**Bijlagenblad ten behoeve van aanvraag omgevingsvergunning gemeente Altena**
**Project: Beter Benutten KIJ-GT380 kV**
**Status: Definitief**
**Datum: 16-07-2021**

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|---|---|---|---|---|---|---|
| | | | | | | |
| 16 | Rapport | Rapportage Mastconstructie S+18 | DNV-GL | 21-1105 | 6-7-2021 | Rev.0 |
| 17 | Rapport | Rapportage Mastconstructie S+24 | DNV-GL | 21-1091 | 6-7-2021 | Rev.0 |
| 18 | Rapport | Rapportage Mastconstructie S+3 | DNV-GL | 21-1089 | 5-7-2021 | Rev.0 |
| 19 | Rapport | Rapportage Mastconstructie S+4 | DNV-GL | 21-1079 | 5-7-2021 | Rev.0 |
| 20 | Rapport | Rapportage Mastconstructie S+48 | DNV-GL | 21-1076 | 2-7-2021 | Rev.0 |
| 21 | Rapport | Rapportage Mastconstructie S+75 & S+75 T | DNV-GL | 21-1093 | 5-7-2021 | Rev.0 |
| 22 | Rapport | Rapportage Mastconstructie S+9 | DNV-GL | 21-1077 | 2-7-2021 | Rev.0 |
| 23 | Rapport | Rapportage Mastconstructie WA+0 | DNV-GL | 21-1078 | 5-7-2021 | Rev.0 |
| 24 | Tekening | Fundatietekeningen rapportage S+0, S+3, S+6 en S+9 | DNV-GL | 10166262-032-200<br>10166262-032-201<br>10166262-032-202<br>10166262-032-203 | 15-7-2021 | Rev.3 |

Bijlage 16 Rapportage Mastconstructie S+18

DNV·GL

"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

| | | |
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| Projectnaam: | "Toetsing en herontwerp masten en fundaties BBB380" | DNV GL - Energy<br>Energy Advisory |
| Rapport titel: | KIJ-GT380 – Rapportage mast S+18 | Postbus 9035 |
| Klant: | TenneT TSO B.V. | 6800 ET ARNHEM |
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DNV GL Netherlands B.V.

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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.

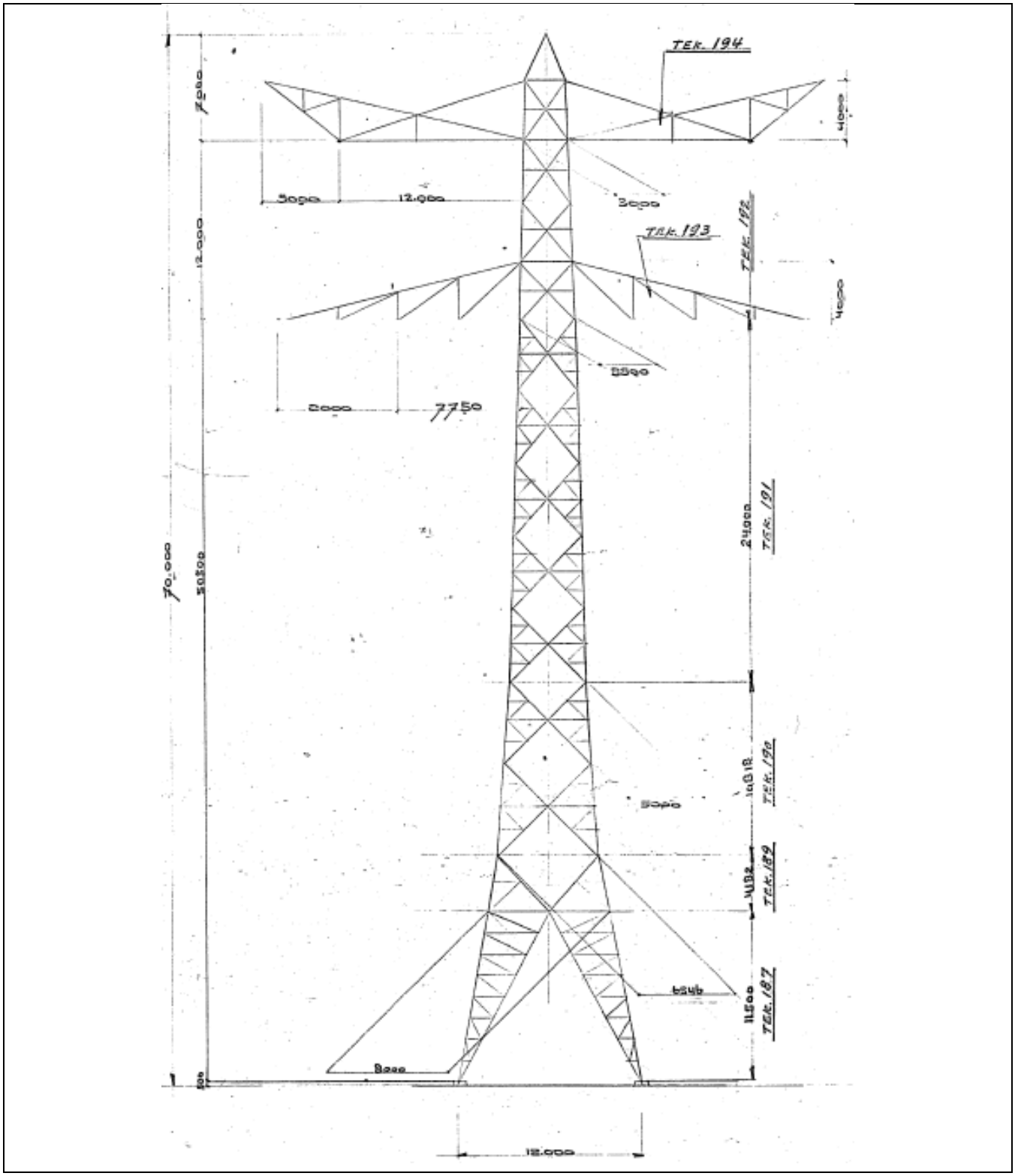
**Tabel 1 Relevante eisen**

| 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".<br><br>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<br>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:

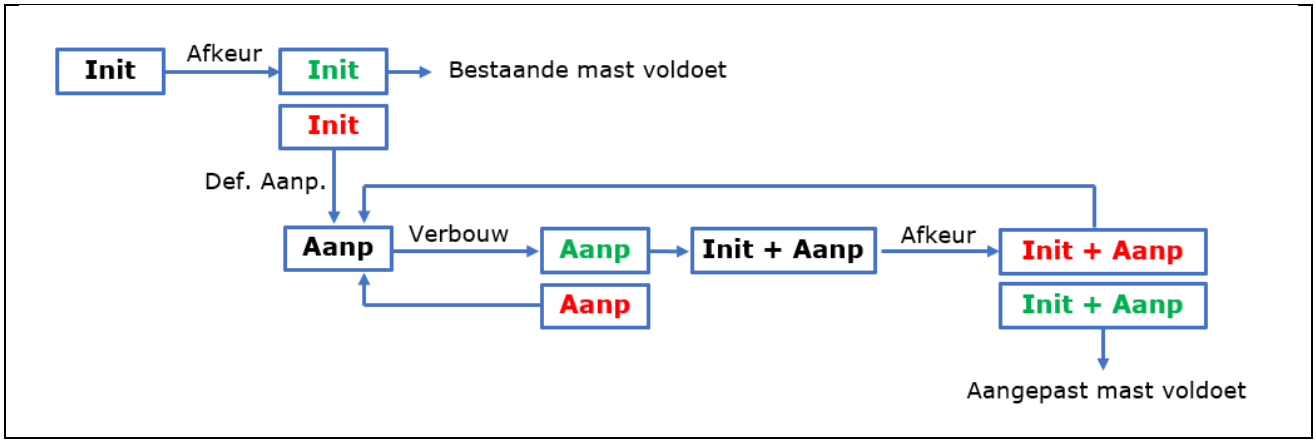
Stap 1: Toets bestaande (Init) mast op Afkeur

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.

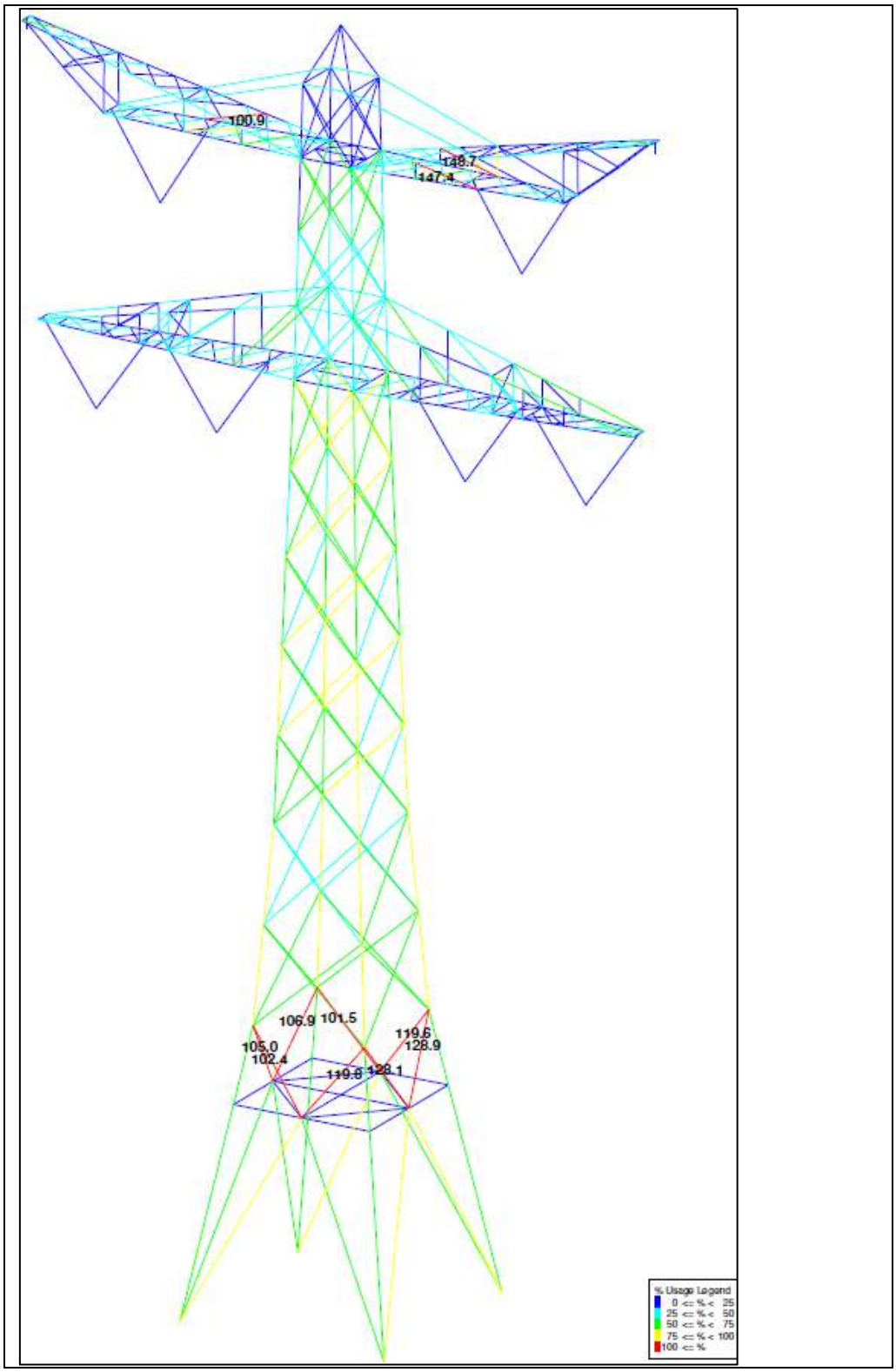
De nieuwe stalen liggers (HEB- en HEM-profielen) die benodigd zijn voor de V-kettingen zijn gemodelleerd in AxisVM (EEM-software). De resultaten van deze berekening zijn opgenomen in bijlage F.

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

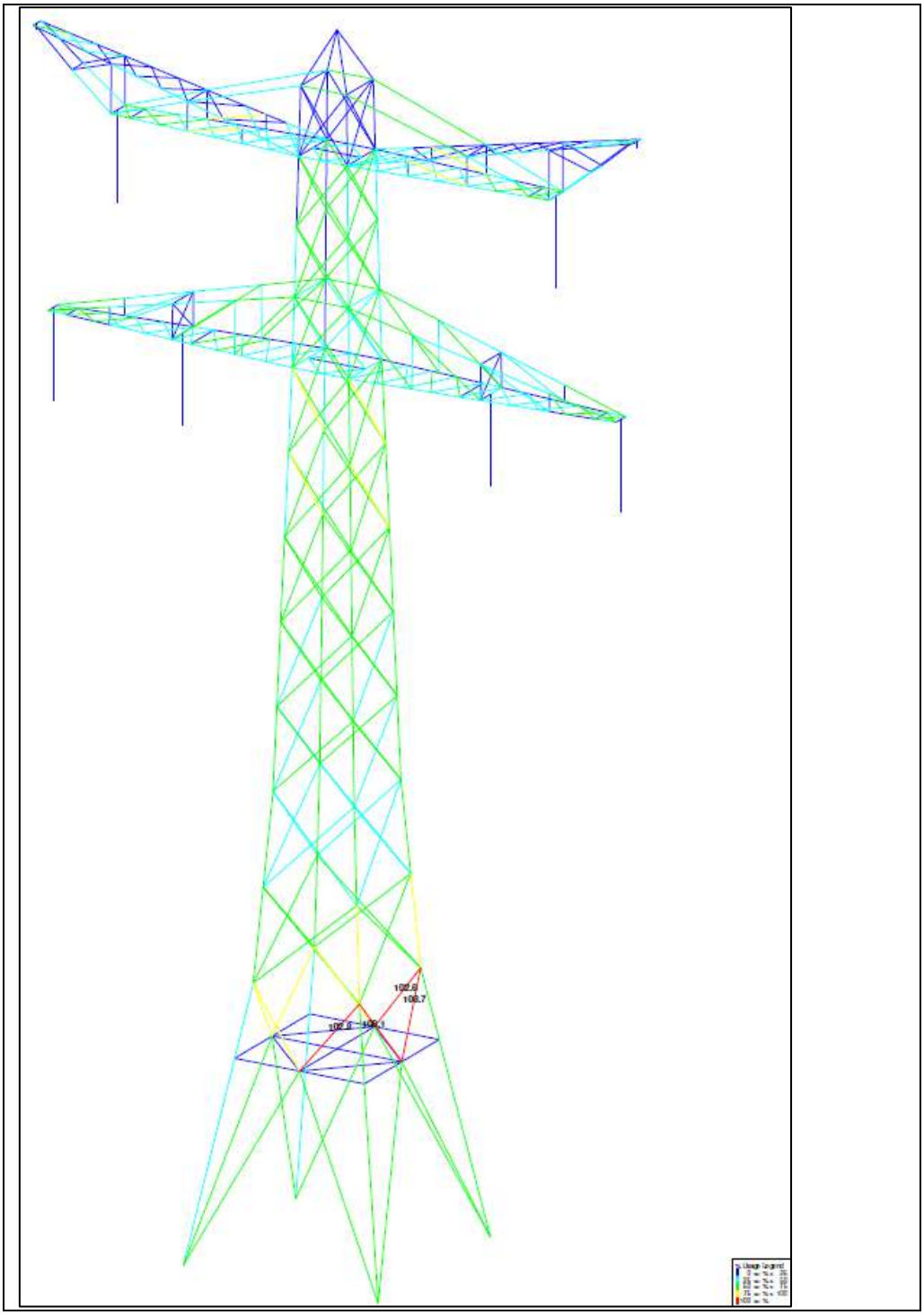
Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

# 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<br>Figuur 4 |
| Knikverkorters | Voldoen | | Appendix C |
| Ankers en voetplaat | Voldoen | | Appendix D |

# 5 AANPASSINGEN

## 5.1 Inleiding

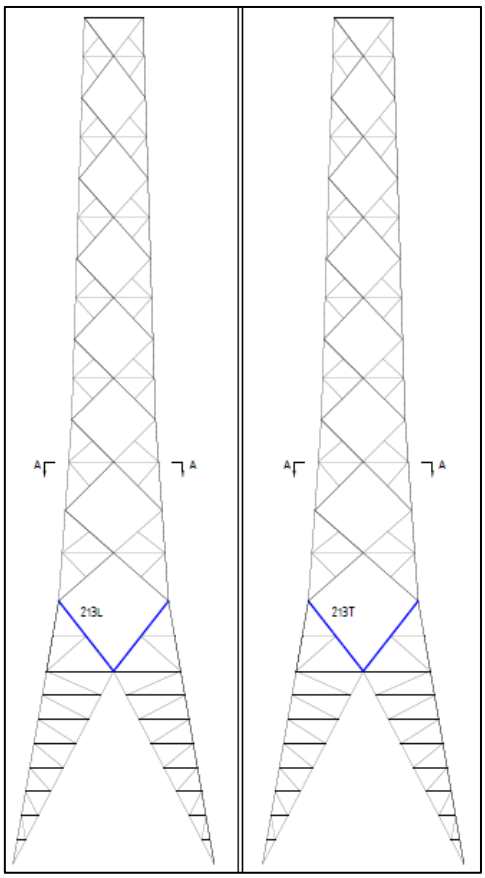
Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen en nieuwe onderdelen aan verbouwniveau is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- 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).

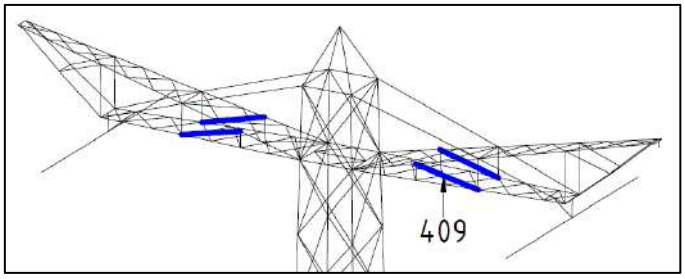
Het aanbrengen van een aanvullend stabiliteitsverband in het centrum van de mast wordt geadviseerd om de algehele stabiliteit van de mast te verbeteren. Dit advies is gebaseerd op de Cigre-publicatie nr. 196 “Diaphragms for steel supports”.

## 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.

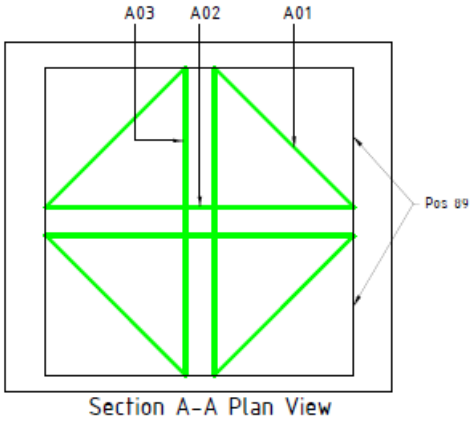



**Figuur 5 Te vervangen diagonalen van masttype S+18 (masten 11-2 en 60), vooraanzicht (links) en zijaanzicht (rechts)**

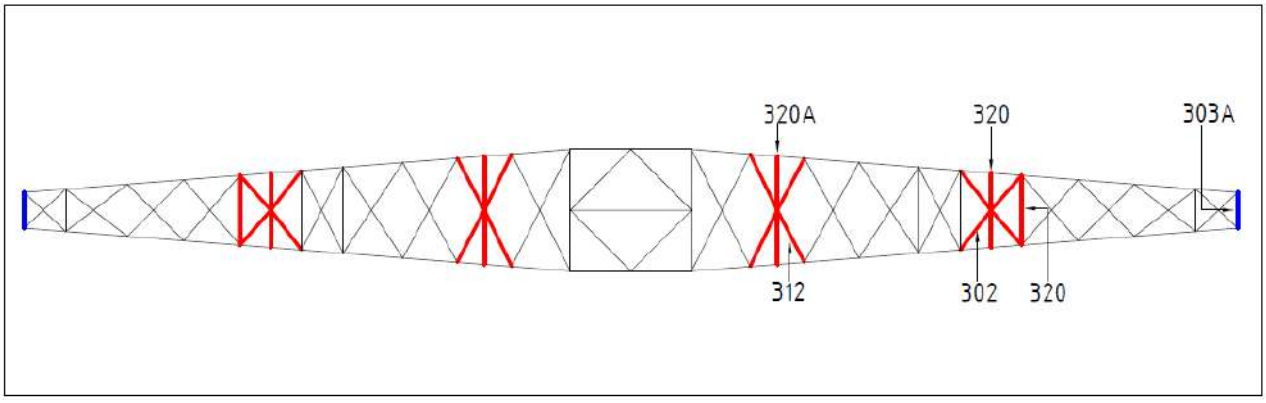



**Figuur 6 Vervanging van diagonalen in de boventraverse (mast 11-2)**

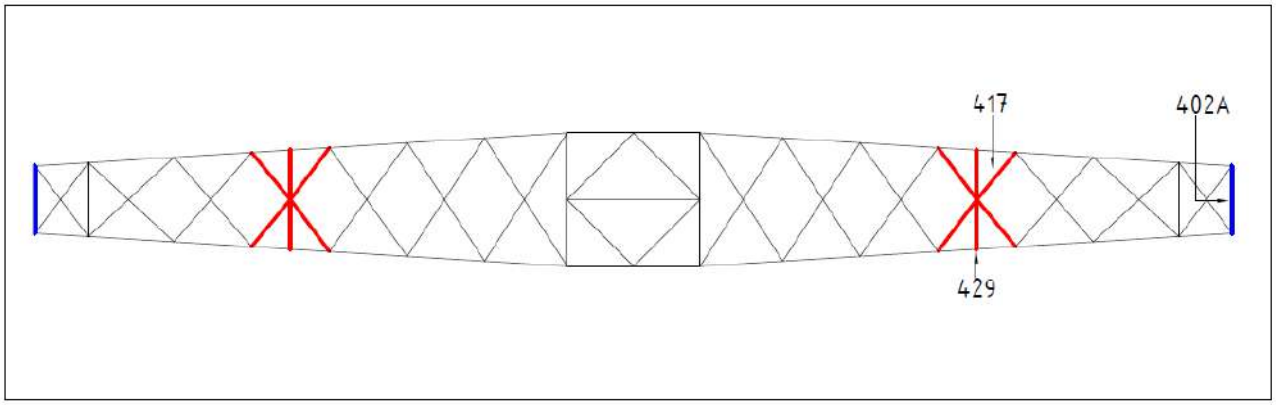
De mast S+18 is een relatief slanke constructie zonder horizontale stabiliteitsverbanden in het mastlichaam. Om deze reden wordt er geadviseerd om een stabiliteitsverband aan te brengen ter plaatse van doorsnede A-A. De vorm van het verband is weergegeven in Figuur 7. Voor afmetingen profielen en bouten,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



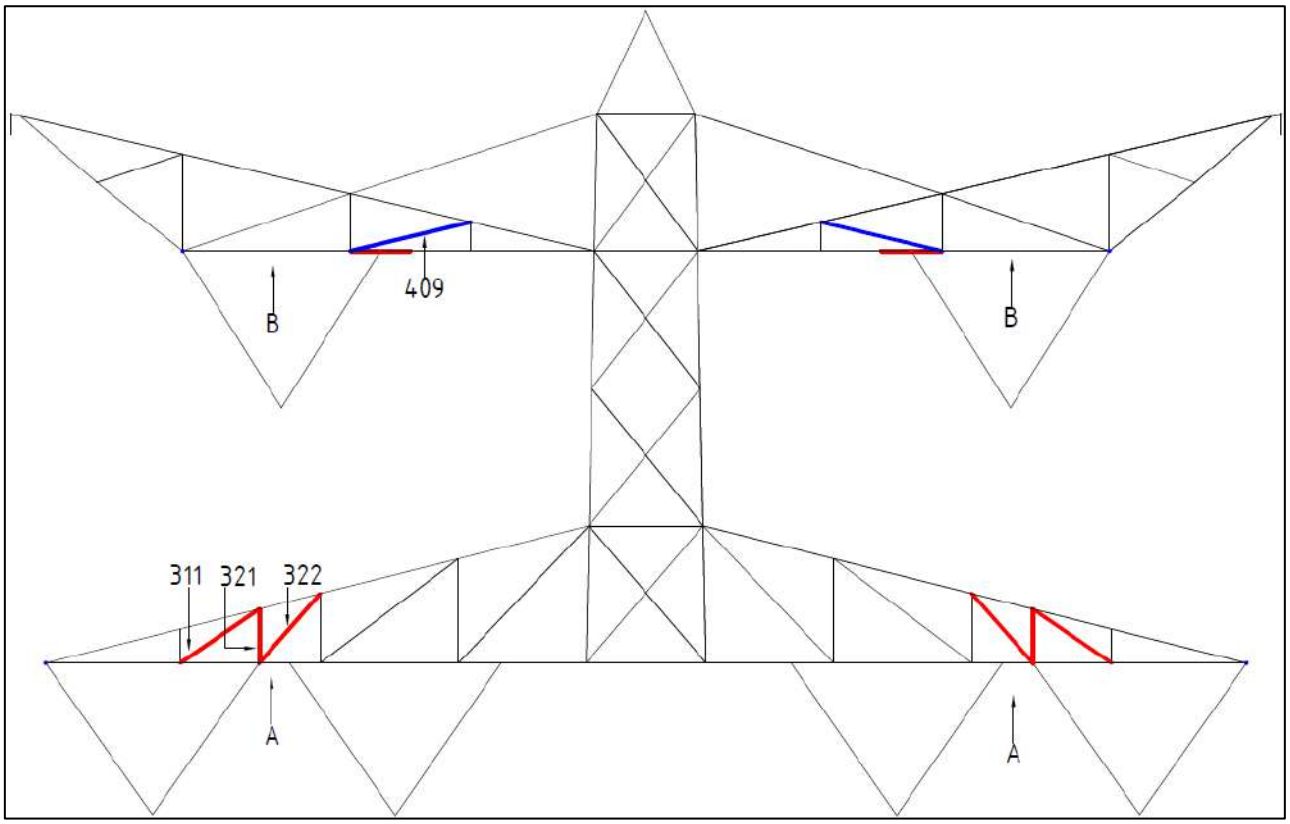

**Figuur 7 Aanbevolen stabiliteitsverband ter hoogte van doorsnede A-A**




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

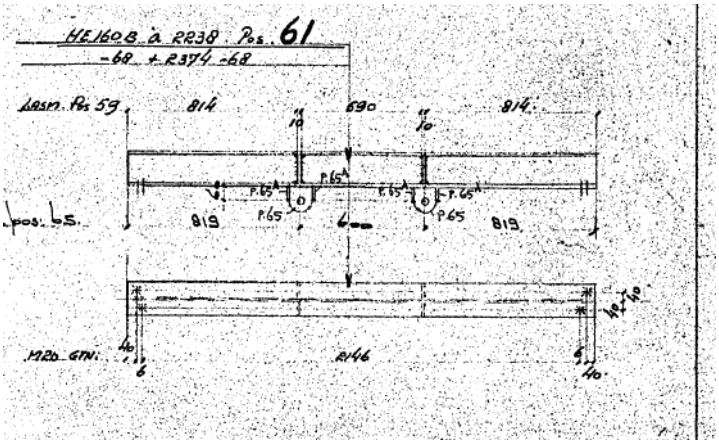



**Figuur 9 Nieuwe stabiliteitsverbanden voor de boventraverse van mast 11-2 (aanzicht ondervlak)**




**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


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | 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

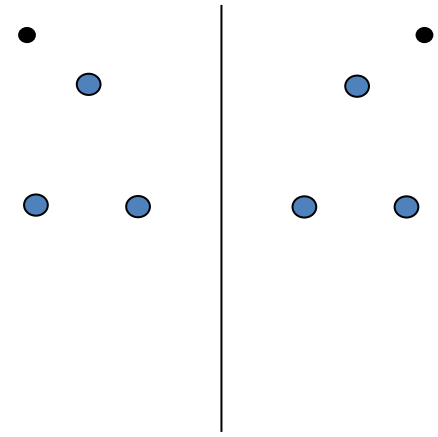
Auteur: TBR
Versie: v11.7

### General

| | |
|---|---|
| Description | S+18 II |
| Tower type | Steunmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |

### 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 |



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 | 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**

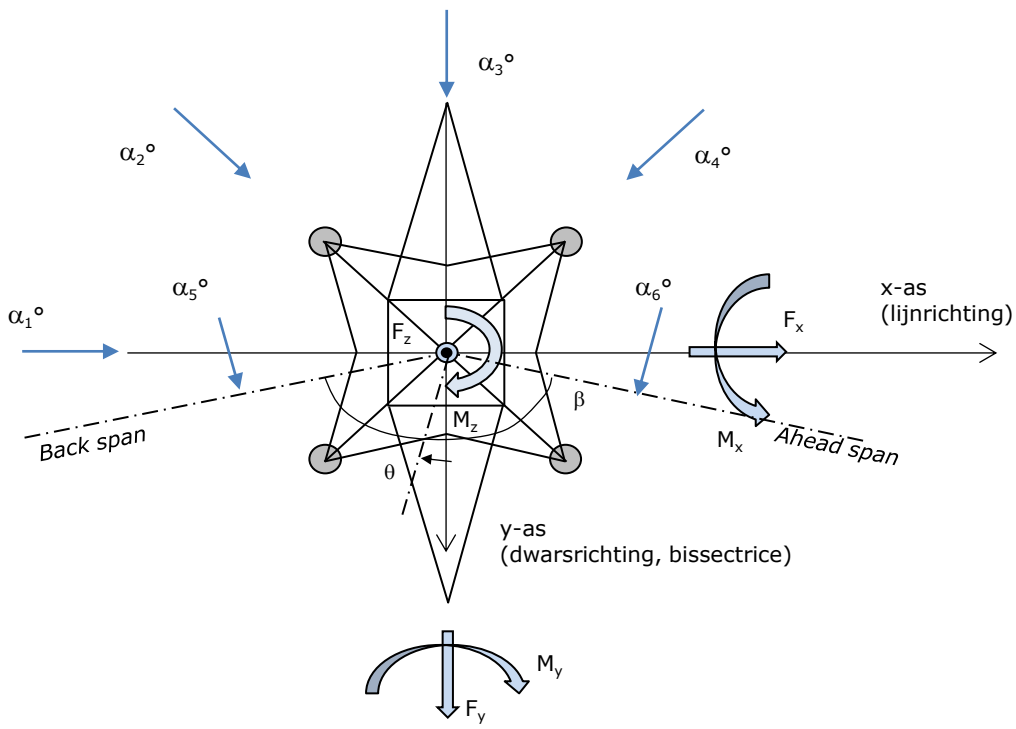
| | | | Hoogteverschil | | | Richtingsverandering | | |
|---|---|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | | Δy_back | Δy_ahead | |
| Circuit 1 | 31 | 380ct1f1 | -19,2 | 76,8 | m | -1,3 | -11,1 | m |
| Circuit 1 | 32 | 380ct1f2 | -19,2 | 76,8 | m | -1,4 | -4,2 | 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 | $\beta$ | 180 | ° | |
| Tower orientation with respect to bis | $\theta$ | 0 | ° | |
| Section length | | 2418 | 2418 | m |
| Height bottom of tower to ground level | | 0,5 | m | |
| Wind directions considered | $\alpha_1$ | 0 | ° | |
| Wind directions according to: | $\alpha_2$ | 45 | ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | ° | |
| | $\alpha_4$ | 135 | ° | |
| | $\alpha_5$ | - | ° | |
| | $\alpha_6$ | - | ° | |

*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

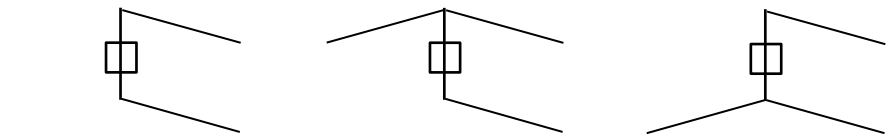
**Absence of conductors**

| | | 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 |

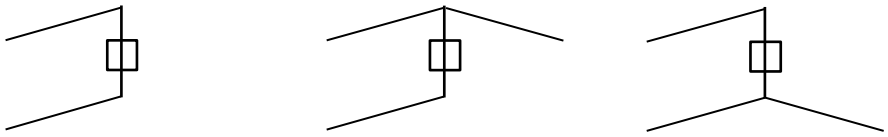
**Load situations SPLS**

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

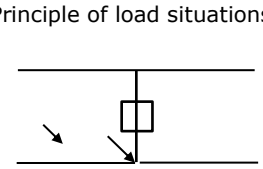
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

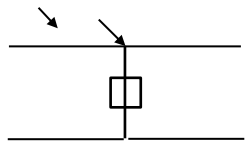
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

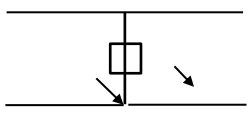
Principle of load situations:



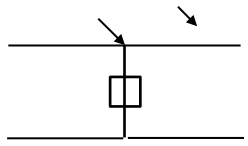
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

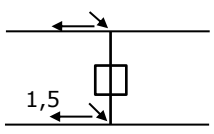
**Load situations 8. Galloping as a static load**

| 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 |

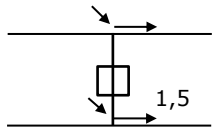
Considered situations galloping 8: None (existing structure)

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

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 [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 transversal direction (side view, xz plane)**

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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.*

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

**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | Factor | $\Delta h$ | $A_1$ |
|---|---|---|---|---|
| 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 |

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**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 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 |

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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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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 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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**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 |

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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 | 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**

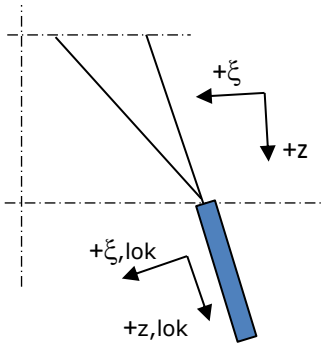
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 520 | 506 | 23230 | -8 | 30 |
| ULS 3_90 | 0 | 217 | 574 | 10384 | -8 | 19 |
| SLS 7 | 0 | 0 | 532 | 0 | -4 | 0 |

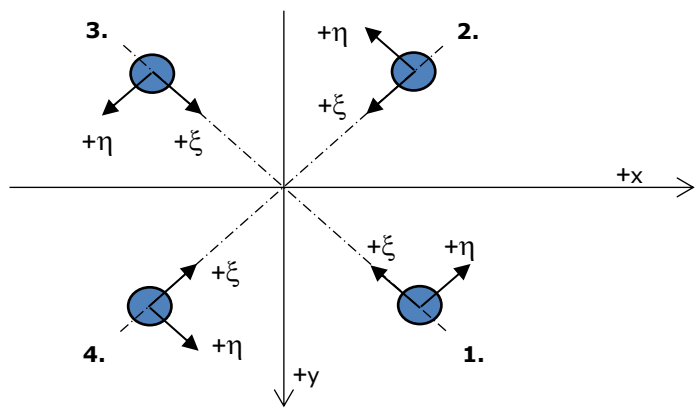
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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 |

Project: KIJ-GT
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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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
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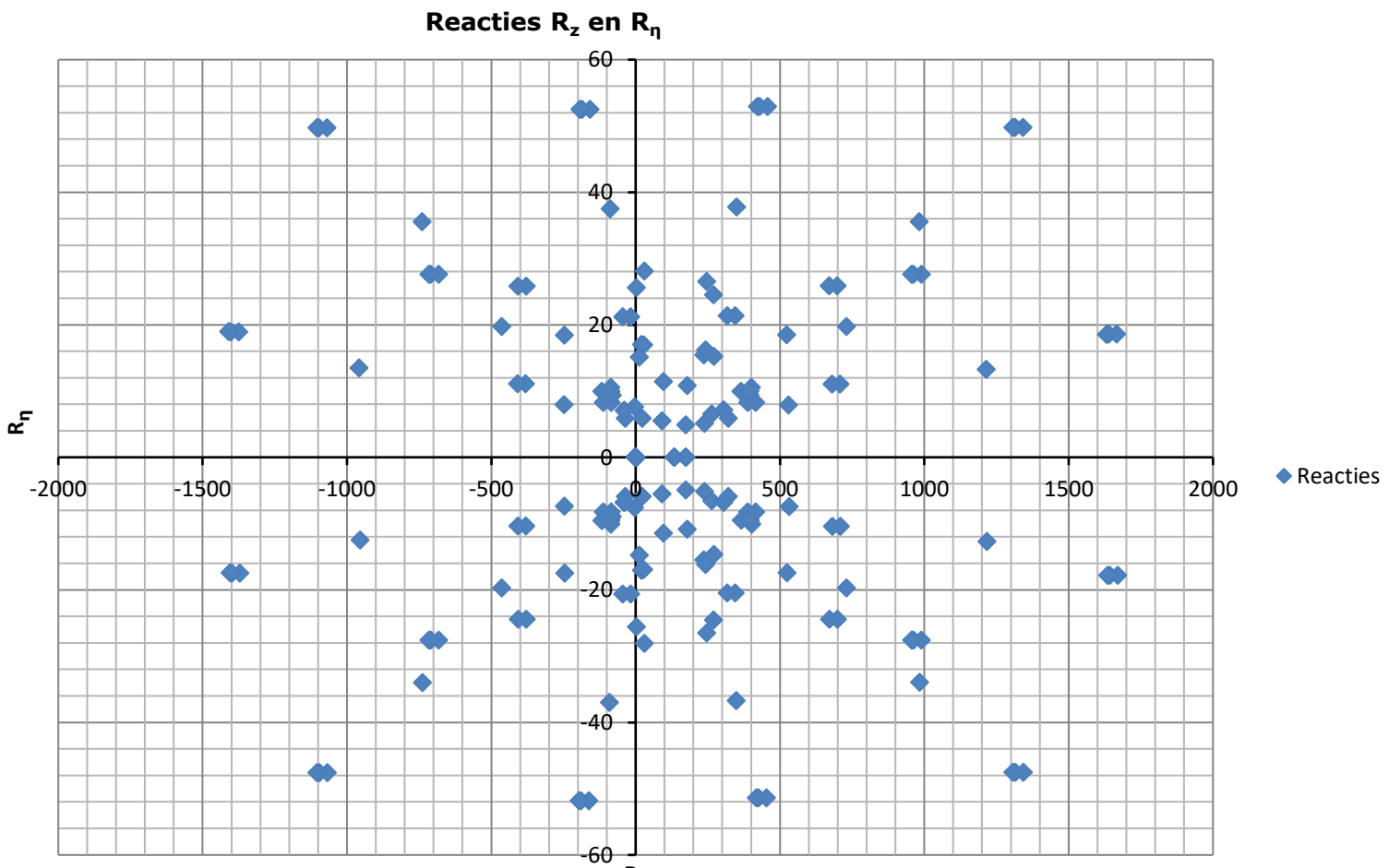

Project: KIJ-GT
Tower: S+18 II
Number: 11-2

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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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**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 | - |

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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 | 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 |

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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 | 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**

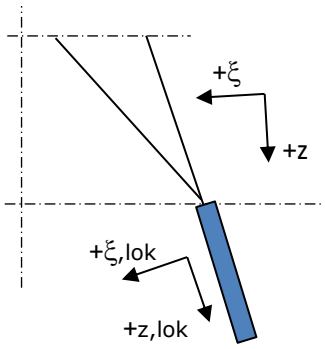
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 647 | 544 | 28933 | -10 | 38 |
| ULS 3_90 | 0 | 270 | 636 | 12933 | -10 | 24 |
| SLS 7 | 0 | 0 | 532 | 0 | -4 | 0 |

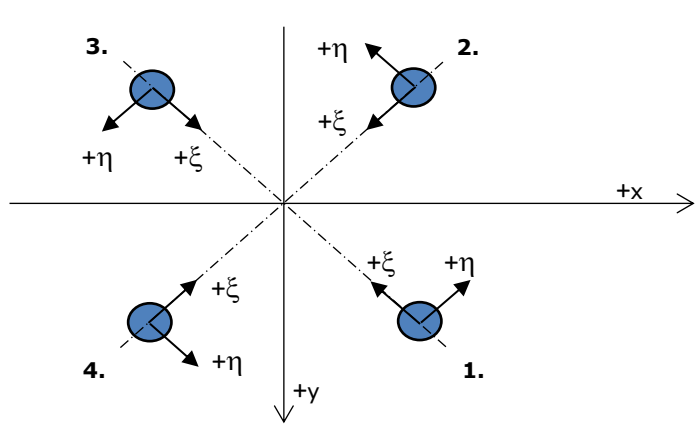
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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 |

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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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 |

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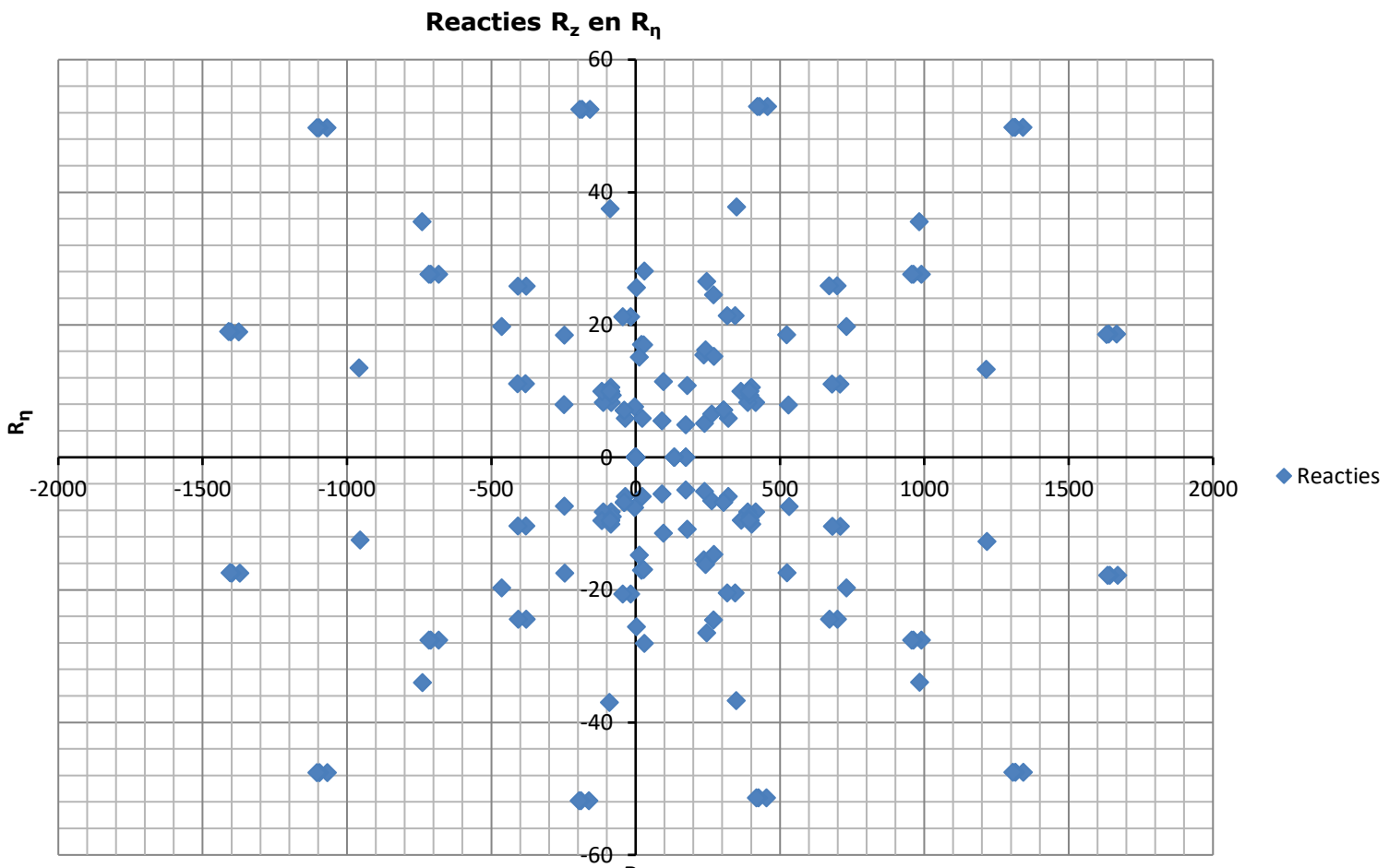
Tower: S+18 II
Number: 11-2



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 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

## Conductor loads

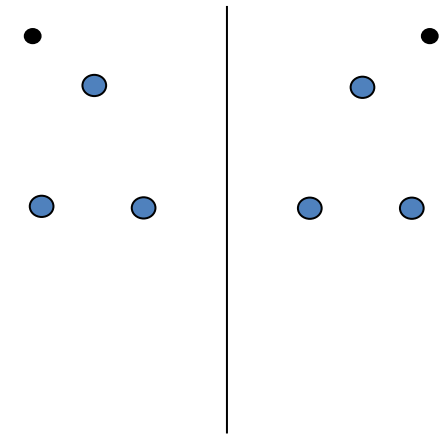
Auteur: TBR
Versie: v11.3

### General

| | |
|---|---|
| Description | S+18 |
| 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 | 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**

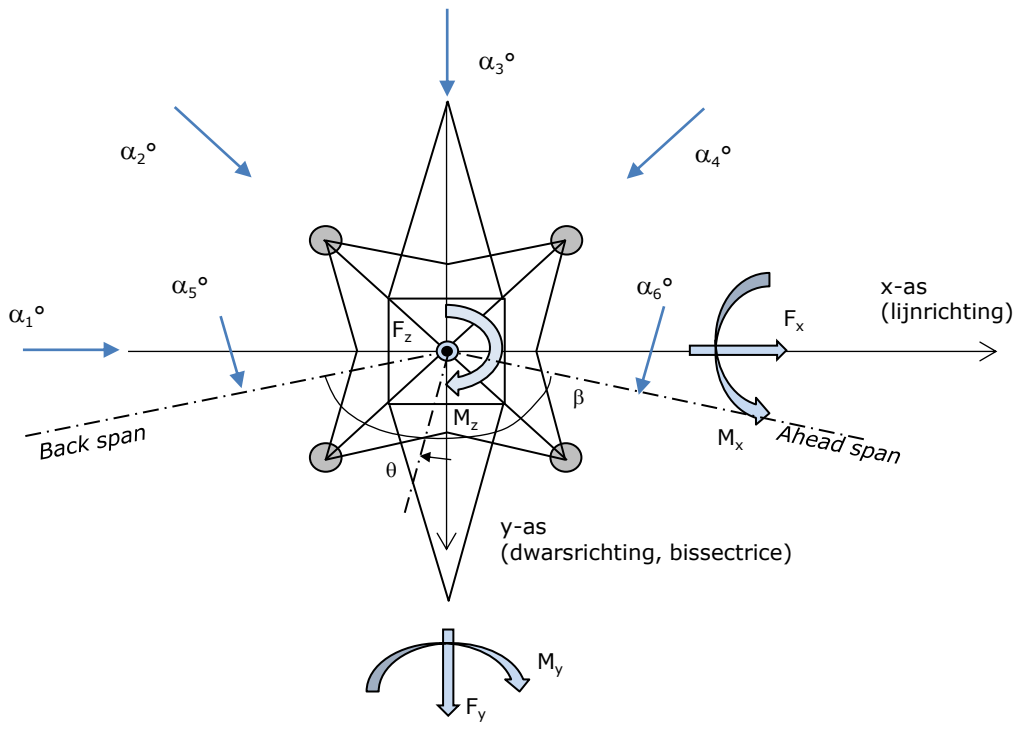
| | | | Hoogteverschil | | | Richtingsverandering | | |
|---|---|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | | Δy_back | Δy_ahead | |
| Circuit 1 | 10 | 380ct1f1 | -18,0 | -18,4 | m | 1,8 | 1,8 | m |
| Circuit 1 | 11 | 380ct1f2 | -18,0 | -18,4 | m | 0,8 | 0,8 | 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 | $\beta$ | 180 | ° | |
| Tower orientation with respect to bis | $\theta$ | 0 | ° | |
| Section length | | 2580 | 2580 | m |
| Height bottom of tower to ground level | | 0,5 | m | |
| Wind directions considered | $\alpha_1$ | 0 | ° | |
| Wind directions according to: | $\alpha_2$ | 45 | ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | ° | |
| | $\alpha_4$ | 135 | ° | |
| | $\alpha_5$ | - | ° | |
| | $\alpha_6$ | - | ° | |

*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

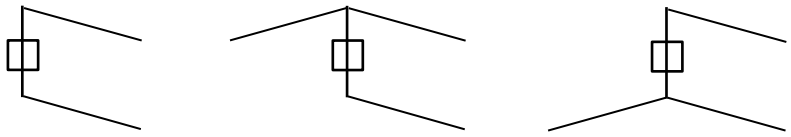
**Absence of conductors**

| | | 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 |

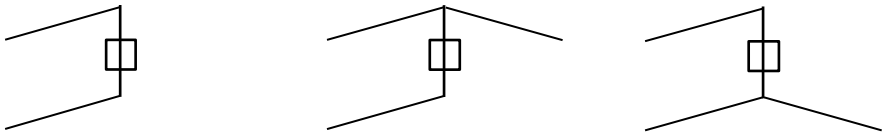
**Load situations SPLS**

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

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

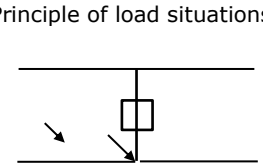
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

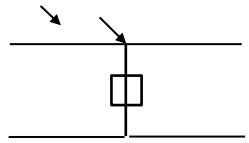
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

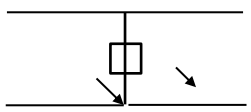
Principle of load situations:



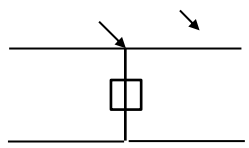
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

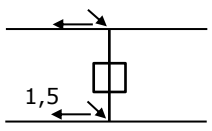
**Load situations 8. Galloping as a static load**

| 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 |

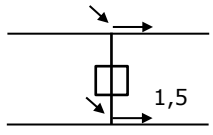
Considered situations galloping 8: None (existing structure)

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] | $\Delta h$ [m] | $\Delta_x$ [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] | $\Delta h$ [m] | $\Delta_x$ [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.*

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

**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | $\Delta$h | $A_1$ |
|---|---|---|---|
| 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 | 0,70 | 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 | $p_w$ [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 | 0,70 | 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 | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [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 |

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

**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 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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**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
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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 °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,05 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk only tower | 10° | 0,90 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk conductors too | 10° | 0,90 | 0,90 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 3_0,9 | Wind+ice 0,9Gk | -5° | 0,90 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 4_0,9 | Cold+wind 0,9Gk | -20° | 0,90 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 5a | Torsional loads | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinal loads | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Construction + maintenance | 5° | 1,05 | 1,05 | 1,20 | 0,22 | 0,00 | 0,0 |
| ULS 6_0,9 | Construction + maintenance | 5° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,15 | 1,15 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (strength, for angle towers: absence of conductors) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,94 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,28 | 0,88 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Number of wind directions | 4 |
| Number of load combinations for ULS | 36 |
| Number of load combinations for SPLS | 0 |
| Number of load combinations for SLS | 11 |
| Number of concentrated loads | 376 |

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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 | -29,5 | 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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**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 |

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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 | 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**

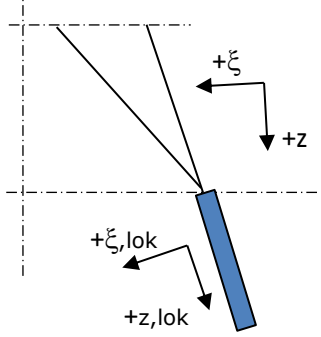
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 416 | 658 | 18528 | 0 | 0 |
| ULS 3_90 | 0 | 165 | 739 | 7804 | 0 | 0 |
| SLS 7 | 0 | 0 | 609 | 0 | 0 | 0 |

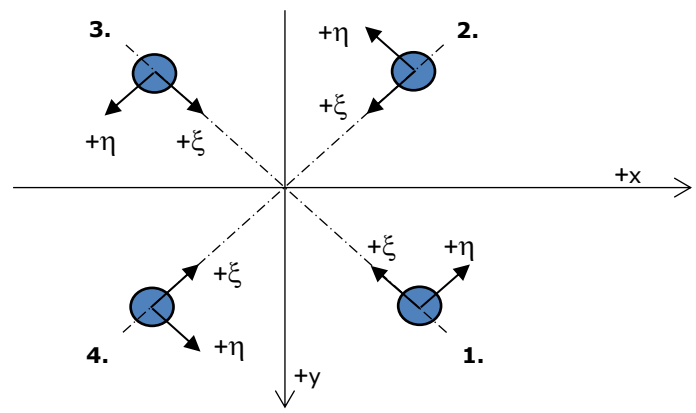
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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 |

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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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 |

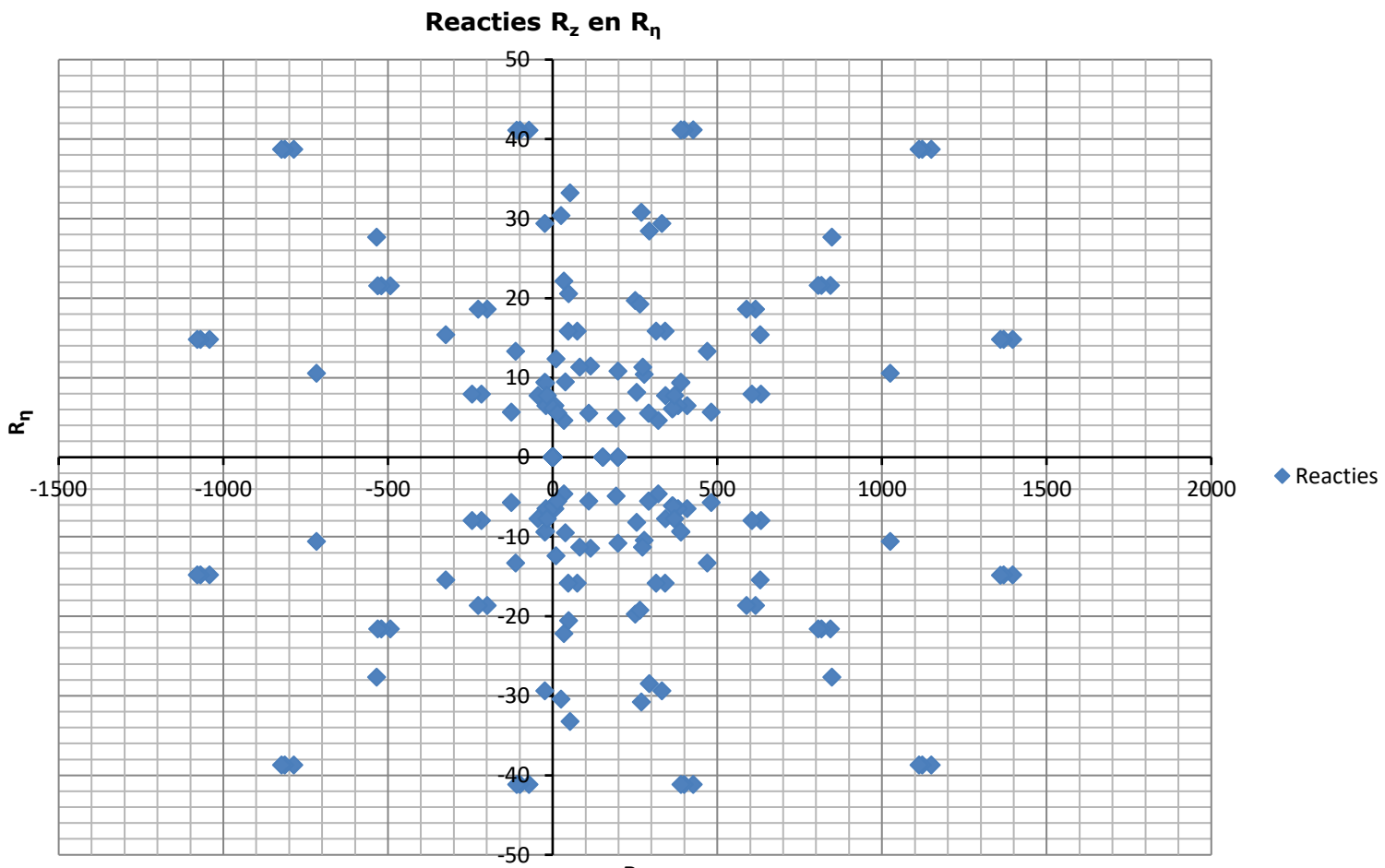
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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
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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 | 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**

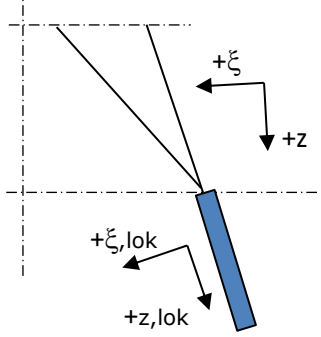
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 521 | 725 | 23228 | 0 | 0 |
| ULS 3_90 | 0 | 207 | 833 | 9783 | 0 | 0 |
| SLS 7 | 0 | 0 | 609 | 0 | 0 | 0 |

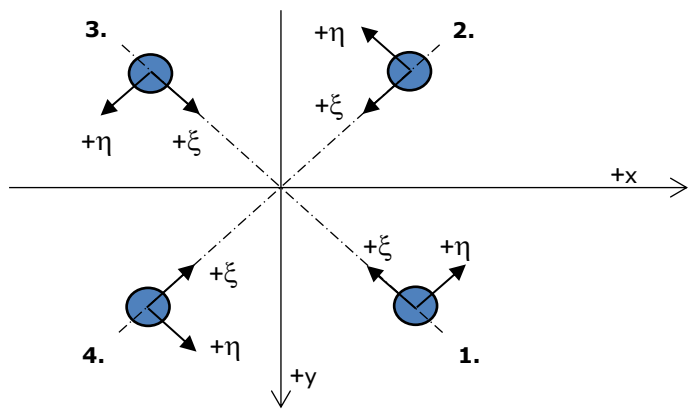
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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 | 40 | -19 | -110 | **-41** | 15 | -12 | -113 |
| 4 | ULS 1a_45 | -100 | 42 | 426 | **-41** | -100 | 4 | 439 |

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

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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 |

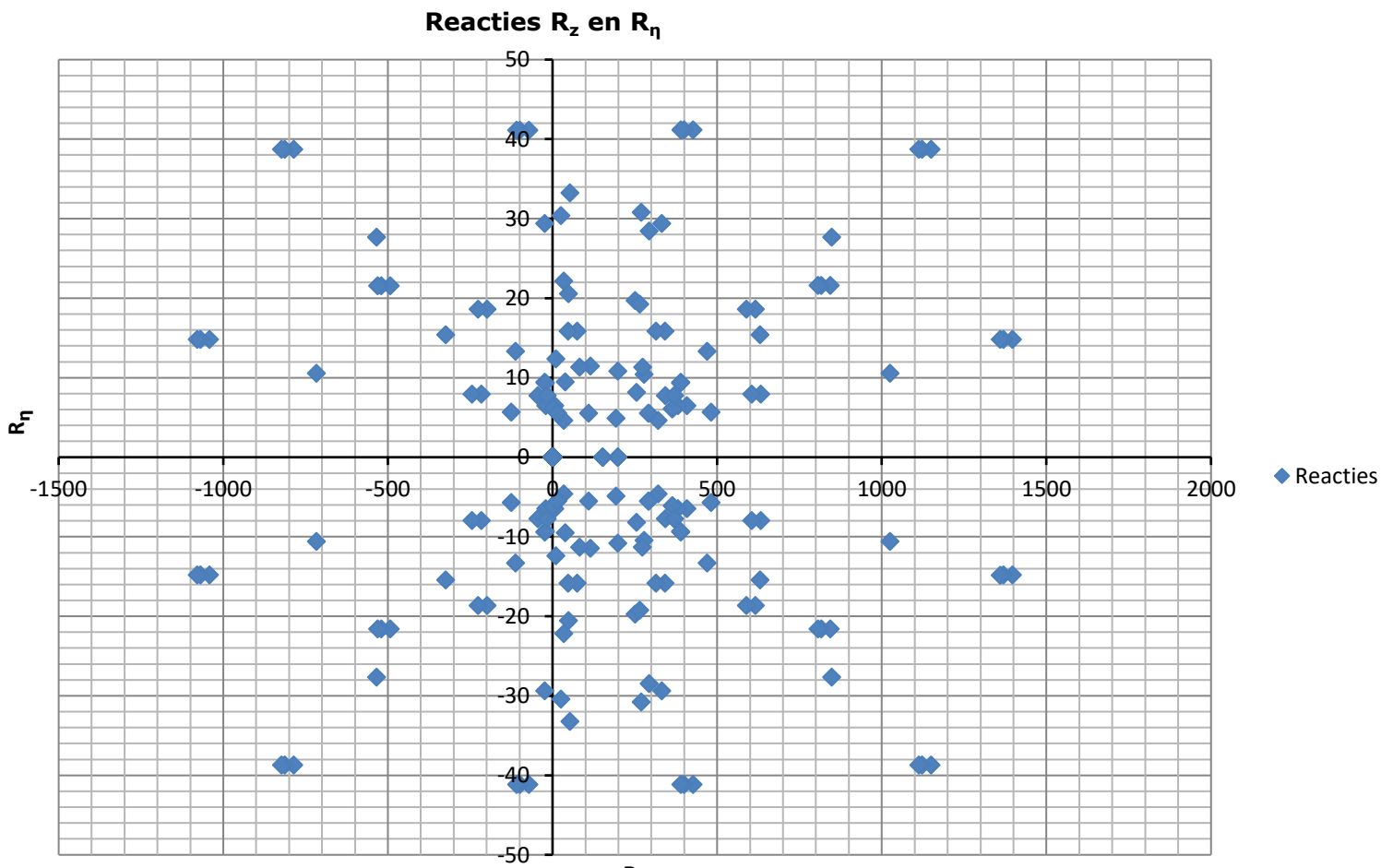
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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**

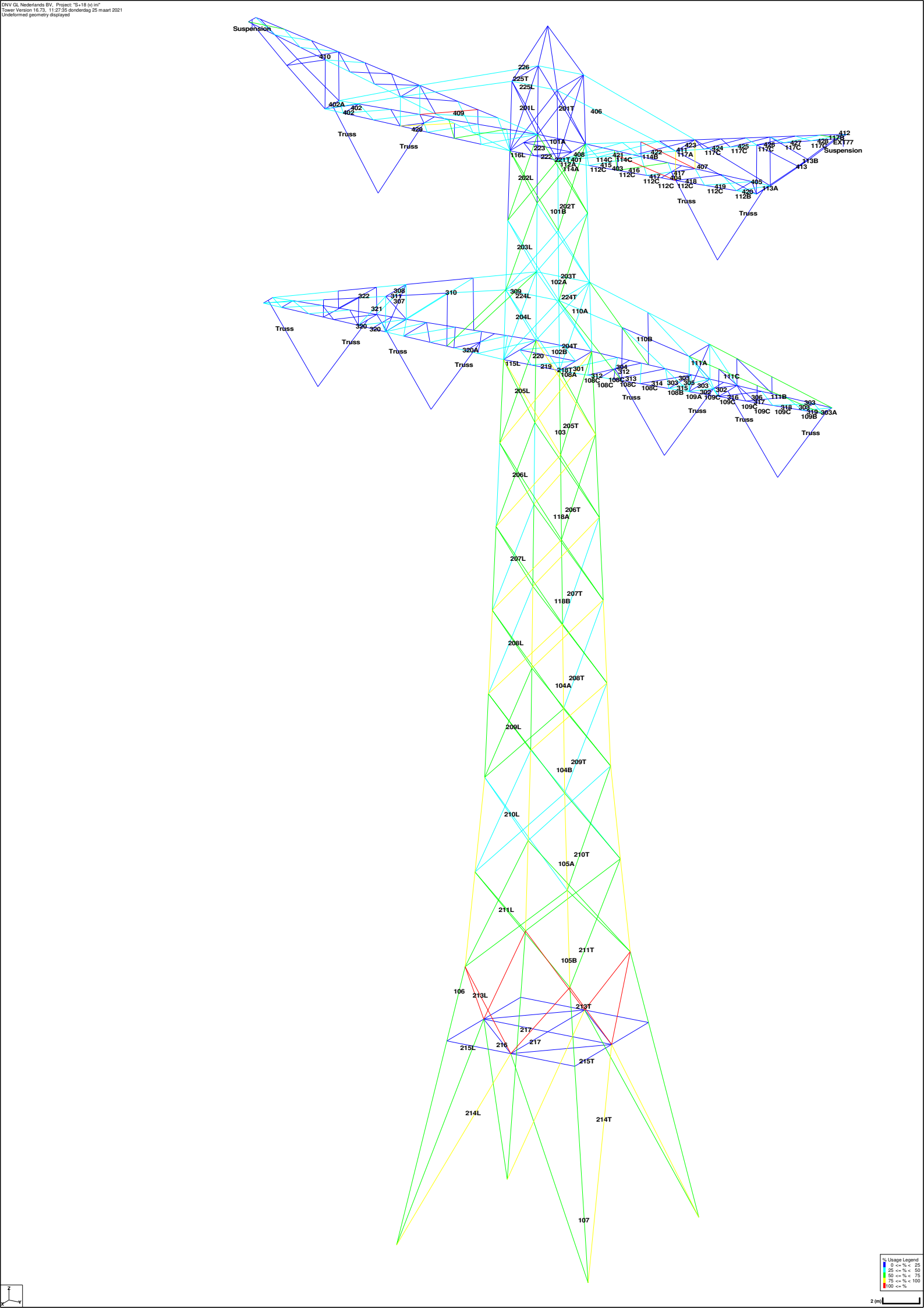
| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 183 | 168 | **1025** | 11 | -248 | 4 | 1055 |
| 2 | SLS 1a_0 | 99 | -120 | **630** | 15 | -155 | 0 | 649 |
| 3 | 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



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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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_0,9_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 | **-10.9** | 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 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 tussı | 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 tussı | 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 tussı | 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 tussı | 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 derd | 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 derd | 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 derd | 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 derd | 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 onc | 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 onc | 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 |

DNV·GL

# 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

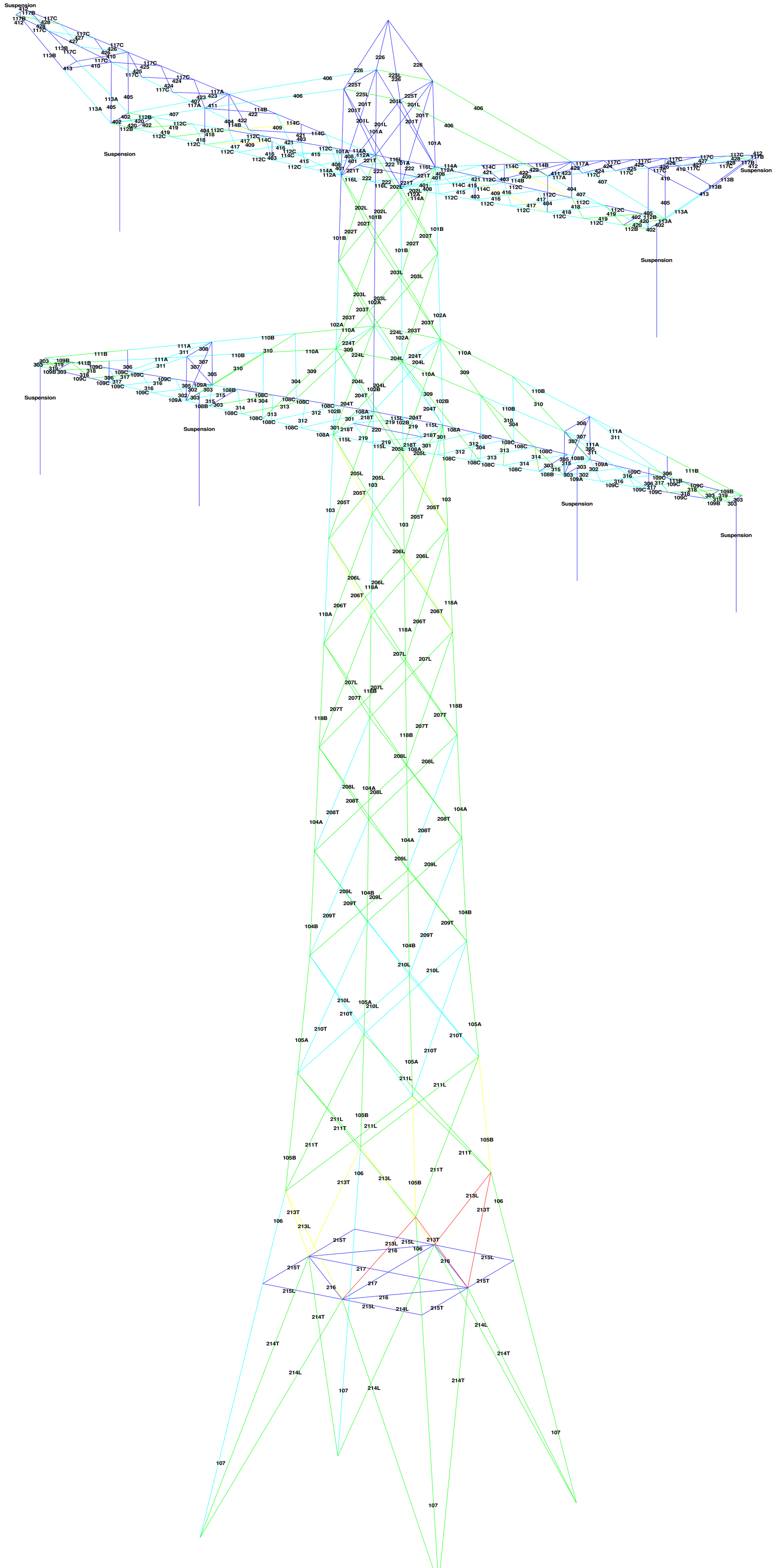
**KIJ-GT380**
**S+18**
**11-2**

| 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 onc | 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 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 |
| 409 | Dwarsligger onc | **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 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 | **-1.5** | 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



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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 tussi | 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 tussi | 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 tussi | 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 tussi | 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 een | 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 l | 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 l | 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 l | 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 bo | 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 bo | 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 |

DNV·GL

## 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

DNV·GL

# 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 |

DNV·GL

# 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 | | |

DNV·GL

**Knikverkorters final construction (verbouw)**

Date: 2020-06-11
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+18
60

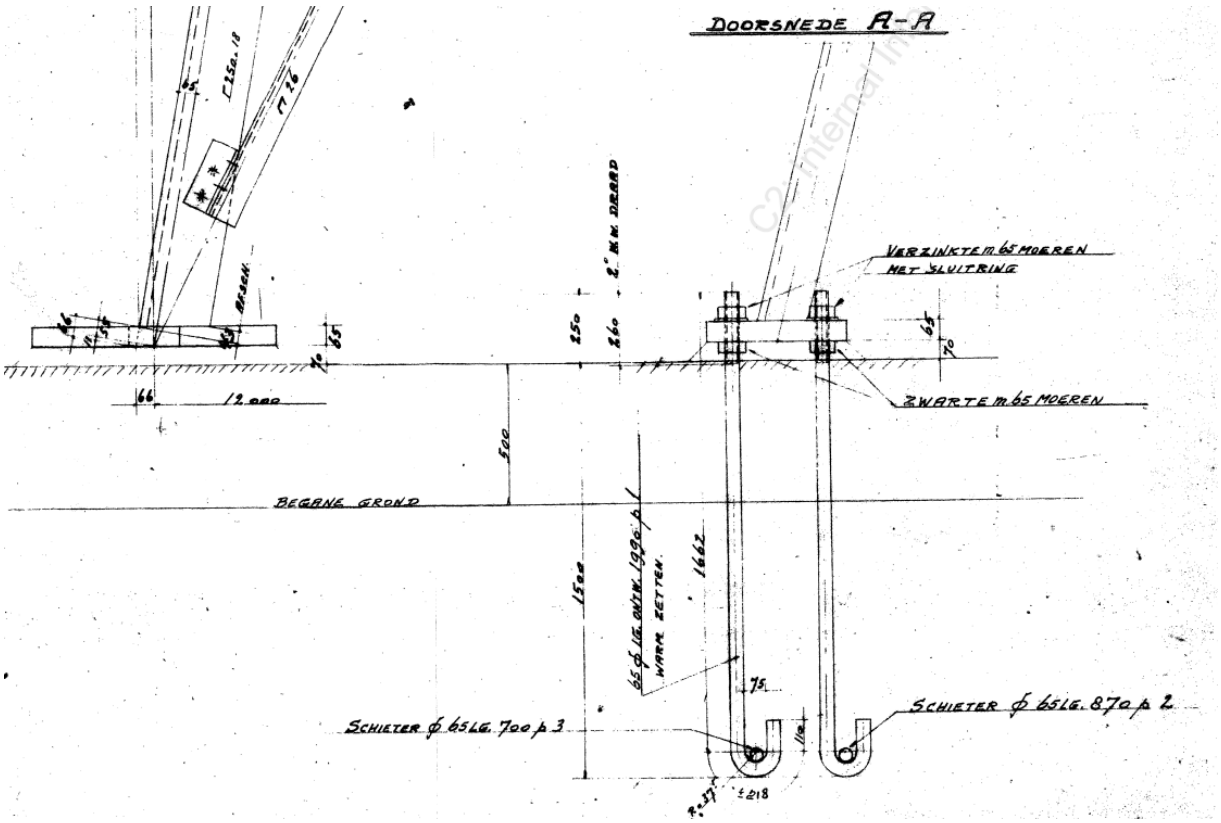
| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness (-) | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Block Tearing Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | 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

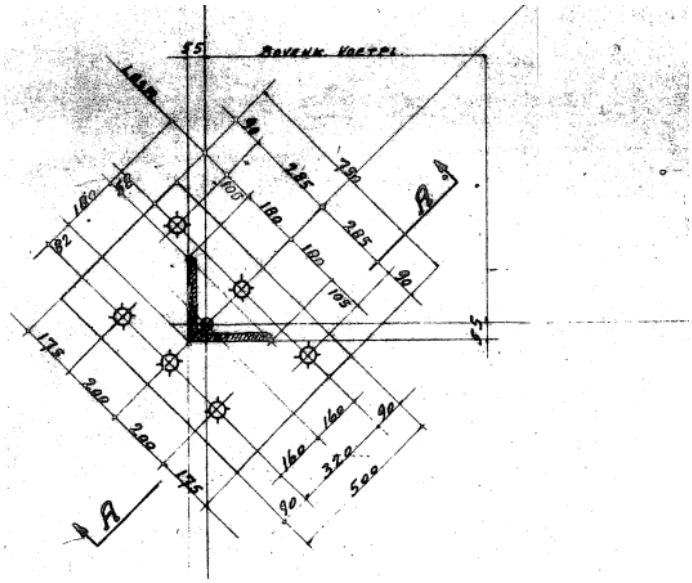
## ANCHORS S+18 AND MAIN BRACING

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

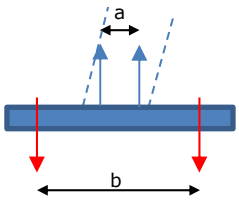
De loads coming from the tower are based on S+18 structure number II-2 in wind zone II:

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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.

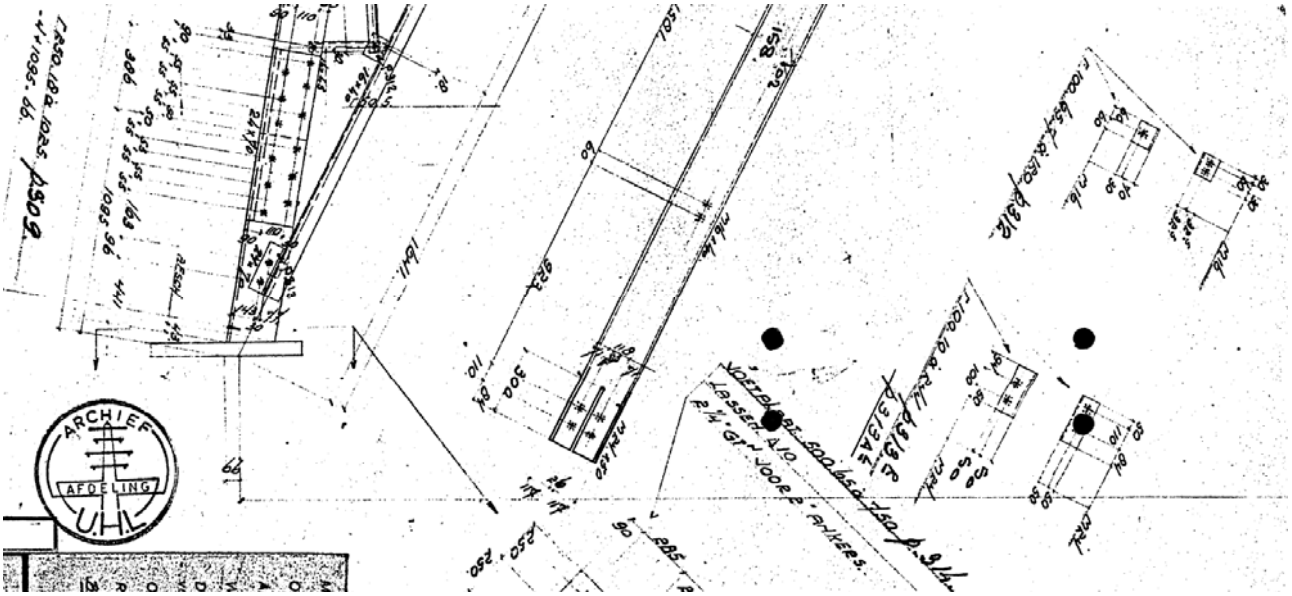
The anchors and plates fulfill the required strength. See the output:

Tower 11-2: U.C. = 181 / 506 = 0,36 ≤ 1,00 OK

Conclusion: The foot plates of tower structure S+18 have sufficient strength.

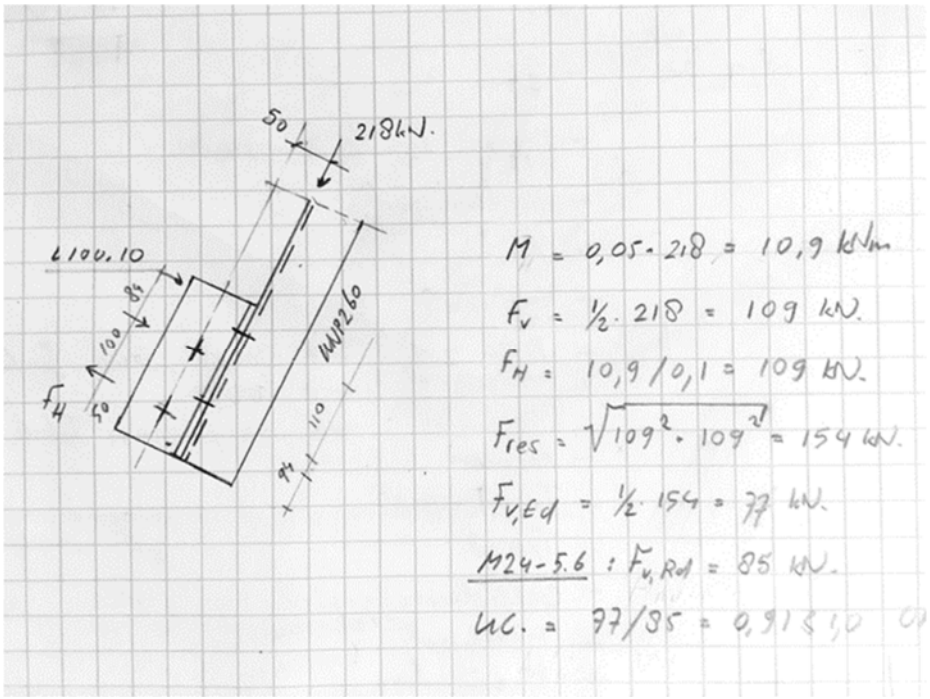
## Main bracing broekstuk

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.

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 | |
| $\gamma_{Mb}$ | 1,25 | - |
| $\alpha_{red;2}$ | 0,85 | - |
| $\alpha_b = 0,44 - 0,0003 f_{yb}$ = | 0,37 | - |

*Capacity per anchor*

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

### *Foot plate*

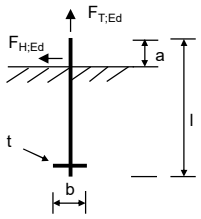
$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

| | | | |
|---|---|---|---|
| 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")*

$$\frac{\sigma_b'}{f_{cd}} = \frac{11,2}{40,0} = 0,28 \quad \textit{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{181}{460} = 0,39 \quad \textit{OK}$$




### *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 | $c = t\sqrt{(f_{yd} / 3 f_{jd})}$ = | 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*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{180,8}{505,9} = 0,36 \quad \textit{OK}$$

### *Capacity of anchor for tension*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{180,8}{655,1} = 0,28 \quad \textit{OK}$$

### *Check foot plate for tension*

$$\frac{T}{n \times F_{t;Rd}} = \frac{1085,0}{3035,5} = 0,36 \quad \textit{OK}$$

### *Check anchor for shear*

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{53,2}{267,9} = 0,20 \quad \textit{OK}$$

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 | |
| $\gamma_{Mb}$ | 1,25 | - |
| $\alpha_{red;2}$ | 0,85 | - |
| $\alpha_b = 0,44 - 0,0003 f_{yb}$ = | 0,37 | - |

*Capacity per anchor*

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

### *Foot plate*

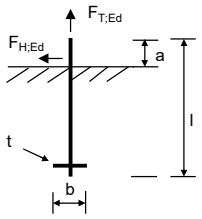
$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

| | | | |
|---|---|---|---|
| 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")*

$$\frac{\sigma_b'}{f_{cd}} = \frac{8,6}{40,0} = 0,22 \quad \textit{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{139}{460} = 0,30 \quad \textit{OK}$$




### *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 | $c = t\sqrt{(f_{yd} / 3 f_{jd})}$ = | 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*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{139,2}{505,9} = 0,28 \quad \textit{OK}$$

### *Capacity of anchor for tension*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{139,2}{655,1} = 0,21 \quad \textit{OK}$$

### *Check foot plate for tension*

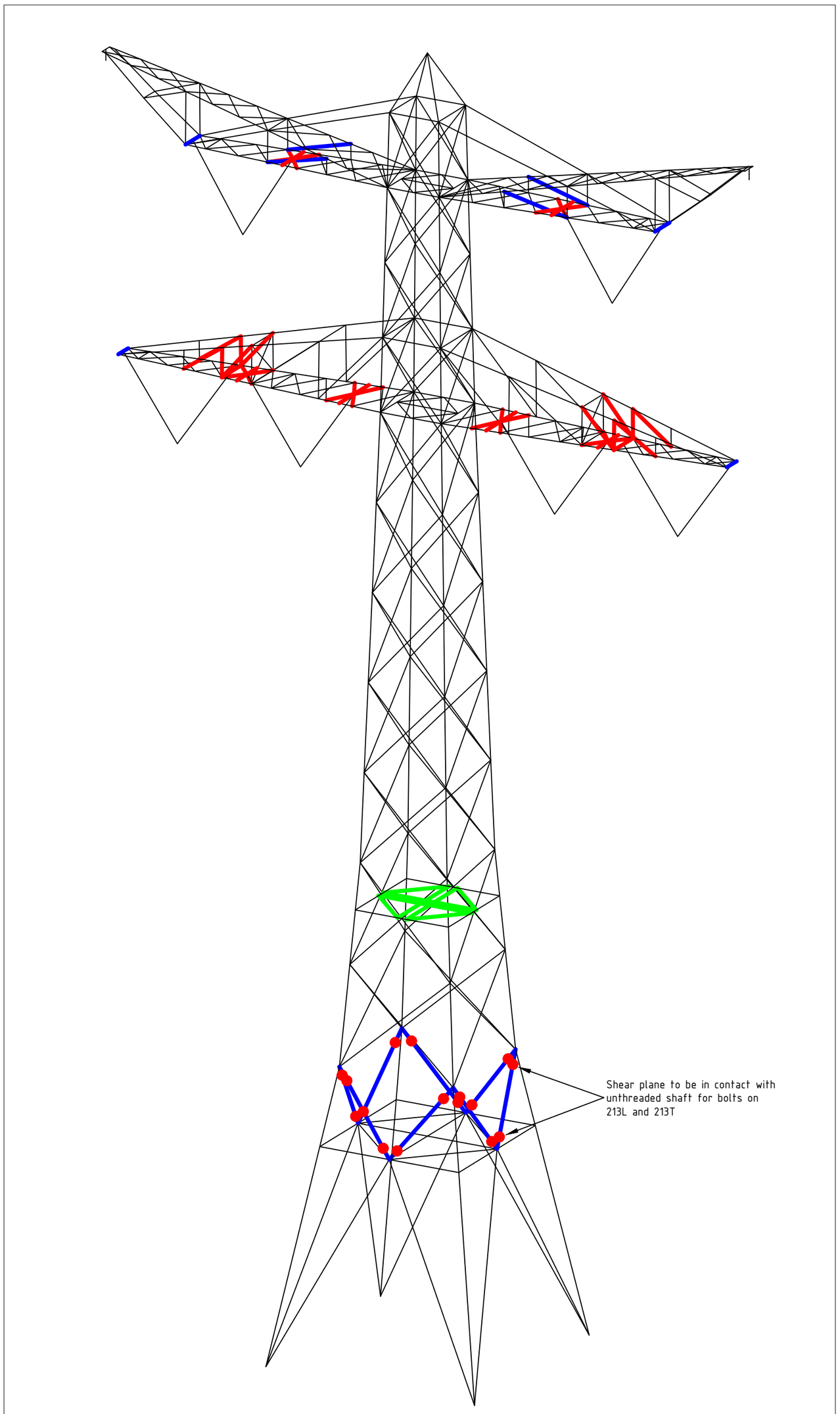
$$\frac{T}{n \times F_{t;Rd}} = \frac{835,0}{3035,5} = 0,28 \quad \textit{OK}$$

### *Check anchor for shear*

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{45,7}{267,9} = 0,17 \quad \textit{OK}$$

# 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 |

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-013

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | 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 | |

Description: Modifications overview for mast type S+18 (mast 11-2) Page 1 of 4

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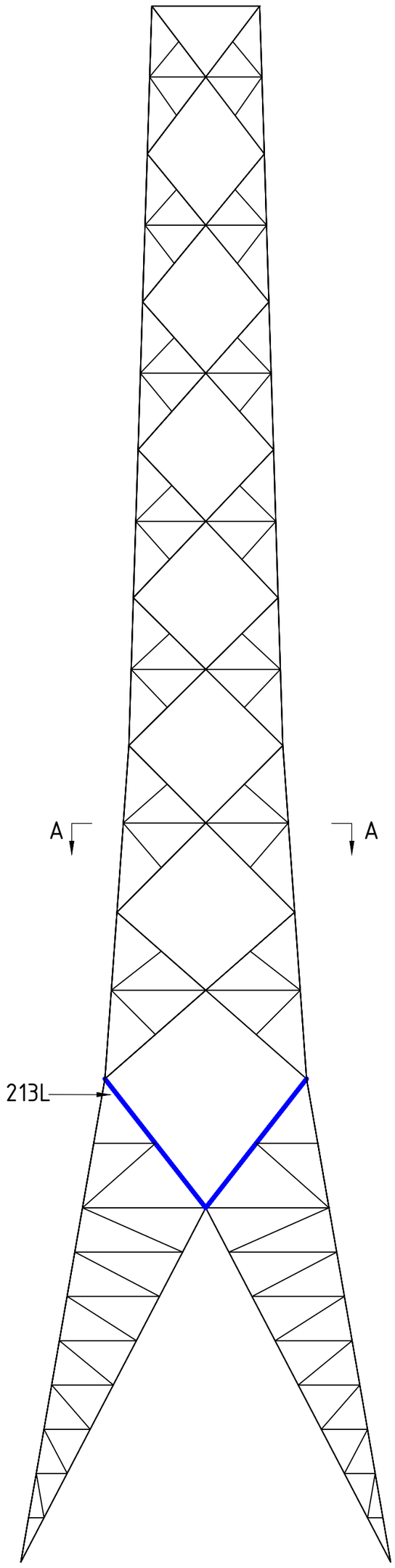
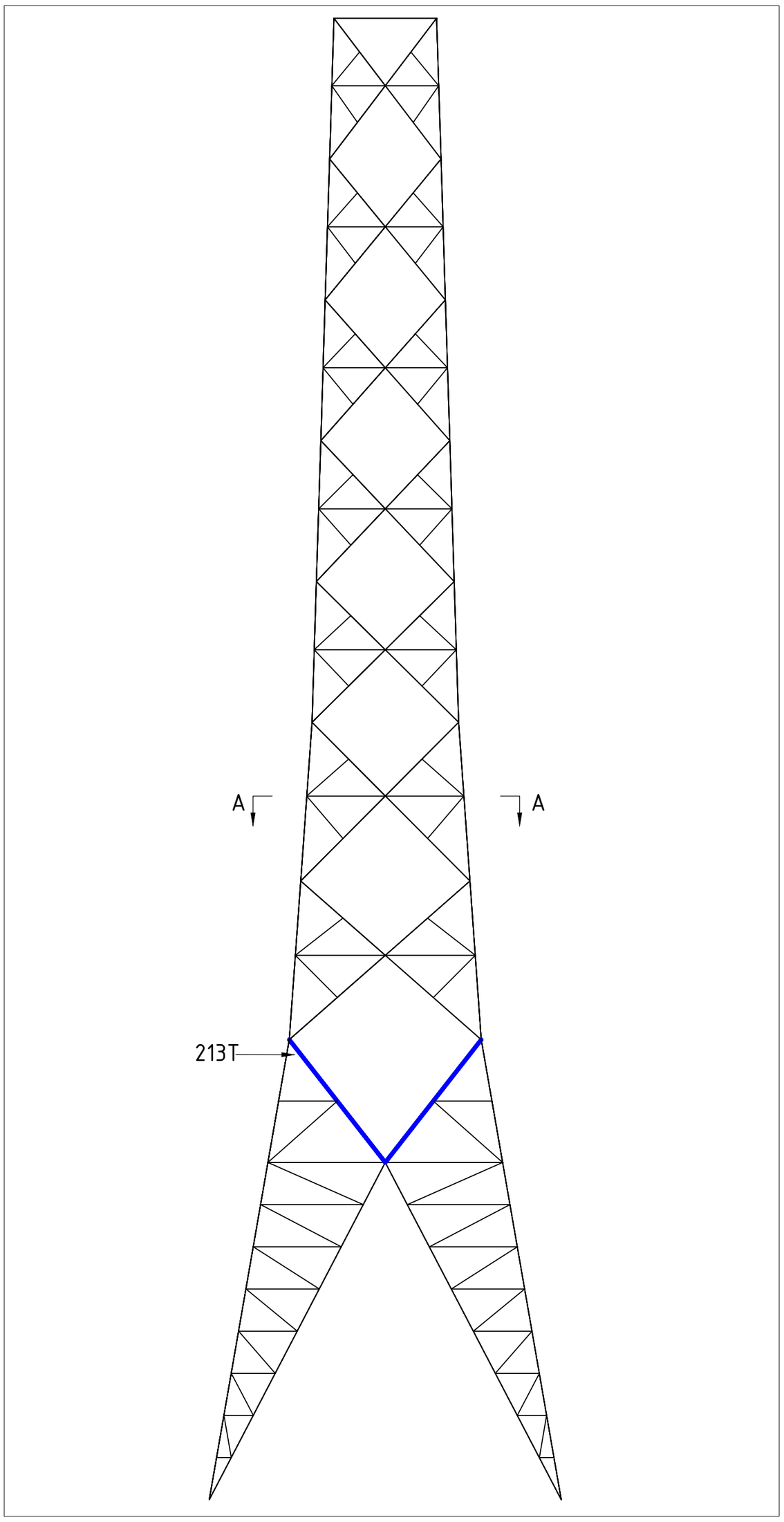
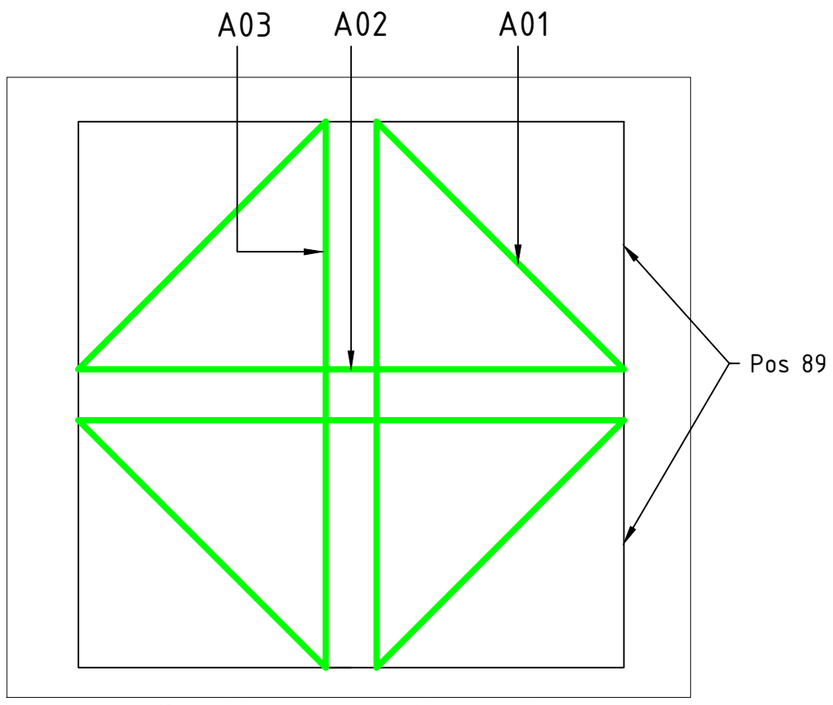



Front View




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**
**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 2 of 4

Revision: 00

Format: A2

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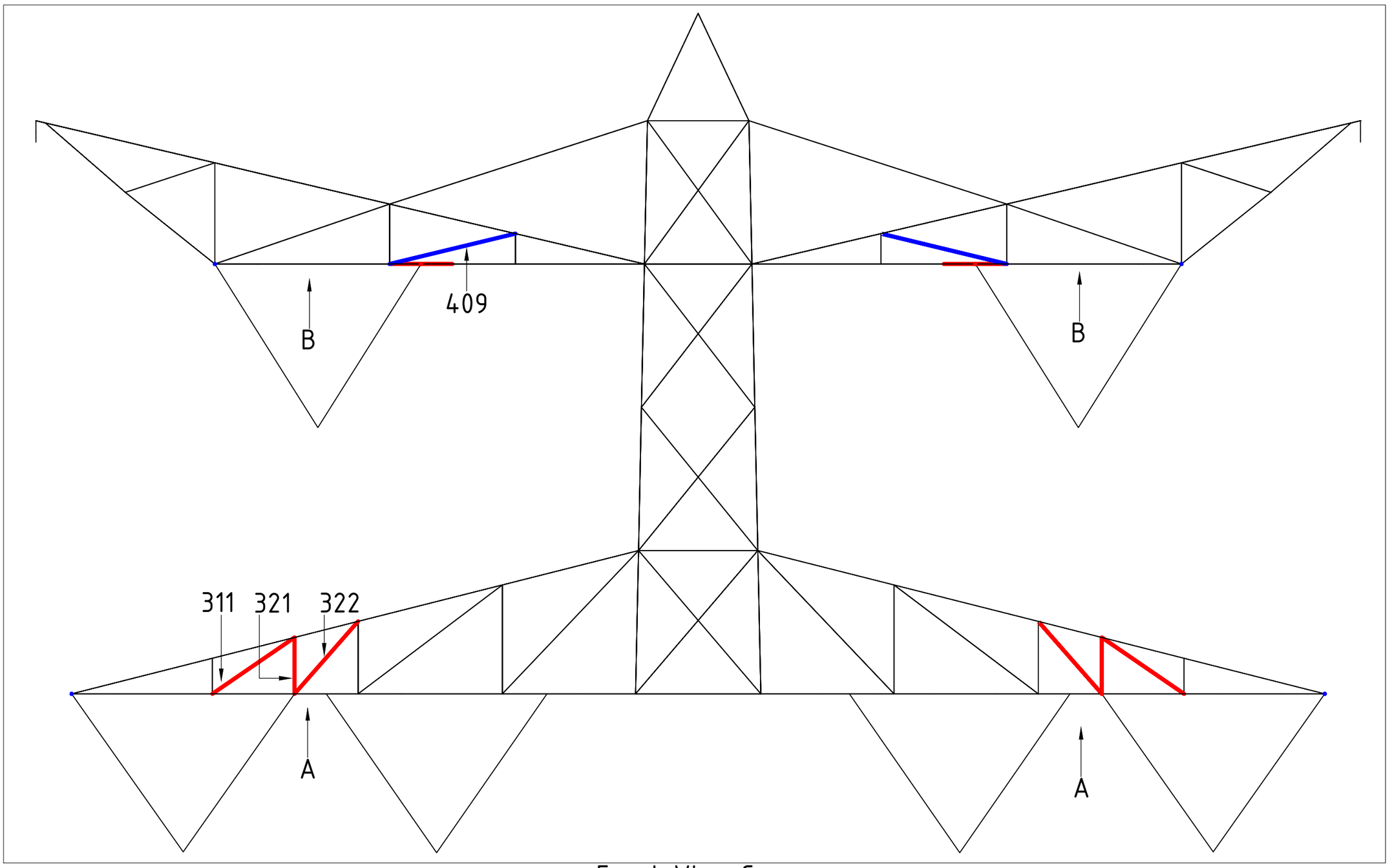
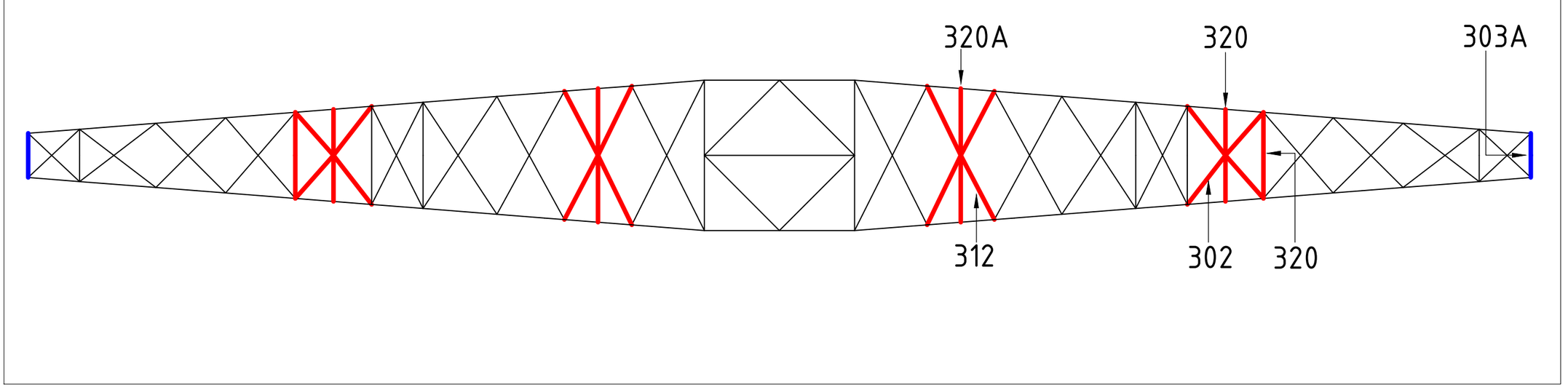
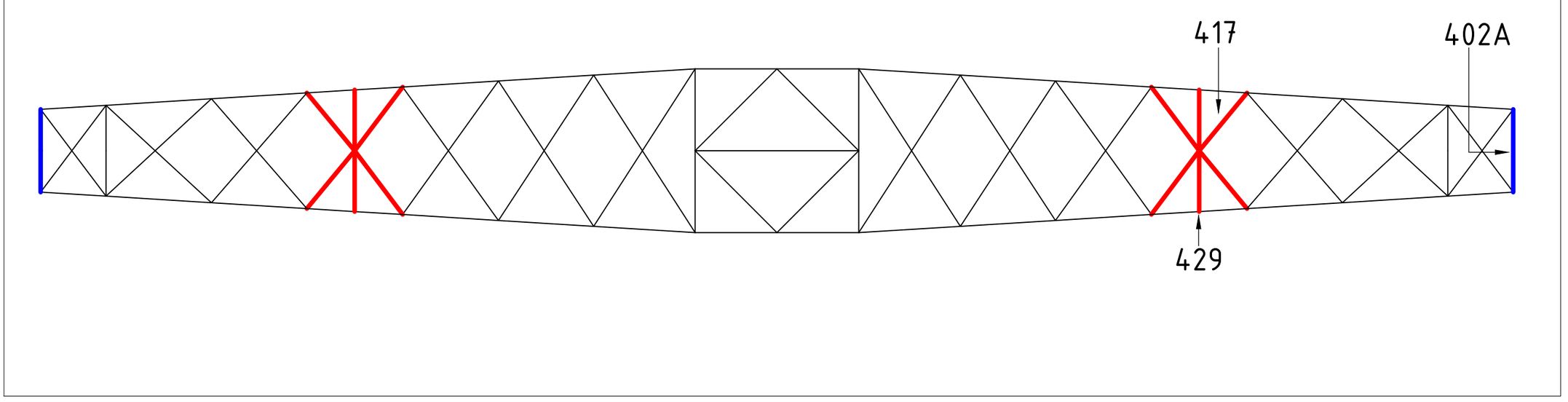



Front View Crossarms




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**
**Profile exchanged**
**New redundant**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 25-3-2021 | Version 2.0 - V insulators added |
| 00 | 6-7-2020 | Version 1.0 |

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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 3 of 4 |
| Drawn by: | MuK | 6-7-2020 | Units: | m | Revision: 00 |
| Checked by: | TBR | 7-7-2020 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 7-7-2020 | Company: | TenneT | |

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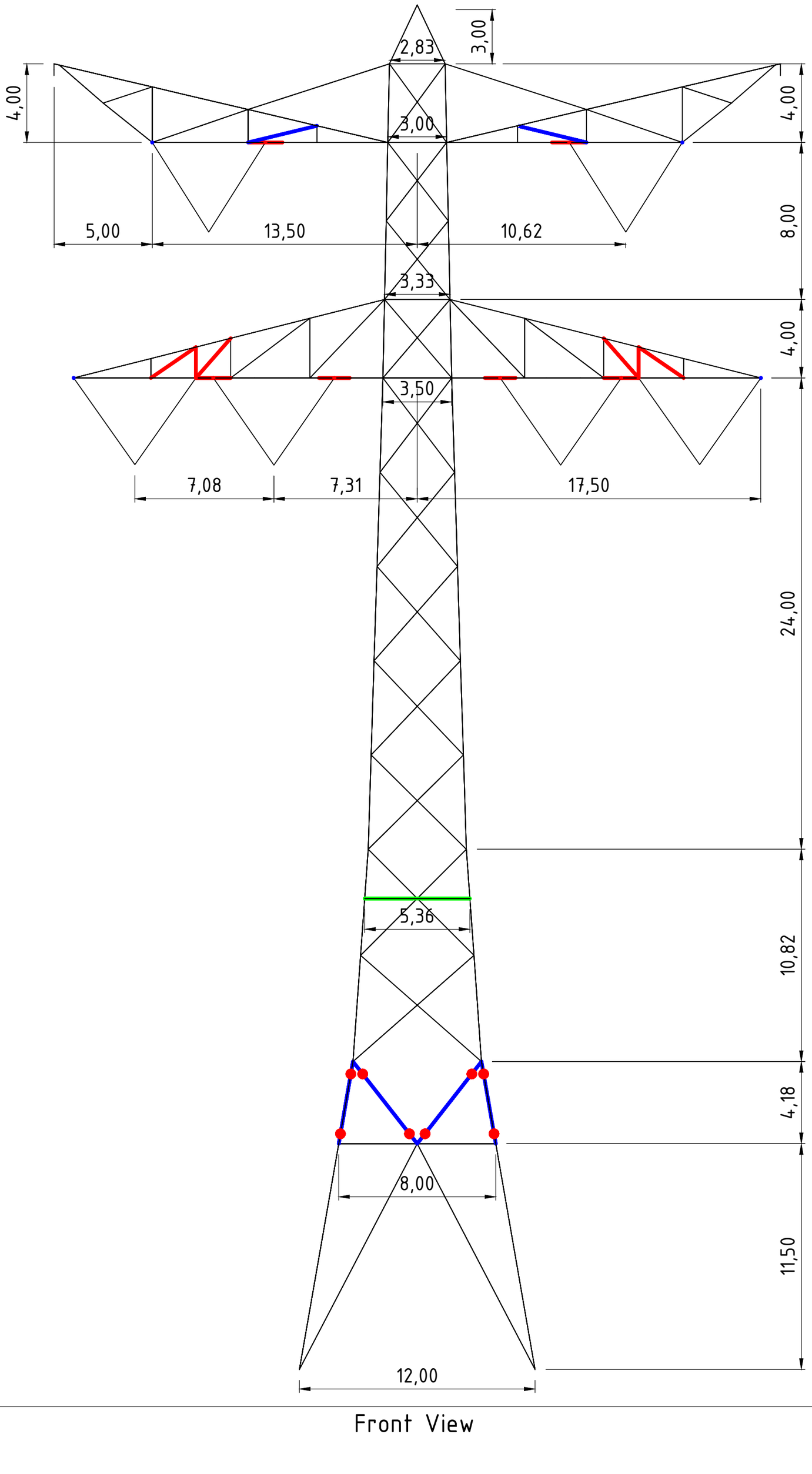
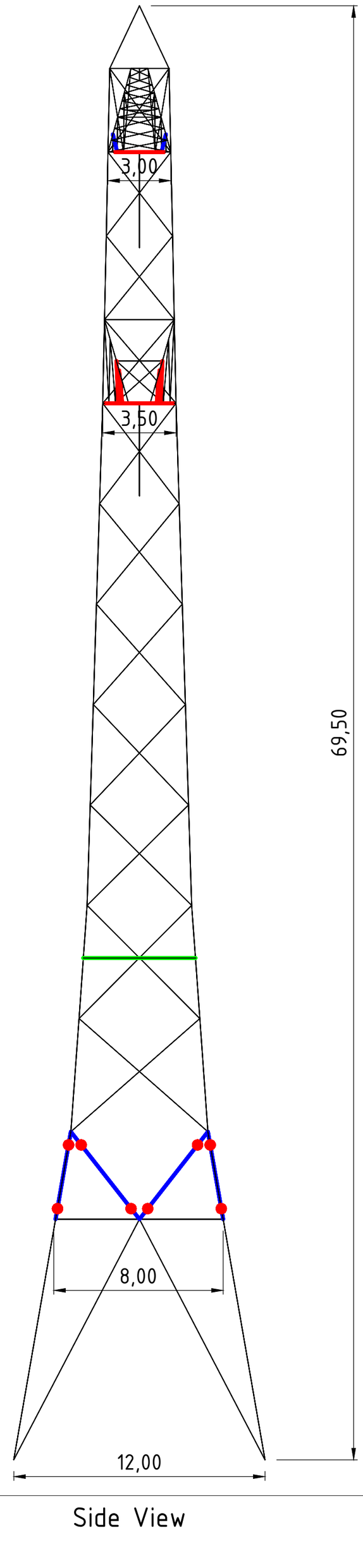



Front View




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**
**Profile exchanged**
**New redundant**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 25-3-2021 | Version 2.0 - V insulators added |
| 00 | 6-7-2020 | Version 1.0 |

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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 |
| Drawn by: | MuK | 6-7-2020 | Units: | m | Revision: 00 |
| Checked by: | TBR | 7-7-2020 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 7-7-2020 | Company: | TenneT | |

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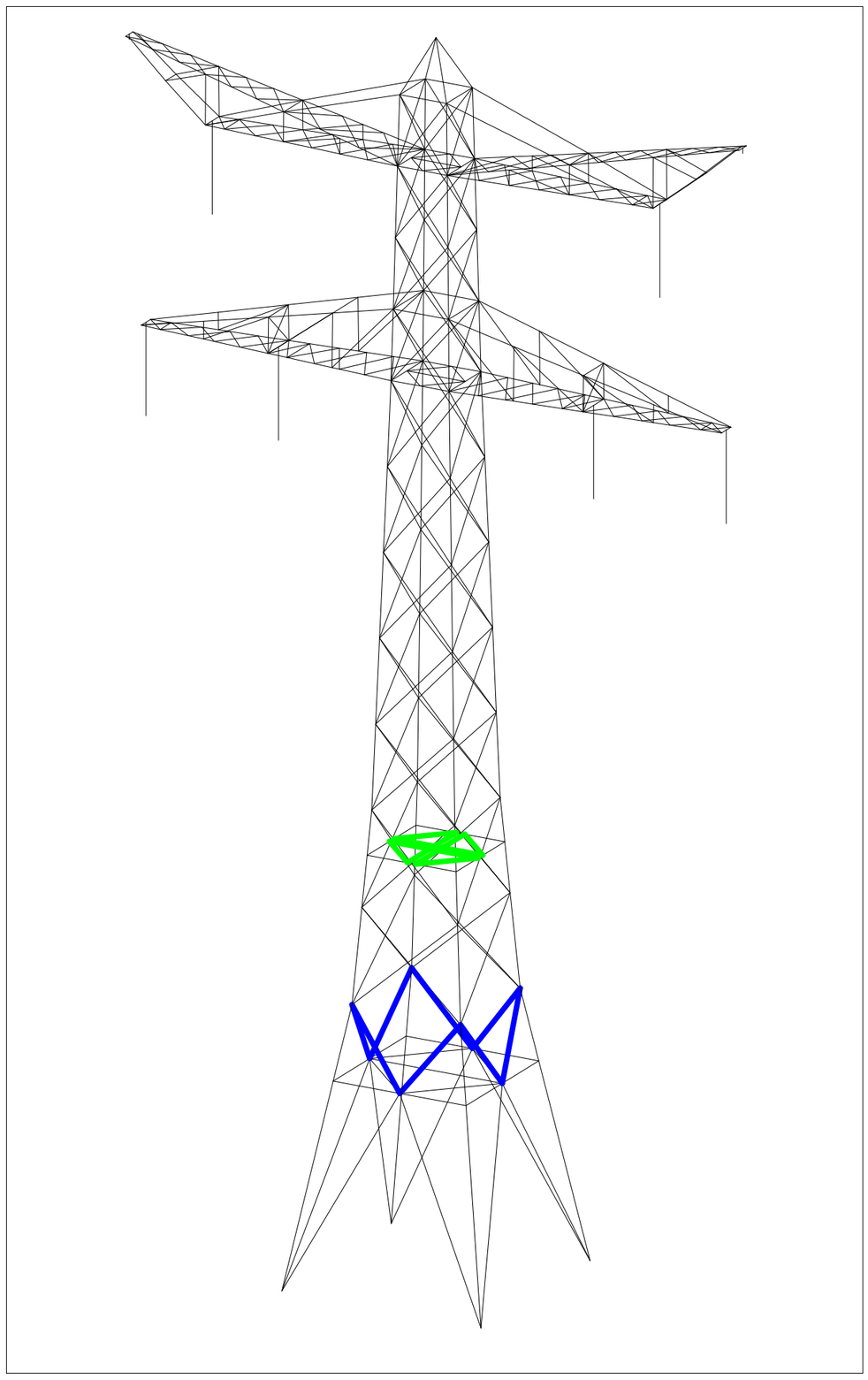
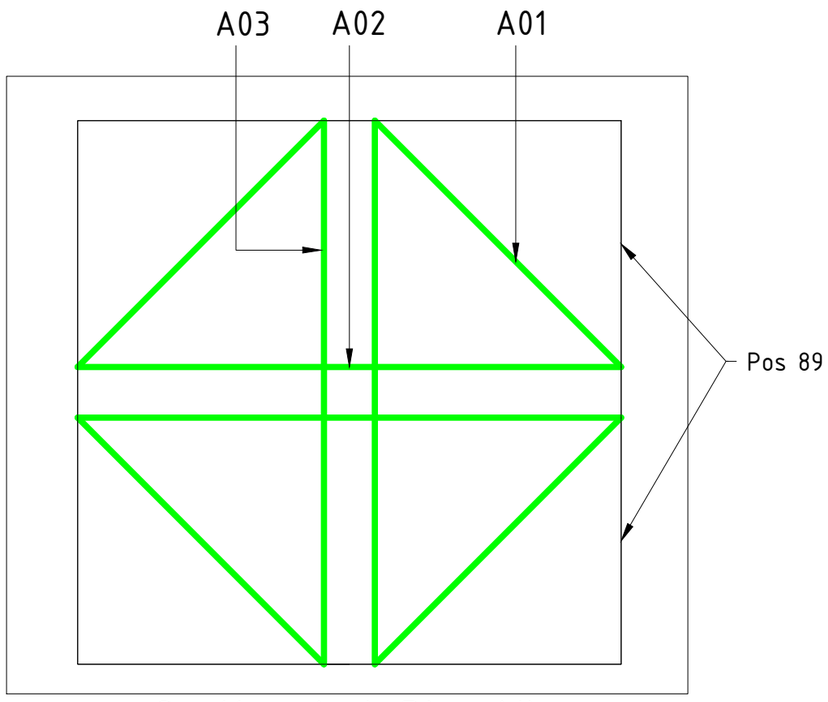
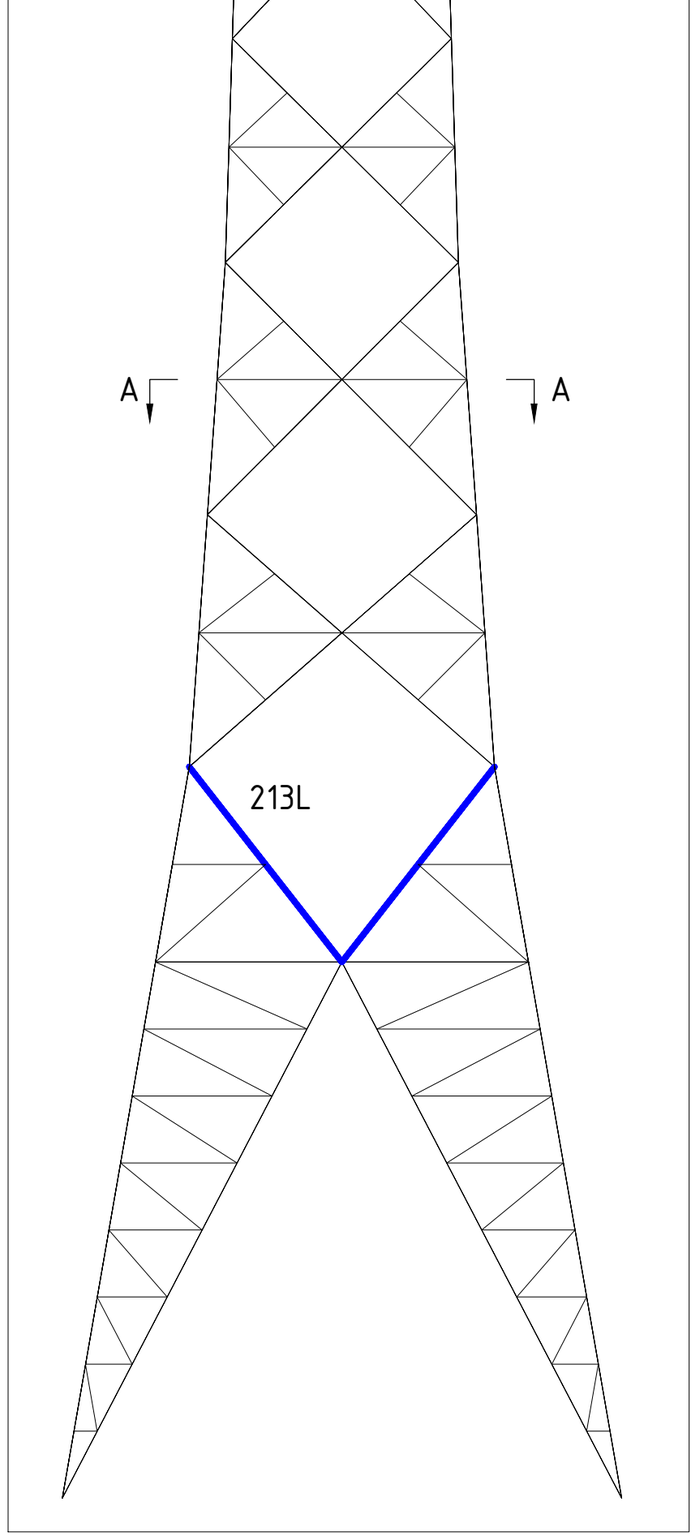
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality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



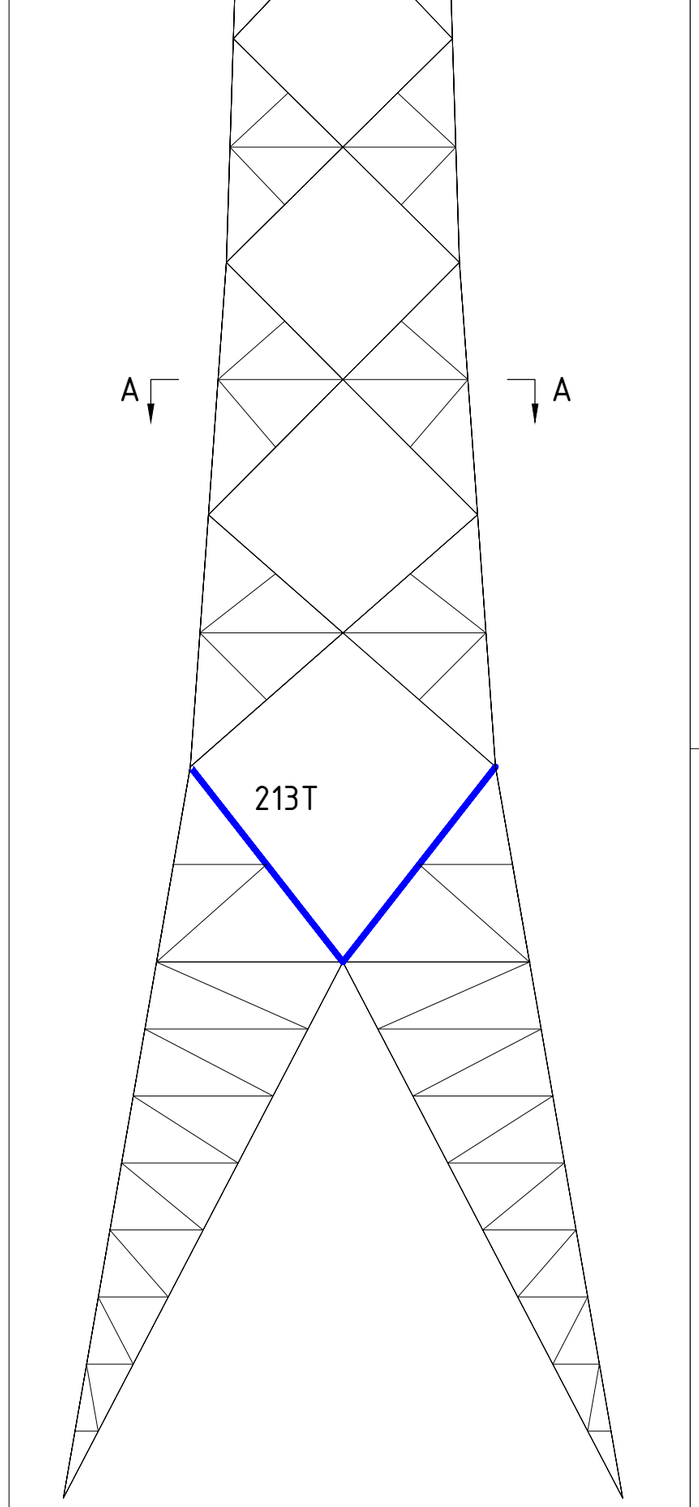
Overview




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: | - | Description: Modifications overview for mast type S+18 (mast 60) |
| Drawn by: | MuK | 7-7-2020 | Units: | m | Revision: 00 |
| Checked by: | TBR | 7-7-2020 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 8-7-2020 | Company: | TenneT | |

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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).

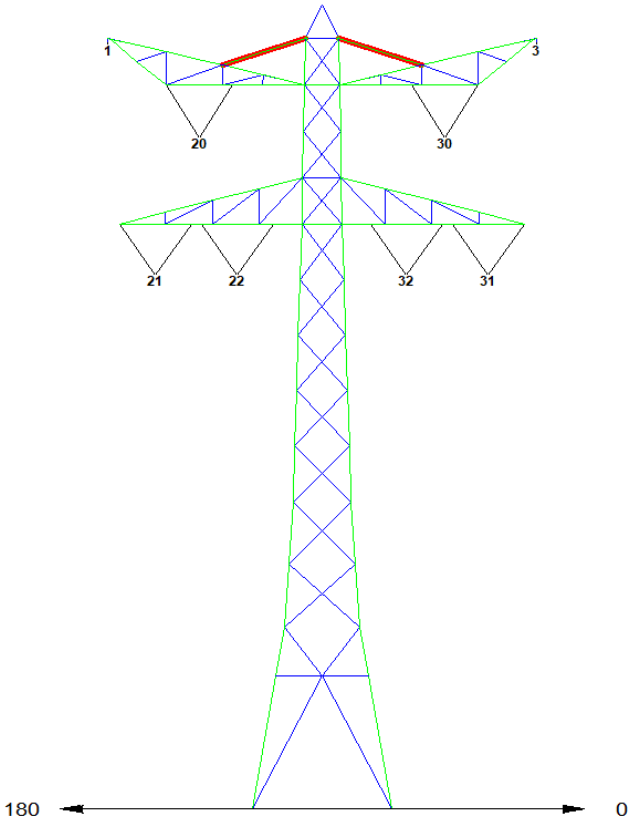



**Figure 1 S+18 PLS tower model**

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.

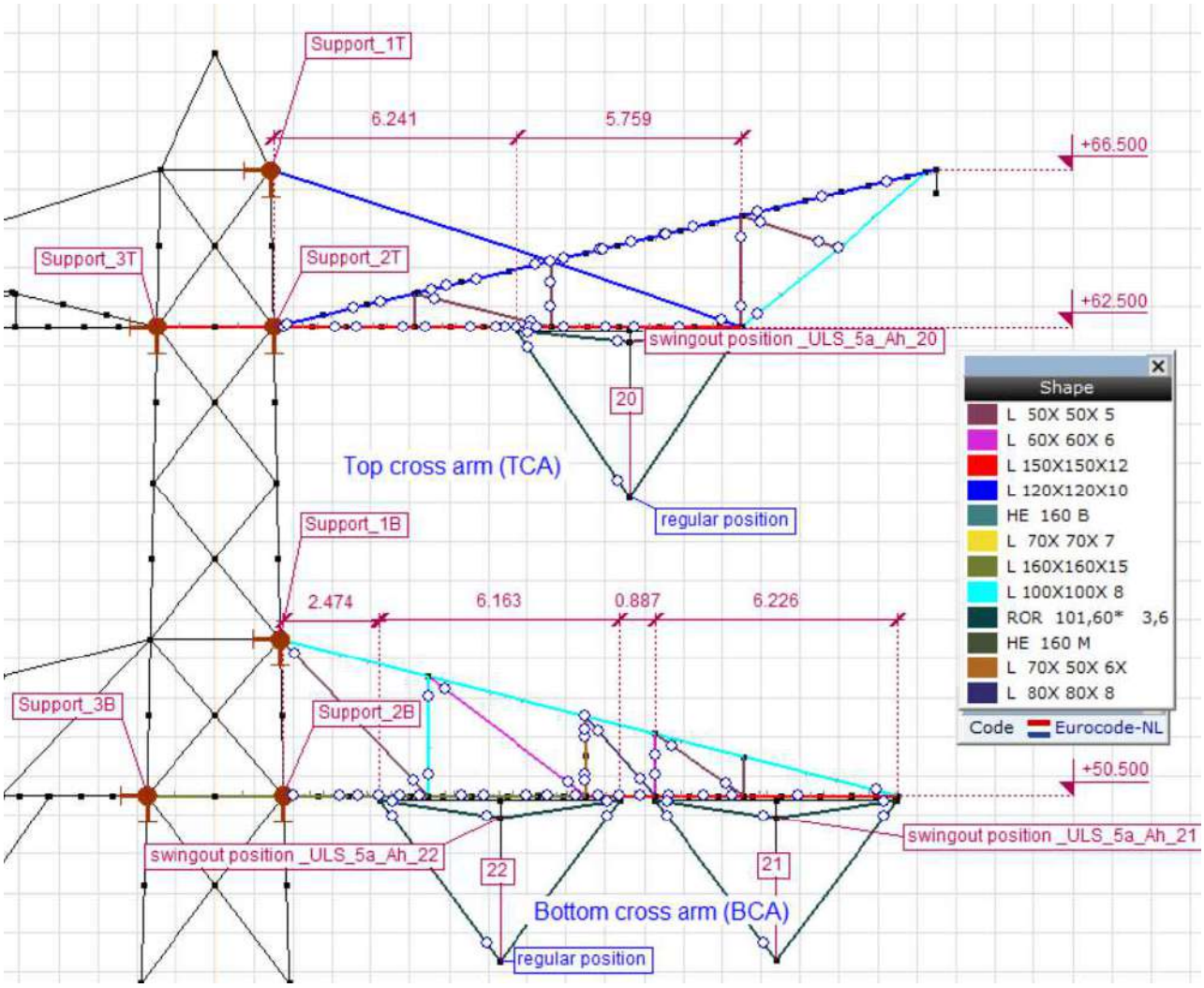



**Figure 2 Location of the v-ketting insulator assembly in S-6 tower**

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.

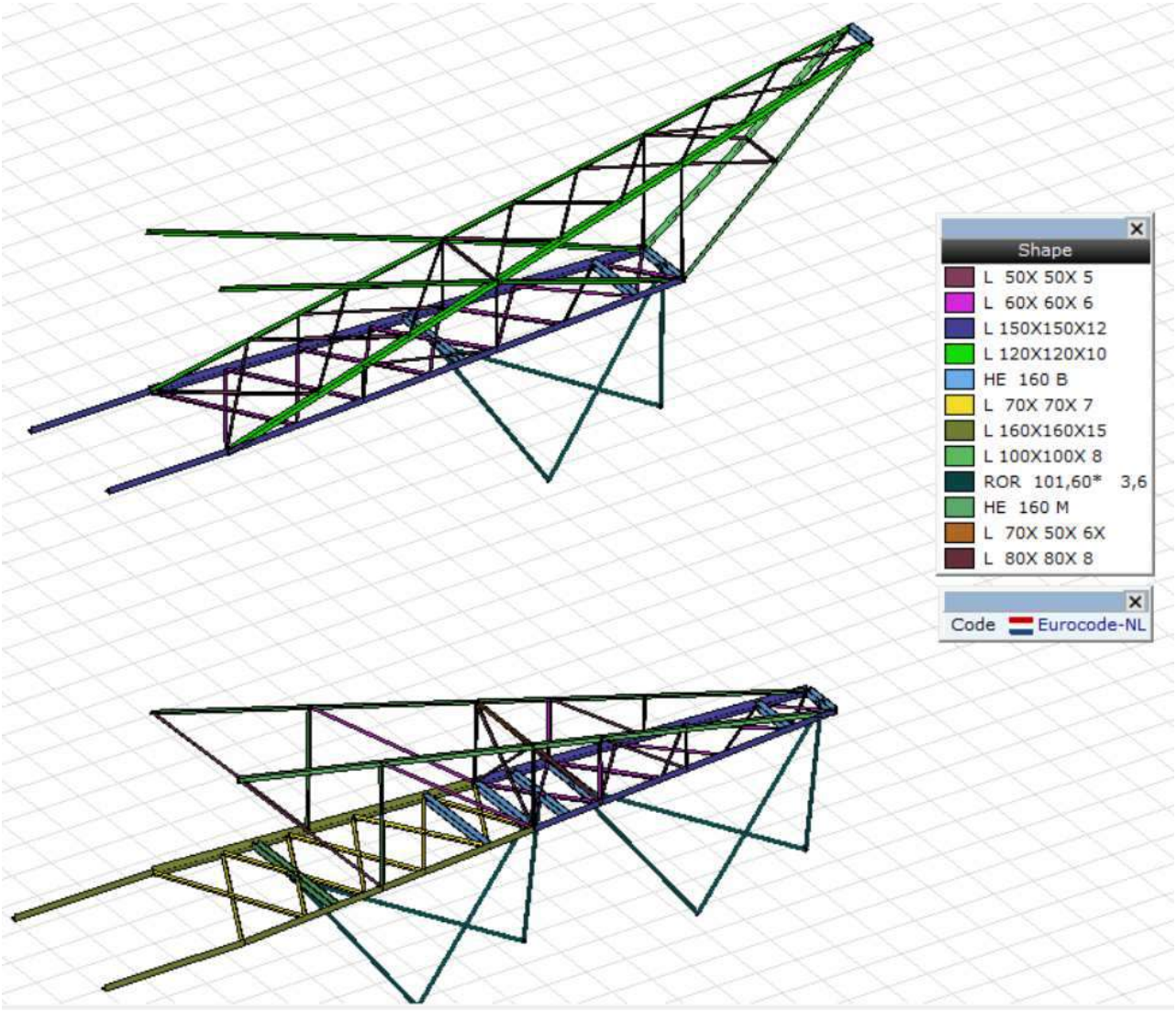



**Figure 3 3D rendered geometry of the Cross arm.**

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.

