Bijlagenblad ten behoeve van aanvraag omgevingsvergunning gemeente Krimpenerwaard Project: Beter Benutten KIJ-GT380 kV Status: Definitief Datum: 16-07-2021						
Nr.	**Type**	**Omschrijving**	**Auteur**	**Kenmerk**	**Datum**	**Versie**
12	Rapport	Rapportage Mastconstructie HB+0	DNV-GL	21-1090	5-7-2021	Rev.0
13	Rapport	Rapportage Mastconstructie S+0	DNV-GL	21-1102	6-7-2021	Rev.0
14	Rapport	Rapportage Mastconstructie S+18	DNV-GL	21-1105	6-7-2021	Rev.0
15	Rapport	Rapportage Mastconstructie S+6	DNV-GL	21-1088	5-7-2021	Rev.0
16	Rapport	Rapportage Mastconstructie S+95 & S+95 T	DNV-GL	21-1095	6-7-2021	Rev.0
17	Rapport	Rapportage Mastconstructie WA+0	DNV-GL	21-1078	5-7-2021	Rev.0
18	Tekening	Fundatietekeningen rapportage S+0, S+3, S+6 en S+9	DNV-GL	10166262-032-200 10166262-032-201 10166262-032-202 10166262-032-203	15-7-2021	Rev.3

Bijlage 12 Rapportage Mastconstructie HB+0

DNV·GL

“TOETSING EN HERONTWERP MASTEN EN FUNDATIES BB380”

KIJ-GT380 – Rapportage mast HB+0

TenneT TSO B.V.

Meridian doc. nr.: 002.589.40 0916486
Rapport nr.: 21-1090 Rev.0
Datum: 2021-07-05

Projectnaam: “Toetsing en herontwerp masten en fundaties BB380”
Rapport titel: KIJ-GT380 – Rapportage mast HB+0
Klant: TenneT TSO B.V.
Contactpersoon: [redacted]
Datum: 2021-07-05
Project nr.: 10166260
Organisatie unit: TDT
Meridian doc.nr.: 002.589.40 0916486
Rapport nr.: 21-1090 Rev.0

DNV GL - Energy
Energy Advisory
Postbus 9035
6800 ET ARNHEM

[redacted]

Geschreven door: Beoordeeld door: Goedgekeurd door:

[redacted]

DNV GL Distributie:
☐ Onbeperkte distributie (intern en extern)
☐ Onbeperkte distributie binnen de DNV GL Groep
☐ Onbeperkte distributie binnen DNV GL Netherlands B.V.
☒ Geen distributie (vertrouwelijk)

Trefwoorden:

Versie	Datum	Reden voor uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2021-07-05	Eerste uitgave	[redacted]		

DNV GL Netherlands B.V.

Inhoud

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 GL 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

In deze studie wordt voor de lijn Krimpen aan den IJssel - Geertruidenberg de controle van de mastconstructie van masttype HB+0 gerapporteerd.

Inhoudelijk is de Nederlandse versie van de rapportage 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.

1.2 Doelstelling en scope van dit rapport

Het doel van deze studie is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de ACCCZ-Warsaw geleider.

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 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 Krimpen aan den IJssel - Geertruidenberg" [1].

1.3.2 E-studie deel 1

In de rapportage "KIJ-GT380 - E-studie deel 1" [2] is bepaald welke aanpassingen benodigd zijn om de ACCCZ Warsaw geleider toe te passen binnen de verbinding Krimpen aan den IJssel - Geertruidenberg. Uit de E-studie volgt dat de volgende aanpassingen vereist zijn:

- Mast 3 – Toepassing van postisolatoren aan één zijde van de ondertraverse om de bretellen te fixeren. Het binnenste circuit moet worden gefixeerd met twee post isolatoren.
- Mast 81 – Toepassing van postisolatoren aan één zijde van de ondertraverse om de bretellen te fixeren. Het binnenste circuit moet worden gefixeerd met twee post isolatoren.

De aanpassingen die bovenstaand zijn omschreven zijn het meest relevant voor de constructieve analyse in dit rapport. Zie de rapportage "KIJ-GT380 - E-studie deel 1" [2] voor een volledige lijst van de aanpassingen.

1.3.3 Uitgangspunten rapport

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport "Uitgangspuntenrapport 380kV verbinding Krimpen aan den IJssel - Geertruidenberg" [3].

2 EISEN

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

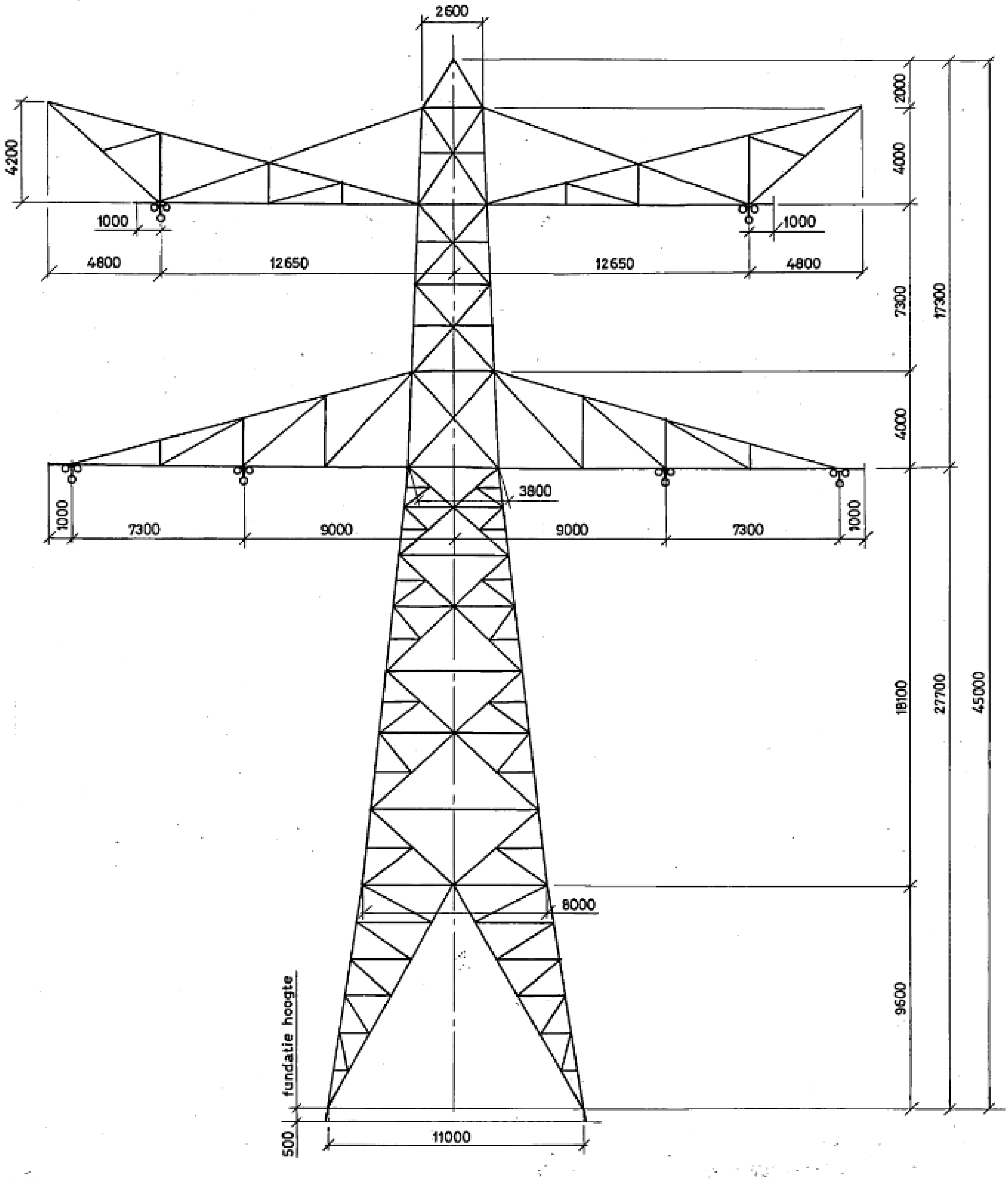
Tabel 1 Relevante eisen

Eis Id	Titel	Eis Tekst	Bewijsvoering
BO Eis: H2.7-6	Omgeving, beperkings factoren	Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid.	Tabel 7
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 1060:1964. 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 1060:1964.	Tabel 7

3 BEREKENINGEN

3.1 Mastbeeld

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



Figuur 1 Mastbeeld

3.2 Mastenlijst

In deze rapportage wordt masttype HB+0 getoetst. Er zijn vier masten van het type HB+0, dit zijn mast 3, 8, 76 en 81. Mast 3 en 8 staan in windgebied II en mast 76 en 81 in windgebied III. De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven. De maatgevende mastnummers zijn aangegeven. Bij zowel de masten in windgebied II als III is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde).

Tabel 2 Mastnummers

Mastnummer	Masttype	Maatgevend mastnummer	Wind span (m)	Weight span (m)	Hoogteverschil
3	HB+0 II	3	347	323	-6.0
8	HB+0 II	3	371	348	-5.0
76	HB+0	81	327	237	-15.2
81	HB+0	81	357	315	-8.6

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 – Mast 3 III – Mast 81
	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:

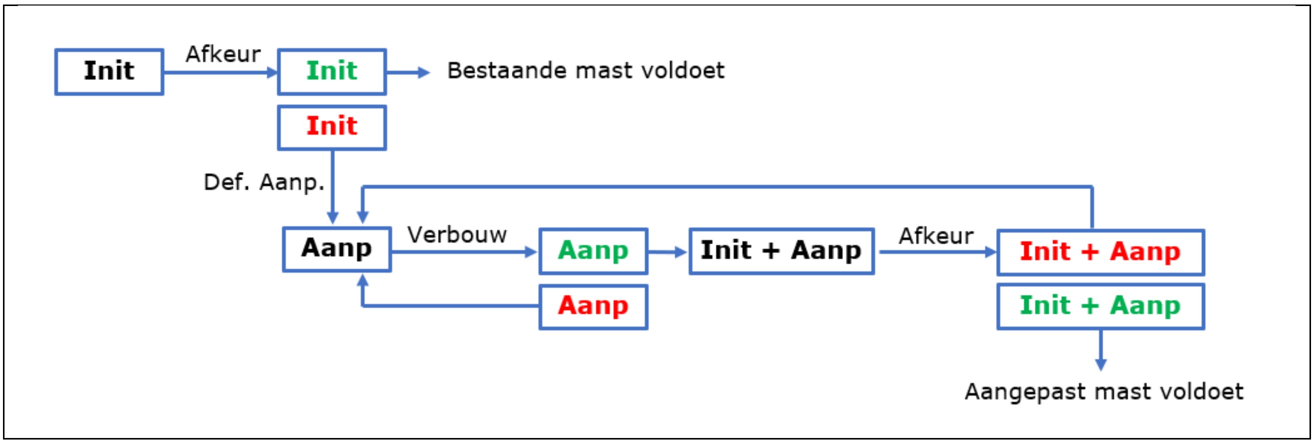
Stap 1: Toets bestaande (Init) mast op Afkeur

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 geleiderbelastingenprogramma van DNV GL. 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

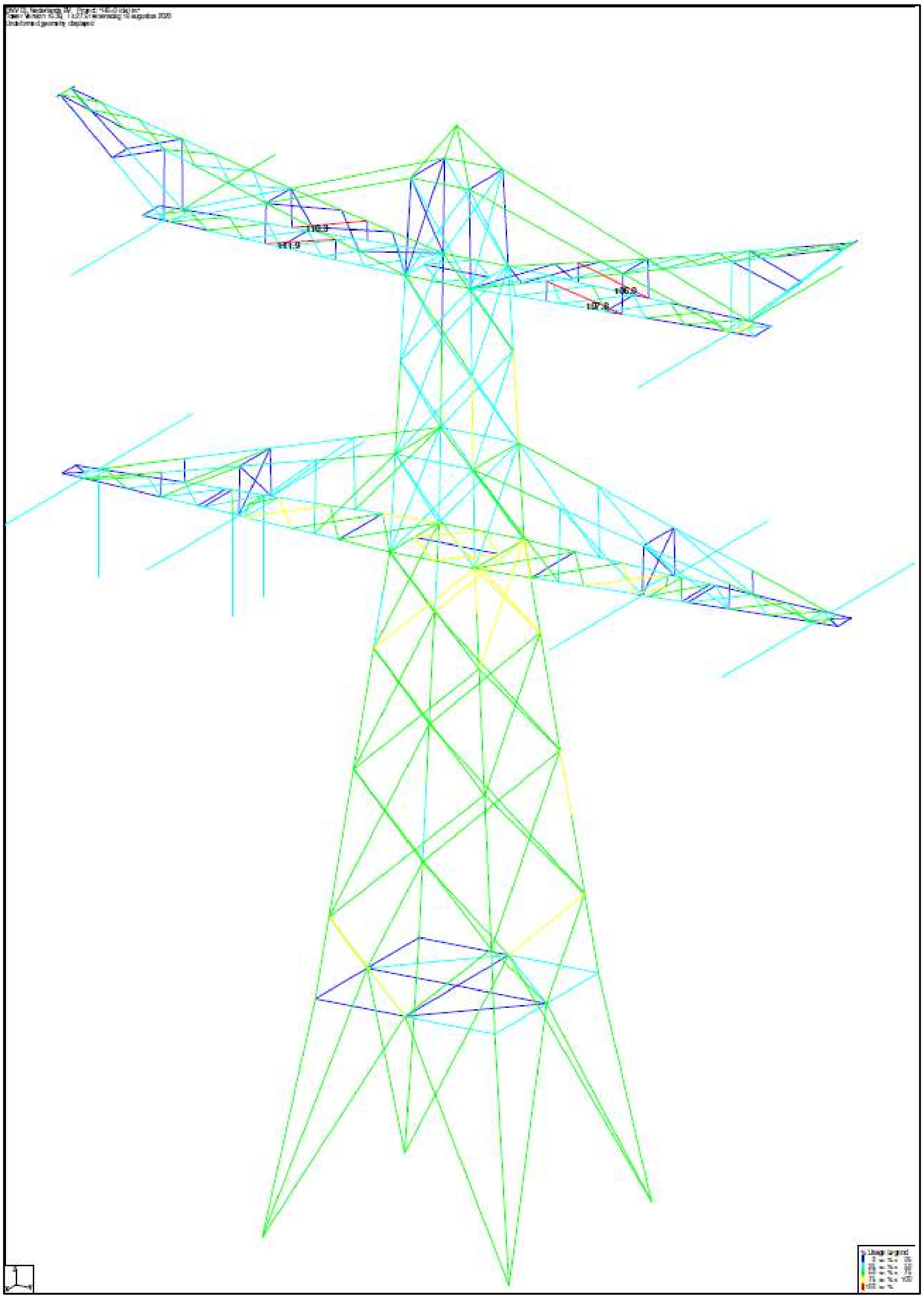
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten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

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

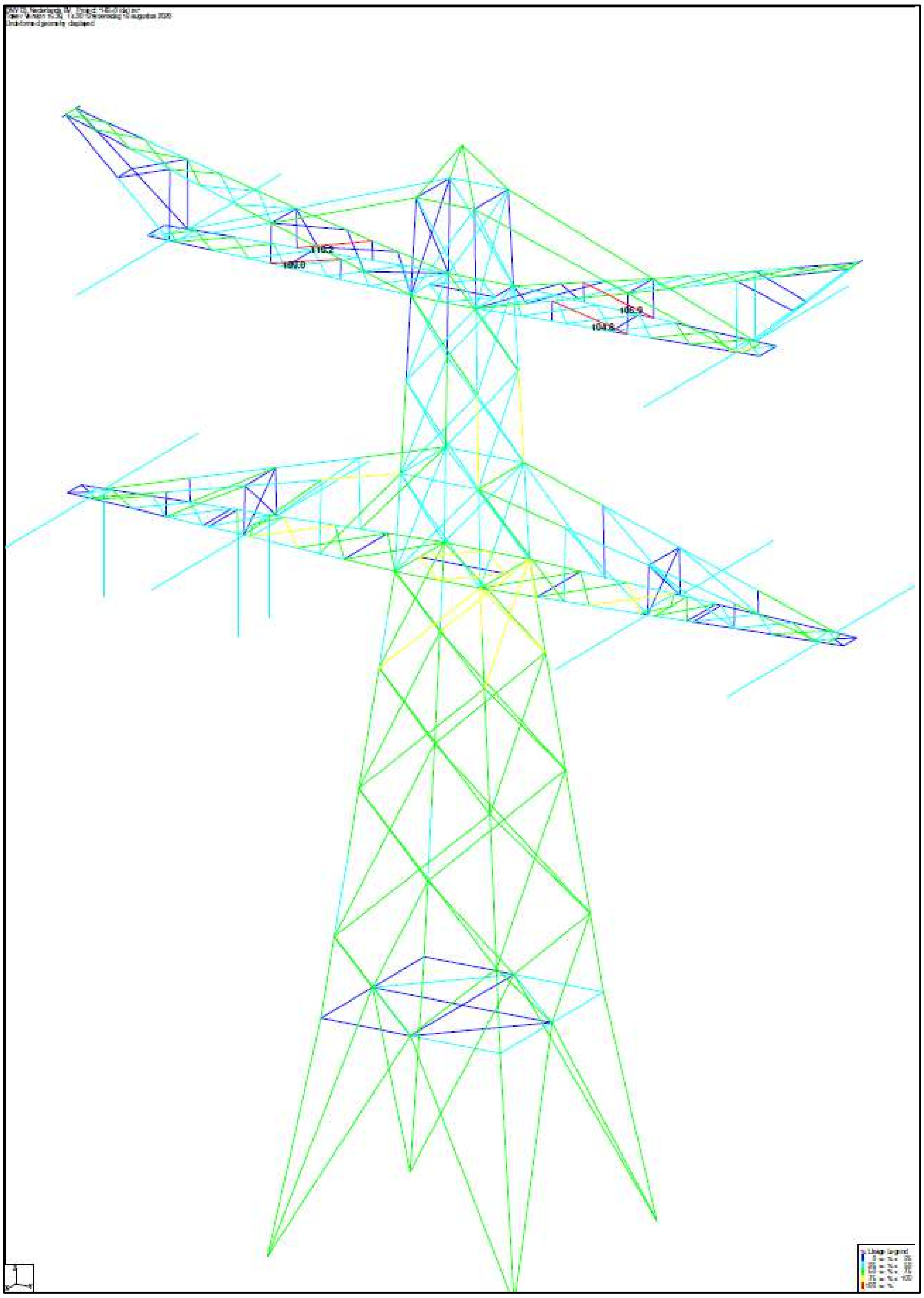
Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

4 TOETSING MAST

Het resultaat van de controle van de mastconstructie type HB+0 met belastingen op afkeurniveau zijn weergegeven in Figuur 3 (mast 3) en Figuur 4 (mast 81).



Figuur 3 Resultaat PLS-TOWER HB+0 (mast 3)



Figuur 4 Resultaat PLS-TOWER HB+0 (mast 81)

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 Figuur 4
Knikverkorters	Voldoen		Appendix C
Ankers en voetplaat	Voldoen		Appendix D

5 AANPASSINGEN

5.1 Inleiding

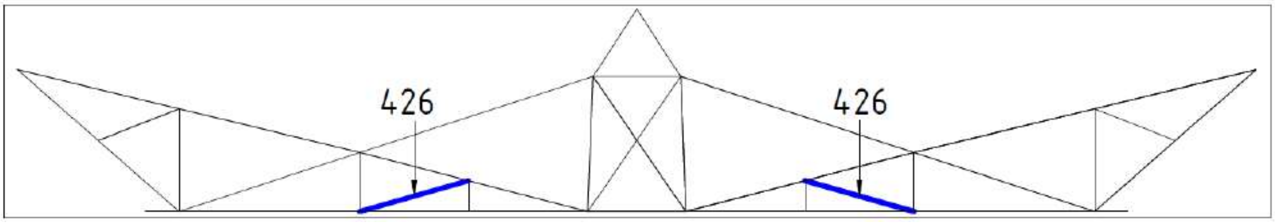
Een versterkingsvoorstel om de masten aan afkeurniveau te laten voldoen is uitgewerkt. Dit voorstel bevat de volgende maatregelen en gelden voor mast 3 en 81:

- Vervanging diagonaal zijvlak boventraverse;
- Toepassing postisolatoren voor fixatie bretelle.

5.2 Aanpassingen

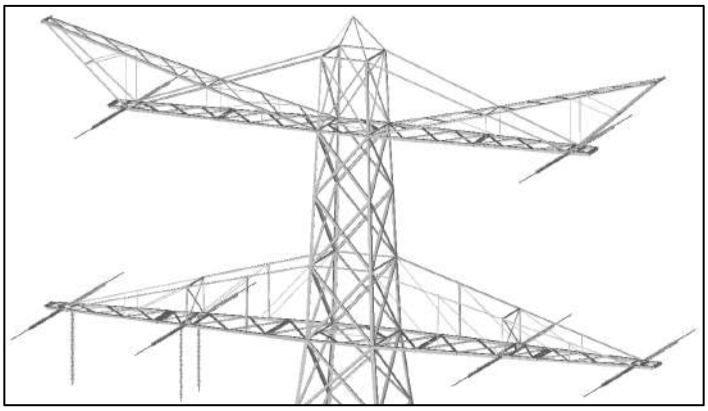
Conform berekening, zie Appendix B, moet er een diagonaal uit het zijvlak van de boventraverse worden vervangen.

In Figuur 5 is de betreffende diagonaal weergegeven. Voor afmetingen profielen en bouten, zie Appendix E.

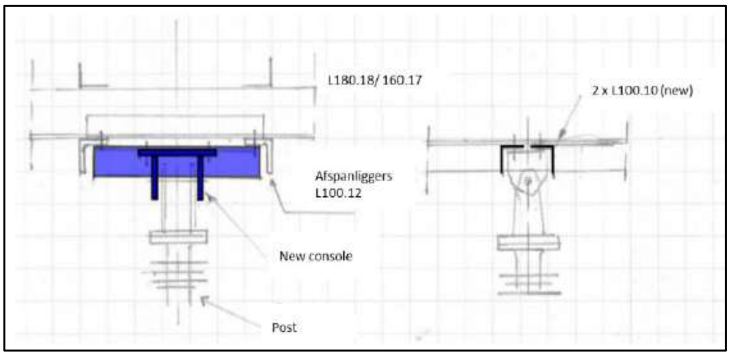


Figuur 5 Vooraanzicht boventraverse ter indicatie te vervangen diagonaal

Vanuit de E-studie is het een vereiste om de bretellen aan de ondertraverse te fixeren. De berekeningen met betrekking tot de verbinding van de postisolatoren aan de ondertraverse staan in Appendix D. Voor het binnenste circuit is het noodzakelijk om twee postisolatoren toe te passen. In Figuur 6 zijn de posities van de postisolatoren weergegeven. Een voorstel voor de verbinding van de postisolatoren aan de ondertraverse is weergegeven in Figuur 7.



Figuur 6 Postisolatoren aan ondertraverse



Figuur 7 Verbinding postisolatoren aan ondertraverse

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen is voor mast 3 gegeven in Tabel 5 en voor mast 81 in Tabel 6. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

Tabel 5 Gewichten HB+0 (3) van aangepaste/toegevoegde profielen

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
426	L50.5	S235	1M16-5.6t	L50.6	S355	1M16-8.8t	Profiel uitgewisseld	4	3.36	60.23
								4	3.36	60.23

Tabel 6 Gewichten HB+0 (81) van aangepaste/toegevoegde profielen

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
426	L50.5	S235	1M16-5.6t	L50.6	S355	1M16-8.8t	Profiel uitgewisseld	4	3.36	60.23
								4	3.36	60.23

5.3 Eisen verificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 7.

Tabel 7 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 1060:1964?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.589.40 0817486 - 20-0473 - Verificatie & validatieplan 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

[2] „002.589.40 0808624 - 20-0472 - E-studie deel 1 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

[3] „002.589.40 0808629 - 20-0345 - Uitgangspuntenrapport 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

APPENDIX A CONDUCTOR LOADS

Content

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

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	II
Wind speed	27 m/s
Terrain categorie	II
Reduction factor C_{dir}	1,00
Ice region	B
Tower type	Hoekmast
Tower height	45 m
Max. Span	393 m
Line angle	142°
Catenary	1400 m
Wind span	347 m
EDS Weight span	322 m
Min. Weight span	285 m
Max. Weight span	325 m

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype HB+0 II

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

Document name:

KIJ-GT_HB+0 II_3_Report.pdf

Project number:

Project client number:

0.0

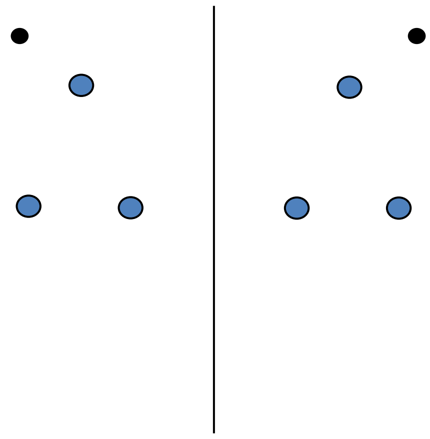
Project: KIJ-GT
Tower: HB+0 II
Number: 3

Auteur: TBR
Versie: v11.3

Conductor loads

General

Description	HB+0 II
Tower type	Hoekmast
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	II
Wind speed	27,0 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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Afspanketting	2,00	4,83	1,00
Circuit 2	Afspanketting	2,00	4,83	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,30	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,30	0,05

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	21	380ct1f1	22,9 m	27,7 m	16,3 m
Circuit 1	20	380ct1f2	22,9 m	27,7 m	9,0 m
Circuit 1	22	380ct1f3	34,2 m	39,0 m	12,7 m
Circuit 2	10	380ct2f1	22,9 m	27,7 m	-16,3 m
Circuit 2	11	380ct2f2	22,9 m	27,7 m	-9,0 m
Circuit 2	12	380ct2f3	34,2 m	39,0 m	-12,7 m
Bliksemdraad 1	1	bl1	42,9 m	43,2 m	-17,5 m
Bliksemdraad 2	3	bl2	42,9 m	43,2 m	17,5 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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

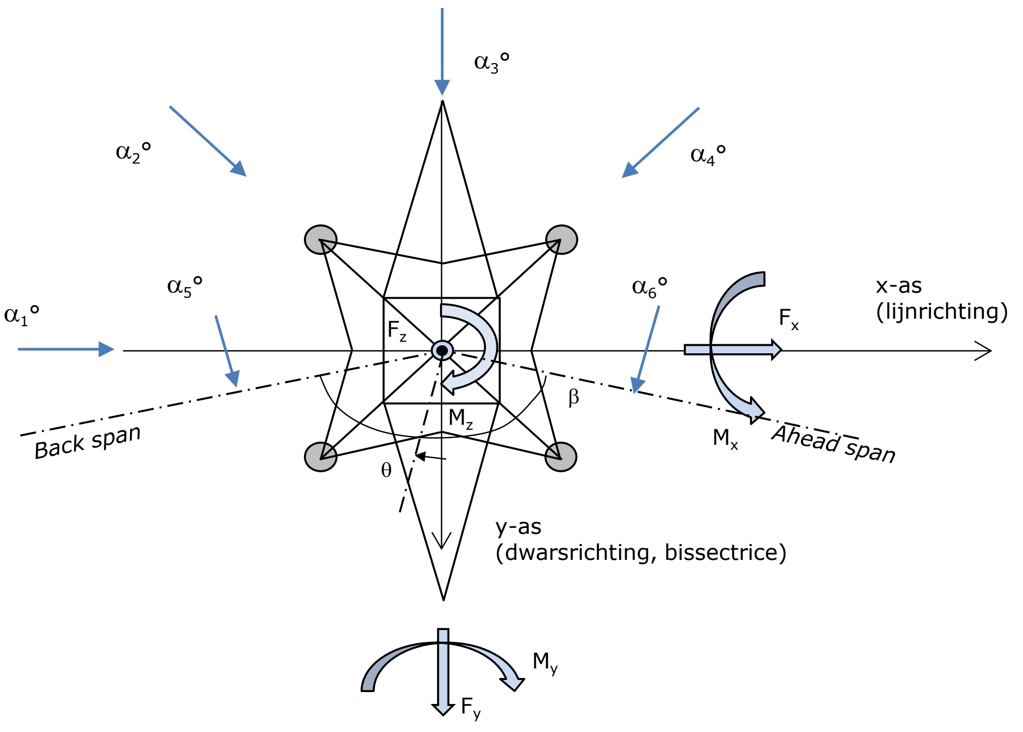
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	21	380ct1f1	0,3	6,4 m	0,0	0,0 m
Circuit 1	20	380ct1f2	0,3	6,4 m	0,0	0,0 m
Circuit 1	22	380ct1f3	0,3	6,4 m	0,0	0,0 m
Circuit 2	10	380ct2f1	0,3	6,4 m	0,0	0,0 m
Circuit 2	11	380ct2f2	0,3	6,4 m	0,0	0,0 m
Circuit 2	12	380ct2f3	0,3	6,4 m	0,0	0,0 m
Bliksemdraad 1	1	bl1	0,3	6,1 m	0,0	0,0 m
Bliksemdraad 2	3	bl2	0,3	6,1 m	0,0	0,0 m

Line and tower data

		Back	Ahead
		300,0	393,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		300,0	354,8 m
Line angle	β	142 °	
Tower orientation with respect to bis	θ	0 °	
Section length		300	1742 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 °	
	α_6	109 °	

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: KIJ-GT
Tower: HB+0 II
Number: 3

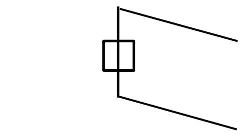
Absence of conductors

		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

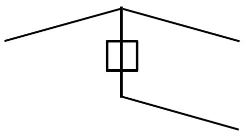
Load situations SPLS

Considered situations SPLS: 1 up to 6, All possible situations

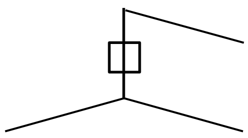
Principle of load situations:



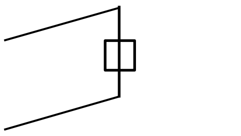
1. Ba All cts



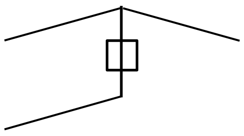
2. Ba ct1



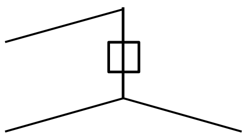
3. Ba ct2



4. Ah All cts



5. Ah ct1

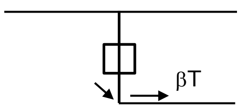


6. Ah ct2

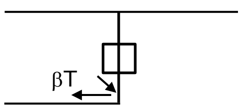
Load situation 5a. Conductor failure

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

Principle of load situations:



1. Ba



2. Ah

Project: KIJ-GT
Tower: HB+0 II
Number: 3

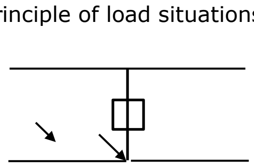
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine 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

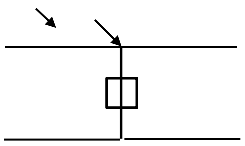
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

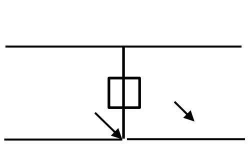
Principle of load situations:



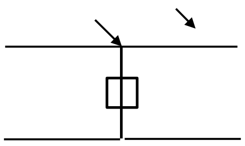
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

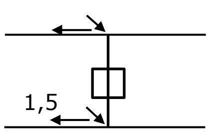
Load situations 8. Galloping as a static load

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

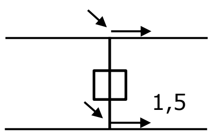
Considered situations galloping 8: None (existing structure)

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: KIJ-GT
Tower: HB+0 II
Number: 3

Tower structure

Properties

Tower type	Hoekmast		
Tower designation	HB+0 II		
Base plate w.r.t. ground level	0,5 m		
Tower height w.r.t. base plate	45,0 m		
Tower self weight	390,0 kN		
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	11,00	11,00	m
Inclination of main leg	0,156	0,156	-
Horizontal force factor	1,1	1,1	-

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,13	0,24	2,78
Topstuk	45,00	2,60		2,00		2,60	0,25	0,10	3,43
Ondertraverse	27,70	14,70		4,00		29,40	4,95	0,17	3,07
Boventraverse	39,00	16,00		4,20		33,60	6,63	0,20	2,94

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,13	0,24	2,78
Topstuk	45,00	2,60		2,00		2,60	0,25	0,10	3,43
Ondertraverse	27,70	14,70		4,00		29,40	4,95	0,17	3,07
Boventraverse	39,00	16,00		4,20		33,60	6,63	0,20	2,94

Note: Surface transverse direction is reduced in calculation.

Project: KIJ-GT
Tower: HB+0 II
Number: 3

Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
Bovenstuk 1			
Bovenstuk 2			

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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 1	0,85	31,9	27,1	0,0	-27,1	4,8	153,2	130,0	0,0	-130,0
Middenstuk 1	0,96	31,5	26,8	0,0	-26,8	14,3	449,3	381,2	0,0	-381,2
Middenstuk 2	1,12	30,5	25,9	0,0	-25,9	23,3	710,8	603,2	0,0	-603,2
Bovenstuk 1	1,22	22,2	18,8	0,0	-18,8	31,6	700,4	594,3	0,0	-594,3
Bovenstuk 2	1,29	18,4	15,6	0,0	-15,6	39,3	723,3	613,7	0,0	-613,7
Topstuk	1,33	1,1	1,0	0,0	-1,0	44,0	50,2	42,6	0,0	-42,6
Ondertraverse	1,19	36,2	21,5	0,0	-21,5	29,0	1050,3	623,8	0,0	-623,8
Boventraverse	1,30	50,8	30,2	0,0	-30,2	40,4	2054,2	1220,1	0,0	-1220,1
Totaal		222,7	166,8	0,0	-166,8		5891,7	4209,0	0,0	-4209,0

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 1	0,85	0,0	27,1	31,9	27,1	4,8	0,0	130,0	153,2	130,0
Middenstuk 1	0,96	0,0	26,8	31,5	26,8	14,3	0,0	381,2	449,3	381,2
Middenstuk 2	1,12	0,0	25,9	30,5	25,9	23,3	0,0	603,2	710,8	603,2
Bovenstuk 1	1,22	0,0	18,8	22,2	18,8	31,6	0,0	594,3	700,4	594,3
Bovenstuk 2	1,29	0,0	15,6	18,4	15,6	39,3	0,0	613,7	723,3	613,7
Topstuk	1,33	0,0	1,0	1,1	1,0	44,0	0,0	42,6	50,2	42,6
Ondertraverse	1,19	0,0	21,5	14,5	21,5	29,0	0,0	623,8	420,1	623,8
Boventraverse	1,30	0,0	30,2	20,3	30,2	40,4	0,0	1220,1	821,7	1220,1
Total		0,0	166,8	170,5	166,8		0,0	4209,0	4029,1	4209,0

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	390	0	0	0
Windrichting 0°	223	0	0	0	5892	0
Windrichting 45°	167	167	0	4209	4209	0
Windrichting 90°	0	171	0	4029	0	0
Windrichting 135°	-167	167	0	4209	-4209	0

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,8	1,0	23,37	1,12	1,2	1,34
380ct1f2	2,00	1	2	4,8	1,0	23,37	1,12	1,2	1,34
380ct1f3	2,00	1	2	4,8	1,0	34,67	1,25	1,2	1,50
380ct2f1	2,00	1	2	4,8	1,0	23,37	1,12	1,2	1,34
380ct2f2	2,00	1	2	4,8	1,0	23,37	1,12	1,2	1,34
380ct2f3	2,00	1	2	4,8	1,0	34,67	1,25	1,2	1,50
bl1	0,10	0,5	0,05	0,3	0,1	43,40	1,33	1,2	0,08
bl2	0,10	0,5	0,05	0,3	0,1	43,40	1,33	1,2	0,08

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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	18,2	1,04	0,55	0,62	1,09	28,25	52,2	59,0	46,9	95,7	108,2
380ct1f2	18,2	1,04	0,55	0,62	1,09	28,25	52,2	59,0	46,9	95,7	108,2
380ct1f3	29,5	1,19	0,59	0,66	1,04	28,25	62,1	70,0	46,9	118,4	133,6
380ct2f1	18,2	1,04	0,55	0,62	1,09	28,25	52,2	59,0	46,9	95,7	108,2
380ct2f2	18,2	1,04	0,55	0,62	1,09	28,25	52,2	59,0	46,9	95,7	108,2
380ct2f3	29,5	1,19	0,59	0,66	1,04	28,25	62,1	70,0	46,9	118,4	133,6
bl1	38,5	1,29	0,61	0,69	1,16	22,24	20,1	22,7	41,5	39,0	44,0
bl2	38,5	1,29	0,61	0,69	1,16	22,13	20,1	22,6	41,4	38,9	43,9

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	17,4	1,02	0,54	0,49	1,09	28,25	51,3	46,1	46,9	93,8	84,3
380ct1f2	17,4	1,02	0,54	0,49	1,09	28,25	51,3	46,1	46,9	93,8	84,3
380ct1f3	28,7	1,19	0,58	0,52	1,05	28,25	61,5	55,2	46,9	117,1	105,1
380ct2f1	17,4	1,02	0,54	0,49	1,09	28,25	51,3	46,1	46,9	93,8	84,3
380ct2f2	17,4	1,02	0,54	0,49	1,09	28,25	51,3	46,1	46,9	93,8	84,3
380ct2f3	28,7	1,19	0,58	0,52	1,05	28,25	61,5	55,2	46,9	117,1	105,1
bl1	37,8	1,28	0,61	0,54	1,16	22,24	20,0	17,9	41,5	38,7	34,7
bl2	37,9	1,28	0,61	0,54	1,16	22,13	19,9	17,9	41,4	38,7	34,7

DNV·GL

Project: KIJ-GT
Tower: HB+0 II
Number: 3

Auteur: TBR
Versie: v11.3

Conductor loads

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	5529

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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	-31,4	29,9	14,1	13,9	5,2	5,5
bl2	-31,5	30,1	14,1	13,9	5,2	5,5
380ct1f1	-105,0	102,1	43,9	42,8	14,0	15,3
380ct1f2	-105,0	102,1	43,9	42,8	14,0	15,3
380ct1f3	-108,7	104,6	48,9	47,8	14,0	15,3
380ct2f1	-105,0	102,1	43,9	42,8	14,0	15,3
380ct2f2	-105,0	102,1	43,9	42,8	14,0	15,3
380ct2f3	-108,7	104,6	48,9	47,8	14,0	15,3
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
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	303,4	317,8	321,9
bl2	303,1	316,7	321,7
380ct1f1	314,6	319,4	322,4
380ct1f2	314,6	319,4	322,4
380ct1f3	311,9	319,2	322,4
380ct2f1	314,6	319,4	322,4
380ct2f2	314,6	319,4	322,4
380ct2f3	311,9	319,2	322,4
Post 1			
Post 2			
Post 3			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	321,6	323,1
bl2	321,4	322,7
380ct1f1	322,4	322,8
380ct1f2	322,4	322,8
380ct1f3	322,3	322,8
380ct2f1	322,4	322,8
380ct2f2	322,4	322,8
380ct2f3	322,3	322,8
Post 1		
Post 2		
Post 3		

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	324,8 m	0,937 -
Min. weight span	293,5 m	0,847 -

Project: KIJ-GT
Tower: HB+0 II
Number: 3

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	31,4	25,9	5,5	-33,5	32,0
bl2	31,5	25,9	5,5	-33,5	32,1
380ct1f1	91,3	81,8	15,3	-112,8	110,3
380ct1f2	91,3	81,8	15,3	-112,8	110,3
380ct1f3	96,2	89,8	15,3	-117,1	113,4
380ct2f1	91,3	81,8	15,3	-112,8	110,3
380ct2f2	91,3	81,8	15,3	-112,8	110,3
380ct2f3	96,2	89,8	15,3	-117,1	113,4
Post 1	2,4	2,4	3,5	0,0	
Post 2	2,4	2,4	3,5	0,0	
Post 3	2,4	2,4	3,5	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	14,2	4,9	1,8	-15,0	15,0
bl2	14,2	4,9	1,8	-15,0	15,0
380ct1f1	60,7	20,9	10,0	-64,2	64,2
380ct1f2	60,7	20,9	10,0	-64,2	64,2
380ct1f3	60,7	20,9	10,0	-64,2	64,2
380ct2f1	60,7	20,9	10,0	-64,2	64,2
380ct2f2	60,7	20,9	10,0	-64,2	64,2
380ct2f3	60,7	20,9	10,0	-64,2	64,2
Post 1	0,0	0,0	3,0	0,0	
Post 2	0,0	0,0	3,0	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	
	Post 3	0,0	

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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		-67	562	132	18296	-2221	0
ULS 1a_0,9_0		12	283	133	9052	349	-82
ULS 1a_0,9_0,9_90		-74	542	112	17684	-2444	0
ULS 3_0		9	440	194	14150	275	-26
SLS 7		0	270	128	8629	0	0

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

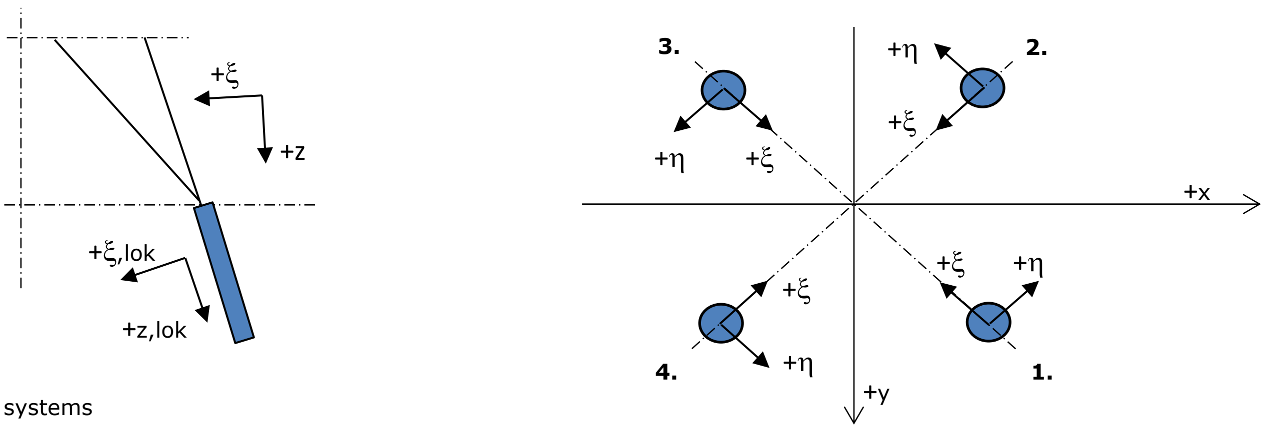
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-67	754	541	22825	-2221	0
ULS 1a_0,9_0,9_90	-74	734	463	22213	-2444	0
SLS 7	0	270	518	8629	0	0

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	-67	754	481	**22841**	-2221	0
SPLS 3_71 Ah All Cts	-585	302	500	9184	**-19278**	-14
SPLS 3_71 Ba Ct2	250	386	536	12203	7864	**-3053**
SPLS 3_0,9_71 Ah All Cts	-585	302	440	**9200**	**-19278**	-14

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_109 Ba All Cts	229	236	**1352**	-5	-328	-30	1384
2	SPLS 1a_0 Ba All Cts	137	-128	**753**	-7	-187	-21	771
3	SPLS 3_135 Ah All Cts	-108	-102	**615**	4	-148	-12	630
4	SPLS 3_71 Ah All Cts	-240	247	**1419**	5	-344	-31	1453

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	-67	-62	**-379**	-3	91	7	-388
2	SPLS 3_0,9_71 Ah All Cts	-199	208	**-1184**	-6	287	26	-1213
3	SPLS 3_0,9_109 Ba All Cts	187	195	**-1113**	6	270	24	-1140
4	SPLS 1a_0,9_0 Ba All Cts	94	-90	**-518**	3	130	16	-530

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_71 Ba Ct1	243	109	1005	**94**	-249	-27	1029
2	SPLS 3_0,9_71 Ba Ct1	-77	-54	-53	**93**	16	4	-55
3	SPLS 3_71 Ba Ct1	61	204	-751	**101**	187	21	-769
4	SPLS 3_71 Ba Ct1	18	127	306	**102**	-78	-10	313

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 3_71 Ba Ct2	111	250	1046	**-98**	-256	-25	1071
2	SPLS 3_71 Ba Ct2	60	82	-63	**-100**	16	2	-65
3	SPLS 3_0,9_71 Ba Ct2	207	68	-794	**-98**	194	19	-813
4	SPLS 3_0,9_71 Ba Ct2	-123	-14	317	**-97**	-77	-7	325

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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	-67	-62	**-379**	**-3**	91	7	-388
2	SPLS 1a_0,9_71 Ah Ct1	-109	228	**-964**	**-84**	238	25	-987
3	SPLS 3_0,9_109 Ba All Cts	187	195	**-1113**	**6**	270	24	-1140
4	SPLS 1a_0,9_0 Ba All Cts	94	-90	**-518**	**3**	130	16	-530

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	90	90	522	0	-127	-12	534
2	SLS 7	-45	45	-263	0	64	6	-269
3	SLS 7	45	45	-263	0	64	6	-269
4	SLS 7	-90	90	522	0	-127	-12	534

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 Ah All Cts	-240	247	**1419**	5	-344	-31	1453
Max. tension	SPLS 3_0,9_71 Ah All Cts	-199	208	**-1184**	-6	287	26	-1213
Max. pos. torsie	SPLS 3_71 Ba Ct1	18	127	306	**102**	-78	-10	313
Max. neg. torsie	SPLS 3_71 Ba Ct2	60	82	-63	**-100**	16	2	-65
Comb. tension+torsie	SPLS 1a_0,9_71 Ah Ct1	-109	228	**-964**	**-84**	238	25	-987

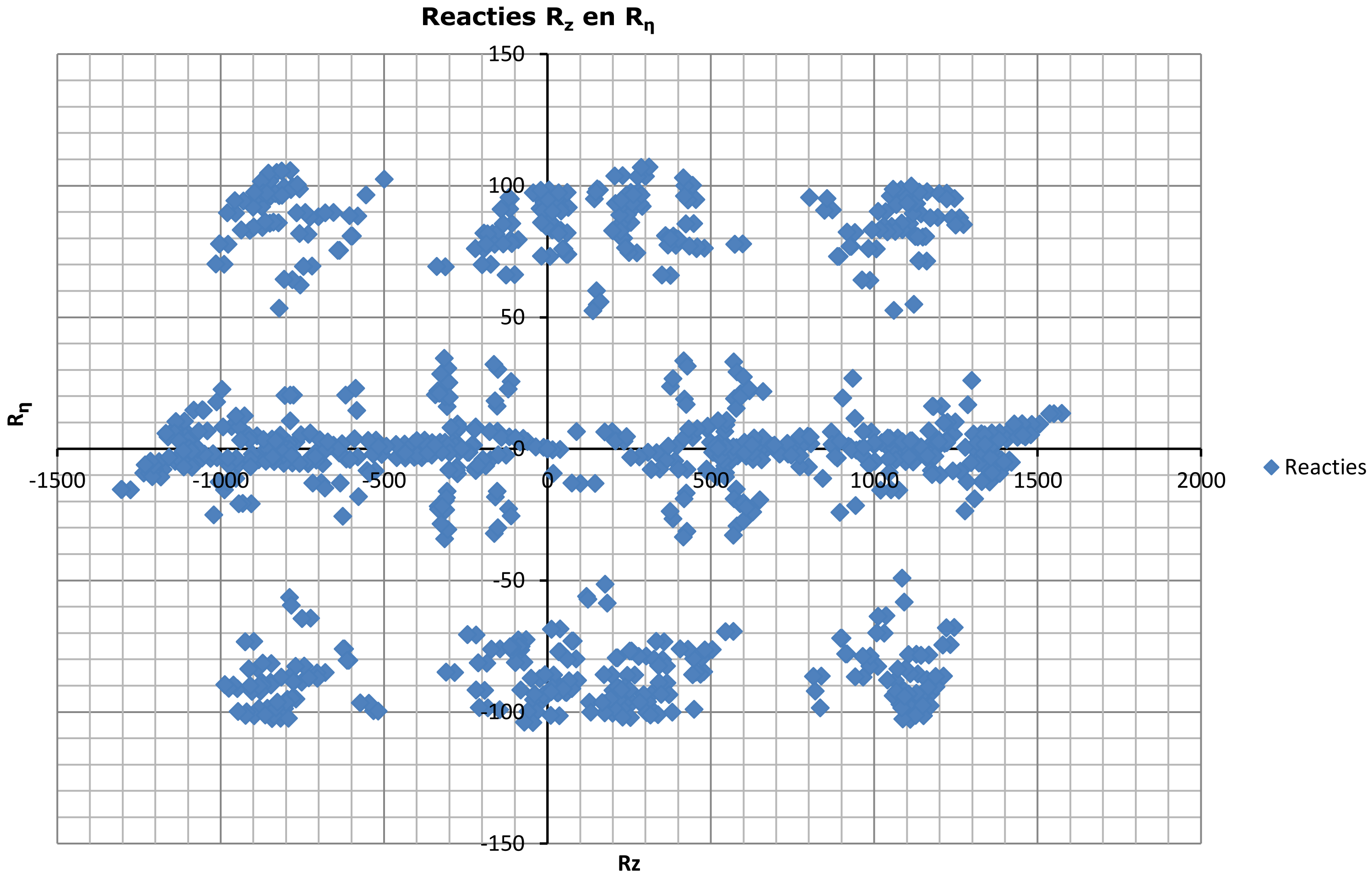
Maximum tension load - SLS

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	90	90	**522**	0	-127	-12	534
2	SLS 1a_90	-148	157	**-866**	-6	216	25	-887
3	SLS 1a_90	120	128	**-695**	6	175	22	-712
4	SLS 1a_0	-37	43	**257**	4	-56	1	264

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	164	172	**953**	-6	-238	-27	976
2	SLS 1a_0	11	1	**2**	-9	-7	-7	2
3	SLS 7	45	45	**-263**	0	64	6	-269
4	SLS 1a_90	-193	202	**1124**	6	-279	-31	1151

Project: KIJ-GT
Tower: HB+0 II
Number: 3



Project: KIJ-GT
Tower: HB+0 II
Number: 3

Auteur: TBR
Versie: v11.3

Conductor loads

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	54
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5529

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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	-35,5	32,3	16,7	16,6	5,6	6,0
bl2	-35,5	32,6	16,7	16,6	5,6	6,0
380ct1f1	-121,0	118,3	51,6	50,5	15,7	18,0
380ct1f2	-121,0	118,3	51,6	50,5	15,7	18,0
380ct1f3	-125,5	121,4	57,9	56,8	15,7	18,0
380ct2f1	-121,0	118,3	51,6	50,5	15,7	18,0
380ct2f2	-121,0	118,3	51,6	50,5	15,7	18,0
380ct2f3	-125,5	121,4	57,9	56,8	15,7	18,0
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
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	301,9	317,7	321,9
bl2	301,5	316,6	321,7
380ct1f1	313,8	319,3	322,4
380ct1f2	313,8	319,3	322,4
380ct1f3	310,9	319,2	322,4
380ct2f1	313,8	319,3	322,4
380ct2f2	313,8	319,3	322,4
380ct2f3	310,9	319,2	322,4
Post 1			
Post 2			
Post 3			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	321,8	324,0
bl2	321,6	323,6
380ct1f1	322,6	323,4
380ct1f2	322,6	323,4
380ct1f3	322,5	323,4
380ct2f1	322,6	323,4
380ct2f2	322,6	323,4
380ct2f3	322,5	323,4
Post 1		
Post 2		
Post 3		

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	325,1 m	0,938 -
Min. weight span	284,8 m	0,822 -

Project: KIJ-GT
Tower: HB+0 II
Number: 3

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	32,2	30,7	6,0	-39,0	35,3
bl2	32,4	30,7	6,0	-39,0	35,6
380ct1f1	95,9	95,5	18,0	-130,2	128,0
380ct1f2	95,9	95,5	18,0	-130,2	128,0
380ct1f3	99,9	106,0	18,0	-135,5	131,9
380ct2f1	95,9	95,5	18,0	-130,2	128,0
380ct2f2	95,9	95,5	18,0	-130,2	128,0
380ct2f3	99,9	106,0	18,0	-135,5	131,9
Post 1	3,0	3,0	3,9	0,0	
Post 2	3,0	3,0	3,9	0,0	
Post 3	3,0	3,0	3,9	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	14,2	4,9	1,8	-15,0	15,0
bl2	14,2	4,9	1,8	-15,0	15,0
380ct1f1	60,7	20,9	10,0	-64,2	64,2
380ct1f2	60,7	20,9	10,0	-64,2	64,2
380ct1f3	60,7	20,9	10,0	-64,2	64,2
380ct2f1	60,7	20,9	10,0	-64,2	64,2
380ct2f2	60,7	20,9	10,0	-64,2	64,2
380ct2f3	60,7	20,9	10,0	-64,2	64,2
Post 1	0,0	0,0	3,0	0,0	
Post 2	0,0	0,0	3,0	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	
	Post 3	0,0	

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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		-81	662	144	21563	-2667	0
ULS 1a_0,9_0		16	307	145	9825	470	-102
ULS 1a_0,9_0,9_90		-92	633	111	20688	-3026	0
ULS 3_0		16	507	227	16296	517	-32
SLS 7		0	270	128	8629	0	0

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

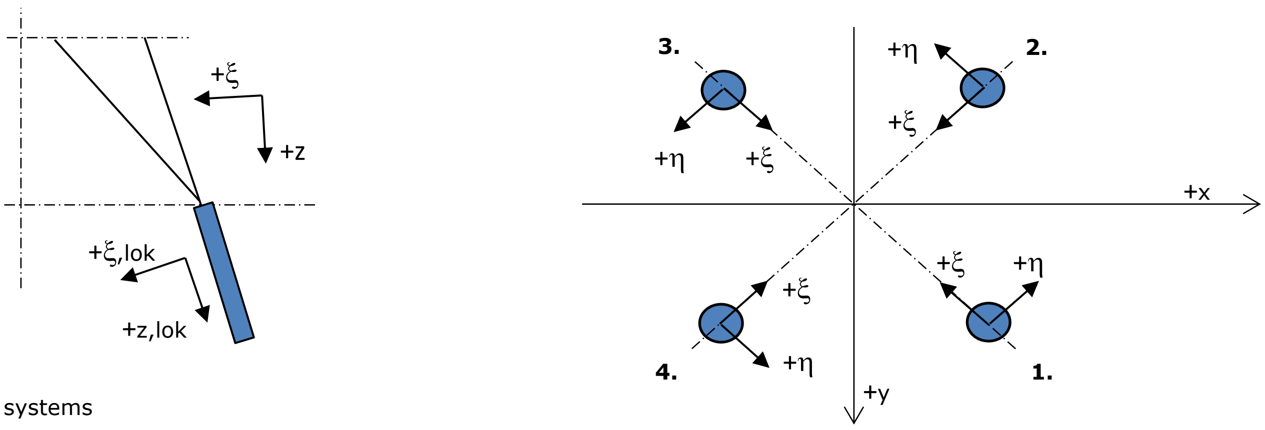
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-81	901	592	27203	-2667	0
ULS 1a_0,9_0,9_90	-92	872	462	26328	-3026	0
SLS 7	0	270	518	8629	0	0

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	-81	901	492	**27229**	-2667	0
SPLS 3_71 Ah All Cts	-610	311	546	9448	**-20074**	-14
SPLS 3_71 Ba Ct2	269	402	586	12706	8493	**-3191**
ULS 1a_0,9_71	-126	876	494	**26377**	**-4997**	-34

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_109 Ba All Cts	240	248	**1420**	-5	-345	-31	1454
2	SPLS 1a_0 Ba All Cts	145	-135	**798**	-7	-198	-22	817
3	SPLS 3_135 Ah All Cts	-115	-109	**658**	4	-159	-13	674
4	ULS 1a_71	-264	283	**1573**	13	-386	-39	1611

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	-72	-67	**-409**	-3	98	8	-419
2	ULS 1a_0,9_0,9_71	-216	238	**-1305**	-15	321	33	-1337
3	SPLS 3_0,9_109 Ba All Cts	196	205	**-1168**	6	284	26	-1196
4	SPLS 1a_0,9_0 Ba All Cts	100	-95	**-549**	3	138	16	-562

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 Ct2 Ba Ct2	97	-42	152	**99**	-39	-5	156
2	SPLS 3_0,9_109 Ah Ct2	-224	86	-897	**97**	219	21	-919
3	SPLS 3_71 Ba Ct1	64	214	-788	**106**	197	22	-807
4	SPLS 3_71 Ba Ct1	20	132	310	**107**	-79	-10	318

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 3_71 Ba Ct2	119	265	1110	**-103**	-271	-26	1137
2	SPLS 3_71 Ba Ct2	66	81	-45	**-104**	11	1	-46
3	SPLS 3_0,9_71 Ba Ct2	218	73	-843	**-103**	206	20	-864
4	SPLS 3_0,9_71 Ba Ct2	-126	-18	314	**-101**	-76	-7	322

Project: KIJ-GT
Tower: HB+0 II
Number: 3

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	-72	-67	**-409**	**-3**	98	8	-419
2	ULS 1a_0,9_0,9_71	-216	238	**-1305**	**-15**	321	33	-1337
3	SPLS 3_0,9_109 Ba All Cts	196	205	**-1168**	**6**	284	26	-1196
4	SPLS 1a_0,9_0 Ba All Cts	100	-95	**-549**	**3**	138	16	-562

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	90	90	522	0	-127	-12	534
2	SLS 7	-45	45	-263	0	64	6	-269
3	SLS 7	45	45	-263	0	64	6	-269
4	SLS 7	-90	90	522	0	-127	-12	534

Envelope of load combinations for all of the legs

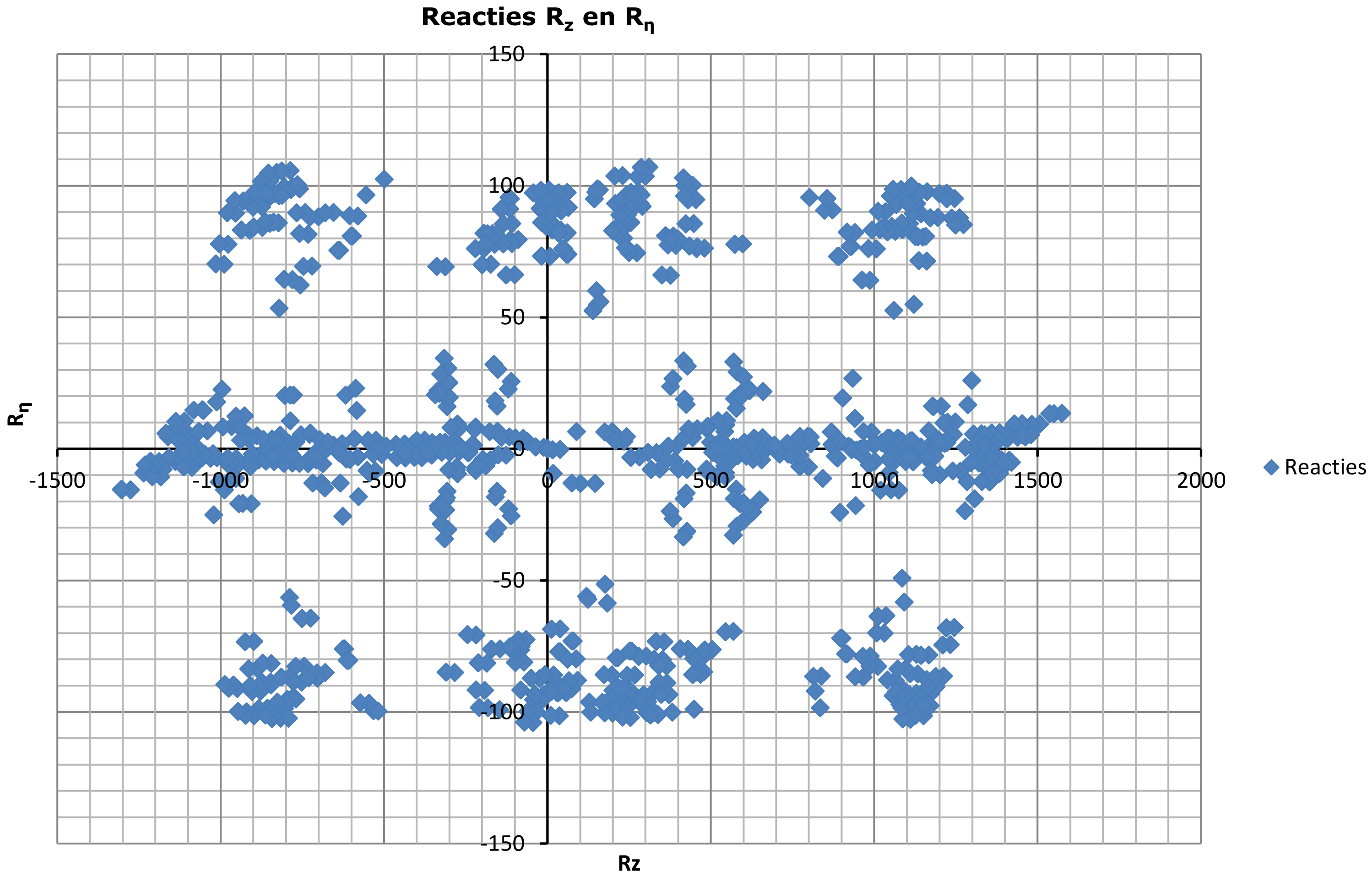
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_71	-264	283	**1573**	13	-386	-39	1611
Max. tension	ULS 1a_0,9_0,9_71	-216	238	**-1305**	-15	321	33	-1337
Max. pos. torsie	SPLS 3_71 Ba Ct1	20	132	310	**107**	-79	-10	318
Max. neg. torsie	SPLS 3_71 Ba Ct2	66	81	-45	**-104**	11	1	-46
Comb. tension+torsie	ULS 1a_0,9_0,9_71	-216	238	**-1305**	**-15**	321	33	-1337

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	90	90	**522**	0	-127	-12	534
2	SLS 1a_90	-156	165	**-909**	-7	227	26	-931
3	SLS 1a_90	125	134	**-726**	6	183	23	-744
4	SLS 1a_0	-33	40	**242**	5	-52	2	248

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	170	178	**984**	-6	-246	-29	1008
2	SLS 1a_0	14	-1	**17**	-9	-11	-7	18
3	SLS 7	45	45	**-263**	0	64	6	-269
4	SLS 1a_90	-200	210	**1167**	7	-290	-32	1195


Reacties R_z en R_η
R_η
Rz
Reacties
150
100
50
0
-50
-100
-150
-1500
-1000
-500
0
500
1000
1500
2000

Content

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 C_{dir}	1,00
Ice region	B
Tower type	Hoekmast
Tower height	45 m
Max. Span	395 m
Line angle	143°
Catenary	1400 m
Wind span	357 m
EDS Weight span	314 m
Min. Weight span	255 m
Max. Weight span	319 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype HB+0

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

Document name:

KIJ-GT_HB+0_81_Report.pdf

Project number:

Project client number:

0.0

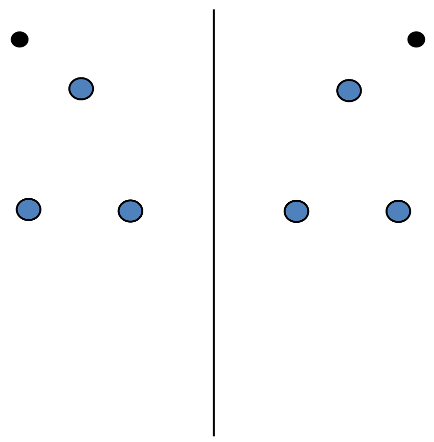
Project: KIJ-GT
Tower: HB+0
Number: 81

Conductor loads

Auteur: TBR
Versie: v11.3

General

Description	HB+0
Tower type	Hoekmast
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	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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Afspanketting	2,00	4,83	1,00
Circuit 2	Afspanketting	2,00	4,83	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,30	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,30	0,05

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	21	380ct1f1	22,9 m	27,7 m	16,3 m
Circuit 1	20	380ct1f2	22,9 m	27,7 m	9,0 m
Circuit 1	22	380ct1f3	34,2 m	39,0 m	12,7 m
Circuit 2	10	380ct2f1	22,9 m	27,7 m	-16,3 m
Circuit 2	11	380ct2f2	22,9 m	27,7 m	-9,0 m
Circuit 2	12	380ct2f3	34,2 m	39,0 m	-12,7 m
Bliksemdraad 1	1	bl1	42,9 m	43,2 m	-17,5 m
Bliksemdraad 2	3	bl2	42,9 m	43,2 m	17,5 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

Project: KIJ-GT
Tower: HB+0
Number: 81

Height adjustment adjacent masts (wind and weight span adjustment)

	Back	Ahead	
Height increase for wind pressure	6,0 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

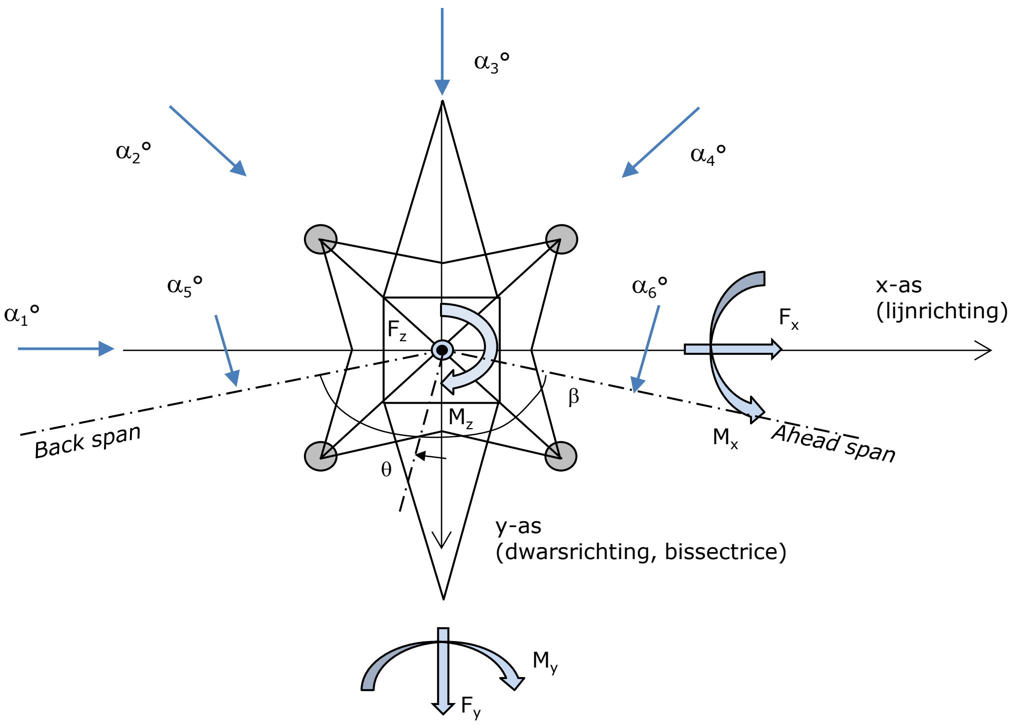
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	21	380ct1f1	9,4	0,5 m	0,0	0,0 m
Circuit 1	20	380ct1f2	9,4	0,5 m	0,0	0,0 m
Circuit 1	22	380ct1f3	9,4	0,5 m	0,0	0,0 m
Circuit 2	10	380ct2f1	9,4	0,5 m	0,0	0,0 m
Circuit 2	11	380ct2f2	9,4	0,5 m	0,0	0,0 m
Circuit 2	12	380ct2f3	9,4	0,5 m	0,0	0,0 m
Bliksemdraad 1	1	bl1	9,1	0,1 m	0,0	0,0 m
Bliksemdraad 2	3	bl2	9,1	0,1 m	0,0	0,0 m

Line and tower data

		Back	Ahead
		319,0	395,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		357,3	395,0 m
Line angle	β	143 °	
Tower orientation with respect to bis	θ	0 °	
Section length		1720	790 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	71,5 °	
	α_6	108,5 °	

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: KIJ-GT
Tower: HB+0
Number: 81

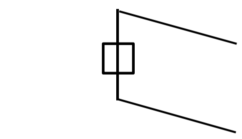
Absence of conductors

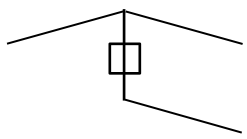
		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	1	0
Circuit 1	380ct1f2	1	0	1	0	1	0
Circuit 1	380ct1f3	1	0	1	0	1	0
Circuit 2	380ct2f1	0	1	1	0	1	0
Circuit 2	380ct2f2	0	1	1	0	1	0
Circuit 2	380ct2f3	0	1	1	0	1	0
Bliksemdraad 1	bl1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

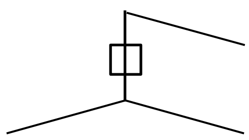
Load situations SPLS

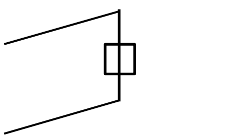
Considered situations SPLS: 1 up to 6, All possible situations

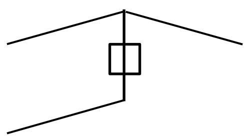
Principle of load situations:

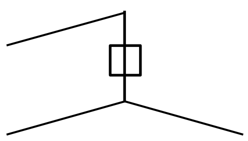

1. Ba All cts


2. Ba ct1


3. Ba ct2


4. Ah All cts

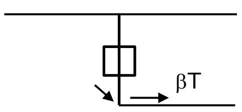

5. Ah ct1


6. Ah ct2

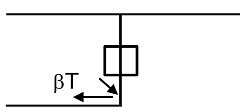
Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1, design assumption is symmetry back and ahead

Principle of load situations:



1. Ba



2. Ah

Project: KIJ-GT
Tower: HB+0
Number: 81

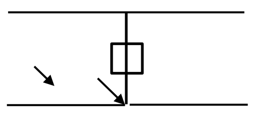
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine 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

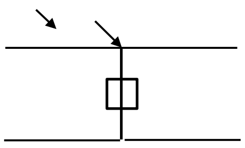
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

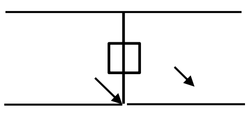
Principle of load situations:



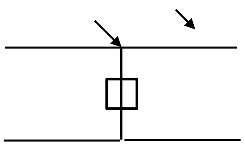
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

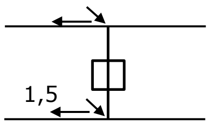
Load situations 8. Galloping as a static load

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

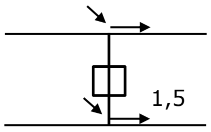
Considered situations galloping 8: None (existing structure)

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: KIJ-GT
Tower: HB+0
Number: 81

Tower structure

Properties

Tower type	Hoekmast		
Tower designation	HB+0		
Base plate w.r.t. ground level	0,5 m		
Tower height w.r.t. base plate	45,0 m		
Tower self weight	362,0 kN		
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	11,00	11,00	m
Inclination of main leg	0,156	0,156	-
Horizontal force factor	1,1	1,1	-

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,13	0,24	2,78
Topstuk	45,00	2,60		2,00		2,60	0,25	0,10	3,43
Ondertraverse	27,70	14,70		4,00		29,40	4,95	0,17	3,07
Boventraverse	39,00	16,00		4,20		33,60	6,63	0,20	2,94

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,13	0,24	2,78
Topstuk	45,00	2,60		2,00		2,60	0,25	0,10	3,43
Ondertraverse	27,70	14,70		4,00		29,40	4,95	0,17	3,07
Boventraverse	39,00	16,00		4,20		33,60	6,63	0,20	2,94

Note: Surface transverse direction is reduced in calculation.

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Project: KIJ-GT
Tower: HB+0
Number: 81

Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
Bovenstuk 1			
Bovenstuk 2			

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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

Description	p_w [kN/m²]	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 1	0,70	26,3	22,3	0,0	-22,3	4,8	126,2	107,1	0,0	-107,1
Middenstuk 1	0,79	26,0	22,0	0,0	-22,0	14,3	369,9	313,9	0,0	-313,9
Middenstuk 2	0,92	25,1	21,3	0,0	-21,3	23,3	585,3	496,6	0,0	-496,6
Bovenstuk 1	1,00	18,2	15,5	0,0	-15,5	31,6	576,7	489,3	0,0	-489,3
Bovenstuk 2	1,06	15,2	12,9	0,0	-12,9	39,3	595,5	505,3	0,0	-505,3
Topstuk	1,10	0,9	0,8	0,0	-0,8	44,0	41,4	35,1	0,0	-35,1
Ondertraverse	0,98	29,8	17,7	0,0	-17,7	29,0	864,8	513,7	0,0	-513,7
Boventraverse	1,07	41,9	24,9	0,0	-24,9	40,4	1691,4	1004,6	0,0	-1004,6
Totaal		183,4	137,4	0,0	-137,4		4851,2	3465,7	0,0	-3465,7

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

Description	p_w [kN/m²]	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 1	0,70	0,0	22,3	26,3	22,3	4,8	0,0	107,1	126,2	107,1
Middenstuk 1	0,79	0,0	22,0	26,0	22,0	14,3	0,0	313,9	369,9	313,9
Middenstuk 2	0,92	0,0	21,3	25,1	21,3	23,3	0,0	496,6	585,3	496,6
Bovenstuk 1	1,00	0,0	15,5	18,2	15,5	31,6	0,0	489,3	576,7	489,3
Bovenstuk 2	1,06	0,0	12,9	15,2	12,9	39,3	0,0	505,3	595,5	505,3
Topstuk	1,10	0,0	0,8	0,9	0,8	44,0	0,0	35,1	41,4	35,1
Ondertraverse	0,98	0,0	17,7	11,9	17,7	29,0	0,0	513,7	345,9	513,7
Boventraverse	1,07	0,0	24,9	16,7	24,9	40,4	0,0	1004,6	676,6	1004,6
Total		0,0	137,4	140,4	137,4		0,0	3465,7	3317,5	3465,7

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	362	0	0	0
Windrichting 0°	183	0	0	0	4851	0
Windrichting 45°	137	137	0	3466	3466	0
Windrichting 90°	0	140	0	3317	0	0
Windrichting 135°	-137	137	0	3466	-3466	0

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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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,8	1,0	23,37	0,92	1,2	1,10
380ct1f2	2,00	1	2	4,8	1,0	23,37	0,92	1,2	1,10
380ct1f3	2,00	1	2	4,8	1,0	34,67	1,03	1,2	1,24
380ct2f1	2,00	1	2	4,8	1,0	23,37	0,92	1,2	1,10
380ct2f2	2,00	1	2	4,8	1,0	23,37	0,92	1,2	1,10
380ct2f3	2,00	1	2	4,8	1,0	34,67	1,03	1,2	1,24
bl1	0,10	0,5	0,05	0,3	0,1	43,40	1,09	1,2	0,07
bl2	0,10	0,5	0,05	0,3	0,1	43,40	1,09	1,2	0,07

Project: KIJ-GT
Tower: HB+0
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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	25,0	0,94	0,57	0,52	1,11	28,25	50,6	45,7	46,9	90,6	81,7
380ct1f2	25,0	0,94	0,57	0,52	1,11	28,25	50,6	45,7	46,9	90,6	81,7
380ct1f3	36,3	1,04	0,60	0,54	1,08	28,25	57,6	51,9	46,9	105,9	95,5
380ct2f1	25,0	0,94	0,57	0,52	1,11	28,25	50,6	45,7	46,9	90,6	81,7
380ct2f2	25,0	0,94	0,57	0,52	1,11	28,25	50,6	45,7	46,9	90,6	81,7
380ct2f3	36,3	1,04	0,60	0,54	1,08	28,25	57,6	51,9	46,9	105,9	95,5
bl1	45,3	1,11	0,62	0,56	1,19	22,24	18,1	16,3	41,5	34,1	30,7
bl2	45,3	1,11	0,62	0,56	1,19	22,13	18,1	16,3	41,4	34,0	30,7

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	14,3	0,79	0,53	0,52	1,16	28,25	40,8	40,2	46,9	70,2	69,3
380ct1f2	14,3	0,79	0,53	0,52	1,16	28,25	40,8	40,2	46,9	70,2	69,3
380ct1f3	25,6	0,94	0,57	0,57	1,11	28,25	51,0	50,4	46,9	91,5	90,3
380ct2f1	14,3	0,79	0,53	0,52	1,16	28,25	40,8	40,2	46,9	70,2	69,3
380ct2f2	14,3	0,79	0,53	0,52	1,16	28,25	40,8	40,2	46,9	70,2	69,3
380ct2f3	25,6	0,94	0,57	0,57	1,11	28,25	51,0	50,4	46,9	91,5	90,3
bl1	34,8	1,03	0,60	0,59	1,20	22,24	16,4	16,2	41,5	30,7	30,3
bl2	34,8	1,03	0,60	0,59	1,20	22,13	16,4	16,1	41,4	30,6	30,2

Project: KIJ-GT
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Number: 81

Auteur:	TBR
Versie:	v11.3

Conductor loads

Starting points

Consequence class	Afkeur CC2-0
Reference period	30 jaar

ULS (strength)		**NEN-EN50341-2-15:2019**						
Load case	description	Temp	γG	γG		γQ		γa
		°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)				γG	γQ			
				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	46
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5377

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Project: KIJ-GT
Tower: HB+0
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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	-30,0	29,2	12,0	12,5	4,2	5,7
bl2	-30,1	29,3	12,0	12,5	4,2	5,7
380ct1f1	-102,6	101,6	39,8	39,3	11,4	16,9
380ct1f2	-102,6	101,6	39,8	39,3	11,4	16,9
380ct1f3	-104,2	103,8	42,5	43,2	11,4	16,9
380ct2f1	-102,6	101,6	39,8	39,3	11,4	16,9
380ct2f2	-102,6	101,6	39,8	39,3	11,4	16,9
380ct2f3	-104,2	103,8	42,5	43,2	11,4	16,9
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
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	285,0	307,2	313,9
bl2	285,0	305,8	313,9
380ct1f1	300,5	308,9	314,1
380ct1f2	300,5	308,9	314,1
380ct1f3	297,2	308,8	314,1
380ct2f1	300,5	308,9	314,1
380ct2f2	300,5	308,9	314,1
380ct2f3	297,2	308,8	314,1
Post 1			
Post 2			
Post 3			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	313,6	316,0
bl2	313,6	315,6
380ct1f1	314,1	314,8
380ct1f2	314,1	314,8
380ct1f3	314,0	314,8
380ct2f1	314,1	314,8
380ct2f2	314,1	314,8
380ct2f3	314,0	314,8
Post 1		
Post 2		
Post 3		

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	318,8 m	0,893 -
Min. weight span	270,0 m	0,756 -

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Project: KIJ-GT
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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	30,0	22,7	5,7	-31,9	31,0
bl2	30,1	22,7	5,7	-32,0	31,1
380ct1f1	88,1	77,6	16,9	-109,9	108,8
380ct1f2	88,1	77,6	16,9	-109,9	108,8
380ct1f3	88,2	80,7	16,9	-111,9	111,6
380ct2f1	88,1	77,6	16,9	-109,9	108,8
380ct2f2	88,1	77,6	16,9	-109,9	108,8
380ct2f3	88,2	80,7	16,9	-111,9	111,6
Post 1	1,9	1,9	3,5	0,0	
Post 2	1,9	1,9	3,5	0,0	
Post 3	1,9	1,9	3,5	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	14,2	4,8	2,0	-15,0	15,0
bl2	14,2	4,8	2,0	-15,0	15,0
380ct1f1	60,9	20,4	11,0	-64,2	64,2
380ct1f2	60,9	20,4	11,0	-64,2	64,2
380ct1f3	60,9	20,4	11,0	-64,2	64,2
380ct2f1	60,9	20,4	11,0	-64,2	64,2
380ct2f2	60,9	20,4	11,0	-64,2	64,2
380ct2f3	60,9	20,4	11,0	-64,2	64,2
Post 1	0,0	0,0	3,0	0,0	
Post 2	0,0	0,0	3,0	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	
	Post 3	0,0	

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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		-16	503	127	16353	-463	0
ULS 1a_0,9_0		10	277	131	8846	315	-67
ULS 1a_0,9_0,9_90		-19	480	107	15634	-547	-1
ULS 3_0		6	432	190	13879	188	-21
SLS 7		0	263	126	8408	0	0

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

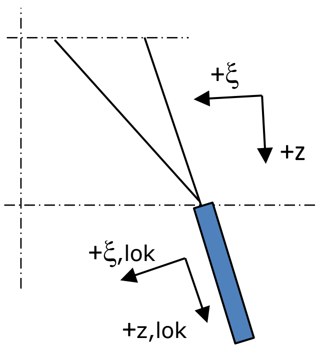
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-16	660	507	20057	-463	0
ULS 1a_0,9_0,9_90	-19	637	433	19339	-547	-1
SLS 7	0	263	488	8408	0	0

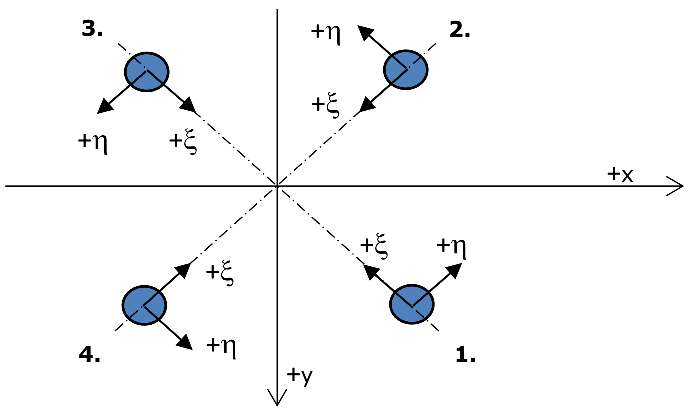
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_90	-16	660	452	**20073**	-463	0
SPLS 3_0 Ba All Cts	576	168	488	5313	**18229**	-19
SPLS 3_71,5 Ba Ct2	261	354	509	11158	8291	**-2872**
SPLS 3_0,9_71,5 Ah All Cts	-547	269	401	**8206**	**-17929**	-11

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_108,5 Ba All Cts	218	225	**1289**	-4	-313	-28	1320
2	SPLS 1a_0 Ba All Cts	129	-121	**713**	-6	-177	-19	731
3	SPLS 3_135 Ah All Cts	-106	-101	**609**	3	-147	-12	623
4	SPLS 3_71,5 Ah All Cts	-221	227	**1301**	4	-316	-29	1333

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	-68	-65	**-392**	-3	94	7	-402
2	SPLS 3_0,9_71,5 Ah All Cts	-183	190	**-1088**	-5	264	24	-1114
3	SPLS 3_0,9_108,5 Ba All Cts	178	185	**-1060**	5	257	23	-1086
4	SPLS 1a_0,9_0 Ba All Cts	88	-85	**-489**	3	122	14	-501

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 Ct2 Ba Ct2	86	-43	121	**91**	-30	-4	123
2	SPLS 3_0,9_108,5 Ah Ct2	-201	74	-799	**90**	195	18	-818
3	SPLS 3_71,5 Ba Ct1	62	196	-736	**95**	183	20	-754
4	SPLS 3_71,5 Ba Ct1	25	111	238	**96**	-61	-8	244

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 3_108,5 Ah Ct1	-28	105	210	**-94**	-55	-8	215
2	SPLS 6a_90 Ah Ct1 Ba Ct1	-58	192	-720	**-94**	177	18	-737
3	SPLS 3_0,9_71,5 Ba Ct2	198	68	-771	**-92**	189	18	-790
4	SPLS 3_0,9_71,5 Ba Ct2	-107	-22	244	**-91**	-60	-6	250

Project: KIJ-GT
Tower: HB+0
Number: 81

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	-68	-65	**-392**	**-3**	94	7	-402
2	SPLS 3_0,9_71,5 Ah All Cts	-183	190	**-1088**	**-5**	264	24	-1114
3	SPLS 3_0,9_108,5 Ba All Cts	178	185	**-1060**	**5**	257	23	-1086
4	SPLS 1a_0,9_0 Ba All Cts	88	-85	**-489**	**3**	122	14	-501

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	87	87	504	0	-123	-11	516
2	SLS 7	-45	45	-260	0	63	6	-266
3	SLS 7	45	45	-260	0	63	6	-266
4	SLS 7	-87	87	504	0	-123	-11	516

Envelope of load combinations for all of the legs

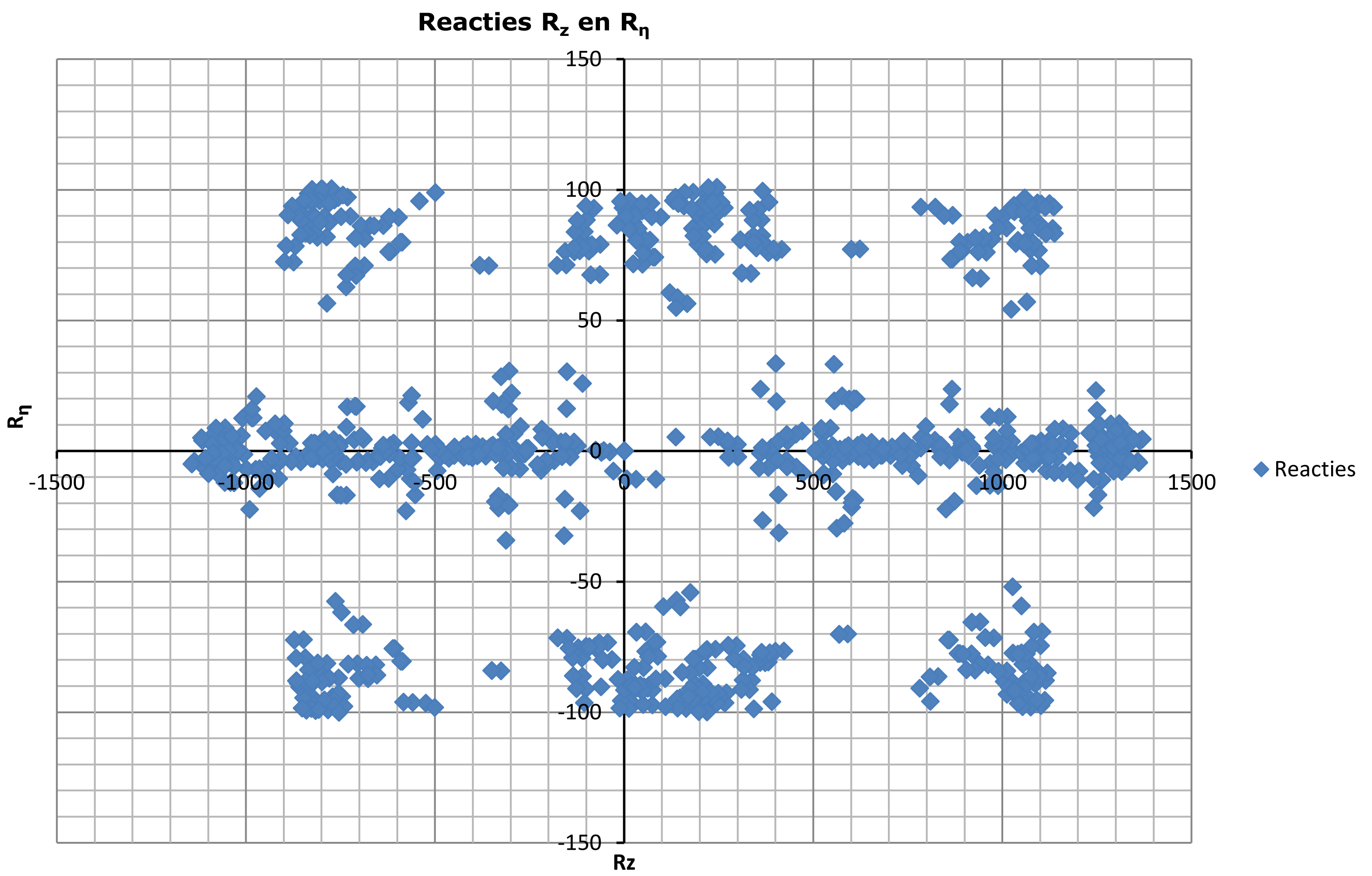
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 3_71,5 Ah All Cts	-221	227	**1301**	4	-316	-29	1333
Max. tension	SPLS 3_0,9_71,5 Ah All Cts	-183	190	**-1088**	-5	264	24	-1114
Max. pos. torsie	SPLS 3_71,5 Ba Ct1	25	111	238	**96**	-61	-8	244
Max. neg. torsie	SPLS 3_108,5 Ah Ct1	-28	105	210	**-94**	-55	-8	215
Comb. tension+torsie	SPLS 3_0,9_71,5 Ah All Cts	-183	190	**-1088**	**-5**	264	24	-1114

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	87	87	**504**	0	-123	-11	516
2	SLS 1a_90	-121	128	**-703**	-5	176	21	-720
3	SLS 1a_90	114	122	**-667**	5	167	20	-684
4	SLS 1a_0	-43	48	**286**	4	-64	-1	293

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	156	163	**909**	-5	-226	-25	931
2	SLS 1a_0	2	9	**-42**	-7	5	-4	-43
3	SLS 7	45	45	**-260**	0	63	6	-266
4	SLS 1a_90	-163	170	**945**	5	-235	-26	968


Reacties R_z en R_η
150
100
50
0
-50
-100
-150
-1500
-1000
-500
0
500
1000
1500
R_η
Rz
Reacties

Conductor loads

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	46
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5377

Project: KIJ-GT
Tower: HB+0
Number: 81

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	-32,1	32,2	14,3	15,0	4,5	6,2
bl2	-32,3	32,5	14,3	14,9	4,5	6,2
380ct1f1	-119,0	118,2	46,7	46,2	13,1	19,9
380ct1f2	-119,0	118,2	46,7	46,2	13,1	19,9
380ct1f3	-121,0	121,0	50,4	51,4	13,1	19,9
380ct2f1	-119,0	118,2	46,7	46,2	13,1	19,9
380ct2f2	-119,0	118,2	46,7	46,2	13,1	19,9
380ct2f3	-121,0	121,0	50,4	51,4	13,1	19,9
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
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	282,4	307,0	313,9
bl2	282,4	305,6	313,9
380ct1f1	299,1	308,9	314,1
380ct1f2	299,1	308,9	314,1
380ct1f3	295,5	308,7	314,1
380ct2f1	299,1	308,9	314,1
380ct2f2	299,1	308,9	314,1
380ct2f3	295,5	308,7	314,1
Post 1			
Post 2			
Post 3			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	314,0	317,5
bl2	313,9	317,1
380ct1f1	314,4	315,8
380ct1f2	314,4	315,8
380ct1f3	314,3	315,8
380ct2f1	314,4	315,8
380ct2f2	314,4	315,8
380ct2f3	314,3	315,8
Post 1		
Post 2		
Post 3		

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	319,3 m	0,894 -
Min. weight span	255,5 m	0,716 -

DNV·GL

Project: KIJ-GT
Tower: HB+0
Number: 81

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	31,0	27,1	6,2	-34,4	34,8
bl2	31,1	27,0	6,2	-34,7	35,1
380ct1f1	93,1	90,9	19,9	-127,7	126,7
380ct1f2	93,1	90,9	19,9	-127,7	126,7
380ct1f3	93,3	94,9	19,9	-130,1	130,2
380ct2f1	93,1	90,9	19,9	-127,7	126,7
380ct2f2	93,1	90,9	19,9	-127,7	126,7
380ct2f3	93,3	94,9	19,9	-130,1	130,2
Post 1	2,4	2,4	3,9	0,0	
Post 2	2,4	2,4	3,9	0,0	
Post 3	2,4	2,4	3,9	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	14,2	4,8	2,0	-15,0	15,0
bl2	14,2	4,8	2,0	-15,0	15,0
380ct1f1	60,9	20,4	11,0	-64,2	64,2
380ct1f2	60,9	20,4	11,0	-64,2	64,2
380ct1f3	60,9	20,4	11,0	-64,2	64,2
380ct2f1	60,9	20,4	11,0	-64,2	64,2
380ct2f2	60,9	20,4	11,0	-64,2	64,2
380ct2f3	60,9	20,4	11,0	-64,2	64,2
Post 1	0,0	0,0	3,0	0,0	
Post 2	0,0	0,0	3,0	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	
	Post 3	0,0	

Project: KIJ-GT
Tower: HB+0
Number: 81

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		-20	593	138	19296	-554	-1
ULS 1a_0,9_0		14	301	143	9625	415	-84
ULS 1a_0,9_0,9_90		-24	559	105	18249	-698	-1
ULS 3_0		10	500	223	16086	326	-26
SLS 7		0	263	126	8408	0	0

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

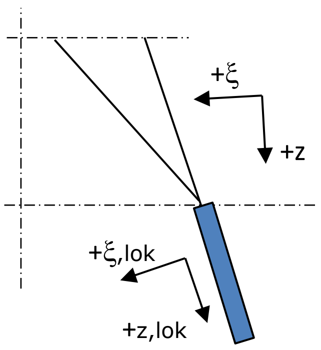
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-20	790	555	23940	-554	-1
ULS 1a_0,9_0,9_90	-24	756	431	22894	-698	-1
SLS 7	0	263	488	8408	0	0

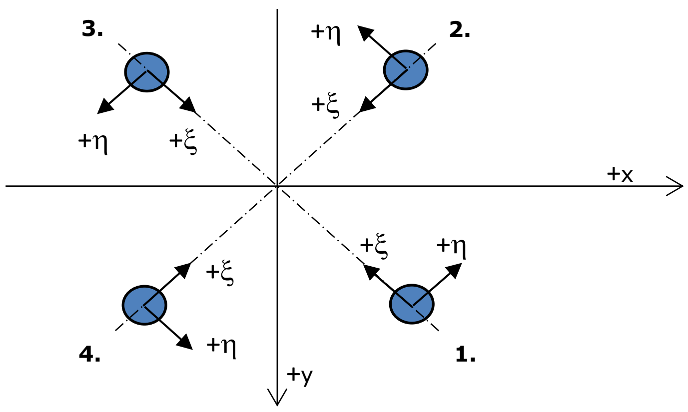
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_0,9_90	-20	790	462	**23966**	-554	-1
SPLS 3_0 Ba All Cts	611	179	533	5684	**19370**	-19
SPLS 3_71,5 Ba Ct2	279	370	556	11686	8894	**-3033**
SPLS 3_0,9_71,5 Ah All Cts	-576	279	407	**8524**	**-18879**	-11

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_108,5 Ba All Cts	231	237	**1361**	-5	-331	-30	1394
2	SPLS 1a_0 Ba All Cts	137	-129	**760**	-6	-188	-20	778
3	SPLS 3_135 Ah All Cts	-114	-109	**653**	3	-157	-13	669
4	SPLS 3_71,5 Ah All Cts	-232	239	**1369**	4	-333	-30	1402

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	-74	-70	**-424**	-2	102	8	-435
2	SPLS 3_0,9_71,5 Ah All Cts	-193	200	**-1144**	-5	278	25	-1171
3	SPLS 3_0,9_108,5 Ba All Cts	188	196	**-1119**	5	272	24	-1146
4	SPLS 1a_0,9_0 Ba All Cts	94	-90	**-521**	2	130	15	-534

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 Ct2 Ba Ct2	93	-45	135	**97**	-34	-4	138
2	SPLS 3_0,9_108,5 Ah Ct2	-213	78	-846	**96**	206	19	-867
3	SPLS 3_71,5 Ba Ct1	65	207	-774	**100**	192	21	-793
4	SPLS 3_71,5 Ba Ct1	27	116	245	**101**	-63	-9	250

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 3_108,5 Ah Ct1	-30	111	219	**-100**	-57	-9	224
2	SPLS 6a_90 Ah Ct1 Ba Ct1	-60	202	-754	**-100**	185	19	-772
3	SPLS 3_0,9_71,5 Ba Ct2	210	73	-821	**-97**	200	19	-841
4	SPLS 3_0,9_71,5 Ba Ct2	-110	-26	244	**-97**	-60	-6	250

Project: KIJ-GT
Tower: HB+0
Number: 81

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	-74	-70	**-424**	**-2**	102	8	-435
2	SPLS 3_0,9_71,5 Ah Ct2	-215	88	**-890**	**90**	214	18	-911
3	SPLS 3_0,9_108,5 Ba All Cts	188	196	**-1119**	**5**	272	24	-1146
4	SPLS 1a_0,9_0 Ba All Cts	94	-90	**-521**	**2**	130	15	-534

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	87	87	504	0	-123	-11	516
2	SLS 7	-45	45	-260	0	63	6	-266
3	SLS 7	45	45	-260	0	63	6	-266
4	SLS 7	-87	87	504	0	-123	-11	516

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_71,5 Ah All Cts	-232	239	**1369**	4	-333	-30	1402
Max. tension	SPLS 3_0,9_71,5 Ah All Cts	-193	200	**-1144**	-5	278	25	-1171
Max. pos. torsie	SPLS 3_71,5 Ba Ct1	27	116	245	**101**	-63	-9	250
Max. neg. torsie	SPLS 6a_90 Ah Ct1 Ba Ct1	-60	202	-754	**-100**	185	19	-772
Comb. tension+torsie	SPLS 3_0,9_71,5 Ah Ct2	-215	88	**-890**	**90**	214	18	-911

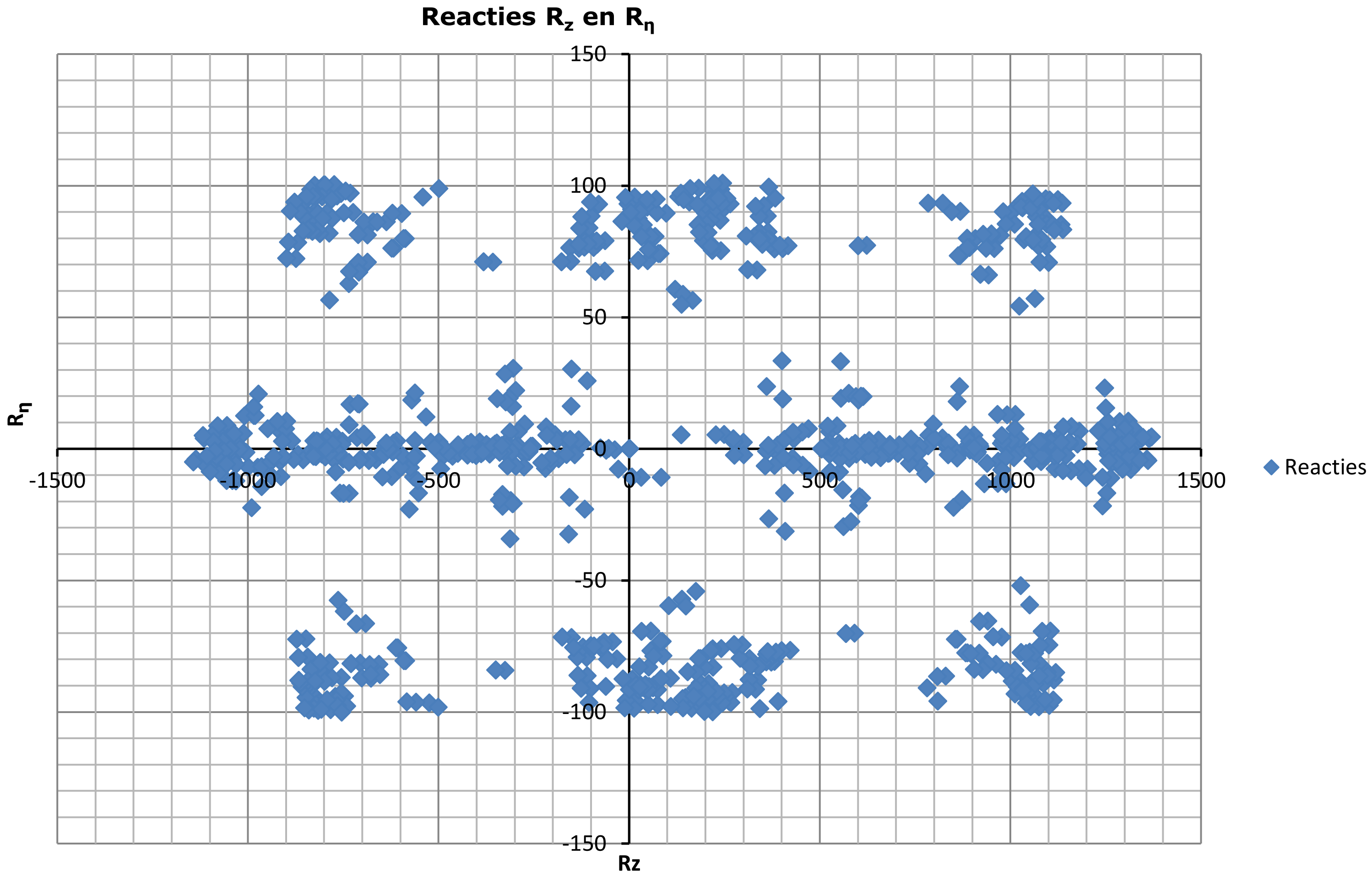
Maximum tension load - SLS

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	87	87	**504**	0	-123	-11	516
2	SLS 1a_90	-127	134	**-735**	-5	184	22	-753
3	SLS 1a_90	119	127	**-697**	6	174	20	-713
4	SLS 1a_0	-40	46	**273**	4	-61	0	279

Maximum compression load - SLS

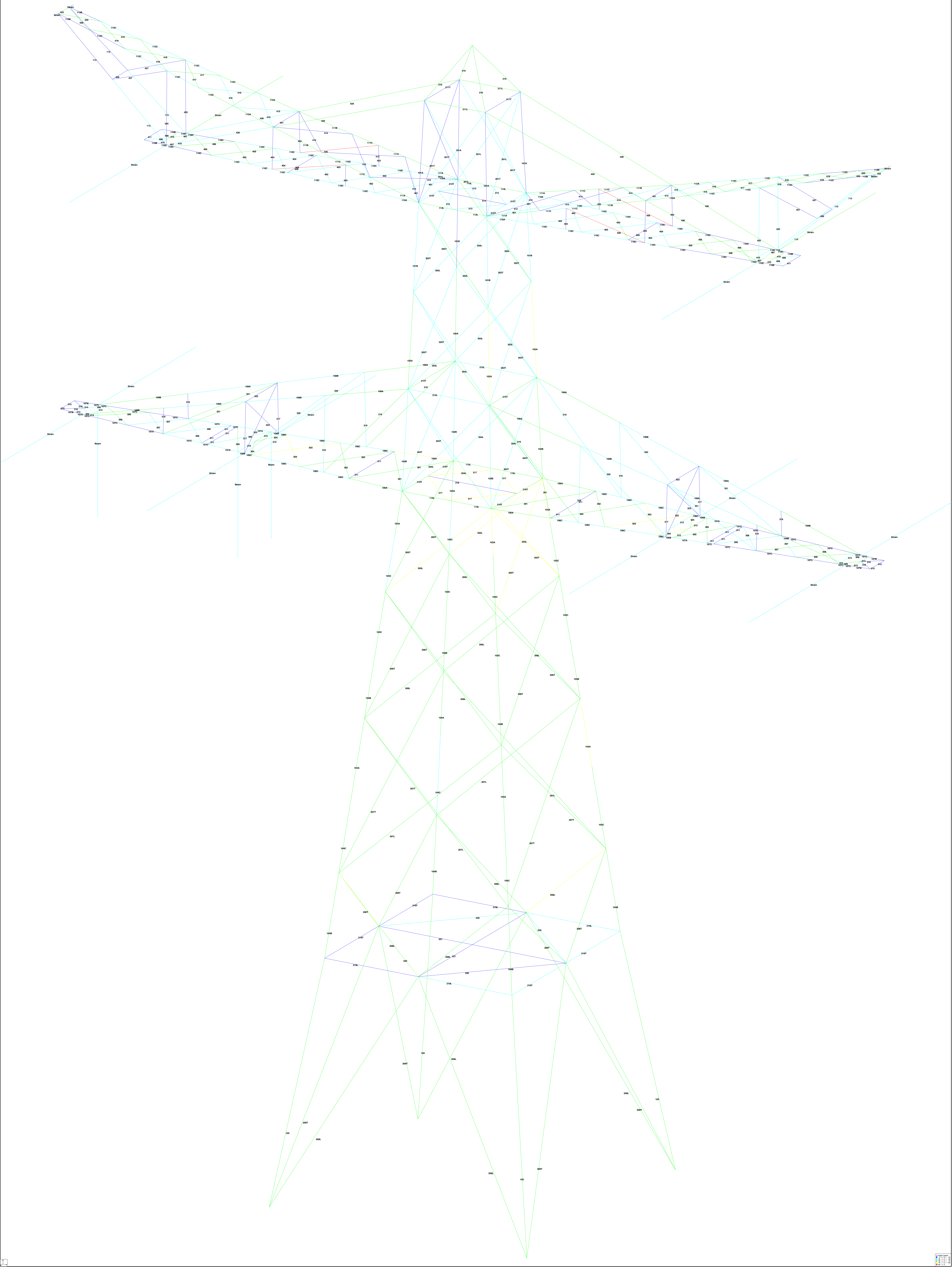
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_90	161	169	**938**	-6	-233	-26	961
2	SLS 1a_0	4	7	**-29**	-8	1	-5	-30
3	SLS 7	45	45	**-260**	0	63	6	-266
4	SLS 1a_90	-168	175	**977**	5	-243	-27	1001

Project: KIJ-GT
Tower: HB+0
Number: 81



APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project: "HB+0 (da) ini"
Tower Version 16.39, 14:29:00 woensdag 19 augustus 2020
Undeformed geometry displayed



Assessment of groups for initial mast (afkeur level)

Date 19-8-2020
Author MKh
Version 1.0

KIJ-GT 380
HB+0
3

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	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	**-47.0**	SPLS 3_71 Ah Ct2	318.3	508.3	622.1	0.15		**8.8**	ULS 1a_0,9_0,9_71	379.5	508.3	531.7	0.02	
101B	Leg	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	74	**-137.3**	ULS 1a_71	344.8	506.7	622.1	0.40		**102.9**	ULS 1a_0,9_0,9_71	379.5	506.7	531.7	0.27	
102A	Leg	180x180x16	S235	8M20-5.6t	0.50	0.50	0.50	54	**-405.9**	SPLS 3_71 Ah All Cts	1141.5	460.8	1382.4	0.88		**321.8**	SPLS 3_0,9_71 Ah All Cts	1253.5	460.8	1382.4	0.70	
102B	Leg	180x180x16	S235	10M24-5.6t	0.50	0.50	0.50	57	**-438.4**	SPLS 3_71 Ah All Cts	1125.2	847.2	2073.6	0.52		**333.1**	SPLS 3_0,9_71 Ah All Cts	1220.3	847.2	1612.8	0.39	
103A	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	22	**-796.5**	SPLS 3_71 Ah All Cts	1444.7	941.5	2488.3	0.85		**650.1**	SPLS 3_0,9_71 Ah All Cts	1386.2	941.5	2126.8	0.69	
103B	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	35	**-991.0**	SPLS 3_71 Ah All Cts	1381.6	1987.7	2488.3	0.72		**838.3**	SPLS 3_0,9_71 Ah All Cts	1386.2	1987.7	2126.8	0.60	
103C	Leg	200x200x16	S235		0.50	0.50	0.50	28	**-988.4**	SPLS 3_71 Ah All Cts	1416.3	0.0	0.0	0.70		**840.5**	SPLS 3_0,9_71 Ah All Cts	1452.3	0.0	0.0	0.58	
104A	Leg	250x250x18	S235	10M24-5.6t	0.50	0.50	0.50	28	**-1246.0**	SPLS 3_71 Ah All Cts	2013.7	1599.1	2332.8	0.78		**1071.9**	SPLS 3_0,9_71 Ah All Cts	2030.6	1599.1	1993.8	0.67	
104B	Leg	250x250x18	S235	12M24-5.6t	0.50	0.50	0.50	34	**-1350.9**	SPLS 3_71 Ah All Cts	1969.4	1859.6	2799.4	0.73		**1166.5**	SPLS 3_0,9_71 Ah All Cts	2030.6	1859.6	2392.6	0.63	
104C	Leg	250x250x18	S235		0.50	0.50	0.50	34	**-1249.4**	SPLS 3_71 Ah All Cts	1969.4	0.0	0.0	0.63		**1069.1**	SPLS 3_0,9_71 Ah All Cts	2061.0	0.0	0.0	0.52	
105	Leg	250x250x18	S235	12M24-5.6t	0.17	0.17	0.17	33	**-1374.4**	SPLS 3_71 Ah All Cts	1974.3	1859.6	2799.4	0.74		**1167.8**	SPLS 3_0,9_71 Ah All Cts	2030.6	1859.6	2392.6	0.63	
106A	Onderregel eerste dwarsarm	180x180x18	S235	10M24-5.6t	1.48	1.00	1.00	68	**-633.3**	SPLS 6a_90 Ah Ct2 Ba Ct2	1175.3	831.3	2332.8	0.76		**448.0**	SPLS 3_0,9_71 Ah Ct1	1361.8	831.3	1993.8	0.54	
106B	Onderregel eerste dwarsarm	180x180x18	S235	8M24-5.6t	12.15	2.00	1.00	67	**-333.7**	SPLS 6a_90 Ah Ct2 Ba Ct2	1186.1	677.8	1866.2	0.49		**225.0**	SPLS 3_0,9_71 Ah Ct1	1361.8	677.8	1595.1	0.33	
106C	Onderregel eerste dwarsarm	180x180x18	S235		2.91	1.93	1.00	61	**-566.4**	SPLS 6a_90 Ah Ct2 Ba Ct2	1226.9	0.0	0.0	0.46		**381.2**	SPLS 3_0,9_71 Ah Ct1	1454.7	0.0	0.0	0.26	
107A	Onderregel eerste dwarsarm	160x160x17	S235		2.67	1.00	1.00	76	**-322.0**	SPLS 6a_90 Ah Ct2 Ba Ct2	939.3	0.0	0.0	0.34		**208.2**	SPLS 3_0,9_71 Ah Ct1	1219.7	0.0	0.0	0.17	
107B	Onderregel eerste dwarsarm	160x160x17	S235	2M20-5.6t	1.00	1.43	1.00	22	**-3.5**	ULS 3_0,9_0	1213.4	117.6	367.2	0.03		**0.1**	SPLS 1a_0 Ba All Cts	668.3	117.6	356.1	0.00	
107C	Onderregel eerste dwarsarm	160x160x17	S235		14.68	1.00	1.00	76	**-307.6**	SPLS 6a_90 Ah Ct2 Ba Ct2	939.4	0.0	0.0	0.33		**193.7**	SPLS 3_0,9_71 Ah Ct1	1219.7	0.0	0.0	0.16	
108A	Bovenregel eerste dwarsarm	80x80x8	S235	3M24-5.6t	1.00	1.96	1.00	311	**0.0**		34.6	254.2	311.0	0.00		**118.1**	ULS 3_135	160.8	254.2	259.0	0.73	
108B	Bovenregel eerste dwarsarm	80x80x8	S235	4M24-5.6t	1.00	2.04	1.00	311	**0.0**		34.6	338.9	414.7	0.00		**87.6**	PLS 6a_90 Ah Ct1 Ba Ct2	211.0	338.9	347.4	0.42	
109A	Bovenregel eerste dwarsarm	70x70x7	S235	4M20-5.6t	1.00	1.99	1.00	358	**0.0**		21.0	235.2	302.4	0.00		**77.4**	PLS 6a_90 Ah Ct1 Ba Ct2	163.8	235.2	191.5	0.47	
109B	Bovenregel eerste dwarsarm	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	356	**0.0**		21.2	176.4	226.8	0.00		**77.5**	PLS 6a_90 Ah Ct1 Ba Ct2	125.5	176.4	155.3	0.62	
110A	Onderregel tweede dwarsarm	160x160x17	S235	12M24-5.6t	1.68	1.00	1.00	67	**-406.1**	SPLS 3_71 Ah All Cts	995.9	991.5	2643.8	0.41		**309.4**	SPLS 3_0,9_71 Ah All Cts	1116.1	991.5	2259.7	0.31	
110B	Onderregel tweede dwarsarm	160x160x17	S235		1.00	1.67	1.00	24	**-4.4**	SPLS 1a_135 Ah All Cts	1206.8	0.0	0.0	0.00		**0.0**		1219.7	0.0	0.0	0.00	
110C	Onderregel tweede dwarsarm	160x160x17	S235		2.48	1.48	1.00	67	**-369.9**	SPLS 3_71 Ah All Cts	995.9	0.0	0.0	0.37		**270.3**	SPLS 3_0,9_71 Ah All Cts	1219.7	0.0	0.0	0.22	
111A	Bovenregel tweede dwarsarm	120x120x11	S235	4M24-5.6t	1.50	1.00	1.00	95	**-200.0**	SPLS 6a_90 Ah All Cts Ba Ct1	326.6	338.9	570.2	0.61		**181.6**	6a_90 Ah All Cts Ba Ct2	346.4	338.9	453.2	0.54	
111B	Bovenregel tweede dwarsarm	120x120x11	S235	3M24-5.6t	1.50	1.00	1.00	95	**-184.1**	SPLS 6a_90 Ah All Cts Ba Ct1	326.6	254.2	427.7	0.72		**174.1**	6a_90 Ah All Cts Ba Ct2	456.8	254.2	365.5	0.69	
111C	Bovenregel tweede dwarsarm	120x120x11	S235		3.00	2.00	1.00	92	**-195.1**	SPLS 6a_90 Ah All Cts Ba Ct1	326.5	0.0	0.0	0.60		**182.0**	6a_90 Ah All Cts Ba Ct2	599.7	0.0	0.0	0.30	
112A	Bovenregel tweede dwarsarm	150x100x10	S235	3M24-5.6t	2.86	1.00	1.00	103	**-161.5**	SPLS 6a_90 Ah All Cts Ba Ct1	283.9	249.9	388.8	0.65		**170.2**	6a_90 Ah All Cts Ba Ct2	437.7	249.9	332.3	0.68	
112B	Bovenregel tweede dwarsarm	150x100x10	S235	4M24-5.6t	3.73	1.00	1.00	105	**-34.5**	SPLS 3_0,9_71 Ah All Cts	278.5	338.9	518.4	0.12		**33.7**	PLS 6a_90 Ah Ct1 Ba Ct2	495.3	338.9	443.1	0.10	
112C	Bovenregel tweede dwarsarm	150x100x10	S235		2.90	1.00	1.00	104	**-147.0**	SPLS 6a_90 Ah All Cts Ba Ct1	280.5	0.0	0.0	0.52		**155.2**	6a_90 Ah All Cts Ba Ct2	571.3	0.0	0.0	0.27	
113	Ladder tweede dwarsarm	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	162	**-31.1**	SPLS 6a_90 Ba Ct1 Ba Ct2	79.8	84.7	77.8	0.40		**11.6**	SPLS 3_0,9_90 Ah Ct2	127.9	84.7	66.5	0.17	
201L	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	**-38.3**	SPLS 3_71 Ah Ct2	91.4	84.7	77.8	0.49		**28.9**	ULS 1a_0,9_90	127.9	84.7	66.5	0.43	
201T	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	**-23.2**	SPLS 6a_90 Ba Ct2 Ah Ct2	91.4	84.7	77.8	0.30		**9.7**	SPLS 1a_0,9_71 Ba Ct2	127.9	84.7	66.5	0.15	
202L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	**-183.7**	SPLS 3_90 Ba Ct2	425.3	338.9	518.4	0.54		**140.4**	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.41	
202T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	**-136.8**	SPLS 3_90 Ah Ct1	425.3	338.9	518.4	0.40		**151.9**	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.45	
203L	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	**-129.0**	SPLS 3_0,9_90 Ba Ct1	406.7	338.9	518.4	0.38		**168.0**	SPLS 3_90 Ba Ct2	384.5	338.9	350.9	0.50	
203T	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	**-138.0**	SPLS 3_0,9_90 Ah Ct2	406.7	338.9	518.4	0.41		**124.3**	SPLS 3_90 Ah Ct1	384.5	338.9	350.9	0.37	
204L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	**-175.6**	SPLS 3_0,9_90 Ah Ct2	381.0	338.9	518.4	0.52		**137.9**	SPLS 3_0,9_71 Ah Ct1	384.5	338.9	350.9	0.41	
204T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	**-160.3**	SPLS 3_90 Ah Ct1	381.0	338.9	518.4	0.47		**151.1**	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.45	
205L	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	**-347.1**	SPLS 3_71 Ba Ct1	449.2	508.3	777.6	0.77		**341.7**	SPLS 3_71 Ba Ct2	384.5	508.3	513.8	0.89	
205T	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	**-322.6**	SPLS 3_0,9_71 Ba Ct2	449.2	508.3	777.6	0.72		**320.2**	SPLS 3_71 Ba Ct1	384.5	508.3	513.8	0.83	
206L	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	**-285.5**	SPLS 3_71 Ba Ct2	463.5	423.6	777.6	0.67		**284.8**	SPLS 3_71 Ba Ct1	456.2	423.6	518.8	0.67	
206T	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	**-265.2**	SPLS 3_71 Ba Ct1	463.5	423.6	777.6	0.63		**265.1**	SPLS 3_0,9_71 Ba Ct2	456.2	423.6	518.8	0.63	
207L	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	**-233.9**	SPLS 3_71 Ba Ct1	392.0	338.9	622.1	0.69		**231.5**	SPLS 3_71 Ba Ct2	456.2	338.9	421.1	0.68	
207T	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	**-218.2**	SPLS 3_0,9_71 Ba Ct2	392.0	338.9	622.1	0.64		**214.3**	SPLS 3_71 Ba Ct1	456.2	338.9	421.1	0.63	
208L	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	**-194.5**	SPLS 3_71 Ba Ct2	332.1	254.2	388.8	0.77		**191.6**	SPLS 3_0,9_71 Ba Ct1	384.5	254.2	269.2	0.75	
208T	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	**-180.9**	SPLS 3_71 Ba Ct1	332.1	254.2	388.8	0.71		**181.4**	SPLS 3_0,9_71 Ba Ct2	384.5	254.2	269.2	0.71	
209L	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	**-244.8**	SPLS 3_71 Ba Ct2	370.1	338.9	570.2	0.72		**233.7**	SPLS 3_0,9_71 Ba Ct1	356.4	338.9	475.6	0.69	
209T	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	**-233.8**	SPLS 3_71 Ba Ct1	370.1	338.9	570.2	0.69		**226.3**	SPLS 3_0,9_71 Ba Ct2	356.4	338.9	475.6	0.67	
210	Top	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	280	**-12.0**	SPLS 6a_90 Ba Ct2 Ah Ct2	16.5	75.4	86.4	0.72		**11.9**	PLS 6a_90 Ba Ct2 Ah Ct2	52.4	75.4	44.1	0.27	
211L	Tweede dwarsarm in tower	80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	167	**0.0**		89.7	254.2	311.0	0.00		**86.5**	ULS 6a_90 Ah Ct2	160.8	254.2	259.0	0.54	
211T	Tweede dwarsarm in tower	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	167	**-3.6**	ULS 1a_0,9_90	89.7	169.4	207.4	0.04		**3.5**	ULS 1a_90	206.0	169.4	177.2	0.02	
114L	Tweede dwarsarm in tower	160x160x15	S235	12M24-5.6t	2.00	1.00	1.00	59	**-527.6**	SPLS 3_71 Ah All Cts	936.1	991.5	2332.8	0.56		**448.5**	SPLS 3_0,9_71 Ah All Cts	1008.5	991.5	1914.1	0.45	
212T	Tweede dwarsarm in tower	100x100x6	S235	4M24-5.6t	2.00	1.00	1.00	95	**-46.6**	SPLS 3_0,9_71 Ba Ct2	144.3	338.9	311.0	0.32		**59.9**	SPLS 3_71 Ba Ct2	225.0	338.9	265.8	0.27	
213	Tweede dwarsarm in tower	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	86	**-65.6**	SPLS 3_0,9_71 Ba Ct2	265.3	169.4	207.4	0.39		**66.6**	SPLS 3_71 Ba Ct2	226.0	169.4	177.2	0.39	
214	Tweede dwarsarm in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	300	**-0.6**	ULS 3_0	11.8	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00	
215L	Eerste dwarsarm in tower	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	178	**0.0**		103.8	254.2	311.0	0.00		**112.4**	6a_90 Ba All Cts Ah Ct2	270.5	254.2	265.8	0.44	
215T	Eerste dwarsarm in tower	100x100x8	S235	1M24-5.6t	1.00	1.00	1.00	178	**-47.3**	ULS 1a_0,9_90	83.1	84.7	103.7	0.57		**52.1**	ULS 1a_90	170.5	84.7	88.6	0.61	
115L	Eerste dwarsarm in tower	180x180x18	S235	10M24-5.6t	2.00	1.00	1.00	69	**-573.1**	SPLS 3_71 Ah All Cts	1169.6	831.3	2332.8	0.69		**418.4**	SPLS 3_0,9_71 Ah All Cts	1361.8	831.3	1993.8	0.50	
216T	Eerste dwarsarm in tower	100x100x8	S235	4M24-5.6t	2.00	1.00	1.00	124	**-109.2**	SPLS 3_0,9_71 Ba Ct2	151.1	338.9	414.7	0.72		**122.7**	SPLS 3_71 Ba Ct1	293.9	338.9	354.5	0.42	
217	Eerste dwarsarm in tower	120x120x11	S235	2M24-5.6t	1.00	1.00	1.00	114	**-148.7**	SPLS 3_0,9_71 Ba Ct2	286.0	169.4	285.1	0.88		**150.1**	SPLS 3_71 Ba Ct2	306.2	169.4	243.7	0.89	
218	Eerste dwarsarm in tower	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	325	**-0.9**	ULS 3_0	12.6	58.8	54.0	0.07		**0.0**		54.7	58.8	37.0	0.00	
219L	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-48.9**	SPLS 3_71 Ah All Cts	195.2	169.4	311.0	0.29		**34.2**	SPLS 3_0,9_71 Ah All Cts	329.5	169.4	265.8	0.20	
219T	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-53.0**	SPLS 3_71 Ah All Cts	195.2	169.4	311.0	0.31		**38.2**	SPLS 3_0,9_71 Ah All Cts	329.5	169.4	265.8	0.23	
220	Onderstuk in tower	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	311	**-5.3**	SPLS 1a_45 Ah Ct1	11.6	37.7	43.2	0.46		**4.2**	ULS 1a_0,9_0,9_135	60.5	37.7	32.0	0.13	
221	Onderstuk in tower	70x70x5#	S235	1M16-5.6t	0.50	1.00	0.50	370	**-0.9**	SPLS 3_71 Ba Ct2	9.9	37.7	43.2	0.09		**0.0**		74.9	37.7	32.0	0.00	
301	Diagonaal onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	120	**-59.8**	SPLS 3_71 Ah All Cts	124.6	117.6	129.6	0.51		**55.7**	SPLS 3_0,9_71 Ah All Cts	138.8	117.6	91.6	0.61	
302	Diagonaal onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	108	**-70.0**	SPLS 3_71 Ah Ct1	138.3	117.6	129.6	0.59		**66.2**	SPLS 3_0,9_71 Ah Ct1	140.5	117.6	91.6	0.72	
303	Diagonaal onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	99	**-81.7**	SPLS 3_71 Ah All Cts	149.4	117.6	129.6	0.69		**84.5**	SPLS 3_0,9_71 Ah All Cts	145.4	117.6	91.6	0.92	
304	Diagonaal onderregel eerste dwarsarm	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	89	**-45.6**	SPLS 3_71 Ah All Cts	103.7	84.7	77.8	0.59		**45.9**	SPLS 3_0,9_71 Ah All Cts	93.3	84.7	59.8	0.77	
305	Diagonaal onderregel eerste dwarsarm	70x70x6	S235	1M20-5.6t	0.55	0.55	0.55	109	**-28.0**	SPLS 6a_90 Ah Ct2 Ba Ct2	75.9	58.8	64.8	0.48		**31.0**	SPLS 3_0,9_71 Ah All Cts	82.9	58.8	52.4	0.59	
306	Diagonaal onderregel eerste dwarsarm	70x70x6	S235	2M20-5.6t	0.55	0.55	0.55	107	**-37.6**	SPLS 3_71 Ah All Cts	96.4	117.6	129.6	0.39		**37.8**	SPLS 3_0,9_71 Ah All Cts	84.5	117.6	91.6	0.45	
307	Diagonaal onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	82	**-47.7**	SPLS 3_0,9_71 Ah All Cts	137.9	117.6	129.6	0.41		**46.8**	SPLS 3_71 Ah All Cts	118.5	117.6	91.6	0.51	
308	Diagonaal onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	77	**-64.7**	SPLS 3_71 Ah All Cts	142.4	117.6	129.6	0.55		**63.7**	SPLS 3_0,9_71 Ah All Cts	117.2	117.6	91.6	0.69	
309	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	1M24-5.6t	1.00	1.00	1.00	64	**-28.7**	SPLS 3_71 Ah Ct2	118.4	84.7	90.7	0.34		**30.1**	SPLS 3_0,9_71 Ah All Cts	88.7	84.7	57.8	0.52	
310	Diagonaal onderregel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	90	**-0.2**	SPLS 1a_0,9_45 Ba Ct2	52.8	37.7	43.2	0.01		**4.0**	ULS 3_0,9_109	37.4	37.7	22.0	0.18	
311	Dwarsligger onderregel eerste dwarsarm	HEA160	S235		1.00	1.00	1.00	28	**-6.5**	ULS 3_0,9_90	784.4	0.0	0.0	0.01		**7.5**	ULS 3_90	916.5	0.0	0.0	0.01	
312	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	82	**-18.8**	SPLS 3_0,9_71 Ah All Cts	315.3	117.6	259.2	0.16		**64.2**	SPLS 3_71 Ah All Cts	278.4	117.6	259.2	0.55	
314	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	38	**0.0**		422.5	117.6	259.2	0.00		**63.4**	ULS 3_0,9_71	278.4	117.6	259.2	0.54	
315	Dwarsligger onderregel eerste dwarsarm	HEA160	S235		1.00	1.00	1.00	13	**-8.1**	ULS 3_0,9_90	825.1	0.0	0.0	0.01		**0.0**		916.5	0.0	0.0	0.00	
316	Verticaal eerste dwarsarm	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	191	**-18.4**	SPLS 6a_90 Ba All Cts Ah Ct2	59.7	58.8	86.4	0.31		**0.0**		133.6	58.8	69.8	0.00	
317	Verticaal eerste dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	186	**-5.4**	ULS 3_90	30.3	37.7	43.2	0.18		**0.0**		37.4	37.7	22.0	0.00	
318	Verticaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	103	**-1.0**	ULS 3_135	47.4	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00	
319	Tussen diagonaal eerste dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	563	**0.0**		5.1	75.4	86.4	0.00		**26.5**	ULS 1a_0	57.7	75.4	44.1	0.60	
320	Tussen diagonaal eerste dwarsarm	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	397	**0.0**		13.4	117.6	129.6	0.00		**40.6**	6a_90 Ba All Cts Ah Ct2	84.4	117.6	88.7	0.48	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 19-8-2020
Author MKh
Version 1.0

KIJ-GT 380
HB+0
3

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)
321	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	432	**0.0**		6.5	37.7	43.2	0.00		**15.4**	ULS 1a_0	37.4	37.7	22.0	0.70	
322	Dwarsligger bovenregel eerste dwarsarm	65x50x5	S235	1M20-5.6t	1.00	1.00	1.00	220	**-3.1**	ULS 3_0,9_90	21.9	58.8	54.0	0.14		**0.0**		61.9	58.8	31.9	0.00	
323	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	0.50	0.50	0.50	163	**-0.3**	SPLS 1a_0 Ah All Cts	28.9	37.7	43.2	0.01		**3.9**	ULS 3_0,9_45	37.4	37.7	22.0	0.18	
401	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	115	**-29.8**	SPLS 3_0,9_71 Ah Ct2	109.4	84.7	103.7	0.35		**30.7**	SPLS 3_71 Ah All Cts	124.4	84.7	88.6	0.36	
402	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	108	**-36.1**	SPLS 3_0,9_71 Ah All Cts	116.0	84.7	103.7	0.43		**36.3**	SPLS 3_71 Ah Ct1	124.4	84.7	88.6	0.43	
403	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	1M24-5.6t	0.54	0.54	0.54	104	**-42.5**	SPLS 3_71 Ah Ct1	120.7	84.7	103.7	0.50		**41.1**	SPLS 3_0,9_71 Ah All Cts	124.4	84.7	88.6	0.49	
404	Diagonaal onderregel tweede dwarsarm	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	90	**-46.0**	SPLS 3_71 Ah Ct1	129.0	117.6	129.6	0.39		**45.6**	SPLS 3_0,9_71 Ah All Cts	100.7	117.6	91.6	0.50	
405	Diagonaal onderregel tweede dwarsarm	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	84	**-54.4**	SPLS 3_0,9_71 Ah All Cts	134.9	117.6	129.6	0.46		**54.2**	SPLS 3_71 Ah Ct1	105.8	117.6	91.6	0.59	
406	Diagonaal onderregel tweede dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	80	**-67.8**	SPLS 3_71 Ah Ct1	139.0	117.6	129.6	0.58		**65.8**	SPLS 3_0,9_71 Ah All Cts	110.9	117.6	91.6	0.72	
407	Diagonaal onderregel tweede dwarsarm	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	82	**-23.9**	SPLS 3_0,9_71 Ah All Cts	79.8	58.8	64.8	0.41		**32.0**	SPLS 3_71 Ah All Cts	65.7	58.8	38.8	0.82	
408	Diagonaal onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	99	**0.0**		49.0	37.7	43.2	0.00		**5.8**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.26	
409	Dwarsligger onderregel tweede dwarsarm	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	54	**-0.6**	ULS 1a_0,9_0,9_90	689.5	117.6	216.0	0.00		**3.7**	ULS 3_90	766.1	117.6	0.0	0.03	
410	Dwarsligger onderregel tweede dwarsarm	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	47	**0.0**		403.5	117.6	259.2	0.00		**63.8**	ULS 3_71	278.4	117.6	259.2	0.54	
411	Dwarsligger onderregel tweede dwarsarm	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	33	**-8.3**	ULS 3_90	768.2	117.6	216.0	0.07		**0.0**		766.1	117.6	0.0	0.00	
412	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	201	**-4.9**	SPLS 1a_0 Ba All Cts	21.8	37.7	43.2	0.23		**5.1**	SPLS 1a_0,9_0 Ba Ct2	37.4	37.7	22.0	0.23	
413	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	187	**-5.2**	SPLS 1a_0 Ba All Cts	24.1	37.7	43.2	0.22		**4.8**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.22	
414	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	173	**-5.4**	SPLS 6a_90 Ah All Cts Ba Ct1	26.6	37.7	43.2	0.20		**6.2**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.28	
415	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	142	**-9.8**	SPLS 6a_90 Ah All Cts Ba Ct2	34.2	37.7	43.2	0.29		**9.7**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.44	
416	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	134	**-11.6**	SPLS 6a_90 Ah All Cts Ba Ct2	36.5	37.7	43.2	0.32		**11.6**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.53	
417	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	117	**-13.0**	SPLS 6a_90 Ah All Cts Ba Ct2	42.1	37.7	43.2	0.35		**12.6**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.57	
418	Diagonaal bovenregel tweede dwarsarm	60x60x5	S235	1M16-5.6t	0.55	0.55	0.55	109	**-18.9**	SPLS 6a_90 Ah All Cts Ba Ct2	54.6	37.7	43.2	0.50		**19.4**	6a_90 Ah All Cts Ba Ct2	60.5	37.7	32.0	0.61	
419	Diagonaal bovenregel tweede dwarsarm	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	94	**-24.4**	SPLS 6a_90 Ah All Cts Ba Ct2	61.7	58.8	54.0	0.45		**23.4**	6a_90 Ah All Cts Ba Ct2	54.7	58.8	37.0	0.63	
420	Diagonaal bovenregel tweede dwarsarm	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	75	**-25.6**	SPLS 6a_90 Ah All Cts Ba Ct2	69.3	58.8	54.0	0.47		**27.1**	6a_90 Ah All Cts Ba Ct2	54.7	58.8	37.0	0.73	
421	Dwarsligger bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	199	**-0.6**	ULS 1a_0,9_90	22.1	37.7	43.2	0.03		**0.5**	ULS 1a_0,9_0,9_90	37.4	37.7	22.0	0.02	
422	Dwarsligger bovenregel tweede dwarsarm	UNP160	S235	1M16-5.6t	1.00	1.00	1.00	42	**0.0**		288.5	37.7	64.8	0.00		**27.8**	ULS 3_0,9_90	155.5	37.7	64.8	0.74	
423	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	85	**-1.6**	SPLS 3_0,9_71 Ba Ct2	54.8	37.7	43.2	0.04		**3.0**	PLS 6a_90 Ba Ct2 Ba Ct1	37.4	37.7	22.0	0.14	
424	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	**0.0**		27.5	37.7	43.2	0.00		**4.8**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.22	
425	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	299	**-3.1**	SPLS 1a_71 Ah All Cts	11.9	37.7	43.2	0.26		**0.0**		37.4	37.7	22.0	0.00	
426	Tussen diagonaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	346	**-10.5**	SPLS 6a_90 Ba Ct2 Ba Ct1	9.4	37.7	43.2	1.12	knik	**2.3**	SPLS 3_0,9_71 Ba Ct2	37.4	37.7	22.0	0.10	
427	Tussen diagonaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	261	**0.0**		14.7	37.7	43.2	0.00		**1.1**	SPLS 1a_109 Ba Ct1	37.4	37.7	22.0	0.05	
428	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	116	**-0.1**	SPLS 6a_90 Ba Ct2 Ah Ct2	42.5	37.7	43.2	0.00		**0.0**	SPLS 3_0,9_71 Ah Ct2	37.4	37.7	22.0	0.00	
429	Bovenregel tweede dwarsarm	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	359	**0.0**		27.1	254.2	233.3	0.00		**106.6**	PLS 6a_90 Ba Ct2 Ah Ct2	161.1	254.2	199.4	0.66	
430	Bovenregel tweede dwarsarm	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	253	**0.0**		47.4	254.2	233.3	0.00		**95.9**	ULS 3_90	161.1	254.2	199.4	0.60	

Assessment of groups for strenghtened mast (afkeur level)

Date 19-8-2020
Author MKh
Version 1.0

KIJ-GT 380
HB+0
3

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	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	-47.0	SPLS 3_71 Ah Ct2	318.3	508.3	622.1	0.15		8.8	ULS 1a_0,9_0,9_71	379.5	508.3	531.7	0.02
101B	Leg	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	74	-137.3	ULS 1a_71	344.8	506.7	622.1	0.40		102.9	ULS 1a_0,9_0,9_71	379.5	506.7	531.7	0.27
102A	Leg	180x180x16#	S235	8M20-5.6t	0.50	0.50	0.50	54	-406.0	SPLS 3_71 Ah All Cts	1141.5	460.8	1382.4	0.88		321.7	SPLS 3_0,9_71 Ah All	1253.5	460.8	1382.4	0.70
102B	Leg	180x180x16#	S235	10M24-5.6t	0.50	0.50	0.50	57	-438.5	SPLS 3_71 Ah All Cts	1125.2	847.2	2073.6	0.52		333.1	SPLS 3_0,9_71 Ah All	1220.3	847.2	1612.8	0.39
103A	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	22	-796.5	SPLS 3_71 Ah All Cts	1444.7	941.5	2488.3	0.85		650.1	SPLS 3_0,9_71 Ah All	1386.2	941.5	2126.8	0.69
103B	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	35	-991.1	SPLS 3_71 Ah All Cts	1381.6	1987.7	2488.3	0.72		838.3	SPLS 3_0,9_71 Ah All	1386.2	1987.7	2126.8	0.60
103C	Leg	200x200x16	S235		0.50	0.50	0.50	28	-988.4	SPLS 3_71 Ah All Cts	1416.3	0.0	0.0	0.70		840.5	SPLS 3_0,9_71 Ah All	1452.3	0.0	0.0	0.58
104A	Leg	250x250x18#	S235	10M24-5.6t	0.50	0.50	0.50	28	-1246.0	SPLS 3_71 Ah All Cts	2013.7	1599.1	2332.8	0.78		1071.9	SPLS 3_0,9_71 Ah All	2030.6	1599.1	1993.8	0.67
104B	Leg	250x250x18#	S235	12M24-5.6t	0.50	0.50	0.50	34	-1351.0	SPLS 3_71 Ah All Cts	1969.4	1859.6	2799.4	0.73		1166.4	SPLS 3_0,9_71 Ah All	2030.6	1859.6	2392.6	0.63
104C	Leg	250x250x18#	S235		0.50	0.50	0.50	34	-1249.5	SPLS 3_71 Ah All Cts	1969.4	0.0	0.0	0.63		1069.0	SPLS 3_0,9_71 Ah All	2061.0	0.0	0.0	0.52
105	Leg	250x250x18#	S235	12M24-5.6t	0.17	0.17	0.17	33	-1374.4	SPLS 3_71 Ah All Cts	1974.3	1859.6	2799.4	0.74		1167.8	SPLS 3_0,9_71 Ah All	2030.6	1859.6	2392.6	0.63
106A	Onderregel eer	180x180x18#	S235	10M24-5.6t	1.48	1.00	1.00	68	-633.3	SPLS 6a_90 Ah Ct2 Ba	1175.3	831.3	2332.8	0.76		448.0	SPLS 3_0,9_71 Ah Ct1	1361.8	831.3	1993.8	0.54
106B	Onderregel eer	180x180x18#	S235	8M24-5.6t	12.15	2.00	1.00	67	-333.7	SPLS 6a_90 Ah Ct2 Ba	1186.1	677.8	1866.2	0.49		225.0	SPLS 3_0,9_71 Ah Ct1	1361.8	677.8	1595.1	0.33
106C	Onderregel eer	180x180x18#	S235		2.91	1.93	1.00	61	-566.4	SPLS 6a_90 Ah Ct2 Ba	1226.9	0.0	0.0	0.46		381.2	SPLS 3_0,9_71 Ah Ct1	1454.7	0.0	0.0	0.26
107A	Onderregel eer	160x160x17#	S235		2.67	1.00	1.00	76	-322.0	SPLS 6a_90 Ah Ct2 Ba	939.3	0.0	0.0	0.34		208.2	SPLS 3_0,9_71 Ah Ct1	1219.7	0.0	0.0	0.17
107B	Onderregel eer	160x160x17#	S235	2M20-5.6t	1.00	1.43	1.00	22	-3.5	ULS 3_0,9_0	1213.4	117.6	367.2	0.03		0.1	SPLS 1a_0 Ba All Cts	668.3	117.6	356.1	0.00
107C	Onderregel eer	160x160x17#	S235		14.68	1.00	1.00	76	-307.6	SPLS 6a_90 Ah Ct2 Ba	939.4	0.0	0.0	0.33		193.7	SPLS 3_0,9_71 Ah Ct1	1219.7	0.0	0.0	0.16
108A	Bovenregel eer	80x80x8	S235	3M24-5.6t	1.00	1.96	1.00	311	0.0		34.6	254.2	311.0	0.00		118.1	ULS 3_135	160.8	254.2	259.0	0.73
108B	Bovenregel eer	80x80x8	S235	4M24-5.6t	1.00	2.04	1.00	311	0.0		34.6	338.9	414.7	0.00		87.6	SPLS 6a_90 Ah Ct1 Ba	211.0	338.9	347.4	0.42
109A	Bovenregel eer	70x70x7	S235	4M20-5.6t	1.00	1.99	1.00	358	0.0		21.0	235.2	302.4	0.00		77.4	SPLS 6a_90 Ah Ct1 Ba	163.8	235.2	191.5	0.47
109B	Bovenregel eer	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	356	0.0		21.2	176.4	226.8	0.00		77.5	SPLS 6a_90 Ah Ct1 Ba	125.5	176.4	155.3	0.62
110A	Onderregel twe	160x160x17#	S235	12M24-5.6t	1.68	1.00	1.00	67	-406.1	SPLS 3_71 Ah All Cts	995.9	991.5	2643.8	0.41		309.4	SPLS 3_0,9_71 Ah All	1116.1	991.5	2259.7	0.31
110B	Onderregel twe	160x160x17#	S235		1.00	1.67	1.00	24	-4.4	SPLS 1a_135 Ah All Ct	1206.8	0.0	0.0	0.00		0.0		1219.7	0.0	0.0	0.00
110C	Onderregel twe	160x160x17#	S235		2.48	1.48	1.00	67	-369.8	SPLS 3_71 Ah All Cts	995.9	0.0	0.0	0.37		270.3	SPLS 3_0,9_71 Ah All	1219.7	0.0	0.0	0.22
111A	Bovenregel twe	120x120x11	S235	4M24-5.6t	1.50	1.00	1.00	95	-200.1	SPLS 6a_90 Ah All Cts	326.6	338.9	570.2	0.61		181.4	SPLS 6a_90 Ah All Cts	346.4	338.9	453.2	0.54
111B	Bovenregel twe	120x120x11	S235	3M24-5.6t	1.50	1.00	1.00	95	-184.1	SPLS 6a_90 Ah All Cts	326.6	254.2	427.7	0.72		174.1	SPLS 6a_90 Ah All Cts	456.8	254.2	365.5	0.69
111C	Bovenregel twe	120x120x11	S235		3.00	2.00	1.00	92	-195.2	SPLS 6a_90 Ah All Cts	326.5	0.0	0.0	0.60		182.0	SPLS 6a_90 Ah All Cts	599.7	0.0	0.0	0.30
112A	Bovenregel twe	150x100x10	S235	3M24-5.6t	2.86	1.00	1.00	103	-161.5	SPLS 6a_90 Ah All Cts	283.9	249.9	388.8	0.65		170.2	SPLS 6a_90 Ah All Cts	437.7	249.9	332.3	0.68
112B	Bovenregel twe	150x100x10	S235	4M24-5.6t	3.73	1.00	1.00	105	-34.5	SPLS 3_0,9_71 Ah All	278.5	338.9	518.4	0.12		33.7	SPLS 6a_90 Ah Ct1 Ba	495.3	338.9	443.1	0.10
112C	Bovenregel twe	150x100x10	S235		2.90	1.00	1.00	104	-147.0	SPLS 6a_90 Ah All Cts	280.5	0.0	0.0	0.52		155.2	SPLS 6a_90 Ah All Cts	571.3	0.0	0.0	0.27
113	Ladder tweede	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	162	-31.1	SPLS 6a_90 Ba Ct1 Ba	79.8	84.7	77.8	0.40		11.6	SPLS 3_0,9_90 Ah Ct2	127.9	84.7	66.5	0.17
201L	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	-38.3	SPLS 3_71 Ah Ct2	91.4	84.7	77.8	0.49		28.8	ULS 1a_0,9_90	127.9	84.7	66.5	0.43
201T	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	-23.2	SPLS 6a_90 Ba Ct2 Ah	91.4	84.7	77.8	0.30		9.7	SPLS 1a_0,9_71 Ba Ct	127.9	84.7	66.5	0.15
202L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	-183.7	SPLS 3_90 Ba Ct2	425.3	338.9	518.4	0.54		140.4	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.41
202T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	-136.8	SPLS 3_90 Ah Ct1	425.3	338.9	518.4	0.40		151.9	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.45
203L	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	-129.0	SPLS 3_0,9_90 Ba Ct1	406.7	338.9	518.4	0.38		168.0	SPLS 3_90 Ba Ct2	384.5	338.9	350.9	0.50
203T	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	-138.0	SPLS 3_0,9_90 Ah Ct2	406.7	338.9	518.4	0.41		124.3	SPLS 3_90 Ah Ct1	384.5	338.9	350.9	0.37
204L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	-175.6	SPLS 3_0,9_90 Ah Ct2	381.0	338.9	518.4	0.52		137.9	SPLS 3_0,9_71 Ah Ct1	384.5	338.9	350.9	0.41
204T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	-160.3	SPLS 3_90 Ah Ct1	381.0	338.9	518.4	0.47		151.1	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.45
205L	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	-347.1	SPLS 3_71 Ba Ct1	449.2	508.3	777.6	0.77		341.7	SPLS 3_71 Ba Ct2	384.5	508.3	513.8	0.89
205T	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	-322.6	SPLS 3_0,9_71 Ba Ct2	449.2	508.3	777.6	0.72		320.2	SPLS 3_71 Ba Ct1	384.5	508.3	513.8	0.83
206L	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	-285.5	SPLS 3_71 Ba Ct2	463.5	423.6	777.6	0.67		284.8	SPLS 3_71 Ba Ct1	456.2	423.6	518.8	0.67
206T	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	-265.2	SPLS 3_71 Ba Ct1	463.5	423.6	777.6	0.63		265.1	SPLS 3_0,9_71 Ba Ct2	456.2	423.6	518.8	0.63
207L	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	-233.9	SPLS 3_71 Ba Ct1	392.0	338.9	622.1	0.69		231.5	SPLS 3_71 Ba Ct2	456.2	338.9	421.1	0.68
207T	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	-218.2	SPLS 3_0,9_71 Ba Ct2	392.0	338.9	622.1	0.64		214.3	SPLS 3_71 Ba Ct1	456.2	338.9	421.1	0.63
208L	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	-194.5	SPLS 3_71 Ba Ct2	332.1	254.2	388.8	0.77		191.6	SPLS 3_0,9_71 Ba Ct1	384.5	254.2	269.2	0.75
208T	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	-180.9	SPLS 3_71 Ba Ct1	332.1	254.2	388.8	0.71		181.4	SPLS 3_0,9_71 Ba Ct2	384.5	254.2	269.2	0.71
209L	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	-244.8	SPLS 3_71 Ba Ct2	370.1	338.9	570.2	0.72		233.7	SPLS 3_0,9_71 Ba Ct1	356.4	338.9	475.6	0.69
209T	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	-233.8	SPLS 3_71 Ba Ct1	370.1	338.9	570.2	0.69		226.3	SPLS 3_0,9_71 Ba Ct2	356.4	338.9	475.6	0.67
210	Top	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	280	-12.0	SPLS 6a_90 Ba Ct2 Ah	16.5	75.4	86.4	0.72		11.9	SPLS 6a_90 Ba Ct2 Ah	52.4	75.4	44.1	0.27
211L	Tweede dwarsa	80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	167	0.0		89.7	254.2	311.0	0.00		86.5	ULS 6a_90 Ah Ct2	160.8	254.2	259.0	0.54
211T	Tweede dwarsa	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	167	-3.6	ULS 1a_0,9_90	89.7	169.4	207.4	0.04		3.5	ULS 1a_90	206.0	169.4	177.2	0.02
114L	Tweede dwarsa	160x160x15#	S235	12M24-5.6t	2.00	1.00	1.00	59	-527.7	SPLS 3_71 Ah All Cts	936.1	991.5	2332.8	0.56		448.5	SPLS 3_0,9_71 Ah All	1008.5	991.5	1914.1	0.45
212T	Tweede dwarsa	100x100x6	S235	4M24-5.6t	2.00	1.00	1.00	95	-46.6	SPLS 3_0,9_71 Ba Ct2	144.3	338.9	311.0	0.32		59.9	SPLS 3_71 Ba Ct2	225.0	338.9	265.8	0.27
213	Tweede dwarsa	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	86	-65.6	SPLS 3_0,9_71 Ba Ct2	265.3	169.4	207.4	0.39		66.6	SPLS 3_71 Ba Ct2	226.0	169.4	177.2	0.39
214	Tweede dwarsa	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	300	-0.6	ULS 3_0	11.8	37.7	43.2	0.05		0.0		37.4	37.7	22.0	0.00
215L	Eerste dwarsarı	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	178	0.0		103.8	254.2	311.0	0.00		112.4	SPLS 6a_90 Ba All Cts	270.5	254.2	265.8	0.44
215T	Eerste dwarsarı	100x100x8	S235	1M24-5.6t	1.00	1.00	1.00	178	-47.3	ULS 1a_0,9_90	83.1	84.7	103.7	0.57		52.1	ULS 1a_90	170.5	84.7	88.6	0.61
115L	Eerste dwarsarı	180x180x18#	S235	10M24-5.6t	2.00	1.00	1.00	69	-573.1	SPLS 3_71 Ah All Cts	1169.6	831.3	2332.8	0.69		418.4	SPLS 3_0,9_71 Ah All	1361.8	831.3	1993.8	0.50
216T	Eerste dwarsarı	100x100x8	S235	4M24-5.6t	2.00	1.00	1.00	124	-109.2	SPLS 3_0,9_71 Ba Ct2	151.1	338.9	414.7	0.72		122.7	SPLS 3_71 Ba Ct1	293.9	338.9	354.5	0.42
217	Eerste dwarsarı	120x120x11	S235	2M24-5.6t	1.00	1.00	1.00	114	-148.7	SPLS 3_0,9_71 Ba Ct2	286.0	169.4	285.1	0.88		150.1	SPLS 3_71 Ba Ct2	306.2	169.4	243.7	0.89
218	Eerste dwarsarı	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	325	-0.9	ULS 3_0	12.6	58.8	54.0	0.07		0.0		54.7	58.8	37.0	0.00
219L	Onderstuk in to	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	-48.9	SPLS 3_71 Ah All Cts	195.2	169.4	311.0	0.29		34.2	SPLS 3_0,9_71 Ah All	329.5	169.4	265.8	0.20
219T	Onderstuk in to	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	-53.0	SPLS 3_71 Ah All Cts	195.2	169.4	311.0	0.31		38.2	SPLS 3_0,9_71 Ah All	329.5	169.4	265.8	0.23
220	Onderstuk in to	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	311	-5.3	SPLS 1a_45 Ah Ct1	11.6	37.7	43.2	0.46		4.2	ULS 1a_0,9_0,9_135	60.5	37.7	32.0	0.13
221	Onderstuk in to	70x70x5#	S235	1M16-5.6t	0.50	1.00	0.50	370	-0.9	SPLS 3_71 Ba Ct2	9.9	37.7	43.2	0.09		0.0		74.9	37.7	32.0	0.00
301	Diagonaal onde	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	120	-59.8	SPLS 3_71 Ah All Cts	124.6	117.6	129.6	0.51		55.7	SPLS 3_0,9_71 Ah All	138.8	117.6	91.6	0.61
302	Diagonaal onde	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	108	-70.0	SPLS 3_71 Ah Ct1	138.3	117.6	129.6	0.59		66.2	SPLS 3_0,9_71 Ah Ct1	140.5	117.6	91.6	0.72
303	Diagonaal onde	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	99	-81.7	SPLS 3_71 Ah All Cts	149.4	117.6	129.6	0.69		84.5	SPLS 3_0,9_71 Ah All	145.4	117.6	91.6	0.92
304	Diagonaal onde	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	89	-45.6	SPLS 3_71 Ah All Cts	103.7	84.7	77.8	0.59		45.9	SPLS 3_0,9_71 Ah All	93.3	84.7	59.8	0.77
305	Diagonaal onde	70x70x6	S235	1M20-5.6t	0.55	0.55	0.55	109	-28.0	SPLS 6a_90 Ah Ct2 Ba	75.9	58.8	64.8	0.48		31.0	SPLS 3_0,9_71 Ah All	82.9	58.8	52.4	0.59
306	Diagonaal onde	70x70x6	S235	2M20-5.6t	0.55	0.55	0.55	107	-37.6	SPLS 3_71 Ah All Cts	96.4	117.6	129.6	0.39		37.8	SPLS 3_0,9_71 Ah All	84.5	117.6	91.6	0.45
307	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	82	-47.7	SPLS 3_0,9_71 Ah All	137.9	117.6	129.6	0.41		46.8	SPLS 3_71 Ah All Cts	118.5	117.6	91.6	0.51
308	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	77	-64.7	SPLS 3_71 Ah All Cts	142.4	117.6	129.6	0.55		63.7	SPLS 3_0,9_71 Ah All	117.2	117.6	91.6	0.69
309	Diagonaal onde	70x70x7	S235	1M24-5.6t	1.00	1.00	1.00	64	-28.7	SPLS 3_71 Ah Ct2	118.4	84.7	90.7	0.34		30.1	SPLS 3_0,9_71 Ah All	88.7	84.7	57.8	0.52
310	Diagonaal onde	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	90	-0.2	SPLS 1a_0,9_45 Ba Ct	52.8	37.7	43.2	0.01		4.0	ULS 3_0,9_109	37.4	37.7	22.0	0.18
311	Dwarsligger on	HEA160	S235		1.00	1.00	1.00	28	-6.5	ULS 3_0,9_90	784.4	0.0	0.0	0.01		7.5	ULS 3_90	916.5	0.0	0.0	0.01
312	Dwarsligger on	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	82	-18.8	SPLS 3_0,9_71 Ah All	315.3	117.6	259.2	0.16		64.2	SPLS 3_71 Ah All Cts	278.4	117.6	259.2	0.55
314	Dwarsligger on	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	38	0.0		422.5	117.6	259.2	0.00		63.4	ULS 3_0,9_71	278.4	117.6	259.2	0.54
315	Dwarsligger on	HEA160	S235		1.00	1.00	1.00	13	-8.1	ULS 3_0,9_90	825.1	0.0	0.0	0.01		0.0		916.5	0.0	0.0	0.00
316	Verticaal eerste	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	191	-18.4	SPLS 6a_90 Ba All Cts	59.7	58.8	86.4	0.31		0.0		133.6	58.8	69.8	0.00
317	Verticaal eerste	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	186	-5.4	ULS 3_90	30.3	37.7	43.2	0.18		0.0		37.4	37.7	22.0	0.00

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date	19-8-2020
Author	MKh
Version	1.0

KIJ-GT 380
HB+0
3

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)
318	Verticaal eerste	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	103	**-1.0**	ULS 3_135	47.4	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00
319	Tussen diagona	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	563	**0.0**		5.1	75.4	86.4	0.00		**26.5**	ULS 1a_0	57.7	75.4	44.1	0.60
320	Tussen diagona	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	397	**0.0**		13.4	117.6	129.6	0.00		**40.6**	SPLS 6a_90 Ba All Cts	84.4	117.6	88.7	0.48
321	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	432	**0.0**		6.5	37.7	43.2	0.00		**15.4**	ULS 1a_0	37.4	37.7	22.0	0.70
322	Dwarsligger bo	65x50x5	S235	1M20-5.6t	1.00	1.00	1.00	220	**-3.1**	ULS 3_0,9_90	21.9	58.8	54.0	0.14		**0.0**		61.9	58.8	31.9	0.00
323	Tussen diagona	50x50x5	S235	1M16-5.6t	0.50	0.50	0.50	163	**-0.3**	SPLS 1a_0 Ah All Cts	28.9	37.7	43.2	0.01		**3.9**	ULS 3_0,9_45	37.4	37.7	22.0	0.18
401	Diagonaal onde	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	115	**-29.8**	SPLS 3_0,9_71 Ah Ct2	109.4	84.7	103.7	0.35		**30.7**	SPLS 3_71 Ah All Cts	124.4	84.7	88.6	0.36
402	Diagonaal onde	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	108	**-36.1**	SPLS 3_0,9_71 Ah All (	116.0	84.7	103.7	0.43		**36.3**	SPLS 3_71 Ah Ct1	124.4	84.7	88.6	0.43
403	Diagonaal onde	80x80x8	S235	1M24-5.6t	0.54	0.54	0.54	104	**-42.5**	SPLS 3_71 Ah Ct1	120.7	84.7	103.7	0.50		**41.1**	SPLS 3_0,9_71 Ah All (	124.4	84.7	88.6	0.49
404	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	90	**-46.0**	SPLS 3_71 Ah Ct1	129.0	117.6	129.6	0.39		**45.6**	SPLS 3_0,9_71 Ah All (	100.7	117.6	91.6	0.50
405	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	84	**-54.4**	SPLS 3_0,9_71 Ah All (	134.9	117.6	129.6	0.46		**54.2**	SPLS 3_71 Ah Ct1	105.8	117.6	91.6	0.59
406	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	80	**-67.8**	SPLS 3_71 Ah Ct1	139.0	117.6	129.6	0.58		**65.8**	SPLS 3_0,9_71 Ah All (	110.9	117.6	91.6	0.72
407	Diagonaal onde	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	82	**-23.9**	SPLS 3_0,9_71 Ah All (	79.8	58.8	64.8	0.41		**32.0**	SPLS 3_71 Ah All Cts	65.7	58.8	38.8	0.82
408	Diagonaal onde	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	99	**0.0**		49.0	37.7	43.2	0.00		**5.8**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.26
409	Dwarsligger on	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	54	**-0.6**	ULS 1a_0,9_0,9_90	689.5	117.6	216.0	0.00		**3.7**	ULS 3_90	766.1	117.6	0.0	0.03
410	Dwarsligger on	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	47	**0.0**		403.5	117.6	259.2	0.00		**63.8**	ULS 3_71	278.4	117.6	259.2	0.54
411	Dwarsligger on	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	33	**-8.3**	ULS 3_90	768.2	117.6	216.0	0.07		**0.0**		766.1	117.6	0.0	0.00
412	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	201	**-4.9**	SPLS 1a_0 Ba All Cts	21.8	37.7	43.2	0.23		**5.1**	SPLS 1a_0,9_0 Ba Ct2	37.4	37.7	22.0	0.23
413	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	187	**-5.2**	SPLS 1a_0 Ba All Cts	24.1	37.7	43.2	0.22		**4.8**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.22
414	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	173	**-5.4**	SPLS 6a_90 Ah All Cts	26.6	37.7	43.2	0.20		**6.2**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.28
415	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	142	**-9.8**	SPLS 6a_90 Ah All Cts	34.2	37.7	43.2	0.29		**9.7**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.44
416	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	134	**-11.6**	SPLS 6a_90 Ah All Cts	36.5	37.7	43.2	0.32		**11.6**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.53
417	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	117	**-13.0**	SPLS 6a_90 Ah All Cts	42.1	37.7	43.2	0.35		**12.6**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.57
418	Diagonaal bove	60x60x5	S235	1M16-5.6t	0.55	0.55	0.55	109	**-18.9**	SPLS 6a_90 Ah All Cts	54.6	37.7	43.2	0.50		**19.4**	SPLS 6a_90 Ah All Cts	60.5	37.7	32.0	0.61
419	Diagonaal bove	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	94	**-24.4**	SPLS 6a_90 Ah All Cts	61.7	58.8	54.0	0.45		**23.4**	SPLS 6a_90 Ah All Cts	54.7	58.8	37.0	0.63
420	Diagonaal bove	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	75	**-25.6**	SPLS 6a_90 Ah All Cts	69.3	58.8	54.0	0.47		**27.1**	SPLS 6a_90 Ah All Cts	54.7	58.8	37.0	0.73
421	Dwarsligger bo	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	199	**-0.6**	ULS 1a_0,9_90	22.1	37.7	43.2	0.03		**0.5**	ULS 1a_0,9_0,9_90	37.4	37.7	22.0	0.02
422	Dwarsligger bo	UNP160	S235	1M16-5.6t	1.00	1.00	1.00	42	**0.0**		288.5	37.7	64.8	0.00		**27.8**	ULS 3_0,9_90	155.5	37.7	64.8	0.74
423	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	85	**-1.6**	SPLS 3_0,9_71 Ba Ct2	54.8	37.7	43.2	0.04		**3.1**	SPLS 6a_90 Ba Ct2 Ba	37.4	37.7	22.0	0.14
424	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	**0.0**		27.5	37.7	43.2	0.00		**4.8**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.22
425	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	299	**-3.1**	SPLS 1a_71 Ah All Cts	11.9	37.7	43.2	0.26		**0.0**		37.4	37.7	22.0	0.00
426	Tussen diagona	**50x50x6**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	346	**-10.7**	SPLS 6a_90 Ba Ct2 Ba	11.9	60.3	70.6	0.90		**2.3**	SPLS 3_0,9_71 Ba Ct2	61.2	60.3	36.0	0.06
427	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	261	**0.0**		14.7	37.7	43.2	0.00		**1.1**	SPLS 1a_109 Ba Ct1	37.4	37.7	22.0	0.05
428	Dwarsligger lad	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	116	**-0.1**	SPLS 6a_90 Ba Ct2 Ah	42.5	37.7	43.2	0.00		**0.0**	SPLS 3_0,9_71 Ah Ct2	37.4	37.7	22.0	0.00
429	Bovenregel twe	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	359	**0.0**		27.1	254.2	233.3	0.00		**106.6**	SPLS 6a_90 Ba Ct2 Ah	161.1	254.2	199.4	0.66
430	Bovenregel twe	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	253	**0.0**		47.4	254.2	233.3	0.00		**96.0**	ULS 3_90	161.1	254.2	199.4	0.60

<u>**Assessment of groups for strengthened mast (verbouw level)**</u>

Date	19-8-2020
Author	MKh
Version	1.0

KIJ-GT 380
HB+0
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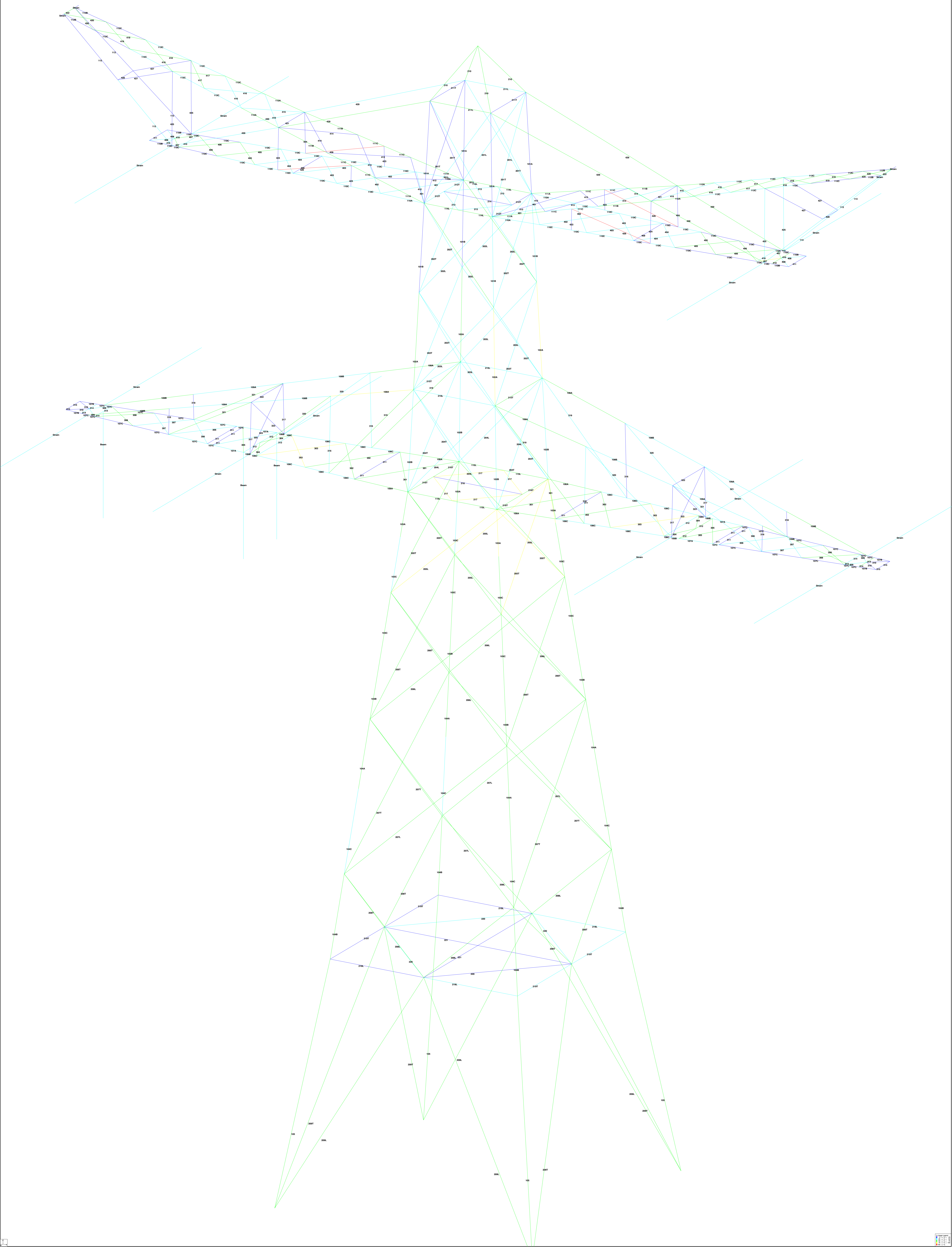
Staafgroep	Omschrijving	Profiel	Staalsoort	Bouten	RLX	RLY	RLZ	Slankheid	Druk	Combinatie druk	Knik	Afschuiving	Stuik (druk)	U.C. (druk)	Opm.	Trek	Combinatie trek	Nettodsn.	Afschuif	Stuik (trek)	U.C. (trek)
426	Tussen diagona	**50x50x6**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	346	**-11.4**	SPLS 6a 90 Ba Ct2 Ba	11.9	60.3	70.6	0.96		**2.6**	SPLS 3 0,9 71 Ba Ct2	61.2	60.3	36.0	0.07

DNV GL Nederlands BV, Project: "HB+0 (da) ini"
Tower Version 16.39, 14:30:48 woensdag 19 augustus 2020
Undeformed geometry displayed



DNV·GL

Assessment of groups for initial mast (afkeur level)

Date	19-8-2020
Author	MKh
Version	1.0

KIJ-GT 380
HB+0
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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)
101A	Leg	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	**-45.6**	SPLS 3_71,5 Ah Ct2	318.3	508.3	622.1	0.14		**5.6**	S 1a_0,9_71,5 Ah All Cts	379.5	508.3	531.7	0.01	
101B	Leg	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	74	**-123.9**	SPLS 3_71,5 Ah Ct2	344.8	506.7	622.1	0.36		**89.3**	LS 3_0,9_71,5 Ah All Cts	379.5	506.7	531.7	0.24	
102A	Leg	180x180x16	S235	8M20-5.6t	0.50	0.50	0.50	54	**-371.1**	SPLS 3_108,5 Ba All Cts	1141.5	460.8	1382.4	0.81		**285.3**	LS 3_0,9_71,5 Ah All Cts	1253.5	460.8	1382.4	0.62	
102B	Leg	180x180x16	S235	10M24-5.6t	0.50	0.50	0.50	57	**-403.9**	SPLS 3_108,5 Ba All Cts	1125.2	847.2	2073.6	0.48		**293.0**	LS 3_0,9_71,5 Ah All Cts	1220.3	847.2	1612.8	0.35	
103A	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	22	**-726.2**	SPLS 3_108,5 Ba All Cts	1444.7	941.5	2488.3	0.77		**579.8**	LS 3_0,9_71,5 Ah All Cts	1386.2	941.5	2126.8	0.62	
103B	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	35	**-903.3**	SPLS 3_108,5 Ba All Cts	1381.6	1987.7	2488.3	0.65		**753.4**	LS 3_0,9_71,5 Ah All Cts	1386.2	1987.7	2126.8	0.54	
103C	Leg	200x200x16	S235		0.50	0.50	0.50	28	**-900.6**	SPLS 3_108,5 Ba All Cts	1416.3	0.0	0.0	0.64		**755.6**	LS 3_0,9_71,5 Ah All Cts	1452.3	0.0	0.0	0.52	
104A	Leg	250x250x18	S235	10M24-5.6t	0.50	0.50	0.50	28	**-1134.3**	SPLS 3_71,5 Ah All Cts	2013.7	1599.1	2332.8	0.71		**967.2**	LS 3_0,9_71,5 Ah All Cts	2030.6	1599.1	1993.8	0.60	
104B	Leg	250x250x18	S235	12M24-5.6t	0.50	0.50	0.50	34	**-1231.7**	SPLS 3_71,5 Ah All Cts	1969.4	1859.6	2799.4	0.66		**1054.6**	LS 3_0,9_71,5 Ah All Cts	2030.6	1859.6	2392.6	0.57	
104C	Leg	250x250x18	S235		0.50	0.50	0.50	34	**-1137.7**	SPLS 3_71,5 Ah All Cts	1969.4	0.0	0.0	0.58		**964.3**	LS 3_0,9_71,5 Ah All Cts	2061.0	0.0	0.0	0.47	
105	Leg	250x250x18	S235	12M24-5.6t	0.17	0.17	0.17	33	**-1253.9**	SPLS 3_71,5 Ah All Cts	1974.3	1859.6	2799.4	0.67		**1055.1**	LS 3_0,9_71,5 Ah All Cts	2030.6	1859.6	2392.6	0.57	
106A	Onderregel eerste dwarsarm	180x180x18	S235	10M24-5.6t	1.48	1.00	1.00	68	**-612.4**	SPLS 6a_90 Ba Ct2 Ah Ct2	1175.3	831.3	2332.8	0.74		**416.0**	SPLS 3_0,9_71,5 Ah Ct1	1361.8	831.3	1993.8	0.50	
106B	Onderregel eerste dwarsarm	180x180x18	S235	8M24-5.6t	12.15	2.00	1.00	67	**-324.0**	SPLS 6a_90 Ba Ct2 Ah Ct2	1186.1	677.8	1866.2	0.48		**209.4**	SPLS 3_0,9_71,5 Ah Ct1	1361.8	677.8	1595.1	0.31	
106C	Onderregel eerste dwarsarm	180x180x18	S235		2.91	1.93	1.00	61	**-549.6**	SPLS 6a_90 Ba Ct2 Ah Ct2	1226.9	0.0	0.0	0.45		**354.1**	SPLS 3_0,9_71,5 Ah Ct1	1454.7	0.0	0.0	0.24	
107A	Onderregel eerste dwarsarm	160x160x17	S235		2.67	1.00	1.00	76	**-312.9**	SPLS 6a_90 Ba Ct2 Ah Ct2	939.3	0.0	0.0	0.33		**193.7**	SPLS 3_0,9_71,5 Ah Ct1	1219.7	0.0	0.0	0.16	
107B	Onderregel eerste dwarsarm	160x160x17	S235	2M20-5.6t	1.00	1.43	1.00	22	**-3.5**	ULS 3_0,9_0	1213.4	117.6	367.2	0.03		**0.0**		668.3	117.6	356.1	0.00	
107C	Onderregel eerste dwarsarm	160x160x17	S235		14.68	1.00	1.00	76	**-299.4**	SPLS 6a_90 Ba Ct2 Ah Ct2	939.4	0.0	0.0	0.32		**180.2**	SPLS 3_0,9_71,5 Ah Ct1	1219.7	0.0	0.0	0.15	
108A	Bovenregel eerste dwarsarm	80x80x8	S235	3M24-5.6t	1.00	1.96	1.00	311	**0.0**		34.6	254.2	311.0	0.00		**121.7**	ULS 3_135	160.8	254.2	259.0	0.76	
108B	Bovenregel eerste dwarsarm	80x80x8	S235	4M24-5.6t	1.00	2.04	1.00	311	**0.0**		34.6	338.9	414.7	0.00		**88.5**	ULS 3_135	211.0	338.9	347.4	0.42	
109A	Bovenregel eerste dwarsarm	70x70x7	S235	4M20-5.6t	1.00	1.99	1.00	358	**0.0**		21.0	235.2	302.4	0.00		**77.3**	ULS 3_135	163.8	235.2	191.5	0.47	
109B	Bovenregel eerste dwarsarm	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	356	**0.0**		21.2	176.4	226.8	0.00		**77.4**	ULS 3_135	125.5	176.4	155.3	0.62	
110A	Onderregel tweede dwarsarm	160x160x17	S235	12M24-5.6t	1.68	1.00	1.00	67	**-385.2**	SPLS 6a_90 Ba All Cts Ah Ct2	995.9	991.5	2643.8	0.39		**280.0**	LS 3_0,9_71,5 Ah All Cts	1116.1	991.5	2259.7	0.28	
110B	Onderregel tweede dwarsarm	160x160x17	S235		1.00	1.67	1.00	24	**-4.3**	SPLS 1a_135 Ah All Cts	1206.8	0.0	0.0	0.00		**0.0**		1219.7	0.0	0.0	0.00	
110C	Onderregel tweede dwarsarm	160x160x17	S235		2.48	1.48	1.00	67	**-353.1**	SPLS 6a_90 Ba All Cts Ah Ct2	995.9	0.0	0.0	0.35		**244.5**	LS 3_0,9_71,5 Ah All Cts	1219.7	0.0	0.0	0.20	
111A	Bovenregel tweede dwarsarm	120x120x11	S235	4M24-5.6t	1.50	1.00	1.00	95	**-192.4**	SPLS 6a_90 Ah All Cts Ba Ct1	326.6	338.9	570.2	0.59		**172.6**	S 6a_90 Ah All Cts Ba Ct2	346.4	338.9	453.2	0.51	
111B	Bovenregel tweede dwarsarm	120x120x11	S235	3M24-5.6t	1.50	1.00	1.00	95	**-176.8**	SPLS 6a_90 Ah All Cts Ba Ct1	326.6	254.2	427.7	0.70		**165.6**	S 6a_90 Ah All Cts Ba Ct2	456.8	254.2	365.5	0.65	
111C	Bovenregel tweede dwarsarm	120x120x11	S235		3.00	2.00	1.00	92	**-187.7**	SPLS 6a_90 Ah All Cts Ba Ct1	326.5	0.0	0.0	0.58		**173.1**	S 6a_90 Ah All Cts Ba Ct2	599.7	0.0	0.0	0.29	
112A	Bovenregel tweede dwarsarm	150x100x10	S235	3M24-5.6t	2.86	1.00	1.00	103	**-154.8**	SPLS 6a_90 Ah All Cts Ba Ct1	283.9	249.9	388.8	0.62		**162.2**	S 6a_90 Ah All Cts Ba Ct2	437.7	249.9	332.3	0.65	
112B	Bovenregel tweede dwarsarm	150x100x10	S235	4M24-5.6t	3.73	1.00	1.00	105	**-30.8**	SPLS 6a_90 Ah All Cts Ba Ct1	278.5	338.9	518.4	0.11		**31.8**	PLS 6a_90 Ah Ct1 Ba Ct2	495.3	338.9	443.1	0.09	
112C	Bovenregel tweede dwarsarm	150x100x10	S235		2.90	1.00	1.00	104	**-141.0**	SPLS 6a_90 Ah All Cts Ba Ct1	280.5	0.0	0.0	0.50		**147.9**	S 6a_90 Ah All Cts Ba Ct2	571.3	0.0	0.0	0.26	
113	Ladder tweede dwarsarm	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	162	**-30.1**	SPLS 6a_90 Ah Ct1 Ah Ct2	79.8	84.7	77.8	0.39		**10.5**	SPLS 3_0,9_90 Ba Ct2	127.9	84.7	66.5	0.16	
201L	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	**-35.7**	SPLS 3_90 Ah Ct2	91.4	84.7	77.8	0.46		**23.7**	PLS 6a_90 Ah Ct2 Ah Ct1	127.9	84.7	66.5	0.36	
201T	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	**-22.7**	SPLS 6a_90 Ba Ct2 Ah Ct2	91.4	84.7	77.8	0.29		**8.9**	SPLS 3_0,9_108,5 Ah Ct2	127.9	84.7	66.5	0.13	
202L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	**-174.3**	SPLS 3_90 Ba Ct2	425.3	338.9	518.4	0.51		**130.3**	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.38	
202T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	**-129.8**	SPLS 3_90 Ba Ct1	425.3	338.9	518.4	0.38		**142.6**	SPLS 3_0,9_90 Ba Ct2	384.5	338.9	350.9	0.42	
203L	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	**-119.6**	SPLS 3_0,9_90 Ba Ct1	406.7	338.9	518.4	0.35		**159.2**	SPLS 3_90 Ba Ct2	384.5	338.9	350.9	0.47	
203T	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	**-129.6**	SPLS 3_0,9_90 Ba Ct2	406.7	338.9	518.4	0.38		**117.9**	SPLS 3_90 Ba Ct1	384.5	338.9	350.9	0.35	
204L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	**-164.1**	SPLS 3_0,9_90 Ah Ct2	381.0	338.9	518.4	0.48		**131.7**	SPLS 3_0,9_108,5 Ba Ct1	384.5	338.9	350.9	0.39	
204T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	**-151.6**	SPLS 3_90 Ba Ct1	381.0	338.9	518.4	0.45		**140.8**	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.42	
205L	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	**-321.2**	SPLS 3_71,5 Ba Ct1	449.2	508.3	777.6	0.72		**318.8**	SPLS 3_71,5 Ba Ct2	384.5	508.3	513.8	0.83	
205T	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	**-306.0**	SPLS 3_0,9_71,5 Ba Ct2	449.2	508.3	777.6	0.68		**303.4**	SPLS 3_71,5 Ba Ct1	384.5	508.3	513.8	0.79	
206L	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	**-266.7**	SPLS 3_71,5 Ba Ct2	463.5	423.6	777.6	0.63		**263.7**	SPLS 3_71,5 Ba Ct1	456.2	423.6	518.8	0.62	
206T	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	**-251.1**	SPLS 3_71,5 Ba Ct1	463.5	423.6	777.6	0.59		**251.2**	SPLS 3_0,9_71,5 Ba Ct2	456.2	423.6	518.8	0.59	
207L	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	**-216.9**	SPLS 3_71,5 Ba Ct1	392.0	338.9	622.1	0.64		**216.3**	SPLS 3_71,5 Ba Ct2	456.2	338.9	421.1	0.64	
207T	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	**-206.6**	SPLS 3_0,9_71,5 Ba Ct2	392.0	338.9	622.1	0.61		**202.7**	SPLS 3_71,5 Ba Ct1	456.2	338.9	421.1	0.60	
208L	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	**-182.3**	SPLS 3_71,5 Ba Ct2	332.1	254.2	388.8	0.72		**178.0**	SPLS 3_0,9_71,5 Ba Ct1	384.5	254.2	269.2	0.70	
208T	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	**-171.0**	SPLS 3_71,5 Ba Ct1	332.1	254.2	388.8	0.67		**171.1**	SPLS 3_0,9_71,5 Ba Ct2	384.5	254.2	269.2	0.67	
209L	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	**-229.3**	SPLS 3_71,5 Ba Ct2	370.1	338.9	570.2	0.68		**215.6**	SPLS 3_0,9_108,5 Ah Ct1	356.4	338.9	475.6	0.64	
209T	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	**-217.8**	SPLS 3_71,5 Ba Ct1	370.1	338.9	570.2	0.64		**210.3**	SPLS 3_0,9_71,5 Ba Ct2	356.4	338.9	475.6	0.62	
210	Top	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	280	**-11.7**	SPLS 6a_90 Ba Ct2 Ah Ct2	16.5	75.4	86.4	0.71		**11.6**	PLS 6a_90 Ba Ct2 Ah Ct2	52.4	75.4	44.1	0.26	
211L	Tweede dwarsarm in tower	80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	167	**0.0**		89.7	254.2	311.0	0.00		**88.8**	ULS 3_0	160.8	254.2	259.0	0.55	
211T	Tweede dwarsarm in tower	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	167	**-3.1**	ULS 1a_0,9_90	89.7	169.4	207.4	0.03		**3.0**	ULS 1a_90	206.0	169.4	177.2	0.02	
114L	Tweede dwarsarm in tower	160x160x15	S235	12M24-5.6t	2.00	1.00	1.00	59	**-484.3**	SPLS 3_108,5 Ba All Cts	936.1	991.5	2332.8	0.52		**403.1**	LS 3_0,9_71,5 Ah All Cts	1008.5	991.5	1914.1	0.41	
212T	Tweede dwarsarm in tower	100x100x6	S235	4M24-5.6t	2.00	1.00	1.00	95	**-43.4**	ULS 5a Ba 12	144.3	338.9	311.0	0.30		**57.9**	ULS 5a Ba 12	225.0	338.9	265.8	0.26	
213	Tweede dwarsarm in tower	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	86	**-65.0**	ULS 5a Ba 12	265.3	169.4	207.4	0.38		**65.5**	ULS 5a Ba 12	226.0	169.4	177.2	0.39	
214	Tweede dwarsarm in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	300	**-0.6**	ULS 3_0	11.8	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00	
215L	Eerste dwarsarm in tower	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	178	**0.0**		103.8	254.2	311.0	0.00		**116.1**	S 6a_90 Ba All Cts Ah Ct2	270.5	254.2	265.8	0.46	
215T	Eerste dwarsarm in tower	100x100x8	S235	1M24-5.6t	1.00	1.00	1.00	178	**-41.1**	ULS 1a_0,9_90	83.1	84.7	103.7	0.50		**45.8**	ULS 1a_90	170.5	84.7	88.6	0.54	
115L	Eerste dwarsarm in tower	180x180x18	S235	10M24-5.6t	2.00	1.00	1.00	69	**-543.4**	SPLS 3_108,5 Ba All Cts	1169.6	831.3	2332.8	0.65		**388.6**	LS 3_0,9_71,5 Ah All Cts	1361.8	831.3	1993.8	0.47	
216T	Eerste dwarsarm in tower	100x100x8	S235	4M24-5.6t	2.00	1.00	1.00	124	**-101.4**	SPLS 3_0,9_71,5 Ba Ct2	151.1	338.9	414.7	0.67		**115.5**	PLS 6a_90 Ba Ct1 Ba Ct2	293.9	338.9	354.5	0.39	
217	Eerste dwarsarm in tower	120x120x11	S235	2M24-5.6t	1.00	1.00	1.00	114	**-141.4**	SPLS 6a_90 Ah Ct2 Ba Ct2	286.0	169.4	285.1	0.83		**142.6**	PLS 6a_90 Ah Ct2 Ba Ct2	306.2	169.4	243.7	0.84	
218	Eerste dwarsarm in tower	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	325	**-0.9**	ULS 3_0	12.6	58.8	54.0	0.07		**0.0**		54.7	58.8	37.0	0.00	
219L	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-44.5**	SPLS 3_71,5 Ah All Cts	195.2	169.4	311.0	0.26		**31.1**	LS 3_0,9_71,5 Ah All Cts	329.5	169.4	265.8	0.18	
219T	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-48.1**	SPLS 3_71,5 Ah All Cts	195.2	169.4	311.0	0.28		**34.7**	LS 3_0,9_71,5 Ah All Cts	329.5	169.4	265.8	0.20	
220	Onderstuk in tower	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	311	**-4.6**	SPLS 1a_45 Ah Ct1	11.6	37.7	43.2	0.40		**3.3**	ULS 1a_0,9_0,9_45	60.5	37.7	32.0	0.10	
221	Onderstuk in tower	70x70x5#	S235	1M16-5.6t	0.50	1.00	0.50	370	**-0.9**	SPLS 3_71,5 Ba Ct2	9.9	37.7	43.2	0.09		**0.0**		74.9	37.7	32.0	0.00	
301	Diagonaal onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	120	**-56.7**	SPLS 6a_90 Ah All Cts Ba Ct1	124.6	117.6	129.6	0.48		**52.6**	S 6a_90 Ah All Cts Ba Ct1	138.8	117.6	91.6	0.57	
302	Diagonaal onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	108	**-66.8**	SPLS 6a_90 Ah Ct1 Ba Ct1	138.3	117.6	129.6	0.57		**63.2**	PLS 6a_90 Ah Ct1 Ba Ct1	140.5	117.6	91.6	0.69	
303	Diagonaal onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	99	**-77.9**	SPLS 6a_90 Ah All Cts Ba Ct1	149.4	117.6	129.6	0.66		**80.3**	S 6a_90 Ah All Cts Ba Ct1	145.4	117.6	91.6	0.88	
304	Diagonaal onderregel eerste dwarsarm	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	89	**-43.5**	SPLS 6a_90 Ah All Cts Ba Ct1	103.7	84.7	77.8	0.56		**43.7**	S 6a_90 Ah All Cts Ba Ct1	93.3	84.7	59.8	0.73	
305	Diagonaal onderregel eerste dwarsarm	70x70x6	S235	1M20-5.6t	0.55	0.55	0.55	109	**-26.8**	SPLS 6a_90 Ah Ct2 Ba Ct2	75.9	58.8	64.8	0.46		**29.4**	S 6a_90 Ah All Cts Ba Ct1	82.9	58.8	52.4	0.56	
306	Diagonaal onderregel eerste dwarsarm	70x70x6	S235	2M20-5.6t	0.55	0.55	0.55	107	**-36.1**	SPLS 6a_90 Ah All Cts Ba Ct1	96.4	117.6	129.6	0.37		**35.8**	S 6a_90 Ah All Cts Ba Ct1	84.5	117.6	91.6	0.42	
307	Diagonaal onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	82	**-45.1**	SPLS 6a_90 Ah All Cts Ba Ct1	137.9	117.6	129.6	0.38		**44.7**	S 6a_90 Ah All Cts Ba Ct1	118.5	117.6	91.6	0.49	
308	Diagonaal onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	77	**-61.8**	SPLS 6a_90 Ah All Cts Ba Ct1	142.4	117.6	129.6	0.53		**60.1**	S 6a_90 Ah All Cts Ba Ct1	117.2	117.6	91.6	0.66	
309	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	1M24-5.6t	1.00	1.00	1.00	64	**-27.4**	SPLS 6a_90 Ah All Cts Ba Ct1	118.4	84.7	90.7	0.32		**28.5**	S 6a_90 Ah All Cts Ba Ct1	88.7	84.7	57.8	0.49	
310	Diagonaal onderregel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	90	**-0.1**	SPLS 1a_0,9_135 Ah Ct2	52.8	37.7	43.2	0.00		**4.3**	ULS 3_0,9_108,5	37.4	37.7	22.0	0.19	
311	Dwarsligger onderregel eerste dwarsarm	HEA160	S235		1.00	1.00	1.00	28	**-6.3**	ULS 3_0,9_90	784.4	0.0	0.0	0.01		**7.3**	ULS 3_90	916.5	0.0	0.0	0.01	
312	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	82	**-18.0**	SPLS 6a_90 Ah All Cts Ba Ct1	315.3	117.6	259.2	0.15		**61.1**	S 6a_90 Ah All Cts Ba Ct1	278.4	117.6	259.2	0.52	
314	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	38	**0.0**		422.5	117.6	259.2	0.00		**61.5**	ULS 3_0,9_71,5	278.4	117.6	259.2	0.52	
315	Dwarsligger onderregel eerste dwarsarm	HEA160	S235		1.00	1.00	1.00	13	**-7.9**	ULS 3_0,9_90	825.1	0.0	0.0	0.01		**0.0**		916.5	0.0	0.0	0.00	
316	Verticaal eerste dwarsarm	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	191	**-19.1**	SPLS 6a_90 Ba All Cts Ah Ct2	59.7	58.8	86.4	0.32		**0.0**		133.6	58.8	69.8	0.00	
317	Verticaal eerste dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	186	**-5.5**	ULS 3_135	30.3	37.7	43.2	0.18		**0.0**		37.4	37.7	22.0	0.00	
318	Verticaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	103	**-1.0**	ULS 3_135	47.4	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00	
319	Tussen diagonaal eerste dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	563	**0.0**		5.1	75.4	86.4	0.00		**28.0**	ULS 3_135	57.7	75.4	44.1	0.63	
320	Tussen diagonaal eerste dwarsarm	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	397	**0.0**		13.4	117.6	129.6	0.00		**42.4**	S 6a_90 Ba All Cts Ah Ct2	84.4	117.6	88.7	0.50	

Assessment of groups for initial mast (afkeur level)

Date	19-8-2020
Author	MKh
Version	1.0

KIJ-GT 380
HB+0
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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)
321	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	432	**0.0**		6.5	37.7	43.2	0.00		**13.8**	ULS 1a_0	37.4	37.7	22.0	0.62	
322	Dwarsligger bovenregel eerste dwarsarm	65x50x5	S235	1M20-5.6t	1.00	1.00	1.00	220	**-3.0**	ULS 3_0,9_90	21.9	58.8	54.0	0.14		**0.0**		61.9	58.8	31.9	0.00	
323	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	0.50	0.50	0.50	163	**-0.1**	SPLS 1a_0 Ah All Cts	28.9	37.7	43.2	0.00		**3.9**	ULS 3_0,9_135	37.4	37.7	22.0	0.18	
401	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	115	**-27.4**	SPLS 6a_90 Ah Ct2 Ba Ct2	109.4	84.7	103.7	0.32		**27.9**	6a_90 Ah All Cts Ba Ct1	124.4	84.7	88.6	0.33	
402	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	108	**-32.8**	SPLS 3_0,9_71,5 Ah All Cts	116.0	84.7	103.7	0.39		**33.3**	PLS 6a_90 Ah Ct1 Ba Ct1	124.4	84.7	88.6	0.39	
403	Diagonaal onderregel tweede dwarsarm	80x80x8	S235	1M24-5.6t	0.54	0.54	0.54	104	**-39.0**	SPLS 6a_90 Ah Ct1 Ba Ct1	120.7	84.7	103.7	0.46		**37.4**	LS 3_0,9_71,5 Ah All Cts	124.4	84.7	88.6	0.44	
404	Diagonaal onderregel tweede dwarsarm	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	90	**-42.0**	SPLS 6a_90 Ah Ct1 Ba Ct1	129.0	117.6	129.6	0.36		**41.4**	LS 3_0,9_71,5 Ah All Cts	100.7	117.6	91.6	0.45	
405	Diagonaal onderregel tweede dwarsarm	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	84	**-49.4**	SPLS 3_0,9_71,5 Ah All Cts	134.9	117.6	129.6	0.42		**49.3**	PLS 6a_90 Ah Ct1 Ba Ct1	105.8	117.6	91.6	0.54	
406	Diagonaal onderregel tweede dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	80	**-61.7**	SPLS 3_71,5 Ah Ct1	139.0	117.6	129.6	0.52		**59.7**	LS 3_0,9_71,5 Ah All Cts	110.9	117.6	91.6	0.65	
407	Diagonaal onderregel tweede dwarsarm	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	82	**-21.3**	SPLS 3_0,9_71,5 Ah All Cts	79.8	58.8	64.8	0.36		**29.6**	SPLS 3_71,5 Ah All Cts	65.7	58.8	38.8	0.76	
408	Diagonaal onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	99	**0.0**		49.0	37.7	43.2	0.00		**5.6**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.26	
409	Dwarsligger onderregel tweede dwarsarr	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	54	**-0.4**	SPLS 1a_0,9_90 Ah Ct2	689.5	117.6	216.0	0.00		**3.6**	ULS 3_90	766.1	117.6	0.0	0.03	
410	Dwarsligger onderregel tweede dwarsarr	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	47	**0.0**		403.5	117.6	259.2	0.00		**61.4**	ULS 3_71,5	278.4	117.6	259.2	0.52	
411	Dwarsligger onderregel tweede dwarsarr	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	33	**-8.1**	ULS 3_90	768.2	117.6	216.0	0.07		**0.0**		766.1	117.6	0.0	0.00	
412	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	201	**-4.4**	SPLS 1a_0 Ba All Cts	21.8	37.7	43.2	0.20		**4.6**	SPLS 1a_0,9_0 Ba Ct2	37.4	37.7	22.0	0.21	
413	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	187	**-4.9**	SPLS 6a_90 Ah All Cts Ba Ct2	24.1	37.7	43.2	0.20		**4.3**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.20	
414	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	173	**-5.2**	SPLS 6a_90 Ah All Cts Ba Ct1	26.6	37.7	43.2	0.19		**5.9**	PLS 6a_90 Ah Ct2 Ba Ct2	37.4	37.7	22.0	0.27	
415	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	142	**-9.4**	SPLS 6a_90 Ah All Cts Ba Ct2	34.2	37.7	43.2	0.27		**9.3**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.42	
416	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	134	**-11.1**	SPLS 6a_90 Ah All Cts Ba Ct2	36.5	37.7	43.2	0.30		**11.1**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.50	
417	Diagonaal bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	117	**-12.4**	SPLS 6a_90 Ah All Cts Ba Ct2	42.1	37.7	43.2	0.33		**12.0**	6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.55	
418	Diagonaal bovenregel tweede dwarsarm	60x60x5	S235	1M16-5.6t	0.55	0.55	0.55	109	**-18.1**	SPLS 6a_90 Ah All Cts Ba Ct2	54.6	37.7	43.2	0.48		**18.5**	6a_90 Ah All Cts Ba Ct2	60.5	37.7	32.0	0.58	
419	Diagonaal bovenregel tweede dwarsarm	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	94	**-23.3**	SPLS 6a_90 Ah All Cts Ba Ct2	61.7	58.8	54.0	0.43		**22.3**	6a_90 Ah All Cts Ba Ct2	54.7	58.8	37.0	0.60	
420	Diagonaal bovenregel tweede dwarsarm	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	75	**-24.5**	SPLS 6a_90 Ah All Cts Ba Ct2	69.3	58.8	54.0	0.45		**25.8**	6a_90 Ah All Cts Ba Ct2	54.7	58.8	37.0	0.70	
421	Dwarsligger bovenregel tweede dwarsarı	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	199	**-0.5**	ULS 3_0,9_90	22.1	37.7	43.2	0.02		**0.4**	ULS 1a_90	37.4	37.7	22.0	0.02	
422	Dwarsligger bovenregel tweede dwarsarı	UNP160	S235	1M16-5.6t	1.00	1.00	1.00	42	**0.0**		288.5	37.7	64.8	0.00		**27.0**	ULS 3_0,9_90	155.5	37.7	64.8	0.72	
423	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	85	**-1.5**	SPLS 6a_90 Ba Ct2 Ba Ct1	54.8	37.7	43.2	0.04		**3.0**	PLS 6a_90 Ah Ct2 Ah Ct1	37.4	37.7	22.0	0.13	
424	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	**0.0**		27.5	37.7	43.2	0.00		**4.8**	6a_90 Ba All Cts Ah Ct2	37.4	37.7	22.0	0.22	
425	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	299	**-3.1**	SPLS 1a_108,5 Ba All Cts	11.9	37.7	43.2	0.26		**0.0**		37.4	37.7	22.0	0.00	
426	Tussen diagonaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	346	**-10.3**	SPLS 6a_90 Ah Ct2 Ah Ct1	9.4	37.7	43.2	1.10	knik	**1.8**	SPLS 3_0,9_71,5 Ba Ct2	37.4	37.7	22.0	0.08	
427	Tussen diagonaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	261	**0.0**		14.7	37.7	43.2	0.00		**1.1**	SPLS 1a_108,5 Ba Ct1	37.4	37.7	22.0	0.05	
428	Dwarsligger ladder tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	116	**-0.1**	SPLS 6a_90 Ba Ct2 Ah Ct2	42.5	37.7	43.2	0.00		**0.0**	PLS 3_0,9_108,5 Ba Ct2	37.4	37.7	22.0	0.00	
429	Bovenregel tweede dwarsarm	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	359	**0.0**		27.1	254.2	233.3	0.00		**108.0**	PLS 6a_90 Ba Ct2 Ah Ct2	161.1	254.2	199.4	0.67	
430	Bovenregel tweede dwarsarm	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	253	**0.0**		47.4	254.2	233.3	0.00		**98.1**	ULS 3_90	161.1	254.2	199.4	0.61	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 19-8-2020
Author MKh
Version 1.0

KIJ-GT 380
HB+0
81

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	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	**-45.6**	SPLS 3_71,5 Ah Ct2	318.3	508.3	622.1	0.14		**5.6**	SPLS 1a_0,9_71,5 Ah /	379.5	508.3	531.7	0.01
101B	Leg	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	74	**-123.9**	SPLS 3_71,5 Ah Ct2	344.8	506.7	622.1	0.36		**89.3**	SPLS 3_0,9_71,5 Ah A	379.5	506.7	531.7	0.24
102A	Leg	180x180x16#	S235	8M20-5.6t	0.50	0.50	0.50	54	**-371.2**	SPLS 3_108,5 Ba All C	1141.5	460.8	1382.4	0.81		**285.3**	SPLS 3_0,9_71,5 Ah A	1253.5	460.8	1382.4	0.62
102B	Leg	180x180x16#	S235	10M24-5.6t	0.50	0.50	0.50	57	**-404.0**	SPLS 3_108,5 Ba All C	1125.2	847.2	2073.6	0.48		**293.0**	SPLS 3_0,9_71,5 Ah A	1220.3	847.2	1612.8	0.35
103A	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	22	**-726.2**	SPLS 3_108,5 Ba All C	1444.7	941.5	2488.3	0.77		**579.7**	SPLS 3_0,9_71,5 Ah A	1386.2	941.5	2126.8	0.62
103B	Leg	200x200x16	S235	12M24-5.6t	0.50	0.50	0.50	35	**-903.3**	SPLS 3_108,5 Ba All C	1381.6	1987.7	2488.3	0.65		**753.4**	SPLS 3_0,9_71,5 Ah A	1386.2	1987.7	2126.8	0.54
103C	Leg	200x200x16	S235		0.50	0.50	0.50	28	**-900.7**	SPLS 3_108,5 Ba All C	1416.3	0.0	0.0	0.64		**755.6**	SPLS 3_0,9_71,5 Ah A	1452.3	0.0	0.0	0.52
104A	Leg	250x250x18#	S235	10M24-5.6t	0.50	0.50	0.50	28	**-1134.3**	SPLS 3_71,5 Ah All Cts	2013.7	1599.1	2332.8	0.71		**967.1**	SPLS 3_0,9_71,5 Ah A	2030.6	1599.1	1993.8	0.60
104B	Leg	250x250x18#	S235	12M24-5.6t	0.50	0.50	0.50	34	**-1231.7**	SPLS 3_71,5 Ah All Cts	1969.4	1859.6	2799.4	0.66		**1054.6**	SPLS 3_0,9_71,5 Ah A	2030.6	1859.6	2392.6	0.57
104C	Leg	250x250x18#	S235		0.50	0.50	0.50	34	**-1137.7**	SPLS 3_71,5 Ah All Cts	1969.4	0.0	0.0	0.58		**964.3**	SPLS 3_0,9_71,5 Ah A	2061.0	0.0	0.0	0.47
105	Leg	250x250x18#	S235	12M24-5.6t	0.17	0.17	0.17	33	**-1253.9**	SPLS 3_71,5 Ah All Cts	1974.3	1859.6	2799.4	0.67		**1055.1**	SPLS 3_0,9_71,5 Ah A	2030.6	1859.6	2392.6	0.57
106A	Onderregel eers	180x180x18#	S235	10M24-5.6t	1.48	1.00	1.00	68	**-612.4**	SPLS 6a_90 Ba Ct2 Ah	1175.3	831.3	2332.8	0.74		**416.0**	SPLS 3_0,9_71,5 Ah C	1361.8	831.3	1993.8	0.50
106B	Onderregel eers	180x180x18#	S235	8M24-5.6t	12.15	2.00	1.00	67	**-324.0**	SPLS 6a_90 Ba Ct2 Ah	1186.1	677.8	1866.2	0.48		**209.4**	SPLS 3_0,9_71,5 Ah C	1361.8	677.8	1595.1	0.31
106C	Onderregel eers	180x180x18#	S235		2.91	1.93	1.00	61	**-549.6**	SPLS 6a_90 Ba Ct2 Ah	1226.9	0.0	0.0	0.45		**354.1**	SPLS 3_0,9_71,5 Ah C	1454.7	0.0	0.0	0.24
107A	Onderregel eers	160x160x17#	S235		2.67	1.00	1.00	76	**-312.9**	SPLS 6a_90 Ba Ct2 Ah	939.3	0.0	0.0	0.33		**193.7**	SPLS 3_0,9_71,5 Ah C	1219.7	0.0	0.0	0.16
107B	Onderregel eers	160x160x17#	S235	2M20-5.6t	1.00	1.43	1.00	22	**-3.5**	ULS 3_0,9_0	1213.4	117.6	367.2	0.03		**0.0**		668.3	117.6	356.1	0.00
107C	Onderregel eers	160x160x17#	S235		14.68	1.00	1.00	76	**-299.4**	SPLS 6a_90 Ba Ct2 Ah	939.4	0.0	0.0	0.32		**180.2**	SPLS 3_0,9_71,5 Ah C	1219.7	0.0	0.0	0.15
108A	Bovenregel eers	80x80x8	S235	3M24-5.6t	1.00	1.96	1.00	311	**0.0**		34.6	254.2	311.0	0.00		**121.7**	ULS 3_135	160.8	254.2	259.0	0.76
108B	Bovenregel eers	80x80x8	S235	4M24-5.6t	1.00	2.04	1.00	311	**0.0**		34.6	338.9	414.7	0.00		**88.5**	ULS 3_135	211.0	338.9	347.4	0.42
109A	Bovenregel eers	70x70x7	S235	4M20-5.6t	1.00	1.99	1.00	358	**0.0**		21.0	235.2	302.4	0.00		**77.3**	ULS 3_135	163.8	235.2	191.5	0.47
109B	Bovenregel eers	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	356	**0.0**		21.2	176.4	226.8	0.00		**77.4**	ULS 3_135	125.5	176.4	155.3	0.62
110A	Onderregel twe	160x160x17#	S235	12M24-5.6t	1.68	1.00	1.00	67	**-385.2**	SPLS 6a_90 Ba All Cts	995.9	991.5	2643.8	0.39		**280.0**	SPLS 3_0,9_71,5 Ah A	1116.1	991.5	2259.7	0.28
110B	Onderregel twe	160x160x17#	S235		1.00	1.67	1.00	24	**-4.3**	SPLS 1a_135 Ah All Ct	1206.8	0.0	0.0	0.00		**0.0**		1219.7	0.0	0.0	0.00
110C	Onderregel twe	160x160x17#	S235		2.48	1.48	1.00	67	**-353.1**	SPLS 6a_90 Ba All Cts	995.9	0.0	0.0	0.35		**244.5**	SPLS 3_0,9_71,5 Ah A	1219.7	0.0	0.0	0.20
111A	Bovenregel twe	120x120x11	S235	4M24-5.6t	1.50	1.00	1.00	95	**-192.4**	SPLS 6a_90 Ah All Cts	326.6	338.9	570.2	0.59		**172.5**	SPLS 6a_90 Ah All Cts	346.4	338.9	453.2	0.51
111B	Bovenregel twe	120x120x11	S235	3M24-5.6t	1.50	1.00	1.00	95	**-176.8**	SPLS 6a_90 Ah All Cts	326.6	254.2	427.7	0.70		**165.6**	SPLS 6a_90 Ah All Cts	456.8	254.2	365.5	0.65
111C	Bovenregel twe	120x120x11	S235		3.00	2.00	1.00	92	**-187.8**	SPLS 6a_90 Ah All Cts	326.5	0.0	0.0	0.58		**173.1**	SPLS 6a_90 Ah All Cts	599.7	0.0	0.0	0.29
112A	Bovenregel twe	150x100x10	S235	3M24-5.6t	2.86	1.00	1.00	103	**-154.8**	SPLS 6a_90 Ah All Cts	283.9	249.9	388.8	0.62		**162.2**	SPLS 6a_90 Ah All Cts	437.7	249.9	332.3	0.65
112B	Bovenregel twe	150x100x10	S235	4M24-5.6t	3.73	1.00	1.00	105	**-30.8**	SPLS 6a_90 Ah All Cts	278.5	338.9	518.4	0.11		**31.8**	SPLS 6a_90 Ah Ct1 Ba	495.3	338.9	443.1	0.09
112C	Bovenregel twe	150x100x10	S235		2.90	1.00	1.00	104	**-141.0**	SPLS 6a_90 Ah All Cts	280.5	0.0	0.0	0.50		**147.9**	SPLS 6a_90 Ah All Cts	571.3	0.0	0.0	0.26
113	Ladder tweede	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	162	**-30.1**	SPLS 6a_90 Ah Ct1 Ah	79.8	84.7	77.8	0.39		**10.5**	SPLS 3_0,9_90 Ba Ct2	127.9	84.7	66.5	0.16
201L	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	**-35.7**	SPLS 3_90 Ah Ct2	91.4	84.7	77.8	0.46		**23.7**	SPLS 6a_90 Ah Ct2 Ah	127.9	84.7	66.5	0.36
201T	Diagonaal	100x100x6	S235	1M24-5.6t	0.53	0.53	0.53	131	**-22.7**	SPLS 6a_90 Ba Ct2 Ah	91.4	84.7	77.8	0.29		**8.9**	SPLS 3_0,9_108,5 Ah	127.9	84.7	66.5	0.13
202L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	**-174.3**	SPLS 3_90 Ba Ct2	425.3	338.9	518.4	0.51		**130.3**	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.38
202T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	83	**-129.8**	SPLS 3_90 Ba Ct1	425.3	338.9	518.4	0.38		**142.6**	SPLS 3_0,9_90 Ba Ct2	384.5	338.9	350.9	0.42
203L	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	**-119.6**	SPLS 3_0,9_90 Ba Ct1	406.7	338.9	518.4	0.35		**159.2**	SPLS 3_90 Ba Ct2	384.5	338.9	350.9	0.47
203T	Diagonaal	150x150x10	S235	4M24-5.6t	0.52	0.52	0.52	89	**-129.6**	SPLS 3_0,9_90 Ba Ct2	406.7	338.9	518.4	0.38		**117.9**	SPLS 3_90 Ba Ct1	384.5	338.9	350.9	0.35
204L	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	**-164.1**	SPLS 3_0,9_90 Ah Ct2	381.0	338.9	518.4	0.48		**131.7**	SPLS 3_0,9_108,5 Ba	384.5	338.9	350.9	0.39
204T	Diagonaal	150x150x10	S235	4M24-5.6t	0.53	0.53	0.53	97	**-151.6**	SPLS 3_90 Ba Ct1	381.0	338.9	518.4	0.45		**140.8**	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.42
205L	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	**-321.2**	SPLS 3_71,5 Ba Ct1	449.2	508.3	777.6	0.72		**318.8**	SPLS 3_71,5 Ba Ct2	384.5	508.3	513.8	0.83
205T	Diagonaal	150x150x10	S235	6M24-5.6t	0.30	0.55	0.30	69	**-306.0**	SPLS 3_0,9_71,5 Ba C	449.2	508.3	777.6	0.68		**303.4**	SPLS 3_71,5 Ba Ct1	384.5	508.3	513.8	0.79
206L	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	**-266.7**	SPLS 3_71,5 Ba Ct2	463.5	423.6	777.6	0.63		**263.7**	SPLS 3_71,5 Ba Ct1	456.2	423.6	518.8	0.62
206T	Diagonaal	150x150x12	S235	5M24-5.6t	0.27	0.55	0.27	87	**-251.1**	SPLS 3_71,5 Ba Ct1	463.5	423.6	777.6	0.59		**251.2**	SPLS 3_0,9_71,5 Ba C	456.2	423.6	518.8	0.59
207L	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	**-216.9**	SPLS 3_71,5 Ba Ct1	392.0	338.9	622.1	0.64		**216.3**	SPLS 3_71,5 Ba Ct2	456.2	338.9	421.1	0.64
207T	Diagonaal	150x150x12	S235	4M24-5.6t	0.27	0.55	0.27	107	**-206.6**	SPLS 3_0,9_71,5 Ba C	392.0	338.9	622.1	0.61		**202.7**	SPLS 3_71,5 Ba Ct1	456.2	338.9	421.1	0.60
208L	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	**-182.3**	SPLS 3_71,5 Ba Ct2	332.1	254.2	388.8	0.72		**178.0**	SPLS 3_0,9_71,5 Ba C	384.5	254.2	269.2	0.70
208T	Diagonaal	150x150x10	S235	3M24-5.6t	0.50	1.00	0.50	106	**-171.0**	SPLS 3_71,5 Ba Ct1	332.1	254.2	388.8	0.67		**171.1**	SPLS 3_0,9_71,5 Ba C	384.5	254.2	269.2	0.67
209L	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	**-229.3**	SPLS 3_71,5 Ba Ct2	370.1	338.9	570.2	0.68		**215.6**	SPLS 3_0,9_108,5 Ah	356.4	338.9	475.6	0.64
209T	Diagonaal	120x120x11	S235	4M24-5.6t	0.17	0.25	0.17	79	**-217.8**	SPLS 3_71,5 Ba Ct1	370.1	338.9	570.2	0.64		**210.3**	SPLS 3_0,9_71,5 Ba C	356.4	338.9	475.6	0.62
210	Top	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	280	**-11.7**	SPLS 6a_90 Ba Ct2 Ah	16.5	75.4	86.4	0.71		**11.6**	SPLS 6a_90 Ba Ct2 Ah	52.4	75.4	44.1	0.26
211L	Tweede dwarsa	80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	167	**0.0**		89.7	254.2	311.0	0.00		**88.8**	ULS 3_0	160.8	254.2	259.0	0.55
211T	Tweede dwarsa	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	167	**-3.1**	ULS 1a_0,9_90	89.7	169.4	207.4	0.03		**3.0**	ULS 1a_90	206.0	169.4	177.2	0.02
114L	Tweede dwarsa	160x160x15#	S235	12M24-5.6t	2.00	1.00	1.00	59	**-484.4**	SPLS 3_108,5 Ba All C	936.1	991.5	2332.8	0.52		**403.0**	SPLS 3_0,9_71,5 Ah A	1008.5	991.5	1914.1	0.41
212T	Tweede dwarsa	100x100x6	S235	4M24-5.6t	2.00	1.00	1.00	95	**-43.4**	ULS 5a Ba 12	144.3	338.9	311.0	0.30		**57.9**	ULS 5a Ba 12	225.0	338.9	265.8	0.26
213	Tweede dwarsa	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	86	**-65.0**	ULS 5a Ba 12	265.3	169.4	207.4	0.38		**65.5**	ULS 5a Ba 12	226.0	169.4	177.2	0.39
214	Tweede dwarsa	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	300	**-0.6**	ULS 3_0	11.8	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00
215L	Eerste dwarsarı	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	178	**0.0**		103.8	254.2	311.0	0.00		**116.1**	SPLS 6a_90 Ba All Cts	270.5	254.2	265.8	0.46
215T	Eerste dwarsarı	100x100x8	S235	1M24-5.6t	1.00	1.00	1.00	178	**-41.1**	ULS 1a_0,9_90	83.1	84.7	103.7	0.50		**45.8**	ULS 1a_90	170.5	84.7	88.6	0.54
115L	Eerste dwarsarı	180x180x18#	S235	10M24-5.6t	2.00	1.00	1.00	69	**-543.4**	SPLS 3_108,5 Ba All C	1169.6	831.3	2332.8	0.65		**388.6**	SPLS 3_0,9_71,5 Ah A	1361.8	831.3	1993.8	0.47
216T	Eerste dwarsarı	100x100x8	S235	4M24-5.6t	2.00	1.00	1.00	124	**-101.4**	SPLS 3_0,9_71,5 Ba C	151.1	338.9	414.7	0.67		**115.5**	SPLS 6a_90 Ba Ct1 Ba	293.9	338.9	354.5	0.39
217	Eerste dwarsarı	120x120x11	S235	2M24-5.6t	1.00	1.00	1.00	114	**-141.4**	SPLS 6a_90 Ah Ct2 Ba	286.0	169.4	285.1	0.83		**142.6**	SPLS 6a_90 Ah Ct2 Ba	306.2	169.4	243.7	0.84
218	Eerste dwarsarı	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	325	**-0.9**	ULS 3_0	12.6	58.8	54.0	0.07		**0.0**		54.7	58.8	37.0	0.00
219L	Onderstuk in to	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-44.5**	SPLS 3_71,5 Ah All Cts	195.2	169.4	311.0	0.26		**31.1**	SPLS 3_0,9_71,5 Ah A	329.5	169.4	265.8	0.18
219T	Onderstuk in to	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-48.1**	SPLS 3_71,5 Ah All Cts	195.2	169.4	311.0	0.28		**34.7**	SPLS 3_0,9_71,5 Ah A	329.5	169.4	265.8	0.20
220	Onderstuk in to	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	311	**-4.6**	SPLS 1a_45 Ah Ct1	11.6	37.7	43.2	0.40		**3.3**	ULS 1a_0,9_0,9_45	60.5	37.7	32.0	0.10
221	Onderstuk in to	70x70x5#	S235	1M16-5.6t	0.50	1.00	0.50	370	**-0.9**	SPLS 3_71,5 Ba Ct2	9.9	37.7	43.2	0.09		**0.0**		74.9	37.7	32.0	0.00
301	Diagonaal onde	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	120	**-56.7**	SPLS 6a_90 Ah All Cts	124.6	117.6	129.6	0.48		**52.6**	SPLS 6a_90 Ah All Cts	138.8	117.6	91.6	0.57
302	Diagonaal onde	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	108	**-66.8**	SPLS 6a_90 Ah Ct1 Ba	138.3	117.6	129.6	0.57		**63.2**	SPLS 6a_90 Ah Ct1 Ba	140.5	117.6	91.6	0.69
303	Diagonaal onde	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	99	**-77.9**	SPLS 6a_90 Ah All Cts	149.4	117.6	129.6	0.66		**80.3**	SPLS 6a_90 Ah All Cts	145.4	117.6	91.6	0.88
304	Diagonaal onde	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	89	**-43.5**	SPLS 6a_90 Ah All Cts	103.7	84.7	77.8	0.56		**43.7**	SPLS 6a_90 Ah All Cts	93.3	84.7	59.8	0.73
305	Diagonaal onde	70x70x6	S235	1M20-5.6t	0.55	0.55	0.55	109	**-26.8**	SPLS 6a_90 Ah Ct2 Ba	75.9	58.8	64.8	0.46		**29.4**	SPLS 6a_90 Ah All Cts	82.9	58.8	52.4	0.56
306	Diagonaal onde	70x70x6	S235	2M20-5.6t	0.55	0.55	0.55	107	**-36.1**	SPLS 6a_90 Ah All Cts	96.4	117.6	129.6	0.37		**35.8**	SPLS 6a_90 Ah All Cts	84.5	117.6	91.6	0.42
307	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	82	**-45.1**	SPLS 6a_90 Ah All Cts	137.9	117.6	129.6	0.38		**44.7**	SPLS 6a_90 Ah All Cts	118.5	117.6	91.6	0.49
308	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	77	**-61.8**	SPLS 6a_90 Ah All Cts	142.4	117.6	129.6	0.53		**60.1**	SPLS 6a_90 Ah All Cts	117.2	117.6	91.6	0.66
309	Diagonaal onde	70x70x7	S235	1M24-5.6t	1.00	1.00	1.00	64	**-27.4**	SPLS 6a_90 Ah All Cts	118.4	84.7	90.7	0.32		**28.5**	SPLS 6a_90 Ah All Cts	88.7	84.7	57.8	0.49
310	Diagonaal onde	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	90	**-0.1**	SPLS 1a_0,9_135 Ah C	52.8	37.7	43.2	0.00		**4.3**	ULS 3_0,9_108,5	37.4	37.7	22.0	0.19
311	Dwarsligger onc	HEA160	S235		1.00	1.00	1.00	28	**-6.3**	ULS 3_0,9_90	784.4	0.0	0.0	0.01		**7.3**	ULS 3_90	916.5	0.0	0.0	0.01
312	Dwarsligger onc	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	82	**-18.0**	SPLS 6a_90 Ah All Cts	315.3	117.6	259.2	0.15		**61.1**	SPLS 6a_90 Ah All Cts	278.4	117.6	259.2	0.52
314	Dwarsligger onc	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	38	**0.0**		422.5	117.6	259.2	0.00		**61.5**	ULS 3_0,9_71,5	278.4	117.6	259.2	0.52
315	Dwarsligger onc	HEA160	S235		1.00	1.00	1.00	13	**-7.9**	ULS 3_0,9_90	825.1	0.0	0.0	0.01		**0.0**		916.5	0.0	0.0	0.00
316	Verticaal eerste	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	191	**-19.1**	SPLS 6a_90 Ba All Cts	59.7	58.8	86.4	0.32		**0.0**		133.6	58.8	69.8	0.00
317	Verticaal eerste	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	186	**-5.5**	ULS 3_135	30.3	37.7	43.2	0.18		**0.0**		37.4	37.7	22.0	0.00

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Assessment of groups for strengthened mast (afkeur level)

Date 19-8-2020
Author MKh
Version 1.0

KIJ-GT 380
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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)
318	Verticaal eerste	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	103	**-1.0**	ULS 3_135	47.4	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00
319	Tussen diagona	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	563	**0.0**		5.1	75.4	86.4	0.00		**28.0**	ULS 3_135	57.7	75.4	44.1	0.63
320	Tussen diagona	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	397	**0.0**		13.4	117.6	129.6	0.00		**42.4**	SPLS 6a_90 Ba All Cts	84.4	117.6	88.7	0.50
321	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	432	**0.0**		6.5	37.7	43.2	0.00		**13.8**	ULS 1a_0	37.4	37.7	22.0	0.62
322	Dwarsligger bo\	65x50x5	S235	1M20-5.6t	1.00	1.00	1.00	220	**-3.0**	ULS 3_0,9_90	21.9	58.8	54.0	0.14		**0.0**		61.9	58.8	31.9	0.00
323	Tussen diagona	50x50x5	S235	1M16-5.6t	0.50	0.50	0.50	163	**-0.1**	SPLS 1a_0 Ah All Cts	28.9	37.7	43.2	0.00		**3.9**	ULS 3_0,9_135	37.4	37.7	22.0	0.18
401	Diagonaal onde	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	115	**-27.4**	SPLS 6a_90 Ah Ct2 Ba	109.4	84.7	103.7	0.32		**27.9**	SPLS 6a_90 Ah All Cts	124.4	84.7	88.6	0.33
402	Diagonaal onde	80x80x8	S235	1M24-5.6t	0.53	0.53	0.53	108	**-32.8**	SPLS 3_0,9_71,5 Ah A	116.0	84.7	103.7	0.39		**33.3**	SPLS 6a_90 Ah Ct1 Ba	124.4	84.7	88.6	0.39
403	Diagonaal onde	80x80x8	S235	1M24-5.6t	0.54	0.54	0.54	104	**-39.0**	SPLS 6a_90 Ah Ct1 Ba	120.7	84.7	103.7	0.46		**37.4**	SPLS 3_0,9_71,5 Ah A	124.4	84.7	88.6	0.44
404	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	90	**-42.0**	SPLS 6a_90 Ah Ct1 Ba	129.0	117.6	129.6	0.36		**41.4**	SPLS 3_0,9_71,5 Ah A	100.7	117.6	91.6	0.45
405	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.54	0.54	0.54	84	**-49.4**	SPLS 3_0,9_71,5 Ah A	134.9	117.6	129.6	0.42		**49.3**	SPLS 6a_90 Ah Ct1 Ba	105.8	117.6	91.6	0.54
406	Diagonaal onde	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	80	**-61.7**	SPLS 3_71,5 Ah Ct1	139.0	117.6	129.6	0.52		**59.7**	SPLS 3_0,9_71,5 Ah A	110.9	117.6	91.6	0.65
407	Diagonaal onde	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	82	**-21.3**	SPLS 3_0,9_71,5 Ah A	79.8	58.8	64.8	0.36		**29.7**	SPLS 3_71,5 Ah All Cts	65.7	58.8	38.8	0.76
408	Diagonaal onde	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	99	**0.0**		49.0	37.7	43.2	0.00		**5.6**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.26
409	Dwarsligger on(	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	54	**-0.4**	SPLS 1a_0,9_90 Ah Ct	689.5	117.6	216.0	0.00		**3.6**	ULS 3_90	766.1	117.6	0.0	0.03
410	Dwarsligger on(	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	47	**0.0**		403.5	117.6	259.2	0.00		**61.4**	ULS 3_71,5	278.4	117.6	259.2	0.52
411	Dwarsligger on(	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	33	**-8.1**	ULS 3_90	768.2	117.6	216.0	0.07		**0.0**		766.1	117.6	0.0	0.00
412	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	201	**-4.4**	SPLS 1a_0 Ba All Cts	21.8	37.7	43.2	0.20		**4.6**	SPLS 1a_0,9_0 Ba Ct2	37.4	37.7	22.0	0.21
413	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	187	**-4.9**	SPLS 6a_90 Ah All Cts	24.1	37.7	43.2	0.20		**4.3**	SPLS 1a_0 Ba All Cts	37.4	37.7	22.0	0.20
414	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	173	**-5.2**	SPLS 6a_90 Ah All Cts	26.6	37.7	43.2	0.19		**5.9**	SPLS 6a_90 Ah Ct2 Ba	37.4	37.7	22.0	0.27
415	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	142	**-9.4**	SPLS 6a_90 Ah All Cts	34.2	37.7	43.2	0.27		**9.3**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.42
416	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	134	**-11.1**	SPLS 6a_90 Ah All Cts	36.5	37.7	43.2	0.30		**11.1**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.50
417	Diagonaal bove	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	117	**-12.4**	SPLS 6a_90 Ah All Cts	42.1	37.7	43.2	0.33		**12.0**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.55
418	Diagonaal bove	60x60x5	S235	1M16-5.6t	0.55	0.55	0.55	109	**-18.1**	SPLS 6a_90 Ah All Cts	54.6	37.7	43.2	0.48		**18.5**	SPLS 6a_90 Ah All Cts	60.5	37.7	32.0	0.58
419	Diagonaal bove	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	94	**-23.3**	SPLS 6a_90 Ah All Cts	61.7	58.8	54.0	0.43		**22.3**	SPLS 6a_90 Ah All Cts	54.7	58.8	37.0	0.60
420	Diagonaal bove	60x60x5	S235	1M20-5.6t	0.55	0.55	0.55	75	**-24.5**	SPLS 6a_90 Ah All Cts	69.3	58.8	54.0	0.45		**25.8**	SPLS 6a_90 Ah All Cts	54.7	58.8	37.0	0.70
421	Dwarsligger bo\	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	199	**-0.5**	ULS 3_0,9_90	22.1	37.7	43.2	0.02		**0.4**	ULS 1a_90	37.4	37.7	22.0	0.02
422	Dwarsligger bo\	UNP160	S235	1M16-5.6t	1.00	1.00	1.00	42	**0.0**		288.5	37.7	64.8	0.00		**27.0**	ULS 3_0,9_90	155.5	37.7	64.8	0.72
423	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	85	**-1.5**	SPLS 6a_90 Ba Ct2 Ba	54.8	37.7	43.2	0.04		**3.0**	SPLS 6a_90 Ah Ct2 Ah	37.4	37.7	22.0	0.14
424	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	**0.0**		27.5	37.7	43.2	0.00		**4.8**	SPLS 6a_90 Ba All Cts	37.4	37.7	22.0	0.22
425	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	299	**-3.1**	SPLS 1a_108,5 Ba All (	11.9	37.7	43.2	0.26		**0.0**		37.4	37.7	22.0	0.00
426	Tussen diagona	**50x50x6**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	346	**-10.6**	SPLS 6a_90 Ah Ct2 Ah	11.9	60.3	70.6	0.89		**1.8**	SPLS 3_0,9_71,5 Ba C	61.2	60.3	36.0	0.05
427	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	261	**0.0**		14.7	37.7	43.2	0.00		**1.1**	SPLS 1a_108,5 Ba Ct1	37.4	37.7	22.0	0.05
428	Dwarsligger lad	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	116	**-0.1**	SPLS 6a_90 Ba Ct2 Ah	42.5	37.7	43.2	0.00		**0.0**	SPLS 3_0,9_108,5 Ba (	37.4	37.7	22.0	0.00
429	Bovenregel twe	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	359	**0.0**		27.1	254.2	233.3	0.00		**108.0**	SPLS 6a_90 Ba Ct2 Ah	161.1	254.2	199.4	0.67
430	Bovenregel twe	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	253	**0.0**		47.4	254.2	233.3	0.00		**98.2**	ULS 3_90	161.1	254.2	199.4	0.61

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Assessment of groups for strengthened mast (verbouw level)

Date 19-8-2020
Author MKh
Version 1.0

KIJ-GT 380
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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)
426	Tussen diagona	**50x50x6**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	346	**-11.2**	SPLS 6a 90 Ah Ct2 Ah	11.9	60.3	70.6	0.95		**2.2**	SPLS 3 0,9 71,5 Ba Ct	61.2	60.3	36.0	0.06

APPENDIX C REDUNDANT MEMBERS CHECK

Knikverkorters initiële constructie afkeur

Datum: 2020-05-07
Auteur: Muhammed Khan
Versie: 1.8

KIJ-GT
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Posnr.	Sectie	Schematisering	Profiel	Staalsoort	Bout	Kwaliteit	Lengte (m)	Hoek (°)	Slankheid (-)	Normaal kracht (kN)	Moment (kNm)	Knikcap. (kN)	Afschuifcap Bout (kN)	Stuikcap. Bout (kN)	Nettodsn. (kN)	Momentcap. (kNm)	Hoogste U.C.	Overschrijding	Opmerking
13	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	0.52	0	53	**19.7**	**0.13**	63.5	37.7	37.3	37.4	0.72	0.53		
18	Onderstuk	Enkele staaf	L60.5	S235	M16	5.6	1.62	80	138	**19.7**	**0.00**	42.7	37.7	37.3	60.5	1.05	0.53		
11	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.23	0	126	**19.7**	**0.31**	38.9	37.7	37.3	37.4	0.72	0.53		
17	Onderstuk	Enkele staaf	L60.5	S235	M16	5.6	1.91	57	163	**19.7**	**0.00**	35.1	37.7	37.3	60.5	1.05	0.56		
10	Onderstuk	Enkele staaf	L60.5	S235	M16	5.6	1.83	0	156	**19.7**	**0.46**	37.0	37.7	37.3	60.5	1.05	0.53		
16	Onderstuk	Enkele staaf	L70.6	S235	M16	5.6	2.25	45	164	**19.7**	**0.00**	48.3	37.7	44.8	107.1	1.71	0.52		
9	Onderstuk	Enkele staaf	L70.6	S235	M16	5.6	2.49	0	182	**19.7**	**0.62**	42.3	37.7	44.8	107.1	1.71	0.52		
15	Onderstuk	Enkele staaf	L70.6	S235	M16	5.6	2.76	35	201	**19.7**	**0.00**	36.8	37.7	44.8	107.1	1.71	0.54		
8	Onderstuk	Enkele staaf	L80.6	S235	M16	5.6	3.15	0	200	**19.7**	**0.79**	42.5	37.7	44.8	141.7	2.25	0.52		
14	Onderstuk	Enkele staaf	L80.6	S235	M16	5.6	3.40	27	216	**19.7**	**0.76**	38.1	37.7	44.8	141.7	2.25	0.52		
23	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	1.25	0	128	**3.7**	**0.31**	38.2	37.7	37.3	37.4	0.72	0.44		
26	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	2.76	77	284	**3.7**	**0.00**	13.0	37.7	37.3	37.4	0.72	0.29		
22	Pootverband	Kniksteun en verticale steun	L50.5	S235	M16	5.6	2.67	0	176	**3.7**	**0.33**	20.8	37.7	37.3	37.4	0.54	0.64		
25	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	2.99	64	307	**3.7**	**0.00**	11.4	37.7	37.3	37.4	0.72	0.32		
21	Pootverband	Kniksteun en verticale steun	L50.5	S235	M16	5.6	4.08	0	270	**3.7**	**0.51**	11.8	37.7	37.3	37.4	0.54	0.98		
24	Pootverband	Enkele staaf	L60.5	S235	M16	5.6	3.39	53	288	**3.7**	**0.00**	15.3	37.7	37.3	60.5	1.05	0.24		
20	Tussenschot	Kniksteun en verticale steun	L60.5	S235	M16	5.6	5.66	0	309	**2.0**	**0.71**	11.7	37.7	37.3	60.5	0.81	0.91		
27	Tussenschot	Kruisende staaf halverwege	L70.5	S235	M16	5.6	7.86	0	368	**2.0**	**0.98**	10.5	37.7	37.3	89.3	1.78	0.55		
69	1e tussenstul	Enkele staaf	L70.5	S235	M16	5.6	2.48	50	180	**20.1**	**0.00**	36.0	37.7	37.3	89.3	1.78	0.56		
59	1e tussenstul	Enkele staaf	L60.5	S235	M16	5.6	1.86	0	158	**20.1**	**0.47**	36.3	37.7	37.3	60.5	1.05	0.56		
60	1e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.45	0	149	**20.1**	**0.36**	32.2	37.7	37.3	37.4	0.72	0.62		
70	1e tussenstul	Enkele staaf	L60.5	S235	M16	5.6	2.11	54	179	**20.1**	**0.00**	30.8	37.7	37.3	60.5	1.05	0.65		
61	1e tussenstul	Enkele staaf	L80.6	S235	M16	5.6	2.91	0	185	**20.1**	**0.73**	47.6	37.7	44.8	141.7	2.25	0.53		
71	1e tussenstul	Enkele staaf	L60.5	S235	M16	5.6	2.06	38	175	**20.1**	**0.00**	31.8	37.7	37.3	60.5	1.05	0.63		
62	1e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.48	0	152	**20.1**	**0.37**	31.4	37.7	37.3	37.4	0.72	0.64		
63	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.19	0	122	**14.5**	**0.30**	40.2	37.7	37.3	37.4	0.72	0.41		
72	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.73	54	177	**14.5**	**0.00**	25.8	37.7	37.3	37.4	0.72	0.56		
64	2e tussenstul	Enkele staaf	L60.6	S235	M16	5.6	2.52	0	216	**14.5**	**0.63**	28.3	37.7	44.8	72.6	1.24	0.51		
73	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.68	37	173	**14.5**	**0.00**	26.8	37.7	37.3	37.4	0.72	0.54		
65	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.22	0	125	**14.5**	**0.31**	39.2	37.7	37.3	37.4	0.72	0.42		
66	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	0.94	0	97	**14.5**	**0.24**	49.9	37.7	37.3	37.4	0.72	0.39		
74	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.37	54	141	**14.5**	**0.00**	34.5	37.7	37.3	37.4	0.72	0.42		
67	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	2.02	0	208	**14.5**	**0.51**	20.8	37.7	37.3	37.4	0.72	0.70		
75	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.32	37	136	**14.5**	**0.00**	36.0	37.7	37.3	37.4	0.72	0.40		
68	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	0.97	0	100	**14.5**	**0.24**	48.7	37.7	37.3	37.4	0.72	0.39		

DNV·GL

Knikverkorters initiële constructie afkeur

Datum: 2020-05-07
Auteur: Muhammed Khan
Versie: 1.8

KIJ-GT
HB+0
81

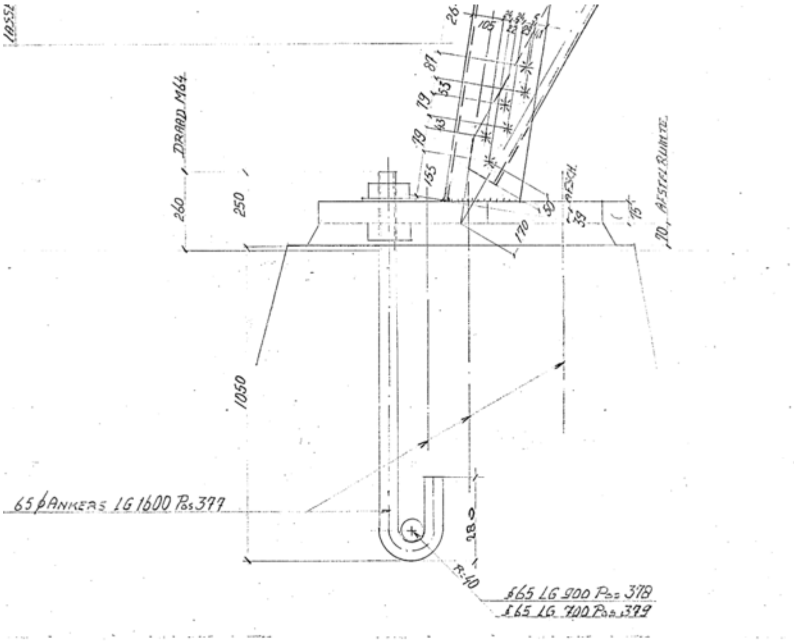
Posnr.	Sectie	Schematisering	Profiel	Staalsoort	Bout	Kwaliteit	Lengte (m)	Hoek (°)	Slankheid (-)	Normaal kracht (kN)	Moment (kNm)	Knikcap. (kN)	Afschuifcap Bout (kN)	Stuikcap. Bout (kN)	Nettodsn. (kN)	Momentcap. (kNm)	Hoogste U.C.	Overschrijding	Opmerking
13	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	0.52	0	53	**19.7**	**0.13**	63.5	37.7	37.3	37.4	0.72	0.53		
18	Onderstuk	Enkele staaf	L60.5	S235	M16	5.6	1.62	80	138	**19.7**	**0.00**	42.7	37.7	37.3	60.5	1.05	0.53		
11	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.23	0	126	**19.7**	**0.31**	38.9	37.7	37.3	37.4	0.72	0.53		
17	Onderstuk	Enkele staaf	L60.5	S235	M16	5.6	1.91	57	163	**19.7**	**0.00**	35.1	37.7	37.3	60.5	1.05	0.56		
10	Onderstuk	Enkele staaf	L60.5	S235	M16	5.6	1.83	0	156	**19.7**	**0.46**	37.0	37.7	37.3	60.5	1.05	0.53		
16	Onderstuk	Enkele staaf	L70.6	S235	M16	5.6	2.25	45	164	**19.7**	**0.00**	48.3	37.7	44.8	107.1	1.71	0.52		
9	Onderstuk	Enkele staaf	L70.6	S235	M16	5.6	2.49	0	182	**19.7**	**0.62**	42.3	37.7	44.8	107.1	1.71	0.52		
15	Onderstuk	Enkele staaf	L70.6	S235	M16	5.6	2.76	35	201	**19.7**	**0.00**	36.8	37.7	44.8	107.1	1.71	0.54		
8	Onderstuk	Enkele staaf	L80.6	S235	M16	5.6	3.15	0	200	**19.7**	**0.79**	42.5	37.7	44.8	141.7	2.25	0.52		
14	Onderstuk	Enkele staaf	L80.6	S235	M16	5.6	3.40	27	216	**19.7**	**0.76**	38.1	37.7	44.8	141.7	2.25	0.52		
23	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	1.25	0	128	**3.7**	**0.31**	38.2	37.7	37.3	37.4	0.72	0.44		
26	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	2.76	77	284	**3.7**	**0.00**	13.0	37.7	37.3	37.4	0.72	0.29		
22	Pootverband	Kniksteun en verticale steun	L50.5	S235	M16	5.6	2.67	0	176	**3.7**	**0.33**	20.8	37.7	37.3	37.4	0.54	0.64		
25	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	2.99	64	307	**3.7**	**0.00**	11.4	37.7	37.3	37.4	0.72	0.32		
21	Pootverband	Kniksteun en verticale steun	L50.5	S235	M16	5.6	4.08	0	270	**3.7**	**0.51**	11.8	37.7	37.3	37.4	0.54	0.98		
24	Pootverband	Enkele staaf	L60.5	S235	M16	5.6	3.39	53	288	**3.7**	**0.00**	15.3	37.7	37.3	60.5	1.05	0.24		
20	Tussenschot	Kniksteun en verticale steun	L60.5	S235	M16	5.6	5.66	0	309	**2.0**	**0.71**	11.7	37.7	37.3	60.5	0.81	0.91		
27	Tussenschot	Kruisende staaf halverwege	L70.5	S235	M16	5.6	7.86	0	368	**2.0**	**0.98**	10.5	37.7	37.3	89.3	1.78	0.55		
69	1e tussenstul	Enkele staaf	L70.5	S235	M16	5.6	2.48	50	180	**20.1**	**0.00**	36.0	37.7	37.3	89.3	1.78	0.56		
59	1e tussenstul	Enkele staaf	L60.5	S235	M16	5.6	1.86	0	158	**20.1**	**0.47**	36.3	37.7	37.3	60.5	1.05	0.56		
60	1e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.45	0	149	**20.1**	**0.36**	32.2	37.7	37.3	37.4	0.72	0.62		
70	1e tussenstul	Enkele staaf	L60.5	S235	M16	5.6	2.11	54	179	**20.1**	**0.00**	30.8	37.7	37.3	60.5	1.05	0.65		
61	1e tussenstul	Enkele staaf	L80.6	S235	M16	5.6	2.91	0	185	**20.1**	**0.73**	47.6	37.7	44.8	141.7	2.25	0.53		
71	1e tussenstul	Enkele staaf	L60.5	S235	M16	5.6	2.06	38	175	**20.1**	**0.00**	31.8	37.7	37.3	60.5	1.05	0.63		
62	1e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.48	0	152	**20.1**	**0.37**	31.4	37.7	37.3	37.4	0.72	0.64		
63	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.19	0	122	**14.5**	**0.30**	40.2	37.7	37.3	37.4	0.72	0.41		
72	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.73	54	177	**14.5**	**0.00**	25.8	37.7	37.3	37.4	0.72	0.56		
64	2e tussenstul	Enkele staaf	L60.6	S235	M16	5.6	2.52	0	216	**14.5**	**0.63**	28.3	37.7	44.8	72.6	1.24	0.51		
73	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.68	37	173	**14.5**	**0.00**	26.8	37.7	37.3	37.4	0.72	0.54		
65	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.22	0	125	**14.5**	**0.31**	39.2	37.7	37.3	37.4	0.72	0.42		
66	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	0.94	0	97	**14.5**	**0.24**	49.9	37.7	37.3	37.4	0.72	0.39		
74	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.37	54	141	**14.5**	**0.00**	34.5	37.7	37.3	37.4	0.72	0.42		
67	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	2.02	0	208	**14.5**	**0.51**	20.8	37.7	37.3	37.4	0.72	0.70		
75	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	1.32	37	136	**14.5**	**0.00**	36.0	37.7	37.3	37.4	0.72	0.40		
68	2e tussenstul	Enkele staaf	L50.5	S235	M16	5.6	0.97	0	100	**14.5**	**0.24**	48.7	37.7	37.3	37.4	0.72	0.39		

APPENDIX D ANCHOR CHECKS AND OTHER CALCULATIONS

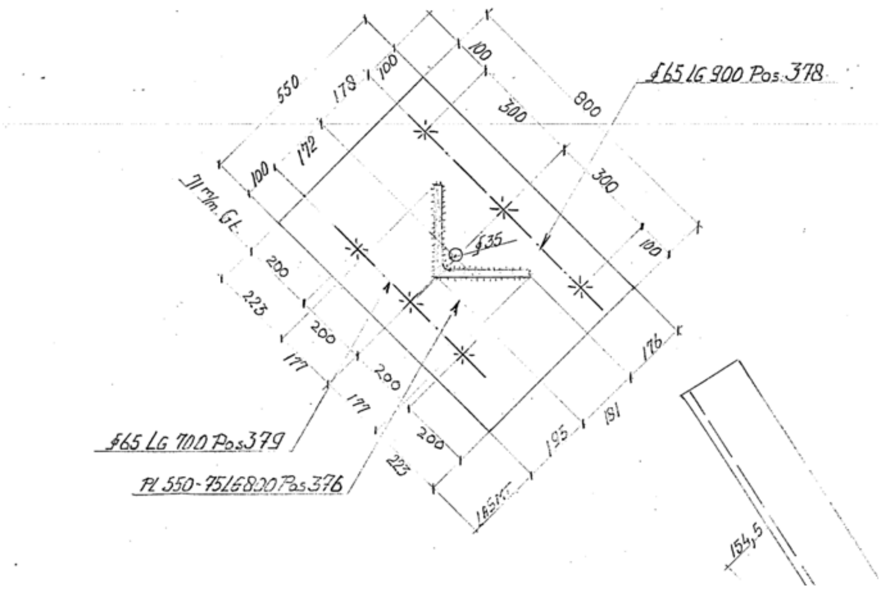
ANCHORS HB+0

Drawings provided for tower structure HB+0 don’t include anchors. However from other data it is certain that 6 anchor bolts are present. The figures below are used of tower structure EA+0. The position of anchor bolts and plate thickness have been verified in field study[1] and confirmed the assumed geometry and thicknesses. The tower legs are connected to the foundation with a foot plate 550x800x75 mm and six anchors with diameter 65 mm.

De anchor rods are connected to a horizontal rod “schieter” which allows for distribution of the tensile force to the concrete.



Figuur 1 Anchor detail



Figuur 2 Voetplaat

[1] Rapport Bejan Bouw en Betontechniek d.d. 4-11-2020; 200152A-003 Krimpen aan den IJssel - Geertruidenberg v1.0.pdf

Loads

De loads coming from the tower are based on HB+0 structure number 3 in wind zone II:

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	SPLS 3_71 Ah All Cts	-245	252	**1448**	5	-352	-32	1483
Max. trek	SPLS 3_0,9_71 Ah All Cts	-204	213	**-1214**	-6	295	26	-1243
Max. pos. torsie	SPLS 3_71 Ba Ct1	17	132	318	**105**	-81	-10	326
Max. neg. torsie	SPLS 3_71 Ba Ct2	59	86	-76	**-103**	19	2	-78
Comb. trek+torsie	SPLS 1a_0,9_71 Ah Ct1	-114	234	**-998**	**-85**	246	26	-1022

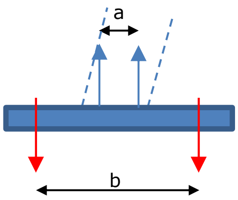
The loads for tower 81 in wind zone III are slightly lower.

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	SPLS 3_71,5 Ah All Cts	-223	229	**1316**	4	-320	-29	1348
Max. trek	SPLS 3_0,9_71,5 Ah All Cts	-186	193	**-1102**	-5	268	24	-1129
Max. pos. torsie	SPLS 3_71,5 Ba Ct1	25	113	243	**97**	-62	-8	249
Max. neg. torsie	SPLS 3_108,5 Ah Ct1	-28	108	219	**-96**	-57	-9	224
Comb. trek+torsie	SPLS 3_0,9_71,5 Ah Ct2	-207	87	**-863**	**85**	208	17	-884

Voetplaat en ankers

The strength of the foot plate will be determined assuming a horizontal yield line across the length of the plate. The tensile force is distributed to two point loads each separated by half of the diagonal width of the tower leg.



Figuur 3 Scheme for check of foot plate

a: $1/2 \cdot 250 / \sqrt{2} = 88$ mm

b: 350 mm

The eccentricity becomes $1/2 \cdot (350-88) = 131$ mm

In the spreadsheet the anchor bolts and foot plate have been checked. The concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but has been verified with concrete cylinder tests. Refer to aforementioned investigation report. The foot plate is embedded in concrete. The anchor bolts will not be loaded by bending.

Both tower fulfill the required strength. See the output:

Tower 3: U.C. = $202 / 655 = 0{,}31 \leq 1{,}00$ OK

Tower 81: U.C. = $184 / 655 = 0{,}28 \leq 1{,}00$ OK

Conclusion: The foot plates of tower structure HB+0 have sufficient strength.

Project: Krimpen - Geertruidenberg 380

Date: 30-11-2020
Version: 2.6

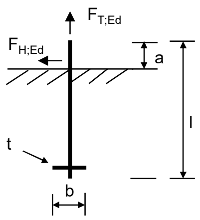
Anchors

NEN-EN 1992-1-1 and 1993-1-8 with NA
CUR-BmS 10

Subject:	**HB+0 II**	**Checks:**		
		Anchor bolt to tension	0,31	**OK**
		Anchor bolt to shear	0,22	**OK**
		Dowel ("schieter")	0,44	**OK**

Inputs

Anchor diameter		**M64**	
Achor quality		**4.6**	
Thread		Cut	
Anchor length	l =	1300	mm
Anchor length above concrete	a =	250	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	**1214**	kN
Shear force	$F_{H,Ed}$ =	**353**	kN
Number of anchors for tension		6	
Number of anchors for shear		6	
$F_{T;Ed} = T / n =$		202,3	kN
$F_{v;Ed} = F_{H,Ed} / n =$		58,8	kN

Anchor properties

$d_b =$	64,00	mm
$A_{b;s} =$	2676	mm^2
$f_{yb} =$	240	N/mm^2
$f_{ub} =$	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0{,}44 - 0{,}0003 f_{yb} =$	0,37	-

Capacity per anchor

$F_{T;Rd} = 0{,}9 \alpha_{red;2} f_{ub} A_s / g_{M2} =$	**655,1**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb} =$	**267,9**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		**S235**	
Thickness	t =	75	mm
Width	b_{ef} =	267	mm
Leverage arm	m =	131	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd} =$		88,2	kNm
$F_{t,Rd} = M_{pl,Rd} / m =$		673,6	kN

Check of dowel ("schieter")

$$\frac{\sigma_b'}{f_{cd}} = \frac{13{,}4}{40{,}0} = 0{,}33 \quad \textbf{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{202}{460} = 0{,}44 \quad \textbf{OK}$$

Capacity of concrete

Concrete strength	**C20/25**	
f_{ck} =	20	N/mm^2
k_b =	3	-
γ_{Mc} =	1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc} =$	40	MPa

Dowel

Diameter	d_S =	**65**	mm
Length	b =	**233**	mm
Spread	$c = t\sqrt{(f_{yd} / 3 f_{jd})} =$	92	mm
Effective length	$b_{eff} = \min(b; d+2c)$	233	mm
Cross section	$A_S = \pi/4\ d_S^2 =$	3318	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff} =$	868	kN/m
Concrete pressure	$\sigma_b' = q / d_S =$	13,4	MPa

Shear stress in dowel

Load	$F_{T,Ed}$ =	202	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s =$	460	kN

Capacity of foot plate

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{202{,}3}{673{,}6} = 0{,}30 \quad \textbf{OK}$$

Capacity of anchor for tension

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{202{,}3}{655{,}1} = 0{,}31 \quad \textbf{OK}$$

Check foot plate for tension

$$\frac{T}{n \times F_{t;Rd}} = \frac{1214{,}0}{4041{,}3} = 0{,}30 \quad \textbf{OK}$$

Check anchor for shear

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{58{,}8}{267{,}9} = 0{,}22 \quad \textbf{OK}$$

Project:	Krimpen - Geertruidenberg 380	Date:	30-11-2020
		Version:	2.6

Anchors

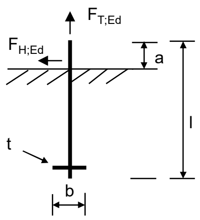
NEN-EN 1992-1-1 and 1993-1-8 with NA

CUR-BmS 10

Subject:	**HB+0**	***Checks:***		
		Anchor bolt to tension	0,28	***OK***
		Anchor bolt to shear	0,20	***OK***
		Dowel ("schieter")	0,40	***OK***

Inputs

Anchor diameter		**M64**	
Achor quality		**4.6**	
Thread		Cut	
Anchor length	l =	1300	mm
Anchor length above concrete	a =	250	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	**1102**	kN
Shear force	$F_{H,Ed}$ =	**321**	kN
Number of anchors for tension		6	
Number of anchors for shear		6	
$F_{T;Ed} = T / n =$		183,7	kN
$F_{v;Ed} = F_{H,Ed} / n =$		53,5	kN

Anchor properties

$d_b =$	64,00	mm
$A_{b;s} =$	2676	mm^2
$f_{yb} =$	240	N/mm^2
$f_{ub} =$	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0{,}44 - 0{,}0003 f_{yb} =$	0,37	-

Capacity per anchor

$F_{T;Rd} = 0{,}9\alpha_{red;2} f_{ub} A_s / g_{M2} =$	**655,1**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb} =$	**267,9**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		**S235**	
Thickness	t =	75	mm
Width	b_{ef} =	267	mm
Leverage arm	m =	131	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd} =$		88,2	kNm
$F_{t,Rd} = M_{pl,Rd} / m =$		673,6	kN

Check of dowel ("schieter")

$$\frac{\sigma_b'}{f_{cd}} = \frac{12{,}1}{40{,}0} = 0{,}30 \quad \textbf{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{184}{460} = 0{,}40 \quad \textbf{OK}$$

Capacity of concrete

Concrete strength		**C20/25**	
f_{ck} =		20	N/mm^2
k_b =		3	-
γ_{Mc} =		1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc} =$		40	MPa

Dowel

Diameter	d_S =	**65**	mm
Length	b =	**233**	mm
Spread	$c = t\sqrt{(f_{yd} / 3f_{jd})} =$	92	mm
Effective length	$b_{eff} = \min(b; d+2c)$	233	mm
Cross section	$A_S = \pi/4\, d_S^2 =$	3318	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff} =$	788	kN/m
Concrete pressure	$\sigma_b' = q / d_S =$	12,1	MPa

Shear stress in dowel

Load	$F_{T,Ed}$ =	184	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s =$	460	kN

Capacity of foot plate

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{183{,}7}{673{,}6} = 0{,}27 \quad \textbf{OK}$$

Capacity of anchor for tension

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{183{,}7}{655{,}1} = 0{,}28 \quad \textbf{OK}$$

Check foot plate for tension

$$\frac{T}{n \times F_{t;Rd}} = \frac{1102{,}0}{4041{,}3} = 0{,}27 \quad \textbf{OK}$$

Check anchor for shear

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{53{,}5}{267{,}9} = 0{,}20 \quad \textbf{OK}$$

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:

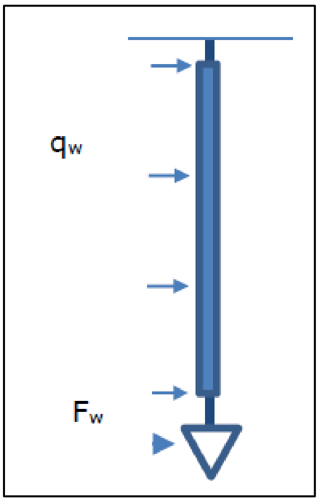


Figure 1: Diagrammatic representation of the loads on the post insulator

1. Forces on the insulator attachment

Wind pressure based on non-urban terrain in wind zone II at a height of 28.2 m: q_h = 1.18 kN/m^2

Wind load per meter based on an insulator diameter of 0.2 m and a drag factor of 1.2:

$\underline{q_w}$ = 1.2 x 0.2 x 1.18 = $\underline{0.29 \text{ kN/m}}$

Before calculating (F_w), the drag factor (C_C) is first calculated:

$V_w = (2 \times 1180 / 1.25)^{0.5} = 43.45 \text{ m.s}^{-1}$

Re = 43.45 x 0.036 / (15 x 10^{-6}) = 104280

$\underline{C_c}$ = $\underline{0.9}$

Then calculate 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 1.18 = 1.032 kN

Calculate the moment based on the wind loading and the point load:

$M_w = 0.5 \times 0.29 \times 4^2 + 4 \times 1.032 = 6.45$ kNm

Design values:

M_{ED} = 1.4 x 6.45 = 9.03 kNm

V_{ED} = 1.4 x (1.032 + 3.5 x 0.29) = 2.87 kN

2. Assessment of the pin

The figure below is a sketch of the insulator attachment mechanism indicating the location of the pin.

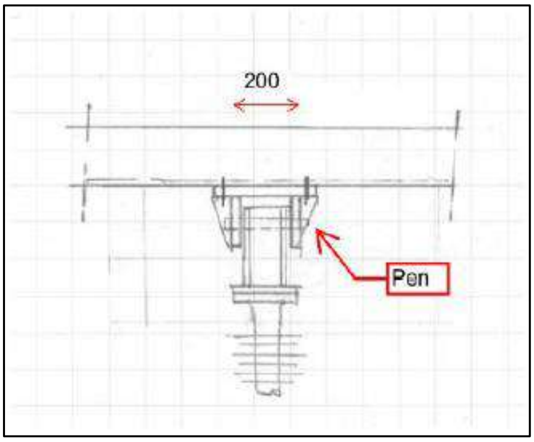


Figure 2: Post insulator attachment mechanism

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 = 9.03 /0.2 + 5/2 = 47.65 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.

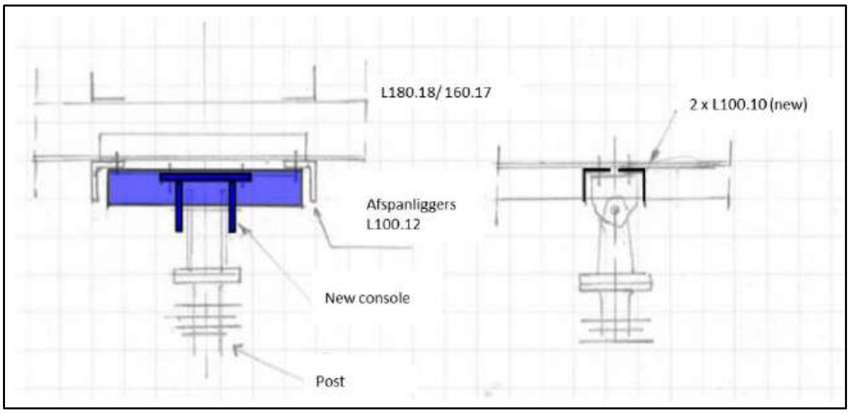


Figure 3: Overview of the new members required for attachment

M = 0.5 x 9.03 + 0.25 x 5 x 0.6 = 5.27 kNm

Proposition: 2 x L100.10: M_{rd} = 2 x 24750 x 355 x 10^{-3} = 17.5 kNm

U.C. = 5.27/ 17.5 = 0.30 < 1 OK

Project: BBB - KIJ GT
Mast: HB+0

DNV·GL

Pen-gatverbinding

Datum: 2020-08-19
Auteur: MKh
Versie: 1.3

Onderwerp	**Post Insulator Attachment**	Toetsing sterkte	0.65 < 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	

Toetsing

Afstanden

Randafstand	OK
Eindafstand	OK
Dikte	OK

Sterkte-eisen

Afschuifsterkte pen	0.25	< 1,0 OK
Buigsterkte pen	0.65	< 1,0 OK
Combinatie M + V	0.48	< 1,0 OK
Stuik plaat	0.43	< 1,0 OK

Belasting

F_{Ed} = 47.7 kN

$\gamma_{m0,staal}$	1.20
$\gamma_{m0,pen}$	1.00
γ_{m2}	1.25
$\gamma_{m6,ser}$	1.00

Berekeningen

Controle eind- en randafstand

Aan de eisen van óf A óf B moet voldaan worden

Type A

Rand	$a > F_{Ed}\ \gamma_{m0}\ /\ 2tf_y + 2\ d0/3 =$	26 mm	OK
Eind	$c > F_{Ed}\ \gamma_{m0}\ /\ 2tf_y + d0/3 =$	17 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	$t > 0{,}7\sqrt{(F_{Ed}\ \gamma_{m0}\ /\ f_y)} =$	11 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. 0.25 < 1,0 OK

Stuik

$F_{b,Rd} = 1{,}5\ t\ d\ f_y\ /\ \gamma_{m0} =$ 110 kN

U.C. 0.43 < 1,0 OK

Buigweerstand

$M_{Ed} = F_{Ed}\ e =$ 0.95 kNm

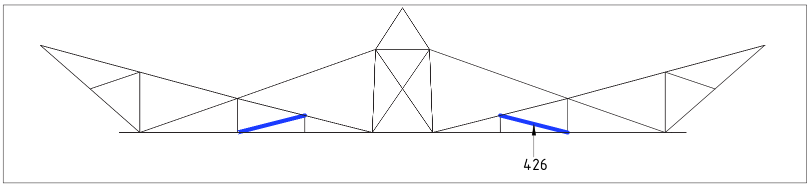
$M_{Rd} = 1{,}5\ W_{el}\ f_{yp}\ /\ \gamma_{m0} =$ 1.47 kNm

U.C. = 0.65 < 1,0 OK

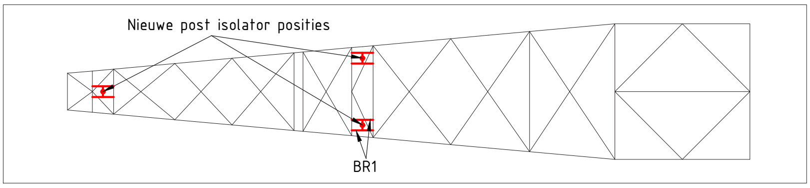
$(M_{Ed}\ /\ M_{Rd})2 + (F_{v,Ed}\ /\ F_{v,Rd})^2 =$ 0.48 < 1,0 OK

APPENDIX E DRAWINGS

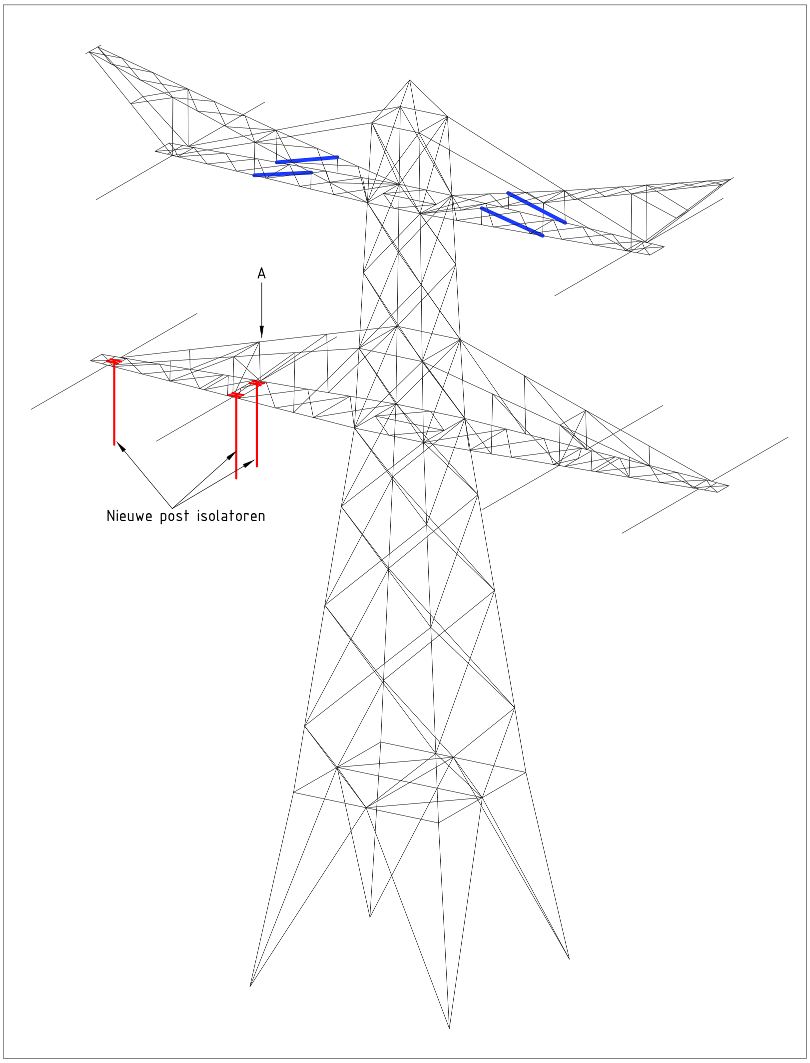
Mast initieel					Mast aanpassingen			
Groep label	Profiel type	Profiel afmetingen	Staal kwaliteit	Bout type en kwaliteit	Nieuw profiel type	Nieuwe profiel afmetingen	Nieuwe staal	Nieuwe bouttype en kwaliteit
426	EA	L50x5	S235 t<=40	M16-5.6t-NEN2012	EA	L50x6	S355 t<=40	M16-8.8t-NEN2012
BR1					EA	L100x10	S355 t<=40	M24-8.8t-NEN2012



Vooraanzicht boventraverse



Zicht op pijl A



Overzicht

Legenda:

- Nieuwe knikverkorters volgens tekening
- Afmeting knikverkorters L50x50x5 t.a.v.
- Overige aanpassingen volgens tabel
- Aanpassingen symmetrisch uitvoeren
- Materiaalkwaliteit t ≤ 16mm S355J0
- Materiaalkwaliteit t > 16mm S355J2
- Boutkwaliteit 8.8 gerolde draad

Nieuwe profiel/ isolator
Te vervangen profiel
Nieuwe knikverkorter
Te vervangen bouten

01	19-8-2020	Tweede versie - toevoeging van post isolatoren
00	7-5-2020	Eerste versie

DNV·GL

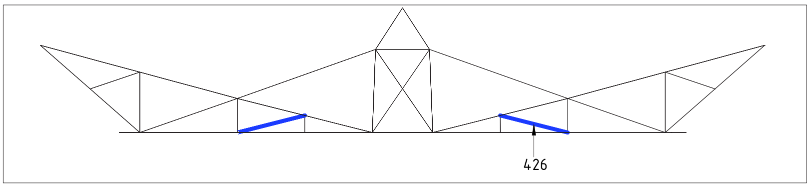
Projectname: Mastconstructies KIJ - GT 380 kV

Third angle projection:

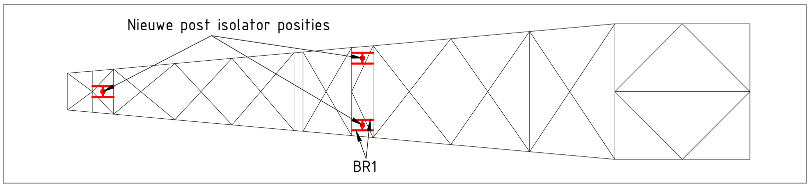
Drawing no.: 10166260-009

Design state: FINAL		Scale: -	Description: Overzicht versterkingen masttype HB+0 Mast 3	Revision: 01
Drawn by: MuK	19-8-2020	Units: m		
Checked by: TBR	20-8-2020	Project no: 10166260		Format: A2
Approved by: JHu	21-8-2020	Company: TenneT		

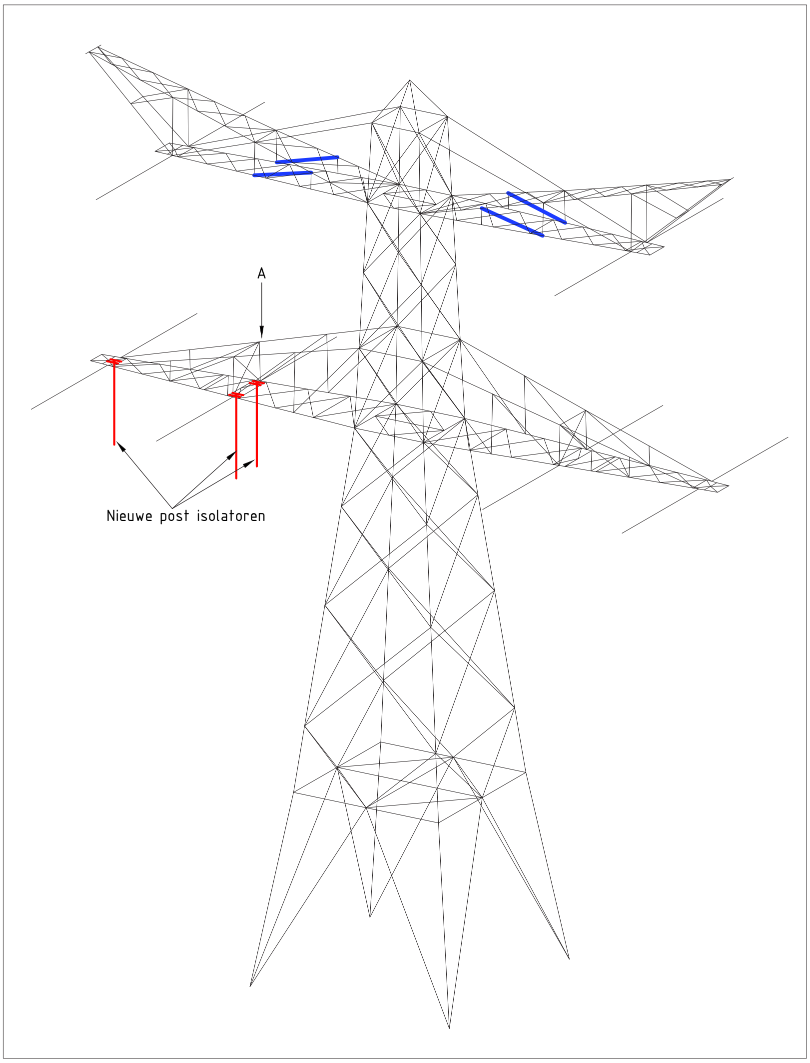
Mast initieel					Mast aanpassingen			
Groep label	Profiel type	Profiel afmetingen	Staal kwaliteit	Bout type en kwaliteit	Nieuw profiel type	Nieuwe profiel afmetingen	Nieuwe staal	Nieuwe bouttype en kwaliteit
426	EA	L50x5	S235 t<=40	M16-5.6t-NEN2012	EA	L50x6	S355 t<=40	M16-8.8t-NEN2012
BR1					EA	L100x10	S355 t<=40	M24-8.8t-NEN2012



Vooraanzicht boventraverse



Zicht op pijl A



Overzicht

Legenda:

- Nieuwe knikverkorters volgens tekening
- Afmeting knikverkorters L50x50x5 t.a.v.
- Overige aanpassingen volgens tabel
- Aanpassingen symmetrisch uitvoeren
- Materiaalkwaliteit t ≤ 16mm S355J0
- Materiaalkwaliteit t > 16mm S355J2
- Boutkwaliteit 8.8 gerolde draad

Nieuwe profiel/ isolator
Te vervangen profiel
Nieuwe knikverkorter
Te vervangen bouten

01	19-8-2020	Tweede versie - toevoeging van post isolatoren
00	7-5-2020	Eerste versie

DNV·GL

Projectname: Mastconstructies KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-010

Design state: FINAL		Scale: -	Description: Overzicht versterkingen masttype HB+0 Mast 81	Revision: 01
Drawn by: MuK	19-8-2020	Units: m		
Checked by: TBR	20-8-2020	Project no: 10166260		Format: A2
Approved by: JHu	21-8-2020	Company: TenneT		

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Bijlage 13 Rapportage Mastconstructie S+0

“TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380”

KIJ-GT380 – Rapportage mast S+0

TenneT TSO B.V.

Meridian doc. nr.: 002.589.40 0916488
Rapport nr.: 21-1102 Rev.0
Datum: 2021-07-06

Projectnaam:	"Toetsing en herontwerp masten en fundaties BBB380"	DNV GL - Energy Energy Advisory Postbus 9035 6800 ET ARNHEM
Rapport titel:	KIJ-GT380 – Rapportage mast S+0	
Klant:	TenneT TSO B.V.	
Contactpersoon:	[redacted]	
Datum:	2021-07-06	
Project nr.:	10166260	[redacted]11 [redacted]
Organisatie unit:	TDT	
Meridian doc.nr.:	002.589.40 0916488	
Rapport nr.:	21-1102 Rev.0	

Geschreven door: Beoordeeld door: Goedgekeurd door:

[redacted]

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☒ Geen distributie (vertrouwelijk)

Trefwoorden:

Versie	Datum	Reden voor uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2021-07-06	Eerste uitgave	[redacted]		

DNV GL Netherlands B.V.

Inhoud

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 GL 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

In deze studie wordt voor de lijn Krimpen aan den IJssel - Geertruidenberg de controle van de mastconstructie van masttype S+0 gerapporteerd.

Inhoudelijk is de Nederlandse versie van de rapportage 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.

1.2 Doelstelling en scope van dit rapport

Het doel van deze studie is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de ACCCZ-Warsaw geleider.

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 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 Krimpen aan den IJssel - Geertruidenberg" [1].

1.3.2 E-studie deel 1

In de rapportage "KIJ-GT380 - E-studie deel 1" [2] is bepaald welke aanpassingen benodigd zijn om de ACCCZ Warsaw geleider toe te passen binnen de verbinding Krimpen aan den IJssel - Geertruidenberg. Uit de E-studie volgen geen zaken die relevant zijn voor de constructie van masttype S+0.

1.3.3 Uitgangspunten rapport

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport "Uitgangspuntenrapport 380kV verbinding Krimpen aan den IJssel - Geertruidenberg" [3].

2 EISEN

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

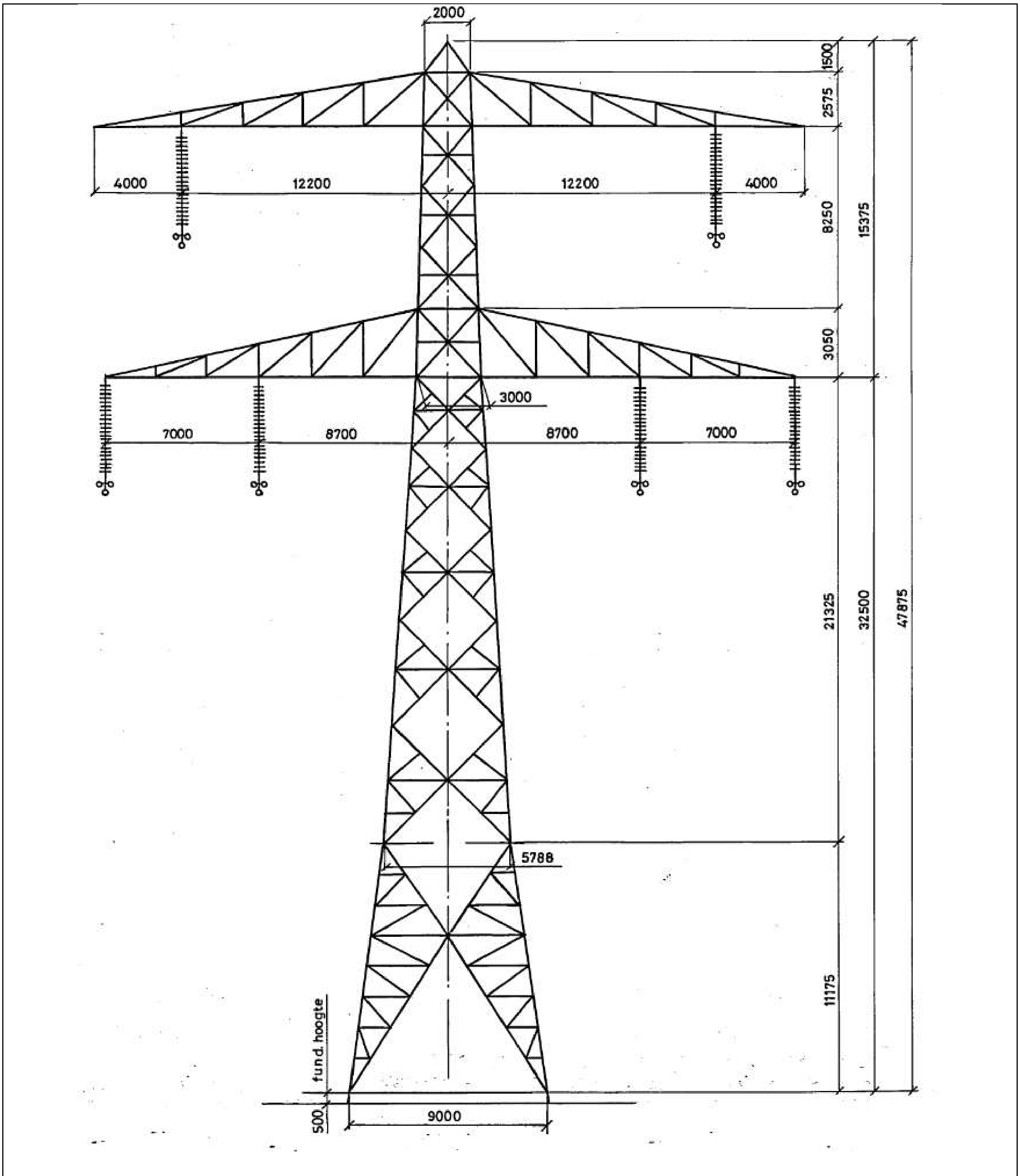
Tabel 1 Relevante eisen

Eis Id	Titel	Eis Tekst	Bewijsvoering
BO Eis: H2.7-6	Omgeving, beperkings factoren	Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid.	Tabel 7
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 1060:1964. 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 1060:1964.	Tabel 7

3 BEREKENINGEN

3.1 Mastbeeld

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



Figuur 1 Mastbeeld

3.2 Mastenlijst

In deze rapportage wordt masttype S+0 getoetst. De berekening is uitgevoerd voor windgebied II en windgebied III. De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven. De maatgevende mastnummers zijn aangegeven. Bij zowel de masten in windgebied II als III is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde).

