	130	15	25	240
Koper	mg/kg ds	113	40	96	190
Kwik	mg/kg ds	4,8	0,15	1,2	10
Nikkel	mg/kg ds	100	35	50	210
Molybdeen	mg/kg ds	105	1,5	5	200
Lood	mg/kg ds	308	50	138	580
Zink	mg/kg ds	430	140	563	2000
PAK					
PAK 10 VROM	mg/kg ds		1,5	9	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB 28	mg/kg ds		0,0015	0,014	
PCB 52	mg/kg ds		0,002	0,015	
PCB 101	mg/kg ds		0,0015	0,023	
PCB 118	mg/kg ds		0,0045	0,016	
PCB 138	mg/kg ds		0,004	0,027	
PCB 153	mg/kg ds		0,0035	0,033	
PCB 180	mg/kg ds		0,0025	0,018	
PCB (som 7)	mg/kg ds		0,02	0,139	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds		190	1250	5000

Tabel 4: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T5)

		AW	MW per	I
METALEN				
Cadmium	mg/kg ds	0,6	7,5	13
Kobalt	mg/kg ds	15		190

		AW	MW per	I
Koper	mg/kg ds	40		190
Kwik	mg/kg ds	0,15		36
Nikkel	mg/kg ds	35		100
Molybdeen	mg/kg ds	1,5		190
Lood	mg/kg ds	50		530
Zink	mg/kg ds	140		720
PAK				
PAK 10 VROM	mg/kg ds	1,5		40
GECHLOREERDE KOOLWATERSTOFFEN				
PCB (som 7)	mg/kg ds	0,02		1
OVERIGE (ORGANISCHE) VERBINDINGEN				
Minerale olie C10 - C40	mg/kg ds	190	3000	5000

Tabel 5: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T6)

		AW	MW zoet	IW
METALEN				
Cadmium	mg/kg ds	0,6	4	14
Kobalt	mg/kg ds	15	25	240
Koper	mg/kg ds	40	96	190
Kwik	mg/kg ds	0,15	1,2	10
Nikkel	mg/kg ds	35	50	210
Molybdeen	mg/kg ds	1,5	5	200
Lood	mg/kg ds	50	138	580
Zink	mg/kg ds	140	563	2000
PAK				
PAK 10 VROM	mg/kg ds	1,5	9	40
GECHLOREERDE KOOLWATERSTOFFEN				
PCB 28	mg/kg ds	0,0015	0,014	
PCB 52	mg/kg ds	0,002	0,015	
PCB 101	mg/kg ds	0,0015	0,023	
PCB 118	mg/kg ds	0,0045	0,016	
PCB 138	mg/kg ds	0,004	0,027	
PCB 153	mg/kg ds	0,0035	0,033	
PCB 180	mg/kg ds	0,0025	0,018	
PCB (som 7)	mg/kg ds	0,02	0,139	1
OVERIGE (ORGANISCHE) VERBINDINGEN				
Minerale olie C10 - C40	mg/kg ds	190	1250	5000

Tabel 6: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit (T7)

		MW zout	IW
METALEN			
Cadmium	mg/kg ds	4	14
Kobalt	mg/kg ds		240
Koper	mg/kg ds	60	190
Kwik	mg/kg ds	1,2	10
Nikkel	mg/kg ds	45	210
Molybdeen	mg/kg ds		200
Lood	mg/kg ds	110	580
Zink	mg/kg ds	365	2000
PAK			

		MW zout	IW
PAK 10 VROM	mg/kg ds	8	40
GECHLOREERDE KOOLWATERSTOFFEN			
PCB (som 7)	mg/kg ds	0,1	1
OVERIGE (ORGANISCHE) VERBINDINGEN			
Minerale olie C10 - C40	mg/kg ds	1250	5000

Tabel 1: Samenstellingwaarden en toetsing voor grond conform Besluit Bodemkwaliteit