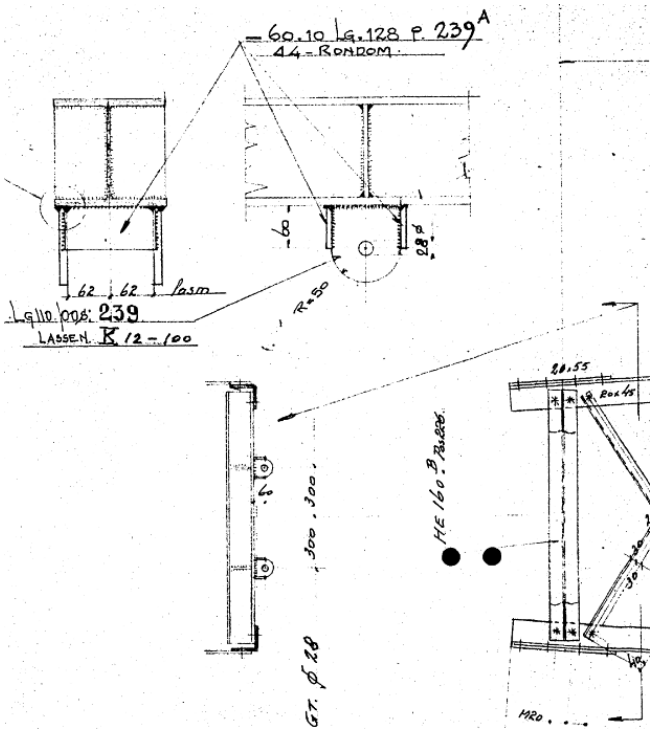



**Figure 4 H beam at the end of the cross arm.**

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.

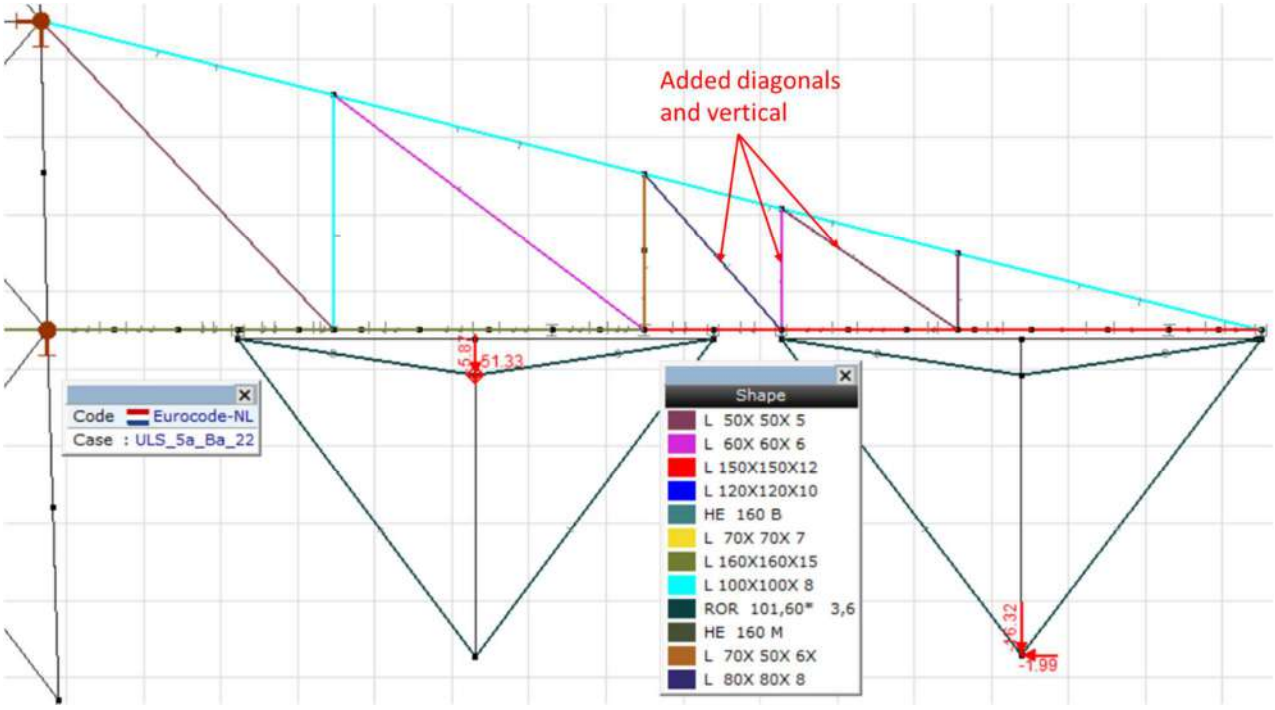



**Figure 5 Additional members in the lower cross arm.**

## 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.

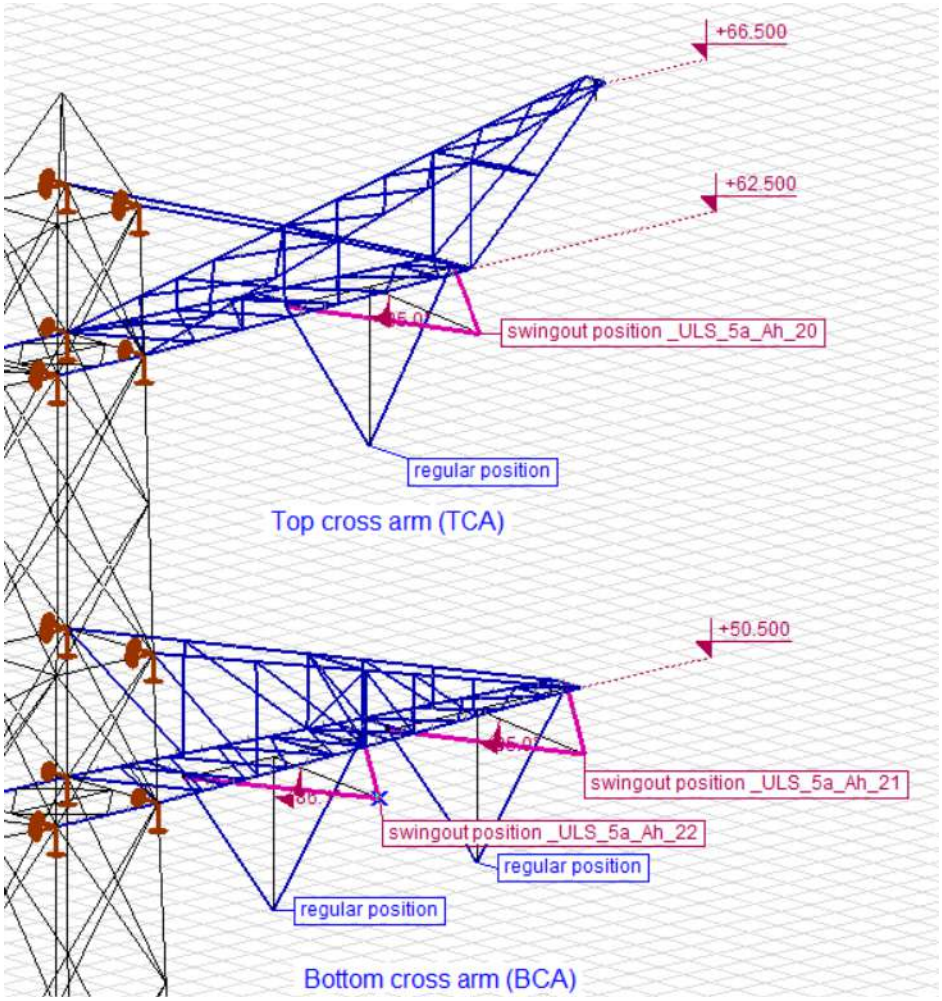



**Figure 6 position of the isolators in working and broken conductors**

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 |

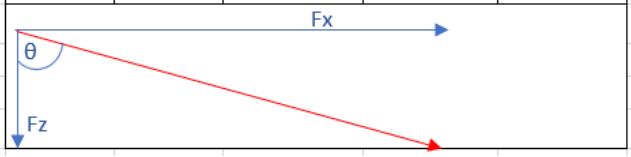
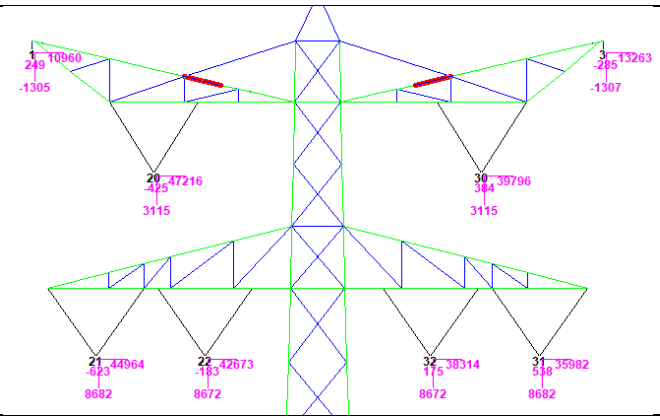
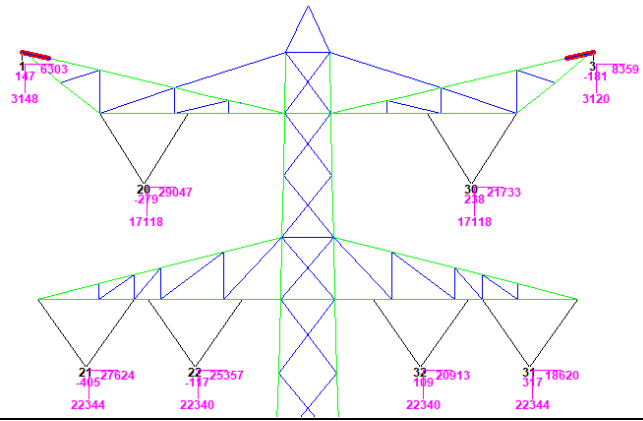
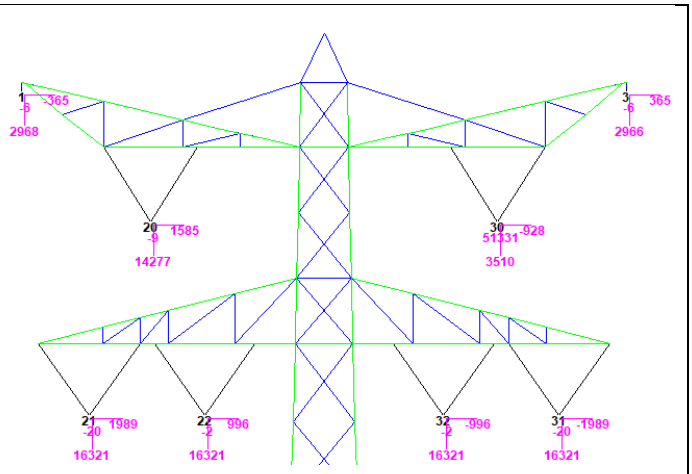
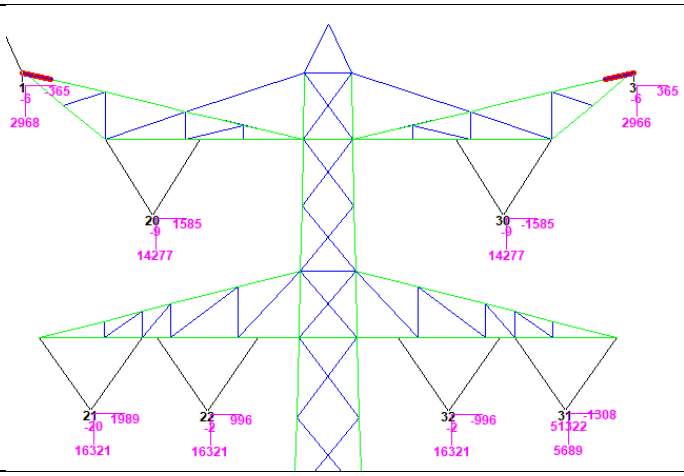
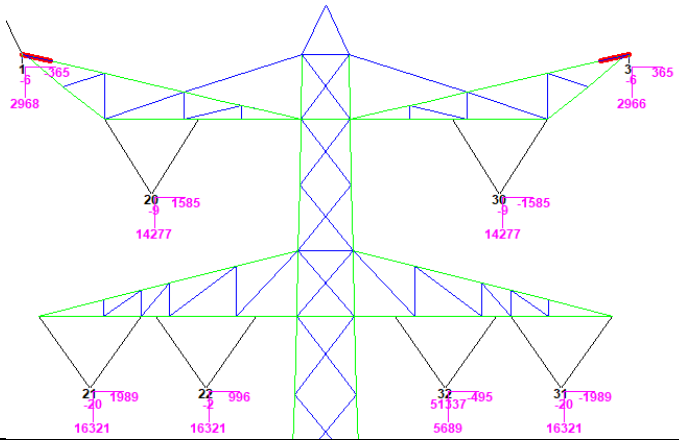
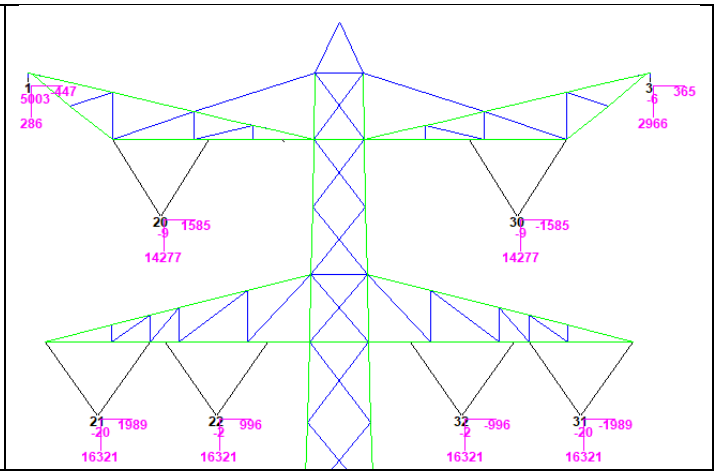



Table 3 gives the load values for the various load cases from PLS tower output.

**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/mm$^2$. 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.

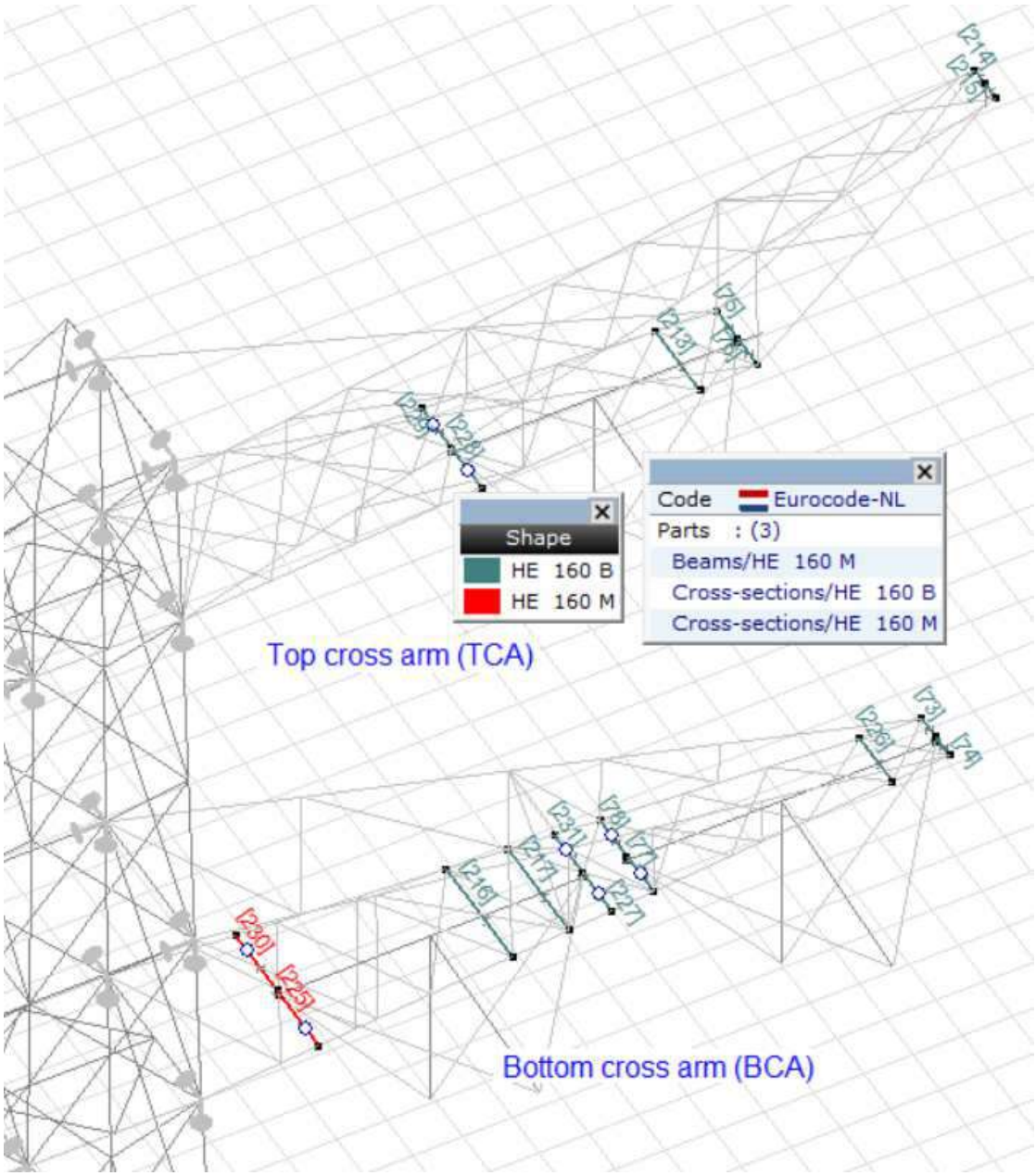



**Figure 7 beam Id's for H beams to be checked for torsion.**

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.

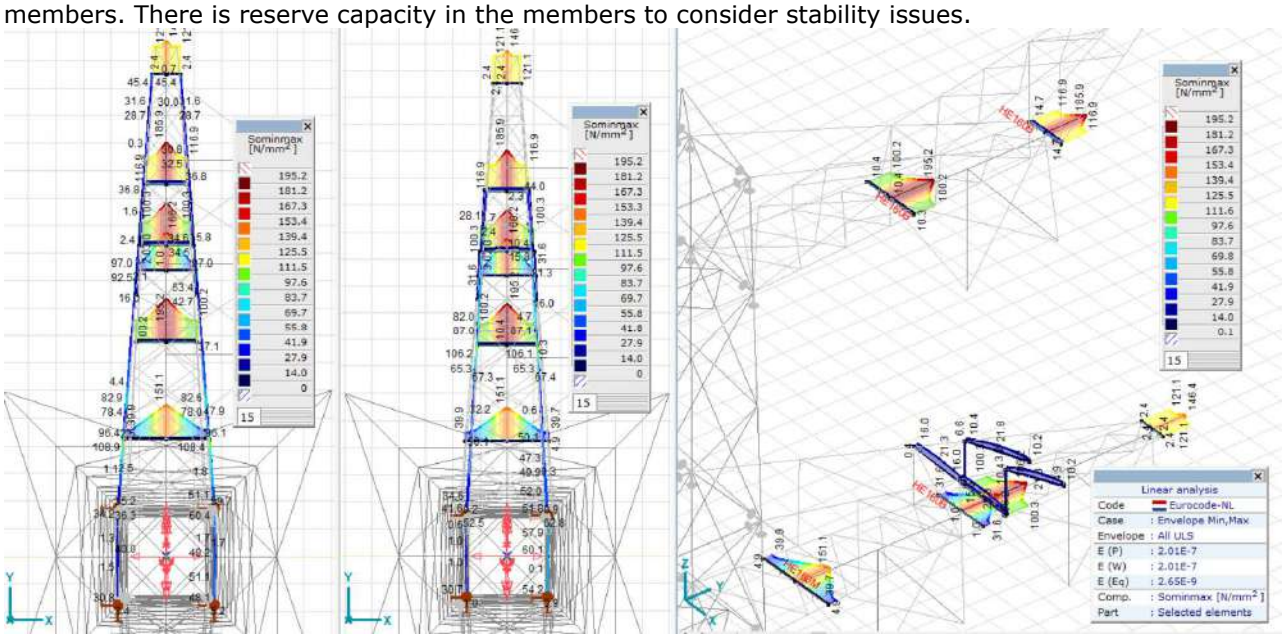
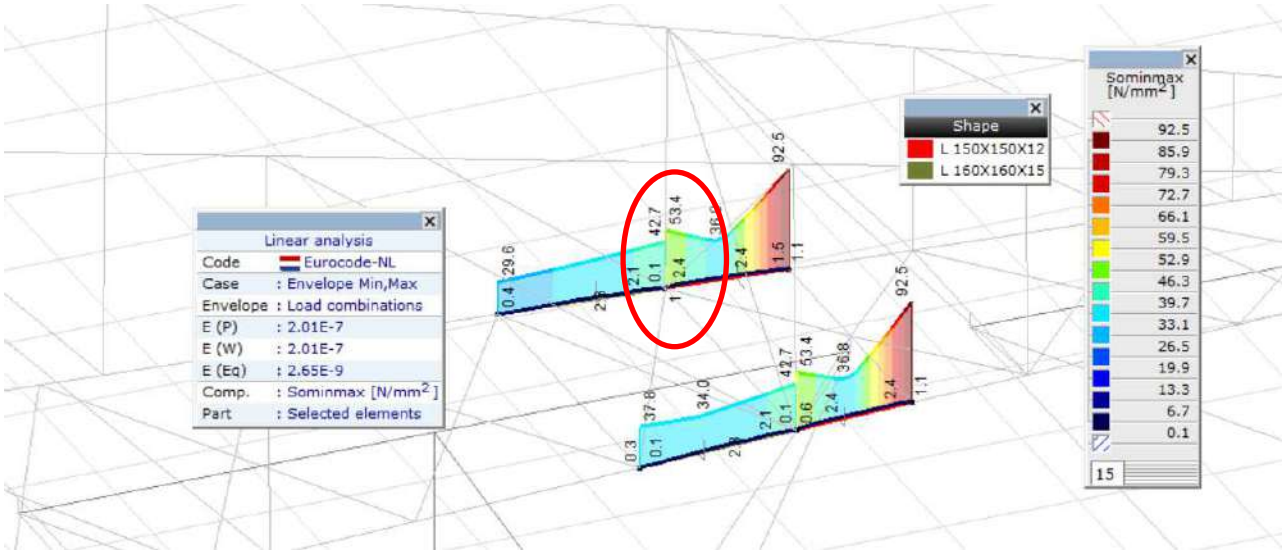



**Figure 9 Stress for ULS Envelope in members**

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

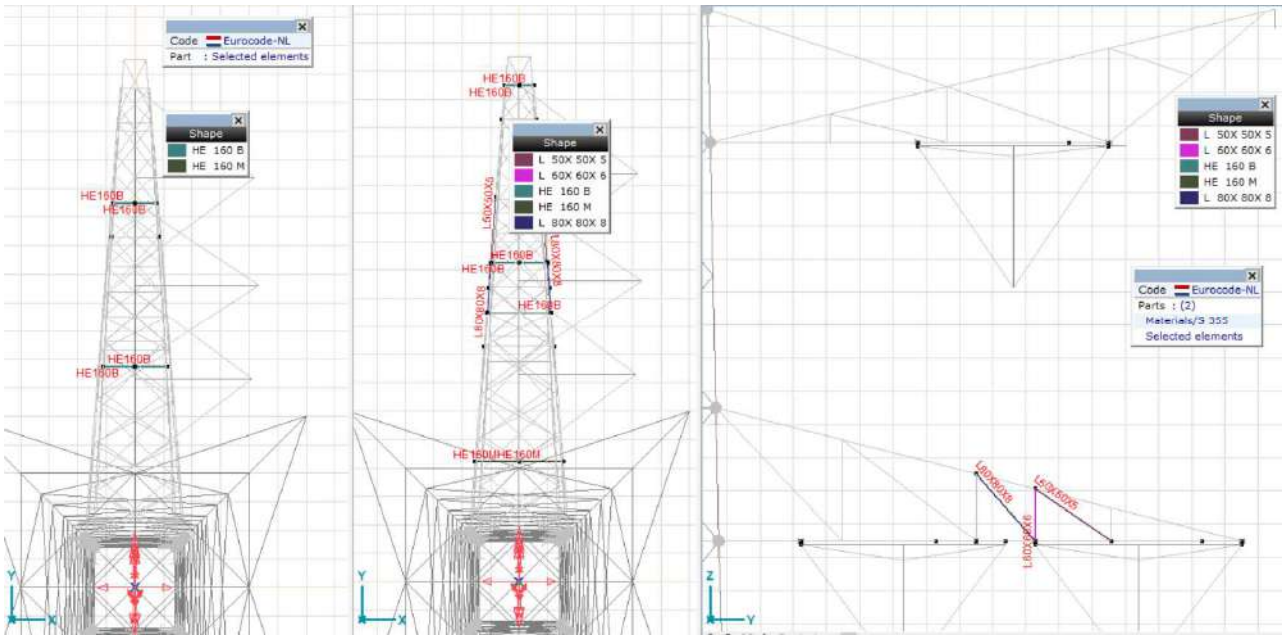
report appendix. The max utilization seen from the torsion + bending stress in excel is 0.6. The utilization has increased due to the warping moment accounted for by the excel calculation. The additional strength can be used for the losses in connection. Thus the structure is assumed to safe.

# 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.


Code Eurocode-NL
Part : Selected elements
Shape
HE 160 B
HE 160 M
HE160B
HE160B
HE160B

# 6 BIJLAGE: UITVOER AXISVM.

# Project

## Analysis by DNV GL - Energy

AxisVM X5 R4j · Registered to DNV GL - Energy
S+18_v_ketting.axs

## Report

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| [StI], > S 355, Linear, Envelope (All ULS ), Utilization ULS [], Filled diagram | 18 |

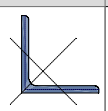
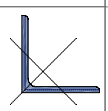
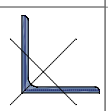
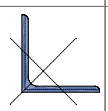
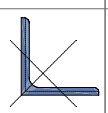
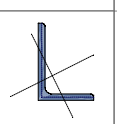
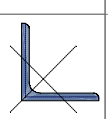
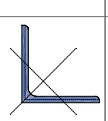
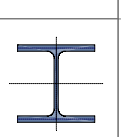
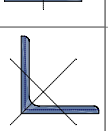
## Materials

| | Name | Type | National design code | Material code | Model | $E_x$ [N/mm²] | $E_y$ [N/mm²] | v | $\alpha_T$ [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; **v:** Poisson's ratio; **$\alpha_T$:** 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;

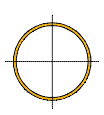
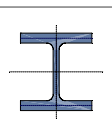
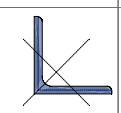
## Cross-sections

| | 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 |

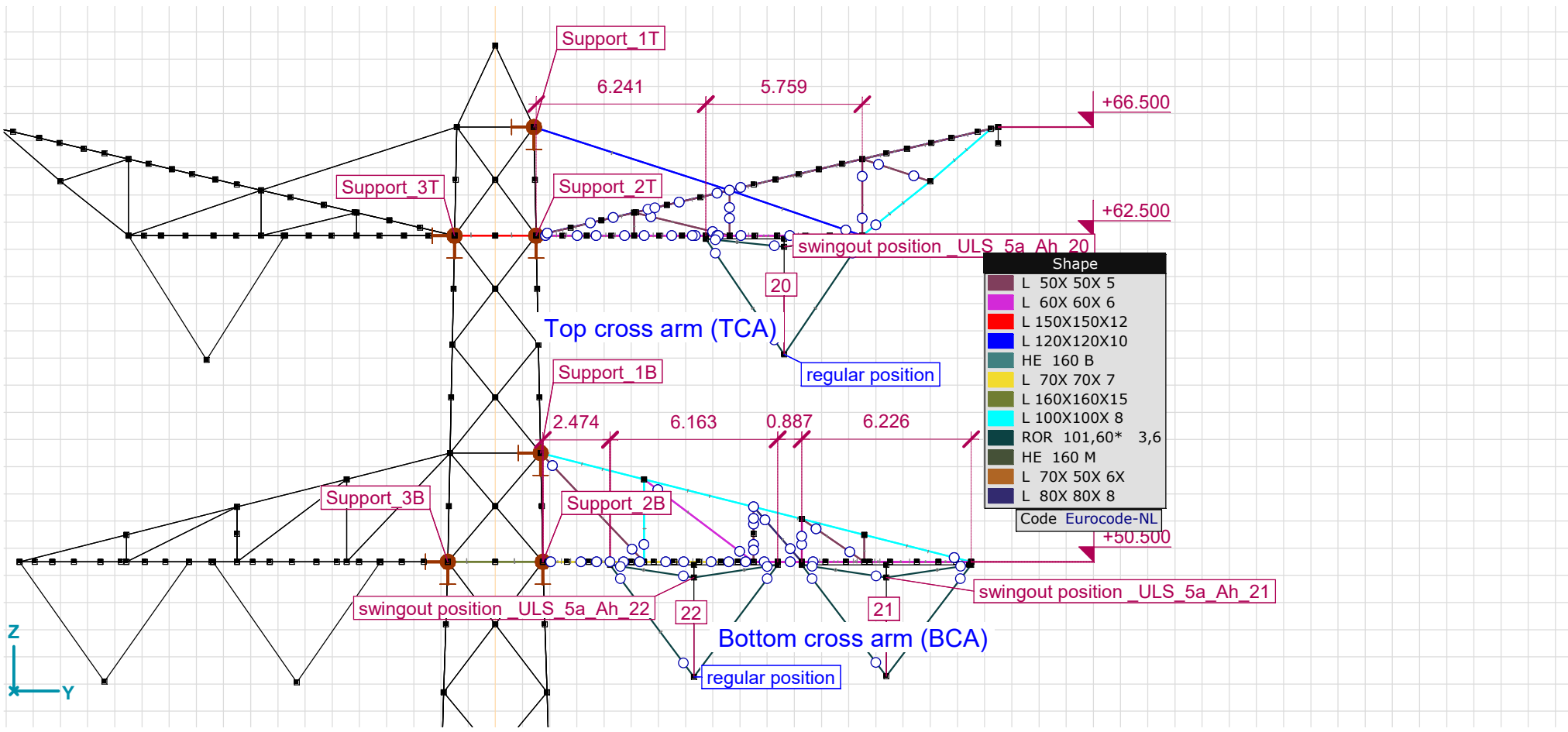
Cross-sections

| | Name | Drawing | Process | Shape | h [mm] | b [mm] | tw [mm] | tf [mm] | $r_1$ [mm] | $r_2$ [mm] | $r_3$ [mm] | Ax [mm²] | Ay [mm²] | Az [mm²] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

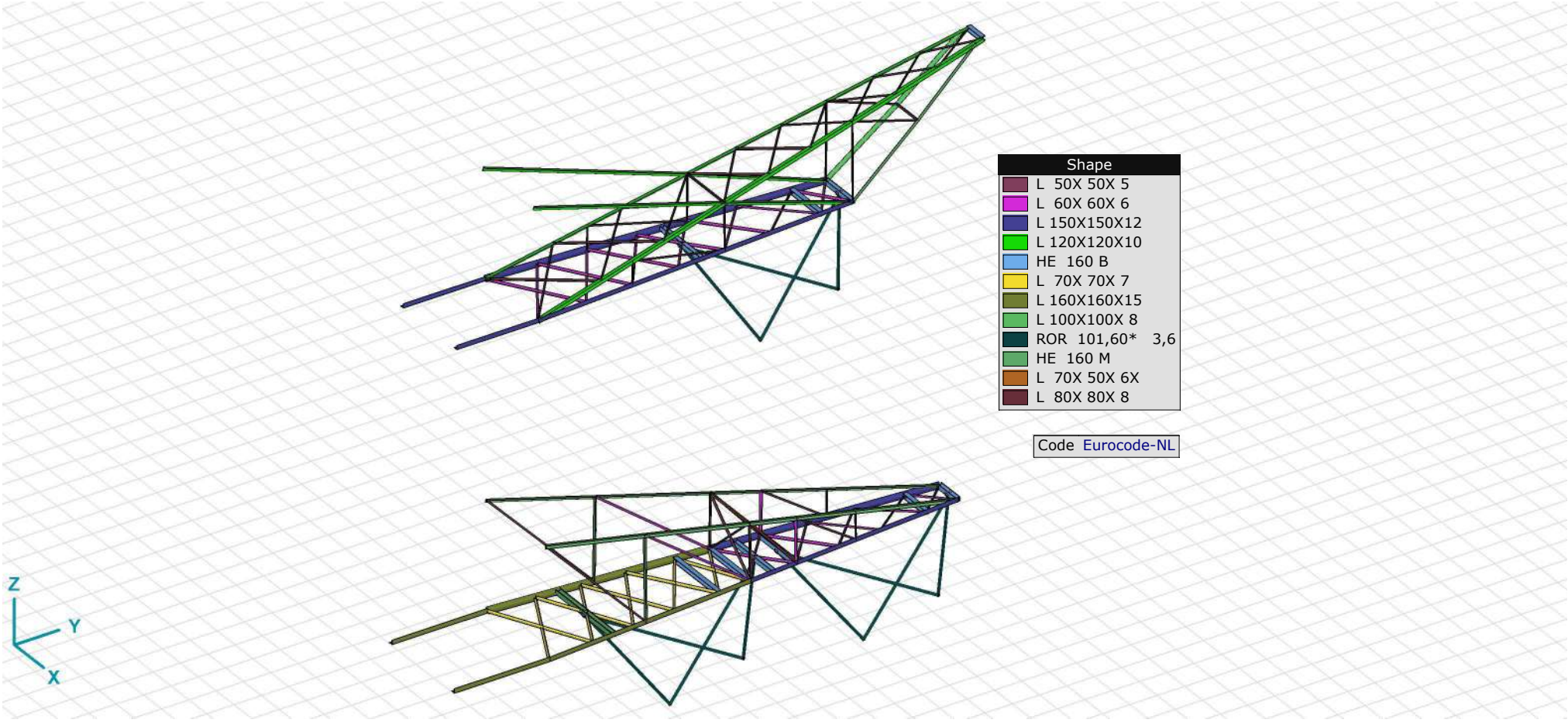
| | Name | Ix [mm⁴] | Iy [mm⁴] | Iz [mm⁴] | Iyz [mm⁴] | $I_1$ [mm⁴] | $I_2$ [mm⁴] | α [°] | Iω [mm⁶] | $W_{1,el,t}$ [mm³] | $W_{1,el,b}$ [mm³] | $W_{2,el,t}$ [mm³] | $W_{2,el,b}$ [mm³] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | ROR 101,60* 3,6 | 2663810.0 | 1328996.0 | 1328996.0 | 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 | $W_{1,pl}$ [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. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

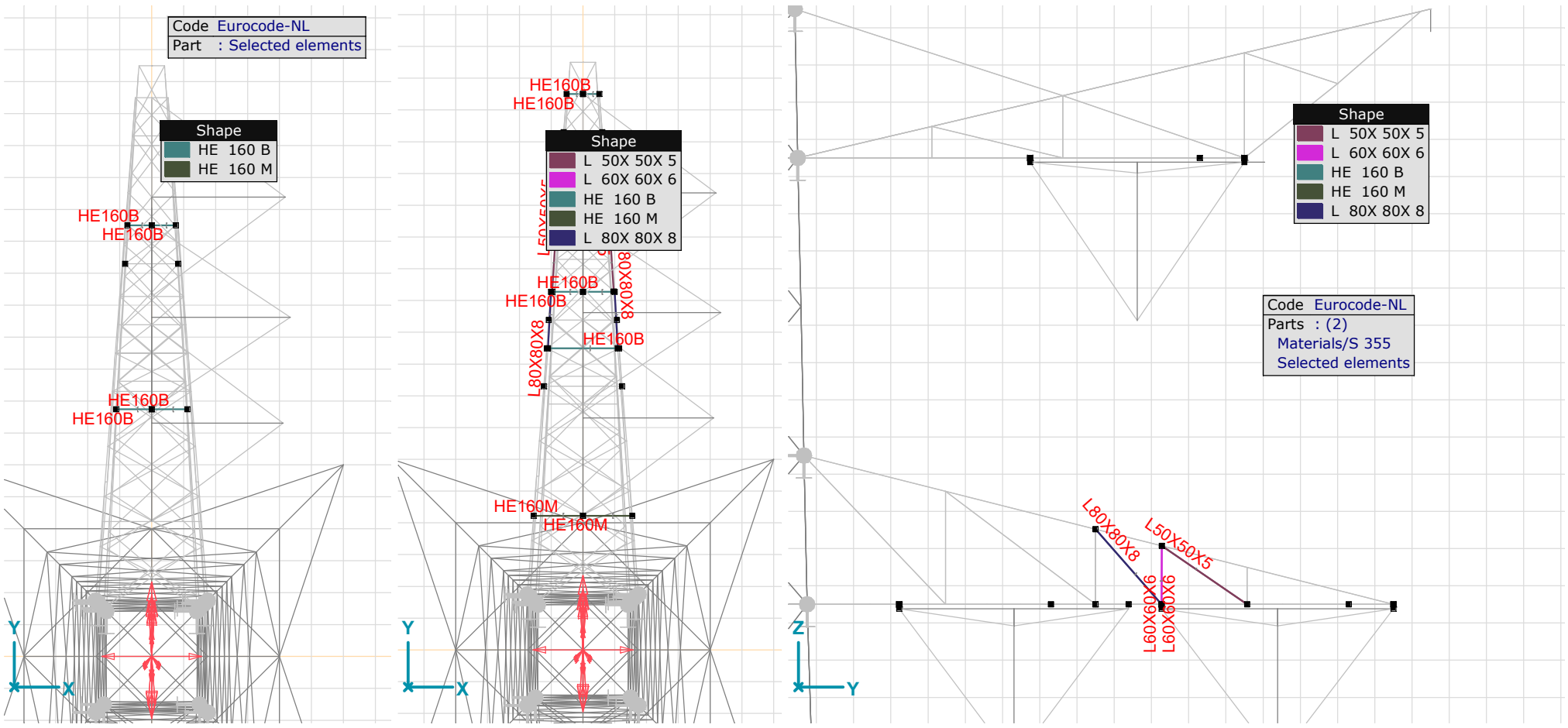
**Name:** Cross-section name; **Process:** Manufacturing process; **h:** Cross-section height; **b:** Cross-section width; **tw:** Web thickness; **tf:** Flange thickness; **$r_1$, $r_2$, $r_3$:** Rounding radius; **Ax:** Cross-section area; **Ay, Az:** Shear area; **Ix:** Torsional inertia; **Iy, Iz:** 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*

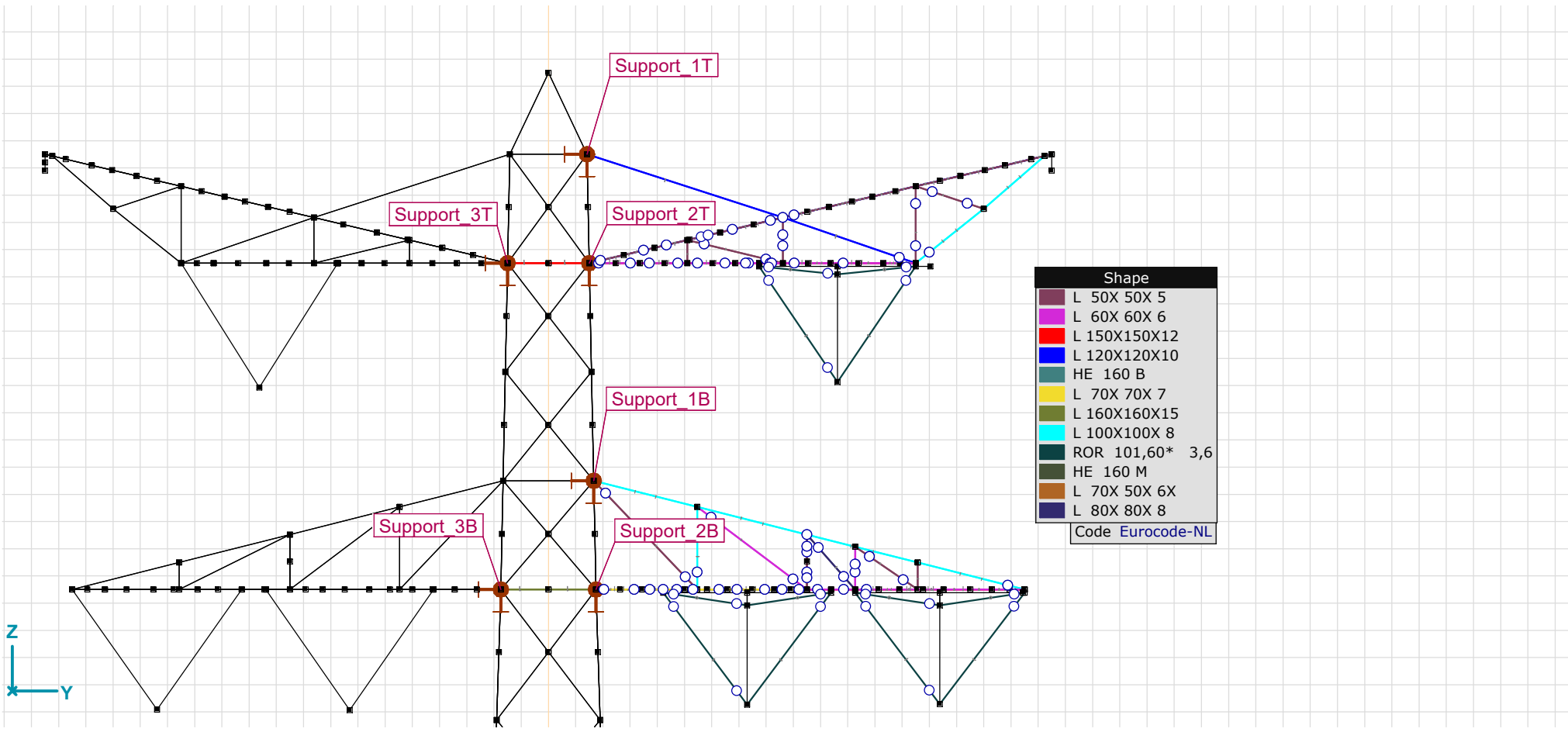
## Nodal supports

| | 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;

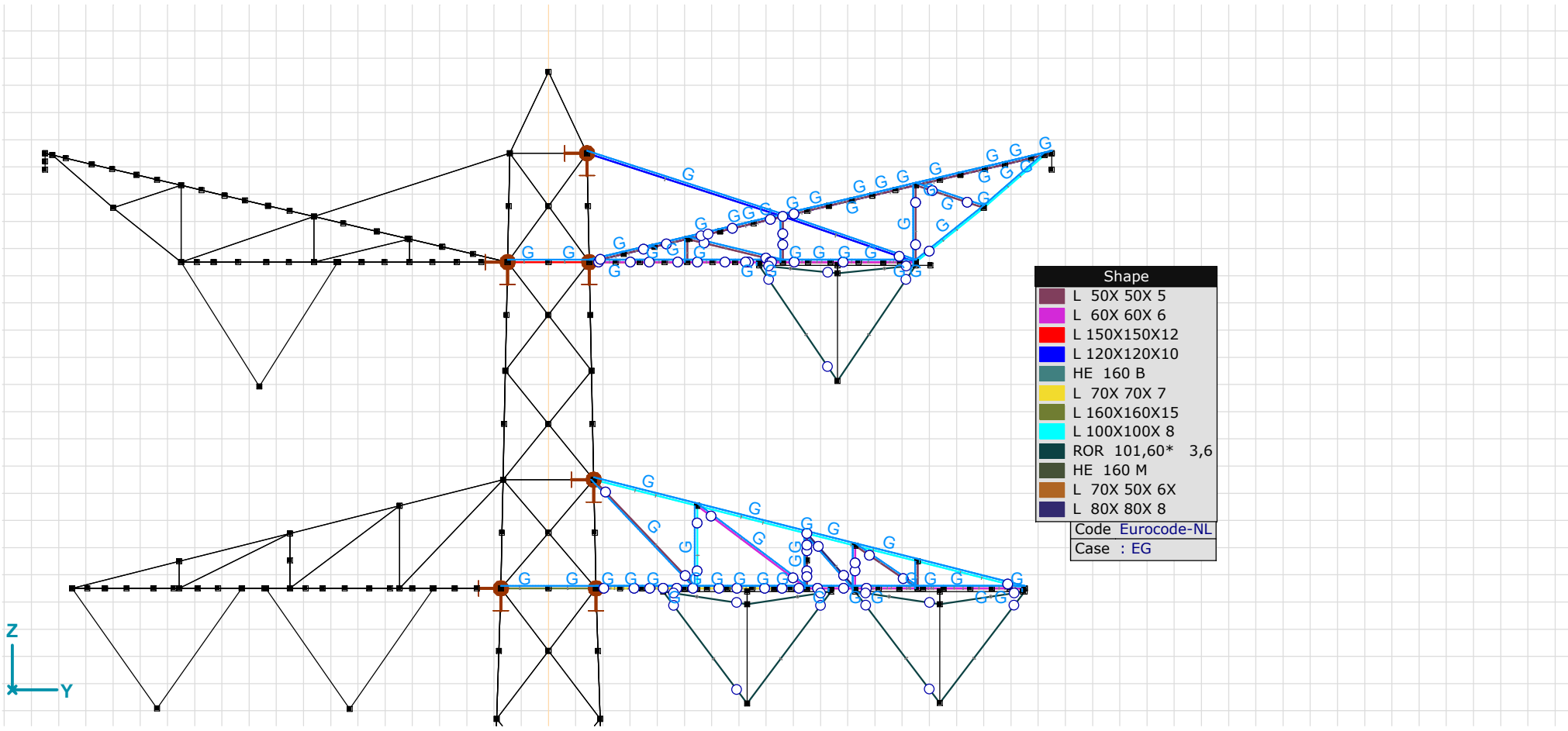



*supports*

## 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;

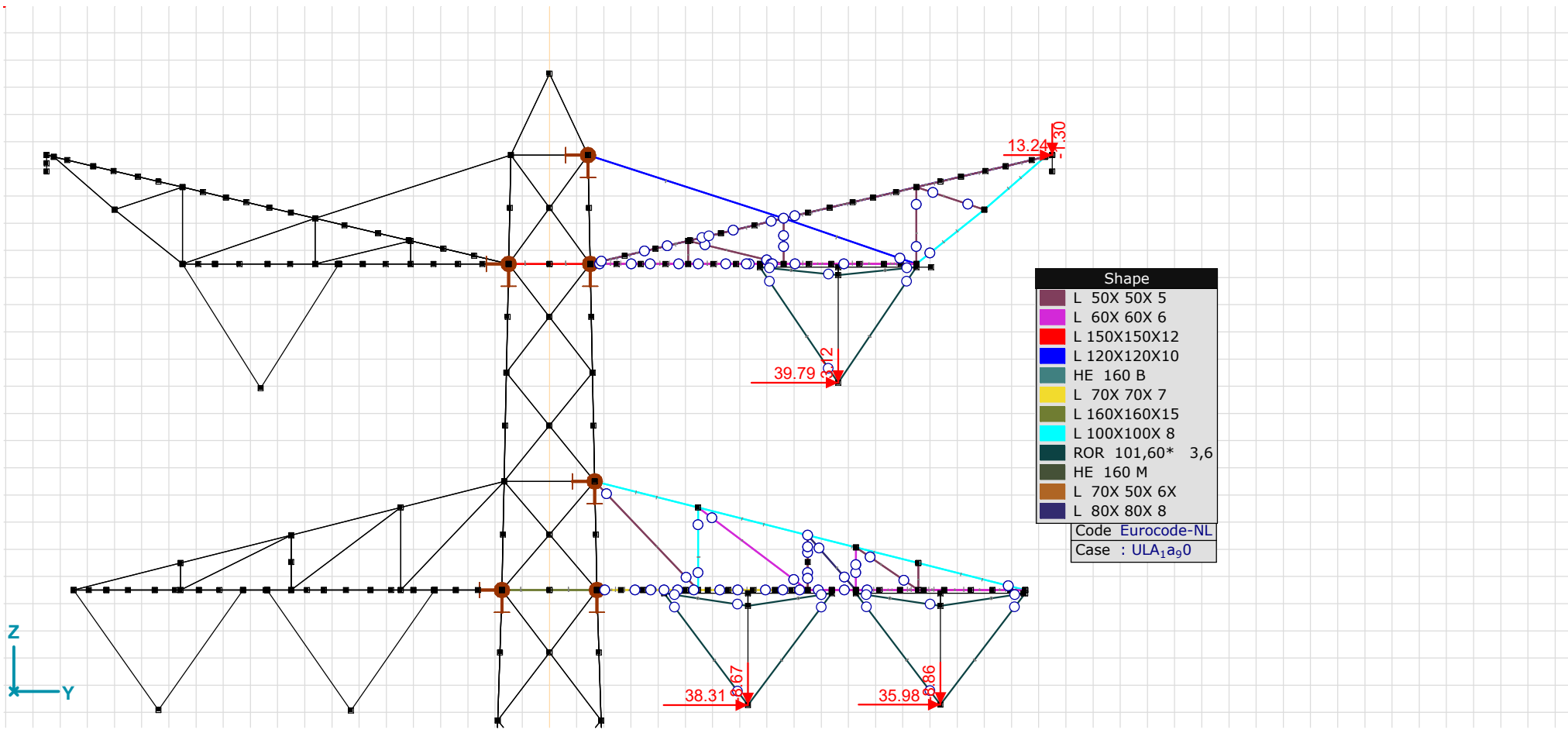



*EG, Side view*

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;

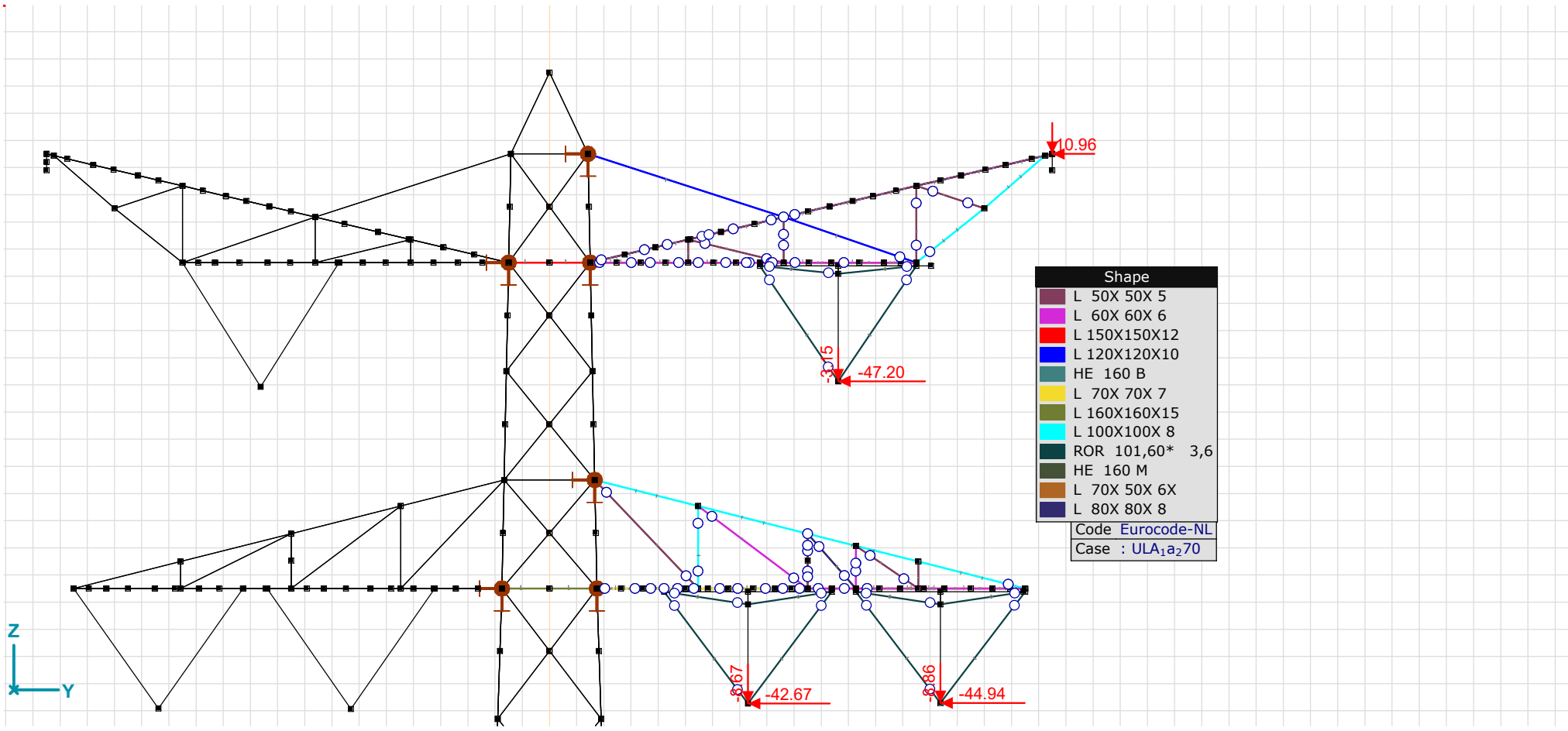



*ULA_1a_90, Side view*

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;

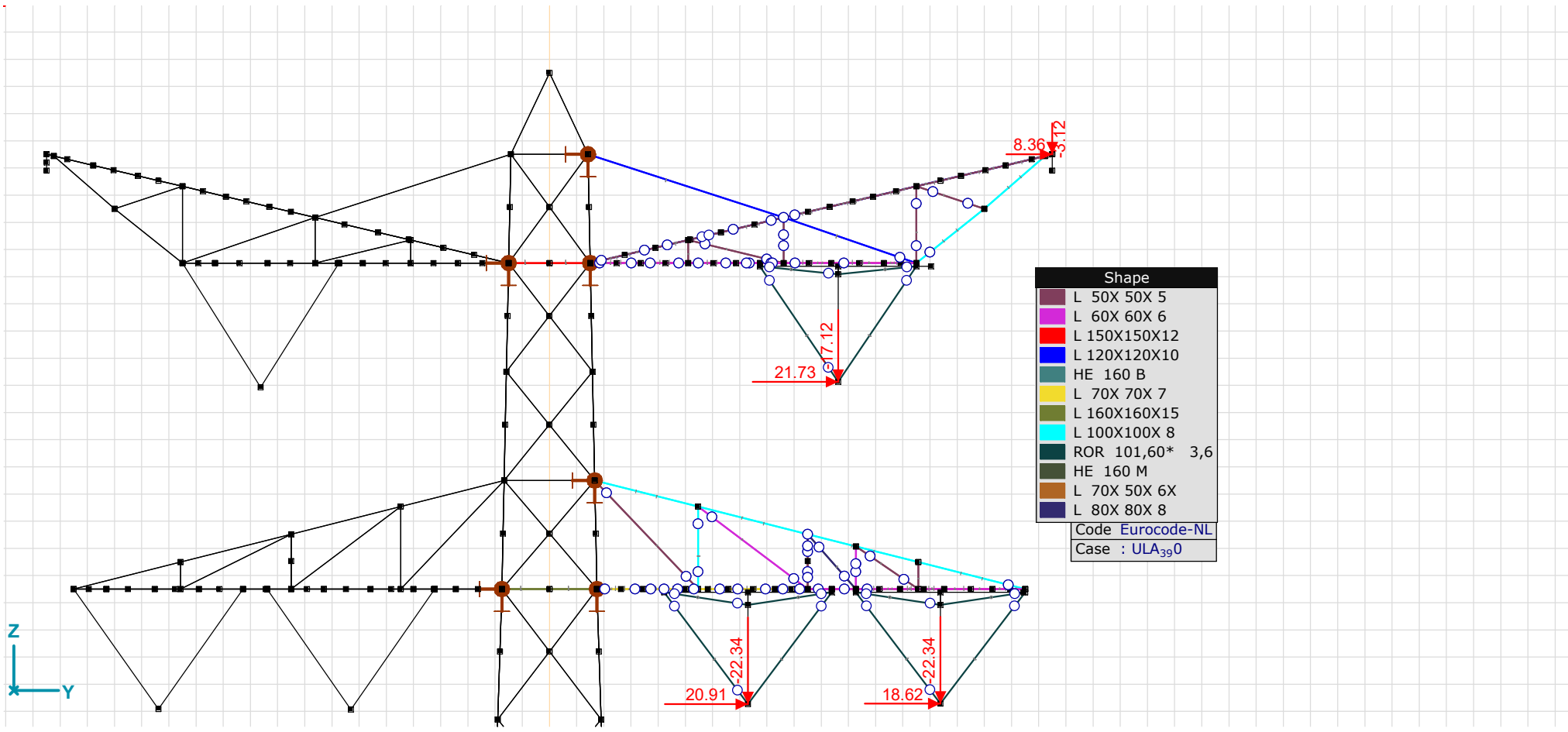



*ULA_1a_270, Side view*

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;

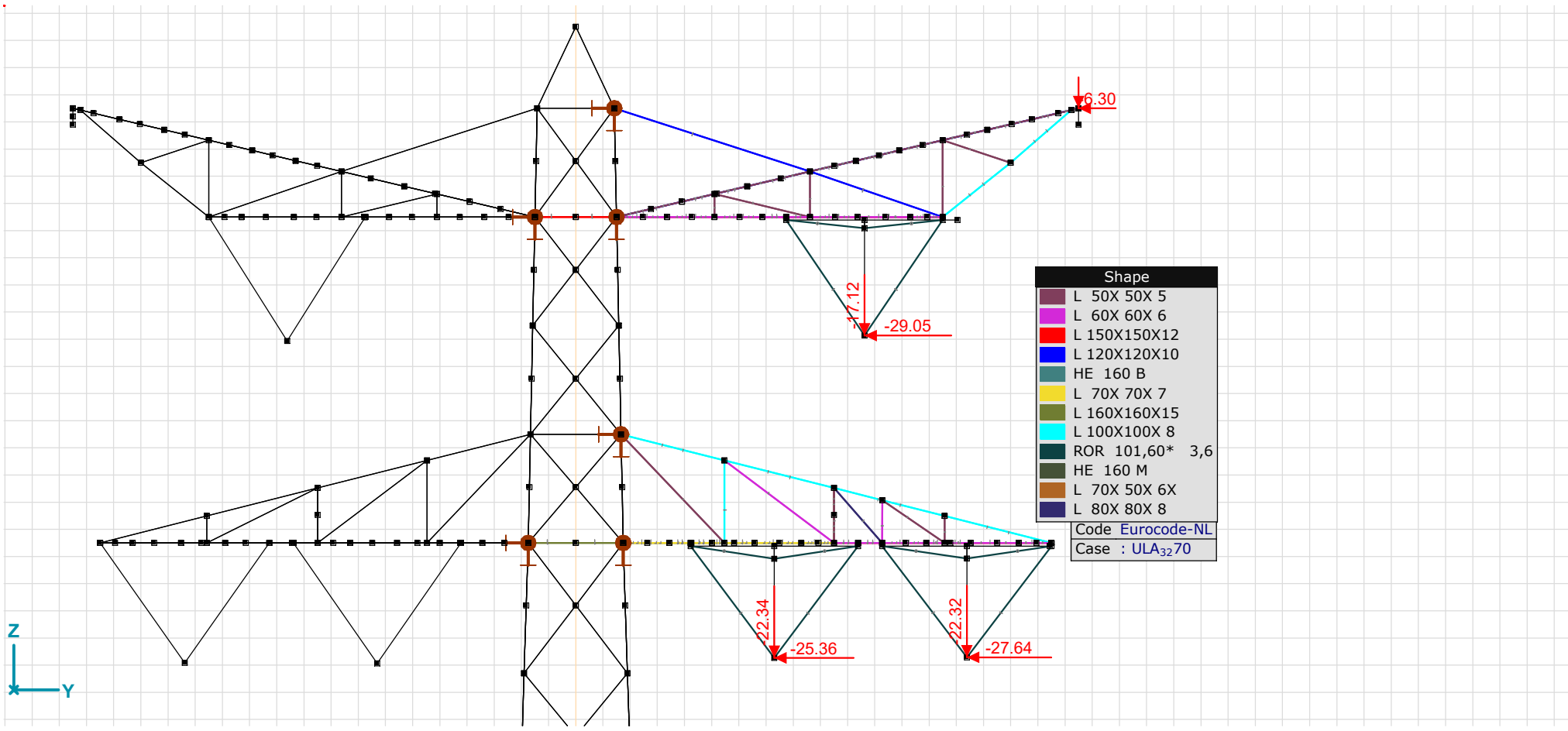



*ULA_3_90, Side view*

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;

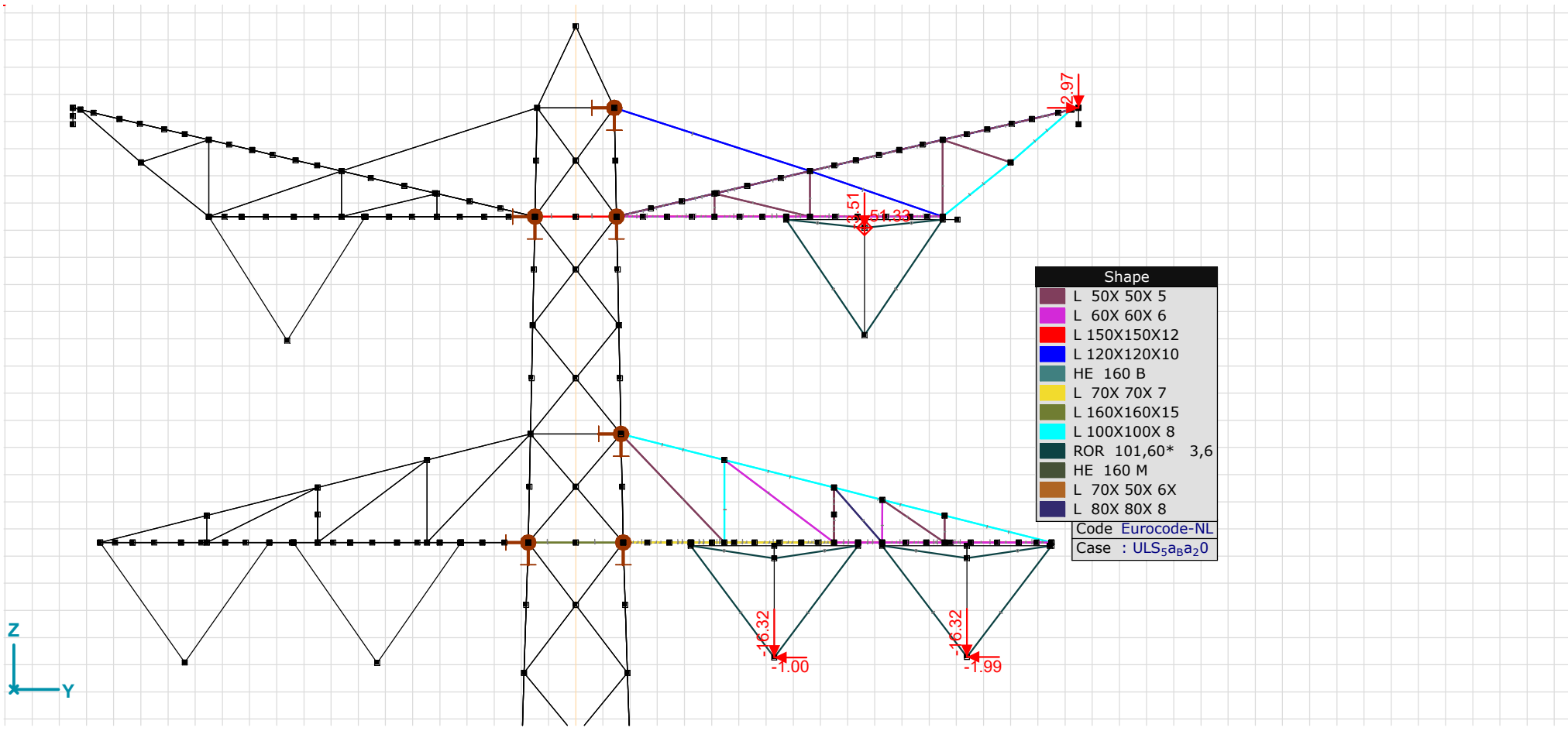



*ULA_3_270, Side view*

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;

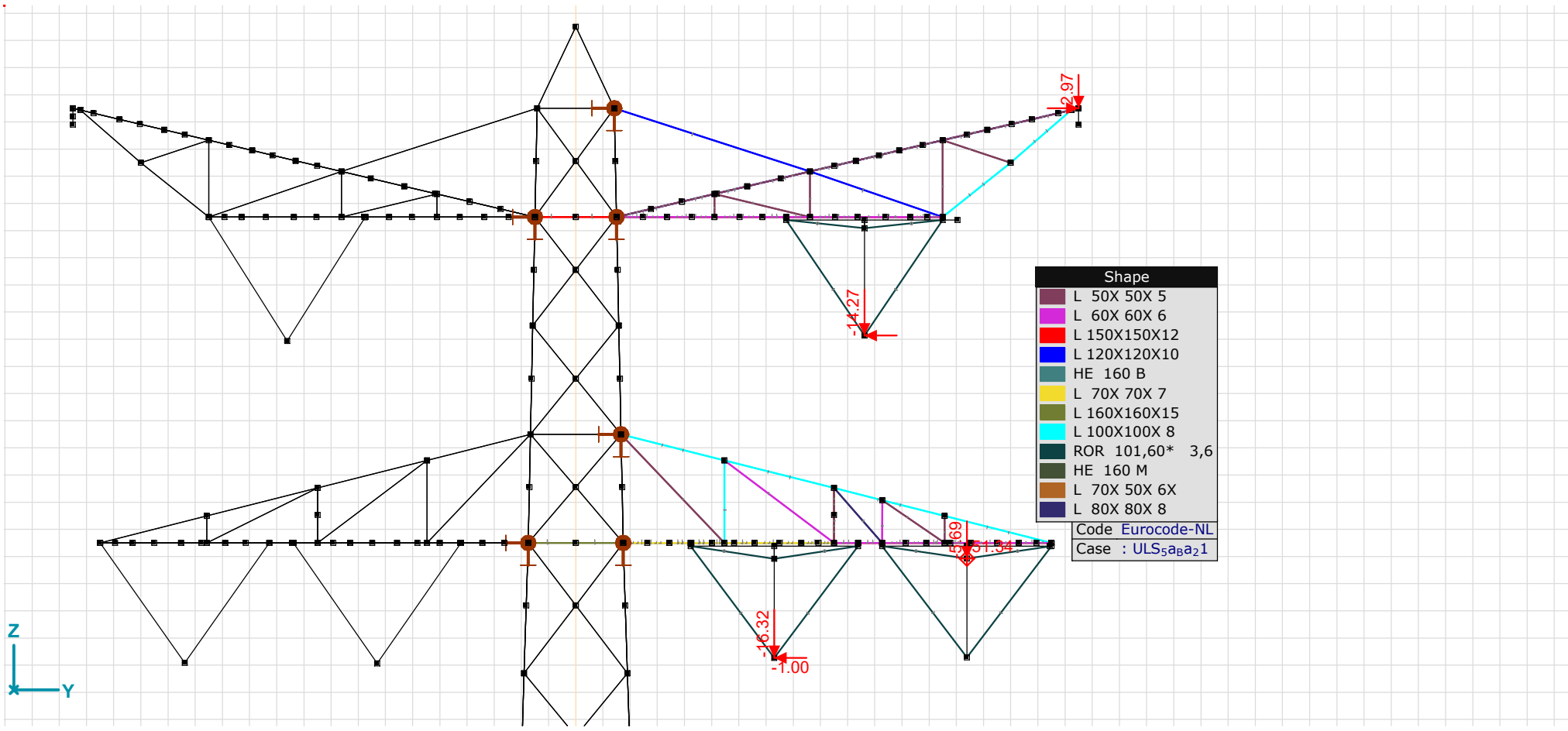



*ULS_5a_Ba_20, Side view*

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;

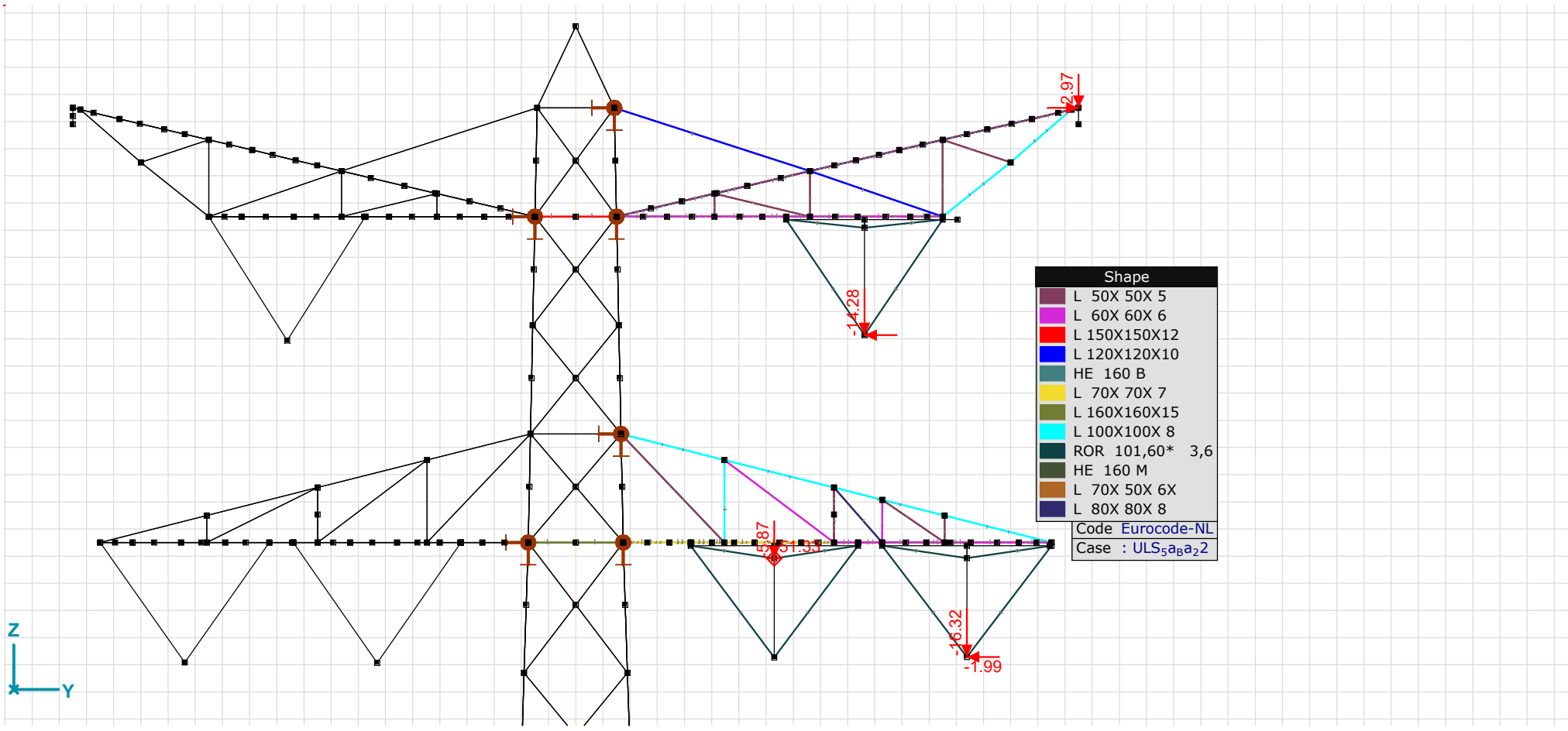



*ULS_5a_Ba_21, Side view*

## 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;

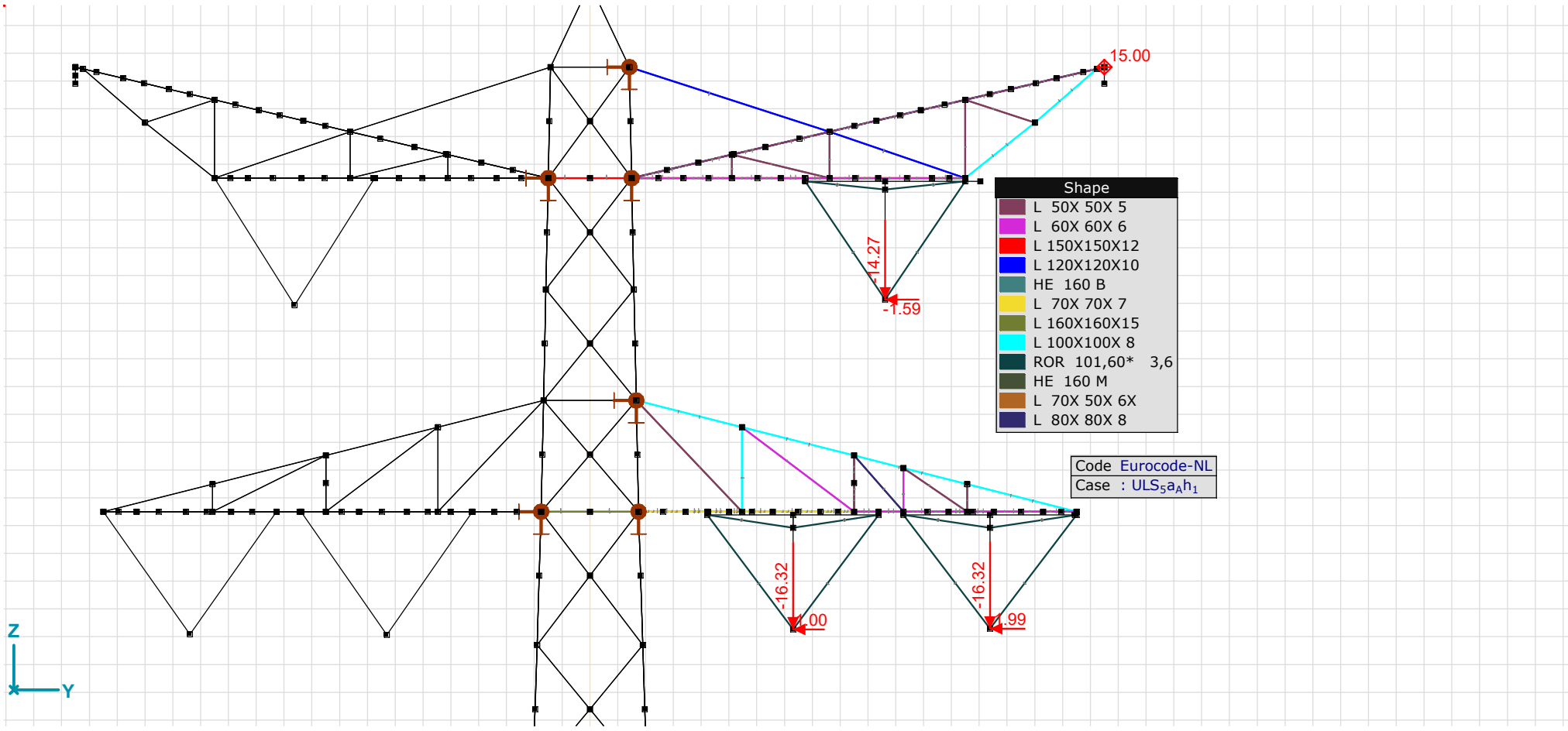



*ULS_5a_Ba_22, Side view*

## 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

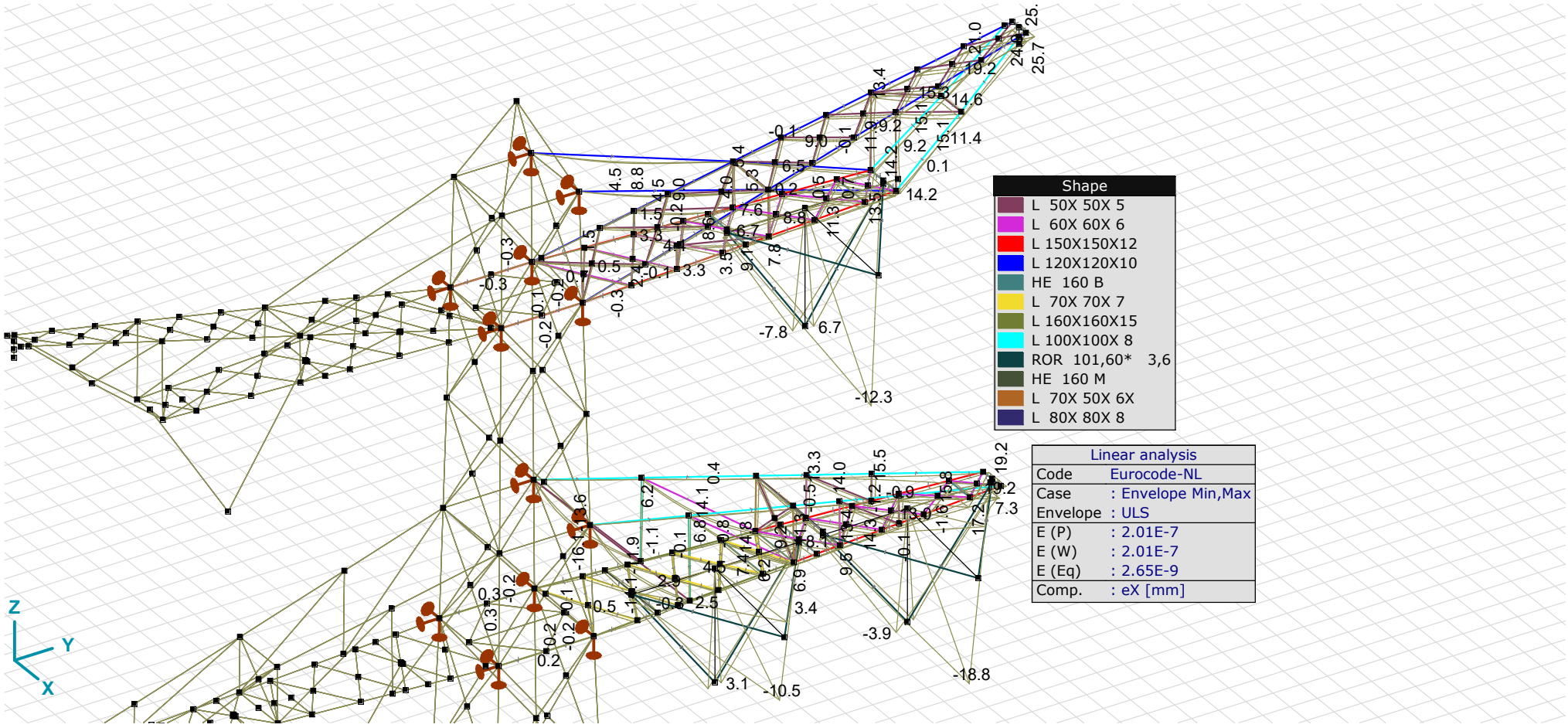
| | *Name* | *Type* | *ULA_1a_90* | *ULA_1a_270* | *ULA_3_90* | *ULA_3_270* | *ULS_5a_Ba_20* | *ULS_5a_Ba_21* | *ULS_5a_Ba_22* | *ULS_5a_Ah_1* | *EG* | *Comment* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Co #1 | ULS | 0.90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.08 | |
| 2 | Co #2 | ULS | 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; **$ULA_1a_90$, $ULA_1a_270$, $ULA_{39}0$, $ULA_{32}70$, $ULS_5a_Ba_20$, $ULS_5a_Ba_21$, $ULS_5a_Ba_22$, $ULS_5a_Ah_1$, EG:** Factor;

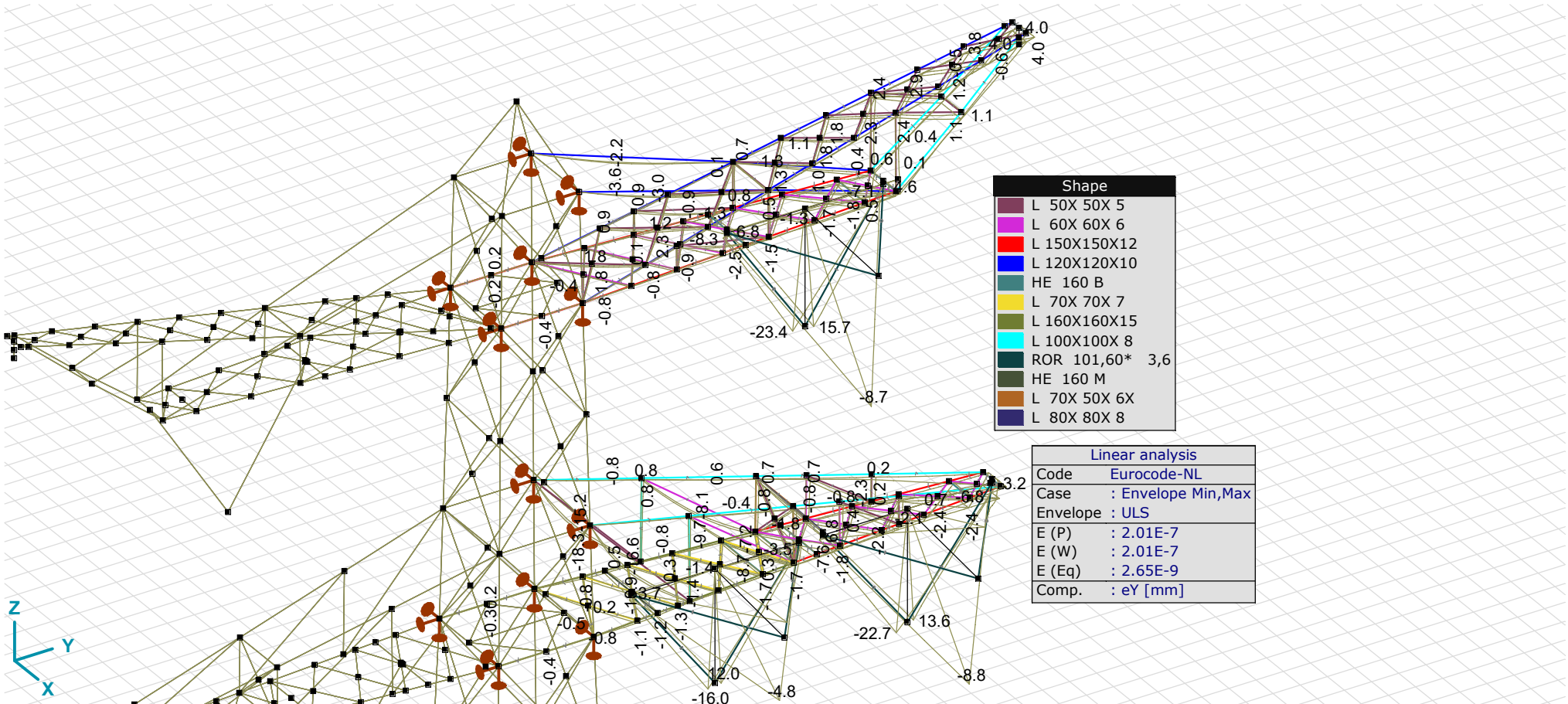
## Modal_Nodal displacements [Linear, Envelope (ULS)]

| | *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 |

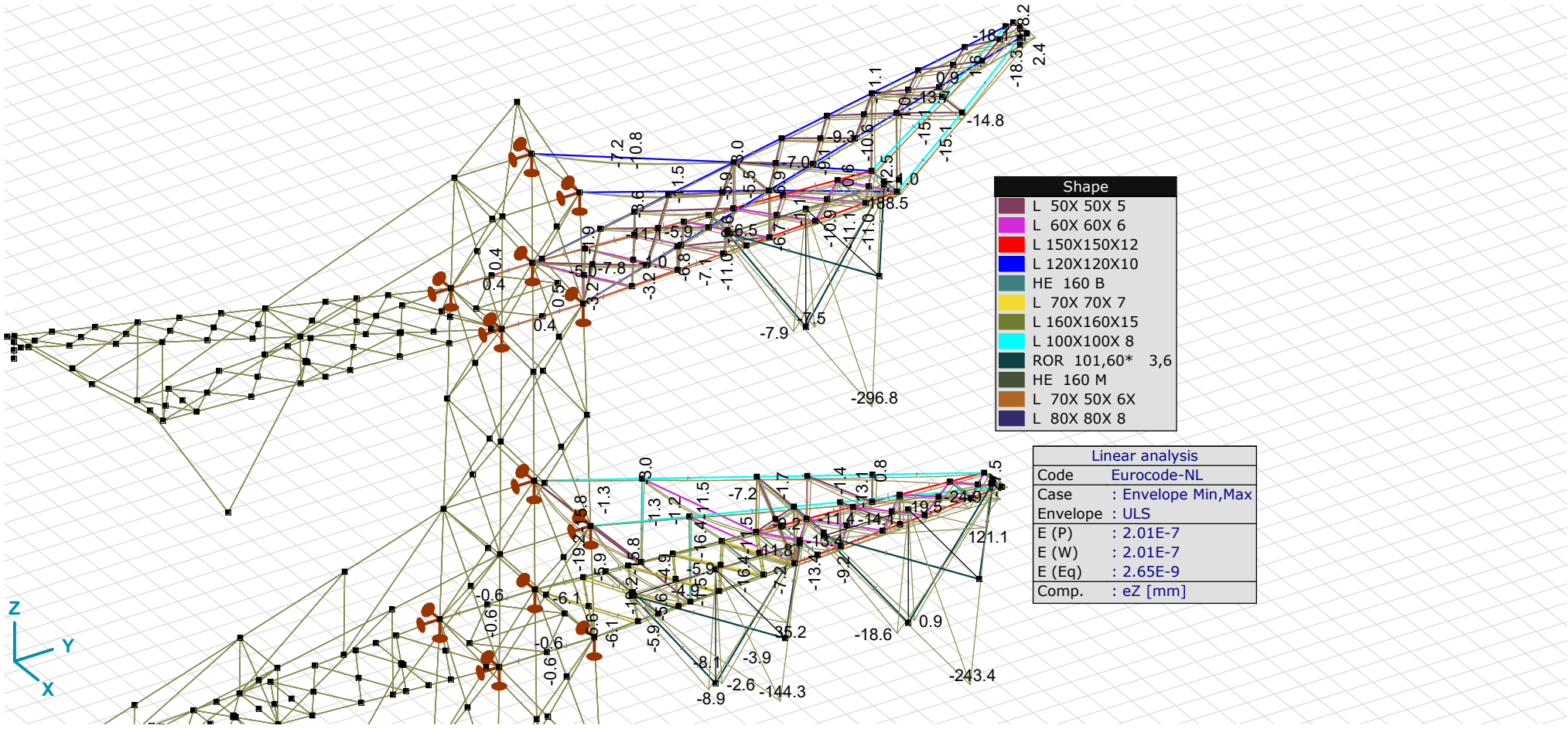
**C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **eX:** Translation in X direction; **eY:** Translation in Y direction; **eZ:** Translation in Z direction; **eR:** Resultant translation; **fX:** Rotation in X direction; **fY:** Rotation in Y direction; **fZ:** Rotation in Z direction; **fR:** Resultant rotation;




*model_Linear, Envelope (ULS), eX [mm], Diagram*




*model_Linear, Envelope (ULS), eY [mm], Diagram*

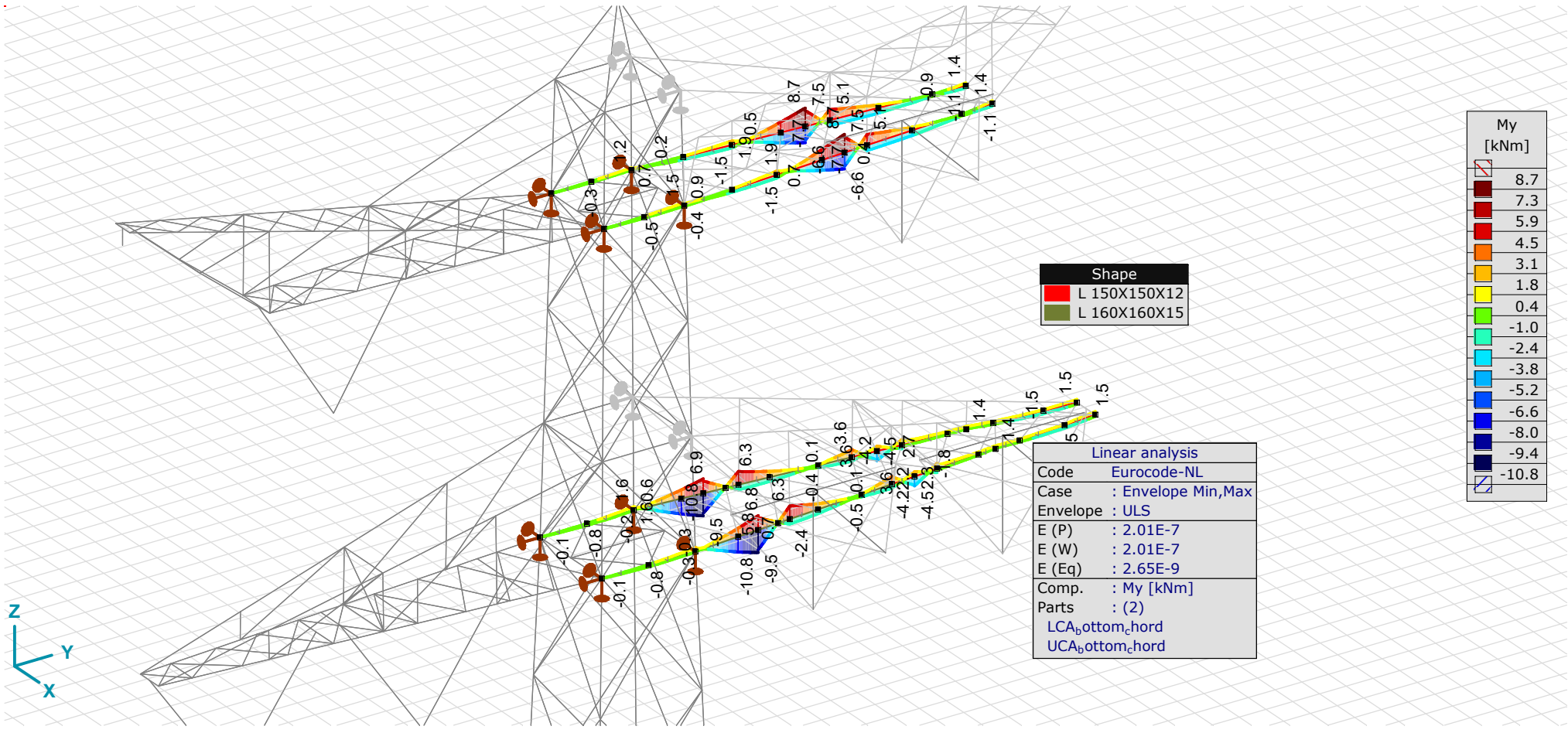



*model_Linear, Envelope (ULS), eZ [mm], Diagram*

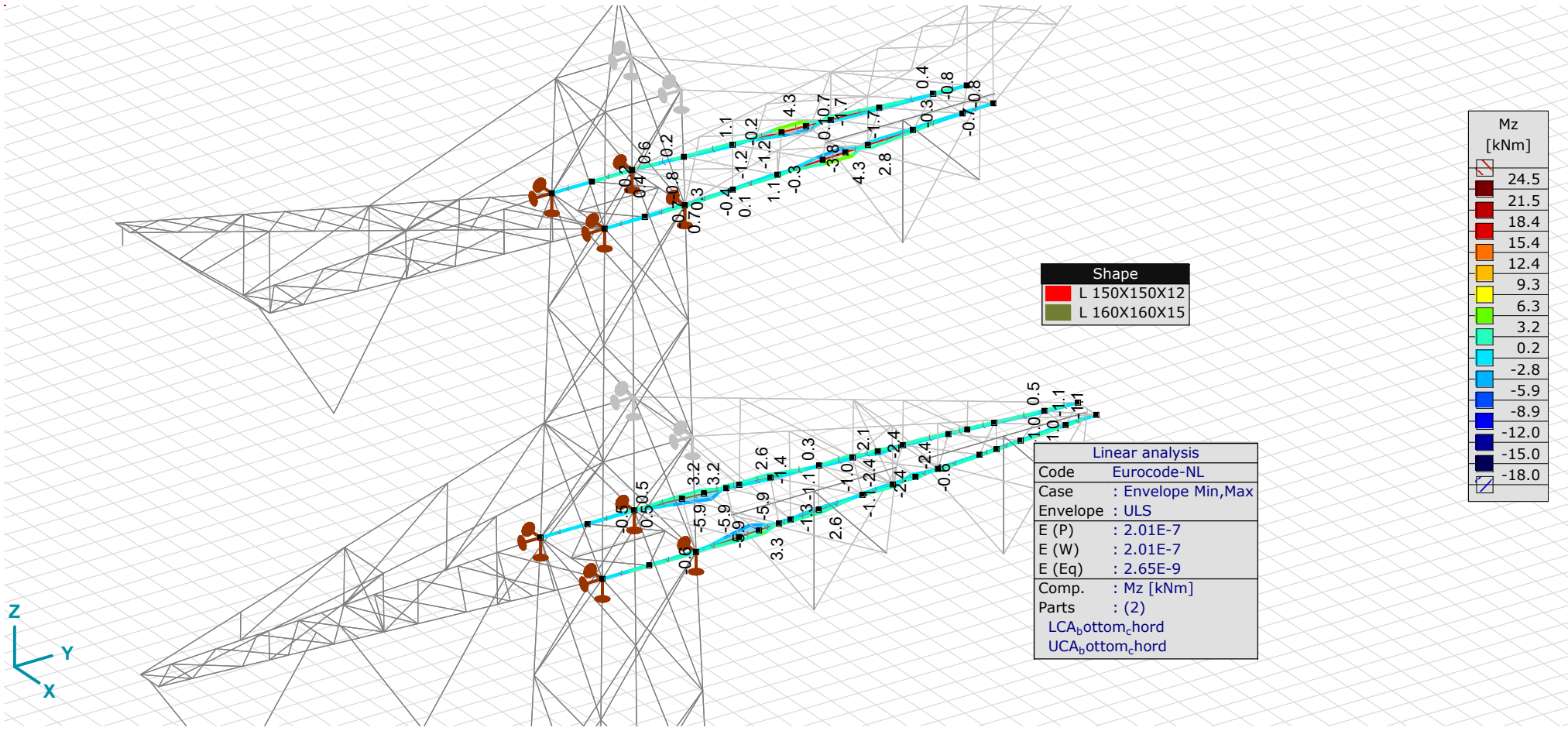
bottom_chord_Beam internal forces [Linear, Envelope (ULS), Parts]

| | *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 |

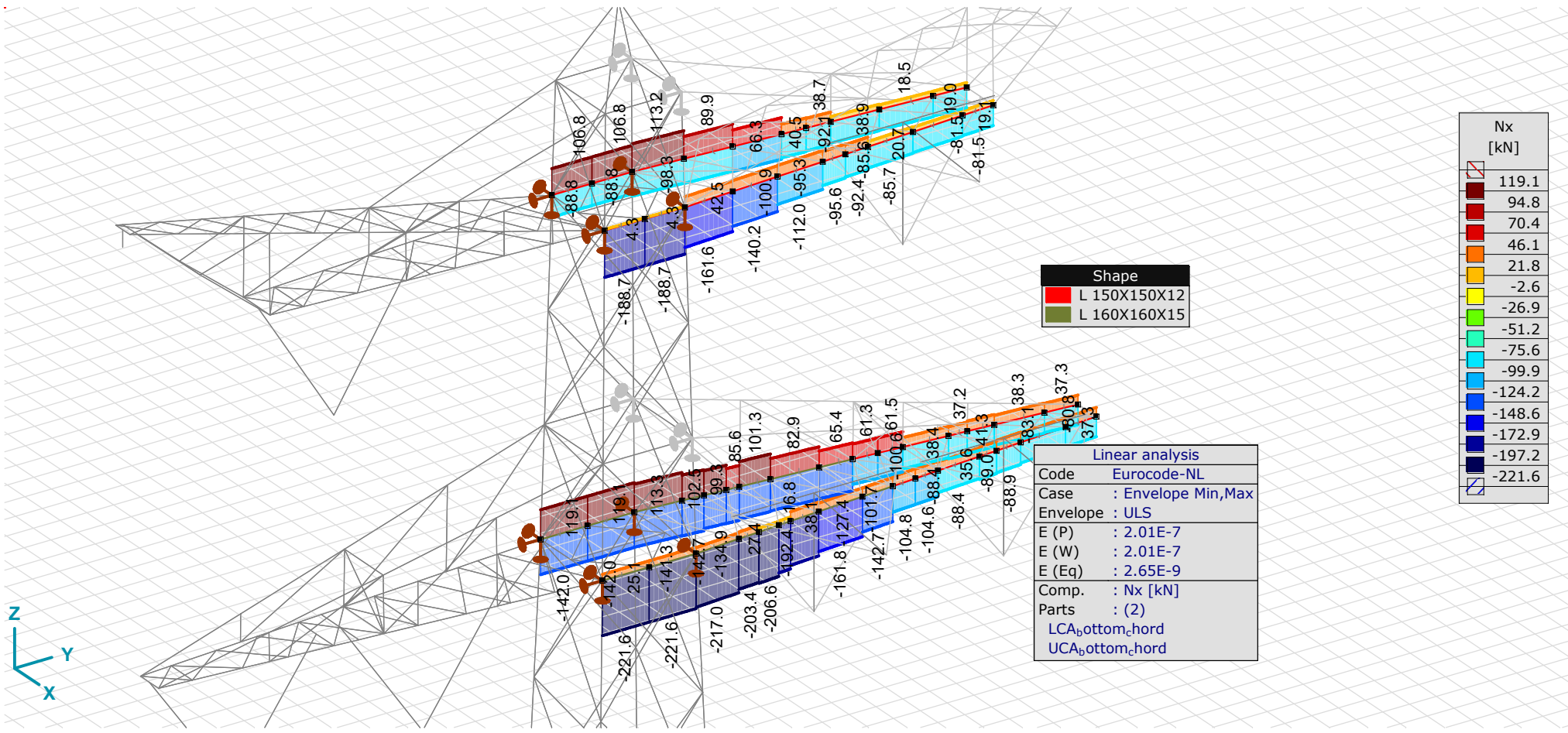
**Sh.:** Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:** Flexural moment about local y axis; **Mz:** Flexural moment about local z axis;



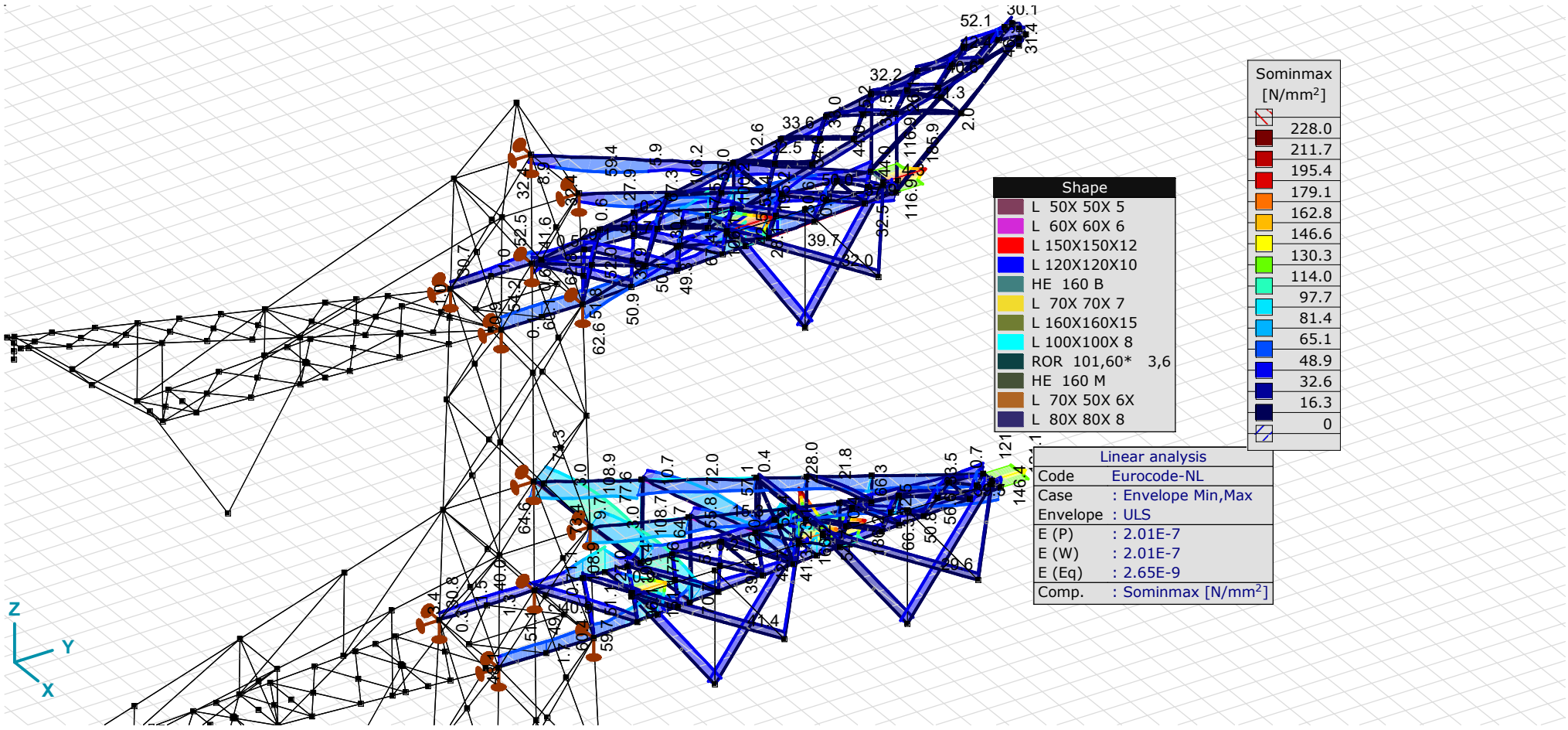

*bottom_chords_Linear, Envelope (ULS), My [kNm], Filled diagram*



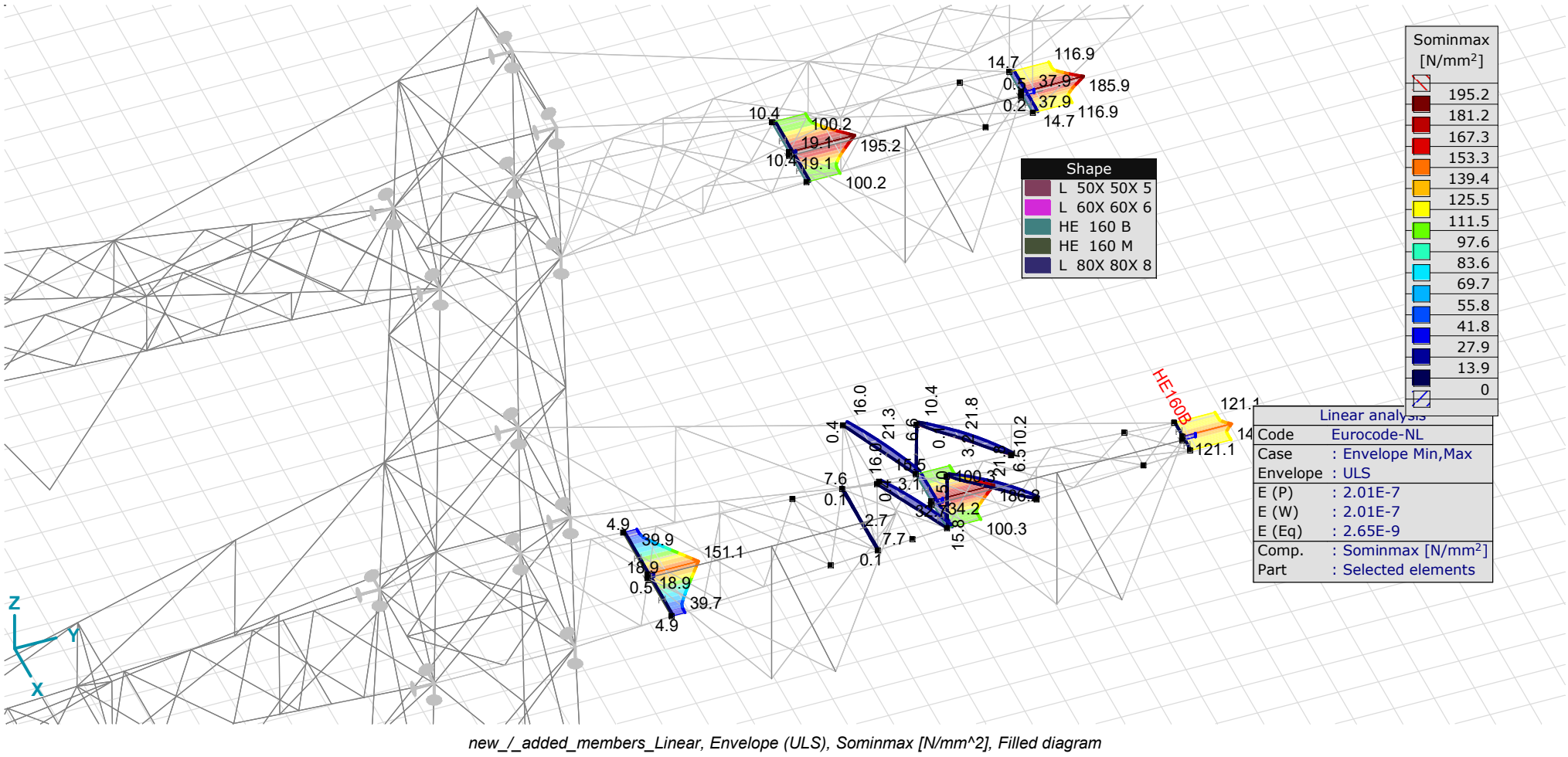

*bottom_chords_Linear, Envelope (ULS), Mz [kNm], Filled diagram*




*bottom_chords_Linear, Envelope (ULS), Nx [kN], Filled diagram*




*model_Linear, Envelope (ULS), Sominmax [N/mm^2], Filled diagram*

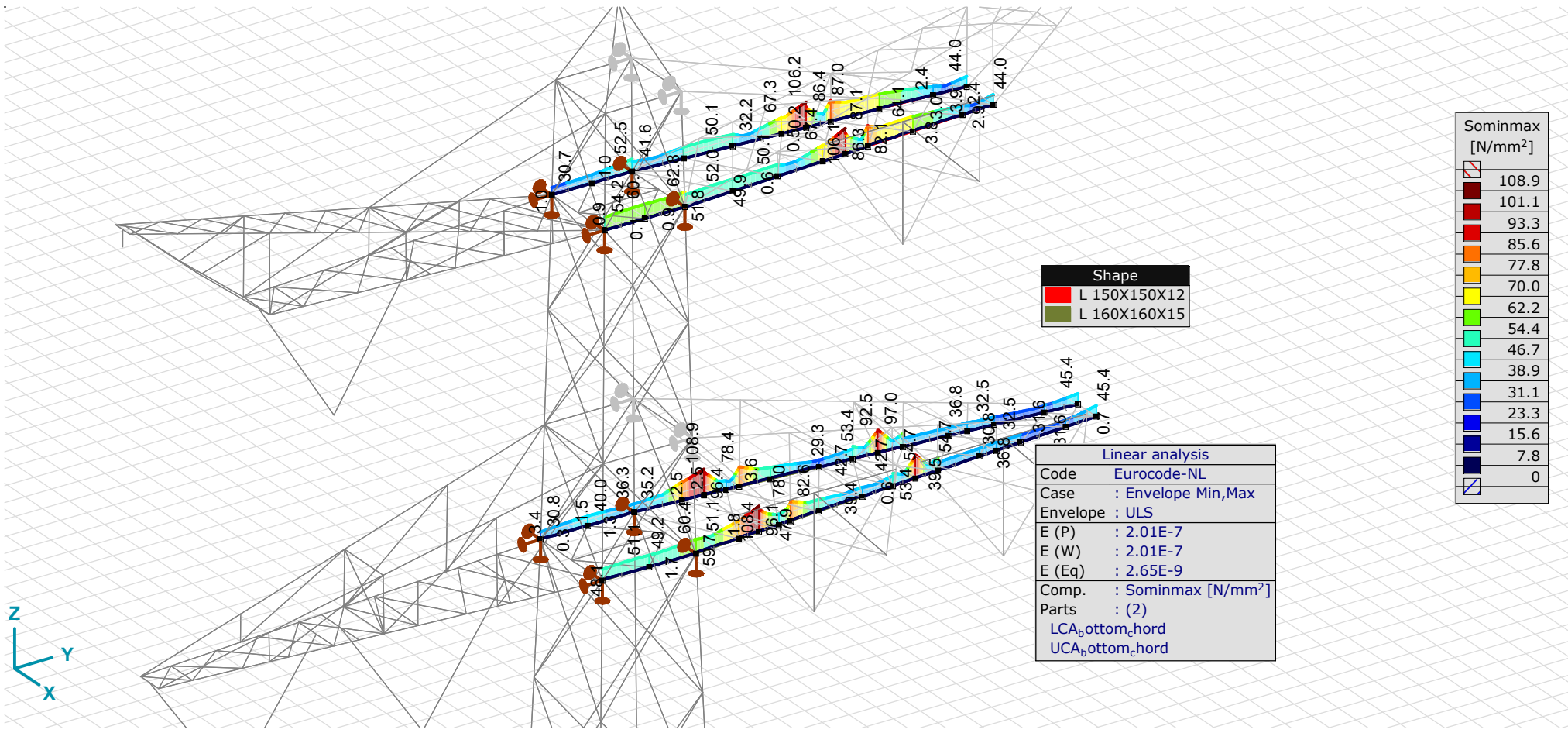



*new_/_added_members_Linear, Envelope (ULS), Sominmax [N/mm^2], Filled diagram*

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;

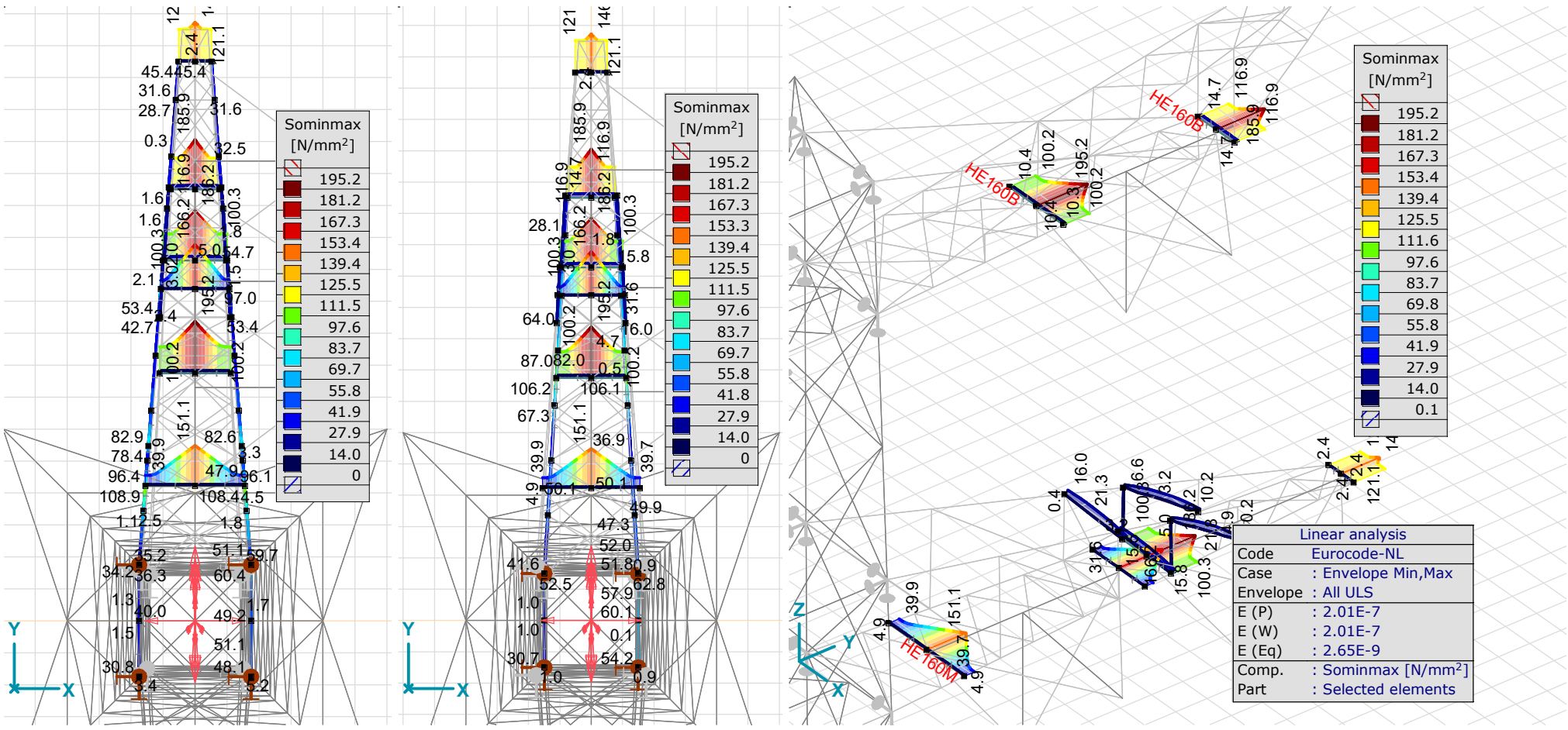



*bottom_chords_Envelope (ULS), Sominmax [N/mm^2], Filled diagram*

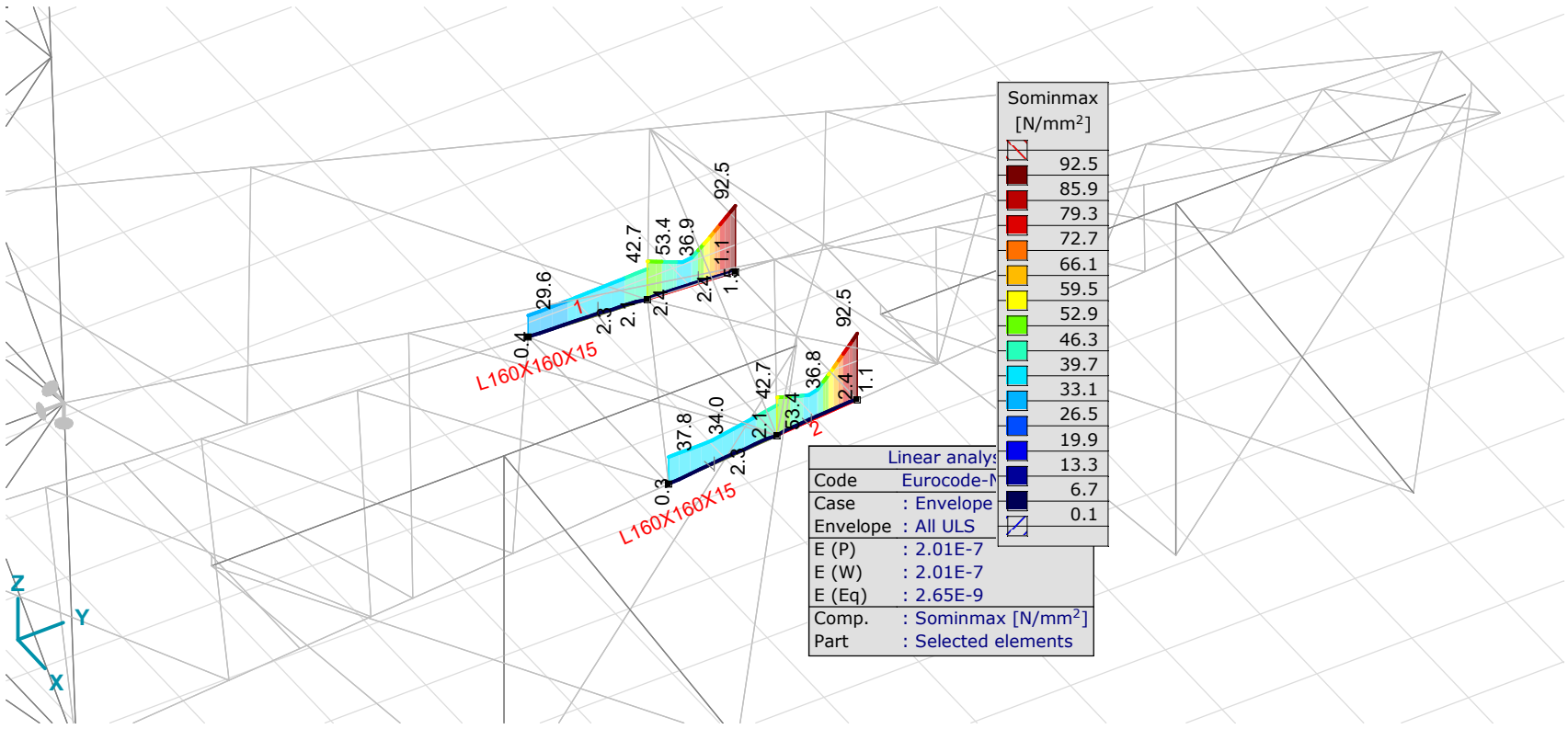
added_members_beam stresses [Linear, Envelope (All ULS ), S 355]

| | 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*



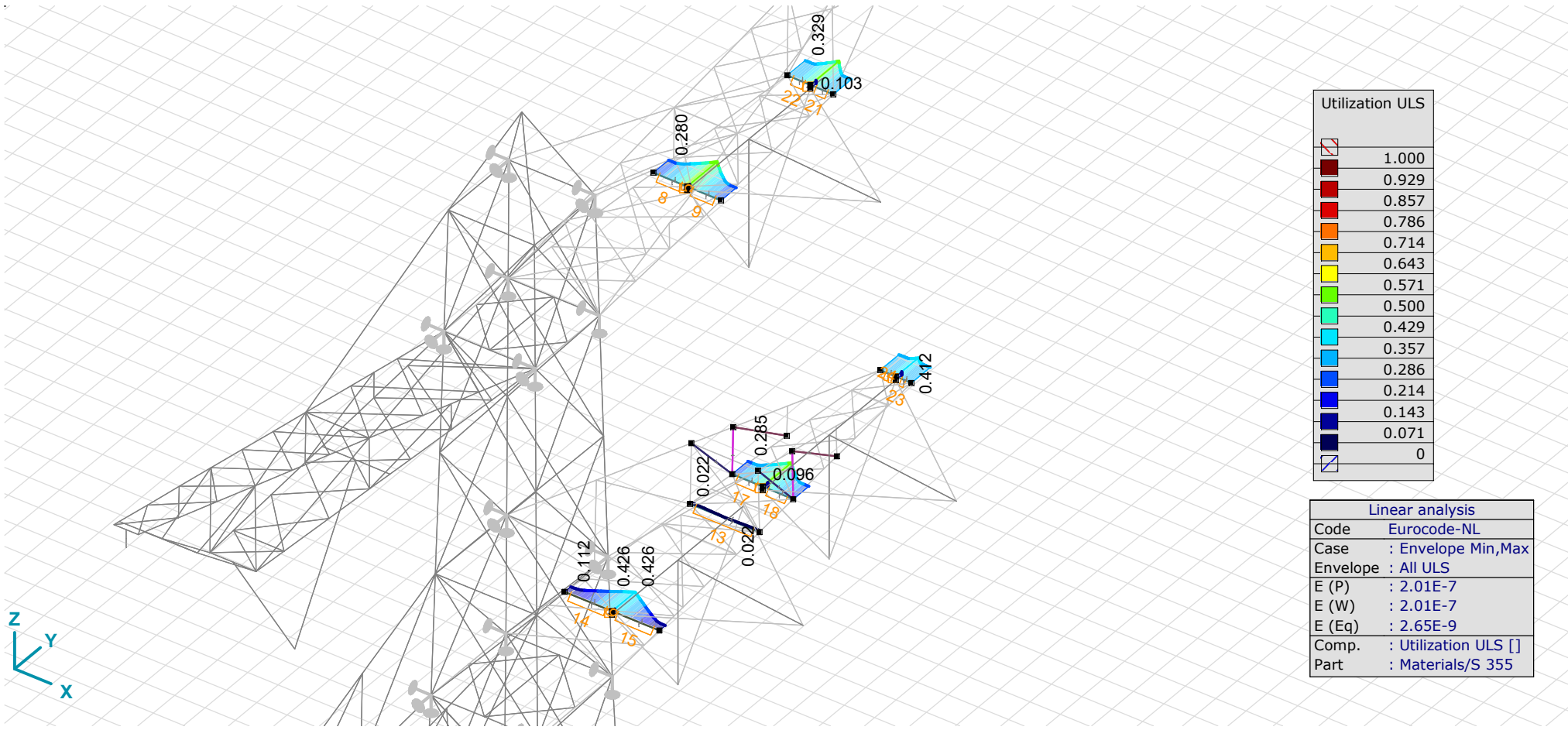

*connection_LCA_Linear, Envelope (All ULS ), Sominmax [N/mm^2], Filled diagram*

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 | $\chi_N$ | Curve class LT | $\chi_{LT}$ | 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, $\chi_N$, Curve class LT, $\chi_{LT}$, a:** Design parameters; **Case:** Load case of extreme;




*[Stl], > S 355, Linear, Envelope (All ULS ), Utilization ULS [], Filled diagram*

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Bijlage 17 Rapportage Mastconstructie S+24

DNV·GL

"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

# KIJ-GT380 – Rapportage mast S+24

## TenneT TSO B.V.

**Meridian doc. nr.:** 002.589.40 0916492
**Rapport nr.:** 21-1091 Rev.0
**Datum:** 2021-07-06

| | | |
|---|---|---|
| Projectnaam: | "Toetsing en herontwerp masten en fundaties BBB380" | DNV GL - Energy<br>Energy Advisory |
| Rapport titel: | KIJ-GT380 – Rapportage mast S+24 | Postbus 9035 |
| Klant: | TenneT TSO B.V. | 6800 ET ARNHEM |
| Contactpersoon: | [redacted] | |
| Datum: | 2021-07-06 | |
| Project nr.: | 10166260 | [redacted] |
| Organisatie unit: | TDT | [redacted] |
| Meridian doc.nr.: | 002.589.40 0916492 | |
| Rapport nr.: | 21-1091 Rev.0 | |

| Geschreven door: | Beoordeeld door: | Goedgekeurd door: |
|---|---|---|
| [redacted] | | |

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DNV GL Netherlands B.V.

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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+24 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 relevantie 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+24.

### 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.

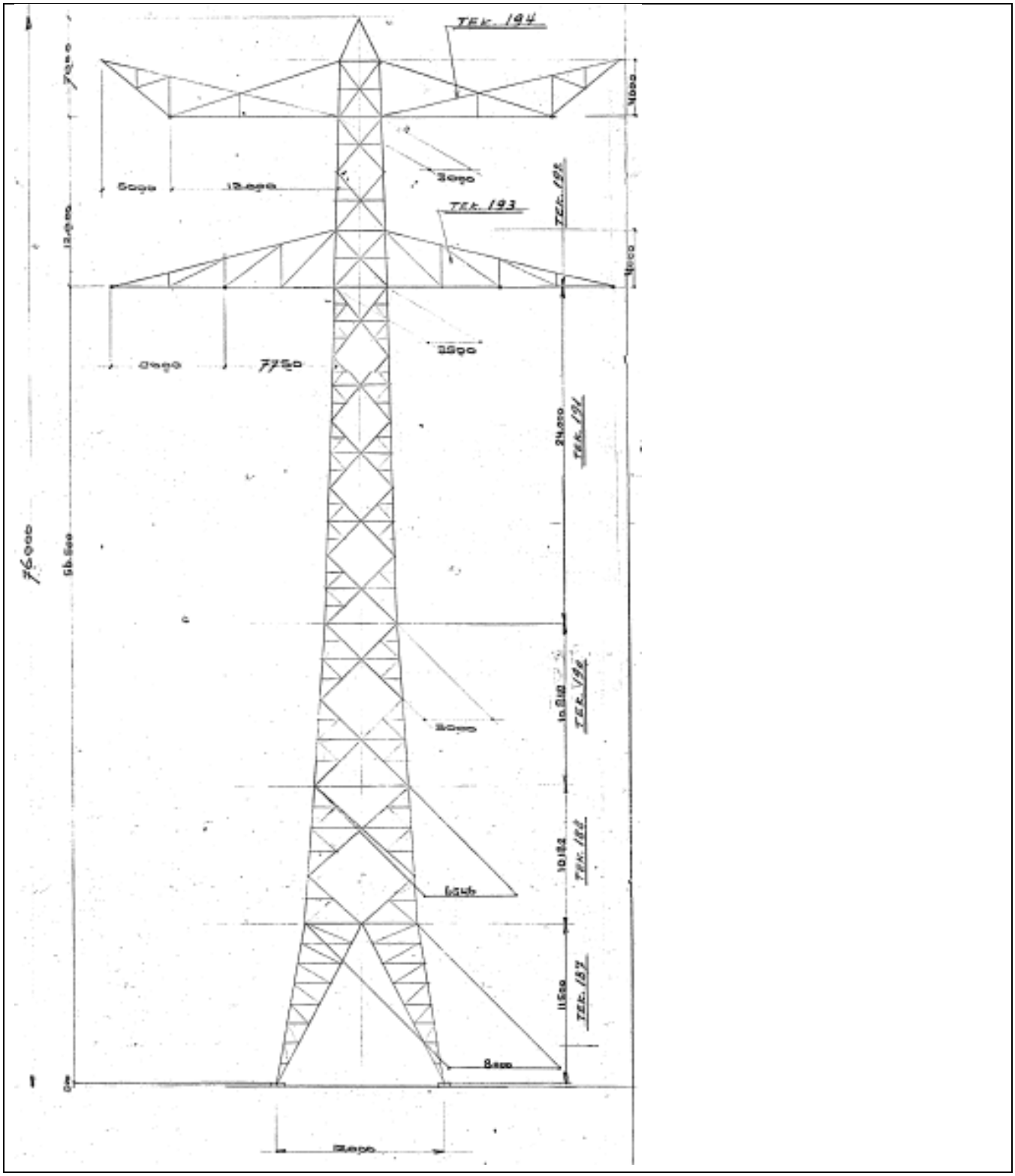
**Tabel 1 Relevante eisen**

| 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".<br><br>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+24 getoetst. De berekening is uitgevoerd voor windgebied III, er zijn geen masten van dit type in windgebied II. De wind en weight span van de verschillende masten zijn in Tabel 2 weergegeven. De maatgevende mastnummers zijn aangegeven. Bij de masten 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 |
|---|---|---|---|---|---|
| 67 | S+24 III | 68 | 399 | 575 | 28.3 |
| 68 | **S+24 III** | **68** | **407** | **542** | **21.6** |

Om de situatie bij mast 67 direct mee te nemen, is er voor de berekening van mast 68 uitgegaan van een aangrenzende mast die 6m lager is.