Tabel 2 Mastnummers

Mastnummer	Masttype	Maatgevend mastnummer	Wind span (m)	Weight span (m)	Hoogteverschil
6	S+0 II	39	341	321	-5.7
7	S+0 II	39	337	337	-0.8
16	S+0 II	39	343	342	-1.1
17	S+0 II	39	388	390	0.2
18	S+0 II	39	393	394	0.0
19	S+0 II	39	390	391	-0.2
20	S+0 II	39	383	387	0.6
21	S+0 II	39	379	379	-0.5
22	S+0 II	39	382	383	0.1
23	S+0 II	39	372	373	-0.1
24	S+0 II	39	350	352	-0.5
26	S+0 II	39	366	347	-6.4
29	S+0 II	39	379	359	-5.8
30	S+0 II	39	379	380	-0.2
31	S+0 II	39	380	382	0.3
32	S+0 II	39	376	376	-0.1
33	S+0 II	39	381	382	-0.1
34	S+0 II	39	377	379	0.2
36	S+0 II	39	394	396	-0.3
39	S+0 II	39	399	400	-0.7
40	S+0 II	39	318	322	0.7
41	S+0 II	39	308	307	-0.5
42	S+0 II	39	388	370	-5.5
45	S+0 II	39	362	330	**-8.6**
55	S+0	65	399	400	-0.7
56	S+0	65	349	326	-5.2
59	S+0	65	399	336	-22.0
62	S+0	65	336	323	-3.2
64	S+0	65	399	388	-3.5
65	S+0	65	404	407	0.2
66	S+0	65	392	296	**-26.2**
70	S+0	65	280	194	-18.5
73	S+0	65	397	344	-15.3
74	S+0	65	399	401	0.0
75	S+0	65	399	402	-0.2
79	S+0	65	404	321	-24.0
82	S+0	65	395	389	-3.3

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:

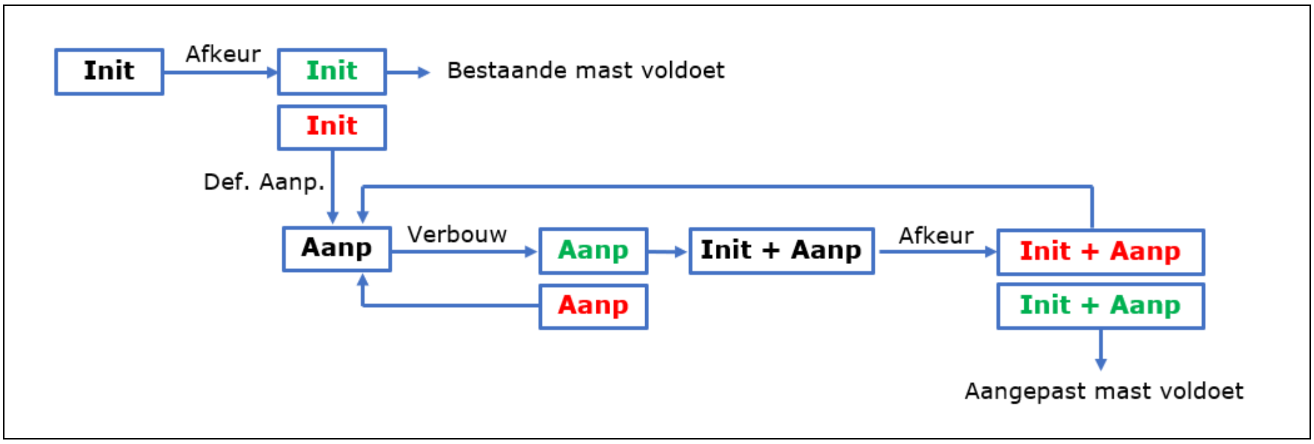
Stap 1: Toets bestaande (Init) mast op Afkeur

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 GL. 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

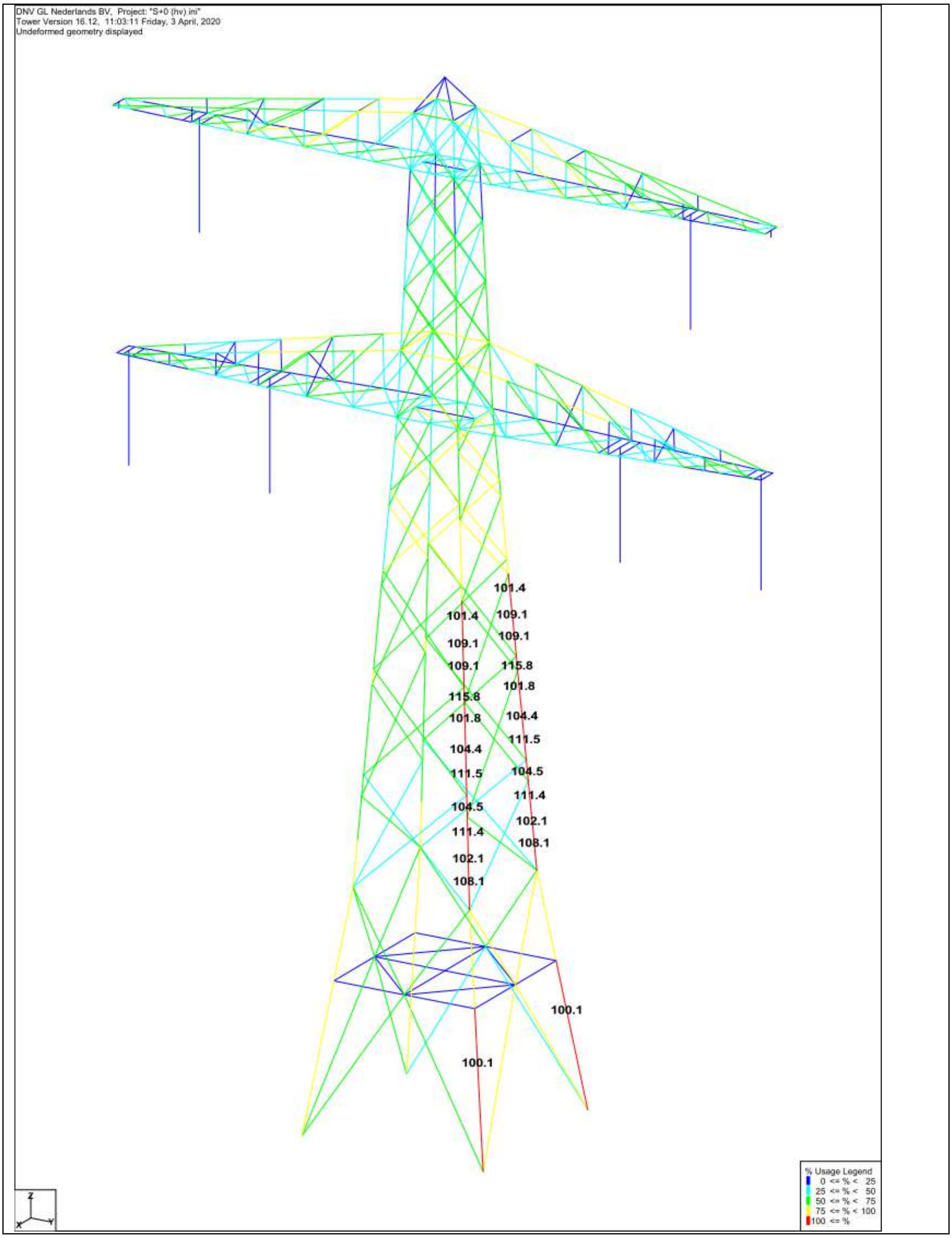
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten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

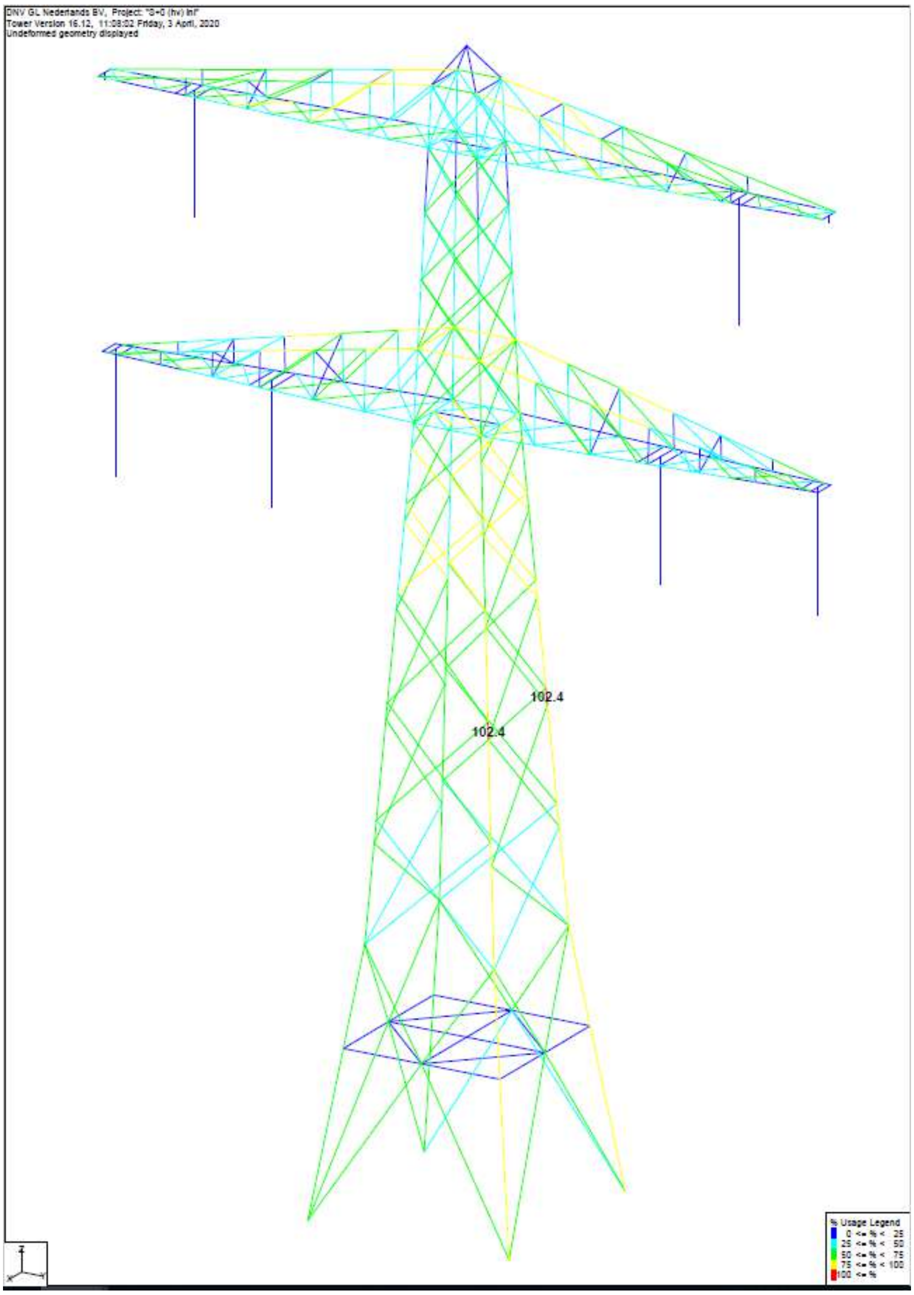
4 TOETSING MAST

Het resultaat van de controle van de mastconstructie type S+0 in windgebied II met belastingen op afkeurniveau is weergegeven in Figuur 3.



Figuur 3 Resultaat PLS-TOWER S+0 II (39)

Het resultaat van de controle van de mastconstructie type S+0 in windgebied III met belastingen op afkeurniveau is weergegeven in Figuur 4.



Figuur 4 Resultaat PLS-TOWER S+0 (65)

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
Knikverkorters		**Voldoen niet**	Appendix C
Ankers en voetplaat		**Voldoen niet**	Appendix D
Blokdeuvels	Voldoen		Appendix D

5 AANPASSINGEN

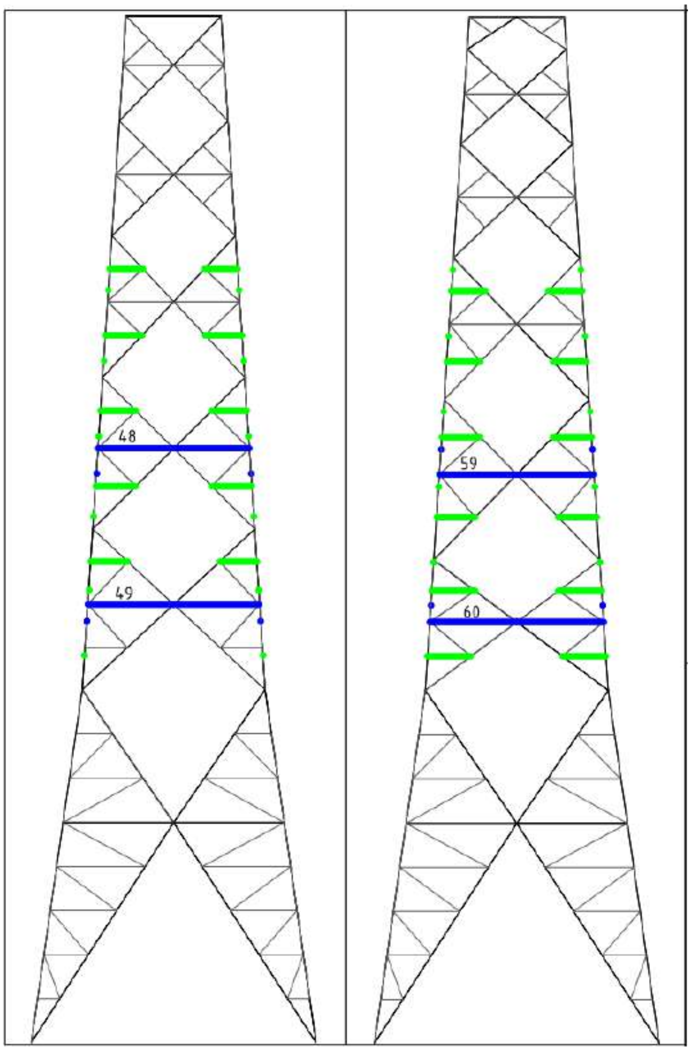
5.1 Inleiding

Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

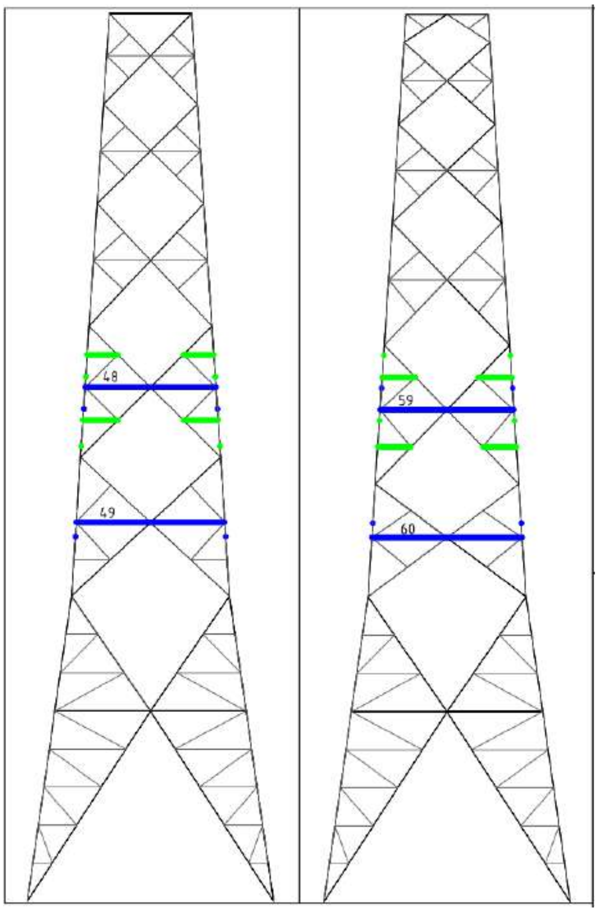
- Knikverkorters vervangen;
- Vervangen van een diagonaal in de bovenste traverse;
- Knikverkorters toevoegen;
- Bouten vervangen;
- Voetplaat verzwaren.

5.2 Aanpassingen

Voor berekening, zie Appendix C. Voor afmetingen profielen en bouten, zie Appendix E. De benodigde aanpassingen zijn weergegeven in Figuur 5 en Figuur 6.

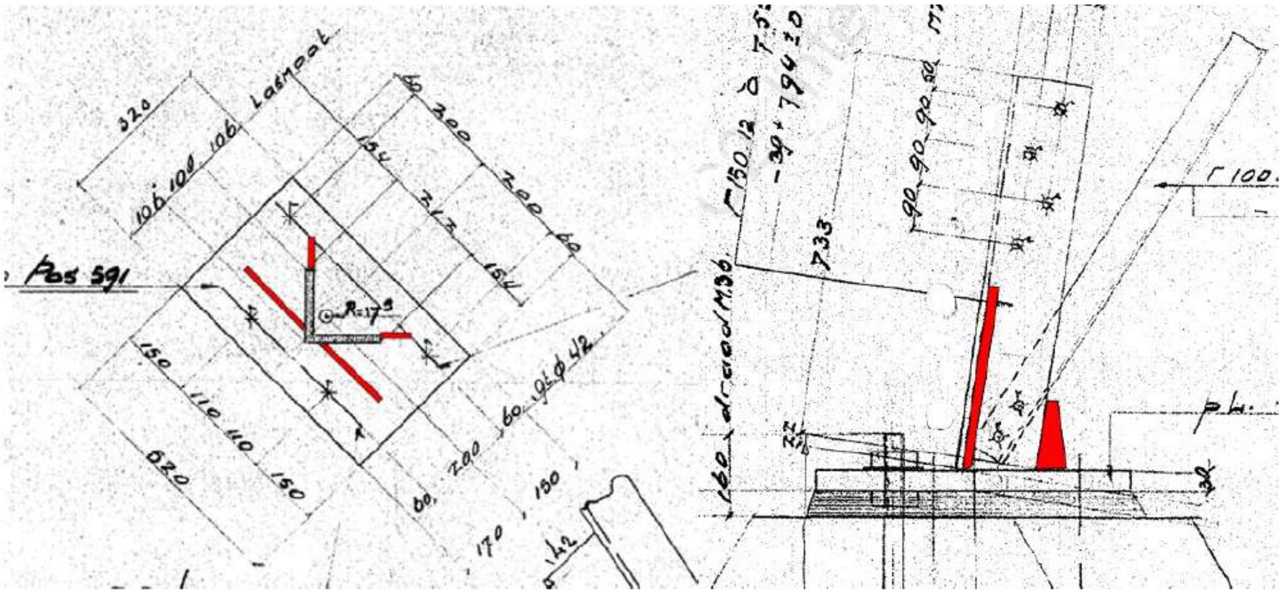


Figuur 5 Principe aanpassing/toevoeging knikverkorters voor S+0 II (39)



Figuur 6 Principe aanpassing/toevoeging knikverkorters voor S+0 (65)

De voetplaat voor S+0 (39) in windgebied II moet versterkt worden. Een aanpassingsvoorstel voor de voetplaat en ankers is de voetplaat versterken met in het werk aan te lassen verstijvingsplaten. Zie hiervoor Figuur 7. Voor de berekening van de ankerverbinding zie Appendix D.



Figuur 7 Principe van te versterken ankerplaat

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen is voor mast 39 gegeven in Tabel 5 en voor mast 65 in Tabel 6. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

Tabel 5 Gewichten S+0 II (39) van toegevoegde knikverkorters en uitgewisselde profielen

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
49	L45.5	S235	M12-5.6	L55.6	S355	M12-8.8	Profiel uitgewisseld	4	2,64	53,3
48	L45.5	S235	M12-5.6	L50.5	S355	M12-8.8	Profiel uitgewisseld	4	2,32	35,6
60	L45.5	S235	M12-5.6	L55.6	S355	M12-8.8	Profiel uitgewisseld	4	2,67	53,9
59	L45.5	S235	M12-5.6	L50.5	S355	M12-8.8	Profiel uitgewisseld	4	2,37	36,4
5000				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,22	18,7
5001				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,32	20,3
5002				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,17	18,0
5005				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,43	22,0
5006				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,43	22,0
5007				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,27	19,5
5008				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,27	19,5
5003				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,22	18,7
5004				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,1	16,9
5009				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,12	17,2
5010				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,12	17,2
										389,2

Tabel 6 Gewichten S+0 (65) van toegevoegde knikverkorters en uitgewisselde profielen

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
49	L45.5	S235	M12-5.6	L55.6	S355	M12-8.8	Profiel uitgewisseld	4	2,64	53,3
48	L45.5	S235	M12-5.6	L50.5	S355	M12-8.8	Profiel uitgewisseld	4	2,32	35,6
60	L45.5	S235	M12-5.6	L55.6	S355	M12-8.8	Profiel uitgewisseld	4	2,67	53,9
59	L45.5	S235	M12-5.6	L50.5	S355	M12-8.8	Profiel uitgewisseld	4	2,37	36,4
5001				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,32	20,3
5002				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,17	18,0
5007				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,27	19,5
5008				L50.5	S355	M16-8.8	Profielen toegevoegd	4	1,27	19,5
										256,5

5.3 Eisen verificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 7.

Tabel 7 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. De verstijving van de voetplaat vereist in het werk lassen. Vanwege de locatie op de grond is dit uitvoerbaar en een bewezen oplossing.
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 1060:1964?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.589.40 0817486 - 20-0473 - Verificatie & validatieplan 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

[2] „002.589.40 0808624 - 20-0472 - E-studie deel 1 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

[3] „002.589.40 0808629 - 20-0345 - Uitgangspuntenrapport 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

APPENDIX A CONDUCTOR LOADS

Content

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

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	II
Wind speed	27 m/s
Terrain categorie	II
Reduction factor C_{dir}	1,00
Ice region	B
Tower type	Steunmast
Tower height	48 m
Max. Span	402 m
Line angle	180°
Catenary	1400 m
Wind span	400 m
EDS Weight span	399 m
Min. Weight span	396 m
Max. Weight span	399 m

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype S+0 II

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

Document name:

KIJ-GT_S+0 II_39_Report.pdf

Project number:

Project client number:

0.0

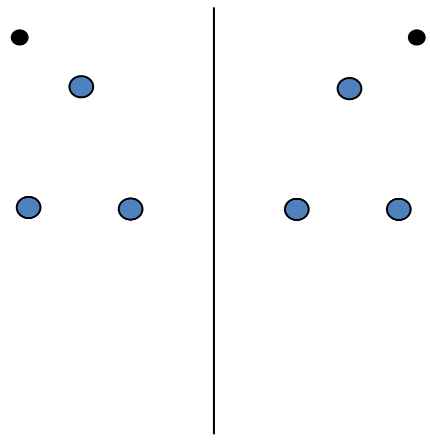
Project: KIJ-GT
Tower: S+0 II
Number: 39

Conductor loads

Auteur: TBR
Versie: v11.3

General

Description	S+0 II
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	II
Wind speed	27,0 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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Halfverankering	2,00	4,30	1,00
Circuit 2	Halfverankering	2,00	4,30	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,50	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,50	0,05

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	28,2 m	32,5 m	15,7 m
Circuit 1	11	380ct1f2	28,2 m	32,5 m	8,7 m
Circuit 1	12	380ct1f3	39,5 m	43,8 m	12,2 m
Circuit 2	20	380ct2f1	28,2 m	32,5 m	-8,7 m
Circuit 2	21	380ct2f2	28,2 m	32,5 m	-15,7 m
Circuit 2	22	380ct2f3	39,5 m	43,8 m	-12,2 m
Bliksemdraad 1	1	bl1	43,3 m	43,8 m	16,2 m
Bliksemdraad 2	3	bl2	43,3 m	43,8 m	-16,2 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

Project: KIJ-GT
Tower: S+0 II
Number: 39

Height adjustment adjacent masts (wind and weight span adjustment)

	Back	Ahead	
Height increase for wind pressure	0,0 m	9,0 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

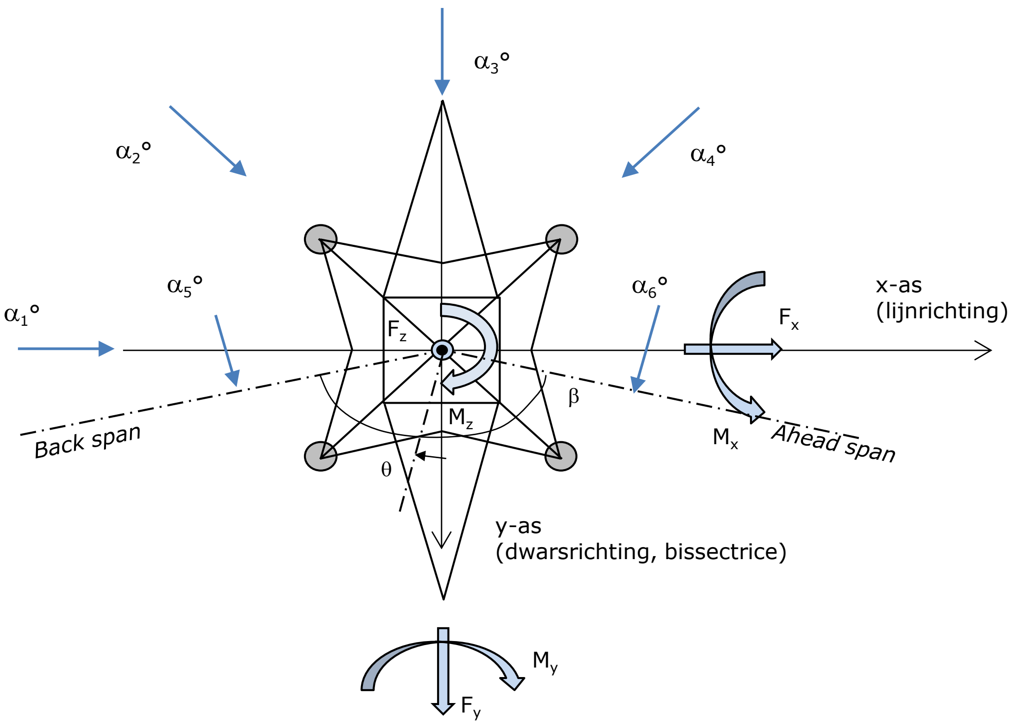
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	-0,4	0,4 m	0,0	0,0 m
Circuit 1	11	380ct1f2	-0,4	0,4 m	0,0	0,0 m
Circuit 1	12	380ct1f3	-0,4	0,4 m	0,0	0,0 m
Circuit 2	20	380ct2f1	-0,4	0,4 m	0,0	0,0 m
Circuit 2	21	380ct2f2	-0,4	0,4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

Line and tower data

		Back	Ahead
		402,0	397,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		366,3	366,3 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		3403	3403 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: KIJ-GT
Tower: S+0 II
Number: 39

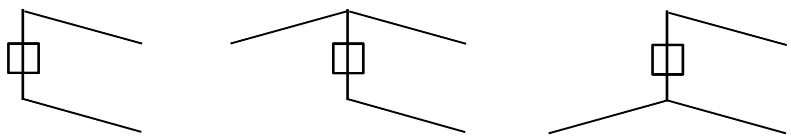
Absence of conductors

		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

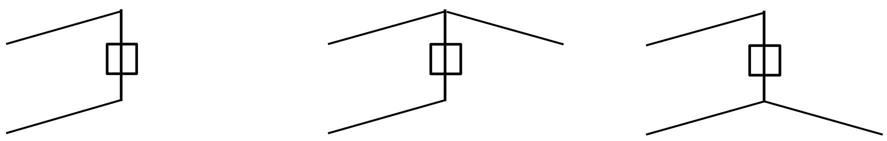
Load situations SPLS

Considered situations SPLS: SPLS for suspension tower not applicable

Principle of load situations:



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

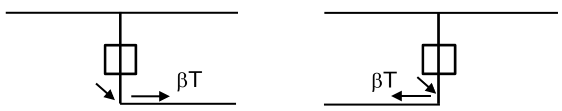


4. Ah All cts 5. Ah ct1 6. Ah ct2

Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1, design assumption is symmetry back and ahead

Principle of load situations:



1. Ba 2. Ah

Project: KIJ-GT
Tower: S+0 II
Number: 39

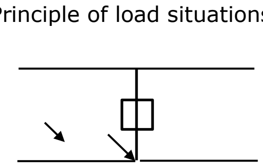
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine 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

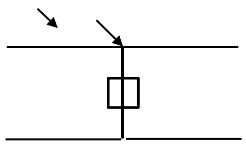
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

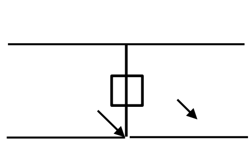
Principle of load situations:



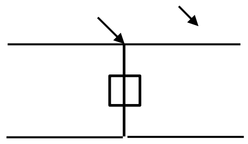
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

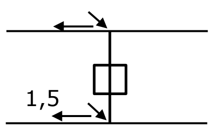
Load situations 8. Galloping as a static load

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

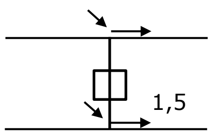
Considered situations galloping 8: None (existing structure)

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: KIJ-GT
Tower: S+0 II
Number: 39

Tower structure

Properties

Tower type	Steunmast		
Tower designation	S+0 II		
Base plate w.r.t. ground level	0,5	m	
Tower height w.r.t. base plate	48,0	m	
Tower self weight	205,0	kN	

Width and slope at foundation	x-ri.	y-ri.	
Leg spread	9,00	9,00	m
Inclination of main leg	0,144	0,144	-
Horizontal force factor	1,4	1,4	-

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 1	11,18	9,00	5,79	11,18	0,144	82,68	8,38	0,10	3,40
Middenstuk 1	21,06	5,79	4,50	9,88	0,065	50,83	6,38	0,13	3,28
Middenstuk 2	32,50	4,50	3,00	11,44	0,066	42,90	7,13	0,17	3,08
Bovenstuk 1	38,40	3,00	2,58	5,90	0,036	16,46	4,17	0,25	2,71
Bovenstuk 2	46,40	2,58	2,00	8,00	0,036	18,32	4,61	0,25	2,72
Topstuk	47,88	2,00		1,48		1,48	0,38	0,26	2,70
Ondertraverse	32,50	15,70		2,90		22,77	4,29	0,19	2,98
Boventraverse	43,80	16,20		2,50		20,25	4,17	0,21	2,90

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 1	11,18	9,00	5,79	11,18	0,144	82,68	8,38	0,10	3,40
Middenstuk 1	21,06	5,79	4,50	9,88	0,065	50,83	6,38	0,13	3,28
Middenstuk 2	32,50	4,50	3,00	11,44	0,066	42,90	7,13	0,17	3,08
Bovenstuk 1	38,40	3,00	2,58	5,90	0,036	16,46	4,17	0,25	2,71
Bovenstuk 2	46,40	2,58	2,00	8,00	0,036	18,32	4,61	0,25	2,72
Topstuk	47,88	2,00		1,48		1,48	0,38	0,26	2,70
Ondertraverse	32,50	15,70		2,90		22,77	4,29	0,19	2,98
Boventraverse	43,80	16,20		2,50		20,25	4,17	0,21	2,90

Note: Surface transverse direction is reduced in calculation.

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Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
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 1	0,85	24,3	20,6	0,0	-20,6	5,6	135,6	115,0	0,0	-115,0
Middenstuk 1	1,00	20,9	17,7	0,0	-17,7	16,1	336,1	285,2	0,0	-285,2
Middenstuk 2	1,16	25,5	21,7	0,0	-21,7	26,8	684,0	580,4	0,0	-580,4
Bovenstuk 1	1,26	14,2	12,1	0,0	-12,1	35,5	503,8	427,4	0,0	-427,4
Bovenstuk 2	1,32	16,5	14,0	0,0	-14,0	42,4	701,0	594,8	0,0	-594,8
Topstuk	1,36	1,4	1,2	0,0	-1,2	47,1	65,6	55,6	0,0	-55,6
Ondertraverse	1,24	31,7	18,8	0,0	-18,8	33,5	1059,7	629,4	0,0	-629,4
Boventraverse	1,34	32,4	19,3	0,0	-19,3	44,6	1447,3	859,7	0,0	-859,7
Totaal		166,9	125,3	0,0	-125,3		4933,0	3547,6	0,0	-3547,6

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 1	0,85	0,0	20,6	24,3	20,6	5,6	0,0	115,0	135,6	115,0
Middenstuk 1	1,00	0,0	17,7	20,9	17,7	16,1	0,0	285,2	336,1	285,2
Middenstuk 2	1,16	0,0	21,7	25,5	21,7	26,8	0,0	580,4	684,0	580,4
Bovenstuk 1	1,26	0,0	12,1	14,2	12,1	35,5	0,0	427,4	503,8	427,4
Bovenstuk 2	1,32	0,0	14,0	16,5	14,0	42,4	0,0	594,8	701,0	594,8
Topstuk	1,36	0,0	1,2	1,4	1,2	47,1	0,0	55,6	65,6	55,6
Ondertraverse	1,24	0,0	18,8	12,7	18,8	33,5	0,0	629,4	423,9	629,4
Boventraverse	1,34	0,0	19,3	13,0	19,3	44,6	0,0	859,7	578,9	859,7
Total		0,0	125,3	128,4	125,3		0,0	3547,6	3428,8	3547,6

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	205	0	0	0
Windrichting 0°	167	0	0	0	4933	0
Windrichting 45°	125	125	0	3548	3548	0
Windrichting 90°	0	128	0	3429	0	0
Windrichting 135°	-125	125	0	3548	-3548	0

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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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,3	1,0	30,85	1,21	1,2	1,45
380ct1f2	2,00	1	2	4,3	1,0	30,85	1,21	1,2	1,45
380ct1f3	2,00	1	2	4,3	1,0	42,15	1,32	1,2	1,58
380ct2f1	2,00	1	2	4,3	1,0	30,85	1,21	1,2	1,45
380ct2f2	2,00	1	2	4,3	1,0	30,85	1,21	1,2	1,45
380ct2f3	2,00	1	2	4,3	1,0	42,15	1,32	1,2	1,58
bl1	0,10	1	0,1	0,5	0,1	44,05	1,33	1,2	0,08
bl2	0,10	1	0,1	0,5	0,1	44,05	1,33	1,2	0,08

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Wind load back

Conductor	Height wind [m]	Pressure [kN/m²]	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	1,05	0,54	0,47	1,08	28,25	52,0	44,9	46,9	95,7	82,6
380ct1f2	18,9	1,05	0,54	0,47	1,08	28,25	52,0	44,9	46,9	95,7	82,6
380ct1f3	30,2	1,20	0,58	0,50	1,04	28,25	61,4	52,9	46,9	117,4	101,1
380ct2f1	18,9	1,05	0,54	0,47	1,08	28,25	52,0	44,9	46,9	95,7	82,6
380ct2f2	18,9	1,05	0,54	0,47	1,08	28,25	52,0	44,9	46,9	95,7	82,6
380ct2f3	30,2	1,20	0,58	0,50	1,04	28,25	61,4	52,9	46,9	117,4	101,1
bl1	34,8	1,25	0,59	0,51	1,16	22,24	19,1	16,4	41,5	36,7	31,6
bl2	34,8	1,25	0,59	0,51	1,16	22,13	19,0	16,3	41,4	36,7	31,5

Wind load ahead

Conductor	Height wind [m]	Pressure [kN/m²]	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	24,0	1,13	0,56	0,48	1,06	28,25	56,8	48,9	46,9	106,5	91,8
380ct1f2	24,0	1,13	0,56	0,48	1,06	28,25	56,8	48,9	46,9	106,5	91,8
380ct1f3	35,3	1,26	0,59	0,51	1,03	28,25	64,7	55,6	46,9	125,3	107,8
380ct2f1	24,0	1,13	0,56	0,48	1,06	28,25	56,8	48,9	46,9	106,5	91,8
380ct2f2	24,0	1,13	0,56	0,48	1,06	28,25	56,8	48,9	46,9	106,5	91,8
380ct2f3	35,3	1,26	0,59	0,51	1,03	28,25	64,7	55,6	46,9	125,3	107,8
bl1	39,7	1,30	0,60	0,52	1,15	22,24	20,0	17,1	41,5	38,8	33,3
bl2	39,7	1,30	0,60	0,52	1,16	22,13	19,9	17,1	41,4	38,7	33,3

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Project: KIJ-GT
Tower: S+0 II
Number: 39

Auteur: TBR
Versie: v11.3

Conductor loads

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

Project: KIJ-GT
Tower: S+0 II
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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	-29,9	29,9	4,3	4,5	5,4	5,3
bl2	-30,2	30,2	4,3	4,5	5,4	5,3
380ct1f1	-110,9	110,9	12,6	13,5	16,4	16,0
380ct1f2	-110,9	110,9	12,6	13,5	16,4	16,0
380ct1f3	-113,5	113,5	14,8	15,3	16,4	16,0
380ct2f1	-110,9	110,9	12,6	13,5	16,4	16,0
380ct2f2	-110,9	110,9	12,6	13,5	16,4	16,0
380ct2f3	-113,5	113,5	14,8	15,3	16,4	16,0

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	396,8	397,7	398,0
bl2	396,8	397,7	398,0
380ct1f1	399,1	399,2	399,2
380ct1f2	399,1	399,2	399,2
380ct1f3	399,1	399,2	399,2
380ct2f1	399,1	399,2	399,2
380ct2f2	399,1	399,2	399,2
380ct2f3	399,1	399,2	399,2

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	398,0	398,0
bl2	398,0	398,0
380ct1f1	399,2	399,2
380ct1f2	399,2	399,2
380ct1f3	399,2	399,2
380ct2f1	399,2	399,2
380ct2f2	399,2	399,2
380ct2f3	399,2	399,2

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	399,2 m	0,999 -
Min. weight span	396,2 m	0,992 -

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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	15,0	8,8	8,1	-31,7	31,7
bl2	15,0	8,8	8,1	-31,8	31,8
380ct1f1	51,3	26,0	32,4	-110,2	111,6
380ct1f2	51,3	26,0	32,4	-110,2	111,6
380ct1f3	51,3	30,1	32,4	-113,0	114,1
380ct2f1	51,3	26,0	32,4	-110,2	111,6
380ct2f2	51,3	26,0	32,4	-110,2	111,6
380ct2f3	51,3	30,1	32,4	-113,0	114,1

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	4,1	-15,0	15,0
bl2	0,0	0,0	4,1	-15,0	15,0
380ct1f1	0,0	0,0	20,3	-64,2	64,2
380ct1f2	0,0	0,0	20,3	-64,2	64,2
380ct1f3	0,0	0,0	20,3	-64,2	64,2
380ct2f1	0,0	0,0	20,3	-64,2	64,2
380ct2f2	0,0	0,0	20,3	-64,2	64,2
380ct2f3	0,0	0,0	20,3	-64,2	64,2

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	2,1	2,0
	bl2	2,1	2,0
	380ct1f1	10,3	10,0
	380ct1f2	10,3	10,0
	380ct1f3	10,3	10,0
	380ct2f1	10,3	10,0
	380ct2f2	10,3	10,0
	380ct2f3	10,3	10,0

Project: KIJ-GT
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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		0	182	136	6796	0	0
ULS 1a_0,9_90		0	182	136	6796	0	0
ULS 3_90		0	100	209	3760	0	0
ULS 3_0,9_90		0	100	209	3760	0	0
SLS 7		0	0	130	0	0	0

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

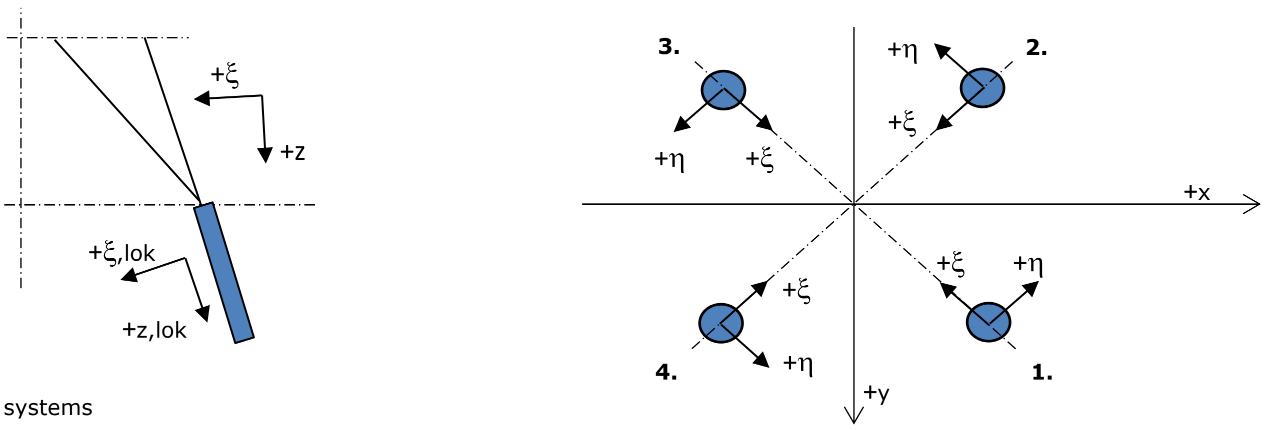
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	326	352	10650	0	0
ULS 3_90	0	144	424	4916	0	0
SLS 7	0	0	335	0	0	0

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	326	352	**10650**	0	0
ULS 1a_0	190	0	352	0	**5645**	0
ULS 5a Ba 10	51	0	334	-145	1669	**806**
ULS 1a_45	143	234	352	**7463**	**4058**	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	137	121	**728**	11	-183	-35	743
2	ULS 1a_0	65	-81	**402**	11	-103	-22	410
3	ULS 7	-19	-19	**96**	0	-27	-8	98
4	ULS 1a_135	-137	121	**728**	-11	-183	-35	743

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-104	89	**-565**	11	136	21	-576
3	ULS 1a_0,9_0,9_45	104	89	**-565**	-11	136	21	-576
4	ULS 1a_0,9_0,9_0	32	-48	**-238**	-11	57	8	-243

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 Ba 10	50	13	168	**26**	-45	-11	171
2	ULS 5a Ba 10	9	-58	184	**35**	-47	-10	188
3	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
4	ULS 5a Ba 10	20	21	-17	**29**	0	-4	-18

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 21	9	58	184	**-35**	-47	-10	188
2	ULS 5a Ba 21	50	-13	168	**-26**	-45	-11	171
3	ULS 5a Ba 21	20	-21	-17	**-29**	0	-4	-18
4	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1

Project: KIJ-GT
Tower: S+0 II
Number: 39

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-104	89	**-565**	**11**	136	21	-576
3	ULS 1a_0,9_0,9_45	104	89	**-565**	**-11**	136	21	-576
4	ULS 1a_0,9_0,9_0	32	-48	**-238**	**-11**	57	8	-243

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	17	17	84	0	-24	-7	85
2	SLS 7	17	-17	84	0	-24	-7	85
3	SLS 7	-17	-17	84	0	-24	-7	85
4	SLS 7	-17	17	84	0	-24	-7	85

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	137	121	**728**	11	-183	-35	743
Max. tension	ULS 1a_0,9_0,9_45	104	89	**-565**	-11	136	21	-576
Max. pos. torsie	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
Max. neg. torsie	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1
Comb. tension+torsie	ULS 1a_0,9_0,9_45	104	89	**-565**	**-11**	136	21	-576

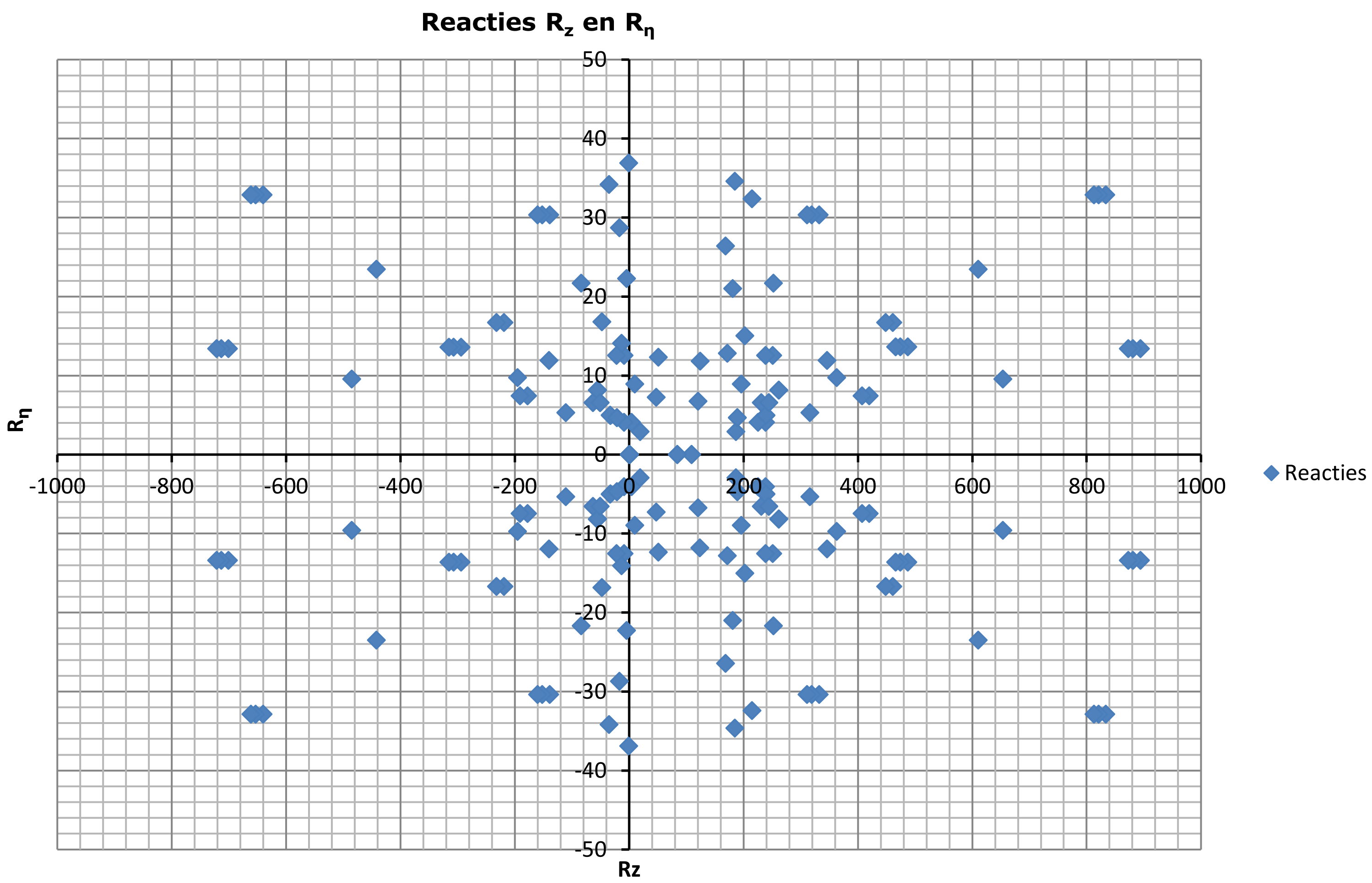
Maximum tension load - SLS

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	17	17	**84**	0	-24	-7	85
2	SLS 1a_135	-83	70	**-453**	9	108	16	-463
3	SLS 1a_45	83	70	**-453**	-9	108	16	-463
4	SLS 1a_0	23	-36	**-179**	-9	42	5	-183

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	117	104	**621**	9	-156	-30	634
2	SLS 1a_0	57	-70	**347**	9	-89	-19	354
3	SLS 7	-17	-17	**84**	0	-24	-7	85
4	SLS 1a_135	-117	104	**621**	-9	-156	-30	634

Project: KIJ-GT
Tower: S+0 II
Number: 39



Project: KIJ-GT
Tower: S+0 II
Number: 39

Auteur: TBR
Versie: v11.3

Conductor loads

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

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Project: KIJ-GT
Tower: S+0 II
Number: 39

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	-34,9	34,9	5,4	5,6	5,9	5,8
bl2	-35,2	35,2	5,4	5,6	5,9	5,8
380ct1f1	-128,9	128,9	15,6	16,8	19,3	18,9
380ct1f2	-128,9	128,9	15,6	16,8	19,3	18,9
380ct1f3	-132,2	132,2	18,4	19,1	19,3	18,9
380ct2f1	-128,9	128,9	15,6	16,8	19,3	18,9
380ct2f2	-128,9	128,9	15,6	16,8	19,3	18,9
380ct2f3	-132,2	132,2	18,4	19,1	19,3	18,9

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	396,7	397,7	398,0
bl2	396,7	397,6	398,0
380ct1f1	399,1	399,2	399,2
380ct1f2	399,1	399,2	399,2
380ct1f3	399,1	399,2	399,2
380ct2f1	399,1	399,2	399,2
380ct2f2	399,1	399,2	399,2
380ct2f3	399,1	399,2	399,2

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	398,0	398,1
bl2	398,0	398,1
380ct1f1	399,2	399,2
380ct1f2	399,2	399,2
380ct1f3	399,2	399,2
380ct2f1	399,2	399,2
380ct2f2	399,2	399,2
380ct2f3	399,2	399,2

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	399,2 m	0,999 -
Min. weight span	395,7 m	0,990 -

Project: KIJ-GT
Tower: S+0 II
Number: 39

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	11,0	9,0	-34,7	35,1
bl2	15,0	11,0	9,0	-35,0	35,4
380ct1f1	51,3	32,4	38,2	-128,1	129,7
380ct1f2	51,3	32,4	38,2	-128,1	129,7
380ct1f3	51,3	37,5	38,2	-131,5	132,9
380ct2f1	51,3	32,4	38,2	-128,1	129,7
380ct2f2	51,3	32,4	38,2	-128,1	129,7
380ct2f3	51,3	37,5	38,2	-131,5	132,9

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	4,1	-15,0	15,0
bl2	0,0	0,0	4,1	-15,0	15,0
380ct1f1	0,0	0,0	20,3	-64,2	64,2
380ct1f2	0,0	0,0	20,3	-64,2	64,2
380ct1f3	0,0	0,0	20,3	-64,2	64,2
380ct2f1	0,0	0,0	20,3	-64,2	64,2
380ct2f2	0,0	0,0	20,3	-64,2	64,2
380ct2f3	0,0	0,0	20,3	-64,2	64,2

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	2,1	2,0
	bl2	2,1	2,0
	380ct1f1	10,3	10,0
	380ct1f2	10,3	10,0
	380ct1f3	10,3	10,0
	380ct2f1	10,3	10,0
	380ct2f2	10,3	10,0
	380ct2f3	10,3	10,0

Project: KIJ-GT
Tower: S+0 II
Number: 39

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	227	149	8464	0	0
ULS 1a_0,9_90		0	227	149	8464	0	0
ULS 3_90		0	125	247	4684	0	0
ULS 3_0,9_90		0	125	247	4684	0	0
SLS 7		0	0	130	0	0	0

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

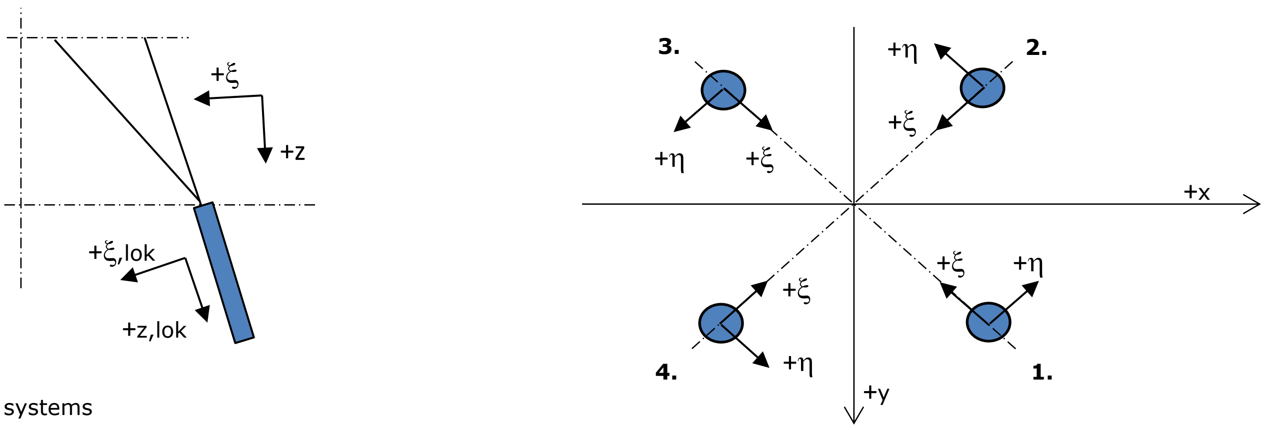
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	406	385	13264	0	0
ULS 3_90	0	179	483	6124	0	0
SLS 7	0	0	335	0	0	0

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	406	385	**13264**	0	0
ULS 1a_0	237	0	385	0	**7031**	0
ULS 5a Ba 10	51	0	334	-145	1669	**806**
ULS 1a_45	178	291	385	**9296**	**5055**	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	168	149	**894**	13	-224	-42	912
2	ULS 1a_0	79	-98	**487**	14	-125	-26	497
3	ULS 7	-22	-22	**109**	0	-31	-9	111
4	ULS 1a_135	-168	149	**894**	-13	-224	-42	912

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-133	114	**-722**	13	175	28	-737
3	ULS 1a_0,9_0,9_45	133	114	**-722**	-13	175	28	-737
4	ULS 1a_0,9_0,9_0	44	-63	**-315**	-14	76	12	-322

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 1a_90	167	121	833	**33**	-204	-35	850
2	ULS 5a Ba 10	9	-58	184	**35**	-47	-10	188
3	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
4	ULS 5a Ba 10	20	21	-17	**29**	0	-4	-18

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 21	9	58	184	**-35**	-47	-10	188
2	ULS 5a Ba 21	50	-13	168	**-26**	-45	-11	171
3	ULS 1a_90	129	82	-641	**-33**	149	19	-654
4	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1

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Project: KIJ-GT
Tower: S+0 II
Number: 39

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-133	114	**-722**	**13**	175	28	-737
3	ULS 1a_0,9_0,9_45	133	114	**-722**	**-13**	175	28	-737
4	ULS 1a_0,9_0,9_0	44	-63	**-315**	**-14**	76	12	-322

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	17	17	84	0	-24	-7	85
2	SLS 7	17	-17	84	0	-24	-7	85
3	SLS 7	-17	-17	84	0	-24	-7	85
4	SLS 7	-17	17	84	0	-24	-7	85

Envelope of load combinations for all of the legs

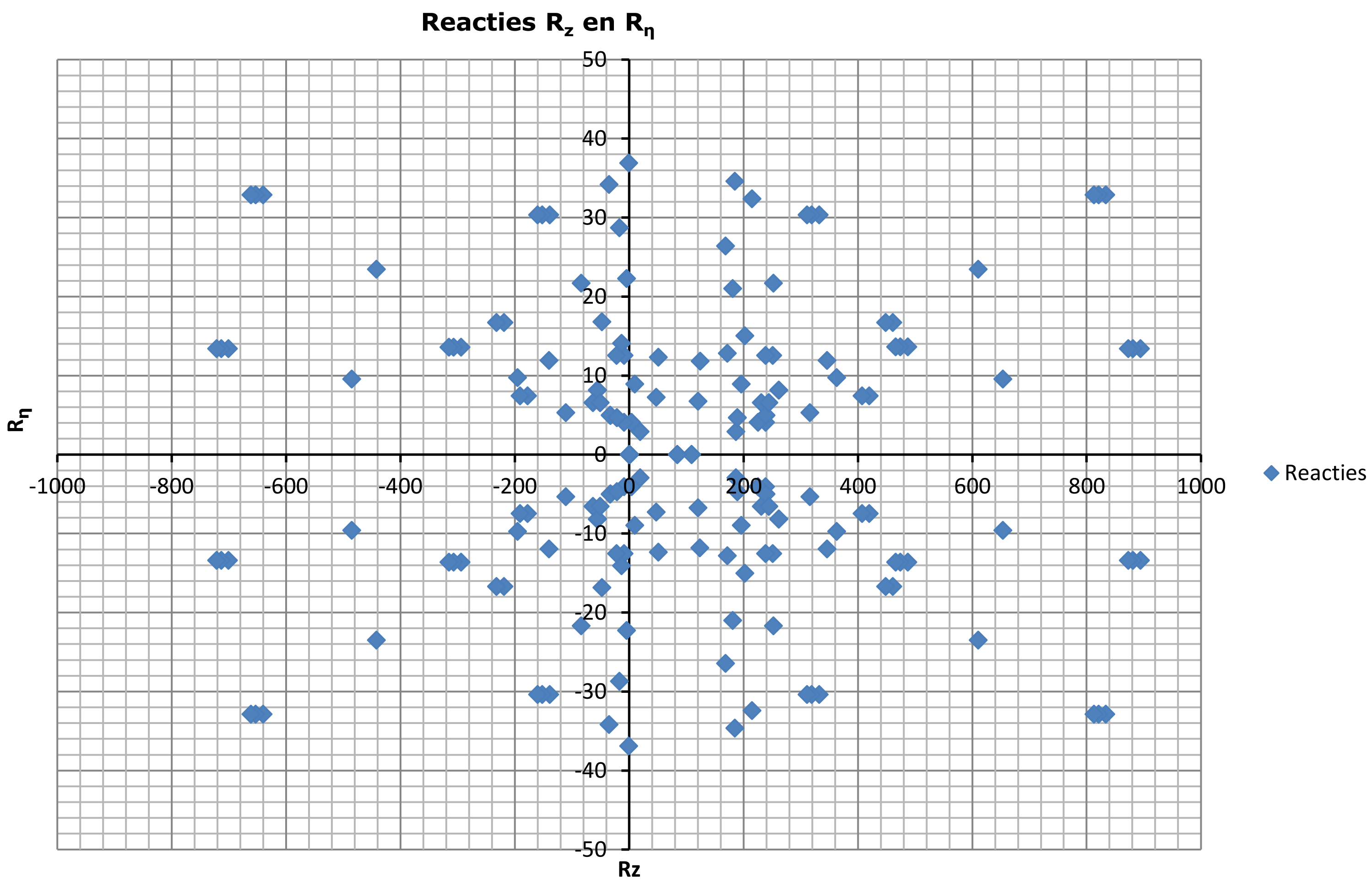
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_45	168	149	**894**	13	-224	-42	912
Max. tension	ULS 1a_0,9_0,9_45	133	114	**-722**	-13	175	28	-737
Max. pos. torsie	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
Max. neg. torsie	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1
Comb. tension+torsie	ULS 1a_0,9_0,9_45	133	114	**-722**	**-13**	175	28	-737

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	17	17	**84**	0	-24	-7	85
2	SLS 1a_135	-89	76	**-486**	10	116	18	-496
3	SLS 1a_45	89	76	**-486**	-10	116	18	-496
4	SLS 1a_0	25	-39	**-195**	-10	46	6	-199

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	123	109	**653**	10	-164	-31	667
2	SLS 1a_0	59	-73	**363**	10	-93	-20	370
3	SLS 7	-17	-17	**84**	0	-24	-7	85
4	SLS 1a_135	-123	109	**653**	-10	-164	-31	667


Reacties R_z en R_η
50
40
30
20
10
0
-10
-20
-30
-40
-50
-1000
-800
-600
-400
-200
0
200
400
600
800
1000
R_η
Rz
Reacties

Content

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

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 C_{dir}	1,00
Ice region	B
Tower type	Steunmast
Tower height	48 m
Max. Span	410 m
Line angle	180°
Catenary	1400 m
Wind span	405 m
EDS Weight span	405 m
Min. Weight span	404 m
Max. Weight span	406 m

Client: TenneT Taking power further

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Title:

Berekening masttype S+0

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

Document name:

KIJ-GT_S+0_65_Report.pdf

Project number:

Project client number:

0.0

Project: KIJ-GT
Tower: S+0
Number: 65

Conductor loads

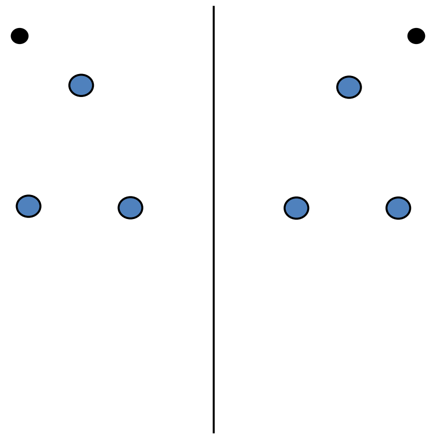
Auteur: TBR
Versie: v11.3

General

Description	S+0
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
Wind speed	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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Halfverankering	2,00	4,30	1,00
Circuit 2	Halfverankering	2,00	4,30	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,50	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,50	0,05

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	28,2 m	32,5 m	15,7 m
Circuit 1	11	380ct1f2	28,2 m	32,5 m	8,7 m
Circuit 1	12	380ct1f3	39,5 m	43,8 m	12,2 m
Circuit 2	20	380ct2f1	28,2 m	32,5 m	-8,7 m
Circuit 2	21	380ct2f2	28,2 m	32,5 m	-15,7 m
Circuit 2	22	380ct2f3	39,5 m	43,8 m	-12,2 m
Bliksemdraad 1	1	bl1	43,3 m	43,8 m	16,2 m
Bliksemdraad 2	3	bl2	43,3 m	43,8 m	-16,2 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

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Project: KIJ-GT
Tower: S+0
Number: 65

Height adjustment adjacent masts	(wind and weight span adjustment)		
	Back	Ahead	
Height increase for wind pressure	0,0 m	26,0 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

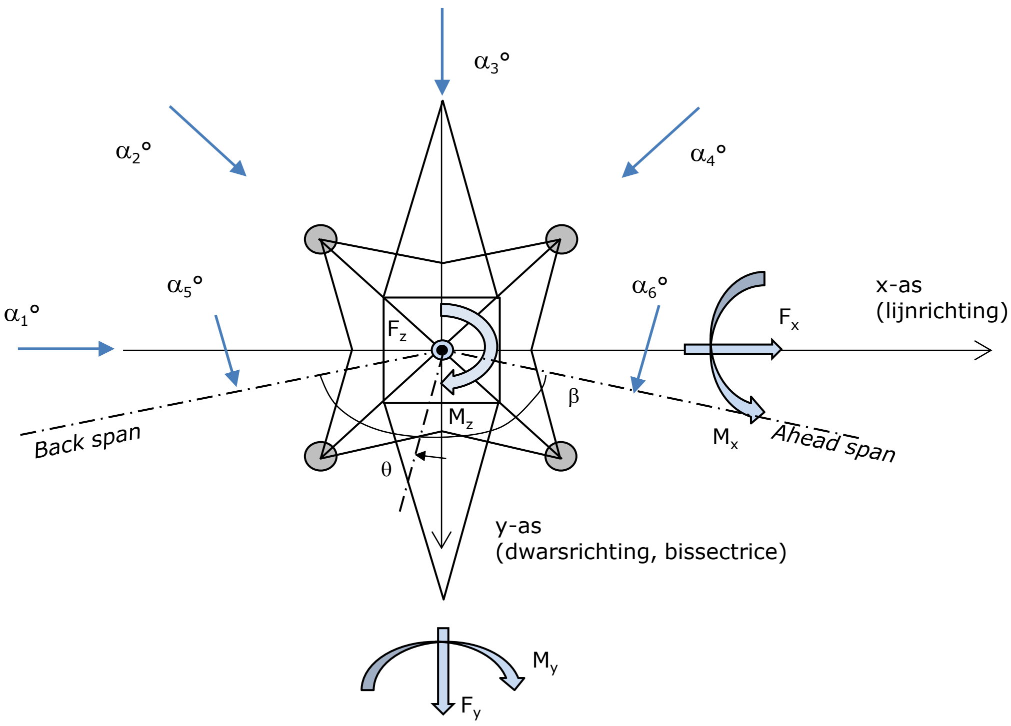
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	-0,2	0,3 m	0,0	0,0 m
Circuit 1	11	380ct1f2	-0,2	0,2 m	0,0	0,0 m
Circuit 1	12	380ct1f3	-0,2	0,1 m	0,0	0,0 m
Circuit 2	20	380ct2f1	-0,2	0,2 m	0,0	0,0 m
Circuit 2	21	380ct2f2	-0,2	0,3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

Line and tower data

		Back	Ahead
		410,0	399,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		390,6	390,6 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		2681	2681 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: KIJ-GT
Tower: S+0
Number: 65

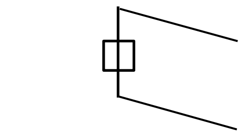
Absence of conductors

		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	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

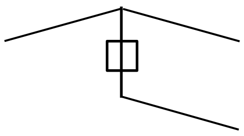
Load situations SPLS

Considered situations SPLS: SPLS for suspension tower not applicable

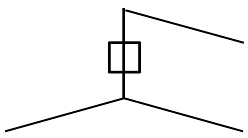
Principle of load situations:



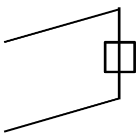
1. Ba All cts



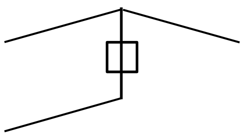
2. Ba ct1



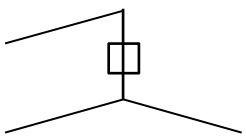
3. Ba ct2



4. Ah All cts



5. Ah ct1

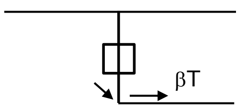


6. Ah ct2

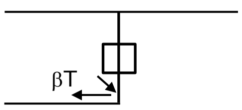
Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1, design assumption is symmetry back and ahead

Principle of load situations:



1. Ba



2. Ah

Project: KIJ-GT
Tower: S+0
Number: 65

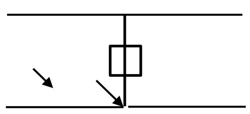
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine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

3,0 kN	2,0 kN
1,0 kN	1,0 kN

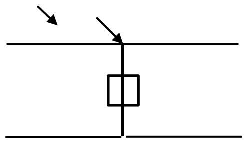
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

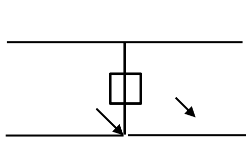
Principle of load situations:



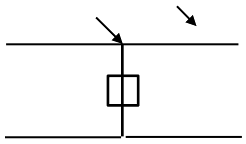
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

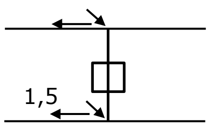
Load situations 8. Galloping as a static load

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

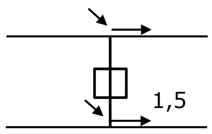
Considered situations galloping 8: None (existing structure)

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

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Project: KIJ-GT
Tower: S+0
Number: 65

Tower structure

Properties

Tower type	Steunmast		
Tower designation	S+0		
Base plate w.r.t. ground level	0,5 m		
Tower height w.r.t. base plate	48,0 m		
Tower self weight	205,0 kN		
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	9,00	9,00	m
Inclination of main leg	0,144	0,144	-
Horizontal force factor	1,4	1,4	-

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 1	11,18	9,00	5,79	11,18	0,144	82,68	8,38	0,10	3,40
Middenstuk 1	21,06	5,79	4,50	9,88	0,065	50,83	6,38	0,13	3,28
Middenstuk 2	32,50	4,50	3,00	11,44	0,066	42,90	7,13	0,17	3,08
Bovenstuk 1	38,40	3,00	2,58	5,90	0,036	16,46	4,17	0,25	2,71
Bovenstuk 2	46,40	2,58	2,00	8,00	0,036	18,32	4,61	0,25	2,72
Topstuk	47,88	2,00		1,48		1,48	0,38	0,26	2,70
Ondertraverse	32,50	15,70		2,90		22,77	4,29	0,19	2,98
Boventraverse	43,80	16,20		2,50		20,25	4,17	0,21	2,90

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 1	11,18	9,00	5,79	11,18	0,144	82,68	8,38	0,10	3,40
Middenstuk 1	21,06	5,79	4,50	9,88	0,065	50,83	6,38	0,13	3,28
Middenstuk 2	32,50	4,50	3,00	11,44	0,066	42,90	7,13	0,17	3,08
Bovenstuk 1	38,40	3,00	2,58	5,90	0,036	16,46	4,17	0,25	2,71
Bovenstuk 2	46,40	2,58	2,00	8,00	0,036	18,32	4,61	0,25	2,72
Topstuk	47,88	2,00		1,48		1,48	0,38	0,26	2,70
Ondertraverse	32,50	15,70		2,90		22,77	4,29	0,19	2,98
Boventraverse	43,80	16,20		2,50		20,25	4,17	0,21	2,90

Note: Surface transverse direction is reduced in calculation.

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Project: KIJ-GT
Tower: S+0
Number: 65

Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
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 1	0,70	20,0	16,9	0,0	-16,9	5,6	111,6	94,7	0,0	-94,7
Middenstuk 1	0,82	17,2	14,6	0,0	-14,6	16,1	276,7	234,8	0,0	-234,8
Middenstuk 2	0,96	21,0	17,8	0,0	-17,8	26,8	563,2	477,9	0,0	-477,9
Bovenstuk 1	1,04	11,7	9,9	0,0	-9,9	35,5	414,8	352,0	0,0	-352,0
Bovenstuk 2	1,09	13,6	11,6	0,0	-11,6	42,4	577,2	489,7	0,0	-489,7
Topstuk	1,12	1,1	1,0	0,0	-1,0	47,1	54,0	45,8	0,0	-45,8
Ondertraverse	1,02	26,1	15,5	0,0	-15,5	33,5	872,5	518,3	0,0	-518,3
Boventraverse	1,10	26,7	15,9	0,0	-15,9	44,6	1191,7	707,8	0,0	-707,8
Totaal		137,4	103,2	0,0	-103,2		4061,8	2921,0	0,0	-2921,0

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 1	0,70	0,0	16,9	20,0	16,9	5,6	0,0	94,7	111,6	94,7
Middenstuk 1	0,82	0,0	14,6	17,2	14,6	16,1	0,0	234,8	276,7	234,8
Middenstuk 2	0,96	0,0	17,8	21,0	17,8	26,8	0,0	477,9	563,2	477,9
Bovenstuk 1	1,04	0,0	9,9	11,7	9,9	35,5	0,0	352,0	414,8	352,0
Bovenstuk 2	1,09	0,0	11,6	13,6	11,6	42,4	0,0	489,7	577,2	489,7
Topstuk	1,12	0,0	1,0	1,1	1,0	47,1	0,0	45,8	54,0	45,8
Ondertraverse	1,02	0,0	15,5	10,4	15,5	33,5	0,0	518,3	349,0	518,3
Boventraverse	1,10	0,0	15,9	10,7	15,9	44,6	0,0	707,8	476,7	707,8
Total		0,0	103,2	105,7	103,2		0,0	2921,0	2823,2	2921,0

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	205	0	0	0
Windrichting 0°	137	0	0	0	4062	0
Windrichting 45°	103	103	0	2921	2921	0
Windrichting 90°	0	106	0	2823	0	0
Windrichting 135°	-103	103	0	2921	-2921	0

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Project: KIJ-GT
Tower: S+0
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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,3	1,0	30,85	1,00	1,2	1,20
380ct1f2	2,00	1	2	4,3	1,0	30,85	1,00	1,2	1,20
380ct1f3	2,00	1	2	4,3	1,0	42,15	1,09	1,2	1,30
380ct2f1	2,00	1	2	4,3	1,0	30,85	1,00	1,2	1,20
380ct2f2	2,00	1	2	4,3	1,0	30,85	1,00	1,2	1,20
380ct2f3	2,00	1	2	4,3	1,0	42,15	1,09	1,2	1,30
bl1	0,10	1	0,1	0,5	0,1	44,05	1,10	1,2	0,07
bl2	0,10	1	0,1	0,5	0,1	44,05	1,10	1,2	0,07

Project: KIJ-GT
Tower: S+0
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	18,6	0,86	0,54	0,47	1,14	28,25	44,5	39,2	46,9	78,1	68,8
380ct1f2	18,6	0,86	0,54	0,47	1,14	28,25	44,5	39,2	46,9	78,1	68,8
380ct1f3	29,9	0,99	0,58	0,51	1,10	28,25	53,0	46,6	46,9	96,1	84,5
380ct2f1	18,6	0,86	0,54	0,47	1,14	28,25	44,5	39,2	46,9	78,1	68,8
380ct2f2	18,6	0,86	0,54	0,47	1,14	28,25	44,5	39,2	46,9	78,1	68,8
380ct2f3	29,9	0,99	0,58	0,51	1,10	28,25	53,0	46,6	46,9	96,1	84,5
bl1	34,3	1,03	0,59	0,52	1,20	22,24	16,1	14,1	41,5	30,0	26,4
bl2	34,3	1,03	0,59	0,52	1,20	22,13	16,0	14,1	41,4	30,0	26,3

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	32,3	1,01	0,58	0,51	1,09	28,25	54,5	47,9	46,9	99,3	87,4
380ct1f2	32,3	1,01	0,58	0,51	1,09	28,25	54,5	47,9	46,9	99,3	87,3
380ct1f3	43,6	1,10	0,61	0,53	1,07	28,25	60,2	52,8	46,9	112,1	98,4
380ct2f1	32,3	1,01	0,58	0,51	1,09	28,25	54,5	47,9	46,9	99,3	87,3
380ct2f2	32,3	1,01	0,58	0,51	1,09	28,25	54,5	47,9	46,9	99,3	87,4
380ct2f3	43,6	1,10	0,61	0,53	1,07	28,25	60,2	52,8	46,9	112,1	98,4
bl1	48,0	1,12	0,61	0,54	1,19	22,24	18,2	16,0	41,5	34,3	30,1
bl2	48,0	1,12	0,61	0,54	1,19	22,13	18,1	15,9	41,4	34,3	30,1

Project: KIJ-GT
Tower: S+0
Number: 65

Conductor loads

Auteur: TBR
Versie: v11.3

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

Project: KIJ-GT
Tower: S+0
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	-29,3	29,3	3,7	4,1	5,3	5,2
bl2	-29,5	29,5	3,7	4,1	5,3	5,2
380ct1f1	-109,9	109,9	10,9	12,8	16,7	16,1
380ct1f2	-109,9	109,9	10,9	12,8	16,7	16,1
380ct1f3	-111,8	111,8	12,9	14,1	16,7	16,1
380ct2f1	-109,9	109,9	10,9	12,8	16,7	16,1
380ct2f2	-109,9	109,9	10,9	12,8	16,7	16,1
380ct2f3	-111,8	111,8	12,9	14,1	16,7	16,1

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	405,3	405,4	405,3
bl2	405,3	405,4	405,3
380ct1f1	404,3	404,4	404,4
380ct1f2	404,8	404,8	404,8
380ct1f3	405,0	405,0	405,0
380ct2f1	404,8	404,8	404,8
380ct2f2	404,3	404,4	404,4
380ct2f3	405,0	405,0	405,0

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	405,8	405,3
bl2	405,8	405,3
380ct1f1	404,4	404,4
380ct1f2	404,8	404,8
380ct1f3	405,1	405,0
380ct2f1	404,8	404,8
380ct2f2	404,4	404,4
380ct2f3	405,1	405,0

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	406,0 m	1,004 -
Min. weight span	404,3 m	0,999 -

Project: KIJ-GT
Tower: S+0
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	15,0	7,8	8,1	-31,1	31,1
bl2	15,0	7,8	8,1	-31,2	31,2
380ct1f1	51,3	23,7	32,8	-108,7	111,1
380ct1f2	51,3	23,7	32,8	-108,7	111,1
380ct1f3	51,3	27,0	32,8	-110,7	112,8
380ct2f1	51,3	23,7	32,8	-108,7	111,1
380ct2f2	51,3	23,7	32,8	-108,7	111,1
380ct2f3	51,3	27,0	32,8	-110,7	112,8

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	4,2	-15,0	15,0
bl2	0,0	0,0	4,2	-15,0	15,0
380ct1f1	0,0	0,0	20,5	-64,2	64,2
380ct1f2	0,0	0,0	20,6	-64,2	64,2
380ct1f3	0,0	0,0	20,6	-64,2	64,2
380ct2f1	0,0	0,0	20,6	-64,2	64,2
380ct2f2	0,0	0,0	20,5	-64,2	64,2
380ct2f3	0,0	0,0	20,6	-64,2	64,2

1 **Control uplift SLS-wind**

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	2,1	2,0
	bl2	2,1	2,0
	380ct1f1	10,4	10,1
	380ct1f2	10,4	10,1
	380ct1f3	10,4	10,1
	380ct2f1	10,4	10,1
	380ct2f2	10,4	10,1
	380ct2f3	10,4	10,1

Project: KIJ-GT
Tower: S+0
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		0	164	138	6124	0	0
ULS 1a_0,9_90		0	164	138	6124	0	0
ULS 3_90		0	87	212	3268	0	0
ULS 3_0,9_90		0	87	212	3268	0	0
SLS 7		0	0	132	0	0	0

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

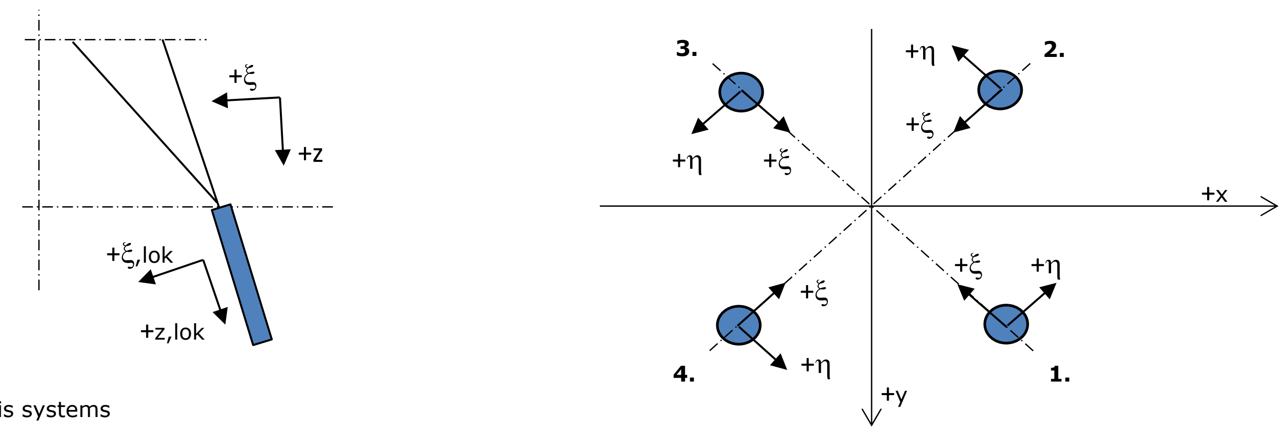
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	282	353	9277	0	0
ULS 3_90	0	123	427	4214	0	0
SLS 7	0	0	337	0	0	0

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	282	353	**9277**	0	0
ULS 1a_0,9_0,9_0	156	0	303	0	**4618**	0
ULS 5a Ba 10	51	0	335	-148	1669	**806**
ULS 1a_45	117	199	353	**6388**	**3320**	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	118	105	**628**	10	-158	-30	640
2	ULS 1a_0	57	-69	**345**	9	-89	-19	352
3	ULS 7	-19	-19	**97**	0	-28	-8	99
4	ULS 1a_135	-118	105	**628**	-10	-158	-30	640

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-85	72	**-464**	10	111	17	-473
3	ULS 1a_0,9_0,9_45	85	72	**-464**	-10	111	17	-473
4	ULS 1a_0,9_0,9_0	24	-36	**-181**	-9	42	6	-184

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 Ba 10	50	13	168	**26**	-45	-11	172
2	ULS 5a Ba 10	9	-58	185	**35**	-47	-10	188
3	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
4	ULS 5a Ba 10	20	21	-17	**29**	0	-4	-17

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 21	9	58	185	**-35**	-47	-10	188
2	ULS 5a Ba 21	50	-13	168	**-26**	-45	-11	172
3	ULS 5a Ba 21	20	-21	-17	**-29**	0	-4	-17
4	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1

Project: KIJ-GT
Tower: S+0
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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_90	-88	55	**-440**	**23**	102	12	-449
3	ULS 1a_0,9_0,9_90	88	55	**-440**	**-23**	102	12	-449
4	ULS 1a_0,9_0,9_0	24	-36	**-181**	**-9**	42	6	-184

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	17	17	84	0	-24	-7	86
2	SLS 7	17	-17	84	0	-24	-7	86
3	SLS 7	-17	-17	84	0	-24	-7	86
4	SLS 7	-17	17	84	0	-24	-7	86

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	118	105	**628**	10	-158	-30	640
Max. tension	ULS 1a_0,9_0,9_45	85	72	**-464**	-10	111	17	-473
Max. pos. torsie	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
Max. neg. torsie	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1
Comb. tension+torsie	ULS 1a_0,9_0,9_90	-88	55	**-440**	**23**	102	12	-449

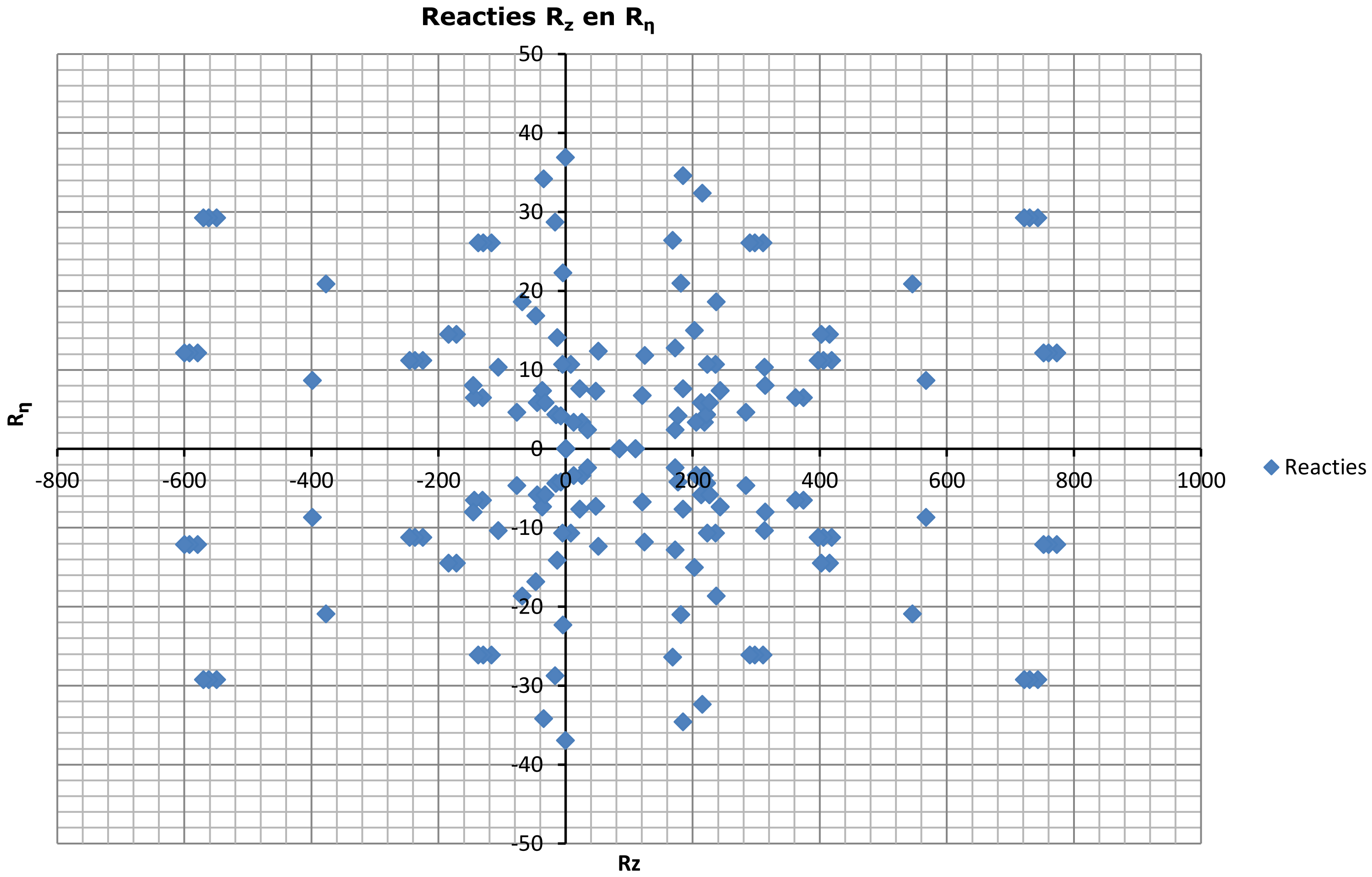
Maximum tension load - SLS

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	17	17	**84**	0	-24	-7	86
2	SLS 1a_135	-68	56	**-371**	8	88	13	-379
3	SLS 1a_45	68	56	**-371**	-8	88	13	-379
4	SLS 1a_0	16	-27	**-133**	-8	30	3	-135

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	102	90	**540**	8	-136	-26	551
2	SLS 1a_0	50	-60	**301**	8	-78	-17	307
3	SLS 7	-17	-17	**84**	0	-24	-7	86
4	SLS 1a_135	-102	90	**540**	-8	-136	-26	551

Project: KIJ-GT
Tower: S+0
Number: 65



Project: KIJ-GT
Tower: S+0
Number: 65

Conductor loads		Auteur:	TBR
		Versie:	v11.3

Starting points

Consequence class	Verbouw CC2
Reference period	50 jaar

ULS (strength)		**NEN-EN50341-2-15:2019**						
Load case	description	Temp °C	γ_G $G_{k,mast}$	γ_G $G_{k,geleider}$	Q_{pk}	γ_Q 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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

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Project: KIJ-GT
Tower: S+0
Number: 65

Summary table - Conductor loads

The four tables below show:
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- 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	-34,3	34,3	4,7	5,1	5,8	5,7
bl2	-34,6	34,6	4,6	5,1	5,8	5,7
380ct1f1	-128,1	128,1	13,6	16,1	19,7	19,0
380ct1f2	-128,1	128,1	13,6	16,1	19,7	19,0
380ct1f3	-130,4	130,4	16,1	17,7	19,7	19,1
380ct2f1	-128,1	128,1	13,6	16,1	19,7	19,0
380ct2f2	-128,1	128,1	13,6	16,1	19,7	19,0
380ct2f3	-130,4	130,4	16,1	17,7	19,7	19,1

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	405,3	405,4	405,3
bl2	405,3	405,4	405,3
380ct1f1	404,3	404,4	404,4
380ct1f2	404,8	404,8	404,8
380ct1f3	405,0	405,0	405,0
380ct2f1	404,8	404,8	404,8
380ct2f2	404,3	404,4	404,4
380ct2f3	405,0	405,0	405,0

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	405,9	405,3
bl2	405,9	405,3
380ct1f1	404,4	404,4
380ct1f2	404,8	404,7
380ct1f3	405,2	405,0
380ct2f1	404,8	404,7
380ct2f2	404,4	404,4
380ct2f3	405,2	405,0

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	406,2 m	1,004 -
Min. weight span	404,2 m	0,999 -

Project: KIJ-GT
Tower: S+0
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	15,0	9,8	9,2	-33,9	34,7
bl2	15,0	9,8	9,2	-34,2	35,0
380ct1f1	51,3	29,7	38,7	-126,5	129,6
380ct1f2	51,3	29,7	38,7	-126,5	129,6
380ct1f3	51,3	33,8	38,7	-129,1	131,7
380ct2f1	51,3	29,7	38,7	-126,5	129,6
380ct2f2	51,3	29,7	38,7	-126,5	129,6
380ct2f3	51,3	33,8	38,7	-129,1	131,7

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	4,2	-15,0	15,0
bl2	0,0	0,0	4,2	-15,0	15,0
380ct1f1	0,0	0,0	20,5	-64,2	64,2
380ct1f2	0,0	0,0	20,6	-64,2	64,2
380ct1f3	0,0	0,0	20,6	-64,2	64,2
380ct2f1	0,0	0,0	20,6	-64,2	64,2
380ct2f2	0,0	0,0	20,5	-64,2	64,2
380ct2f3	0,0	0,0	20,6	-64,2	64,2

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	2,1	2,0
	bl2	2,1	2,0
	380ct1f1	10,4	10,1
	380ct1f2	10,4	10,1
	380ct1f3	10,4	10,1
	380ct2f1	10,4	10,1
	380ct2f2	10,4	10,1
	380ct2f3	10,4	10,1

Project: KIJ-GT
Tower: S+0
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		0	206	151	7678	0	0
ULS 1a_0,9_90		0	206	151	7678	0	0
ULS 3_90		0	110	251	4097	0	0
ULS 3_0,9_90		0	110	251	4097	0	0
SLS 7		0	0	132	0	0	0

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

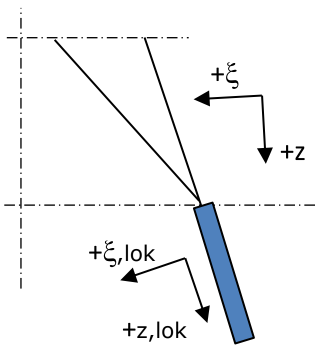
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	354	387	11630	0	0
ULS 3_90	0	154	486	5283	0	0
SLS 7	0	0	337	0	0	0

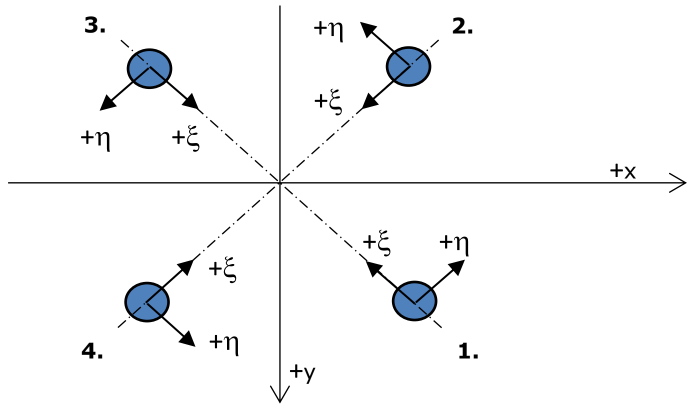
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	354	387	**11630**	0	0
ULS 1a_0	195	0	387	0	**5789**	0
ULS 5a Ba 10	51	0	335	-148	1669	**806**
ULS 1a_45	146	250	387	**8008**	**4162**	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	145	128	**773**	12	-194	-37	789
2	ULS 1a_0	68	-84	**418**	11	-108	-23	427
3	ULS 7	-22	-22	**109**	0	-31	-9	112
4	ULS 1a_135	-145	128	**773**	-12	-194	-37	789

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-111	94	**-600**	12	145	23	-613
3	ULS 1a_0,9_0,9_45	111	94	**-600**	-12	145	23	-613
4	ULS 1a_0,9_0,9_0	34	-49	**-246**	-11	59	9	-251

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 1a_90	149	108	743	**29**	-182	-31	758
2	ULS 5a Ba 10	9	-58	185	**35**	-47	-10	188
3	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
4	ULS 5a Ba 10	20	21	-17	**29**	0	-4	-17

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 21	9	58	185	**-35**	-47	-10	188
2	ULS 5a Ba 21	50	-13	168	**-26**	-45	-11	172
3	ULS 1a_90	110	69	-549	**-29**	127	15	-561
4	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1

Project: KIJ-GT
Tower: S+0
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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_90	-115	73	**-570**	**29**	133	17	-582
3	ULS 1a_0,9_0,9_90	115	73	**-570**	**-29**	133	17	-582
4	ULS 1a_0,9_0,9_0	34	-49	**-246**	**-11**	59	9	-251

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	17	17	84	0	-24	-7	86
2	SLS 7	17	-17	84	0	-24	-7	86
3	SLS 7	-17	-17	84	0	-24	-7	86
4	SLS 7	-17	17	84	0	-24	-7	86

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	145	128	**773**	12	-194	-37	789
Max. tension	ULS 1a_0,9_0,9_45	111	94	**-600**	-12	145	23	-613
Max. pos. torsie	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
Max. neg. torsie	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1
Comb. tension+torsie	ULS 1a_0,9_0,9_90	-115	73	**-570**	**29**	133	17	-582

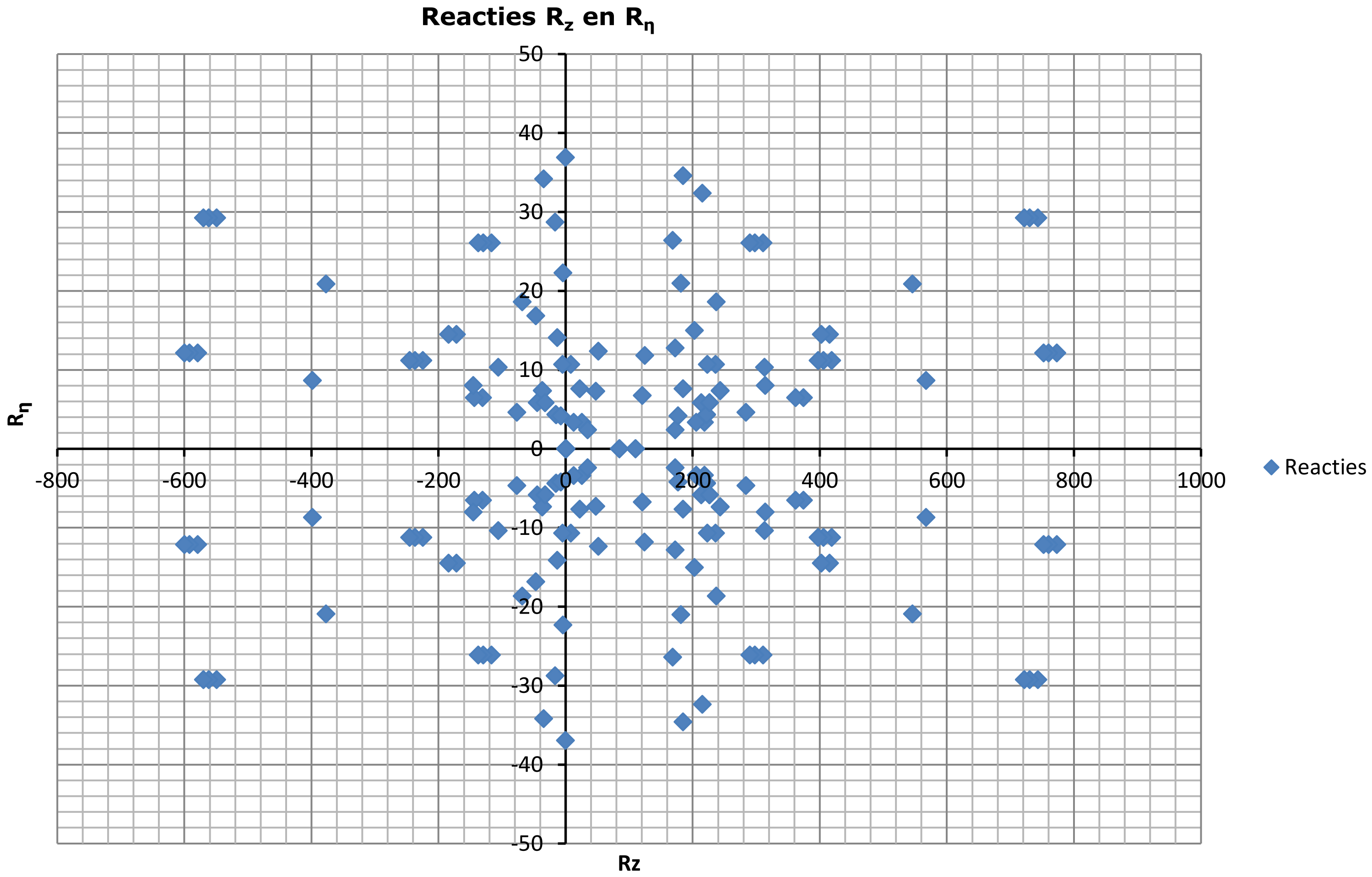
Maximum tension load - SLS

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	17	17	**84**	0	-24	-7	86
2	SLS 1a_135	-73	61	**-399**	9	95	14	-407
3	SLS 1a_45	73	61	**-399**	-9	95	14	-407
4	SLS 1a_0	18	-29	**-146**	-8	33	4	-149

Maximum compression load - SLS

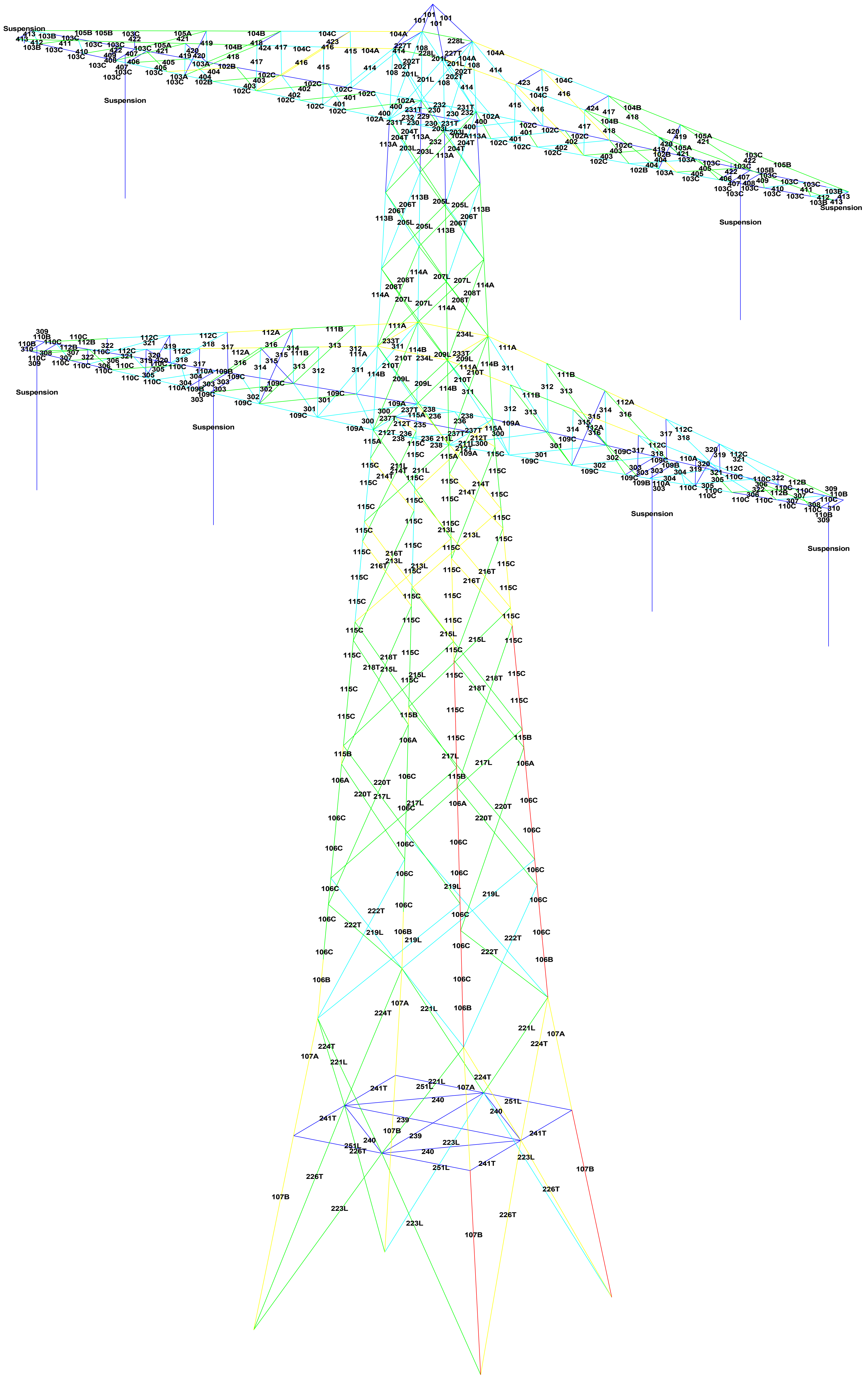
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	107	95	**567**	9	-143	-27	579
2	SLS 1a_0	52	-63	**314**	8	-81	-17	320
3	SLS 7	-17	-17	**84**	0	-24	-7	86
4	SLS 1a_135	-107	95	**567**	-9	-143	-27	579

Project: KIJ-GT
Tower: S+0
Number: 65



APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project: "S+0 (hv) ini"
Tower Version 16.12, 11:01:51 Friday, 3 April, 2020
Undeformed geometry displayed



% Usage Legend
0 <= % < 25
25 <= % < 50
50 <= % < 75
75 <= % < 100
100 <= %

Assessment of groups for initial mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 39

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	mpression	Load Case (Compression)	Buckling	Shear (Comp)	:aring (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	ihear (Tens)	earing (Tens)	U.C. (Tens)	Exceedance (Tens)
101		100x100x6	S235	2M16-5.6t	1.00	1.00	1.00	105	-7.8	ULS 5a Ba 12	142.1	75.4	103.7	0.10		7.7	ULS 5a Ba 12	144.1	75.4	76.8	0.10	
108		90x90x8	S235	5M16-5.6t	1.00	1.00	1.00	146	-41.7	ULS 5a Ba 22	112.9	188.4	345.6	0.37		0.0		285.6	188.4	298.7	0.00	
113A		90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	76	-61.0	ULS 1a_135	251.3	338.9	414.7	0.24		18.9	ULS 5a Ba 22	252.5	338.9	297.7	0.07	
114A		100x100x10	S235	4M24-5.6t	0.50	0.50	0.50	72	-182.9	ULS 1a_135	355.2	338.9	518.4	0.54		131.6	ULS 1a_0,9_0,9_135	362.9	338.9	443.1	0.39	
115A		150x150x10	S235	6M24-5.6t	1.77	1.37	1.14	39	-338.1	ULS 1a_135	643.5	508.3	777.6	0.67		224.5	ULS 1a_0,9_0,9_135	624.7	508.3	664.6	0.44	
106A		150x150x12	S235	8M24-5.6t	1.66	1.73	1.38	76	-639.6	ULS 1a_135	628.6	677.8	1244.2	1.02	knik	500.2	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.74	
106C		150x150x12	S235		1.81	1.89	1.51	87	-641.2	ULS 1a_135	575.2	0.0	0.0	1.11	knik	588.6	ULS 1a_0,9_0,9_135	817.8	0.0	0.0	0.72	
107A		150x150x12	S235	8M24-5.6t	0.33	0.33	0.33	49	-675.9	ULS 1a_135	735.4	677.8	1244.2	1.00		551.1	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.81	
201L		70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	127	-24.3	ULS 5a Ba 22	75.8	84.7	90.7	0.32		18.0	ULS 5a Ba 22	88.7	84.7	64.2	0.28	
202T		50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	178	-10.7	ULS 5a Ba 22	25.7	37.7	43.2	0.42		5.5	ULS 5a Ba 22	37.4	37.7	22.0	0.25	
203L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	93	-108.6	ULS 5a Ba 12	207.7	169.4	207.4	0.64		116.7	ULS 5a Ba 22	181.4	169.4	177.2	0.69	
204T		100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	93	-123.1	ULS 5a Ba 12	256.2	254.2	388.8	0.48		122.1	ULS 5a Ba 22	261.1	254.2	332.3	0.48	
205L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	99	-105.5	ULS 5a Ba 22	198.3	169.4	207.4	0.62		97.2	ULS 5a Ba 12	181.4	169.4	177.2	0.57	
206T		100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	99	-109.8	ULS 5a Ba 22	244.6	254.2	388.8	0.45		110.5	ULS 5a Ba 12	261.1	254.2	332.3	0.43	
207L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	103	-86.9	ULS 5a Ba 12	190.8	169.4	207.4	0.51		94.4	ULS 5a Ba 22	181.4	169.4	177.2	0.56	
208T		100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	104	-99.2	ULS 5a Ba 12	235.3	169.4	259.2	0.59		97.9	ULS 5a Ba 22	224.3	169.4	221.5	0.58	
209L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	112	-94.6	ULS 5a Ba 12	177.9	169.4	207.4	0.56		95.0	ULS 5a Ba 22	181.4	169.4	177.2	0.56	
210T		100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	112	-101.1	ULS 5a Ba 12	219.3	169.4	259.2	0.60		80.3	ULS 5a Ba 22	224.3	169.4	221.5	0.47	
211L		100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	76	-94.7	ULS 5a Ba 21	197.1	169.4	207.4	0.56		89.1	ULS 5a Ba 21	125.9	169.4	116.0	0.77	
212T		100x75x9	S235	2M24-5.6t	1.00	0.55	0.55	65	-96.1	ULS 5a Ba 10	245.9	169.4	233.3	0.57		93.0	ULS 5a Ba 10	121.3	169.4	130.6	0.77	
213L		100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	85	-77.5	ULS 5a Ba 21	161.2	169.4	181.4	0.48		81.2	ULS 5a Ba 21	98.2	169.4	101.5	0.83	
214T		100x75x9	S235	2M24-5.6t	0.52	0.25	0.25	74	-96.3	ULS 5a Ba 10	221.2	169.4	233.3	0.57		99.3	ULS 5a Ba 10	119.9	169.4	130.6	0.83	
215L		100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	101	-73.9	ULS 5a Ba 21	141.1	169.4	181.4	0.52		69.9	ULS 5a Ba 21	100.4	169.4	101.5	0.70	
216T		100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	86	-90.6	ULS 5a Ba 10	182.6	169.4	207.4	0.53		87.2	ULS 5a Ba 21	110.7	169.4	116.0	0.79	
217L		100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	112	-59.4	ULS 5a Ba 21	129.0	117.6	151.2	0.50		62.0	ULS 5a Ba 21	115.4	117.6	106.9	0.58	
218T		100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	102	-80.2	ULS 5a Ba 21	159.3	169.4	207.4	0.50		82.9	ULS 5a Ba 10	113.2	169.4	116.0	0.73	
219L		100x75x8	S235	2M20-5.6t	0.52	0.25	0.25	123	-53.2	ULS 5a Ba 21	133.9	117.6	172.8	0.45		50.2	ULS 5a Ba 21	128.6	117.6	104.7	0.48	
220T		100x75x9	S235	2M20-5.6t	0.52	0.25	0.25	117	-72.5	ULS 5a Ba 10	155.5	117.6	194.4	0.62		69.1	ULS 5a Ba 21	146.1	117.6	137.5	0.59	
221L		130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	-68.7	ULS 5a Ba 10	147.8	117.6	172.8	0.58		57.1	ULS 5a Ba 21	113.0	117.6	136.1	0.51	
222T		100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	113	-53.4	ULS 5a Ba 21	127.3	117.6	151.2	0.45		55.7	ULS 5a Ba 10	107.3	117.6	91.6	0.61	
223L		100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	-71.7	ULS 5a Ba 10	144.3	117.6	151.2	0.61		57.6	ULS 5a Ba 21	119.5	117.6	122.2	0.49	
224T		130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	-91.6	ULS 1a_90	147.8	117.6	172.8	0.78		80.3	ULS 1a_0,9_0,9_90	113.0	117.6	136.1	0.71	
226T		100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	-91.4	ULS 1a_90	144.3	117.6	151.2	0.78		77.6	ULS 1a_0,9_0,9_90	119.5	117.6	122.2	0.66	
227T		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	206	-2.1	ULS 6a_90 Ba Ct2	21.0	37.7	43.2	0.10		0.0	ULS 5a Ba 22	37.4	37.7	22.0	0.00	
228L		80x80x8	S235	4M20-5.6t	1.00	1.00	1.00	128	0.0		122.6	235.2	345.6	0.00		119.6	ULS 3_0	168.3	235.2	244.4	0.71	
229		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	225	-0.3	ULS 3_0	18.5	37.7	43.2	0.01		0.0		37.4	37.7	25.7	0.00	
230		80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	99	-76.2	ULS 5a Ba 12	156.9	169.4	207.4	0.49		76.1	ULS 5a Ba 12	206.0	169.4	159.5	0.48	
231T		100x75x7	S235	3M24-5.6t	2.00	1.00	1.00	69	-48.9	ULS 5a Ba 22	182.6	254.2	272.2	0.27		64.4	ULS 5a Ba 22	214.1	254.2	217.6	0.30	
232		150x100x12	S235	8M24-5.6t	2.00	1.00	1.00	51	-249.6	ULS 5a Ba 22	512.4	677.8	1244.2	0.49		94.2	ULS 5a Ba 22	582.2	677.8	755.0	0.16	
233T		70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	203	-34.0	ULS 1a_0,9_0,9_90	36.2	58.8	64.8	0.94		45.1	ULS 1a_90	82.9	58.8	52.4	0.86	
234L		80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	178	0.0		82.2	254.2	311.0	0.00		147.7	ULS 3_0	169.8	254.2	239.3	0.87	
235		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	-0.6	ULS 3_90	11.3	37.7	43.2	0.05		0.0		37.4	37.7	22.0	0.00	
236		100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	-75.6	ULS 5a Ba 10	182.9	169.4	207.4	0.45		75.8	ULS 5a Ba 10	208.1	169.4	177.2	0.45	
237T		100x75x7	S235	4M24-5.6t	1.00	1.00	1.00	94	-42.6	ULS 5a Ba 22	157.6	338.9	362.9	0.27		69.2	ULS 5a Ba 12	214.1	338.9	290.1	0.32	
238		150x100x14	S235	11M24-5.6t	2.00	1.00	1.00	70	-249.3	ULS 5a Ba 10	526.8	931.9	1995.8	0.47		72.0	ULS 5a Ba 10	666.7	931.9	1211.2	0.11	
239		100x50x6	S235	1M16-5.6t	0.50	0.50	0.50	327	-0.4	ULS 1a_90	18.6	37.7	51.8	0.02		0.0		55.3	37.7	28.0	0.00	
240		60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	272	-1.4	ULS 1a_90	14.1	37.7	43.2	0.10		2.8	ULS 1a_0,9_0,9_135	60.5	37.7	26.7	0.10	
241T		70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	-3.4	ULS 1a_135	28.9	37.7	51.8	0.12		1.2	ULS 1a_0,9_0,9_0	89.9	37.7	38.4	0.03	
251L		70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	-3.6	ULS 1a_90	28.9	37.7	51.8	0.12		0.9	ULS 1a_0,9_0,9_135	89.9	37.7	38.4	0.02	
113B		90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	79	-129.7	ULS 1a_135	245.5	338.9	414.7	0.53		81.7	ULS 1a_0,9_0,9_135	252.5	338.9	354.5	0.32	
114B		100x100x10	S235	6M24-5.6t	0.50	0.50	0.50	78	-218.9	ULS 1a_135	340.4	508.3	777.6	0.64		131.5	ULS 1a_0,9_0,9_135	362.9	508.3	651.3	0.36	
115B		150x150x10	S235	8M24-5.6t	4.00	4.23	3.33	76	-613.7	ULS 1a_135	530.0	677.8	1036.8	1.16	knik	472.5	ULS 1a_0,9_0,9_90	624.7	677.8	886.2	0.76	
115C		150x150x10	S235		1.70	1.70	1.42	80	-561.8	ULS 1a_135	514.8	0.0	0.0	1.09	knik	427.6	ULS 1a_0,9_0,9_135	688.6	0.0	0.0	0.62	
106B		150x150x12	S235	8M24-5.6t	0.76	1.28	0.63	60	-732.7	ULS 1a_135	696.2	677.8	1244.2	1.08	knik, afschuiving	587.4	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.87	
107B		150x150x12	S235	8M24-5.6t	0.20	0.20	0.20	48	-678.7	ULS 1a_135	736.7	677.8	1244.2	1.00	afschuiving	548.4	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.81	
102A		150x150x12	S235	8M24-5.6t	1.00	1.50	1.00	61	-303.0	ULS 5a Ba 12	689.3	677.8	1244.2	0.45		171.8	ULS 5a Ba 22	740.3	677.8	755.0	0.25	
102B		150x150x12	S235	6M24-5.6t	2.52	1.61	1.00	63	-143.2	ULS 5a Ba 12	682.7	508.3	933.1	0.28		36.7	ULS 5a Ba 22	740.3	508.3	797.5	0.07	
102C		150x150x12	S235		3.01	2.00	1.00	59	-274.7	ULS 5a Ba 12	698.8	0.0	0.0	0.39		148.9	ULS 5a Ba 22	817.8	0.0	0.0	0.18	
103A		120x120x8	S235	6M24-5.6t	2.64	4.00	1.00	76	-132.5	ULS 5a Ba 12	340.1	508.3	622.1	0.39		47.5	ULS 5a Ba 22	379.5	508.3	531.7	0.13	
103B		120x120x8	S235	2M16-5.6t	2.00	4.44	2.00	108	-31.4	ULS 3_90	249.9	75.4	138.2	0.42		0.0		316.6	75.4	138.2	0.00	
103C		120x120x8	S235		1.71	1.00	1.00	76	-95.0	ULS 5a Ba 1	340.3	0.0	0.0	0.28		21.3	ULS 5a Ba 1	441.8	0.0	0.0	0.05	
104A		100x65x7*	S235	4M20-5.6t	1.00	1.00	1.00	202	0.0		63.1	235.2	302.4	0.00		111.1	ULS 3_0	115.2	235.2	207.0	0.96	
104B		100x65x7*	S235	3M20-5.6t	1.00	1.00	1.00	209	0.0		60.1	176.4	226.8	0.00		77.0	ULS 3_0	137.8	176.4	155.3	0.56	
104C		100x65x7*	S235		1.00	1.00	1.00	194	0.0		66.4	0.0	0.0	0.00		98.0	ULS 3_0	263.2	0.0	0.0	0.37	
105A		60x60x5	S235	2M16-5.6t	1.00	2.43	1.00	380	0.0		11.8	75.4	86.4	0.00		30.8	ULS 6a_90 Ba Ct1	98.8	75.4	56.0	0.55	
105B		60x60x5	S235	2M16-5.6t	1.00	1.70	1.00	379	0.0		11.8	75.4	86.4	0.00		30.9	ULS 6a_90 Ba Ct1	65.9	75.4	56.0	0.55	
415		60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	180	-8.6	ULS 3_0	30.7	37.7	43.2	0.28		0.0		60.5	37.7	26.7	0.00	
417		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	170	-9.5	ULS 3_0	27.4	37.7	43.2	0.35		0.0		37.4	37.7	18.4	0.00	
419		75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	107	-11.8	ULS 3_0	55.1	37.7	43.2	0.31		0.0		37.4	37.7	22.0	0.00	
422		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	-0.5	ULS 6a_90 Ba Ct1	58.8	37.7	43.2	0.01		0.0		37.4	37.7	18.4	0.00	
414		60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	325	0.0		12.6	37.7	43.2	0.00		13.7	ULS 3_0	60.5	37.7	32.0	0.43	
416		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	353	0.0		9.1	37.7	43.2	0.00		16.9	ULS 3_0	37.4	37.7	22.0	0.77	
418		50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	344	0.0		11.9	75.4	86.4	0.00		25.9	ULS 3_0	56.2	75.4	44.1	0.59	
421		60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	259	0.0		26.8	117.6	129.6	0.00		50.0	ULS 3_0	77.4	117.6	88.7	0.65	
420		45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	111	-1.5	ULS 1a_0,9_0,9_0	39.6	20.2	32.4	0.08		1.4	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.07	
400		60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	124	-20.9	ULS 5a Ba 22	48.1	58.8	54.0	0.43		19.4	ULS 5a Ba 12	54.7	58.8	37.0	0.52	
401		60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	119	-23.1	ULS 5a Ba 12	50.2	58.8	54.0	0.46		23.8	ULS 5a Ba 22	54.7	58.8	37.0	0.64	
402		60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	114	-25.9	ULS 5a Ba 22	52.1	58.8	54.0	0.50		25.5	ULS 5a Ba 12	54.7	58.8	37.0	0.69	
403		60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	108	-29.6	ULS 5a Ba 12	65.2	58.8	64.8	0.50		28.8	ULS 5a Ba 22	65.7	58.8	44.4	0.65	
404		70x70x6	S235	1M24-5.6t	0.53	0.53	0.53	93	-32.0	ULS 5a Ba 22	86.5	84.7	77.8	0.41		34.1	ULS 5a Ba 12	76.0	84.7	44.0	0.78	
405		75x50x7	S235	1M24-5.6t	0.53	0.53	0.53	107	-41.9	ULS 5a Ba 12	76.2	84.7	90.7	0.55		38.4	ULS 5a Ba 22	98.8	84.7	58.0	0.66	
409		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	142	-5.0	ULS 1a_135	37.9	37.7	43.2	0.13		16.3	ULS 5a Ba 1	53.3	37.7	32.0	0.51	
410		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	140	-16.7	ULS 5a Ba 1	38.5	37.7	43.2	0.44		4.0	ULS 1a_135	53.3	37.7	32.0	0.12	
411		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	135	-2.9	ULS 1a_135	40.2	37.7	43.2	0.08		17.1	ULS 5a Ba 1	53.3	37.7	32.0	0.53	
412		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	129	-17.7	ULS 5a Ba 1	42.0	37.7	43.2	0.47		2.3	ULS 1a_0,9_0,9_135	53.3	37.7	32.0	0.07	
406		HEB160	S235		1.00	1.00	1.00	33	-2.1	ULS 1a_0,9_0,9_90	991.1	0.0	0.0	0.00		5.9	ULS 1a_90	1276.1	0.0	0.0	0.00	
407		HEB160	S235		2.00	2.00	2.00	32	-26.4	ULS 5a Ba 12	994.8	0.0	0.0	0.03		25.1	ULS 5a Ba 22	1276.1	0.0	0.0	0.02	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 39

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	mpression	Load Case (Compression)	Buckling	Shear (Comp)	earing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	hear (Tens)	earing (Tens)	U.C. (Tens)	Exceedance (Tens)
408		HEB160	S235		1.00	1.00	1.00	32	-7.0	ULS 5a Ba 1	998.4	0.0	0.0	0.01		3.9	ULS 1a_135	1276.1	0.0	0.0	0.00	
413		HEB160	S235	2M16-5.6t	2.00	2.00	2.00	25	-1.3	ULS 1a_0,9_0,9_135	1067.2	75.4	138.2	0.02		14.2	ULS 5a Ba 1	1296.6	75.4	124.6	0.19	
423		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	0.0	ULS 1a_45	24.0	37.7	43.2	0.00		0.0		37.4	37.7	22.0	0.00	
424		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	0.0	ULS 3_90	27.5	37.7	43.2	0.00		0.0		37.4	37.7	22.0	0.00	
111A		80x80x8	S235	3M24-5.6t	1.00	2.00	1.00	203	0.0		65.4	254.2	311.0	0.00		135.9	ULS 3_45	160.8	254.2	259.0	0.85	
111B		80x80x8	S235	3M20-5.6t	1.00	2.00	1.00	202	0.0		65.8	176.4	259.2	0.00		120.2	ULS 3_0	168.3	176.4	209.5	0.71	
112A		70x70x7	S235	3M20-5.6t	1.00	1.88	1.00	227	0.0		42.7	176.4	226.8	0.00		95.3	ULS 3_0	125.5	176.4	155.3	0.76	
112B		70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	232	0.0		41.4	176.4	226.8	0.00		83.5	ULS 3_0	125.5	176.4	155.3	0.67	
112C		70x70x7	S235		1.00	2.14	1.00	227	0.0		42.7	0.0	0.0	0.00		91.4	ULS 3_0	220.9	0.0	0.0	0.41	
110A		120x120x11	S235	6M24-5.6t	1.64	1.00	1.00	60	-191.0	ULS 5a Ba 21	508.6	508.3	855.4	0.38		104.3	ULS 5a Ba 21	513.2	508.3	731.1	0.21	
110B		120x120x11	S235		1.00	1.00	1.00	13	-0.4	ULS 1a_0,9_0,9_90	599.7	0.0	0.0	0.00		0.4	ULS 1a_90	599.7	0.0	0.0	0.00	
110C		120x120x11	S235		1.71	1.29	1.00	66	-158.8	ULS 5a Ba 21	492.8	0.0	0.0	0.32		80.8	ULS 5a Ba 10	599.7	0.0	0.0	0.13	
109A		150x100x14	S235	11M24-5.6t	1.00	0.52	0.52	56	-302.5	ULS 5a Ba 10	673.7	931.9	1995.8	0.45		142.6	ULS 5a Ba 21	666.7	931.9	1211.2	0.21	
109B		150x100x14	S235	6M24-5.6t	4.78	1.00	1.00	47	-206.2	ULS 5a Ba 10	703.8	508.3	1088.6	0.41		119.3	ULS 5a Ba 21	666.7	508.3	930.5	0.23	
109C		150x100x14	S235		1.00	0.52	0.52	58	-277.9	ULS 5a Ba 21	665.2	0.0	0.0	0.42		131.2	ULS 5a Ba 10	775.5	0.0	0.0	0.17	
312		70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	185	-14.3	ULS 3_135	41.1	58.8	64.8	0.35		0.0		82.9	58.8	39.3	0.00	
314		70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	148	-15.5	ULS 3_0	54.9	58.8	64.8	0.28		0.0		82.9	58.8	39.3	0.00	
317		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	154	-2.9	ULS 1a_0	31.0	37.7	43.2	0.09		0.0		37.4	37.7	18.4	0.00	
319		75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	-2.6	ULS 1a_0	59.5	37.7	43.2	0.07		0.0		37.4	37.7	18.4	0.00	
322		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	53	-1.1	ULS 3_90	63.5	37.7	43.2	0.03		0.0		37.4	37.7	18.4	0.00	
311		60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	332	0.0		12.1	58.8	54.0	0.00		17.4	ULS 3_45	54.7	58.8	37.0	0.47	
313		60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	298	0.0		14.4	58.8	54.0	0.00		23.7	ULS 3_135	54.7	58.8	37.0	0.64	
316		50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	332	0.0		12.6	75.4	86.4	0.00		31.7	ULS 3_135	52.4	75.4	44.1	0.72	
318		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	274	0.0		13.7	37.7	43.2	0.00		6.4	ULS 5a Ba 10	37.4	37.7	22.0	0.29	
321		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	269	0.0		14.1	37.7	43.2	0.00		8.9	ULS 3_0	37.4	37.7	22.0	0.40	
315		45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	180	-1.3	ULS 1a_0	22.7	20.2	32.4	0.06		1.1	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.06	
320		45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	115	-1.1	ULS 1a_0	38.2	20.2	32.4	0.05		1.0	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.05	
300		70x70x7	S235	1M20-5.6t	0.53	0.53	0.53	142	-24.3	ULS 5a Ba 20	66.6	58.8	75.6	0.41		22.2	ULS 5a Ba 11	96.8	58.8	53.5	0.41	
301		70x70x7	S235	1M20-5.6t	0.54	0.54	0.54	138	-27.0	ULS 5a Ba 11	69.0	58.8	75.6	0.46		29.8	ULS 5a Ba 20	96.8	58.8	53.5	0.56	
302		70x70x7	S235	1M24-5.6t	0.54	0.54	0.54	119	-33.6	ULS 5a Ba 20	80.7	84.7	90.7	0.42		30.2	ULS 5a Ba 11	88.7	84.7	44.9	0.67	
304		60x60x5	S235	1M20-5.6t	0.53	0.53	0.53	104	-18.0	ULS 5a Ba 21	57.0	58.8	54.0	0.33		17.6	ULS 5a Ba 21	54.7	58.8	37.0	0.48	
305		60x60x5	S235	1M20-5.6t	0.54	0.54	0.54	112	-24.9	ULS 5a Ba 10	52.9	58.8	54.0	0.47		24.7	ULS 5a Ba 10	54.7	58.8	37.0	0.67	
306		75x50x5	S235	1M24-5.6t	0.55	0.55	0.55	112	-29.5	ULS 5a Ba 10	53.3	84.7	64.8	0.55		29.9	ULS 5a Ba 10	70.6	84.7	41.4	0.72	
307		75x50x7	S235	1M24-5.6t	0.54	0.54	0.54	87	-37.7	ULS 5a Ba 21	86.9	84.7	90.7	0.45		36.4	ULS 5a Ba 21	98.8	84.7	58.0	0.63	
303		HEB160	S235		2.00	2.00	2.00	50	-26.0	ULS 5a Ba 20	918.5	0.0	0.0	0.03		25.4	ULS 5a Ba 11	1276.1	0.0	0.0	0.02	
308		HEB160	S235		1.00	1.00	1.00	27	-1.0	ULS 1a_0,9_0,9_90	1015.5	0.0	0.0	0.00		3.8	ULS 1a_90	1276.1	0.0	0.0	0.00	
309		HEB160	S235		2.00	2.00	2.00	26	-26.7	ULS 5a Ba 10	1021.6	0.0	0.0	0.03		24.9	ULS 5a Ba 21	1276.1	0.0	0.0	0.02	
310		HEB160	S235		1.00	1.00	1.00	25	-3.3	ULS 1a_0,9_0,9_90	1025.6	0.0	0.0	0.00		3.3	ULS 1a_90	1276.1	0.0	0.0	0.00	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 39

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)
101	0	100x100x6	S235	2M16-5.6t	1.00	1.00	1.00	105	-7.8	ULS 5a Ba 12	142.1	75.4	103.7	0.10		7.7	ULS 5a Ba 12	144.1	75.4	76.8	0.10
108	0	90x90x8	S235	5M16-5.6t	1.00	1.00	1.00	146	-41.7	ULS 5a Ba 22	112.9	188.4	345.6	0.37		0.0		285.6	188.4	298.7	0.00
113A	0	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	76	-61.0	ULS 1a_135	251.3	338.9	414.7	0.24		18.9	ULS 5a Ba 22	252.5	338.9	297.7	0.07
114A	0	100x100x10	S235	4M24-5.6t	0.50	0.50	0.50	72	-182.9	ULS 1a_135	355.2	338.9	518.4	0.54		131.6	ULS 1a_0,9_0,9_135	362.9	338.9	443.1	0.39
115A	0	150x150x10	S235	6M24-5.6t	1.77	1.37	1.14	39	-338.1	ULS 1a_135	643.5	508.3	777.6	0.67		224.5	ULS 1a_0,9_0,9_135	624.7	508.3	664.6	0.44
106A	0	150x150x12	S235	8M24-5.6t	0.97	0.97	0.62	34	-639.6	ULS 1a_135	780.4	677.8	1244.2	0.94		500.2	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.74
106C	0	150x150x12	S235		3.06	3.06	1.96	35	-731.8	ULS 1a_135	776.6	0.0	0.0	0.94		588.6	ULS 1a_0,9_0,9_135	817.8	0.0	0.0	0.72
107A	0	150x150x12	S235	8M24-5.6t	0.33	0.33	0.33	49	-675.9	ULS 1a_135	735.4	677.8	1244.2	1.00		551.1	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.81
201L	0	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	127	-24.3	ULS 5a Ba 22	75.8	84.7	90.7	0.32		18.0	ULS 5a Ba 22	88.7	84.7	64.2	0.28
202T	0	50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	178	-10.7	ULS 5a Ba 22	25.7	37.7	43.2	0.42		5.5	ULS 5a Ba 22	37.4	37.7	22.0	0.25
203L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	93	-108.6	ULS 5a Ba 12	207.7	169.4	207.4	0.64		116.7	ULS 5a Ba 22	181.4	169.4	177.2	0.69
204T	0	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	93	-123.1	ULS 5a Ba 12	256.2	254.2	388.8	0.48		122.1	ULS 5a Ba 22	261.1	254.2	332.3	0.48
205L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	99	-105.5	ULS 5a Ba 22	198.3	169.4	207.4	0.62		97.2	ULS 5a Ba 12	181.4	169.4	177.2	0.57
206T	0	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	99	-109.8	ULS 5a Ba 22	244.6	254.2	388.8	0.45		110.5	ULS 5a Ba 12	261.1	254.2	332.3	0.43
207L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	103	-86.9	ULS 5a Ba 12	190.8	169.4	207.4	0.51		94.4	ULS 5a Ba 22	181.4	169.4	177.2	0.56
208T	0	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	104	-99.2	ULS 5a Ba 12	235.3	169.4	259.2	0.59		97.9	ULS 5a Ba 22	224.3	169.4	221.5	0.58
209L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	112	-94.6	ULS 5a Ba 12	177.9	169.4	207.4	0.56		95.0	ULS 5a Ba 22	181.4	169.4	177.2	0.56
210T	0	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	112	-101.1	ULS 5a Ba 12	219.3	169.4	259.2	0.60		80.3	ULS 5a Ba 22	224.3	169.4	221.5	0.47
211L	0	100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	76	-94.7	ULS 5a Ba 21	197.1	169.4	207.4	0.56		89.1	ULS 5a Ba 21	125.9	169.4	116.0	0.77
212T	0	100x75x9	S235	2M24-5.6t	1.00	0.55	0.55	65	-96.1	ULS 5a Ba 10	245.9	169.4	233.3	0.57		93.0	ULS 5a Ba 10	121.3	169.4	130.6	0.77
213L	0	100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	85	-77.5	ULS 5a Ba 21	161.2	169.4	181.4	0.48		81.2	ULS 5a Ba 21	98.2	169.4	101.5	0.83
214T	0	100x75x9	S235	2M24-5.6t	0.52	0.25	0.25	74	-96.3	ULS 5a Ba 10	221.2	169.4	233.3	0.57		99.3	ULS 5a Ba 10	119.9	169.4	130.6	0.83
215L	0	100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	101	-73.9	ULS 5a Ba 21	141.1	169.4	181.4	0.52		69.9	ULS 5a Ba 21	100.4	169.4	101.5	0.70
216T	0	100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	86	-90.6	ULS 5a Ba 10	182.6	169.4	207.4	0.53		87.2	ULS 5a Ba 21	110.7	169.4	116.0	0.79
217L	0	100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	112	-59.4	ULS 5a Ba 21	129.0	117.6	151.2	0.50		62.0	ULS 5a Ba 21	115.4	117.6	106.9	0.58
218T	0	100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	102	-80.2	ULS 5a Ba 21	159.3	169.4	207.4	0.50		82.9	ULS 5a Ba 10	113.2	169.4	116.0	0.73
219L	0	100x75x8	S235	2M20-5.6t	0.52	0.25	0.25	123	-53.2	ULS 5a Ba 21	133.9	117.6	172.8	0.45		50.2	ULS 5a Ba 21	128.6	117.6	104.7	0.48
220T	0	100x75x9	S235	2M20-5.6t	0.52	0.25	0.25	117	-72.5	ULS 5a Ba 10	155.5	117.6	194.4	0.62		69.1	ULS 5a Ba 21	146.1	117.6	137.5	0.59
221L	0	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	-68.7	ULS 5a Ba 10	147.8	117.6	172.8	0.58		57.1	ULS 5a Ba 21	113.0	117.6	136.1	0.51
222T	0	100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	113	-53.4	ULS 5a Ba 21	127.3	117.6	151.2	0.45		55.7	ULS 5a Ba 10	107.3	117.6	91.6	0.61
223L	0	100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	-71.7	ULS 5a Ba 10	144.3	117.6	151.2	0.61		57.6	ULS 5a Ba 21	119.5	117.6	122.2	0.49
224T	0	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	-91.6	ULS 1a_90	147.8	117.6	172.8	0.78		80.3	ULS 1a_0,9_0,9_90	113.0	117.6	136.1	0.71
226T	0	100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	-91.4	ULS 1a_90	144.3	117.6	151.2	0.78		77.6	ULS 1a_0,9_0,9_90	119.5	117.6	122.2	0.66
227T	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	206	-2.1	ULS 6a_90 Ba Ct2	21.0	37.7	43.2	0.10		0.0	ULS 5a Ba 22	37.4	37.7	22.0	0.00
228L	0	80x80x8	S235	4M20-5.6t	1.00	1.00	1.00	128	0.0		122.6	235.2	345.6	0.00		119.6	ULS 3_0	168.3	235.2	244.4	0.71
229	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	225	-0.3	ULS 3_0	18.5	37.7	43.2	0.01		0.0		37.4	37.7	25.7	0.00
230	0	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	99	-76.2	ULS 5a Ba 12	156.9	169.4	207.4	0.49		76.1	ULS 5a Ba 12	206.0	169.4	159.5	0.48
231T	0	100x75x7	S235	3M24-5.6t	2.00	1.00	1.00	69	-48.9	ULS 5a Ba 22	182.6	254.2	272.2	0.27		64.4	ULS 5a Ba 22	214.1	254.2	217.6	0.30
232	0	150x100x12	S235	8M24-5.6t	2.00	1.00	1.00	51	-249.6	ULS 5a Ba 22	512.4	677.8	1244.2	0.49		94.2	ULS 5a Ba 22	582.2	677.8	755.0	0.16
233T	0	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	203	-34.0	ULS 1a_0,9_0,9_90	36.2	58.8	64.8	0.94		45.1	ULS 1a_90	82.9	58.8	52.4	0.86
234L	0	80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	178	0.0		82.2	254.2	311.0	0.00		147.7	ULS 3_0	169.8	254.2	239.3	0.87
235	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	-0.6	ULS 3_90	11.3	37.7	43.2	0.05		0.0		37.4	37.7	22.0	0.00
236	0	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	-75.6	ULS 5a Ba 10	182.9	169.4	207.4	0.45		75.8	ULS 5a Ba 10	208.1	169.4	177.2	0.45
237T	0	100x75x7	S235	4M24-5.6t	1.00	1.00	1.00	94	-42.6	ULS 5a Ba 22	157.6	338.9	362.9	0.27		69.2	ULS 5a Ba 12	214.1	338.9	290.1	0.32
238	0	150x100x14	S235	11M24-5.6t	2.00	1.00	1.00	70	-249.3	ULS 5a Ba 10	526.8	931.9	1995.8	0.47		72.0	ULS 5a Ba 10	666.7	931.9	1211.2	0.11
239	0	100x50x6	S235	1M16-5.6t	0.50	0.50	0.50	327	-0.4	ULS 1a_90	18.6	37.7	51.8	0.02		0.0		55.3	37.7	28.0	0.00
240	0	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	272	-1.4	ULS 1a_90	14.1	37.7	43.2	0.10		2.8	ULS 1a_0,9_0,9_135	60.5	37.7	26.7	0.10
241T	0	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	-3.4	ULS 1a_135	28.9	37.7	51.8	0.12		1.2	ULS 1a_0,9_0,9_0	89.9	37.7	38.4	0.03
251L	0	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	-3.6	ULS 1a_90	28.9	37.7	51.8	0.12		0.9	ULS 1a_0,9_135	89.9	37.7	38.4	0.02
113B	0	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	79	-129.7	ULS 1a_135	245.5	338.9	414.7	0.53		81.7	ULS 1a_0,9_0,9_135	252.5	338.9	354.5	0.32
114B	0	100x100x10	S235	6M24-5.6t	0.50	0.50	0.50	78	-218.9	ULS 1a_135	340.4	508.3	777.6	0.64		131.5	ULS 1a_0,9_0,9_135	362.9	508.3	651.3	0.36
115B	0	150x150x10	S235	8M24-5.6t	1.87	1.87	1.20	27	-613.7	ULS 1a_135	673.5	677.8	1036.8	0.91		472.5	ULS 1a_0,9_0,9_90	624.7	677.8	886.2	0.76
115C	0	150x150x10	S235		1.19	1.19	0.77	43	-561.8	ULS 1a_135	633.8	0.0	0.0	0.89		427.6	ULS 1a_0,9_0,9_135	688.6	0.0	0.0	0.62
106B	0	150x150x12	S235	8M24-8.8t	0.76	0.76	0.49	36	-732.7	ULS 1a_135	776.0	1084.4	1244.2	0.94		587.4	ULS 1a_0,9_0,9_135	740.3	1084.4	1063.4	0.79
107B	0	150x150x12	S235	8M24-8.8t	0.20	0.20	0.20	48	-678.7	ULS 1a_135	736.7	1084.4	1244.2	0.92		548.4	ULS 1a_0,9_0,9_135	740.3	1084.4	1063.4	0.74
102A	0	150x150x12	S235	8M24-5.6t	1.00	1.50	1.00	61	-303.0	ULS 5a Ba 12	689.3	677.8	1244.2	0.45		171.8	ULS 5a Ba 22	740.3	677.8	755.0	0.25
102B	0	150x150x12	S235	6M24-5.6t	2.52	1.61	1.00	63	-143.2	ULS 5a Ba 12	682.7	508.3	933.1	0.28		36.7	ULS 5a Ba 22	740.3	508.3	797.5	0.07
102C	0	150x150x12	S235		3.01	2.00	1.00	59	-274.7	ULS 5a Ba 12	698.8	0.0	0.0	0.39		148.9	ULS 5a Ba 22	817.8	0.0	0.0	0.18
103A	0	120x120x8	S235	6M24-5.6t	2.64	4.00	1.00	76	-132.5	ULS 5a Ba 12	340.1	508.3	622.1	0.39		47.5	ULS 5a Ba 22	379.5	508.3	531.7	0.13
103B	0	120x120x8	S235	2M16-5.6t	2.00	4.44	2.00	108	-31.4	ULS 3_90	249.9	75.4	138.2	0.42		0.0		316.6	75.4	138.2	0.00
103C	0	120x120x8	S235		1.71	1.00	1.00	76	-95.0	ULS 5a Ba 1	340.3	0.0	0.0	0.28		21.3	ULS 5a Ba 1	441.8	0.0	0.0	0.05
104A	0	100x65x7*	S235	4M20-5.6t	1.00	1.00	1.00	202	0.0		63.1	235.2	302.4	0.00		111.1	ULS 3_0	115.2	235.2	207.0	0.96
104B	0	100x65x7*	S235	3M20-5.6t	1.00	1.00	1.00	209	0.0		60.1	176.4	226.8	0.00		77.0	ULS 3_0	137.8	176.4	155.3	0.56
104C	0	100x65x7*	S235		1.00	1.00	1.00	194	0.0		66.4	0.0	0.0	0.00		98.0	ULS 3_0	263.2	0.0	0.0	0.37
105A	0	60x60x5	S235	2M16-5.6t	1.00	2.43	1.00	380	0.0		11.8	75.4	86.4	0.00		30.8	ULS 6a_90 Ba Ct1	98.8	75.4	56.0	0.55
105B	0	60x60x5	S235	2M16-5.6t	1.00	1.70	1.00	379	0.0		11.8	75.4	86.4	0.00		30.9	ULS 6a_90 Ba Ct1	65.9	75.4	56.0	0.55
415	0	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	180	-8.6	ULS 3_0	30.7	37.7	43.2	0.28		0.0		60.5	37.7	26.7	0.00
417	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	170	-9.5	ULS 3_0	27.4	37.7	43.2	0.35		0.0		37.4	37.7	18.4	0.00
419	0	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	107	-11.8	ULS 3_0	55.1	37.7	43.2	0.31		0.0		37.4	37.7	22.0	0.00
422	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	-0.5	ULS 6a_90 Ba Ct1	58.8	37.7	43.2	0.01		0.0		37.4	37.7	18.4	0.00
414	0	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	325	0.0		12.6	37.7	43.2	0.00		13.7	ULS 3_0	60.5	37.7	32.0	0.43
416	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	353	0.0		9.1	37.7	43.2	0.00		16.9	ULS 3_0	37.4	37.7	22.0	0.77
418	0	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	344	0.0		11.9	75.4	86.4	0.00		25.9	ULS 3_0	56.2	75.4	44.1	0.59
421	0	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	259	0.0		26.8	117.6	129.6	0.00		50.0	ULS 3_0	77.4	117.6	88.7	0.65
420	0	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	111	-1.5	ULS 1a_0,9_0,9_0	39.6	20.2	32.4	0.08		1.4	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.07
400	0	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	124	-20.9	ULS 5a Ba 22	48.1	58.8	54.0	0.43		19.4	ULS 5a Ba 12	54.7	58.8	37.0	0.52
401	0	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	119	-23.1	ULS 5a Ba 12	50.2	58.8	54.0	0.46		23.8	ULS 5a Ba 22	54.7	58.8	37.0	0.64
402	0	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	114	-25.9	ULS 5a Ba 22	52.1	58.8	54.0	0.50		25.5	ULS 5a Ba 12	54.7	58.8	37.0	0.69
403	0	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	108	-29.6	ULS 5a Ba 12	65.2	58.8	64.8	0.50		28.8	ULS 5a Ba 22	65.7	58.8	44.4	0.65
404	0	70x70x6	S235	1M24-5.6t	0.53	0.53	0.53	93	-32.0	ULS 5a Ba 22	86.5	84.7	77.8	0.41		34.1	ULS 5a Ba 12	76.0	84.7	44.0	0.78
405	0	75x50x7	S235	1M24-5.6t	0.53	0.53	0.53	107	-41.9	ULS 5a Ba 12	76.2	84.7	90.7	0.55		38.4	ULS 5a Ba 22	98.8	84.7	58.0	0.66

DNV·GL

Assessment of groups for strenghthened mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 39

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)
409	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	142	**-5.0**	ULS 1a_135	37.9	37.7	43.2	0.13		**16.3**	ULS 5a Ba 1	53.3	37.7	32.0	0.51
410	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	140	**-16.7**	ULS 5a Ba 1	38.5	37.7	43.2	0.44		**4.0**	ULS 1a_135	53.3	37.7	32.0	0.12
411	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	135	**-2.9**	ULS 1a_135	40.2	37.7	43.2	0.08		**17.1**	ULS 5a Ba 1	53.3	37.7	32.0	0.53
412	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	129	**-17.7**	ULS 5a Ba 1	42.0	37.7	43.2	0.47		**2.3**	ULS 1a_0,9_0,9_135	53.3	37.7	32.0	0.07
406	0	HEB160	S235		1.00	1.00	1.00	33	**-2.1**	ULS 1a_0,9_0,9_90	991.1	0.0	0.0	0.00		**5.9**	ULS 1a_90	1276.1	0.0	0.0	0.00
407	0	HEB160	S235		2.00	2.00	2.00	32	**-26.4**	ULS 5a Ba 12	994.8	0.0	0.0	0.03		**25.1**	ULS 5a Ba 22	1276.1	0.0	0.0	0.02
408	0	HEB160	S235		1.00	1.00	1.00	32	**-7.0**	ULS 5a Ba 1	998.4	0.0	0.0	0.01		**3.9**	ULS 1a_135	1276.1	0.0	0.0	0.00
413	0	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	25	**-1.3**	ULS 1a_0,9_0,9_135	1067.2	75.4	138.2	0.02		**14.2**	ULS 5a Ba 1	1296.6	75.4	124.6	0.19
423	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	**0.0**	ULS 1a_45	24.0	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00
424	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	**0.0**	ULS 3_90	27.5	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00
111A	0	80x80x8	S235	3M24-5.6t	1.00	2.00	1.00	203	**0.0**		65.4	254.2	311.0	0.00		**135.9**	ULS 3_45	160.8	254.2	259.0	0.85
111B	0	80x80x8	S235	3M20-5.6t	1.00	2.00	1.00	202	**0.0**		65.8	176.4	259.2	0.00		**120.2**	ULS 3_0	168.3	176.4	209.5	0.71
112A	0	70x70x7	S235	3M20-5.6t	1.00	1.88	1.00	227	**0.0**		42.7	176.4	226.8	0.00		**95.3**	ULS 3_0	125.5	176.4	155.3	0.76
112B	0	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	232	**0.0**		41.4	176.4	226.8	0.00		**83.5**	ULS 3_0	125.5	176.4	155.3	0.67
112C	0	70x70x7	S235		1.00	2.14	1.00	227	**0.0**		42.7	0.0	0.0	0.00		**91.4**	ULS 3_0	220.9	0.0	0.0	0.41
110A	0	120x120x11	S235	6M24-5.6t	1.64	1.00	1.00	60	**-191.0**	ULS 5a Ba 21	508.6	508.3	855.4	0.38		**104.3**	ULS 5a Ba 21	513.2	508.3	731.1	0.21
110B	0	120x120x11	S235		1.00	1.00	1.00	13	**-0.4**	ULS 1a_0,9_0,9_90	599.7	0.0	0.0	0.00		**0.4**	ULS 1a_90	599.7	0.0	0.0	0.00
110C	0	120x120x11	S235		1.71	1.29	1.00	66	**-158.8**	ULS 5a Ba 21	492.8	0.0	0.0	0.32		**80.8**	ULS 5a Ba 10	599.7	0.0	0.0	0.13
109A	0	150x100x14	S235	11M24-5.6t	1.00	0.52	0.52	56	**-302.5**	ULS 5a Ba 10	673.7	931.9	1995.8	0.45		**142.6**	ULS 5a Ba 21	666.7	931.9	1211.2	0.21
109B	0	150x100x14	S235	6M24-5.6t	4.78	1.00	1.00	47	**-206.2**	ULS 5a Ba 10	703.8	508.3	1088.6	0.41		**119.3**	ULS 5a Ba 21	666.7	508.3	930.5	0.23
109C	0	150x100x14	S235		1.00	0.52	0.52	58	**-277.9**	ULS 5a Ba 21	665.2	0.0	0.0	0.42		**131.2**	ULS 5a Ba 10	775.5	0.0	0.0	0.17
312	0	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	185	**-14.3**	ULS 3_135	41.1	58.8	64.8	0.35		**0.0**		82.9	58.8	39.3	0.00
314	0	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	148	**-15.5**	ULS 3_0	54.9	58.8	64.8	0.28		**0.0**		82.9	58.8	39.3	0.00
317	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	154	**-2.9**	ULS 1a_0	31.0	37.7	43.2	0.09		**0.0**		37.4	37.7	18.4	0.00
319	0	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	**-2.6**	ULS 1a_0	59.5	37.7	43.2	0.07		**0.0**		37.4	37.7	18.4	0.00
322	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	53	**-1.1**	ULS 3_90	63.5	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00
311	0	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	332	**0.0**		12.1	58.8	54.0	0.00		**17.4**	ULS 3_45	54.7	58.8	37.0	0.47
313	0	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	298	**0.0**		14.4	58.8	54.0	0.00		**23.7**	ULS 3_135	54.7	58.8	37.0	0.64
316	0	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	332	**0.0**		12.6	75.4	86.4	0.00		**31.7**	ULS 3_135	52.4	75.4	44.1	0.72
318	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	274	**0.0**		13.7	37.7	43.2	0.00		**6.4**	ULS 5a Ba 10	37.4	37.7	22.0	0.29
321	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	269	**0.0**		14.1	37.7	43.2	0.00		**8.9**	ULS 3_0	37.4	37.7	22.0	0.40
315	0	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	180	**-1.3**	ULS 1a_0	22.7	20.2	32.4	0.06		**1.1**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.06
320	0	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	115	**-1.1**	ULS 1a_0	38.2	20.2	32.4	0.05		**1.0**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.05
300	0	70x70x7	S235	1M20-5.6t	0.53	0.53	0.53	142	**-24.3**	ULS 5a Ba 20	66.6	58.8	75.6	0.41		**22.2**	ULS 5a Ba 11	96.8	58.8	53.5	0.41
301	0	70x70x7	S235	1M20-5.6t	0.54	0.54	0.54	138	**-27.0**	ULS 5a Ba 11	69.0	58.8	75.6	0.46		**29.8**	ULS 5a Ba 20	96.8	58.8	53.5	0.56
302	0	70x70x7	S235	1M24-5.6t	0.54	0.54	0.54	119	**-33.6**	ULS 5a Ba 20	80.7	84.7	90.7	0.42		**30.2**	ULS 5a Ba 11	88.7	84.7	44.9	0.67
304	0	60x60x5	S235	1M20-5.6t	0.53	0.53	0.53	104	**-18.0**	ULS 5a Ba 21	57.0	58.8	54.0	0.33		**17.6**	ULS 5a Ba 21	54.7	58.8	37.0	0.48
305	0	60x60x5	S235	1M20-5.6t	0.54	0.54	0.54	112	**-24.9**	ULS 5a Ba 10	52.9	58.8	54.0	0.47		**24.7**	ULS 5a Ba 10	54.7	58.8	37.0	0.67
306	0	75x50x5	S235	1M24-5.6t	0.55	0.55	0.55	112	**-29.5**	ULS 5a Ba 10	53.3	84.7	64.8	0.55		**29.9**	ULS 5a Ba 10	70.6	84.7	41.4	0.72
307	0	75x50x7	S235	1M24-5.6t	0.54	0.54	0.54	87	**-37.7**	ULS 5a Ba 21	86.9	84.7	90.7	0.45		**36.4**	ULS 5a Ba 21	98.8	84.7	58.0	0.63
303	0	HEB160	S235		2.00	2.00	2.00	50	**-26.0**	ULS 5a Ba 20	918.5	0.0	0.0	0.03		**25.4**	ULS 5a Ba 11	1276.1	0.0	0.0	0.02
308	0	HEB160	S235		1.00	1.00	1.00	27	**-1.0**	ULS 1a_0,9_0,9_90	1015.5	0.0	0.0	0.00		**3.8**	ULS 1a_90	1276.1	0.0	0.0	0.00
309	0	HEB160	S235		2.00	2.00	2.00	26	**-26.7**	ULS 5a Ba 10	1021.6	0.0	0.0	0.03		**24.9**	ULS 5a Ba 21	1276.1	0.0	0.0	0.02
310	0	HEB160	S235		1.00	1.00	1.00	25	**-3.3**	ULS 1a_0,9_0,9_90	1025.6	0.0	0.0	0.00		**3.3**	ULS 1a_90	1276.1	0.0	0.0	0.00
40	40	**75x50x5**	S235	1M16-5.6c	1.00	1.00	1.00	230	**0.0**		22.4	37.7	43.2	0.00		**0.8**	0.764	ULS 30yr 1a \	146.9	18.4	0.04
903	903	**80x80x8**	S235	1M20-5.6c	1.00	1.00	1.00	201	**-0.1**	ULS 30yr 1a W ZII WR	55.6	58.8	86.4	0.00		**0.0**	0.03	ULS 30yr 1a \	303.6	69.8	0.00
1052	1052	**180x180x16#**	S235	12M24-5.6c	2.00	1.00	1.00	73	**-260.5**	ULS 30yr 5a Trsnl ZII E	1023.5	991.2	2488.3	0.26		**31.0**	30.955	ULS 30yr 5a T	1328.1	2126.8	0.03
20	20	**100x100x8**	S235	2M24-5.6c	2.00	1.00	1.00	131	**-33.7**	ULS 30yr 5a Trsnl ZII E	143.1	169.4	207.4	0.24		**64.1**	64.138	ULS 30yr 5a T	181.4	172.2	0.38
1053	1053	**120x120x8**	S235	2M24-5.6c	1.00	1.00	1.00	119	**-65.9**	ULS 30yr 5a Trsnl ZII E	162.3	169.4	207.4	0.41		**65.7**	65.686	ULS 30yr 5a T	226.0	177.2	0.39
496	496	**50x50x5**	S235	1M16-5.6c	1.00	1.00	1.00	324	**0.0**		10.4	37.7	43.2	0.00		**3.4**	3.436	ULS 30yr 1a \	37.4	18.4	0.19
487	0	**0**	S	1M16-5.6c	0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
497	0	**0**	S	1M16-5.6c	0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
486	0	**0**	S	1M16-5.6c	0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
485	485	**50x50x5**	S235	1M16-5.6c	1.00	1.00	1.00	137	**-0.4**	ULS 30yr 1a W ZII WLE	35.4	37.7	43.2	0.01		**0.1**	0.08	ULS 30yr 1a \	112.3	22.0	0.00
484	484	**50x50x5**	S235	1M16-5.6c	1.00	1.00	1.00	110	**0.0**		44.7	37.7	43.2	0.00		**0.1**	0.126	ULS 30yr 3 W	112.3	22.0	0.01
495	495	**70x70x7**	S235	1M16-5.6c	0.50	1.00	0.50	215	**0.0**		31.6	37.7	60.5	0.00		**0.0**		10°C,T Global	104.8	44.8	0.00
490/91	490/91	**50x50x5**	S235	1M16-5.6c	1.00	1.50	1.00	201	**-2.4**	ULS 30yr 1a W ZII WR	18.5	37.7	43.2	0.13		**3.6**	3.616	ULS 30yr 5a T	112.3	22.0	0.16
494	494	**70x70x7**	S355	2M16-8.8c	0.50	1.00	0.50	171	**-13.7**	ULS 30yr 3 W + I ZII V	49.1	120.6	164.6	0.28		**0.0**		0.0	138.3	106.8	0.00
493	493	**55x55x6**	S235	1M16-5.6c	1.00	1.00	1.00	343	**-8.2**	ULS 30yr 1a W ZII WR_	12.4	37.7	51.8	0.66		**0.0**		0.0	55.3	33.6	0.00
492	492	**50x50x5**	S235	1M16-5.6c	1.00	1.00	1.00	101	**0.0**		48.3	37.7	43.2	0.00		**2.4**	2.372	ULS 30yr 1a \	37.4	22.0	0.11
1500	1500	**200x100x10**	S235	1M20-5.6c	1.00	0.50	0.50	277	**-1.0**	ULS 30yr 1a W ZII WL_	94.1	58.8	108.0	0.02		**0.0**		0.0	224.6	87.3	0.00
1441	1441	**L250.22 + L2(**	S235		1.00	1.00	1.00	46	**-3201.6**	ULS 30yr 1a W ZII WR_	3796.1	0.0	0.0	0.84		**2766.0**	2766.034	ULS 30yr 1a \	4419.4	3421.4	0.86
1443	1443	**150x100x10**	S235	1M24-5.6c	1.00	0.51	0.51	128	**-80.6**	ULS 30yr 1a W ZII WL_	168.5	84.7	129.6	0.95		**77.9**	77.885	ULS 30yr 1a \	213.1	110.8	0.92
1443-1	1443-1	**150x100x10**	S235	1M24-8.8c	1.00	0.51	0.51	148	**-100.5**	ULS 30yr 1a W ZII WL_	146.0	135.6	129.6	0.78		**88.4**	88.369	ULS 30yr 1a \	213.1	110.8	0.80
1445T	1445T	**120x80x10**	S355	2M24-8.8c	0.53	0.25	0.25	90	**-206.0**	ULS 30yr 1a W ZII WR	327.1	271.1	352.8	0.76		**199.0**	198.963	ULS 30yr 1a \	230.5	301.5	0.86
1445L	1445L	**120x80x8**	S235	2M24-5.6c	0.53	0.25	0.25	90	**-121.3**	ULS 30yr 1a W ZII WL_	209.3	169.4	207.4	0.72		**122.3**	122.327	ULS 30yr 1a \	138.1	172.2	0.89
1501	1501	**75x75x7#**	S235		1.00	1.00	1.00	340	**0.0**	ULS 30yr 1a W ZII 0.9	20.5	0.0	0.0	0.00		**0.0**	0.037	ULS 30yr 1a \	239.7	0.0	0.00
1502	1502	**60x60x6**	S235	1M20-5.6c	1.00	1.00	1.00	259	**0.0**		21.4	58.8	64.8	0.00		**1.4**	1.379	ULS 30yr 3 W	65.7	33.3	0.04
1503	1503	**100x100x8**	S235	1M20-5.6c	1.00	1.00	1.00	327	**-5.8**	ULS 30yr 1a W ZII WR_	33.2	58.8	86.4	0.17		**7.1**	7.126	ULS 30yr 1a \	179.7	69.8	0.12
1504	1504	**90x90x8**	S235	1M20-5.6c	1.00	1.00	1.00	258	**-15.1**	ULS 30yr 1a W ZII 0.9	43.5	58.8	86.4	0.35		**12.6**	12.608	ULS 30yr 1a \	156.7	69.8	0.21
1505	1505	**130x65x8**	S235	1M20-5.6c	0.50	0.50	0.50	329	**-0.3**	ULS 30yr 1a W ZII WLE	32.1	58.8	86.4	0.01		**0.0**		0.0	99.1	68.0	0.00
1442	1442	**150x100x10**	S235	1M24-5.6c	1.00	0.51	0.51	142	**-74.4**	ULS 30yr 1a W ZII 0.9	152.2	84.7	129.6	0.88		**80.4**	80.35	ULS 30yr 1a \	213.1	110.8	0.95
1442-1	1442-1	**150x100x10**	S235	1M24-8.8c	1.00	0.51	0.51	162	**-98.1**	ULS 30yr 1a W ZII WLE	132.7	135.6	129.6	0.76		**95.0**	95.029	ULS 30yr 1a \	213.1	110.8	0.86
1506	1506	**110x110x10**	S235	1M20-5.6c	1.00	1.00	1.00	341	**-5.7**	ULS 30yr 1a W ZII WR_	42.3	58.8	108.0	0.13		**7.2**	7.217	ULS 30yr 1a \	224.6	87.3	0.12
1507	1507	**150x100x10**	S235	1M20-5.6c	0.50	0.50	0.50	241	**-0.4**	ULS 30yr 1a W ZII WL_	84.3	58.8	108.0	0.01		**0.0**		0.0	224.6	87.3	0.00
fict01	fict01	**0.1x0.1x0.01**	S235		1.00	1.00	1.00	9,768	**0.0**	ULS 30yr 1a W ZII 0.9	0.0	0.0	0.0	0.00		**0.0**	0.03	ULS 30yr 1a \	0.0	0.0	0.00
1508	1508	**55x55x6**	S355	1M16-8.8c	1.00	1.00	1.00	236	**-4.0**	ULS 30yr 1a W ZII WR_	24.7	60.3	70.6	0.16		**1.7**	1.711	ULS 30yr 1a \	75.3	45.8	0.04
1509	1509	**70x70x7**	S355	1M16-8.8c	1.00	1.00	1.00	177	**-6.8**	ULS 30yr 1a W ZII 0.9	71.9	60.3	82.3	0.11		**9.2**	9.172	ULS 30yr 1a \	142.7	61.0	0.15
1420	1420	**110x110x10**	S355	1M24-8.8c	1.00	1.00	1.00	246	**-9.4**	ULS 30yr 1a W ZII WR_	77.8	135.6	176.4	0.12		**7.0**	6.989	ULS 30yr 1a \	329.3	150.8	0.05

DNV·GL

Assessment of groups for strengthened mast (verbouw level)

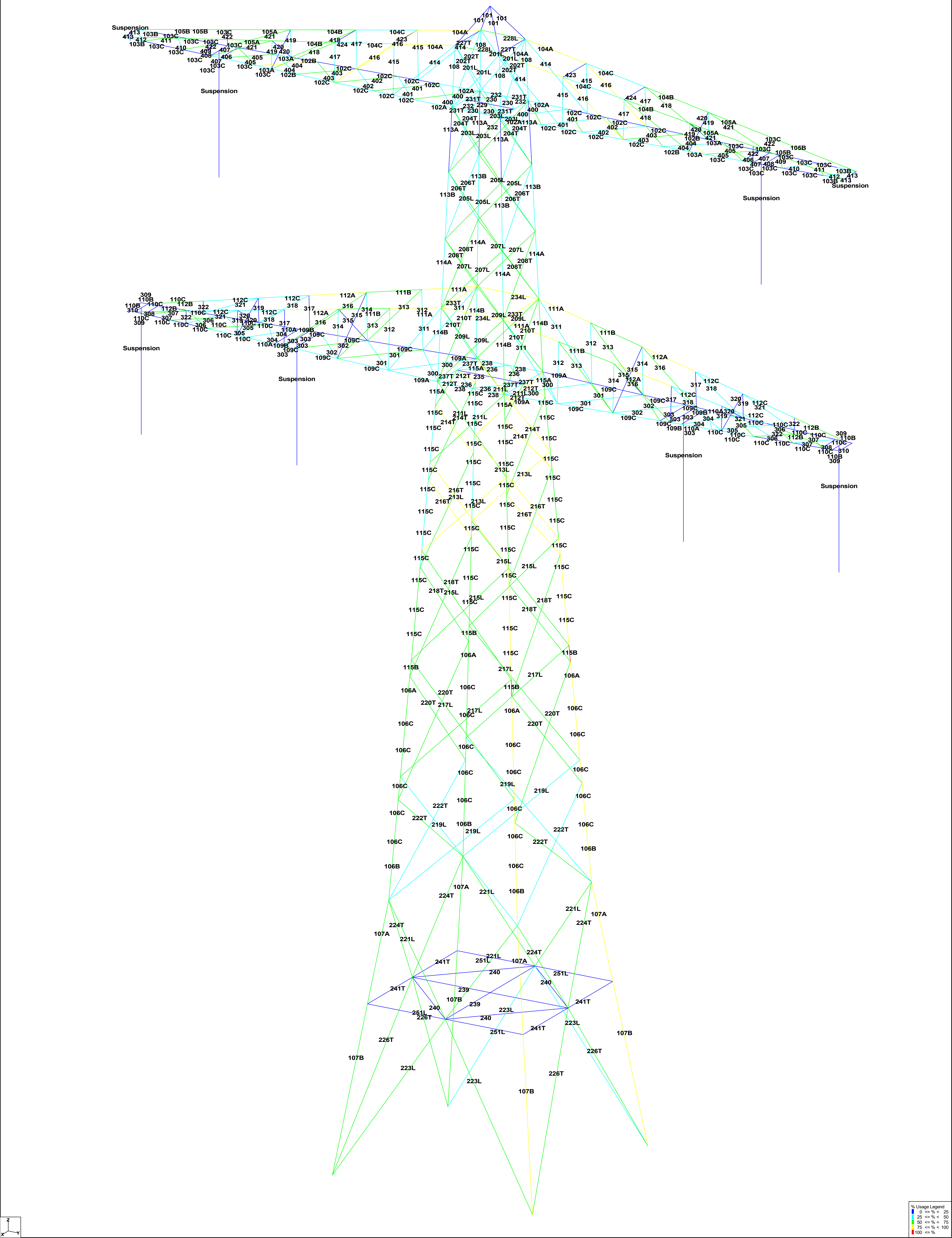
Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 39

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)
106A		150x150x12	S235	8M24-5.6t	**0.97**	**0.97**	**0.62**	34	**-769.0**	ULS 1a_135	780.4	677.8	1244.2	1.13		**625.4**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.92
106C		150x150x12	S235		**3.06**	**3.06**	**1.96**	35	**-881.0**	ULS 1a_135	776.6	0.0	0.0	1.13		**734.5**	ULS 1a_0,9_0,9_135	817.8	0.0	0.0	0.90
115B		150x150x10	S235	8M24-5.6t	**1.87**	**1.87**	**1.20**	27	**-736.1**	ULS 1a_135	673.5	677.8	1036.8	1.09		**590.5**	ULS 1a_0,9_0,9_135	624.7	677.8	886.2	0.95
115C		150x150x10	S235		**1.19**	**1.19**	**0.77**	43	**-674.7**	ULS 1a_135	633.8	0.0	0.0	1.06		**535.8**	ULS 1a_0,9_0,9_135	688.6	0.0	0.0	0.78
106B		150x150x12	S235	**8M24-8.8t**	0.76	**0.76**	**0.49**	36	**-881.9**	ULS 1a_135	776.0	1084.4	1244.2	1.14	(1)	**733.4**	ULS 1a_0,9_0,9_135	740.3	1084.4	1063.4	0.99
107B		150x150x12	S235	**8M24-8.8t**	0.20	0.20	0.20	48	**-818.9**	ULS 1a_135	736.7	1084.4	1244.2	1.11	(1)	**683.9**	ULS 1a_0,9_0,9_135	740.3	1084.4	1063.4	0.92

(1) Redundants (knikverkorters) have been added to groups 106A, 106B, 106C, 115B and 115C. The redundants are checked separately in Appendix C.
The exceeding of compression strength is not relevant, since the main leg itself does not need to be checked for verbouw level.

DNV GL Nederlands BV, Project: "S+0 (hv) ini"
Tower Version 16.12, 09:44:39 Wednesday, 1 April, 2020
Undeformed geometry displayed



Assessment of groups for initial mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 65

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	mpression	Load Case (Compression)	Buckling	Shear (Comp)	earing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	hear (Tens)	earing (Tens)	U.C. (Tens)	Exceedance (Tens)
101		100x100x6	S235	2M16-5.6t	1.00	1.00	1.00	105	**-7.8**	ULS 5a Ba 12	142.1	75.4	103.7	0.10		**7.7**	ULS 5a Ba 12	144.1	75.4	76.8	0.10	
108		90x90x8	S235	5M16-5.6t	1.00	1.00	1.00	146	**-42.1**	ULS 5a Ba 22	112.9	188.4	345.6	0.37		**0.0**		285.6	188.4	298.7	0.00	
113A		90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	76	**-55.3**	ULS 1a_135	251.3	338.9	414.7	0.22		**19.2**	ULS 5a Ba 22	252.5	338.9	297.7	0.08	
114A		100x100x10	S235	4M24-5.6t	0.50	0.50	0.50	72	**-158.7**	ULS 1a_135	355.2	338.9	518.4	0.47		**106.7**	ULS 1a_0,9_0,9_135	362.9	338.9	443.1	0.31	
115A		150x150x10	S235	6M24-5.6t	1.77	1.37	1.14	39	**-297.9**	ULS 1a_90	643.5	508.3	777.6	0.59		**183.4**	ULS 1a_0,9_0,9_90	624.7	508.3	664.6	0.36	
106A		150x150x12	S235	8M24-5.6t	1.66	1.73	1.38	76	**-551.3**	ULS 1a_135	628.6	677.8	1244.2	0.88		**411.7**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.61	
106C		150x150x12	S235		1.81	1.89	1.51	87	**-552.9**	ULS 1a_135	575.2	0.0	0.0	0.96		**485.4**	ULS 1a_0,9_0,9_135	817.8	0.0	0.0	0.59	
107A		150x150x12	S235	8M24-5.6t	0.33	0.33	0.33	49	**-580.0**	ULS 1a_135	735.4	677.8	1244.2	0.86		**454.9**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.67	
201L		70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	127	**-24.6**	ULS 5a Ba 22	75.8	84.7	90.7	0.32		**18.3**	ULS 5a Ba 22	88.7	84.7	64.2	0.28	
202T		50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	178	**-10.7**	ULS 5a Ba 22	25.7	37.7	43.2	0.42		**5.5**	ULS 5a Ba 22	37.4	37.7	22.0	0.25	
203L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	93	**-108.6**	ULS 5a Ba 12	207.7	169.4	207.4	0.64		**116.7**	ULS 5a Ba 22	181.4	169.4	177.2	0.69	
204T		100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	93	**-123.1**	ULS 5a Ba 12	256.2	254.2	388.8	0.48		**122.1**	ULS 5a Ba 22	261.1	254.2	332.3	0.48	
205L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	99	**-105.6**	ULS 5a Ba 22	198.3	169.4	207.4	0.62		**97.2**	ULS 5a Ba 12	181.4	169.4	177.2	0.57	
206T		100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	99	**-109.9**	ULS 5a Ba 22	244.6	254.2	388.8	0.45		**110.5**	ULS 5a Ba 12	261.1	254.2	332.3	0.43	
207L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	103	**-86.9**	ULS 5a Ba 12	190.8	169.4	207.4	0.51		**94.4**	ULS 5a Ba 22	181.4	169.4	177.2	0.56	
208T		100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	104	**-99.2**	ULS 5a Ba 12	235.3	169.4	259.2	0.59		**98.0**	ULS 5a Ba 22	224.3	169.4	221.5	0.58	
209L		100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	112	**-94.6**	ULS 5a Ba 12	177.9	169.4	207.4	0.56		**95.0**	ULS 5a Ba 22	181.4	169.4	177.2	0.56	
210T		100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	112	**-101.1**	ULS 5a Ba 12	219.3	169.4	259.2	0.60		**80.3**	ULS 5a Ba 22	224.3	169.4	221.5	0.47	
211L		100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	76	**-94.8**	ULS 5a Ba 21	197.1	169.4	207.4	0.56		**89.1**	ULS 5a Ba 21	125.9	169.4	116.0	0.77	
212T		100x75x9	S235	2M24-5.6t	1.00	0.55	0.55	65	**-96.1**	ULS 5a Ba 10	245.9	169.4	233.3	0.57		**93.0**	ULS 5a Ba 10	121.3	169.4	130.6	0.77	
213L		100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	85	**-77.5**	ULS 5a Ba 21	161.2	169.4	181.4	0.48		**81.3**	ULS 5a Ba 21	98.2	169.4	101.5	0.83	
214T		100x75x9	S235	2M24-5.6t	0.52	0.25	0.25	74	**-96.3**	ULS 5a Ba 10	221.2	169.4	233.3	0.57		**99.3**	ULS 5a Ba 10	119.9	169.4	130.6	0.83	
215L		100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	101	**-74.0**	ULS 5a Ba 21	141.1	169.4	181.4	0.52		**69.9**	ULS 5a Ba 21	100.4	169.4	101.5	0.70	
216T		100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	86	**-90.6**	ULS 5a Ba 10	182.6	169.4	207.4	0.53		**87.2**	ULS 5a Ba 21	110.7	169.4	116.0	0.79	
217L		100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	112	**-59.4**	ULS 5a Ba 21	129.0	117.6	151.2	0.51		**62.0**	ULS 5a Ba 21	115.4	117.6	106.9	0.58	
218T		100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	102	**-80.2**	ULS 5a Ba 21	159.3	169.4	207.4	0.50		**82.9**	ULS 5a Ba 10	113.2	169.4	116.0	0.73	
219L		100x75x8	S235	2M20-5.6t	0.52	0.25	0.25	123	**-53.2**	ULS 5a Ba 21	133.9	117.6	172.8	0.45		**50.2**	ULS 5a Ba 21	128.6	117.6	104.7	0.48	
220T		100x75x9	S235	2M20-5.6t	0.52	0.25	0.25	117	**-72.5**	ULS 5a Ba 10	155.5	117.6	194.4	0.62		**69.1**	ULS 5a Ba 21	146.1	117.6	137.5	0.59	
221L		130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	**-68.6**	ULS 5a Ba 10	147.8	117.6	172.8	0.58		**57.1**	ULS 5a Ba 21	113.0	117.6	136.1	0.51	
222T		100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	113	**-53.4**	ULS 5a Ba 21	127.3	117.6	151.2	0.45		**55.7**	ULS 5a Ba 10	107.3	117.6	91.6	0.61	
223L		100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	**-71.7**	ULS 5a Ba 10	144.3	117.6	151.2	0.61		**57.6**	ULS 5a Ba 21	119.5	117.6	122.2	0.49	
224T		130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	**-82.1**	ULS 1a_90	147.8	117.6	172.8	0.70		**68.3**	ULS 1a_0,9_0,9_90	113.0	117.6	136.1	0.60	
226T		100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	**-82.1**	ULS 1a_90	144.3	117.6	151.2	0.70		**65.7**	ULS 1a_0,9_0,9_90	119.5	117.6	122.2	0.56	
227T		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	206	**-2.1**	ULS 6a_90 Ba Ct2	21.0	37.7	43.2	0.10		**0.1**	ULS 5a Ba 22	37.4	37.7	22.0	0.00	
228L		80x80x8	S235	4M20-5.6t	1.00	1.00	1.00	128	**0.0**		122.6	235.2	345.6	0.00		**120.7**	ULS 3_0	168.3	235.2	244.4	0.72	
229		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	225	**-0.3**	ULS 3_0	18.5	37.7	43.2	0.02		**0.0**		37.4	37.7	25.7	0.00	
230		80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	99	**-76.2**	ULS 5a Ba 12	156.9	169.4	207.4	0.49		**76.1**	ULS 5a Ba 12	206.0	169.4	159.5	0.48	
231T		100x75x7	S235	3M24-5.6t	2.00	1.00	1.00	69	**-48.9**	ULS 5a Ba 22	182.6	254.2	272.2	0.27		**64.5**	ULS 5a Ba 22	214.1	254.2	217.6	0.30	
232		150x100x12	S235	8M24-5.6t	2.00	1.00	1.00	51	**-250.2**	ULS 5a Ba 22	512.4	677.8	1244.2	0.49		**93.6**	ULS 5a Ba 22	582.2	677.8	755.0	0.16	
233T		70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	203	**-28.8**	ULS 1a_0,9_0,9_90	36.2	58.8	64.8	0.80		**39.9**	ULS 1a_90	82.9	58.8	52.4	0.76	
234L		80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	178	**0.0**		82.2	254.2	311.0	0.00		**147.6**	ULS 3_0	169.8	254.2	239.3	0.87	
235		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	**-0.6**	ULS 3_90	11.3	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00	
236		100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	**-75.6**	ULS 5a Ba 10	182.9	169.4	207.4	0.45		**75.8**	ULS 5a Ba 10	208.1	169.4	177.2	0.45	
237T		100x75x7	S235	4M24-5.6t	1.00	1.00	1.00	94	**-42.5**	ULS 5a Ba 22	157.6	338.9	362.9	0.27		**69.2**	ULS 5a Ba 12	214.1	338.9	290.1	0.32	
238		150x100x14	S235	11M24-5.6t	2.00	1.00	1.00	70	**-249.9**	ULS 5a Ba 10	526.8	931.9	1995.8	0.47		**71.3**	ULS 5a Ba 10	666.7	931.9	1211.2	0.11	
239		100x50x6	S235	1M16-5.6t	0.50	0.50	0.50	327	**-0.4**	ULS 1a_90	18.6	37.7	51.8	0.02		**0.0**		55.3	37.7	28.0	0.00	
240		60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	272	**-1.2**	ULS 1a_45	14.1	37.7	43.2	0.08		**2.1**	ULS 1a_0,9_0,9_135	60.5	37.7	26.7	0.08	
241T		70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	**-2.7**	ULS 1a_135	28.9	37.7	51.8	0.09		**1.0**	ULS 1a_0,9_0,9_0	89.9	37.7	38.4	0.03	
251L		70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	**-2.9**	ULS 1a_90	28.9	37.7	51.8	0.10		**0.7**	ULS 1a_0,9_135	89.9	37.7	38.4	0.02	
113B		90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	79	**-113.5**	ULS 1a_135	245.5	338.9	414.7	0.46		**64.9**	ULS 1a_0,9_0,9_135	252.5	338.9	354.5	0.26	
114B		100x100x10	S235	6M24-5.6t	0.50	0.50	0.50	78	**-192.3**	ULS 1a_135	340.4	508.3	777.6	0.56		**103.6**	ULS 1a_0,9_0,9_135	362.9	508.3	651.3	0.29	
115B		150x150x10	S235	8M24-5.6t	4.00	4.23	3.33	76	**-542.7**	ULS 1a_90	530.0	677.8	1036.8	1.02	knik	**403.7**	ULS 1a_0,9_0,9_90	624.7	677.8	886.2	0.65	
115C		150x150x10	S235		1.70	1.70	1.42	80	**-485.2**	ULS 1a_135	514.8	0.0	0.0	0.94		**351.1**	ULS 1a_0,9_0,9_135	688.6	0.0	0.0	0.51	
106B		150x150x12	S235	8M24-5.6t	0.76	1.28	0.63	60	**-630.6**	ULS 1a_135	696.2	677.8	1244.2	0.93		**484.2**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.71	
107B		150x150x12	S235	8M24-5.6t	0.20	0.20	0.20	48	**-582.6**	ULS 1a_135	736.7	677.8	1244.2	0.86		**452.3**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.67	
102A		150x150x12	S235	8M24-5.6t	1.00	1.50	1.00	61	**-303.4**	ULS 5a Ba 12	689.3	677.8	1244.2	0.45		**171.4**	ULS 5a Ba 22	740.3	677.8	755.0	0.25	
102B		150x150x12	S235	6M24-5.6t	2.52	1.61	1.00	63	**-143.6**	ULS 5a Ba 12	682.7	508.3	933.1	0.28		**36.3**	ULS 5a Ba 22	740.3	508.3	797.5	0.07	
102C		150x150x12	S235		3.01	2.00	1.00	59	**-275.1**	ULS 5a Ba 12	698.8	0.0	0.0	0.39		**148.5**	ULS 5a Ba 22	817.8	0.0	0.0	0.18	
103A		120x120x8	S235	6M24-5.6t	2.64	4.00	1.00	76	**-132.8**	ULS 5a Ba 12	340.1	508.3	622.1	0.39		**47.2**	ULS 5a Ba 22	379.5	508.3	531.7	0.12	
103B		120x120x8	S235	2M16-5.6t	2.00	4.44	2.00	108	**-31.4**	ULS 3_90	249.9	75.4	138.2	0.42		**0.0**		316.6	75.4	138.2	0.00	
103C		120x120x8	S235		1.71	1.00	1.00	76	**-95.4**	ULS 5a Ba 1	340.3	0.0	0.0	0.28		**21.2**	ULS 5a Ba 1	441.8	0.0	0.0	0.05	
104A		100x65x7*	S235	4M20-5.6t	1.00	1.00	1.00	202	**0.0**		63.1	235.2	302.4	0.00		**112.3**	ULS 3_0	115.2	235.2	207.0	0.98	
104B		100x65x7*	S235	3M20-5.6t	1.00	1.00	1.00	209	**0.0**		60.1	176.4	226.8	0.00		**77.7**	ULS 3_0	137.8	176.4	155.3	0.56	
104C		100x65x7*	S235		1.00	1.00	1.00	194	**0.0**		66.4	0.0	0.0	0.00		**99.2**	ULS 3_0	263.2	0.0	0.0	0.38	
105A		60x60x5	S235	2M16-5.6t	1.00	2.43	1.00	380	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ba Ct1	98.8	75.4	56.0	0.55	
105B		60x60x5	S235	2M16-5.6t	1.00	1.70	1.00	379	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ba Ct1	65.9	75.4	56.0	0.55	
415		60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	180	**-8.7**	ULS 3_0	30.7	37.7	43.2	0.28		**0.0**		60.5	37.7	26.7	0.00	
417		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	170	**-9.5**	ULS 3_0	27.4	37.7	43.2	0.35		**0.0**		37.4	37.7	18.4	0.00	
419		75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	107	**-11.9**	ULS 3_0	55.1	37.7	43.2	0.32		**0.0**		37.4	37.7	22.0	0.00	
422		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	**-0.5**	ULS 6a_90 Ba Ct1	58.8	37.7	43.2	0.01		**0.0**		37.4	37.7	18.4	0.00	
414		60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	325	**0.0**		12.6	37.7	43.2	0.00		**13.7**	ULS 3_0	60.5	37.7	32.0	0.43	
416		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	353	**0.0**		9.1	37.7	43.2	0.00		**16.9**	ULS 3_0	37.4	37.7	22.0	0.77	
418		50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	344	**0.0**		11.9	75.4	86.4	0.00		**26.0**	ULS 3_0	56.2	75.4	44.1	0.59	
421		60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	259	**0.0**		26.8	117.6	129.6	0.00		**50.5**	ULS 3_135	77.4	117.6	88.7	0.65	
420		45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	111	**-1.2**	ULS 1a_0,9_0,9_0	39.6	20.2	32.4	0.06		**1.2**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.06	
400		60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	124	**-20.9**	ULS 5a Ba 22	48.1	58.8	54.0	0.43		**19.4**	ULS 5a Ba 12	54.7	58.8	37.0	0.52	
401		60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	119	**-23.1**	ULS 5a Ba 12	50.2	58.8	54.0	0.46		**23.8**	ULS 5a Ba 22	54.7	58.8	37.0	0.64	
402		60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	114	**-25.9**	ULS 5a Ba 22	52.1	58.8	54.0	0.50		**25.5**	ULS 5a Ba 12	54.7	58.8	37.0	0.69	
403		60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	108	**-29.6**	ULS 5a Ba 12	65.2	58.8	64.8	0.50		**28.8**	ULS 5a Ba 22	65.7	58.8	44.4	0.65	
404		70x70x6	S235	1M24-5.6t	0.53	0.53	0.53	93	**-32.0**	ULS 5a Ba 22	86.5	84.7	77.8	0.41		**34.1**	ULS 5a Ba 12	76.0	84.7	44.0	0.78	
405		75x50x7	S235	1M24-5.6t	0.53	0.53	0.53	107	**-41.9**	ULS 5a Ba 12	76.2	84.7	90.7	0.55		**38.4**	ULS 5a Ba 22	98.8	84.7	58.0	0.66	
409		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	142	**-4.1**	ULS 1a_135	37.9	37.7	43.2	0.11		**16.3**	ULS 5a Ba 1	53.3	37.7	32.0	0.51	
410		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	140	**-16.7**	ULS 5a Ba 1	38.5	37.7	43.2	0.44		**3.2**	ULS 1a_135	53.3	37.7	32.0	0.10	
411		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	135	**-2.3**	ULS 1a_135	40.2	37.7	43.2	0.06		**17.1**	ULS 5a Ba 1	53.3	37.7	32.0	0.53	
412		55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	129	**-17.7**	ULS 5a Ba 1	42.0	37.7	43.2	0.47		**1.8**	ULS 1a_0,9_0,9_135	53.3	37.7	32.0	0.06	
406		HEB160	S235		1.00	1.00	1.00	33	**-1.6**	ULS 1a_0,9_0,9_90	991.1	0.0	0.0	0.00		**5.6**	ULS 1a_90	1276.1	0.0	0.0	0.00	
407		HEB160	S235		2.00	2.00	2.00	32	**-26.4**	ULS 5a Ba 12	994.8	0.0	0.0	0.03		**25.1**	ULS 5a Ba 22	1276.1	0.0	0.0	0.02	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 65

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	mpression	Load Case (Compression)	Buckling	Shear (Comp)	earing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	hear (Tens)	earing (Tens)	U.C. (Tens)	Exceedance (Tens)
408		HEB160	S235		1.00	1.00	1.00	32	**-7.0**	ULS 5a Ba 1	998.4	0.0	0.0	0.01		**3.4**	ULS 1a_135	1276.1	0.0	0.0	0.00	
413		HEB160	S235	2M16-5.6t	2.00	2.00	2.00	25	**-1.0**	ULS 1a_0,9_0,9_135	1067.2	75.4	138.2	0.01		**14.2**	ULS 5a Ba 1	1296.6	75.4	124.6	0.19	
423		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	**0.0**	ULS 1a_45	24.0	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00	
424		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	**0.0**	ULS 3_90	27.5	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00	
111A		80x80x8	S235	3M24-5.6t	1.00	2.00	1.00	203	**0.0**		65.4	254.2	311.0	0.00		**137.2**	ULS 3_45	160.8	254.2	259.0	0.85	
111B		80x80x8	S235	3M20-5.6t	1.00	2.00	1.00	202	**0.0**		65.8	176.4	259.2	0.00		**121.3**	ULS 3_0	168.3	176.4	209.5	0.72	
112A		70x70x7	S235	3M20-5.6t	1.00	1.88	1.00	227	**0.0**		42.7	176.4	226.8	0.00		**96.1**	ULS 3_0	125.5	176.4	155.3	0.77	
112B		70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	232	**0.0**		41.4	176.4	226.8	0.00		**84.2**	ULS 3_0	125.5	176.4	155.3	0.67	
112C		70x70x7	S235		1.00	2.14	1.00	227	**0.0**		42.7	0.0	0.0	0.00		**92.2**	ULS 3_0	220.9	0.0	0.0	0.42	
110A		120x120x11	S235	6M24-5.6t	1.64	1.00	1.00	60	**-191.2**	ULS 5a Ba 21	508.6	508.3	855.4	0.38		**104.2**	ULS 5a Ba 21	513.2	508.3	731.1	0.20	
110B		120x120x11	S235		1.00	1.00	1.00	13	**-0.4**	ULS 1a_0,9_0,9_90	599.7	0.0	0.0	0.00		**0.4**	ULS 1a_90	599.7	0.0	0.0	0.00	
110C		120x120x11	S235		1.71	1.29	1.00	66	**-159.0**	ULS 5a Ba 21	492.8	0.0	0.0	0.32		**80.6**	ULS 5a Ba 10	599.7	0.0	0.0	0.13	
109A		150x100x14	S235	11M24-5.6t	1.00	0.52	0.52	56	**-302.9**	ULS 5a Ba 10	673.7	931.9	1995.8	0.45		**142.1**	ULS 5a Ba 21	666.7	931.9	1211.2	0.21	
109B		150x100x14	S235	6M24-5.6t	4.78	1.00	1.00	47	**-206.4**	ULS 5a Ba 10	703.8	508.3	1088.6	0.41		**119.1**	ULS 5a Ba 21	666.7	508.3	930.5	0.23	
109C		150x100x14	S235		1.00	0.52	0.52	58	**-278.3**	ULS 5a Ba 21	665.2	0.0	0.0	0.42		**130.8**	ULS 5a Ba 10	775.5	0.0	0.0	0.17	
312		70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	185	**-14.3**	ULS 3_135	41.1	58.8	64.8	0.35		**0.0**		82.9	58.8	39.3	0.00	
314		70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	148	**-15.6**	ULS 3_0	54.9	58.8	64.8	0.28		**0.0**		82.9	58.8	39.3	0.00	
317		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	154	**-2.9**	ULS 5a Ba 10	31.0	37.7	43.2	0.09		**0.0**		37.4	37.7	18.4	0.00	
319		75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	**-2.5**	ULS 1a_0	59.5	37.7	43.2	0.07		**0.0**		37.4	37.7	18.4	0.00	
322		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	53	**-1.1**	ULS 3_90	63.5	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00	
311		60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	332	**0.0**		12.1	58.8	54.0	0.00		**17.5**	ULS 3_45	54.7	58.8	37.0	0.47	
313		60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	298	**0.0**		14.4	58.8	54.0	0.00		**23.8**	ULS 3_135	54.7	58.8	37.0	0.64	
316		50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	332	**0.0**		12.6	75.4	86.4	0.00		**32.0**	ULS 3_135	52.4	75.4	44.1	0.73	
318		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	274	**0.0**		13.7	37.7	43.2	0.00		**6.4**	ULS 5a Ba 10	37.4	37.7	22.0	0.29	
321		50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	269	**0.0**		14.1	37.7	43.2	0.00		**8.9**	ULS 3_0	37.4	37.7	22.0	0.40	
315		45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	180	**-1.0**	ULS 1a_0	22.7	20.2	32.4	0.05		**0.9**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.05	
320		45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	115	**-0.9**	ULS 1a_0	38.2	20.2	32.4	0.04		**0.8**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.04	
300		70x70x7	S235	1M20-5.6t	0.53	0.53	0.53	142	**-24.3**	ULS 5a Ba 20	66.6	58.8	75.6	0.41		**22.2**	ULS 5a Ba 11	96.8	58.8	53.5	0.41	
301		70x70x7	S235	1M20-5.6t	0.54	0.54	0.54	138	**-27.0**	ULS 5a Ba 11	69.0	58.8	75.6	0.46		**29.8**	ULS 5a Ba 20	96.8	58.8	53.5	0.56	
302		70x70x7	S235	1M24-5.6t	0.54	0.54	0.54	119	**-33.6**	ULS 5a Ba 20	80.7	84.7	90.7	0.42		**30.1**	ULS 5a Ba 11	88.7	84.7	44.9	0.67	
304		60x60x5	S235	1M20-5.6t	0.53	0.53	0.53	104	**-18.0**	ULS 5a Ba 21	57.0	58.8	54.0	0.33		**17.6**	ULS 5a Ba 21	54.7	58.8	37.0	0.48	
305		60x60x5	S235	1M20-5.6t	0.54	0.54	0.54	112	**-24.9**	ULS 5a Ba 10	52.9	58.8	54.0	0.47		**24.7**	ULS 5a Ba 10	54.7	58.8	37.0	0.67	
306		75x50x5	S235	1M24-5.6t	0.55	0.55	0.55	112	**-29.5**	ULS 5a Ba 10	53.3	84.7	64.8	0.55		**29.9**	ULS 5a Ba 10	70.6	84.7	41.4	0.72	
307		75x50x7	S235	1M24-5.6t	0.54	0.54	0.54	87	**-37.7**	ULS 5a Ba 21	86.9	84.7	90.7	0.45		**36.4**	ULS 5a Ba 21	98.8	84.7	58.0	0.63	
303		HEB160	S235		2.00	2.00	2.00	50	**-26.0**	ULS 5a Ba 20	918.5	0.0	0.0	0.03		**25.4**	ULS 5a Ba 11	1276.1	0.0	0.0	0.02	
308		HEB160	S235		1.00	1.00	1.00	27	**-0.8**	ULS 1a_0,9_0,9_90	1015.5	0.0	0.0	0.00		**3.6**	ULS 1a_90	1276.1	0.0	0.0	0.00	
309		HEB160	S235		2.00	2.00	2.00	26	**-26.7**	ULS 5a Ba 10	1021.6	0.0	0.0	0.03		**24.9**	ULS 5a Ba 21	1276.1	0.0	0.0	0.02	
310		HEB160	S235		1.00	1.00	1.00	25	**-3.0**	ULS 1a_0,9_0,9_90	1025.6	0.0	0.0	0.00		**3.0**	ULS 1a_90	1276.1	0.0	0.0	0.00	

Assessment of groups for strengthened mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 65

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)
101	0	100x100x6	S235	2M16-5.6t	1.00	1.00	1.00	105	**-7.8**	ULS 5a Ba 12	142.1	75.4	103.7	0.10		**7.7**	ULS 5a Ba 12	144.1	75.4	76.8	0.10
108	0	90x90x8	S235	5M16-5.6t	1.00	1.00	1.00	146	**-42.1**	ULS 5a Ba 22	112.9	188.4	345.6	0.37		**0.0**		285.6	188.4	298.7	0.00
113A	0	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	76	**-55.3**	ULS 1a_135	251.3	338.9	414.7	0.22		**19.2**	ULS 5a Ba 22	252.5	338.9	297.7	0.08
114A	0	100x100x10	S235	4M24-5.6t	0.50	0.50	0.50	72	**-158.7**	ULS 1a_135	355.2	338.9	518.4	0.47		**106.7**	ULS 1a_0,9_0,9_135	362.9	338.9	443.1	0.31
115A	0	150x150x10	S235	6M24-5.6t	1.77	1.37	1.14	39	**-297.9**	ULS 1a_90	643.5	508.3	777.6	0.59		**183.4**	ULS 1a_0,9_0,9_90	624.7	508.3	664.6	0.36
106A	0	150x150x12	S235	8M24-5.6t	**0.97**	**0.97**	**0.62**	34	**-551.3**	ULS 1a_135	780.4	677.8	1244.2	0.81		**411.7**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.61
106C	0	150x150x12	S235		**1.97**	**1.62**	**1.39**	70	**-628.9**	ULS 1a_135	656.3	0.0	0.0	0.96		**485.4**	ULS 1a_0,9_0,9_135	817.8	0.0	0.0	0.59
107A	0	150x150x12	S235	8M24-5.6t	0.33	0.33	0.33	49	**-580.0**	ULS 1a_135	735.4	677.8	1244.2	0.86		**454.9**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.67
201L	0	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	127	**-24.6**	ULS 5a Ba 22	75.8	84.7	90.7	0.32		**18.3**	ULS 5a Ba 22	88.7	84.7	64.2	0.28
202T	0	50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	178	**-10.7**	ULS 5a Ba 22	25.7	37.7	43.2	0.42		**5.5**	ULS 5a Ba 22	37.4	37.7	22.0	0.25
203L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	93	**-108.6**	ULS 5a Ba 12	207.7	169.4	207.4	0.64		**116.7**	ULS 5a Ba 22	181.4	169.4	177.2	0.69
204T	0	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	93	**-123.1**	ULS 5a Ba 12	256.2	254.2	388.8	0.48		**122.1**	ULS 5a Ba 22	261.1	254.2	332.3	0.48
205L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	99	**-105.6**	ULS 5a Ba 22	198.3	169.4	207.4	0.62		**97.2**	ULS 5a Ba 12	181.4	169.4	177.2	0.57
206T	0	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	99	**-109.9**	ULS 5a Ba 22	244.6	254.2	388.8	0.45		**110.5**	ULS 5a Ba 12	261.1	254.2	332.3	0.43
207L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	103	**-86.9**	ULS 5a Ba 12	190.8	169.4	207.4	0.51		**94.4**	ULS 5a Ba 22	181.4	169.4	177.2	0.56
208T	0	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	104	**-99.2**	ULS 5a Ba 12	235.3	169.4	259.2	0.59		**98.0**	ULS 5a Ba 22	224.3	169.4	221.5	0.58
209L	0	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	112	**-94.6**	ULS 5a Ba 12	177.9	169.4	207.4	0.56		**95.0**	ULS 5a Ba 22	181.4	169.4	177.2	0.56
210T	0	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	112	**-101.1**	ULS 5a Ba 12	219.3	169.4	259.2	0.60		**80.3**	ULS 5a Ba 22	224.3	169.4	221.5	0.47
211L	0	100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	76	**-94.8**	ULS 5a Ba 21	197.1	169.4	207.4	0.56		**89.1**	ULS 5a Ba 21	125.9	169.4	116.0	0.77
212T	0	100x75x9	S235	2M24-5.6t	1.00	0.55	0.55	65	**-96.1**	ULS 5a Ba 10	245.9	169.4	233.3	0.57		**93.0**	ULS 5a Ba 10	121.3	169.4	130.6	0.77
213L	0	100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	85	**-77.5**	ULS 5a Ba 21	161.2	169.4	181.4	0.48		**81.3**	ULS 5a Ba 21	98.2	169.4	101.5	0.83
214T	0	100x75x9	S235	2M24-5.6t	0.52	0.25	0.25	74	**-96.3**	ULS 5a Ba 10	221.2	169.4	233.3	0.57		**99.3**	ULS 5a Ba 10	119.9	169.4	130.6	0.83
215L	0	100x75x7	S235	2M24-5.6t	0.52	0.25	0.25	101	**-74.0**	ULS 5a Ba 21	141.1	169.4	181.4	0.52		**69.9**	ULS 5a Ba 21	100.4	169.4	101.5	0.70
216T	0	100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	86	**-90.6**	ULS 5a Ba 10	182.6	169.4	207.4	0.53		**87.2**	ULS 5a Ba 21	110.7	169.4	116.0	0.79
217L	0	100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	112	**-59.4**	ULS 5a Ba 21	129.0	117.6	151.2	0.51		**62.0**	ULS 5a Ba 21	115.4	117.6	106.9	0.58
218T	0	100x75x8	S235	2M24-5.6t	0.52	0.25	0.25	102	**-80.2**	ULS 5a Ba 21	159.3	169.4	207.4	0.50		**82.9**	ULS 5a Ba 10	113.2	169.4	116.0	0.73
219L	0	100x75x8	S235	2M20-5.6t	0.52	0.25	0.25	123	**-53.2**	ULS 5a Ba 21	133.9	117.6	172.8	0.45		**50.2**	ULS 5a Ba 21	128.6	117.6	104.7	0.48
220T	0	100x75x9	S235	2M20-5.6t	0.52	0.25	0.25	117	**-72.5**	ULS 5a Ba 10	155.5	117.6	194.4	0.62		**69.1**	ULS 5a Ba 21	146.1	117.6	137.5	0.59
221L	0	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	**-68.6**	ULS 5a Ba 10	147.8	117.6	172.8	0.58		**57.1**	ULS 5a Ba 21	113.0	117.6	136.1	0.51
222T	0	100x75x7	S235	2M20-5.6t	0.52	0.25	0.25	113	**-53.4**	ULS 5a Ba 21	127.3	117.6	151.2	0.45		**55.7**	ULS 5a Ba 10	107.3	117.6	91.6	0.61
223L	0	100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	**-71.7**	ULS 5a Ba 10	144.3	117.6	151.2	0.61		**57.6**	ULS 5a Ba 21	119.5	117.6	122.2	0.49
224T	0	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	124	**-82.1**	ULS 1a_90	147.8	117.6	172.8	0.70		**68.3**	ULS 1a_0,9_0,9_90	113.0	117.6	136.1	0.60
226T	0	100x75x7	S235	2M20-5.6t	0.33	0.20	0.20	105	**-82.1**	ULS 1a_90	144.3	117.6	151.2	0.70		**65.7**	ULS 1a_0,9_0,9_90	119.5	117.6	122.2	0.56
227T	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	206	**-2.1**	ULS 6a_90 Ba Ct2	21.0	37.7	43.2	0.10		**0.1**	ULS 5a Ba 22	37.4	37.7	22.0	0.00
228L	0	80x80x8	S235	4M20-5.6t	1.00	1.00	1.00	128	**0.0**		122.6	235.2	345.6	0.00		**120.7**	ULS 3_0	168.3	235.2	244.4	0.72
229	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	225	**-0.3**	ULS 3_0	18.5	37.7	43.2	0.02		**0.0**		37.4	37.7	25.7	0.00
230	0	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	99	**-76.2**	ULS 5a Ba 12	156.9	169.4	207.4	0.49		**76.1**	ULS 5a Ba 12	206.0	169.4	159.5	0.48
231T	0	100x75x7	S235	3M24-5.6t	2.00	1.00	1.00	69	**-48.9**	ULS 5a Ba 22	182.6	254.2	272.2	0.27		**64.5**	ULS 5a Ba 22	214.1	254.2	217.6	0.30
232	0	150x100x12	S235	8M24-5.6t	2.00	1.00	1.00	51	**-250.2**	ULS 5a Ba 22	512.4	677.8	1244.2	0.49		**93.6**	ULS 5a Ba 22	582.2	677.8	755.0	0.16
233T	0	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	203	**-28.8**	ULS 1a_0,9_0,9_90	36.2	58.8	64.8	0.80		**39.9**	ULS 1a_90	82.9	58.8	52.4	0.76
234L	0	80x80x8	S235	3M24-5.6t	1.00	1.00	1.00	178	**0.0**		82.2	254.2	311.0	0.00		**147.6**	ULS 3_0	169.8	254.2	239.3	0.87
235	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	**-0.6**	ULS 3_90	11.3	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00
236	0	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	**-75.6**	ULS 5a Ba 10	182.9	169.4	207.4	0.45		**75.8**	ULS 5a Ba 10	208.1	169.4	177.2	0.45
237T	0	100x75x7	S235	4M24-5.6t	1.00	1.00	1.00	94	**-42.5**	ULS 5a Ba 22	157.6	338.9	362.9	0.27		**69.2**	ULS 5a Ba 12	214.1	338.9	290.1	0.32
238	0	150x100x14	S235	11M24-5.6t	2.00	1.00	1.00	70	**-249.9**	ULS 5a Ba 10	526.8	931.9	1995.8	0.47		**71.3**	ULS 5a Ba 10	666.7	931.9	1211.2	0.11
239	0	100x50x6	S235	1M16-5.6t	0.50	0.50	0.50	327	**-0.4**	ULS 1a_90	18.6	37.7	51.8	0.02		**0.0**		55.3	37.7	28.0	0.00
240	0	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	272	**-1.2**	ULS 1a_45	14.1	37.7	43.2	0.08		**2.1**	ULS 1a_0,9_0,9_135	60.5	37.7	26.7	0.08
241T	0	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	**-2.7**	ULS 1a_135	28.9	37.7	51.8	0.09		**1.0**	ULS 1a_0,9_0,9_0	89.9	37.7	38.4	0.03
251L	0	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	255	**-2.9**	ULS 1a_90	28.9	37.7	51.8	0.10		**0.7**	ULS 1a_0,9_135	89.9	37.7	38.4	0.02
113B	0	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	79	**-113.5**	ULS 1a_135	245.5	338.9	414.7	0.46		**64.9**	ULS 1a_0,9_0,9_135	252.5	338.9	354.5	0.26
114B	0	100x100x10	S235	6M24-5.6t	0.50	0.50	0.50	78	**-192.3**	ULS 1a_135	340.4	508.3	777.6	0.56		**103.6**	ULS 1a_0,9_0,9_135	362.9	508.3	651.3	0.29
115B	0	150x150x10	S235	8M24-5.6t	**1.87**	**1.87**	**1.20**	27	**-542.7**	ULS 1a_90	673.5	677.8	1036.8	0.81		**403.7**	ULS 1a_0,9_0,9_90	624.7	677.8	886.2	0.65
115C	0	150x150x10	S235		1.70	1.70	1.42	80	**-485.2**	ULS 1a_135	514.8	0.0	0.0	0.94		**351.1**	ULS 1a_0,9_0,9_135	688.6	0.0	0.0	0.51
106B	0	150x150x12	S235	8M24-5.6t	0.76	1.28	0.63	60	**-630.6**	ULS 1a_135	696.2	677.8	1244.2	0.93		**484.2**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.71
107B	0	150x150x12	S235	8M24-5.6t	0.20	0.20	0.20	48	**-582.6**	ULS 1a_135	736.7	677.8	1244.2	0.86		**452.3**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.67
102A	0	150x150x12	S235	8M24-5.6t	1.00	1.50	1.00	61	**-303.4**	ULS 5a Ba 12	689.3	677.8	1244.2	0.45		**171.4**	ULS 5a Ba 22	740.3	677.8	755.0	0.25
102B	0	150x150x12	S235	6M24-5.6t	2.52	1.61	1.00	63	**-143.6**	ULS 5a Ba 12	682.7	508.3	933.1	0.28		**36.3**	ULS 5a Ba 22	740.3	508.3	797.5	0.07
102C	0	150x150x12	S235		3.01	2.00	1.00	59	**-275.1**	ULS 5a Ba 12	698.8	0.0	0.0	0.39		**148.5**	ULS 5a Ba 22	817.8	0.0	0.0	0.18
103A	0	120x120x8	S235	6M24-5.6t	2.64	4.00	1.00	76	**-132.8**	ULS 5a Ba 12	340.1	508.3	622.1	0.39		**47.2**	ULS 5a Ba 22	379.5	508.3	531.7	0.12
103B	0	120x120x8	S235	2M16-5.6t	2.00	4.44	2.00	108	**-31.4**	ULS 3_90	249.9	75.4	138.2	0.42		**0.0**		316.6	75.4	138.2	0.00
103C	0	120x120x8	S235		1.71	1.00	1.00	76	**-95.4**	ULS 5a Ba 1	340.3	0.0	0.0	0.28		**21.2**	ULS 5a Ba 1	441.8	0.0	0.0	0.05
104A	0	100x65x7*	S235	4M20-5.6t	1.00	1.00	1.00	202	**0.0**		63.1	235.2	302.4	0.00		**112.3**	ULS 3_0	115.2	235.2	207.0	0.98
104B	0	100x65x7*	S235	3M20-5.6t	1.00	1.00	1.00	209	**0.0**		60.1	176.4	226.8	0.00		**77.7**	ULS 3_0	137.8	176.4	155.3	0.56
104C	0	100x65x7*	S235		1.00	1.00	1.00	194	**0.0**		66.4	0.0	0.0	0.00		**99.2**	ULS 3_0	263.2	0.0	0.0	0.38
105A	0	60x60x5	S235	2M16-5.6t	1.00	2.43	1.00	380	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ba Ct1	98.8	75.4	56.0	0.55
105B	0	60x60x5	S235	2M16-5.6t	1.00	1.70	1.00	379	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ba Ct1	65.9	75.4	56.0	0.55
415	0	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	180	**-8.7**	ULS 3_0	30.7	37.7	43.2	0.28		**0.0**		60.5	37.7	26.7	0.00
417	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	170	**-9.5**	ULS 3_0	27.4	37.7	43.2	0.35		**0.0**		37.4	37.7	18.4	0.00
419	0	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	107	**-11.9**	ULS 3_0	55.1	37.7	43.2	0.32		**0.0**		37.4	37.7	22.0	0.00
422	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	**-0.5**	ULS 6a_90 Ba Ct1	58.8	37.7	43.2	0.01		**0.0**		37.4	37.7	18.4	0.00
414	0	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	325	**0.0**		12.6	37.7	43.2	0.00		**13.7**	ULS 3_0	60.5	37.7	32.0	0.43
416	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	353	**0.0**		9.1	37.7	43.2	0.00		**16.9**	ULS 3_0	37.4	37.7	22.0	0.77
418	0	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	344	**0.0**		11.9	75.4	86.4	0.00		**26.0**	ULS 3_0	56.2	75.4	44.1	0.59
421	0	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	259	**0.0**		26.8	117.6	129.6	0.00		**50.5**	ULS 3_135	77.4	117.6	88.7	0.65
420	0	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	111	**-1.2**	ULS 1a_0,9_0,9_0	39.6	20.2	32.4	0.06		**1.2**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.06
400	0	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	124	**-20.9**	ULS 5a Ba 22	48.1	58.8	54.0	0.43		**19.4**	ULS 5a Ba 12	54.7	58.8	37.0	0.52
401	0	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	119	**-23.1**	ULS 5a Ba 12	50.2	58.8	54.0	0.46		**23.8**	ULS 5a Ba 22	54.7	58.8	37.0	0.64
402	0	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	114	**-25.9**	ULS 5a Ba 22	52.1	58.8	54.0	0.50		**25.5**	ULS 5a Ba 12	54.7	58.8	37.0	0.69
403	0	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	108	**-29.6**	ULS 5a Ba 12	65.2	58.8	64.8	0.50		**28.8**	ULS 5a Ba 22	65.7	58.8	44.4	0.65
404	0	70x70x6	S235	1M24-5.6t	0.53	0.53	0.53	93	**-32.0**	ULS 5a Ba 22	86.5	84.7	77.8	0.41		**34.1**	ULS 5a Ba 12	76.0	84.7	44.0	0.78
405	0	75x50x7	S235	1M24-5.6t	0.53	0.53	0.53	107	**-41.9**	ULS 5a Ba 12	76.2	84.7	90.7	0.55		**38.4**	ULS 5a Ba 22	98.8	84.7	58.0	0.66

Assessment of groups for strengthened mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 65

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)
409	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	142	**-4.1**	ULS 1a_135	37.9	37.7	43.2	0.11		**16.3**	ULS 5a Ba 1	53.3	37.7	32.0	0.51
410	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	140	**-16.7**	ULS 5a Ba 1	38.5	37.7	43.2	0.44		**3.2**	ULS 1a_135	53.3	37.7	32.0	0.10
411	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	135	**-2.3**	ULS 1a_135	40.2	37.7	43.2	0.06		**17.1**	ULS 5a Ba 1	53.3	37.7	32.0	0.53
412	0	55x55x5	S235	1M16-5.6t	1.00	1.00	1.00	129	**-17.7**	ULS 5a Ba 1	42.0	37.7	43.2	0.47		**1.8**	ULS 1a_0,9_0,9_135	53.3	37.7	32.0	0.06
406	0	HEB160	S235		1.00	1.00	1.00	33	**-1.6**	ULS 1a_0,9_0,9_90	991.1	0.0	0.0	0.00		**5.6**	ULS 1a_90	1276.1	0.0	0.0	0.00
407	0	HEB160	S235		2.00	2.00	2.00	32	**-26.4**	ULS 5a Ba 12	994.8	0.0	0.0	0.03		**25.1**	ULS 5a Ba 22	1276.1	0.0	0.0	0.02
408	0	HEB160	S235		1.00	1.00	1.00	32	**-7.0**	ULS 5a Ba 1	998.4	0.0	0.0	0.01		**3.4**	ULS 1a_135	1276.1	0.0	0.0	0.00
413	0	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	25	**-1.0**	ULS 1a_0,9_0,9_135	1067.2	75.4	138.2	0.01		**14.2**	ULS 5a Ba 1	1296.6	75.4	124.6	0.19
423	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	**0.0**	ULS 1a_45	24.0	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00
424	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	169	**0.0**	ULS 3_90	27.5	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00
111A	0	80x80x8	S235	3M24-5.6t	1.00	2.00	1.00	203	**0.0**		65.4	254.2	311.0	0.00		**137.2**	ULS 3_45	160.8	254.2	259.0	0.85
111B	0	80x80x8	S235	3M20-5.6t	1.00	2.00	1.00	202	**0.0**		65.8	176.4	259.2	0.00		**121.3**	ULS 3_0	168.3	176.4	209.5	0.72
112A	0	70x70x7	S235	3M20-5.6t	1.00	1.88	1.00	227	**0.0**		42.7	176.4	226.8	0.00		**96.1**	ULS 3_0	125.5	176.4	155.3	0.77
112B	0	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	232	**0.0**		41.4	176.4	226.8	0.00		**84.2**	ULS 3_0	125.5	176.4	155.3	0.67
112C	0	70x70x7	S235		1.00	2.14	1.00	227	**0.0**		42.7	0.0	0.0	0.00		**92.2**	ULS 3_0	220.9	0.0	0.0	0.42
110A	0	120x120x11	S235	6M24-5.6t	1.64	1.00	1.00	60	**-191.2**	ULS 5a Ba 21	508.6	508.3	855.4	0.38		**104.2**	ULS 5a Ba 21	513.2	508.3	731.1	0.20
110B	0	120x120x11	S235		1.00	1.00	1.00	13	**-0.4**	ULS 1a_0,9_0,9_90	599.7	0.0	0.0	0.00		**0.4**	ULS 1a_90	599.7	0.0	0.0	0.00
110C	0	120x120x11	S235		1.71	1.29	1.00	66	**-159.0**	ULS 5a Ba 21	492.8	0.0	0.0	0.32		**80.6**	ULS 5a Ba 10	599.7	0.0	0.0	0.13
109A	0	150x100x14	S235	11M24-5.6t	1.00	0.52	0.52	56	**-302.9**	ULS 5a Ba 10	673.7	931.9	1995.8	0.45		**142.1**	ULS 5a Ba 21	666.7	931.9	1211.2	0.21
109B	0	150x100x14	S235	6M24-5.6t	4.78	1.00	1.00	47	**-206.4**	ULS 5a Ba 10	703.8	508.3	1088.6	0.41		**119.1**	ULS 5a Ba 21	666.7	508.3	930.5	0.23
109C	0	150x100x14	S235		1.00	0.52	0.52	58	**-278.3**	ULS 5a Ba 21	665.2	0.0	0.0	0.42		**130.8**	ULS 5a Ba 10	775.5	0.0	0.0	0.17
312	0	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	185	**-14.3**	ULS 3_135	41.1	58.8	64.8	0.35		**0.0**		82.9	58.8	39.3	0.00
314	0	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	148	**-15.6**	ULS 3_0	54.9	58.8	64.8	0.28		**0.0**		82.9	58.8	39.3	0.00
317	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	154	**-2.9**	ULS 5a Ba 10	31.0	37.7	43.2	0.09		**0.0**		37.4	37.7	18.4	0.00
319	0	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	**-2.5**	ULS 1a_0	59.5	37.7	43.2	0.07		**0.0**		37.4	37.7	18.4	0.00
322	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	53	**-1.1**	ULS 3_90	63.5	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00
311	0	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	332	**0.0**		12.1	58.8	54.0	0.00		**17.5**	ULS 3_45	54.7	58.8	37.0	0.47
313	0	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	298	**0.0**		14.4	58.8	54.0	0.00		**23.8**	ULS 3_135	54.7	58.8	37.0	0.64
316	0	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	332	**0.0**		12.6	75.4	86.4	0.00		**32.0**	ULS 3_135	52.4	75.4	44.1	0.73
318	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	274	**0.0**		13.7	37.7	43.2	0.00		**6.4**	ULS 5a Ba 10	37.4	37.7	22.0	0.29
321	0	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	269	**0.0**		14.1	37.7	43.2	0.00		**8.9**	ULS 3_0	37.4	37.7	22.0	0.40
315	0	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	180	**-1.0**	ULS 1a_0	22.7	20.2	32.4	0.05		**0.9**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.05
320	0	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	115	**-0.9**	ULS 1a_0	38.2	20.2	32.4	0.04		**0.8**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.04
300	0	70x70x7	S235	1M20-5.6t	0.53	0.53	0.53	142	**-24.3**	ULS 5a Ba 20	66.6	58.8	75.6	0.41		**22.2**	ULS 5a Ba 11	96.8	58.8	53.5	0.41
301	0	70x70x7	S235	1M20-5.6t	0.54	0.54	0.54	138	**-27.0**	ULS 5a Ba 11	69.0	58.8	75.6	0.46		**29.8**	ULS 5a Ba 20	96.8	58.8	53.5	0.56
302	0	70x70x7	S235	1M24-5.6t	0.54	0.54	0.54	119	**-33.6**	ULS 5a Ba 20	80.7	84.7	90.7	0.42		**30.1**	ULS 5a Ba 11	88.7	84.7	44.9	0.67
304	0	60x60x5	S235	1M20-5.6t	0.53	0.53	0.53	104	**-18.0**	ULS 5a Ba 21	57.0	58.8	54.0	0.33		**17.6**	ULS 5a Ba 21	54.7	58.8	37.0	0.48
305	0	60x60x5	S235	1M20-5.6t	0.54	0.54	0.54	112	**-24.9**	ULS 5a Ba 10	52.9	58.8	54.0	0.47		**24.7**	ULS 5a Ba 10	54.7	58.8	37.0	0.67
306	0	75x50x5	S235	1M24-5.6t	0.55	0.55	0.55	112	**-29.5**	ULS 5a Ba 10	53.3	84.7	64.8	0.55		**29.9**	ULS 5a Ba 10	70.6	84.7	41.4	0.72
307	0	75x50x7	S235	1M24-5.6t	0.54	0.54	0.54	87	**-37.7**	ULS 5a Ba 21	86.9	84.7	90.7	0.45		**36.4**	ULS 5a Ba 21	98.8	84.7	58.0	0.63
303	0	HEB160	S235		2.00	2.00	2.00	50	**-26.0**	ULS 5a Ba 20	918.5	0.0	0.0	0.03		**25.4**	ULS 5a Ba 11	1276.1	0.0	0.0	0.02
308	0	HEB160	S235		1.00	1.00	1.00	27	**-0.8**	ULS 1a_0,9_0,9_90	1015.5	0.0	0.0	0.00		**3.6**	ULS 1a_90	1276.1	0.0	0.0	0.00
309	0	HEB160	S235		2.00	2.00	2.00	26	**-26.7**	ULS 5a Ba 10	1021.6	0.0	0.0	0.03		**24.9**	ULS 5a Ba 21	1276.1	0.0	0.0	0.02
310	0	HEB160	S235		1.00	1.00	1.00	25	**-3.0**	ULS 1a_0,9_0,9_90	1025.6	0.0	0.0	0.00		**3.0**	ULS 1a_90	1276.1	0.0	0.0	0.00

DNV·GL

Assessment of groups for strengthened mast (verbouw level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+0
Mast 65

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	ımpression	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)
106A		150x150x12	S235	8M24-5.6t	**0.97**	**0.97**	**0.62**	34	**-679.9**	ULS 1a_135	780.4	677.8	1244.2	1.00		**531.9**	ULS 1a_0,9_0,9_135	740.3	677.8	1063.4	0.78
106C		150x150x12	S235		**1.97**	**1.62**	**1.39**	70	**-776.3**	ULS 1a_135	656.3	0.0	0.0	1.18		**625.4**	ULS 1a_0,9_0,9_135	817.8	0.0	0.0	0.76
115B		150x150x10	S235	8M24-5.6t	**1.87**	**1.87**	**1.20**	27	**-669.0**	ULS 1a_90	673.5	677.8	1036.8	0.99		**522.9**	ULS 1a_0,9_0,9_90	624.7	677.8	886.2	0.84

Redundants (knikverkorters) have been added to groups 106A, 106C and 115B. The redundants are checked separately in Appendix C.
The exceeding of compression strength is not relevant, since the main leg itself does not need to be checked for verbouw level.

APPENDIX C REDUNDANT MEMBERS CHECK

DNV·GL

Knikverkorters initial construction (afkeur)

Date: 2020-12-01
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+0
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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
14	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	0.59	0	68	**7.4**	**0.15**	53.2	20.2	27.7	38.9	0.57	0.37	
3020	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.47	75	169	**7.4**	**0.00**	24.7	20.2	27.7	38.9	0.57	0.37	
3012	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.29	0	148	**7.4**	**0.32**	29.1	20.2	27.7	38.9	0.57	0.56	
19	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.78	53	204	**7.4**	**0.00**	19.0	20.2	27.7	38.9	0.57	0.39	
11	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.99	0	229	**7.4**	**0.50**	16.2	20.2	27.7	38.9	0.57	0.87	
33	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	2.28	38	262	**7.4**	**0.00**	13.1	20.2	27.7	38.9	0.57	0.56	
10	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.69	0	276	**7.4**	**0.67**	13.5	20.2	27.7	44.6	0.72	0.94	
17	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.86	30	294	**7.4**	**0.62**	12.2	20.2	27.7	44.6	0.72	0.86	
16	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.75	29	283	**7.4**	**0.60**	13.0	20.2	27.7	44.6	0.72	0.84	
8	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.22	0	228	**7.4**	**0.56**	18.1	20.2	27.7	44.6	0.72	0.77	
15	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.89	48	217	**7.4**	**0.00**	17.4	20.2	27.7	38.9	0.57	0.42	
7	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.06	0	122	**7.4**	**0.27**	36.2	20.2	27.7	38.9	0.57	0.46	
26	Pootverband	Enkele staaf	L45.5	S235	M12	5.6	1.57	0	180	**1.5**	**0.39**	22.6	20.2	27.7	38.9	0.57	0.69	
24	Pootverband	Enkele staaf	L45.5	S235	M12	5.6	2.77	75	318	**1.5**	**0.00**	9.7	20.2	27.7	38.9	0.57	0.15	
25	Pootverband	Kniksteun en verticale steun	L45.5	S235	M12	5.6	3.21	0	238	**1.5**	**0.40**	12.6	20.2	27.7	38.9	0.42	0.98	
23	Pootverband	Enkele staaf	L50.5	S235	M12	5.6	3.00	59	308	**1.5**	**0.00**	11.3	20.2	27.7	44.6	0.72	0.13	
28	Tussenschot	Kniksteun en verticale steun	L60.5	S235	M12	5.6	4.83	0	264	**0.3**	**0.60**	14.8	20.2	27.7	67.7	0.81	0.78	
27	Tussenschot	Kruisende staaf halverwege	L100.50.6	S235	M12	5.6	7.00	0	329	**0.3**	**0.88**	18.5	20.2	33.2	53.6	3.24	0.27	
50	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.24	0	142	**7.2**	**0.31**	30.5	20.2	27.7	38.9	0.57	0.54	
47	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.83	49	210	**7.2**	**0.00**	18.3	20.2	27.7	38.9	0.57	0.39	
49	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.64	0	303	**7.2**	**0.66**	10.4	20.2	27.7	38.9	0.57	1.15	Bending
46	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.79	40	205	**7.2**	**0.00**	18.9	20.2	27.7	38.9	0.57	0.38	
45	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.66	51	191	**7.2**	**0.00**	21.0	20.2	27.7	38.9	0.57	0.36	
48	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.32	0	266	**7.2**	**0.58**	12.8	20.2	27.7	38.9	0.57	1.01	Bending
44	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.60	41	184	**7.2**	0.30	22.1	20.2	27.7	38.9	0.57	0.53	
270	1e tussenstul	Kruisende staaf halverwege	L100.50.6	S235	M12	5.6	7.00	0	329	**7.2**	0.88	18.5	20.2	33.2	53.6	3.24	0.39	
58	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.67	43	192	**7.2**	0.31	20.8	20.2	27.7	38.9	0.57	0.53	
60	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.67	0	307	**7.2**	0.67	10.2	20.2	27.7	38.9	0.57	1.17	Bending
57	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.67	35	192	**7.2**	0.34	20.8	20.2	27.7	38.9	0.57	0.60	
56	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.71	51	196	**7.2**	0.27	20.1	20.2	27.7	38.9	0.57	0.47	
59	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.37	0	272	**7.2**	0.59	12.4	20.2	27.7	38.9	0.57	1.04	Bending
55	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.65	42	190	**7.2**	0.31	21.1	20.2	27.7	38.9	0.57	0.54	
80	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.49	52	171	**6.4**	0.23	24.3	20.2	27.7	38.9	0.57	0.40	
83	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.02	0	232	**6.4**	0.51	15.8	20.2	27.7	38.9	0.57	0.88	
79	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.42	42	163	**6.4**	0.26	25.8	20.2	27.7	38.9	0.57	0.46	
78	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.25	51	144	**6.4**	0.20	30.2	20.2	27.7	38.9	0.57	0.35	
82	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.76	0	202	**6.4**	0.44	19.3	20.2	27.7	38.9	0.57	0.77	
77	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.19	41	137	**6.4**	0.22	32.0	20.2	27.7	38.9	0.57	0.39	
76	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.13	53	130	**6.4**	0.17	33.9	20.2	27.7	38.9	0.57	0.32	
81	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.53	0	176	**6.4**	0.38	23.4	20.2	27.7	38.9	0.57	0.67	
75	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.06	43	122	**6.4**	0.19	36.2	20.2	27.7	38.9	0.57	0.34	
96	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.50	52	172	**6.4**	0.23	24.0	20.2	27.7	38.9	0.57	0.40	
99	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.06	0	237	**6.4**	**0.52**	15.3	20.2	27.7	38.9	0.57	0.90	
95	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.43	42	164	**6.4**	**0.00**	25.6	20.2	27.7	38.9	0.57	0.32	
94	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.26	50	145	**6.4**	**0.00**	29.9	20.2	27.7	38.9	0.57	0.32	
98	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.80	0	207	**6.4**	**0.45**	18.7	20.2	27.7	38.9	0.57	0.79	
93	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.21	40	139	**6.4**	**0.00**	31.4	20.2	27.7	38.9	0.57	0.32	
92	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.05	46	120	**6.4**	**0.00**	36.8	20.2	27.7	38.9	0.57	0.32	
97	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.60	0	183	**6.4**	**0.40**	22.1	20.2	27.7	38.9	0.57	0.70	
91	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.01	37	116	**6.4**	**0.00**	38.0	20.2	27.7	38.9	0.57	0.32	
90	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	0.96	42	110	**6.4**	**0.00**	39.9	20.2	27.7	38.9	0.57	0.32	

Knikverkorters adjusted construction (verbouw)

Date:	2020-12-01
Author:	Muhammed Khan
Version:	1.8

KIJ-GT

S+0

39

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
49	1e tussenstul	Enkele staaf	**L55.6**	**S355**	M12	**8.8**	2.64	0	246	**7.2**	**0.86**	23.1	32.3	45.2	134.1	1.56	0.55		Profile exchanged
48	1e tussenstul	Enkele staaf	**L50.5**	**S355**	M12	**8.8**	2.32	0	238	**7.2**	**0.75**	18.6	32.3	37.7	92.1	1.08	0.70		Profile exchanged
60	1e tussenstul	Enkele staaf	**L55.6**	**S355**	M12	**8.8**	2.67	0	249	**7.2**	**0.87**	22.7	32.3	45.2	134.1	1.56	0.56		Profile exchanged
59	1e tussenstul	Enkele staaf	**L50.5**	**S355**	M12	**8.8**	2.37	0	244	**7.2**	**0.8**	18.0	32.3	37.7	92.1	1.1	0.71		Profile exchanged
5000	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.22	0	125	**7.2**	**0.4**	46.7	60.3	43.6	51.0	1.1	0.37		Profile added
5001	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.32	0	136	**7.2**	**0.43**	42.3	60.3	43.6	51.0	1.08	0.40		Profile added
5002	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.17	0	120	**7.2**	**0.38**	49.2	60.3	43.6	51.0	1.08	0.35		Profile added
5005	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.43	0	147	**7.2**	**0.46**	38.1	60.3	43.6	51.0	1.08	0.43		Profile added
5006	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.43	0	147	**7.2**	**0.46**	38.1	60.3	43.6	51.0	1.08	0.43		Profile added
5007	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.27	0	130	**7.2**	**0.41**	44.4	60.3	43.6	51.0	1.08	0.38		Profile added
5008	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.27	0	130	**7.2**	**0.41**	44.4	60.3	43.6	51.0	1.08	0.38		Profile added
5003	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.22	0	125	**6.4**	**0.40**	46.7	60.3	43.6	51.0	1.08	0.37		Profile added
5004	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.10	0	113	**6.4**	**0.36**	52.9	60.3	43.6	51.0	1.08	0.33		Profile added
5009	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.12	0	115	**6.4**	**0.36**	51.8	60.3	43.6	51.0	1.08	0.34		Profile added
5010	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.12	0	115	**6.4**	0.36	51.8	60.3	43.6	51.0	1.08	0.34		Profile added

Comment

1) Pos numbers 5000 to 5010 are new added redundants

Knikverkorters initial construction (afkeur)

Date: 2020-12-01
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+0
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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
14	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	0.59	0	68	7.4	0.15	53.2	20.2	27.7	38.9	0.57	0.37	
3020	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.47	75	169	7.4	0.00	24.7	20.2	27.7	38.9	0.57	0.37	
3012	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.29	0	148	7.4	0.32	29.1	20.2	27.7	38.9	0.57	0.56	
19	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.78	53	204	7.4	0.00	19.0	20.2	27.7	38.9	0.57	0.39	
11	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.99	0	229	7.4	0.50	16.2	20.2	27.7	38.9	0.57	0.87	
33	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	2.28	38	262	7.4	0.00	13.1	20.2	27.7	38.9	0.57	0.56	
10	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.69	0	276	7.4	0.67	13.5	20.2	27.7	44.6	0.72	0.94	
17	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.86	30	294	7.4	0.62	12.2	20.2	27.7	44.6	0.72	0.86	
16	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.75	29	283	7.4	0.60	13.0	20.2	27.7	44.6	0.72	0.84	
8	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.22	0	228	7.4	0.56	18.1	20.2	27.7	44.6	0.72	0.77	
15	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.89	48	217	7.4	0.00	17.4	20.2	27.7	38.9	0.57	0.42	
7	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.06	0	122	7.4	0.27	36.2	20.2	27.7	38.9	0.57	0.46	
26	Pootverband	Enkele staaf	L45.5	S235	M12	5.6	1.57	0	180	1.5	0.39	22.6	20.2	27.7	38.9	0.57	0.69	
24	Pootverband	Enkele staaf	L45.5	S235	M12	5.6	2.77	75	318	1.5	0.00	9.7	20.2	27.7	38.9	0.57	0.15	
25	Pootverband	Kniksteun en verticale steun	L45.5	S235	M12	5.6	3.21	0	238	1.5	0.40	12.6	20.2	27.7	38.9	0.42	0.98	
23	Pootverband	Enkele staaf	L50.5	S235	M12	5.6	3.00	59	308	1.5	0.00	11.3	20.2	27.7	44.6	0.72	0.13	
28	Tussenschot	Kniksteun en verticale steun	L60.5	S235	M12	5.6	4.83	0	264	0.3	0.60	14.8	20.2	27.7	67.7	0.81	0.78	
27	Tussenschot	Kruisende staaf halverwege	L100.50.6	S235	M12	5.6	7.00	0	329	0.3	0.88	18.5	20.2	33.2	53.6	3.24	0.27	
50	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.24	0	142	7.2	0.31	30.5	20.2	27.7	38.9	0.57	0.54	
47	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.83	49	210	7.2	0.00	18.3	20.2	27.7	38.9	0.57	0.39	
49	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.64	0	303	7.2	0.66	10.4	20.2	27.7	38.9	0.57	1.15	Bending
46	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.79	40	205	7.2	0.00	18.9	20.2	27.7	38.9	0.57	0.38	
45	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.66	51	191	7.2	0.00	21.0	20.2	27.7	38.9	0.57	0.36	
48	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.32	0	266	7.2	0.58	12.8	20.2	27.7	38.9	0.57	1.01	Bending
44	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.60	41	184	7.2	0.30	22.1	20.2	27.7	38.9	0.57	0.53	
270	1e tussenstul	Kruisende staaf halverwege	L100.50.6	S235	M12	5.6	7.00	0	329	7.2	0.88	18.5	20.2	33.2	53.6	3.24	0.39	
58	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.67	43	192	7.2	0.31	20.8	20.2	27.7	38.9	0.57	0.53	
60	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.67	0	307	7.2	0.67	10.2	20.2	27.7	38.9	0.57	1.17	Bending
57	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.67	35	192	7.2	0.34	20.8	20.2	27.7	38.9	0.57	0.60	
56	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.71	51	196	7.2	0.27	20.1	20.2	27.7	38.9	0.57	0.47	
59	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.37	0	272	7.2	0.59	12.4	20.2	27.7	38.9	0.57	1.04	Bending
55	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.65	42	190	7.2	0.31	21.1	20.2	27.7	38.9	0.57	0.54	
80	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.49	52	171	6.4	0.23	24.3	20.2	27.7	38.9	0.57	0.40	
83	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.02	0	232	6.4	0.51	15.8	20.2	27.7	38.9	0.57	0.88	
79	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.42	42	163	6.4	0.26	25.8	20.2	27.7	38.9	0.57	0.46	
78	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.25	51	144	6.4	0.20	30.2	20.2	27.7	38.9	0.57	0.35	
82	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.76	0	202	6.4	0.44	19.3	20.2	27.7	38.9	0.57	0.77	
77	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.19	41	137	6.4	0.22	32.0	20.2	27.7	38.9	0.57	0.39	
76	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.13	53	130	6.4	0.17	33.9	20.2	27.7	38.9	0.57	0.32	
81	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.53	0	176	6.4	0.38	23.4	20.2	27.7	38.9	0.57	0.67	
75	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.06	43	122	6.4	0.19	36.2	20.2	27.7	38.9	0.57	0.34	
96	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.50	52	172	6.4	0.23	24.0	20.2	27.7	38.9	0.57	0.40	
99	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.06	0	237	6.4	0.52	15.3	20.2	27.7	38.9	0.57	0.90	
95	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.43	42	164	6.4	0.00	25.6	20.2	27.7	38.9	0.57	0.32	
94	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.26	50	145	6.4	0.00	29.9	20.2	27.7	38.9	0.57	0.32	
98	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.80	0	207	6.4	0.45	18.7	20.2	27.7	38.9	0.57	0.79	
93	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.21	40	139	6.4	0.00	31.4	20.2	27.7	38.9	0.57	0.32	
92	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.05	46	120	6.4	0.00	36.8	20.2	27.7	38.9	0.57	0.32	
97	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.60	0	183	6.4	0.40	22.1	20.2	27.7	38.9	0.57	0.70	
91	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.01	37	116	6.4	0.00	38.0	20.2	27.7	38.9	0.57	0.32	
90	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	0.96	42	110	6.4	0.00	39.9	20.2	27.7	38.9	0.57	0.32	

DNV·GL

Knikverkorters adjusted construction (verbouw)

Date: 2020-12-01
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+0
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)	Block Tearing Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Mitigation
49	1e tussenstul	Enkele staaf	**L55.6**	**S355**	M12	**8.8**	2.64	0	246	**7.2**	**0.86**	23.1	32.3	45.2	134.1	1.56	0.55		Profile exchanged
48	1e tussenstul	Enkele staaf	**L50.5**	**S355**	M12	**8.8**	2.32	0	238	**7.2**	**0.75**	18.6	32.3	37.7	92.1	1.08	0.70		Profile exchanged
60	1e tussenstul	Enkele staaf	**L55.6**	**S355**	M12	**8.8**	2.67	0	249	**7.2**	**0.87**	22.7	32.3	45.2	134.1	1.56	0.56		Profile exchanged
59	1e tussenstul	Enkele staaf	**L50.5**	**S355**	M12	**8.8**	2.37	0	244	**7.2**	**0.8**	18.0	32.3	37.7	92.1	1.1	0.71		Profile exchanged
5001	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.32	0	136	**7.2**	**0.43**	42.3	60.3	43.6	51.0	1.08	0.40		Profile added
5002	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.17	0	120	**7.2**	**0.38**	49.2	60.3	43.6	51.0	1.08	0.35		Profile added
5007	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.27	0	130	**7.2**	**0.41**	44.4	60.3	43.6	51.0	1.08	0.38		Profile added
5008	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.27	0	130	**7.2**	**0.41**	44.4	60.3	43.6	51.0	1.08	0.38		Profile added

Comment

1) Pos numbers 5001, 5002, 5007 and 5008 are new added redundants

APPENDIX D ANCHOR CHECKS AND SHEAR BLOCKS

ANCHORS AND SHEAR BLOCKS S+0

The towers in wind zone II are connected via anchor rods, the towers in wind zone III with an inserted leg member into the pile, force transfer is though shear blocks.

Anchors

The tower legs are connected to the foundation with a foot plate 320x520x38 mm and four anchor rods with diameter 38 mm. The thickness and dimensions have been verified by field investigation[1].

The anchor rods are connected to a horizontal rod "schieter" which allows for distribution of the tensile force to the concrete.

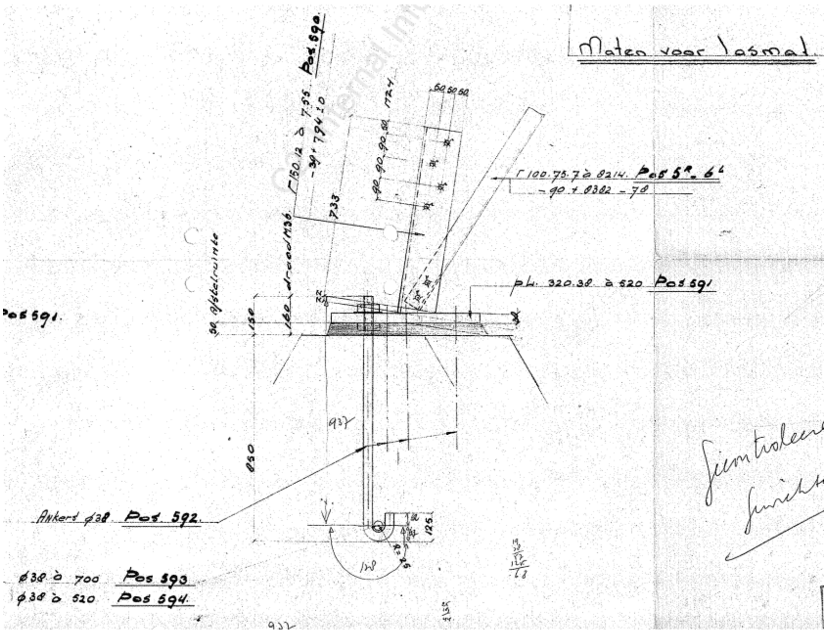


Figure 1 Anchor detail

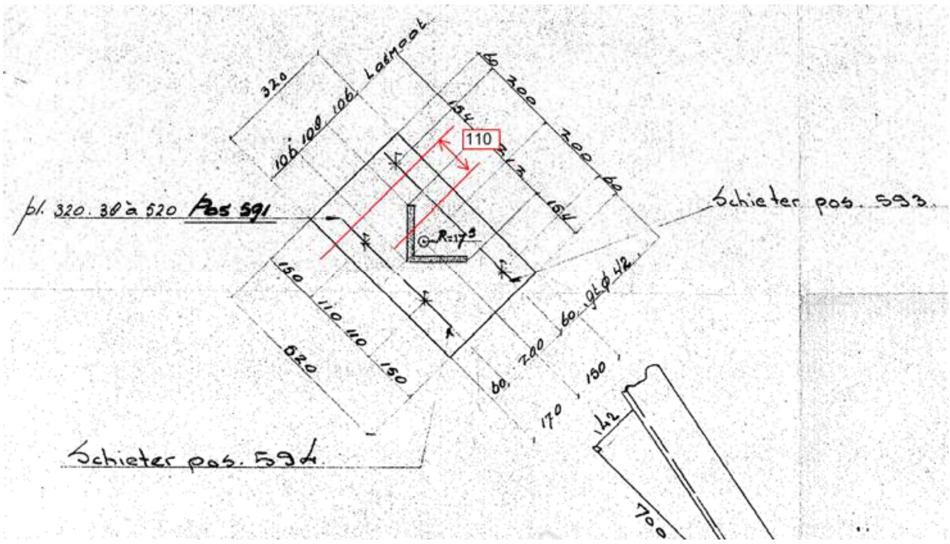


Figure 2 Foot plate with schematisation of effective width and leverage arm

[1] Rapport Bejan Bouw en Betontechniek d.d. 4-11-2020; 200152A-003 Krimpen aan den IJssel - Geertruidenberg v1.0.pdf

Loads

The loads coming from the tower are based on S+0 structure number 39 in wind zone II and can be seen in Table 1.

Table 1 Foundation loads wind zone II for tower 39

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	137	121	**728**	11	-183	-35	743
Max. trek	ULS 1a_0,9_0,9_45	104	89	**-565**	-11	136	21	-576
Max. pos. torsie	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
Max. neg. torsie	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1
Comb. trek+torsie	ULS 1a_0,9_0,9_45	104	89	**-565**	**-11**	136	21	-576

Foot plate and anchors

The strength of the foot plate will be determined with the eccentricity of 110 mm shown in Figure 2. The effective width is equal to half of the foot plate, 160 mm.

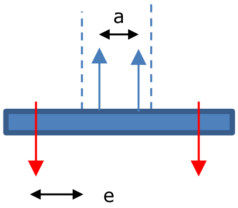


Figure 3 Scheme for check of foot plate

e: 110 mm

In the spreadsheet the anchor bolts and foot plate have been checked. The concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but has been verified with concrete cylinder tests. Refer to aforementioned investigation. The foot plate is embedded in concrete. The anchor bolts will not be loaded by bending.

Check

See output of spreadsheet: the anchor fulfills the requirement, but the foot plate has insufficient capacity:

Tower 39: U.C. = 141 / 123 = 1,14 ≥ 1,00 Not ok

The foot plate needs to be strengthened. This can be done with additional vertical stiffeners that will be positioned to the tower leg. See Figure 4.

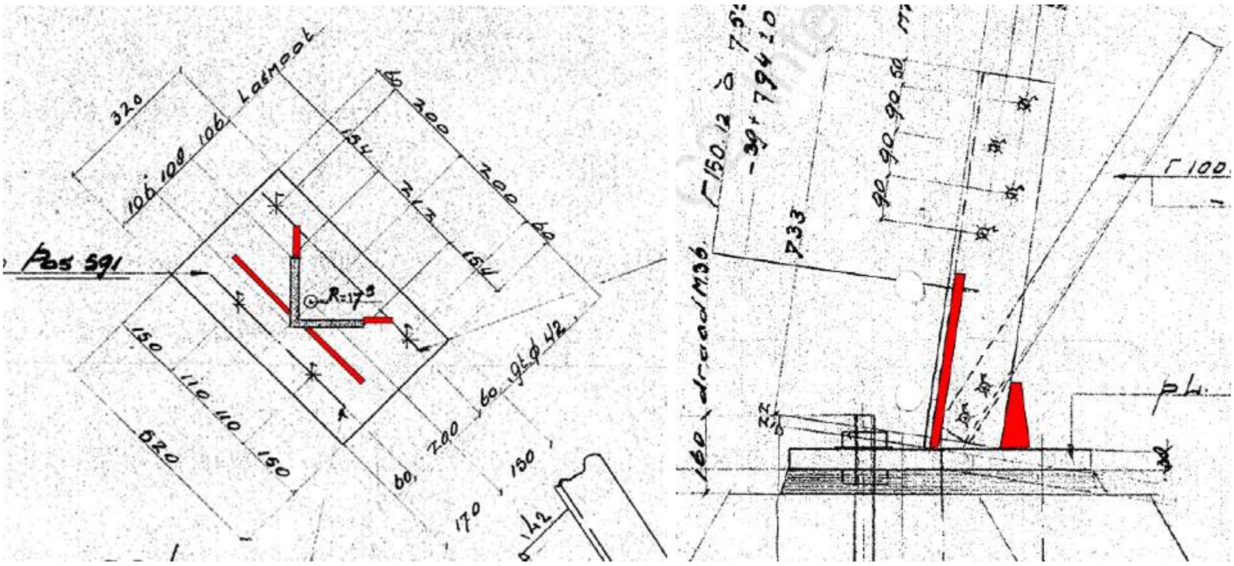


Figure 4 Stiffeners

For the detail-engineering the loads for tower 35 for verbouw load should be used.

Shear blocks

Tower 65 is the governing tower location for the check of the connection to the foundation. Loads to be used in direction of main leg ($R_{z,lok}$).

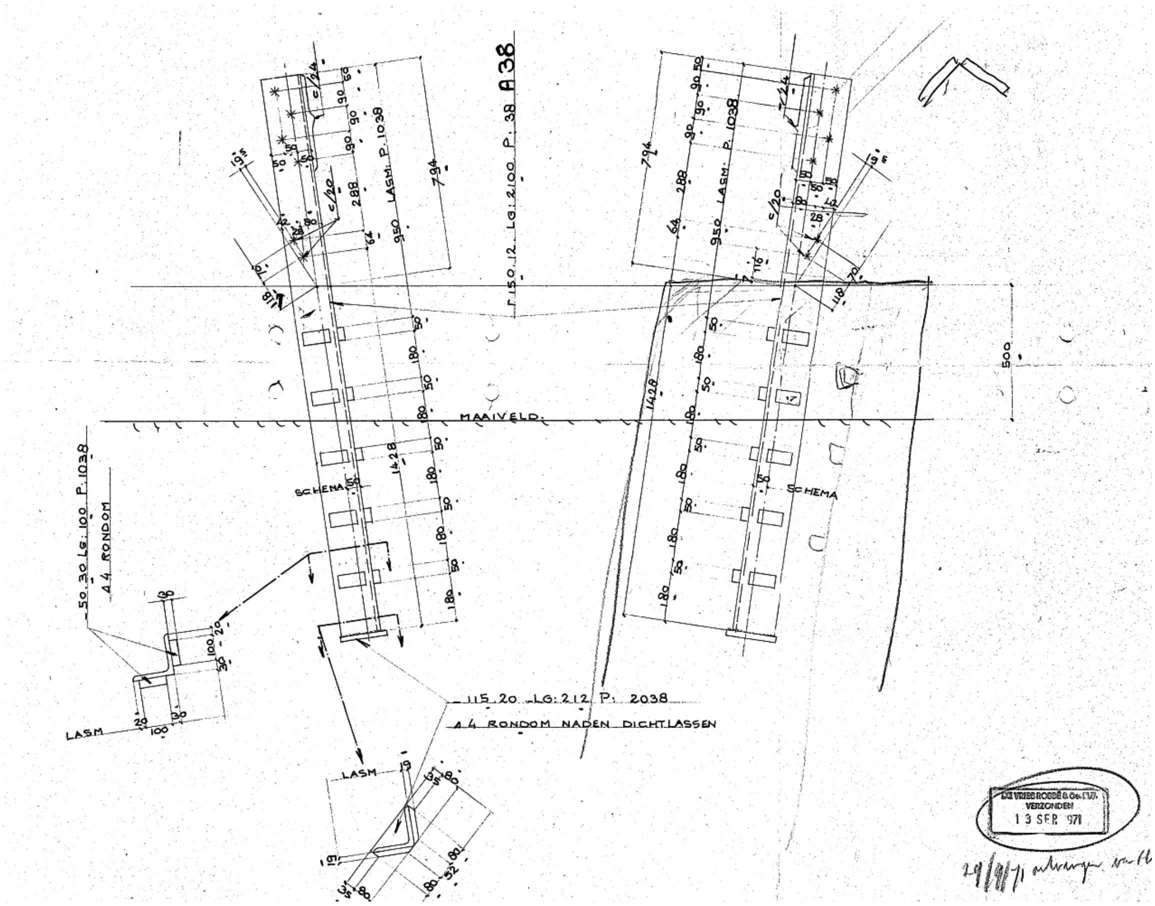


Figure 5 Shear blocks S+0

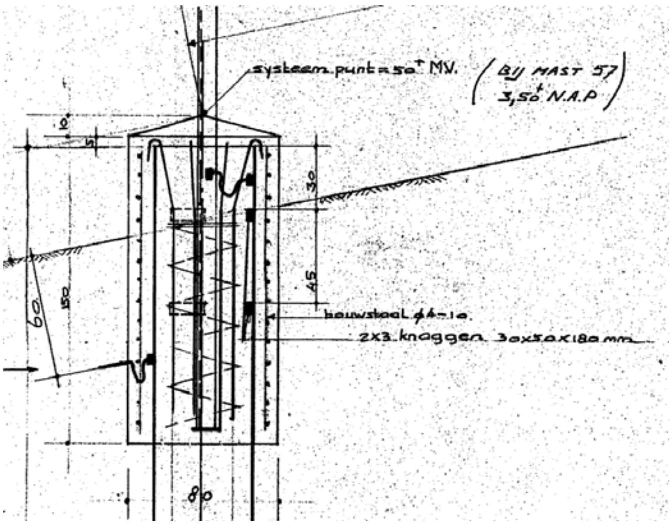


Figure 6 Pile shear blocks

Loads

The loads for wind zone III for tower 65 are tabulated in Table 2.

Table 2 Foundation loads wind zone III for tower 65

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	118	105	**628**	10	-158	-30	640
Max. trek	ULS 1a_0,9_0,9_45	85	72	**-464**	-10	111	17	-473
Max. pos. torsie	ULS 5a Ba 10	-28	24	-1	**37**	-3	-3	-1
Max. neg. torsie	ULS 5a Ba 21	-28	-24	-1	**-37**	-3	-3	-1
Comb. trek+torsie	ULS 1a_0,9_0,9_90	-88	55	**-440**	**23**	102	12	-449

Check

With the spreadsheet the shear blocks have been checked. As with the footplate and anchors check the concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but has been verified with concrete cylinder tests. Refer to aforementioned investigation report.

The conclusion is that the shear blocks on the tower leg and pile have sufficient capacity.

Compression U.C. = 0,80 ≤ 1,00 OK

Tension U.C. = 0,79 ≤ 1,00 OK

DNV·GL

Project: Krimpen - Geertruidenberg 380

Date: 30-11-2020
Version: 2.6

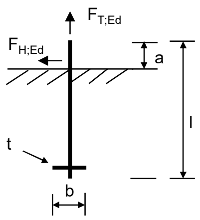
Anchors

NEN-EN 1992-1-1 and 1993-1-8 with NA
CUR-BmS 10

Subject: S+0 II	**Checks:**		
	Anchor bolt to tension	1,14	not OK
	Anchor bolt to shear	0,41	OK
	Dowel ("schieter")	0,90	OK

Inputs

Anchor diameter		M38	
Achor quality		4.6	
Thread		Cut	
Anchor length	l =	900	mm
Anchor length above concrete	a =	110	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	565	kN
Shear force	$F_{H,Ed}$ =	136	kN
Number of anchors for tension		4	
Number of anchors for shear		4	
$F_{T;Ed}$ = T / n =		141,3	kN
$F_{v;Ed}$ = $F_{H,Ed}$ / n =		34,0	kN

Anchor properties

d_b =	38,00	mm
$A_{b;s}$ =	910	mm^2
f_{yb} =	240	N/mm^2
f_{ub} =	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0,44 - 0,0003 f_{yb}$ =	0,37	-

Capacity per anchor

$F_{T;Rd} = 0,9\alpha_{red;2} f_{ub} A_s / g_{M2}$ =	**200,6**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb}$ =	**82,0**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		S235	
Thickness	t =	38	mm
Width	b_{ef} =	160	mm
Leverage arm	m =	110	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd}$ =		13,6	kNm
$F_{t,Rd} = M_{pl,Rd} / m$ =		123,4	kN

Check of dowel ("schieter")

$$\frac{\sigma_b'}{f_{cd}} = \frac{25,6}{40,0} = 0,64 \quad \text{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{141}{157} = 0,90 \quad \text{OK}$$

Capacity of concrete

Concrete strength	C20/25	
f_{ck} =	20	N/mm^2
k_b =	3	-
γ_{Mc} =	1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc}$ =	40	MPa

Dowel

Diameter	d_S =	38	mm
Length	b =	220	mm
Spread	$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	54	mm
Effective length	b_{eff} = min(b; d+2c)	145	mm
Cross section	$A_S = \pi/4\ d_S^2$ =	1134	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff}$ =	971	kN/m
Concrete pressure	$\sigma_b' = q / d_S$ =	25,6	MPa

Shear stress in dowel

Load	$F_{T,Ed}$ =	141	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ =	157	kN

Capacity of foot plate

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{141,3}{123,4} = 1,14 \quad \text{not OK}$$

Capacity of anchor for tension

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{141,3}{200,6} = 0,70 \quad \text{OK}$$

Check foot plate for tension

$$\frac{T}{n \times F_{t;Rd}} = \frac{565,0}{493,6} = 1,14 \quad \text{not OK}$$

Check anchor for shear

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{34,0}{82,0} = 0,41 \quad \text{OK}$$

DNV·GL

Project: KIJ-GT380
Mast: S+0

Shear blocks

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

Datum: 2020-11-30
Auteur: TBR
Versie: 1.3

Load				**Results**			
Compression	$F_{Ed,druk}$	640	kN	Compression	U.C.	0,80	< 1,00 OK
Tension	$F_{Ed,trek}$	473	kN	Tension	U.C.	0,79	< 1,00 OK

Hoekstijl

Profile		**L150.12**	
Steel material		S235	
Cross section		3480	mm^2
Axial capacity	N_{pl}	818	kN
Width	b	150	mm
Thickness	t	12	mm
Length in concrete		1300	mm

Blokdeuvels randstijl

Width	b	50	mm
Thickness	h	30	mm
Length	L	100	mm
Welds	a	4	mm
c.t.c. separation	s	180	mm
Number for compr.	n	10	-
Number for tension	n	10	-

Foot plate

Thickness	t	20	mm
Ext. length	m	19	mm
Welds	a	5	mm

Pile

Name		Buispaal	
Diameter		525	mm
Thickness		10	mm
Cross section		16179	mm^2
Steel material		S235	
Capacity		3802	kN
Concrete strength		C20/25	

Shear blocks pile

Width	b	50	mm
Thickness	h	30	mm
Length	L	540	mm
Welds	a	5	mm
c.t.c. separation	s	450	mm
Number for compr.	n	2	-
Number for tension	n	2	-

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} =	235	N/mm^2
Tensile strength	f_{ud} =	360	N/mm^2

Capacity shear blocks main leg

A_{f1} =	3000	mm^2
A_{f2} =	8512	mm^2
Slope	1:	5
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1,68	
$f_{jd} = C_A \times f_{cd}$ =	18,0	N/mm^2
$F_{Rd,c} = n \times A_{f1} \times f_{jd}$ =	539	kN
$F_{Rd,t} = n \times A_{f1} \times f_{jd}$ =	539	kN

Capacity foot plate

k_d =	1,73	-
$f_{jd} = C_A \times f_{cd}$ =	18,5	N/mm^2
$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	42	mm
$m^* = \min(c,m)$ =	19	mm
Type foot plate	Diagonally cut	
Effective for	Compr. and tension	
$A_{p,trek}$ =	10510	mm^2
$F_{Rd} = A_{p,trek} \times f_{jd}$ =	194	kN
Welds foot plate	479	kN
$A_{p,druk}$ =	13990	mm^2
$F_{Rd} = A_{p,druk} \times f_{jd}$ =	258	kN

Capacity shear blocks pile

A_{f1} =	16200	mm^2
A_{f2} =	48600	mm^2
$C_A = \sqrt{(A_{f2}/A_{f1})}$ =	1,73	-
$f_{jd} = k_d \times f_{cd}$ =	18,5	N/mm^2
$F_{Rd,c} = n \times A_{f1} \times f_{jd}$ =	599	kN
$F_{Rd,t} = n \times A_{f1} \times f_{jd}$ =	599	kN

"Splitting" of pile

Spread of forces		45	°
Length force flow		1048	mm
Splitting force		226	kN/m
Yield strength wall	f_{yd} =	235	N/mm^2
Capacity tubular pile		4700	kN/m
U.C.		0,05	< 1,00 OK

Capacities

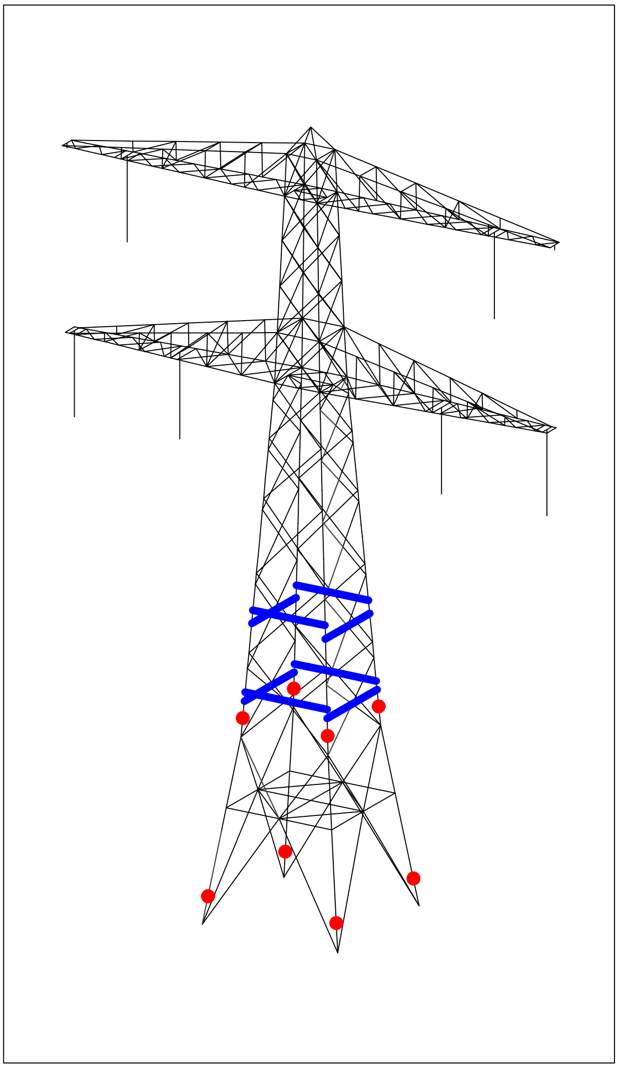
Main leg for tension	733	kN
Tubular pile for tension	599	kN
Main leg for compression	797	kN
Tubular pile for compression	857	kN

Check of welds

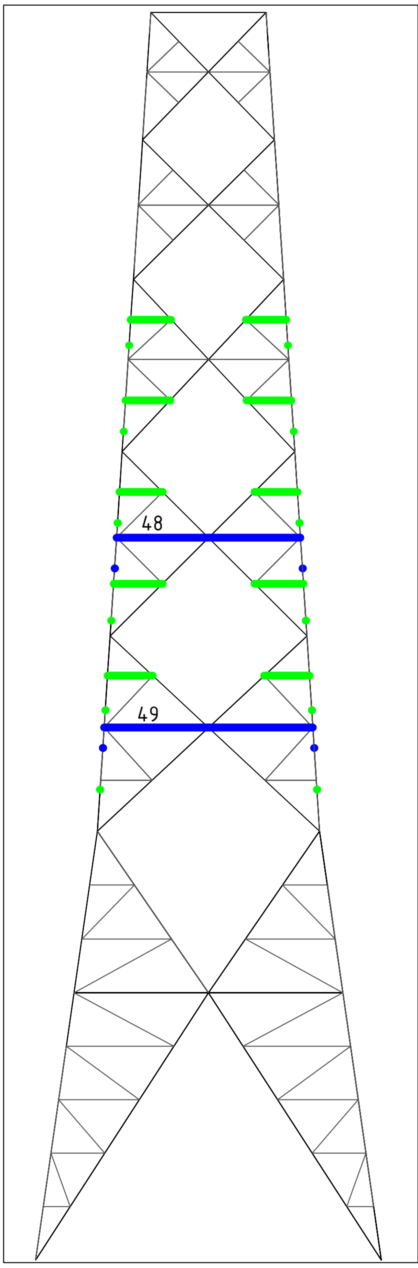
Shear block main leg	0,49	< 1,00 OK
Shear block pile	0,40	< 1,00 OK

APPENDIX E DRAWINGS

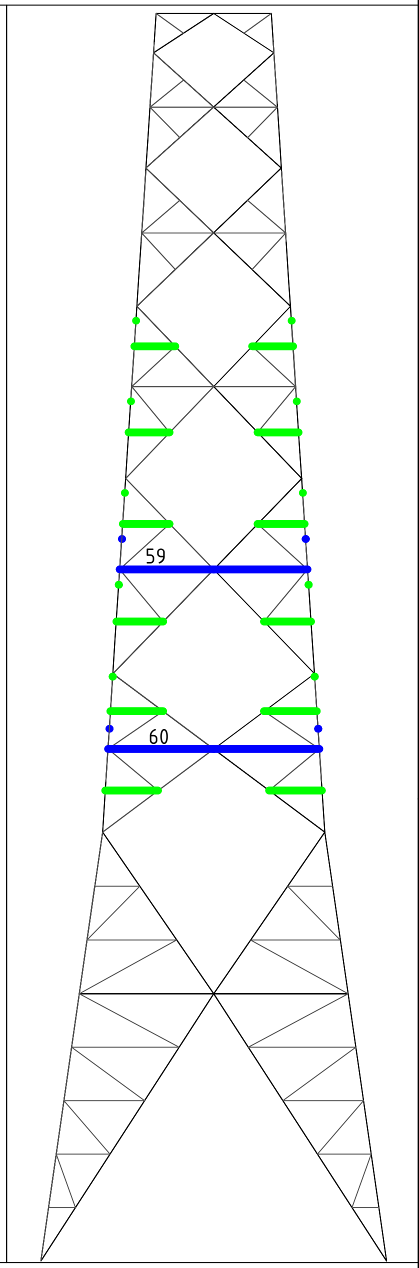
Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
49	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L55x6	S355 t<=40	M12-8.8t-NEN2012
48	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L50x5	S355 t<=40	M12-8.8t-NEN2012
60	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L55x6	S355 t<=40	M12-8.8t-NEN2012
59	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L50x5	S355 t<=40	M12-8.8t-NEN2012



Overview



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

01	24-11-2020	Version 2.0 - Profile exchange added
00	31-3-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-001

Design state:	FINAL		Scale:	-
Drawn by:	MuK	24-11-2020	Units:	m
Checked by:	TBR	24-11-2020	Project no:	10166260
Approved by:	JHu	24-11-2020	Company:	TenneT

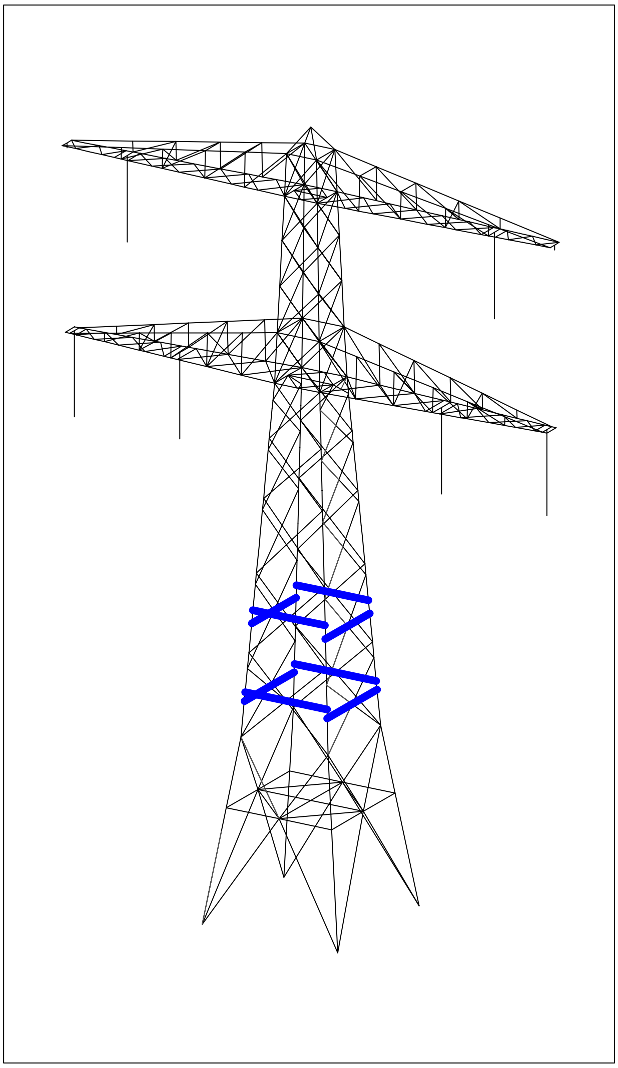
Description: Modifications overview for mast type S+0 Mast 39

Revision: 01

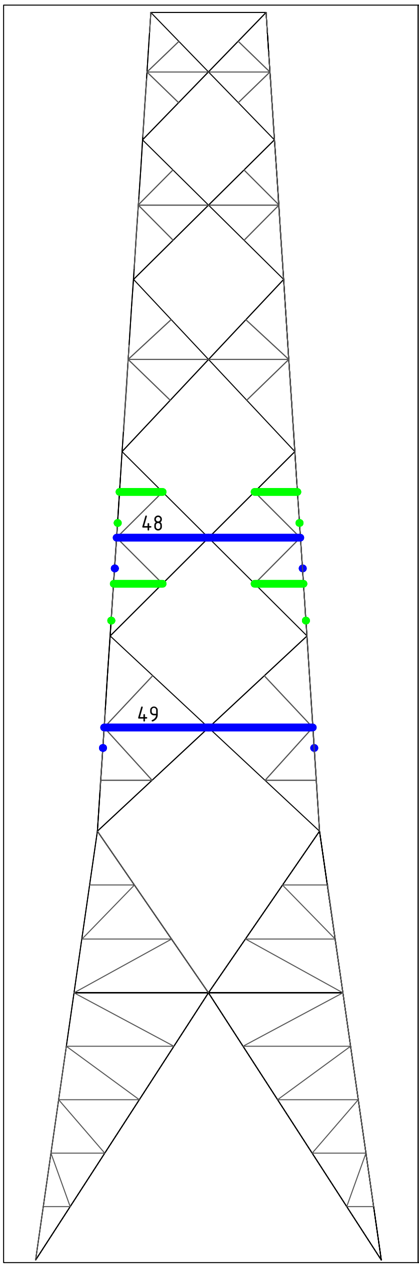
Format: A2

DNV GL Energy & Sustainability, Utrechtseweg 310, 6812 AR Arnhem, tel: +31 26 3 56 91 11, www.dnvgl.com

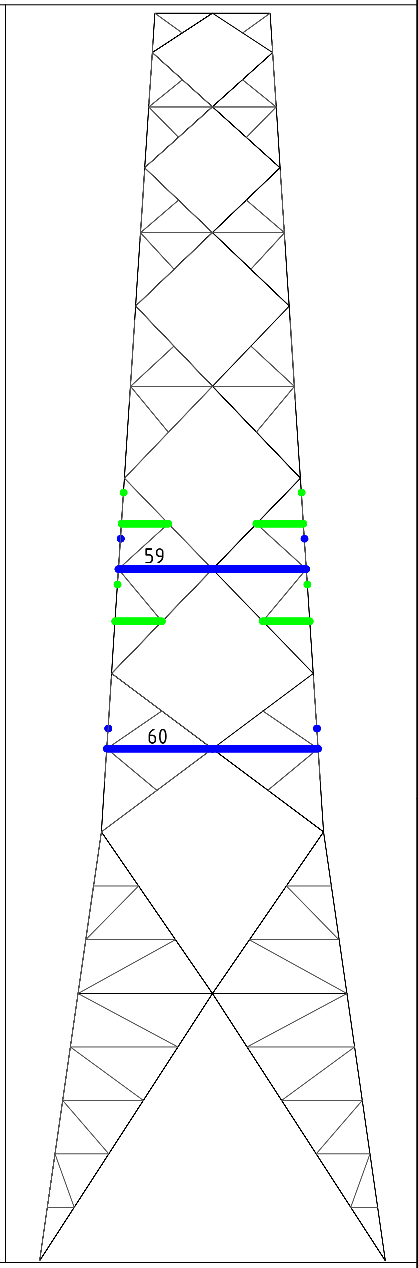
Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
49	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L55x6	S355 t<=40	M12-8.8t-NEN2012
48	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L50x5	S355 t<=40	M12-8.8t-NEN2012
60	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L55x6	S355 t<=40	M12-8.8t-NEN2012
59	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L50x5	S355 t<=40	M12-8.8t-NEN2012



Overview



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

01	24-11-2020	Version 2.0 - Profile exchange added
00	31-3-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-002

Design state: FINAL

Scale: -

Drawn by: MuK 24-11-2020

Units: m

Checked by: TBR 24-11-2020

Project no: 10166260

Approved by: JHu 24-11-2020

Company: TenneT

Description: Modifications overview for mast type S+0 Mast 65

Revision: 01

Format: A2

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Bijlage 14 Rapportage Mastconstructie S+18

“TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380”

KIJ-GT380 – Rapportage mast S+18

TenneT TSO B.V.

Meridian doc. nr.: 002.589.40 0916491
Rapport nr.: 21-1105 Rev.0
Datum: 2021-07-06

Projectnaam:	"Toetsing en herontwerp masten en fundaties BBB380"	DNV GL - Energy Energy Advisory Postbus 9035 6800 ET ARNHEM
Rapport titel:	KIJ-GT380 – Rapportage mast S+18	
Klant:	TenneT TSO B.V.	
Contactpersoon:	[redacted]	
Datum:	2021-07-06	[redacted]
Project nr.:	10166260	
Organisatie unit:	TDT	
Meridian doc.nr.:	002.589.40 0916491	
Rapport nr.:	21-1105 Rev.0	

Geschreven door:	Beoordeeld door:	Goedgekeurd door:

[redacted]

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☐ Onbeperkte distributie binnen DNV GL Netherlands B.V.

☒ Geen distributie (vertrouwelijk)

Trefwoorden:

Versie	Datum	Reden voor uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2021-07-06	Eerste uitgave	[redacted]		

DNV GL Netherlands B.V.

Inhoud

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 GL 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

In deze studie wordt voor de lijn Krimpen aan den IJssel - Geertruidenberg de controle van de mastconstructie van masttype S+18 gerapporteerd.

Inhoudelijk is de Nederlandse versie van de rapportage 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.

1.2 Doelstelling en scope van dit rapport

Het doel van deze studie is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de ACCCZ-Warsaw geleider.

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 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 Krimpen aan den IJssel - Geertruidenberg" [1].

1.3.2 E-studie deel 1

In de rapportage "KIJ-GT380 - E-studie deel 1" [2] is bepaald welke aanpassingen benodigd zijn om de ACCCZ Warsaw geleider toe te passen binnen de verbinding Krimpen aan den IJssel - Geertruidenberg. Uit de E-studie blijkt dat er V-kettingen vereist zijn voor beide traversen van het masttype S+18 (mast 11-2).

1.3.3 Uitgangspunten rapport

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport "Uitgangspuntenrapport 380kV verbinding Krimpen aan den IJssel - Geertruidenberg" [3]

2 EISEN

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

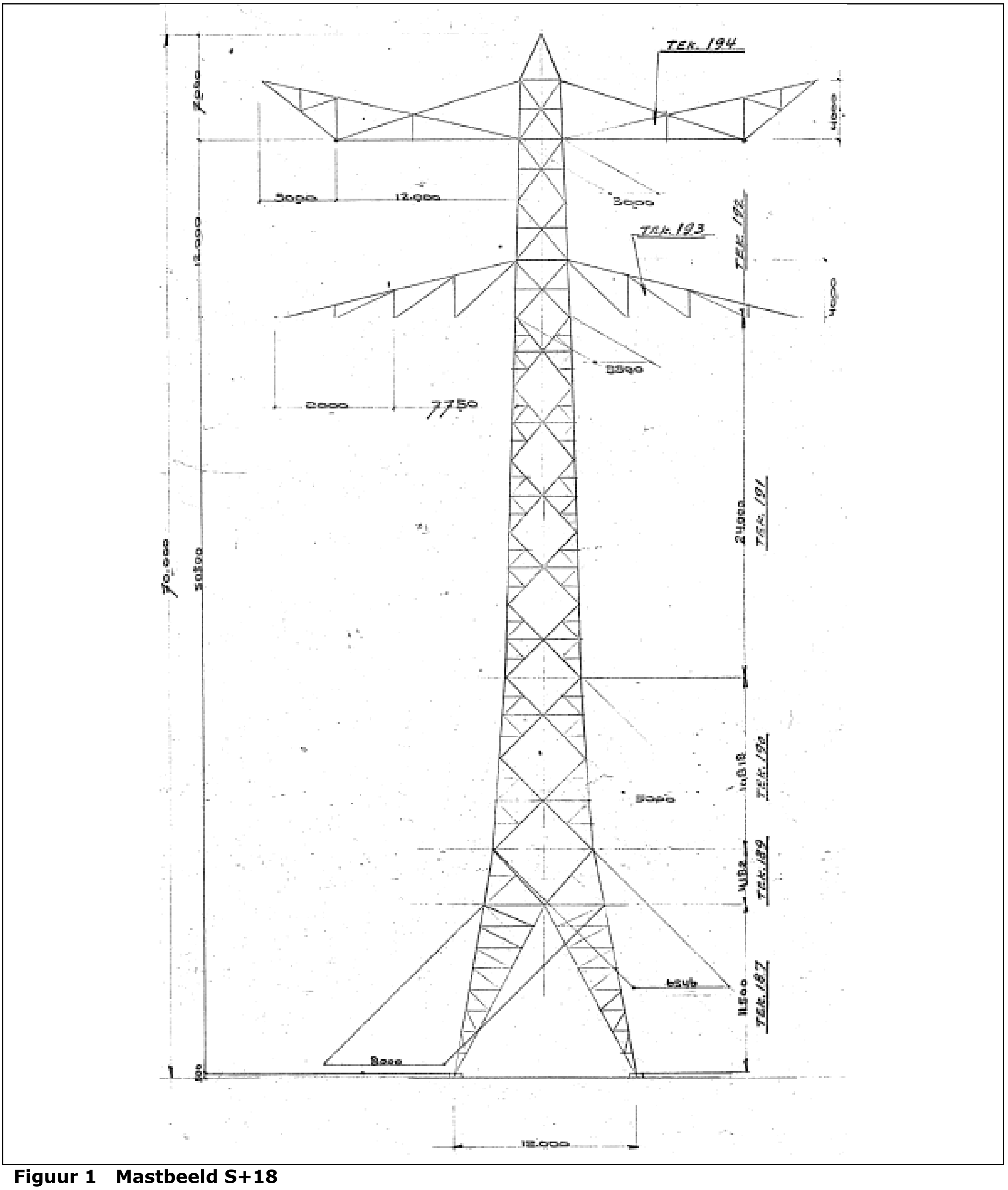
Tabel 1 Relevante eisen

Eis Id	Titel	Eis Tekst	Bewijsvoering
BO Eis: H2.7-6	Omgeving, beperkings factoren	Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid.	Tabel 7
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 1060:1977. 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 1060:1977.	Tabel 7

3 BEREKENINGEN

3.1 Mastbeeld

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



Figuur 1 Mastbeeld S+18

3.2 Mastenlijst

In deze rapportage wordt masttype S+18 getoetst. In de verbinding KIJ-GT komen twee masten voor van het type S+18, dit zijn de mast 11-2 en 60. Mast 11-2 staat in windgebied II en mast 60 staat in windgebied III. Bij de masten is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde). De wind en weight span van de masten zijn in Tabel 2 weergegeven. Ter plaatse van de Lekkruising is er een significant hoogteverschil aanwezig tussen mast 11-2 en mast 12.

Tabel 2 Mastnummers

Mastnummer	Masttype	Maatgevend mastnummer	Wind span (m)	Weight span (m)	Hoogteverschil
11-2	S+18 II	11-2	342	209	-58.1
60	S+18	60	400	617	35.8

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 – Mast 11-2 III – Mast 60
	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:

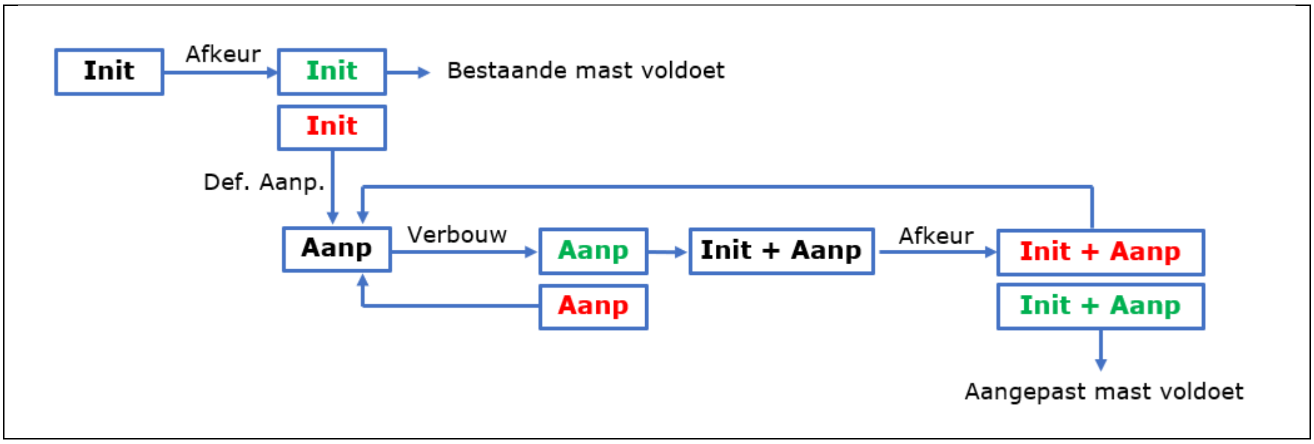
Stap 1: Toets bestaande (Init) mast op Afkeur

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 geleiderbelastingenprogramma van DNV GL. 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.

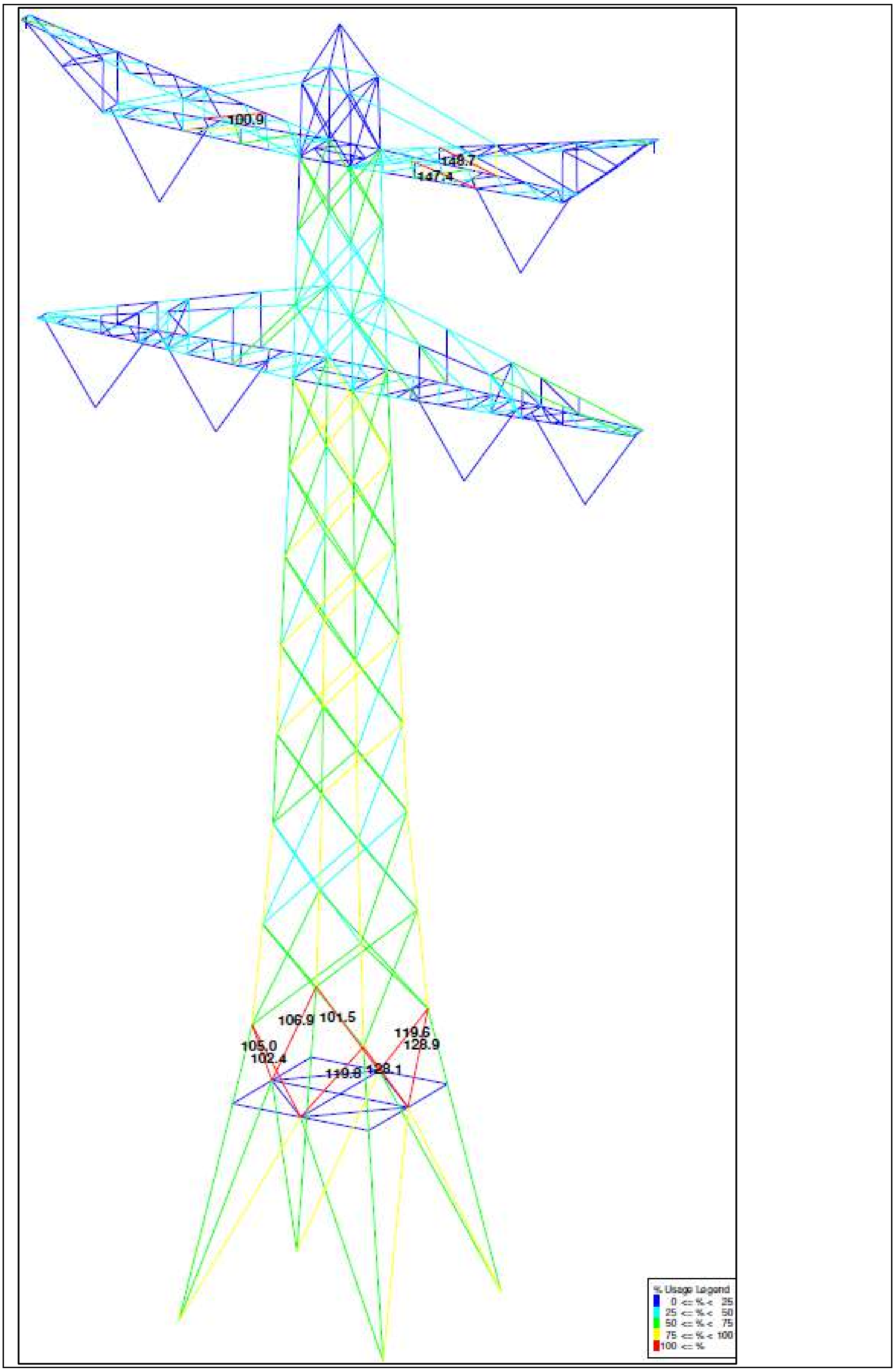
De nieuwe stalen liggers (HEB- en HEM-profielen) die benodigd zijn voor de V-kettingen zijn gemodelleerd in AxisVM (EEM-software). De resultaten van deze berekening zijn opgenomen in bijlage F.

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

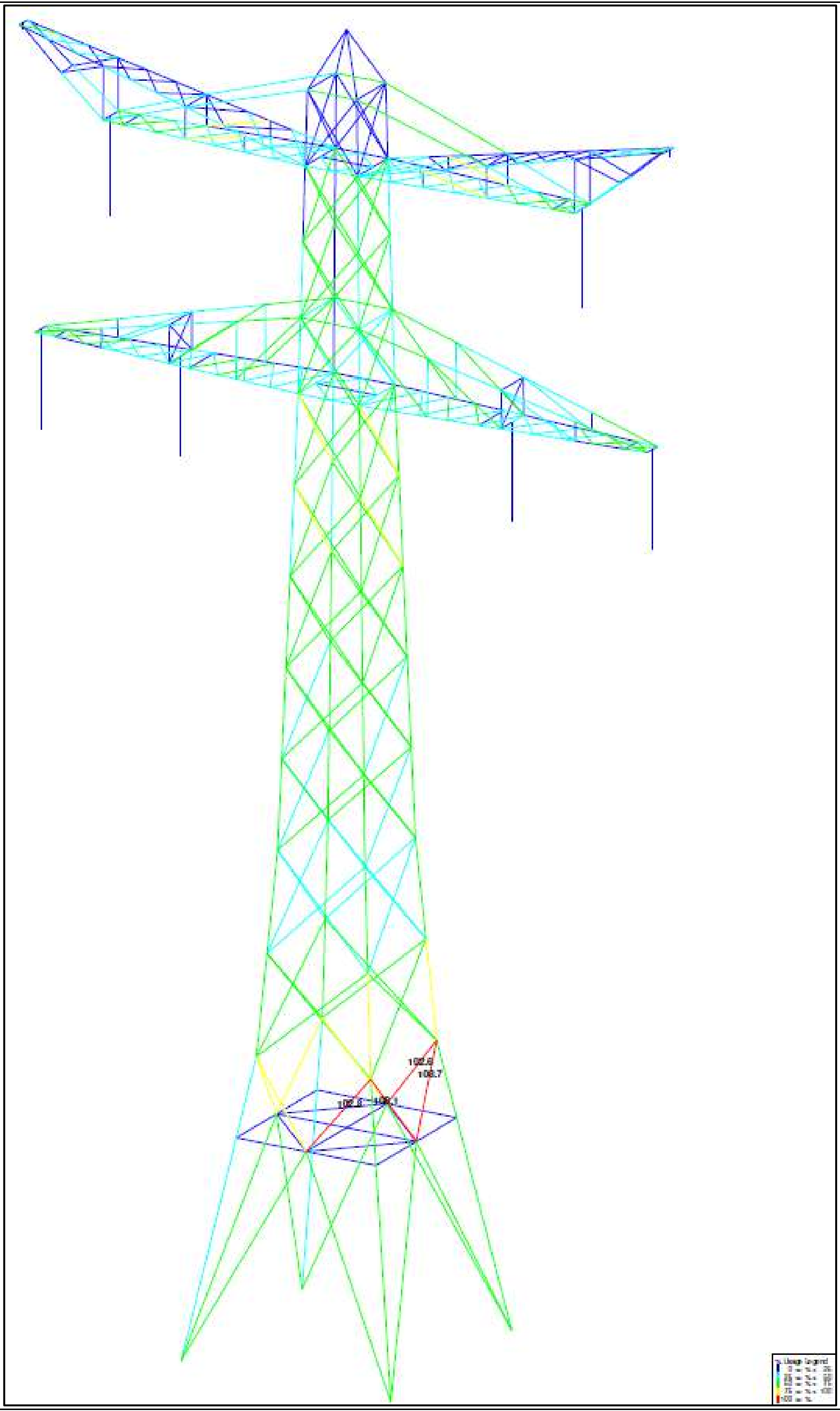
Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

4 TOETSING MAST

Het resultaat van de controle van de mastconstructie type S+18 met belastingen op afkeurniveau is weergegeven in onderstaande figuren.



Figuur 3 Resultaat PLS-TOWER S+18 (11-2)



Figuur 4 Resultaat PLS-TOWER S+18 (60)

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 Figuur 4
Knikverkorters	Voldoen		Appendix C
Ankers en voetplaat	Voldoen		Appendix D

5 AANPASSINGEN

5.1 Inleiding

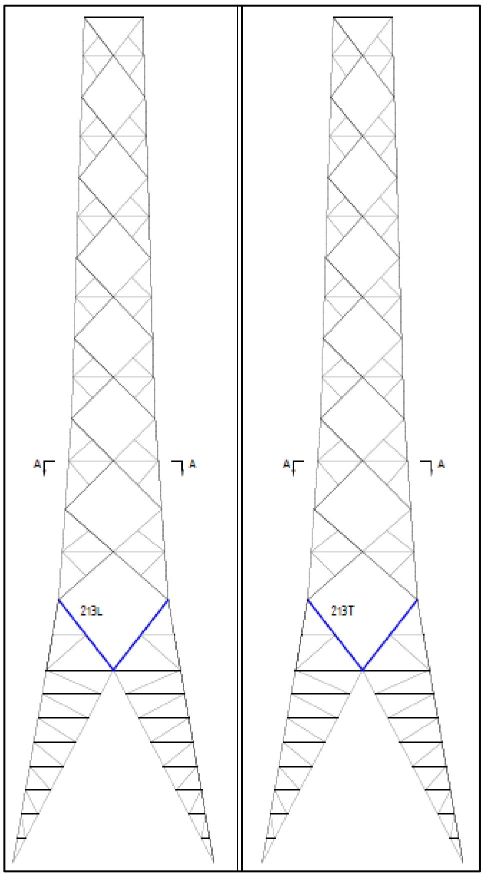
Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen en nieuwe onderdelen aan verbouwniveau is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Vervangen van diagonalen in het middenstuk van de mast;
- Aanbrengen van een aanvullend stabiliteitsverband in het centrum van de mast;
- Vervangen van diagonalen in de boventraverse (alléén voor mast 11-2);
- Vervangen van kruisdiagonalen in de beide traversen (alléén voor mast 11-2);
- Toevoeging van HEB- en HEM-profielen voor bevestiging van V-kettingen (alléén voor mast 11-2).