Grondmonster		64-MM-BG01		64-MM-OG01		64-MM-WB01	
Grondsoort		Klei		Zand		Slib	
Zintuiglijke bijmengingen		matig plantenhoudend, matig wortelhoudend, geen olie-water reactie		lensjes klei, geen olie-water reactie			
Humus (% ds)		12,30		0,70		22,3	
Lutum (% ds)		24,0		4,40		9,30	
Datum van toetsing		9-12-2021		9-12-2021		9-12-2021	
Monster getoetst als		partij		partij		partij	
Bodemklasse monster		Altijd toepasbaar		Altijd toepasbaar		Klasse industrie	
		Meetw	**GSSD**	**Meetw**	**GSSD**	**Meetw**	**GSSD**
METALEN							
Barium	mg/kg ds	130	134 (6)	<20	<42 (6)	65	132 (6)
Cadmium	mg/kg ds	0,4	0,4	<0,2	<0,2	*1,2*	*1,0*
Kobalt	mg/kg ds	6,9	7,1	<3	<6	*14*	*27*
Koper	mg/kg ds	16	16	<5	<7	22	23
Kwik	mg/kg ds	0,14	0,14	<0,05	<0,05	<0,05	<0,04
Nikkel	mg/kg ds	24	25	4,6	11,2	*26*	*47*
Molybdeen	mg/kg ds	<1,5	<1,1	<1,5	<1,1	<1,5	<1,1
Lood	mg/kg ds	44	43	<10	<11	44	46
Zink	mg/kg ds	94	94	<20	<30	*170*	*214*
IJzer	% ds	<5	4 (6)	<5	4 (6)		
PAK							
Naftaleen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,5	0,2 (41)
Anthraceen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,5	0,2 (41)
Fenanthreen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,5	0,2 (41)
Fluorantheen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	0,56	0,25
Chryseen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	0,36	0,16
Benzo(a)anthraceen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	0,27	0,12
Benzo(a)pyreen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,5	0,2 (41)
Benzo(k)fluorantheen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,5	0,2 (41)
Indeno-(1,2,3-c,d)pyreen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	0,29	0,13
Benzo(g,h,i)peryleen	mg/kg ds	<0,05	<0,03	<0,05	<0,04	<0,5	0,2 (41)
PAK 10 VROM	mg/kg ds	0,35	<0,28	0,35	<0,35	*3,6*	*1,6*
GECHLOREERDE KOOLWATERSTOFFEN							
PCB 28	mg/kg ds	<0,001	<0,001	<0,001	<0,004	<0,001	<0,000
PCB 52	mg/kg ds	<0,001	<0,001	<0,001	<0,004	<0,001	<0,000
PCB 101	mg/kg ds	<0,001	<0,001	<0,001	<0,004	<0,001	<0,000
PCB 118	mg/kg ds	<0,001	<0,001	<0,001	<0,004	<0,001	<0,000
PCB 138	mg/kg ds	<0,001	<0,001	<0,001	<0,004	<0,001	<0,000
PCB 153	mg/kg ds	<0,001	<0,001	<0,001	<0,004	<0,001	<0,000
PCB 180	mg/kg ds	<0,001	<0,001	<0,001	<0,004	<0,001	<0,000
PCB (som 7)	mg/kg ds	0,0049	<0,0040	0,0049	<0,0245	0,0049	<0,0022
OVERIGE (ORGANISCHE) VERBINDINGEN							
Minerale olie C10 - C12	mg/kg ds	<3	2 (6)	<3	11 (6)	<15	5 (6)
Minerale olie C12 - C16	mg/kg ds	<3	2 (6)	5	25 (6)	<15	5 (6)
Minerale olie C16 - C20	mg/kg ds	<4	2 (6)	<4	14 (6)	<20	6 (6)
Minerale olie C20 - C24	mg/kg ds	<5	3 (6)	<5	18 (6)	<25	8 (6)
Minerale olie C24 - C28	mg/kg ds	<5	3 (6)	<5	18 (6)	<25	8 (6)
Minerale olie C28 - C32	mg/kg ds	9	7 (6)	<5	18 (6)	30	13 (6)
Minerale olie C32 - C36	mg/kg ds	<5	3 (6)	<5	18 (6)	<25	8 (6)
Minerale olie C36 - C40	mg/kg ds	<5	3 (6)	<5	18 (6)	<25	8 (6)
Minerale olie C10 - C40	mg/kg ds	<35	<20	<35	<123	<180	57 (41)
OVERIG							
Droge stof	%	61,8	61,8 (6)	76,6	76,6 (6)	23,1	23,1 (6)
Lutum	%	24		4,4		9,3	
Organische stof (humus)	% ds	12,3		0,7		22,3	
Korrelfractie < 16 µm	%					18	