## 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 | 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:

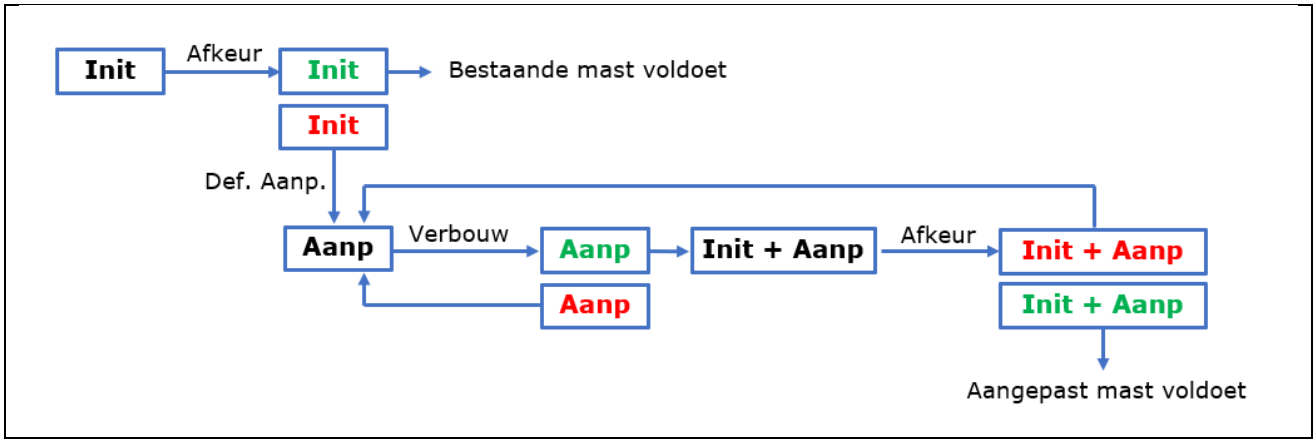
Stap 1: Toets bestaande (Init) mast op Afkeur

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 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

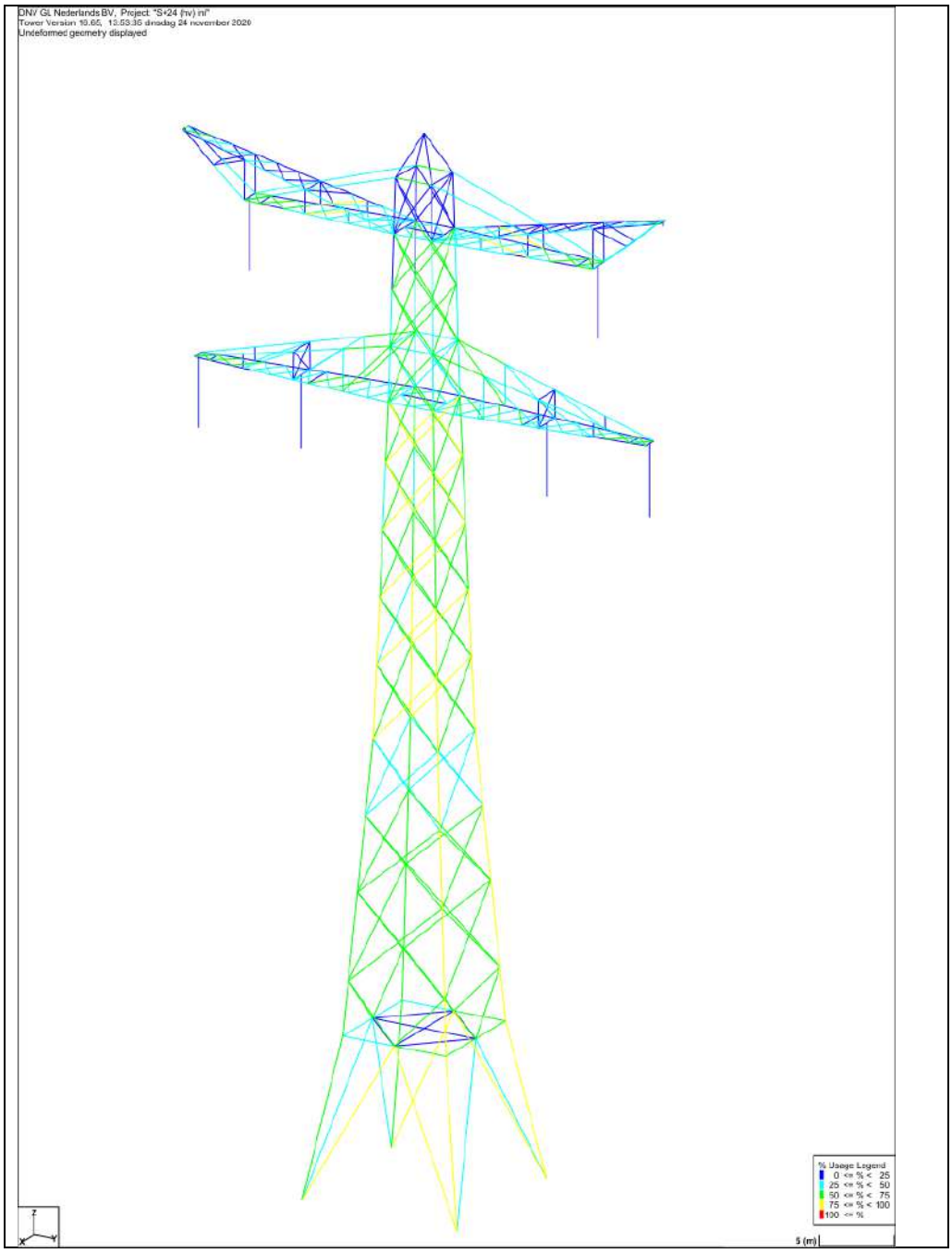
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten 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+24 met belastingen op afkeurniveau is weergegeven in onderstaande figuren.




**Figuur 3 Resultaat PLS-TOWER S+24 (68)**

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 | | Figuur 3 |
| Knikverkorters | Voldoen | | Appendix C |
| Ankers en voetplaat | Voldoen | | Appendix D |

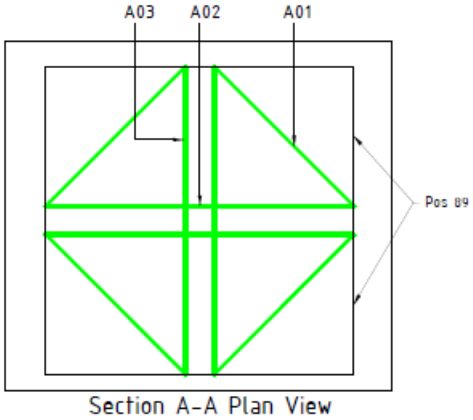
# 5 AANPASSINGEN

## 5.1 Inleiding

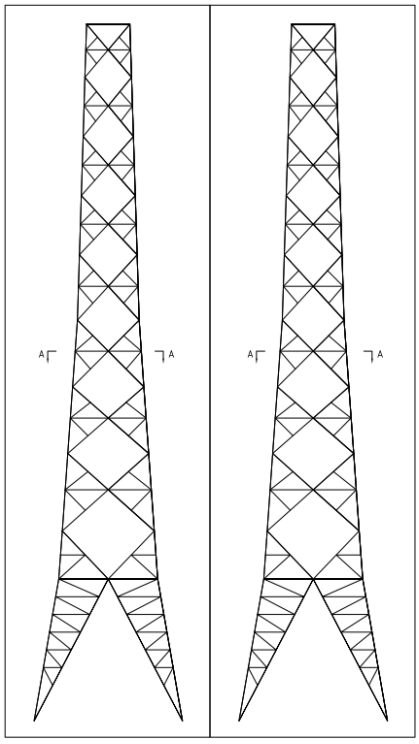
Ondanks dat de mast voldoet aan eisen voor afkeurniveau, worden er een aantal aanpassingen geadviseerd om de algehele stabiliteit van de mast te verbeteren. Dit advies is gebaseerd op de Cigre-publicatie nr. 196 "Diaphragms for steel supports". De aanpassing betreft het aanbrengen van een aanvullend stabiliteitsverband in het centrum van de mast.

## 5.2 Aanpassingen

De mast S+24 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, zie Figuur 5. De vorm van het verband in weergegeven in Figuur 4. Voor afmetingen profielen en bouten, zie Appendix E.




**Figuur 4 Geadviseerd stabiliteitsverband ter hoogte van doorsnede A-A**



**Figuur 5 Locatie van doorsnede A-A**

Een overzicht van het nettogewicht van de profielen die nodig zijn voor het aanbrengen van het stabiliteitsverband is gegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

**Tabel 5 Gewichten S+24 (68) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **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 |
| | | | | | | | | **8** | **14.16** | **284.98** |

## 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 CONDUCTOR LOADS

## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 75,5 m |
| Max. Span | 414 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 406 m |
| EDS Weight span | 530 m |
| Min. Weight span | 211 m |
| Max. Weight span | 643 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-02-10 | | | |

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+24

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

Document name:

KIJ-GT_S+24_68_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+24
Number: 68

**Conductor loads**

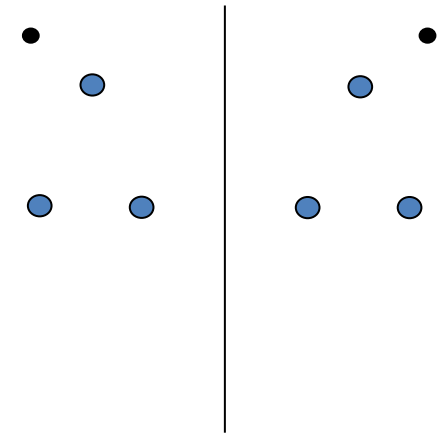
Auteur: TBR
Versie: v11.6

**General**

| | |
|---|---|
| Description | S+24 |
| Tower type | Steunmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |

**Starting points**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Consequence class | CC2-0 |
| Reliability level initial | Afkeur CC2-0 |
| Reference period intial | 30 jaar |
| Consequence class modified | CC2 |
| Reliability level modified | Verbouw |
| Reference period modified | 50 jaar |
| Wind zone | III |
| Terrain category | 24,5 m/s |
| Reduction factor $c_{dir}$ | II |
| Ice region phase conductor | 1,00 |
| Ice region earth conductor | B<br>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 Horizontal distance |
|---|---|---|---|---|---|
| Circuit 1 | 21 | 380ct1f1 | 52,2 m | 56,5 m | 17,5 m |
| Circuit 1 | 22 | 380ct1f2 | 52,2 m | 56,5 m | 9,5 m |
| Circuit 1 | 20 | 380ct1f3 | 64,2 m | 68,5 m | 13,5 m |
| Circuit 2 | 31 | 380ct2f1 | 52,2 m | 56,5 m | -17,5 m |
| Circuit 2 | 32 | 380ct2f2 | 52,2 m | 56,5 m | -9,5 m |
| Circuit 2 | 30 | 380ct2f3 | 64,2 m | 68,5 m | -13,5 m |
| Bliksemdraad 1 | 1 | bl1 | 72,0 m | 72,5 m | 18,5 m |
| Bliksemdraad 2 | 3 | bl2 | 72,0 m | 72,5 m | -18,5 m |

Project: KIJ-GT
Tower: S+24
Number: 68

**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 | -6,0 | 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**

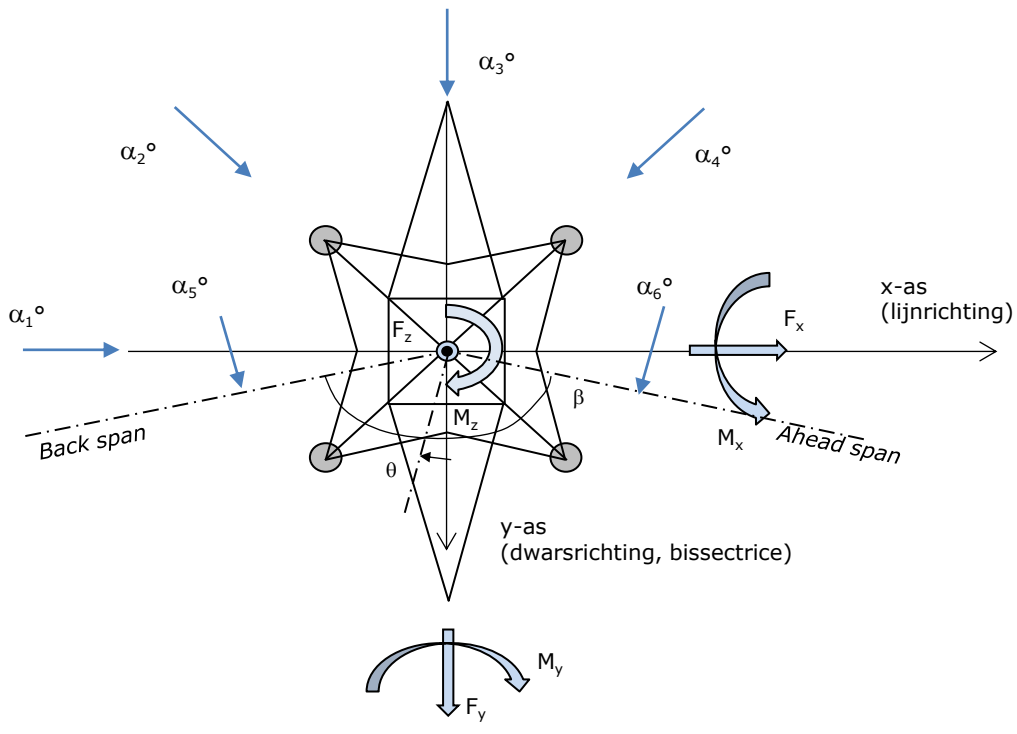
| | | | Hoogteverschil | | | Richtingsverandering | | |
|---|---|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | $\Delta$h_back | $\Delta$h_ahead | | $\Delta$y_back | $\Delta$y_ahead | |
| Circuit 1 | 21 | 380ct1f1 | 2,1 | 25,0 | m | 0,0 | 0,0 | m |
| Circuit 1 | 22 | 380ct1f2 | 2,1 | 25,0 | m | 0,0 | 0,0 | m |
| Circuit 1 | 20 | 380ct1f3 | 2,1 | 24,5 | m | 0,0 | 0,0 | m |
| Circuit 2 | 31 | 380ct2f1 | 2,1 | 25,0 | m | 0,0 | 0,0 | m |
| Circuit 2 | 32 | 380ct2f2 | 2,1 | 25,0 | m | 0,0 | 0,0 | m |
| Circuit 2 | 30 | 380ct2f3 | 2,1 | 24,5 | m | 0,0 | 0,0 | m |
| Bliksemdraad 1 | 1 | bl1 | 2,1 | -28,8 | m | 0,0 | 0,0 | m |
| Bliksemdraad 2 | 3 | bl2 | 2,1 | -28,8 | m | 0,0 | 0,0 | m |

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 414,0 | 398,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 389,6 | 389,6 | m |
| Line angle | $\beta$ | 180 | ° | |
| Tower orientation with respect to bi | $\theta$ | 0 | ° | |
| Section length | | 3064 | 3064 | m |
| Height bottom of tower to ground level | | 0,5 | m | |
| Wind directions considered | $\alpha_1$ | 0 | ° | |
| Wind directions according to: | $\alpha_2$ | 45 | ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | ° | |
| | $\alpha_4$ | 135 | ° | |
| | $\alpha_5$ | - | ° | |
| | $\alpha_6$ | - | ° | |

*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+24
Number: 68

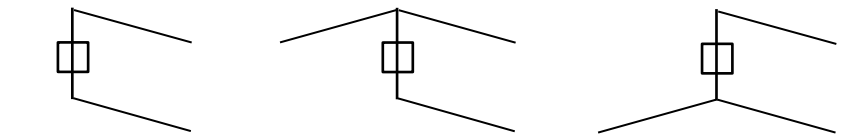
**Absence of conductors**

| | | 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 |

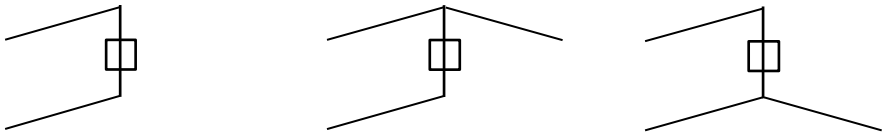
**Load situations SPLS**

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+24
Number: 68

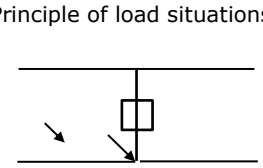
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

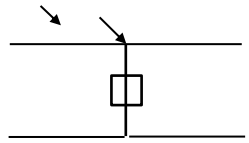
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

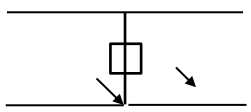
Principle of load situations:



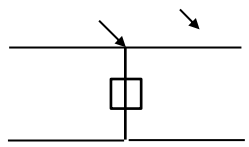
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

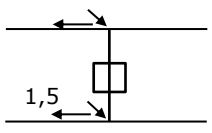
**Load situations 8. Galloping as a static load**

| 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 |

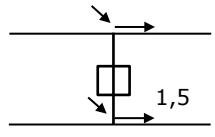
Considered situations galloping 8: None (existing structure)

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+24
Number: 68

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+24 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 75,5 | m | |
| Tower self weight | 494,0 | 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 [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 11,50 | 12,00 | 8,00 | 11,50 | 0,174 | 115,00 | 16,87 | 0,15 | 3,17 |
| Middenstuk 1 | 32,50 | 8,00 | 5,00 | 21,00 | 0,071 | 136,50 | 22,20 | 0,16 | 3,10 |
| Middenstuk 2 | 56,50 | 5,00 | 3,50 | 24,00 | 0,031 | 102,00 | 20,70 | 0,20 | 2,92 |
| Bovenstuk 1 | 64,50 | 3,50 | 3,17 | 8,00 | 0,021 | 26,68 | 5,85 | 0,22 | 2,85 |
| Bovenstuk 2 | 72,50 | 3,17 | 2,83 | 8,00 | 0,021 | 24,00 | 5,10 | 0,21 | 2,88 |
| Topstuk | 75,50 | 2,83 | | 3,00 | | 4,25 | 1,00 | 0,24 | 2,78 |
| Ondertraverse | 56,50 | 15,75 | | 4,00 | | 31,50 | 6,10 | 0,19 | 2,96 |
| Boventraverse | 68,50 | 17,00 | | 4,00 | | 34,00 | 7,60 | 0,22 | 2,83 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 11,50 | 12,00 | 8,00 | 11,50 | 0,174 | 115,00 | 16,87 | 0,15 | 3,17 |
| Middenstuk 1 | 32,50 | 8,00 | 5,00 | 21,00 | 0,071 | 136,50 | 22,20 | 0,16 | 3,10 |
| Middenstuk 2 | 56,50 | 5,00 | 3,50 | 24,00 | 0,031 | 102,00 | 20,70 | 0,20 | 2,92 |
| Bovenstuk 1 | 64,50 | 3,50 | 3,17 | 8,00 | 0,021 | 26,68 | 5,85 | 0,22 | 2,85 |
| Bovenstuk 2 | 72,50 | 3,17 | 2,83 | 8,00 | 0,021 | 24,00 | 5,10 | 0,21 | 2,88 |
| Topstuk | 75,50 | 2,83 | | 3,00 | | 4,25 | 1,00 | 0,24 | 2,78 |
| Ondertraverse | 56,50 | 15,75 | | 4,00 | | 31,50 | 6,10 | 0,19 | 2,96 |
| Boventraverse | 68,50 | 17,00 | | 4,00 | | 34,00 | 7,60 | 0,22 | 2,83 |

*Note: Surface transverse direction is reduced in calculation.*

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**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | Factor | $\Delta h$ | $A_1$ |
|---|---|---|---|---|
| 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 | 0,70 | 37,5 | 31,9 | 0,0 | -31,9 | 5,8 | 215,9 | 183,2 | 0,0 | -183,2 |
| Middenstuk 1 | 0,90 | 62,1 | 52,7 | 0,0 | -52,7 | 22,0 | 1367,1 | 1160,1 | 0,0 | -1160,1 |
| Middenstuk 2 | 1,10 | 66,5 | 56,4 | 0,0 | -56,4 | 44,5 | 2959,8 | 2511,4 | 0,0 | -2511,4 |
| Bovenstuk 1 | 1,20 | 19,9 | 16,9 | 0,0 | -16,9 | 60,5 | 1204,7 | 1022,2 | 0,0 | -1022,2 |
| Bovenstuk 2 | 1,23 | 18,1 | 15,3 | 0,0 | -15,3 | 68,5 | 1236,6 | 1049,3 | 0,0 | -1049,3 |
| Topstuk | 1,25 | 3,5 | 3,0 | 0,0 | -3,0 | 74,0 | 258,1 | 219,0 | 0,0 | -219,0 |
| Ondertraverse | 1,18 | 42,6 | 25,3 | 0,0 | -25,3 | 57,8 | 2461,0 | 1461,8 | 0,0 | -1461,8 |
| Boventraverse | 1,24 | 53,2 | 31,6 | 0,0 | -31,6 | 69,8 | 3714,3 | 2206,2 | 0,0 | -2206,2 |
| Totaal | | 303,4 | 233,1 | 0,0 | -233,1 | | 13417,4 | 9813,1 | 0,0 | -9813,1 |

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

| Description | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 0,70 | 0,0 | 31,9 | 37,5 | 31,9 | 5,8 | 0,0 | 183,2 | 215,9 | 183,2 |
| Middenstuk 1 | 0,90 | 0,0 | 52,7 | 62,1 | 52,7 | 22,0 | 0,0 | 1160,1 | 1367,1 | 1160,1 |
| Middenstuk 2 | 1,10 | 0,0 | 56,4 | 66,5 | 56,4 | 44,5 | 0,0 | 2511,4 | 2959,8 | 2511,4 |
| Bovenstuk 1 | 1,20 | 0,0 | 16,9 | 19,9 | 16,9 | 60,5 | 0,0 | 1022,2 | 1204,7 | 1022,2 |
| Bovenstuk 2 | 1,23 | 0,0 | 15,3 | 18,1 | 15,3 | 68,5 | 0,0 | 1049,3 | 1236,6 | 1049,3 |
| Topstuk | 1,25 | 0,0 | 3,0 | 3,5 | 3,0 | 74,0 | 0,0 | 219,0 | 258,1 | 219,0 |
| Ondertraverse | 1,18 | 0,0 | 25,3 | 17,0 | 25,3 | 57,8 | 0,0 | 1461,8 | 984,4 | 1461,8 |
| Boventraverse | 1,24 | 0,0 | 31,6 | 21,3 | 31,6 | 69,8 | 0,0 | 2206,2 | 1485,7 | 2206,2 |
| Total | | 0,0 | 233,1 | 245,9 | 233,1 | | 0,0 | 9813,1 | 9712,2 | 9813,1 |

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

| Load / wind direction | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 494 | 0 | 0 | 0 |
| Windrichting 0° | 303 | 0 | 0 | 0 | 13417 | 0 |
| Windrichting 45° | 233 | 233 | 0 | 9813 | 9813 | 0 |
| Windrichting 90° | 0 | 246 | 0 | 9712 | 0 | 0 |
| Windrichting 135° | -233 | 233 | 0 | 9813 | -9813 | 0 |

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**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 54,85 | 1,16 | 1,2 | 1,40 |
| 380ct1f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 54,85 | 1,16 | 1,2 | 1,40 |
| 380ct1f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 66,85 | 1,22 | 1,2 | 1,47 |
| 380ct2f1 | 2,00 | 1 | 2 | 4,3 | 1,0 | 54,85 | 1,16 | 1,2 | 1,40 |
| 380ct2f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 54,85 | 1,16 | 1,2 | 1,40 |
| 380ct2f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 66,85 | 1,22 | 1,2 | 1,47 |
| bl1 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 72,75 | 1,25 | 1,2 | 0,07 |
| bl2 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 72,75 | 1,25 | 1,2 | 0,07 |

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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 | 43,5 | 1,09 | 0,61 | 0,53 | 1,07 | 28,25 | 60,1 | 52,2 | 46,9 | 112,0 | 97,2 |
| 380ct1f2 | 43,5 | 1,09 | 0,61 | 0,53 | 1,07 | 28,25 | 60,1 | 52,2 | 46,9 | 112,0 | 97,2 |
| 380ct1f3 | 55,5 | 1,17 | 0,62 | 0,54 | 1,05 | 28,25 | 64,9 | 56,3 | 46,9 | 123,1 | 106,7 |
| 380ct2f1 | 43,5 | 1,09 | 0,61 | 0,53 | 1,07 | 28,25 | 60,1 | 52,2 | 46,9 | 112,0 | 97,2 |
| 380ct2f2 | 43,5 | 1,09 | 0,61 | 0,53 | 1,07 | 28,25 | 60,1 | 52,2 | 46,9 | 112,0 | 97,2 |
| 380ct2f3 | 55,5 | 1,17 | 0,62 | 0,54 | 1,05 | 28,25 | 64,9 | 56,3 | 46,9 | 123,1 | 106,7 |
| bl1 | 64,0 | 1,21 | 0,64 | 0,55 | 1,17 | 22,24 | 20,0 | 17,3 | 41,5 | 38,3 | 33,2 |
| bl2 | 64,0 | 1,21 | 0,64 | 0,55 | 1,17 | 22,13 | 19,9 | 17,3 | 41,4 | 38,2 | 33,1 |

**Wind load ahead**

| Conductor | Height wind [m] | Pressure [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{additional}$ [mm] | $w_y$ [N/m] | $w_{y,section}$ [N/m] | $D_{ijs,additional}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,section}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 55,8 | 1,17 | 0,62 | 0,54 | 1,05 | 28,25 | 65,0 | 56,4 | 46,9 | 123,2 | 106,9 |
| 380ct1f2 | 55,8 | 1,17 | 0,62 | 0,54 | 1,05 | 28,25 | 65,0 | 56,4 | 46,9 | 123,2 | 106,9 |
| 380ct1f3 | 67,5 | 1,23 | 0,64 | 0,55 | 1,04 | 28,25 | 68,9 | 59,6 | 46,9 | 132,4 | 114,7 |
| 380ct2f1 | 55,8 | 1,17 | 0,62 | 0,54 | 1,05 | 28,25 | 65,0 | 56,4 | 46,9 | 123,2 | 106,9 |
| 380ct2f2 | 55,8 | 1,17 | 0,62 | 0,54 | 1,05 | 28,25 | 65,0 | 56,4 | 46,9 | 123,2 | 106,9 |
| 380ct2f3 | 67,5 | 1,23 | 0,64 | 0,55 | 1,04 | 28,25 | 68,9 | 59,6 | 46,9 | 132,4 | 114,7 |
| bl1 | 49,3 | 1,13 | 0,61 | 0,53 | 1,19 | 22,24 | 18,4 | 15,9 | 41,5 | 34,7 | 30,1 |
| bl2 | 49,3 | 1,13 | 0,61 | 0,53 | 1,19 | 22,13 | 18,3 | 15,9 | 41,4 | 34,6 | 30,0 |

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Number: 68

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Afkeur CC2-0 |
| Reference period | 30 jaar |

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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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**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 | 4,7 | 4,1 | 5,2 | 7,9 |
| 380ct1f1 | -113,4 | 113,4 | 14,7 | 15,2 | 16,2 | 11,1 |
| 380ct1f2 | -113,4 | 113,4 | 14,7 | 15,2 | 16,2 | 11,1 |
| 380ct1f3 | -114,8 | 114,8 | 15,8 | 16,1 | 16,2 | 11,3 |
| 380ct2f1 | -113,4 | 113,4 | 14,7 | 15,2 | 16,2 | 11,1 |
| 380ct2f2 | -113,4 | 113,4 | 14,7 | 15,2 | 16,2 | 11,1 |
| 380ct2f3 | -114,8 | 114,8 | 15,8 | 16,1 | 16,2 | 11,3 |
| bl2 | -30,2 | 30,2 | 4,7 | 4,1 | 5,2 | 7,9 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 529,5 | 547,1 | 529,5 |
| 380ct1f1 | 297,9 | 323,6 | 332,1 |
| 380ct1f2 | 297,8 | 323,6 | 332,1 |
| 380ct1f3 | 297,1 | 325,2 | 333,8 |
| 380ct2f1 | 297,8 | 323,6 | 332,1 |
| 380ct2f2 | 297,9 | 323,6 | 332,1 |
| 380ct2f3 | 297,1 | 325,2 | 333,8 |
| bl2 | 529,5 | 550,4 | 529,5 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 625,1 | 537,1 |
| 380ct1f1 | 332,4 | 333,2 |
| 380ct1f2 | 332,4 | 333,2 |
| 380ct1f3 | 334,1 | 334,8 |
| 380ct2f1 | 332,4 | 333,2 |
| 380ct2f2 | 332,4 | 333,2 |
| 380ct2f3 | 334,1 | 334,8 |
| bl2 | 625,1 | 538,3 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 625,1 m | 1,540 - |
| Min. weight span | 238,6 m | 0,588 - |

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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 | 10,7 | -31,2 | 31,1 |
| 380ct1f1 | 51,3 | 29,9 | 27,4 | -112,6 | 114,2 |
| 380ct1f2 | 51,3 | 29,9 | 27,4 | -112,6 | 114,2 |
| 380ct1f3 | 51,3 | 31,9 | 27,5 | -114,1 | 115,5 |
| 380ct2f1 | 51,3 | 29,9 | 27,4 | -112,6 | 114,2 |
| 380ct2f2 | 51,3 | 29,9 | 27,4 | -112,6 | 114,2 |
| 380ct2f3 | 51,3 | 31,9 | 27,5 | -114,1 | 115,5 |
| bl2 | 15,0 | 8,8 | 10,7 | -31,3 | 31,2 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 5,4 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 17,3 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 17,3 | -64,2 | 64,2 |
| bl2 | 0,0 | 0,0 | 5,4 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 2,0 | 3,5 |
| | 380ct1f1 | 10,1 | 6,7 |
| | 380ct1f2 | 10,1 | 6,7 |
| | 380ct1f3 | 10,1 | 6,8 |
| | 380ct2f1 | 10,1 | 6,7 |
| | 380ct2f2 | 10,1 | 6,7 |
| | 380ct2f3 | 10,1 | 6,8 |
| | bl2 | 2,0 | 3,6 |

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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 | 201 | 110 | 12407 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 201 | 100 | 12407 | 0 | 0 |
| ULS 3_90 | | 0 | 111 | 181 | 6886 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 111 | 170 | 6887 | 0 | 0 |
| SLS 7 | | 0 | 0 | 114 | 0 | 0 | 0 |

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

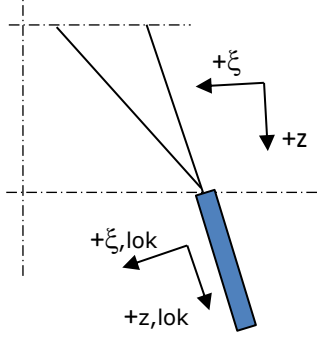
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 476 | 629 | 23253 | 0 | 0 |
| ULS 3_90 | 0 | 194 | 700 | 10140 | 0 | 0 |
| SLS 7 | 0 | 0 | 608 | 0 | 0 | 0 |

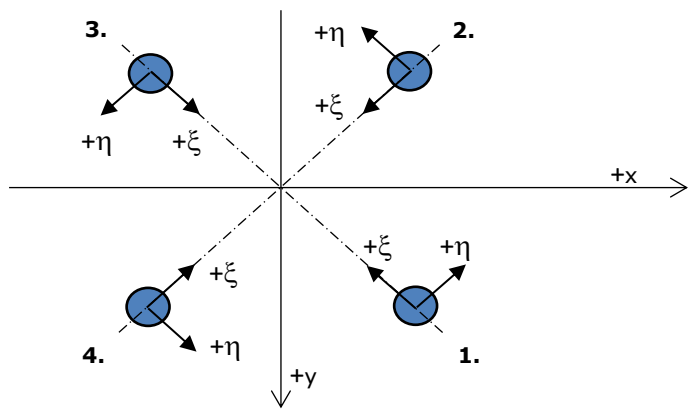
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 476 | 629 | **23253** | 0 | 0 |
| ULS 1a_0 | 341 | 0 | 639 | 0 | **15140** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 607 | -160 | 2901 | **898** |
| ULS 1a_45 | 262 | 363 | 636 | **17284** | **11069** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 234 | 209 | **1340** | 17 | -313 | 16 | 1380 |
| 2 | ULS 1a_0 | 116 | -151 | **791** | 25 | -189 | 6 | 814 |
| 3 | ULS 7 | -33 | -33 | **175** | 0 | -47 | -4 | 180 |
| 4 | ULS 1a_135 | -234 | 209 | **1340** | -17 | -313 | 16 | 1380 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -178 | 153 | **-1047** | 17 | 234 | -24 | -1078 |
| 3 | ULS 1a_0,9_0,9_45 | 178 | 153 | **-1047** | -17 | 234 | -24 | -1078 |
| 4 | ULS 1a_0,9_0,9_0 | 59 | -95 | **-495** | -25 | 109 | -13 | -510 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_135 | 103 | 33 | 418 | **49** | -96 | 7 | 430 |
| 2 | ULS 1a_45 | -42 | -28 | -100 | **49** | 10 | -15 | -103 |
| 3 | ULS 5a Ba 21 | -36 | 13 | 38 | **35** | -17 | -7 | 39 |
| 4 | ULS 5a Ba 21 | 4 | 25 | 24 | **20** | -15 | -9 | 25 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 31 | 24 | 71 | 279 | **-33** | -67 | 1 | 288 |
| 2 | ULS 5a Ba 31 | 59 | -33 | 266 | **-18** | -66 | 0 | 274 |
| 3 | ULS 1a_135 | 42 | -28 | -100 | **-49** | 10 | -15 | -103 |
| 4 | ULS 1a_45 | -103 | 33 | 418 | **-49** | -96 | 7 | 430 |

Project: KIJ-GT
Tower: S+24
Number: 68

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -178 | 153 | **-1047** | **17** | 234 | -24 | -1078 |
| 3 | ULS 1a_0,9_0,9_45 | 178 | 153 | **-1047** | **-17** | 234 | -24 | -1078 |
| 4 | ULS 1a_0,9_0,9_0 | 59 | -95 | **-495** | **-25** | 109 | -13 | -510 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 234 | 209 | **1340** | 17 | -313 | 16 | 1380 |
| Max. tension | ULS 1a_0,9_0,9_45 | 178 | 153 | **-1047** | -17 | 234 | -24 | -1078 |
| Max. pos. torsie | ULS 1a_45 | -42 | -28 | -100 | **49** | 10 | -15 | -103 |
| Max. neg. torsie | ULS 1a_135 | 42 | -28 | -100 | **-49** | 10 | -15 | -103 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 178 | 153 | **-1047** | **-17** | 234 | -24 | -1078 |

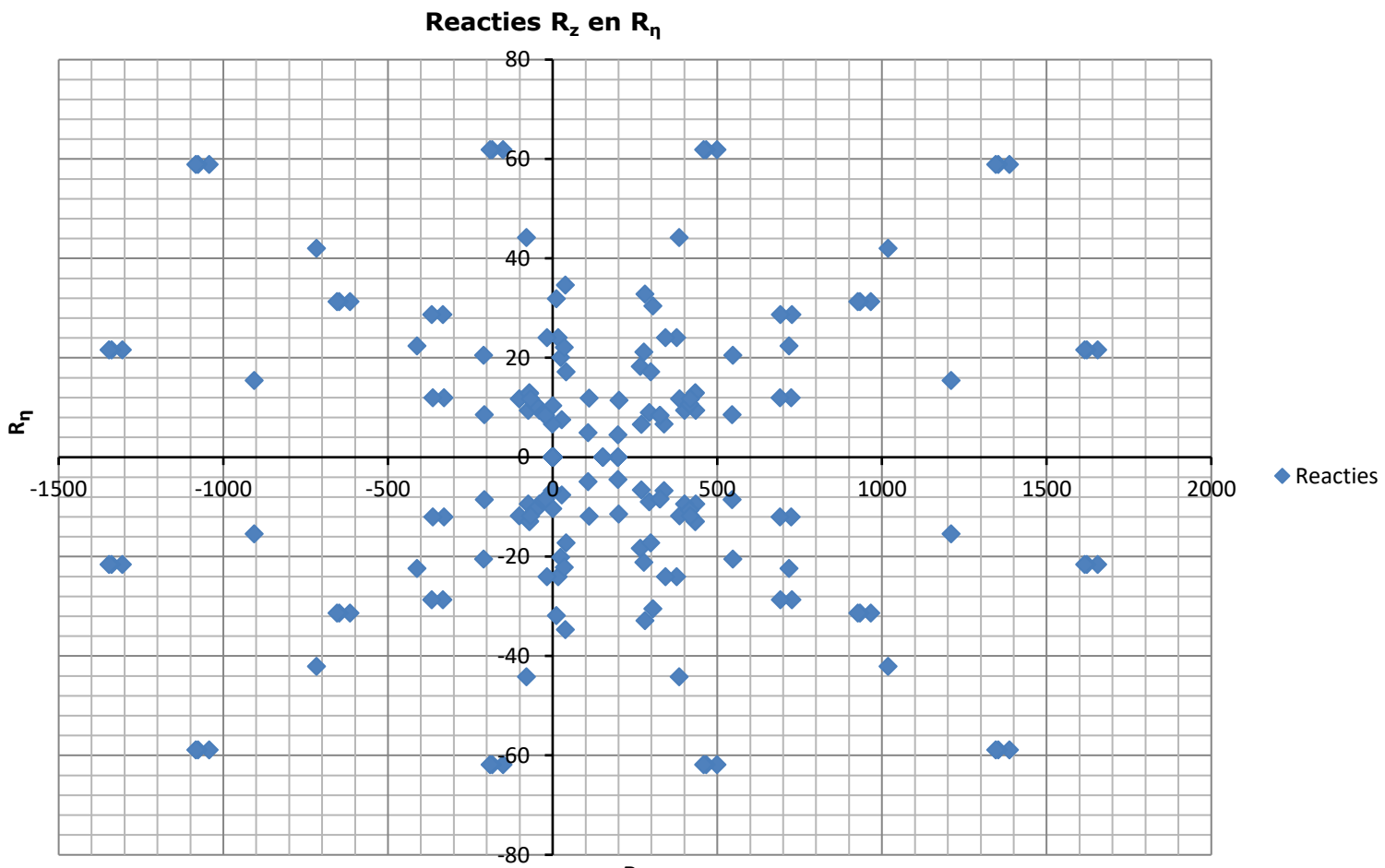
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 29 | 29 | **152** | 0 | -41 | -4 | 157 |
| 2 | SLS 1a_135 | -143 | 122 | **-846** | 15 | 187 | -21 | -872 |
| 3 | SLS 1a_45 | 143 | 122 | **-846** | -15 | 187 | -21 | -872 |
| 4 | SLS 1a_0 | 43 | -73 | **-381** | -21 | 82 | -12 | -392 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 201 | 180 | **1149** | 15 | -269 | 13 | 1184 |
| 2 | SLS 1a_0 | 101 | -131 | **685** | 21 | -164 | 4 | 705 |
| 3 | SLS 7 | -29 | -29 | **152** | 0 | -41 | -4 | 157 |
| 4 | SLS 1a_135 | -201 | 180 | **1149** | -15 | -269 | 13 | 1184 |

Project: KIJ-GT
Tower: S+24
Number: 68



Project: KIJ-GT
Tower: S+24
Number: 68

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Verbouw CC2 |
| Reference period | 50 jaar |

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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
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Number: 68

**Summary table - Conductor loads**

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

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

**Maximum values for back and ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -35,1 | 35,1 | 5,8 | 5,2 | 5,7 | 8,6 |
| 380ct1f1 | -132,4 | 132,4 | 18,4 | 19,1 | 19,1 | 13,3 |
| 380ct1f2 | -132,4 | 132,4 | 18,4 | 19,1 | 19,1 | 13,3 |
| 380ct1f3 | -134,2 | 134,2 | 19,8 | 20,2 | 19,1 | 13,4 |
| 380ct2f1 | -132,4 | 132,4 | 18,4 | 19,1 | 19,1 | 13,3 |
| 380ct2f2 | -132,4 | 132,4 | 18,4 | 19,1 | 19,1 | 13,3 |
| 380ct2f3 | -134,2 | 134,2 | 19,8 | 20,2 | 19,1 | 13,4 |
| bl2 | -35,3 | 35,3 | 5,8 | 5,2 | 5,7 | 8,6 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 529,5 | 547,7 | 529,5 |
| 380ct1f1 | 294,6 | 323,4 | 332,1 |
| 380ct1f2 | 294,5 | 323,4 | 332,1 |
| 380ct1f3 | 293,6 | 325,0 | 333,8 |
| 380ct2f1 | 294,5 | 323,4 | 332,1 |
| 380ct2f2 | 294,6 | 323,4 | 332,1 |
| 380ct2f3 | 293,6 | 325,0 | 333,8 |
| bl2 | 529,5 | 551,0 | 529,5 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 641,1 | 533,6 |
| 380ct1f1 | 333,0 | 334,8 |
| 380ct1f2 | 333,0 | 334,8 |
| 380ct1f3 | 334,7 | 336,4 |
| 380ct2f1 | 333,0 | 334,8 |
| 380ct2f2 | 333,0 | 334,8 |
| 380ct2f3 | 334,7 | 336,4 |
| bl2 | 641,1 | 534,8 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 642,7 m | 1,583 - |
| Min. weight span | 211,3 m | 0,520 - |

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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 | 11,0 | 12,1 | -35,5 | 34,7 |
| 380ct1f1 | 51,3 | 37,5 | 32,4 | -131,4 | 133,4 |
| 380ct1f2 | 51,3 | 37,5 | 32,4 | -131,4 | 133,4 |
| 380ct1f3 | 51,3 | 40,1 | 32,6 | -133,4 | 135,1 |
| 380ct2f1 | 51,3 | 37,5 | 32,4 | -131,4 | 133,4 |
| 380ct2f2 | 51,3 | 37,5 | 32,4 | -131,4 | 133,4 |
| 380ct2f3 | 51,3 | 40,1 | 32,6 | -133,4 | 135,1 |
| bl2 | 15,0 | 11,0 | 12,1 | -35,7 | 35,0 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 5,4 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 17,3 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 17,2 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 17,3 | -64,2 | 64,2 |
| bl2 | 0,0 | 0,0 | 5,4 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 2,0 | 3,5 |
| | 380ct1f1 | 10,1 | 6,7 |
| | 380ct1f2 | 10,1 | 6,7 |
| | 380ct1f3 | 10,1 | 6,8 |
| | 380ct2f1 | 10,1 | 6,7 |
| | 380ct2f2 | 10,1 | 6,7 |
| | 380ct2f3 | 10,1 | 6,8 |
| | bl2 | 2,0 | 3,6 |

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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 | 252 | 118 | 15554 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 252 | 106 | 15554 | 0 | 0 |
| ULS 3_90 | | 0 | 140 | 215 | 8633 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 140 | 202 | 8633 | 0 | 0 |
| SLS 7 | | 0 | 0 | 114 | 0 | 0 | 0 |

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

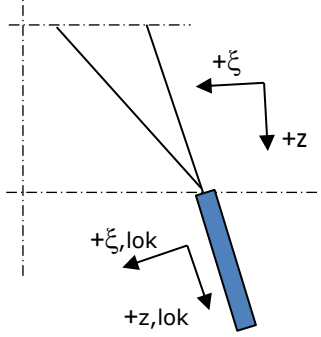
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 596 | 686 | 29151 | 0 | 0 |
| ULS 3_90 | 0 | 243 | 783 | 12712 | 0 | 0 |
| SLS 7 | 0 | 0 | 608 | 0 | 0 | 0 |

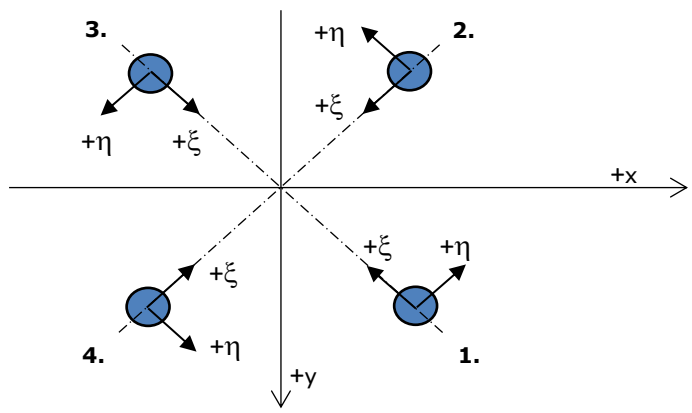
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 596 | 686 | **29151** | 0 | 0 |
| ULS 1a_0 | 428 | 0 | 700 | 0 | **18980** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 607 | -160 | 2901 | **898** |
| ULS 1a_45 | 329 | 455 | 695 | **21668** | **13877** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 288 | 258 | **1655** | 22 | -386 | 21 | 1704 |
| 2 | ULS 1a_0 | 140 | -185 | **966** | 31 | -230 | 8 | 995 |
| 3 | ULS 7 | -38 | -38 | **198** | 0 | -54 | -5 | 204 |
| 4 | ULS 1a_135 | -288 | 258 | **1655** | -22 | -386 | 21 | 1704 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -229 | 199 | **-1347** | 22 | 303 | -29 | -1388 |
| 3 | ULS 1a_0,9_0,9_45 | 229 | 199 | **-1347** | -22 | 303 | -29 | -1388 |
| 4 | ULS 1a_0,9_0,9_0 | 81 | -125 | **-655** | -31 | 146 | -15 | -675 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_135 | 124 | 36 | 499 | **62** | -113 | 9 | 513 |
| 2 | ULS 1a_45 | -57 | -30 | -151 | **62** | 19 | -18 | -155 |
| 3 | ULS 5a Ba 21 | -36 | 13 | 38 | **35** | -17 | -7 | 39 |
| 4 | ULS 5a Ba 21 | 4 | 25 | 24 | **20** | -15 | -9 | 25 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 31 | 24 | 71 | 279 | **-33** | -67 | 1 | 288 |
| 2 | ULS 5a Ba 31 | 59 | -33 | 266 | **-18** | -66 | 0 | 274 |
| 3 | ULS 1a_135 | 57 | -30 | -151 | **-62** | 19 | -18 | -155 |
| 4 | ULS 1a_45 | -124 | 36 | 499 | **-62** | -113 | 9 | 513 |

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Number: 68

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -229 | 199 | **-1347** | **22** | 303 | -29 | -1388 |
| 3 | ULS 1a_0,9_0,9_45 | 229 | 199 | **-1347** | **-22** | 303 | -29 | -1388 |
| 4 | ULS 1a_0,9_0,9_0 | 81 | -125 | **-655** | **-31** | 146 | -15 | -675 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 288 | 258 | **1655** | 22 | -386 | 21 | 1704 |
| Max. tension | ULS 1a_0,9_0,9_45 | 229 | 199 | **-1347** | -22 | 303 | -29 | -1388 |
| Max. pos. torsie | ULS 1a_45 | -57 | -30 | -151 | **62** | 19 | -18 | -155 |
| Max. neg. torsie | ULS 1a_135 | 57 | -30 | -151 | **-62** | 19 | -18 | -155 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 229 | 199 | **-1347** | **-22** | 303 | -29 | -1388 |

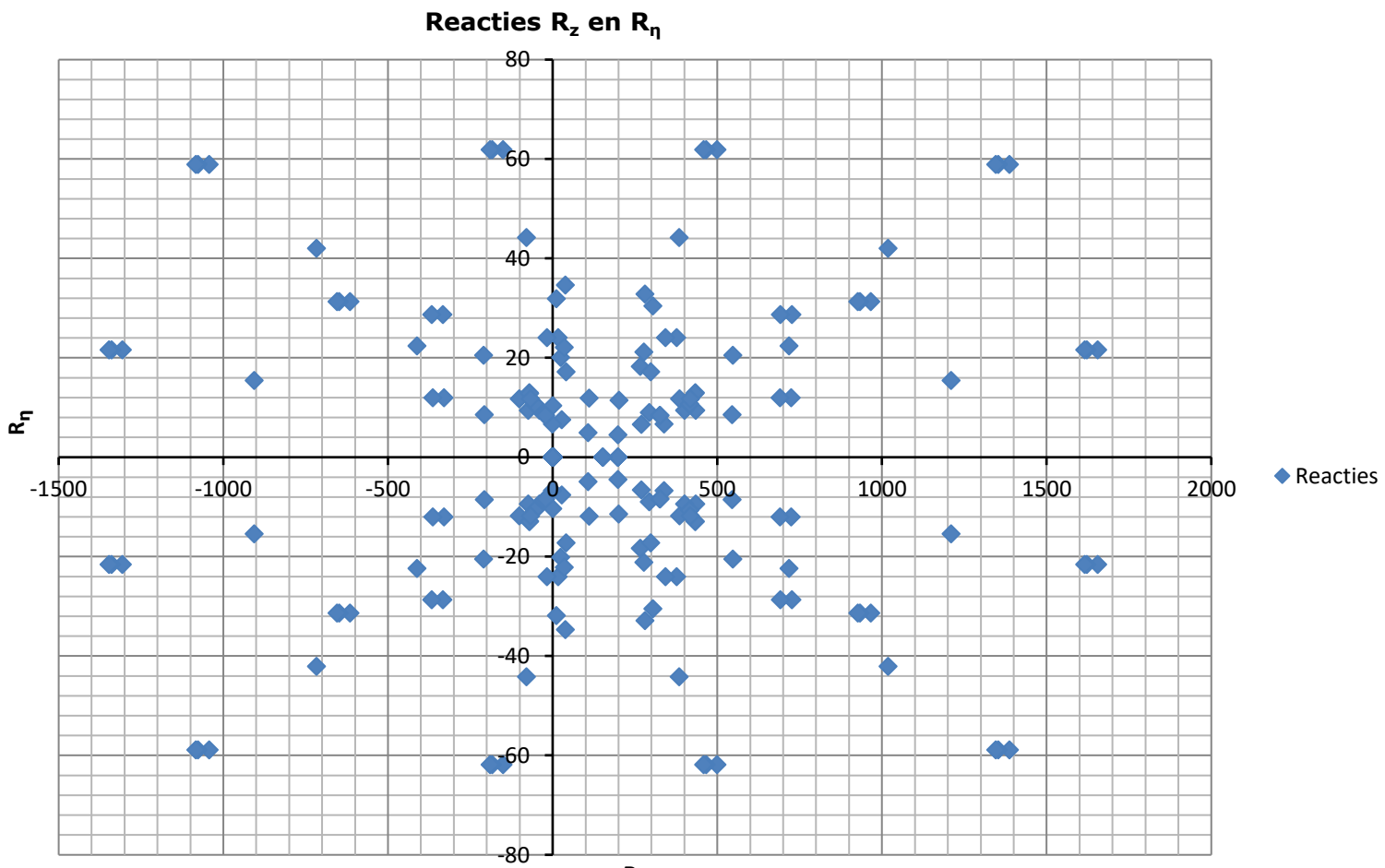
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 29 | 29 | **152** | 0 | -41 | -4 | 157 |
| 2 | SLS 1a_135 | -153 | 131 | **-906** | 15 | 201 | -22 | -934 |
| 3 | SLS 1a_45 | 153 | 131 | **-906** | -15 | 201 | -22 | -934 |
| 4 | SLS 1a_0 | 47 | -79 | **-413** | -22 | 89 | -12 | -425 |

**Maximum compression load - SLS**

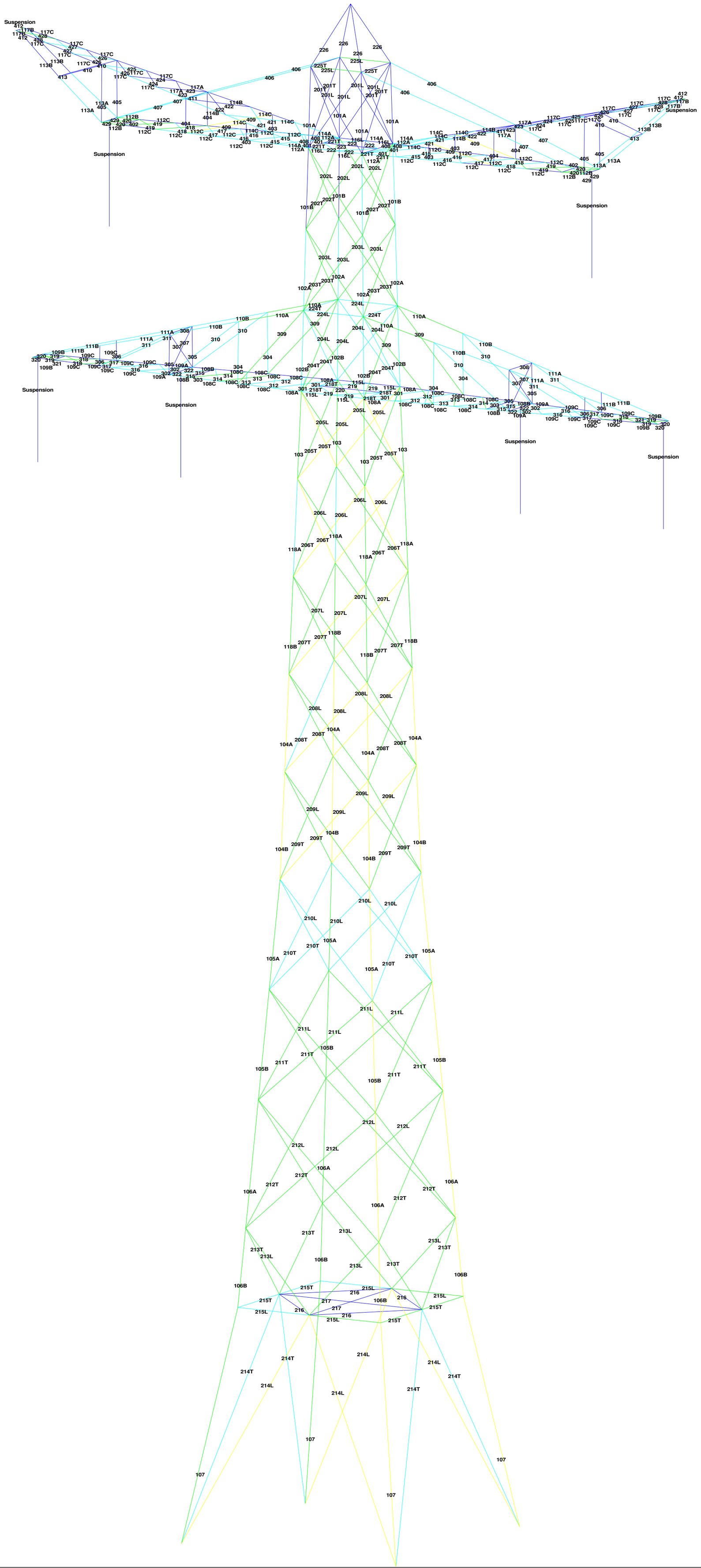
| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 211 | 189 | **1209** | 15 | -283 | 14 | 1245 |
| 2 | SLS 1a_0 | 106 | -137 | **717** | 22 | -172 | 5 | 738 |
| 3 | SLS 7 | -29 | -29 | **152** | 0 | -41 | -4 | 157 |
| 4 | SLS 1a_135 | -211 | 189 | **1209** | -15 | -283 | 14 | 1245 |

Project: KIJ-GT
Tower: S+24
Number: 68



# APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project: "S+24 (hv) ini"
Tower Version 16.28, 22:39:32 donderdag 11 juni 2020
Undeformed geometry displayed


Suspension
Suspension
Suspension

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 11-6-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+24**
**Mast 68**

| 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 | **-41.2** | ULS 5a Ba 30 | 318.5 | 670.3 | 829.4 | 0.13 | | **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 | **-103.9** | ULS 1a_45 | 318.5 | 508.3 | 622.1 | 0.33 | | **62.3** | ULS 1a_0,9_0,9_135 | 379.5 | 508.3 | 531.7 | 0.16 | |
| 102A | Leg vijfde tussenstuk | 150x150x12 | S235 | 6M24-5.6t | 0.50 | 0.50 | 0.50 | 68 | **-231.3** | ULS 1a_45 | 663.4 | 508.3 | 933.1 | 0.45 | | **153.5** | ULS 1a_0,9_0,9_135 | 740.3 | 508.3 | 797.5 | 0.30 | |
| 102B | Leg vijfde tussenstuk | 150x150x12 | S235 | 8M24-5.6t | 0.50 | 0.50 | 0.50 | 68 | **-291.2** | ULS 1a_45 | 663.4 | 677.8 | 1244.2 | 0.44 | | **201.0** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 776.3 | 0.30 | |
| 103 | Leg vierde tussenstuk | 180x180x16 | S235 | 8M24-5.6t | 0.30 | 0.30 | 0.30 | 37 | **-474.2** | ULS 1a_45 | 1230.7 | 677.8 | 1658.9 | 0.70 | | **351.0** | 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 | **-731.4** | ULS 1a_45 | 1210.1 | 1355.5 | 1658.9 | 0.60 | | **564.3** | ULS 1a_0,9_0,9_135 | 1220.3 | 1355.5 | 1417.8 | 0.46 | |
| 118B | Leg vierde tussenstuk | 180x180x16 | S235 | 8M24-5.6t | 0.30 | 0.30 | 0.30 | 41 | **-852.7** | ULS 1a_45 | 1210.1 | 1355.5 | 1658.9 | 0.70 | | **699.8** | ULS 1a_0,9_0,9_135 | 1220.3 | 1355.5 | 1063.4 | 0.66 | |
| 104A | Leg derde tussenstuk | 200x200x18 | S235 | 8M24-5.6t | 0.30 | 0.30 | 0.30 | 37 | **-1090.4** | ULS 1a_45 | 1532.7 | 1355.5 | 1866.2 | 0.80 | | **896.8** | ULS 1a_0,9_0,9_135 | 1548.5 | 1355.5 | 1132.5 | 0.79 | |
| 104B | Leg derde tussenstuk | 200x200x18 | S235 | 10M24-5.6t | 0.30 | 0.30 | 0.30 | 41 | **-1188.6** | ULS 1a_45 | 1509.4 | 1694.4 | 2332.8 | 0.79 | | **1010.0** | ULS 1a_0,9_0,9_135 | 1548.5 | 1694.4 | 1216.2 | 0.83 | |
| 105A | Leg tweede tussenstuk | 250x250x16 | S235 | 10M24-5.6t | 0.30 | 0.30 | 0.30 | 33 | **-1342.4** | ULS 1a_45 | 1766.9 | 1599.1 | 2073.6 | 0.84 | | **1145.0** | ULS 1a_0,9_0,9_135 | 1816.5 | 1599.1 | 1595.1 | 0.72 | |
| 105B | Leg tweede tussenstuk | 250x250x16 | S235 | 10M24-5.6t | 0.30 | 0.30 | 0.30 | 33 | **-1413.6** | ULS 1a_45 | 1766.8 | 1615.0 | 2073.6 | 0.88 | | **1208.4** | ULS 1a_0,9_0,9_45 | 1816.5 | 1615.0 | 1772.3 | 0.75 | |
| 106A | Leg eerste tussenstuk | 250x250x18 | S235 | 12M24-5.6t | 0.30 | 0.30 | 0.30 | 38 | **-1497.5** | ULS 1a_45 | 1936.0 | 1836.3 | 2799.4 | 0.82 | | **1291.5** | ULS 1a_0,9_0,9_135 | 2030.6 | 1836.3 | 2799.4 | 0.70 | |
| 106B | Leg eerste tussenstuk | 250x250x18 | S235 | 12M24-5.6t | 0.50 | 0.50 | 0.50 | 40 | **-1516.0** | ULS 1a_45 | 1925.8 | 1859.6 | 2799.4 | 0.82 | | **1307.5** | ULS 1a_0,9_0,9_135 | 2030.6 | 1859.6 | 2392.6 | 0.70 | |
| 107 | Leg broekstuk | 250x250x18 | S235 | 12M24-5.6t | 0.13 | 0.13 | 0.13 | 30 | **-1567.1** | ULS 1a_45 | 1997.5 | 1929.5 | 2799.4 | 0.81 | | **1325.2** | ULS 1a_0,9_0,9_135 | 2030.6 | 1929.5 | 2392.6 | 0.69 | |
| 108A | Eerste dwarsarm onderregel | 160x160x15 | S235 | 10M24-5.6t | 1.00 | 2.20 | 1.00 | 76 | **-275.7** | ULS 5a Ba 31 | 842.7 | 847.2 | 1944.0 | 0.33 | | **153.8** | ULS 5a Ba 21 | 1008.5 | 847.2 | 1661.5 | 0.18 | |
| 108C | Eerste dwarsarm onderregel | 160x160x15 | S235 | | 1.00 | 2.37 | 1.00 | 76 | **-267.0** | ULS 5a Ba 31 | 842.7 | 0.0 | 0.0 | 0.32 | | **147.4** | ULS 5a Ba 21 | 1097.7 | 0.0 | 0.0 | 0.13 | |
| 108B | Eerste dwarsarm onderregel | 160x160x15 | S235 | 6M24-5.6t | 1.00 | 3.36 | 1.00 | 82 | **-220.8** | ULS 5a Ba 31 | 802.3 | 508.3 | 1166.4 | 0.43 | | **124.5** | ULS 5a Ba 21 | 1008.5 | 508.3 | 996.9 | 0.24 | |
| 109A | Eerste dwarsarm onderregel | 150x150x12 | S235 | 6M24-5.6t | 1.00 | 2.30 | 1.00 | 89 | **-185.4** | ULS 5a Ba 31 | 565.2 | 508.3 | 933.1 | 0.36 | | **124.7** | ULS 5a Ba 21 | 740.3 | 508.3 | 797.5 | 0.25 | |
| 109C | Eerste dwarsarm onderregel | 150x150x12 | S235 | | 1.00 | 2.50 | 1.00 | 89 | **-163.1** | ULS 5a Ba 31 | 567.3 | 0.0 | 0.0 | 0.29 | | **102.0** | ULS 5a Ba 21 | 817.8 | 0.0 | 0.0 | 0.12 | |
| 109B | Eerste dwarsarm onderregel | 150x150x12 | S235 | 5M24-5.6t | 1.00 | 3.28 | 1.00 | 86 | **-73.1** | ULS 3_90 | 581.0 | 420.1 | 777.6 | 0.17 | | **0.0** | | 554.4 | 420.1 | 664.6 | 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 | | **109.5** | ULS 3_0 | 211.1 | 254.2 | 265.8 | 0.52 | |
| 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 | | **81.4** | ULS 3_0 | 293.9 | 338.9 | 368.6 | 0.28 | |
| 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 | | **72.2** | ULS 3_0 | 225.0 | 338.9 | 271.2 | 0.32 | |
| 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 | | **72.2** | ULS 3_0 | 161.1 | 254.2 | 199.4 | 0.45 | |
| 112A | Tweede dwarsarm onderregel | 150x150x12 | S235 | 8M24-5.6t | 1.00 | 1.94 | 1.00 | 79 | **-220.2** | ULS 5a Ba 20 | 615.2 | 677.8 | 1244.2 | 0.36 | | **114.5** | ULS 5a Ba 30 | 740.3 | 677.8 | 1159.1 | 0.17 | |
| 112C | Tweede dwarsarm onderregel | 150x150x12 | S235 | | 1.00 | 2.07 | 1.00 | 79 | **-202.6** | ULS 5a Ba 20 | 615.6 | 0.0 | 0.0 | 0.33 | | **96.6** | ULS 5a Ba 30 | 817.8 | 0.0 | 0.0 | 0.12 | |
| 112B | Tweede dwarsarm onderregel | 150x150x12 | S235 | 2M24-5.6t | 1.00 | 4.07 | 1.00 | 106 | **-110.9** | ULS 3_90 | 470.5 | 169.4 | 311.0 | 0.65 | | **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 | **-21.3** | ULS 3_90 | 70.3 | 84.7 | 77.8 | 0.30 | | **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 | **-20.2** | ULS 3_90 | 82.2 | 84.7 | 77.8 | 0.26 | | **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 | **-87.2** | ULS 5a Ba 1 | 224.6 | 254.2 | 311.0 | 0.39 | | **71.1** | ULS 5a Ba 1 | 263.0 | 254.2 | 265.8 | 0.28 | |
| 114C | Tweede dwarsarm bovenregel | 120x120x8 | S235 | | 2.92 | 2.00 | 1.00 | 97 | **-83.1** | ULS 5a Ba 1 | 230.0 | 0.0 | 0.0 | 0.36 | | **74.1** | 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 | **-74.7** | ULS 5a Ba 1 | 229.6 | 338.9 | 414.7 | 0.33 | | **69.2** | 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 | **-22.6** | ULS 5a Ba 30 | 221.9 | 169.4 | 207.4 | 0.13 | | **17.5** | ULS 1a_90 | 226.0 | 169.4 | 177.2 | 0.10 | |
| 201T | Diagonaal bovenstuk | 120x120x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 108 | **-19.7** | ULS 5a Ba 30 | 221.9 | 169.4 | 207.4 | 0.12 | | **4.1** | 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 | **-109.5** | ULS 5a Ba 20 | 266.8 | 169.4 | 259.2 | 0.65 | | **86.7** | ULS 5a Ba 30 | 278.4 | 169.4 | 221.5 | 0.51 | |
| 202T | Diagonaal bovenstuk | 120x120x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 111 | **-105.7** | ULS 5a Ba 20 | 266.8 | 169.4 | 259.2 | 0.62 | | **112.5** | ULS 5a Ba 30 | 278.4 | 169.4 | 221.5 | 0.66 | |
| 203L | Diagonaal vijfde tussenstuk | 120x120x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 113 | **-79.8** | ULS 5a Ba 30 | 213.8 | 169.4 | 207.4 | 0.47 | | **100.3** | ULS 5a Ba 20 | 226.0 | 169.4 | 177.2 | 0.59 | |
| 203T | Diagonaal vijfde tussenstuk | 120x120x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 113 | **-103.3** | ULS 5a Ba 30 | 213.8 | 169.4 | 207.4 | 0.61 | | **97.1** | ULS 5a Ba 20 | 226.0 | 169.4 | 177.2 | 0.57 | |
| 204L | Diagonaal vijfde tussenstuk | 120x120x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 115 | **-91.7** | ULS 5a Ba 30 | 209.6 | 169.4 | 207.4 | 0.54 | | **80.2** | ULS 5a Ba 20 | 226.0 | 169.4 | 177.2 | 0.47 | |
| 204T | Diagonaal vijfde tussenstuk | 120x120x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 115 | **-99.4** | ULS 5a Ba 20 | 209.6 | 169.4 | 207.4 | 0.59 | | **83.4** | ULS 5a Ba 30 | 226.0 | 169.4 | 177.2 | 0.49 | |
| 205L | Diagonaal vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 85 | **-125.0** | ULS 1a_90 | 221.9 | 169.4 | 207.4 | 0.74 | | **116.6** | ULS 1a_0,9_0,9_90 | 138.1 | 169.4 | 172.2 | 0.84 | |
| 205T | Diagonaal vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 85 | **-115.3** | ULS 5a Ba 21 | 221.9 | 169.4 | 207.4 | 0.68 | | **112.7** | ULS 5a Ba 31 | 138.1 | 169.4 | 172.2 | 0.82 | |
| 206L | Diagonaal vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 93 | **-115.0** | ULS 1a_0,9_0,9_90 | 207.3 | 169.4 | 207.4 | 0.68 | | **121.2** | ULS 1a_90 | 138.1 | 169.4 | 172.2 | 0.88 | |
| 206T | Diagonaal vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 93 | **-106.8** | ULS 5a Ba 31 | 207.3 | 169.4 | 207.4 | 0.63 | | **110.0** | ULS 5a Ba 21 | 138.1 | 169.4 | 172.2 | 0.80 | |
| 207L | Diagonaal vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 96 | **-112.2** | ULS 1a_90 | 202.4 | 169.4 | 207.4 | 0.66 | | **103.7** | ULS 1a_0,9_0,9_90 | 138.1 | 169.4 | 172.2 | 0.75 | |
| 207T | Diagonaal vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 96 | **-98.5** | ULS 5a Ba 21 | 202.4 | 169.4 | 207.4 | 0.58 | | **94.2** | ULS 5a Ba 31 | 138.1 | 169.4 | 172.2 | 0.68 | |
| 208L | Diagonaal derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 99 | **-101.1** | ULS 1a_0,9_0,9_90 | 197.4 | 169.4 | 207.4 | 0.60 | | **106.1** | ULS 1a_90 | 138.1 | 169.4 | 172.2 | 0.77 | |
| 208T | Diagonaal derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 99 | **-84.6** | ULS 5a Ba 31 | 197.4 | 169.4 | 207.4 | 0.50 | | **88.7** | ULS 5a Ba 21 | 138.1 | 169.4 | 172.2 | 0.64 | |
| 209L | Diagonaal derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 108 | **-107.2** | ULS 1a_90 | 183.5 | 169.4 | 207.4 | 0.63 | | **96.6** | ULS 1a_0,9_0,9_90 | 128.6 | 169.4 | 164.6 | 0.75 | |
| 209T | Diagonaal derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.52 | 0.26 | 0.26 | 108 | **-85.3** | ULS 5a Ba 21 | 183.5 | 169.4 | 207.4 | 0.50 | | **79.4** | ULS 5a Ba 31 | 128.6 | 169.4 | 164.6 | 0.62 | |
| 210L | Diagonaal tweede tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 119 | **-61.0** | ULS 5a Ba 31 | 166.6 | 169.4 | 207.4 | 0.37 | | **60.9** | ULS 5a Ba 31 | 138.1 | 169.4 | 172.2 | 0.44 | |
| 210T | Diagonaal tweede tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 119 | **-65.7** | ULS 5a Ba 21 | 166.6 | 169.4 | 207.4 | 0.39 | | **63.1** | ULS 5a Ba 31 | 138.1 | 169.4 | 172.2 | 0.46 | |
| 211L | Diagonaal tweede tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 0.54 | 0.27 | 0.27 | 128 | **-50.0** | ULS 5a Ba 31 | 106.9 | 84.7 | 103.7 | 0.59 | | **50.0** | ULS 5a Ba 31 | 124.4 | 84.7 | 88.6 | 0.59 | |
| 211T | Diagonaal tweede tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 0.54 | 0.27 | 0.27 | 128 | **-53.5** | ULS 5a Ba 31 | 106.9 | 84.7 | 103.7 | 0.63 | | **52.1** | ULS 5a Ba 21 | 124.4 | 84.7 | 88.6 | 0.62 | |
| 212L | Diagonaal eerste tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 0.54 | 0.27 | 0.27 | 149 | **-45.8** | ULS 5a Ba 31 | 113.4 | 84.7 | 129.6 | 0.54 | | **46.6** | ULS 5a Ba 21 | 155.5 | 84.7 | 110.8 | 0.55 | |
| 212T | Diagonaal eerste tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 1.00 | 0.27 | 0.27 | 248 | **-28.8** | ULS 1a_0,9_0,9_90 | 53.1 | 84.7 | 129.6 | 0.54 | | **48.4** | ULS 5a Ba 21 | 155.5 | 84.7 | 110.8 | 0.57 | |
| 213L | Diagonaal eerste tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 1.00 | 0.51 | 0.51 | 159 | **-48.1** | ULS 5a Ba 21 | 87.7 | 84.7 | 103.7 | 0.57 | | **44.9** | ULS 1a_0,9_0,9_135 | 124.4 | 84.7 | 88.6 | 0.53 | |
| 213T | Diagonaal eerste tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 1.00 | 0.51 | 0.51 | 159 | **-46.8** | ULS 5a Ba 21 | 87.7 | 84.7 | 103.7 | 0.55 | | **51.9** | ULS 1a_0,9_0,9_90 | 124.4 | 84.7 | 88.6 | 0.61 | |
| 214L | Diagonaal broekstuk | UNP260 | S235 | 2M24-5.6t | 1.00 | 0.15 | 0.15 | 131 | **-218.5** | ULS 1a_90 | 282.5 | 338.9 | 259.2 | 0.91 | | **197.9** | ULS 1a_0,9_90 | 463.8 | 338.9 | 221.5 | 0.89 | |
| 214T | Diagonaal broekstuk | UNP260 | S235 | 2M24-5.6t | 1.00 | 0.15 | 0.15 | 131 | **-107.2** | ULS 1a_135 | 282.5 | 338.9 | 259.2 | 0.45 | | **94.7** | ULS 1a_0,9_0,9_135 | 463.8 | 338.9 | 221.5 | 0.43 | |
| 215L | Onderstuk in tower | 150x150x14 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 136 | **-149.3** | ULS 1a_45 | 374.7 | 254.2 | 544.3 | 0.59 | | **114.5** | ULS 1a_0,9_0,9_45 | 541.8 | 254.2 | 435.5 | 0.45 | |
| 215T | Onderstuk in tower | 150x150x14 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 136 | **-148.0** | ULS 1a_45 | 374.7 | 254.2 | 544.3 | 0.58 | | **114.1** | ULS 1a_0,9_0,9_135 | 541.8 | 254.2 | 435.5 | 0.45 | |
| 216 | Onderstuk in tower | 100x100x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 287 | **-3.9** | ULS 1a_135 | 31.1 | 58.8 | 64.8 | 0.12 | | **3.2** | ULS 1a_0,9_45 | 134.8 | 58.8 | 52.4 | 0.06 | |
| 217 | onderstuk in tower | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 349 | **-1.2** | ULS 7 | 16.8 | 58.8 | 75.6 | 0.07 | | **0.5** | ULS 1a_0,9_0,9_90 | 106.8 | 58.8 | 61.1 | 0.01 | |
| 115L | Eerste dwarsarm in tower | 160x160x15 | S235 | 10M24-5.6t | 1.00 | 2.00 | 1.00 | 71 | **-212.3** | ULS 5a Ba 31 | 870.6 | 783.7 | 1944.0 | 0.27 | | **86.7** | ULS 5a Ba 21 | 612.0 | 783.7 | 1647.0 | 0.14 | |
| 218T | Eerste dwarsarm in tower | 100x100x6 | S235 | 4M24-5.6t | 1.00 | 2.00 | 1.00 | 114 | **-39.2** | ULS 5a Ba 31 | 123.1 | 338.9 | 311.0 | 0.32 | | **62.3** | ULS 5a Ba 31 | 225.0 | 338.9 | 265.8 | 0.28 | |
| 219 | Eerste dwarsarm in tower | 120x120x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 104 | **-68.7** | ULS 5a Ba 21 | 229.9 | 169.4 | 207.4 | 0.41 | | **69.7** | ULS 5a Ba 21 | 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 | **-1.2** | ULS 3_90 | 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 | **-185.0** | ULS 5a Ba 30 | 674.1 | 677.8 | 1244.2 | 0.27 | | **69.0** | ULS 5a Ba 20 | 740.3 | 677.8 | 1063.4 | 0.10 | |
| 221T | Tweede dwarsboom in tower | 100x100x6 | S235 | 4M24-5.6t | 1.00 | 2.00 | 1.00 | 98 | **-33.4** | ULS 5a Ba 30 | 140.9 | 338.9 | 311.0 | 0.24 | | **50.3** | ULS 5a Ba 30 | 225.0 | 338.9 | 265.8 | 0.22 | |
| 222 | Tweede dwarsboom in tower | 100x100x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 108 | **-54.0** | ULS 5a Ba 20 | 182.9 | 169.4 | 207.4 | 0.32 | | **54.3** | ULS 5a Ba 20 | 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 | **-0.5** | ULS 3_0 | 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 | | **122.8** | ULS 3_0 | 263.0 | 254.2 | 265.8 | 0.48 | |
| 224T | Eerste dwarsboom in tower bovenzijde | 100x100x6 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 169 | **-28.2** | ULS 1a_0,9_90 | 67.1 | 84.7 | 77.8 | 0.42 | | **31.6** | ULS 1a_90 | 127.9 | 84.7 | 66.5 | 0.48 | |
| 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 | | **106.1** | ULS 3_0 | 179.2 | 254.2 | 199.4 | 0.59 | |
| 225T | Tweede dwarsboom in tower bovenzijde | 70x70x7 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 208 | **-2.0** | ULS 1a_0,9_0,9_90 | 50.5 | 254.2 | 272.2 | 0.04 | | **4.8** | ULS 1a_90 | 132.7 | 254.2 | 192.5 | 0.04 | |
| 226 | Top | 100x100x6 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 183 | **-11.8** | ULS 5a Ba 20 | 75.5 | 75.4 | 103.7 | 0.16 | | **11.5** | ULS 5a Ba 20 | 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 | **-17.4** | ULS 5a Ba 32 | 65.7 | 84.7 | 90.7 | 0.26 | | **19.6** | ULS 5a Ba 22 | 68.5 | 84.7 | 47.5 | 0.41 | |
| 302 | Diagonalen ondervlak eerste dwarsarm | 60x60x6 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 129 | **-16.1** | ULS 5a Ba 31 | 54.9 | 58.8 | 64.8 | 0.29 | | **15.4** | ULS 5a Ba 31 | 65.7 | 58.8 | 44.4 | 0.35 | |
| 303 | Dwarsligger ondervlak eerste dwarsarm | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 61 | **-5.6** | ULS 1a_0,9_0,9_90 | 891.1 | 117.6 | 172.8 | 0.05 | | **11.0** | ULS 1a_90 | 1278.1 | 117.6 | 0.0 | 0.09 | |
| 322 | Dwarsligger ondervlak eerste dwarsarm | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-22.8** | ULS 5a Ba 32 | 916.4 | 117.6 | 172.8 | 0.19 | | **28.5** | ULS 5a Ba 22 | 1278.1 | 117.6 | 0.0 | 0.24 | |
| 304 | Verticale regel eerste dwarsarm | 100x100x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 154 | **-15.2** | ULS 3_0 | 75.4 | 58.8 | 64.8 | 0.26 | | **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 | **-3.4** | ULS 1a_0 | 30.0 | 37.7 | 43.2 | 0.11 | | **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 3_45 | 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 | |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 11-6-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+24**
**Mast 68**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | **24.1** | ULS 3_45 | 52.4 | 75.4 | 44.1 | 0.55 | |
| 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 | | **35.9** | ULS 3_0 | 77.4 | 117.6 | 88.7 | 0.46 | |
| 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 | | **10.1** | ULS 3_135 | 37.4 | 37.7 | 22.0 | 0.46 | |
| 312 | Diagonalen ondervlak eerste dwarsarm | 70x70x7 | S235 | 1M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-22.2** | ULS 5a Ba 22 | 71.9 | 84.7 | 90.7 | 0.31 | | **20.6** | ULS 5a Ba 32 | 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 | **-22.4** | ULS 5a Ba 32 | 75.5 | 84.7 | 90.7 | 0.30 | | **24.1** | ULS 5a Ba 22 | 68.5 | 84.7 | 47.5 | 0.51 | |
| 314 | Diagonalen ondervlak eerste dwarsarm | 70x70x7 | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 122 | **-28.5** | ULS 5a Ba 22 | 79.2 | 84.7 | 90.7 | 0.36 | | **26.1** | ULS 5a Ba 32 | 68.5 | 84.7 | 47.5 | 0.55 | |
| 315 | Diagonalen ondervlak eerste dwarsarm | 70x70x7 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 102 | **-27.9** | ULS 5a Ba 22 | 93.6 | 58.8 | 75.6 | 0.47 | | **23.7** | ULS 5a Ba 32 | 96.8 | 58.8 | 61.1 | 0.40 | |
| 316 | Diagonalen ondervlak eerste dwarsarm | 60x60x6 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-18.8** | ULS 5a Ba 21 | 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 | **-22.9** | ULS 5a Ba 31 | 65.3 | 58.8 | 64.8 | 0.39 | | **23.6** | ULS 5a Ba 31 | 65.7 | 58.8 | 44.4 | 0.53 | |
| 318 | Diagonalen ondervlak eerste dwarsarm | 60x60x6 | S235 | 1M20-5.6t | 0.56 | 0.56 | 0.56 | 107 | **-33.5** | ULS 5a Ba 21 | 65.8 | 58.8 | 64.8 | 0.57 | | **31.5** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.71 | |
| 319 | Diagonalen ondervlak eerste dwarsarm | 60x60x6 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 77 | **-34.3** | ULS 5a Ba 31 | 81.6 | 58.8 | 64.8 | 0.58 | | **29.9** | ULS 5a Ba 31 | 65.7 | 58.8 | 44.4 | 0.67 | |
| 320 | Dwarsligger ondervlak eerste dwarsarm | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 25 | **-24.3** | ULS 5a Ba 21 | 1064.1 | 117.6 | 172.8 | 0.21 | | **27.2** | ULS 5a Ba 31 | 1278.1 | 117.6 | 0.0 | 0.23 | |
| 321 | Dwarsligger ondervlak eerste dwarsarm | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 30 | **-1.3** | ULS 1a_0,9_0,9_90 | 1044.4 | 117.6 | 172.8 | 0.01 | | **8.6** | ULS 3_90 | 1278.1 | 117.6 | 0.0 | 0.07 | |
| 401 | Diagonalen ondervlak tweede dwarsarm | 60x60x6 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 153 | **-15.1** | ULS 5a Ba 30 | 45.0 | 58.8 | 64.8 | 0.34 | | **14.7** | ULS 5a Ba 20 | 65.7 | 58.8 | 44.4 | 0.33 | |
| 402 | Dwarsligger ondervlak tweede dwarsarm | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 41 | **0.0** | | 994.3 | 117.6 | 172.8 | 0.00 | | **11.0** | ULS 3_90 | 1278.1 | 117.6 | 0.0 | 0.09 | |
| 429 | Dwarsligger ondervlak tweede dwarsarm | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 37 | **-22.8** | ULS 5a Ba 30 | 1011.5 | 117.6 | 172.8 | 0.19 | | **28.6** | ULS 5a Ba 20 | 1278.1 | 117.6 | 0.0 | 0.24 | |
| 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 7 | 37.4 | 37.7 | 22.0 | 0.16 | |
| 405 | Verticale regel tweede dwarsarm | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 291 | **-2.8** | ULS 1a_45 | 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 | | **115.5** | ULS 3_90 | 263.0 | 254.2 | 265.8 | 0.45 | |
| 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 | | **102.4** | ULS 3_90 | 263.0 | 254.2 | 265.8 | 0.40 | |
| 408 | Diagonalen bovenvlak tweede dwarsarm | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 206 | **-6.1** | ULS 1a_0,9_0,9_0 | 21.0 | 37.7 | 43.2 | 0.29 | | **6.2** | 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 | **-58.7** | ULS 5a Ba 1 | 166.8 | 338.9 | 414.7 | 0.35 | | **75.1** | ULS 5a Ba 1 | 379.5 | 338.9 | 354.5 | 0.22 | |
| 117C | Tweede dwarsarm bovenregel | 120x120x8 | S235 | | 1.00 | 3.06 | 1.00 | 135 | **-52.6** | ULS 5a Ba 1 | 166.8 | 0.0 | 0.0 | 0.32 | | **69.6** | ULS 5a Ba 1 | 441.8 | 0.0 | 0.0 | 0.16 | |
| 117B | Tweede dwarsarm bovenregel | 120x120x8 | S235 | 2M16-5.6t | 6.16 | 1.00 | 1.00 | 46 | **-14.9** | ULS 5a Ba 1 | 335.4 | 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 | **-7.0** | ULS 5a Ba 30 | 8.3 | 37.7 | 43.2 | 0.84 | | **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 | | **0.1** | ULS 1a_0,9_0,9_90 | 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 | 1296.6 | 75.4 | 14.1 | 0.51 | |
| 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 | **-17.4** | ULS 5a Ba 20 | 48.2 | 58.8 | 64.8 | 0.36 | | **17.6** | ULS 5a Ba 30 | 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 30 | 51.4 | 58.8 | 64.8 | 0.37 | | **19.4** | ULS 5a Ba 20 | 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 20 | 54.9 | 58.8 | 64.8 | 0.41 | | **21.5** | ULS 5a Ba 30 | 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 | **-24.3** | ULS 5a Ba 30 | 58.6 | 58.8 | 64.8 | 0.41 | | **26.4** | ULS 5a Ba 20 | 65.7 | 58.8 | 44.4 | 0.59 | |
| 419 | Diagonalen ondervlak tweede dwarsarm | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 119 | **-33.9** | ULS 5a Ba 20 | 59.4 | 58.8 | 64.8 | 0.58 | | **30.1** | ULS 5a Ba 30 | 65.7 | 58.8 | 44.4 | 0.68 | |
| 420 | Diagonalen ondervlak tweede dwarsarm | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 90 | **-32.0** | ULS 5a Ba 20 | 75.6 | 58.8 | 64.8 | 0.54 | | **24.6** | ULS 5a Ba 30 | 65.7 | 58.8 | 44.4 | 0.55 | |
| 421 | Diagonalen bovenvlak tweede dwarsarm | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 197 | **-5.9** | ULS 1a_0 | 22.4 | 37.7 | 43.2 | 0.26 | | **5.6** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.25 | |

# APPENDIX C REDUNDANT MEMBERS CHECK

DNV·GL

## Knikverkorters initial construction (afkeur)

Date: 2020-06-12
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+24
68

| 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 | | |
| 116 | 1e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.47 | 38 | 196 | **19.4** | **0.00** | 40.8 | 37.7 | 52.3 | 104.8 | 1.7 | 0.51 | | |
| 119 | 1e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.86 | 0 | 159 | **19.4** | **0.47** | 42.8 | 37.7 | 44.8 | 72.6 | 1.2 | 0.51 | | |
| 117 | 1e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.60 | 0 | 164 | **19.4** | **0.40** | 28.5 | 37.7 | 33.6 | 37.4 | 0.7 | 0.68 | | |
| 115 | 1e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 2.30 | 47 | 197 | **19.4** | **0.00** | 32.2 | 37.7 | 44.8 | 72.6 | 1.2 | 0.60 | | |
| 118 | 1e tussenstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 3.28 | 0 | 240 | **19.4** | **0.82** | 32.7 | 37.7 | 52.3 | 125.0 | 2.0 | 0.59 | | |
| 114 | 1e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 2.29 | 36 | 196 | **19.4** | **0.00** | 32.4 | 37.7 | 44.8 | 72.6 | 1.2 | 0.60 | | |
| 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: 2020-06-12
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+24
68

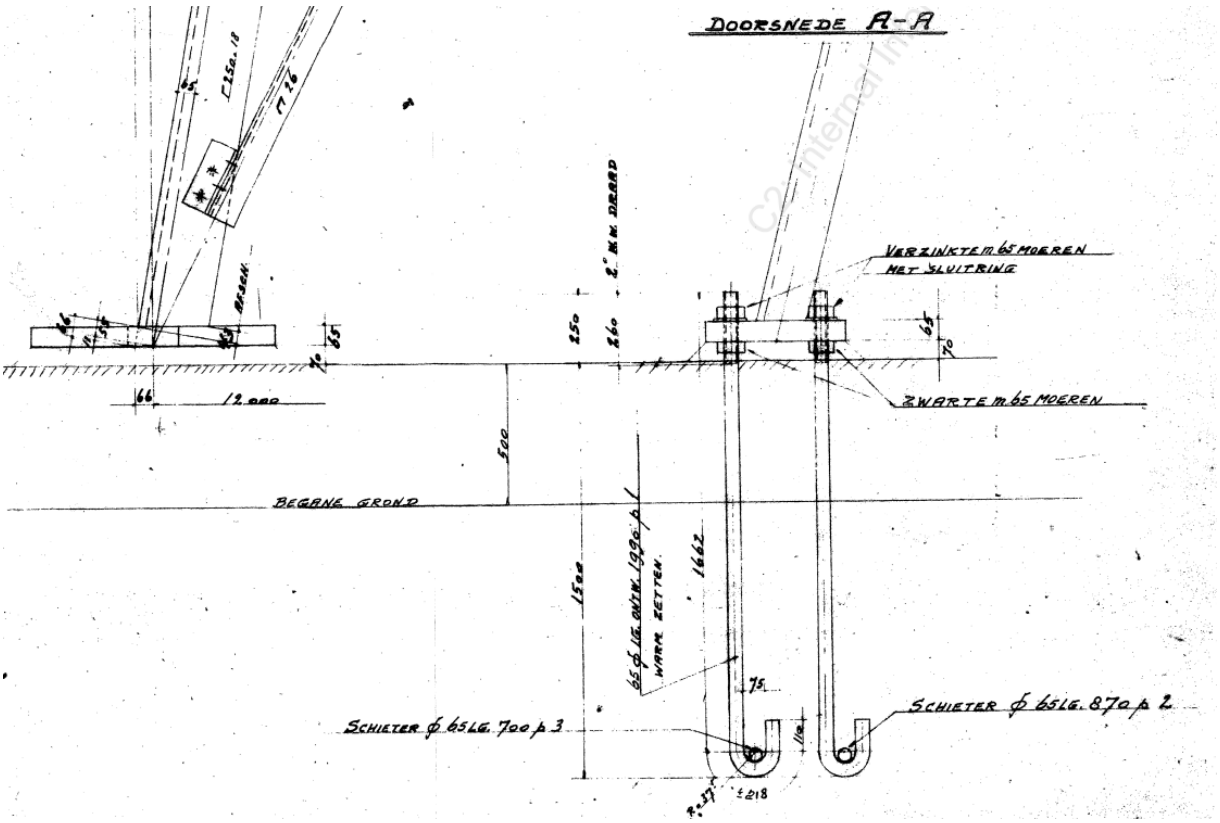
| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness (-) | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Block Tearing Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | 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

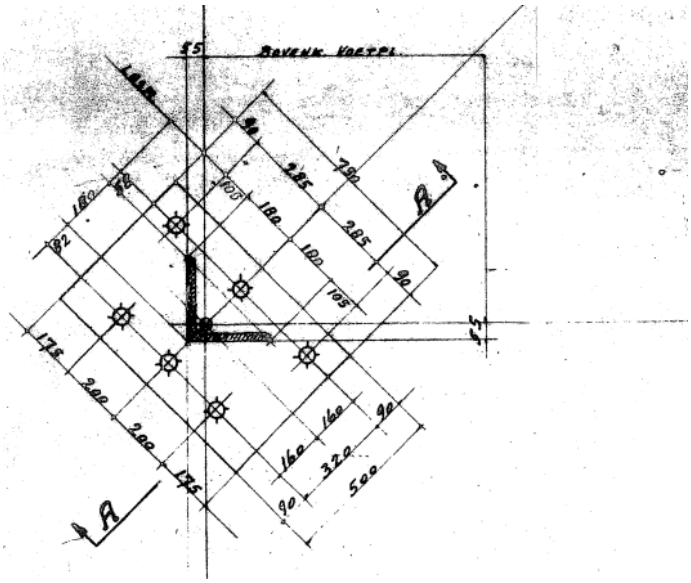
# ANCHORS S+24 AND MAIN BRACING

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

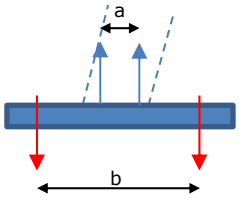
De loads coming from the tower are based on S+24 structure number 68:

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_n$ [kN] | $R_\varepsilon$ [kN] | $R_{\varepsilon,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 234 | 209 | **1340** | 17 | -313 | 16 | 1380 |
| Max. tension | ULS 1a_0,9_0,9_45 | 178 | 153 | **-1047** | -17 | 234 | -24 | -1078 |
| Max. pos. torsie | ULS 1a_135 | 103 | 33 | 418 | **49** | -96 | 7 | 430 |
| Max. neg. torsie | ULS 1a_45 | -103 | 33 | 418 | **-49** | -96 | 7 | 430 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 178 | 153 | **-1047** | **-17** | 234 | -24 | -1078 |

## 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.

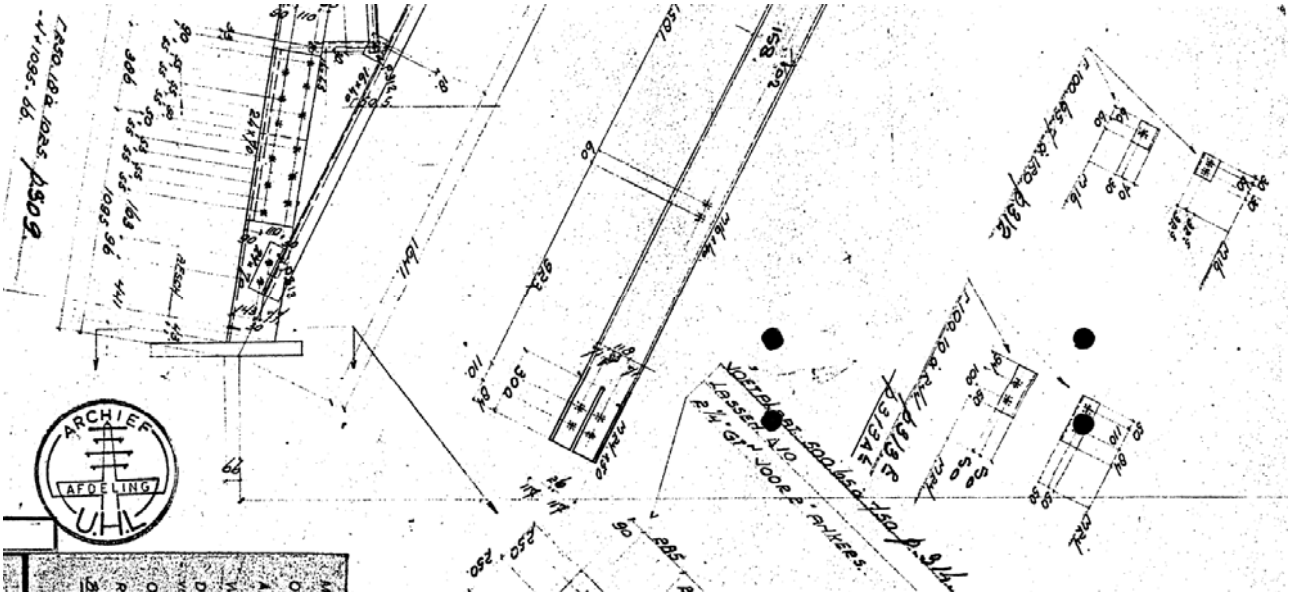
The anchors and plates fulfill the required strength. See the output:

Tower 68: U.C. = 175 / 506 = 0,35 ≤ 1,00 OK

Conclusion: The foot plates of tower structure S+24 have sufficient strength.

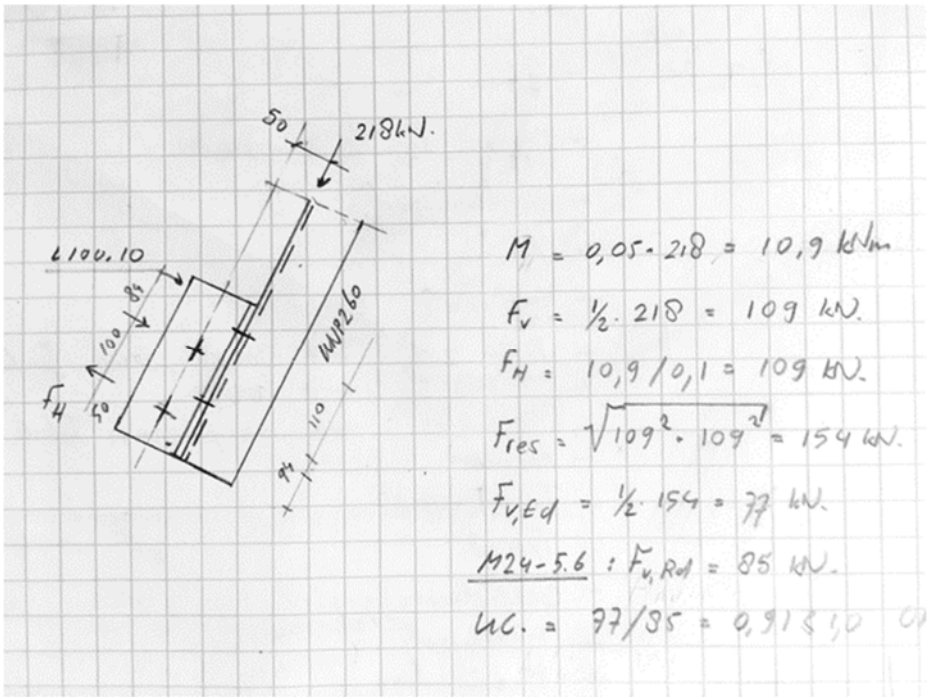
## Main bracing broekstuk

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 224 / 0,91 = 240 kN is used.

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+24** | ***Checks:*** | | |
|---|---|---|---|---|
| | | Anchor bolt to tension | 0,35 | ***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 = | 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 = | **1048** | kN |
| Shear force | $F_{H,Ed}$ = | **313** | kN |
| Number of anchors for tension | | 6 | |
| Number of anchors for shear | | 6 | |
| $F_{T;Ed} = T / n$ = | | 174,7 | kN |
| $F_{v;Ed} = F_{H,Ed} / n$ = | | 52,2 | kN |

### *Anchor properties*

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

*Capacity per anchor*

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

### *Foot plate*

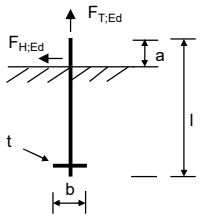
$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

| | | | |
|---|---|---|---|
| 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")*

$$\frac{\sigma_b'}{f_{cd}} = \frac{10,8}{40,0} = 0,27 \quad \textit{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{175}{460} = 0,38 \quad \textit{OK}$$




### *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 | $c = t\sqrt{(f_{yd} / 3 f_{jd})}$ = | 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 | $q = F_{T,Ed} / b_{eff}$ = | 702 | kN/m |
| Concrete pressure | $\sigma_b' = q / d_S$ = | 10,8 | MPa |
| *Shear stress in dowel* | | | |
| Load | $F_{T,Ed}$ = | 175 | kN |
| Allowable | $F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ = | 460 | kN |

### *Capacity of foot plate*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{174,7}{505,9} = 0,35 \quad \textit{OK}$$

### *Capacity of anchor for tension*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{174,7}{655,1} = 0,27 \quad \textit{OK}$$

### *Check foot plate for tension*

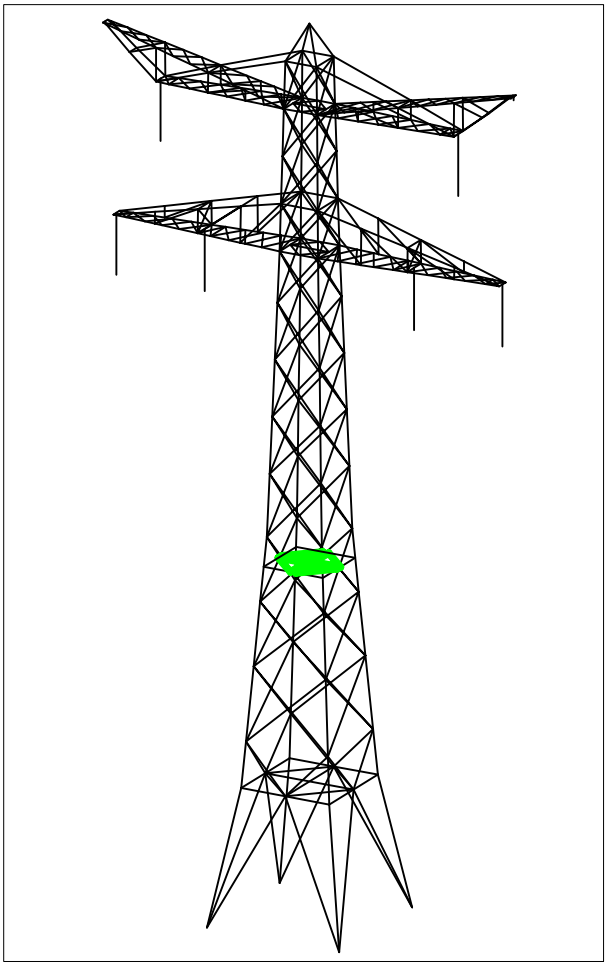
$$\frac{T}{n \times F_{t;Rd}} = \frac{1048,0}{3035,5} = 0,35 \quad \textit{OK}$$

### *Check anchor for shear*

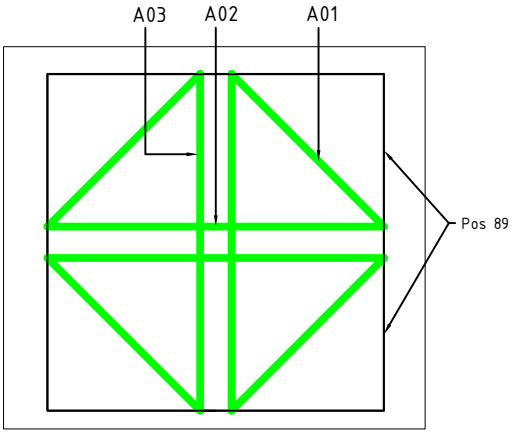
$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{52,2}{267,9} = 0,19 \quad \textit{OK}$$

# APPENDIX E DRAWINGS

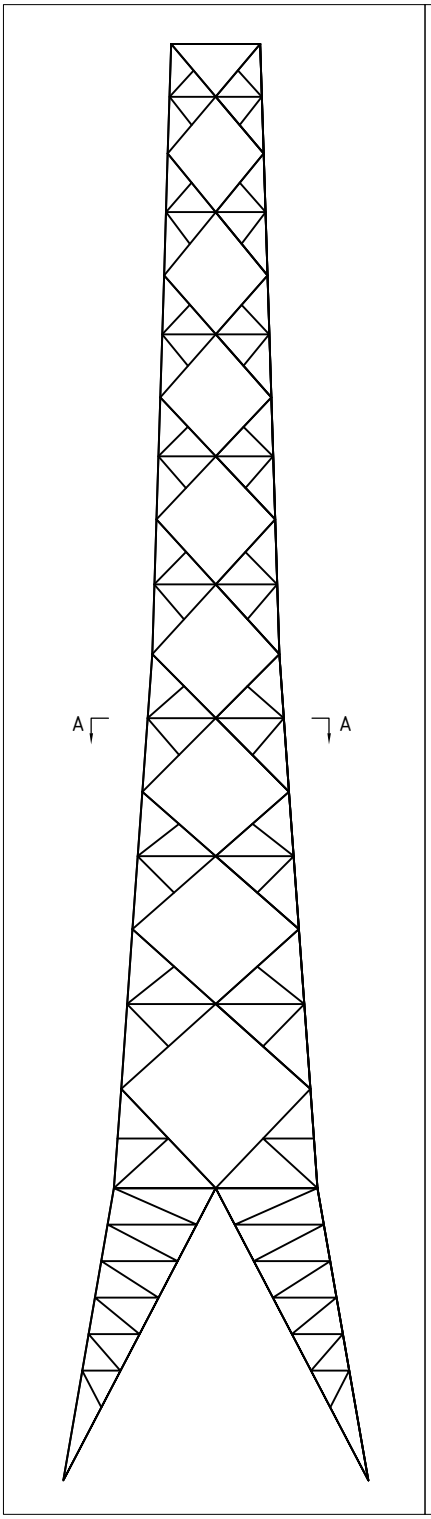
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (new) |
| A01 | | | | | EA | 75x75x7 | S355 t<=40 | M16-8.8t-NEN2012 |
| A02 | | | | | EA | 75x75x7 | S355 t<=40 | M16-8.8t-NEN2012 |
| A03 | | | | | EA | 75x75x7 | S355 t<=40 | M16-8.8t-NEN2012 |



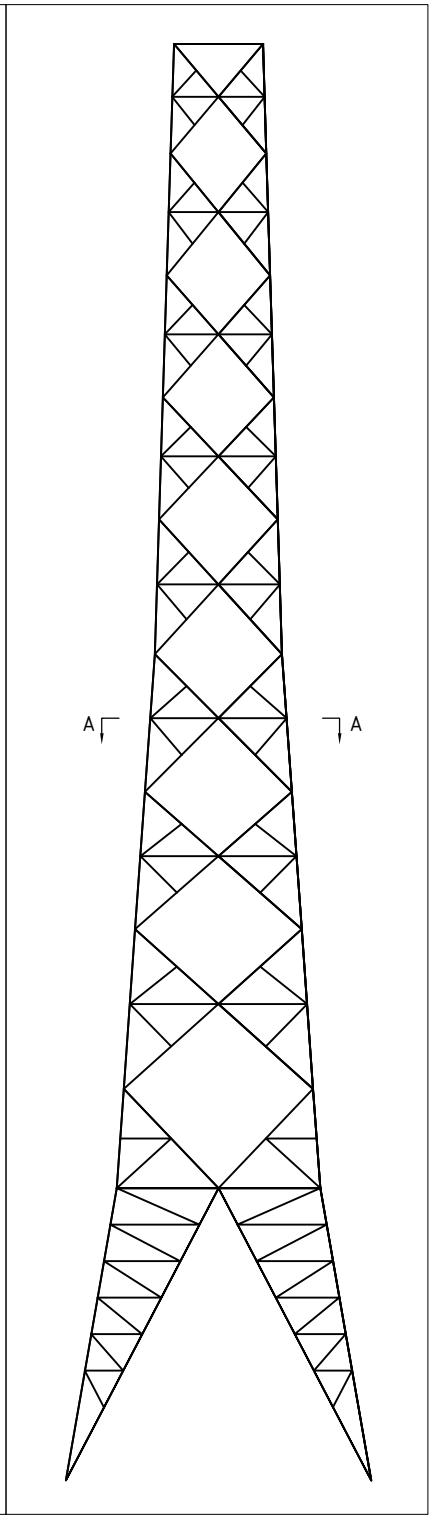
Overview




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

| | | |
|---|---|---|
| 01 | 25-11-2020 | Version 2.0 - Overview updated with new redundants |
| 00 | 11-6-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-015

| | | | | | |
|---|---|---|---|---|---|
| Design state: FINAL | | Scale: - | | Description: Modifications overview for mast type S+24 (mast 68) | 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 | | | |

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Bijlage 18 Rapportage Mastconstructie S+3

DNV·GL

"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

# KIJ-GT380 – Rapportage mast S+3

## TenneT TSO B.V.

**Meridian doc. nr.:** 002.589.40 0916494
**Rapport nr.:** 21-1089 Rev.0
**Datum:** 2021-07-05

| | | |
|---|---|---|
| Projectnaam: | "Toetsing en herontwerp masten en fundaties BBB380" | DNV GL - Energy<br>Energy Advisory |
| Rapport titel: | KIJ-GT380 – Rapportage mast S+3 | Postbus 9035 |
| Klant: | TenneT TSO B.V. | 6800 ET ARNHEM |
| Contactpersoon: | [redacted] | |
| Datum: | 2021-07-05 | |
| Project nr.: | 10166260 | [redacted] |
| Organisatie unit: | TDT | [redacted] |
| Meridian doc.nr.: | 002.589.40 0916494 | |
| Rapport nr.: | 21-1089 Rev.0 | |

| Geschreven door: | Beoordeeld door: | Goedgekeurd door: |
|---|---|---|
| [redacted] | | |

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Trefwoorden:

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

DNV GL Netherlands B.V.

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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+3 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+3.

### 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.

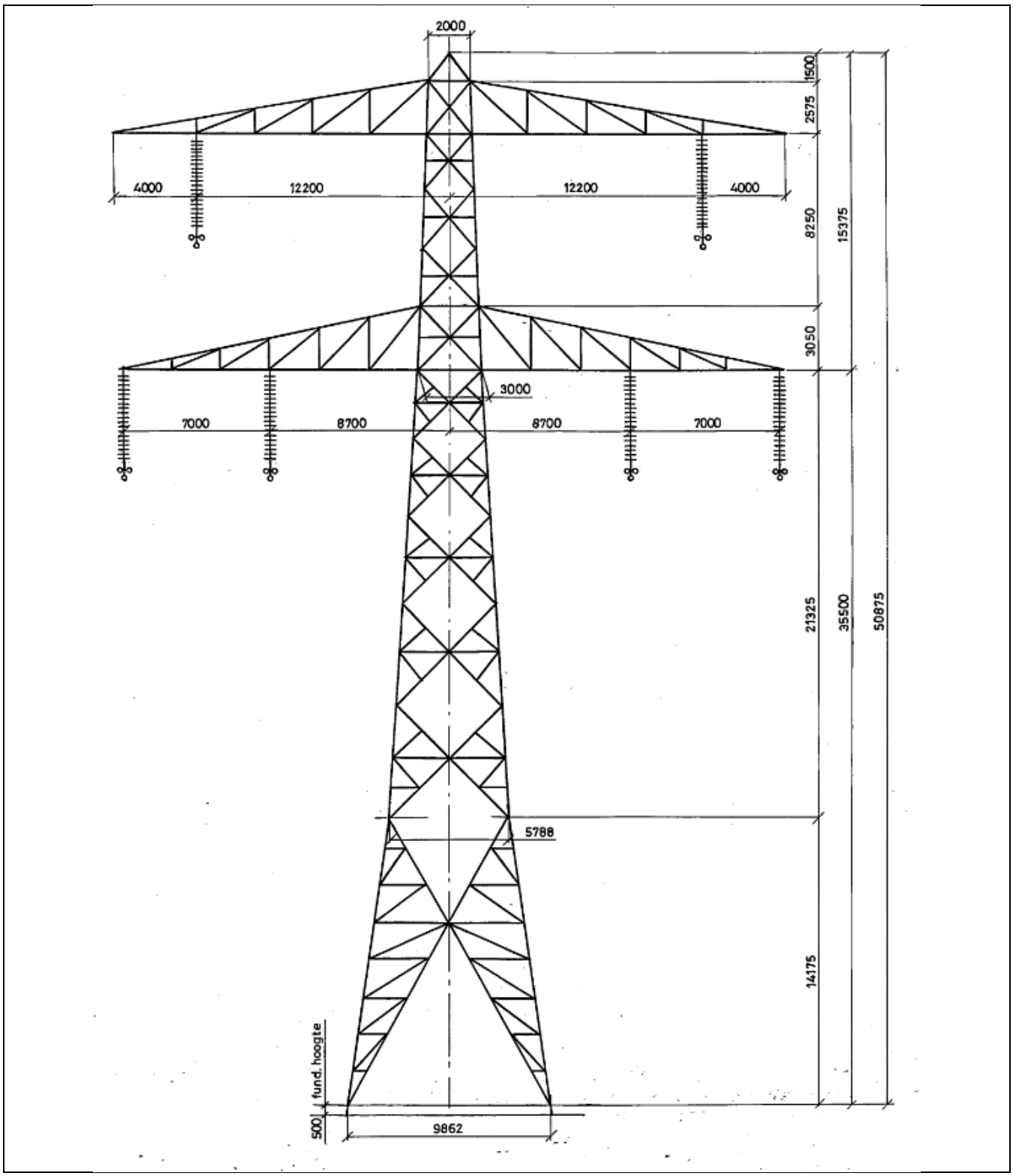
**Tabel 1 Relevante eisen**

| 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".<br><br>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+3 getoetst. De wind en weight span van de verschillende masten in windgebied II en windgebied III zijn in Tabel 2 weergegeven. De maatgevende mastnummers zijn 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+3 komen enkel lager aangrenzende masten voor.

De berekening van de geleiderbelastingen zijn locatiespecifiek uitgevoerd. Bij controle van de masten is gebleken dat mastnummer 63 maatgevend is ten opzichte van 57. De resultaten in deze rapportage zijn gegeven voor mast 63.

**Tabel 2 Mastnummers**

| Mastnummer | Masttype | Maatgevend mastnummer | Wind span (m) | Weight span (m) | Hoogteverschil |
|---|---|---|---|---|---|
| **47** | S+3 II | 47 | 365 | 378 | 2.8 |
| 57 | S+3 | 63 | 292 | 345 | 6.8 |
| **63** | S+3 | 63 | 330 | 358 | 6.2 |

## 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:

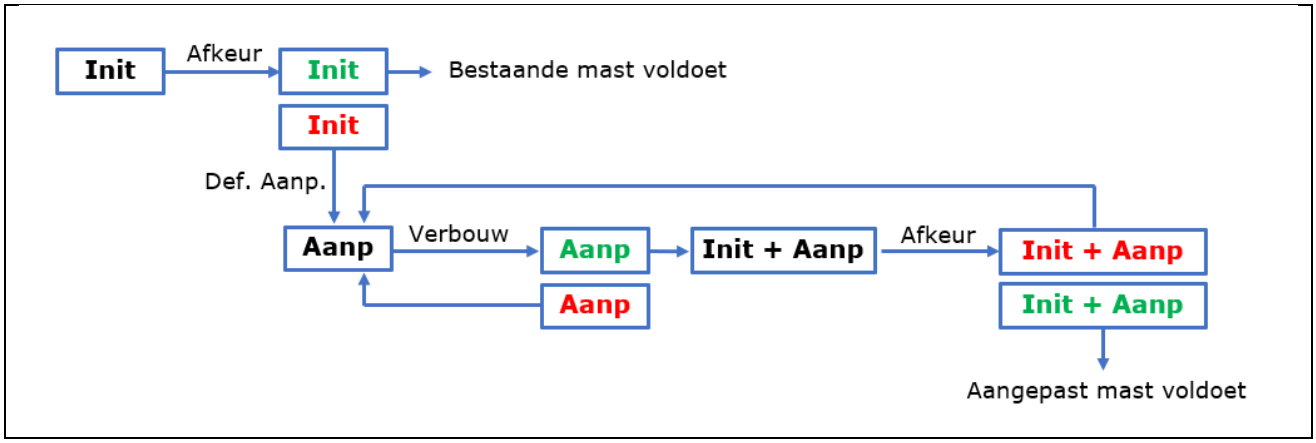
Stap 1: Toets bestaande (Init) mast op Afkeur

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 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

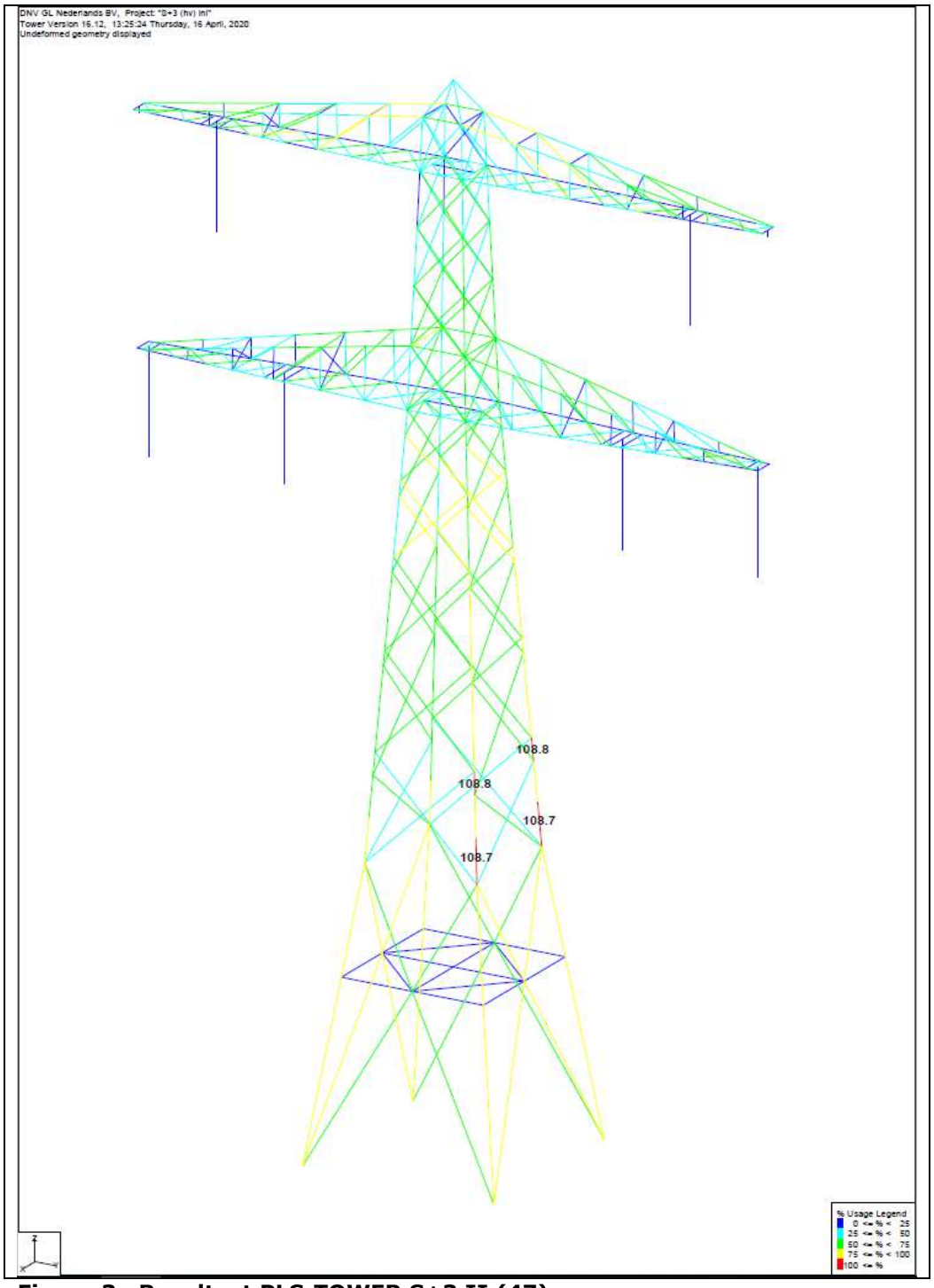
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten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

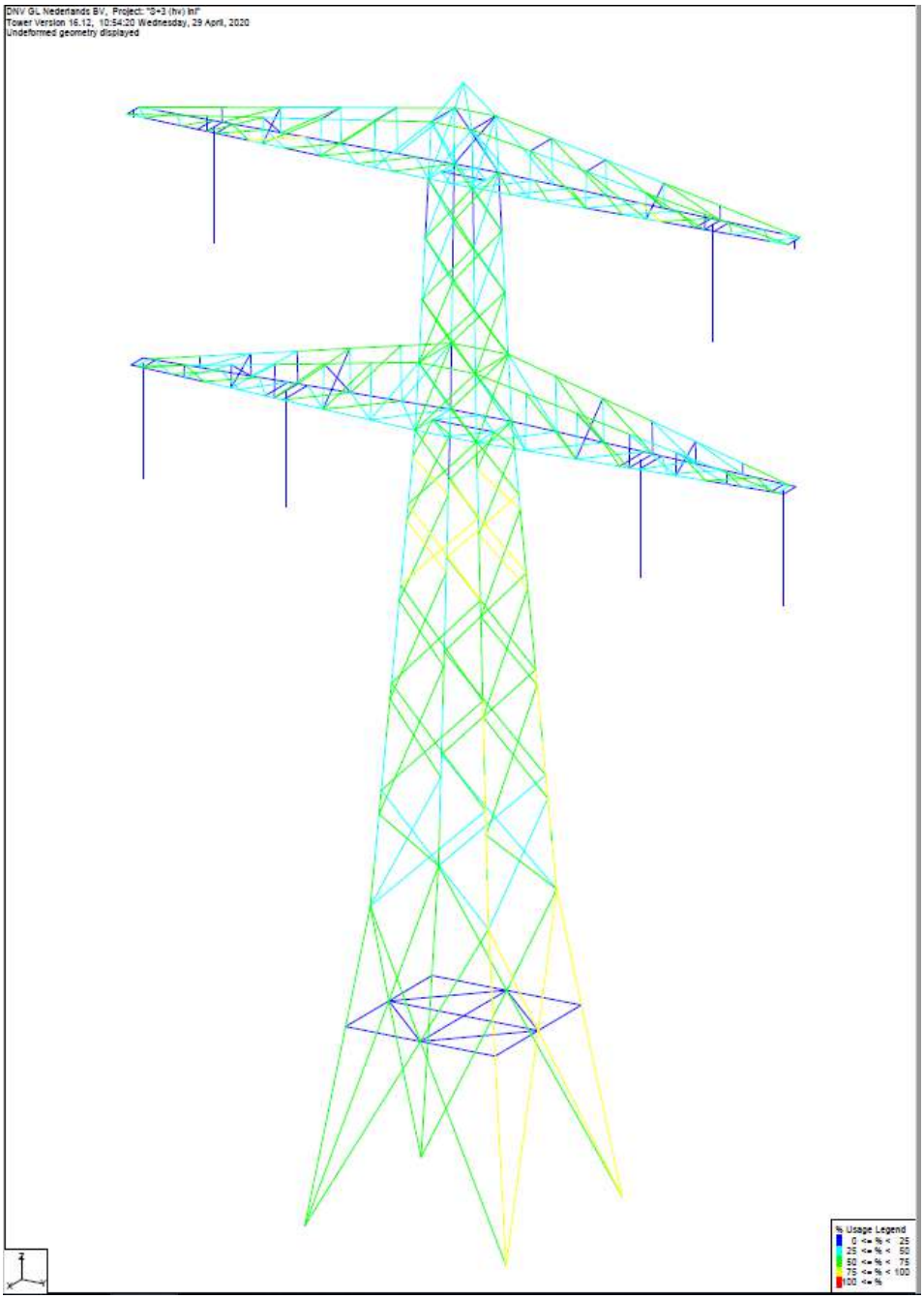
# 4 TOETSING MAST

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




**Figuur 3 Resultaat PLS-TOWER S+3 II (47)**

Het resultaat van de controle van de mastconstructie type S+3 in windgebied III met belastingen op afkeurniveau is weergegeven in Figuur 4.




**Figuur 4 Resultaat PLS-TOWER S+3 (63)**

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 randstijl | **Voldoen** | | Appendix D |

# 5 AANPASSINGEN

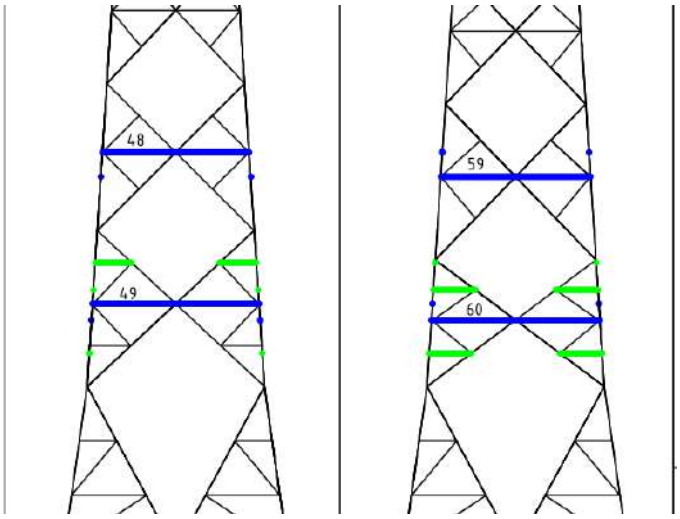
## 5.1 Inleiding

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

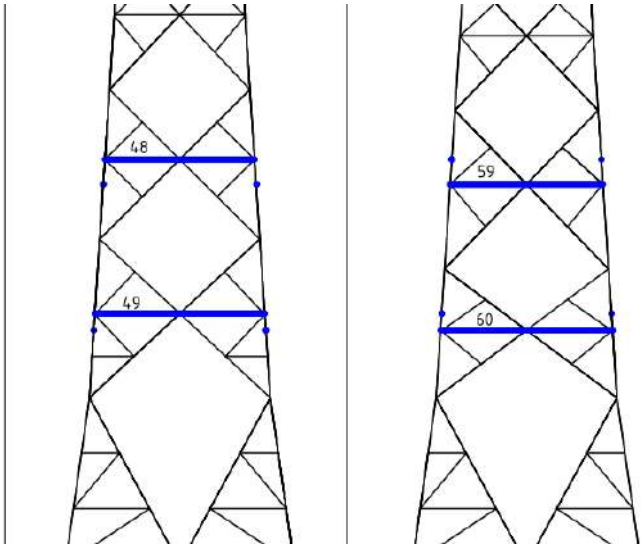
- Knikverkorters vervangen;
- Knikverkorters toevoegen;
- Bouten vervangen;
- Voetplaat verzwaren.