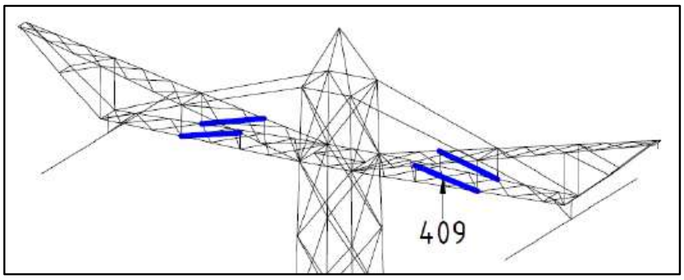
Het aanbrengen van een aanvullend stabiliteitsverband in het centrum van de mast wordt geadviseerd om de algehele stabiliteit van de mast te verbeteren. Dit advies is gebaseerd op de Cigre-publicatie nr. 196 “Diaphragms for steel supports”.

5.2 Aanpassingen

Zoals blijkt uit de uitvoer van PLS Tower, zie Appendix B, moeten de onderdelen die zijn weergegeven in Figuur 5 en Figuur 6 worden aangepast. Voor afmetingen profielen en bouten, zie Appendix E.

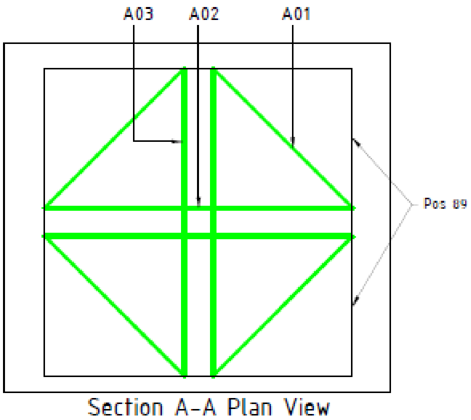


Figuur 5 Te vervangen diagonalen van masttype S+18 (masten 11-2 en 60), vooraanzicht (links) en zijaanzicht (rechts)

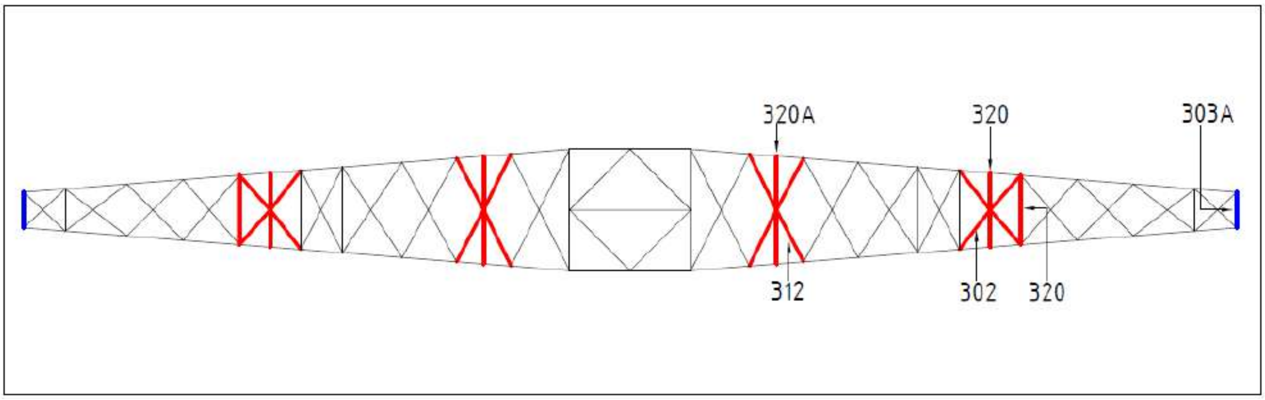


Figuur 6 Vervanging van diagonalen in de boventraverse (mast 11-2)

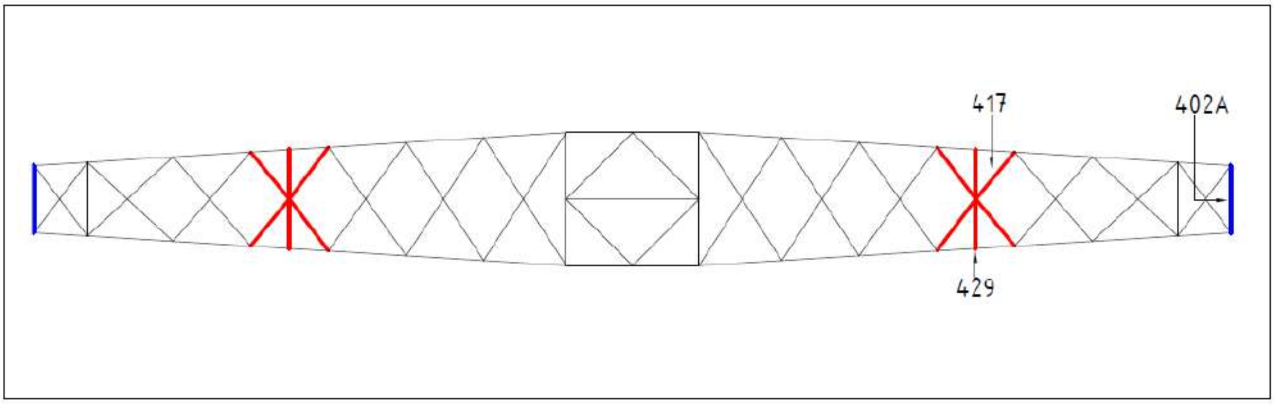
De mast S+18 is een relatief slanke constructie zonder horizontale stabiliteitsverbanden in het mastlichaam. Om deze reden wordt er geadviseerd om een stabiliteitsverband aan te brengen ter plaatse van doorsnede A-A. De vorm van het verband is weergegeven in Figuur 7. Voor afmetingen profielen en bouten, zie Appendix E.



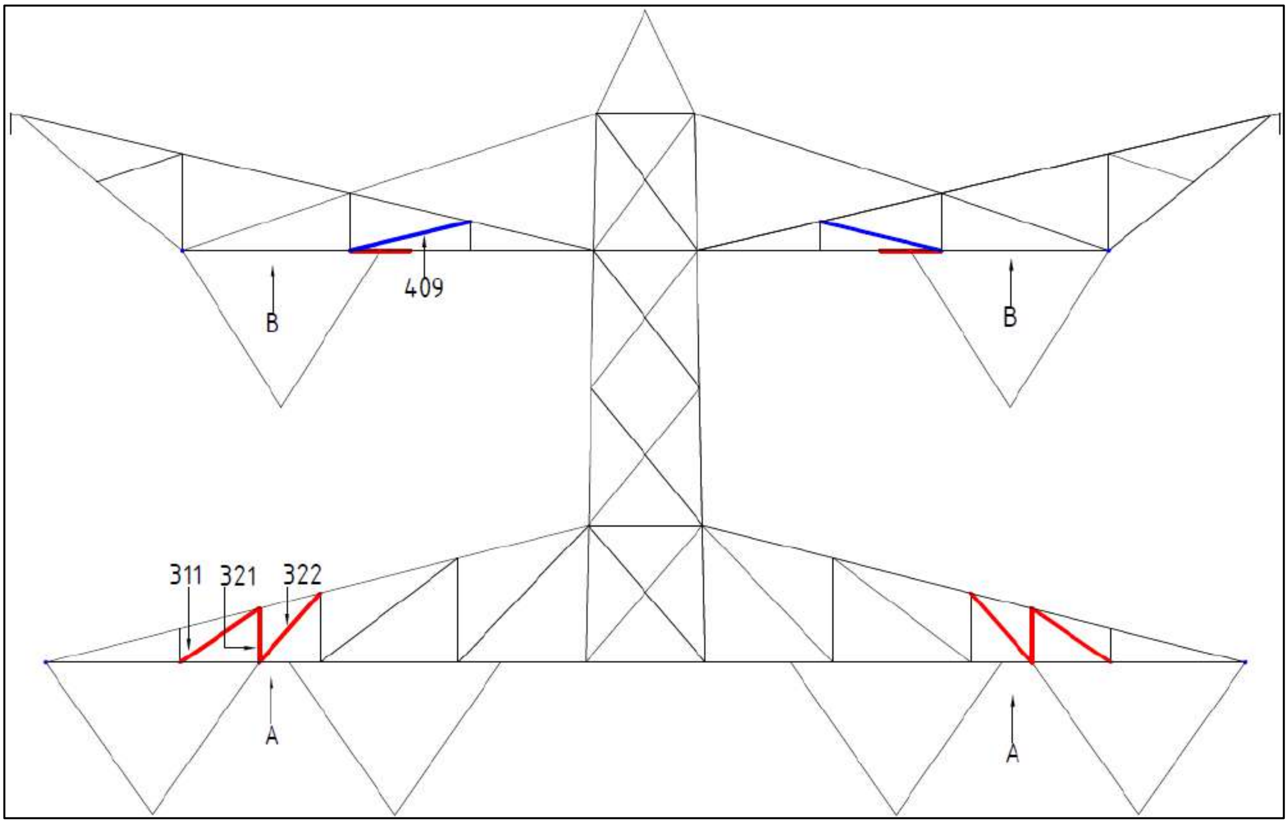
Figuur 7 Aanbevolen stabiliteitsverband ter hoogte van doorsnede A-A



Figuur 8 Nieuwe stabiliteitsverbanden voor de ondertraverse van mast 11-2 (aanzicht ondervlak)

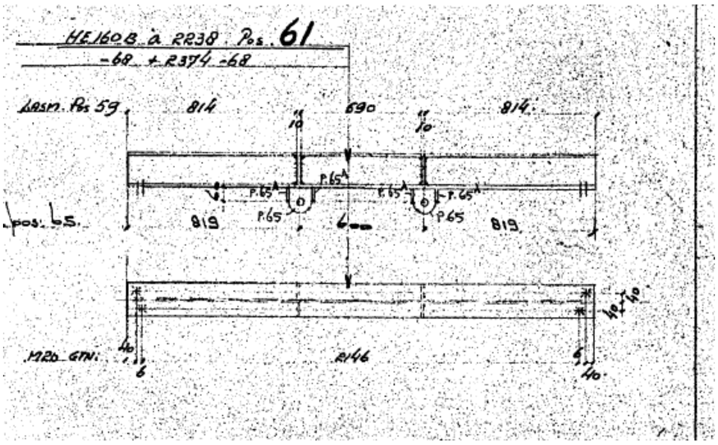


Figuur 9 Nieuwe stabiliteitsverbanden voor de boventraverse van mast 11-2 (aanzicht ondervlak)



Figuur 10 Nieuwe stabiliteitsverbanden in het zijvlak van de ondertraverse

De controle van de HE-profielen is opgenomen in Appendix F. Deze nieuwe liggers zijn benodigd, omdat de bestaande liggers geen bevestigingspunt hebben, halverwege de ligger, voor de bevestiging van de V-kettingen. De detaillering van de nieuwe liggers moet overeenkomen met die van de bestaande liggers, zie Figuur 11.



Figuur 11 Detaillering bestaande HE-liggers

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen zijn gegeven in onderstaande tabellen. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

Tabel 5 Gewichten S+18 (11-2) van aanpassingen

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
213L	L150.100.10	S235	2M24-5.6t	L140.15	S355	2M24-8.8s	Profiel uitgewisseld	4	5.40	681.31
213T	L150.100.10	S235	2M24-5.6t	L140.15	S355	2M24-8.8s	Profiel uitgewisseld	4	5.40	681.31
A01				L75.7	S355	1M16-8.8t	Profiel toegevoegd	4	3.44	111.40
A02				L75.7	S355	1M16-8.8t	Profiel toegevoegd	2	5.36	86.79
A03				L75.7	S355	1M16-8.8t	Profiel toegevoegd	2	5.36	86.79
302				L60.6	S355	1M20-8.8	Profiel toegevoegd	8	1.50	65.08
303A	HEB160	S235	M20-5.6	HEB160	S355	2M20-8.8	Profiel uitgewisseld	2	1.03	180.70
311				L80.8	S355	1M16-8.8	Profiel toegevoegd	4	2.70	114.78
312				L70.7	S355	1M20-8.8	Profiel toegevoegd	8	1.69	99.78
320				HEB160	S355	2M20-8.8	Profiel toegevoegd	4	2.15	754.33
320A				HEM160	S355	2M20-8.8	Profiel toegevoegd	2	3.15	480.06
321				L60.6	S355	1M16-8.8	Profiel toegevoegd	4	1.58	34.27
322				L80.8	S355	1M16-8.8	Profiel toegevoegd	4	2.79	118.60
402A	HEB160	S235	M20-5.6	HEB160	S355	2M20-8.8	Profiel uitgewisseld	2	1.52	266.67
409	L50.5	S235	M16-5.6	L60.6	S355	1M16-8.8	Profiel uitgewisseld	4	3.65	79.20
417				L60.6	S355	1M20-8.8	Profiel toegevoegd	8	1.47	63.77
429				HEB160	S355	2M20-8.8	Profiel toegevoegd	2	2.23	391.23
								68	**50.42**	**4296.07**

Tabel 6 Gewichten S+18 (60) van aanpassingen

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
213L	L150.100.10	S235	2M24-5.6t	L140.15	S355	2M24-8.8t	Profiel uitgewisseld	4	5.40	681.31
213T	L150.100.10	S235	2M24-5.6t	L140.15	S355	2M24-8.8t	Profiel uitgewisseld	4	5.40	681.31
A01				L75.7	S355	1M16-8.8t	Profiel toegevoegd	4	3.44	111.40
A02				L75.7	S355	1M16-8.8t	Profiel toegevoegd	2	5.36	86.79
A03				L75.7	S355	1M16-8.8t	Profiel toegevoegd	2	5.36	86.79
								16	**24.96**	**1647.60**

5.3 Eisen verificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 7.

Tabel 7 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 (diagonalen, randstijlen) zijn in te passen zonder negatieve invloed op de begaanbaarheid.
	klimvoorziening nog in overeenstemming is met de NEN 1060:1964?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.589.40 0817486 - 20-0473 - Verificatie & validatieplan 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

[2] „002.589.40 0808624 - 20-0472 - E-studie deel 1 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

[3] „002.589.40 0808629 - 20-0345 - Uitgangspuntenrapport 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

APPENDIX A CONDUCTOR LOADS

Content

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	II
Wind speed	27 m/s
Terrain categorie	II
Reduction factor Cdir	1,00
Ice region	B
Tower type	Steunmast
Tower height	69,5 m
Max. Span	436 m
Line angle	180°
Catenary	1400 m
Wind span	337 m
EDS Weight span	203 m
Min. Weight span	-244 m
Max. Weight span	206 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-03-31			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype S+18 II

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

Document name:

KIJ-GT_S+18 II_11-2_Report.pdf

Project number:

Project client number:

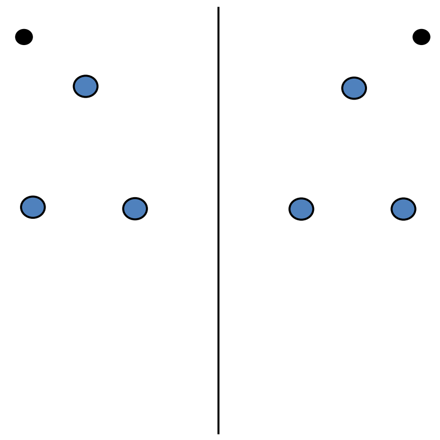
0.0

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

Conductor loads		Auteur:	TBR
		Versie:	v11.7

General

Description	S+18 II
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	II
Wind speed (m/s)	27,0 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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	V-ketting	6,00	5,00	2,00
Circuit 2	V-ketting	6,00	5,00	2,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,50	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,50	0,05

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	31	380ct1f1	45,5 m	50,5 m	14,4 m
Circuit 1	32	380ct1f2	45,5 m	50,5 m	7,3 m
Circuit 1	30	380ct1f3	57,5 m	62,5 m	10,6 m
Circuit 2	21	380ct2f1	45,5 m	50,5 m	-14,4 m
Circuit 2	22	380ct2f2	45,5 m	50,5 m	-7,3 m
Circuit 2	20	380ct2f3	57,5 m	62,5 m	-10,6 m
Bliksemdraad 1	1	bl1	66,0 m	66,5 m	18,5 m
Bliksemdraad 2	3	bl2	66,0 m	66,5 m	-18,5 m

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

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

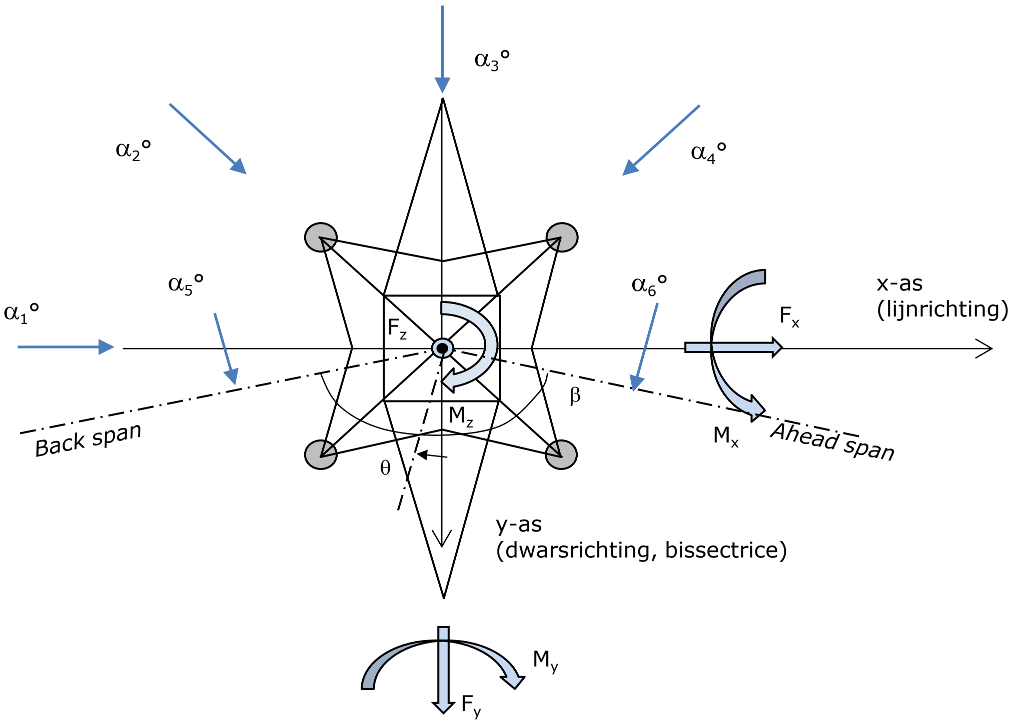
			Hoogteverschil			Richtingsverandering		
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead		Δy_back	Δy_ahead	
Circuit 1	31	380ct1f1	-19,2	76,8	m	-1,3	-11,1	m
Circuit 1	32	380ct1f2	-19,2	76,8	m	-1,4	-4,2	m
Circuit 1	30	380ct1f3	-19,7	91,6	m	-1,6	-7,9	m
Circuit 2	21	380ct2f1	-19,2	76,8	m	1,3	11,1	m
Circuit 2	22	380ct2f2	-19,2	76,8	m	1,4	4,2	m
Circuit 2	20	380ct2f3	-19,7	91,6	m	1,6	7,9	m
Bliksemdraad 1	1	bl1	-23,6	87,0	m	1,3	-13,0	m
Bliksemdraad 2	3	bl2	-23,6	87,0	m	-1,3	13,0	m

Line and tower data

		Back	Ahead	
		238,0	436,0	m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		552,7	552,7	m
Line angle	β	180	°	
Tower orientation with respect to bis	θ	0	°	
Section length		2418	2418	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: KIJ-GT
Tower: S+18 II
Number: 11-2

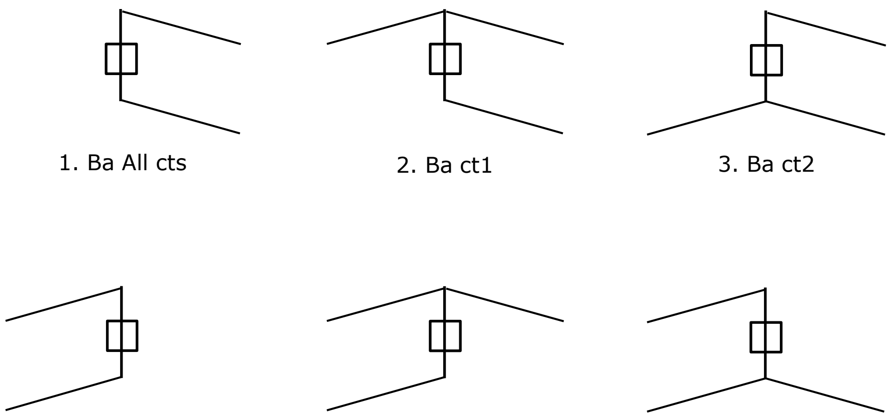
Absence of conductors

		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:

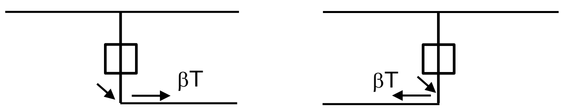


1. Ba All cts
2. Ba ct1
3. Ba ct2
4. Ah All cts
5. Ah ct1
6. Ah ct2

Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1, design assumption is symmetry back and ahead

Principle of load situations:



1. Ba
2. Ah

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

Load situations LC6. Construction and maintenance

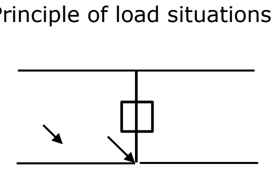
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations 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

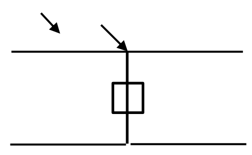
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

Presence line vehicle: Circuit, belasting tegelijk aanwezig in alle geleiders per circuit.

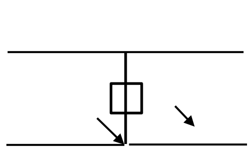
Principle of load situations:



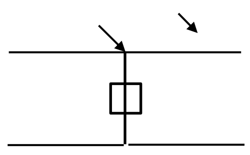
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

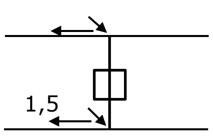
Load situations 8. Galloping as a static load

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

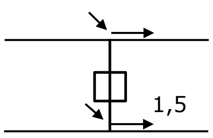
Considered situations galloping 8: None (existing structure)

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

DNV·GL

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

Tower structure

Properties

Tower type	Steunmast	
Tower designation	S+18 II	
Base plate w.r.t. ground level	0,5	m
Tower height w.r.t. base plate	69,5	m
Tower self weight	440,0	kN

Width and slope at foundation	x-ri.	y-ri.	
Leg spread	12,00	12,00	m
Inclination of main leg	0,174	0,174	-
Horizontal force factor	1,1	1,1	-

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	b_1	b_2	Δh	Δ_x	A_0	A_1	$\chi = A_1/A_0$	C_t
	[m]	[m]	[m]	[m]	[m]	[m^2]	[m^2]	[-]	
Broekstuk 1	15,68	12,00	6,55	15,68	0,174	145,42	21,20	0,15	3,18
Middenstuk 1	26,50	6,55	5,00	10,82	0,071	62,45	11,60	0,19	2,99
Middenstuk 2	50,50	5,00	3,50	24,00	0,031	102,00	20,70	0,20	2,92
Bovenstuk 1	58,50	3,50	3,15	8,00	0,022	26,58	5,85	0,22	2,84
Bovenstuk 2	66,50	3,15	2,83	8,00	0,020	23,90	5,10	0,21	2,87
Topstuk	69,50	2,83		3,00		4,25	1,00	0,24	2,78
Ondertraverse	50,50	15,75		4,00		31,50	6,10	0,19	2,96
Boventraverse	62,50	17,00		4,00		34,00	7,60	0,22	2,83

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

Description	h	b_1	b_2	Δh	Δ_x	A_0	A_1	$\chi = A_1/A_0$	C_t
	[m]	[m]	[m]	[m]	[m]	[m^2]	[m^2]	[-]	
Broekstuk 1	15,68	12,00	6,55	15,68	0,174	145,42	21,20	0,15	3,18
Middenstuk 1	26,50	6,55	5,00	10,82	0,071	62,45	11,60	0,19	2,99
Middenstuk 2	50,50	5,00	3,50	24,00	0,031	102,00	20,70	0,20	2,92
Bovenstuk 1	58,50	3,50	3,15	8,00	0,022	26,58	5,85	0,22	2,84
Bovenstuk 2	66,50	3,15	2,83	8,00	0,020	23,90	5,10	0,21	2,87
Topstuk	69,50	2,83		3,00		4,25	1,00	0,24	2,78
Ondertraverse	50,50	15,75		4,00		31,50	6,10	0,19	2,96
Boventraverse	62,50	17,00		4,00		34,00	7,60	0,22	2,83

Note: Surface transverse direction is reduced in calculation.

DNV·GL

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

Wind surface feeders telecom installations

Part	A (m^2/m)	Factor	Δh	A_1
Broekstuk 1				
Middenstuk 1				
Middenstuk 2				
Bovenstuk 1				
Bovenstuk 2				

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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 1	0,85	57,4	48,7	0,0	-48,7	7,8	449,9	381,7	0,0	-381,7
Middenstuk 1	1,08	37,6	31,9	0,0	-31,9	21,1	793,4	673,2	0,0	-673,2
Middenstuk 2	1,29	77,7	65,9	0,0	-65,9	38,5	2991,3	2538,2	0,0	-2538,2
Bovenstuk 1	1,41	23,5	20,0	0,0	-20,0	54,5	1282,1	1087,9	0,0	-1087,9
Bovenstuk 2	1,46	21,4	18,2	0,0	-18,2	62,5	1337,4	1134,9	0,0	-1134,9
Topstuk	1,49	4,1	3,5	0,0	-3,5	68,0	282,0	239,3	0,0	-239,3
Ondertraverse	1,39	50,2	29,8	0,0	-29,8	51,8	2604,3	1546,9	0,0	-1546,9
Boventraverse	1,47	63,2	37,5	0,0	-37,5	63,8	4031,8	2394,8	0,0	-2394,8
Totaal		335,2	255,5	0,0	-255,5		13772,2	9996,8	0,0	-9996,8

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 1	0,85	0,0	48,7	57,4	48,7	7,8	0,0	381,7	449,9	381,7
Middenstuk 1	1,08	0,0	31,9	37,6	31,9	21,1	0,0	673,2	793,4	673,2
Middenstuk 2	1,29	0,0	65,9	77,7	65,9	38,5	0,0	2538,2	2991,3	2538,2
Bovenstuk 1	1,41	0,0	20,0	23,5	20,0	54,5	0,0	1087,9	1282,1	1087,9
Bovenstuk 2	1,46	0,0	18,2	21,4	18,2	62,5	0,0	1134,9	1337,4	1134,9
Topstuk	1,49	0,0	3,5	4,1	3,5	68,0	0,0	239,3	282,0	239,3
Ondertraverse	1,39	0,0	29,8	20,1	29,8	51,8	0,0	1546,9	1041,7	1546,9
Boventraverse	1,47	0,0	37,5	25,3	37,5	63,8	0,0	2394,8	1612,7	2394,8
Total		0,0	255,5	267,1	255,5		0,0	9996,8	9790,6	9996,8

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	440	0	0	0
Windrichting 0°	335	0	0	0	13772	0
Windrichting 45°	256	256	0	9997	9997	0
Windrichting 90°	0	267	0	9791	0	0
Windrichting 135°	-256	256	0	9997	-9997	0

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter	A	G	E	αT
		[mm]	[mm^2]	[N/m]	[N/mm^2]	[-]
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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Conductors ahead

Circuit	Geleider	Diameter	A	G	E	αT
		[mm]	[mm^2]	[N/m]	[N/mm^2]	[-]
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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Vertical load back

Circuit	Bundle	Additional	$w_{z,G}$	Ice region	Formula	$w_{z,ijs}$	$w_{z,ijs,bundel}$
	[-]	[%]	[N/m]			[N/m]	[N/m]
Circuit 1	3	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	B	4+0,2d	8,3	8,3

Vertical load ahead

Circuit	Bundle	Additional	$w_{z,G}$	Ice region	Formula		
	[-]	[%]	[N/m]			[N/m]	[N/m]
Circuit 1	3	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	B	4+0,2d	8,3	8,3

Insulators

Conductor	$G_{isolator}$	Number	$F_{v,iso}$	Length	Wind surf.	Wind heigth	Pressure	Drag factor	$F_{h,iso}$
	[kN]	-	[kN]	[m]	[m^2]	[m]	[kN/m^2]	[-]	[kN]
380ct1f1	6,00	1	6	5,0	2,0	48,50	1,37	1,2	3,28
380ct1f2	6,00	1	6	5,0	2,0	48,50	1,37	1,2	3,28
380ct1f3	6,00	1	6	5,0	2,0	60,50	1,45	1,2	3,48
380ct2f1	6,00	1	6	5,0	2,0	48,50	1,37	1,2	3,28
380ct2f2	6,00	1	6	5,0	2,0	48,50	1,37	1,2	3,28
380ct2f3	6,00	1	6	5,0	2,0	60,50	1,45	1,2	3,48
bl1	0,10	1	0,1	0,5	0,1	66,75	1,48	1,2	0,09
bl2	0,10	1	0,1	0,5	0,1	66,75	1,48	1,2	0,09

Project: KIJ-GT
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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	33,0	1,23	0,60	0,52	1,03	28,25	64,7	56,1	46,9	124,6	108,0
380ct1f2	33,0	1,23	0,60	0,52	1,03	28,25	64,7	56,1	46,9	124,6	108,0
380ct1f3	44,8	1,34	0,62	0,54	1,01	28,25	71,3	61,7	46,9	140,9	121,9
380ct2f1	33,0	1,23	0,60	0,52	1,03	28,25	64,7	56,1	46,9	124,6	108,0
380ct2f2	33,0	1,23	0,60	0,52	1,03	28,25	64,7	56,1	46,9	124,6	108,0
380ct2f3	44,8	1,34	0,62	0,54	1,01	28,25	71,3	61,7	46,9	140,9	121,9
bl1	51,5	1,39	0,63	0,55	1,14	22,24	22,2	19,2	41,5	43,9	38,0
bl2	51,5	1,39	0,63	0,55	1,14	22,13	22,2	19,2	41,4	43,8	37,9

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	73,1	1,52	0,66	0,57	0,97	28,25	82,3	71,1	46,9	169,6	146,5
380ct1f2	73,1	1,52	0,66	0,57	0,97	28,25	82,3	71,1	46,9	169,6	146,5
380ct1f3	92,5	1,61	0,68	0,59	0,95	28,25	87,7	75,7	46,9	184,5	159,2
380ct2f1	73,1	1,52	0,66	0,57	0,97	28,25	82,3	71,1	46,9	169,6	146,5
380ct2f2	73,1	1,52	0,66	0,57	0,97	28,25	82,3	71,1	46,9	169,6	146,5
380ct2f3	92,5	1,61	0,68	0,59	0,95	28,25	87,7	75,7	46,9	184,5	159,2
bl1	99,4	1,64	0,68	0,59	1,09	22,24	27,2	23,5	41,5	55,8	48,2
bl2	99,4	1,64	0,68	0,59	1,09	22,13	27,2	23,4	41,4	55,7	48,1

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

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Project: KIJ-GT
Tower: S+18 II
Number: 11-2

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	-36,2	36,4	3,2	5,6	5,7	-0,3
380ct1f1	-120,0	120,3	9,9	18,9	21,5	2,2
380ct1f2	-120,0	120,1	9,9	20,8	21,5	2,2
380ct1f3	-122,9	123,1	10,8	21,1	22,0	0,0
380ct2f1	-120,0	119,6	11,1	25,2	21,5	2,2
380ct2f2	-120,0	119,9	11,1	23,2	21,5	2,2
380ct2f3	-122,8	122,6	12,2	25,8	22,0	0,0
bl2	-36,2	36,0	2,8	7,9	5,7	-0,3

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	-46,5	161,1	186,7
380ct1f1	82,6	190,2	203,3
380ct1f2	82,5	190,1	203,3
380ct1f3	-6,1	140,7	158,8
380ct2f1	82,6	190,2	203,3
380ct2f2	82,5	190,1	203,3
380ct2f3	-6,1	140,7	158,8
bl2	-46,6	159,2	186,7

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	187,1	190,4
380ct1f1	203,6	204,4
380ct1f2	203,6	204,4
380ct1f3	159,1	160,1
380ct2f1	203,6	204,4
380ct2f2	203,6	204,4
380ct2f3	159,1	160,1
bl2	187,1	189,6

Envelop of weight span over all combinations (incl. 0,9 combinations)		
For all conductors		Wind / Weight span ratio
Max. weight span	204,4 m	0,606 -
Min. weight span	-148,9 m	-0,442 -

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Project: KIJ-GT
Tower: S+18 II
Number: 11-2

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	8,8	5,2	-33,5	38,9
380ct1f1	51,3	28,8	21,8	-115,9	125,2
380ct1f2	51,3	30,7	21,8	-115,9	125,2
380ct1f3	51,3	31,9	18,4	-118,7	130,7
380ct2f1	51,3	36,3	21,8	-115,9	125,2
380ct2f2	51,3	34,4	21,8	-115,9	125,2
380ct2f3	51,3	38,0	18,4	-118,7	130,7
bl2	15,0	10,7	5,2	-33,5	38,8

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	-0,4	2,0	-15,0	15,0
380ct1f1	0,0	-2,0	15,3	-64,2	64,2
380ct1f2	0,0	-1,0	15,3	-64,2	64,2
380ct1f3	0,0	-1,6	13,3	-64,2	64,2
380ct2f1	0,0	2,0	15,3	-64,2	64,2
380ct2f2	0,0	1,0	15,3	-64,2	64,2
380ct2f3	0,0	1,6	13,3	-64,2	64,2
bl2	0,0	0,4	2,0	-15,0	15,0

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	2,9	-1,2
	380ct1f1	14,0	0,7
	380ct1f2	14,0	0,7
	380ct1f3	14,2	-1,7
	380ct2f1	14,0	0,7
	380ct2f2	14,0	0,7
	380ct2f3	14,2	-1,7
	bl2	2,9	-1,2

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

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	219	44	12225	-8	30
ULS 1a_0,9_90		0	219	44	12225	-8	30
ULS 3_90		0	127	112	7082	-8	19
ULS 3_0,9_90		0	127	112	7082	-8	19
SLS 7		0	0	92	0	-4	0

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

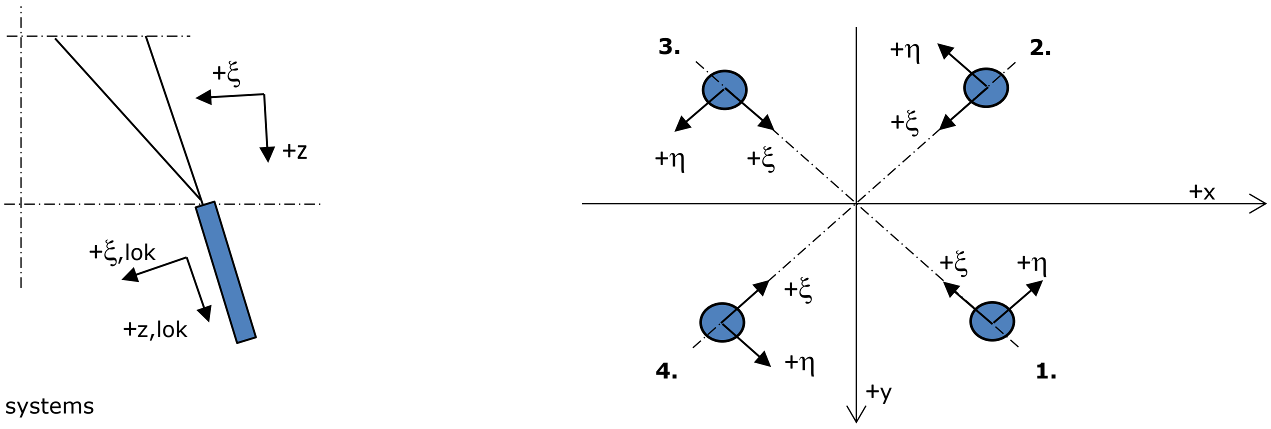
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	520	506	23230	-8	30
ULS 3_90	0	217	574	10384	-8	19
SLS 7	0	0	532	0	-4	0

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	520	506	**23230**	-8	30
ULS 1a_0,9_0,9_0	388	0	478	0	**16107**	0
ULS 5a Ba 21	51	-1	529	119	2589	**-739**
ULS 1a_0,9_0,9_135	-295	402	458	**17645**	**-11691**	15

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	240	219	**1354**	15	-325	8	1394
2	ULS 1a_0	124	-155	**811**	22	-197	2	835
3	ULS 7	-29	-29	**153**	0	-41	-4	158
4	ULS 1a_135	-240	220	**1357**	-14	-325	9	1398

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-193	171	**-1108**	15	258	-15	-1141
3	ULS 1a_0,9_0,9_45	192	172	**-1104**	-14	257	-15	-1137
4	ULS 1a_0,9_0,9_0	74	-105	**-552**	-22	127	-9	-568

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 1a_0,9_0,9_135	89	29	363	**43**	-83	6	373
2	ULS 1a_45	-41	-19	-111	**42**	15	-12	-114
3	ULS 5a Ba 31	-29	11	29	**28**	-13	-5	30
4	ULS 5a Ba 31	4	20	19	**17**	-12	-7	20

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 21	24	61	245	**-26**	-60	0	252
2	ULS 5a Ba 21	53	-31	235	**-15**	-59	-1	242
3	ULS 1a_0,9_0,9_135	45	-14	-134	**-42**	21	-11	-138
4	ULS 1a_45	-92	33	381	**-41**	-89	5	392

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Project: KIJ-GT
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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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-193	171	**-1108**	**15**	258	-15	-1141
3	ULS 1a_0,9_0,9_45	192	172	**-1104**	**-14**	257	-15	-1137
4	ULS 1a_0,9_0,9_0	74	-105	**-552**	**-22**	127	-9	-568

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	25	25	133	0	-36	-3	137
2	SLS 7	25	-25	133	0	-36	-3	137
3	SLS 7	-25	-25	133	0	-36	-3	137
4	SLS 7	-25	25	133	0	-36	-3	137

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_135	-240	220	**1357**	-14	-325	9	1398
Max. tension	ULS 1a_0,9_0,9_135	-193	171	**-1108**	15	258	-15	-1141
Max. pos. torsie	ULS 1a_0,9_0,9_135	89	29	363	**43**	-83	6	373
Max. neg. torsie	ULS 1a_0,9_0,9_135	45	-14	-134	**-42**	21	-11	-138
Comb. tension+torsie	ULS 1a_0,9_0,9_135	-193	171	**-1108**	**15**	258	-15	-1141

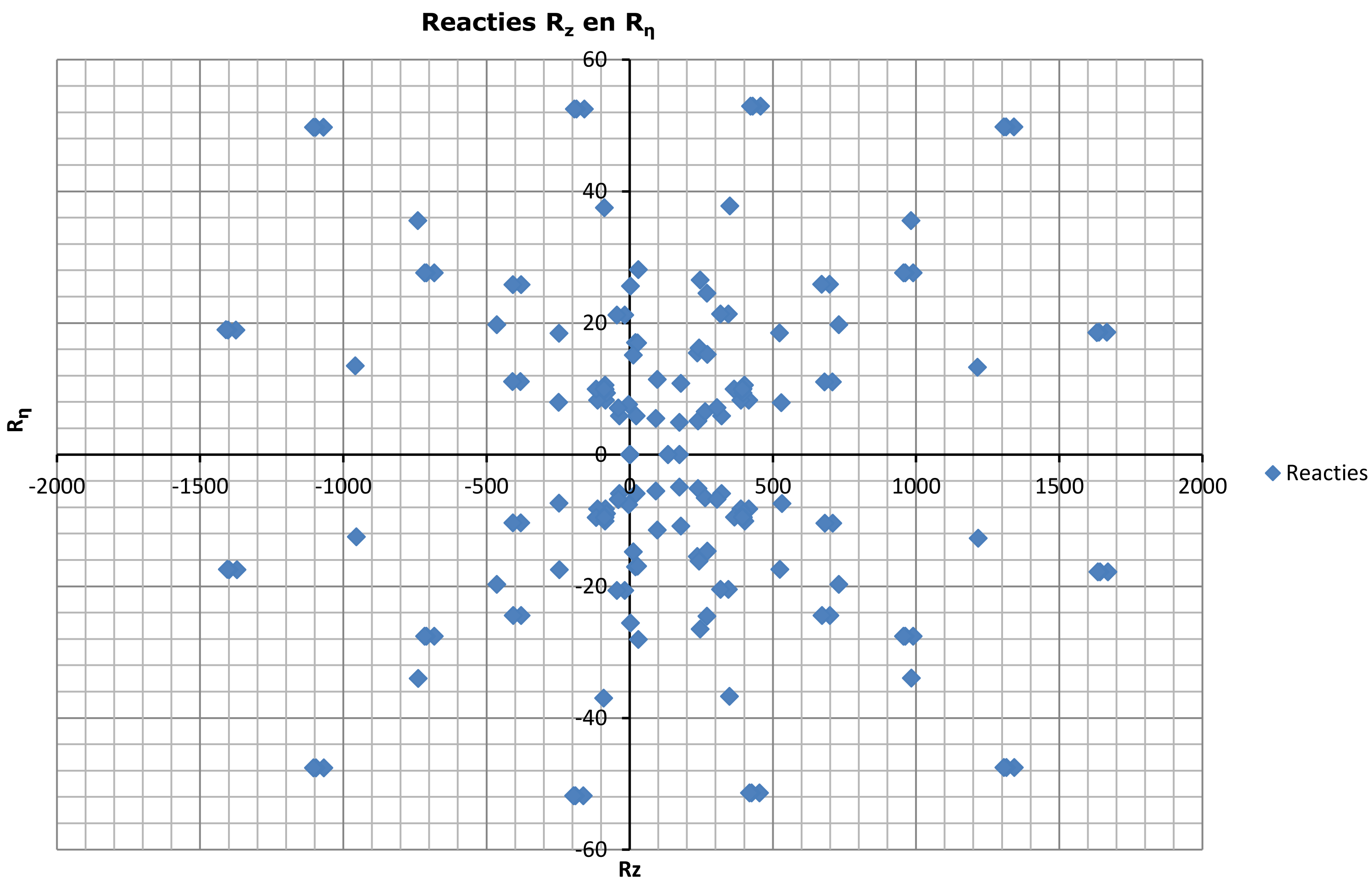
Maximum tension load - SLS

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	25	25	**133**	0	-36	-3	137
2	SLS 1a_135	-155	137	**-896**	13	207	-13	-923
3	SLS 1a_45	154	138	**-894**	-12	207	-13	-920
4	SLS 1a_0	56	-82	**-430**	-19	98	-8	-443

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	205	187	**1152**	13	-277	7	1187
2	SLS 1a_0	107	-133	**696**	19	-170	1	717
3	SLS 7	-25	-25	**133**	0	-36	-3	137
4	SLS 1a_135	-204	188	**1155**	-12	-277	7	1189

Project: KIJ-GT
Tower: S+18 II
Number: 11-2



Project: KIJ-GT
Tower: S+18 II
Number: 11-2

DNV·GL

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

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	-43,2	43,4	4,0	7,0	6,5	-0,3
380ct1f1	-142,0	142,3	12,4	23,8	25,2	2,4
380ct1f2	-142,0	142,1	12,4	26,0	25,2	2,4
380ct1f3	-145,7	145,9	13,5	26,5	25,8	0,0
380ct2f1	-141,9	141,5	13,8	31,2	25,2	2,4
380ct2f2	-141,9	141,8	13,8	28,8	25,2	2,4
380ct2f3	-145,6	145,3	15,2	32,0	25,8	0,0
bl2	-43,2	42,9	3,5	9,7	6,6	-0,3

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	-64,4	159,0	186,7
380ct1f1	71,9	189,3	203,3
380ct1f2	71,7	189,3	203,3
380ct1f3	-20,6	139,5	158,8
380ct2f1	71,9	189,3	203,3
380ct2f2	71,7	189,3	203,3
380ct2f3	-20,6	139,5	158,8
bl2	-64,5	157,1	186,7

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	188,0	193,2
380ct1f1	204,2	206,0
380ct1f2	204,2	206,0
380ct1f3	159,9	162,3
380ct2f1	204,2	206,0
380ct2f2	204,2	206,0
380ct2f3	159,9	162,3
bl2	188,0	192,4

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

For all conductors		Wind / Weight span ratio
Max. weight span	206,0 m	0,611 -
Min. weight span	-244,3 m	-0,725 -

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	11,0	5,5	-40,0	46,4
380ct1f1	51,3	36,2	25,4	-136,9	148,8
380ct1f2	51,3	38,4	25,4	-136,9	148,9
380ct1f3	51,3	39,9	21,5	-140,3	155,8
380ct2f1	51,3	45,0	25,4	-136,9	148,8
380ct2f2	51,3	42,7	25,4	-136,9	148,9
380ct2f3	51,3	47,2	21,5	-140,3	155,8
bl2	15,0	13,3	5,5	-39,9	46,4

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	-0,4	2,0	-15,0	15,0
380ct1f1	0,0	-2,0	15,3	-64,2	64,2
380ct1f2	0,0	-1,0	15,3	-64,2	64,2
380ct1f3	0,0	-1,6	13,3	-64,2	64,2
380ct2f1	0,0	2,0	15,3	-64,2	64,2
380ct2f2	0,0	1,0	15,3	-64,2	64,2
380ct2f3	0,0	1,6	13,3	-64,2	64,2
bl2	0,0	0,4	2,0	-15,0	15,0

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	2,9	-1,2
	380ct1f1	14,0	0,7
	380ct1f2	14,0	0,7
	380ct1f3	14,2	-1,8
	380ct2f1	14,0	0,7
	380ct2f2	14,0	0,7
	380ct2f3	14,2	-1,8
	bl2	2,9	-1,3

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

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	273	38	15227	-10	38
ULS 1a_0,9_90		0	273	38	15227	-10	38
ULS 3_90		0	158	130	8821	-10	24
ULS 3_0,9_90		0	158	130	8821	-10	24
SLS 7		0	0	92	0	-4	0

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

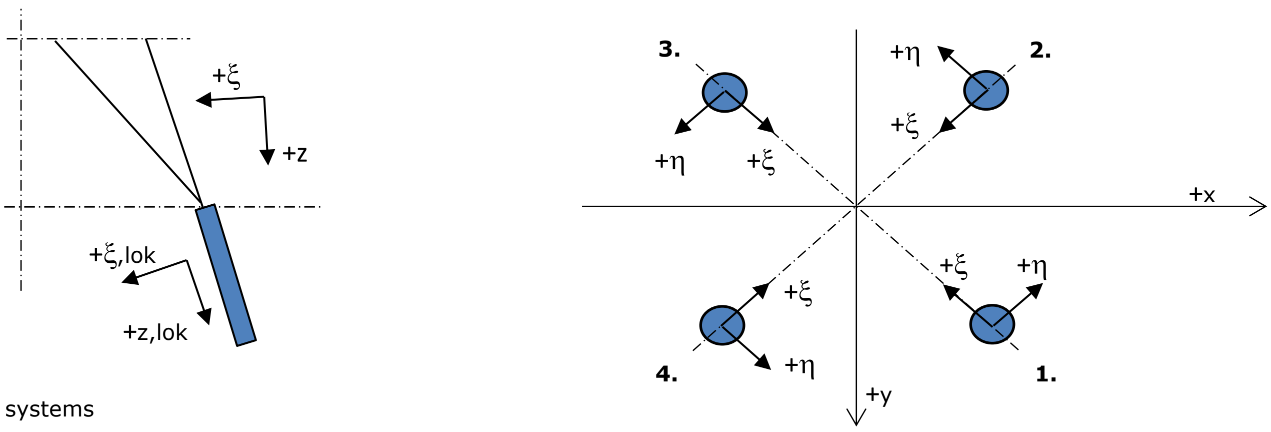
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	647	544	28933	-10	38
ULS 3_90	0	270	636	12933	-10	24
SLS 7	0	0	532	0	-4	0

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	647	544	**28933**	-10	38
ULS 1a_0,9_0,9_0	483	0	478	0	**20062**	0
ULS 5a Ba 21	51	-1	529	119	2589	**-739**
ULS 1a_0,9_0,9_135	-368	501	450	**21980**	**-14560**	19

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	295	269	**1665**	19	-398	11	1715
2	ULS 1a_0	150	-189	**989**	28	-240	3	1018
3	ULS 7	-33	-33	**173**	0	-47	-4	178
4	ULS 1a_135	-295	270	**1669**	-18	-399	11	1719

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-246	219	**-1410**	19	329	-18	-1452
3	ULS 1a_0,9_0,9_45	244	220	**-1406**	-17	328	-17	-1448
4	ULS 1a_0,9_0,9_0	98	-137	**-716**	-28	166	-10	-738

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 1a_0,9_0,9_135	105	30	422	**53**	-96	8	434
2	ULS 1a_45	-55	-19	-159	**53**	25	-14	-164
3	ULS 5a Ba 31	-29	11	29	**28**	-13	-5	30
4	ULS 5a Ba 31	4	20	19	**17**	-12	-7	20

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 1a_0,9_0,9_0	144	183	956	**-28**	-231	4	984
2	ULS 5a Ba 21	53	-31	235	**-15**	-59	-1	242
3	ULS 1a_0,9_0,9_135	61	-12	-197	**-52**	35	-14	-203
4	ULS 1a_45	-110	38	453	**-51**	-104	7	466

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-246	219	**-1410**	**19**	329	-18	-1452
3	ULS 1a_0,9_0,9_45	244	220	**-1406**	**-17**	328	-17	-1448
4	ULS 1a_0,9_0,9_0	98	-137	**-716**	**-28**	166	-10	-738

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	25	25	133	0	-36	-3	137
2	SLS 7	25	-25	133	0	-36	-3	137
3	SLS 7	-25	-25	133	0	-36	-3	137
4	SLS 7	-25	25	133	0	-36	-3	137

Envelope of load combinations for all of the legs

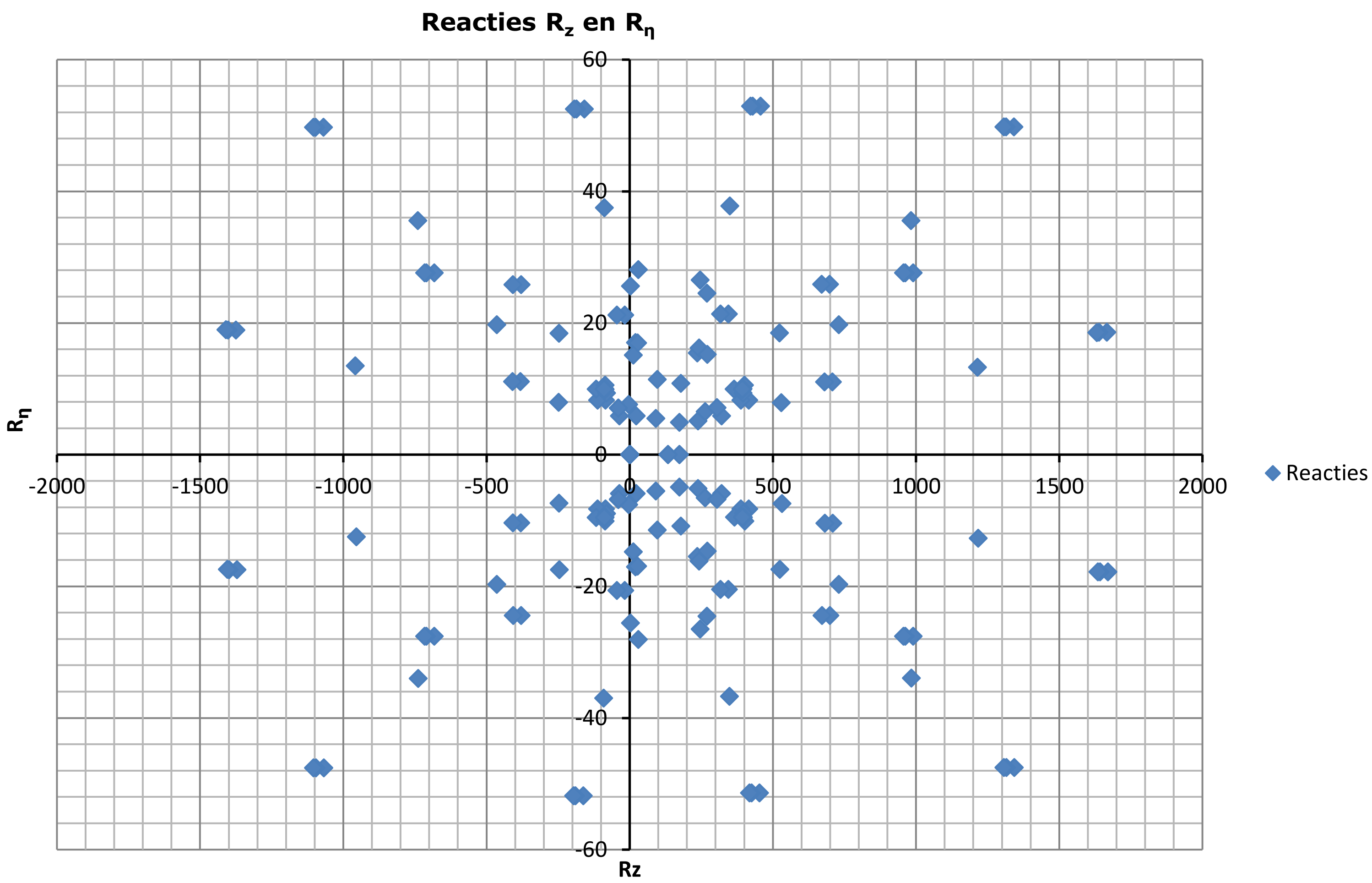
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_135	-295	270	**1669**	-18	-399	11	1719
Max. tension	ULS 1a_0,9_0,9_135	-246	219	**-1410**	19	329	-18	-1452
Max. pos. torsie	ULS 1a_0,9_0,9_135	105	30	422	**53**	-96	8	434
Max. neg. torsie	ULS 1a_0,9_0,9_135	61	-12	-197	**-52**	35	-14	-203
Comb. tension+torsie	ULS 1a_0,9_0,9_135	-246	219	**-1410**	**19**	329	-18	-1452

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	25	25	**133**	0	-36	-3	137
2	SLS 1a_135	-166	147	**-958**	14	222	-14	-987
3	SLS 1a_45	165	148	**-955**	-12	221	-14	-984
4	SLS 1a_0	61	-89	**-464**	-20	106	-8	-478

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	215	197	**1214**	13	-291	7	1250
2	SLS 1a_0	112	-140	**730**	20	-178	2	752
3	SLS 7	-25	-25	**133**	0	-36	-3	137
4	SLS 1a_135	-215	197	**1216**	-13	-292	7	1253


Reacties R_z en R_η
60
40
20
0
-20
-40
-60
-2000
-1500
-1000
-500
0
500
1000
1500
2000
R_η
Rz
Reacties

Content

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 C_{dir}	1,00
Ice region	B
Tower type	Steunmast
Tower height	69,5 m
Max. Span	400 m
Line angle	180°
Catenary	1400 m
Wind span	400 m
EDS Weight span	570 m
Min. Weight span	522 m
Max. Weight span	798 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype S+18

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

Document name:

KIJ-GT_S+18_60_Report.pdf

Project number:

Project client number:

0.0

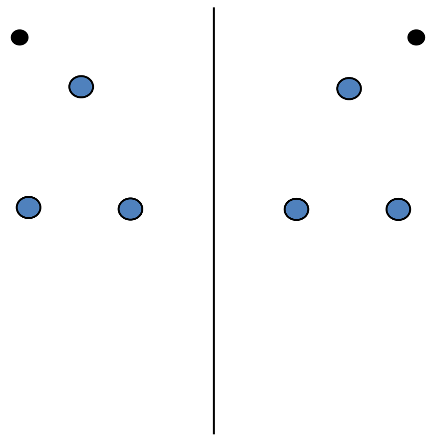
Project: KIJ-GT
Tower: S+18
Number: 60

Auteur: TBR
Versie: v11.3

Conductor loads

General

Description	S+18
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	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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Halfverankering	2,00	4,30	1,00
Circuit 2	Halfverankering	2,00	4,30	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,50	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,50	0,05

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	46,2 m	50,5 m	17,5 m
Circuit 1	11	380ct1f2	46,2 m	50,5 m	9,5 m
Circuit 1	12	380ct1f3	58,2 m	62,5 m	13,5 m
Circuit 2	21	380ct2f1	46,2 m	50,5 m	-17,5 m
Circuit 2	20	380ct2f2	46,2 m	50,5 m	-9,5 m
Circuit 2	22	380ct2f3	58,2 m	62,5 m	-13,5 m
Bliksemdraad 1	1	bl1	66,0 m	66,5 m	18,5 m
Bliksemdraad 2	3	bl2	66,0 m	66,5 m	-18,5 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

Project: KIJ-GT
Tower: S+18
Number: 60

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

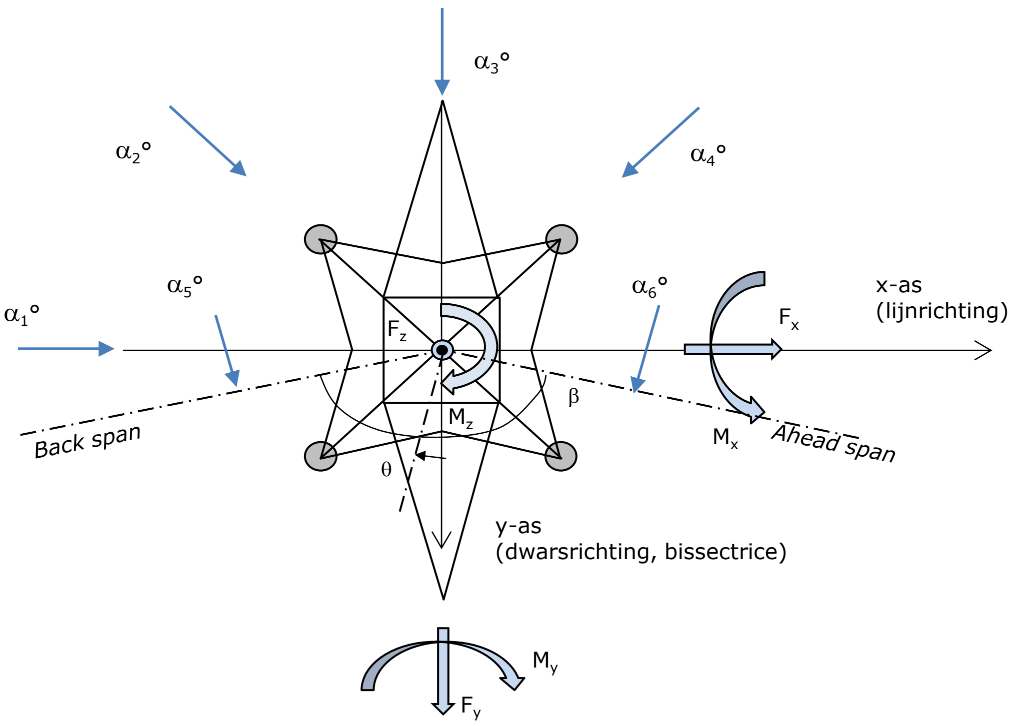
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	-18,0	-18,4 m	1,8	1,8 m
Circuit 1	11	380ct1f2	-18,0	-18,4 m	0,8	0,8 m
Circuit 1	12	380ct1f3	-18,7	-19,1 m	1,3	1,3 m
Circuit 2	21	380ct2f1	-18,0	-18,4 m	-1,8	-1,8 m
Circuit 2	20	380ct2f2	-18,0	-18,4 m	-0,8	-0,8 m
Circuit 2	22	380ct2f3	-18,7	-19,1 m	-1,3	-1,3 m
Bliksemdraad 1	1	bl1	-22,7	-22,8 m	2,3	1,3 m
Bliksemdraad 2	3	bl2	-22,7	-22,8 m	-2,3	-1,3 m

Line and tower data

		Back	Ahead
		399,0	400,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		377,7	377,7 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		2580	2580 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: KIJ-GT
Tower: S+18
Number: 60

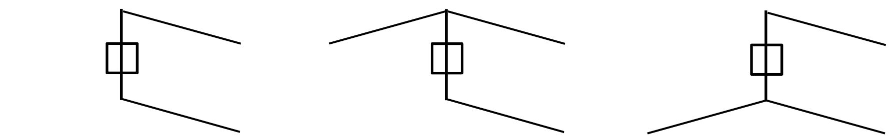
Absence of conductors

		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

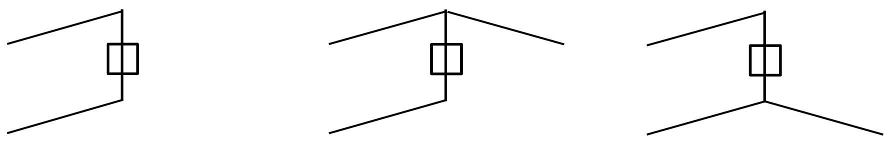
Load situations SPLS

Considered situations SPLS: SPLS for suspension tower not applicable

Principle of load situations:



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

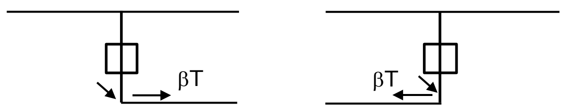


4. Ah All cts 5. Ah ct1 6. Ah ct2

Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1, design assumption is symmetry back and ahead

Principle of load situations:



1. Ba 2. Ah

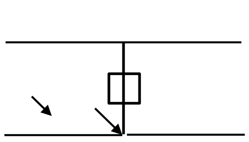
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine 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

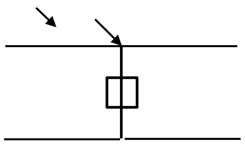
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

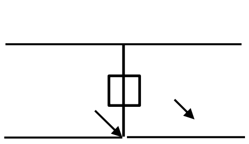
Principle of load situations:



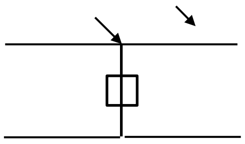
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

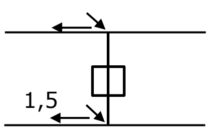
Load situations 8. Galloping as a static load

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

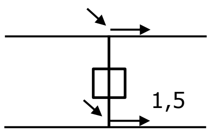
Considered situations galloping 8: None (existing structure)

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: KIJ-GT
Tower: S+18
Number: 60

Tower structure

Properties

Tower type	Steunmast		
Tower designation	S+18		
Base plate w.r.t. ground level	0,5	m	
Tower height w.r.t. base plate	69,5	m	
Tower self weight	440,0	kN	

Width and slope at foundation	x-ri.	y-ri.	
Leg spread	12,00	12,00	m
Inclination of main leg	0,174	0,174	-
Horizontal force factor	1,1	1,1	-

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 1	15,68	12,00	6,55	15,68	0,174	145,42	21,20	0,15	3,18
Middenstuk 1	26,50	6,55	5,00	10,82	0,071	62,45	11,60	0,19	2,99
Middenstuk 2	50,50	5,00	3,50	24,00	0,031	102,00	20,70	0,20	2,92
Bovenstuk 1	58,50	3,50	3,15	8,00	0,022	26,58	5,85	0,22	2,84
Bovenstuk 2	66,50	3,15	2,83	8,00	0,020	23,90	5,10	0,21	2,87
Topstuk	69,50	2,83		3,00		4,25	1,00	0,24	2,78
Ondertraverse	50,50	15,75		4,00		31,50	6,10	0,19	2,96
Boventraverse	62,50	17,00		4,00		34,00	7,60	0,22	2,83

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 1	15,68	12,00	6,55	15,68	0,174	145,42	21,20	0,15	3,18
Middenstuk 1	26,50	6,55	5,00	10,82	0,071	62,45	11,60	0,19	2,99
Middenstuk 2	50,50	5,00	3,50	24,00	0,031	102,00	20,70	0,20	2,92
Bovenstuk 1	58,50	3,50	3,15	8,00	0,022	26,58	5,85	0,22	2,84
Bovenstuk 2	66,50	3,15	2,83	8,00	0,020	23,90	5,10	0,21	2,87
Topstuk	69,50	2,83		3,00		4,25	1,00	0,24	2,78
Ondertraverse	50,50	15,75		4,00		31,50	6,10	0,19	2,96
Boventraverse	62,50	17,00		4,00		34,00	7,60	0,22	2,83

Note: Surface transverse direction is reduced in calculation.

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Project: KIJ-GT
Tower: S+18
Number: 60

Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
Bovenstuk 1			
Bovenstuk 2			

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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/m²]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk 1	0,70	47,2	40,1	0,0	-40,1	7,8	370,4	314,3	0,0	-314,3
Middenstuk 1	0,89	31,0	26,3	0,0	-26,3	21,1	653,3	554,3	0,0	-554,3
Middenstuk 2	1,06	64,0	54,3	0,0	-54,3	38,5	2463,0	2089,9	0,0	-2089,9
Bovenstuk 1	1,16	19,3	16,4	0,0	-16,4	54,5	1053,2	893,7	0,0	-893,7
Bovenstuk 2	1,20	17,6	15,0	0,0	-15,0	62,5	1101,2	934,4	0,0	-934,4
Topstuk	1,23	3,4	2,9	0,0	-2,9	68,0	232,2	197,1	0,0	-197,1
Ondertraverse	1,15	41,4	24,6	0,0	-24,6	51,8	2144,3	1273,7	0,0	-1273,7
Boventraverse	1,21	52,0	30,9	0,0	-30,9	63,8	3319,7	1971,8	0,0	-1971,8
Totaal		275,9	210,4	0,0	-210,4		11337,4	8229,2	0,0	-8229,2

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/m²]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk 1	0,70	0,0	40,1	47,2	40,1	7,8	0,0	314,3	370,4	314,3
Middenstuk 1	0,89	0,0	26,3	31,0	26,3	21,1	0,0	554,3	653,3	554,3
Middenstuk 2	1,06	0,0	54,3	64,0	54,3	38,5	0,0	2089,9	2463,0	2089,9
Bovenstuk 1	1,16	0,0	16,4	19,3	16,4	54,5	0,0	893,7	1053,2	893,7
Bovenstuk 2	1,20	0,0	15,0	17,6	15,0	62,5	0,0	934,4	1101,2	934,4
Topstuk	1,23	0,0	2,9	3,4	2,9	68,0	0,0	197,1	232,2	197,1
Ondertraverse	1,15	0,0	24,6	16,5	24,6	51,8	0,0	1273,7	857,7	1273,7
Boventraverse	1,21	0,0	30,9	20,8	30,9	63,8	0,0	1971,8	1327,9	1971,8
Total		0,0	210,4	219,9	210,4		0,0	8229,2	8058,9	8229,2

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	440	0	0	0
Windrichting 0°	276	0	0	0	11337	0
Windrichting 45°	210	210	0	8229	8229	0
Windrichting 90°	0	220	0	8059	0	0
Windrichting 135°	-210	210	0	8229	-8229	0

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Project: KIJ-GT
Tower: S+18
Number: 60

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter [mm]	A [mm²]	G [N/m]	E [N/mm²]	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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Conductors ahead

Circuit	Geleider	Diameter [mm]	A [mm²]	G [N/m]	E [N/mm²]	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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	B	4+0,2d	8,3	8,3

Insulators

Conductor	$G_{isolator}$ [kN]	Number -	$F_{v,iso}$ [kN]	Length [m]	Wind surf. [m²]	Wind heigth [m]	Pressure [kN/m²]	Drag factor [-]	$F_{h,iso}$ [kN]
380ct1f1	2,00	1	2	4,3	1,0	48,85	1,13	1,2	1,35
380ct1f2	2,00	1	2	4,3	1,0	48,85	1,13	1,2	1,35
380ct1f3	2,00	1	2	4,3	1,0	60,85	1,19	1,2	1,43
380ct2f1	2,00	1	2	4,3	1,0	48,85	1,13	1,2	1,35
380ct2f2	2,00	1	2	4,3	1,0	48,85	1,13	1,2	1,35
380ct2f3	2,00	1	2	4,3	1,0	60,85	1,19	1,2	1,43
bl1	0,10	1	0,1	0,5	0,1	66,75	1,22	1,2	0,07
bl2	0,10	1	0,1	0,5	0,1	66,75	1,22	1,2	0,07

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Project: KIJ-GT
Tower: S+18
Number: 60

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	28,2	0,97	0,57	0,50	1,10	28,25	52,1	45,9	46,9	94,0	82,8
380ct1f2	28,2	0,97	0,57	0,50	1,10	28,25	52,1	45,9	46,9	94,0	82,8
380ct1f3	39,9	1,07	0,60	0,53	1,08	28,25	58,6	51,5	46,9	108,4	95,4
380ct2f1	28,2	0,97	0,57	0,50	1,10	28,25	52,1	45,9	46,9	94,0	82,8
380ct2f2	28,2	0,97	0,57	0,50	1,10	28,25	52,1	45,9	46,9	94,0	82,8
380ct2f3	39,9	1,07	0,60	0,53	1,08	28,25	58,6	51,5	46,9	108,4	95,4
bl1	46,3	1,11	0,61	0,54	1,19	22,24	18,0	15,8	41,5	33,9	29,8
bl2	46,3	1,11	0,61	0,54	1,19	22,13	18,0	15,8	41,4	33,8	29,8

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	28,0	0,97	0,57	0,50	1,10	28,25	51,9	45,7	46,9	93,6	82,5
380ct1f2	28,0	0,97	0,57	0,50	1,10	28,25	51,9	45,7	46,9	93,6	82,5
380ct1f3	39,6	1,07	0,60	0,53	1,08	28,25	58,4	51,4	46,9	108,1	95,1
380ct2f1	28,0	0,97	0,57	0,50	1,10	28,25	51,9	45,7	46,9	93,6	82,5
380ct2f2	28,0	0,97	0,57	0,50	1,10	28,25	51,9	45,7	46,9	93,6	82,5
380ct2f3	39,6	1,07	0,60	0,53	1,08	28,25	58,4	51,4	46,9	108,1	95,1
bl1	46,2	1,11	0,61	0,54	1,19	22,24	18,0	15,8	41,5	33,9	29,8
bl2	46,2	1,11	0,61	0,54	1,19	22,13	17,9	15,8	41,4	33,8	29,7

Project: KIJ-GT
Tower: S+18
Number: 60

Conductor loads

Auteur: TBR
Versie: v11.3

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

Project: KIJ-GT
Tower: S+18
Number: 60

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	-29,5	29,5	4,2	4,2	7,1	7,1
bl2	-29,7	29,7	3,9	4,0	7,1	7,1
380ct1f1	-110,3	110,3	12,8	12,8	21,1	21,3
380ct1f2	-110,3	110,3	12,5	12,5	21,1	21,3
380ct1f3	-112,1	112,1	14,2	14,2	21,4	21,6
380ct2f1	-110,3	110,3	12,0	11,9	21,1	21,3
380ct2f2	-110,3	110,3	12,2	12,2	21,1	21,3
380ct2f3	-112,1	112,1	13,5	13,5	21,4	21,6

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	570,2	595,6	570,2
bl2	570,2	600,5	570,2
380ct1f1	527,1	541,5	527,1
380ct1f2	527,1	541,5	527,1
380ct1f3	532,0	547,5	532,0
380ct2f1	527,1	541,5	527,1
380ct2f2	527,1	541,5	527,1
380ct2f3	532,0	547,5	532,0

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	700,8	580,0
bl2	700,8	581,8
380ct1f1	577,7	532,2
380ct1f2	577,7	532,2
380ct1f3	595,5	539,5
380ct2f1	577,7	532,2
380ct2f2	577,7	532,2
380ct2f3	595,5	539,5

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

For all conductors		Wind / Weight span ratio
Max. weight span	740,7 m	1,854 -
Min. weight span	525,1 m	1,314 -

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Project: KIJ-GT
Tower: S+18
Number: 60

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	8,4	10,9	-31,4	31,4
bl2	15,0	7,8	10,9	-31,5	31,5
380ct1f1	51,3	25,5	42,4	-110,3	110,3
380ct1f2	51,3	25,1	42,4	-110,3	110,3
380ct1f3	51,3	28,3	43,0	-112,1	112,1
380ct2f1	51,3	23,9	42,4	-110,3	110,3
380ct2f2	51,3	24,3	42,4	-110,3	110,3
380ct2f3	51,3	27,1	43,0	-112,1	112,1

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,1	5,8	-15,0	15,0
bl2	0,0	-0,1	5,8	-15,0	15,0
380ct1f1	0,0	0,6	26,2	-64,2	64,2
380ct1f2	0,0	0,3	26,2	-64,2	64,2
380ct1f3	0,0	0,4	26,4	-64,2	64,2
380ct2f1	0,0	-0,6	26,2	-64,2	64,2
380ct2f2	0,0	-0,3	26,2	-64,2	64,2
380ct2f3	0,0	-0,4	26,4	-64,2	64,2

1 **Control uplift SLS-wind**

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	3,0	3,0
	bl2	3,0	3,1
	380ct1f1	13,4	13,5
	380ct1f2	13,4	13,5
	380ct1f3	13,5	13,6
	380ct2f1	13,4	13,5
	380ct2f2	13,4	13,5
	380ct2f3	13,5	13,6

Project: KIJ-GT
Tower: S+18
Number: 60

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	170	196	9528	0	0
ULS 1a_0,9_90		0	170	196	9528	0	0
ULS 3_90		0	91	277	5104	0	0
ULS 3_0,9_90		0	91	277	5104	0	0
SLS 7		0	0	169	0	0	0

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

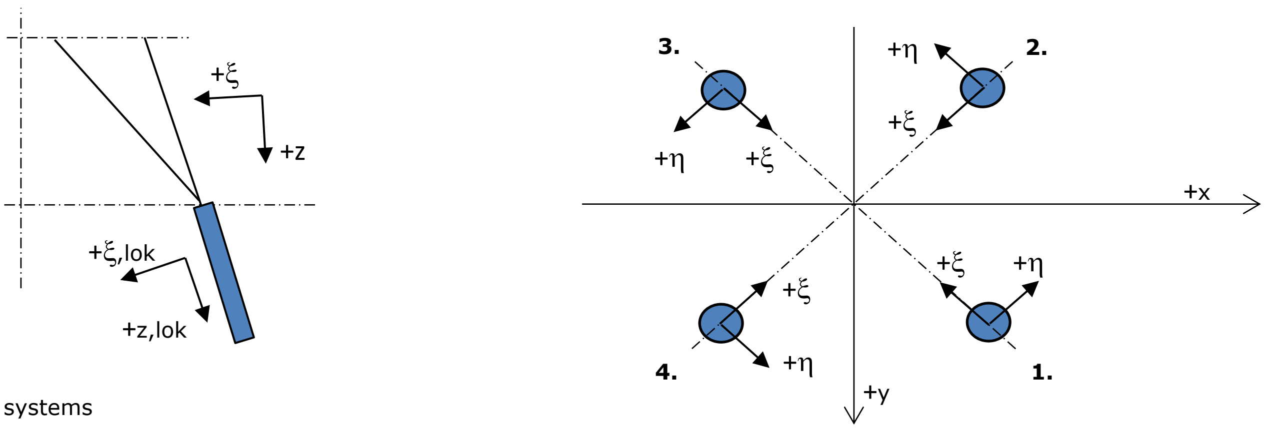
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	416	658	18528	0	0
ULS 3_90	0	165	739	7804	0	0
SLS 7	0	0	609	0	0	0

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	416	658	**18528**	0	0
ULS 1a_0	311	0	639	0	**12798**	0
ULS 5a Ba 10	51	0	605	-228	2593	**898**
ULS 1a_0,9_0,9_135	-237	322	555	**14063**	**-9287**	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	202	185	**1134**	12	-274	5	1168
2	ULS 1a_0	108	-133	**693**	17	-170	0	714
3	ULS 7	-33	-33	**175**	0	-47	-4	180
4	ULS 1a_135	-202	185	**1134**	-12	-274	5	1168

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-145	128	**-834**	12	193	-12	-859
3	ULS 1a_0,9_0,9_45	145	128	**-834**	-12	193	-12	-859
4	ULS 1a_0,9_0,9_0	51	-76	**-396**	-17	90	-7	-408

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 1a_0,9_0,9_135	79	33	338	**33**	-80	4	348
2	ULS 1a_45	-22	-24	-38	**33**	-2	-11	-39
3	ULS 5a Ba 10	-37	10	53	**33**	-19	-6	54
4	ULS 5a Ba 10	4	27	34	**22**	-16	-8	35

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 21	25	68	269	**-31**	-66	0	277
2	ULS 5a Ba 21	59	-31	250	**-20**	-63	-2	257
3	ULS 1a_0,9_0,9_135	26	-20	-60	**-33**	4	-10	-62
4	ULS 5a Ba 21	-37	-10	53	**-33**	-19	-6	54

Project: KIJ-GT
Tower: S+18
Number: 60

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-145	128	**-834**	**12**	193	-12	-859
3	ULS 1a_0,9_0,9_45	145	128	**-834**	**-12**	193	-12	-859
4	ULS 1a_0,9_0,9_0	51	-76	**-396**	**-17**	90	-7	-408

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	29	29	152	0	-41	-4	157
2	SLS 7	29	-29	152	0	-41	-4	157
3	SLS 7	-29	-29	152	0	-41	-4	157
4	SLS 7	-29	29	152	0	-41	-4	157

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_135	-202	185	**1134**	-12	-274	5	1168
Max. tension	ULS 1a_0,9_0,9_135	-145	128	**-834**	12	193	-12	-859
Max. pos. torsie	ULS 5a Ba 10	-37	10	53	**33**	-19	-6	54
Max. neg. torsie	ULS 5a Ba 21	-37	-10	53	**-33**	-19	-6	54
Comb. tension+torsie	ULS 1a_0,9_0,9_135	-145	128	**-834**	**12**	193	-12	-859

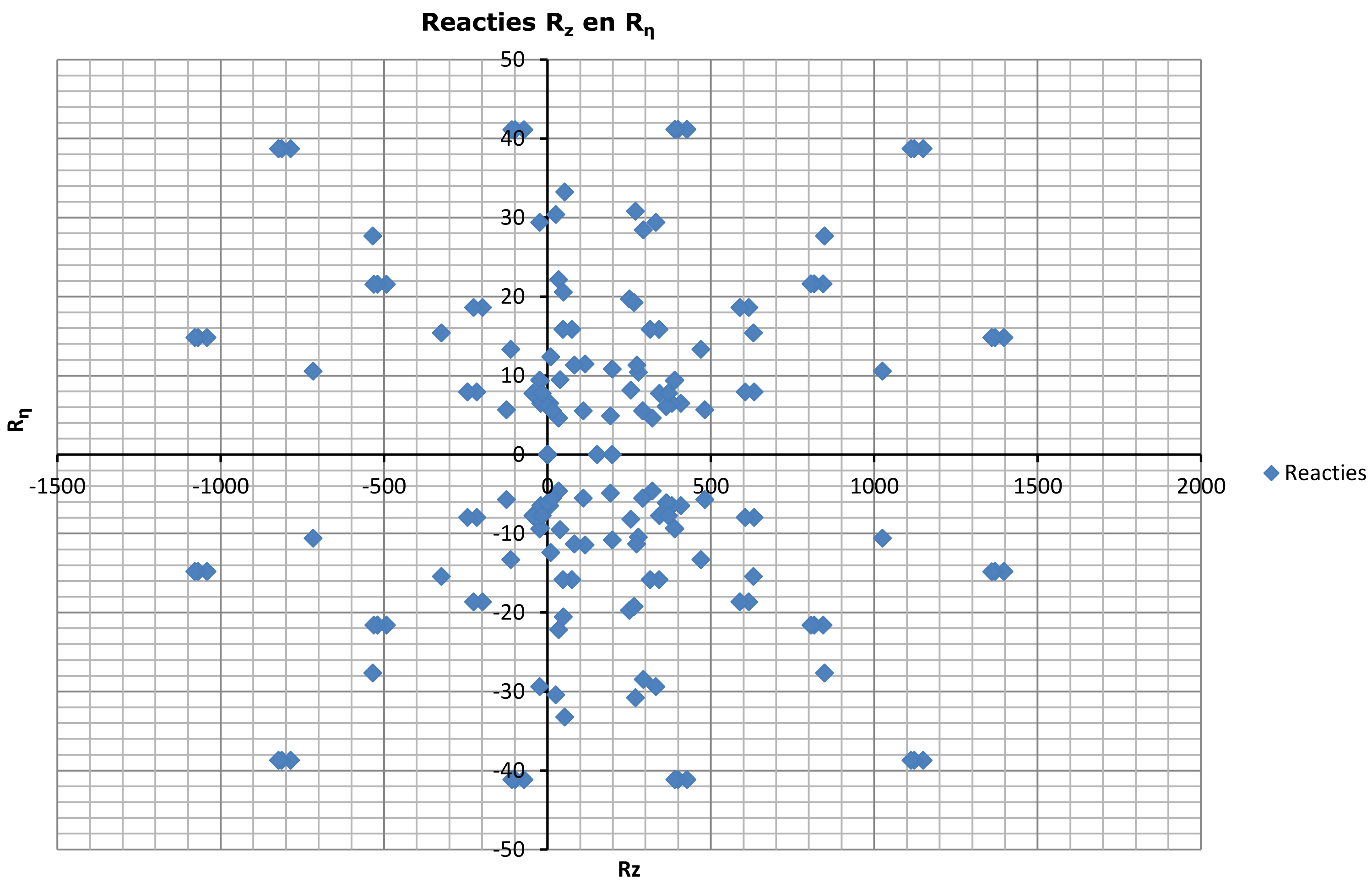
Maximum tension load - SLS

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	29	29	**152**	0	-41	-4	157
2	SLS 1a_135	-115	101	**-668**	10	153	-11	-688
3	SLS 1a_45	115	101	**-668**	-10	153	-11	-688
4	SLS 1a_0	36	-57	**-298**	-15	66	-7	-307

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	174	160	**975**	10	-236	4	1004
2	SLS 1a_0	95	-115	**603**	15	-148	0	621
3	SLS 7	-29	-29	**152**	0	-41	-4	157
4	SLS 1a_135	-174	160	**975**	-10	-236	4	1004

Project: KIJ-GT
Tower: S+18
Number: 60



Project: KIJ-GT
Tower: S+18
Number: 60

		Auteur:	TBR
Conductor loads		Versie:	v11.3

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

Project: KIJ-GT
Tower: S+18
Number: 60

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	-34,5	34,5	5,3	5,2	7,7	7,7
bl2	-34,8	34,8	4,9	5,0	7,7	7,7
380ct1f1	-128,4	128,4	16,0	16,0	24,9	25,0
380ct1f2	-128,4	128,4	15,7	15,7	24,9	25,0
380ct1f3	-130,7	130,7	17,7	17,7	25,2	25,4
380ct2f1	-128,5	128,5	15,0	15,0	24,9	25,0
380ct2f2	-128,4	128,4	15,3	15,3	24,9	25,0
380ct2f3	-130,7	130,7	17,0	17,0	25,2	25,4

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	570,2	596,4	570,2
bl2	570,2	601,3	570,2
380ct1f1	527,1	541,8	527,1
380ct1f2	527,1	541,8	527,1
380ct1f3	532,0	547,9	532,0
380ct2f1	527,1	541,8	527,1
380ct2f2	527,1	541,8	527,1
380ct2f3	532,0	547,9	532,0

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	722,3	575,0
bl2	722,5	576,6
380ct1f1	587,9	529,7
380ct1f2	587,9	529,7
380ct1f3	607,9	537,1
380ct2f1	587,9	529,7
380ct2f2	587,9	529,7
380ct2f3	607,9	537,1

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

For all conductors		Wind / Weight span ratio
Max. weight span	797,8 m	1,997 -
Min. weight span	522,2 m	1,307 -

Project: KIJ-GT
Tower: S+18
Number: 60

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	10,5	13,0	-34,5	34,5
bl2	15,0	9,9	13,0	-34,8	34,8
380ct1f1	51,3	31,9	49,9	-128,4	128,4
380ct1f2	51,3	31,4	49,9	-128,4	128,4
380ct1f3	51,3	35,5	50,6	-130,7	130,7
380ct2f1	51,3	30,1	49,9	-128,4	128,4
380ct2f2	51,3	30,6	49,9	-128,4	128,4
380ct2f3	51,3	34,0	50,6	-130,7	130,7

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,1	5,8	-15,0	15,0
bl2	0,0	-0,1	5,8	-15,0	15,0
380ct1f1	0,0	0,6	26,2	-64,2	64,2
380ct1f2	0,0	0,3	26,2	-64,2	64,2
380ct1f3	0,0	0,4	26,4	-64,2	64,2
380ct2f1	0,0	-0,6	26,2	-64,2	64,2
380ct2f2	0,0	-0,3	26,2	-64,2	64,2
380ct2f3	0,0	-0,4	26,4	-64,2	64,2

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	3,0	3,0
	bl2	3,1	3,1
	380ct1f1	13,4	13,5
	380ct1f2	13,4	13,5
	380ct1f3	13,5	13,6
	380ct2f1	13,4	13,5
	380ct2f2	13,4	13,5
	380ct2f3	13,5	13,6

Project: KIJ-GT
Tower: S+18
Number: 60

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	214	219	11945	0	0
ULS 1a_0,9_90		0	214	219	11945	0	0
ULS 3_90		0	114	327	6398	0	0
ULS 3_0,9_90		0	114	327	6398	0	0
SLS 7		0	0	169	0	0	0

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

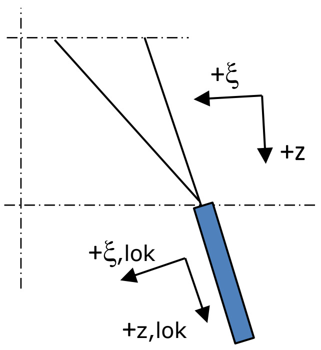
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	521	725	23228	0	0
ULS 3_90	0	207	833	9783	0	0
SLS 7	0	0	609	0	0	0

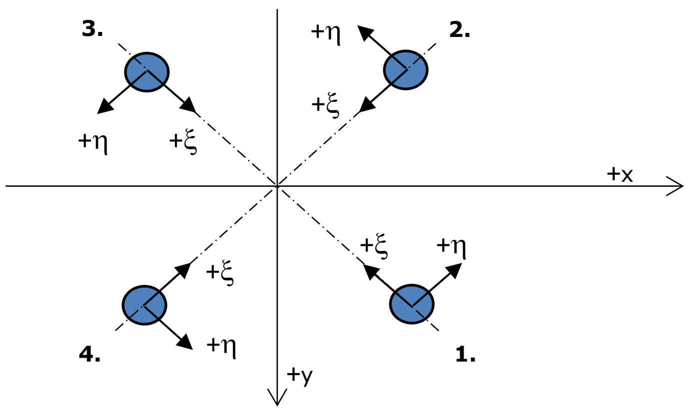
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	521	725	**23228**	0	0
ULS 1a_0	389	0	700	0	**16044**	0
ULS 5a Ba 10	51	0	605	-228	2593	**898**
ULS 1a_0,9_0,9_135	-297	404	558	**17630**	**-11643**	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	248	228	**1396**	15	-337	7	1438
2	ULS 1a_0	131	-161	**843**	22	-207	1	869
3	ULS 7	-38	-38	**198**	0	-53	-5	203
4	ULS 1a_135	-249	228	**1397**	-15	-337	7	1438

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-188	167	**-1080**	15	251	-15	-1112
3	ULS 1a_0,9_0,9_45	188	167	**-1080**	-15	251	-15	-1112
4	ULS 1a_0,9_0,9_0	71	-102	**-531**	-22	122	-9	-547

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 1a_0,9_0,9_135	93	35	389	**41**	-90	5	401
2	ULS 1a_45	-32	-26	-72	**41**	5	-13	-75
3	ULS 5a Ba 10	-37	10	53	**33**	-19	-6	54
4	ULS 5a Ba 10	4	27	34	**22**	-16	-8	35

Maximum torsional load (negative)

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]
Index	Combination							
1	ULS 5a Ba 21	25	68	269	**-31**	-66	0	277
2	ULS 5a Ba 21	59	-31	250	**-20**	-63	-2	257
3	ULS 1a_0,9_0,9_135	40	-19	-110	**-41**	15	-12	-113
4	ULS 1a_45	-100	42	426	**-41**	-100	4	439

DNV·GL

Project: KIJ-GT
Tower: S+18
Number: 60

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-188	167	**-1080**	**15**	251	-15	-1112
3	ULS 1a_0,9_0,9_45	188	167	**-1080**	**-15**	251	-15	-1112
4	ULS 1a_0,9_0,9_0	71	-102	**-531**	**-22**	122	-9	-547

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	29	29	152	0	-41	-4	157
2	SLS 7	29	-29	152	0	-41	-4	157
3	SLS 7	-29	-29	152	0	-41	-4	157
4	SLS 7	-29	29	152	0	-41	-4	157

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_135	-249	228	**1397**	-15	-337	7	1438
Max. tension	ULS 1a_0,9_0,9_135	-188	167	**-1080**	15	251	-15	-1112
Max. pos. torsie	ULS 1a_0,9_0,9_135	93	35	389	**41**	-90	5	401
Max. neg. torsie	ULS 1a_0,9_0,9_135	40	-19	-110	**-41**	15	-12	-113
Comb. tension+torsie	ULS 1a_0,9_0,9_135	-188	167	**-1080**	**15**	251	-15	-1112

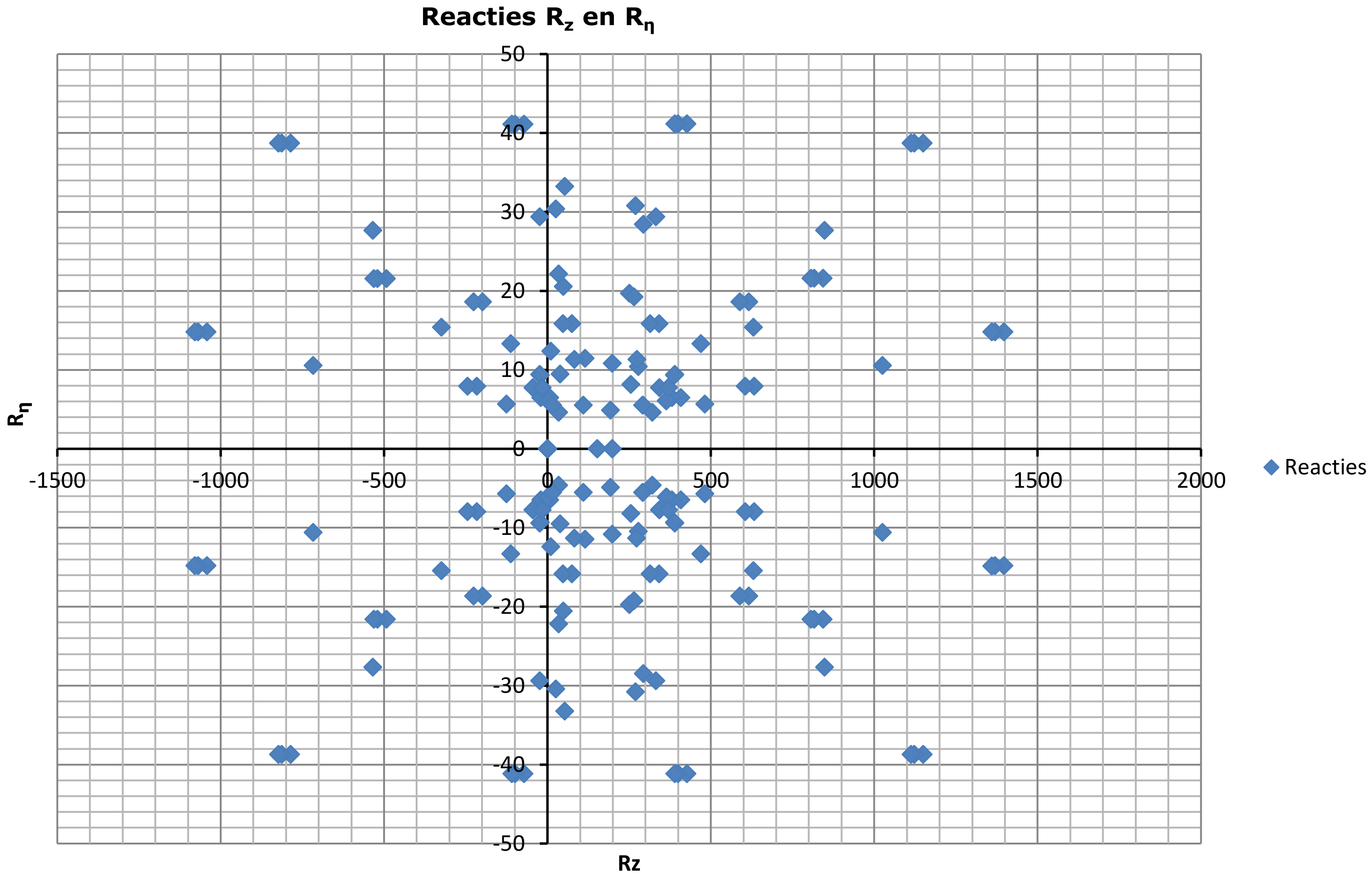
Maximum tension load - SLS

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	29	29	**152**	0	-41	-4	157
2	SLS 1a_135	-124	109	**-718**	11	165	-12	-739
3	SLS 1a_45	124	109	**-718**	-11	165	-12	-739
4	SLS 1a_0	40	-62	**-325**	-15	73	-7	-335

Maximum compression load - SLS

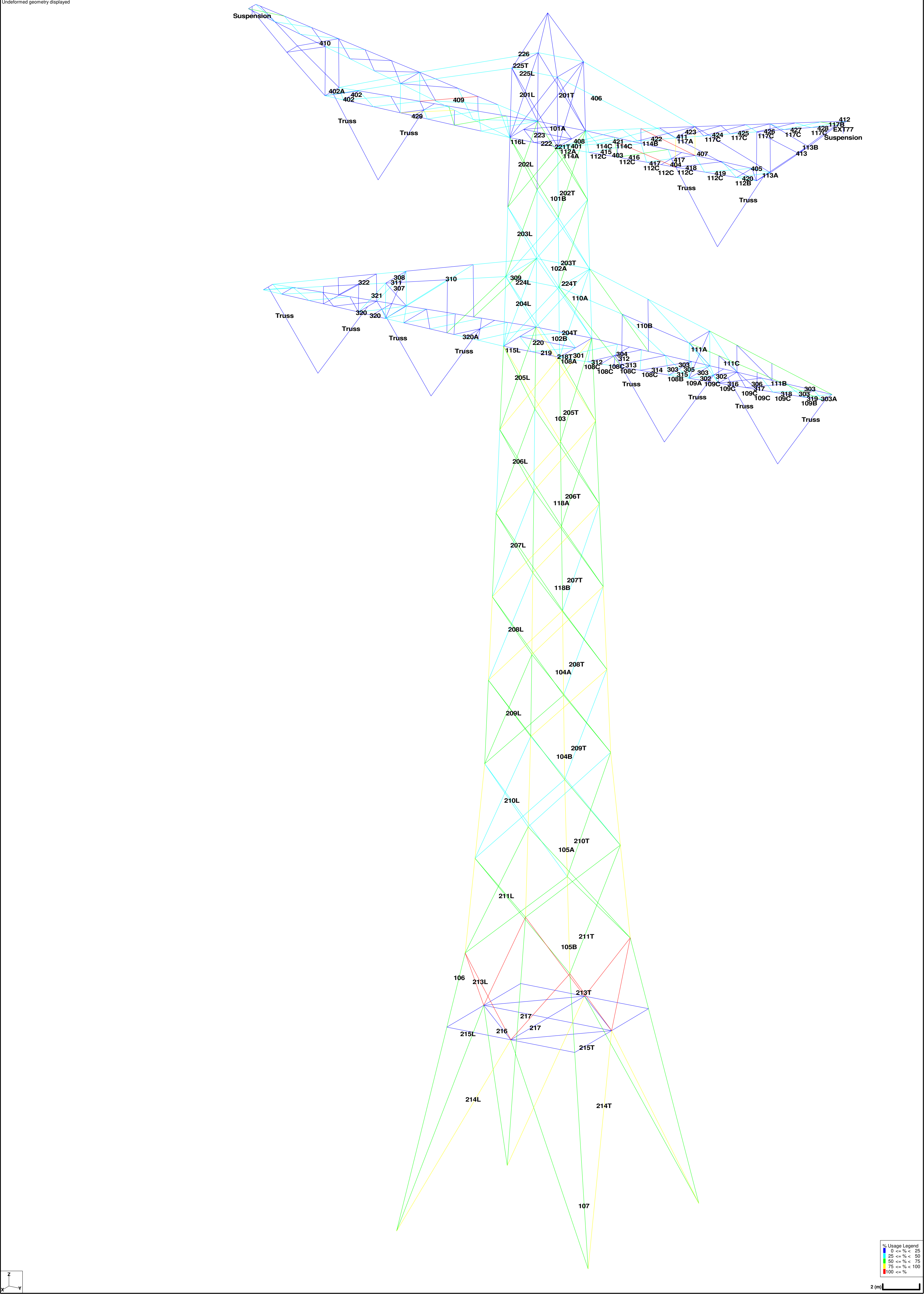
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	183	168	**1025**	11	-248	4	1055
2	SLS 1a_0	99	-120	**630**	15	-155	0	649
3	SLS 7	-29	-29	**152**	0	-41	-4	157
4	SLS 1a_135	-183	168	**1025**	-11	-248	4	1055

Project: KIJ-GT
Tower: S+18
Number: 60



APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project: "S+18 (v) ini"
Tower Version 16.73, 11:27:35 donderdag 25 maart 2021
Undeformed geometry displayed



Assessment of groups for initial mast (afkeur level)

Date 25-3-2021
Author MKh
Version 1.0

KIJ-GT380
S+18
11-2

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 bovenstuk	120x120x8	S235	8M24-5.6t	0.50	0.50	0.50	84	-33.1	ULS 5a Ba 30	318.5	670.3	829.4	0.10		4.5	ULS 1a_0,9_0,9_90	379.5	670.3	779.8	0.01	
101B	Leg bovenstuk	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	-82.9	ULS 1a_45	318.5	508.3	622.1	0.26		48.9	ULS 1a_0,9_0,9_45	379.5	508.3	531.7	0.13	
102A	Leg vijfde tussenstuk	150x150x12	S235	6M24-5.6t	0.50	0.50	0.50	68	-213.4	ULS 1a_45	663.4	508.3	933.1	0.42		149.1	ULS 1a_0,9_0,9_135	740.3	508.3	797.5	0.29	
102B	Leg vijfde tussenstuk	150x150x12	S235	8M24-5.6t	0.50	0.50	0.50	68	-264.1	ULS 1a_135	663.4	677.8	1244.2	0.40		185.1	ULS 1a_0,9_0,9_135	740.3	677.8	776.3	0.27	
103	Leg vierde tussenstuk	180x180x16	S235	8M24-5.6t	0.30	0.30	0.30	41	-465.3	ULS 1a_135	1210.1	677.8	1658.9	0.69		349.1	ULS 1a_0,9_0,9_135	1220.3	677.8	1417.8	0.52	
118A	Leg vierde tussenstuk	180x180x16	S235	8M24-5.6t	0.30	0.30	0.30	41	-722.6	ULS 1a_135	1210.1	1355.5	1658.9	0.60		576.3	ULS 1a_0,9_0,9_135	1220.3	1355.5	1417.8	0.47	
118B	Leg vierde tussenstuk	180x180x16	S235	8M24-5.6t	0.30	0.30	0.30	41	-897.9	ULS 1a_135	1210.1	1355.5	1658.9	0.74		751.8	ULS 1a_0,9_0,9_135	1220.3	1355.5	1063.4	0.71	
104A	Leg derde tussenstuk	200x200x18	S235	8M24-5.6t	0.30	0.30	0.30	37	-1119.0	ULS 1a_135	1532.7	1355.5	1866.2	0.83		947.6	ULS 1a_0,9_0,9_135	1548.5	1355.5	1132.5	0.84	
104B	Leg derde tussenstuk	200x200x18	S235	10M24-5.6t	0.30	0.30	0.30	37	-1277.8	ULS 1a_135	1532.7	1662.6	2332.8	0.83		1108.4	ULS 1a_0,9_0,9_135	1548.5	1662.6	2332.8	0.72	
105A	Leg tweede tussenstuk	250x250x16	S235	10M24-5.6t	0.30	0.30	0.30	33	-1382.6	ULS 1a_135	1766.9	1599.1	2073.6	0.86		1210.3	ULS 1a_0,9_0,9_135	1816.5	1599.1	1595.1	0.76	
105B	Leg tweede tussenstuk	250x250x16	S235	10M24-5.6t	0.30	0.30	0.30	33	-1540.4	ULS 1a_135	1766.8	1615.0	2073.6	0.95		1350.1	ULS 1a_0,9_0,9_135	1816.5	1615.0	1772.3	0.84	
106	Leg eerste tussenstuk	250x250x18	S235	12M24-5.6t	0.50	0.50	0.50	43	-1246.2	ULS 1a_135	1895.4	1859.6	2799.4	0.67		1109.3	ULS 1a_0,9_0,9_135	2030.6	1859.6	2392.6	0.60	
107	Leg broekstuk	250x250x18	S235	12M24-5.6t	0.13	0.13	0.13	30	-1258.3	ULS 1a_135	1997.5	1929.5	2799.4	0.65		1097.5	ULS 1a_0,9_0,9_135	2030.6	1929.5	2392.6	0.57	
108A	Eerste dwarsarm onderregel	160x160x15	S235	10M24-5.6t	1.00	2.20	1.00	76	-222.5	ULS 5a Ba 21	842.7	847.2	1944.0	0.26		118.7	ULS 5a Ba 31	1008.5	847.2	1661.5	0.14	
108C	Eerste dwarsarm onderregel	160x160x15	S235		1.00	4.74	1.00	76	-212.2	ULS 5a Ba 31	842.7	0.0	0.0	0.25		106.7	ULS 5a Ba 21	1097.7	0.0	0.0	0.10	
108B	Eerste dwarsarm onderregel	160x160x15	S235	6M24-5.6t	1.00	3.36	1.00	82	-150.7	ULS 5a Ba 21	802.3	508.3	1166.4	0.30		68.0	ULS 5a Ba 31	1008.5	508.3	996.9	0.13	
109A	Eerste dwarsarm onderregel	150x150x12	S235	6M24-5.6t	1.00	4.58	1.00	89	-111.9	ULS 5a Ba 31	566.9	508.3	933.1	0.22		62.6	ULS 5a Ba 21	740.3	508.3	797.5	0.12	
109C	Eerste dwarsarm onderregel	150x150x12	S235		1.00	4.58	1.00	89	-109.4	ULS 5a Ba 31	566.9	0.0	0.0	0.19		60.9	ULS 5a Ba 31	817.8	0.0	0.0	0.07	
109B	Eerste dwarsarm onderregel	150x150x12	S235	3M24-5.6t	1.00	3.28	1.00	86	-71.9	ULS 1a_90	581.0	254.2	466.6	0.28		32.2	ULS 1a_0,9_0,9_90	638.7	254.2	398.8	0.13	
110A	Eerste dwarsarm bovenregel	100x100x8	S235	3M24-5.6t	1.00	2.06	1.00	265	-7.9	ULS 1a_0,9_0,9_90	56.0	254.2	311.0	0.14		91.6	ULS 3_90	211.1	254.2	265.8	0.43	
110B	Eerste dwarsarm bovenregel	100x100x8	S235	4M24-5.6t	1.00	1.95	1.00	266	-14.7	ULS 1a_0,9_0,9_90	55.7	338.9	414.7	0.26		73.2	ULS 1a_90	293.9	338.9	368.6	0.25	
111A	Eerste dwarsarm bovenregel	100x100x6	S235	4M24-5.6t	2.29	4.51	2.29	269	-24.3	ULS 1a_0,9_0,9_90	41.2	338.9	311.0	0.59		72.8	ULS 1a_90	225.0	338.9	265.8	0.32	
111B	Eerste dwarsarm bovenregel	100x100x6	S235	3M24-5.6t	1.00	2.03	1.00	269	-29.2	ULS 1a_0,9_0,9_90	41.5	254.2	233.3	0.70		68.2	ULS 1a_90	161.1	254.2	199.4	0.42	
111C	Eerste dwarsarm bovenregel	100x100x6	S235		3.49	1.77	1.77	269	-28.9	ULS 1a_0,9_0,9_90	41.2	0.0	0.0	0.70		67.8	ULS 1a_90	277.3	0.0	0.0	0.24	
112A	Tweede dwarsarm onderregel	150x150x12	S235	8M24-5.6t	1.00	1.94	1.00	79	-156.4	ULS 5a Ba 20	615.2	677.8	1244.2	0.25		94.5	ULS 5a Ba 30	740.3	677.8	1159.1	0.14	
112C	Tweede dwarsarm onderregel	150x150x12	S235		1.00	2.07	1.00	79	-135.8	ULS 5a Ba 20	615.6	0.0	0.0	0.22		70.8	ULS 5a Ba 30	817.8	0.0	0.0	0.09	
112B	Tweede dwarsarm onderregel	150x150x12	S235	2M24-5.6t	1.00	4.07	1.00	106	-74.2	ULS 3_90	470.5	169.4	311.0	0.44		16.2	ULS 1a_0,9_0,9_90	638.7	169.4	265.8	0.10	
113A	Tweede dwarsarm tussenregel	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	163	-13.1	ULS 5a Ba 20	70.3	84.7	77.8	0.19		0.5	ULS 1a_0,9_0,9_90	127.9	84.7	66.5	0.01	
113B	Tweede dwarsarm tussenregel	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	150	-12.1	ULS 5a Ba 20	82.2	84.7	77.8	0.16		1.2	ULS 1a_0,9_0,9_90	127.9	84.7	66.5	0.02	
114A	Tweede dwarsarm bovenregel	120x120x8	S235	3M24-5.6t	1.00	1.50	1.00	104	-97.0	ULS 5a Ba 1	224.6	254.2	311.0	0.43		59.9	ULS 5a Ba 1	263.0	254.2	265.8	0.24	
114C	Tweede dwarsarm bovenregel	120x120x8	S235		2.00	3.00	1.00	100	-93.4	ULS 5a Ba 1	224.6	0.0	0.0	0.42		63.8	ULS 5a Ba 1	441.8	0.0	0.0	0.14	
114B	Tweede dwarsarm bovenregel	120x120x8	S235	4M24-5.6t	1.00	1.52	1.00	100	-82.7	ULS 5a Ba 1	229.6	338.9	414.7	0.36		59.5	ULS 5a Ba 1	379.5	338.9	354.5	0.18	
201L	Diagonaal bovenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	-18.6	ULS 5a Ba 30	221.9	169.4	207.4	0.11		16.9	ULS 1a_0_90	226.0	169.4	177.2	0.10	
201T	Diagonaal bovenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	-15.3	ULS 5a Ba 30	221.9	169.4	207.4	0.09		3.2	ULS 5a Ba 30	226.0	169.4	177.2	0.02	
202L	Diagonaal bovenstuk	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	-86.9	ULS 5a Ba 20	266.8	169.4	259.2	0.51		68.1	ULS 5a Ba 30	278.4	169.4	221.5	0.40	
202T	Diagonaal bovenstuk	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	-87.1	ULS 5a Ba 20	266.8	169.4	259.2	0.51		93.3	ULS 5a Ba 30	278.4	169.4	221.5	0.55	
203L	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	-62.8	ULS 5a Ba 30	213.8	169.4	207.4	0.37		79.5	ULS 5a Ba 20	226.0	169.4	177.2	0.47	
203T	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	-85.7	ULS 5a Ba 30	213.8	169.4	207.4	0.51		80.1	ULS 5a Ba 20	226.0	169.4	177.2	0.47	
204L	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	-75.0	ULS 5a Ba 20	209.6	169.4	207.4	0.44		64.1	ULS 5a Ba 30	226.0	169.4	177.2	0.38	
204T	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	-82.7	ULS 5a Ba 20	209.6	169.4	207.4	0.49		68.4	ULS 5a Ba 30	226.0	169.4	177.2	0.40	
205L	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	-134.5	ULS 1a_0,9_0,9_90	211.6	169.4	207.4	0.79		128.2	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.93	
205T	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	-104.3	ULS 5a Ba 21	211.6	169.4	207.4	0.62		102.6	ULS 5a Ba 31	138.1	169.4	172.2	0.74	
206L	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	-118.6	ULS 1a_0,9_0,9_90	206.8	169.4	207.4	0.70		122.4	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.89	
206T	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	-90.7	ULS 5a Ba 31	206.8	169.4	207.4	0.54		92.4	ULS 5a Ba 21	138.1	169.4	172.2	0.67	
207L	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	-114.2	ULS 1a_0,9_0,9_90	201.9	169.4	207.4	0.67		109.4	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.79	
207T	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	-82.6	ULS 5a Ba 21	201.9	169.4	207.4	0.49		80.3	ULS 5a Ba 31	138.1	169.4	172.2	0.58	
208L	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	-108.3	ULS 1a_0,9_0,9_90	196.9	169.4	207.4	0.64		110.0	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.80	
208T	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	-72.5	ULS 5a Ba 31	196.9	169.4	207.4	0.43		74.1	ULS 5a Ba 21	138.1	169.4	172.2	0.54	
209L	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	-105.0	ULS 1a_0,9_0,9_90	191.8	169.4	207.4	0.62		100.3	ULS 1a_0,9_0,9_90	128.6	169.4	164.6	0.78	
209T	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	-67.6	ULS 5a Ba 21	191.8	169.4	207.4	0.40		66.4	ULS 1a_0,9_0,9_135	128.6	169.4	164.6	0.52	
210L	Diagonaal tweede tussenstuk	120x80x8	S235	2M24-5.6t	1.00	0.27	0.27	198	-35.1	ULS 1a_0	85.4	169.4	207.4	0.41		53.4	ULS 1a_0,9_45	138.1	169.4	172.2	0.39	
210T	Diagonaal tweede tussenstuk	120x80x8	S235	2M24-5.6t	1.00	0.27	0.27	198	-50.2	ULS 1a_90	88.0	169.4	207.4	0.57		56.7	ULS 1a_0,9_0,9_135	138.1	169.4	172.2	0.41	
211L	Diagonaal tweede tussenstuk	120x80x8	S235	1M24-5.6t	0.54	0.27	0.27	128	-50.3	ULS 1a_0,9_45	106.9	84.7	103.7	0.59		56.9	ULS 1a_0,9_0,9_135	124.4	84.7	88.6	0.67	
211T	Diagonaal tweede tussenstuk	120x80x8	S235	1M24-5.6t	1.00	0.27	0.27	213	-32.6	ULS 1a_0,9_0,9_90	50.2	84.7	103.7	0.65		47.1	ULS 1a_45	124.4	84.7	88.6	0.56	
213L	Diagonaal eerste tussenstuk	150x100x10	S235	2M24-5.6t	1.00	0.51	0.51	127	-203.1	ULS 1a_45	170.1	169.4	259.2	1.20	knik, afschuiving	173.5	ULS 1a_0,9_0,9_135	225.8	169.4	221.5	1.02	afschuiving
213T	Diagonaal eerste tussenstuk	150x100x10	S235	2M24-5.6t	1.00	0.51	0.51	127	-218.5	ULS 1a_135	170.1	169.4	259.2	1.29	knik, afschuiving	181.2	ULS 1a_0,9_0,9_90	225.8	169.4	221.5	1.07	afschuiving
214L	Diagonaal broekstuk	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	-195.1	ULS 1a_45	282.5	338.9	259.2	0.81		159.2	ULS 1a_0,9_0,9_135	463.8	338.9	221.5	0.72	
214T	Diagonaal broekstuk	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	-209.6	ULS 1a_135	282.5	338.9	259.2	0.87		156.4	ULS 1a_0,9_0,9_90	463.8	338.9	221.5	0.71	
215L	Onderstuk in tower	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	-11.0	ULS 1a_135	374.7	254.2	544.3	0.04		3.4	ULS 1a_0,9_0,9_90	525.6	254.2	416.5	0.01	
215T	Onderstuk in tower	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	-15.9	ULS 1a_135	374.7	254.2	544.3	0.04		3.9	ULS 1a_0,9_0,9_0	525.6	254.2	416.5	0.02	
216	Onderstuk in tower	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	287	-5.5	ULS 1a_45	31.1	58.8	64.8	0.18		7.8	ULS 1a_0,9_0,9_135	134.8	58.8	52.4	0.15	
217	onderstuk in tower	75x75x7#	S235	1M20-5.6t	1.00	0.50	0.50	349	-0.7	ULS 1a_90	12.3	58.8	75.6	0.05		0.0		106.8	58.8	61.1	0.00	
115L	Eerste dwarsarm in tower	160x160x15	S235	10M24-5.6t	1.00	2.00	1.00	71	-174.7	ULS 5a Ba 21	870.6	783.7	1944.0	0.22		65.1	ULS 5a Ba 21	612.0	783.7	1647.0	0.11	
218T	Eerste dwarsarm in tower	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	114	-28.9	ULS 5a Ba 31	123.1	338.9	311.0	0.24		51.2	ULS 5a Ba 31	225.0	338.9	265.8	0.23	
219	Eerste dwarsarm in tower	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	104	-53.6	ULS 5a Ba 21	229.9	169.4	207.4	0.32		54.7	ULS 5a Ba 21	226.0	169.4	177.2	0.32	
220	Eerste dwarsarm in tower	55x55x6	S235	1M16-5.6t	1.00	1.00	1.00	330	-1.1	ULS 5a Ba 22	12.7	37.7	51.8	0.09		0.0		55.3	37.7	33.6	0.00	
116L	Tweede dwarsboom in tower	150x150x12	S235	8M24-5.6t	1.00	2.00	1.00	65	-148.3	ULS 1a_0	674.1	677.8	1244.2	0.22		57.8	ULS 1a_0,9_0,9_0	740.3	677.8	1063.4	0.09	
221T	Tweede dwarsboom in tower	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	98	-24.2	ULS 5a Ba 30	140.9	338.9	311.0	0.17		37.9	ULS 5a Ba 30	225.0	338.9	265.8	0.17	
222	Tweede dwarsboom in tower	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	-39.2	ULS 5a Ba 20	182.9	169.4	207.4	0.23		39.5	ULS 5a Ba 20	181.4	169.4	177.2	0.23	
223	Tweede dwarsboom in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	-0.4	ULS 3_0	11.3	37.7	43.2	0.03		0.0		37.4	37.7	22.0	0.00	
224L	Eerste dwarsboom in tower bovenzijde	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	140	0.0		169.7	254.2	311.0	0.00		95.6	ULS 1a_0	263.0	254.2	265.8	0.38	
224T	Eerste dwarsboom in tower bovenzijde	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	169	-22.5	ULS 1a_0,9_0,9_90	67.1	84.7	77.8	0.34		25.4	ULS 1a_90	127.9	84.7	66.5	0.38	
225L	Tweede dwarsboom in tower bovenzijde	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	144	0.0		102.6	254.2	233.3	0.00		64.4	ULS 3_0	179.2	254.2	199.4	0.36	
225T	Tweede dwarsboom in tower bovenzijde	70x70x7	S235	3M24-5.6t	1.00	1.00	1.00	208	-1.4	ULS 1a_0,9_90	50.5	254.2	272.2	0.03		3.2	ULS 1a_90	132.7	254.2	232.6	0.02	
226	Top	100x100x6	S235	2M16-5.6t	0.30	0.30	0.30	55	-8.3	ULS 5a Ba 20	204.8	75.4	103.7	0.11		8.0	ULS 5a Ba 20	144.1	75.4	76.8	0.11	
301	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	144	-25.3	ULS 5a Ba 32	65.7	84.7	90.7	0.38		17.9	ULS 5a Ba 22	68.5	84.7	47.5	0.38	
302	Diagonalen ondervlak eerste dwarsarm	60x60x6	S355	1M20-8.8t	1.00	1.00	1.00	124	-24.1	ULS 5a Ba 31	68.3	94.1	88.2	0.35		20.3	ULS 5a Ba 31	89.4	94.1	60.4	0.34	
303	Dwarsligger ondervlak eerste dwarsarm	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	30	-3.7	ULS 1a_0,9_0,9_90	1044.4	117.6	172.8	0.03		13.9	ULS 1a_90	1278.1	117.6	0.0	0.12	
303A	Dwarsligger ondervlak eerste dwarsarm	HEB160	S355	2M20-8.8t	2.00	2.00	2.00	25	-13.3	ULS 5a Ba 31	1525.0	188.2	235.2	0.07		13.0	ULS 5a Ba 21	1739.7	188.2	0.0	0.07	
304	Verticale regel eerste dwarsarm	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	154	-11.8	ULS 3_45	75.4	58.8	64.8	0.20		0.0		134.8	58.8	52.4	0.00	
305	Verticale regel eerste dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	-9.5	ULS 3_90	30.0	37.7	43.2	0.32		0.0		37.4	37.7	22.0	0.00	
306	Verticale regel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	102	-1.1	ULS 1a_90	47.6	37.7	43.2	0.03		0.0		37.4	37.7	22.0	0.00	
307	Diagonaal eerste dwarsarm dwarsrichtin	50x50x5	S235	1M16-5.6t	1.00	0.52	0.52	200	-2.9	ULS 3_90	17.8	37.7	43.2	0.16		1.2	ULS 1a_0,9_0,9_135	37.4	37.7	18.4	0.06	
308	Bovenregel eerste dwarsarm dwrsrichtin	75x50x5	S235	1M24-5.6t	1.00	1.00	1.00	203	-0.3	ULS 1a_0,9_0,9_90	26.7	84.7	64.8	0.01		2.1	ULS 3_90	70.6	84.7	51.8	0.04	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 25-3-2021
Author MKh
Version 1.0

KIJ-GT380
S+18
11-2

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)
309	Diagonaal voor eerste dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	569	**0.0**		5.0	75.4	86.4	0.00		**26.9**	ULS 3_90	52.4	75.4	44.1	0.61	
310	Diagonaal voor eerste dwarsarm	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	432	**0.0**		11.6	117.6	129.6	0.00		**27.6**	ULS 3_45	77.4	117.6	88.7	0.36	
311	Diagonaal voor eerste dwarsarm	80x80x8	S355	1M16-8.8t	1.00	1.00	1.00	173	**-1.2**	ULS 1a_0,9_0,9_90	77.9	60.3	94.1	0.02		**18.3**	ULS 3_90	194.4	60.3	69.7	0.30	
312	Diagonalen ondervlak eerste dwarsarm	70x70x7	S355	1M20-8.8t	1.00	1.00	1.00	132	**-17.5**	ULS 5a Ba 22	85.6	94.1	102.9	0.20		**26.5**	ULS 5a Ba 32	104.3	94.1	70.5	0.38	
313	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	127	**-14.2**	ULS 5a Ba 31	75.5	84.7	90.7	0.19		**17.2**	ULS 5a Ba 21	68.5	84.7	47.5	0.36	
314	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	122	**-18.9**	ULS 5a Ba 21	79.2	84.7	90.7	0.24		**16.0**	ULS 5a Ba 31	68.5	84.7	47.5	0.34	
315	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M20-5.6t	0.52	0.52	0.52	102	**-17.8**	ULS 5a Ba 31	93.6	58.8	75.6	0.30		**15.4**	ULS 5a Ba 31	96.8	58.8	61.1	0.26	
316	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	115	**-9.3**	ULS 5a Ba 31	61.7	58.8	64.8	0.16		**9.8**	ULS 5a Ba 31	65.7	58.8	44.4	0.22	
317	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	108	**-11.3**	ULS 5a Ba 21	65.3	58.8	64.8	0.19		**12.9**	ULS 5a Ba 21	65.7	58.8	44.4	0.29	
318	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.56	0.56	0.56	107	**-17.5**	ULS 5a Ba 31	65.8	58.8	64.8	0.30		**14.2**	ULS 5a Ba 31	65.7	58.8	44.4	0.32	
319	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	77	**-17.0**	ULS 5a Ba 31	81.6	58.8	64.8	0.29		**12.9**	ULS 5a Ba 31	65.7	58.8	44.4	0.29	
321	Lower crossarm front vert new	60x60x6	S355	1M16-8.8t	1.00	1.00	1.00	134	**-3.1**	ULS 7	61.5	60.3	70.6	0.05		**0.0**		61.2	60.3	36.0	0.00	
322	Lower crossarm front diag new	80x80x8	S355	1M16-8.8t	1.00	1.00	1.00	179	**0.0**		74.1	60.3	94.1	0.00		**6.8**	ULS 7	194.4	60.3	69.7	0.11	
401	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	153	**-19.8**	ULS 5a Ba 30	45.0	58.8	64.8	0.44		**17.8**	ULS 5a Ba 20	65.7	58.8	44.4	0.40	
402	Dwarsligger ondervlak tweede dwarsarm	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	41	**-1.4**	ULS 1a_0,9_0,9_90	994.3	117.6	172.8	0.01		**7.1**	ULS 3_90	1278.1	117.6	0.0	0.06	
402A	Dwarsligger ondervlak tweede dwarsarm	HEB160	S355	2M20-8.8t	2.00	2.00	2.00	37	**-12.4**	ULS 5a Ba 30	1426.1	188.2	235.2	0.07		**13.6**	ULS 5a Ba 20	1739.7	188.2	0.0	0.07	
403	Verticale regel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	87	**-2.9**	ULS 1a_0,9_0,9_90	53.8	37.7	43.2	0.08		**4.4**	ULS 1a_90	37.4	37.7	22.0	0.20	
404	Verticale regel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	173	**-10.2**	ULS 1a_0,9_0,9_90	26.7	37.7	43.2	0.38		**17.1**	ULS 1a_90	37.4	37.7	22.0	0.78	
405	Verticale regel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	291	**-2.9**	ULS 1a_90	12.4	37.7	43.2	0.24		**0.0**		37.4	37.7	22.0	0.00	
406	Bovenarm tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	318	**0.0**		52.7	254.2	311.0	0.00		**70.4**	ULS 3_135	263.0	254.2	265.8	0.28	
407	Bovenarm tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	217	**-15.9**	ULS 1a_0,9_0,9_90	95.2	254.2	311.0	0.17		**67.8**	ULS 1a_90	263.0	254.2	265.8	0.27	
408	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	206	**-7.0**	ULS 1a_0	21.0	37.7	43.2	0.34		**6.5**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.30	
409	Dwarsligger ondervlak V-ophanging	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	373	**-12.3**	ULS 1a_90	8.3	37.7	43.2	1.49	knik	**3.3**	ULS 1a_0,9_0,9_90	37.4	37.7	22.0	0.15	
117A	Tweede dwarsarm bovenregel	120x120x8	S235	4M24-5.6t	1.00	2.89	1.00	135	**-62.3**	ULS 5a Ba 1	166.8	338.9	414.7	0.37		**71.5**	ULS 5a Ba 1	379.5	338.9	354.5	0.21	
117C	Tweede dwarsarm bovenregel	120x120x8	S235		1.00	3.06	1.00	136	**-56.3**	ULS 5a Ba 1	166.7	0.0	0.0	0.34		**65.9**	ULS 5a Ba 1	441.8	0.0	0.0	0.15	
117B	Tweede dwarsarm bovenregel	120x120x8	S235	2M16-5.6t	1.00	6.39	1.00	48	**-14.0**	ULS 5a Ba 1	332.1	75.4	138.2	0.19		**13.6**	ULS 5a Ba 1	323.3	75.4	138.2	0.18	
429	Diagonaal voor tweede dwarsarm	HEB160	S355	2M20-8.8t	1.00	1.00	1.00	28	**-0.3**	ULS 5a Ba 30	1508.8	188.2	235.2	0.00		**2.0**	ULS 5a Ba 20	1739.7	188.2	0.0	0.01	
410	Diagonaal voor tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	272	**0.0**		13.8	37.7	43.2	0.00		**1.3**	ULS 1a_45	37.4	37.7	22.0	0.06	
411	Dwarsligger bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	214	**-0.6**	ULS 1a_90	19.8	37.7	43.2	0.03		**0.4**	ULS 1a_0,9_90	37.4	37.7	22.0	0.02	
412	Dwarsligger bovenvlak tweede dwarsarm	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	20	**-7.6**	ULS 5a Ba 1	1087.1	75.4	138.2	0.10		**7.4**	ULS 5a Ba 1	984.5	75.4	138.2	0.10	
413	Ladder tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	119	**-0.1**	ULS 1a_90	41.2	37.7	43.2	0.00		**0.1**	ULS 1a_0,9_0,9_90	37.4	37.7	22.0	0.00	
415	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	144	**-19.9**	ULS 5a Ba 20	48.2	58.8	64.8	0.41		**23.3**	ULS 5a Ba 30	65.7	58.8	44.4	0.52	
416	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	136	**-26.9**	ULS 5a Ba 30	51.4	58.8	64.8	0.52		**21.2**	ULS 5a Ba 20	65.7	58.8	44.4	0.48	
417	Diagonalen ondervlak tweede dwarsarm	60x60x6	S355	1M20-8.8t	1.00	1.00	1.00	125	**-21.2**	ULS 5a Ba 20	67.5	94.1	88.2	0.31		**28.1**	ULS 5a Ba 30	89.4	94.1	60.4	0.47	
418	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	121	**-9.7**	ULS 5a Ba 30	58.6	58.8	64.8	0.17		**16.4**	ULS 5a Ba 20	65.7	58.8	44.4	0.37	
419	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	119	**-19.2**	ULS 5a Ba 20	59.4	58.8	64.8	0.33		**12.2**	ULS 5a Ba 30	65.7	58.8	44.4	0.27	
420	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	90	**-16.0**	ULS 5a Ba 20	75.6	58.8	64.8	0.27		**10.3**	ULS 5a Ba 30	65.7	58.8	44.4	0.23	
421	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	197	**-6.1**	ULS 1a_0,9_0,9_0	22.4	37.7	43.2	0.27		**6.5**	ULS 1a_0	37.4	37.7	22.0	0.30	
422	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	181	**-5.9**	ULS 1a_0	25.1	37.7	43.2	0.24		**5.4**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.24	
423	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	143	**-4.9**	ULS 1a_0,9_0,9_0	33.7	37.7	43.2	0.15		**5.0**	ULS 1a_0	37.4	37.7	22.0	0.23	
424	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	131	**-4.6**	ULS 5a Ba 1	37.3	37.7	43.2	0.12		**4.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.20	
425	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	126	**-5.5**	ULS 5a Ba 1	39.1	37.7	43.2	0.15		**5.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.25	
426	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	120	**-7.0**	ULS 5a Ba 1	41.1	37.7	43.2	0.19		**7.0**	ULS 5a Ba 1	37.4	37.7	22.0	0.32	
427	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	115	**-9.6**	ULS 5a Ba 1	42.8	37.7	43.2	0.25		**9.4**	ULS 5a Ba 1	37.4	37.7	22.0	0.42	
428	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.56	0.56	0.56	115	**-13.5**	ULS 5a Ba 1	42.9	37.7	43.2	0.36		**14.0**	ULS 5a Ba 1	37.4	37.7	22.0	0.63	
EXT77	Pivot -77cm	80x80x8	S235		1.00	1.00	1.00	19	**0.0**		256.4	0.0	0.0	0.00		**15.0**	ULS 5a Ba 1	289.1	0.0	0.0	0.00	
320	Dwarsligger ondervlak dwarsarm V-opha	HEB160	S355	2M20-8.8t	2.00	2.00	2.00	50	**-10.7**	ULS 5a Ba 21	1313.8	188.2	235.2	0.06		**14.3**	ULS 5a Ba 31	1739.7	188.2	0.0	0.08	
320A	HEM	HEM160	S355	2M20-8.8t	1.00	1.00	1.00	37	**-1.1**	ULS 5a Ba 21	2729.8	188.2	411.6	0.01		**2.7**	ULS 5a Ba 32	3069.0	188.2	0.0	0.01	

DNV·GL

Assessment of groups for strenghtened mast (afkeur level)

Date 25-3-2021
Author MKh
Version 1.0

KIJ-GT380
S+18
11-2

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 bovenstuk	120x120x8	S235	8M24-5.6t	0.50	0.50	0.50	84	**-33.1**	ULS 5a Ba 30	318.5	670.3	829.4	0.10		**4.4**	ULS 1a_0,9_0,9_90	379.5	670.3	779.8	0.01
101B	Leg bovenstuk	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	**-83.2**	ULS 1a_45	318.5	508.3	622.1	0.26		**49.1**	ULS 1a_0,9_0,9_45	379.5	508.3	531.7	0.13
102A	Leg vijfde tusse	150x150x12	S235	6M24-5.6t	0.50	0.50	0.50	68	**-214.0**	ULS 1a_45	663.4	508.3	933.1	0.42		**149.5**	ULS 1a_0,9_0,9_135	740.3	508.3	797.5	0.29
102B	Leg vijfde tusse	150x150x12	S235	8M24-5.6t	0.50	0.50	0.50	68	**-264.6**	ULS 1a_135	663.4	677.8	1244.2	0.40		**185.5**	ULS 1a_0,9_0,9_135	740.3	677.8	776.3	0.27
103	Leg vierde tuss	180x180x16#	S235	8M24-5.6t	0.30	0.30	0.30	41	**-468.3**	ULS 1a_135	1210.1	677.8	1658.9	0.69		**351.1**	ULS 1a_0,9_0,9_135	1220.3	677.8	1417.8	0.52
118A	Leg vierde tuss	180x180x16#	S235	8M24-5.6t	0.30	0.30	0.30	41	**-721.8**	ULS 1a_135	1210.1	1355.5	1658.9	0.60		**576.0**	ULS 1a_0,9_0,9_135	1220.3	1355.5	1417.8	0.47
118B	Leg vierde tuss	180x180x16#	S235	8M24-5.6t	0.30	0.30	0.30	41	**-901.2**	ULS 1a_135	1210.1	1355.5	1658.9	0.74		**754.2**	ULS 1a_0,9_0,9_135	1220.3	1355.5	1063.4	0.71
104A	Leg derde tusse	200x200x18	S235	8M24-5.6t	0.30	0.30	0.30	37	**-1118.1**	ULS 1a_135	1532.7	1355.5	1866.2	0.82		**947.2**	ULS 1a_0,9_0,9_135	1548.5	1355.5	1132.5	0.84
104B	Leg derde tusse	200x200x18	S235	10M24-5.6t	0.30	0.30	0.30	37	**-1282.2**	ULS 1a_135	1532.7	1662.6	2332.8	0.84		**1111.9**	ULS 1a_0,9_0,9_135	1548.5	1662.6	2332.8	0.72
105A	Leg tweede tus	250x250x16#	S235	10M24-5.6t	0.30	0.30	0.30	33	**-1380.2**	ULS 1a_135	1766.9	1599.1	2073.6	0.86		**1208.4**	ULS 1a_0,9_0,9_135	1816.5	1599.1	1595.1	0.76
105B	Leg tweede tus	250x250x16#	S235	10M24-5.6t	0.30	0.30	0.30	33	**-1546.4**	ULS 1a_135	1766.8	1615.0	2073.6	0.96		**1355.5**	ULS 1a_0,9_0,9_135	1816.5	1615.0	1772.3	0.84
106	Leg eerste tuss	250x250x18#	S235	12M24-5.6t	0.50	0.50	0.50	43	**-1241.2**	ULS 1a_135	1895.4	1859.6	2799.4	0.67		**1103.0**	ULS 1a_0,9_0,9_135	2030.6	1859.6	2392.6	0.59
107	Leg broekstuk	250x250x18#	S235	12M24-5.6t	0.13	0.13	0.13	30	**-1253.6**	ULS 1a_135	1997.5	1929.5	2799.4	0.65		**1090.5**	ULS 1a_0,9_0,9_135	2030.6	1929.5	2392.6	0.57
108A	Eerste dwarsarr	160x160x15#	S235	10M24-5.6t	1.00	2.20	1.00	76	**-222.5**	ULS 5a Ba 21	842.7	847.2	1944.0	0.26		**118.7**	ULS 5a Ba 31	1008.5	847.2	1661.5	0.14
108C	Eerste dwarsarr	160x160x15#	S235		1.00	4.74	1.00	76	**-212.2**	ULS 5a Ba 31	842.7	0.0	0.0	0.25		**106.7**	ULS 5a Ba 21	1097.7	0.0	0.0	0.10
108B	Eerste dwarsarr	160x160x15#	S235	6M24-5.6t	1.00	3.36	1.00	82	**-150.7**	ULS 5a Ba 21	802.3	508.3	1166.4	0.30		**68.0**	ULS 5a Ba 31	1008.5	508.3	996.9	0.13
109A	Eerste dwarsarr	150x150x12	S235	6M24-5.6t	1.00	4.58	1.00	89	**-111.9**	ULS 5a Ba 31	566.9	508.3	933.1	0.22		**62.6**	ULS 5a Ba 21	740.3	508.3	797.5	0.12
109C	Eerste dwarsarr	150x150x12	S235		1.00	4.58	1.00	89	**-109.4**	ULS 5a Ba 31	566.9	0.0	0.0	0.19		**60.9**	ULS 5a Ba 31	817.8	0.0	0.0	0.07
109B	Eerste dwarsarr	150x150x12	S235	3M24-5.6t	1.00	3.28	1.00	86	**-71.9**	ULS 1a_90	581.0	254.2	466.6	0.28		**32.2**	ULS 1a_0,9_0,9_90	638.7	254.2	398.8	0.13
110A	Eerste dwarsarr	100x100x8	S235	3M24-5.6t	1.00	2.06	1.00	265	**-7.9**	ULS 1a_0,9_0,9_90	56.0	254.2	311.0	0.14		**91.6**	ULS 3_90	211.1	254.2	265.8	0.43
110B	Eerste dwarsarr	100x100x8	S235	4M24-5.6t	1.00	1.95	1.00	266	**-14.6**	ULS 1a_0,9_0,9_90	55.7	338.9	414.7	0.26		**73.2**	ULS 1a_90	293.9	338.9	368.6	0.25
111A	Eerste dwarsarr	100x100x6	S235	4M24-5.6t	2.29	4.51	2.29	269	**-24.3**	ULS 1a_0,9_0,9_90	41.2	338.9	311.0	0.59		**72.8**	ULS 1a_90	225.0	338.9	265.8	0.32
111B	Eerste dwarsarr	100x100x6	S235	3M24-5.6t	1.00	2.03	1.00	269	**-29.2**	ULS 1a_0,9_0,9_90	41.5	254.2	233.3	0.70		**68.2**	ULS 1a_90	161.1	254.2	199.4	0.42
111C	Eerste dwarsarr	100x100x6	S235		3.49	1.77	1.77	269	**-28.9**	ULS 1a_0,9_0,9_90	41.2	0.0	0.0	0.70		**67.8**	ULS 1a_90	277.3	0.0	0.0	0.24
112A	Tweede dwarsa	150x150x12	S235	8M24-5.6t	1.00	1.94	1.00	79	**-156.3**	ULS 5a Ba 20	615.2	677.8	1244.2	0.25		**94.4**	ULS 5a Ba 30	740.3	677.8	1159.1	0.14
112C	Tweede dwarsa	150x150x12	S235		1.00	2.07	1.00	79	**-135.7**	ULS 5a Ba 20	615.6	0.0	0.0	0.22		**70.8**	ULS 5a Ba 30	817.8	0.0	0.0	0.09
112B	Tweede dwarsa	150x150x12	S235	2M24-5.6t	1.00	4.07	1.00	106	**-74.4**	ULS 3_90	470.5	169.4	311.0	0.44		**16.0**	ULS 1a_0,9_0,9_90	638.7	169.4	265.8	0.09
113A	Tweede dwarsa	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	163	**-13.1**	ULS 5a Ba 20	70.3	84.7	77.8	0.19		**0.5**	ULS 1a_0,9_0,9_90	127.9	84.7	66.5	0.01
113B	Tweede dwarsa	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	150	**-12.1**	ULS 5a Ba 20	82.2	84.7	77.8	0.16		**1.2**	ULS 1a_0,9_0,9_90	127.9	84.7	66.5	0.02
114A	Tweede dwarsa	120x120x8	S235	3M24-5.6t	1.00	1.50	1.00	104	**-97.1**	ULS 5a Ba 1	224.6	254.2	311.0	0.43		**59.6**	ULS 5a Ba 1	263.0	254.2	265.8	0.23
114C	Tweede dwarsa	120x120x8	S235		2.00	3.00	1.00	100	**-93.5**	ULS 5a Ba 1	224.6	0.0	0.0	0.42		**63.8**	ULS 5a Ba 1	441.8	0.0	0.0	0.14
114B	Tweede dwarsa	120x120x8	S235	4M24-5.6t	1.00	1.52	1.00	100	**-82.8**	ULS 5a Ba 1	229.6	338.9	414.7	0.36		**59.5**	ULS 5a Ba 1	379.5	338.9	354.5	0.18
201L	Diagonaal bove	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	**-18.6**	ULS 5a Ba 30	221.9	169.4	207.4	0.11		**16.8**	ULS 1a_0,9_90	226.0	169.4	177.2	0.10
201T	Diagonaal bove	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	**-15.3**	ULS 5a Ba 30	221.9	169.4	207.4	0.09		**3.1**	ULS 5a Ba 30	226.0	169.4	177.2	0.02
202L	Diagonaal bove	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	**-86.9**	ULS 5a Ba 20	266.8	169.4	259.2	0.51		**68.1**	ULS 5a Ba 30	278.4	169.4	221.5	0.40
202T	Diagonaal bove	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	**-87.1**	ULS 5a Ba 20	266.8	169.4	259.2	0.51		**93.3**	ULS 5a Ba 30	278.4	169.4	221.5	0.55
203L	Diagonaal vijfde	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	**-62.8**	ULS 5a Ba 30	213.8	169.4	207.4	0.37		**79.5**	ULS 5a Ba 20	226.0	169.4	177.2	0.47
203T	Diagonaal vijfde	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	**-85.7**	ULS 5a Ba 30	213.8	169.4	207.4	0.51		**80.1**	ULS 5a Ba 20	226.0	169.4	177.2	0.47
204L	Diagonaal vijfde	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	**-75.0**	ULS 5a Ba 20	209.6	169.4	207.4	0.44		**64.1**	ULS 5a Ba 30	226.0	169.4	177.2	0.38
204T	Diagonaal vijfde	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	**-82.7**	ULS 5a Ba 20	209.6	169.4	207.4	0.49		**68.3**	ULS 5a Ba 30	226.0	169.4	177.2	0.40
205L	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	**-134.4**	ULS 1a_0,9_0,9_90	211.6	169.4	207.4	0.79		**128.4**	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.93
205T	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	**-104.2**	ULS 5a Ba 21	211.6	169.4	207.4	0.62		**102.7**	ULS 5a Ba 31	138.1	169.4	172.2	0.74
206L	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	**-118.8**	ULS 1a_0,9_0,9_90	206.8	169.4	207.4	0.70		**122.3**	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.89
206T	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	**-90.8**	ULS 5a Ba 31	206.8	169.4	207.4	0.54		**92.3**	ULS 5a Ba 21	138.1	169.4	172.2	0.67
207L	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	**-114.1**	ULS 1a_0,9_0,9_90	201.9	169.4	207.4	0.67		**109.5**	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.79
207T	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	**-82.4**	ULS 5a Ba 21	201.9	169.4	207.4	0.49		**80.4**	ULS 5a Ba 31	138.1	169.4	172.2	0.58
208L	Diagonaal derde	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	**-108.5**	ULS 1a_0,9_0,9_90	196.9	169.4	207.4	0.64		**109.8**	ULS 1a_0,9_0,9_90	138.1	169.4	172.2	0.80
208T	Diagonaal derde	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	**-72.7**	ULS 5a Ba 31	196.9	169.4	207.4	0.43		**73.9**	ULS 5a Ba 21	138.1	169.4	172.2	0.54
209L	Diagonaal derde	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	**-104.8**	ULS 1a_0,9_0,9_90	191.8	169.4	207.4	0.62		**100.6**	ULS 1a_0,9_0,9_90	128.6	169.4	164.6	0.78
209T	Diagonaal derde	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	**-67.4**	ULS 5a Ba 21	191.8	169.4	207.4	0.40		**65.7**	ULS 5a Ba 31	128.6	169.4	164.6	0.51
210L	Diagonaal twee	120x80x8	S235	2M24-5.6t	1.00	0.27	0.27	198	**-38.2**	ULS 1a_0	85.4	169.4	207.4	0.45		**55.4**	ULS 1a_0,9_45	138.1	169.4	172.2	0.40
210T	Diagonaal twee	120x80x8	S235	2M24-5.6t	1.00	0.27	0.27	198	**-51.2**	ULS 1a_90	83.0	169.4	207.4	0.62		**59.0**	ULS 1a_0,9_0,9_135	138.1	169.4	172.2	0.43
211L	Diagonaal twee	120x80x8	S235	1M24-5.6t	0.54	0.27	0.27	128	**-53.4**	ULS 1a_0,9_45	106.9	84.7	103.7	0.63		**60.0**	ULS 1a_0,9_0,9_135	124.4	84.7	88.6	0.71
211T	Diagonaal twee	120x80x8	S235	1M24-5.6t	1.00	0.27	0.27	213	**-41.4**	ULS 1a_0,9_0,9_90	55.3	84.7	103.7	0.75		**50.6**	ULS 1a_45	124.4	84.7	88.6	0.60
213L	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8s**	1.00	0.51	0.51	126	**-207.5**	ULS 1a_45	304.9	347.4	529.2	0.68		**178.2**	ULS 1a_0,9_0,9_135	663.8	347.4	452.3	0.51
213T	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8s**	1.00	0.51	0.51	126	**-223.2**	ULS 1a_135	304.9	347.4	529.2	0.73		**188.5**	ULS 1a_0,9_0,9_90	663.8	347.4	452.3	0.54
214L	Diagonaal broek	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	**-199.3**	ULS 1a_45	282.5	338.9	259.2	0.83		**162.6**	ULS 1a_0,9_0,9_135	463.8	338.9	221.5	0.73
214T	Diagonaal broek	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	**-214.2**	ULS 1a_135	282.5	338.9	259.2	0.89		**162.6**	ULS 1a_0,9_0,9_90	463.8	338.9	221.5	0.73
215L	Onderstuk in to	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	**-11.9**	ULS 1a_135	374.7	254.2	544.3	0.05		**3.6**	ULS 1a_0,9_0,9_90	525.6	254.2	416.5	0.01
215T	Onderstuk in to	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	**-11.8**	ULS 1a_135	374.7	254.2	544.3	0.05		**4.1**	ULS 1a_0,9_0	525.6	254.2	416.5	0.02
216	Onderstuk in to	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	287	**-5.6**	ULS 1a_45	31.1	58.8	64.8	0.18		**7.7**	ULS 1a_0,9_0,9_135	134.8	58.8	52.4	0.15
217	onderstuk in to	75x75x7#	S235	1M20-5.6t	1.00	0.50	0.50	349	**-1.2**	ULS 1a_90	21.8	58.8	75.6	0.06		**0.0**		106.8	58.8	61.1	0.00
115L	Eerste dwarsarr	160x160x15#	S235	10M24-5.6t	1.00	2.00	1.00	71	**-174.8**	ULS 5a Ba 21	870.6	783.7	1944.0	0.22		**65.2**	ULS 5a Ba 21	612.0	783.7	1647.0	0.11
218T	Eerste dwarsarr	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	114	**-29.0**	ULS 5a Ba 31	123.1	338.9	311.0	0.24		**51.1**	ULS 5a Ba 31	225.0	338.9	265.8	0.23
219	Eerste dwarsarr	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	104	**-53.6**	ULS 5a Ba 21	229.9	169.4	207.4	0.32		**54.7**	ULS 5a Ba 21	226.0	169.4	177.2	0.32
220	Eerste dwarsarr	55x55x6	S235	1M16-5.6t	1.00	1.00	1.00	330	**-1.1**	ULS 5a Ba 22	12.7	37.7	51.8	0.09		**0.0**		55.3	37.7	33.6	0.00
116L	Tweede dwarsb	150x150x12	S235	8M24-5.6t	1.00	2.00	1.00	65	**-148.9**	ULS 1a_0	674.1	677.8	1244.2	0.22		**58.1**	ULS 1a_0,9_0,9_0	740.3	677.8	1063.4	0.09
221T	Tweede dwarsb	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	98	**-24.1**	ULS 5a Ba 30	140.9	338.9	311.0	0.17		**38.0**	ULS 5a Ba 30	225.0	338.9	265.8	0.17
222	Tweede dwarsb	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	**-39.2**	ULS 5a Ba 20	182.9	169.4	207.4	0.23		**39.5**	ULS 5a Ba 20	181.4	169.4	177.2	0.23
223	Tweede dwarsb	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	**-0.4**	ULS 3_0	11.3	37.7	43.2	0.03		**0.0**		37.4	37.7	22.0	0.00
224L	Eerste dwarsbo	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	140	**0.0**		169.7	254.2	311.0	0.00		**95.6**	ULS 1a_0	263.0	254.2	265.8	0.38
224T	Eerste dwarsbo	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	169	**-22.6**	ULS 1a_0,9_0,9_90	67.1	84.7	77.8	0.34		**25.6**	ULS 1a_90	127.9	84.7	66.5	0.38
225L	Tweede dwarsb	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	144	**0.0**		102.6	254.2	233.3	0.00		**64.6**	ULS 3_0	179.2	254.2	199.4	0.36
225T	Tweede dwarsb	70x70x7	S235	3M24-5.6t	1.00	1.00	1.00	208	**-1.4**	ULS 1a_0,9_90	50.5	254.2	272.2	0.03		**3.2**	ULS 1a_90	132.7	254.2	232.6	0.02
226	Top	100x100x6	S235	2M16-5.6t	0.30	0.30	0.30	55	**-8.3**	ULS 5a Ba 20	204.8	75.4	103.7	0.11		**8.0**	ULS 5a Ba 20	144.1	75.4	76.8	0.11
301	Diagonalen ond	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	144	**-25.3**	ULS 5a Ba 32	65.7	84.7	90.7	0.38		**17.9**	ULS 5a Ba 22	68.5	84.7	47.5	0.38
302	Diagonalen ond	60x60x6	S355	1M20-8.8t	1.00	1.00	1.00	124	**-24.1**	ULS 5a Ba 31	68.3	94.1	88.2	0.35		**20.3**	ULS 5a Ba 31	89.4	94.1	60.4	0.34
303	Dwarsligger ond	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	30	**-3.7**	ULS 1a_0,9_0,9_90	1044.4	117.6	172.8	0.03		**13.9**	ULS 1a_90	1278.1	117.6	0.0	0.12
303A	Dwarsligger ond	HEB160	S355	2M20-8.8t	2.00	2.00	2.00	25	**-13.3**	ULS 5a Ba 31	1525.0	188.2	235.2	0.07		**13.0**	ULS 5a Ba 21	1739.7	188.2	0.0	0.07
304	Verticale regel (	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	154	**-11.8**	ULS 3_45	75.4	58.8	64.8	0.20		**0.0**		134.8	58.8	52.4	0.00

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Assessment of groups for strengthened mast (afkeur level)

Date	25-3-2021
Author	MKh
Version	1.0

KIJ-GT380
S+18
11-2

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)
305	Verticale regel (	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	**-9.5**	ULS 3_90	30.0	37.7	43.2	0.32		**0.0**		37.4	37.7	22.0	0.00
306	Verticale regel (	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	102	**-1.1**	ULS 1a_90	47.6	37.7	43.2	0.03		**0.0**		37.4	37.7	22.0	0.00
307	Diagonaal eerst	50x50x5	S235	1M16-5.6t	1.00	0.52	0.52	200	**-2.9**	ULS 3_90	17.8	37.7	43.2	0.16		**1.2**	ULS 1a_0,9_0,9_135	37.4	37.7	18.4	0.06
308	Bovenregel eers	75x50x5	S235	1M24-5.6t	1.00	1.00	1.00	203	**-0.3**	ULS 1a_0,9_0,9_90	26.7	84.7	64.8	0.01		**2.1**	ULS 3_90	70.6	84.7	51.8	0.04
309	Diagonaal voor	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	569	**0.0**		5.0	75.4	86.4	0.00		**26.9**	ULS 3_90	52.4	75.4	44.1	0.61
310	Diagonaal voor	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	432	**0.0**		11.6	117.6	129.6	0.00		**27.6**	ULS 3_45	77.4	117.6	88.7	0.36
311	Diagonaal voor	80x80x8	S355	1M16-8.8t	1.00	1.00	1.00	173	**-1.2**	ULS 1a_0,9_0,9_90	77.9	60.3	94.1	0.02		**18.3**	ULS 3_90	194.4	60.3	69.7	0.30
312	Diagonalen ond	70x70x7	S355	1M20-8.8t	1.00	1.00	1.00	132	**-17.5**	ULS 5a Ba 22	85.6	94.1	102.9	0.20		**26.5**	ULS 5a Ba 32	104.3	94.1	70.5	0.38
313	Diagonalen ond	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	127	**-14.2**	ULS 5a Ba 31	75.5	84.7	90.7	0.19		**17.2**	ULS 5a Ba 21	68.5	84.7	47.5	0.36
314	Diagonalen ond	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	122	**-18.9**	ULS 5a Ba 21	79.2	84.7	90.7	0.24		**16.0**	ULS 5a Ba 31	68.5	84.7	47.5	0.34
315	Diagonalen ond	70x70x7	S235	1M20-5.6t	0.52	0.52	0.52	102	**-17.8**	ULS 5a Ba 31	93.6	58.8	75.6	0.30		**15.4**	ULS 5a Ba 31	96.8	58.8	61.1	0.26
316	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	115	**-9.3**	ULS 5a Ba 31	61.7	58.8	64.8	0.16		**9.8**	ULS 5a Ba 31	65.7	58.8	44.4	0.22
317	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	108	**-11.3**	ULS 5a Ba 21	65.3	58.8	64.8	0.19		**12.9**	ULS 5a Ba 21	65.7	58.8	44.4	0.29
318	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.56	0.56	0.56	107	**-17.5**	ULS 5a Ba 31	65.8	58.8	64.8	0.30		**14.2**	ULS 5a Ba 31	65.7	58.8	44.4	0.32
319	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	77	**-17.0**	ULS 5a Ba 31	81.6	58.8	64.8	0.29		**12.9**	ULS 5a Ba 31	65.7	58.8	44.4	0.29
321	Lower crossarm	60x60x6	S355	1M16-8.8t	1.00	1.00	1.00	134	**-3.1**	ULS 7	61.5	60.3	70.6	0.05		**0.0**		61.2	60.3	36.0	0.00
322	Lower crossarm	80x80x8	S355	1M16-8.8t	1.00	1.00	1.00	179	**0.0**		74.1	60.3	94.1	0.00		**6.8**	ULS 7	194.4	60.3	69.7	0.11
401	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	153	**-19.8**	ULS 5a Ba 30	45.0	58.8	64.8	0.44		**17.8**	ULS 5a Ba 20	65.7	58.8	44.4	0.40
402	Dwarsligger onc	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	41	**-1.4**	ULS 1a_0,9_0,9_90	994.3	117.6	172.8	0.01		**7.1**	ULS 3_90	1278.1	117.6	0.0	0.06
402A	Dwarsligger onc	HEB160	S355	2M20-8.8t	2.00	2.00	2.00	37	**-12.4**	ULS 5a Ba 30	1426.1	188.2	235.2	0.07		**13.6**	ULS 5a Ba 20	1739.7	188.2	0.0	0.07
403	Verticale regel t	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	87	**-2.9**	ULS 1a_0,9_0,9_90	53.8	37.7	43.2	0.08		**4.6**	ULS 1a_90	37.4	37.7	22.0	0.21
404	Verticale regel t	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	173	**-10.2**	ULS 1a_0,9_0,9_90	26.7	37.7	43.2	0.38		**17.1**	ULS 1a_90	37.4	37.7	22.0	0.78
405	Verticale regel t	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	291	**-3.0**	ULS 1a_90	12.4	37.7	43.2	0.24		**0.0**		37.4	37.7	22.0	0.00
406	Bovenarm twee	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	318	**0.0**		52.7	254.2	311.0	0.00		**70.6**	ULS 3_135	263.0	254.2	265.8	0.28
407	Bovenarm twee	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	217	**-15.7**	ULS 1a_0,9_0,9_90	95.2	254.2	311.0	0.16		**67.9**	ULS 1a_90	263.0	254.2	265.8	0.27
408	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	206	**-7.1**	ULS 1a_0	21.0	37.7	43.2	0.34		**6.6**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.30
409	Dwarsligger onc	**60x60x6**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	309	**-12.7**	ULS 1a_90	17.4	60.3	70.6	0.73		**3.4**	ULS 1a_0,9_0,9_90	61.2	60.3	36.0	0.10
117A	Tweede dwarsa	120x120x8	S235	4M24-5.6t	1.00	2.89	1.00	135	**-62.3**	ULS 5a Ba 1	166.8	338.9	414.7	0.37		**71.5**	ULS 5a Ba 1	379.5	338.9	354.5	0.21
117C	Tweede dwarsa	120x120x8	S235		1.00	3.06	1.00	136	**-56.3**	ULS 5a Ba 1	166.7	0.0	0.0	0.34		**66.0**	ULS 5a Ba 1	441.8	0.0	0.0	0.15
117B	Tweede dwarsa	120x120x8	S235	2M16-5.6t	1.00	6.39	1.00	48	**-14.0**	ULS 5a Ba 1	332.1	75.4	138.2	0.19		**13.6**	ULS 5a Ba 1	323.3	75.4	138.2	0.18
429	Diagonaal voor	HEB160	S355	2M20-8.8t	1.00	1.00	1.00	28	**-0.3**	ULS 5a Ba 30	1508.8	188.2	235.2	0.00		**2.0**	ULS 5a Ba 20	1739.7	188.2	0.0	0.01
410	Diagonaal voor	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	272	**0.0**		13.8	37.7	43.2	0.00		**1.3**	ULS 1a_45	37.4	37.7	22.0	0.06
411	Dwarsligger bov	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	214	**-0.6**	ULS 1a_90	19.8	37.7	43.2	0.03		**0.4**	ULS 1a_0,9_90	37.4	37.7	22.0	0.02
412	Dwarsligger bov	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	20	**-7.6**	ULS 5a Ba 1	1087.1	75.4	138.2	0.10		**7.4**	ULS 5a Ba 1	984.5	75.4	138.2	0.10
413	Ladder tweede	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	119	**-0.1**	ULS 1a_90	41.2	37.7	43.2	0.00		**0.1**	ULS 1a_0,9_0,9_90	37.4	37.7	22.0	0.00
415	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	144	**-19.9**	ULS 5a Ba 20	48.2	58.8	64.8	0.41		**23.3**	ULS 5a Ba 30	65.7	58.8	44.4	0.52
416	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	136	**-26.9**	ULS 5a Ba 30	51.4	58.8	64.8	0.52		**21.2**	ULS 5a Ba 20	65.7	58.8	44.4	0.48
417	Diagonalen ond	60x60x6	S355	1M20-8.8t	1.00	1.00	1.00	125	**-21.2**	ULS 5a Ba 20	67.5	94.1	88.2	0.31		**28.1**	ULS 5a Ba 30	89.4	94.1	60.4	0.47
418	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	121	**-9.7**	ULS 5a Ba 30	58.6	58.8	64.8	0.17		**16.4**	ULS 5a Ba 20	65.7	58.8	44.4	0.37
419	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	119	**-19.2**	ULS 5a Ba 20	59.4	58.8	64.8	0.33		**12.2**	ULS 5a Ba 30	65.7	58.8	44.4	0.27
420	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	90	**-16.0**	ULS 5a Ba 20	75.6	58.8	64.8	0.27		**10.3**	ULS 5a Ba 30	65.7	58.8	44.4	0.23
421	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	197	**-6.1**	ULS 1a_0,9_0,9_0	22.4	37.7	43.2	0.27		**6.6**	ULS 1a_0	37.4	37.7	22.0	0.30
422	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	181	**-6.0**	ULS 1a_0	25.1	37.7	43.2	0.24		**5.4**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.24
423	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	143	**-4.9**	ULS 1a_0,9_0,9_0	33.7	37.7	43.2	0.15		**5.0**	ULS 1a_0	37.4	37.7	22.0	0.23
424	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	131	**-4.7**	ULS 1a_0	37.3	37.7	43.2	0.12		**4.5**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.20
425	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	126	**-5.5**	ULS 5a Ba 1	39.1	37.7	43.2	0.15		**5.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.25
426	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	120	**-7.0**	ULS 5a Ba 1	41.1	37.7	43.2	0.19		**7.0**	ULS 5a Ba 1	37.4	37.7	22.0	0.32
427	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	115	**-9.6**	ULS 5a Ba 1	42.8	37.7	43.2	0.25		**9.4**	ULS 5a Ba 1	37.4	37.7	22.0	0.42
428	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.56	0.56	0.56	115	**-13.5**	ULS 5a Ba 1	42.9	37.7	43.2	0.36		**14.0**	ULS 5a Ba 1	37.4	37.7	22.0	0.63
EXT77	Pivot -77cm	80x80x8	S235		1.00	1.00	1.00	19	**0.0**		256.4	0.0	0.0	0.00		**15.0**	ULS 5a Ba 1	289.1	0.0	0.0	0.00
320	Dwarsligger onc	HEB160	S355	2M20-8.8t	2.00	2.00	2.00	50	**-10.7**	ULS 5a Ba 21	1313.8	188.2	235.2	0.06		**14.3**	ULS 5a Ba 31	1739.7	188.2	0.0	0.08
320A	HEM	HEM160	S355	2M20-8.8t	1.00	1.00	1.00	37	**-1.1**	ULS 5a Ba 21	2729.8	188.2	411.6	0.01		**2.7**	ULS 5a Ba 32	3069.0	188.2	0.0	0.01

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Assessment of groups for strengthened mast (verbouw level)

Date 25-3-2021
Author MKh
Version 1.0

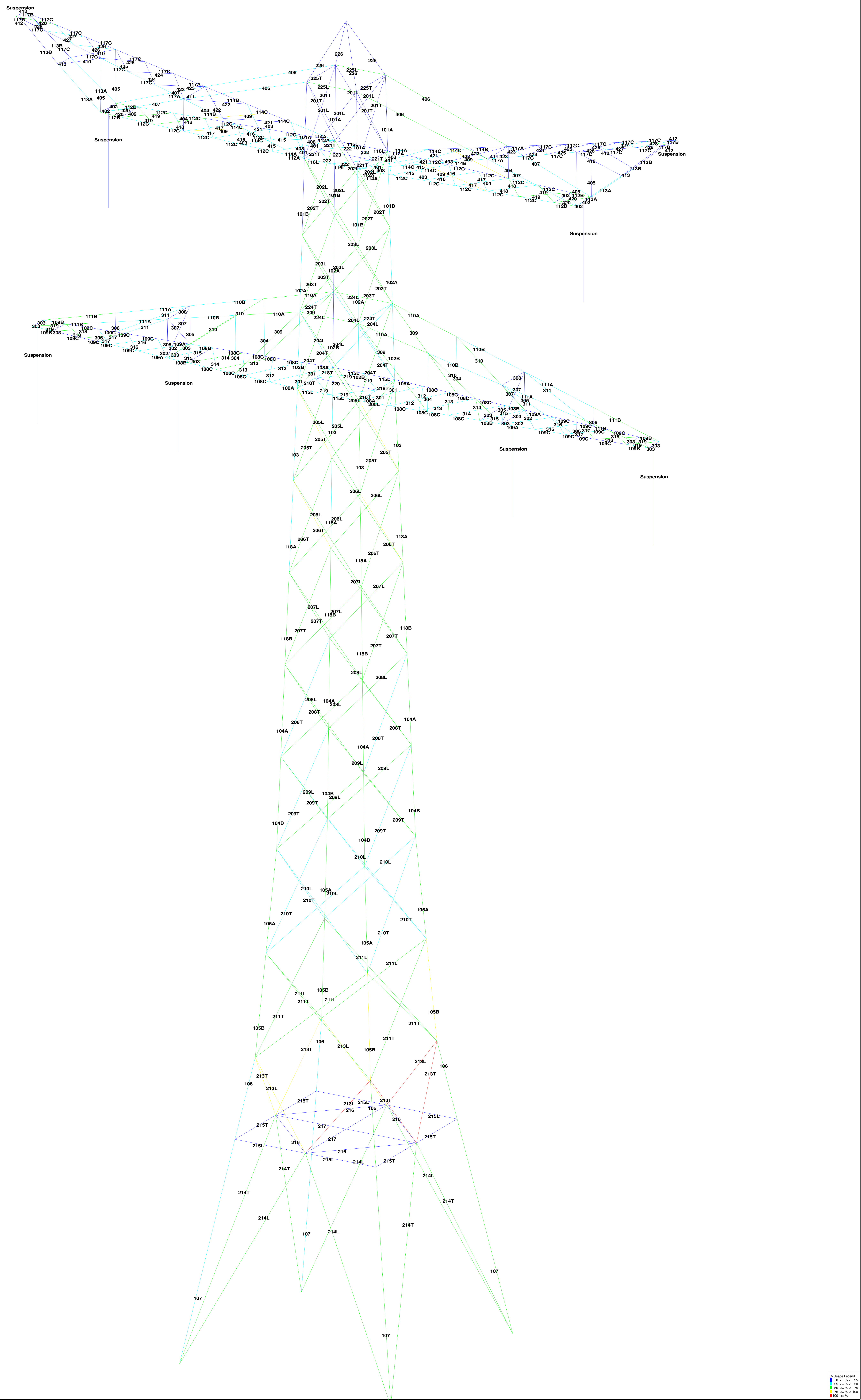
KIJ-GT380
S+18
11-2

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)
213L	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8s**	1.00	0.51	0.51	126	**-255.0**	ULS 1a_45	304.9	347.4	529.2	0.84		**228.2**	ULS 1a_0,9_0,9_135	663.8	347.4	452.3	0.66
213T	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8s**	1.00	0.51	0.51	126	**-276.0**	ULS 1a_135	304.9	347.4	529.2	0.91		**250.5**	ULS 1a_0,9_0,9_90	663.8	347.4	452.3	0.72
302	Diagonalen ond	**60x60x6**	**S355**	**1M20-8.8t**	1.00	1.00	1.00	124	**-24.1**	ULS 5a Ba 31	68.3	94.1	88.2	0.35		**20.3**	ULS 5a Ba 31	89.4	94.1	60.4	0.34
303A	Dwarsligger ond	HEB160	**S355**	**2M20-8.8t**	2.00	2.00	2.00	25	**-13.3**	ULS 5a Ba 31	1525.0	188.2	235.2	0.07		**13.0**	ULS 5a Ba 21	1739.7	188.2	0.0	0.07
311	Diagonaal voor	**80x80x8**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	173	**-4.5**	ULS 1a_0,9_0,9_90	77.9	60.3	94.1	0.07		**21.1**	ULS 3_90	194.4	60.3	69.7	0.35
312	Diagonalen ond	**70x70x7**	**S355**	**1M20-8.8t**	1.00	1.00	1.00	132	**-17.5**	ULS 5a Ba 22	85.6	94.1	102.9	0.20		**26.5**	ULS 5a Ba 32	104.3	94.1	70.5	0.38
321	Lower crossarm	**60x60x6**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	134	**-3.5**	ULS 7	61.5	60.3	70.6	0.06		**0.0**		61.2	60.3	36.0	0.00
322	Lower crossarm	**80x80x8**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	179	**0.0**		74.1	60.3	94.1	0.00		**7.6**	ULS 7	194.4	60.3	69.7	0.13
402A	Dwarsligger ond	HEB160	**S355**	**2M20-8.8t**	2.00	2.00	2.00	37	**-12.4**	ULS 5a Ba 30	1426.1	188.2	235.2	0.07		**13.6**	ULS 5a Ba 20	1739.7	188.2	0.0	0.07
409	Dwarsligger ond	**60x60x6**	**S355**	**1M16-8.8t**	1.00	1.00	1.00	309	**-14.7**	ULS 1a_90	17.4	60.3	70.6	0.84		**5.4**	ULS 1a_0,9_90	61.2	60.3	36.0	0.15
429	Diagonaal voor	**HEB160**	**S355**	**2M20-8.8t**	1.00	1.00	1.00	28	**-2.1**	ULS 1a_0,9_0,9_90	1508.8	188.2	235.2	0.01		**2.0**	ULS 1a_0,9_0,9_135	1739.7	188.2	0.0	0.01
417	Diagonalen ond	**60x60x6**	**S355**	**1M20-8.8t**	1.00	1.00	1.00	125	**-21.2**	ULS 5a Ba 20	67.5	94.1	88.2	0.31		**28.1**	ULS 5a Ba 30	89.4	94.1	60.4	0.47
320	Dwarsligger ond	**HEB160**	**S355**	**2M20-8.8t**	2.00	2.00	2.00	50	**-10.7**	ULS 5a Ba 21	1313.8	188.2	235.2	0.06		**14.3**	ULS 5a Ba 31	1739.7	188.2	0.0	0.08
320A	HEM	**HEM160**	**S355**	**2M20-8.8t**	1.00	1.00	1.00	37	**-1.5**	ULS 1a_0,9_0,9_90	2729.8	188.2	411.6	0.01		**3.0**	ULS 1a_0,9_0,9_90	3069.0	188.2	0.0	0.02

Notes

1) The bolts for groups 213L and 213T should have the shear plane in contact with the unthreaded shaft
2) The following groups were added to facilitate the attachment of the V-assemblies: 312, 320A, 302, 320, 417, 429

DNV GL Nederlands BV, Project: "S+18 (hv) ini"
Tower Version 16.28, 16:35:36 donderdag 11 juni 2020
Undeformed geometry displayed



Assessment of groups for initial mast (afkeur level)

Date	6-7-2020
Author	MKh
Version	1.0

KIJ-GT380
S+18
60

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 bovenstuk	120x120x8	S235	8M24-5.6t	0.50	0.50	0.50	84	-47.0	ULS 5a Ba 22	318.5	670.3	829.4	0.15		0.0		379.5	670.3	779.8	0.00	
101B	Leg bovenstuk	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	-98.6	ULS 1a_45	318.5	508.3	622.1	0.31		50.6	ULS 1a_0,9_0,9_45	379.5	508.3	531.7	0.13	
102A	Leg vijfde tussenstuk	150x150x12	S235	6M24-5.6t	0.50	0.50	0.50	68	-219.2	ULS 1a_45	663.4	508.3	933.1	0.43		123.8	ULS 1a_0,9_0,9_45	740.3	508.3	797.5	0.24	
102B	Leg vijfde tussenstuk	150x150x12	S235	8M24-5.6t	0.50	0.50	0.50	68	-276.5	ULS 1a_45	663.4	677.8	1244.2	0.42		156.4	ULS 1a_0,9_0,9_45	740.3	677.8	776.3	0.23	
103	Leg vierde tussenstuk	180x180x16	S235	8M24-5.6t	0.30	0.30	0.30	41	-457.6	ULS 1a_45	1210.1	677.8	1658.9	0.68		297.9	ULS 1a_0,9_0,9_45	1220.3	677.8	1417.8	0.44	
118A	Leg vierde tussenstuk	180x180x16	S235	8M24-5.6t	0.30	0.30	0.30	41	-661.6	ULS 1a_45	1210.1	1355.5	1658.9	0.55		469.7	ULS 1a_0,9_0,9_45	1220.3	1355.5	1417.8	0.38	
118B	Leg vierde tussenstuk	180x180x16	S235	8M24-5.6t	0.30	0.30	0.30	41	-790.4	ULS 1a_45	1210.1	1355.5	1658.9	0.65		604.6	ULS 1a_0,9_0,9_45	1220.3	1355.5	1063.4	0.57	
104A	Leg derde tussenstuk	200x200x18	S235	8M24-5.6t	0.30	0.30	0.30	37	-967.0	ULS 1a_45	1532.7	1355.5	1866.2	0.71		753.3	ULS 1a_0,9_0,9_45	1548.5	1355.5	1132.5	0.67	
104B	Leg derde tussenstuk	200x200x18	S235	10M24-5.6t	0.30	0.30	0.30	37	-1086.5	ULS 1a_45	1532.7	1662.6	2332.8	0.71		877.6	ULS 1a_0,9_0,9_45	1548.5	1662.6	2332.8	0.57	
105A	Leg tweede tussenstuk	250x250x16	S235	10M24-5.6t	0.30	0.30	0.30	33	-1166.7	ULS 1a_45	1766.9	1599.1	2073.6	0.73		953.2	ULS 1a_0,9_0,9_45	1816.5	1599.1	1595.1	0.60	
105B	Leg tweede tussenstuk	250x250x16	S235	10M24-5.6t	0.30	0.30	0.30	33	-1294.0	ULS 1a_45	1766.8	1615.0	2073.6	0.80		1056.4	ULS 1a_0,9_0,9_45	1816.5	1615.0	1772.3	0.65	
106	Leg eerste tussenstuk	250x250x18	S235	12M24-5.6t	0.50	0.50	0.50	43	-1040.6	ULS 1a_45	1895.4	1859.6	2799.4	0.56		865.4	ULS 1a_0,9_0,9_45	2030.6	1859.6	2392.6	0.47	
107	Leg broekstuk	250x250x18	S235	12M24-5.6t	0.13	0.13	0.13	30	-1052.5	ULS 1a_45	1997.5	1929.5	2799.4	0.55		854.1	ULS 1a_0,9_0,9_45	2030.6	1929.5	2392.6	0.44	
108A	Eerste dwarsarm onderregel	160x160x15	S235	10M24-5.6t	1.00	2.20	1.00	76	-295.8	ULS 5a Ba 10	842.7	847.2	1944.0	0.35		131.6	ULS 5a Ba 21	1008.5	847.2	1661.5	0.16	
108C	Eerste dwarsarm onderregel	160x160x15	S235		1.00	2.37	1.00	76	-287.0	ULS 5a Ba 21	842.7	0.0	0.0	0.34		127.9	ULS 5a Ba 21	1097.7	0.0	0.0	0.12	
108B	Eerste dwarsarm onderregel	160x160x15	S235	6M24-5.6t	1.00	3.36	1.00	82	-237.4	ULS 5a Ba 10	802.3	508.3	1166.4	0.47		105.3	ULS 5a Ba 21	1008.5	508.3	996.9	0.21	
109A	Eerste dwarsarm onderregel	150x150x12	S235	6M24-5.6t	1.00	2.30	1.00	89	-196.7	ULS 5a Ba 21	565.2	508.3	933.1	0.39		111.7	ULS 5a Ba 10	740.3	508.3	797.5	0.22	
109C	Eerste dwarsarm onderregel	150x150x12	S235		1.00	2.50	1.00	89	-174.6	ULS 5a Ba 21	567.3	0.0	0.0	0.31		88.9	ULS 5a Ba 10	817.8	0.0	0.0	0.11	
109B	Eerste dwarsarm onderregel	150x150x12	S235	3M24-5.6t	1.00	3.28	1.00	86	-89.3	ULS 3_90	581.0	254.2	466.6	0.35		0.0		638.7	254.2	398.8	0.00	
110A	Eerste dwarsarm bovenregel	100x100x8	S235	3M24-5.6t	1.00	2.06	1.00	265	0.0		56.0	254.2	311.0	0.00		136.7	ULS 3_90	211.1	254.2	265.8	0.65	
110B	Eerste dwarsarm bovenregel	100x100x8	S235	4M24-5.6t	1.00	1.95	1.00	266	0.0		55.7	338.9	414.7	0.00		101.2	ULS 3_90	293.9	338.9	368.6	0.34	
111A	Eerste dwarsarm bovenregel	100x100x6	S235	4M24-5.6t	1.00	1.96	1.00	269	0.0		41.3	338.9	311.0	0.00		91.3	ULS 3_135	225.0	338.9	265.8	0.41	
111B	Eerste dwarsarm bovenregel	100x100x6	S235	3M24-5.6t	1.00	2.03	1.00	269	0.0		41.5	254.2	233.3	0.00		91.4	ULS 3_90	161.1	254.2	199.4	0.57	
112A	Tweede dwarsarm onderregel	150x150x12	S235	8M24-5.6t	1.00	1.94	1.00	79	-230.0	ULS 5a Ba 12	615.2	677.8	1244.2	0.37		104.3	ULS 5a Ba 22	740.3	677.8	1159.1	0.15	
112C	Tweede dwarsarm onderregel	150x150x12	S235		1.00	2.07	1.00	79	-212.5	ULS 5a Ba 12	615.6	0.0	0.0	0.35		86.3	ULS 5a Ba 22	817.8	0.0	0.0	0.11	
112B	Tweede dwarsarm onderregel	150x150x12	S235	2M24-5.6t	1.00	4.07	1.00	106	-121.0	ULS 3_90	470.5	169.4	311.0	0.71		0.0		638.7	169.4	265.8	0.00	
113A	Tweede dwarsarm tussenregel	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	163	-20.4	ULS 5a Ba 12	70.3	84.7	77.8	0.29		0.0		127.9	84.7	66.5	0.00	
113B	Tweede dwarsarm tussenregel	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	150	-19.3	ULS 5a Ba 12	82.2	84.7	77.8	0.25		0.0		127.9	84.7	66.5	0.00	
114A	Tweede dwarsarm bovenregel	120x120x8	S235	3M24-5.6t	1.00	1.50	1.00	104	-88.0	ULS 5a Ba 1	224.6	254.2	311.0	0.39		70.0	ULS 5a Ba 1	263.0	254.2	265.8	0.28	
114C	Tweede dwarsarm bovenregel	120x120x8	S235		2.00	3.00	1.00	100	-84.0	ULS 5a Ba 1	224.6	0.0	0.0	0.37		72.9	ULS 5a Ba 1	441.8	0.0	0.0	0.17	
114B	Tweede dwarsarm bovenregel	120x120x8	S235	4M24-5.6t	1.00	1.52	1.00	100	-75.5	ULS 5a Ba 1	229.6	338.9	414.7	0.33		68.1	ULS 5a Ba 1	379.5	338.9	354.5	0.20	
201L	Diagonaal bovenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	-26.0	ULS 5a Ba 22	221.9	169.4	207.4	0.15		17.2	ULS 5a Ba 22	226.0	169.4	177.2	0.10	
201T	Diagonaal bovenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	-22.5	ULS 5a Ba 22	221.9	169.4	207.4	0.13		3.9	ULS 5a Ba 22	226.0	169.4	177.2	0.02	
202L	Diagonaal bovenstuk	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	-112.4	ULS 5a Ba 12	266.8	169.4	259.2	0.66		84.0	ULS 5a Ba 22	278.4	169.4	221.5	0.50	
202T	Diagonaal bovenstuk	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	-104.2	ULS 5a Ba 12	266.8	169.4	259.2	0.62		113.8	ULS 5a Ba 22	278.4	169.4	221.5	0.67	
203L	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	-77.4	ULS 5a Ba 22	213.8	169.4	207.4	0.46		103.0	ULS 5a Ba 12	226.0	169.4	177.2	0.61	
203T	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	-104.4	ULS 5a Ba 22	213.8	169.4	207.4	0.62		95.7	ULS 5a Ba 12	226.0	169.4	177.2	0.56	
204L	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	-91.1	ULS 5a Ba 12	209.6	169.4	207.4	0.54		79.5	ULS 5a Ba 22	226.0	169.4	177.2	0.47	
204T	Diagonaal vijfde tussenstuk	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	-100.3	ULS 5a Ba 12	209.6	169.4	207.4	0.59		82.0	ULS 5a Ba 22	226.0	169.4	177.2	0.48	
205L	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	-107.9	ULS 5a Ba 10	211.6	169.4	207.4	0.64		100.9	ULS 5a Ba 21	138.1	169.4	172.2	0.73	
205T	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	-122.0	ULS 5a Ba 10	211.6	169.4	207.4	0.72		120.0	ULS 5a Ba 21	138.1	169.4	172.2	0.87	
206L	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	-90.3	ULS 5a Ba 21	206.8	169.4	207.4	0.53		94.5	ULS 5a Ba 10	138.1	169.4	172.2	0.68	
206T	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	-106.1	ULS 5a Ba 21	206.8	169.4	207.4	0.63		107.8	ULS 5a Ba 10	138.1	169.4	172.2	0.78	
207L	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	-86.8	ULS 1a_90	201.9	169.4	207.4	0.51		80.1	ULS 5a Ba 21	138.1	169.4	172.2	0.58	
207T	Diagonaal vierde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	-96.3	ULS 5a Ba 10	201.9	169.4	207.4	0.57		94.0	ULS 5a Ba 21	138.1	169.4	172.2	0.68	
208L	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	-79.3	ULS 1a_0,9_0,9_90	196.9	169.4	207.4	0.47		83.7	ULS 1a_90	138.1	169.4	172.2	0.61	
208T	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	-84.9	ULS 5a Ba 21	196.9	169.4	207.4	0.50		86.5	ULS 5a Ba 10	138.1	169.4	172.2	0.63	
209L	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	-80.1	ULS 1a_90	191.8	169.4	207.4	0.47		73.6	ULS 1a_0,9_0,9_90	128.6	169.4	164.6	0.57	
209T	Diagonaal derde tussenstuk	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	-78.9	ULS 5a Ba 10	191.8	169.4	207.4	0.47		76.6	ULS 5a Ba 21	128.6	169.4	164.6	0.60	
210L	Diagonaal tweede tussenstuk	120x80x8	S235	2M24-5.6t	0.54	0.27	0.27	119	-66.7	ULS 5a Ba 10	166.6	169.4	207.4	0.40		62.5	ULS 5a Ba 21	138.1	169.4	172.2	0.45	
210T	Diagonaal tweede tussenstuk	120x80x8	S235	2M24-5.6t	1.00	0.27	0.27	198	-43.5	ULS 1a_90	86.6	169.4	207.4	0.50		60.3	ULS 5a Ba 21	138.1	169.4	172.2	0.44	
211L	Diagonaal tweede tussenstuk	120x80x8	S235	1M24-5.6t	0.54	0.27	0.27	128	-51.8	ULS 5a Ba 21	106.9	84.7	103.7	0.61		54.5	ULS 5a Ba 10	124.4	84.7	88.6	0.64	
211T	Diagonaal tweede tussenstuk	120x80x8	S235	1M24-5.6t	0.54	0.27	0.27	128	-49.9	ULS 5a Ba 21	106.9	84.7	103.7	0.59		55.7	ULS 5a Ba 10	124.4	84.7	88.6	0.66	
213L	Diagonaal eerste tussenstuk	150x100x10	S235	2M24-5.6t	1.00	0.51	0.51	127	-176.7	ULS 1a_45	170.1	169.4	259.2	1.04	knik, afschuiving	133.9	ULS 1a_0,9_0,9_135	225.8	169.4	221.5	0.79	
213T	Diagonaal eerste tussenstuk	150x100x10	S235	2M24-5.6t	1.00	0.51	0.51	127	-184.6	ULS 1a_90	170.1	169.4	259.2	1.09	knik, afschuiving	143.3	ULS 1a_0,9_0,9_90	225.8	169.4	221.5	0.85	
214L	Diagonaal broekstuk	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	-173.3	ULS 1a_45	282.5	338.9	259.2	0.72		122.7	ULS 1a_0,9_0,9_135	463.8	338.9	221.5	0.55	
214T	Diagonaal broekstuk	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	-174.0	ULS 1a_135	282.5	338.9	259.2	0.73		123.1	ULS 1a_0,9_0,9_45	463.8	338.9	221.5	0.56	
215L	Onderstuk in tower	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	-8.9	ULS 1a_90	374.7	254.2	544.3	0.04		2.8	ULS 1a_0,9_0,9_90	525.6	254.2	416.5	0.01	
215T	Onderstuk in tower	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	-8.8	ULS 1a_45	374.7	254.2	544.3	0.03		3.1	ULS 1a_0,9_0	525.6	254.2	416.5	0.01	
216	Onderstuk in tower	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	287	-5.0	ULS 1a_45	31.1	58.8	64.8	0.16		5.9	ULS 1a_0,9_0,9_135	134.8	58.8	52.4	0.11	
217	onderstuk in tower	75x75x7#	S235	1M20-5.6t	1.00	0.50	0.50	349	-1.0	ULS 1a_90	20.6	58.8	75.6	0.05		0.0		106.8	58.8	61.1	0.00	
115L	Eerste dwarsarm in tower	160x160x15	S235	10M24-5.6t	1.00	2.00	1.00	71	-236.0	ULS 5a Ba 10	870.6	783.7	1944.0	0.30		63.7	ULS 5a Ba 10	612.0	783.7	1647.0	0.10	
218T	Eerste dwarsarm in tower	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	114	-36.9	ULS 5a Ba 21	123.1	338.9	311.0	0.30		65.6	ULS 5a Ba 21	225.0	338.9	265.8	0.29	
219	Eerste dwarsarm in tower	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	104	-68.4	ULS 5a Ba 10	229.9	169.4	207.4	0.40		69.5	ULS 5a Ba 10	226.0	169.4	177.2	0.41	
220	Eerste dwarsarm in tower	55x55x6	S235	1M16-5.6t	1.00	1.00	1.00	330	-1.4	ULS 3_90	12.7	37.7	51.8	0.11		0.0		55.3	37.7	33.6	0.00	
116L	Tweede dwarsboom in tower	150x150x12	S235	8M24-5.6t	1.00	2.00	1.00	65	-195.5	ULS 5a Ba 22	674.1	677.8	1244.2	0.29		58.1	ULS 5a Ba 12	740.3	677.8	1063.4	0.09	
221T	Tweede dwarsboom in tower	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	98	-33.2	ULS 5a Ba 22	140.9	338.9	311.0	0.24		52.7	ULS 5a Ba 22	225.0	338.9	265.8	0.23	
222	Tweede dwarsboom in tower	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	-53.8	ULS 5a Ba 12	182.9	169.4	207.4	0.32		54.1	ULS 5a Ba 12	181.4	169.4	177.2	0.32	
223	Tweede dwarsboom in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	-0.6	ULS 3_90	11.3	37.7	43.2	0.05		0.0		37.4	37.7	22.0	0.00	
224L	Eerste dwarsboom in tower bovenzijde	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	140	0.0		169.7	254.2	311.0	0.00		148.7	ULS 3_0	263.0	254.2	265.8	0.59	
224T	Eerste dwarsboom in tower bovenzijde	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	169	-22.3	ULS 1a_0,9_90	67.1	84.7	77.8	0.33		26.2	ULS 1a_90	127.9	84.7	66.5	0.39	
225L	Tweede dwarsboom in tower bovenzijde	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	144	0.0		102.6	254.2	233.3	0.00		118.3	ULS 3_90	179.2	254.2	199.4	0.66	
225T	Tweede dwarsboom in tower bovenzijde	70x70x7	S235	3M24-5.6t	1.00	1.00	1.00	208	-1.1	ULS 1a_0,9_0,9_90	50.5	254.2	272.2	0.02		4.6	ULS 1a_90	132.7	254.2	232.6	0.03	
226	Top	100x100x6	S235	2M16-5.6t	0.30	0.30	0.30	55	-11.9	ULS 5a Ba 12	204.8	75.4	103.7	0.16		11.6	ULS 5a Ba 12	144.1	75.4	76.8	0.15	
301	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	144	-17.1	ULS 5a Ba 20	65.7	84.7	90.7	0.26		19.8	ULS 5a Ba 11	68.5	84.7	47.5	0.42	
302	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	129	-16.3	ULS 5a Ba 21	54.9	58.8	64.8	0.30		15.3	ULS 5a Ba 21	65.7	58.8	44.4	0.34	
303	Dwarsligger ondervlak eerste dwarsarm	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	25	-23.5	ULS 5a Ba 21	1064.1	117.6	172.8	0.20		29.5	ULS 5a Ba 11	1278.1	117.6	0.0	0.25	
304	Verticale regel eerste dwarsarm	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	154	-18.3	ULS 3_0	75.4	58.8	64.8	0.31		0.0		134.8	58.8	52.4	0.00	
305	Verticale regel eerste dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	-3.5	ULS 1a_0	30.0	37.7	43.2	0.12		0.0		37.4	37.7	22.0	0.00	
306	Verticale regel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	102	-1.2	ULS 3_90	47.6	37.7	43.2	0.03		0.0		37.4	37.7	22.0	0.00	
307	Diagonaal eerste dwarsarm dwarsrichtin	50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	162	-2.3	ULS 1a_0	29.1	37.7	43.2	0.08		1.1	ULS 1a_0,9_0,9_0	37.4	37.7	18.4	0.06	
308	Bovenregel eerste dwarsarm dwrsrichtin	75x50x5	S235	1M24-5.6t	1.00	1.00	1.00	203	0.0		26.7	84.7	64.8	0.00		0.5	ULS 7	70.6	84.7	51.8	0.01	
309	Diagonaal voor eerste dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	569	0.0		5.0	75.4	86.4	0.00		28.6	ULS 3_135	52.4	75.4	44.1	0.65	
310	Diagonaal voor eerste dwarsarm	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	432	0.0		11.6	117.6	129.6	0.00		43.5	ULS 3_0	77.4	117.6	88.7	0.56	
311	Diagonaal voor eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	469	0.0		5.6	37.7	43.2	0.00		10.8	ULS 3_45	37.4	37.7	22.0	0.49	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date	6-7-2020
Author	MKh
Version	1.0

KIJ-GT380
S+18
60

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)
312	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	133	**-22.3**	ULS 5a Ba 11	71.9	84.7	90.7	0.31		**20.3**	ULS 5a Ba 20	68.5	84.7	47.5	0.43	
313	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	127	**-22.3**	ULS 5a Ba 20	75.5	84.7	90.7	0.30		**24.5**	ULS 5a Ba 11	68.5	84.7	47.5	0.52	
314	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	122	**-28.1**	ULS 5a Ba 11	79.2	84.7	90.7	0.36		**24.9**	ULS 5a Ba 20	68.5	84.7	47.5	0.52	
315	Diagonalen ondervlak eerste dwarsarm	70x70x7	S235	1M20-5.6t	0.52	0.52	0.52	102	**-27.2**	ULS 5a Ba 20	93.6	58.8	75.6	0.46		**21.5**	ULS 5a Ba 20	96.8	58.8	61.1	0.36	
316	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	115	**-18.7**	ULS 5a Ba 10	61.7	58.8	64.8	0.32		**18.8**	ULS 5a Ba 21	65.7	58.8	44.4	0.42	
317	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	108	**-23.1**	ULS 5a Ba 10	65.3	58.8	64.8	0.39		**24.1**	ULS 5a Ba 10	65.7	58.8	44.4	0.54	
318	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.56	0.56	0.56	107	**-32.5**	ULS 5a Ba 21	65.8	58.8	64.8	0.55		**29.4**	ULS 5a Ba 21	65.7	58.8	44.4	0.66	
319	Diagonalen ondervlak eerste dwarsarm	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	77	**-32.3**	ULS 5a Ba 21	81.6	58.8	64.8	0.55		**25.8**	ULS 5a Ba 21	65.7	58.8	44.4	0.58	
401	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	153	**-15.2**	ULS 5a Ba 22	45.0	58.8	64.8	0.34		**14.5**	ULS 5a Ba 12	65.7	58.8	44.4	0.33	
402	Dwarsligger ondervlak tweede dwarsarm	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	37	**-22.2**	ULS 5a Ba 22	1011.5	117.6	172.8	0.19		**29.3**	ULS 5a Ba 12	1278.1	117.6	0.0	0.25	
403	Verticale regel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	87	**0.0**		53.8	37.7	43.2	0.00		**1.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.07	
404	Verticale regel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	173	**0.0**		26.7	37.7	43.2	0.00		**3.6**	ULS 5a Ba 22	37.4	37.7	22.0	0.17	
405	Verticale regel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	291	**-2.8**	ULS 1a_135	12.4	37.7	43.2	0.23		**0.0**		37.4	37.7	22.0	0.00	
406	Bovenarm tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	318	**0.0**		52.7	254.2	311.0	0.00		**129.8**	ULS 3_90	263.0	254.2	265.8	0.51	
407	Bovenarm tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	217	**0.0**		95.2	254.2	311.0	0.00		**116.2**	ULS 3_90	263.0	254.2	265.8	0.46	
408	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	206	**-5.9**	ULS 1a_0,9_0,9_0	21.0	37.7	43.2	0.28		**6.1**	ULS 1a_0,9_0	37.4	37.7	22.0	0.28	
117A	Tweede dwarsarm bovenregel	120x120x8	S235	4M24-5.6t	1.00	2.89	1.00	135	**-59.1**	ULS 5a Ba 1	166.8	338.9	414.7	0.35		**74.7**	ULS 5a Ba 1	379.5	338.9	354.5	0.22	
117C	Tweede dwarsarm bovenregel	120x120x8	S235		1.00	3.06	1.00	136	**-53.1**	ULS 5a Ba 1	166.7	0.0	0.0	0.32		**69.1**	ULS 5a Ba 1	441.8	0.0	0.0	0.16	
117B	Tweede dwarsarm bovenregel	120x120x8	S235	2M16-5.6t	1.00	6.39	1.00	48	**-14.8**	ULS 5a Ba 1	332.1	75.4	138.2	0.20		**12.8**	ULS 5a Ba 1	323.3	75.4	138.2	0.17	
409	Diagonaal voor tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	373	**-6.8**	ULS 5a Ba 1	8.3	37.7	43.2	0.83		**0.0**		37.4	37.7	22.0	0.00	
410	Diagonaal voor tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	272	**0.0**		13.8	37.7	43.2	0.00		**1.4**	ULS 1a_90	37.4	37.7	22.0	0.06	
411	Dwarsligger bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	214	**-1.2**	ULS 3_90	19.8	37.7	43.2	0.06		**0.0**		37.4	37.7	22.0	0.00	
412	Dwarsligger bovenvlak tweede dwarsarm	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	20	**-7.8**	ULS 5a Ba 1	1087.1	75.4	138.2	0.10		**7.2**	ULS 5a Ba 1	984.5	75.4	138.2	0.10	
413	Ladder tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	119	**-0.1**	ULS 1a_90	41.2	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00	
415	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	144	**-17.3**	ULS 5a Ba 12	48.2	58.8	64.8	0.36		**17.6**	ULS 5a Ba 22	65.7	58.8	44.4	0.40	
416	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	136	**-19.2**	ULS 5a Ba 22	51.4	58.8	64.8	0.37		**19.4**	ULS 5a Ba 12	65.7	58.8	44.4	0.44	
417	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	128	**-22.5**	ULS 5a Ba 12	54.9	58.8	64.8	0.41		**21.4**	ULS 5a Ba 22	65.7	58.8	44.4	0.48	
418	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	121	**-24.4**	ULS 5a Ba 22	58.6	58.8	64.8	0.42		**26.8**	ULS 5a Ba 12	65.7	58.8	44.4	0.60	
419	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	119	**-33.3**	ULS 5a Ba 12	59.4	58.8	64.8	0.57		**28.7**	ULS 5a Ba 22	65.7	58.8	44.4	0.65	
420	Diagonalen ondervlak tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	90	**-30.4**	ULS 5a Ba 12	75.6	58.8	64.8	0.52		**21.7**	ULS 5a Ba 22	65.7	58.8	44.4	0.49	
421	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	197	**-5.8**	ULS 1a_0,9_0	22.4	37.7	43.2	0.26		**5.4**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.25	
422	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	181	**-4.9**	ULS 1a_0,9_0,9_0	25.1	37.7	43.2	0.19		**5.1**	ULS 1a_0,9_0	37.4	37.7	22.0	0.23	
423	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	143	**-4.3**	ULS 1a_0,9_0,9_0	33.7	37.7	43.2	0.13		**4.5**	ULS 1a_0	37.4	37.7	22.0	0.20	
424	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	131	**-4.7**	ULS 5a Ba 1	37.3	37.7	43.2	0.12		**4.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.20	
425	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	126	**-5.5**	ULS 5a Ba 1	39.1	37.7	43.2	0.15		**5.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.25	
426	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	120	**-7.0**	ULS 5a Ba 1	41.1	37.7	43.2	0.19		**7.0**	ULS 5a Ba 1	37.4	37.7	22.0	0.32	
427	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	115	**-9.6**	ULS 5a Ba 1	42.8	37.7	43.2	0.26		**9.3**	ULS 5a Ba 1	37.4	37.7	22.0	0.42	
428	Diagonalen bovenvlak tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.56	0.56	0.56	115	**-13.4**	ULS 5a Ba 1	42.9	37.7	43.2	0.36		**14.2**	ULS 5a Ba 1	37.4	37.7	22.0	0.64	

DNV·GL

Assessment of groups for strenghtened mast (afkeur level)

Date 6-7-2020
Author MKh
Version 1.0

KIJ-GT380
S+18
60

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 bovenstuk	120x120x8	S235	8M24-5.6t	0.50	0.50	0.50	84	**-46.8**	ULS 5a Ba 22	318.5	670.3	829.4	0.15		**0.0**		379.5	670.3	779.8	0.00
101B	Leg bovenstuk	120x120x8	S235	6M24-5.6t	0.50	0.50	0.50	84	**-98.1**	ULS 1a_45	318.5	508.3	622.1	0.31		**49.4**	ULS 1a_0,9_0,9_45	379.5	508.3	531.7	0.13
102A	Leg vijfde tusse	150x150x12	S235	6M24-5.6t	0.50	0.50	0.50	68	**-218.7**	ULS 1a_45	663.4	508.3	933.1	0.43		**120.5**	ULS 1a_0,9_0,9_45	740.3	508.3	797.5	0.24
102B	Leg vijfde tusse	150x150x12	S235	8M24-5.6t	0.50	0.50	0.50	68	**-276.5**	ULS 1a_45	663.4	677.8	1244.2	0.42		**151.7**	ULS 1a_0,9_0,9_45	740.3	677.8	776.3	0.22
103	Leg vierde tuss	180x180x16#	S235	8M24-5.6t	0.30	0.30	0.30	41	**-456.5**	ULS 1a_45	1210.1	677.8	1658.9	0.67		**293.2**	ULS 1a_0,9_0,9_45	1220.3	677.8	1417.8	0.43
118A	Leg vierde tuss	180x180x16#	S235	8M24-5.6t	0.30	0.30	0.30	41	**-652.3**	ULS 1a_45	1210.1	1355.5	1658.9	0.54		**463.9**	ULS 1a_0,9_0,9_45	1220.3	1355.5	1417.8	0.38
118B	Leg vierde tuss	180x180x16#	S235	8M24-5.6t	0.30	0.30	0.30	41	**-781.3**	ULS 1a_45	1210.1	1355.5	1658.9	0.65		**601.3**	ULS 1a_0,9_0,9_45	1220.3	1355.5	1063.4	0.57
104A	Leg derde tusse	200x200x18	S235	8M24-5.6t	0.30	0.30	0.30	37	**-952.2**	ULS 1a_45	1532.7	1355.5	1866.2	0.70		**746.9**	ULS 1a_0,9_0,9_45	1548.5	1355.5	1132.5	0.66
104B	Leg derde tusse	200x200x18	S235	10M24-5.6t	0.30	0.30	0.30	37	**-1075.7**	ULS 1a_45	1532.7	1662.6	2332.8	0.70		**873.4**	ULS 1a_0,9_0,9_45	1548.5	1662.6	2332.8	0.56
105A	Leg tweede tus	250x250x16#	S235	10M24-5.6t	0.30	0.30	0.30	33	**-1152.8**	ULS 1a_45	1766.9	1599.1	2073.6	0.72		**942.5**	ULS 1a_0,9_0,9_45	1816.5	1599.1	1595.1	0.59
105B	Leg tweede tus	250x250x16#	S235	10M24-5.6t	0.30	0.30	0.30	33	**-1290.2**	ULS 1a_45	1766.8	1615.0	2073.6	0.80		**1048.1**	ULS 1a_0,9_0,9_45	1816.5	1615.0	1772.3	0.65
106	Leg eerste tuss	250x250x18#	S235	12M24-5.6t	0.50	0.50	0.50	43	**-1032.3**	ULS 1a_45	1895.4	1859.6	2799.4	0.56		**848.8**	ULS 1a_0,9_0,9_45	2030.6	1859.6	2392.6	0.46
107	Leg broekstuk	250x250x18#	S235	12M24-5.6t	0.13	0.13	0.13	30	**-1044.0**	ULS 1a_45	1997.5	1929.5	2799.4	0.54		**837.2**	ULS 1a_0,9_0,9_45	2030.6	1929.5	2392.6	0.43
108A	Eerste dwarsarı	160x160x15#	S235	10M24-5.6t	1.00	2.20	1.00	76	**-296.2**	ULS 5a Ba 10	842.7	847.2	1944.0	0.35		**131.4**	ULS 5a Ba 21	1008.5	847.2	1661.5	0.16
108C	Eerste dwarsarı	160x160x15#	S235		1.00	2.37	1.00	76	**-287.4**	ULS 5a Ba 21	842.7	0.0	0.0	0.34		**127.5**	ULS 5a Ba 21	1097.7	0.0	0.0	0.12
108B	Eerste dwarsarı	160x160x15#	S235	6M24-5.6t	1.00	3.36	1.00	82	**-237.9**	ULS 5a Ba 10	802.3	508.3	1166.4	0.47		**104.9**	ULS 5a Ba 21	1008.5	508.3	996.9	0.21
109A	Eerste dwarsarı	150x150x12	S235	6M24-5.6t	1.00	2.30	1.00	89	**-197.2**	ULS 5a Ba 21	565.2	508.3	933.1	0.39		**111.0**	ULS 5a Ba 10	740.3	508.3	797.5	0.22
109C	Eerste dwarsarı	150x150x12	S235		1.00	2.50	1.00	89	**-175.1**	ULS 5a Ba 21	567.3	0.0	0.0	0.31		**88.3**	ULS 5a Ba 10	817.8	0.0	0.0	0.11
109B	Eerste dwarsarı	150x150x12	S235	3M24-5.6t	1.00	3.28	1.00	86	**-89.2**	ULS 3_90	581.0	254.2	466.6	0.35		**0.0**		638.7	254.2	398.8	0.00
110A	Eerste dwarsarı	100x100x8	S235	3M24-5.6t	1.00	2.06	1.00	265	**0.0**		56.0	254.2	311.0	0.00		**136.9**	ULS 3_90	211.1	254.2	265.8	0.65
110B	Eerste dwarsarı	100x100x8	S235	4M24-5.6t	1.00	1.95	1.00	266	**0.0**		55.7	338.9	414.7	0.00		**101.4**	ULS 3_90	293.9	338.9	368.6	0.35
111A	Eerste dwarsarı	100x100x6	S235	4M24-5.6t	1.00	1.96	1.00	269	**0.0**		41.3	338.9	311.0	0.00		**91.4**	ULS 3_90	225.0	338.9	265.8	0.41
111B	Eerste dwarsarı	100x100x6	S235	3M24-5.6t	1.00	2.03	1.00	269	**0.0**		41.5	254.2	233.3	0.00		**91.3**	ULS 3_90	161.1	254.2	199.4	0.57
112A	Tweede dwarsa	150x150x12	S235	8M24-5.6t	1.00	1.94	1.00	79	**-229.6**	ULS 5a Ba 12	615.2	677.8	1244.2	0.37		**104.0**	ULS 5a Ba 22	740.3	677.8	1159.1	0.15
112C	Tweede dwarsa	150x150x12	S235		1.00	2.07	1.00	79	**-212.0**	ULS 5a Ba 12	615.6	0.0	0.0	0.34		**86.0**	ULS 5a Ba 22	817.8	0.0	0.0	0.11
112B	Tweede dwarsa	150x150x12	S235	2M24-5.6t	1.00	4.07	1.00	106	**-121.0**	ULS 3_90	470.5	169.4	311.0	0.71		**0.0**		638.7	169.4	265.8	0.00
113A	Tweede dwarsa	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	163	**-20.5**	ULS 5a Ba 12	70.3	84.7	77.8	0.29		**0.0**		127.9	84.7	66.5	0.00
113B	Tweede dwarsa	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	150	**-19.3**	ULS 5a Ba 12	82.2	84.7	77.8	0.25		**0.0**		127.9	84.7	66.5	0.00
114A	Tweede dwarsa	120x120x8	S235	3M24-5.6t	1.00	1.50	1.00	104	**-88.0**	ULS 5a Ba 1	224.6	254.2	311.0	0.39		**70.2**	ULS 5a Ba 1	263.0	254.2	265.8	0.28
114C	Tweede dwarsa	120x120x8	S235		2.00	3.00	1.00	100	**-83.8**	ULS 5a Ba 1	224.6	0.0	0.0	0.37		**73.1**	ULS 5a Ba 1	441.8	0.0	0.0	0.17
114B	Tweede dwarsa	120x120x8	S235	4M24-5.6t	1.00	1.52	1.00	100	**-75.3**	ULS 5a Ba 1	229.6	338.9	414.7	0.33		**68.1**	ULS 5a Ba 1	379.5	338.9	354.5	0.20
201L	Diagonaal bove	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	**-25.7**	ULS 5a Ba 22	221.9	169.4	207.4	0.15		**16.9**	ULS 5a Ba 22	226.0	169.4	177.2	0.10
201T	Diagonaal bove	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	108	**-22.4**	ULS 5a Ba 22	221.9	169.4	207.4	0.13		**3.7**	ULS 5a Ba 22	226.0	169.4	177.2	0.02
202L	Diagonaal bove	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	**-112.5**	ULS 5a Ba 12	266.8	169.4	259.2	0.66		**83.9**	ULS 5a Ba 22	278.4	169.4	221.5	0.50
202T	Diagonaal bove	120x120x10	S235	2M24-5.6t	0.52	0.52	0.52	111	**-104.2**	ULS 5a Ba 12	266.8	169.4	259.2	0.61		**113.8**	ULS 5a Ba 22	278.4	169.4	221.5	0.67
203L	Diagonaal vijfd	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	**-77.1**	ULS 5a Ba 22	213.8	169.4	207.4	0.46		**103.2**	ULS 5a Ba 12	226.0	169.4	177.2	0.61
203T	Diagonaal vijfd	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	113	**-104.3**	ULS 5a Ba 22	213.8	169.4	207.4	0.62		**95.7**	ULS 5a Ba 12	226.0	169.4	177.2	0.56
204L	Diagonaal vijfd	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	**-91.4**	ULS 5a Ba 12	209.6	169.4	207.4	0.54		**79.8**	ULS 5a Ba 22	226.0	169.4	177.2	0.47
204T	Diagonaal vijfd	120x120x8	S235	2M24-5.6t	0.52	0.52	0.52	115	**-100.4**	ULS 5a Ba 12	209.6	169.4	207.4	0.59		**82.3**	ULS 5a Ba 22	226.0	169.4	177.2	0.49
205L	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	**-107.5**	ULS 5a Ba 10	211.6	169.4	207.4	0.63		**100.8**	ULS 5a Ba 21	138.1	169.4	172.2	0.73
205T	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	91	**-121.6**	ULS 5a Ba 10	211.6	169.4	207.4	0.72		**120.1**	ULS 5a Ba 21	138.1	169.4	172.2	0.87
206L	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	**-90.0**	ULS 5a Ba 21	206.8	169.4	207.4	0.53		**94.2**	ULS 5a Ba 10	138.1	169.4	172.2	0.68
206T	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	93	**-106.0**	ULS 5a Ba 21	206.8	169.4	207.4	0.63		**107.6**	ULS 5a Ba 10	138.1	169.4	172.2	0.78
207L	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	**-85.4**	ULS 1a_90	201.9	169.4	207.4	0.50		**80.0**	ULS 5a Ba 21	138.1	169.4	172.2	0.58
207T	Diagonaal vierd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	96	**-96.0**	ULS 5a Ba 10	201.9	169.4	207.4	0.57		**94.0**	ULS 5a Ba 21	138.1	169.4	172.2	0.68
208L	Diagonaal derd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	**-78.5**	ULS 1a_0,9_0,9_90	196.9	169.4	207.4	0.46		**83.3**	ULS 1a_90	138.1	169.4	172.2	0.60
208T	Diagonaal derd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	99	**-84.8**	ULS 5a Ba 21	196.9	169.4	207.4	0.50		**86.2**	ULS 5a Ba 10	138.1	169.4	172.2	0.62
209L	Diagonaal derd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	**-78.7**	ULS 1a_90	191.8	169.4	207.4	0.46		**74.2**	ULS 1a_0,9_0,9_90	128.6	169.4	164.6	0.58
209T	Diagonaal derd	120x80x8	S235	2M24-5.6t	0.52	0.26	0.26	103	**-78.5**	ULS 5a Ba 10	191.8	169.4	207.4	0.46		**76.7**	ULS 5a Ba 21	128.6	169.4	164.6	0.60
210L	Diagonaal twee	120x80x8	S235	2M24-5.6t	0.54	0.27	0.27	119	**-67.4**	ULS 5a Ba 10	166.6	169.4	207.4	0.40		**62.6**	ULS 5a Ba 21	138.1	169.4	172.2	0.45
210T	Diagonaal twee	120x80x8	S235	2M24-5.6t	1.00	0.27	0.27	198	**-45.9**	ULS 1a_90	86.5	169.4	207.4	0.53		**60.0**	ULS 5a Ba 21	138.1	169.4	172.2	0.43
211L	Diagonaal twee	120x80x8	S235	1M24-5.6t	0.54	0.27	0.27	128	**-51.8**	ULS 5a Ba 21	106.9	84.7	103.7	0.61		**55.5**	ULS 5a Ba 10	124.4	84.7	88.6	0.65
211T	Diagonaal twee	120x80x8	S235	1M24-5.6t	**1.00**	0.27	0.27	213	**-31.8**	ULS 1a_0,9_0,9_90	53.7	84.7	103.7	0.59		**56.1**	ULS 5a Ba 10	124.4	84.7	88.6	0.66
213L	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8t**	1.00	0.51	0.51	126	**-178.7**	ULS 1a_45	304.9	271.1	529.2	0.66		**136.2**	ULS 1a_0,9_0,9_135	663.8	271.1	452.3	0.50
213T	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8t**	1.00	0.51	0.51	126	**-190.7**	ULS 1a_90	304.9	271.1	529.2	0.70		**146.3**	ULS 1a_0,9_0,9_90	663.8	271.1	452.3	0.54
214L	Diagonaal broel	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	**-174.3**	ULS 1a_45	282.5	338.9	259.2	0.73		**123.4**	ULS 1a_0,9_0,9_135	463.8	338.9	221.5	0.56
214T	Diagonaal broel	UNP260	S235	2M24-5.6t	1.00	0.13	0.13	131	**-177.0**	ULS 1a_90	282.5	338.9	259.2	0.74		**124.5**	ULS 1a_0,9_0,9_90	463.8	338.9	221.5	0.56
215L	Onderstuk in to	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	**-8.1**	ULS 1a_135	374.7	254.2	544.3	0.03		**4.7**	ULS 1a_0,9_45	525.6	254.2	416.5	0.02
215T	Onderstuk in to	150x150x14	S235	3M24-5.6t	1.00	1.00	1.00	136	**-8.2**	ULS 1a_45	374.7	254.2	544.3	0.03		**4.7**	ULS 1a_0,9_135	525.6	254.2	416.5	0.02
216	Onderstuk in to	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	287	**-6.4**	ULS 1a_45	31.1	58.8	64.8	0.20		**4.6**	ULS 1a_0,9_0,9_135	134.8	58.8	52.4	0.09
217	onderstuk in to	75x75x7#	S235	1M20-5.6t	1.00	0.50	0.50	349	**-0.9**	ULS 7	17.0	58.8	75.6	0.05		**0.0**		106.8	58.8	61.1	0.00
115L	Eerste dwarsarı	160x160x15#	S235	10M24-5.6t	1.00	2.00	1.00	71	**-236.3**	ULS 5a Ba 21	870.6	783.7	1944.0	0.30		**63.7**	ULS 5a Ba 10	612.0	783.7	1647.0	0.10
218T	Eerste dwarsarı	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	114	**-36.9**	ULS 5a Ba 21	123.1	338.9	311.0	0.30		**65.4**	ULS 5a Ba 21	225.0	338.9	265.8	0.29
219	Eerste dwarsarı	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	104	**-68.4**	ULS 5a Ba 21	229.9	169.4	207.4	0.40		**69.5**	ULS 5a Ba 10	226.0	169.4	177.2	0.41
220	Eerste dwarsarı	55x55x6	S235	1M16-5.6t	1.00	1.00	1.00	330	**-1.4**	ULS 3_90	12.7	37.7	51.8	0.11		**0.0**		55.3	37.7	33.6	0.00
116L	Tweede dwarsb	150x150x12	S235	8M24-5.6t	1.00	2.00	1.00	65	**-195.4**	ULS 5a Ba 22	674.1	677.8	1244.2	0.29		**57.6**	ULS 5a Ba 12	740.3	677.8	1063.4	0.09
221T	Tweede dwarsb	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	98	**-33.1**	ULS 5a Ba 22	140.9	338.9	311.0	0.24		**52.7**	ULS 5a Ba 22	225.0	338.9	265.8	0.23
222	Tweede dwarsb	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	**-53.9**	ULS 5a Ba 22	182.9	169.4	207.4	0.32		**54.2**	ULS 5a Ba 12	181.4	169.4	177.2	0.32
223	Tweede dwarsb	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	**-0.6**	ULS 3_90	11.3	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00
224L	Eerste dwarsbo	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	140	**0.0**		169.7	254.2	311.0	0.00		**148.8**	ULS 3_0	263.0	254.2	265.8	0.59
224T	Eerste dwarsbo	100x100x6	S235	1M24-5.6t	1.00	1.00	1.00	169	**-22.1**	ULS 1a_0,9_90	67.1	84.7	77.8	0.33		**26.0**	ULS 1a_90	127.9	84.7	66.5	0.39
225L	Tweede dwarsb	100x100x6	S235	3M24-5.6t	1.00	1.00	1.00	144	**0.0**		102.6	254.2	233.3	0.00		**118.4**	ULS 3_90	179.2	254.2	199.4	0.66
225T	Tweede dwarsb	70x70x7	S235	3M24-5.6t	1.00	1.00	1.00	208	**-1.1**	ULS 1a_0,9_0,9_90	50.5	254.2	272.2	0.02		**4.6**	ULS 1a_90	132.7	254.2	232.6	0.03
226	Top	100x100x6	S235	2M16-5.6t	0.30	0.30	0.30	55	**-11.8**	ULS 5a Ba 12	204.8	75.4	103.7	0.16		**11.5**	ULS 5a Ba 22	144.1	75.4	76.8	0.15
301	Diagonalen ond	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	144	**-17.1**	ULS 5a Ba 20	65.7	84.7	90.7	0.26		**19.9**	ULS 5a Ba 11	68.5	84.7	47.5	0.42
302	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	129	**-16.3**	ULS 5a Ba 10	54.9	58.8	64.8	0.30		**15.3**	ULS 5a Ba 21	65.7	58.8	44.4	0.35
303	Dwarsligger ond	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	25	**-23.4**	ULS 5a Ba 21	1064.1	117.6	172.8	0.20		**29.4**	ULS 5a Ba 11	1278.1	117.6	0.0	0.25
304	Verticale regel	100x100x6	S235	1M20-5.6t	1.00	1.00	1.00	154	**-18.2**	ULS 3_0	75.4	58.8	64.8	0.31		**0.0**		134.8	58.8	52.4	0.00
305	Verticale regel	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	**-3.5**	ULS 1a_0	30.0	37.7	43.2	0.12		**0.0**		37.4	37.7	22.0	0.00
306	Verticale regel	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	102	**-1.0**	ULS 1a_135	47.6	37.7	43.2	0.03		**0.0**		37.4	37.7	22.0	0.00
307	Diagonaal eerst	50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	162	**-2.3**	ULS 1a_0	29.1	37.7	43.2	0.08		**1.1**	ULS 1a_0,9_0,9_0	37.4	37.7	18.4	0.06
308	Bovenregel eer	75x50x5	S235	1M24-5.6t	1.00	1.00	1.00	203	**0.0**		26.7	84.7	64.8	0.00		**0.5**	ULS 7	70.6	84.7	51.8	0.01

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 6-7-2020
Author MKh
Version 1.0

KIJ-GT380
S+18
60

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)
309	Diagonaal voor	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	569	**0.0**		5.0	75.4	86.4	0.00		**28.6**	ULS 3_135	52.4	75.4	44.1	0.65
310	Diagonaal voor	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	432	**0.0**		11.6	117.6	129.6	0.00		**43.6**	ULS 3_0	77.4	117.6	88.7	0.56
311	Diagonaal voor	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	469	**0.0**		5.6	37.7	43.2	0.00		**10.9**	ULS 3_135	37.4	37.7	22.0	0.50
312	Diagonalen ond	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	133	**-22.3**	ULS 5a Ba 11	71.9	84.7	90.7	0.31		**20.3**	ULS 5a Ba 20	68.5	84.7	47.5	0.43
313	Diagonalen ond	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	127	**-22.3**	ULS 5a Ba 20	75.5	84.7	90.7	0.30		**24.5**	ULS 5a Ba 11	68.5	84.7	47.5	0.52
314	Diagonalen ond	70x70x7	S235	1M24-5.6t	0.53	0.53	0.53	122	**-28.1**	ULS 5a Ba 11	79.2	84.7	90.7	0.36		**24.8**	ULS 5a Ba 20	68.5	84.7	47.5	0.52
315	Diagonalen ond	70x70x7	S235	1M20-5.6t	0.52	0.52	0.52	102	**-27.1**	ULS 5a Ba 20	93.6	58.8	75.6	0.46		**21.5**	ULS 5a Ba 11	96.8	58.8	61.1	0.36
316	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	115	**-18.7**	ULS 5a Ba 10	61.7	58.8	64.8	0.32		**18.8**	ULS 5a Ba 21	65.7	58.8	44.4	0.42
317	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	108	**-23.0**	ULS 5a Ba 21	65.3	58.8	64.8	0.39		**24.1**	ULS 5a Ba 10	65.7	58.8	44.4	0.54
318	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.56	0.56	0.56	107	**-32.6**	ULS 5a Ba 10	65.8	58.8	64.8	0.55		**29.4**	ULS 5a Ba 21	65.7	58.8	44.4	0.66
319	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	77	**-32.7**	ULS 5a Ba 10	81.6	58.8	64.8	0.56		**26.0**	ULS 5a Ba 21	65.7	58.8	44.4	0.58
401	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	153	**-15.2**	ULS 5a Ba 22	45.0	58.8	64.8	0.34		**14.7**	ULS 5a Ba 12	65.7	58.8	44.4	0.33
402	Dwarsligger ond	HEB160	S235	2M20-5.6t	2.00	2.00	2.00	37	**-22.2**	ULS 5a Ba 22	1011.5	117.6	172.8	0.19		**29.2**	ULS 5a Ba 12	1278.1	117.6	0.0	0.25
403	Verticale regel t	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	87	**0.0**		53.8	37.7	43.2	0.00		**1.8**	ULS 5a Ba 12	37.4	37.7	22.0	0.08
404	Verticale regel t	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	173	**0.0**		26.7	37.7	43.2	0.00		**3.9**	ULS 5a Ba 12	37.4	37.7	22.0	0.18
405	Verticale regel t	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	291	**-2.8**	ULS 1a_135	12.4	37.7	43.2	0.23		**0.0**		37.4	37.7	22.0	0.00
406	Bovenarm twee	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	318	**0.0**		52.7	254.2	311.0	0.00		**129.9**	ULS 3_90	263.0	254.2	265.8	0.51
407	Bovenarm twee	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	217	**0.0**		95.2	254.2	311.0	0.00		**116.3**	ULS 3_90	263.0	254.2	265.8	0.46
408	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	206	**-5.9**	ULS 1a_0,9_0,9_0	21.0	37.7	43.2	0.28		**6.1**	ULS 1a_0,9_0	37.4	37.7	22.0	0.28
117A	Tweede dwarsa	120x120x8	S235	4M24-5.6t	1.00	2.89	1.00	135	**-58.8**	ULS 5a Ba 1	166.8	338.9	414.7	0.35		**74.4**	ULS 5a Ba 1	379.5	338.9	354.5	0.22
117C	Tweede dwarsa	120x120x8	S235		1.00	3.06	1.00	136	**-52.8**	ULS 5a Ba 1	166.7	0.0	0.0	0.32		**68.9**	ULS 5a Ba 1	441.8	0.0	0.0	0.16
117B	Tweede dwarsa	120x120x8	S235	2M16-5.6t	1.00	6.39	1.00	48	**-14.9**	ULS 5a Ba 1	332.1	75.4	138.2	0.20		**12.8**	ULS 5a Ba 1	323.3	75.4	138.2	0.17
409	Diagonaal voor	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	373	**-7.6**	ULS 5a Ba 12	8.3	37.7	43.2	0.92		**0.0**		37.4	37.7	22.0	0.00
410	Diagonaal voor	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	272	**0.0**		13.8	37.7	43.2	0.00		**1.4**	ULS 1a_90	37.4	37.7	22.0	0.06
411	Dwarsligger bov	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	214	**-1.2**	ULS 3_90	19.8	37.7	43.2	0.06		**0.0**		37.4	37.7	22.0	0.00
412	Dwarsligger bov	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	20	**-7.8**	ULS 5a Ba 1	1087.1	75.4	138.2	0.10		**7.2**	ULS 5a Ba 1	984.5	75.4	138.2	0.10
413	Ladder tweede	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	119	**-0.1**	ULS 1a_90	41.2	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00
415	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	144	**-17.4**	ULS 5a Ba 12	48.2	58.8	64.8	0.36		**17.7**	ULS 5a Ba 22	65.7	58.8	44.4	0.40
416	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	136	**-19.3**	ULS 5a Ba 22	51.4	58.8	64.8	0.37		**19.4**	ULS 5a Ba 12	65.7	58.8	44.4	0.44
417	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	128	**-22.5**	ULS 5a Ba 12	54.9	58.8	64.8	0.41		**21.4**	ULS 5a Ba 22	65.7	58.8	44.4	0.48
418	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	121	**-24.4**	ULS 5a Ba 22	58.6	58.8	64.8	0.42		**26.8**	ULS 5a Ba 12	65.7	58.8	44.4	0.60
419	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	119	**-33.3**	ULS 5a Ba 12	59.4	58.8	64.8	0.57		**28.6**	ULS 5a Ba 22	65.7	58.8	44.4	0.65
420	Diagonalen ond	60x60x6	S235	1M20-5.6t	0.53	0.53	0.53	90	**-30.4**	ULS 5a Ba 12	75.6	58.8	64.8	0.52		**21.7**	ULS 5a Ba 22	65.7	58.8	44.4	0.49
421	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	197	**-5.8**	ULS 1a_0,9_0	22.4	37.7	43.2	0.26		**5.4**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.25
422	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	181	**-4.8**	ULS 1a_0,9_0,9_0	25.1	37.7	43.2	0.19		**5.1**	ULS 1a_0,9_0	37.4	37.7	22.0	0.23
423	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	143	**-4.3**	ULS 1a_0,9_0,9_0	33.7	37.7	43.2	0.13		**4.4**	ULS 1a_0	37.4	37.7	22.0	0.20
424	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	131	**-4.6**	ULS 5a Ba 1	37.3	37.7	43.2	0.12		**4.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.20
425	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	126	**-5.5**	ULS 5a Ba 1	39.1	37.7	43.2	0.15		**5.5**	ULS 5a Ba 1	37.4	37.7	22.0	0.25
426	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	120	**-6.9**	ULS 5a Ba 1	41.1	37.7	43.2	0.18		**7.0**	ULS 5a Ba 1	37.4	37.7	22.0	0.32
427	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	115	**-9.6**	ULS 5a Ba 1	42.8	37.7	43.2	0.25		**9.3**	ULS 5a Ba 1	37.4	37.7	22.0	0.42
428	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.56	0.56	0.56	115	**-13.3**	ULS 5a Ba 1	42.9	37.7	43.2	0.35		**14.1**	ULS 5a Ba 1	37.4	37.7	22.0	0.64

Assessment of groups for strengthened mast (verbouw level)

Date 6-7-2020
Author MKh
Version 1.0

KIJ-GT380
S+18
60

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)
213L	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8t**	1.00	0.51	0.51	126	**-220.4**	ULS 1a_45	304.9	271.1	529.2	0.81		**175.5**	ULS 1a_0,9_0,9_135	663.8	271.1	452.3	0.65
213T	Diagonaal eerst	**140x140x15**	**S355**	**2M24-8.8t**	1.00	0.51	0.51	126	**-235.7**	ULS 1a_90	304.9	271.1	529.2	0.87		**188.5**	ULS 1a_0,9_0,9_90	663.8	271.1	452.3	0.70

APPENDIX C REDUNDANT MEMBERS CHECK

Knikverkorters initial construction (afkeur)

Date: 2020-06-11
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+18
11-2

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	Notes
308	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	0.32	0	33	**20.0**	**0.08**	68.8	37.7	33.6	37.4	0.72	0.59		
300	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.52	89	156	**20.0**	**0.00**	30.4	37.7	33.6	37.4	0.72	0.66		
307	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	0.76	0	78	**20.0**	**0.19**	56.5	37.7	33.6	37.4	0.72	0.59		
299	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.55	71	159	**20.0**	**0.00**	29.8	37.7	33.6	37.4	0.72	0.67		
305	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.26	0	129	**20.0**	**0.32**	37.9	37.7	33.6	37.4	0.72	0.59		
298	Onderstuk	Enkele staaf	L60.6	S235	M16	5.6	1.78	56	152	**20.0**	**0.00**	45.3	37.7	44.8	72.6	1.24	0.53		
304	Onderstuk	Enkele staaf	L60.6	S235	M16	5.6	1.76	0	151	**20.0**	**0.44**	45.8	37.7	44.8	72.6	1.24	0.53		
297	Onderstuk	Enkele staaf	L60.6	S235	M16	5.6	2.10	44	180	**20.0**	**0.00**	36.5	37.7	44.8	72.6	1.24	0.55		
303	Onderstuk	Enkele staaf	L65.7	S235	M16	5.6	2.26	0	179	**20.0**	**0.56**	46.1	37.7	52.3	104.8	1.69	0.53		
296	Onderstuk	Enkele staaf	L65.7	S235	M16	5.6	2.47	33	196	**20.0**	**0.00**	40.9	37.7	52.3	104.8	1.69	0.53		
302	Onderstuk	Enkele staaf	L65.7	S235	M16	5.6	2.76	0	219	**20.0**	**0.69**	34.8	37.7	52.3	104.8	1.69	0.57		
295	Onderstuk	Enkele staaf	L75.7	S235	M16	5.6	2.90	28	198	**20.0**	**0.64**	46.8	37.7	52.3	145.2	2.27	0.53		
301	Onderstuk	Enkele staaf	L75.7	S235	M16	5.6	3.26	0	223	**20.0**	**0.82**	39.5	37.7	52.3	145.2	2.27	0.53		
294	Onderstuk	Enkele staaf	L75.7	S235	M16	5.6	3.18	21	217	**20.0**	**0.74**	41.0	37.7	52.3	145.2	2.27	0.53		
292	Tussenschot	Enkele staaf	L100.6	S235	M20	5.6	5.25	0	265	**3.8**	**1.31**	35.3	58.8	52.4	186.6	4.10	0.32		
293	Tussenschot	Kruisende staaf halverwege	L75.7	S235	M20	5.6	7.73	0	340	**3.8**	**0.97**	17.6	58.8	61.1	116.9	2.27	0.42		
330	1e tussenstuk	Enkele staaf	L65.7	S235	M16	5.6	2.78	40	220	**19.0**	**0.00**	34.5	37.7	52.3	104.8	1.69	0.55		
329	1e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.86	0	159	**19.0**	**0.46**	42.9	37.7	44.8	72.6	1.24	0.50		
86	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.39	0	143	**17.7**	**0.35**	33.9	37.7	33.6	37.4	0.72	0.53		
78	2e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.94	44	166	**17.7**	**0.00**	40.5	37.7	44.8	72.6	1.24	0.47		
88	2e tussenstuk	Enkele staaf	L65.7	S235	M16	5.6	2.74	0	217	**17.7**	**0.68**	35.2	37.7	52.3	104.8	1.69	0.50		
79	2e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.90	34	162	**17.7**	**0.00**	41.7	37.7	44.8	72.6	1.24	0.47		
87	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.41	0	144	**17.7**	**0.35**	33.4	37.7	33.6	37.4	0.72	0.53		
90	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.21	0	125	**17.7**	**0.30**	39.5	37.7	33.6	37.4	0.72	0.53		
80	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.82	49	186	**17.7**	**0.00**	24.1	37.7	33.6	37.4	0.72	0.73		
89	2e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	2.48	0	212	**17.7**	**0.62**	28.9	37.7	44.8	72.6	1.24	0.61		
81	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.72	37	177	**17.7**	**0.00**	25.9	37.7	33.6	37.4	0.72	0.68		
92	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.09	0	112	**15.3**	**0.27**	43.7	37.7	33.6	37.4	0.72	0.46		
82	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.62	46	166	**15.3**	**0.00**	28.1	37.7	33.6	37.4	0.72	0.55		
91	3e tussenstuk	Enkele staaf	L55.6	S235	M16	5.6	2.27	0	212	**15.3**	**0.57**	26.5	37.7	43.0	55.3	1.03	0.58		
83	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.56	40	160	**15.3**	**0.00**	29.5	37.7	33.6	37.4	0.72	0.52		
94	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.02	0	105	**15.3**	**0.26**	46.6	37.7	33.6	37.4	0.72	0.46		
84	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.57	48	161	**15.3**	**0.00**	29.2	37.7	33.6	37.4	0.72	0.52		
93	3e tussenstuk	Enkele staaf	L55.6	S235	M16	5.6	2.19	0	204	**15.3**	**0.55**	27.9	37.7	43.0	55.3	1.03	0.55		
85	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.50	41	154	**15.3**	**0.00**	31.0	37.7	33.6	37.4	0.72	0.49		
157	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.00	0	103	**12.1**	**0.25**	47.5	37.7	33.6	37.4	0.72	0.36		
152	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.54	50	159	**12.1**	**0.00**	29.9	37.7	33.6	37.4	0.72	0.41		
158	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.00	0	205	**12.1**	**0.50**	21.1	37.7	33.6	37.4	0.72	0.70		
151	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.46	42	150	**12.1**	**0.00**	32.0	37.7	33.6	37.4	0.72	0.38		
155	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	0.90	0	93	**12.1**	**0.23**	51.5	37.7	33.6	37.4	0.72	0.36		
150	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.49	52	153	**12.1**	**0.00**	31.2	37.7	33.6	37.4	0.72	0.39		
156	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.85	0	190	**12.1**	**0.46**	23.5	37.7	33.6	37.4	0.72	0.64		
149	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.40	44	144	**12.1**	**0.00**	33.6	37.7	33.6	37.4	0.72	0.36		
153	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	0.83	0	85	**12.1**	**0.21**	54.6	37.7	33.6	37.4	0.72	0.36		
148	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.45	54	149	**12.1**	**0.00**	32.3	37.7	33.6	37.4	0.72	0.37		
154	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.70	0	175	**12.1**	**0.43**	26.3	37.7	33.6	37.4	0.72	0.59		
147	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.34	47	138	**12.1**	**0.00**	35.3	37.7	33.6	37.4	0.72	0.36		

DNV·GL

Knikverkorters final construction (verbouw)

Date: 2020-06-11
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+18

11-2

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
A01	Section A-A	Enkele staaf	**L75.7**	**S355**	**M16**	**8.8**	3.44	0	235	**1.7**	**1.1**	40.1	60.3	71.1	197.6	3.44	0.33		Profile added
A02	Section A-A	Kruisende staaf hal\	**L75.7**	**S355**	**M16**	**8.8**	5.36	0	236	**1.7**	**0.9**	33.9	60.3	71.1	197.6	3.44	0.25		Profile added
A03	Section A-A	Kruisende staaf hal\	**L75.7**	**S355**	**M16**	**8.8**	5.36	0	236	**1.7**	**0.9**	33.9	60.3	71.1	197.6	3.44	0.25		Profile added

Knikverkorters initial construction (afkeur)

Date: 2020-06-11
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+18
60

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	Notes
308	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	0.32	0	33	20.0	0.08	68.8	37.7	33.6	37.4	0.72	0.59		
300	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.52	89	156	20.0	0.00	30.4	37.7	33.6	37.4	0.72	0.66		
307	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	0.76	0	78	20.0	0.19	56.5	37.7	33.6	37.4	0.72	0.59		
299	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.55	71	159	20.0	0.00	29.8	37.7	33.6	37.4	0.72	0.67		
305	Onderstuk	Enkele staaf	L50.5	S235	M16	5.6	1.26	0	129	20.0	0.32	37.9	37.7	33.6	37.4	0.72	0.59		
298	Onderstuk	Enkele staaf	L60.6	S235	M16	5.6	1.78	56	152	20.0	0.00	45.3	37.7	44.8	72.6	1.24	0.53		
304	Onderstuk	Enkele staaf	L60.6	S235	M16	5.6	1.76	0	151	20.0	0.44	45.8	37.7	44.8	72.6	1.24	0.53		
297	Onderstuk	Enkele staaf	L60.6	S235	M16	5.6	2.10	44	180	20.0	0.00	36.5	37.7	44.8	72.6	1.24	0.55		
303	Onderstuk	Enkele staaf	L65.7	S235	M16	5.6	2.26	0	179	20.0	0.56	46.1	37.7	52.3	104.8	1.69	0.53		
296	Onderstuk	Enkele staaf	L65.7	S235	M16	5.6	2.47	33	196	20.0	0.00	40.9	37.7	52.3	104.8	1.69	0.53		
302	Onderstuk	Enkele staaf	L65.7	S235	M16	5.6	2.76	0	219	20.0	0.69	34.8	37.7	52.3	104.8	1.69	0.57		
295	Onderstuk	Enkele staaf	L75.7	S235	M16	5.6	2.90	28	198	20.0	0.64	46.8	37.7	52.3	145.2	2.27	0.53		
301	Onderstuk	Enkele staaf	L75.7	S235	M16	5.6	3.26	0	223	20.0	0.82	39.5	37.7	52.3	145.2	2.27	0.53		
294	Onderstuk	Enkele staaf	L75.7	S235	M16	5.6	3.18	21	217	20.0	0.74	41.0	37.7	52.3	145.2	2.27	0.53		
292	Tussenschot	Enkele staaf	L100.6	S235	M20	5.6	5.25	0	265	3.8	1.31	35.3	58.8	52.4	186.6	4.10	0.32		
293	Tussenschot	Kruisende staaf halverwege	L75.7	S235	M20	5.6	7.73	0	340	3.8	0.97	17.6	58.8	61.1	116.9	2.27	0.42		
330	1e tussenstuk	Enkele staaf	L65.7	S235	M16	5.6	2.78	40	220	19.0	0.00	34.5	37.7	52.3	104.8	1.69	0.55		
329	1e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.86	0	159	19.0	0.46	42.9	37.7	44.8	72.6	1.24	0.50		
86	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.39	0	143	17.7	0.35	33.9	37.7	33.6	37.4	0.72	0.53		
78	2e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.94	44	166	17.7	0.00	40.5	37.7	44.8	72.6	1.24	0.47		
88	2e tussenstuk	Enkele staaf	L65.7	S235	M16	5.6	2.74	0	217	17.7	0.68	35.2	37.7	52.3	104.8	1.69	0.50		
79	2e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.90	34	162	17.7	0.00	41.7	37.7	44.8	72.6	1.24	0.47		
87	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.41	0	144	17.7	0.35	33.4	37.7	33.6	37.4	0.72	0.53		
90	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.21	0	125	17.7	0.30	39.5	37.7	33.6	37.4	0.72	0.53		
80	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.82	49	186	17.7	0.00	24.1	37.7	33.6	37.4	0.72	0.73		
89	2e tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	2.48	0	212	17.7	0.62	28.9	37.7	44.8	72.6	1.24	0.61		
81	2e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.72	37	177	17.7	0.00	25.9	37.7	33.6	37.4	0.72	0.68		
92	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.09	0	112	15.3	0.27	43.7	37.7	33.6	37.4	0.72	0.46		
82	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.62	46	166	15.3	0.00	28.1	37.7	33.6	37.4	0.72	0.55		
91	3e tussenstuk	Enkele staaf	L55.6	S235	M16	5.6	2.27	0	212	15.3	0.57	26.5	37.7	43.0	55.3	1.03	0.58		
83	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.56	40	160	15.3	0.00	29.5	37.7	33.6	37.4	0.72	0.52		
94	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.02	0	105	15.3	0.26	46.6	37.7	33.6	37.4	0.72	0.46		
84	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.57	48	161	15.3	0.00	29.2	37.7	33.6	37.4	0.72	0.52		
93	3e tussenstuk	Enkele staaf	L55.6	S235	M16	5.6	2.19	0	204	15.3	0.55	27.9	37.7	43.0	55.3	1.03	0.55		
85	3e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.50	41	154	15.3	0.00	31.0	37.7	33.6	37.4	0.72	0.49		
157	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.00	0	103	12.1	0.25	47.5	37.7	33.6	37.4	0.72	0.36		
152	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.54	50	159	12.1	0.00	29.9	37.7	33.6	37.4	0.72	0.41		
158	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.00	0	205	12.1	0.50	21.1	37.7	33.6	37.4	0.72	0.70		
151	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.46	42	150	12.1	0.00	32.0	37.7	33.6	37.4	0.72	0.38		
155	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	0.90	0	93	12.1	0.23	51.5	37.7	33.6	37.4	0.72	0.36		
150	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.49	52	153	12.1	0.00	31.2	37.7	33.6	37.4	0.72	0.39		
156	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.85	0	190	12.1	0.46	23.5	37.7	33.6	37.4	0.72	0.64		
149	4e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.40	44	144	12.1	0.00	33.6	37.7	33.6	37.4	0.72	0.36		
153	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	0.83	0	85	12.1	0.21	54.6	37.7	33.6	37.4	0.72	0.36		
148	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.45	54	149	12.1	0.00	32.3	37.7	33.6	37.4	0.72	0.37		
154	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.70	0	175	12.1	0.43	26.3	37.7	33.6	37.4	0.72	0.59		
147	5e tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.34	47	138	12.1	0.00	35.3	37.7	33.6	37.4	0.72	0.36		

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<u>Knikverkorters final construction (verbouw)</u>

Date: 2020-06-11
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+18

60

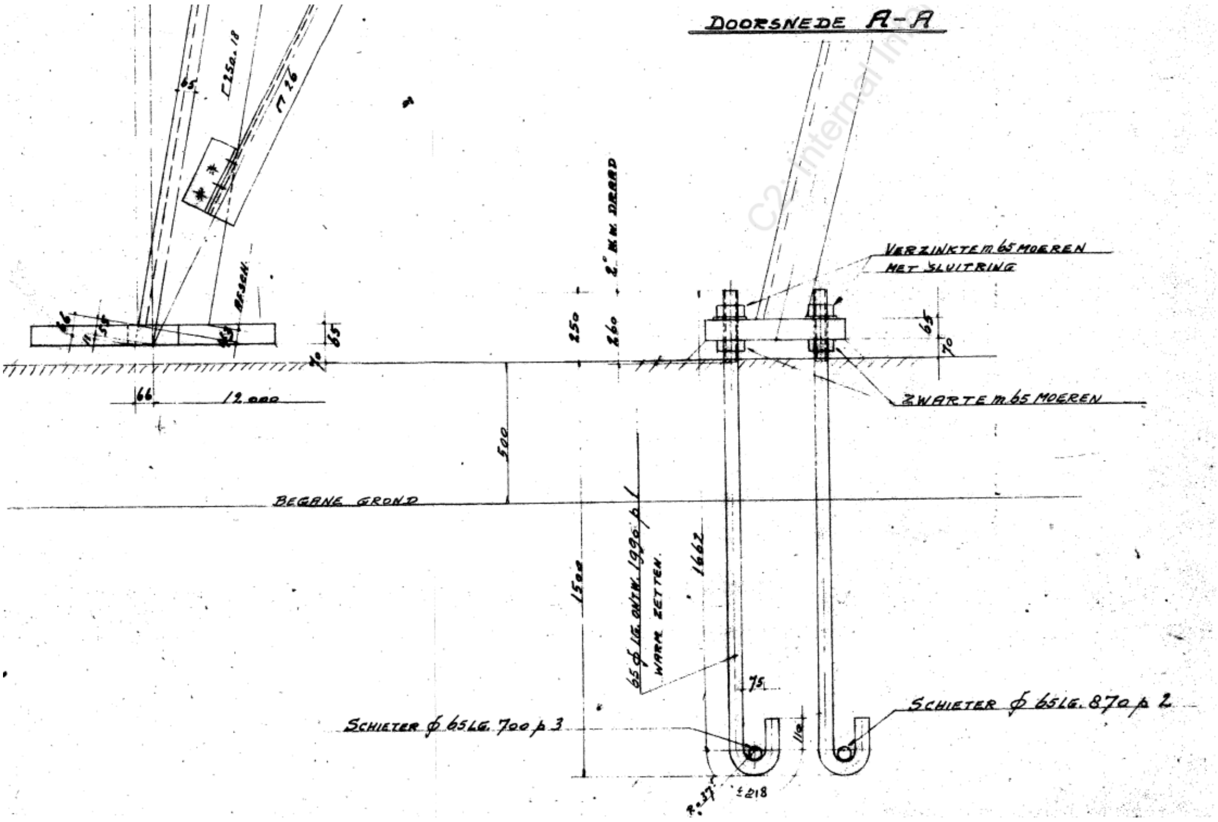
Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slenderness (-)	Normal Force (kN)	Moment (kNm)	Buckling Cap. (kN)	Shear Cap. Bolt (kN)	Bearing Cap. (kN)	Block Tearing Cap. (kN)	Moment Cap. (kNm)	Highest U.C.	Exceedance Type	Mitigation
A01	Section A-A	Enkele staaf	**L75.7**	**S355**	**M16**	**8.8**	3.44	0	235	**1.7**	**1.1**	40.1	60.3	71.1	197.6	3.44	0.33		Profile added
A02	Section A-A	Kruisende staaf hal\	**L75.7**	**S355**	**M16**	**8.8**	5.36	0	236	**1.7**	**0.9**	33.9	60.3	71.1	197.6	3.44	0.25		Profile added
A03	Section A-A	Kruisende staaf hal\	**L75.7**	**S355**	**M16**	**8.8**	5.36	0	236	**1.7**	**0.9**	33.9	60.3	71.1	197.6	3.44	0.25		Profile added

APPENDIX D CHECK ANCHORS

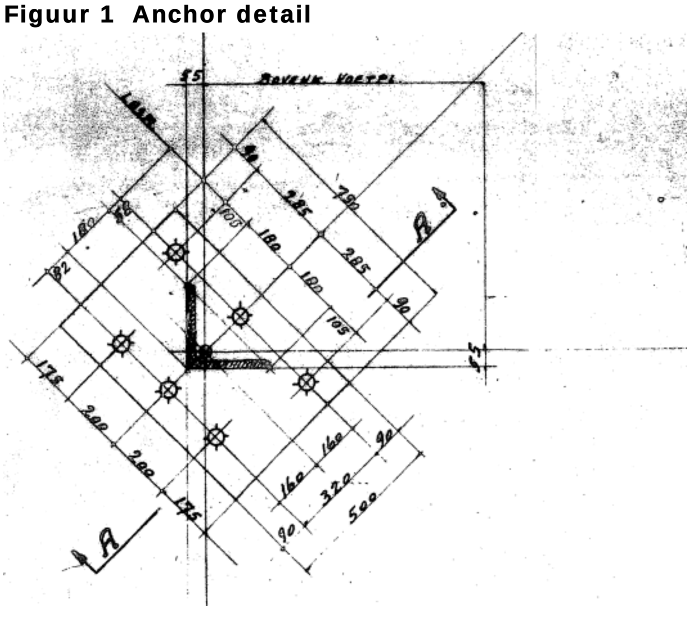
ANCHORS S+18 AND MAIN BRACING

Drawings show that 6 anchor bolts are present. The tower legs are connected to the foundation with a foot plate 500x750x65 mm and six anchors with diameter 65 mm.

De anchor rods are connected to a horizontal rod “schieter” which allows for distribution of the tensile force to the concrete.



Figuur 1 Anchor detail



Figuur 2 Voetplaat

Loads

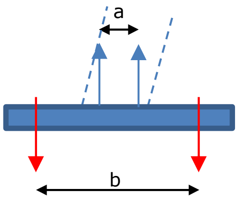
De loads coming from the tower are based on S+18 structure number II-2 in wind zone II:

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_135	-236	215	**1328**	-14	-319	8	1368
Max. tension	ULS 1a_0,9_0,9_135	-189	169	**-1085**	14	253	-14	-1118
Max. pos. torsie	ULS 1a_0,9_0,9_135	86	29	353	**40**	-81	6	364
Max. neg. torsie	ULS 1a_0,9_0,9_135	43	-14	-130	**-41**	21	-11	-134
Comb. tension+torsie	ULS 1a_0,9_0,9_135	-189	169	**-1085**	**14**	253	-14	-1118

Voetplaat en ankers

The strength of the foot plate will be determined assuming a horizontal yield line across the length of the plate. The tensile force is distributed to two point loads each separated by half of the diagonal width of the tower leg.



Figuur 3 Scheme for check of foot plate

a: 1/2 · 250 / √2 = 88 mm

b: 320 mm

The eccentricity becomes 1/2 · (320-88) = 116 mm

In the spreadsheet the anchor bolts and foot plate have been checked. The concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but is based on findings in similar projects. The assumption should be verified with concrete cilinder tests. The foot plate is embedded in concrete. The anchor bolts will not be loaded by bending.

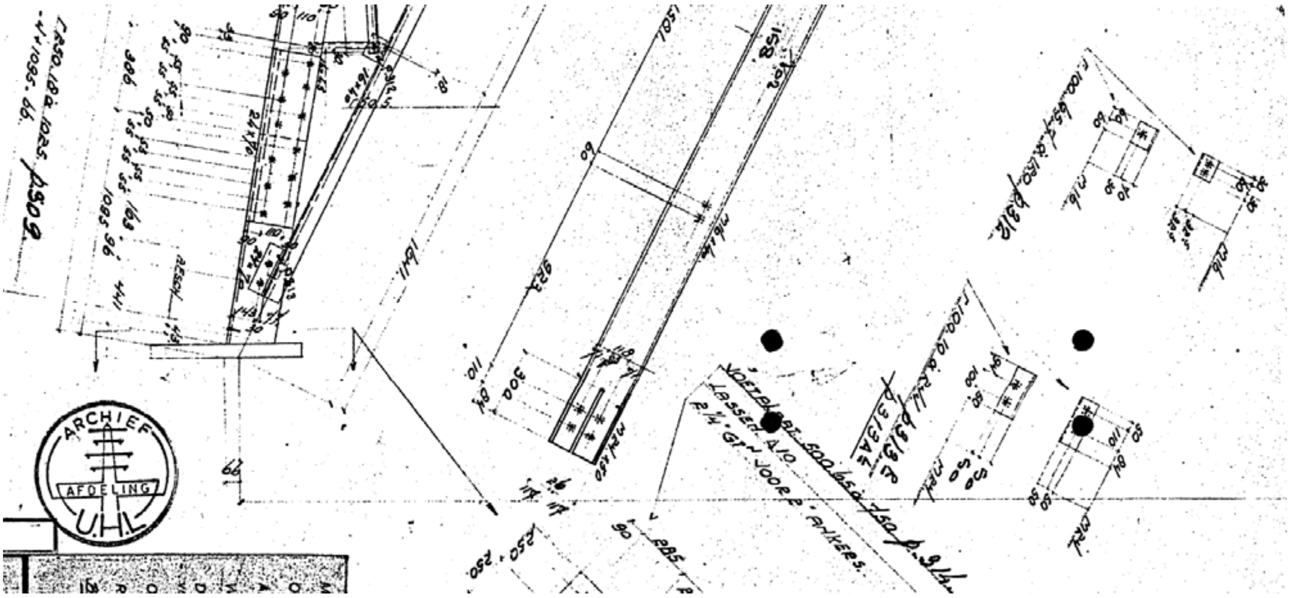
The anchors and plates fulfill the required strength. See the output:

Tower 11-2: U.C. = 181 / 506 = 0,36 ≤ 1,00 OK

Conclusion: The foot plates of tower structure S+18 have sufficient strength.

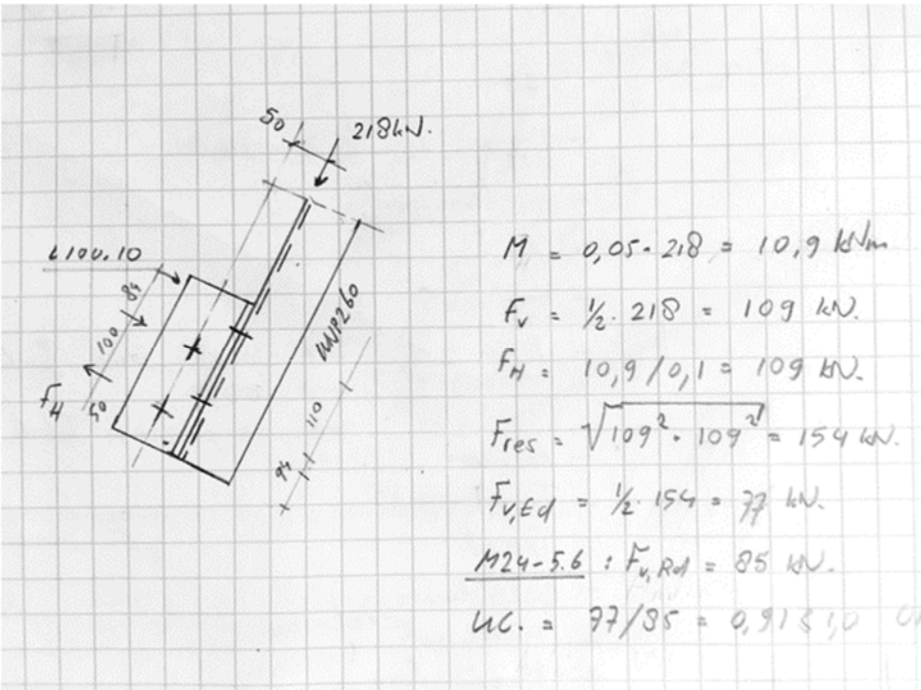
Main bracing broekstuk

The connection of the bracing is verified into more detail because of the eccentricity associated with the connection angles.



Figuur 4 Connection of brace to tower leg

The connection is found to have sufficient capacity:



In PLS TOWER an override value of 218 / 0,91 = 240 kN is used.

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Project:	Krimpen - Geertruidenberg 380	Date:	30-11-2020
		Version:	2.6

Anchors

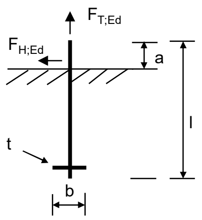
NEN-EN 1992-1-1 and 1993-1-8 with NA

CUR-BmS 10

Subject:	**S+18 II**	***Checks:***		
		Anchor bolt to tension	0,36	***OK***
		Anchor bolt to shear	0,20	***OK***
		Dowel ("schieter")	0,39	***OK***

Inputs

Anchor diameter		**M64**	
Achor quality		**4.6**	
Thread		Cut	
Anchor length	l =	1750	mm
Anchor length above concrete	a =	250	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	**1085**	kN
Shear force	$F_{H,Ed}$ =	**319**	kN
Number of anchors for tension		6	
Number of anchors for shear		6	
$F_{T;Ed} = T / n =$		180,8	kN
$F_{v;Ed} = F_{H,Ed} / n =$		53,2	kN

Anchor properties

$d_b =$	64,00	mm
$A_{b;s} =$	2676	mm^2
$f_{yb} =$	240	N/mm^2
$f_{ub} =$	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0{,}44 - 0{,}0003 f_{yb} =$	0,37	-

Capacity per anchor

$F_{T;Rd} = 0{,}9\alpha_{red;2} f_{ub} A_s / g_{M2} =$	**655,1**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb} =$	**267,9**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		**S235**	
Thickness	t =	65	mm
Width	b_{ef} =	267	mm
Leverage arm	m =	131	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd} =$		66,3	kNm
$F_{t,Rd} = M_{pl,Rd} / m =$		505,9	kN

Check of dowel ("schieter")

$$\frac{\sigma_b'}{f_{cd}} = \frac{11{,}2}{40{,}0} = 0{,}28 \quad \textbf{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{181}{460} = 0{,}39 \quad \textbf{OK}$$

Capacity of concrete

Concrete strength	**C20/25**	
f_{ck} =	20	N/mm^2
k_b =	3	-
γ_{Mc} =	1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc}$ =	40	MPa

Dowel

Diameter	d_S =	**65**	mm
Length	b =	**300**	mm
Spread	$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	92	mm
Effective length	$b_{eff} = \min(b; d+2c)$	249	mm
Cross section	$A_S = \pi/4\ d_S^2$ =	3318	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff}$ =	727	kN/m
Concrete pressure	$\sigma_b' = q / d_S$ =	11,2	MPa

Shear stress in dowel

Load	$F_{T,Ed}$ =	181	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ =	460	kN

Capacity of foot plate

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{180{,}8}{505{,}9} = 0{,}36 \quad \textbf{OK}$$

Capacity of anchor for tension

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{180{,}8}{655{,}1} = 0{,}28 \quad \textbf{OK}$$

Check foot plate for tension

$$\frac{T}{n \times F_{t;Rd}} = \frac{1085{,}0}{3035{,}5} = 0{,}36 \quad \textbf{OK}$$

Check anchor for shear

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{53{,}2}{267{,}9} = 0{,}20 \quad \textbf{OK}$$

Project: Krimpen - Geertruidenberg 380

Date: 30-11-2020
Version: 2.6

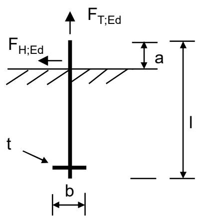
Anchors

NEN-EN 1992-1-1 and 1993-1-8 with NA
CUR-BmS 10

Subject:	**S+18**	**Checks:**		
		Anchor bolt to tension	0,28	**OK**
		Anchor bolt to shear	0,17	**OK**
		Dowel ("schieter")	0,30	**OK**

Inputs

Anchor diameter		**M64**	
Achor quality		**4.6**	
Thread		Cut	
Anchor length	l =	1750	mm
Anchor length above concrete	a =	250	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	**835**	kN
Shear force	$F_{H,Ed}$ =	**274**	kN
Number of anchors for tension		6	
Number of anchors for shear		6	
$F_{T;Ed} = T / n =$		139,2	kN
$F_{v;Ed} = F_{H,Ed} / n =$		45,7	kN

Anchor properties

$d_b =$	64,00	mm
$A_{b;s} =$	2676	mm^2
$f_{yb} =$	240	N/mm^2
$f_{ub} =$	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0,44 - 0,0003 f_{yb} =$	0,37	-

Capacity per anchor

$F_{T;Rd} = 0,9\alpha_{red;2} f_{ub} A_s / g_{M2} =$	**655,1**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb} =$	**267,9**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		**S235**	
Thickness	t =	65	mm
Width	b_{ef} =	267	mm
Leverage arm	m =	131	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd} =$		66,3	kNm
$F_{t,Rd} = M_{pl,Rd} / m =$		505,9	kN

Check of dowel ("schieter")

$$\frac{\sigma_b'}{f_{cd}} = \frac{8,6}{40,0} = 0,22 \quad \textbf{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{139}{460} = 0,30 \quad \textbf{OK}$$

Capacity of concrete

Concrete strength	**C20/25**	
$f_{ck} =$	20	N/mm^2
$k_b =$	3	-
$\gamma_{Mc} =$	1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc} =$	40	MPa

Dowel

Diameter	$d_S =$	**65**	mm
Length	b =	**300**	mm
Spread	$c = t\sqrt{(f_{yd} / 3f_{jd})} =$	92	mm
Effective length	$b_{eff} = \min(b; d+2c)$	249	mm
Cross section	$A_S = \pi/4\, d_S^2 =$	3318	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff} =$	559	kN/m
Concrete pressure	$\sigma_b' = q / d_S =$	8,6	MPa

Shear stress in dowel

Load	$F_{T,Ed} =$	139	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s =$	460	kN

Capacity of foot plate

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{139,2}{505,9} = 0,28 \quad \textbf{OK}$$

Capacity of anchor for tension

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{139,2}{655,1} = 0,21 \quad \textbf{OK}$$

Check foot plate for tension

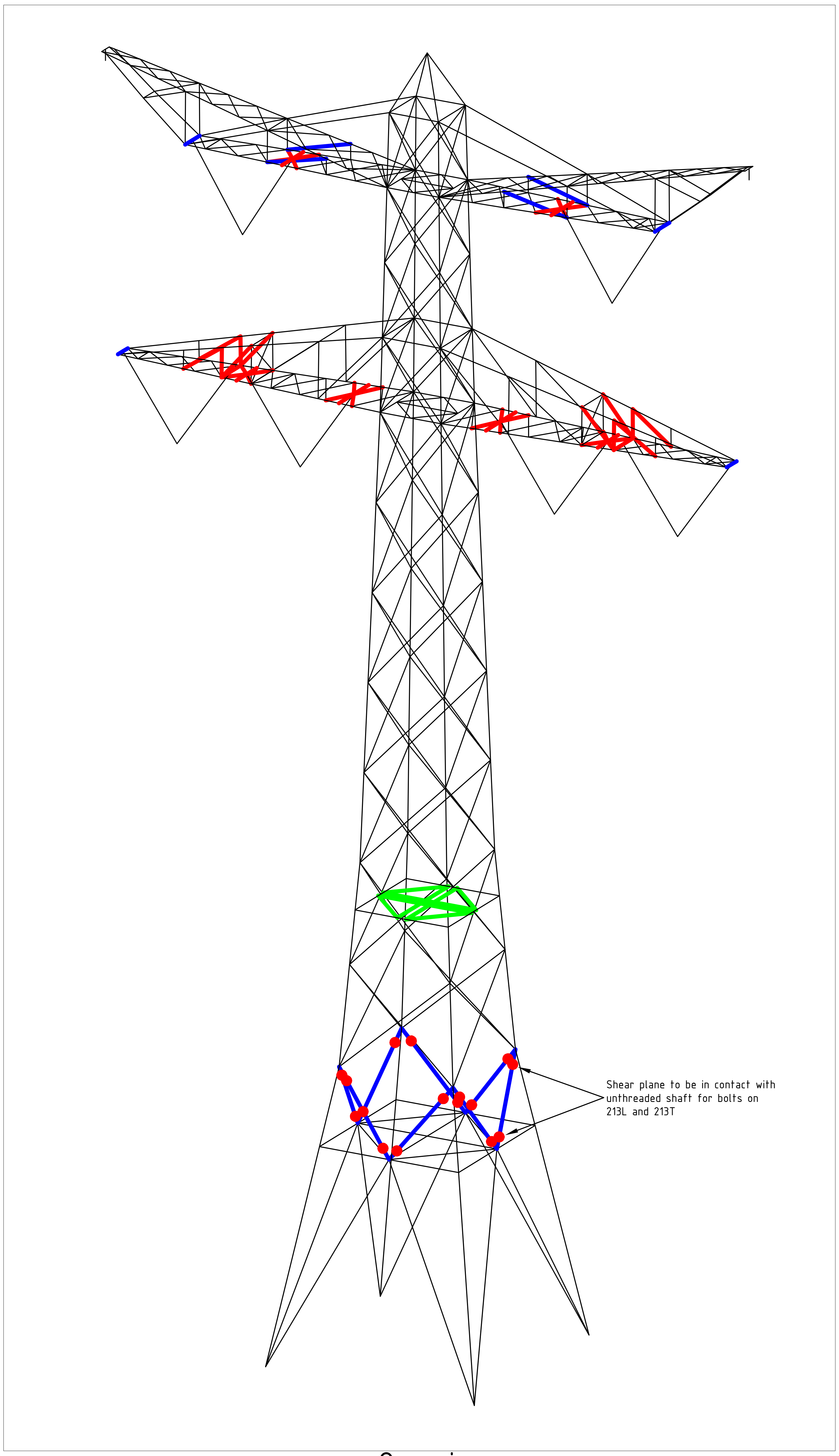
$$\frac{T}{n \times F_{t;Rd}} = \frac{835,0}{3035,5} = 0,28 \quad \textbf{OK}$$

Check anchor for shear

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{45,7}{267,9} = 0,17 \quad \textbf{OK}$$

APPENDIX E DRAWINGS

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)
213L	UA	L150x100x10	S235 t<=40	M24-5.6t-NEN2012	EA	L140x15	S355 t<=40	M24-8.8s-NEN2012
213T	UA	L150x100x10	S235 t<=40	M24-5.6t-NEN2012	EA	L140x15	S355 t<=40	M24-8.8s-NEN2012
A01					EA	L75x7	S355 t<=40	M16-8.8t-NEN2012
A02					EA	L75x7	S355 t<=40	M16-8.8t-NEN2012
A03					EA	L75x7	S355 t<=40	M16-8.8t-NEN2012
302					EA	L60x6	S355 t<=40	M20-8.8t-NEN2012
303A	HEB	HEB160	S235 t<=40	M20-5.6t-NEN2012	HEB	HEB160	S355 t<=40	M20-8.8t-NEN2012
311					EA	80x8	S355 t<=40	M16-8.8t-NEN2012
312					EA	70x7	S355 t<=40	M20-8.8t-NEN2012
320					HEB	HEB160	S355 t<=40	M20-8.8t-NEN2012
320A					HEM	HEM160	S355 t<=40	M20-8.8t-NEN2012
321					EA	L60x6	S355 t<=40	M16-8.8t-NEN2012
322					EA	L80x8	S355 t<=40	M16-8.8t-NEN2012
402A	HEB	HEB160	S235 t<=40	M20-5.6t-NEN2012	HEB	HEB160	S355 t<=40	M20-8.8t-NEN2012
409	EA	L50x5	S235 t<=40	M16-5.6t-NEN2012	EA	L60x6	S355 t<=40	M16-8.8t-NEN2012
417					EA	L60x6	S355 t<=40	M20-8.8t-NEN2012
429					HEB	HEB160	S355 t<=40	M20-8.8t-NEN2012



Overview

Notes and legend:

- New redundants according to drawing
- Size for new redundants is 50x50x5
- 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 added
Profile exchanged
New redundant
Bolt exchanged

01	25-3-2021	Version 2.0 - V insulators added
00	6-7-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-013

Design state: FINAL		Scale:	-
Drawn by: MuK	6-7-2020	Units:	m
Checked by: TBR	7-7-2020	Project no:	10166260
Approved by: JHu	7-7-2020	Company:	TenneT

Description: Modifications overview for mast type S+18 (mast 11-2) Page 1 of 4

Revision: 00

Format: A2

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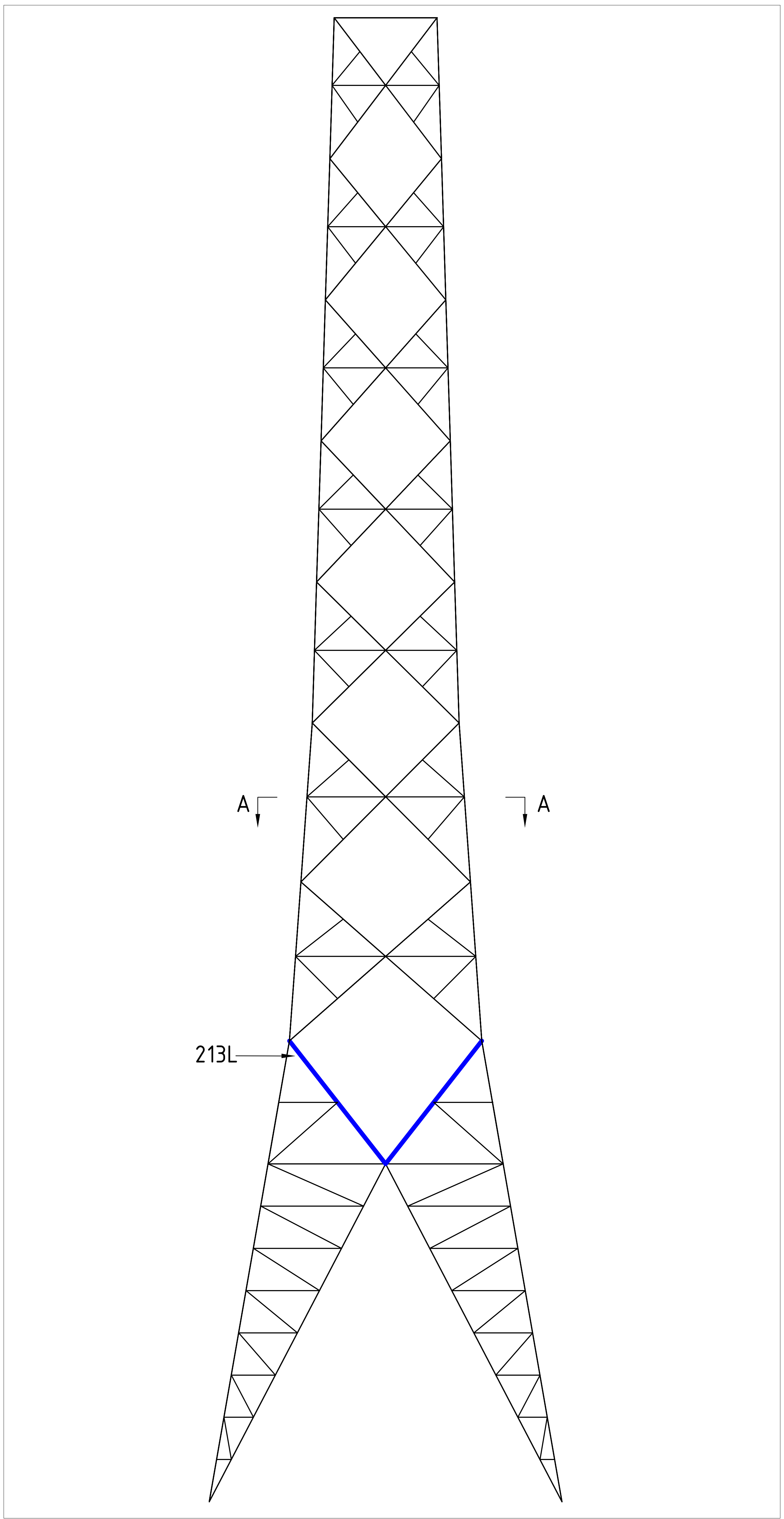
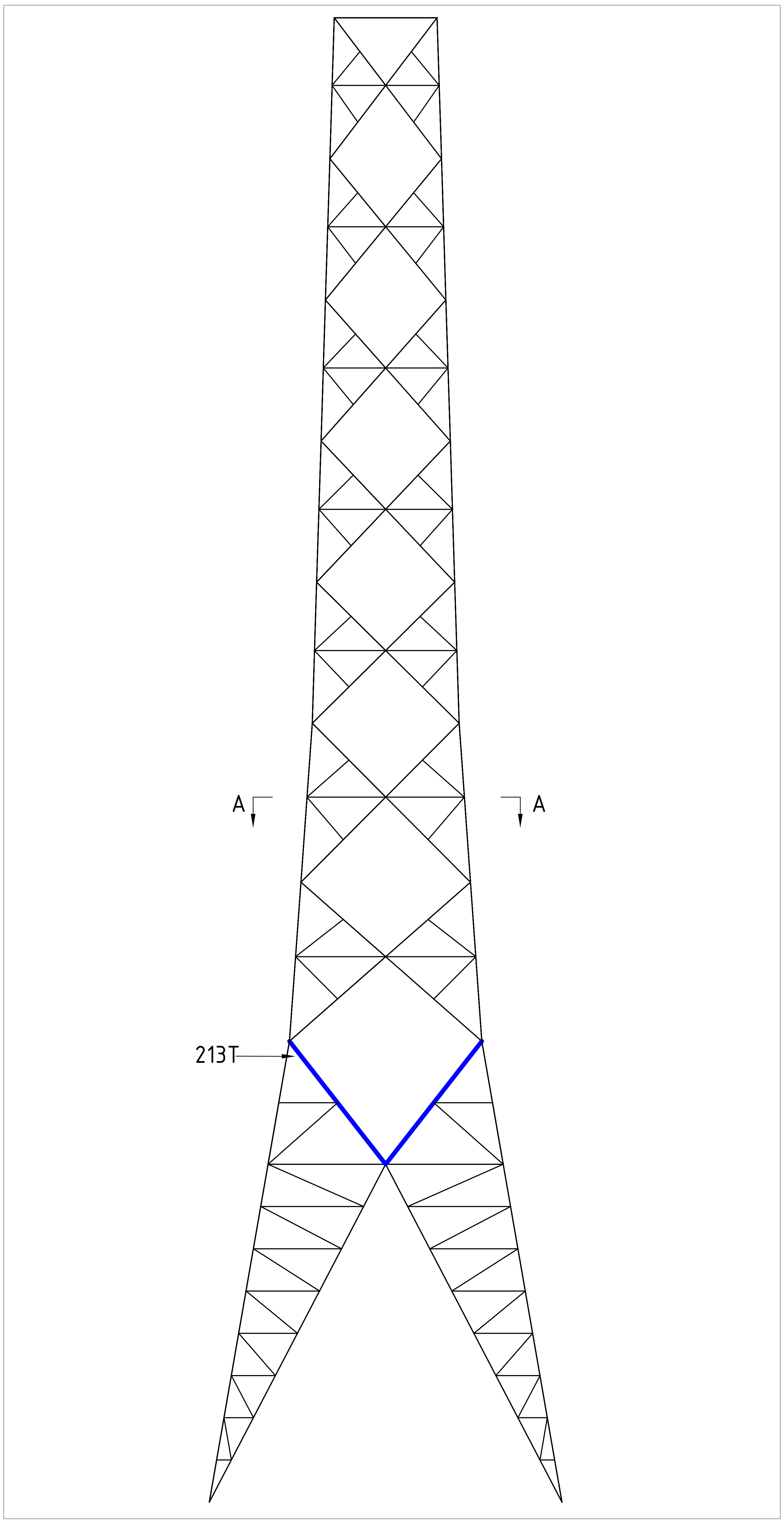
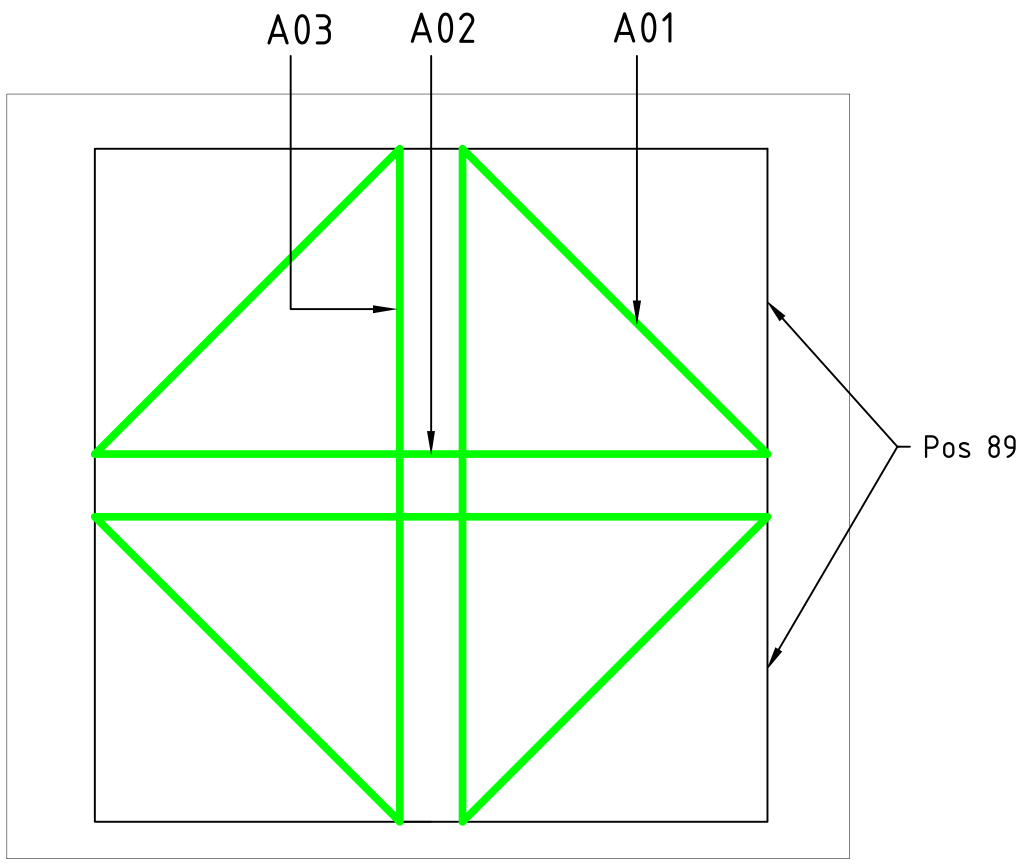


Front View



Side View



Section A-A Plan View

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is 50x50x5**
- **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 added (red line)
Profile exchanged (blue line)
New redundant (green line)
Bolt exchanged (red dot)

01	25-3-2021	Version 2.0 - V insulators added
00	6-7-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-013

Design state: FINAL		Scale: -		
Drawn by: MuK	6-7-2020	Units: m		
Checked by: TBR	7-7-2020	Project no: 10166260		
Approved by: JHu	7-7-2020	Company: TenneT		

Description: Modifications overview for mast type S+18 (mast 11-2) Page 2 of 4

Revision: 00

Format: A2

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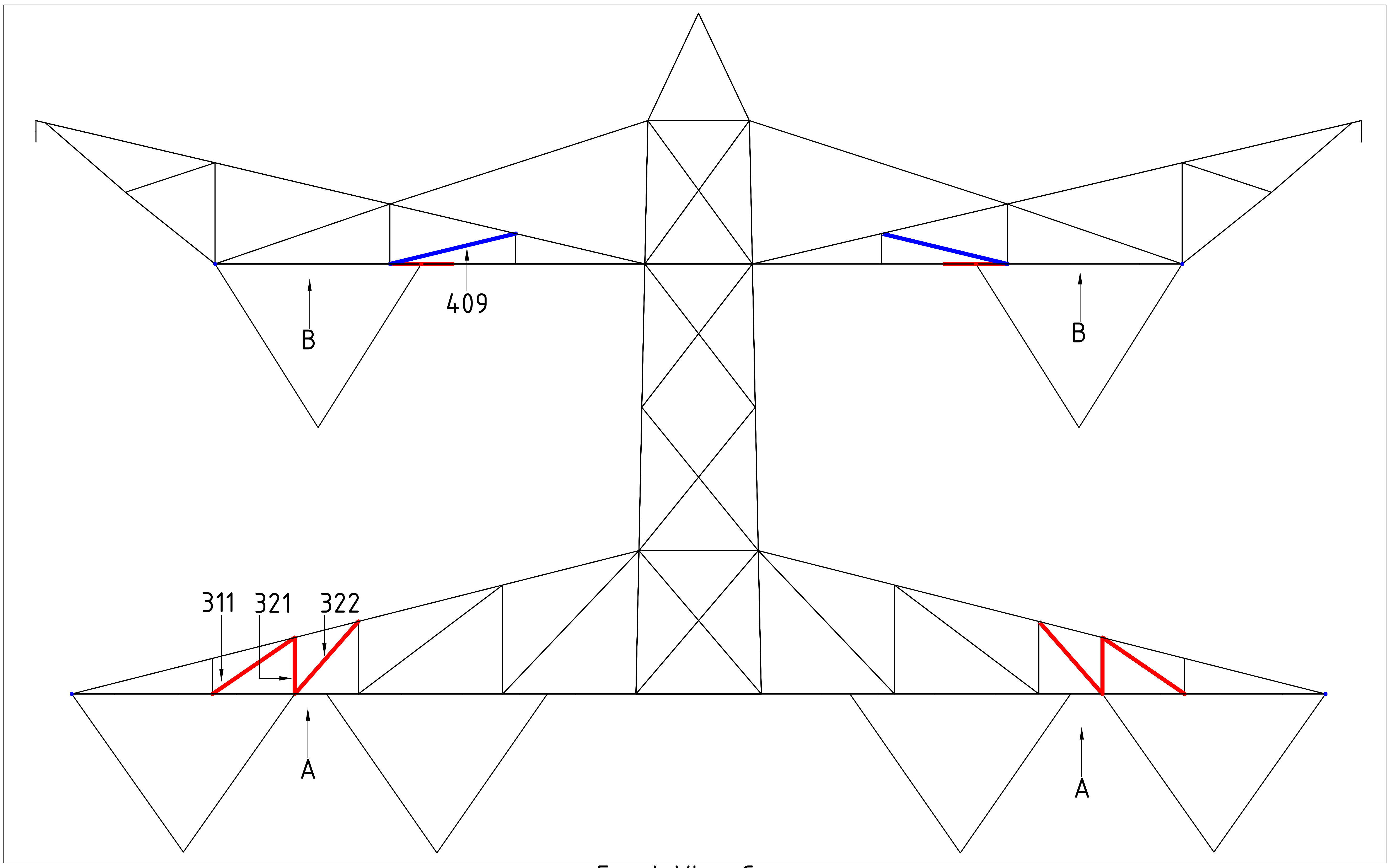
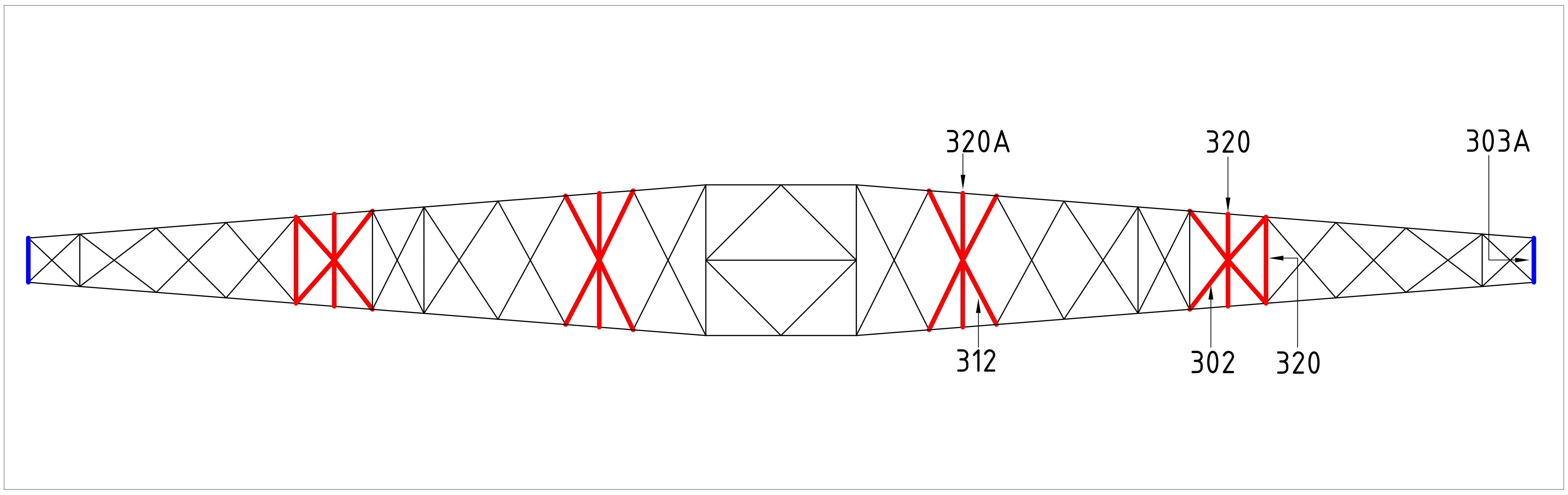
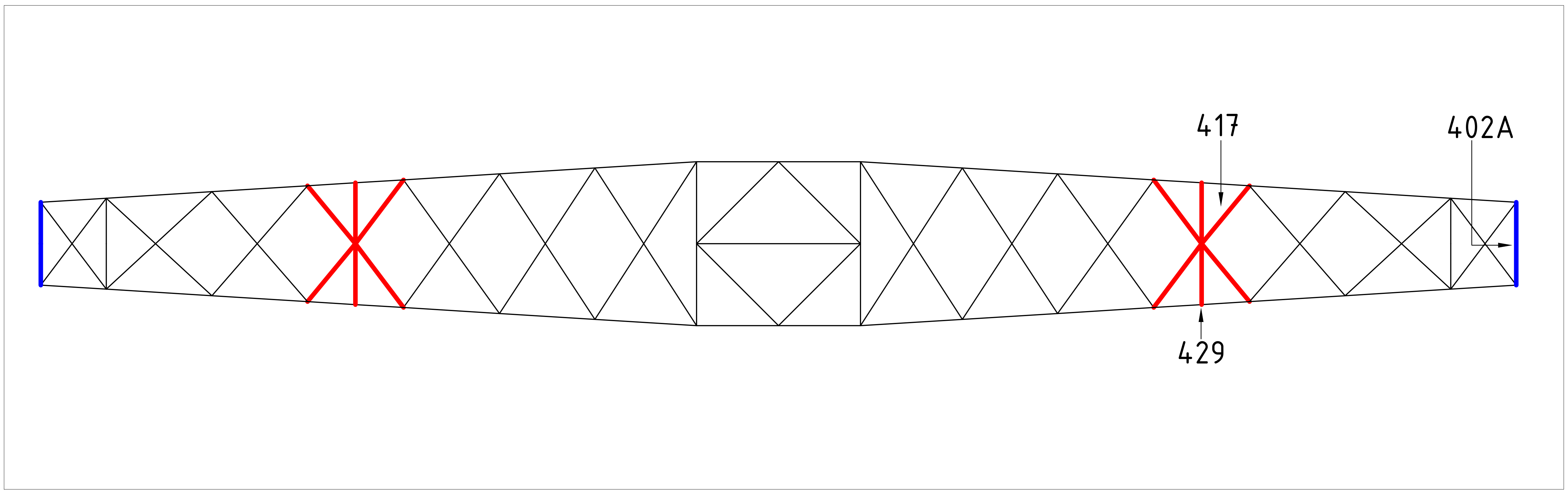


Front View Crossarms



View on Arrow A



View on Arrow B

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is 50x50x5**
- **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 added (red line)
Profile exchanged (blue line)
New redundant (green line)
Bolt exchanged (red dot)

01	25-3-2021	Version 2.0 - V insulators added
00	6-7-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

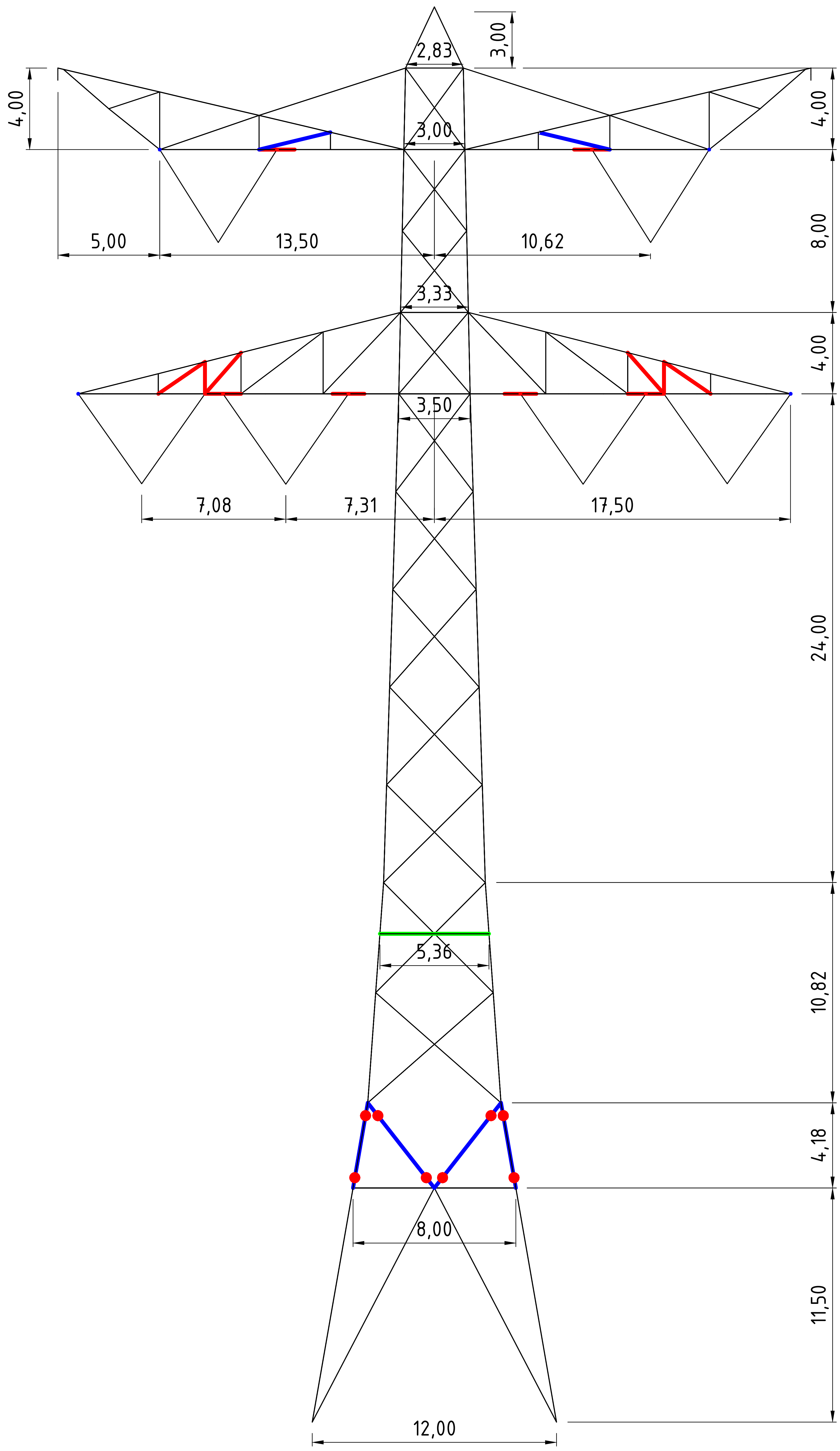
Drawing no.: 10166260-013

Design state: FINAL		Scale: -		
Drawn by: MuK	6-7-2020	Units: m		
Checked by: TBR	7-7-2020	Project no: 10166260		
Approved by: JHu	7-7-2020	Company: TenneT		

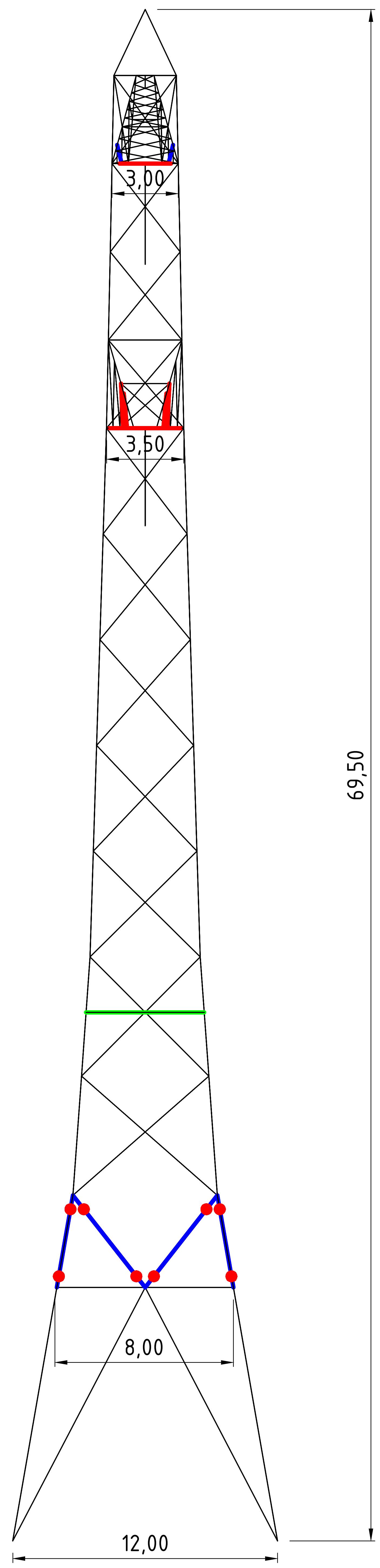
Description: Modifications overview for mast type S+18 (mast 11-2) Page 3 of 4

Revision: 00

Format: A2



Front View



Side View

* The outline drawing shown above also applies to mast 60

Notes and legend:

- **New redundants according to drawing**
- **Size for new redundants is 50x50x5**
- **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 added (red)
Profile exchanged (blue)
New redundant (green)
Bolt exchanged (red dot)

01	25-3-2021	Version 2.0 - V insulators added
00	6-7-2020	Version 1.0

DNV·GL		Projectname: Mast constructions KIJ - GT 380 kV		
	Third angle projection:	Drawing no.: 10166260-013		
Design state: FINAL	Scale: -	Description: Modifications overview for mast type S+18 (mast 11-2) Page 4 of 4		Revision: 00
Drawn by: MuK 6-7-2020	Units: m			
Checked by: TBR 7-7-2020	Project no: 10166260			Format: A2
Approved by: JHu 7-7-2020	Company: TenneT			

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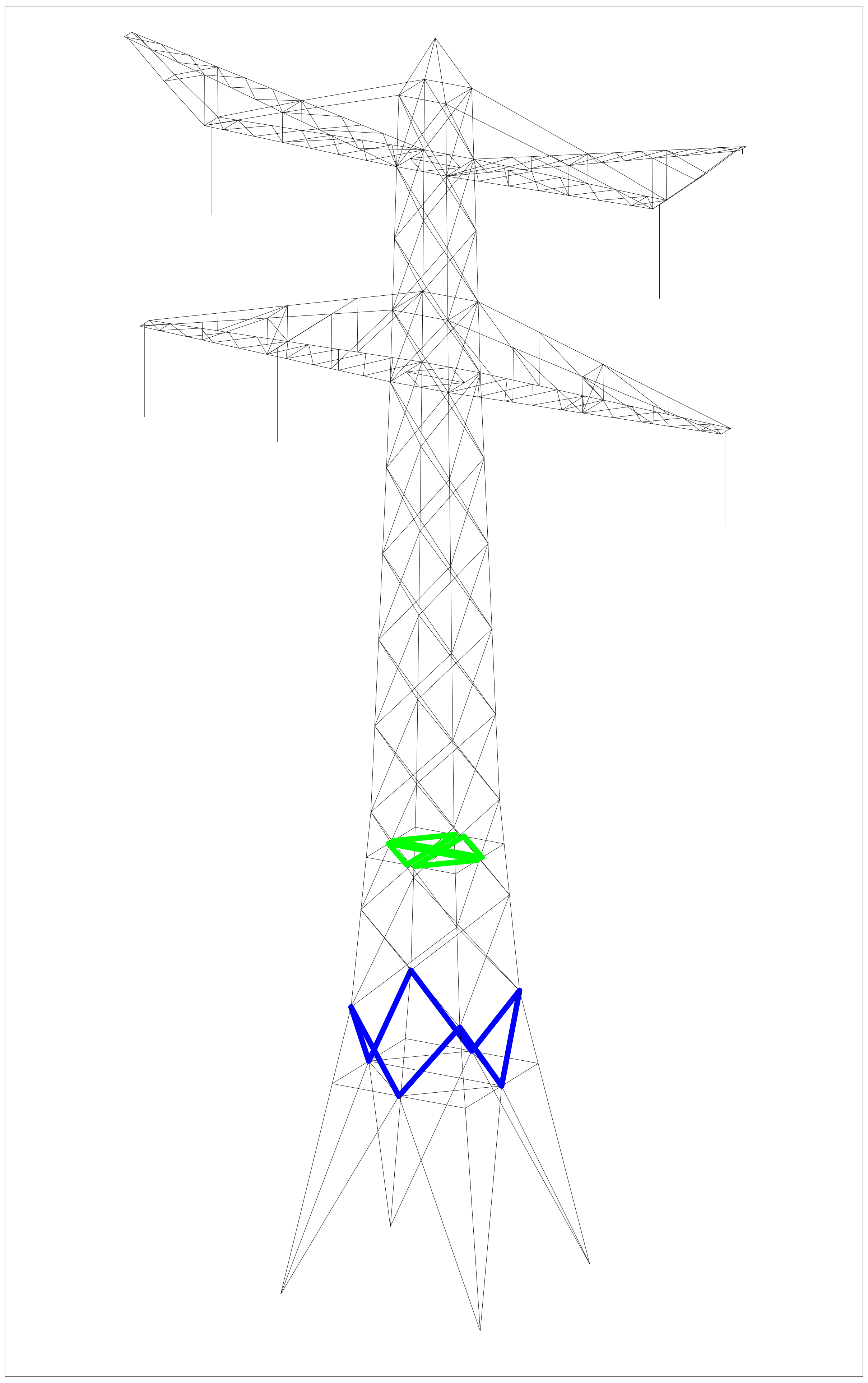
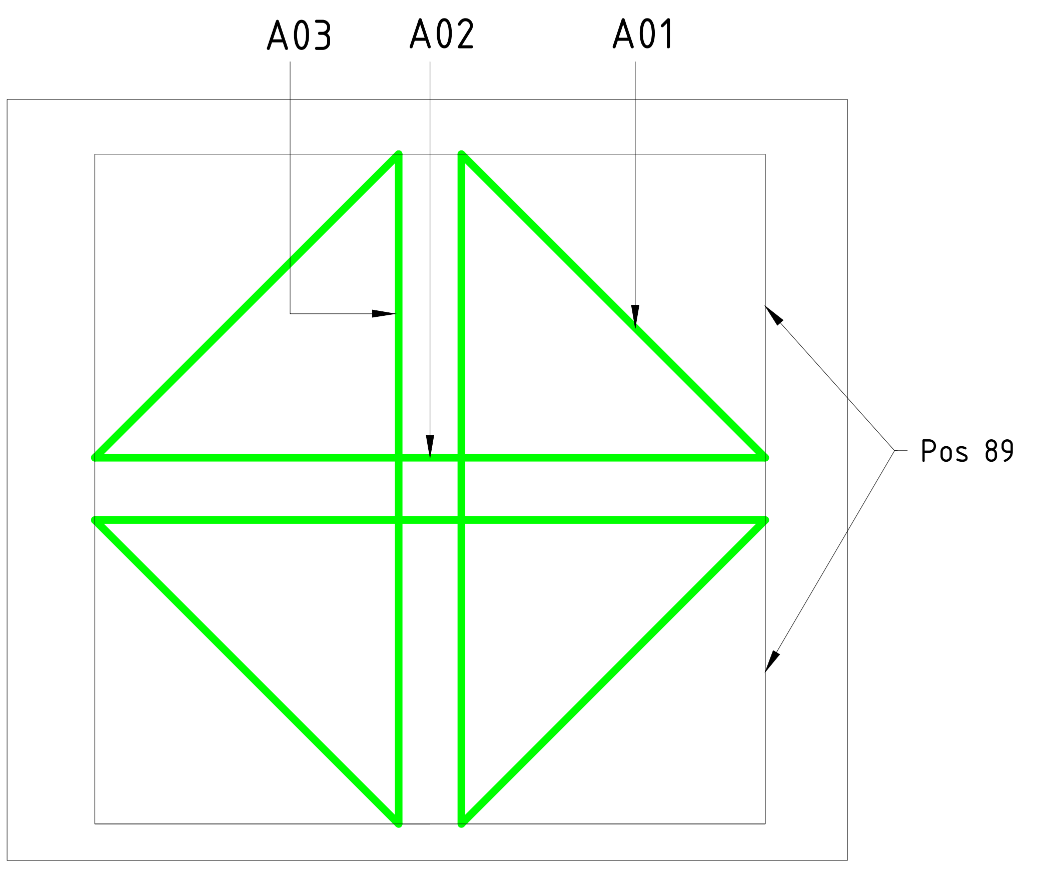
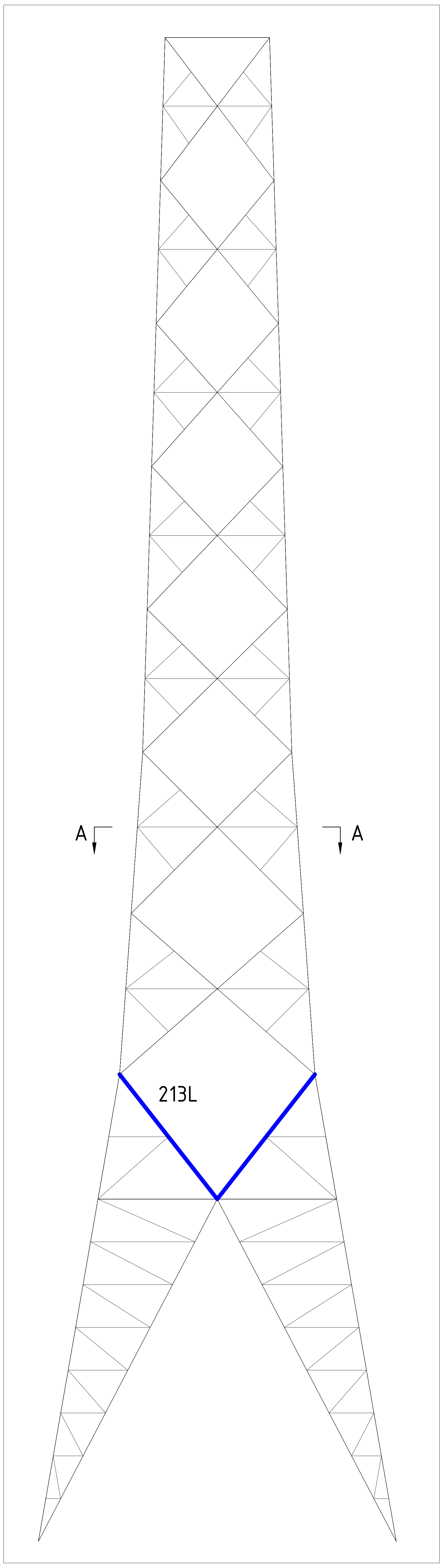
Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
213L	UA	L150x100x10	S235 t<=40	M24-5.6t-NEN2012	EA	L140x15	S355 t<=40	M24-8.8t-NEN2012
213T	UA	L150x100x10	S235 t<=40	M24-5.6t-NEN2012	EA	L140x15	S355 t<=40	M24-8.8t-NEN2012
A01					EA	L75x7	S355 t<=40	M16-8.8t-NEN2012
A02					EA	L75x7	S355 t<=40	M16-8.8t-NEN2012
A03					EA	L75x7	S355 t<=40	M16-8.8t-NEN2012



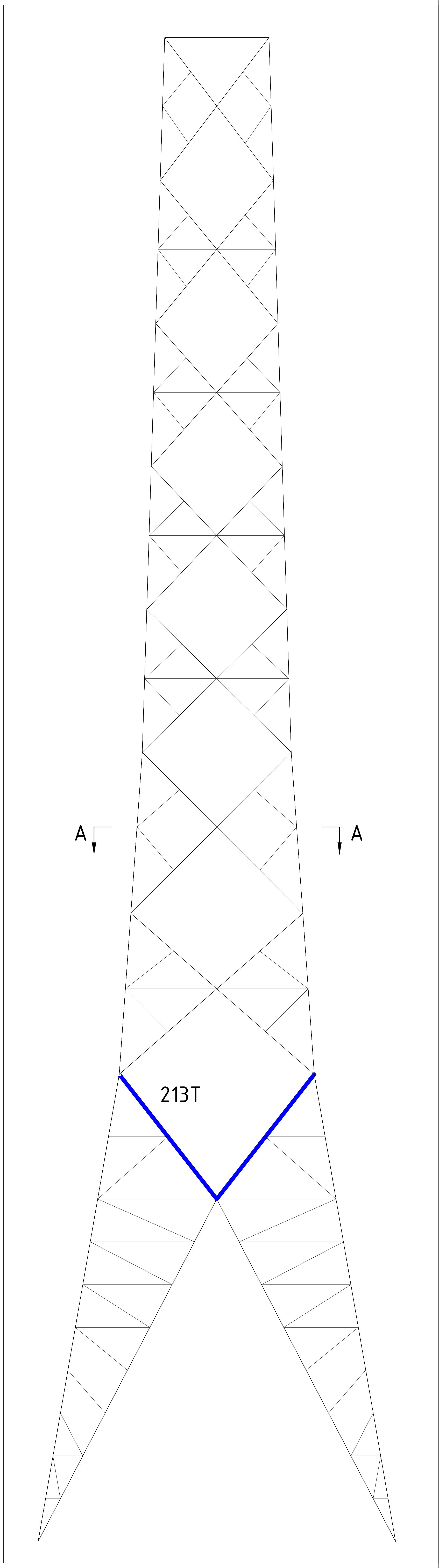
Overview



Section A-A Plan View



Front View



Side View

Notes and legend:

- New redundants according to drawing
- Size for new redundants is 50x50x5
- 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	6-7-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-014

Design state: FINAL		Scale: -	
Drawn by: MuK	7-7-2020	Units: m	
Checked by: TBR	7-7-2020	Project no: 10166260	
Approved by: JHu	8-7-2020	Company: TenneT	

Description: Modifications overview for mast type S+18 (mast 60)

Revision: 00

Format: A2

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APPENDIX F AXIS VM ANALYSIS

NEW MEMBERS CROSS ARM S+18 MAST 11-2

1 INTRODUCTION

The mast 11-2 is categorized as S+18 T tower in the "KIJ-GT" project. The PLS tower model of the tower with a 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).