-------	: Geen toetsnorm aanwezig
<	: kleiner dan de detectielimiet
8,88	: <= Achtergrondwaarde
8,88	: Wonen
8,88	: Industrie
8,88	: <= Interventiewaarde
8,88	: Niet Toepasbaar > IW
38	: Bij antropogene bron: > voormalige interventiewaarde
41	: Verhoogde rapportagegrens geconstateerd door BoToVa service
6	: Heeft geen normwaarde
#	: verhoogde rapportagegrens
GSSD	: Gestandaardiseerde meetwaarde

- Getoetst via de BoToVa service, versie 3.1.0 -

Tabel 2: Normwaarden (mg/kg) conform Regeling Besluit Bodemkwaliteit

		AW	WO	IND	I
METALEN					
Cadmium	mg/kg ds	0,6	1,2	4,3	13
Kobalt	mg/kg ds	15	35	190	190
Koper	mg/kg ds	40	54	190	190
Kwik	mg/kg ds	0,15	0,83	4,8	36
Nikkel	mg/kg ds	35	39	100	100
Molybdeen	mg/kg ds	1,5	88	190	190
Lood	mg/kg ds	50	210	530	530
Zink	mg/kg ds	140	200	720	720
PAK					
PAK 10 VROM	mg/kg ds	1,5	6,8	40	40
GECHLOREERDE KOOLWATERSTOFFEN					
PCB (som 7)	mg/kg ds	0,02	0,04	0,5	1
OVERIGE (ORGANISCHE) VERBINDINGEN					
Minerale olie C10 - C40	mg/kg ds	190	190	500	5000

Bijlage E – Toelichting toetsingskader

MATE VAN BODEMVERONTREINIGING
Toetsing van de analyseresultaten van grond- en grondwater heeft plaatsgevonden aan de hand van het toetsingskader zoals gedefinieerd in de Circulaire bodemsanering per 1 juli 2013 en de Regeling bodemkwaliteit van 13 december 2007. Onderstaande toetswaarden worden gehanteerd om de mate van bodemverontreiniging weer te geven:

Bij toetsing van de grond zijn de gehalten teruggerekend naar de standaard middels de percentages humus (10%) en lutum (25%). De gecorrigeerde gehalten zijn getoetst aan de van toepassing zijnde normen.

Interventiewaarden (I)
De interventiewaarden bodemsanering geven het concentratieniveau voor verontreinigingen in grond en grondwater aan waarboven ernstige vermindering of dreigende vermindering optreedt van de functionele eigenschappen die de bodem heeft voor mens, plant en dier. Bij gehalten boven de interventiewaarde is mogelijk sprake van (een geval van) ernstige verontreiniging en is er mogelijk een saneringsnoodzaak.

Streefwaarden grondwater (S)
De streefwaarden gelden als referentiewaarden en hebben betrekking op de in de natuur voorkomende achtergrondwaarden in het grondwater of op detectiegrenzen bij stoffen die niet in natuurlijk milieu voorkomen.

Achtergrondwaarden grond (AW)
De achtergrondwaarden gelden als referentiewaarden waar relatief onbelaste gebieden (natuur en landbouwgebieden) voor 95 % aan voldoen. Grond die aan de AW voldoet is blijvend geschikt voor alle bodemfuncties (waaronder moestuin, natuur en landbouw).

Per 1 november 2013 dient toetsing plaats te vinden via de landelijke toetsingsmodule van de Rijksoverheid genaamd BoToVa. Conform de Circulaire bodemsanering per 1 juli 2013 en de Regeling bodemkwaliteit van 13 december 2007 worden de gemeten gehalten voor grond gecorrigeerd naar een standaardbodem (25% lutum en 10% organische stof). Hierna wordt getoetst aan de hierboven genoemde toetswaarden. De toetsing geeft weer of sprake is van een overschrijding van deze toetswaarden. Om de mate van bodemverontreiniging aan te geven wordt de volgende terminologie gebruikt:

- Niet verontreinigd: Index ≤ 0,0 (gehalte ≤ AW (achtergrondwaarde) / S (streefwaarde)
- Licht verontreinigd: Index > 0,0 ≤ 1,0 (AW / S < gehalte ≤ I (interventiewaarde))
- Sterk verontreinigd: Index > 1,0 (gehalte > I)

Geval van ernstige bodemverontreiniging
Er is sprake van een ernstig geval van bodemverontreiniging indien voor één of meerdere stoffen de gemiddelde gemeten concentratie van 25 m^3 bodemvolume in het geval van grondverontreiniging, of in 100 m^3 bodemvolume in het geval van grondwaterverontreiniging, hoger is dan de interventiewaarde voor landbodems.