## 5.2 Aanpassingen

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

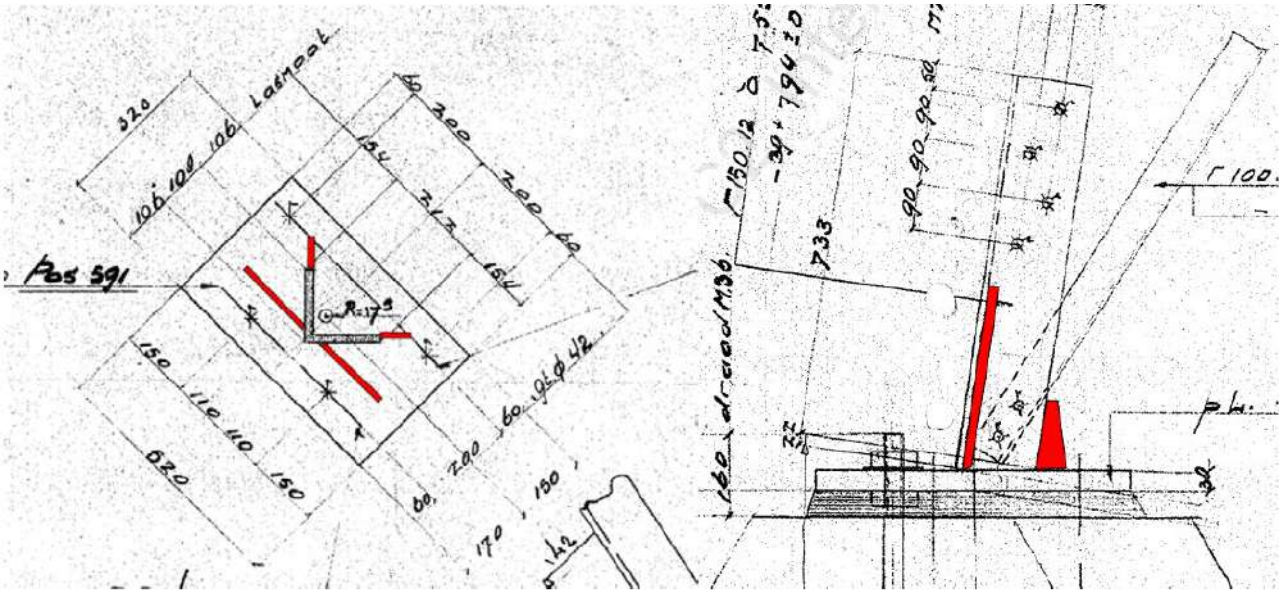



**Figuur 5 Principe aanpassing (blauw) /toevoeging (groen) knikverkorters voor S+3 II (47)**




**Figuur 6 Principe aanpassing (blauw) knikverkorters voor S+3 (63)**

De voetplaat voor S+3 (47) in windgebied II 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 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 47 gegeven in Tabel 5 en voor mast 63 in Tabel 6. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

**Tabel 5 Gewichten S+3 II (47) 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 | 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 |
| **60** | L45.5 | S235 | 1M12-5.6t | L55.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.67 | 53.9 |
| **59** | L45.5 | S235 | 1M12-5.6t | L50.5 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.37 | 36.4 |
| **3001** | | | | L50.5 | S355 | 1M16-8.8t | Profielen toegevoegd | 4 | 1.20 | 18.4 |
| **3002** | | | | L50.5 | S355 | 1M16-8.8t | Profielen toegevoegd | 4 | 1.40 | 21.5 |
| **3003** | | | | L50.5 | S355 | 1M16-8.8t | Profielen toegevoegd | 4 | 1.40 | 21.5 |
| | | | | | | | | **28** | **14.00** | **240.7** |

**Tabel 6 Gewichten S+3 (63) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **49** | 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 |
| **60** | L45.5 | S235 | 1M12-5.6t | L55.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.67 | 53.9 |
| **59** | L45.5 | S235 | 1M12-5.6t | L50.5 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.37 | 36.4 |
| | | | | | | | | **16** | **10.00** | **179.3** |

## 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.<br><br>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 | | | Na aanpassing van de staaldelen blijft de klimweg in overeenstemming |

# 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


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | II |
| Wind speed | 27 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 51 m |
| Max. Span | 397 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 365 m |
| EDS Weight span | 377 m |
| Min. Weight span | 375 m |
| Max. Weight span | 393 m |

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

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+3 II

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

Document name:

KIJ-GT_S+3 II_47_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+3 II
Number: 47

**Conductor loads**

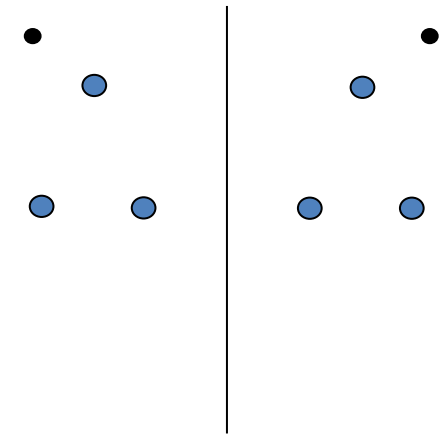
Auteur: TBR
Versie: v11.3

**General**

| | |
|---|---|
| Description | S+3 II |
| 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 | 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 |



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 | 31,2 m | 35,5 m | -15,5 m |
| Circuit 1 | 11 | 380ct1f2 | 31,2 m | 35,5 m | -8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 42,5 m | 46,8 m | -12,2 m |
| Circuit 2 | 20 | 380ct2f1 | 31,2 m | 35,5 m | 8,7 m |
| Circuit 2 | 21 | 380ct2f2 | 31,2 m | 35,5 m | 15,5 m |
| Circuit 2 | 22 | 380ct2f3 | 42,5 m | 46,8 m | 12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 46,3 m | 46,8 m | -16,2 m |
| Bliksemdraad 2 | 3 | bl2 | 46,3 m | 46,8 m | 16,2 m |

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

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**Height adjustment adjacent masts** (wind and weight span adjustment)

| | Back | Ahead | |
|---|---|---|---|
| Height increase for wind pressure | 0,0 m | 0,0 m | (positive: higher) |
| Height decrease for vertical load | 0,0 m | 0,0 m | (negative: decrease, more weight span) |

Decrease: Niet in 0,9EG-combinaties

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

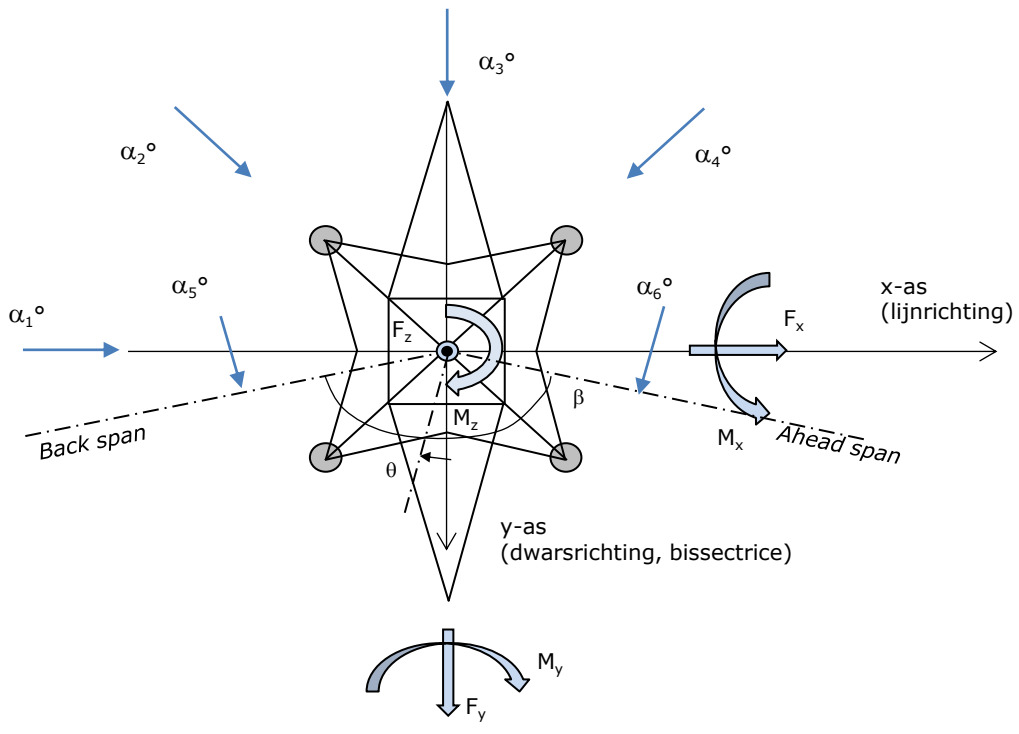
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | -0,1 | -3,4 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | -0,1 | -3,4 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 332,0 | 397,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 366,0 | 366,0 | m |
| Line angle | $\beta$ | 180 | ° | |
| Tower orientation with respect to bi | $\theta$ | 0 | ° | |
| Section length | | 3401 | 3401 | m |
| Height bottom of tower to ground level | | 0,5 | m | |
| Wind directions considered | $\alpha_1$ | 0 | ° | |
| Wind directions according to: | $\alpha_2$ | 45 | ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | ° | |
| | $\alpha_4$ | 135 | ° | |
| | $\alpha_5$ | - | ° | |
| | $\alpha_6$ | - | ° | |

*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 |

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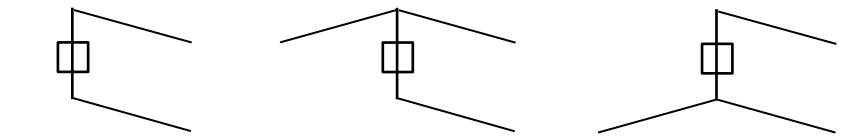
**Absence of conductors**

| | | 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 |

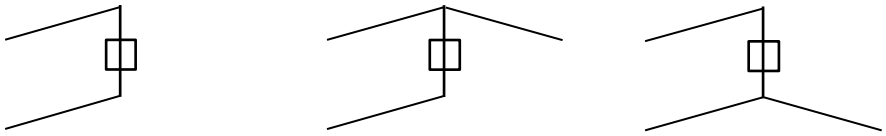
**Load situations SPLS**

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

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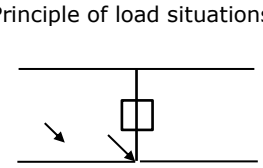
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

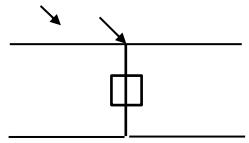
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

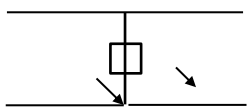
Principle of load situations:



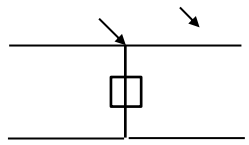
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

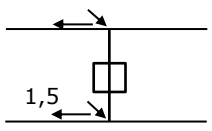
**Load situations 8. Galloping as a static load**

| 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 |

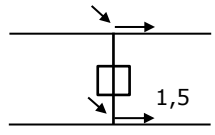
Considered situations galloping 8: None (existing structure)

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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## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+3 II | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 51,0 | m | |
| Tower self weight | 238,0 | kN | |
| | | | |
| *Width and slope at foundation* | x-ri. | y-ri. | |
| Leg spread | 9,86 | 9,86 | 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] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 9,86 | 5,79 | 14,18 | 0,144 | 110,96 | 11,25 | 0,10 | 3,40 |
| Middenstuk 1 | 24,18 | 5,79 | 4,48 | 10,00 | 0,066 | 51,35 | 6,25 | 0,12 | 3,30 |
| Middenstuk 2 | 35,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 41,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 49,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 51,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 35,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 46,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

**Properties tower sections transverse direction (side view, xz plane)**

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 9,86 | 5,79 | 14,18 | 0,144 | 110,96 | 11,25 | 0,10 | 3,40 |
| Middenstuk 1 | 24,18 | 5,79 | 4,48 | 10,00 | 0,066 | 51,35 | 6,25 | 0,12 | 3,30 |
| Middenstuk 2 | 35,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 41,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 49,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 51,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 35,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 46,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

*Note: Surface transverse direction is reduced in calculation.*

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**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | $\Delta$h | $A_1$ |
|---|---|---|---|
| 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 | 32,6 | 27,6 | 0,0 | -27,6 | 7,1 | 230,8 | 195,9 | 0,0 | -195,9 |
| Middenstuk 1 | 1,05 | 21,7 | 18,4 | 0,0 | -18,4 | 19,2 | 415,9 | 352,9 | 0,0 | -352,9 |
| Middenstuk 2 | 1,20 | 27,3 | 23,2 | 0,0 | -23,2 | 29,8 | 814,5 | 691,1 | 0,0 | -691,1 |
| Bovenstuk 1 | 1,29 | 15,2 | 12,9 | 0,0 | -12,9 | 38,4 | 584,2 | 495,7 | 0,0 | -495,7 |
| Bovenstuk 2 | 1,34 | 17,7 | 15,0 | 0,0 | -15,0 | 45,4 | 802,6 | 681,0 | 0,0 | -681,0 |
| Topstuk | 1,38 | | | | | 50,2 | | | | |
| Ondertraverse | 1,27 | 34,4 | 20,4 | 0,0 | -20,4 | 36,5 | 1254,4 | 745,1 | 0,0 | -745,1 |
| Boventraverse | 1,36 | 35,6 | 21,2 | 0,0 | -21,2 | 47,7 | 1697,4 | 1008,2 | 0,0 | -1008,2 |
| Totaal | | 184,4 | 138,6 | 0,0 | -138,6 | | 5799,8 | 4169,9 | 0,0 | -4169,9 |

**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 | 27,6 | 32,6 | 27,6 | 7,1 | 0,0 | 195,9 | 230,8 | 195,9 |
| Middenstuk 1 | 1,05 | 0,0 | 18,4 | 21,7 | 18,4 | 19,2 | 0,0 | 352,9 | 415,9 | 352,9 |
| Middenstuk 2 | 1,20 | 0,0 | 23,2 | 27,3 | 23,2 | 29,8 | 0,0 | 691,1 | 814,5 | 691,1 |
| Bovenstuk 1 | 1,29 | 0,0 | 12,9 | 15,2 | 12,9 | 38,4 | 0,0 | 495,7 | 584,2 | 495,7 |
| Bovenstuk 2 | 1,34 | 0,0 | 15,0 | 17,7 | 15,0 | 45,4 | 0,0 | 681,0 | 802,6 | 681,0 |
| Topstuk | 1,38 | | | | | 50,2 | | | | |
| Ondertraverse | 1,27 | 0,0 | 20,4 | 13,7 | 20,4 | 36,5 | 0,0 | 745,1 | 501,8 | 745,1 |
| Boventraverse | 1,36 | 0,0 | 21,2 | 14,2 | 21,2 | 47,7 | 0,0 | 1008,2 | 679,0 | 1008,2 |
| Total | | 0,0 | 138,6 | 142,4 | 138,6 | | 0,0 | 4169,9 | 4028,7 | 4169,9 |

**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 | 238 | 0 | 0 | 0 |
| Windrichting 0° | 184 | 0 | 0 | 0 | 5800 | 0 |
| Windrichting 45° | 139 | 139 | 0 | 4170 | 4170 | 0 |
| Windrichting 90° | 0 | 142 | 0 | 4029 | 0 | 0 |
| Windrichting 135° | -139 | 139 | 0 | 4170 | -4170 | 0 |

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**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 33,85 | 1,24 | 1,2 | 1,49 |
| 380ct1f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,24 | 1,2 | 1,49 |
| 380ct1f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 45,15 | 1,34 | 1,2 | 1,61 |
| 380ct2f1 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,24 | 1,2 | 1,49 |
| 380ct2f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,24 | 1,2 | 1,49 |
| 380ct2f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 45,15 | 1,34 | 1,2 | 1,61 |
| bl1 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 47,05 | 1,36 | 1,2 | 0,08 |
| bl2 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 47,05 | 1,36 | 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 | 25,1 | 1,14 | 0,57 | 0,49 | 1,06 | 28,25 | 58,3 | 49,7 | 46,9 | 109,8 | 93,6 |
| 380ct1f2 | 25,1 | 1,14 | 0,57 | 0,49 | 1,06 | 28,25 | 58,3 | 49,7 | 46,9 | 109,8 | 93,6 |
| 380ct1f3 | 36,4 | 1,27 | 0,60 | 0,51 | 1,03 | 28,25 | 66,1 | 56,2 | 46,9 | 128,4 | 109,1 |
| 380ct2f1 | 25,1 | 1,14 | 0,57 | 0,49 | 1,06 | 28,25 | 58,3 | 49,7 | 46,9 | 109,8 | 93,6 |
| 380ct2f2 | 25,1 | 1,14 | 0,57 | 0,49 | 1,06 | 28,25 | 58,3 | 49,7 | 46,9 | 109,8 | 93,6 |
| 380ct2f3 | 36,4 | 1,27 | 0,60 | 0,51 | 1,03 | 28,25 | 66,1 | 56,2 | 46,9 | 128,4 | 109,1 |
| bl1 | 40,6 | 1,31 | 0,61 | 0,52 | 1,15 | 22,24 | 20,3 | 17,3 | 41,5 | 39,6 | 33,6 |
| bl2 | 40,6 | 1,31 | 0,61 | 0,52 | 1,15 | 22,13 | 20,3 | 17,2 | 41,4 | 39,5 | 33,5 |

**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 | 20,6 | 1,08 | 0,55 | 0,47 | 1,08 | 28,25 | 54,4 | 46,3 | 46,9 | 100,8 | 85,9 |
| 380ct1f2 | 20,6 | 1,08 | 0,55 | 0,47 | 1,08 | 28,25 | 54,4 | 46,3 | 46,9 | 100,8 | 85,9 |
| 380ct1f3 | 31,9 | 1,22 | 0,59 | 0,50 | 1,04 | 28,25 | 63,3 | 53,9 | 46,9 | 121,6 | 103,5 |
| 380ct2f1 | 20,6 | 1,08 | 0,55 | 0,47 | 1,08 | 28,25 | 54,4 | 46,3 | 46,9 | 100,8 | 85,9 |
| 380ct2f2 | 20,6 | 1,08 | 0,55 | 0,47 | 1,08 | 28,25 | 54,4 | 46,3 | 46,9 | 100,8 | 85,9 |
| 380ct2f3 | 31,9 | 1,22 | 0,59 | 0,50 | 1,04 | 28,25 | 63,3 | 53,9 | 46,9 | 121,6 | 103,5 |
| bl1 | 36,5 | 1,27 | 0,60 | 0,51 | 1,16 | 22,24 | 19,6 | 16,7 | 41,5 | 37,9 | 32,2 |
| bl2 | 36,5 | 1,27 | 0,60 | 0,51 | 1,16 | 22,13 | 19,6 | 16,6 | 41,4 | 37,8 | 32,2 |

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**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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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**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 | 30,0 | 3,8 | 4,4 | 4,6 | 5,6 |
| bl2 | -30,2 | 30,2 | 3,8 | 4,4 | 4,6 | 5,6 |
| 380ct1f1 | -111,2 | 111,2 | 11,7 | 13,0 | 13,7 | 17,0 |
| 380ct1f2 | -111,2 | 111,2 | 11,7 | 13,0 | 13,7 | 17,0 |
| 380ct1f3 | -113,8 | 113,8 | 13,2 | 15,0 | 13,7 | 17,1 |
| 380ct2f1 | -111,2 | 111,2 | 11,7 | 13,0 | 13,7 | 17,0 |
| 380ct2f2 | -111,2 | 111,2 | 11,7 | 13,0 | 13,7 | 17,0 |
| 380ct2f3 | -113,8 | 113,8 | 13,2 | 15,0 | 13,7 | 17,1 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 376,4 | 378,3 | 376,4 |
| bl2 | 376,4 | 378,7 | 376,4 |
| 380ct1f1 | 376,8 | 378,3 | 376,8 |
| 380ct1f2 | 376,8 | 378,3 | 376,8 |
| 380ct1f3 | 376,8 | 378,3 | 376,8 |
| 380ct2f1 | 376,8 | 378,3 | 376,8 |
| 380ct2f2 | 376,8 | 378,3 | 376,8 |
| 380ct2f3 | 376,8 | 378,3 | 376,8 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 386,2 | 377,2 |
| bl2 | 386,2 | 377,4 |
| 380ct1f1 | 381,8 | 377,3 |
| 380ct1f2 | 381,8 | 377,3 |
| 380ct1f3 | 383,2 | 377,6 |
| 380ct2f1 | 381,8 | 377,3 |
| 380ct2f2 | 381,8 | 377,3 |
| 380ct2f3 | 383,2 | 377,6 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 389,1 m | 1,068 - |
| Min. weight span | 375,1 m | 1,029 - |

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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 | 8,3 | 8,0 | -31,7 | 31,7 |
| bl2 | 15,0 | 8,2 | 8,0 | -31,8 | 31,8 |
| 380ct1f1 | 51,3 | 24,7 | 30,7 | -111,8 | 110,7 |
| 380ct1f2 | 51,3 | 24,7 | 30,7 | -111,8 | 110,7 |
| 380ct1f3 | 51,3 | 28,3 | 30,7 | -114,3 | 113,4 |
| 380ct2f1 | 51,3 | 24,7 | 30,7 | -111,8 | 110,7 |
| 380ct2f2 | 51,3 | 24,7 | 30,7 | -111,8 | 110,7 |
| 380ct2f3 | 51,3 | 28,3 | 30,7 | -114,3 | 113,4 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,9 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1,7 | 2,2 |
| | bl2 | 1,7 | 2,2 |
| | 380ct1f1 | 8,6 | 10,7 |
| | 380ct1f2 | 8,6 | 10,7 |
| | 380ct1f3 | 8,6 | 10,7 |
| | 380ct2f1 | 8,6 | 10,7 |
| | 380ct2f2 | 8,6 | 10,7 |
| | 380ct2f3 | 8,6 | 10,7 |

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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 | 172 | 131 | 6925 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 172 | 131 | 6925 | 0 | 0 |
| ULS 3_90 | | 0 | 95 | 198 | 3835 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 95 | 198 | 3835 | 0 | 0 |
| SLS 7 | | 0 | 0 | 123 | 1 | 0 | 0 |

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

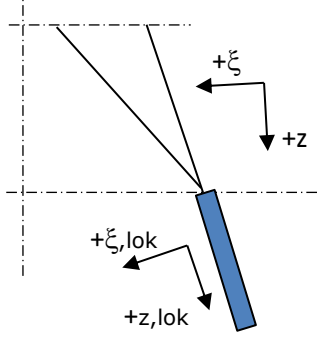
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 332 | 381 | 11453 | 0 | 0 |
| ULS 3_90 | 0 | 143 | 448 | 5194 | 0 | 0 |
| SLS 7 | 0 | 0 | 361 | 1 | 0 | 0 |

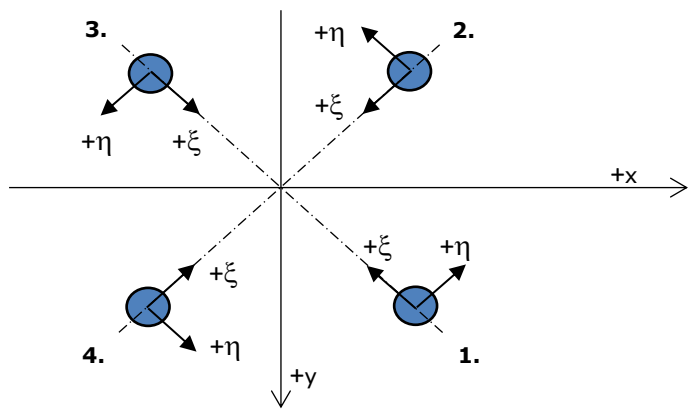
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 332 | 381 | **11453** | 0 | 0 |
| ULS 1a_0 | 210 | 0 | 379 | 1 | **6629** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 362 | -118 | 1823 | **796** |
| ULS 1a_45 | 158 | 244 | 380 | **8236** | **4765** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 142 | 129 | **754** | 10 | -192 | -39 | 770 |
| 2 | ULS 1a_0 | 72 | -87 | **431** | 11 | -112 | -24 | 440 |
| 3 | ULS 7 | -21 | -21 | **104** | 0 | -30 | -8 | 106 |
| 4 | ULS 1a_135 | -142 | 129 | **754** | -10 | -192 | -39 | 770 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -107 | 93 | **-578** | 10 | 142 | 24 | -590 |
| 3 | ULS 1a_0,9_0,9_45 | 107 | 93 | **-578** | -10 | 142 | 24 | -590 |
| 4 | ULS 1a_0,9_0,9_0 | 36 | -51 | **-255** | -11 | 62 | 10 | -260 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_90 | 136 | 102 | 676 | **24** | -168 | -31 | 690 |
| 2 | ULS 5a Ba 21 | 12 | -57 | 189 | **32** | -49 | -10 | 193 |
| 3 | ULS 5a Ba 21 | -27 | 21 | 4 | **33** | -4 | -4 | 4 |
| 4 | ULS 5a Ba 21 | 16 | 20 | -8 | **25** | -3 | -4 | -8 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 12 | 57 | 189 | **-32** | -49 | -10 | 193 |
| 2 | ULS 5a Ba 10 | 50 | -17 | 177 | **-24** | -47 | -11 | 180 |
| 3 | ULS 5a Ba 10 | 16 | -20 | -8 | **-25** | -3 | -4 | -8 |
| 4 | ULS 5a Ba 10 | -27 | -21 | 4 | **-33** | -4 | -4 | 4 |

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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -107 | 93 | **-578** | **10** | 142 | 24 | -590 |
| 3 | ULS 1a_0,9_0,9_45 | 107 | 93 | **-578** | **-10** | 142 | 24 | -590 |
| 4 | ULS 1a_0,9_0,9_0 | 36 | -51 | **-255** | **-11** | 62 | 10 | -260 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 18 | 18 | 90 | 0 | -26 | -7 | 92 |
| 2 | SLS 7 | 18 | -18 | 90 | 0 | -26 | -7 | 92 |
| 3 | SLS 7 | -18 | -18 | 90 | 0 | -26 | -7 | 92 |
| 4 | SLS 7 | -18 | 18 | 90 | 0 | -26 | -7 | 92 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 142 | 129 | **754** | 10 | -192 | -39 | 770 |
| Max. tension | ULS 1a_0,9_0,9_45 | 107 | 93 | **-578** | -10 | 142 | 24 | -590 |
| Max. pos. torsie | ULS 5a Ba 21 | -27 | 21 | 4 | **33** | -4 | -4 | 4 |
| Max. neg. torsie | ULS 5a Ba 10 | -27 | -21 | 4 | **-33** | -4 | -4 | 4 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 107 | 93 | **-578** | **-10** | 142 | 24 | -590 |

**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 18 | 18 | **90** | 0 | -26 | -7 | 92 |
| 2 | SLS 1a_135 | -85 | 74 | **-463** | 8 | 112 | 19 | -472 |
| 3 | SLS 1a_45 | 85 | 74 | **-463** | -8 | 112 | 19 | -472 |
| 4 | SLS 1a_0 | 26 | -39 | **-192** | -9 | 46 | 7 | -196 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 122 | 110 | **644** | 8 | -164 | -33 | 657 |
| 2 | SLS 1a_0 | 62 | -75 | **372** | 9 | -97 | -21 | 380 |
| 3 | SLS 7 | -18 | -18 | **90** | 0 | -26 | -7 | 92 |
| 4 | SLS 1a_135 | -122 | 110 | **644** | -8 | -164 | -33 | 657 |

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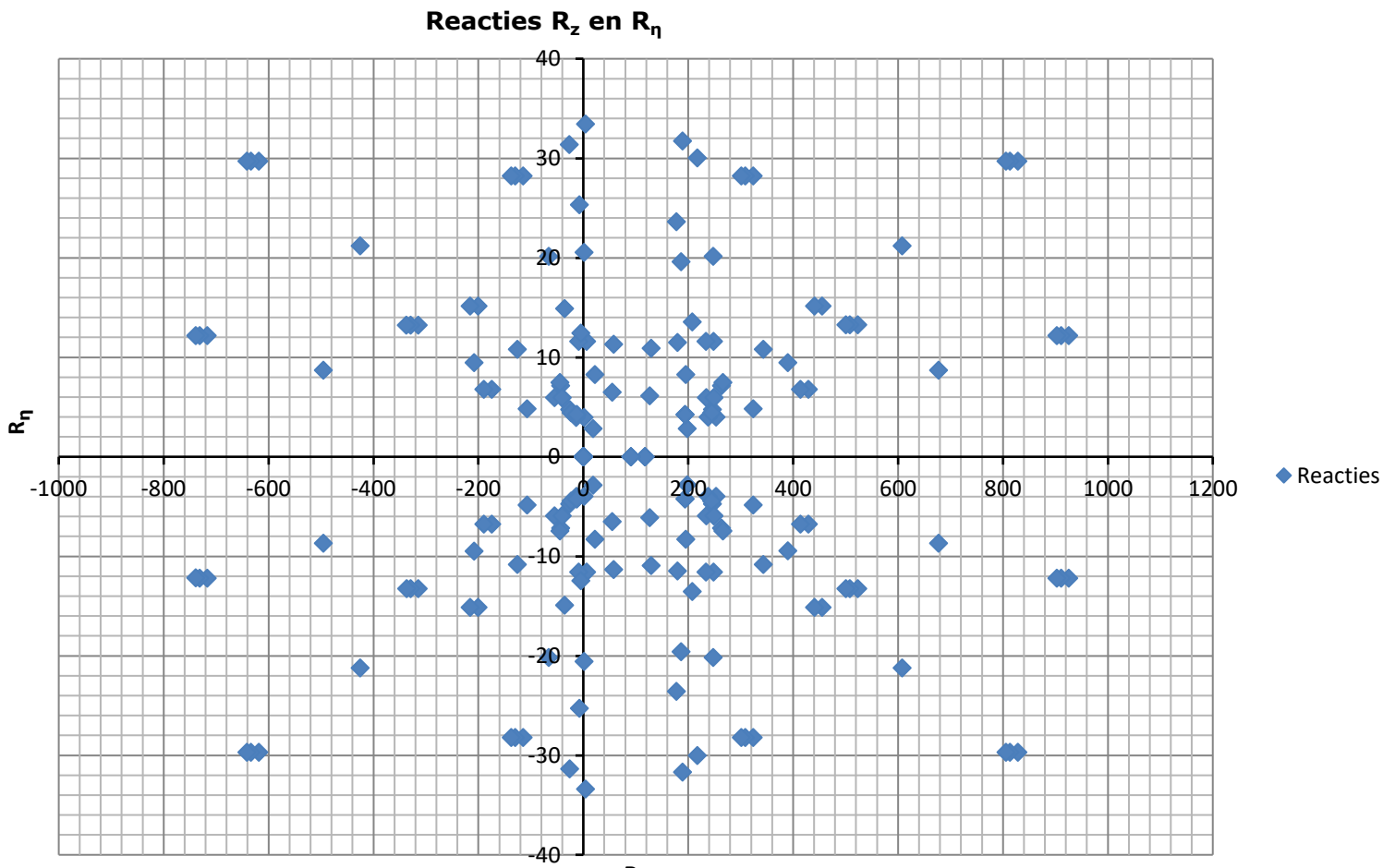
Tower: S+3 II
Number: 47



Project: KIJ-GT
Tower: S+3 II
Number: 47

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+3 II
Number: 47

**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 | -35,0 | 35,0 | 4,8 | 5,5 | 5,0 | 6,1 |
| bl2 | -35,3 | 35,3 | 4,8 | 5,5 | 5,0 | 6,1 |
| 380ct1f1 | -129,3 | 129,3 | 14,6 | 16,1 | 16,1 | 20,1 |
| 380ct1f2 | -129,3 | 129,3 | 14,6 | 16,1 | 16,1 | 20,1 |
| 380ct1f3 | -132,5 | 132,5 | 16,5 | 18,7 | 16,1 | 20,1 |
| 380ct2f1 | -129,3 | 129,3 | 14,6 | 16,1 | 16,1 | 20,1 |
| 380ct2f2 | -129,3 | 129,3 | 14,6 | 16,1 | 16,1 | 20,1 |
| 380ct2f3 | -132,5 | 132,5 | 16,5 | 18,7 | 16,1 | 20,1 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 376,4 | 378,4 | 376,4 |
| bl2 | 376,4 | 378,7 | 376,4 |
| 380ct1f1 | 376,8 | 378,3 | 376,8 |
| 380ct1f2 | 376,8 | 378,3 | 376,8 |
| 380ct1f3 | 376,8 | 378,4 | 376,8 |
| 380ct2f1 | 376,8 | 378,3 | 376,8 |
| 380ct2f2 | 376,8 | 378,3 | 376,8 |
| 380ct2f3 | 376,8 | 378,4 | 376,8 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 387,6 | 376,9 |
| bl2 | 387,6 | 377,0 |
| 380ct1f1 | 382,7 | 377,1 |
| 380ct1f2 | 382,7 | 377,1 |
| 380ct1f3 | 384,3 | 377,4 |
| 380ct2f1 | 382,7 | 377,1 |
| 380ct2f2 | 382,7 | 377,1 |
| 380ct2f3 | 384,3 | 377,4 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 393,1 m | 1,079 - |
| Min. weight span | 375,0 m | 1,029 - |

Project: KIJ-GT
Tower: S+3 II
Number: 47

**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 | 10,3 | 8,7 | -35,2 | 34,9 |
| bl2 | 15,0 | 10,3 | 8,7 | -35,5 | 35,1 |
| 380ct1f1 | 51,3 | 30,7 | 36,2 | -130,0 | 128,6 |
| 380ct1f2 | 51,3 | 30,7 | 36,2 | -130,0 | 128,6 |
| 380ct1f3 | 51,3 | 35,2 | 36,2 | -133,1 | 132,0 |
| 380ct2f1 | 51,3 | 30,7 | 36,2 | -130,0 | 128,6 |
| 380ct2f2 | 51,3 | 30,7 | 36,2 | -130,0 | 128,6 |
| 380ct2f3 | 51,3 | 35,2 | 36,2 | -133,1 | 132,0 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,9 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 19,3 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1,7 | 2,2 |
| | bl2 | 1,7 | 2,2 |
| | 380ct1f1 | 8,6 | 10,7 |
| | 380ct1f2 | 8,6 | 10,7 |
| | 380ct1f3 | 8,6 | 10,7 |
| | 380ct2f1 | 8,6 | 10,7 |
| | 380ct2f2 | 8,6 | 10,7 |
| | 380ct2f3 | 8,6 | 10,7 |

Project: KIJ-GT
Tower: S+3 II
Number: 47

**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 | 144 | 8625 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 214 | 144 | 8625 | 0 | 0 |
| ULS 3_90 | | 0 | 118 | 234 | 4777 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 118 | 234 | 4777 | 0 | 0 |
| SLS 7 | | 0 | 0 | 123 | 1 | 0 | 0 |

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

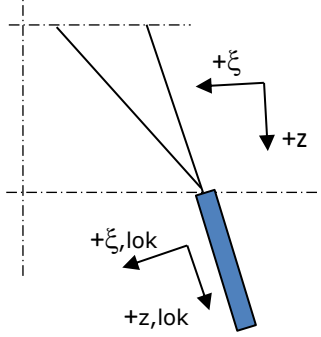
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 413 | 418 | 14265 | 0 | 0 |
| ULS 3_90 | 0 | 178 | 508 | 6469 | 0 | 0 |
| SLS 7 | 0 | 0 | 361 | 1 | 0 | 0 |

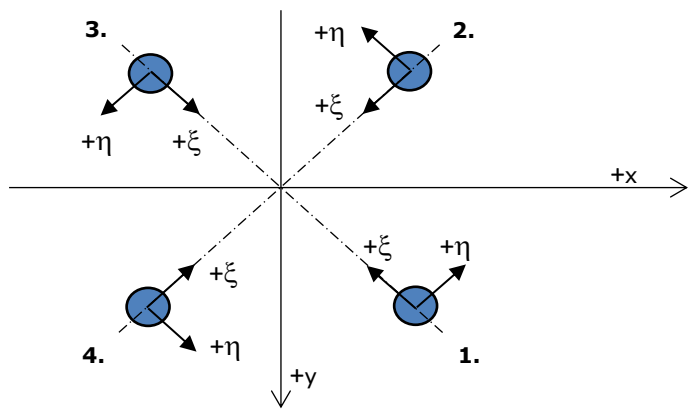
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 413 | 418 | **14265** | 0 | 0 |
| ULS 1a_0 | 262 | 0 | 416 | 1 | **8257** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 362 | -118 | 1823 | **796** |
| ULS 1a_45 | 197 | 304 | 416 | **10258** | **5935** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 175 | 157 | **925** | 12 | -235 | -47 | 944 |
| 2 | ULS 1a_0 | 86 | -105 | **523** | 13 | -135 | -29 | 533 |
| 3 | ULS 7 | -24 | -24 | **117** | 0 | -33 | -10 | 120 |
| 4 | ULS 1a_135 | -175 | 157 | **925** | -12 | -235 | -47 | 944 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -137 | 120 | **-740** | 12 | 182 | 32 | -755 |
| 3 | ULS 1a_0,9_0,9_45 | 137 | 120 | **-740** | -12 | 182 | 32 | -755 |
| 4 | ULS 1a_0,9_0,9_0 | 49 | -68 | **-337** | -13 | 83 | 14 | -344 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0,9_90 | 163 | 121 | 813 | **30** | -201 | -36 | 830 |
| 2 | ULS 5a Ba 21 | 12 | -57 | 189 | **32** | -49 | -10 | 193 |
| 3 | ULS 5a Ba 21 | -27 | 21 | 4 | **33** | -4 | -4 | 4 |
| 4 | ULS 5a Ba 21 | 16 | 20 | -8 | **25** | -3 | -4 | -8 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 12 | 57 | 189 | **-32** | -49 | -10 | 193 |
| 2 | ULS 5a Ba 10 | 50 | -17 | 177 | **-24** | -47 | -11 | 180 |
| 3 | ULS 1a_90 | 124 | 82 | -619 | **-30** | 146 | 21 | -632 |
| 4 | ULS 5a Ba 10 | -27 | -21 | 4 | **-33** | -4 | -4 | 4 |

Project: KIJ-GT
Tower: S+3 II
Number: 47

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -137 | 120 | **-740** | **12** | 182 | 32 | -755 |
| 3 | ULS 1a_0,9_0,9_45 | 137 | 120 | **-740** | **-12** | 182 | 32 | -755 |
| 4 | ULS 1a_0,9_0,9_0 | 49 | -68 | **-337** | **-13** | 83 | 14 | -344 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 18 | 18 | 90 | 0 | -26 | -7 | 92 |
| 2 | SLS 7 | 18 | -18 | 90 | 0 | -26 | -7 | 92 |
| 3 | SLS 7 | -18 | -18 | 90 | 0 | -26 | -7 | 92 |
| 4 | SLS 7 | -18 | 18 | 90 | 0 | -26 | -7 | 92 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 175 | 157 | **925** | 12 | -235 | -47 | 944 |
| Max. tension | ULS 1a_0,9_0,9_45 | 137 | 120 | **-740** | -12 | 182 | 32 | -755 |
| Max. pos. torsie | ULS 5a Ba 21 | -27 | 21 | 4 | **33** | -4 | -4 | 4 |
| Max. neg. torsie | ULS 5a Ba 10 | -27 | -21 | 4 | **-33** | -4 | -4 | 4 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 137 | 120 | **-740** | **-12** | 182 | 32 | -755 |

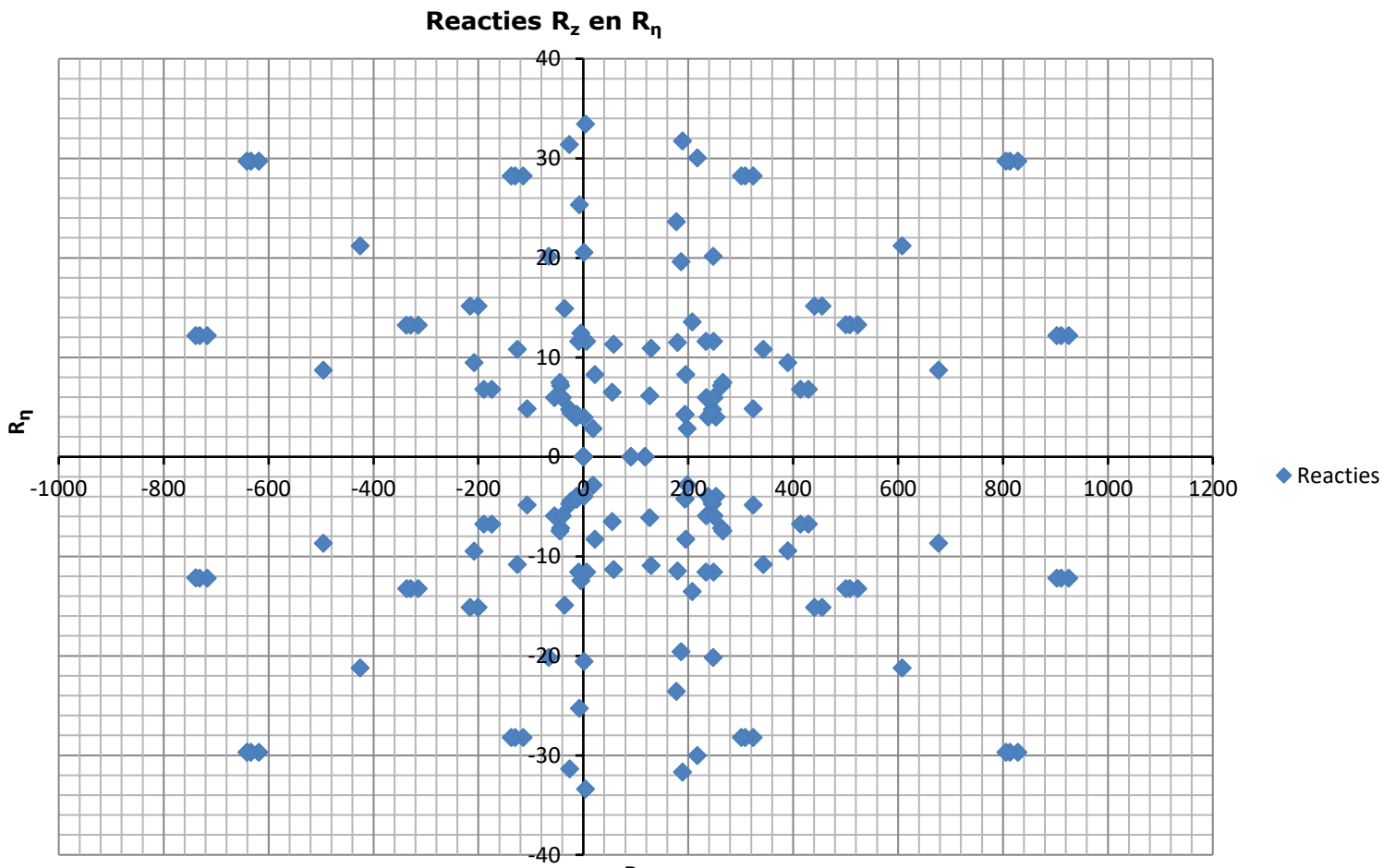
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 18 | 18 | **90** | 0 | -26 | -7 | 92 |
| 2 | SLS 1a_135 | -92 | 79 | **-496** | 9 | 121 | 20 | -506 |
| 3 | SLS 1a_45 | 92 | 79 | **-496** | -9 | 121 | 20 | -506 |
| 4 | SLS 1a_0 | 29 | -42 | **-209** | -9 | 50 | 7 | -213 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 128 | 116 | **677** | 9 | -172 | -35 | 691 |
| 2 | SLS 1a_0 | 65 | -78 | **389** | 9 | -101 | -22 | 397 |
| 3 | SLS 7 | -18 | -18 | **90** | 0 | -26 | -7 | 92 |
| 4 | SLS 1a_135 | -128 | 116 | **677** | -9 | -172 | -35 | 691 |

Project: KIJ-GT
Tower: S+3 II
Number: 47



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 51 m |
| Max. Span | 300 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 292 m |
| EDS Weight span | 348 m |
| Min. Weight span | 341 m |
| Max. Weight span | 417 m |

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

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+3

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

Document name:

KIJ-GT_S+3_57_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+3
Number: 57

**Conductor loads**

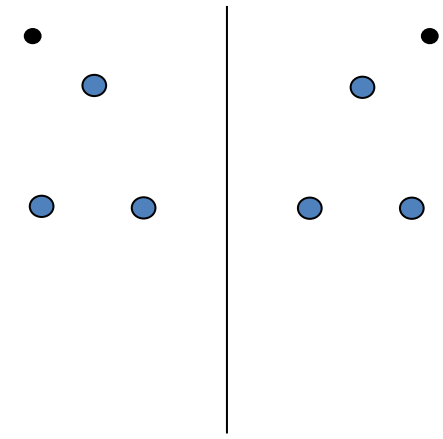
Auteur: TBR
Versie: v11.3

**General**

| | |
|---|---|
| Description | S+3 |
| 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 | 31,2 m | 35,5 m | 15,7 m |
| Circuit 1 | 11 | 380ct1f2 | 31,2 m | 35,5 m | 8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 42,5 m | 46,8 m | 12,2 m |
| Circuit 2 | 20 | 380ct2f1 | 31,2 m | 35,5 m | -8,7 m |
| Circuit 2 | 21 | 380ct2f2 | 31,2 m | 35,5 m | -15,7 m |
| Circuit 2 | 22 | 380ct2f3 | 42,5 m | 46,8 m | -12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 46,3 m | 46,8 m | 16,2 m |
| Bliksemdraad 2 | 3 | bl2 | 46,3 m | 46,8 m | -16,2 m |

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

Project: KIJ-GT
Tower: S+3
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**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**

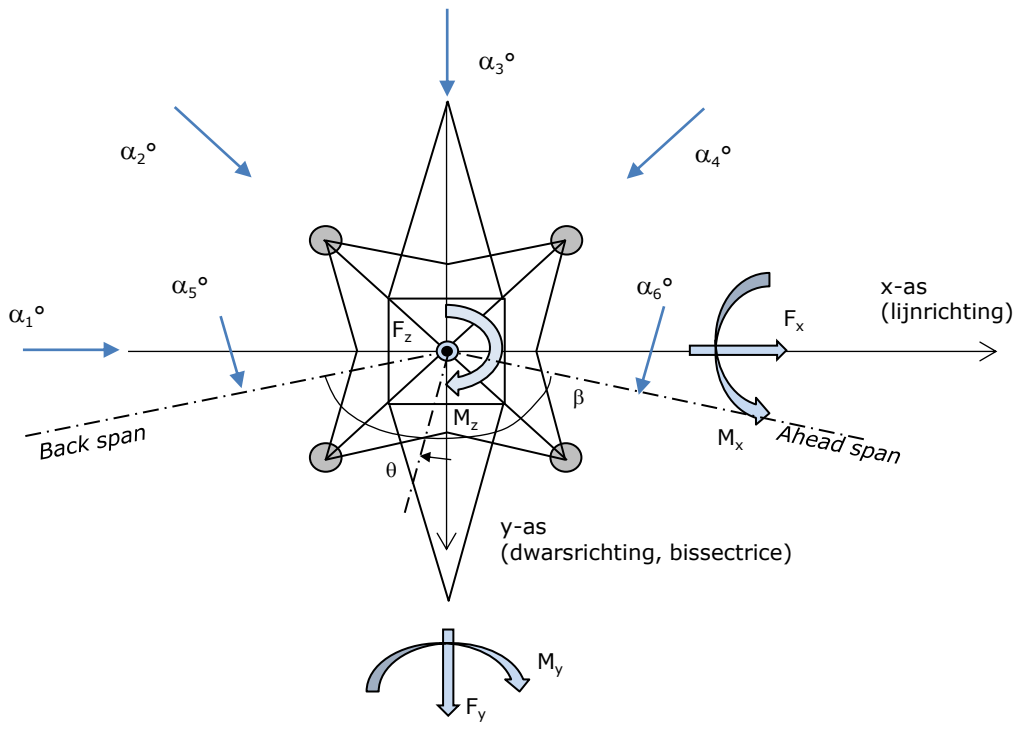
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | -5,4 | -5,4 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | -5,4 | -5,4 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 300,0 | 284,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 377,7 | 377,7 | m |
| Line angle | $\beta$ | 180 | | ° |
| Tower orientation with respect to bis | $\theta$ | 0 | | ° |
| Section length | | 2580 | 2580 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+3
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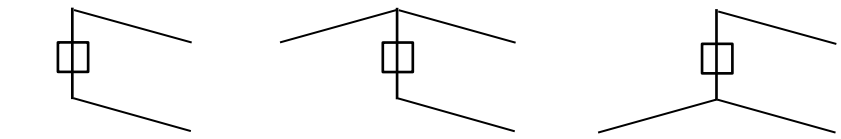
**Absence of conductors**

| | | 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 |

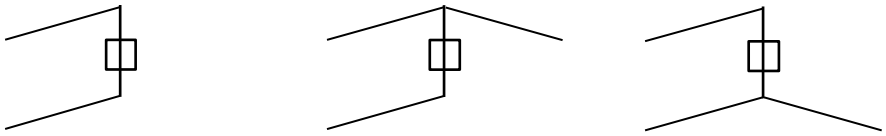
**Load situations SPLS**

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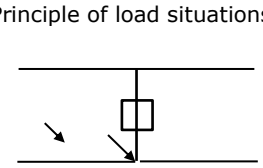
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

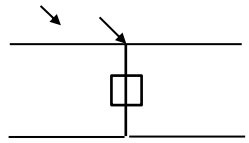
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

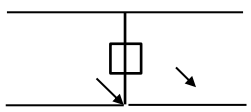
Principle of load situations:



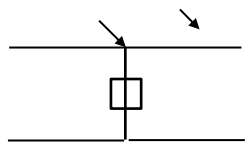
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

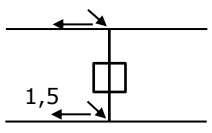
**Load situations 8. Galloping as a static load**

| 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 |

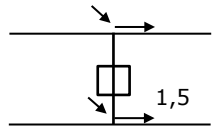
Considered situations galloping 8: None (existing structure)

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+3
Number: 57

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+3 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 51,0 | m | |
| Tower self weight | 230,0 | kN | |
| | | | |
| *Width and slope at foundation* | x-ri. | y-ri. | |
| Leg spread | 9,86 | 9,86 | 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] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 9,86 | 5,79 | 14,18 | 0,144 | 110,96 | 11,25 | 0,10 | 3,40 |
| Middenstuk 1 | 24,18 | 5,79 | 4,48 | 10,00 | 0,066 | 51,35 | 6,25 | 0,12 | 3,30 |
| Middenstuk 2 | 35,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 41,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 49,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 51,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 35,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 46,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

**Properties tower sections transverse direction (side view, xz plane)**

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 9,86 | 5,79 | 14,18 | 0,144 | 110,96 | 11,25 | 0,10 | 3,40 |
| Middenstuk 1 | 24,18 | 5,79 | 4,48 | 10,00 | 0,066 | 51,35 | 6,25 | 0,12 | 3,30 |
| Middenstuk 2 | 35,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 41,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 49,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 51,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 35,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 46,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

*Note: Surface transverse direction is reduced in calculation.*

Project: KIJ-GT
Tower: S+3
Number: 57

**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | $\Delta$h | $A_1$ |
|---|---|---|---|
| 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 | $p_w$ [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 | 0,70 | 26,8 | 22,7 | 0,0 | -22,7 | 7,1 | 190,1 | 161,3 | 0,0 | -161,3 |
| Middenstuk 1 | 0,87 | 17,9 | 15,1 | 0,0 | -15,1 | 19,2 | 342,4 | 290,5 | 0,0 | -290,5 |
| Middenstuk 2 | 0,99 | 22,5 | 19,1 | 0,0 | -19,1 | 29,8 | 670,7 | 569,1 | 0,0 | -569,1 |
| Bovenstuk 1 | 1,06 | 12,5 | 10,6 | 0,0 | -10,6 | 38,4 | 481,0 | 408,2 | 0,0 | -408,2 |
| Bovenstuk 2 | 1,11 | 14,6 | 12,4 | 0,0 | -12,4 | 45,4 | 660,8 | 560,7 | 0,0 | -560,7 |
| Topstuk | 1,14 | | | | | 50,2 | | | | |
| Ondertraverse | 1,04 | 28,3 | 16,8 | 0,0 | -16,8 | 36,5 | 1032,9 | 613,5 | 0,0 | -613,5 |
| Boventraverse | 1,12 | 29,3 | 17,4 | 0,0 | -17,4 | 47,7 | 1397,6 | 830,1 | 0,0 | -830,1 |
| Totaal | | 151,8 | 114,2 | 0,0 | -114,2 | | 4775,5 | 3433,4 | 0,0 | -3433,4 |

**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 | 0,70 | 0,0 | 22,7 | 26,8 | 22,7 | 7,1 | 0,0 | 161,3 | 190,1 | 161,3 |
| Middenstuk 1 | 0,87 | 0,0 | 15,1 | 17,9 | 15,1 | 19,2 | 0,0 | 290,5 | 342,4 | 290,5 |
| Middenstuk 2 | 0,99 | 0,0 | 19,1 | 22,5 | 19,1 | 29,8 | 0,0 | 569,1 | 670,7 | 569,1 |
| Bovenstuk 1 | 1,06 | 0,0 | 10,6 | 12,5 | 10,6 | 38,4 | 0,0 | 408,2 | 481,0 | 408,2 |
| Bovenstuk 2 | 1,11 | 0,0 | 12,4 | 14,6 | 12,4 | 45,4 | 0,0 | 560,7 | 660,8 | 560,7 |
| Topstuk | 1,14 | | | | | 50,2 | | | | |
| Ondertraverse | 1,04 | 0,0 | 16,8 | 11,3 | 16,8 | 36,5 | 0,0 | 613,5 | 413,1 | 613,5 |
| Boventraverse | 1,12 | 0,0 | 17,4 | 11,7 | 17,4 | 47,7 | 0,0 | 830,1 | 559,0 | 830,1 |
| Total | | 0,0 | 114,2 | 117,3 | 114,2 | | 0,0 | 3433,4 | 3317,2 | 3433,4 |

**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 | 230 | 0 | 0 | 0 |
| Windrichting 0° | 152 | 0 | 0 | 0 | 4775 | 0 |
| Windrichting 45° | 114 | 114 | 0 | 3433 | 3433 | 0 |
| Windrichting 90° | 0 | 117 | 0 | 3317 | 0 | 0 |
| Windrichting 135° | -114 | 114 | 0 | 3433 | -3433 | 0 |

Project: KIJ-GT
Tower: S+3
Number: 57

**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 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct1f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct1f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 45,15 | 1,11 | 1,2 | 1,33 |
| 380ct2f1 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct2f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct2f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 45,15 | 1,11 | 1,2 | 1,33 |
| bl1 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 47,05 | 1,12 | 1,2 | 0,07 |
| bl2 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 47,05 | 1,12 | 1,2 | 0,07 |

Project: KIJ-GT
Tower: S+3
Number: 57

**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 | 23,6 | 0,92 | 0,58 | 0,49 | 1,12 | 28,25 | 50,9 | 43,1 | 46,9 | 90,8 | 76,8 |
| 380ct1f2 | 23,6 | 0,92 | 0,58 | 0,49 | 1,12 | 28,25 | 50,9 | 43,1 | 46,9 | 90,8 | 76,8 |
| 380ct1f3 | 34,9 | 1,03 | 0,61 | 0,52 | 1,09 | 28,25 | 58,4 | 49,3 | 46,9 | 107,1 | 90,5 |
| 380ct2f1 | 23,6 | 0,92 | 0,58 | 0,49 | 1,12 | 28,25 | 50,9 | 43,1 | 46,9 | 90,8 | 76,8 |
| 380ct2f2 | 23,6 | 0,92 | 0,58 | 0,49 | 1,12 | 28,25 | 50,9 | 43,1 | 46,9 | 90,8 | 76,8 |
| 380ct2f3 | 34,9 | 1,03 | 0,61 | 0,52 | 1,09 | 28,25 | 58,4 | 49,3 | 46,9 | 107,1 | 90,5 |
| bl1 | 39,1 | 1,06 | 0,62 | 0,53 | 1,20 | 22,24 | 17,7 | 14,9 | 41,5 | 33,1 | 27,9 |
| bl2 | 39,1 | 1,06 | 0,62 | 0,53 | 1,20 | 22,13 | 17,6 | 14,9 | 41,4 | 33,0 | 27,9 |

**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 | 24,2 | 0,93 | 0,58 | 0,49 | 1,12 | 28,25 | 51,4 | 43,4 | 46,9 | 91,7 | 77,6 |
| 380ct1f2 | 24,2 | 0,93 | 0,58 | 0,49 | 1,12 | 28,25 | 51,4 | 43,4 | 46,9 | 91,7 | 77,6 |
| 380ct1f3 | 35,5 | 1,04 | 0,62 | 0,52 | 1,09 | 28,25 | 58,7 | 49,6 | 46,9 | 107,8 | 91,0 |
| 380ct2f1 | 24,2 | 0,93 | 0,58 | 0,49 | 1,12 | 28,25 | 51,4 | 43,4 | 46,9 | 91,7 | 77,6 |
| 380ct2f2 | 24,2 | 0,93 | 0,58 | 0,49 | 1,12 | 28,25 | 51,4 | 43,4 | 46,9 | 91,7 | 77,6 |
| 380ct2f3 | 35,5 | 1,04 | 0,62 | 0,52 | 1,09 | 28,25 | 58,7 | 49,6 | 46,9 | 107,8 | 91,0 |
| bl1 | 39,6 | 1,07 | 0,62 | 0,53 | 1,20 | 22,24 | 17,8 | 15,0 | 41,5 | 33,2 | 28,1 |
| bl2 | 39,6 | 1,07 | 0,62 | 0,53 | 1,20 | 22,13 | 17,7 | 15,0 | 41,4 | 33,2 | 28,0 |

Project: KIJ-GT
Tower: S+3
Number: 57

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+3
Number: 57

**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 | -29,2 | 29,2 | 3,0 | 2,9 | 4,7 | 4,5 |
| bl2 | -29,4 | 29,4 | 3,0 | 2,8 | 4,7 | 4,5 |
| 380ct1f1 | -109,6 | 109,6 | 9,2 | 8,8 | 14,4 | 13,9 |
| 380ct1f2 | -109,6 | 109,6 | 9,2 | 8,8 | 14,4 | 13,9 |
| 380ct1f3 | -111,5 | 111,5 | 10,5 | 10,1 | 14,4 | 13,9 |
| 380ct2f1 | -109,6 | 109,6 | 9,2 | 8,8 | 14,4 | 13,9 |
| 380ct2f2 | -109,6 | 109,6 | 9,2 | 8,8 | 14,4 | 13,9 |
| 380ct2f3 | -111,5 | 111,5 | 10,5 | 10,1 | 14,4 | 13,9 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 347,6 | 355,6 | 347,6 |
| bl2 | 347,6 | 357,2 | 347,6 |
| 380ct1f1 | 343,9 | 349,6 | 343,9 |
| 380ct1f2 | 343,9 | 349,6 | 343,9 |
| 380ct1f3 | 343,9 | 349,9 | 343,9 |
| 380ct2f1 | 343,9 | 349,6 | 343,9 |
| 380ct2f2 | 343,9 | 349,6 | 343,9 |
| 380ct2f3 | 343,9 | 349,9 | 343,9 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 386,9 | 350,1 |
| bl2 | 386,8 | 350,7 |
| 380ct1f1 | 362,6 | 345,6 |
| 380ct1f2 | 362,6 | 345,6 |
| 380ct1f3 | 367,2 | 346,5 |
| 380ct2f1 | 362,6 | 345,6 |
| 380ct2f2 | 362,6 | 345,6 |
| 380ct2f3 | 367,2 | 346,5 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 399,1 m | 1,367 - |
| Min. weight span | 342,1 m | 1,171 - |

Project: KIJ-GT
Tower: S+3
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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 | 5,9 | 7,2 | -31,4 | 31,4 |
| bl2 | 15,0 | 5,8 | 7,2 | -31,5 | 31,5 |
| 380ct1f1 | 51,3 | 18,0 | 28,3 | -109,5 | 109,6 |
| 380ct1f2 | 51,3 | 18,0 | 28,3 | -109,5 | 109,6 |
| 380ct1f3 | 51,3 | 20,6 | 28,4 | -111,4 | 111,5 |
| 380ct2f1 | 51,3 | 18,0 | 28,3 | -109,5 | 109,6 |
| 380ct2f2 | 51,3 | 18,0 | 28,3 | -109,5 | 109,6 |
| 380ct2f3 | 51,3 | 20,6 | 28,4 | -111,4 | 111,5 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,6 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,6 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

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

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Tower: S+3
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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 | 125 | 126 | 5036 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 125 | 126 | 5036 | 0 | 0 |
| ULS 3_90 | | 0 | 66 | 183 | 2657 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 66 | 183 | 2657 | 0 | 0 |
| SLS 7 | | 0 | 0 | 114 | 0 | 0 | 0 |

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

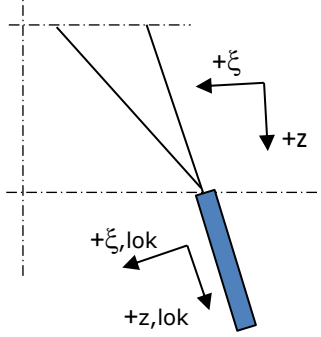
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 256 | 368 | 8741 | 0 | 0 |
| ULS 3_90 | 0 | 105 | 425 | 3768 | 0 | 0 |
| SLS 7 | 0 | 0 | 344 | 0 | 0 | 0 |

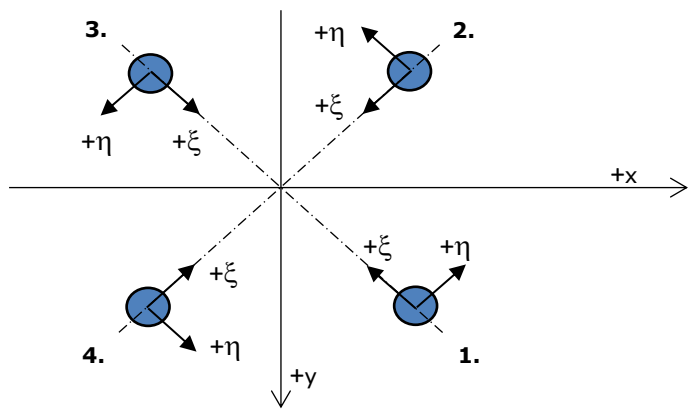
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 256 | 368 | **8741** | 0 | 0 |
| ULS 1a_0 | 172 | 0 | 361 | 0 | **5423** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 344 | -126 | 1823 | **806** |
| ULS 1a_45 | 129 | 192 | 363 | **6423** | **3898** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 116 | 106 | **614** | 7 | -157 | -32 | 627 |
| 2 | ULS 1a_0 | 61 | -73 | **365** | 9 | -95 | -21 | 373 |
| 3 | ULS 7 | -20 | -20 | **99** | 0 | -28 | -8 | 101 |
| 4 | ULS 1a_135 | -116 | 106 | **614** | -7 | -157 | -32 | 627 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -82 | 72 | **-445** | 7 | 109 | 19 | -454 |
| 3 | ULS 1a_0,9_0,9_45 | 82 | 72 | **-445** | -7 | 109 | 19 | -454 |
| 4 | ULS 1a_0,9_0,9_0 | 27 | -40 | **-198** | -9 | 47 | 7 | -202 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 49 | 15 | 172 | **24** | -46 | -11 | 175 |
| 2 | ULS 5a Ba 10 | 11 | -56 | 185 | **32** | -48 | -10 | 189 |
| 3 | ULS 5a Ba 10 | -26 | 22 | 0 | **34** | -3 | -3 | 0 |
| 4 | ULS 5a Ba 10 | 17 | 19 | -13 | **26** | -1 | -4 | -13 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 11 | 56 | 185 | **-32** | -48 | -10 | 189 |
| 2 | ULS 5a Ba 21 | 49 | -15 | 172 | **-24** | -46 | -11 | 175 |
| 3 | ULS 5a Ba 21 | 17 | -19 | -13 | **-26** | -1 | -4 | -13 |
| 4 | ULS 5a Ba 21 | -26 | -22 | 0 | **-34** | -3 | -3 | 0 |

Project: KIJ-GT
Tower: S+3
Number: 57

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -82 | 72 | **-445** | **7** | 109 | 19 | -454 |
| 3 | ULS 1a_0,9_0,9_45 | 82 | 72 | **-445** | **-7** | 109 | 19 | -454 |
| 4 | ULS 1a_0,9_0,9_0 | 27 | -40 | **-198** | **-9** | 47 | 7 | -202 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | 86 | 0 | -24 | -7 | 88 |
| 2 | SLS 7 | 17 | -17 | 86 | 0 | -24 | -7 | 88 |
| 3 | SLS 7 | -17 | -17 | 86 | 0 | -24 | -7 | 88 |
| 4 | SLS 7 | -17 | 17 | 86 | 0 | -24 | -7 | 88 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 116 | 106 | **614** | 7 | -157 | -32 | 627 |
| Max. tension | ULS 1a_0,9_0,9_45 | 82 | 72 | **-445** | -7 | 109 | 19 | -454 |
| Max. pos. torsie | ULS 5a Ba 10 | -26 | 22 | 0 | **34** | -3 | -3 | 0 |
| Max. neg. torsie | ULS 5a Ba 21 | -26 | -22 | 0 | **-34** | -3 | -3 | 0 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 82 | 72 | **-445** | **-7** | 109 | 19 | -454 |

**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | **86** | 0 | -24 | -7 | 88 |
| 2 | SLS 1a_135 | -65 | 57 | **-356** | 6 | 86 | 14 | -363 |
| 3 | SLS 1a_45 | 65 | 57 | **-356** | -6 | 86 | 14 | -363 |
| 4 | SLS 1a_0 | 19 | -29 | **-146** | -7 | 34 | 5 | -149 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 100 | 91 | **528** | 6 | -135 | -28 | 539 |
| 2 | SLS 1a_0 | 54 | -64 | **318** | 7 | -83 | -18 | 325 |
| 3 | SLS 7 | -17 | -17 | **86** | 0 | -24 | -7 | 88 |
| 4 | SLS 1a_135 | -100 | 91 | **528** | -6 | -135 | -28 | 539 |

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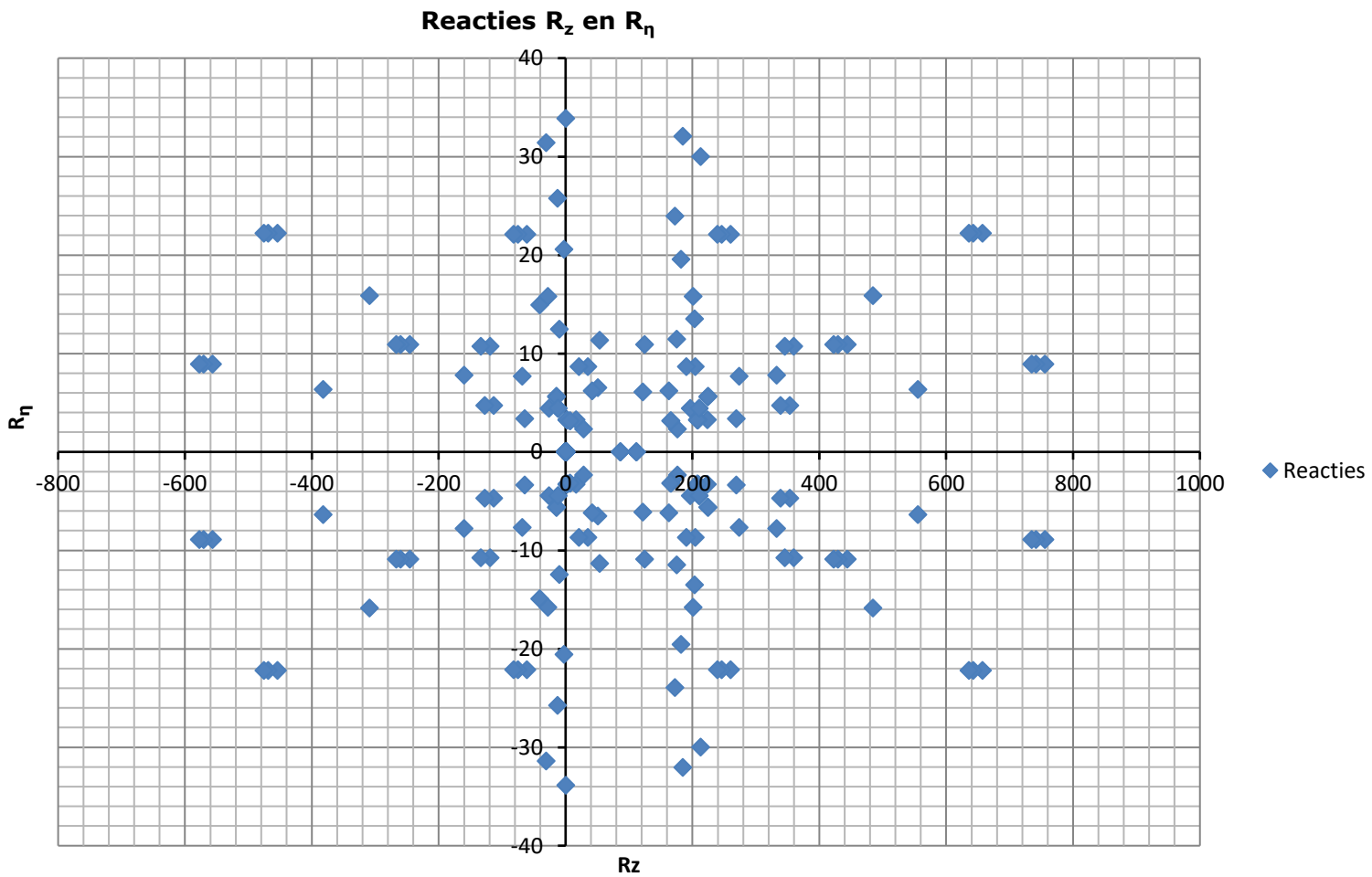

Project: KIJ-GT
Tower: S+3
Number: 57

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+3
Number: 57

**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 | -34,1 | 34,1 | 3,8 | 3,6 | 5,1 | 4,9 |
| bl2 | -34,4 | 34,4 | 3,7 | 3,6 | 5,1 | 4,9 |
| 380ct1f1 | -127,5 | 127,5 | 11,6 | 11,1 | 16,9 | 16,4 |
| 380ct1f2 | -127,5 | 127,5 | 11,6 | 11,1 | 16,9 | 16,4 |
| 380ct1f3 | -129,9 | 129,9 | 13,2 | 12,6 | 17,0 | 16,4 |
| 380ct2f1 | -127,5 | 127,5 | 11,6 | 11,1 | 16,9 | 16,4 |
| 380ct2f2 | -127,5 | 127,5 | 11,6 | 11,1 | 16,9 | 16,4 |
| 380ct2f3 | -129,9 | 129,9 | 13,2 | 12,6 | 17,0 | 16,4 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 347,6 | 355,9 | 347,6 |
| bl2 | 347,6 | 357,4 | 347,6 |
| 380ct1f1 | 343,9 | 349,7 | 343,9 |
| 380ct1f2 | 343,9 | 349,7 | 343,9 |
| 380ct1f3 | 343,9 | 350,0 | 343,9 |
| 380ct2f1 | 343,9 | 349,7 | 343,9 |
| 380ct2f2 | 343,9 | 349,7 | 343,9 |
| 380ct2f3 | 343,9 | 350,0 | 343,9 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 393,5 | 348,5 |
| bl2 | 393,4 | 349,0 |
| 380ct1f1 | 366,4 | 344,5 |
| 380ct1f2 | 366,4 | 344,5 |
| 380ct1f3 | 371,8 | 345,5 |
| 380ct2f1 | 366,4 | 344,5 |
| 380ct2f2 | 366,4 | 344,5 |
| 380ct2f3 | 371,8 | 345,5 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 416,7 m | 1,427 - |
| Min. weight span | 341,4 m | 1,169 - |

Project: KIJ-GT
Tower: S+3
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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 | 7,3 | 7,9 | -34,1 | 34,1 |
| bl2 | 15,0 | 7,3 | 7,9 | -34,4 | 34,4 |
| 380ct1f1 | 51,3 | 22,6 | 33,3 | -127,4 | 127,6 |
| 380ct1f2 | 51,3 | 22,6 | 33,3 | -127,4 | 127,6 |
| 380ct1f3 | 51,3 | 25,8 | 33,4 | -129,8 | 129,9 |
| 380ct2f1 | 51,3 | 22,6 | 33,3 | -127,4 | 127,6 |
| 380ct2f2 | 51,3 | 22,6 | 33,3 | -127,4 | 127,6 |
| 380ct2f3 | 51,3 | 25,8 | 33,4 | -129,8 | 129,9 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,6 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,6 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 17,8 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

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

Project: KIJ-GT
Tower: S+3
Number: 57

**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 | 157 | 140 | 6314 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 157 | 140 | 6314 | 0 | 0 |
| ULS 3_90 | | 0 | 82 | 216 | 3330 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 82 | 216 | 3330 | 0 | 0 |
| SLS 7 | | 0 | 0 | 114 | 0 | 0 | 0 |

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

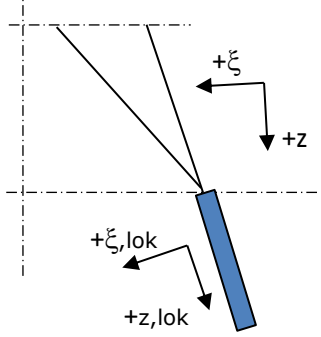
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 321 | 404 | 10958 | 0 | 0 |
| ULS 3_90 | 0 | 132 | 480 | 4724 | 0 | 0 |
| SLS 7 | 0 | 0 | 344 | 0 | 0 | 0 |

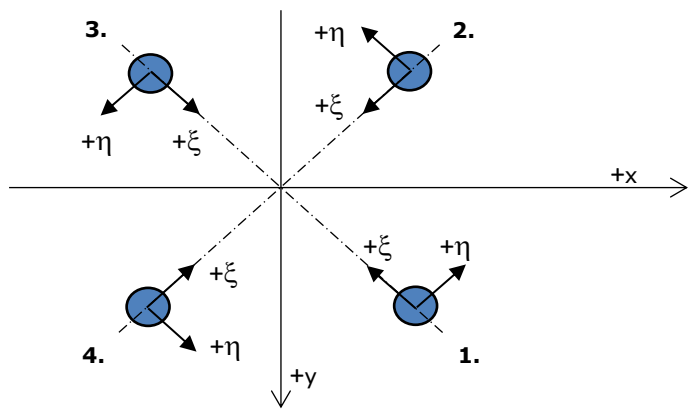
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 321 | 404 | **10958** | 0 | 0 |
| ULS 1a_0 | 215 | 0 | 395 | 0 | **6799** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 344 | -126 | 1823 | **806** |
| ULS 1a_45 | 162 | 240 | 398 | **8052** | **4887** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 142 | 130 | **756** | 9 | -193 | -39 | 771 |
| 2 | ULS 1a_0 | 74 | -89 | **444** | 11 | -115 | -25 | 453 |
| 3 | ULS 7 | -22 | -22 | **112** | 0 | -32 | -9 | 114 |
| 4 | ULS 1a_135 | -142 | 130 | **756** | -9 | -193 | -39 | 771 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -107 | 94 | **-578** | 9 | 142 | 25 | -590 |
| 3 | ULS 1a_0,9_0,9_45 | 107 | 94 | **-578** | -9 | 142 | 25 | -590 |
| 4 | ULS 1a_0,9_0,9_0 | 38 | -54 | **-267** | -11 | 65 | 11 | -273 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 49 | 15 | 172 | **24** | -46 | -11 | 175 |
| 2 | ULS 5a Ba 10 | 11 | -56 | 185 | **32** | -48 | -10 | 189 |
| 3 | ULS 5a Ba 10 | -26 | 22 | 0 | **34** | -3 | -3 | 0 |
| 4 | ULS 5a Ba 10 | 17 | 19 | -13 | **26** | -1 | -4 | -13 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 11 | 56 | 185 | **-32** | -48 | -10 | 189 |
| 2 | ULS 5a Ba 21 | 49 | -15 | 172 | **-24** | -46 | -11 | 175 |
| 3 | ULS 5a Ba 21 | 17 | -19 | -13 | **-26** | -1 | -4 | -13 |
| 4 | ULS 5a Ba 21 | -26 | -22 | 0 | **-34** | -3 | -3 | 0 |

Project: KIJ-GT
Tower: S+3
Number: 57

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -107 | 94 | **-578** | **9** | 142 | 25 | -590 |
| 3 | ULS 1a_0,9_0,9_45 | 107 | 94 | **-578** | **-9** | 142 | 25 | -590 |
| 4 | ULS 1a_0,9_0,9_0 | 38 | -54 | **-267** | **-11** | 65 | 11 | -273 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | 86 | 0 | -24 | -7 | 88 |
| 2 | SLS 7 | 17 | -17 | 86 | 0 | -24 | -7 | 88 |
| 3 | SLS 7 | -17 | -17 | 86 | 0 | -24 | -7 | 88 |
| 4 | SLS 7 | -17 | 17 | 86 | 0 | -24 | -7 | 88 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 142 | 130 | **756** | 9 | -193 | -39 | 771 |
| Max. tension | ULS 1a_0,9_0,9_45 | 107 | 94 | **-578** | -9 | 142 | 25 | -590 |
| Max. pos. torsie | ULS 5a Ba 10 | -26 | 22 | 0 | **34** | -3 | -3 | 0 |
| Max. neg. torsie | ULS 5a Ba 21 | -26 | -22 | 0 | **-34** | -3 | -3 | 0 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 107 | 94 | **-578** | **-9** | 142 | 25 | -590 |

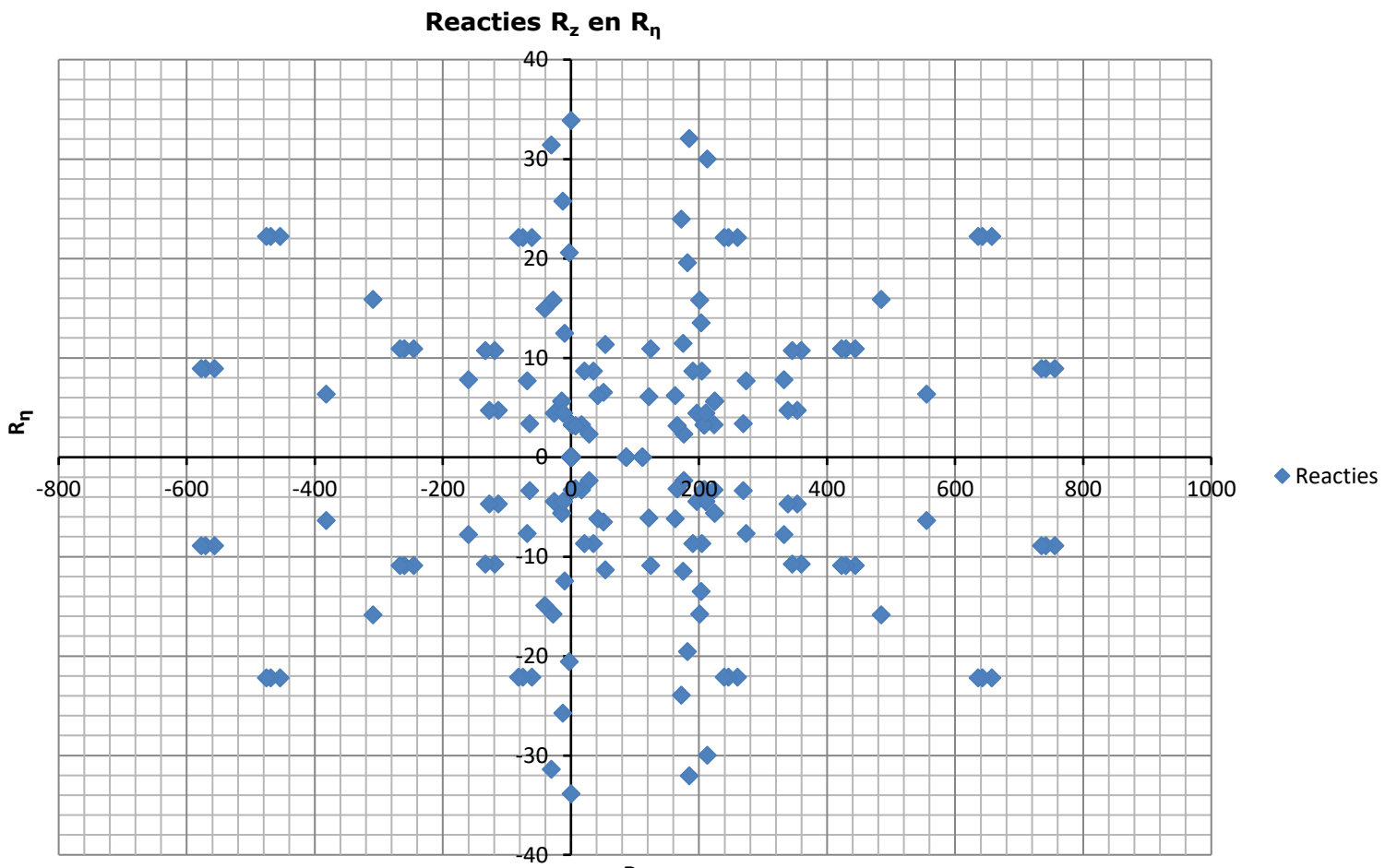
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | **86** | 0 | -24 | -7 | 88 |
| 2 | SLS 1a_135 | -70 | 61 | **-382** | 6 | 93 | 15 | -390 |
| 3 | SLS 1a_45 | 70 | 61 | **-382** | -6 | 93 | 15 | -390 |
| 4 | SLS 1a_0 | 21 | -32 | **-160** | -8 | 38 | 5 | -164 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 105 | 96 | **555** | 6 | -142 | -29 | 566 |
| 2 | SLS 1a_0 | 56 | -67 | **332** | 8 | -87 | -19 | 339 |
| 3 | SLS 7 | -17 | -17 | **86** | 0 | -24 | -7 | 88 |
| 4 | SLS 1a_135 | -105 | 96 | **555** | -6 | -142 | -29 | 566 |

Project: KIJ-GT
Tower: S+3
Number: 57



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 51 m |
| Max. Span | 388 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 330 m |
| EDS Weight span | 359 m |
| Min. Weight span | 356 m |
| Max. Weight span | 395 m |

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

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+3

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

Document name:

KIJ-GT_S+3_63_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+3
Number: 63

**Conductor loads**

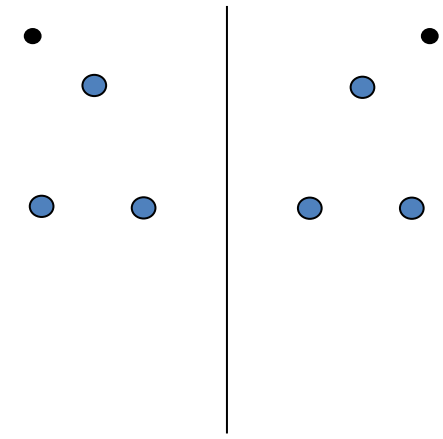
Auteur: TBR
Versie: v11.3

**General**

| | |
|---|---|
| Description | S+3 |
| 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 | 31,2 m | 35,5 m | 15,7 m |
| Circuit 1 | 11 | 380ct1f2 | 31,2 m | 35,5 m | 8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 42,5 m | 46,8 m | 12,2 m |
| Circuit 2 | 20 | 380ct2f1 | 31,2 m | 35,5 m | -8,7 m |
| Circuit 2 | 21 | 380ct2f2 | 31,2 m | 35,5 m | -15,7 m |
| Circuit 2 | 22 | 380ct2f3 | 42,5 m | 46,8 m | -12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 46,3 m | 46,8 m | 16,2 m |
| Bliksemdraad 2 | 3 | bl2 | 46,3 m | 46,8 m | -16,2 m |

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

Project: KIJ-GT
Tower: S+3
Number: 63

**Height adjustment adjacent masts** (wind and weight span adjustment)

| | Back | | Ahead | | |
|---|---|---|---|---|---|
| Height increase for wind pressure | 0,0 | m | 0,0 | m | (positive: higher) |
| Height decrease for vertical load | 0,0 | m | 0,0 | m | (negative: decrease, more weight span) |

Decrease: Niet in 0,9EG-combinaties

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

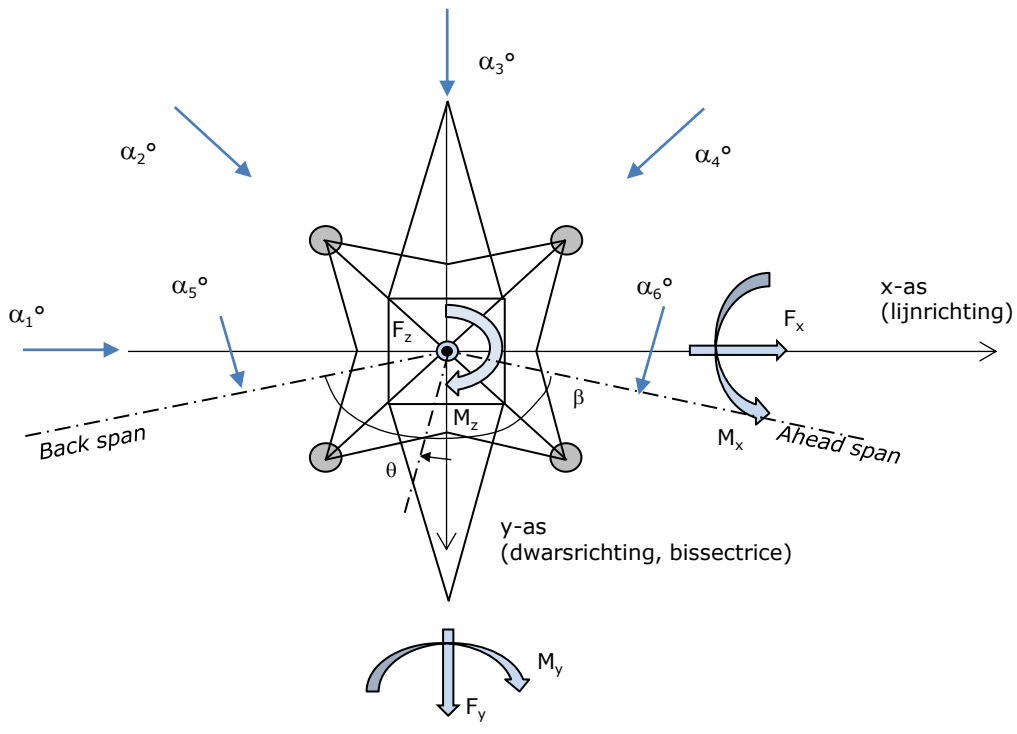
| | | | Hoogteverschil | | | Richtingsverandering | | |
|---|---|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | | Δy_back | Δy_ahead | |
| Circuit 1 | 10 | 380ct1f1 | -3,0 | -3,3 | m | 0,0 | 0,0 | m |
| Circuit 1 | 11 | 380ct1f2 | -3,0 | -3,3 | m | 0,0 | 0,0 | m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

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 272,0 | 388,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 389,6 | 389,6 | m |
| Line angle | $\beta$ | 180 | ° | |
| Tower orientation with respect to bi | $\theta$ | 0 | ° | |
| Section length | | 3064 | 3064 | m |
| Height bottom of tower to ground level | | 0,5 | m | |
| Wind directions considered | $\alpha_1$ | 0 | ° | |
| Wind directions according to: | $\alpha_2$ | 45 | ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | ° | |
| | $\alpha_4$ | 135 | ° | |
| | $\alpha_5$ | - | ° | |
| | $\alpha_6$ | - | ° | |

*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+3
Number: 63

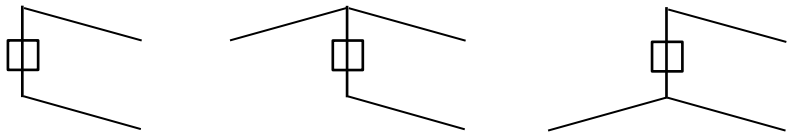
**Absence of conductors**

| | | 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 |

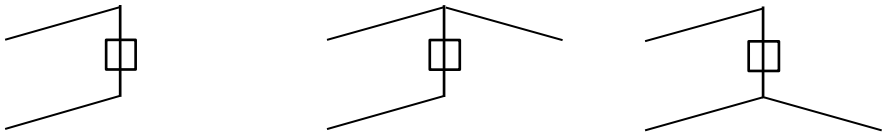
**Load situations SPLS**

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+3
Number: 63

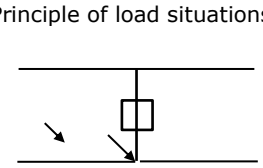
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

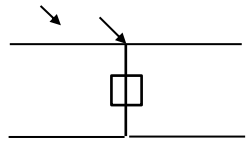
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

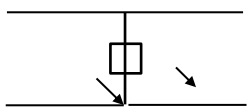
Principle of load situations:



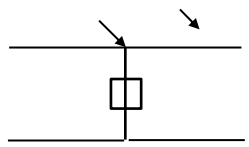
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

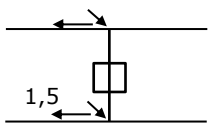
**Load situations 8. Galloping as a static load**

| 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 |

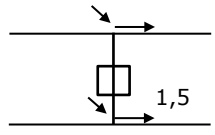
Considered situations galloping 8: None (existing structure)

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+3
Number: 63

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+3 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 51,0 | m | |
| Tower self weight | 230,0 | kN | |
| | | | |
| *Width and slope at foundation* | x-ri. | y-ri. | |
| Leg spread | 9,86 | 9,86 | 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] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 9,86 | 5,79 | 14,18 | 0,144 | 110,96 | 11,25 | 0,10 | 3,40 |
| Middenstuk 1 | 24,18 | 5,79 | 4,48 | 10,00 | 0,066 | 51,35 | 6,25 | 0,12 | 3,30 |
| Middenstuk 2 | 35,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 41,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 49,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 51,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 35,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 46,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

**Properties tower sections transverse direction (side view, xz plane)**

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 9,86 | 5,79 | 14,18 | 0,144 | 110,96 | 11,25 | 0,10 | 3,40 |
| Middenstuk 1 | 24,18 | 5,79 | 4,48 | 10,00 | 0,066 | 51,35 | 6,25 | 0,12 | 3,30 |
| Middenstuk 2 | 35,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 41,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 49,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 51,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 35,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 46,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

*Note: Surface transverse direction is reduced in calculation.*

Project: KIJ-GT
Tower: S+3
Number: 63

**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | $\Delta$h | $A_1$ |
|---|---|---|---|
| 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 | $p_w$ [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 | 0,70 | 26,8 | 22,7 | 0,0 | -22,7 | 7,1 | 190,1 | 161,3 | 0,0 | -161,3 |
| Middenstuk 1 | 0,87 | 17,9 | 15,1 | 0,0 | -15,1 | 19,2 | 342,4 | 290,5 | 0,0 | -290,5 |
| Middenstuk 2 | 0,99 | 22,5 | 19,1 | 0,0 | -19,1 | 29,8 | 670,7 | 569,1 | 0,0 | -569,1 |
| Bovenstuk 1 | 1,06 | 12,5 | 10,6 | 0,0 | -10,6 | 38,4 | 481,0 | 408,2 | 0,0 | -408,2 |
| Bovenstuk 2 | 1,11 | 14,6 | 12,4 | 0,0 | -12,4 | 45,4 | 660,8 | 560,7 | 0,0 | -560,7 |
| Topstuk | 1,14 | | | | | 50,2 | | | | |
| Ondertraverse | 1,04 | 28,3 | 16,8 | 0,0 | -16,8 | 36,5 | 1032,9 | 613,5 | 0,0 | -613,5 |
| Boventraverse | 1,12 | 29,3 | 17,4 | 0,0 | -17,4 | 47,7 | 1397,6 | 830,1 | 0,0 | -830,1 |
| Totaal | | 151,8 | 114,2 | 0,0 | -114,2 | | 4775,5 | 3433,4 | 0,0 | -3433,4 |

**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 | 0,70 | 0,0 | 22,7 | 26,8 | 22,7 | 7,1 | 0,0 | 161,3 | 190,1 | 161,3 |
| Middenstuk 1 | 0,87 | 0,0 | 15,1 | 17,9 | 15,1 | 19,2 | 0,0 | 290,5 | 342,4 | 290,5 |
| Middenstuk 2 | 0,99 | 0,0 | 19,1 | 22,5 | 19,1 | 29,8 | 0,0 | 569,1 | 670,7 | 569,1 |
| Bovenstuk 1 | 1,06 | 0,0 | 10,6 | 12,5 | 10,6 | 38,4 | 0,0 | 408,2 | 481,0 | 408,2 |
| Bovenstuk 2 | 1,11 | 0,0 | 12,4 | 14,6 | 12,4 | 45,4 | 0,0 | 560,7 | 660,8 | 560,7 |
| Topstuk | 1,14 | | | | | 50,2 | | | | |
| Ondertraverse | 1,04 | 0,0 | 16,8 | 11,3 | 16,8 | 36,5 | 0,0 | 613,5 | 413,1 | 613,5 |
| Boventraverse | 1,12 | 0,0 | 17,4 | 11,7 | 17,4 | 47,7 | 0,0 | 830,1 | 559,0 | 830,1 |
| Total | | 0,0 | 114,2 | 117,3 | 114,2 | | 0,0 | 3433,4 | 3317,2 | 3433,4 |

**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 | 230 | 0 | 0 | 0 |
| Windrichting 0° | 152 | 0 | 0 | 0 | 4775 | 0 |
| Windrichting 45° | 114 | 114 | 0 | 3433 | 3433 | 0 |
| Windrichting 90° | 0 | 117 | 0 | 3317 | 0 | 0 |
| Windrichting 135° | -114 | 114 | 0 | 3433 | -3433 | 0 |

Project: KIJ-GT
Tower: S+3
Number: 63

**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct1f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct1f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 45,15 | 1,11 | 1,2 | 1,33 |
| 380ct2f1 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct2f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 33,85 | 1,02 | 1,2 | 1,23 |
| 380ct2f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 45,15 | 1,11 | 1,2 | 1,33 |
| bl1 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 47,05 | 1,12 | 1,2 | 0,07 |
| bl2 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 47,05 | 1,12 | 1,2 | 0,07 |

Project: KIJ-GT
Tower: S+3
Number: 63

**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 | 25,8 | 0,95 | 0,58 | 0,49 | 1,11 | 28,25 | 51,7 | 43,8 | 46,9 | 92,8 | 78,6 |
| 380ct1f2 | 25,8 | 0,95 | 0,58 | 0,49 | 1,11 | 28,25 | 51,7 | 43,8 | 46,9 | 92,8 | 78,6 |
| 380ct1f3 | 37,1 | 1,05 | 0,61 | 0,52 | 1,08 | 28,25 | 58,6 | 49,6 | 46,9 | 107,9 | 91,3 |
| 380ct2f1 | 25,8 | 0,95 | 0,58 | 0,49 | 1,11 | 28,25 | 51,7 | 43,8 | 46,9 | 92,8 | 78,6 |
| 380ct2f2 | 25,8 | 0,95 | 0,58 | 0,49 | 1,11 | 28,25 | 51,7 | 43,8 | 46,9 | 92,8 | 78,6 |
| 380ct2f3 | 37,1 | 1,05 | 0,61 | 0,52 | 1,08 | 28,25 | 58,6 | 49,6 | 46,9 | 107,9 | 91,3 |
| bl1 | 41,2 | 1,08 | 0,62 | 0,52 | 1,20 | 22,24 | 17,7 | 15,0 | 41,5 | 33,2 | 28,1 |
| bl2 | 41,2 | 1,08 | 0,62 | 0,52 | 1,20 | 22,13 | 17,7 | 15,0 | 41,4 | 33,1 | 28,0 |

**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 | 21,1 | 0,89 | 0,56 | 0,48 | 1,13 | 28,25 | 48,0 | 40,7 | 46,9 | 84,9 | 72,1 |
| 380ct1f2 | 21,1 | 0,89 | 0,56 | 0,48 | 1,13 | 28,25 | 48,0 | 40,7 | 46,9 | 84,9 | 72,1 |
| 380ct1f3 | 32,4 | 1,01 | 0,60 | 0,51 | 1,09 | 28,25 | 56,0 | 47,4 | 46,9 | 102,1 | 86,4 |
| 380ct2f1 | 21,1 | 0,89 | 0,56 | 0,48 | 1,13 | 28,25 | 48,0 | 40,7 | 46,9 | 84,9 | 72,1 |
| 380ct2f2 | 21,1 | 0,89 | 0,56 | 0,48 | 1,13 | 28,25 | 48,0 | 40,7 | 46,9 | 84,9 | 72,1 |
| 380ct2f3 | 32,4 | 1,01 | 0,60 | 0,51 | 1,09 | 28,25 | 56,0 | 47,4 | 46,9 | 102,1 | 86,4 |
| bl1 | 36,8 | 1,05 | 0,61 | 0,51 | 1,20 | 22,24 | 17,0 | 14,4 | 41,5 | 31,7 | 26,8 |
| bl2 | 36,8 | 1,05 | 0,61 | 0,51 | 1,20 | 22,13 | 16,9 | 14,3 | 41,4 | 31,7 | 26,8 |

Project: KIJ-GT
Tower: S+3
Number: 63

**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 °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,05 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk only tower | 10° | 0,90 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk conductors too | 10° | 0,90 | 0,90 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 3_0,9 | Wind+ice 0,9Gk | -5° | 0,90 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 4_0,9 | Cold+wind 0,9Gk | -20° | 0,90 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 5a | Torsional loads | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinal loads | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Construction + maintenance | 5° | 1,05 | 1,05 | 1,20 | 0,22 | 0,00 | 0,0 |
| ULS 6_0,9 | Construction + maintenance | 5° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,15 | 1,15 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (strength, for angle towers: absence of conductors) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,94 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,28 | 0,88 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Number of wind directions | 4 |
| Number of load combinations for ULS | 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+3
Number: 63

**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 | -29,2 | 29,2 | 2,7 | 3,7 | 4,1 | 5,3 |
| bl2 | -29,4 | 29,4 | 2,7 | 3,7 | 4,1 | 5,3 |
| 380ct1f1 | -109,5 | 109,5 | 8,5 | 11,1 | 12,6 | 16,7 |
| 380ct1f2 | -109,5 | 109,5 | 8,5 | 11,1 | 12,6 | 16,7 |
| 380ct1f3 | -111,3 | 111,3 | 9,6 | 12,9 | 12,6 | 16,7 |
| 380ct2f1 | -109,5 | 109,5 | 8,5 | 11,1 | 12,6 | 16,7 |
| 380ct2f2 | -109,5 | 109,5 | 8,5 | 11,1 | 12,6 | 16,7 |
| 380ct2f3 | -111,3 | 111,3 | 9,6 | 12,9 | 12,6 | 16,7 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 358,9 | 362,9 | 358,9 |
| bl2 | 358,9 | 363,7 | 358,9 |
| 380ct1f1 | 357,0 | 359,8 | 357,0 |
| 380ct1f2 | 357,0 | 359,8 | 357,0 |
| 380ct1f3 | 357,0 | 360,0 | 357,0 |
| 380ct2f1 | 357,0 | 359,8 | 357,0 |
| 380ct2f2 | 357,0 | 359,8 | 357,0 |
| 380ct2f3 | 357,0 | 360,0 | 357,0 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 379,1 | 360,3 |
| bl2 | 379,1 | 360,6 |
| 380ct1f1 | 366,5 | 357,9 |
| 380ct1f2 | 366,5 | 357,9 |
| 380ct1f3 | 368,9 | 358,4 |
| 380ct2f1 | 366,5 | 357,9 |
| 380ct2f2 | 366,5 | 357,9 |
| 380ct2f3 | 368,9 | 358,4 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 385,4 m | 1,168 - |
| Min. weight span | 356,3 m | 1,080 - |

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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 | 6,5 | 7,6 | -31,1 | 31,1 |
| bl2 | 15,0 | 6,4 | 7,6 | -31,2 | 31,2 |
| 380ct1f1 | 51,3 | 19,6 | 29,2 | -109,9 | 109,1 |
| 380ct1f2 | 51,3 | 19,6 | 29,2 | -109,9 | 109,1 |
| 380ct1f3 | 51,3 | 22,5 | 29,3 | -111,7 | 111,0 |
| 380ct2f1 | 51,3 | 19,6 | 29,2 | -109,9 | 109,1 |
| 380ct2f2 | 51,3 | 19,6 | 29,2 | -109,9 | 109,1 |
| 380ct2f3 | 51,3 | 22,5 | 29,3 | -111,7 | 111,0 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1,6 | 2,1 |
| | bl2 | 1,6 | 2,1 |
| | 380ct1f1 | 8,0 | 10,5 |
| | 380ct1f2 | 8,0 | 10,5 |
| | 380ct1f3 | 8,0 | 10,5 |
| | 380ct2f1 | 8,0 | 10,5 |
| | 380ct2f2 | 8,0 | 10,5 |
| | 380ct2f3 | 8,0 | 10,5 |

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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 | 136 | 127 | 5497 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 136 | 127 | 5497 | 0 | 0 |
| ULS 3_90 | | 0 | 72 | 189 | 2902 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 72 | 189 | 2902 | 0 | 0 |
| SLS 7 | | 0 | 0 | 118 | 0 | 0 | 0 |

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

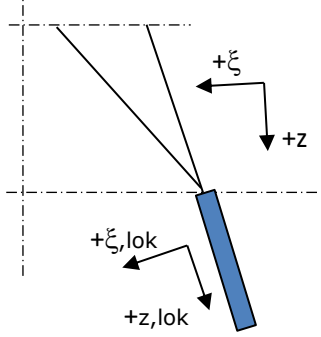
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 267 | 368 | 9202 | 0 | 0 |
| ULS 3_90 | 0 | 111 | 431 | 4014 | 0 | 0 |
| SLS 7 | 0 | 0 | 348 | 0 | 0 | 0 |

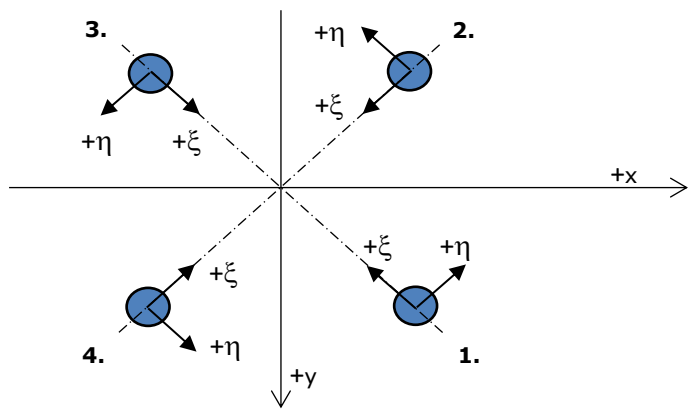
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 267 | 368 | **9202** | 0 | 0 |
| ULS 1a_0 | 172 | 0 | 365 | 0 | **5423** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 349 | -109 | 1823 | **806** |
| ULS 1a_45 | 129 | 197 | 366 | **6653** | **3898** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 118 | 107 | **627** | 8 | -160 | -33 | 639 |
| 2 | ULS 1a_0 | 61 | -74 | **366** | 9 | -95 | -21 | 374 |
| 3 | ULS 7 | -20 | -20 | **100** | 0 | -28 | -8 | 102 |
| 4 | ULS 1a_135 | -118 | 107 | **627** | -8 | -160 | -33 | 639 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -84 | 73 | **-457** | 8 | 111 | 19 | -466 |
| 3 | ULS 1a_0,9_0,9_45 | 84 | 73 | **-457** | -8 | 111 | 19 | -466 |
| 4 | ULS 1a_0,9_0,9_0 | 27 | -40 | **-197** | -9 | 47 | 7 | -201 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 50 | 16 | 174 | **24** | -46 | -11 | 178 |
| 2 | ULS 5a Ba 10 | 11 | -57 | 185 | **32** | -48 | -10 | 189 |
| 3 | ULS 5a Ba 10 | -26 | 21 | 0 | **34** | -3 | -3 | 0 |
| 4 | ULS 5a Ba 10 | 17 | 19 | -11 | **26** | -2 | -4 | -11 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 11 | 57 | 185 | **-32** | -48 | -10 | 189 |
| 2 | ULS 5a Ba 21 | 50 | -16 | 174 | **-24** | -46 | -11 | 178 |
| 3 | ULS 5a Ba 21 | 17 | -19 | -11 | **-26** | -2 | -4 | -11 |
| 4 | ULS 5a Ba 21 | -26 | -21 | 0 | **-34** | -3 | -3 | 0 |

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Tower: S+3
Number: 63

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -84 | 73 | **-457** | **8** | 111 | 19 | -466 |
| 3 | ULS 1a_0,9_0,9_45 | 84 | 73 | **-457** | **-8** | 111 | 19 | -466 |
| 4 | ULS 1a_0,9_0,9_0 | 27 | -40 | **-197** | **-9** | 47 | 7 | -201 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | 87 | 0 | -25 | -7 | 89 |
| 2 | SLS 7 | 17 | -17 | 87 | 0 | -25 | -7 | 89 |
| 3 | SLS 7 | -17 | -17 | 87 | 0 | -25 | -7 | 89 |
| 4 | SLS 7 | -17 | 17 | 87 | 0 | -25 | -7 | 89 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 118 | 107 | **627** | 8 | -160 | -33 | 639 |
| Max. tension | ULS 1a_0,9_0,9_45 | 84 | 73 | **-457** | -8 | 111 | 19 | -466 |
| Max. pos. torsie | ULS 5a Ba 10 | -26 | 21 | 0 | **34** | -3 | -3 | 0 |
| Max. neg. torsie | ULS 5a Ba 21 | -26 | -21 | 0 | **-34** | -3 | -3 | 0 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 84 | 73 | **-457** | **-8** | 111 | 19 | -466 |

**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | **87** | 0 | -25 | -7 | 89 |
| 2 | SLS 1a_135 | -67 | 58 | **-365** | 7 | 88 | 14 | -372 |
| 3 | SLS 1a_45 | 67 | 58 | **-365** | -7 | 88 | 14 | -372 |
| 4 | SLS 1a_0 | 19 | -29 | **-145** | -7 | 34 | 4 | -148 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 102 | 93 | **539** | 7 | -138 | -28 | 550 |
| 2 | SLS 1a_0 | 54 | -64 | **319** | 7 | -83 | -19 | 326 |
| 3 | SLS 7 | -17 | -17 | **87** | 0 | -25 | -7 | 89 |
| 4 | SLS 1a_135 | -102 | 93 | **539** | -7 | -138 | -28 | 550 |

Project: KIJ-GT
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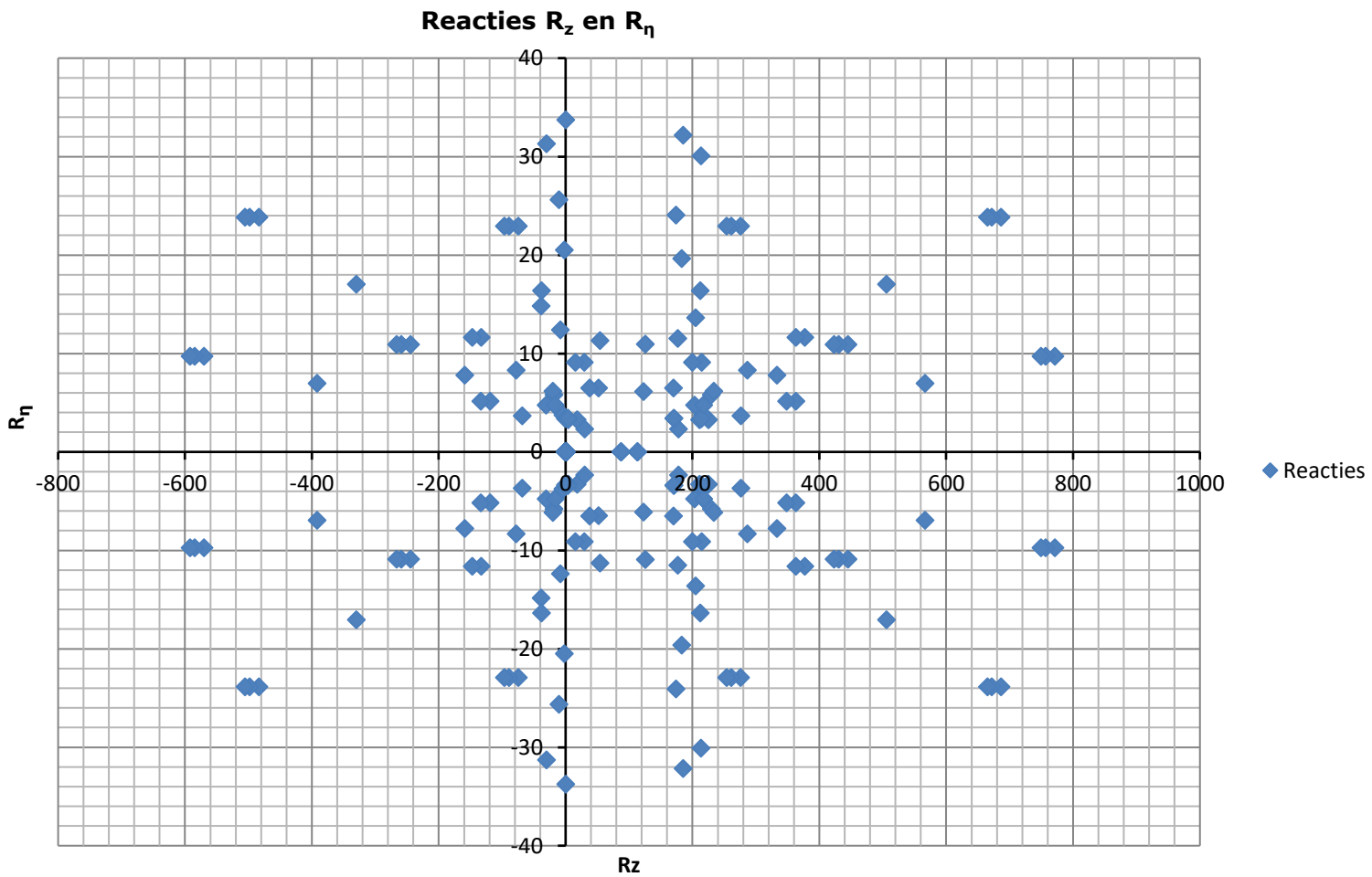


Project: KIJ-GT
Tower: S+3
Number: 63

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+3
Number: 63

**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 | -34,2 | 34,2 | 3,4 | 4,7 | 4,5 | 5,8 |
| bl2 | -34,4 | 34,4 | 3,4 | 4,6 | 4,5 | 5,8 |
| 380ct1f1 | -127,5 | 127,5 | 10,7 | 13,9 | 14,8 | 19,7 |
| 380ct1f2 | -127,5 | 127,5 | 10,7 | 13,9 | 14,8 | 19,7 |
| 380ct1f3 | -129,8 | 129,8 | 12,1 | 16,1 | 14,8 | 19,7 |
| 380ct2f1 | -127,5 | 127,5 | 10,7 | 13,9 | 14,8 | 19,7 |
| 380ct2f2 | -127,5 | 127,5 | 10,7 | 13,9 | 14,8 | 19,7 |
| 380ct2f3 | -129,8 | 129,8 | 12,1 | 16,1 | 14,8 | 19,7 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 358,9 | 363,0 | 358,9 |
| bl2 | 358,9 | 363,8 | 358,9 |
| 380ct1f1 | 357,0 | 359,9 | 357,0 |
| 380ct1f2 | 357,0 | 359,9 | 357,0 |
| 380ct1f3 | 357,0 | 360,0 | 357,0 |
| 380ct2f1 | 357,0 | 359,9 | 357,0 |
| 380ct2f2 | 357,0 | 359,9 | 357,0 |
| 380ct2f3 | 357,0 | 360,0 | 357,0 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 382,6 | 359,5 |
| bl2 | 382,6 | 359,7 |
| 380ct1f1 | 368,5 | 357,4 |
| 380ct1f2 | 368,5 | 357,4 |
| 380ct1f3 | 371,3 | 357,9 |
| 380ct2f1 | 368,5 | 357,4 |
| 380ct2f2 | 368,5 | 357,4 |
| 380ct2f3 | 371,3 | 357,9 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 394,5 m | 1,196 - |
| Min. weight span | 356,0 m | 1,079 - |

Project: KIJ-GT
Tower: S+3
Number: 63

**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 | 8,1 | 8,3 | -34,3 | 34,0 |
| bl2 | 15,0 | 8,1 | 8,3 | -34,5 | 34,3 |
| 380ct1f1 | 51,3 | 24,6 | 34,4 | -128,0 | 127,0 |
| 380ct1f2 | 51,3 | 24,6 | 34,4 | -128,0 | 127,0 |
| 380ct1f3 | 51,3 | 28,2 | 34,5 | -130,3 | 129,4 |
| 380ct2f1 | 51,3 | 24,6 | 34,4 | -128,0 | 127,0 |
| 380ct2f2 | 51,3 | 24,6 | 34,4 | -128,0 | 127,0 |
| 380ct2f3 | 51,3 | 28,2 | 34,5 | -130,3 | 129,4 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 18,4 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1,6 | 2,1 |
| | bl2 | 1,6 | 2,1 |
| | 380ct1f1 | 8,0 | 10,5 |
| | 380ct1f2 | 8,0 | 10,5 |
| | 380ct1f3 | 8,0 | 10,5 |
| | 380ct2f1 | 8,0 | 10,5 |
| | 380ct2f2 | 8,0 | 10,5 |
| | 380ct2f3 | 8,0 | 10,5 |

Project: KIJ-GT
Tower: S+3
Number: 63

**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 | 171 | 140 | 6892 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 171 | 140 | 6892 | 0 | 0 |
| ULS 3_90 | | 0 | 90 | 223 | 3638 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 90 | 223 | 3638 | 0 | 0 |
| SLS 7 | | 0 | 0 | 118 | 0 | 0 | 0 |

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

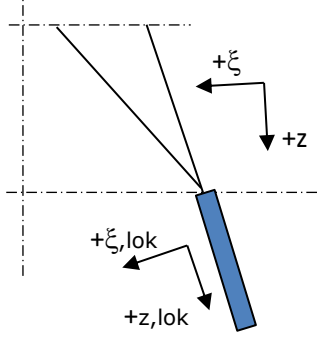
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 335 | 404 | 11536 | 0 | 0 |
| ULS 3_90 | 0 | 139 | 488 | 5032 | 0 | 0 |
| SLS 7 | 0 | 0 | 348 | 0 | 0 | 0 |

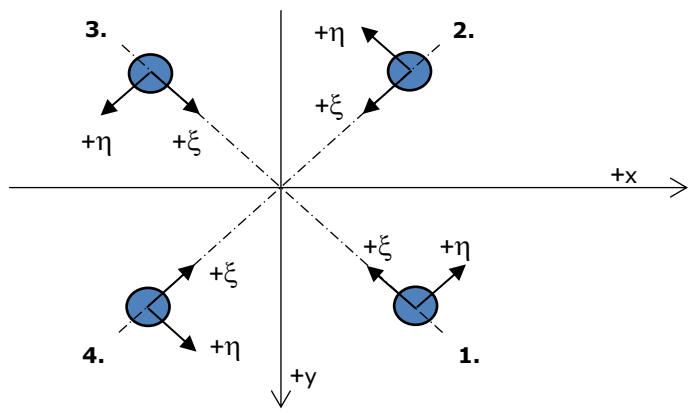
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 335 | 404 | **11536** | 0 | 0 |
| ULS 1a_0 | 215 | 0 | 400 | 0 | **6799** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 349 | -109 | 1823 | **806** |
| ULS 1a_45 | 162 | 248 | 401 | **8341** | **4887** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 146 | 132 | **771** | 10 | -196 | -40 | 787 |
| 2 | ULS 1a_0 | 74 | -89 | **445** | 11 | -115 | -25 | 454 |
| 3 | ULS 7 | -23 | -23 | **113** | 0 | -32 | -9 | 115 |
| 4 | ULS 1a_135 | -146 | 132 | **771** | -10 | -196 | -40 | 787 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -110 | 96 | **-592** | 10 | 145 | 25 | -604 |
| 3 | ULS 1a_0,9_0,9_45 | 110 | 96 | **-592** | -10 | 145 | 25 | -604 |
| 4 | ULS 1a_0,9_0,9_0 | 38 | -54 | **-267** | -11 | 65 | 11 | -272 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 50 | 16 | 174 | **24** | -46 | -11 | 178 |
| 2 | ULS 5a Ba 10 | 11 | -57 | 185 | **32** | -48 | -10 | 189 |
| 3 | ULS 5a Ba 10 | -26 | 21 | 0 | **34** | -3 | -3 | 0 |
| 4 | ULS 5a Ba 10 | 17 | 19 | -11 | **26** | -2 | -4 | -11 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 11 | 57 | 185 | **-32** | -48 | -10 | 189 |
| 2 | ULS 5a Ba 21 | 50 | -16 | 174 | **-24** | -46 | -11 | 178 |
| 3 | ULS 5a Ba 21 | 17 | -19 | -11 | **-26** | -2 | -4 | -11 |
| 4 | ULS 5a Ba 21 | -26 | -21 | 0 | **-34** | -3 | -3 | 0 |

Project: KIJ-GT
Tower: S+3
Number: 63

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -110 | 96 | **-592** | **10** | 145 | 25 | -604 |
| 3 | ULS 1a_0,9_0,9_45 | 110 | 96 | **-592** | **-10** | 145 | 25 | -604 |
| 4 | ULS 1a_0,9_0,9_0 | 38 | -54 | **-267** | **-11** | 65 | 11 | -272 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | 87 | 0 | -25 | -7 | 89 |
| 2 | SLS 7 | 17 | -17 | 87 | 0 | -25 | -7 | 89 |
| 3 | SLS 7 | -17 | -17 | 87 | 0 | -25 | -7 | 89 |
| 4 | SLS 7 | -17 | 17 | 87 | 0 | -25 | -7 | 89 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 146 | 132 | **771** | 10 | -196 | -40 | 787 |
| Max. tension | ULS 1a_0,9_0,9_45 | 110 | 96 | **-592** | -10 | 145 | 25 | -604 |
| Max. pos. torsie | ULS 5a Ba 10 | -26 | 21 | 0 | **34** | -3 | -3 | 0 |
| Max. neg. torsie | ULS 5a Ba 21 | -26 | -21 | 0 | **-34** | -3 | -3 | 0 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 110 | 96 | **-592** | **-10** | 145 | 25 | -604 |

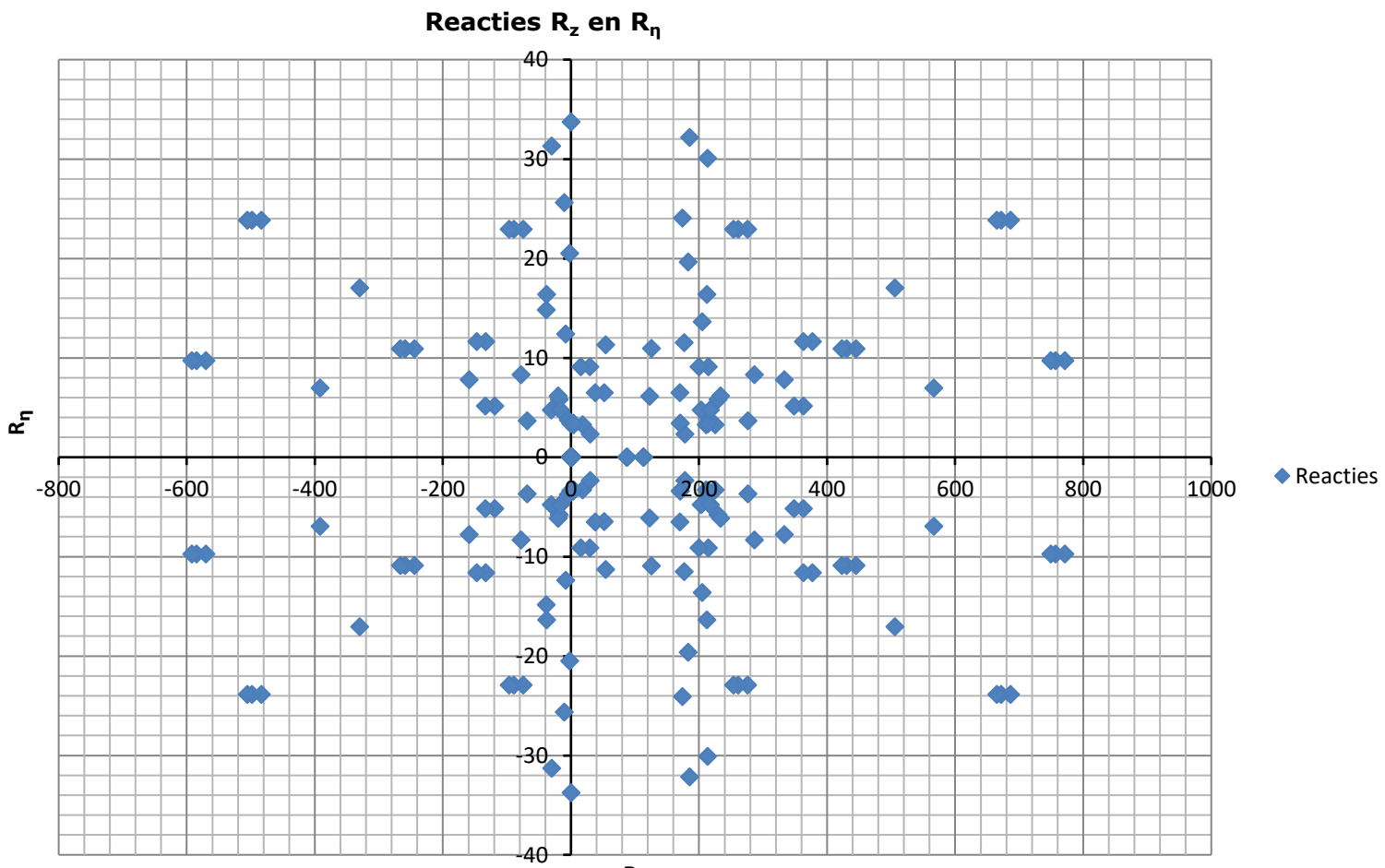
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 17 | 17 | **87** | 0 | -25 | -7 | 89 |
| 2 | SLS 1a_135 | -72 | 62 | **-392** | 7 | 95 | 15 | -400 |
| 3 | SLS 1a_45 | 72 | 62 | **-392** | -7 | 95 | 15 | -400 |
| 4 | SLS 1a_0 | 21 | -32 | **-159** | -8 | 37 | 5 | -163 |

**Maximum compression load - SLS**

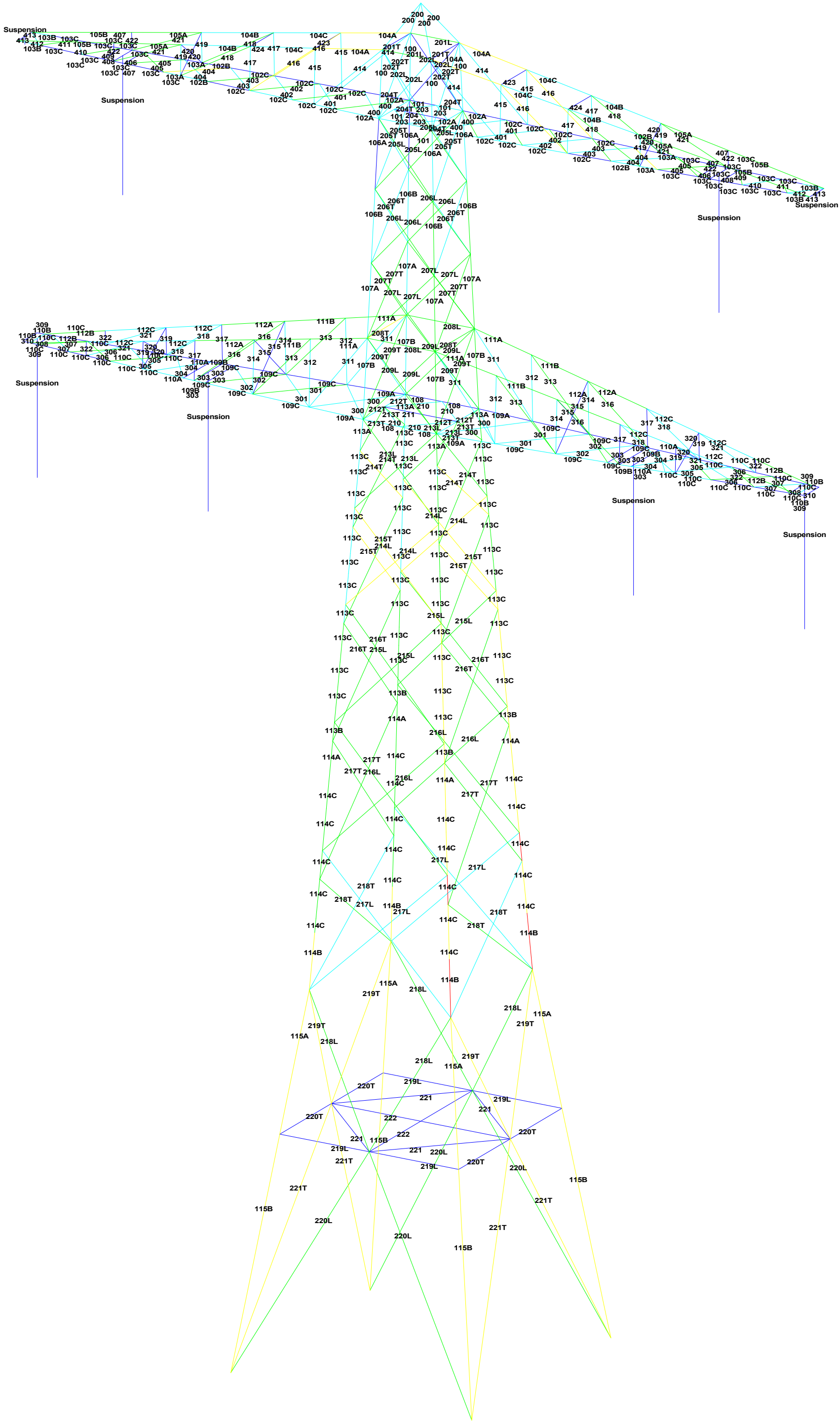
| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 107 | 97 | **566** | 7 | -145 | -30 | 578 |
| 2 | SLS 1a_0 | 56 | -67 | **333** | 8 | -87 | -19 | 340 |
| 3 | SLS 7 | -17 | -17 | **87** | 0 | -25 | -7 | 89 |
| 4 | SLS 1a_135 | -107 | 97 | **566** | -7 | -145 | -30 | 578 |