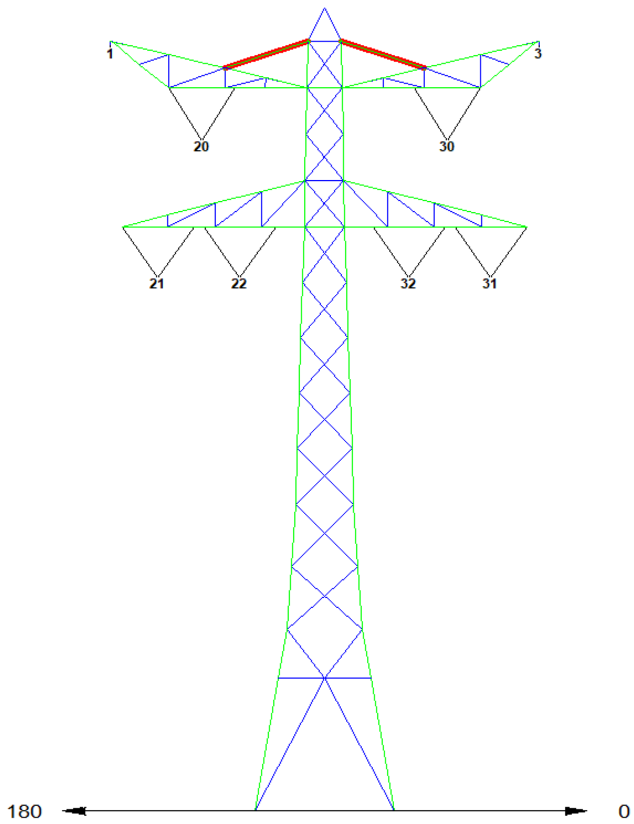


Figure 1 S+18 PLS tower model

Figure 1 was taken from the PLS-Tower application for visualization. The insulators ID's: 20-22 and 30-32 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 (1) efficacy of the H beams for the loads from the v-ketting, and (2) bottom chord of the cross-arms of the S+18 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 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". Furthermore, 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.

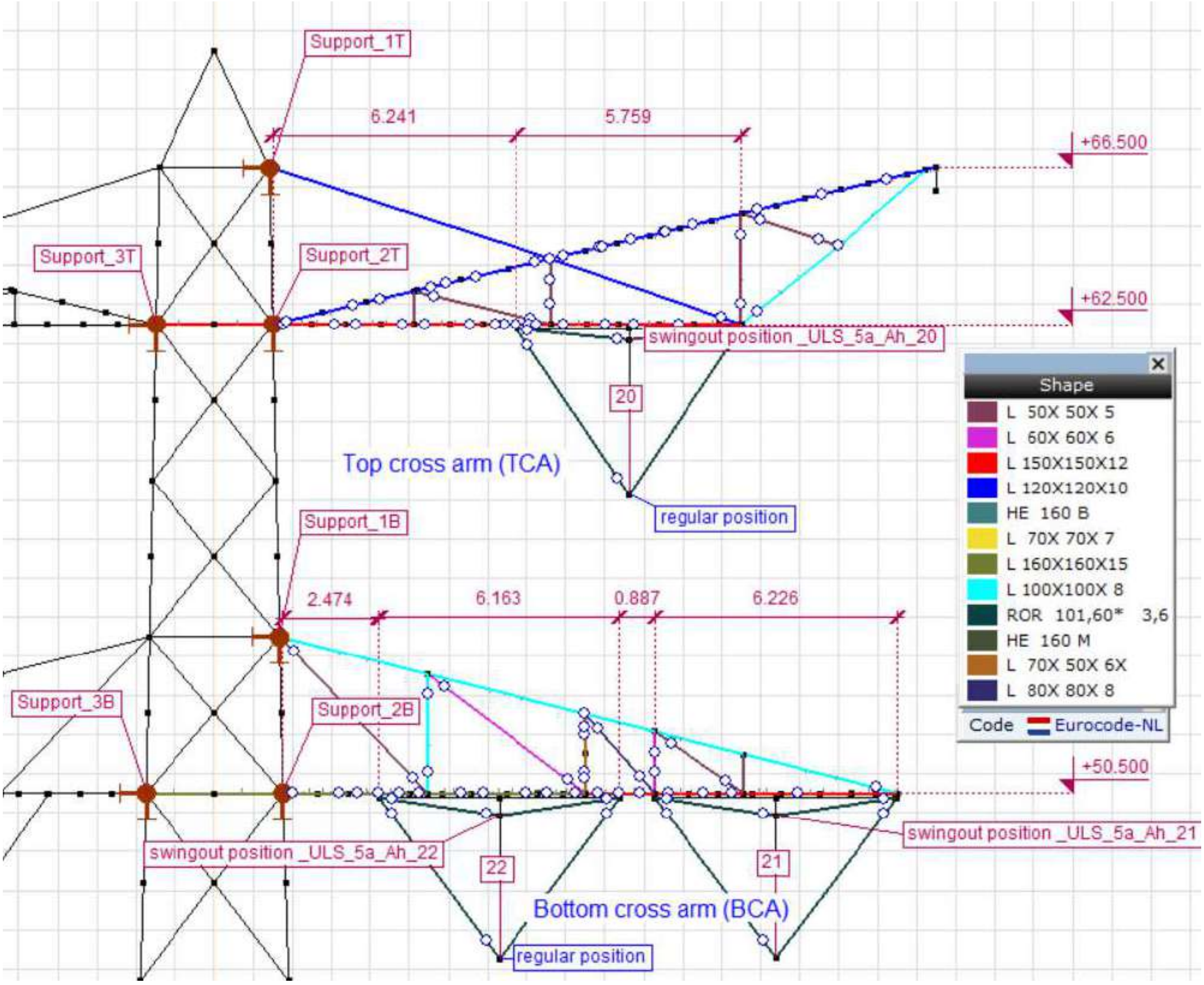


Figure 2 Location of the v-ketting insulator assembly in S-6 tower

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. The insulators are strong enough to transmit both tensile and compressive loads. The new as well as the added members are of S355 grade.

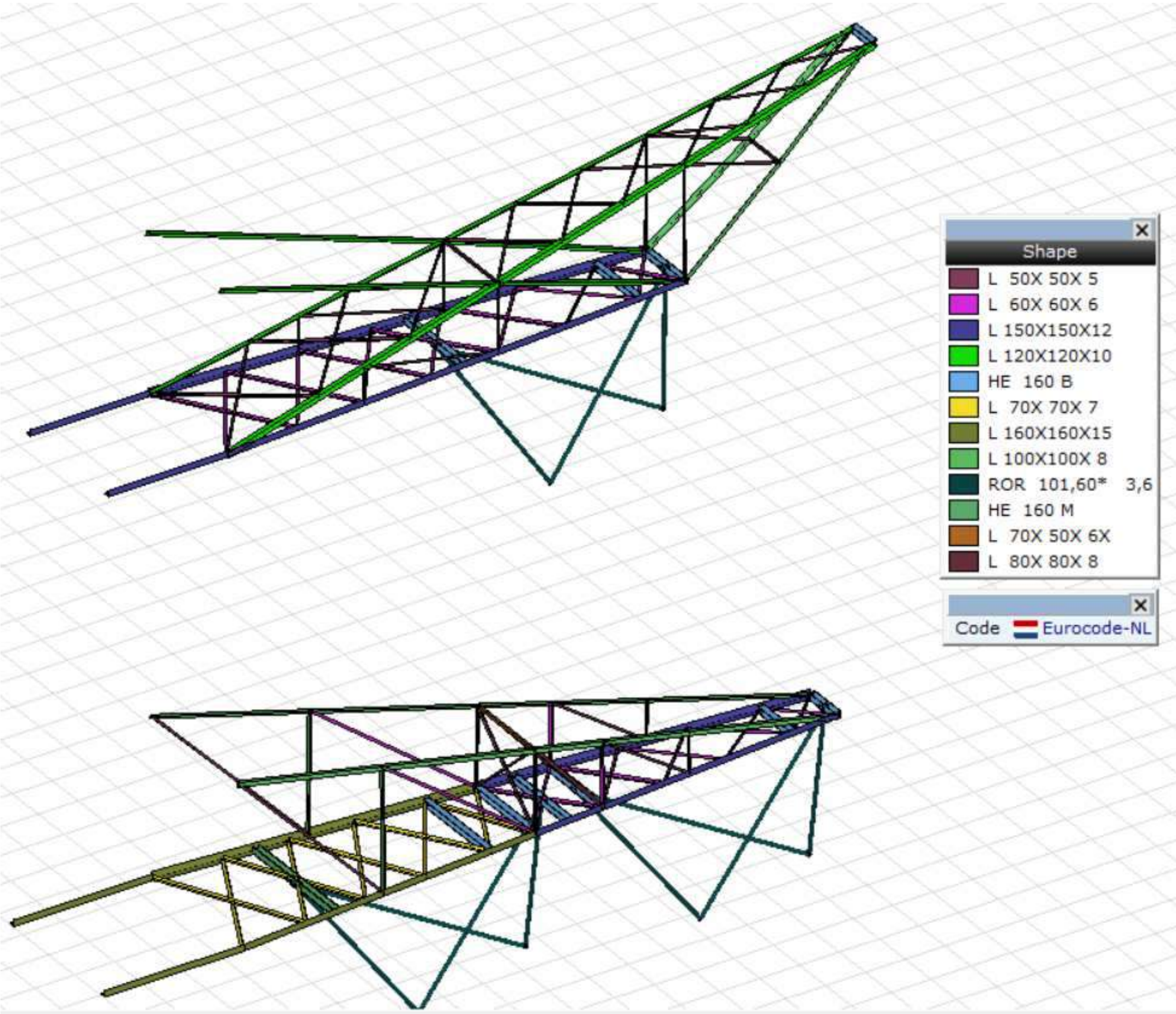


Figure 3 3D rendered geometry of the Cross arm.

Figure 3 shows the 3d render of the cross arm. The V-ketting insulators are attached to an HEB 160 steel beam. The HEB 160 beams are in light blue. The distance between the H beam (light blue) and the hinge (light green) is 70+45 = 115 mm. The above-explained offsets were incorporated in the axis VM model via dummy elements with HEB 160 profile. 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 from 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. 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.

The H beams at the end of the cross arms supporting the isolators are changed as the hinge in the existing H beam does not have a hinge in the centre. The details of the existing beam are shown in figure 4. The current insulator assembly requires an attachment point in the centre of the beam. The new H beam is added similar to the other added H beams. Thus, a dummy element of 115mm is developed in the model.

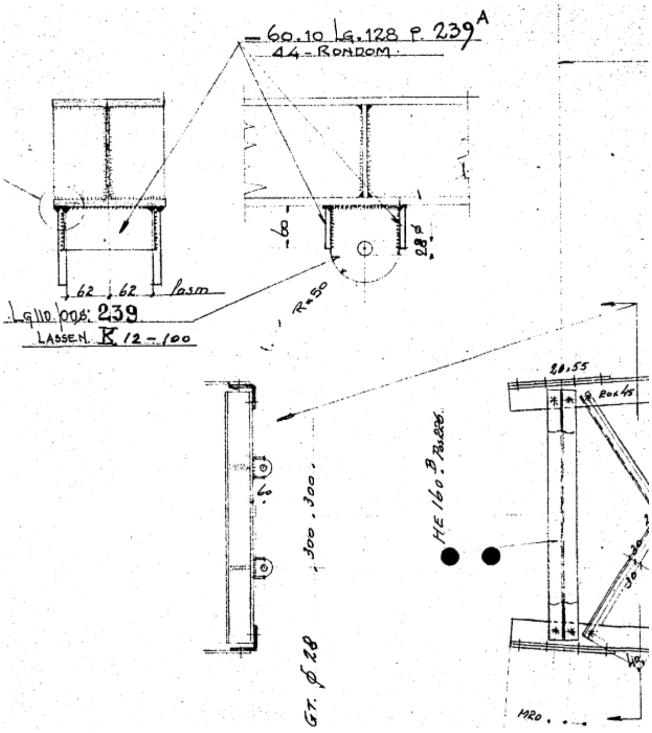


Figure 4 H beam at the end of the cross arm.

A second strengthening measure is made in the form of extra diagonal and vertical in the lower cross arm as figure 5. The new members are highlighted in magenta in the figure. The new diagonal help to redistribute the force from the bottom chord. This location is especially critical as it located close to the lapping of the bottom cross arm.

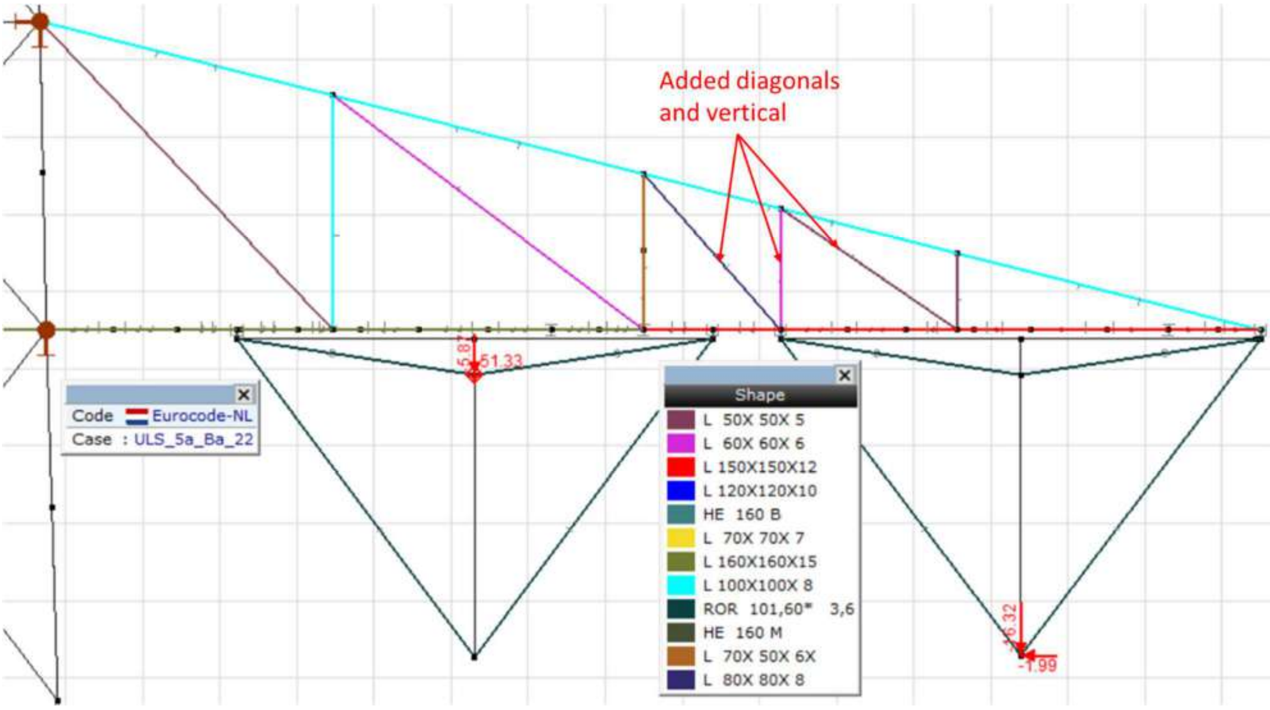


Figure 5 Additional members in the lower cross arm.

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 for the “Verbouw level” of acceptance. 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. The loads are applied at the tip of the insulators as they capable of transmitting both compressive and tensile loads. This helps the inaccurate distribution of loads from the conductor to the tower body.

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.

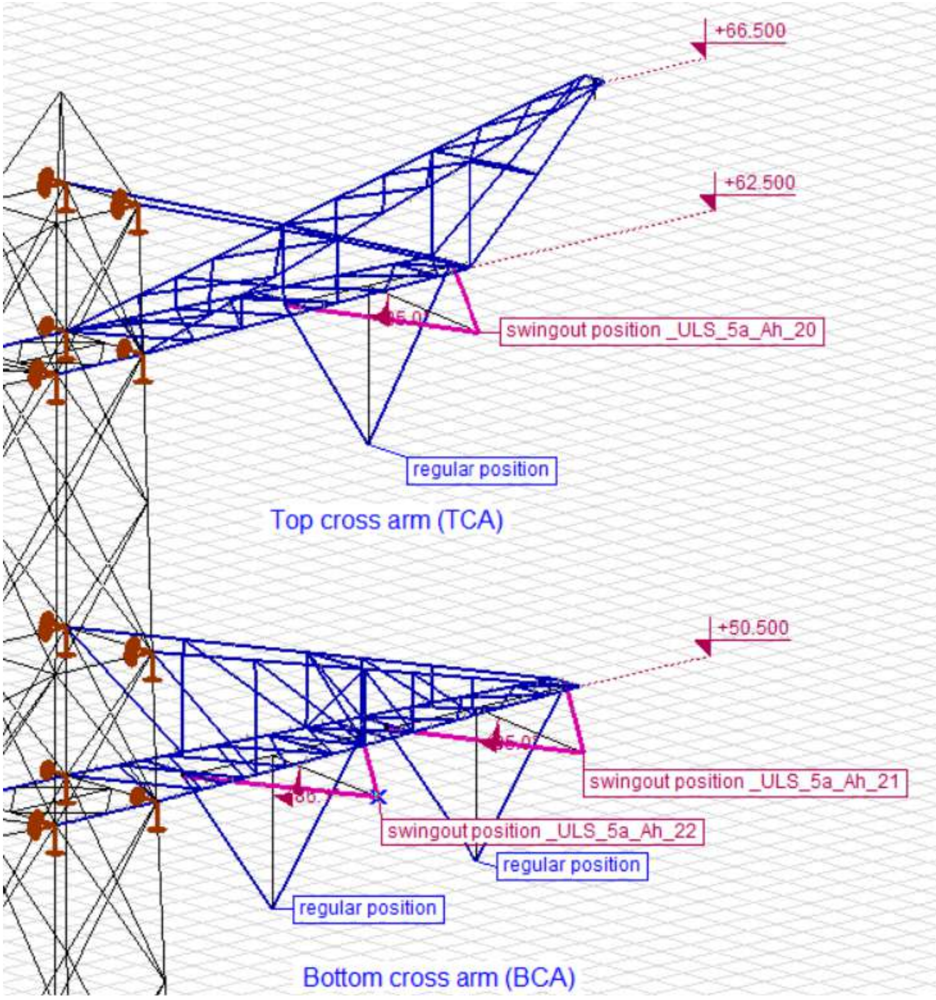


Figure 6 position of the isolators in working and broken conductors

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 gives the insulator swing out angles from their normal position for the conductor break load cases. The position of the isolator in case of the conductor being intact on both side (default and operating situation) by annotation in blue in figure 6. The position of the isolator when the conductor fails on 1 side is shown in magenta in the figure above.

Table 2 Swing out the angle of the insulators for conductor break situations

		ULS 5a Ba 20	ULS 5a Ba 21	ULS 5a Ba 22
horizontal	Fx	51.34	51.32	51.33
vertical	Fz	5.87	5.87	3.51
theta		83.48	83.48	86.09

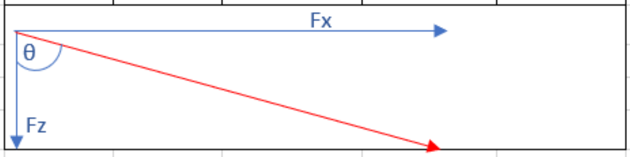
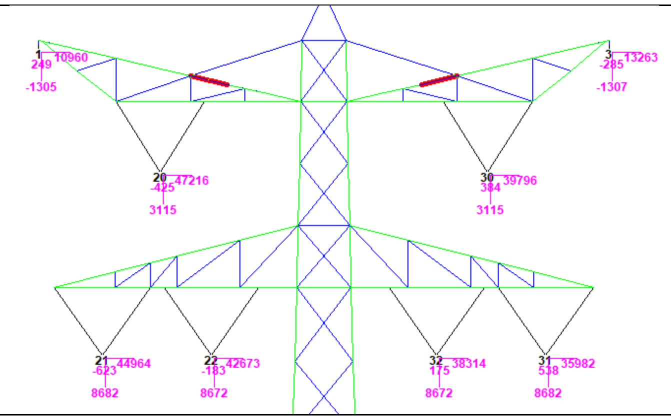
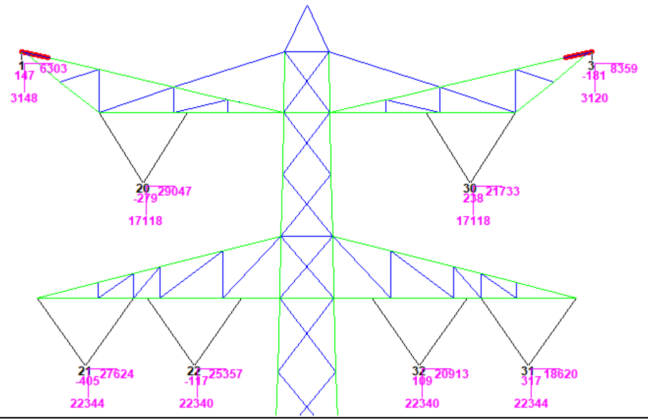
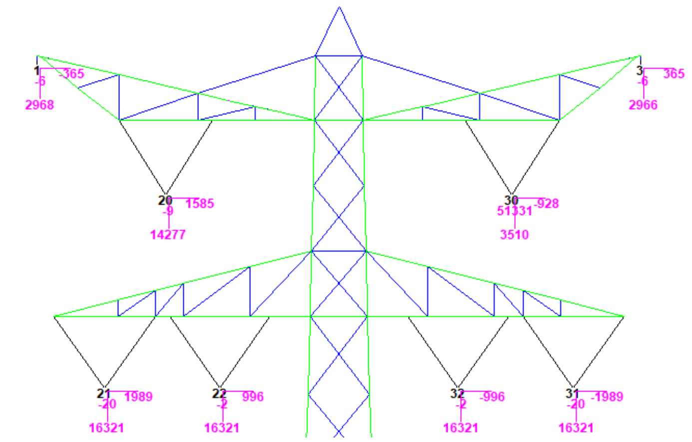
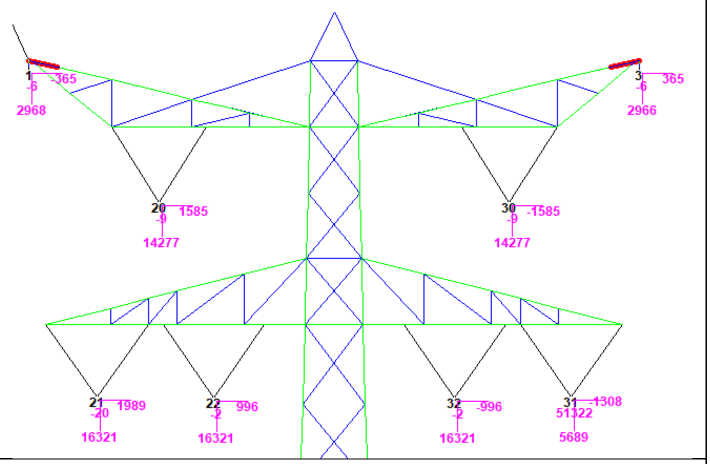
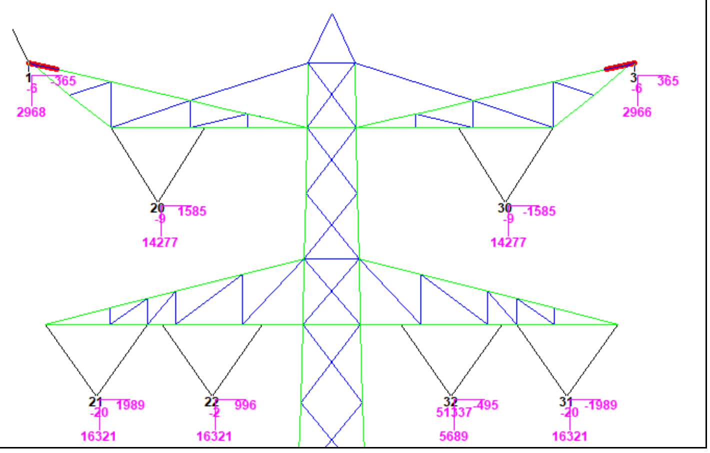
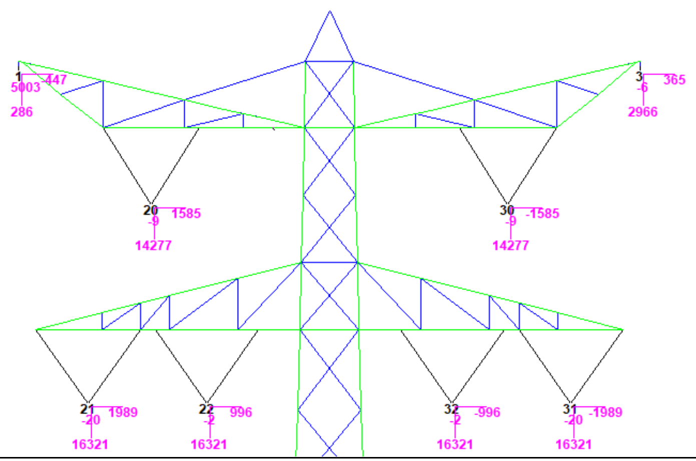


Table 3 gives the load values for the various load cases from PLS tower output.

Table 3 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.
The load combination as per the Eurocode for afkeur level loading implemented in the axis VM model are:

	Name	Type	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	EG
1	Co #1	ULS	0.90	0	0	0	0	0	0	0	1.08
2	Co #2	ULS	0	0.90	0	0	0	0	0	0	1.08
3	Co #3	ULS	0	0	0	0.90	0	0	0	0	1.08
4	Co #4	ULS	0	0	0.90	0	0	0	0	0	1.08
5	Co #5	ULS	1.00	0	0	0	0	0	0	0	1.26
6	Co #6	ULS	0	1.00	0	0	0	0	0	0	1.26
7	Co #7	ULS	0	0	1.00	0	0	0	0	0	1.26
8	Co #8	ULS	0	0	0	1.00	0	0	0	0	1.26
9	Co #9	ULS	0	0	0	0	1.00	0	0	0	1.20
10	Co #10	ULS	0	0	0	0	0	1.00	0	0	1.20
11	Co #11	ULS	0	0	0	0	0	0	1.00	0	1.20
12	Co #12	ULS	0	0	0	0	0	0	0	1.00	1.20

The self-weight in EG has a multiplication factor of 1.2 on account of the redundant and non-structural members, that have not been modelled.

4 RESULTS

4.1 H beams in torsion:

The H - 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 8 is used to verify the efficacy of the H beams under torsion. 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 210 N/mm². Thus, the utility ratio is 0.59. There is ample reserve strength for the stability of the beams. The beam Id's for the H beams supporting the insulators are shown in figure 8.

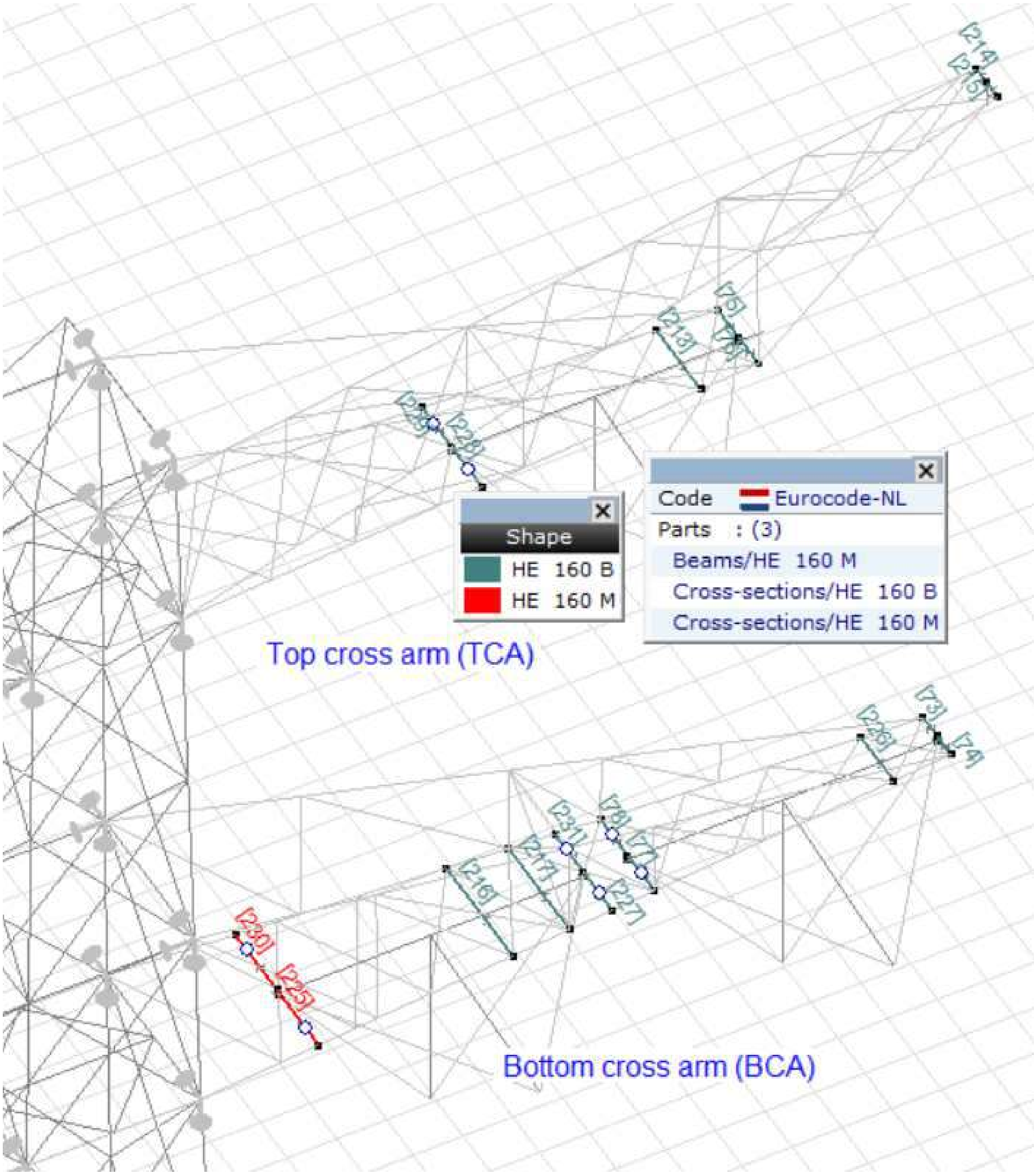


Figure 7 beam Id's for H beams to be checked for torsion.

DNV

Project: KIJ - GT(BBB)
Mast: S+18

Steel beams in torsion

Calculation of unrestrained beams with eccentric load - Lower cross arm

Datum: 2021/03/25
Auteur: RSH
Versie: 1.1

Axis VM ID		225,230	227,231	77,78	73,74	228,229	75,76	
Conductor ID		22	22	21	21	20	20	
		LC -5	LC -6	LC -5	LC -6	LC -5	LC -6	
position		left	right	left	right	left	right	
Profile of beam		HEM160	HEB 160	HEB 160	HEB 160	HEB 160	HEB 160	
$M_{w,Ed}$ =								
$M_{y,Ed}$ =		17.4	1.9	10.7	6.7	2.4	9.3	kNm
$M_{z,Ed}$ =		24.5	17.5	14.4	8.8	17.7	14	kNm
Torsion =		1.3	0.3	1.2	1.5	1.2	1.4	kNm
Horizontal force	F_h	27.22222	70.92199	15.3682	11.73333	23.6	18.66667	
Vertical force	F_v	19.33333	7.700101	11.41942	8.933333	3.2	12.4	
Orientation of beam		y-as	y-as	y-as	y-as	y-as	y-as	
Horizontal force	F_h	27.2	70.9	15.4	11.7	23.6	18.7	kN
Vertical force	F_v	19.3	7.7	11.4	8.9	3.2	12.4	kN
Eccentricity of force (below beam)	e	110	550	40	40	40	40	mm
Torsional moment	T	1.30	0.30	1.20	1.50	1.20	1.40	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
Height	h	180	160	160	160	160	160	mm
Width	b	166	160	160	160	160	160	mm
Web thickness	t_w	14.0	8.0	8.0	8.0	8.0	8.0	mm
Flange thickness	t_f	23.0	13.0	13.0	13.0	13.0	13.0	mm
Torsional constant	I_t	161	31	31	31	31	31	mm^4
Warping constant	I_{wa}	108054	47943	47943	47943	47943	47943	mm^6
Moment of inertia	I_y	5098	2492	2492	2492	2492	2492	mm^4
	I_z	1759	889	889	889	889	889	mm^4
Flange stiffness	$I_f = I_z / 2 =$	879	445	445	445	445	445	mm^3
Moment of resistance	$W_{y,el}$	566	311	311	311	311	311	mm^3
	$W_{z,el}$	212	111	111	111	111	111	mm^3
Torsional bending constant	d	418	630	630	630	630	630	mm
	L/d	8.6	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:								
$M_{w,Ed} = E \cdot I_f \cdot (h-t_f) \cdot \phi'' / 2 =$		1.7	0.4	2.6	3.2	2.5	3.0	kNm
$M_{y,Ed} = 1/4 \cdot F \cdot L =$		17.4	1.9	10.7	6.7	2.4	9.3	kNm
$M_{z,Ed} = 1/4 \cdot F \cdot L =$		24.5	17.5	14.4	8.8	17.7	14.0	kNm
Capacities of beams:								
$M_{w,Rd} = W_{z,el} \cdot f_y / 2 =$		37.6	19.7	19.7	19.7	19.7	19.7	kNm
$M_{y,Rd} = W_{y,el} \cdot f_y =$		201.1	110.6	110.6	110.6	110.6	110.6	kNm
$M_{z,Rd} = W_{z,el} \cdot f_y =$		75.2	39.5	39.5	39.5	39.5	39.5	kNm
Combined check of beam:								
UC		0.46	0.48	0.59	0.44	0.60	0.59	
Displacements:								
Factor F_{ed} / F_k		1.2	1.2	1.2	1.2	1.2	1.2	
Displacement y-direction	u_y	2.06	0.23	2.68	1.05	2.11	1.67	mm
Relative displacement	rel.	1748	4363	1396	2854	1419	1794	-
Displacement z-direction	u_z	4.24	0.07	5.59	2.24	0.80	3.11	mm
Relative displacement	rel.	849	14339	671	1338	3735	964	-

Figure 8 HEM & HEB 160 beams checked for torsion

4.2 Stress check:

The maximum Von-Misses stress in the bottom chord and the newly added members are shown in Figure 9. The maximum stress of 106 MPa across the bottom chord of the cross arms. The yield stress of the bottom chord is 235 MPa (S235 steel grade). Thus the max utility ratio os 0.45 develops in the added members. There is reserve capacity in the members to consider stability issues.

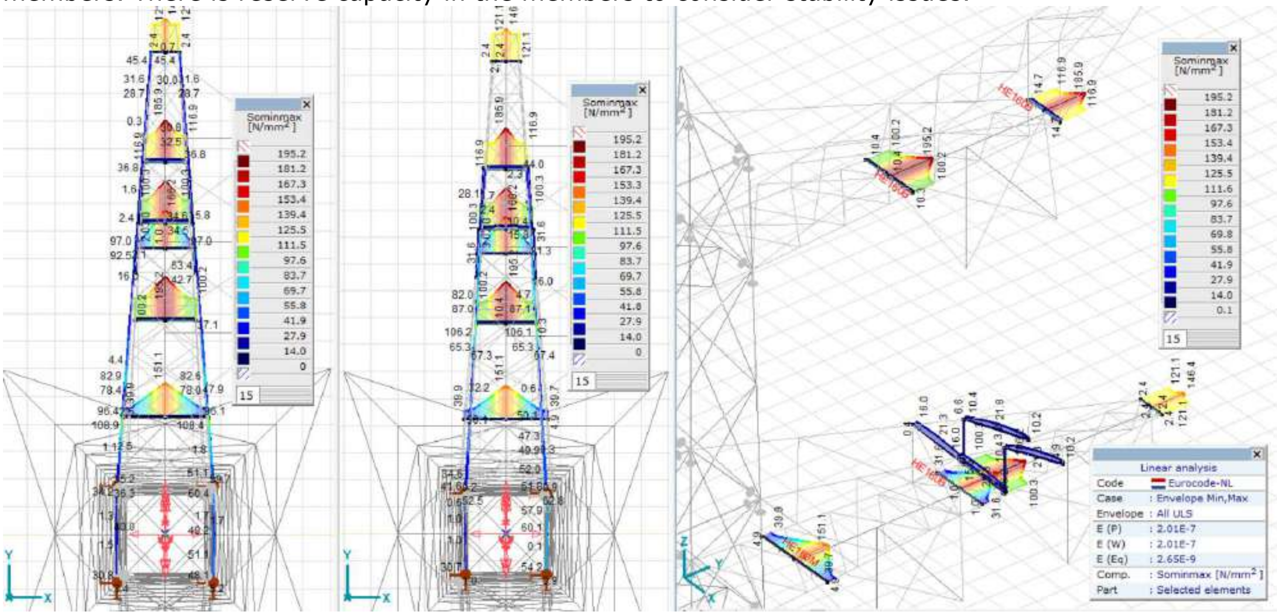
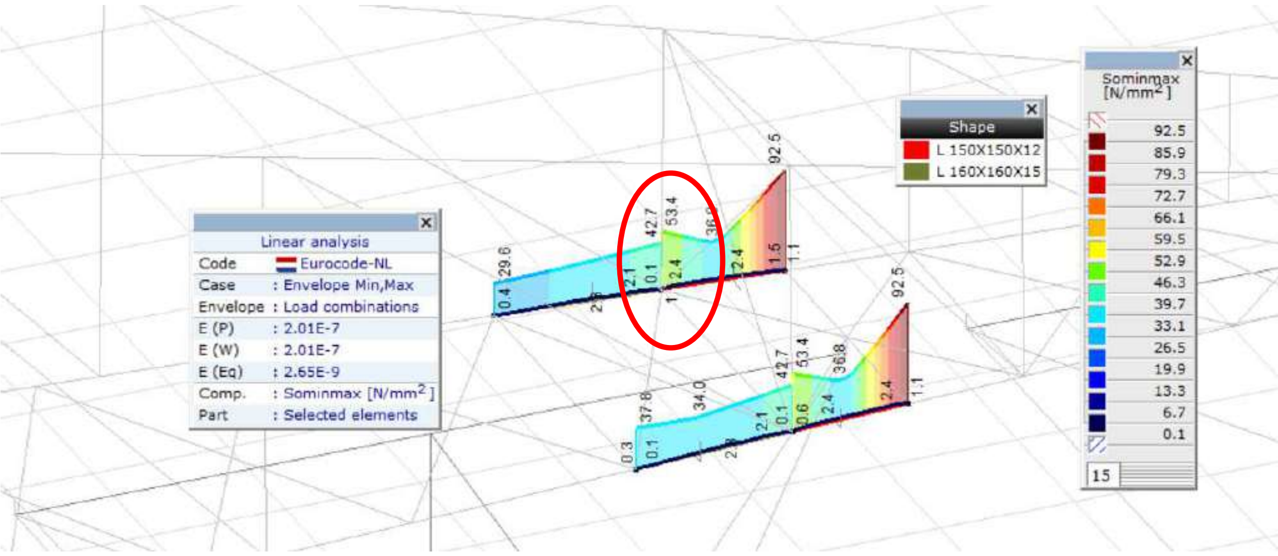


Figure 9 Stress for ULS Envelope in members

The max stress being 195 MPa in the structure exists in the H – beams. This is within the permissible values of 355 MPa.

The transition between the cross-section profiles in the bottom chord is critical. The figure 10 shows the stress at this transition point. The stress at this junction is approx. 55 MPa. The max moment is below 3.5 kNm. A low value of moment with a lot of reserve stress capacity (helpful in the redistribution of moments) is seen at the junction. Thus the existing shear connection can be considered safe.



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 0.53 in Axis VM. The details can be seen in the axis VM report appendix. The max utilization seen from the torsion + bending stress in excel is 0.6. The utilization has increased due to the warping moment accounted for by the excel calculation. The additional strength can be used for the losses in connection. Thus the structure is assumed to safe.

5 CONCLUSION:

The existing cross arm can be assumed safe for the loads imposed by the torsion in the v – ketting isolator configuration. 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 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 the left corresponds to (1) the top view of the top cross-arm, (2) the top view of the bottom cross-arm and (3) the side view of the cross arms.

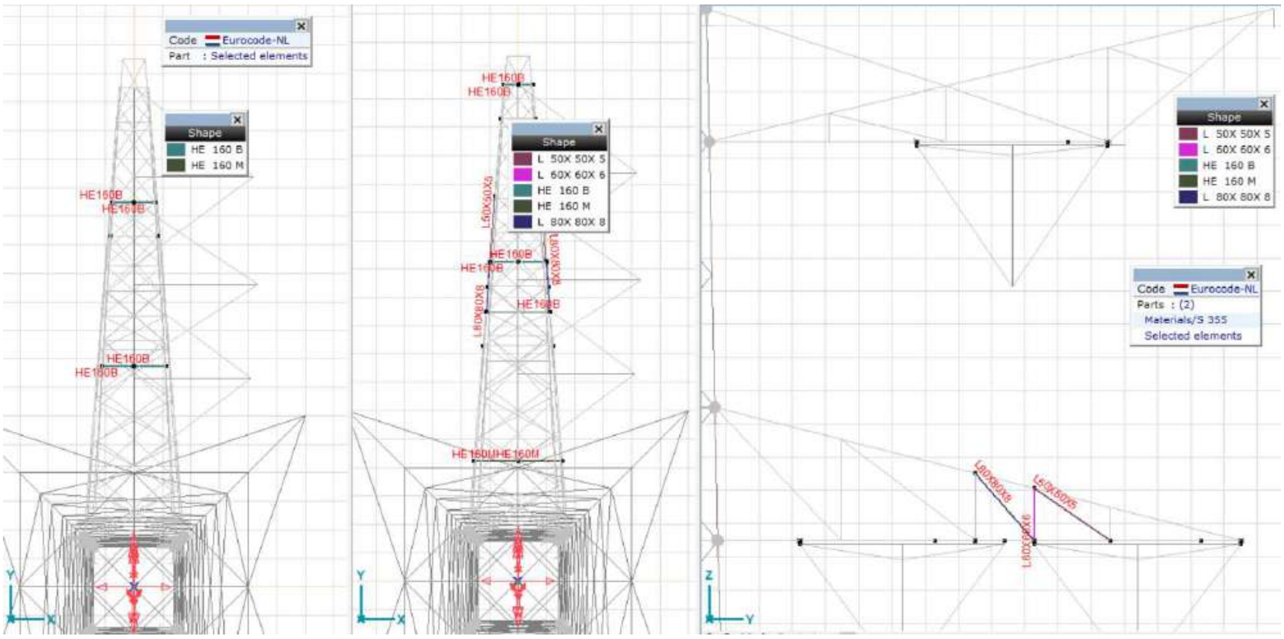


Figure 10 Beams added to support v-ketting insulator configuration

6 BIJLAGE: UITVOER AXISVM.

Project

Analysis by DNV GL - Energy

AxisVM X5 R4j · Registered to DNV GL - Energy

S+18_v_ketting.axs

Report

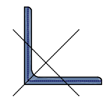
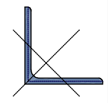
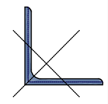
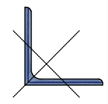
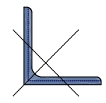
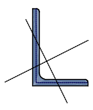
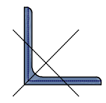
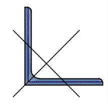
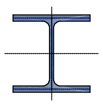
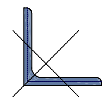
Materials

	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	10025-2	Linear	210000	210000	0.30	1.2E-5	7850			Steel
2	S 355	Steel	Eurocode-NL	10025-2	Linear	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] = 360.00										
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;

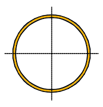
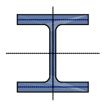
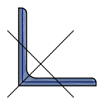
Cross-sections

	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]
1	L 160X160X15		Rolled	L	160.0	160.0	15.0	15.0	17.0	8.5	0	4606.15	2011.73	2029.76
2	L 150X150X12		Rolled	L	150.0	150.0	12.0	12.0	16.0	8.0	0	3483.60	1505.64	1521.61
3	L 100X100X 8		Rolled	L	100.0	100.0	8.0	8.0	12.0	6.0	0	1551.52	669.67	678.46
4	L 100X100X 8_1		Rolled	L	100.0	100.0	8.0	8.0	12.0	6.0	0	1551.52	669.67	678.46
5	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
6	L 70X 50X 6X		Rolled	L	70.0	50.0	6.0	6.0	6.0	3.0	0	687.88	244.09	359.89
7	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
8	L 120X120X10		Rolled	L	120.0	120.0	10.0	10.0	13.0	6.5	0	2318.22	1004.33	1014.85
9	HE 160 B		Rolled	I	160.0	160.0	8.0	13.0	15.0	0	0	5426.04	3754.44	1237.48
10	L 70X 70X 7		Rolled	L	70.0	70.0	7.0	7.0	9.0	4.5	0	939.73	412.00	416.89

	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]
1	L 160X160X15	365558.2	1.1E+07	1.1E+07	−6461627.0	1.7E+07	4525910.0	45.0	6.2E+08	154230.3	154230.3	79787.9	71275.7
2	L 150X150X12	179274.1	7368515.0	7368513.0	−4334081.0	1.2E+07	3034433.0	45.0	2.7E+08	110333.1	110333.1	57321.5	52048.1
3	L 100X100X 8	36218.9	1448264.0	1448264.0	−849655.4	2297919.0	598608.2	45.0	2.3E+07	32497.5	32497.5	17014.9	15467.6
4	L 100X100X 8_1	36218.9	1448264.0	1448264.0	−849655.4	2297919.0	598608.2	45.0	2.3E+07	32497.5	32497.5	17014.9	15467.6
5	L 60X 60X 6	9044.2	227898.9	227898.9	−133497.7	361396.6	94401.2	45.0	2037188	8518.2	8518.2	4463.6	3956.0
6	L 70X 50X 6X	8659.5	335259.6	142666.4	−127188.3	398493.2	79432.8	26.4	2273335	8268.1	10845.2	3145.5	3752.5
7	L 50X 50X 5	4408.9	109629.1	109629.1	−64162.8	173791.9	45466.3	45.0	678722	4915.6	4915.6	2584.4	2290.7
8	L 120X120X10	82759.6	3129113.0	3129113.0	−1840138.0	4969251.0	1288975.0	45.0	7.9E+07	58563.2	58563.2	30420.2	27507.4
9	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
10	L 70X 70X 7	16632.0	422933.4	422933.4	−247895.0	670828.4	175038.4	45.0	5155803	13552.8	13552.8	7084.6	6279.1

	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.
1	L 160X160X15	243874.6	124879.6	48.8	48.8	160.0	160.0	44.9	44.9	−36.2	−36.2	4
2	L 150X150X12	173526.6	89044.1	46.0	46.0	150.0	150.0	41.2	41.2	−34.2	−34.2	4
3	L 100X100X 8	51224.3	26412.7	30.6	30.6	100.0	100.0	27.4	27.4	−22.6	−22.6	4
4	L 100X100X 8_1	51224.3	26412.7	30.6	30.6	100.0	100.0	27.4	27.4	−22.6	−22.6	4
5	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
6	L 70X 50X 6X	14393.0	6211.8	22.1	14.4	50.0	70.0	12.5	22.4	−9.3	−18.5	4
7	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
8	L 120X120X10	92246.3	47331.9	36.7	36.7	120.0	120.0	33.1	33.1	−27.3	−27.3	4
9	HE 160 B	354020.6	169972.2	67.8	40.5	160.0	160.0	80.0	80.0	0	0	9
10	L 70X 70X 7	21550.0	11096.7	21.2	21.2	70.0	70.0	19.7	19.7	−15.5	−15.5	4

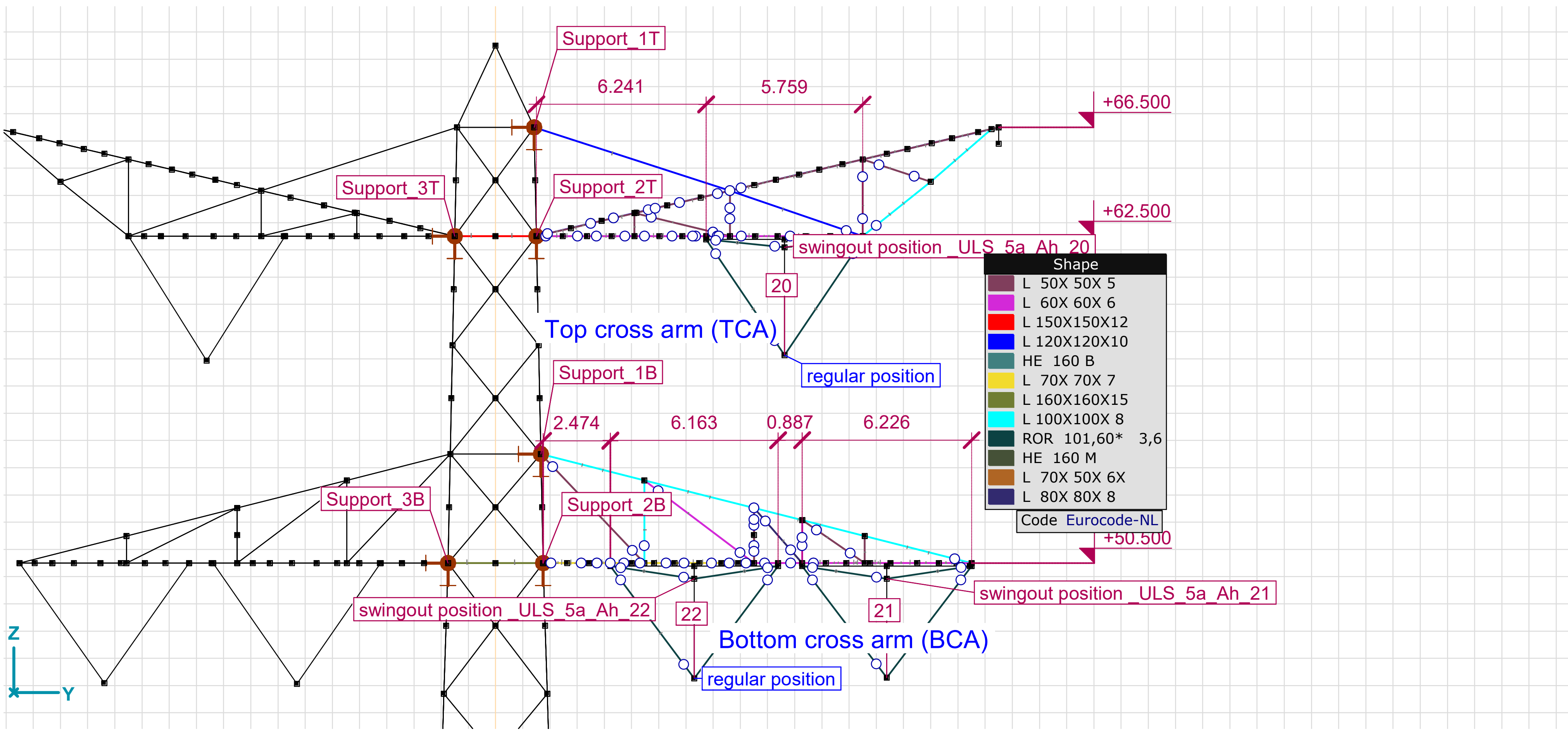
Cross-sections

	Name	Drawing	Process	Shape	h [mm]	b [mm]	tw [mm]	tf [mm]	r_1 [mm]	r_2 [mm]	r_3 [mm]	Ax [mm^2]	Ay [mm^2]	Az [mm^2]
11	ROR 101,60* 3,6		Rolled	Pipe	101.6	101.6	3.6	3.6	0	0	0	1106.95	554.66	554.72
12	HE 160 M		Rolled	I	180.0	166.0	14.0	23.0	15.0	0	0	9706.04	6815.19	2380.69
13	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

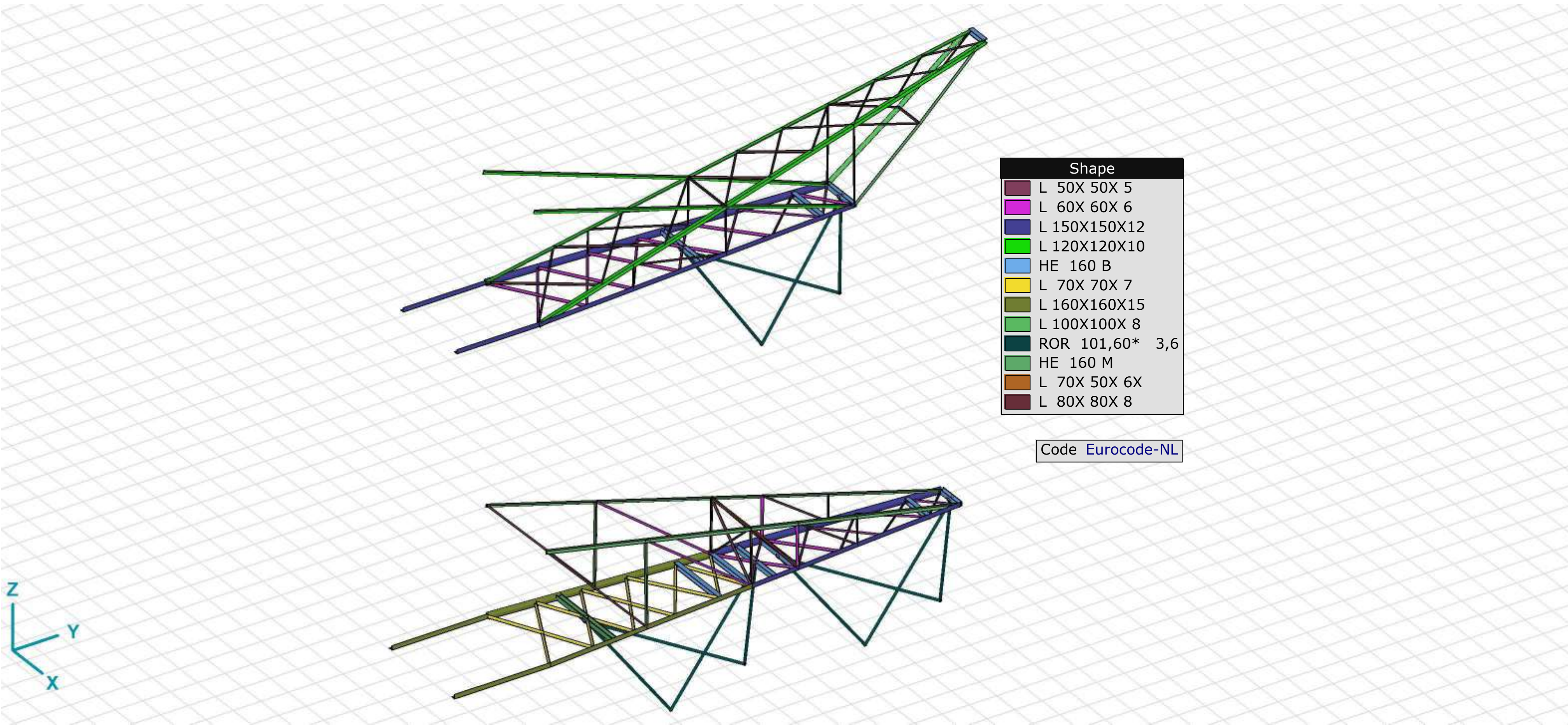
	Name	Ix [mm^4]	Iy [mm^4]	Iz [mm^4]	Iyz [mm^4]	I_1 [mm^4]	I_2 [mm^4]	α [°]	Iω [mm^6]	$W_{1,el,t}$ [mm^3]	$W_{1,el,b}$ [mm^3]	$W_{2,el,t}$ [mm^3]	$W_{2,el,b}$ [mm^3]
11	ROR 101,60* 3,6	2663810.0	1328996.0	1328996.0	0	1328996.0	1328996.0	0	0	26161.3	26161.3	26161.3	26161.3
12	HE 160 M	1624195.0	5.1E+07	1.8E+07	0	5.1E+07	1.8E+07	0	1E+11	566512.2	566512.2	211901.4	211901.4
13	L 80X 80X 8	28221.9	722397.8	722397.8	−423612.4	1146010.0	298785.4	45.0	1.2E+07	20258.8	20258.8	10570.7	9369.6

	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.
11	ROR 101,60* 3,6	34524.1	34524.1	34.6	34.6	101.6	101.6	50.8	50.8	0	0	5
12	HE 160 M	674620.6	325470.3	72.5	42.6	166.0	180.0	83.0	90.0	0	0	9
13	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

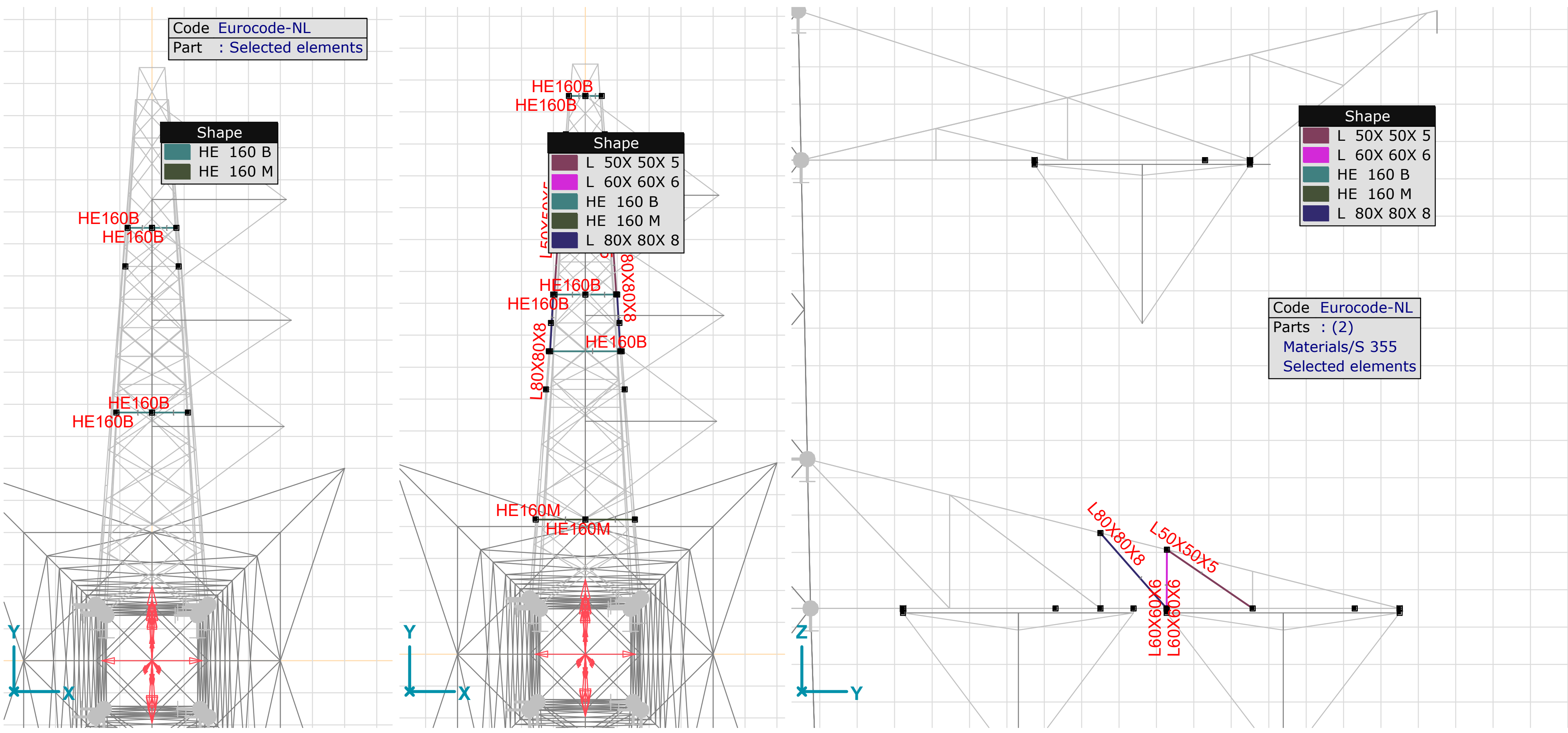
Name: Cross-section name; **Process:** Manufacturing process; **h:** Cross-section height; **b:** Cross-section width; **tw:** Web thickness; **tf:** Flange thickness; **r_1, r_2, r_3:** Rounding radius; **Ax:** Cross-section area; **Ay, Az:** Shear area; **Ix:** Torsional inertia; **Iy, Iz:** Flexural 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;



dimesion_&_isolator_details



3D render



add_/_modified_members

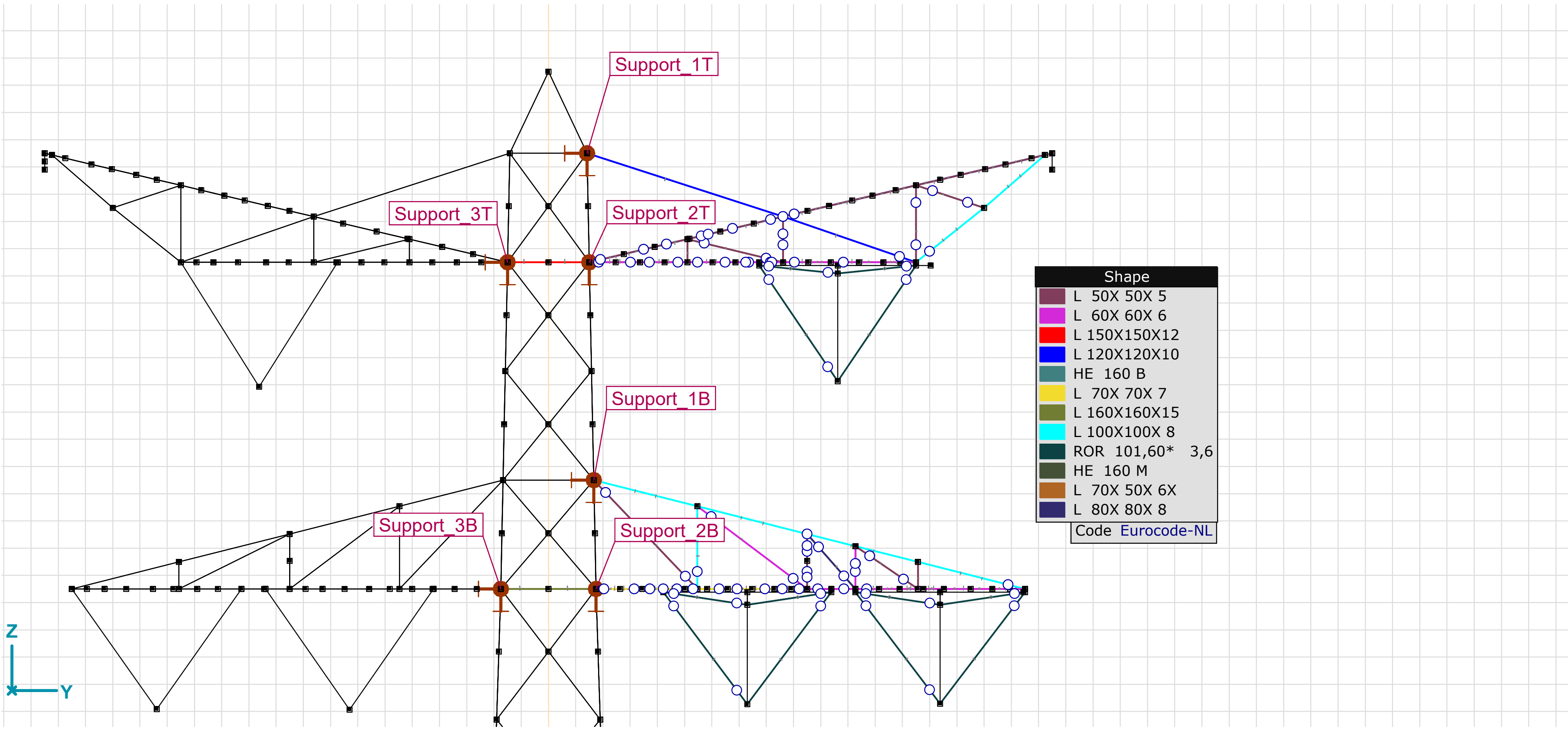
Nodal supports

	Node	*X [m]*	*Y [m]*	*Z [m]*
1	144	1.4	1.4	66.5
2	150	−1.4	1.4	66.5
3	164	1.7	1.7	54.5
4	171	−1.7	1.7	54.5
5	143	1.5	1.5	62.5
6	155	−1.5	1.5	62.5
7	172	1.8	1.7	50.5
8	179	−1.7	1.8	50.5
9	145	1.5	−1.5	62.5
10	151	−1.5	−1.5	62.5
11	175	1.7	−1.8	50.5
12	176	−1.8	−1.7	50.5

	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	144	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
2	150	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
3	164	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
4	171	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
5	143	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
6	155	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
7	172	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
8	179	Glob.	Rigid - Translational	1E+10	1E+10	—	–	–	Rigid - Translational	1E+10	1E+10	—	–	–
9	145	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
10	151	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
11	175	Glob.	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	Rigid - Translational	1E+10	1E+10	—	–	–
12	176	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	144	—	–	–	—	–	–
2	150	—	–	–	—	–	–
3	164	—	–	–	—	–	–
4	171	—	–	–	—	–	–
5	143	—	–	–	—	–	–
6	155	—	–	–	—	–	–
7	172	—	–	–	—	–	–
8	179	—	–	–	—	–	–
9	145	—	–	–	—	–	–
10	151	—	–	–	—	–	–
11	175	—	–	–	—	–	–
12	176	—	–	–	—	–	–

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;

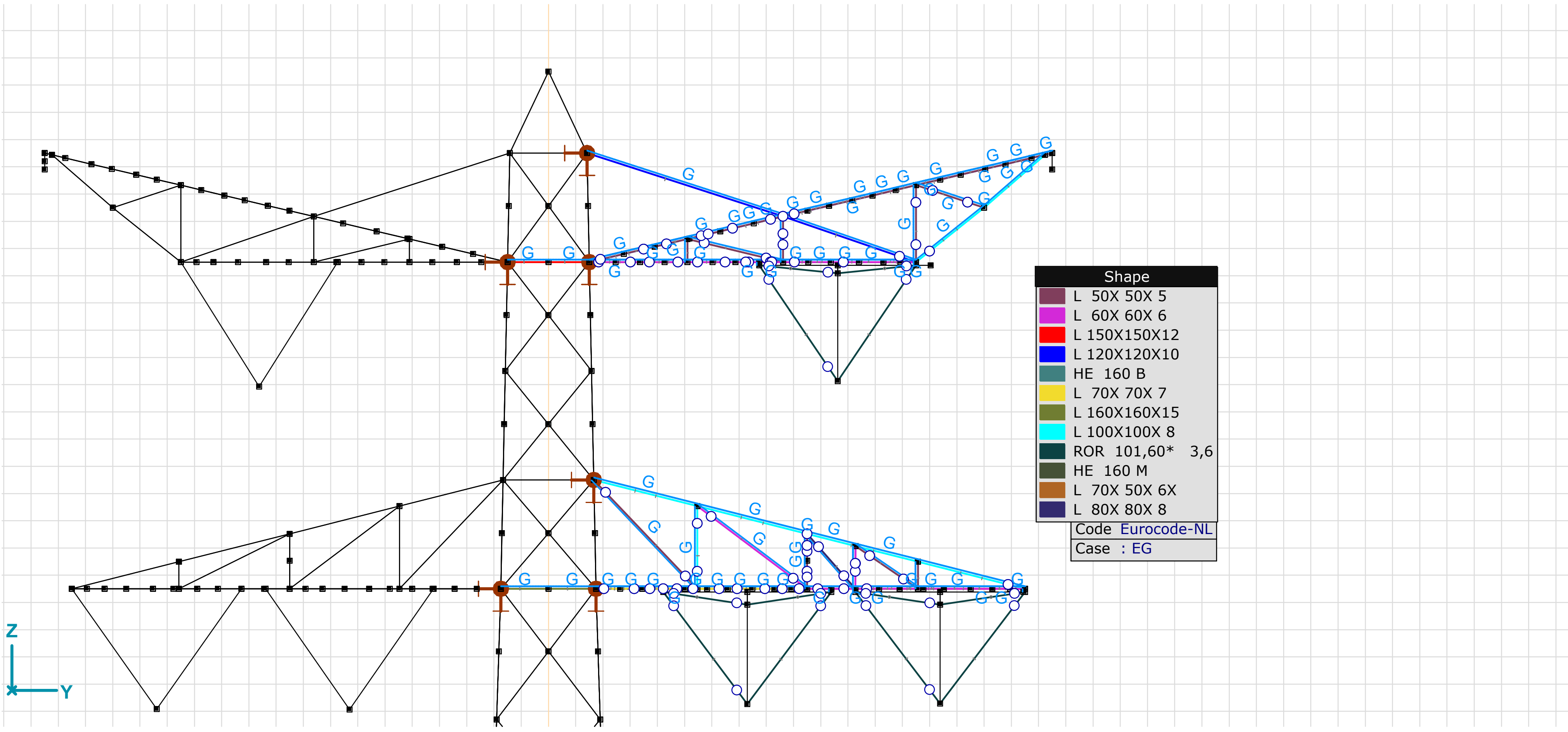


supports

Spring characteristics

	Name	*Type*	*Degree of freedom*	*Model*	*K*	K_V	*NL*	*Limit value*	K_T	K_C
1	Soft - Translational	N-N	Translational	Linear	1E+0 kN/m	1E+0 kN/m	Symmetric	—	1E+0 kN/m	1E+0 kN/m
2	Rigid - Translational	N-N	Translational	Linear	1E+10 kN/m	1E+10 kN/m	Symmetric	—	1E+10 kN/m	1E+10 kN/m
3	Soft - Rotational	N-N	Rotational	Linear	1E+0 kNm/rad	1E+0 kNm/rad	Symmetric	—	1E+0 kNm/rad	1E+0 kNm/rad
4	Rigid - Rotational	N-N	Rotational	Linear	1E+10 kNm/rad	1E+10 kNm/rad	Symmetric	—	1E+10 kNm/rad	1E+10 kNm/rad
5	Rigid_comp_only	N-N	Translational	NL elastic	1E+10 kN/m	1E+10 kN/m	Comp|Compression only	2415.0 kN	0 kN/m	1E+10 kN/m

Name: Name of the spring characteristics; **Model:** Material model; **K:** Initial stiffness; **K$_V$:** Vibration stiffness; **NL:** Nonlinear parameters; **K$_T$:** Initial stiffness, in tension; **K$_C$:** Initial stiffness, in compression;

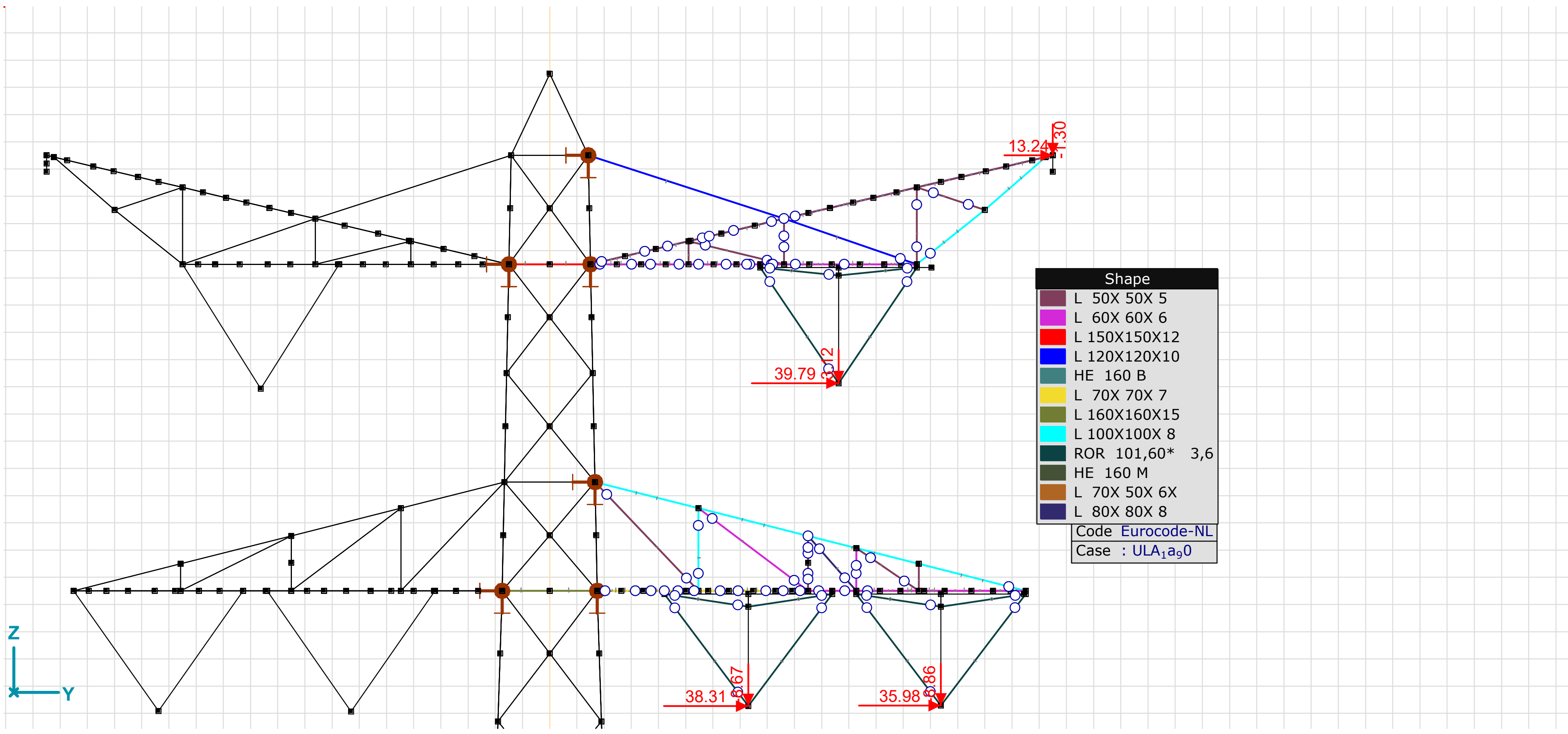


EG, Side view

ULA_1a_90: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Global	0	38.31	−8.67	0	0	0
2	Global	0	35.98	−8.86	0	0	0
56	Global	0	39.79	−3.12	0	0	0
111	Global	0	13.24	−1.30	0	0	0

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

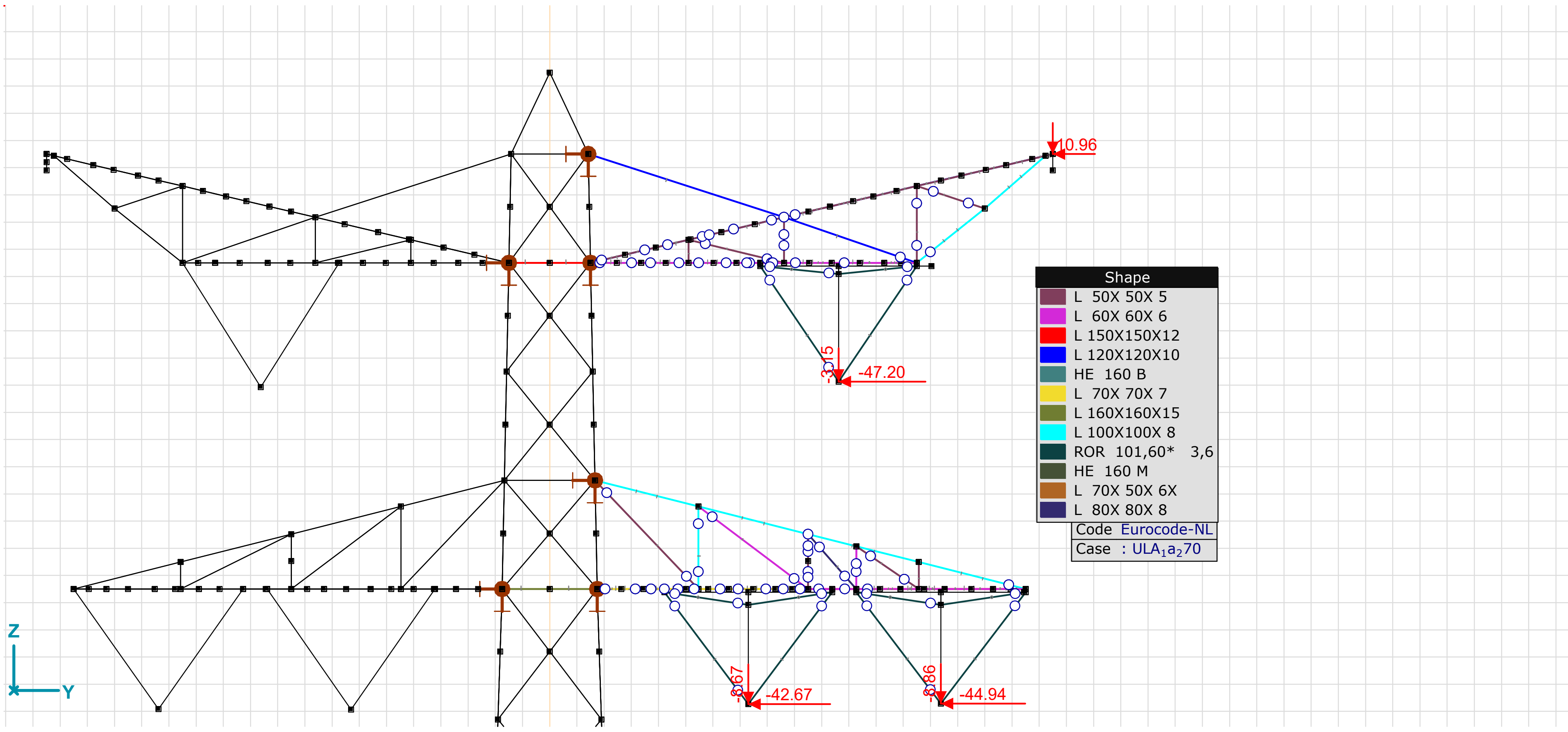


ULA_1a_90, Side view

ULA_1a_270: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Global	0	−42.67	−8.67	0	0	0
2	Global	0	−44.94	−8.86	0	0	0
56	Global	0	−47.20	−3.15	0	0	0
111	Global	0	−10.96	−1.30	0	0	0

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

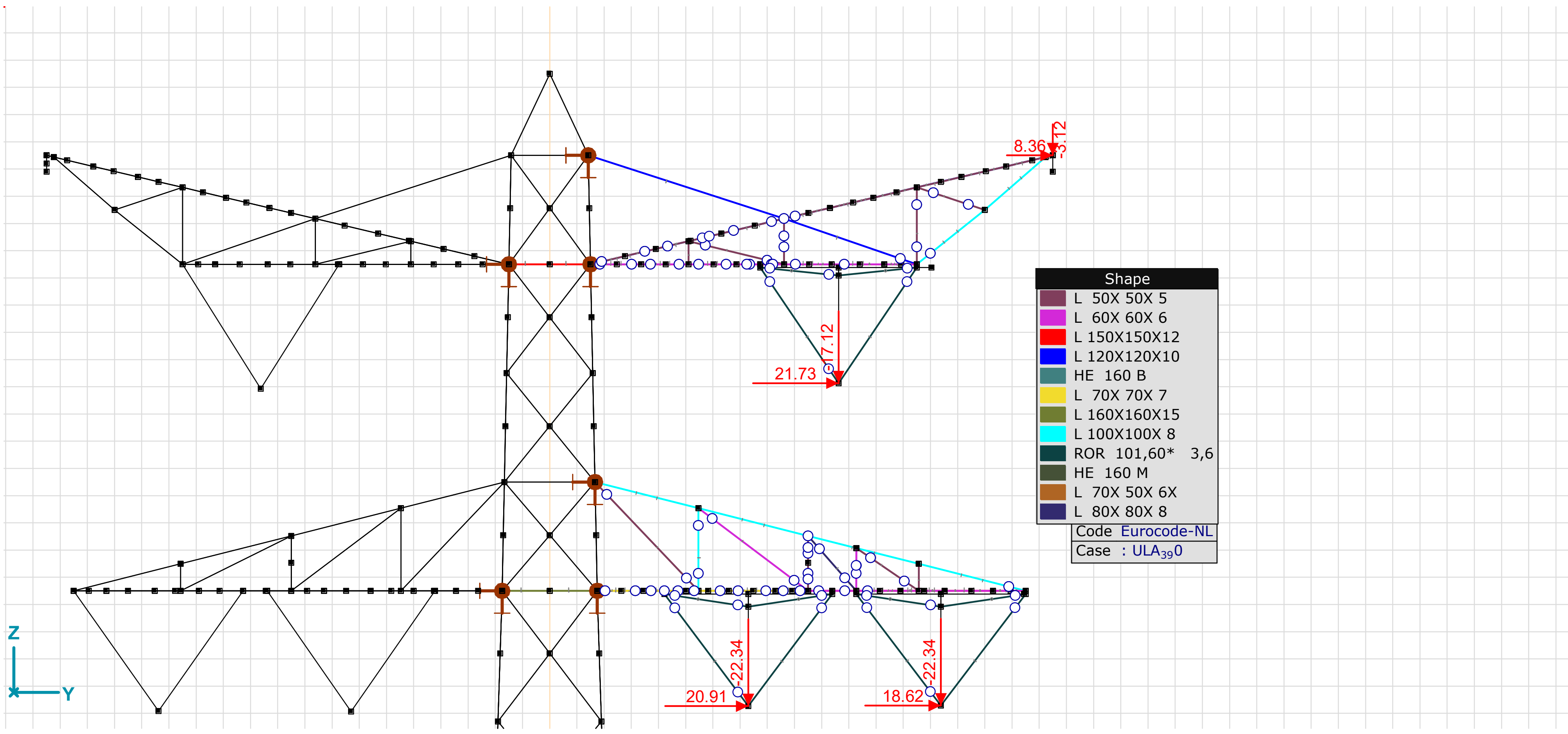


ULA_1a_270, Side view

ULA_3_90: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Global	0	20.91	−22.34	0	0	0
2	Global	0	18.62	−22.34	0	0	0
56	Global	0	21.73	−17.12	0	0	0
111	Global	0	8.36	−3.12	0	0	0

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

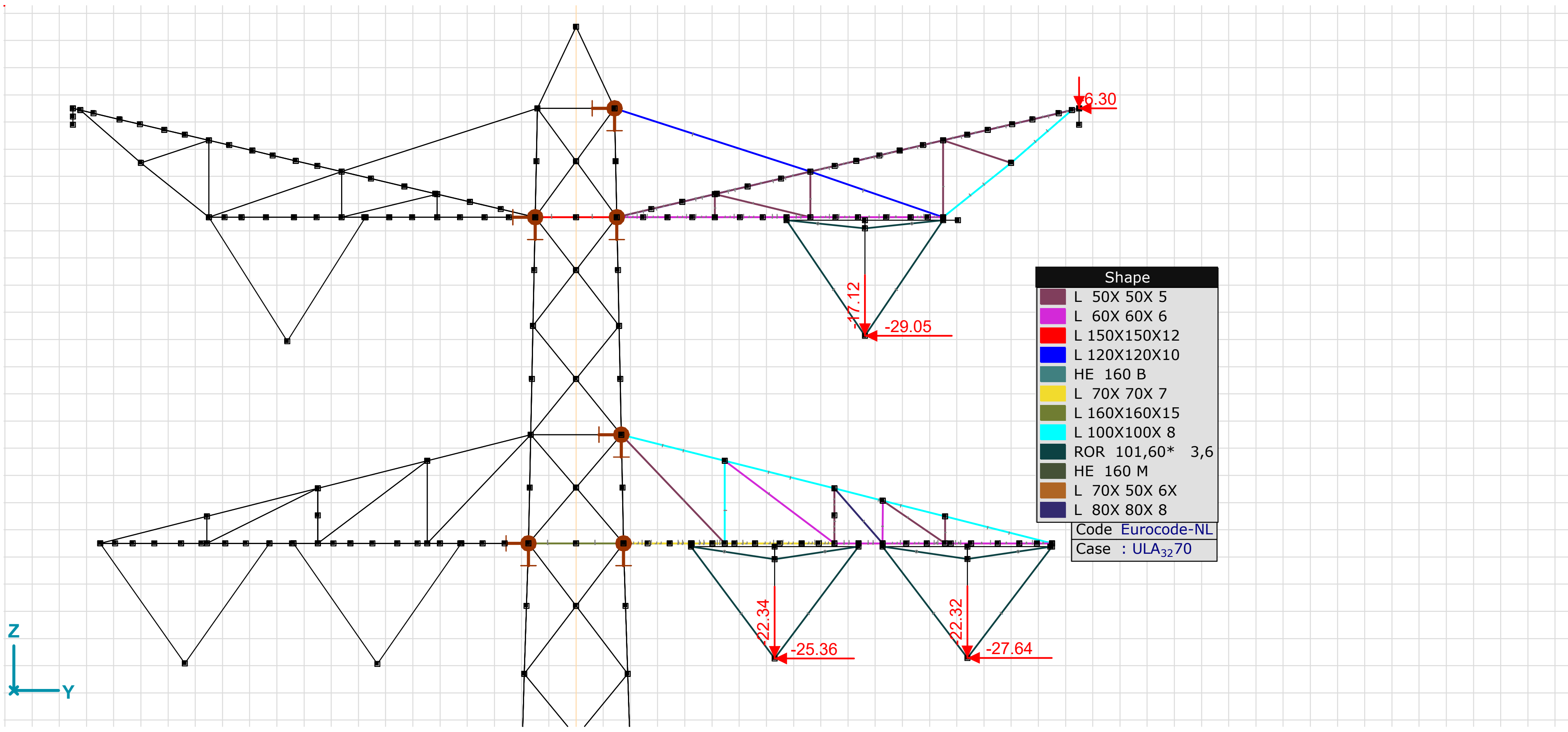


ULA_3_90, Side view

ULA_3_270: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Global	0	−25.36	−22.34	0	0	0
2	Global	0	−27.64	−22.32	0	0	0
56	Global	0	−29.05	−17.12	0	0	0
111	Global	0	−6.30	−3.14	0	0	0

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

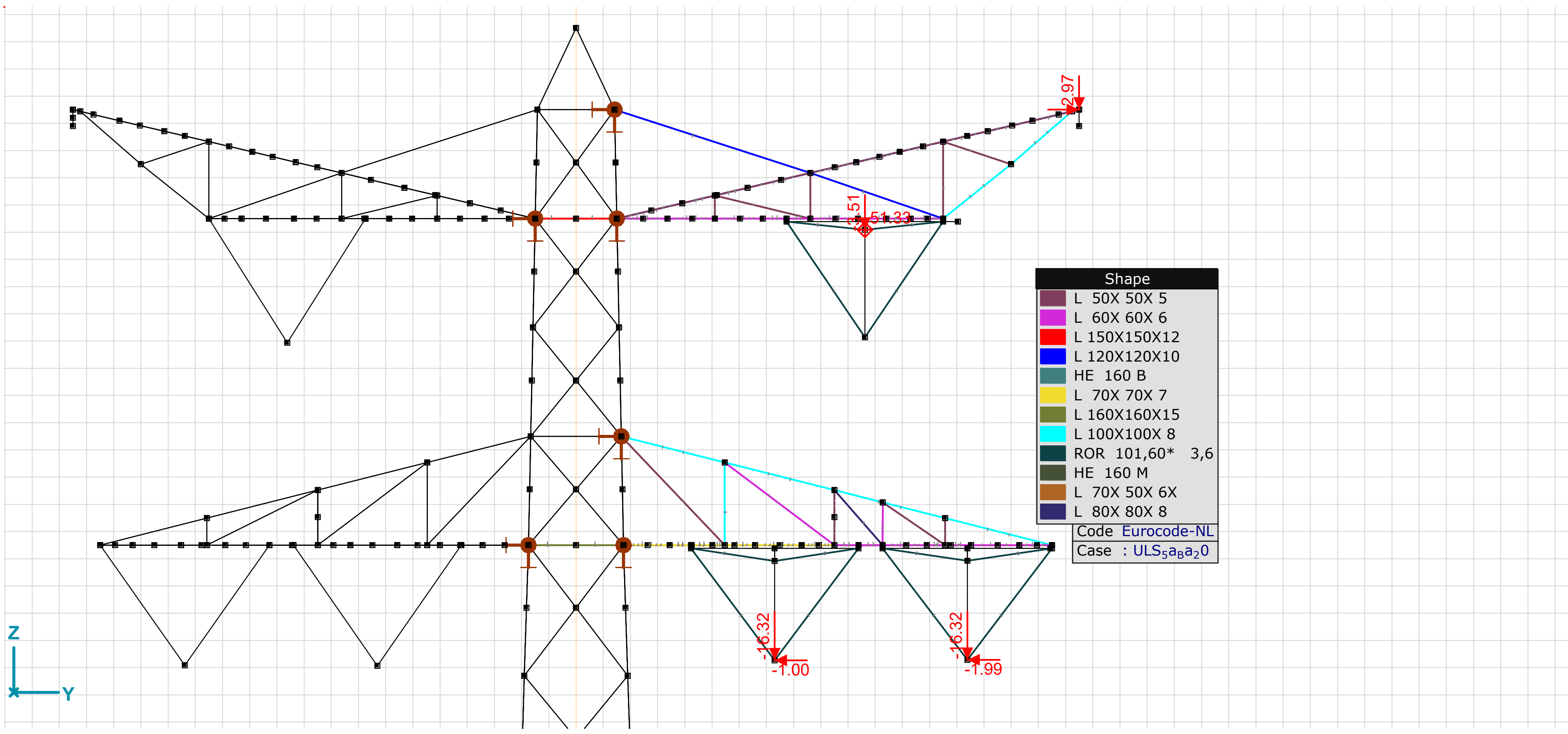


ULA_3_270, Side view

ULS_5a_Ba_20: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Global	0	−1.00	−16.32	0	0	0
2	Global	0	−1.99	−16.32	0	0	0
111	Global	0	0.37	−2.97	0	0	0
362	Global	51.33	0	−3.51	0	0	0

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

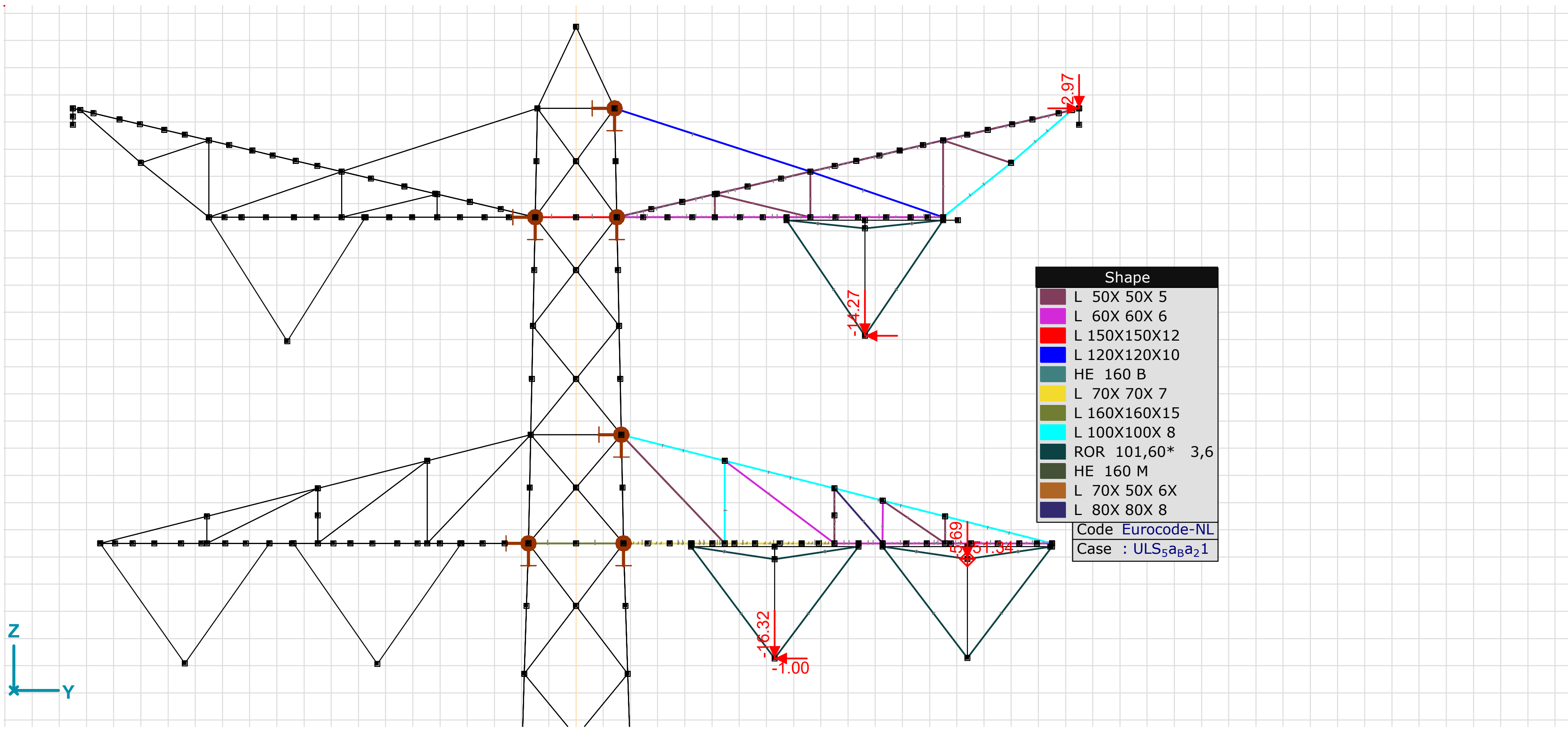


ULS_5a_Ba_20, Side view

ULS_5a_Ba_21: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Global	0	−1.00	−16.32	0	0	0
56	Global	0	−1.59	−14.27	0	0	0
111	Global	0	0.37	−2.97	0	0	0
361	Global	51.34	0	−5.69	0	0	0

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

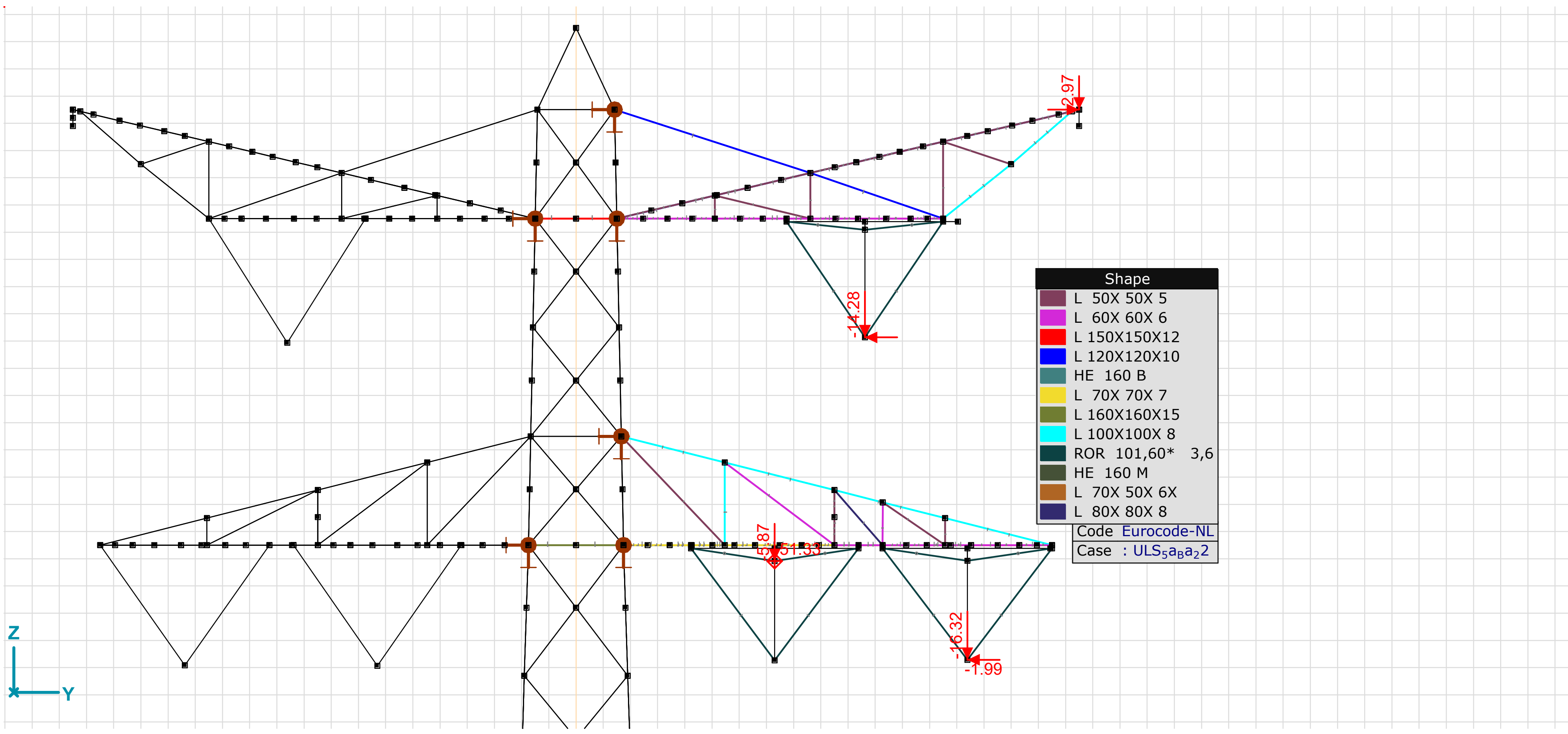


ULS_5a_Ba_21, Side view

ULS_5a_Ba_22: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
2	Global	0	−1.99	−16.32	0	0	0
56	Global	0	−1.59	−14.28	0	0	0
111	Global	0	0.37	−2.97	0	0	0
360	Global	51.33	0	−5.87	0	0	0

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

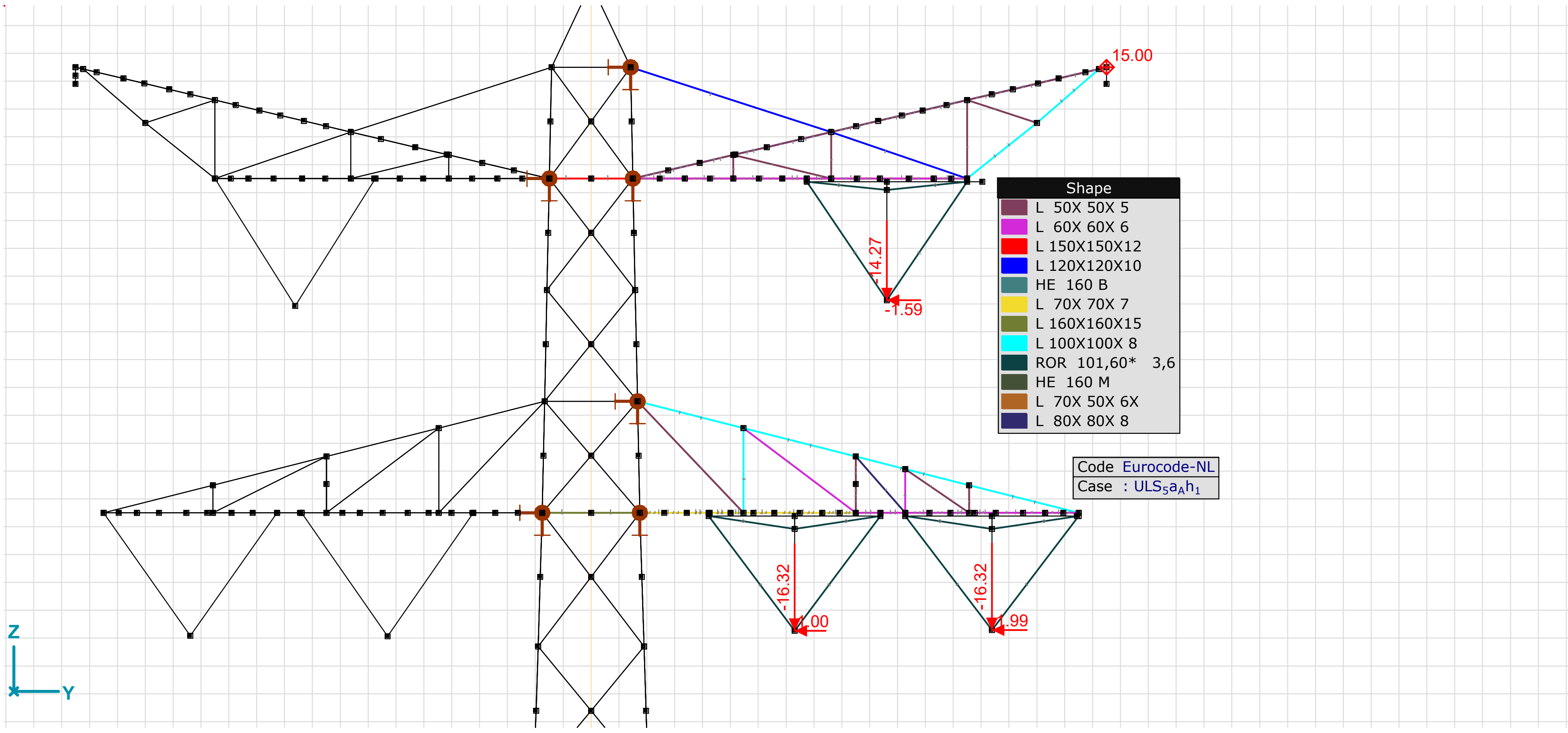


ULS_5a_Ba_22, Side view

ULS_5a_Ah_1: Nodal loads

	Direction	Fx [kN]	Fy [kN]	Fz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Global	0	−1.00	−16.32	0	0	0
2	Global	0	−1.99	−16.32	0	0	0
56	Global	0	−1.59	−14.27	0	0	0
111	Global	15.00	0	0	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

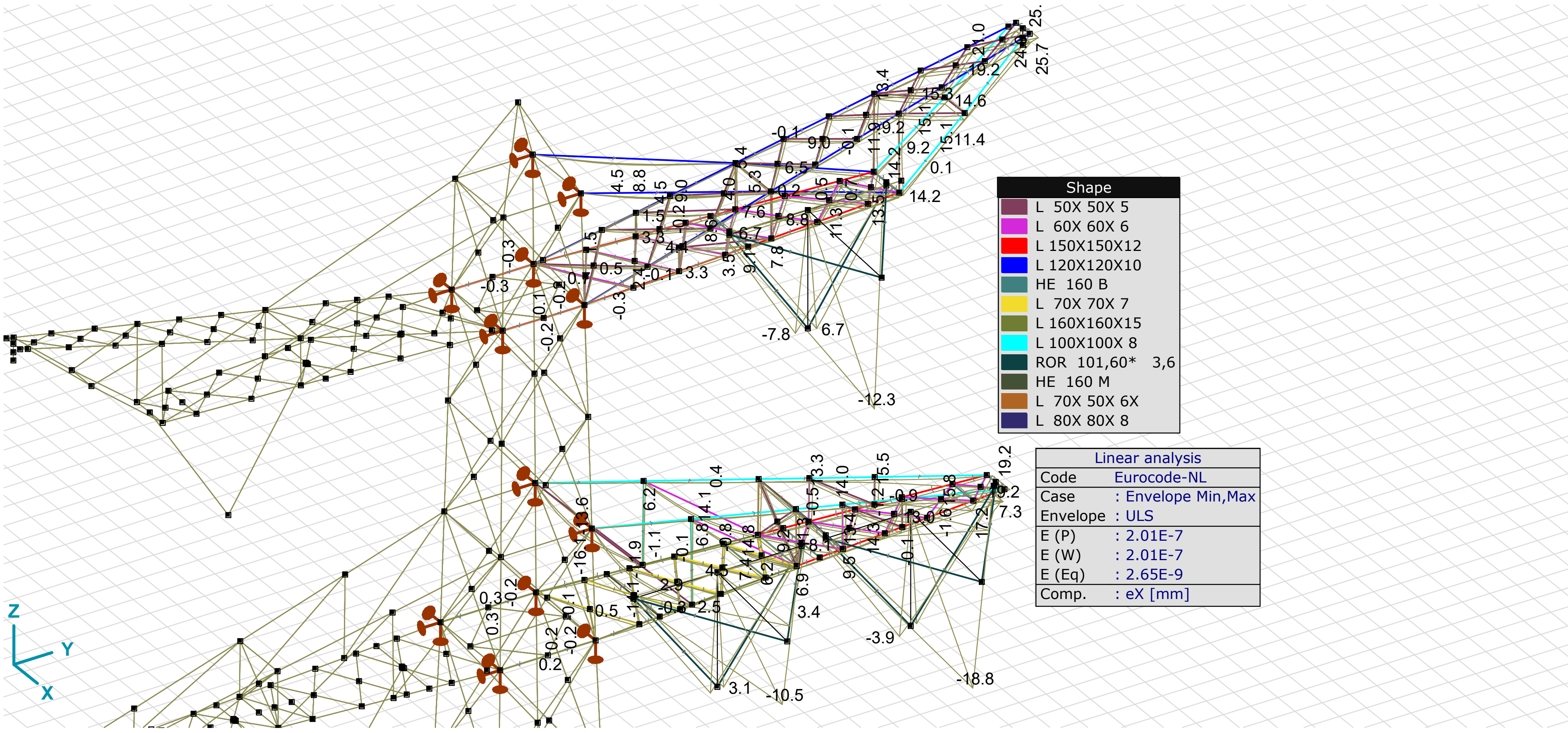
	Name	Type	ULA_1a_90	ULA_1a_270	ULA_3_90	ULA_3_270	ULS_5a_Ba_20	ULS_5a_Ba_21	ULS_5a_Ba_22	ULS_5a_Ah_1	EG	Comment
1	Co #1	ULS	0.90	0	0	0	0	0	0	0	1.08	
2	Co #2	ULS	0	0.90	0	0	0	0	0	0	1.08	
3	Co #3	ULS	0	0	0	0.90	0	0	0	0	1.08	
4	Co #4	ULS	0	0	0.90	0	0	0	0	0	1.08	
5	Co #5	ULS	1.00	0	0	0	0	0	0	0	1.26	
6	Co #6	ULS	0	1.00	0	0	0	0	0	0	1.26	
7	Co #7	ULS	0	0	1.00	0	0	0	0	0	1.26	
8	Co #8	ULS	0	0	0	1.00	0	0	0	0	1.26	
9	Co #9	ULS	0	0	0	0	1.00	0	0	0	1.20	
10	Co #10	ULS	0	0	0	0	0	1.00	0	0	1.20	
11	Co #11	ULS	0	0	0	0	0	0	1.00	0	1.20	
12	Co #12	ULS	0	0	0	0	0	0	0	1.00	1.20	

Name: Load combination name; **Type:** Load combination type; **ULA_1a_90, ULA_1a_270, ULA_30, $ULA_{32}70$, $ULS_5a_Ba_20$, $ULS_5a_Ba_21$, $ULS_5a_Ba_22$, $ULS_5a_Ah_1$, EG:** Factor;

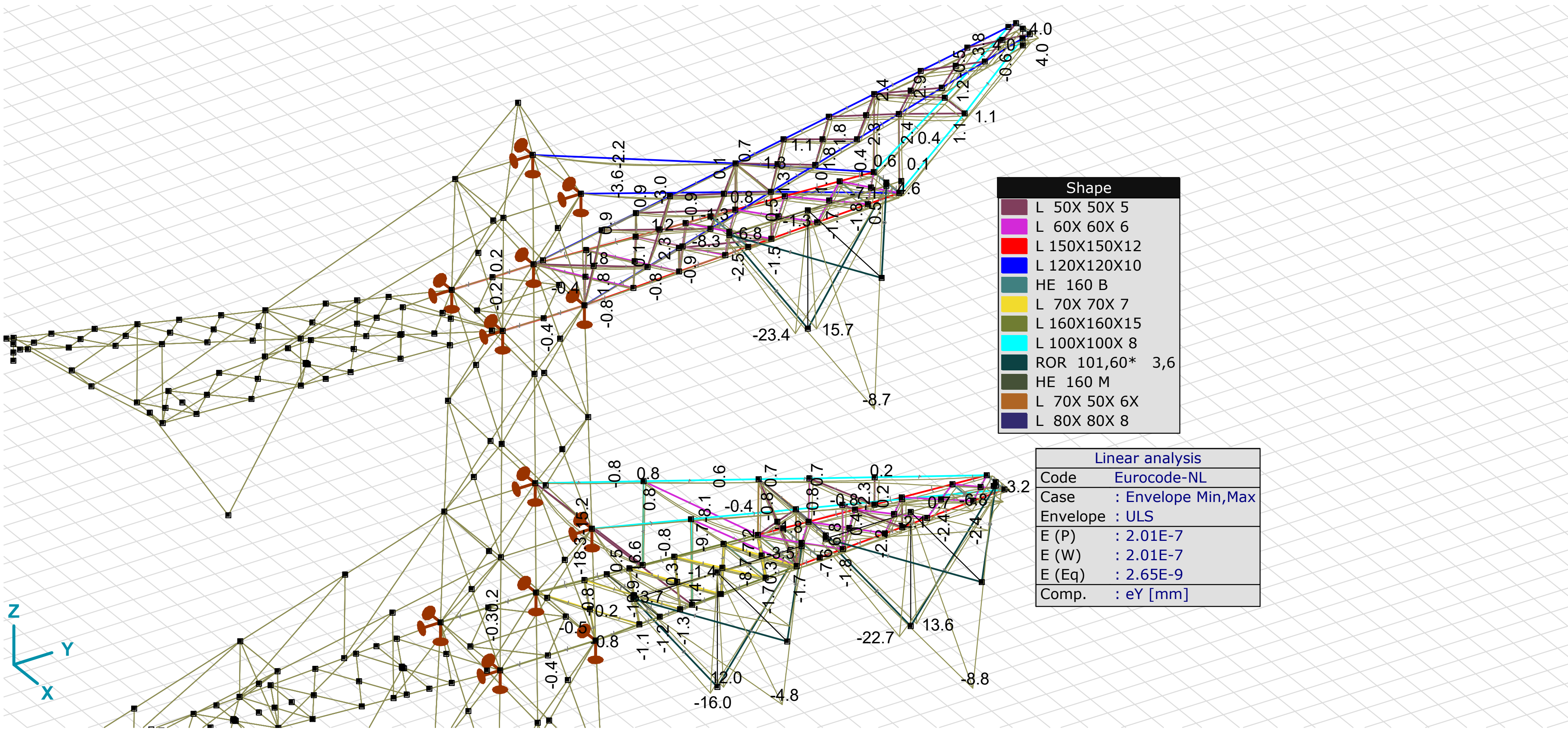
Modal_Nodal displacements [Linear, Envelope (ULS)]

	C	min. max.	Case	eX [mm]	eY [mm]	eZ [mm]	eR [mm]	fX [rad]	fY [rad]	fZ [rad]	fR [rad]
Ext.											
361	eX	min	Co #5	**−18.8**	5.8	−179.4	180.4	0	0	0	0
111		max	Co #12	**25.7**	1.4	−8.0	27.0	0	0	0	0
115		max	Co #12	**25.7**	2.9	−10.5	27.9	0	0	0	0
117		max	Co #12	**25.7**	−0.1	−5.4	26.3	0	0	0	0
56	eY	min	Co #6	0	**−23.4**	−2.7	23.5	0	0	0	0
56		max	Co #5	0	**15.7**	−4.6	16.4	0	0	0	0
362	eZ	min	Co #9	−5.8	−5.1	**−296.8**	296.9	0	0.1	0	0.1
362		max	Co #6	12.7	−8.7	**188.5**	189.2	−0.1	0	0	0.1
119	eR	min	Co #1	0	0	0	**0**	0	0	0	0
362		max	Co #9	−5.8	−5.1	−296.8	**296.9**	0	0.1	0	0.1

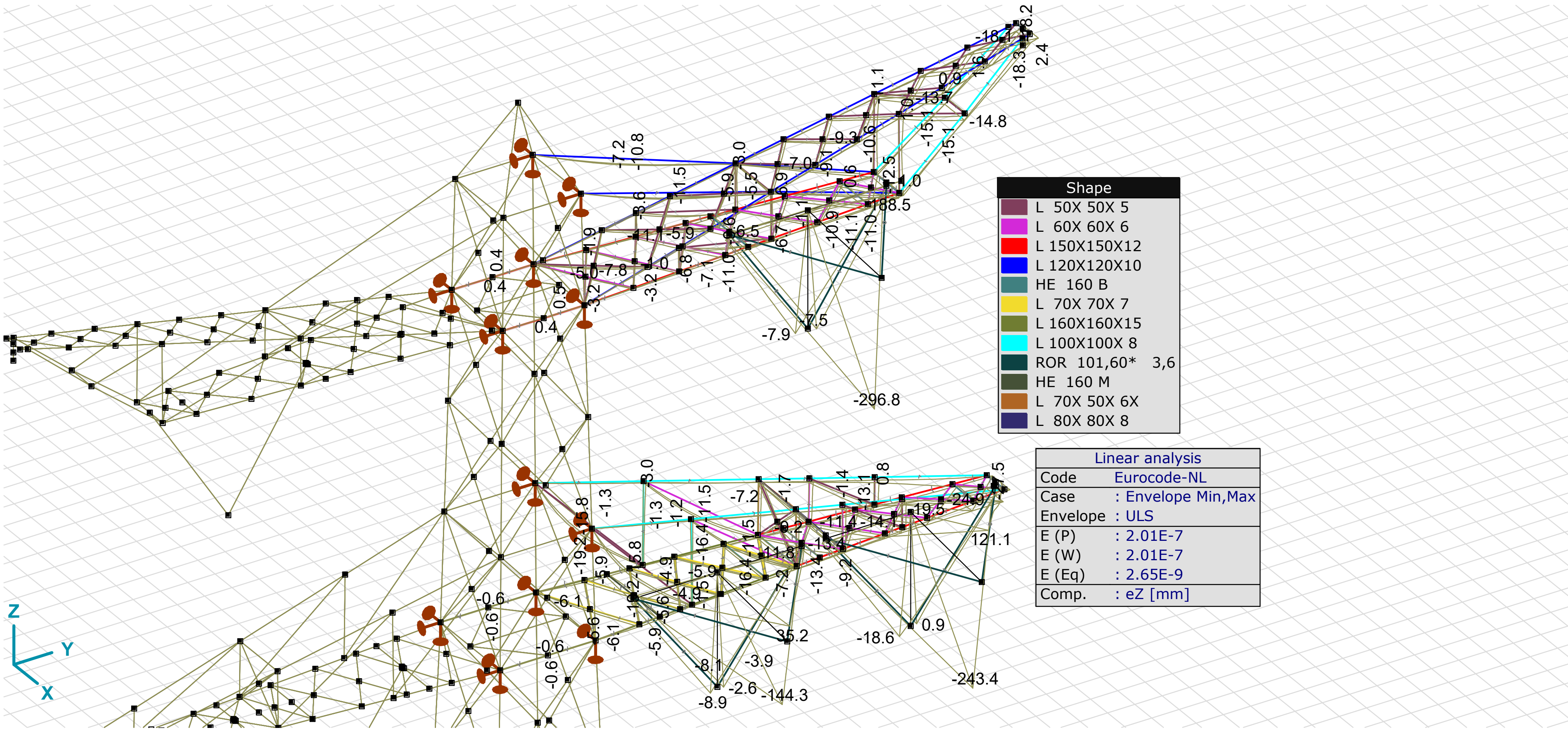
C: Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **eX:** Translation in X direction; **eY:** Translation in Y direction; **eZ:** Translation in Z direction; **eR:** Resultant translation; **fX:** Rotation in X direction; **fY:** Rotation in Y direction; **fZ:** Rotation in Z direction; **fR:** Resultant rotation;



model_Linear, Envelope (ULS), eX [mm], Diagram



model_Linear, Envelope (ULS), eY [mm], Diagram

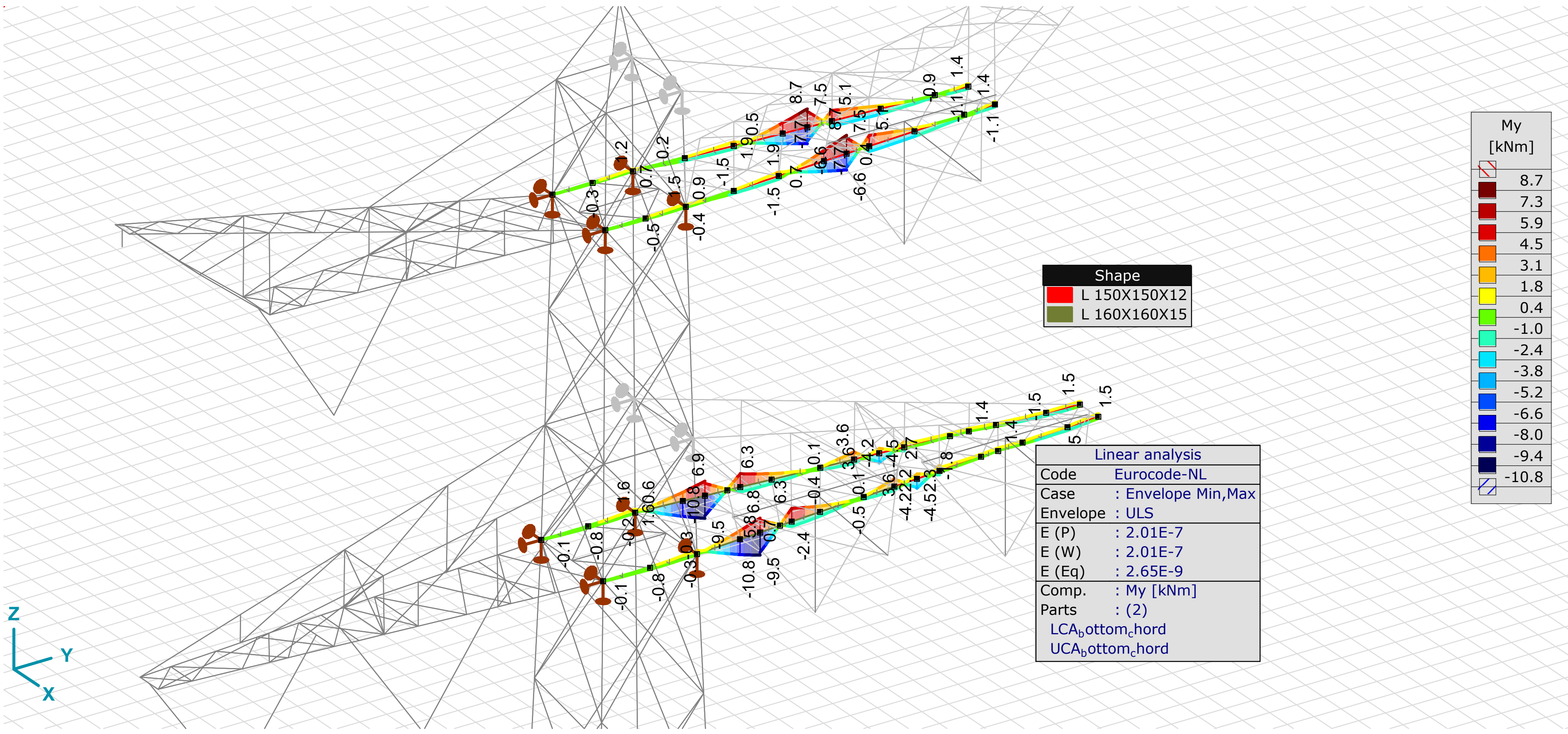


model_Linear, Envelope (ULS), eZ [mm], Diagram

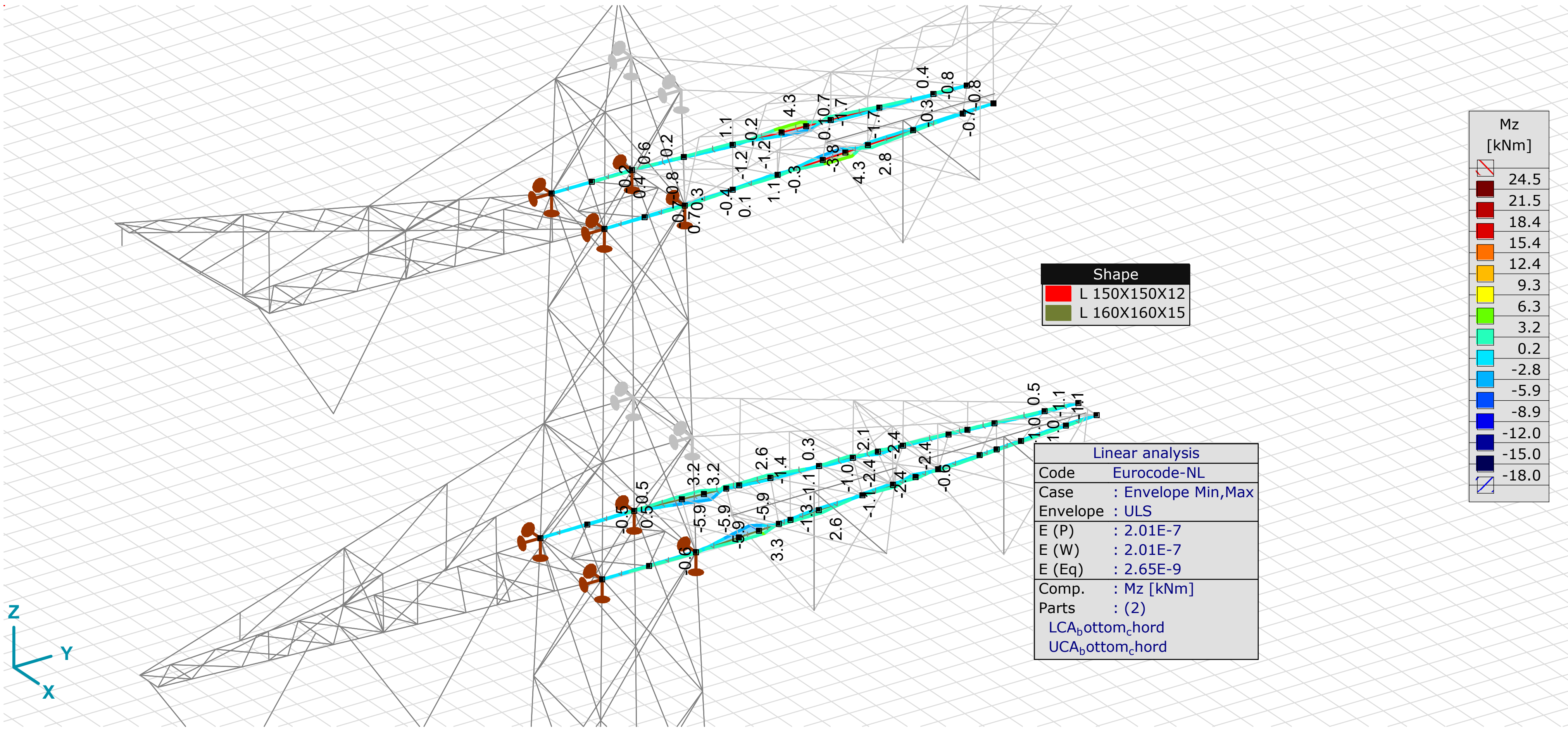
bottom_chord_Beam internal forces [Linear, Envelope (ULS), Parts]

	Sh.	Cross-section name	C	min. max.	Case	Loc. [m]	Node	Nx [kN]	Vy [kN]	Vz [kN]	Tx [kNm]	My [kNm]	Mz [kNm]
Ext.													
234	1	L 160X160X15	Nx	min	Co #10	0	(175)	**−221.6**	0.1	−0.5	0	0	0
235	1	L 160X160X15		min	Co #10	0	(309)	**−221.6**	0.1	0.3	0	−0.2	−0.2
236	1	L 160X160X15		max	Co #10	0	(315)	**119.1**	0.1	0.2	0	−0.3	−0.2
237	1	L 160X160X15		max	Co #10	0	(176)	**119.1**	0.1	−0.5	0	0	0

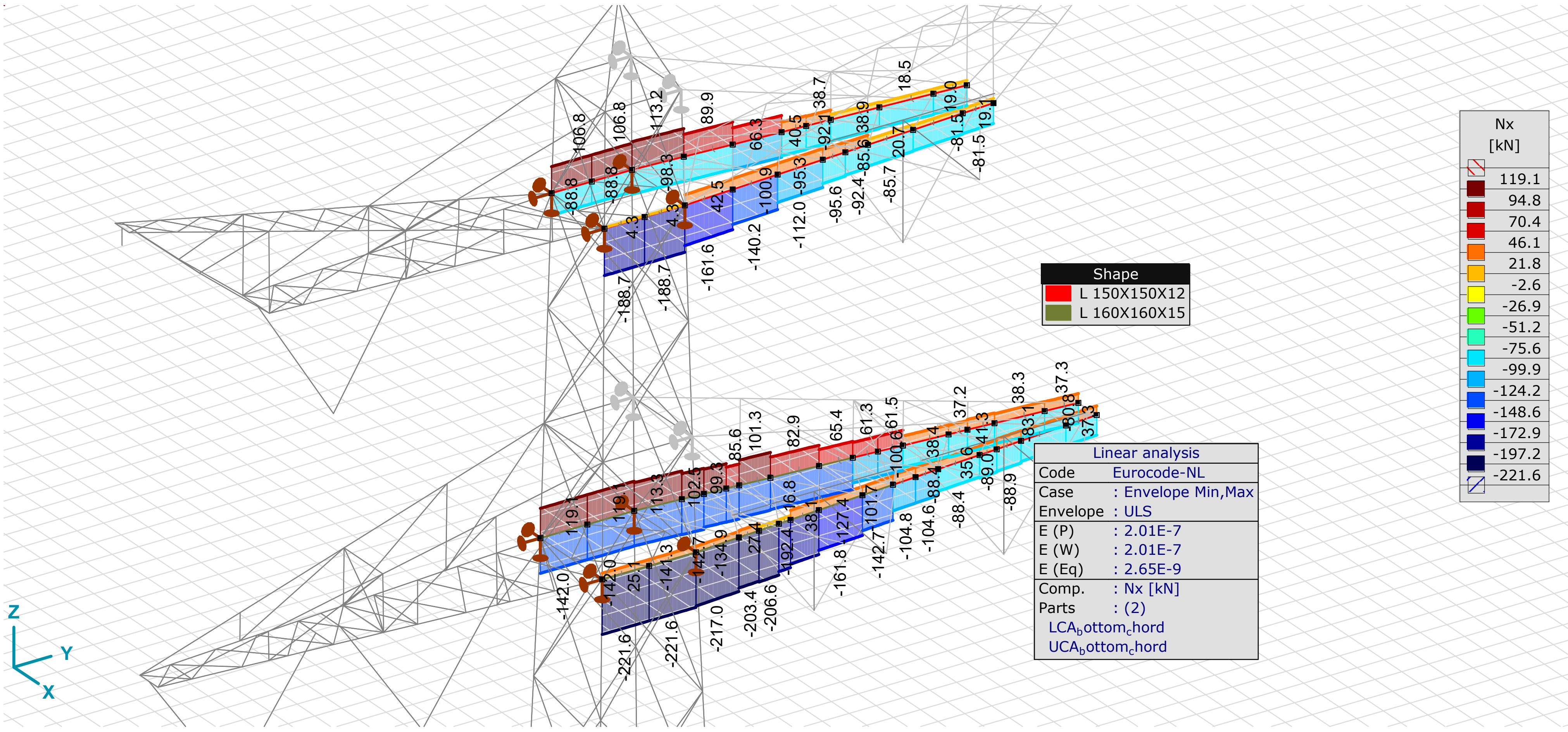
Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:** Flexural moment about local y axis; **Mz:** Flexural moment about local z axis;



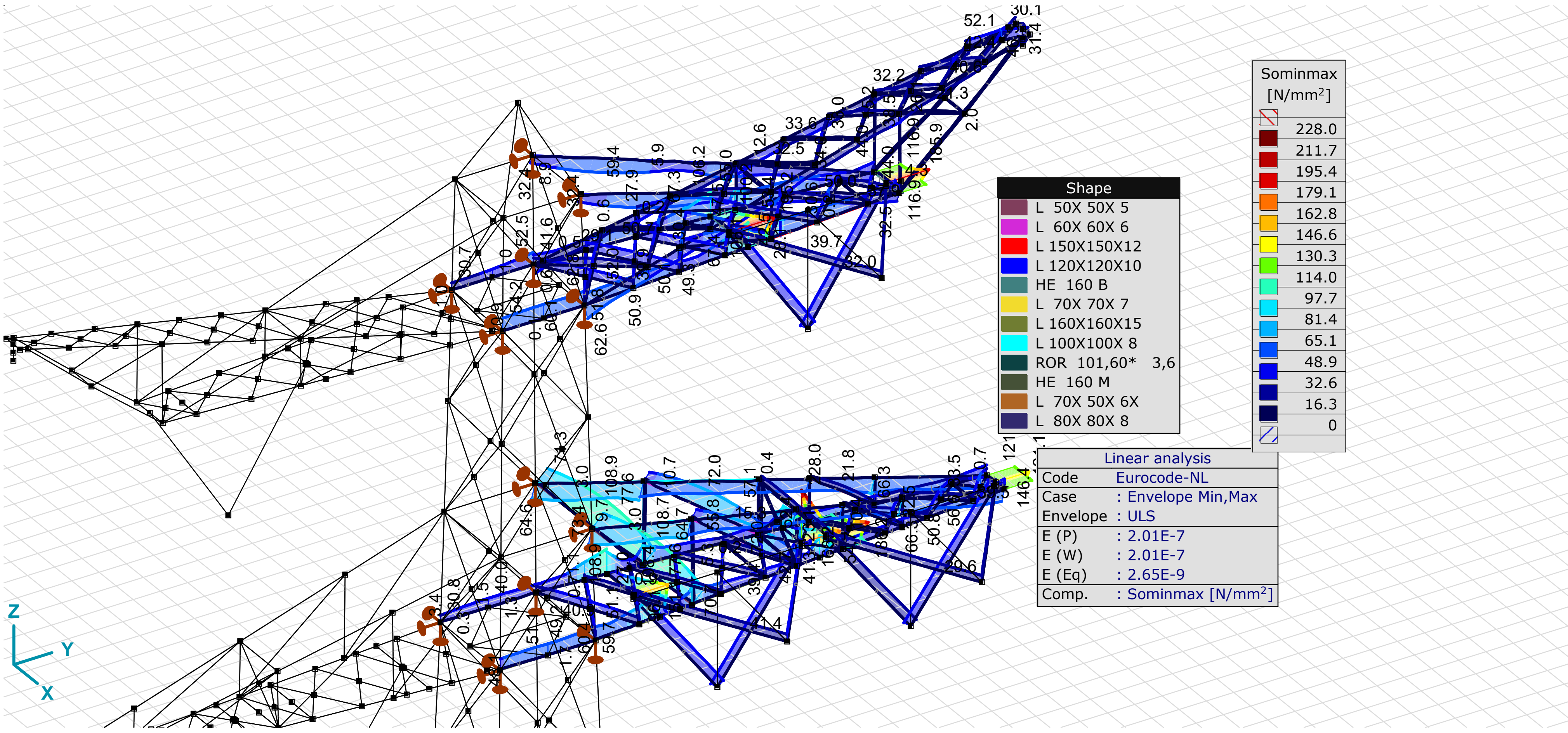
bottom_chords_Linear, Envelope (ULS), My [kNm], Filled diagram



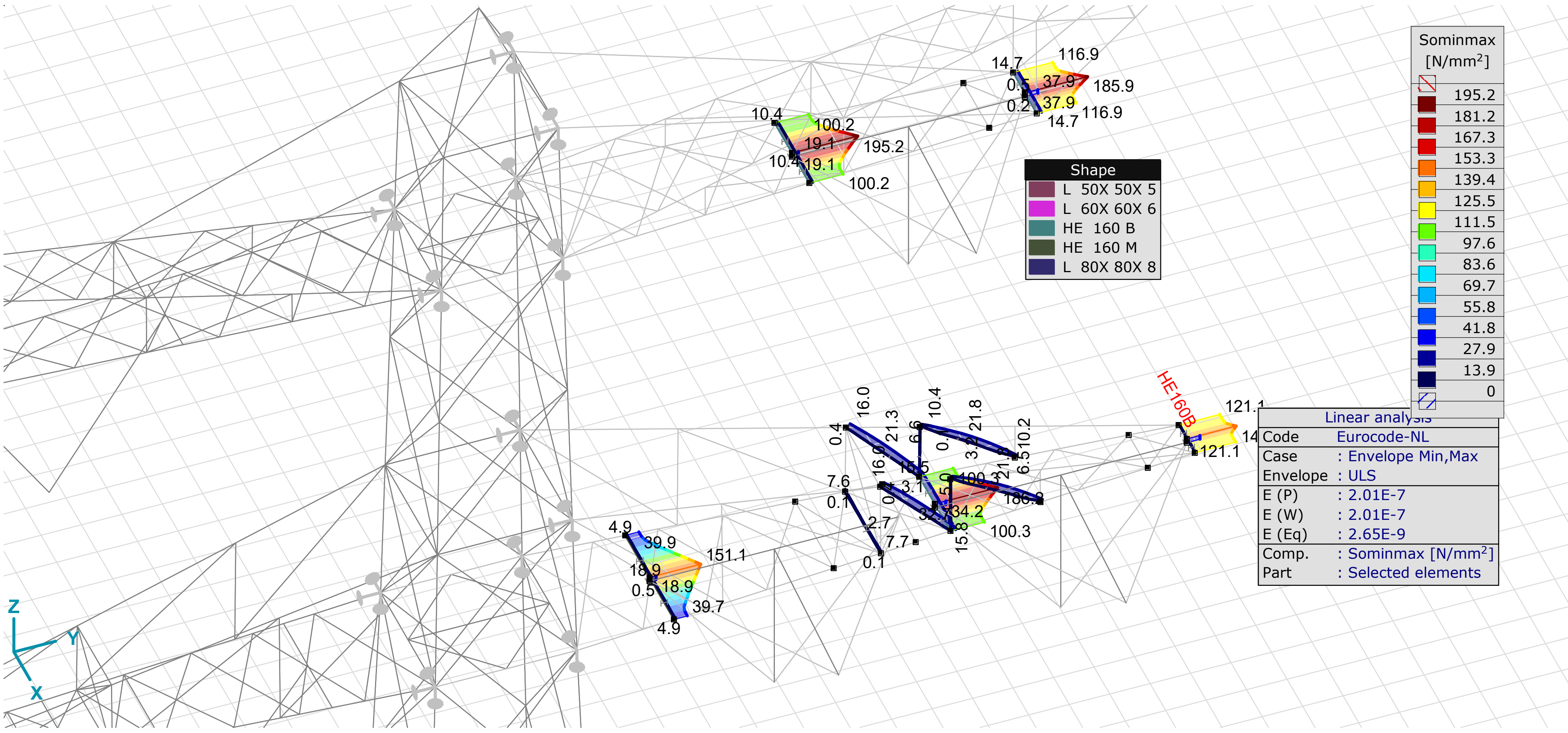
bottom_chords_Linear, Envelope (ULS), Mz [kNm], Filled diagram



bottom_chords_Linear, Envelope (ULS), Nx [kN], Filled diagram



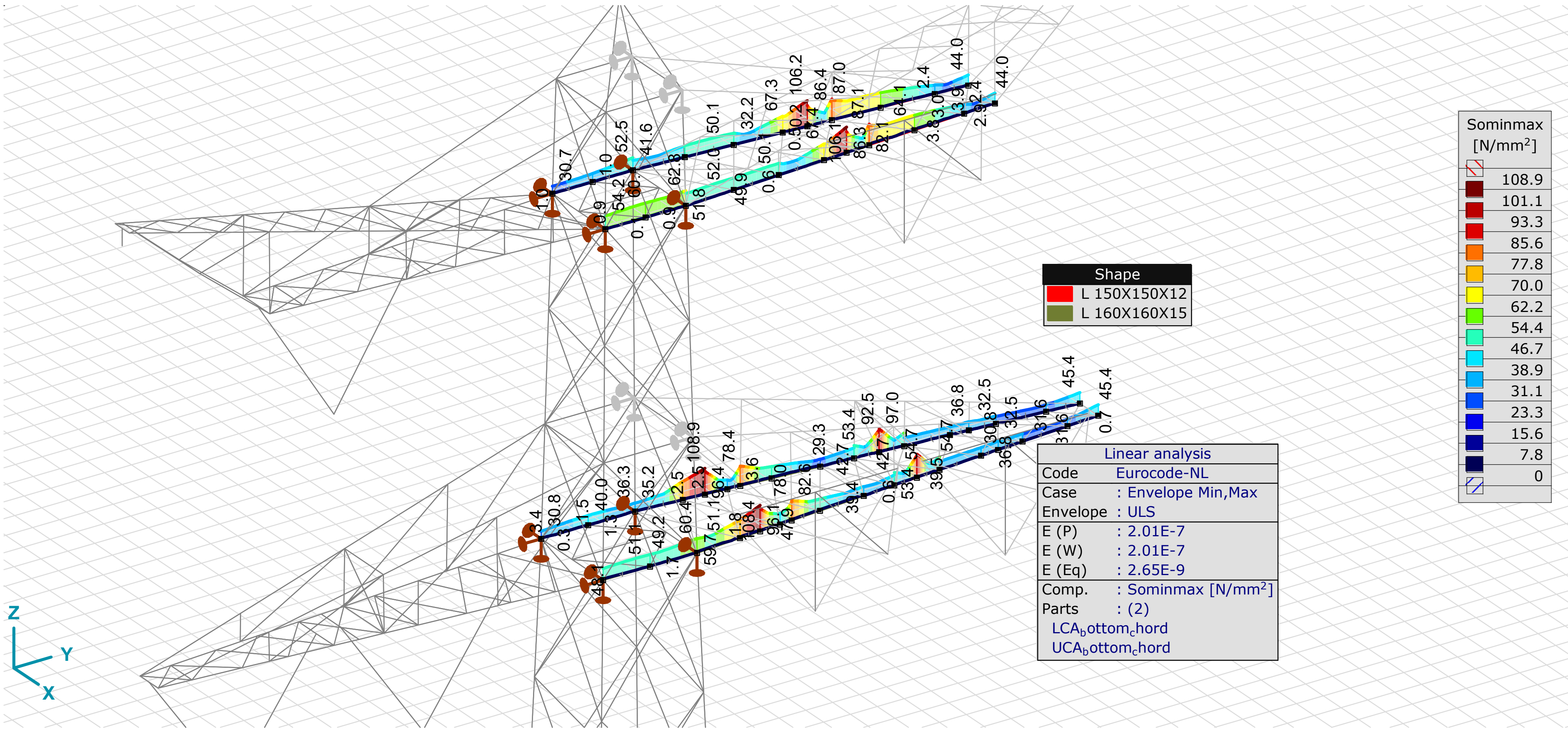
model_Linear, Envelope (ULS), Sominmax [N/mm^2], Filled diagram



new_/_added_members_Linear, Envelope (ULS), Sominmax [N/mm^2], Filled diagram bottom_chord_beam stresses [Linear, Envelope (All ULS), Parts]

	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.															
177	5	L 60X 60X 6	Smin	min	Co #6	1.339	(27)	**−227.8**	93.4	0	8.4	1.4	228.0	0.8	−1.2
178	5	L 60X 60X 6		min	Co #6	0	(27)	**−227.8**	93.4	0	8.4	1.4	227.9	−0.8	1.2
43	7	L 50X 50X 5		max	Co #7	5.523	(171)	**71.2**	71.2	0	0.9	71.2	71.3	0	0.2
238	2	L 150X150X12	Smax	min	Co #9	0	(145)	−54.2	**−54.2**	0	0.3	54.2	54.2	0.1	−0.2
228	9	HE 160 B		max	Co #6	1.114	(68)	−173.5	**170.6**	34.0	58.1	59.0	195.2	3.0	−0.5
229	9	HE 160 B		max	Co #6	0	(68)	−173.5	**170.6**	34.0	58.1	59.0	195.2	−3.0	0.5
1	1	L 160X160X15	Vmin	min	Co #1	0	(172)	−4.5	22.3	**0**	7.3	4.9	23.8	0.5	−1.1
73	9	HE 160 B		max	Co #6	0	(45)	−100.0	101.8	**48.0**	69.8	84.1	146.4	3.1	2.4
74	9	HE 160 B		max	Co #6	0	(46)	0.9	0.9	**48.0**	69.9	83.1	121.1	−3.2	−2.4
232	11	ROR 101,60* 3,6	Vmax	min	Co #4	0	(2)	−1.1	−1.1	0	**0**	1.1	1.1	0	0
73	9	HE 160 B		max	Co #6	0.515	(44)	0.9	0.9	48.0	**69.9**	83.1	121.1	3.2	2.4
74	9	HE 160 B		max	Co #6	0	(46)	0.9	0.9	48.0	**69.9**	83.1	121.1	−3.2	−2.4
252	11	ROR 101,60* 3,6	Somin	min	Co #12	4.642		0	0	0	0	**0**	0	0	0
73	9	HE 160 B		max	Co #6	0	(45)	−100.0	101.8	48.0	69.8	**84.1**	146.4	3.1	2.4
74	9	HE 160 B		max	Co #6	0.515	(45)	−100.0	101.8	48.0	69.8	**84.1**	146.4	−3.1	−2.4
252	11	ROR 101,60* 3,6	Somax	min	Co #3	0	(3)	0	0	0	0	0	**0**	0	0
177	5	L 60X 60X 6		max	Co #6	1.339	(27)	−227.8	93.4	0	8.4	1.4	**228.0**	0.8	−1.2
178	5	L 60X 60X 6		max	Co #6	0	(27)	−227.8	93.4	0	8.4	1.4	**227.9**	−0.8	1.2
260	9	HE 160 B	Vymean	min	Co #10	0	(5)	0.4	0.7	0.1	16.7	0.4	28.9	**−4.7**	−3.5
261	9	HE 160 B		min	Co #9	0	(363)	0	0.7	0.1	14.9	0.2	25.8	**−4.7**	3.1
262	9	HE 160 B		min	Co #10	0	(365)	0.5	0.6	0	16.7	0.5	28.9	**−4.7**	3.5
263	9	HE 160 B		min	Co #11	0	(4)	−0.2	1.3	0.4	17.0	0.6	29.5	**−4.7**	3.5
75	9	HE 160 B		max	Co #6	0.758	(79)	0.6	0.6	45.8	67.5	79.3	116.9	**3.4**	2.3
260	9	HE 160 B	Vzmean	min	Co #5	0	(5)	5.2	5.2	0	18.6	5.2	32.7	0	**−3.9**
262	9	HE 160 B		max	Co #6	0	(365)	6.3	6.3	0	22.5	6.3	39.5	0	**4.8**

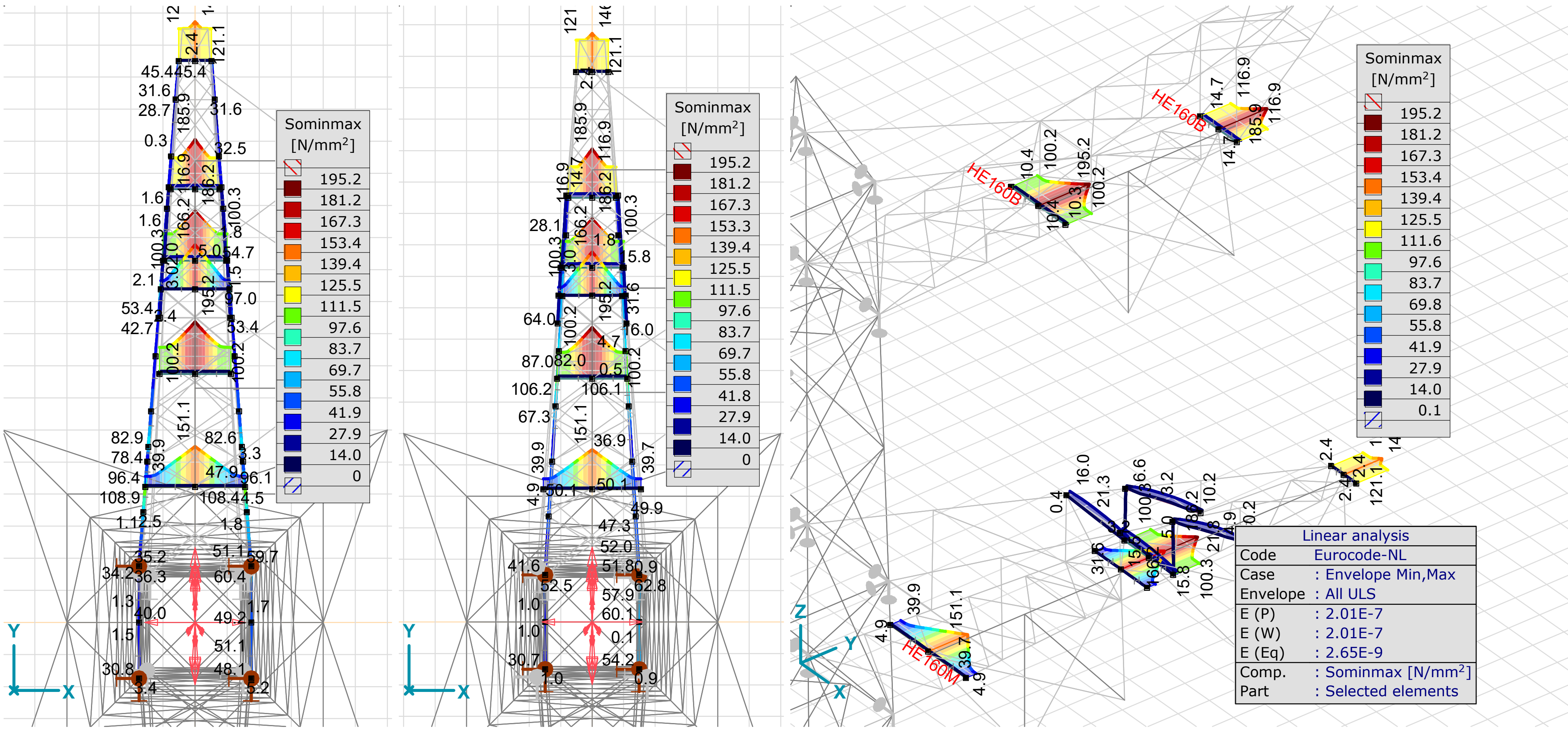
Sh.: Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Smin:** Axial stress cross-Section minimum; **Smax:** Axial stress cross-Section maximum; **Vmin:** Shear stress cross-section minimum; **Vmax:** 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;



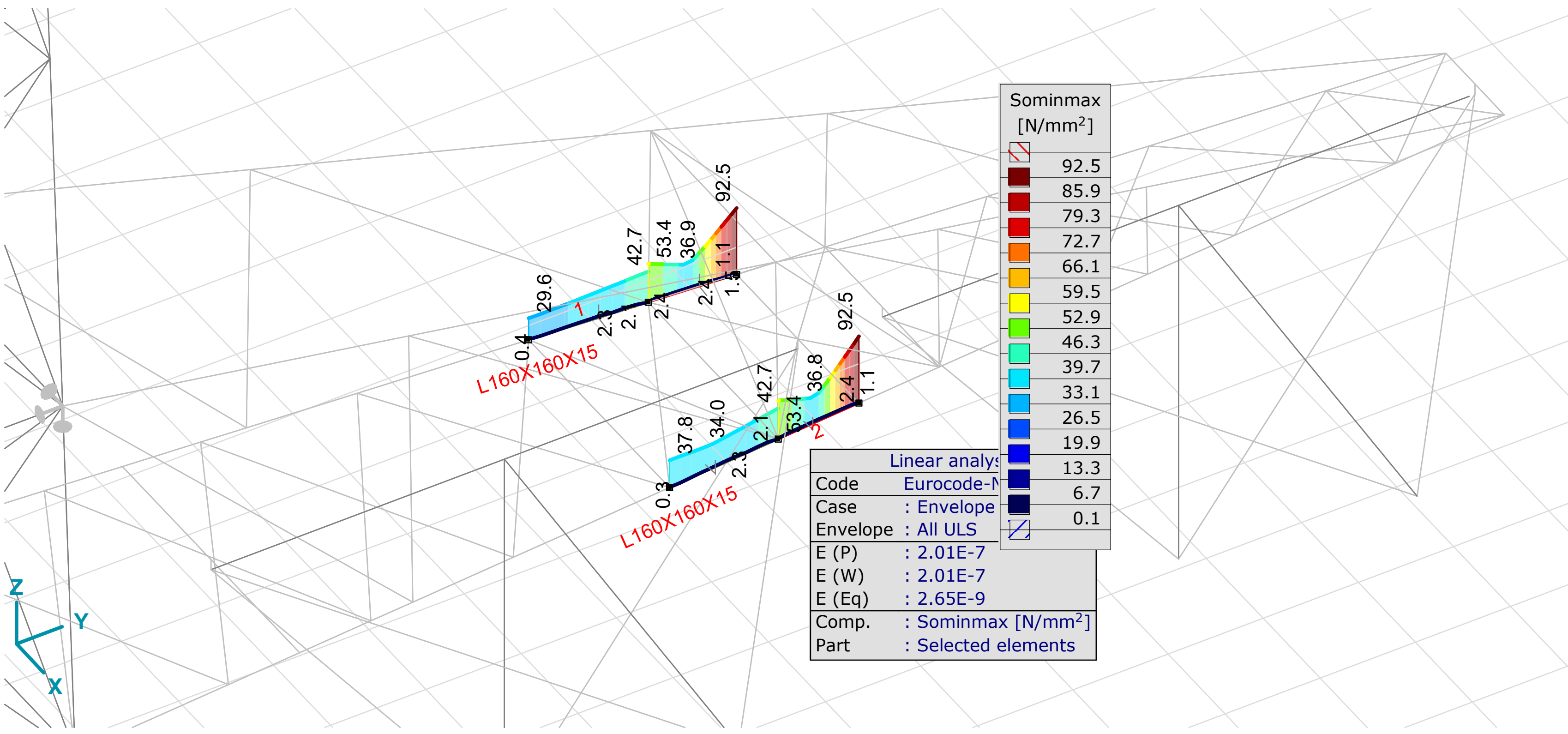
bottom_chords_Envelope (ULS), Sominmax [N/mm^2], Filled diagram added_members_beam stresses [Linear, Envelope (All ULS), S 355]

	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.															
177	5	L 60X 60X 6	Smin	min	Co #6	1.339	(27)	**−227.8**	93.4	0	8.4	1.4	228.0	0.8	−1.2
178	5	L 60X 60X 6		min	Co #6	0	(27)	**−227.8**	93.4	0	8.4	1.4	227.9	−0.8	1.2
43	7	L 50X 50X 5		max	Co #7	5.523	(171)	**71.2**	71.2	0	0.9	71.2	71.3	0	0.2
238	2	L 150X150X12	Smax	min	Co #9	0	(145)	−54.2	**−54.2**	0	0.3	54.2	54.2	0.1	−0.2
228	9	HE 160 B		max	Co #6	1.114	(68)	−173.5	**170.6**	34.0	58.1	59.0	195.2	3.0	−0.5
229	9	HE 160 B		max	Co #6	0	(68)	−173.5	**170.6**	34.0	58.1	59.0	195.2	−3.0	0.5
1	1	L 160X160X15	Vmin	min	Co #1	0	(172)	−4.5	22.3	**0**	7.3	4.9	23.8	0.5	−1.1
73	9	HE 160 B		max	Co #6	0	(45)	−100.0	101.8	**48.0**	69.8	84.1	146.4	3.1	2.4
74	9	HE 160 B		max	Co #6	0	(46)	0.9	0.9	**48.0**	69.9	83.1	121.1	−3.2	−2.4
232	11	ROR 101,60* 3,6	Vmax	min	Co #4	0	(2)	−1.1	−1.1	0	**0**	1.1	1.1	0	0
73	9	HE 160 B		max	Co #6	0.515	(44)	0.9	0.9	48.0	**69.9**	83.1	121.1	3.2	2.4
74	9	HE 160 B		max	Co #6	0	(46)	0.9	0.9	48.0	**69.9**	83.1	121.1	−3.2	−2.4
252	11	ROR 101,60* 3,6	Somin	min	Co #12	4.642		0	0	0	0	**0**	0	0	0
73	9	HE 160 B		max	Co #6	0	(45)	−100.0	101.8	48.0	69.8	**84.1**	146.4	3.1	2.4
74	9	HE 160 B		max	Co #6	0.515	(45)	−100.0	101.8	48.0	69.8	**84.1**	146.4	−3.1	−2.4
252	11	ROR 101,60* 3,6	Somax	min	Co #3	0	(3)	0	0	0	0	0	**0**	0	0
177	5	L 60X 60X 6		max	Co #6	1.339	(27)	−227.8	93.4	0	8.4	1.4	**228.0**	0.8	−1.2
178	5	L 60X 60X 6		max	Co #6	0	(27)	−227.8	93.4	0	8.4	1.4	**227.9**	−0.8	1.2
260	9	HE 160 B	Vymean	min	Co #10	0	(5)	0.4	0.7	0.1	16.7	0.4	28.9	**−4.7**	−3.5
261	9	HE 160 B		min	Co #9	0	(363)	0	0.7	0.1	14.9	0.2	25.8	**−4.7**	3.1
262	9	HE 160 B		min	Co #10	0	(365)	0.5	0.6	0	16.7	0.5	28.9	**−4.7**	3.5
263	9	HE 160 B		min	Co #11	0	(4)	−0.2	1.3	0.4	17.0	0.6	29.5	**−4.7**	3.5
75	9	HE 160 B		max	Co #6	0.758	(79)	0.6	0.6	45.8	67.5	79.3	116.9	**3.4**	2.3
260	9	HE 160 B	Vzmean	min	Co #5	0	(5)	5.2	5.2	0	18.6	5.2	32.7	0	**−3.9**
262	9	HE 160 B		max	Co #6	0	(365)	6.3	6.3	0	22.5	6.3	39.5	0	**4.8**

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;



critical_members_ Linear, Envelope (All ULS), Sominmax [N/mm^2], Filled diagram, x 3



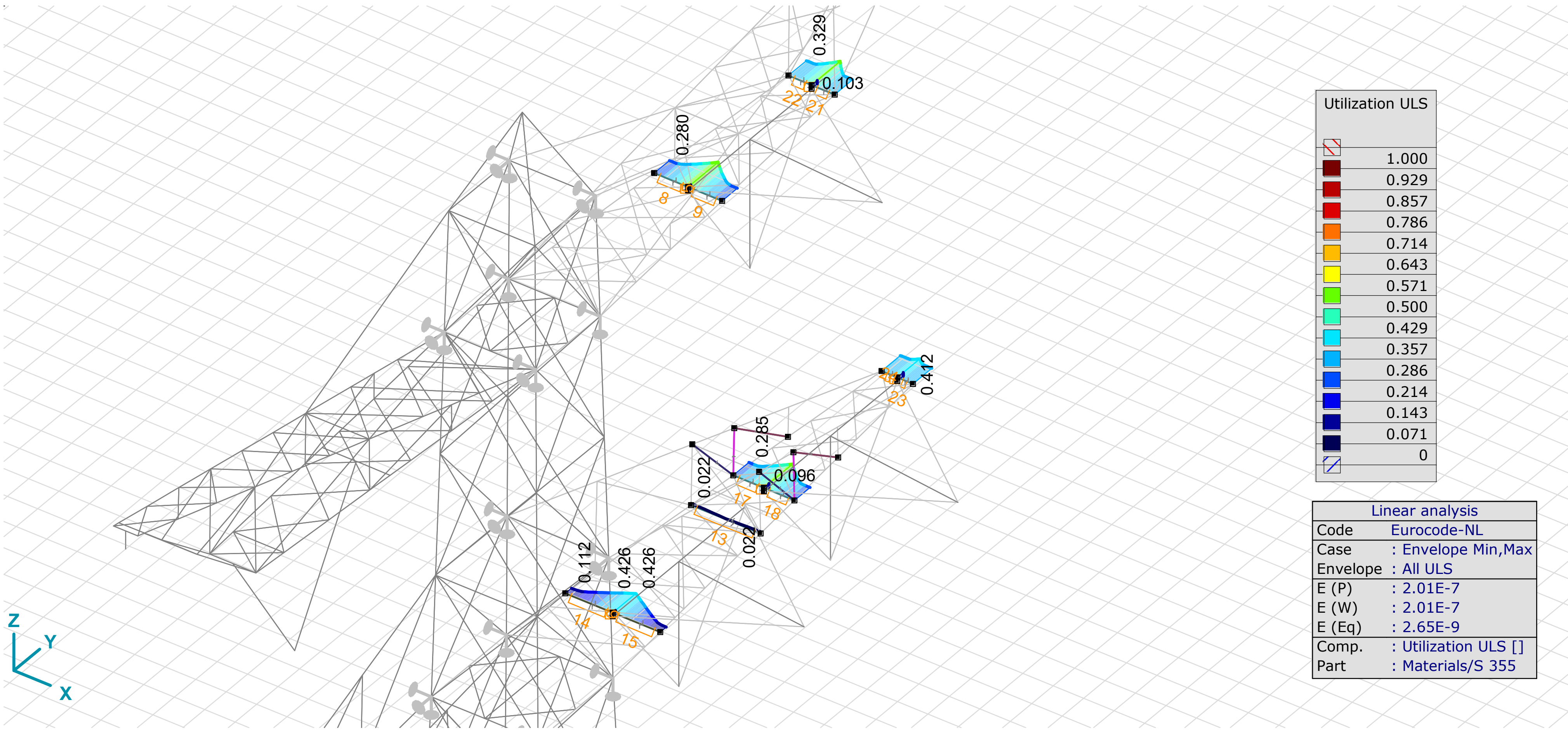
connection_LCA_Linear, Envelope (All ULS), Sominmax [N/mm^2], Filled diagram

Structural member utilization (Eurocode-NL) [Linear, Envelope (All ULS), S 355]

	Design member	Type	Material	Shape	Max. Loc. [m]	Analysis	Max.		Nx [kN]	Vy [kN]	Vz [kN]	Tx [kNm]	My [kNm]	Mz [kNm]	K_y	K_z	K_w
	1(45–365)	(Beam)	S 355	HE 160 B	0	Vz	0.108		34.0	0	25.8	0	0	0	1.000	1.000	1.000
	2(80–363)	(Beam)	S 355	HE 160 B	0	Vz	0.103		36.4	0	24.7	0	0	0	1.000	1.000	1.000
	4(5–30)	(Beam)	S 355	HE 160 B	0.115	N-M-V	0.096		2.9	−25.7	−19.1	0	−2.2	3.0	1.000	1.000	1.000
	5(57–68)	(Beam)	S 355	HE 160 M	0	Vz	0.051		−33.3	0	22.5	0	0	0	1.000	1.000	1.000
	6(3–10)	(Beam)	S 355	HE 160 M	0	Vz	0.051		29.9	0	−22.4	0	0	0	1.000	1.000	1.000
	8(67–68)	(Beam)	S 355	HE 160 B	0	N-M-V	0.550		−7.8	−16.5	2.7	−1.3	−3.0	−18.0	1.000	1.000	1.000
	9(69–68)	(Beam)	S 355	HE 160 B	1.114	N-M-V	0.550		−7.8	16.5	−2.7	1.3	−3.0	−18.0	1.000	1.000	1.000
	13(24–25)	(Beam)	S 355	HE 160 B	0	N-M-V	0.022		7.7	0.6	−0.6	0	0	0.7	1.000	1.000	1.000
	14(9–10)	(Beam)	S 355	HE 160 M	0	N-M-V	0.426		12.3	15.0	−11.2	1.3	17.4	24.5	1.000	1.000	1.000
	15(11–10)	(Beam)	S 355	HE 160 M	1.556	N-M-V	0.426		12.3	−15.0	11.2	−1.3	17.4	24.5	1.000	1.000	1.000
	17(29–30)	(Beam)	S 355	HE 160 B	0	N-M-V	0.525		4.4	14.1	−10.7	1.2	10.7	14.4	1.000	1.000	1.000
	18(31–30)	(Beam)	S 355	HE 160 B	1.003	N-M-V	0.525		4.4	−14.1	10.7	−1.2	10.7	14.4	1.000	1.000	1.000
	21(80–81)	(Beam)	S 355	HE 160 B	0.758	N-M-V	0.524		3.3	−18.2	−12.3	1.4	−9.3	14.0	1.000	1.000	1.000
	22(80–79)	(Beam)	S 355	HE 160 B	0	N-M-V	0.524		3.3	18.2	12.3	−1.4	−9.3	14.0	1.000	1.000	1.000
	23(45–46)	(Beam)	S 355	HE 160 B	0.515	N-M-V	0.412		5.0	−17.0	−12.9	1.5	−6.7	8.8	1.000	1.000	1.000
	24(45–44)	(Beam)	S 355	HE 160 B	0	N-M-V	0.412		5.0	17.0	12.9	−1.5	−6.7	8.8	1.000	1.000	1.000
	9(69–68)	(Beam)	S 355	HE 160 B	1.114	N-M-V	0.550		−7.8	16.5	−2.7	1.3	−3.0	−18.0	1.000	1.000	1.000

	Design member	Z_a	C_1	C_2	C_3	Curve class N	χ_N	Curve class LT	χ_{LT}	a [m]	Case
	1(45–365)	0.500	—	—	—	c	1.000	b	0		Co #6
	2(80–363)	0.500	—	—	—	c	1.000	b	0		Co #6
	4(5–30)	0.500	—	—	—	c	1.000	b	1.000		Co #10
	5(57–68)	0.500	—	—	—	c	1.000	b	0		Co #6
	6(3–10)	0.500	—	—	—	c	1.000	b	0		Co #5
	8(67–68)	0.500	—	—	—	c	0.918	b	1.000		Co #6
	9(69–68)	0.500	—	—	—	c	0.918	b	1.000		Co #6
	13(24–25)	0.500	—	—	—	c	1.000	b	1.000		Co #11
	14(9–10)	0.500	—	—	—	c	1.000	b	1.000		Co #5
	15(11–10)	0.500	—	—	—	c	1.000	b	1.000		Co #5
	17(29–30)	0.500	—	—	—	c	1.000	b	1.000		Co #5
	18(31–30)	0.500	—	—	—	c	1.000	b	1.000		Co #5
	21(80–81)	0.500	—	—	—	c	1.000	b	1.000		Co #6
	22(80–79)	0.500	—	—	—	c	1.000	b	1.000		Co #6
	23(45–46)	0.500	—	—	—	c	1.000	b	1.000		Co #6
	24(45–44)	0.500	—	—	—	c	1.000	b	1.000		Co #6
	9(69–68)	0.500	—	—	—	c	0.918	b	1.000		Co #6

Design member: Design member (endpoint nodes); **Shape:** Cross-section; **Max. Loc.:** Maximum Location; **Analysis:** Analysis resulting the maximum value; **Max.:** Maximum Value; **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; **K_y, K_z, K_w, Z_a, C_1, C_2, C_3, Curve class N, χ_N, Curve class LT, χ_{LT}, a:** Design parameters; **Case:** Load case of extreme;



[Stl], > S 355, Linear, Envelope (All ULS), Utilization ULS [], Filled diagram

OVER DNV GL

DNV GL is een wereldwijd bedrijf voor kwaliteitsborging en risicobeheer. Vanuit haar streven leven, bezit en het milieu te beschermen stelt DNV GL organisaties in staat de veiligheid en duurzaamheid van hun activiteiten te bevorderen. DNV GL biedt classificering en technische borging, naast software en onafhankelijk, deskundig advies voor de maritieme, de olie- en gasindustrie, energiecentrales en de duurzame energiesector. Daarnaast biedt het bedrijf certificeringsservices en datamanagement voor klanten in uiteenlopende sectoren. Onze medewerkers zijn actief in meer dan 100 landen over de hele wereld en streven ernaar klanten te helpen de wereld veiliger, slimmer en groener te maken.

Bijlage 15 Rapportage Mastconstructie S+6

“TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380”

KIJ-GT380 – Rapportage mast S+6

TenneT TSO B.V.

Meridian doc. nr.: 002.589.40 0916502
Rapport nr.: 21-1088 Rev.0
Datum: 2021-07-05

Projectnaam:	"Toetsing en herontwerp masten en fundaties BBB380"	DNV GL - Energy Energy Advisory Postbus 9035 6800 ET ARNHEM
Rapport titel:	KIJ-GT380 – Rapportage mast S+6	
Klant:	TenneT TSO B.V.	
Contactpersoon:	[redacted]	
Datum:	2021-07-05	
Project nr.:	10166260	[redacted]
Organisatie unit:	TDT	
Meridian doc.nr.:	002.589.40 0916502	
Rapport nr.:	21-1088 Rev.0	

Geschreven door:	Beoordeeld door:	Goedgekeurd door:

[redacted]

DNV GL Distributie:

☐ Onbeperkte distributie (intern en extern)
☐ Onbeperkte distributie binnen de DNV GL Groep
☐ Onbeperkte distributie binnen DNV GL Netherlands B.V.
☒ Geen distributie (vertrouwelijk)

Trefwoorden:

Versie	Datum	Reden voor uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2021-07-05	Eerste uitgave	[redacted]	[redacted]	[redacted]

DNV GL Netherlands B.V.

Inhoud

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 GL 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

In deze studie wordt voor de lijn Krimpen aan den IJssel - Geertruidenberg de controle van de mastconstructie van masttype S+6 gerapporteerd.

Inhoudelijk is de Nederlandse versie van de rapportage 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.

1.2 Doelstelling en scope van dit rapport

Het doel van deze studie is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de ACCCZ-Warsaw geleider.

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 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 Krimpen aan den IJssel - Geertruidenberg" [1].

1.3.2 E-studie deel 1

In de rapportage "KIJ-GT380 - E-studie deel 1" [2] is bepaald welke aanpassingen benodigd zijn om de ACCCZ Warsaw geleider toe te passen binnen de verbinding Krimpen aan den IJssel - Geertruidenberg. Uit de E-studie volgen geen zaken die relevant zijn voor de constructie van masttype S+6.

1.3.3 Uitgangspunten rapport

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport "Uitgangspuntenrapport 380kV verbinding Krimpen aan den IJssel - Geertruidenberg" [3]

2 EISEN

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

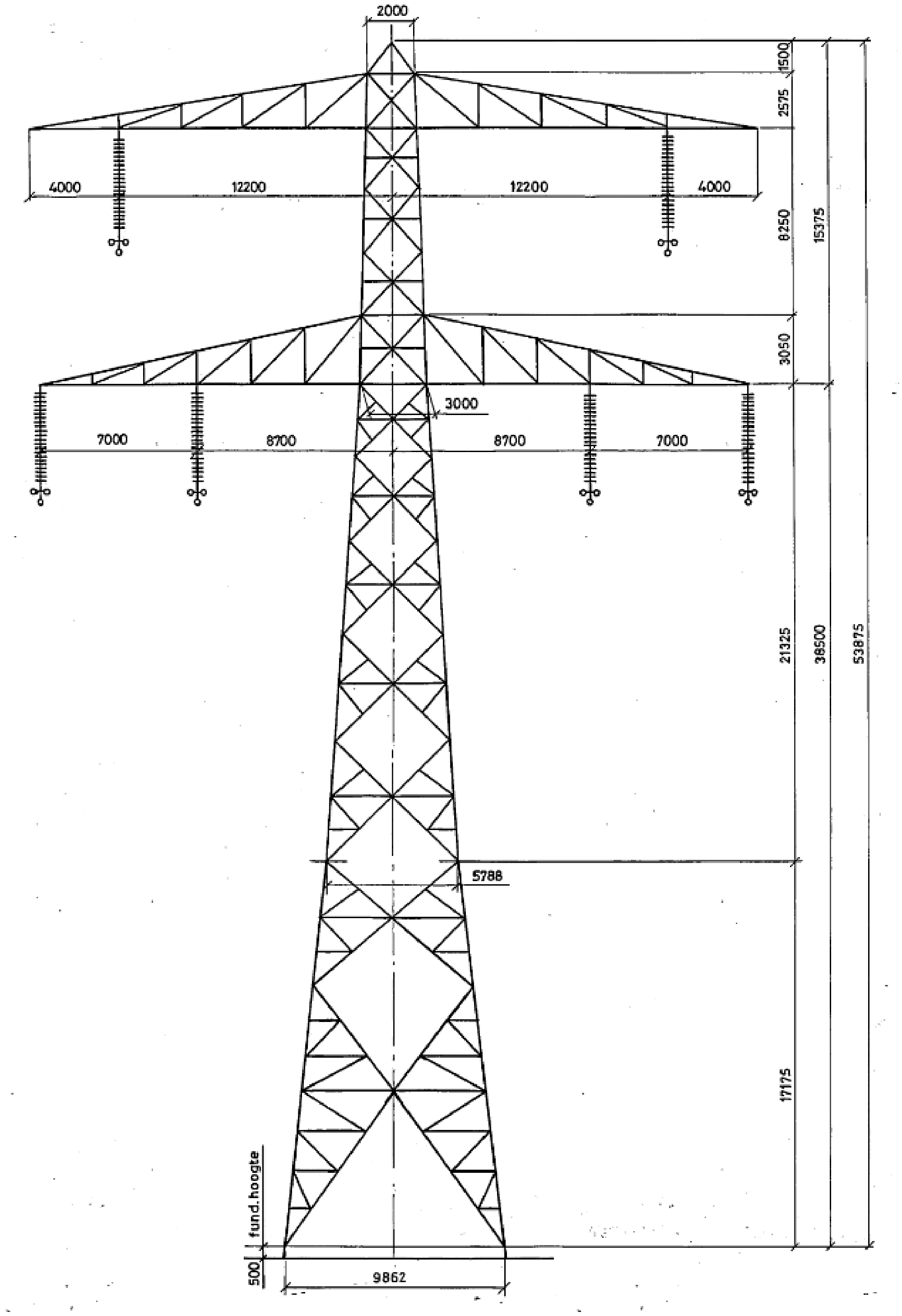
Tabel 1 Relevante eisen

Eis Id	Titel	Eis Tekst	Bewijsvoering
BO Eis: H2.7-6	Omgeving, beperkings factoren	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 1060:1977. 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 1060:1977.	Tabel 6

3 BEREKENINGEN

3.1 Mastbeeld

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



Figuur 1 Mastbeeld

3.2 Mastenlijst

In deze rapportage wordt masttype S+6 getoetst. De berekening is uitgevoerd voor windgebied II, er zijn geen masten van dit type in windgebied III. De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven. Het maatgevende mastnummer is aangegeven. Bij de masten is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde). Voor masttype S+6 komen enkel lager aangrenzende masten voor.

Tabel 2 Mastnummers

Mastnummer	Masttype	Maatgevend mastnummer	Wind span (m)	Weight span (m)	Hoogteverschil
4	S+6 II	10	346	369	5.6
5	S+6 II	10	338	361	6.0
9	S+6 II	10	366	391	5.6
10	S+6 II	10	367	392	5.8
27	S+6 II	10	358	381	6.1
28	S+6 II	10	355	377	5.8
43	S+6 II	10	267	288	5.7
44	S+6 II	10	262	284	5.8

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

3.4 Proces stappen

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

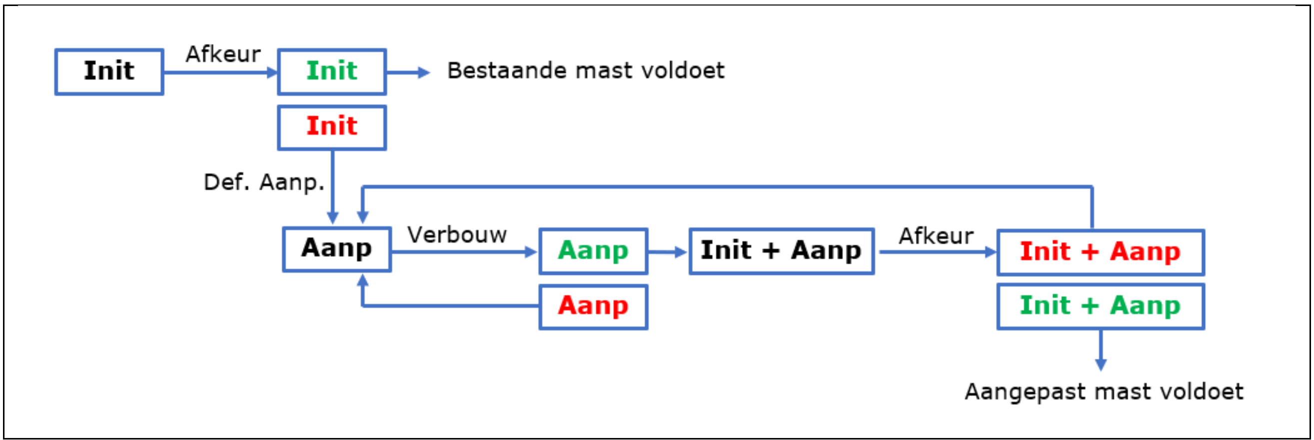
Stap 1: Toets bestaande (Init) mast op Afkeur

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 geleiderbelastingenprogramma van DNV GL. 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

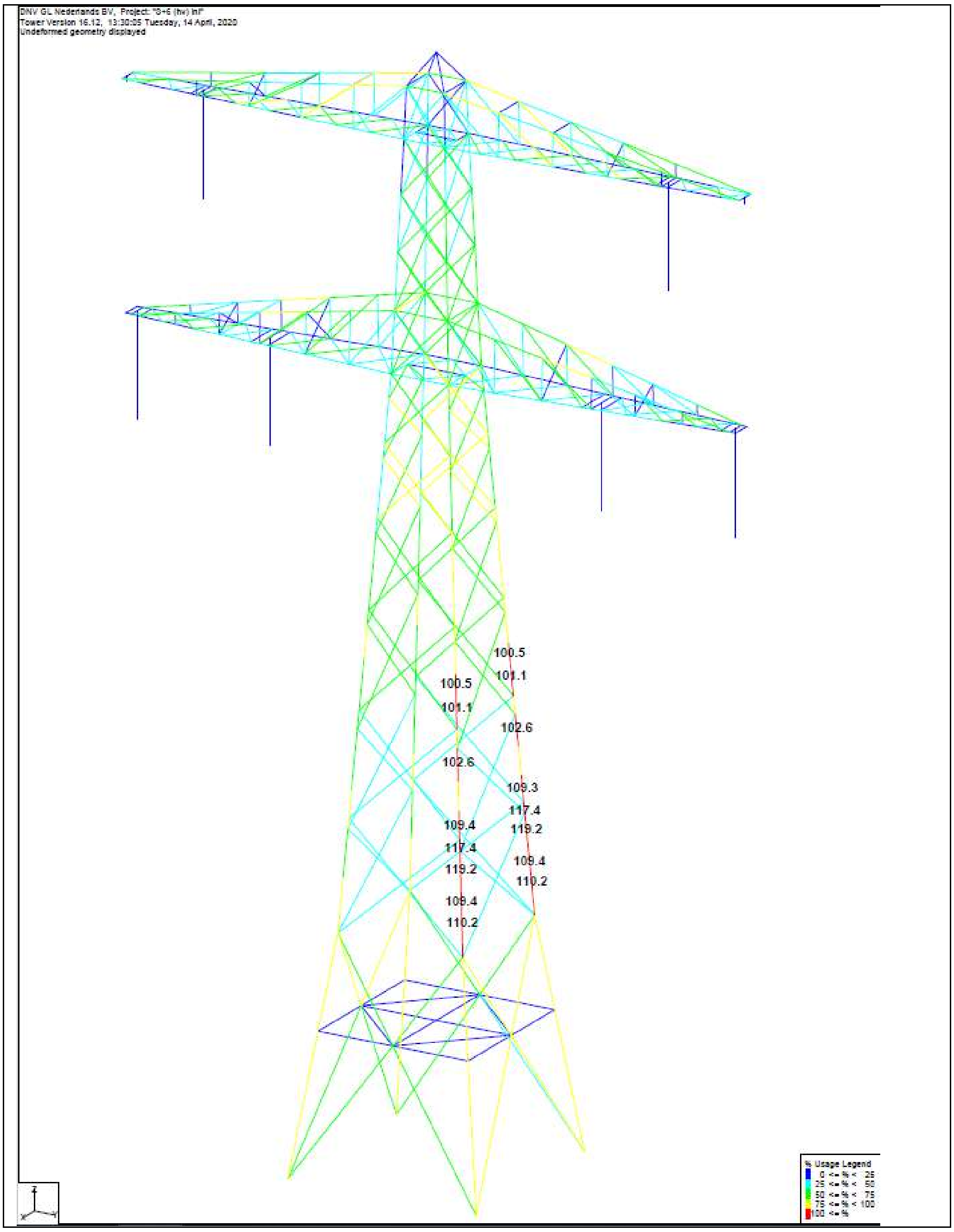
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten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

Het resultaat van de controle van de mastconstructie type S+6 met belastingen op afkeurniveau is weergegeven in onderstaande figuren.



Figuur 3 Resultaat PLS-TOWER S+6

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
Knikverkorters		**Voldoen niet**	Appendix C
Ankers en voetplaat		**Voldoen niet**	Appendix D

5 AANPASSINGEN

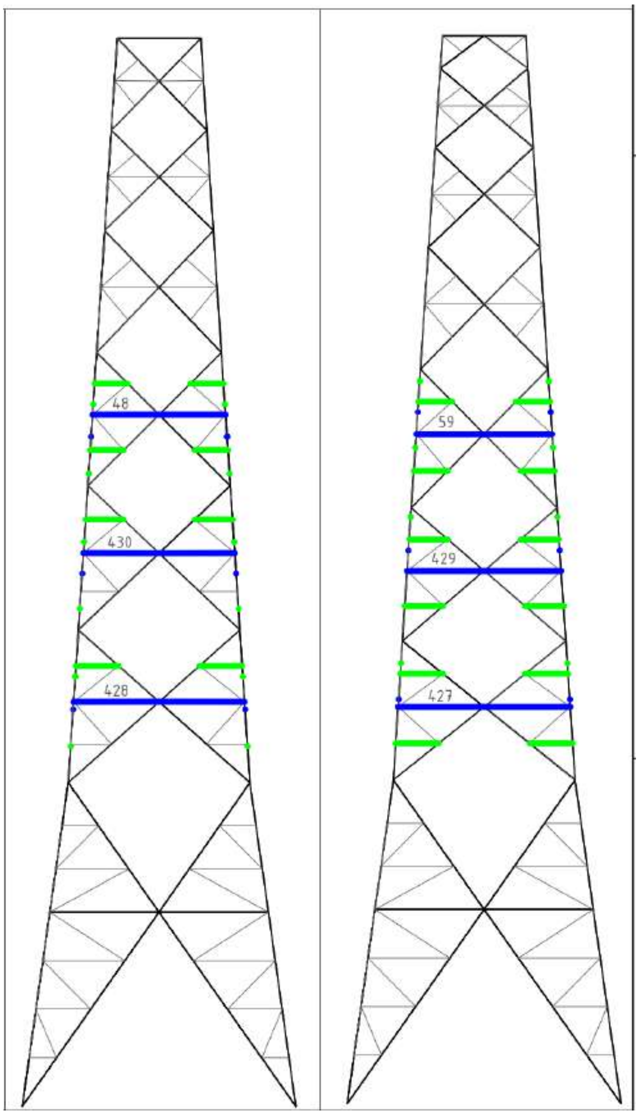
5.1 Inleiding

Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen en nieuwe onderdelen aan verbouwniveau is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Knikverkorters vervangen;
- Knikverkorters toevoegen;
- Bouten vervangen;
- Voetplaat verzwaren.

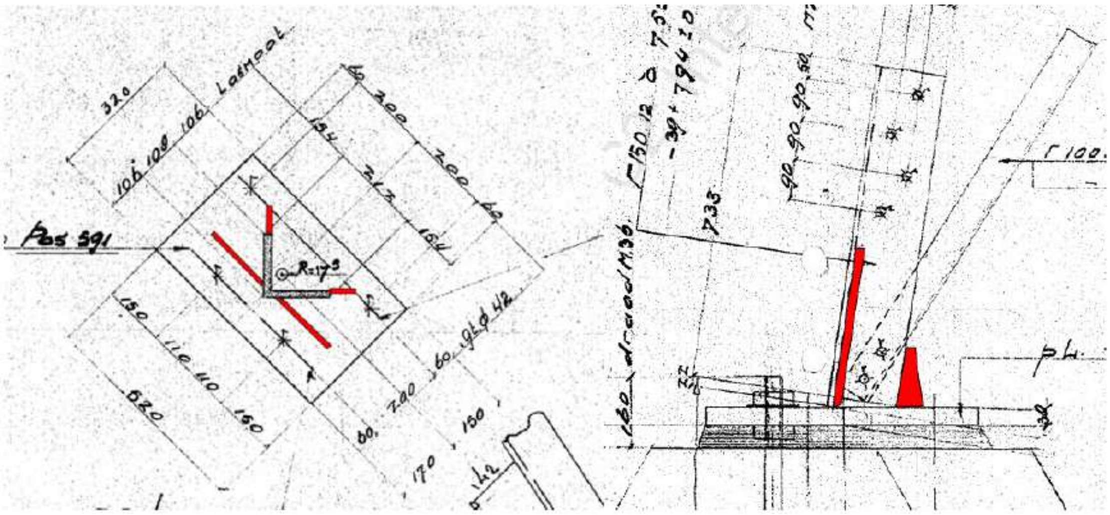
5.2 Aanpassingen

Voor berekening, zie Appendix C. Voor afmetingen profielen en bouten, zie Appendix E. De benodigde aanpassingen zijn weergegeven in Figuur 4.



Figuur 4 Principe aanpassing (blauw) /en toevoeging (groen) knikverkorters voor S+6

De voetplaat van masttype S+6 moet verzwaard worden. Een aanpassingsvoorstel voor de voetplaat en ankers is de voetplaat versterken met in het werk aan te lassen verstijvingsplaten. Zie hiervoor Figuur 5. Voor de berekening van de ankerverbinding zie Appendix D.



Figuur 5 Principe van te versterken ankerplaat

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen is voor mast 10 gegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen. Ook de benodigde onderdelen voor de verbinding van de postisolator zijn niet in de tabel opgenomen. Voor mast 61 zijn geen constructieve aanpassingen benodigd, behalve de toepassing van postisolatoren.

Tabel 5 Gewichten S+6 (10) van toegevoegde knikverkorters en uitgewisselde profielen

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
428	L50.5	S235	1M12-5.6t	L65.6	S355	1M12-8.8t	Profiel uitgewisseld	4	2.99	72.0
427	L50.5	S235	1M12-5.6t	L65.6	S355	1M12-8.8t	Profiel uitgewisseld	4	3.10	74.7
430	L45.5	S235	1M12-5.6t	L55.6	S355	1M12-8.8t	Profiel uitgewisseld	4	2.64	53.3
48	L45.5	S235	1M12-5.6t	L50.5	S355	1M12-8.8t	Profiel uitgewisseld	4	2.32	35.6
429	L45.5	S235	1M12-5.6t	L60.6	S355	1M12-8.8t	Profiel uitgewisseld	4	2.78	61.5
59	L45.5	S235	1M12-5.6t	L50.5	S355	1M12-8.8t	Profiel uitgewisseld	4	2.37	36.4
6001				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.55	23.8
6002				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.36	20.9
6003				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.20	18.4
6004				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.20	18.4
6005				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.55	23.8
6006				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.55	23.8
6007				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.40	21.5
6008				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.40	21.5
6009				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.23	18.9
6010				L50.5	S355	1M16-8.8t	Profielen toegevoegd	4	1.23	18.9
								64	29.87	543.5

5.3 Eisen verificatie

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. De verstijving van de voetplaat vereist in het werk lassen. Vanwege de locatie op de grond is dit uitvoerbaar en een bewezen oplossing.
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 1060:1964?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.589.40 0817486 - 20-0473 - Verificatie & validatieplan 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

[2] „002.589.40 0808624 - 20-0472 - E-studie deel 1 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

[3] „002.589.40 0808629 - 20-0345 - Uitgangspuntenrapport 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

APPENDIX A CONDUCTOR LOADS

Content

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

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	II
Wind speed	27 m/s
Terrain categorie	II
Reduction factor C_{dir}	1,00
Ice region	B
Tower type	Steunmast
Tower height	54 m
Max. Span	375 m
Line angle	180°
Catenary	1400 m
Wind span	367 m
EDS Weight span	391 m
Min. Weight span	388 m
Max. Weight span	431 m

Client:

Title:

Berekening masttype S+6 II

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

Document name:

KIJ-GT_S+6 II_10_Report.pdf

Project number:

Project client number:

0.0

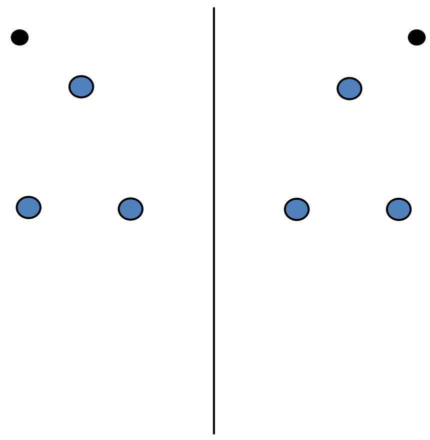
Project: KIJ-GT
Tower: S+6 II
Number: 10

Conductor loads

Auteur: TBR
Versie: v11.3

General

Description	S+6 II
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	II
Wind speed	27,0 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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Halfverankering	2,00	4,30	1,00
Circuit 2	Halfverankering	2,00	4,30	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,50	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,50	0,05

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	21	380ct1f1	34,2 m	38,5 m	15,7 m
Circuit 1	20	380ct1f2	34,2 m	38,5 m	8,7 m
Circuit 1	22	380ct1f3	45,5 m	49,8 m	12,2 m
Circuit 2	10	380ct2f1	34,2 m	38,5 m	-15,7 m
Circuit 2	11	380ct2f2	34,2 m	38,5 m	-8,7 m
Circuit 2	12	380ct2f3	45,5 m	49,8 m	-12,2 m
Bliksemdraad 1	1	bl1	49,3 m	49,8 m	16,2 m
Bliksemdraad 2	3	bl2	49,3 m	49,8 m	-16,2 m

1. *Positive = adjacent mast higher*
2. *Positive = in direction of rotation coordinate system x => y*

Project: KIJ-GT
Tower: S+6 II
Number: 10

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

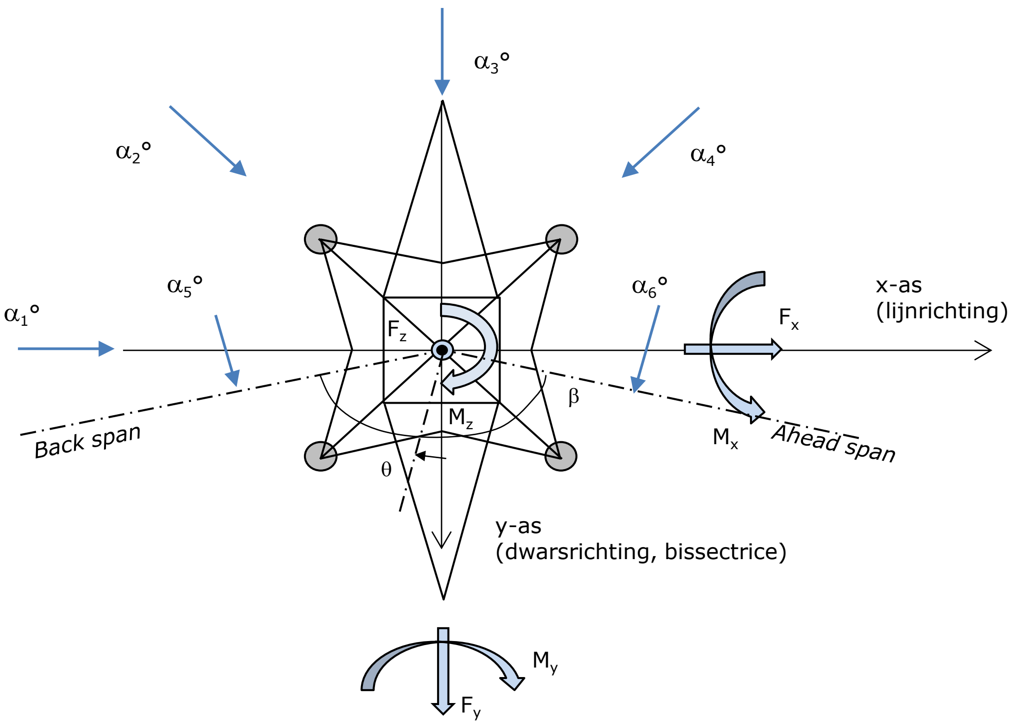
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	21	380ct1f1	0,0	-6,5 m	0,0	0,0 m
Circuit 1	20	380ct1f2	0,0	-6,5 m	0,0	0,0 m
Circuit 1	22	380ct1f3	0,0	-6,5 m	0,0	0,0 m
Circuit 2	10	380ct2f1	0,0	-6,5 m	0,0	0,0 m
Circuit 2	11	380ct2f2	0,0	-6,5 m	0,0	0,0 m
Circuit 2	12	380ct2f3	0,0	-6,5 m	0,0	0,0 m
Bliksemdraad 1	1	bl1	0,0	-6,2 m	0,0	0,0 m
Bliksemdraad 2	3	bl2	0,0	-6,2 m	0,0	0,0 m

Line and tower data

		Back	Ahead
		358,0	375,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		369,2	369,2 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		1107	1107 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: KIJ-GT
Tower: S+6 II
Number: 10

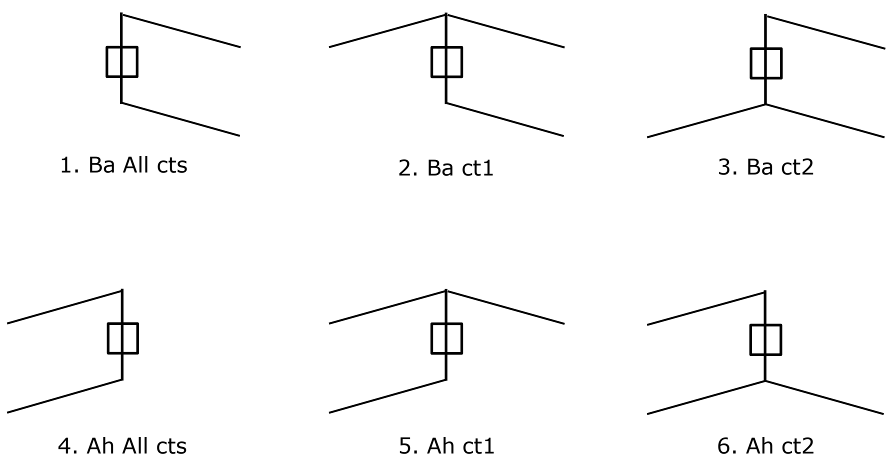
Absence of conductors

		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

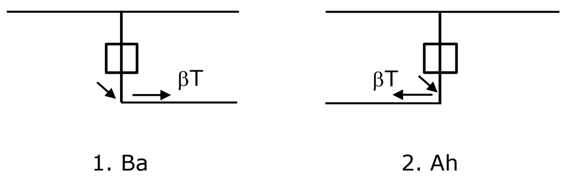
Principle of load situations:



Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1, design assumption is symmetry back and ahead

Principle of load situations:



Project: KIJ-GT
Tower: S+6 II
Number: 10

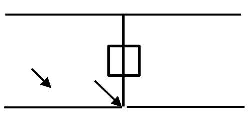
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine 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

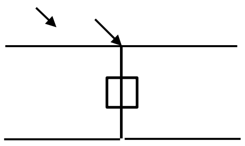
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

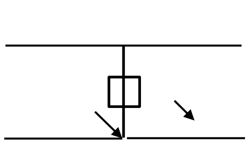
Principle of load situations:



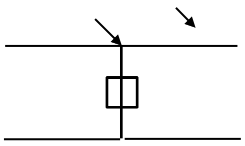
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

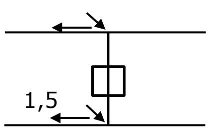
Load situations 8. Galloping as a static load

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

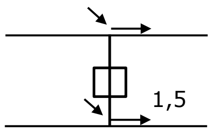
Considered situations galloping 8: None (existing structure)

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

DNV·GL

Project: KIJ-GT
Tower: S+6 II
Number: 10

Tower structure

Properties

Tower type	Steunmast	
Tower designation	S+6 II	
Base plate w.r.t. ground level	0,5	m
Tower height w.r.t. base plate	54,0	m
Tower self weight	250,0	kN

Width and slope at foundation	x-ri.	y-ri.	
Leg spread	9,86	9,86	m
Inclination of main leg	0,142	0,142	-
Horizontal force factor	1,4	1,4	-

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 1	11,67	9,86	6,55	11,67	0,142	95,74	9,11	0,10	3,43
Middenstuk 1	27,18	6,55	4,50	15,51	0,066	85,66	11,31	0,13	3,24
Middenstuk 2	38,50	4,50	3,00	11,32	0,066	42,44	8,60	0,20	2,92
Bovenstuk 1	44,37	3,00	2,56	5,87	0,037	16,32	4,16	0,25	2,70
Bovenstuk 2	52,38	2,56	2,00	8,01	0,035	18,26	5,10	0,28	2,61
Topstuk	53,88	2,00		1,50		1,50	0,38	0,25	2,71
Ondertraverse	38,50	14,20		3,05		21,66	4,63	0,21	2,87
Boventraverse	49,80	15,10		2,58		19,48	4,63	0,24	2,77

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 1	11,67	9,86	6,55	11,67	0,142	95,74	9,11	0,10	3,43
Middenstuk 1	27,18	6,55	4,50	15,51	0,066	85,66	11,31	0,13	3,24
Middenstuk 2	38,50	4,50	3,00	11,32	0,066	42,44	8,60	0,20	2,92
Bovenstuk 1	44,37	3,00	2,56	5,87	0,037	16,32	4,16	0,25	2,70
Bovenstuk 2	52,38	2,56	2,00	8,01	0,035	18,26	5,10	0,28	2,61
Topstuk	53,88	2,00		1,50		1,50	0,38	0,25	2,71
Ondertraverse	38,50	14,20		3,05		21,66	4,63	0,21	2,87
Boventraverse	49,80	15,10		2,58		19,48	4,63	0,24	2,77

Note: Surface transverse direction is reduced in calculation.

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Project: KIJ-GT
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Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
Bovenstuk 1			
Bovenstuk 2			

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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 1	0,85	26,6	22,6	0,0	-22,6	5,8	155,3	131,8	0,0	-131,8
Middenstuk 1	1,06	38,8	32,9	0,0	-32,9	19,4	753,3	639,2	0,0	-639,2
Middenstuk 2	1,23	30,9	26,2	0,0	-26,2	32,8	1015,1	861,4	0,0	-861,4
Bovenstuk 1	1,31	14,8	12,5	0,0	-12,5	41,4	611,4	518,8	0,0	-518,8
Bovenstuk 2	1,37	18,2	15,4	0,0	-15,4	48,4	880,4	747,1	0,0	-747,1
Topstuk	1,40	1,4	1,2	0,0	-1,2	53,1	76,6	65,0	0,0	-65,0
Ondertraverse	1,30	34,4	20,5	0,0	-20,5	39,5	1361,1	808,5	0,0	-808,5
Boventraverse	1,38	35,5	21,1	0,0	-21,1	50,7	1799,5	1068,8	0,0	-1068,8
Totaal		200,7	152,5	0,0	-152,5		6652,8	4840,5	0,0	-4840,5

Tower section loads longitudinal (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 1	0,85	0,0	22,6	26,6	22,6	5,8	0,0	131,8	155,3	131,8
Middenstuk 1	1,06	0,0	32,9	38,8	32,9	19,4	0,0	639,2	753,3	639,2
Middenstuk 2	1,23	0,0	26,2	30,9	26,2	32,8	0,0	861,4	1015,1	861,4
Bovenstuk 1	1,31	0,0	12,5	14,8	12,5	41,4	0,0	518,8	611,4	518,8
Bovenstuk 2	1,37	0,0	15,4	18,2	15,4	48,4	0,0	747,1	880,4	747,1
Topstuk	1,40	0,0	1,2	1,4	1,2	53,1	0,0	65,0	76,6	65,0
Ondertraverse	1,30	0,0	20,5	13,8	20,5	39,5	0,0	808,5	544,4	808,5
Boventraverse	1,38	0,0	21,1	14,2	21,1	50,7	0,0	1068,8	719,8	1068,8
Total		0,0	152,5	158,7	152,5		0,0	4840,5	4756,4	4840,5

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	250	0	0	0
Windrichting 0°	201	0	0	0	6653	0
Windrichting 45°	152	152	0	4841	4841	0
Windrichting 90°	0	159	0	4756	0	0
Windrichting 135°	-152	152	0	4841	-4841	0

Project: KIJ-GT
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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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,3	1,0	36,85	1,27	1,2	1,53
380ct1f2	2,00	1	2	4,3	1,0	36,85	1,27	1,2	1,53
380ct1f3	2,00	1	2	4,3	1,0	48,15	1,37	1,2	1,64
380ct2f1	2,00	1	2	4,3	1,0	36,85	1,27	1,2	1,53
380ct2f2	2,00	1	2	4,3	1,0	36,85	1,27	1,2	1,53
380ct2f3	2,00	1	2	4,3	1,0	48,15	1,37	1,2	1,64
bl1	0,10	1	0,1	0,5	0,1	50,05	1,38	1,2	0,08
bl2	0,10	1	0,1	0,5	0,1	50,05	1,38	1,2	0,08

Project: KIJ-GT
Tower: S+6 II
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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	27,1	1,17	0,58	0,55	1,05	28,25	59,9	56,9	46,9	113,4	107,8
380ct1f2	27,1	1,17	0,58	0,55	1,05	28,25	59,9	56,9	46,9	113,4	107,8
380ct1f3	38,4	1,29	0,60	0,57	1,02	28,25	67,2	63,8	46,9	131,1	124,5
380ct2f1	27,1	1,17	0,58	0,55	1,05	28,25	59,9	56,9	46,9	113,4	107,8
380ct2f2	27,1	1,17	0,58	0,55	1,05	28,25	59,9	56,9	46,9	113,4	107,8
380ct2f3	38,4	1,29	0,60	0,57	1,02	28,25	67,2	63,8	46,9	131,1	124,5
bl1	42,7	1,32	0,61	0,58	1,15	22,24	20,7	19,6	41,5	40,3	38,3
bl2	42,7	1,32	0,61	0,58	1,15	22,13	20,6	19,6	41,4	40,3	38,2

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	23,1	1,11	0,56	0,53	1,07	28,25	56,6	53,8	46,9	105,8	100,6
380ct1f2	23,1	1,11	0,56	0,53	1,07	28,25	56,6	53,8	46,9	105,8	100,6
380ct1f3	34,4	1,25	0,59	0,57	1,03	28,25	64,8	61,6	46,9	125,3	119,1
380ct2f1	23,1	1,11	0,56	0,53	1,07	28,25	56,6	53,8	46,9	105,8	100,6
380ct2f2	23,1	1,11	0,56	0,53	1,07	28,25	56,6	53,8	46,9	105,8	100,6
380ct2f3	34,4	1,25	0,59	0,57	1,03	28,25	64,8	61,6	46,9	125,3	119,1
bl1	38,9	1,29	0,60	0,57	1,15	22,24	20,0	19,0	41,5	38,9	36,9
bl2	38,9	1,29	0,60	0,57	1,16	22,13	20,0	19,0	41,4	38,8	36,8

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Project: KIJ-GT
Tower: S+6 II
Number: 10

Auteur: TBR
Versie: v11.3

Conductor loads

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

Project: KIJ-GT
Tower: S+6 II
Number: 10

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	-31,6	31,6	4,2	4,3	4,9	5,6
bl2	-31,6	31,6	4,2	4,3	4,9	5,6
380ct1f1	-113,5	113,5	12,9	12,8	14,6	17,2
380ct1f2	-113,5	113,5	12,9	12,8	14,6	17,2
380ct1f3	-116,6	116,6	14,4	14,6	14,6	17,3
380ct2f1	-113,5	113,5	12,9	12,8	14,6	17,2
380ct2f2	-113,5	113,5	12,9	12,8	14,6	17,2
380ct2f3	-116,6	116,6	14,4	14,6	14,6	17,3

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	391,0	395,2	391,0
bl2	391,0	395,9	391,0
380ct1f1	390,6	393,5	390,6
380ct1f2	390,6	393,5	390,6
380ct1f3	390,6	393,7	390,6
380ct2f1	390,6	393,5	390,6
380ct2f2	390,6	393,5	390,6
380ct2f3	390,6	393,7	390,6

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	415,2	393,6
bl2	415,2	393,9
380ct1f1	403,0	392,1
380ct1f2	403,0	392,1
380ct1f3	405,9	392,8
380ct2f1	403,0	392,1
380ct2f2	403,0	392,1
380ct2f3	405,9	392,8

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	422,1 m	1,152 -
Min. weight span	388,6 m	1,060 -

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Number: 10

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	8,5	8,1	-31,9	31,7
bl2	15,0	8,5	8,1	-31,9	31,8
380ct1f1	51,3	25,7	31,8	-114,1	112,9
380ct1f2	51,3	25,7	31,8	-114,1	112,9
380ct1f3	51,3	29,0	31,9	-117,1	116,1
380ct2f1	51,3	25,7	31,8	-114,1	112,9
380ct2f2	51,3	25,7	31,8	-114,1	112,9
380ct2f3	51,3	29,0	31,9	-117,1	116,1

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,0	4,0	-15,0	15,0
bl2	0,0	0,0	4,0	-15,0	15,0
380ct1f1	0,0	0,0	19,9	-64,2	64,2
380ct1f2	0,0	0,0	19,9	-64,2	64,2
380ct1f3	0,0	0,0	19,9	-64,2	64,2
380ct2f1	0,0	0,0	19,9	-64,2	64,2
380ct2f2	0,0	0,0	19,9	-64,2	64,2
380ct2f3	0,0	0,0	19,9	-64,2	64,2

1 **Control uplift SLS-wind**

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	1,8	2,2
	bl2	1,8	2,2
	380ct1f1	9,2	10,8
	380ct1f2	9,2	10,8
	380ct1f3	9,2	10,8
	380ct2f1	9,2	10,8
	380ct2f2	9,2	10,8
	380ct2f3	9,2	10,8

Project: KIJ-GT
Tower: S+6 II
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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		0	178	138	7689	0	0
ULS 1a_0,9_90		0	178	138	7689	0	0
ULS 3_90		0	99	206	4286	0	0
ULS 3_0,9_90		0	99	206	4286	0	0
SLS 7		0	0	127	0	0	0

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

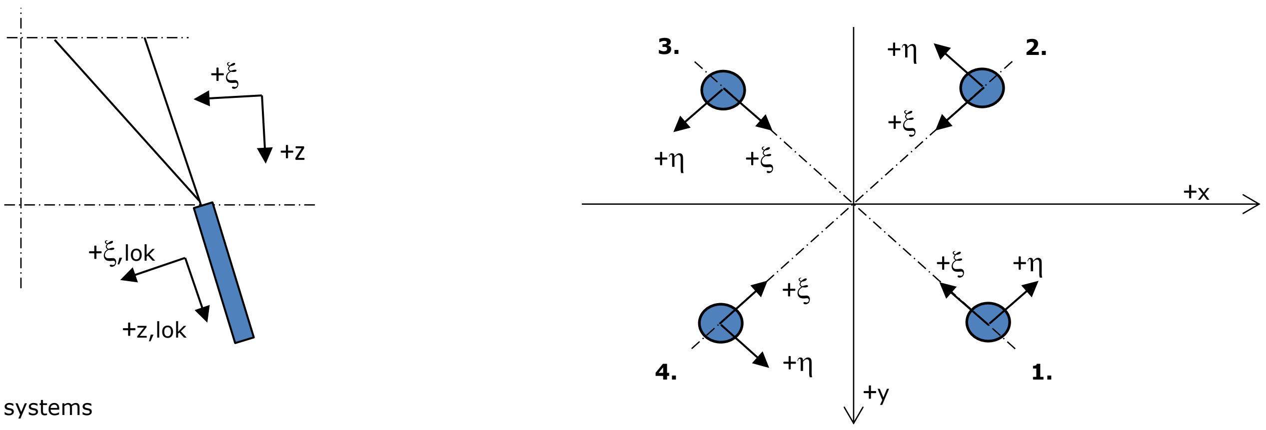
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	356	401	13035	0	0
ULS 3_90	0	152	468	5890	0	0
SLS 7	0	0	377	0	0	0

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	356	401	**13035**	0	0
ULS 1a_0	228	0	396	0	**7599**	0
ULS 5a Ba 21	51	0	377	-129	1977	**806**
ULS 1a_45	173	262	398	**9380**	**5527**	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	158	141	**855**	12	-211	-40	872
2	ULS 1a_0	77	-96	**484**	14	-122	-25	494
3	ULS 7	-22	-22	**108**	0	-30	-9	111
4	ULS 1a_135	-158	141	**855**	-12	-211	-40	872

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-121	104	**-671**	12	159	25	-684
3	ULS 1a_0,9_0,9_45	121	104	**-671**	-12	159	25	-684
4	ULS 1a_0,9_0,9_0	40	-60	**-300**	-14	71	10	-306

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 1a_90	151	109	761	**30**	-184	-31	776
2	ULS 5a Ba 21	12	-59	201	**33**	-51	-10	205
3	ULS 5a Ba 21	-28	22	1	**35**	-4	-4	1
4	ULS 5a Ba 21	16	19	-12	**25**	-2	-5	-13

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 10	12	59	201	**-33**	-51	-10	205
2	ULS 5a Ba 10	51	-18	188	**-23**	-49	-11	192
3	ULS 1a_90	111	69	-561	**-30**	128	15	-572
4	ULS 5a Ba 10	-28	-22	1	**-35**	-4	-4	1

Project: KIJ-GT
Tower: S+6 II
Number: 10

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-121	104	**-671**	**12**	159	25	-684
3	ULS 1a_0,9_0,9_45	121	104	**-671**	**-12**	159	25	-684
4	ULS 1a_0,9_0,9_0	40	-60	**-300**	**-14**	71	10	-306

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	19	19	94	0	-27	-8	96
2	SLS 7	19	-19	94	0	-27	-8	96
3	SLS 7	-19	-19	94	0	-27	-8	96
4	SLS 7	-19	19	94	0	-27	-8	96

Envelope of load combinations for all of the legs

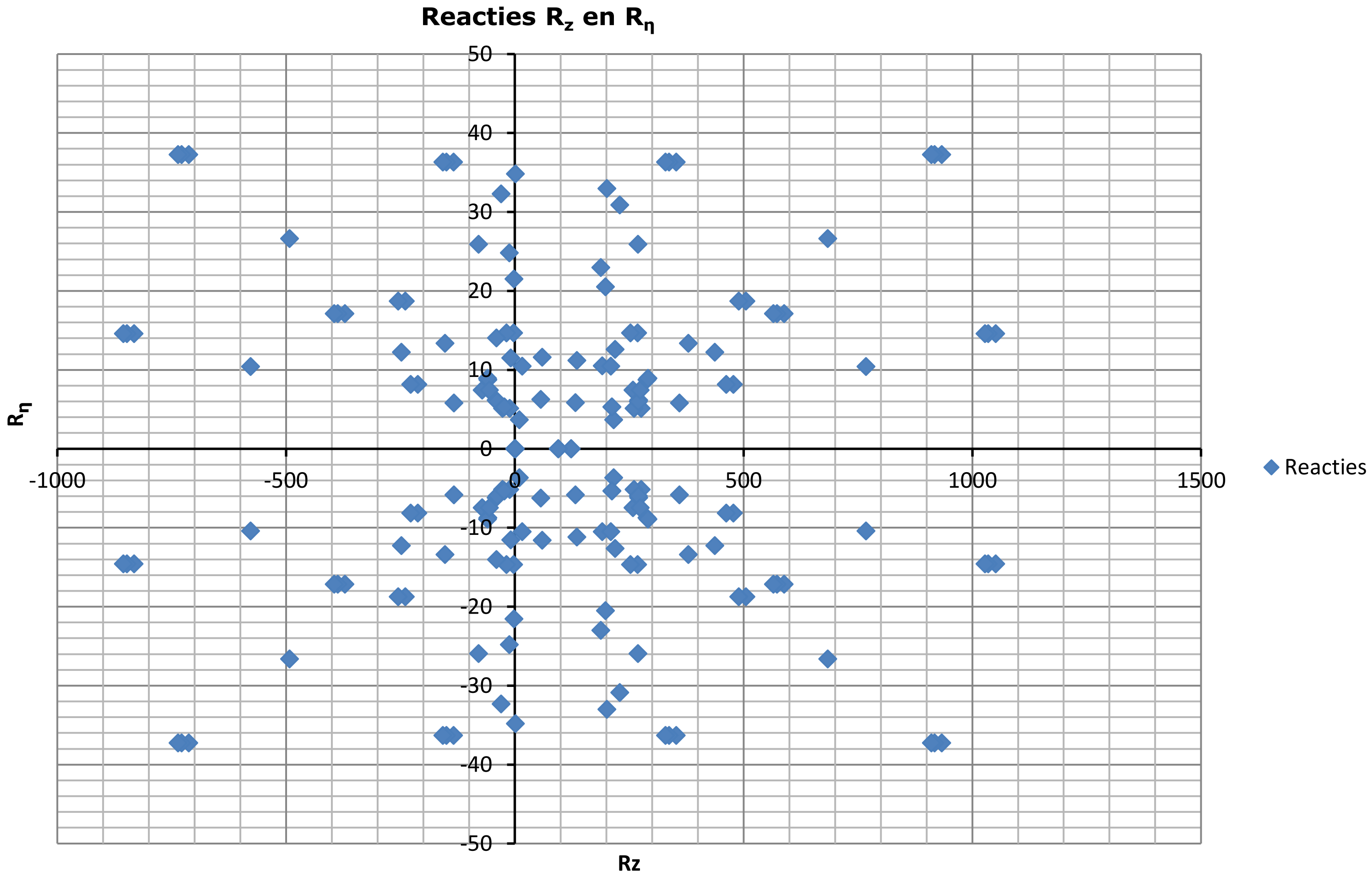
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_45	158	141	**855**	12	-211	-40	872
Max. tension	ULS 1a_0,9_0,9_45	121	104	**-671**	-12	159	25	-684
Max. pos. torsie	ULS 5a Ba 21	-28	22	1	**35**	-4	-4	1
Max. neg. torsie	ULS 5a Ba 10	-28	-22	1	**-35**	-4	-4	1
Comb. tension+torsie	ULS 1a_0,9_0,9_45	121	104	**-671**	**-12**	159	25	-684

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	19	19	**94**	0	-27	-8	96
2	SLS 1a_135	-97	83	**-540**	10	127	19	-550
3	SLS 1a_45	97	83	**-540**	-10	127	19	-550
4	SLS 1a_0	29	-45	**-229**	-12	53	7	-234

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	134	121	**729**	10	-180	-34	743
2	SLS 1a_0	67	-83	**418**	12	-106	-22	426
3	SLS 7	-19	-19	**94**	0	-27	-8	96
4	SLS 1a_135	-134	121	**729**	-10	-180	-34	743


Reacties R_z en R_η
50
40
30
20
10
0
-10
-20
-30
-40
-50
-1000
-500
0
500
1000
1500
R_η
Rz
Reacties

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Project: KIJ-GT
Tower: S+6 II
Number: 10

Auteur: TBR
Versie: v11.3

Conductor loads

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	36
Number of load combinations for SPLS	0
Number of load combinations for SLS	11
Number of concentrated loads	376

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Project: KIJ-GT
Tower: S+6 II
Number: 10

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	37,1	5,2	5,3	5,3	6,1
bl2	-37,1	37,1	5,2	5,3	5,3	6,1
380ct1f1	-132,2	132,2	16,1	15,9	17,2	20,3
380ct1f2	-132,2	132,2	16,1	15,9	17,2	20,3
380ct1f3	-136,0	136,0	18,0	18,2	17,2	20,3
380ct2f1	-132,2	132,2	16,1	15,9	17,2	20,3
380ct2f2	-132,2	132,2	16,1	15,9	17,2	20,3
380ct2f3	-136,0	136,0	18,0	18,2	17,2	20,3

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	391,0	395,4	391,0
bl2	391,0	396,1	391,0
380ct1f1	390,6	393,6	390,6
380ct1f2	390,6	393,6	390,6
380ct1f3	390,6	393,8	390,6
380ct2f1	390,6	393,6	390,6
380ct2f2	390,6	393,6	390,6
380ct2f3	390,6	393,8	390,6

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	418,6	392,8
bl2	418,6	393,1
380ct1f1	405,2	391,6
380ct1f2	405,2	391,6
380ct1f3	408,5	392,4
380ct2f1	405,2	391,6
380ct2f2	405,2	391,6
380ct2f3	408,5	392,4

Envelop of weight span over all combinations (incl. 0,9 combinations)		
For all conductors		Wind / Weight span ratio
Max. weight span	431,5 m	1,177 -
Min. weight span	388,3 m	1,059 -

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Project: KIJ-GT
Tower: S+6 II
Number: 10

Maximum values back + ahead span **Maximum tension in conductor**

	Fx	Fy	Fz	Ft_ba	Ft_ah
Geleider	[kN]	[kN]	[kN]	[kN]	[kN]
bl1	15,0	10,6	8,9	-37,5	36,7
bl2	15,0	10,5	8,9	-37,5	36,7
380ct1f1	51,3	32,0	37,5	-133,0	131,5
380ct1f2	51,3	32,0	37,5	-133,0	131,5
380ct1f3	51,3	36,2	37,6	-136,7	135,4
380ct2f1	51,3	32,0	37,5	-133,0	131,5
380ct2f2	51,3	32,0	37,5	-133,0	131,5
380ct2f3	51,3	36,2	37,6	-136,7	135,4

EDS-loads conductor

	Fx	Fy	Fz	Ft_ba	Ft_ah
Geleider	[kN]	[kN]	[kN]	[kN]	[kN]
bl1	0,0	0,0	4,0	-15,0	15,0
bl2	0,0	0,0	4,0	-15,0	15,0
380ct1f1	0,0	0,0	19,9	-64,2	64,2
380ct1f2	0,0	0,0	19,9	-64,2	64,2
380ct1f3	0,0	0,0	19,9	-64,2	64,2
380ct2f1	0,0	0,0	19,9	-64,2	64,2
380ct2f2	0,0	0,0	19,9	-64,2	64,2
380ct2f3	0,0	0,0	19,9	-64,2	64,2

1 **Control uplift SLS-wind**

		Fz_ba	Fz_ah
Combinatie:	Geleider	[kN]	[kN]
SLS 4	bl1	1,8	2,2
	bl2	1,8	2,2
	380ct1f1	9,2	10,8
	380ct1f2	9,2	10,8
	380ct1f3	9,2	10,9
	380ct2f1	9,2	10,8
	380ct2f2	9,2	10,8
	380ct2f3	9,2	10,9

Project: KIJ-GT
Tower: S+6 II
Number: 10

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	221	152	9577	0	0
ULS 1a_0,9_90		0	221	152	9577	0	0
ULS 3_90		0	123	243	5338	0	0
ULS 3_0,9_90		0	123	243	5338	0	0
SLS 7		0	0	127	0	0	0

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

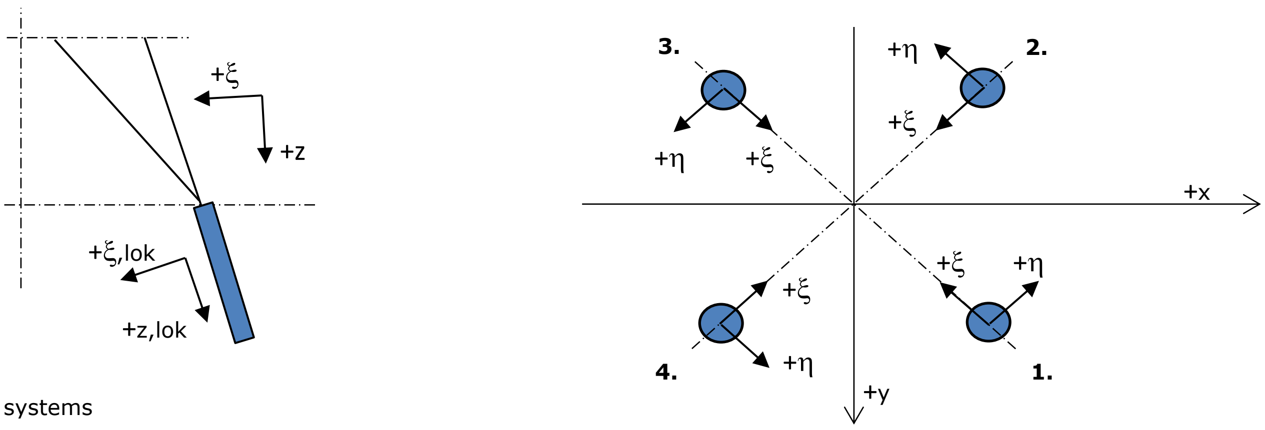
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	444	440	16236	0	0
ULS 3_90	0	190	531	7336	0	0
SLS 7	0	0	377	0	0	0

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	444	440	**16236**	0	0
ULS 1a_0	284	0	434	0	**9465**	0
ULS 5a Ba 21	51	0	377	-129	1977	**806**
ULS 1a_45	216	327	436	**11683**	**6883**	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	193	173	**1050**	15	-259	-48	1071
2	ULS 1a_0	93	-117	**588**	17	-148	-30	600
3	ULS 7	-24	-24	**123**	0	-34	-10	125
4	ULS 1a_135	-193	173	**1050**	-15	-259	-48	1071

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-155	134	**-856**	15	204	32	-873
3	ULS 1a_0,9_0,9_45	155	134	**-856**	-15	204	32	-873
4	ULS 1a_0,9_0,9_0	54	-78	**-395**	-17	94	15	-403

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 1a_90	185	133	933	**37**	-225	-38	952
2	ULS 1a_90	-142	89	-713	**37**	163	20	-728
3	ULS 5a Ba 21	-28	22	1	**35**	-4	-4	1
4	ULS 5a Ba 21	16	19	-12	**25**	-2	-5	-13

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 5a Ba 10	12	59	201	**-33**	-51	-10	205
2	ULS 5a Ba 10	51	-18	188	**-23**	-49	-11	192
3	ULS 1a_90	142	89	-713	**-37**	163	20	-728
4	ULS 1a_90	-185	133	933	**-37**	-225	-38	952

Project: KIJ-GT
Tower: S+6 II
Number: 10

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-155	134	**-856**	**15**	204	32	-873
3	ULS 1a_0,9_0,9_45	155	134	**-856**	**-15**	204	32	-873
4	ULS 1a_0,9_0,9_0	54	-78	**-395**	**-17**	94	15	-403

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	19	19	94	0	-27	-8	96
2	SLS 7	19	-19	94	0	-27	-8	96
3	SLS 7	-19	-19	94	0	-27	-8	96
4	SLS 7	-19	19	94	0	-27	-8	96

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	193	173	**1050**	15	-259	-48	1071
Max. tension	ULS 1a_0,9_0,9_45	155	134	**-856**	-15	204	32	-873
Max. pos. torsie	ULS 1a_90	185	133	933	**37**	-225	-38	952
Max. neg. torsie	ULS 1a_90	-185	133	933	**-37**	-225	-38	952
Comb. tension+torsie	ULS 1a_0,9_0,9_45	155	134	**-856**	**-15**	204	32	-873

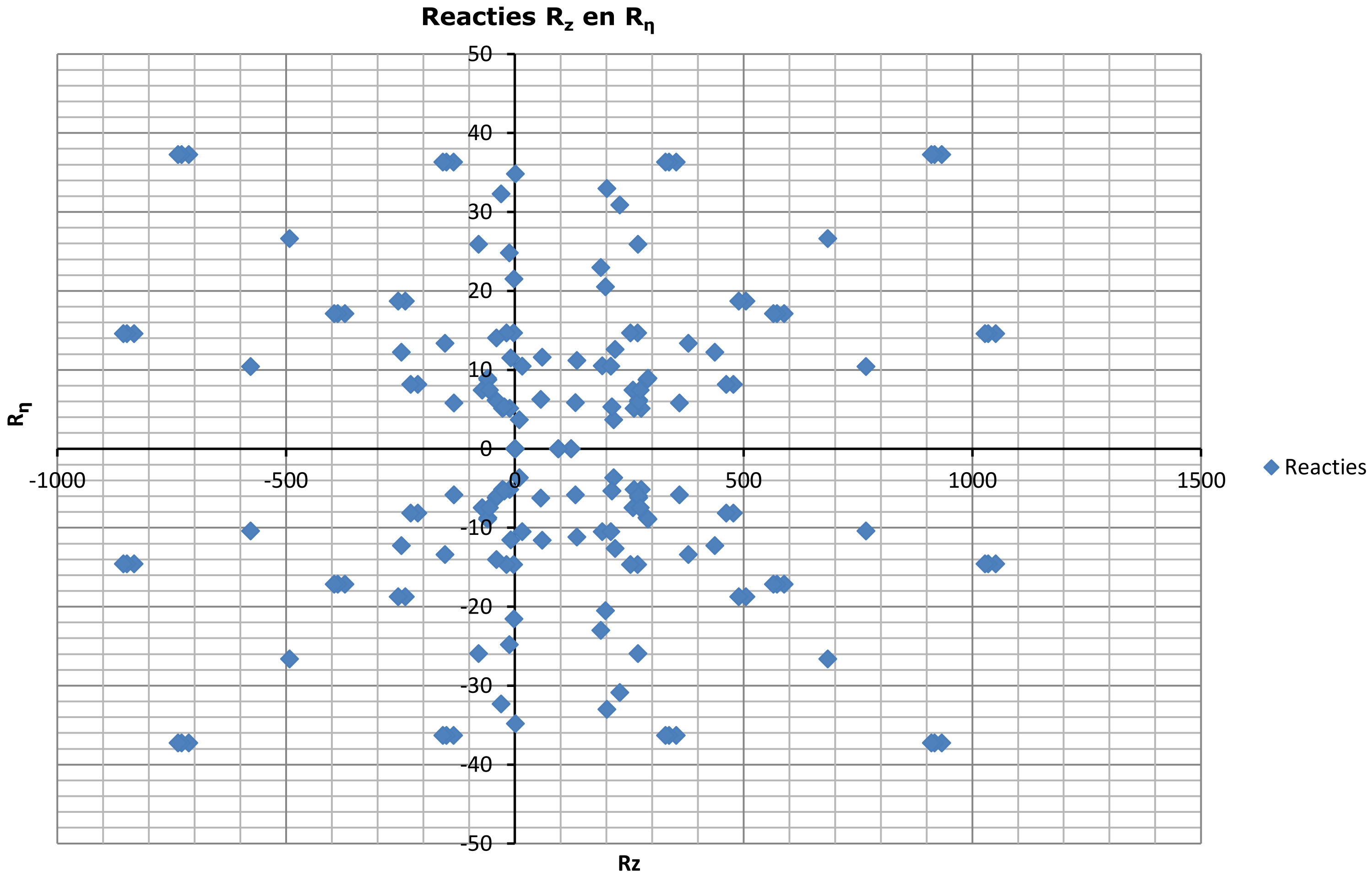
Maximum tension load - SLS

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	19	19	**94**	0	-27	-8	96
2	SLS 1a_135	-104	89	**-578**	10	136	20	-589
3	SLS 1a_45	104	89	**-578**	-10	136	20	-589
4	SLS 1a_0	32	-49	**-248**	-12	58	8	-253

Maximum compression load - SLS

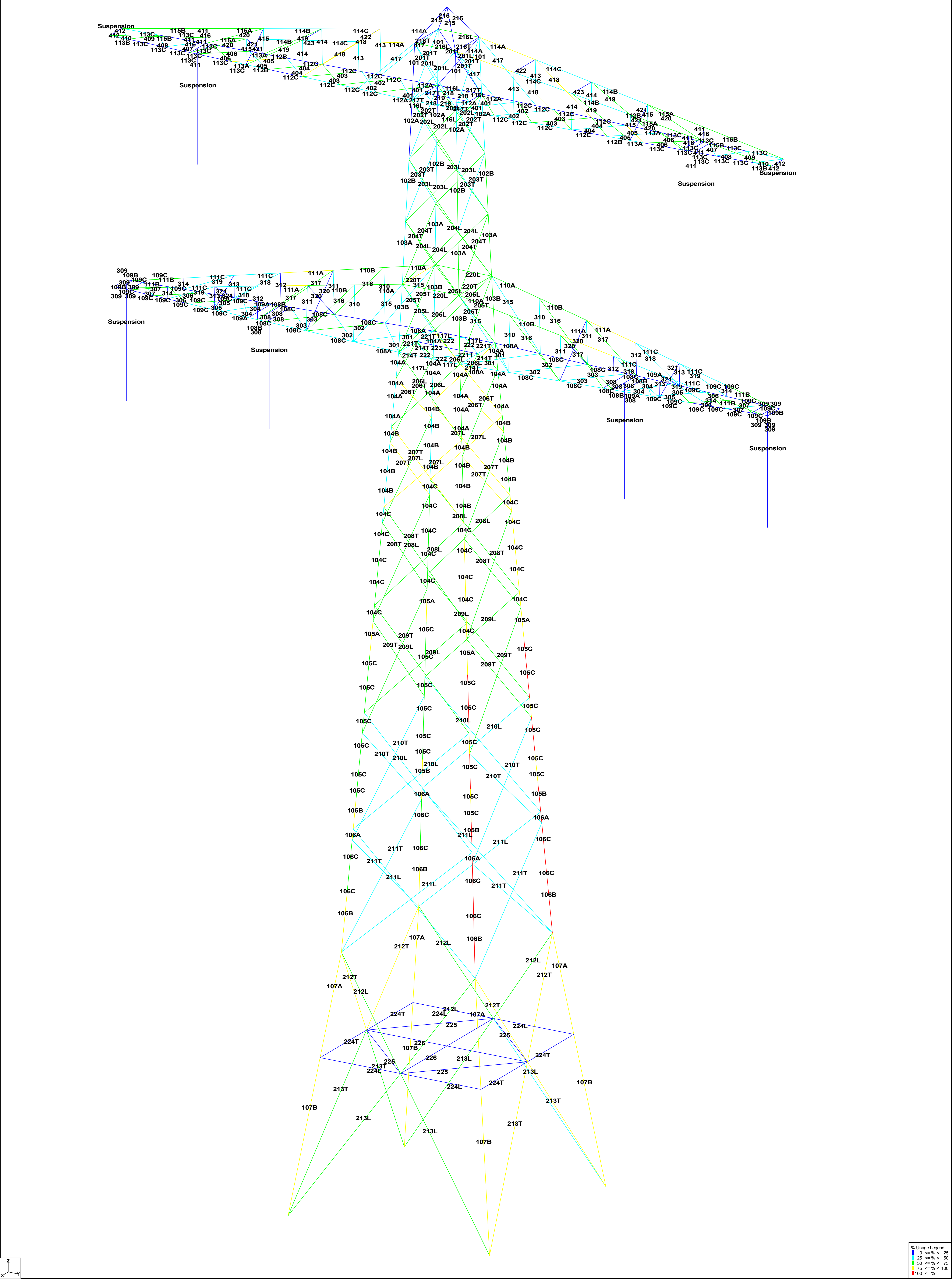
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
1	SLS 1a_45	141	127	**767**	10	-190	-36	782
2	SLS 1a_0	70	-87	**437**	12	-111	-23	446
3	SLS 7	-19	-19	**94**	0	-27	-8	96
4	SLS 1a_135	-141	127	**767**	-10	-190	-36	782

Project: KIJ-GT
Tower: S+6 II
Number: 10



APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project: "S+6 (hv) ini"
Tower Version 16.12, 13:34:43 Tuesday, 14 April, 2020
Undeformed geometry displayed



DNV·GL

Assessment of groups for initial mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+6
Mast 10

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	mpression	Load Case (Compression)	Buckling	Shear (Comp)	earing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	hear (Tens)	earing (Tens)	U.C. (Tens)	Exceedance (Tens)
101	Leg Vierde TSNSTUK	90x90x8	S235	5M20-5.6t	1.00	1.00	1.00	146	**-40.8**	ULS 5a Ba 22	112.9	294.0	432.0	0.36		**0.0**		269.1	294.0	392.7	0.00	
102A	Leg Vierde TSNSTUK	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	76	**-63.4**	ULS 1a_45	251.3	338.9	414.7	0.25		**18.5**	ULS 1a_0,9_0,9_45	252.5	338.9	297.7	0.07	
102B	Leg Vierde TSNSTUK	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	79	**-131.2**	ULS 1a_45	245.5	338.9	414.7	0.53		**82.2**	ULS 1a_0,9_0,9_45	252.5	338.9	354.5	0.33	
103A	Leg Derde TSNSTUK	100x100x12	S235	4M24-5.6t	0.50	0.50	0.50	73	**-186.0**	ULS 1a_45	418.8	338.9	622.1	0.55		**135.3**	ULS 1a_0,9_0,9_45	426.6	338.9	531.7	0.40	
103B	Leg Derde TSNSTUK	100x100x12	S235	6M24-5.6t	0.50	0.50	0.50	79	**-227.9**	ULS 1a_45	401.2	508.3	933.1	0.57		**138.1**	ULS 1a_0,9_0,9_45	426.6	508.3	781.6	0.32	
104A	Leg Tweede TSNSTUK	150x150x12	S235	6M24-5.6t	1.55	1.19	0.99	40	**-336.2**	ULS 1a_45	763.4	508.3	933.1	0.66		**222.7**	ULS 1a_0,9_0,9_45	740.3	508.3	797.5	0.44	
104C	Leg Tweede TSNSTUK	150x150x12	S235	8M24-5.6t	3.79	3.99	3.16	75	**-623.2**	ULS 1a_45	630.8	677.8	1244.2	0.99		**477.6**	ULS 1a_0,9_0,9_45	740.3	677.8	1063.4	0.70	
104B	Leg Tweede TSNSTUK	150x150x12	S235		1.90	1.90	1.59	66	**-481.1**	ULS 1a_45	672.3	0.0	0.0	0.72		**345.0**	ULS 1a_0,9_0,9_45	817.8	0.0	0.0	0.42	
105A	Leg Eerste TSNSTUK	150x150x14	S235	8M24-5.6t	1.74	1.81	1.45	76	**-666.0**	ULS 1a_45	722.2	677.8	1451.5	0.98		**519.2**	ULS 1a_0,9_0,9_45	851.7	677.8	1240.6	0.77	
105C	Leg Eerste TSNSTUK	150x150x14	S235		1.90	1.77	1.47	77	**-738.9**	ULS 1a_45	720.3	0.0	0.0	1.03	knik	**592.4**	ULS 1a_0,9_0,9_45	943.3	0.0	0.0	0.63	
105B	Leg Eerste TSNSTUK	150x150x14	S235	8M24-5.6t	1.19	2.10	0.99	62	**-741.2**	ULS 1a_45	794.1	677.8	1451.5	1.09	afschuiving	**590.9**	ULS 1a_0,9_0,9_45	851.7	677.8	1240.6	0.87	
106A	Leg Eerste TSNSTUK	150x150x14	S235	8M24-5.6t	6.09	5.57	4.64	79	**-795.9**	ULS 1a_45	706.6	677.8	1451.5	1.17	knik, afschuiving	**639.7**	ULS 1a_0,9_0,9_45	851.7	677.8	1240.6	0.94	
106C	Leg Eerste TSNSTUK	150x150x14	S235		1.48	1.35	1.13	81	**-832.7**	ULS 1a_45	698.6	0.0	0.0	1.19	knik	**676.6**	ULS 1a_0,9_0,9_45	943.3	0.0	0.0	0.72	
106B	Leg Eerste TSNSTUK	150x150x14	S235	10M24-5.6t	0.64	1.20	0.54	69	**-834.6**	ULS 1a_45	757.3	839.3	1814.4	1.10	knik	**675.3**	ULS 1a_0,9_0,9_45	851.7	839.3	1550.8	0.80	
107A	Leg Broekstuk	160x160x15#	S235	10M24-5.6t	0.33	0.33	0.33	50	**-776.5**	ULS 1a_45	978.7	839.3	1944.0	0.93		**641.4**	ULS 1a_0,9_0,9_45	1008.5	839.3	1661.5	0.76	
107B	Leg Broekstuk	160x160x15#	S235	10M24-5.6t	0.25	0.25	0.25	57	**-780.1**	ULS 1a_45	949.1	839.3	1944.0	0.93		**638.1**	ULS 1a_0,9_0,9_45	1008.5	839.3	1661.5	0.76	
108A	Onderregel eerste dwarsarm	150x100x16	S235	11M24-5.6t	1.00	0.50	0.50	54	**-306.2**	ULS 5a Ba 10	782.9	931.9	2281.0	0.39		**139.1**	ULS 5a Ba 21	767.8	931.9	1384.2	0.18	
108C	Onderregel eerste dwarsarm	150x100x16	S235		1.00	0.50	0.50	56	**-281.4**	ULS 5a Ba 21	773.8	0.0	0.0	0.36		**127.9**	ULS 5a Ba 10	891.6	0.0	0.0	0.14	
108B	Onderregel eerste dwarsarm	150x100x16	S235	6M24-5.6t	4.78	1.00	1.00	47	**-209.9**	ULS 5a Ba 10	809.2	508.3	1244.2	0.41		**115.8**	ULS 5a Ba 21	767.8	508.3	1063.4	0.23	
109A	Onderregel eerste dwarsarm	120x120x13	S235	6M24-5.6t	1.64	1.00	1.00	61	**-194.6**	ULS 5a Ba 21	597.1	508.3	1010.9	0.38		**100.8**	ULS 5a Ba 21	602.4	508.3	864.0	0.20	
109C	Onderregel eerste dwarsarm	120x120x13	S235		1.71	1.29	1.00	66	**-162.2**	ULS 5a Ba 21	578.1	0.0	0.0	0.28		**77.2**	ULS 5a Ba 10	705.0	0.0	0.0	0.11	
109B	Onderregel eerste dwarsarm	120x120x13	S235		1.00	1.00	1.00	13	**-1.0**	ULS 5a Ba 10	705.0	0.0	0.0	0.00		**1.0**	ULS 5a Ba 21	705.0	0.0	0.0	0.00	
110A	Bovenregel eerste dwarsarm	80x80x10	S235	3M24-5.6t	1.00	2.00	1.00	205	**0.0**		79.3	254.2	388.8	0.00		**136.3**	ULS 3_90	196.6	254.2	323.8	0.69	
110B	Bovenregel eerste dwarsarm	80x80x10	S235	3M20-5.6t	1.00	2.00	1.00	204	**0.0**		79.9	176.4	324.0	0.00		**120.5**	ULS 3_0	206.0	176.4	261.8	0.68	
111A	Bovenregel eerste dwarsarm	70x70x7	S235	3M20-5.6t	1.00	2.84	1.00	343	**0.0**		22.6	176.4	226.8	0.00		**95.8**	ULS 3_0	125.5	176.4	183.3	0.76	
111C	Bovenregel eerste dwarsarm	70x70x7	S235		1.00	3.23	1.00	343	**0.0**		22.6	0.0	0.0	0.00		**91.7**	ULS 3_0	220.9	0.0	0.0	0.42	
111B	Bovenregel eerste dwarsarm	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	232	**0.0**		41.4	176.4	226.8	0.00		**83.3**	ULS 3_0	125.5	176.4	155.3	0.66	
112A	Onderregel tweede dwarsarm	150x150x14	S235	9M24-5.6t	1.50	1.00	1.00	62	**-309.6**	ULS 5a Ba 12	792.6	762.5	1633.0	0.41		**171.4**	ULS 5a Ba 22	851.7	762.5	990.9	0.22	
112C	Onderregel tweede dwarsarm	150x150x14	S235		3.00	2.00	1.00	59	**-281.0**	ULS 5a Ba 12	805.5	0.0	0.0	0.35		**148.5**	ULS 5a Ba 22	943.3	0.0	0.0	0.16	
112B	Onderregel tweede dwarsarm	150x150x14	S235	6M24-5.6t	2.55	1.64	1.00	61	**-144.9**	ULS 5a Ba 12	796.1	508.3	1088.6	0.29		**34.8**	ULS 5a Ba 22	851.7	508.3	930.5	0.07	
113A	Onderregel tweede dwarsarm	120x120x11	S235	6M24-5.6t	4.00	2.57	1.00	77	**-132.9**	ULS 5a Ba 12	458.4	508.3	855.4	0.29		**46.0**	ULS 5a Ba 22	513.2	508.3	731.1	0.09	
113C	Onderregel tweede dwarsarm	120x120x11	S235	2M16-5.6t	2.22	1.00	1.00	109	**-30.7**	ULS 6a_90 Ah Ct1	333.3	75.4	190.1	0.41		**23.5**	ULS 5a Ba 1	599.7	0.0	0.0	0.04	
113B	Onderregel tweede dwarsarm	120x120x11	S235	2M16-5.6t	4.44	1.00	1.00	109	**-31.2**	ULS 6a_90 Ah Ct1	333.3	75.4	190.1	0.41		**0.0**		429.4	75.4	190.1	0.00	
114A	Bovenregel tweede dwarsarm	100x65x9*	S235	4M20-5.6t	1.00	1.00	1.00	204	**0.0**		78.6	235.2	388.8	0.00		**112.7**	ULS 3_45	144.1	235.2	266.2	0.78	
114C	Bovenregel tweede dwarsarm	100x65x9*	S235		1.00	1.00	1.00	204	**0.0**		78.6	0.0	0.0	0.00		**98.4**	ULS 3_90	332.5	0.0	0.0	0.30	
114B	Bovenregel tweede dwarsarm	100x65x9*	S235	3M20-5.6t	1.00	1.00	1.00	204	**0.0**		78.6	176.4	291.6	0.00		**77.0**	ULS 3_135	172.4	176.4	199.6	0.45	
115A	Bovenregel tweede dwarsarm	60x60x5	S235	2M16-5.6t	1.00	2.43	1.00	379	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ah Ct2	98.8	75.4	56.0	0.55	
115B	Bovenregel tweede dwarsarm	60x60x5	S235	2M16-5.6t	1.00	1.70	1.00	379	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ah Ct1	65.9	75.4	56.0	0.55	
201L	Diagonaal vierde tussenstuk	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	127	**-23.1**	ULS 5a Ba 22	76.0	84.7	90.7	0.30		**16.0**	ULS 5a Ba 22	88.7	84.7	64.2	0.25	
201T	Diagonaal vierde tussenstuk	50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	178	**-11.0**	ULS 5a Ba 22	25.8	37.7	43.2	0.43		**5.3**	ULS 5a Ba 22	37.4	37.7	22.0	0.24	
202L	Diagonaal vierde tussenstuk	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	93	**-110.9**	ULS 5a Ba 12	208.2	169.4	207.4	0.65		**116.5**	ULS 5a Ba 22	181.4	169.4	177.2	0.69	
202T	Diagonaal vierde tussenstuk	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	93	**-124.4**	ULS 5a Ba 12	256.9	254.2	388.8	0.49		**123.5**	ULS 5a Ba 22	261.1	254.2	332.3	0.49	
203L	Diagonaal vierde tussenstuk	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	98	**-104.9**	ULS 5a Ba 22	198.7	169.4	207.4	0.62		**98.8**	ULS 5a Ba 12	181.4	169.4	177.2	0.58	
203T	Diagonaal vierde tussenstuk	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	99	**-110.6**	ULS 5a Ba 22	245.1	254.2	388.8	0.45		**111.2**	ULS 5a Ba 12	261.1	254.2	332.3	0.44	
204L	Diagonaal derde tussenstuk	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	103	**-88.0**	ULS 5a Ba 12	191.1	169.4	207.4	0.52		**93.4**	ULS 5a Ba 22	181.4	169.4	177.2	0.55	
204T	Diagonaal derde tussenstuk	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	104	**-99.4**	ULS 5a Ba 12	235.6	169.4	259.2	0.59		**98.2**	ULS 5a Ba 22	224.3	169.4	221.5	0.58	
205L	Diagonaal derde tussenstuk	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	111	**-92.8**	ULS 5a Ba 12	178.0	169.4	207.4	0.55		**90.9**	ULS 5a Ba 22	181.4	169.4	177.2	0.54	
205T	Diagonaal derde tussenstuk	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	112	**-100.2**	ULS 5a Ba 12	219.4	169.4	259.2	0.59		**80.8**	ULS 5a Ba 22	224.3	169.4	221.5	0.48	
206L	Diagonaal tweede tussenstuk	100x75x8	S235	2M24-5.6t	0.54	0.27	0.27	79	**-95.5**	ULS 5a Ba 10	192.7	169.4	207.4	0.56		**90.2**	ULS 5a Ba 21	112.0	169.4	116.0	0.81	
206T	Diagonaal tweede tussenstuk	100x75x9	S235	2M24-5.6t	0.53	0.27	0.27	75	**-94.2**	ULS 5a Ba 10	221.4	169.4	233.3	0.56		**96.2**	ULS 5a Ba 10	119.9	169.4	130.6	0.80	
207L	Diagonaal tweede tussenstuk	100x75x7	S235	2M24-5.6t	0.54	0.27	0.27	88	**-78.2**	ULS 5a Ba 21	157.3	169.4	181.4	0.50		**80.8**	ULS 5a Ba 10	98.2	169.4	101.5	0.82	
207T	Diagonaal tweede tussenstuk	100x75x8	S235	2M24-5.6t	0.54	0.27	0.27	89	**-89.6**	ULS 5a Ba 21	177.6	169.4	207.4	0.53		**87.7**	ULS 5a Ba 10	110.7	169.4	116.0	0.79	
208L	Diagonaal tweede tussenstuk	100x75x7	S235	2M24-5.6t	0.54	0.27	0.27	104	**-72.8**	ULS 5a Ba 10	137.7	169.4	181.4	0.53		**70.4**	ULS 5a Ba 21	100.4	169.4	101.5	0.70	
208T	Diagonaal tweede tussenstuk	100x75x8	S235	2M24-5.6t	0.54	0.27	0.27	105	**-80.2**	ULS 5a Ba 10	155.3	169.4	207.4	0.52		**80.9**	ULS 5a Ba 21	113.2	169.4	116.0	0.71	
209L	Diagonaal eerste tussenstuk	100x75x7	S235	2M20-5.6t	0.53	0.27	0.27	116	**-60.5**	ULS 5a Ba 21	126.6	117.6	151.2	0.51		**61.5**	ULS 5a Ba 10	115.4	117.6	106.9	0.58	
209T	Diagonaal eerste tussenstuk	100x75x9	S235	2M20-5.6t	0.54	0.27	0.27	120	**-70.7**	ULS 5a Ba 21	150.9	117.6	194.4	0.60		**69.5**	ULS 5a Ba 10	146.1	117.6	137.5	0.59	
210L	Diagonaal eerste tussenstuk	100x75x8	S235	2M20-5.6t	0.53	0.27	0.27	127	**-53.0**	ULS 5a Ba 10	129.5	117.6	172.8	0.45		**51.7**	ULS 5a Ba 21	130.1	117.6	104.7	0.49	
210T	Diagonaal eerste tussenstuk	100x75x9	S235	2M20-5.6t	0.53	0.27	0.27	125	**-57.2**	ULS 5a Ba 10	146.6	117.6	194.4	0.49		**57.4**	ULS 5a Ba 21	137.6	117.6	117.8	0.49	
211L	Diagonaal eerste tussenstuk	100x75x8	S235	2M20-5.6t	0.53	0.27	0.27	139	**-48.7**	ULS 1a_0,9_0,9_90	117.1	117.6	172.8	0.42		**49.8**	ULS 1a_90	127.0	117.6	104.7	0.48	
211T	Diagonaal eerste tussenstuk	100x75x9	S235	2M20-5.6t	0.53	0.27	0.27	136	**-50.3**	ULS 5a Ba 21	134.3	117.6	194.4	0.43		**49.4**	ULS 5a Ba 10	135.9	117.6	117.8	0.42	
212L	Diagonaal broekstuk	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	139	**-67.1**	ULS 5a Ba 10	131.3	117.6	172.8	0.57		**49.3**	ULS 5a Ba 21	113.0	117.6	82.8	0.60	
212T	Diagonaal broekstuk	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	139	**-90.3**	ULS 1a_90	131.3	117.6	172.8	0.77		**77.5**	ULS 1a_0,9_0,9_90	113.0	117.6	82.8	0.94	
213L	Diagonaal broekstuk	90x90x9	S235	2M20-5.6t	0.33	0.25	0.25	122	**-68.8**	ULS 5a Ba 10	161.1	117.6	194.4	0.58		**47.0**	ULS 5a Ba 21	186.1	117.6	157.1	0.40	
213T	Diagonaal broekstuk	90x90x9	S235	2M20-5.6t	0.33	0.25	0.25	122	**-92.5**	ULS 1a_90	161.1	117.6	194.4	0.79		**75.9**	ULS 1a_0,9_0,9_90	186.1	117.6	157.1	0.65	
214T	Diagonaal tweede tussenstuk	100x75x9	S235	2M24-5.6t	1.00	0.52	0.52	64	**-100.3**	ULS 5a Ba 10	240.8	169.4	233.3	0.59		**97.2**	ULS 5a Ba 10	140.7	169.4	186.5	0.69	
215	Top	100x100x6	S235	2M16-5.6t	1.00	1.00	1.00	105	**-8.1**	ULS 5a Ba 12	142.1	75.4	103.7	0.11		**8.0**	ULS 5a Ba 12	144.1	75.4	76.8	0.11	
216L	Tweede dwarsarm in tower	80x80x8	S235	4M20-5.6t	1.00	1.00	1.00	128	**0.0**		122.6	235.2	345.6	0.00		**121.9**	ULS 3_0	168.3	235.2	244.4	0.72	
216T	Tweede dwarsarm in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	206	**-1.8**	ULS 5a Ba 22	21.0	37.7	43.2	0.09		**0.0**	ULS 5a Ba 22	37.4	37.7	22.0	0.00	
217T	Tweede dwarsarm in tower	100x75x7	S235	4M24-5.6t	2.00	1.00	1.00	68	**-49.1**	ULS 5a Ba 22	183.5	338.9	362.9	0.27		**64.0**	ULS 5a Ba 22	261.3	338.9	290.1	0.24	
218	Tweede dwarsarm in tower	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	98	**-76.9**	ULS 5a Ba 12	158.2	169.4	207.4	0.49		**76.9**	ULS 5a Ba 12	206.0	169.4	159.5	0.48	
219	Tweede dwarsarm in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	223	**-0.3**	ULS 3_135	18.7	37.7	43.2	0.02		**0.0**		37.4	37.7	22.0	0.00	
116L	Tweede dwarsarm in tower	150x100x12	S235	9M24-5.6t	2.00	1.00	1.00	50	**-254.5**	ULS 5a Ba 22	602.5	762.5	1399.7	0.42		**95.6**	ULS 5a Ba 22	582.2	762.5	849.4	0.16	
220L	Eerste dwarsarm in tower	80x80x10	S235	3M24-5.6t	1.00	1.00	1.00	179	**0.0**		100.3	254.2	388.8	0.00		**149.0**	ULS 3_0	207.7	254.2	299.1	0.72	
220T	Eerste dwarsarm in tower	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	202	**-29.0**	ULS 1a_0,9_0,9_90	36.3	58.8	64.8	0.80		**36.5**	ULS 1a_90	82.9	58.8	52.4	0.70	
221T	Eerste dwarsarm in tower	100x75x7	S235	4M24-5.6t	1.00	1.00	1.00	94	**-43.0**	ULS 5a Ba 22	157.6	338.9	362.9	0.27		**68.7**	ULS 5a Ba 12	214.1	338.9	290.1	0.32	
222	Eerste dwarsarm in tower	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	**-75.7**	ULS 5a Ba 10	182.9	169.4	207.4	0.45		**76.0**	ULS 5a Ba 10	208.1	169.4	177.2	0.45	
223	Eerste dwarsarm in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	**-0.6**	ULS 3_0	11.3	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00	
117L	Eerste dwarsarm in tower	150x100x16	S235	11M24-5.6t	2.00	1.00	1.00	70	**-249.7**	ULS 5a Ba 10	714.3	931.9	2281.0	0.35		**69.7**	ULS 5a Ba 10	767.8	931.9	1384.2	0.09	
224L	Onderstuk in tower	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	287	**-3.7**	ULS 1a_90	24.1	37.7	51.8	0.15		**1.0**	ULS 1a_0,9_0,9_45	89.9	37.7	38.4	0.03	
224T	Onderstuk in tower	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	287	**-3.4**	ULS 1a_45	24.1	37.7	51.8	0.14		**1.2**	ULS 1a_0,9_0,9_0	89.9	37.7	38.4	0.03	
225	Onderstuk in tower	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	306	**-1.6**	ULS 1a_135	11.9	37.7	43.2	0.13		**2.9**	ULS 1a_0,9_0,9_45	60.5	37.7	26.7	0.11	
226	Onderstuk in tower	100x50x6	S235	1M16-5.6t	0.50	0.50	0.50	368	**-0.4**	ULS 1a_90	15.3	37.7	51.8	0.03		**0.0**		44.9	37.7	22.0	0.00	
301	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	1M20-5.6t	0.52	0.52	0.52	140	**-24.1**	ULS 5a Ba 20	68.1	58.8	75.6	0.41		**22.3**	ULS 5a Ba 11	96.8	58.8	53.5	0.42	
302	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	1M20-5.6t	0.54	0.54	0.54	138	**-27.2**	ULS 5a Ba 11	69.0	58.8	75.6	0.46		**29.6**	ULS 5a Ba 20	96.8	58.8	53.5	0.55	
303	Diagonaal onderregel eerste dwarsarm	70x70x7	S235	1M24-5.6t	0.54	0.54	0.54	119	**-33.4**	ULS 5a Ba 20	80.7	84.7	90.7	0.41		**30.4**	ULS 5a Ba 11	88.7	84.7	44.9	0.68	
304	Diagonaal onderregel eerste dwarsarm	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	102	**-18.1**	ULS 5a Ba 21	57.9	58.8	54.0	0.34		**17.7**	ULS 5a Ba 21	54.7	58.8	37.0	0.48	
305	Diagonaal onderregel eerste dwarsarm	60x60x5	S235	1M20-5.6t	0.54	0.54	0.54	112	**-24.7**	ULS 5a Ba 10	52.9	58.8	54.0	0.47		**24.5**	ULS 5a Ba 10	54.7	58.8	37.0	0.66	

Assessment of groups for initial mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+6
Mast 10

Group Label	Description	Profile	Steel Quality	Bolts	RLX	RLY	RLZ	Slenderness	mpression	Load Case (Compression)	Buckling	Shear (Comp)	earing (Comp)	U.C. (Comp)	Exceedance (Comp)	Tension	Load Case (Tension)	Net Section	hear (Tens)	earing (Tens)	U.C. (Tens)	Exceedance (Tens)
306	Diagonaal onderregel eerste dwarsarm	75x50x5	S235	1M24-5.6t	0.55	0.55	0.55	112	**-30.3**	ULS 5a Ba 10	53.3	84.7	64.8	0.57		**30.7**	ULS 5a Ba 10	70.6	84.7	41.4	0.74	
307	Diagonaal onderregel eerste dwarsarm	75x50x7	S235	1M24-5.6t	0.54	0.54	0.54	87	**-32.9**	ULS 5a Ba 21	86.9	84.7	90.7	0.39		**31.6**	ULS 5a Ba 21	98.8	84.7	58.0	0.54	
308	Dwarsligger onderregel eerste dwarsarm	HEB160	S235		2.00	2.00	2.00	50	**-26.0**	ULS 5a Ba 20	918.5	0.0	0.0	0.03		**25.4**	ULS 5a Ba 11	1276.1	0.0	0.0	0.02	
309	Dwarsligger onderregel eerste dwarsarm	HEB160	S235		2.00	2.00	2.00	26	**-25.8**	ULS 5a Ba 21	1021.6	0.0	0.0	0.03		**25.8**	ULS 5a Ba 10	1276.1	0.0	0.0	0.02	
310	Verticaal eerste dwarsarm	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	185	**-14.3**	ULS 3_45	41.1	58.8	64.8	0.35		**0.0**		82.9	58.8	39.3	0.00	
311	Verticaal eerste dwarsarm	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	148	**-15.4**	ULS 3_135	54.9	58.8	64.8	0.28		**0.0**		82.9	58.8	39.3	0.00	
312	Verticaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	154	**-3.1**	ULS 1a_0	31.0	37.7	43.2	0.10		**0.0**		37.4	37.7	18.4	0.00	
313	Verticaal eerste dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	**-2.7**	ULS 1a_0	59.5	37.7	43.2	0.07		**0.0**		37.4	37.7	18.4	0.00	
314	Verticaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	53	**-1.1**	ULS 3_90	63.5	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00	
315	Tussen diagonaal eerste dwarsarm	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	332	**0.0**		12.1	58.8	54.0	0.00		**17.4**	ULS 3_135	54.7	58.8	37.0	0.47	
316	Tussen diagonaal eerste dwarsarm	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	298	**0.0**		14.4	58.8	54.0	0.00		**23.6**	ULS 3_45	54.7	58.8	37.0	0.64	
317	Tussen diagonaal eerste dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	332	**0.0**		12.6	75.4	86.4	0.00		**31.5**	ULS 3_135	52.4	75.4	44.1	0.71	
318	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	274	**0.0**		13.7	37.7	43.2	0.00		**6.5**	ULS 1a_0	37.4	37.7	22.0	0.30	
319	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	269	**0.0**		14.0	37.7	43.2	0.00		**9.4**	ULS 3_0	37.4	37.7	22.0	0.43	
320	Dwars diagonaal eerste dwarsarm	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	180	**-1.3**	ULS 1a_0	22.7	20.2	32.4	0.06		**1.2**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.06	
321	Dwars diagonaal eerste dwarsarm	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	115	**-1.1**	ULS 1a_0	38.2	20.2	32.4	0.06		**1.0**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.05	
401	Diagonaal onderregel tweede dwarsarm	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	123	**-21.1**	ULS 5a Ba 22	48.3	58.8	54.0	0.44		**19.5**	ULS 5a Ba 12	54.7	58.8	37.0	0.53	
402	Diagonaal onderregel tweede dwarsarm	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	118	**-23.3**	ULS 5a Ba 12	50.4	58.8	54.0	0.46		**24.1**	ULS 5a Ba 22	54.7	58.8	37.0	0.65	
403	Diagonaal onderregel tweede dwarsarm	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	117	**-27.0**	ULS 5a Ba 22	51.0	58.8	54.0	0.53		**26.5**	ULS 5a Ba 12	54.7	58.8	37.0	0.72	
404	Diagonaal onderregel tweede dwarsarm	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	106	**-29.1**	ULS 5a Ba 12	66.4	58.8	64.8	0.49		**28.4**	ULS 5a Ba 22	65.7	58.8	44.4	0.64	
405	Diagonaal onderregel tweede dwarsarm	70x70x6	S235	1M24-5.6t	0.52	0.52	0.52	90	**-32.7**	ULS 5a Ba 22	89.0	84.7	77.8	0.42		**34.9**	ULS 5a Ba 12	76.0	84.7	44.0	0.79	
406	Diagonaal onderregel tweede dwarsarm	75x50x7	S235	1M24-5.6t	0.52	0.52	0.52	111	**-40.8**	ULS 5a Ba 12	74.5	84.7	90.7	0.55		**36.9**	ULS 5a Ba 22	98.8	84.7	58.0	0.64	
407	Diagonaal onderregel tweede dwarsarm	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	137	**-4.2**	ULS 1a_0,9_135	43.1	37.7	43.2	0.11		**14.5**	ULS 5a Ba 1	60.5	37.7	32.0	0.45	
408	Diagonaal onderregel tweede dwarsarm	60x60x5	S235	1M16-8.8t	1.00	1.00	1.00	126	**-16.3**	ULS 5a Ba 1	47.0	60.3	43.2	0.38		**3.3**	ULS 1a_135	60.5	60.3	32.0	0.10	
409	Diagonaal onderregel tweede dwarsarm	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	122	**-3.0**	ULS 1a_135	48.9	37.7	43.2	0.08		**17.5**	ULS 5a Ba 1	60.5	37.7	32.0	0.55	
410	Diagonaal onderregel tweede dwarsarm	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	117	**-17.6**	ULS 5a Ba 1	50.8	37.7	43.2	0.47		**2.3**	ULS 1a_0,9_0,9_135	60.5	37.7	32.0	0.07	
411	Dwarsligger onderregel tweede dwarsarr	HEB160	S235		2.00	2.00	2.00	32	**-25.9**	ULS 5a Ba 22	995.4	0.0	0.0	0.03		**25.6**	ULS 5a Ba 12	1276.1	0.0	0.0	0.02	
412	Dwarsligger onderregel tweede dwarsarr	HEB160	S235		2.00	2.00	2.00	25	**-1.3**	ULS 1a_0,9_0,9_135	1025.6	0.0	0.0	0.00		**13.9**	ULS 5a Ba 1	1276.1	0.0	0.0	0.01	
413	Verticaal tweede dwarsarm	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	180	**-9.1**	ULS 3_0	30.7	37.7	43.2	0.30		**0.0**		60.5	37.7	26.7	0.00	
414	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	168	**-10.0**	ULS 3_0	27.8	37.7	43.2	0.36		**0.0**		37.4	37.7	18.4	0.00	
415	Verticaal tweede dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	107	**-12.0**	ULS 3_0	55.1	37.7	43.2	0.32		**0.0**		37.4	37.7	22.0	0.00	
416	Verticaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	**-0.6**	ULS 6a_90 Ah Ct1	58.8	37.7	43.2	0.02		**0.0**		37.4	37.7	18.4	0.00	
417	Tussen diagonaal tweede dwarsarm	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	325	**0.0**		12.6	37.7	43.2	0.00		**14.6**	ULS 3_0	60.5	37.7	32.0	0.46	
418	Tussen diagonaal tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	361	**0.0**		8.8	37.7	43.2	0.00		**18.2**	ULS 3_0	37.4	37.7	22.0	0.83	
419	Tussen diagonaal tweede dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	334	**0.0**		12.4	75.4	86.4	0.00		**26.4**	ULS 3_0	56.2	75.4	44.1	0.60	
420	Tussen diagonaal tweede dwarsarm	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	259	**0.0**		26.8	117.6	129.6	0.00		**50.5**	ULS 3_135	77.4	117.6	88.7	0.65	
421	Dwars diagonaal tweede dwarsarm	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	111	**-1.7**	ULS 1a_0,9_0,9_0	39.6	20.2	32.4	0.08		**1.6**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.08	
422	Dwarsligger bovenregel tweede dwarsarr	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	**0.0**	ULS 1a_45	24.0	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00	

Assessment of groups for strengthened mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+6
Mast 10

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)
101	Leg Vierde TSN	90x90x8	S235	5M20-5.6t	1.00	1.00	1.00	146	**-40.8**	ULS 5a Ba 22	112.9	294.0	432.0	0.36		**0.0**		269.1	294.0	392.7	0.00
102A	Leg Vierde TSN	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	76	**-63.4**	ULS 1a_45	251.3	338.9	414.7	0.25		**18.5**	ULS 1a_0,9_0,9_45	252.5	338.9	297.7	0.07
102B	Leg Vierde TSN	90x90x8	S235	4M24-5.6t	0.50	0.50	0.50	79	**-131.2**	ULS 1a_45	245.5	338.9	414.7	0.53		**82.2**	ULS 1a_0,9_0,9_45	252.5	338.9	354.5	0.33
103A	Leg Derde TSN	100x100x12	S235	4M24-5.6t	0.50	0.50	0.50	73	**-186.0**	ULS 1a_45	418.8	338.9	622.1	0.55		**135.3**	ULS 1a_0,9_0,9_45	426.6	338.9	531.7	0.40
103B	Leg Derde TSN	100x100x12	S235	6M24-5.6t	0.50	0.50	0.50	79	**-227.9**	ULS 1a_45	401.2	508.3	933.1	0.57		**138.1**	ULS 1a_0,9_0,9_45	426.6	508.3	781.6	0.32
104A	Leg Tweede TS	150x150x12	S235	6M24-5.6t	1.55	1.19	0.99	40	**-336.2**	ULS 1a_45	763.4	508.3	933.1	0.66		**222.7**	ULS 1a_0,9_0,9_45	740.3	508.3	797.5	0.44
104C	Leg Tweede TS	150x150x12	S235	8M24-5.6t	**2.14**	**2.14**	**1.37**	33	**-623.2**	ULS 1a_45	784.4	677.8	1244.2	0.92		**477.6**	ULS 1a_0,9_0,9_45	740.3	677.8	1063.4	0.70
104B	Leg Tweede TS	150x150x12	S235		1.90	1.90	1.59	66	**-481.1**	ULS 1a_45	672.3	0.0	0.0	0.72		**345.0**	ULS 1a_0,9_0,9_45	817.8	0.0	0.0	0.42
105A	Leg Eerste TSN	150x150x14	S235	8M24-5.6t	**0.98**	**0.98**	**0.63**	33	**-666.0**	ULS 1a_45	903.2	677.8	1451.5	0.98		**519.2**	ULS 1a_0,9_0,9_45	851.7	677.8	1240.6	0.77
105C	Leg Eerste TSN	150x150x14	S235		**2.00**	**2.00**	**1.28**	31	**-740.4**	ULS 1a_45	911.7	0.0	0.0	0.81		**592.4**	ULS 1a_0,9_0,9_45	943.3	0.0	0.0	0.63
105B	Leg Eerste TSN	150x150x14	S235	**8M24-8.8t**	**1.04**	**1.04**	**0.66**	31	**-741.2**	ULS 1a_45	912.0	1084.4	1451.5	0.81		**590.9**	ULS 1a_0,9_0,9_45	851.7	1084.4	1240.6	0.69
106A	Leg Eerste TSN	150x150x14	S235	**8M24-8.8t**	**3.35**	**3.35**	**2.15**	37	**-795.9**	ULS 1a_45	891.1	1084.4	1451.5	0.89		**639.7**	ULS 1a_0,9_0,9_45	851.7	1084.4	1240.6	0.75
106C	Leg Eerste TSN	150x150x14	S235		**0.81**	**0.81**	**0.52**	37	**-832.7**	ULS 1a_45	889.7	0.0	0.0	0.94		**676.6**	ULS 1a_0,9_0,9_45	943.3	0.0	0.0	0.72
106B	Leg Eerste TSN	150x150x14	S235	10M24-5.6t	0.64	**0.64**	**0.41**	37	**-834.6**	ULS 1a_45	890.1	839.3	1814.4	0.99		**675.3**	ULS 1a_0,9_0,9_45	851.7	839.3	1550.8	0.80
107A	Leg Broekstuk	160x160x15#	S235	10M24-5.6t	0.33	0.33	0.33	50	**-776.5**	ULS 1a_45	978.7	839.3	1944.0	0.93		**641.4**	ULS 1a_0,9_0,9_45	1008.5	839.3	1661.5	0.76
107B	Leg Broekstuk	160x160x15#	S235	10M24-5.6t	0.25	0.25	0.25	57	**-780.1**	ULS 1a_45	949.1	839.3	1944.0	0.93		**638.1**	ULS 1a_0,9_0,9_45	1008.5	839.3	1661.5	0.76
108A	Onderregel eers	150x100x16	S235	11M24-5.6t	1.00	0.50	0.50	54	**-306.2**	ULS 5a Ba 10	782.9	931.9	2281.0	0.39		**139.1**	ULS 5a Ba 21	767.8	931.9	1384.2	0.18
108C	Onderregel eers	150x100x16	S235		1.00	0.50	0.50	56	**-281.4**	ULS 5a Ba 21	773.8	0.0	0.0	0.36		**127.9**	ULS 5a Ba 10	891.6	0.0	0.0	0.14
108B	Onderregel eers	150x100x16	S235	6M24-5.6t	4.78	1.00	1.00	47	**-209.9**	ULS 5a Ba 10	809.2	508.3	1244.2	0.41		**115.8**	ULS 5a Ba 21	767.8	508.3	1063.4	0.23
109A	Onderregel eers	120x120x13	S235	6M24-5.6t	1.64	1.00	1.00	61	**-194.6**	ULS 5a Ba 21	597.1	508.3	1010.9	0.38		**100.8**	ULS 5a Ba 21	602.4	508.3	864.0	0.20
109C	Onderregel eers	120x120x13	S235		1.71	1.29	1.00	66	**-162.2**	ULS 5a Ba 21	578.1	0.0	0.0	0.28		**77.2**	ULS 5a Ba 10	705.0	0.0	0.0	0.11
109B	Onderregel eers	120x120x13	S235		1.00	1.00	1.00	13	**-1.0**	ULS 5a Ba 10	705.0	0.0	0.0	0.00		**1.0**	ULS 5a Ba 21	705.0	0.0	0.0	0.00
110A	Bovenregel eers	80x80x10	S235	3M24-5.6t	1.00	2.00	1.00	205	**0.0**		79.3	254.2	388.8	0.00		**136.3**	ULS 3_90	196.6	254.2	323.8	0.69
110B	Bovenregel eers	80x80x10	S235	3M20-5.6t	1.00	2.00	1.00	204	**0.0**		79.9	176.4	324.0	0.00		**120.5**	ULS 3_0	206.0	176.4	261.8	0.68
111A	Bovenregel eers	70x70x7	S235	3M20-5.6t	1.00	2.84	1.00	343	**0.0**		22.6	176.4	226.8	0.00		**95.8**	ULS 3_0	125.5	176.4	183.3	0.76
111C	Bovenregel eers	70x70x7	S235		1.00	3.23	1.00	343	**0.0**		22.6	0.0	0.0	0.00		**91.7**	ULS 3_0	220.9	0.0	0.0	0.42
111B	Bovenregel eers	70x70x7	S235	3M20-5.6t	1.00	2.00	1.00	232	**0.0**		41.4	176.4	226.8	0.00		**83.3**	ULS 3_0	125.5	176.4	155.3	0.66
112A	Onderregel twe	150x150x14	S235	9M24-5.6t	1.50	1.00	1.00	62	**-309.6**	ULS 5a Ba 12	792.6	762.5	1633.0	0.41		**171.4**	ULS 5a Ba 22	851.7	762.5	990.9	0.22
112C	Onderregel twe	150x150x14	S235		3.00	2.00	1.00	59	**-281.0**	ULS 5a Ba 12	805.5	0.0	0.0	0.35		**148.5**	ULS 5a Ba 22	943.3	0.0	0.0	0.16
112B	Onderregel twe	150x150x14	S235	6M24-5.6t	2.55	1.64	1.00	61	**-144.9**	ULS 5a Ba 12	796.1	508.3	1088.6	0.29		**34.8**	ULS 5a Ba 22	851.7	508.3	930.5	0.07
113A	Onderregel twe	120x120x11	S235	6M24-5.6t	4.00	2.57	1.00	77	**-132.9**	ULS 5a Ba 12	458.4	508.3	855.4	0.29		**46.0**	ULS 5a Ba 22	513.2	508.3	731.1	0.09
113C	Onderregel twe	120x120x11	S235	2M16-5.6t	2.22	1.00	1.00	109	**-30.7**	ULS 6a_90 Ah Ct1	333.3	75.4	190.1	0.41		**23.5**	ULS 5a Ba 1	599.7	0.0	0.0	0.04
113B	Onderregel twe	120x120x11	S235	2M16-5.6t	4.44	1.00	1.00	109	**-31.2**	ULS 6a_90 Ah Ct1	333.3	75.4	190.1	0.41		**0.0**		429.4	75.4	190.1	0.00
114A	Bovenregel twe	100x65x9*	S235	4M20-5.6t	1.00	1.00	1.00	204	**0.0**		78.6	235.2	388.8	0.00		**112.7**	ULS 3_45	144.1	235.2	266.2	0.78
114C	Bovenregel twe	100x65x9*	S235		1.00	1.00	1.00	204	**0.0**		78.6	0.0	0.0	0.00		**98.4**	ULS 3_90	332.5	0.0	0.0	0.30
114B	Bovenregel twe	100x65x9*	S235	3M20-5.6t	1.00	1.00	1.00	204	**0.0**		78.6	176.4	291.6	0.00		**77.0**	ULS 3_135	172.4	176.4	199.6	0.45
115A	Bovenregel twe	60x60x5	S235	2M16-5.6t	1.00	2.43	1.00	379	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ah Ct2	98.8	75.4	56.0	0.55
115B	Bovenregel twe	60x60x5	S235	2M16-5.6t	1.00	1.70	1.00	379	**0.0**		11.8	75.4	86.4	0.00		**30.8**	ULS 6a_90 Ah Ct1	65.9	75.4	56.0	0.55
201L	Diagonaal vierd	70x70x7	S235	1M24-5.6t	0.52	0.52	0.52	127	**-23.1**	ULS 5a Ba 22	76.0	84.7	90.7	0.30		**16.0**	ULS 5a Ba 22	88.7	84.7	64.2	0.25
201T	Diagonaal vierd	50x50x5	S235	1M16-5.6t	0.52	0.52	0.52	178	**-11.0**	ULS 5a Ba 22	25.8	37.7	43.2	0.43		**5.3**	ULS 5a Ba 22	37.4	37.7	22.0	0.24
202L	Diagonaal vierd	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	93	**-110.9**	ULS 5a Ba 12	208.2	169.4	207.4	0.65		**116.5**	ULS 5a Ba 22	181.4	169.4	177.2	0.69
202T	Diagonaal vierd	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	93	**-124.4**	ULS 5a Ba 12	256.9	254.2	388.8	0.49		**123.5**	ULS 5a Ba 22	261.1	254.2	332.3	0.49
203L	Diagonaal vierd	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	98	**-104.9**	ULS 5a Ba 22	198.7	169.4	207.4	0.62		**98.8**	ULS 5a Ba 12	181.4	169.4	177.2	0.58
203T	Diagonaal vierd	100x100x10	S235	3M24-5.6t	0.52	0.52	0.52	99	**-110.6**	ULS 5a Ba 22	245.1	254.2	388.8	0.45		**111.2**	ULS 5a Ba 12	261.1	254.2	332.3	0.44
204L	Diagonaal derde	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	103	**-88.0**	ULS 5a Ba 12	191.1	169.4	207.4	0.52		**93.4**	ULS 5a Ba 22	181.4	169.4	177.2	0.55
204T	Diagonaal derde	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	104	**-99.4**	ULS 5a Ba 12	235.6	169.4	259.2	0.59		**98.2**	ULS 5a Ba 22	224.3	169.4	221.5	0.58
205L	Diagonaal derde	100x100x8	S235	2M24-5.6t	0.52	0.52	0.52	111	**-92.8**	ULS 5a Ba 12	178.0	169.4	207.4	0.55		**90.9**	ULS 5a Ba 22	181.4	169.4	177.2	0.54
205T	Diagonaal derde	100x100x10	S235	2M24-5.6t	0.52	0.52	0.52	112	**-100.2**	ULS 5a Ba 12	219.4	169.4	259.2	0.59		**80.8**	ULS 5a Ba 22	224.3	169.4	221.5	0.48
206L	Diagonaal twee	100x75x8	S235	2M24-5.6t	0.54	0.27	0.27	79	**-95.5**	ULS 5a Ba 10	192.7	169.4	207.4	0.56		**90.2**	ULS 5a Ba 21	112.0	169.4	116.0	0.81
206T	Diagonaal twee	100x75x9	S235	2M24-5.6t	0.53	0.27	0.27	75	**-94.2**	ULS 5a Ba 10	221.4	169.4	233.3	0.56		**96.2**	ULS 5a Ba 10	119.9	169.4	130.6	0.80
207L	Diagonaal twee	100x75x7	S235	2M24-5.6t	0.54	0.27	0.27	88	**-78.2**	ULS 5a Ba 21	157.3	169.4	181.4	0.50		**80.8**	ULS 5a Ba 10	98.2	169.4	101.5	0.82
207T	Diagonaal twee	100x75x8	S235	2M24-5.6t	0.54	0.27	0.27	89	**-89.6**	ULS 5a Ba 21	177.6	169.4	207.4	0.53		**87.7**	ULS 5a Ba 10	110.7	169.4	116.0	0.79
208L	Diagonaal twee	100x75x7	S235	2M24-5.6t	0.54	0.27	0.27	104	**-72.8**	ULS 5a Ba 10	137.7	169.4	181.4	0.53		**70.4**	ULS 5a Ba 21	100.4	169.4	101.5	0.70
208T	Diagonaal twee	100x75x8	S235	2M24-5.6t	0.54	0.27	0.27	105	**-80.2**	ULS 5a Ba 10	155.3	169.4	207.4	0.52		**80.9**	ULS 5a Ba 21	113.2	169.4	116.0	0.71
209L	Diagonaal eerst	100x75x7	S235	2M20-5.6t	0.53	0.27	0.27	116	**-60.5**	ULS 5a Ba 21	126.6	117.6	151.2	0.51		**61.5**	ULS 5a Ba 10	115.4	117.6	106.9	0.58
209T	Diagonaal eerst	100x75x9	S235	2M20-5.6t	0.54	0.27	0.27	120	**-70.7**	ULS 5a Ba 21	150.9	117.6	194.4	0.60		**69.5**	ULS 5a Ba 10	146.1	117.6	137.5	0.59
210L	Diagonaal eerst	100x75x8	S235	2M20-5.6t	0.53	0.27	0.27	127	**-53.0**	ULS 5a Ba 10	129.5	117.6	172.8	0.45		**51.7**	ULS 5a Ba 21	130.1	117.6	104.7	0.49
210T	Diagonaal eerst	100x75x9	S235	2M20-5.6t	0.53	0.27	0.27	125	**-57.2**	ULS 5a Ba 10	146.6	117.6	194.4	0.49		**57.4**	ULS 5a Ba 21	137.6	117.6	117.8	0.49
211L	Diagonaal eerst	100x75x8	S235	2M20-5.6t	0.53	0.27	0.27	139	**-48.7**	ULS 1a_0,9_0,9_90	117.1	117.6	172.8	0.42		**49.8**	ULS 1a_90	127.0	117.6	104.7	0.48
211T	Diagonaal eerst	100x75x9	S235	2M20-5.6t	0.53	0.27	0.27	136	**-50.3**	ULS 5a Ba 21	134.3	117.6	194.4	0.43		**49.4**	ULS 5a Ba 10	135.9	117.6	117.8	0.42
212L	Diagonaal broek	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	139	**-67.1**	ULS 5a Ba 10	131.3	117.6	172.8	0.57		**49.3**	ULS 5a Ba 21	113.0	117.6	82.8	0.60
212T	Diagonaal broek	130x65x8	S235	2M20-5.6t	1.00	0.33	0.33	139	**-90.3**	ULS 1a_90	131.3	117.6	172.8	0.77		**77.5**	ULS 1a_0,9_0,9_90	113.0	117.6	82.8	0.94
213L	Diagonaal broek	90x90x9	S235	2M20-5.6t	0.33	0.25	0.25	122	**-68.8**	ULS 5a Ba 10	161.1	117.6	194.4	0.58		**47.0**	ULS 5a Ba 21	186.1	117.6	157.1	0.40
213T	Diagonaal broek	90x90x9	S235	2M20-5.6t	0.33	0.25	0.25	122	**-92.5**	ULS 1a_90	161.1	117.6	194.4	0.79		**75.9**	ULS 1a_0,9_0,9_90	186.1	117.6	157.1	0.65
214T	Diagonaal twee	100x75x9	S235	2M24-5.6t	1.00	0.52	0.52	64	**-100.3**	ULS 5a Ba 10	240.8	169.4	233.3	0.59		**97.2**	ULS 5a Ba 10	140.7	169.4	186.5	0.69
215	Top	100x100x6	S235	2M16-5.6t	1.00	1.00	1.00	105	**-8.1**	ULS 5a Ba 12	142.1	75.4	103.7	0.11		**8.0**	ULS 5a Ba 12	144.1	75.4	76.8	0.11
216L	Tweede dwarsa	80x80x8	S235	4M20-5.6t	1.00	1.00	1.00	128	**0.0**		122.6	235.2	345.6	0.00		**121.9**	ULS 3_0	168.3	235.2	244.4	0.72
216T	Tweede dwarsa	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	206	**-1.8**	ULS 5a Ba 22	21.0	37.7	43.2	0.09		**0.0**	ULS 5a Ba 22	37.4	37.7	22.0	0.00
217T	Tweede dwarsa	100x75x7	S235	4M24-5.6t	2.00	1.00	1.00	68	**-49.1**	ULS 5a Ba 22	183.5	338.9	362.9	0.27		**64.0**	ULS 5a Ba 22	261.3	338.9	290.1	0.24
218	Tweede dwarsa	80x80x8	S235	2M24-5.6t	1.00	1.00	1.00	98	**-76.9**	ULS 5a Ba 12	158.2	169.4	207.4	0.49		**76.9**	ULS 5a Ba 12	206.0	169.4	159.5	0.48
219	Tweede dwarsa	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	223	**-0.3**	ULS 3_135	18.7	37.7	43.2	0.02		**0.0**		37.4	37.7	22.0	0.00
116L	Tweede dwarsa	150x100x12	S235	9M24-5.6t	2.00	1.00	1.00	50	**-254.5**	ULS 5a Ba 22	602.5	762.5	1399.7	0.42		**95.6**	ULS 5a Ba 22	582.2	762.5	849.4	0.16
220L	Eerste dwarsarr	80x80x10	S235	3M24-5.6t	1.00	1.00	1.00	179	**0.0**		100.3	254.2	388.8	0.00		**149.0**	ULS 3_0	207.7	254.2	299.1	0.72
220T	Eerste dwarsarr	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	202	**-29.0**	ULS 1a_0,9_0,9_90	36.3	58.8	64.8	0.80		**36.5**	ULS 1a_90	82.9	58.8	52.4	0.70
221T	Eerste dwarsarr	100x75x7	S235	4M24-5.6t	1.00	1.00	1.00	94	**-43.0**	ULS 5a Ba 22	157.6	338.9	362.9	0.27		**68.7**	ULS 5a Ba 12	214.1	338.9	290.1	0.32
222	Eerste dwarsarr	100x100x8	S235	2M24-5.6t	1.00	1.00	1.00	108	**-75.7**	ULS 5a Ba 10	182.9	169.4	207.4	0.45		**76.0**	ULS 5a Ba 10	208.1	169.4	177.2	0.45
223	Eerste dwarsarr	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	309	**-0.6**	ULS 3_0	11.3	37.7	43.2	0.05		**0.0**		37.4	37.7	22.0	0.00
117L	Eerste dwarsarr	150x100x16	S235	11M24-5.6t	2.00	1.00	1.00	70	**-249.7**	ULS 5a Ba 10	714.3	931.9	2281.0	0.35		**69.7**	ULS 5a Ba 10	767.8	931.9	1384.2	0.09
224L	Onderstuk in to	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	287	**-3.7**	ULS 1a_90	24.1	37.7	51.8	0.15		**1.0**	ULS 1a_0,9_0,9_45	89.9	37.7	38.4	0.03
224T	Onderstuk in to	70x70x6	S235	1M16-5.6t	1.00	1.00	1.00	287	**-3.4**	ULS 1a_45	24.1	37.7	51.8	0.14		**1.2**	ULS 1a_0,9_0,9_0	89.9	37.7	38.4	0.03
225	Onderstuk in to	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	306	**-1.6**	ULS 1a_135	11.9	37.7	43.2	0.13		**2.9**	ULS 1a_0,9_0,9_45	60.5	37.7	26.7	0.11

Assessment of groups for strengthened mast (afkeur level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+6
Mast 10

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)
226	Onderstuk in to	100x50x6	S235	1M16-5.6t	0.50	0.50	0.50	368	**-0.4**	ULS 1a_90	15.3	37.7	51.8	0.03		**0.0**		44.9	37.7	22.0	0.00
301	Diagonaal onde	70x70x7	S235	1M20-5.6t	0.52	0.52	0.52	140	**-24.1**	ULS 5a Ba 20	68.1	58.8	75.6	0.41		**22.3**	ULS 5a Ba 11	96.8	58.8	53.5	0.42
302	Diagonaal onde	70x70x7	S235	1M20-5.6t	0.54	0.54	0.54	138	**-27.2**	ULS 5a Ba 11	69.0	58.8	75.6	0.46		**29.6**	ULS 5a Ba 20	96.8	58.8	53.5	0.55
303	Diagonaal onde	70x70x7	S235	1M24-5.6t	0.54	0.54	0.54	119	**-33.4**	ULS 5a Ba 20	80.7	84.7	90.7	0.41		**30.4**	ULS 5a Ba 11	88.7	84.7	44.9	0.68
304	Diagonaal onde	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	102	**-18.1**	ULS 5a Ba 21	57.9	58.8	54.0	0.34		**17.7**	ULS 5a Ba 21	54.7	58.8	37.0	0.48
305	Diagonaal onde	60x60x5	S235	1M20-5.6t	0.54	0.54	0.54	112	**-24.7**	ULS 5a Ba 10	52.9	58.8	54.0	0.47		**24.5**	ULS 5a Ba 10	54.7	58.8	37.0	0.66
306	Diagonaal onde	75x50x5	S235	1M24-5.6t	0.55	0.55	0.55	112	**-30.3**	ULS 5a Ba 10	53.3	84.7	64.8	0.57		**30.7**	ULS 5a Ba 10	70.6	84.7	41.4	0.74
307	Diagonaal onde	75x50x7	S235	1M24-5.6t	0.54	0.54	0.54	87	**-32.9**	ULS 5a Ba 21	86.9	84.7	90.7	0.39		**31.6**	ULS 5a Ba 21	98.8	84.7	58.0	0.54
308	Dwarsligger onc	HEB160	S235		2.00	2.00	2.00	50	**-26.0**	ULS 5a Ba 20	918.5	0.0	0.0	0.03		**25.4**	ULS 5a Ba 11	1276.1	0.0	0.0	0.02
309	Dwarsligger onc	HEB160	S235		2.00	2.00	2.00	26	**-25.8**	ULS 5a Ba 21	1021.6	0.0	0.0	0.03		**25.8**	ULS 5a Ba 10	1276.1	0.0	0.0	0.02
310	Verticaal eerste	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	185	**-14.3**	ULS 3_45	41.1	58.8	64.8	0.35		**0.0**		82.9	58.8	39.3	0.00
311	Verticaal eerste	70x70x6	S235	1M20-5.6t	1.00	1.00	1.00	148	**-15.4**	ULS 3_135	54.9	58.8	64.8	0.28		**0.0**		82.9	58.8	39.3	0.00
312	Verticaal eerste	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	154	**-3.1**	ULS 1a_0	31.0	37.7	43.2	0.10		**0.0**		37.4	37.7	18.4	0.00
313	Verticaal eerste	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	**-2.7**	ULS 1a_0	59.5	37.7	43.2	0.07		**0.0**		37.4	37.7	18.4	0.00
314	Verticaal eerste	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	53	**-1.1**	ULS 3_90	63.5	37.7	43.2	0.03		**0.0**		37.4	37.7	18.4	0.00
315	Tussen diagona	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	332	**0.0**		12.1	58.8	54.0	0.00		**17.4**	ULS 3_135	54.7	58.8	37.0	0.47
316	Tussen diagona	60x60x5	S235	1M20-5.6t	1.00	1.00	1.00	298	**0.0**		14.4	58.8	54.0	0.00		**23.6**	ULS 3_45	54.7	58.8	37.0	0.64
317	Tussen diagona	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	332	**0.0**		12.6	75.4	86.4	0.00		**31.5**	ULS 3_135	52.4	75.4	44.1	0.71
318	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	274	**0.0**		13.7	37.7	43.2	0.00		**6.5**	ULS 1a_0	37.4	37.7	22.0	0.30
319	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	269	**0.0**		14.0	37.7	43.2	0.00		**9.4**	ULS 3_0	37.4	37.7	22.0	0.43
320	Dwars diagonaa	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	180	**-1.3**	ULS 1a_0	22.7	20.2	32.4	0.06		**1.2**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.06
321	Dwars diagonaa	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	115	**-1.1**	ULS 1a_0	38.2	20.2	32.4	0.06		**1.0**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.05
401	Diagonaal onde	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	123	**-21.1**	ULS 5a Ba 22	48.3	58.8	54.0	0.44		**19.5**	ULS 5a Ba 12	54.7	58.8	37.0	0.53
402	Diagonaal onde	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	118	**-23.3**	ULS 5a Ba 12	50.4	58.8	54.0	0.46		**24.1**	ULS 5a Ba 22	54.7	58.8	37.0	0.65
403	Diagonaal onde	60x60x5	S235	1M20-5.6t	0.52	0.52	0.52	117	**-27.0**	ULS 5a Ba 22	51.0	58.8	54.0	0.53		**26.5**	ULS 5a Ba 12	54.7	58.8	37.0	0.72
404	Diagonaal onde	60x60x6	S235	1M20-5.6t	0.52	0.52	0.52	106	**-29.1**	ULS 5a Ba 12	66.4	58.8	64.8	0.49		**28.4**	ULS 5a Ba 22	65.7	58.8	44.4	0.64
405	Diagonaal onde	70x70x6	S235	1M24-5.6t	0.52	0.52	0.52	90	**-32.7**	ULS 5a Ba 22	89.0	84.7	77.8	0.42		**34.9**	ULS 5a Ba 12	76.0	84.7	44.0	0.79
406	Diagonaal onde	75x50x7	S235	1M24-5.6t	0.52	0.52	0.52	111	**-40.8**	ULS 5a Ba 12	74.5	84.7	90.7	0.55		**36.9**	ULS 5a Ba 22	98.8	84.7	58.0	0.64
407	Diagonaal onde	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	137	**-4.2**	ULS 1a_0,9_135	43.1	37.7	43.2	0.11		**14.5**	ULS 5a Ba 1	60.5	37.7	32.0	0.45
408	Diagonaal onde	60x60x5	S235	1M16-8.8t	1.00	1.00	1.00	126	**-16.3**	ULS 5a Ba 1	47.0	60.3	43.2	0.38		**3.3**	ULS 1a_135	60.5	60.3	32.0	0.10
409	Diagonaal onde	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	122	**-3.0**	ULS 1a_135	48.9	37.7	43.2	0.08		**17.5**	ULS 5a Ba 1	60.5	37.7	32.0	0.55
410	Diagonaal onde	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	117	**-17.6**	ULS 5a Ba 1	50.8	37.7	43.2	0.47		**2.3**	ULS 1a_0,9_0,9_135	60.5	37.7	32.0	0.07
411	Dwarsligger onc	HEB160	S235		2.00	2.00	2.00	32	**-25.9**	ULS 5a Ba 22	995.4	0.0	0.0	0.03		**25.6**	ULS 5a Ba 12	1276.1	0.0	0.0	0.02
412	Dwarsligger onc	HEB160	S235		2.00	2.00	2.00	25	**-1.3**	ULS 1a_0,9_0,9_135	1025.6	0.0	0.0	0.00		**13.9**	ULS 5a Ba 1	1276.1	0.0	0.0	0.01
413	Verticaal tweed	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	180	**-9.1**	ULS 3_0	30.7	37.7	43.2	0.30		**0.0**		60.5	37.7	26.7	0.00
414	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	168	**-10.0**	ULS 3_0	27.8	37.7	43.2	0.36		**0.0**		37.4	37.7	18.4	0.00
415	Verticaal tweed	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	107	**-12.0**	ULS 3_0	55.1	37.7	43.2	0.32		**0.0**		37.4	37.7	22.0	0.00
416	Verticaal tweed	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	**-0.6**	ULS 6a_90 Ah Ct1	58.8	37.7	43.2	0.02		**0.0**		37.4	37.7	18.4	0.00
417	Tussen diagona	60x60x5	S235	1M16-5.6t	1.00	1.00	1.00	325	**0.0**		12.6	37.7	43.2	0.00		**14.6**	ULS 3_0	60.5	37.7	32.0	0.46
418	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	361	**0.0**		8.8	37.7	43.2	0.00		**18.2**	ULS 3_0	37.4	37.7	22.0	0.83
419	Tussen diagona	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	334	**0.0**		12.4	75.4	86.4	0.00		**26.4**	ULS 3_0	56.2	75.4	44.1	0.60
420	Tussen diagona	60x60x6	S235	2M20-5.6t	1.00	1.00	1.00	259	**0.0**		26.8	117.6	129.6	0.00		**50.5**	ULS 3_135	77.4	117.6	88.7	0.65
421	Dwars diagonaa	45x45x5	S235	1M12-5.6t	0.52	0.52	0.52	111	**-1.7**	ULS 1a_0,9_0,9_0	39.6	20.2	32.4	0.08		**1.6**	ULS 1a_0,9_0,9_0	37.4	20.2	23.7	0.08
422	Dwarsligger bov	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	187	**0.0**	ULS 1a_45	24.0	37.7	43.2	0.00		**0.0**		37.4	37.7	22.0	0.00
423	423	**50x50x5**	S235	1M16-5.6t	1.00	1.00	1.00	168	**0.0**	ULS 1a_90	27.7	37.7	43.2	0.00		**0.0**		0.0	37.4	22.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00
0	0	**0**	S		0.00	0.00	0.00	0	**0.0**		0.0	0.0	0.0	0.00		**0.0**		0.0	0.0	0.0	0.00

DNV·GL

Assessment of groups for strengthened mast (verbouw level)

Date: 30-11-20
Author: TBR
Version: 1.0

KIJ-GT380
S+6
Mast 10

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)
104C	Leg Tweede TSI	150x150x12	S235	8M24-5.6t	**2.14**	**2.14**	**1.37**	33	**-734.2**	ULS 1a_90	784.4	677.8	1244.2	1.08		**643.2**	ULS 1a_0,9_0,9_45	740.3	677.8	1063.4	0.95
105A	Leg Eerste TSN	150x150x14	S235	8M24-5.6t	**0.98**	**0.98**	**0.63**	33	**-771.6**	ULS 1a_45	903.2	677.8	1451.5	1.14		**699.1**	ULS 1a_45	851.7	677.8	1240.6	1.03
105C	Leg Eerste TSN	150x150x14	S235		**2.00**	**2.00**	**1.28**	31	**-845.4**	ULS 1a_135	911.7	0.0	0.0	0.93		**800.1**	ULS 1a_45	943.3	0.0	0.0	0.85
105B	Leg Eerste TSN	150x150x14	S235	**8M24-8.8t**	**1.04**	**1.04**	**0.66**	31	**-845.6**	ULS 1a_135	912.0	1084.4	1451.5	0.93		**798.1**	ULS 1a_45	851.7	1084.4	1240.6	0.94
106A	Leg Eerste TSN	150x150x14	S235	**8M24-8.8t**	**3.35**	**3.35**	**2.15**	37	**-920.4**	ULS 1a_45	891.1	1084.4	1451.5	1.03	(1)	**862.9**	ULS 1a_45	851.7	1084.4	1240.6	1.01
106C	Leg Eerste TSN	150x150x14	S235		**0.81**	**0.81**	**0.52**	37	**-959.6**	ULS 1a_135	889.7	0.0	0.0	1.08		**913.0**	ULS 1a_45	943.3	0.0	0.0	0.97
106B	Leg Eerste TSN	150x150x14	S235	10M24-5.6t	0.64	**0.64**	**0.41**	37	**-961.0**	ULS 1a_135	890.1	839.3	1814.4	1.15		**911.3**	ULS 1a_45	851.7	839.3	1550.8	1.09

(1) Redundants (knikverkorters) have been added to groups 104 to 106. The redundants are checked separately in Appendix C.
The exceeding of compression strength is not relevant, since the main leg itself does not need to be checked for verbouw level.