Voor ernstige bodemverontreinigingen die ontstaan zijn vóór 1987, dient middels een risicobeoordeling te worden vastgesteld of sanering al dan niet spoedig uitgevoerd dient te worden (Circulaire bodemsanering 2009).

TOETSING VAN ASBEST IN GROND/PUIN
De landelijke norm voor asbest in grond, bodem en puingranulaat is vastgesteld op 100 mg/kg d.s. gemeten (serpentijnconcentratie vermeerderd met tienmaal de amfiboolconcentratie) zoals vastgesteld in de Circulaire bodemsanering 2013. Grond en/of puin met een (gemeten) concentratie asbest boven de norm van 100 mg/kg d.s. wordt beoordeeld als ‘’verontreinigd met asbest’’. Grond en/of puin met een (gemeten) concentratie aan asbest lager dan de interventiewaarde of restconcentratienorm wordt als ‘’niet verontreinigd’’ beoordeeld.

TOEPASSEN VAN GROND EN TOEPASSEN EN VERSPREIDEN VAN BAGGERSPECIE
Op het toepassen van grond en het toepassen en verspreiden van baggerspecie is de Regeling bodemkwaliteit van 13 december 2007 van toepassing. Daarin kunnen lokale (water)bodembeheerders kiezen tussen generiek en gebiedspecifiek beleid.

Gebiedspecifiek beleid
Met het gebiedspecifiek beleid kunnen lokale (water)bodembeheerders zelf kwaliteitsnormen vaststellen. Als randvoorwaarden geldt dat sprake moet zijn van stand still op gebiedsniveau. De normen in het gebiedspecifiek kader worden lokale Maximale waarden genoemd.

Generiek beleid
Binnen het generieke (landelijke) beleid is het toetsingskader gebaseerd op een klassenindeling voor kwaliteit en functie. Uitgangspunt bij het toepassen van grond en het toepassen en verspreiden van baggerspecie binnen het generieke kader is, dat de kwaliteit moet aansluiten bij de functie van de (water)bodem en dat de lokale (water)bodemkwaliteit op klasse niveau niet mag verslechteren en waar mogelijk verbetert.

Landbodem
Binnen het generieke kader zijn voor het toepassen op landbodem vier kwaliteitsklassen onderscheiden:

- Vrij toepasbaar

Een partij grond is vrij toepasbaar wanneer deze voldoet aan de achtergrondwaarden. Daarnaast wordt een partij grond als “vrij toepasbaar” geclassificeerd als bij meting van 7-16 parameters de rekenkundig gemiddelde gehalten van maximaal twee stoffen verhoogd zijn ten opzichte van de achtergrondwaarden, met een maximum van tweemaal de achtergrondwaarden.

- Bodemkwaliteitsklasse wonen

Een partij grond wordt als “wonen” geclassificeerd als geen van de gemeten gehalten de maximale waarden wonen overschrijden, maar wel één of meer gehalten meer dan tweemaal de achtergrondwaarden overschrijden en/of drie of meer gemeten gehalten de achtergrondwaarden overschrijden.

- Bodemkwaliteitsklasse industrie

Een partij grond wordt als “industrie” geclassificeerd als één of meer van de gemeten gehalten de maximale waarden wonen overschrijden, maar de maximale waarden industrie niet worden overschreden.

- Niet toepasbaar

Een partij grond is niet toepasbaar wanneer één of meer van de gemeten gehalten de maximale waarden industrie overschrijden.

Bijlage F – Kwaliteitsborging

Dit onderzoek is uitgevoerd conform de eisen uit de KWALIBO-regeling; KWALIBO staat voor 'Kwaliteitsborging bij bodemintermediairs'. Arcadis Nederland B.V. is gecertificeerd volgens het procescertificaat 'Veldwerk bij milieuhygiënisch bodem- en waterbodemonderzoek'. Het veldwerk is uitgevoerd door Poelsema Veldwerk Bureau conform de BRL SIKB 2000 en de onderliggende protocollen 2001, 2002 en 2003. Het milieukundig veldwerk is onafhankelijk van de opdrachtgever uitgevoerd; voor de onafhankelijkheidsverklaring van de betrokken erkende milieutechnici zie bijlage G.