Project: KIJ-GT
Tower: S+3
Number: 63



# APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project: "S+3 (hv) ini"
Tower Version 16.12, 13:26:50 Thursday, 16 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+3**
**Mast 47**

| 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 | hear (Tens) | earing (Tens) | U.C. (Tens) | Exceedance (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115A | | 150x150x14 | S235 | 8M24-5.6t | 0.33 | 0.33 | 0.33 | 62 | **-651.0** | ULS 1a_135 | 793.2 | 677.8 | 1451.5 | 0.96 | | **529.7** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.78 | |
| 115B | | 150x150x14 | S235 | 8M24-5.6t | 0.20 | 0.20 | 0.20 | 61 | **-654.9** | ULS 1a_135 | 795.4 | 677.8 | 1451.5 | 0.97 | | **526.1** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.78 | |
| 114A | | 150x150x14 | S235 | 8M24-5.6t | 1.66 | 1.73 | 1.38 | 80 | **-631.5** | ULS 1a_135 | 703.1 | 677.8 | 1451.5 | 0.93 | | **491.6** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.73 | |
| 114B | | 150x150x14 | S235 | 8M24-5.6t | 0.76 | 1.28 | 0.63 | 60 | **-736.7** | ULS 1a_135 | 801.9 | 677.8 | 1451.5 | 1.09 | afschuiving | **586.9** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.87 | |
| 114C | | 150x150x14 | S235 | | 3.04 | 3.36 | 2.53 | 92 | **-687.3** | ULS 1a_135 | 631.9 | 0.0 | 0.0 | 1.09 | knik | **588.2** | ULS 1a_0,9_0,9_135 | 943.3 | 0.0 | 0.0 | 0.62 | |
| 113A | | 150x150x12 | S235 | 6M24-5.6t | 1.77 | 1.37 | 1.14 | 46 | **-338.7** | ULS 1a_135 | 745.1 | 508.3 | 933.1 | 0.67 | | **222.4** | ULS 1a_0,9_0,9_135 | 740.3 | 508.3 | 797.5 | 0.44 | |
| 113B | | 150x150x12 | S235 | 8M24-5.6t | 4.01 | 4.23 | 3.34 | 80 | **-609.0** | ULS 1a_135 | 610.6 | 677.8 | 1244.2 | 1.00 | | **466.3** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.69 | |
| 113C | | 150x150x12 | S235 | | 1.70 | 1.70 | 1.42 | 75 | **-564.1** | ULS 1a_135 | 633.7 | 0.0 | 0.0 | 0.89 | | **426.1** | ULS 1a_0,9_0,9_135 | 817.8 | 0.0 | 0.0 | 0.52 | |
| 107A | | 100x100x12 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 76 | **-181.8** | ULS 1a_135 | 410.3 | 338.9 | 622.1 | 0.54 | | **130.1** | ULS 1a_0,9_0,9_135 | 426.6 | 338.9 | 531.7 | 0.38 | |
| 107B | | 100x100x12 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-221.9** | ULS 1a_135 | 391.5 | 508.3 | 933.1 | 0.57 | | **133.0** | ULS 1a_0,9_0,9_135 | 426.6 | 508.3 | 781.6 | 0.31 | |
| 106A | | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 79 | **-61.5** | ULS 1a_135 | 245.7 | 338.9 | 414.7 | 0.25 | | **16.7** | ULS 1a_0,9_0,9_135 | 252.5 | 338.9 | 297.7 | 0.07 | |
| 106B | | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-127.6** | ULS 1a_135 | 239.6 | 338.9 | 414.7 | 0.53 | | **78.2** | ULS 1a_0,9_0,9_135 | 252.5 | 338.9 | 354.5 | 0.31 | |
| 100 | | 90x90x8 | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 146 | **-39.0** | ULS 5a Ba 22 | 112.9 | 235.2 | 345.6 | 0.35 | | **0.0** | | 269.1 | 235.2 | 314.2 | 0.00 | |
| 200 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 222 | **-7.1** | ULS 5a Ba 12 | 23.5 | 75.4 | 86.4 | 0.30 | | **7.1** | ULS 5a Ba 12 | 52.4 | 75.4 | 44.1 | 0.16 | |
| 111A | | 80x80x10 | S235 | 3M24-5.6t | 1.00 | 2.00 | 1.00 | 205 | **0.0** | | 79.4 | 254.2 | 388.8 | 0.00 | | **132.1** | ULS 3_45 | 196.6 | 254.2 | 323.8 | 0.67 | |
| 111B | | 80x80x10 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 204 | **0.0** | | 79.9 | 176.4 | 324.0 | 0.00 | | **116.5** | ULS 3_0 | 206.0 | 176.4 | 261.8 | 0.66 | |
| 112A | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 1.88 | 1.00 | 227 | **0.0** | | 42.7 | 176.4 | 226.8 | 0.00 | | **92.4** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.74 | |
| 112B | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 176.4 | 226.8 | 0.00 | | **79.9** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.64 | |
| 112C | | 70x70x7 | S235 | | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 0.0 | 0.0 | 0.00 | | **88.2** | ULS 3_0 | 220.9 | 0.0 | 0.0 | 0.40 | |
| 110A | | 120x120x13 | S235 | 6M24-5.6t | 1.64 | 1.00 | 1.00 | 61 | **-194.4** | ULS 5a Ba 21 | 596.9 | 508.3 | 1010.9 | 0.38 | | **102.3** | ULS 5a Ba 21 | 602.4 | 508.3 | 864.0 | 0.20 | |
| 110B | | 120x120x13 | S235 | | 1.00 | 10.43 | 1.00 | 86 | **-0.4** | ULS 1a_0,9_0,9_90 | 499.4 | 0.0 | 0.0 | 0.00 | | **0.4** | ULS 1a_90 | 705.0 | 0.0 | 0.0 | 0.00 | |
| 110C | | 120x120x13 | S235 | | 1.29 | 1.71 | 1.00 | 66 | **-161.8** | ULS 5a Ba 21 | 578.1 | 0.0 | 0.0 | 0.28 | | **79.1** | ULS 5a Ba 10 | 705.0 | 0.0 | 0.0 | 0.11 | |
| 109A | | 150x100x16 | S235 | 11M24-5.6t | 1.00 | 0.52 | 0.52 | 56 | **-305.2** | ULS 5a Ba 10 | 774.5 | 931.9 | 2281.0 | 0.39 | | **140.9** | ULS 5a Ba 21 | 767.8 | 931.9 | 1384.2 | 0.18 | |
| 109B | | 150x100x16 | S235 | 6M24-5.6t | 4.78 | 1.00 | 1.00 | 47 | **-209.5** | ULS 5a Ba 10 | 809.1 | 508.3 | 1244.2 | 0.41 | | **117.3** | ULS 5a Ba 21 | 767.8 | 508.3 | 1063.4 | 0.23 | |
| 109C | | 150x100x16 | S235 | | 1.00 | 0.52 | 0.52 | 58 | **-280.5** | ULS 5a Ba 21 | 764.8 | 0.0 | 0.0 | 0.37 | | **129.7** | ULS 5a Ba 10 | 891.6 | 0.0 | 0.0 | 0.15 | |
| 104A | | 100x65x9* | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 204 | **0.0** | | 78.6 | 235.2 | 388.8 | 0.00 | | **109.3** | ULS 3_135 | 144.1 | 235.2 | 266.2 | 0.76 | |
| 104B | | 100x65x9* | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 211 | **0.0** | | 74.7 | 176.4 | 291.6 | 0.00 | | **75.4** | ULS 3_0 | 172.4 | 176.4 | 199.6 | 0.44 | |
| 104C | | 100x65x9* | S235 | | 1.00 | 1.00 | 1.00 | 196 | **0.0** | | 82.7 | 0.0 | 0.0 | 0.00 | | **96.2** | ULS 3_0 | 332.5 | 0.0 | 0.0 | 0.29 | |
| 105B | | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 1.70 | 1.00 | 379 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **31.2** | ULS 6a_90 Ah Ct1 | 65.9 | 75.4 | 56.0 | 0.56 | |
| 105A | | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 2.43 | 1.00 | 380 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **31.1** | ULS 6a_90 Ah Ct2 | 98.8 | 75.4 | 56.0 | 0.56 | |
| 103A | | 120x120x11 | S235 | 6M24-5.6t | 2.64 | 4.00 | 1.00 | 77 | **-134.2** | ULS 5a Ba 12 | 458.3 | 508.3 | 855.4 | 0.29 | | **46.0** | ULS 5a Ba 22 | 513.2 | 508.3 | 731.1 | 0.09 | |
| 103B | | 120x120x11 | S235 | 2M16-5.6t | 2.00 | 4.44 | 2.00 | 109 | **-31.6** | ULS 6a_90 Ah Ct1 | 333.2 | 75.4 | 190.1 | 0.42 | | **0.0** | | 429.4 | 75.4 | 190.1 | 0.00 | |
| 103C | | 120x120x11 | S235 | | 1.71 | 1.00 | 1.00 | 77 | **-96.5** | ULS 5a Ba 1 | 458.5 | 0.0 | 0.0 | 0.21 | | **20.6** | ULS 5a Ba 1 | 599.7 | 0.0 | 0.0 | 0.03 | |
| 102A | | 150x150x14 | S235 | 9M24-5.6t | 1.00 | 1.50 | 1.00 | 62 | **-307.0** | ULS 5a Ba 12 | 794.2 | 762.5 | 1633.0 | 0.40 | | **168.0** | ULS 5a Ba 22 | 851.7 | 762.5 | 990.9 | 0.22 | |
| 102B | | 150x150x14 | S235 | 6M24-5.6t | 2.52 | 1.61 | 1.00 | 63 | **-145.8** | ULS 5a Ba 12 | 786.2 | 508.3 | 1088.6 | 0.29 | | **34.2** | ULS 5a Ba 22 | 851.7 | 508.3 | 930.5 | 0.07 | |
| 102C | | 150x150x14 | S235 | | 3.01 | 2.00 | 1.00 | 59 | **-278.7** | ULS 5a Ba 12 | 805.0 | 0.0 | 0.0 | 0.35 | | **145.6** | ULS 5a Ba 22 | 943.3 | 0.0 | 0.0 | 0.15 | |
| 220L | | 100x75x9 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 128 | **-81.8** | ULS 5a Ba 10 | 149.5 | 117.6 | 194.4 | 0.70 | | **60.7** | ULS 5a Ba 21 | 149.4 | 117.6 | 157.1 | 0.52 | |
| 218L | | 150x75x9 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 128 | **-80.9** | ULS 5a Ba 10 | 195.8 | 117.6 | 194.4 | 0.69 | | **64.2** | ULS 5a Ba 21 | 182.9 | 117.6 | 157.1 | 0.55 | |
| 217L | | 100x75x8 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 129 | **-54.1** | ULS 5a Ba 21 | 127.3 | 117.6 | 172.8 | 0.46 | | **51.3** | ULS 5a Ba 10 | 128.6 | 117.6 | 104.7 | 0.49 | |
| 216L | | 100x75x7 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 116 | **-59.5** | ULS 5a Ba 10 | 124.6 | 117.6 | 151.2 | 0.51 | | **62.4** | ULS 5a Ba 21 | 115.4 | 117.6 | 106.9 | 0.58 | |
| 215L | | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 104 | **-73.5** | ULS 5a Ba 21 | 137.9 | 169.4 | 181.4 | 0.53 | | **68.9** | ULS 5a Ba 21 | 100.4 | 169.4 | 101.5 | 0.69 | |
| 214L | | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 88 | **-76.7** | ULS 5a Ba 21 | 157.5 | 169.4 | 181.4 | 0.49 | | **81.0** | ULS 5a Ba 21 | 98.2 | 169.4 | 101.5 | 0.82 | |
| 213L | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 79 | **-94.5** | ULS 5a Ba 21 | 192.8 | 169.4 | 207.4 | 0.56 | | **88.4** | ULS 5a Ba 21 | 128.4 | 169.4 | 165.8 | 0.69 | |
| 209L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-93.1** | ULS 5a Ba 12 | 177.9 | 169.4 | 207.4 | 0.55 | | **90.5** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.53 | |
| 207L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 103 | **-87.5** | ULS 5a Ba 12 | 190.8 | 169.4 | 207.4 | 0.52 | | **92.5** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.55 | |
| 206L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-103.5** | ULS 5a Ba 22 | 198.3 | 169.4 | 207.4 | 0.61 | | **97.8** | ULS 5a Ba 12 | 181.4 | 169.4 | 177.2 | 0.58 | |
| 205L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-109.3** | ULS 5a Ba 12 | 207.7 | 169.4 | 207.4 | 0.65 | | **114.4** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.68 | |
| 202L | | 70x70x7 | S235 | 1M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-21.9** | ULS 5a Ba 22 | 75.8 | 84.7 | 90.7 | 0.29 | | **15.0** | ULS 5a Ba 22 | 88.7 | 84.7 | 64.2 | 0.23 | |
| 221T | | 100x75x9 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 128 | **-110.2** | ULS 1a_90 | 149.5 | 117.6 | 194.4 | 0.94 | | **92.2** | ULS 1a_0,9_0,9_90 | 149.4 | 117.6 | 157.1 | 0.78 | |
| 219T | | 150x75x9 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 128 | **-107.4** | ULS 1a_90 | 195.8 | 117.6 | 194.4 | 0.91 | | **93.3** | ULS 1a_0,9_0,9_90 | 182.9 | 117.6 | 157.1 | 0.79 | |
| 218T | | 100x75x7 | S235 | 2M20-5.6t | 0.53 | 0.27 | 0.27 | 117 | **-53.1** | ULS 5a Ba 21 | 125.0 | 117.6 | 151.2 | 0.45 | | **56.0** | ULS 5a Ba 10 | 107.3 | 117.6 | 91.6 | 0.61 | |
| 217T | | 100x75x9 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 122 | **-73.6** | ULS 5a Ba 10 | 148.5 | 117.6 | 194.4 | 0.63 | | **69.5** | ULS 5a Ba 21 | 146.1 | 117.6 | 137.5 | 0.59 | |
| 216T | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 105 | **-79.3** | ULS 5a Ba 21 | 155.5 | 169.4 | 207.4 | 0.51 | | **82.5** | ULS 5a Ba 10 | 113.2 | 169.4 | 116.0 | 0.73 | |
| 215T | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 89 | **-90.8** | ULS 5a Ba 10 | 177.8 | 169.4 | 207.4 | 0.54 | | **86.9** | ULS 5a Ba 21 | 110.7 | 169.4 | 116.0 | 0.79 | |
| 214T | | 100x75x9 | S235 | 2M24-5.6t | 0.53 | 0.27 | 0.27 | 75 | **-93.6** | ULS 5a Ba 21 | 221.5 | 169.4 | 233.3 | 0.55 | | **96.8** | ULS 5a Ba 10 | 119.9 | 169.4 | 130.6 | 0.81 | |
| 213T | | 100x75x9 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 64 | **-100.6** | ULS 5a Ba 10 | 240.8 | 169.4 | 233.3 | 0.59 | | **97.5** | ULS 5a Ba 10 | 140.7 | 169.4 | 186.5 | 0.69 | |
| 209T | | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-100.7** | ULS 5a Ba 12 | 219.3 | 169.4 | 259.2 | 0.59 | | **80.8** | ULS 5a Ba 22 | 224.3 | 169.4 | 221.5 | 0.48 | |
| 207T | | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 104 | **-99.4** | 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 | |
| 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 | | **110.7** | ULS 5a Ba 12 | 261.1 | 254.2 | 332.3 | 0.44 | |
| 205T | | 100x100x10 | S235 | 3M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-123.3** | ULS 5a Ba 12 | 256.2 | 254.2 | 388.8 | 0.49 | | **122.2** | ULS 5a Ba 22 | 261.1 | 254.2 | 332.3 | 0.48 | |
| 202T | | 50x50x5 | S235 | 1M16-5.6t | 0.52 | 0.52 | 0.52 | 178 | **-9.7** | ULS 5a Ba 22 | 25.7 | 37.7 | 43.2 | 0.38 | | **4.2** | ULS 5a Ba 22 | 37.4 | 37.7 | 22.0 | 0.19 | |
| 219L | | 70x70x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 267 | **-4.0** | ULS 1a_90 | 27.0 | 37.7 | 51.8 | 0.15 | | **1.2** | ULS 1a_0,9_135 | 89.9 | 37.7 | 38.4 | 0.03 | |
| 220T | | 70x70x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 267 | **-3.9** | ULS 1a_135 | 27.0 | 37.7 | 51.8 | 0.14 | | **1.5** | ULS 1a_0,9_0,9_0 | 89.9 | 37.7 | 38.4 | 0.04 | |
| 221 | | 60x60x5 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 285 | **-2.1** | ULS 1a_45 | 13.2 | 37.7 | 43.2 | 0.16 | | **3.3** | ULS 1a_0,9_0,9_45 | 60.5 | 37.7 | 26.7 | 0.12 | |
| 222 | | 100x50x6 | S235 | 1M16-5.6t | 0.50 | 0.50 | 0.50 | 342 | **-0.6** | ULS 1a_90 | 17.3 | 37.7 | 51.8 | 0.03 | | **0.0** | | 55.3 | 37.7 | 28.0 | 0.00 | |
| 108 | | 150x100x16 | S235 | 11M24-5.6t | 2.00 | 1.00 | 1.00 | 70 | **-251.2** | ULS 5a Ba 10 | 714.3 | 931.9 | 2281.0 | 0.35 | | **73.3** | ULS 5a Ba 10 | 767.8 | 931.9 | 1384.2 | 0.10 | |
| 212T | | 100x75x7 | S235 | 4M24-5.6t | 2.00 | 1.00 | 1.00 | 95 | **-43.8** | ULS 5a Ba 22 | 148.8 | 338.9 | 362.9 | 0.29 | | **68.7** | ULS 5a Ba 12 | 214.1 | 338.9 | 290.1 | 0.32 | |
| 210 | | 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 | | **75.9** | ULS 5a Ba 10 | 208.1 | 169.4 | 177.2 | 0.45 | |
| 211 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 309 | **-0.5** | ULS 3_90 | 11.3 | 37.7 | 43.2 | 0.04 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 208L | | 80x80x10 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 179 | **0.0** | | 100.0 | 254.2 | 388.8 | 0.00 | | **145.2** | ULS 3_0 | 207.7 | 254.2 | 299.1 | 0.70 | |
| 208T | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-28.6** | ULS 1a_0,9_0,9_90 | 36.2 | 58.8 | 64.8 | 0.79 | | **36.8** | ULS 1a_90 | 82.9 | 58.8 | 52.4 | 0.70 | |
| 101 | | 150x100x12 | S235 | 12M24-5.6t | 2.00 | 1.00 | 1.00 | 51 | **-251.6** | ULS 5a Ba 22 | 601.1 | 1016.6 | 1866.2 | 0.42 | | **93.7** | ULS 5a Ba 22 | 582.2 | 1016.6 | 1132.5 | 0.16 | |
| 204T | | 100x75x7 | S235 | 2M24-5.6t | 2.00 | 1.00 | 1.00 | 69 | **-49.0** | ULS 5a Ba 22 | 182.6 | 169.4 | 181.4 | 0.29 | | **63.8** | ULS 5a Ba 22 | 136.2 | 169.4 | 155.1 | 0.47 | |
| 203 | | 80x80x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-76.9** | ULS 5a Ba 12 | 156.9 | 169.4 | 207.4 | 0.49 | | **76.9** | ULS 5a Ba 12 | 206.0 | 169.4 | 159.5 | 0.48 | |
| 204 | | 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 | |
| 201L | | 80x80x8 | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 128 | **0.0** | | 122.6 | 235.2 | 345.6 | 0.00 | | **118.0** | ULS 3_0 | 168.3 | 235.2 | 244.4 | 0.70 | |
| 201T | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-2.2** | ULS 6a_90 Ah Ct2 | 21.0 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 312 | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 185 | **-14.1** | ULS 3_0 | 41.1 | 58.8 | 64.8 | 0.34 | | **0.0** | | 82.9 | 58.8 | 39.3 | 0.00 | |
| 314 | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-15.1** | ULS 3_135 | 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 | **-3.1** | ULS 1a_0 | 31.0 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 319 | | 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 | |
| 322 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 53 | **-1.0** | 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 | | **17.1** | ULS 3_135 | 54.7 | 58.8 | 37.0 | 0.46 | |
| 313 | | 60x60x5 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 299 | **0.0** | | 14.4 | 58.8 | 54.0 | 0.00 | | **23.3** | ULS 3_0 | 54.7 | 58.8 | 37.0 | 0.63 | |
| 316 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 332 | **0.0** | | 12.6 | 75.4 | 86.4 | 0.00 | | **30.8** | ULS 3_135 | 52.4 | 75.4 | 44.1 | 0.70 | |
| 318 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 274 | **0.0** | | 13.7 | 37.7 | 43.2 | 0.00 | | **6.6** | ULS 5a Ba 10 | 37.4 | 37.7 | 22.0 | 0.30 | |
| 321 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 269 | **0.0** | | 14.0 | 37.7 | 43.2 | 0.00 | | **9.3** | ULS 3_45 | 37.4 | 37.7 | 22.0 | 0.42 | |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

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

**KIJ-GT380**
**S+3**
**Mast 47**

| 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 | hear (Tens) | earing (Tens) | U.C. (Tens) | Exceedance (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 315 | | 45x45x5 | S235 | 1M12-5.6t | 0.52 | 0.52 | 0.52 | 180 | **-1.3** | ULS 1a_0 | 22.7 | 20.2 | 32.4 | 0.07 | | **1.2** | 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 | 0.06 | | **1.1** | 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 | **-24.1** | ULS 5a Ba 20 | 66.6 | 58.8 | 75.6 | 0.41 | | **22.3** | ULS 5a Ba 11 | 96.8 | 58.8 | 53.5 | 0.42 | |
| 301 | | 70x70x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-27.3** | 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 | |
| 302 | | 70x70x7 | S235 | 1M24-5.6t | 0.54 | 0.54 | 0.54 | 119 | **-33.3** | 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 | | 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 | | **17.7** | 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 | **-25.0** | ULS 5a Ba 10 | 52.9 | 58.8 | 54.0 | 0.47 | | **24.4** | ULS 5a Ba 10 | 54.7 | 58.8 | 37.0 | 0.66 | |
| 306 | | 75x50x5 | S235 | 1M24-5.6t | 0.55 | 0.55 | 0.55 | 112 | **-29.6** | ULS 5a Ba 10 | 53.3 | 84.7 | 64.8 | 0.56 | | **30.6** | ULS 5a Ba 10 | 70.6 | 84.7 | 41.4 | 0.74 | |
| 307 | | 75x50x7 | S235 | 1M24-5.6t | 0.54 | 0.54 | 0.54 | 92 | **-38.4** | ULS 5a Ba 21 | 83.8 | 84.7 | 90.7 | 0.46 | | **36.3** | 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 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 27 | **-2.1** | ULS 1a_0,9_0,9_90 | 770.5 | 58.8 | 86.4 | 0.04 | | **5.7** | ULS 1a_90 | 318.0 | 58.8 | 86.4 | 0.10 | |
| 309 | | HEB160 | S235 | 1M20-5.6t | 2.00 | 2.00 | 2.00 | 26 | **-26.7** | ULS 5a Ba 10 | 956.7 | 58.8 | 86.4 | 0.45 | | **24.8** | ULS 5a Ba 21 | 318.0 | 58.8 | 86.4 | 0.42 | |
| 310 | | HEB160 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 25 | **-3.3** | ULS 1a_0,9_90 | 775.4 | 58.8 | 86.4 | 0.06 | | **3.2** | ULS 1a_90 | 318.0 | 58.8 | 86.4 | 0.05 | |
| 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 | **-11.6** | 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 Ah 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 | | **13.9** | 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 | | **17.0** | 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 | | **25.6** | ULS 3_0 | 56.2 | 75.4 | 44.1 | 0.58 | |
| 421 | | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 259 | **0.0** | | 26.8 | 117.6 | 129.6 | 0.00 | | **48.8** | ULS 3_135 | 77.4 | 117.6 | 88.7 | 0.63 | |
| 420 | | 45x45x5 | S235 | 1M12-5.6t | 0.52 | 0.52 | 0.52 | 111 | **-1.6** | ULS 1a_0,9_0,9_0 | 39.6 | 20.2 | 32.4 | 0.08 | | **1.5** | 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 | **-20.8** | 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 | **-29.4** | ULS 5a Ba 12 | 65.2 | 58.8 | 64.8 | 0.50 | | **28.9** | 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 | **-32.3** | ULS 5a Ba 22 | 86.5 | 84.7 | 77.8 | 0.42 | | **33.9** | ULS 5a Ba 12 | 76.0 | 84.7 | 44.0 | 0.77 | |
| 405 | | 75x50x7 | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 107 | **-41.5** | ULS 5a Ba 12 | 76.2 | 84.7 | 90.7 | 0.54 | | **38.7** | ULS 5a Ba 22 | 98.8 | 84.7 | 58.0 | 0.67 | |
| 409 | | 55x55x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 142 | **-5.2** | ULS 1a_135 | 37.9 | 37.7 | 43.2 | 0.14 | | **16.2** | 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 | **-16.8** | ULS 5a Ba 1 | 38.5 | 37.7 | 43.2 | 0.44 | | **4.1** | ULS 1a_135 | 53.3 | 37.7 | 32.0 | 0.13 | |
| 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 | | **17.0** | ULS 5a Ba 1 | 53.3 | 37.7 | 32.0 | 0.53 | |
| 406 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 33 | **-2.4** | 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 | |
| 408 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 32 | **-6.8** | ULS 5a Ba 1 | 998.4 | 0.0 | 0.0 | 0.01 | | **4.1** | 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 | | **13.9** | 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 | |
| 412 | | 55x55x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 129 | **-17.4** | ULS 5a Ba 1 | 42.0 | 37.7 | 43.2 | 0.46 | | **2.4** | ULS 1a_0,9_0,9_135 | 53.3 | 37.7 | 32.0 | 0.07 | |

DNV·GL

## Assessment of groups for strengthened mast (afkeur level)

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

**KIJ-GT380**
**S+3**
**Mast 47**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compres | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115A | 0 | 150x150x14 | S235 | 8M24-5.6t | 0.33 | 0.33 | 0.33 | 62 | **-651.0** | ULS 1a_135 | 793.2 | 677.8 | 1451.5 | 0.96 | | **529.7** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.78 |
| 115B | 0 | 150x150x14 | S235 | 8M24-5.6t | 0.20 | 0.20 | 0.20 | 61 | **-654.9** | ULS 1a_135 | 795.4 | 677.8 | 1451.5 | 0.97 | | **526.1** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.78 |
| 114A | 0 | 150x150x14 | S235 | 8M24-5.6t | 1.66 | 1.73 | 1.38 | 80 | **-631.5** | ULS 1a_135 | 703.1 | 677.8 | 1451.5 | 0.93 | | **491.6** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.73 |
| 114B | 0 | 150x150x14 | S235 | **8M24-8.8t** | 0.76 | **0.76** | **0.49** | 36 | **-736.7** | ULS 1a_135 | 894.7 | 1084.4 | 1451.5 | 0.82 | | **586.9** | ULS 1a_0,9_0,9_135 | 851.7 | 1084.4 | 1240.6 | 0.69 |
| 114C | 0 | 150x150x14 | S235 | | **1.81** | **1.89** | **1.51** | 81 | **-633.2** | ULS 1a_135 | 695.0 | 0.0 | 0.0 | 0.91 | | **588.2** | ULS 1a_0,9_0,9_135 | 943.3 | 0.0 | 0.0 | 0.62 |
| 113A | 0 | 150x150x12 | S235 | 6M24-5.6t | 1.77 | 1.37 | 1.14 | 46 | **-338.7** | ULS 1a_135 | 745.1 | 508.3 | 933.1 | 0.67 | | **222.4** | ULS 1a_0,9_0,9_135 | 740.3 | 508.3 | 797.5 | 0.44 |
| 113B | 0 | 150x150x12 | S235 | 8M24-5.6t | 4.01 | 4.23 | 3.34 | 80 | **-609.0** | ULS 1a_135 | 610.6 | 677.8 | 1244.2 | 1.00 | | **466.3** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.69 |
| 113C | 0 | 150x150x12 | S235 | | 1.70 | 1.70 | 1.42 | 75 | **-564.1** | ULS 1a_135 | 633.7 | 0.0 | 0.0 | 0.89 | | **426.1** | ULS 1a_0,9_0,9_135 | 817.8 | 0.0 | 0.0 | 0.52 |
| 107A | 0 | 100x100x12 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 76 | **-181.8** | ULS 1a_135 | 410.3 | 338.9 | 622.1 | 0.54 | | **130.1** | ULS 1a_0,9_0,9_135 | 426.6 | 338.9 | 531.7 | 0.38 |
| 107B | 0 | 100x100x12 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-221.9** | ULS 1a_135 | 391.5 | 508.3 | 933.1 | 0.57 | | **133.0** | ULS 1a_0,9_0,9_135 | 426.6 | 508.3 | 781.6 | 0.31 |
| 106A | 0 | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 79 | **-61.5** | ULS 1a_135 | 245.7 | 338.9 | 414.7 | 0.25 | | **16.7** | ULS 1a_0,9_0,9_135 | 252.5 | 338.9 | 297.7 | 0.07 |
| 106B | 0 | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-127.6** | ULS 1a_135 | 239.6 | 338.9 | 414.7 | 0.53 | | **78.2** | ULS 1a_0,9_0,9_135 | 252.5 | 338.9 | 354.5 | 0.31 |
| 100 | 0 | 90x90x8 | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 146 | **-39.0** | ULS 5a Ba 22 | 112.9 | 235.2 | 345.6 | 0.35 | | **0.0** | | 269.1 | 235.2 | 314.2 | 0.00 |
| 200 | 0 | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 222 | **-7.1** | ULS 5a Ba 12 | 23.5 | 75.4 | 86.4 | 0.30 | | **7.1** | ULS 5a Ba 12 | 52.4 | 75.4 | 44.1 | 0.16 |
| 111A | 0 | 80x80x10 | S235 | 3M24-5.6t | 1.00 | 2.00 | 1.00 | 205 | **0.0** | | 79.4 | 254.2 | 388.8 | 0.00 | | **132.1** | ULS 3_45 | 196.6 | 254.2 | 323.8 | 0.67 |
| 111B | 0 | 80x80x10 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 204 | **0.0** | | 79.9 | 176.4 | 324.0 | 0.00 | | **116.5** | ULS 3_0 | 206.0 | 176.4 | 261.8 | 0.66 |
| 112A | 0 | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 1.88 | 1.00 | 227 | **0.0** | | 42.7 | 176.4 | 226.8 | 0.00 | | **92.4** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.74 |
| 112B | 0 | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 176.4 | 226.8 | 0.00 | | **79.9** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.64 |
| 112C | 0 | 70x70x7 | S235 | | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 0.0 | 0.0 | 0.00 | | **88.2** | ULS 3_0 | 220.9 | 0.0 | 0.0 | 0.40 |
| 110A | 0 | 120x120x13 | S235 | 6M24-5.6t | 1.64 | 1.00 | 1.00 | 61 | **-194.4** | ULS 5a Ba 21 | 596.9 | 508.3 | 1010.9 | 0.38 | | **102.3** | ULS 5a Ba 21 | 602.4 | 508.3 | 864.0 | 0.20 |
| 110B | 0 | 120x120x13 | S235 | | 1.00 | 10.43 | 1.00 | 86 | **-0.4** | ULS 1a_0,9_0,9_90 | 499.4 | 0.0 | 0.0 | 0.00 | | **0.4** | ULS 1a_90 | 705.0 | 0.0 | 0.0 | 0.00 |
| 110C | 0 | 120x120x13 | S235 | | 1.29 | 1.71 | 1.00 | 66 | **-161.8** | ULS 5a Ba 21 | 578.1 | 0.0 | 0.0 | 0.28 | | **79.1** | ULS 5a Ba 10 | 705.0 | 0.0 | 0.0 | 0.11 |
| 109A | 0 | 150x100x16 | S235 | 11M24-5.6t | 1.00 | 0.52 | 0.52 | 56 | **-305.2** | ULS 5a Ba 10 | 774.5 | 931.9 | 2281.0 | 0.39 | | **140.9** | ULS 5a Ba 21 | 767.8 | 931.9 | 1384.2 | 0.18 |
| 109B | 0 | 150x100x16 | S235 | 6M24-5.6t | 4.78 | 1.00 | 1.00 | 47 | **-209.5** | ULS 5a Ba 10 | 809.1 | 508.3 | 1244.2 | 0.41 | | **117.3** | ULS 5a Ba 21 | 767.8 | 508.3 | 1063.4 | 0.23 |
| 109C | 0 | 150x100x16 | S235 | | 1.00 | 0.52 | 0.52 | 58 | **-280.5** | ULS 5a Ba 21 | 764.8 | 0.0 | 0.0 | 0.37 | | **129.7** | ULS 5a Ba 10 | 891.6 | 0.0 | 0.0 | 0.15 |
| 104A | 0 | 100x65x9* | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 204 | **0.0** | | 78.6 | 235.2 | 388.8 | 0.00 | | **109.3** | ULS 3_135 | 144.1 | 235.2 | 266.2 | 0.76 |
| 104B | 0 | 100x65x9* | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 211 | **0.0** | | 74.7 | 176.4 | 291.6 | 0.00 | | **75.4** | ULS 3_0 | 172.4 | 176.4 | 199.6 | 0.44 |
| 104C | 0 | 100x65x9* | S235 | | 1.00 | 1.00 | 1.00 | 196 | **0.0** | | 82.7 | 0.0 | 0.0 | 0.00 | | **96.2** | ULS 3_0 | 332.5 | 0.0 | 0.0 | 0.29 |
| 105B | 0 | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 1.70 | 1.00 | 379 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **31.2** | ULS 6a_90 Ah Ct1 | 65.9 | 75.4 | 56.0 | 0.56 |
| 105A | 0 | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 2.43 | 1.00 | 380 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **31.1** | ULS 6a_90 Ah Ct2 | 98.8 | 75.4 | 56.0 | 0.56 |
| 103A | 0 | 120x120x11 | S235 | 6M24-5.6t | 2.64 | 4.00 | 1.00 | 77 | **-134.2** | ULS 5a Ba 12 | 458.3 | 508.3 | 855.4 | 0.29 | | **46.0** | ULS 5a Ba 22 | 513.2 | 508.3 | 731.1 | 0.09 |
| 103B | 0 | 120x120x11 | S235 | 2M16-5.6t | 2.00 | 4.44 | 2.00 | 109 | **-31.6** | ULS 6a_90 Ah Ct1 | 333.2 | 75.4 | 190.1 | 0.42 | | **0.0** | | 429.4 | 75.4 | 190.1 | 0.00 |
| 103C | 0 | 120x120x11 | S235 | | 1.71 | 1.00 | 1.00 | 77 | **-96.5** | ULS 5a Ba 1 | 458.5 | 0.0 | 0.0 | 0.21 | | **20.6** | ULS 5a Ba 1 | 599.7 | 0.0 | 0.0 | 0.03 |
| 102A | 0 | 150x150x14 | S235 | 9M24-5.6t | 1.00 | 1.50 | 1.00 | 62 | **-307.0** | ULS 5a Ba 12 | 794.2 | 762.5 | 1633.0 | 0.40 | | **168.0** | ULS 5a Ba 22 | 851.7 | 762.5 | 990.9 | 0.22 |
| 102B | 0 | 150x150x14 | S235 | 6M24-5.6t | 2.52 | 1.61 | 1.00 | 63 | **-145.8** | ULS 5a Ba 12 | 786.2 | 508.3 | 1088.6 | 0.29 | | **34.2** | ULS 5a Ba 22 | 851.7 | 508.3 | 930.5 | 0.07 |
| 102C | 0 | 150x150x14 | S235 | | 3.01 | 2.00 | 1.00 | 59 | **-278.7** | ULS 5a Ba 12 | 805.0 | 0.0 | 0.0 | 0.35 | | **145.6** | ULS 5a Ba 22 | 943.3 | 0.0 | 0.0 | 0.15 |
| 220L | 0 | 100x75x9 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 128 | **-81.8** | ULS 5a Ba 10 | 149.5 | 117.6 | 194.4 | 0.70 | | **60.7** | ULS 5a Ba 21 | 149.4 | 117.6 | 157.1 | 0.52 |
| 218L | 0 | 150x75x9 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 128 | **-80.9** | ULS 5a Ba 10 | 195.8 | 117.6 | 194.4 | 0.69 | | **64.2** | ULS 5a Ba 21 | 182.9 | 117.6 | 157.1 | 0.55 |
| 217L | 0 | 100x75x8 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 129 | **-54.1** | ULS 5a Ba 21 | 127.3 | 117.6 | 172.8 | 0.46 | | **51.3** | ULS 5a Ba 10 | 128.6 | 117.6 | 104.7 | 0.49 |
| 216L | 0 | 100x75x7 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 116 | **-59.5** | ULS 5a Ba 10 | 124.6 | 117.6 | 151.2 | 0.51 | | **62.4** | ULS 5a Ba 21 | 115.4 | 117.6 | 106.9 | 0.58 |
| 215L | 0 | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 104 | **-73.5** | ULS 5a Ba 21 | 137.9 | 169.4 | 181.4 | 0.53 | | **68.9** | ULS 5a Ba 21 | 100.4 | 169.4 | 101.5 | 0.69 |
| 214L | 0 | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 88 | **-76.7** | ULS 5a Ba 21 | 157.5 | 169.4 | 181.4 | 0.49 | | **81.0** | ULS 5a Ba 21 | 98.2 | 169.4 | 101.5 | 0.82 |
| 213L | 0 | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 79 | **-94.5** | ULS 5a Ba 21 | 192.8 | 169.4 | 207.4 | 0.56 | | **88.4** | ULS 5a Ba 21 | 128.4 | 169.4 | 165.8 | 0.69 |
| 209L | 0 | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-93.1** | ULS 5a Ba 12 | 177.9 | 169.4 | 207.4 | 0.55 | | **90.5** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.53 |
| 207L | 0 | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 103 | **-87.5** | ULS 5a Ba 12 | 190.8 | 169.4 | 207.4 | 0.52 | | **92.5** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.55 |
| 206L | 0 | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-103.5** | ULS 5a Ba 22 | 198.3 | 169.4 | 207.4 | 0.61 | | **97.8** | ULS 5a Ba 12 | 181.4 | 169.4 | 177.2 | 0.58 |
| 205L | 0 | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-109.3** | ULS 5a Ba 12 | 207.7 | 169.4 | 207.4 | 0.65 | | **114.4** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.68 |
| 202L | 0 | 70x70x7 | S235 | 1M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-21.9** | ULS 5a Ba 22 | 75.8 | 84.7 | 90.7 | 0.29 | | **15.0** | ULS 5a Ba 22 | 88.7 | 84.7 | 64.2 | 0.23 |
| 221T | 0 | 100x75x9 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 128 | **-110.2** | ULS 1a_90 | 149.5 | 117.6 | 194.4 | 0.94 | | **92.2** | ULS 1a_0,9_0,9_90 | 149.4 | 117.6 | 157.1 | 0.78 |
| 219T | 0 | 150x75x9 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 128 | **-107.4** | ULS 1a_90 | 195.8 | 117.6 | 194.4 | 0.91 | | **93.3** | ULS 1a_0,9_0,9_90 | 182.9 | 117.6 | 157.1 | 0.79 |
| 218T | 0 | 100x75x7 | S235 | 2M20-5.6t | 0.53 | 0.27 | 0.27 | 117 | **-53.1** | ULS 5a Ba 21 | 125.0 | 117.6 | 151.2 | 0.45 | | **56.0** | ULS 5a Ba 10 | 107.3 | 117.6 | 91.6 | 0.61 |
| 217T | 0 | 100x75x9 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 122 | **-73.6** | ULS 5a Ba 10 | 148.5 | 117.6 | 194.4 | 0.63 | | **69.5** | ULS 5a Ba 21 | 146.1 | 117.6 | 137.5 | 0.59 |
| 216T | 0 | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 105 | **-79.3** | ULS 5a Ba 21 | 155.5 | 169.4 | 207.4 | 0.51 | | **82.5** | ULS 5a Ba 10 | 113.2 | 169.4 | 116.0 | 0.73 |
| 215T | 0 | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 89 | **-90.8** | ULS 5a Ba 10 | 177.8 | 169.4 | 207.4 | 0.54 | | **86.9** | ULS 5a Ba 21 | 110.7 | 169.4 | 116.0 | 0.79 |
| 214T | 0 | 100x75x9 | S235 | 2M24-5.6t | 0.53 | 0.27 | 0.27 | 75 | **-93.6** | ULS 5a Ba 21 | 221.5 | 169.4 | 233.3 | 0.55 | | **96.8** | ULS 5a Ba 10 | 119.9 | 169.4 | 130.6 | 0.81 |
| 213T | 0 | 100x75x9 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 64 | **-100.6** | ULS 5a Ba 10 | 240.8 | 169.4 | 233.3 | 0.59 | | **97.5** | ULS 5a Ba 10 | 140.7 | 169.4 | 186.5 | 0.69 |
| 209T | 0 | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-100.7** | ULS 5a Ba 12 | 219.3 | 169.4 | 259.2 | 0.59 | | **80.8** | ULS 5a Ba 22 | 224.3 | 169.4 | 221.5 | 0.48 |
| 207T | 0 | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 104 | **-99.4** | 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 |
| 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 | | **110.7** | ULS 5a Ba 12 | 261.1 | 254.2 | 332.3 | 0.44 |
| 205T | 0 | 100x100x10 | S235 | 3M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-123.3** | ULS 5a Ba 12 | 256.2 | 254.2 | 388.8 | 0.49 | | **122.2** | ULS 5a Ba 22 | 261.1 | 254.2 | 332.3 | 0.48 |
| 202T | 0 | 50x50x5 | S235 | 1M16-5.6t | 0.52 | 0.52 | 0.52 | 178 | **-9.7** | ULS 5a Ba 22 | 25.7 | 37.7 | 43.2 | 0.38 | | **4.2** | ULS 5a Ba 22 | 37.4 | 37.7 | 22.0 | 0.19 |
| 219L | 0 | 70x70x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 267 | **-4.0** | ULS 1a_90 | 27.0 | 37.7 | 51.8 | 0.15 | | **1.2** | ULS 1a_0,9_135 | 89.9 | 37.7 | 38.4 | 0.03 |
| 220T | 0 | 70x70x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 267 | **-3.9** | ULS 1a_135 | 27.0 | 37.7 | 51.8 | 0.14 | | **1.5** | ULS 1a_0,9_0,9_0 | 89.9 | 37.7 | 38.4 | 0.04 |
| 221 | 0 | 60x60x5 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 285 | **-2.1** | ULS 1a_45 | 13.2 | 37.7 | 43.2 | 0.16 | | **3.3** | ULS 1a_0,9_0,9_45 | 60.5 | 37.7 | 26.7 | 0.12 |
| 222 | 0 | 100x50x6 | S235 | 1M16-5.6t | 0.50 | 0.50 | 0.50 | 342 | **-0.6** | ULS 1a_90 | 17.3 | 37.7 | 51.8 | 0.03 | | **0.0** | | 55.3 | 37.7 | 28.0 | 0.00 |
| 108 | 0 | 150x100x16 | S235 | 11M24-5.6t | 2.00 | 1.00 | 1.00 | 70 | **-251.2** | ULS 5a Ba 10 | 714.3 | 931.9 | 2281.0 | 0.35 | | **73.3** | ULS 5a Ba 10 | 767.8 | 931.9 | 1384.2 | 0.10 |
| 212T | 0 | 100x75x7 | S235 | 4M24-5.6t | 2.00 | 1.00 | 1.00 | 95 | **-43.8** | ULS 5a Ba 22 | 148.8 | 338.9 | 362.9 | 0.29 | | **68.7** | ULS 5a Ba 12 | 214.1 | 338.9 | 290.1 | 0.32 |
| 210 | 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 | | **75.9** | ULS 5a Ba 10 | 208.1 | 169.4 | 177.2 | 0.45 |
| 211 | 0 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 309 | **-0.5** | ULS 3_90 | 11.3 | 37.7 | 43.2 | 0.04 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 208L | 0 | 80x80x10 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 179 | **0.0** | | 100.0 | 254.2 | 388.8 | 0.00 | | **145.2** | ULS 3_0 | 207.7 | 254.2 | 299.1 | 0.70 |
| 208T | 0 | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-28.6** | ULS 1a_0,9_0,9_90 | 36.2 | 58.8 | 64.8 | 0.79 | | **36.8** | ULS 1a_90 | 82.9 | 58.8 | 52.4 | 0.70 |
| 101 | 0 | 150x100x12 | S235 | 12M24-5.6t | 2.00 | 1.00 | 1.00 | 51 | **-251.6** | ULS 5a Ba 22 | 601.1 | 1016.6 | 1866.2 | 0.42 | | **93.7** | ULS 5a Ba 22 | 582.2 | 1016.6 | 1132.5 | 0.16 |
| 204T | 0 | 100x75x7 | S235 | 2M24-5.6t | 2.00 | 1.00 | 1.00 | 69 | **-49.0** | ULS 5a Ba 22 | 182.6 | 169.4 | 181.4 | 0.29 | | **63.8** | ULS 5a Ba 22 | 136.2 | 169.4 | 155.1 | 0.47 |
| 203 | 0 | 80x80x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-76.9** | ULS 5a Ba 12 | 156.9 | 169.4 | 207.4 | 0.49 | | **76.9** | ULS 5a Ba 12 | 206.0 | 169.4 | 159.5 | 0.48 |
| 204 | 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 |
| 201L | 0 | 80x80x8 | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 128 | **0.0** | | 122.6 | 235.2 | 345.6 | 0.00 | | **118.0** | ULS 3_0 | 168.3 | 235.2 | 244.4 | 0.70 |
| 201T | 0 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-2.2** | ULS 6a_90 Ah Ct2 | 21.0 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 312 | 0 | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 185 | **-14.1** | ULS 3_0 | 41.1 | 58.8 | 64.8 | 0.34 | | **0.0** | | 82.9 | 58.8 | 39.3 | 0.00 |
| 314 | 0 | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-15.1** | ULS 3_135 | 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 | **-3.1** | ULS 1a_0 | 31.0 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 |
| 319 | 0 | 75x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 95 | **-2.7** | ULS 1a_0 | 59.5 | 37.7 | 43.2 | 0.07 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 |

DNV·GL

## Assessment of groups for strengthened mast (afkeur level)

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

**KIJ-GT380**
**S+3**
**Mast 47**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compres | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 322 | 0 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 53 | **-1.0** | 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 | | **17.1** | ULS 3_135 | 54.7 | 58.8 | 37.0 | 0.46 |
| 313 | 0 | 60x60x5 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 299 | **0.0** | | 14.4 | 58.8 | 54.0 | 0.00 | | **23.3** | ULS 3_0 | 54.7 | 58.8 | 37.0 | 0.63 |
| 316 | 0 | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 332 | **0.0** | | 12.6 | 75.4 | 86.4 | 0.00 | | **30.8** | ULS 3_135 | 52.4 | 75.4 | 44.1 | 0.70 |
| 318 | 0 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 274 | **0.0** | | 13.7 | 37.7 | 43.2 | 0.00 | | **6.6** | ULS 5a Ba 10 | 37.4 | 37.7 | 22.0 | 0.30 |
| 321 | 0 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 269 | **0.0** | | 14.0 | 37.7 | 43.2 | 0.00 | | **9.3** | ULS 3_45 | 37.4 | 37.7 | 22.0 | 0.42 |
| 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 | 0.07 | | **1.2** | 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 | 0.06 | | **1.1** | 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 | **-24.1** | ULS 5a Ba 20 | 66.6 | 58.8 | 75.6 | 0.41 | | **22.3** | ULS 5a Ba 11 | 96.8 | 58.8 | 53.5 | 0.42 |
| 301 | 0 | 70x70x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-27.3** | 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 |
| 302 | 0 | 70x70x7 | S235 | 1M24-5.6t | 0.54 | 0.54 | 0.54 | 119 | **-33.3** | 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 | 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 | | **17.7** | 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 | **-25.0** | ULS 5a Ba 10 | 52.9 | 58.8 | 54.0 | 0.47 | | **24.4** | ULS 5a Ba 10 | 54.7 | 58.8 | 37.0 | 0.66 |
| 306 | 0 | 75x50x5 | S235 | 1M24-5.6t | 0.55 | 0.55 | 0.55 | 112 | **-29.6** | ULS 5a Ba 10 | 53.3 | 84.7 | 64.8 | 0.56 | | **30.6** | ULS 5a Ba 10 | 70.6 | 84.7 | 41.4 | 0.74 |
| 307 | 0 | 75x50x7 | S235 | 1M24-5.6t | 0.54 | 0.54 | 0.54 | 92 | **-38.4** | ULS 5a Ba 21 | 83.8 | 84.7 | 90.7 | 0.46 | | **36.3** | 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 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 27 | **-2.1** | ULS 1a_0,9_0,9_90 | 770.5 | 58.8 | 86.4 | 0.04 | | **5.7** | ULS 1a_90 | 318.0 | 58.8 | 86.4 | 0.10 |
| 309 | 0 | HEB160 | S235 | 1M20-5.6t | 2.00 | 2.00 | 2.00 | 26 | **-26.7** | ULS 5a Ba 10 | 956.7 | 58.8 | 86.4 | 0.45 | | **24.8** | ULS 5a Ba 21 | 318.0 | 58.8 | 86.4 | 0.42 |
| 310 | 0 | HEB160 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 25 | **-3.3** | ULS 1a_0,9_90 | 775.4 | 58.8 | 86.4 | 0.06 | | **3.2** | ULS 1a_90 | 318.0 | 58.8 | 86.4 | 0.05 |
| 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 | **-11.6** | 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 Ah 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 | | **13.9** | 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 | | **17.0** | 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 | | **25.6** | ULS 3_0 | 56.2 | 75.4 | 44.1 | 0.58 |
| 421 | 0 | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 259 | **0.0** | | 26.8 | 117.6 | 129.6 | 0.00 | | **48.8** | ULS 3_135 | 77.4 | 117.6 | 88.7 | 0.63 |
| 420 | 0 | 45x45x5 | S235 | 1M12-5.6t | 0.52 | 0.52 | 0.52 | 111 | **-1.6** | ULS 1a_0,9_0,9_0 | 39.6 | 20.2 | 32.4 | 0.08 | | **1.5** | 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 | **-20.8** | 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 | **-29.4** | ULS 5a Ba 12 | 65.2 | 58.8 | 64.8 | 0.50 | | **28.9** | 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 | **-32.3** | ULS 5a Ba 22 | 86.5 | 84.7 | 77.8 | 0.42 | | **33.9** | ULS 5a Ba 12 | 76.0 | 84.7 | 44.0 | 0.77 |
| 405 | 0 | 75x50x7 | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 107 | **-41.5** | ULS 5a Ba 12 | 76.2 | 84.7 | 90.7 | 0.54 | | **38.7** | ULS 5a Ba 22 | 98.8 | 84.7 | 58.0 | 0.67 |
| 409 | 0 | 55x55x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 142 | **-5.2** | ULS 1a_135 | 37.9 | 37.7 | 43.2 | 0.14 | | **16.2** | 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 | **-16.8** | ULS 5a Ba 1 | 38.5 | 37.7 | 43.2 | 0.44 | | **4.1** | ULS 1a_135 | 53.3 | 37.7 | 32.0 | 0.13 |
| 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 | | **17.0** | 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 | **-17.4** | ULS 5a Ba 1 | 42.0 | 37.7 | 43.2 | 0.46 | | **2.4** | 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 | **-2.4** | 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 | **-6.8** | ULS 5a Ba 1 | 998.4 | 0.0 | 0.0 | 0.01 | | **4.1** | 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 | | **13.9** | 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 |

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## Assessment of groups for strengthened mast (verbouw level)

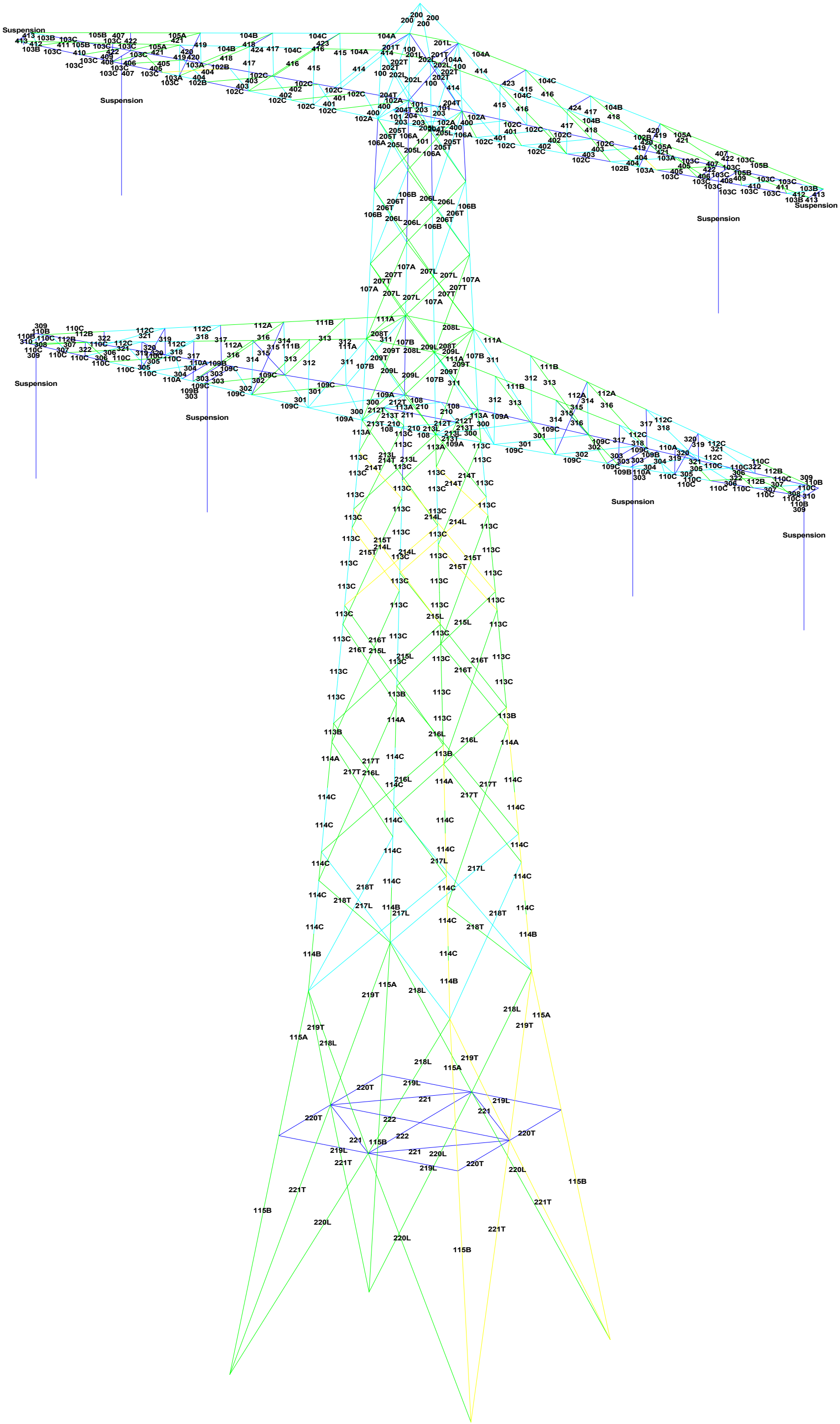
Date: 30-11-20
Author: TBR
Version: 1.0

**KIJ-GT380**
**S+3**
**Mast 47**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Compressi | Load Case (Compres | Buckling | Shear (Comp) | Bearing (Com | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens | Bearing (Tens | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 114B | | 150x150x14 | S235 | **8M24-8.8t** | 0.76 | **0.76** | **0.49** | 36 | **-905.8** | ULS 1a_135 | 894.7 | 1084.4 | 1451.5 | 1.01 | (1) | **749.3** | ULS 1a_0,9_0,9_135 | 851.7 | 1084.4 | 1240.6 | 0.88 |
| 114C | | 150x150x14 | S235 | | **1.81** | **1.89** | **1.51** | 81 | **-778.3** | ULS 1a_135 | 695.0 | 0.0 | 0.0 | 1.12 | | **750.5** | ULS 1a_0,9_0,9_135 | 943.3 | 0.0 | 0.0 | 0.80 |

(1) Redundants (knikverkorters) have been added to groups 114B and 114C. 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+3 (hv) ini"
Tower Version 16.12, 11:37:41 Wednesday, 29 April, 2020
Undeformed geometry displayed



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## Assessment of groups for initial mast (afkeur level)

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

**KIJ-GT380**
**S+3**
**Mast 63**

| 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 | hear (Tens) | earing (Tens) | U.C. (Tens) | Exceedance (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115A | | 150x150x14 | S235 | 8M24-5.6t | 0.33 | 0.33 | 0.33 | 62 | **-538.6** | ULS 1a_135 | 793.2 | 677.8 | 1451.5 | 0.79 | | **420.3** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.62 | |
| 115B | | 150x150x14 | S235 | 8M24-5.6t | 0.20 | 0.20 | 0.20 | 61 | **-542.3** | ULS 1a_135 | 795.4 | 677.8 | 1451.5 | 0.80 | | **416.9** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.62 | |
| 114A | | 150x150x14 | S235 | 8M24-5.6t | 1.66 | 1.73 | 1.38 | 80 | **-524.3** | ULS 1a_135 | 703.1 | 677.8 | 1451.5 | 0.77 | | **387.8** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.57 | |
| 114B | | 150x150x14 | S235 | 8M24-5.6t | 0.76 | 1.28 | 0.63 | 60 | **-611.2** | ULS 1a_135 | 801.9 | 677.8 | 1451.5 | 0.90 | | **463.8** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.68 | |
| 114C | | 150x150x14 | S235 | | 3.04 | 3.36 | 2.53 | 92 | **-569.8** | ULS 1a_135 | 631.9 | 0.0 | 0.0 | 0.90 | | **465.1** | ULS 1a_0,9_0,9_135 | 943.3 | 0.0 | 0.0 | 0.49 | |
| 113A | | 150x150x12 | S235 | 6M24-5.6t | 1.77 | 1.37 | 1.14 | 46 | **-284.9** | ULS 1a_135 | 745.1 | 508.3 | 933.1 | 0.56 | | **171.0** | ULS 1a_0,9_0,9_135 | 740.3 | 508.3 | 797.5 | 0.34 | |
| 113B | | 150x150x12 | S235 | 8M24-5.6t | 4.01 | 4.23 | 3.34 | 80 | **-506.1** | ULS 1a_135 | 610.6 | 677.8 | 1244.2 | 0.83 | | **366.7** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.54 | |
| 113C | | 150x150x12 | S235 | | 1.70 | 1.70 | 1.42 | 75 | **-469.3** | ULS 1a_135 | 633.7 | 0.0 | 0.0 | 0.74 | | **335.1** | ULS 1a_0,9_0,9_135 | 817.8 | 0.0 | 0.0 | 0.41 | |
| 107A | | 100x100x12 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 76 | **-152.2** | ULS 1a_135 | 410.3 | 338.9 | 622.1 | 0.45 | | **101.1** | ULS 1a_0,9_0,9_135 | 426.6 | 338.9 | 531.7 | 0.30 | |
| 107B | | 100x100x12 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-188.1** | ULS 1a_135 | 391.5 | 508.3 | 933.1 | 0.48 | | **100.6** | ULS 1a_0,9_0,9_135 | 426.6 | 508.3 | 781.6 | 0.24 | |
| 106A | | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 79 | **-53.9** | ULS 1a_45 | 245.7 | 338.9 | 414.7 | 0.22 | | **12.2** | ULS 5a Ba 22 | 252.5 | 338.9 | 297.7 | 0.05 | |
| 106B | | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-108.1** | ULS 1a_135 | 239.6 | 338.9 | 414.7 | 0.45 | | **59.3** | ULS 1a_0,9_0,9_135 | 252.5 | 338.9 | 354.5 | 0.24 | |
| 100 | | 90x90x8 | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 146 | **-37.8** | ULS 5a Ba 22 | 112.9 | 235.2 | 345.6 | 0.34 | | **0.0** | | 269.1 | 235.2 | 314.2 | 0.00 | |
| 200 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 222 | **-7.1** | ULS 5a Ba 12 | 23.5 | 75.4 | 86.4 | 0.30 | | **7.1** | ULS 5a Ba 12 | 52.4 | 75.4 | 44.1 | 0.16 | |
| 111A | | 80x80x10 | S235 | 3M24-5.6t | 1.00 | 2.00 | 1.00 | 205 | **0.0** | | 79.4 | 254.2 | 388.8 | 0.00 | | **127.0** | ULS 3_45 | 196.6 | 254.2 | 323.8 | 0.65 | |
| 111B | | 80x80x10 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 204 | **0.0** | | 79.9 | 176.4 | 324.0 | 0.00 | | **111.9** | ULS 3_135 | 206.0 | 176.4 | 261.8 | 0.63 | |
| 112A | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 1.88 | 1.00 | 227 | **0.0** | | 42.7 | 176.4 | 226.8 | 0.00 | | **88.6** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.71 | |
| 112B | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 176.4 | 226.8 | 0.00 | | **76.2** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.61 | |
| 112C | | 70x70x7 | S235 | | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 0.0 | 0.0 | 0.00 | | **84.4** | ULS 3_0 | 220.9 | 0.0 | 0.0 | 0.38 | |
| 110A | | 120x120x13 | S235 | 6M24-5.6t | 1.64 | 1.00 | 1.00 | 61 | **-193.9** | ULS 5a Ba 21 | 596.9 | 508.3 | 1010.9 | 0.38 | | **102.8** | ULS 5a Ba 21 | 602.4 | 508.3 | 864.0 | 0.20 | |
| 110B | | 120x120x13 | S235 | | 1.00 | 10.43 | 1.00 | 86 | **-0.3** | ULS 1a_0,9_0,9_90 | 499.4 | 0.0 | 0.0 | 0.00 | | **0.3** | ULS 1a_90 | 705.0 | 0.0 | 0.0 | 0.00 | |
| 110C | | 120x120x13 | S235 | | 1.29 | 1.71 | 1.00 | 66 | **-161.3** | ULS 5a Ba 21 | 578.1 | 0.0 | 0.0 | 0.28 | | **79.6** | ULS 5a Ba 10 | 705.0 | 0.0 | 0.0 | 0.11 | |
| 109A | | 150x100x16 | S235 | 11M24-5.6t | 1.00 | 0.52 | 0.52 | 56 | **-303.6** | ULS 5a Ba 10 | 774.5 | 931.9 | 2281.0 | 0.39 | | **142.5** | ULS 5a Ba 21 | 767.8 | 931.9 | 1384.2 | 0.19 | |
| 109B | | 150x100x16 | S235 | 6M24-5.6t | 4.78 | 1.00 | 1.00 | 47 | **-209.0** | ULS 5a Ba 10 | 809.1 | 508.3 | 1244.2 | 0.41 | | **117.9** | ULS 5a Ba 21 | 767.8 | 508.3 | 1063.4 | 0.23 | |
| 109C | | 150x100x16 | S235 | | 1.00 | 0.52 | 0.52 | 58 | **-279.1** | ULS 5a Ba 21 | 764.8 | 0.0 | 0.0 | 0.37 | | **131.1** | ULS 5a Ba 10 | 891.6 | 0.0 | 0.0 | 0.15 | |
| 104A | | 100x65x9* | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 204 | **0.0** | | 78.6 | 235.2 | 388.8 | 0.00 | | **105.3** | ULS 3_90 | 144.1 | 235.2 | 266.2 | 0.73 | |
| 104B | | 100x65x9* | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 211 | **0.0** | | 74.7 | 176.4 | 291.6 | 0.00 | | **72.4** | ULS 3_0 | 172.4 | 176.4 | 199.6 | 0.42 | |
| 104C | | 100x65x9* | S235 | | 1.00 | 1.00 | 1.00 | 196 | **0.0** | | 82.7 | 0.0 | 0.0 | 0.00 | | **92.6** | ULS 3_90 | 332.5 | 0.0 | 0.0 | 0.28 | |
| 105B | | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 1.70 | 1.00 | 379 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **30.1** | ULS 6a_90 Ah Ct1 | 65.9 | 75.4 | 56.0 | 0.54 | |
| 105A | | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 2.43 | 1.00 | 380 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **30.0** | ULS 6a_90 Ah Ct2 | 98.8 | 75.4 | 56.0 | 0.54 | |
| 103A | | 120x120x11 | S235 | 6M24-5.6t | 2.64 | 4.00 | 1.00 | 77 | **-133.4** | ULS 5a Ba 12 | 458.3 | 508.3 | 855.4 | 0.29 | | **46.8** | ULS 5a Ba 22 | 513.2 | 508.3 | 731.1 | 0.09 | |
| 103B | | 120x120x11 | S235 | 2M16-5.6t | 2.00 | 4.44 | 2.00 | 109 | **-30.3** | ULS 6a_90 Ah Ct1 | 333.2 | 75.4 | 190.1 | 0.40 | | **0.0** | | 429.4 | 75.4 | 190.1 | 0.00 | |
| 103C | | 120x120x11 | S235 | | 1.71 | 1.00 | 1.00 | 77 | **-95.3** | ULS 5a Ba 1 | 458.5 | 0.0 | 0.0 | 0.21 | | **20.8** | ULS 5a Ba 1 | 599.7 | 0.0 | 0.0 | 0.03 | |
| 102A | | 150x150x14 | S235 | 9M24-5.6t | 1.00 | 1.50 | 1.00 | 62 | **-306.0** | ULS 5a Ba 12 | 794.2 | 762.5 | 1633.0 | 0.40 | | **169.0** | ULS 5a Ba 22 | 851.7 | 762.5 | 990.9 | 0.22 | |
| 102B | | 150x150x14 | S235 | 6M24-5.6t | 2.52 | 1.61 | 1.00 | 63 | **-144.9** | ULS 5a Ba 12 | 786.2 | 508.3 | 1088.6 | 0.29 | | **35.1** | ULS 5a Ba 22 | 851.7 | 508.3 | 930.5 | 0.07 | |
| 102C | | 150x150x14 | S235 | | 3.01 | 2.00 | 1.00 | 59 | **-277.7** | ULS 5a Ba 12 | 805.0 | 0.0 | 0.0 | 0.35 | | **146.6** | ULS 5a Ba 22 | 943.3 | 0.0 | 0.0 | 0.16 | |
| 220L | | 100x75x9 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 128 | **-81.8** | ULS 5a Ba 10 | 149.5 | 117.6 | 194.4 | 0.70 | | **60.6** | ULS 5a Ba 21 | 149.4 | 117.6 | 157.1 | 0.52 | |
| 218L | | 150x75x9 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 128 | **-81.0** | ULS 5a Ba 10 | 195.8 | 117.6 | 194.4 | 0.69 | | **64.2** | ULS 5a Ba 21 | 182.9 | 117.6 | 157.1 | 0.55 | |
| 217L | | 100x75x8 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 129 | **-54.0** | ULS 5a Ba 21 | 127.3 | 117.6 | 172.8 | 0.46 | | **51.4** | ULS 5a Ba 10 | 128.6 | 117.6 | 104.7 | 0.49 | |
| 216L | | 100x75x7 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 116 | **-59.6** | ULS 5a Ba 10 | 124.6 | 117.6 | 151.2 | 0.51 | | **62.2** | ULS 5a Ba 21 | 115.4 | 117.6 | 106.9 | 0.58 | |
| 215L | | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 104 | **-73.3** | ULS 5a Ba 21 | 137.9 | 169.4 | 181.4 | 0.53 | | **68.8** | ULS 5a Ba 21 | 100.4 | 169.4 | 101.5 | 0.69 | |
| 214L | | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 88 | **-76.6** | ULS 5a Ba 21 | 157.5 | 169.4 | 181.4 | 0.49 | | **80.8** | ULS 5a Ba 21 | 98.2 | 169.4 | 101.5 | 0.82 | |
| 213L | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 79 | **-94.3** | ULS 5a Ba 21 | 192.8 | 169.4 | 207.4 | 0.56 | | **88.4** | ULS 5a Ba 21 | 128.4 | 169.4 | 165.8 | 0.69 | |
| 209L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-93.2** | ULS 5a Ba 12 | 177.9 | 169.4 | 207.4 | 0.55 | | **90.4** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.53 | |
| 207L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 103 | **-87.7** | ULS 5a Ba 12 | 190.8 | 169.4 | 207.4 | 0.52 | | **92.3** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.55 | |
| 206L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-103.3** | ULS 5a Ba 22 | 198.3 | 169.4 | 207.4 | 0.61 | | **98.0** | ULS 5a Ba 12 | 181.4 | 169.4 | 177.2 | 0.58 | |
| 205L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-109.6** | ULS 5a Ba 12 | 207.7 | 169.4 | 207.4 | 0.65 | | **114.2** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.67 | |
| 202L | | 70x70x7 | S235 | 1M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-20.8** | ULS 5a Ba 22 | 75.8 | 84.7 | 90.7 | 0.27 | | **13.9** | ULS 5a Ba 22 | 88.7 | 84.7 | 64.2 | 0.22 | |
| 221T | | 100x75x9 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 128 | **-92.7** | ULS 1a_90 | 149.5 | 117.6 | 194.4 | 0.79 | | **70.7** | ULS 1a_0,9_0,9_90 | 149.4 | 117.6 | 157.1 | 0.60 | |
| 219T | | 150x75x9 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 128 | **-90.0** | ULS 1a_90 | 195.8 | 117.6 | 194.4 | 0.77 | | **72.0** | ULS 1a_0,9_0,9_90 | 182.9 | 117.6 | 157.1 | 0.61 | |
| 218T | | 100x75x7 | S235 | 2M20-5.6t | 0.53 | 0.27 | 0.27 | 117 | **-53.1** | ULS 5a Ba 21 | 125.0 | 117.6 | 151.2 | 0.45 | | **56.0** | ULS 5a Ba 10 | 107.3 | 117.6 | 91.6 | 0.61 | |
| 217T | | 100x75x9 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 122 | **-73.6** | ULS 5a Ba 10 | 148.5 | 117.6 | 194.4 | 0.63 | | **69.5** | ULS 5a Ba 21 | 146.1 | 117.6 | 137.5 | 0.59 | |
| 216T | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 105 | **-79.3** | ULS 5a Ba 21 | 155.5 | 169.4 | 207.4 | 0.51 | | **82.5** | ULS 5a Ba 10 | 113.2 | 169.4 | 116.0 | 0.73 | |
| 215T | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 89 | **-90.8** | ULS 5a Ba 10 | 177.8 | 169.4 | 207.4 | 0.54 | | **86.9** | ULS 5a Ba 21 | 110.7 | 169.4 | 116.0 | 0.79 | |
| 214T | | 100x75x9 | S235 | 2M24-5.6t | 0.53 | 0.27 | 0.27 | 75 | **-93.6** | ULS 5a Ba 21 | 221.5 | 169.4 | 233.3 | 0.55 | | **96.8** | ULS 5a Ba 10 | 119.9 | 169.4 | 130.6 | 0.81 | |
| 213T | | 100x75x9 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 64 | **-100.6** | ULS 5a Ba 10 | 240.8 | 169.4 | 233.3 | 0.59 | | **97.5** | ULS 5a Ba 10 | 140.7 | 169.4 | 186.5 | 0.69 | |
| 209T | | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-100.7** | ULS 5a Ba 12 | 219.3 | 169.4 | 259.2 | 0.59 | | **80.8** | ULS 5a Ba 22 | 224.3 | 169.4 | 221.5 | 0.48 | |
| 207T | | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 104 | **-99.4** | 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 | |
| 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 | | **110.8** | ULS 5a Ba 12 | 261.1 | 254.2 | 332.3 | 0.44 | |
| 205T | | 100x100x10 | S235 | 3M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-123.4** | ULS 5a Ba 12 | 256.2 | 254.2 | 388.8 | 0.49 | | **122.1** | ULS 5a Ba 22 | 261.1 | 254.2 | 332.3 | 0.48 | |
| 202T | | 50x50x5 | S235 | 1M16-5.6t | 0.52 | 0.52 | 0.52 | 178 | **-9.5** | ULS 5a Ba 22 | 25.7 | 37.7 | 43.2 | 0.37 | | **4.1** | ULS 5a Ba 22 | 37.4 | 37.7 | 22.0 | 0.19 | |
| 219L | | 70x70x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 267 | **-3.1** | ULS 1a_90 | 27.0 | 37.7 | 51.8 | 0.12 | | **0.9** | ULS 1a_0,9_135 | 89.9 | 37.7 | 38.4 | 0.02 | |
| 220T | | 70x70x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 267 | **-3.1** | ULS 1a_135 | 27.0 | 37.7 | 51.8 | 0.11 | | **1.2** | ULS 1a_0,9_0,9_0 | 89.9 | 37.7 | 38.4 | 0.03 | |
| 221 | | 60x60x5 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 285 | **-1.8** | ULS 1a_45 | 13.2 | 37.7 | 43.2 | 0.14 | | **2.5** | ULS 1a_0,9_0,9_135 | 60.5 | 37.7 | 26.7 | 0.10 | |
| 222 | | 100x50x6 | S235 | 1M16-5.6t | 0.50 | 0.50 | 0.50 | 342 | **-0.5** | ULS 1a_90 | 17.3 | 37.7 | 51.8 | 0.03 | | **0.0** | | 55.3 | 37.7 | 28.0 | 0.00 | |
| 108 | | 150x100x16 | S235 | 11M24-5.6t | 2.00 | 1.00 | 1.00 | 70 | **-248.8** | ULS 5a Ba 10 | 714.3 | 931.9 | 2281.0 | 0.35 | | **75.6** | ULS 5a Ba 10 | 767.8 | 931.9 | 1384.2 | 0.10 | |
| 212T | | 100x75x7 | S235 | 4M24-5.6t | 2.00 | 1.00 | 1.00 | 95 | **-44.1** | ULS 5a Ba 22 | 148.8 | 338.9 | 362.9 | 0.30 | | **68.4** | ULS 5a Ba 12 | 214.1 | 338.9 | 290.1 | 0.32 | |
| 210 | | 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 | | **75.9** | ULS 5a Ba 10 | 208.1 | 169.4 | 177.2 | 0.45 | |
| 211 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 309 | **-0.5** | ULS 3_90 | 11.3 | 37.7 | 43.2 | 0.04 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 208L | | 80x80x10 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 179 | **0.0** | | 100.0 | 254.2 | 388.8 | 0.00 | | **138.6** | ULS 3_0 | 207.7 | 254.2 | 299.1 | 0.67 | |
| 208T | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-22.2** | ULS 1a_0,9_0,9_90 | 36.2 | 58.8 | 64.8 | 0.61 | | **30.3** | ULS 1a_90 | 82.9 | 58.8 | 52.4 | 0.58 | |
| 101 | | 150x100x12 | S235 | 12M24-5.6t | 2.00 | 1.00 | 1.00 | 51 | **-249.8** | ULS 5a Ba 22 | 601.1 | 1016.6 | 1866.2 | 0.42 | | **95.5** | ULS 5a Ba 22 | 582.2 | 1016.6 | 1132.5 | 0.16 | |
| 204T | | 100x75x7 | S235 | 2M24-5.6t | 2.00 | 1.00 | 1.00 | 69 | **-48.9** | ULS 5a Ba 22 | 182.6 | 169.4 | 181.4 | 0.29 | | **63.5** | ULS 5a Ba 22 | 136.2 | 169.4 | 155.1 | 0.47 | |
| 203 | | 80x80x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-76.9** | ULS 5a Ba 12 | 156.9 | 169.4 | 207.4 | 0.49 | | **76.9** | ULS 5a Ba 12 | 206.0 | 169.4 | 159.5 | 0.48 | |
| 204 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 225 | **-0.3** | ULS 3_90 | 18.5 | 37.7 | 43.2 | 0.02 | | **0.0** | | 37.4 | 37.7 | 25.7 | 0.00 | |
| 201L | | 80x80x8 | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 128 | **0.0** | | 122.6 | 235.2 | 345.6 | 0.00 | | **113.5** | ULS 3_0 | 168.3 | 235.2 | 244.4 | 0.67 | |
| 201T | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-2.0** | ULS 6a_90 Ah Ct2 | 21.0 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 312 | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 185 | **-13.5** | ULS 3_0 | 41.1 | 58.8 | 64.8 | 0.33 | | **0.0** | | 82.9 | 58.8 | 39.3 | 0.00 | |
| 314 | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-14.5** | ULS 3_135 | 54.9 | 58.8 | 64.8 | 0.26 | | **0.0** | | 82.9 | 58.8 | 39.3 | 0.00 | |
| 317 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 154 | **-3.0** | ULS 5a Ba 10 | 31.0 | 37.7 | 43.2 | 0.10 | | **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 | **-1.0** | 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 | | **16.4** | ULS 3_135 | 54.7 | 58.8 | 37.0 | 0.44 | |
| 313 | | 60x60x5 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 299 | **0.0** | | 14.4 | 58.8 | 54.0 | 0.00 | | **22.3** | ULS 3_0 | 54.7 | 58.8 | 37.0 | 0.60 | |
| 316 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 332 | **0.0** | | 12.6 | 75.4 | 86.4 | 0.00 | | **29.6** | ULS 3_135 | 52.4 | 75.4 | 44.1 | 0.67 | |
| 318 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 274 | **0.0** | | 13.7 | 37.7 | 43.2 | 0.00 | | **6.6** | ULS 5a Ba 10 | 37.4 | 37.7 | 22.0 | 0.30 | |
| 321 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 269 | **0.0** | | 14.0 | 37.7 | 43.2 | 0.00 | | **9.1** | ULS 3_45 | 37.4 | 37.7 | 22.0 | 0.41 | |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

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

**KIJ-GT380**
**S+3**
**Mast 63**

| 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 | hear (Tens) | earing (Tens) | U.C. (Tens) | Exceedance (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 315 | | 45x45x5 | S235 | 1M12-5.6t | 0.52 | 0.52 | 0.52 | 180 | **-1.1** | ULS 1a_0 | 22.7 | 20.2 | 32.4 | 0.05 | | **1.0** | 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 | 0.05 | | **0.9** | 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 | **-24.1** | ULS 5a Ba 20 | 66.6 | 58.8 | 75.6 | 0.41 | | **22.4** | ULS 5a Ba 11 | 96.8 | 58.8 | 53.5 | 0.42 | |
| 301 | | 70x70x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-27.3** | ULS 5a Ba 11 | 69.0 | 58.8 | 75.6 | 0.46 | | **29.5** | ULS 5a Ba 20 | 96.8 | 58.8 | 53.5 | 0.55 | |
| 302 | | 70x70x7 | S235 | 1M24-5.6t | 0.54 | 0.54 | 0.54 | 119 | **-33.3** | ULS 5a Ba 20 | 80.7 | 84.7 | 90.7 | 0.41 | | **30.5** | ULS 5a Ba 11 | 88.7 | 84.7 | 44.9 | 0.68 | |
| 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 | | **17.7** | 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 | | **24.4** | ULS 5a Ba 10 | 54.7 | 58.8 | 37.0 | 0.66 | |
| 306 | | 75x50x5 | S235 | 1M24-5.6t | 0.55 | 0.55 | 0.55 | 112 | **-29.6** | ULS 5a Ba 10 | 53.3 | 84.7 | 64.8 | 0.56 | | **30.6** | ULS 5a Ba 10 | 70.6 | 84.7 | 41.4 | 0.74 | |
| 307 | | 75x50x7 | S235 | 1M24-5.6t | 0.54 | 0.54 | 0.54 | 92 | **-38.4** | ULS 5a Ba 21 | 83.8 | 84.7 | 90.7 | 0.46 | | **36.3** | 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 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 27 | **-1.4** | ULS 1a_0,9_0,9_90 | 770.5 | 58.8 | 86.4 | 0.02 | | **4.9** | ULS 1a_90 | 318.0 | 58.8 | 86.4 | 0.08 | |
| 309 | | HEB160 | S235 | 1M20-5.6t | 2.00 | 2.00 | 2.00 | 26 | **-26.7** | ULS 5a Ba 10 | 956.7 | 58.8 | 86.4 | 0.45 | | **24.8** | ULS 5a Ba 21 | 318.0 | 58.8 | 86.4 | 0.42 | |
| 310 | | HEB160 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 25 | **-2.6** | ULS 1a_0,9_90 | 775.4 | 58.8 | 86.4 | 0.04 | | **2.5** | ULS 1a_90 | 318.0 | 58.8 | 86.4 | 0.04 | |
| 415 | | 60x60x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 180 | **-8.4** | ULS 3_0 | 30.7 | 37.7 | 43.2 | 0.27 | | **0.0** | | 60.5 | 37.7 | 26.7 | 0.00 | |
| 417 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 170 | **-9.1** | ULS 3_0 | 27.4 | 37.7 | 43.2 | 0.33 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 419 | | 75x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 107 | **-11.1** | ULS 3_0 | 55.1 | 37.7 | 43.2 | 0.29 | | **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 7 | 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 | | **13.5** | ULS 3_0 | 60.5 | 37.7 | 32.0 | 0.42 | |
| 416 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 353 | **0.0** | | 9.1 | 37.7 | 43.2 | 0.00 | | **16.3** | ULS 3_0 | 37.4 | 37.7 | 22.0 | 0.74 | |
| 418 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **0.0** | | 11.9 | 75.4 | 86.4 | 0.00 | | **24.5** | ULS 3_0 | 56.2 | 75.4 | 44.1 | 0.56 | |
| 421 | | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 259 | **0.0** | | 26.8 | 117.6 | 129.6 | 0.00 | | **46.8** | ULS 3_135 | 77.4 | 117.6 | 88.7 | 0.60 | |
| 420 | | 45x45x5 | S235 | 1M12-5.6t | 0.52 | 0.52 | 0.52 | 111 | **-1.3** | 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 | **-20.8** | ULS 5a Ba 22 | 48.1 | 58.8 | 54.0 | 0.43 | | **19.4** | ULS 5a Ba 12 | 54.7 | 58.8 | 37.0 | 0.53 | |
| 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 | **-29.4** | ULS 5a Ba 12 | 65.2 | 58.8 | 64.8 | 0.50 | | **28.9** | 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 | **-32.3** | ULS 5a Ba 22 | 86.5 | 84.7 | 77.8 | 0.42 | | **33.9** | ULS 5a Ba 12 | 76.0 | 84.7 | 44.0 | 0.77 | |
| 405 | | 75x50x7 | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 107 | **-41.5** | ULS 5a Ba 12 | 76.2 | 84.7 | 90.7 | 0.54 | | **38.7** | ULS 5a Ba 22 | 98.8 | 84.7 | 58.0 | 0.67 | |
| 409 | | 55x55x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 142 | **-4.2** | ULS 1a_135 | 37.9 | 37.7 | 43.2 | 0.11 | | **16.2** | 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 | **-16.8** | ULS 5a Ba 1 | 38.5 | 37.7 | 43.2 | 0.44 | | **3.4** | ULS 1a_135 | 53.3 | 37.7 | 32.0 | 0.10 | |
| 411 | | 55x55x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 135 | **-2.4** | ULS 1a_135 | 40.2 | 37.7 | 43.2 | 0.06 | | **17.0** | 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 | **-17.4** | ULS 5a Ba 1 | 42.0 | 37.7 | 43.2 | 0.46 | | **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 | | **4.7** | 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 | |
| 408 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 32 | **-6.8** | 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 | **-1.1** | ULS 5a Ba 1 | 1067.2 | 75.4 | 138.2 | 0.01 | | **13.9** | 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 | |

# APPENDIX C REDUNDANT MEMBERS CHECK

DNV·GL

# Knikverkorters initial construction (afkeur)

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

KIJ-GT
S+3
47

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 311 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 0.69 | 0 | 79 | **8.0** | **0.17** | 50.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 309 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.90 | 79 | 218 | **8.0** | **0.00** | 17.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.46 | |
| 307 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.40 | 0 | 160 | **8.0** | **0.35** | 26.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.61 | |
| 306 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.17 | 59 | 249 | **8.0** | **0.00** | 14.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.56 | |
| 330 | Onderstuk | Enkele staaf | L50.5 | S235 | M12 | 5.6 | 2.12 | 0 | 218 | **8.0** | **0.53** | 19.3 | 20.2 | 27.7 | 44.6 | 0.72 | 0.74 | |
| 304 | Onderstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.62 | 45 | 269 | **8.0** | **0.00** | 14.1 | 37.7 | 30.3 | 31.7 | 0.72 | 0.57 | |
| 303 | Onderstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.85 | 0 | 293 | **8.0** | **0.71** | 12.3 | 37.7 | 30.3 | 31.7 | 0.72 | 0.99 | |
| 302 | Onderstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 3.18 | 36 | 326 | **8.0** | **0.00** | 10.3 | 37.7 | 30.3 | 31.7 | 0.72 | 0.77 | |
| 301 | Onderstuk | Enkele staaf | L50.5 | S235 | M12 | 5.6 | 3.10 | 33 | 318 | **8.0** | **0.00** | 10.8 | 20.2 | 27.7 | 44.6 | 0.72 | 0.74 | |
| 300 | Onderstuk | Enkele staaf | L50.5 | S235 | M12 | 5.6 | 2.37 | 0 | 243 | **8.0** | **0.59** | 16.4 | 20.2 | 27.7 | 44.6 | 0.72 | 0.82 | |
| 299 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.26 | 52 | 259 | **8.0** | **0.00** | 13.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.59 | |
| 298 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.15 | 0 | 132 | **8.0** | **0.29** | 33.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.50 | |
| 321 | Pootverband | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.63 | 0 | 167 | **1.5** | **0.41** | 27.8 | 37.7 | 30.3 | 31.7 | 0.72 | 0.57 | |
| 319 | Pootverband | Enkele staaf | L60.5 | S235 | M16 | 5.6 | 3.48 | 78 | 296 | **1.5** | **0.00** | 14.6 | 37.7 | 32.0 | 60.5 | 1.05 | 0.10 | |
| 320 | Pootverband | Kniksteun en verticale steun | L60.5 | S235 | M16 | 5.6 | 3.28 | 0 | 179 | **1.5** | **0.41** | 24.7 | 37.7 | 32.0 | 60.5 | 0.81 | 0.53 | |
| 318 | Pootverband | Enkele staaf | L60.5 | S235 | M16 | 5.6 | 3.68 | 64 | 313 | **1.5** | **0.00** | 13.4 | 37.7 | 32.0 | 60.5 | 1.05 | 0.11 | |
| 316 | Tussenschot | Kniksteun en verticale steun | L60.5 | S235 | M16 | 5.6 | 5.03 | 0 | 275 | **0.3** | **0.63** | 13.9 | 37.7 | 32.0 | 60.5 | 0.81 | 0.81 | |
| 317 | Tussenschot | Kruisende staaf halverwege | L100.50.6 | S235 | M12 | 5.6 | 7.30 | 0 | 344 | **0.3** | **0.91** | 17.3 | 20.2 | 33.2 | 53.6 | 3.24 | 0.28 | |
| 50 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.24 | 0 | 142 | **9.0** | **0.31** | 30.5 | 20.2 | 27.7 | 38.9 | 0.57 | 0.54 | |
| 47 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.83 | 49 | 210 | **9.0** | **0.00** | 18.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.49 | |
| 49 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.64 | 0 | 303 | **9.0** | **0.66** | 10.4 | 20.2 | 27.7 | 38.9 | 0.57 | 1.15 | Bending |
| 46 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.79 | 40 | 205 | **9.0** | **0.00** | 18.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.47 | |
| 45 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.66 | 51 | 191 | **9.0** | **0.00** | 21.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 48 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.32 | 0 | 266 | **9.0** | **0.58** | 12.8 | 20.2 | 27.7 | 38.9 | 0.57 | 1.01 | Bending |
| 44 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.60 | 41 | 184 | **9.0** | 0.00 | 22.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 346 | 1e tussenstui | Kruisende staaf halverwege | L100.50.6 | S235 | M16 | 5.6 | 6.85 | 0 | 322 | **9.0** | 0.86 | 19.2 | 37.7 | 36.4 | 38.0 | 3.24 | 0.47 | |
| 58 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.67 | 43 | 192 | **9.0** | 0.00 | 20.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 60 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.67 | 0 | 307 | **9.0** | 0.67 | 10.2 | 20.2 | 27.7 | 38.9 | 0.57 | 1.17 | Bending |
| 57 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.67 | 35 | 192 | **9.0** | 0.00 | 20.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 56 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.71 | 51 | 196 | **9.0** | 0.00 | 20.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 59 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.37 | 0 | 272 | **9.0** | 0.59 | 12.4 | 20.2 | 27.7 | 38.9 | 0.57 | 1.04 | Bending |
| 55 | 1e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.65 | 42 | 190 | **9.0** | 0.00 | 21.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 80 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.49 | 52 | 171 | **7.8** | 0.00 | 24.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 83 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.02 | 0 | 232 | **7.8** | 0.51 | 15.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.88 | |
| 79 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.42 | 42 | 163 | **7.8** | 0.00 | 25.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 78 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.25 | 51 | 144 | **7.8** | 0.00 | 30.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 82 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.76 | 0 | 202 | **7.8** | 0.44 | 19.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.77 | |
| 77 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.19 | 41 | 137 | **7.8** | 0.00 | 32.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 76 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.13 | 53 | 130 | **7.8** | 0.00 | 33.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 81 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.53 | 0 | 176 | **7.8** | 0.38 | 23.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.67 | |
| 75 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.06 | 43 | 122 | **7.8** | 0.00 | 36.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 96 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.50 | 52 | 172 | **7.8** | 0.00 | 24.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 99 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.06 | 0 | 237 | **7.8** | **0.52** | 15.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.90 | |
| 95 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.43 | 42 | 164 | **7.8** | **0.00** | 25.6 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 94 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.26 | 50 | 145 | **7.8** | **0.00** | 29.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 98 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.80 | 0 | 207 | **7.8** | **0.45** | 18.7 | 20.2 | 27.7 | 38.9 | 0.57 | 0.79 | |
| 93 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.21 | 40 | 139 | **7.8** | **0.00** | 31.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 92 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.05 | 46 | 120 | **7.8** | **0.00** | 36.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 97 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.60 | 0 | 183 | **7.8** | **0.40** | 22.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.70 | |
| 91 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.01 | 37 | 116 | **7.8** | **0.00** | 38.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 90 | 2e tussenstui | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 0.96 | 42 | 110 | **7.8** | **0.00** | 39.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |

DNV·GL

**Knikverkorters adjusted construction (verbouw)**

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

KIJ-GT

S+3
47

| 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 | 9.0 | 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 | 9.0 | 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 | 9.0 | 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 | 9.0 | 0.8 | 18.0 | 32.3 | 37.7 | 92.1 | 1.1 | 0.71 | | Profile exchanged |
| 3001 | 1e tussenstul | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.20 | 0 | 123 | 9.0 | 0.39 | 47.7 | 60.3 | 43.6 | 51.0 | 1.08 | 0.36 | | Profile added |
| 3002 | 1e tussenstul | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.40 | 0 | 144 | 9.0 | 0.46 | 39.2 | 60.3 | 43.6 | 51.0 | 1.08 | 0.42 | | Profile added |
| 3003 | 1e tussenstul | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.40 | 0 | 144 | 9.0 | 0.46 | 39.2 | 60.3 | 43.6 | 51.0 | 1.08 | 0.42 | | Profile added |

Comment

1) Pos numbers 3001 to 3003 are new added redundants

DNV·GL

# Knikverkorters initial construction (afkeur)

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

KIJ-GT
S+3
63

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 311 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 0.69 | 0 | 79 | **8.0** | **0.17** | 50.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 309 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.90 | 79 | 218 | **8.0** | **0.00** | 17.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.46 | |
| 307 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.40 | 0 | 160 | **8.0** | **0.35** | 26.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.61 | |
| 306 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.17 | 59 | 249 | **8.0** | **0.00** | 14.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.56 | |
| 330 | Onderstuk | Enkele staaf | L50.5 | S235 | M12 | 5.6 | 2.12 | 0 | 218 | **8.0** | **0.53** | 19.3 | 20.2 | 27.7 | 44.6 | 0.72 | 0.74 | |
| 304 | Onderstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.62 | 45 | 269 | **8.0** | **0.00** | 14.1 | 37.7 | 30.3 | 31.7 | 0.72 | 0.57 | |
| 303 | Onderstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.85 | 0 | 293 | **8.0** | **0.71** | 12.3 | 37.7 | 30.3 | 31.7 | 0.72 | 0.99 | |
| 302 | Onderstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 3.18 | 36 | 326 | **8.0** | **0.00** | 10.3 | 37.7 | 30.3 | 31.7 | 0.72 | 0.77 | |
| 301 | Onderstuk | Enkele staaf | L50.5 | S235 | M12 | 5.6 | 3.10 | 33 | 318 | **8.0** | **0.00** | 10.8 | 20.2 | 27.7 | 44.6 | 0.72 | 0.74 | |
| 300 | Onderstuk | Enkele staaf | L50.5 | S235 | M12 | 5.6 | 2.37 | 0 | 243 | **8.0** | **0.59** | 16.4 | 20.2 | 27.7 | 44.6 | 0.72 | 0.82 | |
| 299 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.26 | 52 | 259 | **8.0** | **0.00** | 13.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.59 | |
| 298 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.15 | 0 | 132 | **8.0** | **0.29** | 33.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.50 | |
| 321 | Pootverband | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.63 | 0 | 167 | **1.5** | **0.41** | 27.8 | 37.7 | 30.3 | 31.7 | 0.72 | 0.57 | |
| 319 | Pootverband | Enkele staaf | L60.5 | S235 | M16 | 5.6 | 3.48 | 78 | 296 | **1.5** | **0.00** | 14.6 | 37.7 | 32.0 | 60.5 | 1.05 | 0.10 | |
| 320 | Pootverband | Kniksteun en verticale steun | L60.5 | S235 | M16 | 5.6 | 3.28 | 0 | 179 | **1.5** | **0.41** | 24.7 | 37.7 | 32.0 | 60.5 | 0.81 | 0.53 | |
| 318 | Pootverband | Enkele staaf | L60.5 | S235 | M16 | 5.6 | 3.68 | 64 | 313 | **1.5** | **0.00** | 13.4 | 37.7 | 32.0 | 60.5 | 1.05 | 0.11 | |
| 316 | Tussenschot | Kniksteun en verticale steun | L60.5 | S235 | M16 | 5.6 | 5.03 | 0 | 275 | **0.3** | **0.63** | 13.9 | 37.7 | 32.0 | 60.5 | 0.81 | 0.81 | |
| 317 | Tussenschot | Kruisende staaf halverwege | L100.50.6 | S235 | M12 | 5.6 | 7.30 | 0 | 344 | **0.3** | **0.91** | 17.3 | 20.2 | 33.2 | 53.6 | 3.24 | 0.28 | |
| 50 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.24 | 0 | 142 | **9.0** | **0.31** | 30.5 | 20.2 | 27.7 | 38.9 | 0.57 | 0.54 | |
| 47 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.83 | 49 | 210 | **9.0** | **0.00** | 18.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.49 | |
| 49 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.64 | 0 | 303 | **9.0** | **0.66** | 10.4 | 20.2 | 27.7 | 38.9 | 0.57 | 1.15 | Bending |
| 46 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.79 | 40 | 205 | **9.0** | **0.00** | 18.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.47 | |
| 45 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.66 | 51 | 191 | **9.0** | **0.00** | 21.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 48 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.32 | 0 | 266 | **9.0** | **0.58** | 12.8 | 20.2 | 27.7 | 38.9 | 0.57 | 1.01 | Bending |
| 44 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.60 | 41 | 184 | **9.0** | 0.00 | 22.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 346 | 1e tussenstuk | Kruisende staaf halverwege | L100.50.6 | S235 | M16 | 5.6 | 6.85 | 0 | 322 | **9.0** | 0.86 | 19.2 | 37.7 | 36.4 | 38.0 | 3.24 | 0.47 | |
| 58 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.67 | 43 | 192 | **9.0** | 0.00 | 20.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 60 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.67 | 0 | 307 | **9.0** | 0.67 | 10.2 | 20.2 | 27.7 | 38.9 | 0.57 | 1.17 | Bending |
| 57 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.67 | 35 | 192 | **9.0** | 0.00 | 20.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 56 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.71 | 51 | 196 | **9.0** | 0.00 | 20.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 59 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.37 | 0 | 272 | **9.0** | 0.59 | 12.4 | 20.2 | 27.7 | 38.9 | 0.57 | 1.04 | Bending |
| 55 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.65 | 42 | 190 | **9.0** | 0.00 | 21.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.44 | |
| 80 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.49 | 52 | 171 | **7.8** | 0.00 | 24.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 83 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.02 | 0 | 232 | **7.8** | 0.51 | 15.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.88 | |
| 79 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.42 | 42 | 163 | **7.8** | 0.00 | 25.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 78 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.25 | 51 | 144 | **7.8** | 0.00 | 30.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 82 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.76 | 0 | 202 | **7.8** | 0.44 | 19.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.77 | |
| 77 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.19 | 41 | 137 | **7.8** | 0.00 | 32.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 76 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.13 | 53 | 130 | **7.8** | 0.00 | 33.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 81 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.53 | 0 | 176 | **7.8** | 0.38 | 23.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.67 | |
| 75 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.06 | 43 | 122 | **7.8** | 0.00 | 36.2 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 96 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.50 | 52 | 172 | **7.8** | 0.00 | 24.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 99 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.06 | 0 | 237 | **7.8** | **0.52** | 15.3 | 20.2 | 27.7 | 38.9 | 0.57 | 0.90 | |
| 95 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.43 | 42 | 164 | **7.8** | **0.00** | 25.6 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 94 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.26 | 50 | 145 | **7.8** | **0.00** | 29.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 98 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.80 | 0 | 207 | **7.8** | **0.45** | 18.7 | 20.2 | 27.7 | 38.9 | 0.57 | 0.79 | |
| 93 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.21 | 40 | 139 | **7.8** | **0.00** | 31.4 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 92 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.05 | 46 | 120 | **7.8** | **0.00** | 36.8 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 97 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.60 | 0 | 183 | **7.8** | **0.40** | 22.1 | 20.2 | 27.7 | 38.9 | 0.57 | 0.70 | |
| 91 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.01 | 37 | 116 | **7.8** | **0.00** | 38.0 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |
| 90 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 0.96 | 42 | 110 | **7.8** | **0.00** | 39.9 | 20.2 | 27.7 | 38.9 | 0.57 | 0.39 | |

DNV·GL

**Knikverkorters adjusted construction (verbouw)**

KIJ-GT

S+3

63

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

| 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 | 9.0 | 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 | 9.0 | 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 | 9.0 | 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 | 9.0 | 0.8 | 18.0 | 32.3 | 37.7 | 92.1 | 1.1 | 0.71 | | Profile exchanged |

# APPENDIX D ANCHOR CHECKS AND SHEAR BLOCKS

# ANCHORS AND SHEAR BLOCKS S+3

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.

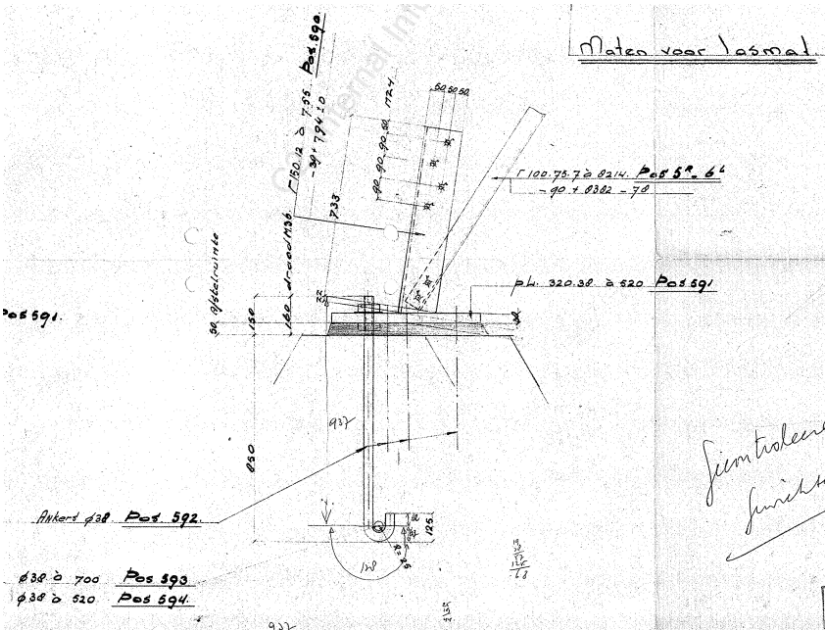



**Figure 1 Anchor detail**

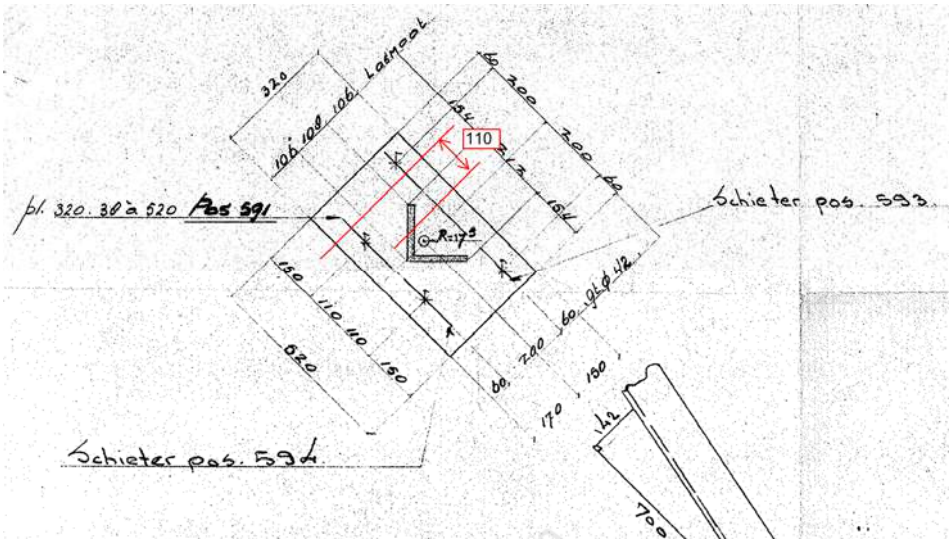



**Figure 2 Foot plate with schematisation of effective width and leverage arm**

[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+3 structure number 47 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] | $R_n$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. druk | ULS 1a_45 | 142 | 129 | **754** | 10 | -192 | -39 | 770 |
| Max. trek | ULS 1a_0,9_0,9_45 | 107 | 93 | **-579** | -10 | 142 | 24 | -591 |
| Max. pos. torsie | ULS 5a Ba 21 | -27 | 21 | 4 | **33** | -4 | -4 | 4 |
| Max. neg. torsie | ULS 5a Ba 10 | -27 | -21 | 4 | **-33** | -4 | -4 | 4 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_45 | 107 | 93 | **-579** | **-10** | 142 | 24 | -591 |

## 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.

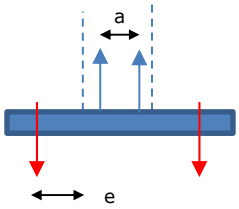



**Figure 3 Scheme for check of foot plate**

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. = 145 / 123 = 1,17 ≥ 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.

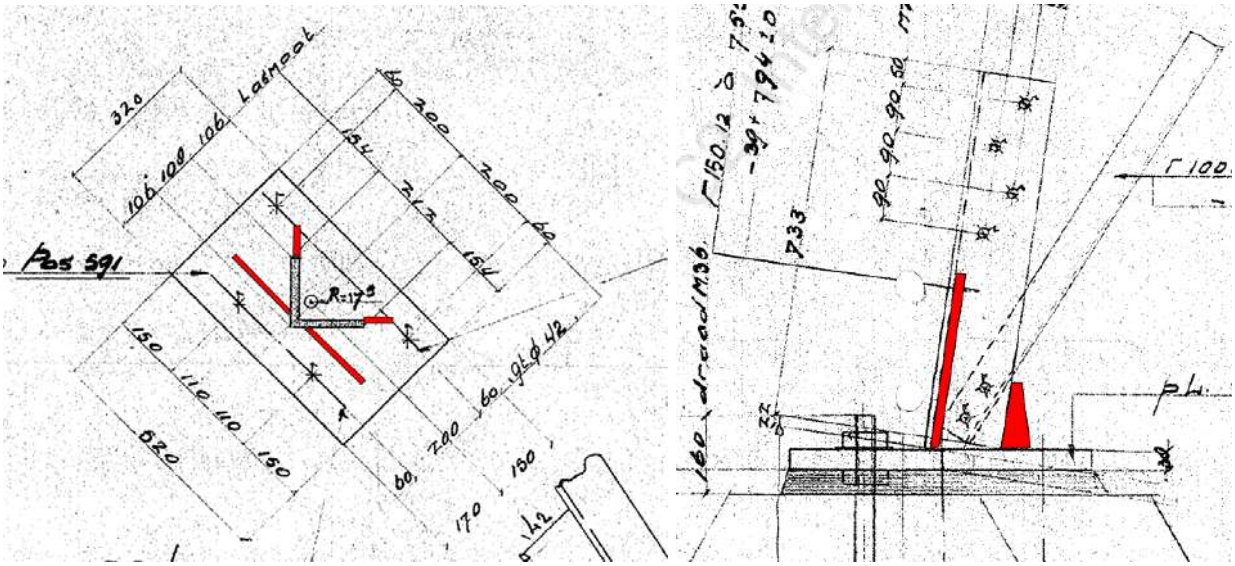



**Figure 4 Stiffeners**

For the detail-engineering the loads for tower 47 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 ($R_{z,lok}$).

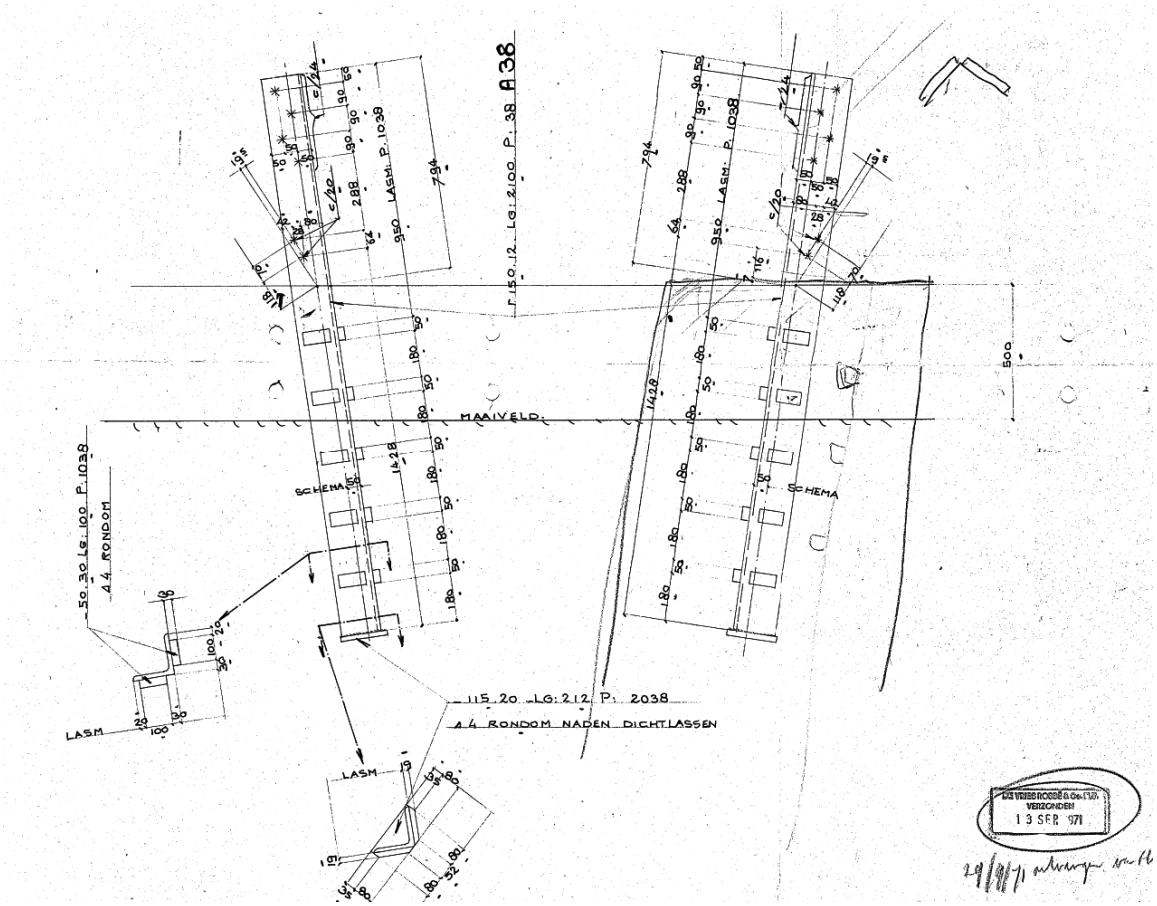



**Figure 5 Shear blocks S+0**

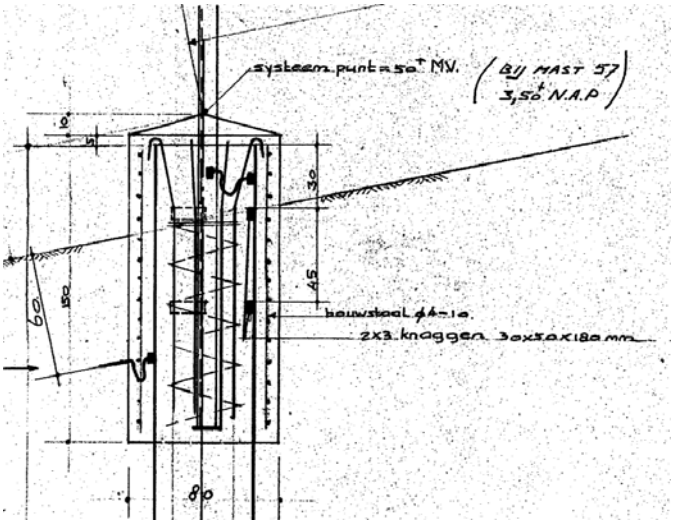



**Figure 6 Pile shear blocks**

## Loads

The loads for wind zone III for tower 63 are tabulated in Table 2.

**Table 2 Foundation loads wind zone III for tower 63**

**Omhullenden ongeacht stijl**

| Belasting | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. druk | ULS 1a_45 | 118 | 107 | **627** | 8 | -160 | -33 | 639 |
| Max. trek | ULS 1a_0,9_0,9_45 | 85 | 74 | **-459** | -8 | 112 | 19 | -468 |
| Max. pos. torsie | ULS 5a Ba 10 | -26 | 21 | 0 | **34** | -3 | -3 | 0 |
| Max. neg. torsie | ULS 5a Ba 21 | -26 | -21 | 0 | **-34** | -3 | -3 | 0 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_45 | 85 | 74 | **-459** | **-8** | 112 | 19 | -468 |

## 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.

U.C. = 0,80 ≤ 1,00 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+3 II** | ***Checks:*** | | |
|---|---|---|---|---|
| | | Anchor bolt to tension | 1,17 | ***not OK*** |
| | | Anchor bolt to shear | 0,59 | ***OK*** |
| | | Dowel ("schieter") | 0,92 | ***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 = | **579** | kN |
| Shear force | $F_{H,Ed}$ = | **192** | kN |
| Number of anchors for tension | | 4 | |
| Number of anchors for shear | | 4 | |
| $F_{T;Ed} = T / n$ = | | 144,8 | kN |
| $F_{v;Ed} = F_{H,Ed} / n$ = | | 48,0 | kN |

### *Anchor properties*

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

*Capacity per anchor*

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

### *Foot plate*

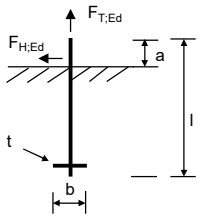
$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

| | | | |
|---|---|---|---|
| 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")*

$$\frac{\sigma_b'}{f_{cd}} = \frac{26,2}{40,0} = 0,65 \quad \textit{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{145}{157} = 0,92 \quad \textit{OK}$$




### *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 | $d_S$ = | **38** | mm |
| Length | b = | **220** | mm |
| Spread | $c = t\sqrt{(f_{yd} / 3 f_{jd})}$ = | 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 | $q = F_{T,Ed} / b_{eff}$ = | 995 | kN/m |
| Concrete pressure | $\sigma_b' = q / d_S$ = | 26,2 | MPa |
| *Shear stress in dowel* | | | |
| Load | $F_{T,Ed}$ = | 145 | kN |
| Allowable | $F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ = | 157 | kN |

### *Capacity of foot plate*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{144,8}{123,4} = 1,17 \quad \textit{not OK}$$

### *Capacity of anchor for tension*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{144,8}{200,6} = 0,72 \quad \textit{OK}$$

### *Check foot plate for tension*

$$\frac{T}{n \times F_{t;Rd}} = \frac{579,0}{493,6} = 1,17 \quad \textit{not OK}$$

### *Check anchor for shear*

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{48,0}{82,0} = 0,59 \quad \textit{OK}$$

Project: KIJ-GT380
Mast: S+3

# 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 | $F_{Ed,druk}$ | 639 | kN | Compression | U.C. | 0,80 | < 1,00 OK |
| Tension | $F_{Ed,trek}$ | 468 | kN | Tension | U.C. | 0,78 | < 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 | $\gamma_c$ | 1,5 | |
| Add. mat. factor | $\gamma_m$ | 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 | | 223 | 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***

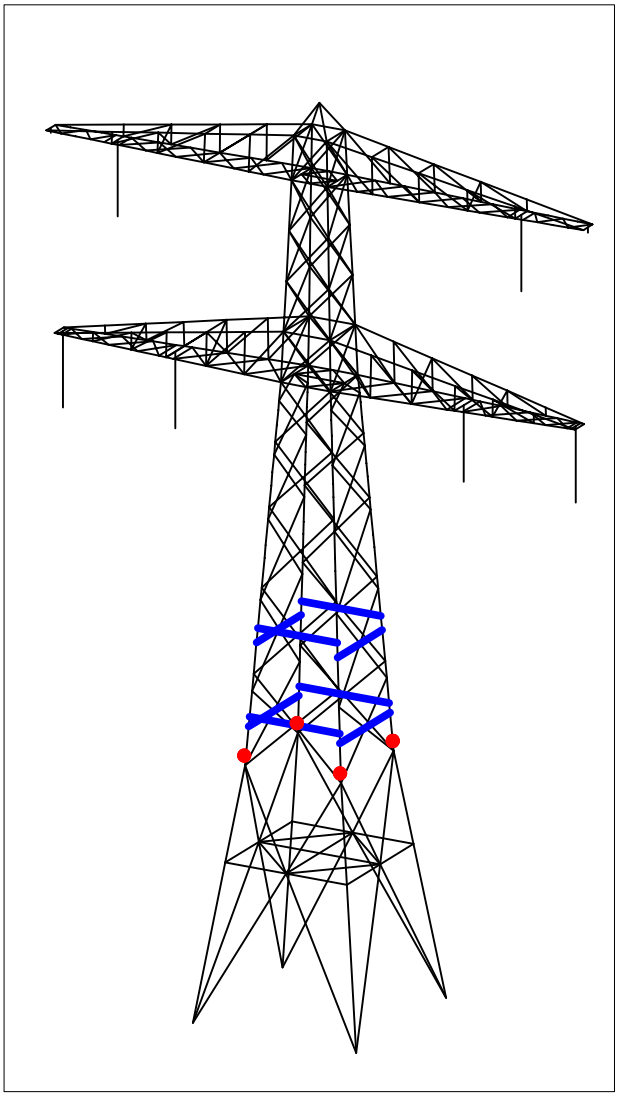
| | | |
|---|---|---|
| Main leg for tension | 733 | kN |
| Tubular pile for tension | 599 | kN |
| Main leg for compression | 797 | kN |
| Tubular pile for compression | 857 | kN |

***Check of welds***

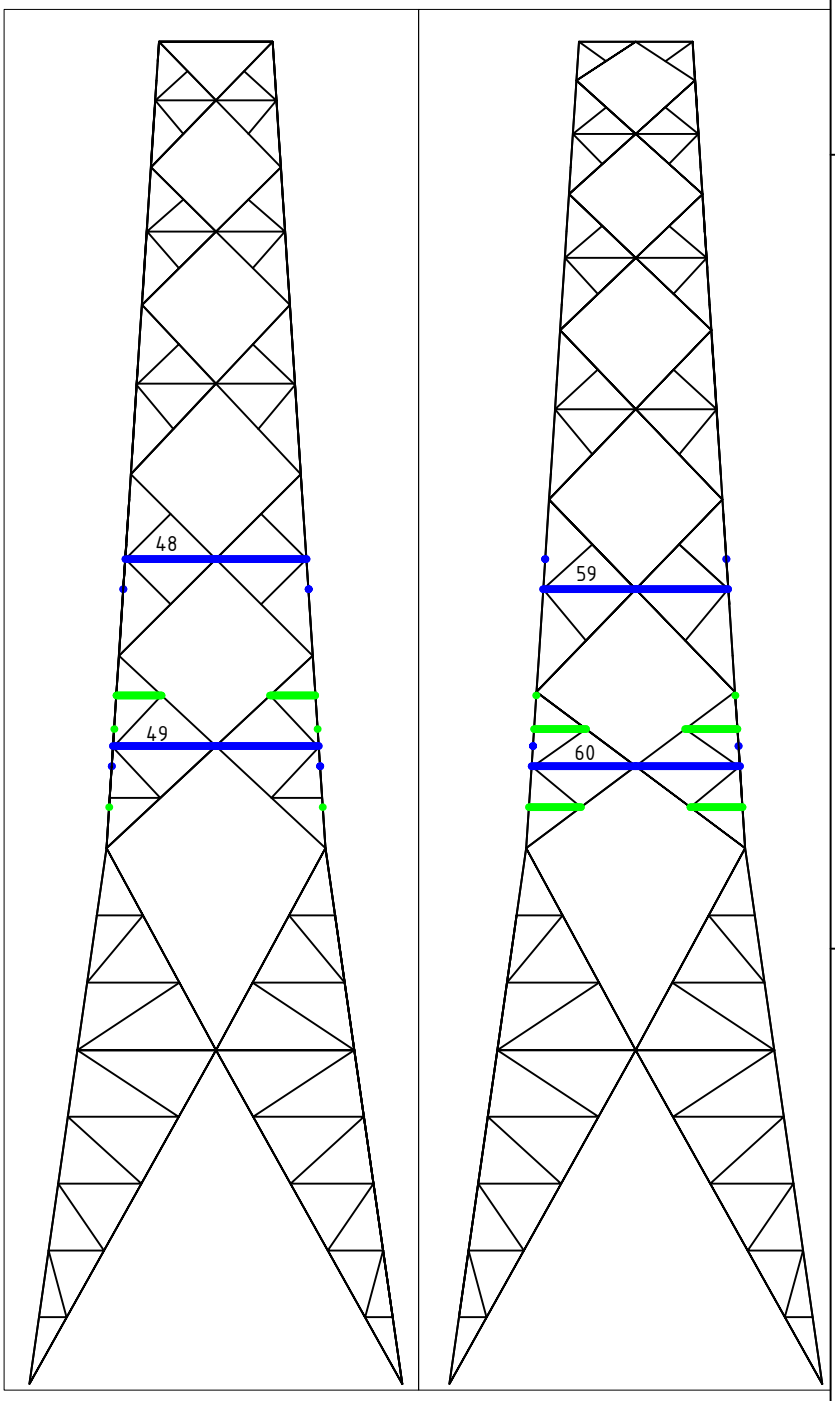
| | | |
|---|---|---|
| Shear block main leg | 0,49 | < 1,00 OK |
| Shear block pile | 0,40 | < 1,00 OK |

# 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 | 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.: 10166260-005

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | |
| Drawn by: | MuK | 25-11-2020 | Units: | m | |
| Checked by: | TBR | 25-11-2020 | Project no: | 10166260 | |
| Approved by: | JHu | 25-11-2020 | Company: | TenneT | |

Description: Modifications overview for mast type S+3 Mast 47

Revision: 01

Format: A2

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

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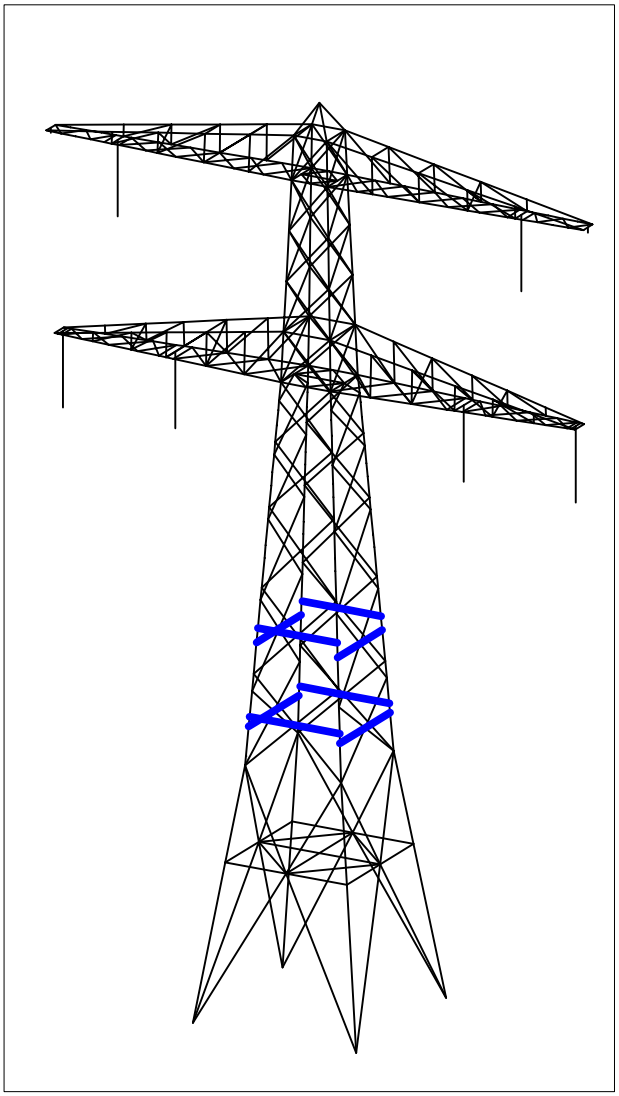
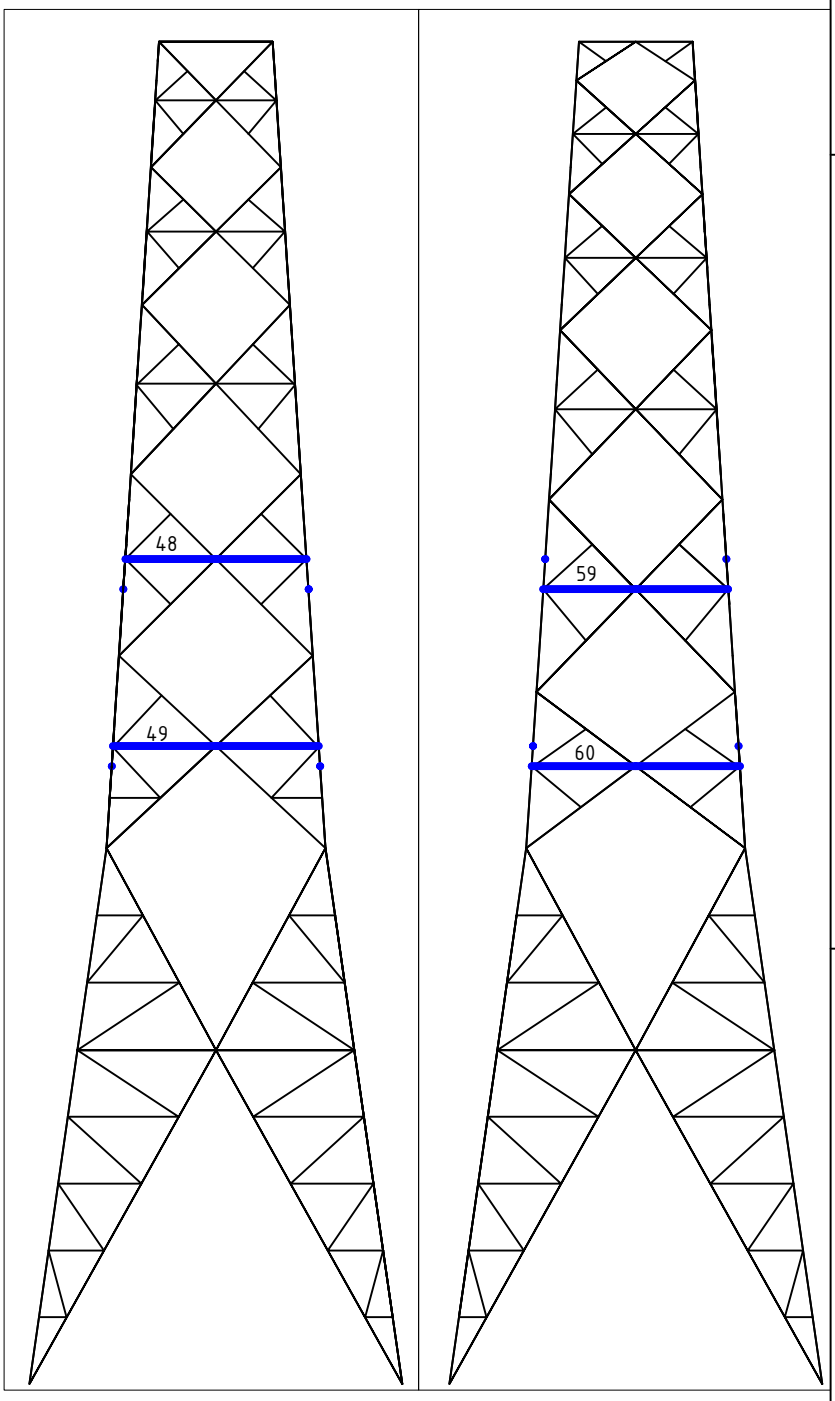
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (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 | 25-11-2020 | Version 2.0 - Profile exchange added |
| 00 | 29-4-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-007

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | Scale: | - | Description: Modifications overview for mast type S+3 Mast 63 | 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 | | |

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Bijlage 19 Rapportage Mastconstructie S+4

DNV·GL

"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

# KIJ-GT380 – Rapportage mast S+4

## TenneT TSO B.V.

**Meridian doc. nr.:** 002.589.40 0916497
**Rapport nr.:** 21-1079 Rev.0
**Datum:** 2021-07-05

| | | |
|---|---|---|
| Projectnaam: | "Toetsing en herontwerp masten en fundaties BBB380" | DNV GL - Energy<br>Energy Advisory |
| Rapport titel: | KIJ-GT380 – Rapportage mast S+4 | Postbus 9035 |
| Klant: | TenneT TSO B.V. | 6800 ET ARNHEM |
| Contactpersoon: | [redacted] | |
| Datum: | 2021-07-05 | |
| Project nr.: | 10166260 | [redacted] |
| Organisatie unit: | TDT | [redacted] |
| Meridian doc.nr.: | 002.589.40 0916497 | |
| Rapport nr.: | 21-1079 Rev.0 | |

| Geschreven door: | Beoordeeld door: | Goedgekeurd door: |
|---|---|---|
| [redacted] | | |

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Trefwoorden:

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

DNV GL Netherlands B.V.

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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+4 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+4.

### 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.

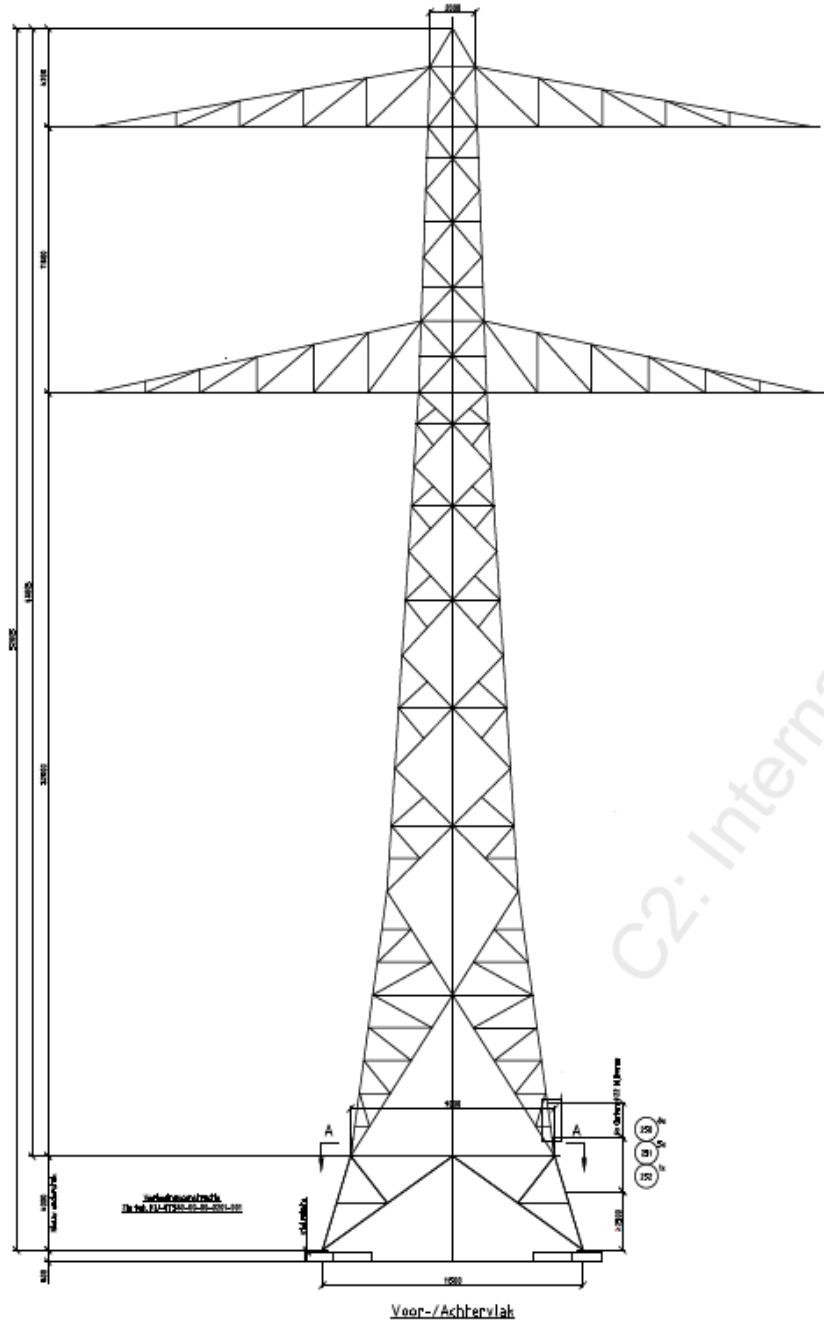
**Tabel 1 Relevante eisen**

| 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".<br><br>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+4 getoetst. In de verbinding KIJ-GT komt maar één mast voor van het type S+4 (mast 58), de gegevens van de mast zijn in Tabel 2 weergegeven. De berekening van de geleiderbelastingen is in dit geval locatie specifiek uitgevoerd.

**Tabel 2 Mastnummers**

| Mastnummer | Masttype | Maatgevend mastnummer | Wind span (m) | Weight span (m) | Hoogteverschil |
|---|---|---|---|---|---|
| 58 | S+4 | 58 | 341 | 315 | 2.6 |

## 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 | 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:

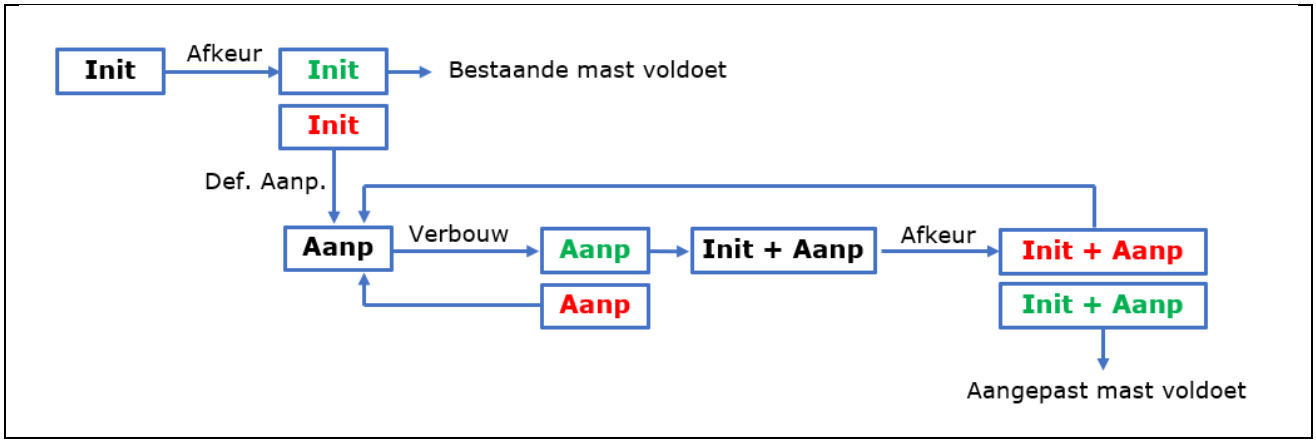
Stap 1: Toets bestaande (Init) mast op Afkeur

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 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

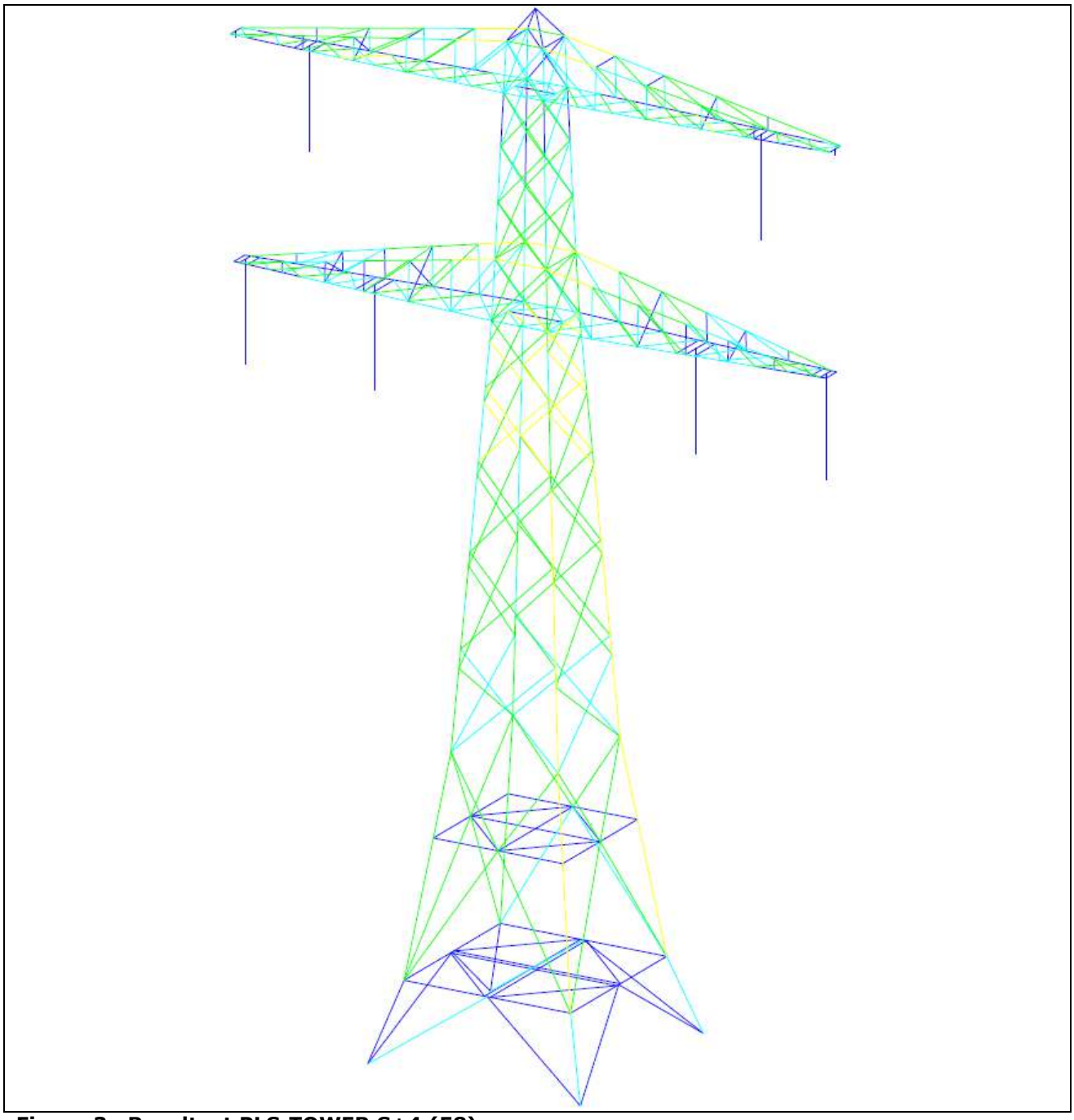
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten 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+4 met belastingen op afkeurniveau is weergegeven in onderstaande figuren.