APPENDIX C REDUNDANT MEMBERS CHECK

DNV·GL

Knikverkorters initial construction (afkeur)

Date: 2020-12-01
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+6
10

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
488	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	0.86	0	98	9.8	0.21	44.1	20.2	27.7	38.9	0.57	0.49	
3486	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.87	71	215	9.8	0.00	17.7	20.2	27.7	38.9	0.57	0.55	
3483	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.89	0	217	9.8	0.47	17.4	20.2	27.7	38.9	0.57	0.83	
482	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.38	48	245	9.8	0.00	16.3	20.2	27.7	44.6	0.72	0.60	
481	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.82	0	290	9.8	0.71	12.5	20.2	27.7	44.6	0.72	0.98	
480	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	3.12	44	321	9.8	0.00	10.6	20.2	27.7	44.6	0.72	0.92	
500	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	3.10	33	319	9.8	0.00	10.7	20.2	27.7	44.6	0.72	0.91	
478	Onderstuk	Enkele staaf	L50.5	S235	M12	5.6	2.51	0	258	9.8	0.63	15.0	20.2	27.7	44.6	0.72	0.87	
477	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	2.12	48	244	9.8	0.00	14.7	20.2	27.7	38.9	0.57	0.67	
476	Onderstuk	Enkele staaf	L45.5	S235	M12	5.6	1.20	0	138	9.8	0.30	31.7	20.2	27.7	38.9	0.57	0.52	
493	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	1.69	0	174	1.6	0.42	26.5	37.7	30.3	31.7	0.72	0.59	
492	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	2.84	73	292	1.6	0.00	12.4	37.7	30.3	31.7	0.72	0.13	
491	Pootverband	Kniksteun en verticale steun	L50.5	S235	M16	5.6	3.59	0	237	1.6	0.45	14.2	37.7	30.3	31.7	0.54	0.86	
490	Pootverband	Enkele staaf	L60.5	S235	M16	5.6	3.14	57	267	1.6	0.00	17.3	37.7	32.0	60.5	1.05	0.09	
475	Tussenschot	Kniksteun en verticale steun	L60.5	S235	M16	5.6	5.48	0	299	1.6	0.69	12.3	37.7	32.0	60.5	0.81	0.88	
474	Tussenschot	Kruisende staaf halverwege	L100.50.6	S235	M16	5.6	7.87	0	370	0.3	0.98	15.2	37.7	36.4	38.0	3.24	0.30	
446	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.46	0	168	8.9	0.37	24.9	20.2	27.7	38.9	0.57	0.64	
440	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.00	47	230	8.9	0.00	16.0	20.2	27.7	38.9	0.57	0.55	
428	1e tussenstul	Enkele staaf	L50.5	S235	M12	5.6	2.99	0	307	8.9	0.75	11.4	20.2	27.7	44.6	0.72	1.04	Bending
441	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.98	38	227	8.9	0.00	16.3	20.2	27.7	38.9	0.57	0.55	
434	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.92	45	221	8.9	0.00	17.0	20.2	27.7	38.9	0.57	0.52	
427	1e tussenstul	Enkele staaf	L50.5	S235	M12	5.6	3.10	0	319	8.9	0.78	10.7	20.2	27.7	44.6	0.72	1.08	Bending
435	1e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.91	36	219	8.9	0.00	17.2	20.2	27.7	38.9	0.57	0.52	
433	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.25	0	144	9.1	0.31	30.2	20.2	27.7	38.9	0.57	0.55	
442	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.84	49	211	9.1	0.00	18.1	20.2	27.7	38.9	0.57	0.50	
430	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.64	0	303	9.1	0.66	10.4	20.2	27.7	38.9	0.57	1.15	Bending
443	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.79	58	206	9.1	0.00	18.9	20.2	27.7	38.9	0.57	0.48	
45	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.66	51	191	9.1	0.00	21.0	20.2	27.7	38.9	0.57	0.45	
48	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.32	0	266	9.1	0.58	12.8	20.2	27.7	38.9	0.57	1.01	Bending
44	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.60	41	184	9.1	0.00	22.1	20.2	27.7	38.9	0.57	0.45	
346	2e tussenstul	Kruisende staaf halverwege	L100.50.6	S235	M16	5.6	6.80	0	320	9.1	0.85	19.4	37.7	36.4	38.0	3.24	0.47	
436	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.77	46	203	9.1	0.00	19.2	20.2	27.7	38.9	0.57	0.47	
429	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.78	0	319	9.1	0.70	9.6	20.2	27.7	38.9	0.57	1.21	Bending
437	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.75	37	201	9.1	0.00	19.5	20.2	27.7	38.9	0.57	0.47	
56	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.71	51	196	9.1	0.00	20.1	20.2	27.7	38.9	0.57	0.45	
59	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.37	0	272	9.1	0.59	12.4	20.2	27.7	38.9	0.57	1.04	Bending
55	2e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.65	42	190	9.1	0.00	21.1	20.2	27.7	38.9	0.57	0.45	
80	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.49	52	171	7.9	0.00	24.3	20.2	27.7	38.9	0.57	0.39	
83	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.02	0	232	7.9	0.51	15.8	20.2	27.7	38.9	0.57	0.88	
79	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.42	42	163	7.9	0.00	25.8	20.2	27.7	38.9	0.57	0.39	
78	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.25	51	144	7.9	0.00	30.2	20.2	27.7	38.9	0.57	0.39	
82	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.76	0	202	7.9	0.44	19.3	20.2	27.7	38.9	0.57	0.77	
77	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.19	41	137	7.9	0.00	32.0	20.2	27.7	38.9	0.57	0.39	
76	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.13	53	130	7.9	0.00	33.9	20.2	27.7	38.9	0.57	0.39	
81	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.53	0	176	7.9	0.38	23.4	20.2	27.7	38.9	0.57	0.67	
75	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.06	43	122	7.9	0.00	36.2	20.2	27.7	38.9	0.57	0.39	
96	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.50	52	172	7.9	0.00	24.0	20.2	27.7	38.9	0.57	0.39	
99	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	2.06	0	237	7.9	0.52	15.3	20.2	27.7	38.9	0.57	0.90	
95	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.43	42	164	7.9	0.27	25.6	20.2	27.7	38.9	0.6	0.47	
94	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.26	50	145	7.9	0.20	29.9	20.2	27.7	38.9	0.6	0.39	
98	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.80	0	207	7.9	0.45	18.7	20.2	27.7	38.9	0.6	0.79	
93	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.21	40	139	7.9	0.23	31.4	20.2	27.7	38.9	0.6	0.41	
92	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.05	46	120	7.9	0.18	36.8	20.2	27.7	38.9	0.6	0.39	
97	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.60	0	183	7.9	0.40	22.1	20.2	27.7	38.9	0.57	0.70	
91	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	1.01	37	116	7.9	0.00	38.0	20.2	27.7	38.9	0.57	0.39	
90	3e tussenstul	Enkele staaf	L45.5	S235	M12	5.6	0.96	42	110	7.9	0.00	39.9	20.2	27.7	38.9	0.57	0.39	

Knikverkorters adjusted construction (verbouw)

Date: 2020-12-01
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+6
10

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
428	1e tussenstul	Enkele staaf	**L65.6**	**S355**	M12	**8.8**	2.99	0	236	**8.9**	**0.97**	29.6	32.3	45.2	181.1	2.20	0.44		Profile exchanged
427	1e tussenstul	Enkele staaf	**L65.6**	**S355**	M12	**8.8**	3.10	0	244	**8.9**	**1.01**	28.0	32.3	45.2	181.1	2.20	0.46		Profile exchanged
430	2e tussenstul	Enkele staaf	**L55.6**	**S355**	M12	**8.8**	2.64	0	246	**9.1**	**0.86**	23.1	32.3	45.2	134.1	1.56	0.55		Profile exchanged
48	2e tussenstul	Enkele staaf	**L50.5**	**S355**	M12	**8.8**	2.32	0	238	**9.1**	**0.75**	18.6	32.3	37.7	92.1	1.08	0.70		Profile exchanged
429	2e tussenstul	Enkele staaf	**L60.6**	**S355**	M12	**8.8**	2.78	0	238	**9.1**	**0.9**	26.8	32.3	45.2	157.6	1.9	0.48		Profile exchanged
59	2e tussenstul	Enkele staaf	**L50.5**	**S355**	M12	**8.8**	2.37	0	244	**9.1**	**0.8**	18.0	32.3	37.7	92.1	1.1	0.71		Profile exchanged
6001	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.55	0	159	**8.9**	0.50	34.1	60.3	43.6	51.0	1.08	0.46		Profile added
6002	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.36	0	140	**9.1**	**0.4**	40.7	60.3	43.6	51.0	1.1	0.41		Profile added
6003	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.20	0	123	**9.1**	0.39	47.7	60.3	43.6	51.0	1.08	0.36		Profile added
6004	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.20	0	123	**9.1**	**0.39**	47.7	60.3	43.6	51.0	1.08	0.36		Profile added
6005	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.55	0	159	**8.9**	0.50	34.1	60.3	43.6	51.0	1.08	0.46		Profile added
6006	1e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.55	0	159	**8.9**	0.50	34.1	60.3	43.6	51.0	1.08	0.46		Profile added
6007	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.40	0	144	**9.1**	0.46	39.2	60.3	43.6	51.0	1.08	0.42		Profile added
6008	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.40	0	144	**9.1**	0.46	39.2	60.3	43.6	51.0	1.08	0.42		Profile added
6009	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.23	0	126	**9.1**	**0.40**	46.3	60.3	43.6	51.0	1.08	0.37		Profile added
6010	2e tussenstul	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.23	0	126	**9.1**	**0.40**	46.3	60.3	43.6	51.0	1.08	0.37		Profile added

Comment

1) Pos numbers 6001 to 6010 are new added redundants

APPENDIX D ANCHOR CHECKS AND OTHER CALCULATIONS

ANCHORS S+6 II

The tower is connected to the pile cap of the foundation via anchor rods.

Anchors

The tower legs are connected to the foundation with a foot plate 320x520x38 mm and four anchor rods with diameter 38 mm. The thickness and dimensions have been verified by field investigation[1].

The anchor rods are connected to a horizontal rod "schieter" which allows for distribution of the tensile force to the concrete.

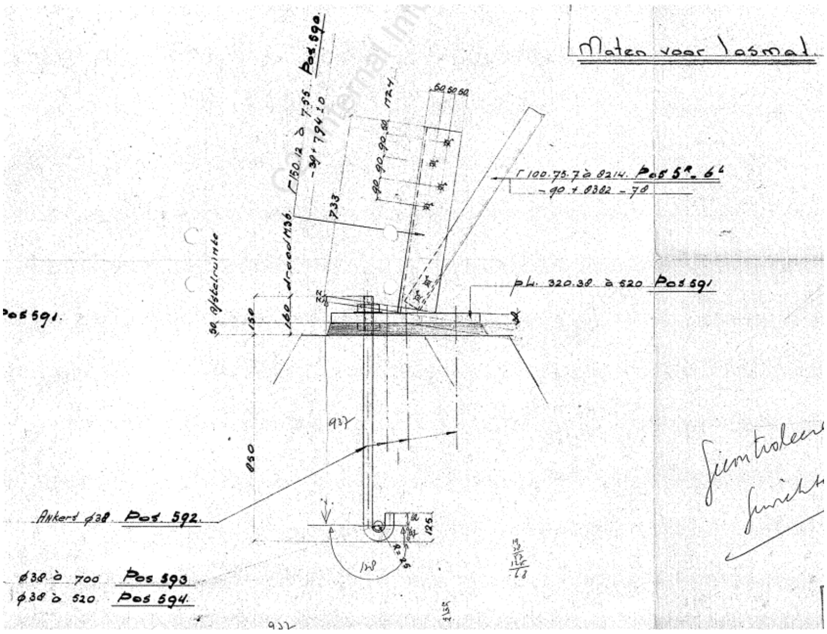


Figure 1 Anchor detail

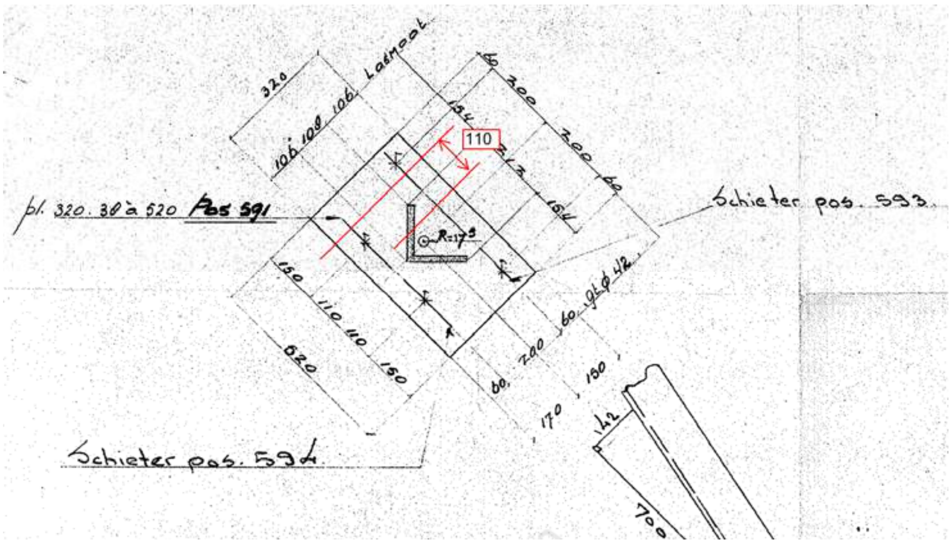


Figure 2 Foot plate with schematisation of effective width and leverage arm

1 Rapport Bejan Bouw en Betontechniek d.d. 4-11-2020; 200152A-003 Krimpen aan den IJssel - Geertruidenberg v1.0.pdf

Loads

The loads coming from the tower are based on S+6 II structure number 10 in wind zone II and can be seen in Table 1.

Table 1 Foundation loads wind zone II for tower 10

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	158	141	**855**	12	-211	-40	872
Max. tension	ULS 1a_0,9_0,9_45	121	104	**-671**	-12	159	25	-684
Max. pos. torsie	ULS 5a Ba 21	-28	22	1	**35**	-4	-4	1
Max. neg. torsie	ULS 5a Ba 10	-28	-22	1	**-35**	-4	-4	1
Comb. tension+torsie	ULS 1a_0,9_0,9_45	121	104	**-671**	**-12**	159	25	-684

Foot plate and anchors

The strength of the foot plate will be determined with the eccentricity of 110 mm shown in Figure 2. The effective width is equal to half of the foot plate, 160 mm.

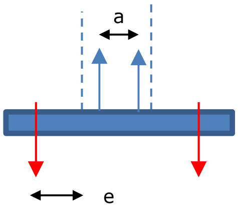


Figure 3 Scheme for check of foot plate

e: 110 mm

In the spreadsheet the anchor bolts and foot plate have been checked. The concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but has been verified with concrete cylinder tests. Refer to aforementioned investigation. The foot plate is embedded in concrete. The anchor bolts will not be loaded by bending.

Check

See output of spreadsheet: the anchor fulfills the requirement, but the foot plate has insufficient capacity:

Tower 35: U.C. = 168 / 123 = 1,36 ≥ 1,00 Not ok

The foot plate needs to be strengthened. This can be done with additional vertical stiffeners that will be positioned to the tower leg. See Figure 4.

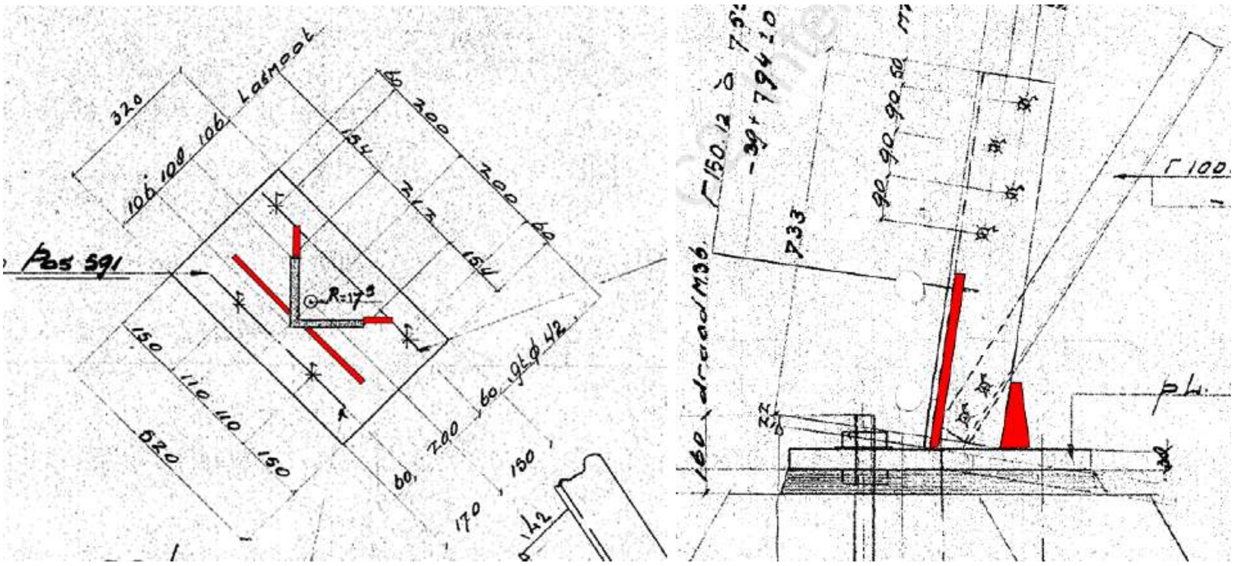


Figure 4 Stiffeners

For the detail-engineering the loads for tower 10 for verbouw load should be used.

DNV·GL

Project: Krimpen - Geertruidenberg 380 | Date: 30-11-2020 | Version: 2.6

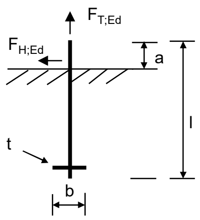
Anchors

NEN-EN 1992-1-1 and 1993-1-8 with NA
CUR-BmS 10

Subject: S+6 II	**Checks:**		
	Anchor bolt to tension	1,36	not OK
	Anchor bolt to shear	0,64	OK
	Dowel ("schieter")	1,07	not OK

Inputs

Anchor diameter		M38	
Achor quality		4.6	
Thread		Cut	
Anchor length	l =	900	mm
Anchor length above concrete	a =	110	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	673	kN
Shear force	$F_{H,Ed}$ =	211	kN
Number of anchors for tension		4	
Number of anchors for shear		4	
$F_{T;Ed}$ = T / n =		168,3	kN
$F_{v;Ed}$ = $F_{H,Ed}$ / n =		52,8	kN

Anchor properties

d_b =	38,00	mm
$A_{b;s}$ =	910	mm^2
f_{yb} =	240	N/mm^2
f_{ub} =	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0,44 - 0,0003 f_{yb}$ =	0,37	-

Capacity per anchor

$F_{T;Rd} = 0,9\alpha_{red;2} f_{ub} A_s / g_{M2}$ =	**200,6**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb}$ =	**82,0**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		S235	
Thickness	t =	38	mm
Width	b_{ef} =	160	mm
Leverage arm	m =	110	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd}$ =		13,6	kNm
$F_{t,Rd} = M_{pl,Rd} / m$ =		123,4	kN

Check of dowel ("schieter")

$\frac{\sigma_b'}{f_{cd}} = \frac{30,4}{40,0} = 0,76$ OK

$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{168}{157} = 1,07$ not OK

Capacity of concrete

Concrete strength	C20/25	
f_{ck} =	20	N/mm^2
k_b =	3	-
γ_{Mc} =	1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc}$ =	40	MPa

Dowel

Diameter	d_S =	38	mm
Length	b =	220	mm
Spread	$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	54	mm
Effective length	b_{eff} = min(b; d+2c)	145	mm
Cross section	$A_S = \pi/4\ d_S^2$ =	1134	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff}$ =	1157	kN/m
Concrete pressure	$\sigma_b' = q / d_S$ =	30,4	MPa

Shear stress in dowel

Load	$F_{T,Ed}$ =	168	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ =	157	kN

Capacity of foot plate

$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{168,3}{123,4} = 1,36$ not OK

Capacity of anchor for tension

$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{168,3}{200,6} = 0,84$ OK

Check foot plate for tension

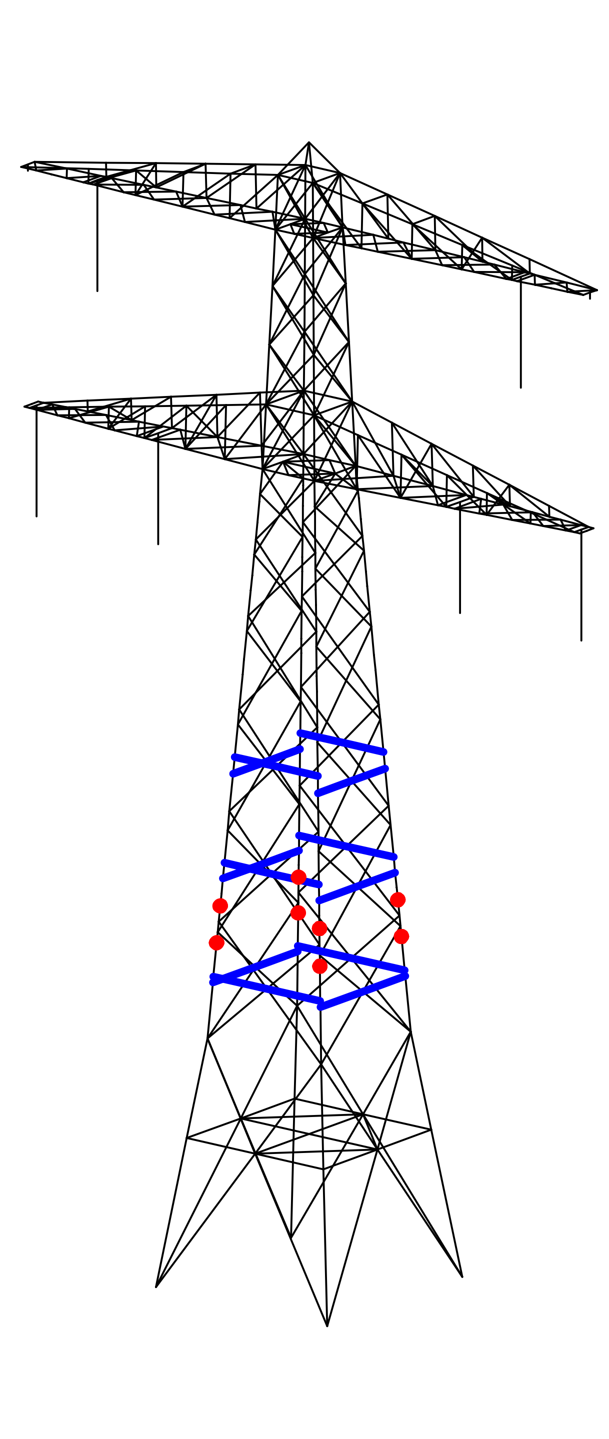
$\frac{T}{n \times F_{t;Rd}} = \frac{673,0}{493,6} = 1,36$ not OK

Check anchor for shear

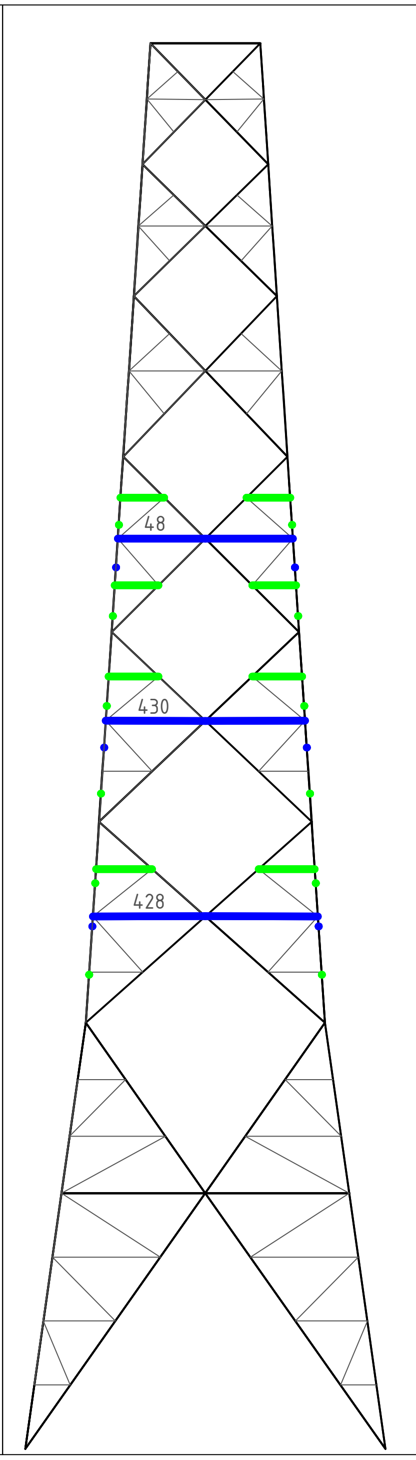
$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{52,8}{82,0} = 0,64$ OK

APPENDIX E DRAWINGS

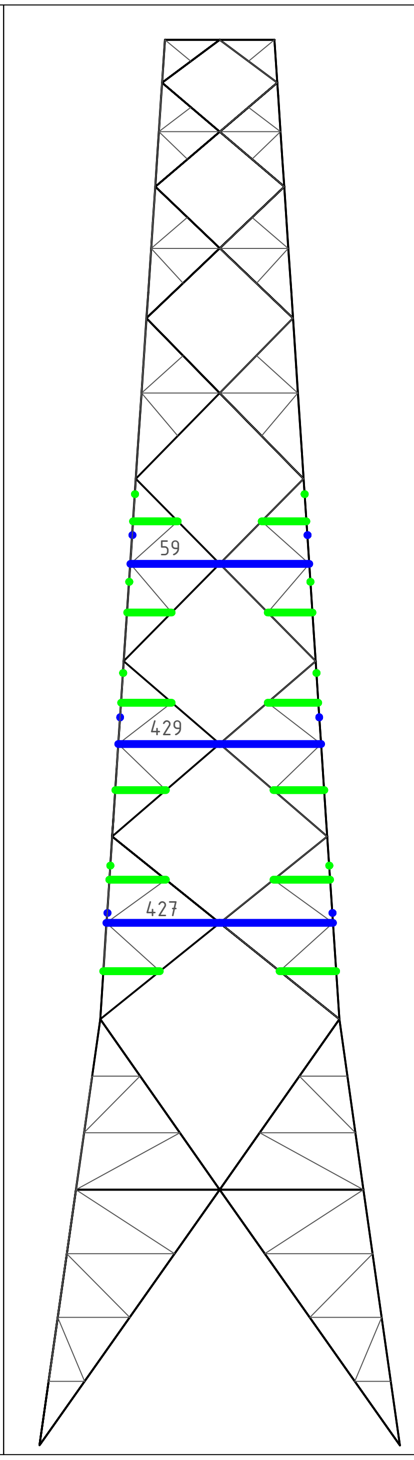
Initial Profiles and Bolts					Final Profiles and Bolts			
Group label	Profile type (ini)	Profile size (ini)	Steel quality (ini)	Bolt size and quality (ini)	Profile type (new)	Profile size (new)	Steel quality (new)	Bolt size and quality (new)
427	EA	L50x5	S235 t<=40	M12-5.6t-NEN2012	EA	L65x6	S355 t<=40	M12-8.8t-NEN2012
428	EA	L50x5	S235 t<=40	M12-5.6t-NEN2012	EA	L65x6	S355 t<=40	M12-8.8t-NEN2012
429	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L60x6	S355 t<=40	M12-8.8t-NEN2012
430	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L55x6	S355 t<=40	M12-8.8t-NEN2012
48	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L50x5	S355 t<=40	M12-8.8t-NEN2012
59	EA	L45x5	S235 t<=40	M12-5.6t-NEN2012	EA	L50x5	S355 t<=40	M12-8.8t-NEN2012



Overview



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

01	25-11-2020	Version 2.0 - Profile exchange added
00	22-4-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-004

Design state: FINAL		Scale: -	Description: Modifications overview for mast type S+6 Mast 10	Revision: 01
Drawn by: MuK	25-11-2020	Units: m		
Checked by: TBR	25-11-2020	Project no: 10166260		Format: A2
Approved by: JHu	25-11-2020	Company: TenneT		

DNV GL Energy & Sustainability, Utrechtseweg 310, 6812 AR Arnhem, tel: +31 26 3 56 91 11, www.dnvgl.com

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Bijlage 16 Rapportage Mastconstructie S+95 & S+95 T

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"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

KIJ-GT380 – Rapportage mast S+95 & S+95T

TenneT TSO B.V.

Meridian doc. nr.: 002.589.40 0916506
Rapport nr.: 21-1095 Rev.0
Datum: 2021-07-06

Projectnaam:	"Toetsing en herontwerp masten en fundaties BBB380"	DNV GL - Energy
		Energy Advisory
Rapport titel:	KIJ-GT380 – Rapportage mast S+95 & S+95T	Postbus 9035
Klant:	TenneT TSO B.V.	6800 ET ARNHEM
Contactpersoon:	[redacted]	
Datum:	2021-07-06	
Project nr.:	10166260	[redacted]
Organisatie unit:	TDT	
Meridian doc.nr.:	002.589.40 0916506	
Rapport nr.:	21-1095 Rev.0	

[redacted]

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Trefwoorden:

Versie	Datum	Reden voor uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2021-07-06	Eerste uitgave	[redacted]		

DNV GL Netherlands B.V.

Inhoud

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 GL 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

In deze studie wordt voor de lijn Krimpen aan den IJssel - Geertruidenberg de controle van de mastconstructie van masttypen S+95 en S+95T gerapporteerd.

Inhoudelijk is de Nederlandse versie van de rapportage 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. Bijlage G is nieuw toegevoegd.

1.2 Doelstelling en scope van dit rapport

Het doel van deze studie is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de ACCCZ-Warsaw geleider.

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 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 Krimpen aan den IJssel - Geertruidenberg" [1].

1.3.2 E-studie deel 1

In de rapportage "KIJ-GT380 - E-studie deel 1" [2] is bepaald welke aanpassingen benodigd zijn om de ACCCZ Warsaw geleider toe te passen binnen de verbinding Krimpen aan den IJssel - Geertruidenberg. Uit de E-studie volgen geen zaken die relevant zijn voor de constructie van masttype S+95.

1.3.3 Uitgangspunten rapport

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport "Uitgangspuntenrapport 380kV verbinding Krimpen aan den IJssel - Geertruidenberg" [3]

1.3.4 Haalbaarheidsstudie

De eerste controleberekening van dit masttype toonde dat met de gangbare eisen vanuit het PVE-lijnen een groot aantal verzwaringen benodigd zou zijn. De omvang en de uitvoerbaarheid daarvan was de reden om een haalbaarheidsstudie uit te voeren naar de mogelijke alternatieve oplossingen voor dit masttype. De resultaten zijn in onderstaand document beschreven:

- DNV GL 20-1581 20-1581 DNV GL TenneT memo rev.3 PVA S+95

1.3.5 Documenten TNO

Voortvloeiend uit de haalbaarheidsstudie heeft TNO twee studies uitgevoerd die gerelateerd zijn aan de kruisingsmasten van KIJ-GT. De eerste studie bevat een risicobeoordeling over de toepassing van gevolgklasse CC2-0 in combinatie met een referentieperiode van 15 jaar in plaats van 30 jaar in de nabijheid van stedelijk gebied. De tweede studie gaat over de toepassing van de windrichtingsfactor c_{dir}:

- TNO 20210 R10305 Beoordeling individueel risico draagmasten Lekkruising;
- TNO 20210 M10197 Briefrapport Toepassing van windrichtingsafhankelijke stuwdruk (cdir).

Deze zijn als Appendix bij dit rapport gevoegd.

2 EISEN

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

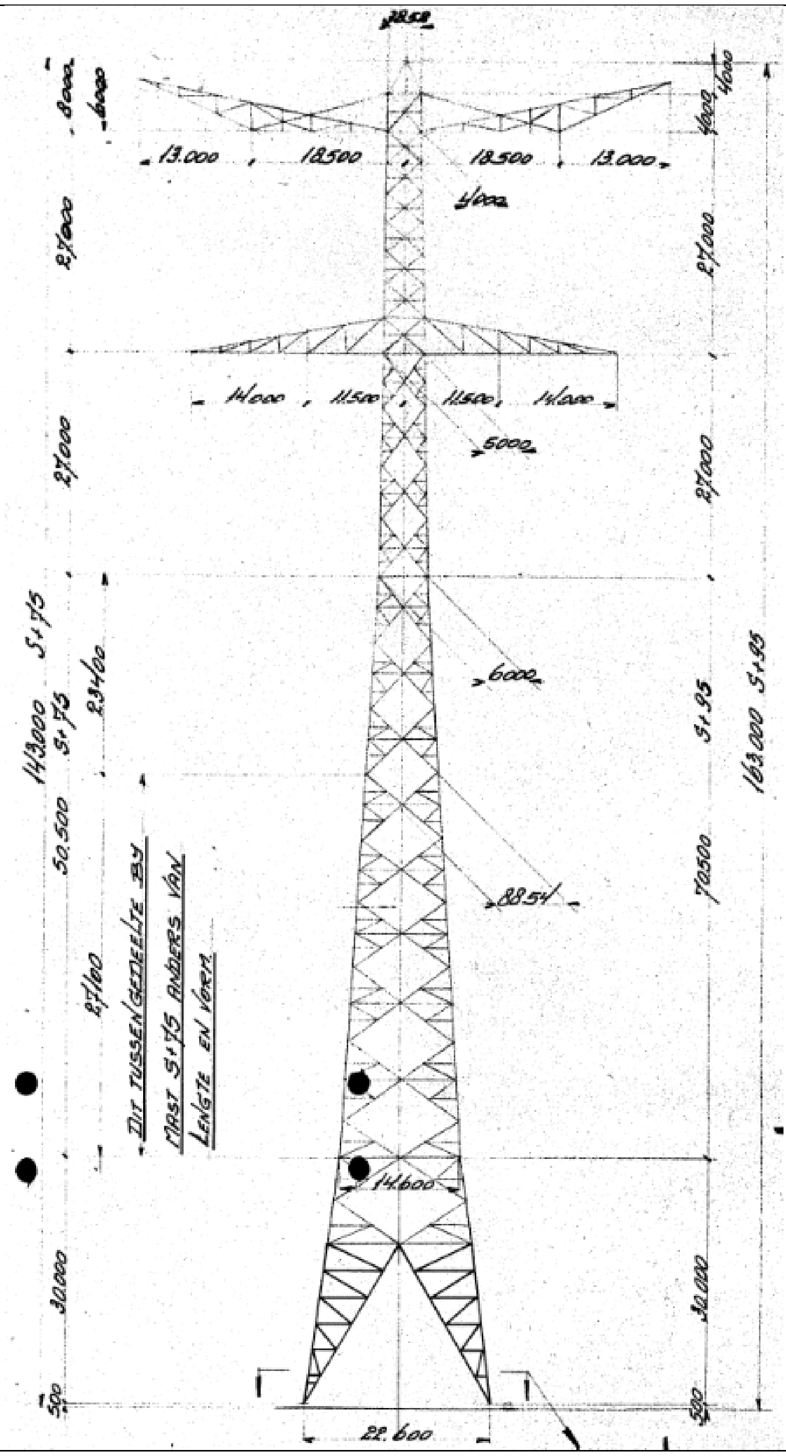
Tabel 1 Relevante eisen

Eis Id	Titel	Eis Tekst	Bewijsvoering
BO Eis: H2.7-6	Omgeving, beperkings factoren	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 1060:1977. 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 1060:1977.	Tabel 6

3 BEREKENINGEN

3.1 Mastbeeld

Het mastbeeld op basis van de Asset-data is weergegeven in Figuur 3-1.



Figuur 3-1 Mastbeeld

	
Mast 12	*Mast 13*
	
Detail INP-profielen	*Overgang van INP naar XEA-kruisvormig profiel*

Figuur 3-2 Afbeeldingen van mast 12 en 13

3.2 Mastenlijst

In deze rapportage worden masttypen S+95 en S+95T getoetst. De geometrie en de constructie van de masttypen S+95 en S+95T komen met elkaar overeen, alleen beschikt de mast van het type S+95T over een extra telecominstallatie.

Bij de masten is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde). De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven.

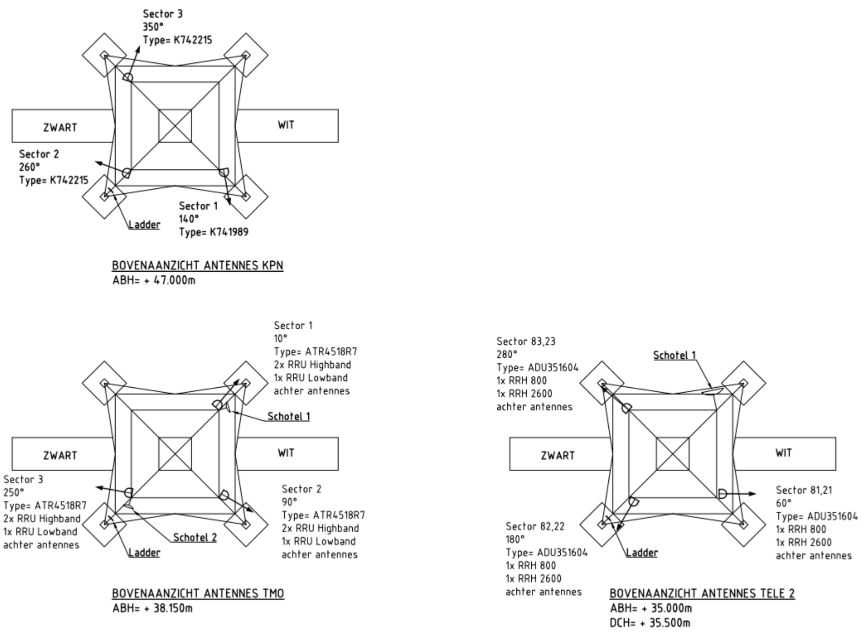
Tabel 2 Mastnummers

Mastnummer	Masttype	Maatgevend mastnummer	Wind span (m)	Weight span (m)	Hoogteverschil
12	S+95	12	573	1166	77.1
13	S+95T	13	647	1012	64.7

3.3 Telecominstallatie

Mast 13 bevat meerdere telecominstallaties. Installaties van TMO, KPN en Tele2 zijn aanwezig op hoogtes van 35,0, 38,15 en 47 m en bestaan uit drie antennes, op elke stijl één.

Het exacte gewicht en wind oppervlak zijn niet te herleiden uit de asset-gegevens. Een redelijke schatting is uitgevoerd; doordat de providers relatief laag in de constructie aanwezig zijn is de invloed op de uitkomst van de berekening zeer beperkt. In Figuur 3-3 is de positie aangegeven.



Figuur 3-3 Telecominstallatie mast 13

3.4 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.

Voor masttype S+95 is de referentieperiode gereduceerd van 30 jaar naar 15 jaar[1] om een betere overeenkomst te krijgen met de betrouwbaarheid van het oorspronkelijke ontwerp.

Tabel 3 Uitgangspunten berekening

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

3.5 Proces stappen

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

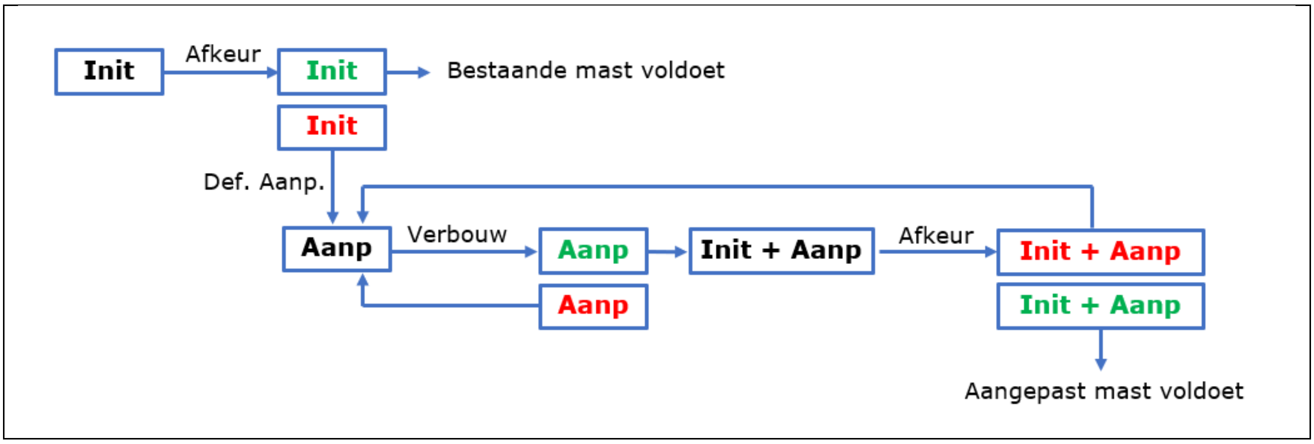
Stap 1: Toets bestaande (Init) mast op Afkeur

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 3-4 weergegeven.



Figuur 3-4 Proces diagram

[1] Zie TNO rapport 2021 R10305

3.6 Geleiderbelastingen

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

3.7 Reacties op de fundering

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

3.8 Modellering

Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd en in softwarepakket AxisVM. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten in PLS-TOWER en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst.

In AxisVM is detailstudie verricht naar de stabiliteit van de randstijl en naar het effect van benodigde versterkingen en verstijvingen.

De geleiderbelastingen vanuit het geleiderbelastingenprogramma zijn als invoer voor de belastingen gebruikt. De reductiefactor c_{dir} op windbelastingen is niet in de berekening betrokken omdat asymmetrisch versterken van de doorsnede van de randstijl in de constructie niet als wenselijk werd gezien.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. In geval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep. Controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

3.9 Dynamische factor

Conform NEN-EN 50341-2 moet de dynamische factor c_d worden berekend voor masten hoger dan 60m. Aan de hand van AxisVM is de eigenfrequentie van de mast bepaald, waarna de procedure uit NEN-EN 50341-2-15 is gevolgd. Uit de procedure voor de S+95 blijkt er een dynamische factor van 1,02 moet worden toegepast, voor berekening zie Appendix D.

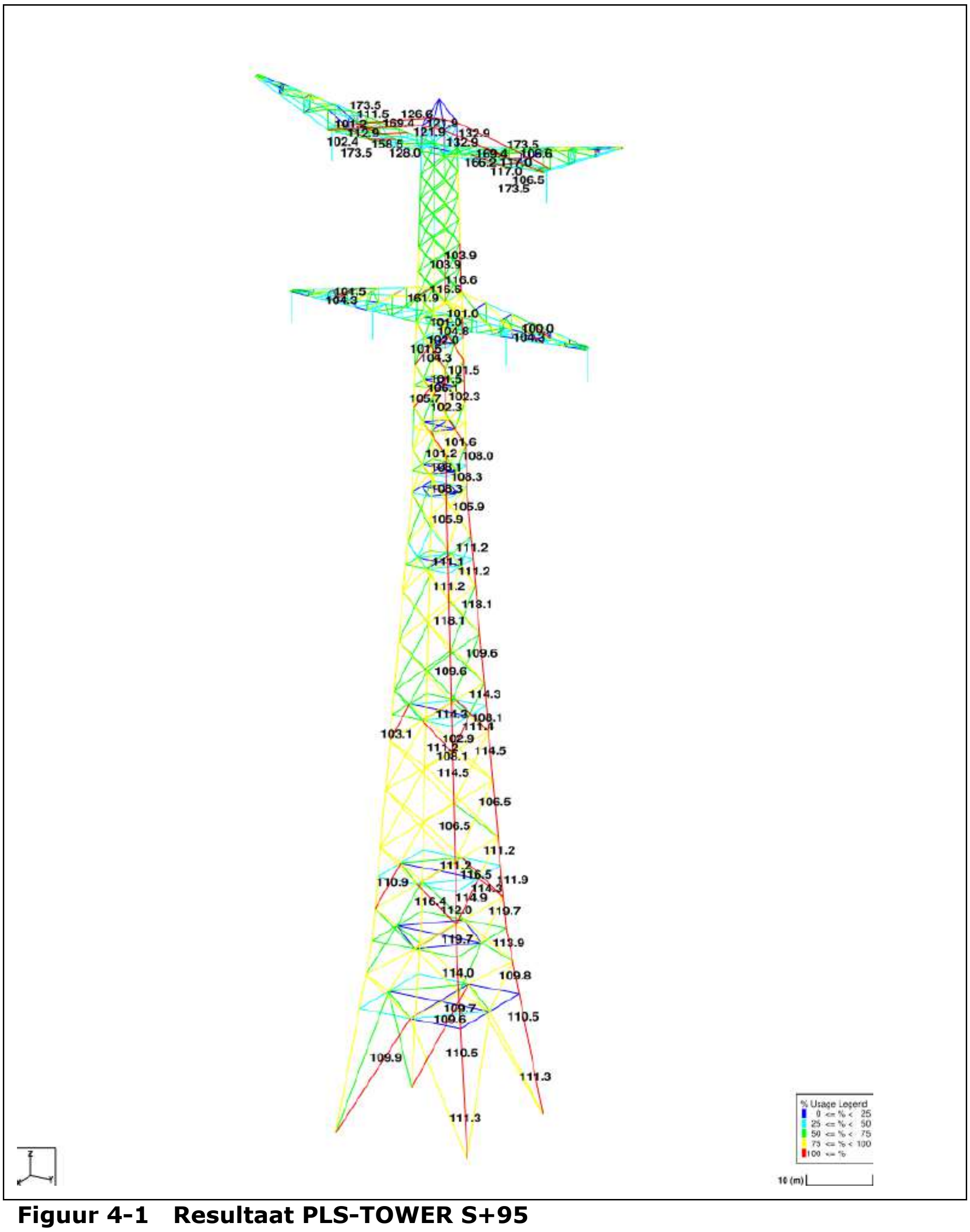
4 TOETSING MAST

4.1 Inleiding

Voor het globale model van de mast is PLS-TOWER gehanteerd. Hierin zijn de gegevens verwerkt die volgen uit de berekeningen aan de stabiliteit van de randstijl (Appendix F) en de sterkte van boutverbindingen (Appendix D). Via aangepaste kniklengte-factoren in PLS-TOWER is de torsieknik-capaciteit ingevoerd. Berekening van mast 12 en 13 is gelijk genomen en gebaseerd op de zwaarst belaste mast 13 (S+95 T).

4.2 Resultaat PLS-TOWER

Het resultaat van de controle van masttype S+95 T met belastingen op afkeurniveau en referentieperiode 15 jaar is weergegeven in Figuur 4-1.



Figuur 4-1 Resultaat PLS-TOWER S+95

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 4-1 Appendix D
Knikverkorters		Voldoen niet	Appendix C
Ankers en voetplaat	Voldoen		Appendix D

De berekening van masttype S+95 toont aan dat ruime overschrijdingen aanwezig zijn op de sterkte van de constructie. Deze zijn van grotere omvang dan vergelijkbaar masttype S+75. Het verschil wordt toegeschreven aan de locatie van masttype S+95 in windgebied II. De windbelasting op de constructie wordt verder vergroot door de omvang van hulpbordessen en andere onderdelen.

5 AANPASSINGEN

5.1 Inleiding

In dit hoofdstuk worden de mastverzwaringen beschreven die volgen uit de studie, zodat de aangepaste constructie voldoet aan het afkeurniveau en de verzwaarde onderdelen aan verbouwniveau. Voor niet aangepaste onderdelen waar knikverkorters of andere steunen worden toegevoegd, blijft het afkeurniveau van toepassing. Een aantal van de overschrijdingen op de sterkte van de constructie is overeenkomstig met wat bij andere masttypes optreedt. Deze overschrijdingen zijn met de volgende set van maatregelen op te lossen:

- Het lokaal versterken met platen van verbindingen met onvoldoende capaciteit op netto-doorsnede;
- het uitwisselen van diagonalen in boven en ondertraverses, door exemplaren met grotere doorsnede en hogere staalsoort;
- het uitwisselen van bouten in meerdere profielen;
- het uitwisselen van bestaande knikverkorters door exemplaren van zwaarder profiel of grotere boutdoorsnede;
- het versterken van verbindingen tussen kruisende diagonalen en randstijlen in de mast.

De overschrijding op de drukcapaciteit van de randstijl die is gevonden over een groot gedeelte van de hoogte van het mastlichaam is te hoog om op te lossen met het toevoegen van knikverkorters. Dit geldt zeker voor de kruisprofielen uit hoekstaal. Een separate studie is uitgevoerd naar de stabiliteit van de kruisvormige profielen van INP-profiel en hoekstaal en de optimale oplossing om deze te versterken. De studie is opgenomen in Appendix F. De randstijlen van de mast worden op de volgende wijze verzwaard:

- het uitwisselen van bouten voor exemplaren met kwaliteit 8.8;
- het aanbrengen van strippen van 20 of 25 mm dikte op de bestaande flenzen van de randstijlen uit INP- en hoekstaal;
- het toevoegen van kniksteunen waarmee de torsiestabiliteit van de randstijl wordt verhoogd;
- het aanbrengen van koppelplaten tussen de flenzen van de INP-profielen waarmee de torsiestijfheid van het profiel wordt vergroot.

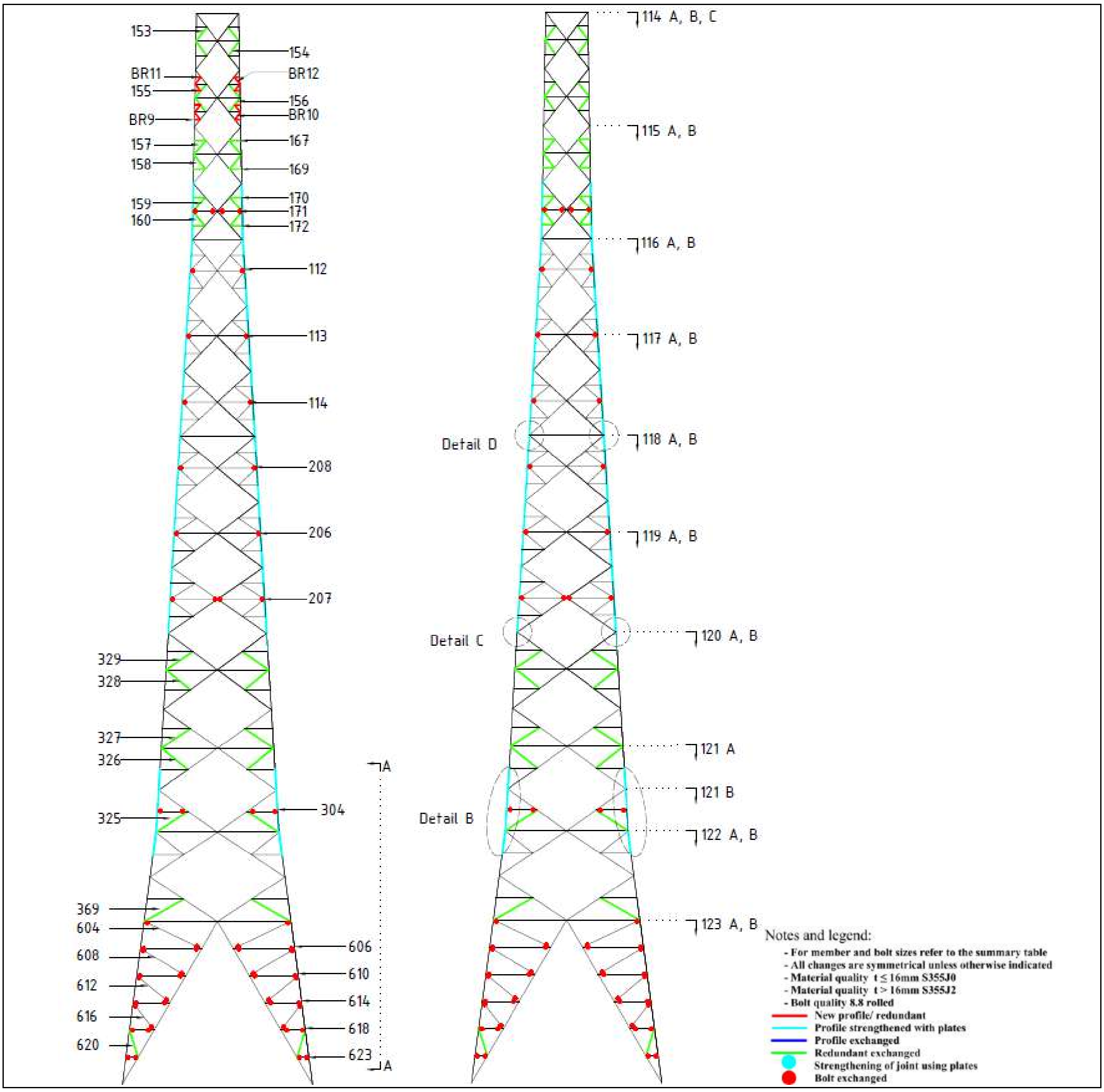
Het betreft een aandachtspunt dat de aanwezigheid van waarschuwingslichten, platforms of andere obstakels het aanbrengen van de aanpassingen kunnen bemoeilijken. Het is noodzakelijk dat er een haalbaarheidsstudie wordt uitgevoerd vóór de uitvoering van dit project.

5.2 Aanpassingen

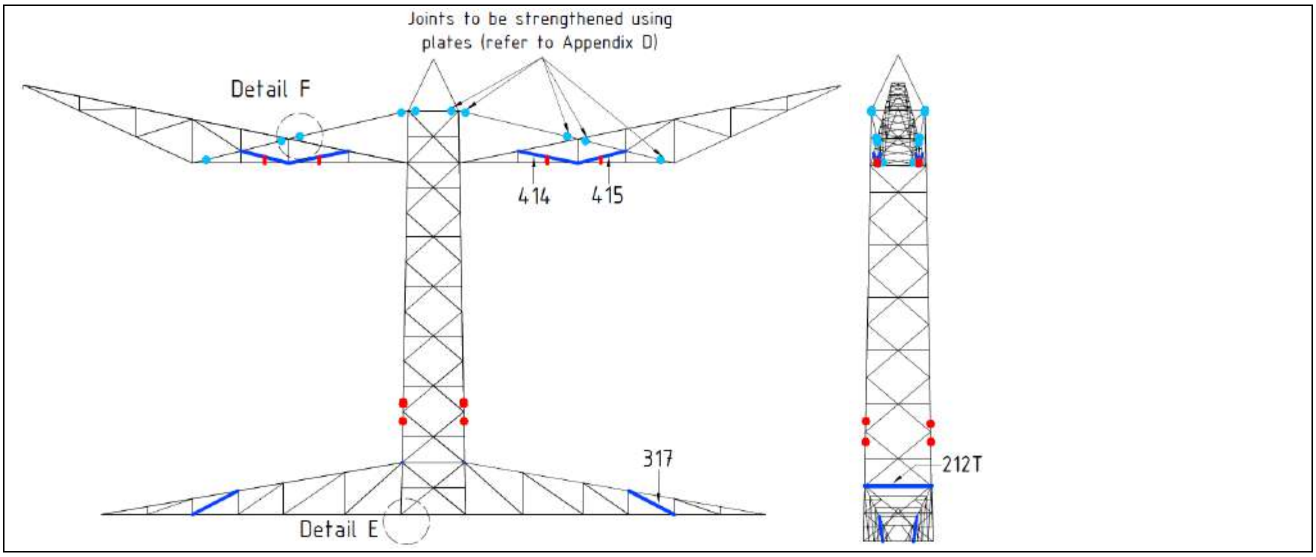
In deze paragraaf wordt nader ingegaan op de voorgestelde verzwaringen aan de constructie.

5.2.1 Overzicht van verzwaringen aan profielen

Conform berekening, zie Appendix B, moet de constructie worden aangepast, zoals weergegeven in Figuur 5-1 en Figuur 5-2 voor de betreffende masten. Voor afmetingen profielen en bouten, zie Appendix E.



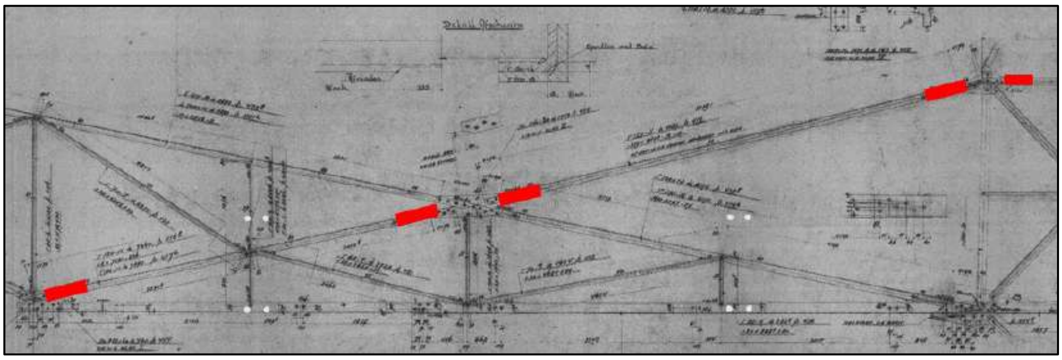
Figuur 5-1 Aanpassingen aan mastlichaam. Voor volledig overzicht zie Appendix E



Figuur 5-2 Benodigde aanpassingen aan de traversen

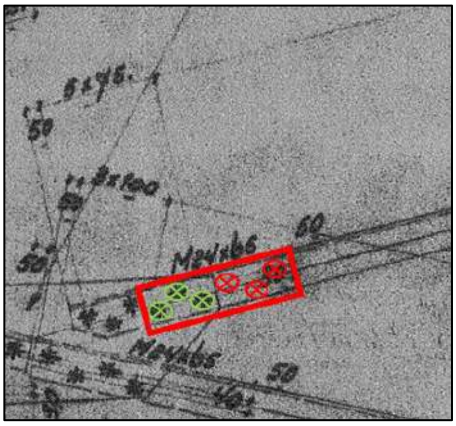
5.2.2 Verhogen capaciteit nettodoorsnede

Voor masttype S+95 is aanpassing benodigd om de trekstaven die de boventraverse aan het mastlichaam verbinden te verzwaren. De aanpassingen zijn nodig om de capaciteit van de netto doorsnede te verhogen door het toevoegen van staalplaten met een dikte van 10 mm. In Figuur 5-3 zijn de posities van de platen weergegeven.



Figuur 5-3 Posities waarvoor een hogere capaciteit benodigd is

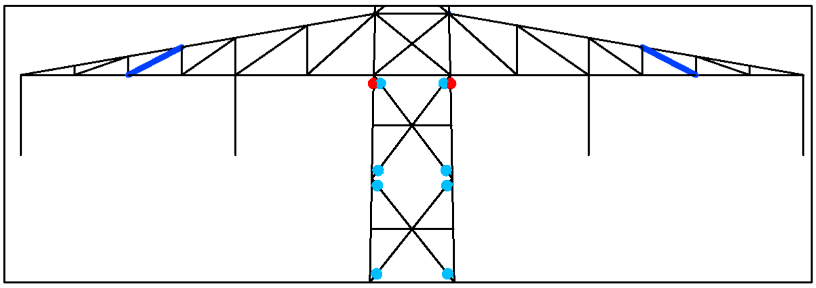
Bij elke verbinding zijn reeds 6 bouten aanwezig, 3 van deze 6 bouten worden gebruikt om de nieuwe plaat aan te verbinden en 3 nieuwe bouten worden toegevoegd. Voor principe, zie Figuur 5-4. De nieuwe bouten zijn in het rood weergegeven en de bestaande bouten in het groen.



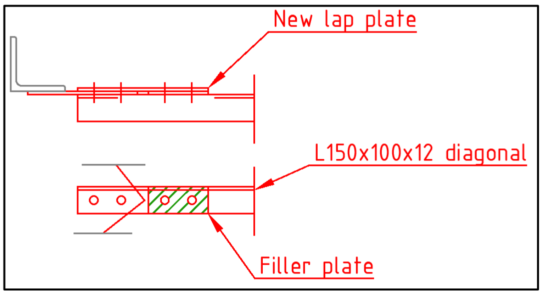
Figuur 5-4 Verbinding van de plaat aan de bestaande staaf

Voor relevante berekening van de sterkte van de platen, zie Appendix D.

Bij een aantal van de diagonalen in het mastlichaam is een gelijksoortige aanpassing vereist aan de kruisende diagonalen in het mastlichaam beneden de ondertraverse. De locaties van deze aanpassingen zijn aangegeven in Figuur 5-5, in Figuur 5-6 is het principe weergegeven.



Figuur 5-5 Aanpassingen diagonalen mastlichaam



Figuur 5-6 Voorstel voor versterken van diagonalen met overlappende verbinding

5.2.3 Versterken van randstijlen

Vanwege de complexiteit van de samengestelde randstijl is met een eindige elementen model de volgende aspecten onderzocht:

- Torsieknikstabiliteit;
- gecombineerde spanningen door buiging en axiaalkracht;
- flexibele ondersteuning van de randstijl vanuit de diagonalen.

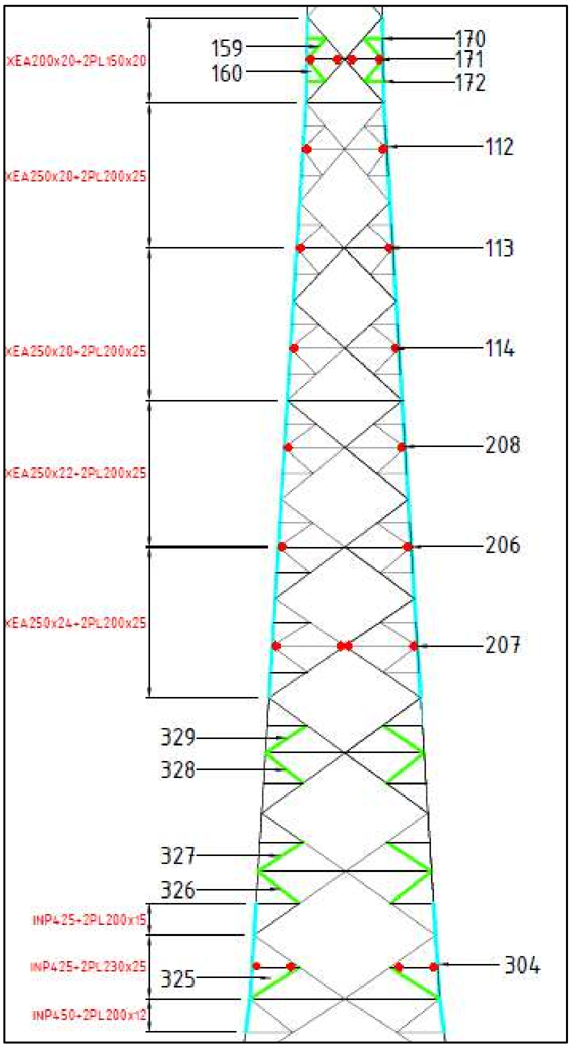
De studie van de AxisVM analyse toont dat de volgende modificaties benodigd zijn:

- versterken van de randstijlen met platen van 20 of 25 mm dikte vanaf de ondertraverse groep 115 tot en met groep 119 en inclusief de groepen 121A, 122A en 122B;
- het aanbrengen van extra diagonale profielen om de randstijl tegen rotatie te steunen;
- het aanbrengen van koppelplaten tussen de flenzen om de torsiestijfheid te verhogen.

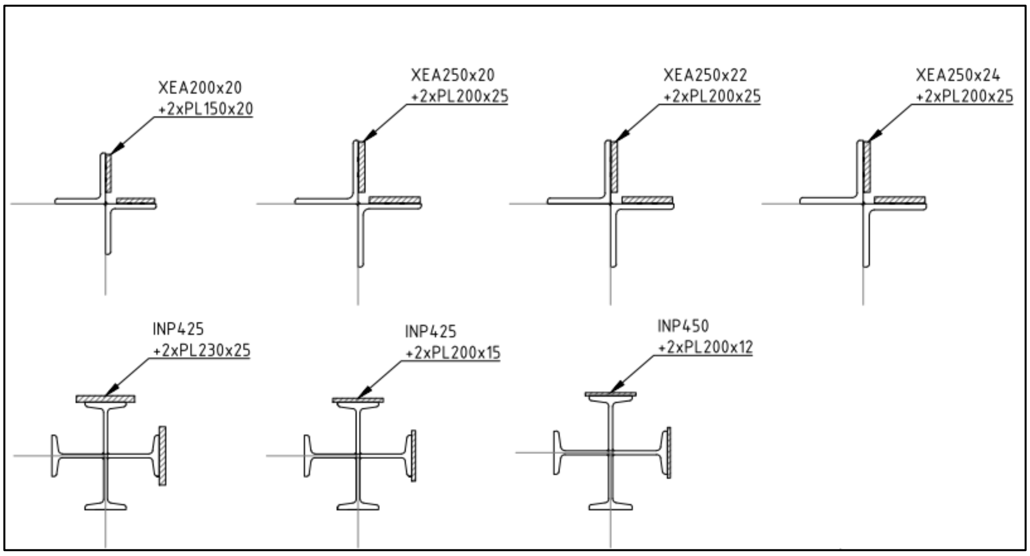
Gedetailleerde informatie is opgenomen in Appendix F.

Knikverkorters moeten minimaal een knikcapaciteit hebben van 1% van de knikcapaciteit van de randstijl. Over een groot gedeelte van de mast hebben de knikverkorters deze sterkte niet. Deze knikverkorters moeten vervangen worden door staven met een grotere doorsnede, omdat de knikcontrole veelal maatgevend is. Zie de groen gekleurde staven in Figuur 5-1 en Figuur 5-7.

De profielen met de platen als versterking zijn weergegeven in Figuur 5-6 en Figuur 5-7. De bestaande doorsnedes die versterkt worden met platen zijn gedimensioneerd op de belasting op basis van verbouwniveau. Hierdoor valt de doorsnede relatief zwaar uit ten opzichte van het relatief geringe tekort bij afkeurniveau.



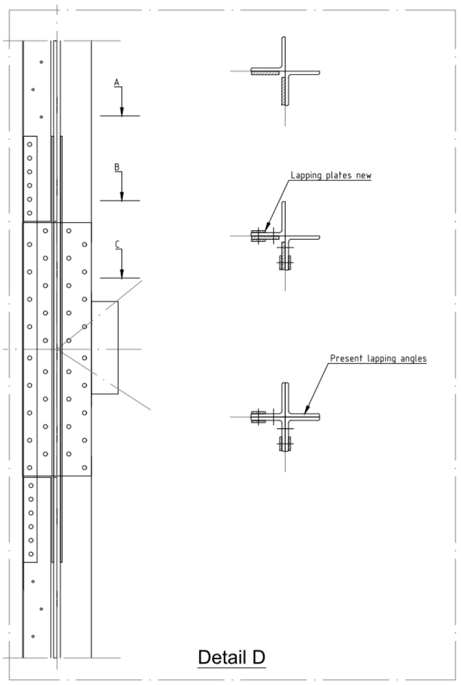
Figuur 5-7 Posities waarvoor een hogere capaciteit benodigd is



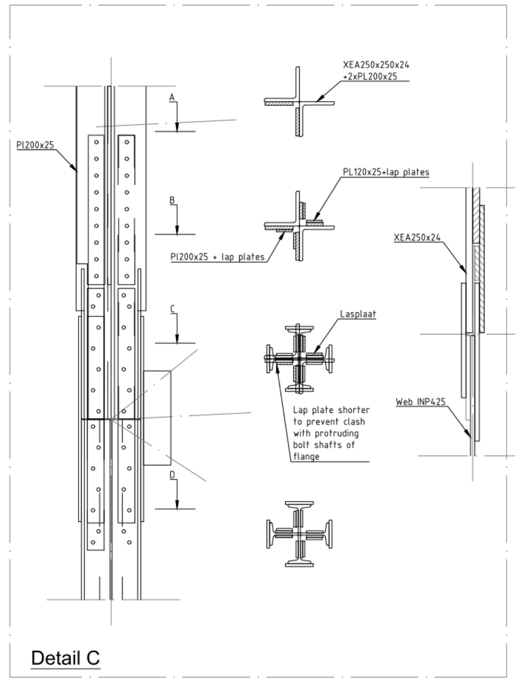
Figuur 5-8 Verzwaarde doorsneden van de randstijl

5.2.4 Verbindingen randstijl

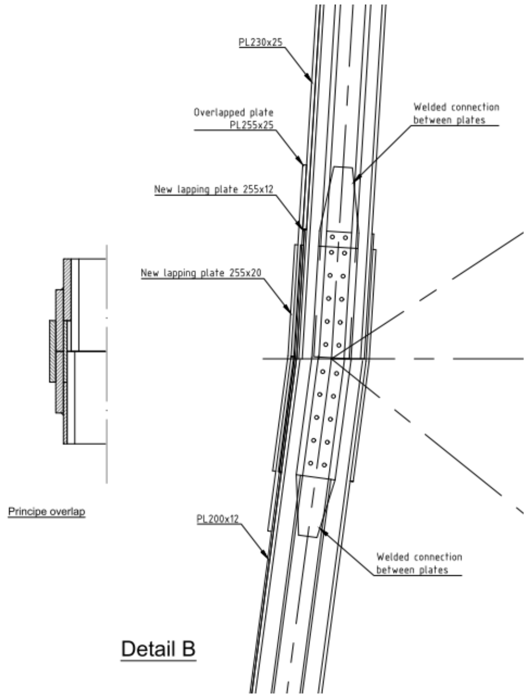
De belangrijkste verbindingen in de randstijl zijn op detailniveau beschouwd om de haalbaarheid (passen) van de verbinding te bepalen. In Appendix D zijn de details nader beschouwd. In Figuur 5-9 zijn de details samengevat.



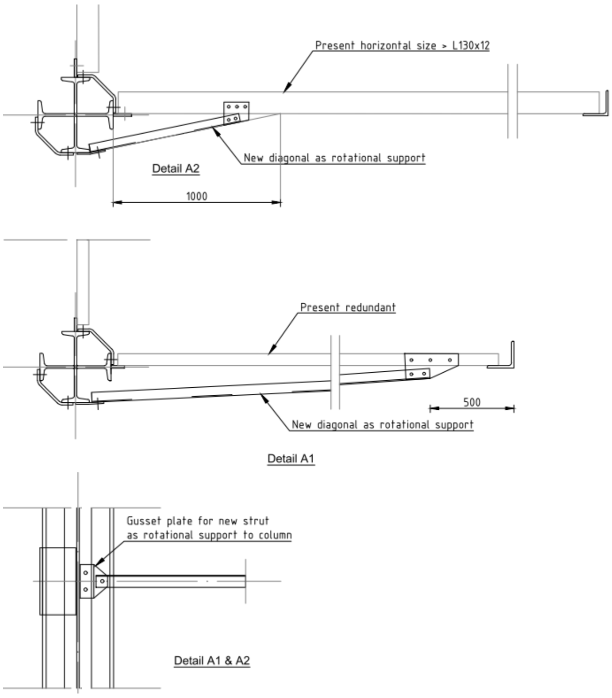
Splice joint between reinforced cruciform angle sections.



Transition of reinforced cruciform angle section to INP-section.



Transition of INP425 to INP450 section

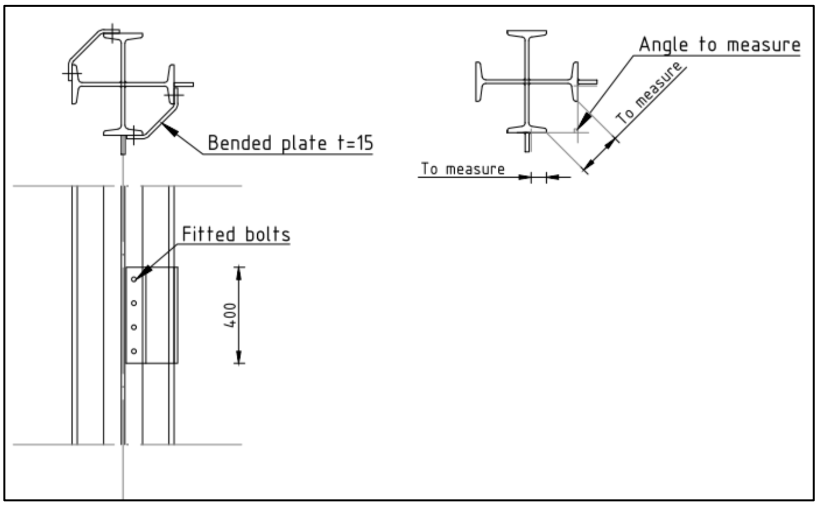


Rotational supports

Figuur 5-9 Versterking van verbinding randstijl

5.2.5 Koppelplaten

Het detail van de koppelplaten tegen twee van de vier flenzen van het INP-profiel is in Figuur 5-10 opgenomen. In de basis moeten deze koppelplaten ter plaatse van iedere knikverkorter in de constructie worden aangebracht. In het zwaarst belaste gedeelte van de randstijl, nabij de hellingsverandering op 30 m hoogte, moeten twee paar platen tussen iedere steun aanwezig zijn. Zie verder Appendix E.



Figuur 5-10 Koppelplaten tegen de INP450 en INP425-profielen

5.2.6 Gewicht benodigde profielen

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de aanpassingen zijn weergegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

Tabel 5 Gewichten profielen voor aanpassingen

Staaf-groep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Nr	Lengte (m)	Gewicht (kg)
118A	XEA 250.22	S235	36M30-5.6t	XEA250.22+ PL200x25	S235 (staaf) S355 (platen)	36M30-8.8t	Versterkt met platen	8	7.85	2464.90
118B	XEA 250.22	S235	36M30-5.6t	XEA250.22+ PL200x25	S235 (staaf) S355 (platen)	36M30-8.8t	Versterkt met platen	8	3.75	1177.50
119A	XEA 250.24	S235	36M30-5.6t	XEA250.24+ PL200x25	S235 (staaf) S355 (platen)	36M30-8.8t	Versterkt met platen	8	4.10	1287.40
119B	XEA 250.24	S235	68M24-5.6t	XEA250.24+ PL200x25	S235 (staaf) S355 (platen)	68M24-8.8t	Versterkt met platen	8	7.85	2464.90
120A	INP 425	S235	68M24-5.6t	INP 425	S235	68M24-8.8t	Bout uitgewisseld			
120B	INP 425	S235	56M24-5.6t	INP 425	S235	56M24-8.8t	Bout uitgewisseld			
121A	INP 425	S235	56M24-5.6t	INP 425	S235	56M24-8.8t	Bout uitgewisseld			
121B	INP 425	S235	64M24-5.6t	INP425+PL2 30x25	S235 (staaf) S355 (platen)	64M24-8.8t	Versterkt met platen	8	10.29	2709.03
122A	INP 450	S235	56M24-5.6t	INP 450	S235	56M24-8.8t	Bout uitgewisseld			
122B	INP 450	S235	56M24-5.6t	INP 450	S235	56M24-8.8t	Bout uitgewisseld			
123A	INP 450	S235	56M24-5.6t	INP 450	S235	56M24-8.8t	Bout uitgewisseld			
123B	INP 450	S235	56M24-5.6t	INP 450	S235	56M24-8.8t	Bout uitgewisseld			
245L	L150.10	S235	1M30-5.6t	L150.10	S235	1M30-8.8t	Bout uitgewisseld			
245T	L150.10	S235	1M30-5.6t	L150.10	S235	1M30-8.8t	Bout uitgewisseld			
250L	L160.15	S235	2M24-5.6t	L160.15	S235	2M24-8.8t	Bout uitgewisseld			
250T	L160.15	S235	2M24-5.6t	L160.15	S235	2M24-8.8t	Bout uitgewisseld			
256LB	L150.10	S235	2M24-5.6t	L150.10	S235	2M24-8.8t	Bout uitgewisseld			
414	L70.7	S235	1M16-5.6t	DBL L70.7	S235 bestaand S355 nieuw	1M16-8.8t	Profiel toegevoegd aan bestaand	4	4.80	142.39
415	L65.7	S235	1M16-5.6t	DBL L65.7	S235 bestaand S355 nieuw	1M16-8.8t	Profiel toegevoegd aan bestaand	4	3.90	107.54
108B	L180.16	S235	12M24-5.6t	L180.16	S235	12M24-8.8t	Bout uitgewisseld			
109A	L200.20	S235	8M30-5.6t	L200.20	S235	8M30-8.8t	Bout uitgewisseld			
212T	L80.8	S235	2M20-5.6t	L100.10	S355	2M20-8.8t	Profiel uitgewisseld	2	4.80	145.73
317	L60.6	S235	1M16-5.6t	L60.6	S355	1M16-8.8t	Profiel uitgewisseld	4	3.96	86.32
114A	L250.22	S235	18M30-5.6t	L250.22	S235	18M30-5.6t	Knikverkorter toegevoegd			
114B	L250.22	S235	14M30-5.6t	L250.22	S235	14M30-8.8t	Bout uitgewisseld			
114C	L250.22	S235		L250.22	S235		Knikverkorter toegevoegd			
216L	L150.100.12	S235	2M30-5.6t	L150.100.12	S235	2M30-8.8t	Verbinding versterkt			
217L	L150.100.12	S235	2M30-5.6t	L150.100.12	S235	2M30-8.8t	Verbinding versterkt			
224L	L150.100.12	S235	2M30-5.6t	L150.100.12	S235	2M30-8.8t	Bout uitgewisseld			
115A	XEA200.20	S235	28M30-5.6t	XEA200.20+ PL150x20	S235 (staaf) S355 (platen)	28M30-8.8t	Versterkt met platen	8	6.80	1281.12
116A	XEA250.20	S235	28M30-5.6t	XEA250.20+ PL200x25	S235 (staaf) S355 (platen)	28M30-8.8t	Versterkt met platen	8	7.85	2464.90
116B	XEA250.20	S235	32M30-5.6t	XEA250.20+ PL200x25	S235 (staaf) S355 (platen)	32M30-8.8t	Versterkt met platen	8	3.65	1146.10
117A	XEA250.20	S235	32M30-5.6t	XEA250.20+ PL200x25	S235 (staaf) S355 (platen)	32M30-8.8t	Versterkt met platen	8	4.25	1334.50
117B	XEA250.20	S235	36M30-5.6t	XEA250.20+ PL200x25	S235 (staaf) S355 (platen)	36M30-8.8t	Versterkt met platen	8	7.85	2464.90
623	L65.7	S235	1M20-5.6t	L65.7	S235	1M20-8.8t	Bout uitgewisseld			
620	L80.8	S235	1M20-5.6t	L80.8	S355	1M20-8.8t	Profiel uitgewisseld	8	3.09	243.24
618	L100.8	S235	1M20-5.6t	L100.8	S235	1M20-8.8t	Bout uitgewisseld			
616	L100.10	S235	1M20-5.6t	L100.10	S235	1M20-8.8t	Bout uitgewisseld			
614	L110.10	S235	1M20-5.6t	L110.10	S235	1M20-8.8t	Bout uitgewisseld			
612	L110.10	S235	1M20-5.6t	L110.10	S235	1M20-8.8t	Bout uitgewisseld			
610	L130.12	S235	1M20-5.6t	L130.12	S235	1M20-8.8t	Bout uitgewisseld			
608	L120.11	S235	1M20-5.6t	L120.11	S235	1M20-8.8t	Bout uitgewisseld			
606	L150.10	S235	1M20-5.6t	L150.10	S235	1M20-8.8t	Bout uitgewisseld			
604	L150.10	S235	1M20-5.6t	L150.10	S235	1M20-8.8t	Bout uitgewisseld			
369	L100.10	S235	1M24-5.6t	L120.10	S355	1M24-8.8t	Profiel uitgewisseld	8	5.01	743.88
325	L100.8	S235	1M20-5.6t	L100.10	S355	1M20-8.8t	Profiel uitgewisseld	8	4.25	522.24
304	L100.10	S235	1M20-5.6t	L100.10	S235	1M20-8.8t	Bout uitgewisseld			
326	L80.8	S235	1M16-5.6t	L100.10	S355	1M20-8.8t	Profiel uitgewisseld	8	3.77	463.26
327	L80.8	S235	1M20-5.6t	L100.10	S355	1M20-8.8t	Profiel uitgewisseld	8	3.87	475.55
328	L70.7	S235	1M20-5.6t	L100.8	S355	1M20-8.8t	Profiel uitgewisseld	8	3.49	346.21
329	L70.7	S235	1M20-5.6t	L100.8	S355	1M20-8.8t	Profiel uitgewisseld	8	3.58	355.14
207	L120.11	S235	1M20-5.6t	L120.11	S235	1M20-8.8t	Bout uitgewisseld			
206	L120.11	S235	1M20-5.6t	L120.11	S235	1M20-8.8t	Bout uitgewisseld			
208	L110.10	S235	1M20-5.6t	L110.10	S235	1M20-8.8t	Bout uitgewisseld			

Staaf-groep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Nr	Lengte (m)	Gewicht (kg)
114	L100.8	S235	1M20-5.6t	L100.8	S235	1M20-8.8t	Bout uitgewisseld			
113	L100.8	S235	1M20-5.6t	L100.8	S235	1M20-8.8t	Bout uitgewisseld			
112	L100.8	S235	1M20-5.6t	L100.8	S235	1M20-8.8t	Bout uitgewisseld			
172	L60.6	S235	1M16-5.6t	L60.6	S355	1M16-8.8t	Profiel uitgewisseld	8	1.38	61.03
160	L50.5	S235	1M16-5.6t	L60.8	S355	1M16-8.8t	Profiel uitgewisseld	8	2.12	122.51
171	L80.8	S235	1M16-5.6t	L80.8	S235	1M16-8.8t	Bout uitgewisseld			
159	L50.5	S235	1M16-5.6t	L60.8	S355	1M16-8.8t	Profiel uitgewisseld	8	2.19	126.55
170	L60.6	S235	1M16-5.6t	L60.6	S355	1M16-8.8t	Profiel uitgewisseld	8	1.38	61.03
169	L50.5	S235	1M16-5.6t	L55.6	S355	1M16-8.8t	Profiel uitgewisseld	8	1.32	53.31
158	L50.5	S235	1M16-5.6t	L60.8	S355	1M16-8.8t	Profiel uitgewisseld	8	2.08	120.19
157	L50.5	S235	1M16-5.6t	L60.8	S355	1M16-8.8t	Profiel uitgewisseld	8	2.14	123.66
167	L50.5	S235	1M16-5.6t	L55.6	S355	1M16-8.8t	Profiel uitgewisseld	8	1.30	52.38
156	L50.5	S235	1M16-5.6t	L60.8	S355	1M16-8.8t	Profiel uitgewisseld	8	2.03	117.30
155	L50.5	S235	1M16-5.6t	L60.6	S355	1M16-8.8t	Profiel uitgewisseld	8	2.07	91.72
154	L50.5	S235	1M16-5.6t	L55.6	S355	1M16-8.8t	Profiel uitgewisseld	8	2.00	80.77
153	L50.5	S235	1M16-5.6t	L60.6	S355	1M16-8.8t	Profiel uitgewisseld	8	2.07	91.54
BR9				L50.5	S355	1M16-8.8t	Profiel toegevoegd	8	0.69	21.20
BR10				L50.5	S355	1M16-8.8t	Profiel toegevoegd	8	1.11	34.10
BR11				L50.5	S355	1M16-8.8t	Profiel toegevoegd	8	0.67	20.58
BR12				L50.5	S355	1M16-8.8t	Profiel toegevoegd	8	1.05	32.26
RS1				L60.6	S355	1M16-8.8t	Profiel toegevoegd	4	0.98	21.67
RS2				L70.7	S355	1M16-8.8t	Profiel toegevoegd	4	2.42	72.79
RS3				L80.6	S355	1M16-8.8t	Profiel toegevoegd	4	3.87	115.76
RS4				L80.6	S355	1M16-8.8t	Profiel toegevoegd	4	3.16	94.52
RS5				L80.6	S355	1M16-8.8t	Profiel toegevoegd	4	3.16	94.52
RS6				L70.7	S355	1M16-8.8t	Profiel toegevoegd	4	2.88	86.63
RS7				L70.7	S355	1M16-8.8t	Profiel toegevoegd	4	2.88	86.63
RS8				L60.6	S355	1M16-8.8t	Profiel toegevoegd	4	2.57	56.83
RS9				L60.6	S355	1M16-8.8t	Profiel toegevoegd	4	2.57	56.83
RS10				L50.5	S355	1M16-8.8t	Profiel toegevoegd	60	1.00	230.40
Koppel platen (INP 450)				Plaat t=15 mm	S355			88		1554.30
Koppel platen (INP 425)				Plaat t=15 mm	S355			120		1978.20
								582	**159.85**	**28085.97**

5.3 Eisen verificatie

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 1060:1964?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.589.40 0817486 - 20-0473 - Verificatie & validatieplan 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

[2] „002.589.40 0808624 - 20-0472 - E-studie deel 1 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

[3] „002.589.40 0808629 - 20-0345 - Uitgangspuntenrapport 380kV verbinding Krimpen aan de IJssel - Geertruidenberg".

APPENDIX A GELEIDERBELASTINGEN

Content

Data

Norm	NEN-EN50341-2-15:2019
Initial	
Consequence class	CC2-0
Reliability level	Afkeur
Reference period	15 jaar
After adjustment	
Consequence class	CC2
Reliability level	Verbouw
Reference period	50 jaar
Wind zone	II
Wind speed	27 m/s
Terrain categorie	II
Reduction factor Cdir	1,00
Ice region	B
Tower type	Steunmast
Tower height	162,5 m
Max. Span	701 m
Line angle	180°
Catenary	1400 m
Wind span	569 m
EDS Weight span	895 m
Min. Weight span	811 m
Max. Weight span	1680 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-04-06			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype S+95 II

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

Document name:

KIJ-GT_S+95 II_12_Report.pdf

Project number:

Project client number:

0.0

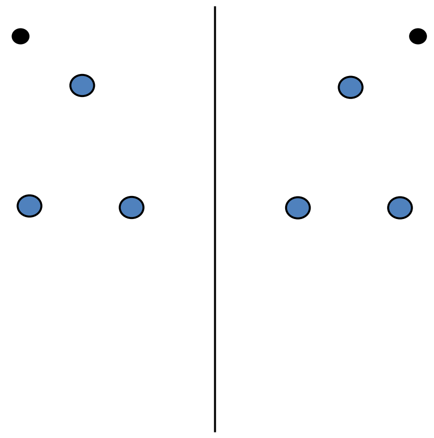
Project: KIJ-GT
Tower: S+95 II
Number: 12

Conductor loads

Auteur: TBR
Versie: v11.7

General

Description	S+95 II
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	15 jaar
Consequence class modified	CC2
Reliability level modified	Verbouw
Reference period modified	50 jaar
Wind zone	II
Wind speed (m/s)	27,0 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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Halfverankering	3,00	4,30	1,50
Circuit 2	Halfverankering	3,00	4,30	1,50
Bliksemdraad 1	Vast (Bliksemdraad)	0,20	0,30	0,10
Bliksemdraad 2	Vast (Bliksemdraad)	0,20	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	123,7 m	128,0 m	25,5 m
Circuit 1	11	380ct1f2	123,7 m	128,0 m	11,5 m
Circuit 1	12	380ct1f3	150,7 m	155,0 m	18,5 m
Circuit 2	20	380ct2f1	123,7 m	128,0 m	-11,5 m
Circuit 2	21	380ct2f2	123,7 m	128,0 m	-25,5 m
Circuit 2	22	380ct2f3	150,7 m	155,0 m	-18,5 m
Bliksemdraad 1	1	bl1	160,7 m	161,0 m	31,5 m
Bliksemdraad 2	3	bl2	160,7 m	161,0 m	-31,5 m

Project: KIJ-GT
Tower: S+95 II
Number: 12

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

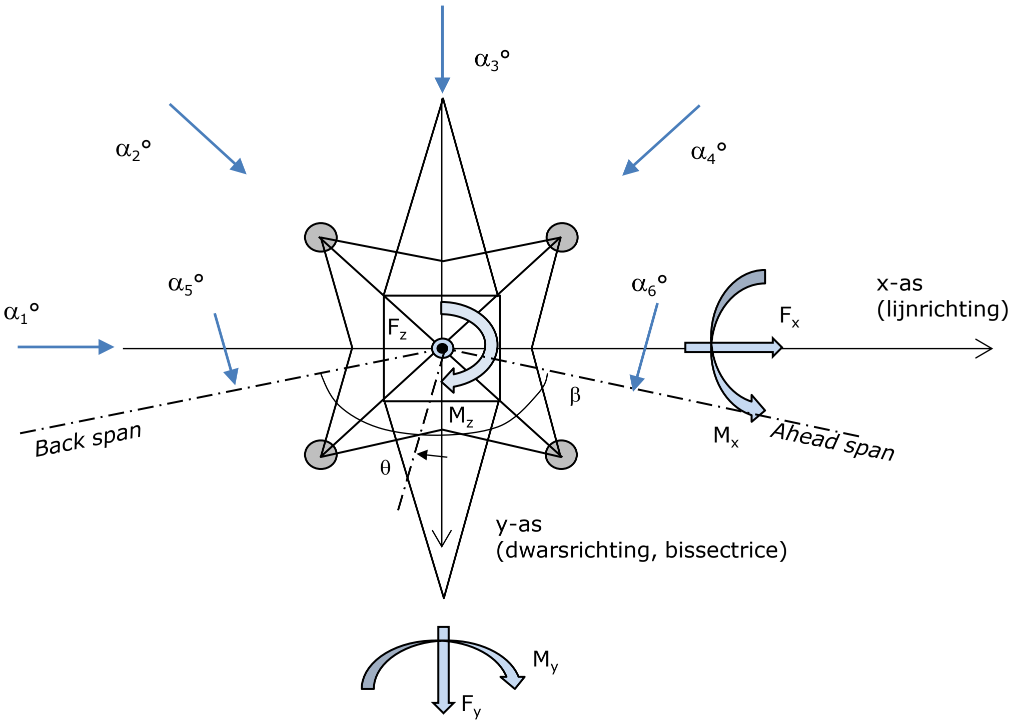
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	-76,9	-0,4 m	8,0	0,0 m
Circuit 1	11	380ct1f2	-76,9	-0,4 m	2,0	0,0 m
Circuit 1	12	380ct1f3	-91,9	-0,4 m	5,0	0,0 m
Circuit 2	20	380ct2f1	-76,9	-0,4 m	-2,0	0,0 m
Circuit 2	21	380ct2f2	-76,9	-0,4 m	-8,0	0,0 m
Circuit 2	22	380ct2f3	-91,9	-0,4 m	-5,0	0,0 m
Bliksemdraad 1	1	bl1	-94,6	-0,4 m	13,0	0,0 m
Bliksemdraad 2	3	bl2	-94,6	-0,4 m	-13,0	0,0 m

Line and tower data

		Back	Ahead
		436,0	701,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		552,7	552,7 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		2418	2418 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: KIJ-GT
Tower: S+95 II
Number: 12

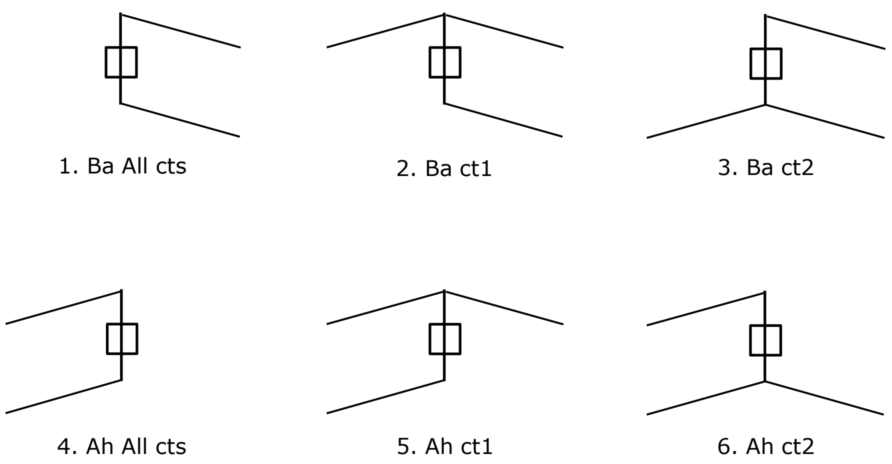
Absence of conductors

		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

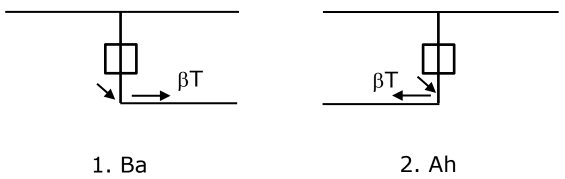
Principle of load situations:



Load situation 5a. Conductor failure

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

Principle of load situations:



Project: KIJ-GT
Tower: S+95 II
Number: 12

Load situations LC6. Construction and maintenance

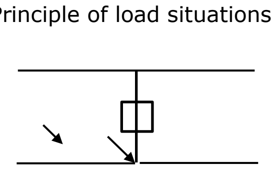
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations 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

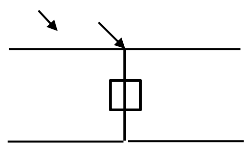
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

Presence line vehicle: Circuit, belasting tegelijk aanwezig in alle geleiders per circuit.

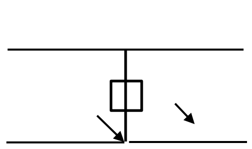
Principle of load situations:



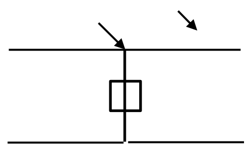
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

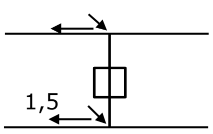
Load situations 8. Galloping as a static load

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

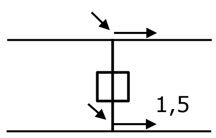
Considered situations galloping 8: None (existing structure)

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

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Project: KIJ-GT
Tower: S+95 II
Number: 12

Tower structure

Properties

Tower type	Steunmast		
Tower designation	S+95 II		
Base plate w.r.t. ground level	0,5		m
Tower height w.r.t. base plate	162,5		m
Tower self weight	2500,0		kN
Width and slope at foundation	x-ri.	y-ri.	
Leg spread	22,60	22,60	m
Inclination of main leg	0,133	0,133	-
Horizontal force factor	1,1	1,1	-

Calculation Wind load

Dynamic factor G_T	1,02
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 1	30,00	22,60	14,60	30,00	0,133	558,00	63,60	0,11	3,33
Middenstuk 1	65,58	14,60	10,26	35,58	0,061	442,26	73,04	0,17	3,09
Middenstuk 2	100,50	10,26	6,00	34,92	0,061	283,90	64,60	0,23	2,81
Bovenstuk 1	127,50	6,00	5,00	27,00	0,019	148,50	37,92	0,26	2,70
Bovenstuk 2	158,50	5,00	3,83	31,00	0,019	136,87	29,28	0,21	2,87
Topstuk	162,50	3,83		4,00		7,66	1,40	0,18	3,01
Ondertraverse	127,50	23,00		4,00		46,00	10,29	0,22	2,83
Boventraverse	154,50	29,50		6,00		88,50	14,56	0,16	3,09

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 1	30,00	22,60	14,60	30,00	0,133	558,00	63,60	0,11	3,33
Middenstuk 1	65,58	14,60	10,26	35,58	0,061	442,26	73,04	0,17	3,09
Middenstuk 2	100,50	10,26	6,00	34,92	0,061	283,90	64,60	0,23	2,81
Bovenstuk 1	127,50	6,00	5,00	27,00	0,019	148,50	37,92	0,26	2,70
Bovenstuk 2	158,50	5,00	3,83	31,00	0,019	136,87	29,28	0,21	2,87
Topstuk	162,50	3,83		4,00		7,66	1,40	0,18	3,01
Ondertraverse	127,50	23,00		4,00		46,00	10,29	0,22	2,83
Boventraverse	154,50	29,50		6,00		88,50	14,56	0,16	3,09

Note: Surface transverse direction is reduced in calculation.

Project: KIJ-GT
Tower: S+95 II
Number: 12

Wind surface feeders telecom installations

Part	A (m^2/m)	Factor	Δh	A_1
Broekstuk 1				
Middenstuk 1				
Middenstuk 2				
Bovenstuk 1				
Bovenstuk 2				

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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 1	0,97	206,7	175,4	0,0	-175,4	15,0	3100,9	2631,2	0,0	-2631,2
Middenstuk 1	1,36	307,3	260,8	0,0	-260,8	47,8	14685,9	12461,4	0,0	-12461,4
Middenstuk 2	1,57	284,8	241,6	0,0	-241,6	83,0	23647,8	20065,8	0,0	-20065,8
Bovenstuk 1	1,69	173,2	147,0	0,0	-147,0	114,0	19748,7	16757,3	0,0	-16757,3
Bovenstuk 2	1,78	149,5	126,9	0,0	-126,9	143,0	21384,8	18145,6	0,0	-18145,6
Topstuk	1,83	7,7	6,5	0,0	-6,5	160,5	1232,2	1045,6	0,0	-1045,6
Ondertraverse	1,74	101,2	60,1	0,0	-60,1	128,8	13038,4	7744,4	0,0	-7744,4
Boventraverse	1,82	163,4	97,0	0,0	-97,0	156,5	25566,1	15185,5	0,0	-15185,5
Totaal		1393,8	1115,4	0,0	-1115,4		122404,8	94036,8	0,0	-94036,8

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 1	0,97	0,0	175,4	206,7	175,4	15,0	0,0	2631,2	3100,9	2631,2
Middenstuk 1	1,36	0,0	260,8	307,3	260,8	47,8	0,0	12461,4	14685,9	12461,4
Middenstuk 2	1,57	0,0	241,6	284,8	241,6	83,0	0,0	20065,8	23647,8	20065,8
Bovenstuk 1	1,69	0,0	147,0	173,2	147,0	114,0	0,0	16757,3	19748,7	16757,3
Bovenstuk 2	1,78	0,0	126,9	149,5	126,9	143,0	0,0	18145,6	21384,8	18145,6
Topstuk	1,83	0,0	6,5	7,7	6,5	160,5	0,0	1045,6	1232,2	1045,6
Ondertraverse	1,74	0,0	60,1	40,5	60,1	128,8	0,0	7744,4	5215,3	7744,4
Boventraverse	1,82	0,0	97,0	65,3	97,0	156,5	0,0	15185,5	10226,4	15185,5
Total		0,0	1115,4	1235,1	1115,4		0,0	94036,8	99242,1	94036,8

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	2500	0	0	0
Windrichting 0°	1394	0	0	0	124853	0
Windrichting 45°	1115	1115	0	95918	95918	0
Windrichting 90°	0	1235	0	101227	0	0
Windrichting 135°	-1115	1115	0	95918	-95918	0

Project: KIJ-GT
Tower: S+95 II
Number: 12

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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,3	1,5	126,35	1,73	1,2	3,11
380ct1f2	3,00	1	3	4,3	1,5	126,35	1,73	1,2	3,11
380ct1f3	3,00	1	3	4,3	1,5	153,35	1,81	1,2	3,25
380ct2f1	3,00	1	3	4,3	1,5	126,35	1,73	1,2	3,11
380ct2f2	3,00	1	3	4,3	1,5	126,35	1,73	1,2	3,11
380ct2f3	3,00	1	3	4,3	1,5	153,35	1,81	1,2	3,25
bl1	0,20	1	0,2	0,3	0,1	161,35	1,83	1,2	0,22
bl2	0,20	1	0,2	0,3	0,1	161,35	1,83	1,2	0,22

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Project: KIJ-GT
Tower: S+95 II
Number: 12

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	74,4	1,53	0,62	0,57	0,97	28,25	77,4	71,4	46,9	159,8	147,4
380ct1f2	74,4	1,53	0,62	0,57	0,97	28,25	77,4	71,4	46,9	159,8	147,4
380ct1f3	93,9	1,61	0,64	0,59	0,95	28,25	82,5	76,0	46,9	173,7	160,1
380ct2f1	74,4	1,53	0,62	0,57	0,97	28,25	77,4	71,4	46,9	159,8	147,4
380ct2f2	74,4	1,53	0,62	0,57	0,97	28,25	77,4	71,4	46,9	159,8	147,4
380ct2f3	93,9	1,61	0,64	0,59	0,95	28,25	82,5	76,0	46,9	173,7	160,1
bl1	103,3	1,65	0,64	0,59	1,09	22,24	25,8	23,7	41,5	53,0	48,8
bl2	103,3	1,65	0,64	0,59	1,09	22,13	25,7	23,7	41,4	52,9	48,7

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	94,7	1,62	0,64	0,59	0,95	28,25	82,7	76,2	46,9	174,3	160,6
380ct1f2	94,7	1,62	0,64	0,59	0,95	28,25	82,7	76,2	46,9	174,3	160,6
380ct1f3	121,7	1,72	0,66	0,60	0,92	28,25	88,1	81,2	46,9	190,0	175,0
380ct2f1	94,7	1,62	0,64	0,59	0,95	28,25	82,7	76,2	46,9	174,3	160,6
380ct2f2	94,7	1,62	0,64	0,59	0,95	28,25	82,7	76,2	46,9	174,3	160,6
380ct2f3	121,7	1,72	0,66	0,60	0,92	28,25	88,1	81,2	46,9	190,0	175,0
bl1	133,7	1,75	0,66	0,61	1,07	22,24	27,7	25,5	41,5	57,9	53,3
bl2	133,7	1,75	0,66	0,61	1,08	22,13	27,6	25,4	41,4	57,7	53,2

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class	Afkeur CC2-0
Reference period	15 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	1,02	0,00	0,0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0,90	1,05	0,00	1,02	0,00	0,0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0,90	0,90	0,00	1,02	0,00	0,0
ULS 3	Wind+ice	-5°	1,05	1,05	0,00	0,31	0,79	0,0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0,90	1,05	0,00	0,31	0,79	0,0
ULS 4	Cold+wind	-20°	1,05	1,05	0,00	0,20	0,00	0,0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0,90	1,05	0,00	0,20	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	0,20	0,00	0,0
ULS 6_0,9	Construction + maintenance	5°	1,05	1,05	0,00	0,20	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	0,87	0,0	0,0
SLS 3	Wind+ice	-5°	1,00	1,00	0,0	0,26	0,71	0,0
SLS 4	Wind	-20°	1,00	1,00	0,0	0,17	0,0	0,0
SLS 6	Maintenance	5°	1,00	1,00	0,0	0,17	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

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Project: KIJ-GT
Tower: S+95 II
Number: 12

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	-37,2	37,4	6,9	10,0	11,0	7,4
380ct1f1	-120,0	120,3	21,0	31,1	37,3	26,4
380ct1f2	-120,2	120,3	19,3	31,1	37,4	26,4
380ct1f3	-125,3	125,5	21,4	33,2	41,9	26,4
380ct2f1	-120,4	120,3	18,3	31,1	37,4	26,4
380ct2f2	-120,6	120,3	16,7	31,1	37,3	26,4
380ct2f3	-125,7	125,5	18,6	33,2	41,9	26,4
bl2	-37,6	37,4	4,8	10,0	11,0	7,4

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	894,9	937,1	894,9
380ct1f1	816,3	836,0	816,3
380ct1f2	816,3	836,1	816,3
380ct1f3	864,5	889,4	864,5
380ct2f1	816,3	836,1	816,3
380ct2f2	816,3	836,0	816,3
380ct2f3	864,5	889,4	864,5
bl2	894,9	941,3	894,9

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	1322,8	982,5
380ct1f1	1001,7	858,2
380ct1f2	1001,8	858,3
380ct1f3	1107,4	922,7
380ct2f1	1001,8	858,3
380ct2f2	1001,7	858,2
380ct2f3	1107,4	922,7
bl2	1322,9	984,7

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	1432,0 m	2,519 -
Min. weight span	814,7 m	1,433 -

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Project: KIJ-GT
Tower: S+95 II
Number: 12

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	16,9	17,0	-36,4	38,5
380ct1f1	51,3	52,1	63,7	-117,8	122,9
380ct1f2	51,3	50,5	63,7	-117,8	122,9
380ct1f3	51,3	54,6	68,3	-122,7	128,3
380ct2f1	51,3	49,4	63,7	-117,8	122,9
380ct2f2	51,3	47,8	63,7	-117,8	122,9
380ct2f3	51,3	51,8	68,3	-122,7	128,3
bl2	15,0	14,7	17,0	-36,4	38,4

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,4	9,2	-15,0	15,0
380ct1f1	0,0	1,2	40,4	-64,2	64,2
380ct1f2	0,0	0,3	40,4	-64,2	64,2
380ct1f3	0,0	0,7	42,6	-64,2	64,2
380ct2f1	0,0	-0,3	40,4	-64,2	64,2
380ct2f2	0,0	-1,2	40,4	-64,2	64,2
380ct2f3	0,0	-0,7	42,6	-64,2	64,2
bl2	0,0	-0,4	9,1	-15,0	15,0

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	6,0	3,6
	380ct1f1	23,7	17,6
	380ct1f2	23,7	17,6
	380ct1f3	26,2	17,6
	380ct2f1	23,7	17,6
	380ct2f2	23,7	17,6
	380ct2f3	26,2	17,6
	bl2	6,0	3,6

Project: KIJ-GT
Tower: S+95 II
Number: 12

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	338	347	47138	13	36
ULS 1a_0,9_90		0	338	347	47138	13	36
ULS 3_90		0	207	426	28879	13	23
ULS 3_0,9_90		0	207	426	28879	13	23
SLS 7		0	0	265	0	6	0

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

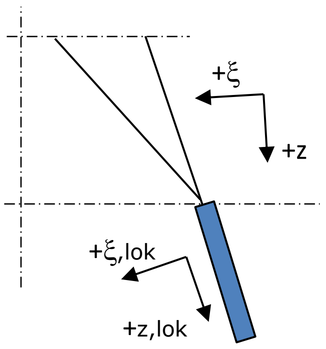
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	1597	2972	150361	13	36
ULS 3_90	0	585	3051	59846	13	23
SLS 7	0	0	2765	0	6	0

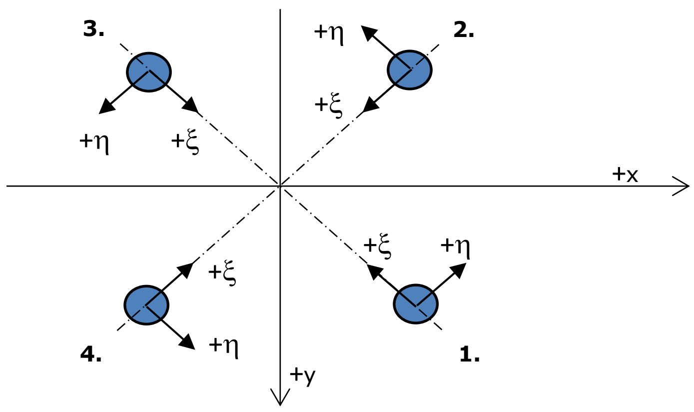
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	1597	2972	**150361**	13	36
ULS 1a_0	1427	0	2903	0	**128058**	0
ULS 5a Ah 21	-51	0	2757	441	-6565	**1309**
ULS 1a_0,9_0,9_135	-1141	1310	2514	**121990**	**-98317**	18

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	788	754	**5604**	24	-1090	-34	5703
2	ULS 1a_0	463	-522	**3559**	42	-697	-25	3622
3	ULS 5a Ah 12	-104	-137	**872**	-23	-171	-7	888
4	ULS 1a_135	-788	754	**5605**	-24	-1091	-34	5704

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-589	554	**-4245**	25	808	8	-4320
3	ULS 1a_0,9_0,9_45	588	555	**-4244**	-24	808	8	-4319
4	ULS 1a_0,9_0,9_0	265	-324	**-2211**	-42	417	0	-2250

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 1a_0,9_0,9_135	203	101	1152	**72**	-215	3	1173
2	ULS 1a_45	-3	-99	210	**72**	-68	-28	214
3	ULS 1a_0	250	309	-2107	**42**	395	-2	-2144
4	ULS 5a Ah 21	-101	137	844	**26**	-168	-9	859

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 1a_0,9_0	449	508	3465	**-42**	-677	-24	3526
2	ULS 5a Ah 10	104	-65	554	**-27**	-120	-15	564
3	ULS 1a_0,9_0,9_135	18	-83	105	**-72**	-46	-26	107
4	ULS 1a_45	-217	116	1253	**-72**	-236	1	1275

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Project: KIJ-GT
Tower: S+95 II
Number: 12

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-589	554	**-4245**	**25**	808	8	-4320
3	ULS 1a_0,9_0,9_45	588	555	**-4244**	**-24**	808	8	-4319
4	ULS 1a_0,9_0,9_0	265	-324	**-2211**	**-42**	417	0	-2250

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	101	101	691	0	-143	-13	704
2	SLS 7	101	-101	691	0	-143	-13	704
3	SLS 7	-101	-101	691	0	-143	-13	703
4	SLS 7	-101	101	691	0	-143	-13	703

Envelope of load combinations for all of the legs

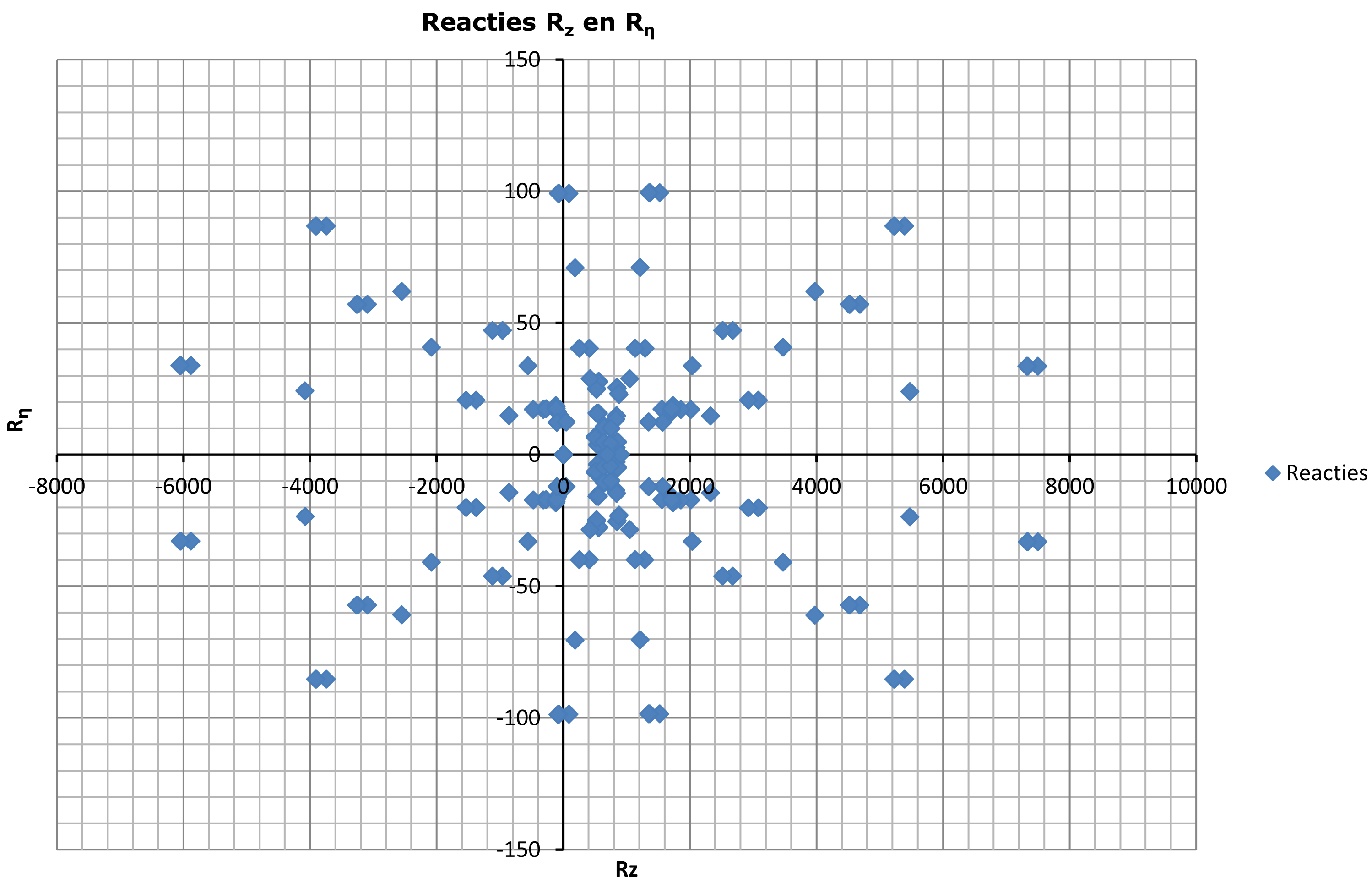
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_135	-788	754	**5605**	-24	-1091	-34	5704
Max. tension	ULS 1a_0,9_0,9_135	-589	554	**-4245**	25	808	8	-4320
Max. pos. torsie	ULS 1a_0,9_0,9_135	203	101	1152	**72**	-215	3	1173
Max. neg. torsie	ULS 1a_0,9_0,9_135	18	-83	105	**-72**	-46	-26	107
Comb. tension+torsie	ULS 1a_0,9_0,9_135	-589	554	**-4245**	**25**	808	8	-4320

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	101	101	**691**	0	-143	-13	704
2	SLS 1a_135	-477	447	**-3445**	21	653	4	-3505
3	SLS 1a_45	476	447	**-3443**	-20	653	4	-3504
4	SLS 1a_0	202	-252	**-1715**	-35	320	-3	-1746

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	681	651	**4835**	21	-942	-30	4920
2	SLS 1a_0	404	-454	**3098**	35	-607	-23	3153
3	SLS 7	-101	-101	**691**	0	-143	-13	703
4	SLS 1a_135	-680	651	**4836**	-20	-942	-30	4921


Reacties R_z en R_η
150
100
50
0
-50
-100
-150
-8000
-6000
-4000
-2000
0
2000
4000
6000
8000
10000
R_η
Rz
Reacties

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Project: KIJ-GT
Tower: S+95 II
Number: 12

	Auteur:	TBR
Conductor loads	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: KIJ-GT
Tower: S+95 II
Number: 12

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	-47,9	48,2	9,4	13,7	14,1	8,1
380ct1f1	-152,5	152,9	28,5	42,7	47,3	33,3
380ct1f2	-152,8	152,9	26,5	42,7	47,3	33,3
380ct1f3	-159,8	160,1	29,2	45,5	53,2	33,3
380ct2f1	-153,1	152,9	25,2	42,7	47,3	33,3
380ct2f2	-153,3	152,9	23,2	42,7	47,3	33,3
380ct2f3	-160,4	160,1	25,7	45,5	53,2	33,3
bl2	-48,4	48,2	6,6	13,7	14,1	8,1

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	894,9	945,2	894,9
380ct1f1	816,3	838,9	816,3
380ct1f2	816,3	838,9	816,3
380ct1f3	864,5	893,2	864,5
380ct2f1	816,3	838,9	816,3
380ct2f2	816,3	838,9	816,3
380ct2f3	864,5	893,2	864,5
bl2	894,9	949,4	894,9

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	1454,2	976,6
380ct1f1	1070,1	858,6
380ct1f2	1070,3	858,6
380ct1f3	1195,2	923,9
380ct2f1	1070,3	858,6
380ct2f2	1070,1	858,6
380ct2f3	1195,2	923,9
bl2	1454,6	978,8

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	1680,0 m	2,955 -
Min. weight span	811,3 m	1,427 -

Project: KIJ-GT
Tower: S+95 II
Number: 12

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	23,1	22,1	-46,8	49,5
380ct1f1	51,3	71,3	80,7	-149,4	156,5
380ct1f2	51,3	69,2	80,7	-149,4	156,5
380ct1f3	51,3	74,8	86,5	-156,2	164,0
380ct2f1	51,3	67,9	80,7	-149,4	156,5
380ct2f2	51,3	65,9	80,7	-149,4	156,5
380ct2f3	51,3	71,2	86,5	-156,2	164,0
bl2	15,0	20,3	22,1	-46,8	49,5

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,4	9,2	-15,0	15,0
380ct1f1	0,0	1,2	40,4	-64,2	64,2
380ct1f2	0,0	0,3	40,4	-64,2	64,2
380ct1f3	0,0	0,7	42,6	-64,2	64,2
380ct2f1	0,0	-0,3	40,4	-64,2	64,2
380ct2f2	0,0	-1,2	40,4	-64,2	64,2
380ct2f3	0,0	-0,7	42,6	-64,2	64,2
bl2	0,0	-0,4	9,1	-15,0	15,0

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	6,0	3,6
	380ct1f1	23,8	17,6
	380ct1f2	23,8	17,6
	380ct1f3	26,3	17,6
	380ct2f1	23,8	17,6
	380ct2f2	23,8	17,6
	380ct2f3	26,3	17,6
	bl2	6,1	3,6

Project: KIJ-GT
Tower: S+95 II
Number: 12

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

Combination	Combination	F_x	F_y	F_z	M_x	M_y	M_z
		[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
ULS 1a_90		0	464	406	64716	17	50
ULS 1a_0,9_90		0	464	406	64716	17	50
ULS 3_90		0	284	540	39648	16	31
ULS 3_0,9_90		0	284	540	39648	16	31
SLS 7		0	0	265	0	6	0

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

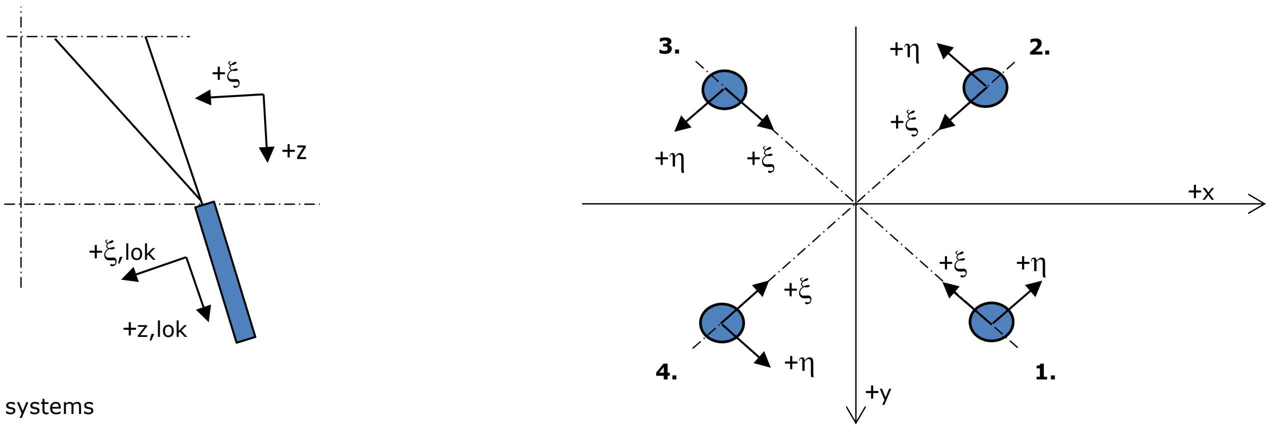
Combination	F_x	F_y	F_z	M_x	M_y	M_z
	[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
ULS 1a_90	0	2193	3281	206433	17	50
ULS 3_90	0	802	3415	82164	16	31
SLS 7	0	0	2765	0	6	0

Foundation loads, selection of load combinations based on greatest value

Combination	F_x	F_y	F_z	M_x	M_y	M_z
	[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
ULS 1a_90	0	2193	3281	**206433**	17	50
ULS 1a_0	1959	0	3179	0	**175811**	0
ULS 5a Ah 21	-51	0	2757	441	-6565	**1309**
ULS 1a_0,9_0,9_135	-1567	1799	2531	**167489**	**-134983**	25

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	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
		[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 1a_45	1053	1005	**7493**	34	-1455	-42	7625
2	ULS 1a_0	606	-687	**4684**	57	-914	-31	4767
3	ULS 7	-132	-132	**898**	0	-186	-17	914
4	ULS 1a_135	-1053	1006	**7495**	-33	-1456	-42	7628

Maximum tension load

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
		[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-843	795	**-6059**	34	1158	15	-6166
3	ULS 1a_0,9_0,9_45	842	795	**-6056**	-33	1157	15	-6163
4	ULS 1a_0,9_0,9_0	398	-479	**-3267**	-57	621	4	-3325

Maximum torsional load (positive)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
		[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 1a_0,9_0,9_135	245	104	1352	**99**	-247	8	1376
2	ULS 1a_45	-34	-107	88	**99**	-51	-35	89
3	ULS 1a_0	373	454	-3095	**57**	585	1	-3149
4	ULS 5a Ah 21	-101	137	844	**26**	-168	-9	859

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 1a_0	606	687	4684	**-57**	-915	-31	4767
2	ULS 5a Ah 10	104	-65	554	**-27**	-120	-15	564
3	ULS 1a_0,9_0,9_135	59	-81	-86	**-99**	-16	-32	-88
4	ULS 1a_45	-269	130	1520	**-98**	-282	5	1546

Project: KIJ-GT
Tower: S+95 II
Number: 12

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-843	795	**-6059**	**34**	1158	15	-6166
3	ULS 1a_0,9_0,9_45	842	795	**-6056**	**-33**	1157	15	-6163
4	ULS 1a_0,9_0,9_0	398	-479	**-3267**	**-57**	621	4	-3325

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	101	101	691	0	-143	-13	704
2	SLS 7	101	-101	691	0	-143	-13	704
3	SLS 7	-101	-101	691	0	-143	-13	703
4	SLS 7	-101	101	691	0	-143	-13	703

Envelope of load combinations for all of the legs

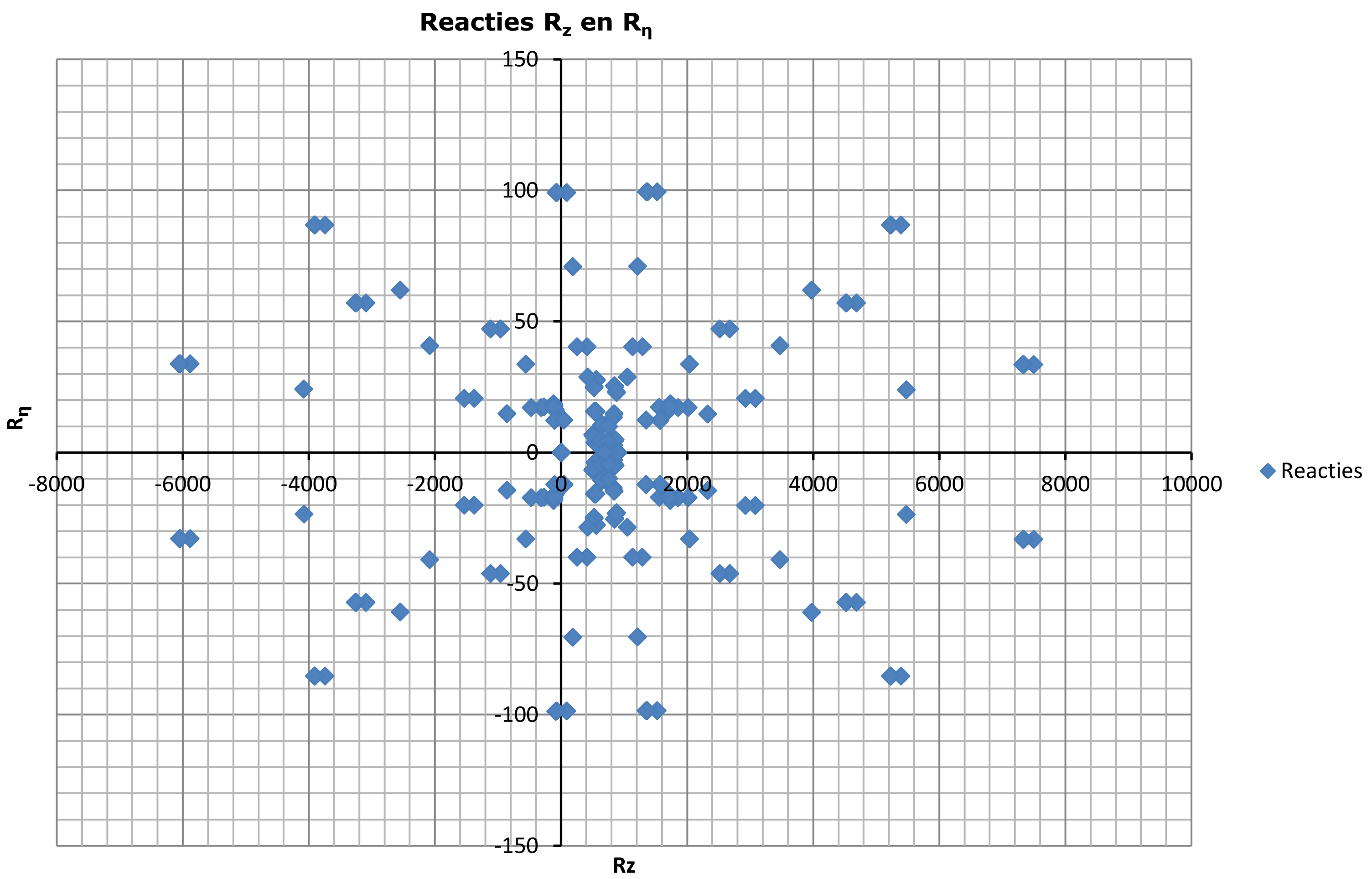
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_135	-1053	1006	**7495**	-33	-1456	-42	7628
Max. tension	ULS 1a_0,9_0,9_135	-843	795	**-6059**	34	1158	15	-6166
Max. pos. torsie	ULS 1a_0,9_0,9_135	245	104	1352	**99**	-247	8	1376
Max. neg. torsie	ULS 1a_0,9_0,9_135	59	-81	-86	**-99**	-16	-32	-88
Comb. tension+torsie	ULS 1a_0,9_0,9_135	-843	795	**-6059**	**34**	1158	15	-6166

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	101	101	**691**	0	-143	-13	704
2	SLS 1a_135	-566	532	**-4083**	24	776	6	-4155
3	SLS 1a_45	565	532	**-4081**	-23	776	6	-4153
4	SLS 1a_0	248	-306	**-2087**	-41	392	-1	-2124

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	770	736	**5475**	24	-1065	-33	5572
2	SLS 1a_0	451	-509	**3470**	41	-679	-25	3531
3	SLS 7	-101	-101	**691**	0	-143	-13	703
4	SLS 1a_135	-770	737	**5477**	-24	-1065	-33	5573


Reacties R_z en $R_η$
$R_η$
Rz
150
100
50
0
-50
-100
-150
-8000
-6000
-4000
-2000
0
2000
4000
6000
8000
10000
Reacties

Content

Data

Norm	NEN-EN50341-2-15:2019
Initial	
Consequence class	CC2-0
Reliability level	Afkeur
Reference period	15 jaar
After adjustment	
Consequence class	CC2
Reliability level	Verbouw
Reference period	50 jaar
Wind zone	II
Wind speed	27 m/s
Terrain categorie	II
Reduction factor Cdir	1,00
Ice region	B
Tower type	Steunmast
Tower height	162,5 m
Max. Span	701 m
Line angle	180°
Catenary	1400 m
Wind span	645 m
EDS Weight span	837 m
Min. Weight span	795 m
Max. Weight span	1299 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2021-04-06			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype S+95 II T

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

Document name:

KIJ-GT_S+95 II T_13_Report.pdf

Project number:

Project client number:

0.0

Project: KIJ-GT
Tower: S+95 II T
Number: 13

Auteur: TBR
Versie: v11.7

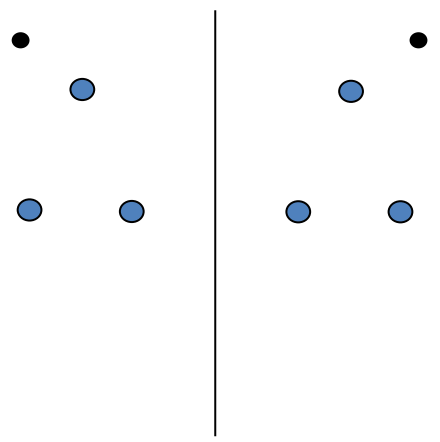
Conductor loads

General

Description	S+95 II T
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	15 jaar
Consequence class modified	CC2
Reliability level modified	Verbouw
Reference period modified	50 jaar
Wind zone	II
Wind speed (m/s)	27,0 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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Halfverankering	3,00	4,30	1,50
Circuit 2	Halfverankering	3,00	4,30	1,50
Bliksemdraad 1	Vast (Bliksemdraad)	0,20	0,30	0,10
Bliksemdraad 2	Vast (Bliksemdraad)	0,20	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	21	380ct1f1	123,7 m	128,0 m	25,5 m
Circuit 1	20	380ct1f2	123,7 m	128,0 m	11,5 m
Circuit 1	22	380ct1f3	150,7 m	155,0 m	18,5 m
Circuit 2	11	380ct2f1	123,7 m	128,0 m	-11,5 m
Circuit 2	10	380ct2f2	123,7 m	128,0 m	-25,5 m
Circuit 2	12	380ct2f3	150,7 m	155,0 m	-18,5 m
Bliksemdraad 1	3	bl1	160,7 m	161,0 m	31,5 m
Bliksemdraad 2	1	bl2	160,7 m	161,0 m	-31,5 m

Project: KIJ-GT
Tower: S+95 II T
Number: 13

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

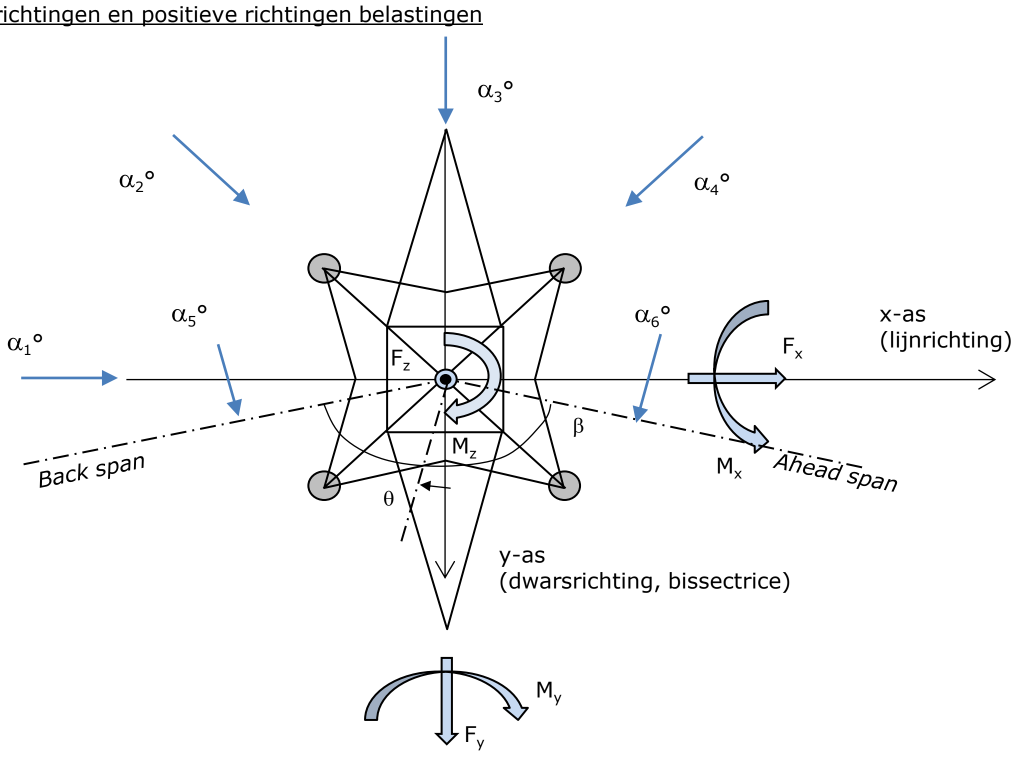
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	21	380ct1f1	0,4	-65,0 m	0,0	5,0 m
Circuit 1	20	380ct1f2	0,4	-65,0 m	0,0	1,0 m
Circuit 1	22	380ct1f3	0,4	-75,5 m	0,0	3,0 m
Circuit 2	11	380ct2f1	0,4	-65,0 m	0,0	-1,0 m
Circuit 2	10	380ct2f2	0,4	-65,0 m	0,0	-5,0 m
Circuit 2	12	380ct2f3	0,4	-75,5 m	0,0	-3,0 m
Bliksemdraad 1	3	bl1	0,4	-75,6 m	0,0	8,5 m
Bliksemdraad 2	1	bl2	0,4	-75,6 m	0,0	-8,5 m

Line and tower data

		Back	Ahead
		701,0	589,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		552,7	552,7 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		2418	2418 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: KIJ-GT
Tower: S+95 II T
Number: 13

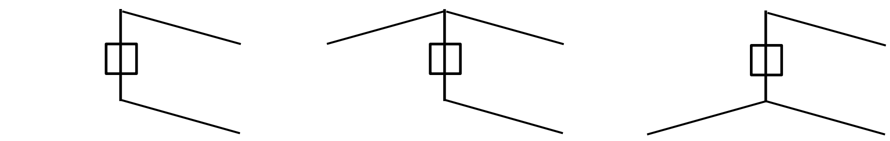
Absence of conductors

		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

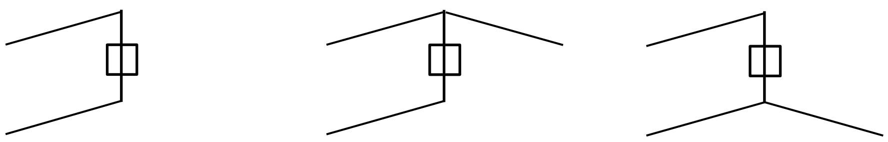
Load situations SPLS

Considered situations SPLS: SPLS for suspension tower not applicable

Principle of load situations:



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

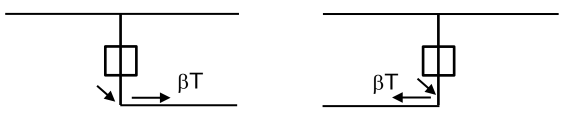


4. Ah All cts 5. Ah ct1 6. Ah ct2

Load situation 5a. Conductor failure

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

Principle of load situations:



1. Ba 2. Ah

Load situations LC6. Construction and maintenance

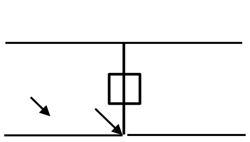
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations 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

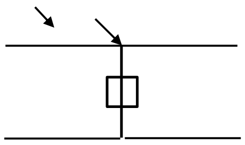
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

Presence line vehicle: Circuit, belasting tegelijk aanwezig in alle geleiders per circuit.

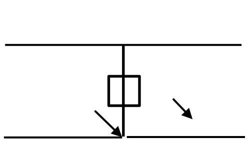
Principle of load situations:



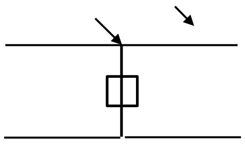
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

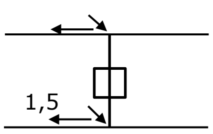
Load situations 8. Galloping as a static load

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

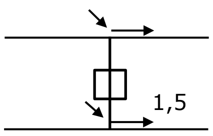
Considered situations galloping 8: None (existing structure)

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: KIJ-GT
Tower: S+95 II T
Number: 13

Tower structure

Properties

Tower type	Steunmast		
Tower designation	S+95 II T		
Base plate w.r.t. ground level	0,5	m	
Tower height w.r.t. base plate	162,5	m	
Tower self weight	2500,0	kN	

Width and slope at foundation	x-ri.	y-ri.	
Leg spread	22,60	22,60	m
Inclination of main leg	0,133	0,133	-
Horizontal force factor	1,1	1,1	-

Calculation Wind load

Dynamic factor G_T	1,02
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	b_1	b_2	Δh	Δ_x	A_0	A_1	$\chi = A_1/A_0$	C_t
	[m]	[m]	[m]	[m]	[m]	[m^2]	[m^2]	[-]	
Broekstuk 1	30,00	22,60	14,60	30,00	0,133	558,00	66,21	0,12	3,31
Middenstuk 1	65,58	14,60	10,26	35,58	0,061	442,26	73,77	0,17	3,08
Middenstuk 2	100,50	10,26	6,00	34,92	0,061	283,90	65,38	0,23	2,80
Bovenstuk 1	127,50	6,00	5,00	27,00	0,019	148,50	33,73	0,23	2,82
Bovenstuk 2	158,50	5,00	3,83	31,00	0,019	136,87	33,26	0,24	2,75
Topstuk	162,50	3,83		4,00		7,66	1,40	0,18	3,01
Ondertraverse	127,50	23,00		4,00		46,00	14,30	0,31	2,50
Boventraverse	154,50	29,50		6,00		88,50	17,60	0,20	2,94

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

Description	h	b_1	b_2	Δh	Δ_x	A_0	A_1	$\chi = A_1/A_0$	C_t
	[m]	[m]	[m]	[m]	[m]	[m^2]	[m^2]	[-]	
Broekstuk 1	30,00	22,60	14,60	30,00	0,133	558,00	66,21	0,12	3,31
Middenstuk 1	65,58	14,60	10,26	35,58	0,061	442,26	73,77	0,17	3,08
Middenstuk 2	100,50	10,26	6,00	34,92	0,061	283,90	65,38	0,23	2,80
Bovenstuk 1	127,50	6,00	5,00	27,00	0,019	148,50	33,73	0,23	2,82
Bovenstuk 2	158,50	5,00	3,83	31,00	0,019	136,87	33,26	0,24	2,75
Topstuk	162,50	3,83		4,00		7,66	1,40	0,18	3,01
Ondertraverse	127,50	23,00		4,00		46,00	14,30	0,31	2,50
Boventraverse	154,50	29,50		6,00		88,50	17,60	0,20	2,94

Note: Surface transverse direction is reduced in calculation.

Project: KIJ-GT
Tower: S+95 II T
Number: 13

Wind surface feeders telecom installations

Part	A (m^2/m)	Factor	Δh	A_1
Broekstuk 1	0,08	1,00	30,0	2,4
Middenstuk 1				
Middenstuk 2				
Bovenstuk 1				
Bovenstuk 2				

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1	3,75	40	1,5
Schotel			
Schotel			

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 1	0,97	213,7	181,3	0,0	-181,3	15,0	3205,2	2719,7	0,0	-2719,7
Middenstuk 1	1,36	309,6	262,7	0,0	-262,7	47,8	14796,4	12555,2	0,0	-12555,2
Middenstuk 2	1,57	287,1	243,6	0,0	-243,6	83,0	23837,1	20226,4	0,0	-20226,4
Bovenstuk 1	1,69	160,6	136,3	0,0	-136,3	114,0	18305,5	15532,7	0,0	-15532,7
Bovenstuk 2	1,78	162,8	138,1	0,0	-138,1	143,0	23277,0	19751,2	0,0	-19751,2
Topstuk	1,83	7,7	6,5	0,0	-6,5	160,5	1233,7	1046,8	0,0	-1046,8
Ondertraverse	1,74	124,1	73,7	0,0	-73,7	128,8	15982,3	9493,0	0,0	-9493,0
Boventraverse	1,82	187,6	111,4	0,0	-111,4	156,5	29362,3	17440,3	0,0	-17440,3
Totaal		1453,1	1153,6	0,0	-1153,6		129999,4	98765,3	0,0	-98765,3

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 1	0,97	0,0	181,3	213,7	181,3	15,0	0,0	2719,7	3205,2	2719,7
Middenstuk 1	1,36	0,0	262,7	309,6	262,7	47,8	0,0	12555,2	14796,4	12555,2
Middenstuk 2	1,57	0,0	243,6	287,1	243,6	83,0	0,0	20226,4	23837,1	20226,4
Bovenstuk 1	1,69	0,0	136,3	160,6	136,3	114,0	0,0	15532,7	18305,5	15532,7
Bovenstuk 2	1,78	0,0	138,1	162,8	138,1	143,0	0,0	19751,2	23277,0	19751,2
Topstuk	1,83	0,0	6,5	7,7	6,5	160,5	0,0	1046,8	1233,7	1046,8
Ondertraverse	1,74	0,0	73,7	49,6	73,7	128,8	0,0	9493,0	6392,9	9493,0
Boventraverse	1,82	0,0	111,4	75,0	111,4	156,5	0,0	17440,3	11744,9	17440,3
Total		0,0	1153,6	1266,1	1153,6		0,0	98765,3	102792,6	98765,3

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	2500	0	0	0
Windrichting 0°	1460	0	0	0	132898	0
Windrichting 45°	1159	1159	0	100952	100952	0
Windrichting 90°	0	1273	0	105147	0	0
Windrichting 135°	-1159	1159	0	100952	-100952	0

Project: KIJ-GT
Tower: S+95 II T
Number: 13

Intermediate results for conductor loads

Conductors back

Circuit	Geleider	Diameter [mm]	A [mm²]	G [N/m]	E [N/mm²]	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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-05
Bliksemdraad 2	OPGW 226	21,7	264,0	9,80	81000	2,30E-05

Conductors ahead

Circuit	Geleider	Diameter [mm]	A [mm²]	G [N/m]	E [N/mm²]	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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	B	4+0,2d	8,3	8,3

Insulators

Conductor	$G_{isolator}$ [kN]	Number -	$F_{v,iso}$ [kN]	Length [m]	Wind surf. [m²]	Wind heigth [m]	Pressure [kN/m²]	Drag factor [-]	$F_{h,iso}$ [kN]
380ct1f1	3,00	1	3	4,3	1,5	126,35	1,73	1,2	3,11
380ct1f2	3,00	1	3	4,3	1,5	126,35	1,73	1,2	3,11
380ct1f3	3,00	1	3	4,3	1,5	153,35	1,81	1,2	3,25
380ct2f1	3,00	1	3	4,3	1,5	126,35	1,73	1,2	3,11
380ct2f2	3,00	1	3	4,3	1,5	126,35	1,73	1,2	3,11
380ct2f3	3,00	1	3	4,3	1,5	153,35	1,81	1,2	3,25
bl1	0,20	1	0,2	0,3	0,1	161,35	1,83	1,2	0,22
bl2	0,20	1	0,2	0,3	0,1	161,35	1,83	1,2	0,22

DNV·GL

Project: KIJ-GT
Tower: S+95 II T
Number: 13

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	95,2	1,62	0,63	0,59	0,95	28,25	81,5	76,3	46,9	172,0	160,8
380ct1f2	95,2	1,62	0,63	0,59	0,95	28,25	81,5	76,3	46,9	172,0	160,8
380ct1f3	122,2	1,72	0,65	0,60	0,92	28,25	86,9	81,2	46,9	187,5	175,2
380ct2f1	95,2	1,62	0,63	0,59	0,95	28,25	81,5	76,3	46,9	172,0	160,8
380ct2f2	95,2	1,62	0,63	0,59	0,95	28,25	81,5	76,3	46,9	172,0	160,8
380ct2f3	122,2	1,72	0,65	0,60	0,92	28,25	86,9	81,2	46,9	187,5	175,2
bl1	134,1	1,75	0,65	0,61	1,07	22,24	27,3	25,5	41,5	57,1	53,3
bl2	134,1	1,75	0,65	0,61	1,08	22,13	27,3	25,5	41,4	56,9	53,2

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	71,1	1,51	0,61	0,57	0,97	28,25	75,3	70,5	46,9	154,9	145,0
380ct1f2	71,1	1,51	0,61	0,57	0,97	28,25	75,3	70,5	46,9	154,9	145,0
380ct1f3	92,8	1,61	0,63	0,59	0,95	28,25	81,0	75,8	46,9	170,5	159,4
380ct2f1	71,1	1,51	0,61	0,57	0,97	28,25	75,3	70,5	46,9	154,9	145,0
380ct2f2	71,1	1,51	0,61	0,57	0,97	28,25	75,3	70,5	46,9	154,9	145,0
380ct2f3	92,8	1,61	0,63	0,59	0,95	28,25	81,0	75,8	46,9	170,5	159,4
bl1	104,1	1,65	0,64	0,59	1,09	22,24	25,4	23,8	41,5	52,3	48,9
bl2	104,1	1,65	0,64	0,59	1,09	22,13	25,4	23,7	41,4	52,2	48,8

Project: KIJ-GT
Tower: S+95 II T
Number: 13

Conductor loads

Auteur: TBR
Versie: v11.7

Starting points

Consequence class: Afkeur CC2-0
Reference period: 15 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	1,02	0,00	0,0
ULS 1a_0,9	Wind 0,9Gk only tower	10°	0,90	1,05	0,00	1,02	0,00	0,0
ULS 1a_0,9_0,9	Wind 0,9Gk conductors too	10°	0,90	0,90	0,00	1,02	0,00	0,0
ULS 3	Wind+ice	-5°	1,05	1,05	0,00	0,31	0,79	0,0
ULS 3_0,9	Wind+ice 0,9Gk	-5°	0,90	1,05	0,00	0,31	0,79	0,0
ULS 4	Cold+wind	-20°	1,05	1,05	0,00	0,20	0,00	0,0
ULS 4_0,9	Cold+wind 0,9Gk	-20°	0,90	1,05	0,00	0,20	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	0,20	0,00	0,0
ULS 6_0,9	Construction + maintenance	5°	1,05	1,05	0,00	0,20	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	0,87	0,0	0,0
SLS 3	Wind+ice	-5°	1,00	1,00	0,0	0,26	0,71	0,0
SLS 4	Wind	-20°	1,00	1,00	0,0	0,17	0,0	0,0
SLS 6	Maintenance	5°	1,00	1,00	0,0	0,17	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: KIJ-GT
Tower: S+95 II T
Number: 13

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	37,4	9,9	8,3	7,4	10,0
380ct1f1	-119,9	119,7	30,7	25,2	26,3	35,1
380ct1f2	-119,9	119,9	30,7	24,4	26,3	35,1
380ct1f3	-125,4	125,3	32,7	26,6	26,3	37,5
380ct2f1	-119,9	119,9	30,7	24,0	26,3	35,1
380ct2f2	-119,9	120,1	30,7	23,3	26,3	35,1
380ct2f3	-125,4	125,5	32,7	25,4	26,3	37,5
bl2	-37,5	37,6	9,9	7,2	7,4	10,0

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	836,6	861,4	836,6
380ct1f1	798,5	810,6	798,5
380ct1f2	798,5	810,6	798,5
380ct1f3	823,5	838,5	823,5
380ct2f1	798,5	810,6	798,5
380ct2f2	798,5	810,6	798,5
380ct2f3	823,5	838,5	823,5
bl2	836,6	863,8	836,6

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	1088,5	888,2
380ct1f1	911,1	823,6
380ct1f2	911,1	823,7
380ct1f3	969,2	858,3
380ct2f1	911,1	823,7
380ct2f2	911,1	823,6
380ct2f3	969,2	858,3
bl2	1088,5	889,5

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	1152,7 m	1,787 -
Min. weight span	797,5 m	1,236 -

Project: KIJ-GT
Tower: S+95 II T
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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	15,0	18,1	15,4	-38,5	36,5
380ct1f1	51,3	55,9	61,3	-123,0	116,8
380ct1f2	51,3	55,1	61,3	-123,0	116,8
380ct1f3	51,3	59,3	63,8	-128,4	122,4
380ct2f1	51,3	54,8	61,3	-123,0	116,8
380ct2f2	51,3	54,0	61,3	-123,0	116,8
380ct2f3	51,3	58,1	63,8	-128,4	122,4
bl2	15,0	17,1	15,4	-38,5	36,5

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,2	8,6	-15,0	15,0
380ct1f1	0,0	0,5	39,6	-64,2	64,2
380ct1f2	0,0	0,1	39,6	-64,2	64,2
380ct1f3	0,0	0,3	40,7	-64,2	64,2
380ct2f1	0,0	-0,1	39,6	-64,2	64,2
380ct2f2	0,0	-0,5	39,6	-64,2	64,2
380ct2f3	0,0	-0,3	40,7	-64,2	64,2
bl2	0,0	-0,2	8,6	-15,0	15,0

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	3,6	5,2
	380ct1f1	17,5	22,6
	380ct1f2	17,5	22,6
	380ct1f3	17,5	23,9
	380ct2f1	17,5	22,6
	380ct2f2	17,5	22,6
	380ct2f3	17,5	23,9
	bl2	3,6	5,2

Project: KIJ-GT
Tower: S+95 II T
Number: 13

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	372	311	51997	-3	-22
ULS 1a_0,9_90		0	372	311	51997	-3	-22
ULS 3_90		0	228	403	31877	-3	-14
ULS 3_0,9_90		0	228	403	31877	-3	-14
SLS 7		0	0	257	0	-1	0

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

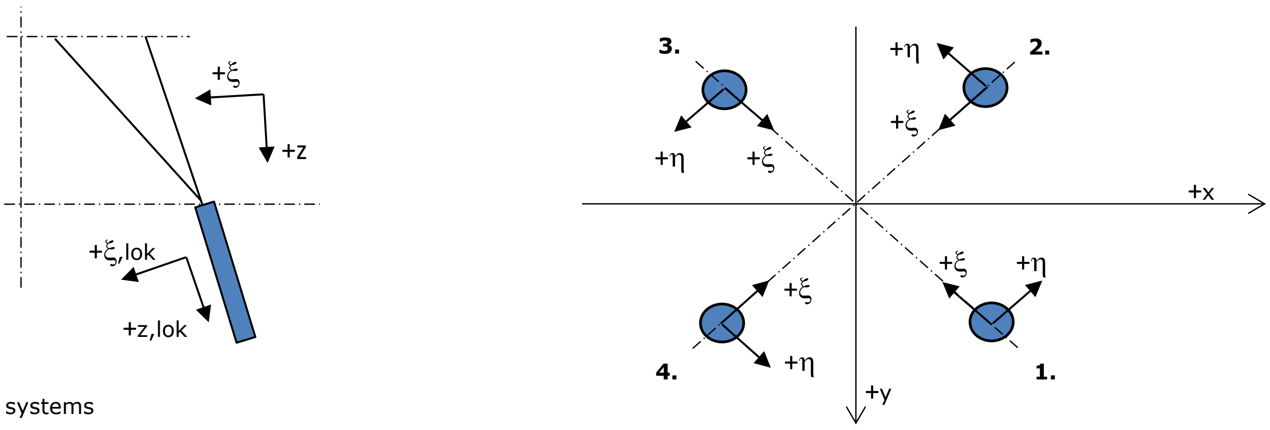
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	1671	2936	159218	-3	-22
ULS 3_90	0	618	3028	64044	-3	-14
SLS 7	0	0	2757	0	-1	0

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	1671	2936	**159218**	-3	-22
ULS 1a_0,9_0,9_0	1494	0	2482	0	**136254**	0
ULS 5a Ba 10	51	0	2749	423	6570	**-1309**
ULS 1a_0,9_0,9_135	-1185	1372	2497	**129518**	**-103466**	-11

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	823	785	**5881**	27	-1137	-28	5985
2	ULS 1a_0	480	-548	**3738**	48	-727	-22	3804
3	ULS 5a Ah 22	-104	-137	**872**	-23	-171	-6	887
4	ULS 1a_135	-823	785	**5882**	-27	-1137	-28	5985

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-625	587	**-4530**	27	857	3	-4610
3	ULS 1a_0,9_0,9_45	625	587	**-4530**	-27	857	3	-4610
4	ULS 1a_0,9_0,9_0	283	-351	**-2394**	-48	448	-3	-2436

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 1a_0,9_0,9_135	215	99	1201	**82**	-222	4	1222
2	ULS 1a_45	-17	-99	151	**82**	-58	-30	154
3	ULS 1a_0,9_0,9_0	283	351	-2394	**48**	448	-3	-2436
4	ULS 5a Ah 10	-101	137	845	**25**	-168	-9	860

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 1a_0,9_0,9_0	465	533	3635	**-48**	-705	-20	3699
2	ULS 5a Ah 21	104	-65	554	**-28**	-120	-15	564
3	ULS 1a_0,9_0,9_135	32	-84	48	**-83**	-37	-28	49
4	ULS 1a_45	-231	114	1303	**-83**	-244	2	1326

Project: KIJ-GT
Tower: S+95 II T
Number: 13

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-625	587	**-4530**	**27**	857	3	-4610
3	ULS 1a_0,9_0,9_45	625	587	**-4530**	**-27**	857	3	-4610
4	ULS 1a_0,9_0,9_0	283	-351	**-2394**	**-48**	448	-3	-2436

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	101	101	689	0	-143	-13	701
2	SLS 7	101	-101	689	0	-143	-13	701
3	SLS 7	-101	-101	689	0	-143	-13	701
4	SLS 7	-101	101	689	0	-143	-13	701

Envelope of load combinations for all of the legs

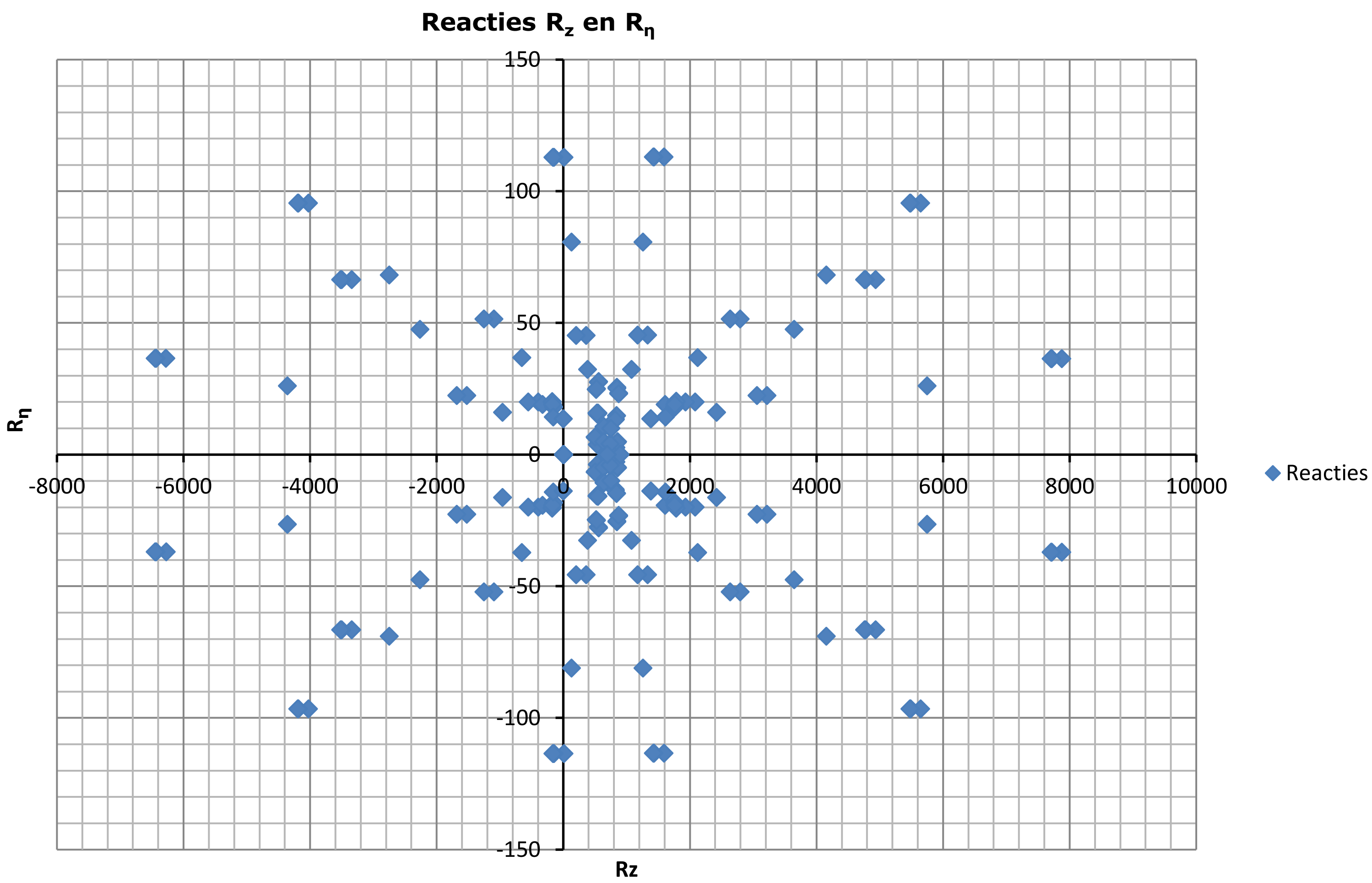
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_135	-823	785	**5882**	-27	-1137	-28	5985
Max. tension	ULS 1a_0,9_0,9_135	-625	587	**-4530**	27	857	3	-4610
Max. pos. torsie	ULS 1a_0,9_0,9_135	215	99	1201	**82**	-222	4	1222
Max. neg. torsie	ULS 1a_0,9_0,9_135	32	-84	48	**-83**	-37	-28	49
Comb. tension+torsie	ULS 1a_0,9_0,9_45	625	587	**-4530**	**-27**	857	3	-4610

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	101	101	**689**	0	-143	-13	701
2	SLS 1a_135	-507	475	**-3687**	23	695	-1	-3752
3	SLS 1a_45	507	475	**-3686**	-23	695	-1	-3751
4	SLS 1a_0	216	-274	**-1871**	-41	347	-6	-1904

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	710	678	**5070**	23	-982	-26	5159
2	SLS 1a_0	418	-477	**3250**	41	-633	-20	3307
3	SLS 7	-101	-101	**689**	0	-143	-13	701
4	SLS 1a_135	-710	678	**5070**	-23	-982	-26	5160


Reacties R_z en R_η
150
100
50
0
-50
-100
-150
-8000
-6000
-4000
-2000
0
2000
4000
6000
8000
10000
R_η
Rz
Reacties

Project: KIJ-GT
Tower: S+95 II T
Number: 13

Auteur: TBR
Versie: v11.7

Conductor loads

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: KIJ-GT
Tower: S+95 II T
Number: 13

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	-48,3	48,1	13,6	11,3	8,1	12,1
380ct1f1	-152,3	152,1	42,2	34,5	33,2	44,4
380ct1f2	-152,3	152,3	42,2	33,5	33,2	44,4
380ct1f3	-160,0	159,8	44,9	36,5	33,2	47,5
380ct2f1	-152,3	152,4	42,2	33,0	33,2	44,4
380ct2f2	-152,3	152,6	42,2	32,0	33,2	44,4
380ct2f3	-160,0	160,2	44,9	34,9	33,2	47,5
bl2	-48,2	48,4	13,5	10,0	8,1	12,1

Min. Weight span (m)

Weight spar	Combinatie1		
Geleider	SLS 1a	SLS 4	SLS 7
bl1	836,6	866,2	836,6
380ct1f1	798,5	812,3	798,5
380ct1f2	798,5	812,3	798,5
380ct1f3	823,5	840,8	823,5
380ct2f1	798,5	812,3	798,5
380ct2f2	798,5	812,3	798,5
380ct2f3	823,5	840,8	823,5
bl2	836,6	868,7	836,6

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	1165,7	884,8
380ct1f1	952,9	823,8
380ct1f2	952,9	823,8
380ct1f3	1021,9	859,0
380ct2f1	952,9	823,8
380ct2f2	952,9	823,8
380ct2f3	1021,9	859,0
bl2	1166,0	886,0

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	1298,6 m	2,013 -
Min. weight span	795,4 m	1,233 -

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Project: KIJ-GT
Tower: S+95 II T
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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	15,0	24,9	20,0	-49,6	46,9
380ct1f1	51,3	76,7	77,5	-156,6	148,0
380ct1f2	51,3	75,7	77,5	-156,6	148,1
380ct1f3	51,3	81,4	80,7	-164,1	155,9
380ct2f1	51,3	75,2	77,5	-156,6	148,1
380ct2f2	51,3	74,2	77,5	-156,6	148,0
380ct2f3	51,3	79,8	80,7	-164,1	155,9
bl2	15,0	23,5	20,0	-49,6	46,9

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	0,0	0,2	8,6	-15,0	15,0
380ct1f1	0,0	0,5	39,6	-64,2	64,2
380ct1f2	0,0	0,1	39,6	-64,2	64,2
380ct1f3	0,0	0,3	40,7	-64,2	64,2
380ct2f1	0,0	-0,1	39,6	-64,2	64,2
380ct2f2	0,0	-0,5	39,6	-64,2	64,2
380ct2f3	0,0	-0,3	40,7	-64,2	64,2
bl2	0,0	-0,2	8,6	-15,0	15,0

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	3,6	5,3
	380ct1f1	17,5	22,7
	380ct1f2	17,5	22,7
	380ct1f3	17,5	24,0
	380ct2f1	17,5	22,7
	380ct2f2	17,5	22,7
	380ct2f3	17,5	24,0
	bl2	3,6	5,3

Project: KIJ-GT
Tower: S+95 II T
Number: 13

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	511	357	71388	-4	-30
ULS 1a_0,9_90		0	511	357	71388	-4	-30
ULS 3_90		0	313	512	43765	-4	-19
ULS 3_0,9_90		0	313	512	43765	-4	-19
SLS 7		0	0	257	0	-1	0

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

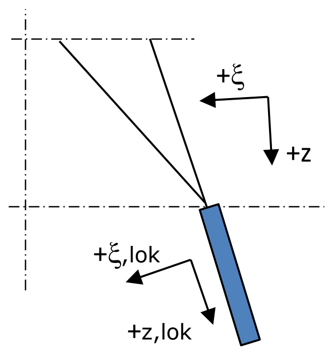
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	2294	3232	218594	-4	-30
ULS 3_90	0	848	3387	87927	-4	-19
SLS 7	0	0	2757	0	-1	0

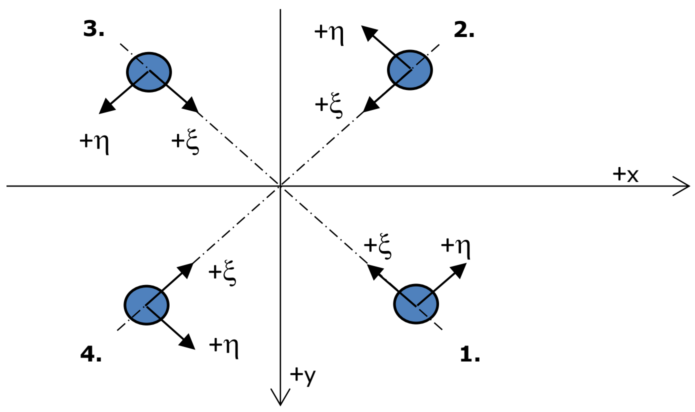
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	0	2294	3232	**218594**	-4	-30
ULS 1a_0,9_0,9_0	2052	0	2482	0	**187065**	0
ULS 5a Ba 10	51	0	2749	423	6570	**-1309**
ULS 1a_0,9_0,9_135	-1627	1884	2507	**177820**	**-142050**	-15

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	1101	1049	**7874**	36	-1520	-35	8013
2	ULS 1a_0	629	-723	**4931**	67	-956	-26	5018
3	ULS 7	-131	-131	**896**	0	-186	-17	912
4	ULS 1a_135	-1101	1049	**7875**	-37	-1520	-35	8013

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	-	0	0	**0**	0	0	0	0
2	ULS 1a_0,9_0,9_135	-892	840	**-6450**	37	1225	8	-6564
3	ULS 1a_0,9_0,9_45	892	840	**-6449**	-37	1224	8	-6563
4	ULS 1a_0,9_0,9_0	422	-516	**-3518**	-67	663	0	-3580

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 1a_0,9_0,9_135	262	102	1418	**113**	-257	10	1443
2	ULS 1a_45	-53	-107	7	**113**	-38	-37	7
3	ULS 1a_0,9_0,9_0	422	516	-3518	**67**	663	0	-3580
4	ULS 5a Ah 10	-101	137	845	**25**	-168	-9	860

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	ULS 1a_0,9_0,9_0	604	698	4759	**-67**	-921	-23	4843
2	ULS 5a Ah 21	104	-65	554	**-28**	-120	-15	564
3	ULS 1a_0,9_0,9_135	78	-82	-165	**-113**	-3	-34	-167
4	ULS 1a_45	-287	127	1589	**-113**	-293	7	1617

Project: KIJ-GT
Tower: S+95 II T
Number: 13

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	-	0	0	**0**	**0**	0	0	0
2	ULS 1a_0,9_0,9_135	-892	840	**-6450**	**37**	1225	8	-6564
3	ULS 1a_0,9_0,9_45	892	840	**-6449**	**-37**	1224	8	-6563
4	ULS 1a_0,9_0,9_0	422	-516	**-3518**	**-67**	663	0	-3580

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	101	101	689	0	-143	-13	701
2	SLS 7	101	-101	689	0	-143	-13	701
3	SLS 7	-101	-101	689	0	-143	-13	701
4	SLS 7	-101	101	689	0	-143	-13	701

Envelope of load combinations for all of the legs

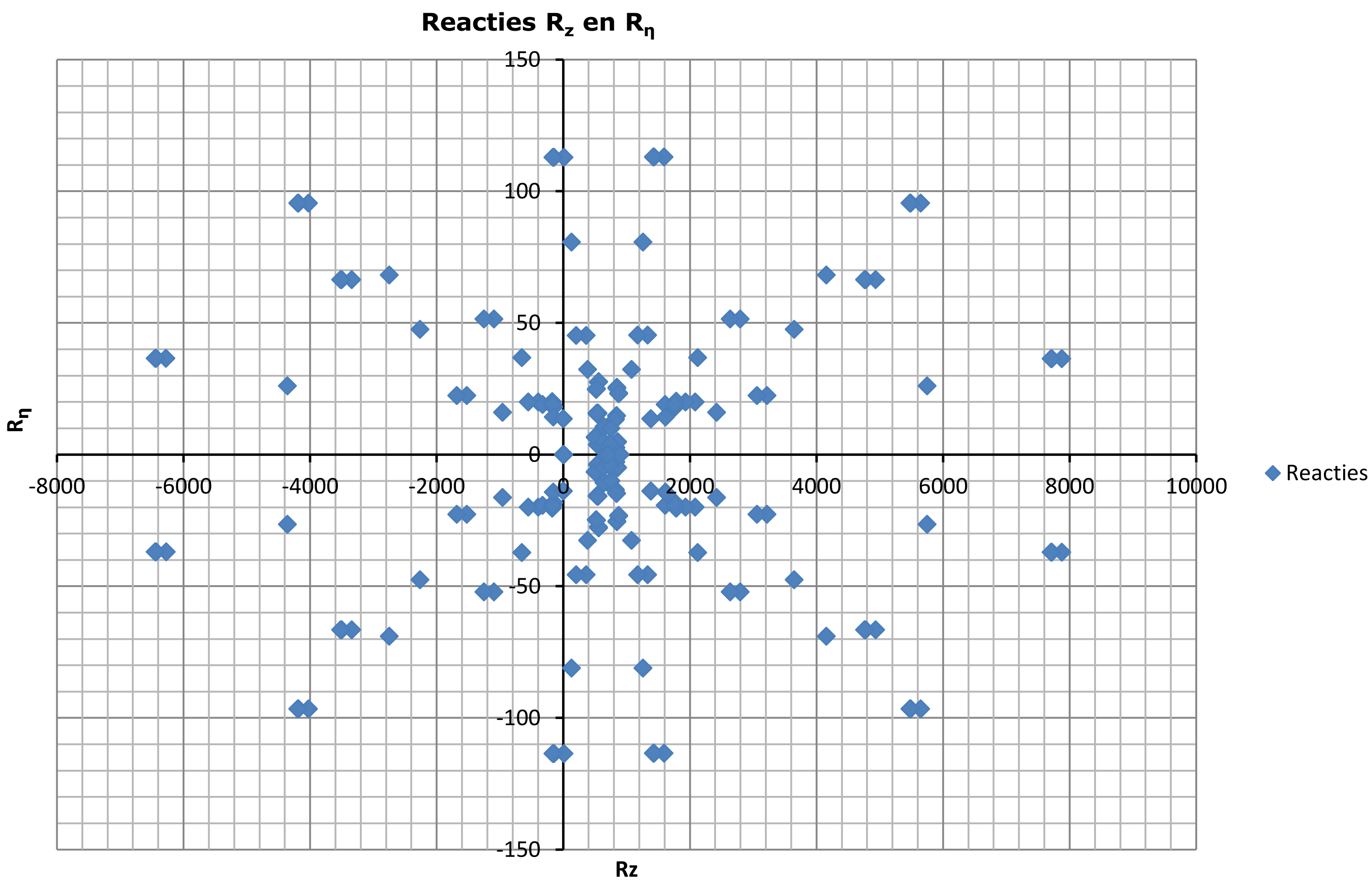
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	ULS 1a_135	-1101	1049	**7875**	-37	-1520	-35	8013
Max. tension	ULS 1a_0,9_0,9_135	-892	840	**-6450**	37	1225	8	-6564
Max. pos. torsie	ULS 1a_0,9_0,9_135	262	102	1418	**113**	-257	10	1443
Max. neg. torsie	ULS 1a_0,9_0,9_135	78	-82	-165	**-113**	-3	-34	-167
Comb. tension+torsie	ULS 1a_0,9_0,9_45	892	840	**-6449**	**-37**	1224	8	-6563

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	101	101	**689**	0	-143	-13	701
2	SLS 1a_135	-601	564	**-4362**	26	824	1	-4439
3	SLS 1a_45	601	564	**-4362**	-26	824	1	-4438
4	SLS 1a_0	265	-332	**-2267**	-48	423	-5	-2307

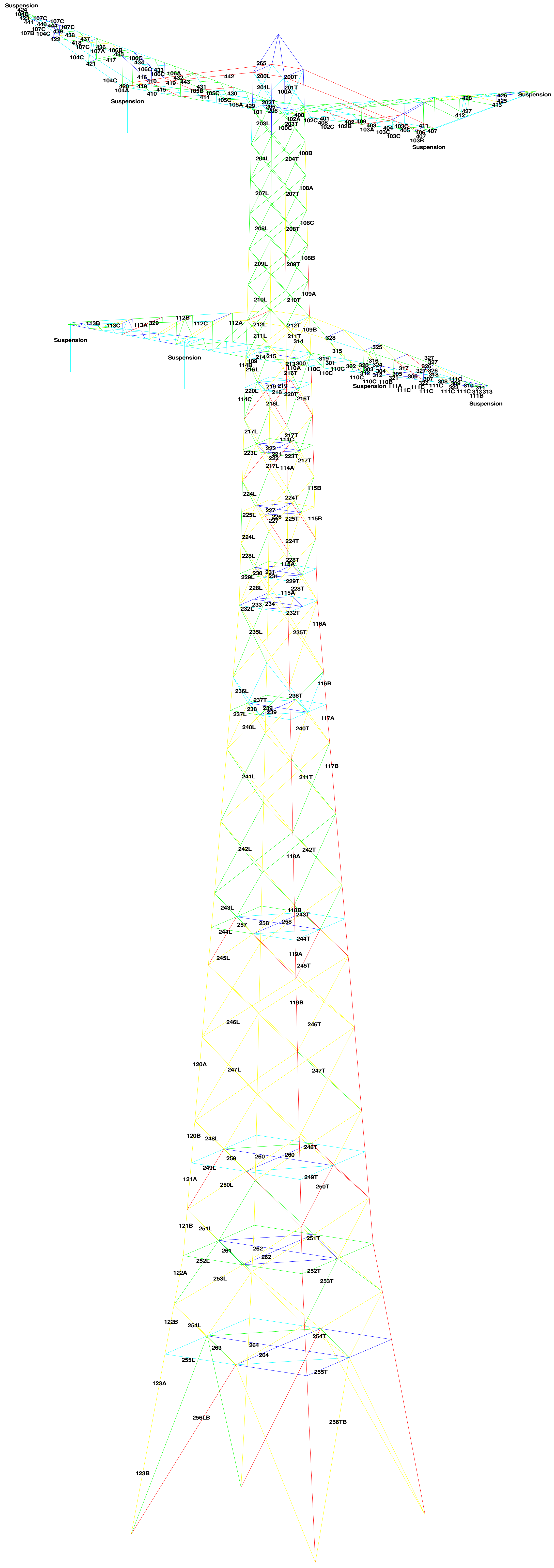
Maximum compression load - SLS

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	804	767	**5747**	26	-1111	-28	5848
2	SLS 1a_0	467	-535	**3645**	48	-709	-21	3710
3	SLS 7	-101	-101	**689**	0	-143	-13	701
4	SLS 1a_135	-804	767	**5747**	-26	-1111	-27	5849


Reacties R_z en R_η
150
100
50
0
-50
-100
-150
R_η
-8000
-6000
-4000
-2000
0
2000
4000
6000
8000
10000
Rz
Reacties

APPENDIX B UITVOER PLS-TOWER

DNV GL Nederlands BV, Project: "S+95 (hv) ini"
Tower Version 16.73, 09:36:54 vrijdag 9 april 2021
Undeformed geometry displayed



% Usage Legend
0 <= % < 25
25 <= % < 50
50 <= % < 75
75 <= % < 100
100 <= %

2 (m)

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Assessment of groups for initial mast (afkeur level)

Date 9-4-2021
Author MKh
Version 1.0

KIJ-GT380
S+95
12

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)
118A	Vijfde TSNSTK - Main member	250x250x22	S235	36M30-5.6t	0.25	0.25	0.66	54	**-4653.4**	ULS 1a_135	4246.0	4503.7	12830.4	1.10	knik, afschuiving	**3894.8**	ULS 1a_0,9_0,9_45	4747.5	4503.7	10368.0	0.86	
118B	Vijfde TSNSTK - Main member	250x250x22	S235	36M30-5.6t	0.50	0.50	1.39	54	**-4847.1**	ULS 1a_135	4239.9	4503.7	12830.4	1.14	knik, afschuiving	**4054.7**	ULS 1a_0,9_0,9_45	4747.5	4503.7	10368.0	0.90	
119A	Vierde TSNSTK - Main member* 24	250x250x24	S235	36M30-5.6t	0.50	0.50	1.17	50	**-4867.6**	ULS 1a_135	4715.3	4503.7	13996.8	1.08	knik, afschuiving	**4033.6**	ULS 1a_0,9_0,9_45	5560.4	4503.7	11310.5	0.90	
119B	Vierde TSNSTK - Main member* 24	250x250x24	S235	36M30-5.6t	0.25	0.25	0.61	50	**-5158.0**	ULS 1a_45	4719.6	4503.7	13996.8	1.15	knik, afschuiving	**4249.6**	ULS 1a_0,9_0,9_135	5560.4	4503.7	11310.5	0.94	
120A	Derde TSNSTK - Main member* INP425	INP 425	S235	36M24-5.6t	0.25	0.25	0.78	59	**-5442.7**	ULS 1a_135	5109.7	5723.4	7138.4	1.07	knik	**4508.9**	ULS 1a_0,9_0,9_45	6417.5	5723.4	6101.2	0.79	
120B	Derde TSNSTK - Main member* INP425	INP 425	S235	36M24-5.6t	0.50	0.50	1.57	59	**-5668.2**	ULS 1a_45	5096.5	5723.4	7138.4	1.11	knik	**4669.9**	ULS 1a_0,9_0,9_135	6417.5	5723.4	6101.2	0.82	
121A	Tweede TSNSTK - Main member* INP425	INP 425	S235	36M24-5.6t	0.50	0.50	1.42	59	**-5698.2**	ULS 1a_45	5089.4	5723.4	7138.4	1.12	knik	**4638.7**	ULS 1a_0,9_0,9_135	6417.5	5723.4	6101.2	0.81	
121B	Tweede TSNSTK - Main member* INP425	INP 425	S235	36M24-5.6t	0.50	0.50	1.43	59	**-6101.3**	ULS 1a_45	5095.0	5723.4	7138.4	1.20	knik, afschuiving	**4942.6**	ULS 1a_0,9_0,9_135	6417.5	5723.4	6101.2	0.86	
122A	Eerste TSNSTK - Main member	INP 450	S235	36M24-5.6t	0.50	0.50	1.55	65	**-6199.9**	ULS 1a_45	5440.8	5723.4	7558.3	1.14	knik, afschuiving	**4977.9**	ULS 1a_0,9_0,9_135	7183.8	5723.4	6460.1	0.87	
122B	Eerste TSNSTK - Main member	INP 450	S235	36M24-5.6t	0.50	0.50	1.55	65	**-5971.8**	ULS 1a_135	5440.8	5723.4	7558.3	1.10	knik, afschuiving	**4700.9**	ULS 1a_0,9_0,9_135	7183.8	5723.4	6460.1	0.82	
123A	Broekstuk - Main member	INP 450	S235	36M24-5.6t	0.33	0.33	0.85	65	**-6008.0**	ULS 1a_135	5437.9	5723.4	7558.3	1.10	knik, afschuiving	**4653.9**	ULS 1a_0,9_0,9_135	7183.8	5723.4	6460.1	0.81	
123B	Broekstuk - Main member	INP 450	S235	36M24-5.6t	0.33	0.33	0.85	66	**-6035.5**	ULS 1a_135	5424.0	5723.4	7558.3	1.11	knik, afschuiving	**4633.3**	ULS 1a_0,9_0,9_135	7183.8	5723.4	6460.1	0.81	
242L	Vijfde TSNSTK - CD 1 front	150x100x12	S235	1M30-5.6t	0.55	0.27	0.27	152	**-115.8**	ULS 1a_90	161.4	134.6	194.4	0.86		**100.9**	ULS 1a_0,9_90	231.6	134.6	157.1	0.75	
242T	Vijfde TSNSTK - CD 1 side	150x100x12	S235	1M30-5.6t	0.55	0.27	0.27	152	**-100.6**	ULS 1a_0	161.4	134.6	194.4	0.75		**89.4**	ULS 1a_0,9_0	231.6	134.6	157.1	0.66	
243L	Vijfde TSNSTK - Diag fr 1 above horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	148	**-91.7**	ULS 1a_0,9_90	148.5	134.6	162.0	0.68		**99.4**	ULS 1a_90	193.0	134.6	130.9	0.76	
243T	Vijfde TSNSTK - Diag si 1 above horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	148	**-82.3**	ULS 1a_0,9_0	148.5	134.6	162.0	0.61		**88.9**	ULS 1a_135	193.0	134.6	130.9	0.68	
244L	Vierde TSNSTK - Horizontal front	120x120x11	S235	1M20-5.6t	1.00	1.00	1.00	218	**-30.6**	ULS 1a_0,9_0,9_45	115.4	58.8	118.8	0.52		**22.7**	ULS 1a_0,9_135	310.5	58.8	96.0	0.39	
244T	Vierde TSNSTK - Horizontal side	120x120x11	S235	1M20-5.6t	1.00	1.00	1.00	218	**-30.9**	ULS 1a_0,9_0,9_45	115.4	58.8	118.8	0.53		**22.8**	ULS 1a_0,9_135	310.5	58.8	96.0	0.39	
245L	Vierde TSNSTK - Diag fr 1 below horiz	150x150x10	S235	1M30-5.6t	1.00	0.52	0.52	146	**-149.9**	ULS 1a_90	157.9	134.6	162.0	1.11	afschuiving	**123.9**	ULS 1a_0,9_0,9_90	337.0	134.6	130.9	0.95	
245T	Vierde TSNSTK - Diag si 1 below horiz	150x150x10	S235	1M30-5.6t	1.00	0.52	0.52	146	**-138.8**	ULS 1a_0	157.9	134.6	162.0	1.03	afschuiving	**111.3**	ULS 1a_0,9_0,9_0	337.0	134.6	130.9	0.85	
246L	Vierde TSNSTK - CD 1 front	150x150x12	S235	1M30-5.6t	0.55	0.27	0.27	164	**-120.1**	ULS 1a_0,9_0,9_90	165.0	134.6	194.4	0.89		**129.8**	ULS 1a_90	404.4	134.6	157.1	0.96	
246T	Vierde TSNSTK - CD 1 side	150x150x12	S235	1M30-5.6t	0.55	0.27	0.27	164	**-108.5**	ULS 1a_0,9_0,9_0	165.0	134.6	194.4	0.81		**122.2**	ULS 1a_0	404.4	134.6	157.1	0.91	
247L	Derde TSNSTK - CD 1 front	150x150x16	S235	2M24-5.6t	0.55	0.27	0.27	184	**-144.4**	ULS 1a_90	279.5	169.4	414.7	0.85		**127.8**	ULS 1a_0,9_0,9_90	565.4	169.4	344.4	0.75	
247T	Derde TSNSTK - CD 1 side	150x150x16	S235	2M24-5.6t	0.55	0.27	0.27	184	**-137.9**	ULS 1a_45	279.5	169.4	414.7	0.81		**117.4**	ULS 1a_0,9_0,9_0	565.4	169.4	344.4	0.69	
248L	Derde TSNSTK - Diag fr 1 above horiz	150x150x16	S235	2M24-5.6t	1.00	0.52	0.52	173	**-133.8**	ULS 1a_0,9_135	302.7	169.4	414.7	0.79		**141.6**	ULS 1a_45	565.4	169.4	344.4	0.84	
248T	Derde TSNSTK - Diag si 1 above horiz	150x150x16	S235	2M24-5.6t	1.00	0.52	0.52	173	**-130.3**	ULS 1a_0,9_135	302.7	169.4	414.7	0.77		**139.9**	ULS 1a_45	565.4	169.4	344.4	0.83	
249L	Tweede TSNSTK - Horizontal front	150x150x10	S235	1M24-5.6t	1.00	1.00	1.00	227	**-36.8**	ULS 1a_0,9_0,9_135	125.1	84.7	129.6	0.43		**32.1**	ULS 1a_45	357.1	84.7	110.8	0.38	
249T	Tweede TSNSTK - Horizontal side	150x150x10	S235	1M24-5.6t	1.00	1.00	1.00	223	**-37.4**	ULS 1a_0,9_0,9_45	128.2	84.7	129.6	0.44		**32.2**	ULS 1a_135	357.1	84.7	110.8	0.38	
250L	Tweede TSNSTK - Diag fr 1 below horiz	160x160x15	S235	2M24-5.6t	1.00	0.52	0.52	175	**-197.4**	ULS 1a_90	304.1	169.4	388.8	1.17	afschuiving	**154.1**	ULS 1a_0,9_0,9_45	578.5	169.4	332.3	0.91	
250T	Tweede TSNSTK - Diag si 1 below horiz	160x160x15	S235	2M24-5.6t	1.00	0.52	0.52	177	**-194.7**	ULS 1a_45	300.0	169.4	388.8	1.15	afschuiving	**151.3**	ULS 1a_0,9_0,9_135	578.5	169.4	332.3	0.89	
251L	Tweede TSNSTK - Diag fr 2 above horiz	160x160x15	S235	2M24-5.6t	1.00	0.52	0.52	175	**-117.6**	ULS 1a_0,9_0,9_90	303.4	169.4	388.8	0.69		**148.3**	ULS 1a_90	578.5	169.4	332.3	0.88	
251T	Tweede TSNSTK - Diag si 2 above horiz	160x160x15	S235	2M24-5.6t	1.00	0.52	0.52	175	**-111.7**	ULS 1a_0,9_0,9_0	303.4	169.4	388.8	0.66		**145.9**	ULS 1a_0	578.5	169.4	332.3	0.86	
252L	Eerste TSNSTK - Horizontal front	250x250x22	S235	4M30-5.6t	1.00	1.00	1.00	148	**-387.8**	ULS 1a_45	897.2	538.6	1425.6	0.72		**285.9**	ULS 1a_0,9_0,9_135	1494.6	538.6	960.0	0.53	
252T	Eerste TSNSTK - Horizontal side	250x250x22	S235	4M30-5.6t	1.00	1.00	1.00	148	**-387.6**	ULS 1a_135	897.2	538.6	1425.6	0.72		**285.9**	ULS 1a_0,9_0,9_45	1494.6	538.6	960.0	0.53	
253L	Eerste TSNSTK - Diag fr 2 below horiz	180x180x16	S235	2M24-5.6t	1.00	0.52	0.52	175	**-146.0**	ULS 1a_90	361.1	169.4	414.7	0.86		**137.8**	ULS 1a_90	896.8	169.4	354.5	0.81	
253T	Eerste TSNSTK - Diag si 2 below horiz	180x180x16	S235	2M24-5.6t	1.00	0.52	0.52	175	**-102.2**	ULS 1a_0	361.1	169.4	414.7	0.60		**97.5**	ULS 1a_0	896.8	169.4	354.5	0.58	
254L	Eerste TSNSTK - Diag fr 1 above horiz	180x180x16	S235	2M24-5.6t	1.00	0.52	0.52	175	**-155.2**	ULS 1a_90	361.1	169.4	414.7	0.92		**150.2**	ULS 1a_0,9_0,9_135	896.8	169.4	354.5	0.89	
254T	Eerste TSNSTK - Diag si 1 above horiz	180x180x16	S235	2M24-5.6t	1.00	0.52	0.52	175	**-135.6**	ULS 1a_45	361.1	169.4	414.7	0.80		**150.7**	ULS 1a_0,9_0,9_135	896.8	169.4	354.5	0.89	
255L	Broekstuk - Horizontal front	180x180x16	S235	2M24-5.6t	1.00	1.00	1.00	247	**-60.3**	ULS 1a_135	231.7	169.4	414.7	0.36		**25.1**	ULS 1a_0,9_45	692.4	169.4	354.5	0.15	
255T	Broekstuk - Horizontal side	180x180x16	S235	2M24-5.6t	1.00	1.00	1.00	247	**-60.5**	ULS 1a_45	231.7	169.4	414.7	0.36		**25.2**	ULS 1a_0,9_135	692.4	169.4	354.5	0.15	
256LB	Broekstuk - Lower part	150x150x10	S235	2M24-5.6t	0.17	0.25	0.17	127	**-186.3**	ULS 1a_90	290.1	169.4	259.2	1.10	afschuiving	**133.9**	ULS 1a_0,9_90	431.8	169.4	221.5	0.79	
256TB	Broekstuk - Lower part	150x150x10	S235	2M24-5.6t	0.17	0.25	0.17	127	**-139.0**	ULS 1a_45	290.1	169.4	259.2	0.82		**95.0**	ULS 1a_0,9_135	431.8	169.4	221.5	0.56	
257	Vierde TSNSTK - Diag A-A	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	370	**-10.1**	ULS 1a_135	27.1	58.8	86.4	0.37		**21.6**	ULS 1a_0,9_45	179.7	58.8	69.8	0.37	
258	Vierde TSNSTK - CD A-A	80x80x8	S235	1M20-5.6t	1.00	0.50	0.50	422	**-0.5**	ULS 7	15.2	58.8	86.4	0.03		**0.0**		133.6	58.8	69.8	0.00	
259	Tweede TSNSTK - Diag B-B	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	487	**-11.6**	ULS 1a_135	17.0	58.8	86.4	0.68		**17.5**	ULS 1a_0,9_135	179.7	58.8	69.8	0.30	
260	Tweede TSNSTK - CD B-B	100x100x8	S235	1M20-5.6t	1.00	0.50	0.50	437	**-0.9**	ULS 7	18.2	58.8	86.4	0.05		**0.0**		179.7	58.8	69.8	0.00	
261	Eerste TSNSTK - Diag C-C*	UNP200	S235	3M20-5.6t	1.00	1.00	1.00	482	**-8.2**	ULS 1a_90	44.3	176.4	275.4	0.18		**17.9**	ULS 1a_0,9_135	347.3	176.4	222.5	0.10	
262	Eerste TSNSTK - CD C-C	100x100x8	S235	2M20-5.6t	1.00	0.50	0.50	477	**-0.5**	ULS 7	21.5	117.6	172.8	0.02		**0.0**		277.0	117.6	139.6	0.00	
263	Broekstuk - Diag D-D	100x100x8	S235	1M20-5.6t	1.00	0.50	0.50	403	**-13.1**	ULS 1a_135	20.7	58.8	86.4	0.63		**15.8**	ULS 1a_0,9_45	179.7	58.8	69.8	0.27	
264	Broekstuk - CD D-D	100x100x8	S235	1M20-5.6t	1.00	0.50	0.50	569	**-2.4**	ULS 7	11.7	58.8	86.4	0.21		**0.0**		179.7	58.8	69.8	0.00	
100A	BVNSTK - Main Member	150x150x10	S235	6M24-5.6t	0.52	0.52	0.52	70	**-120.7**	ULS 1a_90	550.6	508.3	777.6	0.24		**0.0**		624.7	508.3	664.6	0.00	
100B	BVNSTK - Main Member	150x150x10	S235	6M24-5.6t	0.52	0.52	0.52	67	**-488.3**	ULS 1a_135	563.0	508.3	777.6	0.96		**267.0**	ULS 1a_0,9_0,9_135	624.7	508.3	664.6	0.53	
100C	BVNSTK - Main Member	150x150x10	S235		0.52	0.52	0.52	67	**-283.8**	ULS 1a_135	563.0	0.0	0.0	0.50		**106.5**	ULS 1a_0,9_0,9_135	688.6	0.0	0.0	0.15	
200L	BVNSTK - first horiz from top front	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	164	**0.0**		190.2	506.7	855.4	0.00		**422.4**	ULS 3_135	346.4	506.7	677.1	1.22	nettodsn.
200T	BVNSTK - first horiz from top side	120x120x11	S235	2M20-5.6t	1.00	1.00	1.00	164	**-6.6**	ULS 1a_0,9_90	190.2	117.6	237.6	0.06		**6.4**	ULS 1a_90	360.5	117.6	237.6	0.05	
201L	BVNSTK - CD 1 from top front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	124	**-34.0**	ULS 1a_0,9_0,9_135	263.5	169.4	285.1	0.20		**66.7**	ULS 1a_135	306.2	169.4	243.7	0.39	
201T	BVNSTK - CD 1 from top side	120x120x11	S235	1M24-5.6t	1.00	0.52	0.52	153	**-41.1**	ULS 1a_45	165.0	84.7	142.6	0.49		**0.0**		297.8	84.7	121.8	0.00	
101	BVNSTK - lower horiz lower CA front	200x200x18	S235	14M24-5.6t	1.00	2.00	1.00	65	**-737.9**	ULS 1a_0	1338.3	1066.2	3265.9	0.69		**61.4**	ULS 1a_0,9_0,9_0	1548.5	1066.2	2623.9	0.06	
202T	BVNSTK - lower horiz lower CA side	100x100x8	S235	4M20-5.6t	1.00	2.00	1.00	131	**-13.2**	ULS 5a Ah 22	143.1	235.2	345.6	0.09		**77.1**	ULS 5a Ah 22	310.5	235.2	279.3	0.33	
203L	BVNSTK - CD 2 from top front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	123	**-113.7**	ULS 1a_90	265.5	169.4	285.1	0.67		**76.3**	ULS 1a_0,9_0,9_90	291.2	169.4	229.3	0.45	
203T	BVNSTK - CD 2 from top side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	123	**-90.5**	ULS 5a Ba 12	265.5	169.4	285.1	0.53		**101.3**	ULS 5a Ah 22	291.2	169.4	229.3	0.60	
204L	BVNSTK - CD 3 from top front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	125	**-77.9**	ULS 1a_0,9_0,9_90	260.7	169.4	285.1	0.46		**111.8**	ULS 1a_90	291.2	169.4	229.3	0.66	
204T	BVNSTK - CD 3 from top side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	125	**-96.5**	ULS 5a Ah 22	260.7	169.4	285.1	0.57		**86.9**	ULS 5a Ba 12	291.2	169.4	229.3	0.51	
205	BVNSTK - Diaphragm diagonal	110x110x10	S235	2M20-5.6t	1.00	1.00	1.00	131	**-54.8**	ULS 5a Ah 22	205.7	117.6	216.0	0.47		**56.3**	ULS 5a Ba 22	262.5	117.6	174.5	0.48	
206	BVNSTK - Diaphragm horiz	70x70x7	S235	1M20-5.6t	1.00	1.00	1.00	294	**-1.7**	ULS 3_90	23.9	58.8	75.6	0.07		**0.0**		76.6	58.8	51.8	0.00	
400	Tweede DWSRM - CD under 1	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	167	**-18.3**	ULS 5a Ah 22	71.4	58.8	86.4	0.31		**14.3**	ULS 5a Ba 12	110.6	58.8	69.8	0.24	
401	Tweede DWSRM - CD under 2	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	155	**-17.8**	ULS 5a Ba 12	78.4	58.8	86.4	0.30		**21.8**	ULS 5a Ah 22	110.6	58.8	69.8	0.37	
402	Tweede DWSRM - CD under 3	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	147	**-24.1**	ULS 5a Ah 12	84.2	58.8	86.4	0.41		**21.5**	ULS 5a Ba 12	110.6	58.8	69.8	0.37	
403	Tweede DWSRM - CD under 4	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	118	**-23.0**	ULS 5a Ba 12	107.3	58.8	86.4	0.39		**21.9**	ULS 5a Ah 22	110.6	58.8	69.8	0.37	
404	Tweede DWSRM - CD under 5	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	111	**-21.5**	ULS 5a Ah 22	113.3	58.8	86.4	0.37		**29.5**	ULS 5a Ba 12	110.6	58.8	69.8	0.50	
405	Tweede DWSRM - CD under 6	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	108	**-37.9**	ULS 5a Ba 12	116.1	58.8	86.4	0.65		**21.9**	ULS 5a Ah 22	110.6	58.8	69.8	0.37	
406	Tweede DWSRM - CD under 7	80x80x8	S235	1M20-5.6t	0.52	0.52	0.52	82	**-38.0**	ULS 5a Ba 12	142.3	58.8	86.4	0.65		**8.8**	ULS 5a Ah 22	110.6	58.8	69.8	0.15	
407	Tweede DWSRM - Horiz 1&2 under	HEB200	S235	2M20-5.6t	2.00	2.00	2.00	41	**-10.8**	ULS 5a Ah 22	1434.3	117.6	324.0	0.09		**41.9**	ULS 5a Ba 12	1626.6	117.6	0.0	0.36	
408	Tweede DWSRM - front vert 1	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	**0.0**		50.7	37.7	43.2	0.00		**6.6**	ULS 1a_0	37.4	37.7	22.0	0.30	
409	Tweede DWSRM - front vert 2	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	191	**0.0**		23.4	37.7	43.2	0.00		**14.9**	ULS 7	37.4	37.7	22.0	0.68	
410	Tweede DWSRM - front vert 3	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	171	**-6.3**	ULS 1a_135	30.4	37.7	43.2	0.21		**9.2**	ULS 1a_45	37.4	37.7	22.0	0.42	
411	Tweede DWSRM - front vert 4	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	287	**-13.3**	ULS 1a_45	18.3	37.7	51.8	0.73		**0.0**		55.3	37.7	33.6	0.00	
412	Tweede DWSRM - front vert 5	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	231	**-12.0**	ULS 1a_0	17.7	37.7	43.2	0.68		**0.0**		37.4	37.7	22.0	0.00	
413	Tweede DWSRM - front vert 6	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	114	**-7.6**	ULS 7	43.2	37.7	43.2	0.20		**0.0**		37.4	37.7	22.0	0.00	
102A	Tweede DWSRM - Main member 1	200x200x18	S235	14M24-5.6t	1.00	1.46	1.00	80	**-493.5**	ULS 1a_0	1211.0	1066.2	3265.9	0.46		**0.0**		1548.5	1066.2	2791.4	0.00	
102B	Tweede DWSRM - Main member 1	200x200x18	S235	8M24-5.6t	1.00	1.53	1.00	77	**-466.4**	ULS 3_135	1237.8	677.8	1866.2	0.69		**0.0**		1548.5	677.8	1595.1	0.00	
102C	Tweede DWSRM - Main member 1	200x200x18	S235		1.89	2.89	1.00	75	**-476.8**	ULS 1a_0	1257.1	0.0	0.0	0.38		**0.0**		1623.9	0.0	0.0	0.00	
103A	Tweede DWSRM - Main member 2	180x180x16	S235	8M24-5.6t	1.00	1.82	1.00	67	**-449.9**	ULS 3_135	1063.9	677.8	1658.9	0.66		**0.0**		1220.3	677.8	1417.8	0.00	
103B	Tweede DWSRM - Main member 2	180x180x16	S235	7M24-5.6t	3.10	1.00	1.00	68	**-433.1**	ULS 3_90	1055.4	574.5	1451.5	0.75		**0.0**		828.7	574.5	1343.7	0.00	
103C	Tweede DWSRM - Main member 2	180x180x16	S235		5.59	10.37	1.00	68	**-449.9**	ULS 3_135	1055.8	0.0	0.0	0.43		**0.0**		1301.9	0.0	0.0	0.00	
414	Tweede DWSRM - front diag 1	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	344	**-31.4**	ULS 1a_0	18.6	37.7	60.5	1.69	knik	**0.0**		84.7	37.7	44.8	0.00	

Assessment of groups for initial mast (afkeur level)

Date 9-4-2021
Author MKh
Version 1.0

KIJ-GT380
S+95
12

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)
415	Tweede DWSRM - front diag 2	65x65x7	S235	1M16-5.6t	1.00	1.00	1.00	301	**-37.1**	ULS 7	21.4	37.7	60.5	1.73	knik	**0.0**		84.7	37.7	44.8	0.00	
416	Tweede DWSRM - front diag 3	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	328	**0.0**		20.1	37.7	60.5	0.00		**0.0**	ULS 1a_0	84.7	37.7	44.8	0.00	
417	Tweede DWSRM - front diag 4	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	333	**0.0**		19.5	37.7	60.5	0.00		**22.2**	ULS 1a_135	84.7	37.7	44.8	0.59	
418	Tweede DWSRM - front diag 5	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	325	**0.0**		20.3	37.7	60.5	0.00		**29.0**	ULS 1a_0	84.7	37.7	44.8	0.77	
419	Tweede DWSRM - main diag front	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	164	**0.0**		189.7	506.7	855.4	0.00		**405.4**	ULS 3_90	346.4	506.7	677.1	1.17	nettodsn.
420	Tweede DWSRM - raised horiz under 1	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	189	**-17.3**	ULS 1a_0,9_90	35.4	37.7	51.8	0.49		**6.8**	ULS 1a_0,9_0,9_90	44.9	37.7	41.4	0.18	
421	Tweede DWSRM - raised horiz under 2	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	155	**0.0**		45.9	37.7	51.8	0.00		**0.6**	ULS 1a_90	44.9	37.7	39.7	0.02	
422	Tweede DWSRM - raised horiz under 3	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	119	**0.0**		60.9	37.7	51.8	0.00		**0.8**	ULS 1a_135	44.9	37.7	34.4	0.02	
423	Tweede DWSRM - raised horiz under 4	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	87	**-0.1**	ULS 1a_0,9_0,9_90	74.7	37.7	51.8	0.00		**1.6**	ULS 1a_0,9_0,9_90	44.9	37.7	31.7	0.05	
104A	Tweede DWSRM - main member raised	150x150x10	S235	2M24-5.6t	1.00	19.90	1.00	103	**-106.0**	ULS 1a_135	413.3	169.4	259.2	0.63		**0.0**		343.1	169.4	208.5	0.00	
104B	Tweede DWSRM - main member raised	150x150x10	S235	2M24-5.6t	1.00	9.78	1.00	102	**-74.2**	ULS 1a_135	416.7	169.4	259.2	0.44		**0.0**		431.8	169.4	221.5	0.00	
104C	Tweede DWSRM - main member raised	150x150x10	S235		1.00	1.00	1.00	164	**-91.5**	ULS 1a_135	191.7	0.0	0.0	0.48		**0.0**		688.6	0.0	0.0	0.00	
424	Tweede DWSRM - horiz at end of raised	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	22	**-8.7**	ULS 5a Ba 3	1077.2	75.4	138.2	0.12		**6.3**	ULS 5a Ah 3	1296.6	75.4	11.9	0.53	
425	Tweede DWSRM - raised DS A-A diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	132	**-5.3**	ULS 1a_45	37.2	37.7	43.2	0.14		**3.4**	ULS 1a_0,9_45	37.4	37.7	22.0	0.15	
426	Tweede DWSRM - raised DS A-A horiz	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	**-1.4**	ULS 1a_0,9_0	69.2	37.7	43.2	0.04		**1.5**	ULS 1a_0	37.4	37.7	22.0	0.07	
427	Tweede DWSRM - raised DS B-B diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	247	**-4.2**	ULS 5a Ah 22	16.1	37.7	43.2	0.26		**2.2**	ULS 5a Ah 22	37.4	37.7	22.0	0.10	
428	Tweede DWSRM - raised DS B-B horiz	50x50x5	S235	1M16-5.6t	1.00	2.00	1.00	120	**-5.4**	ULS 1a_135	43.6	37.7	43.2	0.14		**0.0**		37.4	37.7	22.0	0.00	
429	Tweede DWSRM - CD top 1	65x65x7	S235	1M16-5.6t	0.53	0.53	0.53	208	**-19.0**	ULS 1a_0,9_0,9_0	37.4	37.7	60.5	0.51		**21.3**	ULS 1a_0	84.7	37.7	44.8	0.57	
430	Tweede DWSRM - CD top 2	65x65x7	S235	1M16-5.6t	0.53	0.53	0.53	196	**-20.5**	ULS 1a_0	40.9	37.7	60.5	0.55		**18.2**	ULS 1a_0,9_0,9_0	84.7	37.7	44.8	0.48	
431	Tweede DWSRM - CD top 3	65x65x7	S235	1M16-5.6t	0.53	0.53	0.53	188	**-17.8**	ULS 1a_0,9_0,9_0	43.2	37.7	60.5	0.47		**20.1**	ULS 1a_0	84.7	37.7	44.8	0.53	
432	Tweede DWSRM - CD top 4	60x60x6	S235	1M16-5.6t	0.53	0.53	0.53	175	**-17.2**	ULS 1a_0,9_0,9_0	37.8	37.7	51.8	0.46		**20.1**	ULS 1a_0	55.3	37.7	33.6	0.60	
433	Tweede DWSRM - CD top 5	60x60x6	S235	1M16-5.6t	0.53	0.53	0.53	162	**-18.9**	ULS 1a_0	41.8	37.7	51.8	0.50		**15.6**	ULS 1a_0,9_0,9_0	55.3	37.7	33.6	0.46	
434	Tweede DWSRM - CD top 6	60x60x6	S235	1M16-5.6t	0.53	0.53	0.53	161	**-15.3**	ULS 1a_0,9_0,9_0	42.0	37.7	51.8	0.41		**19.3**	ULS 1a_0	55.3	37.7	33.6	0.58	
435	Tweede DWSRM - CD top 7	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	180	**-20.3**	ULS 1a_0	25.4	37.7	43.2	0.80		**15.4**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.70	
436	Tweede DWSRM - CD top 8	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	148	**-13.5**	ULS 1a_0,9_0,9_0	32.6	37.7	43.2	0.41		**18.6**	ULS 1a_0	37.4	37.7	22.0	0.85	
437	Tweede DWSRM - CD top 9	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	147	**-13.5**	ULS 1a_0,9_0,9_0	32.8	37.7	43.2	0.41		**17.3**	ULS 1a_0	37.4	37.7	22.0	0.79	
438	Tweede DWSRM - CD top 10	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	124	**-16.2**	ULS 1a_0	39.8	37.7	43.2	0.43		**12.2**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.55	
439	Tweede DWSRM - diag top "CD"	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	106	**-10.9**	ULS 1a_0,9_0,9_0	46.0	37.7	43.2	0.29		**15.4**	ULS 1a_0	37.4	37.7	22.0	0.70	
440	Tweede DWSRM - CD top 11	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	115	**-11.7**	ULS 5a Ba 3	42.8	37.7	43.2	0.31		**8.6**	ULS 5a Ah 3	37.4	37.7	22.0	0.39	
441	Tweede DWSRM - CD top 12	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	103	**-10.2**	ULS 5a Ah 3	47.4	37.7	43.2	0.27		**14.3**	ULS 5a Ba 3	37.4	37.7	22.0	0.65	
442	Tweede DWSRM - Main diag from tower	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	401	**0.0**		48.7	506.7	855.4	0.00		**460.4**	ULS 3_90	346.4	506.7	677.1	1.33	nettodsn.
443	Tweede DWSRM - diag top "CD"	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	260	**-13.0**	ULS 3_90	21.3	37.7	51.8	0.61		**0.0**		55.3	37.7	33.6	0.00	
105A	Tweede DWSRM - Main member top 1	130x130x12	S235	6M24-5.6t	1.00	1.47	1.00	124	**-252.1**	ULS 1a_0	310.9	506.7	933.1	0.81		**248.5**	ULS 1a_0,9_0	410.9	506.7	738.6	0.60	
105B	Tweede DWSRM - Main member top 1	130x130x12	S235	6M24-5.6t	1.50	1.00	1.00	123	**-182.7**	ULS 1a_0,9_0,9_0	308.4	508.3	933.1	0.59		**228.4**	ULS 1a_0	615.9	508.3	797.5	0.45	
105C	Tweede DWSRM - Main member top 1	130x130x12	S235		3.12	2.05	1.00	116	**-224.8**	ULS 1a_0	312.3	0.0	0.0	0.72		**255.4**	ULS 1a_0	705.0	0.0	0.0	0.36	
106A	Tweede DWSRM - Main member top 2	100x100x10	S235	7M24-5.6t	1.00	1.48	1.00	130	**-115.6**	ULS 1a_0,9_0,9_0	188.5	593.0	907.2	0.61		**258.8**	ULS 1a_0	362.9	593.0	775.4	0.71	
106B	Tweede DWSRM - Main member top 2	100x100x10	S235	4M24-5.6t	1.00	1.77	1.00	145	**-49.2**	ULS 1a_0,9_0,9_0	157.6	338.9	518.4	0.31		**169.7**	ULS 1a_135	362.9	338.9	443.1	0.50	
106C	Tweede DWSRM - Main member top 2	100x100x10	S235		2.02	3.23	1.00	126	**-90.5**	ULS 1a_0,9_0,9_0	185.0	0.0	0.0	0.49		**237.6**	ULS 1a_0	451.2	0.0	0.0	0.53	
107A	Tweede DWSRM - Main member top 3	100x75x7	S235	4M20-5.6t	2.31	1.00	1.00	139	**-29.2**	ULS 1a_0,9_0,9_45	102.5	235.2	302.4	0.29		**143.6**	ULS 1a_135	228.6	235.2	302.4	0.63	
107B	Tweede DWSRM - Main member top 3	100x75x7	S235	2M16-5.6t	2.86	1.00	1.00	138	**0.0**		103.6	75.4	121.0	0.00		**70.3**	ULS 1a_135	196.1	75.4	121.0	0.93	
107C	Tweede DWSRM - Main member top 3	100x75x7	S235		2.17	1.00	1.00	142	**-19.3**	ULS 5a Ah 3	100.0	0.0	0.0	0.19		**94.6**	ULS 1a_135	279.7	0.0	0.0	0.34	
444	Tweede DWSRM - diag top "CD"	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	131	**-8.2**	ULS 1a_0,9_0,9_0	37.3	37.7	43.2	0.22		**11.9**	ULS 1a_0	37.4	37.7	22.0	0.54	
108A	Elfde TSNSTK - Main member	180x180x16	S235	8M24-5.6t	0.51	0.51	0.51	55	**-660.0**	ULS 1a_135	1135.8	677.8	1658.9	0.97		**452.7**	ULS 1a_0,9_0,9_135	1220.3	677.8	1417.8	0.67	
108B	Elfde TSNSTK - Main member	180x180x16	S235	12M24-5.6t	0.51	0.51	0.51	56	**-1038.4**	ULS 1a_135	1127.4	999.7	2488.3	1.04	afschuiving	**817.0**	ULS 1a_0,9_0,9_135	1220.3	999.7	2126.8	0.82	
108C	Elfde TSNSTK - Main member	180x180x16	S235		0.51	0.51	0.51	55	**-865.3**	ULS 1a_135	1135.8	0.0	0.0	0.76		**619.4**	ULS 1a_0,9_0,9_135	1301.9	0.0	0.0	0.48	
207L	Elfde TSNSTK - CD 1 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	127	**-115.4**	ULS 1a_90	255.9	169.4	285.1	0.68		**82.4**	ULS 1a_0,9_0,9_90	306.2	169.4	236.8	0.49	
207T	Elfde TSNSTK - CD 1 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	127	**-83.3**	ULS 5a Ba 12	255.9	169.4	285.1	0.49		**91.9**	ULS 5a Ah 22	306.2	169.4	236.8	0.54	
208L	Elfde TSNSTK - CD 2 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	130	**-83.0**	ULS 1a_0,9_0,9_90	251.2	169.4	285.1	0.49		**115.1**	ULS 1a_90	306.2	169.4	236.8	0.68	
208T	Elfde TSNSTK - CD 2 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	130	**-91.9**	ULS 1a_0	251.2	169.4	285.1	0.54		**83.6**	ULS 1a_0,9_0,9_0	306.2	169.4	236.8	0.49	
209L	Elfde TSNSTK - CD 3 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	133	**-118.8**	ULS 1a_90	243.6	169.4	285.1	0.70		**82.9**	ULS 1a_0,9_0,9_90	306.2	169.4	236.8	0.49	
209T	Elfde TSNSTK - CD 3 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	133	**-85.6**	ULS 1a_0,9_0,9_0	243.6	169.4	285.1	0.51		**93.1**	ULS 1a_0	306.2	169.4	236.8	0.55	
109A	Tiende TSNSTK - Main member	200x200x20	S235	8M30-5.6t	0.52	0.52	0.52	52	**-1255.8**	ULS 1a_135	1590.7	1077.1	2592.0	1.17	afschuiving	**979.8**	ULS 1a_0,9_0,9_135	1638.1	1077.1	2094.5	0.91	
109B	Tiende TSNSTK - Main member	200x200x20	S235	12M30-5.6t	0.52	0.52	0.52	53	**-1453.7**	ULS 1a_45	1580.5	1588.8	3888.0	0.92		**1026.0**	ULS 1a_0,9_0,9_135	1638.1	1588.8	3194.2	0.65	
210L	Tiende TSNSTK - CD 1 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	136	**-84.9**	ULS 1a_0,9_0,9_90	238.9	169.4	285.1	0.50		**123.4**	ULS 1a_90	306.2	169.4	236.8	0.73	
210T	Tiende TSNSTK - CD 1 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	136	**-98.9**	ULS 1a_0	238.9	169.4	285.1	0.58		**89.2**	ULS 1a_0,9_0,9_0	306.2	169.4	236.8	0.53	
211L	Tiende TSNSTK - CD 2 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	140	**-139.2**	ULS 1a_0,9_0,9_45	230.6	169.4	285.1	0.82		**161.4**	ULS 1a_45	306.2	169.4	236.8	0.95	
211T	Tiende TSNSTK - CD 2 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	140	**-144.6**	ULS 1a_135	230.6	169.4	285.1	0.85		**104.7**	ULS 1a_0,9_0,9_45	306.2	169.4	236.8	0.62	
212L	Tiende TSNSTK - upper horiz lower CA fr	150x150x10	S235	7M24-5.6t	1.00	1.00	1.00	162	**0.0**		222.3	578.2	907.2	0.00		**384.2**	ULS 3_0	420.0	578.2	778.3	0.91	
212T	Tiende TSNSTK - upper horiz lower CA si	80x80x8	S235	2M20-5.6t	1.00	1.00	1.00	308	**-59.0**	ULS 1a_90	36.4	117.6	172.8	1.62	knik	**41.9**	ULS 1a_0,9_0,9_90	212.5	117.6	139.6	0.36	
109	Tiende TSNSTK - lower horiz lower CA fr	200x200x18	S235	12M24-5.6t	1.00	2.00	1.00	82	**-431.0**	ULS 3_0	1194.7	906.5	2799.4	0.48		**0.0**		1548.5	906.5	2392.6	0.00	
213	Tiende TSNSTK - lower horiz lower CA si	110x110x10	S235	4M20-5.6t	1.00	2.00	1.00	148	**-10.2**	ULS 5a Ah 21	168.8	235.2	432.0	0.06		**86.2**	ULS 5a Ah 21	433.4	235.2	349.1	0.37	
214	Tiende TSNSTK - Diaphragm diagonal	130x130x12	S235	2M20-5.6t	1.00	1.00	1.00	139	**-60.8**	ULS 5a Ba 21	272.8	117.6	259.2	0.52		**62.7**	ULS 5a Ba 21	379.7	117.6	209.5	0.53	
215	Tiende TSNSTK - Diaphragm horiz	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	321	**-2.2**	ULS 3_90	27.3	58.8	86.4	0.08		**0.0**		133.6	58.8	69.8	0.00	
300	Eerste DWSRM - CD under 1	100x100x8	S235	1M20-5.6t	0.53	0.53	0.53	146	**-21.3**	ULS 5a Ah 20	106.2	58.8	86.4	0.36		**19.2**	ULS 5a Ba 11	179.7	58.8	69.8	0.33	
301	Eerste DWSRM - CD under 2	100x100x8	S235	1M20-5.6t	0.53	0.53	0.53	136	**-20.9**	ULS 5a Ah 11	116.1	58.8	86.4	0.36		**26.6**	ULS 5a Ba 20	179.7	58.8	69.8	0.45	
302	Eerste DWSRM - CD under 3	100x100x8	S235	1M20-5.6t	0.53	0.53	0.53	128	**-32.8**	ULS 5a Ba 20	123.5	58.8	86.4	0.56		**22.6**	ULS 5a Ah 11	179.7	58.8	69.8	0.38	
303	Eerste DWSRM - CD under 4	100x100x8	S235	1M20-5.6t	0.52	0.52	0.52	99	**-27.4**	ULS 5a Ba 11	157.9	58.8	86.4	0.47		**17.4**	ULS 5a Ah 20	179.7	58.8	69.8	0.30	
304	Eerste DWSRM - CD under 5	65x65x7	S235	1M20-5.6t	0.53	0.53	0.53	163	**-16.5**	ULS 1a_135	52.2	58.8	75.6	0.32		**12.2**	ULS 1a_0,9_0,9_0	86.7	58.8	59.5	0.21	
305	Eerste DWSRM - CD under 6	65x65x7	S235	1M20-5.6t	0.53	0.53	0.53	147	**-13.2**	ULS 1a_0,9_0,9_0	59.5	58.8	75.6	0.23		**14.7**	ULS 1a_0	86.7	58.8	59.5	0.25	
306	Eerste DWSRM - CD under 7	65x65x7	S235	1M20-5.6t	0.54	0.54	0.54	138	**-14.3**	ULS 1a_0	64.1	58.8	75.6	0.24		**13.7**	ULS 1a_0,9_0,9_0	86.7	58.8	59.5	0.23	
307	Eerste DWSRM - CD under 8	65x65x7	S235	1M20-5.6t	0.54	0.54	0.54	126	**-14.6**	ULS 5a Ah 10	70.4	58.8	75.6	0.25		**16.5**	ULS 5a Ba 10	86.7	58.8	59.5	0.28	
308	Eerste DWSRM - CD under 9	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	115	**-17.7**	ULS 5a Ba 10	61.4	58.8	64.8	0.30		**17.3**	ULS 5a Ah 10	65.7	58.8	44.4	0.39	
309	Eerste DWSRM - CD under 10	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	108	**-21.7**	ULS 5a Ah 10	65.5	58.8	64.8	0.37		**23.3**	ULS 5a Ba 10	65.7	58.8	44.4	0.53	
310	Eerste DWSRM - CD under 11	65x65x7	S235	2M20-5.6t	0.56	0.56	0.56	95	**-31.9**	ULS 5a Ba 21	114.4	117.6	151.2	0.28		**26.1**	ULS 5a Ah 21	99.4	117.6	104.2	0.26	
311	Eerste DWSRM - CD under 12	65x65x7	S235	1M20-5.6t	0.55	0.55	0.55	72	**-36.1**	ULS 5a Ba 21	105.7	58.8	75.6	0.61		**20.9**	ULS 5a Ah 21	86.7	58.8	59.5	0.36	
312	Eerste DWSRM - 1st & 2nd horiz under	HEB240	S235	2M20-5.6t	2.00	2.00	2.00	56	**-18.5**	ULS 5a Ah 11	1771.8	117.6	367.2	0.16		**32.9**	ULS 5a Ba 11	2249.6	117.6	0.0	0.28	
313	Eerste DWSRM - 3rd & 4th horiz under	HEB200	S235	2M20-5.6t	2.00	2.00	2.00	20	**-20.9**	ULS 5a Ah 10	1583.1	117.6	324.0	0.18		**31.5**	ULS 5a Ba 10	1626.6	117.6	0.0	0.27	
314	Eerste DWSRM - front diag 1	65x65x7	S235	2M20-5.6t	1.00	1.00	1.00	475	**0.0**		12.4	117.6	151.2	0.00		**70.4**	ULS 3_135	99.4	117.6	119.1	0.71	
315	Eerste DWSRM - front diag 2	65x65x7	S235	2M20-5.6t	1.00	1.00	1.00	450	**0.0**		13.6	117.6	151.2	0.00		**93.0**	ULS 3_0	99.4	117.6	119.1	0.94	
316	Eerste DWSRM - front diag 3	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	364	**0.0**		12.4	37.7	51.8	0.00		**34.5**	ULS 1a_0	72.6	37.7	38.4	0.92	
317	Eerste DWSRM - front diag 4	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	338	**0.0**		14.0	37.7	51.8	0.00		**39.3**	ULS 1a_0	72.6	37.7	38.4	1.04	afschuiving, stuik
318	Eerste DWSRM - front diag 5	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	317	**0.0**		15.5	37.7	51.8	0.00		**36.9**	ULS 7	72.6	37.7	38.4	0.98	
319	Eerste DWSRM - front vert 1	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	165	**-42.1**	ULS 3_0	91.7	58.8	86.4	0.72		**0.0**		179.7	58.8	69.8	0.00	
320	Eerste DWSRM - front vert 2	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	225	**-16.8**	ULS 7	27.8	37.7	51.8	0.61		**0.0**		44.9	37.7	26.5	0.00	
321	Eerste DWSRM - front vert 3	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	188	**-14.4**	ULS 1a_0	23.9	37.7	43.2	0.60		**0.0**		37.4	37.7	22.0	0.00	
322	Eerste DWSRM - front vert 4	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	112	**-8.9**	ULS 1a_135	63.5	37.7	51.8	0.24		**0.0**		44.9	37.7	26.5	0.00	
323	Eerste DWSRM - front vert 5	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	63	**-3.6**	ULS 3_90	60.9	37.7	43.2	0.10		**0.0**		37.4	37.7	22.0	0.00	

Assessment of groups for initial mast (afkeur level)

Date 9-4-2021
Author MKh
Version 1.0

KIJ-GT380
S+95
12

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)
324	Eerste DWSRM - Doorsnede A-A diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	306	**-7.0**	ULS 1a_0	11.5	37.7	43.2	0.61		**4.7**	ULS 1a_0,9_0	37.4	37.7	22.0	0.21	
325	Eerste DWSRM - Doorsnede A-A horiz top	50x50x5	S235	1M16-5.6t	1.00	2.00	1.00	219	**-2.8**	ULS 1a_0	20.7	37.7	43.2	0.13		**2.6**	ULS 1a_0,9_0	37.4	37.7	22.0	0.12	
326	Eerste DWSRM - Doorsnede B-B diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	156	**-8.3**	ULS 1a_0	30.6	37.7	43.2	0.27		**3.7**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.17	
327	Eerste DWSRM - Doorsnede B-B horiz top	50x50x5	S235	1M16-5.6t	1.00	2.49	1.00	142	**-2.3**	ULS 1a_0,9_0,9_0	36.2	37.7	43.2	0.06		**2.1**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.10	
110A	Eerste DWSRM - Main member bottom 1	200x200x18	S235	12M24-5.6t	1.00	1.70	1.00	71	**-511.6**	ULS 1a_135	1289.1	906.5	2799.4	0.56		**0.0**		1548.5	906.5	2392.6	0.00	
110B	Eerste DWSRM - Main member bottom 1	200x200x18	S235	8M24-5.6t	2.53	1.40	1.00	57	**-336.3**	ULS 5a Ba 21	1398.2	677.8	1866.2	0.50		**7.9**	ULS 5a Ah 21	1548.5	677.8	1595.1	0.01	
110C	Eerste DWSRM - Main member bottom 1	200x200x18	S235		2.42	1.40	1.00	71	**-500.6**	ULS 1a_135	1289.3	0.0	0.0	0.39		**19.7**	ULS 5a Ah 21	1623.9	0.0	0.0	0.01	
111A	Eerste DWSRM - Main member bottom 1	160x160x15	S235	8M24-5.6t	3.53	6.36	1.00	72	**-311.8**	ULS 5a Ba 21	869.0	677.8	1555.2	0.46		**32.5**	ULS 5a Ah 21	1008.5	677.8	1329.2	0.05	
111B	Eerste DWSRM - Main member bottom 1	160x160x15	S235		2.89	1.00	1.00	72	**-197.2**	ULS 3_90	869.3	0.0	0.0	0.23		**0.0**		1097.7	0.0	0.0	0.00	
111C	Eerste DWSRM - Main member bottom 1	160x160x15	S235		1.80	1.00	1.00	72	**-297.8**	ULS 5a Ba 21	869.1	0.0	0.0	0.34		**26.9**	ULS 5a Ah 21	1097.7	0.0	0.0	0.02	
112A	Eerste DWSRM - Main member top 1	130x130x12	S235	6M24-5.6t	1.00	1.00	1.00	178	**0.0**		200.4	504.1	933.1	0.00		**362.0**	ULS 3_90	422.8	504.1	796.6	0.86	
112B	Eerste DWSRM - Main member top 1	130x130x12	S235	5M24-5.6t	1.00	1.00	1.00	140	**0.0**		270.4	423.6	777.6	0.00		**259.4**	ULS 3_90	615.9	423.6	664.6	0.61	
112C	Eerste DWSRM - Main member top 1	130x130x12	S235		1.00	1.00	1.00	187	**0.0**		188.2	0.0	0.0	0.00		**285.8**	ULS 3_90	705.0	0.0	0.0	0.41	
113A	Eerste DWSRM - Main member top 1	110x110x10	S235	5M24-5.6t	1.00	1.00	1.00	165	**0.0**		156.1	423.6	648.0	0.00		**232.8**	ULS 3_135	412.6	423.6	553.8	0.56	
113B	Eerste DWSRM - Main member top 1	110x110x10	S235	5M24-5.6t	2.00	1.00	1.00	212	**0.0**		106.2	423.6	648.0	0.00		**198.4**	ULS 3_135	291.3	423.6	553.8	0.68	
113C	Eerste DWSRM - Main member top 1	110x110x10	S235		2.00	1.00	1.00	212	**0.0**		106.2	0.0	0.0	0.00		**198.1**	ULS 3_135	496.3	0.0	0.0	0.40	
328	Eerste DWSRM - Horiz top 1	65x50x5	S235	1M16-5.6t	1.00	1.00	1.00	380	**-0.2**	ULS 1a_90	9.2	37.7	43.2	0.02		**0.0**		60.5	37.7	32.0	0.00	
329	Eerste DWSRM - Horiz top 2	65x50x5	S235	1M16-5.6t	1.00	1.00	1.00	255	**-0.1**	ULS 1a_90	17.5	37.7	43.2	0.00		**0.0**		60.5	37.7	32.0	0.00	
114A	Negende TSNSTK - Main member	250x250x22	S235	18M30-5.6t	0.52	0.52	0.52	36	**-2412.2**	ULS 1a_45	2358.2	2423.5	6415.2	1.02	knik	**1903.1**	ULS 1a_0,9_0,9_45	2373.8	2423.5	4626.7	0.80	
114B	Negende TSNSTK - Main member	250x250x22	S235	14M30-5.6t	0.52	0.52	0.52	35	**-1903.4**	ULS 1a_45	2373.4	1885.0	4989.6	1.01	afschuiving	**1426.7**	ULS 1a_0,9_0,9_45	2373.8	1885.0	4032.0	0.76	
114C	Negende TSNSTK - Main member	250x250x22	S235		0.52	0.52	0.52	35	**-2409.3**	ULS 1a_45	2373.0	0.0	0.0	1.02	knik	**1906.8**	ULS 1a_0,9_0,9_45	2493.4	0.0	0.0	0.76	
216L	Negende TSNSTK - Diag fr 1 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	103	**-282.1**	ULS 1a_90	355.4	269.3	388.8	1.05	afschuiving	**255.3**	ULS 1a_0,9_0,9_90	250.2	269.3	314.2	1.02	nettodsn.
216T	Negende TSNSTK - Diag si 1 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	103	**-200.8**	ULS 1a_0	355.4	269.3	388.8	0.75		**198.0**	ULS 1a_0	250.2	269.3	314.2	0.79	
217L	Negende TSNSTK - Diag fr 2 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	104	**-261.6**	ULS 1a_90	350.2	269.3	388.8	0.97		**265.4**	ULS 1a_90	250.2	269.3	314.2	1.06	nettodsn.
217T	Negende TSNSTK - Diag si 2 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	104	**-207.2**	ULS 1a_0	350.2	269.3	388.8	0.77		**191.3**	ULS 1a_0,9_0,9_0	250.2	269.3	314.2	0.76	
218	Negende TSNSTK - Diaphragm K diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	266	**-11.3**	ULS 5a Ah 21	35.0	75.4	121.0	0.32		**11.2**	ULS 5a Ah 21	109.4	75.4	89.6	0.15	
219	Negende TSNSTK - Diaphragm K CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	239	**-0.4**	ULS 1a_90	38.0	113.0	155.5	0.01		**0.1**	ULS 1a_0,9_90	90.2	113.0	100.9	0.00	
220L	Negende TSNSTK - Diaphragm K horiz fr	65x65x7	S235	1M16-5.6t	1.00	1.00	1.00	203	**-17.9**	ULS 1a_0,9_45	43.6	37.7	60.5	0.47		**16.9**	ULS 1a_135	94.8	37.7	44.8	0.45	
220T	Negende TSNSTK - Diaphragm K horiz si	65x65x7	S235	1M16-5.6t	1.00	1.00	1.00	203	**-14.5**	ULS 1a_0,9_0,9_135	43.6	37.7	60.5	0.39		**18.8**	ULS 1a_45	94.8	37.7	44.8	0.50	
221	Negende TSNSTK - Diaphragm L diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	279	**-1.9**	ULS 1a_0	32.5	75.4	121.0	0.06		**4.8**	ULS 1a_45	109.4	75.4	89.6	0.06	
222	Negende TSNSTK - Diaphragm L CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	251	**-0.2**	ULS 1a_90	35.4	113.0	155.5	0.01		**0.3**	ULS 1a_90	90.2	113.0	100.9	0.00	
223L	Negende TSNSTK - Diaphragm L horiz fr	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	198	**-21.9**	ULS 1a_0,9_0,9_135	49.1	37.7	60.5	0.58		**20.5**	ULS 1a_45	104.8	37.7	44.8	0.54	
223T	Negende TSNSTK - Diaphragm L horiz si	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	198	**-21.6**	ULS 1a_0,9_0,9_45	49.1	37.7	60.5	0.57		**19.8**	ULS 1a_135	104.8	37.7	44.8	0.52	
224L	Achtste TSNSTK - Diag fr 1 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	106	**-273.5**	ULS 1a_90	345.0	269.3	388.8	1.02	afschuiving	**256.0**	ULS 1a_0,9_0,9_90	348.4	269.3	314.2	0.95	
224T	Achtste TSNSTK - Diag si 1 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	106	**-205.1**	ULS 1a_0	345.0	269.3	388.8	0.76		**204.5**	ULS 1a_0	348.4	269.3	314.2	0.76	
225L	Achtste TSNSTK - Diaphragm M horiz fr	75x75x7#	S235	1M16-5.6t	1.00	1.00	1.00	191	**-29.2**	ULS 1a_0,9_0,9_135	55.7	37.7	60.5	0.77		**28.3**	ULS 1a_45	114.9	37.7	44.8	0.75	
225T	Achtste TSNSTK - Diaphragm M horiz si	75x75x7#	S235	1M16-5.6t	1.00	1.00	1.00	191	**-28.7**	ULS 1a_0,9_0,9_135	55.7	37.7	60.5	0.76		**28.9**	ULS 1a_90	114.9	37.7	44.8	0.77	
226	Achtste TSNSTK - Diaphragm M diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	292	**-2.5**	ULS 1a_90	30.2	75.4	121.0	0.08		**5.6**	ULS 1a_45	109.4	75.4	89.6	0.07	
227	Achtste TSNSTK - Diaphragm M CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	263	**-0.4**	ULS 1a_90	33.0	113.0	155.5	0.01		**0.1**	ULS 1a_0,9_90	90.2	113.0	100.9	0.00	
228L	Achtste TSNSTK - Diag fr 2 above horiz	150x150x10	S235	2M30-5.6t	1.00	0.51	0.51	99	**-260.6**	ULS 1a_90	353.4	269.3	324.0	0.97		**253.3**	ULS 1a_0,9_90	347.2	269.3	261.8	0.97	
228T	Achtste TSNSTK - Diag si 2 above horiz	150x150x10	S235	2M30-5.6t	1.00	0.51	0.51	99	**-213.5**	ULS 1a_45	353.4	269.3	324.0	0.79		**198.8**	ULS 1a_0,9_0,9_135	347.2	269.3	261.8	0.76	
229L	Achtste TSNSTK - Diaphragm N horiz fr	80x80x8	S235	1M16-5.6t	1.00	1.00	1.00	188	**-22.9**	ULS 1a_0,9_0,9_135	61.0	37.7	69.1	0.61		**15.1**	ULS 1a_0,9_135	142.8	37.7	51.2	0.40	
229T	Achtste TSNSTK - Diaphragm N horiz si	80x80x8	S235	1M16-5.6t	1.00	1.00	1.00	188	**-23.2**	ULS 1a_0,9_0,9_45	61.0	37.7	69.1	0.62		**14.9**	ULS 1a_0,9_90	142.8	37.7	51.2	0.39	
230	Achtste TSNSTK - Diaphragm N diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	305	**-2.7**	ULS 1a_135	28.2	75.4	121.0	0.10		**6.7**	ULS 1a_135	109.4	75.4	89.6	0.09	
231	Achtste TSNSTK - Diaphragm N CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	274	**-0.3**	ULS 1a_90	30.8	113.0	155.5	0.01		**0.4**	ULS 1a_0,9_90	75.4	113.0	100.9	0.01	
115A	Achtste TSNSTK - Main member	200x200x20	S235	28M30-5.6t	0.52	0.52	1.05	47	**-3452.0**	ULS 1a_45	3186.4	3628.5	9072.0	1.08	knik	**2888.4**	ULS 1a_0,9_0,9_135	3607.3	0.0	0.0	0.80	
115B	Achtste TSNSTK - Main member	200x200x20	S235		0.50	0.50	0.50	22	**-2975.7**	ULS 1a_45	3556.9	0.0	0.0	0.84		**2439.0**	ULS 1a_0,9_0,9_135	3607.3	0.0	0.0	0.68	
116A	Zevende TSNSTK - Main member	250x250x20	S235	28M30-5.6t	0.25	0.25	0.74	60	**-3844.0**	ULS 1a_45	3729.7	3628.5	9072.0	1.06	knik, afschuiving	**3249.5**	ULS 1a_0,9_0,9_135	4683.2	3628.5	7330.9	0.90	
116B	Zevende TSNSTK - Main member	250x250x20	S235	32M30-5.6t	0.50	0.50	1.60	60	**-4150.0**	ULS 1a_135	3732.8	4075.1	10368.0	1.11	knik, afschuiving	**3480.6**	ULS 1a_0,9_0,9_45	4683.2	4075.1	8378.2	0.85	
117A	Zesde TSNSTK - Main member	250x250x20	S235	32M30-5.6t	0.50	0.50	1.36	59	**-4166.3**	ULS 1a_135	3745.4	4075.1	10368.0	1.11	knik, afschuiving	**3462.1**	ULS 1a_0,9_0,9_45	4683.2	4075.1	8378.2	0.85	
117B	Zesde TSNSTK - Main member	250x250x20	S235	36M30-5.6t	0.25	0.25	0.74	60	**-4404.8**	ULS 1a_135	3729.7	4503.7	11664.0	1.18	knik	**3657.2**	ULS 1a_0,9_0,9_45	4341.1	4503.7	9425.5	0.84	
232L	Zevende TSNSTK - Doorsnede B-B horiz f	100x100x8	S235	2M20-5.6t	1.00	2.00	1.00	196	**-39.4**	ULS 1a_0,9_0	86.6	117.6	172.8	0.45		**23.1**	ULS 1a_0	190.7	117.6	139.6	0.20	
232T	Zevende TSNSTK - Doorsnede B-B horiz s	100x100x8	S235	2M20-5.6t	1.00	2.00	1.00	196	**-43.1**	ULS 1a_0,9_90	86.6	117.6	172.8	0.50		**27.8**	ULS 1a_90	190.7	117.6	139.6	0.24	
233	Zevende TSNSTK - Doorsnede B-B diag	75x75x7#	S235	1M20-5.6t	1.00	1.00	1.00	289	**-3.8**	ULS 1a_90	26.8	58.8	75.6	0.14		**8.8**	ULS 1a_135	106.8	58.8	61.1	0.15	
234	Zevende TSNSTK - Doorsnede B-B horiz i	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	385	**0.0**	ULS 1a_0	20.2	58.8	86.4	0.00		**0.0**	ULS 1a_0,9_0,9_90	133.6	58.8	69.8	0.00	
235L	Zevende TSNSTK - CD 1 front	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	127	**-125.7**	ULS 1a_135	163.7	134.6	162.0	0.93		**101.9**	ULS 1a_0,9_0,9_45	193.0	134.6	130.9	0.78	
235T	Zevende TSNSTK - CD 1 side	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	127	**-113.4**	ULS 1a_135	163.7	134.6	162.0	0.84		**94.7**	ULS 1a_0,9_0,9_45	193.0	134.6	130.9	0.72	
236L	Zevende TSNSTK - Diag fr 1 above horiz	130x90x10	S235	2M24-5.6t	1.00	0.52	0.52	135	**-75.5**	ULS 1a_0,9_0,9_90	197.0	169.4	259.2	0.45		**90.0**	ULS 1a_90	194.6	169.4	221.5	0.53	
236T	Zevende TSNSTK - Diag si 1 above horiz	130x90x10	S235	2M24-5.6t	1.00	0.52	0.52	137	**-64.2**	ULS 5a Ba 10	194.1	169.4	259.2	0.38		**77.6**	ULS 5a Ah 10	194.6	169.4	221.5	0.46	
237L	Zevende TSNSTK - Doorsnede A-A horiz f	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	186	**-34.8**	ULS 1a_0,9_0,9_45	87.9	58.8	86.4	0.59		**24.1**	ULS 1a_135	179.7	58.8	69.8	0.41	
237T	Zevende TSNSTK - Doorsnede A-A horiz s	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	186	**-34.7**	ULS 1a_0,9_0,9_135	87.9	58.8	86.4	0.59		**24.6**	ULS 1a_45	179.7	58.8	69.8	0.42	
238	Zevende TSNSTK - Doorsnede A-A diag	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	331	**-8.8**	ULS 1a_135	25.9	58.8	86.4	0.34		**18.2**	ULS 1a_0,9_45	133.6	58.8	69.8	0.31	
239	Zevende TSNSTK - Doorsnede A-A CD	70x70x7	S235	1M20-5.6t	1.00	0.50	0.50	349	**-0.4**	ULS 7	15.8	58.8	75.6	0.03		**0.0**		96.8	58.8	61.1	0.00	
240L	Zesde TSNSTK - Diag fr 1 below horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	140	**-131.1**	ULS 1a_90	157.6	134.6	162.0	0.97		**119.6**	ULS 1a_0,9_90	193.0	134.6	130.9	0.91	
240T	Zesde TSNSTK - Diag si 1 below horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	138	**-111.5**	ULS 1a_0	159.4	134.6	162.0	0.83		**100.1**	ULS 1a_0,9_0	193.0	134.6	130.9	0.76	
241L	Zesde TSNSTK - CD 1 front	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	143	**-104.5**	ULS 1a_0,9_90	145.1	134.6	162.0	0.78		**106.5**	ULS 1a_90	193.0	134.6	130.9	0.81	
241T	Zesde TSNSTK - CD 1 side	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	143	**-89.9**	ULS 1a_0,9_0	145.1	134.6	162.0	0.67		**91.8**	ULS 1a_135	193.0	134.6	130.9	0.70	
275L	Vijfde TSNSTK - Doorsnede A-A horiz fr	120x120x11	S235	1M30-5.6t	1.00	1.00	1.00	377	**0.0**		43.3	134.6	178.2	0.00		**0.0**	ULS 1a_0	275.6	134.6	144.0	0.00	
275T	Vijfde TSNSTK - Doorsnede A-A horiz si	120x120x11	S235	1M30-5.6t	1.00	1.00	1.00	377	**0.0**		43.3	134.6	178.2	0.00		**0.0**	ULS 1a_0	275.6	134.6	144.0	0.00	
265	Top*	120x120x11	S235		1.00	1.00	1.00	206	**-15.7**	ULS 5a Ba 12	139.5	0.0	0.0	0.11		**15.0**	ULS 5a Ba 12	599.7	0.0	0.0	0.03	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 9-4-2021
Author MKh
Version 1.0