Het laboratoriumonderzoek is uitgevoerd door een door de Raad van Accreditatie geaccrediteerd en conform AS SIKB 3000 gecertificeerd laboratorium. Indien mogelijk zijn de analyses uitgevoerd conform AS SIKB 3000 en de onderliggende relevante protocollen. Dergelijke protocollen zijn echter niet voor alle stoffen opgesteld, en derhalve zijn niet alle analyses conform AS SIKB 3000 uit te voeren. Op de analysecertificaten in bijlage C staat per parameter aangegeven of de gehanteerde analysemethode erkend is volgens AS SIKB 3000.

Dit rapport draagt het keurmerk 'kwaliteitswaarborg bodembeheer SIKB'. Tijdens het uitgevoerde onderzoek is namelijk niet op kritieke punten afgeweken van de gehanteerde certificatieschema's, richtlijnen of normen.

Afwijkingen						
Van toepassing zijnde BRL	Onderwerp	Juiste wijze volgens BRL/NEN	Omschrijving afwijking	Motivatie	Risico	Conclusie
Conserverings-methoden en -termijnen voor milieumonsters, protocol 3001, tabel 2 (grond en waterbodem).	Conserverings-termijn.	De conserverings-termijn voor de desbetreffende parameter bedraagt minder dagen dan hetgeen nu tussen monstername en analyse heeft gezeten.	De conserverings-termijn is overschreden voor analyse van diverse monsters.	De monsters zijn gekoeld en donker opgeslagen geweest ten tijde van transport en opslag bij zowel het veldwerkwerkbureau als bij het laboratorium. De analyses zijn uitgevoerd nadat alle monsters waren verzameld.	Wegens mogelijke afbraak van de stoffen, wordt de concentratie mogelijk onderschat.	Niet-kritiek, omdat op basis van het vooronderzoek geen verontreinigingen worden verwacht en bij omliggende mastlocaties de waarden in dezelfde orde van grootte zijn vastgesteld.

In geval van BRL-gerelateerde klachten kunt u (de opdrachtgever) zich wenden tot ons (de certificaathouder) en, zo nodig, tot onze certificatie-instelling SGS Intron Certificatie B.V.

Bijlage G – Onafhankelijkheidsverklaring

Verklaring uitgevoerd conform BRL 2000 en in onafhankelijkheid van de opdrachtgever.*			
Opmerking en/of afwijkingen t.o.v BRL2000/P2002	Nee: ☑	Ja, reden:	
Functie:	Naam:	Paraaf:	Datum veldwerk:
Veldwerker (ervaren)	M. La Crois		22-11-21 tm 09-03-22
Veldwerker in opleiding		nvt	
Assistent		nvt	
* Verklaart hiermee tevens de opdracht; materiaal en benodigde apparatuur en hulpmiddelen enz. gecontroleerd te hebben.			

Colofon

VERKENNEND BODEMONDERZOEK OPWAARDERING 380KV ENS-ZWOLLE
MAST 64

KLANT
Opdrachtgever: TenneT

AUTEUR
Andries Faber

PROJECTNUMMER
30073259

ONZE REFERENTIE
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STATUS
Concept

GECONTROLEERD DOOR	VRIJGEGEVEN DOOR
Chris Jansonius Senior Specialist Bodemonderzoek en -sanering	Simon van den Bosse Projectmanager

Over Arcadis

Arcadis is een toonaangevend wereldwijd ontwerp- en consultancybureau voor de natuurlijke en gebouwde omgeving. Wij maken het verschil voor onze klanten en de maatschappij met doeltreffende, duurzame en digitale oplossingen. Met 27.000 mensen in meer dan 70 landen genereerden we in 2020 een omzet van €3,3 miljard. Wij ondersteunen UN-Habitat met kennis en expertise om leefomstandigheden te verbeteren in gebieden getroffen door de gevolgen van de klimaatverandering.

www.arcadis.com

Arcadis Nederland B.V.

Postbus 63
9400 AB Assen
Nederland

T +31 (0)88 4261 261

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