**Figuur 3 Resultaat PLS-TOWER S+4 (58)**

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 | | Figuur 3 |
| Knikverkorters | | **Voldoen niet** | Appendix C |
| Ankers en voetplaat | Voldoen | | Appendix D |

# 5 AANPASSINGEN

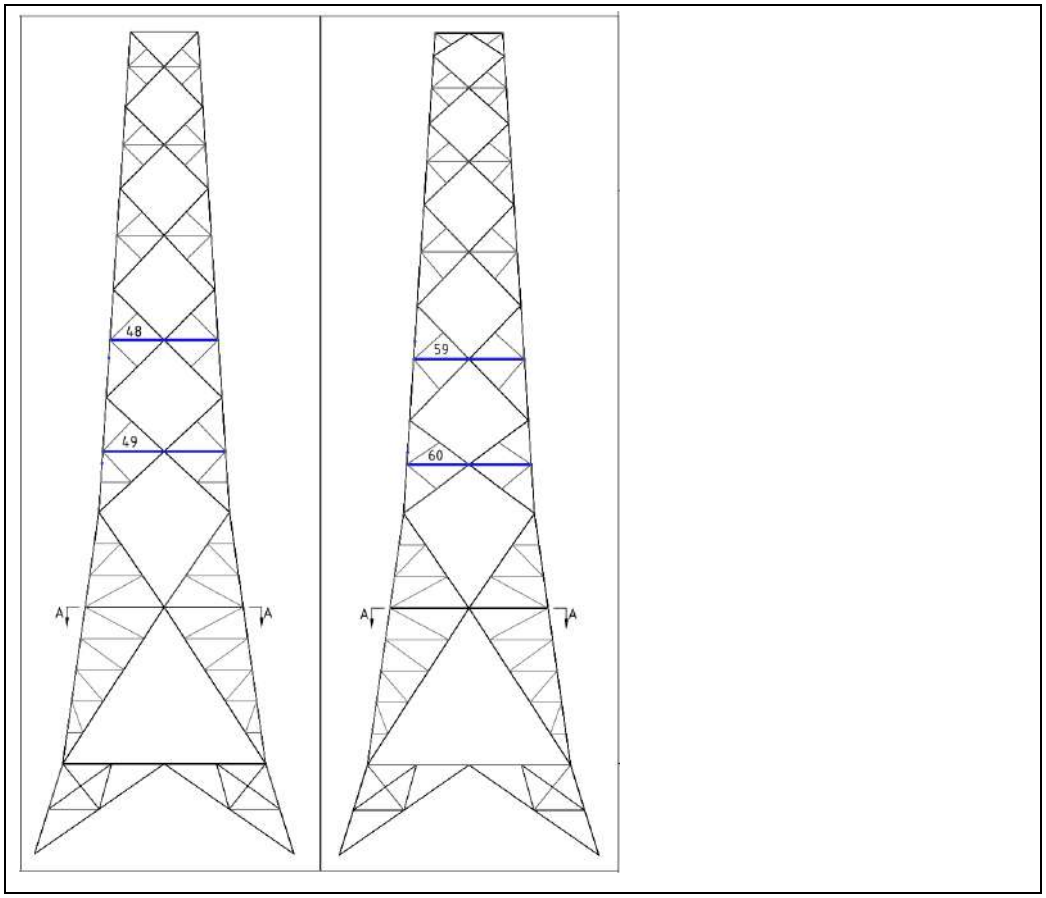
## 5.1 Inleiding

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 knikverkorters in het tussenstuk en het broekstuk.

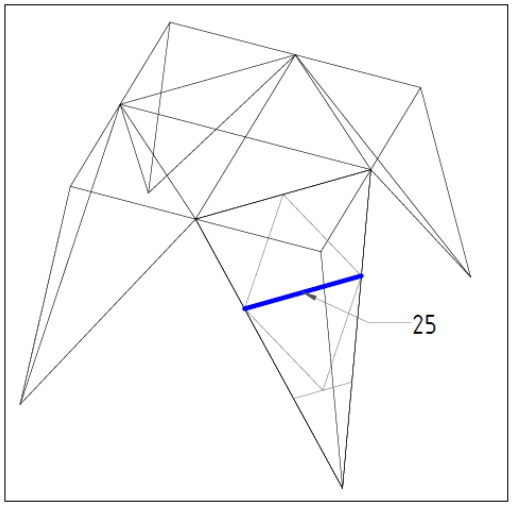
## 5.2 Aanpassingen

Zoals blijkt uit de controle van de knikverkorters, zie Appendix C, moeten de onderdelen die zijn weergegeven in Figuur 4 worden aangepast. Voor afmetingen profielen en bouten, zie Appendix E.




**Figuur 4 Aanpassingen voor S+4 (58), vooraanzicht (links) en zijaanzicht (rechts)**

Een knikverkorter aan de binnenzijde van het broekstuk moet vervangen worden, waarbij rekening gehouden dient te worden met een klimbelasting van 1kN. Zie Figuur 5.




**Figuur 5 Te vervangen knikverkorter in broekstuk**

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen is voor mast 58 gegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

**Tabel 5 Gewichten S+4 (58) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **25** | L45.5 | S235 | 1M12-8.8t | L70.7 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 3.21 | 96.62 |
| **49** | L45.5 | S235 | 1M12-5.6t | L55.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.64 | 53.31 |
| **48** | L45.5 | S235 | 1M12-5.6t | L50.5 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.32 | 35.64 |
| **60** | L45.5 | S235 | 1M12-5.6t | L55.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.67 | 53.91 |
| **59** | L45.5 | S235 | 1M12-5.6t | L50.5 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.37 | 36.40 |
| | | | | | | | | **20** | **134.74** | **275.87** |

## 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, 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


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 51 m |
| Max. Span | 399 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 342 m |
| EDS Weight span | 364 m |
| Min. Weight span | 361 m |
| Max. Weight span | 392 m |

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

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+4

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

Document name:

KIJ-GT_S+4_58_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+4
Number: 58

## Conductor loads

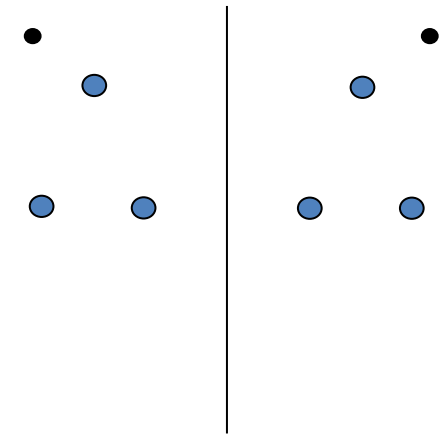
Auteur: TBR
Versie: v11.3

### General

| | |
|---|---|
| Description | S+4 |
| 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 | 32,2 m | 36,5 m | 15,7 m |
| Circuit 1 | 11 | 380ct1f2 | 32,2 m | 36,5 m | 8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 43,5 m | 47,8 m | 12,2 m |
| Circuit 2 | 20 | 380ct2f1 | 32,2 m | 36,5 m | -8,7 m |
| Circuit 2 | 21 | 380ct2f2 | 32,2 m | 36,5 m | -15,7 m |
| Circuit 2 | 22 | 380ct2f3 | 43,5 m | 47,8 m | -12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 47,3 m | 47,8 m | 16,2 m |
| Bliksemdraad 2 | 3 | bl2 | 47,3 m | 47,8 m | -16,2 m |

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

Project: KIJ-GT
Tower: S+4
Number: 58

**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**

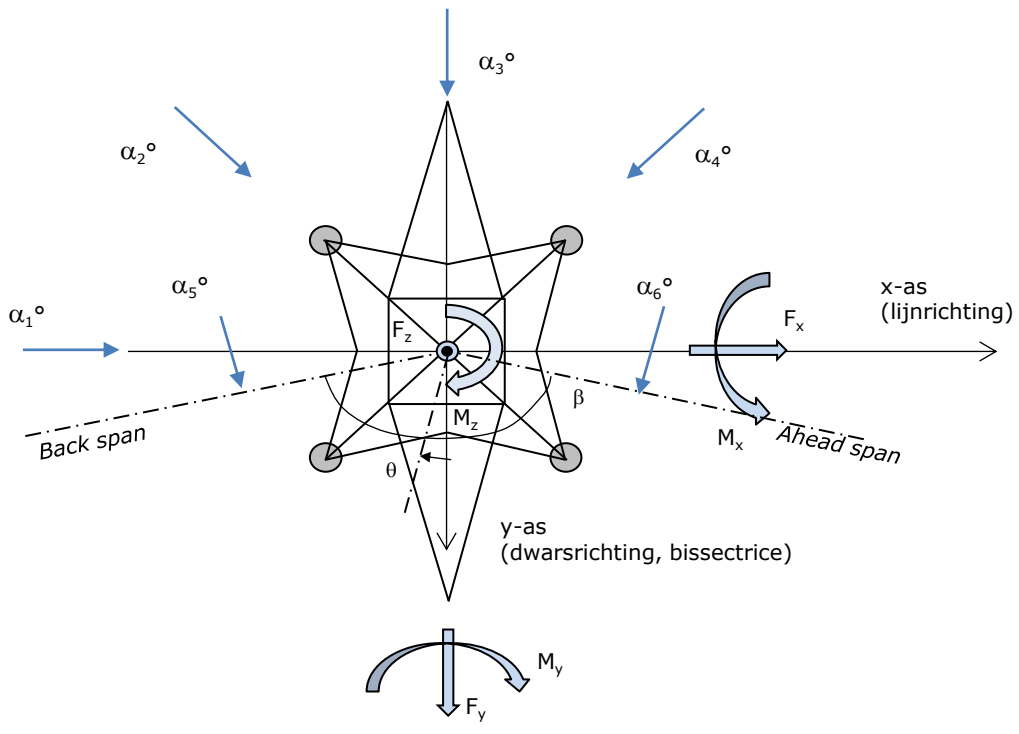
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | -1,4 | -4,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | -1,4 | -4,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 284,0 | 399,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 377,7 | 377,7 | m |
| Line angle | $\beta$ | 180 | | ° |
| Tower orientation with respect to bi | $\theta$ | 0 | | ° |
| Section length | | 2580 | 2580 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+4
Number: 58

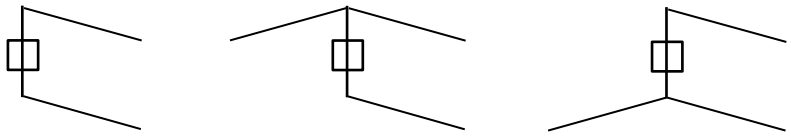
**Absence of conductors**

| | | 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 |

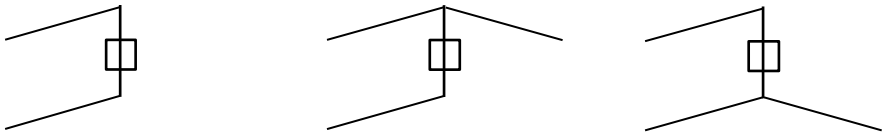
**Load situations SPLS**

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+4
Number: 58

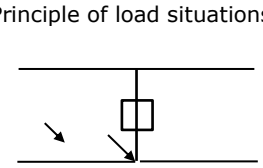
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

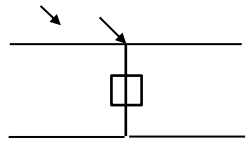
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

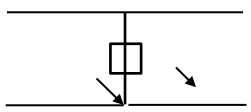
Principle of load situations:



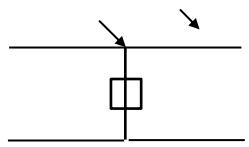
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

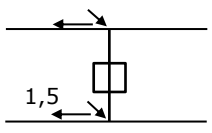
**Load situations 8. Galloping as a static load**

| 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 |

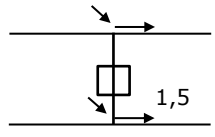
Considered situations galloping 8: None (existing structure)

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+4
Number: 58

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+4 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 51,0 | m | |
| Tower self weight | 240,0 | kN | |
| | | | |
| *Width and slope at foundation* | x-ri. | y-ri. | |
| Leg spread | 11,50 | 11,50 | m |
| Inclination of main leg | 0,313 | 0,313 | - |
| 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] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 4,00 | 11,50 | 9,00 | 4,00 | 0,313 | 41,00 | 5,55 | 0,14 | 3,23 |
| Middenstuk 1 | 15,18 | 9,00 | 5,79 | 11,18 | 0,144 | 82,68 | 8,38 | 0,10 | 3,40 |
| Middenstuk 2 | 36,50 | 5,79 | 3,00 | 21,32 | 0,065 | 93,70 | 13,51 | 0,14 | 3,19 |
| Bovenstuk 1 | 42,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 50,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 52,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 36,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 47,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

**Properties tower sections transverse direction (side view, xz plane)**

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 4,00 | 11,50 | 9,00 | 4,00 | 0,313 | 41,00 | 5,55 | 0,14 | 3,23 |
| Middenstuk 1 | 15,18 | 9,00 | 5,79 | 11,18 | 0,144 | 82,68 | 8,38 | 0,10 | 3,40 |
| Middenstuk 2 | 36,50 | 5,79 | 3,00 | 21,32 | 0,065 | 93,70 | 13,51 | 0,14 | 3,19 |
| Bovenstuk 1 | 42,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,50 | 0,27 | 2,63 |
| Bovenstuk 2 | 50,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 52,00 | 2,00 | 2,00 | 1,62 | -3,765 | 3,24 | | | |
| Ondertraverse | 36,50 | 14,20 | | 3,05 | | 21,66 | 4,76 | 0,22 | 2,85 |
| Boventraverse | 47,80 | 15,10 | | 2,58 | | 19,48 | 4,77 | 0,24 | 2,74 |

*Note: Surface transverse direction is reduced in calculation.*

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**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | $\Delta$h | $A_1$ |
|---|---|---|---|
| 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 | $p_w$ [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 | 0,70 | 12,6 | 10,7 | 0,0 | -10,7 | 2,0 | 25,1 | 21,3 | 0,0 | -21,3 |
| Middenstuk 1 | 0,70 | 20,0 | 16,9 | 0,0 | -16,9 | 9,6 | 191,5 | 162,5 | 0,0 | -162,5 |
| Middenstuk 2 | 0,95 | 40,8 | 34,6 | 0,0 | -34,6 | 25,8 | 1053,4 | 893,8 | 0,0 | -893,8 |
| Bovenstuk 1 | 1,07 | 12,6 | 10,7 | 0,0 | -10,7 | 39,4 | 497,0 | 421,7 | 0,0 | -421,7 |
| Bovenstuk 2 | 1,11 | 14,6 | 12,4 | 0,0 | -12,4 | 46,4 | 679,3 | 576,4 | 0,0 | -576,4 |
| Topstuk | 1,14 | | | | | 51,2 | | | | |
| Ondertraverse | 1,05 | 28,5 | 16,9 | 0,0 | -16,9 | 37,5 | 1069,0 | 635,0 | 0,0 | -635,0 |
| Boventraverse | 1,13 | 29,5 | 17,5 | 0,0 | -17,5 | 48,7 | 1434,7 | 852,2 | 0,0 | -852,2 |
| Totaal | | 158,5 | 119,8 | 0,0 | -119,8 | | 4950,1 | 3562,9 | 0,0 | -3562,9 |

**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 | 0,70 | 0,0 | 10,7 | 12,6 | 10,7 | 2,0 | 0,0 | 21,3 | 25,1 | 21,3 |
| Middenstuk 1 | 0,70 | 0,0 | 16,9 | 20,0 | 16,9 | 9,6 | 0,0 | 162,5 | 191,5 | 162,5 |
| Middenstuk 2 | 0,95 | 0,0 | 34,6 | 40,8 | 34,6 | 25,8 | 0,0 | 893,8 | 1053,4 | 893,8 |
| Bovenstuk 1 | 1,07 | 0,0 | 10,7 | 12,6 | 10,7 | 39,4 | 0,0 | 421,7 | 497,0 | 421,7 |
| Bovenstuk 2 | 1,11 | 0,0 | 12,4 | 14,6 | 12,4 | 46,4 | 0,0 | 576,4 | 679,3 | 576,4 |
| Topstuk | 1,14 | | | | | 51,2 | | | | |
| Ondertraverse | 1,05 | 0,0 | 16,9 | 11,4 | 16,9 | 37,5 | 0,0 | 635,0 | 427,6 | 635,0 |
| Boventraverse | 1,13 | 0,0 | 17,5 | 11,8 | 17,5 | 48,7 | 0,0 | 852,2 | 573,9 | 852,2 |
| Total | | 0,0 | 119,8 | 123,7 | 119,8 | | 0,0 | 3562,9 | 3447,8 | 3562,9 |

**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 | 240 | 0 | 0 | 0 |
| Windrichting 0° | 159 | 0 | 0 | 0 | 4950 | 0 |
| Windrichting 45° | 120 | 120 | 0 | 3563 | 3563 | 0 |
| Windrichting 90° | 0 | 124 | 0 | 3448 | 0 | 0 |
| Windrichting 135° | -120 | 120 | 0 | 3563 | -3563 | 0 |

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**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 34,85 | 1,03 | 1,2 | 1,24 |
| 380ct1f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 34,85 | 1,03 | 1,2 | 1,24 |
| 380ct1f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 46,15 | 1,11 | 1,2 | 1,33 |
| 380ct2f1 | 2,00 | 1 | 2 | 4,3 | 1,0 | 34,85 | 1,03 | 1,2 | 1,24 |
| 380ct2f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 34,85 | 1,03 | 1,2 | 1,24 |
| 380ct2f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 46,15 | 1,11 | 1,2 | 1,33 |
| bl1 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 48,05 | 1,12 | 1,2 | 0,07 |
| bl2 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 48,05 | 1,12 | 1,2 | 0,07 |

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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 | 27,2 | 0,96 | 0,58 | 0,50 | 1,11 | 28,25 | 52,4 | 45,3 | 46,9 | 94,4 | 81,6 |
| 380ct1f2 | 27,2 | 0,96 | 0,58 | 0,50 | 1,11 | 28,25 | 52,4 | 45,3 | 46,9 | 94,4 | 81,6 |
| 380ct1f3 | 38,5 | 1,06 | 0,61 | 0,53 | 1,08 | 28,25 | 59,1 | 50,9 | 46,9 | 109,1 | 94,0 |
| 380ct2f1 | 27,2 | 0,96 | 0,58 | 0,50 | 1,11 | 28,25 | 52,4 | 45,3 | 46,9 | 94,4 | 81,6 |
| 380ct2f2 | 27,2 | 0,96 | 0,58 | 0,50 | 1,11 | 28,25 | 52,4 | 45,3 | 46,9 | 94,4 | 81,6 |
| 380ct2f3 | 38,5 | 1,06 | 0,61 | 0,53 | 1,08 | 28,25 | 59,1 | 50,9 | 46,9 | 109,1 | 94,0 |
| bl1 | 42,6 | 1,09 | 0,62 | 0,53 | 1,20 | 22,24 | 17,9 | 15,4 | 41,5 | 33,5 | 28,9 |
| bl2 | 42,6 | 1,09 | 0,62 | 0,53 | 1,20 | 22,13 | 17,8 | 15,4 | 41,4 | 33,4 | 28,8 |

**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 | 21,2 | 0,89 | 0,56 | 0,49 | 1,13 | 28,25 | 47,9 | 41,4 | 46,9 | 84,7 | 73,3 |
| 380ct1f2 | 21,2 | 0,89 | 0,56 | 0,49 | 1,13 | 28,25 | 47,9 | 41,4 | 46,9 | 84,7 | 73,3 |
| 380ct1f3 | 32,5 | 1,01 | 0,60 | 0,51 | 1,09 | 28,25 | 55,8 | 48,2 | 46,9 | 101,8 | 87,8 |
| 380ct2f1 | 21,2 | 0,89 | 0,56 | 0,49 | 1,13 | 28,25 | 47,9 | 41,4 | 46,9 | 84,7 | 73,3 |
| 380ct2f2 | 21,2 | 0,89 | 0,56 | 0,49 | 1,13 | 28,25 | 47,9 | 41,4 | 46,9 | 84,7 | 73,3 |
| 380ct2f3 | 32,5 | 1,01 | 0,60 | 0,51 | 1,09 | 28,25 | 55,8 | 48,2 | 46,9 | 101,8 | 87,8 |
| bl1 | 37,0 | 1,05 | 0,61 | 0,52 | 1,20 | 22,24 | 16,9 | 14,6 | 41,5 | 31,6 | 27,3 |
| bl2 | 37,0 | 1,05 | 0,61 | 0,52 | 1,20 | 22,13 | 16,9 | 14,5 | 41,4 | 31,6 | 27,2 |

Project: KIJ-GT
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Number: 58

**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 °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,05 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk only tower | 10° | 0,90 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk conductors too | 10° | 0,90 | 0,90 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 3_0,9 | Wind+ice 0,9Gk | -5° | 0,90 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 4_0,9 | Cold+wind 0,9Gk | -20° | 0,90 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 5a | Torsional loads | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinal loads | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Construction + maintenance | 5° | 1,05 | 1,05 | 1,20 | 0,22 | 0,00 | 0,0 |
| ULS 6_0,9 | Construction + maintenance | 5° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,15 | 1,15 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (strength, for angle towers: absence of conductors) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,94 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,28 | 0,88 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Number of wind directions | 4 |
| Number of load combinations for ULS | 36 |
| Number of load combinations for SPLS | 0 |
| Number of load combinations for SLS | 11 |
| Number of concentrated loads | 376 |

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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 | -29,2 | 29,2 | 2,9 | 3,8 | 4,1 | 5,6 |
| bl2 | -29,4 | 29,4 | 2,9 | 3,8 | 4,1 | 5,6 |
| 380ct1f1 | -109,6 | 109,6 | 9,0 | 11,4 | 12,4 | 17,3 |
| 380ct1f2 | -109,6 | 109,6 | 9,0 | 11,4 | 12,4 | 17,3 |
| 380ct1f3 | -111,5 | 111,5 | 10,1 | 13,2 | 12,4 | 17,3 |
| 380ct2f1 | -109,6 | 109,6 | 9,0 | 11,4 | 12,4 | 17,3 |
| 380ct2f2 | -109,6 | 109,6 | 9,0 | 11,4 | 12,4 | 17,3 |
| 380ct2f3 | -111,5 | 111,5 | 10,1 | 13,2 | 12,4 | 17,3 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 363,9 | 367,2 | 363,9 |
| bl2 | 363,9 | 367,8 | 363,9 |
| 380ct1f1 | 362,4 | 364,8 | 362,4 |
| 380ct1f2 | 362,4 | 364,8 | 362,4 |
| 380ct1f3 | 362,4 | 364,9 | 362,4 |
| 380ct2f1 | 362,4 | 364,8 | 362,4 |
| 380ct2f2 | 362,4 | 364,8 | 362,4 |
| 380ct2f3 | 362,4 | 364,9 | 362,4 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 379,6 | 364,9 |
| bl2 | 379,6 | 365,2 |
| 380ct1f1 | 369,8 | 363,1 |
| 380ct1f2 | 369,8 | 363,1 |
| 380ct1f3 | 371,7 | 363,5 |
| 380ct2f1 | 369,8 | 363,1 |
| 380ct2f2 | 369,8 | 363,1 |
| 380ct2f3 | 371,7 | 363,5 |

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

| For all conductors | | Wind / Weight span ratio |
|---|---|---|
| Max. weight span | 384,5 m | 1,126 - |
| Min. weight span | 361,7 m | 1,059 - |

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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 | 6,7 | 7,8 | -31,4 | 31,4 |
| bl2 | 15,0 | 6,7 | 7,8 | -31,5 | 31,5 |
| 380ct1f1 | 51,3 | 20,4 | 29,6 | -110,2 | 109,1 |
| 380ct1f2 | 51,3 | 20,4 | 29,6 | -110,2 | 109,1 |
| 380ct1f3 | 51,3 | 23,3 | 29,6 | -111,9 | 111,0 |
| 380ct2f1 | 51,3 | 20,4 | 29,6 | -110,2 | 109,1 |
| 380ct2f2 | 51,3 | 20,4 | 29,6 | -110,2 | 109,1 |
| 380ct2f3 | 51,3 | 23,3 | 29,6 | -111,9 | 111,0 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1,6 | 2,2 |
| | bl2 | 1,6 | 2,2 |
| | 380ct1f1 | 7,9 | 10,9 |
| | 380ct1f2 | 7,9 | 10,9 |
| | 380ct1f3 | 7,9 | 10,9 |
| | 380ct2f1 | 7,9 | 10,9 |
| | 380ct2f2 | 7,9 | 10,9 |
| | 380ct2f3 | 7,9 | 10,9 |

Project: KIJ-GT
Tower: S+4
Number: 58

**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 | 141 | 128 | 5838 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 141 | 128 | 5838 | 0 | 0 |
| ULS 3_90 | | 0 | 75 | 192 | 3089 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 75 | 192 | 3089 | 0 | 0 |
| SLS 7 | | 0 | 0 | 119 | 0 | 0 | 0 |

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

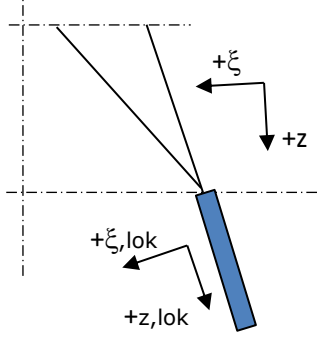
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 280 | 380 | 9688 | 0 | 0 |
| ULS 3_90 | 0 | 116 | 444 | 4244 | 0 | 0 |
| SLS 7 | 0 | 0 | 359 | 0 | 0 | 0 |

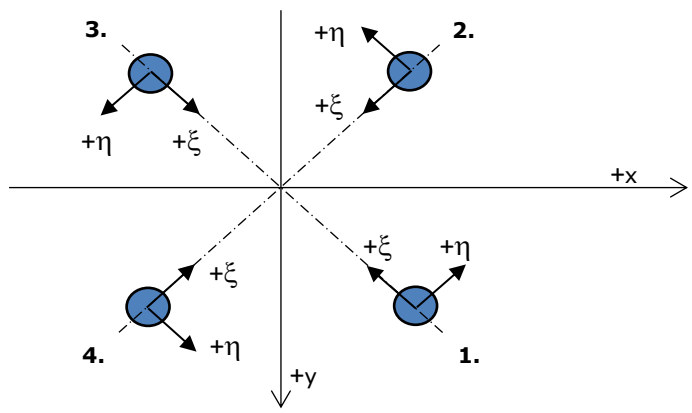
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 280 | 380 | **9688** | 0 | 0 |
| ULS 1a_0,9_0,9_0 | 179 | 0 | 323 | 0 | **5621** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 360 | -107 | 1874 | **806** |
| ULS 1a_45 | 135 | 206 | 378 | **6971** | **4045** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 208 | 170 | **573** | 27 | -267 | -14 | 627 |
| 2 | ULS 1a_0 | 86 | -148 | **339** | 44 | -166 | -16 | 370 |
| 3 | ULS 7 | -45 | -45 | **103** | 0 | -64 | -18 | 113 |
| 4 | ULS 1a_135 | -208 | 170 | **573** | -27 | -267 | -14 | 627 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -131 | 93 | **-398** | 27 | 158 | -17 | -435 |
| 3 | ULS 1a_0,9_0,9_45 | 131 | 93 | **-398** | -27 | 158 | -17 | -435 |
| 4 | ULS 1a_0,9_0,9_0 | 9 | -72 | **-164** | -44 | 57 | -15 | -179 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_135 | 140 | 16 | 222 | **88** | -110 | -12 | 242 |
| 2 | ULS 1a_45 | -57 | -67 | -33 | **88** | -7 | -21 | -36 |
| 3 | ULS 5a Ba 12 | -42 | 21 | -13 | **44** | -15 | -21 | -14 |
| 4 | ULS 5a Ba 10 | -7 | 21 | 4 | **10** | -20 | -18 | 4 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0,9_0,9_0 | 80 | 142 | 325 | **-44** | -157 | -14 | 356 |
| 2 | ULS 5a Ba 21 | 68 | -58 | 167 | **-7** | -89 | -15 | 182 |
| 3 | ULS 1a_135 | 57 | -67 | -33 | **-88** | -7 | -21 | -36 |
| 4 | ULS 1a_45 | -140 | 16 | 222 | **-88** | -110 | -12 | 242 |

Project: KIJ-GT
Tower: S+4
Number: 58

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0,9_0,9_135 | 134 | 10 | **208** | **88** | -102 | -10 | 228 |
| 2 | ULS 1a_0,9_0,9_90 | -149 | 34 | **-340** | **81** | 129 | -21 | -371 |
| 3 | ULS 1a_0,9_0,9_90 | 149 | 34 | **-340** | **-81** | 129 | -21 | -371 |
| 4 | ULS 1a_0,9_0,9_0 | 9 | -72 | **-164** | **-44** | 57 | -15 | -179 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 39 | 39 | 90 | 0 | -56 | -16 | 98 |
| 2 | SLS 7 | 39 | -39 | 90 | 0 | -56 | -16 | 98 |
| 3 | SLS 7 | -39 | -39 | 90 | 0 | -56 | -16 | 98 |
| 4 | SLS 7 | -39 | 39 | 90 | 0 | -56 | -16 | 98 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 208 | 170 | **573** | 27 | -267 | -14 | 627 |
| Max. tension | ULS 1a_0,9_0,9_45 | 131 | 93 | **-398** | -27 | 158 | -17 | -435 |
| Max. pos. torsie | ULS 1a_45 | -57 | -67 | -33 | **88** | -7 | -21 | -36 |
| Max. neg. torsie | ULS 1a_45 | -140 | 16 | 222 | **-88** | -110 | -12 | 242 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_90 | -149 | 34 | **-340** | **81** | 129 | -21 | -371 |

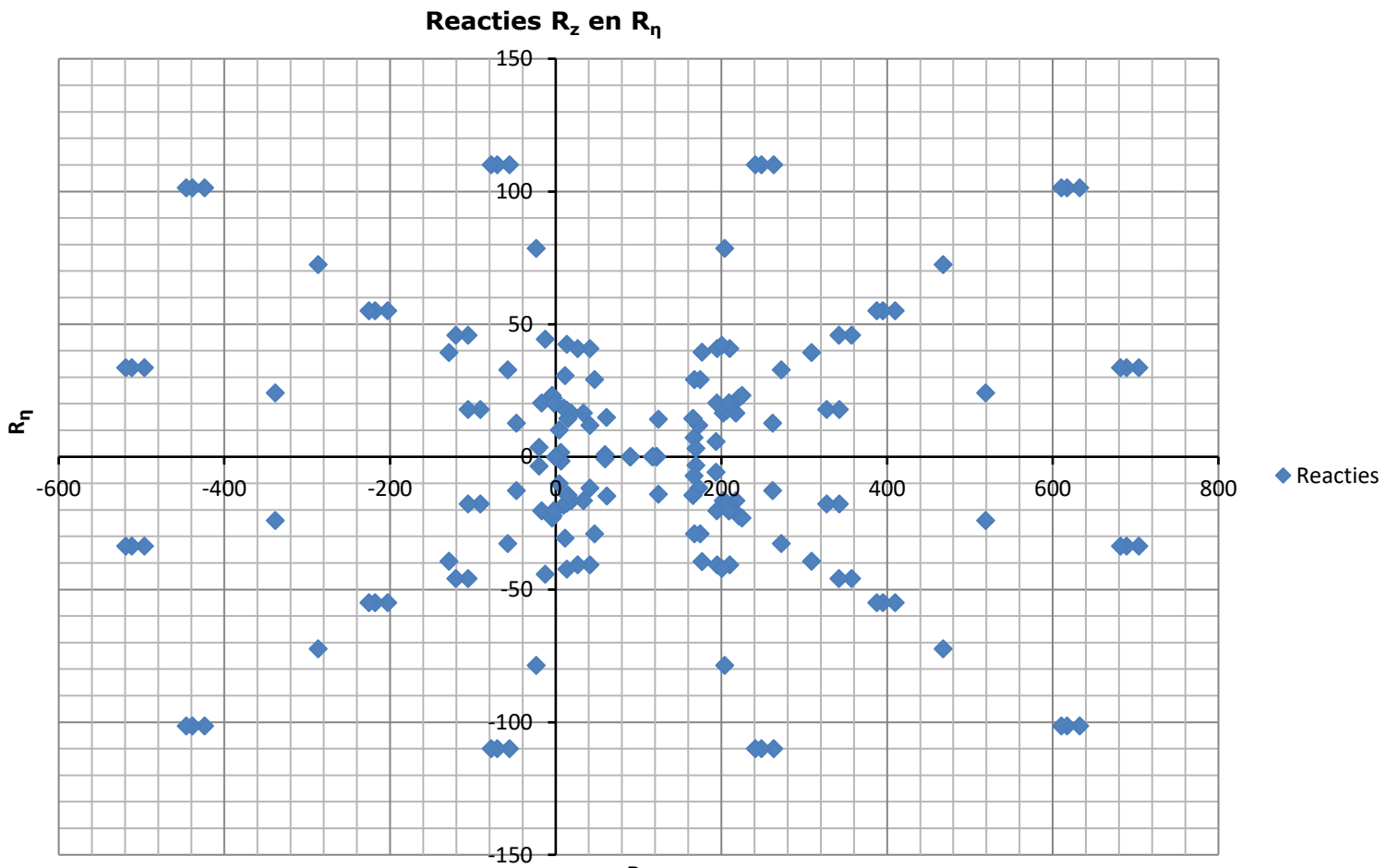
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 39 | 39 | **90** | 0 | -56 | -16 | 98 |
| 2 | SLS 1a_135 | -101 | 69 | **-315** | 23 | 120 | -19 | -344 |
| 3 | SLS 1a_45 | 101 | 69 | **-315** | -23 | 120 | -19 | -344 |
| 4 | SLS 1a_0 | -1 | -51 | **-117** | -37 | 35 | -16 | -128 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 180 | 148 | **494** | 23 | -232 | -13 | 541 |
| 2 | SLS 1a_0 | 77 | -130 | **296** | 37 | -146 | -15 | 324 |
| 3 | SLS 7 | -39 | -39 | **90** | 0 | -56 | -16 | 98 |
| 4 | SLS 1a_135 | -180 | 148 | **494** | -23 | -232 | -13 | 541 |

Project: KIJ-GT
Tower: S+4
Number: 58



Project: KIJ-GT
Tower: S+4
Number: 58

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+4
Number: 58

**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 | -34,1 | 34,1 | 3,6 | 4,8 | 4,5 | 6,1 |
| bl2 | -34,4 | 34,4 | 3,6 | 4,8 | 4,5 | 6,1 |
| 380ct1f1 | -127,6 | 127,6 | 11,3 | 14,2 | 14,6 | 20,4 |
| 380ct1f2 | -127,6 | 127,6 | 11,3 | 14,2 | 14,6 | 20,4 |
| 380ct1f3 | -129,9 | 129,9 | 12,7 | 16,5 | 14,6 | 20,4 |
| 380ct2f1 | -127,6 | 127,6 | 11,3 | 14,2 | 14,6 | 20,4 |
| 380ct2f2 | -127,6 | 127,6 | 11,3 | 14,2 | 14,6 | 20,4 |
| 380ct2f3 | -129,9 | 129,9 | 12,7 | 16,5 | 14,6 | 20,4 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 363,9 | 367,3 | 363,9 |
| bl2 | 363,9 | 367,9 | 363,9 |
| 380ct1f1 | 362,4 | 364,8 | 362,4 |
| 380ct1f2 | 362,4 | 364,8 | 362,4 |
| 380ct1f3 | 362,4 | 364,9 | 362,4 |
| 380ct2f1 | 362,4 | 364,8 | 362,4 |
| 380ct2f2 | 362,4 | 364,8 | 362,4 |
| 380ct2f3 | 362,4 | 364,9 | 362,4 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 382,3 | 364,3 |
| bl2 | 382,2 | 364,5 |
| 380ct1f1 | 371,3 | 362,7 |
| 380ct1f2 | 371,3 | 362,7 |
| 380ct1f3 | 373,6 | 363,1 |
| 380ct2f1 | 371,3 | 362,7 |
| 380ct2f2 | 371,3 | 362,7 |
| 380ct2f3 | 373,6 | 363,1 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 391,6 m | 1,147 - |
| Min. weight span | 361,4 m | 1,058 - |

Project: KIJ-GT
Tower: S+4
Number: 58

**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 | 8,5 | -34,3 | 34,0 |
| bl2 | 15,0 | 8,3 | 8,5 | -34,6 | 34,2 |
| 380ct1f1 | 51,3 | 25,5 | 34,9 | -128,2 | 126,9 |
| 380ct1f2 | 51,3 | 25,5 | 34,9 | -128,2 | 126,9 |
| 380ct1f3 | 51,3 | 29,2 | 34,9 | -130,5 | 129,3 |
| 380ct2f1 | 51,3 | 25,5 | 34,9 | -128,2 | 126,9 |
| 380ct2f2 | 51,3 | 25,5 | 34,9 | -128,2 | 126,9 |
| 380ct2f3 | 51,3 | 29,2 | 34,9 | -130,5 | 129,3 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 3,7 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 18,6 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1,6 | 2,2 |
| | bl2 | 1,6 | 2,2 |
| | 380ct1f1 | 7,9 | 10,9 |
| | 380ct1f2 | 7,9 | 10,9 |
| | 380ct1f3 | 7,9 | 10,9 |
| | 380ct2f1 | 7,9 | 10,9 |
| | 380ct2f2 | 7,9 | 10,9 |
| | 380ct2f3 | 7,9 | 10,9 |

Project: KIJ-GT
Tower: S+4
Number: 58

**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 | 177 | 141 | 7319 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 177 | 141 | 7319 | 0 | 0 |
| ULS 3_90 | | 0 | 94 | 226 | 3873 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 94 | 226 | 3873 | 0 | 0 |
| SLS 7 | | 0 | 0 | 119 | 0 | 0 | 0 |

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

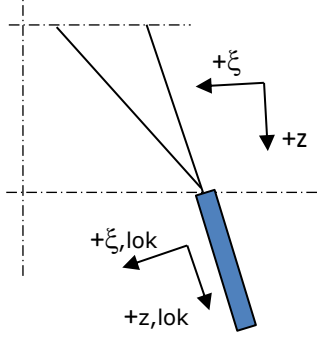
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 350 | 417 | 12146 | 0 | 0 |
| ULS 3_90 | 0 | 146 | 502 | 5321 | 0 | 0 |
| SLS 7 | 0 | 0 | 359 | 0 | 0 | 0 |

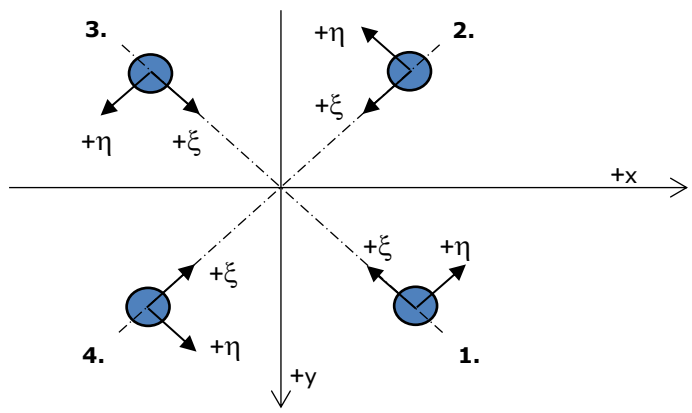
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 350 | 417 | **12146** | 0 | 0 |
| ULS 1a_0 | 225 | 0 | 413 | 0 | **7047** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 360 | -107 | 1874 | **806** |
| ULS 1a_45 | 170 | 259 | 414 | **8739** | **5071** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 254 | 206 | **704** | 34 | -325 | -14 | 770 |
| 2 | ULS 1a_0 | 101 | -179 | **410** | 55 | -198 | -17 | 448 |
| 3 | ULS 7 | -51 | -51 | **117** | 0 | -72 | -21 | 128 |
| 4 | ULS 1a_135 | -254 | 206 | **704** | -34 | -325 | -14 | 770 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -173 | 126 | **-519** | 34 | 211 | -18 | -568 |
| 3 | ULS 1a_0,9_0,9_45 | 173 | 126 | **-519** | -34 | 211 | -18 | -568 |
| 4 | ULS 1a_0,9_0,9_0 | 21 | -99 | **-226** | -55 | 85 | -15 | -247 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_135 | 169 | 13 | 263 | **110** | -129 | -13 | 288 |
| 2 | ULS 1a_45 | -79 | -77 | -56 | **110** | 1 | -24 | -61 |
| 3 | ULS 1a_0,9_0,9_0 | 21 | 99 | -226 | **55** | 85 | -15 | -247 |
| 4 | ULS 5a Ba 10 | -7 | 21 | 4 | **10** | -20 | -18 | 4 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0,9_0,9_0 | 92 | 169 | 387 | **-55** | -185 | -13 | 423 |
| 2 | ULS 5a Ba 21 | 68 | -58 | 167 | **-7** | -89 | -15 | 182 |
| 3 | ULS 1a_135 | 79 | -77 | -56 | **-110** | 1 | -24 | -61 |
| 4 | ULS 1a_45 | -169 | 13 | 263 | **-110** | -129 | -13 | 288 |

Project: KIJ-GT
Tower: S+4
Number: 58

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0,9_0,9_135 | 159 | 4 | **241** | **110** | -115 | -9 | 263 |
| 2 | ULS 1a_0,9_0,9_90 | -195 | 52 | **-446** | **101** | 175 | -23 | -488 |
| 3 | ULS 1a_0,9_0,9_90 | 195 | 52 | **-446** | **-101** | 175 | -23 | -488 |
| 4 | ULS 1a_0,9_0,9_0 | 21 | -99 | **-226** | **-55** | 85 | -15 | -247 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 39 | 39 | 90 | 0 | -56 | -16 | 98 |
| 2 | SLS 7 | 39 | -39 | 90 | 0 | -56 | -16 | 98 |
| 3 | SLS 7 | -39 | -39 | 90 | 0 | -56 | -16 | 98 |
| 4 | SLS 7 | -39 | 39 | 90 | 0 | -56 | -16 | 98 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 254 | 206 | **704** | 34 | -325 | -14 | 770 |
| Max. tension | ULS 1a_0,9_0,9_45 | 173 | 126 | **-519** | -34 | 211 | -18 | -568 |
| Max. pos. torsie | ULS 1a_45 | -79 | -77 | -56 | **110** | 1 | -24 | -61 |
| Max. neg. torsie | ULS 1a_135 | 79 | -77 | -56 | **-110** | 1 | -24 | -61 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_90 | -195 | 52 | **-446** | **101** | 175 | -23 | -488 |

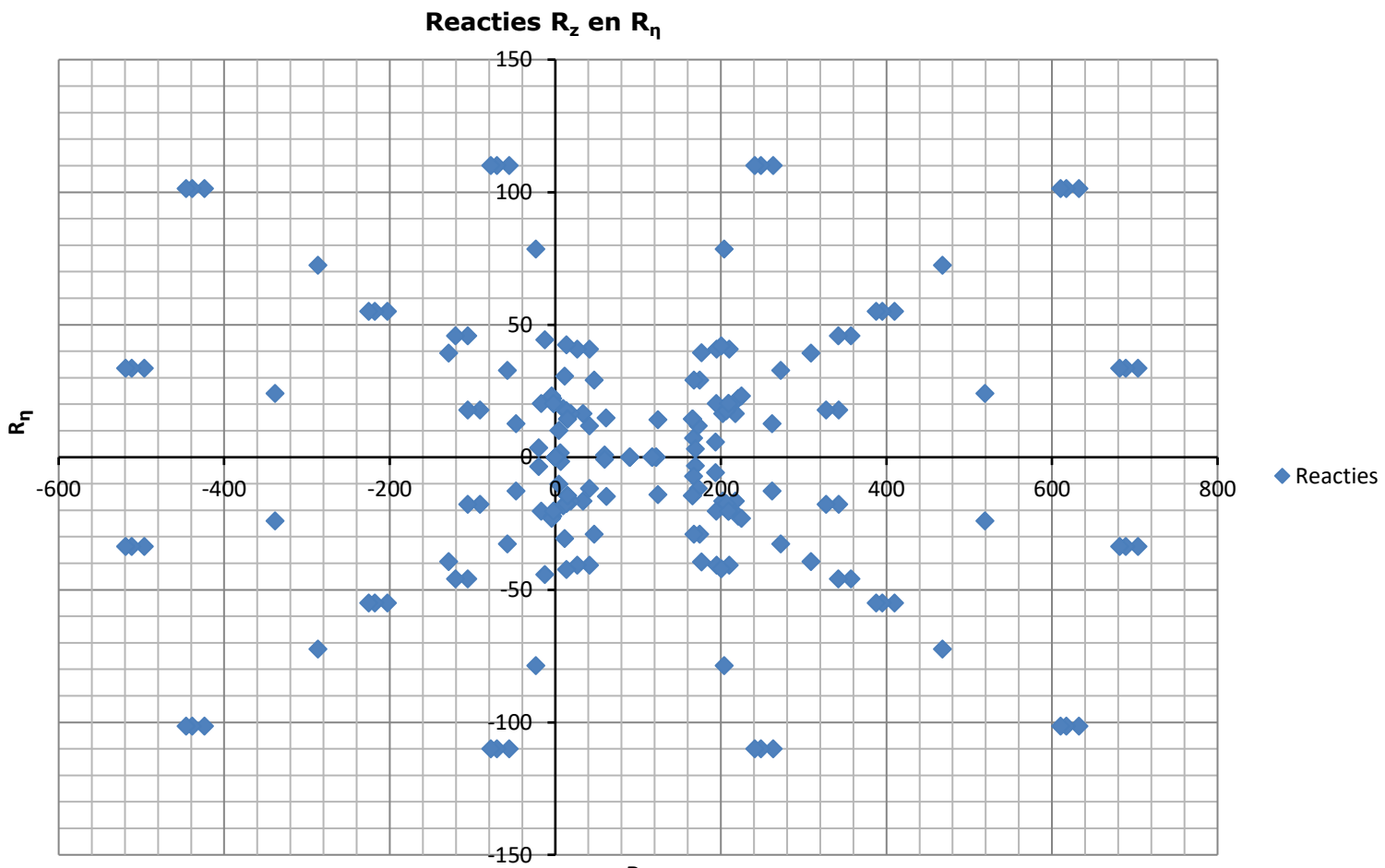
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 39 | 39 | **90** | 0 | -56 | -16 | 98 |
| 2 | SLS 1a_135 | -110 | 76 | **-339** | 24 | 131 | -19 | -371 |
| 3 | SLS 1a_45 | 110 | 76 | **-339** | -24 | 131 | -19 | -371 |
| 4 | SLS 1a_0 | 1 | -56 | **-129** | -39 | 41 | -17 | -141 |

**Maximum compression load - SLS**

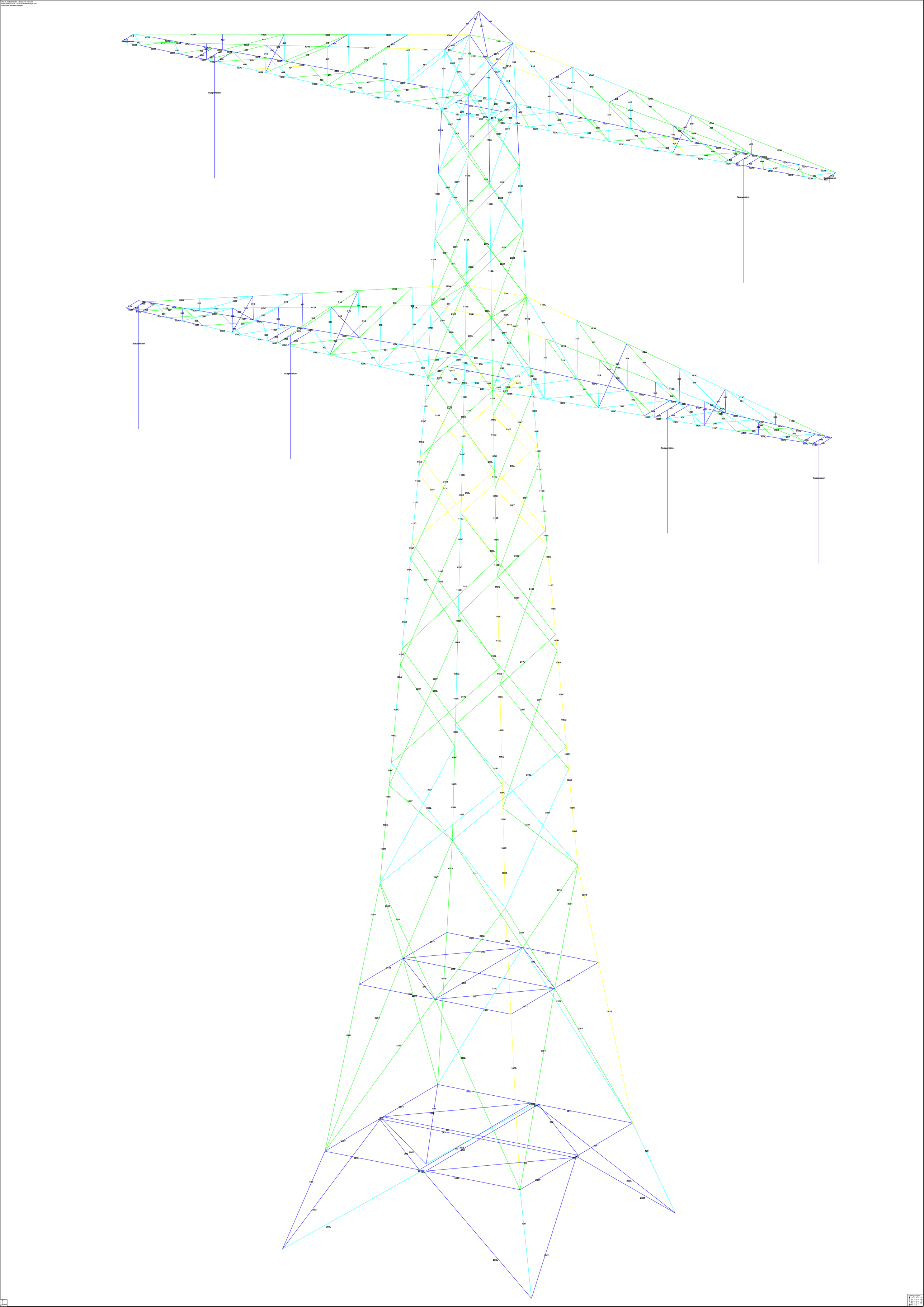
| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 188 | 154 | **519** | 24 | -242 | -13 | 567 |
| 2 | SLS 1a_0 | 79 | -135 | **309** | 39 | -152 | -15 | 337 |
| 3 | SLS 7 | -39 | -39 | **90** | 0 | -56 | -16 | 98 |
| 4 | SLS 1a_135 | -188 | 154 | **519** | -24 | -242 | -13 | 567 |

Project: KIJ-GT
Tower: S+4
Number: 58



# APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV - Project "G-4 (hs) nl"
Tower Version 16.05, 10:05:30 woensdag 8 juli 2020
Uniformed geometry displayed



DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 8-7-2020
Author Muhammed Khan
Version 1.0

**KIJ-GT380**
**S+4**
**Mast 58**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) | Exceedance (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | | 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 | **-37.8** | ULS 5a Ba 22 | 112.9 | 188.4 | 345.6 | 0.33 | | **0.0** | | 285.6 | 188.4 | 298.7 | 0.00 | |
| 113A | | 90x90x8 | S235 | 4M24-5.6t | 0.50 | 0.50 | 0.50 | 76 | **-50.6** | ULS 1a_135 | 251.3 | 338.9 | 414.7 | 0.20 | | **14.1** | ULS 5a Ba 22 | 252.5 | 338.9 | 297.7 | 0.06 | |
| 114A | | 100x100x10 | S235 | 4M24-5.6t | 0.50 | 0.50 | 0.50 | 72 | **-144.2** | ULS 1a_135 | 355.2 | 338.9 | 518.4 | 0.43 | | **96.5** | ULS 1a_0,9_0,9_135 | 362.9 | 338.9 | 443.1 | 0.28 | |
| 115A | | 150x150x10 | S235 | 6M24-5.6t | 1.77 | 1.37 | 1.14 | 39 | **-268.8** | ULS 1a_135 | 643.5 | 508.3 | 777.6 | 0.53 | | **163.0** | ULS 1a_0,9_0,9_135 | 624.7 | 508.3 | 664.6 | 0.32 | |
| 106A | | 150x150x12 | S235 | 8M24-5.6t | 1.66 | 1.73 | 1.38 | 76 | **-509.3** | ULS 1a_135 | 628.6 | 677.8 | 1244.2 | 0.81 | | **379.3** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.56 | |
| 106C | | 150x150x12 | S235 | | 1.97 | 1.62 | 1.39 | 70 | **-586.2** | ULS 1a_135 | 656.3 | 0.0 | 0.0 | 0.89 | | **451.4** | ULS 1a_0,9_0,9_135 | 817.8 | 0.0 | 0.0 | 0.55 | |
| 107A | | 150x150x12 | S235 | 8M24-5.6t | 0.33 | 0.33 | 0.33 | 49 | **-545.1** | ULS 1a_135 | 735.4 | 677.8 | 1244.2 | 0.80 | | **426.8** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.63 | |
| 201L | | 70x70x7 | S235 | 1M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-20.3** | ULS 5a Ba 22 | 75.8 | 84.7 | 90.7 | 0.27 | | **14.1** | ULS 5a Ba 22 | 88.7 | 84.7 | 64.2 | 0.22 | |
| 202T | | 50x50x5 | S235 | 1M16-5.6t | 0.52 | 0.52 | 0.52 | 178 | **-10.0** | ULS 5a Ba 22 | 25.7 | 37.7 | 43.2 | 0.39 | | **5.0** | ULS 5a Ba 22 | 37.4 | 37.7 | 22.0 | 0.23 | |
| 203L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-109.3** | ULS 5a Ba 12 | 207.7 | 169.4 | 207.4 | 0.64 | | **116.1** | 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 | **-123.6** | ULS 5a Ba 12 | 256.2 | 254.2 | 388.8 | 0.49 | | **121.7** | 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 | **-105.0** | ULS 5a Ba 22 | 198.3 | 169.4 | 207.4 | 0.62 | | **97.8** | ULS 5a Ba 12 | 181.4 | 169.4 | 177.2 | 0.58 | |
| 206T | | 100x100x10 | S235 | 3M24-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-109.5** | ULS 5a Ba 22 | 244.6 | 254.2 | 388.8 | 0.45 | | **110.9** | ULS 5a Ba 12 | 261.1 | 254.2 | 332.3 | 0.44 | |
| 207L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 103 | **-87.4** | ULS 5a Ba 12 | 190.8 | 169.4 | 207.4 | 0.52 | | **93.9** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.55 | |
| 208T | | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 104 | **-99.5** | ULS 5a Ba 12 | 235.3 | 169.4 | 259.2 | 0.59 | | **97.6** | 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 | **-94.9** | ULS 5a Ba 12 | 177.9 | 169.4 | 207.4 | 0.56 | | **94.8** | 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 | **-101.4** | ULS 5a Ba 12 | 219.3 | 169.4 | 259.2 | 0.60 | | **80.0** | 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 | **-94.0** | ULS 5a Ba 21 | 197.1 | 169.4 | 207.4 | 0.55 | | **88.8** | ULS 5a Ba 21 | 125.9 | 169.4 | 116.0 | 0.76 | |
| 212T | | 100x75x9 | S235 | 2M24-5.6t | 1.00 | 0.55 | 0.55 | 65 | **-95.9** | ULS 5a Ba 10 | 245.9 | 169.4 | 233.3 | 0.57 | | **93.1** | 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 | **-77.1** | ULS 5a Ba 21 | 161.2 | 169.4 | 181.4 | 0.48 | | **80.6** | ULS 5a Ba 21 | 98.2 | 169.4 | 101.5 | 0.82 | |
| 214T | | 100x75x9 | S235 | 2M24-5.6t | 0.52 | 0.25 | 0.25 | 74 | **-96.4** | ULS 5a Ba 10 | 221.2 | 169.4 | 233.3 | 0.57 | | **99.2** | 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 | **-73.4** | ULS 5a Ba 21 | 141.1 | 169.4 | 181.4 | 0.52 | | **69.6** | ULS 5a Ba 21 | 100.4 | 169.4 | 101.5 | 0.69 | |
| 216T | | 100x75x8 | S235 | 2M24-5.6t | 0.52 | 0.25 | 0.25 | 86 | **-90.5** | ULS 5a Ba 10 | 182.6 | 169.4 | 207.4 | 0.53 | | **87.3** | 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 | **-59.1** | ULS 5a Ba 21 | 129.0 | 117.6 | 151.2 | 0.50 | | **61.6** | 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 | **-80.3** | ULS 5a Ba 21 | 159.3 | 169.4 | 207.4 | 0.50 | | **82.8** | 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 | **-52.9** | ULS 5a Ba 21 | 133.9 | 117.6 | 172.8 | 0.45 | | **49.9** | 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 | **-69.2** | ULS 5a Ba 10 | 147.8 | 117.6 | 172.8 | 0.59 | | **56.7** | ULS 5a Ba 21 | 113.0 | 117.6 | 136.1 | 0.50 | |
| 222T | | 100x75x7 | S235 | 2M20-5.6t | 0.52 | 0.25 | 0.25 | 113 | **-53.5** | 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 | **-72.7** | ULS 5a Ba 10 | 144.3 | 117.6 | 151.2 | 0.62 | | **57.0** | ULS 5a Ba 21 | 119.5 | 117.6 | 122.2 | 0.48 | |
| 224T | | 130x65x8 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 124 | **-75.2** | ULS 1a_90 | 147.8 | 117.6 | 172.8 | 0.64 | | **60.9** | ULS 1a_0,9_0,9_90 | 113.0 | 117.6 | 136.1 | 0.54 | |
| 226T | | 100x75x7 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 105 | **-75.6** | ULS 1a_90 | 144.3 | 117.6 | 151.2 | 0.64 | | **58.2** | ULS 1a_0,9_0,9_90 | 119.5 | 117.6 | 122.2 | 0.49 | |
| 227T | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-2.1** | ULS 6a_90 Ah Ct2 | 21.0 | 37.7 | 43.2 | 0.10 | | **0.0** | | 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 | | **110.2** | ULS 3_0 | 168.3 | 235.2 | 244.4 | 0.65 | |
| 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 | | **76.2** | 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 | **-48.5** | ULS 5a Ba 22 | 182.6 | 254.2 | 272.2 | 0.27 | | **63.2** | 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 | **-246.3** | ULS 5a Ba 22 | 512.4 | 677.8 | 1244.2 | 0.48 | | **97.5** | ULS 5a Ba 22 | 582.2 | 677.8 | 755.0 | 0.17 | |
| 233T | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-25.0** | ULS 1a_0,9_0,9_90 | 36.2 | 58.8 | 64.8 | 0.69 | | **35.3** | ULS 1a_90 | 82.9 | 58.8 | 52.4 | 0.67 | |
| 234L | | 80x80x8 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 178 | **0.0** | | 82.2 | 254.2 | 311.0 | 0.00 | | **135.3** | ULS 3_0 | 169.8 | 254.2 | 239.3 | 0.80 | |
| 235 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 309 | **-0.5** | 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 | **-43.0** | ULS 5a Ba 22 | 157.6 | 338.9 | 362.9 | 0.27 | | **68.8** | 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 | **-245.8** | ULS 5a Ba 10 | 526.8 | 931.9 | 1995.8 | 0.47 | | **75.5** | 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 | **-0.3** | ULS 1a_90 | 18.6 | 37.7 | 51.8 | 0.02 | | **0.0** | | 55.3 | 37.7 | 28.0 | 0.00 | |
| 240 | | 90x90x7* | S355 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 180 | **-1.5** | ULS 1a_45 | 59.7 | 60.3 | 82.3 | 0.02 | | **2.4** | ULS 1a_0,9_0,9_135 | 279.9 | 60.3 | 71.1 | 0.04 | |
| 241T | | 80x80x8 | S355 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 224 | **-2.8** | ULS 1a_135 | 59.0 | 37.7 | 94.1 | 0.07 | | **1.0** | ULS 1a_0,9_0,9_0 | 225.8 | 37.7 | 81.3 | 0.03 | |
| 251L | | 80x80x8 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 224 | **-2.7** | ULS 1a_90 | 59.0 | 60.3 | 94.1 | 0.05 | | **0.7** | ULS 1a_0,9_135 | 225.8 | 60.3 | 81.3 | 0.01 | |
| 113B | | 90x90x8 | S235 | 4M24-5.6t | 0.50 | 0.50 | 0.50 | 79 | **-103.4** | ULS 1a_135 | 245.5 | 338.9 | 414.7 | 0.42 | | **58.8** | ULS 1a_0,9_0,9_135 | 252.5 | 338.9 | 354.5 | 0.23 | |
| 114B | | 100x100x10 | S235 | 6M24-5.6t | 0.50 | 0.50 | 0.50 | 78 | **-175.1** | ULS 1a_135 | 340.4 | 508.3 | 777.6 | 0.51 | | **93.2** | ULS 1a_0,9_0,9_135 | 362.9 | 508.3 | 651.3 | 0.26 | |
| 115B | | 150x150x10 | S235 | 8M24-5.6t | 4.00 | 4.23 | 3.33 | 76 | **-488.3** | ULS 1a_135 | 530.0 | 677.8 | 1036.8 | 0.92 | | **356.5** | ULS 1a_0,9_0,9_135 | 624.7 | 677.8 | 886.2 | 0.57 | |
| 115C | | 150x150x10 | S235 | | 1.70 | 1.70 | 1.42 | 80 | **-446.5** | ULS 1a_135 | 514.8 | 0.0 | 0.0 | 0.87 | | **321.8** | ULS 1a_0,9_0,9_135 | 688.6 | 0.0 | 0.0 | 0.47 | |
| 106B | | 150x150x12 | S235 | 8M24-5.6t | 0.76 | 1.28 | 0.63 | 60 | **-587.8** | ULS 1a_135 | 696.2 | 677.8 | 1244.2 | 0.87 | | **450.3** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.66 | |
| 107B | | 150x150x12 | S235 | 8M24-5.6t | 0.20 | 0.20 | 0.20 | 48 | **-548.3** | ULS 1a_135 | 736.7 | 677.8 | 1244.2 | 0.81 | | **423.8** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.63 | |
| 102A | | 150x150x12 | S235 | 8M24-5.6t | 1.00 | 1.50 | 1.00 | 61 | **-302.5** | ULS 5a Ba 12 | 689.3 | 677.8 | 1244.2 | 0.45 | | **172.4** | 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 | **-142.7** | ULS 5a Ba 12 | 682.7 | 508.3 | 933.1 | 0.28 | | **37.2** | ULS 5a Ba 22 | 740.3 | 508.3 | 797.5 | 0.07 | |
| 102C | | 150x150x12 | S235 | | 3.01 | 2.00 | 1.00 | 59 | **-274.2** | ULS 5a Ba 12 | 698.8 | 0.0 | 0.0 | 0.39 | | **149.4** | 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 | **-131.8** | ULS 5a Ba 12 | 340.1 | 508.3 | 622.1 | 0.39 | | **48.2** | 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 | **-29.9** | ULS 6a_90 Ah Ct1 | 249.9 | 75.4 | 138.2 | 0.40 | | **0.0** | | 316.6 | 75.4 | 138.2 | 0.00 | |
| 103C | | 120x120x8 | S235 | | 1.71 | 1.00 | 1.00 | 76 | **-93.0** | ULS 5a Ba 1 | 340.3 | 0.0 | 0.0 | 0.27 | | **21.1** | 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 | | **102.5** | ULS 3_135 | 115.2 | 235.2 | 207.0 | 0.89 | |
| 104B | | 100x65x7* | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 209 | **0.0** | | 60.1 | 176.4 | 226.8 | 0.00 | | **70.7** | ULS 3_0 | 137.8 | 176.4 | 155.3 | 0.51 | |
| 104C | | 100x65x7* | S235 | | 1.00 | 1.00 | 1.00 | 194 | **0.0** | | 66.4 | 0.0 | 0.0 | 0.00 | | **90.3** | ULS 3_45 | 263.2 | 0.0 | 0.0 | 0.34 | |
| 105A | | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 2.43 | 1.00 | 380 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **29.6** | ULS 6a_90 Ah Ct2 | 98.8 | 75.4 | 56.0 | 0.53 | |
| 105B | | 60x60x5 | S235 | 2M16-5.6t | 1.00 | 1.70 | 1.00 | 379 | **0.0** | | 11.8 | 75.4 | 86.4 | 0.00 | | **29.7** | ULS 6a_90 Ah Ct1 | 65.9 | 75.4 | 56.0 | 0.53 | |
| 415 | | 60x60x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 180 | **-8.0** | ULS 3_0 | 30.7 | 37.7 | 43.2 | 0.26 | | **0.0** | | 60.5 | 37.7 | 26.7 | 0.00 | |
| 417 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 170 | **-8.7** | ULS 3_0 | 27.4 | 37.7 | 43.2 | 0.32 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 419 | | 75x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 107 | **-10.9** | ULS 3_0 | 55.1 | 37.7 | 43.2 | 0.29 | | **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 Ah 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 | | **12.7** | ULS 3_0 | 60.5 | 37.7 | 32.0 | 0.40 | |
| 416 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 353 | **0.0** | | 9.1 | 37.7 | 43.2 | 0.00 | | **15.6** | ULS 3_0 | 37.4 | 37.7 | 22.0 | 0.71 | |
| 418 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **0.0** | | 11.9 | 75.4 | 86.4 | 0.00 | | **23.8** | ULS 3_0 | 56.2 | 75.4 | 44.1 | 0.54 | |
| 421 | | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 259 | **0.0** | | 26.8 | 117.6 | 129.6 | 0.00 | | **46.0** | ULS 3_135 | 77.4 | 117.6 | 88.7 | 0.59 | |
| 420 | | 45x45x5 | S355 | 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 | | **1.1** | 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 | **-20.8** | ULS 5a Ba 22 | 48.1 | 58.8 | 54.0 | 0.43 | | **19.4** | ULS 5a Ba 12 | 54.7 | 58.8 | 37.0 | 0.53 | |
| 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 | 0.77 | |
| 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 | **-3.9** | ULS 1a_135 | 37.9 | 37.7 | 43.2 | 0.10 | | **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 | | **3.1** | ULS 1a_135 | 53.3 | 37.7 | 32.0 | 0.10 | |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 8-7-2020
Author Muhammed Khan
Version 1.0

**KIJ-GT380**
**S+4**
**Mast 58**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 411 | | 55x55x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 135 | **-2.2** | 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 | | **1.7** | ULS 1a_0,9_0,9_135 | 53.3 | 37.7 | 32.0 | 0.05 | |
| 406 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 33 | **-1.3** | ULS 1a_0,9_0,9_90 | 991.1 | 0.0 | 0.0 | 0.00 | | **5.0** | 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 | |
| 408 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 32 | **-7.0** | ULS 5a Ba 1 | 998.4 | 0.0 | 0.0 | 0.01 | | **3.1** | 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 | | **125.7** | ULS 3_45 | 160.8 | 254.2 | 259.0 | 0.78 | |
| 111B | | 80x80x8 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 202 | **0.0** | | 65.8 | 176.4 | 259.2 | 0.00 | | **111.0** | ULS 3_0 | 168.3 | 176.4 | 209.5 | 0.66 | |
| 112A | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 1.88 | 1.00 | 227 | **0.0** | | 42.7 | 176.4 | 226.8 | 0.00 | | **88.0** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.70 | |
| 112B | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 176.4 | 226.8 | 0.00 | | **76.6** | ULS 3_0 | 125.5 | 176.4 | 155.3 | 0.61 | |
| 112C | | 70x70x7 | S235 | | 1.00 | 2.14 | 1.00 | 227 | **0.0** | | 42.7 | 0.0 | 0.0 | 0.00 | | **84.1** | ULS 3_0 | 220.9 | 0.0 | 0.0 | 0.38 | |
| 110A | | 120x120x11 | S235 | 6M24-5.6t | 1.64 | 1.00 | 1.00 | 60 | **-192.4** | ULS 5a Ba 21 | 508.6 | 508.3 | 855.4 | 0.38 | | **103.0** | ULS 5a Ba 21 | 513.2 | 508.3 | 731.1 | 0.20 | |
| 110B | | 120x120x11 | S235 | | 1.00 | 1.00 | 1.00 | 13 | **-0.3** | ULS 1a_0,9_0,9_90 | 599.7 | 0.0 | 0.0 | 0.00 | | **0.3** | ULS 1a_90 | 599.7 | 0.0 | 0.0 | 0.00 | |
| 110C | | 120x120x11 | S235 | | 1.71 | 1.29 | 1.00 | 66 | **-160.3** | ULS 5a Ba 21 | 492.8 | 0.0 | 0.0 | 0.33 | | **79.3** | 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 | **-301.5** | ULS 5a Ba 10 | 673.7 | 931.9 | 1995.8 | 0.45 | | **143.5** | ULS 5a Ba 21 | 666.7 | 931.9 | 1211.2 | 0.22 | |
| 109B | | 150x100x14 | S235 | 6M24-5.6t | 4.78 | 1.00 | 1.00 | 47 | **-207.5** | ULS 5a Ba 10 | 703.8 | 508.3 | 1088.6 | 0.41 | | **118.0** | ULS 5a Ba 21 | 666.7 | 508.3 | 930.5 | 0.23 | |
| 109C | | 150x100x14 | S235 | | 1.00 | 0.52 | 0.52 | 58 | **-277.3** | ULS 5a Ba 21 | 665.2 | 0.0 | 0.0 | 0.42 | | **131.7** | 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 | **-13.2** | ULS 3_135 | 41.1 | 58.8 | 64.8 | 0.32 | | **0.0** | | 82.9 | 58.8 | 39.3 | 0.00 | |
| 314 | | 70x70x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-14.3** | ULS 3_135 | 54.9 | 58.8 | 64.8 | 0.26 | | **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 | **-2.3** | ULS 1a_0 | 59.5 | 37.7 | 43.2 | 0.06 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 322 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 53 | **-1.0** | 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 | | **16.1** | ULS 3_45 | 54.7 | 58.8 | 37.0 | 0.44 | |
| 313 | | 60x60x5 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 298 | **0.0** | | 14.4 | 58.8 | 54.0 | 0.00 | | **21.9** | ULS 3_135 | 54.7 | 58.8 | 37.0 | 0.59 | |
| 316 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 332 | **0.0** | | 12.6 | 75.4 | 86.4 | 0.00 | | **29.3** | ULS 3_135 | 52.4 | 75.4 | 44.1 | 0.67 | |
| 318 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 274 | **0.0** | | 13.7 | 37.7 | 43.2 | 0.00 | | **6.3** | ULS 5a Ba 10 | 37.4 | 37.7 | 22.0 | 0.28 | |
| 321 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 269 | **0.0** | | 14.1 | 37.7 | 43.2 | 0.00 | | **8.4** | ULS 5a Ba 21 | 37.4 | 37.7 | 22.0 | 0.38 | |
| 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 | 0.04 | |
| 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 | **-24.2** | ULS 5a Ba 20 | 66.6 | 58.8 | 75.6 | 0.41 | | **22.2** | ULS 5a Ba 11 | 96.8 | 58.8 | 53.5 | 0.42 | |
| 301 | | 70x70x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-27.1** | ULS 5a Ba 11 | 69.0 | 58.8 | 75.6 | 0.46 | | **29.7** | 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 | **-33.5** | ULS 5a Ba 20 | 80.7 | 84.7 | 90.7 | 0.41 | | **30.3** | 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 | **-29.4** | 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 | **-0.6** | ULS 1a_0,9_0,9_90 | 1015.5 | 0.0 | 0.0 | 0.00 | | **3.2** | 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 | **-2.6** | ULS 1a_0,9_0,9_90 | 1025.6 | 0.0 | 0.0 | 0.00 | | **2.6** | ULS 1a_90 | 1276.1 | 0.0 | 0.0 | 0.00 | |
| 120 | Heightened Main M | 180x180x18# | S355 | | 0.50 | 0.50 | 0.50 | 62 | **-677.8** | ULS 1a_135 | 1682.2 | 0.0 | 0.0 | 0.40 | | **496.4** | ULS 1a_0,9_0,9_135 | 2197.5 | 0.0 | 0.0 | 0.23 | |
| 260L | Diag leg front | 140x140x13# | S355 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 132 | **-104.5** | ULS 1a_90 | 401.8 | 406.7 | 688.0 | 0.26 | | **89.7** | ULS 1a_0,9_90 | 681.4 | 406.7 | 688.0 | 0.22 | |
| 260T | Diag leg side | 140x140x13# | S355 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 132 | **-61.2** | ULS 5a Ba 12 | 401.8 | 406.7 | 688.0 | 0.15 | | **46.0** | ULS 5a Ba 12 | 681.4 | 406.7 | 688.0 | 0.11 | |
| 261L | Horizontal front | 160x160x15# | S355 | 3M24-8.8t | 1.04 | 1.00 | 1.00 | 138 | **-92.0** | ULS 1a_90 | 502.6 | 406.7 | 793.8 | 0.23 | | **69.5** | ULS 1a_0,9_0,9_90 | 916.5 | 406.7 | 746.3 | 0.17 | |
| 261T | Horizontal side | 160x160x15# | S355 | 3M24-8.8t | 1.04 | 1.00 | 1.00 | 138 | **-79.6** | ULS 1a_135 | 502.6 | 406.7 | 793.8 | 0.20 | | **58.2** | ULS 1a_0,9_0,9_45 | 916.5 | 406.7 | 746.3 | 0.14 | |

# APPENDIX C REDUNDANT MEMBERS CHECK

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2020-07-08
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+4
58

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 207 | Verhogingsstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.21 | 0 | 162 | **16.8** | **0.55** | 65.3 | 94.1 | 83.2 | 131.7 | 2.99 | 0.26 | | |
| 208 | Verhogingsstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.36 | 52 | 173 | **16.8** | **0.00** | 59.4 | 94.1 | 83.2 | 131.7 | 2.99 | 0.28 | | |
| 221 | Verhogingsstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 3.00 | 0 | 256 | **4.0** | **0.75** | 23.8 | 60.3 | 52.3 | 98.8 | 1.88 | 0.40 | | |
| 222 | Verhogingsstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 3.40 | 63 | 291 | **4.0** | **0.00** | 19.4 | 60.3 | 52.3 | 98.8 | 1.88 | 0.21 | | |
| 218 | Verhogingsstuk | Kniksteun en verticale steur | L90.9 | S355 | M20 | 8.8 | 6.24 | 0 | 228 | **7.6** | **0.78** | 54.4 | 94.1 | 106.9 | 310.5 | 4.73 | 0.17 | | |
| 216 | Verhogingsstuk | Kruisende staaf halverwege | L100.10 | S355 | M20 | 8.8 | 9.09 | 0 | 299 | **7.6** | **1.14** | 44.7 | 94.1 | 118.8 | 423.4 | 8.75 | 0.17 | | |
| 217 | Verhogingsstuk | Enkele staaf | L100.10 | S355 | M20 | 8.8 | 4.34 | 0 | 222 | **7.6** | **1.08** | 83.2 | 94.1 | 118.8 | 423.4 | 8.75 | 0.12 | | |
| 14 | Onderstuk | Enkele staaf | L45.5 | S235 | M12 | 8.8 | 0.59 | 0 | 68 | **7.4** | **0.15** | 53.2 | 32.3 | 27.7 | 53.3 | 0.57 | 0.27 | | |
| 3020R | Onderstuk | Enkele staaf | L50.5 | S355 | M12 | 8.8 | 1.53 | 75 | 157 | **7.4** | **0.00** | 34.7 | 32.3 | 37.7 | 92.1 | 1.08 | 0.23 | | |
| 3012R | Onderstuk | Enkele staaf | L75.8 | S355 | M16 | 8.8 | 1.27 | 0 | 87 | **7.4** | **0.32** | 166.1 | 60.3 | 69.7 | 225.8 | 3.89 | 0.12 | | |
| 19V | Onderstuk | Enkele staaf | L75.8 | S355 | M16 | 8.8 | 1.77 | 53 | 122 | **7.4** | **0.00** | 116.0 | 60.3 | 69.7 | 225.8 | 3.89 | 0.12 | | |
| 11V | Onderstuk | Enkele staaf | L75.8 | S355 | M16 | 8.8 | 1.96 | 0 | 135 | **7.4** | **0.49** | 102.2 | 60.3 | 69.7 | 225.8 | 3.89 | 0.13 | | |
| 33V | Onderstuk | Enkele staaf | L75.8 | S355 | M16 | 8.8 | 2.28 | 38 | 157 | **7.4** | **0.00** | 83.6 | 60.3 | 69.7 | 225.8 | 3.89 | 0.12 | | |
| 10V | Onderstuk | Enkele staaf | L75.8 | S355 | M16 | 8.8 | 2.64 | 0 | 181 | **7.4** | **0.66** | 67.7 | 60.3 | 69.7 | 225.8 | 3.89 | 0.17 | | |
| 17VR | Onderstuk | Enkele staaf | L75.8 | S355 | M16 | 8.8 | 2.86 | 30 | 197 | **7.4** | **0.62** | 60.1 | 60.3 | 69.7 | 225.8 | 3.89 | 0.16 | | |
| 26 | Pootverband | Kniksteun en verticale steur | L45.5 | S235 | M12 | 8.8 | 1.57 | 0 | 116 | **1.5** | **0.20** | 29.3 | 32.3 | 27.7 | 53.3 | 0.42 | 0.48 | | |
| 101NR | Pootverband | Enkele staaf | L50.5 | S355 | M12 | 8.8 | 3.08 | 59 | 316 | **1.5** | **0.00** | 11.7 | 32.3 | 37.7 | 92.1 | 1.1 | 0.12 | | |
| 25 | Pootverband | Enkele staaf | L45.5 | S235 | M12 | 8.8 | 3.21 | 0 | 369 | **1.5** | **0.80** | 7.6 | 32.3 | 27.7 | 53.3 | 0.6 | 1.40 | Bending | |
| 23 | Pootverband | Enkele staaf | L50.5 | S235 | M12 | 8.8 | 3.00 | 59 | 308 | **1.5** | **0.00** | 11.3 | 32.3 | 37.7 | 67.7 | 0.7 | 0.13 | | |
| 28V | Tussenschot | Kniksteun en verticale steur | L90.7 | S355 | M16 | 8.8 | 4.90 | 0 | 178 | **0.6** | **0.61** | 60.8 | 60.3 | 61.0 | 279.9 | 3.9 | 0.16 | | |
| 27 | Tussenschot | Kruisende staaf halverwege | L100.50.6 | S235 | M16 | 8.8 | 7.00 | 0 | 329 | **0.6** | **0.88** | 18.5 | 60.3 | 37.0 | 44.9 | 3.2 | 0.27 | | |
| 16 | Onderstuk | Enkele staaf | L50.5 | S235 | M12 | 5.6 | 2.75 | 29 | 283 | **7.4** | **0.60** | 13.0 | 20.2 | 27.7 | 67.7 | 0.7 | 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 | 67.7 | 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 | 53.3 | 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 | 53.3 | 0.57 | 0.46 | | |
| 50 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.24 | 0 | 142 | **7.2** | **0.31** | 30.5 | 20.2 | 27.7 | 53.3 | 0.57 | 0.54 | | |
| 47 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.83 | 49 | 210 | **7.2** | **0.00** | 18.3 | 20.2 | 27.7 | 53.3 | 0.57 | 0.39 | | |
| 49 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.64 | 0 | 303 | **7.2** | **0.66** | 10.4 | 20.2 | 27.7 | 53.3 | 0.57 | 1.15 | Bending | |
| 46 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.79 | 40 | 205 | **7.2** | **0.00** | 18.9 | 20.2 | 27.7 | 53.3 | 0.57 | 0.38 | | |
| 45 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.66 | 51 | 191 | **7.2** | **0.00** | 21.0 | 20.2 | 27.7 | 53.3 | 0.57 | 0.36 | | |
| 48 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.32 | 0 | 266 | **7.2** | 0.58 | 12.8 | 20.2 | 27.7 | 53.3 | 0.6 | 1.01 | Bending | |
| 44 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.60 | 41 | 184 | **7.2** | **0.00** | 22.1 | 20.2 | 27.7 | 53.3 | 0.57 | 0.36 | | |
| 270 | 1e tussenstuk | Kruisende staaf halverwege | L100.50.6 | S235 | M12 | 5.6 | 7.00 | 0 | 329 | **7.2** | **0.88** | 18.5 | 20.2 | 33.2 | 81.2 | 3.24 | 0.39 | | |
| 58 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.67 | 43 | 192 | **7.2** | **0.00** | 20.8 | 20.2 | 27.7 | 53.3 | 0.57 | 0.36 | | |
| 60 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.67 | 0 | 307 | **7.2** | **0.67** | 10.2 | 20.2 | 27.7 | 53.3 | 0.57 | 1.17 | Bending | |
| 57 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.67 | 35 | 192 | **7.2** | **0.00** | 20.8 | 20.2 | 27.7 | 53.3 | 0.57 | 0.36 | | |
| 56 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.71 | 51 | 196 | **7.2** | **0.00** | 20.1 | 20.2 | 27.7 | 53.3 | 0.57 | 0.36 | | |
| 59 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.37 | 0 | 272 | **7.2** | **0.59** | 12.4 | 20.2 | 27.7 | 53.3 | 0.57 | 1.04 | Bending | |
| 55 | 1e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.65 | 42 | 190 | **7.2** | **0.00** | 21.1 | 20.2 | 27.7 | 53.3 | 0.57 | 0.36 | | |
| 80 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.49 | 52 | 171 | **6.4** | **0.00** | 24.3 | 20.2 | 27.7 | 53.3 | 0.57 | 0.32 | | |
| 83 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.02 | 0 | 232 | **6.4** | **0.51** | 15.8 | 20.2 | 27.7 | 53.3 | 0.57 | 0.88 | | |
| 79 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.42 | 42 | 163 | **6.4** | **0.00** | 25.8 | 20.2 | 27.7 | 53.3 | 0.57 | 0.32 | | |
| 78 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.25 | 51 | 144 | **6.4** | **0.00** | 30.2 | 20.2 | 27.7 | 53.3 | 0.57 | 0.32 | | |
| 82 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.76 | 0 | 202 | **6.4** | **0.44** | 19.3 | 20.2 | 27.7 | 53.3 | 0.57 | 0.77 | | |
| 77 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.19 | 41 | 137 | **6.4** | **0.00** | 32.0 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 76 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.13 | 53 | 130 | **6.4** | **0.00** | 33.9 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 81 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.53 | 0 | 176 | **6.4** | **0.38** | 23.4 | 20.2 | 27.7 | 53.3 | 0.6 | 0.67 | | |
| 75 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.06 | 43 | 122 | **6.4** | **0.00** | 36.2 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 96 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.50 | 52 | 172 | **6.4** | **0.00** | 24.0 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 99 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 2.06 | 0 | 237 | **6.4** | **0.52** | 15.3 | 20.2 | 27.7 | 53.3 | 0.6 | 0.90 | | |
| 95 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.43 | 42 | 164 | **6.4** | **0.00** | 25.6 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 94 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.26 | 50 | 145 | **6.4** | **0.00** | 29.9 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 98 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.80 | 0 | 207 | **6.4** | **0.45** | 18.7 | 20.2 | 27.7 | 53.3 | 0.6 | 0.79 | | |
| 93 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.21 | 40 | 139 | **6.4** | **0.00** | 31.4 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 92 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.05 | 46 | 120 | **6.4** | **0.00** | 36.8 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 97 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.60 | 0 | 183 | **6.4** | **0.40** | 22.1 | 20.2 | 27.7 | 53.3 | 0.6 | 0.70 | | |
| 91 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 1.01 | 37 | 116 | **6.4** | **0.00** | 38.0 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |
| 90 | 2e tussenstuk | Enkele staaf | L45.5 | S235 | M12 | 5.6 | 0.96 | 42 | 110 | **6.4** | **0.00** | 39.9 | 20.2 | 27.7 | 53.3 | 0.6 | 0.32 | | |

DNV·GL

**Knikverkorters final construction (verbouw)**

Date: 2020-07-08
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+4

58

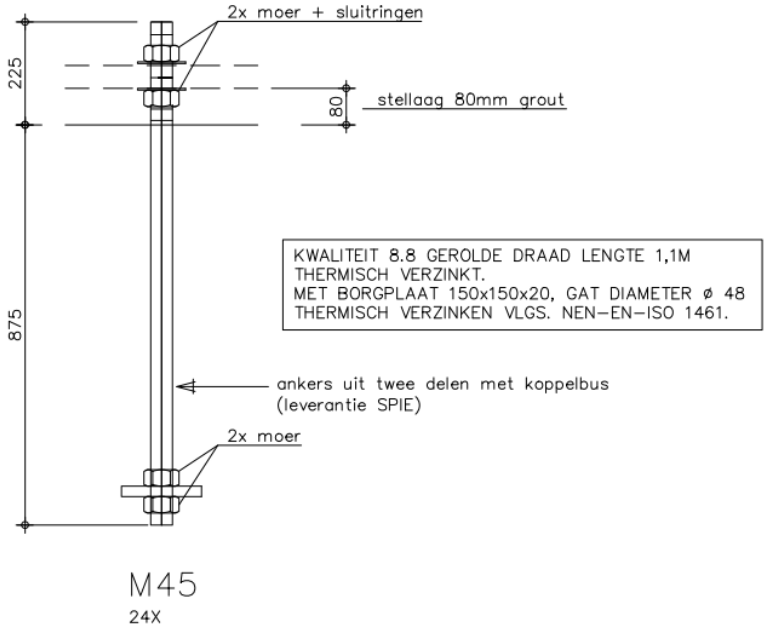
| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness (-) | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Block Tearing Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | Mitigation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | Pootverband | Enkele staaf | **L70.7** | **S355** | M12 | **8.8** | 3.21 | 0 | 235 | **1.5** | **1.04** | 37.1 | 32.3 | 52.8 | 238.7 | 2.99 | 0.35 | | Profile exchanged |
| 49 | 1e tussenstuk | 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 tussenstuk | 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 tussenstuk | 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 tussenstuk | Enkele staaf | **L50.5** | **S355** | M12 | **8.8** | 2.37 | 0 | 244 | **7.2** | **0.77** | 18.0 | 32.3 | 37.7 | 92.1 | 1.08 | 0.71 | | Profile exchanged |

# APPENDIX D CHECK ANCHORS

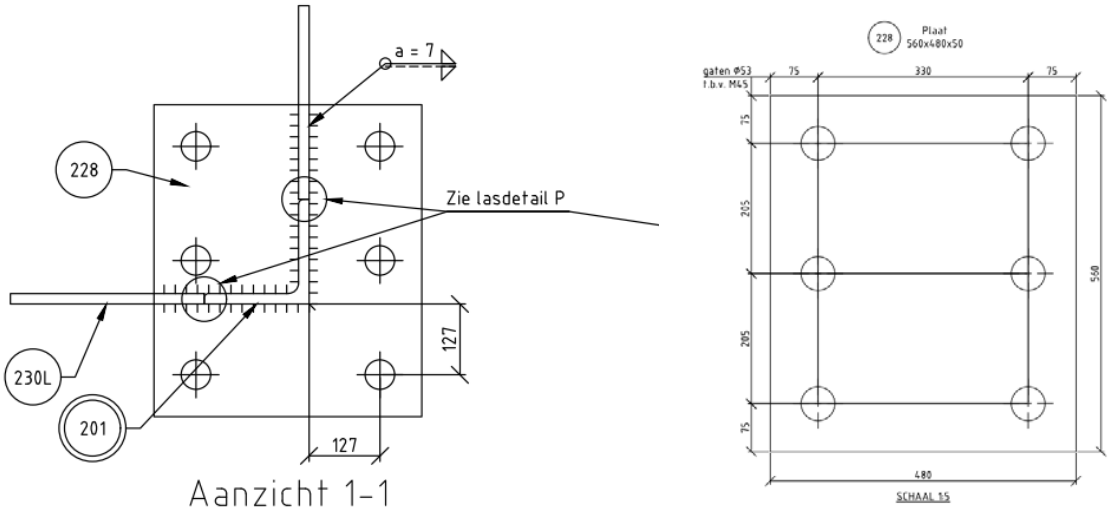
## ANCHORS S+4

Drawings provided for tower structure S+4 include anchors. No statical calculation has been provided. 6 anchor bolt M45 in quality 8.8 have been used. The foot plate has dimensions 560x480x50.

The 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 with schematisation of effective width and leverage arm**

## Loads

The loads coming from the tower are based on S+4 structure number 58 in wind zone III for verbouwniveau 50 jaar:

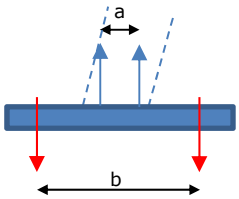
**Omhullenden ongeacht stijl**

| Belasting | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_n$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. druk | ULS 1a_45 | 254 | 206 | **704** | 34 | -325 | -14 | 770 |
| Max. trek | ULS 1a_0,9_0,9_45 | 173 | 126 | **-519** | -34 | 211 | -18 | -568 |
| Max. pos. torsie | ULS 1a_45 | -79 | -77 | -56 | **110** | 1 | -24 | -61 |
| Max. neg. torsie | ULS 1a_135 | 79 | -77 | -56 | **-110** | 1 | -24 | -61 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_90 | -195 | 52 | **-446** | **101** | 175 | -23 | -488 |

Due to the steep inclination of the main leg, the lateral force on the anchors is relatively high (325 kN).

## 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 · 180 / √2 = 64 mm

b: 330 mm

The eccentricity becomes 1/2 · (330-64) = 133 mm.

In the spreadsheet the anchor bolts and foot plate have been checked. The concrete strength is equal to C30/37. The foot plate is embedded in concrete. The anchor bolts will not be loaded by bending.

See output of spreadsheet: the anchor and the plate have more than sufficient strength.

Tower 78: U.C. = 0,28 ≤ 1,00 OK

# Ankers

Versie: 2.2

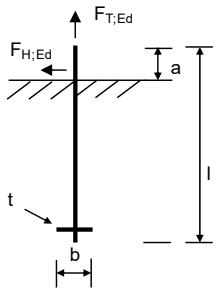
*Volgens NEN-EN 1992-1-1 en 1993-1-8 met NB*

*Kolomvoetplaatverbindingen*

| ***Onderdeel:*** | **Ankers S+4** | ***Toetsingen*** | |
|---|---|---|---|
| | | Ankerbout op trek | 0,28 ***OK*** |
| | | Ankerbout op afschuiving | 0,42 ***OK*** |
| | | Ankerplaat | 0,19 ***OK*** |

### *Invoer*

| | | |
|---|---|---|
| Ankerdiameter | | **M45** |
| Ankerkwaliteit | | **8.8** |
| Draad | | Gerold |
| Ankerlengte | l = | 1100 mm |
| Anker boven beton | a = | 150 mm |




### *Belasting op ankergroep*

T: de uitwendige trekkracht op de anker groep.

| | | |
|---|---|---|
| Trekbelasting | T = | **519** kN |
| Schuifkracht | $F_{H,Ed}$ = | **325** kN |
| Aantal (n) ankers voor trek | | 6 |
| Aantal ankers voor afschuiving | | 6 |
| $F_{T;Ed}$ = T / n = | | 86,5 kN |
| $F_{v;Ed}$ = $F_{H,Ed}$ / n = | | 54,2 kN |

### *Ankergegevens*

| | |
|---|---|
| $d_b$ = | 45 mm |
| $A_{b;s}$ = | 817 $mm^2$ |
| $f_{y\,b}$ = | 640 $N/mm^2$ |
| $f_{ub}$ = | 800 $N/mm^2$ |
| $\gamma_{Mb}$ | 1,25 - |
| $\alpha_{red;2}$ | 1,00 - |
| $\alpha_b$ = 0,44 - 0,0003$f_{y\,b}$ = | 0,25 - |

*Capaciteit per anker*

| | |
|---|---|
| $F_{T;Rd}$ = 0,9$\alpha_{red;2}f_{ub}A_s$ / $\gamma_{M2}$ = | **470,6** kN |
| $F_{v;Rd}$ = $\alpha_b f_{ub}A_s$ / $\gamma_{Mb}$ = | **129,7** kN |

### *Voetplaat*

$F_{t,Rd}$: de trekkracht in de ankers waarbij de voetplaat vloeit.

| | | |
|---|---|---|
| Staalsoort | | **S355** |
| Dikte | t = | 50 mm |
| Breedte | $b_{ef}$ = | 186,6667 mm |
| Hefboomsarm | m = | 133 mm |
| $M_{pl,Rd}$ = 1/4$b_{ef}t_p^2f_{y\,d}$ = | | 41,42 kNm |
| $F_{t,Rd}$ = $M_{pl,Rd}$ / m = | | 311,4 kN |

### *Capaciteit ankerplaat*

| | |
|---|---|
| Betonkwaliteit | **C30/37** |
| $f_{ck}$ = | 30 $N/mm^2$ |

### *Idieële belasting*

$N_{di}$ = $\sqrt{(F_{T,Ed}^2+3F_{v,Ed}^2)}$ = 128 kN

### *Ankerplaat*

| | | |
|---|---|---|
| Afmeting ankerplaat | a = | **150** mm |
| Dikte | $t_{pl}$ = | **20** mm |
| Overhoekse maat | $d_m$ = | 72 mm |
| Capaciteit ankerplaat: | | |
| $A_h$ = $\pi$/4 $((d_m+2t)^2-d^2)$ = | | 8262 $mm^2$ |
| Beton | | Ongescheurd |
| $\psi_{ucr,N}$ = | | 1,4 - |
| $N_{Rd,p}$ = 5$A_h f_{ck}\psi_{ucr,N}$ / $\gamma_{Mc}$ = | | 1157 kN |

### *Sterkte voetplaat*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{86,5}{311,4} = 0,28$$ ***OK***

### *Toets trek op anker*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{86,5}{470,6} = 0,18$$ ***OK***

### *Toets trek op voetplaat*

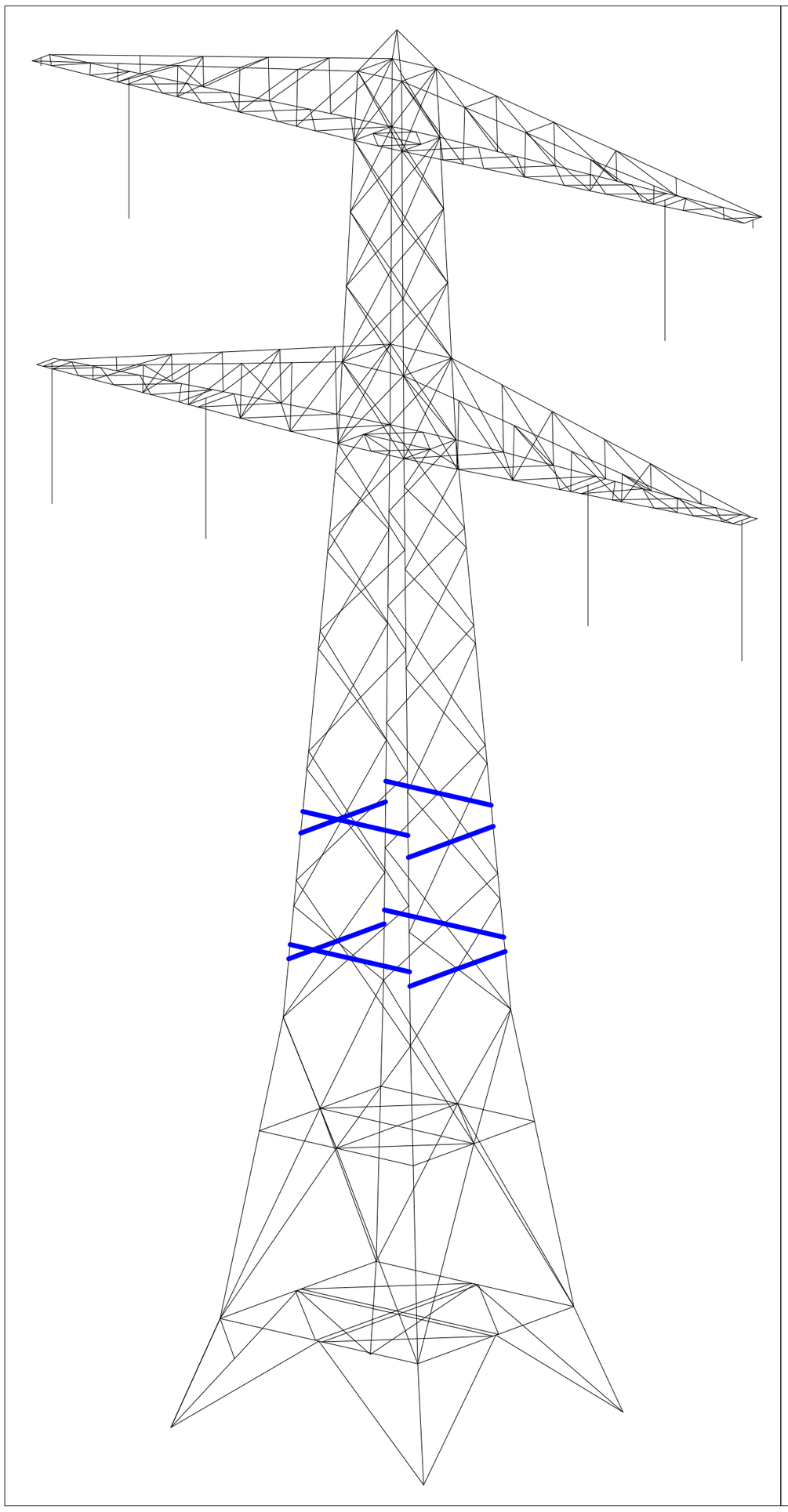
$$\frac{T}{n \times F_{t;Rd}} = \frac{519,0}{1868,4} = 0,28$$ ***OK***

### *Toets afschuiving anker*

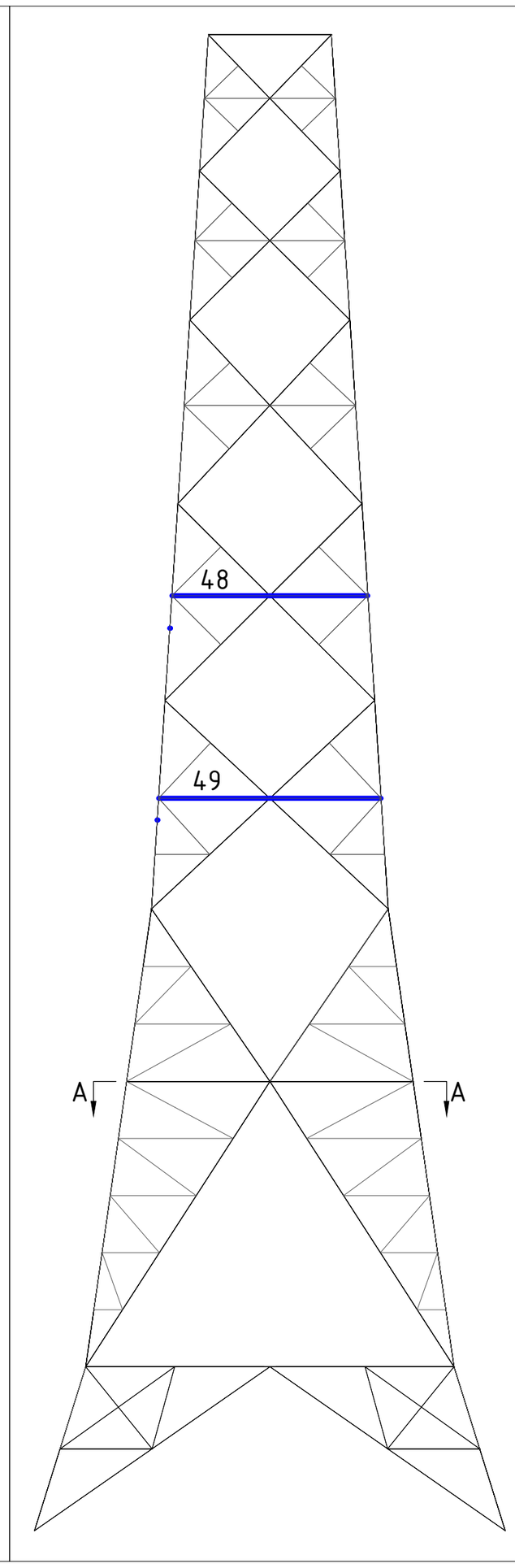
$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{54,2}{129,7} = 0,42$$ ***OK***

# APPENDIX E DRAWINGS

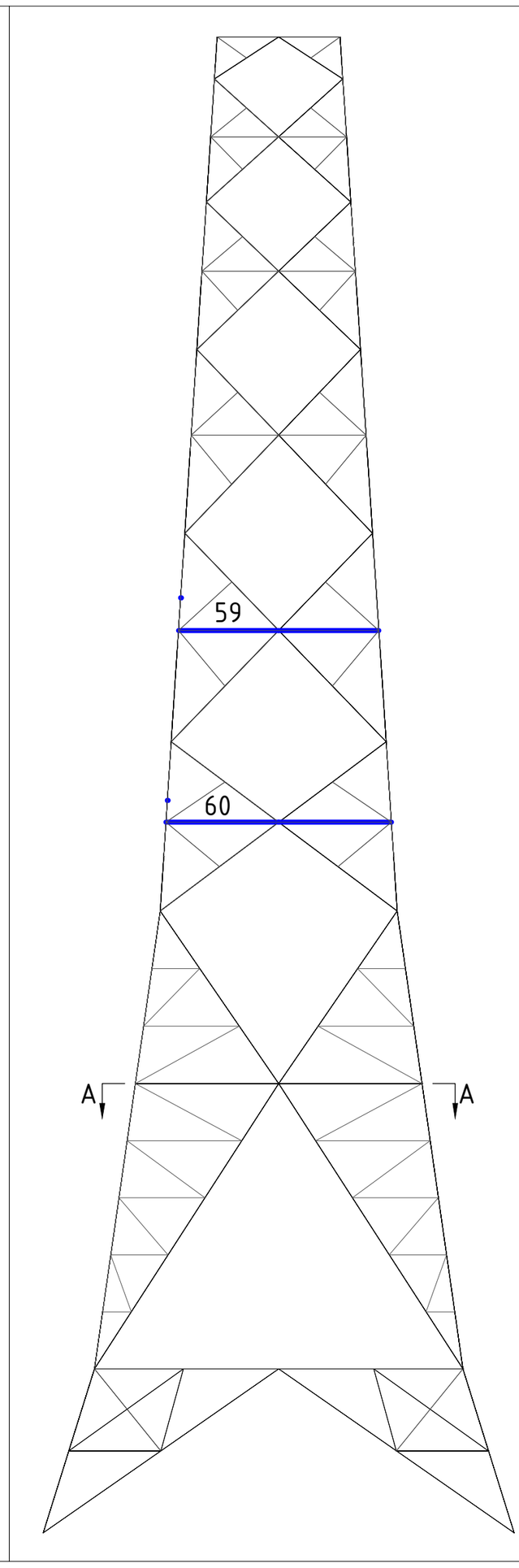
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (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 |
| 25 | EA | L45x5 | S235 t<=40 | M12-8.8t-NEN2012 | EA | L70x7 | S355 t<=40 | M12-8.8t-NEN2012 |



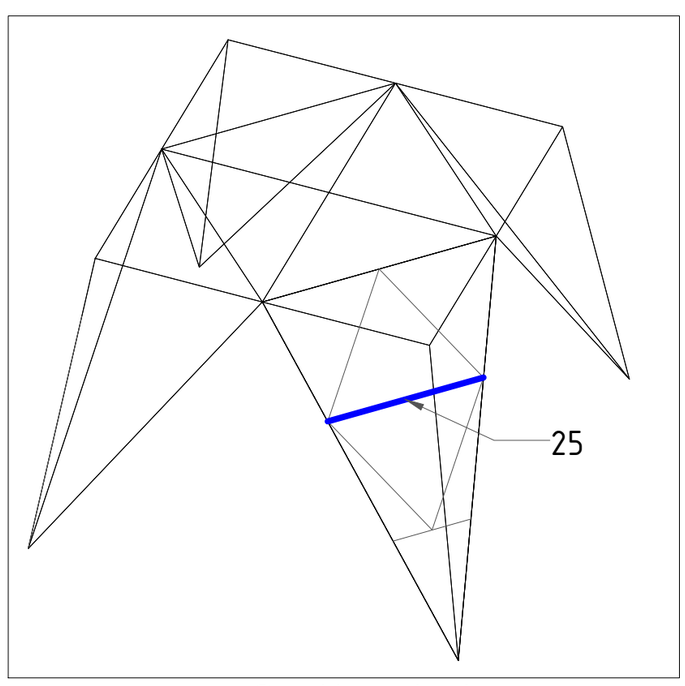
Overview




Front View




Side View




Section A-A

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 | 8-7-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-019

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | Description: Modifications overview for mast type S+4 (mast 58) |
| Drawn by: | MuK | 8-7-2020 | Units: | m | Revision: 00 |
| Checked by: | TBR | 8-7-2020 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 8-7-2020 | Company: | TenneT | |

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Bijlage 20 Rapportage Mastconstructie S+48

DNV·GL

"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

# KIJ-GT380 – Rapportage mast S+48

## TenneT TSO B.V.

**Meridian doc. nr.:** 002.589.40 0916500
**Rapport nr.:** 21-1076 Rev.0
**Datum:** 2021-07-02

| | | |
|---|---|---|
| Projectnaam: | "Toetsing en herontwerp masten en fundaties BBB380" | DNV GL - Energy<br>Energy Advisory |
| Rapport titel: | KIJ-GT380 – Rapportage mast S+48 | Postbus 9035 |
| Klant: | TenneT TSO B.V. | 6800 ET ARNHEM |
| Contactpersoon: | [redacted] | |
| Datum: | 2021-07-02 | |
| Project nr.: | 10166260 | [redacted] |
| Organisatie unit: | TDT | [redacted] |
| Meridian doc.nr.: | 002.589.40 0916500 | |
| Rapport nr.: | 21-1076 Rev.0 | |

| Geschreven door: | Beoordeeld door: | Goedgekeurd door: |
|---|---|---|
| [redacted] | | |

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Trefwoorden:

| Versie | Datum | Reden voor uitgave | Auteur | Beoordeeld | Goedgekeurd |
|---|---|---|---|---|---|
| 0 | 2021-07-02 | Eerste uitgave | [redacted] | | |

DNV GL Netherlands B.V.

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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+48 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+48.

### 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.

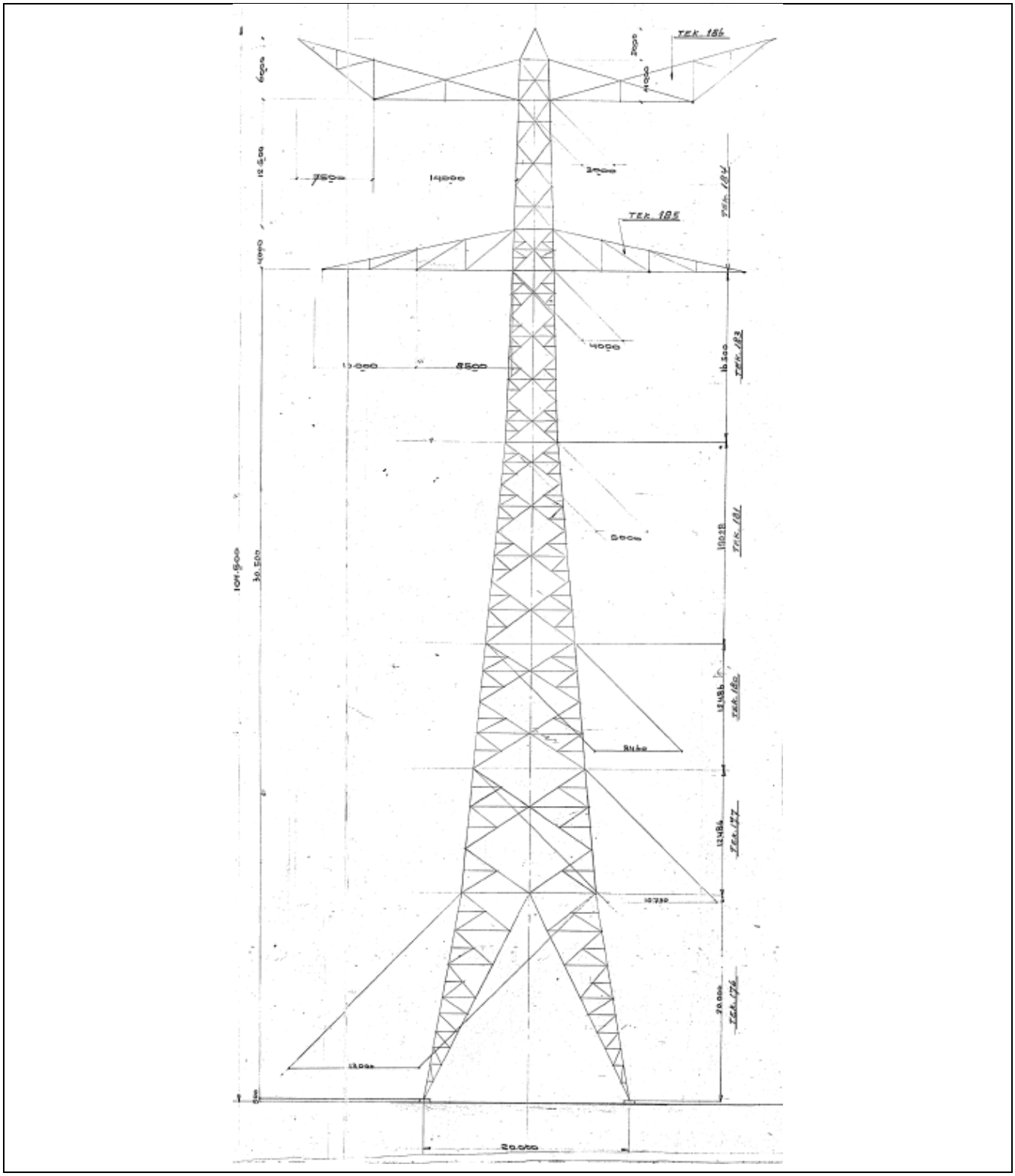
**Tabel 1 Relevante eisen**

| 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".<br><br>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+48 getoetst. In de verbinding KIJ-GT komt maar één mast voor van het type S+48 (mast 84), de gegevens van de mast zijn in Tabel 2 weergegeven. De berekening van de geleiderbelastingen is in dit geval locatie specifiek uitgevoerd.

**Tabel 2 Mastnummers**

| Mastnummer | Masttype | Maatgevend mastnummer | Wind span (m) | Weight span (m) | Hoogteverschil |
|---|---|---|---|---|---|
| 84 | S+48 | 84 | 451 | 867 | 50.8 |

## 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 | 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:

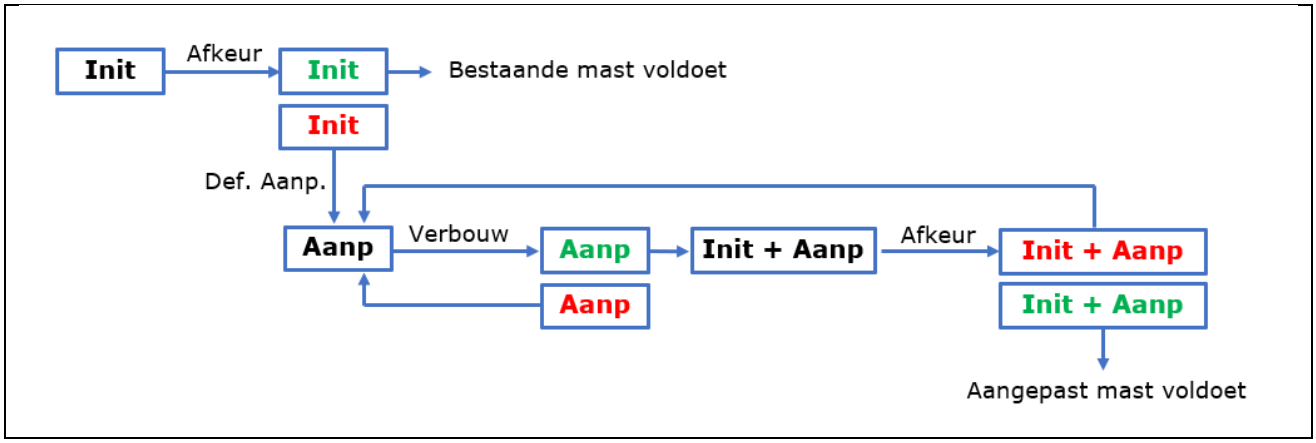
Stap 1: Toets bestaande (Init) mast op Afkeur

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 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

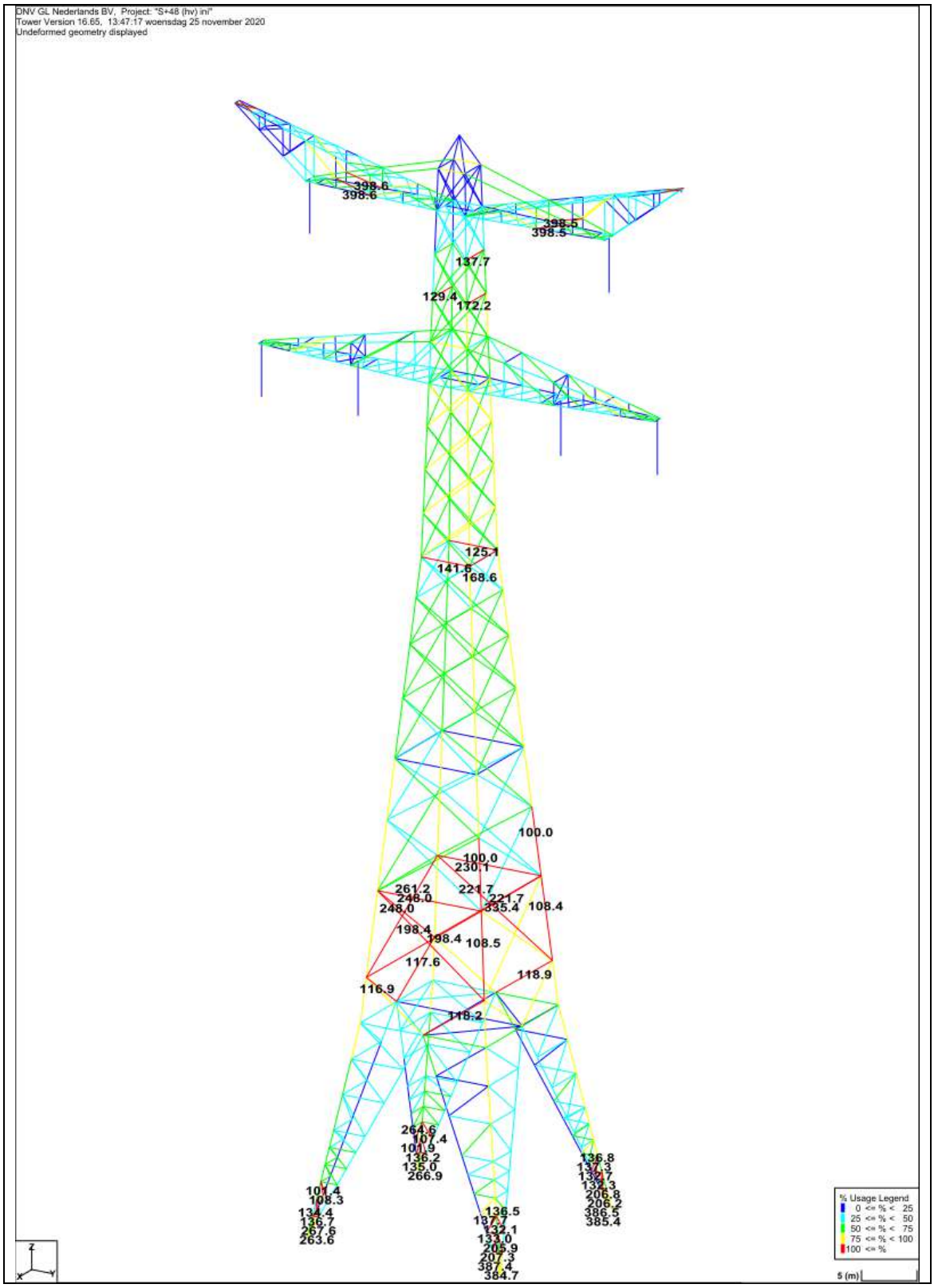
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten 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+48 met belastingen op afkeurniveau is weergegeven in onderstaande figuren.




**Figuur 3 Resultaat PLS-TOWER S+48 (84)**

De resultaten van de controles van profielen, knikverkorters en ankers randstijl zijn opgenomen in Tabel 4. Figuur 3 laat zien dat een aantal knikverkorters niet voldoen volgens de PLS-Tower berekening. Aanvullend is er een meer nauwkeurige berekening gemaakt met behulp van Axis VM en een op Excel gebaseerd programma ontwikkeld door DNV GL. Uit deze berekeningen blijkt dat er enkel een aantal bouten moeten worden vervangen van de onderste, diagonale knikverkorters.

**Tabel 4 Samenvatting controle**

| Controle van | Beoordeling | | Referentie |
|---|---|---|---|
| Profielen | | **Voldoen niet** | Figuur 3 |
| Knikverkorters | | **Voldoen niet** | Appendix C |
| Ankers en voetplaat | Voldoen | | Appendix D |

# 5 AANPASSINGEN

## 5.1 Inleiding

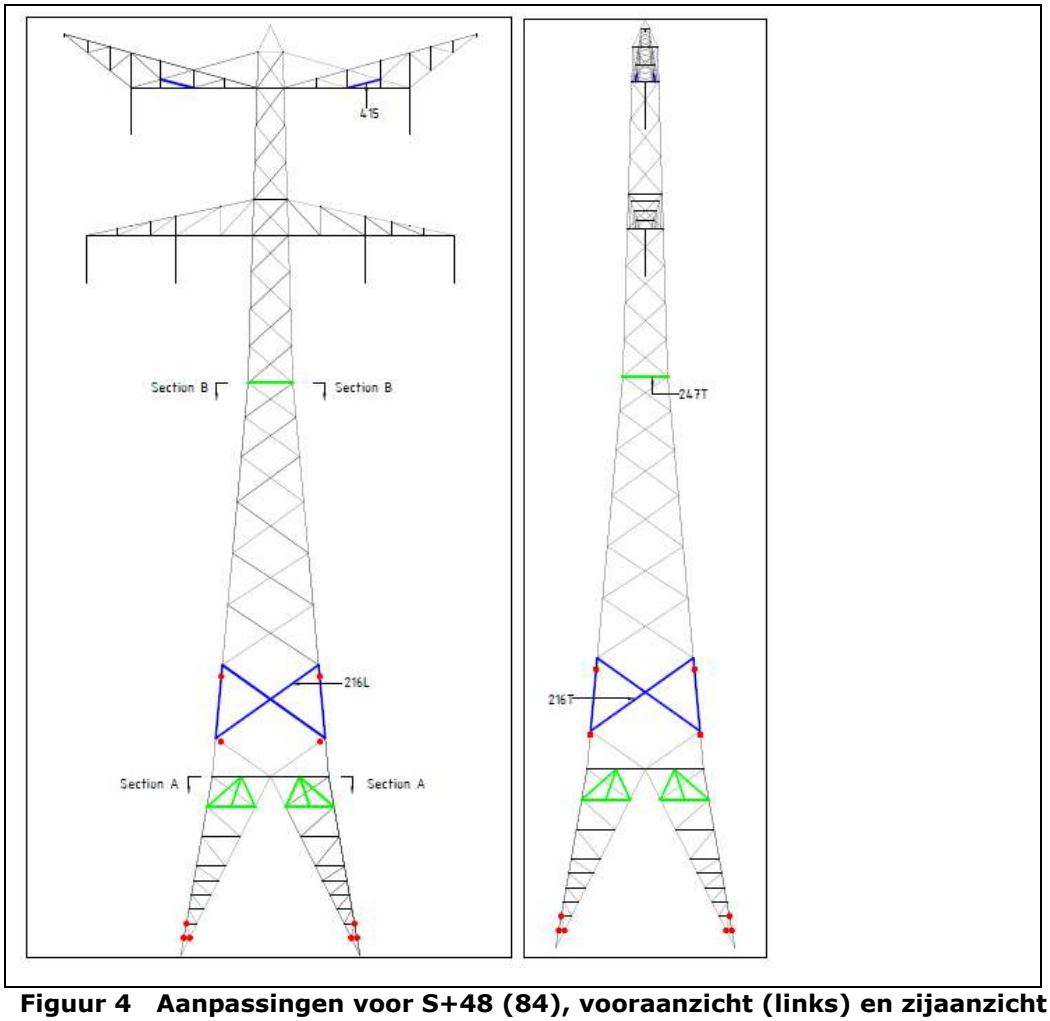
Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen en nieuwe onderdelen aan verbouwniveau is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Vervangen van kruisverbanden in het middenstuk van de mast;
- Vervangen van een diagonaal in de boventraverse;
- Toevoeging van knikverkorters om de hoofdiagonaal van het broekstuk te stabiliseren;
- Aanbrengen van een aanvullend stabiliteitsverband in het centrum van de mast;
- Vervanging van bouten in één van de knikverkorters in het boekstuk.

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”.

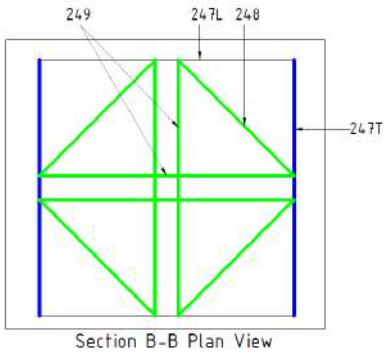
## 5.2 Aanpassingen

Zoals blijkt uit de uitvoer van PLS Tower, zie Appendix B, moeten de onderdelen die zijn weergegeven in Figuur 4 worden aangepast. Voor afmetingen profielen en bouten, zie Appendix E.



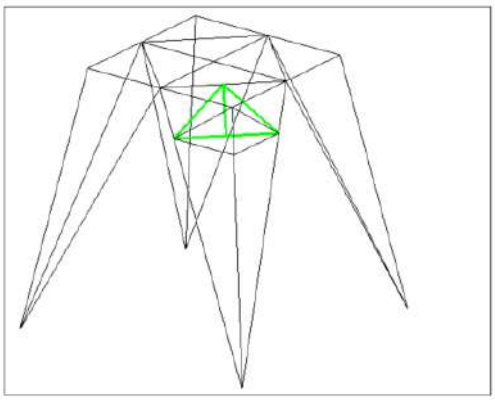

**Figuur 4 Aanpassingen voor S+48 (84), vooraanzicht (links) en zijaanzicht (rechts)**

De mast S+48 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 B-B, zie Figuur 4. De vorm van het verband is weergegeven in Figuur 5. Voor afmetingen profielen en bouten, zie Appendix E.

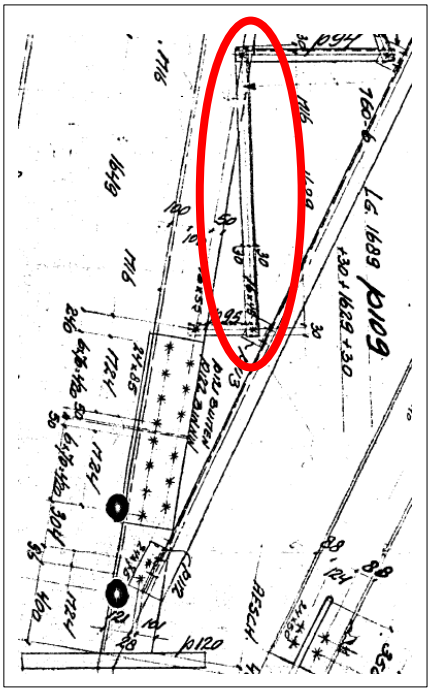



**Figuur 5 Geadviseerd stabiliteitsverband ter hoogte van doorsnede B-B**

Het onderste gedeelte van het mastlichaam is ook relatief slank met een hoogte van 20m zonder dat de hoofdiagonalen UNP300 worden gesteund door aanvullende stabiliteitsverbanden. Het overschrijden van de slankheid van 180 voor primaire stabiliteitsverbanden in combinatie met optredende windbelasting loodrecht op de profielen vormen een risico voor de stabiliteit van de constructie. Om de stabiliteit van dit gedeelte te verbeteren wordt er geadviseerd om een stabiliteitsverband toe te voegen, zoals weergegeven in Figuur 6.