KIJ-GT380
S+95
12

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)	Opm.2
118A	Vijfde TSNSTK - Main member	250x250x22+PL200x25	S235	36M30-8.8t	0.25	0.25	0.50	40	-4668.4	ULS 1a_135	6717.9	7205.9	12830.4	0.69		3866.6	ULS 1a_0,9_0,9_45	7329.7	7205.9	10368.0	0.54	
118B	Vijfde TSNSTK - Main member	250x250x22+PL200x25	S235	36M30-8.8t	0.50	0.50	1.00	38	-4883.8	ULS 1a_135	6775.5	7205.9	12830.4	0.72		4029.2	ULS 1a_0,9_0,9_45	7329.7	7205.9	10368.0	0.56	
119A	Vierde TSNSTK - Main member* 24	250x250x24+PL200x25	S235	36M30-8.8t	0.50	0.50	1.00	42	-4908.5	ULS 1a_135	7047.0	7205.9	13996.8	0.70		4004.5	ULS 1a_0,9_0,9_45	8142.5	7205.9	11310.5	0.56	
119B	Vierde TSNSTK - Main member* 24	250x250x24+PL200x25	S235	36M30-8.8t	0.25	0.25	0.50	40	-5194.3	ULS 1a_45	7109.2	7205.9	13996.8	0.73		4212.3	ULS 1a_0,9_0,9_135	8142.5	7205.9	11310.5	0.58	
120A	Derde TSNSTK - Main member* INP425	INP 425	S235	36M24-8.8t	0.25	0.25	0.51	38	-5496.0	ULS 1a_135	5715.8	9157.4	7138.4	0.96		4478.6	ULS 1a_0,9_0,9_45	6417.5	9157.4	6101.2	0.73	
120B	Derde TSNSTK - Main member* INP425	INP 425	S235	36M24-5.6t	0.50	0.50	0.90	34	-5709.9	ULS 1a_45	5831.7	5723.4	7138.4	1.00		4634.9	ULS 1a_0,9_0,9_135	6417.5	5723.4	6101.2	0.81	
121A	Tweede TSNSTK - Main member* INP425	INP 425	S235	36M24-8.8t	0.50	0.50	0.81	34	-5741.1	ULS 1a_45	5832.9	9157.4	7138.4	0.98		4603.1	ULS 1a_0,9_0,9_135	6417.5	9157.4	6101.2	0.75	
121B	Tweede TSNSTK - Main member* INP425	INP425+PL230x25	S235	36M24-8.8t	0.50	0.50	0.87	34	-6161.2	ULS 1a_45	8382.4	9157.4	9331.2	0.74		4911.9	ULS 1a_0,9_0,9_135	9303.7	9157.4	7975.4	0.62	
122A	Eerste TSNSTK - Main member	INP 450	S235	36M24-8.8t	0.50	0.50	1.00	42	-6260.3	ULS 1a_45	6265.5	9157.4	7558.3	1.00		4945.2	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	0.77	
122B	Eerste TSNSTK - Main member	INP 450	S235	36M24-8.8t	0.50	0.50	1.16	49	-6019.7	ULS 1a_135	6050.8	9157.4	7558.3	0.99		4662.9	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	0.72	
123A	Broekstuk - Main member	INP 450	S235	36M24-8.8t	0.33	0.33	0.62	48	-6055.8	ULS 1a_135	6089.9	9157.4	7558.3	0.99		4616.0	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	0.71	
123B	Broekstuk - Main member	INP 450	S235	36M24-8.8t	0.33	0.33	0.62	47	-6083.3	ULS 1a_135	6094.5	9157.4	7558.3	1.00		4595.4	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	0.71	
242L	Vijfde TSNSTK - CD 1 front	150x100x12	S235	1M30-5.6t	0.55	0.27	0.27	152	-118.3	ULS 1a_90	161.4	134.6	194.4	0.88		101.0	ULS 1a_0,9_90	231.6	134.6	157.1	0.75	
242T	Vijfde TSNSTK - CD 1 side	150x100x12	S235	1M30-5.6t	0.55	0.27	0.27	152	-103.2	ULS 1a_0	161.4	134.6	194.4	0.77		89.2	ULS 1a_0,9_0,9_0	231.6	134.6	157.1	0.66	
243L	Vijfde TSNSTK - Diag fr 1 above horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	148	-91.4	ULS 1a_0,9_90	148.5	134.6	162.0	0.68		103.3	ULS 1a_90	193.0	134.6	130.9	0.79	
243T	Vijfde TSNSTK - Diag si 1 above horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	148	-81.8	ULS 1a_0,9_0	148.5	134.6	162.0	0.61		92.4	ULS 1a_0	193.0	134.6	130.9	0.71	
244L	Vierde TSNSTK - Horizontal front	120x120x11	S235	1M20-5.6t	1.00	1.00	1.00	218	-28.4	ULS 1a_0,9_0,9_45	115.4	58.8	118.8	0.48		24.3	ULS 1a_0,9_135	310.5	58.8	96.0	0.41	
244T	Vierde TSNSTK - Horizontal side	120x120x11	S235	1M20-5.6t	1.00	1.00	1.00	218	-28.8	ULS 1a_0,9_0,9_45	115.4	58.8	118.8	0.49		24.5	ULS 1a_0,9_135	310.5	58.8	96.0	0.42	
245L	Vierde TSNSTK - Diag fr 1 below horiz	150x150x10	S235	1M30-8.8t	1.00	0.52	0.52	146	-152.0	ULS 1a_90	157.9	215.4	162.0	0.96		123.3	ULS 1a_0,9_0,9_90	337.0	215.4	130.9	0.94	
245T	Vierde TSNSTK - Diag si 1 below horiz	150x150x10	S235	1M30-8.8t	1.00	0.52	0.52	146	-140.7	ULS 1a_0	157.9	215.4	162.0	0.89		110.7	ULS 1a_0,9_0,9_0	337.0	215.4	130.9	0.85	
246L	Vierde TSNSTK - CD 1 front	150x150x12	S235	1M30-5.6t	0.55	0.27	0.27	164	-120.7	ULS 1a_0,9_0,9_90	165.0	134.6	194.4	0.90		131.7	ULS 1a_90	404.4	134.6	157.1	0.98	
246T	Vierde TSNSTK - CD 1 side	150x150x12	S235	1M30-5.6t	0.55	0.27	0.27	164	-109.1	ULS 1a_0,9_0,9_0	165.0	134.6	194.4	0.81		124.0	ULS 1a_0	404.4	134.6	157.1	0.92	
247L	Derde TSNSTK - CD 1 front	150x150x16	S235	2M24-5.6t	0.55	0.27	0.27	184	-145.1	ULS 1a_90	279.5	169.4	414.7	0.86		129.5	ULS 1a_0,9_90	565.4	169.4	344.4	0.76	
247T	Derde TSNSTK - CD 1 side	150x150x16	S235	2M24-5.6t	0.55	0.27	0.27	184	-141.3	ULS 1a_45	279.5	169.4	414.7	0.83		121.0	ULS 1a_0,9_135	565.4	169.4	344.4	0.71	
248L	Derde TSNSTK - Diag fr 1 above horiz	150x150x16	S235	2M24-5.6t	1.00	0.52	0.52	173	-140.8	ULS 1a_0,9_135	302.7	169.4	414.7	0.83		144.3	ULS 1a_135	565.4	169.4	344.4	0.85	
248T	Derde TSNSTK - Diag si 1 above horiz	150x150x16	S235	2M24-5.6t	1.00	0.52	0.52	173	-137.5	ULS 1a_0,9_135	302.7	169.4	414.7	0.81		142.8	ULS 1a_45	565.4	169.4	344.4	0.84	
249L	Tweede TSNSTK - Horizontal front	150x150x10	S235	1M24-5.6t	1.00	1.00	1.00	227	-35.4	ULS 1a_0,9_0,9_135	125.1	84.7	129.6	0.42		30.3	ULS 1a_45	357.1	84.7	110.8	0.36	
249T	Tweede TSNSTK - Horizontal side	150x150x10	S235	1M24-5.6t	1.00	1.00	1.00	223	-35.9	ULS 1a_0,9_0,9_45	128.2	84.7	129.6	0.42		30.3	ULS 1a_135	357.1	84.7	110.8	0.36	
250L	Tweede TSNSTK - Diag fr 1 below horiz	160x160x15#	S235	2M24-8.8t	1.00	0.52	0.52	175	-204.9	ULS 1a_135	304.1	271.1	388.8	0.76		156.5	ULS 1a_0,9_0,9_45	578.5	271.1	332.3	0.58	
250T	Tweede TSNSTK - Diag si 1 below horiz	160x160x15#	S235	2M24-8.8t	1.00	0.52	0.52	177	-202.4	ULS 1a_45	300.0	271.1	388.8	0.75		153.8	ULS 1a_0,9_0,9_135	578.5	271.1	332.3	0.57	
251L	Tweede TSNSTK - Diag fr 2 above horiz	160x160x15#	S235	2M24-5.6t	1.00	0.52	0.52	175	-115.7	ULS 1a_0,9_0,9_45	303.4	169.4	388.8	0.68		148.4	ULS 1a_90	578.5	169.4	332.3	0.88	
251T	Tweede TSNSTK - Diag si 2 above horiz	160x160x15#	S235	2M24-5.6t	1.00	0.52	0.52	175	-113.4	ULS 1a_0,9_0,9_135	303.4	169.4	388.8	0.67		146.3	ULS 1a_0	578.5	169.4	332.3	0.86	
252L	Eerste TSNSTK - Horizontal front	250x250x22#	S235	4M30-5.6t	1.00	1.00	1.00	148	-385.3	ULS 1a_45	897.2	538.6	1425.6	0.72		280.5	ULS 1a_0,9_0,9_135	1494.6	538.6	960.0	0.52	
252T	Eerste TSNSTK - Horizontal side	250x250x22#	S235	4M30-5.6t	1.00	1.00	1.00	148	-385.1	ULS 1a_135	897.2	538.6	1425.6	0.72		280.5	ULS 1a_0,9_0,9_45	1494.6	538.6	960.0	0.52	
253L	Eerste TSNSTK - Diag fr 2 below horiz	180x180x16#	S235	2M24-5.6t	1.00	0.52	0.52	175	-141.7	ULS 1a_90	361.1	169.4	414.7	0.84		135.1	ULS 1a_0,9_90	896.8	169.4	354.5	0.80	
253T	Eerste TSNSTK - Diag si 2 below horiz	180x180x16#	S235	2M24-5.6t	1.00	0.52	0.52	175	-103.2	ULS 1a_135	361.1	169.4	414.7	0.61		99.8	ULS 1a_45	896.8	169.4	354.5	0.59	
254L	Eerste TSNSTK - Diag fr 1 above horiz	180x180x16#	S235	2M24-5.6t	1.00	0.52	0.52	175	-157.1	ULS 1a_90	361.1	169.4	414.7	0.93		154.0	ULS 1a_0,9_0,9_135	896.8	169.4	354.5	0.91	
254T	Eerste TSNSTK - Diag si 1 above horiz	180x180x16#	S235	2M24-5.6t	1.00	0.52	0.52	175	-143.7	ULS 1a_45	361.1	169.4	414.7	0.85		154.1	ULS 1a_0,9_0,9_135	896.8	169.4	354.5	0.91	
255L	Broekstuk - Horizontal front	180x180x16#	S235	2M24-5.6t	1.00	1.00	1.00	247	-59.9	ULS 1a_135	231.7	169.4	414.7	0.35		25.6	ULS 1a_0,9_45	692.4	169.4	354.5	0.15	
255T	Broekstuk - Horizontal side	180x180x16#	S235	2M24-5.6t	1.00	1.00	1.00	247	-60.1	ULS 1a_45	231.7	169.4	414.7	0.35		25.8	ULS 1a_0,9_135	692.4	169.4	354.5	0.15	
256LB	Broekstuk - Lower part	150x150x10	S235	2M24-8.8t	0.17	0.25	0.17	127	-187.0	ULS 1a_90	290.1	271.1	259.2	0.72		132.5	ULS 1a_0,9_90	431.8	271.1	221.5	0.60	
256TB	Broekstuk - Lower part	150x150x10	S235	2M24-5.6t	0.17	0.25	0.17	127	-143.3	ULS 1a_45	290.1	169.4	259.2	0.85		96.5	ULS 1a_0,9_135	431.8	169.4	221.5	0.57	
257	Vierde TSNSTK - Diag A-A	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	370	-12.1	ULS 1a_135	27.1	58.8	86.4	0.45		19.7	ULS 1a_0,9_45	179.7	58.8	69.8	0.33	
258	Vierde TSNSTK - CD A-A	80x80x8	S235	1M20-5.6t	1.00	0.50	0.50	422	-0.6	ULS 7	15.2	58.8	86.4	0.04		0.0		133.6	58.8	69.8	0.00	
259	Tweede TSNSTK - Diag B-B	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	487	-12.0	ULS 1a_135	17.0	58.8	86.4	0.71		17.1	ULS 1a_0,9_45	179.7	58.8	69.8	0.29	
260	Tweede TSNSTK - CD B-B	100x100x8	S235	1M20-5.6t	1.00	0.50	0.50	437	-0.9	ULS 7	18.2	58.8	86.4	0.05		0.0		179.7	58.8	69.8	0.00	
261	Eerste TSNSTK - Diag C-C*	UNP200	S235	3M20-5.6t	1.00	1.00	1.00	482	-8.6	ULS 1a_90	44.3	176.4	275.4	0.19		18.3	ULS 1a_0,9_135	347.3	176.4	222.5	0.10	
262	Eerste TSNSTK - CD C-C	100x100x8	S235	2M20-5.6t	1.00	0.50	0.50	477	-0.5	ULS 7	21.4	117.6	172.8	0.02		0.0		277.0	117.6	139.6	0.00	
263	Broekstuk - Diag D-D	100x100x8	S235	1M20-5.6t	1.00	0.50	0.50	403	-13.1	ULS 1a_135	20.7	58.8	86.4	0.63		15.8	ULS 1a_0,9_45	179.7	58.8	69.8	0.27	
264	Broekstuk - CD D-D	100x100x8	S235	1M20-5.6t	1.00	0.50	0.50	569	-2.4	ULS 7	11.7	58.8	86.4	0.21		0.0		179.7	58.8	69.8	0.00	
100A	BVNSTK - Main Member	150x150x10	S235	6M24-5.6t	0.52	0.52	0.52	70	-121.7	ULS 1a_90	550.6	508.3	777.6	0.24		0.0		624.7	508.3	664.6	0.00	
100B	BVNSTK - Main Member	150x150x10	S235	6M24-5.6t	0.52	0.52	0.52	67	-487.0	ULS 1a_135	563.0	508.3	777.6	0.96		263.2	ULS 1a_0,9_0,9_135	624.7	508.3	664.6	0.52	
100C	BVNSTK - Main Member	150x150x10	S235		0.52	0.52	0.52	67	-284.3	ULS 1a_135	563.0	0.0	0.0	0.51		104.8	ULS 1a_0,9_0,9_135	688.6	0.0	0.0	0.15	
200L	BVNSTK - first horiz from top front	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	164	0.0		190.2	506.7	855.4	0.00		426.6	ULS 3_135	346.4	506.7	677.1	0.72	
200T	BVNSTK - first horiz from top side	120x120x11	S235	2M20-5.6t	1.00	1.00	1.00	164	-6.7	ULS 1a_0,9_90	190.2	117.6	237.6	0.06		6.4	ULS 1a_90	360.5	117.6	237.6	0.05	
201L	BVNSTK - CD 1 from top front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	124	-33.7	ULS 1a_0,9_0,9_135	263.5	169.4	285.1	0.20		66.5	ULS 1a_135	306.2	169.4	243.7	0.39	
201T	BVNSTK - CD 1 from top side	120x120x11	S235	1M24-5.6t	1.00	0.52	0.52	153	-41.4	ULS 1a_45	164.2	84.7	142.6	0.49		0.0		297.8	84.7	121.8	0.00	
101	BVNSTK - lower horiz lower CA front	200x200x18	S235	14M24-5.6t	1.00	2.00	1.00	65	-738.4	ULS 1a_0	1338.3	1066.2	3265.9	0.69		53.1	ULS 1a_0,9_0,9_0	1548.5	1066.2	2623.9	0.05	
202T	BVNSTK - lower horiz lower CA side	100x100x8	S235	4M20-5.6t	1.00	2.00	1.00	131	-12.7	ULS 5a Ah 22	143.1	235.2	345.6	0.09		77.5	ULS 5a Ah 22	310.5	235.2	279.3	0.33	
203L	BVNSTK - CD 2 from top front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	123	-113.5	ULS 1a_90	265.5	169.4	285.1	0.67		76.0	ULS 1a_0,9_0,9_90	291.2	169.4	229.3	0.45	
203T	BVNSTK - CD 2 from top side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	123	-90.6	ULS 5a Ba 12	265.5	169.4	285.1	0.53		101.1	ULS 5a Ah 22	291.2	169.4	229.3	0.60	
204L	BVNSTK - CD 3 from top front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	125	-77.6	ULS 1a_0,9_0,9_90	260.7	169.4	285.1	0.46		111.6	ULS 1a_90	291.2	169.4	229.3	0.66	
204T	BVNSTK - CD 3 from top side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	125	-96.3	ULS 5a Ah 22	260.7	169.4	285.1	0.57		87.0	ULS 5a Ba 12	291.2	169.4	229.3	0.51	
205	BVNSTK - Diaphragm diagonal	110x110x10	S235	2M20-5.6t	1.00	1.00	1.00	131	-54.8	ULS 5a Ah 22	205.7	117.6	216.0	0.47		56.3	ULS 5a Ba 22	262.5	117.6	174.5	0.48	
206	BVNSTK - Diaphragm horiz	70x70x7	S235	1M20-5.6t	1.00	1.00	1.00	294	-1.8	ULS 3_90	23.9	58.8	75.6	0.07		0.0		76.6	58.8	51.8	0.00	
400	Tweede DWSRM - CD under 1	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	167	-18.3	ULS 5a Ah 22	71.4	58.8	86.4	0.31		14.3	ULS 5a Ba 12	110.6	58.8	69.8	0.24	
401	Tweede DWSRM - CD under 2	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	155	-17.8	ULS 5a Ba 12	78.4	58.8	86.4	0.30		21.8	ULS 5a Ah 22	110.6	58.8	69.8	0.37	
402	Tweede DWSRM - CD under 3	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	147	-24.1	ULS 5a Ah 12	84.2	58.8	86.4	0.41		21.4	ULS 5a Ba 12	110.6	58.8	69.8	0.36	
403	Tweede DWSRM - CD under 4	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	118	-23.1	ULS 5a Ba 12	107.3	58.8	86.4	0.39		21.8	ULS 5a Ah 22	110.6	58.8	69.8	0.37	
404	Tweede DWSRM - CD under 5	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	111	-21.5	ULS 5a Ah 22	113.3	58.8	86.4	0.37		29.5	ULS 5a Ba 12	110.6	58.8	69.8	0.50	
405	Tweede DWSRM - CD under 6	80x80x8	S235	1M20-5.6t	0.53	0.53	0.53	108	-38.0	ULS 5a Ba 12	116.1	58.8	86.4	0.65		21.9	ULS 5a Ah 22	110.6	58.8	69.8	0.37	
406	Tweede DWSRM - CD under 7	80x80x8	S235	1M20-5.6t	0.52	0.52	0.52	82	-38.1	ULS 5a Ba 12	142.3	58.8	86.4	0.65		8.7	ULS 5a Ah 22	110.6	58.8	69.8	0.15	
407	Tweede DWSRM - Horiz 1&2 under	HEB200	S235	2M20-5.6t	2.00	2.00	2.00	41	-10.7	ULS 5a Ah 22	1434.3	117.6	324.0	0.09		42.0	ULS 5a Ba 12	1626.6	117.6	0.0	0.36	
408	Tweede DWSRM - front vert 1	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	95	0.0		50.7	37.7	43.2	0.00		7.3	ULS 1a_0	37.4	37.7	22.0	0.33	
409	Tweede DWSRM - front vert 2	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	191	0.0		23.4	37.7	43.2	0.00		15.2	ULS 7	37.4	37.7	22.0	0.69	
410	Tweede DWSRM - front vert 3	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	171	-6.6	ULS 1a_135	30.4	37.7	43.2	0.22		9.8	ULS 1a_45	37.4	37.7	22.0	0.45	
411	Tweede DWSRM - front vert 4	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	287	-13.5	ULS 1a_135	18.3	37.7	51.8	0.74		0.0		55.3	37.7	33.6	0.00	
412	Tweede DWSRM - front vert 5	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	231	-12.1	ULS 1a_0	17.7	37.7	43.2	0.68		0.0		37.4	37.7	22.0	0.00	
413	Tweede DWSRM - front vert 6	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	114	-7.8	ULS 7	43.2	37.7	43.2	0.21		0.0		37.4	37.7	22.0	0.00	
102A	Tweede DWSRM - Main member 1	200x200x18	S235	14M24-5.6t	1.00	1.46	1.00	80	-495.7	ULS 1a_0	1211.0	1066.2	3265.9	0.46		0.0		1548.5	1066.2	2791.4	0.00	
102B	Tweede DWSRM - Main member 1	200x200x18	S235	8M24-5.6t	1.00	1.53	1.00	77	-469.2	ULS 3_135	1237.8	677.8	1866.2	0.69		0.0		1548.5	677.8	1595.1	0.00	
102C	Tweede DWSRM - Main member 1	200x200x18	S235		1.89	2.89	1.00	75	-479.2	ULS 1a_0	1257.1	0.0	0.0	0.38		0.0		1623.9	0.0	0.0	0.00	
103A	Tweede DWSRM - Main member 2	180x180x16#	S235	8M24-5.6t	1.00	1.82	1.00	67	-452.4	ULS 3_135	1063.9	677.8	1658.9	0.67		0.0		1220.3	677.8	1417.8	0.00	

Assessment of groups for strengthened mast (afkeur level)

Date 9-4-2021
Author MKh
Version 1.0

KIJ-GT380
S+95
12

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)	Opm.2
103B	Tweede DWSRM - Main member 2	180x180x16#	S235	7M24-5.6t	3.10	1.00	1.00	68	**-436.0**	ULS 3_90	1055.4	574.5	1451.5	0.76		**0.0**		828.7	574.5	1343.7	0.00	
103C	Tweede DWSRM - Main member 2	180x180x16#	S235		5.59	10.37	1.00	68	**-452.6**	ULS 3_135	1055.8	0.0	0.0	0.43		**0.0**		1301.9	0.0	0.0	0.00	
414	Tweede DWSRM - front diag 1	**70x70x7(11,0.17)**	S235	**1M16-8.8t**	1.00	1.00	1.00	221	**-34.0**	ULS 1a_0	76.4	60.3	121.0	0.56		**0.0**		209.7	60.3	89.6	0.00	
415	Tweede DWSRM - front diag 2	**65x65x7(11,0.17)**	S235	**1M16-8.8t**	1.00	1.00	1.00	193	**-39.6**	ULS 7	84.6	60.3	121.0	0.66		**0.0**		189.5	60.3	89.6	0.00	
416	Tweede DWSRM - front diag 3	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	328	**0.0**		20.1	37.7	60.5	0.00		**0.0**	ULS 1a_0	84.7	37.7	44.8	0.00	
417	Tweede DWSRM - front diag 4	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	333	**0.0**		19.5	37.7	60.5	0.00		**22.6**	ULS 1a_135	84.7	37.7	44.8	0.60	
418	Tweede DWSRM - front diag 5	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	325	**0.0**		20.3	37.7	60.5	0.00		**29.2**	ULS 1a_0	84.7	37.7	44.8	0.78	
419	Tweede DWSRM - main diag front	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	164	**0.0**		189.7	506.7	855.4	0.00		**409.5**	ULS 3_90	346.4	506.7	677.1	0.69	
420	Tweede DWSRM - raised horiz under 1	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	189	**-17.7**	ULS 1a_0,9_90	35.4	37.7	51.8	0.50		**7.1**	ULS 1a_0,9_0,9_90	44.9	37.7	41.4	0.19	
421	Tweede DWSRM - raised horiz under 2	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	155	**0.0**		45.9	37.7	51.8	0.00		**0.6**	ULS 1a_90	44.9	37.7	39.7	0.02	
422	Tweede DWSRM - raised horiz under 3	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	119	**0.0**		60.9	37.7	51.8	0.00		**0.8**	ULS 1a_135	44.9	37.7	34.4	0.02	
423	Tweede DWSRM - raised horiz under 4	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	87	**-0.3**	ULS 1a_0,9_0,9_90	74.7	37.7	51.8	0.01		**1.6**	ULS 1a_0,9_0,9_90	44.9	37.7	31.7	0.05	
104A	Tweede DWSRM - main member raised	150x150x10	S235	2M24-5.6t	1.00	19.90	1.00	103	**-107.3**	ULS 1a_135	413.3	169.4	259.2	0.63		**0.0**		343.1	169.4	208.5	0.00	
104B	Tweede DWSRM - main member raised	150x150x10	S235	2M24-5.6t	1.00	9.78	1.00	102	**-74.7**	ULS 1a_135	416.7	169.4	259.2	0.44		**0.0**		431.8	169.4	221.5	0.00	
104C	Tweede DWSRM - main member raised	150x150x10	S235		1.00	**1.01**	1.00	152	**-107.0**	ULS 1a_135	221.6	0.0	0.0	0.48		**0.0**		688.6	0.0	0.0	0.00	
424	Tweede DWSRM - horiz at end of raised	HEB160	S235	2M16-5.6t	2.00	2.00	2.00	22	**-8.7**	ULS 5a Ba 3	1077.2	75.4	138.2	0.12		**6.3**	ULS 5a Ah 3	1296.6	75.4	11.9	0.53	
425	Tweede DWSRM - raised DS A-A diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	132	**-5.2**	ULS 1a_45	37.2	37.7	43.2	0.14		**3.2**	ULS 1a_0,9_45	37.4	37.7	22.0	0.15	
426	Tweede DWSRM - raised DS A-A horiz	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	70	**-1.4**	ULS 1a_0,9_0	69.2	37.7	43.2	0.04		**1.5**	ULS 1a_0	37.4	37.7	22.0	0.07	
427	Tweede DWSRM - raised DS B-B diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	247	**-4.2**	ULS 5a Ah 22	16.1	37.7	43.2	0.26		**2.1**	ULS 5a Ah 22	37.4	37.7	22.0	0.10	
428	Tweede DWSRM - raised DS B-B horiz	50x50x5	S235	1M16-5.6t	1.00	2.00	1.00	120	**-5.4**	ULS 1a_135	43.6	37.7	43.2	0.14		**0.0**		37.4	37.7	22.0	0.00	
429	Tweede DWSRM - CD top 1	65x65x7	S235	1M16-5.6t	0.53	0.53	0.53	208	**-18.8**	ULS 1a_0,9_0,9_0	37.4	37.7	60.5	0.50		**21.2**	ULS 1a_0	84.7	37.7	44.8	0.56	
430	Tweede DWSRM - CD top 2	65x65x7	S235	1M16-5.6t	0.53	0.53	0.53	196	**-20.4**	ULS 1a_0	40.9	37.7	60.5	0.54		**18.0**	ULS 1a_0,9_0,9_0	84.7	37.7	44.8	0.48	
431	Tweede DWSRM - CD top 3	65x65x7	S235	1M16-5.6t	0.53	0.53	0.53	188	**-17.6**	ULS 1a_0,9_0,9_0	43.2	37.7	60.5	0.47		**20.0**	ULS 1a_0	84.7	37.7	44.8	0.53	
432	Tweede DWSRM - CD top 4	60x60x6	S235	1M16-5.6t	0.53	0.53	0.53	175	**-17.0**	ULS 1a_0,9_0,9_0	37.8	37.7	51.8	0.45		**20.0**	ULS 1a_0	55.3	37.7	33.6	0.59	
433	Tweede DWSRM - CD top 5	60x60x6	S235	1M16-5.6t	0.53	0.53	0.53	162	**-18.8**	ULS 1a_0	41.8	37.7	51.8	0.50		**15.4**	ULS 1a_0,9_0,9_0	55.3	37.7	33.6	0.46	
434	Tweede DWSRM - CD top 6	60x60x6	S235	1M16-5.6t	0.53	0.53	0.53	161	**-15.1**	ULS 1a_0,9_0,9_0	42.0	37.7	51.8	0.40		**19.2**	ULS 1a_0	55.3	37.7	33.6	0.57	
435	Tweede DWSRM - CD top 7	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	180	**-20.1**	ULS 1a_0	25.4	37.7	43.2	0.79		**15.1**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.69	
436	Tweede DWSRM - CD top 8	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	148	**-13.3**	ULS 1a_0,9_0,9_0	32.6	37.7	43.2	0.41		**18.5**	ULS 1a_0	37.4	37.7	22.0	0.84	
437	Tweede DWSRM - CD top 9	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	147	**-13.4**	ULS 1a_0,9_0,9_0	32.8	37.7	43.2	0.41		**17.2**	ULS 1a_0	37.4	37.7	22.0	0.78	
438	Tweede DWSRM - CD top 10	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	124	**-16.0**	ULS 1a_0	39.8	37.7	43.2	0.43		**12.0**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.55	
439	Tweede DWSRM - diag top "CD"	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	106	**-10.7**	ULS 1a_0,9_0,9_0	46.0	37.7	43.2	0.28		**15.3**	ULS 1a_0	37.4	37.7	22.0	0.69	
440	Tweede DWSRM - CD top 11	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	115	**-11.7**	ULS 5a Ba 3	42.8	37.7	43.2	0.31		**8.5**	ULS 5a Ah 3	37.4	37.7	22.0	0.39	
441	Tweede DWSRM - CD top 12	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	103	**-10.2**	ULS 5a Ah 3	47.4	37.7	43.2	0.27		**14.3**	ULS 5a Ba 3	37.4	37.7	22.0	0.65	
442	Tweede DWSRM - Main diag from tower	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	401	**0.0**		48.7	506.7	855.4	0.00		**465.0**	ULS 3_90	346.4	506.7	677.1	0.78	
443	Tweede DWSRM - diag top "CD"	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	260	**-13.1**	ULS 3_90	21.3	37.7	51.8	0.62		**0.0**		55.3	37.7	33.6	0.00	
105A	Tweede DWSRM - Main member top 1	130x130x12#	S235	6M24-5.6t	1.00	1.47	1.00	124	**-250.4**	ULS 1a_0	310.9	506.7	933.1	0.81		**244.4**	ULS 1a_0,9_0	410.9	506.7	738.6	0.59	
105B	Tweede DWSRM - Main member top 1	130x130x12#	S235	6M24-5.6t	1.50	1.00	1.00	123	**-180.2**	ULS 1a_0,9_0,9_0	308.4	508.3	933.1	0.58		**226.9**	ULS 1a_0	615.9	508.3	797.5	0.45	
105C	Tweede DWSRM - Main member top 1	130x130x12#	S235		3.12	2.05	1.00	116	**-223.4**	ULS 1a_0	312.3	0.0	0.0	0.72		**253.7**	ULS 1a_0	705.0	0.0	0.0	0.36	
106A	Tweede DWSRM - Main member top 2	100x100x10	S235	7M24-5.6t	1.00	1.48	1.00	130	**-112.7**	ULS 1a_0,9_0,9_0	188.5	593.0	907.2	0.60		**258.2**	ULS 1a_0	362.9	593.0	775.4	0.71	
106B	Tweede DWSRM - Main member top 2	100x100x10	S235	4M24-5.6t	1.00	1.77	1.00	145	**-47.4**	ULS 1a_0,9_0,9_0	157.6	338.9	518.4	0.30		**169.6**	ULS 1a_135	362.9	338.9	443.1	0.50	
106C	Tweede DWSRM - Main member top 2	100x100x10	S235		2.02	3.23	1.00	126	**-87.8**	ULS 1a_0,9_0,9_0	185.0	0.0	0.0	0.47		**237.4**	ULS 1a_0	451.2	0.0	0.0	0.53	
107A	Tweede DWSRM - Main member top 3	100x75x7	S235	4M20-5.6t	2.31	1.00	1.00	139	**-27.8**	ULS 1a_0,9_0,9_45	102.5	235.2	302.4	0.27		**143.6**	ULS 1a_135	228.6	235.2	302.4	0.63	
107B	Tweede DWSRM - Main member top 3	100x75x7	S235	2M16-5.6t	2.86	1.00	1.00	138	**0.0**		103.6	75.4	121.0	0.00		**70.4**	ULS 1a_135	196.1	75.4	121.0	0.93	
107C	Tweede DWSRM - Main member top 3	100x75x7	S235		2.17	1.00	1.00	142	**-18.9**	ULS 5a Ah 3	100.0	0.0	0.0	0.19		**94.3**	ULS 1a_135	279.7	0.0	0.0	0.34	
444	Tweede DWSRM - diag top "CD"	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	131	**-8.1**	ULS 1a_0,9_0,9_0	37.3	37.7	43.2	0.22		**11.8**	ULS 1a_0	37.4	37.7	22.0	0.54	
108A	Elfde TSNSTK - Main member	180x180x16#	S235	8M24-5.6t	0.51	0.51	0.51	55	**-658.2**	ULS 1a_135	1135.8	677.8	1658.9	0.97		**449.0**	ULS 1a_0,9_0,9_135	1220.3	677.8	1417.8	0.66	
108B	Elfde TSNSTK - Main member	180x180x16#	S235	**12M24-8.8t**	0.51	0.51	0.51	56	**-1034.7**	ULS 1a_135	1127.4	1599.5	2488.3	0.92		**811.6**	ULS 1a_0,9_0,9_135	1220.3	1599.5	2126.8	0.67	
108C	Elfde TSNSTK - Main member	180x180x16#	S235		0.51	0.51	0.51	55	**-861.8**	ULS 1a_135	1135.8	0.0	0.0	0.76		**613.5**	ULS 1a_0,9_0,9_135	1301.9	0.0	0.0	0.47	
207L	Elfde TSNSTK - CD 1 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	127	**-115.2**	ULS 1a_90	255.9	169.4	285.1	0.68		**82.1**	ULS 1a_0,9_0,9_90	306.2	169.4	236.8	0.48	
207T	Elfde TSNSTK - CD 1 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	127	**-83.5**	ULS 5a Ba 12	255.9	169.4	285.1	0.49		**91.7**	ULS 5a Ah 22	306.2	169.4	236.8	0.54	
208L	Elfde TSNSTK - CD 2 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	130	**-82.7**	ULS 1a_0,9_0,9_90	251.2	169.4	285.1	0.49		**114.9**	ULS 1a_90	306.2	169.4	236.8	0.68	
208T	Elfde TSNSTK - CD 2 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	130	**-91.0**	ULS 1a_0	251.2	169.4	285.1	0.54		**83.1**	ULS 1a_0,9_0,9_0	306.2	169.4	236.8	0.49	
209L	Elfde TSNSTK - CD 3 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	133	**-118.6**	ULS 1a_90	243.6	169.4	285.1	0.70		**82.5**	ULS 1a_0,9_0,9_90	306.2	169.4	236.8	0.49	
209T	Elfde TSNSTK - CD 3 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	133	**-85.1**	ULS 1a_0,9_0,9_0	243.6	169.4	285.1	0.50		**92.2**	ULS 1a_0	306.2	169.4	236.8	0.54	
109A	Tiende TSNSTK - Main member	200x200x20	S235	**8M30-8.8t**	0.52	0.52	0.52	52	**-1250.1**	ULS 1a_135	1590.7	1723.4	2592.0	0.79		**971.7**	ULS 1a_0,9_0,9_135	1638.1	1723.4	2094.5	0.59	
109B	Tiende TSNSTK - Main member	200x200x20	S235	12M30-5.6t	0.52	0.52	0.52	53	**-1447.0**	ULS 1a_45	1580.5	1588.8	3888.0	0.92		**1015.8**	ULS 1a_0,9_0,9_135	1638.1	1588.8	3194.2	0.64	
210L	Tiende TSNSTK - CD 1 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	136	**-84.5**	ULS 1a_0,9_0,9_90	238.9	169.4	285.1	0.50		**123.2**	ULS 1a_90	306.2	169.4	236.8	0.73	
210T	Tiende TSNSTK - CD 1 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	136	**-97.9**	ULS 1a_0	238.9	169.4	285.1	0.58		**88.7**	ULS 1a_0,9_0,9_0	306.2	169.4	236.8	0.52	
211L	Tiende TSNSTK - CD 2 front	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	140	**-138.0**	ULS 1a_0,9_0,9_45	230.6	169.4	285.1	0.81		**160.0**	ULS 1a_45	306.2	169.4	236.8	0.94	
211T	Tiende TSNSTK - CD 2 side	120x120x11	S235	2M24-5.6t	0.52	0.52	0.52	140	**-146.0**	ULS 1a_135	230.6	169.4	285.1	0.86		**108.5**	ULS 1a_0,9_0,9_45	306.2	169.4	236.8	0.64	
212L	Tiende TSNSTK - upper horiz lower CA fr	150x150x10	S235	7M24-5.6t	1.00	1.00	1.00	162	**0.0**		222.3	578.2	907.2	0.00		**384.1**	ULS 3_0	420.0	578.2	778.3	0.91	
212T	Tiende TSNSTK - upper horiz lower CA si	**100x100x10**	**S355**	**2M20-8.8t**	1.00	1.00	**0.85**	209	**-65.9**	ULS 1a_90	113.9	188.2	294.0	0.58		**46.1**	ULS 1a_0,9_0,9_90	466.5	188.2	237.6	0.24	
109	Tiende TSNSTK - lower horiz lower CA fr	200x200x18	S235	12M24-5.6t	1.00	2.00	1.00	82	**-428.1**	ULS 3_0	1194.7	906.5	2799.4	0.47		**0.0**		1548.5	906.5	2392.6	0.00	
213	Tiende TSNSTK - lower horiz lower CA si	110x110x10	S235	4M20-5.6t	1.00	2.00	1.00	148	**-13.2**	ULS 1a_0,9_0,9_90	168.8	235.2	432.0	0.08		**91.8**	ULS 1a_90	433.4	235.2	349.1	0.39	
214	Tiende TSNSTK - Diaphragm diagonal	130x130x12#	S235	2M20-5.6t	1.00	1.00	1.00	139	**-60.8**	ULS 5a Ba 21	272.8	117.6	259.2	0.52		**62.7**	ULS 5a Ba 21	379.7	117.6	209.5	0.53	
215	Tiende TSNSTK - Diaphragm horiz	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	321	**-2.2**	ULS 3_90	27.3	58.8	86.4	0.08		**0.0**		133.6	58.8	69.8	0.00	
300	Eerste DWSRM - CD under 1	100x100x8	S235	1M20-5.6t	0.53	0.53	0.53	146	**-21.3**	ULS 5a Ah 20	106.2	58.8	86.4	0.36		**19.2**	ULS 5a Ba 11	179.7	58.8	69.8	0.33	
301	Eerste DWSRM - CD under 2	100x100x8	S235	1M20-5.6t	0.53	0.53	0.53	136	**-20.9**	ULS 5a Ah 11	116.1	58.8	86.4	0.36		**26.6**	ULS 5a Ba 20	179.7	58.8	69.8	0.45	
302	Eerste DWSRM - CD under 3	100x100x8	S235	1M20-5.6t	0.53	0.53	0.53	128	**-32.8**	ULS 5a Ba 20	123.5	58.8	86.4	0.56		**22.6**	ULS 5a Ah 11	179.7	58.8	69.8	0.38	
303	Eerste DWSRM - CD under 4	100x100x8	S235	1M20-5.6t	0.52	0.52	0.52	99	**-27.4**	ULS 5a Ba 11	157.9	58.8	86.4	0.47		**17.4**	ULS 5a Ah 20	179.7	58.8	69.8	0.30	
304	Eerste DWSRM - CD under 5	65x65x7	S235	1M20-5.6t	0.53	0.53	0.53	163	**-16.4**	ULS 1a_135	52.2	58.8	75.6	0.31		**12.2**	ULS 1a_0,9_0,9_0	86.7	58.8	59.5	0.21	
305	Eerste DWSRM - CD under 6	65x65x7	S235	1M20-5.6t	0.53	0.53	0.53	147	**-13.2**	ULS 1a_0,9_0,9_0	59.5	58.8	75.6	0.22		**14.6**	ULS 1a_0	86.7	58.8	59.5	0.25	
306	Eerste DWSRM - CD under 7	65x65x7	S235	1M20-5.6t	0.54	0.54	0.54	138	**-14.2**	ULS 1a_0	64.1	58.8	75.6	0.24		**13.6**	ULS 1a_0,9_0,9_0	86.7	58.8	59.5	0.23	
307	Eerste DWSRM - CD under 8	65x65x7	S235	1M20-5.6t	0.54	0.54	0.54	126	**-14.6**	ULS 5a Ah 10	70.4	58.8	75.6	0.25		**16.5**	ULS 5a Ba 10	86.7	58.8	59.5	0.28	
308	Eerste DWSRM - CD under 9	60x60x6	S235	1M20-5.6t	0.54	0.54	0.54	115	**-17.7**	ULS 5a Ba 10	61.4	58.8	64.8	0.30		**17.3**	ULS 5a Ah 10	65.7	58.8	44.4	0.39	
309	Eerste DWSRM - CD under 10	60x60x6	S235	1M20-5.6t	0.55	0.55	0.55	108	**-21.7**	ULS 5a Ah 10	65.5	58.8	64.8	0.37		**23.3**	ULS 5a Ba 10	65.7	58.8	44.4	0.53	
310	Eerste DWSRM - CD under 11	65x65x7	S235	2M20-5.6t	0.56	0.56	0.56	95	**-31.9**	ULS 5a Ba 21	114.4	117.6	151.2	0.28		**26.1**	ULS 5a Ah 21	99.4	117.6	104.2	0.26	
311	Eerste DWSRM - CD under 12	65x65x7	S235	1M20-5.6t	0.55	0.55	0.55	72	**-36.1**	ULS 5a Ba 21	105.7	58.8	75.6	0.61		**20.9**	ULS 5a Ah 21	86.7	58.8	59.5	0.36	
312	Eerste DWSRM - 1st & 2nd horiz under	HEB240	S235	2M20-5.6t	2.00	2.00	2.00	56	**-18.5**	ULS 5a Ah 11	1771.8	117.6	367.2	0.16		**32.9**	ULS 5a Ba 20	2249.6	117.6	0.0	0.28	
313	Eerste DWSRM - 3rd & 4th horiz under	HEB200	S235	2M20-5.6t	2.00	2.00	2.00	20	**-20.9**	ULS 5a Ah 10	1583.1	117.6	324.0	0.18		**31.5**	ULS 5a Ba 10	1626.6	117.6	0.0	0.27	
314	Eerste DWSRM - front diag 1	65x65x7	S235	2M20-5.6t	1.00	1.00	1.00	475	**0.0**		12.4	117.6	151.2	0.00		**70.4**	ULS 3_135	99.4	117.6	119.1	0.71	
315	Eerste DWSRM - front diag 2	65x65x7	S235	2M20-5.6t	1.00	1.00	1.00	450	**0.0**		13.6	117.6	151.2	0.00		**93.0**	ULS 3_0	99.4	117.6	119.1	0.94	
316	Eerste DWSRM - front diag 3	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	364	**0.0**		12.4	37.7	51.8	0.00		**34.6**	ULS 1a_0	72.6	37.7	38.4	0.92	
317	Eerste DWSRM - front diag 4	60x60x6	**S355**	**1M16-8.8t**	1.00	1.00	1.00	338	**0.0**		15.0	60.3	70.6	0.00		**39.3**	ULS 1a_0	98.8	60.3	52.3	0.75	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 9-4-2021
Author MKh
Version 1.0

KIJ-GT380
S+95
12

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)	Opm.2
318	Eerste DWSRM - front diag 5	60x60x6	S235	1M16-5.6t	1.00	1.00	1.00	317	0.0		15.5	37.7	51.8	0.00		36.9	ULS 7	72.6	37.7	38.4	0.98	
319	Eerste DWSRM - front vert 1	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	165	-42.2	ULS 3_0	91.7	58.8	86.4	0.72		0.0		179.7	58.8	69.8	0.00	
320	Eerste DWSRM - front vert 2	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	225	-16.8	ULS 7	27.8	37.7	51.8	0.61		0.0		44.9	37.7	26.5	0.00	
321	Eerste DWSRM - front vert 3	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	188	-14.4	ULS 1a_0	23.9	37.7	43.2	0.60		0.0		37.4	37.7	22.0	0.00	
322	Eerste DWSRM - front vert 4	75x50x6	S235	1M16-5.6t	1.00	1.00	1.00	112	-8.9	ULS 1a_135	63.5	37.7	51.8	0.24		0.0		44.9	37.7	26.5	0.00	
323	Eerste DWSRM - front vert 5	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	63	-3.6	ULS 3_90	60.9	37.7	43.2	0.10		0.0		37.4	37.7	22.0	0.00	
324	Eerste DWSRM - Doorsnede A-A diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	306	-7.0	ULS 1a_0	11.5	37.7	43.2	0.61		4.6	ULS 1a_0,9_0	37.4	37.7	22.0	0.21	
325	Eerste DWSRM - Doorsnede A-A horiz top	50x50x5	S235	1M16-5.6t	1.00	2.00	1.00	219	-2.7	ULS 1a_0	20.7	37.7	43.2	0.13		2.6	ULS 1a_0,9_0	37.4	37.7	22.0	0.12	
326	Eerste DWSRM - Doorsnede B-B diag	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	156	-8.3	ULS 1a_0	30.6	37.7	43.2	0.27		3.7	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.17	
327	Eerste DWSRM - Doorsnede B-B horiz top	50x50x5	S235	1M16-5.6t	1.00	2.49	1.00	142	-2.2	ULS 1a_0,9_0,9_0	36.2	37.7	43.2	0.06		2.1	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.09	
110A	Eerste DWSRM - Main member bottom 1	200x200x18	S235	12M24-5.6t	1.00	1.70	1.00	71	-510.7	ULS 1a_135	1289.1	906.5	2799.4	0.56		0.0		1548.5	906.5	2392.6	0.00	
110B	Eerste DWSRM - Main member bottom 1	200x200x18	S235	8M24-5.6t	2.53	1.40	1.00	57	-336.3	ULS 5a Ba 21	1398.2	677.8	1866.2	0.50		7.8	ULS 5a Ah 21	1548.5	677.8	1595.1	0.01	
110C	Eerste DWSRM - Main member bottom 1	200x200x18	S235		2.42	1.40	1.00	71	-500.3	ULS 1a_135	1289.3	0.0	0.0	0.39		19.7	ULS 5a Ah 21	1623.9	0.0	0.0	0.01	
111A	Eerste DWSRM - Main member bottom 1	160x160x15#	S235	8M24-5.6t	3.53	6.36	1.00	72	-311.8	ULS 5a Ba 21	869.0	677.8	1555.2	0.46		32.5	ULS 5a Ah 21	1008.5	677.8	1329.2	0.05	
111B	Eerste DWSRM - Main member bottom 1	160x160x15#	S235		2.89	1.00	1.00	72	-197.2	ULS 3_90	869.3	0.0	0.0	0.23		0.0		1097.7	0.0	0.0	0.00	
111C	Eerste DWSRM - Main member bottom 1	160x160x15#	S235		1.80	1.00	1.00	72	-297.8	ULS 5a Ba 21	869.1	0.0	0.0	0.34		26.9	ULS 5a Ah 21	1097.7	0.0	0.0	0.02	
112A	Eerste DWSRM - Main member top 1	130x130x12#	S235	6M24-5.6t	1.00	1.00	1.00	178	0.0		200.4	504.1	933.1	0.00		362.2	ULS 3_90	422.8	504.1	796.6	0.86	
112B	Eerste DWSRM - Main member top 1	130x130x12#	S235	5M24-5.6t	1.00	1.00	1.00	140	0.0		270.4	423.6	777.6	0.00		259.5	ULS 3_90	615.9	423.6	664.6	0.61	
112C	Eerste DWSRM - Main member top 1	130x130x12#	S235		1.00	1.00	1.00	187	0.0		188.2	0.0	0.0	0.00		285.9	ULS 3_90	705.0	0.0	0.0	0.41	
113A	Eerste DWSRM - Main member top 1	110x110x10	S235	5M24-5.6t	1.00	1.00	1.00	165	0.0		156.1	423.6	648.0	0.00		232.8	ULS 3_135	412.6	423.6	553.8	0.56	
113B	Eerste DWSRM - Main member top 1	110x110x10	S235	5M24-5.6t	2.00	1.00	1.00	212	0.0		106.2	423.6	648.0	0.00		198.4	ULS 3_135	291.3	423.6	553.8	0.68	
113C	Eerste DWSRM - Main member top 1	110x110x10	S235		2.00	1.00	1.00	212	0.0		106.2	0.0	0.0	0.00		198.1	ULS 3_135	496.3	0.0	0.0	0.40	
328	Eerste DWSRM - Horiz top 1	65x50x5	S235	1M16-5.6t	1.00	1.00	1.00	380	-0.1	ULS 1a_90	9.2	37.7	43.2	0.01		0.0		60.5	37.7	32.0	0.00	
329	Eerste DWSRM - Horiz top 2	65x50x5	S235	1M16-5.6t	1.00	1.00	1.00	255	-0.1	ULS 1a_90	17.5	37.7	43.2	0.00		0.0		60.5	37.7	32.0	0.00	
114A	Negende TSNSTK - Main member	250x250x22#	S235	18M30-5.6t	0.52	0.26	0.26	23	-2416.7	ULS 1a_45	2472.3	2423.5	6415.2	1.00		1901.4	ULS 1a_0,9_0,9_45	2373.8	2423.5	4626.7	0.80	
114B	Negende TSNSTK - Main member	250x250x22#	S235	14M30-8.8t	0.52	0.52	0.52	35	-1880.2	ULS 1a_45	2373.4	3015.9	4989.6	0.79		1406.2	ULS 1a_0,9_0,9_45	2373.8	3015.9	4032.0	0.59	
114C	Negende TSNSTK - Main member	250x250x22#	S235		0.52	0.26	0.26	22	-2413.9	ULS 1a_45	2481.2	0.0	0.0	0.97		1905.2	ULS 1a_0,9_0,9_45	2493.4	0.0	0.0	0.76	
216L	Negende TSNSTK - Diag fr 1 above horiz	150x100x12	S235	2M30-8.8t	1.00	0.51	0.51	103	-282.1	ULS 1a_90	355.4	861.7	388.8	0.79		253.6	ULS 1a_0,9_0,9_90	417.0	861.7	314.2	0.61	
216T	Negende TSNSTK - Diag si 1 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	103	-200.2	ULS 1a_0	355.4	269.3	388.8	0.74		195.6	ULS 1a_0	250.2	269.3	314.2	0.78	
217L	Negende TSNSTK - Diag fr 2 above horiz	150x100x12	S235	2M30-8.8t	1.00	0.51	0.51	104	-259.7	ULS 1a_90	350.2	861.7	388.8	0.74		265.4	ULS 1a_90	417.0	861.7	314.2	0.64	
217T	Negende TSNSTK - Diag si 2 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	104	-204.9	ULS 1a_0	350.2	269.3	388.8	0.76		190.8	ULS 1a_0,9_0,9_0	250.2	269.3	314.2	0.76	
218	Negende TSNSTK - Diaphragm K diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	266	-11.3	ULS 5a Ah 21	35.0	75.4	121.0	0.32		11.2	ULS 5a Ah 21	109.4	75.4	89.6	0.15	
219	Negende TSNSTK - Diaphragm K CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	239	-0.4	ULS 1a_90	38.0	113.0	155.5	0.01		0.1	ULS 1a_0,9_90	90.2	113.0	100.9	0.00	
220L	Negende TSNSTK - Diaphragm K horiz fr	65x65x7	S235	1M16-5.6t	1.00	1.00	1.00	203	-17.2	ULS 1a_0,9_45	43.6	37.7	60.5	0.46		16.2	ULS 1a_135	94.8	37.7	44.8	0.43	
220T	Negende TSNSTK - Diaphragm K horiz si	65x65x7	S235	1M16-5.6t	1.00	1.00	1.00	203	-13.9	ULS 1a_0,9_0,9_135	43.6	37.7	60.5	0.37		18.3	ULS 1a_45	94.8	37.7	44.8	0.48	
221	Negende TSNSTK - Diaphragm L diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	279	-1.9	ULS 1a_0	32.5	75.4	121.0	0.06		4.7	ULS 1a_45	109.4	75.4	89.6	0.06	
222	Negende TSNSTK - Diaphragm L CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	251	-0.2	ULS 1a_90	35.4	113.0	155.5	0.00		0.2	ULS 1a_0,9_90	90.2	113.0	100.9	0.00	
223L	Negende TSNSTK - Diaphragm L horiz fr	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	198	-22.5	ULS 1a_0,9_0,9_45	49.1	37.7	60.5	0.60		21.1	ULS 1a_45	104.8	37.7	44.8	0.56	
223T	Negende TSNSTK - Diaphragm L horiz si	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	198	-22.2	ULS 1a_0,9_0,9_45	49.1	37.7	60.5	0.59		20.5	ULS 1a_135	104.8	37.7	44.8	0.54	
224L	Achtste TSNSTK - Diag fr 1 above horiz	150x100x12	S235	2M30-8.8t	1.00	0.51	0.51	106	-274.7	ULS 1a_90	345.0	430.8	388.8	0.80		254.4	ULS 1a_0,9_0,9_90	348.4	430.8	314.2	0.81	
224T	Achtste TSNSTK - Diag si 1 above horiz	150x100x12	S235	2M30-5.6t	1.00	0.51	0.51	106	-205.8	ULS 1a_0	345.0	269.3	388.8	0.76		202.2	ULS 1a_0	348.4	269.3	314.2	0.75	
225L	Achtste TSNSTK - Diaphragm M horiz fr	75x75x7#	S235	1M16-5.6t	1.00	1.00	1.00	191	-28.7	ULS 1a_0,9_0,9_135	55.7	37.7	60.5	0.76		29.0	ULS 1a_45	114.9	37.7	44.8	0.77	
225T	Achtste TSNSTK - Diaphragm M horiz si	75x75x7#	S235	1M16-5.6t	1.00	1.00	1.00	191	-28.3	ULS 1a_0,9_0,9_135	55.7	37.7	60.5	0.75		29.6	ULS 1a_90	114.9	37.7	44.8	0.78	
226	Achtste TSNSTK - Diaphragm M diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	292	-2.5	ULS 1a_90	30.2	75.4	121.0	0.08		5.6	ULS 1a_45	109.4	75.4	89.6	0.07	
227	Achtste TSNSTK - Diaphragm M CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	263	-0.2	ULS 1a_90	33.0	113.0	155.5	0.01		0.0	ULS 1a_0,9_90	90.2	113.0	100.9	0.00	
228L	Achtste TSNSTK - Diag fr 2 above horiz	150x150x10	S235	2M30-5.6t	1.00	0.51	0.51	99	-260.0	ULS 1a_90	353.4	269.3	324.0	0.97		254.0	ULS 1a_0,9_90	347.2	269.3	261.8	0.97	
228T	Achtste TSNSTK - Diag si 2 above horiz	150x150x10	S235	2M30-5.6t	1.00	0.51	0.51	99	-210.7	ULS 1a_0	353.4	269.3	324.0	0.78		192.9	ULS 1a_0,9_0,9_0	347.2	269.3	261.8	0.74	
229L	Achtste TSNSTK - Diaphragm N horiz fr	80x80x8	S235	1M16-5.6t	1.00	1.00	1.00	188	-21.3	ULS 1a_0,9_0,9_45	61.0	37.7	69.1	0.56		16.4	ULS 1a_0,9_135	142.8	37.7	51.2	0.43	
229T	Achtste TSNSTK - Diaphragm N horiz si	80x80x8	S235	1M16-5.6t	1.00	1.00	1.00	188	-21.7	ULS 1a_45	61.0	37.7	69.1	0.57		15.2	ULS 1a_0,9_135	142.8	37.7	51.2	0.40	
230	Achtste TSNSTK - Diaphragm N diag	70x70x7	S235	2M16-5.6t	1.00	1.00	1.00	305	-2.4	ULS 1a_0	28.2	75.4	121.0	0.09		6.1	ULS 1a_135	109.4	75.4	89.6	0.08	
231	Achtste TSNSTK - Diaphragm N CD	100x50x6	S235	3M16-5.6t	0.50	0.50	0.50	274	-0.2	ULS 1a_90	30.8	113.0	155.5	0.01		0.3	ULS 1a_0,9_90	75.4	113.0	100.9	0.00	
115A	Achtste TSNSTK - Main member	200x200x20+PL150x20	S235	28M30-8.8t	0.50	0.50	0.50	22	-3454.7	ULS 1a_45	4955.6	5805.7	9072.0	0.70		2885.1	ULS 1a_0,9_0,9_135	5013.3	0.0	0.0	0.58	
115B	Achtste TSNSTK - Main member	200x200x20	S235		0.50	0.50	0.50	22	-2947.9	ULS 1a_45	3556.9	0.0	0.0	0.83		2411.0	ULS 1a_0,9_0,9_135	3607.3	0.0	0.0	0.67	
116A	Zevende TSNSTK - Main member	250x250x20+PL200x25	S235	28M30-8.8t	0.25	0.25	0.50	40	-3841.4	ULS 1a_45	6326.6	5805.7	9072.0	0.66		3240.8	ULS 1a_0,9_0,9_135	7275.2	5805.7	7330.9	0.56	
116B	Zevende TSNSTK - Main member	250x250x20+PL200x25	S235	32M30-8.8t	0.50	0.50	1.00	37	-4146.9	ULS 1a_135	6416.9	6520.2	10368.0	0.65		3456.1	ULS 1a_0,9_0,9_45	7275.2	6520.2	8378.2	0.53	
117A	Zesde TSNSTK - Main member	250x250x20+PL200x25	S235	32M30-8.8t	0.50	0.50	1.00	43	-4167.7	ULS 1a_135	6233.1	6520.2	10368.0	0.67		3433.9	ULS 1a_0,9_0,9_45	7275.2	6520.2	8378.2	0.53	
117B	Zesde TSNSTK - Main member	250x250x20+PL200x25	S235	36M30-8.8t	0.25	0.25	0.50	40	-4427.4	ULS 1a_135	6326.6	7205.9	11664.0	0.70		3636.7	ULS 1a_0,9_0,9_45	6933.1	7205.9	9425.5	0.52	
232L	Zevende TSNSTK - Doorsnede B-B horiz fr	100x100x8	S235	2M20-5.6t	1.00	2.00	1.00	196	-45.3	ULS 1a_0,9_0	86.6	117.6	172.8	0.52		36.5	ULS 1a_0	190.7	117.6	139.6	0.31	
232T	Zevende TSNSTK - Doorsnede B-B horiz si	100x100x8	S235	2M20-5.6t	1.00	2.00	1.00	196	-50.0	ULS 1a_0,9_90	86.6	117.6	172.8	0.58		44.3	ULS 1a_90	190.7	117.6	139.6	0.38	
233	Zevende TSNSTK - Doorsnede B-B diag	75x75x7#	S235	1M20-5.6t	1.00	1.00	1.00	289	-4.0	ULS 1a_45	26.8	58.8	75.6	0.15		8.0	ULS 1a_0,9_135	106.8	58.8	61.1	0.14	
234	Zevende TSNSTK - Doorsnede B-B horiz in	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	385	0.0	ULS 1a_0	20.2	58.8	86.4	0.00		0.0	ULS 1a_0,9_0,9_90	133.6	58.8	69.8	0.00	
235L	Zevende TSNSTK - CD 1 front	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	127	-125.9	ULS 1a_135	163.7	134.6	162.0	0.94		95.9	ULS 1a_0,9_0,9_45	193.0	134.6	130.9	0.73	
235T	Zevende TSNSTK - CD 1 side	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	127	-113.7	ULS 1a_135	163.7	134.6	162.0	0.84		88.7	ULS 1a_0,9_0,9_45	193.0	134.6	130.9	0.68	
236L	Zevende TSNSTK - Diag fr 1 above horiz	130x90x10	S235	2M24-5.6t	1.00	0.52	0.52	135	-76.0	ULS 1a_0,9_0,9_90	197.0	169.4	259.2	0.45		92.7	ULS 1a_90	194.6	169.4	221.5	0.55	
236T	Zevende TSNSTK - Diag si 1 above horiz	130x90x10	S235	2M24-5.6t	1.00	0.52	0.52	137	-63.1	ULS 5a Ba 10	194.1	169.4	259.2	0.37		78.7	ULS 5a Ah 10	194.6	169.4	221.5	0.46	
237L	Zevende TSNSTK - Doorsnede A-A horiz fr	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	186	-31.4	ULS 1a_0,9_0,9_45	87.9	58.8	86.4	0.53		26.1	ULS 1a_135	179.7	58.8	69.8	0.44	
237T	Zevende TSNSTK - Doorsnede A-A horiz si	100x100x8	S235	1M20-5.6t	1.00	1.00	1.00	186	-31.4	ULS 1a_0,9_0,9_135	87.9	58.8	86.4	0.53		26.6	ULS 1a_45	179.7	58.8	69.8	0.45	
238	Zevende TSNSTK - Doorsnede A-A diag	80x80x8	S235	1M20-5.6t	1.00	1.00	1.00	331	-10.7	ULS 1a_135	25.9	58.8	86.4	0.41		16.2	ULS 1a_0,9_45	133.6	58.8	69.8	0.27	
239	Zevende TSNSTK - Doorsnede A-A CD	70x70x7	S235	1M20-5.6t	1.00	0.50	0.50	349	-0.5	ULS 7	15.8	58.8	75.6	0.03		0.0		96.8	58.8	61.1	0.00	
240L	Zesde TSNSTK - Diag fr 1 below horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	140	-133.5	ULS 1a_90	157.6	134.6	162.0	0.99		118.0	ULS 1a_0,9_90	193.0	134.6	130.9	0.90	
240T	Zesde TSNSTK - Diag si 1 below horiz	150x100x10	S235	1M30-5.6t	1.00	0.52	0.52	138	-113.6	ULS 1a_0	159.4	134.6	162.0	0.84		98.8	ULS 1a_0,9_0	193.0	134.6	130.9	0.75	
241L	Zesde TSNSTK - CD 1 front	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	143	-103.7	ULS 1a_0,9_90	145.1	134.6	162.0	0.77		110.5	ULS 1a_90	193.0	134.6	130.9	0.84	
241T	Zesde TSNSTK - CD 1 side	150x100x10	S235	1M30-5.6t	0.55	0.27	0.27	143	-89.5	ULS 1a_0,9_0	145.1	134.6	162.0	0.66		94.5	ULS 1a_0	193.0	134.6	130.9	0.72	
275L	Vijfde TSNSTK - Doorsnede A-A horiz fr	120x120x11	S235	1M30-5.6t	1.00	1.00	1.00	377	0.0		43.3	134.6	178.2	0.00		0.0	ULS 1a_0	275.6	134.6	144.0	0.00	
275T	Vijfde TSNSTK - Doorsnede A-A horiz si	120x120x11	S235	1M30-5.6t	1.00	1.00	1.00	377	0.0		43.3	134.6	178.2	0.00		0.0	ULS 1a_0	275.6	134.6	144.0	0.00	
265	Top*	120x120x11	S235		1.00	1.00	1.00	206	-15.7	ULS 5a Ba 12	139.5	0.0	0.0	0.11		15.0	ULS 5a Ba 12	599.7	0.0	0.0	0.03	

Notes:

1) Groups 200L, 419 and 442 which were failing under net section capacity (afkeur) were strengthened using a plate. In the tower model an override value was used to represent the increased net section capacity so no change highlighted in this table. For details of the plate calculations refer to Appendix D.
2) Groups 216L and 217L failed due to net section capacity at the afkeur level and were strengthened using a plate so no change is recorded in this table. For details of the plate calculation refer to Appendix D.

DNV·GL

Assessment of groups for strenghtened mast (verbouw level)

Date	9-4-2021
Author	MKh
Version	1.0

KIJ-GT380
S+95
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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)	Opm.2
118A	Vijfde TSNSTK - Main member	250x250x22+PL200x25	S235	36M30-8.8t	0.25	0.25	0.50	40	-6332.8	ULS 1a_135	6717.9	7205.9	12830.4	0.94		5474.9	ULS 1a_0,9_0,9_45	7329.7	7205.9	10368.0	0.76	
118B	Vijfde TSNSTK - Main member	250x250x22+PL200x25	S235	36M30-8.8t	0.50	0.50	1.00	38	-6622.6	ULS 1a_135	6775.5	7205.9	12830.4	0.98		5709.4	ULS 1a_0,9_0,9_45	7329.7	7205.9	10368.0	0.79	
119A	Vierde TSNSTK - Main member* 24	250x250x24+PL200x25	S235	36M30-8.8t	0.50	0.50	1.00	42	-6649.3	ULS 1a_135	7047.0	7205.9	13996.8	0.94		5683.8	ULS 1a_0,9_0,9_45	8142.5	7205.9	11310.5	0.79	
119B	Vierde TSNSTK - Main member* 24	250x250x24+PL200x25	S235	36M30-8.8t	0.25	0.25	0.50	40	-7029.5	ULS 1a_45	7109.2	7205.9	13996.8	0.99		5985.7	ULS 1a_0,9_0,9_135	8142.5	7205.9	11310.5	0.83	
120A	Derde TSNSTK - Main member* INP425	INP 425	S235	36M24-8.8t	0.25	0.25	0.51	38	-7441.7	ULS 1a_135	5715.8	9157.4	7138.4	1.30	(8)	6359.8	ULS 1a_0,9_0,9_45	6417.5	9157.4	6101.2	1.04	
120B	Derde TSNSTK - Main member* INP425	INP 425	S235	36M24-5.6t	0.50	0.50	0.90	34	-7724.7	ULS 1a_45	5831.7	5723.4	7138.4	1.35	(8)	6588.6	ULS 1a_0,9_0,9_135	6417.5	5723.4	6101.2	1.15	
121A	Tweede TSNSTK - Main member* INP425	INP 425	S235	36M24-8.8t	0.50	0.50	0.81	34	-7758.4	ULS 1a_45	5832.9	9157.4	7138.4	1.33	(8)	6555.3	ULS 1a_0,9_0,9_135	6417.5	9157.4	6101.2	1.07	
121B	Tweede TSNSTK - Main member* INP425	INP425+PL230x25	S235	36M24-8.8t	0.50	0.50	0.87	34	-8318.1	ULS 1a_45	8382.4	9157.4	9331.2	0.99		7005.7	ULS 1a_0,9_0,9_135	9303.7	9157.4	7975.4	0.88	
122A	Eerste TSNSTK - Main member	INP 450	S235	36M24-8.8t	0.50	0.50	1.00	42	-8447.4	ULS 1a_45	6265.5	9157.4	7558.3	1.35	(8)	7061.4	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	1.09	
122B	Eerste TSNSTK - Main member	INP 450	S235	36M24-8.8t	0.50	0.50	1.16	49	-8122.2	ULS 1a_135	6050.8	9157.4	7558.3	1.34	(8)	6672.5	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	1.03	
123A	Broekstuk - Main member	INP 450	S235	36M24-8.8t	0.33	0.33	0.62	48	-8164.6	ULS 1a_135	6089.9	9157.4	7558.3	1.34	(8)	6619.5	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	1.02	
123B	Broekstuk - Main member	INP 450	S235	36M24-8.8t	0.33	0.33	0.62	47	-8195.1	ULS 1a_135	6094.5	9157.4	7558.3	1.34	(8)	6599.6	ULS 1a_0,9_0,9_135	7183.8	9157.4	6460.1	1.02	
245L	Vierde TSNSTK - Diag fr 1 below horiz	150x150x10	S235	1M30-8.8t	1.00	0.52	0.52	146	-205.1	ULS 1a_90	157.9	215.4	162.0	1.30	(4)	174.9	ULS 1a_0,9_0,9_90	337.0	215.4	130.9	1.34	(5)
245T	Vierde TSNSTK - Diag si 1 below horiz	150x150x10	S235	1M30-8.8t	1.00	0.52	0.52	146	-189.8	ULS 1a_0	157.9	215.4	162.0	1.20	(4)	157.7	ULS 1a_0,9_0,9_0	337.0	215.4	130.9	1.20	(5)
250L	Tweede TSNSTK - Diag fr 1 below horiz	160x160x15#	S235	2M24-8.8t	1.00	0.52	0.52	175	-274.8	ULS 1a_135	304.1	271.1	388.8	1.01	(7)	225.7	ULS 1a_0,9_0,9_45	578.5	271.1	332.3	0.83	(5)
250T	Tweede TSNSTK - Diag si 1 below horiz	160x160x15#	S235	2M24-8.8t	1.00	0.52	0.52	177	-271.3	ULS 1a_45	300.0	271.1	388.8	1.00	(7)	222.2	ULS 1a_0,9_0,9_135	578.5	271.1	332.3	0.82	(5)
256LB	Broekstuk - Lower part	150x150x10	S235	2M24-8.8t	0.17	0.25	0.17	127	-250.4	ULS 1a_90	290.1	271.1	259.2	0.97		191.4	ULS 1a_0,9_90	431.8	271.1	221.5	0.86	
200L	BVNSTK - first horiz from top front	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	164	0.0		190.2	506.7	855.4	0.00		499.8	ULS 3_135	346.4	506.7	677.1	0.84	
414	Tweede DWSRM - front diag 1	70x70x7(11,0.17)	S235	1M16-8.8t	1.00	1.00	1.00	221	-40.3	ULS 1a_0	76.4	60.3	121.0	0.67		0.0		209.7	60.3	89.6	0.00	
415	Tweede DWSRM - front diag 2	65x65x7(11,0.17)	S235	1M16-8.8t	1.00	1.00	1.00	193	-44.8	ULS 7	84.6	60.3	121.0	0.74		0.0		189.5	60.3	89.6	0.00	
419	Tweede DWSRM - main diag front	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	164	0.0		189.7	506.7	855.4	0.00		484.5	ULS 3_90	346.4	506.7	677.1	0.82	
442	Tweede DWSRM - Main diag from tower	120x120x11	S235	6M24-5.6t	1.00	1.00	1.00	401	0.0		48.7	506.7	855.4	0.00		546.9	ULS 3_90	346.4	506.7	677.1	0.92	
108B	Elfde TSNSTK - Main member	180x180x16#	S235	12M24-8.8t	0.51	0.51	0.51	56	-1398.3	ULS 1a_135	1127.4	1599.5	2488.3	1.24	(4)	1158.1	ULS 1a_0,9_0,9_135	1220.3	1599.5	2126.8	0.95	
109A	Tiende TSNSTK - Main member	200x200x20	S235	8M30-8.8t	0.52	0.52	0.52	52	-1687.3	ULS 1a_135	1590.7	1723.4	2592.0	1.06	(4)	1389.1	ULS 1a_0,9_0,9_135	1638.1	1723.4	2094.5	0.85	(5)
212T	Tiende TSNSTK - upper horiz lower CA si	100x100x10	S355	2M20-8.8t	1.00	1.00	0.85	209	-88.1	ULS 1a_90	113.9	188.2	294.0	0.77		66.6	ULS 1a_0,9_0,9_90	466.5	188.2	237.6	0.35	
317	Eerste DWSRM - front diag 4	60x60x6	S355	1M16-8.8t	1.00	1.00	1.00	338	0.0		15.0	60.3	70.6	0.00		45.3	ULS 1a_0	98.8	60.3	52.3	0.87	
114A	Negende TSNSTK - Main member	250x250x22#	S235	18M30-5.6t	0.52	0.26	0.26	23	-3263.7	ULS 1a_45	2472.3	2423.5	6415.2	1.35	(6)	2713.5	ULS 1a_0,9_0,9_45	2373.8	2423.5	4626.7	1.14	
114B	Negende TSNSTK - Main member	250x250x22#	S235	14M30-8.8t	0.52	0.52	0.52	35	-2531.3	ULS 1a_45	2373.4	3015.9	4989.6	1.07	(4)	2021.6	ULS 1a_0,9_0,9_45	2373.8	3015.9	4032.0	0.85	(5)
114C	Negende TSNSTK - Main member	250x250x22#	S235		0.52	0.26	0.26	22	-3260.7	ULS 1a_45	2481.2	0.0	0.0	1.31	(6)	2717.7	ULS 1a_0,9_0,9_45	2493.4	0.0	0.0	1.09	
216L	Negende TSNSTK - Diag fr 1 above horiz	150x100x12	S235	2M30-8.8t	1.00	0.51	0.51	103	-385.1	ULS 1a_90	355.4	861.7	388.8	1.08	(3)	353.3	ULS 1a_0,9_0,9_90	417.0	861.7	314.2	0.85	
217L	Negende TSNSTK - Diag fr 2 above horiz	150x100x12	S235	2M30-8.8t	1.00	0.51	0.51	104	-359.4	ULS 1a_90	350.2	861.7	388.8	1.03	(3)	364.8	ULS 1a_90	417.0	861.7	314.2	0.87	
224L	Achtste TSNSTK - Diag fr 1 above horiz	150x100x12	S235	2M30-8.8t	1.00	0.51	0.51	106	-376.0	ULS 1a_90	345.0	430.8	388.8	1.09	(4)	353.0	ULS 1a_0,9_0,9_90	348.4	430.8	314.2	1.12	
115A	Achtste TSNSTK - Main member	200x200x20+PL150x20	S235	28M30-8.8t	0.50	0.50	0.50	22	-4692.1	ULS 1a_45	4955.6	5805.7	9072.0	0.95		4078.0	ULS 1a_0,9_0,9_135	5013.3	0.0	0.0	0.81	
116A	Zevende TSNSTK - Main member	250x250x20+PL200x25	S235	28M30-8.8t	0.25	0.25	0.50	40	-5222.1	ULS 1a_45	6326.6	5805.7	9072.0	0.90		4575.6	ULS 1a_0,9_0,9_135	7275.2	5805.7	7330.9	0.79	
116B	Zevende TSNSTK - Main member	250x250x20+PL200x25	S235	32M30-8.8t	0.50	0.50	1.00	37	-5629.4	ULS 1a_135	6416.9	6520.2	10368.0	0.88		4889.3	ULS 1a_0,9_0,9_45	7275.2	6520.2	8378.2	0.75	
117A	Zesde TSNSTK - Main member	250x250x20+PL200x25	S235	32M30-8.8t	0.50	0.50	1.00	43	-5651.9	ULS 1a_135	6233.1	6520.2	10368.0	0.91		4865.9	ULS 1a_0,9_0,9_45	7275.2	6520.2	8378.2	0.75	
117B	Zesde TSNSTK - Main member	250x250x20+PL200x25	S235	36M30-8.8t	0.25	0.25	0.50	40	-6003.6	ULS 1a_135	6326.6	7205.9	11664.0	0.95		5154.5	ULS 1a_0,9_0,9_45	6933.1	7205.9	9425.5	0.74	

Notes:

1) Groups 200L, 419 and 442 which were failing under net section capacity (afkeur) were strengthened using a plate. In the tower model an override value was used to represent the increased net section capacity so no change highlighted in this table. For details of the plate calculations refer to Appendix D.
2) Groups 216L and 217L failed due to net section capacity at the afkeur level and were strengthened using a plate so no change is recorded in this table. For details of the plate calculation refer to Appendix D.
3) Failed in tension at the afkeur level. Compression failure not relevant.
4) Failed in shear under compression at the afkeur level but failing in buckling at the verbouw level. Failure not relevant.
5) Failure at the afkeur level was under compression. Failure not relevant.
6) New redundant members added. The member itself does not need to fulfil the verbouw loads.
7) Less than 1.5% exceedance is acceptable
8) Group has localised strengthening. Fulfilment of verbouw loads is not required.

APPENDIX C TOETSING KNIKVERKORTERS

DNV·GL

Knikverkorters initial structure (afkeur)

Date: 2021-04-07
Author: M Khan
Version: 1.8

KIJ-GT
S+95
Masts 12 and 13

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
623	Onderstuk	Enkele staaf	L65.7	S235	M20	5.6	1.18	0	93	60.5	0.29	93.0	58.8	59.0	76.6	1.69	1.03	Bolt Bearing	
620	Onderstuk	Enkele staaf	L80.8	S235	M20	5.6	3.09	77	198	60.5	0.00	56.8	58.8	69.8	133.6	2.95	1.07	Buckling Bolt	
618	Onderstuk	Enkele staaf	L100.8	S235	M20	5.6	2.62	0	133	60.5	0.65	118.8	58.8	69.8	179.7	4.76	1.03	Bolt	
616	Onderstuk	Enkele staaf	L100.10	S235	M20	5.6	3.79	54	194	60.5	0.00	91.4	58.8	87.3	224.6	5.79	1.03	Bolt	
614	Onderstuk	Enkele staaf	L110.10	S235	M20	5.6	4.07	0	189	60.5	1.02	104.5	58.8	87.3	253.4	7.07	1.03	Bolt	
612	Onderstuk	Enkele staaf	L110.10	S235	M20	5.6	4.79	40	222	60.5	0.00	82.8	58.8	87.3	253.4	7.07	1.03	Bolt	
610	Onderstuk	Enkele staaf	L130.12	S235	M20	5.6	5.52	0	217	60.5	1.38	121.8	58.8	104.7	442.4	11.85	1.03	Bolt	
608	Onderstuk	Enkele staaf	L120.11	S235	M20	5.6	5.99	31	254	60.5	0.00	81.3	58.8	96.0	310.5	9.27	1.03	Bolt	
606	Onderstuk	Enkele staaf	L150.10	S235	M20	5.6	6.89	0	232	60.5	1.72	107.3	58.8	87.3	368.6	14.71	1.03	Bolt	
604	Onderstuk	Enkele staaf	L150.10	S235	M20	5.6	7.22	25	243	60.5	1.64	100.0	58.8	87.3	368.6	14.71	1.03	Bolt	
65	Pootverband	Enkele staaf	L65.7	S235	M20	5.6	2.88	0	229	2.9	0.72	32.7	58.8	59.0	76.6	1.69	0.43		
62	Pootverband	Enkele staaf	L110.10	S235	M20	5.6	5.68	76	263	2.9	0.00	64.1	58.8	87.3	253.4	7.07	0.05		
64	Pootverband	Kniksteun en verticale steur	L65.7	S235	M20	5.6	5.90	0	301	2.9	0.74	18.2	58.8	59.0	76.6	1.25	0.61		
61	Pootverband	Enkele staaf	L120.11	S235	M20	5.6	6.19	63	263	2.9	0.00	77.2	58.8	96.0	310.5	9.27	0.05		
63	Pootverband	Kniksteun en verticale steur	L80.8	S235	M20	5.6	8.98	0	370	2.9	1.12	18.8	58.8	69.8	133.6	2.20	0.53		
60	Pootverband	Enkele staaf	L130.12	S235	M20	5.6	6.94	50	272	2.9	0.00	86.1	58.8	104.7	442.4	11.85	0.05		
70	Tussenschot D-D	Kniksteun en verticale steur	L100.8	S235	M20	5.6	11.84	0	384	2.3	1.48	22.3	58.8	69.8	179.7	3.63	0.42		
71	Tussenschot D-D	Kruisende staaf halverwege	L100.8	S235	M20	5.6	16.88	0	548	2.3	2.11	12.5	58.8	69.8	179.7	4.76	0.44		
369	1e Tussenstuk	Enkele staaf	L100.10	S235	M24	5.6	5.01	33	256	62.5	0.00	60.6	84.7	110.8	213.1	5.79	1.03	Buckling	
367	1e Tussenstuk	Enkele staaf	L110.10	S235	M24	5.6	4.08	0	189	62.5	1.02	104.2	84.7	110.8	241.9	7.07	0.74		
364	1e Tussenstuk	Enkele staaf	L100.10	S235	M24	5.6	3.37	0	172	62.5	0.84	107.1	84.7	110.8	213.1	5.79	0.74		
362	1e Tussenstuk	Enkele staaf	L100.8	S235	M24	5.6	3.84	43	195	62.5	0.00	73.2	84.7	88.6	170.5	4.76	0.85		
73	Tussenschot C-C	Enkele staaf	L100.10	S235	M20	5.6	9.38	0	480	9.0	2.35	21.5	58.8	87.3	224.6	5.8	0.42		
74	Tussenschot C-C	Kruisende staaf halverwege	L100.8	S235	M20	5.6	13.92	0	452	9.0	1.74	17.2	58.8	69.8	179.7	4.76	0.52		
325	2e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	4.25	36	216	83.5	0.00	63.3	58.8	69.8	179.7	4.76	1.42	Buckling Bolt Bearing	
304	2e Tussenstuk	Enkele staaf	L100.10	S235	M20	5.6	3.31	0	169	83.5	0.83	109.7	58.8	87.3	224.6	5.79	1.42	Bolt	
307	2e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	3.07	0	156	58.3	0.77	98.4	58.8	69.8	179.7	4.76	0.99		
326	2e Tussenstuk	Enkele staaf	L80.8	S235	M16	5.6	3.77	41	242	58.3	0.00	42.4	37.7	51.2	142.8	2.95	1.55	Buckling Bolt Bearing	
332	2e Tussenstuk	Enkele staaf	L150.10	S235	M24	5.6	6.44	0	217	58.3	1.61	118.7	84.7	110.8	357.1	14.71	0.69		
75	Tussenschot B-B	Enkele staaf	L100.8	S235	M20	5.6	9.03	0	459	1.3	2.26	18.8	58.8	69.8	179.7	4.8	0.47		
76	Tussenschot B-B	Kruisende staaf halverwege	L100.8	S235	M20	5.6	13.03	0	423	1.3	1.63	19.1	58.8	69.8	179.7	4.8	0.34		
327	3e Tussenstuk	Enkele staaf	L80.8	S235	M20	5.6	3.87	37	248	58.3	0.00	40.8	58.8	69.8	133.6	2.95	1.43	Buckling	
310	3e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	3.09	0	157	58.3	0.77	97.6	58.8	69.8	179.7	4.76	0.99		
313	3e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	2.86	0	145	55.3	0.72	107.3	58.8	69.8	179.7	4.76	0.94		
328	3e Tussenstuk	Enkele staaf	L70.7	S235	M20	5.6	3.49	40	256	55.3	0.00	29.8	58.8	61.1	96.8	1.98	1.86	Buckling	
341	3e Tussenstuk	Enkele staaf	L130.12	S235	M20	5.6	5.64	0	221	55.3	1.41	118.0	58.8	104.7	442.4	11.9	0.94		
329	3e Tussenstuk	Enkele staaf	L70.7	S235	M20	5.6	3.58	36	262	55.3	0.00	28.6	58.8	61.1	96.8	2.0	1.93	Buckling	
316	3e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	2.81	0	143	55.3	0.70	109.6	58.8	69.8	179.7	4.8	0.94		

DNV·GL

Knikverkorters initial structure (afkeur)

Date: 2021-04-07
Author: M Khan
Version: 1.8

KIJ-GT
S+95
Masts 12 and 13

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slender ness	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
209	4e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	2.68	0	136	**0.0**	**0.67**	115.7	58.8	69.8	179.7	4.8	0.14		
216	4e Tussenstuk	Enkele staaf	L70.7	S235	M20	5.6	3.18	37	233	**0.0**	**0.00**	34.3	58.8	61.1	96.8	2.0	0.00		
207	4e Tussenstuk	Enkele staaf	L120.11	S235	M20	5.6	5.22	0	222	**71.3**	**1.31**	99.9	58.8	96.0	310.5	9.3	1.21	Bolt	
215	4e Tussenstuk	Enkele staaf	L70.7	S235	M20	5.6	3.30	35	242	**0.0**	**0.00**	32.4	58.8	61.1	96.8	2.0	0.00		
232	4e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	2.60	0	132	**0.0**	**0.65**	119.7	58.8	69.8	179.7	4.8	0.14		
211	4e Tussenstuk	Enkele staaf	L80.8	S235	M20	5.6	2.45	0	157	**0.0**	**0.61**	77.3	58.8	69.8	133.6	3.0	0.21		
220	4e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	2.92	44	250	**0.0**	**0.00**	22.7	58.8	47.5	48.4	1.2	0.00		
206	4e Tussenstuk	Enkele staaf	L120.11	S235	M20	5.6	4.84	0	205	**66.9**	1.21	111.5	58.8	96.0	310.5	9.3	1.14	Bolt	
77	Tussenschot A-A	Enkele staaf	L100.8	S235	M20	5.6	6.86	0	348	**1.2**	**1.72**	30.0	58.8	69.8	179.7	4.8	0.36		
78	Tussenschot A-A	Kruisende staaf halverwege	L80.8	S235	M20	5.6	9.97	0	411	**1.2**	**1.25**	15.9	58.8	69.8	133.6	3.0	0.42		
219	5e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	2.98	39	255	**0.0**	**0.00**	22.0	58.8	47.5	48.4	1.2	0.00		
212	5e Tussenstuk	Enkele staaf	L80.8	S235	M20	5.6	2.42	0	155	**0.0**	**0.60**	78.7	58.8	69.8	133.6	3.0	0.20		
213	5e Tussenstuk	Enkele staaf	L80.8	S235	M20	5.6	2.21	0	142	**0.0**	**0.55**	87.6	58.8	69.8	133.6	3.0	0.19		
218	5e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	2.89	42	247	**0.0**	**0.00**	23.1	58.8	47.5	48.4	1.2	0.00		
208	5e Tussenstuk	Enkele staaf	L110.10	S235	M20	5.6	4.84	0	224	**66.9**	**1.21**	81.6	58.8	87.3	253.4	7.1	1.14	Bolt	
217	5e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	2.97	40	254	**0.0**	**0.00**	22.1	58.8	47.5	48.4	1.2	0.00		
214	5e Tussenstuk	Enkele staaf	L80.8	S235	M20	5.6	2.10	0	135	**0.0**	**0.53**	92.9	58.8	69.8	133.6	3.0	0.18		
110	5e Tussenstuk	Enkele staaf	L120.11	S235	M30	5.6	8.32	0	353	**0.0**	**2.08**	48.0	134.6	156.0	275.6	9.3	0.22		Not structural
119	6e Tussenstuk	Enkele staaf	L70.7	S235	M20	5.6	1.97	0	144	**0.0**	0.49	65.5	58.8	61.1	96.8	2.0	0.25		
126	6e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	2.72	46	233	**0.0**	0.00	25.3	58.8	47.5	48.4	1.2	0.00		
114	6e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	3.88	0	197	**62.5**	0.97	72.1	58.8	69.8	179.7	4.8	1.06	Bolt	
125	6e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	2.78	41	238	**0.0**	0.00	24.5	58.8	47.5	48.4	1.2	0.00		
120	6e Tussenstuk	Enkele staaf	L70.7	S235	M20	5.6	1.95	0	143	**0.0**	0.49	66.3	58.8	61.1	96.8	2.0	0.25		
121	6e Tussenstuk	Enkele staaf	L65.7	S235	M20	5.6	1.65	0	131	**0.0**	0.41	67.8	58.8	59.0	76.6	1.7	0.24		
130	6e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.48	57	255	**0.0**	0.00	15.3	37.7	30.3	31.7	0.7	0.00		
113	6e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	3.43	0	174	**62.5**	0.86	85.4	58.8	69.8	179.7	4.8	1.06	Bolt	
116	Tussenschot A-A	Enkele staaf	L80.8	S235	M20	5.6	4.89	0	314	**0.9**	**1.22**	28.2	58.8	69.8	133.6	3.0	0.41		
118	Tussenschot A-A	Kruisende staaf halverwege	L70.7	S235	M20	5.6	7.02	0	331	**0.9**	**0.88**	17.1	58.8	61.1	96.8	2.0	0.44		
129	7e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.42	46	249	**0.0**	**0.00**	15.9	37.7	30.3	31.7	0.7	0.00		
122	7e Tussenstuk	Enkele staaf	L65.7	S235	M20	5.6	1.73	0	137	**0.0**	**0.43**	64.3	58.8	59.0	76.6	1.7	0.26		
124	7e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	1.48	0	127	**0.0**	**0.37**	55.8	58.8	47.5	48.4	1.2	0.30		
128	7e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.41	56	248	**0.0**	**0.00**	16.0	37.7	30.3	31.7	0.7	0.00		
112	7e Tussenstuk	Enkele staaf	L100.8	S235	M20	5.6	2.94	0	149	**62.5**	**0.74**	103.8	58.8	69.8	179.7	4.8	1.06	Bolt	
127	7e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.33	47	239	**0.0**	**0.00**	16.8	37.7	30.3	31.7	0.7	0.00		
123	7e Tussenstuk	Enkele staaf	L60.6	S235	M20	5.6	1.49	0	127	**0.0**	**0.37**	55.4	58.8	47.5	48.4	1.2	0.30		
117	Tussenschot B-B	Enkele staaf	L75.7	S235	M20	5.6	3.91	0	267	**0.9**	**0.98**	30.0	58.8	61.1	96.8	2.3	0.43		
115-1	Tussenschot B-B	Enkele staaf	L80.8	S235	M20	5.6	5.74	0	368	**0.9**	**1.44**	21.7	58.8	69.8	133.6	3.0	0.49		
172	8e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.38	0	118	**47.0**	**0.35**	60.0	37.7	38.4	72.6	1.2	1.25	Bolt Bearing	

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Knikverkorters initial structure (afkeur)

Date: 2021-04-07
Author: M Khan
Version: 1.8

KIJ-GT
S+95
Masts 12 and 13

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
160	8e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.12	54	218	**47.0**	**0.00**	19.4	37.7	30.3	31.7	0.7	2.43	Buckling Bolt Bearing Net sectio	
171	8e Tussenstuk	Enkele staaf	L80.8	S235	M16	5.6	2.67	0	171	**47.0**	**0.67**	69.2	37.7	51.2	142.8	3.0	1.25	Bolt	
159	8e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.19	29	225	**47.0**	**0.48**	18.5	37.7	30.3	31.7	0.7	2.55	Buckling Bolt Bearing Net sectio	
170	8e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.38	0	118	**47.0**	**0.35**	60.0	37.7	38.4	72.6	1.2	1.25	Bolt Bearing	
169	8e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.32	0	136	**35.4**	**0.33**	36.0	37.7	30.3	31.7	0.7	1.17	Bearing Net section	
158	8e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.08	51	214	**35.4**	**0.00**	19.9	37.7	30.3	31.7	0.7	1.78	Buckling Bearing Net section	
182	8e Tussenstuk	Enkele staaf	L75.7	S235	M16	5.6	2.58	0	176	**35.4**	**0.65**	54.9	37.7	44.8	104.8	2.3	0.94		
157	8e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.14	50	220	**35.4**	**0.00**	19.1	37.7	30.3	31.7	0.7	1.85	Buckling Bearing Net section	
167	8e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.30	0	133	**35.4**	**0.32**	36.7	37.7	30.3	31.7	0.7	1.17	Bearing Net section	
166	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.20	0	123	**24.0**	**0.30**	39.9	37.7	30.3	31.7	0.7	0.79		
156	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.03	55	209	**24.0**	**0.00**	20.6	37.7	30.3	31.7	0.7	1.16	Buckling	
165	9e Tussenstuk	Enkele staaf	L70.7	S235	M16	5.6	2.42	0	177	**24.0**	**0.60**	50.7	37.7	44.8	104.8	2.0	0.64		
155	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.07	51	213	**24.0**	**0.00**	20.0	37.7	30.3	31.7	0.7	1.20	Buckling	
164	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.22	0	125	**24.0**	**0.31**	39.2	37.7	30.3	31.7	0.7	0.79		
163	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.18	0	121	**24.0**	**0.29**	40.7	37.7	30.3	31.7	0.7	0.79		
154	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.00	55	205	**24.0**	**0.00**	21.1	37.7	30.3	31.7	0.7	1.14	Buckling	
162	9e Tussenstuk	Enkele staaf	L65.7	S235	M16	5.6	2.29	0	182	**24.0**	**0.57**	45.2	37.7	44.8	84.7	1.7	0.64		
153	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	2.07	53	213	**24.0**	**0.00**	20.0	37.7	30.3	31.7	0.7	1.20	Buckling	
161	9e Tussenstuk	Enkele staaf	L50.5	S235	M16	5.6	1.16	0	119	**24.0**	**0.29**	41.3	37.7	30.3	31.7	0.7	0.79		
12	Tussenschot N	Enkele staaf	L70.7	S235	M16	5.6	3.86	0	283	**0.6**	**0.97**	25.5	37.7	44.8	104.8	2.0	0.49		
8	Tussenschot N	Kruisende staaf halverwege	L100.50.6	S235	M16	5.6	5.75	0	271	**0.6**	**0.72**	25.4	37.7	36.4	38.0	3.2	0.22		
11	Tussenschot M	Enkele staaf	L70.7	S235	M16	5.6	3.63	0	266	**0.6**	**0.91**	28.0	37.7	44.8	104.8	2.0	0.46		
6	Tussenschot M	Kruisende staaf halverwege	L100.50.6	S235	M16	5.6	5.53	0	260	**0.6**	**0.69**	26.9	37.7	36.4	38.0	3.2	0.21		
10	Tussenschot L	Enkele staaf	L70.7	S235	M16	5.6	3.45	0	253	**0.5**	**0.86**	30.3	37.7	44.8	104.8	2.0	0.44		
3	Tussenschot L	Kruisende staaf halverwege	L100.50.6	S235	M16	5.6	5.28	0	248	**0.5**	**0.66**	28.9	37.7	36.4	38.0	3.2	0.20		
9	Tussenschot K	Enkele staaf	L70.7	S235	M16	5.6	3.28	0	240	**0.4**	**0.82**	32.7	37.7	44.8	104.8	2.0	0.41		
2	Tussenschot K	Kruisende staaf halverwege	L100.50.6	S235	M16	5.6	5.02	0	236	**0.4**	**0.63**	31.2	37.7	36.4	38.0	3.2	0.19		
41	10e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	2.20	0	188	**15.9**	**0.55**	34.4	37.7	38.4	72.6	1.2	0.46		
40	10e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	2.13	0	182	**15.9**	**0.53**	35.9	37.7	38.4	72.6	1.2	0.44		
39	11e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	2.08	0	178	**11.4**	**0.52**	37.1	37.7	38.4	72.6	1.2	0.42		
38	11e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	2.01	0	172	**11.4**	**0.50**	38.8	37.7	38.4	72.6	1.2	0.40		
37	11e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.94	0	166	**11.4**	**0.49**	40.5	37.7	38.4	72.6	1.2	0.39		
11-1	12e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.89	0	162	**5.6**	**0.47**	41.9	37.7	38.4	72.6	1.2	0.38		
10-1	12e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.82	0	156	**5.6**	**0.46**	44.0	37.7	38.4	72.6	1.2	0.37		
9-1	12e Tussenstuk	Enkele staaf	L60.6	S235	M16	5.6	1.76	0	151	**5.6**	**0.44**	45.8	37.7	38.4	72.6	1.2	0.35		

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Knikverkorters adjusted structure (verbouw)

Date:	2021-04-07
Author:	M Khan
Version:	1.8

KIJ-GT

S+95

Masts 12 and 13

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
623	Onderstuk	Enkele staaf	L65.7	S235	M20	8.8	1.18	0	93	60.5	0.38	93.0	94.1	61.1	76.6	1.69	0.99		Bolt exchanged
620	Onderstuk	Enkele staaf	L80.8	S355	M20	8.8	3.09	77	198	60.5	0.00	63.4	94.1	95.0	213.2	4.46	0.95		Profile exchanged
618	Onderstuk	Enkele staaf	L100.8	S235	M20	8.8	2.62	0	133	60.5	0.85	118.8	94.1	69.8	248.8	4.76	0.87		Bolt exchanged
616	Onderstuk	Enkele staaf	L100.10	S235	M20	8.8	3.79	54	194	60.5	0.00	91.4	94.1	87.3	311.0	5.79	0.69		Bolt exchanged
614	Onderstuk	Enkele staaf	L110.10	S235	M20	8.8	4.07	0	189	60.5	1.32	104.5	94.1	87.3	368.6	7.07	0.69		Bolt exchanged
612	Onderstuk	Enkele staaf	L110.10	S235	M20	8.8	4.79	40	222	60.5	0.00	82.8	94.1	87.3	368.6	7.07	0.73		Bolt exchanged
610	Onderstuk	Enkele staaf	L130.12	S235	M20	8.8	5.52	0	217	60.5	1.79	121.8	94.1	104.7	580.6	11.85	0.64		Bolt exchanged
608	Onderstuk	Enkele staaf	L120.11	S235	M20	8.8	5.99	31	254	60.5	0.00	81.3	94.1	96.0	468.9	9.27	0.74		Bolt exchanged
606	Onderstuk	Enkele staaf	L150.10	S235	M20	8.8	6.89	0	232	60.5	2.24	107.3	94.1	87.3	599.0	14.71	0.69		Bolt exchanged
604	Onderstuk	Enkele staaf	L150.10	S235	M20	8.8	7.22	25	243	60.5	2.13	100.0	94.1	87.3	599.0	14.71	0.69		Bolt exchanged
369	1e Tussenstuk	Enkele staaf	L120.10	S355	M24	8.8	5.01	33	211	62.5	0.00	108.9	135.6	150.8	525.3	12.83	0.57		Profile exchanged
325	2e Tussenstuk	Enkele staaf	L100.10	S355	M20	8.8	4.25	36	218	83.5	0.00	85.8	94.1	118.8	423.4	8.75	0.97		Profile exchanged
304	2e Tussenstuk	Enkele staaf	L100.10	S235	M20	8.8	3.31	0	169	83.5	1.08	109.7	94.1	87.3	311.0	5.79	0.96		Bolt exchanged
326	2e Tussenstuk	Enkele staaf	L100.10	S355	M20	8.8	3.77	41	193	58.3	0.00	103.1	94.1	118.8	423.4	8.75	0.62		Profile exchanged
327	3e Tussenstuk	Enkele staaf	L100.10	S355	M20	8.8	3.87	37	198	58.3	0.0	99.1	94.1	118.8	423.4	8.8	0.62		Profile exchanged
328	3e Tussenstuk	Enkele staaf	L100.8	S355	M20	8.8	3.49	40	177	55.3	0.0	94.4	94.1	95.0	338.7	7.2	0.59		Profile exchanged
329	3e Tussenstuk	Enkele staaf	L100.8	S355	M20	8.8	3.58	36	182	55.3	0.0	90.9	94.1	95.0	338.7	7.19	0.61		Profile exchanged
207	4e Tussenstuk	Enkele staaf	L120.11	S235	M20	8.8	5.22	0	222	71.3	1.7	99.9	94.1	96.0	468.9	9.27	0.76		Bolt exchanged
206	4e Tussenstuk	Enkele staaf	L120.11	S235	M20	8.8	4.84	0	205	66.9	1.6	111.5	94.1	96.0	468.9	9.3	0.71		Bolt exchanged
208	5e Tussenstuk	Enkele staaf	L110.10	S235	M20	8.8	4.84	0	224	66.9	1.57	81.6	94.1	87.3	368.6	7.07	0.82		Bolt exchanged
114	6e Tussenstuk	Enkele staaf	L100.8	S235	M20	8.8	3.88	0	197	62.5	1.26	72.1	94.1	69.8	248.8	4.76	0.90		Bolt exchanged
113	6e Tussenstuk	Enkele staaf	L100.8	S235	M20	8.8	3.43	0	174	62.5	1.11	85.4	94.1	69.8	248.8	4.76	0.90		Bolt exchanged
112	7e Tussenstuk	Enkele staaf	L100.8	S235	M20	8.8	2.94	0	149	62.5	0.96	103.8	94.1	69.8	248.8	4.76	0.90		Bolt exchanged
172	8e Tussenstuk	Enkele staaf	L60.6	S355	M16	8.8	1.38	0	118	47.0	0.45	72.3	60.3	52.3	98.8	1.88	0.90		Profile exchanged
160	8e Tussenstuk	Enkele staaf	L60.8	S355	M16	8.8	2.12	54	183	47.0	0.00	52.6	60.3	69.7	131.7	2.45	0.89		Profile exchanged
171	8e Tussenstuk	Enkele staaf	L80.8	S235	M16	8.8	2.67	0	171	47.0	0.87	69.2	60.3	51.2	188.9	2.95	0.92		Bolt exchanged
159	8e Tussenstuk	Enkele staaf	L60.8	S355	M16	8.8	2.19	29	189	47.0	0.62	50.1	60.3	69.7	131.7	2.45	0.94		Profile exchanged
170	8e Tussenstuk	Enkele staaf	L60.6	S355	M16	8.8	1.38	0	118	47.0	0.45	72.3	60.3	52.3	98.8	1.88	0.90		Profile exchanged
169	8e Tussenstuk	Enkele staaf	L55.6	S355	M16	8.8	1.32	0	123	35.4	0.43	62.7	60.3	52.3	75.3	1.56	0.68		Profile exchanged
158	8e Tussenstuk	Enkele staaf	L60.8	S355	M16	8.8	2.08	51	179	35.4	0.00	54.1	60.3	69.7	131.7	2.45	0.65		Profile exchanged
157	8e Tussenstuk	Enkele staaf	L60.8	S355	M16	8.8	2.14	50	184	35.4	0.00	51.9	60.3	69.7	131.7	2.45	0.68		Profile exchanged
167	8e Tussenstuk	Enkele staaf	L55.6	S355	M16	8.8	1.30	0	121	35.4	0.42	64.1	60.3	52.3	75.3	1.56	0.68		Profile exchanged
156	9e Tussenstuk	Enkele staaf	L60.8	S355	M16	8.8	2.03	55	175	24.0	0.00	56.1	60.3	69.7	131.7	2.45	0.43		Profile exchanged
155	9e Tussenstuk	Enkele staaf	L60.6	S355	M16	8.8	2.07	51	177	24.0	0.00	42.0	60.3	52.3	98.8	1.88	0.57		Profile exchanged
154	9e Tussenstuk	Enkele staaf	L55.6	S355	M16	8.8	2.00	55	187	24.0	0.00	35.6	60.3	52.3	75.3	1.56	0.67		Profile exchanged
153	9e Tussenstuk	Enkele staaf	L60.6	S355	M16	8.8	2.07	53	177	24.0	0.00	42.1	60.3	52.3	98.8	1.88	0.57		Profile exchanged
BR9	5e Tussenstuk	Enkele staaf	L50.5	S355	M16	8.8	0.69	0	71	24.0	0.22	81.4	60.3	43.6	51.0	1.08	0.55		Profile added
BR10	5e Tussenstuk	Enkele staaf	L50.5	S355	M16	8.8	1.11	50	114	24.0	0.00	52.3	60.3	43.6	51.0	1.08	0.55		Profile added
BR11	5e Tussenstuk	Enkele staaf	L50.5	S355	M16	8.8	0.67	0	69	24.0	0.22	82.6	60.3	43.6	51.0	1.08	0.55		Profile added

Knikverkorters adjusted structure (verbouw)

Date: 2021-04-07
Author: M Khan
Version: 1.8

KIJ-GT

S+95

Masts 12 and 13

Posnr.	Section	Schematization	Profile	Steel Quality	Bolt	Quality	Length (m)	Angle (°)	Slender ness (-)	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
BR12	5e Tussenstuk	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.05	50	108	**24.0**	0.00	55.7	60.3	43.6	51.0	1.08	0.55		Profile added
RS1	Onderstuk	Enkele staaf	**L60.6**	**S355**	**M16**	**8.8**	0.98	0	84	**31.0**	0.32	102.9	60.3	52.3	98.8	1.88	0.59		Profile added
RS2	Onderstuk	Enkele staaf	**L70.7**	**S355**	**M16**	**8.8**	2.42	0	177	**31.0**	0.79	57.2	60.3	61.0	170.1	2.99	0.54		Profile added
RS3	1e Tussenstuk	Enkele staaf	**L80.6**	**S355**	**M16**	**8.8**	3.87	0	246	**31.0**	1.26	34.4	60.3	52.3	192.9	3.40	0.90		Profile added
RS4	1e Tussenstuk	Enkele staaf	**L80.6**	**S355**	**M16**	**8.8**	3.16	0	201	**42.0**	1.03	47.2	60.3	52.3	192.9	3.40	0.89		Profile added
RS5	2e Tussenstuk	Enkele staaf	**L80.6**	**S355**	**M16**	**8.8**	3.16	0	201	**42.0**	1.03	47.2	60.3	52.3	192.9	3.40	0.89		Profile added
RS6	2e Tussenstuk	Enkele staaf	**L70.7**	**S355**	**M16**	**8.8**	2.88	0	211	**29.5**	0.94	44.0	60.3	61.0	170.1	2.99	0.67		Profile added
RS7	3e Tussenstuk	Enkele staaf	**L70.7**	**S355**	**M16**	**8.8**	2.88	0	211	**29.5**	0.94	44.0	60.3	61.0	170.1	2.99	0.67		Profile added
RS8	3e Tussenstuk	Enkele staaf	**L60.6**	**S355**	**M16**	**8.8**	2.57	0	220	**28.0**	0.84	30.4	60.3	52.3	98.8	1.88	0.92		Profile added
RS9	3e Tussenstuk	Enkele staaf	**L60.6**	**S355**	**M16**	**8.8**	2.57	0	220	**28.0**	0.84	30.4	60.3	52.3	98.8	1.88	0.92		Profile added
RS10	Onder- 3e tusser	Enkele staaf	**L50.5**	**S355**	**M16**	**8.8**	1.00	0	103	**30.3**	0.33	58.8	60.3	43.6	51.0	1.08	0.69		Profile added

Notes

1) Members BR9 to BR12 are new redundant members. Refer to Appendix E.
2) Members RS1 to RS10 are new redundant members. Refer to Appendix E.

APPENDIX D TOETSING ANKERS & OVERIGE BEREKENINGEN

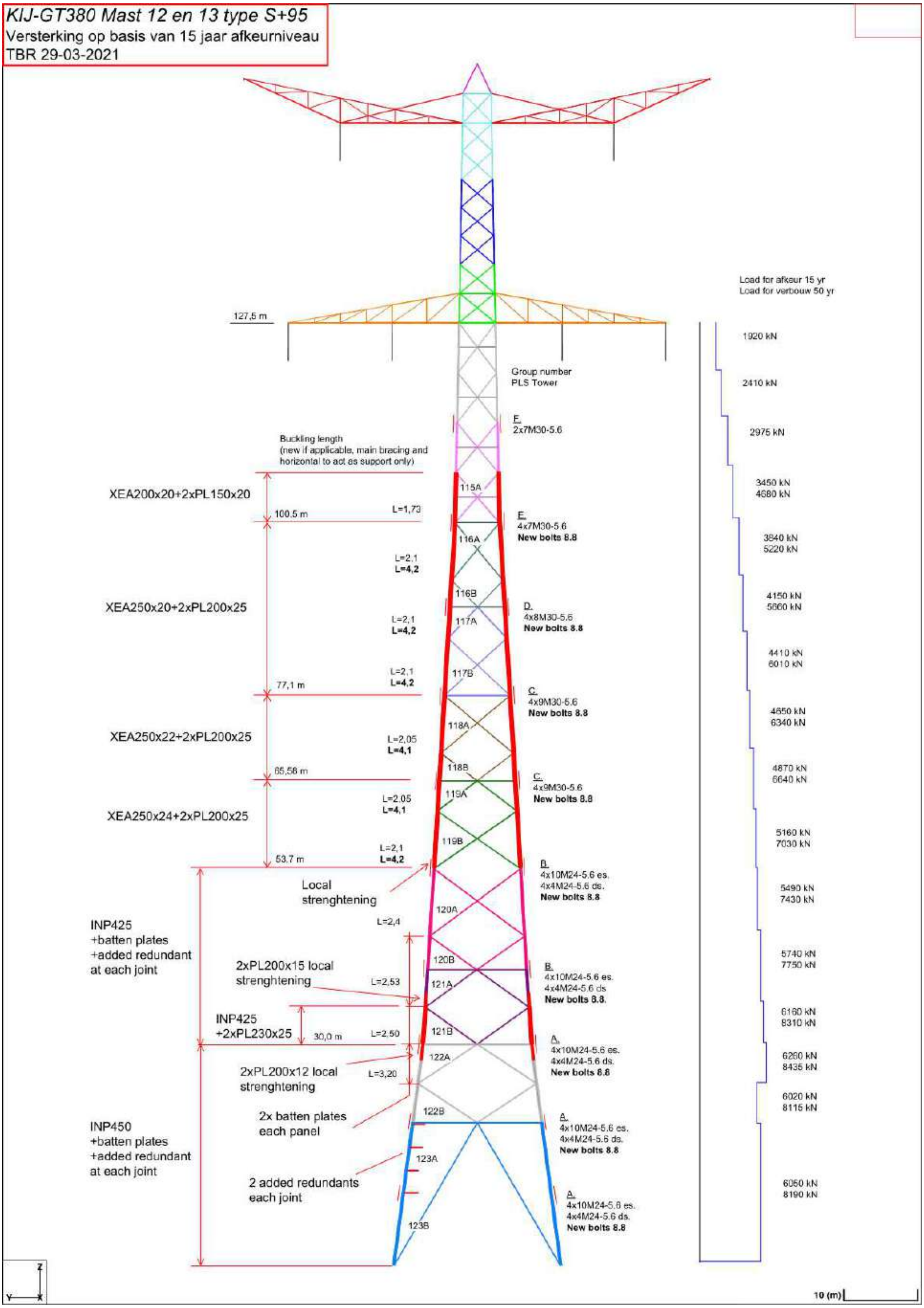
CAPACITY AND CONNECTIONS OF MAIN LEG

Contents

1 SPLICE CONNECTIONS

The main leg of the structure is composed of cruciform sections of XEA and INP-sections over a large part of the height of the structure. In this appendix the capacity of these sections will be looked at in more detail then the software package of AxisVM offers.

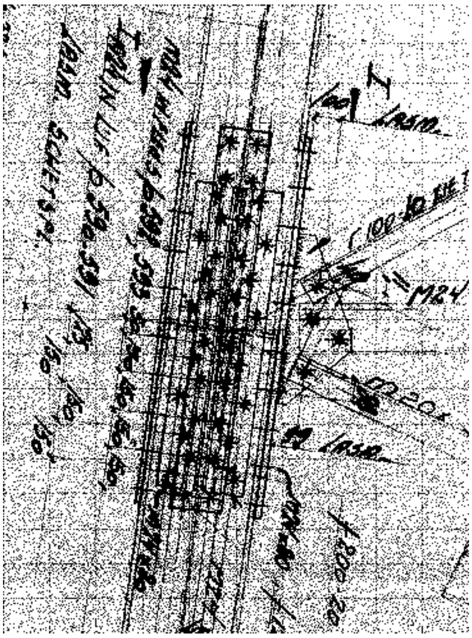
At first the bolted connection in the INP-main members will be checked since this type of section is not offered by the software package PLS-TOWER. The buckling capacity of the main leg with INP-sections is checked in Appendix F. After that, the buckling capacity and the strength of the connections of the XEA-sections will be checked.



Figuur 1 Scheme of lower part tower S+95 with bolted connections and profiles

1.1 Bolted splice INP450 (A)

The flanges 170x24,3 mm are connected with one plate of 200x20 cross section. The web with thickness 16,2 mm is connected with two plates 120x16 mm cross section. In total 72 shear planes exist for the bolts M24-5.6.



Figuur 2 Splice connection INP450

The capacity of the two plate connections within the connection will be determined with a spreadsheet.

M24-5.6: $F_{v,Rd}$ = 84,7 kN. Due to the length of the connection, the bolts in the flange are considered 95% effective (see spreadsheet).

The results for the capacity of the plate connections from the spreadsheet are used to determine total capacity of all the four flanges and the web.

Compression capacity:

Flanges:	4 x 805 =	3219 kN
Web:	4 x 678 =	2710 kN
Total:		5928 kN

Tension capacity:

Flanges:	4 x 767 =	3070 kN
Web:	4 x 678 =	2710 kN
Total:		5780 kN

The bolt capacity is with a slight difference decisive.

INP450 gross section: 29152 mm2

$F_{b,Rd}$ = 29152 x 235 = 6850 kN.

Net section of INP450 for tension

INP450 gross section:	29152 mm2
Holes in flange: - 4 x 2 x 26 x 24,3 =	-5054 mm2
Holes in web: - 4 x 26 x 16,2 =	-1685 mm2
Total:	22413 mm2

$F_{t,Rd}$ = 0,9 x 22413 x 360 / 1,25 = 5809 kN.

Conclusion: for compression the strength of the connection is equal to 5928 kN. The ratio between compression and tension force is such that tension capacity is not relevant.

Capacity with bolts exchanged to 8.8 quality.

Compression capacity:

Flanges:	4 x 940 =	3760 kN
Web:	4 x 777 =	3108 kN
Total:		6868 kN

Tension capacity:

Flanges:	4 x 767 =	3070 kN
Web:	4 x 777 =	3108 kN
Total:		6178 kN

With 8.8 class bolts, the bolts are not decisive anymore, but gross and net section are.

Flensverbinding met strip 200x20 en 10M24-5.6 enkelsnedig

Capaciteit strip met boutverbinding

Volgens NEN-EN 1993-1-1+C2 en 1993-1-8 met NB

Stripgegevens

Breedte	b =	**200**	mm
Dikte	t =	**20**	mm
Dubbele of enkele strip:		**Enkel**	
Factor	a =	1	
Staalsoort		**S235**	
Schetsplaat			
Dikte schetsplaat	t_{pl} =	**24,3**	mm
Staalsoort		**S235**	
Treksterkte	f_u =	360	N/mm²

Belasting	$F_{t,Ed}$ =	**765**	kN
Resultaat			
Sterkte van de verbinding			
Boutverbinding:	UC. =	**0,95**	**OK**
Nettodoorsnede:	UC. =	**1,00**	**OK**

Vervormingscapaciteit

Voorwaarde: $N_{pl;Rd}$ / $N_{u;Rd}$ < 1,00 1,23 => Nee

Doorsnede strip

A_{bruto} = b x t =	4000	mm²
A_{net} = (b - nd_g)t =	2960	mm²
f_u =	360	N/mm²
γ_{m0} =	1,00	-
γ_{m2} =	1,25	-
$N_{u;Rd}$ = a x 0,9 x A_{net} x f_u / γ_{m2} =	**767**	kN
Vloeien van brutodoorsnede		
$N_{pl;Rd}$ = a x A x f_y / γ_{m0} =	**940**	kN

Boutgegevens en -configuratie

Boutdiameter		**M24**		
Boutkwaliteit		**5.6**		
Fabricage draad		Gerold		
Aantal schuifvlakken per bout		1		
Boutdiameter	d_b =	24	mm	
Boutgatdiameter	d_0 =	26	mm	
Aantal boutrijen	n =	**5**		
Aantal dwarsrijen	m =	**2**		
Eindafstand	e_1 =	40	mm	Ok
Tussenafstand	p_1 =	150	mm	Ok
Tussenafstand haaks	p_2 =	90	mm	Ok
Eindafstand haaks	e_2 =	55	mm	Ok

Stuik strip

Factor f_{ub} / f_u =		2,13	
		1,00	
Eindbout	α_d = e_1 / 3d_0 =	0,51	
	k_1 = 2,8e_2 / d_0 - 1,7 =	4,22	
	k_1 = 1,4p_2 / d_0 - 1,7 =	3,15	
	k_1 =	2,50	
$F_{b;Rd}$ = a x $k_1 \alpha_b f_u$ d t / γ_{M2} =		177	kN
Tussenbt	α_d = p_1 / 3d_0 - $^1/_4$ =	1,67	
	k_1 = 2,8e_2 / d_0 - 1,7 =	4,22	
	k_1 = 1,4p_2 / d_0 - 1,7 =	3,15	
	k_1 =	2,50	
$F_{b;Rd}$ = a x $k_1 \alpha_b f_u$ d t / γ_{M2} =		346	kN

Afschuiving bouten

Afschuifdoorsnede door:		Schacht	
Factor boutkwaliteit	α_v =	0,60	-
Factor fabricage	α_{red} =	1,00	-
Oppervlakte	$A_{b;s}$ =	353	mm²
Treksterkte	$f_{u;b}$ =	500	N/mm²
$F_{v;Rd}$ = $\alpha_v A_{b;s} f_{u;b} \alpha_{red;2}$ / γ_{M2} =		85	kN
Lengte verbinding:		600	mm
Reductie β_l = 1 - (L_j - 15d) / 200d		0,95	

Boutrij	$F_{v,Rd}$	Schuif-vlakken	Beta	Bouten $F_{v;Rd}$	Strip $F_{v,Rd}$	Schtsplt $F_{v,Rd}$	Min.	Toets
1	84,7	1	0,95	80,5	177,2	419,9	80,5	elastisch
2	84,7	1	0,95	80,5	345,6	419,9	80,5	elastisch
3	84,7	1	0,95	80,5	345,6	419,9	80,5	elastisch
4	84,7	1	0,95	80,5	345,6	419,9	80,5	elastisch
5	84,7	1	0,95	80,5	345,6	215,3	80,5	elastisch
6	0,0	1	0,95	0,0	0,0	0,0	0,0	
7	0,0	1	0,95	0,0	0,0	0,0	0,0	
8	0,0	1	0,95	0,0	0,0	0,0	0,0	

Σ F_{Rd} = 402,4 kN

Min. F_{Rd} = 80,5 kN

Resultaat boutverbinding

Elastisch $\frac{F_{v,Ed}}{\min. F_{v,Rd}} = \frac{76,5}{80} = 0,95$ ***OK***

Plastisch $\frac{F_{t,Ed}}{\Sigma F_{Rd}} = \frac{765,0}{402,4 \times 2} = 0,95$ ***NVT***

Lijfverbinding met strippen 120x16 en 4M24-5.6 dubbelsnedig

Capaciteit strip met boutverbinding

Volgens NEN-EN 1993-1-1+C2 en 1993-1-8 met NB

Stripgegevens

Breedte	b =	**120**	mm
Dikte	t =	**16**	mm
Dubbele of enkele strip:		**Dubbel**	
Factor	a =	2	
Staalsoort		**S235**	
Schetsplaat			
Dikte schetsplaat	t_{pl} =	**16,2**	mm
Staalsoort		**S235**	
Treksterkte	f_u =	360	N/mm^2

Belasting	$F_{t,Ed}$ =	**678**	kN
Resultaat			
Sterkte van de verbinding			
Boutverbinding:	UC. =	**1,00**	**OK**
Nettodoorsnede:	UC. =	**0,87**	**OK**

Vervormingscapaciteit

Voorwaarde: $N_{pl;Rd}$ / $N_{u;Rd}$ < 1,00 1,16 => Nee

Doorsnede strip

A_{bruto} = b x t =	1920	mm^2
A_{net} = (b - nd_g)t =	1504	mm^2
f_u =	360	N/mm^2
γ_{m0} =	1,00	-
γ_{m2} =	1,25	-
$N_{u;Rd}$ = a x 0,9 x A_{net} x f_u / γ_{m2} =	**780**	kN
Vloeien van brutodoorsnede		
$N_{pl;Rd}$ = a x A x f_y / γ_{m0} =	**902**	kN

Boutgegevens en -configuratie

Boutdiameter		**M24**		
Boutkwaliteit		**5.6**		
Fabricage draad		Gerold		
Aantal schuifvlakken per bout		2		
Boutdiameter	d_b =	24	mm	
Boutgatdiameter	d_0 =	26	mm	
Aantal boutrijen	n =	**4**		
Aantal dwarsrijen	m =	**1**		
Eindafstand	e_1 =	50	mm	Ok
Tussenafstand	p_1 =	75	mm	Ok
Tussenafstand haaks	p_2 =	0	mm	Ok
Eindafstand haaks	e_2 =	60	mm	Ok

Stuik strip

Factor f_{ub} / f_u =	2,13	
	1,00	
Eindbout $\alpha_d = e_1 / 3d_0$ =	0,64	
$k_1 = 2{,}8e_2 / d_0 - 1{,}7$ =	4,76	
$k_1 = 1{,}4p_2 / d_0 - 1{,}7$ =	2,50	
k_1 =	2,50	
$F_{b;Rd}$ = a x $k_1 \alpha_b f_u$ d t / γ_{M2} =	354	kN
Tussenbt $\alpha_d = p_1 / 3d_0 - {}^1/_4$ =	0,71	
$k_1 = 2{,}8e_2 / d_0 - 1{,}7$ =	4,76	
$k_1 = 1{,}4p_2 / d_0 - 1{,}7$ =	2,50	
k_1 =	2,50	
$F_{b;Rd}$ = a x $k_1 \alpha_b f_u$ d t / γ_{M2} =	393	kN

Afschuiving bouten

Afschuifdoorsnede door:		Schacht	
Factor boutkwaliteit	α_v =	0,60	-
Factor fabricage	α_{red} =	1,00	-
Oppervlakte	$A_{b;s}$ =	353	mm^2
Treksterkte	$f_{u;b}$ =	500	N/mm^2
$F_{v;Rd} = \alpha_v A_{b;s} f_{u;b} \alpha_{red;2} / \gamma_{M2}$ =		85	kN
Lengte verbinding:		225	mm
Reductie $\beta_l = 1 - (L_j - 15d) / 200d$		1,00	

Boutrij	$F_{v,Rd}$	Schuif-vlakken	Beta	Bouten $F_{v;Rd}$	Strip $F_{v,Rd}$	Schtsplt $F_{v,Rd}$	Min.	Toets
1	84,7	2	1,00	169,4	354,5	199,2	169,4	elastisch
2	84,7	2	1,00	169,4	393,5	199,2	169,4	elastisch
3	84,7	2	1,00	169,4	393,5	199,2	169,4	elastisch
4	84,7	2	1,00	169,4	393,5	179,4	169,4	elastisch
5	0,0	2	1,00	0,0	0,0	0,0	0,0	
6	0,0	2	1,00	0,0	0,0	0,0	0,0	
7	0,0	2	1,00	0,0	0,0	0,0	0,0	
8	0,0	2	1,00	0,0	0,0	0,0	0,0	

ΣF_{Rd} = 677,8 kN

Min. F_{Rd} = 169,4 kN

Resultaat boutverbinding

Elastisch $\frac{F_{v,Ed}}{\text{min. } F_{v,Rd}} = \frac{169{,}5}{169} = 1{,}00$ ***OK***

Plastisch $\frac{F_{t,Ed}}{\Sigma F_{Rd}} = \frac{678{,}0}{677{,}8 \times 1} = 1{,}00$ ***NVT***

Flensverbinding met strip 200x20 en **10M24-8.8** enkelsnedig

Capaciteit strip met boutverbinding

Volgens NEN-EN 1993-1-1+C2 en 1993-1-8 met NB

Stripgegevens

Breedte	b =	**200**	mm
Dikte	t =	**20**	mm
Dubbele of enkele strip:		**Enkel**	
Factor	a =	1	
Staalsoort		**S235**	
Schetsplaat			
Dikte schetsplaat	t_{pl} =	**24,3**	mm
Staalsoort		**S235**	
Treksterkte	f_u =	360	N/mm^2

Doorsnede strip

$A_{bruto} = b \times t$ =	4000	mm^2
$A_{net} = (b - nd_g)t$ =	2960	mm^2
f_u =	360	N/mm^2
γ_{m0} =	1,00	-
γ_{m2} =	1,25	-
$N_{u;Rd} = a \times 0{,}9 \times A_{net} \times f_u / \gamma_{m2}$ =	**767**	kN
Vloeien van brutodoorsnede		
$N_{pl;Rd} = a \times A \times f_y / \gamma_{m0}$ =	**940**	kN

Stuik strip

Factor f_{ub} / f_u =		3,40	
		1,00	
Eindbout	$\alpha_d = e_1 / 3d_0$ =	0,51	
	$k_1 = 2{,}8e_2 / d_0 - 1{,}7$ =	4,22	
	$k_1 = 1{,}4p_2 / d_0 - 1{,}7$ =	3,15	
	k_1 =	2,50	
$F_{b;Rd} = a \times k_1 \alpha_b f_u\, d\, t / \gamma_{M2}$ =		177	kN
Tussenbt	$\alpha_d = p_1 / 3d_0 - {}^1/_4$ =	1,67	
	$k_1 = 2{,}8e_2 / d_0 - 1{,}7$ =	4,22	
	$k_1 = 1{,}4p_2 / d_0 - 1{,}7$ =	3,15	
	k_1 =	2,50	
$F_{b;Rd} = a \times k_1 \alpha_b f_u\, d\, t / \gamma_{M2}$ =		346	kN

Belasting	$F_{t,Ed}$ =	**765**	kN
Resultaat			
Sterkte van de verbinding			
Boutverbinding:	UC. =	**0,59**	**OK**
Nettodoorsnede:	UC. =	**1,00**	**OK**

Vervormingscapaciteit

Voorwaarde: $N_{pl;Rd} / N_{u;Rd} < 1{,}00$ 1,23 => Nee

Boutgegevens en -configuratie

Boutdiameter		**M24**		
Boutkwaliteit		**8.8**		
Fabricage draad		Gerold		
Aantal schuifvlakken per bout		1		
Boutdiameter	d_b =	24	mm	
Boutgatdiameter	d_0 =	26	mm	
Aantal boutrijen	n =	**5**		
Aantal dwarsrijen	m =	**2**		
Eindafstand	e_1 =	40	mm	Ok
Tussenafstand	p_1 =	150	mm	Ok
Tussenafstand haaks	p_2 =	90	mm	Ok
Eindafstand haaks	e_2 =	55	mm	Ok

Afschuiving bouten

Afschuifdoorsnede door:		Schacht	
Factor boutkwaliteit	α_v =	0,60	-
Factor fabricage	α_{red} =	1,00	-
Oppervlakte	$A_{b;s}$ =	353	mm^2
Treksterkte	$f_{u;b}$ =	800	N/mm^2
$F_{v;Rd} = \alpha_v A_{b;s} f_{u;b} \alpha_{red;2} / \gamma_{M2}$ =		136	kN
Lengte verbinding:		600	mm
Reductie $\beta_l = 1 - (L_j - 15d) / 200d$		0,95	

Boutrij	$F_{v,Rd}$	Schuif-vlakken	Beta	Bouten $F_{v;Rd}$	Strip $F_{v,Rd}$	Schtsplt $F_{v,Rd}$	Min.	Toets
1	135,6	1	0,95	128,8	177,2	419,9	128,8	elastisch
2	135,6	1	0,95	128,8	345,6	419,9	128,8	elastisch
3	135,6	1	0,95	128,8	345,6	419,9	128,8	elastisch
4	135,6	1	0,95	128,8	345,6	419,9	128,8	elastisch
5	135,6	1	0,95	128,8	345,6	215,3	128,8	elastisch
6	0,0	1	0,95	0,0	0,0	0,0	0,0	
7	0,0	1	0,95	0,0	0,0	0,0	0,0	
8	0,0	1	0,95	0,0	0,0	0,0	0,0	

ΣF_{Rd} = 643,9 kN

Min. F_{Rd} = 128,8 kN

Resultaat boutverbinding

Elastisch $\dfrac{F_{v,Ed}}{\min. F_{v,Rd}} = \dfrac{76{,}5}{129} = 0{,}59$ ***OK***

Plastisch $\dfrac{F_{t,Ed}}{\Sigma F_{Rd}} = \dfrac{765{,}0}{643{,}9 \times 2} = 0{,}59$ ***NVT***

Lijfverbinding met strippen 120x16 en **4M24-8.8** dubbelsnedig

Capaciteit strip met boutverbinding

Volgens NEN-EN 1993-1-1+C2 en 1993-1-8 met NB

Stripgegevens

Breedte	b =	120	mm
Dikte	t =	16	mm
Dubbele of enkele strip:		Dubbel	
Factor	a =	2	
Staalsoort		S235	
Schetsplaat			
Dikte schetsplaat	t_{pl} =	16,2	mm
Staalsoort		S235	
Treksterkte	f_u =	360	N/mm^2

Belasting $F_{t,Ed}$ =	777	kN
Resultaat		
Sterkte van de verbinding		
Boutverbinding: UC. =	1,00	OK
Nettodoorsnede: UC. =	1,00	OK

Vervormingscapaciteit

Voorwaarde: $N_{pl;Rd}$ / $N_{u;Rd}$ < 1,00   1,16   => Nee

Doorsnede strip

A_{bruto} = b x t =	1920	mm^2
A_{net} = (b - nd_g)t =	1504	mm^2
f_u =	360	N/mm^2
γ_{m0} =	1,00	-
γ_{m2} =	1,25	-
$N_{u;Rd}$ = a x 0,9 x A_{net} x f_u / γ_{m2} =	**780**	kN
Vloeien van brutodoorsnede		
$N_{pl;Rd}$ = a x A x f_y / γ_{m0} =	**902**	kN

Boutgegevens en -configuratie

Boutdiameter		M24		
Boutkwaliteit		8.8		
Fabricage draad		Gerold		
Aantal schuifvlakken per bout		2		
Boutdiameter	d_b =	24	mm	
Boutgatdiameter	d_0 =	26	mm	
Aantal boutrijen	n =	4		
Aantal dwarsrijen	m =	1		
Eindafstand	e_1 =	50	mm	Ok
Tussenafstand	p_1 =	75	mm	Ok
Tussenafstand haaks	p_2 =	0	mm	Ok
Eindafstand haaks	e_2 =	60	mm	Ok

Stuik strip

Factor f_{ub} / f_u =	3,40	
	1,00	
Eindbout $\alpha_d = e_1 / 3d_0$ =	0,64	
$k_1 = 2{,}8e_2 / d_0 - 1{,}7$ =	4,76	
$k_1 = 1{,}4p_2 / d_0 - 1{,}7$ =	2,50	
k_1 =	2,50	
$F_{b;Rd}$ = a x $k_1 \alpha_b f_u$ d t / γ_{M2} =	354	kN
Tussenbt $\alpha_d = p_1 / 3d_0 - {}^1/_4$ =	0,71	
$k_1 = 2{,}8e_2 / d_0 - 1{,}7$ =	4,76	
$k_1 = 1{,}4p_2 / d_0 - 1{,}7$ =	2,50	
k_1 =	2,50	
$F_{b;Rd}$ = a x $k_1 \alpha_b f_u$ d t / γ_{M2} =	393	kN

Afschuiving bouten

Afschuifdoorsnede door:		Schacht	
Factor boutkwaliteit	α_v =	0,60	-
Factor fabricage	α_{red} =	1,00	-
Oppervlakte	$A_{b;s}$ =	353	mm^2
Treksterkte	$f_{u;b}$ =	800	N/mm^2
$F_{v;Rd} = \alpha_v A_{b;s} f_{u;b} \alpha_{red;2} / \gamma_{M2}$ =		136	kN
Lengte verbinding:		225	mm
Reductie β_l = 1 - (L_j - 15d) / 200d		1,00	

Boutrij	$F_{v,Rd}$	Schuif-vlakken	Beta	Bouten $F_{v;Rd}$	Strip $F_{v,Rd}$	Schtsplt $F_{v,Rd}$	Min.	Toets
1	135,6	2	1,00	271,1	354,5	199,2	199,2	plastisch
2	135,6	2	1,00	271,1	393,5	199,2	199,2	plastisch
3	135,6	2	1,00	271,1	393,5	199,2	199,2	plastisch
4	135,6	2	1,00	271,1	393,5	179,4	179,4	plastisch
5	0,0	2	1,00	0,0	0,0	0,0	0,0	
6	0,0	2	1,00	0,0	0,0	0,0	0,0	
7	0,0	2	1,00	0,0	0,0	0,0	0,0	
8	0,0	2	1,00	0,0	0,0	0,0	0,0	
						ΣF_{Rd} =	777,0	kN
						Min. F_{Rd} =	179,4	kN

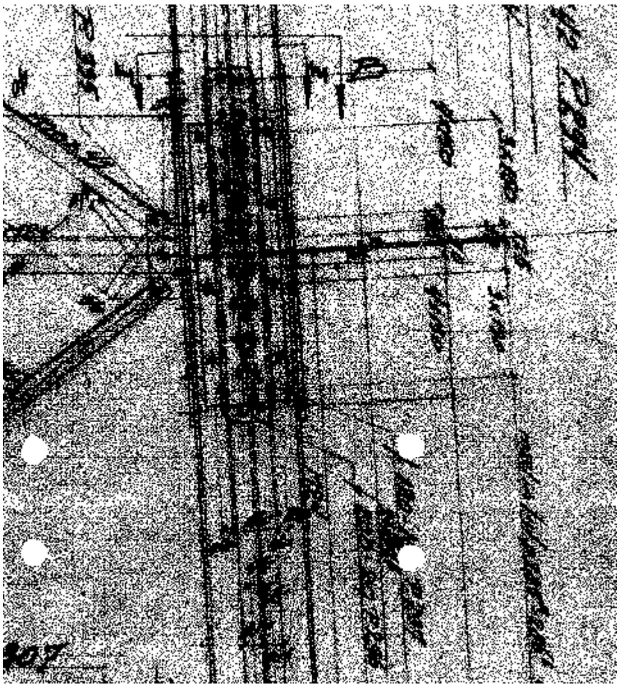
Resultaat boutverbinding

Elastisch $\frac{F_{v,Ed}}{\min. F_{v,Rd}} = \frac{194{,}3}{179} = 1{,}08$ ***Niet OK***

Plastisch $\frac{F_{t,Ed}}{\Sigma F_{Rd}} = \frac{777{,}0}{777{,}0 \times 1} = 1{,}00$ ***OK***

1.2 Bolted splice INP425 (B)

The splice joint is similar to the INP450 joint, plates and bolts are the same. The only difference is the thickness of the flange and web.



This means the gross section and net section will be slightly less, since the cross section of INP425 is smaller.

INP425 gross section:	26400 mm2
$F_{b,Rd}$ = 26400 x 235 =	6204 kN.

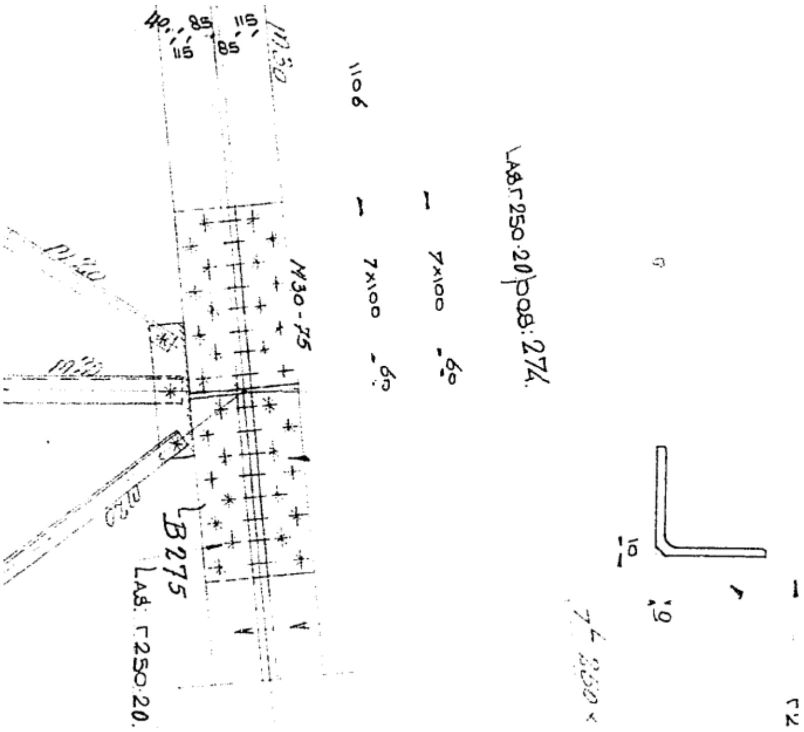
Net section of INP425 for tension

INP425 gross section:	26400 mm2
Holes in flange: -4 x 2 x 26 x 23 =	-4780 mm2
Holes in web: -4 x 26 x 15,3 =	-1591 mm2
Total:	20030 mm2
$F_{t,Rd}$ = 0,9 x 20029 x 360 / 1,25 =	5190 kN.

1.3 Calculations for XEA-profiles

The buckling strength of XEA-profiles is governed by torsional buckling. The resistance will be determined with a spreadsheet. The spreadsheet is also capable to check the connection, as a verification to the calculation included in PLS-TOWER. The resulting buckling capacity is used in PLS-TOWER model of the initial structure to check the main leg.

Splice connections are single lap with an angle that is connected to the back of the leg-profiles.



Figuur 3 Splice connection XEA 250x250x20

Five XEA-cross sections have been calculated with the spreadsheet.

- XEA250x250x24 connection (C) L_{buc} = 2,05 m (group 119B)
- XEA250x250x22 connection (C) L_{buc} = 2,05 m (group 118A)
- XEA250x250x20 connection (C) L_{buc} = 2,10 m (group 117A)
- XEA250x250x20 connection (D) L_{buc} = 2,10 m (group 117A)
- XEA200x200x20 connection (E) L_{buc} = 1,73 m (group 115A)

The loads for afkeurlevel of Figuur 1 have been used.

See results of spreadsheet summarized below: all of the XEA-members have insufficient torsional buckling capacity. This also holds for the L-profile directly above the last XEA-profile.

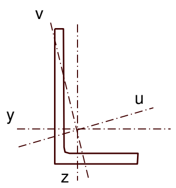
Section	Group	Lbuc	Connection	Load	Capacity	U.C.
XEA250x250x24	119B	2,1	C	5160	4720	1,09
XEA250x250x22	118A	2,05	C	4860	4253	1,14
XEA250x250x20	117A	2,1	C	4410	3707	1,19
XEA250x250x20	117A	2,1	D	4150	3707	1,12
XEA200x200x20	115A	1,73	E	3450	3180	1,08
L250x250x22	114A	1,73	F	2410	2323	1,04

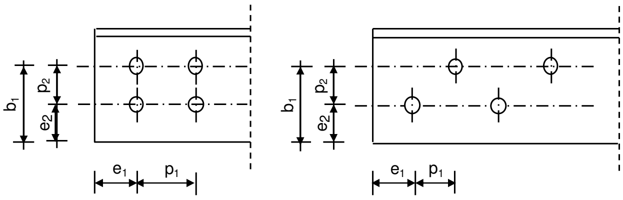
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	Group 119B	***Conclusion***			
Section	XEA 250x250x24	U.C.	(compression)	**1,09**	Not OK
		U.C.	(tension)	**0,85**	< 1,0 OK





Steel grade		**S235**	
Member loads			
Compressive force	N_{Ed} =	**5160**	kN
Tensile force		**-4128**	kN
Crossing diagonal loads			
Applicable:		**No**	
Min. tensile force diagonal 2		**1**	kN
Max. comp. force diagonal 1		**1**	kN
Position crossing diagonal y-axis		1,00	m
Construction loads			
Vertical construction load		**1,0**	kN
Member angle to horizontal		**0**	°
Bending around axis		y-axis	
Geometry			
System length y-axis	$L_{y,buc}$ =	2,10	m
System length z-axis	$L_{z,buc}$ =	2,10	m
System length v-axis	$L_{v,buc}$ =	2,10	m
System length x-axis	$L_{tk,buc}$ =	2,10	m
Member type		**Leg**	
Type bracing		Non staggered	
End conditions			
Begin		Continuous	
End		Continuous	
Restraint code TOWER		C4	

Bolted connection				
Bolt type		M30		
Bolt class		5.6		
Number of bolts per leg		9		(36 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ⊥	p_2 =	115	mm	Ok
End distance ⊥	e_2 =	60	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	230	mm	OK
	t_p =	24	mm	OK
	e_2 =	40	mm	OK
A		23036	mm^2	
G		184,3	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	$F_{v;b;Rd}$ =	134,6	kN	
Slenderness	λ_{max} = L / i	22	-	
Allowed:		120		OK
Bending due to vertical construction load				
$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =		0,79	kNm	
U.C. =		**0,00**		< 1,00 OK

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	2,10 m	0,21	1,00 l	0,21	0,99	1	5385	0,96
$L_{z,buc}$ =	2,10 m	0,21	1,00 l	0,21	0,99	1	5385	0,96
$L_{v,buc}$ =	2,10 m	0,23	0,10+0,80	0,23	0,99	1	5352	0,96
$L_{tk,buc}$ =	2,10 m	0,53			0,87	1	4722	1,09

Bolted connection

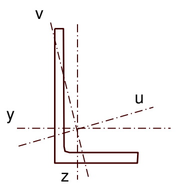
Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	5413	0,95		*Net section angle*	$F_{u;Rd}$ =	5147	0,80	
Cross section tie plate	$F_{u;Rd}$ =	5189	0,99		*Net section tie plate*	$F_{u;Rd}$ =	4902	0,84	
Shear strength	$F_{v;Rd}$ =	4847	1,06		*Block shear*	$F_{u;Rd}$ =	11445	0,36	
Bearing strength	$F_{b;Rd}$ =	14185	0,36		*Shear strength*	$F_{v;Rd}$ =	4847	0,85	
Combined effect	$F_{v;Rd}$ =	4847	1,06	elastisch	*Bearing strength*	$F_{b;Rd}$ =	13461	0,31	
					Combined effect	$F_{v;Rd}$ =	4847	0,85	elastisch

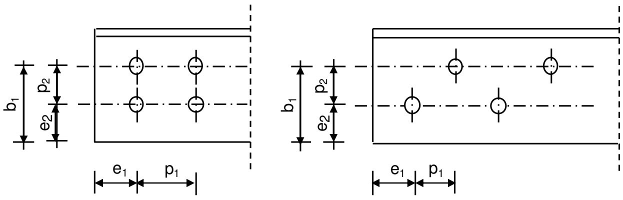
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 118B**	**Conclusion**		
Section	**XEA 250x250x22**	U.C. (compression)	**1,15**	**Not OK**
		U.C. (tension)	**0,82**	**< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force N_{Ed} = **4870** kN
Tensile force **-3896** kN

Crossing diagonal loads

Applicable: **No**
Min. tensile force diagonal 2 **1** kN
Max. comp. force diagonal 1 **1** kN
Position crossing diagonal y-axis 1,00 m

Construction loads

Vertical construction load **1,0** kN
Member angle to horizontal **0** °
Bending around axis y-axis

Geometry

System length y-axis $L_{y,buc}$ = 2,05 m
System length z-axis $L_{z,buc}$ = 2,05 m
System length v-axis $L_{v,buc}$ = 2,05 m
System length x-axis $L_{tk,buc}$ = 2,05 m
Member type **Leg**
Type bracing Non staggered

End conditions

Begin Continuous
End Continuous
Restraint code TOWER C4

Bolted connection

Bolt type M30
Bolt class 5.6
Number of bolts per leg 9 (36 totaal)
Shearplane through Thread
Boltpattern Zigzag
Boltpattern (leg-member only) Staggered

End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ⊥	p_2 =	115	mm	Ok
End distance ⊥	e_2 =	60	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	230	mm	OK
	t_p =	24	mm	OK
	e_2 =	40	mm	OK

A 21220 mm^2
G 169,8 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 $F_{v;b;Rd}$ = 134,6 kN

Slenderness $\lambda_{max} = L / i$ 21 -
Allowed: 120 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0,77 kNm
U.C. = **0,00** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	2,05 m	0,21	1,00 l	0,21	1,00	1	4967	0,98
$L_{z,buc}$ =	2,05 m	0,21	1,00 l	0,21	1,00	1	4967	0,98
$L_{v,buc}$ =	2,05 m	0,23	0,10+0,80	0,23	0,99	1	4940	0,99
$L_{tk,buc}$ =	2,05 m	0,57			0,85	1	4253	1,15

Bolted connection

Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	4987	0,98	
Cross section tie plate	$F_{u;Rd}$ =	5189	0,94	
Shear strength	$F_{v;Rd}$ =	4847	1,00	
Bearing strength	$F_{b;Rd}$ =	13003	0,37	
Combined effect	$F_{v;Rd}$ =	4847	1,00	elastisch

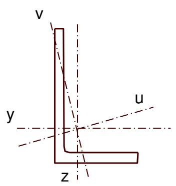
Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	4739	0,82	
Net section tie plate	$F_{u;Rd}$ =	4902	0,79	
Block shear	$F_{u;Rd}$ =	10491	0,37	
Shear strength	$F_{v;Rd}$ =	4847	0,80	
Bearing strength	$F_{b;Rd}$ =	12710	0,31	
Combined effect	$F_{v;Rd}$ =	4847	0,80	elastisch

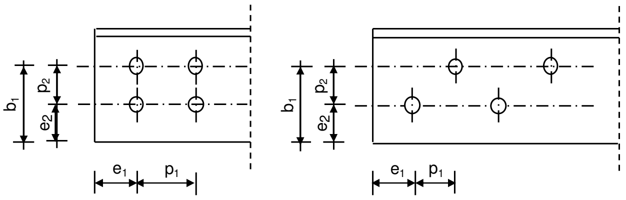
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 117A**	***Conclusion***			
Section	**XEA 250x250x20**	U.C.	(compression)	**1,19**	**Not OK**
		U.C.	(tension)	**0,81**	**< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force N_{Ed} = **4410** kN
Tensile force **-3528** kN

Crossing diagonal loads

Applicable: **No**
Min. tensile force diagonal 2 **1** kN
Max. comp. force diagonal 1 **1** kN
Position crossing diagonal y-axis 1,00 m

Construction loads

Vertical construction load **1,0** kN
Member angle to horizontal **0** °
Bending around axis y-axis

Geometry

System length y-axis $L_{y,buc}$ = 2,10 m
System length z-axis $L_{z,buc}$ = 2,10 m
System length v-axis $L_{v,buc}$ = 2,10 m
System length x-axis $L_{tk,buc}$ = 2,10 m
Member type **Leg**
Type bracing Non staggered

End conditions

Begin Continuous
End Continuous
Restraint code TOWER C4

Bolted connection

Bolt type M30
Bolt class 5.6
Number of bolts per leg 9 (36 totaal)
Shearplane through Thread
Boltpattern Zigzag
Boltpattern (leg-member only) Staggered

End distance e_1 = 60 mm Ok
Separation distance // p_1 = 100 mm Ok
Separation distance ⊥ p_2 = 115 mm Ok
End distance ⊥ e_2 = 60 mm Ok
Double strap or single strap Single
Tie plate b_p = 230 mm OK
t_p = 24 mm OK
e_2 = 40 mm OK

A 19388 mm^2
G 155,1 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 $F_{v;b;Rd}$ = 134,6 kN

Slenderness $\lambda_{max} = L / i$ 22 -
Allowed: 120 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0,79 kNm
U.C. = **0,00** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi Af_y / \gamma_{M1}$	
$L_{y,buc}$ =	2,10 m	0,22	1,00 l	0,22	0,99	1	4530	0,97
$L_{z,buc}$ =	2,10 m	0,22	1,00 l	0,22	0,99	1	4530	0,97
$L_{v,buc}$ =	2,10 m	0,23	0,10+0,80	0,23	0,99	1	4507	0,98
$L_{tk,buc}$ =	2,10 m	0,65			0,81	1	3707	1,19

Bolted connection

Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	4556	0,97	
Cross section tie plate	$F_{u;Rd}$ =	5189	0,85	
Shear strength	$F_{v;Rd}$ =	4847	0,91	
Bearing strength	$F_{b;Rd}$ =	11821	0,37	
Combined effect	$F_{v;Rd}$ =	4847	0,91	elastisch

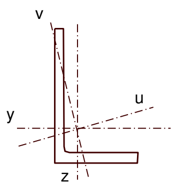
Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	4329	0,81	
Net section tie plate	$F_{u;Rd}$ =	4902	0,72	
Block shear	$F_{u;Rd}$ =	9538	0,37	
Shear strength	$F_{v;Rd}$ =	4847	0,73	
Bearing strength	$F_{b;Rd}$ =	11555	0,31	
Combined effect	$F_{v;Rd}$ =	4847	0,73	elastisch

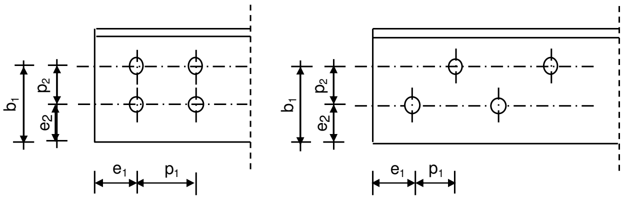
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 116B**	***Conclusion***			
Section	**XEA 250x250x20**	U.C.	(compression)	**1,12**	**Not OK**
		U.C.	(tension)	**0,77**	**< 1,0 OK**





Steel grade		**S235**	

Member loads

Compressive force	N_{Ed} =	**4150**	kN
Tensile force		**-3320**	kN

Crossing diagonal loads

Applicable:	**No**	
Min. tensile force diagonal 2	**1**	kN
Max. comp. force diagonal 1	**1**	kN
Position crossing diagonal y-axis	1,00	m

Construction loads

Vertical construction load	**1,0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	2,10	m
System length z-axis	$L_{z,buc}$ =	2,10	m
System length v-axis	$L_{v,buc}$ =	2,10	m
System length x-axis	$L_{tk,buc}$ =	2,10	m
Member type		**Leg**	
Type bracing		Non staggered	

End conditions

Begin	Continuous
End	Continuous
Restraint code TOWER	C4

Bolted connection

Bolt type		M30		
Bolt class		5.6		
Number of bolts per leg		8		(32 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ⊥	p_2 =	115	mm	Ok
End distance ⊥	e_2 =	60	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	230	mm	OK
	t_p =	24	mm	OK
	e_2 =	40	mm	OK
A		19388	mm^2	
G		155,1	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	$F_{v;b;Rd}$ =	134,6	kN	

Slenderness	λ_{max} = L / i	22	-	
Allowed:		120		**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =	0,79	kNm	
U.C. =	**0,00**		**< 1,00 OK**

Results stability

			$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	2,10	m	0,22	1,00 I	0,22	0,99	1	4530	0,92
$L_{z,buc}$ =	2,10	m	0,22	1,00 I	0,22	0,99	1	4530	0,92
$L_{v,buc}$ =	2,10	m	0,23	0,10+0,80	0,23	0,99	1	4507	0,92
$L_{tk,buc}$ =	2,10	m	0,65			0,81	1	3707	1,12

Bolted connection

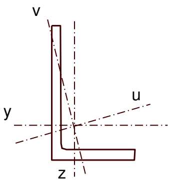
Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	4556	0,91		*Net section angle*	$F_{u;Rd}$ =	4329	0,77	
Cross section tie plate	$F_{u;Rd}$ =	5189	0,80		*Net section tie plate*	$F_{u;Rd}$ =	4902	0,68	
Shear strength	$F_{v;Rd}$ =	4308	0,96		*Block shear*	$F_{u;Rd}$ =	8452	0,39	
Bearing strength	$F_{b;Rd}$ =	10508	0,39		*Shear strength*	$F_{v;Rd}$ =	4308	0,77	
Combined effect	$F_{v;Rd}$ =	4308	0,96	elastisch	*Bearing strength*	$F_{b;Rd}$ =	10241	0,32	
					Combined effect	$F_{v;Rd}$ =	4308	0,77	elastisch

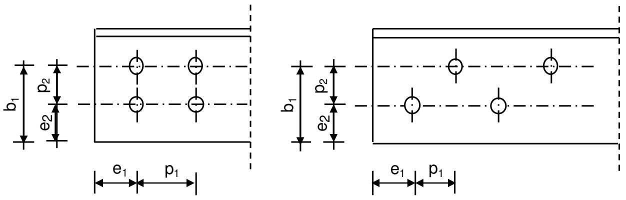
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 115A**	**Conclusion**			
Section	**XEA 200x200x20**	U.C.	(compression)	**1,08**	**Not OK**
		U.C.	(tension)	**0,85**	**< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**3450**	kN
Tensile force		**-2760**	kN

Crossing diagonal loads

Applicable:	**No**	
Min. tensile force diagonal 2	**1**	kN
Max. comp. force diagonal 1	**1**	kN
Position crossing diagonal y-axis	1,00	m

Construction loads

Vertical construction load	**1,0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	1,73	m
System length z-axis	$L_{z,buc}$ =	1,73	m
System length v-axis	$L_{v,buc}$ =	1,73	m
System length x-axis	$L_{tk,buc}$ =	1,73	m
Member type		**Leg**	
Type bracing		Non staggered	

End conditions

Begin	Continuous
End	Continuous
Restraint code TOWER	C4

Bolted connection

Bolt type		M30		
Bolt class		5.6		
Number of bolts per leg		7		(28 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ⊥	p_2 =	65	mm	Ok
End distance ⊥	e_2 =	60	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	190	mm	OK
	t_p =	20	mm	OK
	e_2 =	40	mm	OK

A		15350	mm^2
G		122,8	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	$F_{v;b;Rd}$ =	134,6	kN

Slenderness	λ_{max} = L / i	23	-
Allowed:		120	**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} = 0,65 kNm

U.C. = **0,01** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1,73 m	0,22	1,00 l	0,22	0,99	1	3580	0,96
$L_{z,buc}$ =	1,73 m	0,22	1,00 l	0,22	0,99	1	3580	0,96
$L_{v,buc}$ =	1,73 m	0,24	0,10+0,80	0,24	0,99	1	3556	0,97
$L_{tk,buc}$ =	1,73 m	0,51			0,88	1	3180	1,08

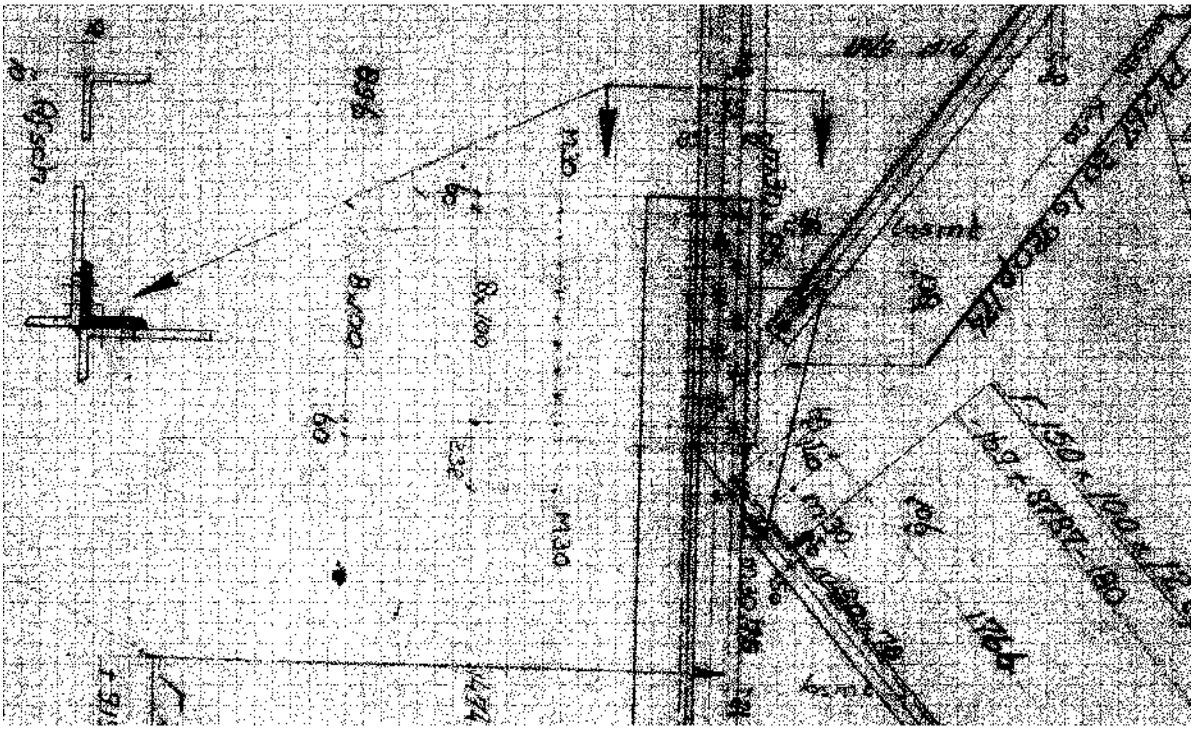
Bolted connection

Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	3607	0,96	
Cross section tie plate	$F_{u;Rd}$ =	3572	0,97	
Shear strength	$F_{v;Rd}$ =	3770	0,92	
Bearing strength	$F_{b;Rd}$ =	9194	0,38	
Combined effect	$F_{v;Rd}$ =	3770	0,92	elastisch

Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	3294	0,84	
Net section tie plate	$F_{u;Rd}$ =	3256	0,85	
Block shear	$F_{u;Rd}$ =	7149	0,39	
Shear strength	$F_{v;Rd}$ =	3770	0,73	
Bearing strength	$F_{b;Rd}$ =	8590	0,32	
Combined effect	$F_{v;Rd}$ =	3770	0,73	elastisch

1.4 Connection (F)

The transition from XEA to EA-section is given additional attention. The increased force from the diagonal is not transferred by the lapping connection, so the bolted connection in the XEA-member does not need to be checked here.



Figuur 4 Transition from XEA200x200x20 to EA 250x250x22

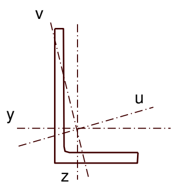
The result of the spreadsheet shows that buckling capacity is insufficient.

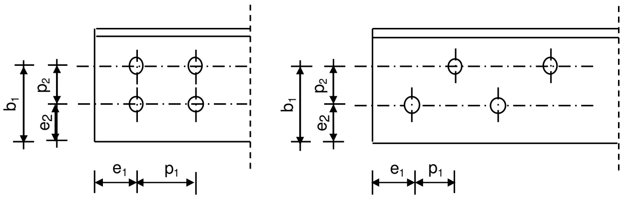
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 114A**	***Conclusion***			
Section	**L250x22**	U.C.	(compression)	**1,04**	**Not OK**
		U.C.	(tension)	**0,82**	**< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**2410**	kN
Tensile force		**-1928**	kN

Crossing diagonal loads

Applicable:	**No**	
Min. tensile force diagonal 2	**1**	kN
Max. comp. force diagonal 1	**1**	kN
Position crossing diagonal y-axis	1,00	m

Construction loads

Vertical construction load	**1,0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	1,73	m
System length z-axis	$L_{z,buc}$ =	1,73	m
System length v-axis	$L_{v,buc}$ =	1,73	m
System length x-axis	$L_{tk,buc}$ =	1,73	m
Member type		**Leg**	
Type bracing		Non staggered	

End conditions

Begin	Continuous
End	Continuous
Restraint code TOWER	C4

Bolted connection

Bolt type		M30		
Bolt class		5.6		
Number of bolts per leg		9		(18 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ⊥	p_2 =	65	mm	Ok
End distance ⊥	e_2 =	60	mm	Ok
Double strap or single strap		Single		
Tie plate	b_p =	240	mm	OK
	t_p =	22	mm	OK
	e_2 =	40	mm	OK

A		10559	mm^2
G		84,5	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	$F_{v;b;Rd}$ =	134,6	kN

Slenderness $\lambda_{max} = L / i$ 35 -

Allowed: 120 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0,65 kNm

U.C. = **0,01** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1,73 m	0,24	1,00 l	0,24	0,99	1	2446	0,99
$L_{z,buc}$ =	1,73 m	0,24	1,00 l	0,24	0,99	1	2446	0,99
$L_{v,buc}$ =	1,73 m	0,37	0,10+0,80	0,37	0,94	1	2323	1,04
$L_{tk,buc}$ =	- m	-			-	-	-	0,00

Bolted connection

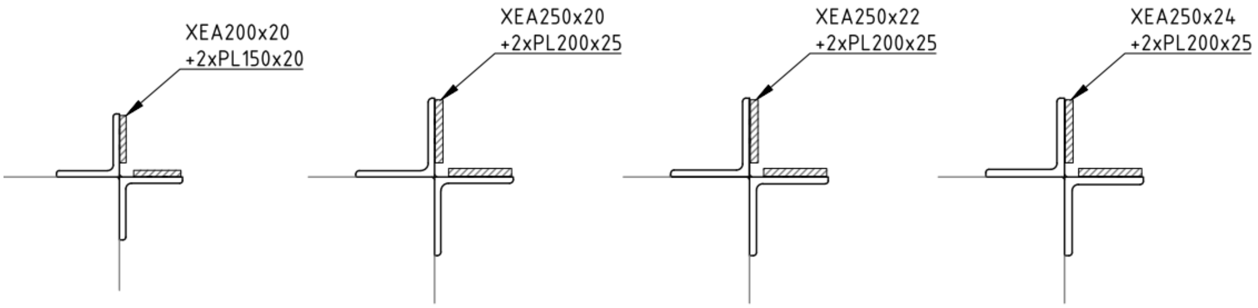
Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	2481	0,97	
Cross section tie plate	$F_{u;Rd}$ =	2482	0,97	
Shear strength	$F_{v;Rd}$ =	2424	0,99	
Bearing strength	$F_{b;Rd}$ =	6502	0,37	
Combined effect	$F_{v;Rd}$ =	2424	0,99	elastisch

Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	2361	0,82	
Net section tie plate	$F_{u;Rd}$ =	2361	0,82	
Block shear	$F_{u;Rd}$ =	4929	0,39	
Shear strength	$F_{v;Rd}$ =	2424	0,80	
Bearing strength	$F_{b;Rd}$ =	6169	0,31	
Combined effect	$F_{v;Rd}$ =	2424	0,80	elastisch

2 REINFORCED SECTIONS

2.1 XEA-sections

The XEA-sections have too high over-utilisations to overcome by adding additional redundants. The solution that will be adopted is to retrofit the main leg with additional plates.



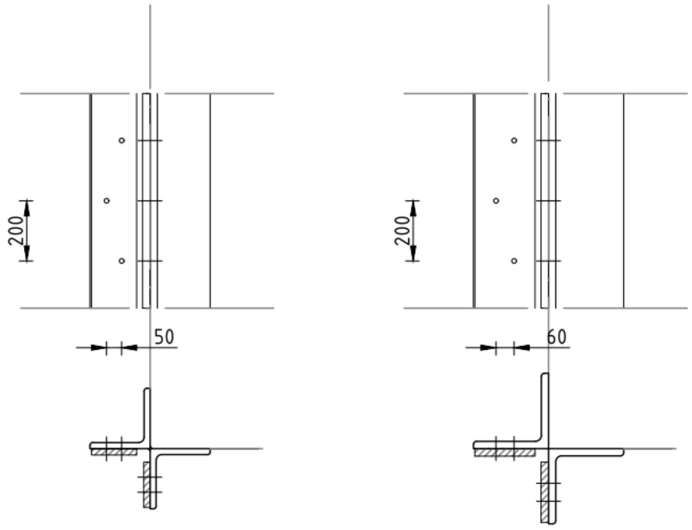
Figuur 5 Reinforced sections

For reason of continuity of forces, the entire height of the structure with XEA-sections needs to be modified with plates, except the top panel with XEA200x20 section.

The modified members have to fulfill the load level for verbouw 50 yrs.

With the same approach as before for the non-strengthened section, a composed section was chosen and calculated to have sufficient capacity for verbouw. All material is assumed to be S235, since it is coupled with existing material S235.

The section properties of the modified section have been determined with AxisVM. Refer to Appendix F. To increase the torsional moment of inertia, the plates need to be connected with bolt rows in a zig-zag pattern. To prevent corrosion, the bolt spacing should not be more than 200 mm.



Figuur 6 principle of continuous bolted connection, left XEA200, right for XEA250

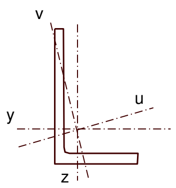
The spreadsheet output is provided after this page. Detailed study of the connections is not included since it is beyond the scope of this report.

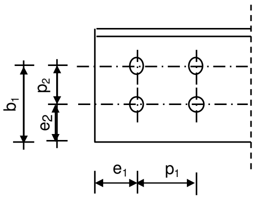
Angle check

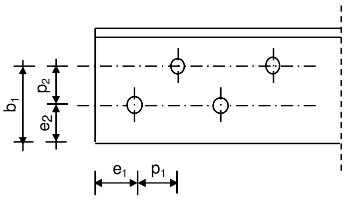
NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 119B**	**Conclusion**			
Section	**XEA 250x24+PL200x25 bu**	U.C.	(compression)	**1,00**	**< 1,0 OK**
		U.C.	(tension)	**0,73**	**< 1,0 OK**







Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**7030**	kN
Tensile force		**-5624**	kN

Crossing diagonal loads

Applicable:	**No**	
Min. tensile force diagonal 2	**1**	kN
Max. comp. force diagonal 1	**1**	kN
Position crossing diagonal y-axis	1,00	m

Construction loads

Vertical construction load	**1,0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	4,10	m
System length z-axis	$L_{z,buc}$ =	4,10	m
System length v-axis	$L_{v,buc}$ =	4,10	m
System length x-axis	$L_{tk,buc}$ =	2,05	m
Member type		**Leg**	
Type bracing		Non staggered	

End conditions

Begin	Continuous
End	Continuous
Restraint code TOWER	C4

Bolted connection

Bolt type		M30		
Bolt class		8.8		
Number of bolts per leg		9		(36 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ∣	p_2 =	115	mm	Ok
End distance ┘	e_2 =	60	mm	Ok
Double strap or single strap		Double		
Tie plate	b_p =	230	mm	OK
	t_p =	24	mm	OK
	e_2 =	40	mm	OK

A		32998	mm^2
G		264,0	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	$F_{v;b;Rd}$ =	215,4	kN

Slenderness λ_{max} = L / i 42 -

Allowed: 120 **OK**

Bending due to vertical construction load

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 1,54 kNm

U.C. = **0,00** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	4,10 m	0,42	1,00 l	0,42	0,92	1	7115	0,99
$L_{z,buc}$ =	4,10 m	0,42	1,00 l	0,42	0,92	1	7115	0,99
$L_{v,buc}$ =	4,10 m	0,44	0,10+0,80	0,44	0,91	1	7046	1,00
$L_{tk,buc}$ =	2,05 m	0,42			0,92	1	7129	0,99

Bolted connection

Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	7755	0,91	
Cross section tie plate	$F_{u;Rd}$ =	10378	0,68	
Shear strength	$F_{v;Rd}$ =	15511	0,45	
Bearing strength	$F_{b;Rd}$ =	14185	0,50	
Combined effect	$F_{v;Rd}$ =	14185	0,50	plastisch

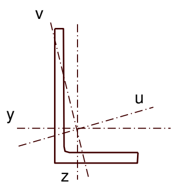
Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	7729	0,73	
Net section tie plate	$F_{u;Rd}$ =	9804	0,57	
Block shear	$F_{u;Rd}$ =	11445	0,49	
Shear strength	$F_{v;Rd}$ =	15511	0,36	
Bearing strength	$F_{b;Rd}$ =	13866	0,41	
Combined effect	$F_{v;Rd}$ =	13866	0,41	plastisch

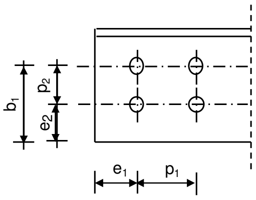
Angle check

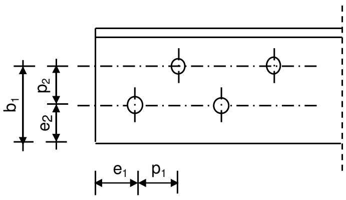
NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 118B**	***Conclusion***			
Section	**XEA 250x22+PL200x25 bu**	U.C.	(compression)	**0,99**	**< 1,0 OK**
		U.C.	(tension)	**0,72**	**< 1,0 OK**







Steel grade		**S235**	
Member loads			
Compressive force	N_{Ed} =	**6615**	kN
Tensile force		**-5292**	kN
Crossing diagonal loads			
Applicable:		**No**	
Min. tensile force diagonal 2		**1**	kN
Max. comp. force diagonal 1		**1**	kN
Position crossing diagonal y-axis		1,00	m
Construction loads			
Vertical construction load		**1,0**	kN
Member angle to horizontal		**0**	°
Bending around axis		y-axis	
Geometry			
System length y-axis	$L_{y,buc}$ =	4,10	m
System length z-axis	$L_{z,buc}$ =	4,10	m
System length v-axis	$L_{v,buc}$ =	4,10	m
System length x-axis	$L_{tk,buc}$ =	2,05	m
Member type		**Leg**	
Type bracing		Non staggered	
End conditions			
Begin		Continuous	
End		Continuous	
Restraint code TOWER		C4	

Bolted connection				
Bolt type		M30		
Bolt class		8.8		
Number of bolts per leg		9		(36 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ⊥	p_2 =	115	mm	Ok
End distance ⊥	e_2 =	60	mm	Ok
Double strap or single strap		Double		
Tie plate	b_p =	230	mm	OK
	t_p =	22	mm	OK
	e_2 =	40	mm	OK
A		31182	mm^2	
G		249,5	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	$F_{v;b;Rd}$ =	215,4	kN	
Slenderness	λ_{max} = L / i	42	-	
Allowed:		120		**OK**
Bending due to vertical construction load				
$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =		1,54	kNm	
U.C. =		**0,00**	**< 1,00 OK**	

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	4,10 m	0,42	1,00 l	0,42	0,92	1	6718	0,98
$L_{z,buc}$ =	4,10 m	0,42	1,00 l	0,42	0,92	1	6718	0,98
$L_{v,buc}$ =	4,10 m	0,44	0,10+0,80	0,44	0,91	1	6657	0,99
$L_{tk,buc}$ =	2,05 m	0,43			0,91	1	6684	0,99

Bolted connection

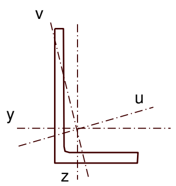
Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	7328	0,90	
Cross section tie plate	$F_{u;Rd}$ =	9513	0,70	
Shear strength	$F_{v;Rd}$ =	15511	0,43	
Bearing strength	$F_{b;Rd}$ =	13003	0,51	
Combined effect	$F_{v;Rd}$ =	13003	0,51	plastisch

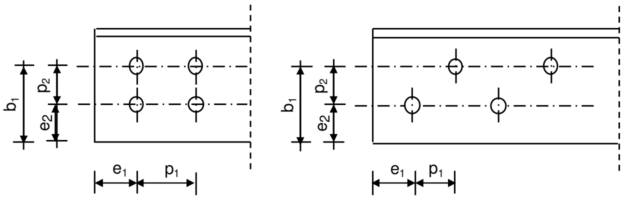
Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	7321	0,72	
Net section tie plate	$F_{u;Rd}$ =	8987	0,59	
Block shear	$F_{u;Rd}$ =	10491	0,50	
Shear strength	$F_{v;Rd}$ =	15511	0,34	
Bearing strength	$F_{b;Rd}$ =	12710	0,42	
Combined effect	$F_{v;Rd}$ =	12710	0,42	plastisch

Angle check NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 117B**	***Conclusion***		
Section	**XEA 250x20+PL200x25 bu**	U.C. (compression)	**0,96**	**< 1,0 OK**
		U.C. (tension)	**0,69**	**< 1,0 OK**





Steel grade **S235**

Member loads

Compressive force	N_{Ed} =	**6010**	kN
Tensile force		**-4808**	kN

Crossing diagonal loads

Applicable:	**No**	
Min. tensile force diagonal 2	**1**	kN
Max. comp. force diagonal 1	**1**	kN
Position crossing diagonal y-axis	1,00	m

Construction loads

Vertical construction load	**1,0**	kN
Member angle to horizontal	**0**	°
Bending around axis	y-axis	

Geometry

System length y-axis	$L_{y,buc}$ =	4,20	m
System length z-axis	$L_{z,buc}$ =	4,20	m
System length v-axis	$L_{v,buc}$ =	4,20	m
System length x-axis	$L_{tk,buc}$ =	2,10	m
Member type		**Leg**	
Type bracing		Non staggered	

End conditions

Begin	Continuous
End	Continuous
Restraint code TOWER	C4

Bolted connection

Bolt type		M30		
Bolt class		8.8		
Number of bolts per leg		9		(36 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ⊥	p_2 =	115	mm	Ok
End distance ⊥	e_2 =	60	mm	Ok
Double strap or single strap		Double		
Tie plate	b_p =	230	mm	OK
	t_p =	22	mm	OK
	e_2 =	40	mm	OK

A		29388	mm^2
G		235,1	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	$F_{v;b;Rd}$ =	215,4	kN

Slenderness	λ_{max} = L / i	43	-
Allowed:		120	**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =	1,58	kNm
U.C. =	**0,01**	**< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	4,20 m	0,44	1,00 l	0,44	0,91	1	6294	0,95
$L_{z,buc}$ =	4,20 m	0,44	1,00 l	0,44	0,91	1	6294	0,95
$L_{v,buc}$ =	4,20 m	0,46	0,10+0,80	0,46	0,90	1	6238	0,96
$L_{tk,buc}$ =	2,10 m	0,45			0,91	1	6252	0,96

Bolted connection

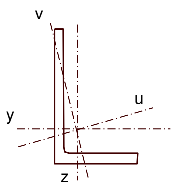
Compression		F_{Rd} (kN)	U.C.		Tension		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	6906	0,87		*Net section angle*	$F_{u;Rd}$ =	6921	0,69	
Cross section tie plate	$F_{u;Rd}$ =	9513	0,63		*Net section tie plate*	$F_{u;Rd}$ =	8987	0,53	
Shear strength	$F_{v;Rd}$ =	15511	0,39		*Block shear*	$F_{u;Rd}$ =	9538	0,50	
Bearing strength	$F_{b;Rd}$ =	11821	0,51		*Shear strength*	$F_{v;Rd}$ =	15511	0,31	
Combined effect	$F_{v;Rd}$ =	11821	0,51	plastisch	*Bearing strength*	$F_{b;Rd}$ =	11555	0,42	
					Combined effect	$F_{v;Rd}$ =	11555	0,42	plastisch

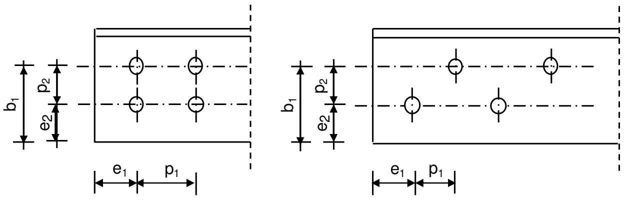
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	Group 115A	***Conclusion***			
Section	XEA 200x20+PL150x20 bu	U.C.	(compression)	**1,00**	**< 1,0 OK**
		U.C.	(tension)	**0,77**	**< 1,0 OK**





Steel grade		**S235**	
Member loads			
Compressive force	N_{Ed} =	**4680**	kN
Tensile force		**-3744**	kN
Crossing diagonal loads			
Applicable:		**No**	
Min. tensile force diagonal 2		**1**	kN
Max. comp. force diagonal 1		**1**	kN
Position crossing diagonal y-axis		1,00	m
Construction loads			
Vertical construction load		**1,0**	kN
Member angle to horizontal		**0**	°
Bending around axis		y-axis	
Geometry			
System length y-axis	$L_{y,buc}$ =	1,73	m
System length z-axis	$L_{z,buc}$ =	1,73	m
System length v-axis	$L_{v,buc}$ =	1,73	m
System length x-axis	$L_{tk,buc}$ =	1,73	m
Member type		**Leg**	
Type bracing		Non staggered	
End conditions			
Begin		Continuous	
End		Continuous	
Restraint code TOWER		C4	

Bolted connection				
Bolt type		M30		
Bolt class		8.8		
Number of bolts per leg		7		(28 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ∣	p_2 =	65	mm	Ok
End distance ┘	e_2 =	60	mm	Ok
Double strap or single strap		Double		
Tie plate	b_p =	230	mm	OK
	t_p =	22	mm	OK
	e_2 =	40	mm	OK
A		21397	mm^2	
G		171,2	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	$F_{v;b;Rd}$ =	215,4	kN	
Slenderness	λ_{max} = L / i	22	-	
Allowed:		120		**OK**
Bending due to vertical construction load				
$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} =		0,65	kNm	
U.C. =		**0,00**	**< 1,00 OK**	

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	1,73 m	0,22	1,00 l	0,22	0,99	1	4991	0,94
$L_{z,buc}$ =	1,73 m	0,22	1,00 l	0,22	0,99	1	4991	0,94
$L_{v,buc}$ =	1,73 m	0,23	0,10+0,80	0,23	0,99	1	4969	0,94
$L_{tk,buc}$ =	1,73 m	0,40			0,93	1	4658	1,00

Bolted connection

Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	5028	0,93	
Cross section tie plate	$F_{u;Rd}$ =	9513	0,49	
Shear strength	$F_{v;Rd}$ =	12064	0,39	
Bearing strength	$F_{b;Rd}$ =	9194	0,51	
Combined effect	$F_{v;Rd}$ =	9194	0,51	plastisch

Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	4862	0,77	
Net section tie plate	$F_{u;Rd}$ =	8987	0,42	
Block shear	$F_{u;Rd}$ =	7149	0,52	
Shear strength	$F_{v;Rd}$ =	12064	0,31	
Bearing strength	$F_{b;Rd}$ =	8928	0,42	
Combined effect	$F_{v;Rd}$ =	8928	0,42	plastisch

The capacity of the L250x250x22 section of group 114A can be increased by adding redundants, one per panel. This is seen in the spreadsheet output below. The load level is for afkeurlevel.

Results of the calculations have been summarized in the table below.

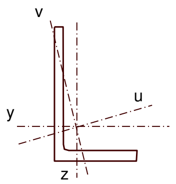
Section	Group	Lbuc	Connection	Load	Capacity	U.C.
XEA250x250x24	119B	4,1	C	7030	7129	0,99
XEA250x250x22	118A	4,1	C	6615	6683	0,99
XEA250x250x20	117A	4,2	C	6010	6252	0,96
XEA200x200x20	115A	1,73	E	4680	4658	1,00
L250x250x22	114A	0,85	F	2410	2481	0,97

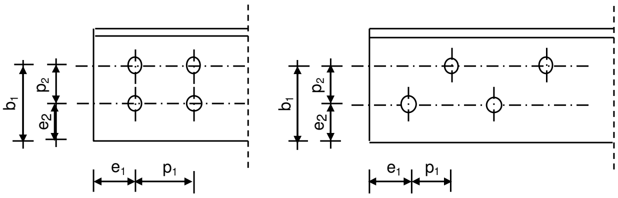
Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-03-29
Auteur: TBR
Versie: 2,9

Member name	**Group 114A**	**Conclusion**	
Section	**L250x22**	U.C. (compression)	**0,97** **< 1,0 OK**
		U.C. (tension)	**0,82** **< 1,0 OK**





Steel grade		**S235**	
Member loads			
Compressive force	N_{Ed} =	**2410**	kN
Tensile force		**-1928**	kN
Crossing diagonal loads			
Applicable:		**No**	
Min. tensile force diagonal 2		**1**	kN
Max. comp. force diagonal 1		**1**	kN
Position crossing diagonal y-axis		1,00	m
Construction loads			
Vertical construction load		**1,0**	kN
Member angle to horizontal		**0**	°
Bending around axis		y-axis	
Geometry			
System length y-axis	$L_{y,buc}$ =	0,85	m
System length z-axis	$L_{z,buc}$ =	0,85	m
System length v-axis	$L_{v,buc}$ =	0,85	m
System length x-asis	$L_{tk,buc}$ =	0,85	m
Member type		**Leg**	
Type bracing		Non staggered	
End conditions			
Begin		Continuous	
End		Continuous	
Restraint code TOWER		C4	

Bolted connection

Bolt type		M30		
Bolt class		8.8		
Number of bolts per leg		9		(18 totaal)
Shearplane through		Thread		
Boltpattern		Zigzag		
Boltpattern (leg-member only)		Staggered		
End distance	e_1 =	60	mm	Ok
Separation distance //	p_1 =	100	mm	Ok
Separation distance ∣	p_2 =	65	mm	Ok
End distance ˩	e_2 =	60	mm	Ok
Double strap or single strap		Double		
Tie plate	b_p =	230	mm	OK
	t_p =	22	mm	OK
	e_2 =	40	mm	OK
A		10559	mm^2	
G		84,5	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	$F_{v;b;Rd}$ =	215,4	kN	
Slenderness	λ_{max} = L / i	17	-	
Allowed:		120		**OK**

Bending due to vertical construction load

$M_{y,Ed}$ = 1/4 F_{Ed} L_{pr} = 0,32 kNm

U.C. = **0,00** **< 1,00 OK**

Results stability

		$\lambda_{eff,rel}$	λ_{eff}	$\lambda_{eff,mod}$	χ_{buc}	η	$N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$	
$L_{y,buc}$ =	0,85 m	0,12	1,00 l	0,12	1,00	1	2481	0,97
$L_{z,buc}$ =	0,85 m	0,12	1,00 l	0,12	1,00	1	2481	0,97
$L_{v,buc}$ =	0,85 m	0,18	0,10+0,80	0,18	1,00	1	2481	0,97
$L_{tk,buc}$ =	- m	-			-	-	-	0,00

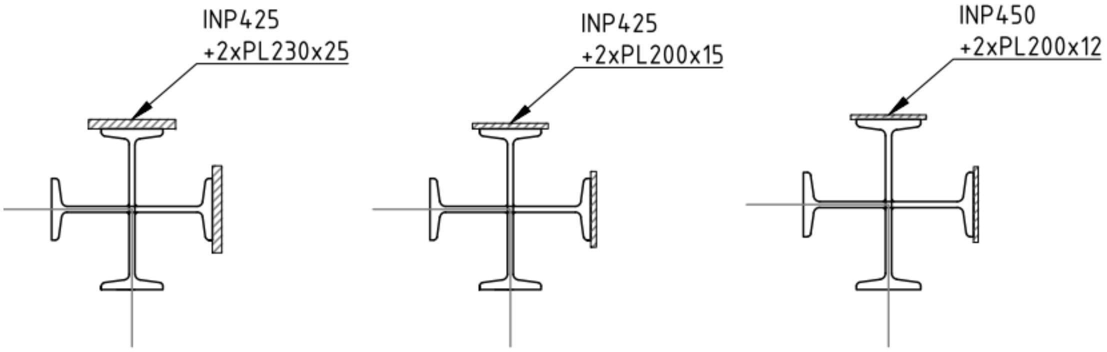
Bolted connection

Compression		F_{Rd} (kN)	U.C.	
Cross section angle	$F_{u;Rd}$ =	2481	0,97	
Cross section tie plate	$F_{u;Rd}$ =	4756	0,51	
Shear strength	$F_{v;Rd}$ =	7755	0,31	
Bearing strength	$F_{b;Rd}$ =	6502	0,37	
Combined effect	$F_{v;Rd}$ =	6502	0,37	plastisch

Tension		F_{Rd} (kN)	U.C.	
Net section angle	$F_{u;Rd}$ =	2361	0,82	
Net section tie plate	$F_{u;Rd}$ =	4493	0,43	
Block shear	$F_{u;Rd}$ =	4929	0,39	
Shear strength	$F_{v;Rd}$ =	7755	0,25	
Bearing strength	$F_{b;Rd}$ =	6355	0,30	
Combined effect	$F_{v;Rd}$ =	6355	0,30	plastisch

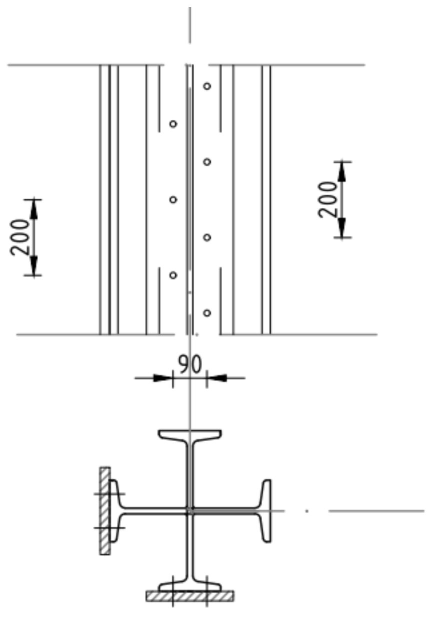
2.2 Reinforced section of INP425

The most heavily loaded part of the structure with section INP425 in the main leg (group 121B) has to be reinforced by adding plate material, see appendix F. In this section the check of the capacity is performed. Although the members directly below and above the INP425 member do not show overutilization, they have to be adjusted as well, to ascertain the continuous transfer of forces from non-reinforced to reinforced sections. These cross sections can be lighter since they do not have to comply to verbouwlevel.



Figuur 7 Reinforced INP425 sections

The load in the INP425 section of interest here is for verbouwlevel. The cross section properties of the section have been determined with AxisVM. The capacity is calculated below. The section is sufficient for verbouwlevel.



Figuur 8 Connection of plates to INP-members

Similarly to XEA-sections, the plates to INP-members should be connected with bolts with maximum spacing of 200 mm. Since two bolt rows exist, in both rows the distance should be less than 200 mm.

Onderwerp	Randstijl S+95	*Toetsing*		
Profiel	INP425x2+2PL230x25	U.C.	**0,99**	Voldoet

Normaalkracht

$N_{c;s;d}$ = **8310,0** kN

Staalsoort	**S235**	
Doorsnedeklasse:	**1**	Geldig
Gewicht	2,98	kN/m

Doorsnedegrootheden

I_y	I_z	I_v	A
10^4 mm^4	10^4 mm^4	10^4 mm^4	mm^4
65980	65980	61570	37974

I_t	I_{wa}
10^4 mm^4	mm^4
1499	3,32E+12

Geometrie

$l_{y;buc}$ =	2,50	m
$l_{z;buc}$ =	2,50	m
$l_{v;buc}$ =	2,50	m
l_{tk} =	2,50	m
Steun 1	Gaffel	
Steun 2	Gaffel	
Classificatie	Geschoord	

Doorsnedecapaciteit

$N_{pl;d} = A \times f_{y;d}$ = 8924 kN

Knikstabiliteit y-as

$\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$	0,20	-	
$\chi_{y;buc}$ = (kromme b)	1,00	-	
$N_{b,Rd} = \chi A f_y$ =	8918	kN	
U.C.	**0,93**	Voldoet	

Knikstabiliteit z-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,20	-	
$\chi_{z;buc}$ = (kromme b)	1,00	-	
$N_{b,Rd} = \chi A f_y$ =	8918	kN	
U.C.	**0,93**	Voldoet	

Knikstabiliteit v-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,21	-	
$\lambda_{eff} = 0{,}10+0{,}80\ \lambda =$	0,27	-	
$\chi_{z;buc}$ = (kromme b)	0,98	-	
$N_{b,Rd} = \chi A f_y$ =	8710	kN	
U.C.	**0,95**	Voldoet	

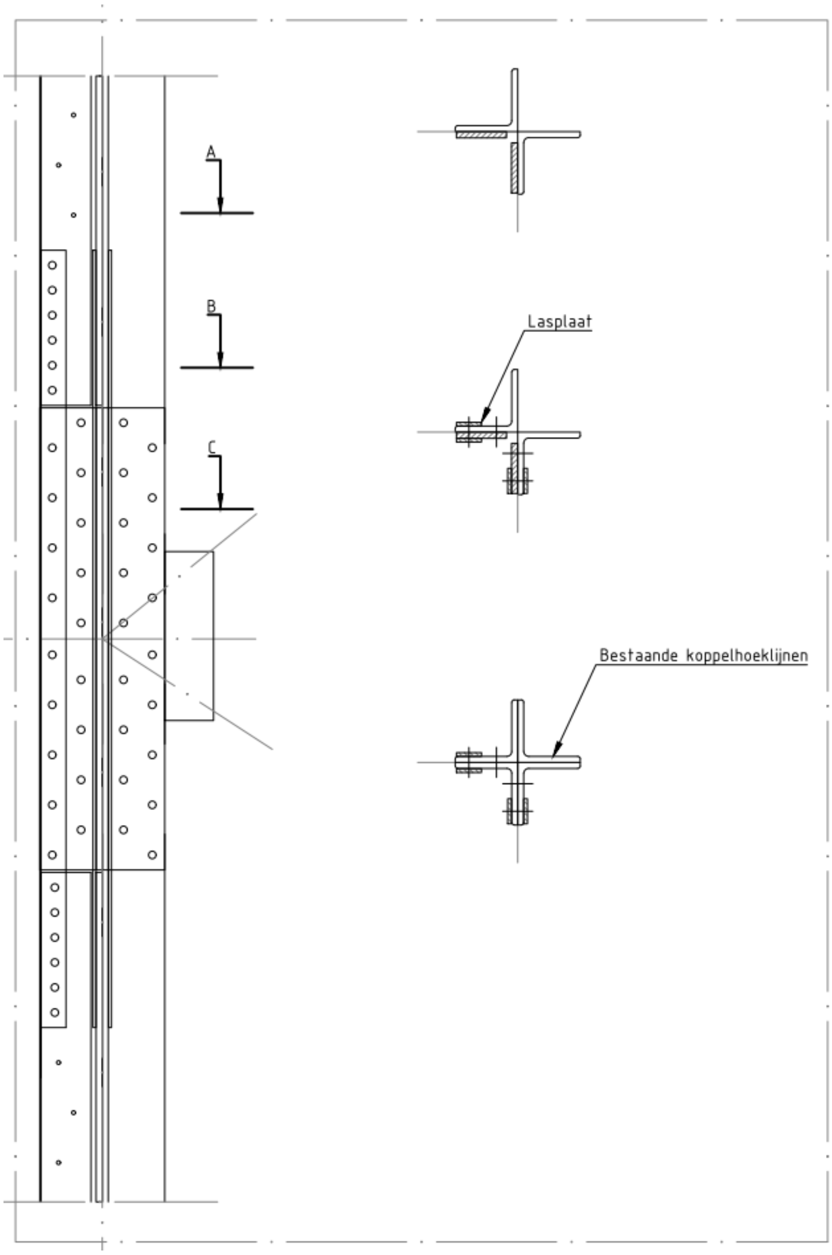
Torsieknikstabiliteit

$i_0^2 = i_y^2 + i_z^2 + y_0^2$ =	34750	mm^2	
$\beta = 1 - y_0^2/i_0^2$ =	1,000	-	
$F_{y;E} = \pi^2 EI_y / l_y^2$ =	218802	kN	
$F_{t;E} = 1/i_0^2(G_d I_t + \pi^2 EI_{wa}/l_{t;buc})$ =	66658	kN	
$F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E})+\sqrt{(F_{y;E}+F_{t;E})^2 - 4\beta^2 F_{y;E}F_{t;E}})$			
$F_{tk;E}$ =	66658	kN	
$\lambda_{tk;rel} = \sqrt{N_{Rd} / F_{tk;E}}$ =	0,37	-	
$\chi_{z;buc}$ = (kromme b)	0,939	-	
$N_{b,Rd} = \chi A f_y$ =	8383	kN	
U.C.	**0,99**	Voldoet	

2.3 Detail principles of the reinforced section

In this section explanation is given to the design principles of the retrofitted sections.

2.3.1 Splice joint XEA-sections



Figuur 9 Splice joint of XEA-profile

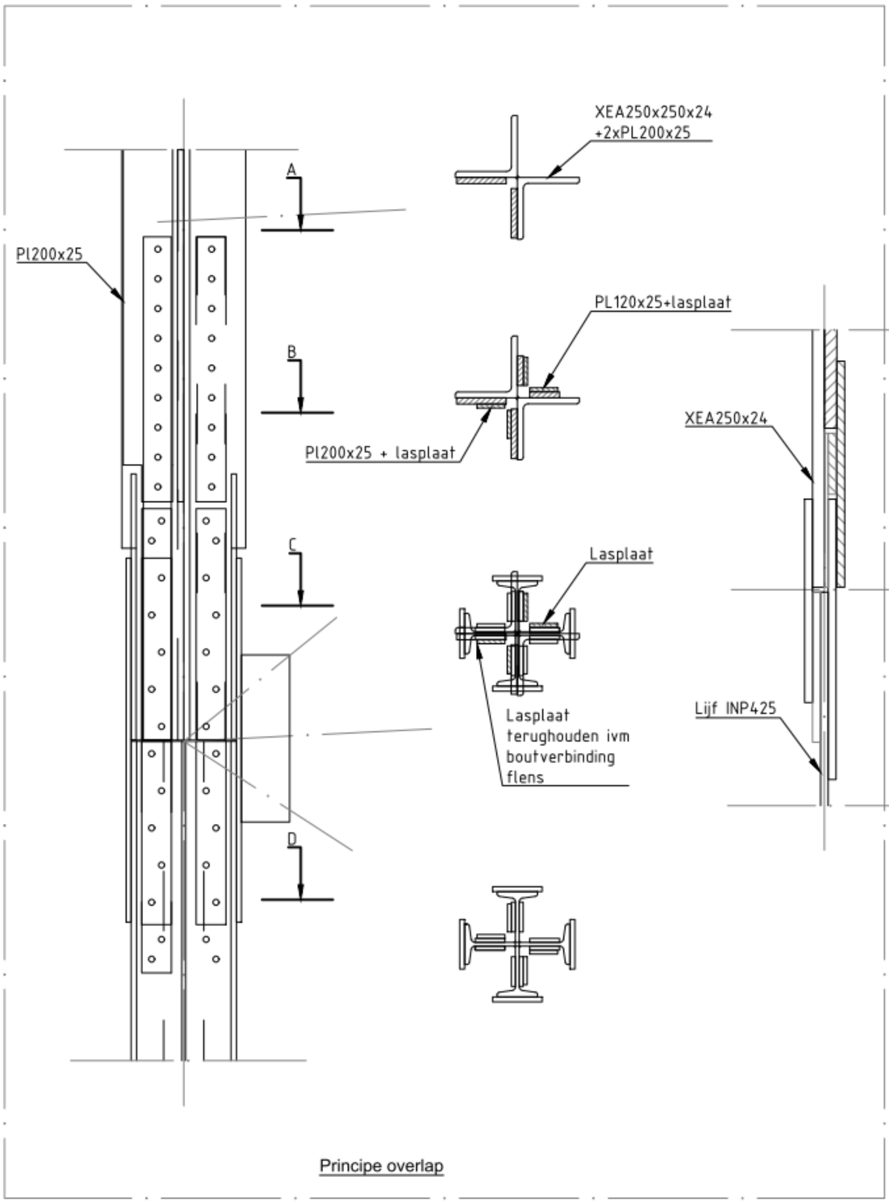
The plates in the XEA-retrofitted section should be coupled at the locations of the already present joints. Since the joints are equipped with M30-bolts, it is not possible to overlap both bolt rows with added lap plates of 25 mm thickness. It is proposed that the outer row is used with a double shear connection. In the connection the S355 strength can be used instead of the S235 in the check for stability. This allows to reduce the required cross section in the plate pairs. The center of gravity of the lap joint should coincide with center of gravity of the main section. This can be worked out further in detailing phase. The number of bolts should have more than adequate reserve to prevent slippage between plates as much as possible, since pre-tensioning is not possible.

2.3.2 Transition of XEA- to INP-section

At the height of 53,7 m the main leg changes to the INP-section. The INP does not need to be reinforced whereas the XEA-section on top of it is reinforced. This would cause an eccentric introduction of force on the INP-section if no measures would be taken to prevent this.

To solve this, the XEA-section is over the last 2 m before the INP starts, additionally reinforced at the otherwise unreinforced two inner flanges of the XEA-section. This results in a more centric distribution of force at the transition to INP-section. The additional plates will be coupled with plates that overlap and connect to the double shear lap plates of the web.

The joint itself does not have to fulfill the verbouw load level, which allows to reduce the cross section of the plates to currently present 113x16 in order to fit between the flanges and bolt shafts extending through the flange.

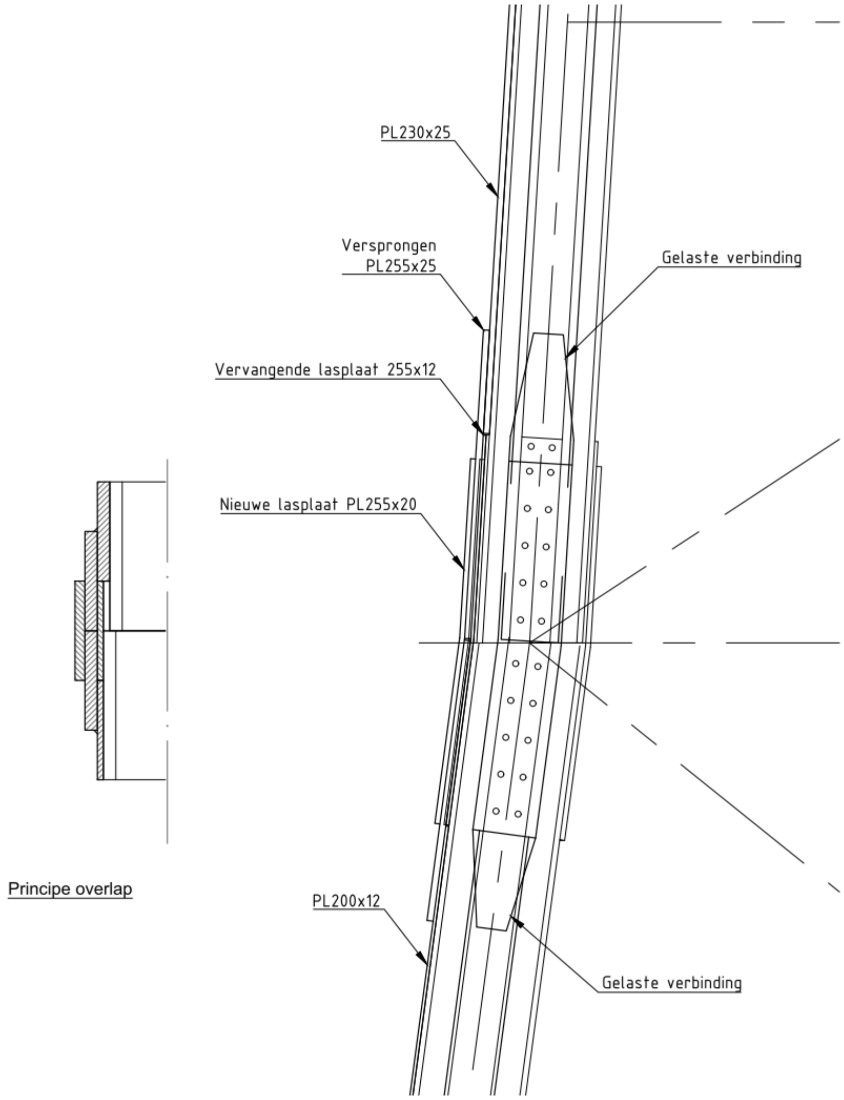


Figuur 10 Transition between XEA- and INP-section

2.3.3 Transition between INP425 and INP450

At the top of the hip structure at the inclination change, the section changes from INP425 to INP450. The INP425 section on top of the transition has to be reinforced with plates, whereas the section below it does not need to be changed, if strictly looked only at axial forces.

Alike the transition from XEA- to INP additional plates will be added in INP450 to smoothen out the difference of cross sections. The thickness of the plates is chosen in such a way that the height difference (12,5 mm each side) between INP425 and INP450 is overcome. To connect the plate with the actual lap plates, a second joint is needed. This joint should not cause any slippage between plates, otherwise the force flow towards the new plates is interrupted. Therefore, the connecting plates should be welded.



Figuur 11 Joint at transition between INP425 and INP450 section

The actual joint is composed of two plates, at the outside a plate of 255x20 (equal to present size), directly on the top of the flange is at the position of the 12 mm plate that is used to reinforce the INP450 section.

3 CONCLUSION

The main leg sections including their joints have been checked in this appendix for adequacy. The existing sections turn out to have insufficient capacity. For the joints, the bolted connections in XEA-sections and INP425 sections can be considered adequate. In the INP450 however, load level is slightly above their capacity.

Reinforced sections were developed since adding additional redundants did not increase capacity to the level needed. The reinforced sections are checked in the appendix showing that capacity is sufficient to full the design load of verbouwlevel. In the calculations the buckling length was used twice the distance between redundants, allowing for neglecting the insuffiency that is present in the strength of redundants. The one section of the main leg where redundant members were found to be useful, is included and turns out well.

As a third part of the appendix, the design ideas of the main joints in the reinforced tower leg were developed. In the detailing phase, these can be worked out further.

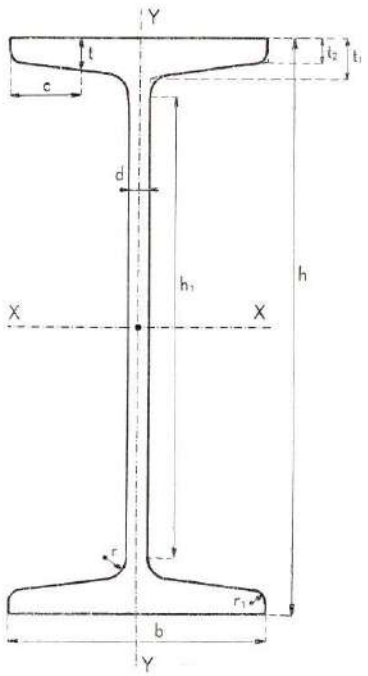
APPENDIX

- INP-Profiles
- AxisVM output of cross section propertie

Overgenomen uit “Gewalste profielen voor staalconstructies”

Min. van Verkeer en Waterstaat, 1949.

BALKSTAAL MET SMALLE FLENS



Benaderde waarden voor enkele profielgrootheden:

$F = b \cdot h - (b - d) \cdot (h - 2t)$

$I_x = {}^1/_{12} \{ b \cdot h^3 - (b - d) \cdot (h - 2t)^3 \}$

$I_y \; {}^1/_6 \, t \cdot b^3$

$i_x = 0{,}4\,h$

$i_y = 0{,}2\,b$

$k_x = 0{,}32\,h$

$k_y = 0{,}08\,b.$

9

WEST-EUROPESE BALKPROFIELEN MET SMALLE FLENS

(Duitse normaalprofielen)

De profielen worden aangeduid door het profielteken (I), de letters NP (Normaal Profiel) en een getal dat de hoogte van het profiel in cm aangeeft, bijv.:

I NP 20.

Bij profielen met afwijkende breedte-afmetingen wordt ook de lijfdikte vermeld.
Er bestaan vaste verhoudingen tussen de afmetingen van het normale profiel, n.l.:

$b = 0{,}40\ h + 10$ mm (voor $h \leq 250$ mm)
$d = 0{,}03\ h + 1{,}5$ mm (voor $h \leq 250$ mm)
$b = 0{,}30\ h + 35$ mm (voor $h \geq 250$ mm)
$d = 0{,}036\ h$ (voor $h \geq 250$ mm, uitgezonderd voor I NP 55)
$r = d$ $r_1 = $ ca $0{,}6\ d$ (uitgezonderd voor I NP 55)

De helling van de binnenkant van de flens is 14% (= ca 1 : 7 = 7° 58′ 11″).
De gemiddelde dikte van de flens (t) wordt gewoonlijk gemeten op een afstand $c = \frac{1}{4}$ b. Met het oog op de te verwachten aanmaak van profielen met lijven, dunner en dikker dan die der normale profielen, is in deze tabellen hiervan afgeweken en de gemiddelde dikte t is aangegeven, gemeten op een afstand $\frac{1}{4}$ (b—d). Het verschil tussen beide waarden bedraagt 0,035 d.
De normale en gangbare profielen zijn aangegeven door gewone cijfers, de abnormale en weinig gangbare profielen zijn aangegeven door magere cijfers.

I NP	AFMETINGEN							F	G	x—x—as			y—y—as			I NP
	h	b	d	t	r	r_1	h_1			I_x	i_x	W_x	I_y	i_y	W_y	
8	80	42	3,9	5,76	3,9	2,3	59	7,58	5,95	77,8	3,20	19,5	6,29	0,91	3,00	8
8 max	80	47	8,9	5,76	3,9	2,3	59	11,58	9,09	99,1	2,93	24,8	9,17	0,89	3,90	8 max
9	90	46	4,2	6,15	4,2	2,5	67	9,00	7,07	117	3,61	26,0	8,78	1,00	3,82	9
9 max	90	51	9,2	6,15	4,2	2,5	67	13,5	10,6	147	3,30	32,7	12,4	0,96	4,87	9 max
10 min	100	49,5	4,0	6,64	4,5	2,7	75	10,1	7,95	166	4,05	33,2	11,8	1,08	4,75	10 min
10	100	50	4,5	6,64	4,5	2,7	75	10,6	8,32	171	4,01	34,2	12,2	1,07	4,88	10
10 max	100	55	9,5	6,64	4,5	2,7	75	15,6	12,2	212	3,69	42,3	16,6	1,03	6,06	10 max
11	110	54	4,8	7,03	4,8	2,9	83	12,3	9,66	239	4,41	43,5	16,2	1,15	6,00	11
11 max	110	59	9,8	7,03	4,8	2,9	83	17,8	14,0	294	4,06	53,4	21,7	1,10	7,35	11 max
12 min	120	57,3	4,4	7,52	5,1	3,1	92	13,3	10,5	317	4,87	52,8	20,5	1,24	7,17	12 min
12	120	58	5,1	7,52	5,1	3,1	92	14,2	11,2	328	4,81	54,7	21,5	1,23	7,41	12
12 max	120	63	10,1	7,52	5,1	3,1	92	20,2	15,9	400	4,45	66,7	28,3	1,19	8,98	12 max
13	130	62	5,4	7,91	5,4	3,2	100	16,1	12,6	436	5,20	67,1	27,5	1,31	8,87	13
13 max	130	67	10,4	7,91	5,4	3,2	100	22,6	17,7	528	4,83	81,2	35,6	1,25	10,6	13 max
14 min	140	65,2	4,9	8,40	5,7	3,4	109	17,1	13,4	554	5,69	79,2	33,7	1,40	10,3	14 min
14	140	66	5,7	8,40	5,7	3,4	109	18,3	14,4	573	5,61	81,9	35,2	1,40	10,7	14
14 max	140	71	10,7	8,40	5,7	3,4	109	25,3	19,9	686	5,21	98,0	44,8	1,33	12,7	14 max
15	150	70	6,0	8,79	6,0	3,6	117	20,4	16,0	735	6,00	98,0	43,9	1,47	12,5	15
15 max	150	75	11,0	8,79	6,0	3,6	117	27,9	21,9	875	5,60	117	55,3	1,41	14,8	15 max
16 min	160	73,1	5,4	9,28	6,3	3,8	125	21,4	16,8	903	6,50	113	52,4	1,57	14,3	16 min
16	160	74	6,3	9,28	6,3	3,8	125	22,8	17,9	935	6,40	117	54,7	1,55	14,8	16
16 max	160	79	11,3	9,28	6,3	3,8	125	30,8	24,2	1106	5,99	138	68,1	1,49	17,3	16 max
17	170	78	6,6	9,67	6,6	4,0	133	25,2	19,8	1167	6,80	137	66,6	1,63	17,1	17
17 max	170	83	11,6	9,67	6,6	4,0	133	33,7	26,5	1372	6,38	161	82,2	1,56	19,8	17 max
18 min	180	81	5,9	10,16	6,9	4,1	142	26,1	20,5	1395	7,32	155	77,9	1,73	19,2	18 min
18	180	82	6,9	10,16	6,9	4,1	142	27,9	21,9	1446	7,20	161	81,3	1,71	19,8	18
18 max	180	87	11,9	10,16	6,9	4,1	142	36,9	28,9	1689	6,77	188	99,5	1,64	22,8	18 max
19	190	86	7,2	10,55	7,2	4,3	150	30,6	24,0	1759	7,60	186	97,4	1,80	22,7	19
19 max	190	91	12,2	10,55	7,2	4,3	150	40,1	31,5	2045	7,14	215	118	1,71	26,0	19 max
20 min	200	88,9	6,4	11,04	7,5	4,5	159	31,2	24,5	2064	8,13	206	112	1,89	25,1	20 min
20	200	90	7,5	11,04	7,5	4,5	159	33,5	26,3	2142	8,00	214	117	1,87	26,0	20
20 max	200	95	12,5	11,04	7,5	4,5	159	43,5	34,1	2475	7,54	248	140	1,79	29,6	20 max

I NP	AFMETINGEN							F	G	x—x—as			y—y—as			I NP
	h	b	d	t	r	r_1	h_1			I_x	i_x	W_x	I_y	i_y	W_y	
21	210	94	7,8	11,43	7,8	4,7	167	36,4	28,6	2558	8,40	244	138	1,95	29,4	21
21 max	210	99	12,8	11,43	7,8	4,7	167	46,9	36,8	2945	7,92	280	164	1,87	33,2	21 max
22 min	220	96,9	7,0	11,92	8,1	4,9	175	37,1	29,1	2957	8,93	269	156	2,05	33,2	22 min
22	220	98	8,1	11,92	8,1	4,9	175	39,6	31,1	3060	8,80	278	162	2,02	33,1	22
22 max	220	103	13,1	11,92	8,1	4,9	175	50,6	39,7	3504	8,32	318	193	1,95	37,5	22 max
23	230	102	8,4	12,31	8,4	5,0	183	42,7	33,5	3605	9,21	314	189	2,10	37,1	23
23 max	230	107	13,4	12,31	8,4	5,0	183	54,2	42,5	4112	8,71	358	223	2,02	41,7	23 max
24 min	240	104,9	7,6	12,80	8,7	5,2	192	43,4	34,1	4112	9,73	343	212	2,21	40,5	24 min
24	240	106	8,7	12,80	8,7	5,2	192	46,1	36,2	4246	9,59	354	221	2,20	41,7	24
24 max	240	111	13,7	12,80	8,7	5,2	192	58,1	45,6	4822	9,11	402	259	2,11	46,4	24 max
25	250	110	9,0	13,29	9,0	5,4	200	49,7	39,0	4966	10,0	397	256	2,27	46,5	25
25 max	250	115	14,0	13,29	9,0	5,4	200	62,2	48,8	5617	9,50	449	300	2,19	52,2	25 max
26 min	260	111,8	8,2	13,77	9,4	5,6	208	50,2	39,4	5558	10,5	428	277	2,35	49,6	26 min
26	260	113	9,4	13,77	9,4	5,6	208	53,4	41,9	5744	10,4	442	288	2,32	51,0	26
26 max	260	118	14,4	13,77	9,4	5,6	208	66,3	52,1	6476	9,88	498	335	2,25	56,7	26 max
27	270	116	9,7	14,36	9,7	5,8	216	57,2	44,9	6630	10,8	491	326	2,40	56,2	27
27 max	270	121	14,7	14,36	9,7	5,8	216	70,7	55,5	7450	10,3	552	379	2,32	62,6	27 max
28 min	280	117,7	8,8	14,85	10,1	6,1	225	57,4	45,0	7337	11,3	524	350	2,47	59,4	28 min
28	280	119	10,1	14,85	10,1	6,1	225	61,1	48,0	7587	11,1	542	364	2,45	61,2	28
28 max	280	124	15,1	14,85	10,1	6,1	225	75,1	59,0	8502	10,6	607	420	2,36	67,8	28 max
29	290	122	10,4	15,34	10,4	6,3	233	64,9	51,0	8640	11,6	596	406	2,50	66,6	29
29 max	290	127	15,4	15,34	10,4	6,3	233	79,4	62,3	9656	11,0	665	465	2,42	73,2	29 max
30 min	300	123,6	9,4	15,82	10,8	6,5	241	64,8	50,9	9470	12,1	631	433	2,58	70,0	30 min
30	300	125	10,8	15,82	10,8	6,5	241	69,1	54,2	9800	11,9	653	451	2,56	72,2	30
30 max	300	130	15,8	15,82	10,8	6,5	241	84,1	66,0	10925	11,4	728	515	2,47	79,3	30 max
32 min	320	129,5	10,0	16,90	11,5	6,9	257	72,9	57,2	12084	12,9	755	533	2,70	82,3	32 min
32	320	131	11,5	16,90	11,5	6,9	257	77,8	61,1	12510	12,7	782	555	2,67	84,7	32
32 max	320	136	16,5	16,90	11,5	6,9	257	93,8	73,6	13875	12,2	867	633	2,60	93,0	32 max
34 min	340	135,4	10,6	17,87	12,2	7,3	274	81,2	63,8	15145	13,7	891	646	2,82	95,4	34 min
34	340	137	12,2	17,87	12,2	7,3	274	86,8	68,1	15695	13,5	923	674	2,80	98,4	34
34 max	340	142	17,2	17,87	12,2	7,3	274	104	81,5	17333	12,9	1020	770	2,72	108	34 max
36 min	360	141,2	11,2	19,05	13,0	7,8	290	90,5	71,0	18875	14,4	1049	782	2,94	111	36 min
36	360	143	13,0	19,05	13,0	7,8	290	97,1	76,2	19605	14,2	1089	818	2,90	114	36
36 max	360	148	18,0	19,05	13,0	7,8	290	115	90,4	21549	13,7	1197	924	2,83	125	36 max
38 min	380	147,1	11,8	20,02	13,7	8,2	306	99,8	78,3	23109	15,2	1216	931	3,06	127	38 min
38	380	149	13,7	20,02	13,7	8,2	306	107	84,0	24012	15,0	1264	975	3,02	131	38
38 max	380	154	18,7	20,02	13,7	8,2	306	126	98,9	26298	14,4	1384	1092	2,94	142	38 max
40 min	400	153	12,4	21,10	14,4	8,6	323	110	86,1	28106	16,0	1405	1106	3,18	145	40 min
40	400	155	14,4	21,10	14,4	8,6	323	118	92,6	29213	15,7	1461	1158	3,13	149	40
40 max	400	160	19,4	21,10	14,4	8,6	323	138	108	31880	15,2	1594	1295	3,06	162	40 max
42½ min	425	161	13,3	22,46	15,3	9,2	343	124	97,2	35645	17,0	1677	1375	3,33	171	42½ min
42½	425	163	15,3	22,46	15,3	9,2	343	132	104	36973	16,7	1740	1437	3,30	176	42½
42½ max	425	168	20,3	22,46	15,3	9,2	343	153	120	40172	16,2	1890	1600	3,23	191	42½ max
45 min	450	168	14,2	23,73	16,2	9,7	363	138	108	44271	17,9	1968	1654	3,46	197	45 min
45	450	170	16,2	23,73	16,2	9,7	363	147	115	45852	17,7	2037	1725	3,43	203	45
45 max	450	175	21,2	23,73	16,2	9,7	363	170	133	49649	17,1	2207	1915	3,36	219	45 max
47½ min	475	176	15,1	25,00	17,1	10,3	384	153	120	54619	18,9	2300	2005	3,62	228	47½ min
47½	475	178	17,1	25,00	17,1	10,3	384	163	128	56481	18,6	2378	2088	3,60	235	47½
47½ max	475	183	22,1	25,00	17,1	10,3	384	187	146	60946	18,1	2566	2300	3,51	252	47½ max
50 min	500	183	16,0	26,37	18,0	10,8	404	169	133	66563	19,8	2663	2384	3,75	261	50 min
50	500	185	18,0	26,37	18,0	10,8	404	180	141	68738	19,6	2750	2478	3,72	268	50
50 max	500	190	23,0	26,37	18,0	10,8	404	205	161	73946	19,0	2958	2728	3,65	287	50 max
55 min	550	198	17,0	29,34	19,8	11,9	444	201	158	96279	21,9	3501	3366	4,09	340	55 min
55	550	200	19,0	29,34	19,8	11,9	444	213	167	99184	21,6	3607	3488	4,02	349	55
55 max	550	205	24,0	29,34	19,8	11,9	444	241	189	106116	21,0	3858	3720	3,93	366	55 max
60	600	215	21,6	31,64	21,6	13,0	485	254	199	139000	23,4	4630	4670	4,30	434	60

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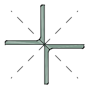
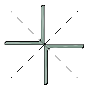
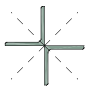
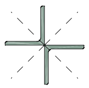
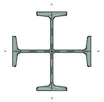
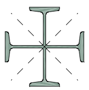
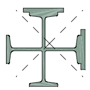
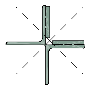
Profielen

	Naam	Tekening	Productie	Vorm	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	XEA L200x20		Ander	Eigen gedefinieerd	400,0	400,0	0	0	0	0	0	15349,90	6428,61	6428,51
2	XEA L250x20		Ander	Eigen gedefinieerd	500,0	500,0	0	0	0	0	0	19387,70	8119,15	8119,07
3	XEA L250x22		Ander	Eigen gedefinieerd	500,0	500,0	0	0	0	0	0	21219,70	8812,59	8812,60
4	XEA L250x24		Ander	Eigen gedefinieerd	500,0	500,0	0	0	0	0	0	23035,70	9485,77	9485,77

	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]
1	XEA L200x20	2152964,000	1,06E+08	1,06E+08	−1,572E+07	1,218E+08	9,032E+07	45,00	2,975E+10	804103,200	804103,200
2	XEA L250x20	2747387,000	2,059E+08	2,059E+08	−2,455E+07	2,305E+08	1,814E+08	45,00	5,938E+10	1239425,000	1239425,000
3	XEA L250x22	3611307,000	2,272E+08	2,272E+08	−2,972E+07	2,569E+08	1,974E+08	45,00	7,811E+10	1371104,000	1371104,000
4	XEA L250x24	4635503,000	2,485E+08	2,485E+08	−3,539E+07	2,839E+08	2,131E+08	45,00	1,003E+11	1503799,000	1503799,000

	Naam	$W_{2,el,t}$ [mm^3]	$W_{2,el,b}$ [mm^3]	$W_{1,pl}$ [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	XEA L200x20	638654,900	638654,900	1226168,000	1011961,000	83,1	83,1	400,0	400,0	200,0	200,0	0	0	1
2	XEA L250x20	1026019,000	1026019,000	1883722,000	1611360,000	103,1	103,1	500,0	500,0	250,0	250,0	0	0	1
3	XEA L250x22	1116918,000	1116918,000	2086977,000	1759861,000	103,5	103,5	500,0	500,0	250,0	250,0	0	0	1
4	XEA L250x24	1205463,000	1205463,000	2292314,000	1905783,000	103,9	103,9	500,0	500,0	250,0	250,0	0	0	1

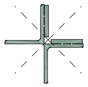
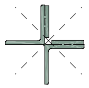
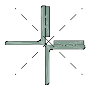
Profielen

	Naam	*Tekening*	*Productie*	*Vorm*	*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]*
5	INP425		Ander	Eigen gedefinieerd	425,0	425,0	0	0	0	0	0	26474,12	6961,37	6961,31
6	INP450		Ander	Eigen gedefinieerd	450,0	450,0	0	0	0	0	0	29190,77	7773,54	7773,97
7	INP425+PL230x25		Ander	Eigen gedefinieerd	450,0	450,0	0	0	0	0	0	37974,11	7379,82	7387,21
8	XEA250x20+PL200x25 bu		Ander	Eigen gedefinieerd	500,0	500,0	0	0	0	0	0	29515,70	8222,01	8227,97

	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]*
5	INP425	4285422,000	3,871E+08	3,871E+08	0	3,871E+08	3,871E+08	0	1,119E+12	1821837,000	1821837,000
6	INP450	5169170,000	4,751E+08	4,751E+08	–480,779	4,751E+08	4,751E+08	45,00	1,483E+12	2167457,000	2167456,000
7	INP425+PL230x25	1,499E+07	6,598E+08	6,598E+08	–4,408E+07	7,039E+08	6,157E+08	45,00	3,32E+12	2823940,000	2823940,000
8	XEA250x20+PL200x25 bu	7512729,000	3,084E+08	3,084E+08	–2,556E+07	3,339E+08	2,828E+08	45,00	2,206E+11	1795847,000	1795847,000

	Naam	*$W_{2,el,t}$ [mm^3]*	*$W_{2,el,b}$ [mm^3]*	*$W_{1,pl}$ [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.*
5	INP425	1821837,000	1821837,000	2361893,000	2361893,000	120,9	120,9	425,0	425,0	212,5	212,5	0	0	1
6	INP450	2167435,000	2167468,000	3385217,000	3385212,000	127,6	127,6	450,0	450,0	225,0	225,0	0	0	1
7	INP425+PL230x25	3062193,000	2404521,000	4741041,000	4049625,000	131,8	131,8	450,0	450,0	246,6	246,6	–26,4	–26,4	1
8	XEA250x20+PL200x25 bu	1840364,000	1312765,000	2819536,000	2390326,000	102,2	102,2	500,0	500,0	277,3	277,3	–33,7	–33,7	1

Profielen

	Naam	Tekening	Productie	Vorm	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]
9	XEA250x22+PL200x25 bu		Ander	Eigen gedefinieerd	500,0	500,0	0	0	0	0	0	31309,90	8884,14	8887,93
10	XEA250x24+PL200x25 bu		Ander	Eigen gedefinieerd	500,0	500,0	0	0	0	0	0	33125,90	9566,94	9570,99
11	XEA200x20+PL150x20 bu		Ander	Eigen gedefinieerd	400,0	400,0	0	0	0	0	0	21397,58	6524,58	6528,12

	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]
9	XEA250x22+PL200x25 bu	8640465,000	3,32E+08	3,32E+08	−2,958E+07	3,616E+08	3,024E+08	45,00	2,562E+11	1921196,000	1921196,000
10	XEA250x24+PL200x25 bu	1E+07	3,544E+08	3,544E+08	−3,412E+07	3,885E+08	3,203E+08	45,00	3E+11	2049217,000	2049217,000
11	XEA200x20+PL150x20 bu	4514794,000	1,487E+08	1,487E+08	−1,519E+07	1,639E+08	1,336E+08	45,00	8,141E+10	1079665,000	1079665,000

	Naam	$W_{2,el,t}$ [mm^3]	$W_{2,el,b}$ [mm^3]	$W_{1,pl}$ [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.
9	XEA250x22+PL200x25 bu	1939783,000	1418213,000	3026721,000	2560065,000	103,0	103,0	500,0	500,0	275,8	275,8	−32,0	−32,0	1
10	XEA250x24+PL200x25 bu	2028705,000	1516444,000	3231897,000	2725759,000	103,4	103,4	500,0	500,0	274,4	274,4	−30,5	−30,5	1
11	XEA200x20+PL150x20 bu	1055723,000	796631,400	1695276,000	1428152,000	83,4	83,4	400,0	400,0	218,5	218,5	−23,4	−23,4	1

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; **$W_{1,el,t}$, $W_{1,el,b}$, $W_{2,el,t}$, $W_{2,el,b}$:** Elasticiteit modulus; **$W_{1,pl}$, $W_{2,pl}$:** Plasticiteit modulus; **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); **S.p.:** Spanningspunten;

NET SECTION CAPACITY IMPROVEMENT

Top cross arm

The improvement of net section capacity is required on the following members of the top cross arm of tower 12 and 13:

- P415
- P416/ 417
- P7

The figures below depict the locations where the net section modification is required and the proposed bolt arrangement. New bolts are depicted in red and existing bolts in green.

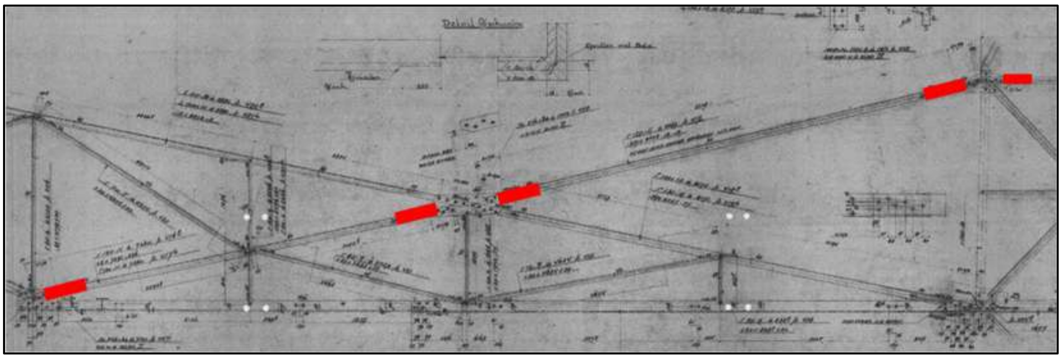


Figure D.1 Locations requiring net section capacity modification

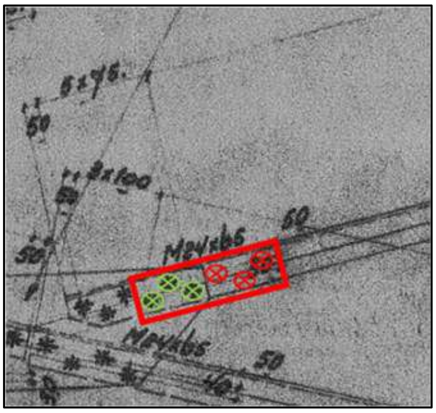


Figure D.2 Proposed positions of bolts for the net section capacity modification

Force in the member should ultimately be less than net section capacity of 346.4 kN:

Force in member P415 under afkeur loads = 493.84 kN

Assume plate dimensions are 120 mm width x 12 mm thick

Cross-sectional area of the plate = 1440 mm^2

Cross-sectional area of member P415 (over which the force acts) = (120 + 60) x 11 = 1980 mm^2

Total cross-sectional area = 1440 + 1980 = 3420 mm^2

Force on the plate = 1440/3420 x 493.84 = 207.93 kN

Force in the member = 493.84 – 207.93 = 285.91 < 346.40 kN **(member fulfils afkeur loads)**

Calculation of PLS Tower override value (afkeur):

1980/3420 x F = 346.40

F = 598.33 kN

Check bearing capacity of plate:

Assume end distance of last bolt = 50 mm, short edge distance of last bolt = 40 mm and S235 steel.

α_d = 50/(3 x 26) = 0.64 (end bolt), α_d = 150/(3 x 26) - 0.25 = 1.67 (inner bolt)

k_1 = min (2.8 x (40/26) – 1.7; 2.5) = 2.5

Bearing capacity = 2.5 x 0.64 x 360 x 24 x 12 / 1.25 = 132.71 kN > 207.93/3 = 69.31 kN **(plate has sufficient thickness)**

Total bearing cap = 132.71 x 3 = 398.13 kN

Check net section capacity of plate:

Assume similar bolt spacing as the member

A_{net1} = 120 x 12 – 26 x 12 = 1128 mm^2

A_{net2} = 120 x 12 – 2 x 26 x 12 + (75^2/ (4 x 30)) x 12 = 1378.5 mm^2

Net section capacity = 0.9 x 1128 x 360 / 1.25 = 292.38 kN > 207.93 kN **(net section capacity is sufficient)**

Check plate fulfils verbouw:

Force in the member due to verbouw loads = 562.8 kN

Force in the plate = 1440/3420 x 562.8 = 236.97 kN

236.97 < 292.38 & 398.13 **(plate fulfils verbouw)**

Crossing diagonals

Members P149 and P150 exhibit shear and net section failure at the afkeur level. To mitigate against failure, a strengthening proposal using a plate was developed. The figures below show the locations where the plates are to be installed. For detailed drawings of the joint, refer to Appendix E.

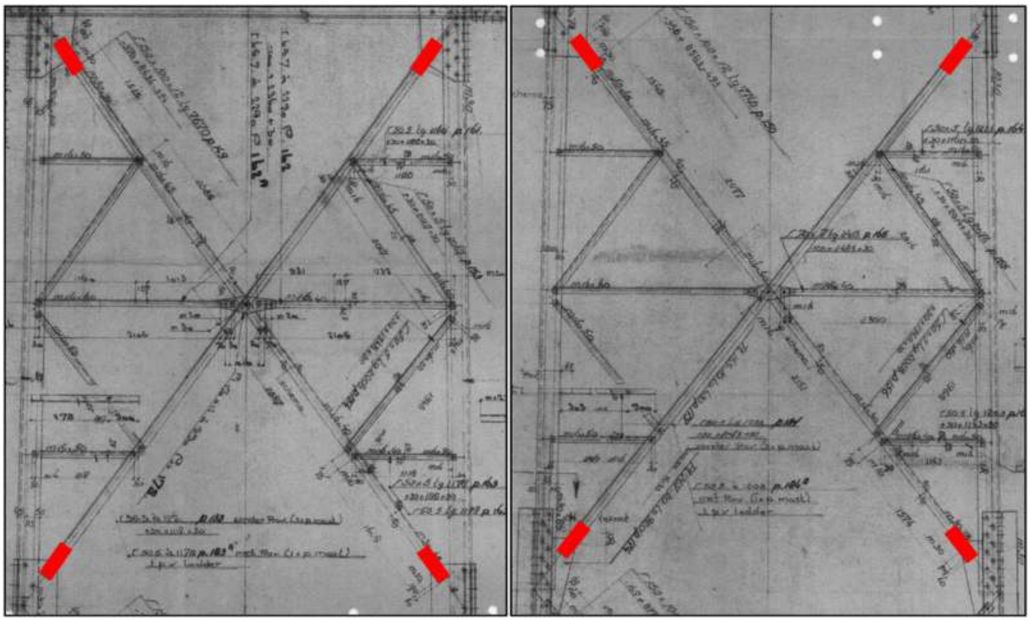


Figure D.3 Joints requiring strengthening on P149 (left) and P150 (right)

Table D.1 summarises the forces obtained from PLS Tower which were used to design the joint.

Table D.1 Forces on P149 and P150

Member label	Afkeur loads (kN)		Verbouw loads (kN)	
	Tension	Compression	Tension	Compression
P149	256	283	355	384
P150	266	262	364	361

Check shear capacity of the joint:

Capacity of 2 x M30-8.8 (double shear) = 215.42 x 4 = 861.68 kN > 384 kN (**shear capacity of joint is ok**)

Check force in the plate:

Maximum force in member under verbouw loads = 384 kN

Assume plate dimensions are 100 mm width x 12 mm thick

Cross-sectional area of the plate = 1200 mm^2

Cross-sectional area of member (over which the force acts) = (100 + 50) x 12 = 1800 mm^2

Total cross-sectional area = 1200 + 1800 = 3000 mm^2

Force on the plate = 1200/3000 x 384 = 153.6 kN

Check bearing capacity of the plate:

Assume bolt end distance on plate = 60 mm, bolt short edge distance on plate = 50 mm and S235 steel.

α_d = 60/(3 x 33) = 0.606 (end bolt), α_d = 100/(3 x 33) - 0.25 = 0.76 (inner bolt)

k_1 = min (2.8 x (50/33) – 1.7; 2.5) = 2.5

Bearing capacity = 2.5 x 0.606 x 360 x 30 x 12 / 1.25 = 157.1 kN > 153.6/2 kN **(bearing capacity is sufficient)**

Check net section capacity of the plate:

A_{net} = 1200 – 33 x 12 = 804 mm^2

Net section capacity = 0.9 x 804 x 360 / 1.25 = 208.40 kN> 153.6 kN **(net section capacity is sufficient)**

Check if member has sufficient net section capacity under afkeur loads:

Force in the member = 1800/3000 x 266 = 159.6 kN

Net section capacity of the member = 250.23 > 159.6 **(member has sufficient capacity)**

Calculate override value for PLS Tower:

1800/3000 x F = 250.23

F = 417.05 kN

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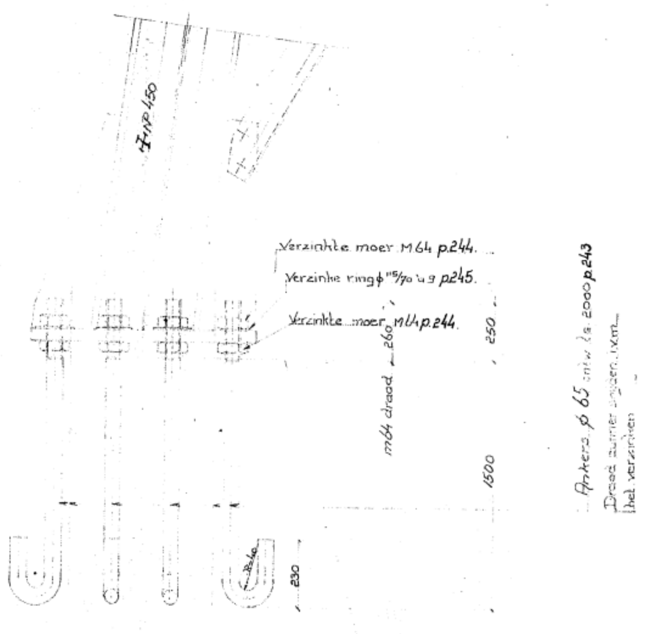
ANCHORS S+95

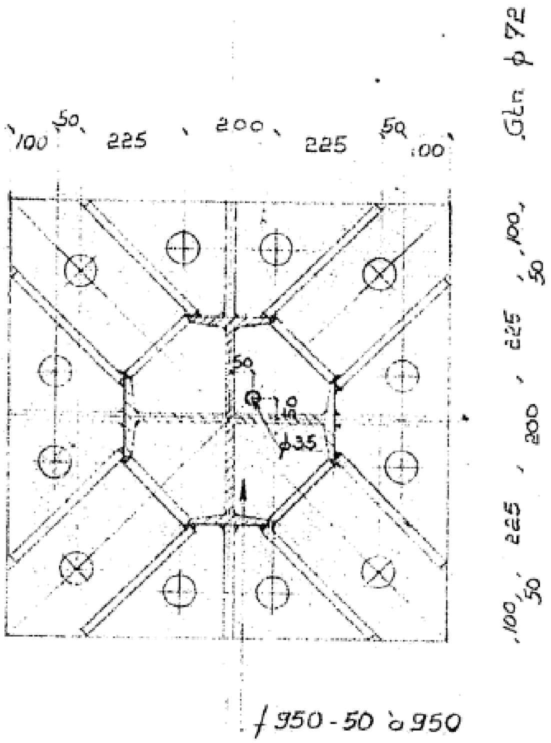
12 anchor bolts M64 have been applied. The figures below are used of tower structure S+95. The tower legs are connected to the foundation with a foot plate 950x950x50 mm and 12 anchors with diameter 65 mm.

De anchor rods are connected to a horizontal rod “schieter” which allows for distribution of the tensile force to the concrete.



Figuur 1 Anchor detail

Figuur 2 Picture of foot detail tower 49 (similar to tower 12 and 13)



Figuur 3 Voetplaat

Loads

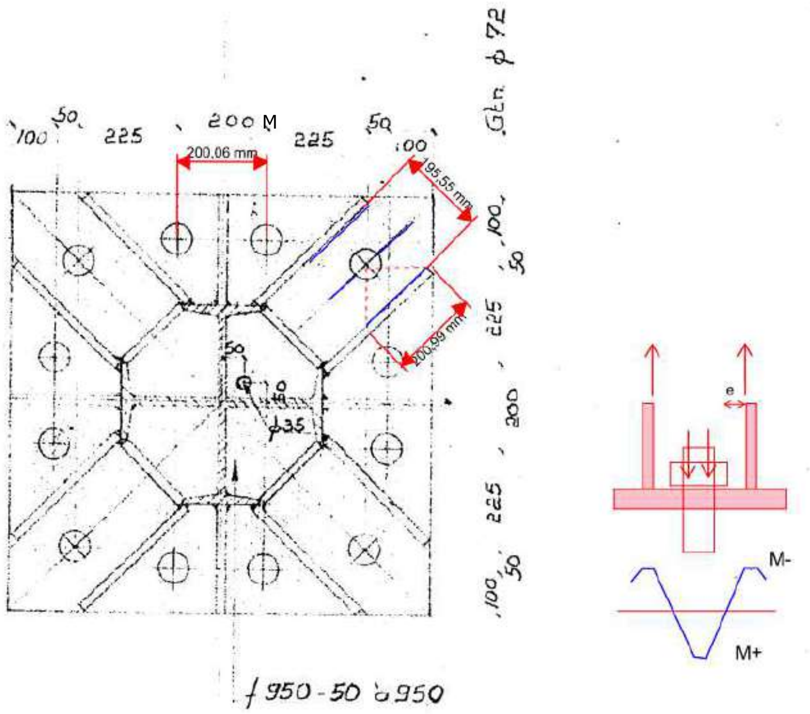
The loads coming from the tower are based on S+95 structure:

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_135	-823	785	**5882**	-27	-1137	-28	5985
Max. tension	ULS 1a_0,9_0,9_135	-625	587	**-4530**	27	857	3	-4610
Max. pos. torsie	ULS 1a_0,9_0,9_135	215	99	1201	**82**	-222	4	1222
Max. neg. torsie	ULS 1a_0,9_0,9_135	32	-84	48	**-83**	-37	-28	49
Comb. tension+torsie	ULS 1a_0,9_0,9_45	625	587	**-4530**	**-27**	857	3	-4610

Foot plate and anchors

The strength of the foot plate will be determined assuming a set of horizontal yield lines across, one through the hole for the anchor, the second along the length of the stiffener. Refer to figure on next page.



Figuur 4 Scheme for check of foot plate

The eccentricity is taken as half of the half span between the stiffeners: 50 mm, since the bending moment changes sign halfway the distance between bolt and stiffener, refer to figure.

The effective width assuming a 45° spread used is equal to 200 mm.

In the spreadsheet the anchor bolts and foot plate have been checked. The concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but has been verified by field investigation[1]. The foot plate is embedded in concrete. The anchor bolts will not be loaded by bending.

The footplate fulfills the required strength. The bending capacity of the foot plate has the highest utilisation. See the output:

U.C. = 378 / 588 = 0,82 ≤ 1,00 OK

Conclusion: The foot plates of tower structure S+95 have sufficient strength.

Compressive stress on concrete

The compressive stress directly below the footplate has additionally been checked.

Effective spread in the plate at each side of each stiffener:

$l_s = t\sqrt{(f_{y;d} / 3f'_{j;u;d})} = 50 \times \sqrt{(355 / 3 * 13,33)} = 148$ mm

The distance between stiffeners is 200 mm, which is far less than 2 x 148 mm, thus the effective spread lengths overlap. That means the complete surface area underneath the foot plate is effective.

The compression stress is equal to: $5882 / 0,95^2 \times 10^{-3} = 6,5$ N/mm^2

U.C. = 6,5 / 13,33 = 0,49 ≤ 1,00 OK

[1] Rapport Bejan Bouw en Betontechniek d.d. 4-11-2020; 200152A-003 Krimpen aan den IJssel - Geertruidenberg v1.0.pdf

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Project: Krimpen - Geertruidenberg 380 — Date: 8-4-2021, Version: 2.6

Anchors

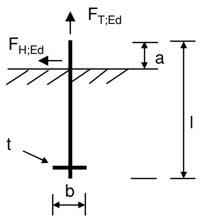
NEN-EN 1992-1-1 and 1993-1-8 with NA

CUR-BmS 10

Subject:	**S+95**	**Checks:**		
		Anchor bolt to tension	0,64	**OK**
		Anchor bolt to shear	0,35	**OK**
		Dowel ("schieter")	0,82	**OK**

Inputs

Anchor diameter		**M64**	
Achor quality		**4.6**	
Thread		Cut	
Anchor length	l =	1300	mm
Anchor length above concrete	a =	250	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	**4530**	kN
Shear force	$F_{H,Ed}$ =	**1137**	kN
Number of anchors for tension		12	
Number of anchors for shear		12	
$F_{T;Ed} = T / n$ =		377,5	kN
$F_{v;Ed} = F_{H,Ed} / n$ =		94,8	kN

Anchor properties

d_b =	64,00	mm
$A_{b;s}$ =	2676	mm^2
f_{yb} =	240	N/mm^2
f_{ub} =	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0,44 - 0,0003 f_{yb}$ =	0,37	-

Capacity per anchor

$F_{T;Rd} = 0,9\alpha_{red;2} f_{ub} A_s / g_{M2}$ =	**655,1**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb}$ =	**267,9**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		**S235**	
Thickness	t =	50	mm
Width	b_{ef} =	200	mm
Leverage arm	m =	50	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd}$ =		29,4	kNm
$F_{t,Rd} = M_{pl,Rd} / m$ =		587,5	kN

Check of dowel ("schieter")

$$\frac{\sigma_b'}{f_{cd}} = \frac{23,3}{40,0} = 0,58 \quad \textbf{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{378}{460} = 0,82 \quad \textbf{OK}$$

Capacity of concrete

Concrete strength	**C20/25**	
f_{ck} =	20	N/mm^2
k_b =	3	-
γ_{Mc} =	1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc}$ =	40	MPa

Dowel

Diameter	d_S =	**65**	mm
Length	b =	**250**	mm
Spread	$c = t\sqrt{(f_{yd} / 3f_{jd})}$ =	92	mm
Effective length	$b_{eff} = \min(b; d+2c)$	249	mm
Cross section	$A_S = \pi/4\ d_S^2$ =	3318	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff}$ =	1517	kN/m
Concrete pressure	$\sigma_b' = q / d_S$ =	23,3	MPa

Shear stress in dowel

Load	$F_{T,Ed}$ =	378	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ =	460	kN

Capacity of foot plate

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{377,5}{587,5} = 0,64 \quad \textbf{OK}$$

Capacity of anchor for tension

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{377,5}{655,1} = 0,58 \quad \textbf{OK}$$

Check foot plate for tension

$$\frac{T}{n \times F_{t;Rd}} = \frac{4530,0}{7050,0} = 0,64 \quad \textbf{OK}$$

Check anchor for shear

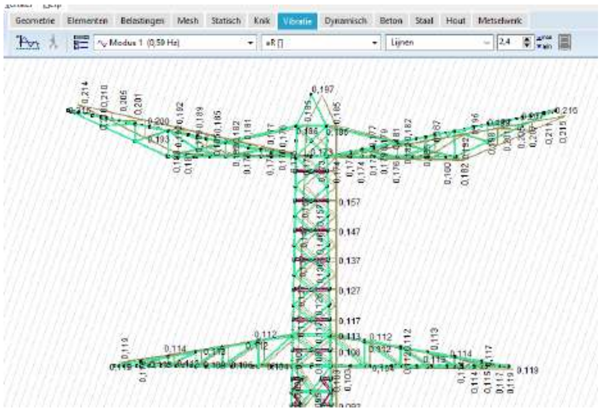
$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{94,8}{267,9} = 0,35 \quad \textbf{OK}$$

DYNAMIC FACTOR C_SC_D

The crossing towers S+75 and S+95 have heights exceeding 60 m. This is a limit from NEN-EN 50341-2-15 above which it should be investigated if the dynamic factor C_d exceeds a value of 1,0.

To use the method of NEN-EN 50431-2-15 the eigenfrequency needs to be known. The software AxisVM was used to calculate the first eigen modes of the towers.

The results are:



S+95

f_e = 0,59 Hz

The procedure of NEN-EN 50341-2-15 clause 4.4.3.1 is followed.

Average width is taken at the level of lower cross arm: 6,0 m.

Height of the tower for the turbulence intensity is taken at 60% of the height according to NEN-EN 1991-1-4 clause 6.3.1.

For resonance factor R^2 the following assumptions are used.

Logaritmic damping from NEN-EN 1991-1-4 Appendix F: “stalen Bruggen en vakwerktorens, bouten met hoge kwaliteit”: δ_s = 0,030.

Equivalent mass m_e is taken as mass per unit length. It is calculated by dividing the estimated total weight of the tower by the total height.

S+95: 250 ton / 162,5 = 1538 kg/m

S+75: 230 ton / 142,5 = 1615 kg/m

Factors K_y and K_z for parabolic deformation shape are used.

G_y = 1/2

G_z = 5/18

Drag coefficient is taken as the product of χ (solidity ratio) and C_t (drag factor taking into account the open lattice structure). C_f = 0,24 x 2,8 = 0,66.

Peak factor is set to 3,5 according to NEN-EN 50341-2-15.

Results

Bouwwerkfactor $c_s c_d$ Mast: S+95 II

$c_s c_d = 1 + 2\,k_p\,I_v(z_s)\,\sqrt{(B^2+R^2)}\,/\,1+7I_v(z)$		**1,02**	-
k_p	piekfactor		
I_v	turbulentieintensiteit	0,161569	
B^2	achtergrondresponsiefactor, brengt het volleige gebrek aan correlatie in rekening		
R^2	resonantieresponsfactor		
z_s	referentiehoogte, temnminste gelijk aan zmin		

Piekfactor kp

$k_p = \sqrt{(2\ln(\nu T))} + 0{,}6 / \sqrt{(2\ln(\nu T))} \geq 3{,}5$		3,50	-
T =	600	s	
$\nu = n_1\sqrt{(R^2 / (B^2+R^2))} \geq 0{,}08$	0,44	-	

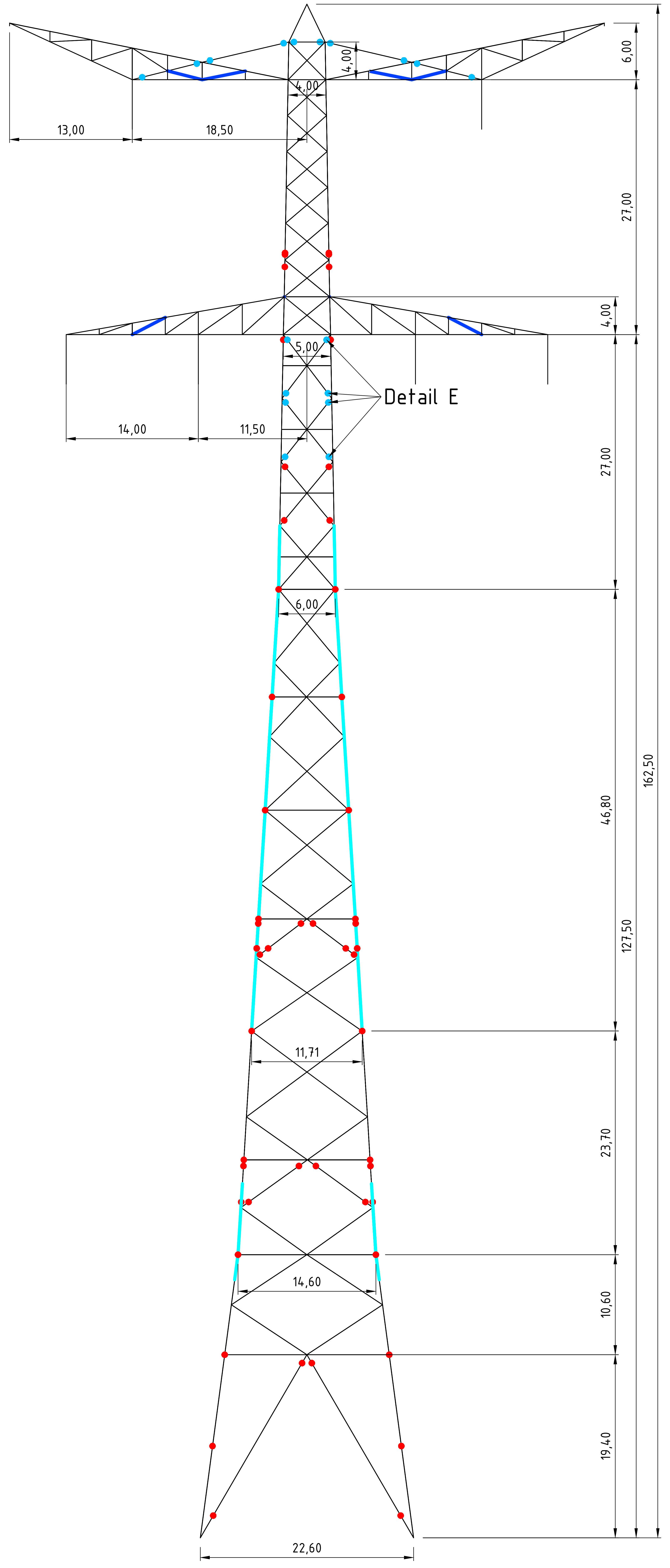
Achtergrondresponsiefactor B^2

b =	6,00	m	
d =	6,00	m	
h =	162,5	m	
$z_s = h =$	97,5		
$L(z_s) = L_t\,(z_s / z_t)^{\alpha}$	196,4	m	
$L_t =$	300	m	(referentielengteschaal)
$z_t =$	200	m	(referentiehoogte zmax)
$\alpha = 0{,}67 + 0{,}05\ln(z_0) =$	0,59		
$B^2 =$	0,45		

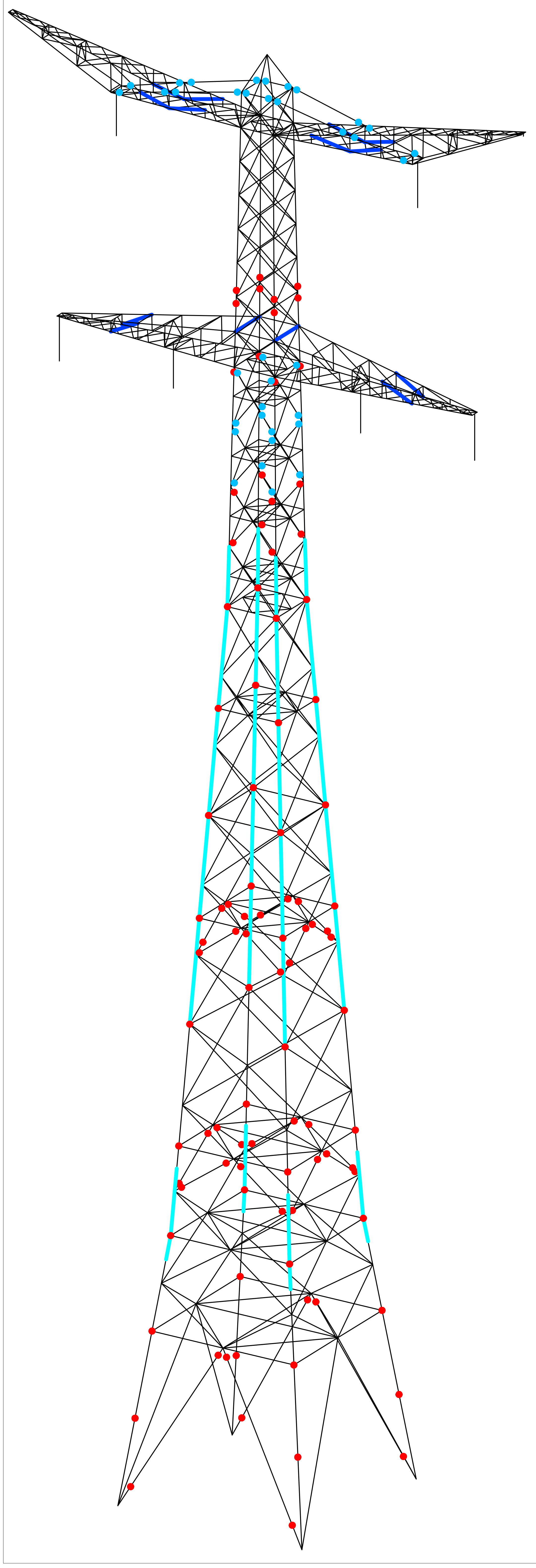
Resonantieresponsfactor R^2

$R^2 = \pi^2 / 2\delta \times S_L K_s =$	0,5572	
$\delta = \delta_s + \delta_a + \delta_d =$	0,05	
Type constructie	Stalen toren, bout met hoge weerstand	
$\delta_s =$	0,03	
$\delta_a = c_f r b v_m(z_s) / 2n_1 m_e =$	0,01677	
$c_f =$	0,67	(krachtcoefficient windrichting)
$n_1 =$	0,59	(berekend AxisVM)
m_e	1538,5	(equivalente massa)
$\delta_d =$	0,0	
S_L	0,0623019	(dimensieloze spectrale dichtheidsfunctie)
$f_L =$	3,2	
K_s	0,0848	(afmetingsreductiefunctie)
$\psi_y =$	1,1	
$\psi_z =$	36,6	
$c_y = c_z =$	11,5	
G_y	0,50	
G_z	0,28	
K_y	1	
K_z	1,67	

APPENDIX E TEKENINGEN



Front View



3D View

Notes and legend:

- **For member and bolt sizes refer to the summary 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/ redundant
Profile strengthened with plates
Profile exchanged
Redundant exchanged
Strengthening of joint using plates
Bolt exchanged

01	7-4-2021	Version 2.0 - Loads calculated according to 15 year return period
00	6-10-2020	Version 1.0

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

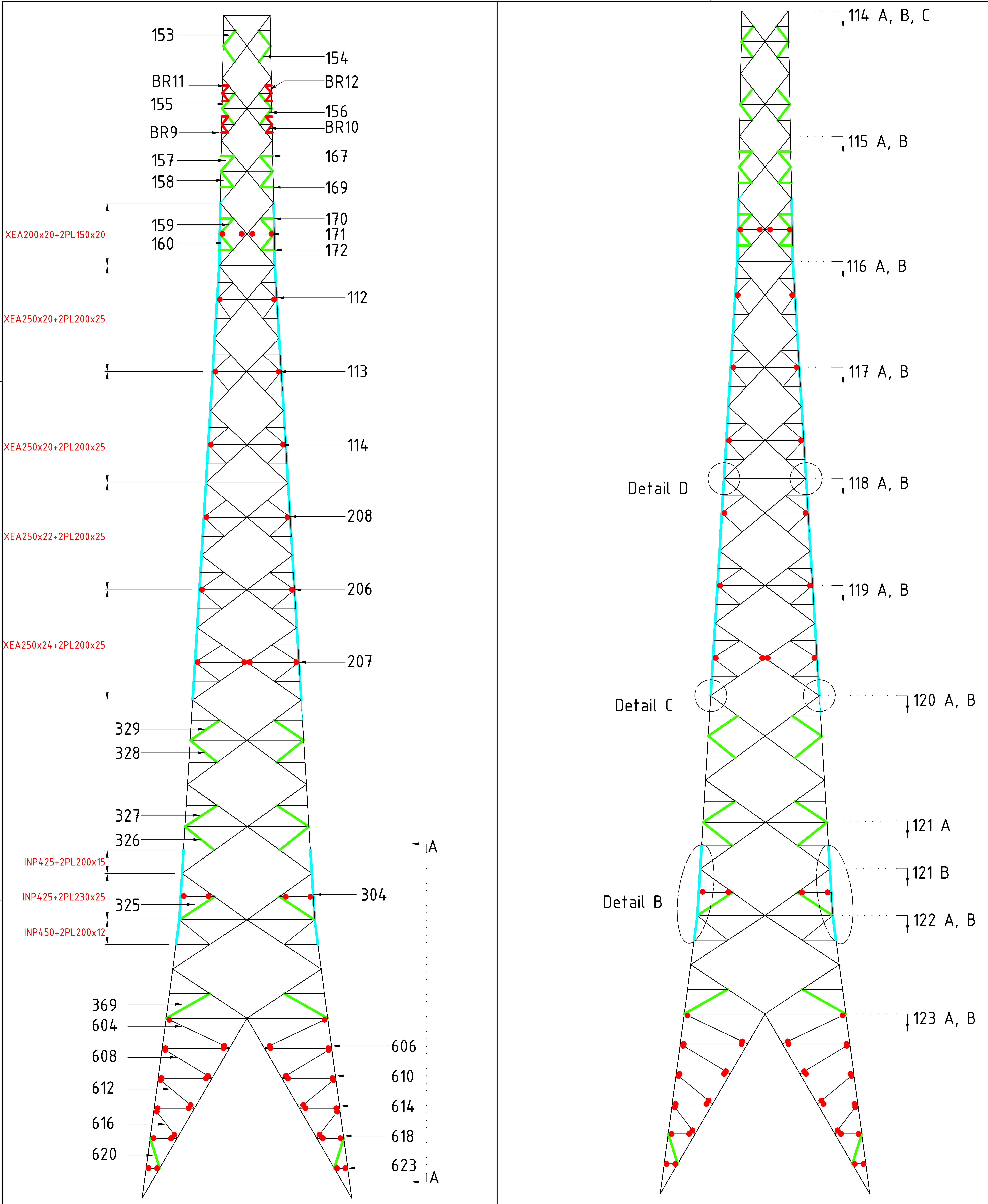
Drawing no.: 10166260-037

Design state: FINAL		Scale: -		
Drawn by: MuK	6-10-2020	Units: m		
Checked by: TBR	7-10-2020	Project no: 10166260		
Approved by: JHu	8-10-2020	Company: TenneT		

Description: Modifications overview for mast type S+95 (Mast 12 & 13) Page 1 of 6

Revision: 00

Format: A2



Front View

Side View

*For locations of bolt modifications on the legs and main diagonals, see overview drawings on page 1

Notes and legend:

- For member and bolt sizes refer to the summary table
- All changes are symmetrical unless otherwise indicated
- Material quality t ≤ 16mm S355J0
- Material quality t > 16mm S355J2
- Bolt quality 8.8 rolled

Red line: New profile/ redundant
Cyan line: Profile strengthened with plates
Blue line: Profile exchanged
Green line: Redundant exchanged
Cyan dot: Strengthening of joint using plates
Red dot: Bolt exchanged

01	7-4-2021	Version 2.0 - Loads calculated according to 15 year return period
00	6-10-2020	Version 1.0

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

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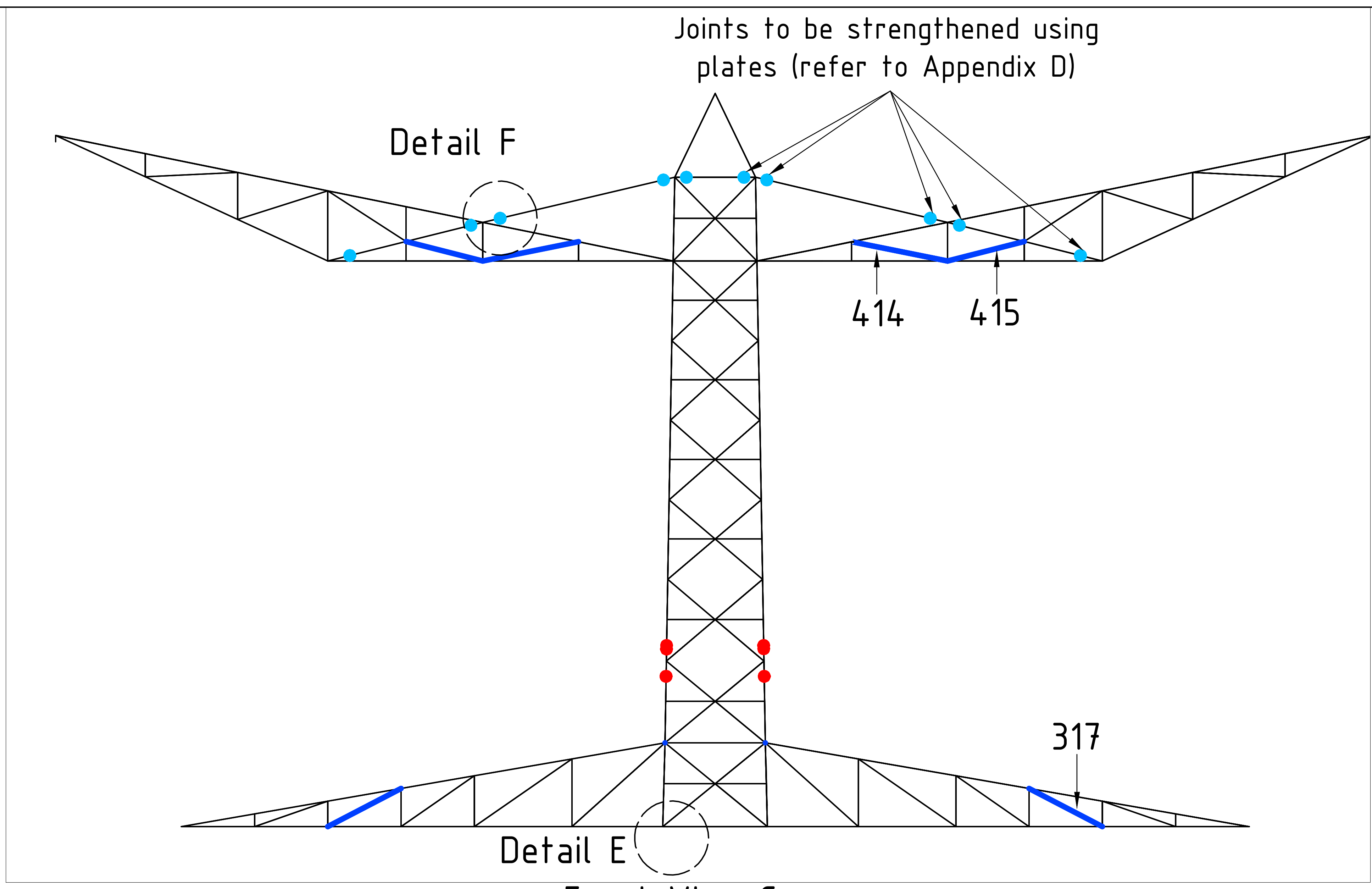
Design state: FINAL		Scale: -		
Drawn by: MuK	6-10-2020	Units: m		
Checked by: TBR	7-10-2020	Project no: 10166260		
Approved by: JHu	8-10-2020	Company: TenneT		

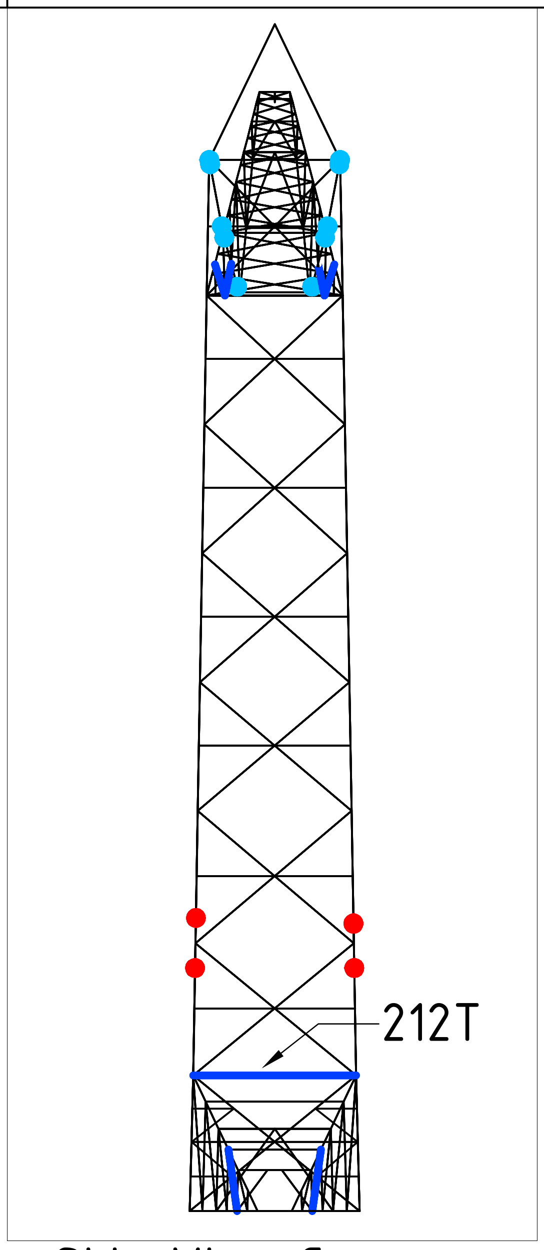
Description: Modifications overview for mast type S+95 (Mast 12 & 13) Page 2 of 6

Revision: 00

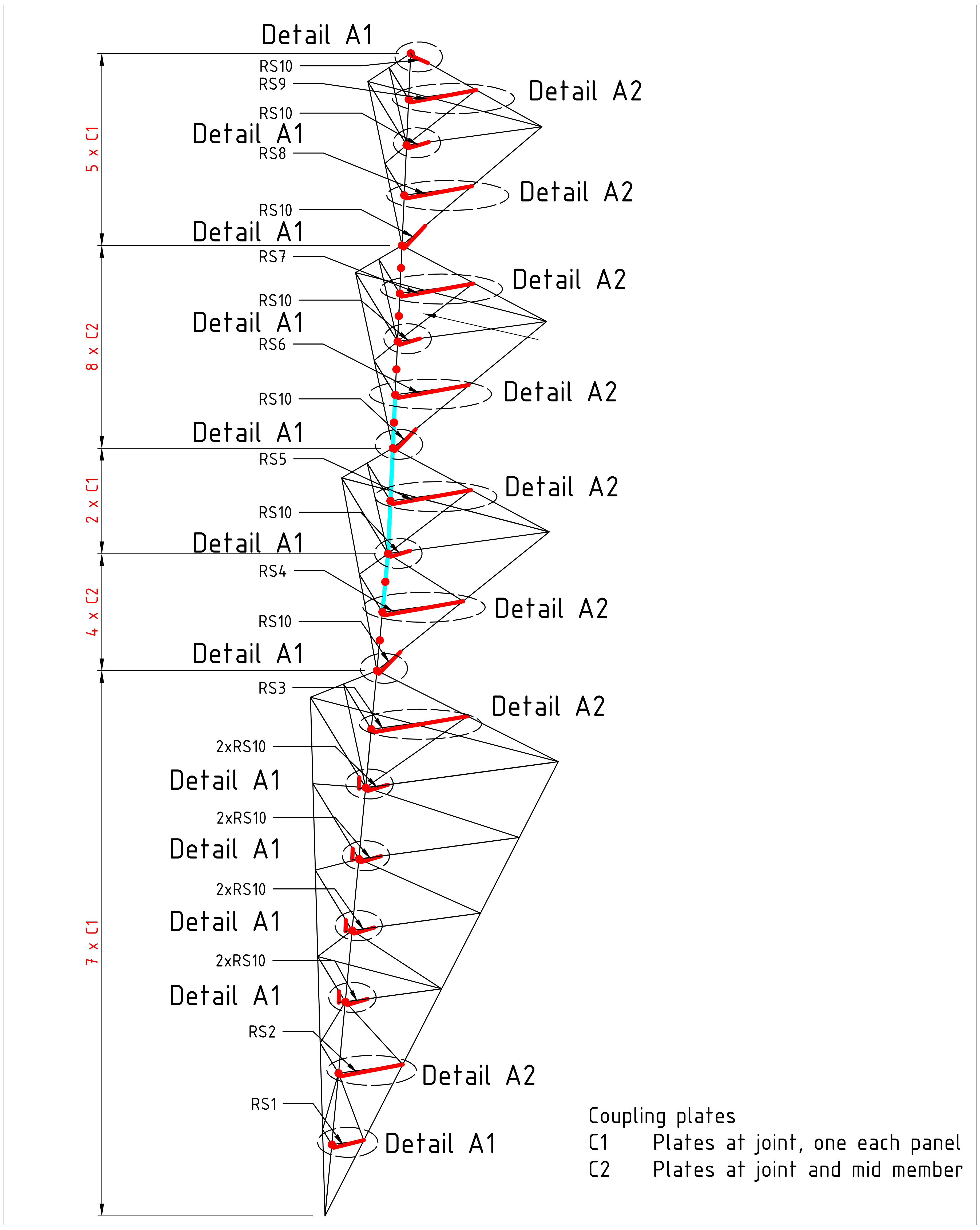
Format: A2



Front View Crossarms



Side View Crossarms



Section A-A: Lower Leg Section View

Notes and legend:

- For member and bolt sizes refer to the summary 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/ redundant
Profile strengthened with plates
Profile exchanged
Redundant exchanged
Strengthening of joint using plates
Bolt exchanged

01	7-4-2021	Version 2.0 - Loads calculated according to 15 year return period
00	6-10-2020	Version 1.0

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-037

Design state: FINAL		Scale: -	
Drawn by: MuK	6-10-2020	Units: m	
Checked by: TBR	7-10-2020	Project no: 10166260	
Approved by: JHu	8-10-2020	Company: TenneT	

Description: Modifications overview for mast type S+95 (Mast 12 & 13) Page 3 of 6

Revision: 00

Format: A2

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)
118A	XEA	L250.22	S235	M30-5.6t	XEA +Plates	L250.22 + Plates	S235 (member), S355 (plates)	M30-8.8t
118B	XEA	L250.22	S235	M30-5.6t	XEA +Plates	L250.22 + Plates	S235 (member), S355 (plates)	M30-8.8t
119A	XEA	L250.24	S235	M30-5.6t	XEA +Plates	L250.24 + Plates	S235 (member), S355 (plates)	M30-8.8t
119B	XEA	L250.24	S235	M24-5.6t	XEA +Plates	L250.24 + Plates	S235 (member), S355 (plates)	M24-8.8t
121B	XEA	INP 425	S235	M24-5.6t	XEA +Plates	INP 425 + Plates	S235 (member), S355 (plates)	M24-8.8t
414	EA	L70.7	S235	M16-5.6t	DEA	L70.7	S235 (existing) S355 (new)	M16-8.8t
415	EA	L65.7	S235	M16-5.6t	DEA	L65.7	S235 (existing) S355 (new)	M16-8.8t
212T	EA	L80.8	S235	M20-5.6t	EA	L100.10	S355	M20-8.8t
317	EA	L60.6	S235	M16-5.6t	EA	L60.6	S355	M16-8.8t
114A	EA	L250.22	S235	M30-5.6t	EA	L250.22	S235	M30-5.6t
114C	EA	L250.22	S235		EA	L250.22	S235	
216L	UA	L150.100.12	S235	M30-5.6t	UA	L150.100.12	S235	M30-8.8t
217L	UA	L150.100.12	S235	M30-5.6t	UA	L150.100.12	S235	M30-8.8t
115A	XEA	L200.20	S235	M30-5.6t	XEA +Plates	L200.20 + Plates	S235 (member), S355 (plates)	M30-8.8t
116A	XEA	L250.20	S235	M30-5.6t	XEA +Plates	L250.20 + Plates	S235 (member), S355 (plates)	M30-8.8t
116B	XEA	L250.20	S235	M30-5.6t	XEA +Plates	L250.20 + Plates	S235 (member), S355 (plates)	M30-8.8t
117A	XEA	L250.20	S235	M30-5.6t	XEA +Plates	L250.20 + Plates	S235 (member), S355 (plates)	M30-8.8t
117B	XEA	L250.20	S235	M30-5.6t	XEA +Plates	L250.20 + Plates	S235 (member), S355 (plates)	M30-8.8t
620	EA	L80.8	S235	M20-5.6t	EA	L80.8	S355	M20-8.8t
369	EA	L100.10	S235	M24-5.6t	EA	L120.10	S355	M24-8.8t
325	EA	L100.8	S235	M20-5.6t	EA	L100.10	S355	M20-8.8t
326	EA	L80.8	S235	M16-5.6t	EA	L100.10	S355	M20-8.8t
327	EA	L80.8	S235	M20-5.6t	EA	L100.10	S355	M20-8.8t
328	EA	L70.7	S235	M20-5.6t	EA	L100.8	S355	M20-8.8t
329	EA	L70.7	S235	M20-5.6t	EA	L100.8	S355	M20-8.8t
172	EA	L60.6	S235	M16-5.6t	EA	L60.6	S355	M16-8.8t
160	EA	L50.5	S235	M16-5.6t	EA	L60.8	S355	M16-8.8t
159	EA	L50.5	S235	M16-5.6t	EA	L60.8	S355	M16-8.8t
170	EA	L60.6	S235	M16-5.6t	EA	L60.6	S355	M16-8.8t
169	EA	L50.5	S235	M16-5.6t	EA	L55.6	S355	M16-8.8t
158	EA	L50.5	S235	M16-5.6t	EA	L60.8	S355	M16-8.8t
157	EA	L50.5	S235	M16-5.6t	EA	L60.8	S355	M16-8.8t
167	EA	L50.5	S235	M16-5.6t	EA	L55.6	S355	M16-8.8t
156	EA	L50.5	S235	M16-5.6t	EA	L60.8	S355	M16-8.8t
155	EA	L50.5	S235	M16-5.6t	EA	L60.6	S355	M16-8.8t
154	EA	L50.5	S235	M16-5.6t	EA	L55.6	S355	M16-8.8t
153	EA	L50.5	S235	M16-5.6t	EA	L60.6	S355	M16-8.8t
BR9	EA				EA	L50.5	S355	M16-8.8t
BR10	EA				EA	L50.5	S355	M16-8.8t
BR11	EA				EA	L50.5	S355	M16-8.8t
BR12	EA				EA	L50.5	S355	M16-8.8t
RS1	EA				EA	L60.6	S355	M16-8.8t
RS2	EA				EA	L70.7	S355	M16-8.8t
RS3	EA				EA	L80.6	S355	M16-8.8t
RS4	EA				EA	L80.6	S355	M16-8.8t
RS5	EA				EA	L80.6	S355	M16-8.8t
RS6	EA				EA	L70.7	S355	M16-8.8t
RS7	EA				EA	L70.7	S355	M16-8.8t
RS8	EA				EA	L60.6	S355	M16-8.8t
RS9	EA				EA	L60.6	S355	M16-8.8t
RS10	EA				EA	L50.5	S355	M16-8.8t

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-037

Design state: FINAL		Scale: -		
Drawn by: MuK	6-10-2020	Units: m		
Checked by: TBR	7-10-2020	Project no: 10166260		
Approved by: JHu	8-10-2020	Company: TenneT		

Description: Modifications overview for mast type S+95 (Mast 12 & 13) Page 4 of 6

Revision: 00

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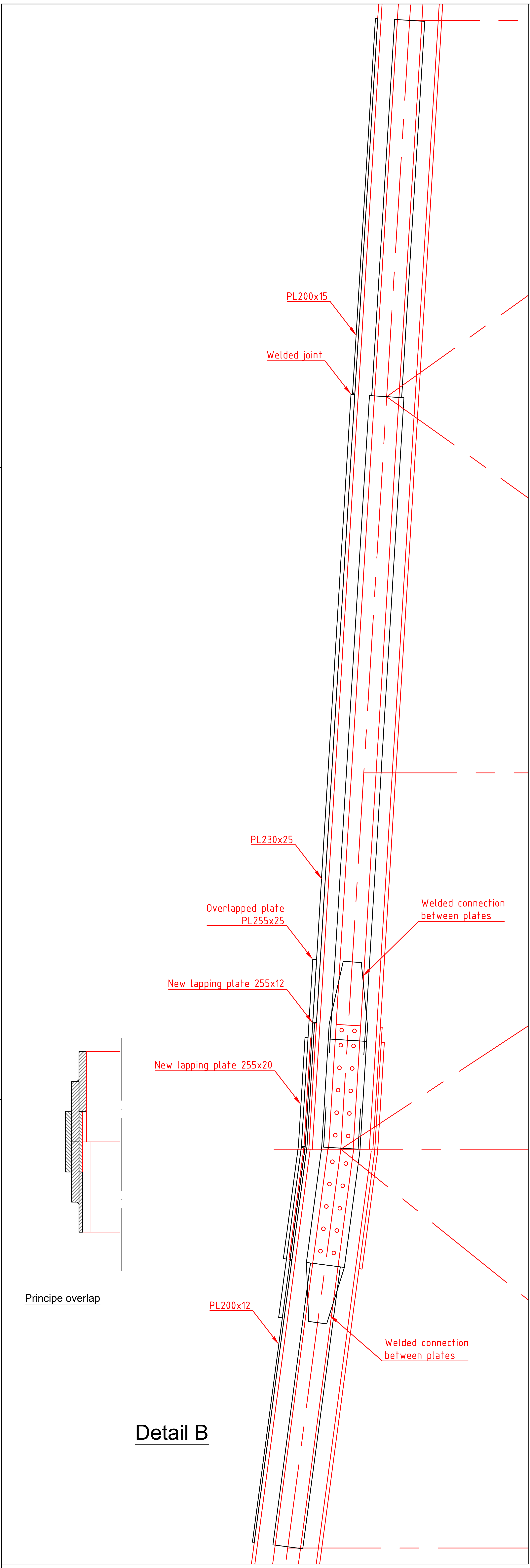

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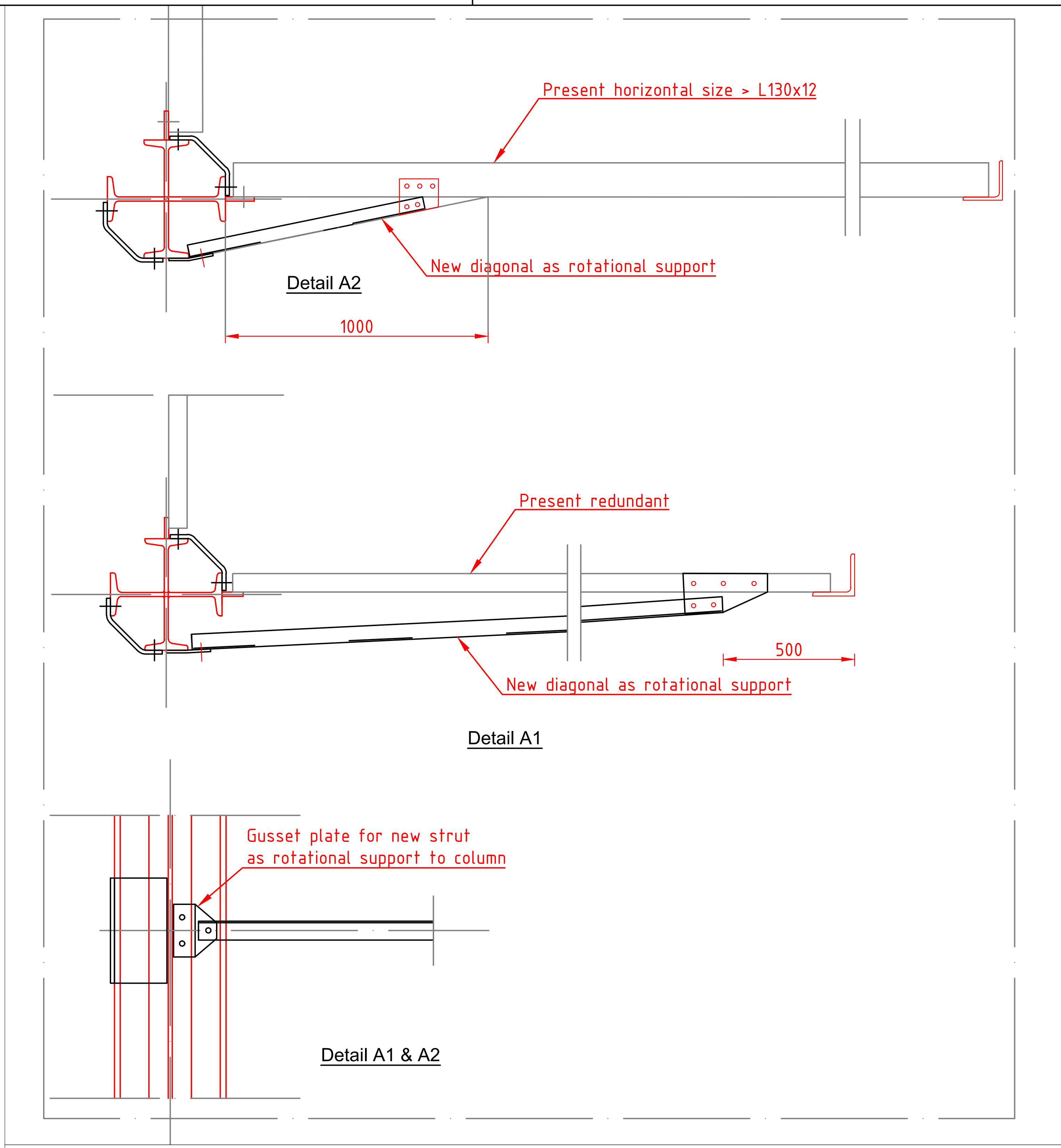

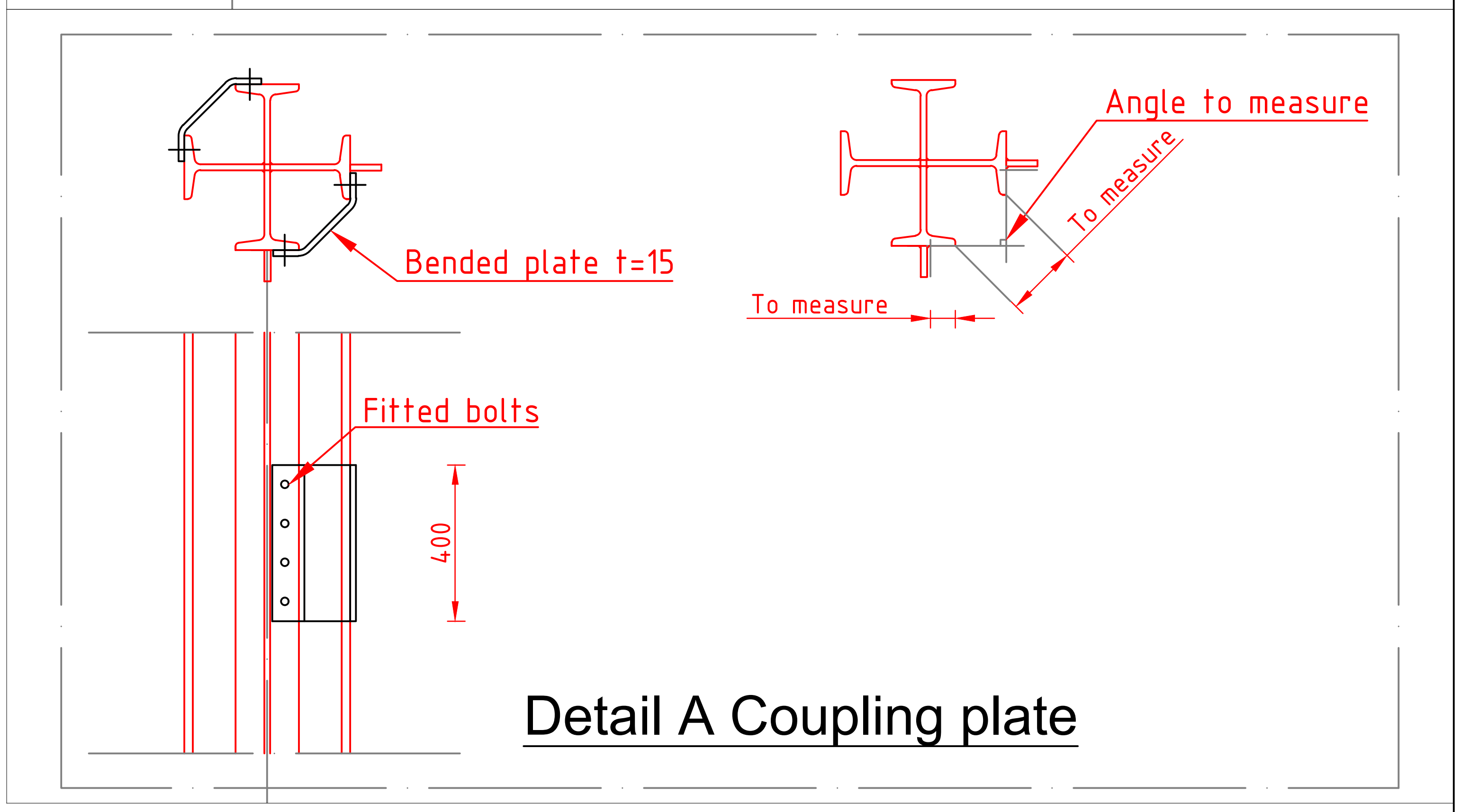

Detail A Coupling plate

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Projectname: Mast constructions KIJ - GT 380 kV			
Third angle projection:	Drawing no.: 10166260-037		
Design state: FINAL	Scale: -	Description: Modifications overview for mast type S+95 (Mast 12 & 13) Page 5 of 6	Revision: 00
Drawn by: MuK 6-10-2020	Units: m		
Checked by: TBR 7-10-2020	Project no: 10166260		Format: A2
Approved by: JHu 8-10-2020	Company: TenneT		

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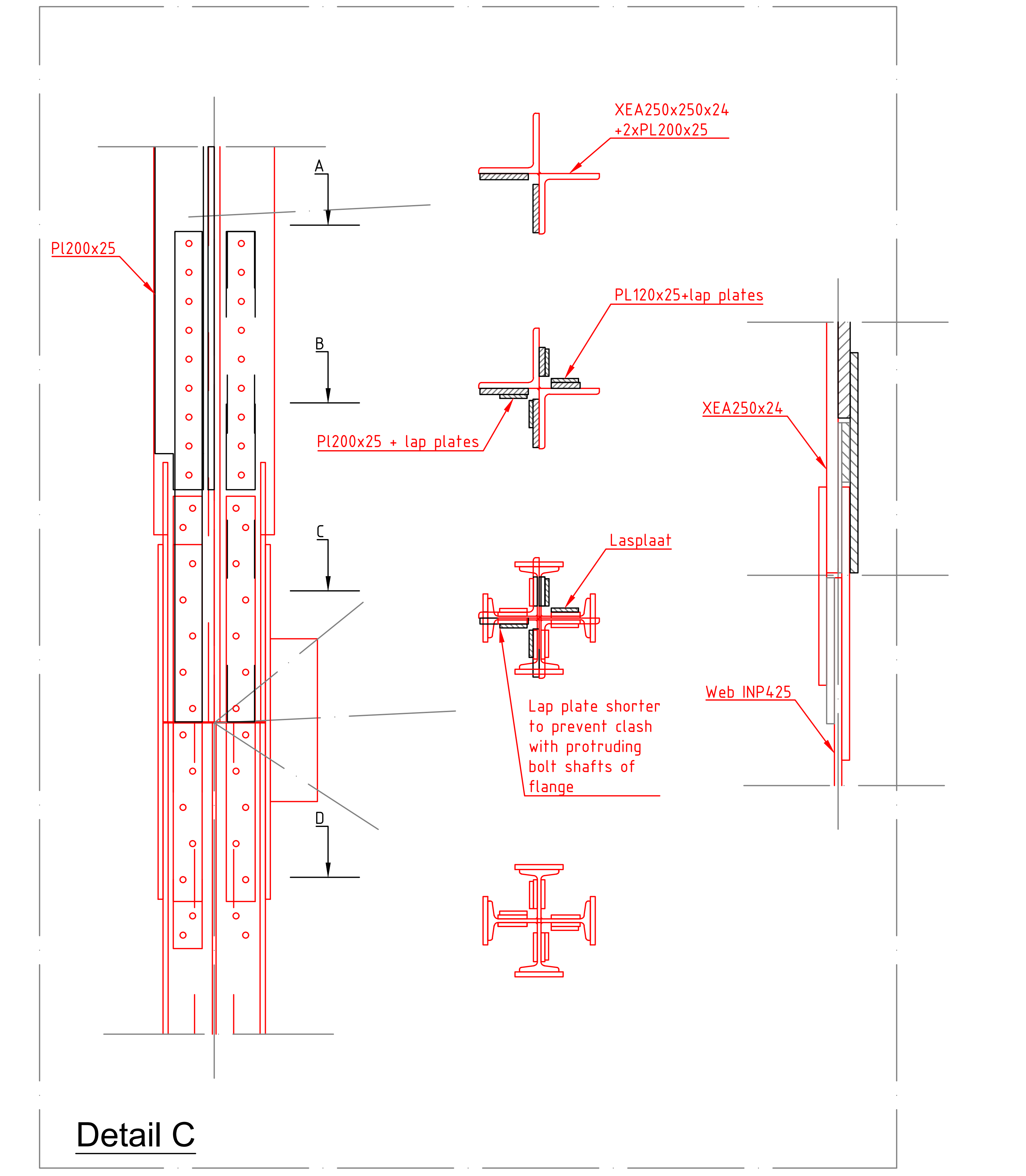

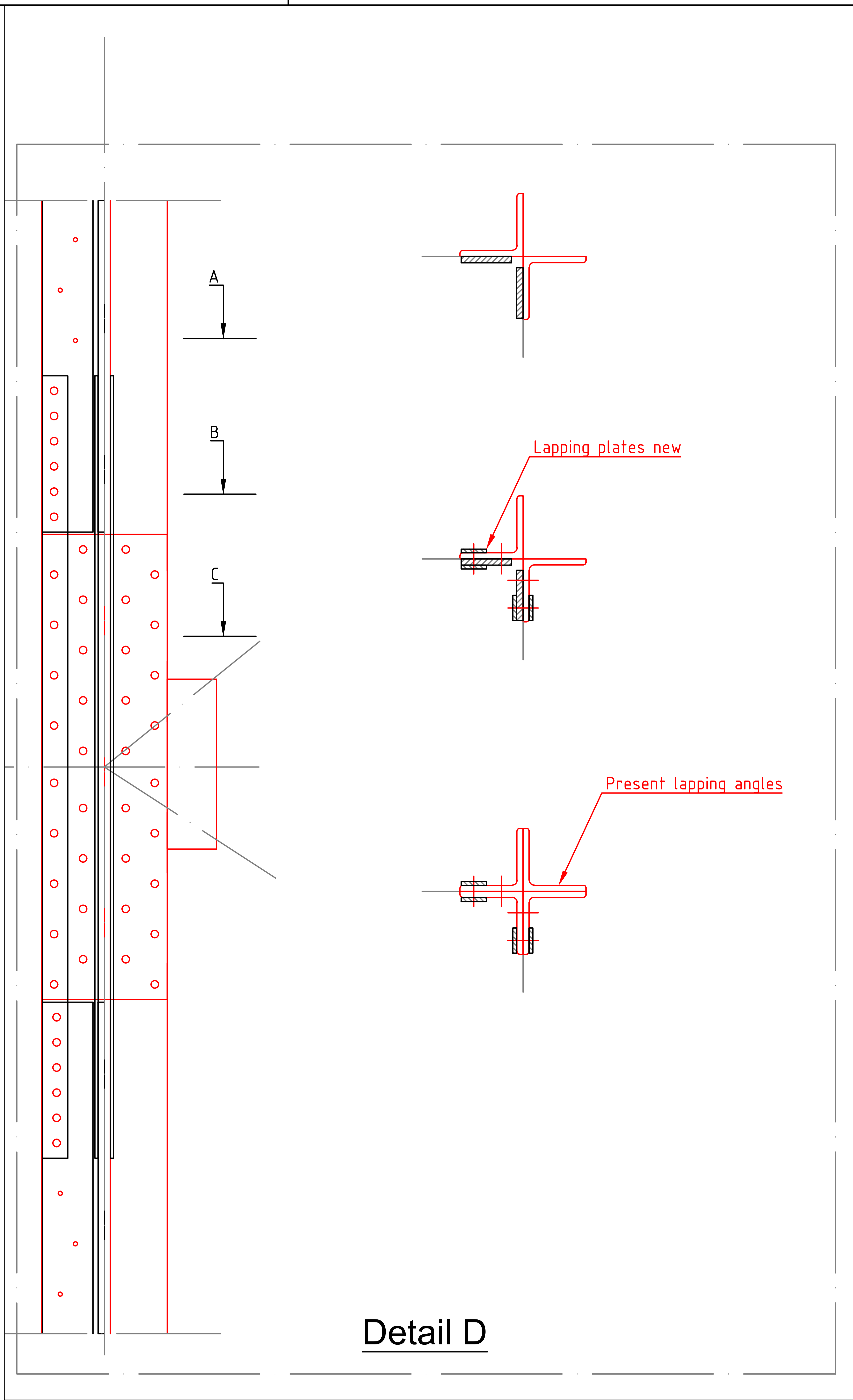

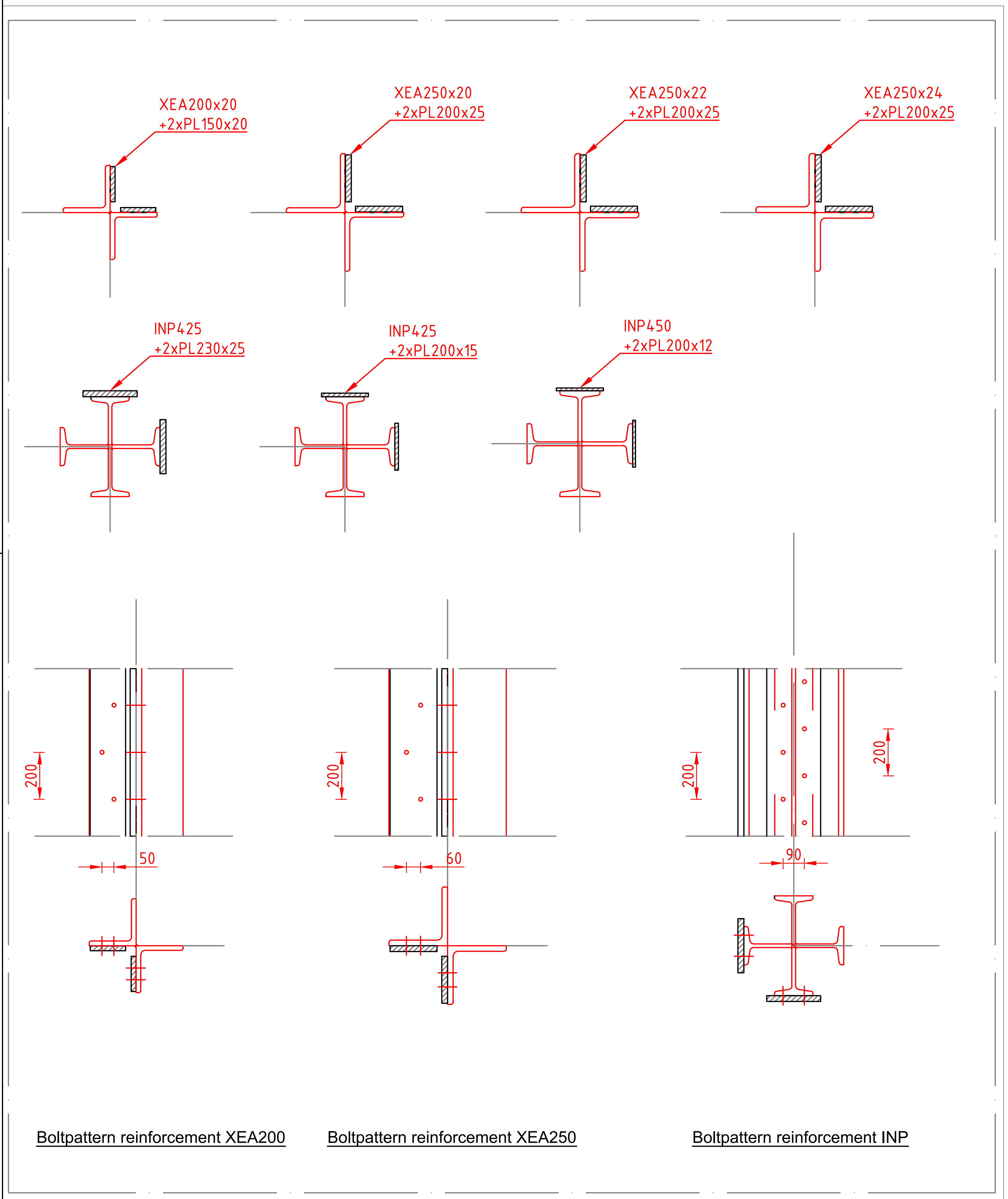

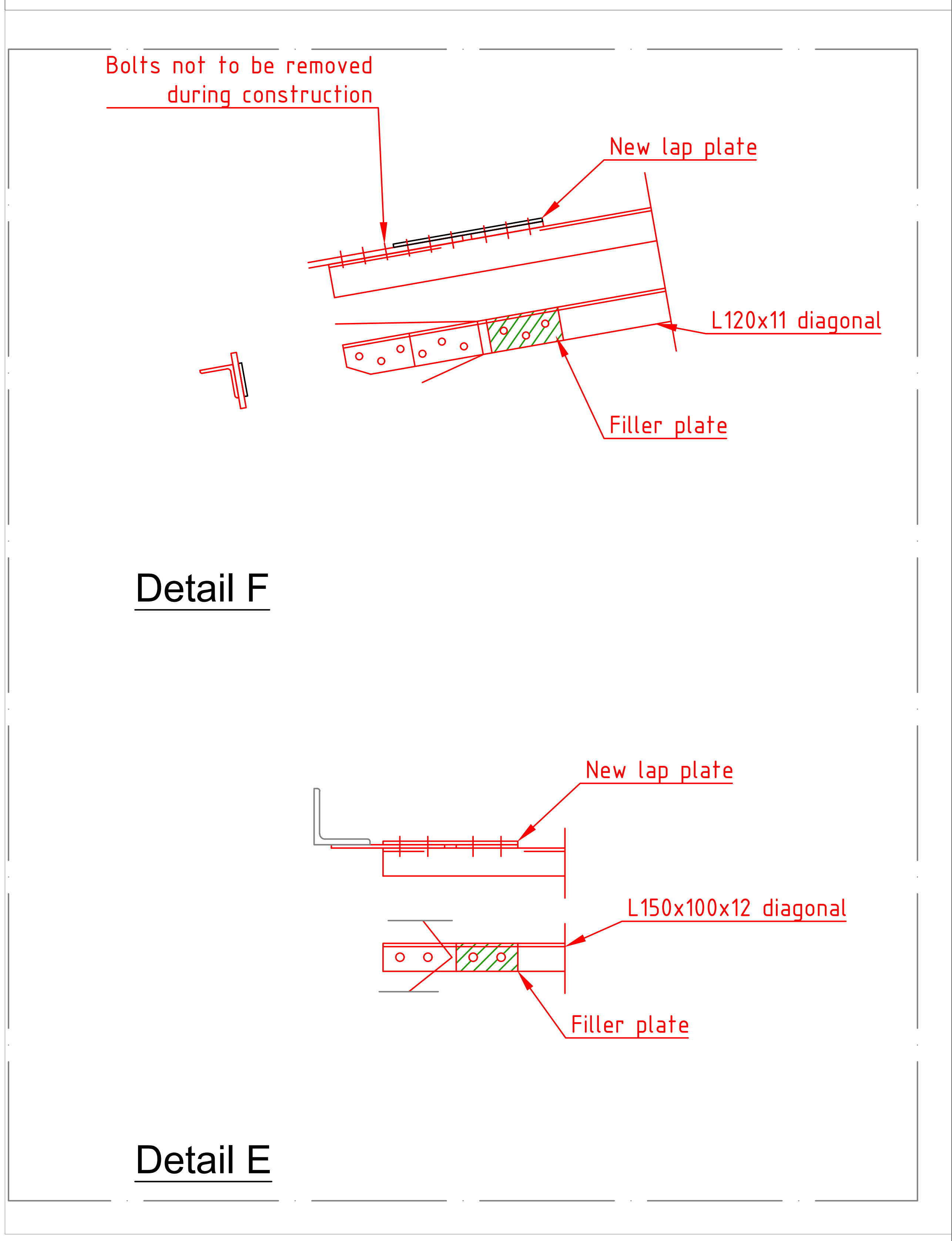

01	7-4-2021	Version 2.0 - Loads calculated according to 15 year return period
00	6-10-2020	Version 1.0

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

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Approved by:	JHu	8-10-2020	Company:	TenneT

Description: Modifications overview for mast type S+95 (Mast 12 & 13)
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APPENDIX F AXIS VM STUDIE

BUCKLING STUDY OF TOWER LEG

Contents

1 INTRODUCTION

1.1 Scope

This report examines the buckling of the INP-cruciform section in the leg of the tower S+95. In the feasibility study of S+95, DNV GL report 20-1581, the main leg was found to have inadequate capacity against torsional buckling. Two causes were found for this:

- the INP-section as a cruciform is sensitive to torsional buckling. It was however designed for flexural buckling only, which leads to insufficient torsional buckling capacity.
- the support against rotation or warping of the cross section provided by the rest of the structure is ineffective, since it was solely designed to support against flexural buckling. This leads to further reduction of capacity.

The impact of the initially proposed strengthening measures was considered disproportional, since it meant to reinforce all the tower leg section with plates up to the height of the cross arm. Furthermore all of the redundant members needed to be exchanged. Assignment was given to DNV GL to investigate a more economical solution.

First of all, based upon TNO risk assessment, it was possible to reduce the load level to afkeurniveau 15 yr instead of 30 yr. Still however, significant over-utilisation occurred in the tower leg members. To increase the capacity of the main leg three modifications were proposed. In descending order of ease of construction:

- Reinforcing the INP-section with plates. This was proposed only at locations with load level above or nearby yield strength of steel material
- Coupling the flanges with plates to increase the torsional resistance
- adding supports against warping of the section.

After the calculations were performed, the solution would include all of the tree above measures. The reinforcing with plates was however only locally needed at the height of the inclination change, where the transition from INP450 to INP425 section takes place.

The goal of the study described in this appendix is to find the capacity for torsional buckling of the main leg after applying the three solutions above. At first the initial structure is included. In Chapter 2 the method of the study is described. In chapter 3 the results are presented.

1.2 Capacity of not-reinforced structure

The capacity of the main leg in the not-reinforced structure or initial structure was derived with the AxisVM-model to the stability in the feasibility study of S+95. The result of the AxisVM buckling study was the "n-value", the ratio between load and theoretical buckling capacity. With a spreadsheet, the capacity based upon the n-value and the Eurocode buckling curves was derived. The output of spreadsheet is included on next pages. The results are summarised in table below and checked against afkeurlevel 15 yr. loads. It is clear that the structure has insufficient capacity. For explanation of "height" see Figure 2-1 next section.

Tabel 1 capacity of main leg in initial structure

Section	Height	n-value	Load	Capacity	U.C.
INP425	ID10-ID12	2,61	6000	5111	1,17
INP450	ID1-ID10	2,4	6000	5414	1,11

Torsieknik

Versie: 1.4

Onderwerp	Randstijl S+95 (initial structure)	*Toetsing*		
Profiel	INP425x2 v1	U.C.	1.09	Voldoet niet

Normaalkracht

$N_{c;s;d}$ = 6000.0 kN

Staalsoort	S235	
Doorsnedeklasse:	1	Geldig
Gewicht	2.08	kN/m

Doorsnedegrootheden

I_y	I_z	I_v	A
$10^4\,mm^4$	$10^4\,mm^4$	$10^4\,mm^4$	mm^4
38710	38710	38710	26474

I_t	I_{wa}
$10^4\,mm^4$	mm^4
429	1.119E+12

Geometrie

$l_{y;buc}$ =	2.50	m
$l_{z;buc}$ =	2.50	m
$l_{v;buc}$ =	2.50	m
l_{tk} =	2.50	m
Steun 1	Gaffel	
Steun 2	Gaffel	
Classificatie	Geschoord	

Doorsnedecapaciteit

$N_{pl;d} = A \times f_{y;d}$ = 6221 kN

Knikstabiliteit y-as

$\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$	0.22	-
$\chi_{y;buc}$ = (kromme b)	0.99	-
$N_{b,Rd} = \chi A f_y$ =	6177	kN
U.C.	**0.97**	Voldoet

Knikstabiliteit z-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0.22	-
$\chi_{z;buc}$ = (kromme b)	0.99	-
$N_{b,Rd} = \chi A f_y$ =	6177	kN
U.C.	**0.97**	Voldoet

Knikstabiliteit v-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0.22	-
$\lambda_{eff} = 0{,}10+0{,}80\,\lambda =$	0.28	-
$\chi_{z;buc}$ = (kromme b)	0.97	-
$N_{b,Rd} = \chi A f_y$ =	6052	kN
U.C.	**0.99**	Voldoet

Torsieknikstabiliteit

$i_0^2 = i_y^2 + i_z^2 + y_0^2$ =	29244	mm^2
$\beta = 1 - y_0^2/i_0^2$ =	1.000	-
$F_{y;E} = \pi^2 EI_y / l_y^2$ =	128370	kN
$F_{t;E} = 1/i_0^2(G_d I_t + \pi^2 EI_{wa}/l_{t;buc})$ =	24570	kN
$F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E})+\sqrt{(F_{y;E}+F_{t;E})^2-4\beta^2 F_{y;E}F_{t;E}})$		
$F_{tk;E}$ =	24570	kN
$\lambda_{tk;rel} = \sqrt{N_{Rd} / F_{tk;E}}$ =	0.50	-
$\chi_{z;buc}$ = (kromme b)	0.883	-
$N_{b,Rd} = \chi A f_y$ =	5492	kN
U.C.	**1.09**	Voldoet niet

Buckling length with FEM-software		
n-value	2.61	
N_{Ed} =	6000	kN
$N_{cr;E} = n \times N_{Ed}$ =	15660	kN
$N_{pl,Rd}$ =	6221	kN
$\lambda_{rel} = \sqrt{N_{pl;Rd} / N_{cr;E}}$ =	0.63	-
χ_{buc} = (curve b)	0.82	-
$N_{b,Rd} = \chi A f_y / \gamma_{M1}$ =	**5111**	kN
U.C. =	1.17	Voldoet niet

Torsieknik

Versie: 1.4

Onderwerp	Randstijl S+95 (initial structure)	*Toetsing*		
Profiel	INP450x2 v1	U.C.	**1.02**	Voldoet niet

Normaalkracht

$N_{c;s;d}$ = **6000.0** kN

Staalsoort: **S235**

Doorsnedeklasse: **1** Geldig

Gewicht: 2.29 kN/m

Doorsnedegrootheden

I_y 10^4 mm^4	I_z 10^4 mm^4	I_v 10^4 mm^4	A mm^2
47510	47510	47510	29191

I_t 10^4 mm^4	I_{wa} mm^4
517	1.483E+12

Geometrie

$l_{y;buc}$ =	3.20	m
$l_{z;buc}$ =	3.20	m
$l_{v;buc}$ =	3.20	m
l_{tk} =	3.20	m
Steun 1	Gaffel	
Steun 2	Gaffel	
Classificatie	Geschoord	

Doorsnedecapaciteit

$N_{pl;d} = A \times f_{y;d}$ = 6860 kN

Knikstabiliteit y-as

$\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$	0.27	-
$\chi_{y;buc}$ = (kromme b)	0.98	-
$N_{b,Rd} = \chi A f_y$ =	6696	kN
U.C.	**0.90**	Voldoet

Knikstabiliteit z-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0.27	-
$\chi_{z;buc}$ = (kromme b)	0.98	-
$N_{b,Rd} = \chi A f_y$ =	6696	kN
U.C.	**0.90**	Voldoet

Knikstabiliteit v-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0.27	-
$\lambda_{eff} = 0,10+0,80\ \lambda$ =	0.31	-
$\chi_{z;buc}$ = (kromme b)	0.96	-
$N_{b,Rd} = \chi A f_y$ =	6579	kN
U.C.	**0.91**	Voldoet

Torsieknikstabiliteit

$i_0^2 = i_y^2 + i_z^2 + y_0^2$ =	32551	mm^2
$\beta = 1 - y_0^2/i_0^2$ =	1.000	-
$F_{y;E} = \pi^2 E I_y / l_y^2$ =	96162	kN
$F_{t;E} = 1/i_0^2(G_d I_t + \pi^2 E I_{wa}/l_{t;buc})$ =	22097	kN
$F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E})+\sqrt{(F_{y;E}+F_{t;E})^2-4\beta^2 F_{y;E}F_{t;E}})$		
$F_{tk;E}$ =	22097	kN
$\lambda_{tk;rel} = \sqrt{N_{Rd} / F_{tk;E}}$ =	0.56	-
$\chi_{z;buc}$ = (kromme b)	0.858	-
$N_{b,Rd} = \chi A f_y$ =	5886	kN
U.C.	**1.02**	Voldoet niet

Buckling length with FEM-software		
n-value	2.4	
N_{Ed} =	6000	kN
$N_{cr;E} = n \times N_{Ed}$ =	14400	kN
$N_{pl,Rd}$ =	6860	kN
$\lambda_{rel} = \sqrt{N_{pl;Rd} / N_{cr;E}}$ =	0.69	-
χ_{buc} = (curve b)	0.79	-
$N_{b,Rd} = \chi A f_y / \gamma_{M1}$ =	**5414**	kN
U.C. =	1.11	Voldoet niet

2 MODEL

The model of the initial structure was expanded to the entire height of the tower section with INP-sections to investigate the stability after applying reinforcements and additional members and plates to support the tower leg.

2.1.1 Scheme

The main leg of the tower is modelled with shell elements in the software package AxisVM. The leg from level of foundation to 53,7 m of height was included in the model.

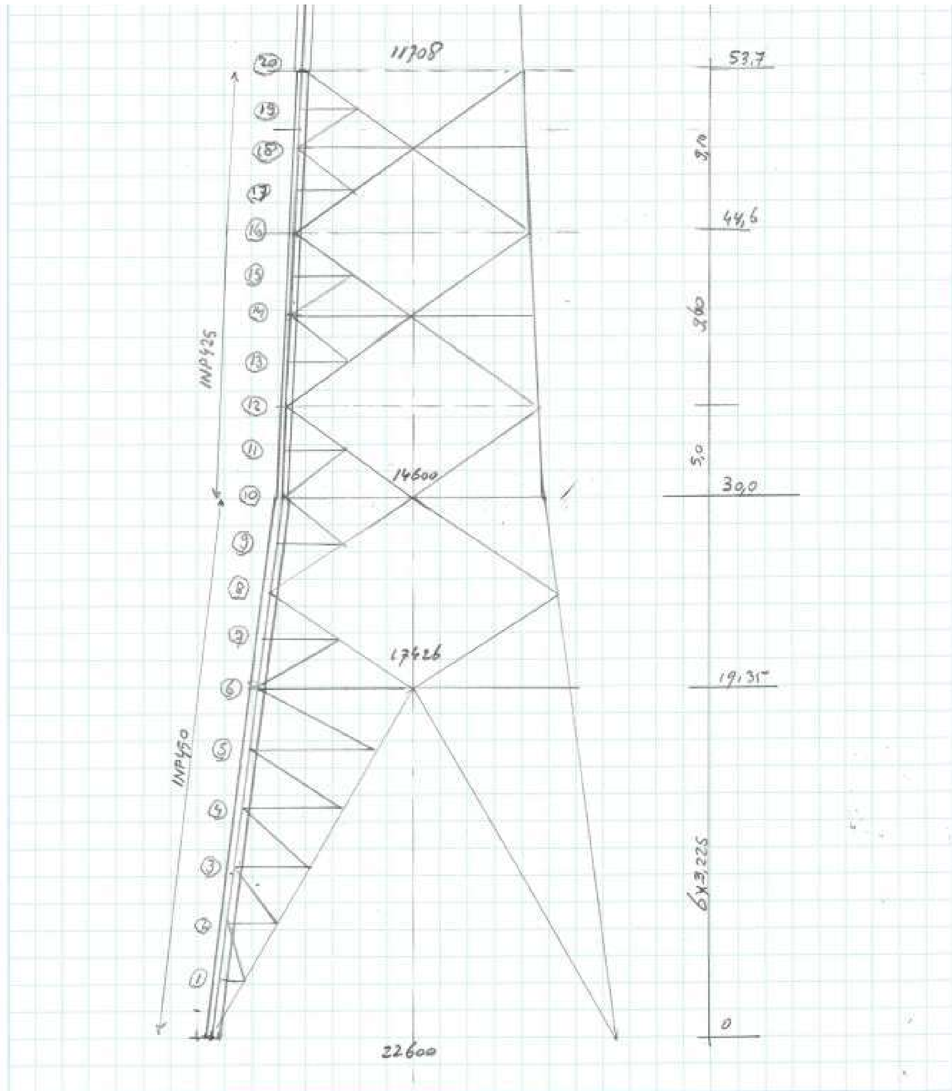


Figure 2-1 schematic of the tower leg for the study

Figure 1 shows the sketch of the S+95 tower. The segments of the INP 450 and 425 profiles between the redundant are marked in numbers 1 to 20 in the figure on the left.

The method of analysis is at first the n-value calculation offered by the software package AxisVM. Secondly linear-elastic calculations as well as physically and geometric nonlinear calculations were performed. The structure is modelled with shell elements.

2.2 Model of main leg

The INP profiles do not have constant flange thickness, see section properties in Appendix D. An equivalent cross-section is derived for the shell-elements with constant flange thickness as illustrated in figure 7. The area for the derived section is kept same as the area of the INP profiles.

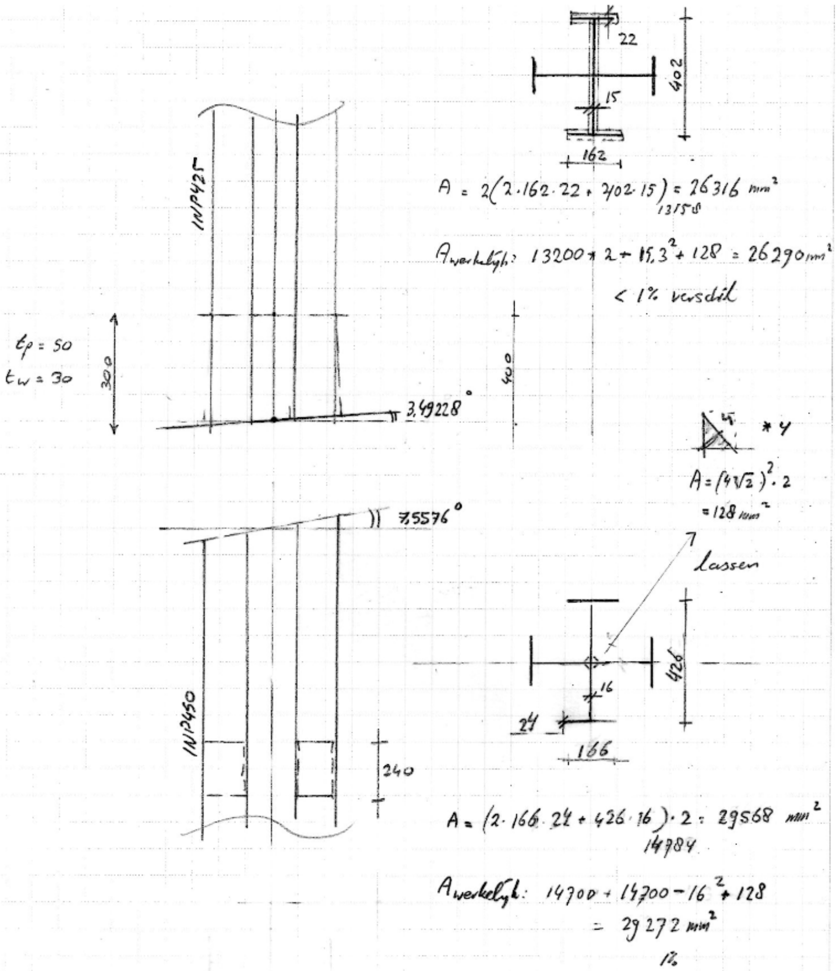


Figure 2-2 Equivalent cross-section for INP 425 and 450 profiles.

The geometry with different plate thickness used to construct the numerical model is shown in the figure 8. The center figure shows the zoomed in view of the hip of the tower leg. The change in slope occurs at this location. Additional plates for connecting the two segments are modelled with a thickness of 50 mm.

The reinforced section of INP425 has a combined thickness of 50 mm (the 230x25 translates into at least 28 mm of added thickness at a width of 162 mm). The INP425 and INP450 with respectively 15 and 12 mm added thickness are modelled as being 36 and 37 mm thick.

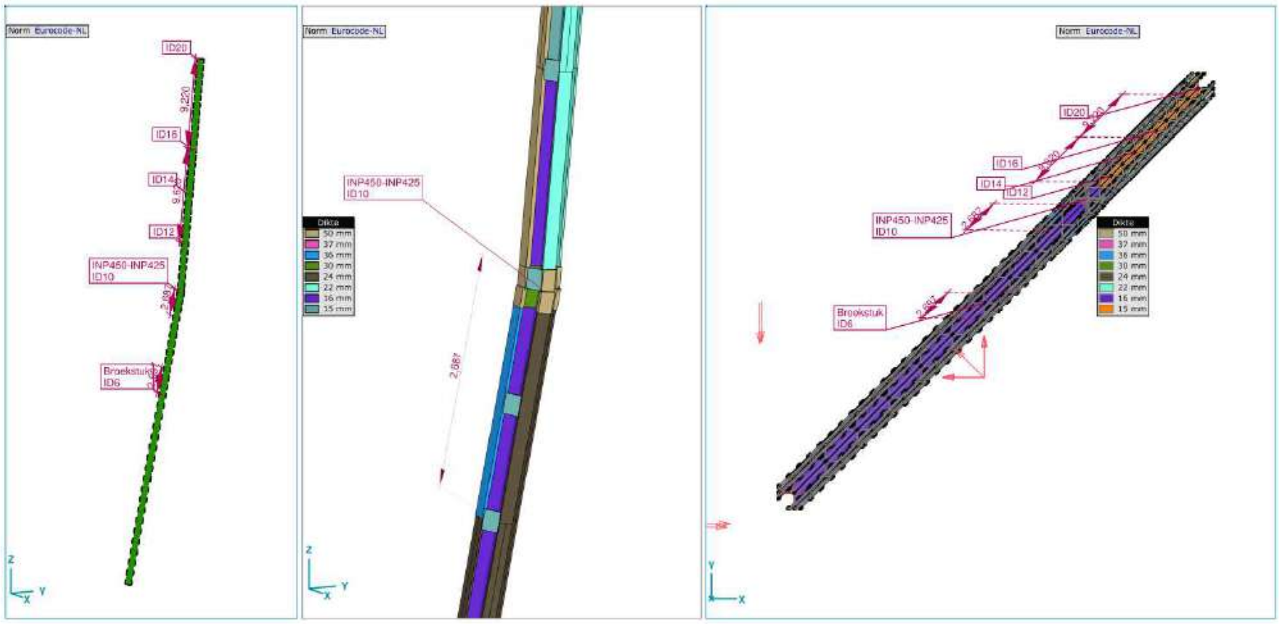


Figure 2-3 Geometry of the tower leg

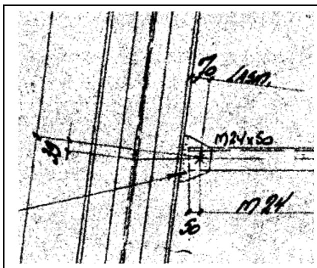
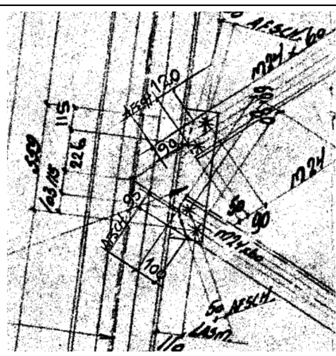
2.3 Support springs

An important part of the modelling is the supports provided to the main leg by the structure. Firstly, the boundary conditions at top and bottom.

- the connection to the foundation. The main leg is considered fixed to translation and rotation for all the axes.
- the connection at top. The main leg is considered fixed here for horizontal translations. Rotations are free.

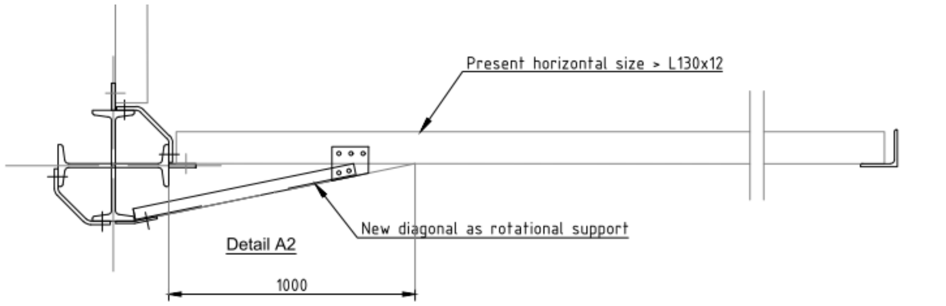
The existing connection of the leg with diagonals, horizontals and redundants via a welded plate is found to be inadequate as a support to warping of the section. These connections will be modified to smaller or larger extent, depending on the location in the structure and if one or two planes are modified. Four type of supports exist in the model:

1. the existing connection of the leg with diagonals, horizontals and redundants via a welded plate.

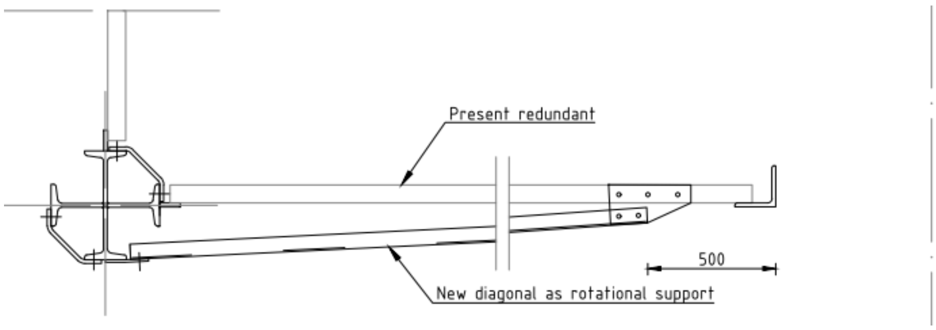
	
Connecting plate in existing situation for horizontal redundants	*Larger gusset plate for main diagonals*

2. the connection of diagonals, horizontals and redundants to the leg connected with an additional strut or support of short length. In this solution the flexural stiffness of the existing member will be activated, the relatively flexible connection with the plate is bypassed via the strut.
3. the addition of a second additional strut in the other plane to activate the bending stiffness of two horizontals instead of one.
4. the addition of an additional strut which extends to the diagonal of the primary bracing. This is the solution when the redundant brings insufficient gain in stiffness.

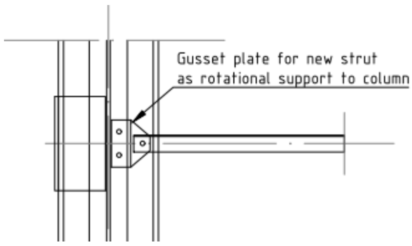
Solution 2 and 3: addition of a strut from main horizontal or diagonal. In solution 3, the strut is in both planes (front and side) of the tower.



Solution 4 comprises a longer strut extending to the main diagonal. In this way no bending of the redundant will occur.



The struts will be connected with a small gusset plate



The redundant and the diagonals connected to the tower leg is simulated via support spring at their corresponding locations. The support springs are calculated in Table 2 to 5.

The adopted solution for each of the joints are tabulated below and shown in Figure 2-4.

Tabel 2 Solutions for increased stiffness of supports

ID	Main leg	Solution supports
1	INP450	2
2	INP450	2
3	INP450	4
4	INP450	4
5	INP450	4

6	INP450	4
7	INP450	2
8	INP450	3
9	INP450	2
10	INP450	3
11	INP425	2
12	INP425	3
13	INP425	2
14	INP425	3
15	INP425	2
16	INP425	3
17	INP425	2
18	INP425	3
19	INP425	2
20	INP425	3

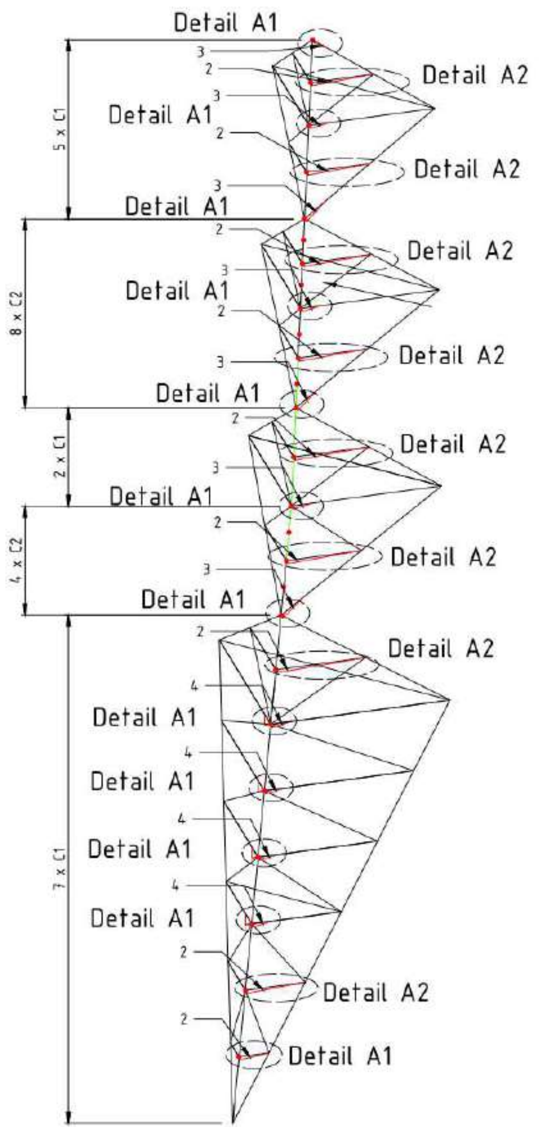


Figure 2-4 Visualisation of adopted solutions, refer to Appendix E

2.3.1 Solution 1

The supports are modelled as line supports over roughly the height of the plate (0,2 m). The lateral stiffness in the plane is given by Rx or Ry depending on the side of the section. The stiffness is chosen arbitrarily at 1 x 10^6 kN/m, the exact value is not important since global buckling of the column is investigated in PLS Tower already. The rotational support provided from connecting beams is modelled as the Rzz-value and needs to be determined first.

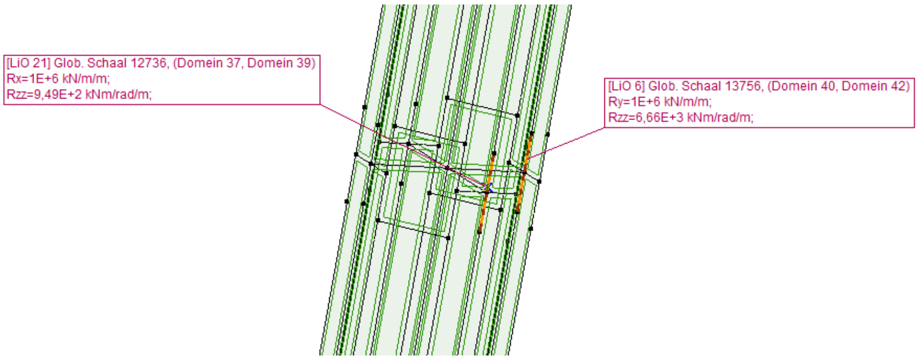


Figure 2-5 Line supports in the model

Each of the members that connect to the joint acts as a support to prevent rotation of the section to its length direction (local x-axis, global Z-axis). The rotational stiffness of the redundant and diagonals and their corresponding connecting plates are calculated as per equations below.

$$C_{beam} = \frac{4EI_1}{l_1 \cdot sin\theta_1} \quad \text{Equation 1}$$

$$C_{beams} = C_1 + C_2 + C_3 \quad \text{Equation 2}$$

$$C_{plates} = \frac{EI}{l} \quad \text{Equation 3}$$

The node ID corresponding to table is used to identify the members associated with a joint in the tower leg. The stiffness of the redundant / diagonals in series add up in series, while the plate and beams are added in parallel as the sum of reciprocal values (equation 4).

$$\frac{1}{C_{rot}} = \frac{1}{c_{beams}} + \frac{1}{c_{plate}} \quad \text{Equation 4}$$

The equivalent rotational stiffness C_{rot} is applied as the K_{zz} in the axis VM models.

The axial and rotational stiffness of the individual redundant and diagonals connected to the tower leg are calculated in table 2. Bold profiles are exchanged profiles.

Table 1 Calculation of stiffness for redundant and diagonals

ID	Section 1	Moment of inertia (I) (mm4)	length (l) (m)	angle (alpha)	C (kNm/rad)
1	**L 80X 80X 8**	722397,8	1,452	82,5	414
2	**L 90X 90X 8**	1043715	3,418	24,9	108
2	L 100X100X8	1448264	2,904	107,5	400
3	L 100X100X10	1766604	4,094	44,7	255
3	L 110X110X10	2386800	4,356	97,5	456
4	L 110X110X10	2386800	5,104	57,8	332

4	L 130X130X12	4721381	5,809	107,5	651
5	L 120X120X11	3406132	6,29	66,3	417
5	L 150X150X10	6414133	7,261	97,5	736
6	L 150X150X10	6414133	7,569	72	677
6	L 150X150X10	6414133	8,713	97,5	613
6	**L 110X110X10**	2386800	5,32	129,2	292
7	L 110X110X10	2386800	4,155	107,5	460
8	L 180X180X16	17000000	9,626	63,8	1331
8	L 180X180X16	17000000	9,628	131,3	1114
9	L 100X100X10	1766604	3,65	97,5	403
10	L 100X100X8	1448264	4,245	58,5	244
10	L 250X250X22	62000000	7,3	97,5	7073
10	**L 100X100X10**	1766604	4,553	130,8	247
11	L 100X100X10	1766604	3,31	93,5	447
12	L 160X160X15	11000000	8,35	58	938
12	L 160X160X15	11000000	8,32	129	863
13	L 100X100X8	1448264	3,15	93,5	385
14	**L 100X100X10**	1766604	3,8	55,4	321
14	L 150X150X12	7368515	6,43	93,5	961
14	**L 100X100X10**	1766604	3,8	126	316
15	L 100X100X8	1448264	3,08	93,5	394
16	L 150X150X16	9496198	7,63	57,8	885
16	L 150X150X16	9496198	7,7	130,1	792
17	L 100X100X8	1448264	2,84	93,5	428
18	**L 100X100X8**	1448264	3,57	54	276
18	L 130X130X12	4721381	5,64	93,5	702
18	**L 100X100X8**	1448264	3,58	128	268
19	L 100X100X8	1448264	2,8	93,5	434
20	L 150X150X16	9496198	7	57	956
20	L 150X150X12	7368515	7	130	677

In the second table the stiffness of the plates can be seen. The plates are the weak point in the connection, even considering their small length. For the length the distance from flange to bolt was used.

ID	b(mm)	t(mm)	l(mm)	EI (kNm²)	EI/l (kNm)
1	150	10	60	2,63	43,8
2	260	10	70	4,55	65,0
3	260	10	70	4,55	65,0
4	260	10	70	4,55	65,0
5	260	10	70	4,55	65,0
6	560	12	100	16,93	169,3
7	370	8	70	3,32	47,4
8	660	12	97	19,96	205,8
9	200	8	70	1,79	25,6
10	690	16	80	49,46	618,2
11	200	8	62,5	1,79	28,7
12	640	16	144	45,88	318,6
13	200	8	62,5	1,79	28,7
14	390	16	80	27,96	349,4
15	200	8	62,5	1,79	28,7
16	660	16	144	47,31	328,5
17	200	8	62,5	1,79	28,7
18	355	10	70	6,21	88,8
19	200	8	62,5	1,79	28,7
20	675	16	112	48,38	432,0

The resulting rotational stiffness of the plates connecting redundant and diagonals connected to the tower leg is calculated in table 3. By division with the height of the line support, the Kzz-value is derived.

Table 2 Calculation of stiffness of connecting plates

ID	Cbeams,tot (kNm/rad)	Cplate (kNm/rad)	Cresult (kNm/rad)	Height of line support (m)	Kzz (kNm/m/rad)
1	414,3	43,8	39,6	0,200	198
2	507,5	65,0	57,6	0,200	288
3	711,3	65,0	59,6	0,200	298
4	983,5	65,0	61,0	0,200	305
5	1152,2	65,0	61,5	0,200	308
6	1582,1	169,3	153,0	0,200	765
7	460,2	47,4	42,9	0,200	215
8	2445,3	205,8	189,8	0,200	949
9	403,1	25,6	24,1	0,200	120
10	7564,3	618,2	571,5	0,200	2858
11	447,5	28,7	26,9	0,200	135
12	1801,5	318,6	270,7	0,200	1354
13	385,5	28,7	26,7	0,200	133
14	1598,2	349,4	286,7	0,200	1434
15	394,2	28,7	26,7	0,200	134
16	1677,1	328,5	274,7	0,200	1374
17	427,6	28,7	26,9	0,200	134
18	1245,3	88,8	82,8	0,200	414
19	433,7	28,7	26,9	0,200	134
20	1633,1	432,0	341,6	0,200	1708

All of the joints will be strengthened with additional supports. The above solution 1 values that represent the current structure, were only used at a certain joint if at only one of the faces an additional strut was applied.

2.3.2 Solution 2

In this case the weak plate and the existing member is completely bypassed by a long strut, thus increasing the rotational stiffness. The solution is modelled by adding a line support with flexural support perpendicular to flange surface.

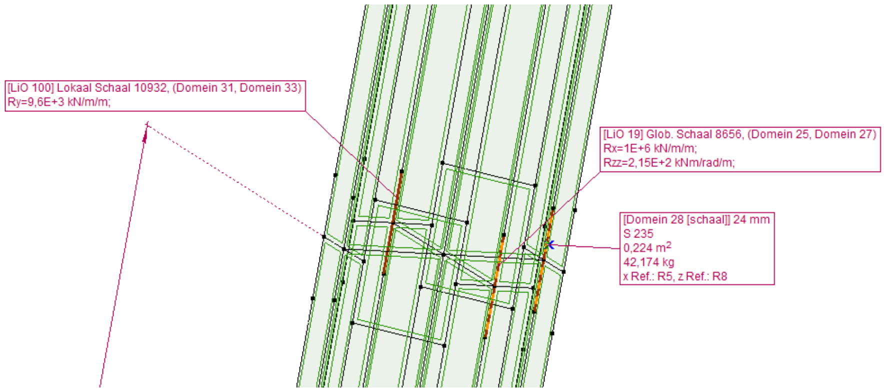


Figure 2-6 Modelling of the additional strut in solution 2

The solution brings additional stiffness, but cannot be considered infinitely stiff since it is still connected to the primary bracing loaded in bending. Alike solution 1, the resulting spring stiffness is composed of two springs acting in parallel, the axial stiffness of the strut and the spring stiffness of the primary bracing out of plane.

Tabel 3 Spring stiffnesses of primary bracing

ID	Primary member	Moment of inertia (I) (mm4)	length (l) (m)	k (kN/m)	C (kNm/rad)	a	Veerstijfheid k1 (kN/m)
1	L 150X150X10	6414133	3,6	1386	1,45	0,225	8943
2	L 150X150X10	6414133	3,6	1386	3,42	0,225	21051
7	L 180X180X16	17000000	9,18	222	4,16	0,225	4090
9	L 180X180X16	17000000	8,8	251	3,65	0,225	4079
11	L 160X160X15	11000000	8,16	204	3,31	0,212	3186
13	L 160X160X15	11000000	7,99	217	3,15	0,212	3230
15	L 150X150X16	9496198	7,695	210	3,08	0,212	3052
17	L 150X150X16	9496198	7,7	210	2,84	0,212	2809
19	L 150X150X12	7368515	7	217	2,80	0,212	2860

In the next step the axial stiffness is calculated of the strut (k2) and combined with the stiffness of the primary bracing (k1) into the resulting stiffness of strut and primary bracing. The K-value was used in the AxisVM model. Comparing k1 and k2 shows that bending of primary member is decisive.

ID	Section 1	Area (mm2)	length (l) (m)	k2 (kN/m)	k1 (kNm/rad)	Effectieve axiale stijfheid	Height of line support (m)	K-value (kN/m/m)
1	L 60X 60X 6	690,9	1,452	99924	8943	4,1E+03	0,2	2,1E+04
2	L 70X 70X 7	939,7	3,418	57736	21051	7,7E+03	0,2	3,9E+04
7	L 80X 80X 8	1226,8	4,155	62003	4090	1,9E+03	0,2	9,6E+03
9	L 70X 70X 7	939,7	3,65	54067	4079	1,9E+03	0,2	9,5E+03
11	L 70X 70X 7	939,7	3,31	59620	3186	1,5E+03	0,2	7,6E+03
13	L 70X 70X 7	939,7	3,15	62649	3230	1,5E+03	0,2	7,7E+03
15	L 70X 70X 7	939,7	3,08	64073	3052	1,5E+03	0,2	7,3E+03
17	L 70X 70X 7	939,7	2,84	69487	2809	1,3E+03	0,2	6,7E+03
19	L 70X 70X 7	939,7	2,8	70480	2860	1,4E+03	0,2	6,9E+03

2.3.3 Solution 3 and 4

In these solution the plate is bypassed, but with a relatively small strut only. It is applicable when the existing member is not too small in size. In situations when more stiffness is needed, members in both planes can be activated by using two struts (solution 4). The application of the struts in the model is similar to solution 1, with a rotational support.

Tabel 4 stiffnesses for solution 3 and 4

ID	Section	Moment of inertia (I) (mm4)	Length	Alpha	C (kNm/rad)	Height of line support (m)	K value (kNm/rad/m)
3	L 110X110X10	2386800	4,356	97,5	456	0,2	2282
4	L 130X130X12	2386800	5,809	107,5	329	0,2	1646
5	L 150X150X10	4721381	7,261	97,5	542	0,2	2708
6	L 150X150X10	6414133	8,713	97,5	613	0,2	3065
8	L 180X180X16	17000000	9,626	63,8	1331	0,2	6655
10	L 250X250X22	62000000	7,3	97,5	7073	0,2	35366
12	L 160X160X15	11000000	8,35	58	938	0,2	4692
14	L 150X150X12	7368515	6,43	93,5	961	0,2	4804
16	L 150X150X16	9496198	7,63	57,8	885	0,2	4423
18	L 130X130X12	4721381	5,64	93,5	702	0,2	3509
20	L 150X150X16	9496198	7	57	956	0,1	9557

The table shows that the stiffness values are considerately higher than solution 1. Especially when two struts are applied, resulting in both supports with increased stiffness.

2.4 Coupling plates

The torsional buckling mode is somewhat comparable to buckling over the weak axis of a single INP-section. That means the flanges bend in their plane, resulting in rotation at the supports. The bending can be reduced by coupling the flanges to another. This is the idea behind the coupling plates. The feasibility study showed that the plates are very effective, however the installing and construction of the plates in an existing structure is not straightforward. In order to be effective, plates are not allowed to have any slippage with the flange. This is hard to avoid when using bolted connections.

Pre-tensioned bolts have the disadvantage that the zinc and coating layer should be removed for effectiveness. In addition the tensioning of the bolts is hindered because flanges are not parallel but perpundicular to another. The only possible bolt types are injection bolts and fitted bolts. Since bolt holes will be drilled in-situ and holes can be chosen equal to bolt diameter, the best solution is considered to be the fitted bolts. Since play is not allowed it is of great importance that the dimensions of the INP-section should be measured beforehand and plates should match the actual dimension.

In the AxisVM model the heigth of the stiffeners was used as 240 mm. Since the effectiveness of the plate is highly dependent on the height, as a safety margin a height of 400 mm is proposed, with allows for application of 4 bolts instead of 3.

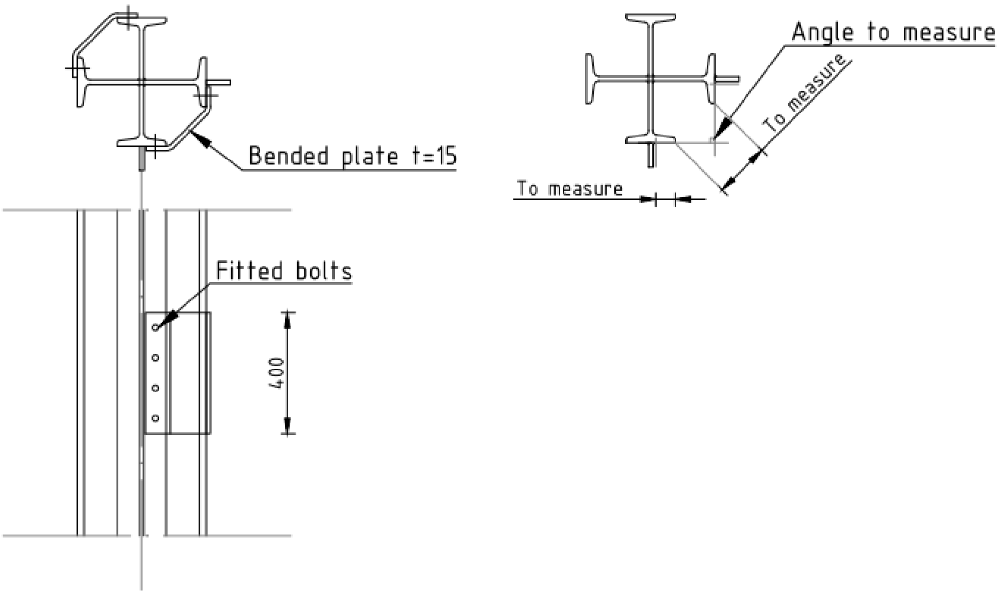


Figure 2-7 Solution with coupling plates

The feasibility study showed that coupling plates should be added at least at every joint in the structure, 2 for every joint. In the final study here, with actual spring stiffnesses, it has turned out that the part of the structure in the vicinity of the inclination change needs to be equipped with two pair of coupling plates each panel between the joints as can be seen in Figure 2-4.

The design of the connection between plate and flange should be done according to Eurocode 1993-1-1 section 6.4.3.1.

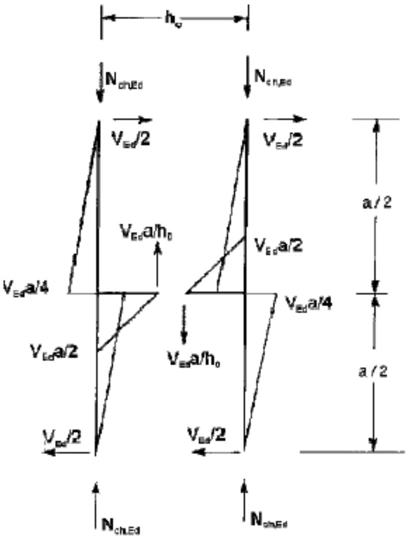


Figure 2-8 Eurocode figure for scheme of coupling plates

For the shear force acting to the ladder frame, the value 1% may be taken of the compression force in the total column, (2% of the flange force) (refer to construeren B of Overspannend staal).

With A_{fl} = 170x23=3910 mm^2 and stress level of 205 N/mm^2:

N_{Ed} = 205 x 3910 = 801 kN

V_{Ed} = 2% x 801 kN

With a = 3,2 m and h = 0,32 m, The shear force acting is equivalent to 3,2 / 0,32 x 1602 x 1% = 160 kN.

The bending moment on the pattern of the bolted connection with the flange is 160 x 0,5 x 0,32 = 25,4 kNm.

2.5 Loading

The loading applied on the tower leg is matched with the compression force seen in the PLS tower model for the design load with a return period of afkeurlevel 15 years. The load is applied as distributed line loads at each main joint. The distributed loads on the web and flange on the INP profiles are calculated in Table 4.

Table 3 calculation of distributed load in the flange and web of cruciform profile

Joint	∆N	N	Prof	Atot	Aweb	Lweb	qweb (kN/m)	Aflange	Lflange	qflange (kN/m)
20	5440	5440	INP425	26316	6030	402	**3101**	3564	162	**4548**
16	260	5700	INP425	26316	6030	402	**148**	3564	162	**217**
12	400	6100	INP425	26316	6030	402	**228**	3564	162	**334**
8	100	6200	INP450	29568	6816	426	**54**	3984	166	**81**
6	-230	5970	INP450	29568	6816	426	**-124**	3984	166	**-187**
3	80	6050	INP450	29568	6816	426	**43**	3984	166	**65**

The loads applied in the Axis VM model are shown in figure 9. The locations of load are applied at the locations marked in red and blue boxes. The locations of load is shown in zoomed view on the right. The thickness of the plates are also shown in figure 9.

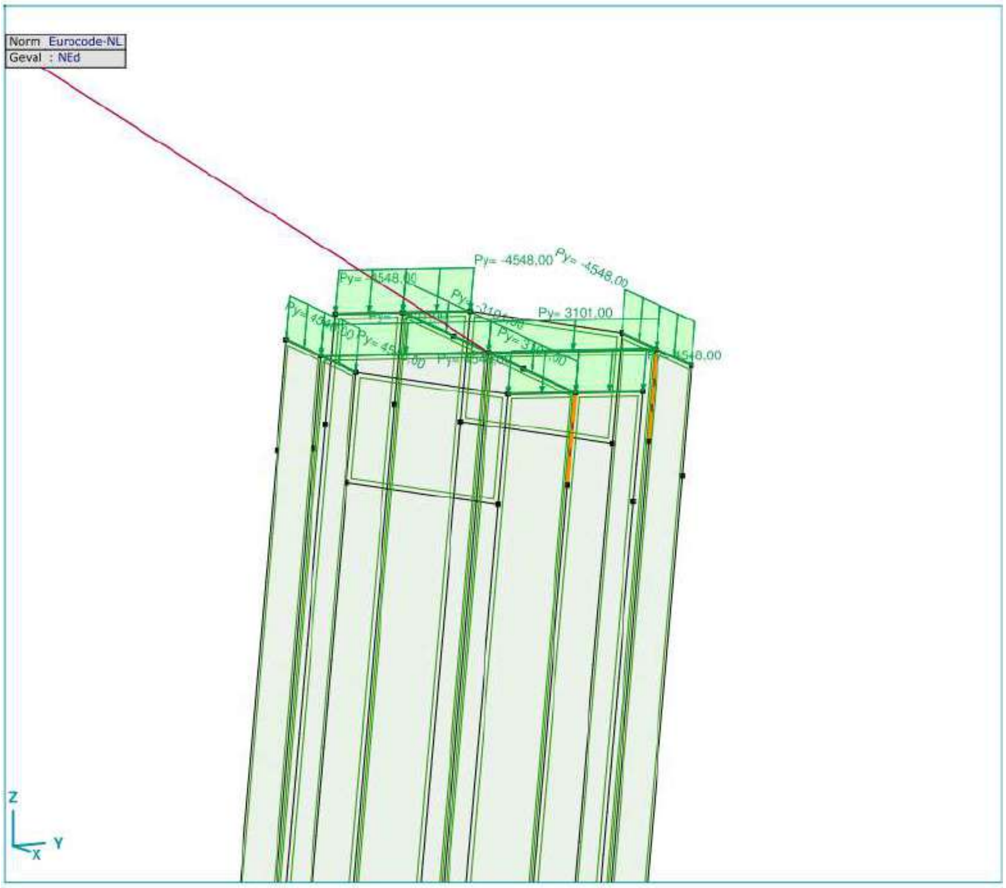


Figure 2-9 Distributed load applied on top of the structure

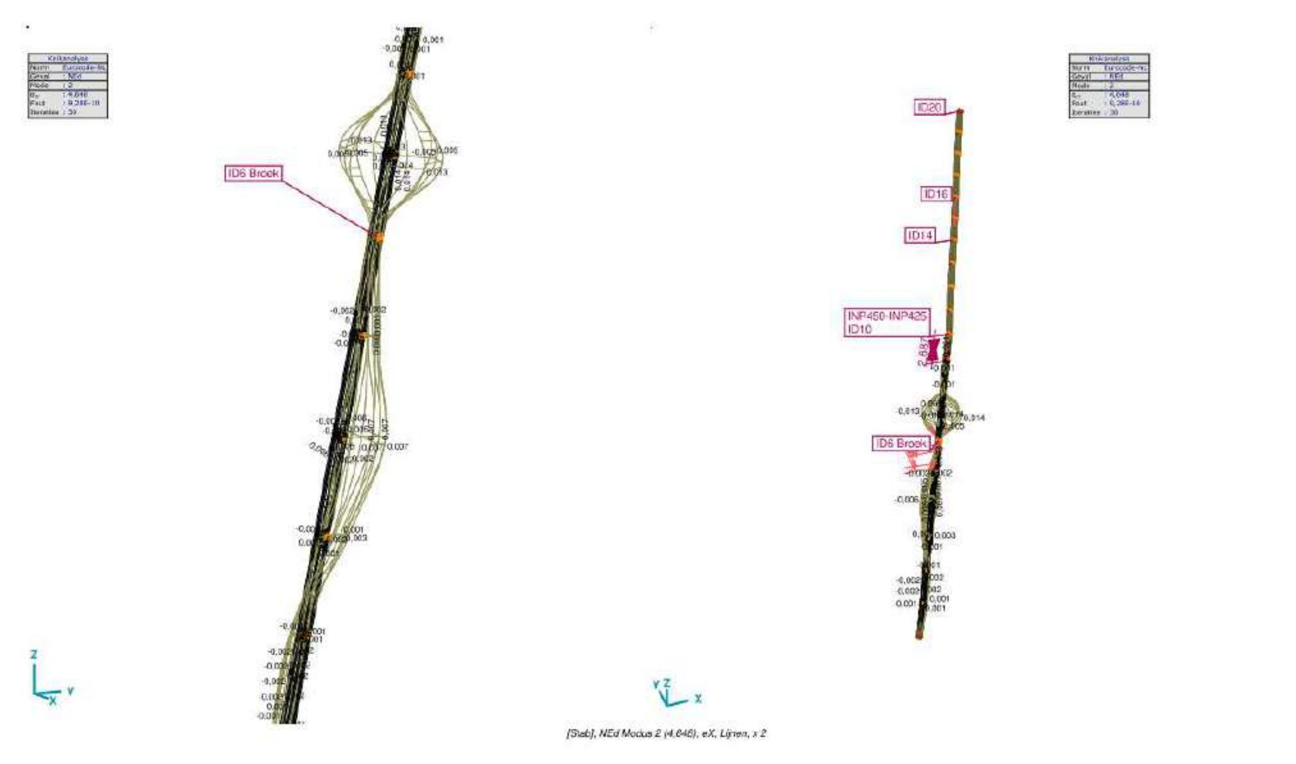
3 RESULTS

The result of the buckling analysis is the eigenvalue or n-value, the ratio between elastic capacity and load. Secondly the elastic stresses have been analysed to verify the stress level at the most critical section, the inclination change.

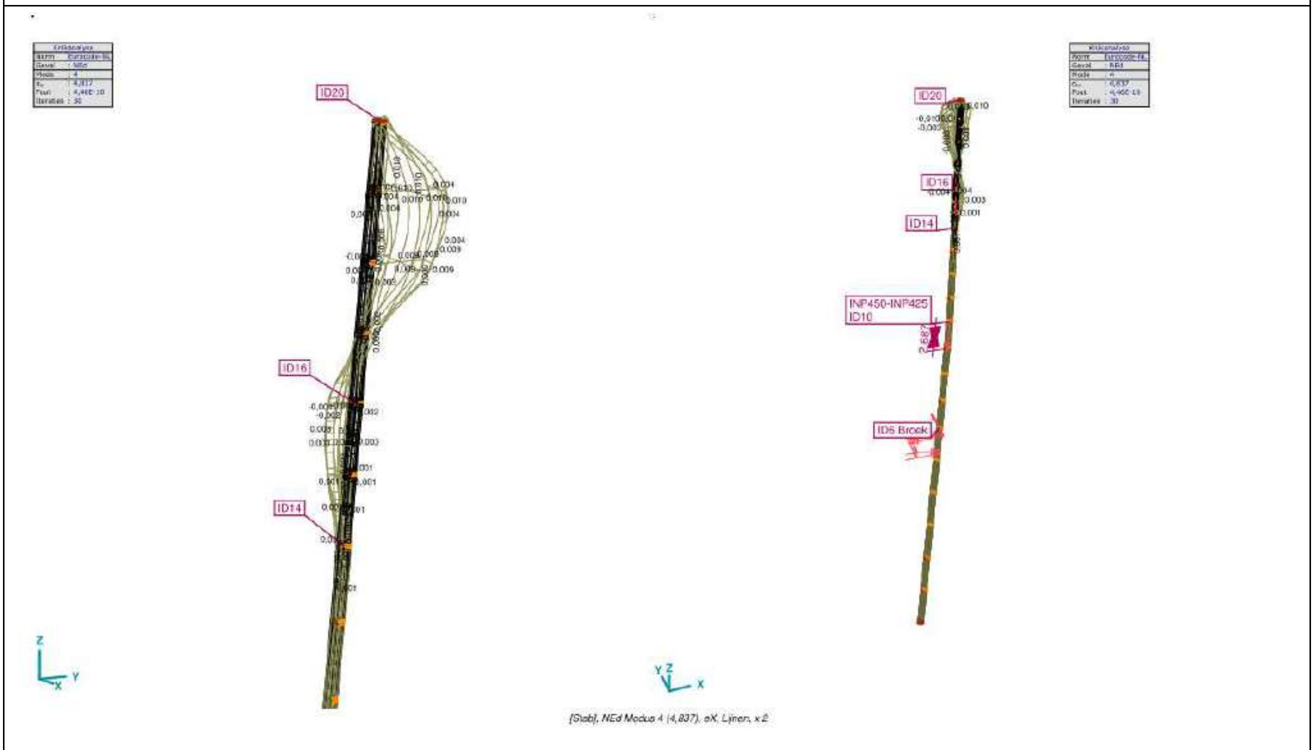
3.1 Buckling analysis

The first 15 buckling modes have been investigated in the AxisVM package. In ascending order, the most important ones will be looked at.

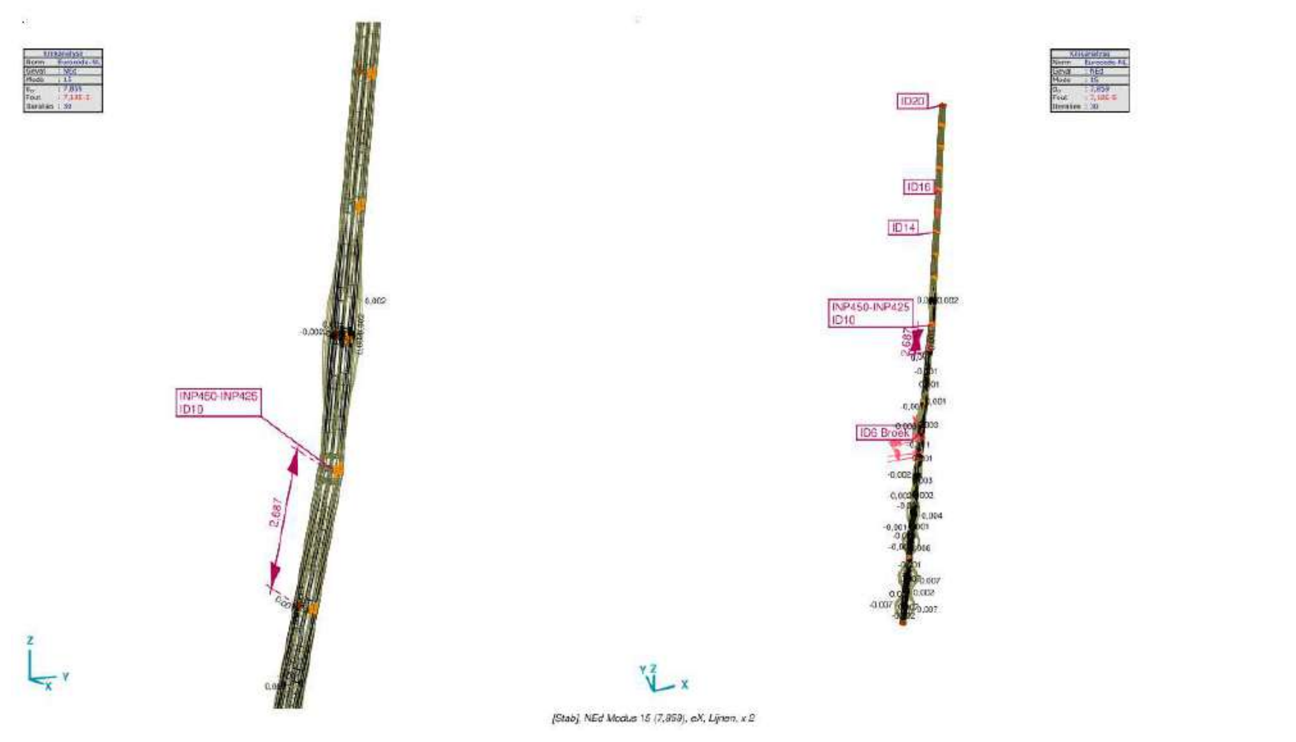
The first mode with n=4,44 occurs lower down in the structure with INP450-section. It is a combination of warping and lateral displacement.



The second mode with slightly higher n=4,64 occurs halfway the height of the broekstuk, with INP450-section. The buckling mode includes a purely torsional mode. The height of the deflected shape is more than the spacing of redundant, indicating the flexible supports.



The third mode is at the same location as the second, so not of interest. The fourth mode is at the top of the structure in the segment with INP425-sections. Its n-value is 4,84.



All of the higher modes occur in the INP450-leg. The final investigated mode shows the deflection at the reinforced part of the INP425 section. The n-value has increased to 7,8.

The buckling analysis shows that lowest n-value of 4,4 occurs in the not reinforced part of the main leg with INP450-section in the hip structure. The second mode of interest after this occurs at top, in the part with INP425-sections. The n-value is 4,8. No buckling mode was observed in the not-reinforced part of the INP425-structure with two coupling plates. The lower boundary for the n-value in that section is at least 7,8. The reinforced part with INP4250-section has a n-value of 7,8.

The n-value is a theoretical value, a second step is necessary to derive the buckling capacity according to Eurocode. This is done with a spreadsheet and included on following pages. The results are summarised in table below. The capacities have been input into PLS-TOWER for the “afk-model”.

Tabel 5 Capacities with Eurocode check

Section	Height	n-value	Load	Capacity	U.C.
INP425	ID16-ID20	4,8	5400	5530	0,98
INP425	ID12-ID16	> 7,8	5700	5825	0,98
INP425+PL230x25	ID10-ID12	7,8	8310	8365	0,99
INP450	ID1-ID10	4,44	6050	6050	1,00

Torsieknik

Versie: 1.4

Onderwerp	**Randstijl S+95**	*Toetsing*	
Profiel	**INP450x2 v1**	U.C.	**1,00** Voldoet

Normaalkracht

$N_{c;s;d}$ = **6050,0** kN

Staalsoort **S235**

Doorsnedeklasse: **1** Geldig

Gewicht 2,29 kN/m

Doorsnedegrootheden

I_y	I_z	I_v	A
10^4 mm^4	10^4 mm^4	10^4 mm^4	mm^4
47510	47510	47510	29191

I_t	I_{wa}
10^4 mm^4	mm^4
517	1,483E+12

Geometrie

$l_{y;buc}$ =	3,20	m
$l_{z;buc}$ =	3,20	m
$l_{v;buc}$ =	3,20	m
l_{tk} =	3,20	m
Steun 1	Gaffel	
Steun 2	Gaffel	
Classificatie	Geschoord	

Doorsnedecapaciteit

$N_{pl;d} = A \times f_{y;d}$ = 6860 kN

Knikstabiliteit y-as

$\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$	0,27	-
$\chi_{y;buc}$ = (kromme b)	0,98	-
$N_{b,Rd} = \chi A f_y$ =	6696	kN
U.C.	**0,90**	Voldoet

Knikstabiliteit z-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,27	-
$\chi_{z;buc}$ = (kromme b)	0,98	-
$N_{b,Rd} = \chi A f_y$ =	6696	kN
U.C.	**0,90**	Voldoet

Knikstabiliteit v-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,27	-
$\lambda_{eff} = 0{,}10+0{,}80\ \lambda =$	0,31	-
$\chi_{z;buc}$ = (kromme b)	0,96	-
$N_{b,Rd} = \chi A f_y$ =	6579	kN
U.C.	**0,92**	Voldoet

Torsieknikstabiliteit

$i_0^2 = i_y^2 + i_z^2 + y_0^2$ =	32551	mm^2
$\beta = 1 - y_0^2/i_0^2$ =	1,000	-
$F_{y;E} = \pi^2 E I_y / l_y^2$ =	96162	kN
$F_{t;E} = 1/i_0^2(G_d I_t + \pi^2 E I_{wa}/l_{t;buc})$ =	22097	kN
$F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E})+\sqrt{(F_{y;E}+F_{t;E})^2-4\beta^2 F_{y;E}F_{t;E}})$		
$F_{tk;E}$ =	22097	kN
$\lambda_{tk;rel} = \sqrt{N_{Rd} / F_{tk;E}}$ =	0,56	-
$\chi_{z;buc}$ = (kromme b)	0,858	-
$N_{b,Rd} = \chi A f_y$ =	5886	kN
U.C.	**1,03**	n-waarde OK

Buckling length with FEM-software		
n-value	4,44	
N_{Ed} =	6050	kN
$N_{cr;E} = n \times N_{Ed}$ =	26862	kN
$N_{pl,Rd}$ =	6860	kN
$\lambda_{rel} = \sqrt{N_{pl;Rd} / N_{cr;E}}$ =	0,51	-
χ_{buc} = (curve =)	0,88	-
$N_{b,Rd} = \chi A f_y / \gamma_{M1}$ =	**6049**	kN
U.C. =	1,00	Voldoet

Torsieknik

Versie: 1.4

Onderwerp	**Randstijl S+95**	*Toetsing*	
Profiel	**INP425x2 v1**	U.C.	**0,98** Voldoet

Normaalkracht

$N_{c;s;d}$ = **5400,0** kN

Staalsoort	**S235**	
Doorsnedeklasse:	**1**	Geldig
Gewicht	2,08	kN/m

Doorsnedegrootheden

I_y	I_z	I_v	A
10^4 mm^4	10^4 mm^4	10^4 mm^4	mm^4
38710	38710	38710	26474

I_t	I_{wa}
10^4 mm^4	mm^4
429	1,119E+12

Geometrie

$l_{y;buc}$ =	2,50	m
$l_{z;buc}$ =	2,50	m
$l_{v;buc}$ =	2,50	m
l_{tk} =	2,50	m
Steun 1	Gaffel	
Steun 2	Gaffel	
Classificatie	Geschoord	

Doorsnedecapaciteit

$N_{pl;d} = A \times f_{y;d}$ = 6221 kN

Knikstabiliteit y-as

$\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$	0,22	-
$\chi_{y;buc}$ = (kromme b)	0,99	-
$N_{b,Rd} = \chi A f_y$ =	6177	kN
U.C.	**0,87**	Voldoet

Knikstabiliteit z-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,22	-
$\chi_{z;buc}$ = (kromme b)	0,99	-
$N_{b,Rd} = \chi A f_y$ =	6177	kN
U.C.	**0,87**	Voldoet

Knikstabiliteit v-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,22	-
$\lambda_{eff} = 0,10 + 0,80\ \lambda$ =	0,28	-
$\chi_{z;buc}$ = (kromme b)	0,97	-
$N_{b,Rd} = \chi A f_y$ =	6052	kN
U.C.	**0,89**	Voldoet

Torsieknikstabiliteit

$i_0^2 = i_y^2 + i_z^2 + y_0^2$ =	29244	mm^2
$\beta = 1 - y_0^2/i_0^2$ =	1,000	-
$F_{y;E} = \pi^2 E I_y / l_y^2$ =	128370	kN
$F_{t;E} = 1/i_0^2 (G_d I_t + \pi^2 E I_{wa} / l_{t;buc})$ =	24570	kN
$F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E})+\sqrt{(F_{y;E}+F_{t;E})^2 - 4\beta^2 F_{y;E} F_{t;E}})$		
$F_{tk;E}$ =	24570	kN
$\lambda_{tk;rel} = \sqrt{N_{Rd} / F_{tk;E}}$ =	0,50	-
$\chi_{z;buc}$ = (kromme b)	0,883	-
$N_{b,Rd} = \chi A f_y$ =	5492	kN
U.C.	**0,98**	Voldoet

Buckling length with FEM-software		
n-value	4,8	
N_{Ed} =	5400	kN
$N_{cr;E} = n \times N_{Ed}$ =	25920	kN
$N_{pl,Rd}$ =	6221	kN
$\lambda_{rel} = \sqrt{N_{pl;Rd} / N_{cr;E}}$ =	0,49	-
χ_{buc} = (curve =)	0,89	-
$N_{b,Rd} = \chi A f_y / \gamma_{M1}$ =	**5529**	kN
U.C. =	0,98	Voldoet

Torsieknik

Versie: 1.4

Onderwerp	**Randstijl S+95 ID12-ID16**	*Toetsing*		
Profiel	**INP425x2 v1**	U.C.	**0,98**	**Voldoet**

Normaalkracht

$N_{c;s;d}$ = **5700,0** kN

Staalsoort	**S235**	
Doorsnedeklasse:	**1**	**Geldig**
Gewicht	2,08	kN/m

Doorsnedegrootheden

I_y	I_z	I_v	A
10^4 mm^4	10^4 mm^4	10^4 mm^4	mm^4
38710	38710	38710	26474

I_t	I_{wa}
10^4 mm^4	mm^4
429	1,119E+12

Geometrie

$l_{y;buc}$ =	2,50	m
$l_{z;buc}$ =	2,50	m
$l_{v;buc}$ =	2,50	m
l_{tk} =	2,50	m
Steun 1	Gaffel	
Steun 2	Gaffel	
Classificatie	Geschoord	

Doorsnedecapaciteit

$N_{pl;d} = A \times f_{y;d}$ = 6221 kN

Knikstabiliteit y-as

$\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$	0,22	-
$\chi_{y;buc}$ = (kromme b)	0,99	-
$N_{b,Rd} = \chi A f_y$ =	6177	kN
U.C.	**0,92**	**Voldoet**

Knikstabiliteit z-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,22	-
$\chi_{z;buc}$ = (kromme b)	0,99	-
$N_{b,Rd} = \chi A f_y$ =	6177	kN
U.C.	**0,92**	**Voldoet**

Knikstabiliteit v-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$	0,22	-
$\lambda_{eff} = 0{,}10+0{,}80\ \lambda =$	0,28	-
$\chi_{z;buc}$ = (kromme b)	0,97	-
$N_{b,Rd} = \chi A f_y$ =	6052	kN
U.C.	**0,94**	**Voldoet**

Torsieknikstabiliteit

$i_0^2 = i_y^2 + i_z^2 + y_0^2$ =	29244	mm^2
$\beta = 1 - y_0^2/i_0^2$ =	1,000	-
$F_{y;E} = \pi^2 E I_y / l_y^2$ =	128370	kN
$F_{t;E} = 1/i_0^2(G_d I_t + \pi^2 E I_{wa}/l_{t;buc})$ =	24570	kN
$F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E})+\sqrt{(F_{y;E}+F_{t;E})^2-4\beta^2 F_{y;E}F_{t;E}})$		
$F_{tk;E}$ =	24570	kN
$\lambda_{tk;rel} = \sqrt{N_{Rd} / F_{tk;E}}$ =	0,50	-
$\chi_{z;buc}$ = (kromme b)	0,883	-
$N_{b,Rd} = \chi A f_y$ =	5492	kN
U.C.	**1,04**	**n-waarde OK**

Buckling length with FEM-software		
n-value	7,8	
N_{Ed} =	5700	kN
$N_{cr;E} = n \times N_{Ed}$ =	44460	kN
$N_{pl,Rd}$ =	6221	kN
$\lambda_{rel} = \sqrt{N_{pl;Rd} / N_{cr;E}}$ =	0,37	-
χ_{buc} = (curve =)	0,94	-
$N_{b,Rd} = \chi A f_y / \gamma_{M1}$ =	**5825**	kN
U.C. =	0,98	**Voldoet**

Torsieknik

Versie: 1.4

Onderwerp	**Randstijl S+95**	***Toetsing***	
Profiel	**INP425x2+2PL230x25**	U.C.	**0,99** Voldoet

Normaalkracht

$N_{c;s;d}$ = **8310,0** kN

Staalsoort **S235**

Doorsnedeklasse: **1** Geldig

Gewicht 2,98 kN/m

Doorsnedegrootheden

I_y	I_z	I_v	A
$10^4\,mm^4$	$10^4\,mm^4$	$10^4\,mm^4$	mm^4
65980	65980	61570	37974

I_t	I_{wa}
$10^4\,mm^4$	mm^4
1499	3,32E+12

Geometrie

$l_{y;buc}$ =	2,50	m
$l_{z;buc}$ =	2,50	m
$l_{v;buc}$ =	2,50	m
l_{tk} =	2,50	m
Steun 1	Gaffel	
Steun 2	Gaffel	
Classificatie	Geschoord	

Doorsnedecapaciteit

$N_{pl;d} = A \times f_{y;d}$ = 8924 kN

Knikstabiliteit y-as

$\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$		0,20	-
$\chi_{y;buc}$ =	(kromme b)	1,00	-
$N_{b,Rd} = \chi A f_y$ =		8918	kN
U.C.		**0,93**	Voldoet

Knikstabiliteit z-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$		0,20	-
$\chi_{z;buc}$ =	(kromme b)	1,00	-
$N_{b,Rd} = \chi A f_y$ =		8918	kN
U.C.		**0,93**	Voldoet

Knikstabiliteit v-as

$\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$		0,21	-
$\lambda_{eff} = 0{,}10 + 0{,}80\,\lambda =$		0,27	-
$\chi_{z;buc}$ =	(kromme b)	0,98	-
$N_{b,Rd} = \chi A f_y$ =		8710	kN
U.C.		**0,95**	Voldoet

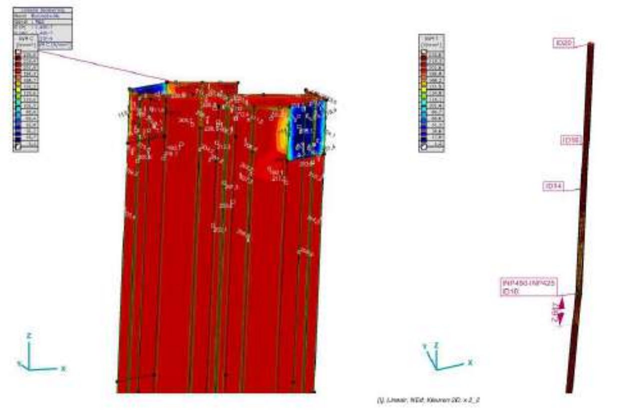
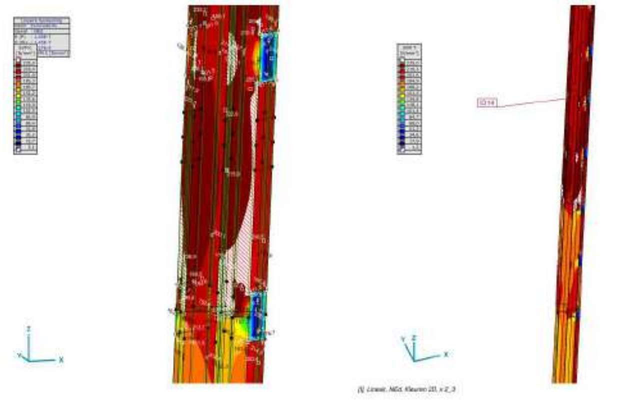
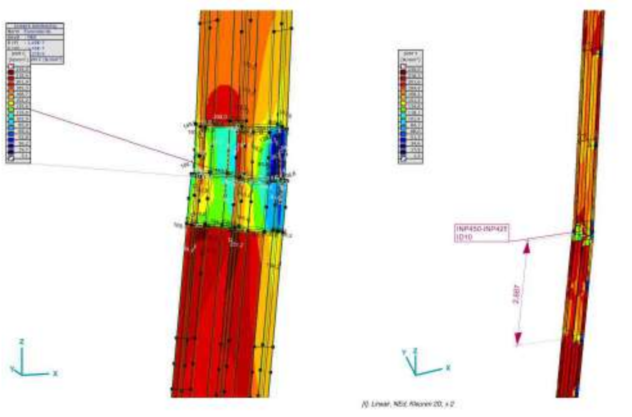
Torsieknikstabiliteit

$i_0^2 = i_y^2 + i_z^2 + y_0^2$ =		34750	mm^2
$\beta = 1 - y_0^2/i_0^2$ =		1,000	-
$F_{y;E} = \pi^2 E I_y / l_y^2$ =		218802	kN
$F_{t;E} = 1/i_0^2(G_d I_t + \pi^2 E I_{wa}/l_{t;buc})$ =		66658	kN
$F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E}) + \sqrt{(F_{y;E}+F_{t;E})^2 - 4\beta^2 F_{y;E} F_{t;E}})$			
$F_{tk;E}$ =		66658	kN
$\lambda_{tk;rel} = \sqrt{N_{Rd} / F_{tk;E}}$ =		0,37	-
$\chi_{z;buc}$ =	(kromme b)	0,939	-
$N_{b,Rd} = \chi A f_y$ =		8383	kN
U.C.		**0,99**	Voldoet

Buckling length with FEM-software		
n-value	7,8	
N_{Ed} =	8310	kN
$N_{cr;E} = n \times N_{Ed}$ =	64818	kN
$N_{pl,Rd}$ =	8924	kN
$\lambda_{rel} = \sqrt{N_{pl;Rd} / N_{cr;E}}$ =	0,37	-
χ_{buc} = (curve =)	0,94	-
$N_{b,Rd} = \chi A f_y / \gamma_{M1}$ =	**8365**	kN
U.C. =	0,99	Voldoet

3.2 Stress level

The stress level has been observed as a second topic of the study. At four critical locations the stresses are displayed.

	
At top it is observed that stresses are equally distributed over the section with the exception of the coupling plate. The stress level of 205 N/mm2 corresponds to 5412 kN of force, in accordance with expectation.	*At the start of the reinforcement, some local areas in the web show stresses above 235 N/mm2. This is as expected and the reason the reinforced section was continued one panel above the height it was required. In reality due to bolt losses, the stress will smoothen out, making it acceptable.*
	
At the inclination change with transition of INP450 to INP425 the stresses were initially above 235 N/mm2. With the proposed reinforcements, stress levels stay below yield limit, although margin is less than expected if an equal stress distribution would be assumed.	*At the bottom it is observed that stresses are equally distributed over the section with the exception of the coupling plate. The stress level of 208 N/mm2 corresponds to 6110 kN of force, in accordance with expectation.*

4 CONCLUSION

The main legs of tower type S+95 consisting of cruciform INP-sections which were found inadequate for torsional buckling have been subject of investigation to their stability. The main reason was the insufficient capacity of the cross section, secondly, insufficient support against rotation played another role.

The proposed solution is to couple the flanges with plates in order to increase torsional resistance of the section. The inadequate support against rotation of the section is solved by adding horizontal members to make a stable system consisting of three members.

In this study the effectiveness of the proposed strengthening measures has been investigated using the buckling analysis offered by the software package AxisVM.

A model consisting of one of the four main legs was used in the study, using shell elements and linear line supports against rotation and lateral supports.

The study shows that the strengthening proposal with a combination of plates and added struts is effective. The n-value which is the ratio between load and capacity increases from 2,4 to a minimum of 4,4 which suffices for roughly two-thirds of the length of the INP-column. Two segments of the main leg however had still insufficient capacity. For the most heavily loaded section within this segment, the INP425 needs to be reinforced with plates. This section reaches the capacity based on verbouwlevel loads. The other part of the segment that was insufficient requires a higher number of coupling plates in order to fulfill afkeurlevel loads.

ATTACHMENTS

Output of AxisVM

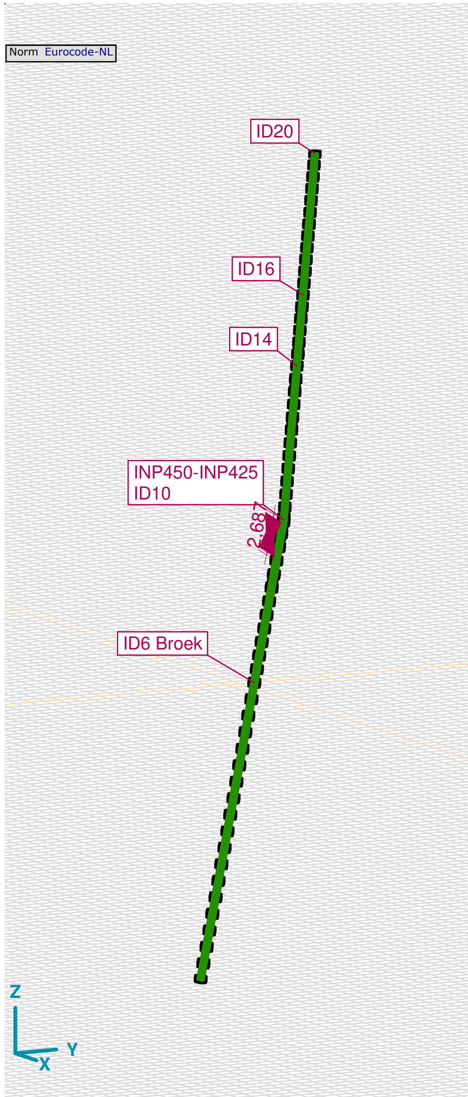
Project: KIJ-GT

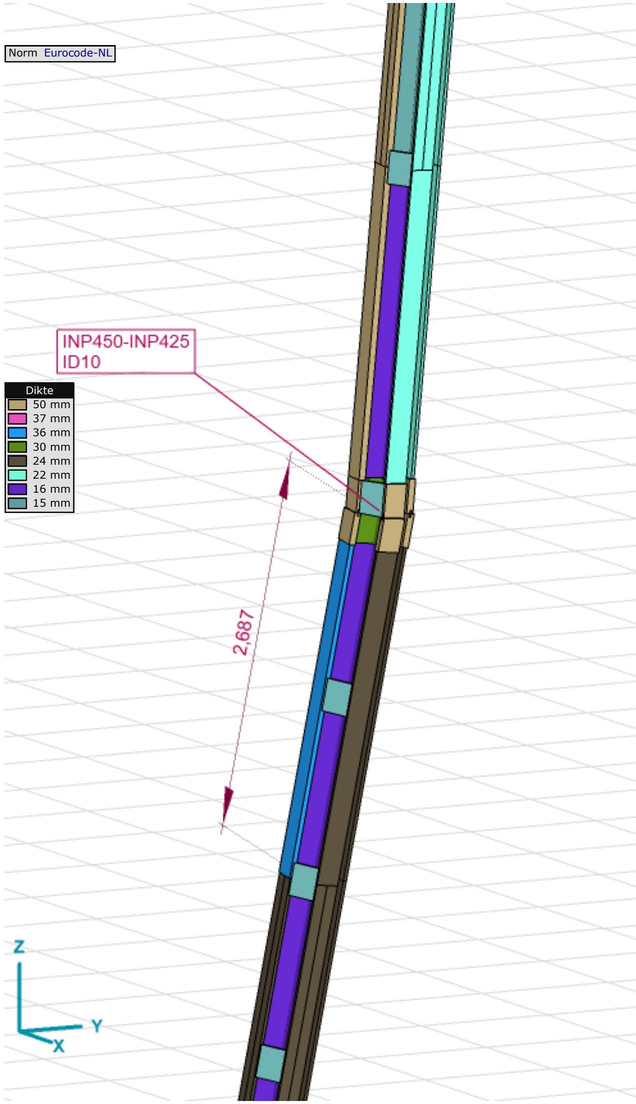
Constructeur: DNV GL - Energy

AxisVM X5 R4h · Geregistreerd aan DNV GL - Energy
S+95 Leg study 16.axs

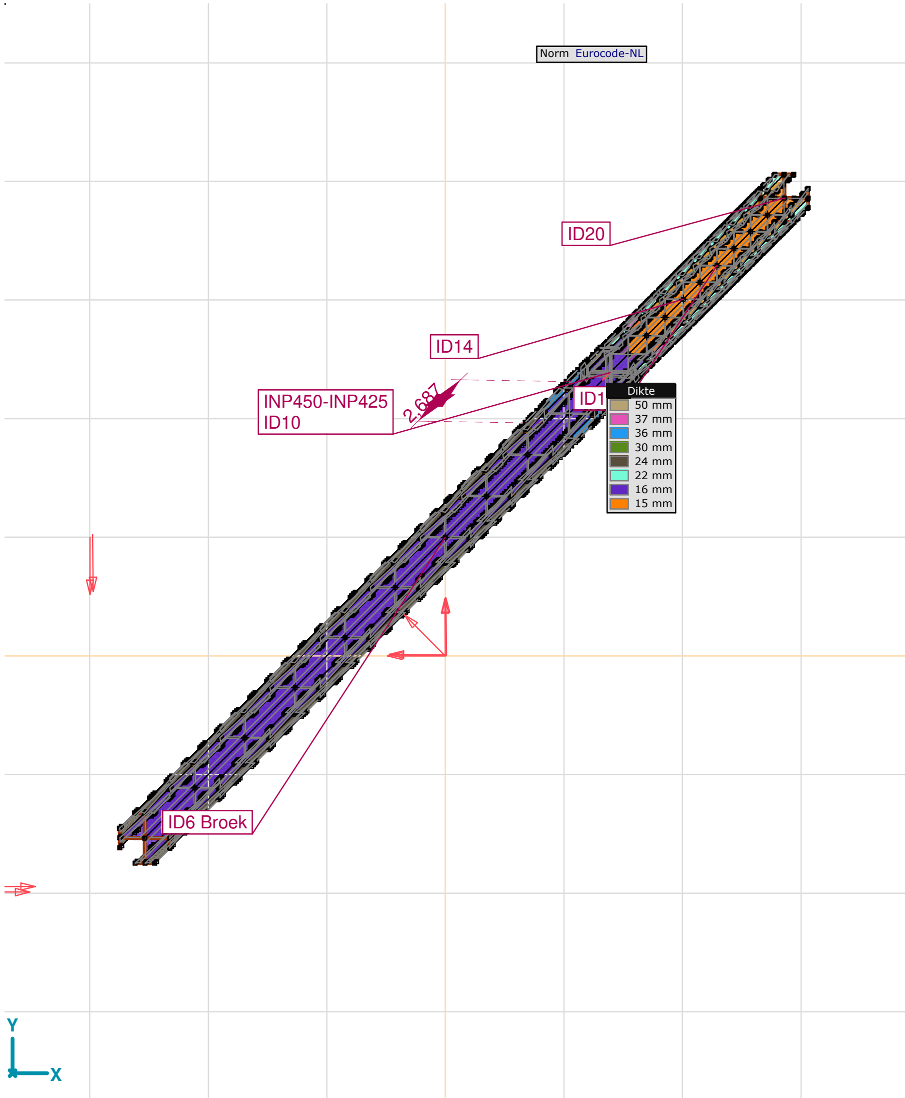
Rapport

Rapport, Inhoudsopgave


Norm Eurocode-NL
ID20
ID16
ID14
INP450-INP425
ID10
2,687
ID6 Broek
Z
Y
X


Norm Eurocode-NL
INP450-INP425
ID10
Dikte
50 mm
37 mm
36 mm
30 mm
24 mm
22 mm
16 mm
15 mm
2,687
Z
Y
X

x 3


Norm Eurocode-NL
ID20
ID14
INP450-INP425
ID10
2,687
Dikte
50 mm
37 mm
36 mm
30 mm
24 mm
22 mm
16 mm
15 mm
ID6 Broek
Y
X

Materialen

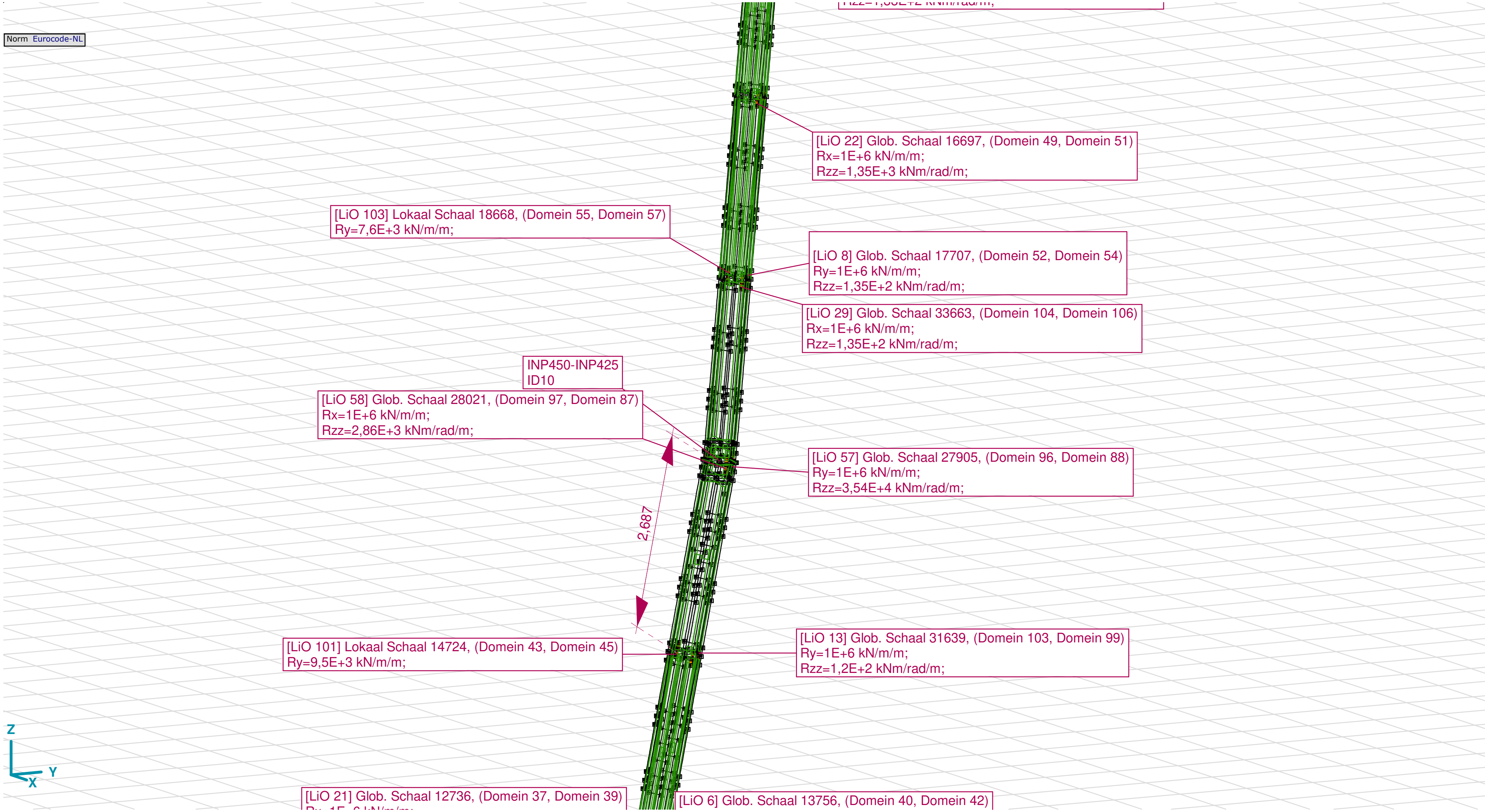
	Naam	*Type*	*Nationale norm*	*Materiaalnorm*	*Model*	*E_x [N/mm^2]*	*E_y [N/mm^2]*	*ν*	*α_T [1/°C]*	*ρ [kg/m^3]*	*Materiaal kleur*	*Contour kleur*	*Structuur*
1	S 235	Staal	Eurocode-NL	10025-2	Plastisch	210000	210000	0,30	1,2E-5	7850			Steel
2	S 355	Staal	Eurocode-NL	10025-2	Plastisch	210000	210000	0,30	1,2E-5	7850			Steel

	Naam	*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/mm^2] = 235,00	f_u[N/mm^2] = 360,00	f_y^*[N/mm^2] = 215,00	f_u^*[N/mm^2] = 360,00										
2	S 355	f_y[N/mm^2] = 355,00	f_u[N/mm^2] = 510,00	f_y^*[N/mm^2] = 335,00	f_u^*[N/mm^2] = 470,00										

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;

Project: KIJ-GT

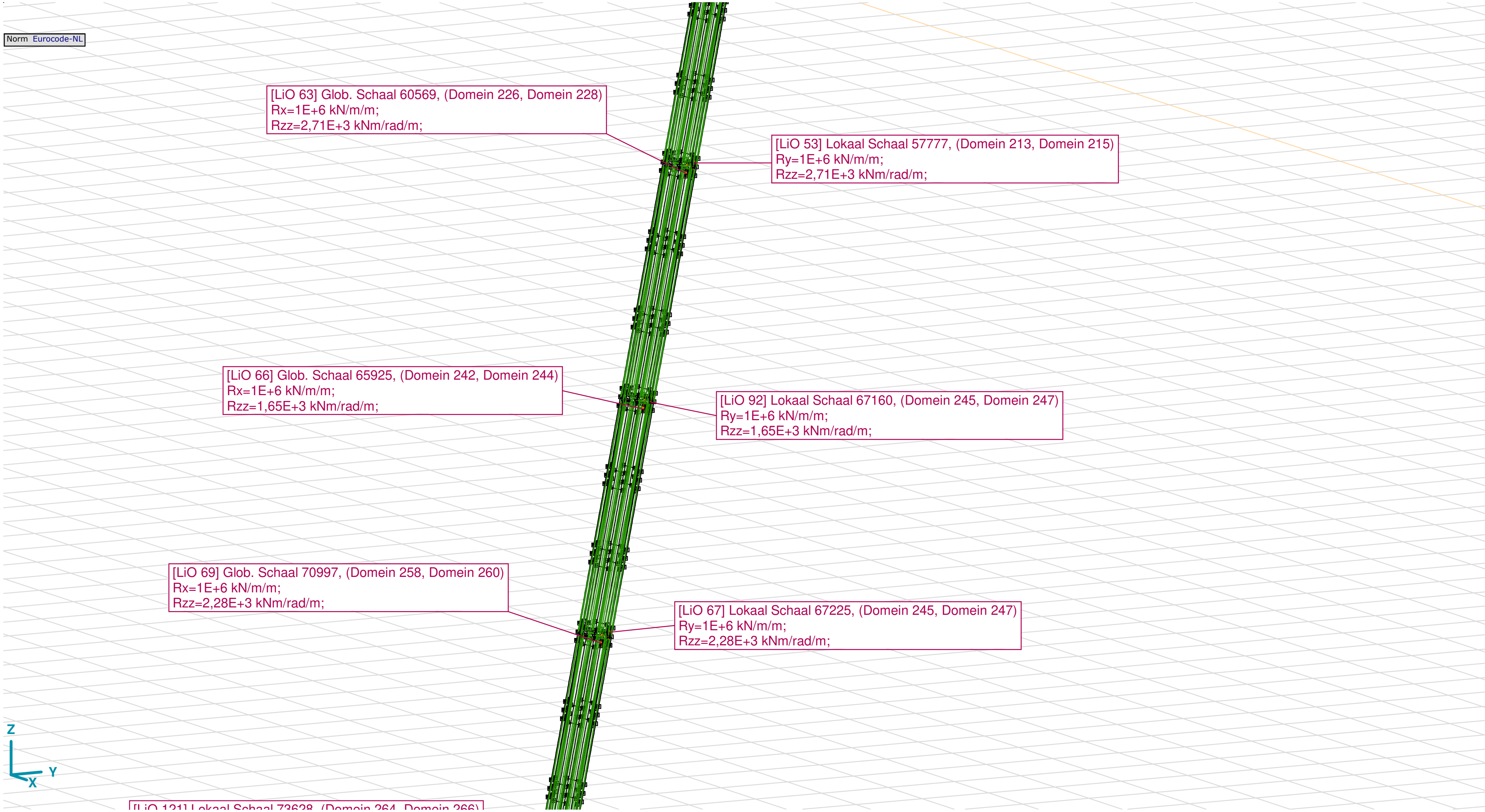
Constructeur: DNV GL - Energy
Model: **S+95 Leg study 16.axs**



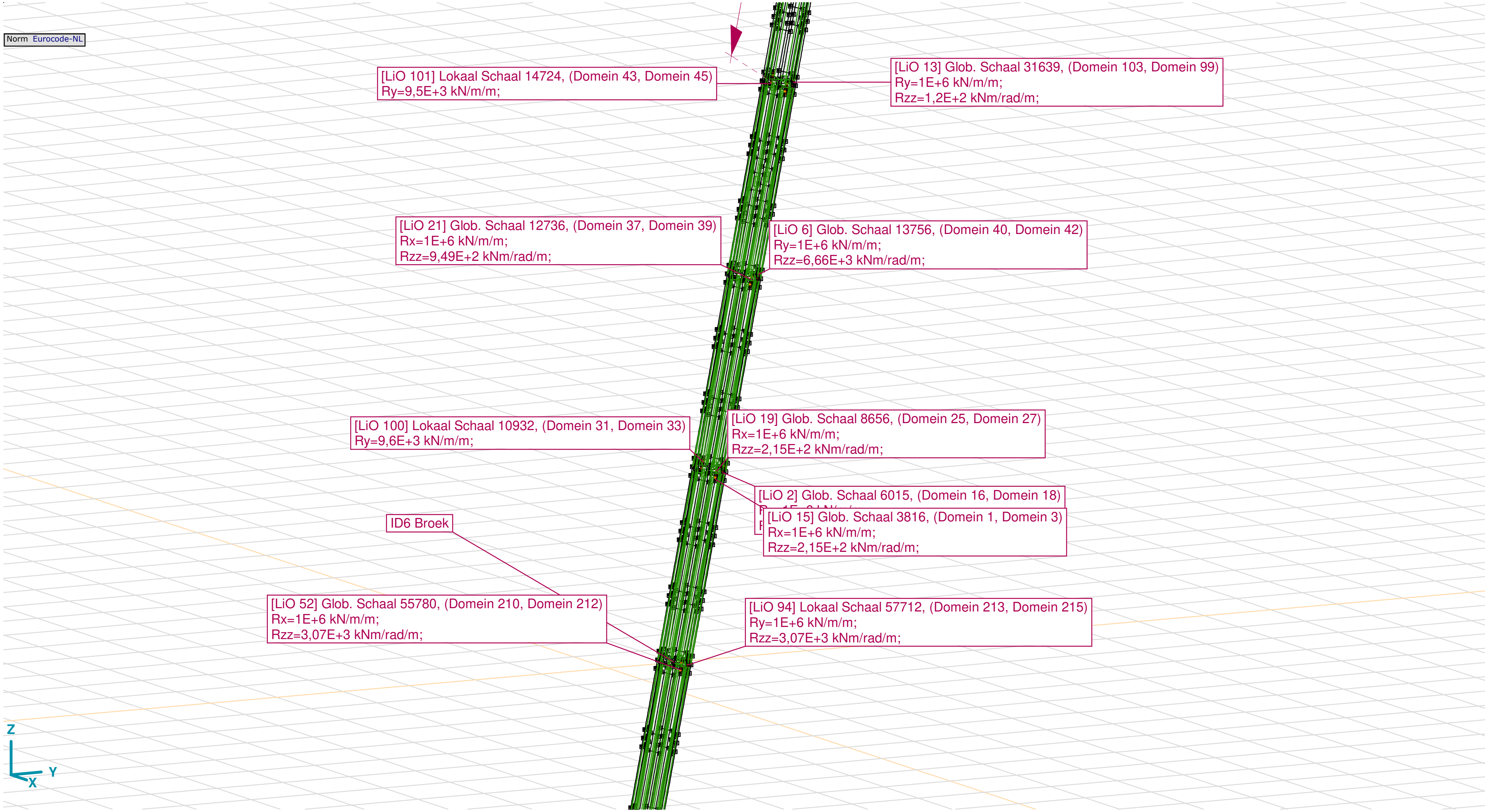
Tekening


Norm Eurocode-NL
[LiO 121] Lokaal Schaal 73628, (Domein 264, Domein 266)
Ry=3,9E+4 kN/m/m;
[LiO 70] Lokaal Schaal 72013, (Domein 261, Domein 263)
Ry=1E+6 kN/m/m;
Rzz=2,86E+2 kNm/rad/m;
[LiO 72] Glob. Schaal 76069, (Domein 274, Domein 276)
Rx=1E+6 kN/m/m;
Rzz=2,86E+2 kNm/rad/m;
[LiO 73] Lokaal Schaal 77369, (Domein 277, Domein 279)
Ry=1E+6 kN/m/m;
Rzz=1,98E+2 kNm/rad/m;
[LiO 119] Lokaal Schaal 78701, (Domein 280, Domein 282)
Ry=2,1E+4 kN/m/m;
[LiO 83] Glob. Schaal 81140, (Domein 290, Domein 292)
Rx=1E+6 kN/m/m;
Rzz=1,98E+2 kNm/rad/m;
[LiO 76] Lokaal Schaal 80291, Domein 291
Rx=1E+10 kN/m/m;
Ry=1E+10 kN/m/m;
Z
Y
X

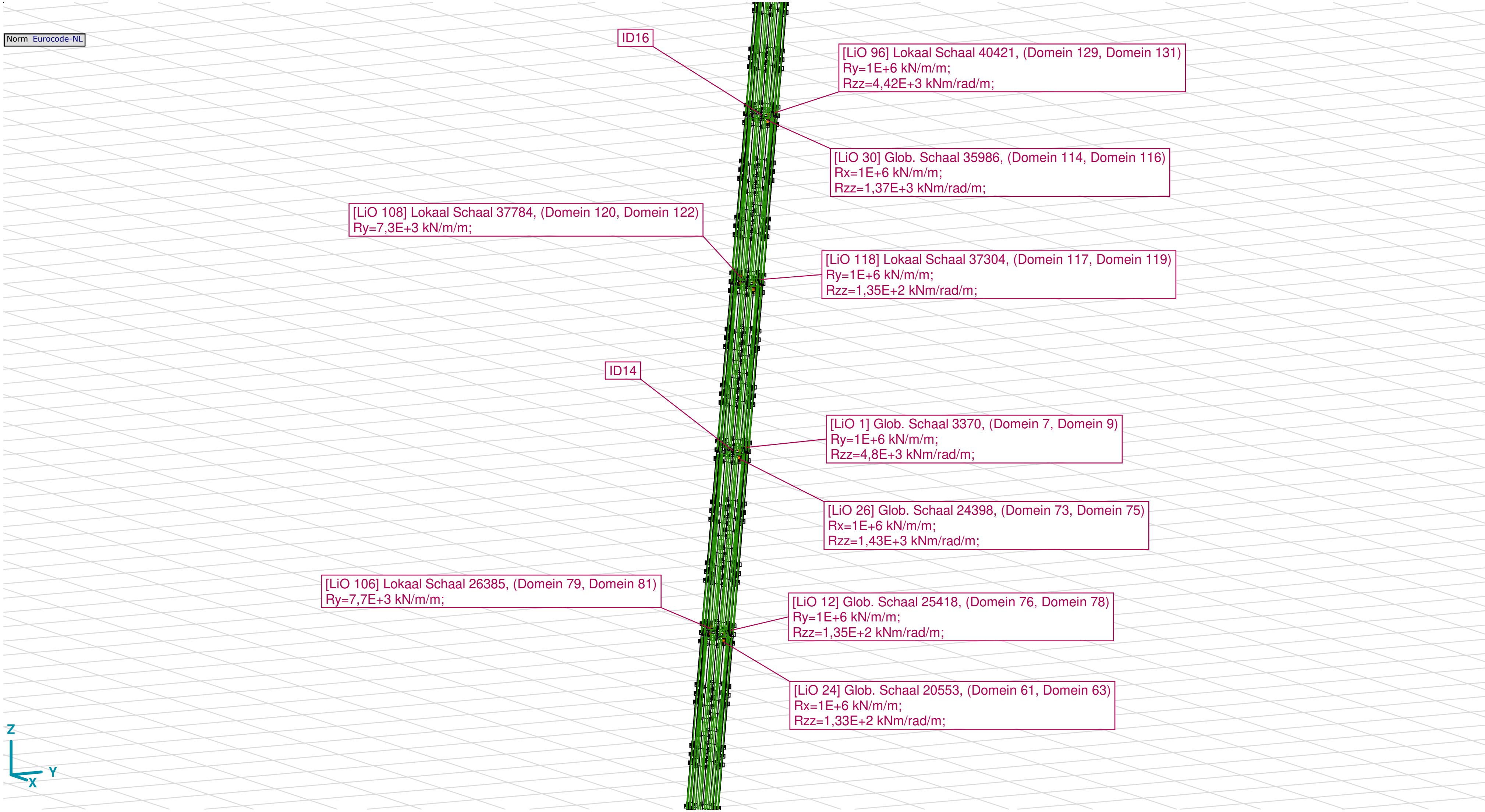
Tekening1


Norm Eurocode-NL
[LiO 63] Glob. Schaal 60569, (Domein 226, Domein 228)
Rx=1E+6 kN/m/m;
Rzz=2,71E+3 kNm/rad/m;
[LiO 53] Lokaal Schaal 57777, (Domein 213, Domein 215)
Ry=1E+6 kN/m/m;
Rzz=2,71E+3 kNm/rad/m;
[LiO 66] Glob. Schaal 65925, (Domein 242, Domein 244)
Rx=1E+6 kN/m/m;
Rzz=1,65E+3 kNm/rad/m;
[LiO 92] Lokaal Schaal 67160, (Domein 245, Domein 247)
Ry=1E+6 kN/m/m;
Rzz=1,65E+3 kNm/rad/m;
[LiO 69] Glob. Schaal 70997, (Domein 258, Domein 260)
Rx=1E+6 kN/m/m;
Rzz=2,28E+3 kNm/rad/m;
[LiO 67] Lokaal Schaal 67225, (Domein 245, Domein 247)
Ry=1E+6 kN/m/m;
Rzz=2,28E+3 kNm/rad/m;
Z
Y
X

Tekening2


Norm Eurocode-NL
[LiO 101] Lokaal Schaal 14724, (Domein 43, Domein 45)
Ry=9,5E+3 kN/m/m;
[LiO 13] Glob. Schaal 31639, (Domein 103, Domein 99)
Ry=1E+6 kN/m/m;
Rzz=1,2E+2 kNm/rad/m;
[LiO 21] Glob. Schaal 12736, (Domein 37, Domein 39)
Rx=1E+6 kN/m/m;
Rzz=9,49E+2 kNm/rad/m;
[LiO 6] Glob. Schaal 13756, (Domein 40, Domein 42)
Ry=1E+6 kN/m/m;
Rzz=6,66E+3 kNm/rad/m;
[LiO 100] Lokaal Schaal 10932, (Domein 31, Domein 33)
Ry=9,6E+3 kN/m/m;
[LiO 19] Glob. Schaal 8656, (Domein 25, Domein 27)
Rx=1E+6 kN/m/m;
Rzz=2,15E+2 kNm/rad/m;
[LiO 2] Glob. Schaal 6015, (Domein 16, Domein 18)
[LiO 15] Glob. Schaal 3816, (Domein 1, Domein 3)
Rx=1E+6 kN/m/m;
Rzz=2,15E+2 kNm/rad/m;
ID6 Broek
[LiO 52] Glob. Schaal 55780, (Domein 210, Domein 212)
Rx=1E+6 kN/m/m;
Rzz=3,07E+3 kNm/rad/m;
[LiO 94] Lokaal Schaal 57712, (Domein 213, Domein 215)
Ry=1E+6 kN/m/m;
Rzz=3,07E+3 kNm/rad/m;
Z
Y
X

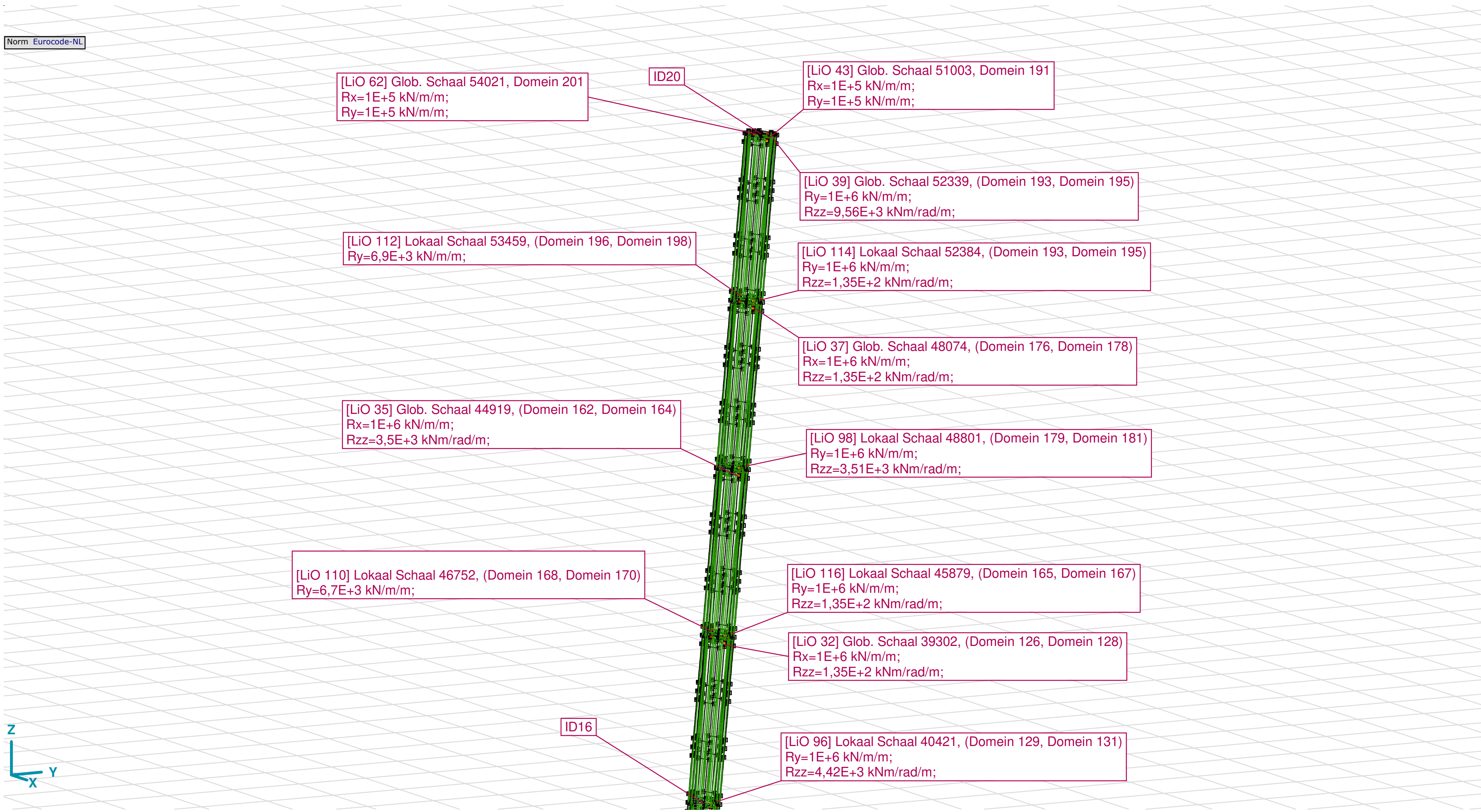
Tekening3



Norm Eurocode-NL
ID16
[LiO 96] Lokaal Schaal 40421, (Domein 129, Domein 131)
Ry=1E+6 kN/m/m;
Rzz=4,42E+3 kNm/rad/m;
[LiO 30] Glob. Schaal 35986, (Domein 114, Domein 116)
Rx=1E+6 kN/m/m;
Rzz=1,37E+3 kNm/rad/m;
[LiO 108] Lokaal Schaal 37784, (Domein 120, Domein 122)
Ry=7,3E+3 kN/m/m;
[LiO 118] Lokaal Schaal 37304, (Domein 117, Domein 119)
Ry=1E+6 kN/m/m;
Rzz=1,35E+2 kNm/rad/m;
ID14
[LiO 1] Glob. Schaal 3370, (Domein 7, Domein 9)
Ry=1E+6 kN/m/m;
Rzz=4,8E+3 kNm/rad/m;
[LiO 26] Glob. Schaal 24398, (Domein 73, Domein 75)
Rx=1E+6 kN/m/m;
Rzz=1,43E+3 kNm/rad/m;
[LiO 106] Lokaal Schaal 26385, (Domein 79, Domein 81)
Ry=7,7E+3 kN/m/m;
[LiO 12] Glob. Schaal 25418, (Domein 76, Domein 78)
Ry=1E+6 kN/m/m;
Rzz=1,35E+2 kNm/rad/m;
[LiO 24] Glob. Schaal 20553, (Domein 61, Domein 63)
Rx=1E+6 kN/m/m;
Rzz=1,33E+2 kNm/rad/m;
Z
Y
X

Tekening5

Project: KIJ-GT
Constructeur: DNV GL - Energy
Model: **S+95 Leg study 16.axs**



Tekening6

Lijnopleggingen

	Lijn	*Type*	*Ref. elem.*	*Rx [kN/m/m]*	*Ry [kN/m/m]*	*Rz [kN/m/m]*	*Rxx [kNm/rad/m]*	*Ryy [kNm/rad/m]*	*Rzz [kNm/rad/m]*	*NL(x)*	*NL(y)*	*NL(z)*
1	Rand (631)	Glob.	(Domein 7, Domein 9)	0	1E+6	0	0	0	4,8E+3		Symmetrisch	
2	Rand (4337)	Glob.	(Domein 16, Domein 18)	0	1E+6	0	0	0	2,15E+2		Symmetrisch	
3	Rand (12600)	Glob.	(Domein 28, Domein 30)	0	1E+6	0	0	0	6,66E+3		Symmetrisch	
4	Rand (12652)	Glob.	(Domein 28, Domein 30)	0	1E+6	0	0	0	2,15E+2		Symmetrisch	
5	Rand (18798)	Glob.	(Domein 40, Domein 42)	0	1E+6	0	0	0	1,2E+2		Symmetrisch	
6	Rand (18850)	Glob.	(Domein 40, Domein 42)	0	1E+6	0	0	0	6,66E+3		Symmetrisch	
7	Rand (24949)	Glob.	(Domein 52, Domein 54)	0	1E+6	0	0	0	4,69E+3		Symmetrisch	
8	Rand (24998)	Glob.	(Domein 52, Domein 54)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
9	Rand (30807)	Glob.	(Domein 64, Domein 66)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
10	Rand (30856)	Glob.	(Domein 64, Domein 66)	0	1E+6	0	0	0	4,69E+3		Symmetrisch	
11	Rand (36636)	Glob.	(Domein 76, Domein 78)	0	1E+6	0	0	0	4,8E+3		Symmetrisch	
12	Rand (36685)	Glob.	(Domein 76, Domein 78)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
13	Rand (43826)	Glob.	(Domein 103, Domein 99)	0	1E+6	0	0	0	1,2E+2		Symmetrisch	
14	Rand (46557)	Glob.	(Domein 105, Domein 107)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
15	Rand (1648)	Glob.	(Domein 1, Domein 3)	1E+6	0	0	0	0	2,15E+2	Symmetrisch		
16	Rand (322)	Glob.	(Domein 4, Domein 6)	1E+6	0	0	0	0	1,34E+2	Symmetrisch		
17	Rand (277)	Glob.	(Domein 4, Domein 6)	1E+6	0	0	0	0	1,43E+3	Symmetrisch		
18	Rand (11059)	Glob.	(Domein 25, Domein 27)	1E+6	0	0	0	0	9,49E+2	Symmetrisch		

	Lijn	*NL(xx)*	*NL(yy)*	*NL(zz)*	*F(x) [kN/m]*	*F(y) [kN/m]*	*F(z) [kN/m]*	*M(x) [kNm/m]*	*M(y) [kNm/m]*	*M(z) [kNm/m]*
1	Rand (631)			Symmetrisch						
2	Rand (4337)			Symmetrisch						
3	Rand (12600)			Symmetrisch						
4	Rand (12652)			Symmetrisch						
5	Rand (18798)			Symmetrisch						
6	Rand (18850)			Symmetrisch						
7	Rand (24949)			Symmetrisch						
8	Rand (24998)			Symmetrisch						
9	Rand (30807)			Symmetrisch						
10	Rand (30856)			Symmetrisch						
11	Rand (36636)			Symmetrisch						
12	Rand (36685)			Symmetrisch						
13	Rand (43826)			Symmetrisch						
14	Rand (46557)			Symmetrisch						
15	Rand (1648)			Symmetrisch						
16	Rand (322)			Symmetrisch						
17	Rand (277)			Symmetrisch						
18	Rand (11059)			Symmetrisch						

Lijnopleggingen

	Lijn	*Type*	*Ref. elem.*	*Rx [kN/m/m]*	*Ry [kN/m/m]*	*Rz [kN/m/m]*	*Rxx [kNm/rad/m]*	*Ryy [kNm/rad/m]*	*Rzz [kNm/rad/m]*	*NL(x)*	*NL(y)*	*NL(z)*
19	Rand (11111)	Glob.	(Domein 25, Domein 27)	1E+6	0	0	0	0	2,15E+2	Symmetrisch		
20	Rand (16494)	Glob.	(Domein 37, Domein 39)	1E+6	0	0	0	0	1,2E+2	Symmetrisch		
21	Rand (16546)	Glob.	(Domein 37, Domein 39)	1E+6	0	0	0	0	9,49E+2	Symmetrisch		
22	Rand (23460)	Glob.	(Domein 49, Domein 51)	1E+6	0	0	0	0	1,35E+3	Symmetrisch		
23	Rand (23509)	Glob.	(Domein 49, Domein 51)	1E+6	0	0	0	0	1,35E+2	Symmetrisch		
24	Rand (29342)	Glob.	(Domein 61, Domein 63)	1E+6	0	0	0	0	1,33E+2	Symmetrisch		
25	Rand (29391)	Glob.	(Domein 61, Domein 63)	1E+6	0	0	0	0	1,35E+3	Symmetrisch		
26	Rand (35188)	Glob.	(Domein 73, Domein 75)	1E+6	0	0	0	0	1,43E+3	Symmetrisch		
27	Rand (35237)	Glob.	(Domein 73, Domein 75)	1E+6	0	0	0	0	1,33E+2	Symmetrisch		
28	Rand (43148)	Glob.	(Domein 102, Domein 98)	1E+6	0	0	0	0	1,2E+2	Symmetrisch		
29	Rand (45839)	Glob.	(Domein 104, Domein 106)	1E+6	0	0	0	0	1,35E+2	Symmetrisch		
30	Rand (48340)	Glob.	(Domein 114, Domein 116)	1E+6	0	0	0	0	1,37E+3	Symmetrisch		
31	Rand (48385)	Glob.	(Domein 114, Domein 116)	1E+6	0	0	0	0	1,34E+2	Symmetrisch		
32	Rand (58519)	Glob.	(Domein 126, Domein 128)	1E+6	0	0	0	0	1,35E+2	Symmetrisch		
33	Rand (58564)	Glob.	(Domein 126, Domein 128)	1E+6	0	0	0	0	1,37E+3	Symmetrisch		
34	Rand (1596)	Glob.	Domein 1	1E+6	0	0	0	0	3,07E+3	Symmetrisch		
35	Rand (66393)	Glob.	(Domein 162, Domein 164)	1E+6	0	0	0	0	3,5E+3	Symmetrisch		
36	Rand (66438)	Glob.	(Domein 162, Domein 164)	1E+6	0	0	0	0	1,35E+2	Symmetrisch		

	Lijn	*NL(xx)*	*NL(yy)*	*NL(zz)*	*F(x) [kN/m]*	*F(y) [kN/m]*	*F(z) [kN/m]*	*M(x) [kNm/m]*	*M(y) [kNm/m]*	*M(z) [kNm/m]*
19	Rand (11111)			Symmetrisch						
20	Rand (16494)			Symmetrisch						
21	Rand (16546)			Symmetrisch						
22	Rand (23460)			Symmetrisch						
23	Rand (23509)			Symmetrisch						
24	Rand (29342)			Symmetrisch						
25	Rand (29391)			Symmetrisch						
26	Rand (35188)			Symmetrisch						
27	Rand (35237)			Symmetrisch						
28	Rand (43148)			Symmetrisch						
29	Rand (45839)			Symmetrisch						
30	Rand (48340)			Symmetrisch						
31	Rand (48385)			Symmetrisch						
32	Rand (58519)			Symmetrisch						
33	Rand (58564)			Symmetrisch						
34	Rand (1596)			Symmetrisch						
35	Rand (66393)			Symmetrisch						
36	Rand (66438)			Symmetrisch						

Lijnopleggingen

	Lijn	Type	Ref. elem.	Rx [kN/m/m]	Ry [kN/m/m]	Rz [kN/m/m]	Rxx [kNm/rad/m]	Ryy [kNm/rad/m]	Rzz [kNm/rad/m]	NL(x)	NL(y)	NL(z)
37	Rand (70477)	Glob.	(Domein 176, Domein 178)	1E+6	0	0	0	0	1,35E+2	Symmetrisch		
38	Rand (70522)	Glob.	(Domein 176, Domein 178)	1E+6	0	0	0	0	3,5E+3	Symmetrisch		
39	Rand (77910)	Glob.	(Domein 193, Domein 195)	0	1E+6	0	0	0	9,56E+3		Symmetrisch	
40	Rand (77259)	Glob.	(Domein 190, Domein 192)	1E+6	0	0	0	0	1,71E+3	Symmetrisch		
41	Rand (77304)	Glob.	(Domein 190, Domein 192)	1E+6	0	0	0	0	1,35E+2	Symmetrisch		
42	Rand (77357)	Glob.	Domein 190	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
43	Rand (77605)	Glob.	Domein 191	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
44	Rand (79385)	Glob.	Domein 196	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
45	Rand (80294)	Glob.	Domein 197	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
46	Rand (80697)	Glob.	Domein 199	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
47	Rand (80945)	Glob.	Domein 200	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
48	Rand (81250)	Glob.	Domein 198	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
49	Rand (78608)	Glob.	Domein 192	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
50	Rand (78008)	Glob.	Domein 193	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
51	Rand (78256)	Glob.	Domein 194	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
52	Rand (82958)	Glob.	(Domein 210, Domein 212)	1E+6	0	0	0	0	3,07E+3	Symmetrisch		
54	Rand (83022)	Glob.	Domein 210	1E+6	0	0	0	0	2,71E+3	Symmetrisch		
55	Rand (42099)	Glob.	(Domein 94, Domein 91)	1E+6	0	0	0	0	2,86E+3	Symmetrisch		

	Lijn	NL(xx)	NL(yy)	NL(zz)	F(x) [kN/m]	F(y) [kN/m]	F(z) [kN/m]	M(x) [kNm/m]	M(y) [kNm/m]	M(z) [kNm/m]
37	Rand (70477)			Symmetrisch						
38	Rand (70522)			Symmetrisch						
39	Rand (77910)			Symmetrisch						
40	Rand (77259)			Symmetrisch						
41	Rand (77304)			Symmetrisch						
42	Rand (77357)									
43	Rand (77605)									
44	Rand (79385)									
45	Rand (80294)									
46	Rand (80697)									
47	Rand (80945)									
48	Rand (81250)									
49	Rand (78608)									
50	Rand (78008)									
51	Rand (78256)									
52	Rand (82958)			Symmetrisch						
54	Rand (83022)			Symmetrisch						
55	Rand (42099)			Symmetrisch						

Lijnopleggingen

	Lijn	Type	Ref. elem.	Rx [kN/m/m]	Ry [kN/m/m]	Rz [kN/m/m]	Rxx [kNm/rad/m]	Ryy [kNm/rad/m]	Rzz [kNm/rad/m]	NL(x)	NL(y)	NL(z)
56	Rand (42495)	Glob.	(Domein 95, Domein 112)	0	1E+6	0	0	0	3,54E+4		Symmetrisch	
57	Rand (41864)	Glob.	(Domein 96, Domein 88)	0	1E+6	0	0	0	3,54E+4		Symmetrisch	
58	Rand (41069)	Glob.	(Domein 97, Domein 87)	1E+6	0	0	0	0	2,86E+3	Symmetrisch		
59	Rand (78610)	Glob.	Domein 192	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
60	Rand (79633)	Glob.	Domein 195	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
61	Rand (81252)	Glob.	Domein 198	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
62	Rand (82117)	Glob.	Domein 201	1E+5	1E+5	0	0	0	0	Symmetrisch	Symmetrisch	
63	Rand (89716)	Glob.	(Domein 226, Domein 228)	1E+6	0	0	0	0	2,71E+3	Symmetrisch		
65	Rand (89780)	Glob.	Domein 226	1E+6	0	0	0	0	1,65E+3	Symmetrisch		
66	Rand (98346)	Glob.	(Domein 242, Domein 244)	1E+6	0	0	0	0	1,65E+3	Symmetrisch		
68	Rand (98410)	Glob.	Domein 242	1E+6	0	0	0	0	2,28E+3	Symmetrisch		
69	Rand (106040)	Glob.	(Domein 258, Domein 260)	1E+6	0	0	0	0	2,28E+3	Symmetrisch		
71	Rand (106104)	Glob.	Domein 258	1E+6	0	0	0	0	2,86E+2	Symmetrisch		
72	Rand (113734)	Glob.	(Domein 274, Domein 276)	1E+6	0	0	0	0	2,86E+2	Symmetrisch		
74	Rand (113798)	Glob.	Domein 274	1E+6	0	0	0	0	1,98E+2	Symmetrisch		
83	Rand (121428)	Glob.	(Domein 290, Domein 292)	1E+6	0	0	0	0	1,98E+2	Symmetrisch		
53	Rand (83946)	Rand r.	(Domein 213, Domein 215)	0	1E+6	0	0	0	2,71E+3		Symmetrisch	
64	Rand (91640)	Rand r.	(Domein 229, Domein 231)	0	1E+6	0	0	0	1,65E+3		Symmetrisch	

	Lijn	NL(xx)	NL(yy)	NL(zz)	F(x) [kN/m]	F(y) [kN/m]	F(z) [kN/m]	M(x) [kNm/m]	M(y) [kNm/m]	M(z) [kNm/m]
56	Rand (42495)			Symmetrisch						
57	Rand (41864)			Symmetrisch						
58	Rand (41069)			Symmetrisch						
59	Rand (78610)									
60	Rand (79633)									
61	Rand (81252)									
62	Rand (82117)									
63	Rand (89716)			Symmetrisch						
65	Rand (89780)			Symmetrisch						
66	Rand (98346)			Symmetrisch						
68	Rand (98410)			Symmetrisch						
69	Rand (106040)			Symmetrisch						
71	Rand (106104)			Symmetrisch						
72	Rand (113734)			Symmetrisch						
74	Rand (113798)			Symmetrisch						
83	Rand (121428)			Symmetrisch						
53	Rand (83946)			Symmetrisch						
64	Rand (91640)			Symmetrisch						

Lijnopleggingen

	Lijn	*Type*	*Ref. elem.*	*Rx [kN/m/m]*	*Ry [kN/m/m]*	*Rz [kN/m/m]*	*Rxx [kNm/rad/m]*	*Ryy [kNm/rad/m]*	*Rzz [kNm/rad/m]*	*NL(x)*	*NL(y)*	*NL(z)*
67	Rand (99334)	Rand r.	(Domein 245, Domein 247)	0	1E+6	0	0	0	2,28E+3		Symmetrisch	
70	Rand (107028)	Rand r.	(Domein 261, Domein 263)	0	1E+6	0	0	0	2,86E+2		Symmetrisch	
73	Rand (114722)	Rand r.	(Domein 277, Domein 279)	0	1E+6	0	0	0	1,98E+2		Symmetrisch	
75	Rand (121494)	Rand r.	Domein 290	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
76	Rand (121995)	Rand r.	Domein 291	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
77	Rand (122418)	Rand r.	Domein 293	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
78	Rand (122919)	Rand r.	Domein 294	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
79	Rand (124344)	Rand r.	Domein 296	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
80	Rand (124845)	Rand r.	Domein 297	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
81	Rand (126256)	Rand r.	Domein 299	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
82	Rand (126754)	Rand r.	Domein 300	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
84	Rand (123342)	Rand r.	Domein 292	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
85	Rand (127160)	Rand r.	Domein 298	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
86	Rand (125202)	Rand r.	Domein 295	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
87	Rand (128141)	Rand r.	Domein 301	1E+10	1E+10	0	0	0	0	Symmetrisch	Symmetrisch	
88	Rand (122352)	Rand r.	(Domein 293, Domein 295)	0	1E+6	0	0	0	1,98E+2		Symmetrisch	
89	Rand (114658)	Rand r.	(Domein 277, Domein 279)	0	1E+6	0	0	0	2,86E+2		Symmetrisch	
90	Rand (106964)	Rand r.	(Domein 261, Domein 263)	0	1E+6	0	0	0	2,28E+3		Symmetrisch	

	Lijn	*NL(xx)*	*NL(yy)*	*NL(zz)*	*F(x) [kN/m]*	*F(y) [kN/m]*	*F(z) [kN/m]*	*M(x) [kNm/m]*	*M(y) [kNm/m]*	*M(z) [kNm/m]*
67	Rand (99334)			Symmetrisch						
70	Rand (107028)			Symmetrisch						
73	Rand (114722)			Symmetrisch						
75	Rand (121494)									
76	Rand (121995)									
77	Rand (122418)									
78	Rand (122919)									
79	Rand (124344)									
80	Rand (124845)									
81	Rand (126256)									
82	Rand (126754)									
84	Rand (123342)									
85	Rand (127160)									
86	Rand (125202)									
87	Rand (128141)									
88	Rand (122352)			Symmetrisch						
89	Rand (114658)			Symmetrisch						
90	Rand (106964)			Symmetrisch						

Lijnopleggingen

	Lijn	*Type*	*Ref. elem.*	*Rx [kN/m/m]*	*Ry [kN/m/m]*	*Rz [kN/m/m]*	*Rxx [kNm/rad/m]*	*Ryy [kNm/rad/m]*	*Rzz [kNm/rad/m]*	*NL(x)*	*NL(y)*	*NL(z)*
91	Rand (91576)	Rand r.	(Domein 229, Domein 231)	0	1E+6	0	0	0	2,71E+3		Symmetrisch	
92	Rand (99270)	Rand r.	(Domein 245, Domein 247)	0	1E+6	0	0	0	1,65E+3		Symmetrisch	
93	Rand (4389)	Rand r.	(Domein 16, Domein 18)	0	1E+6	0	0	0	3,07E+3		Symmetrisch	
94	Rand (83882)	Rand r.	(Domein 213, Domein 215)	0	1E+6	0	0	0	3,07E+3		Symmetrisch	
95	Rand (54508)	Rand r.	(Domein 117, Domein 119)	0	1E+6	0	0	0	4,42E+3		Symmetrisch	
96	Rand (60600)	Rand r.	(Domein 129, Domein 131)	0	1E+6	0	0	0	4,42E+3		Symmetrisch	
97	Rand (67044)	Rand r.	(Domein 165, Domein 167)	0	1E+6	0	0	0	3,51E+3		Symmetrisch	
98	Rand (72526)	Rand r.	(Domein 179, Domein 181)	0	1E+6	0	0	0	3,51E+3		Symmetrisch	
99	Rand (7969)	Rand r.	(Domein 19, Domein 21)	0	9,6E+3	0	0	0	0		Symmetrisch	
100	Rand (14242)	Rand r.	(Domein 31, Domein 33)	0	9,6E+3	0	0	0	0		Symmetrisch	
101	Rand (20388)	Rand r.	(Domein 43, Domein 45)	0	9,5E+3	0	0	0	0		Symmetrisch	
102	Rand (44519)	Rand r.	(Domein 102, Domein 100)	0	9,5E+3	0	0	0	0		Symmetrisch	
103	Rand (26485)	Rand r.	(Domein 55, Domein 57)	0	7,6E+3	0	0	0	0		Symmetrisch	
104	Rand (47184)	Rand r.	(Domein 104, Domein 108)	0	7,6E+3	0	0	0	0		Symmetrisch	
105	Rand (32302)	Rand r.	(Domein 67, Domein 69)	0	7,7E+3	0	0	0	0		Symmetrisch	
106	Rand (38181)	Rand r.	(Domein 79, Domein 81)	0	7,7E+3	0	0	0	0		Symmetrisch	
107	Rand (2304)	Rand r.	(Domein 10, Domein 12)	0	7,3E+3	0	0	0	0		Symmetrisch	
108	Rand (55912)	Rand r.	(Domein 120, Domein 122)	0	7,3E+3	0	0	0	0		Symmetrisch	

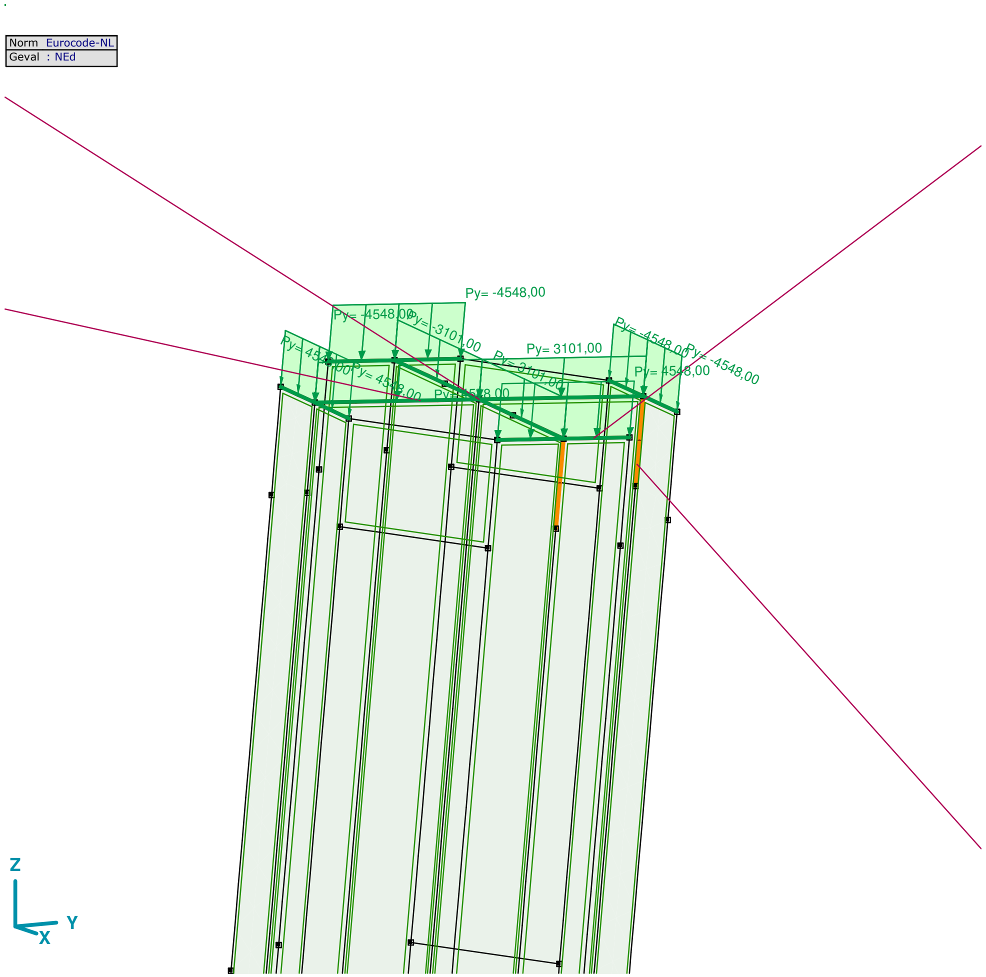
	Lijn	*NL(xx)*	*NL(yy)*	*NL(zz)*	*F(x) [kN/m]*	*F(y) [kN/m]*	*F(z) [kN/m]*	*M(x) [kNm/m]*	*M(y) [kNm/m]*	*M(z) [kNm/m]*
91	Rand (91576)			Symmetrisch						
92	Rand (99270)			Symmetrisch						
93	Rand (4389)			Symmetrisch						
94	Rand (83882)			Symmetrisch						
95	Rand (54508)			Symmetrisch						
96	Rand (60600)			Symmetrisch						
97	Rand (67044)			Symmetrisch						
98	Rand (72526)			Symmetrisch						
99	Rand (7969)									
100	Rand (14242)									
101	Rand (20388)									
102	Rand (44519)									
103	Rand (26485)									
104	Rand (47184)									
105	Rand (32302)									
106	Rand (38181)									
107	Rand (2304)									
108	Rand (55912)									

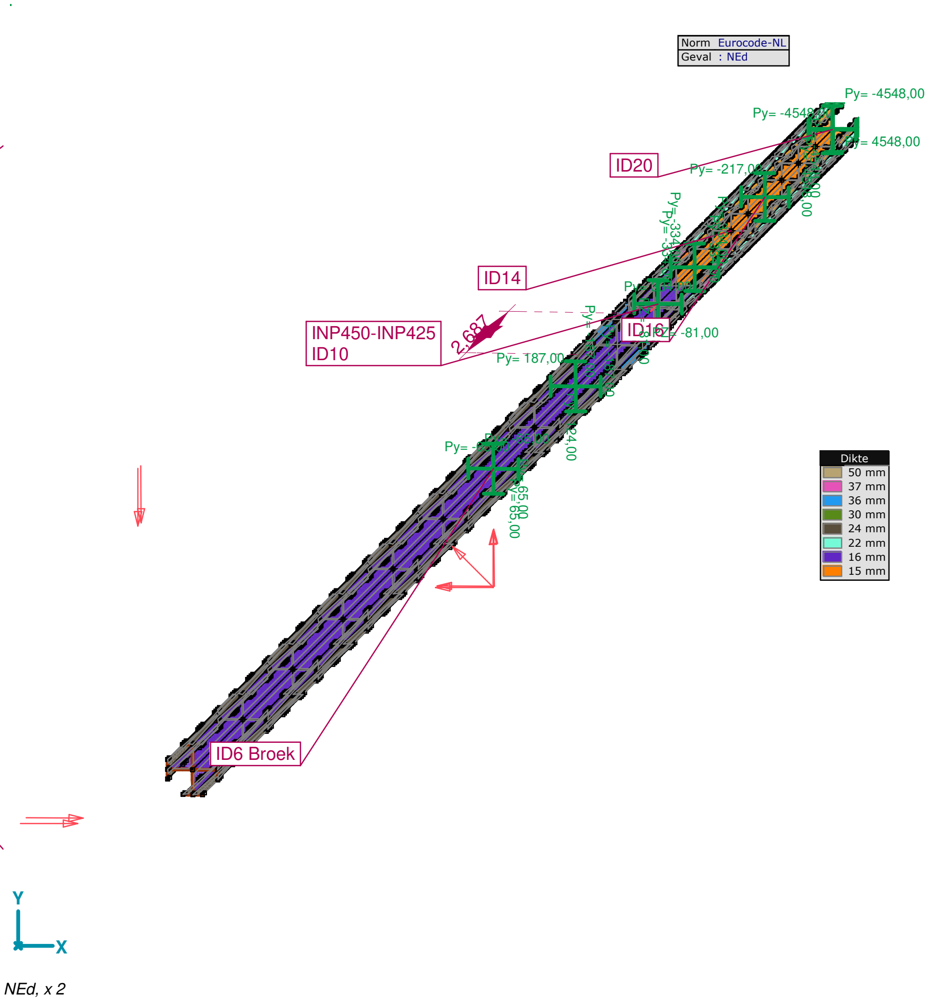
Lijnopleggingen

	Lijn	Type	Ref. elem.	Rx [kN/m/m]	Ry [kN/m/m]	Rz [kN/m/m]	Rxx [kNm/rad/m]	Ryy [kNm/rad/m]	Rzz [kNm/rad/m]	NL(x)	NL(y)	NL(z)
109	Rand (61206)	Rand r.	(Domein 132, Domein 134)	0	6,7E+3	0	0	0	0		Symmetrisch	
110	Rand (67740)	Rand r.	(Domein 168, Domein 170)	0	6,7E+3	0	0	0	0		Symmetrisch	
111	Rand (73853)	Rand r.	(Domein 182, Domein 184)	0	6,9E+3	0	0	0	0		Symmetrisch	
112	Rand (79332)	Rand r.	(Domein 196, Domein 198)	0	6,9E+3	0	0	0	0		Symmetrisch	
113	Rand (72481)	Rand r.	(Domein 179, Domein 181)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
114	Rand (77955)	Rand r.	(Domein 193, Domein 195)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
115	Rand (60555)	Rand r.	(Domein 129, Domein 131)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
116	Rand (67089)	Rand r.	(Domein 165, Domein 167)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
117	Rand (676)	Rand r.	(Domein 7, Domein 9)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
118	Rand (54553)	Rand r.	(Domein 117, Domein 119)	0	1E+6	0	0	0	1,35E+2		Symmetrisch	
119	Rand (116648)	Rand r.	(Domein 280, Domein 282)	0	2,1E+4	0	0	0	0		Symmetrisch	
120	Rand (124278)	Rand r.	(Domein 296, Domein 298)	0	2,1E+4	0	0	0	0		Symmetrisch	
121	Rand (108954)	Rand r.	(Domein 264, Domein 266)	0	3,9E+4	0	0	0	0		Symmetrisch	
122	Rand (116584)	Rand r.	(Domein 280, Domein 282)	0	3,9E+4	0	0	0	0		Symmetrisch	

	Lijn	NL(xx)	NL(yy)	NL(zz)	F(x) [kN/m]	F(y) [kN/m]	F(z) [kN/m]	M(x) [kNm/m]	M(y) [kNm/m]	M(z) [kNm/m]
109	Rand (61206)									
110	Rand (67740)									
111	Rand (73853)									
112	Rand (79332)									
113	Rand (72481)			Symmetrisch						
114	Rand (77955)			Symmetrisch						
115	Rand (60555)			Symmetrisch						
116	Rand (67089)			Symmetrisch						
117	Rand (676)			Symmetrisch						
118	Rand (54553)			Symmetrisch						
119	Rand (116648)									
120	Rand (124278)									
121	Rand (108954)									
122	Rand (116584)									

Lijn: Ondersteund lijnelement; **Type:** Opleggingstype; **Ref. elem.:** Referentie-element; **Rx, Ry, Rz:** Verplaatsingsstijfheid; **Rxx, Ryy, Rzz:** Rotatiestijfheid; **NL(x), NL(y), NL(z), NL(xx), NL(yy), NL(zz):** Niet-lineaire parameters; **F(x):** Weerstand in X-richting; **F(y):** Weerstand in Y-richting; **F(z):** Weerstand in Z-richting; **M(x):** Weerstandsmoment in X-richting; **M(y):** Weerstandsmoment in Y-richting; **M(z):** Weerstandsmoment in Z-richting;





NEd: Oppervlak lijnlast

	Richting	px [kN/m]	py [kN/m]	pz [kN/m]	pm [kNm/m]	X [m]	Y [m]	Z [m]	Richting	dL [m]
1	Globaal	0	0	–81,00	0	1,189	2,309	10,634	-	0
		0	0	–81,00	0	1,189	2,471	10,619	-	0,162

NEd: Oppervlak lijnlast

	Richting	*px [kN/m]*	*py [kN/m]*	*pz [kN/m]*	*pm [kNm/m]*	*X [m]*	*Y [m]*	*Z [m]*	*Richting*	*dL [m]*
2	Globaal	0	0	–81,00	0	1,590	2,308	10,596	-	0
		0	0	–81,00	0	1,589	2,469	10,581	-	0,162
3	Globaal	0	0	–81,00	0	1,308	2,590	10,596	-	0
		0	0	–81,00	0	1,469	2,589	10,581	-	0,162
4	Globaal	0	0	–81,00	0	1,309	2,189	10,634	-	0
		0	0	–81,00	0	1,471	2,189	10,619	-	0,162
5	Globaal	0	0	–54,00	0	1,189	2,390	10,627	-	0
		0	0	–54,00	0	1,590	2,388	10,588	-	0,402
6	Globaal	0	0	–54,00	0	1,390	2,189	10,627	-	0
		0	0	–54,00	0	1,389	2,590	10,588	-	0,402
7	Relatief aan rand	0	4548,00	0	0	2,779	3,659	34,384	-	0
		0	4548,00	0	0	2,940	3,658	34,374	-	0,162
8	Relatief aan rand	0	–4548,00	0	0	2,778	4,060	34,359	-	0
		0	–4548,00	0	0	2,940	4,060	34,349	-	0,162
9	Relatief aan rand	0	–4548,00	0	0	2,659	3,779	34,384	-	0
		0	–4548,00	0	0	2,658	3,940	34,374	-	0,162
10	Relatief aan rand	0	4548,00	0	0	3,060	3,778	34,359	-	0
		0	4548,00	0	0	3,060	3,940	34,349	-	0,162
11	Relatief aan rand	0	–3101,00	0	0	2,860	3,659	34,379	-	0
		0	–3101,00	0	0	2,859	3,859	34,367	-	0,201
12	Relatief aan rand	0	3101,00	0	0	2,859	3,859	34,367	-	0
		0	3101,00	0	0	2,859	4,060	34,354	-	0,201
13	Relatief aan rand	0	–3101,00	0	0	2,659	3,860	34,379	-	0
		0	–3101,00	0	0	2,859	3,859	34,367	-	0,201
14	Relatief aan rand	0	3101,00	0	0	2,859	3,859	34,367	-	0
		0	3101,00	0	0	3,060	3,859	34,354	-	0,201
15	Relatief aan rand	0	217,00	0	0	2,211	3,091	25,199	-	0
		0	217,00	0	0	2,372	3,090	25,189	-	0,162
16	Relatief aan rand	0	217,00	0	0	2,492	3,210	25,174	-	0
		0	217,00	0	0	2,491	3,371	25,165	-	0,162
17	Relatief aan rand	0	–217,00	0	0	2,091	3,211	25,199	-	0
		0	–217,00	0	0	2,090	3,372	25,189	-	0,162
18	Relatief aan rand	0	–217,00	0	0	2,210	3,492	25,174	-	0
		0	–217,00	0	0	2,371	3,491	25,165	-	0,162
19	Relatief aan rand	0	–148,00	0	0	2,291	3,090	25,194	-	0
		0	–148,00	0	0	2,291	3,291	25,182	-	0,201
20	Relatief aan rand	0	148,00	0	0	2,291	3,291	25,182	-	0
		0	148,00	0	0	2,291	3,492	25,169	-	0,201
21	Relatief aan rand	0	–148,00	0	0	2,090	3,291	25,194	-	0
		0	–148,00	0	0	2,291	3,291	25,182	-	0,201

NEd: Oppervlak lijnlast

	Richting	*px* *[kN/m]*	*py* *[kN/m]*	*pz* *[kN/m]*	*pm* *[kNm/m]*	*X* *[m]*	*Y* *[m]*	*Z* *[m]*	*Richting*	*dL* *[m]*
22	Relatief aan rand	0	148,00	0	0	2,291	3,291	25,182	-	0
		0	148,00	0	0	2,492	3,291	25,169	-	0,201
23	Relatief aan rand	0	–334,00	0	0	1,498	2,618	15,616	-	0
		0	–334,00	0	0	1,497	2,779	15,606	-	0,162
24	Relatief aan rand	0	334,00	0	0	1,899	2,617	15,591	-	0
		0	334,00	0	0	1,899	2,779	15,581	-	0,162
25	Relatief aan rand	0	–334,00	0	0	1,617	2,899	15,591	-	0
		0	–334,00	0	0	1,779	2,899	15,581	-	0,162
26	Relatief aan rand	0	–228,00	0	0	1,699	2,498	15,611	-	0
		0	–228,00	0	0	1,698	2,698	15,598	-	0,201
27	Relatief aan rand	0	–228,00	0	0	1,498	2,699	15,611	-	0
		0	–228,00	0	0	1,698	2,698	15,598	-	0,201
28	Relatief aan rand	0	228,00	0	0	1,698	2,698	15,598	-	0
		0	228,00	0	0	1,899	2,698	15,586	-	0,201
29	Relatief aan rand	0	228,00	0	0	1,698	2,698	15,598	-	0
		0	228,00	0	0	1,698	2,899	15,586	-	0,201
30	Relatief aan rand	0	334,00	0	0	1,618	2,498	15,616	-	0
		0	334,00	0	0	1,779	2,497	15,606	-	0,162
31	Relatief aan rand	0	–187,00	0	0	0,614	1,484	5,342	-	0
		0	–187,00	0	0	0,779	1,483	5,321	-	0,166
32	Relatief aan rand	0	187,00	0	0	0,484	1,614	5,342	-	0
		0	187,00	0	0	0,483	1,779	5,321	-	0,166
33	Relatief aan rand	0	187,00	0	0	0,611	1,907	5,287	-	0
		0	187,00	0	0	0,775	1,905	5,266	-	0,166
34	Relatief aan rand	0	–187,00	0	0	0,907	1,611	5,287	-	0
		0	–187,00	0	0	0,905	1,775	5,266	-	0,166
35	Relatief aan rand	0	124,00	0	0	0,696	1,483	5,331	-	0
		0	124,00	0	0	0,695	1,695	5,304	-	0,213
36	Relatief aan rand	0	124,00	0	0	0,483	1,696	5,331	-	0
		0	124,00	0	0	0,695	1,695	5,304	-	0,213
37	Relatief aan rand	0	–124,00	0	0	0,695	1,695	5,304	-	0
		0	–124,00	0	0	0,693	1,906	5,276	-	0,213
38	Relatief aan rand	0	–124,00	0	0	0,695	1,695	5,304	-	0
		0	–124,00	0	0	0,906	1,693	5,276	-	0,213
39	Relatief aan rand	0	65,00	0	0	–0,081	0,789	0,038	-	0
		0	65,00	0	0	0,084	0,788	0,017	-	0,166
40	Relatief aan rand	0	–65,00	0	0	–0,211	0,919	0,038	-	0
		0	–65,00	0	0	–0,212	1,084	0,017	-	0,166
41	Relatief aan rand	0	–65,00	0	0	–0,084	1,212	–0,017	-	0
		0	–65,00	0	0	0,081	1,211	–0,038	-	0,166

NEd: Oppervlak lijnlast

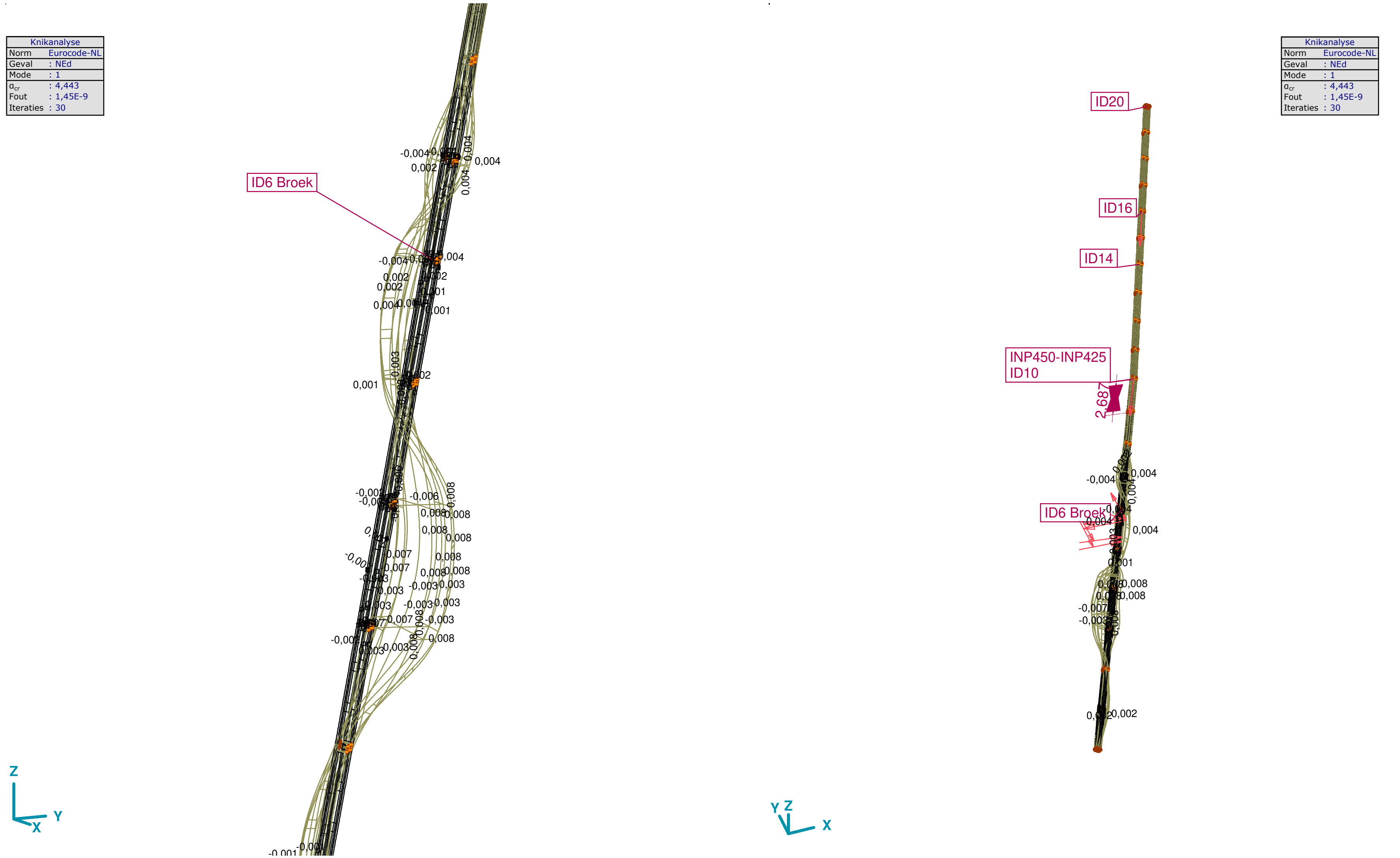
	Richting	*px [kN/m]*	*py [kN/m]*	*pz [kN/m]*	*pm [kNm/m]*	*X [m]*	*Y [m]*	*Z [m]*	*Richting*	*dL [m]*
42	Relatief aan rand	0	65,00	0	0	0,212	0,916	–0,017	-	0
		0	65,00	0	0	0,211	1,081	–0,038	-	0,166
43	Relatief aan rand	0	–43,00	0	0	0,002	0,789	0,027	-	0
		0	–43,00	0	0	0	1,000	0	-	0,213
44	Relatief aan rand	0	–43,00	0	0	–0,211	1,002	0,027	-	0
		0	–43,00	0	0	0	1,000	0	-	0,213
45	Relatief aan rand	0	43,00	0	0	0	1,000	0	-	0
		0	43,00	0	0	0,211	0,998	–0,027	-	0,213
46	Relatief aan rand	0	43,00	0	0	0	1,000	0	-	0
		0	43,00	0	0	–0,002	1,211	–0,027	-	0,213

px, py, pz: Belastingkracht component; **pm:** Belastingsmoment component; **X:** Belasting in X-richting; **Y:** Belasting in Y-richting; **Z:** Belasting in Z-richting;

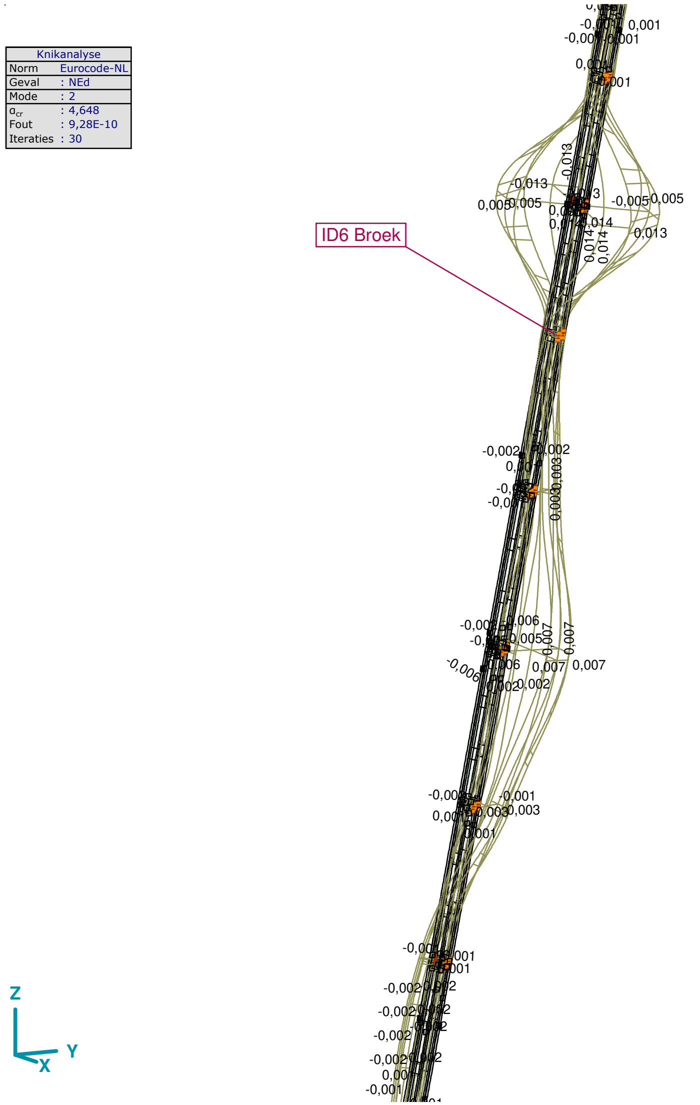
Maatgevende belastingsfactoren [NEd]

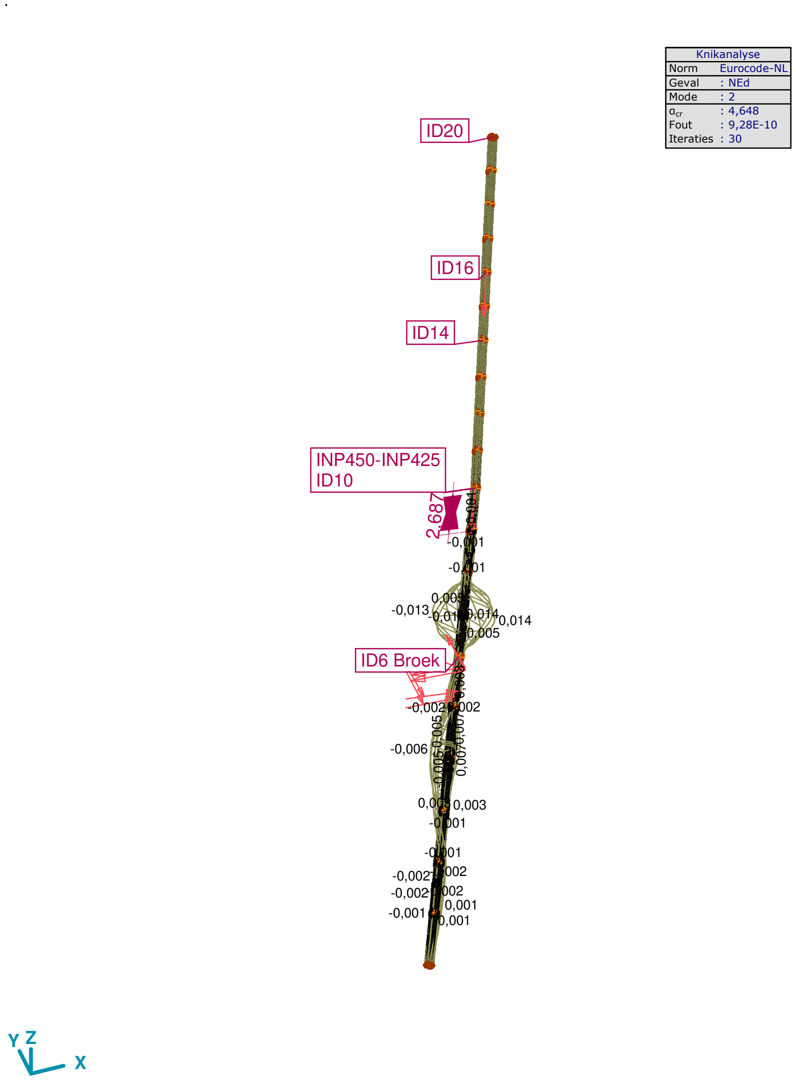
	α_{cr}	*Fout*
1	4,443	1,45E-9
2	4,648	9,28E-10
3	4,814	1,43E-9
4	4,837	4,46E-10
5	6,195	3,29E-8
6	6,428	2,27E-7
7	6,879	1,22E-6
8	7,027	1,66E-6
9	7,121	6,02E-6
10	7,246	1,01E-5
11	7,369	8,08E-6
12	7,493	8,73E-6
13	7,718	5,17E-5
14	7,843	4,89E-5
15	7,859	7,18E-5

α_{cr}: Maatgevende belasting parameter; **Fout:** Fout in oplossing;

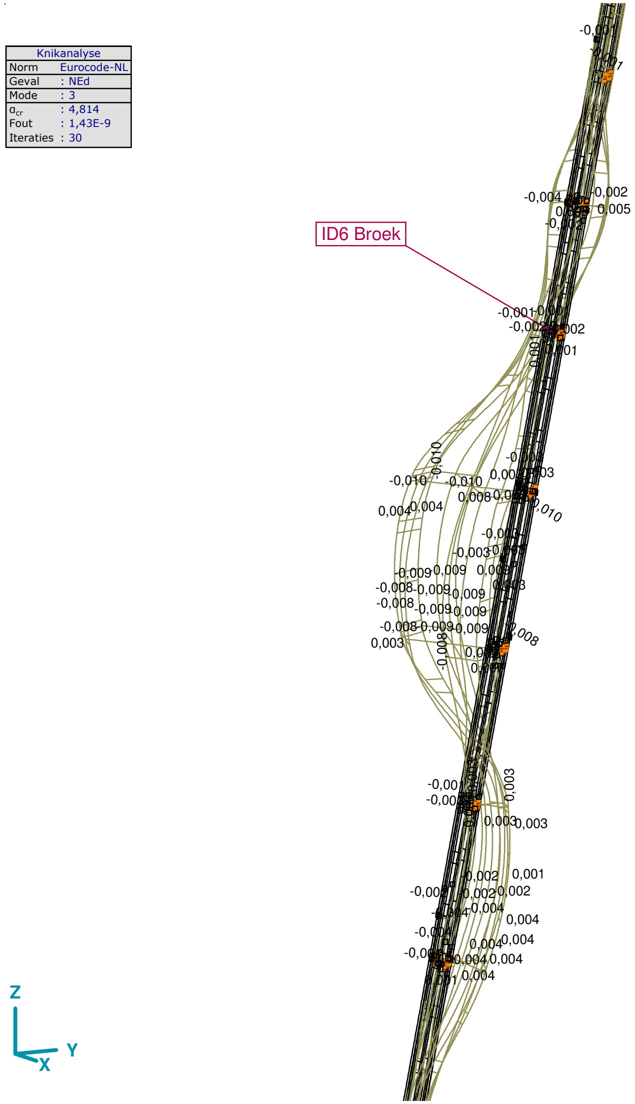


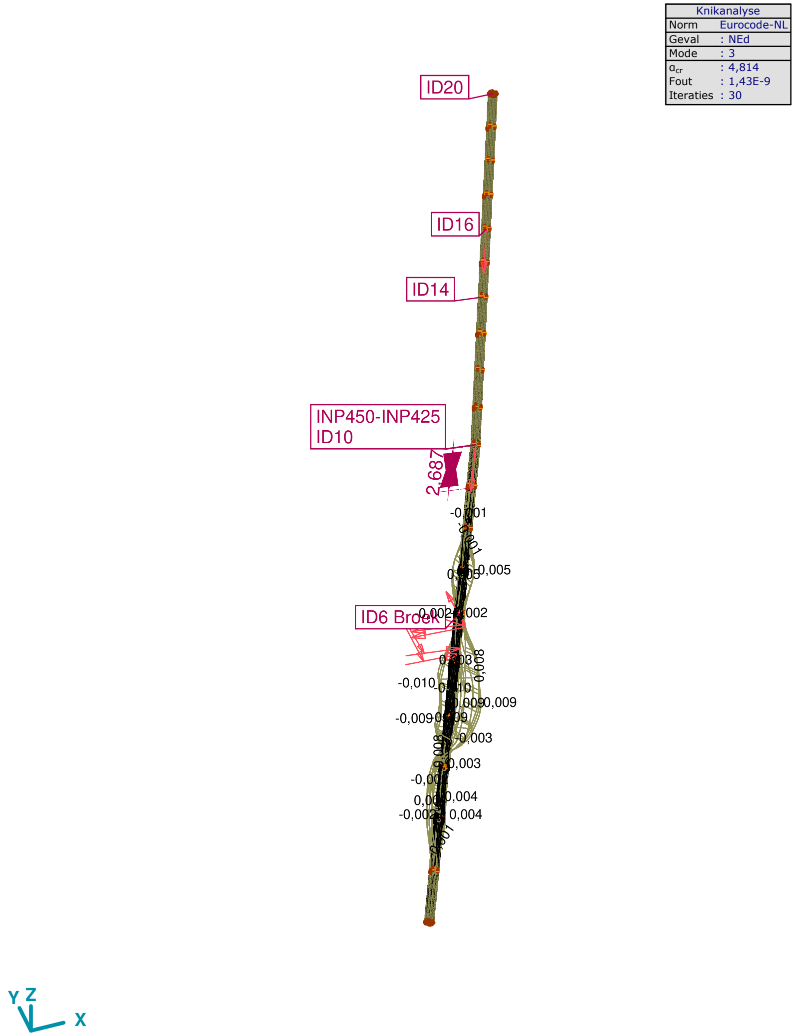
[Stab], NEd Modus 1 (4,443), eX, Lijnen, x 2





[Stab], NEd Modus 2 (4,648), eX, Lijnen, x 2

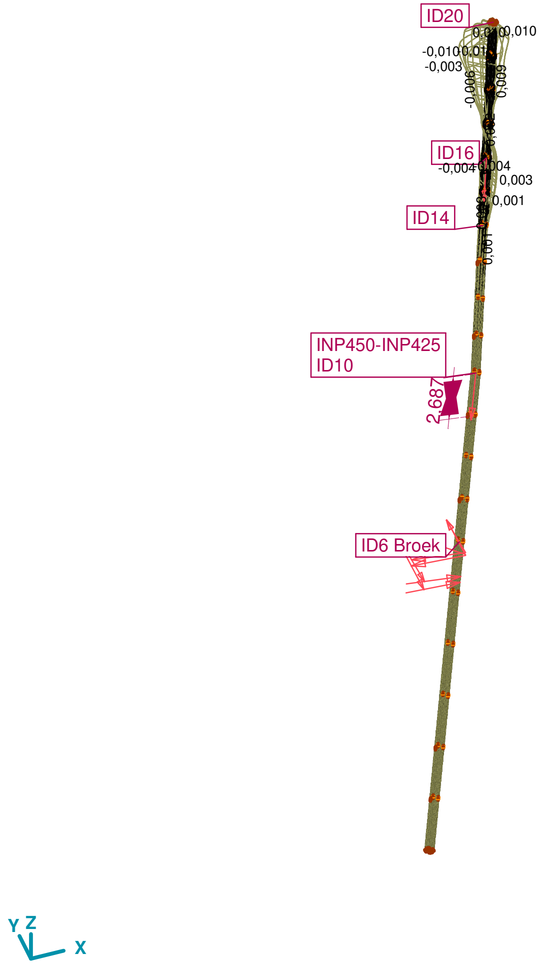




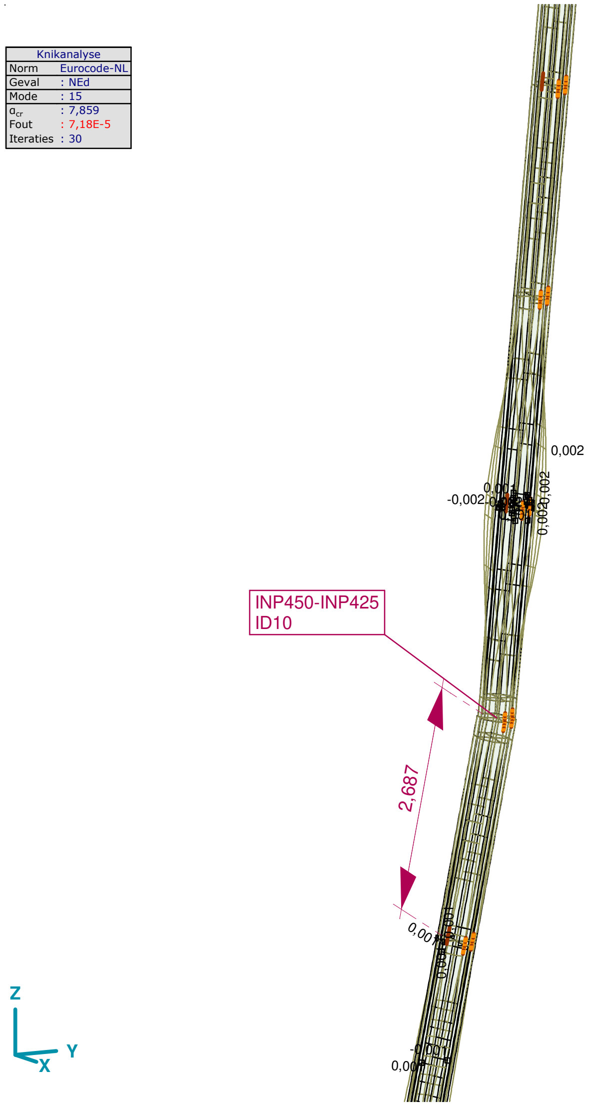
[Stab], NEd Modus 3 (4,814), eX, Lijnen, x 2

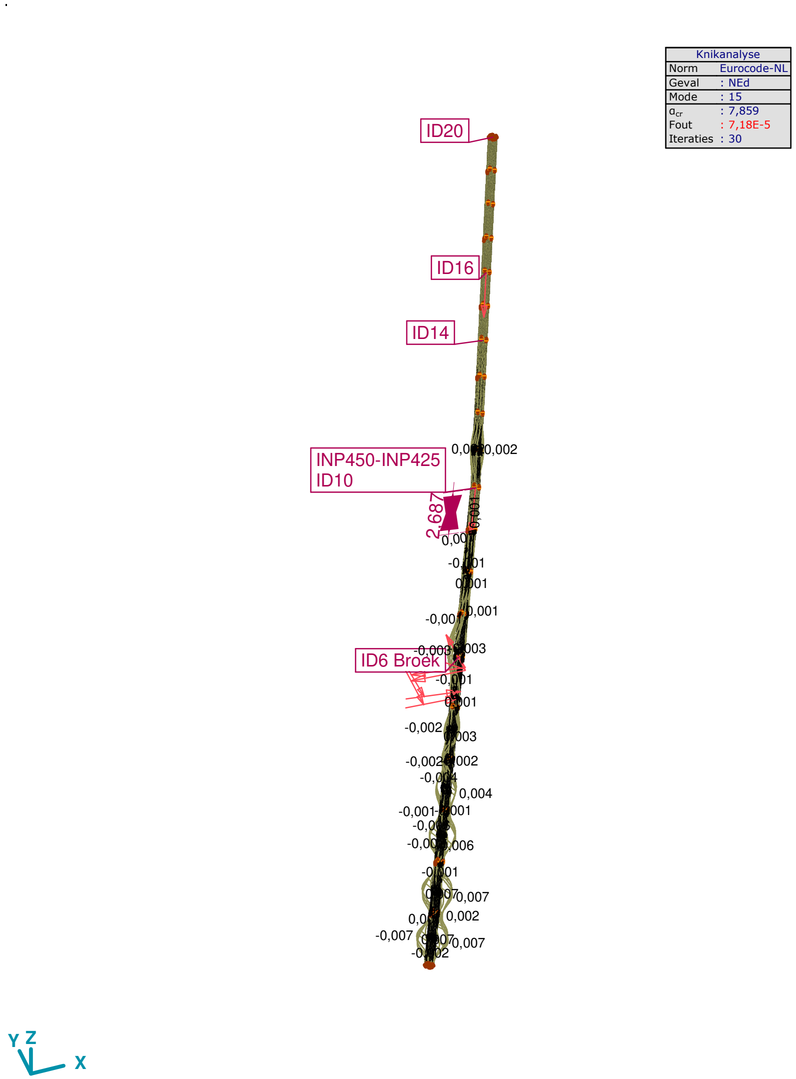
Knikanalyse	
Norm	Eurocode-NL
Geval	: NEd
Mode	: 4
α_{cr}	: 4,837
Fout	: 4,46E-10
Iteraties	: 30

Knikanalyse	
Norm	Eurocode-NL
Geval	: NEd
Mode	: 4
α_{cr}	: 4,837
Fout	: 4,46E-10
Iteraties	: 30

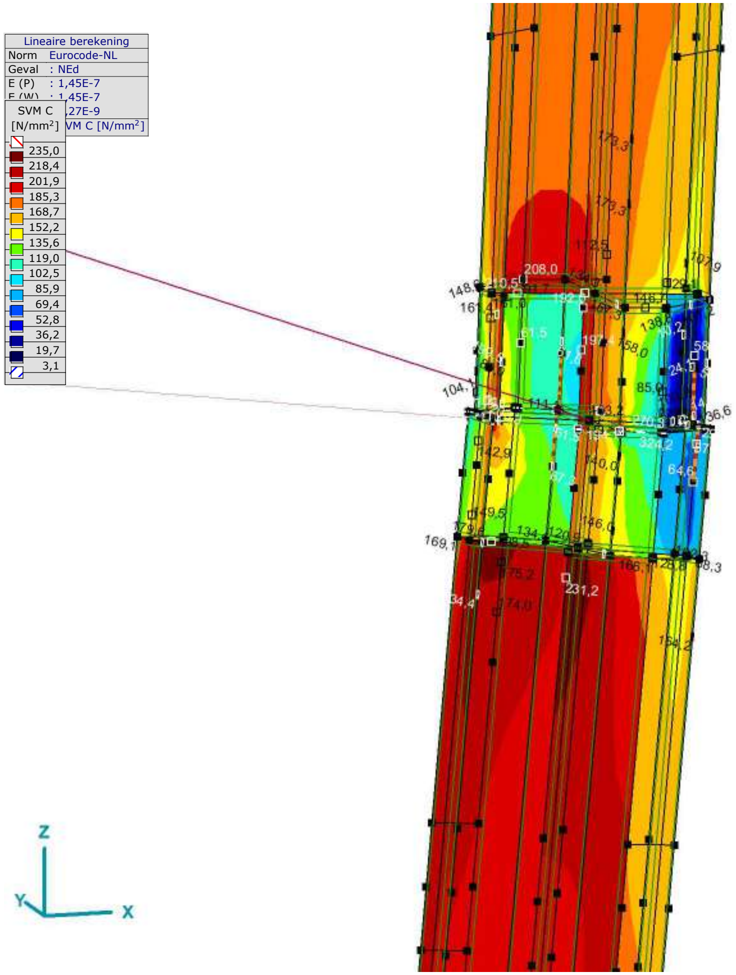


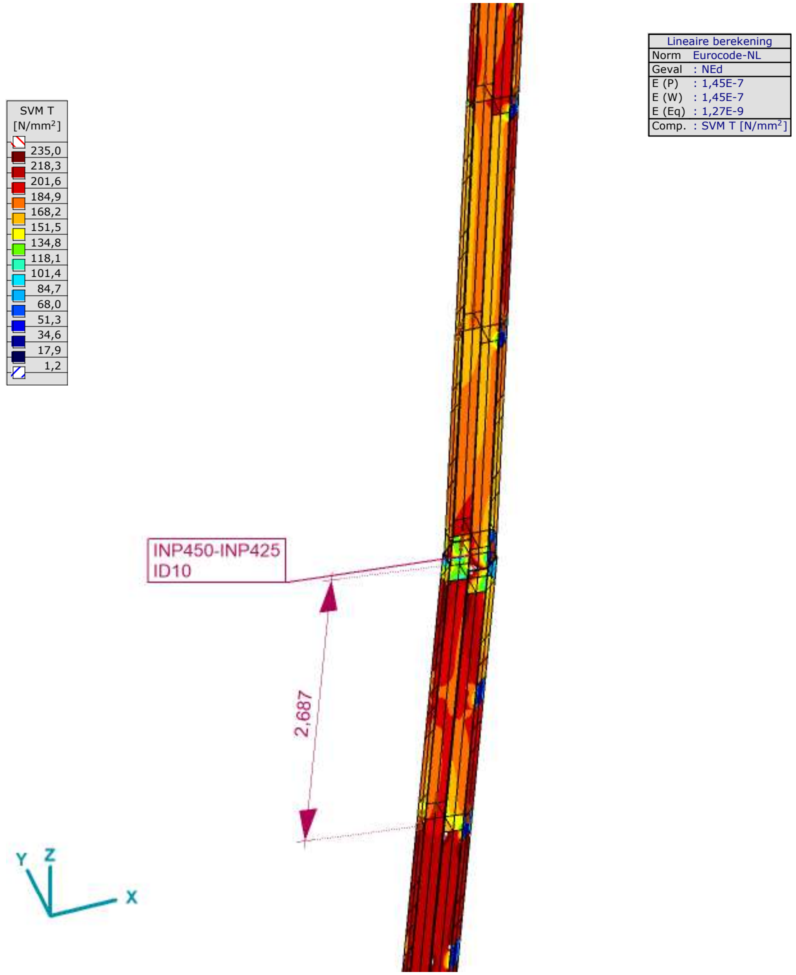
[Stab], NEd Modus 4 (4,837), eX, Lijnen, x 2



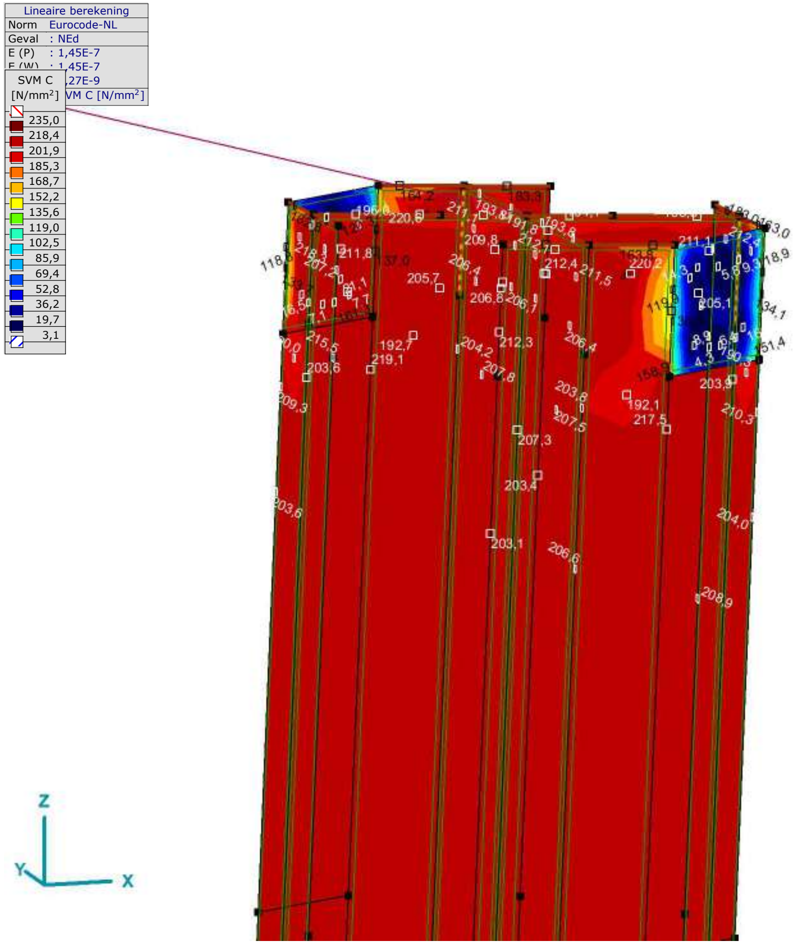


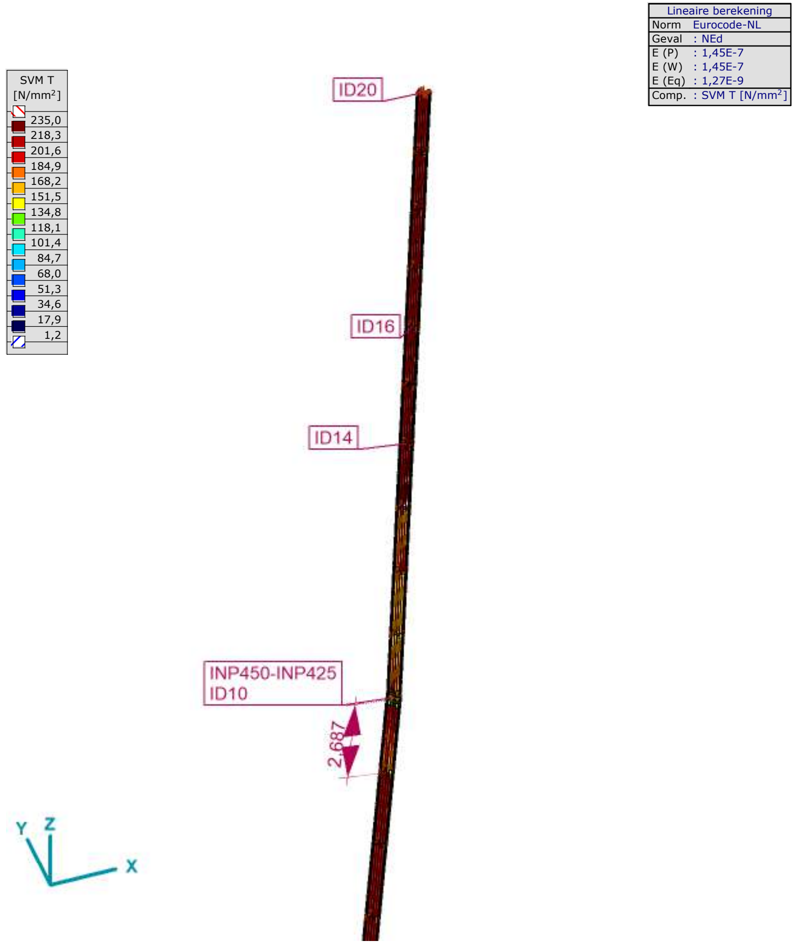
[Stab], NEd Modus 15 (7,859), eX, Lijnen, x 2



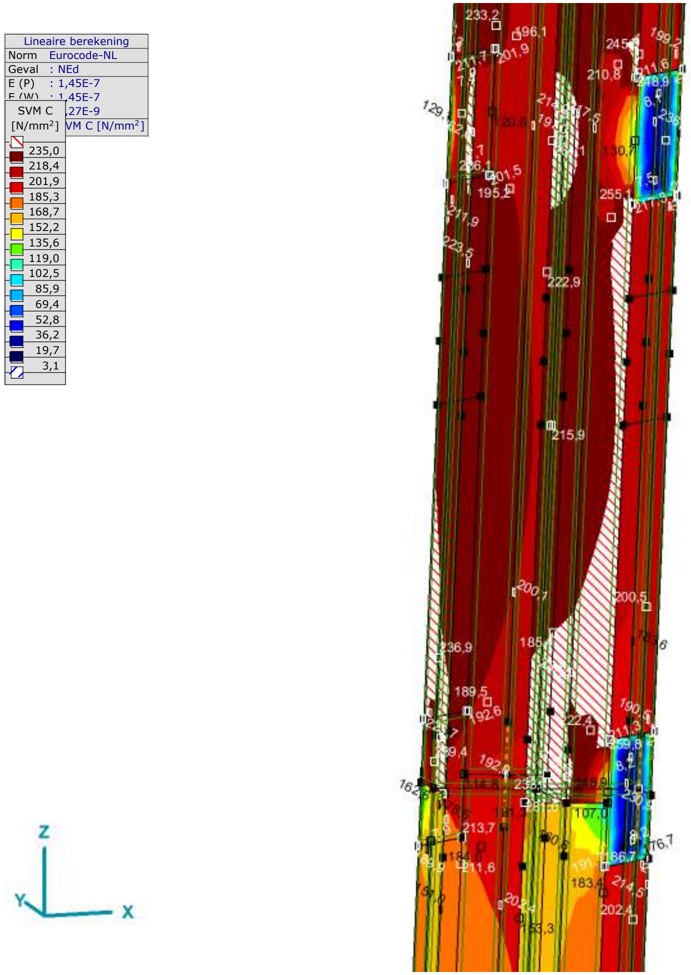


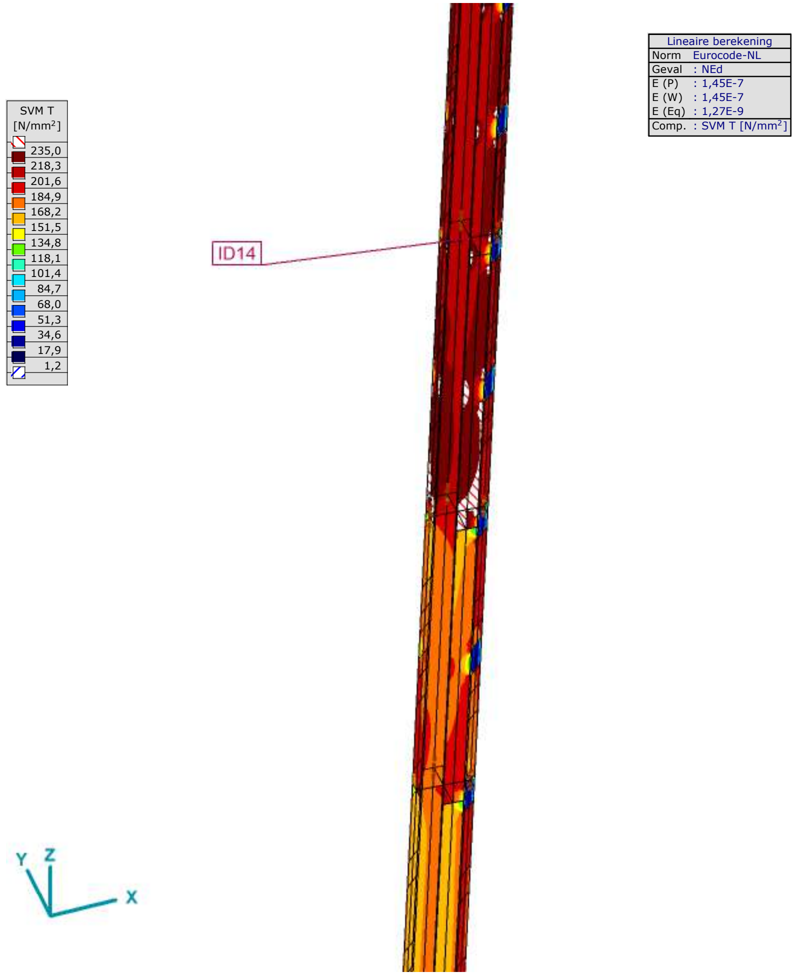
[I], Lineair, NEd, Kleuren 2D, x 2



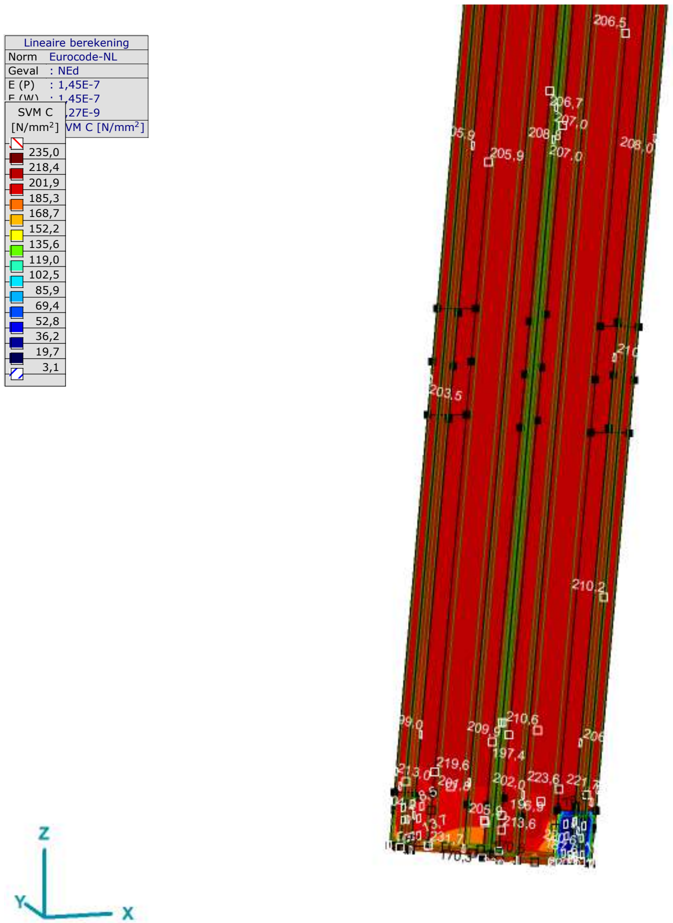


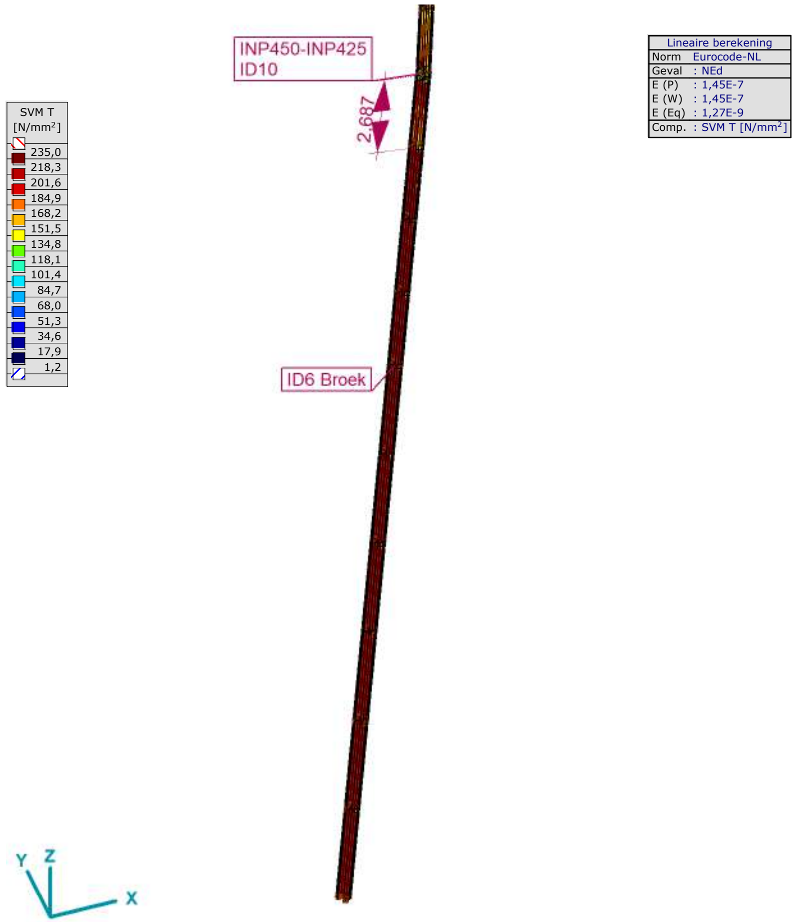
[I], Lineair, NEd, Kleuren 2D, x 2_2





[I], Lineair, NEd, Kleuren 2D, x 2_3





[I], Lineair, NEd, Kleuren 2D, x 2_4

APPENDIX G DOCUMENTEN TNO

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2628 CK Delft
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Datum
18 februari 2021

Onze referentie
Rapport TNO 2021 R10305

E-mail
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Doorkiesnummer
+31888663469

Projectnummer
060.48035/01.01

Onderwerp
Beoordeling individueel risico draagmasten Lekkruising

Geachte heer Van der Wekken,

Hierbij ontvangt u het briefrapport betreffende ‘Beoordeling individueel risico draagmasten Lekkruising.

Dit document heeft de status van een TNO rapport, en is bij TNO bekend onder het nummer **TNO 2021 R10305**. Dit rapport mag niet worden vermenigvuldigd en/of openbaar gemaakt door middel van druk, fotokopie, microfilm of op welke andere wijze dan ook, zonder voorafgaande toestemming van TNO. Dit rapport is in opdracht opgesteld. Voor de rechten en verplichtingen van opdrachtgever wordt verwezen naar de Algemene Voorwaarden voor onderzoeksopdrachten aan TNO. Het ter inzage geven van het TNO-rapport aan direct belanghebbenden is toegestaan.

Met vriendelijke groet,

ValidSigned door IJsbrand van Straalen op 18-02-2021

Dr. ir. YJ van Straalen
Auteur

ValidSigned door Peter Rasker op 19-02-2021

Dr. P.C. Rasker
Research manager
Structural Reliability

Inleiding

Voor de beoordeling van de constructieve veiligheid van bestaande hoogspanningsmasten gaat TenneT uit van het TNO-rapport [1]. In paragrafen 2.4 en 2.5 van dit rapport zijn de aan te houden betrouwbaarheidsindices voor respectievelijk verbouw en afkeur gegeven. In voetnoot b van tabel 2.3 voor de situatie afkeur, is aangegeven dat het maatschappelijk risico waarop de gegeven waarden voor de betrouwbaarheidsindices voor verbouw en afkeur zijn gebaseerd, in alle gevallen boven het individuele risico liggen met een minimale waarde van de betrouwbaarheid van β_{15} = 1,1 (waarde behorende bij een referentieperiode van 15 jaar). De achtergronden hiervoor zijn nader uiteengezet in hoofdstuk 5 van bijlage B1 van het rapport.

TenneT vraagt zich af of de conclusie dat de waarde van het individuele risico lager ligt dan van het maatschappelijke risico, ook van toepassing is voor drie masten van de verbinding Krimpen – Geertruidenberg. Dit betreft de masten 12 en 13 – type S+95 – van 163m, en de mast 49 – type S+75- van 143m, elders in de verbinding Krimpen – Geertruidenberg. Dit, omdat deze masten veel hoger zijn dan de meest voorkomende masten en omdat nabij deze masten bebouwing aanwezig is.

TNO heeft een nadere analyse uitgevoerd om antwoord te kunnen geven op deze vraag van TenneT. In dit memorandum is deze analyse toegelicht, die gebaseerd is op de aanpak zoals nader omschreven in hoofdstuk 5 van bijlage B1 van het TNO-rapport [1]. In aanvulling daarop is ook ingegaan op het groepsrisico.

Aanpak beoordeling individueel risico

Onder het individuele risico (IR) wordt verstaan de kans op overlijden van een maatgevend individu gedurende een periode van een jaar als gevolg van een bepaalde dreiging. Voor het IR wordt een eis gehanteerd van 10^{-5} per jaar.
Het individuele risico IR is gedefinieerd als:

$$IR = P_f \cdot P_{d|f}$$

waarbij P_f de kans op falen van een hoogspanningsmast is [-/jaar] en $P_{d|f}$ de kans op overlijden is gegeven dat een hoogspanningsmast faalt [-]. Indien de eis voor IR wordt aangehouden (10^{-5} per jaar) en de kans voor $P_{d|f}$ kan worden ingeschat, dan is de aan te houden minimale kans op falen als volgt te bepalen:

$$P_f = IR / P_{d|f}$$

De overeenkomende betrouwbaarheidsindex β volgt uit de definitie P = Φ(-β).
Voor een woning dichtbij een hoogspanningsmast is de kans op overlijden van een bewoner gegeven dat een hoogspanningsmast faalt, gelijk aan het product van de volgende factoren:

- De kans dat de bewoner aanwezig is;
- De kans dat de mast het huis raakt;
- De kans op een zware beschadiging;
- De kans dat een persoon komt te overlijden.

De kans dat de bewoner aanwezig is, is gelijk aan 1. Dit, omdat moet worden verondersteld dat in geval van een maatgevend individu de bewoner permanent aanwezig is. In hoofdstuk 5 van bijlage B1 van het TNO-rapport [1] is aangenomen dat de kans dat de mast het huis raakt orde 0,25 is (huis staat in één van de vier valrichtingen), dat de kans op zware beschadiging orde 0,1 is, en dat de kans op overlijden orde 0,1 is. Hieruit volgt dat de kans op overlijden gegeven een instorting orde 0,002 is. Vervolgens is geredeneerd dat dit past bij een betrouwbaarheidsindex op jaarbasis van $\beta_1 = 2,3$, op basis waarvan een betrouwbaarheidsindex voor een referentieperiode van 15 jaar is aangehouden van $\beta_{15} = 1,1$.

Beoordeling individueel risico draagmasten Lekkruising

In de bijlage zijn op luchtfoto's cirkels aangegeven waarbinnen de masten kunnen neerkomen indien deze falen. Ervan uitgaande dat een mast bij falen vanwege een storm in oostelijke richting zal neerkomen, kan de conclusie getrokken worden dat voor elk van de drie masten woningen of andere gebouwen in de betreffende zone aanwezig zijn.

Aangaande de kans dat de mast een huis zal raken, is de observatie dat de in het TNO-rapport [1] aangenomen orde 0,25 hoog is voor de hier beschouwde drie masten en de locaties van de woningen in de nabijheid van deze masten. De kans is voor een woning in de meest kritische zone is ingeschat op orde 0,1. Deze waarde volgt uit de overweging voor de situatie voor de laagste van de drie masten (mast 49, zie bijlage) waarbij een woning ten oosten van de mast op ca. 70 m afstand in de sector van 90°, een kans van ca. 0,1 heeft dat deze geraakt wordt door de mast na falen.

Aangaande de kans op zware schade, zal de kans voor de hier beschouwde masten hoger zijn dan de kans ingeschat in het TNO-rapport [1] met een orde 0,1. De veel hogere masten zijn opgebouwd uit zwaardere elementen en de valhoogte is ook veel groter. Voor een betonnen woning waarbij de aaneengesloten betonnen wanden en vloeren nog enige weerstand bezitten, is ingeschat dat de kans op zware schade orde 0,4 is. Voor een woning opgebouwd uit baksteen wanden, een houten dak en houten vloeren waarbij de constructie veel minder robuust is vergeleken met een betonnen woning, is de kans op zware schade orde 0,8. De kans dat een persoon komt te overlijden blijft ongewijzigd (orde 0,1).

In onderstaande tabel zijn de berekeningsresultaten voor beide situaties gegeven

Berekening	Betonnen woning	Woning met metsel-werk wanden, houten dak en houten vloeren
IR [-/jaar]	10^{-5}	10^{-5}
Kans dat mast woning raakt	0,1	0,1
Kans op zware beschadiging woning	0,4	0,8
Kans dat persoon overlijdt	0,1	0,1
$P_{d\|f}$ [-]	0,004	0,008
P_f [-/jaar]	0,0025	0,00125
β_1	2,8	3,0
β_{15}	1,8	2,1

Uit deze nadere analyse volgt dat de betrouwbaarheidsindex β_{15} (1,8 en 2,1 afhankelijk van de constructie van de woning) aanmerkelijk hoger is dan voor de meest voorkomende hoogspanningsmasten met een ingeschatte waarde β_{15} = 1,1 (TNO-rapport [1]). Weliswaar is de kans dat een mast de woning raakt kleiner vanwege een grotere afstand, maar de kans op zware beschadiging van de woning is aanmerkelijk hoger. Deze waarden van de betrouwbaarheidsindex komen overeen met de waarden die in het TNO-rapport zijn aangehouden voor de constructieve toets van bestaande hoogspanningsmasten. Voor afkeur geldt dat β_{15} = 2,0 voor CC2-0 (van toepassing is voor de beschouwde drie masten) en voor verbouw geldt dat β_{15} = 2,4 voor CC2. Op basis van deze analyse trekt TNO de conclusie dat de waarden van de betrouwbaarheidsindex voor het individuele risico op het zelfde niveau liggen als voor het maatschappelijke risico.

Groepsrisico

Bij de indeling van bouwwerken in een gevolgklasse houdt NEN-EN 1990 o.a. rekening met het aantal personen dat bedreigd wordt bij falen van een constructie. Voor gevolgklasse CC2 betreft dit een beperkt aantal. Ook voor de situatie van de hier beschouwde drie masten is nog altijd sprake van één of enkele woningen die bij falen van een mast kunnen worden geraakt. De conclusie is dan ook dat het niet noodzakelijk is dat er gekozen moet worden voor een hogere gevolgklasse.

Conclusies

Voor de drie masten van de verbinding Krimpen – Geertruidenberg, is het individuele risico hoger dan de waarde die in het TNO-rapport [1] is vastgesteld voor de meest voorkomende hoogspanningsmasten. Omdat de bijbehorende betrouwbaarheidsindex voor het individuele risico voor een referentieperiode van 15 jaar overeenkomt met de betrouwbaarheidsindex voor het maatschappelijke risico die als maatgevend is aangehouden, betekent dit dat voor de drie beschouwde masten van de bepalingsmethodes zoals beschreven in het TNO-rapport kan worden uitgegaan bij toetsing van deze drie masten. Met de huidige aanwezige bebouwing is het groepsrisico niet van belang; uiteraard moet TenneT zich er wel van bewust zijn dat bij wijzigingen in de bebouwing dit anders kan worden.

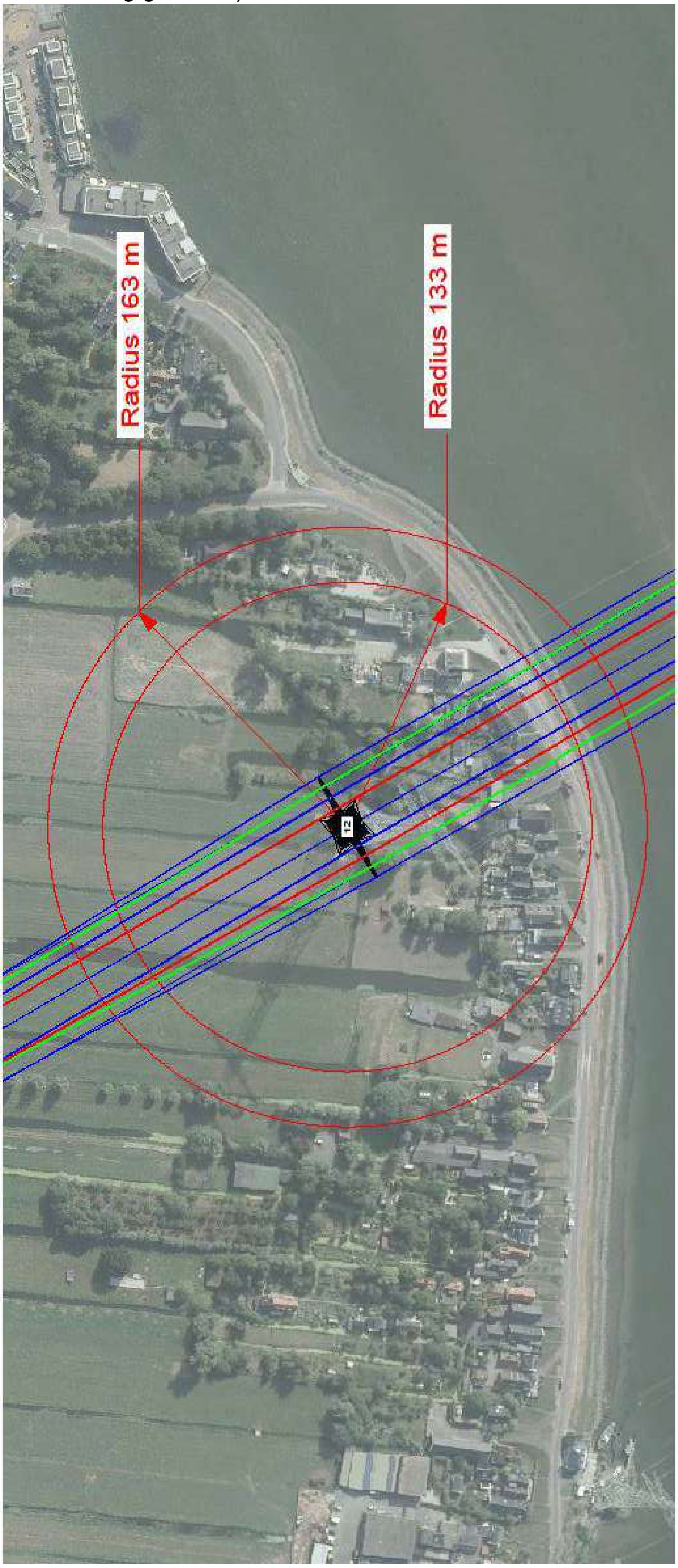
Referenties

[1] Geurts, C.P.W., Steenbergen R.J.D.M., Steenbergen, H.M.G.M., Ploeg, T.J., Scholten, N.P.M., Tol, A.F. van, *Beoordeling van de constructie van bestaande hoogspanningsmaten*, TNO 2018 R11159, 16 oktober 2018

Bijlage – Overzicht van gebieden waar masten kunnen neerkomen
(4 pagina's)

TenneT heeft op luchtfoto's van de omgeving van de drie beschouwde masten de cirkels aangegeven waarbinnen de masten zullen neerkomen. De grootste cirkel heeft een radius gelijk aan de hoogte van de mast en de binnenste cirkel komt overeen de afstand tussen de top van de mast en de locatie met het meest kritische onderdeel van de staalconstructie van de mast.
De verwachte valrichting is loodrecht op de lijnverbinding in oostelijke richting (maar rechts op de schetsen), met een mogelijk afwijking van +45° en -45°.

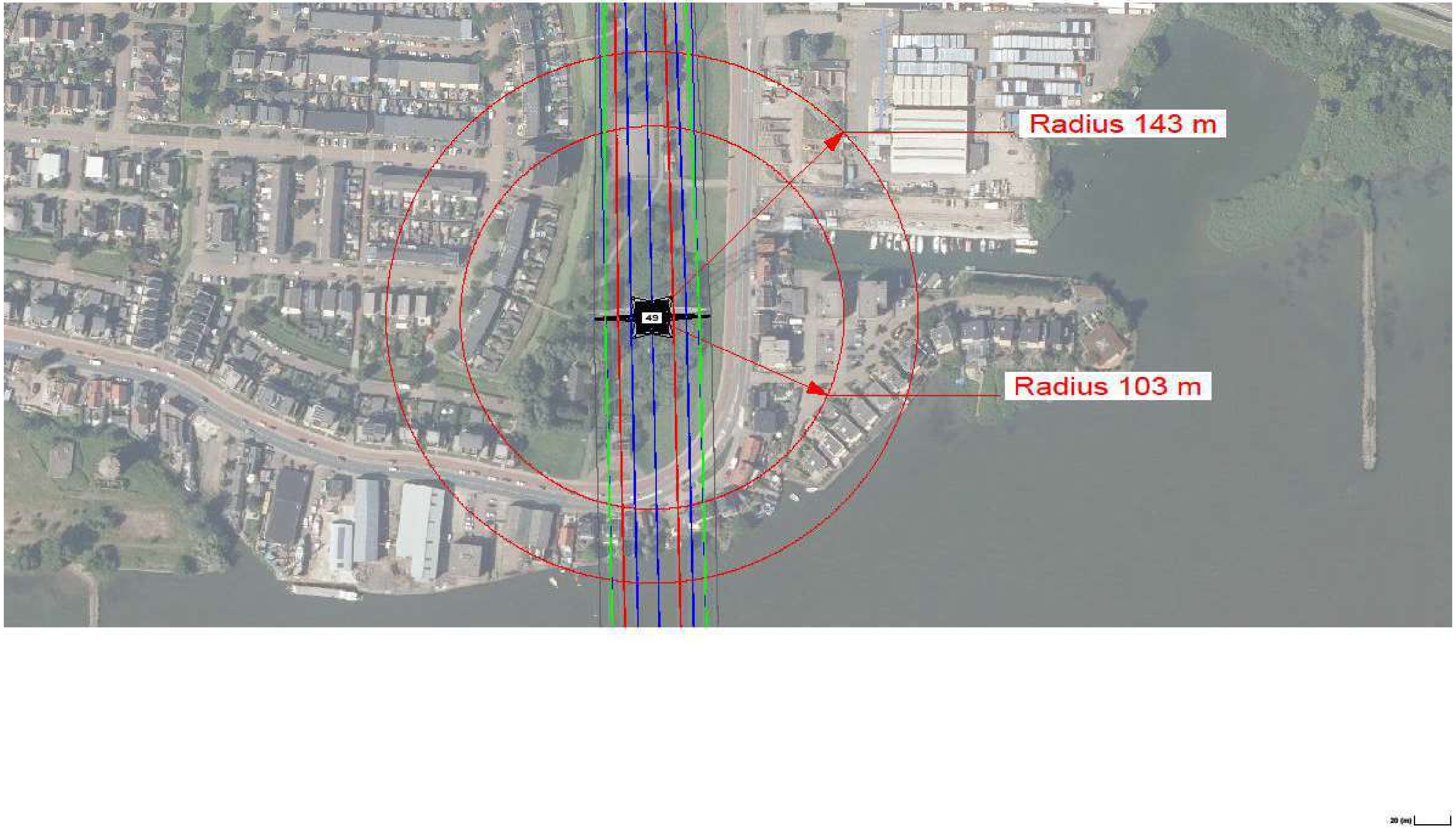
Mast 12 (afbeelding is kwart slag gedraaid)



Mast 13 (afbeelding is kwart slag gedraaid)

Mast 49 (afbeelding is kwart slag gedraaid)

DNV GL Nederlands BV, Project: "706-50-001 GT-KIJ nieuwe situatie"
PLS-CADD Version 16.61, 13:53:02 vrijdag 5 februari 2021
Line Title: 'Mitigations in towers'



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Onderwerp
Briefrapport Toepassing van windrichtingsafhankelijke stuwdruk (cdir)

Geachte mevrouw Van der Ploeg,

Voor Nederland schrijft de Nationale Bijlage bij NEN-EN 1991-1-4 voor alle windrichtingen een waarde c_{dir} = 1 voor. In specifieke gevallen kan het zinvol zijn toch met windrichtingsafhankelijkheid te rekenen onder toepassing van het gelijkwaardigheidsbeginsel, waarbij de veiligheid niet lager mag zijn dan die vanuit het Bouwbesluit wordt voorgeschreven. De keuze van c_{dir} alsmede de wijze van toepassen moet daarom zorgvuldig worden vastgelegd. Doel is om een karakteristieke waarde voor de windbelasting te bepalen die ten hoogste eens in de 50 jaar wordt overschreden. Toepassing van de veiligheidsfactoren conform de regelgeving leidt dan tot de rekenwaarde die toegepast dient te worden.

Afleiding van c_{dir} voor Nederland.

De waarde van c_{dir} is afgeleid als de verhouding tussen de windsnelheid met een herhalingstijd van 50 jaar, gegeven een windrichtingsinterval, gedeeld door de windsnelheid met een herhalingstijd ongeacht de windrichting.
Op basis van de statistische gegevens van de meteostations Den Helder, Schiphol en Eindhoven is een waarde voor c_{dir} voor de windgebieden I, II en III in Nederland afgeleid voor intervallen van 15 graden (dit zijn de meteostations die in de basis de stuwdrukken bepalen zoals die in de Nationale Bijlage zijn gegeven). Na toepassing van enkele vereenvoudigingen (samenvoegen van windrichtingen en windgebieden) en het kiezen van een minimaal te hanteren waarde voor c_{dir} = 0,85, levert dit voor Nederland de waarden voor c_{dir} die in Tabel 1 zijn vermeld. Deze waarden zijn van toepassing voor alle windgebieden (dus voor geheel Nederland).

Tabel 1: Waarde voor c_{dir} voor Nederland.

Windrichting ϕ (graden)	c_{dir}
$0 \leq \phi \leq 195$	0,85
$195 < \phi \leq 225$	0,90
$225 < \phi < 315$	1,00
$315 \leq \phi \leq 360$	0,85

De c_{dir} geldt als een factor op de te hanteren basiswindsnelheid. Omdat de windbelasting evenredig is met het kwadraat van de windsnelheid is de belasting evenredig met c_{dir}^2. Bij de laagste waarden van c_{dir} uit de tabel is de reductie in de windbelasting 28%.
Voor Nederland kan het gebruik van c_{dir} interessant zijn wanneer de maatgevende belasting wordt gevonden bij een windrichting uit het noorden of uit het oosten.
Bij toepassing van druk- en krachtcoëfficiënten uit normbladen wordt geadviseerd voor de te hanteren c_{dir} de hoogste waarde binnen het interval rond de maatgevende windrichting ±45˚ te kiezen. Als voorbeeld: Als de constructie wordt berekend voor een windrichting van 180 graden (zuidenwind) dan wordt voor c_{dir} de maximale waarde uit het interval 135 – 225 graden aanstroming gekozen. Dit betekent dat c_{dir} = 0,90 voor deze aanstroomrichting.

Wanneer er richtingsafhankelijke waarden beschikbaar zijn van de druk- of krachtcoëfficiënten c_p of c_f (bepaald uit windtunnelonderzoek) kunnen deze coëfficiënten worden gebruikt in combinatie met de betreffende waarden voor c_{dir}. Er wordt dan per beschouwde windrichting een belasting berekend met een herhalingstijd van 50 jaar.

Tenslotte kan er bij constructies waarbij in de omgeving sprake is van duidelijk verschillende ruwheid in verschillende richtingen ook gebruik gemaakt worden van c_{dir}.
Het kan voorkomen dat bij de overheersende windrichting een hogere terreinruwheid (en daarmee lagere belasting) hoort dan bij een minder relevante windrichting (bijvoorbeeld noordoostenwind). Het is dan te overwegen de waarde voor c_{dir} te berekenen, en per windrichtingsinterval de stuwdruk met de specifieke stuwdruk te bepalen. Voor de ruwheidsbepaling per 90 graden interval is de procedure uit de Nationale Bijlage van toepassing.

Hoogachtend,

ValidSigned by Chris Geurts on 08-02-2021

C.P.W. Geurts
Auteur

ValidSigned by Adri Vervuurt on 09-02-2021

A.H.J.M. Vervuurt
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OVER DNV GL

DNV GL is een wereldwijd bedrijf voor kwaliteitsborging en risicobeheer. Vanuit haar streven leven, bezit en het milieu te beschermen stelt DNV GL organisaties in staat de veiligheid en duurzaamheid van hun activiteiten te bevorderen. DNV GL biedt classificering en technische borging, naast software en onafhankelijk, deskundig advies voor de maritieme, de olie- en gasindustrie, energiecentrales en de duurzame energiesector. Daarnaast biedt het bedrijf certificeringsservices en datamanagement voor klanten in uiteenlopende sectoren. Onze medewerkers zijn actief in meer dan 100 landen over de hele wereld en streven ernaar klanten te helpen de wereld veiliger, slimmer en groener te maken.

Bijlage 17 Rapportage Mastconstructie WA+0

DNV·GL

“TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380”

KIJ-GT380 – Rapportage mast WA+0

TenneT TSO B.V.

Meridian doc. nr.: 002.589.40 0916511
Rapport nr.: 21-1078 Rev.0
Datum: 2021-07-05

Projectnaam:	"Toetsing en herontwerp masten en fundaties BBB380"	DNV GL - Energy
		Energy Advisory
Rapport titel:	KIJ-GT380 – Rapportage mast WA+0	Postbus 9035
Klant:	TenneT TSO B.V.	6800 ET ARNHEM
Contactpersoon:	[redacted]	
Datum:	2021-07-05	
Project nr.:	10166260	Tel: +31 26 356 9111
Organisatie unit:	TDT	KvK 09006404
Meridian doc.nr.:	002.589.40 0916511	
Rapport nr.:	21-1078 Rev.0	

[redacted]

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☒ Geen distributie (vertrouwelijk)

Trefwoorden:

Versie	Datum	Reden voor uitgave	Auteur	Beoordeeld	Goedgekeurd
0	2021-07-05	Eerste uitgave	[redacted]	[redacted]	[redacted]

DNV GL Netherlands B.V.

Inhoud

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 GL 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

In deze studie wordt voor de lijn Krimpen aan den IJssel - Geertruidenberg de controle van de mastconstructie van masttypen WA+0 gerapporteerd.

Inhoudelijk is de Nederlandse versie van de rapportage 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.

1.2 Doelstelling en scope van dit rapport

Het doel van deze studie is om te bepalen of de in dit rapport beschreven bestaande mast geschikt is om te worden uitgerust met de ACCCZ-Warsaw geleider.

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 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 Krimpen aan den IJssel - Geertruidenberg" [1].

1.3.2 E-studie deel 1

In de rapportage "KIJ-GT380 - E-studie deel 1" [2] is bepaald welke aanpassingen benodigd zijn om de ACCCZ Warsaw geleider toe te passen binnen de verbinding Krimpen aan den IJssel - Geertruidenberg. Uit de E-studie volgt dat de volgende aanpassingen vereist zijn:

- Mast 11-1 – Toepassing van postisolatoren om de bretellen te fixeren;
- Mast 61 – Toepassing van postisolatoren om de bretellen te fixeren.

Bovenstaande maatregelen zijn het meest relevant voor de constructieve analyse die dit rapport bevat. Zie rapportage "KIJ-GT380 - E-studie deel 1" [2] voor een complete lijst van de benodigde aanpassingen.

1.3.3 Uitgangspunten rapport

De uitgangspunten op basis waarvan de berekeningen in deze rapportage zijn uitgevoerd zijn opgenomen in het rapport "Uitgangspuntenrapport 380kV verbinding Krimpen aan den IJssel - Geertruidenberg" [3]

2 EISEN

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

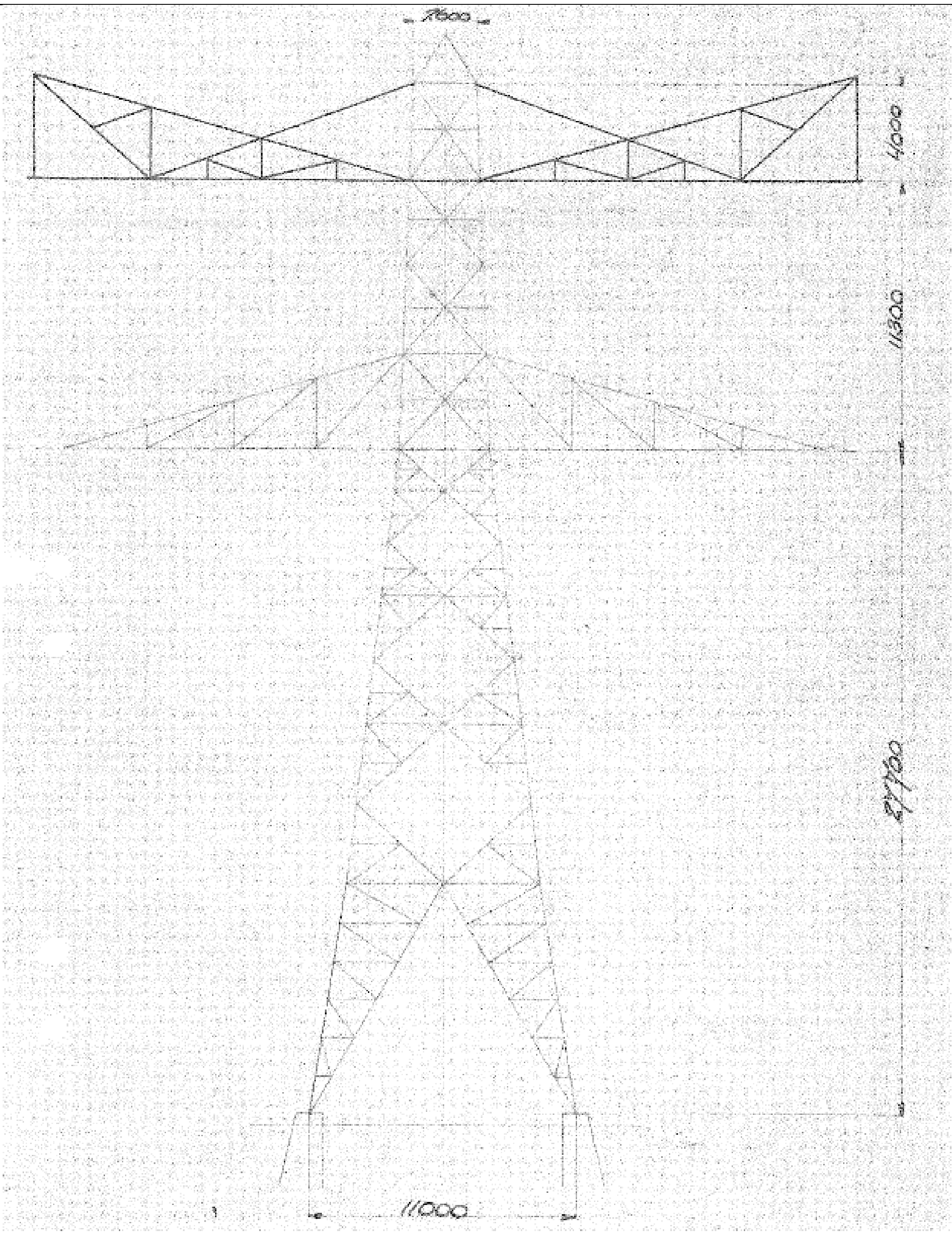
Tabel 1 Relevante eisen

Eis Id	Titel	Eis Tekst	Bewijsvoering
BO Eis: H2.7-6	Omgeving, beperkings factoren	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 1060:1977. 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 1060:1977.	Tabel 6

3 BEREKENINGEN

3.1 Mastbeeld

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



Figuur 1 Mastbeeld WA+0

3.2 Mastenlijst

In deze rapportage wordt masttype WA+0 getoetst. Er komen twee masten van het type WA+0 voor in de verbinding, dit zijn de masten 11-1 en 61. Mast 11-1 staat in windgebied II en mast 61 in windgebied III. Bij de masten is rekening gehouden met verhoogde windbelasting als gevolg van een hogere aangrenzende mast (hoger is een negatieve waarde). De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven.

Tabel 2 Mastnummers

Mastnummer	Masttype	Maatgevend mastnummer	Wind span (m)	Weight span (m)	Hoogteverschil
11-1	WA+0	11-1	307	169	-24.5
61	WA+0	61	400	334	-17.6

Bovenstaande waarden voor de wind en weight span zijn gebruikt om de geleiderbelastingen te bepalen.

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 – Mast 11-1 III – Mast 61
	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:

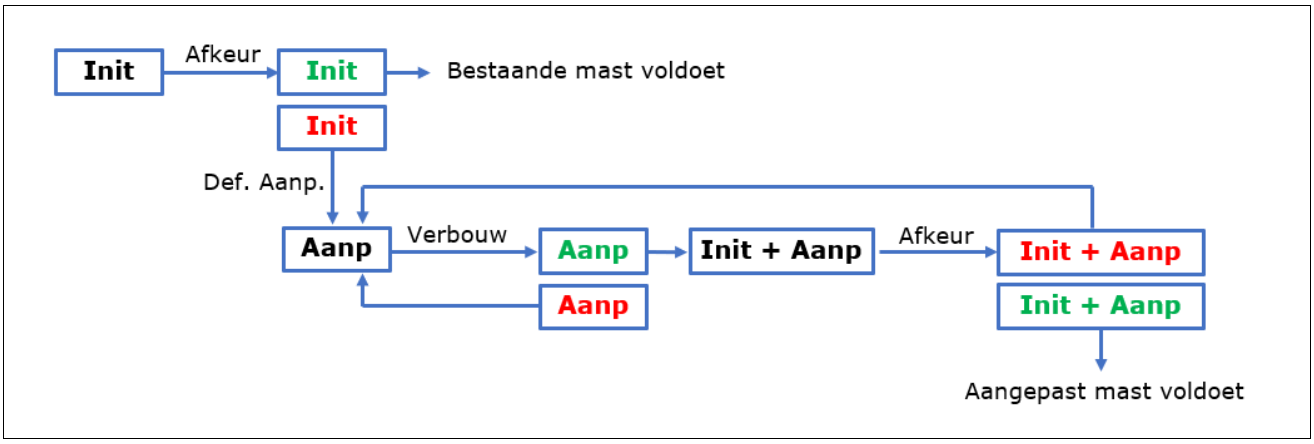
Stap 1: Toets bestaande (Init) mast op Afkeur

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 GL. 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

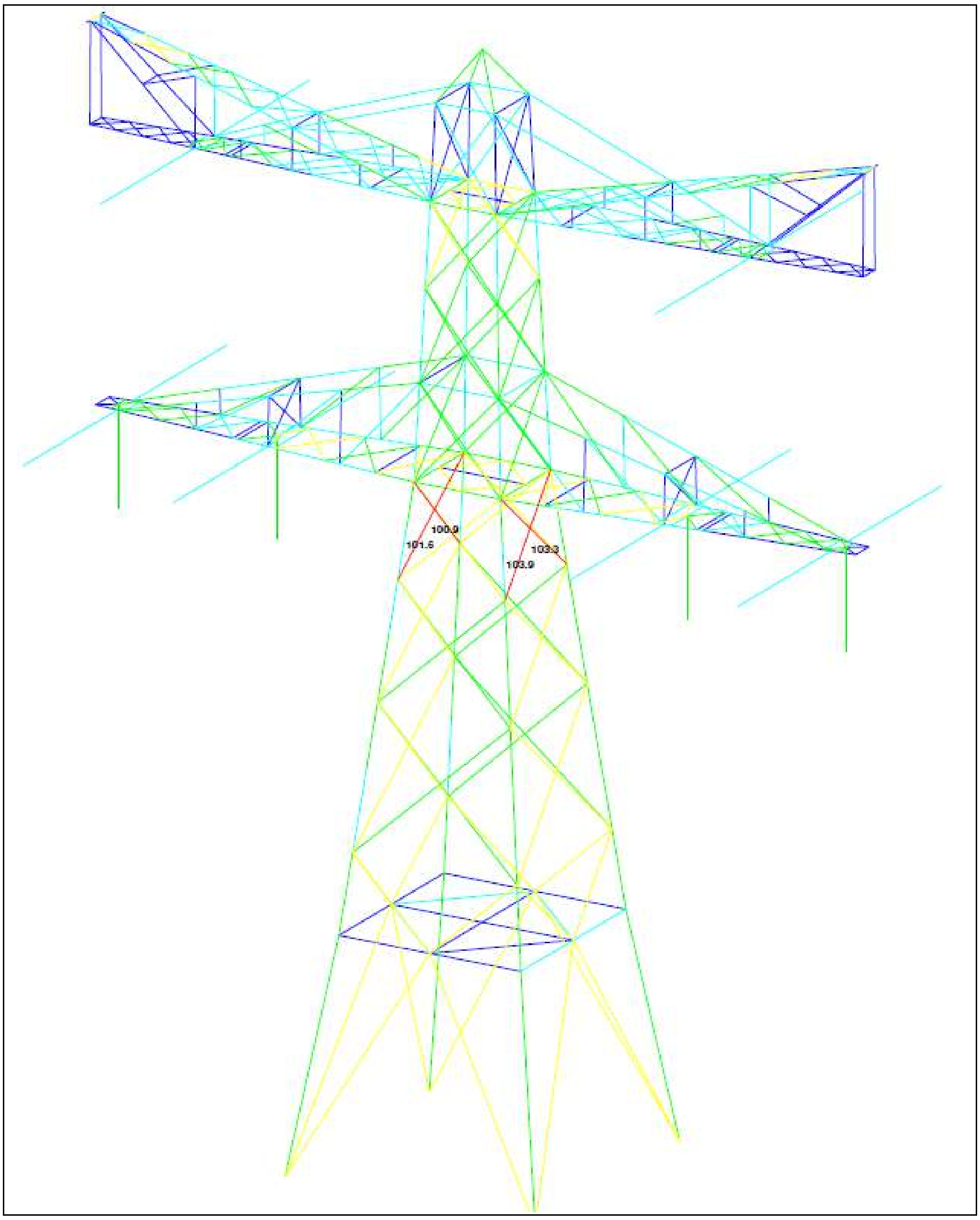
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten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

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

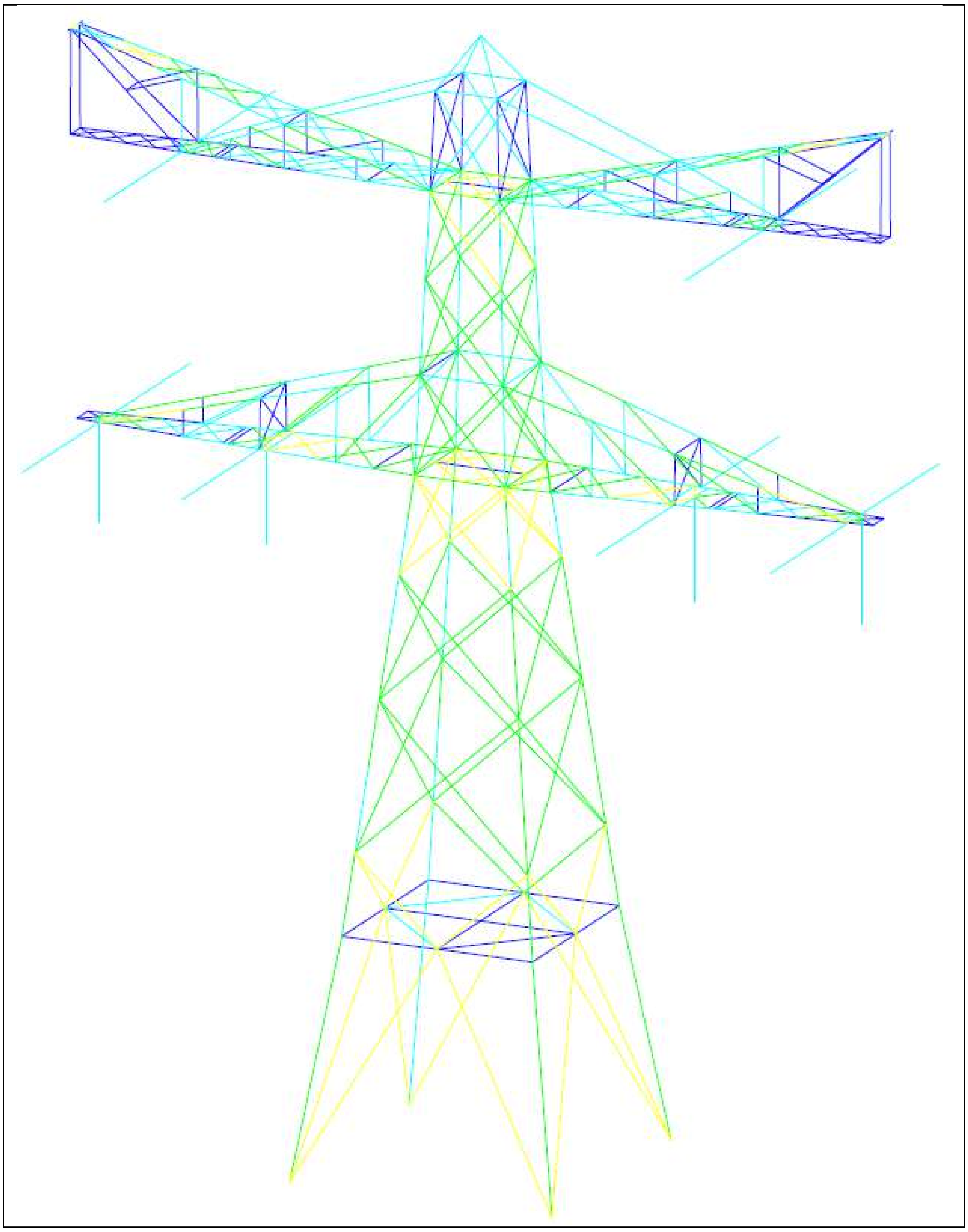
Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

4 TOETSING MAST

Het resultaat van de controle van de mastconstructie type WA+0 met belastingen op afkeurniveau is weergegeven in Figuur 3 tot Figuur 4.



Figuur 3 Resultaat PLS-TOWER WA+0 (11-1)



Figuur 4 Resultaat PLS-TOWER WA+0 (61)

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 Figuur 4
Knikverkorters	Voldoen		Appendix C
Ankers en voetplaat	Voldoen		Appendix D

5 AANPASSINGEN

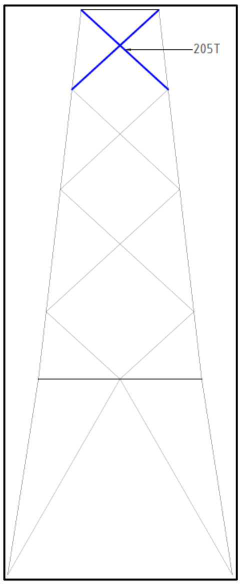
5.1 Inleiding

Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen en nieuwe onderdelen aan verbouwniveau is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Vervangen van kruisdiagonalen in het tussenstuk (alléén mast 11-1);
- Toepassing postisolatoren aan de ondertraverse voor fixatie bretelle (mast 11-1 en 61).

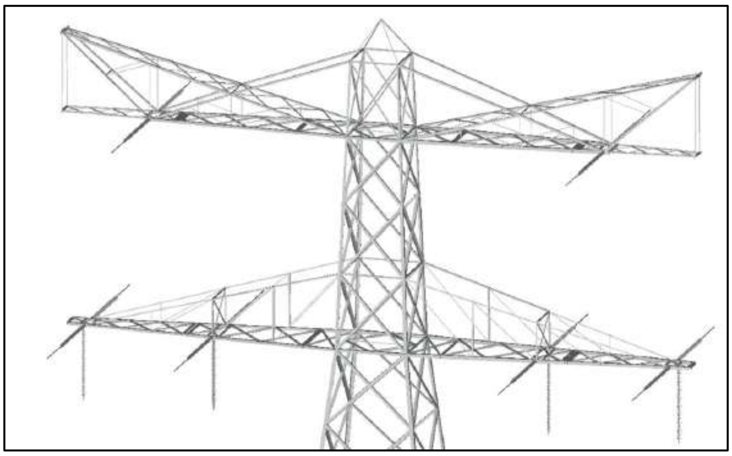
5.2 Aanpassingen

Conform berekening, zie Appendix B, moeten de kruisdiagonalen in het tussenstuk loodrecht op de lijnrichting worden vervangen. Deze aanpassing geldt alléén voor masten 11-1. In Figuur 5 zijn de betreffende kruisdiagonaal weergegeven. Voor afmetingen profielen en bouten, zie Appendix E.

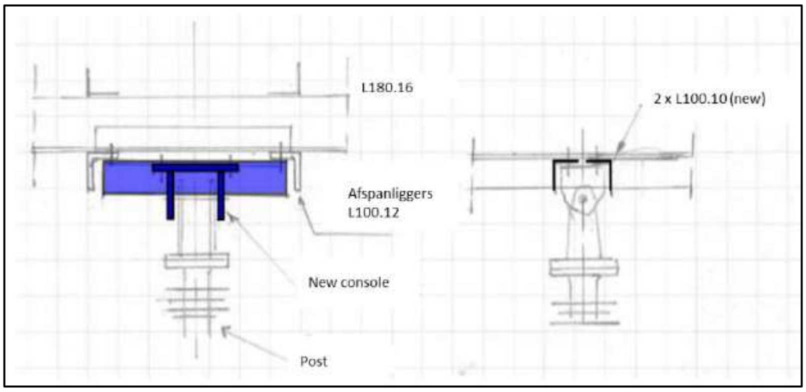


Figuur 5 Zij-aanzicht tussenstuk met te vervangen kruisdiagonalen

Vanuit de E-studie is het een vereiste om de bretellen aan de ondertraverse te fixeren. De berekeningen met betrekking tot de verbinding van de postisolatoren aan de ondertraverse staan in Appendix D. In Figuur 6 zijn de benodigde postisolatoren weergegeven. Een voorstel voor de verbinding van de postisolatoren aan de ondertraverse is weergegeven in Figuur 7.



Figuur 6 Postisolatoren ondertraverse mast 11-1 en 61



Figuur 7 Verbinding postisolatoren aan ondertraverse

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de aanpassingen van mast 11-1 zijn weergegeven in Tabel 5. Het gewicht van de onderdelen voor de verbinding van de postisolatoren en van eventueel benodigde schetsplaten is niet meegenomen. Naast toepassing van postisolatoren behoeft mast 61 geen aanpassingen.

Tabel 5 Gewichten profielen voor aanpassingen mast 11-1

Staafgroep	Profiel	Materiaal	Bouten	Profiel nw.	Materiaal nw.	Bouten nw.	Maatregel	Aantal	Lengte (m)	Gewicht (kg)
205T	L150.10	S235	6M24-5.6t	L150.10	S355	6M24-8.8t	Profiel uitgewisseld	4	5.788	533.95
								4	**5.788**	**533.95**

5.3 Eisen verificatie

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 (diagonalen) zijn in te passen zonder negatieve invloed op de begaanbaarheid.
	klimvoorziening nog in overeenstemming is met de NEN 1060:1964?			X	Geen wijzigingen

6 REFERENTIES

[1] „002.589.40 0817486 - 20-0473 - Verificatie & validatieplan 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

[2] „002.589.40 0808624 - 20-0472 - E-studie deel 1 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

[3] „002.589.40 0808629 - 20-0345 - Uitgangspuntenrapport 380kV verbinding Krimpen aan de IJssel - Geertruidenberg”.

APPENDIX A CONDUCTOR LOADS

Content

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

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	II
Wind speed	27 m/s
Terrain categorie	II
Reduction factor C_{dir}	1,00
Ice region	B
Tower type	Hoekmast
Tower height	45 m
Max. Span	375 m
Line angle	180°
Catenary	1400 m
Wind span	307 m
EDS Weight span	169 m
Min. Weight span	-189 m
Max. Weight span	172 m

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype WA+0 II

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

Document name:

KIJ-GT_WA+0 II_11-1_Report.pdf

Project number:

Project client number:

0.0

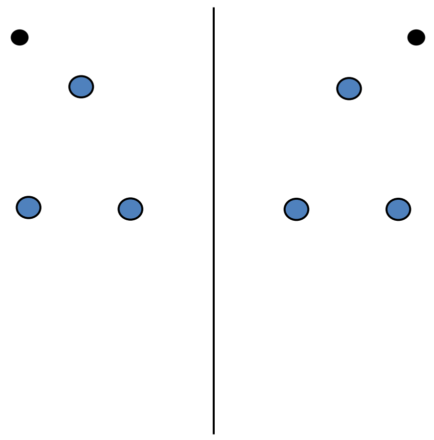
Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

Conductor loads

Auteur: TBR
Versie: v11.3

General

Description	WA+0 II
Tower type	Hoekmast
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	II
Wind speed	27,0 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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Afspanketting	2,00	4,83	1,00
Circuit 2	Afspanketting	2,00	4,83	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,30	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,30	0,05

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	22,9 m	27,7 m	15,7 m
Circuit 1	11	380ct1f2	22,9 m	27,7 m	8,7 m
Circuit 1	12	380ct1f3	34,2 m	39,0 m	12,2 m
Circuit 2	20	380ct2f1	22,9 m	27,7 m	-8,7 m
Circuit 2	21	380ct2f2	22,9 m	27,7 m	-15,7 m
Circuit 2	22	380ct2f3	34,2 m	39,0 m	-12,2 m
Bliksemdraad 1	1	bl1	42,9 m	43,2 m	17,0 m
Bliksemdraad 2	3	bl2	42,9 m	43,2 m	-17,0 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

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

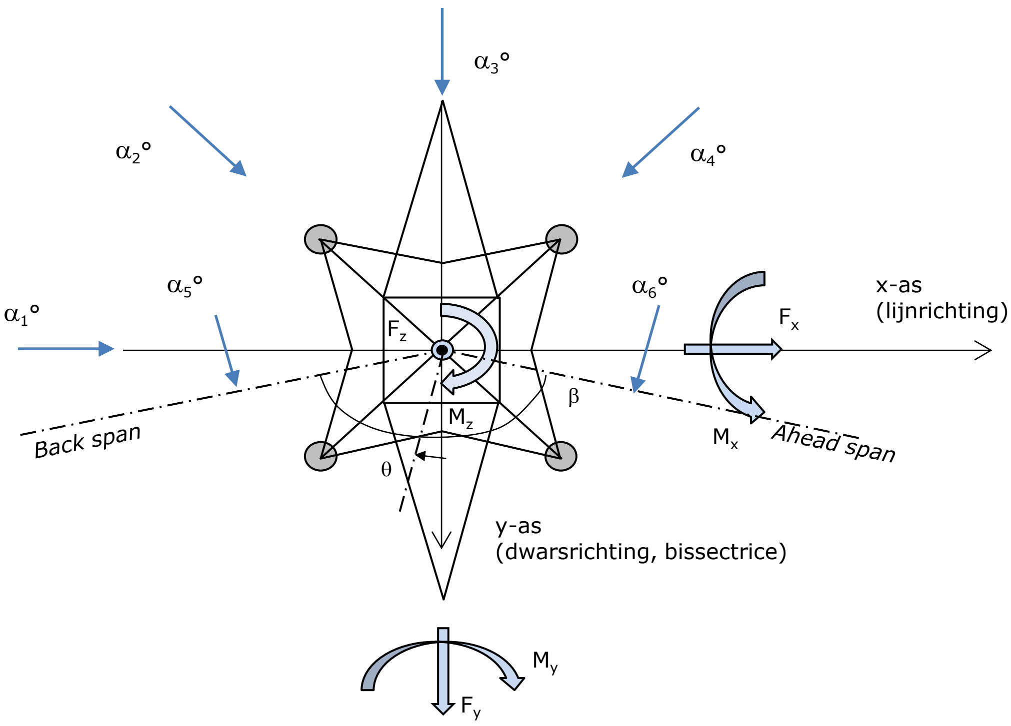
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	6,5	19,3 m	0,0	-1,8 m
Circuit 1	11	380ct1f2	6,5	19,3 m	0,0	-0,8 m
Circuit 1	12	380ct1f3	6,5	20,0 m	0,0	-1,3 m
Circuit 2	20	380ct2f1	6,5	19,3 m	0,0	0,8 m
Circuit 2	21	380ct2f2	6,5	19,3 m	0,0	1,8 m
Circuit 2	22	380ct2f3	6,5	20,0 m	0,0	1,3 m
Bliksemdraad 1	1	bl1	6,2	23,6 m	1,0	-1,3 m
Bliksemdraad 2	3	bl2	6,2	23,6 m	-1,0	1,3 m

Line and tower data

		Back	Ahead
		375,0	238,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		369,2	552,7 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		1107	2418 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	75 °	
	α_6	105 °	

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: KIJ-GT
Tower: WA+0 II
Number: 11-1

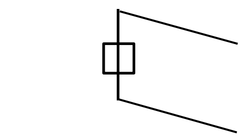
Absence of conductors

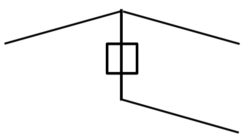
		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	1	0
Circuit 1	380ct1f2	1	0	1	0	1	0
Circuit 1	380ct1f3	1	0	1	0	1	0
Circuit 2	380ct2f1	0	1	1	0	1	0
Circuit 2	380ct2f2	0	1	1	0	1	0
Circuit 2	380ct2f3	0	1	1	0	1	0
Bliksemdraad 1	bl1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

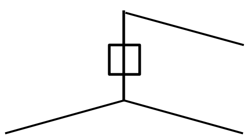
Load situations SPLS

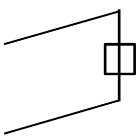
Considered situations SPLS: 1 up to 6, All possible situations

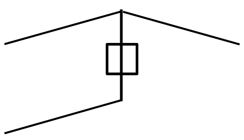
Principle of load situations:

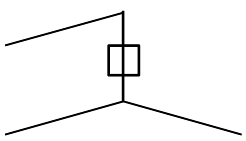

1. Ba All cts


2. Ba ct1


3. Ba ct2


4. Ah All cts

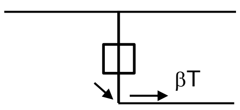

5. Ah ct1


6. Ah ct2

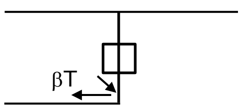
Load situation 5a. Conductor failure

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

Principle of load situations:



1. Ba



2. Ah

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

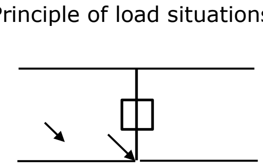
Load situations LC6. Construction and maintenance
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine 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

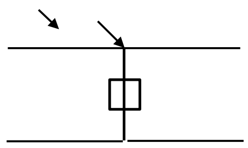
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

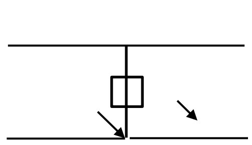
Principle of load situations:



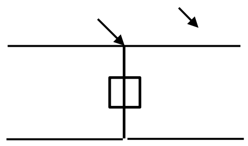
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

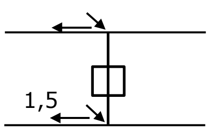
Load situations 8. Galloping as a static load

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

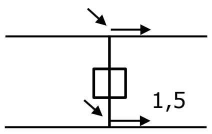
Considered situations galloping 8: None (existing structure)

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: KIJ-GT
Tower: WA+0 II
Number: 11-1

Tower structure

Properties

Tower type	Hoekmast		
Tower designation	WA+0 II		
Base plate w.r.t. ground level	0,5	m	
Tower height w.r.t. base plate	45,0	m	
Tower self weight	380,0	kN	

Width and slope at foundation	x-ri.	y-ri.	
Leg spread	11,00	11,00	m
Inclination of main leg	0,156	0,156	-
Horizontal force factor	1,1	1,1	-

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,25	0,24	2,76
Topstuk	45,00	2,60		2,00		2,60	0,24	0,09	3,45
Ondertraverse	27,70	13,80		4,00		27,60	5,54	0,20	2,93
Boventraverse	39,00	15,45		4,20		32,45	8,64	0,27	2,66

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,25	0,24	2,76
Topstuk	45,00	2,60		2,00		2,60	0,24	0,09	3,45
Ondertraverse	27,70	13,80		4,00		27,60	5,54	0,20	2,93
Boventraverse	39,00	15,45		4,20		32,45	8,64	0,27	2,66

Note: Surface transverse direction is reduced in calculation.