**Figuur 6 Geadviseerd stabiliteitsverband voor de UNP300 diagonalen**



**Figuur 7 Knikverkorter waarvan bouten moeten worden vervangen**

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen is voor mast 84 gegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

**Tabel 5 Gewichten S+48 (84) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **216L** | L120.10 | S235 | 1M24-5.6t | L130.11 | S355 | 1M24-8.8t | Profiel uitgewisseld | 4 | 14.12 | 1229.51 |
| **216T** | L120.10 | S235 | 1M24-5.6t | L130.11 | S355 | 1M24-8.8t | Profiel uitgewisseld | 4 | 14.12 | 1229.51 |
| **247T** | L80.8 | S235 | 1M24-5.6t | L90.8 | S355 | 1M24-5.6t | Profiel uitgewisseld | 2 | 5.00 | 109.91 |
| **415** | L55.6 | S235 | 1M16-5.6t | L80.8 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 3.78 | 146.67 |
| **248** | | | | L75.7 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 3.54 | 113.43 |
| **249** | | | | L70.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 5.00 | 128.25 |
| **250** | | | | L120.10 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 5.36 | 784.91 |
| **251** | | | | L120.10 | S355 | 1M20-8.8t | Profiel uitgewisseld | 4 | 7.64 | 559.39 |
| **252** | | | | L80.8 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 3.76 | 145.89 |
| | | | | | | | | **38** | **62.32** | **4447.47** |

## 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, 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


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 104 m |
| Max. Span | 542 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 449 m |
| EDS Weight span | 707 m |
| Min. Weight span | 641 m |
| Max. Weight span | 1146 m |

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

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+48

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

Document name:

KIJ-GT_S+48_84_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+48
Number: 84

**Conductor loads**

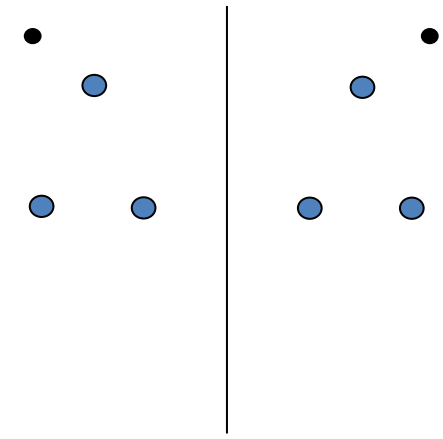
Auteur: TBR
Versie: v11.3

**General**

| | |
|---|---|
| Description | S+48 |
| 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 | 21 | 380ct1f1 | 76,2 m | 80,5 m | 20,5 m |
| Circuit 1 | 20 | 380ct1f2 | 76,2 m | 80,5 m | 10,5 m |
| Circuit 1 | 22 | 380ct1f3 | 92,7 m | 97,0 m | 15,5 m |
| Circuit 2 | 10 | 380ct2f1 | 76,2 m | 80,5 m | -20,5 m |
| Circuit 2 | 11 | 380ct2f2 | 76,2 m | 80,5 m | -10,5 m |
| Circuit 2 | 12 | 380ct2f3 | 92,7 m | 97,0 m | -15,5 m |
| Bliksemdraad 1 | 1 | bl1 | 102,5 m | 103,0 m | -23,0 m |
| Bliksemdraad 2 | 3 | bl2 | 102,5 m | 103,0 m | 23,0 m |

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

Project: KIJ-GT
Tower: S+48
Number: 84

**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**

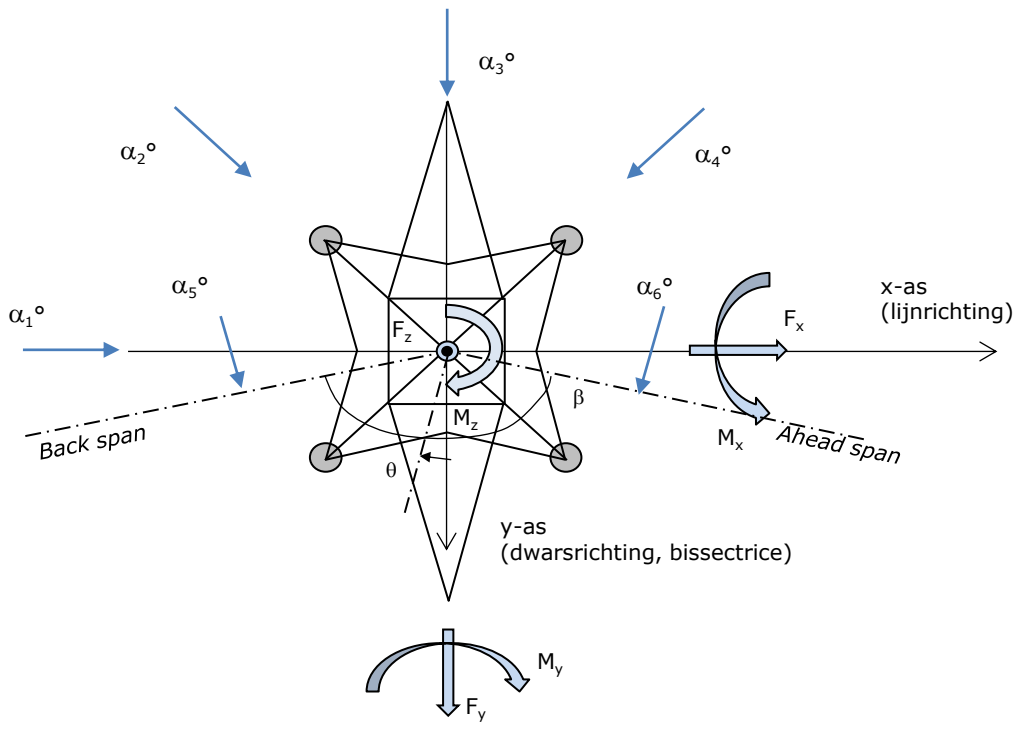
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 21 | 380ct1f1 | -48,4 | -3,2 m | -4,8 | 0,0 m |
| Circuit 1 | 20 | 380ct1f2 | -48,4 | -3,2 m | -1,8 | 0,0 m |
| Circuit 1 | 22 | 380ct1f3 | -53,4 | -3,1 m | -3,3 | 0,0 m |
| Circuit 2 | 10 | 380ct2f1 | -48,4 | -3,2 m | 4,8 | 0,0 m |
| Circuit 2 | 11 | 380ct2f2 | -48,4 | -3,2 m | 1,8 | 0,0 m |
| Circuit 2 | 12 | 380ct2f3 | -53,4 | -3,1 m | 3,3 | 0,0 m |
| Bliksemdraad 1 | 1 | bl1 | -59,1 | -3,1 m | 6,8 | 0,0 m |
| Bliksemdraad 2 | 3 | bl2 | -59,1 | -3,1 m | -6,8 | 0,0 m |

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 356,0 | 542,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 441,8 | 441,8 | m |
| Line angle | $\beta$ | 180 | | ° |
| Tower orientation with respect to bis | $\theta$ | 0 | | ° |
| Section length | | 1672 | 1672 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+48
Number: 84

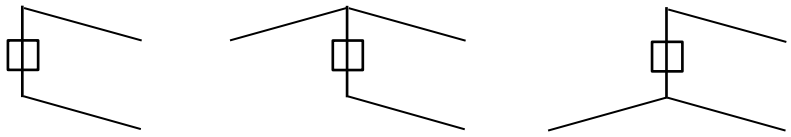
**Absence of conductors**

| | | 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 |

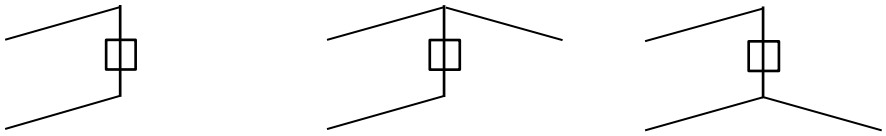
**Load situations SPLS**

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+48
Number: 84

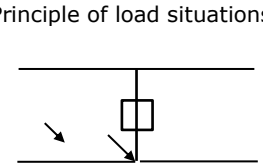
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

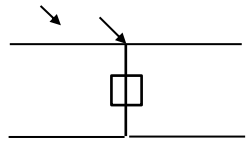
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

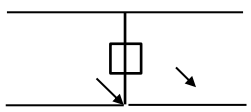
Principle of load situations:



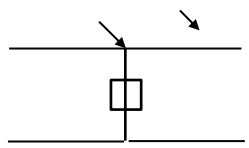
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

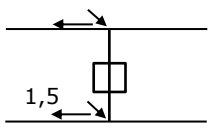
**Load situations 8. Galloping as a static load**

| 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 |

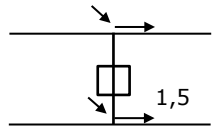
Considered situations galloping 8: None (existing structure)

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+48
Number: 84

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+48 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 104,0 | m | |
| Tower self weight | 900,0 | kN | |
| | | | |
| *Width and slope at foundation* | x-ri. | y-ri. | |
| Leg spread | 20,00 | 20,00 | m |
| Inclination of main leg | 0,175 | 0,175 | - |
| Horizontal force factor | 1,1 | 1,1 | - |

### Calculation Wind load

| | |
|---|---|
| Dynamic factor $G_T$ | 1,05 |
| 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] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 20,00 | 20,00 | 13,00 | 20,00 | 0,175 | 330,00 | 37,37 | 0,11 | 3,34 |
| Middenstuk 1 | 44,97 | 13,00 | 8,46 | 24,97 | 0,091 | 267,95 | 33,51 | 0,13 | 3,28 |
| Middenstuk 2 | 64,00 | 8,46 | 5,00 | 19,03 | 0,091 | 128,06 | 24,20 | 0,19 | 2,98 |
| Bovenstuk 1 | 80,50 | 5,00 | 4,00 | 16,50 | 0,030 | 74,25 | 16,81 | 0,23 | 2,82 |
| Bovenstuk 2 | 101,00 | 4,00 | 2,80 | 20,50 | 0,029 | 69,70 | 20,90 | 0,30 | 2,54 |
| Topstuk | 104,00 | 2,80 | | 3,00 | | 4,20 | 0,99 | 0,24 | 2,78 |
| Ondertraverse | 80,50 | 18,50 | | 4,00 | | 37,00 | 8,60 | 0,23 | 2,79 |
| Boventraverse | 97,00 | 21,50 | | 6,00 | | 64,50 | 12,65 | 0,20 | 2,95 |

### Properties tower sections transverse direction (side view, xz plane)

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 20,00 | 20,00 | 13,00 | 20,00 | 0,175 | 330,00 | 37,37 | 0,11 | 3,34 |
| Middenstuk 1 | 44,97 | 13,00 | 8,46 | 24,97 | 0,091 | 267,95 | 33,51 | 0,13 | 3,28 |
| Middenstuk 2 | 64,00 | 8,46 | 5,00 | 19,03 | 0,091 | 128,06 | 24,20 | 0,19 | 2,98 |
| Bovenstuk 1 | 80,50 | 5,00 | 4,00 | 16,50 | 0,030 | 74,25 | 16,81 | 0,23 | 2,82 |
| Bovenstuk 2 | 101,00 | 4,00 | 2,80 | 20,50 | 0,029 | 69,70 | 20,90 | 0,30 | 2,54 |
| Topstuk | 104,00 | 2,80 | | 3,00 | | 4,20 | 0,99 | 0,24 | 2,78 |
| Ondertraverse | 80,50 | 18,50 | | 4,00 | | 37,00 | 8,60 | 0,23 | 2,79 |
| Boventraverse | 97,00 | 21,50 | | 6,00 | | 64,50 | 12,65 | 0,20 | 2,95 |

*Note: Surface transverse direction is reduced in calculation.*

Project: KIJ-GT
Tower: S+48
Number: 84

**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 | 0,70 | 87,5 | 74,2 | 0,0 | -74,2 | 10,0 | 874,8 | 742,3 | 0,0 | -742,3 |
| Middenstuk 1 | 1,01 | 111,1 | 94,3 | 0,0 | -94,3 | 32,5 | 3608,5 | 3061,9 | 0,0 | -3061,9 |
| Middenstuk 2 | 1,16 | 83,7 | 71,0 | 0,0 | -71,0 | 54,5 | 4561,2 | 3870,3 | 0,0 | -3870,3 |
| Bovenstuk 1 | 1,25 | 59,1 | 50,1 | 0,0 | -50,1 | 72,3 | 4268,6 | 3622,0 | 0,0 | -3622,0 |
| Bovenstuk 2 | 1,32 | 69,8 | 59,2 | 0,0 | -59,2 | 90,8 | 6336,8 | 5376,9 | 0,0 | -5376,9 |
| Topstuk | 1,36 | 3,7 | 3,2 | 0,0 | -3,2 | 102,5 | 383,9 | 325,8 | 0,0 | -325,8 |
| Ondertraverse | 1,29 | 61,8 | 36,7 | 0,0 | -36,7 | 81,8 | 5055,7 | 3002,9 | 0,0 | -3002,9 |
| Boventraverse | 1,35 | 100,3 | 59,6 | 0,0 | -59,6 | 99,0 | 9934,2 | 5900,6 | 0,0 | -5900,6 |
| Totaal | | 577,0 | 448,4 | 0,0 | -448,4 | | 35023,6 | 25902,7 | 0,0 | -25902,7 |

**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 | 0,70 | 0,0 | 74,2 | 87,5 | 74,2 | 10,0 | 0,0 | 742,3 | 874,8 | 742,3 |
| Middenstuk 1 | 1,01 | 0,0 | 94,3 | 111,1 | 94,3 | 32,5 | 0,0 | 3061,9 | 3608,5 | 3061,9 |
| Middenstuk 2 | 1,16 | 0,0 | 71,0 | 83,7 | 71,0 | 54,5 | 0,0 | 3870,3 | 4561,2 | 3870,3 |
| Bovenstuk 1 | 1,25 | 0,0 | 50,1 | 59,1 | 50,1 | 72,3 | 0,0 | 3622,0 | 4268,6 | 3622,0 |
| Bovenstuk 2 | 1,32 | 0,0 | 59,2 | 69,8 | 59,2 | 90,8 | 0,0 | 5376,9 | 6336,8 | 5376,9 |
| Topstuk | 1,36 | 0,0 | 3,2 | 3,7 | 3,2 | 102,5 | 0,0 | 325,8 | 383,9 | 325,8 |
| Ondertraverse | 1,29 | 0,0 | 36,7 | 24,7 | 36,7 | 81,8 | 0,0 | 3002,9 | 2022,3 | 3002,9 |
| Boventraverse | 1,35 | 0,0 | 59,6 | 40,1 | 59,6 | 99,0 | 0,0 | 5900,6 | 3973,7 | 5900,6 |
| Total | | 0,0 | 448,4 | 479,8 | 448,4 | | 0,0 | 25902,7 | 26029,7 | 25902,7 |

**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 | 900 | 0 | 0 | 0 |
| Windrichting 0° | 577 | 0 | 0 | 0 | 36783 | 0 |
| Windrichting 45° | 448 | 448 | 0 | 27204 | 27204 | 0 |
| Windrichting 90° | 0 | 480 | 0 | 27337 | 0 | 0 |
| Windrichting 135° | -448 | 448 | 0 | 27204 | -27204 | 0 |

Project: KIJ-GT
Tower: S+48
Number: 84

**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 78,85 | 1,27 | 1,2 | 1,53 |
| 380ct1f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 78,85 | 1,27 | 1,2 | 1,53 |
| 380ct1f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 95,35 | 1,33 | 1,2 | 1,60 |
| 380ct2f1 | 2,00 | 1 | 2 | 4,3 | 1,0 | 78,85 | 1,27 | 1,2 | 1,53 |
| 380ct2f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 78,85 | 1,27 | 1,2 | 1,53 |
| 380ct2f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 95,35 | 1,33 | 1,2 | 1,60 |
| bl1 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 103,25 | 1,36 | 1,2 | 0,08 |
| bl2 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 103,25 | 1,36 | 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 | 45,0 | 1,10 | 0,60 | 0,56 | 1,07 | 28,25 | 60,0 | 55,9 | 46,9 | 112,0 | 104,3 |
| 380ct1f2 | 45,0 | 1,10 | 0,60 | 0,56 | 1,07 | 28,25 | 60,0 | 55,9 | 46,9 | 112,0 | 104,3 |
| 380ct1f3 | 59,0 | 1,18 | 0,62 | 0,58 | 1,05 | 28,25 | 65,3 | 60,7 | 46,9 | 124,3 | 115,6 |
| 380ct2f1 | 45,0 | 1,10 | 0,60 | 0,56 | 1,07 | 28,25 | 60,0 | 55,9 | 46,9 | 112,0 | 104,3 |
| 380ct2f2 | 45,0 | 1,10 | 0,60 | 0,56 | 1,07 | 28,25 | 60,0 | 55,9 | 46,9 | 112,0 | 104,3 |
| 380ct2f3 | 59,0 | 1,18 | 0,62 | 0,58 | 1,05 | 28,25 | 65,3 | 60,7 | 46,9 | 124,3 | 115,6 |
| bl1 | 66,4 | 1,22 | 0,63 | 0,59 | 1,17 | 22,24 | 20,0 | 18,6 | 41,5 | 38,3 | 35,7 |
| bl2 | 66,4 | 1,22 | 0,63 | 0,59 | 1,17 | 22,13 | 19,9 | 18,5 | 41,4 | 38,2 | 35,6 |

**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 | 57,6 | 1,18 | 0,62 | 0,58 | 1,05 | 28,25 | 64,8 | 60,3 | 46,9 | 123,2 | 114,7 |
| 380ct1f2 | 57,6 | 1,18 | 0,62 | 0,58 | 1,05 | 28,25 | 64,8 | 60,3 | 46,9 | 123,2 | 114,7 |
| 380ct1f3 | 74,1 | 1,25 | 0,64 | 0,59 | 1,03 | 28,25 | 69,9 | 65,0 | 46,9 | 135,3 | 125,8 |
| 380ct2f1 | 57,6 | 1,18 | 0,62 | 0,58 | 1,05 | 28,25 | 64,8 | 60,3 | 46,9 | 123,2 | 114,7 |
| 380ct2f2 | 57,6 | 1,18 | 0,62 | 0,58 | 1,05 | 28,25 | 64,8 | 60,3 | 46,9 | 123,2 | 114,7 |
| 380ct2f3 | 74,1 | 1,25 | 0,64 | 0,59 | 1,03 | 28,25 | 69,9 | 65,0 | 46,9 | 135,3 | 125,8 |
| bl1 | 85,1 | 1,30 | 0,65 | 0,60 | 1,15 | 22,24 | 21,6 | 20,1 | 41,5 | 41,9 | 39,0 |
| bl2 | 85,1 | 1,30 | 0,65 | 0,60 | 1,16 | 22,13 | 21,5 | 20,0 | 41,4 | 41,9 | 38,9 |

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Number: 84

**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 °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,05 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk only tower | 10° | 0,90 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk conductors too | 10° | 0,90 | 0,90 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 3_0,9 | Wind+ice 0,9Gk | -5° | 0,90 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 4_0,9 | Cold+wind 0,9Gk | -20° | 0,90 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 5a | Torsional loads | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinal loads | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Construction + maintenance | 5° | 1,05 | 1,05 | 1,20 | 0,22 | 0,00 | 0,0 |
| ULS 6_0,9 | Construction + maintenance | 5° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,15 | 1,15 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** | (strength, for angle towers: absence of conductors) | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** | (deformations, fatigue, EDS) | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,94 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,28 | 0,88 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Number of wind directions | 4 |
| Number of load combinations for ULS | 36 |
| Number of load combinations for SPLS | 0 |
| Number of load combinations for SLS | 11 |
| Number of concentrated loads | 376 |

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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 | -32,4 | 32,3 | 4,6 | 6,6 | 9,5 | 6,6 |
| bl2 | -32,5 | 32,6 | 3,4 | 6,6 | 9,5 | 6,6 |
| 380ct1f1 | -115,3 | 115,4 | 11,4 | 20,5 | 30,1 | 22,3 |
| 380ct1f2 | -115,3 | 115,3 | 12,3 | 20,5 | 30,1 | 22,3 |
| 380ct1f3 | -117,4 | 117,4 | 12,9 | 22,0 | 32,0 | 22,3 |
| 380ct2f1 | -115,1 | 115,1 | 14,2 | 20,5 | 30,1 | 22,3 |
| 380ct2f2 | -115,2 | 115,2 | 13,3 | 20,5 | 30,1 | 22,3 |
| 380ct2f3 | -117,2 | 117,2 | 14,9 | 22,0 | 32,0 | 22,3 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 706,6 | 741,7 | 706,6 |
| bl2 | 706,6 | 746,9 | 706,6 |
| 380ct1f1 | 647,3 | 666,2 | 647,3 |
| 380ct1f2 | 647,3 | 666,2 | 647,3 |
| 380ct1f3 | 666,9 | 688,7 | 666,9 |
| 380ct2f1 | 647,3 | 666,2 | 647,3 |
| 380ct2f2 | 647,3 | 666,2 | 647,3 |
| 380ct2f3 | 666,9 | 688,7 | 666,9 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 966,6 | 736,9 |
| bl2 | 966,6 | 739,0 |
| 380ct1f1 | 760,0 | 662,7 |
| 380ct1f2 | 760,1 | 662,8 |
| 380ct1f3 | 807,9 | 688,1 |
| 380ct2f1 | 760,0 | 662,7 |
| 380ct2f2 | 760,1 | 662,8 |
| 380ct2f3 | 807,9 | 688,1 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 1038,7 m | 2,313 - |
| Min. weight span | 645,0 m | 1,437 - |

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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 | 11,2 | 13,8 | -31,6 | 33,3 |
| bl2 | 15,0 | 10,0 | 13,8 | -31,6 | 33,3 |
| 380ct1f1 | 51,3 | 31,9 | 52,3 | -114,3 | 116,2 |
| 380ct1f2 | 51,3 | 32,7 | 52,3 | -114,3 | 116,2 |
| 380ct1f3 | 51,3 | 34,9 | 54,3 | -116,3 | 118,3 |
| 380ct2f1 | 51,3 | 34,7 | 52,3 | -114,3 | 116,2 |
| 380ct2f2 | 51,3 | 33,8 | 52,3 | -114,3 | 116,2 |
| 380ct2f3 | 51,3 | 36,9 | 54,3 | -116,3 | 118,3 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 7,2 | -15,0 | 15,0 |
| bl2 | 0,0 | -0,3 | 7,2 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | -0,9 | 31,7 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | -0,3 | 31,7 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | -0,6 | 32,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,9 | 31,7 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,3 | 31,7 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,6 | 32,6 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 4,7 | 2,9 |
| | bl2 | 4,7 | 2,9 |
| | 380ct1f1 | 18,7 | 13,8 |
| | 380ct1f2 | 18,7 | 13,8 |
| | 380ct1f3 | 19,7 | 13,8 |
| | 380ct2f1 | 18,7 | 13,8 |
| | 380ct2f2 | 18,7 | 13,8 |
| | 380ct2f3 | 19,7 | 13,8 |

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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 | 226 | 257 | 19850 | 0 | 10 |
| ULS 1a_0,9_90 | | 0 | 226 | 257 | 19850 | 0 | 10 |
| ULS 3_90 | | 0 | 126 | 345 | 11101 | 0 | 6 |
| ULS 3_0,9_90 | | 0 | 126 | 345 | 11101 | 0 | 6 |
| SLS 7 | | 0 | 0 | 206 | 0 | 0 | 0 |

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

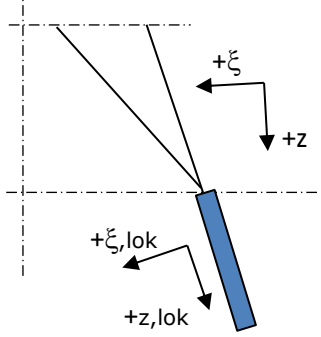
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 762 | 1202 | 50379 | 0 | 10 |
| ULS 3_90 | 0 | 287 | 1290 | 20259 | 0 | 6 |
| SLS 7 | 0 | 0 | 1106 | 0 | 0 | 0 |

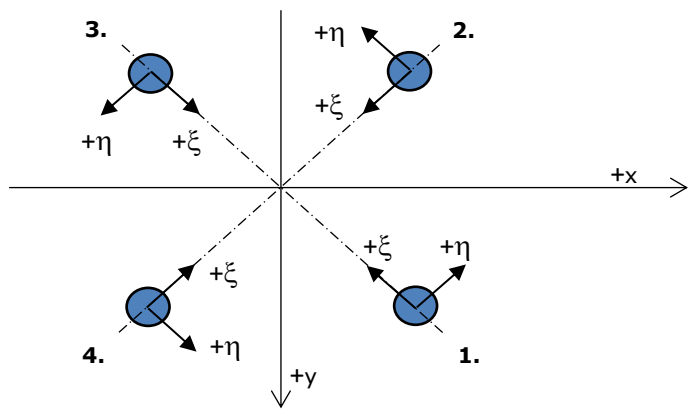
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_0,9_90 | 0 | 762 | 1041 | **50379** | 0 | 10 |
| ULS 1a_0,9_0,9_0 | 647 | 0 | 996 | 0 | **41320** | 0 |
| ULS 5a Ba 21 | 51 | 1 | 1097 | -276 | 4132 | **1052** |
| ULS 1a_0,9_0,9_45 | 503 | 616 | 1011 | **40500** | **30550** | 5 |

*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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 377 | 357 | **2070** | 14 | -519 | -7 | 2132 |
| 2 | ULS 1a_0 | 218 | -255 | **1323** | 26 | -334 | -7 | 1363 |
| 3 | ULS 7 | -61 | -61 | **318** | 0 | -87 | -8 | 327 |
| 4 | ULS 1a_135 | -377 | 358 | **2070** | -14 | -519 | -7 | 2132 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -272 | 252 | **-1523** | 14 | 371 | -6 | -1569 |
| 3 | ULS 1a_0,9_0,9_45 | 272 | 252 | **-1524** | -14 | 371 | -6 | -1570 |
| 4 | ULS 1a_0,9_0,9_0 | 114 | -151 | **-784** | -26 | 187 | -7 | -808 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_135 | 126 | 63 | 542 | **44** | -134 | 0 | 558 |
| 2 | ULS 1a_0,9_0,9_45 | -21 | -42 | 4 | **44** | -15 | -14 | 4 |
| 3 | ULS 1a_0 | 106 | 143 | -743 | **26** | 176 | -8 | -765 |
| 4 | ULS 5a Ba 21 | -25 | 46 | 164 | **15** | -51 | -10 | 169 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0 | 218 | 255 | 1323 | **-26** | -334 | -7 | 1363 |
| 2 | ULS 5a Ba 10 | 77 | -60 | 371 | **-13** | -97 | -5 | 382 |
| 3 | ULS 1a_135 | 13 | -49 | 45 | **-44** | -26 | -15 | 46 |
| 4 | ULS 1a_0,9_0,9_45 | -118 | 56 | 501 | **-44** | -123 | 1 | 517 |

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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -272 | 252 | **-1523** | **14** | 371 | -6 | -1569 |
| 3 | ULS 1a_0,9_0,9_45 | 272 | 252 | **-1524** | **-14** | 371 | -6 | -1570 |
| 4 | ULS 1a_0,9_0,9_0 | 114 | -151 | **-784** | **-26** | 187 | -7 | -808 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 53 | 53 | 277 | 0 | -75 | -7 | 285 |
| 2 | SLS 7 | 53 | -53 | 277 | 0 | -75 | -7 | 285 |
| 3 | SLS 7 | -53 | -53 | 277 | 0 | -75 | -7 | 285 |
| 4 | SLS 7 | -53 | 53 | 277 | 0 | -75 | -7 | 285 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 377 | 357 | **2070** | 14 | -519 | -7 | 2132 |
| Max. tension | ULS 1a_0,9_0,9_45 | 272 | 252 | **-1524** | -14 | 371 | -6 | -1570 |
| Max. pos. torsie | ULS 1a_0,9_0,9_45 | -21 | -42 | 4 | **44** | -15 | -14 | 4 |
| Max. neg. torsie | ULS 1a_0,9_0,9_45 | -118 | 56 | 501 | **-44** | -123 | 1 | 517 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -272 | 252 | **-1523** | **14** | 371 | -6 | -1569 |

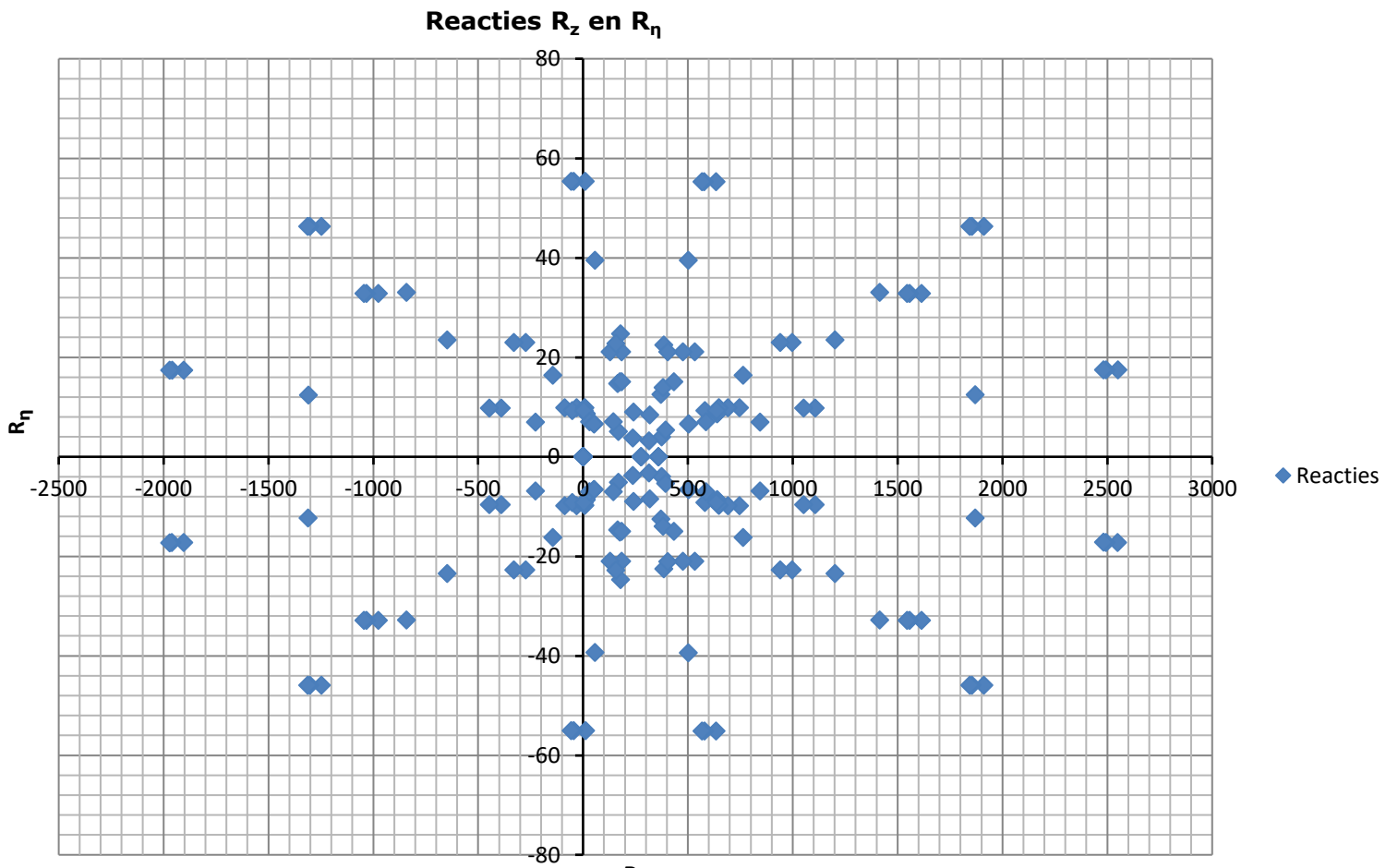
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 53 | 53 | **277** | 0 | -75 | -7 | 285 |
| 2 | SLS 1a_135 | -217 | 200 | **-1221** | 12 | 295 | -7 | -1258 |
| 3 | SLS 1a_45 | 217 | 201 | **-1221** | -12 | 295 | -7 | -1258 |
| 4 | SLS 1a_0 | 83 | -115 | **-596** | -22 | 140 | -7 | -614 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 325 | 308 | **1779** | 12 | -447 | -7 | 1833 |
| 2 | SLS 1a_0 | 190 | -221 | **1149** | 22 | -291 | -6 | 1184 |
| 3 | SLS 7 | -53 | -53 | **277** | 0 | -75 | -7 | 285 |
| 4 | SLS 1a_135 | -324 | 308 | **1779** | -12 | -447 | -7 | 1833 |

Project: KIJ-GT
Tower: S+48
Number: 84



Project: KIJ-GT
Tower: S+48
Number: 84

**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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+48
Number: 84

**Summary table - Conductor loads**

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

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

**Maximum values for back and ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -38,4 | 38,4 | 5,7 | 8,2 | 10,3 | 7,2 |
| bl2 | -38,6 | 38,7 | 4,3 | 8,2 | 10,3 | 7,2 |
| 380ct1f1 | -135,4 | 135,5 | 14,4 | 25,7 | 35,4 | 26,3 |
| 380ct1f2 | -135,4 | 135,4 | 15,4 | 25,7 | 35,4 | 26,3 |
| 380ct1f3 | -138,0 | 138,1 | 16,2 | 27,6 | 37,6 | 26,3 |
| 380ct2f1 | -135,2 | 135,1 | 17,7 | 25,7 | 35,4 | 26,3 |
| 380ct2f2 | -135,3 | 135,3 | 16,6 | 25,7 | 35,4 | 26,3 |
| 380ct2f3 | -137,9 | 137,8 | 18,6 | 27,6 | 37,6 | 26,3 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 706,6 | 743,5 | 706,6 |
| bl2 | 706,6 | 748,7 | 706,6 |
| 380ct1f1 | 647,3 | 666,8 | 647,3 |
| 380ct1f2 | 647,3 | 666,8 | 647,3 |
| 380ct1f3 | 666,9 | 689,5 | 666,9 |
| 380ct2f1 | 647,3 | 666,8 | 647,3 |
| 380ct2f2 | 647,3 | 666,8 | 647,3 |
| 380ct2f3 | 666,9 | 689,5 | 666,9 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1009,5 | 731,4 |
| bl2 | 1009,6 | 733,4 |
| 380ct1f1 | 782,7 | 660,5 |
| 380ct1f2 | 782,7 | 660,5 |
| 380ct1f3 | 835,5 | 685,9 |
| 380ct2f1 | 782,7 | 660,5 |
| 380ct2f2 | 782,7 | 660,5 |
| 380ct2f3 | 835,5 | 685,9 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 1145,9 m | 2,552 - |
| Min. weight span | 641,4 m | 1,428 - |

Project: KIJ-GT
Tower: S+48
Number: 84

**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 | 14,0 | 16,5 | -37,5 | 39,6 |
| bl2 | 15,0 | 12,5 | 16,5 | -37,5 | 39,6 |
| 380ct1f1 | 51,3 | 40,1 | 61,7 | -134,2 | 136,5 |
| 380ct1f2 | 51,3 | 41,1 | 61,7 | -134,2 | 136,5 |
| 380ct1f3 | 51,3 | 43,9 | 64,0 | -136,7 | 139,2 |
| 380ct2f1 | 51,3 | 43,4 | 61,7 | -134,2 | 136,5 |
| 380ct2f2 | 51,3 | 42,3 | 61,7 | -134,2 | 136,5 |
| 380ct2f3 | 51,3 | 46,2 | 64,0 | -136,7 | 139,2 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 7,2 | -15,0 | 15,0 |
| bl2 | 0,0 | -0,3 | 7,2 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | -0,9 | 31,7 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | -0,3 | 31,7 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | -0,6 | 32,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,9 | 31,7 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,3 | 31,7 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,6 | 32,6 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 4,7 | 2,9 |
| | bl2 | 4,7 | 2,9 |
| | 380ct1f1 | 18,7 | 13,8 |
| | 380ct1f2 | 18,7 | 13,8 |
| | 380ct1f3 | 19,8 | 13,8 |
| | 380ct2f1 | 18,7 | 13,8 |
| | 380ct2f2 | 18,7 | 13,8 |
| | 380ct2f3 | 19,8 | 13,8 |

Project: KIJ-GT
Tower: S+48
Number: 84

**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 | 283 | 290 | 24886 | 0 | 12 |
| ULS 1a_0,9_90 | | 0 | 283 | 290 | 24886 | 0 | 12 |
| ULS 3_90 | | 0 | 158 | 408 | 13916 | 0 | 7 |
| ULS 3_0,9_90 | | 0 | 158 | 408 | 13916 | 0 | 7 |
| SLS 7 | | 0 | 0 | 206 | 0 | 0 | 0 |

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

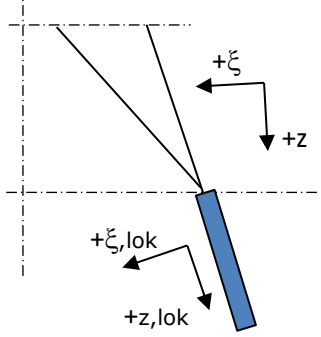
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 955 | 1325 | 63157 | 0 | 12 |
| ULS 3_90 | 0 | 360 | 1443 | 25398 | 0 | 7 |
| SLS 7 | 0 | 0 | 1106 | 0 | 0 | 0 |

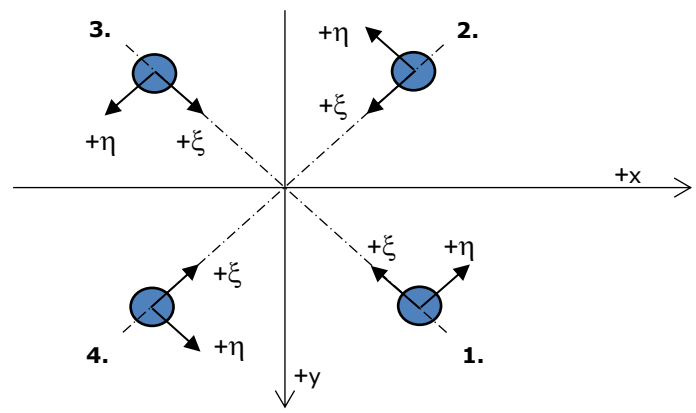
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_0,9_90 | 0 | 955 | 1058 | **63157** | 0 | 12 |
| ULS 1a_0 | 811 | 0 | 1271 | 0 | **51800** | 0 |
| ULS 5a Ba 21 | 51 | 1 | 1097 | -276 | 4132 | **1052** |
| ULS 1a_0,9_0,9_45 | 630 | 772 | 1018 | **50774** | **38299** | 6 |

*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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 464 | 439 | **2549** | 17 | -639 | -8 | 2626 |
| 2 | ULS 1a_0 | 264 | -310 | **1613** | 33 | -406 | -7 | 1662 |
| 3 | ULS 7 | -69 | -69 | **359** | 0 | -98 | -9 | 370 |
| 4 | ULS 1a_135 | -464 | 439 | **2549** | -17 | -639 | -8 | 2626 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -353 | 328 | **-1972** | 17 | 482 | -6 | -2031 |
| 3 | ULS 1a_0,9_0,9_45 | 353 | 328 | **-1972** | -17 | 482 | -6 | -2032 |
| 4 | ULS 1a_0,9_0,9_0 | 155 | -201 | **-1046** | -33 | 252 | -7 | -1078 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_135 | 149 | 71 | 634 | **55** | -155 | 2 | 653 |
| 2 | ULS 1a_0,9_0,9_45 | -38 | -40 | -57 | **55** | -2 | -16 | -59 |
| 3 | ULS 1a_0 | 142 | 188 | -977 | **33** | 233 | -9 | -1007 |
| 4 | ULS 5a Ba 21 | -25 | 46 | 164 | **15** | -51 | -10 | 169 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0,9_0 | 253 | 300 | 1557 | **-33** | -391 | -6 | 1604 |
| 2 | ULS 5a Ba 10 | 77 | -60 | 371 | **-13** | -97 | -5 | 382 |
| 3 | ULS 1a_135 | 25 | -53 | 11 | **-55** | -20 | -18 | 11 |
| 4 | ULS 1a_0,9_0,9_45 | -136 | 58 | 566 | **-55** | -137 | 3 | 583 |

Project: KIJ-GT
Tower: S+48
Number: 84

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -353 | 328 | **-1972** | **17** | 482 | -6 | -2031 |
| 3 | ULS 1a_0,9_0,9_45 | 353 | 328 | **-1972** | **-17** | 482 | -6 | -2032 |
| 4 | ULS 1a_0,9_0,9_0 | 155 | -201 | **-1046** | **-33** | 252 | -7 | -1078 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 53 | 53 | 277 | 0 | -75 | -7 | 285 |
| 2 | SLS 7 | 53 | -53 | 277 | 0 | -75 | -7 | 285 |
| 3 | SLS 7 | -53 | -53 | 277 | 0 | -75 | -7 | 285 |
| 4 | SLS 7 | -53 | 53 | 277 | 0 | -75 | -7 | 285 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 464 | 439 | **2549** | 17 | -639 | -8 | 2626 |
| Max. tension | ULS 1a_0,9_0,9_45 | 353 | 328 | **-1972** | -17 | 482 | -6 | -2032 |
| Max. pos. torsie | ULS 1a_0,9_0,9_45 | -38 | -40 | -57 | **55** | -2 | -16 | -59 |
| Max. neg. torsie | ULS 1a_0,9_0,9_45 | -136 | 58 | 566 | **-55** | -137 | 3 | 583 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -353 | 328 | **-1972** | **17** | 482 | -6 | -2031 |

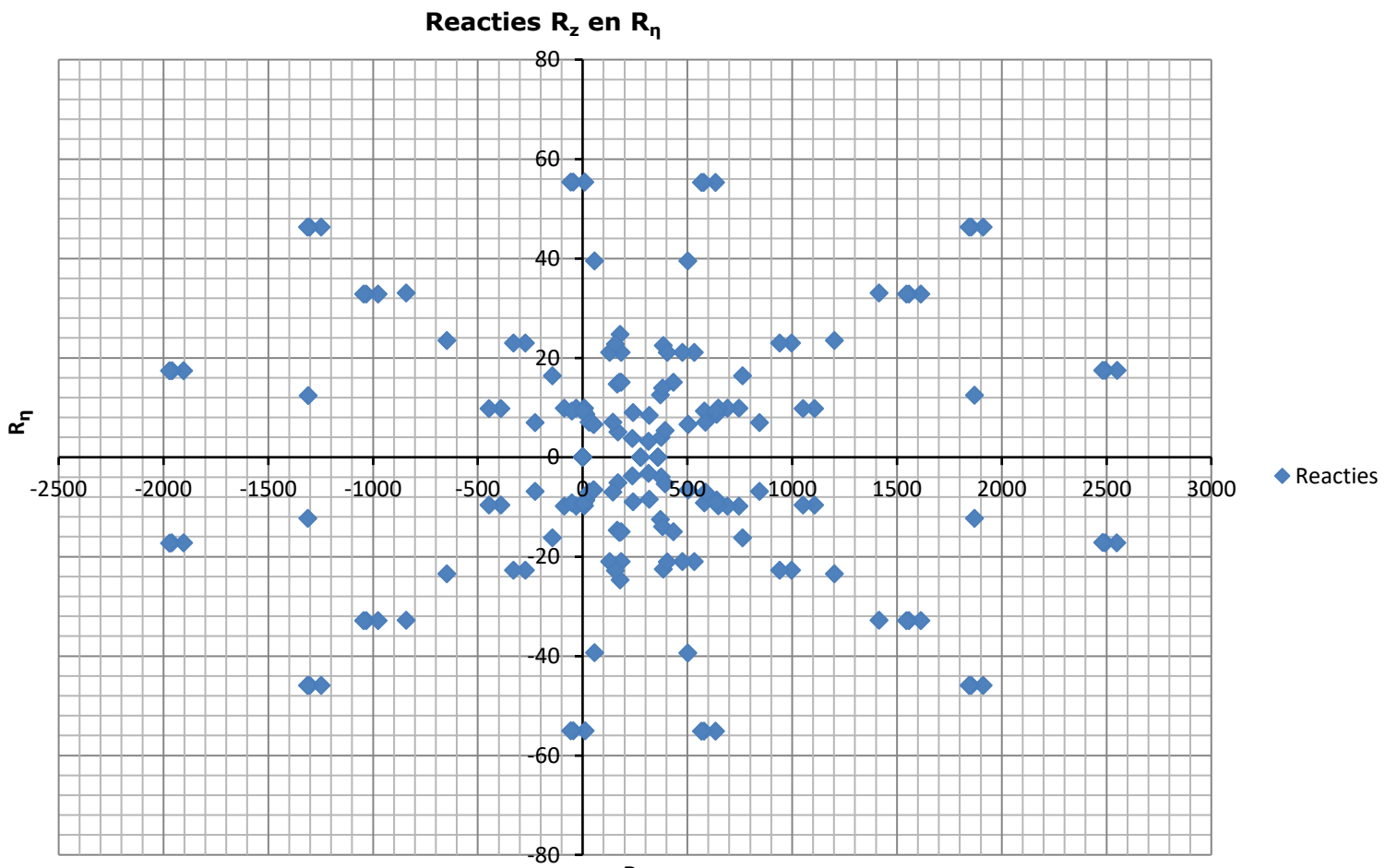
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 53 | 53 | **277** | 0 | -75 | -7 | 285 |
| 2 | SLS 1a_135 | -233 | 216 | **-1311** | 12 | 318 | -7 | -1351 |
| 3 | SLS 1a_45 | 233 | 216 | **-1311** | -12 | 318 | -7 | -1351 |
| 4 | SLS 1a_0 | 92 | -125 | **-648** | -23 | 153 | -7 | -668 |

**Maximum compression load - SLS**

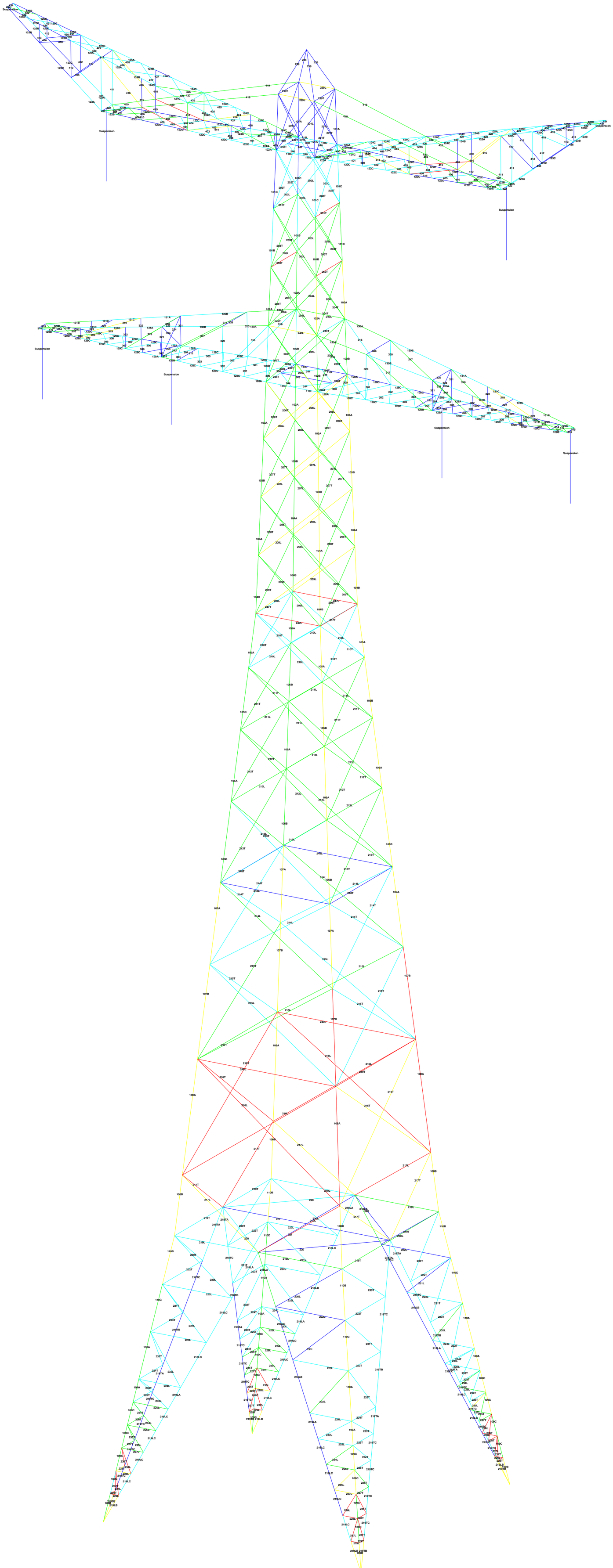
| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 341 | 323 | **1870** | 12 | -470 | -7 | 1926 |
| 2 | SLS 1a_0 | 198 | -231 | **1202** | 23 | -304 | -6 | 1238 |
| 3 | SLS 7 | -53 | -53 | **277** | 0 | -75 | -7 | 285 |
| 4 | SLS 1a_135 | -341 | 323 | **1870** | -12 | -470 | -7 | 1926 |

Project: KIJ-GT
Tower: S+48
Number: 84



# APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV - Project "G+40 (hs) (4)"
Tower Version 16.05, 21.02.17 donderdag 2 juli 2020
Uniformed geometry displayed



DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 2-7-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+48**
**84**

| 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 | 150x150x10 | S235 | 8M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-70.6** | ULS 5a Ba 22 | 550.5 | 669.3 | 1036.8 | 0.13 | | **0.0** | | 624.7 | 669.3 | 974.8 | 0.00 | |
| 101C | Leg vierde tussenstuk | 150x150x10 | S235 | | 0.50 | 0.50 | 0.50 | 70 | **-171.7** | ULS 1a_45 | 550.5 | 0.0 | 0.0 | 0.31 | | **84.3** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.12 | |
| 101B | Leg vierde tussenstuk | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 73 | **-320.6** | ULS 1a_45 | 539.5 | 508.3 | 777.6 | 0.63 | | **231.9** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.46 | |
| 102A | Leg vierde tussenstuk | 150x150x14 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 74 | **-441.2** | ULS 1a_45 | 735.2 | 508.3 | 1088.6 | 0.87 | | **344.6** | ULS 1a_0,9_0,9_45 | 851.7 | 508.3 | 930.5 | 0.68 | |
| 102B | Leg vierde tussenstuk | 150x150x14 | S235 | 10M24-5.6t | 0.26 | 0.26 | 0.26 | 35 | **-590.3** | ULS 1a_45 | 895.7 | 847.2 | 1814.4 | 0.70 | | **405.1** | ULS 1a_0,9_0,9_45 | 851.7 | 847.2 | 1798.9 | 0.48 | |
| 103A | Leg derde tussenstuk | 160x160x17 | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 34 | **-847.5** | ULS 1a_45 | 1165.2 | 999.7 | 2643.8 | 0.85 | | **611.2** | ULS 1a_0,9_0,9_45 | 1116.1 | 999.7 | 2259.7 | 0.61 | |
| 103B | Leg derde tussenstuk | 160x160x17 | S235 | 8M24-5.6t | 0.26 | 0.26 | 0.26 | 34 | **-1054.5** | ULS 1a_45 | 1163.0 | 1355.5 | 1762.6 | 0.91 | | **790.2** | ULS 1a_0,9_0,9_45 | 1116.1 | 1355.5 | 1506.5 | 0.71 | |
| 104A | Leg derde tussenstuk | 200x200x18 | S235 | 10M24-5.6t | 0.26 | 0.26 | 0.26 | 28 | **-1267.9** | ULS 1a_45 | 1586.2 | 1694.4 | 2332.8 | 0.80 | | **983.5** | ULS 1a_0,9_0,9_45 | 1548.5 | 1694.4 | 1993.8 | 0.64 | |
| 104B | Leg derde tussenstuk | 200x200x18 | S235 | 10M24-5.6t | 0.26 | 0.26 | 0.26 | 28 | **-1440.0** | ULS 1a_45 | 1586.2 | 1694.4 | 2332.8 | 0.91 | | **1137.7** | ULS 1a_0,9_0,9_45 | 1548.5 | 1694.4 | 2013.8 | 0.73 | |
| 105A | Leg tweede tussenstuk | 250x250x16 | S235 | 12M24-5.6t | 0.27 | 0.27 | 0.27 | 21 | **-1565.4** | ULS 1a_45 | 1841.6 | 1859.6 | 2488.3 | 0.85 | | **1247.7** | ULS 1a_0,9_0,9_45 | 1816.5 | 1859.6 | 2488.3 | 0.69 | |
| 105B | Leg tweede tussenstuk | 250x250x16 | S235 | 12M24-5.6t | 0.27 | 0.27 | 0.27 | 24 | **-1622.8** | ULS 1a_45 | 1822.7 | 1859.6 | 2488.3 | 0.89 | | **1297.1** | ULS 1a_0,9_0,9_45 | 1816.5 | 1859.6 | 2126.8 | 0.71 | |
| 106A | Leg tweede tussenstuk | 250x250x18 | S235 | 12M24-5.6t | 0.27 | 0.27 | 0.27 | 28 | **-1673.5** | ULS 1a_45 | 2012.3 | 1859.6 | 2799.4 | 0.90 | | **1336.8** | ULS 1a_0,9_0,9_45 | 2030.6 | 1859.6 | 2392.6 | 0.72 | |
| 106B | Leg tweede tussenstuk | 250x250x18 | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 30 | **-1725.5** | ULS 1a_45 | 1994.1 | 1859.6 | 2799.4 | 0.93 | | **1384.1** | ULS 1a_0,9_0,9_45 | 2030.6 | 1859.6 | 2799.4 | 0.74 | |
| 107A | Leg eerste tussenstuk | 250x250x20 | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 31 | **-1808.9** | ULS 1a_45 | 2202.2 | 1859.6 | 3110.4 | 0.97 | | **1449.8** | ULS 1a_0,9_0,9_45 | 2244.7 | 1859.6 | 3110.4 | 0.78 | |
| 107B | Leg eerste tussenstuk | 250x250x20 | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 36 | **-1860.4** | ULS 1a_45 | 2163.5 | 1859.6 | 3110.4 | 1.00 | afschuiving | **1491.6** | ULS 1a_0,9_0,9_45 | 2244.7 | 1859.6 | 3110.4 | 0.80 | |
| 108A | Leg eerste tussenstuk | 250x250x24 | S235 | 12M24-5.6t | 0.27 | 0.27 | 0.27 | 45 | **-2017.0** | ULS 1a_45 | 2463.6 | 1859.6 | 3732.5 | 1.08 | afschuiving | **1648.7** | ULS 1a_0,9_0,9_45 | 2655.2 | 1859.6 | 3732.5 | 0.89 | |
| 108B | Leg eerste tussenstuk | 250x250x24 | S235 | 14M24-5.6t | 0.53 | 0.53 | 0.53 | 47 | **-1994.4** | ULS 1a_45 | 2449.0 | 2100.4 | 4354.6 | 0.95 | | **1583.5** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.75 | |
| 109A | Leg broekstuk main member 1 | 250x250x24 | S235 | 14M24-5.6t | 1.00 | 1.00 | 1.00 | 34 | **-2032.2** | ULS 1a_45 | 2582.6 | 2100.4 | 4354.6 | 0.97 | | **1525.6** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.73 | |
| 109C | Leg broekstuk main member 1 | 250x250x24 | S235 | | 1.00 | 1.00 | 1.00 | 34 | **-2015.6** | ULS 1a_45 | 2582.6 | 0.0 | 0.0 | 0.78 | | **1500.0** | ULS 1a_0,9_0,9_45 | 2700.6 | 0.0 | 0.0 | 0.56 | |
| 109B | Leg broekstuk main member 1 | 250x250x24 | S235 | 14M24-5.6t | 1.00 | 1.00 | 1.00 | 41 | **-1586.9** | ULS 1a_45 | 2506.0 | 2100.4 | 4354.6 | 0.76 | | **1174.2** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.56 | |
| 110A | Leg broekstuk main member 2 | 250x250x24 | S235 | 14M24-5.6t | 0.50 | 0.50 | 0.50 | 35 | **-2038.4** | ULS 1a_45 | 2570.6 | 2100.4 | 4354.6 | 0.97 | | **1543.9** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.74 | |
| 110C | Leg broekstuk main member 2 | 250x250x24 | S235 | | 0.50 | 0.50 | 0.50 | 35 | **-2047.9** | ULS 1a_45 | 2570.6 | 0.0 | 0.0 | 0.80 | | **1573.6** | ULS 1a_0,9_0,9_45 | 2700.6 | 0.0 | 0.0 | 0.58 | |
| 110B | Leg broekstuk main member 2 | 250x250x24 | S235 | 14M24-5.6t | 0.50 | 0.50 | 0.50 | 35 | **-2047.2** | ULS 1a_45 | 2563.7 | 2100.4 | 4354.6 | 0.97 | | **1591.0** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.76 | |
| 201L | Diagonalen bovenstuk | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 111 | **-41.5** | ULS 5a Ba 22 | 267.5 | 169.4 | 259.2 | 0.24 | | **31.1** | ULS 1a_45 | 278.4 | 169.4 | 221.5 | 0.18 | |
| 201T | Diagonalen bovenstuk | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 111 | **-27.1** | ULS 5a Ba 22 | 267.5 | 169.4 | 259.2 | 0.16 | | **6.5** | ULS 5a Ba 22 | 278.4 | 169.4 | 221.5 | 0.04 | |
| 202L | Diagonalen vierde tussenstuk | 120x120x10 | S235 | 3M24-5.6t | 0.53 | 0.53 | 0.53 | 117 | **-110.7** | ULS 5a Ba 12 | 254.4 | 254.2 | 388.8 | 0.44 | | **115.8** | ULS 5a Ba 22 | 324.0 | 254.2 | 332.3 | 0.46 | |
| 202T | Diagonalen vierde tussenstuk | 120x120x10 | S235 | 3M24-5.6t | 0.53 | 0.53 | 0.53 | 117 | **-123.1** | ULS 5a Ba 12 | 254.4 | 254.2 | 388.8 | 0.48 | | **123.3** | ULS 5a Ba 22 | 324.0 | 254.2 | 332.3 | 0.49 | |
| 203L | Diagonalen vierde tussenstuk | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 121 | **-103.3** | ULS 5a Ba 22 | 246.5 | 169.4 | 259.2 | 0.61 | | **96.9** | ULS 5a Ba 12 | 278.4 | 169.4 | 221.5 | 0.57 | |
| 203T | Diagonalen vierde tussenstuk | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 121 | **-110.7** | ULS 5a Ba 12 | 246.5 | 169.4 | 259.2 | 0.65 | | **106.9** | ULS 5a Ba 22 | 278.4 | 169.4 | 221.5 | 0.63 | |
| 204L | Diagonalen vierde tussenstuk | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-86.1** | ULS 5a Ba 12 | 239.0 | 169.4 | 259.2 | 0.51 | | **92.4** | ULS 5a Ba 22 | 278.4 | 169.4 | 221.5 | 0.55 | |
| 204T | Diagonalen vierde tussenstuk | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-101.8** | ULS 5a Ba 12 | 239.0 | 169.4 | 259.2 | 0.60 | | **92.2** | ULS 5a Ba 22 | 278.4 | 169.4 | 221.5 | 0.54 | |
| 205L | Diagonalen vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 81 | **-94.4** | ULS 1a_135 | 224.3 | 169.4 | 207.4 | 0.56 | | **87.6** | ULS 1a_0,9_45 | 138.1 | 169.4 | 172.2 | 0.63 | |
| 205T | Diagonalen vierde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 81 | **-94.7** | ULS 1a_45 | 224.3 | 169.4 | 207.4 | 0.56 | | **73.5** | ULS 5a Ba 22 | 138.1 | 169.4 | 172.2 | 0.53 | |
| 206L | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 84 | **-129.4** | ULS 1a_90 | 219.0 | 169.4 | 207.4 | 0.76 | | **117.8** | ULS 1a_0,9_0,9_90 | 138.1 | 169.4 | 172.2 | 0.85 | |
| 206T | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 84 | **-105.3** | ULS 5a Ba 10 | 219.0 | 169.4 | 207.4 | 0.62 | | **108.1** | ULS 5a Ba 21 | 138.1 | 169.4 | 172.2 | 0.78 | |
| 207L | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 87 | **-113.8** | ULS 1a_0,9_0,9_90 | 213.8 | 169.4 | 207.4 | 0.67 | | **120.5** | ULS 1a_90 | 138.1 | 169.4 | 172.2 | 0.87 | |
| 207T | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 87 | **-100.0** | ULS 5a Ba 21 | 213.8 | 169.4 | 207.4 | 0.59 | | **97.8** | ULS 5a Ba 10 | 138.1 | 169.4 | 172.2 | 0.71 | |
| 208L | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 90 | **-116.9** | ULS 1a_90 | 209.3 | 169.4 | 207.4 | 0.69 | | **110.6** | ULS 1a_0,9_0,9_90 | 138.1 | 169.4 | 172.2 | 0.80 | |
| 208T | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 90 | **-90.3** | ULS 5a Ba 10 | 209.3 | 169.4 | 207.4 | 0.53 | | **92.0** | ULS 5a Ba 10 | 138.1 | 169.4 | 172.2 | 0.67 | |
| 209L | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 92 | **-107.7** | ULS 1a_90 | 204.9 | 169.4 | 207.4 | 0.64 | | **108.6** | ULS 1a_90 | 134.0 | 169.4 | 159.5 | 0.81 | |
| 209T | Diagonalen derde tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 92 | **-86.0** | ULS 5a Ba 10 | 204.9 | 169.4 | 207.4 | 0.51 | | **83.0** | ULS 5a Ba 21 | 134.0 | 169.4 | 159.5 | 0.62 | |
| 210L | Diagonalen tweede tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 95 | **-65.6** | ULS 5a Ba 21 | 200.5 | 169.4 | 207.4 | 0.39 | | **63.6** | ULS 5a Ba 21 | 185.7 | 169.4 | 177.2 | 0.38 | |
| 210T | Diagonalen tweede tussenstuk | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 95 | **-67.9** | ULS 5a Ba 10 | 200.5 | 169.4 | 207.4 | 0.40 | | **65.4** | ULS 5a Ba 21 | 185.7 | 169.4 | 177.2 | 0.39 | |
| 211L | Diagonalen tweede tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 109 | **-56.9** | ULS 5a Ba 21 | 117.6 | 84.7 | 103.7 | 0.67 | | **56.7** | ULS 5a Ba 21 | 124.4 | 84.7 | 88.6 | 0.67 | |
| 211T | Diagonalen tweede tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 109 | **-58.8** | ULS 5a Ba 21 | 117.6 | 84.7 | 103.7 | 0.69 | | **58.4** | ULS 5a Ba 10 | 124.4 | 84.7 | 88.6 | 0.69 | |
| 212L | Diagonalen tweede tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 124 | **-50.5** | ULS 5a Ba 21 | 103.9 | 84.7 | 103.7 | 0.60 | | **49.3** | ULS 5a Ba 21 | 124.4 | 84.7 | 88.6 | 0.58 | |
| 212T | Diagonalen tweede tussenstuk | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 124 | **-51.7** | ULS 5a Ba 10 | 103.9 | 84.7 | 103.7 | 0.61 | | **51.2** | ULS 5a Ba 21 | 124.4 | 84.7 | 88.6 | 0.60 | |
| 213L | Diagonalen tweede tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 0.54 | 0.27 | 0.27 | 156 | **-44.0** | ULS 5a Ba 21 | 108.6 | 84.7 | 129.6 | 0.52 | | **43.4** | ULS 5a Ba 21 | 155.5 | 84.7 | 110.8 | 0.51 | |
| 213T | Diagonalen tweede tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 0.54 | 0.27 | 0.27 | 156 | **-46.1** | ULS 5a Ba 21 | 108.6 | 84.7 | 129.6 | 0.54 | | **44.1** | ULS 5a Ba 10 | 155.5 | 84.7 | 110.8 | 0.52 | |
| 214L | Diagonalen eerste tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 0.52 | 0.26 | 0.26 | 164 | **-46.3** | ULS 1a_90 | 102.9 | 84.7 | 129.6 | 0.55 | | **36.5** | ULS 5a Ba 21 | 155.5 | 84.7 | 110.8 | 0.43 | |
| 214T | Diagonalen eerste tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 0.52 | 0.26 | 0.26 | 164 | **-40.5** | ULS 1a_135 | 102.9 | 84.7 | 129.6 | 0.48 | | **38.7** | ULS 5a Ba 21 | 155.5 | 84.7 | 110.8 | 0.46 | |
| 215L | Diagonalen eerste tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 0.52 | 0.26 | 0.26 | 186 | **-41.9** | ULS 1a_135 | 89.0 | 84.7 | 129.6 | 0.49 | | **45.7** | ULS 1a_90 | 155.5 | 84.7 | 110.8 | 0.54 | |
| 215T | Diagonalen eerste tussenstuk | 120x80x10 | S235 | 1M24-5.6t | 0.52 | 0.26 | 0.26 | 186 | **-39.6** | ULS 1a_45 | 89.0 | 84.7 | 129.6 | 0.47 | | **43.4** | ULS 1a_0,9_0,9_135 | 155.5 | 84.7 | 110.8 | 0.51 | |
| 216L | Diagonalen eerste tussenstuk | 120x120x10 | S235 | 1M24-5.6t | 1.00 | 0.27 | 0.27 | 385 | **-74.0** | ULS 1a_0 | 33.4 | 84.7 | 129.6 | 2.22 | knik | **82.5** | ULS 1a_135 | 270.7 | 84.7 | 110.8 | 0.97 | |
| 216T | Diagonalen eerste tussenstuk | 120x120x10 | S235 | 1M24-5.6t | 1.00 | 0.27 | 0.27 | 385 | **-81.6** | ULS 1a_90 | 32.9 | 84.7 | 129.6 | 2.48 | knik | **82.4** | ULS 1a_45 | 270.7 | 84.7 | 110.8 | 0.97 | |
| 217L | Diagonalen eerste tussenstuk | 120x120x10 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 204 | **-80.2** | ULS 1a_135 | 83.8 | 84.7 | 129.6 | 0.96 | | **100.7** | ULS 1a_45 | 270.7 | 84.7 | 110.8 | 1.19 | afschuiving |
| 217T | Diagonalen eerste tussenstuk | 120x120x10 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 204 | **-80.2** | ULS 1a_45 | 83.8 | 84.7 | 129.6 | 0.96 | | **99.7** | ULS 1a_135 | 270.7 | 84.7 | 110.8 | 1.18 | afschuiving |
| 218LA | Diagonaal broekstuk | UNP300 | S235 | 2M24-5.6t | 5.93 | 1.00 | 1.00 | 194 | **-127.6** | ULS 1a_45 | 324.9 | 338.9 | 259.2 | 0.49 | | **146.6** | ULS 1a_90 | 584.8 | 338.9 | 221.5 | 0.66 | |
| 218LB | Diagonaal broekstuk | UNP300 | S235 | 7M24-5.6t | 5.94 | 1.00 | 1.00 | 191 | **-111.4** | ULS 1a_45 | 303.7 | 593.0 | 907.2 | 0.37 | | **132.0** | ULS 1a_90 | 1320.9 | 593.0 | 775.4 | 0.22 | |
| 218LC | Diagonaal broekstuk | UNP300 | S235 | | 5.94 | 1.00 | 1.00 | 191 | **-119.8** | ULS 1a_45 | 303.7 | 0.0 | 0.0 | 0.39 | | **140.8** | ULS 1a_90 | 1380.9 | 0.0 | 0.0 | 0.10 | |
| 219LA | Diagonaal broekstuk | UNP300 | S235 | 7M24-5.6t | 12.31 | 1.00 | 1.00 | 191 | **-102.2** | ULS 1a_45 | 303.7 | 593.0 | 907.2 | 0.34 | | **117.2** | ULS 1a_90 | 1320.9 | 593.0 | 775.4 | 0.20 | |
| 219LB | Diagonaal broekstuk | UNP300 | S235 | 2M24-5.6t | 11.36 | 1.00 | 1.00 | 216 | **-212.2** | ULS 1a_135 | 279.7 | 338.9 | 259.2 | 0.82 | | **187.2** | ULS 1a_0,9_0,9_45 | 584.8 | 338.9 | 221.5 | 0.85 | |
| 219LC | Diagonaal broekstuk | UNP300 | S235 | | 12.31 | 1.00 | 1.00 | 191 | **-99.2** | ULS 1a_45 | 303.7 | 0.0 | 0.0 | 0.33 | | **105.8** | ULS 1a_90 | 1380.9 | 0.0 | 0.0 | 0.08 | |
| 218TA | Diagonaal broekstuk | UNP300 | S235 | 2M24-5.6t | 5.93 | 1.00 | 1.00 | 194 | **-124.7** | ULS 1a_135 | 324.9 | 338.9 | 259.2 | 0.48 | | **80.4** | ULS 1a_0,9_0,9_45 | 584.8 | 338.9 | 221.5 | 0.36 | |
| 218TB | Diagonaal broekstuk | UNP300 | S235 | 7M24-5.6t | 5.94 | 1.00 | 1.00 | 191 | **-109.1** | ULS 1a_135 | 303.7 | 593.0 | 907.2 | 0.36 | | **67.3** | ULS 1a_0,9_0,9_45 | 1320.9 | 593.0 | 775.4 | 0.11 | |
| 218TC | Diagonaal broekstuk | UNP300 | S235 | | 5.94 | 1.00 | 1.00 | 191 | **-117.1** | ULS 1a_135 | 303.7 | 0.0 | 0.0 | 0.39 | | **74.4** | ULS 1a_0,9_0,9_45 | 1380.9 | 0.0 | 0.0 | 0.05 | |
| 219TA | Diagonaal broekstuk | UNP300 | S235 | 7M24-5.6t | 12.31 | 1.00 | 1.00 | 191 | **-100.4** | ULS 1a_135 | 303.7 | 593.0 | 907.2 | 0.33 | | **58.0** | ULS 1a_0,9_0,9_45 | 1320.9 | 593.0 | 775.4 | 0.10 | |
| 219TB | Diagonaal broekstuk | UNP300 | S235 | 2M24-5.6t | 11.36 | 1.00 | 1.00 | 216 | **-219.0** | ULS 1a_90 | 279.7 | 338.9 | 259.2 | 0.84 | | **190.0** | ULS 1a_0,9_0,9_135 | 584.8 | 338.9 | 221.5 | 0.86 | |
| 219TC | Diagonaal broekstuk | UNP300 | S235 | | 12.31 | 1.00 | 1.00 | 191 | **-110.8** | ULS 1a_90 | 303.7 | 0.0 | 0.0 | 0.36 | | **91.7** | ULS 1a_0,9_0,9_135 | 1380.9 | 0.0 | 0.0 | 0.07 | |
| 219L | Onderstuk in tower | 200x200x16 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-160.3** | ULS 1a_45 | 456.7 | 254.2 | 622.1 | 0.63 | | **106.2** | ULS 1a_0,9_0,9_45 | 1030.8 | 254.2 | 531.7 | 0.42 | |
| 219T | Onderstuk in tower | 200x200x16 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-160.1** | ULS 1a_45 | 456.7 | 254.2 | 622.1 | 0.63 | | **106.2** | ULS 1a_0,9_0,9_135 | 1030.8 | 254.2 | 531.7 | 0.42 | |
| 220 | Onderstuk in tower | 150x150x10 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 310 | **-15.5** | ULS 1a_135 | 68.7 | 58.8 | 108.0 | 0.26 | | **9.9** | ULS 1a_45 | 368.6 | 58.8 | 87.3 | 0.17 | |
| 221 | Onderstuk in tower | 150x100x10 | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **-2.9** | ULS 1a_90 | 59.7 | 58.8 | 108.0 | 0.05 | | **2.0** | ULS 1a_90 | 224.6 | 58.8 | 87.3 | 0.03 | |
| 222T | Knikverkorter broekstuk | 100x100x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 275 | **-20.6** | ULS 1a_0 | 43.8 | 37.7 | 69.1 | 0.55 | | **20.6** | ULS 1a_0 | 188.9 | 37.7 | 51.2 | 0.55 | |
| 223T | Knikverkorter broekstuk | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 219 | **-21.8** | ULS 1a_0 | 46.9 | 37.7 | 51.8 | 0.58 | | **21.8** | ULS 1a_0 | 141.7 | 37.7 | 38.4 | 0.58 | |
| 224T | Knikverkorter broekstuk | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 221 | **-16.5** | ULS 1a_0 | 40.4 | 37.7 | 60.5 | 0.44 | | **16.5** | ULS 1a_0 | 114.9 | 37.7 | 44.8 | 0.44 | |
| 225T | Knikverkorter broekstuk | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-16.6** | ULS 1a_0 | 35.5 | 37.7 | 60.5 | 0.47 | | **16.6** | ULS 1a_0 | 94.8 | 37.7 | 44.8 | 0.44 | |
| 226T | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-18.6** | ULS 1a_0,9_0,9_45 | 34.3 | 37.7 | 51.8 | 0.54 | | **17.2** | ULS 1a_0,9_135 | 72.6 | 37.7 | 38.4 | 0.46 | |
| 227T | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 144 | **-24.0** | ULS 1a_0,9_0,9_45 | 48.4 | 37.7 | 51.8 | 0.64 | | **26.8** | ULS 1a_135 | 72.6 | 37.7 | 38.4 | 0.71 | |
| 228T | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-36.2** | ULS 1a_0,9_0,9_45 | 70.3 | 37.7 | 51.8 | 0.96 | | **49.9** | ULS 1a_135 | 72.6 | 37.7 | 38.4 | 1.32 | afschuiving, stuik |
| 229T | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 55 | **-50.9** | ULS 1a_0,9_0,9_45 | 90.6 | 37.7 | 51.8 | 1.35 | afschuiving | **77.7** | ULS 1a_135 | 72.6 | 37.7 | 38.4 | 2.06 | afschuiving, nettodsn., |
| 222L | Knikverkorter broekstuk | 100x100x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 275 | **-20.6** | ULS 1a_0 | 43.8 | 37.7 | 69.1 | 0.55 | | **20.6** | ULS 1a_0 | 188.9 | 37.7 | 51.2 | 0.55 | |
| 223L | Knikverkorter broekstuk | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 219 | **-21.8** | ULS 1a_0 | 46.9 | 37.7 | 51.8 | 0.58 | | **21.8** | ULS 1a_0 | 141.7 | 37.7 | 38.4 | 0.58 | |
| 224L | Knikverkorter broekstuk | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 221 | **-16.5** | ULS 1a_90 | 40.4 | 37.7 | 60.5 | 0.44 | | **13.4** | ULS 1a_0,9_90 | 114.9 | 37.7 | 44.8 | 0.35 | |
| 225L | Knikverkorter broekstuk | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-18.8** | ULS 1a_90 | 35.5 | 37.7 | 60.5 | 0.53 | | **15.8** | ULS 1a_90 | 94.8 | 37.7 | 44.8 | 0.42 | |
| 226L | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-21.1** | ULS 1a_90 | 34.3 | 37.7 | 51.8 | 0.62 | | **20.6** | ULS 1a_90 | 72.6 | 37.7 | 38.4 | 0.55 | |
| 227L | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 144 | **-26.0** | ULS 1a_90 | 48.4 | 37.7 | 51.8 | 0.69 | | **28.3** | ULS 1a_90 | 72.6 | 37.7 | 38.4 | 0.75 | |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 2-7-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+48**
**84**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 228L | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-36.7** | ULS 1a_0,9_0,9_135 | 70.3 | 37.7 | 51.8 | 0.97 | | **50.1** | ULS 1a_45 | 72.6 | 37.7 | 38.4 | 1.33 | afschuiving, stuik |
| 229L | Knikverkorter broekstuk | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 55 | **-51.5** | ULS 1a_0,9_0,9_135 | 90.6 | 37.7 | 51.8 | 1.37 | afschuiving | **78.1** | ULS 1a_45 | 72.6 | 37.7 | 38.4 | 2.07 | afschuiving, nettodsn., |
| 230T | Diagonaal tussen knikverkorters broekst | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 193 | **-7.5** | ULS 1a_0,9_0 | 45.6 | 37.7 | 51.8 | 0.20 | | **14.0** | ULS 1a_45 | 141.7 | 37.7 | 38.4 | 0.37 | |
| 231T | Diagonaal tussen knikverkorters broekst | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 220 | **-7.0** | ULS 1a_0,9_135 | 33.3 | 37.7 | 60.5 | 0.21 | | **17.7** | ULS 1a_135 | 114.9 | 37.7 | 44.8 | 0.47 | |
| 232T | Diagonaal tussen knikverkorters broekst | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 219 | **-11.8** | ULS 1a_0,9_0 | 28.6 | 37.7 | 60.5 | 0.41 | | **17.2** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.46 | |
| 233T | Diagonaal tussen knikverkorters broekst | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-15.6** | ULS 1a_0 | 38.5 | 37.7 | 60.5 | 0.41 | | **15.6** | ULS 1a_0 | 104.8 | 37.7 | 44.8 | 0.41 | |
| 234T | Diagonaal tussen knikverkorters broekst | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 200 | **-15.5** | ULS 1a_0,9_135 | 39.7 | 37.7 | 60.5 | 0.41 | | **18.0** | ULS 1a_0,9_0,9_45 | 94.8 | 37.7 | 44.8 | 0.48 | |
| 235T | Diagonaal tussen knikverkorters broekst | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 183 | **-24.0** | ULS 1a_135 | 35.5 | 37.7 | 51.8 | 0.68 | | **22.0** | ULS 1a_0,9_0,9_45 | 72.6 | 37.7 | 38.4 | 0.58 | |
| 236T | Diagonaal tussen knikverkorters broekst | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 158 | **-51.5** | ULS 1a_135 | 43.1 | 37.7 | 51.8 | 1.37 | knik, afschuiving | **38.4** | ULS 1a_0,9_0,9_45 | 72.6 | 37.7 | 38.4 | 1.02 | afschuiving, stuik |
| 237T | Diagonaal tussen knikverkorters broekst | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 142 | **-145.2** | ULS 1a_135 | 49.0 | 37.7 | 51.8 | 3.85 | knik, afschuiving, stuik | **99.7** | ULS 1a_0,9_0,9_45 | 72.6 | 37.7 | 38.4 | 2.65 | afschuiving, nettodsn., |
| 230L | Diagonaal tussen knikverkorters broekst | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 193 | **-9.2** | ULS 1a_0,9_90 | 45.6 | 37.7 | 51.8 | 0.25 | | **14.4** | ULS 1a_45 | 141.7 | 37.7 | 38.4 | 0.38 | |
| 231L | Diagonaal tussen knikverkorters broekst | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 220 | **-7.3** | ULS 1a_0,9_45 | 33.3 | 37.7 | 60.5 | 0.22 | | **18.2** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.48 | |
| 232L | Diagonaal tussen knikverkorters broekst | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 219 | **-14.8** | ULS 1a_0,9_90 | 28.6 | 37.7 | 60.5 | 0.52 | | **17.1** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.45 | |
| 233L | Diagonaal tussen knikverkorters broekst | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-13.6** | ULS 1a_90 | 38.5 | 37.7 | 60.5 | 0.36 | | **15.6** | ULS 1a_90 | 104.8 | 37.7 | 44.8 | 0.41 | |
| 234L | Diagonaal tussen knikverkorters broekst | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 200 | **-20.1** | ULS 1a_90 | 39.7 | 37.7 | 60.5 | 0.53 | | **20.7** | ULS 1a_90 | 94.8 | 37.7 | 44.8 | 0.55 | |
| 235L | Diagonaal tussen knikverkorters broekst | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 183 | **-27.3** | ULS 1a_90 | 35.5 | 37.7 | 51.8 | 0.77 | | **25.1** | ULS 1a_90 | 72.6 | 37.7 | 38.4 | 0.67 | |
| 236L | Diagonaal tussen knikverkorters broekst | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 158 | **-51.9** | ULS 1a_45 | 43.1 | 37.7 | 51.8 | 1.38 | knik, afschuiving, stuik | **40.8** | ULS 1a_90 | 72.6 | 37.7 | 38.4 | 1.08 | afschuiving, stuik |
| 237L | Diagonaal tussen knikverkorters broekst | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 142 | **-146.0** | ULS 1a_45 | 49.0 | 37.7 | 51.8 | 3.87 | knik, afschuiving, stuik | **100.8** | ULS 1a_0,9_0,9_135 | 72.6 | 37.7 | 38.4 | 2.68 | afschuiving, nettodsn., |
| 238 | Top | 100x100x6 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 182 | **-15.6** | ULS 5a Ba 22 | 75.9 | 75.4 | 103.7 | 0.21 | | **15.3** | ULS 5a Ba 22 | 144.1 | 75.4 | 76.8 | 0.20 | |
| 239L | | 120x120x8 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 118 | **0.0** | | 204.9 | 338.9 | 414.7 | 0.00 | | **200.2** | ULS 3_90 | 263.0 | 338.9 | 354.5 | 0.76 | |
| 239T | | 70x70x7 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-2.5** | ULS 1a_0,9_0,9_90 | 51.4 | 254.2 | 272.2 | 0.05 | | **4.7** | ULS 1a_90 | 119.2 | 254.2 | 192.5 | 0.04 | |
| 240 | Tweede dwarsarm in tower | 100x100x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 108 | **-64.0** | ULS 5a Ba 12 | 182.9 | 169.4 | 207.4 | 0.38 | | **64.9** | ULS 5a Ba 12 | 181.4 | 169.4 | 177.2 | 0.38 | |
| 241 | Tweede dwarsarm in tower | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 309 | **-1.4** | ULS 3_90 | 11.3 | 37.7 | 43.2 | 0.12 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 118L | Tweede dwarsarm in tower | 160x160x15 | S235 | 11M24-5.6t | 1.00 | 2.00 | 1.00 | 61 | **-340.3** | ULS 1a_0 | 926.7 | 924.2 | 2138.4 | 0.37 | | **62.6** | ULS 1a_0,9_0,9_0 | 1008.5 | 924.2 | 1644.9 | 0.07 | |
| 242T | Tweede dwarsarm in tower | 100x100x8 | S235 | 4M24-5.6t | 1.00 | 2.00 | 1.00 | 98 | **-35.7** | ULS 5a Ba 22 | 188.3 | 338.9 | 414.7 | 0.19 | | **74.3** | ULS 5a Ba 22 | 293.9 | 338.9 | 354.5 | 0.25 | |
| 243L | | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 160 | **0.0** | | 178.9 | 338.9 | 518.4 | 0.00 | | **243.2** | ULS 3_0 | 324.0 | 338.9 | 443.1 | 0.75 | |
| 243T | | 100x100x8 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 192 | **-57.7** | ULS 1a_0,9_90 | 93.4 | 254.2 | 311.0 | 0.62 | | **65.1** | ULS 1a_90 | 223.0 | 254.2 | 265.8 | 0.29 | |
| 244 | Eerste dwarsarm in tower | 120x120x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 119 | **-71.4** | ULS 5a Ba 10 | 202.8 | 169.4 | 207.4 | 0.42 | | **72.5** | ULS 5a Ba 10 | 226.0 | 169.4 | 177.2 | 0.43 | |
| 245 | Eerste dwarsarm in tower | 60x60x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 342 | **-1.5** | ULS 3_90 | 13.8 | 58.8 | 64.8 | 0.11 | | **0.0** | | 65.7 | 58.8 | 44.4 | 0.00 | |
| 119L | Eerste dwarsarm in tower | 180x180x15 | S235 | 12M24-5.6t | 2.00 | 1.00 | 1.00 | 73 | **-288.3** | ULS 5a Ba 10 | 959.5 | 999.7 | 2332.8 | 0.30 | | **16.3** | ULS 5a Ba 10 | 1144.0 | 999.7 | 1993.8 | 0.02 | |
| 246T | Eerste dwarsarm in tower | 100x100x8 | S235 | 4M24-5.6t | 2.00 | 1.00 | 1.00 | 131 | **-35.9** | ULS 5a Ba 21 | 143.1 | 338.9 | 414.7 | 0.25 | | **72.3** | ULS 5a Ba 21 | 293.9 | 338.9 | 354.5 | 0.25 | |
| 247L | | 80x80x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 321 | **-38.6** | ULS 1a_0 | 27.3 | 84.7 | 103.7 | 1.42 | knik | **21.3** | ULS 1a_0,9_0,9_0 | 124.4 | 84.7 | 88.6 | 0.25 | |
| 247T | | 80x80x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 321 | **-46.0** | ULS 1a_90 | 27.3 | 84.7 | 103.7 | 1.69 | knik | **28.5** | ULS 1a_0,9_0,9_90 | 124.4 | 84.7 | 88.6 | 0.34 | |
| 248L | | 100x100x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 432 | **-2.6** | ULS 1a_0 | 20.9 | 84.7 | 103.7 | 0.13 | | **4.7** | ULS 1a_90 | 170.5 | 84.7 | 88.6 | 0.06 | |
| 248T | | 100x100x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 432 | **-3.8** | ULS 1a_90 | 20.9 | 84.7 | 103.7 | 0.18 | | **1.5** | ULS 1a_45 | 170.5 | 84.7 | 88.6 | 0.02 | |
| 249L | | 100x100x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 547 | **-36.0** | ULS 1a_0 | 13.8 | 84.7 | 103.7 | 2.61 | knik | **47.7** | ULS 1a_0 | 170.5 | 84.7 | 88.6 | 0.56 | |
| 249T | | 100x100x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 547 | **-46.2** | ULS 1a_90 | 13.8 | 84.7 | 103.7 | 3.35 | knik | **52.0** | ULS 1a_90 | 170.5 | 84.7 | 88.6 | 0.61 | |
| 250T | Horizontal side | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 258 | **-38.0** | ULS 1a_0,9_0,9_90 | 29.4 | 37.7 | 60.5 | 1.29 | knik, afschuiving | **64.9** | ULS 1a_90 | 104.8 | 37.7 | 59.7 | 1.72 | afschuiving, stuik |
| 251T | Horizontal side | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 239 | **-24.5** | ULS 1a_0,9_0,9_90 | 33.0 | 37.7 | 60.5 | 0.74 | | **51.9** | ULS 1a_90 | 104.8 | 37.7 | 59.7 | 1.38 | afschuiving |
| 400 | Tweede DWSRM - CD under 1 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 145 | **-14.0** | ULS 5a Ba 22 | 60.5 | 58.8 | 75.6 | 0.24 | | **13.0** | ULS 5a Ba 12 | 76.6 | 58.8 | 51.8 | 0.25 | |
| 401 | Tweede DWSRM - CD under 2 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 135 | **-16.1** | ULS 5a Ba 12 | 65.4 | 58.8 | 75.6 | 0.27 | | **16.8** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.32 | |
| 402 | Tweede DWSRM - CD under 3 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 128 | **-17.9** | ULS 5a Ba 22 | 69.3 | 58.8 | 75.6 | 0.30 | | **17.4** | ULS 5a Ba 12 | 76.6 | 58.8 | 51.8 | 0.34 | |
| 403 | Tweede DWSRM - CD under 4 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 122 | **-19.6** | ULS 5a Ba 12 | 73.3 | 58.8 | 75.6 | 0.33 | | **20.1** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.39 | |
| 404 | Tweede DWSRM - CD under 5 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 115 | **-23.1** | ULS 5a Ba 12 | 77.4 | 58.8 | 75.6 | 0.39 | | **21.9** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.42 | |
| 405 | Tweede DWSRM - CD under 6 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 113 | **-25.5** | ULS 5a Ba 22 | 78.7 | 58.8 | 75.6 | 0.43 | | **28.6** | ULS 5a Ba 12 | 76.6 | 58.8 | 51.8 | 0.55 | |
| 406 | Tweede DWSRM - CD under 7 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 112 | **-37.3** | ULS 5a Ba 12 | 79.8 | 58.8 | 75.6 | 0.63 | | **31.5** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.61 | |
| 407 | Tweede DWSRM - CD under 8 from towe | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 81 | **-34.3** | ULS 5a Ba 12 | 101.0 | 58.8 | 75.6 | 0.58 | | **23.3** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.45 | |
| 408 | Tweede DWSRM - Front vert 1 from tow | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 104 | **0.0** | | 47.1 | 37.7 | 43.2 | 0.00 | | **2.7** | ULS 1a_135 | 37.4 | 37.7 | 22.0 | 0.12 | |
| 409 | Tweede DWSRM - Front vert 2 from tow | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 204 | **0.0** | | 21.2 | 37.7 | 43.2 | 0.00 | | **15.7** | ULS 7 | 37.4 | 37.7 | 22.0 | 0.71 | |
| 410 | Tweede DWSRM - Front vert 3 from tow | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 213 | **-3.2** | ULS 1a_90 | 22.5 | 37.7 | 43.2 | 0.14 | | **3.6** | ULS 3_135 | 37.4 | 37.7 | 22.0 | 0.16 | |
| 411 | Tweede DWSRM - Front vert 4 from tow | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 334 | **-4.7** | ULS 1a_90 | 14.3 | 37.7 | 51.8 | 0.33 | | **5.4** | ULS 4_0,9_90 | 72.6 | 37.7 | 38.4 | 0.14 | |
| 412 | Tweede DWSRM - Front vert 5 from tow | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 273 | **-3.8** | ULS 1a_45 | 13.7 | 37.7 | 43.2 | 0.27 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 413 | Tweede DWSRM - Front vert 6 from tow | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 138 | **-2.9** | ULS 1a_45 | 35.3 | 37.7 | 43.2 | 0.08 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 414 | Tweede DWSRM - Front diag 1 from tow | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **-9.8** | ULS 1a_0 | 11.8 | 37.7 | 51.8 | 0.82 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | |
| 415 | Tweede DWSRM - Front diag 2 from tow | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 356 | **-44.7** | ULS 7 | 11.2 | 37.7 | 51.8 | 3.99 | knik, afschuiving | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | |
| 416 | Tweede DWSRM - Front diag 3 from tow | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 324 | **-20.3** | ULS 7 | 20.5 | 37.7 | 60.5 | 0.99 | | **0.0** | ULS 1a_0 | 104.8 | 37.7 | 44.8 | 0.00 | |
| 417 | Tweede DWSRM - Front diag 4 from tow | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 322 | **0.0** | | 10.6 | 37.7 | 43.2 | 0.00 | | **4.5** | ULS 1a_90 | 37.4 | 37.7 | 18.4 | 0.24 | |
| 418 | Tweede DWSRM - Front diag 5 from tow | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 269 | **0.0** | | 14.1 | 37.7 | 43.2 | 0.00 | | **4.9** | ULS 1a_45 | 37.4 | 37.7 | 18.4 | 0.27 | |
| 419 | Tweede DWSRM - Main diag from tower | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 317 | **0.0** | | 65.4 | 338.9 | 518.4 | 0.00 | | **216.5** | ULS 3_90 | 324.0 | 338.9 | 443.1 | 0.67 | |
| 420 | Tweede DWSRM - Main front diag | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 144 | **0.0** | | 203.6 | 338.9 | 518.4 | 0.00 | | **198.5** | ULS 3_90 | 324.0 | 338.9 | 443.1 | 0.61 | |
| 122A | Tweede DWSRM - Main member bottom | 160x160x15 | S235 | 11M24-5.6t | 1.00 | 1.95 | 1.00 | 73 | **-303.0** | ULS 5a Ba 12 | 857.7 | 924.2 | 2138.4 | 0.35 | | **83.2** | ULS 5a Ba 22 | 1008.5 | 924.2 | 1827.7 | 0.09 | |
| 122C | Tweede DWSRM - Main member bottom | 160x160x15 | S235 | | 1.00 | 2.06 | 1.00 | 73 | **-287.1** | ULS 5a Ba 12 | 857.8 | 0.0 | 0.0 | 0.33 | | **66.4** | ULS 5a Ba 22 | 1097.7 | 0.0 | 0.0 | 0.06 | |
| 122B | Tweede DWSRM - Main member bottom | 160x160x15 | S235 | 6M24-5.6t | 1.00 | 2.71 | 1.00 | 66 | **-188.6** | ULS 3_90 | 899.0 | 488.2 | 1166.4 | 0.39 | | **0.0** | | 787.2 | 488.2 | 996.9 | 0.00 | |
| 421 | Tweede DWSRM - Horiz under 1 | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 39 | **0.0** | | 1004.9 | 117.6 | 172.8 | 0.00 | | **17.1** | ULS 3_90 | 1278.1 | 117.6 | 0.0 | 0.15 | |
| 422 | Tweede DWSRM - Horiz under 2 | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 36 | **-21.2** | ULS 5a Ba 22 | 1020.1 | 117.6 | 172.8 | 0.18 | | **30.2** | ULS 5a Ba 12 | 1278.1 | 117.6 | 0.0 | 0.26 | |
| 123A | Tweede DWSRM - Main member under r | 150x100x10 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 143 | **-30.6** | ULS 3_90 | 186.0 | 84.7 | 129.6 | 0.36 | | **0.0** | | 155.5 | 84.7 | 99.7 | 0.00 | |
| 123B | Tweede DWSRM - Main member under r | 150x100x10 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 152 | **-23.3** | ULS 5a Ba 12 | 165.4 | 84.7 | 129.6 | 0.27 | | **0.7** | ULS 5a Ba 1 | 155.5 | 84.7 | 99.7 | 0.01 | |
| 123C | Tweede DWSRM - Main member under r | 150x100x10 | S235 | | 1.00 | 1.00 | 1.00 | 150 | **-27.2** | ULS 3_90 | 189.0 | 0.0 | 0.0 | 0.14 | | **0.0** | | 571.3 | 0.0 | 0.0 | 0.00 | |
| 423 | Tweede DWSRM - CD Top 1 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 210 | **-11.6** | ULS 1a_0 | 20.4 | 37.7 | 43.2 | 0.57 | | **11.9** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.54 | |
| 424 | Tweede DWSRM - CD Top 2 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 194 | **-10.9** | ULS 1a_0,9_0 | 22.8 | 37.7 | 43.2 | 0.48 | | **10.6** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.48 | |
| 425 | Tweede DWSRM - CD Top 3 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 187 | **-9.9** | ULS 1a_0 | 24.0 | 37.7 | 43.2 | 0.41 | | **10.0** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.45 | |
| 426 | Tweede DWSRM - CD Top 4 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 182 | **-10.8** | ULS 1a_0,9_0,9_0 | 24.8 | 37.7 | 43.2 | 0.43 | | **11.1** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.50 | |
| 427 | Tweede DWSRM - CD Top 5 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 168 | **-9.9** | ULS 1a_0 | 27.7 | 37.7 | 43.2 | 0.36 | | **9.6** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.43 | |
| 428 | Tweede DWSRM - CD Top 6 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 150 | **-8.2** | ULS 1a_0,9_0,9_0 | 31.8 | 37.7 | 43.2 | 0.26 | | **8.5** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.38 | |
| 429 | Tweede DWSRM - CD Top 7 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 164 | **-9.8** | ULS 1a_0 | 28.7 | 37.7 | 43.2 | 0.34 | | **9.5** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.43 | |
| 430 | Tweede DWSRM - CD Top 8 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 123 | **-8.4** | ULS 5a Ba 1 | 40.0 | 37.7 | 43.2 | 0.22 | | **8.6** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.39 | |
| 431 | Tweede DWSRM - CD Top 9 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 111 | **-10.6** | ULS 5a Ba 1 | 44.4 | 37.7 | 43.2 | 0.28 | | **10.1** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.46 | |
| 432 | Tweede DWSRM - CD Top 10 from tower | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 117 | **-14.6** | ULS 5a Ba 1 | 42.0 | 37.7 | 43.2 | 0.39 | | **15.9** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.72 | |
| 433 | Tweede DWSRM - Horiz on top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 234 | **-5.6** | ULS 3_90 | 17.4 | 37.7 | 43.2 | 0.32 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 434 | Tweede DWSRM - Horiz at end of raised | HEB160 | S235 | 2M12-5.6t | 2.00 | 2.00 | 2.00 | 20 | **-7.8** | ULS 5a Ba 1 | 1087.1 | 40.3 | 103.7 | 0.19 | | **7.2** | ULS 5a Ba 1 | 1315.0 | 40.3 | 57.6 | 0.18 | |
| 435 | Tweede DWSRM - Horiz bracing raised 1 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 127 | **-0.2** | ULS 1a_0,9_90 | 38.6 | 37.7 | 43.2 | 0.01 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 436 | Tweede DWSRM - Horiz bracing raised 2 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 105 | **0.0** | | 46.6 | 37.7 | 43.2 | 0.00 | | **0.1** | ULS 3_90 | 37.4 | 37.7 | 22.0 | 0.00 | |
| 124A | Tweede DWSRM - Main member top 1 | 120x120x8 | S235 | 3M24-5.6t | 1.00 | 1.47 | 1.00 | 107 | **-135.2** | ULS 1a_0 | 223.0 | 254.2 | 311.0 | 0.61 | | **119.0** | ULS 1a_0,9_0 | 263.0 | 254.2 | 262.5 | 0.47 | |
| 124B | Tweede DWSRM - Main member top 1 | 120x120x8 | S235 | 4M24-5.6t | 2.04 | 2.84 | 1.00 | 91 | **-68.3** | ULS 5a Ba 1 | 242.1 | 338.9 | 414.7 | 0.28 | | **98.4** | ULS 5a Ba 1 | 379.5 | 338.9 | 354.5 | 0.29 | |
| 124C | Tweede DWSRM - Main member top 1 | 120x120x8 | S235 | | 2.00 | 3.13 | 1.00 | 101 | **-119.8** | ULS 1a_0 | 223.0 | 0.0 | 0.0 | 0.54 | | **112.8** | ULS 1a_0,9_0 | 441.8 | 0.0 | 0.0 | 0.26 | |
| 125A | Tweede DWSRM - Main member top 2 | 100x100x6 | S235 | 4M24-5.6t | 1.54 | 1.00 | 1.00 | 111 | **-59.5** | ULS 5a Ba 1 | 127.2 | 338.9 | 311.0 | 0.47 | | **89.9** | ULS 5a Ba 1 | 225.0 | 338.9 | 265.8 | 0.40 | |
| 125B | Tweede DWSRM - Main member top 2 | 100x100x6 | S235 | 2M16-5.6t | 1.00 | 1.43 | 1.00 | 95 | **-0.1** | ULS 5a Ba 1 | 154.1 | 75.4 | 103.7 | 0.00 | | **20.6** | ULS 1a_90 | 203.8 | 75.4 | 103.7 | 0.27 | |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 2-7-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+48**
**84**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 125C | Tweede DWSRM - Main member top 2 | 100x100x6 | S235 | | 1.00 | 1.00 | 1.00 | 127 | **-50.1** | ULS 5a Ba 1 | 116.8 | 0.0 | 0.0 | 0.43 | | **70.7** | ULS 5a Ba 1 | 277.3 | 0.0 | 0.0 | 0.25 | |
| 300 | Eerste DWSRM - CD under 1 from tower | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 153 | **-16.7** | ULS 5a Ba 20 | 66.2 | 84.7 | 90.7 | 0.25 | | **19.7** | ULS 5a Ba 11 | 98.8 | 84.7 | 72.5 | 0.27 | |
| 301 | Eerste DWSRM - CD under 2 from tower | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 144 | **-22.6** | ULS 5a Ba 11 | 71.6 | 84.7 | 90.7 | 0.32 | | **20.1** | ULS 5a Ba 20 | 98.8 | 84.7 | 72.5 | 0.28 | |
| 302 | Eerste DWSRM - CD under 3 from tower | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 134 | **-21.6** | ULS 5a Ba 20 | 77.3 | 84.7 | 90.7 | 0.28 | | **24.7** | ULS 5a Ba 11 | 98.8 | 84.7 | 72.5 | 0.34 | |
| 303 | Eerste DWSRM - CD under 4 from tower | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 128 | **-29.8** | ULS 5a Ba 11 | 81.6 | 84.7 | 90.7 | 0.37 | | **25.0** | ULS 5a Ba 20 | 98.8 | 84.7 | 72.5 | 0.34 | |
| 304 | Eerste DWSRM - CD under 5 from tower | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 126 | **-28.0** | ULS 5a Ba 20 | 70.6 | 58.8 | 75.6 | 0.48 | | **21.6** | ULS 5a Ba 20 | 86.7 | 58.8 | 59.5 | 0.37 | |
| 305 | Eerste DWSRM - CD under 6 from tower | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 133 | **-12.6** | ULS 5a Ba 21 | 53.0 | 58.8 | 64.8 | 0.24 | | **11.0** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.25 | |
| 306 | Eerste DWSRM - CD under 7 from tower | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 121 | **-13.2** | ULS 5a Ba 10 | 58.5 | 58.8 | 64.8 | 0.23 | | **13.9** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.31 | |
| 307 | Eerste DWSRM - CD under 8 from tower | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 112 | **-15.6** | ULS 5a Ba 21 | 63.0 | 58.8 | 64.8 | 0.26 | | **15.5** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.35 | |
| 308 | Eerste DWSRM - CD under 9 from tower | 60x60x6 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 106 | **-18.7** | ULS 5a Ba 10 | 66.5 | 58.8 | 64.8 | 0.32 | | **18.0** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.40 | |
| 309 | Eerste DWSRM - CD under 10 from towe | 60x60x6 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 98 | **-21.4** | ULS 5a Ba 21 | 71.2 | 58.8 | 64.8 | 0.36 | | **23.1** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.52 | |
| 310 | Eerste DWSRM - CD under 11 from towe | 60x60x6 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 97 | **-32.6** | ULS 5a Ba 10 | 71.8 | 58.8 | 64.8 | 0.56 | | **28.6** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.65 | |
| 311 | Eerste DWSRM - CD under 12 from towe | 60x60x6 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 77 | **-36.5** | ULS 5a Ba 21 | 81.7 | 58.8 | 64.8 | 0.62 | | **27.8** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.63 | |
| 312 | Eerste DWSRM - Horiz under 1 | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-2.2** | ULS 1a_0,9_0,9_90 | 842.3 | 117.6 | 172.8 | 0.02 | | **15.1** | ULS 1a_90 | 1278.1 | 117.6 | 0.0 | 0.13 | |
| 313 | Eerste DWSRM - Horiz under 2 | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 65 | **-20.8** | ULS 5a Ba 20 | 870.7 | 117.6 | 172.8 | 0.18 | | **30.6** | ULS 5a Ba 11 | 1278.1 | 117.6 | 0.0 | 0.26 | |
| 314 | Eerste DWSRM - Horiz under 3 | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 30 | **0.0** | | 1046.7 | 117.6 | 172.8 | 0.00 | | **14.4** | ULS 3_90 | 1278.1 | 117.6 | 0.0 | 0.12 | |
| 315 | Eerste DWSRM - Horiz under 4 | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 25 | **-23.0** | ULS 5a Ba 10 | 1067.2 | 117.6 | 172.8 | 0.20 | | **28.6** | ULS 5a Ba 21 | 1278.1 | 117.6 | 0.0 | 0.24 | |
| 316 | Eerste DWSRM - Front diag 1 | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 465 | **0.0** | | 10.2 | 117.6 | 129.6 | 0.00 | | **36.8** | ULS 3_135 | 77.4 | 117.6 | 88.7 | 0.48 | |
| 317 | Eerste DWSRM - Front diag 2 | 60x60x8 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 508 | **0.0** | | 11.4 | 117.6 | 172.8 | 0.00 | | **65.2** | ULS 3_45 | 100.5 | 117.6 | 118.3 | 0.65 | |
| 318 | Eerste DWSRM - Front diag 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 376 | **0.0** | | 8.2 | 37.7 | 43.2 | 0.00 | | **12.7** | ULS 7 | 37.4 | 37.7 | 22.0 | 0.58 | |
| 319 | Eerste DWSRM - Front diag 4 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 409 | **0.0** | | 7.1 | 37.7 | 43.2 | 0.00 | | **18.4** | ULS 3_45 | 37.4 | 37.7 | 22.0 | 0.83 | |
| 320 | Eerste DWSRM - Front vert 1 | 100x100x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 163 | **-25.0** | ULS 3_0 | 70.4 | 58.8 | 64.8 | 0.42 | | **0.0** | | 117.5 | 58.8 | 52.4 | 0.00 | |
| 321 | Eerste DWSRM - Front vert 2 | 75x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 199 | **-6.8** | ULS 1a_0 | 27.5 | 37.7 | 43.2 | 0.25 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 322 | Eerste DWSRM - Front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-5.2** | ULS 7 | 30.4 | 37.7 | 43.2 | 0.17 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 323 | Eerste DWSRM - Front vert 4 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 75 | **-2.7** | ULS 3_90 | 57.4 | 37.7 | 43.2 | 0.07 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 324 | Eerste DWSRM - Doorsnede BB CD | 50x50x5 | S235 | 1M16-5.6t | 0.50 | 0.50 | 0.50 | 172 | **-4.4** | ULS 1a_0 | 26.9 | 37.7 | 43.2 | 0.16 | | **2.0** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.09 | |
| 325 | Eerste DWSRM - Doorsnede BB Horiz | 75x50x5 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 230 | **0.0** | | 22.3 | 84.7 | 64.8 | 0.00 | | **1.1** | ULS 7 | 63.4 | 84.7 | 36.7 | 0.03 | |
| 326 | Eerste DWSRM - Horiz on top 1 | 80x80x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-0.1** | ULS 1a_90 | 53.6 | 84.7 | 103.7 | 0.00 | | **0.0** | ULS 1a_0,9_0,9_90 | 124.4 | 84.7 | 70.9 | 0.00 | |
| 327 | Eerste DWSRM - Horiz on top 2 | 75x50x5 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 161 | **-0.1** | ULS 1a_90 | 36.7 | 84.7 | 64.8 | 0.00 | | **0.0** | | 63.4 | 84.7 | 36.7 | 0.00 | |
| 128A | Eerste DWSRM - Main member lower 1 | 180x180x15 | S235 | 12M24-5.6t | 1.00 | 1.99 | 1.00 | 65 | **-340.2** | ULS 5a Ba 10 | 1008.7 | 999.7 | 2332.8 | 0.34 | | **91.0** | ULS 5a Ba 21 | 1144.0 | 999.7 | 1993.8 | 0.09 | |
| 128B | Eerste DWSRM - Main member lower 1 | 180x180x15 | S235 | 6M24-5.6t | 1.00 | 4.06 | 1.00 | 93 | **-285.5** | ULS 5a Ba 10 | 816.1 | 508.3 | 1166.4 | 0.56 | | **76.4** | ULS 5a Ba 21 | 1144.0 | 508.3 | 996.9 | 0.15 | |
| 128C | Eerste DWSRM - Main member lower 1 | 180x180x15 | S235 | | 1.00 | 2.76 | 1.00 | 89 | **-306.9** | ULS 5a Ba 10 | 843.1 | 0.0 | 0.0 | 0.36 | | **94.4** | ULS 5a Ba 21 | 1220.5 | 0.0 | 0.0 | 0.08 | |
| 129A | Eerste DWSRM - Main member lower 2 | 150x150x12 | S235 | 6M24-5.6t | 1.00 | 1.90 | 1.00 | 63 | **-235.3** | ULS 5a Ba 21 | 681.6 | 508.3 | 933.1 | 0.46 | | **101.3** | ULS 5a Ba 10 | 740.3 | 508.3 | 797.5 | 0.20 | |
| 129B | Eerste DWSRM - Main member lower 2 | 150x150x12 | S235 | 5M24-5.6t | 1.00 | 2.79 | 1.00 | 74 | **-128.6** | ULS 3_90 | 637.2 | 420.1 | 777.6 | 0.31 | | **0.0** | | 554.4 | 420.1 | 664.6 | 0.00 | |
| 129C | Eerste DWSRM - Main member lower 2 | 150x150x12 | S235 | | 1.00 | 2.11 | 1.00 | 65 | **-222.5** | ULS 5a Ba 21 | 673.5 | 0.0 | 0.0 | 0.33 | | **87.4** | ULS 5a Ba 10 | 817.8 | 0.0 | 0.0 | 0.11 | |
| 130A | Eerste DWSRM - Main member upper 1 | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 160 | **0.0** | | 178.4 | 338.9 | 518.4 | 0.00 | | **213.1** | ULS 3_90 | 324.0 | 338.9 | 443.1 | 0.66 | |
| 130B | Eerste DWSRM - Main member upper 1 | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 215 | **0.0** | | 119.5 | 338.9 | 518.4 | 0.00 | | **157.9** | ULS 3_90 | 466.6 | 338.9 | 443.1 | 0.47 | |
| 131A | Eerste DWSRM - Main member upper 2 | 120x120x8 | S235 | 4M24-5.6t | 1.00 | 1.70 | 1.00 | 139 | **0.0** | | 162.5 | 338.9 | 414.7 | 0.00 | | **148.1** | ULS 3_90 | 379.5 | 338.9 | 354.5 | 0.44 | |
| 131B | Eerste DWSRM - Main member upper 2 | 120x120x8 | S235 | 3M24-5.6t | 1.46 | 1.00 | 1.00 | 146 | **0.0** | | 161.8 | 254.2 | 311.0 | 0.00 | | **131.3** | ULS 3_90 | 263.0 | 254.2 | 265.8 | 0.52 | |

**Notes:**

**1) Groups 251T, 250T, 248L/T and 249L/T are not structural members. These members are used for support of the ladder and their unity check exceedance is not a cause for concern.**
**2) Groups 222L/T to 237L/T are redundant members in the lowest section of the tower. These members were assessed more accurately using Axis VM which showed no failures.**

DNV·GL

## Assessment of groups for strengthened mast (afkeur level)

Date 2-7-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+48**
**84**

| 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 | 150x150x10 | S235 | 8M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-70.0** | ULS 5a Ba 22 | 550.5 | 669.3 | 1036.8 | 0.13 | | **0.0** | | 624.7 | 669.3 | 974.8 | 0.00 |
| 101C | Leg vierde tussı | 150x150x10 | S235 | | 0.50 | 0.50 | 0.50 | 70 | **-184.6** | ULS 1a_45 | 550.5 | 0.0 | 0.0 | 0.34 | | **86.4** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.13 |
| 101B | Leg vierde tussı | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 73 | **-360.6** | ULS 1a_45 | 539.5 | 508.3 | 777.6 | 0.71 | | **243.8** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.48 |
| 102A | Leg vierde tussı | 150x150x14 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 74 | **-470.0** | ULS 1a_45 | 735.2 | 508.3 | 1088.6 | 0.92 | | **351.5** | ULS 1a_0,9_0,9_45 | 851.7 | 508.3 | 930.5 | 0.69 |
| 102B | Leg vierde tussı | 150x150x14 | S235 | 10M24-5.6t | 0.26 | 0.26 | 0.26 | 35 | **-598.1** | ULS 1a_45 | 895.7 | 847.2 | 1814.4 | 0.71 | | **395.4** | ULS 1a_0,9_0,9_45 | 851.7 | 847.2 | 1798.9 | 0.47 |
| 103A | Leg derde tussı | 160x160x17# | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 34 | **-855.4** | ULS 1a_45 | 1165.2 | 999.7 | 2643.8 | 0.86 | | **604.9** | ULS 1a_0,9_0,9_45 | 1116.1 | 999.7 | 2259.7 | 0.61 |
| 103B | Leg derde tussı | 160x160x17# | S235 | 8M24-5.6t | 0.26 | 0.26 | 0.26 | 34 | **-1053.9** | ULS 1a_45 | 1163.0 | 1355.5 | 1762.6 | 0.91 | | **790.9** | ULS 1a_0,9_0,9_45 | 1116.1 | 1355.5 | 1506.5 | 0.71 |
| 104A | Leg derde tussı | 200x200x18 | S235 | 10M24-5.6t | 0.26 | 0.26 | 0.26 | 28 | **-1261.3** | ULS 1a_45 | 1586.2 | 1694.4 | 2332.8 | 0.80 | | **990.2** | ULS 1a_0,9_0,9_45 | 1548.5 | 1694.4 | 1993.8 | 0.64 |
| 104B | Leg derde tussı | 200x200x18 | S235 | 10M24-5.6t | 0.26 | 0.26 | 0.26 | 28 | **-1425.1** | ULS 1a_45 | 1586.2 | 1694.4 | 2332.8 | 0.90 | | **1150.6** | ULS 1a_0,9_0,9_45 | 1548.5 | 1694.4 | 2013.8 | 0.74 |
| 105A | Leg tweede tus | 250x250x16# | S235 | 12M24-5.6t | 0.27 | 0.27 | 0.27 | 21 | **-1562.4** | ULS 1a_45 | 1841.6 | 1859.6 | 2488.3 | 0.85 | | **1262.6** | ULS 1a_0,9_0,9_45 | 1816.5 | 1859.6 | 2488.3 | 0.70 |
| 105B | Leg tweede tus | 250x250x16# | S235 | 12M24-5.6t | 0.27 | 0.27 | 0.27 | 24 | **-1612.3** | ULS 1a_45 | 1822.7 | 1859.6 | 2488.3 | 0.88 | | **1305.9** | ULS 1a_0,9_0,9_45 | 1816.5 | 1859.6 | 2126.8 | 0.72 |
| 106A | Leg tweede tus | 250x250x18# | S235 | 12M24-5.6t | 0.27 | 0.27 | 0.27 | 28 | **-1681.5** | ULS 1a_45 | 2012.3 | 1859.6 | 2799.4 | 0.90 | | **1350.1** | ULS 1a_0,9_0,9_45 | 2030.6 | 1859.6 | 2392.6 | 0.73 |
| 106B | Leg tweede tus | 250x250x18# | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 30 | **-1717.5** | ULS 1a_45 | 1994.1 | 1859.6 | 2799.4 | 0.92 | | **1385.2** | ULS 1a_0,9_0,9_45 | 2030.6 | 1859.6 | 2799.4 | 0.74 |
| 107A | Leg eerste tus | 250x250x20# | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 31 | **-1820.8** | ULS 1a_45 | 2202.2 | 1859.6 | 3110.4 | 0.98 | | **1455.6** | ULS 1a_0,9_0,9_45 | 2244.7 | 1859.6 | 3110.4 | 0.78 |
| 107B | Leg eerste tus | 250x250x20# | S235 | 12M24-5.6t | 0.26 | 0.26 | 0.26 | 36 | **-1854.1** | ULS 1a_45 | 2163.5 | 1859.6 | 3110.4 | 1.00 | | **1486.7** | ULS 1a_0,9_0,9_45 | 2244.7 | 1859.6 | 3110.4 | 0.80 |
| 108A | Leg eerste tus | 250x250x24# | S235 | **12M24-8.8t** | 0.27 | 0.27 | 0.27 | 45 | **-1989.2** | ULS 1a_45 | 2463.6 | 2975.4 | 3732.5 | 0.81 | | **1592.5** | ULS 1a_0,9_0,9_45 | 2655.2 | 2975.4 | 3732.5 | 0.60 |
| 108B | Leg eerste tus | 250x250x24# | S235 | 14M24-5.6t | 0.53 | 0.53 | 0.53 | 47 | **-2021.7** | ULS 1a_45 | 2449.0 | 2100.4 | 4354.6 | 0.96 | | **1620.0** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.77 |
| 109A | Leg broekstuk r | 250x250x24# | S235 | 14M24-5.6t | 1.00 | 1.00 | 1.00 | 34 | **-2047.9** | ULS 1a_45 | 2582.6 | 2100.4 | 4354.6 | 0.98 | | **1535.5** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.73 |
| 109C | Leg broekstuk r | 250x250x24# | S235 | | 1.00 | 1.00 | 1.00 | 34 | **-2032.2** | ULS 1a_45 | 2582.6 | 0.0 | 0.0 | 0.79 | | **1509.6** | ULS 1a_0,9_0,9_45 | 2700.6 | 0.0 | 0.0 | 0.56 |
| 109B | Leg broekstuk r | 250x250x24# | S235 | 14M24-5.6t | 1.00 | 1.00 | 1.00 | 41 | **-1613.1** | ULS 1a_45 | 2506.0 | 2100.4 | 4354.6 | 0.77 | | **1175.8** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.56 |
| 110A | Leg broekstuk r | 250x250x24# | S235 | 14M24-5.6t | 0.50 | 0.50 | 0.50 | 35 | **-2053.6** | ULS 1a_45 | 2570.6 | 2100.4 | 4354.6 | 0.98 | | **1554.0** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.74 |
| 110C | Leg broekstuk r | 250x250x24# | S235 | | 0.50 | 0.50 | 0.50 | 35 | **-2061.9** | ULS 1a_45 | 2570.6 | 0.0 | 0.0 | 0.80 | | **1582.0** | ULS 1a_0,9_0,9_45 | 2700.6 | 0.0 | 0.0 | 0.59 |
| 110B | Leg broekstuk r | 250x250x24# | S235 | 14M24-5.6t | 0.50 | 0.50 | 0.50 | 35 | **-2060.1** | ULS 1a_45 | 2563.7 | 2100.4 | 4354.6 | 0.98 | | **1601.7** | ULS 1a_0,9_0,9_45 | 2655.2 | 2100.4 | 3721.8 | 0.76 |
| 201L | Diagonalen bov | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 111 | **-41.6** | ULS 5a Ba 22 | 267.5 | 169.4 | 259.2 | 0.25 | | **31.2** | ULS 1a_0,9_45 | 278.4 | 169.4 | 221.5 | 0.18 |
| 201T | Diagonalen bov | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 111 | **-28.3** | ULS 5a Ba 22 | 267.5 | 169.4 | 259.2 | 0.17 | | **6.6** | ULS 5a Ba 22 | 278.4 | 169.4 | 221.5 | 0.04 |
| 202L | Diagonalen vier | 120x120x10 | S235 | 3M24-5.6t | 0.53 | 0.53 | 0.53 | 117 | **-110.4** | ULS 5a Ba 12 | 254.4 | 254.2 | 388.8 | 0.43 | | **115.9** | ULS 5a Ba 22 | 324.0 | 254.2 | 332.3 | 0.46 |
| 202T | Diagonalen vier | 120x120x10 | S235 | 3M24-5.6t | 0.53 | 0.53 | 0.53 | 117 | **-124.0** | ULS 5a Ba 12 | 254.4 | 254.2 | 388.8 | 0.49 | | **122.5** | ULS 5a Ba 22 | 324.0 | 254.2 | 332.3 | 0.48 |
| 203L | Diagonalen vier | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 121 | **-103.4** | ULS 5a Ba 22 | 246.5 | 169.4 | 259.2 | 0.61 | | **96.7** | ULS 5a Ba 12 | 278.4 | 169.4 | 221.5 | 0.57 |
| 203T | Diagonalen vier | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 121 | **-108.1** | ULS 5a Ba 22 | 246.5 | 169.4 | 259.2 | 0.64 | | **109.5** | ULS 5a Ba 12 | 278.4 | 169.4 | 221.5 | 0.65 |
| 204L | Diagonalen vier | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-85.9** | ULS 5a Ba 12 | 239.0 | 169.4 | 259.2 | 0.51 | | **92.5** | ULS 5a Ba 22 | 278.4 | 169.4 | 221.5 | 0.55 |
| 204T | Diagonalen vier | 120x120x10 | S235 | 2M24-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-98.1** | ULS 5a Ba 12 | 239.0 | 169.4 | 259.2 | 0.58 | | **95.9** | ULS 5a Ba 22 | 278.4 | 169.4 | 221.5 | 0.57 |
| 205L | Diagonalen vier | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 81 | **-95.8** | ULS 1a_135 | 224.3 | 169.4 | 207.4 | 0.57 | | **86.2** | ULS 1a_0,9_45 | 138.1 | 169.4 | 172.2 | 0.62 |
| 205T | Diagonalen vier | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 81 | **-98.5** | ULS 1a_45 | 224.3 | 169.4 | 207.4 | 0.58 | | **73.2** | ULS 5a Ba 22 | 138.1 | 169.4 | 172.2 | 0.53 |
| 206L | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 84 | **-128.7** | ULS 1a_90 | 219.0 | 169.4 | 207.4 | 0.76 | | **117.5** | ULS 1a_0,9_0,9_90 | 138.1 | 169.4 | 172.2 | 0.85 |
| 206T | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 84 | **-104.2** | ULS 5a Ba 10 | 219.0 | 169.4 | 207.4 | 0.62 | | **107.1** | ULS 5a Ba 21 | 138.1 | 169.4 | 172.2 | 0.78 |
| 207L | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 87 | **-113.5** | ULS 1a_0,9_0,9_90 | 213.8 | 169.4 | 207.4 | 0.67 | | **119.8** | ULS 1a_90 | 138.1 | 169.4 | 172.2 | 0.87 |
| 207T | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 87 | **-99.1** | ULS 5a Ba 21 | 213.8 | 169.4 | 207.4 | 0.58 | | **96.8** | ULS 5a Ba 10 | 138.1 | 169.4 | 172.2 | 0.70 |
| 208L | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 90 | **-116.1** | ULS 1a_90 | 209.3 | 169.4 | 207.4 | 0.69 | | **110.5** | ULS 1a_0,9_0,9_90 | 138.1 | 169.4 | 172.2 | 0.80 |
| 208T | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 90 | **-89.3** | ULS 5a Ba 10 | 209.3 | 169.4 | 207.4 | 0.53 | | **91.3** | ULS 5a Ba 10 | 138.1 | 169.4 | 172.2 | 0.66 |
| 209L | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 92 | **-108.3** | ULS 1a_90 | 204.9 | 169.4 | 207.4 | 0.64 | | **107.4** | ULS 1a_0,9_90 | 134.0 | 169.4 | 159.5 | 0.80 |
| 209T | Diagonalen den | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 92 | **-85.7** | ULS 5a Ba 10 | 204.9 | 169.4 | 207.4 | 0.51 | | **81.6** | ULS 5a Ba 21 | 134.0 | 169.4 | 159.5 | 0.61 |
| 210L | Diagonalen twe | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 95 | **-64.4** | ULS 5a Ba 21 | 200.5 | 169.4 | 207.4 | 0.38 | | **63.3** | ULS 5a Ba 21 | 185.7 | 169.4 | 177.2 | 0.37 |
| 210T | Diagonalen twe | 120x80x8 | S235 | 2M24-5.6t | 0.53 | 0.25 | 0.25 | 95 | **-67.5** | ULS 5a Ba 10 | 200.5 | 169.4 | 207.4 | 0.40 | | **67.4** | ULS 5a Ba 21 | 185.7 | 169.4 | 177.2 | 0.40 |
| 211L | Diagonalen twe | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 109 | **-56.3** | ULS 5a Ba 21 | 117.6 | 84.7 | 103.7 | 0.66 | | **56.0** | ULS 5a Ba 21 | 124.4 | 84.7 | 88.6 | 0.66 |
| 211T | Diagonalen twe | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 109 | **-60.2** | ULS 5a Ba 21 | 117.6 | 84.7 | 103.7 | 0.71 | | **58.4** | ULS 5a Ba 10 | 124.4 | 84.7 | 88.6 | 0.69 |
| 212L | Diagonalen twe | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 124 | **-49.5** | ULS 5a Ba 21 | 103.9 | 84.7 | 103.7 | 0.58 | | **49.1** | ULS 5a Ba 21 | 124.4 | 84.7 | 88.6 | 0.58 |
| 212T | Diagonalen twe | 120x80x8 | S235 | 1M24-5.6t | 0.53 | 0.25 | 0.25 | 124 | **-51.1** | ULS 5a Ba 10 | 103.9 | 84.7 | 103.7 | 0.60 | | **52.9** | ULS 5a Ba 21 | 124.4 | 84.7 | 88.6 | 0.62 |
| 213L | Diagonalen twe | 120x80x10 | S235 | 1M24-5.6t | 0.54 | 0.27 | 0.27 | 156 | **-44.3** | ULS 5a Ba 21 | 108.6 | 84.7 | 129.6 | 0.52 | | **42.1** | ULS 5a Ba 21 | 155.5 | 84.7 | 110.8 | 0.50 |
| 213T | Diagonalen twe | 120x80x10 | S235 | 1M24-5.6t | 0.54 | 0.27 | 0.27 | 156 | **-48.1** | ULS 5a Ba 10 | 108.6 | 84.7 | 129.6 | 0.57 | | **43.1** | ULS 5a Ba 10 | 155.5 | 84.7 | 110.8 | 0.51 |
| 214L | Diagonalen een | 120x80x10 | S235 | 1M24-5.6t | 0.52 | 0.26 | 0.26 | 164 | **-44.4** | ULS 1a_0,9_0,9_45 | 102.9 | 84.7 | 129.6 | 0.52 | | **43.9** | ULS 1a_135 | 155.5 | 84.7 | 110.8 | 0.52 |
| 214T | Diagonalen een | 120x80x10 | S235 | 1M24-5.6t | 0.52 | 0.26 | 0.26 | 164 | **-42.2** | ULS 1a_0,9_0,9_135 | 102.9 | 84.7 | 129.6 | 0.50 | | **41.7** | ULS 1a_45 | 155.5 | 84.7 | 110.8 | 0.49 |
| 215L | Diagonalen een | 120x80x10 | S235 | 1M24-5.6t | 0.52 | 0.26 | 0.26 | 186 | **-52.0** | ULS 1a_135 | 89.0 | 84.7 | 129.6 | 0.61 | | **47.5** | ULS 1a_0,9_0,9_45 | 155.5 | 84.7 | 110.8 | 0.56 |
| 215T | Diagonalen een | 120x80x10 | S235 | 1M24-5.6t | **1.00** | 0.26 | 0.26 | 320 | **-24.8** | ULS 1a_90 | 34.9 | 84.7 | 129.6 | 0.71 | | **45.8** | ULS 1a_0,9_0,9_135 | 155.5 | 84.7 | 110.8 | 0.54 |
| 216L | Diagonalen een | **130x130x11** | **S355** | **1M24-8.8t** | 1.00 | 0.27 | 0.27 | 355 | **-24.8** | ULS 1a_0,9_0,9_0 | 49.0 | 135.6 | 194.0 | 0.51 | | **55.7** | ULS 1a_135 | 405.3 | 135.6 | 165.8 | 0.41 |
| 216T | Diagonalen een | **130x130x11** | **S355** | **1M24-8.8t** | 1.00 | 0.27 | 0.27 | 355 | **-31.1** | ULS 1a_0,9_0,9_90 | 47.4 | 135.6 | 194.0 | 0.66 | | **54.0** | ULS 1a_45 | 405.3 | 135.6 | 165.8 | 0.40 |
| 217L | Diagonalen een | 120x120x10 | S235 | **1M24-8.8t** | 1.00 | 0.52 | 0.52 | 204 | **-59.7** | ULS 1a_135 | 83.8 | 135.6 | 129.6 | 0.71 | | **59.1** | ULS 1a_0,9_0,9_45 | 270.7 | 135.6 | 110.8 | 0.53 |
| 217T | Diagonalen een | 120x120x10 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 204 | **-58.3** | ULS 1a_45 | 83.8 | 84.7 | 129.6 | 0.70 | | **58.6** | ULS 1a_0,9_0,9_135 | 270.7 | 84.7 | 110.8 | 0.69 |
| 218LA | Diagonaal broel | UNP300 | S235 | 2M24-5.6t | 5.93 | 1.00 | 1.00 | 194 | **-131.2** | ULS 1a_90 | 324.9 | 338.9 | 259.2 | 0.51 | | **113.8** | ULS 1a_0,9_90 | 584.8 | 338.9 | 221.5 | 0.51 |
| 218LB | Diagonaal broel | UNP300 | S235 | 7M24-5.6t | 5.94 | 1.00 | 1.00 | 191 | **-111.9** | ULS 1a_90 | 303.7 | 593.0 | 907.2 | 0.37 | | **94.8** | ULS 1a_0,9_90 | 1320.9 | 593.0 | 775.4 | 0.16 |
| 218LC | Diagonaal broel | UNP300 | S235 | | 5.94 | 1.00 | 1.00 | 191 | **-120.7** | ULS 1a_90 | 303.7 | 0.0 | 0.0 | 0.40 | | **103.2** | ULS 1a_0,9_90 | 1380.9 | 0.0 | 0.0 | 0.07 |
| 219LA | Diagonaal broel | UNP300 | S235 | 7M24-5.6t | 12.31 | 1.00 | 1.00 | 191 | **-99.3** | ULS 1a_90 | 303.7 | 593.0 | 907.2 | 0.33 | | **81.8** | ULS 1a_0,9_90 | 1320.9 | 593.0 | 775.4 | 0.14 |
| 219LB | Diagonaal broel | UNP300 | S235 | 2M24-5.6t | 11.36 | 1.00 | 1.00 | 216 | **-218.6** | ULS 1a_135 | 279.7 | 338.9 | 259.2 | 0.84 | | **164.0** | ULS 1a_0,9_0,9_45 | 584.8 | 338.9 | 221.5 | 0.74 |
| 219LC | Diagonaal broel | UNP300 | S235 | | 12.31 | 1.00 | 1.00 | 191 | **-92.3** | ULS 1a_90 | 303.7 | 0.0 | 0.0 | 0.30 | | **72.1** | ULS 1a_0,9_90 | 1380.9 | 0.0 | 0.0 | 0.05 |
| 218TA | Diagonaal broel | UNP300 | S235 | 2M24-5.6t | 5.93 | 1.00 | 1.00 | 194 | **-98.9** | ULS 1a_135 | 324.9 | 338.9 | 259.2 | 0.38 | | **74.1** | ULS 1a_0,9_0,9_45 | 584.8 | 338.9 | 221.5 | 0.33 |
| 218TB | Diagonaal broel | UNP300 | S235 | 7M24-5.6t | 5.94 | 1.00 | 1.00 | 191 | **-85.4** | ULS 1a_135 | 303.7 | 593.0 | 907.2 | 0.28 | | **56.9** | ULS 1a_0,9_0,9_45 | 1320.9 | 593.0 | 775.4 | 0.10 |
| 218TC | Diagonaal broel | UNP300 | S235 | | 5.94 | 1.00 | 1.00 | 191 | **-91.5** | ULS 1a_135 | 303.7 | 0.0 | 0.0 | 0.30 | | **64.0** | ULS 1a_0,9_0,9_45 | 1380.9 | 0.0 | 0.0 | 0.05 |
| 219TA | Diagonaal broel | UNP300 | S235 | 7M24-5.6t | 12.31 | 1.00 | 1.00 | 191 | **-77.6** | ULS 1a_135 | 303.7 | 593.0 | 907.2 | 0.26 | | **49.0** | ULS 5a Ba 12 | 1320.9 | 593.0 | 775.4 | 0.08 |
| 219TB | Diagonaal broel | UNP300 | S235 | 2M24-5.6t | 11.36 | 1.00 | 1.00 | 216 | **-221.5** | ULS 1a_45 | 279.7 | 338.9 | 259.2 | 0.85 | | **167.4** | ULS 1a_0,9_0,9_135 | 584.8 | 338.9 | 221.5 | 0.76 |
| 219TC | Diagonaal broel | UNP300 | S235 | | 12.31 | 1.00 | 1.00 | 191 | **-97.8** | ULS 1a_90 | 303.7 | 0.0 | 0.0 | 0.32 | | **72.7** | ULS 1a_0,9_0,9_90 | 1380.9 | 0.0 | 0.0 | 0.05 |
| 219L | Onderstuk in to | 200x200x16 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-149.3** | ULS 1a_45 | 456.7 | 254.2 | 622.1 | 0.59 | | **88.6** | ULS 1a_0,9_0,9_45 | 1030.8 | 254.2 | 531.7 | 0.35 |
| 219T | Onderstuk in to | 200x200x16 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-149.1** | ULS 1a_45 | 456.7 | 254.2 | 622.1 | 0.59 | | **88.5** | ULS 1a_0,9_0,9_135 | 1030.8 | 254.2 | 531.7 | 0.35 |
| 220 | Onderstuk in to | 150x150x10 | S235 | 1M20-5.6t | 1.00 | **2.00** | 1.00 | 199 | **-5.7** | ULS 1a_0,9_135 | 144.4 | 58.8 | 108.0 | 0.10 | | **6.6** | ULS 1a_135 | 368.6 | 58.8 | 87.3 | 0.11 |
| 221 | Onderstuk in to | 150x100x10 | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **-1.0** | ULS 1a_90 | 59.7 | 58.8 | 108.0 | 0.02 | | **0.0** | | 224.6 | 58.8 | 87.3 | 0.00 |
| 222T | Knikverkorter b | 100x100x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 275 | **-20.8** | ULS 1a_0 | 43.8 | 37.7 | 69.1 | 0.55 | | **20.8** | ULS 1a_0 | 188.9 | 37.7 | 51.2 | 0.55 |
| 223T | Knikverkorter b | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 219 | **-22.0** | ULS 1a_0 | 46.9 | 37.7 | 51.8 | 0.58 | | **22.0** | ULS 1a_0 | 141.7 | 37.7 | 38.4 | 0.58 |
| 224T | Knikverkorter b | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 221 | **-16.6** | ULS 1a_0 | 40.4 | 37.7 | 60.5 | 0.44 | | **16.6** | ULS 1a_0 | 114.9 | 37.7 | 44.8 | 0.44 |
| 225T | Knikverkorter b | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-16.7** | ULS 1a_0 | 35.5 | 37.7 | 60.5 | 0.47 | | **16.7** | ULS 1a_0 | 94.8 | 37.7 | 44.8 | 0.44 |
| 226T | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-19.6** | ULS 1a_0,9_0,9_45 | 34.3 | 37.7 | 51.8 | 0.57 | | **16.4** | ULS 1a_0,9_135 | 72.6 | 37.7 | 38.4 | 0.44 |
| 227T | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 144 | **-25.1** | ULS 1a_0,9_0,9_45 | 48.4 | 37.7 | 51.8 | 0.67 | | **25.8** | ULS 1a_135 | 72.6 | 37.7 | 38.4 | 0.68 |
| 228T | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-37.5** | ULS 1a_0,9_0,9_45 | 70.3 | 37.7 | 51.8 | 0.99 | | **48.3** | ULS 1a_135 | 72.6 | 37.7 | 38.4 | 1.28 |
| 229T | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 55 | **-51.1** | ULS 1a_0,9_0,9_45 | 90.6 | 37.7 | 51.8 | 1.36 | | **76.5** | ULS 1a_135 | 72.6 | 37.7 | 38.4 | 2.03 |
| 222L | Knikverkorter b | 100x100x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 275 | **-20.8** | ULS 1a_0 | 43.8 | 37.7 | 69.1 | 0.55 | | **20.8** | ULS 1a_0 | 188.9 | 37.7 | 51.2 | 0.55 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 2-7-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+48**
**84**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 223L | Knikverkorter b | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 219 | **-22.0** | ULS 1a_0 | 46.9 | 37.7 | 51.8 | 0.58 | | **22.0** | ULS 1a_0 | 141.7 | 37.7 | 38.4 | 0.58 |
| 224L | Knikverkorter b | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 221 | **-16.6** | ULS 1a_0 | 40.4 | 37.7 | 60.5 | 0.44 | | **16.6** | ULS 1a_0 | 114.9 | 37.7 | 44.8 | 0.44 |
| 225L | Knikverkorter b | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-16.7** | ULS 1a_0 | 35.5 | 37.7 | 60.5 | 0.47 | | **16.7** | ULS 1a_0 | 94.8 | 37.7 | 44.8 | 0.44 |
| 226L | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-19.7** | ULS 1a_0,9_0,9_135 | 34.3 | 37.7 | 51.8 | 0.57 | | **17.4** | ULS 1a_0,9_90 | 72.6 | 37.7 | 38.4 | 0.46 |
| 227L | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 144 | **-25.3** | ULS 1a_0,9_0,9_135 | 48.4 | 37.7 | 51.8 | 0.67 | | **25.9** | ULS 1a_45 | 72.6 | 37.7 | 38.4 | 0.69 |
| 228L | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-37.7** | ULS 1a_0,9_0,9_135 | 70.3 | 37.7 | 51.8 | 1.00 | | **48.5** | ULS 1a_45 | 72.6 | 37.7 | 38.4 | 1.29 |
| 229L | Knikverkorter b | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 55 | **-51.4** | ULS 1a_0,9_0,9_135 | 90.6 | 37.7 | 51.8 | 1.36 | | **76.8** | ULS 1a_45 | 72.6 | 37.7 | 38.4 | 2.04 |
| 230T | Diagonaal tusse | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 193 | **-13.4** | ULS 1a_0,9_135 | 45.6 | 37.7 | 51.8 | 0.36 | | **37.5** | ULS 1a_45 | 141.7 | 37.7 | 38.4 | 0.99 |
| 231T | Diagonaal tusse | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 220 | **-12.6** | ULS 1a_0 | 33.3 | 37.7 | 60.5 | 0.38 | | **12.6** | ULS 1a_0 | 114.9 | 37.7 | 44.8 | 0.33 |
| 232T | Diagonaal tusse | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 219 | **-12.3** | ULS 1a_0 | 28.6 | 37.7 | 60.5 | 0.43 | | **12.3** | ULS 1a_0 | 94.8 | 37.7 | 44.8 | 0.33 |
| 233T | Diagonaal tusse | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-15.7** | ULS 1a_0 | 38.5 | 37.7 | 60.5 | 0.42 | | **15.7** | ULS 1a_0 | 104.8 | 37.7 | 44.8 | 0.42 |
| 234T | Diagonaal tusse | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 200 | **-14.8** | ULS 1a_0,9_135 | 39.7 | 37.7 | 60.5 | 0.39 | | **18.2** | ULS 1a_0,9_0,9_45 | 94.8 | 37.7 | 44.8 | 0.48 |
| 235T | Diagonaal tusse | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 183 | **-23.0** | ULS 1a_135 | 35.5 | 37.7 | 51.8 | 0.65 | | **22.9** | ULS 1a_0,9_0,9_45 | 72.6 | 37.7 | 38.4 | 0.61 |
| 236T | Diagonaal tusse | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 158 | **-49.9** | ULS 1a_135 | 43.1 | 37.7 | 51.8 | 1.32 | | **39.8** | ULS 1a_0,9_0,9_45 | 72.6 | 37.7 | 38.4 | 1.06 |
| 237T | Diagonaal tusse | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 142 | **-143.1** | ULS 1a_135 | 49.0 | 37.7 | 51.8 | 3.80 | | **102.1** | ULS 1a_0,9_0,9_45 | 72.6 | 37.7 | 38.4 | 2.71 |
| 230L | Diagonaal tusse | 100x100x6 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 193 | **-13.4** | ULS 1a_0,9_45 | 45.6 | 37.7 | 51.8 | 0.35 | | **37.6** | ULS 1a_135 | 141.7 | 37.7 | 38.4 | 1.00 |
| 231L | Diagonaal tusse | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 220 | **-8.1** | ULS 1a_0,9_135 | 33.3 | 37.7 | 60.5 | 0.24 | | **15.6** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.42 |
| 232L | Diagonaal tusse | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 219 | **-12.9** | ULS 1a_0,9_90 | 28.6 | 37.7 | 60.5 | 0.45 | | **16.9** | ULS 1a_0,9_0,9_90 | 94.8 | 37.7 | 44.8 | 0.45 |
| 233L | Diagonaal tusse | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 216 | **-15.7** | ULS 1a_0 | 38.5 | 37.7 | 60.5 | 0.42 | | **15.7** | ULS 1a_0 | 104.8 | 37.7 | 44.8 | 0.42 |
| 234L | Diagonaal tusse | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 200 | **-17.1** | ULS 1a_0,9_90 | 39.7 | 37.7 | 60.5 | 0.45 | | **18.2** | ULS 1a_0,9_0,9_135 | 94.8 | 37.7 | 44.8 | 0.48 |
| 235L | Diagonaal tusse | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 183 | **-23.2** | ULS 1a_45 | 35.5 | 37.7 | 51.8 | 0.65 | | **23.0** | ULS 1a_0,9_0,9_135 | 72.6 | 37.7 | 38.4 | 0.61 |
| 236L | Diagonaal tusse | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 158 | **-50.1** | ULS 1a_45 | 43.1 | 37.7 | 51.8 | 1.33 | | **40.1** | ULS 1a_0,9_0,9_135 | 72.6 | 37.7 | 38.4 | 1.07 |
| 237L | Diagonaal tusse | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 142 | **-143.6** | ULS 1a_45 | 49.0 | 37.7 | 51.8 | 3.81 | | **102.7** | ULS 1a_0,9_0,9_135 | 72.6 | 37.7 | 38.4 | 2.73 |
| 238 | Top | 100x100x6 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 182 | **-15.8** | ULS 5a Ba 22 | 75.9 | 75.4 | 103.7 | 0.21 | | **15.4** | ULS 5a Ba 22 | 144.1 | 75.4 | 76.8 | 0.20 |
| 239L | 0 | 120x120x8 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 118 | **0.0** | | 204.9 | 338.9 | 414.7 | 0.00 | | **200.8** | ULS 3_90 | 263.0 | 338.9 | 354.5 | 0.76 |
| 239T | 0 | 70x70x7 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-2.7** | ULS 1a_0,9_0,9_90 | 51.4 | 254.2 | 272.2 | 0.05 | | **5.6** | ULS 1a_90 | 119.2 | 254.2 | 192.5 | 0.05 |
| 240 | Tweede dwarsa | 100x100x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 108 | **-64.1** | ULS 5a Ba 12 | 182.9 | 169.4 | 207.4 | 0.38 | | **64.8** | ULS 5a Ba 12 | 181.4 | 169.4 | 177.2 | 0.38 |
| 241 | Tweede dwarsa | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 309 | **-1.2** | ULS 3_90 | 11.3 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 118L | Tweede dwarsa | 160x160x15# | S235 | 11M24-5.6t | 1.00 | 2.00 | 1.00 | 61 | **-343.8** | ULS 1a_0 | 926.7 | 924.2 | 2138.4 | 0.37 | | **64.1** | ULS 1a_0,9_0,9_0 | 1008.5 | 924.2 | 1644.9 | 0.07 |
| 242T | Tweede dwarsa | 100x100x8 | S235 | 4M24-5.6t | 1.00 | 2.00 | 1.00 | 98 | **-35.1** | ULS 5a Ba 22 | 188.3 | 338.9 | 414.7 | 0.19 | | **67.8** | ULS 5a Ba 22 | 293.9 | 338.9 | 354.5 | 0.23 |
| 243T | 0 | 100x100x8 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 192 | **-43.1** | ULS 1a_0,9_90 | 93.4 | 254.2 | 311.0 | 0.46 | | **42.9** | ULS 1a_90 | 223.0 | 254.2 | 265.8 | 0.19 |
| 244 | Eerste dwarsarı | 120x120x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 119 | **-70.1** | ULS 5a Ba 21 | 202.8 | 169.4 | 207.4 | 0.41 | | **71.2** | ULS 5a Ba 10 | 226.0 | 169.4 | 177.2 | 0.42 |
| 245 | Eerste dwarsarı | 60x60x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 342 | **-1.5** | ULS 3_90 | 13.8 | 58.8 | 64.8 | 0.11 | | **0.0** | | 65.7 | 58.8 | 44.4 | 0.00 |
| 119L | Eerste dwarsarı | 180x180x15# | S235 | 12M24-5.6t | 2.00 | 1.00 | 1.00 | 73 | **-287.6** | ULS 5a Ba 10 | 959.5 | 999.7 | 2332.8 | 0.30 | | **15.2** | ULS 5a Ba 10 | 1144.0 | 999.7 | 1993.8 | 0.02 |
| 246T | Eerste dwarsarı | 100x100x8 | S235 | 4M24-5.6t | 2.00 | 1.00 | 1.00 | 131 | **-34.6** | ULS 5a Ba 21 | 143.1 | 338.9 | 414.7 | 0.24 | | **71.8** | ULS 5a Ba 21 | 293.9 | 338.9 | 354.5 | 0.24 |
| 247L | 0 | 80x80x8 | S235 | 1M24-5.6t | 1.00 | **2.00** | 1.00 | 206 | **-42.3** | ULS 1a_0 | 57.8 | 84.7 | 103.7 | 0.73 | | **22.9** | ULS 1a_0,9_0,9_0 | 124.4 | 84.7 | 88.6 | 0.27 |
| 247T | 0 | **90x90x8** | **S355** | 1M24-5.6t | 1.00 | **2.00** | 1.00 | 182 | **-52.6** | ULS 1a_90 | 87.3 | 84.7 | 141.1 | 0.62 | | **30.5** | ULS 1a_0,9_0,9_90 | 200.7 | 84.7 | 120.6 | 0.36 |
| 248L | 0 | 100x100x8 | S235 | | **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 |
| 248T | 0 | 100x100x8 | S235 | | **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 |
| 249L | 0 | 100x100x8 | S235 | | **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 |
| 249T | 0 | 100x100x8 | S235 | | **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 |
| 250T | Horizontal side | 70x70x7 | S235 | | **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 |
| 251T | Horizontal side | 70x70x7 | S235 | | **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 |
| 400 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 145 | **-13.9** | ULS 5a Ba 22 | 60.5 | 58.8 | 75.6 | 0.24 | | **13.0** | ULS 5a Ba 12 | 76.6 | 58.8 | 51.8 | 0.25 |
| 401 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 135 | **-16.0** | ULS 5a Ba 12 | 65.4 | 58.8 | 75.6 | 0.27 | | **16.8** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.32 |
| 402 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 128 | **-18.0** | ULS 5a Ba 22 | 69.3 | 58.8 | 75.6 | 0.31 | | **17.3** | ULS 5a Ba 12 | 76.6 | 58.8 | 51.8 | 0.34 |
| 403 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 122 | **-19.4** | ULS 5a Ba 22 | 73.3 | 58.8 | 75.6 | 0.33 | | **20.2** | ULS 5a Ba 12 | 76.6 | 58.8 | 51.8 | 0.39 |
| 404 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 115 | **-23.3** | ULS 5a Ba 12 | 77.4 | 58.8 | 75.6 | 0.40 | | **21.6** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.42 |
| 405 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 113 | **-25.1** | ULS 5a Ba 22 | 78.7 | 58.8 | 75.6 | 0.43 | | **29.0** | ULS 5a Ba 12 | 76.6 | 58.8 | 51.8 | 0.56 |
| 406 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 112 | **-38.0** | ULS 5a Ba 12 | 79.8 | 58.8 | 75.6 | 0.65 | | **30.7** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.59 |
| 407 | Tweede DWSR | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 81 | **-35.5** | ULS 5a Ba 12 | 101.0 | 58.8 | 75.6 | 0.60 | | **22.1** | ULS 5a Ba 22 | 76.6 | 58.8 | 51.8 | 0.43 |
| 408 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 104 | **0.0** | | 47.1 | 37.7 | 43.2 | 0.00 | | **2.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.13 |
| 409 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 204 | **0.0** | | 21.2 | 37.7 | 43.2 | 0.00 | | **11.0** | ULS 5a Ba 3 | 37.4 | 37.7 | 22.0 | 0.50 |
| 410 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 213 | **-3.3** | ULS 1a_90 | 22.5 | 37.7 | 43.2 | 0.15 | | **3.9** | ULS 3_135 | 37.4 | 37.7 | 22.0 | 0.18 |
| 411 | Tweede DWSR | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 334 | **-4.7** | ULS 1a_90 | 14.3 | 37.7 | 51.8 | 0.33 | | **0.8** | ULS 5a Ba 3 | 72.6 | 37.7 | 38.4 | 0.02 |
| 412 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 273 | **-3.9** | ULS 1a_45 | 13.7 | 37.7 | 43.2 | 0.28 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 413 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 138 | **-2.9** | ULS 1a_45 | 35.3 | 37.7 | 43.2 | 0.08 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 414 | Tweede DWSR | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **-10.5** | ULS 1a_45 | 11.8 | 37.7 | 51.8 | 0.89 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 |
| 415 | Tweede DWSR | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 242 | **-27.4** | ULS 5a Ba 3 | 46.5 | 60.3 | 94.1 | 0.59 | | **0.0** | | 194.4 | 60.3 | 69.7 | 0.00 |
| 416 | Tweede DWSR | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 324 | **-10.2** | ULS 5a Ba 3 | 20.5 | 37.7 | 60.5 | 0.50 | | **0.0** | ULS 1a_0 | 104.8 | 37.7 | 44.8 | 0.00 |
| 417 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 322 | **0.0** | | 10.6 | 37.7 | 43.2 | 0.00 | | **4.6** | ULS 1a_90 | 37.4 | 37.7 | 18.4 | 0.25 |
| 418 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 269 | **0.0** | | 14.1 | 37.7 | 43.2 | 0.00 | | **4.9** | ULS 1a_45 | 37.4 | 37.7 | 18.4 | 0.27 |
| 419 | Tweede DWSR | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 317 | **0.0** | | 65.4 | 338.9 | 518.4 | 0.00 | | **217.3** | ULS 3_90 | 324.0 | 338.9 | 443.1 | 0.67 |
| 420 | Tweede DWSR | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 144 | **0.0** | | 203.6 | 338.9 | 518.4 | 0.00 | | **199.2** | ULS 3_90 | 324.0 | 338.9 | 443.1 | 0.61 |
| 122A | Tweede DWSR | 160x160x15# | S235 | 11M24-5.6t | 1.00 | 1.95 | 1.00 | 73 | **-302.8** | ULS 5a Ba 12 | 857.7 | 924.2 | 2138.4 | 0.35 | | **82.3** | ULS 5a Ba 22 | 1008.5 | 924.2 | 1827.7 | 0.09 |
| 122C | Tweede DWSR | 160x160x15# | S235 | | 1.00 | 2.06 | 1.00 | 73 | **-286.9** | ULS 5a Ba 12 | 857.8 | 0.0 | 0.0 | 0.33 | | **65.5** | ULS 5a Ba 22 | 1097.7 | 0.0 | 0.0 | 0.06 |
| 122B | Tweede DWSR | 160x160x15# | S235 | 6M24-5.6t | 1.00 | 2.71 | 1.00 | 66 | **-188.6** | ULS 3_90 | 899.0 | 488.2 | 1166.4 | 0.39 | | **0.0** | | 787.2 | 488.2 | 996.9 | 0.00 |
| 421 | Tweede DWSR | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 39 | **0.0** | | 1004.9 | 117.6 | 172.8 | 0.00 | | **17.1** | ULS 3_90 | 1278.1 | 117.6 | 0.0 | 0.15 |
| 422 | Tweede DWSR | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 36 | **-20.3** | ULS 5a Ba 22 | 1020.1 | 117.6 | 172.8 | 0.17 | | **31.1** | ULS 5a Ba 12 | 1278.1 | 117.6 | 0.0 | 0.26 |
| 123A | Tweede DWSR | 150x100x10 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 143 | **-30.7** | ULS 3_90 | 186.0 | 84.7 | 129.6 | 0.36 | | **0.0** | | 155.5 | 84.7 | 99.7 | 0.00 |
| 123B | Tweede DWSR | 150x100x10 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 152 | **-23.4** | ULS 5a Ba 12 | 165.4 | 84.7 | 129.6 | 0.28 | | **0.5** | ULS 5a Ba 1 | 155.5 | 84.7 | 99.7 | 0.01 |
| 123C | Tweede DWSR | 150x100x10 | S235 | | 1.00 | 1.00 | 1.00 | 150 | **-27.3** | ULS 3_90 | 189.0 | 0.0 | 0.0 | 0.14 | | **0.0** | | 571.3 | 0.0 | 0.0 | 0.00 |
| 423 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 210 | **-11.8** | ULS 1a_0 | 20.4 | 37.7 | 43.2 | 0.58 | | **11.9** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.54 |
| 424 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 194 | **-10.9** | ULS 1a_0,9_0 | 22.8 | 37.7 | 43.2 | 0.48 | | **10.8** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.49 |
| 425 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 187 | **-10.0** | ULS 1a_0 | 24.0 | 37.7 | 43.2 | 0.42 | | **9.9** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.45 |
| 426 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 182 | **-11.0** | ULS 1a_0 | 24.8 | 37.7 | 43.2 | 0.44 | | **11.1** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.50 |
| 427 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 168 | **-9.9** | ULS 1a_0 | 27.7 | 37.7 | 43.2 | 0.36 | | **9.8** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.44 |
| 428 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 150 | **-8.4** | ULS 1a_0 | 31.8 | 37.7 | 43.2 | 0.26 | | **8.5** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.38 |
| 429 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 164 | **-9.8** | ULS 1a_0 | 28.7 | 37.7 | 43.2 | 0.34 | | **9.6** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.44 |
| 430 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 123 | **-8.4** | ULS 5a Ba 1 | 40.0 | 37.7 | 43.2 | 0.22 | | **8.7** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.39 |
| 431 | Tweede DWSR | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 111 | **-10.6** | ULS 5a Ba 1 | 44.4 | 37.7 | 43.2 | 0.28 | | **10.1** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.46 |