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
Bovenstuk 1			
Bovenstuk 2			

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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 1	0,85	31,9	27,1	0,0	-27,1	4,8	153,2	130,0	0,0	-130,0
Middenstuk 1	0,96	31,5	26,8	0,0	-26,8	14,3	449,3	381,2	0,0	-381,2
Middenstuk 2	1,12	30,5	25,9	0,0	-25,9	23,3	710,8	603,2	0,0	-603,2
Bovenstuk 1	1,22	22,2	18,8	0,0	-18,8	31,6	700,6	594,5	0,0	-594,5
Bovenstuk 2	1,29	18,7	15,9	0,0	-15,9	39,3	734,2	623,0	0,0	-623,0
Topstuk	1,33	1,1	0,9	0,0	-0,9	44,0	48,5	41,2	0,0	-41,2
Ondertraverse	1,19	38,6	22,9	0,0	-22,9	29,0	1119,3	664,8	0,0	-664,8
Boventraverse	1,30	59,9	35,6	0,0	-35,6	40,4	2419,4	1437,0	0,0	-1437,0
Totaal		234,4	173,8	0,0	-173,8		6335,4	4475,0	0,0	-4475,0

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 1	0,85	0,0	27,1	31,9	27,1	4,8	0,0	130,0	153,2	130,0
Middenstuk 1	0,96	0,0	26,8	31,5	26,8	14,3	0,0	381,2	449,3	381,2
Middenstuk 2	1,12	0,0	25,9	30,5	25,9	23,3	0,0	603,2	710,8	603,2
Bovenstuk 1	1,22	0,0	18,8	22,2	18,8	31,6	0,0	594,5	700,6	594,5
Bovenstuk 2	1,29	0,0	15,9	18,7	15,9	39,3	0,0	623,0	734,2	623,0
Topstuk	1,33	0,0	0,9	1,1	0,9	44,0	0,0	41,2	48,5	41,2
Ondertraverse	1,19	0,0	22,9	15,4	22,9	29,0	0,0	664,8	447,7	664,8
Boventraverse	1,30	0,0	35,6	24,0	35,6	40,4	0,0	1437,0	967,8	1437,0
Total		0,0	173,8	175,3	173,8		0,0	4475,0	4212,2	4475,0

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	380	0	0	0
Windrichting 0°	234	0	0	0	6335	0
Windrichting 45°	174	174	0	4475	4475	0
Windrichting 90°	0	175	0	4212	0	0
Windrichting 135°	-174	174	0	4475	-4475	0

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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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,8	1,0	23,37	1,12	1,2	1,34
380ct1f2	2,00	1	2	4,8	1,0	23,37	1,12	1,2	1,34
380ct1f3	2,00	1	2	4,8	1,0	34,67	1,25	1,2	1,50
380ct2f1	2,00	1	2	4,8	1,0	23,37	1,12	1,2	1,34
380ct2f2	2,00	1	2	4,8	1,0	23,37	1,12	1,2	1,34
380ct2f3	2,00	1	2	4,8	1,0	34,67	1,25	1,2	1,50
bl1	0,10	0,5	0,05	0,3	0,1	43,40	1,33	1,2	0,08
bl2	0,10	0,5	0,05	0,3	0,1	43,40	1,33	1,2	0,08

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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	18,2	1,04	0,56	0,52	1,09	28,25	53,1	49,3	46,9	97,5	90,5
380ct1f2	18,2	1,04	0,56	0,52	1,09	28,25	53,1	49,3	46,9	97,5	90,5
380ct1f3	29,5	1,20	0,60	0,55	1,04	28,25	63,1	58,6	46,9	120,5	111,8
380ct2f1	18,2	1,04	0,56	0,52	1,09	28,25	53,1	49,3	46,9	97,5	90,5
380ct2f2	18,2	1,04	0,56	0,52	1,09	28,25	53,1	49,3	46,9	97,5	90,5
380ct2f3	29,5	1,20	0,60	0,55	1,04	28,25	63,1	58,6	46,9	120,5	111,8
bl1	38,7	1,29	0,62	0,57	1,16	22,24	20,5	19,0	41,5	39,7	36,8
bl2	38,7	1,29	0,62	0,57	1,16	22,13	20,4	18,9	41,4	39,6	36,8

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	29,6	1,20	0,60	0,51	1,04	28,25	63,2	54,1	46,9	120,7	103,3
380ct1f2	29,6	1,20	0,60	0,51	1,04	28,25	63,2	54,1	46,9	120,7	103,3
380ct1f3	41,3	1,31	0,62	0,53	1,02	28,25	70,4	60,2	46,9	138,2	118,1
380ct2f1	29,6	1,20	0,60	0,51	1,04	28,25	63,2	54,1	46,9	120,7	103,3
380ct2f2	29,6	1,20	0,60	0,51	1,04	28,25	63,2	54,1	46,9	120,7	103,3
380ct2f3	41,3	1,31	0,62	0,53	1,02	28,25	70,4	60,2	46,9	138,2	118,1
bl1	52,1	1,39	0,64	0,55	1,14	22,24	22,6	19,3	41,5	44,6	38,1
bl2	52,1	1,39	0,64	0,55	1,14	22,13	22,6	19,3	41,4	44,5	38,0

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Number: 11-1

Conductor loads

Auteur: TBR
Versie: v11.3

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

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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	-31,8	33,6	4,4	2,9	5,1	1,3
bl2	-31,9	33,6	4,3	3,2	5,1	1,3
380ct1f1	-111,4	115,1	12,7	9,2	14,5	3,6
380ct1f2	-111,4	115,1	12,7	9,6	14,5	3,6
380ct1f3	-114,8	117,9	14,8	10,3	14,5	3,3
380ct2f1	-111,4	115,1	12,7	10,3	14,5	3,6
380ct2f2	-111,4	115,0	12,7	10,8	14,5	3,6
380ct2f3	-114,8	117,9	14,8	11,5	14,5	3,3
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
Post 3	0,0	0,0	0,0	0,0	0,0	
Post 4	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	-31,0	111,9	132,9
bl2	-30,9	109,3	132,9
380ct1f1	107,1	158,2	168,9
380ct1f2	107,2	158,3	169,0
380ct1f3	87,9	153,0	164,8
380ct2f1	107,2	158,3	169,0
380ct2f2	107,1	158,2	168,9
380ct2f3	87,9	153,0	164,8
Post 1			
Post 2			
Post 3			
Post 4			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	133,5	137,8
bl2	133,5	136,8
380ct1f1	169,3	170,1
380ct1f2	169,3	170,2
380ct1f3	165,1	166,1
380ct2f1	169,3	170,2
380ct2f2	169,3	170,1
380ct2f3	165,1	166,1
Post 1		
Post 2		
Post 3		
Post 4		

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

For all conductors		Wind / Weight span ratio
Max. weight span	170,2 m	0,555 -
Min. weight span	-111,6 m	-0,364 -

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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	31,8	7,3	5,1	-31,8	33,6
bl2	31,9	7,5	5,1	-31,9	33,6
380ct1f1	96,1	21,9	14,5	-111,4	115,1
380ct1f2	96,0	22,3	14,5	-111,4	115,1
380ct1f3	100,0	25,2	14,5	-114,8	117,9
380ct2f1	96,0	23,0	14,5	-111,4	115,1
380ct2f2	96,0	23,5	14,5	-111,4	115,1
380ct2f3	100,0	26,4	14,5	-114,8	117,9
Post 1	3,2	3,2	4,0	0,0	
Post 2	3,2	3,2	4,0	0,0	
Post 3	3,2	3,2	4,0	0,0	
Post 4	3,2	3,2	4,0	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	0,0	1,7	-15,0	15,0
bl2	15,0	0,1	1,7	-15,0	15,0
380ct1f1	64,2	0,0	9,5	-64,2	64,2
380ct1f2	64,2	0,0	9,5	-64,2	64,2
380ct1f3	64,2	0,0	9,5	-64,2	64,2
380ct2f1	64,2	0,2	9,5	-64,2	64,2
380ct2f2	64,2	0,5	9,5	-64,2	64,2
380ct2f3	64,2	0,4	9,5	-64,2	64,2
Post 1	0,0	0,0	3,5	0,0	
Post 2	0,0	0,0	3,5	0,0	
Post 3	0,0	0,0	3,5	0,0	
Post 4	0,0	0,0	3,5	0,0	

1 **Control uplift SLS-wind**

Combinatie:	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0,0	-0,4
	bl2	0,0	-0,4
	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	
	Post 3	0,0	
	Post 4	0,0	

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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		47	170	64	5511	1491	6
ULS 1a_0,9_0		14	0	89	0	386	0
ULS 1a_0,9_0,9_90		45	170	48	5511	1441	6
ULS 3_0		10	0	122	0	315	2
SLS 7		0	0	87	0	0	0

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

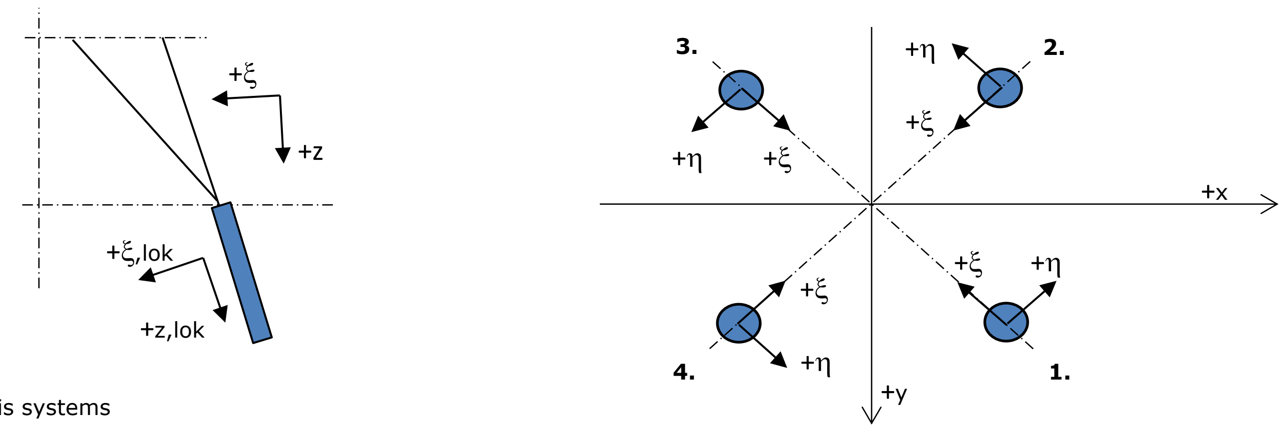
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	47	367	463	10246	1491	6
ULS 1a_0,9_0,9_90	45	367	390	10246	1441	6
SLS 7	0	0	467	0	0	0

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_90	47	367	404	**10246**	1491	6
SPLS 3_75 Ba All Cts	646	92	431	2448	**20876**	7
SPLS 3_90 Ah Ct2	-302	106	494	2854	-9848	**4042**
SPLS 1a_75 Ba All Cts	613	200	428	**5303**	**19645**	13

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 1a_75 Ba All Cts	213	222	**1241**	-6	-308	-33	1271
2	SPLS 3_0 Ba All Cts	173	-171	**998**	-1	-244	-23	1022
3	SPLS 3_105 Ah All Cts	-158	-156	**930**	2	-222	-17	953
4	SPLS 1a_105 Ah All Cts	-213	222	**1243**	6	-308	-33	1273

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_105 Ah All Cts	-118	-116	**-696**	-1	165	11	-712
2	SPLS 1a_0,9_105 Ah All Cts	-174	183	**-1014**	-6	252	28	-1039
3	SPLS 1a_0,9_75 Ba All Cts	178	188	**-1042**	7	259	29	-1067
4	SPLS 3_0,9_0 Ba All Cts	138	-136	**-793**	1	194	19	-812

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_90 Ah Ct2	60	-121	-194	**128**	43	0	-199
2	SPLS 3_90 Ah Ct2	-168	-10	-454	**126**	112	12	-465
3	SPLS 3_90 Ba Ct1	-7	179	-485	**132**	122	14	-497
4	SPLS 3_90 Ah Ct2	-27	217	701	**134**	-172	-17	718

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 3_90 Ah Ct1	-122	63	-184	**-131**	41	1	-188
2	SPLS 3_90 Ah Ct1	13	175	-465	**-133**	114	12	-476
3	SPLS 3_90 Ah Ct1	19	-162	431	**-128**	-101	-6	441
4	SPLS 6a_90 Ba Ct2 Ba Ct1	-94	-87	25	**-128**	-5	0	26

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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_105 Ah All Cts	-118	-116	**-696**	**-1**	165	11	-712
2	SPLS 1a_0,9_105 Ah All Cts	-174	183	**-1014**	**-6**	252	28	-1039
3	SPLS 1a_0,9_75 Ba All Cts	178	188	**-1042**	**7**	259	29	-1067
4	SPLS 3_0,9_0 Ba All Cts	138	-136	**-793**	**1**	194	19	-812

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	20	20	117	0	-28	-3	120
2	SLS 7	20	-20	117	0	-28	-3	120
3	SLS 7	-20	-20	117	0	-28	-3	120
4	SLS 7	-20	20	117	0	-28	-3	120

Envelope of load combinations for all of the legs

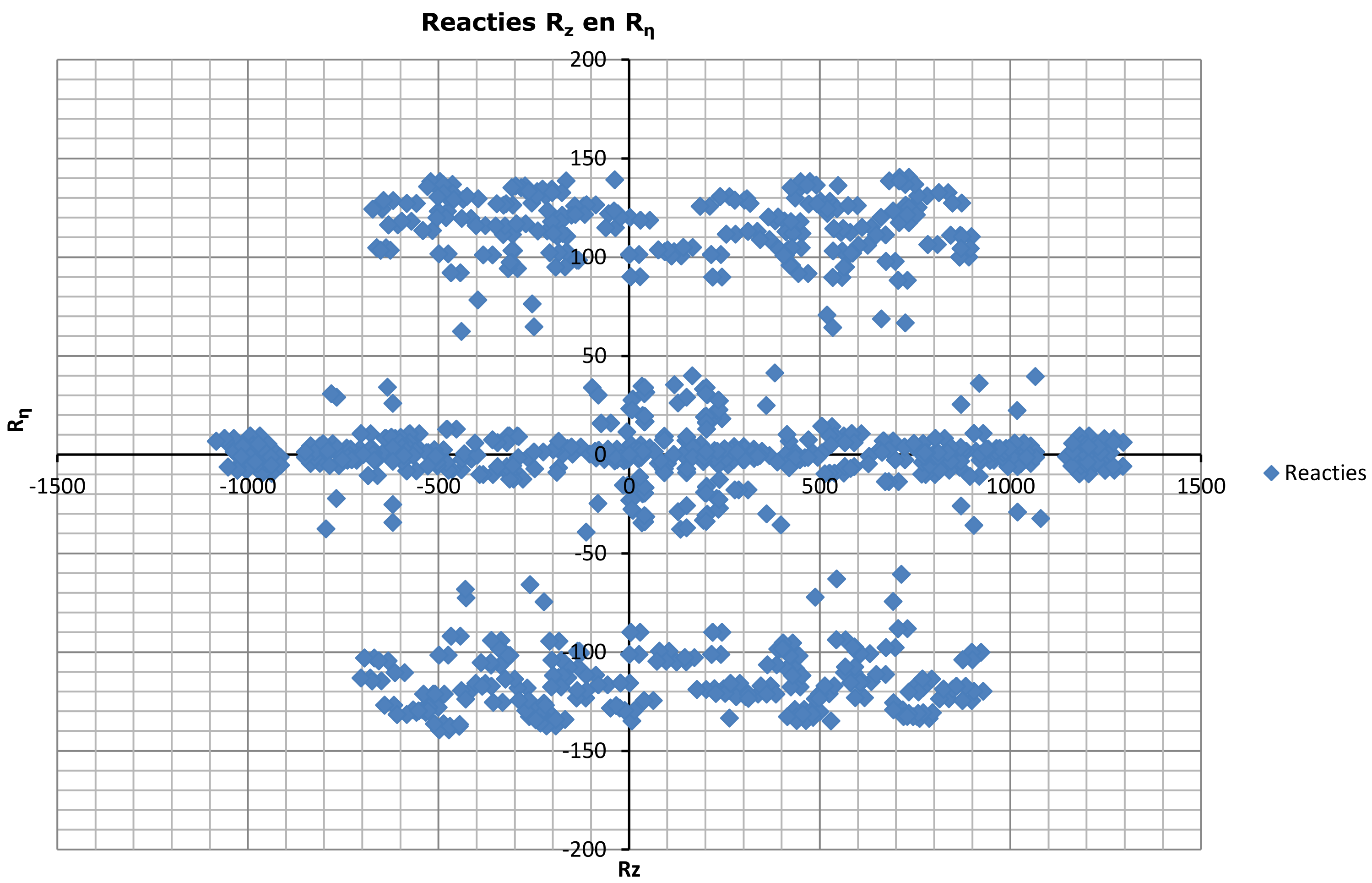
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 1a_105 Ah All Cts	-213	222	**1243**	6	-308	-33	1273
Max. tension	SPLS 1a_0,9_75 Ba All Cts	178	188	**-1042**	7	259	29	-1067
Max. pos. torsie	SPLS 3_0,9_90 Ah Ct2	-25	214	686	**134**	-169	-17	703
Max. neg. torsie	SPLS 3_90 Ah Ct1	13	175	-465	**-133**	114	12	-476
Comb. tension+torsie	SPLS 1a_75 Ba All Cts	178	188	**-1042**	**7**	259	29	-1067

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	20	20	**117**	0	-28	-3	120
2	SLS 1a_135	-72	72	**-371**	0	101	20	-380
3	SLS 1a_45	77	77	**-401**	0	109	20	-411
4	SLS 1a_0	38	-29	**-168**	6	47	10	-172

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	117	116	**631**	1	-165	-25	646
2	SLS 1a_0	78	-69	**402**	-6	-104	-15	411
3	SLS 7	-20	-20	**117**	0	-28	-3	120
4	SLS 1a_135	-112	111	**601**	-1	-157	-25	616


Reacties R_z en R_η
200
150
100
50
0
-50
-100
-150
-200
-1500
-1000
-500
0
500
1000
1500
R_η
Rz
Reacties

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

Auteur:	TBR
Versie:	v11.3

Conductor loads

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	54
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5820

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

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	-36,6	40,1	5,5	3,6	5,6	1,3
bl2	-36,6	40,0	5,3	4,0	5,6	1,3
380ct1f1	-129,6	135,8	15,8	11,5	17,1	3,9
380ct1f2	-129,6	135,8	15,8	12,0	17,1	3,9
380ct1f3	-133,8	139,4	18,5	12,9	17,1	3,6
380ct2f1	-129,6	135,8	15,8	12,8	17,1	3,9
380ct2f2	-129,6	135,7	15,8	13,3	17,1	3,9
380ct2f3	-133,8	139,3	18,5	14,3	17,1	3,6
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
Post 3	0,0	0,0	0,0	0,0	0,0	
Post 4	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	-44,9	110,6	132,9
bl2	-44,8	108,0	132,9
380ct1f1	101,0	157,8	168,9
380ct1f2	101,0	157,9	169,0
380ct1f3	80,5	152,5	164,8
380ct2f1	101,0	157,9	169,0
380ct2f2	101,0	157,8	168,9
380ct2f3	80,5	152,5	164,8
Post 1			
Post 2			
Post 3			
Post 4			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	134,6	141,4
bl2	134,6	140,4
380ct1f1	170,0	172,1
380ct1f2	170,0	172,2
380ct1f3	165,9	168,1
380ct2f1	170,0	172,2
380ct2f2	170,0	172,1
380ct2f3	165,9	168,1
Post 1		
Post 2		
Post 3		
Post 4		

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	172,2 m	0,562 -
Min. weight span	-188,5 m	-0,615 -

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	32,8	9,1	5,6	-36,6	40,1
bl2	32,9	9,3	5,6	-36,6	40,0
380ct1f1	101,1	27,4	17,1	-129,6	135,8
380ct1f2	101,1	27,8	17,1	-129,6	135,8
380ct1f3	104,9	31,4	17,1	-133,8	139,4
380ct2f1	101,1	28,6	17,1	-129,6	135,8
380ct2f2	101,1	29,2	17,1	-129,6	135,8
380ct2f3	104,8	32,8	17,1	-133,8	139,4
Post 1	3,9	3,9	4,6	0,0	
Post 2	3,9	3,9	4,6	0,0	
Post 3	3,9	3,9	4,6	0,0	
Post 4	3,9	3,9	4,6	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	0,0	1,7	-15,0	15,0
bl2	15,0	0,1	1,7	-15,0	15,0
380ct1f1	64,2	0,0	9,5	-64,2	64,2
380ct1f2	64,2	0,0	9,5	-64,2	64,2
380ct1f3	64,2	0,0	9,5	-64,2	64,2
380ct2f1	64,2	0,2	9,5	-64,2	64,2
380ct2f2	64,2	0,5	9,5	-64,2	64,2
380ct2f3	64,2	0,4	9,5	-64,2	64,2
Post 1	0,0	0,0	3,5	0,0	
Post 2	0,0	0,0	3,5	0,0	
Post 3	0,0	0,0	3,5	0,0	
Post 4	0,0	0,0	3,5	0,0	

1 **Control uplift SLS-wind**

Combinatie	Geleider	Fz_ba [kN]	Fz_ah [kN]
SLS 4	bl1	0,0	-0,4
	bl2	0,0	-0,4
	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	
	Post 3	0,0	
	Post 4	0,0	

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

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		66	211	64	6864	2120	7
ULS 1a_0,9_0		19	0	97	0	549	0
ULS 1a_0,9_0,9_90		64	211	37	6864	2036	7
ULS 3_0		22	0	142	0	705	2
SLS 7		0	0	87	0	0	0

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

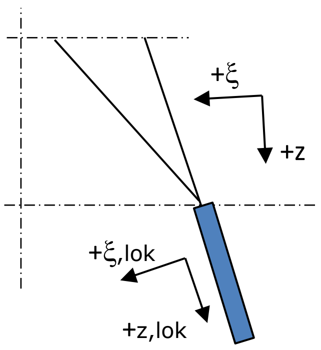
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	66	457	501	12761	2120	7
ULS 1a_0,9_0,9_90	64	457	379	12761	2036	7
SLS 7	0	0	467	0	0	0

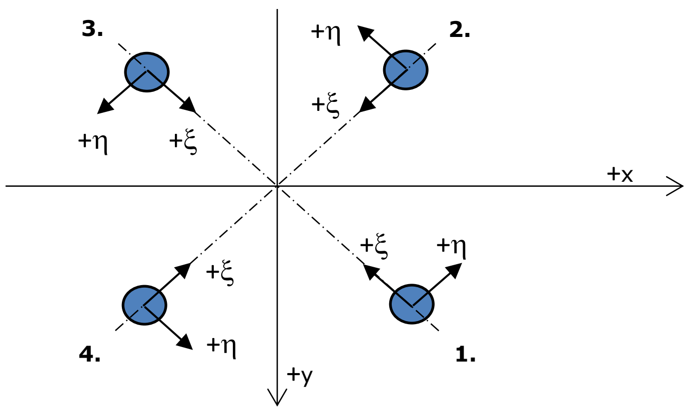
Foundation loads, selection of load combinations based on greatest value

Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	66	457	501	**12761**	2120	7
SPLS 3_75 Ba All Cts	678	92	474	2448	**21923**	6
SPLS 3_90 Ah Ct2	-316	106	541	2857	-10306	**4241**
SPLS 1a_75 Ba All Cts	642	200	471	**5304**	**20583**	13

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 1a_75 Ba All Cts	222	231	**1294**	-6	-320	-34	1326
2	SPLS 3_0 Ba All Cts	185	-183	**1066**	-1	-260	-25	1092
3	SPLS 3_135 Ah All Cts	-171	-167	**988**	3	-239	-21	1012
4	SPLS 1a_105 Ah All Cts	-222	231	**1295**	6	-321	-34	1327

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	-128	-124	**-739**	-3	178	15	-757
2	SPLS 1a_0,9_105 Ah All Cts	-181	189	**-1053**	-6	262	29	-1078
3	SPLS 1a_0,9_75 Ba All Cts	186	195	**-1084**	7	269	30	-1110
4	SPLS 3_0,9_0 Ba All Cts	148	-146	**-850**	1	208	20	-870

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_90 Ah Ct2	63	-127	-203	**134**	45	0	-208
2	SPLS 3_90 Ah Ct2	-175	-13	-463	**132**	115	12	-474
3	SPLS 6a_90 Ba Ct1 Ba Ct2	-66	130	-166	**139**	45	8	-170
4	SPLS 3_90 Ah Ct2	-28	227	734	**140**	-180	-18	751

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 3_90 Ah Ct1	-128	66	-193	**-137**	43	1	-197
2	SPLS 3_90 Ah Ct1	16	181	-473	**-139**	116	12	-485
3	SPLS 6a_90 Ba Ct2 Ba Ct1	132	-60	-212	**-135**	51	4	-217
4	SPLS 6a_90 Ba Ct2 Ba Ct1	-96	-95	7	**-135**	-1	1	7

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

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	-128	-124	**-739**	**-3**	178	15	-757
2	SPLS 1a_0,9_105 Ah All Cts	-181	189	**-1053**	**-6**	262	29	-1078
3	SPLS 1a_0,9_75 Ba All Cts	186	195	**-1084**	**7**	269	30	-1110
4	SPLS 3_0,9_0 Ba All Cts	148	-146	**-850**	**1**	208	20	-870

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	20	20	117	0	-28	-3	120
2	SLS 7	20	-20	117	0	-28	-3	120
3	SLS 7	-20	-20	117	0	-28	-3	120
4	SLS 7	-20	20	117	0	-28	-3	120

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 1a_105 Ah All Cts	-222	231	**1295**	6	-321	-34	1327
Max. tension	SPLS 1a_0,9_75 Ba All Cts	186	195	**-1084**	7	269	30	-1110
Max. pos. torsie	SPLS 3_90 Ah Ct2	-28	227	734	**140**	-180	-18	751
Max. neg. torsie	SPLS 3_90 Ah Ct1	16	181	-473	**-139**	116	12	-485
Comb. tension+torsie	SPLS 1a_0,9_75 Ba All Cts	186	195	**-1084**	**7**	269	30	-1110

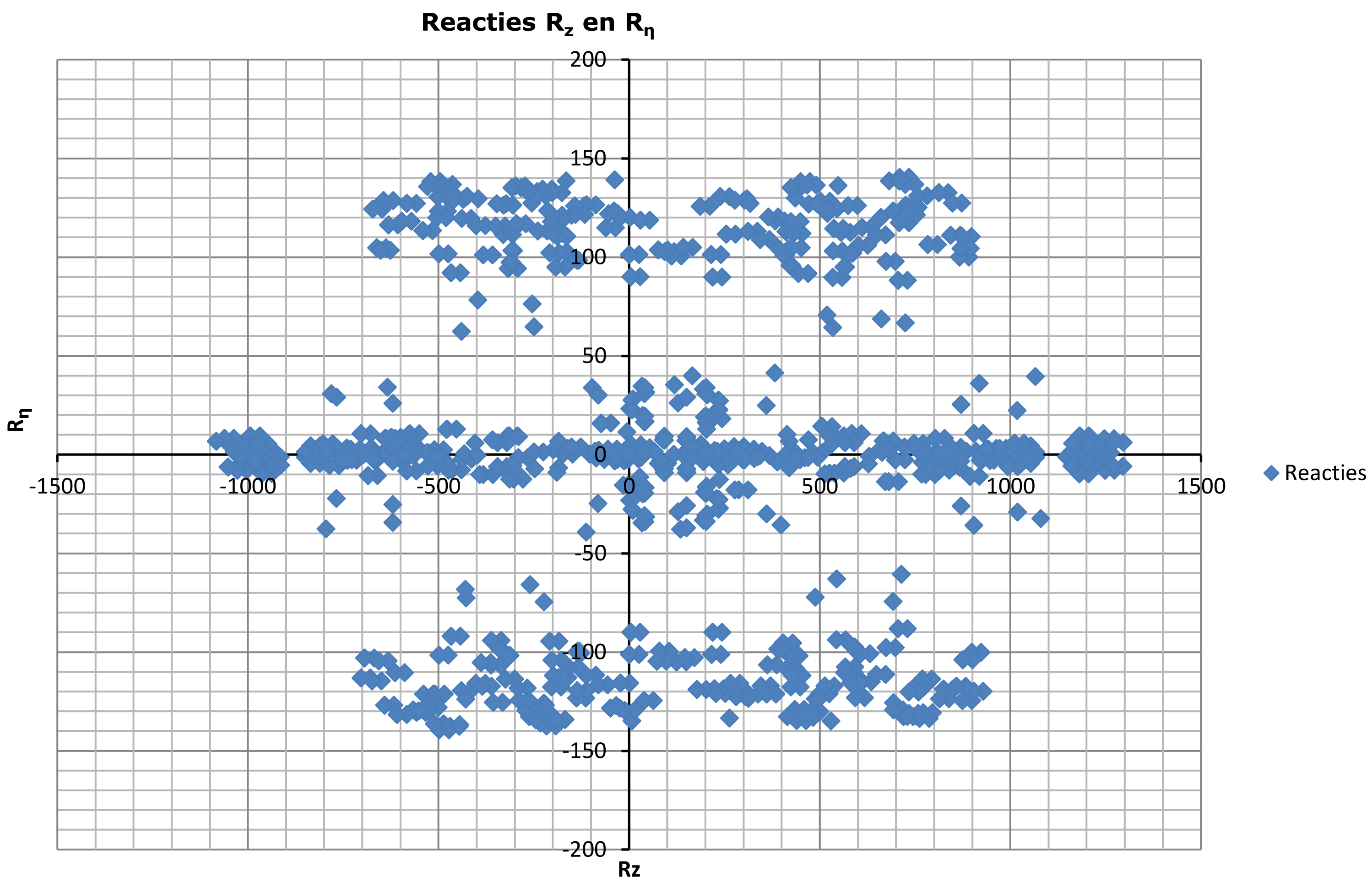
Maximum tension load - SLS

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	20	20	**117**	0	-28	-3	120
2	SLS 1a_135	-77	77	**-400**	0	109	21	-409
3	SLS 1a_45	83	83	**-433**	0	117	22	-444
4	SLS 1a_0	41	-32	**-185**	7	52	11	-190

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	123	122	**663**	1	-173	-27	679
2	SLS 1a_0	81	-72	**419**	-7	-109	-16	429
3	SLS 7	-20	-20	**117**	0	-28	-3	120
4	SLS 1a_135	-117	116	**629**	-1	-165	-26	645

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1



Content

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 C_{dir}	1,00
Ice region	B
Tower type	Hoekmast
Tower height	45 m
Max. Span	400 m
Line angle	180°
Catenary	1400 m
Wind span	400 m
EDS Weight span	334 m
Min. Weight span	200 m
Max. Weight span	336 m

ISSUE	DATE	REVISION	CHK'D	APP'D
0.0	2020-11-26			

Client: TenneT Taking power further

DNV·GL

Title:

Berekening masttype WA+0

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

Document name:

KIJ-GT_WA+0_61_Report.pdf

Project number:

Project client number:

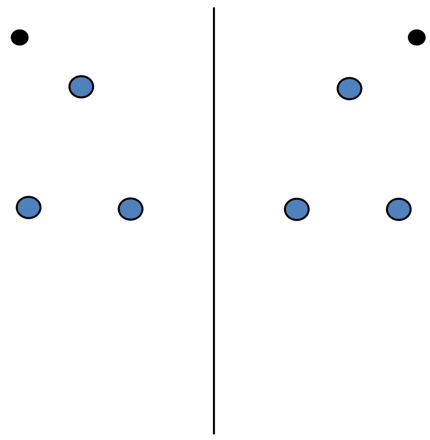
0.0

Project: KIJ-GT
Tower: WA+0
Number: 61

Conductor loads		Auteur: TBR
		Versie: v11.3

General

Description	WA+0
Tower type	Hoekmast
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	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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

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	2 %	2 %	1400
Circuit 2	380 kV	ACCCZ-Warsaw	3	B	2 %	2 %	1400
Bliksemdraad 1		ACSR-26/7-242/39-HAWK	1	B	2 %	2 %	1500
Bliksemdraad 2		OPGW 226	1	B	2 %	2 %	1500

Insulators *(1)*

Description	Suspension	Weight [kN]	Length [m]	Wind area [m^2]
Circuit 1	Afspanketting	2,00	4,83	1,00
Circuit 2	Afspanketting	2,00	4,83	1,00
Bliksemdraad 1	Vast (Bliksemdraad)	0,10	0,30	0,05
Bliksemdraad 2	Vast (Bliksemdraad)	0,10	0,30	0,05

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	22,9 m	27,7 m	15,7 m
Circuit 1	11	380ct1f2	22,9 m	27,7 m	8,7 m
Circuit 1	12	380ct1f3	34,2 m	39,0 m	12,2 m
Circuit 2	20	380ct2f1	22,9 m	27,7 m	-8,7 m
Circuit 2	21	380ct2f2	22,9 m	27,7 m	-15,7 m
Circuit 2	22	380ct2f3	34,2 m	39,0 m	-12,2 m
Bliksemdraad 1	1	bl1	42,9 m	43,2 m	17,0 m
Bliksemdraad 2	3	bl2	42,9 m	43,2 m	-17,0 m

1. Positive = adjacent mast higher
2. Positive = in direction of rotation coordinate system x => y

Project: KIJ-GT
Tower: WA+0
Number: 61

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

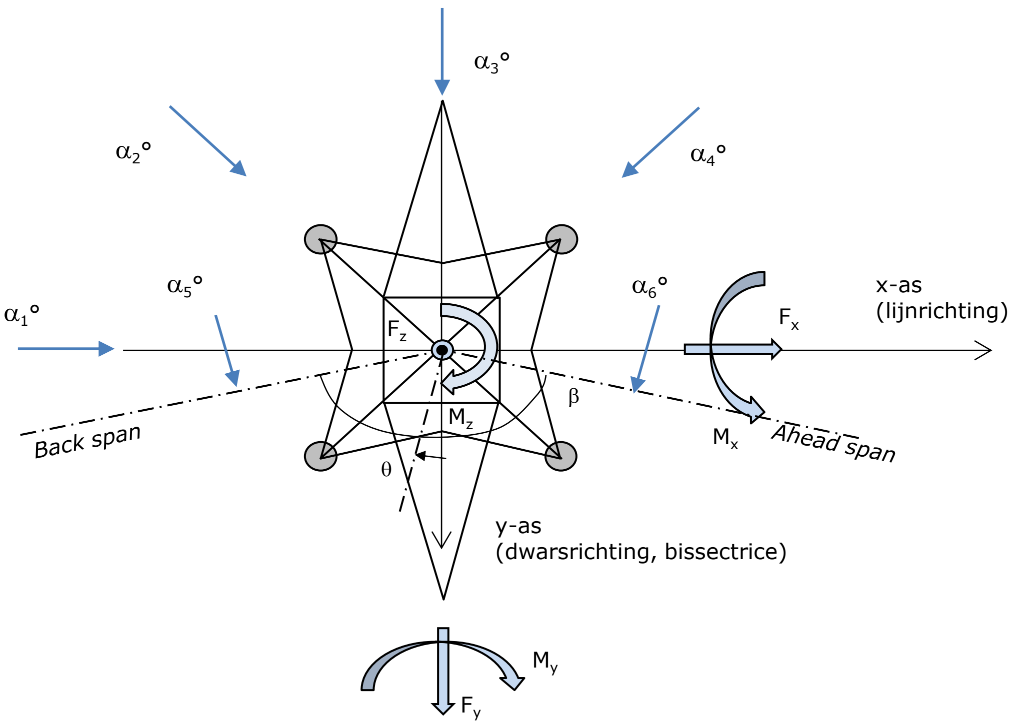
			Hoogteverschil		Richtingsverandering	
Circuits	Aanduiding	Nummer	Δh_back	Δh_ahead	Δy_back	Δy_ahead
Circuit 1	10	380ct1f1	18,4	0,4 m	-1,8	0,0 m
Circuit 1	11	380ct1f2	18,4	0,4 m	-0,8	0,0 m
Circuit 1	12	380ct1f3	19,1	0,5 m	-1,3	0,0 m
Circuit 2	20	380ct2f1	18,4	0,4 m	0,8	0,0 m
Circuit 2	21	380ct2f2	18,4	0,4 m	1,8	0,0 m
Circuit 2	22	380ct2f3	19,1	0,5 m	1,3	0,0 m
Bliksemdraad 1	1	bl1	22,8	0,1 m	-1,3	1,0 m
Bliksemdraad 2	3	bl2	22,8	0,1 m	1,3	-1,0 m

Line and tower data

		Back	Ahead
		400,0	400,0 m
Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$		377,7	389,6 m
Line angle	β	180 °	
Tower orientation with respect to bis	θ	0 °	
Section length		2580	3064 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	75 °	
	α_6	105 °	

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: KIJ-GT
Tower: WA+0
Number: 61

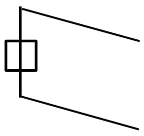
Absence of conductors

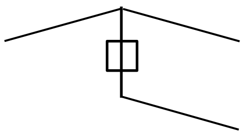
		SPLS - torsie		SPLS - Enkelzijdige trek		5a - geleiderbreuk	
		Aanw.	Afw.	Aanw.	Afw.	Aanw.	Afw.
Circuit 1	380ct1f1	1	0	1	0	1	0
Circuit 1	380ct1f2	1	0	1	0	1	0
Circuit 1	380ct1f3	1	0	1	0	1	0
Circuit 2	380ct2f1	0	1	1	0	1	0
Circuit 2	380ct2f2	0	1	1	0	1	0
Circuit 2	380ct2f3	0	1	1	0	1	0
Bliksemdraad 1	bl1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

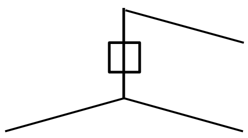
Load situations SPLS

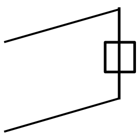
Considered situations SPLS: 1 up to 6, All possible situations

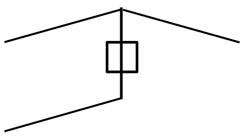
Principle of load situations:

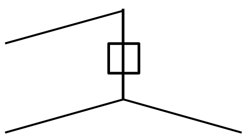

1. Ba All cts


2. Ba ct1


3. Ba ct2


4. Ah All cts

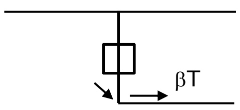

5. Ah ct1


6. Ah ct2

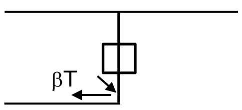
Load situation 5a. Conductor failure

Considered situations conductor failure 5a: 1, design assumption is symmetry back and ahead

Principle of load situations:



1. Ba



2. Ah

Load situations LC6. Construction and maintenance

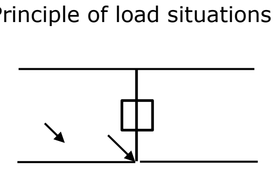
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able to combine with separate control platforms, etc. The situations 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

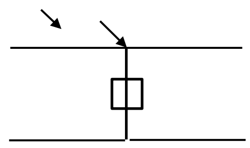
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

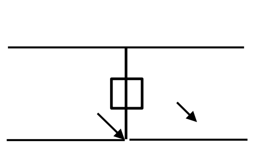
Principle of load situations:



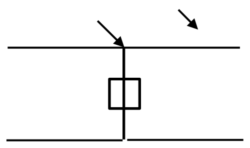
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

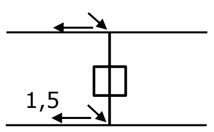
Load situations 8. Galloping as a static load

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

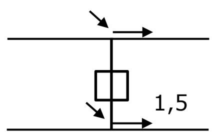
Considered situations galloping 8: None (existing structure)

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: KIJ-GT
Tower: WA+0
Number: 61

Tower structure

Properties

Tower type	Hoekmast		
Tower designation	WA+0		
Base plate w.r.t. ground level	0,5	m	
Tower height w.r.t. base plate	45,0	m	
Tower self weight	380,0	kN	

Width and slope at foundation	x-ri.	y-ri.	
Leg spread	11,00	11,00	m
Inclination of main leg	0,156	0,156	-
Horizontal force factor	1,1	1,1	-

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,25	0,24	2,76
Topstuk	45,00	2,60		2,00		2,60	0,24	0,09	3,45
Ondertraverse	27,70	13,80		4,00		27,60	5,54	0,20	2,93
Boventraverse	39,00	15,45		4,20		32,45	8,64	0,27	2,66

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 1	9,60	11,00	8,00	9,60	0,156	91,20	11,44	0,13	3,28
Middenstuk 1	18,90	8,00	5,84	9,30	0,116	64,36	10,66	0,17	3,08
Middenstuk 2	27,70	5,84	3,80	8,80	0,116	42,42	9,75	0,23	2,80
Bovenstuk 1	35,50	3,80	3,19	7,80	0,039	27,26	6,61	0,24	2,75
Bovenstuk 2	43,00	3,19	2,60	7,50	0,039	21,71	5,25	0,24	2,76
Topstuk	45,00	2,60		2,00		2,60	0,24	0,09	3,45
Ondertraverse	27,70	13,80		4,00		27,60	5,54	0,20	2,93
Boventraverse	39,00	15,45		4,20		32,45	8,64	0,27	2,66

Note: Surface transverse direction is reduced in calculation.

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Project: KIJ-GT
Tower: WA+0
Number: 61

Wind surface feeders telecom installations

Part	A (m^2/m)	Δh	A_1
Broekstuk 1			
Middenstuk 1			
Middenstuk 2			
Bovenstuk 1			
Bovenstuk 2			

Input antennas

Description	A (m^2)	h (m)	C_f (m)
Antenne 1			
Schotel			
Schotel			

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/m²]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk 1	0,70	26,3	22,3	0,0	-22,3	4,8	126,2	107,1	0,0	-107,1
Middenstuk 1	0,79	26,0	22,0	0,0	-22,0	14,3	369,9	313,9	0,0	-313,9
Middenstuk 2	0,92	25,1	21,3	0,0	-21,3	23,3	585,3	496,6	0,0	-496,6
Bovenstuk 1	1,00	18,3	15,5	0,0	-15,5	31,6	576,9	489,5	0,0	-489,5
Bovenstuk 2	1,06	15,4	13,1	0,0	-13,1	39,3	604,6	513,0	0,0	-513,0
Topstuk	1,10	0,9	0,8	0,0	-0,8	44,0	39,9	33,9	0,0	-33,9
Ondertraverse	0,98	31,7	18,9	0,0	-18,9	29,0	921,6	547,4	0,0	-547,4
Boventraverse	1,07	49,3	29,3	0,0	-29,3	40,4	1992,1	1183,2	0,0	-1183,2
Totaal		193,0	143,1	0,0	-143,1		5216,5	3684,6	0,0	-3684,6

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/m²]	[kN]	[kN]	[kN]	[kN]	[m]	[kNm]	[kNm]	[kNm]	[kNm]
Broekstuk 1	0,70	0,0	22,3	26,3	22,3	4,8	0,0	107,1	126,2	107,1
Middenstuk 1	0,79	0,0	22,0	26,0	22,0	14,3	0,0	313,9	369,9	313,9
Middenstuk 2	0,92	0,0	21,3	25,1	21,3	23,3	0,0	496,6	585,3	496,6
Bovenstuk 1	1,00	0,0	15,5	18,3	15,5	31,6	0,0	489,5	576,9	489,5
Bovenstuk 2	1,06	0,0	13,1	15,4	13,1	39,3	0,0	513,0	604,6	513,0
Topstuk	1,10	0,0	0,8	0,9	0,8	44,0	0,0	33,9	39,9	33,9
Ondertraverse	0,98	0,0	18,9	12,7	18,9	29,0	0,0	547,4	368,7	547,4
Boventraverse	1,07	0,0	29,3	19,7	29,3	40,4	0,0	1183,2	796,8	1183,2
Total		0,0	143,1	144,4	143,1		0,0	3684,6	3468,3	3684,6

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	380	0	0	0
Windrichting 0°	193	0	0	0	5217	0
Windrichting 45°	143	143	0	3685	3685	0
Windrichting 90°	0	144	0	3468	0	0
Windrichting 135°	-143	143	0	3685	-3685	0

Project: KIJ-GT
Tower: WA+0
Number: 61

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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	ACSR-26/7-242/39-HAWK	21,8	281,1	9,81	75000	1,89E-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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	2	45,8	B	4+0,2d	9,5	28,6
Circuit 2	3	2	45,8	B	4+0,2d	9,5	28,6
Bliksemdraad 1	1	2	10,0	B	4+0,2d	8,4	8,4
Bliksemdraad 2	1	2	10,0	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	4,8	1,0	23,37	0,92	1,2	1,10
380ct1f2	2,00	1	2	4,8	1,0	23,37	0,92	1,2	1,10
380ct1f3	2,00	1	2	4,8	1,0	34,67	1,03	1,2	1,24
380ct2f1	2,00	1	2	4,8	1,0	23,37	0,92	1,2	1,10
380ct2f2	2,00	1	2	4,8	1,0	23,37	0,92	1,2	1,10
380ct2f3	2,00	1	2	4,8	1,0	34,67	1,03	1,2	1,24
bl1	0,10	0,5	0,05	0,3	0,1	43,40	1,09	1,2	0,07
bl2	0,10	0,5	0,05	0,3	0,1	43,40	1,09	1,2	0,07

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Project: KIJ-GT
Tower: WA+0
Number: 61

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	23,1	0,92	0,56	0,49	1,12	28,25	48,4	42,7	46,9	86,1	76,0
380ct1f2	23,1	0,92	0,56	0,49	1,12	28,25	48,4	42,7	46,9	86,1	76,0
380ct1f3	34,7	1,03	0,59	0,52	1,09	28,25	55,9	49,2	46,9	102,4	90,2
380ct2f1	23,1	0,92	0,56	0,49	1,12	28,25	48,4	42,7	46,9	86,1	76,0
380ct2f2	23,1	0,92	0,56	0,49	1,12	28,25	48,4	42,7	46,9	86,1	76,0
380ct2f3	34,7	1,03	0,59	0,52	1,09	28,25	55,9	49,2	46,9	102,4	90,2
bl1	45,9	1,11	0,61	0,54	1,19	22,24	17,9	15,8	41,5	33,8	29,7
bl2	45,9	1,11	0,61	0,54	1,19	22,13	17,9	15,7	41,4	33,7	29,7

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	14,1	0,79	0,52	0,45	1,16	28,25	39,9	34,8	46,9	68,6	59,8
380ct1f2	14,1	0,79	0,52	0,45	1,16	28,25	39,9	34,8	46,9	68,6	59,8
380ct1f3	25,4	0,94	0,56	0,49	1,11	28,25	50,1	43,5	46,9	89,8	78,0
380ct2f1	14,1	0,79	0,52	0,45	1,16	28,25	39,9	34,8	46,9	68,6	59,8
380ct2f2	14,1	0,79	0,52	0,45	1,16	28,25	39,9	34,8	46,9	68,6	59,8
380ct2f3	25,4	0,94	0,56	0,49	1,11	28,25	50,1	43,5	46,9	89,8	78,0
bl1	34,6	1,03	0,59	0,51	1,20	22,24	16,1	14,0	41,5	30,2	26,2
bl2	34,6	1,03	0,59	0,51	1,20	22,13	16,1	13,9	41,4	30,1	26,1

Project: KIJ-GT
Tower: WA+0
Number: 61

Conductor loads	Auteur: TBR Versie: v11.3

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	46
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5660

Project: KIJ-GT
Tower: WA+0
Number: 61

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	-31,4	31,1	4,0	3,7	4,1	5,8
bl2	-31,5	31,2	4,1	3,6	4,1	5,8
380ct1f1	-109,5	107,7	11,7	10,1	12,5	17,1
380ct1f2	-109,5	107,7	11,9	10,1	12,5	17,1
380ct1f3	-111,4	109,8	13,4	12,4	12,3	17,1
380ct2f1	-109,4	107,7	12,2	10,1	12,5	17,1
380ct2f2	-109,4	107,7	12,4	10,1	12,5	17,1
380ct2f3	-111,4	109,8	14,0	12,4	12,3	17,1
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
Post 3	0,0	0,0	0,0	0,0	0,0	
Post 4	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	258,1	301,4	314,1
bl2	258,1	298,9	314,1
380ct1f1	314,6	326,6	333,9
380ct1f2	314,6	326,6	333,9
380ct1f3	306,0	323,6	331,5
380ct2f1	314,6	326,6	333,9
380ct2f2	314,6	326,6	333,9
380ct2f3	306,0	323,6	331,5
Post 1			
Post 2			
Post 3			
Post 4			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	314,6	318,1
bl2	314,6	317,3
380ct1f1	334,2	334,9
380ct1f2	334,2	334,9
380ct1f3	331,8	332,5
380ct2f1	334,2	334,9
380ct2f2	334,2	334,9
380ct2f3	331,8	332,5
Post 1		
Post 2		
Post 3		
Post 4		

Envelop of weight span over all combinations (incl. 0,9 combinations) For all conductors		Wind / Weight span ratio
Max. weight span	335,0 m	0,838 -
Min. weight span	228,8 m	0,572 -

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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	31,4	7,7	5,8	-31,4	31,1
bl2	31,5	7,7	5,8	-31,5	31,2
380ct1f1	92,6	21,8	17,1	-109,4	107,7
380ct1f2	92,6	22,0	17,1	-109,4	107,7
380ct1f3	93,0	25,8	17,1	-111,4	109,8
380ct2f1	92,6	22,4	17,1	-109,4	107,7
380ct2f2	92,6	22,6	17,1	-109,4	107,7
380ct2f3	92,9	26,5	17,1	-111,4	109,8
Post 1	2,6	2,6	4,0	0,0	
Post 2	2,6	2,6	4,0	0,0	
Post 3	2,6	2,6	4,0	0,0	
Post 4	2,6	2,6	4,0	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	0,0	2,0	-15,0	15,0
bl2	15,0	0,0	2,0	-15,0	15,0
380ct1f1	64,2	0,0	11,1	-64,2	64,2
380ct1f2	64,2	0,0	11,1	-64,2	64,2
380ct1f3	64,2	0,0	11,1	-64,2	64,2
380ct2f1	64,2	0,1	11,1	-64,2	64,2
380ct2f2	64,2	0,3	11,1	-64,2	64,2
380ct2f3	64,2	0,2	11,1	-64,2	64,2
Post 1	0,0	0,0	3,5	0,0	
Post 2	0,0	0,0	3,5	0,0	
Post 3	0,0	0,0	3,5	0,0	
Post 4	0,0	0,0	3,5	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	
	Post 3	0,0	
	Post 4	0,0	

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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		-42	167	134	5447	-1341	-3
ULS 1a_0,9_0		10	0	141	0	291	0
ULS 1a_0,9_0,9_90		-46	167	112	5447	-1471	-3
ULS 3_0		4	0	204	0	106	0
SLS 7		0	0	136	0	0	0

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

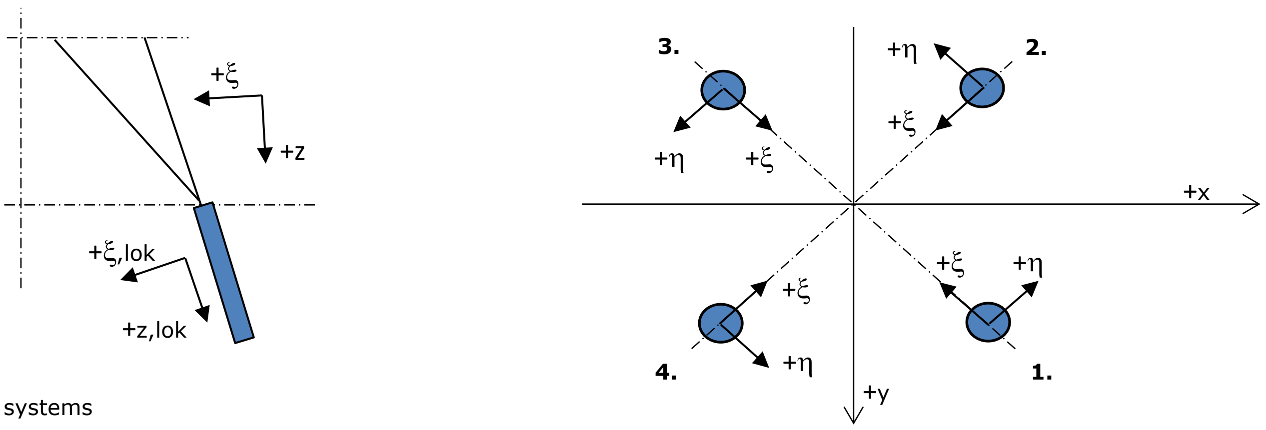
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-42	328	533	9320	-1341	-3
ULS 1a_0,9_0,9_90	-46	328	454	9320	-1471	-3
SLS 7	0	0	516	0	0	0

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_90	-42	328	474	**9320**	-1341	-3
SPLS 3_105 Ah All Cts	-604	85	486	2298	**-19506**	5
SPLS 6a_90 Ba Ct2 Ba Ct1	138	61	550	2082	4377	**-3928**
SPLS 1a_105 Ah All Cts	-555	183	476	**4978**	**-17791**	1

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 1a_75 Ba All Cts	192	199	**1118**	-5	-276	-29	1145
2	SPLS 3_0 Ba All Cts	174	-172	**1004**	-1	-245	-23	1028
3	SPLS 3_135 Ah All Cts	-158	-154	**912**	3	-220	-19	934
4	SPLS 1a_105 Ah All Cts	-198	205	**1154**	5	-285	-30	1182

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	-118	-115	**-683**	-2	165	14	-699
2	SPLS 1a_0,9_105 Ah All Cts	-160	167	**-931**	-5	231	25	-953
3	SPLS 1a_0,9_75 Ba All Cts	151	159	**-882**	5	219	24	-904
4	SPLS 3_0,9_0 Ba All Cts	132	-131	**-762**	1	186	18	-780

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 Ct2 Ba Ct2	50	-129	-235	**127**	56	4	-240
2	SPLS 6a_90 Ah Ct2 Ah Ct1	-119	-60	-178	**127**	42	3	-183
3	SPLS 6a_90 Ba Ct1 Ba Ct2	-68	116	-124	**130**	34	7	-127
4	SPLS 6a_90 Ba Ct1 Ba Ct2	89	95	2	**130**	-4	-3	2

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 6a_90 Ah Ct1 Ah Ct2	-92	92	-17	**-130**	0	-4	-18
2	SPLS 6a_90 Ah Ct1 Ba Ct1	22	161	-395	**-130**	98	10	-405
3	SPLS 6a_90 Ba Ct2 Ba Ct1	116	-63	-156	**-127**	38	3	-160
4	SPLS 6a_90 Ba Ct2 Ba Ct1	-95	-85	33	**-127**	-7	0	34

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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 6a_90 Ah All Cts Ba Ct2	-76	-125	**-600**	**35**	142	9	-614
2	SPLS 1a_0,9_105 Ah All Cts	-160	167	**-931**	**-5**	231	25	-953
3	SPLS 1a_0,9_75 Ba All Cts	151	159	**-882**	**5**	219	24	-904
4	SPLS 3_0,9_0 Ba All Cts	132	-131	**-762**	**1**	186	18	-780

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	22	22	129	0	-31	-3	132
2	SLS 7	22	-22	129	0	-31	-3	132
3	SLS 7	-22	-22	129	0	-31	-3	132
4	SLS 7	-22	22	129	0	-31	-3	132

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 1a_105 Ah All Cts	-198	205	**1154**	5	-285	-30	1182
Max. tension	SPLS 1a_0,9_105 Ah All Cts	-160	167	**-931**	-5	231	25	-953
Max. pos. torsie	SPLS 6a_90 Ba Ct1 Ba Ct2	89	95	2	**130**	-4	-3	2
Max. neg. torsie	SPLS 6a_90 Ah Ct1 Ah Ct2	-92	92	-17	**-130**	0	-4	-18
Comb. tension+torsie	SPLS 1a_0,9_105 Ah All Cts	-160	167	**-931**	**-5**	231	25	-953

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	22	22	**129**	0	-31	-3	132
2	SLS 1a_135	-62	61	**-318**	1	87	16	-326
3	SLS 1a_45	56	55	**-286**	-1	79	16	-293
4	SLS 1a_0	26	-18	**-106**	5	31	8	-108

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	100	100	**543**	0	-141	-21	556
2	SLS 1a_0	70	-63	**364**	-5	-94	-13	372
3	SLS 7	-22	-22	**129**	0	-31	-3	132
4	SLS 1a_135	-105	105	**575**	0	-149	-22	589

Project: KIJ-GT
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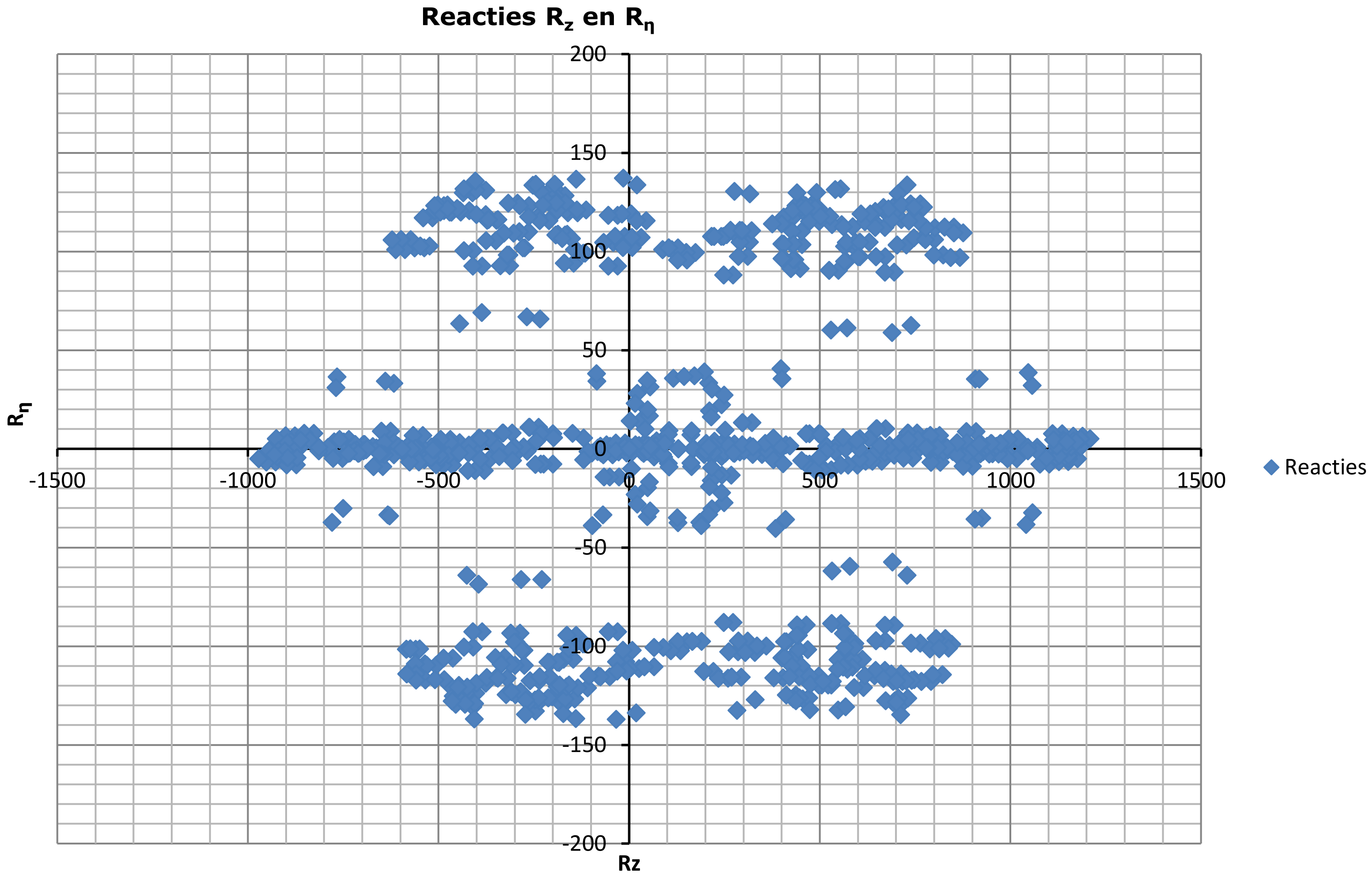

Project: KIJ-GT
Tower: WA+0
Number: 61

Conductor loads

Auteur: TBR
Versie: v11.3

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	46
Number of load combinations for SPLS	222
Number of load combinations for SLS	15
Number of concentrated loads	5660

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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	-34,5	33,9	5,0	4,6	4,5	6,3
bl2	-34,7	34,1	5,2	4,5	4,5	6,3
380ct1f1	-127,3	125,3	14,7	12,7	14,7	20,1
380ct1f2	-127,3	125,3	14,9	12,7	14,7	20,1
380ct1f3	-129,8	128,0	16,9	15,6	14,5	20,1
380ct2f1	-127,3	125,3	15,3	12,7	14,7	20,1
380ct2f2	-127,3	125,3	15,6	12,7	14,7	20,1
380ct2f3	-129,7	128,0	17,6	15,6	14,5	20,1
Post 1	0,0	0,0	0,0	0,0	0,0	
Post 2	0,0	0,0	0,0	0,0	0,0	
Post 3	0,0	0,0	0,0	0,0	0,0	
Post 4	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	253,1	301,0	314,1
bl2	253,1	298,5	314,1
380ct1f1	312,6	326,5	333,9
380ct1f2	312,6	326,5	333,9
380ct1f3	303,4	323,4	331,5
380ct2f1	312,6	326,5	333,9
380ct2f2	312,6	326,5	333,9
380ct2f3	303,4	323,4	331,5
Post 1			
Post 2			
Post 3			
Post 4			

Max. Weight span (m)

Weight spar	Combinatie1	
Geleider	ULS 1a	ULS 3
bl1	315,6	320,9
bl2	315,6	320,1
380ct1f1	334,8	336,5
380ct1f2	334,8	336,5
380ct1f3	332,4	334,1
380ct2f1	334,8	336,5
380ct2f2	334,8	336,5
380ct2f3	332,4	334,1
Post 1		
Post 2		
Post 3		
Post 4		

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

For all conductors		Wind / Weight span ratio
Max. weight span	336,5 m	0,841 -
Min. weight span	200,1 m	0,500 -

Project: KIJ-GT
Tower: WA+0
Number: 61

Maximum values back + ahead span **Maximum tension in conductor**

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	32,5	9,6	6,3	-34,5	33,9
bl2	32,6	9,6	6,3	-34,7	34,1
380ct1f1	98,0	27,4	20,1	-127,3	125,3
380ct1f2	98,0	27,6	20,1	-127,3	125,3
380ct1f3	98,3	32,4	20,1	-129,8	128,0
380ct2f1	98,0	28,0	20,1	-127,3	125,3
380ct2f2	98,0	28,3	20,1	-127,3	125,3
380ct2f3	98,3	33,1	20,1	-129,8	128,0
Post 1	3,2	3,2	4,6	0,0	
Post 2	3,2	3,2	4,6	0,0	
Post 3	3,2	3,2	4,6	0,0	
Post 4	3,2	3,2	4,6	0,0	

EDS-loads conductor

Geleider	Fx [kN]	Fy [kN]	Fz [kN]	Ft_ba [kN]	Ft_ah [kN]
bl1	15,0	0,0	2,0	-15,0	15,0
bl2	15,0	0,0	2,0	-15,0	15,0
380ct1f1	64,2	0,0	11,1	-64,2	64,2
380ct1f2	64,2	0,0	11,1	-64,2	64,2
380ct1f3	64,2	0,0	11,1	-64,2	64,2
380ct2f1	64,2	0,1	11,1	-64,2	64,2
380ct2f2	64,2	0,3	11,1	-64,2	64,2
380ct2f3	64,2	0,2	11,1	-64,2	64,2
Post 1	0,0	0,0	3,5	0,0	
Post 2	0,0	0,0	3,5	0,0	
Post 3	0,0	0,0	3,5	0,0	
Post 4	0,0	0,0	3,5	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	
	Post 3	0,0	
	Post 4	0,0	

Project: KIJ-GT
Tower: WA+0
Number: 61

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		-54	209	145	6828	-1716	-4
ULS 1a_0,9_0		13	0	153	0	371	0
ULS 1a_0,9_0,9_90		-61	209	108	6828	-1940	-4
ULS 3_0		6	0	239	1	163	0
SLS 7		0	0	136	0	0	0

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

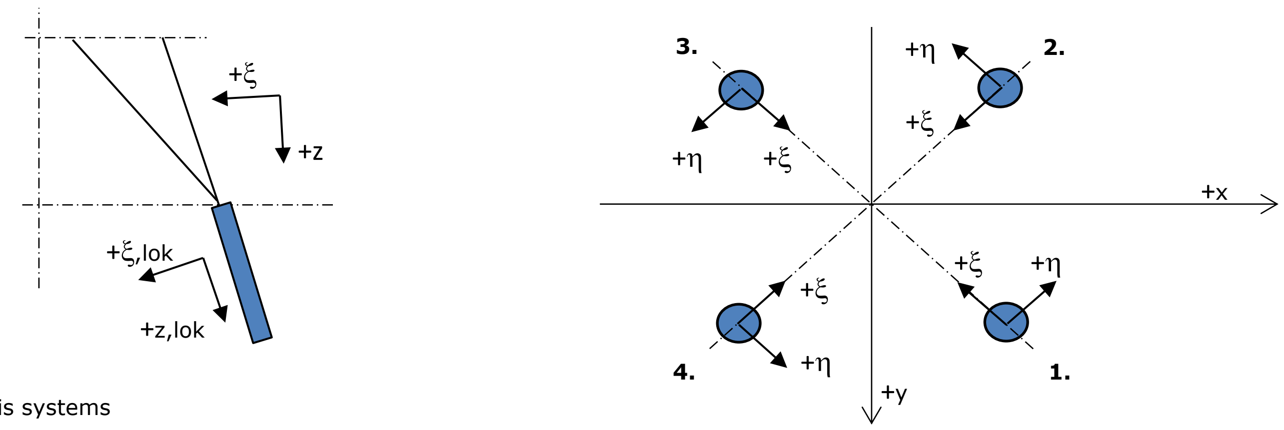
Combination	F_x [kN]	F_y [kN]	F_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
ULS 1a_90	-54	411	582	11684	-1716	-4
ULS 1a_0,9_0,9_90	-61	411	450	11684	-1940	-4
SLS 7	0	0	516	0	0	0

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	-54	411	582	**11684**	-1716	-4
SPLS 3_105 Ah All Cts	-637	85	532	2298	**-20557**	5
SPLS 6a_90 Ba Ct2 Ba Ct1	158	61	600	2107	5011	**-4144**
SPLS 1a_105 Ah All Cts	-585	183	523	**4978**	**-18743**	1

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 1a_75 Ba All Cts	202	209	**1176**	-5	-290	-31	1204
2	SPLS 3_0 Ba All Cts	185	-184	**1070**	-1	-261	-25	1096
3	SPLS 3_135 Ah All Cts	-169	-165	**975**	3	-236	-20	999
4	SPLS 1a_105 Ah All Cts	-207	215	**1209**	5	-299	-31	1238

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	-127	-124	**-733**	-2	177	15	-751
2	SPLS 1a_0,9_105 Ah All Cts	-167	174	**-972**	-5	241	26	-996
3	SPLS 1a_0,9_75 Ba All Cts	159	166	**-926**	5	230	25	-949
4	SPLS 3_0,9_0 Ba All Cts	141	-140	**-814**	1	199	19	-834

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 Ct2 Ba Ct2	53	-136	-246	**134**	59	4	-252
2	SPLS 6a_90 Ah Ct2 Ah Ct1	-127	-62	-196	**134**	46	3	-200
3	SPLS 6a_90 Ba Ct1 Ba Ct2	-70	123	-139	**137**	38	7	-143
4	SPLS 6a_90 Ba Ct1 Ba Ct2	97	97	-16	**137**	0	-3	-16

Maximum torsional load (negative)

Index	Combination	R_x	R_y	R_z	R_η	R_ξ	$R_{\xi,lok}$	$R_{z,lok}$
Index	Combination	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
1	SPLS 6a_90 Ah Ct1 Ah Ct2	-100	94	-34	**-137**	4	-4	-35
2	SPLS 6a_90 Ah Ct1 Ba Ct1	26	168	-406	**-137**	101	11	-416
3	SPLS 6a_90 Ba Ct2 Ba Ct1	124	-65	-174	**-134**	42	3	-178
4	SPLS 6a_90 Ba Ct2 Ba Ct1	-97	-92	18	**-134**	-3	1	18

Project: KIJ-GT
Tower: WA+0
Number: 61

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 Ct2	-83	-132	**-640**	**34**	152	10	-656
2	SPLS 1a_0,9_105 Ah All Cts	-167	174	**-972**	**-5**	241	26	-996
3	SPLS 1a_0,9_75 Ba All Cts	159	166	**-926**	**5**	230	25	-949
4	SPLS 3_0,9_0 Ba All Cts	141	-140	**-814**	**1**	199	19	-834

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	22	22	129	0	-31	-3	132
2	SLS 7	22	-22	129	0	-31	-3	132
3	SLS 7	-22	-22	129	0	-31	-3	132
4	SLS 7	-22	22	129	0	-31	-3	132

Envelope of load combinations for all of the legs

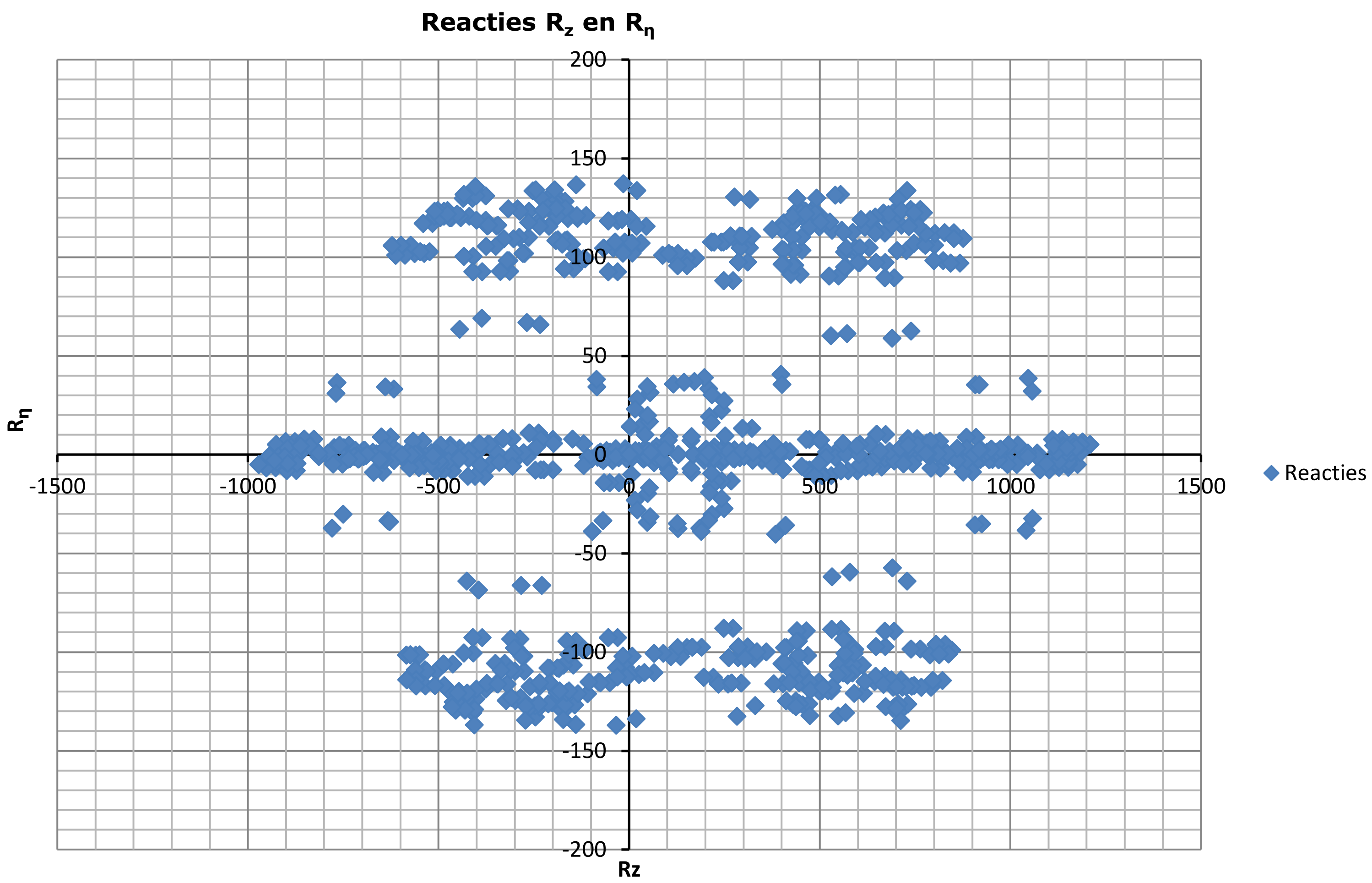
Index	Combination	R_x [kN]	R_y [kN]	R_z [kN]	R_η [kN]	R_ξ [kN]	$R_{\xi,lok}$ [kN]	$R_{z,lok}$ [kN]
Max. pressure	SPLS 1a_105 Ah All Cts	-207	215	**1209**	5	-299	-31	1238
Max. tension	SPLS 1a_0,9_105 Ah All Cts	-167	174	**-972**	-5	241	26	-996
Max. pos. torsie	SPLS 6a_90 Ba Ct1 Ba Ct2	97	97	-16	**137**	0	-3	-16
Max. neg. torsie	SPLS 6a_90 Ah Ct1 Ah Ct2	-100	94	-34	**-137**	4	-4	-35
Comb. tension+torsie	SPLS 1a_0,9_105 Ah All Cts	-167	174	**-972**	**-5**	241	26	-996

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	22	22	**129**	0	-31	-3	132
2	SLS 1a_135	-67	66	**-346**	1	94	17	-354
3	SLS 1a_45	61	60	**-310**	-1	85	17	-318
4	SLS 1a_0	28	-21	**-120**	6	35	8	-123

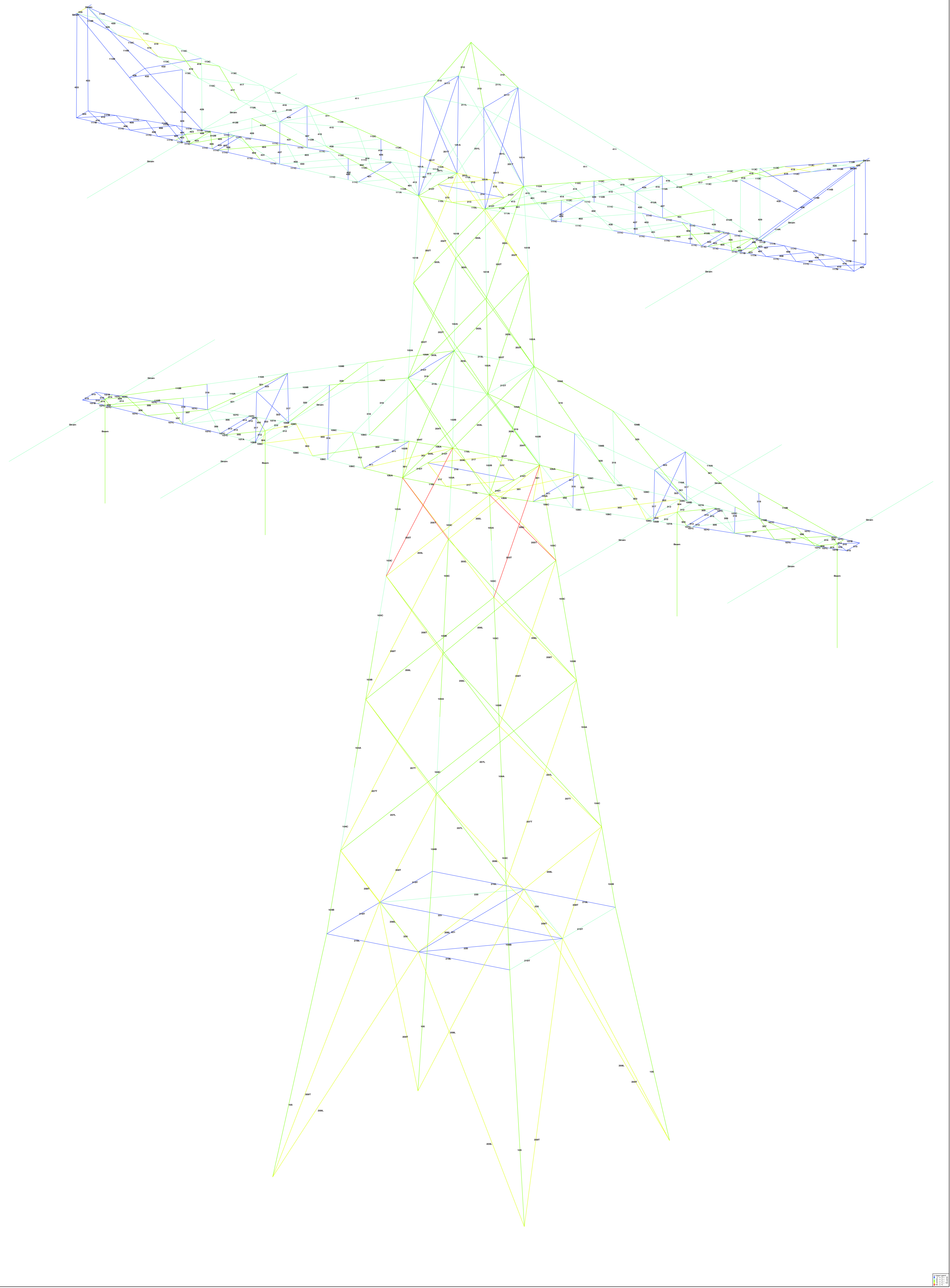
Maximum compression load - SLS

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	104	104	**567**	0	-148	-22	581
2	SLS 1a_0	73	-65	**378**	-6	-97	-14	387
3	SLS 7	-22	-22	**129**	0	-31	-3	132
4	SLS 1a_135	-111	110	**603**	0	-156	-23	617


Reacties R_z en R_η
200
150
100
50
0
-50
-100
-150
-200
-1500
-1000
-500
0
500
1000
1500
R_η
Rz
Reacties

APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project "WA+0 (da) afk (11-1)"
Tower Version 16.39, 11:49:40 woensdag 29 juli 2020
Undeformed geometry displayed



Assessment of groups for initial mast (afkeur level)

Date 29-7-2020
Author MKh
Version 1.0

KIJ-GT380
WA+0
11-1

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 derde tussenstuk	120x120x8	S235	6M24-5.6t	0.52	0.52	0.52	88	-45.1	SPLS 6a_90 Ba Ct1 Ba Ct2	309.4	508.3	622.1	0.15		8.4	SPLS 1a_0,9_90 Ba All Cts	379.5	508.3	531.7	0.02	
101B	Leg derde tussenstuk	120x120x8	S235	6M24-5.6t	0.52	0.52	0.52	77	-119.5	SPLS 1a_105 Ah All Cts	337.6	506.7	622.1	0.35		90.0	SPLS 1a_0,9_75 Ba Ct1	379.5	506.7	531.7	0.24	
102A	Leg derde tussenstuk	180x180x16#	S235	8M24-5.6t	0.52	0.52	0.52	56	-354.9	SPLS 1a_105 Ah All Cts	1129.2	674.7	1658.9	0.53		275.3	SPLS 1a_0,9_75 Ba All Cts	1220.3	674.7	1417.8	0.41	
102B	Leg derde tussenstuk	180x180x16#	S235	10M24-5.6t	0.52	0.52	0.52	59	-389.0	SPLS 1a_105 Ah All Cts	1111.8	847.2	2073.6	0.46		285.9	SPLS 1a_0,9_75 Ba All Cts	1220.3	847.2	1612.8	0.34	
103A	Leg tweede tussenstuk	200x200x16	S235	12M24-5.6t	0.52	0.52	0.52	23	-707.0	SPLS 1a_105 Ah All Cts	1440.3	941.5	2488.3	0.75		565.9	SPLS 1a_0,9_75 Ba All Cts	1386.2	941.5	2126.8	0.60	
103C	Leg tweede tussenstuk	200x200x16	S235		0.52	0.52	0.52	29	-868.2	SPLS 1a_105 Ah All Cts	1410.7	0.0	0.0	0.62		729.5	SPLS 1a_0,9_75 Ba All Cts	1452.3	0.0	0.0	0.50	
103B	Leg tweede tussenstuk	200x200x16	S235	12M24-5.6t	0.52	0.52	0.52	36	-870.9	SPLS 1a_105 Ah All Cts	1374.3	1987.7	2488.3	0.63		727.4	SPLS 1a_0,9_75 Ba All Cts	1386.2	1987.7	2126.8	0.52	
104A	Leg eerste tussenstuk	250x250x18#	S235	10M24-5.6t	0.52	0.52	0.52	29	-1087.3	SPLS 1a_105 Ah All Cts	2005.8	1599.1	2332.8	0.68		927.7	SPLS 1a_0,9_75 Ba All Cts	2030.6	1599.1	1993.8	0.58	
104C	Leg eerste tussenstuk	250x250x18#	S235		0.52	0.52	0.52	35	-1090.8	SPLS 1a_105 Ah All Cts	1959.5	0.0	0.0	0.56		925.0	SPLS 1a_0,9_75 Ba All Cts	2061.0	0.0	0.0	0.45	
104B	Leg eerste tussenstuk	250x250x18#	S235	12M24-5.6t	0.52	0.52	0.52	35	-1184.0	SPLS 1a_105 Ah All Cts	1959.5	1859.6	2799.4	0.64		1015.3	SPLS 1a_0,9_75 Ba All Cts	2030.6	1859.6	2392.6	0.55	
105	Leg broekstuk	250x250x18#	S235	12M24-5.6t	0.17	0.17	0.17	33	-1205.4	SPLS 1a_105 Ah All Cts	1974.3	1859.6	2799.4	0.65		1015.6	SPLS 1a_0,9_75 Ba All Cts	2030.6	1859.6	2392.6	0.55	
106A	Eerste dwarsarm onderregel	180x180x16#	S235	10M24-5.6t	1.00	1.92	1.00	63	-586.1	SPLS 6a_90 Ah Ct1 Ba Ct1	1086.9	815.4	2073.6	0.72		462.3	SPLS 3_0,9_90 Ba Ct2	1220.3	815.4	1772.3	0.57	
106C	Eerste dwarsarm onderregel	180x180x16#	S235		2.09	1.42	1.00	63	-522.8	SPLS 6a_90 Ah Ct1 Ba Ct1	1087.0	0.0	0.0	0.48		403.7	SPLS 3_0,9_90 Ba Ct2	1301.9	0.0	0.0	0.31	
106B	Eerste dwarsarm onderregel	180x180x16#	S235	8M24-5.6t	2.00	11.19	1.00	61	-311.3	SPLS 6a_90 Ah Ct1 Ba Ct1	1098.2	677.8	1658.9	0.46		235.7	SPLS 3_0,9_90 Ba Ct2	1220.3	677.8	1417.8	0.35	
107A	Eerste dwarsarm onderregel	160x160x17#	S235	8M24-5.6t	3.12	1.00	1.00	69	-315.1	SPLS 6a_90 Ah Ct1 Ba Ct1	981.2	677.8	1762.6	0.47		234.9	SPLS 3_0,9_90 Ba Ct2	1116.1	677.8	1506.5	0.35	
107C	Eerste dwarsarm onderregel	160x160x17#	S235		26.86	2.00	2.00	69	-292.0	SPLS 6a_90 Ah Ct1 Ba Ct1	981.3	0.0	0.0	0.30		212.6	SPLS 3_0,9_90 Ba Ct2	1219.7	0.0	0.0	0.17	
107B	Eerste dwarsarm onderregel	160x160x17#	S235	2M20-5.6t	1.43	1.00	1.00	22	-4.2	ULS 3_75	1213.4	117.6	367.2	0.04		2.5	SPLS 1a_105 Ah Ct2	668.3	117.6	367.2	0.02	
109A	Eerste dwarsarm bovenregel	80x80x8	S235	3M24-5.6t	1.00	1.92	1.00	299	0.0		36.8	254.2	311.0	0.00		105.6	SPLS 1a_0 Ba Ct1	160.8	254.2	259.0	0.66	
109B	Eerste dwarsarm bovenregel	80x80x8	S235	4M24-5.6t	1.00	2.08	1.00	299	-6.1	SPLS 1a_0,9_75 Ba All Cts	36.8	338.9	414.7	0.16		79.5	SPLS 1a_0 Ba Ct1	211.0	338.9	354.5	0.38	
110A	Eerste dwarsarm bovenregel	70x70x7	S235	5M24-5.6t	1.00	2.09	1.00	345	-9.8	SPLS 1a_0,9_75 Ba All Cts	22.4	423.6	453.6	0.44		69.0	SPLS 1a_45 Ba Ct2	149.3	423.6	320.9	0.46	
110B	Eerste dwarsarm bovenregel	70x70x7	S235	2M24-5.6t	1.00	1.92	1.00	345	-9.9	SPLS 1a_0,9_75 Ba All Cts	22.4	169.4	181.4	0.44		69.1	SPLS 1a_45 Ba Ct2	102.4	169.4	128.4	0.67	
111A	Tweede dwarsarm onderregel	180x180x16#	S235	10M24-5.6t	0.50	1.17	0.50	58	-375.4	SPLS 6a_90 Ah Ct1 Ba Ct1	1115.4	847.2	2073.6	0.44		296.0	SPLS 3_0,9_90 Ba All Cts	1220.3	847.2	1772.3	0.35	
111C	Tweede dwarsarm onderregel	180x180x16#	S235		0.54	1.43	1.00	62	-317.5	SPLS 6a_90 Ah Ct1 Ba Ct1	1094.7	0.0	0.0	0.29		232.2	SPLS 3_0,9_90 Ba All Cts	1301.9	0.0	0.0	0.18	
111B	Tweede dwarsarm onderregel	180x180x16#	S235	3M20-5.6t	2.19	16.11	1.00	87	-5.3	ULS 1a_0,9_0,9_0	912.3	176.4	518.4	0.03		11.1	ULS 1a_135	1253.5	176.4	418.9	0.06	
112A	Tweede dwarsarm bovenregel	120x120x10	S235	3M24-5.6t	1.00	1.52	1.00	93	-190.8	SPLS 6a_90 Ah All Cts Ba Ct1	300.3	254.2	388.8	0.75		176.2	S 6a_90 Ah All Cts Ba Ct2	324.0	254.2	332.3	0.69	
112C	Tweede dwarsarm bovenregel	120x120x10	S235		1.91	2.91	1.00	91	-181.3	SPLS 6a_90 Ah All Cts Ba Ct1	300.0	0.0	0.0	0.60		170.7	S 6a_90 Ah All Cts Ba Ct2	545.2	0.0	0.0	0.31	
112B	Tweede dwarsarm bovenregel	120x120x10	S235	5M24-5.6t	1.00	1.50	1.00	93	-163.7	SPLS 6a_90 Ah All Cts Ba Ct1	303.2	423.6	648.0	0.54		158.6	S 6a_90 Ah All Cts Ba Ct2	466.6	423.6	553.8	0.37	
113A	Tweede dwarsarm bovenregel	150x100x10	S235	5M24-5.6t	2.40	1.00	1.00	97	-138.2	SPLS 6a_90 Ah All Cts Ba Ct1	297.8	423.6	648.0	0.46		157.2	S 6a_90 Ah All Cts Ba Ct2	495.3	423.6	553.8	0.37	
113C	Tweede dwarsarm bovenregel	150x100x10	S235		2.40	1.00	1.00	97	-121.8	SPLS 6a_90 Ah All Cts Ba Ct1	297.8	0.0	0.0	0.41		141.4	S 6a_90 Ah All Cts Ba Ct2	571.3	0.0	0.0	0.25	
113B	Tweede dwarsarm bovenregel	150x100x10	S235	4M24-5.6t	2.60	1.00	1.00	105	-27.5	SPLS 3_0,9_90 Ba All Cts	278.3	338.9	518.4	0.10		38.9	S 6a_90 Ah All Cts Ba Ct2	495.3	338.9	443.1	0.11	
114A	Tweede dwarsarm tussenregel	120x120x8	S235	1M24-5.6t	1.00	1.00	1.00	134	-18.4	ULS 5a Ba 12	160.4	84.7	103.7	0.22		1.6	SPLS 1a_0,9_75 Ba Ct1	216.6	84.7	88.6	0.02	
114B	Tweede dwarsarm tussenregel	120x120x8	S235	1M24-5.6t	1.00	1.00	1.00	134	-17.6	ULS 5a Ba 12	160.4	84.7	103.7	0.21		2.3	SPLS 1a_0,9_75 Ba Ct1	216.6	84.7	88.6	0.03	
115L	Eerste dwarsarm in tower	180x180x16#	S235	8M24-5.6t	1.00	2.00	1.00	53	-519.9	SPLS 3_90 Ah All Cts	1147.6	677.8	1658.9	0.77		450.0	SPLS 3_0,9_90 Ba All Cts	1220.3	677.8	1417.8	0.66	
116L	Eerste dwarsarm in tower	180x180x16#	S235	10M24-5.6t	1.00	2.00	1.00	69	-555.2	SPLS 3_90 Ah All Cts	1048.4	815.4	2073.6	0.68		426.0	SPLS 3_0,9_90 Ba All Cts	1220.3	815.4	1772.3	0.52	
201L	Diagonaal derde tussenstuk	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	136	-28.6	SPLS 1a_75 Ba Ct1	87.7	84.7	77.8	0.37		22.1	SPLS 1a_0,9_90 Ah Ct2	127.9	84.7	66.5	0.33	
201T	Diagonaal derde tussenstuk	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	136	-16.1	SPLS 1a_105 Ah Ct2	87.7	84.7	77.8	0.21		7.6	SPLS 1a_0,9_75 Ba Ct1	127.9	84.7	66.5	0.11	
202L	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	86	-264.8	SPLS 3_90 Ah Ct1	415.1	338.9	518.4	0.78		231.6	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.68	
202T	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	86	-256.4	SPLS 3_90 Ah Ct2	415.1	338.9	518.4	0.76		256.4	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.76	
203L	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	94	-212.7	SPLS 3_0,9_90 Ah Ct2	390.3	338.9	518.4	0.63		242.0	SPLS 3_90 Ah Ct1	384.5	338.9	350.9	0.71	
203T	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	94	-233.9	SPLS 3_0,9_90 Ba Ct1	390.3	338.9	518.4	0.69		232.8	SPLS 3_90 Ah Ct2	384.5	338.9	350.9	0.69	
204L	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	100	-244.9	SPLS 3_90 Ba Ct1	369.7	338.9	518.4	0.72		236.9	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.70	
204T	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	100	-231.1	SPLS 3_90 Ah Ct2	369.7	338.9	518.4	0.68		212.2	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.63	
205L	Diagonaal tweede tussenstuk	150x150x10	S235	6M24-5.6t	0.55	0.28	0.28	69	-357.9	SPLS 3_90 Ba Ct2	447.9	508.3	777.6	0.80		356.2	SPLS 3_0,9_90 Ah Ct1	384.5	508.3	513.8	0.93	
205T	Diagonaal tweede tussenstuk	150x150x10	S235	6M24-5.6t	0.55	0.28	0.28	69	-395.5	SPLS 3_0,9_90 Ah Ct1	447.9	508.3	777.6	0.88		399.3	SPLS 3_90 Ah Ct2	384.5	508.3	513.8	1.04	nettodsn.
206L	Diagonaal tweede tussenstuk	150x150x12	S235	5M24-5.6t	0.55	0.28	0.28	87	-297.9	SPLS 3_90 Ah Ct1	463.5	423.6	777.6	0.70		294.9	SPLS 3_0,9_90 Ba Ct2	456.2	423.6	518.8	0.70	
206T	Diagonaal tweede tussenstuk	150x150x12	S235	5M24-5.6t	0.55	0.28	0.28	87	-327.8	SPLS 3_90 Ah Ct2	463.5	423.6	777.6	0.77		321.6	SPLS 3_0,9_90 Ah Ct1	456.2	423.6	518.8	0.76	
207L	Diagonaal eerste tussenstuk	150x150x12	S235	4M24-5.6t	0.55	0.28	0.28	107	-242.6	SPLS 3_90 Ba Ct2	392.0	338.9	622.1	0.72		242.4	SPLS 3_0,9_90 Ah Ct1	456.2	338.9	421.1	0.72	
207T	Diagonaal eerste tussenstuk	150x150x12	S235	4M24-5.6t	0.55	0.28	0.28	107	-259.5	SPLS 3_0,9_90 Ah Ct1	392.0	338.9	622.1	0.77		261.7	SPLS 3_90 Ah Ct2	456.2	338.9	421.1	0.77	
208L	Diagonaal eerste tussenstuk	150x150x10	S235	3M24-5.6t	1.00	0.52	0.52	106	-205.8	SPLS 1a_90 Ah Ct1	332.1	254.2	388.8	0.81		202.9	SPLS 3_0,9_90 Ba Ct2	384.5	254.2	269.2	0.80	
208T	Diagonaal eerste tussenstuk	150x150x10	S235	3M24-5.6t	1.00	0.52	0.52	106	-215.4	SPLS 3_90 Ah Ct2	332.1	254.2	388.8	0.85		209.8	SPLS 3_0,9_90 Ah Ct1	384.5	254.2	269.2	0.83	
209L	Diagonaal broekstuk	120x120x10	S235	4M24-5.6t	0.25	0.17	0.17	79	-291.5	SPLS 3_90 Ah Ct1	337.0	338.9	518.4	0.86		276.8	SPLS 3_0,9_90 Ba Ct2	324.0	338.9	432.3	0.85	
209T	Diagonaal broekstuk	120x120x10	S235	4M24-5.6t	0.25	0.17	0.17	79	-283.8	SPLS 3_90 Ah Ct2	337.0	338.9	518.4	0.84		268.9	SPLS 3_0,9_90 Ah Ct1	324.0	338.9	432.3	0.83	
210	Top	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	280	-9.4	SPLS 3_90 Ah Ct1	16.5	75.4	86.4	0.57		9.4	SPLS 3_0,9_90 Ah Ct1	52.4	75.4	44.1	0.21	
211L	Tweede dwarsarm in tower	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	133	0.0		148.9	254.2	311.0	0.00		80.3	ULS 6a_90 Ba Ct2	211.1	254.2	265.8	0.38	
211T	Tweede dwarsarm in tower	70x70x5#	S235	2M24-5.6t	1.00	1.00	1.00	187	-2.3	SPLS 6a_90 Ba Ct1 Ba Ct2	43.2	169.4	129.6	0.05		2.7	SPLS 6a_90 Ba Ct1 Ba Ct2	112.9	169.4	91.7	0.03	
212T	Tweede dwarsarm in tower	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	95	-103.5	SPLS 6a_90 Ba Ct1 Ba Ct2	144.3	338.9	311.0	0.72		120.8	SPLS 6a_90 Ba Ct1 Ba Ct2	225.0	338.9	265.8	0.54	
213	Tweede dwarsarm in tower	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	86	-151.0	SPLS 3_0,9_90 Ah Ct2	265.3	169.4	207.4	0.89		152.2	SPLS 3_90 Ah Ct1	226.0	169.4	177.2	0.90	
214	Tweede dwarsarm in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	300	-0.8	SPLS 6a_90 Ah Ct2 Ba Ct2	11.8	37.7	43.2	0.07		0.0		37.4	37.7	22.0	0.00	
215L	Eerste dwarsarm in tower	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	178	-1.9	SPLS 3_0,9_90 Ba All Cts	103.8	254.2	311.0	0.02		113.0	S 6a_90 Ah All Cts Ba Ct2	270.5	254.2	265.8	0.44	
215T	Eerste dwarsarm in tower	100x100x8	S235	1M24-5.6t	1.00	1.00	1.00	178	-18.8	ULS 1a_0,9_0,9_90	83.1	84.7	103.7	0.23		23.2	ULS 1a_90	170.5	84.7	88.6	0.27	
216T	Eerste dwarsarm in tower	100x100x8	S235	4M24-5.6t	1.00	2.00	1.00	124	-104.1	SPLS 3_0,9_90 Ah Ct1	151.1	338.9	414.7	0.69		114.0	SPLS 3_90 Ah Ct2	293.9	338.9	354.5	0.39	
217	Eerste dwarsarm in tower	120x120x10	S235	2M24-5.6t	1.00	1.00	1.00	114	-150.5	SPLS 3_0,9_90 Ah Ct1	261.1	169.4	259.2	0.89		151.9	SPLS 3_90 Ah Ct1	278.4	169.4	221.5	0.90	
218	Eerste dwarsarm in tower	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	325	-0.7	ULS 3_0	15.0	58.8	64.8	0.05		0.0		65.7	58.8	44.4	0.00	
219L	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	-40.2	SPLS 1a_105 Ah All Cts	195.2	169.4	311.0	0.24		27.9	SPLS 1a_0,9_75 Ba All Cts	329.5	169.4	265.8	0.16	
219T	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	-45.5	SPLS 1a_105 Ah All Cts	195.2	169.4	311.0	0.27		32.8	SPLS 1a_0,9_75 Ba All Cts	329.5	169.4	265.8	0.19	
220	Onderstuk in tower	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	311	-5.3	ULS 1a_135	11.6	37.7	43.2	0.46		4.4	ULS 1a_0,9_135	60.5	37.7	32.0	0.14	
221	Onderstuk in tower	70x70x5#	S235	1M16-5.6t	1.00	0.50	0.50	370	-1.1	SPLS 3_90 Ah Ct1	10.0	37.7	43.2	0.11		0.0		74.9	37.7	32.0	0.00	
301	Diagonalen onderregel eerste dwarsarm	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	113	-53.8	SPLS 3_90 Ba All Cts	105.9	84.7	77.8	0.69		52.2	SPLS 3_0,9_90 Ba All Cts	127.9	84.7	66.5	0.79	
302	Diagonalen onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	112	-71.6	SPLS 3_90 Ba Ct2	133.9	117.6	129.6	0.61		68.0	SPLS 3_90 Ba Ct2	142.1	117.6	104.7	0.65	
303	Diagonalen onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	102	-85.3	SPLS 3_90 Ba All Cts	145.6	117.6	129.6	0.73		87.2	SPLS 3_0,9_90 Ba All Cts	147.1	117.6	104.7	0.83	
304	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	89	-46.5	SPLS 3_90 Ba Ct1	103.8	84.7	77.8	0.60		52.4	SPLS 3_0,9_90 Ba All Cts	93.3	84.7	59.8	0.88	
305	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	98	-31.8	SPLS 3_90 Ba All Cts	96.7	84.7	77.8	0.41		35.5	SPLS 3_0,9_90 Ba All Cts	93.3	84.7	57.2	0.62	
306	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	93	-38.0	SPLS 3_90 Ba All Cts	126.2	117.6	129.6	0.32		38.3	SPLS 3_0,9_90 Ba All Cts	99.4	117.6	91.6	0.42	
307	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	83	-48.6	SPLS 3_0,9_90 Ba All Cts	136.5	117.6	129.6	0.41		47.4	SPLS 3_90 Ba All Cts	107.0	117.6	91.6	0.52	
308	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.56	0.56	0.56	77	-66.1	SPLS 3_90 Ba All Cts	142.4	117.6	129.6	0.56		65.0	SPLS 3_0,9_90 Ba All Cts	113.4	117.6	91.6	0.71	
309	Diagonalen onderregel eerste dwarsarm	70x70x6	S235	1M24-5.6t	1.00	1.00	1.00	63	-29.8	SPLS 3_90 Ba All Cts	102.4	84.7	77.8	0.38		32.0	SPLS 1a_90 Ba All Cts	76.0	84.7	49.5	0.65	
310	Diagonalen onderregel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	89	-3.5	ULS 1a_75	53.3	37.7	43.2	0.09		4.9	SPLS 3_75 Ah Ct2	37.4	37.7	22.0	0.22	
311	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	87	0.0		548.0	117.6	216.0	0.00		4.4	ULS 3_90	766.1	117.6	0.0	0.04	
312	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	81	0.0		316.3	117.6	259.2	0.00		58.6	ULS 3_90	278.4	117.6	259.2	0.50	
313	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	57	-5.6	ULS 1a_0,9_90	679.0	117.6	216.0	0.05		1.0	SPLS 1a_45 Ah All Cts	766.1	117.6	0.0	0.01	
314	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	1.00	2.00	1.00	38	0.0		424.1	117.6	259.2	0.00		67.3	ULS 3_90	278.4	117.6	259.2	0.57	
315	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	25	-8.5	ULS 3_90	794.2	117.6	216.0	0.07		0.0		766.1	117.6	0.0	0.00	
316	Tussenregel eerste dwarsarm	90x90x6#	S235	1M20-5.6t	1.00	1.00	1.00	166	-17.2	ULS 3_0	70.1	58.8	64.8	0.29		0.0		117.5	58.8	52.4	0.00	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date	29-7-2020
Author	MKh
Version	1.0

KIJ-GT380
WA+0
11-1

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)
317	Tussenregel eerste dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	186	**-6.0**	SPLS 3_90 Ba Ct1	30.3	37.7	43.2	0.20		**0.0**		37.4	37.7	22.0	0.00	
318	Tussenregel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	108	**-0.8**	SPLS 6a_90 Ba Ct1 Ba Ct2	45.5	37.7	43.2	0.02		**0.0**		37.4	37.7	18.4	0.00	
319	Tussen diagonaal eerste dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	556	**0.0**		5.2	75.4	86.4	0.00		**24.7**	ULS 3_0	52.4	75.4	44.1	0.56	
320	Tussen diagonaal eerste dwarsarm	60x60x5	S235	2M20-5.6t	1.00	1.00	1.00	382	**0.0**		12.0	117.6	108.0	0.00		**36.8**	ULS 3_0	65.2	117.6	73.9	0.56	
321	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	404	**0.0**		7.2	37.7	43.2	0.00		**12.6**	SPLS 1a_45 Ba Ct1	37.4	37.7	22.0	0.57	
322	Diagonaal eerste dwarsarm dwarsrichting	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	172	**-0.1**	SPLS 1a_0 Ah All Cts	26.9	37.7	43.2	0.00		**4.4**	ULS 3_0,9_75	37.4	37.7	18.4	0.24	
323	Dwarsligger bovenregel eerste dwarsarm	65x50x5	S235	1M24-5.6t	1.00	1.00	1.00	219	**-3.5**	ULS 3_0,9_90	22.0	84.7	64.8	0.16		**0.0**		63.4	84.7	27.5	0.00	
401	Diagonalen onderregel tweede dwarsarm	90x90x6#	S235	2M20-5.6t	0.53	0.53	0.53	115	**-40.3**	SPLS 3_90 Ah All Cts	118.5	117.6	129.6	0.34		**37.3**	SPLS 3_0,9_90 Ba All Cts	128.8	117.6	104.7	0.36	
402	Diagonalen onderregel tweede dwarsarm	90x90x6#	S235	2M20-5.6t	0.53	0.53	0.53	105	**-49.0**	SPLS 3_90 Ba Ct1	128.3	117.6	129.6	0.42		**46.5**	SPLS 3_0,9_90 Ba Ct2	146.3	117.6	104.7	0.44	
403	Diagonalen onderregel tweede dwarsarm	75x75x8	S235	2M20-5.6t	0.55	0.55	0.55	104	**-47.7**	SPLS 3_0,9_90 Ba All Cts	139.3	117.6	172.8	0.41		**49.7**	SPLS 3_90 Ba All Cts	133.8	117.6	139.6	0.42	
404	Diagonalen onderregel tweede dwarsarm	75x75x8	S235	2M20-5.6t	0.54	0.54	0.54	99	**-61.1**	SPLS 3_90 Ba Ct1	145.1	117.6	172.8	0.52		**58.3**	SPLS 3_0,9_90 Ba All Cts	148.9	117.6	139.6	0.50	
405	Diagonalen onderregel tweede dwarsarm	65x65x7	S235	2M20-5.6t	0.55	0.55	0.55	84	**-52.9**	SPLS 3_90 Ba Ct1	125.3	117.6	151.2	0.45		**56.8**	SPLS 3_0,9_90 Ba Ct2	96.0	117.6	119.1	0.59	
406	Diagonalen onderregel tweede dwarsarm	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	87	**-32.5**	SPLS 3_90 Ba Ct1	77.6	58.8	64.8	0.55		**31.1**	SPLS 3_0,9_90 Ba All Cts	65.7	58.8	44.4	0.70	
407	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	109	**-2.1**	ULS 1a_0,9_0,9_0	45.1	37.7	43.2	0.05		**2.9**	ULS 1a_0,9_0	37.4	37.7	22.0	0.13	
408	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	100	**-2.5**	ULS 1a_0,9_0	48.4	37.7	43.2	0.07		**1.3**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.06	
409	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	94	**-0.9**	ULS 1a_0,9_0,9_0	50.9	37.7	43.2	0.02		**1.9**	ULS 1a_0,9_0	37.4	37.7	22.0	0.09	
410	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	87	**-1.3**	ULS 1a_0,9_135	54.1	37.7	43.2	0.03		**0.4**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.02	
411	Bovenregel tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	289	**0.0**		61.7	254.2	311.0	0.00		**90.5**	;PLS 6a_90 Ba Ct1 Ba Ct2	263.0	254.2	265.8	0.36	
412A	Bovenregel tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.90	1.00	128	**0.0**		177.3	254.2	311.0	0.00		**78.7**	;PLS 6a_90 Ba Ct1 Ba Ct2	263.0	254.2	265.8	0.31	
412B	Bovenregel tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	2.11	1.00	128	**-1.8**	SPLS 1a_0,9_90 Ba All Cts	177.1	254.2	311.0	0.01		**73.7**	S 6a_90 Ah All Cts Ba Ct2	263.0	254.2	265.8	0.29	
413	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	200	**-7.1**	SPLS 1a_45 Ba All Cts	21.9	37.7	43.2	0.33		**7.0**	'LS 1a_0,9_135 Ah All Cts	37.4	37.7	22.0	0.32	
414	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	187	**-8.1**	SPLS 6a_90 Ah Ct2 Ba Ct2	24.0	37.7	43.2	0.34		**7.7**	SPLS 1a_45 Ba Ct1	37.4	37.7	22.0	0.35	
415	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	175	**-9.6**	SPLS 6a_90 Ah All Cts Ba Ct1	26.2	37.7	43.2	0.37		**9.7**	S 6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.44	
416	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	148	**-10.0**	SPLS 6a_90 Ah All Cts Ba Ct2	32.4	37.7	43.2	0.31		**10.1**	S 6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.46	
417	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	142	**-12.2**	SPLS 6a_90 Ah All Cts Ba Ct2	34.2	37.7	43.2	0.36		**11.8**	S 6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.54	
418	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	133	**-15.5**	SPLS 6a_90 Ah All Cts Ba Ct2	36.8	37.7	43.2	0.42		**15.8**	S 6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.72	
419	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.57	0.57	0.57	132	**-22.3**	SPLS 6a_90 Ah All Cts Ba Ct2	37.1	37.7	43.2	0.60		**21.4**	S 6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.97	
420	Diagonalen bovenregel tweede dwarsarm	55x55x6	S235	2M16-5.6t	0.57	0.57	0.57	114	**-31.4**	SPLS 6a_90 Ah All Cts Ba Ct2	67.3	75.4	103.7	0.47		**33.0**	;PLS 6a_90 Ah Ct2 Ba Ct2	66.1	75.4	67.2	0.50	
421	Dwarsliggers onderregel tweede dwarsarı	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	64	**0.0**		647.3	117.6	216.0	0.00		**5.1**	;PLS 6a_90 Ah Ct2 Ba Ct1	766.1	117.6	0.0	0.04	
422	Dwarsliggers onderregel tweede dwarsarı	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	43	**-9.2**	ULS 1a_0,9_90	734.3	117.6	216.0	0.08		**2.7**	;PLS 6a_90 Ah Ct1 Ba Ct1	766.1	117.6	0.0	0.02	
423	Dwarsliggers onderregel tweede dwarsarı	100x100x12	S235	2M20-5.6t	1.00	2.00	1.00	49	**0.0**		398.0	117.6	259.2	0.00		**60.9**	ULS 3_90	278.4	117.6	259.2	0.52	
424	Dwarsliggers onderregel tweede dwarsarı	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	22	**0.0**		802.6	117.6	216.0	0.00		**0.5**	ULS 3_0,9_90	766.1	117.6	0.0	0.00	
117A	Onderregel tweede dwarsarm	100x100x6	S235	3M20-5.6t	6.00	1.00	1.00	157	**-8.1**	ULS 1a_0,9_0	84.1	176.4	194.4	0.10		**7.4**	ULS 1a_0,9_0,9_0	237.4	176.4	157.1	0.05	
117C	Onderregel tweede dwarsarm	100x100x6	S235		1.00	3.81	1.00	157	**-4.2**	ULS 1a_0,9_0,9_0	84.2	0.0	0.0	0.05		**5.0**	ULS 1a_0,9_0	277.3	0.0	0.0	0.02	
117B	Onderregel tweede dwarsarm	100x100x6	S235	2M20-5.6t	1.00	4.06	1.00	157	**-0.3**	SPLS 1a_45 Ah All Cts	84.2	117.6	129.6	0.00		**1.2**	ULS 1a_0,9_135	145.4	117.6	91.6	0.01	
426	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	89	**-1.7**	ULS 5a Ah 12	53.0	37.7	43.2	0.04		**3.5**	ULS 5a Ah 22	37.4	37.7	22.0	0.16	
427	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	176	**0.0**		26.1	37.7	43.2	0.00		**5.0**	ULS 5a Ah 12	37.4	37.7	22.0	0.22	
428	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	83	**-1.3**	SPLS 3_0,9_90 Ah Ct1	55.1	37.7	43.2	0.03		**5.8**	;PLS 6a_90 Ah Ct1 Ba Ct1	37.4	37.7	22.0	0.26	
429	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	299	**-3.2**	ULS 1a_75	11.9	37.7	43.2	0.27		**0.0**		37.4	37.7	22.0	0.00	
430	Tussen diagonaal tweede dwarsarm	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	238	**-9.5**	ULS 5a Ah 22	33.3	37.7	60.5	0.29		**1.3**	ULS 5a Ah 12	104.8	37.7	44.8	0.03	

DNV·GL

Assessment of groups for strengthened mast (afkeur level)

Date 29-7-2020
Author MKh
Version 1.0

KIJ-GT380
WA+0
11-1

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 derde tusse	120x120x8	S235	6M24-5.6t	0.52	0.52	0.52	88	**-45.1**	SPLS 6a_90 Ba Ct1 Ba	309.4	508.3	622.1	0.15		**8.4**	SPLS 1a_0,9_90 Ba All	379.5	508.3	531.7	0.02
101B	Leg derde tusse	120x120x8	S235	6M24-5.6t	0.52	0.52	0.52	77	**-119.5**	SPLS 1a_105 Ah All Ct:	337.6	506.7	622.1	0.35		**90.0**	SPLS 1a_0,9_75 Ba Ct	379.5	506.7	531.7	0.24
102A	Leg derde tusse	180x180x16#	S235	8M24-5.6t	0.52	0.52	0.52	56	**-354.9**	SPLS 1a_105 Ah All Ct:	1129.2	674.7	1658.9	0.53		**275.3**	SPLS 1a_0,9_75 Ba All	1220.3	674.7	1417.8	0.41
102B	Leg derde tusse	180x180x16#	S235	10M24-5.6t	0.52	0.52	0.52	59	**-389.0**	SPLS 1a_105 Ah All Ct:	1111.8	847.2	2073.6	0.46		**285.9**	SPLS 1a_0,9_75 Ba All	1220.3	847.2	1612.8	0.34
103A	Leg tweede tus:	200x200x16	S235	12M24-5.6t	0.52	0.52	0.52	23	**-707.0**	SPLS 1a_105 Ah All Ct:	1440.3	941.5	2488.3	0.75		**565.9**	SPLS 1a_0,9_75 Ba All	1386.2	941.5	2126.8	0.60
103C	Leg tweede tus:	200x200x16	S235		0.52	0.52	0.52	29	**-868.2**	SPLS 1a_105 Ah All Ct:	1410.7	0.0	0.0	0.62		**729.5**	SPLS 1a_0,9_75 Ba All	1452.3	0.0	0.0	0.50
103B	Leg tweede tus:	200x200x16	S235	12M24-5.6t	0.52	0.52	0.52	36	**-870.9**	SPLS 1a_105 Ah All Ct:	1374.3	1987.7	2488.3	0.63		**727.4**	SPLS 1a_0,9_75 Ba All	1386.2	1987.7	2126.8	0.52
104A	Leg eerste tuss	250x250x18#	S235	10M24-5.6t	0.52	0.52	0.52	29	**-1087.3**	SPLS 1a_105 Ah All Ct:	2005.8	1599.1	2332.8	0.68		**927.7**	SPLS 1a_0,9_75 Ba All	2030.6	1599.1	1993.8	0.58
104C	Leg eerste tuss	250x250x18#	S235		0.52	0.52	0.52	35	**-1090.8**	SPLS 1a_105 Ah All Ct:	1959.5	0.0	0.0	0.56		**925.0**	SPLS 1a_0,9_75 Ba All	2061.0	0.0	0.0	0.45
104B	Leg eerste tuss	250x250x18#	S235	12M24-5.6t	0.52	0.52	0.52	35	**-1184.0**	SPLS 1a_105 Ah All Ct:	1959.5	1859.6	2799.4	0.64		**1015.3**	SPLS 1a_0,9_75 Ba All	2030.6	1859.6	2392.6	0.55
105	Leg broekstuk	250x250x18#	S235	12M24-5.6t	0.17	0.17	0.17	33	**-1205.4**	SPLS 1a_105 Ah All Ct:	1974.3	1859.6	2799.4	0.65		**1015.6**	SPLS 1a_0,9_75 Ba All	2030.6	1859.6	2392.6	0.55
106A	Eerste dwarsarr	180x180x16#	S235	10M24-5.6t	1.00	1.92	1.00	63	**-586.1**	SPLS 6a_90 Ah Ct1 Ba	1086.9	815.4	2073.6	0.72		**462.3**	SPLS 3_0,9_90 Ba Ct2	1220.3	815.4	1772.3	0.57
106C	Eerste dwarsarr	180x180x16#	S235		2.09	1.42	1.00	63	**-522.8**	SPLS 6a_90 Ah Ct1 Ba	1087.0	0.0	0.0	0.48		**403.7**	SPLS 3_0,9_90 Ba Ct2	1301.9	0.0	0.0	0.31
106B	Eerste dwarsarr	180x180x16#	S235	8M24-5.6t	2.00	11.19	1.00	61	**-311.3**	SPLS 6a_90 Ah Ct1 Ba	1098.2	677.8	1658.9	0.46		**235.7**	SPLS 3_0,9_90 Ba Ct2	1220.3	677.8	1417.8	0.35
107A	Eerste dwarsarr	160x160x17#	S235	8M24-5.6t	3.12	1.00	1.00	69	**-315.1**	SPLS 6a_90 Ah Ct1 Ba	981.2	677.8	1762.6	0.47		**234.9**	SPLS 3_0,9_90 Ba Ct2	1116.1	677.8	1506.5	0.35
107C	Eerste dwarsarr	160x160x17#	S235		26.86	2.00	2.00	69	**-292.0**	SPLS 6a_90 Ah Ct1 Ba	981.3	0.0	0.0	0.30		**212.6**	SPLS 3_0,9_90 Ba Ct2	1219.7	0.0	0.0	0.17
107B	Eerste dwarsarr	160x160x17#	S235	2M20-5.6t	1.43	1.00	1.00	22	**-4.2**	ULS 3_75	1213.4	117.6	367.2	0.04		**2.5**	SPLS 1a_105 Ah Ct2	668.3	117.6	367.2	0.02
109A	Eerste dwarsarr	80x80x8	S235	3M24-5.6t	1.00	1.92	1.00	299	**0.0**		36.8	254.2	311.0	0.00		**105.6**	SPLS 1a_0 Ba Ct1	160.8	254.2	259.0	0.66
109B	Eerste dwarsarr	80x80x8	S235	4M24-5.6t	1.00	2.08	1.00	299	**-6.1**	SPLS 1a_0,9_75 Ba All	36.8	338.9	414.7	0.16		**79.5**	SPLS 1a_0 Ba Ct1	211.0	338.9	354.5	0.38
110A	Eerste dwarsarr	70x70x7	S235	5M24-5.6t	1.00	2.09	1.00	345	**-9.8**	SPLS 1a_0,9_75 Ba All	22.4	423.6	453.6	0.44		**69.0**	SPLS 1a_45 Ba Ct2	149.3	423.6	320.9	0.46
110B	Eerste dwarsarr	70x70x7	S235	2M24-5.6t	1.00	1.92	1.00	345	**-9.9**	SPLS 1a_0,9_75 Ba All	22.4	169.4	181.4	0.44		**69.1**	SPLS 1a_45 Ba Ct2	102.4	169.4	128.4	0.67
111A	Tweede dwarsa	180x180x16#	S235	10M24-5.6t	0.50	1.17	0.50	58	**-375.4**	SPLS 6a_90 Ah Ct1 Ba	1115.4	847.2	2073.6	0.44		**296.0**	SPLS 3_0,9_90 Ba All (	1220.3	847.2	1772.3	0.35
111C	Tweede dwarsa	180x180x16#	S235		0.54	1.43	1.00	62	**-317.5**	SPLS 6a_90 Ah Ct1 Ba	1094.7	0.0	0.0	0.29		**232.2**	SPLS 3_0,9_90 Ba All (	1301.9	0.0	0.0	0.18
111B	Tweede dwarsa	180x180x16#	S235	3M20-5.6t	2.19	16.11	1.00	87	**-5.3**	ULS 1a_0,9_0	912.3	176.4	518.4	0.03		**11.1**	ULS 1a_135	1253.5	176.4	418.9	0.06
112A	Tweede dwarsa	120x120x10	S235	3M24-5.6t	1.00	1.52	1.00	93	**-190.8**	SPLS 6a_90 Ah All Cts	300.3	254.2	388.8	0.75		**176.2**	SPLS 6a_90 Ah All Cts	324.0	254.2	332.3	0.69
112C	Tweede dwarsa	120x120x10	S235		1.91	2.91	1.00	91	**-181.3**	SPLS 6a_90 Ah All Cts	300.0	0.0	0.0	0.60		**170.7**	SPLS 6a_90 Ah All Cts	545.2	0.0	0.0	0.31
112B	Tweede dwarsa	120x120x10	S235	5M24-5.6t	1.00	1.50	1.00	93	**-163.7**	SPLS 6a_90 Ah All Cts	303.2	423.6	648.0	0.54		**158.6**	SPLS 6a_90 Ah All Cts	466.6	423.6	553.8	0.37
113A	Tweede dwarsa	150x100x10	S235	5M24-5.6t	2.40	1.00	1.00	97	**-138.2**	SPLS 6a_90 Ah All Cts	297.8	423.6	648.0	0.46		**157.2**	SPLS 6a_90 Ah All Cts	495.3	423.6	553.8	0.37
113C	Tweede dwarsa	150x100x10	S235		2.40	1.00	1.00	97	**-121.8**	SPLS 6a_90 Ah All Cts	297.8	0.0	0.0	0.41		**141.4**	SPLS 6a_90 Ah All Cts	571.3	0.0	0.0	0.25
113B	Tweede dwarsa	150x100x10	S235	4M24-5.6t	2.60	1.00	1.00	105	**-27.5**	SPLS 3_0,9_90 Ba All (	278.3	338.9	518.4	0.10		**38.9**	SPLS 6a_90 Ah All Cts	495.3	338.9	443.1	0.11
114A	Tweede dwarsa	120x120x8	S235	1M24-5.6t	1.00	1.00	1.00	134	**-18.4**	ULS 5a Ba 12	160.4	84.7	103.7	0.22		**1.6**	SPLS 1a_0,9_75 Ba Ct	216.6	84.7	88.6	0.02
114B	Tweede dwarsa	120x120x8	S235	1M24-5.6t	1.00	1.00	1.00	134	**-17.6**	ULS 5a Ba 12	160.4	84.7	103.7	0.21		**2.3**	SPLS 1a_0,9_75 Ba Ct	216.6	84.7	88.6	0.03
115L	Eerste dwarsarr	180x180x16#	S235	8M24-5.6t	1.00	2.00	1.00	53	**-519.9**	SPLS 3_90 Ah All Cts	1147.6	677.8	1658.9	0.77		**450.0**	SPLS 3_0,9_90 Ba All (	1220.3	677.8	1417.8	0.66
116L	Eerste dwarsarr	180x180x16#	S235	10M24-5.6t	1.00	2.00	1.00	69	**-555.2**	SPLS 3_90 Ah All Cts	1048.4	815.4	2073.6	0.68		**426.0**	SPLS 3_0,9_90 Ba All (	1220.3	815.4	1772.3	0.52
201L	Diagonaal derd	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	136	**-28.6**	SPLS 1a_75 Ba Ct1	87.7	84.7	77.8	0.37		**22.1**	SPLS 1a_0,9_90 Ah Ct	127.9	84.7	66.5	0.33
201T	Diagonaal derd	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	136	**-16.1**	SPLS 1a_105 Ah Ct2	87.7	84.7	77.8	0.21		**7.6**	SPLS 1a_0,9_75 Ba Ct	127.9	84.7	66.5	0.11
202L	Diagonaal derd	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	86	**-264.8**	SPLS 3_90 Ah Ct1	415.1	338.9	518.4	0.78		**231.6**	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.68
202T	Diagonaal derd	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	86	**-256.4**	SPLS 3_90 Ah Ct2	415.1	338.9	518.4	0.76		**256.4**	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.76
203L	Diagonaal derd	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	94	**-212.7**	SPLS 3_0,9_90 Ah Ct2	390.3	338.9	518.4	0.63		**242.0**	SPLS 3_90 Ah Ct1	384.5	338.9	350.9	0.71
203T	Diagonaal derd	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	94	**-233.9**	SPLS 3_0,9_90 Ba Ct1	390.3	338.9	518.4	0.69		**232.8**	SPLS 3_90 Ah Ct2	384.5	338.9	350.9	0.69
204L	Diagonaal derd	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	100	**-244.9**	SPLS 3_90 Ba Ct1	369.7	338.9	518.4	0.72		**236.9**	SPLS 3_0,9_90 Ah Ct2	384.5	338.9	350.9	0.70
204T	Diagonaal derd	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	100	**-231.1**	SPLS 3_90 Ah Ct2	369.7	338.9	518.4	0.68		**212.2**	SPLS 3_0,9_90 Ba Ct1	384.5	338.9	350.9	0.63
205L	Diagonaal twee	150x150x10	S235	6M24-5.6t	0.55	0.28	0.28	69	**-357.9**	SPLS 3_90 Ba Ct2	447.9	508.3	777.6	0.80		**356.2**	SPLS 3_0,9_90 Ah Ct1	384.5	508.3	513.8	0.93
205T	Diagonaal twee	150x150x10	**S355**	**6M24-8.8t**	0.55	0.28	0.28	69	**-395.5**	SPLS 3_0,9_90 Ah Ct1	579.8	813.3	1058.4	0.68		**399.3**	SPLS 3_90 Ah Ct2	523.3	813.3	732.7	0.76
206L	Diagonaal twee	150x150x12	S235	5M24-5.6t	0.55	0.28	0.28	87	**-297.9**	SPLS 3_90 Ah Ct1	463.5	423.6	777.6	0.70		**294.9**	SPLS 3_0,9_90 Ba Ct2	456.2	423.6	518.8	0.70
206T	Diagonaal twee	150x150x12	S235	5M24-5.6t	0.55	0.28	0.28	87	**-327.8**	SPLS 3_90 Ah Ct2	463.5	423.6	777.6	0.77		**321.6**	SPLS 3_0,9_90 Ah Ct1	456.2	423.6	518.8	0.76
207L	Diagonaal eerst	150x150x12	S235	4M24-5.6t	0.55	0.28	0.28	107	**-242.6**	SPLS 3_90 Ba Ct2	392.0	338.9	622.1	0.72		**242.4**	SPLS 3_0,9_90 Ah Ct1	456.2	338.9	421.1	0.72
207T	Diagonaal eerst	150x150x12	S235	4M24-5.6t	0.55	0.28	0.28	107	**-259.5**	SPLS 3_0,9_90 Ah Ct1	392.0	338.9	622.1	0.77		**261.7**	SPLS 3_90 Ah Ct2	456.2	338.9	421.1	0.77
208L	Diagonaal eerst	150x150x10	S235	3M24-5.6t	1.00	0.52	0.52	106	**-205.8**	SPLS 1a_90 Ah Ct1	332.1	254.2	388.8	0.81		**202.9**	SPLS 3_0,9_90 Ba Ct2	384.5	254.2	269.2	0.80
208T	Diagonaal eerst	150x150x10	S235	3M24-5.6t	1.00	0.52	0.52	106	**-215.4**	SPLS 3_90 Ah Ct2	332.1	254.2	388.8	0.85		**209.8**	SPLS 3_0,9_90 Ah Ct1	384.5	254.2	269.2	0.83
209L	Diagonaal broel	120x120x10	S235	4M24-5.6t	0.25	0.17	0.17	79	**-291.5**	SPLS 3_90 Ah Ct1	337.0	338.9	518.4	0.86		**276.8**	SPLS 3_0,9_90 Ba Ct2	324.0	338.9	432.3	0.85
209T	Diagonaal broel	120x120x10	S235	4M24-5.6t	0.25	0.17	0.17	79	**-283.8**	SPLS 3_90 Ah Ct2	337.0	338.9	518.4	0.84		**268.9**	SPLS 3_0,9_90 Ah Ct1	324.0	338.9	432.3	0.83
210	Top	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	280	**-9.4**	SPLS 3_90 Ah Ct1	16.5	75.4	86.4	0.57		**9.4**	SPLS 3_0,9_90 Ah Ct1	52.4	75.4	44.1	0.21
211L	Tweede dwarsa	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	133	**0.0**		148.9	254.2	311.0	0.00		**80.3**	ULS 6a_90 Ba Ct2	211.1	254.2	265.8	0.38
211T	Tweede dwarsa	70x70x5#	S235	2M24-5.6t	1.00	1.00	1.00	187	**-2.3**	SPLS 6a_90 Ba Ct1 Ba	43.2	169.4	129.6	0.05		**2.7**	SPLS 6a_90 Ba Ct1 Ba	112.9	169.4	91.7	0.03
212T	Tweede dwarsa	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	95	**-103.5**	SPLS 6a_90 Ba Ct1 Ba	144.3	338.9	311.0	0.72		**120.8**	SPLS 6a_90 Ba Ct1 Ba	225.0	338.9	265.8	0.54
213	Tweede dwarsa	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	86	**-151.0**	SPLS 3_0,9_90 Ah Ct2	265.3	169.4	207.4	0.89		**152.2**	SPLS 3_90 Ah Ct1	226.0	169.4	177.2	0.90
214	Tweede dwarsa	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	300	**-0.8**	SPLS 6a_90 Ah Ct2 Ba	11.8	37.7	43.2	0.07		**0.0**		37.4	37.7	22.0	0.00
215L	Eerste dwarsarr	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	178	**-1.9**	SPLS 3_0,9_90 Ba All (	103.8	254.2	311.0	0.02		**113.0**	SPLS 6a_90 Ah All Cts	270.5	254.2	265.8	0.44
215T	Eerste dwarsarr	100x100x8	S235	1M24-5.6t	1.00	1.00	1.00	178	**-18.8**	ULS 1a_0,9_0,9_90	83.1	84.7	103.7	0.23		**23.2**	ULS 1a_90	170.5	84.7	88.6	0.27
216T	Eerste dwarsarr	100x100x8	S235	4M24-5.6t	1.00	2.00	1.00	124	**-104.1**	SPLS 3_0,9_90 Ah Ct1	151.1	338.9	414.7	0.69		**114.0**	SPLS 3_90 Ah Ct2	293.9	338.9	354.5	0.39
217	Eerste dwarsarr	120x120x10	S235	2M24-5.6t	1.00	1.00	1.00	114	**-150.5**	SPLS 3_0,9_90 Ah Ct1	261.1	169.4	259.2	0.89		**151.9**	SPLS 3_90 Ah Ct1	278.4	169.4	221.5	0.90
218	Eerste dwarsarr	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	325	**-0.7**	ULS 3_0	15.0	58.8	64.8	0.05		**0.0**		65.7	58.8	44.4	0.00
219L	Onderstuk in to	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-40.2**	SPLS 1a_105 Ah All Ct:	195.2	169.4	311.0	0.24		**27.9**	SPLS 1a_0,9_75 Ba All	329.5	169.4	265.8	0.16
219T	Onderstuk in to	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-45.5**	SPLS 1a_105 Ah All Ct:	195.2	169.4	311.0	0.27		**32.8**	SPLS 1a_0,9_75 Ba All	329.5	169.4	265.8	0.19
220	Onderstuk in to	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	311	**-5.3**	ULS 1a_135	11.6	37.7	43.2	0.46		**4.4**	ULS 1a_0,9_135	60.5	37.7	32.0	0.14
221	Onderstuk in to	70x70x5#	S235	1M16-5.6t	1.00	0.50	0.50	370	**-1.1**	SPLS 3_90 Ah Ct1	10.0	37.7	43.2	0.11		**0.0**		74.9	37.7	32.0	0.00
301	Diagonalen ond	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	113	**-53.8**	SPLS 3_90 Ba All Cts	105.9	84.7	77.8	0.69		**52.2**	SPLS 3_0,9_90 Ba All (	127.9	84.7	66.5	0.79
302	Diagonalen ond	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	112	**-71.6**	SPLS 3_90 Ba Ct2	133.9	117.6	129.6	0.61		**68.0**	SPLS 3_90 Ba Ct2	142.1	117.6	104.7	0.65
303	Diagonalen ond	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	102	**-85.3**	SPLS 3_90 Ba All Cts	145.6	117.6	129.6	0.73		**87.2**	SPLS 3_0,9_90 Ba All (	147.1	117.6	104.7	0.83
304	Diagonalen ond	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	89	**-46.5**	SPLS 3_90 Ba Ct1	103.8	84.7	77.8	0.60		**52.4**	SPLS 3_0,9_90 Ba All (	93.3	84.7	59.8	0.88
305	Diagonalen ond	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	98	**-31.8**	SPLS 3_90 Ba All Cts	96.7	84.7	77.8	0.41		**35.5**	SPLS 3_0,9_90 Ba All (	93.3	84.7	57.2	0.62
306	Diagonalen ond	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	93	**-38.0**	SPLS 3_90 Ba All Cts	126.2	117.6	129.6	0.32		**38.3**	SPLS 3_0,9_90 Ba All (	99.4	117.6	91.6	0.42
307	Diagonalen ond	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	83	**-48.6**	SPLS 3_0,9_90 Ba All (	136.5	117.6	129.6	0.41		**47.4**	SPLS 3_90 Ba All Cts	107.0	117.6	91.6	0.52
308	Diagonalen ond	80x80x6#	S235	2M20-5.6t	0.56	0.56	0.56	77	**-66.1**	SPLS 3_90 Ba All Cts	142.4	117.6	129.6	0.56		**65.0**	SPLS 3_0,9_90 Ba All (	113.4	117.6	91.6	0.71
309	Diagonalen ond	70x70x6	S235	1M24-5.6t	1.00	1.00	1.00	63	**-29.8**	SPLS 3_90 Ba All Cts	102.4	84.7	77.8	0.38		**32.0**	SPLS 1a_90 Ba All Cts	76.0	84.7	49.5	0.65
310	Diagonalen ond	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	89	**-3.5**	ULS 1a_75	53.3	37.7	43.2	0.09		**4.9**	SPLS 3_75 Ah Ct2	37.4	37.7	22.0	0.22
311	Dwarsligger onc	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	87	**0.0**		548.0	117.6	216.0	0.00		**4.4**	ULS 3_90	766.1	117.6	0.0	0.04
312	Dwarsligger onc	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	81	**0.0**		316.3	117.6	259.2	0.00		**58.6**	ULS 3_90	278.4	117.6	259.2	0.50
313	Dwarsligger onc	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	57	**-5.6**	ULS 1a_0,9_90	679.0	117.6	216.0	0.05		**1.0**	SPLS 1a_45 Ah All Cts	766.1	117.6	0.0	0.01
314	Dwarsligger onc	100x100x12	S235	2M20-5.6t	1.00	2.00	1.00	38	**0.0**		424.1	117.6	259.2	0.00		**67.3**	ULS 3_90	278.4	117.6	259.2	0.57

Assessment of groups for strengthened mast (afkeur level)

Date 29-7-2020
Author MKh
Version 1.0

KIJ-GT380
WA+0
11-1

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)
315	Dwarsligger ond	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	25	**-8.5**	ULS 3_90	794.2	117.6	216.0	0.07		**0.0**		766.1	117.6	0.0	0.00
316	Tussenregel eer	90x90x6#	S235	1M20-5.6t	1.00	1.00	1.00	166	**-17.2**	ULS 3_0	70.1	58.8	64.8	0.29		**0.0**		117.5	58.8	52.4	0.00
317	Tussenregel eer	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	186	**-6.0**	SPLS 3_90 Ba Ct1	30.3	37.7	43.2	0.20		**0.0**		37.4	37.7	22.0	0.00
318	Tussenregel eer	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	108	**-0.8**	SPLS 6a_90 Ba Ct1 Ba	45.5	37.7	43.2	0.02		**0.0**		37.4	37.7	18.4	0.00
319	Tussen diagona	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	556	**0.0**		5.2	75.4	86.4	0.00		**24.7**	ULS 3_0	52.4	75.4	44.1	0.56
320	Tussen diagona	60x60x5	S235	2M20-5.6t	1.00	1.00	1.00	382	**0.0**		12.0	117.6	108.0	0.00		**36.8**	ULS 3_0	65.2	117.6	73.9	0.56
321	Tussen diagona	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	404	**0.0**		7.2	37.7	43.2	0.00		**12.6**	SPLS 1a_45 Ba Ct1	37.4	37.7	22.0	0.57
322	Diagonaal eerst	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	172	**-0.1**	SPLS 1a_0 Ah All Cts	26.9	37.7	43.2	0.00		**4.4**	ULS 3_0,9_75	37.4	37.7	18.4	0.24
323	Dwarsligger bov	65x50x5	S235	1M24-5.6t	1.00	1.00	1.00	219	**-3.5**	ULS 3_0,9_90	22.0	84.7	64.8	0.16		**0.0**		63.4	84.7	27.5	0.00
401	Diagonalen ond	90x90x6#	S235	2M20-5.6t	0.53	0.53	0.53	115	**-40.3**	SPLS 3_90 Ah All Cts	118.5	117.6	129.6	0.34		**37.3**	SPLS 3_0,9_90 Ba All (	128.8	117.6	104.7	0.36
402	Diagonalen ond	90x90x6#	S235	2M20-5.6t	0.53	0.53	0.53	105	**-49.0**	SPLS 3_90 Ba Ct1	128.3	117.6	129.6	0.42		**46.5**	SPLS 3_0,9_90 Ba Ct2	146.3	117.6	104.7	0.44
403	Diagonalen ond	75x75x8	S235	2M20-5.6t	0.55	0.55	0.55	104	**-47.7**	SPLS 3_0,9_90 Ba All (	139.3	117.6	172.8	0.41		**49.7**	SPLS 3_90 Ba All Cts	133.8	117.6	139.6	0.42
404	Diagonalen ond	75x75x8	S235	2M20-5.6t	0.54	0.54	0.54	99	**-61.1**	SPLS 3_90 Ba Ct1	145.1	117.6	172.8	0.52		**58.3**	SPLS 3_0,9_90 Ba All (	148.9	117.6	139.6	0.50
405	Diagonalen ond	65x65x7	S235	2M20-5.6t	0.55	0.55	0.55	84	**-52.9**	SPLS 3_90 Ba Ct1	125.3	117.6	151.2	0.45		**56.8**	SPLS 3_0,9_90 Ba Ct2	96.0	117.6	119.1	0.59
406	Diagonalen ond	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	87	**-32.5**	SPLS 3_90 Ba Ct1	77.6	58.8	64.8	0.55		**31.1**	SPLS 3_0,9_90 Ba All (	65.7	58.8	44.4	0.70
407	Diagonalen ond	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	109	**-2.1**	ULS 1a_0,9_0,9_0	45.1	37.7	43.2	0.05		**2.9**	ULS 1a_0,9_0	37.4	37.7	22.0	0.13
408	Diagonalen ond	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	100	**-2.5**	ULS 1a_0,9_0	48.4	37.7	43.2	0.07		**1.3**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.06
409	Diagonalen ond	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	94	**-0.9**	ULS 1a_0,9_0,9_0	50.9	37.7	43.2	0.02		**1.9**	ULS 1a_0,9_0	37.4	37.7	22.0	0.09
410	Diagonalen ond	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	87	**-1.3**	ULS 1a_0,9_135	54.1	37.7	43.2	0.03		**0.4**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.02
411	Bovenregel twe	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	289	**0.0**		61.7	254.2	311.0	0.00		**90.5**	SPLS 6a_90 Ba Ct1 Ba	263.0	254.2	265.8	0.36
412A	Bovenregel twe	120x120x8	S235	3M24-5.6t	1.00	1.90	1.00	128	**0.0**		177.3	254.2	311.0	0.00		**78.7**	SPLS 6a_90 Ba Ct1 Ba	263.0	254.2	265.8	0.31
412B	Bovenregel twe	120x120x8	S235	3M24-5.6t	1.00	2.11	1.00	128	**-1.8**	SPLS 1a_0,9_90 Ba All	177.1	254.2	311.0	0.01		**73.7**	SPLS 6a_90 Ah All Cts	263.0	254.2	265.8	0.29
413	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	200	**-7.1**	SPLS 1a_45 Ba All Cts	21.9	37.7	43.2	0.33		**7.0**	SPLS 1a_0,9_135 Ah A	37.4	37.7	22.0	0.32
414	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	187	**-8.1**	SPLS 6a_90 Ah Ct2 Ba	24.0	37.7	43.2	0.34		**7.7**	SPLS 1a_45 Ba Ct1	37.4	37.7	22.0	0.35
415	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	175	**-9.6**	SPLS 6a_90 Ah All Cts	26.2	37.7	43.2	0.37		**9.7**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.44
416	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	148	**-10.0**	SPLS 6a_90 Ah All Cts	32.4	37.7	43.2	0.31		**10.1**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.46
417	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	142	**-12.2**	SPLS 6a_90 Ah All Cts	34.2	37.7	43.2	0.36		**11.8**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.54
418	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	133	**-15.5**	SPLS 6a_90 Ah All Cts	36.8	37.7	43.2	0.42		**15.8**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.72
419	Diagonalen bov	50x50x5	S235	1M16-5.6t	0.57	0.57	0.57	132	**-22.3**	SPLS 6a_90 Ah All Cts	37.1	37.7	43.2	0.60		**21.4**	SPLS 6a_90 Ah All Cts	37.4	37.7	22.0	0.97
420	Diagonalen bov	55x55x6	S235	2M16-5.6t	0.57	0.57	0.57	114	**-31.4**	SPLS 6a_90 Ah All Cts	67.3	75.4	103.7	0.47		**33.0**	SPLS 6a_90 Ah Ct2 Ba	66.1	75.4	67.2	0.50
421	Dwarsliggers or	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	64	**0.0**		647.3	117.6	216.0	0.00		**5.1**	SPLS 6a_90 Ah Ct2 Ba	766.1	117.6	0.0	0.04
422	Dwarsliggers or	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	43	**-9.2**	ULS 1a_0,9_90	734.3	117.6	216.0	0.08		**2.7**	SPLS 6a_90 Ah Ct1 Ba	766.1	117.6	0.0	0.02
423	Dwarsliggers or	100x100x12	S235	2M20-5.6t	1.00	2.00	1.00	49	**0.0**		398.0	117.6	259.2	0.00		**60.9**	ULS 3_90	278.4	117.6	259.2	0.52
424	Dwarsliggers or	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	22	**0.0**		802.6	117.6	216.0	0.00		**0.5**	ULS 3_0,9_90	766.1	117.6	0.0	0.00
117A	Onderregel twe	100x100x6	S235	3M20-5.6t	6.00	1.00	1.00	157	**-8.1**	ULS 1a_0,9_0	84.1	176.4	194.4	0.10		**7.4**	ULS 1a_0,9_0,9_0	237.4	176.4	157.1	0.05
117C	Onderregel twe	100x100x6	S235		1.00	3.81	1.00	157	**-4.2**	ULS 1a_0,9_0,9_0	84.2	0.0	0.0	0.05		**5.0**	ULS 1a_0,9_0	277.3	0.0	0.0	0.02
117B	Onderregel twe	100x100x6	S235	2M20-5.6t	1.00	4.06	1.00	157	**-0.3**	SPLS 1a_45 Ah All Cts	84.2	117.6	129.6	0.00		**1.2**	ULS 1a_0,9_135	145.4	117.6	91.6	0.01
426	Tussenregel tw	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	89	**-1.7**	ULS 5a Ah 12	53.0	37.7	43.2	0.04		**3.5**	ULS 5a Ah 22	37.4	37.7	22.0	0.16
427	Tussenregel tw	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	176	**0.0**		26.1	37.7	43.2	0.00		**5.0**	ULS 5a Ah 12	37.4	37.7	22.0	0.22
428	Tussenregel tw	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	83	**-1.3**	SPLS 3_0,9_90 Ah Ct1	55.1	37.7	43.2	0.03		**5.8**	SPLS 6a_90 Ah Ct1 Ba	37.4	37.7	22.0	0.26
429	Tussenregel tw	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	299	**-3.2**	ULS 1a_75	11.9	37.7	43.2	0.27		**0.0**		37.4	37.7	22.0	0.00
430	Tussen diagona	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	238	**-9.5**	ULS 5a Ah 22	33.3	37.7	60.5	0.29		**1.3**	ULS 5a Ah 12	104.8	37.7	44.8	0.03

DNV·GL

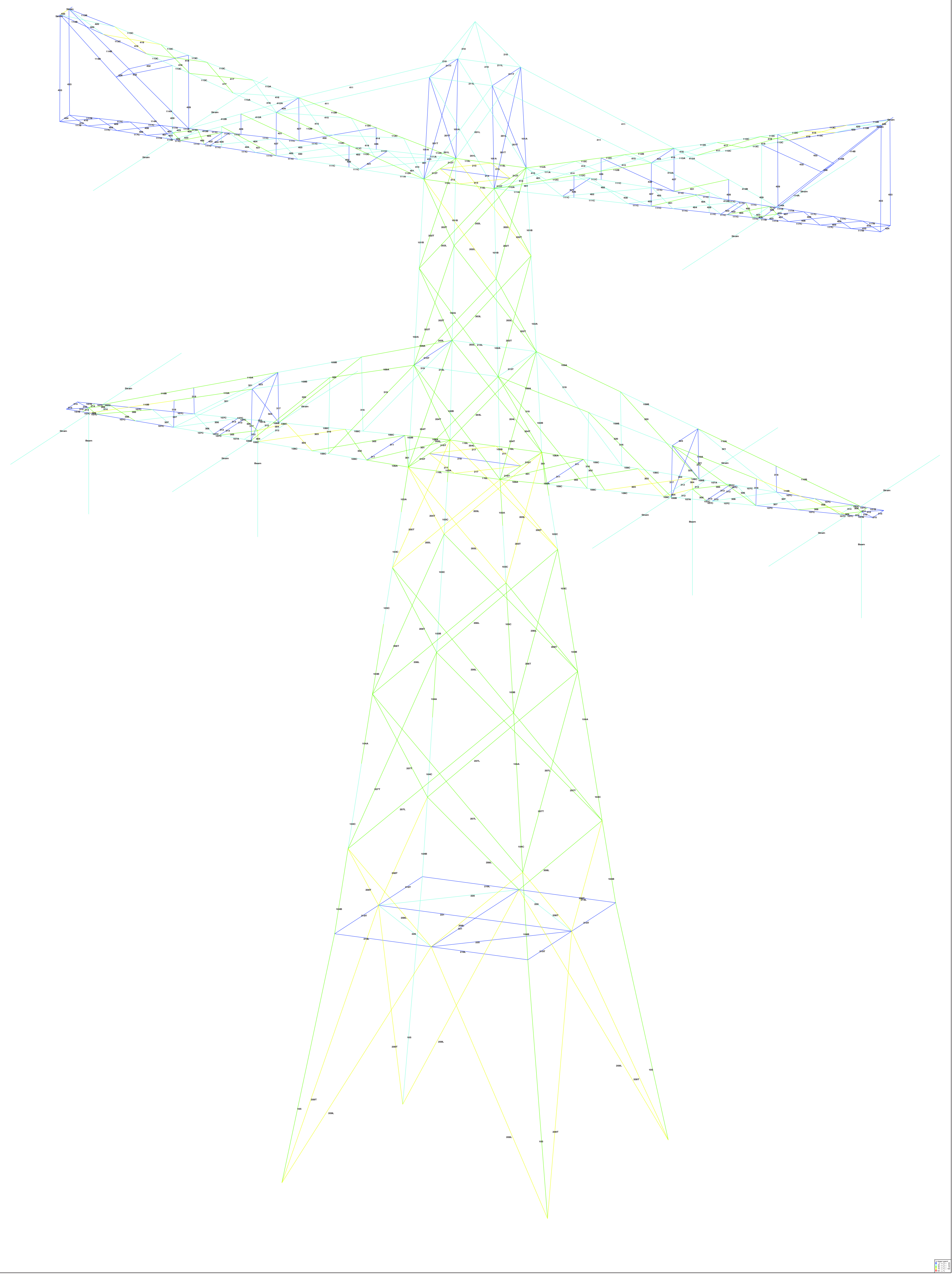
Assessment of groups for strengthened mast (verbouw level)

Date 29-7-2020
Author MKh
Version 1.0

KIJ-GT380
WA+0
11-1

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)
205T	Diagonaal twee	150x150x10	**S355**	**6M24-8.8t**	0.55	0.28	0.28	69	**-414.0**	SPLS 3 0,9 90 Ah Ct1	579.8	813.3	1058.4	0.71		**418.2**	SPLS 3 90 Ah Ct2	523.3	813.3	732.7	0.80

DNV GL Nederlands BV, Project: "WA+0 (da) ini (For Geleiderbelasting Analysis)"
Tower Version 16.39, 12:02:42 woensdag 29 juli 2020
Undeformed geometry displayed



DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 29-7-2020
Author MKh
Version 1.0

KIJ-GT 380
WA+0
61

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 derde tussenstuk	120x120x8	S235	6M24-5.6t	0.52	0.52	0.52	88	**-50.6**	SPLS 6a_90 Ah Ct1 Ah Ct2	309.4	508.3	622.1	0.16		**2.5**	SPLS 1a_0,9_90 Ah Ct1	379.5	508.3	531.7	0.01	
101B	Leg derde tussenstuk	120x120x8	S235	6M24-5.6t	0.52	0.52	0.52	77	**-117.0**	SPLS 6a_90 Ba All Cts Ah Ct2	337.6	506.7	622.1	0.35		**84.4**	SPLS 1a_0,9_105 Ah Ct1	379.5	506.7	531.7	0.22	
102A	Leg derde tussenstuk	180x180x16#	S235	8M24-5.6t	0.52	0.52	0.52	56	**-325.1**	SPLS 1a_105 Ah All Cts	1129.2	674.7	1658.9	0.48		**243.8**	LS 1a_0,9_105 Ah All Cts	1220.3	674.7	1417.8	0.36	
102B	Leg derde tussenstuk	180x180x16#	S235	10M24-5.6t	0.52	0.52	0.52	59	**-354.9**	SPLS 1a_105 Ah All Cts	1111.8	847.2	2073.6	0.42		**253.0**	LS 1a_0,9_105 Ah All Cts	1220.3	847.2	1612.8	0.30	
103A	Leg tweede tussenstuk	200x200x16	S235	12M24-5.6t	0.52	0.52	0.52	23	**-649.1**	SPLS 1a_105 Ah All Cts	1440.3	941.5	2488.3	0.69		**504.4**	LS 1a_0,9_105 Ah All Cts	1386.2	941.5	2126.8	0.54	
103C	Leg tweede tussenstuk	200x200x16	S235		0.52	0.52	0.52	29	**-799.8**	SPLS 1a_105 Ah All Cts	1410.7	0.0	0.0	0.57		**654.4**	LS 1a_0,9_105 Ah All Cts	1452.3	0.0	0.0	0.45	
103B	Leg tweede tussenstuk	200x200x16	S235	12M24-5.6t	0.52	0.52	0.52	36	**-802.4**	SPLS 1a_105 Ah All Cts	1374.3	1987.7	2488.3	0.58		**652.3**	LS 1a_0,9_105 Ah All Cts	1386.2	1987.7	2126.8	0.47	
104A	Leg eerste tussenstuk	250x250x18#	S235	10M24-5.6t	0.52	0.52	0.52	29	**-1002.4**	SPLS 1a_105 Ah All Cts	2005.8	1599.1	2332.8	0.63		**833.9**	LS 1a_0,9_105 Ah All Cts	2030.6	1599.1	1993.8	0.52	
104C	Leg eerste tussenstuk	250x250x18#	S235		0.52	0.52	0.52	35	**-1006.0**	SPLS 1a_105 Ah All Cts	1959.5	0.0	0.0	0.51		**831.1**	LS 1a_0,9_105 Ah All Cts	2061.0	0.0	0.0	0.40	
104B	Leg eerste tussenstuk	250x250x18#	S235	12M24-5.6t	0.52	0.52	0.52	35	**-1091.9**	SPLS 1a_105 Ah All Cts	1959.5	1859.6	2799.4	0.59		**913.9**	LS 1a_0,9_105 Ah All Cts	2030.6	1859.6	2392.6	0.49	
105	Leg broekstuk	250x250x18#	S235	12M24-5.6t	0.17	0.17	0.17	33	**-1112.4**	SPLS 1a_105 Ah All Cts	1974.3	1859.6	2799.4	0.60		**913.4**	LS 1a_0,9_105 Ah All Cts	2030.6	1859.6	2392.6	0.49	
106A	Eerste dwarsarm onderregel	180x180x16#	S235	10M24-5.6t	1.00	1.92	1.00	63	**-585.2**	SPLS 6a_90 Ba Ct1 Ah Ct1	1086.9	815.4	2073.6	0.72		**420.2**	SPLS 3_0,9_90 Ah Ct2	1220.3	815.4	1772.3	0.52	
106C	Eerste dwarsarm onderregel	180x180x16#	S235		2.09	1.42	1.00	63	**-523.2**	SPLS 6a_90 Ba Ct1 Ah Ct1	1087.0	0.0	0.0	0.48		**365.7**	SPLS 3_0,9_90 Ah Ct2	1301.9	0.0	0.0	0.28	
106B	Eerste dwarsarm onderregel	180x180x16#	S235	8M24-5.6t	2.00	11.19	1.00	61	**-311.2**	SPLS 6a_90 Ba Ct1 Ah Ct1	1098.2	677.8	1658.9	0.46		**209.6**	SPLS 3_0,9_90 Ah Ct2	1220.3	677.8	1417.8	0.31	
107A	Eerste dwarsarm onderregel	160x160x17#	S235	8M24-5.6t	3.12	1.00	1.00	69	**-315.0**	SPLS 6a_90 Ba Ct1 Ah Ct1	981.2	677.8	1762.6	0.46		**208.9**	SPLS 3_0,9_90 Ah Ct2	1116.1	677.8	1506.5	0.31	
107C	Eerste dwarsarm onderregel	160x160x17#	S235		26.86	2.00	2.00	69	**-292.4**	SPLS 6a_90 Ba Ct1 Ah Ct1	981.3	0.0	0.0	0.30		**187.8**	SPLS 3_0,9_90 Ah Ct2	1219.7	0.0	0.0	0.15	
107B	Eerste dwarsarm onderregel	160x160x17#	S235	2M20-5.6t	1.43	1.00	1.00	22	**-3.9**	ULS 3_105	1213.4	117.6	367.2	0.03		**2.2**	ULS 1a_105	668.3	117.6	367.2	0.02	
109A	Eerste dwarsarm bovenregel	80x80x8	S235	3M24-5.6t	1.00	1.92	1.00	299	**0.0**		36.8	254.2	311.0	0.00		**118.1**	PLS 6a_90 Ah Ct2 Ah Ct1	160.8	254.2	259.0	0.73	
109B	Eerste dwarsarm bovenregel	80x80x8	S235	4M24-5.6t	1.00	2.08	1.00	299	**0.0**		36.8	338.9	414.7	0.00		**89.7**	SPLS 3_135 Ah Ct2	211.0	338.9	354.5	0.43	
110A	Eerste dwarsarm bovenregel	70x70x7	S235	5M24-5.6t	1.00	2.09	1.00	345	**0.0**		22.4	423.6	453.6	0.00		**80.1**	SPLS 3_135 Ah Ct2	149.3	423.6	320.9	0.54	
110B	Eerste dwarsarm bovenregel	70x70x7	S235	2M24-5.6t	1.00	1.92	1.00	345	**0.0**		22.4	169.4	181.4	0.00		**80.2**	SPLS 3_135 Ah Ct2	102.4	169.4	128.4	0.78	
111A	Tweede dwarsarm onderregel	180x180x16#	S235	10M24-5.6t	0.50	1.17	0.50	58	**-374.4**	SPLS 6a_90 Ba All Cts Ah Ct1	1115.4	847.2	2073.6	0.44		**258.8**	SPLS 3_0,9_90 Ah All Cts	1220.3	847.2	1772.3	0.31	
111C	Tweede dwarsarm onderregel	180x180x16#	S235		0.54	1.43	1.00	62	**-317.4**	SPLS 6a_90 Ba All Cts Ah Ct1	1094.7	0.0	0.0	0.29		**199.8**	SPLS 3_0,9_90 Ah All Cts	1301.9	0.0	0.0	0.15	
111B	Tweede dwarsarm onderregel	180x180x16#	S235	3M20-5.6t	2.19	16.11	1.00	87	**-3.8**	ULS 1a_0,9_0,9_0	912.3	176.4	518.4	0.02		**9.5**	ULS 1a_45	1253.5	176.4	418.9	0.05	
112A	Tweede dwarsarm bovenregel	120x120x10	S235	3M24-5.6t	1.00	1.52	1.00	93	**-188.9**	SPLS 6a_90 Ah Ct1 Ba Ct1	300.3	254.2	388.8	0.74		**173.4**	S 6a_90 Ba All Cts Ah Ct2	324.0	254.2	332.3	0.68	
112C	Tweede dwarsarm bovenregel	120x120x10	S235		1.91	2.91	1.00	91	**-179.8**	SPLS 6a_90 Ah Ct1 Ba Ct1	300.0	0.0	0.0	0.60		**168.2**	PLS 6a_90 Ba Ct2 Ah Ct2	545.2	0.0	0.0	0.31	
112B	Tweede dwarsarm bovenregel	120x120x10	S235	5M24-5.6t	1.00	1.50	1.00	93	**-161.8**	SPLS 6a_90 Ah All Cts Ba Ct1	303.2	423.6	648.0	0.53		**156.5**	PLS 6a_90 Ba Ct2 Ah Ct2	466.6	423.6	553.8	0.37	
113A	Tweede dwarsarm bovenregel	150x100x10	S235	5M24-5.6t	2.40	1.00	1.00	97	**-136.9**	SPLS 6a_90 Ah All Cts Ba Ct1	297.8	423.6	648.0	0.46		**155.2**	PLS 6a_90 Ba Ct2 Ah Ct2	495.3	423.6	553.8	0.37	
113C	Tweede dwarsarm bovenregel	150x100x10	S235		2.40	1.00	1.00	97	**-120.8**	SPLS 6a_90 Ah All Cts Ba Ct1	297.8	0.0	0.0	0.41		**139.7**	PLS 6a_90 Ba Ct2 Ah Ct2	571.3	0.0	0.0	0.24	
113B	Tweede dwarsarm bovenregel	150x100x10	S235	4M24-5.6t	2.60	1.00	1.00	105	**-24.0**	SPLS 1a_0,9_90 Ah All Cts	278.3	338.9	518.4	0.09		**39.0**	PLS 6a_90 Ba Ct2 Ah Ct2	495.3	338.9	443.1	0.12	
114A	Tweede dwarsarm tussenregel	120x120x8	S235	1M24-5.6t	1.00	1.00	1.00	134	**-21.1**	ULS 5a Ba 12	160.4	84.7	103.7	0.25		**0.4**	SPLS 1a_0,9_105 Ah Ct1	216.6	84.7	88.6	0.00	
114B	Tweede dwarsarm tussenregel	120x120x8	S235	1M24-5.6t	1.00	1.00	1.00	134	**-20.3**	ULS 5a Ba 12	160.4	84.7	103.7	0.24		**1.2**	SPLS 1a_0,9_105 Ah Ct1	216.6	84.7	88.6	0.01	
115L	Eerste dwarsarm in tower	180x180x16#	S235	8M24-5.6t	1.00	2.00	1.00	53	**-489.3**	SPLS 6a_90 Ba All Cts Ah Ct1	1147.6	677.8	1658.9	0.72		**401.7**	SPLS 3_0,9_90 Ah All Cts	1220.3	677.8	1417.8	0.59	
116L	Eerste dwarsarm in tower	180x180x16#	S235	10M24-5.6t	1.00	2.00	1.00	69	**-533.2**	SPLS 3_90 Ba All Cts	1048.4	815.4	2073.6	0.65		**386.5**	SPLS 3_0,9_90 Ah All Cts	1220.3	815.4	1772.3	0.47	
201L	Diagonaal derde tussenstuk	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	136	**-32.2**	SPLS 6a_90 Ah Ct1 Ba Ct2	87.7	84.7	77.8	0.41		**23.3**	PLS 6a_90 Ah Ct1 Ah Ct2	127.9	84.7	66.5	0.35	
201T	Diagonaal derde tussenstuk	100x100x6	S235	1M24-5.6t	1.00	0.55	0.55	158	**-10.9**	SPLS 6a_90 Ah Ct1 Ah Ct2	45.0	84.7	77.8	0.24		**5.3**	SPLS 1a_0,9_105 Ah Ct1	127.9	84.7	66.5	0.08	
202L	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	86	**-262.0**	SPLS 6a_90 Ba Ct1 Ah Ct1	415.1	338.9	518.4	0.77		**220.0**	PLS 6a_90 Ah Ct2 Ba Ct2	384.5	338.9	350.9	0.65	
202T	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	86	**-244.0**	SPLS 6a_90 Ba Ct2 Ah Ct2	415.1	338.9	518.4	0.72		**249.5**	PLS 6a_90 Ah Ct1 Ba Ct1	384.5	338.9	350.9	0.74	
203L	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	94	**-201.4**	SPLS 6a_90 Ah Ct2 Ba Ct2	390.3	338.9	518.4	0.59		**238.8**	PLS 6a_90 Ba Ct1 Ah Ct1	384.5	338.9	350.9	0.70	
203T	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	94	**-227.5**	SPLS 6a_90 Ah Ct1 Ba Ct1	390.3	338.9	518.4	0.67		**221.5**	PLS 6a_90 Ba Ct2 Ah Ct2	384.5	338.9	350.9	0.65	
204L	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	100	**-228.3**	SPLS 6a_90 Ah Ct1 Ba Ct1	369.7	338.9	518.4	0.67		**212.9**	PLS 6a_90 Ba Ct2 Ah Ct2	384.5	338.9	350.9	0.63	
204T	Diagonaal derde tussenstuk	150x150x10	S235	4M24-5.6t	0.55	0.55	0.55	100	**-218.7**	SPLS 6a_90 Ba Ct2 Ah Ct2	369.7	338.9	518.4	0.65		**194.4**	PLS 6a_90 Ah Ct1 Ba Ct1	384.5	338.9	350.9	0.57	
205L	Diagonaal tweede tussenstuk	150x150x10	S235	6M24-5.6t	0.55	0.28	0.28	69	**-343.2**	SPLS 6a_90 Ah Ct2 Ah Ct1	447.9	508.3	777.6	0.77		**331.0**	PLS 6a_90 Ba Ct1 Ah Ct1	384.5	508.3	513.8	0.86	
205T	Diagonaal tweede tussenstuk	150x150x10	S235	6M24-5.6t	0.55	0.28	0.28	69	**-377.5**	SPLS 6a_90 Ah Ct1 Ba Ct1	447.9	508.3	777.6	0.84		**383.5**	PLS 6a_90 Ah Ct2 Ba Ct2	384.5	508.3	513.8	1.00	
206L	Diagonaal tweede tussenstuk	150x150x12	S235	5M24-5.6t	0.55	0.28	0.28	87	**-277.0**	SPLS 6a_90 Ba Ct1 Ah Ct1	463.5	423.6	777.6	0.65		**281.9**	PLS 6a_90 Ah Ct2 Ba Ct2	456.2	423.6	518.8	0.67	
206T	Diagonaal tweede tussenstuk	150x150x12	S235	5M24-5.6t	0.55	0.28	0.28	87	**-314.5**	SPLS 6a_90 Ah Ct2 Ba Ct2	463.5	423.6	777.6	0.74		**306.8**	PLS 6a_90 Ah Ct1 Ba Ct1	456.2	423.6	518.8	0.72	
207L	Diagonaal eerste tussenstuk	150x150x12	S235	4M24-5.6t	0.55	0.28	0.28	107	**-230.8**	SPLS 6a_90 Ah Ct2 Ba Ct2	392.0	338.9	622.1	0.68		**224.9**	PLS 6a_90 Ba Ct1 Ah Ct1	456.2	338.9	421.1	0.66	
207T	Diagonaal eerste tussenstuk	150x150x12	S235	4M24-5.6t	0.55	0.28	0.28	107	**-247.4**	SPLS 6a_90 Ah Ct1 Ba Ct1	392.0	338.9	622.1	0.73		**250.8**	PLS 6a_90 Ah Ct2 Ba Ct2	456.2	338.9	421.1	0.74	
208L	Diagonaal eerste tussenstuk	150x150x10	S235	3M24-5.6t	1.00	0.52	0.52	106	**-190.9**	SPLS 6a_90 Ba Ct1 Ah Ct1	332.1	254.2	388.8	0.75		**192.0**	PLS 6a_90 Ah Ct2 Ba Ct2	384.5	254.2	269.2	0.76	
208T	Diagonaal eerste tussenstuk	150x150x10	S235	3M24-5.6t	1.00	0.52	0.52	106	**-205.9**	SPLS 6a_90 Ah Ct2 Ba Ct2	332.1	254.2	388.8	0.81		**199.4**	PLS 6a_90 Ah Ct1 Ba Ct1	384.5	254.2	269.2	0.78	
209L	Diagonaal broekstuk	120x120x10	S235	4M24-5.6t	0.25	0.17	0.17	79	**-270.7**	SPLS 6a_90 Ba Ct1 Ah Ct1	337.0	338.9	518.4	0.80		**261.4**	PLS 6a_90 Ah Ct2 Ba Ct2	324.0	338.9	432.3	0.81	
209T	Diagonaal broekstuk	120x120x10	S235	4M24-5.6t	0.25	0.17	0.17	79	**-271.1**	SPLS 6a_90 Ah Ct2 Ba Ct2	337.0	338.9	518.4	0.80		**254.8**	PLS 6a_90 Ah Ct1 Ba Ct1	324.0	338.9	432.3	0.79	
210	Top	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	280	**-8.2**	ULS 5a Ba 22	16.5	75.4	86.4	0.50		**8.2**	ULS 5a Ba 22	52.4	75.4	44.1	0.19	
211L	Tweede dwarsarm in tower	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	133	**0.0**		148.9	254.2	311.0	0.00		**95.6**	ULS 3_135	211.1	254.2	265.8	0.45	
211T	Tweede dwarsarm in tower	70x70x5#	S235	2M24-5.6t	1.00	1.00	1.00	187	**-2.7**	SPLS 6a_90 Ah Ct1 Ah Ct2	43.2	169.4	129.6	0.06		**3.1**	PLS 6a_90 Ah Ct1 Ah Ct2	112.9	169.4	91.7	0.03	
212T	Tweede dwarsarm in tower	100x100x6	S235	4M24-5.6t	1.00	2.00	1.00	95	**-100.9**	SPLS 6a_90 Ah Ct1 Ah Ct2	144.3	338.9	311.0	0.70		**121.6**	PLS 6a_90 Ah Ct1 Ah Ct2	225.0	338.9	265.8	0.54	
213	Tweede dwarsarm in tower	120x120x8	S235	2M24-5.6t	1.00	1.00	1.00	86	**-146.6**	SPLS 6a_90 Ba Ct2 Ah Ct2	265.3	169.4	207.4	0.87		**148.0**	PLS 6a_90 Ba Ct1 Ah Ct1	226.0	169.4	177.2	0.87	
214	Tweede dwarsarm in tower	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	300	**-1.0**	ULS 3_0	11.8	37.7	43.2	0.08		**0.0**		37.4	37.7	22.0	0.00	
215L	Eerste dwarsarm in tower	100x100x8	S235	3M24-5.6t	1.00	1.00	1.00	178	**0.0**		103.8	254.2	311.0	0.00		**119.3**	S 6a_90 Ba All Cts Ah Ct2	270.5	254.2	265.8	0.47	
215T	Eerste dwarsarm in tower	100x100x8	S235	1M24-5.6t	1.00	1.00	1.00	178	**-17.2**	ULS 1a_0,9_0,9_90	83.1	84.7	103.7	0.21		**22.1**	ULS 1a_90	170.5	84.7	88.6	0.26	
216T	Eerste dwarsarm in tower	100x100x8	S235	4M24-5.6t	1.00	2.00	1.00	124	**-96.5**	SPLS 6a_90 Ah Ct2 Ah Ct1	151.1	338.9	414.7	0.64		**113.7**	PLS 6a_90 Ah Ct2 Ah Ct1	293.9	338.9	354.5	0.39	
217	Eerste dwarsarm in tower	120x120x10	S235	2M24-5.6t	1.00	1.00	1.00	114	**-144.6**	SPLS 6a_90 Ah Ct1 Ba Ct1	261.1	169.4	259.2	0.85		**145.8**	PLS 6a_90 Ah Ct1 Ba Ct1	278.4	169.4	221.5	0.86	
218	Eerste dwarsarm in tower	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	325	**-1.0**	ULS 3_0	15.0	58.8	64.8	0.07		**0.0**		65.7	58.8	44.4	0.00	
219L	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-37.3**	SPLS 1a_105 Ah All Cts	195.2	169.4	311.0	0.22		**25.4**	LS 1a_0,9_105 Ah All Cts	329.5	169.4	265.8	0.15	
219T	Onderstuk in tower	120x120x12	S235	2M24-5.6t	1.00	1.00	1.00	170	**-42.0**	SPLS 1a_105 Ah All Cts	195.2	169.4	311.0	0.25		**29.6**	LS 1a_0,9_105 Ah All Cts	329.5	169.4	265.8	0.17	
220	Onderstuk in tower	60x60x5	S235	1M16-5.6t	1.00	0.50	0.50	311	**-4.6**	SPLS 1a_45 Ah Ct2	11.6	37.7	43.2	0.40		**3.5**	ULS 1a_0,9_0,9_45	60.5	37.7	32.0	0.11	
221	Onderstuk in tower	70x70x5#	S235	1M16-5.6t	1.00	0.50	0.50	370	**-1.1**	SPLS 6a_90 Ba Ct1 Ba Ct2	9.8	37.7	43.2	0.11		**0.0**		74.9	37.7	32.0	0.00	
301	Diagonalen onderregel eerste dwarsarm	100x100x6	S235	1M24-5.6t	0.55	0.55	0.55	113	**-50.4**	SPLS 3_90 Ah All Cts	105.9	84.7	77.8	0.65		**48.2**	S 6a_90 Ah All Cts Ba Ct1	127.9	84.7	66.5	0.73	
302	Diagonalen onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	112	**-67.6**	SPLS 6a_90 Ah Ct2 Ba Ct2	133.9	117.6	129.6	0.58		**64.2**	PLS 6a_90 Ah Ct2 Ba Ct2	142.1	117.6	104.7	0.61	
303	Diagonalen onderregel eerste dwarsarm	100x100x6	S235	2M20-5.6t	0.55	0.55	0.55	102	**-80.9**	SPLS 6a_90 Ah All Cts Ba Ct2	145.6	117.6	129.6	0.69		**81.9**	S 6a_90 Ah All Cts Ba Ct2	147.1	117.6	104.7	0.78	
304	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	89	**-45.0**	SPLS 6a_90 Ah Ct1 Ba Ct1	103.8	84.7	77.8	0.58		**48.0**	SPLS 3_0,9_90 Ah All Cts	93.3	84.7	59.8	0.80	
305	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	1M24-5.6t	1.00	1.00	1.00	98	**-30.5**	SPLS 6a_90 Ah All Cts Ba Ct2	96.7	84.7	77.8	0.39		**32.4**	S 6a_90 Ah All Cts Ba Ct1	93.3	84.7	57.2	0.57	
306	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	93	**-36.4**	SPLS 6a_90 Ah All Cts Ba Ct1	126.2	117.6	129.6	0.31		**35.5**	S 6a_90 Ah All Cts Ba Ct2	99.4	117.6	91.6	0.39	
307	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.55	0.55	0.55	83	**-45.3**	SPLS 6a_90 Ah All Cts Ba Ct2	136.5	117.6	129.6	0.38		**45.5**	S 6a_90 Ah All Cts Ba Ct2	107.0	117.6	91.6	0.50	
308	Diagonalen onderregel eerste dwarsarm	80x80x6#	S235	2M20-5.6t	0.56	0.56	0.56	77	**-63.5**	SPLS 6a_90 Ah All Cts Ba Ct1	142.4	117.6	129.6	0.54		**60.2**	S 6a_90 Ah All Cts Ba Ct2	113.4	117.6	91.6	0.66	
309	Diagonalen onderregel eerste dwarsarm	70x70x6	S235	1M24-5.6t	1.00	1.00	1.00	63	**-28.4**	SPLS 6a_90 Ah All Cts Ba Ct1	102.4	84.7	77.8	0.37		**29.4**	SPLS 3_0,9_90 Ah All Cts	76.0	84.7	49.5	0.59	
310	Diagonalen onderregel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	89	**-3.5**	ULS 1a_105	53.3	37.7	43.2	0.09		**4.8**	SPLS 1a_135 Ba Ct2	37.4	37.7	22.0	0.22	
311	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	87	**0.0**		548.0	117.6	216.0	0.00		**4.8**	ULS 3_90	766.1	117.6	0.0	0.04	
312	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	2.00	1.00	1.00	81	**0.0**		316.3	117.6	259.2	0.00		**55.5**	ULS 3_90	278.4	117.6	259.2	0.47	
313	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	57	**-4.9**	ULS 3_0,9_90	679.0	117.6	216.0	0.04		**1.0**	SPLS 1a_135 Ba All Cts	766.1	117.6	0.0	0.01	
314	Dwarsligger onderregel eerste dwarsarm	100x100x12	S235	2M20-5.6t	1.00	2.00	1.00	38	**0.0**		424.1	117.6	259.2	0.00		**63.9**	ULS 3_90	278.4	117.6	259.2	0.54	
315	Dwarsligger onderregel eerste dwarsarm	HEA160	S235	2M20-5.6t	2.00	2.00	2.00	25	**-8.1**	ULS 3_90	794.2	117.6	216.0	0.07		**0.0**		766.1	117.6	0.0	0.00	
316	Tussenregel eerste dwarsarm	90x90x6#	S235	1M20-5.6t	1.00	1.00	1.00	166	**-18.4**	SPLS 6a_90 Ba All Cts Ah Ct2	70.1	58.8	64.8	0.31		**0.0**		117.5	58.8	52.4	0.00	

DNV·GL

Assessment of groups for initial mast (afkeur level)

Date 29-7-2020
Author MKh
Version 1.0

KIJ-GT 380
WA+0
61

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)
317	Tussenregel eerste dwarsarm	75x50x5	S235	1M16-5.6t	1.00	1.00	1.00	186	**-5.7**	ULS 3_90	30.3	37.7	43.2	0.19		**0.0**		37.4	37.7	22.0	0.00	
318	Tussenregel eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	108	**-0.9**	SPLS 6a_90 Ah Ct2 Ah Ct1	45.5	37.7	43.2	0.02		**0.0**		37.4	37.7	18.4	0.00	
319	Tussen diagonaal eerste dwarsarm	50x50x5	S235	2M16-5.6t	1.00	1.00	1.00	556	**0.0**		5.2	75.4	86.4	0.00		**26.3**	ULS 3_135	52.4	75.4	44.1	0.60	
320	Tussen diagonaal eerste dwarsarm	60x60x5	S235	2M20-5.6t	1.00	1.00	1.00	382	**0.0**		12.0	117.6	108.0	0.00		**39.4**	S 6a_90 Ba All Cts Ah Ct2	65.2	117.6	73.9	0.60	
321	Tussen diagonaal eerste dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	404	**0.0**		7.2	37.7	43.2	0.00		**12.1**	SPLS 1a_135 Ah Ct1	37.4	37.7	22.0	0.55	
322	Diagonaal eerste dwarsarm dwarsrichting	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	172	**0.0**		26.9	37.7	43.2	0.00		**4.1**	ULS 3_0,9_135	37.4	37.7	18.4	0.22	
323	Dwarsligger bovenregel eerste dwarsarm	65x50x5	S235	1M24-5.6t	1.00	1.00	1.00	219	**-3.3**	ULS 3_0,9_90	22.0	84.7	64.8	0.15		**0.0**		63.4	84.7	27.5	0.00	
401	Diagonalen onderregel tweede dwarsarm	90x90x6#	S235	2M20-5.6t	0.53	0.53	0.53	115	**-37.8**	SPLS 3_105 Ah All Cts	118.5	117.6	129.6	0.32		**33.2**	SPLS 3_0,9_90 Ah All Cts	128.8	117.6	104.7	0.32	
402	Diagonalen onderregel tweede dwarsarm	90x90x6#	S235	2M20-5.6t	0.53	0.53	0.53	105	**-46.3**	SPLS 6a_90 Ah Ct1 Ba Ct1	128.3	117.6	129.6	0.39		**42.0**	SPLS 3_0,9_90 Ah Ct2	146.3	117.6	104.7	0.40	
403	Diagonalen onderregel tweede dwarsarm	75x75x8	S235	2M20-5.6t	0.55	0.55	0.55	104	**-43.2**	SPLS 3_0,9_90 Ah All Cts	139.3	117.6	172.8	0.37		**46.8**	S 6a_90 Ah All Cts Ba Ct2	133.8	117.6	139.6	0.40	
404	Diagonalen onderregel tweede dwarsarm	75x75x8	S235	2M20-5.6t	0.54	0.54	0.54	99	**-57.5**	SPLS 6a_90 Ah Ct1 Ba Ct1	145.1	117.6	172.8	0.49		**52.7**	SPLS 3_0,9_90 Ah All Cts	148.9	117.6	139.6	0.45	
405	Diagonalen onderregel tweede dwarsarm	65x65x7	S235	2M20-5.6t	0.55	0.55	0.55	84	**-49.4**	SPLS 3_90 Ah Ct1	125.3	117.6	151.2	0.42		**51.6**	SPLS 3_0,9_90 Ah Ct2	96.0	117.6	119.1	0.54	
406	Diagonalen onderregel tweede dwarsarm	60x60x6	S235	1M20-5.6t	1.00	1.00	1.00	87	**-29.6**	SPLS 3_90 Ah Ct1	77.6	58.8	64.8	0.50		**28.1**	SPLS 3_0,9_90 Ah All Cts	65.7	58.8	44.4	0.63	
407	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	109	**-1.6**	ULS 1a_0,9_0,9_0	45.1	37.7	43.2	0.04		**2.4**	ULS 1a_0,9_0	37.4	37.7	22.0	0.11	
408	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	100	**-2.1**	ULS 1a_0,9_0	48.4	37.7	43.2	0.06		**1.0**	ULS 1a_0,9_0,9_0	37.4	37.7	22.0	0.04	
409	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	94	**-0.7**	ULS 1a_0,9_0,9_0	50.9	37.7	43.2	0.02		**1.7**	ULS 1a_0,9_0	37.4	37.7	22.0	0.08	
410	Diagonalen onderregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	87	**-1.1**	ULS 1a_0,9_0	54.1	37.7	43.2	0.03		**0.3**	SPLS 1a_0 Ba Ct1	37.4	37.7	22.0	0.01	
411	Bovenregel tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.00	1.00	289	**0.0**		61.7	254.2	311.0	0.00		**103.9**	ULS 3_105	263.0	254.2	265.8	0.41	
412A	Bovenregel tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	1.90	1.00	128	**0.0**		177.3	254.2	311.0	0.00		**91.5**	;PLS 6a_90 Ah Ct1 Ah Ct2	263.0	254.2	265.8	0.36	
412B	Bovenregel tweede dwarsarm	120x120x8	S235	3M24-5.6t	1.00	2.11	1.00	128	**0.0**		177.1	254.2	311.0	0.00		**85.3**	ULS 3_105	263.0	254.2	265.8	0.34	
413	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	200	**-6.3**	SPLS 1a_135 Ah All Cts	21.9	37.7	43.2	0.29		**6.6**	S 6a_90 Ba All Cts Ah Ct2	37.4	37.7	22.0	0.30	
414	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	187	**-7.9**	SPLS 6a_90 Ah All Cts Ba Ct2	24.0	37.7	43.2	0.33		**7.6**	;PLS 6a_90 Ah Ct1 Ba Ct1	37.4	37.7	22.0	0.35	
415	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.55	0.55	0.55	175	**-9.6**	SPLS 6a_90 Ah Ct1 Ba Ct1	26.2	37.7	43.2	0.37		**9.6**	S 6a_90 Ba All Cts Ah Ct2	37.4	37.7	22.0	0.43	
416	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.53	0.53	0.53	148	**-9.9**	SPLS 6a_90 Ah Ct2 Ba Ct2	32.4	37.7	43.2	0.31		**10.0**	;PLS 6a_90 Ah Ct2 Ba Ct2	37.4	37.7	22.0	0.45	
417	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	142	**-12.0**	SPLS 6a_90 Ah Ct2 Ba Ct2	34.2	37.7	43.2	0.35		**11.7**	S 6a_90 Ah All Cts Ba Ct2	37.4	37.7	22.0	0.53	
418	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.54	0.54	0.54	133	**-15.3**	SPLS 6a_90 Ah Ct2 Ba Ct2	36.8	37.7	43.2	0.42		**15.6**	;PLS 6a_90 Ah Ct2 Ba Ct2	37.4	37.7	22.0	0.71	
419	Diagonalen bovenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	0.57	0.57	0.57	132	**-22.0**	SPLS 6a_90 Ah Ct2 Ba Ct2	37.1	37.7	43.2	0.59		**21.2**	;PLS 6a_90 Ah Ct2 Ba Ct2	37.4	37.7	22.0	0.96	
420	Diagonalen bovenregel tweede dwarsarm	55x55x6	S235	2M16-5.6t	0.57	0.57	0.57	114	**-31.1**	SPLS 6a_90 Ah Ct2 Ba Ct2	67.3	75.4	103.7	0.46		**32.6**	;PLS 6a_90 Ah Ct2 Ba Ct2	66.1	75.4	67.2	0.49	
421	Dwarsliggers onderregel tweede dwarsarı	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	64	**0.0**		647.3	117.6	216.0	0.00		**6.8**	ULS 3_90	766.1	117.6	0.0	0.06	
422	Dwarsliggers onderregel tweede dwarsarı	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	43	**-7.6**	ULS 3_0,9_90	734.3	117.6	216.0	0.06		**3.3**	;PLS 6a_90 Ah Ct2 Ah Ct1	766.1	117.6	0.0	0.03	
423	Dwarsliggers onderregel tweede dwarsarı	100x100x12	S235	2M20-5.6t	1.00	2.00	1.00	49	**0.0**		398.0	117.6	259.2	0.00		**57.8**	ULS 3_90	278.4	117.6	259.2	0.49	
424	Dwarsliggers onderregel tweede dwarsarı	HEA160	S235	2M20-5.6t	1.00	1.00	1.00	22	**0.0**		802.6	117.6	216.0	0.00		**0.5**	ULS 3_0,9_90	766.1	117.6	0.0	0.00	
117A	Onderregel tweede dwarsarm	100x100x6	S235	3M20-5.6t	6.00	1.00	1.00	157	**-6.6**	ULS 1a_0,9_0	84.1	176.4	194.4	0.08		**6.0**	ULS 1a_0,9_0,9_0	237.4	176.4	157.1	0.04	
117C	Onderregel tweede dwarsarm	100x100x6	S235		1.00	3.81	1.00	157	**-3.4**	ULS 1a_0,9_0,9_0	84.2	0.0	0.0	0.04		**4.2**	ULS 1a_0,9_0	277.3	0.0	0.0	0.02	
117B	Onderregel tweede dwarsarm	100x100x6	S235	2M20-5.6t	1.00	4.06	1.00	157	**-0.2**	SPLS 1a_135 Ba Ct1	84.2	117.6	129.6	0.00		**1.0**	ULS 1a_0,9_45	145.4	117.6	91.6	0.01	
426	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	89	**-1.5**	ULS 5a Ba 12	53.0	37.7	43.2	0.04		**3.5**	ULS 5a Ba 22	37.4	37.7	22.0	0.16	
427	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	176	**0.0**		26.1	37.7	43.2	0.00		**5.0**	ULS 5a Ba 22	37.4	37.7	22.0	0.23	
428	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	83	**-1.1**	SPLS 3_0,9_75 Ba All Cts	55.1	37.7	43.2	0.03		**6.0**	;PLS 6a_90 Ba Ct1 Ah Ct1	37.4	37.7	22.0	0.27	
429	Tussenregel tweede dwarsarm	50x50x5	S235	1M16-5.6t	1.00	1.00	1.00	299	**-3.0**	ULS 1a_105	11.9	37.7	43.2	0.26		**0.0**		37.4	37.7	22.0	0.00	
430	Tussen diagonaal tweede dwarsarm	70x70x7	S235	1M16-5.6t	1.00	1.00	1.00	238	**-9.6**	ULS 5a Ba 22	33.3	37.7	60.5	0.29		**0.9**	ULS 5a Ba 12	104.8	37.7	44.8	0.02	

APPENDIX C REDUNDANT MEMBERS CHECK

Knikverkorters initial construction (afkeur)

Date: 2020-08-04
Author: Muhammed Khan
Version: 1.8

KIJ-GT
WA+0
11-1

Pos nr.	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
13	Broekstuk	Enkele staaf	L50.5	S235	M16	5.6	0.58	0	59	**19.8**	**0.14**	61.8	37.7	30.3	31.7	0.72	0.65	
18	Broekstuk	Enkele staaf	L60.5	S235	M16	5.6	1.69	79	143	**19.8**	**0.00**	40.9	37.7	32.0	60.5	1.05	0.62	
11	Broekstuk	Enkele staaf	L50.5	S235	M16	5.6	1.24	0	127	**19.8**	**0.31**	38.7	37.7	30.3	31.7	0.72	0.65	
17	Broekstuk	Enkele staaf	L60.5	S235	M16	5.6	1.91	57	163	**19.8**	**0.00**	35.1	37.7	32.0	60.5	1.05	0.62	
10	Broekstuk	Enkele staaf	L60.6	S235	M16	5.6	1.89	0	162	**19.8**	**0.47**	41.8	37.7	38.4	72.6	1.24	0.52	
16	Broekstuk	Enkele staaf	L70.6	S235	M16	5.6	2.31	44	169	**19.8**	**0.00**	46.7	37.7	38.4	89.9	1.71	0.52	
9	Broekstuk	Enkele staaf	L70.6	S235	M16	5.6	2.55	0	186	**19.8**	**0.64**	41.0	37.7	38.4	89.9	1.71	0.52	
15	Broekstuk	Enkele staaf	L70.6	S235	M16	5.6	2.82	34	205	**19.8**	**0.00**	35.7	37.7	38.4	89.9	1.71	0.55	
8	Broekstuk	Enkele staaf	L80.6	S235	M16	5.6	3.21	0	204	**19.8**	**0.80**	41.4	37.7	38.4	107.1	2.25	0.52	
14	Broekstuk	Enkele staaf	L80.6	S235	M16	5.6	3.22	27	204	**19.8**	**0.72**	41.3	37.7	38.4	107.1	2.25	0.52	
23	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	1.31	0	135	**3.4**	**0.33**	36.2	37.7	30.3	31.7	0.72	0.46	
26	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	2.83	77	291	**3.4**	**0.00**	12.5	37.7	30.3	31.7	0.72	0.27	
22	Pootverband	Kniksteun en verticale steur	L50.5	S235	M16	5.6	2.73	0	180	**3.4**	**0.34**	20.3	37.7	30.3	31.7	0.54	0.66	
25	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	3.05	64	314	**3.4**	**0.00**	11.0	37.7	30.3	31.7	0.72	0.31	
21	Pootverband	Kniksteun en verticale steur	L50.5	S235	M16	5.6	4.14	0	274	**3.4**	**0.52**	11.6	37.7	30.3	31.7	0.54	1.00	
24	Pootverband	Enkele staaf	L60.5	S235	M16	5.6	3.39	51	288	**3.4**	**0.00**	15.3	37.7	32.0	60.5	1.05	0.22	
69	Eerste TSNSTUK	Enkele staaf	L70.5	S235	M16	5.6	2.48	38	180	**19.6**	**0.00**	36.0	37.7	32.0	74.9	1.78	0.61	
59	Eerste TSNSTUK	Enkele staaf	L60.5	S235	M16	5.6	1.92	0	164	**19.6**	**0.48**	34.7	37.7	32.0	60.5	1.05	0.61	
60	Eerste TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.51	0	155	**19.6**	**0.38**	30.7	37.7	30.3	31.7	0.72	0.65	
70	Eerste TSNSTUK	Enkele staaf	L60.5	S235	M16	5.6	2.17	52	184	**19.6**	**0.00**	29.7	37.7	32.0	60.5	1.05	0.66	
61	Eerste TSNSTUK	Enkele staaf	L80.6	S235	M16	5.6	2.97	0	189	**19.6**	**0.74**	46.3	37.7	38.4	107.1	2.25	0.52	
71	Eerste TSNSTUK	Enkele staaf	L60.5	S235	M16	5.6	2.12	40	180	**19.6**	**0.00**	30.6	37.7	32.0	60.5	1.05	0.64	
62	Eerste TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.54	0	158	**19.6**	**0.39**	29.9	37.7	30.3	31.7	0.72	0.65	
63	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.25	0	128	**14.1**	**0.31**	38.2	37.7	30.3	31.7	0.72	0.47	
72	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.79	52	183	**14.1**	**0.00**	24.7	37.7	30.3	31.7	0.72	0.57	
64	Tweede TSNSTUK	Enkele staaf	L60.6	S235	M16	5.6	2.39	0	204	**14.1**	**0.60**	30.5	37.7	38.4	72.6	1.24	0.48	
73	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.74	40	178	**14.1**	**0.00**	25.6	37.7	30.3	31.7	0.72	0.55	
65	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.28	0	131	**14.1**	**0.32**	37.3	37.7	30.3	31.7	0.72	0.47	
66	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.00	0	102	**14.1**	**0.25**	47.6	37.7	30.3	31.7	0.72	0.47	
74	Tweede TSNSTUK	Enkele staaf	L60.5	S235	M16	5.6	1.42	52	121	**14.1**	**0.00**	49.4	37.7	32.0	60.5	1.05	0.44	
67	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.89	0	194	**14.1**	**0.47**	22.9	37.7	30.3	31.7	0.72	0.66	
75	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.38	40	142	**14.1**	**0.00**	34.2	37.7	30.3	31.7	0.72	0.47	
68	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.03	0	105	**14.1**	**0.26**	46.4	37.7	30.3	31.7	0.72	0.47	
20	Tussenschot	Kniksteun en verticale steur	L60.5	S235	M16	5.6	5.39	0	294	**2.0**	**0.67**	12.6	37.7	32.0	60.5	0.81	0.87	
27	Tussenschot	Kruisende staaf halverwege	L70.5	S235	M16	5.6	7.86	0	368	**2.0**	**0.98**	10.5	37.7	32.0	74.9	1.78	0.55	

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Knikverkorters initial construction (afkeur)

Date: 2020-08-04
Author: Muhammed Khan
Version: 1.8

KIJ-GT
WA+0
61

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
13	Broekstuk	Enkele staaf	L50.5	S235	M16	5.6	0.58	0	59	**19.8**	**0.14**	61.8	37.7	30.3	31.7	0.72	0.65	
18	Broekstuk	Enkele staaf	L60.5	S235	M16	5.6	1.69	79	143	**19.8**	**0.00**	40.9	37.7	32.0	60.5	1.05	0.62	
11	Broekstuk	Enkele staaf	L50.5	S235	M16	5.6	1.24	0	127	**19.8**	**0.31**	38.7	37.7	30.3	31.7	0.72	0.65	
17	Broekstuk	Enkele staaf	L60.5	S235	M16	5.6	1.91	57	163	**19.8**	**0.00**	35.1	37.7	32.0	60.5	1.05	0.62	
10	Broekstuk	Enkele staaf	L60.6	S235	M16	5.6	1.89	0	162	**19.8**	**0.47**	41.8	37.7	38.4	72.6	1.24	0.52	
16	Broekstuk	Enkele staaf	L70.6	S235	M16	5.6	2.31	44	169	**19.8**	**0.00**	46.7	37.7	38.4	89.9	1.71	0.52	
9	Broekstuk	Enkele staaf	L70.6	S235	M16	5.6	2.55	0	186	**19.8**	**0.64**	41.0	37.7	38.4	89.9	1.71	0.52	
15	Broekstuk	Enkele staaf	L70.6	S235	M16	5.6	2.82	34	205	**19.8**	**0.00**	35.7	37.7	38.4	89.9	1.71	0.55	
8	Broekstuk	Enkele staaf	L80.6	S235	M16	5.6	3.21	0	204	**19.8**	**0.80**	41.4	37.7	38.4	107.1	2.25	0.52	
14	Broekstuk	Enkele staaf	L80.6	S235	M16	5.6	3.22	27	204	**19.8**	**0.72**	41.3	37.7	38.4	107.1	2.25	0.52	
23	Pootverband	Enkele staaf	L50.5	S235	M16	5.6	1.31	0	135	**3.4**	**0.33**	36.2	37.7	30.3	31.7	0.72	0.46	
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21	Pootverband	Kniksteun en verticale steur	L50.5	S235	M16	5.6	4.14	0	274	**3.4**	**0.52**	11.6	37.7	30.3	31.7	0.54	1.00	
24	Pootverband	Enkele staaf	L60.5	S235	M16	5.6	3.39	51	288	**3.4**	**0.00**	15.3	37.7	32.0	60.5	1.05	0.22	
69	Eerste TSNSTUK	Enkele staaf	L70.5	S235	M16	5.6	2.48	38	180	**19.6**	**0.00**	36.0	37.7	32.0	74.9	1.78	0.61	
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70	Eerste TSNSTUK	Enkele staaf	L60.5	S235	M16	5.6	2.17	52	184	**19.6**	**0.00**	29.7	37.7	32.0	60.5	1.05	0.66	
61	Eerste TSNSTUK	Enkele staaf	L80.6	S235	M16	5.6	2.97	0	189	**19.6**	**0.74**	46.3	37.7	38.4	107.1	2.25	0.52	
71	Eerste TSNSTUK	Enkele staaf	L60.5	S235	M16	5.6	2.12	40	180	**19.6**	**0.00**	30.6	37.7	32.0	60.5	1.05	0.64	
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64	Tweede TSNSTUK	Enkele staaf	L60.6	S235	M16	5.6	2.39	0	204	**14.1**	**0.60**	30.5	37.7	38.4	72.6	1.24	0.48	
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65	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.28	0	131	**14.1**	**0.32**	37.3	37.7	30.3	31.7	0.72	0.47	
66	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.00	0	102	**14.1**	**0.25**	47.6	37.7	30.3	31.7	0.72	0.47	
74	Tweede TSNSTUK	Enkele staaf	L60.5	S235	M16	5.6	1.42	52	121	**14.1**	**0.00**	49.4	37.7	32.0	60.5	1.05	0.44	
67	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.89	0	194	**14.1**	**0.47**	22.9	37.7	30.3	31.7	0.72	0.66	
75	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.38	40	142	**14.1**	**0.00**	34.2	37.7	30.3	31.7	0.72	0.47	
68	Tweede TSNSTUK	Enkele staaf	L50.5	S235	M16	5.6	1.03	0	105	**14.1**	**0.26**	46.4	37.7	30.3	31.7	0.72	0.47	
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27	Tussenschot	Kruisende staaf halverwege	L70.5	S235	M16	5.6	7.86	0	368	**2.0**	**0.98**	10.5	37.7	32.0	74.9	1.78	0.55	

APPENDIX D ANCHOR CHECKS AND OTHER CALCULATIONS

ANCHORS & SHEAR BLOCKS WA+0

Drawings provided for tower structure WA+0 include the anchor arrangement but specific details of the anchors are not present. Figure 1 and Figure 2 below, which will be used for mast 11-1, are based on structures EA+0, HB+0 and HC+0. The position of anchor bolts and plate thickness have been verified by a field study[1]. The tower legs are connected to the foundation with a 550x800x75 mm footplate and six anchors with diameter 65 mm.

The anchor rods are connected to a horizontal rod "schieter" which allows for distribution of the tensile force to the concrete.

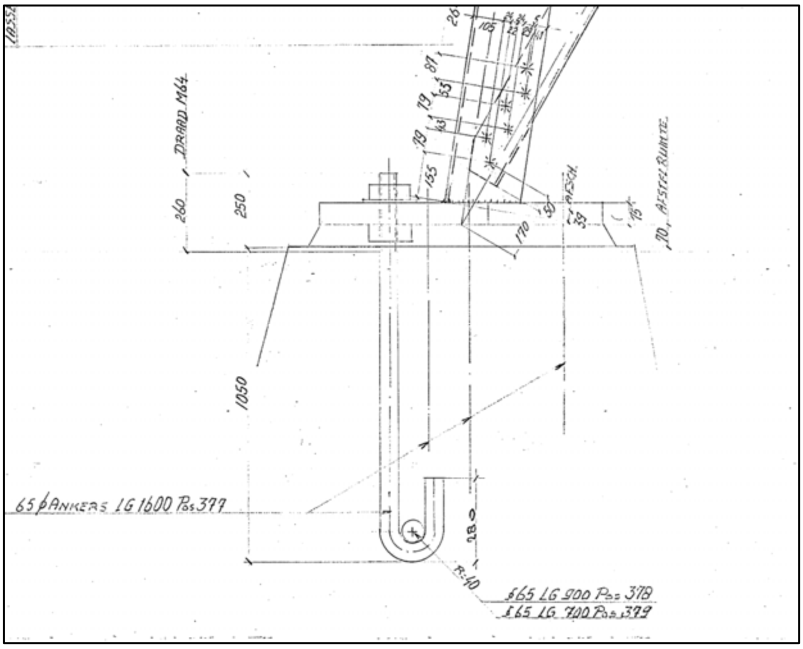


Figure 1 Anchor detail mast 11-1

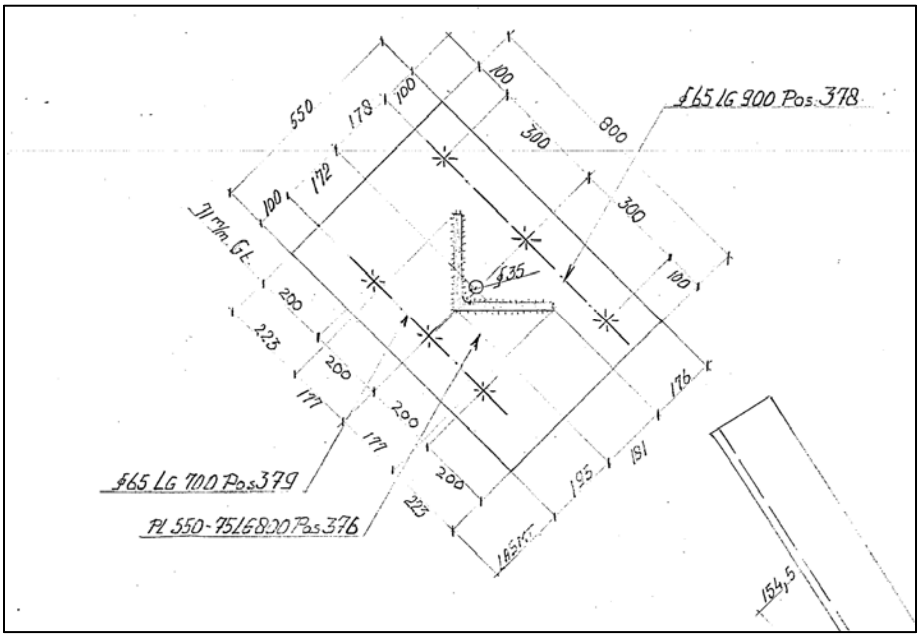


Figure 2 Anchor footplate mast 11-1

[1] Rapport Bejan Bouw en Betontechniek d.d. 4-11-2020; 200152A-003 Krimpen aan den IJssel - Geertruidenberg v1.0.pdf

It must be noted that on mast 61, the WA+0 structure also has information which shows the presence of in the foundation. There is no steel pile casing which the shear blocks is inserted into, it is inserted into the pile cap. The check in the spreadsheet is adjusted for that.

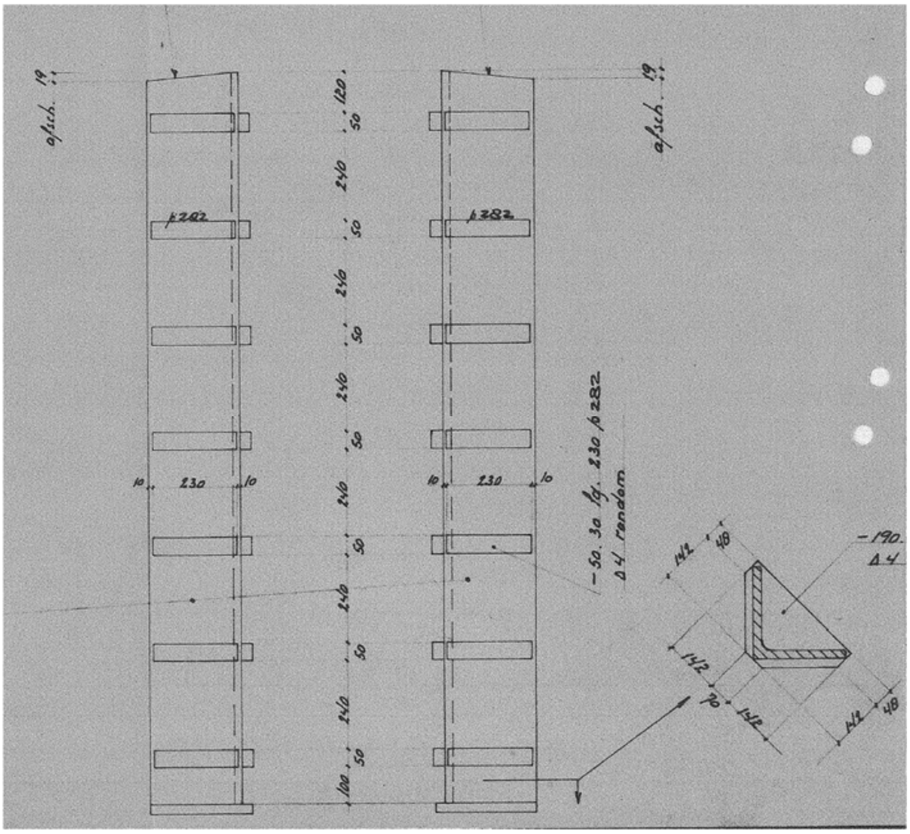


Figure 3 Blokdeuvels (shear blocks) drawing available for mast 61

However the "ankerstaat" mentions the presence of anchor rods, like the other similar angle towers.

Both the shear blocks and anchor rods have been used as a design assumption.

Loads

The loads generated on the tower are based on WA+0 structure number 11-1 in wind zone II:

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	SPLS 1a_105 Ah All Cts	-218	226	**1267**	6	-314	-34	1298
Max. trek	SPLS 1a_0,9_75 Ba All Cts	181	191	**-1058**	7	263	29	-1084
Max. pos. torsie	SPLS 3_90 Ah Ct2	-28	220	715	**136**	-176	-18	732
Max. neg. torsie	SPLS 3_0,9_90 Ah Ct1	10	181	-494	**-135**	121	12	-506
Comb. trek+torsie	SPLS 1a_0,9_75 Ba All Cts	181	191	**-1058**	**7**	263	29	-1084

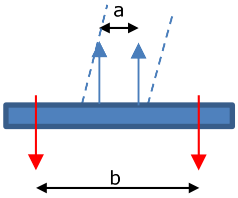
The loads generated on the tower are based on WA+0 structure number 61 in wind zone III:

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	SPLS 1a_105 Ah All Cts	-201	208	**1170**	5	-289	-31	1198
Max. trek	SPLS 1a_0,9_105 Ah All Cts	-163	170	**-947**	-5	235	26	-970
Max. pos. torsie	SPLS 6a_90 Ba Ct1 Ba Ct2	89	95	3	**130**	-4	-3	3
Max. neg. torsie	SPLS 6a_90 Ah Ct1 Ah Ct2	-92	92	-16	**-130**	0	-4	-16
Comb. trek+torsie	SPLS 1a_0,9_105 Ah All Cts	-163	170	**-947**	**-5**	235	26	-970

Footplate and anchors

The strength of the foot plate will be determined assuming a horizontal yield line across the length of the plate. The tensile force is distributed to two point loads each separated by half of the diagonal width of the tower leg.



Figuur 1 Scheme for check of foot plate

a: 1/2 · 250 / √2 = 88 mm

b: 350 mm

The eccentricity becomes 1/2 · (350-88) = 131 mm

In the spreadsheet the anchor bolts and foot plate have been checked. The concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but has been verified with concrete cylinder tests. Refer to aforementioned investigation report. The foot plate is embedded in concrete. The anchor bolts will not be loaded by bending.

Both towers fulfill the required strength. See the output:

Tower 11-I: U.C. = 176 / 655 = 0,27 ≤ 1,00 OK

Conclusion: The foot plates of tower structure WA+0 have sufficient strength.

Shear blocks (blokdeuvels)

The calculation for the shear blocks adequacy is based on the fact that there is no steel pile casing that surrounds the main leg member. This means that the calculation for the strength of the "buis" is ignored and only the interaction between the concrete foundation and the main leg member is considered.

In the spreadsheet the shear blocks have been checked. As with the footplate and anchors check the concrete strength is assumed to be equal or more than C20/25. This assumption is higher than what would be derived for old designation K225 but has been verified with concrete cylinder tests. Refer to aforementioned investigation report.

Compression U.C. = 1170 / 1393 = 0,84 ≤ 1,00 OK

Tension U.C. = 947 / 1232 = 0,77 ≤ 1,00 OK

DNV·GL

Project: Krimpen - Geertruidenberg 380

Date: 30-11-2020
Version: 2.6

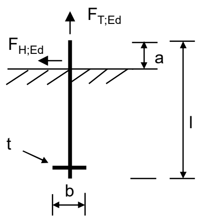
Anchors

NEN-EN 1992-1-1 and 1993-1-8 with NA
CUR-BmS 10

Subject: WA II	***Checks:***	
	Anchor bolt to tension	0,27 ***OK***
	Anchor bolt to shear	0,19 ***OK***
	Dowel ("schieter")	0,38 ***OK***

Inputs

Anchor diameter		**M64**	
Achor quality		**4.6**	
Thread		Cut	
Anchor length	l =	1300	mm
Anchor length above concrete	a =	250	mm



Load on anchor group

T: the external tension force on the anchor group

Tension force	T =	**1058**	kN
Shear force	$F_{H,Ed}$ =	**304**	kN
Number of anchors for tension		6	
Number of anchors for shear		6	
$F_{T;Ed} = T / n =$		176,3	kN
$F_{v;Ed} = F_{H,Ed} / n =$		50,7	kN

Anchor properties

d_b =	64,00	mm
$A_{b;s}$ =	2676	mm^2
f_{yb} =	240	N/mm^2
f_{ub} =	400	
γ_{Mb}	1,25	-
$\alpha_{red;2}$	0,85	-
$\alpha_b = 0,44 - 0,0003 f_{yb} =$	0,37	-

Capacity per anchor

$F_{T;Rd} = 0,9 \alpha_{red;2} f_{ub} A_s / g_{M2} =$	**655,1**	kN
$F_{v;Rd} = \alpha_b f_{ub} A_s / g_{Mb} =$	**267,9**	kN

Foot plate

$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

Steel material		**S235**	
Thickness	t =	75	mm
Width	b_{ef} =	267	mm
Leverage arm	m =	131	mm
$M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd} =$		88,2	kNm
$F_{t,Rd} = M_{pl,Rd} / m =$		673,6	kN

Check of dowel ("schieter")

$$\frac{\sigma_b'}{f_{cd}} = \frac{11,6}{40,0} = 0,29$$ ***OK***

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{176}{460} = 0,38$$ ***OK***

Capacity of concrete

Concrete strength	**C20/25**	
f_{ck} =	20	N/mm^2
k_b =	3	-
γ_{Mc} =	1,5	-
$f_{cd} = f_{ck} k_b / \gamma_{Mc} =$	40	MPa

Dowel

Diameter	d_S =	**65**	mm
Length	b =	**233**	mm
Spread	$c = t\sqrt{(f_{yd} / 3f_{jd})} =$	92	mm
Effective length	$b_{eff} = \min(b; d+2c)$	233	mm
Cross section	$A_S = \pi/4\ d_S^2 =$	3318	mm^2
Distributed load	$q = F_{T,Ed} / b_{eff} =$	757	kN/m
Concrete pressure	$\sigma_b' = q / d_S =$	11,6	MPa

Shear stress in dowel

Load	$F_{T,Ed}$ =	176	kN
Allowable	$F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s =$	460	kN

Capacity of foot plate

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{176,3}{673,6} = 0,26$$ ***OK***

Capacity of anchor for tension

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{176,3}{655,1} = 0,27$$ ***OK***

Check foot plate for tension

$$\frac{T}{n \times F_{t;Rd}} = \frac{1058,0}{4041,3} = 0,26$$ ***OK***

Check anchor for shear

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{50,7}{267,9} = 0,19$$ ***OK***

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:

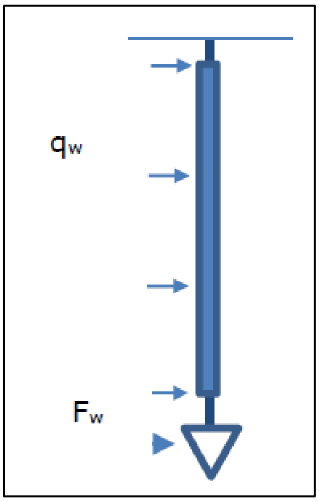


Figure 1: Diagrammatic representation of the loads on the post insulator

1. Forces on the insulator attachment

Wind pressure based on non-urban terrain in wind zone II at a height of 28.2 m: $q_h = 1.18$ kN/m^2

Wind load per meter based on an insulator diameter of 0.2 m and a drag factor of 1.2:

$\underline{q_w}$ = 1.2 x 0.2 x 1.18 = $\underline{\text{0.29 kN/m}}$

Before calculating (F_w), the drag factor (C_C) is first calculated:

V_w = (2 x 1180/ 1.25)$^{0.5}$ = 43.45 m.s^{-1}

Re = 43.45 x 0.036 / (15 x 10^{-6}) = 104280

$\underline{C_c}$ = $\underline{0.9}$

Then calculate 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 1.18 = 1.032 kN

Calculate the moment based on the wind loading and the point load:

M_w = 0.5 x 0.29 x 4^2 + 4 x 1.032 = 6.45 kNm

Design values:

M_{ED} = 1.4 x 6.45 = 9.03 kNm

V_{ED} = 1.4 x (1.032 + 3.5 x 0.29) = 2.87 kN

2. Assessment of the pin

The figure below is a sketch of the insulator attachment mechanism indicating the location of the pin.

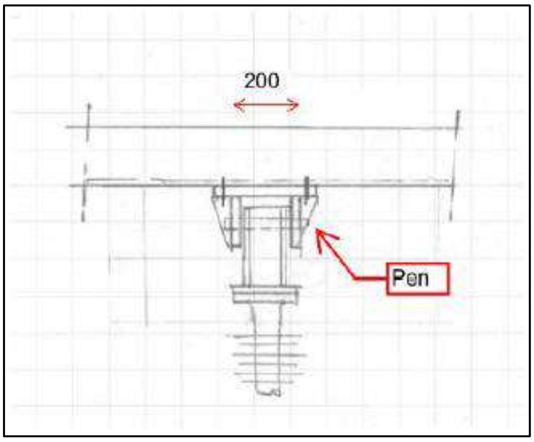


Figure 2: Post insulator attachment mechanism

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 = 9.03 /0.2 + 5/2 = 47.65 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.

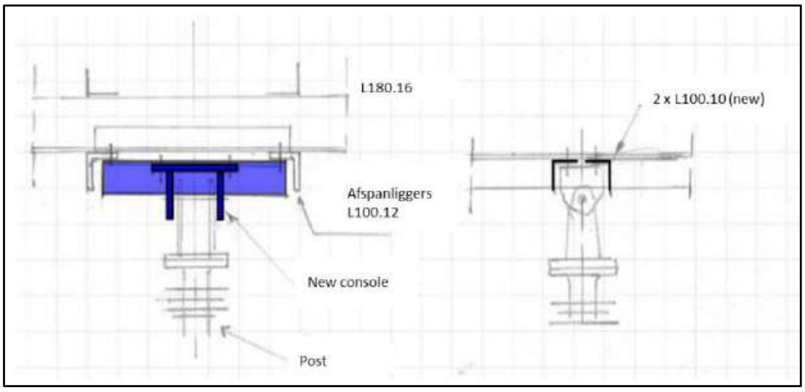


Figure 3: Overview of the new members required for attachment

M = 0.5 x 9.03 + 0.25 x 5 x 0.6 = 5.27 kNm

Proposition: 2 x L100.10: M_{rd} = 2 x 24750 x 355 x 10^{-3} = 17.5 kNm

U.C. = 5.27/ 17.5 = 0.30 < 1 OK

Project: BBB - KIJ GT
Mast: WA+0

DNV·GL

Pen-gatverbinding

Datum: 2020-08-10
Auteur: TBR
Versie: 1.3

Onderwerp	**Post Insulator Attachment**	Toetsing sterkte	0.65 < 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} = 47.7 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	0.25	< 1,0 OK
Buigsterkte pen	0.65	< 1,0 OK
Combinatie M + V	0.48	< 1,0 OK
Stuik plaat	0.43	< 1,0 OK

Berekeningen

Controle eind- en randafstand

Aan de eisen van óf A óf B moet voldaan worden

Type A

Rand	$a > F_{Ed}\,\gamma_{m0} / 2tf_y + 2\,d0/3$ =	26 mm	OK
Eind	$c > F_{Ed}\,\gamma_{m0} / 2tf_y + d0/3$ =	17 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	$t > 0{,}7\sqrt{(F_{Ed}\,\gamma_{m0} / f_y)}$ =	11 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.	0.25	< 1,0 OK

Stuik

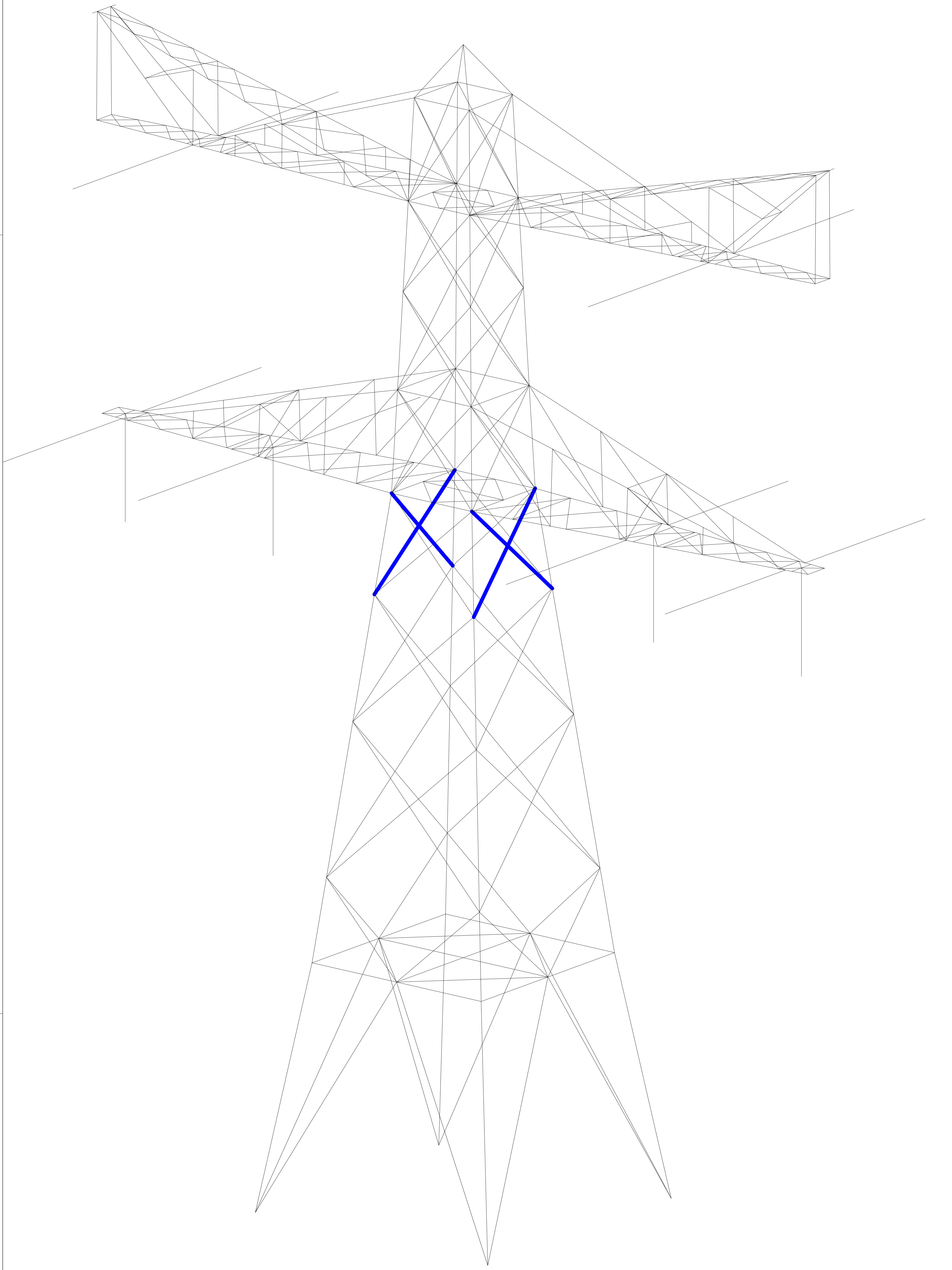
$F_{b,Rd} = 1{,}5\,t\,d\,f_y / \gamma_{m0}$ =	110	kN
U.C.	0.43	< 1,0 OK

Buigweerstand

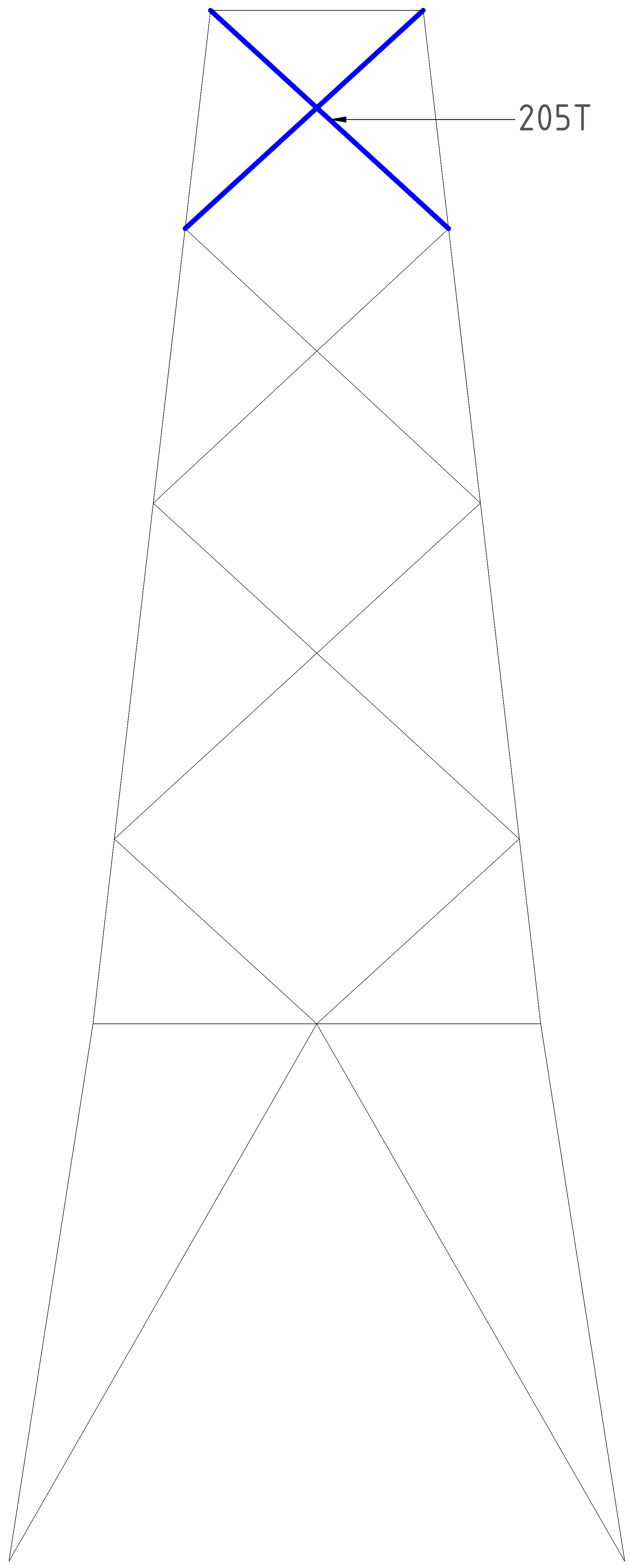
$M_{Ed} = F_{Ed}\,e$ =	0.95	kNm
$M_{Rd} = 1{,}5\,W_{el}\,f_{yp} / \gamma_{m0}$ =	1.47	kNm
U.C. =	0.65	< 1,0 OK
$(M_{Ed} / M_{Rd})2 + (F_{v,Ed} / F_{v,Rd})^2$ =	0.48	< 1,0 OK

APPENDIX E DRAWINGS

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)
205T	EA	L150x10	S235 t<=40	M24-5.6t-NEN2012	EA	L150x10	S355 t<=40	M24-8.8t-NEN2012



Overview



Side View

Notes and legend:

- New redundants according to drawing
- Size for new redundants is 50x50x5
- 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	29-7-2020	Version 1.0

Projectname: Mast constructions KIJ - GT 380 kV

DNV·GL

Third angle projection:

Drawing no.: 10166260-021

Design state: FINAL | Scale: -
Drawn by: MuK 29-7-2020 | Units: m
Checked by: TBR 29-7-2020 | Project no: 10166260
Approved by: JHu 29-7-2020 | Company: TenneT

Description: Modifications overview for mast type WA+0 (mast 11-1)

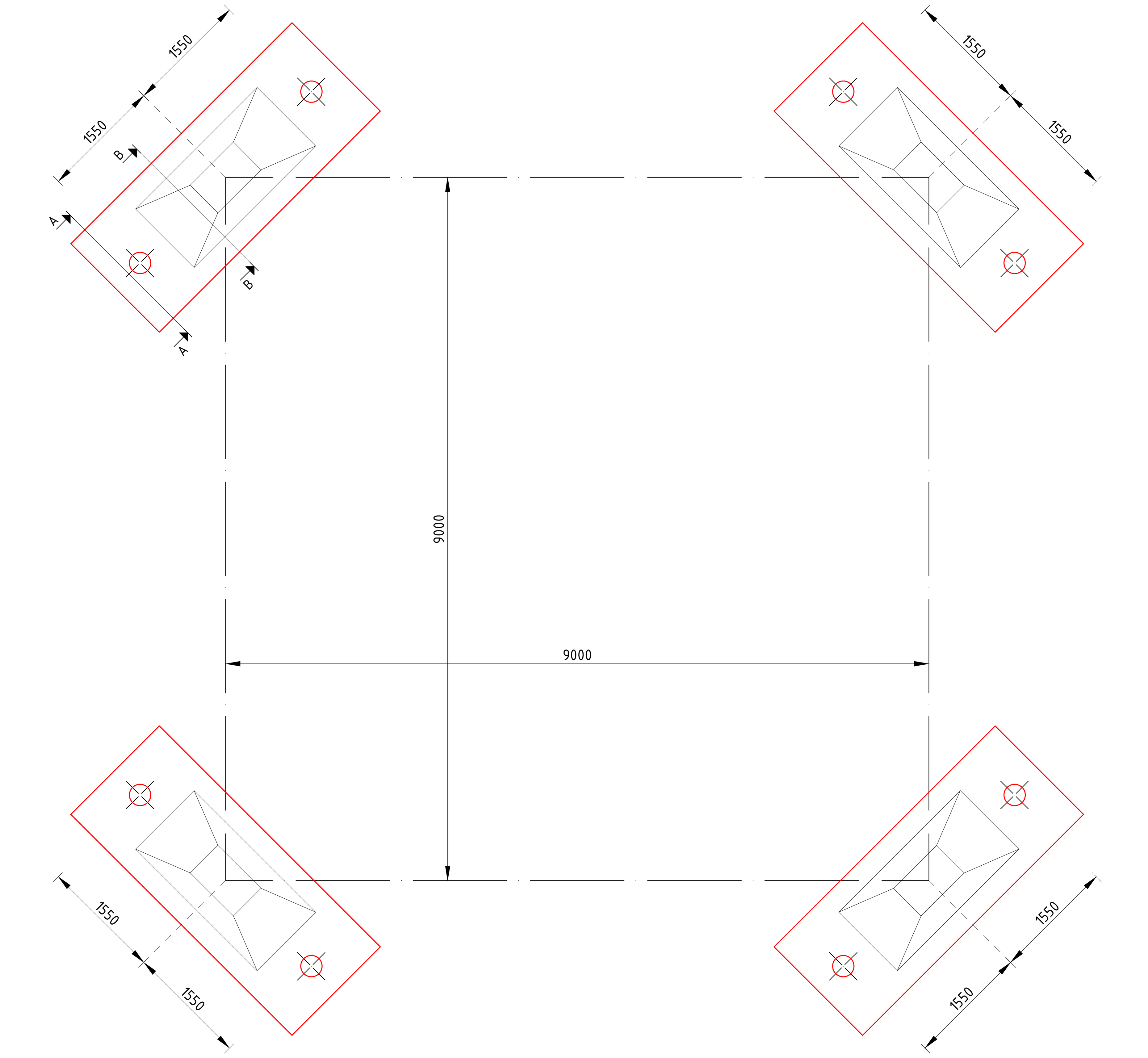
Revision: 00

Format: A2

OVER DNV GL

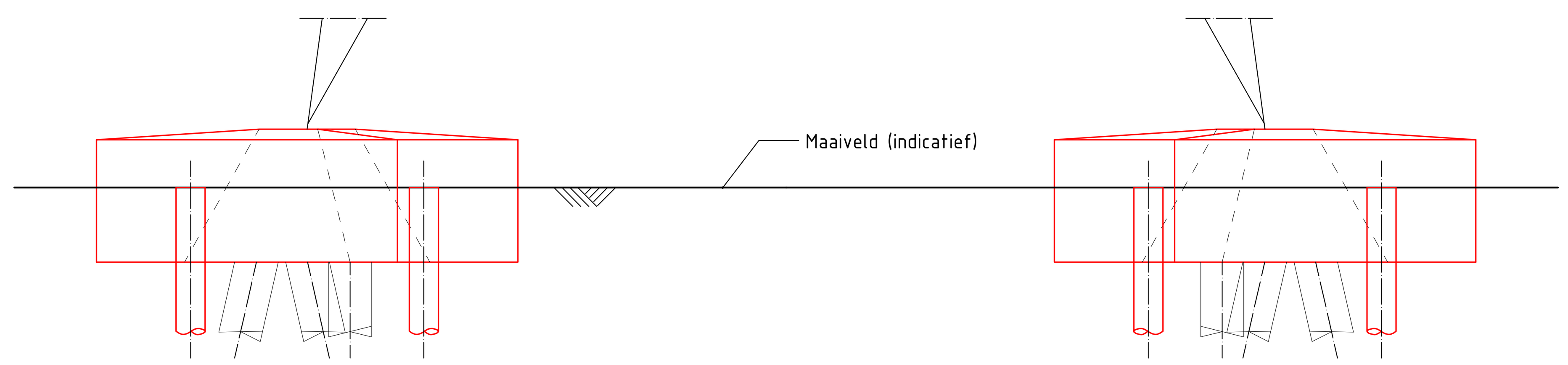
DNV GL is een wereldwijd bedrijf voor kwaliteitsborging en risicobeheer. Vanuit haar streven leven, bezit en het milieu te beschermen stelt DNV GL organisaties in staat de veiligheid en duurzaamheid van hun activiteiten te bevorderen. DNV GL biedt classificering en technische borging, naast software en onafhankelijk, deskundig advies voor de maritieme, de olie- en gasindustrie, energiecentrales en de duurzame energiesector. Daarnaast biedt het bedrijf certificeringsservices en datamanagement voor klanten in uiteenlopende sectoren. Onze medewerkers zijn actief in meer dan 100 landen over de hele wereld en streven ernaar klanten te helpen de wereld veiliger, slimmer en groener te maken.

Bijlage 18 Fundatietekeningen rapportage S+0, S+3, S+6 en S+9



Palenplan

schaal 1:50

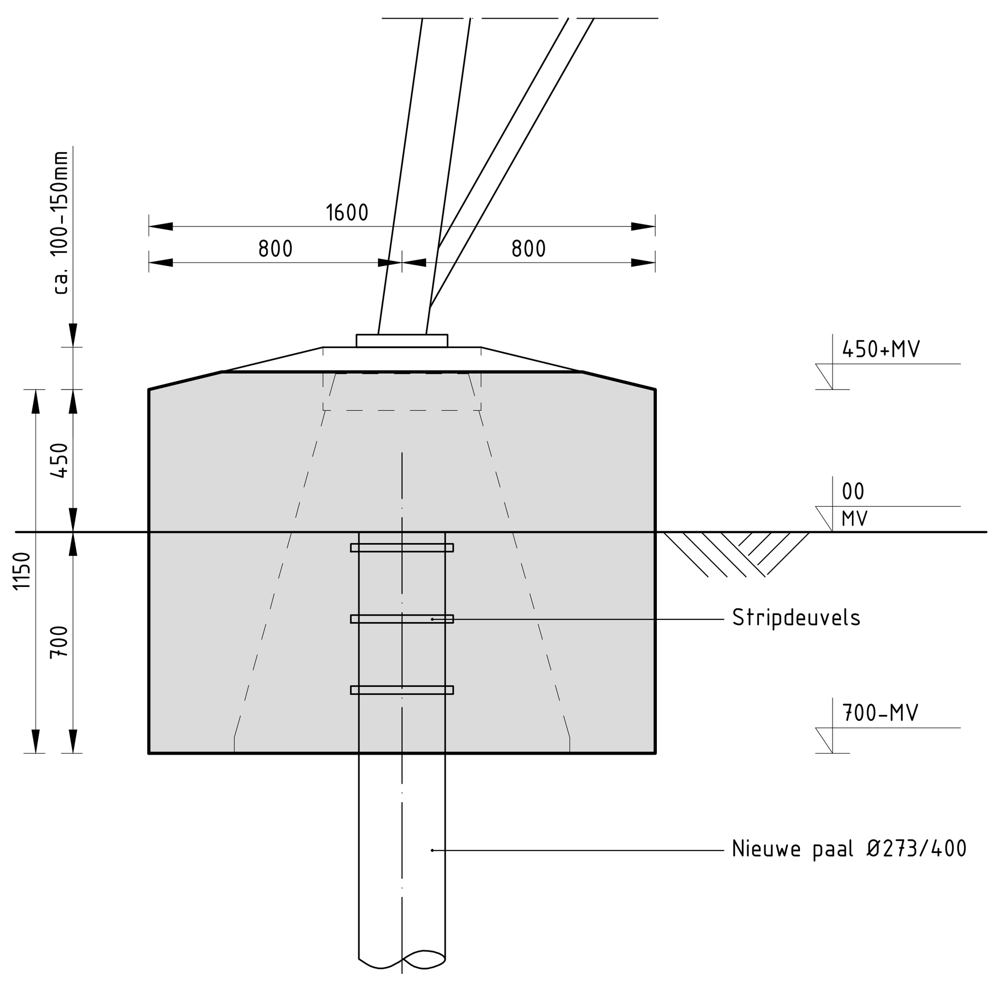


Langsdoorsnede

schaal 1:50

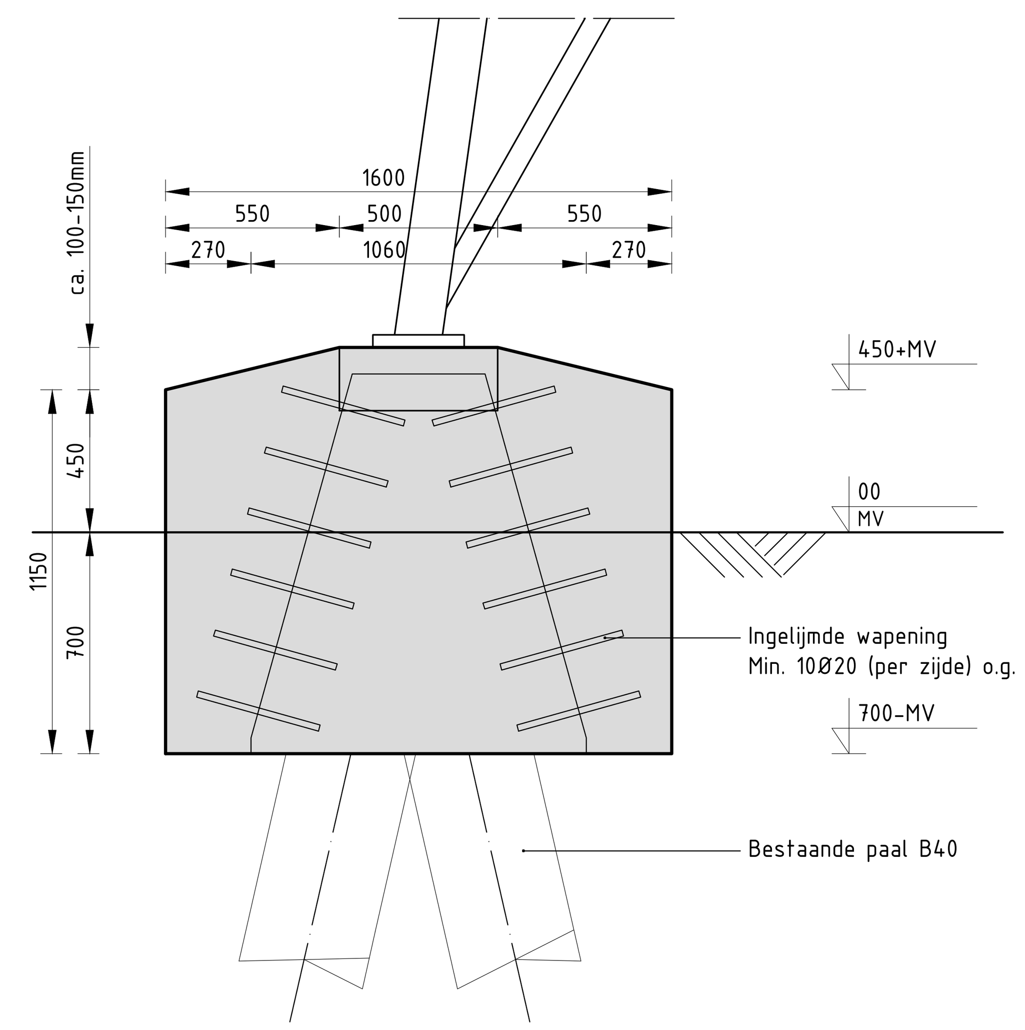
Mastnr.	Masttype	Aantal	Paaltype	Paallengte (m)	b.k. paal t.o.v. NAP (m)	PPN t.o.v. NAP (m)	Schoorstand	Staalkwaliteit
6	S+0 II	8	SI-paal 273/400	15.56	-1.44	-17.0	-	S355
7	S+0 II	8	SI-paal 273/400	15.34	-1.66	-17.0	-	S355
16	S+0 II	8	SI-paal 273/400	18.59	-1.91	-20.5	-	S355
17	S+0 II	8	SI-paal 273/400	18.69	-1.81	-20.5	-	S355
18	S+0 II	8	SI-paal 273/400	17.79	-1.71	-19.5	-	S355
19	S+0 II	8	SI-paal 273/400	17.37	-1.63	-19.0	-	S355
20	S+0 II	8	SI-paal 273/400	18.56	-1.44	-20.0	-	S355
21	S+0 II	8	SI-paal 273/400	15.75	-1.75	-17.5	-	S355
22	S+0 II	8	SI-paal 273/400	16.86	-1.65	-18.5	-	S355
23	S+0 II	8	SI-paal 273/400	17.28	-1.72	-19.0	-	S355
24	S+0 II	8	SI-paal 273/400	16.42	-1.58	-18.0	-	S355
26	S+0 II	8	SI-paal 273/400	17.45	-1.55	-19.0	-	S355
29	S+0 II	8	SI-paal 273/400	17.36	-1.64	-19.0	-	S355
30	S+0 II	8	SI-paal 273/400	17.40	-1.60	-19.0	-	S355
31	S+0 II	8	SI-paal 273/400	18.02	-1.48	-19.5	-	S355
32	S+0 II	8	SI-paal 273/400	15.95	-1.55	-17.5	-	S355
33	S+0 II	8	SI-paal 273/400	15.42	-1.59	-17.0	-	S355
34	S+0 II	8	SI-paal 273/400	17.03	-1.47	-18.5	-	S355
35	S+0 II	8	SI-paal 273/400	16.91	-1.60	-18.5	-	S355
36	S+0 II	8	SI-paal 273/400	16.28	-1.72	-18.0	-	S355
39	S+0 II	8	SI-paal 273/400	16.92	-1.58	-18.5	-	S355
41	S+0 II	8	SI-paal 273/400	15.46	-1.54	-17.0	-	S355
42	S+0 II	8	SI-paal 273/400	13.63	-1.37	-15.0	-	S355
45	S+0 II	8	SI-paal 273/400	15.75	-1.25	-17.0	-	S355
47	S+3 II	8	SI-paal 273/400	16.16	-1.34	-17.5	-	S355

Overzichtstabel



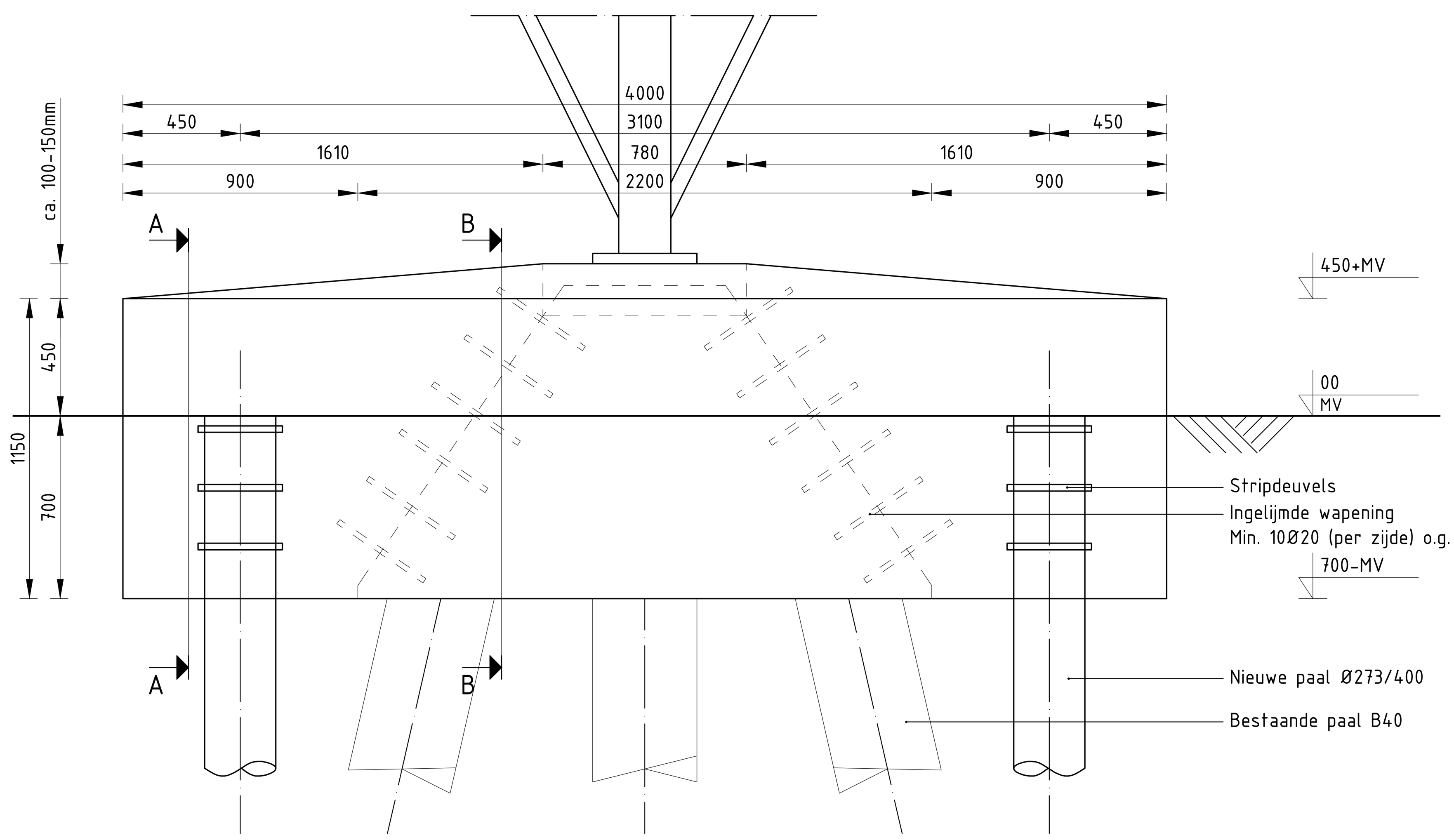
Doorsnede A-A

schaal 1:20



Doorsnede B-B

schaal 1:20



Aanzicht

schaal 1:20

Opmerkingen :

- Alle maatvoering in mm
- Alle hoogtemaatvoering in mm t.o.v. maaiveld (tenzij anders aangegeven)
- Maatvoering en hoogteligging i.h.w. controleren
- Voor palenplan en langsdoorsnede:
  - Bestaande fundatie
  - Nieuwe fundatie
- Zijvlakken bestaande poer opruwen t.p.v. aansluitvlak
- Aardingsvoorzieningen zijn niet weergegeven op tekening
- Ontwerp volgens rapportage DNV 20-0731 rev.2 (Meridian 002.589.40 0808656)

3.0	15-7-2021	Projectnummer gecorrigeerd
2.0	15-7-2021	RFA-commentaar verwerkt
1.0	07-07-2021	Eerste uitgave
0.1	06-07-2021	Concept versie

DNV·GL

Projectname: BBB380 - Modelleren funderingen

Third angle projection:

Drawing no.: 10166262-032-200 002.589.40 0945015

Design state: Definitief		Scale:	1:20 / 1:50	Description: Verbinding KIJ-GT380 Principetekening fundatie 3P+2P
Drawn by: MRE	7-7-2021	Units:	mm	Revision: 3.0
Checked by: TBO	7-7-2021	Project no:	10166262	Format: A1
Approved by: JHU	7-7-2021	Client:	TenneT	

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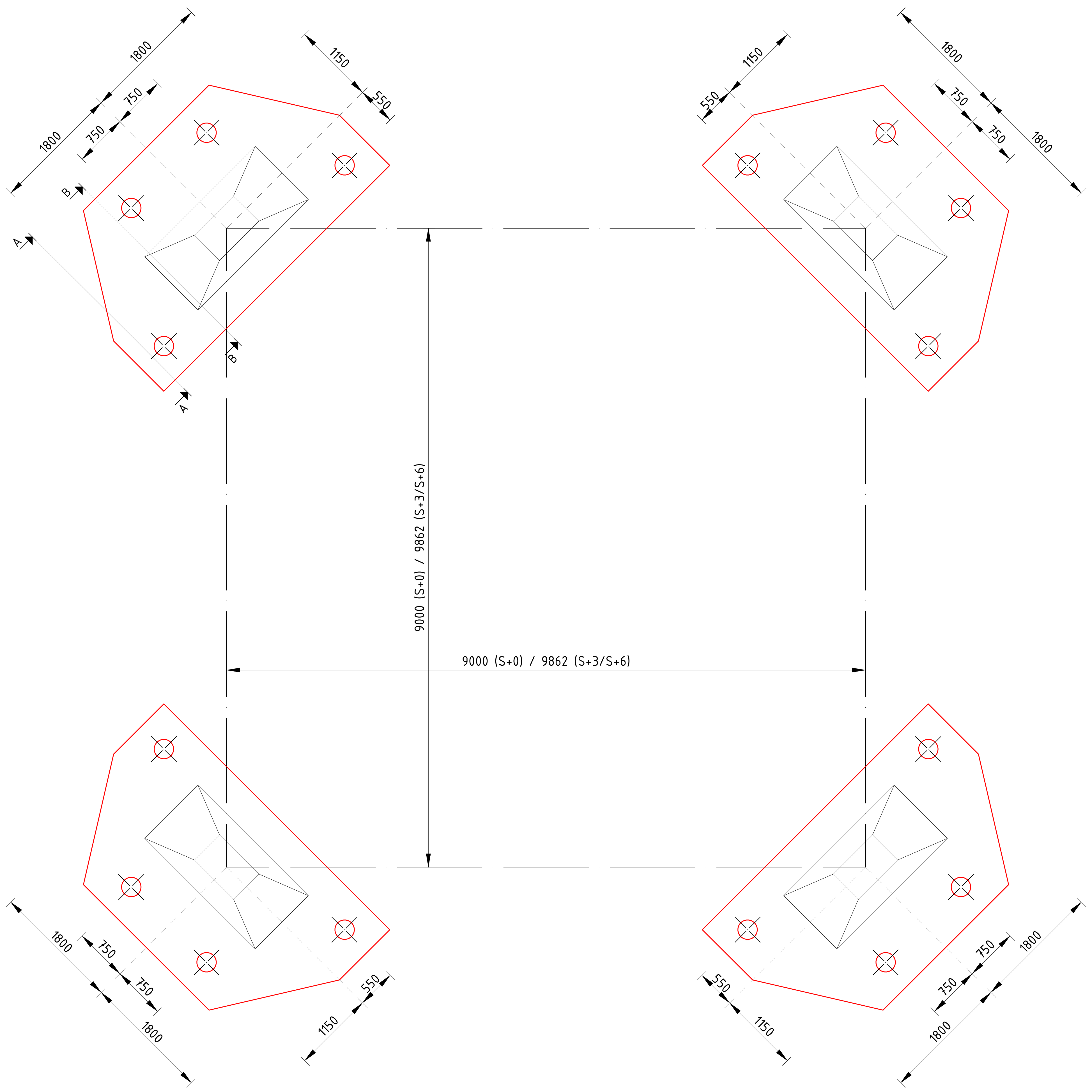
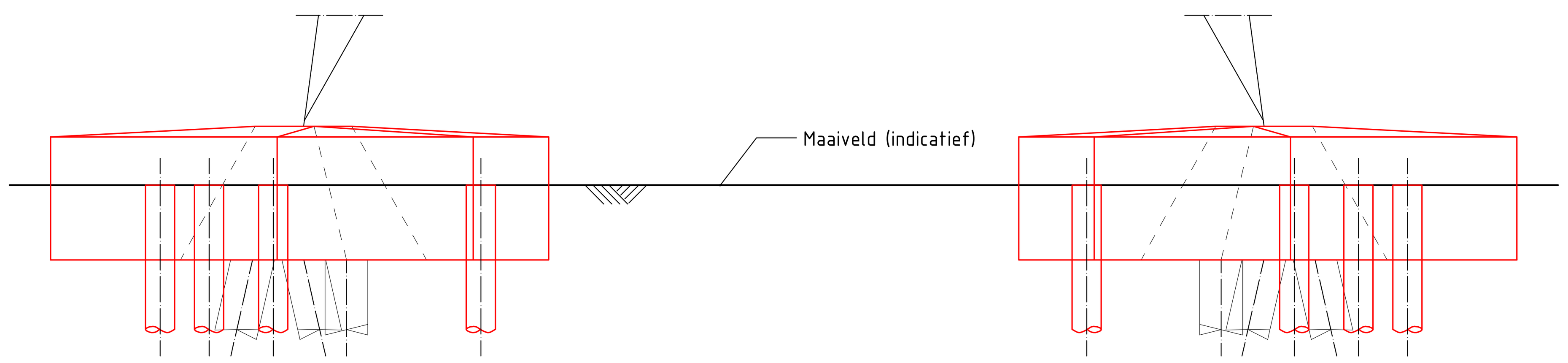


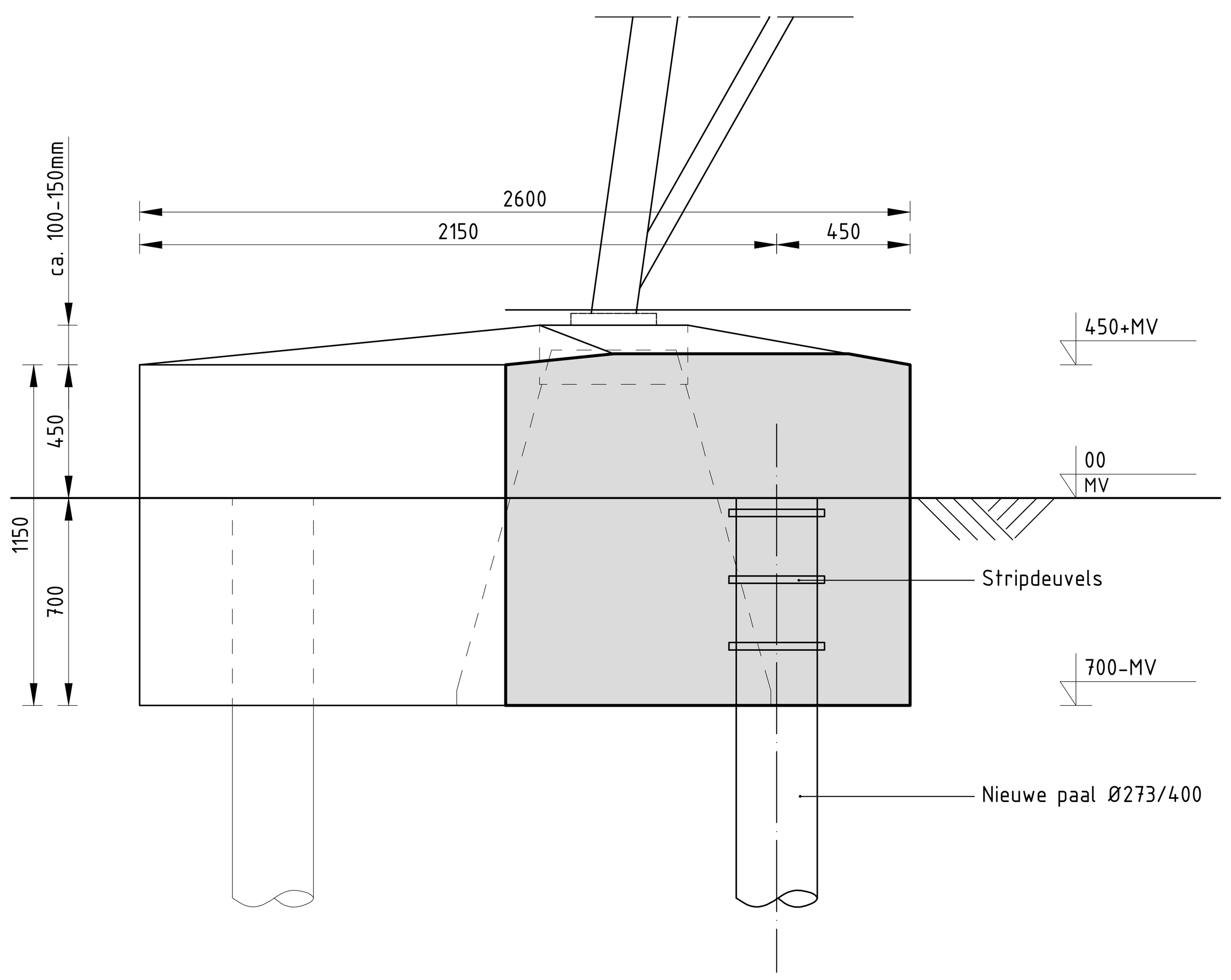
Palenplan

schaal 1:50



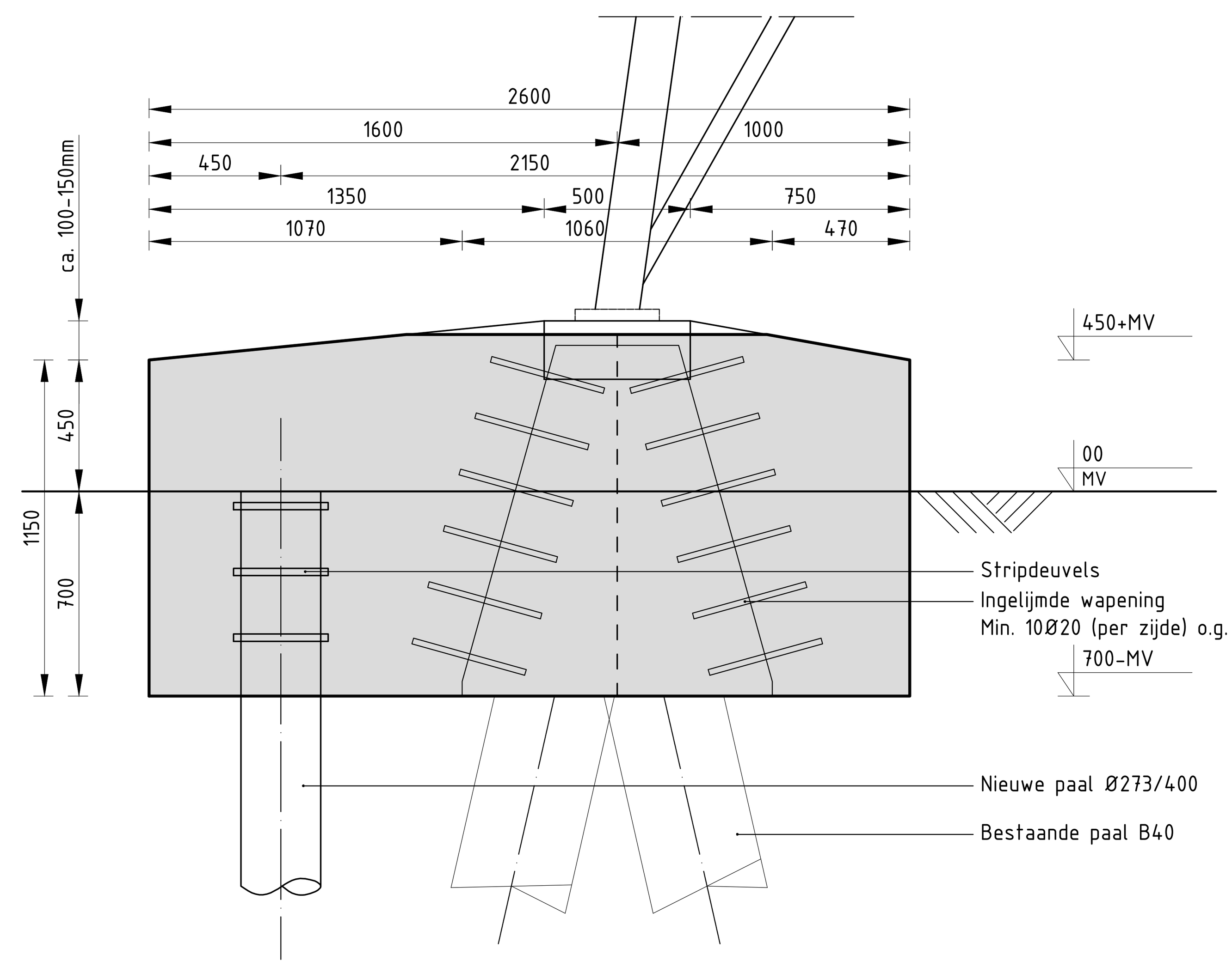
Langsdoorsnede

schaal 1:50



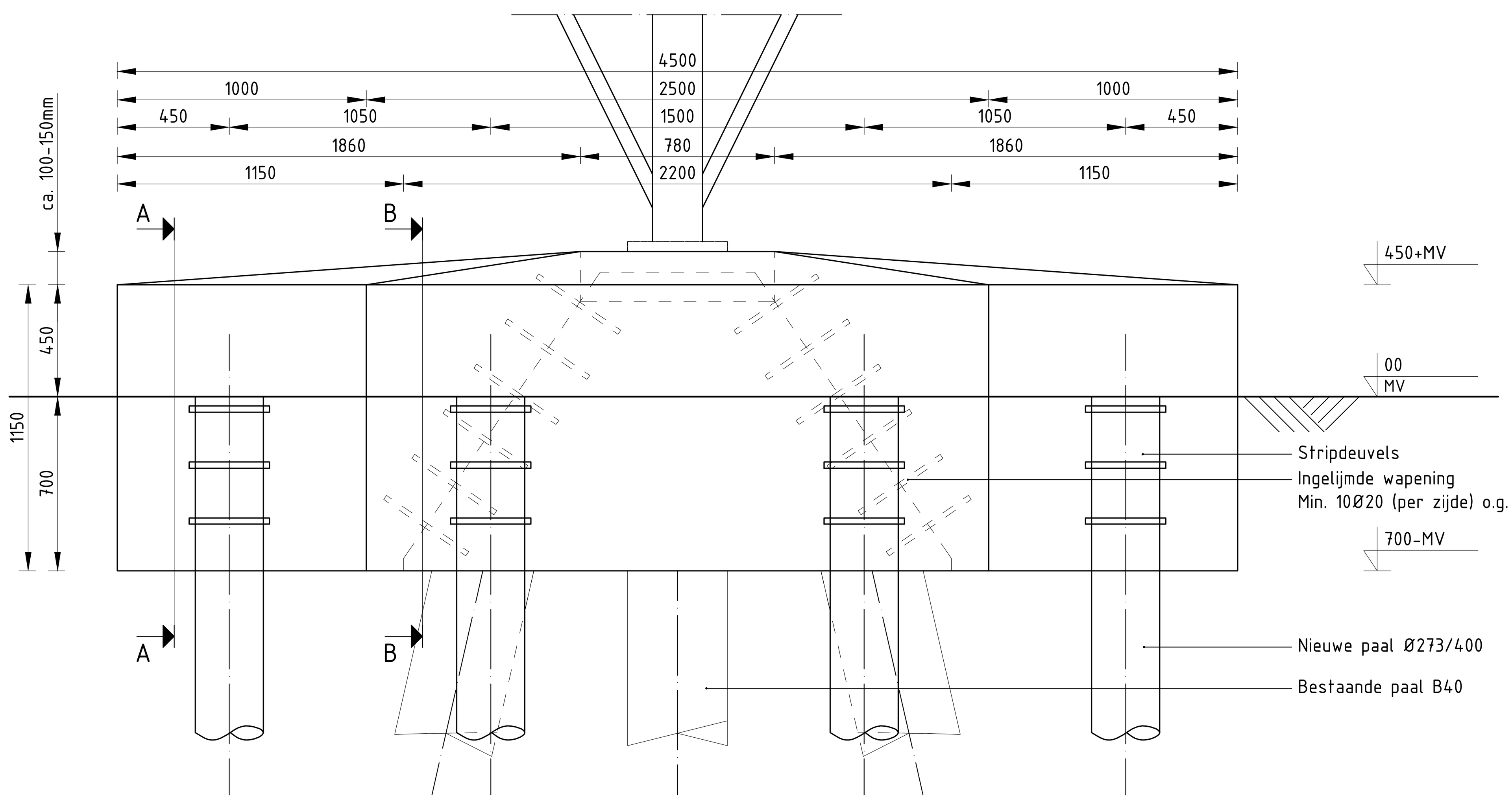
Doorsnede A-A

schaal 1:20



Doorsnede B-B

schaal 1:20



Aanzicht

schaal 1:20

Mastnr.	Masttype	Aantal	Paaltype	Paallengte (m)	b.k. paal t.o.v. NAP (m)	PPN t.o.v. NAP (m)	Schoorstand	Staalkwaliteit
4	S+6 II	16	SI-paal 273/400	16.23	-1.77	-18.0	-	S355
5	S+6 II	16	SI-paal 273/400	15.46	-1.54	-17.0	-	S355
9	S+6 II	16	SI-paal 273/400	13.58	-1.42	-15.0	-	S355
10	S+6 II	16	SI-paal 273/400	14.64	-1.36	-16.0	-	S355
27	S+6 II	16	SI-paal 273/400	16.46	-1.54	-18.0	-	S355
28	S+6 II	16	SI-paal 273/400	16.32	-1.68	-18.0	-	S355
40	S+0 II	16	SI-paal 273/400	15.21	-1.29	-16.5	-	S355
43	S+6 II	16	SI-paal 273/400	16.04	-1.46	-17.5	-	S355
44	S+6 II	16	SI-paal 273/400	14.58	-1.42	-16.0	-	S355
46	S+3 II T	16	SI-paal 273/400	15.65	-1.35	-17.0	-	S355

Overzichtstabel

Opmerkingen :

- Alle maatvoering in mm
- Alle hoogtemaatvoering in mm t.o.v. maaiveld (tenzij anders aangegeven)
- Maatvoering en hoogteligging i.h.w. controleren

- Voor palenplan en langsdoorsnede:
  - Bestaande fundatie
  - Nieuwe fundatie

- Zijvlakken bestaande poer opruwen t.p.v. aansluitvlak
- Aardingsvoorzieningen zijn niet weergegeven op tekening

- Ontwerp volgens rapportage DNV 20-0731 rev.2 (Meridian 002.589.40 0808656)

3.0	15-7-2021	Projectnummer gecorrigeerd
2.0	15-7-2021	RFA-commentaar verwerkt
1.0	07-07-2021	Eerste uitgave
0.1	06-07-2021	Concept versie

DNV·GL

Projectname: BBB380 - Modelleren funderingen

Third angle projection:

Drawing no.: 10166262-032-201 002.589.40 0945016

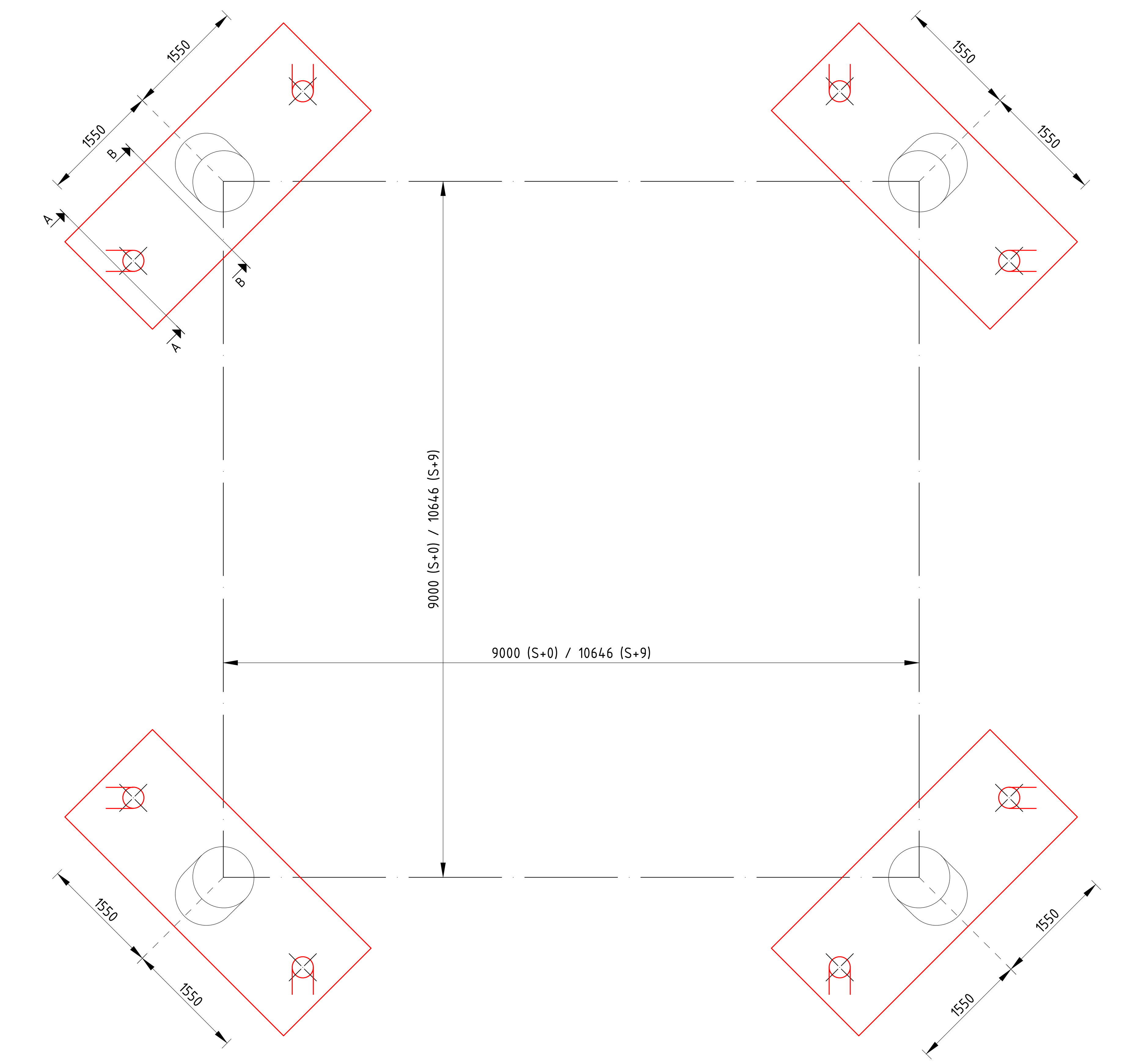
Design state:	Definitief		Scale:	1:20 / 1:50
Drawn by:	MRE	7-7-2021	Units:	mm
Checked by:	TBO	7-7-2021	Project no:	10166262
Approved by:	JHU	7-7-2021	Client:	TenneT

Description: Verbinding KIJ-GT380 Principetekening fundatie 3P+4P

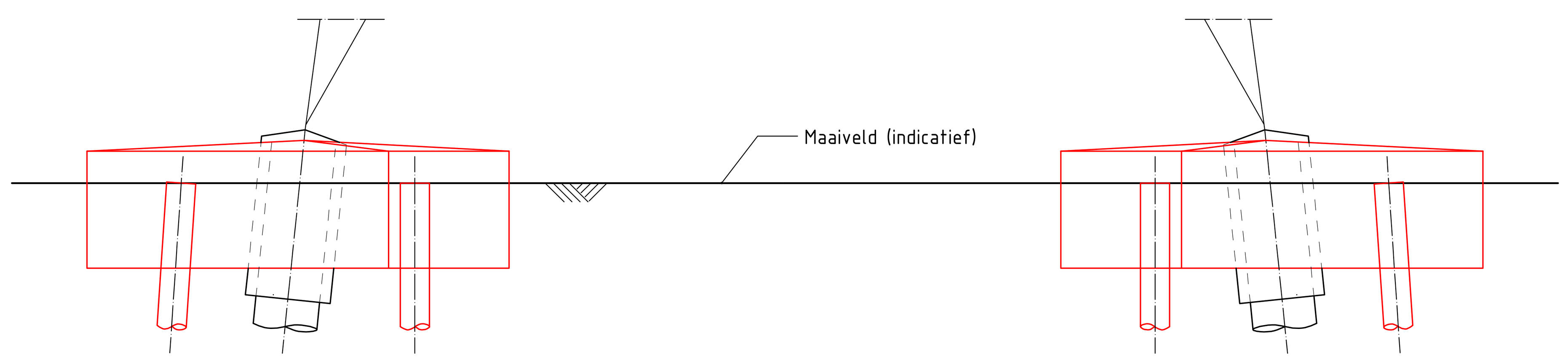
Revision: 3.0

Format: A1

[redacted]



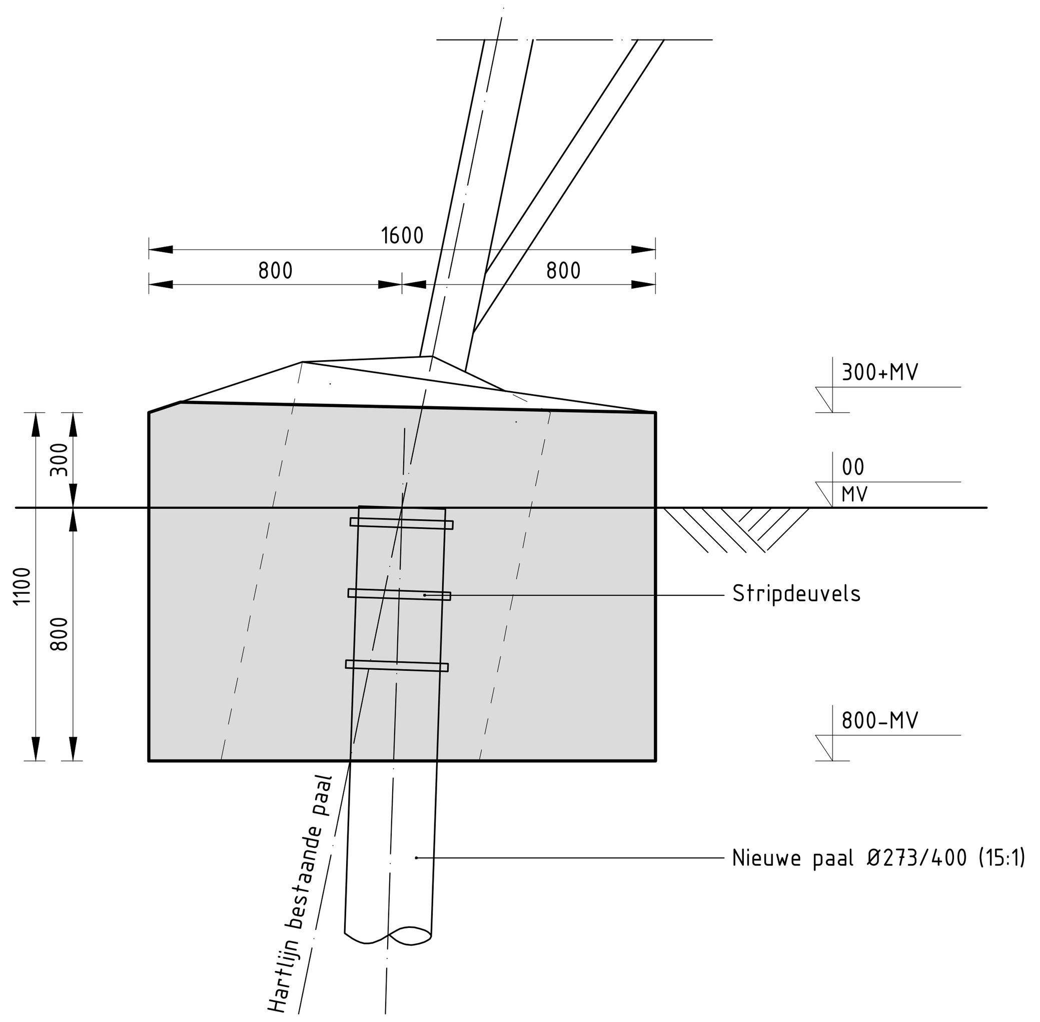
Palenplan
schaal 1:50



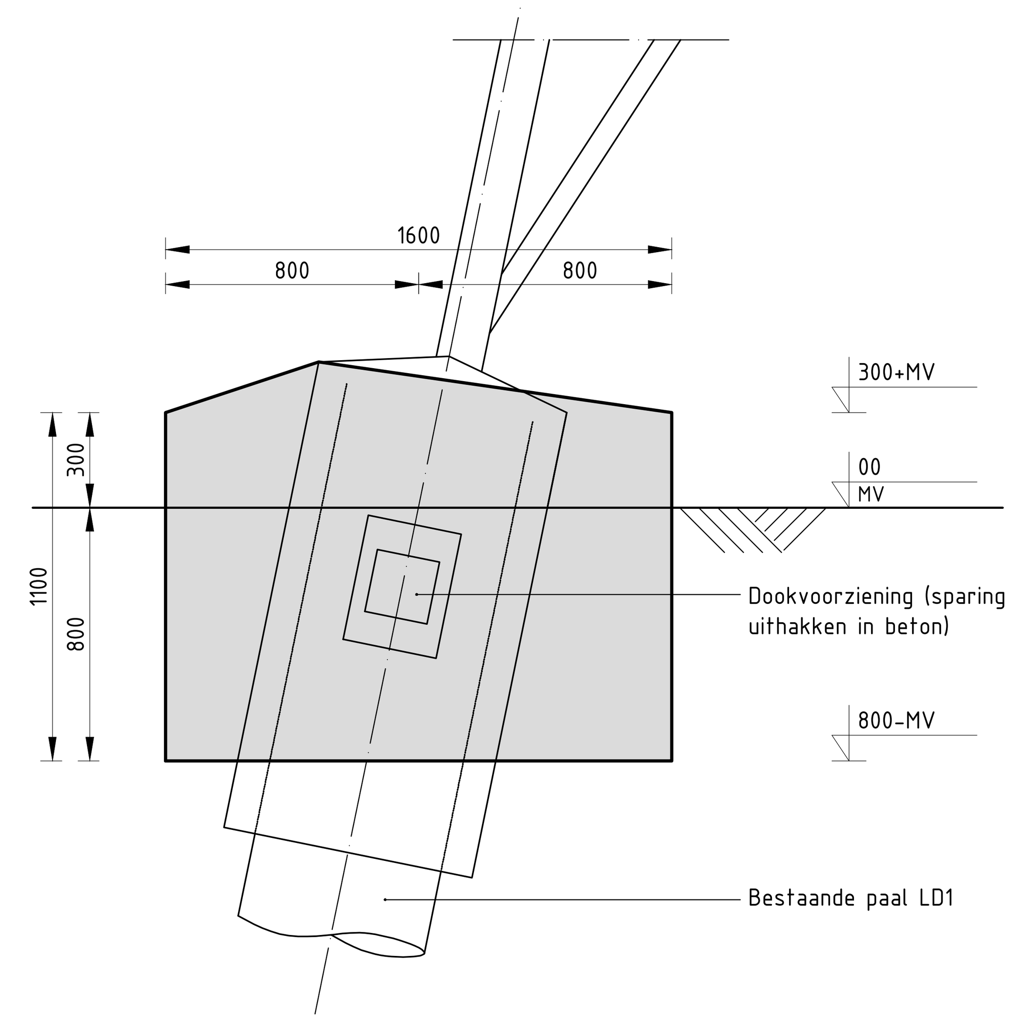
Langsdoorsnede
schaal 1:50

Mastnr.	Masttype	Aantal	Paaltype	Paallengte (m)	b.k. paal t.o.v. NAP (m)	PPN t.o.v. NAP (m)	Schoorstand	Staalkwaliteit
55	S+0	8	SI-paal 273/400	18.97	0.47	-18.5	1:15	S355
56	S+0	8	SI-paal 273/400	16.22	0.72	-15.5	1:15	S355
64	S+0	8	SI-paal 273/400	19.90	0.40	-19.5	1:15	S355
66	S+0	8	SI-paal 273/400	12.00	0.75	-11.3	1:15	S355
79	S+0	8	SI-paal 273/400	15.00	0.24	-14.8	1:15	S355
80	S+9	8	SI-paal 273/400	13.50	0.54	-13.0	1:15	S355
82	S+0	8	SI-paal 273/400	13.00	0.40	-12.6	1:15	S355

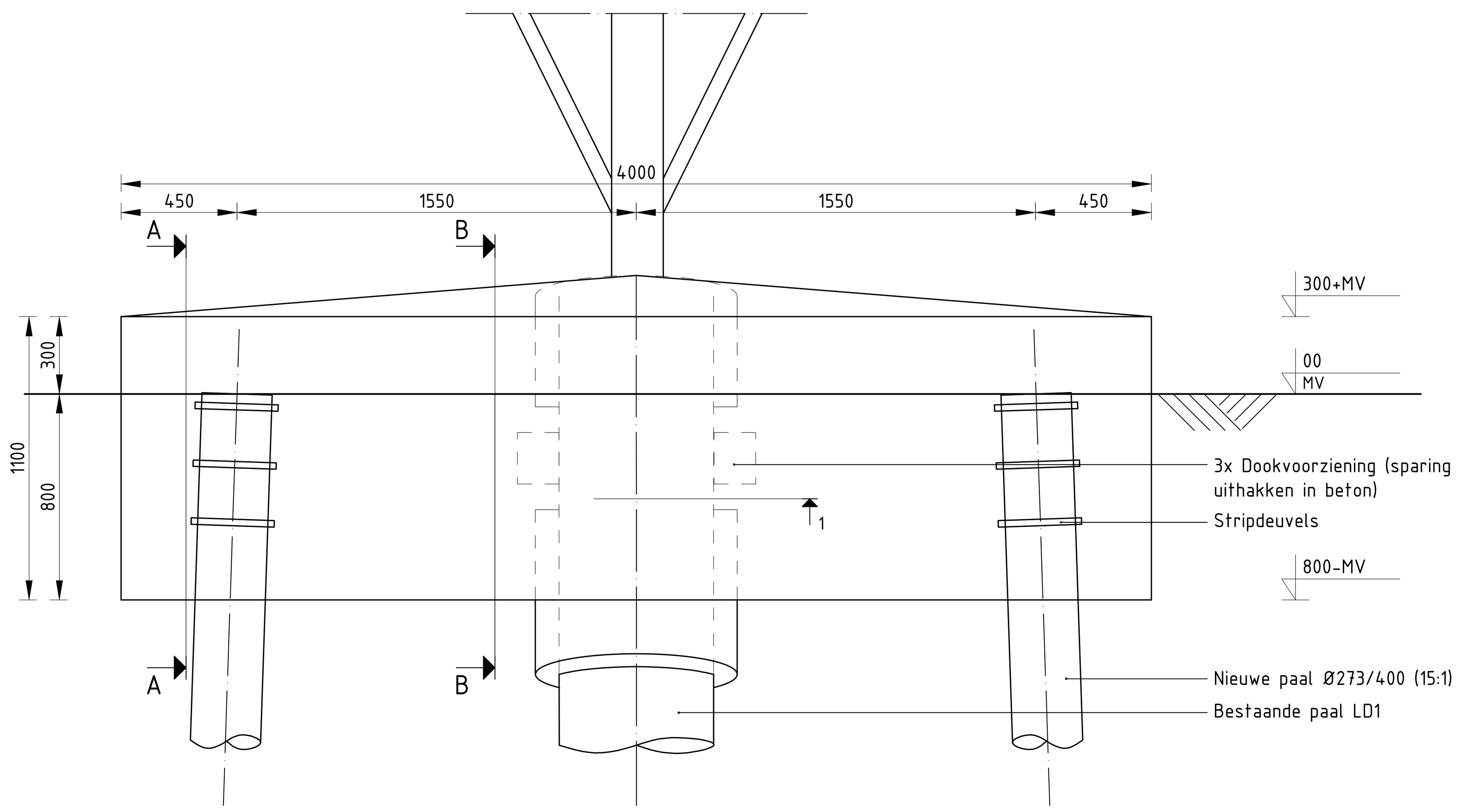
Overzichtstabel



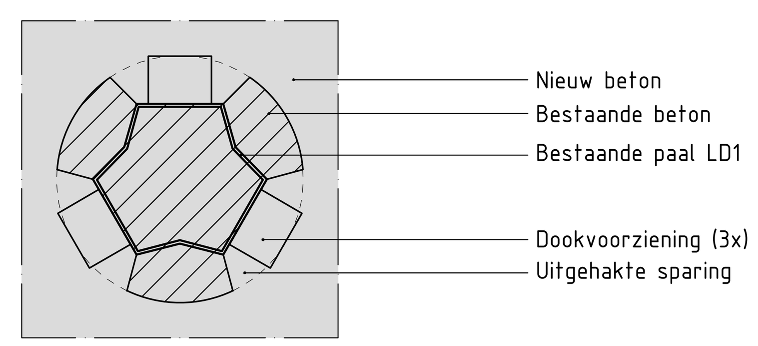
Doorsnede A-A
schaal 1:20



Doorsnede B-B
schaal 1:20



Aanzicht
schaal 1:20



Detail 1 - principe dookvoorziening
schaal 1:20

Opmerkingen :

- Alle maatvoering in mm
- Alle hoogtemaatvoering in mm t.o.v. maaiveld (tenzij anders aangegeven)
- Maatvoering en hoogteligging i.h.w. controleren
- Voor palenplan en langsdoorsnede:
  - Bestaande fundatie
  - Nieuwe fundatie
- Zijvlakken bestaande poer opruwen t.p.v. aansluitvlak
- Aardingsvoorzieningen zijn niet weergegeven op tekening
- Ontwerp volgens rapportage DNV 20-0731 rev.2 (Meridian 002.589.40 0808656)

3.0	15-7-2021	Projectnummer gecorrigeerd
2.0	15-7-2021	RFA-commentaar verwerkt
1.0	07-07-2021	Eerste uitgave
0.1	06-07-2021	Concept versie

DNV·GL

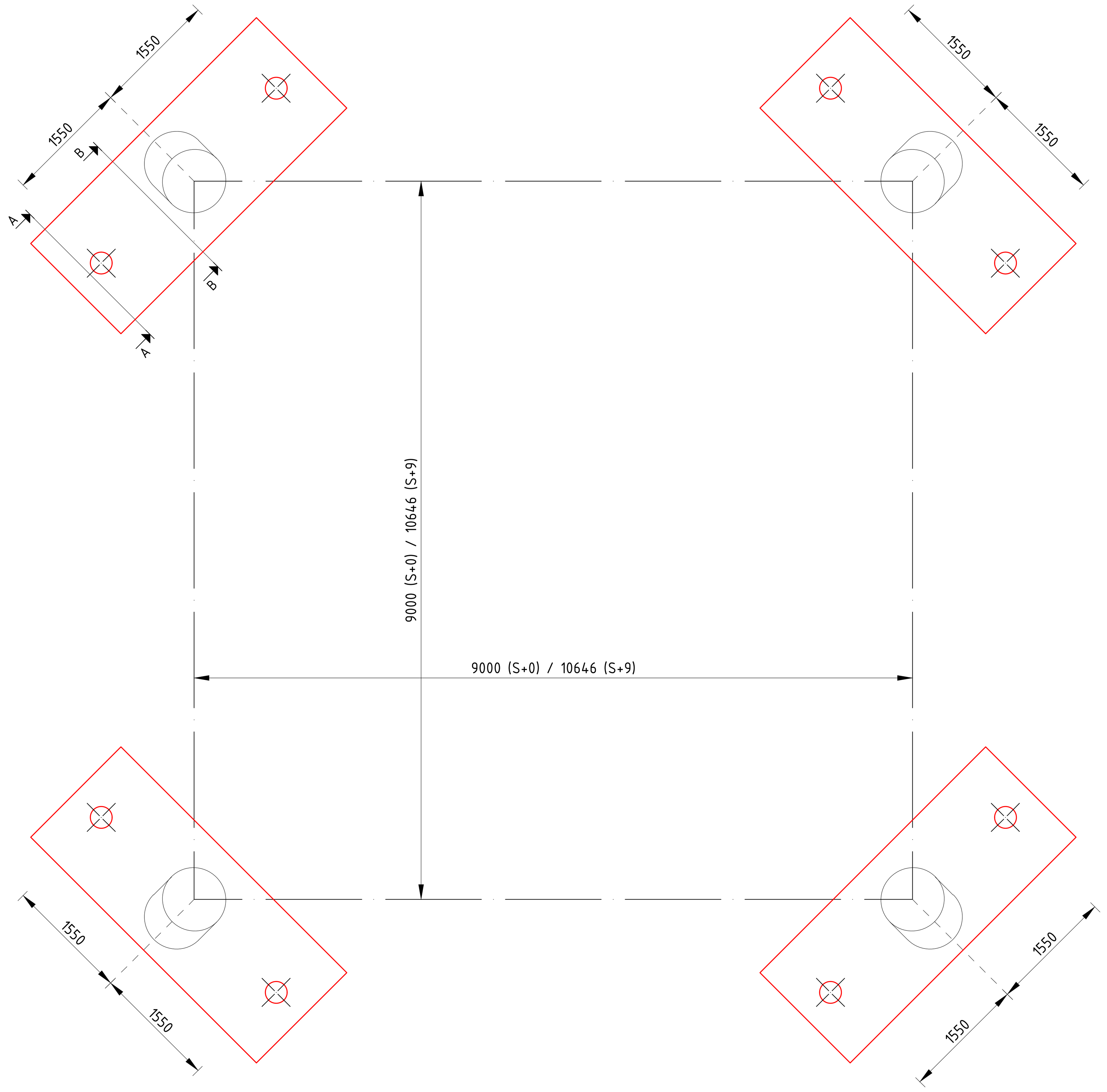
Projectname: BBB380 - Modelleren funderingen

Third angle projection:

Drawing no.: 10166262-032-202 002.589.40 0945019

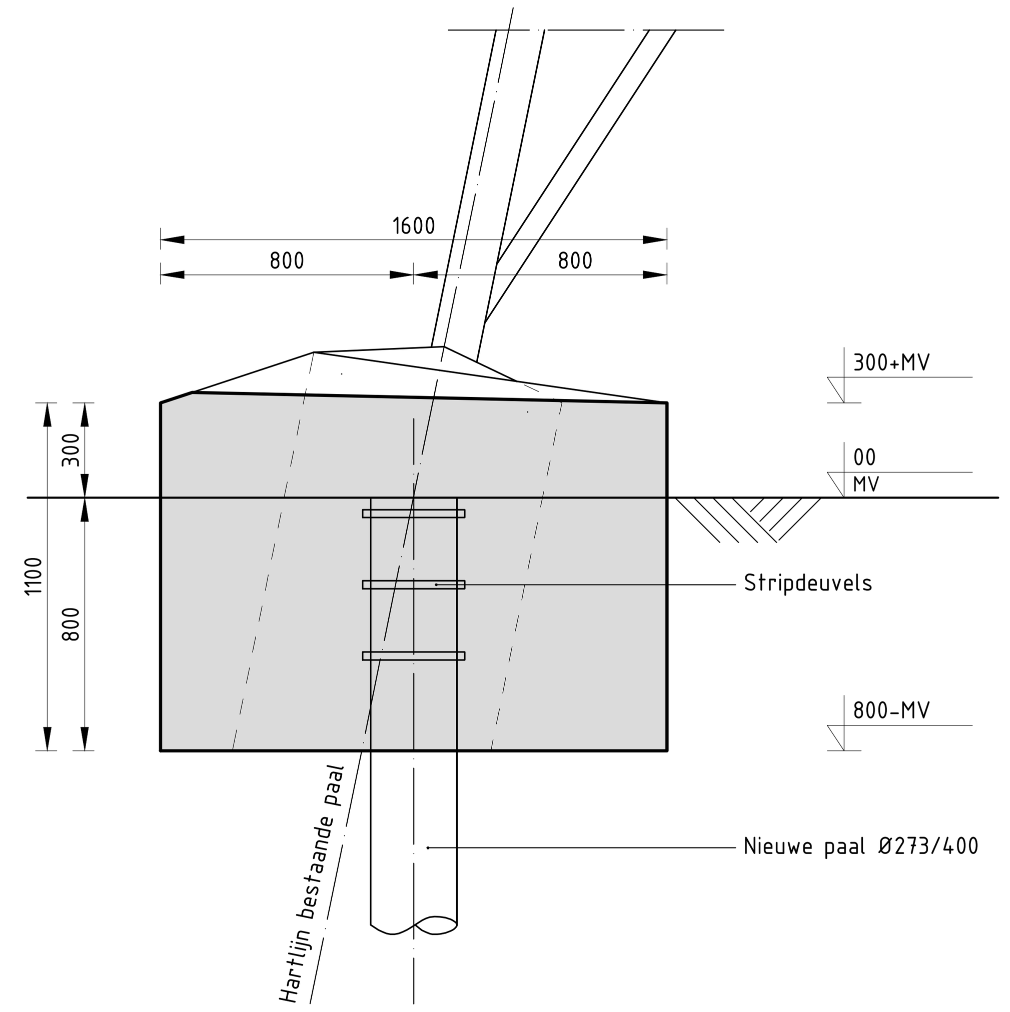
Design state: Definitief		Scale: 1:20 / 1:50	Description: Verbinding KIJ-GT380 Principetekening fundatie 1P+2P - type 1	Revision: 3.0
Drawn by: MRE	7-7-2021	Units: mm		Format: A1
Checked by: TBO	7-7-2021	Project no: 10166262		
Approved by: JHU	7-7-2021	Client: TenneT		

[redacted]



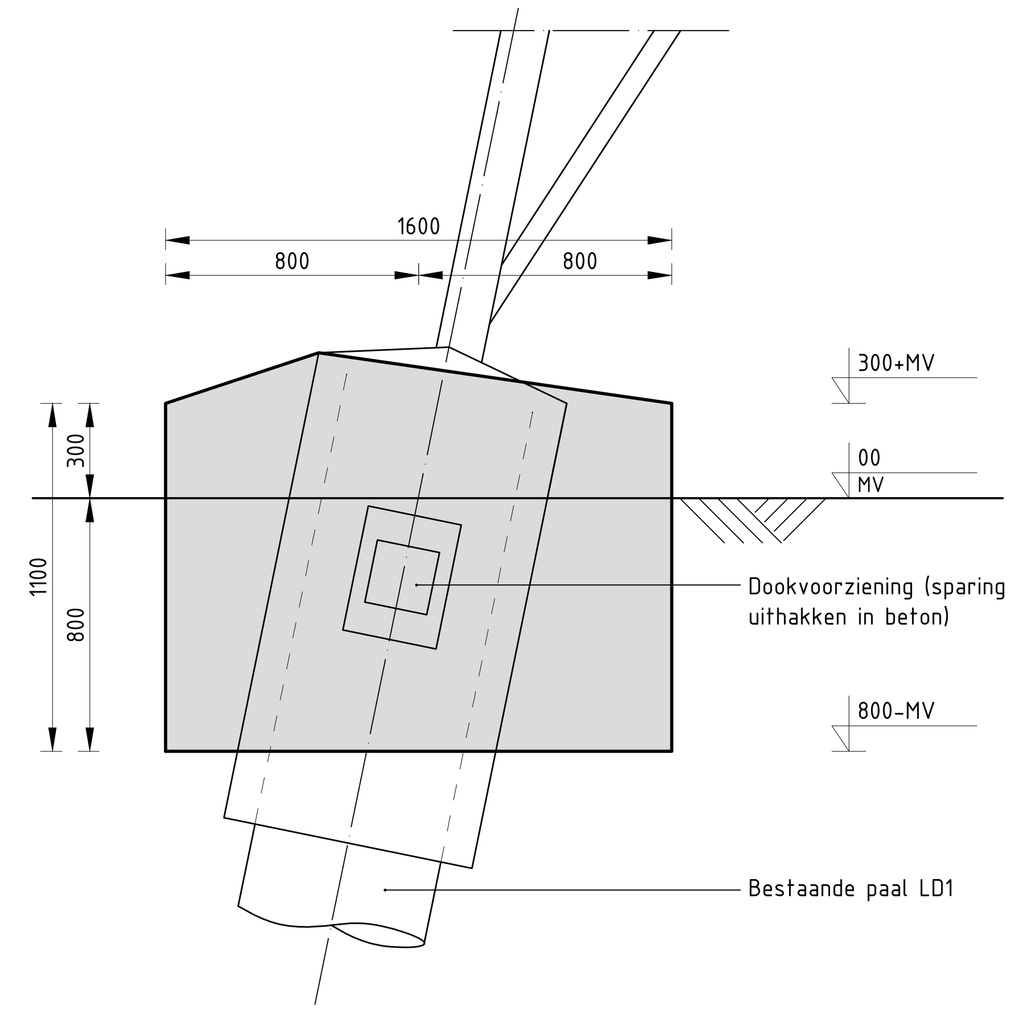
Palenplan

schaal 1:50



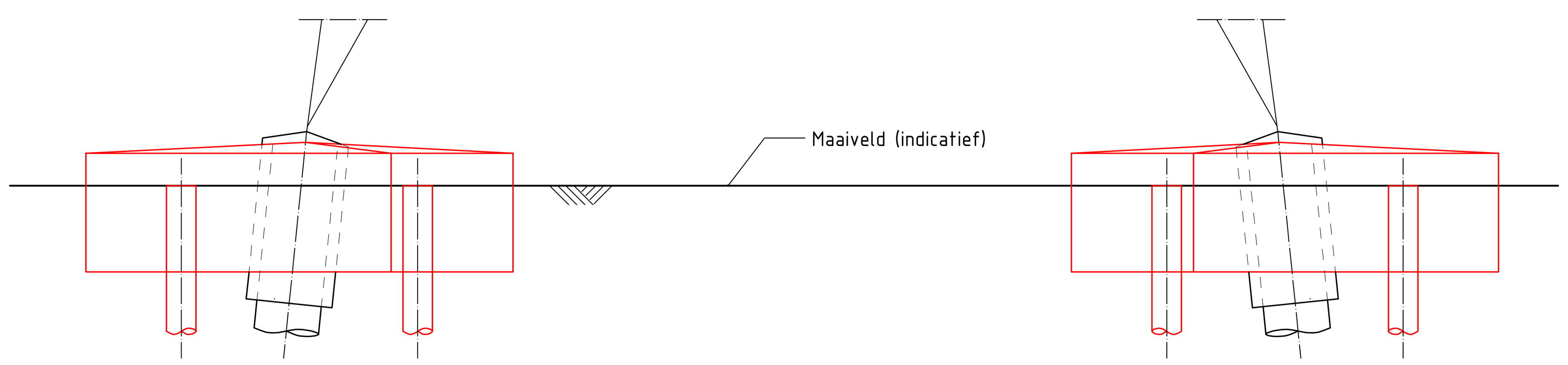
Doorsnede A-A

schaal 1:20



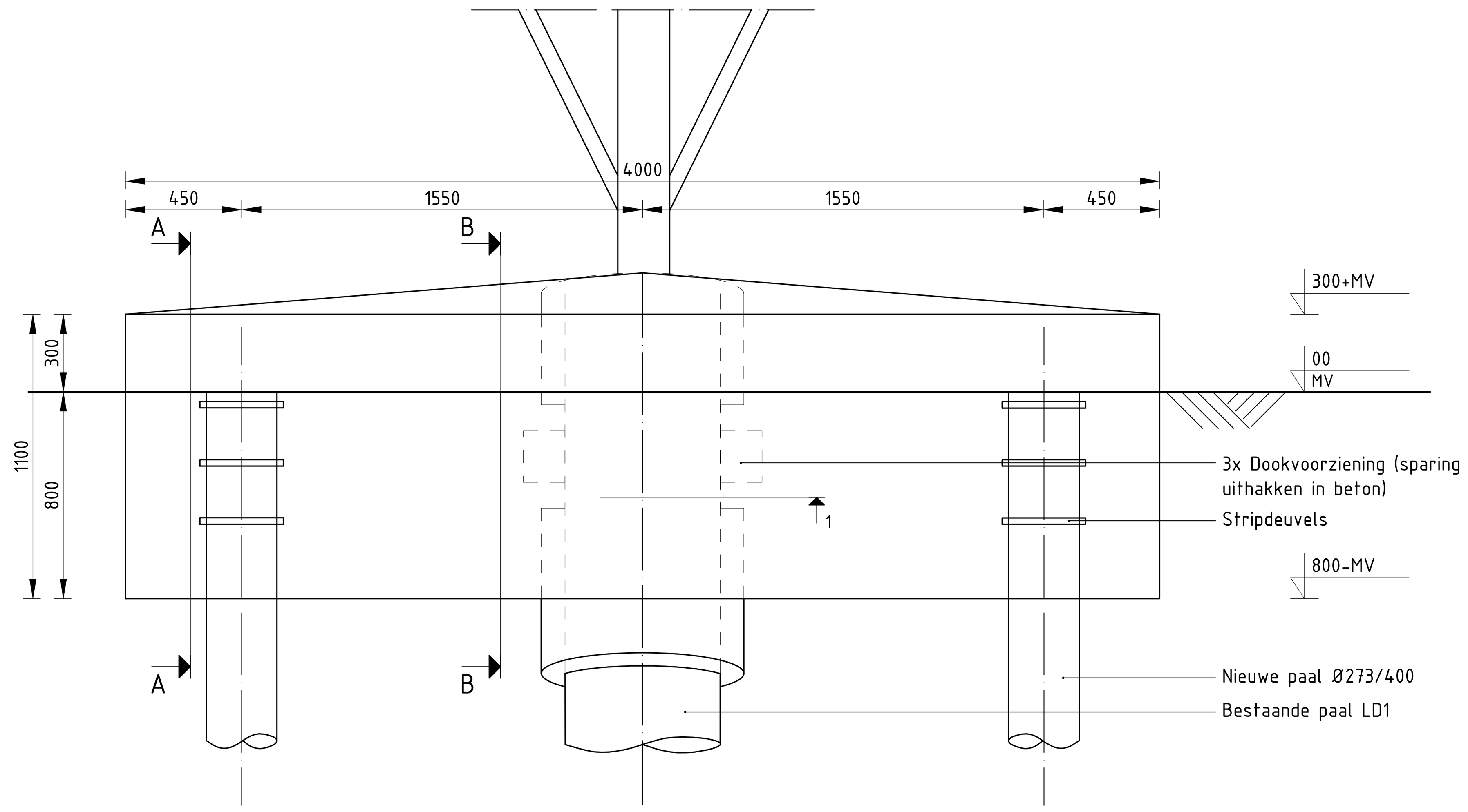
Doorsnede B-B

schaal 1:20



Langsdoorsnede

schaal 1:50



Aanzicht

schaal 1:20

Mastnr.	Masttype	Aantal	Paaltype	Paallengte (m)	b.k. paal t.o.v. NAP (m)	PPN t.o.v. NAP (m)	Schoorstand	Staalkwaliteit
62	S+0	8	SI-paal 273/400	17.21	1.21	-16.0	-	S355

Overzichtstabel

Opmerkingen :

- Alle maatvoering in mm
- Alle hoogtemaatvoering in mm t.o.v. maaiveld (tenzij anders aangegeven)
- Maatvoering en hoogteligging i.h.w. controleren

- Voor palenplan en langsdoorsnede:
  Bestaande fundatie
  Nieuwe fundatie

- Zijvlakken bestaande poer opruwen t.p.v. aansluitvlak
- Aardingsvoorzieningen zijn niet weergegeven op tekening

- Ontwerp volgens rapportage DNV 20-0731 rev.2 (Meridian 002.589.40 0808656)

3.0	15-7-2021	Projectnummer gecorrigeerd
2.0	15-7-2021	RFA-commentaar verwerkt
1.0	07-07-2021	Eerste uitgave
0.1	06-07-2021	Concept versie

DNV·GL

Projectname: BBB380 - Modelleren funderingen

Third angle projection:

Drawing no.: 10166262-032-203 002.589.40 0945021

Design state:	Definitief		Scale:	1:20 / 1:50	
Drawn by:	MRE	7-7-2021	Units:	mm	
Checked by:	TBO	7-7-2021	Project no:	10166262	
Approved by:	JHU	7-7-2021	Client:	TenneT	

Description: Verbinding KIJ-GT380
Principetekening fundatie 1P+2P - type 2

Revision: 3.0

Format: A1

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