DNV·GL

## Assessment of groups for strengthened mast (afkeur level)

Date 2-7-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+48**
**84**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 432 | Tweede DWSRM | 50x50x5 | S235 | 1M16-5.6t | 0.55 | 0.55 | 0.55 | 117 | **-14.6** | ULS 5a Ba 1 | 42.0 | 37.7 | 43.2 | 0.39 | | **15.9** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.72 |
| 433 | Tweede DWSRM | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 234 | **-5.5** | ULS 3_90 | 17.4 | 37.7 | 43.2 | 0.32 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 434 | Tweede DWSRM | HEB160 | S235 | 2M12-5.6t | 2.00 | 2.00 | 2.00 | 20 | **-7.8** | ULS 5a Ba 1 | 1087.1 | 40.3 | 103.7 | 0.19 | | **7.2** | ULS 5a Ba 1 | 1315.0 | 40.3 | 57.6 | 0.18 |
| 435 | Tweede DWSRM | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 127 | **-0.2** | ULS 1a_0,9_90 | 38.6 | 37.7 | 43.2 | 0.01 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 436 | Tweede DWSRM | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 105 | **0.0** | | 46.6 | 37.7 | 43.2 | 0.00 | | **0.1** | ULS 3_90 | 37.4 | 37.7 | 22.0 | 0.00 |
| 124A | Tweede DWSRM | 120x120x8 | S235 | 3M24-5.6t | 1.00 | 1.47 | 1.00 | 107 | **-135.9** | ULS 1a_0 | 223.0 | 254.2 | 311.0 | 0.61 | | **119.3** | ULS 1a_0,9_0 | 263.0 | 254.2 | 262.5 | 0.47 |
| 124B | Tweede DWSRM | 120x120x8 | S235 | 4M24-5.6t | 2.04 | 2.84 | 1.00 | 91 | **-68.3** | ULS 5a Ba 1 | 242.1 | 338.9 | 414.7 | 0.28 | | **101.8** | ULS 5a Ba 1 | 379.5 | 338.9 | 354.5 | 0.30 |
| 124C | Tweede DWSRM | 120x120x8 | S235 | | 2.00 | 3.13 | 1.00 | 101 | **-120.5** | ULS 1a_0 | 223.0 | 0.0 | 0.0 | 0.54 | | **113.5** | ULS 1a_0,9_0 | 441.8 | 0.0 | 0.0 | 0.26 |
| 125A | Tweede DWSRM | 100x100x6 | S235 | 4M24-5.6t | 1.54 | 1.00 | 1.00 | 111 | **-59.5** | ULS 5a Ba 1 | 127.2 | 338.9 | 311.0 | 0.47 | | **93.2** | ULS 5a Ba 1 | 225.0 | 338.9 | 265.8 | 0.41 |
| 125B | Tweede DWSRM | 100x100x6 | S235 | 2M16-5.6t | 1.00 | 1.43 | 1.00 | 95 | **-0.2** | ULS 5a Ba 1 | 154.1 | 75.4 | 103.7 | 0.00 | | **20.6** | ULS 1a_90 | 203.8 | 75.4 | 103.7 | 0.27 |
| 125C | Tweede DWSRM | 100x100x6 | S235 | | 1.00 | 1.00 | 1.00 | 127 | **-50.1** | ULS 5a Ba 1 | 116.8 | 0.0 | 0.0 | 0.43 | | **70.9** | ULS 5a Ba 1 | 277.3 | 0.0 | 0.0 | 0.26 |
| 300 | Eerste DWSRM | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 153 | **-16.7** | ULS 5a Ba 20 | 66.2 | 84.7 | 90.7 | 0.25 | | **19.7** | ULS 5a Ba 11 | 98.8 | 84.7 | 72.5 | 0.27 |
| 301 | Eerste DWSRM | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 144 | **-22.6** | ULS 5a Ba 11 | 71.6 | 84.7 | 90.7 | 0.32 | | **20.1** | ULS 5a Ba 20 | 98.8 | 84.7 | 72.5 | 0.28 |
| 302 | Eerste DWSRM | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 134 | **-21.6** | ULS 5a Ba 20 | 77.3 | 84.7 | 90.7 | 0.28 | | **24.7** | ULS 5a Ba 11 | 98.8 | 84.7 | 72.5 | 0.34 |
| 303 | Eerste DWSRM | 75x75x7# | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 128 | **-29.8** | ULS 5a Ba 11 | 81.6 | 84.7 | 90.7 | 0.37 | | **25.0** | ULS 5a Ba 20 | 98.8 | 84.7 | 72.5 | 0.34 |
| 304 | Eerste DWSRM | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 126 | **-28.0** | ULS 5a Ba 20 | 70.6 | 58.8 | 75.6 | 0.48 | | **21.6** | ULS 5a Ba 20 | 86.7 | 58.8 | 59.5 | 0.37 |
| 305 | Eerste DWSRM | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 133 | **-12.6** | ULS 5a Ba 21 | 53.0 | 58.8 | 64.8 | 0.24 | | **11.0** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.25 |
| 306 | Eerste DWSRM | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 121 | **-13.2** | ULS 5a Ba 10 | 58.5 | 58.8 | 64.8 | 0.23 | | **13.9** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.31 |
| 307 | Eerste DWSRM | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 112 | **-15.6** | ULS 5a Ba 21 | 63.0 | 58.8 | 64.8 | 0.26 | | **15.5** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.35 |
| 308 | Eerste DWSRM | 60x60x6 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 106 | **-18.7** | ULS 5a Ba 10 | 66.5 | 58.8 | 64.8 | 0.32 | | **18.0** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.40 |
| 309 | Eerste DWSRM | 60x60x6 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 98 | **-21.4** | ULS 5a Ba 21 | 71.2 | 58.8 | 64.8 | 0.36 | | **23.1** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.52 |
| 310 | Eerste DWSRM | 60x60x6 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 97 | **-32.6** | ULS 5a Ba 10 | 71.8 | 58.8 | 64.8 | 0.55 | | **28.6** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.65 |
| 311 | Eerste DWSRM | 60x60x6 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 77 | **-36.5** | ULS 5a Ba 21 | 81.7 | 58.8 | 64.8 | 0.62 | | **27.8** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.63 |
| 312 | Eerste DWSRM | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-2.2** | ULS 1a_0,9_0,9_90 | 842.3 | 117.6 | 172.8 | 0.02 | | **15.1** | ULS 1a_90 | 1278.1 | 117.6 | 0.0 | 0.13 |
| 313 | Eerste DWSRM | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 65 | **-20.8** | ULS 5a Ba 20 | 870.7 | 117.6 | 172.8 | 0.18 | | **30.6** | ULS 5a Ba 11 | 1278.1 | 117.6 | 0.0 | 0.26 |
| 314 | Eerste DWSRM | HEB160 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 30 | **0.0** | | 1046.7 | 117.6 | 172.8 | 0.00 | | **14.4** | ULS 3_90 | 1278.1 | 117.6 | 0.0 | 0.12 |
| 315 | Eerste DWSRM | HEB160 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 25 | **-23.0** | ULS 5a Ba 10 | 1067.2 | 117.6 | 172.8 | 0.20 | | **28.6** | ULS 5a Ba 21 | 1278.1 | 117.6 | 0.0 | 0.24 |
| 316 | Eerste DWSRM | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 465 | **0.0** | | 10.2 | 117.6 | 129.6 | 0.00 | | **36.8** | ULS 3_135 | 77.4 | 117.6 | 88.7 | 0.48 |
| 317 | Eerste DWSRM | 60x60x8 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 508 | **0.0** | | 11.4 | 117.6 | 172.8 | 0.00 | | **65.2** | ULS 3_45 | 100.5 | 117.6 | 118.3 | 0.65 |
| 318 | Eerste DWSRM | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 376 | **0.0** | | 8.2 | 37.7 | 43.2 | 0.00 | | **12.7** | ULS 7 | 37.4 | 37.7 | 22.0 | 0.58 |
| 319 | Eerste DWSRM | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 409 | **0.0** | | 7.1 | 37.7 | 43.2 | 0.00 | | **18.4** | ULS 3_45 | 37.4 | 37.7 | 22.0 | 0.83 |
| 320 | Eerste DWSRM | 100x100x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 163 | **-25.0** | ULS 3_0 | 70.4 | 58.8 | 64.8 | 0.42 | | **0.0** | | 117.5 | 58.8 | 52.4 | 0.00 |
| 321 | Eerste DWSRM | 75x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 199 | **-6.8** | ULS 1a_0 | 27.5 | 37.7 | 43.2 | 0.25 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 322 | Eerste DWSRM | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-5.2** | ULS 7 | 30.4 | 37.7 | 43.2 | 0.17 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 323 | Eerste DWSRM | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 75 | **-2.7** | ULS 3_90 | 57.4 | 37.7 | 43.2 | 0.07 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 |
| 324 | Eerste DWSRM | 50x50x5 | S235 | 1M16-5.6t | 0.50 | 0.50 | 0.50 | 172 | **-4.4** | ULS 1a_0 | 26.9 | 37.7 | 43.2 | 0.16 | | **2.0** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.09 |
| 325 | Eerste DWSRM | 75x50x5 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 230 | **0.0** | | 22.3 | 84.7 | 64.8 | 0.00 | | **1.1** | ULS 7 | 63.4 | 84.7 | 36.7 | 0.03 |
| 326 | Eerste DWSRM | 80x80x8 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-0.1** | ULS 1a_90 | 53.6 | 84.7 | 103.7 | 0.00 | | **0.0** | | 124.4 | 84.7 | 70.9 | 0.00 |
| 327 | Eerste DWSRM | 75x50x5 | S235 | 1M24-5.6t | 1.00 | 1.00 | 1.00 | 161 | **-0.1** | ULS 1a_90 | 36.7 | 84.7 | 64.8 | 0.00 | | **0.0** | | 63.4 | 84.7 | 36.7 | 0.00 |
| 128A | Eerste DWSRM | 180x180x15# | S235 | 12M24-5.6t | 1.00 | 1.99 | 1.00 | 65 | **-340.4** | ULS 5a Ba 10 | 1008.7 | 999.7 | 2332.8 | 0.34 | | **91.1** | ULS 5a Ba 21 | 1144.0 | 999.7 | 1993.8 | 0.09 |
| 128B | Eerste DWSRM | 180x180x15# | S235 | 6M24-5.6t | 1.00 | 4.06 | 1.00 | 93 | **-285.6** | ULS 5a Ba 10 | 816.1 | 508.3 | 1166.4 | 0.56 | | **76.5** | ULS 5a Ba 21 | 1144.0 | 508.3 | 996.9 | 0.15 |
| 128C | Eerste DWSRM | 180x180x15# | S235 | | 1.00 | 2.76 | 1.00 | 89 | **-307.1** | ULS 5a Ba 10 | 843.1 | 0.0 | 0.0 | 0.36 | | **94.5** | ULS 5a Ba 21 | 1220.5 | 0.0 | 0.0 | 0.08 |
| 129A | Eerste DWSRM | 150x150x12 | S235 | 6M24-5.6t | 1.00 | 1.90 | 1.00 | 63 | **-235.5** | ULS 5a Ba 21 | 681.6 | 508.3 | 933.1 | 0.46 | | **101.5** | ULS 5a Ba 10 | 740.3 | 508.3 | 797.5 | 0.20 |
| 129B | Eerste DWSRM | 150x150x12 | S235 | 5M24-5.6t | 1.00 | 2.79 | 1.00 | 74 | **-128.6** | ULS 3_90 | 637.2 | 420.1 | 777.6 | 0.31 | | **0.0** | | 554.4 | 420.1 | 664.6 | 0.00 |
| 129C | Eerste DWSRM | 150x150x12 | S235 | | 1.00 | 2.11 | 1.00 | 65 | **-222.6** | ULS 5a Ba 21 | 673.5 | 0.0 | 0.0 | 0.33 | | **87.5** | ULS 5a Ba 10 | 817.8 | 0.0 | 0.0 | 0.11 |
| 130A | Eerste DWSRM | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 160 | **0.0** | | 178.4 | 338.9 | 518.4 | 0.00 | | **213.1** | ULS 3_90 | 324.0 | 338.9 | 443.1 | 0.66 |
| 130B | Eerste DWSRM | 120x120x10 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 215 | **0.0** | | 119.5 | 338.9 | 518.4 | 0.00 | | **157.9** | ULS 3_90 | 466.6 | 338.9 | 443.1 | 0.47 |
| 131A | Eerste DWSRM | 120x120x8 | S235 | 4M24-5.6t | 1.00 | 1.70 | 1.00 | 139 | **0.0** | | 162.5 | 338.9 | 414.7 | 0.00 | | **148.1** | ULS 3_90 | 379.5 | 338.9 | 354.5 | 0.44 |
| 131B | Eerste DWSRM | 120x120x8 | S235 | 3M24-5.6t | 1.46 | 1.00 | 1.00 | 146 | **0.0** | | 161.8 | 254.2 | 311.0 | 0.00 | | **131.3** | ULS 3_90 | 263.0 | 254.2 | 265.8 | 0.52 |
| 131C | 131C | **120x120x8** | S235 | | 2.35 | 3.17 | 1.00 | 137 | **0.0** | | 165.1 | 0.0 | 0.0 | 0.00 | | **131.0** | 130.986 | ULS 3_90 | 441.8 | 0.0 | 0.30 |
| 248 | 248 | **75x75x7#** | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 241 | **-3.3** | ULS 1a_0,9_45 | 38.9 | 60.3 | 82.3 | 0.08 | | **6.6** | 6.578 | ULS 1a_45 | 156.4 | 61.0 | 0.11 |
| 249 | 249 | **70x70x6** | S355 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 235 | **-0.1** | ULS 7 | 30.3 | 60.3 | 70.6 | 0.00 | | **0.0** | | 0.0 | 122.3 | 52.3 | 0.00 |
| 250 | 250 | **120x120x10** | S355 | 1M20-8.8t | 1.00 | 1.00 | 1.00 | 227 | **-10.4** | ULS 1a_135 | 97.1 | 94.1 | 147.0 | 0.11 | | **4.9** | 4.861 | ULS 1a_0,9_1 | 384.2 | 133.6 | 0.05 |
| 251 | 251 | **120x120x10** | S355 | 1M20-8.8t | 1.00 | 2.00 | 1.00 | 208 | **-12.7** | ULS 1a_45 | 120.1 | 94.1 | 147.0 | 0.13 | | **10.2** | 10.174 | ULS 1a_0,9_4 | 384.2 | 133.6 | 0.11 |
| 252 | 252 | **80x80x8** | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 241 | **-0.1** | ULS 1a_0,9_0,9_45 | 46.9 | 60.3 | 94.1 | 0.00 | | **3.3** | 3.288 | ULS 1a_45 | 194.4 | 81.3 | 0.05 |

**Notes:**

**1) Groups 251T, 250T, 248L/T and 249L/T are not structural members. These members were removed from the verbouw model to prevent interference in the load calculations of other members.**
**2) Groups 222L/T to 237L/T are redundant members in the lowest section of the tower. These members were assessed more accurately using Axis VM which showed no failures.**
**3) Groups 252 to 256 are new members which were added. For more information see the overview drawing.**

DNV·GL

# Assessment of groups for strengthened mast (verbouw level)

Date 2-7-2020
Author MKh
Version 1.0

**KIJ-GT380**
**S+48**
**84**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 108A | Leg eerste tussenst | 250x250x24# | S235 | **12M24-8.8t** | 0.27 | 0.27 | 0.27 | 45 | **-2457.8** | ULS 1a_45 | 2463.6 | 2975.4 | 3732.5 | 1.00 | | **2046.0** | ULS 1a_0,9_0,9_45 | 2655.2 | 2975.4 | 3732.5 | 0.77 |
| 216L | Diagonalen eerste t | **130x130x11** | **S355** | **1M24-8.8t** | 1.00 | 0.27 | 0.27 | 355 | **-33.0** | ULS 1a_0,9_0,9_0 | 49.0 | 135.6 | 194.0 | 0.67 | | **66.6** | ULS 1a_135 | 405.3 | 135.6 | 165.8 | 0.49 |
| 216T | Diagonalen eerste t | **130x130x11** | **S355** | **1M24-8.8t** | 1.00 | 0.27 | 0.27 | 355 | **-42.8** | ULS 1a_0,9_0,9_90 | 49.4 | 135.6 | 194.0 | 0.87 | | **64.4** | ULS 1a_45 | 405.3 | 135.6 | 165.8 | 0.48 |
| 217L | Diagonalen eerste t | 120x120x10 | S235 | **1M24-8.8t** | 1.00 | 0.52 | 0.52 | 204 | **-71.7** | ULS 1a_135 | 83.8 | 135.6 | 129.6 | 0.86 | | **76.3** | ULS 1a_0,9_0,9_45 | 270.7 | 135.6 | 110.8 | 0.69 |
| 220 | Onderstuk in tower | 150x150x10 | S235 | 1M20-5.6t | 1.00 | **2.00** | 1.00 | 199 | **-7.2** | ULS 1a_0,9_0,9_135 | 144.4 | 58.8 | 108.0 | 0.12 | | **8.6** | ULS 1a_45 | 368.6 | 58.8 | 87.3 | 0.15 |
| 247L | | 80x80x8 | S235 | 1M24-5.6t | 1.00 | **2.00** | 1.00 | 206 | **-53.0** | ULS 1a_0 | 57.8 | 84.7 | 103.7 | 0.92 | | **29.8** | ULS 1a_0,9_0,9_0 | 124.4 | 84.7 | 88.6 | 0.35 |
| 247T | | **90x90x8** | **S355** | 1M24-5.6t | 1.00 | **2.00** | 1.00 | 182 | **-67.0** | ULS 1a_90 | 87.3 | 84.7 | 141.1 | 0.79 | | **38.6** | ULS 1a_0,9_0,9_90 | 200.7 | 84.7 | 120.6 | 0.46 |
| 415 | Tweede DWSRM - F | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 242 | **-27.4** | ULS 5a Ba 3 | 46.5 | 60.3 | 94.1 | 0.59 | | **0.0** | | 194.4 | 60.3 | 69.7 | 0.00 |
| 248 | Toegevoegde horizo | **75x75x7#** | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 241 | **-5.1** | ULS 1a_0,9_45 | 38.9 | 60.3 | 82.3 | 0.13 | | **9.3** | ULS 1a_45 | 156.4 | 60.3 | 61.0 | 0.15 |
| 249 | Toegevoegde horizo | **70x70x6** | S355 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 235 | **-0.1** | ULS 7 | 24.5 | 60.3 | 70.6 | 0.01 | | **0.0** | | 122.3 | 60.3 | 52.3 | 0.00 |
| 250 | Binnenpootverband | **120x120x10** | S355 | 1M20-8.8t | 1.00 | 1.00 | 1.00 | 227 | **-12.7** | ULS 1a_45 | 97.1 | 94.1 | 147.0 | 0.13 | | **6.8** | ULS 1a_0,9_135 | 384.2 | 94.1 | 133.6 | 0.07 |
| 251 | Binnenpootverband | **120x120x10** | S355 | 1M20-8.8t | 1.00 | 2.00 | 1.00 | 208 | **-15.9** | ULS 1a_45 | 120.1 | 94.1 | 147.0 | 0.17 | | **13.0** | ULS 1a_0,9_45 | 384.2 | 94.1 | 133.6 | 0.14 |
| 252 | Binnenpootverband | **80x80x8** | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 241 | **-0.5** | ULS 1a_0,9_0,9_45 | 46.9 | 60.3 | 94.1 | 0.01 | | **3.8** | ULS 1a_45 | 194.4 | 60.3 | 81.3 | 0.06 |

# APPENDIX C REDUNDANT MEMBERS CHECK

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2020-07-02
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+48
84

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 95 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 0.40 | 0 | 34 | **25.8** | **0.10** | 98.7 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 109 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.63 | 86 | 139 | **25.8** | **0.00** | 50.2 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 94 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 0.92 | 0 | 78 | **25.8** | **0.23** | 81.3 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 108 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.75 | 69 | 149 | **25.8** | **0.00** | 46.3 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 90 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.44 | 0 | 123 | **25.8** | **0.36** | 57.6 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 107 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.99 | 55 | 171 | **25.8** | **0.00** | 39.1 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 89 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.96 | 0 | 167 | **25.8** | **0.49** | 40.1 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 106 | Onderstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.33 | 44 | 185 | **25.8** | **0.00** | 44.1 | 37.7 | 44.8 | 104.8 | 1.69 | 0.69 | | |
| 87 | Onderstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.48 | 0 | 197 | **25.8** | **0.62** | 40.6 | 37.7 | 44.8 | 104.8 | 1.69 | 0.69 | | |
| 105 | Onderstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 2.72 | 35 | 199 | **25.8** | **0.00** | 43.1 | 37.7 | 44.8 | 125.0 | 1.98 | 0.69 | | |
| 126 | Onderstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 3.00 | 0 | 205 | **25.8** | **0.75** | 44.6 | 37.7 | 44.8 | 145.2 | 2.27 | 0.69 | | |
| 104 | Onderstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.41 | 38 | 192 | **25.8** | **0.00** | 42.1 | 37.7 | 44.8 | 104.8 | 1.69 | 0.69 | | |
| 85 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.56 | 0 | 133 | **25.8** | **0.39** | 52.7 | 37.7 | 38.4 | 72.6 | 1.24 | 0.69 | | |
| 103 | Onderstuk | Kniksteun op 0,5L | L65.7 | S235 | M16 | 5.6 | 4.10 | 53 | 209 | **25.8** | **0.00** | 30.4 | 37.7 | 44.8 | 104.8 | 1.69 | 0.85 | | |
| 84 | Onderstuk | Enkele staaf | L100.6 | S235 | M16 | 5.6 | 4.08 | 0 | 206 | **25.8** | **1.02** | 51.6 | 37.7 | 38.4 | 210.8 | 4.10 | 0.69 | | |
| 101 | Onderstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 2.89 | 31 | 212 | **25.8** | **0.00** | 39.5 | 37.7 | 44.8 | 125.0 | 1.98 | 0.69 | | |
| 82 | Onderstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 2.12 | 0 | 181 | **25.8** | **0.53** | 36.1 | 37.7 | 38.4 | 72.6 | 1.2 | 0.71 | | |
| 100 | Onderstuk | Kniksteun op 0,5L | L75.7 | S235 | M16 | 5.6 | 4.82 | 43 | 212 | **25.8** | **0.00** | 34.7 | 37.7 | 44.8 | 145.2 | 2.3 | 0.74 | | |
| 81 | Onderstuk | Enkele staaf | L100.8 | S235 | M16 | 5.6 | 5.15 | 0 | 262 | **25.8** | **1.29** | 47.4 | 37.7 | 51.2 | 281.1 | 4.8 | 0.69 | | |
| 98 | Onderstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 3.31 | 27 | 226 | **25.8** | **0.74** | 38.6 | 37.7 | 44.8 | 145.2 | 2.3 | 0.69 | | |
| 79 | Onderstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.59 | 0 | 205 | **25.8** | **0.65** | 38.2 | 37.7 | 44.8 | 104.8 | 1.7 | 0.69 | | |
| 97 | Onderstuk | Kniksteun op 0,5L | L100.6 | S235 | M16 | 5.6 | 5.83 | 34 | 190 | **25.8** | **0.00** | 46.6 | 37.7 | 38.4 | 210.8 | 4.1 | 0.69 | | |
| 110 | Tussenschot | Kniksteun en verticale steur | L150.10 | S235 | M20 | 5.6 | 8.69 | 0 | 188 | **4.6** | **1.09** | 117.0 | 58.8 | 87.3 | 599.0 | 10.61 | 0.11 | | |
| 111 | Tussenschot | Kruisende staaf halverwege | L150.100.10 | S235 | M20 | 5.6 | 12.65 | 0 | 291 | **4.6** | **1.58** | 61.1 | 58.8 | 87.3 | 311.0 | 12.72 | 0.12 | | |
| 150 | 1e tussenstuk | Enkele staaf | L100.6 | S235 | M16 | 5.6 | 3.88 | 30 | 196 | **24.6** | **0.84** | 55.3 | 37.7 | 38.4 | 210.8 | 4.10 | 0.65 | | |
| 145 | 1e tussenstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 3.18 | 0 | 217 | **24.6** | **0.79** | 41.0 | 37.7 | 44.8 | 145.2 | 2.27 | 0.65 | | |
| 157 | 1e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.78 | 0 | 221 | **24.6** | **0.70** | 34.4 | 37.7 | 44.8 | 104.8 | 1.69 | 0.72 | | |
| 148 | 1e tussenstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 3.44 | 39 | 235 | **24.6** | **0.00** | 36.5 | 37.7 | 44.8 | 145.2 | 2.27 | 0.68 | | |
| 142 | 1e tussenstuk | Enkele staaf | L100.8 | S235 | M16 | 5.6 | 5.42 | 0 | 275 | **24.6** | **1.36** | 43.8 | 37.7 | 51.2 | 281.1 | 4.76 | 0.65 | | |
| 147 | 1e tussenstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 3.53 | 30 | 241 | **24.6** | **0.76** | 35.1 | 37.7 | 44.8 | 145.2 | 2.27 | 0.70 | | |
| 141 | 1e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.78 | 0 | 221 | **24.6** | 0.70 | 34.4 | 37.7 | 44.8 | 104.8 | 1.7 | 0.72 | | |
| 176 | 2e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.39 | 0 | 190 | **22.0** | **0.60** | 42.7 | 37.7 | 44.8 | 104.8 | 1.69 | 0.58 | | |
| 171 | 2e tussenstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 2.89 | 37 | 211 | **22.0** | **0.00** | 39.6 | 37.7 | 44.8 | 125.0 | 1.98 | 0.58 | | |
| 175 | 2e tussenstuk | Enkele staaf | L100.6 | S235 | M16 | 5.6 | 4.76 | 0 | 240 | **22.0** | **1.19** | 41.1 | 37.7 | 38.4 | 210.8 | 4.10 | 0.58 | | |
| 170 | 2e tussenstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 2.96 | 29 | 217 | **22.0** | **0.65** | 38.1 | 37.7 | 44.8 | 125.0 | 1.98 | 0.58 | | |
| 174 | 2e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.39 | 0 | 190 | **22.0** | **0.60** | 42.7 | 37.7 | 44.8 | 104.8 | 1.69 | 0.58 | | |
| 172 | 2e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 2.10 | 0 | 180 | **22.0** | **0.53** | 36.5 | 37.7 | 38.4 | 72.6 | 1.24 | 0.60 | | |
| 169 | 2e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.54 | 36 | 202 | **22.0** | **0.00** | 39.2 | 37.7 | 44.8 | 104.8 | 1.69 | 0.58 | | |
| 173 | 2e tussenstuk | Enkele staaf | L100.6 | S235 | M16 | 5.6 | 4.60 | 0 | 232 | **22.0** | **1.15** | 43.2 | 37.7 | 38.4 | 210.8 | 4.10 | 0.58 | | |
| 168 | 2e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.60 | 27 | 206 | **22.0** | **0.58** | 37.9 | 37.7 | 44.8 | 104.8 | 1.69 | 0.58 | | |
| 235 | 3e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.84 | 0 | 157 | **20.1** | **0.46** | 43.4 | 37.7 | 38.4 | 72.6 | 1.24 | 0.53 | | |
| 223 | 3e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 2.32 | 40 | 198 | **20.1** | **0.00** | 31.8 | 37.7 | 38.4 | 72.6 | 1.24 | 0.63 | | |
| 234 | 3e tussenstuk | Enkele staaf | L75.8 | S235 | M16 | 5.6 | 3.71 | 0 | 255 | **20.1** | **0.93** | 36.7 | 37.7 | 51.2 | 165.9 | 2.58 | 0.55 | | |
| 222 | 3e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 2.36 | 31 | 202 | **20.1** | **0.00** | 31.1 | 37.7 | 38.4 | 72.6 | 1.24 | 0.65 | | |
| 233 | 3e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.84 | 0 | 157 | **20.1** | **0.46** | 43.4 | 37.7 | 38.4 | 72.6 | 1.2 | 0.53 | | |
| 232 | 3e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.60 | 0 | 164 | **20.1** | **0.40** | 28.6 | 37.7 | 30.8 | 37.4 | 0.7 | 0.70 | | |
| 221 | 3e tussenstuk | Enkele staaf | L55.6 | S235 | M16 | 5.6 | 2.02 | 40 | 189 | **20.1** | **0.00** | 31.2 | 37.7 | 37.8 | 55.3 | 1.0 | 0.65 | | |
| 231 | 3e tussenstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 3.22 | 0 | 236 | **20.1** | **0.81** | 33.7 | 37.7 | 44.8 | 125.0 | 2.0 | 0.60 | | |
| 220 | 3e tussenstuk | Enkele staaf | L55.6 | S235 | M16 | 5.6 | 2.06 | 30 | 192 | **20.1** | **0.45** | 30.4 | 37.7 | 37.8 | 55.3 | 1.0 | 0.66 | | |
| 230 | 3e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.66 | 0 | 170 | **20.1** | **0.41** | 27.3 | 37.7 | 30.8 | 37.4 | 0.7 | 0.74 | | |
| 229 | 4e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.38 | 0 | 142 | **18.4** | **0.35** | 34.2 | 37.7 | 30.8 | 37.4 | 0.7 | 0.60 | | |
| 219 | 4e tussenstuk | Enkele staaf | L55.6 | S235 | M16 | 5.6 | 1.76 | 39 | 164 | **18.4** | **0.00** | 37.5 | 37.7 | 37.8 | 55.3 | 1.0 | 0.49 | | |
| 228 | 4e tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.90 | 0 | 230 | **18.4** | **0.73** | 32.3 | 37.7 | 44.8 | 104.8 | 1.7 | 0.57 | | |
| 218 | 4e tussenstuk | Enkele staaf | L55.6 | S235 | M16 | 5.6 | 1.79 | 29 | 167 | **18.4** | **0.39** | 36.7 | 37.7 | 37.8 | 55.3 | 1.0 | 0.50 | | |
| 227 | 4e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.44 | 0 | 148 | **18.4** | **0.36** | 32.5 | 37.7 | 30.8 | 37.4 | 0.7 | 0.60 | | |
| 226 | 4e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.22 | 0 | 125 | **18.4** | **0.31** | 39.2 | 37.7 | 30.8 | 37.4 | 0.7 | 0.60 | | |
| 217 | 4e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.55 | 39 | 159 | **18.4** | **0.00** | 29.7 | 37.7 | 30.8 | 37.4 | 0.7 | 0.62 | | |
| 225 | 4e tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 2.53 | 0 | 216 | **18.4** | **0.63** | 28.1 | 37.7 | 38.4 | 72.6 | 1.2 | 0.66 | | |
| 216 | 4e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.51 | 30 | 155 | **18.4** | **0.33** | 30.7 | 37.7 | 30.8 | 37.4 | 0.7 | 0.60 | | |
| 224 | 4e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.14 | 0 | 117 | **18.4** | **0.29** | 42.0 | 37.7 | 30.8 | 37.4 | 0.7 | 0.60 | | |
| 293 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.13 | 0 | 116 | **15.9** | **0.28** | 42.4 | 37.7 | 30.8 | 37.4 | 0.72 | 0.52 | | |
| 305 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.53 | 40 | 157 | **15.9** | **0.00** | 30.2 | 37.7 | 30.8 | 37.4 | 0.72 | 0.53 | | |
| 292 | 5e tussenstuk | Enkele staaf | L55.6 | S235 | M16 | 5.6 | 2.26 | 0 | 211 | **15.9** | **0.56** | 26.7 | 37.7 | 37.8 | 55.3 | 1.03 | 0.59 | | |
| 303 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.49 | 35 | 154 | **15.9** | **0.00** | 31.1 | 37.7 | 30.8 | 37.4 | 0.72 | 0.52 | | |
| 291 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.13 | 0 | 116 | **15.9** | **0.28** | 42.4 | 37.7 | 30.8 | 37.4 | 0.72 | 0.52 | | |
| 290 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.07 | 0 | 110 | **15.9** | **0.27** | 44.7 | 37.7 | 30.8 | 37.4 | 0.72 | 0.52 | | |
| 302 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.49 | 42 | 153 | **15.9** | **0.00** | 31.3 | 37.7 | 30.8 | 37.4 | 0.72 | 0.52 | | |
| 289 | 5e tussenstuk | Enkele staaf | L55.6 | S235 | M16 | 5.6 | 2.22 | 0 | 208 | **15.9** | **0.56** | 27.3 | 37.7 | 37.8 | 55.3 | 1.03 | 0.58 | | |
| 300 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.45 | 36 | 149 | **15.9** | **0.00** | 32.3 | 37.7 | 30.8 | 37.4 | 0.7 | 0.52 | | |
| 288 | 5e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.07 | 0 | 110 | **15.9** | **0.27** | 44.7 | 37.7 | 30.8 | 37.4 | 0.7 | 0.52 | | |
| 287 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.05 | 0 | 107 | **11.7** | **0.26** | 45.6 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |
| 299 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.47 | 43 | 151 | **11.7** | **0.00** | 31.7 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |

DNV·GL

## Knikverkorters initial construction (afkeur)

Date: 2020-07-02
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+48
84

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 286 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.05 | 0 | 210 | **11.7** | **0.51** | 20.4 | 37.7 | 30.8 | 37.4 | 0.7 | 0.71 | | |
| 297 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.43 | 37 | 147 | **11.7** | **0.00** | 32.8 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |
| 285 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.05 | 0 | 108 | **11.7** | **0.26** | 45.5 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |
| 284 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 0.99 | 0 | 101 | **11.7** | **0.25** | 48.0 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |
| 296 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.43 | 45 | 147 | **11.7** | **0.00** | 32.8 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |
| 283 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.92 | 0 | 197 | **11.7** | **0.48** | 22.3 | 37.7 | 30.8 | 37.4 | 0.7 | 0.67 | | |
| 294 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.38 | 39 | 142 | **11.7** | **0.00** | 34.2 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |
| 282 | 6e tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 0.99 | 0 | 101 | **11.7** | **0.25** | 48.1 | 37.7 | 30.8 | 37.4 | 0.7 | 0.38 | | |

DNV·GL

**Knikverkorters final construction (verbouw)**

Date: 2020-07-02
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+48
84

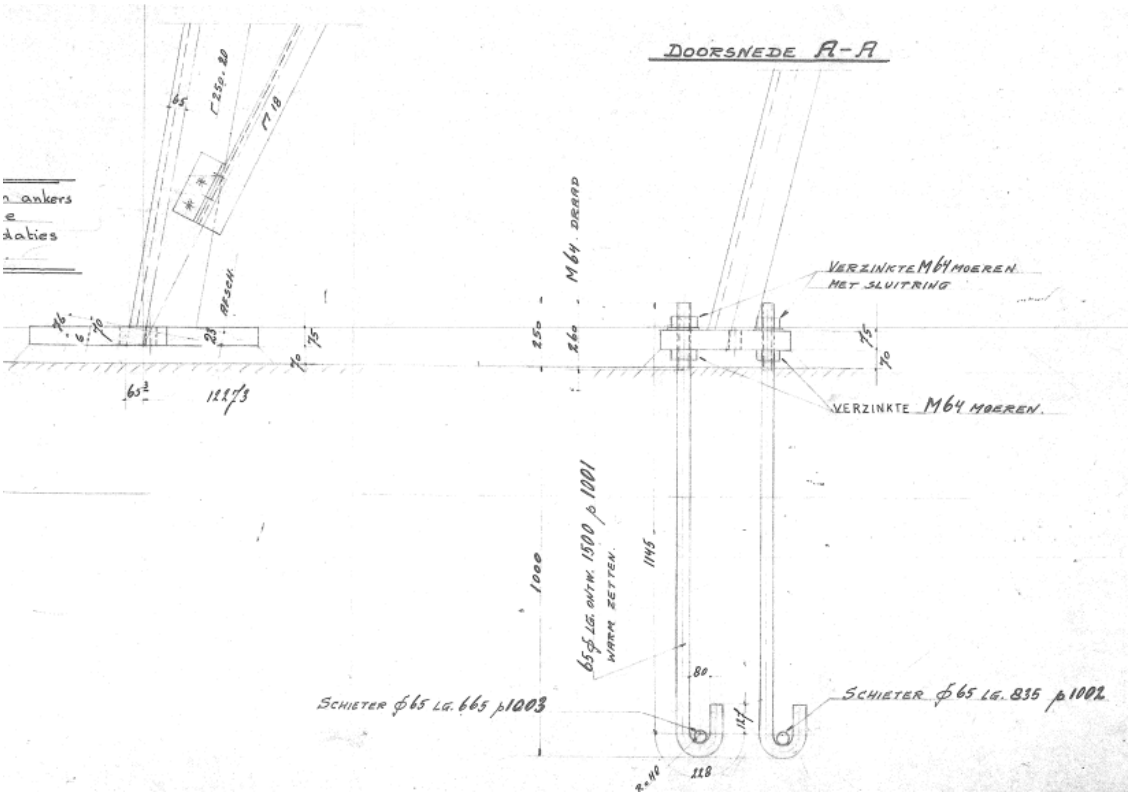
| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness (-) | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Block Tearing Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | Mitigation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BPV 1 (247) | Pootverband | Enkele staaf | L120.10 | S355 | M20 | 8.8 | 5.35 | 44 | 225 | **3.3** | **0.00** | 98.3 | 94.1 | 118.8 | 580.2 | 12.83 | 0.03 | | Profile added |
| BPV 2 (248) | Pootverband | Kniksteun en vertical | L120.10 | S355 | M20 | 8.8 | 7.64 | 0 | 208 | **3.3** | **1.24** | 93.2 | 94.1 | 118.8 | 580.2 | 12.83 | 0.13 | | Profile added |
| BPV 3 (248) | Pootverband | Enkele staaf | L80.8 | S355 | M16 | 8.8 | 3.74 | 90 | 240 | **3.3** | **0.00** | 47.1 | 60.3 | 69.7 | 257.2 | 4.46 | 0.07 | | Profile added |
| TTH1 (251) | Tussenschot | Kruisende staaf halve | L70.6 | S355 | M16 | 8.8 | 5.00 | 0 | 235 | **2.4** | **0.81** | 27.4 | 60.3 | 52.3 | 145.8 | 2.58 | 0.31 | | Profile added |
| TTH2 (250) | Tussenschot | Enkele staaf | L75.7 | S355 | M16 | 8.8 | 3.54 | 0 | 242 | **2.4** | **1.15** | 38.3 | 60.3 | 61.0 | 197.6 | 3.44 | 0.33 | | Profile added |

# APPENDIX D CHECK ANCHORS

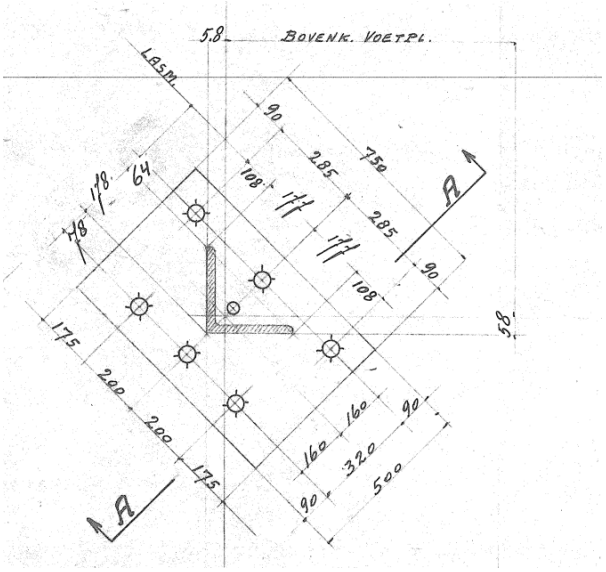
## ANCHORS S+48

Asset-data contain drawings of anchors. 6 anchor bolts are present. The tower legs are connected to the foundation with a foot plate 500x750x75 mm and six anchors with diameter 65 mm. This will be the basis of the check.

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

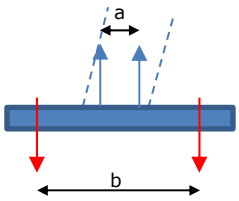
De loads coming from the tower are based on S+48 structure number 84:

**Omhullenden ongeacht stijl**

| Belasting | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. druk | ULS 1a_45 | 377 | 357 | **2070** | 14 | -519 | -7 | 2132 |
| Max. trek | ULS 1a_0,9_0,9_45 | 272 | 252 | **-1524** | -14 | 371 | -6 | -1570 |
| Max. pos. torsie | ULS 1a_0,9_0,9_45 | -21 | -42 | 4 | **44** | -15 | -14 | 4 |
| Max. neg. torsie | ULS 1a_0,9_0,9_45 | -118 | 56 | 501 | **-44** | -123 | 1 | 517 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_135 | -272 | 252 | **-1523** | **14** | 371 | -6 | -1569 |

## 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 has been verified with concrete cylinder tests. Refer to investigation report[1]. The anchor bolts will not be loaded by bending.

The anchors and plates fulfill the required strength. See the output:

Tower 85: U.C. = 254 / 460 = 0,55 ≤ 1,00 OK

Conclusion: The foot plates of tower structure S+48 have sufficient strength.

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

## Main bracing broekstuk

The connection of the bracing is verified into more detail because of the eccentricity associated with the connection angles.

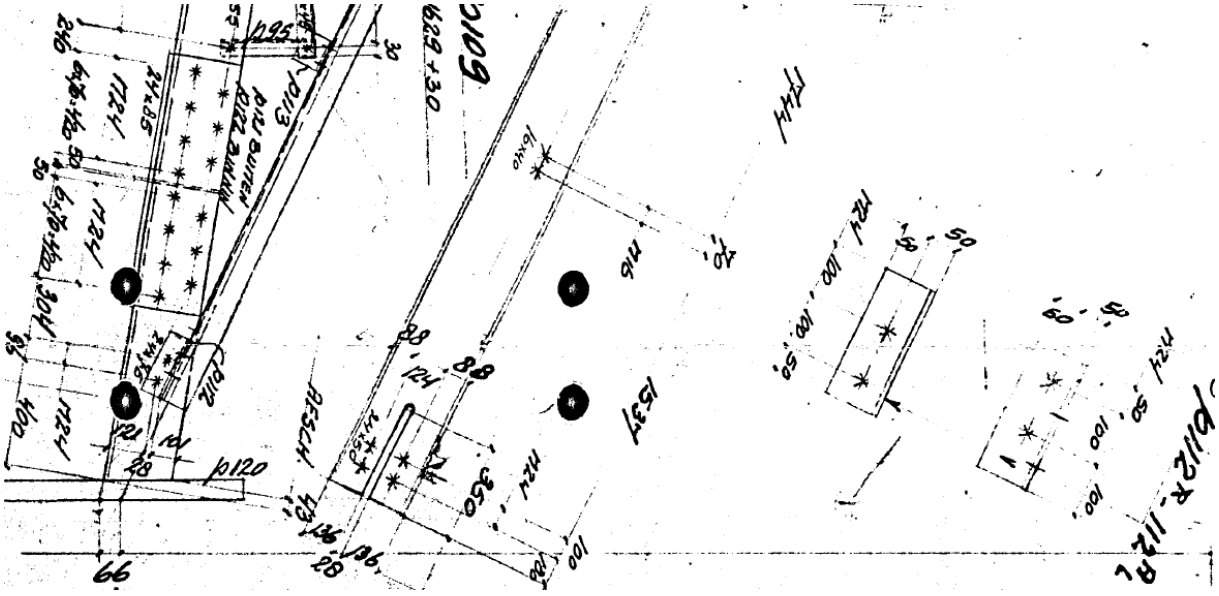


**Figure 1 Relevant dimensions for the calculation of connection capacity**

The maximum possible force in the diagonal is calculated as shown below. The calculated force is the maximum force which can occur before the two bolts connecting the main diagonal to the leg fail under shear.

$M = 0.05 \times F$

$F_v = 0.5 \times F$

$F_H = 0.05F / 0.1 = 0.5F$

$F_{Res} = ((0.5F)^2 + (0.5F)^2)^{0.5}$

$= 0.707F$

M24-5.6 $F_{v,RD}$ = 85 kN

Considering two shear planes: 85 x 2 = 170 kN

Maximum force = 170/ 0.707 = 240.42 kN

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+48** | ***Checks:*** | | |
|---|---|---|---|---|
| | | Anchor bolt to tension | 0,39 | ***OK*** |
| | | Anchor bolt to shear | 0,32 | ***OK*** |
| | | Dowel ("schieter") | 0,55 | ***OK*** |

### *Inputs*

| | | | |
|---|---|---|---|
| Anchor diameter | | **M64** | |
| Achor quality | | **4.6** | |
| Thread | | Cut | |
| Anchor length | l = | 1500 | mm |
| Anchor length above concrete | a = | 250 | mm |

### *Load on anchor group*

T: the external tension force on the anchor group

| | | | |
|---|---|---|---|
| Tension force | T = | **1524** | kN |
| Shear force | $F_{H,Ed}$ = | **519** | kN |
| Number of anchors for tension | | 6 | |
| Number of anchors for shear | | 6 | |
| $F_{T;Ed} = T / n$ = | | 254,0 | kN |
| $F_{v;Ed} = F_{H,Ed} / n$ = | | 86,5 | kN |

### *Anchor properties*

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

*Capacity per anchor*

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

### *Foot plate*

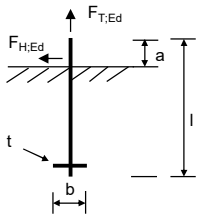
$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

| | | | |
|---|---|---|---|
| Steel material | | **S235** | |
| Thickness | t = | 75 | mm |
| Width | $b_{ef}$ = | 250 | mm |
| Leverage arm | m = | 116 | mm |
| $M_{pl,Rd} = 1/4 b_{ef} t_p^2 f_{yd}$ = | | 82,6 | kNm |
| $F_{t,Rd} = M_{pl,Rd} / m$ = | | 712,2 | kN |

### *Check of dowel ("schieter")*

$$\frac{\sigma_b'}{f_{cd}} = \frac{15,7}{40,0} = 0,39 \quad \textit{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{254}{460} = 0,55 \quad \textit{OK}$$




### *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 = | **250** | mm |
| Spread | $c = t\sqrt{(f_{yd} / 3 f_{jd})}$ = | 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 | $q = F_{T,Ed} / b_{eff}$ = | 1021 | kN/m |
| Concrete pressure | $\sigma_b' = q / d_S$ = | 15,7 | MPa |
| *Shear stress in dowel* | | | |
| Load | $F_{T,Ed}$ = | 254 | kN |
| Allowable | $F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ = | 460 | kN |

### *Capacity of foot plate*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{254,0}{712,2} = 0,36 \quad \textit{OK}$$

### *Capacity of anchor for tension*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{254,0}{655,1} = 0,39 \quad \textit{OK}$$

### *Check foot plate for tension*

$$\frac{T}{n \times F_{t;Rd}} = \frac{1524,0}{4273,3} = 0,36 \quad \textit{OK}$$

### *Check anchor for shear*

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{86,5}{267,9} = 0,32 \quad \textit{OK}$$

# INTERACTION BETWEEN MAIN DIAGONAL AND REDUNDANTS HIP STRUCTURE S+48

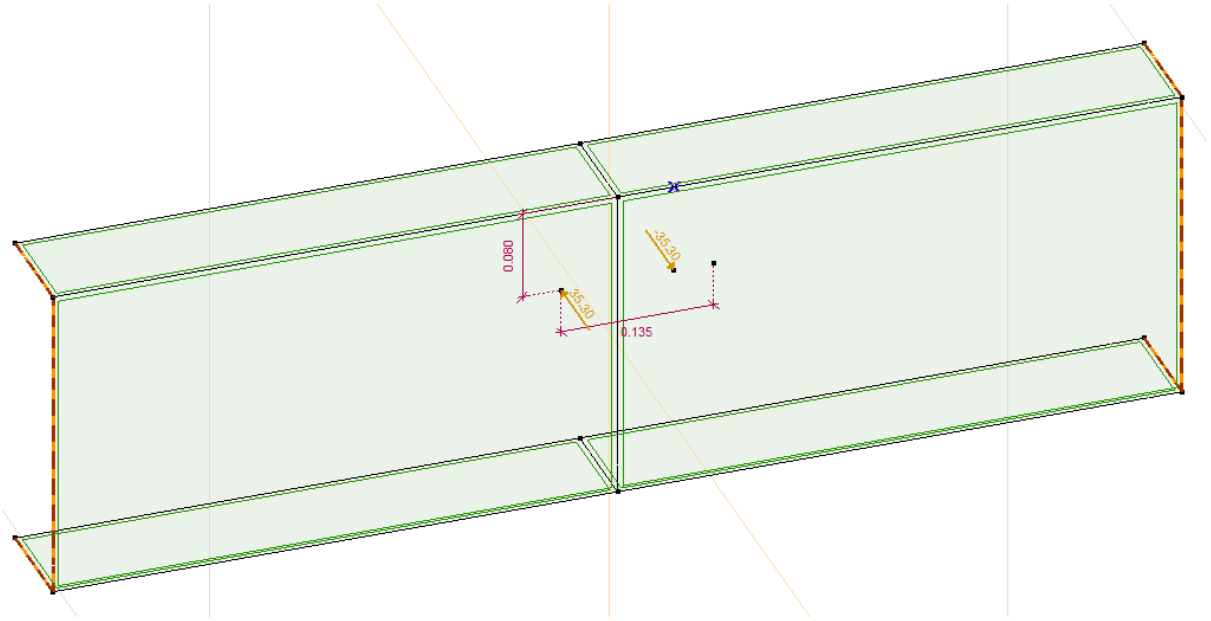



**Figure 1 Loading - standalone UNP 300 model.**

The main diagonal of the tower leg is UNP 300. A standalone Axis VM model is created for evaluating the rotational spring stiffness of the web of the UNP 300 section. A length of 1m of UNP 300 section is modelled with shell elements. The ends are restrained for all degrees of freedom. A couple is applied in the web by applying equal and opposite forces of 35.3 kN at the position of bolts in the web. Figure 1 shows the location of the bolts in the web.

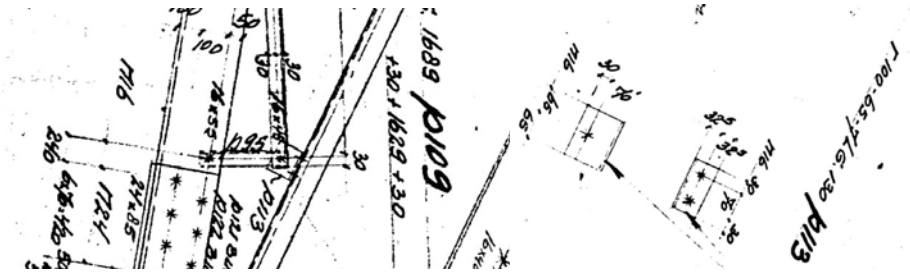


**Figure 2 Onderstuk - detail for UNP - redundant connection**

The value of 35.3 kN is found by an iterative method. Applying the load, the rotational stiffness of the web is found by the formula below. This stiffness is applied in the complete model of the onderstuk as explained below. The developing force in the diagonals is then compared to the force applied to the web as shown in Figure 1. The initial value of rotational spring stiffness was taken as 500kNm and the corresponding force was 100kN. The axial force in the diagonals was approximately 50kN. Thus, the axial force in the model for web analysis was reduced and iteration continued until the applied axial force applied in the web of the UNP section and the axial force in the diagonals converged. This occurred at a load of 35.3kN. The corresponding rotational stiffness is calculated below.

The rotational spring stiffness is calculated via:

$$K_{rot} = \frac{M}{\theta} = \frac{35.3 * 0.10}{0.0153} = \frac{235kNm}{rad}$$

Krot - Rotational stiffness of the web of UNP 300.

M – Moment applied in the UNP section.

Θ – Rotation of the web in rad.

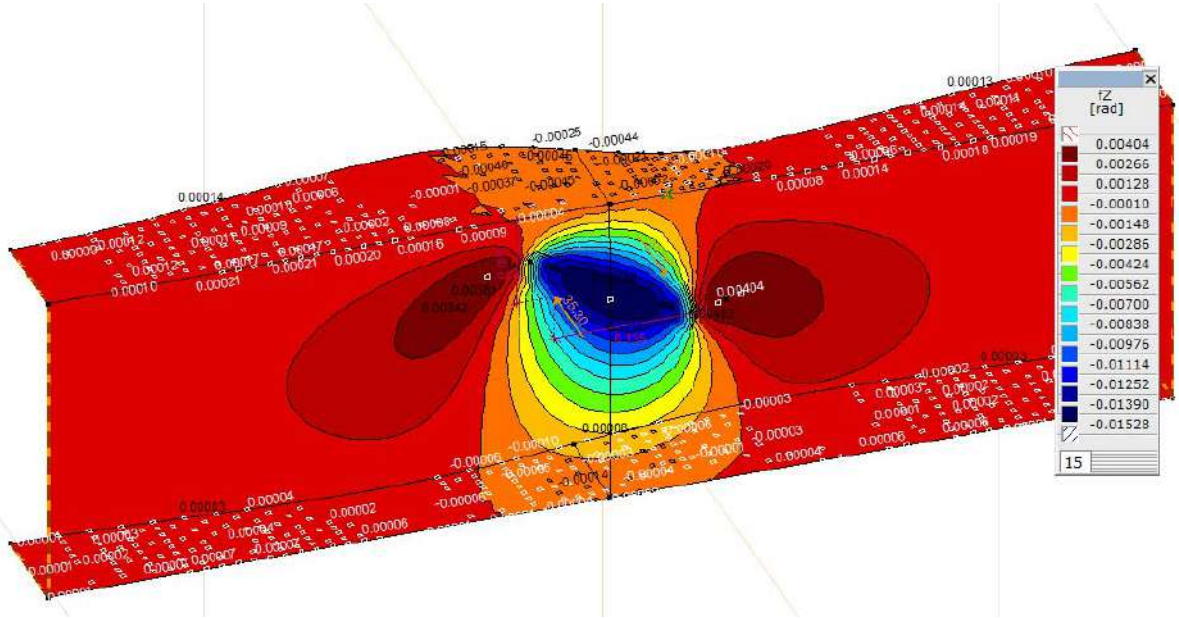



**Figure 3 Rotation of the web for the force from diagonal L60.6**

The rotation of 0.0153 radians which is used for the calculation of rotational stiffness is seen in Figure 3.

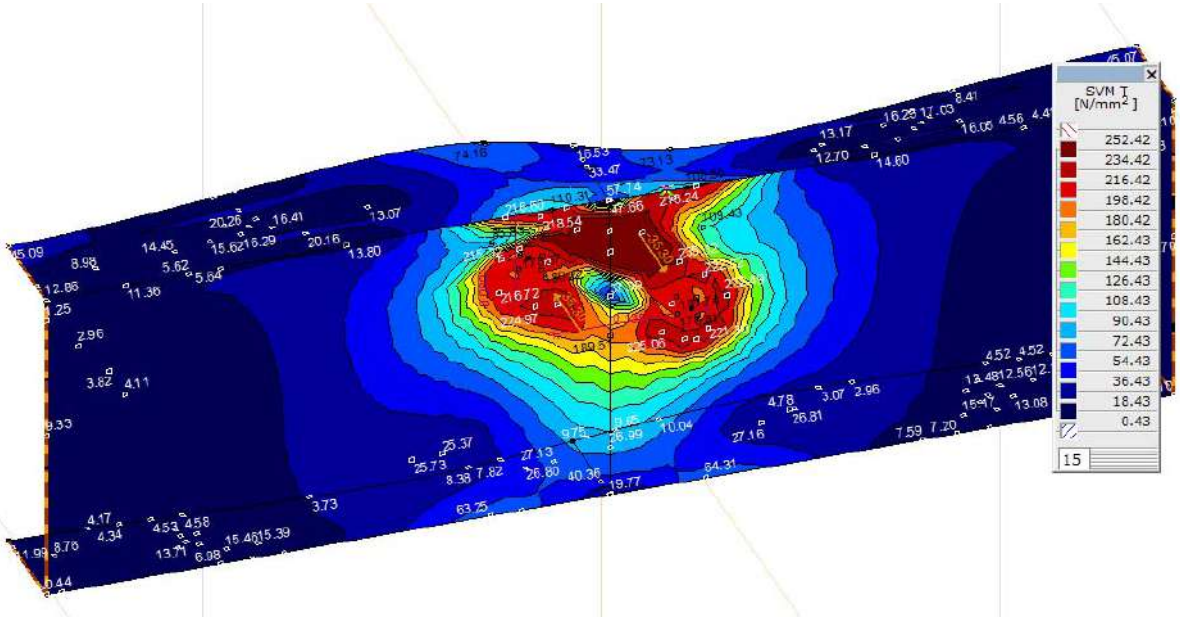



**Figure 4 Stress in the web of UNP 300 member**

The stress in the UNP 300 section is shown in Figure 4. The entire web has not platicised and thus the main diagonal in the onderstuk is structurally sound. No additional strengthening measures are required for the UNP 300 member.

Figure 5 shows the geometry which is modelled in accordance with the asset data.

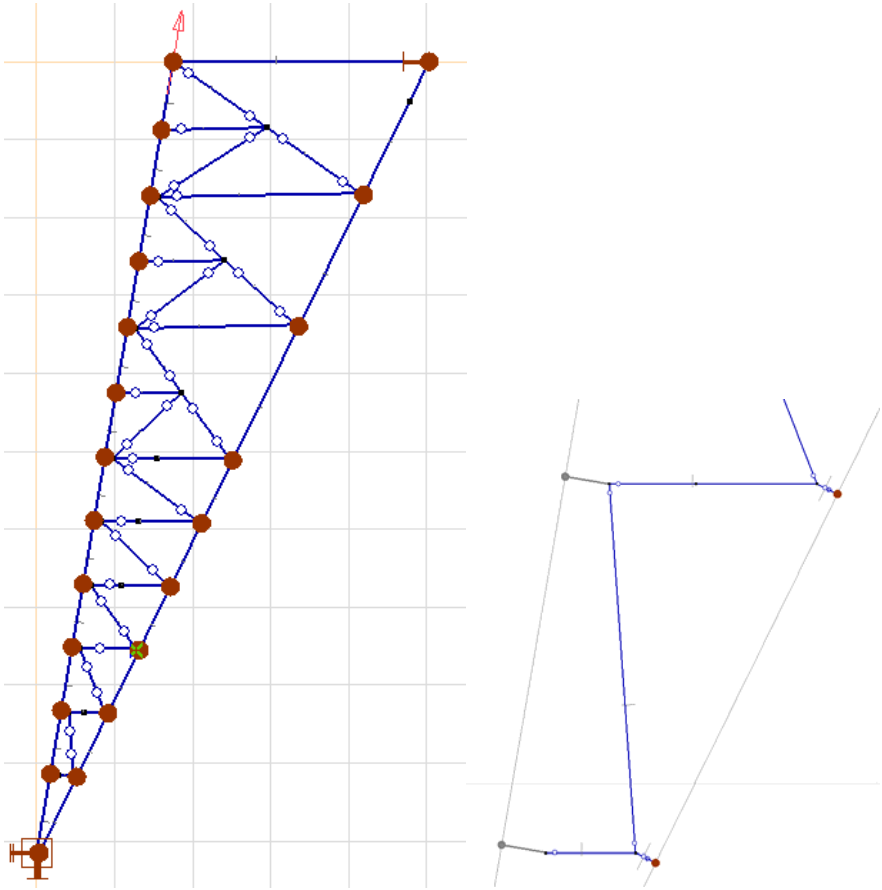


**Figure 5 Axis VM model geometry**

Figure 5 shows the beam end release applied in the full models between the redundant diagonals, and the leg and primary diagonals. The diagonals and the leg members are connected by a fictitious member with a hinge at the end of the diagonal and the value of 235 kNm/m for rotational rigidity a the end of the leg or UNP member. The fictitious member is assigned the cross-section properties of the 130 x 7 mm plate.

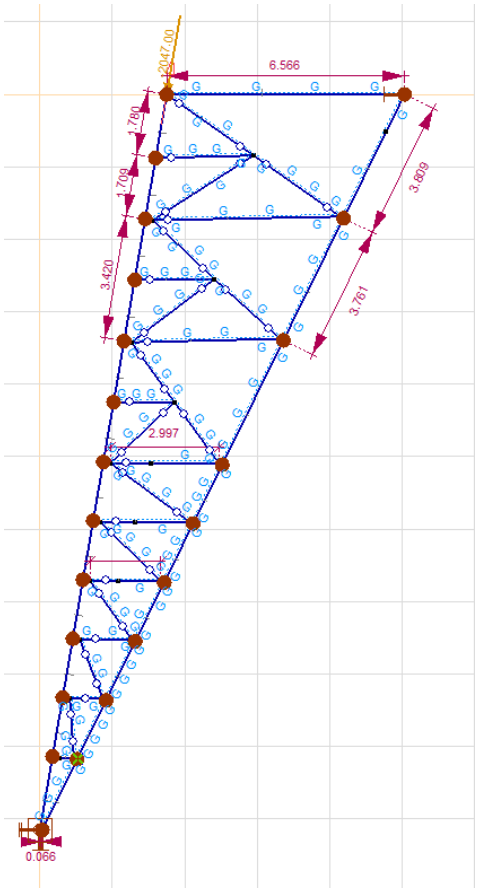



**Figure 6 Axial loading in leg member and dead-load application.**

Figure 6 shows the loading. The axial force is taken from the S+48 tower model. The axial force in the lowest leg segment in the PLS Tower model (2047 kN) together with the dead weight were applied in the AxisVM model. Figure 7 and Figure 8 show the resulting forces in the redundant members.

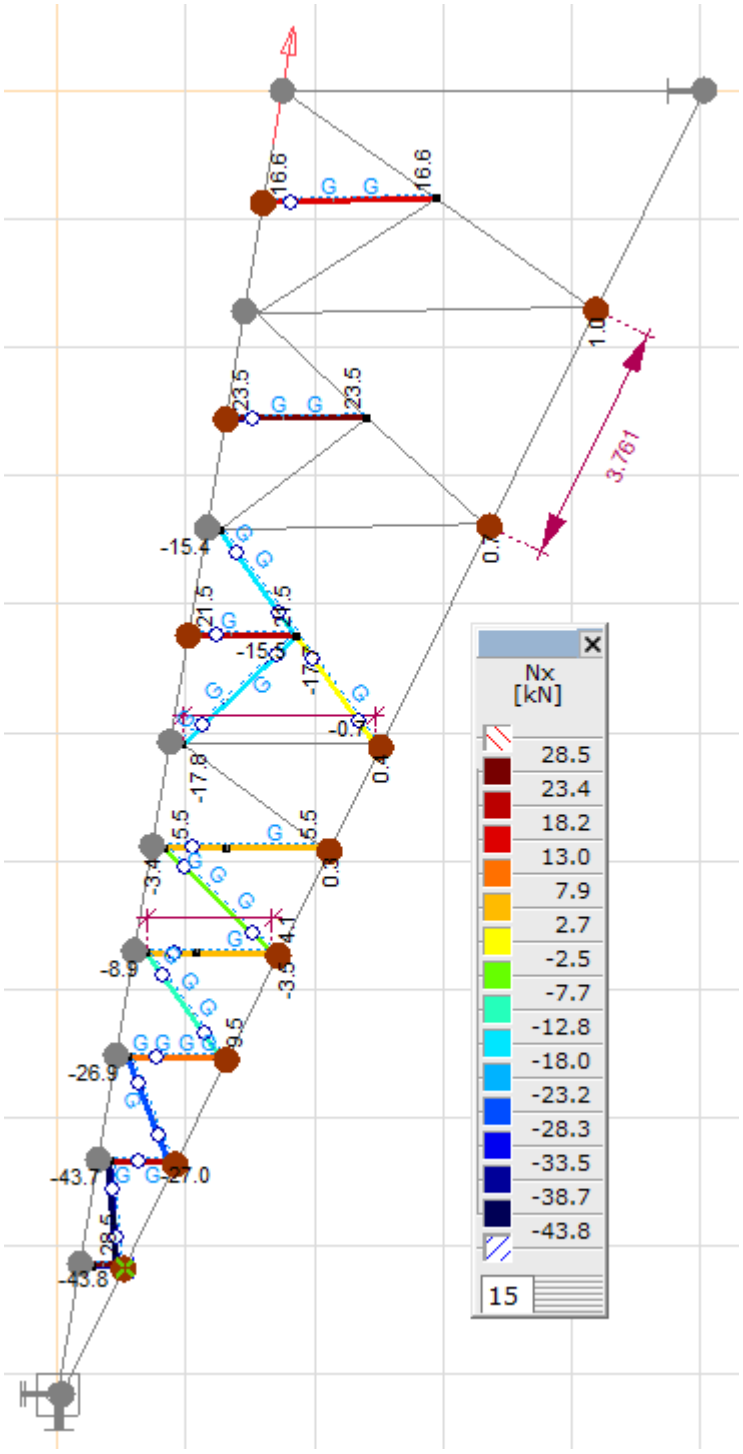



**Figure 7: Axial forces (Nx) in the redundants**

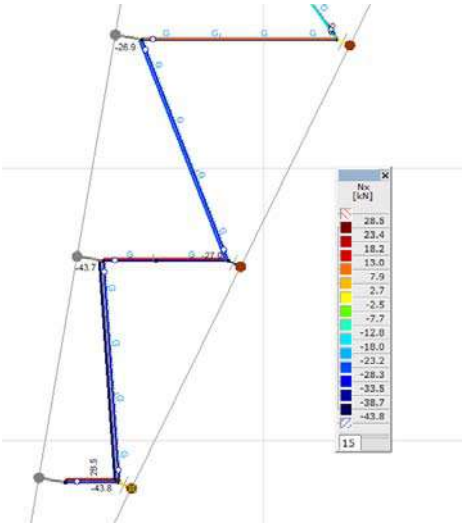



**Figure 8 Axial forces (Nx) in the lower redundants**

Figure 7 shows the axial force in the redundant members. The maximum compressive force occurs in the lower most members. The value being 43 kN in first diagonal and 28.5 in the horizontal member. The forces in the rest of the diagonals are within the capacities of the members. Figure 9 shows an image from PLS Tower with the capacity of the member.

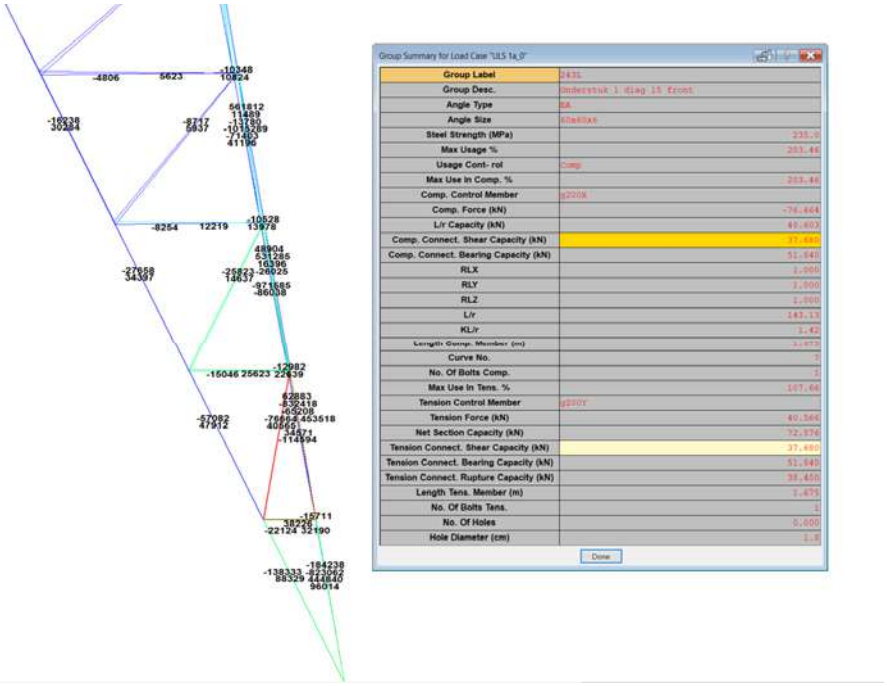



**Figure 9 L60.6 capacity from PLS tower**

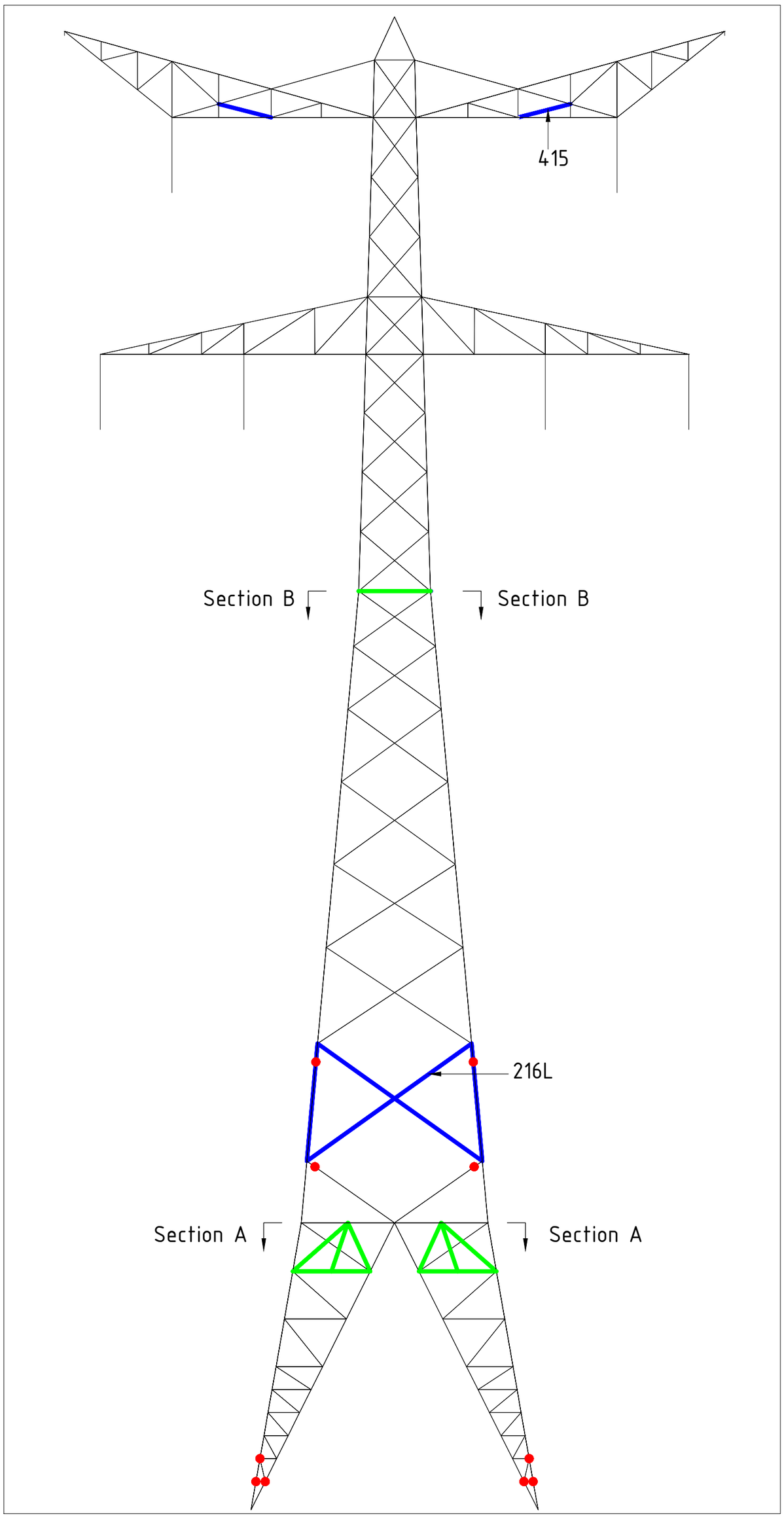
The capacity of all connections which contain 1 x M24-5.6 bolt are limited to 37.68 kN in shear. All the members except the first diagonal which experiences a compressive force of 43 kN, as seen in the AxisVM output, do not require shear strengthening. The shear capacity of the first diagonal marked in Figure 10 below should be increased to accommodate the compressive force of 43 kN.

**Figure 10 strengthening recommendation for redundant members**

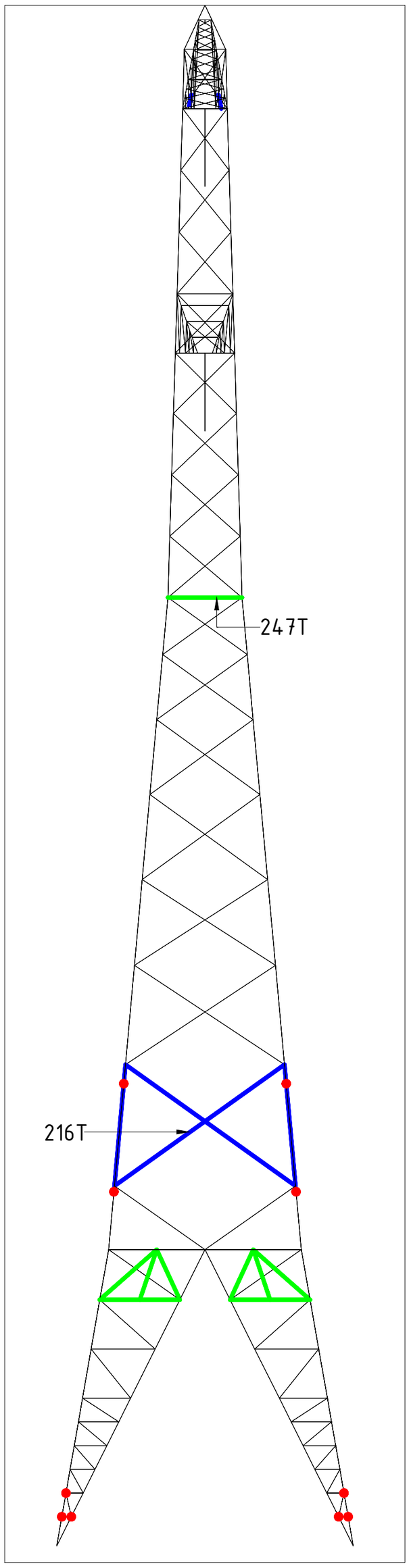
It is recommended that the bolt on the redundant member (indicated in Figure 10) be changed to an M24-8.8. PLS Tower indicates that the shear capacity would then increase to 60 kN which is sufficient.

# 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) |
| 415 | EA | L55x6 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L80x8 | S355 t<=40 | M16-8.8t-NEN2012 |
| 216L | EA | L120x10 | S235 t<=40 | M24-5.6t-NEN2012 | EA | L130x11 | S355 t<=40 | M24-8.8t-NEN2012 |
| 216T | EA | L120x10 | S235 t<=40 | M24-5.6t-NEN2012 | EA | L130x11 | S355 t<=40 | M24-8.8t-NEN2012 |
| 247T | EA | L80x8 | S235 t<=40 | M24-5.6t-NEN2012 | EA | L90x8 | S355 t<=40 | M24-8.8t-NEN2012 |
| 250 | | | | | EA | L120x10 | S355 t<=40 | M20-8.8t-NEN2012 |
| 251 | | | | | EA | L120x10 | S355 t<=40 | M20-8.8t-NEN2012 |
| 252 | | | | | EA | L80x8 | S355 t<=40 | M16-8.8t-NEN2012 |
| 248 | | | | | EA | L75x7 | S355 t<=40 | M16-8.8t-NEN2012 |
| 249 | | | | | EA | L70x6 | S355 t<=40 | M16-8.8t-NEN2012 |




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 | 1-7-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-018

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | Description: Modifications overview for mast type S+48 (mast 84) Page 1 of 2 |
| Drawn by: | MuK | 1-7-2020 | Units: | m | Revision: 00 |
| Checked by: | TBR | 1-7-2020 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 2-7-2020 | 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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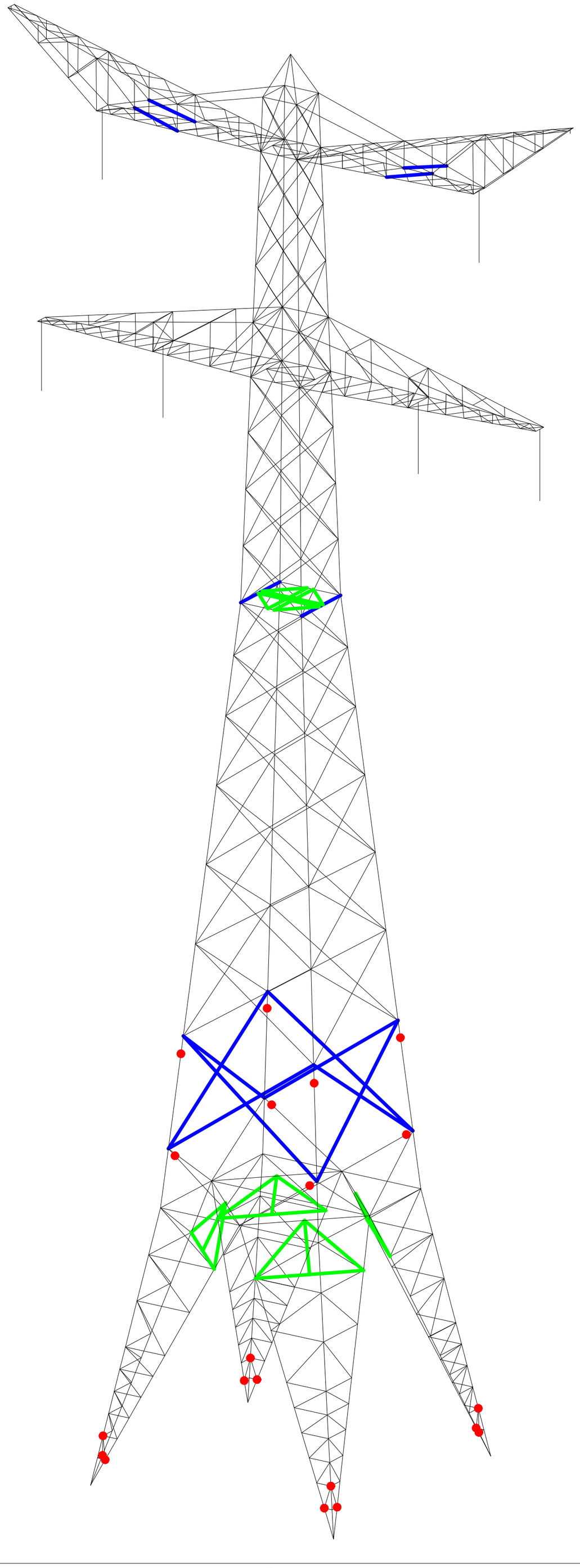
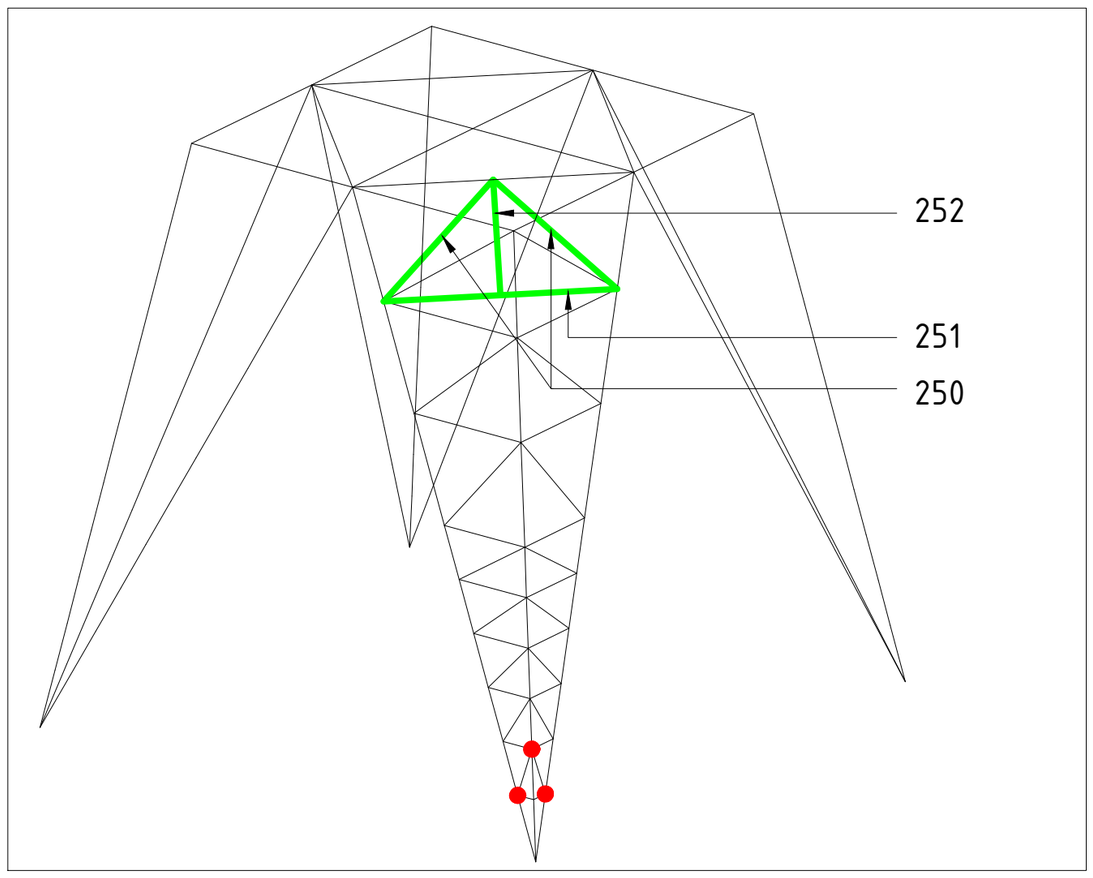
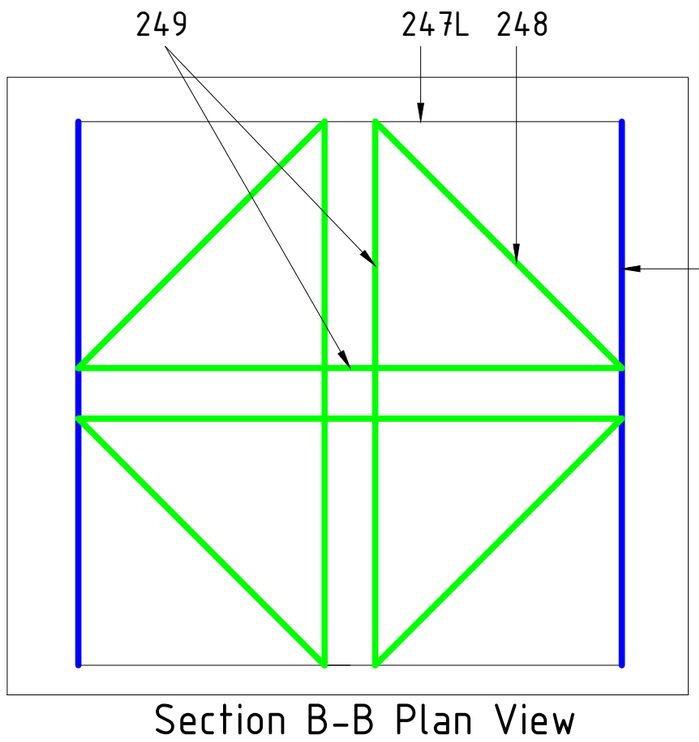


Overview




Section A-A Overview




Section B-B 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 exchanged**
**New redundant**
**Bolt exchanged**

| | | |
|---|---|---|
| 00 | 1-7-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-018

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| Design state: | FINAL | | Scale: | - | Description: Modifications overview for mast type S+48 (mast 84) Page 2 of 2 |
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Bijlage 21 Rapportage Mastconstructie S+75 & S+75 T

DNV·GL

"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

# KIJ-GT380 – Rapportage mast S+75 & S+75T

## TenneT TSO B.V.

**Meridian doc. nr.:** 002.589.40 0916503
**Rapport nr.:** 21-1093 Rev.0
**Datum:** 2021-07-05

| | | |
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| Projectnaam: | "Toetsing en herontwerp masten en fundaties BBB380" | DNV GL - Energy<br>Energy Advisory |
| Rapport titel: | KIJ-GT380 – Rapportage mast S+75 & S+75T | Postbus 9035 |
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| Rapport nr.: | 21-1093 Rev.0 | |

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|---|---|---|
| [redacted] | | |

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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+75 en S+75T 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+75.

### 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 Documenten TNO

TNO heeft 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.

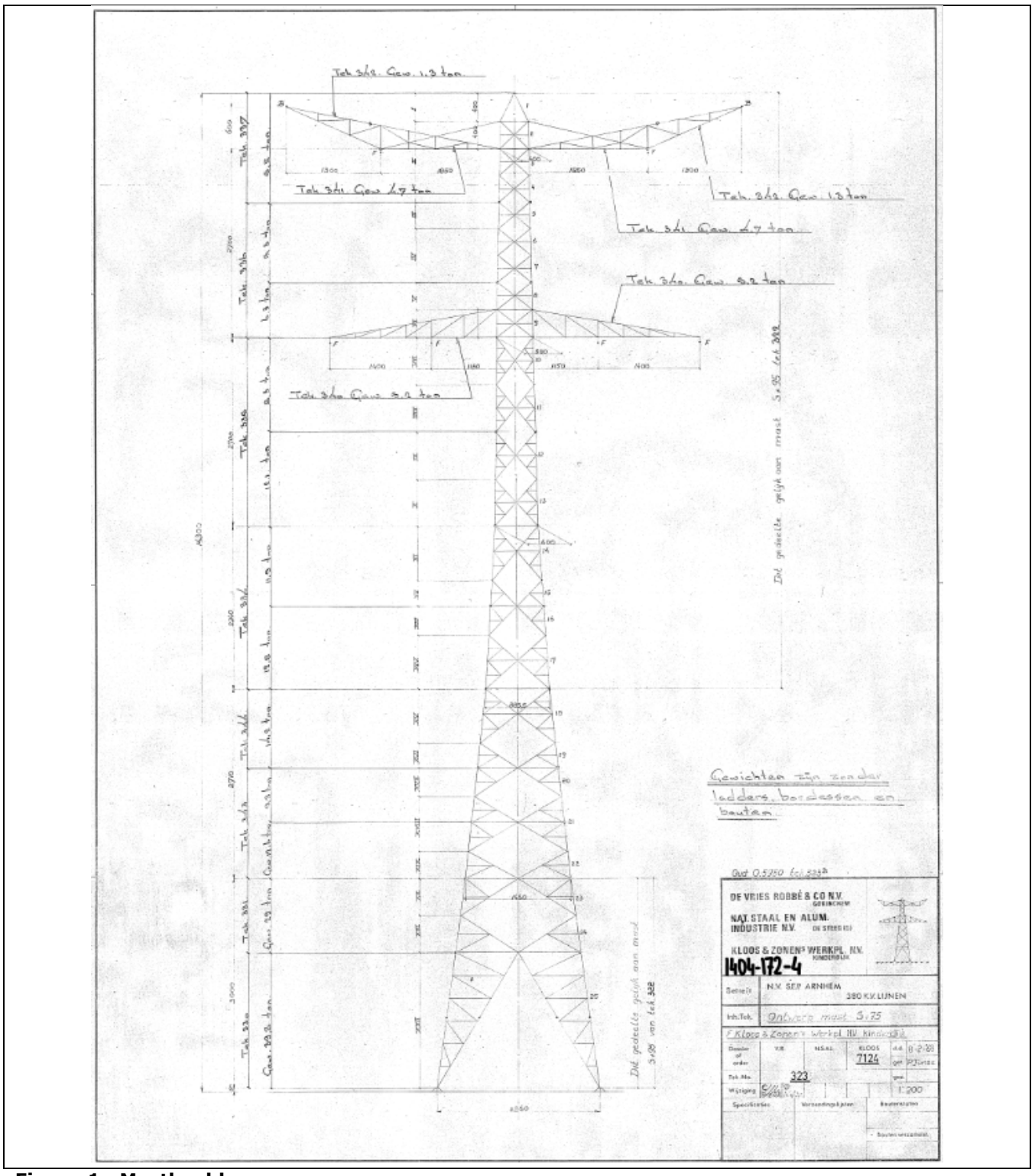
**Tabel 1 Relevante eisen**

| Eis Id | Titel | Eis Tekst | Bewijsvoering |
|---|---|---|---|
| BO Eis: H2.7-6 | Omgeving, beperkings factoren | Het ontwerp dient geverifieerd te worden op de uitvoerbaarheid. | Tabel 10 |
| 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".<br><br>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 10 |

# 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 worden masttypen S+75 en S+75T getoetst. Er zijn twee masten van het type S+75 (mast 50 en 52) en ook twee masten van het type S+75T (mast 49 en 53). De geometrie en de constructie van de masttypen S+75 en S+75T komen met elkaar overeen, alleen beschikt de mast van het type S+75T 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**

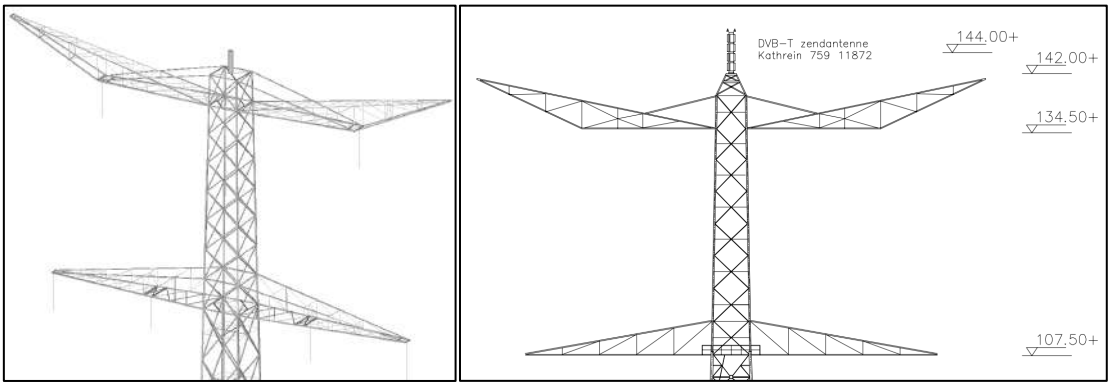
| Mastnummer | Masttype | Maatgevend mastnummer | Wind span (m) | Weight span (m) | Hoogteverschil |
|---|---|---|---|---|---|
| 49 | S+75T | 49 | 594 | 1145 | 74.3 |
| 50 | S+75 | 50 | 651 | 1056 | 70.2 |
| 52 | S+75 | 50 | 651 | 1053 | 69.7 |
| 53 | S+75T | 53 | 631 | 1113 | 75.4 |

Masten 49, 50 en 52 liggen tussen windgebied II en windgebied III. Mast 53 ligt in windgebied III.

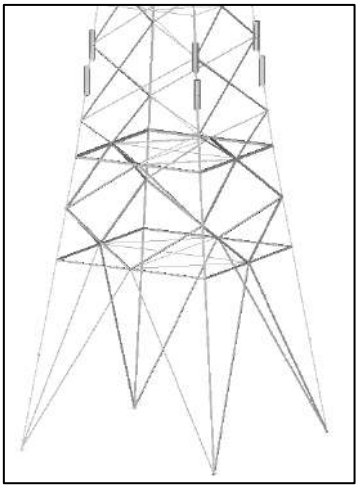
## 3.3 Telecominstallatie

Mast 49 en 53 bevatten een telecominstallatie. Op mast 49 is er een installatie aanwezig op de top van de mast en de onderzijde van de mast. Op mast 53 is er alleen een installatie aan de onderzijde van de mast aanwezig.

De antenne op de top van mast 49 is een televisieantenne welke verschilt van het antennetype (5G-antenne) uit het uitgangspuntenrapport. Er zijn geen specifieke gegevens over deze antenne aangeleverd. De afmetingen van de antenne zijn geschat op 5x1m op basis van de beschikbare tekening, zie Figuur 2. Dit oppervlak van 5m$^2$ is ook aangenomen in het PLS Tower model. Voor de reguliere antenne aan de onderzijde van de mast zijn dezelfde uitgangspunten gehanteerd, zoals omschreven in het uitgangspuntenrapport. In Figuur 2 en Figuur 3 zijn de installaties in het PLS Tower model weergegeven.




**Figuur 2 Positie telecominstallatie op mast 49**



**Figuur 3 Positie telecominstallatie aan de onderzijde van mast 49 en 53**

## 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 mast S+75 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 | NEN-EN50341-2-15:2019 |
| | Windgebied | II/III – Mast 49 en 50<br>III – Mast 53 |
| | Terreincategorie | II (onbebouwde omgeving) |
| | Reductiefactor cdir | 1,00 |
| Situatie initieel | Gevolgklasse | CC2-0 |
| | Betrouwbaarheidsniveau | Afkeur CC2-0 |
| | Referentieperiode | 15 jaar |
| Situatie na aanpassingen | Gevolgklasse | CC2 |
| | Betrouwbaarheidsniveau | Verbouw |
| | Referentieperiode | 50 jaar |

Op foto's van de S+75 is waargenomen dat er horizontale stabiliteitsverbanden aanwezig zijn in het mastlichaam, echter zijn de daaraan gerelateerde tekeningen niet beschikbaar. Het achterwege laten van deze stabiliteitsverbanden in het rekenmodel heeft geen invloed op de resultaten van de randstijlen en kruisverbanden, desalniettemin kunnen deze onderdelen niet getoetst worden aan de ontwerpcriteria voor knikverkorters.

## 3.5 Windrichtingsfactor ($c_{dir}$)

De windrichtingsfactor $c_{dir}$ houdt rekening met de gevarieerde referentie windsnelheid afhankelijk van de windrichting. Het artikel gerelateerd aan $c_{dir}$ uit de NEN-EN 50341-2 is weergegeven in Figuur 4. Het volledige oostelijke deel aan windrichtingen heeft een $c_{dir}$ van 0,85. De reductie van 1,00 naar 0,85 heeft

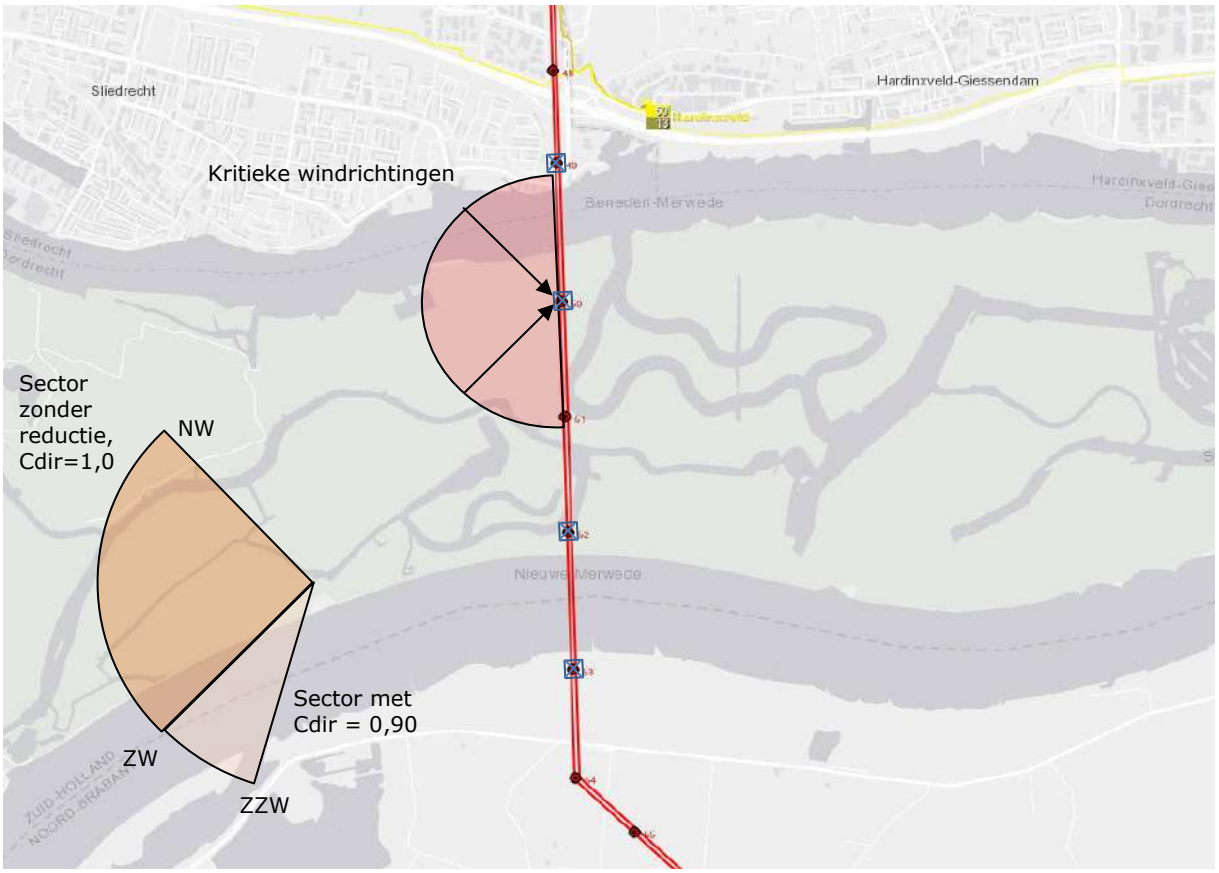
[1] Zie TNO rapport 2021 R10305

een significant positieve invloed op de windbelasting, aangezien de stuwdruk een kwadratische relatie heeft met de windsnelheid.

Tijdens het proces van de beoordeling van mast S+75 is het gebruik van factor $c_{dir}$ aangenomen om een betrouwbaarheidsniveau te verkrijgen die beter past bij de oorspronkelijke ontwerpbelasting volgens NEN 1060. Conform NEN-EN 50341-2-15 is het gebruik van $c_{dir}$ alleen toegestaan voor kustgebieden, echter na discussie met TNO[2] is er geconcludeerd dat $c_{dir}$ ook gebruikt kan worden voor andere gebieden.

**NL.1** For area category 0 "coast" (see Figure 4.3/NL.3) the wind directional factor $c_{dir}$ may be taken into account:
- for wind direction (degrees) 315 - 360 and 0 - 195 (North is 0 and 360 degrees, East is 90 degrees and so on): $c_{dir}$ = 0,85;
- for wind direction (degrees) 195 - 225: $c_{dir}$ = 0,9;
- for wind direction (degrees) 225 - 315: $c_{dir}$ = 1,0.

**Figuur 4 $c_{dir}$ uit NEN-EN 50431-2 art. 4.3.2 NL1**



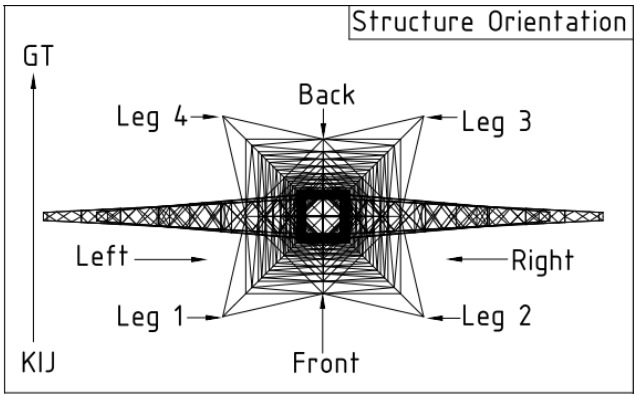

**Figuur 5 Toepassing van $c_{dir}$ voor mast S+75 in KIJ-GT**

In Figuur 5 is weergegeven dat de noord-zuid oriëntatie van de lijn het toestaat om onderscheid te maken tussen wind uit het westen en gereduceerde wind uit het oosten. Dit is weergegeven in Tabel 4 en in Figuur 6. De factor $c_{dir}$ resulteert in een grote reductie van de windbelasting, in hoofdstuk 4 is omschreven hoe $c_{dir}$ is meegenomen in de controle van de constructie.

[2] Zie TNO rapport 2021 M10197

**Tabel 4 Uitgangspunten berekening**

| Leg | Position | $C_{dir}$ (comp) | $C_{dir}$ (ten) | $R_{comp}$ (kN) | $R_{ten}$ (kN) | Ratio comp. |
|---|---|---|---|---|---|---|
| 1 | NO | 1,00 | 0,85 | 4233 | -2028 | 100% |
| 2 | NW | 0,85 | 1,00 | 3281 | -2978 | 78% |
| 3 | ZW | 0,85 | 1,00 | 3281 | -2978 | 78% |
| 4 | ZO | 1,00 | 0,85 | 4233 | -2028 | 100% |




**Figuur 6 Oriëntatie van de constructie, het noorden is aan de onderzijde**

## 3.6 Proces stappen

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

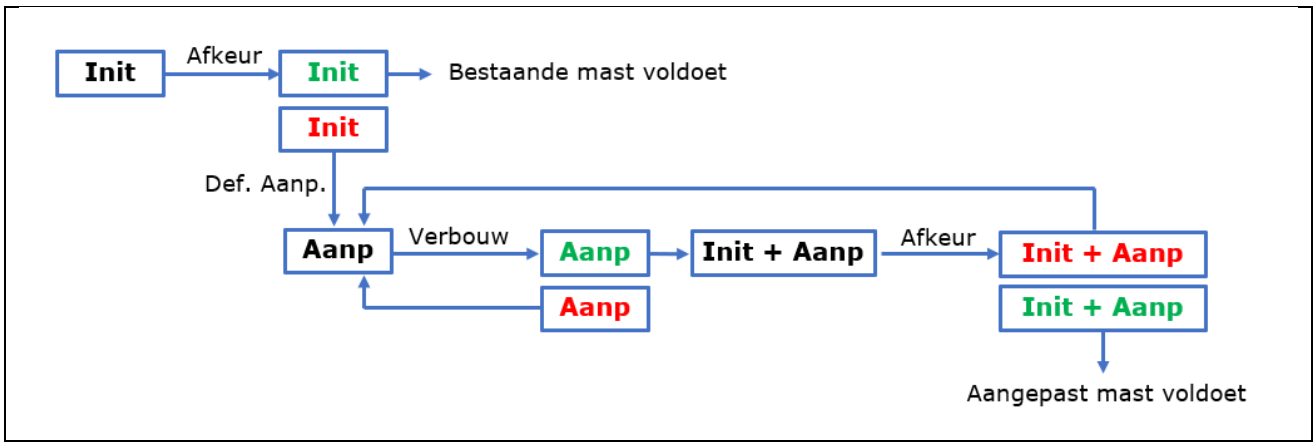
Stap 1: Toets bestaande (Init) mast op Afkeur

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 7 weergegeven.




**Figuur 7 Proces diagram**

## 3.7 Geleiderbelastingen

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

## 3.8 Reacties op de fundering

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

## 3.9 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. Aan de hand van een FEM-analyse is bepaald wat de effecten zijn van het aanpassen van het aangrijpingspunt van de geleider en de bliksemdraad op de boventraverse. 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. In geval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

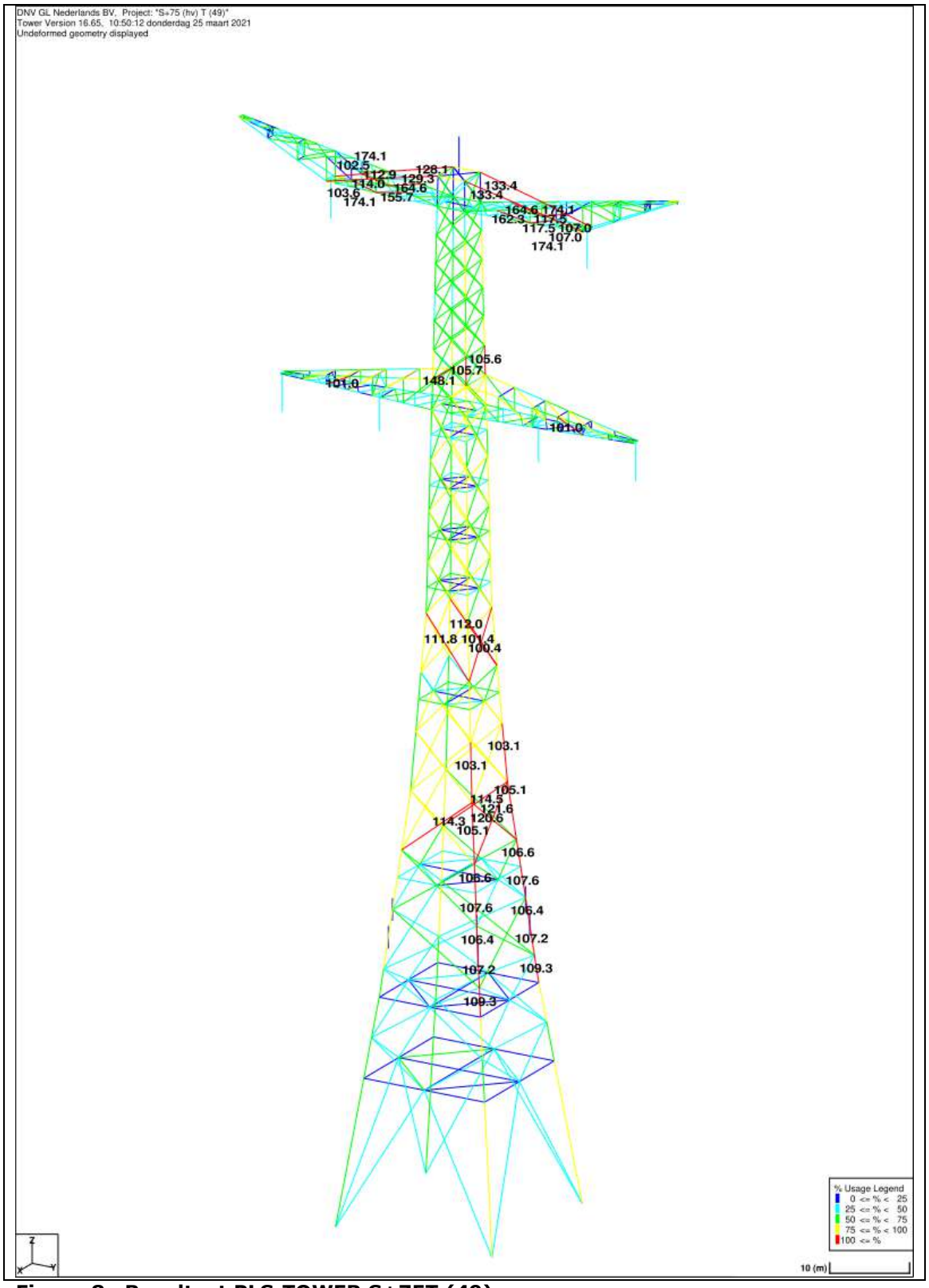
Door toepassing van de factor $c_{dir}$ wordt er een onderscheid gemaakt in de benodigde maatregelen aan de randstijlen aan de oostzijde (randstijl 1 en 4) en aan de westzijde (randstijl 2 en 3), zie Figuur 6.

## 3.10 Dynamische factor

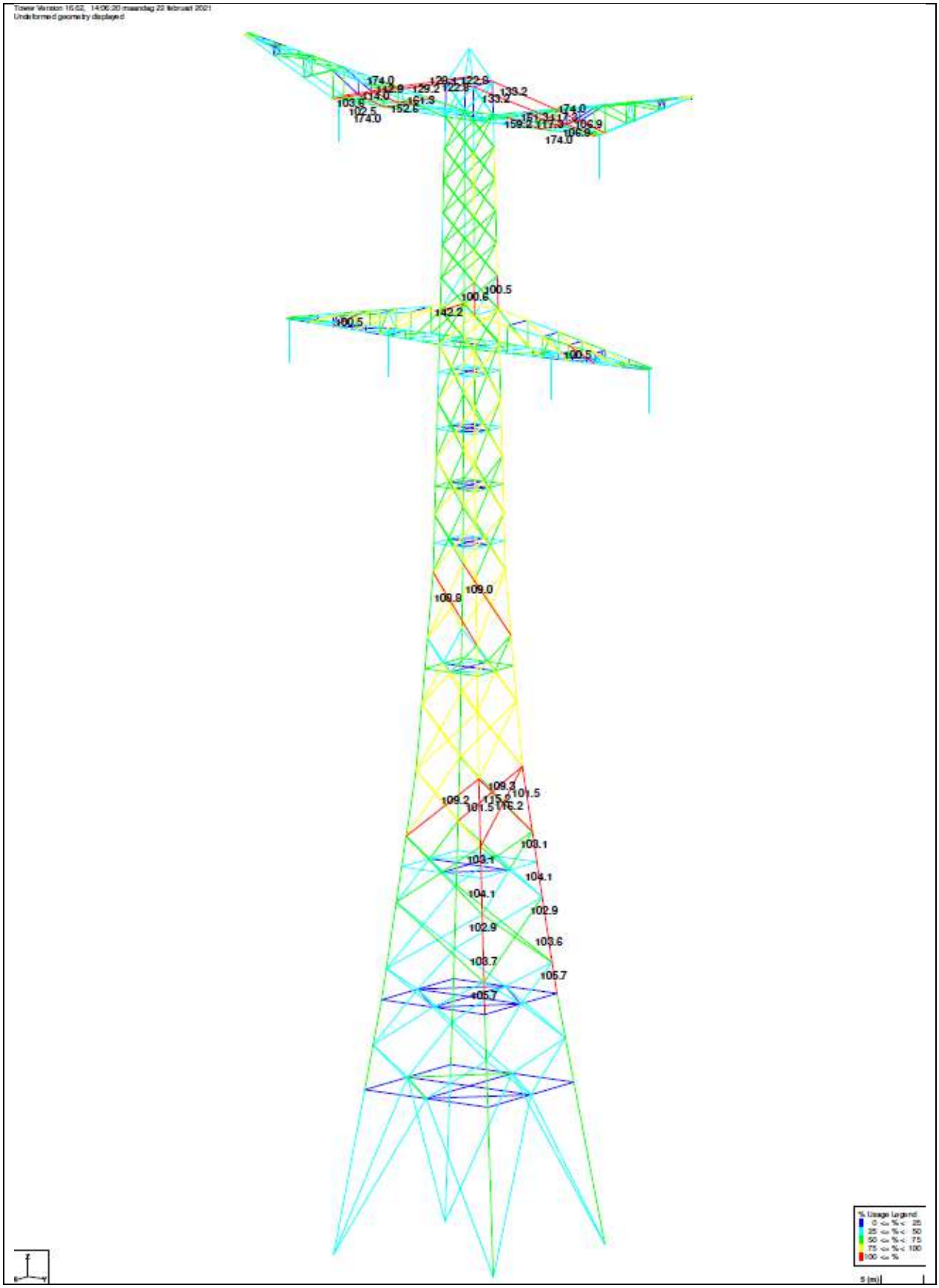
Conform NEN-EN 50341-2 moet de dynamische factor $c_d$ worden berekend voor masten hoger dan 60m. Aan de hand van Axis-VM is de eigen frequentie van de mast bepaald, waarna de procedure uit NEN-EN 50341-2-15 is gevolgd. Uit de procedure voor de S+75 blijkt er een dynamische factor van 1,01 moet worden toegepast, voor berekening zie Appendix D.

# 4 TOETSING MAST

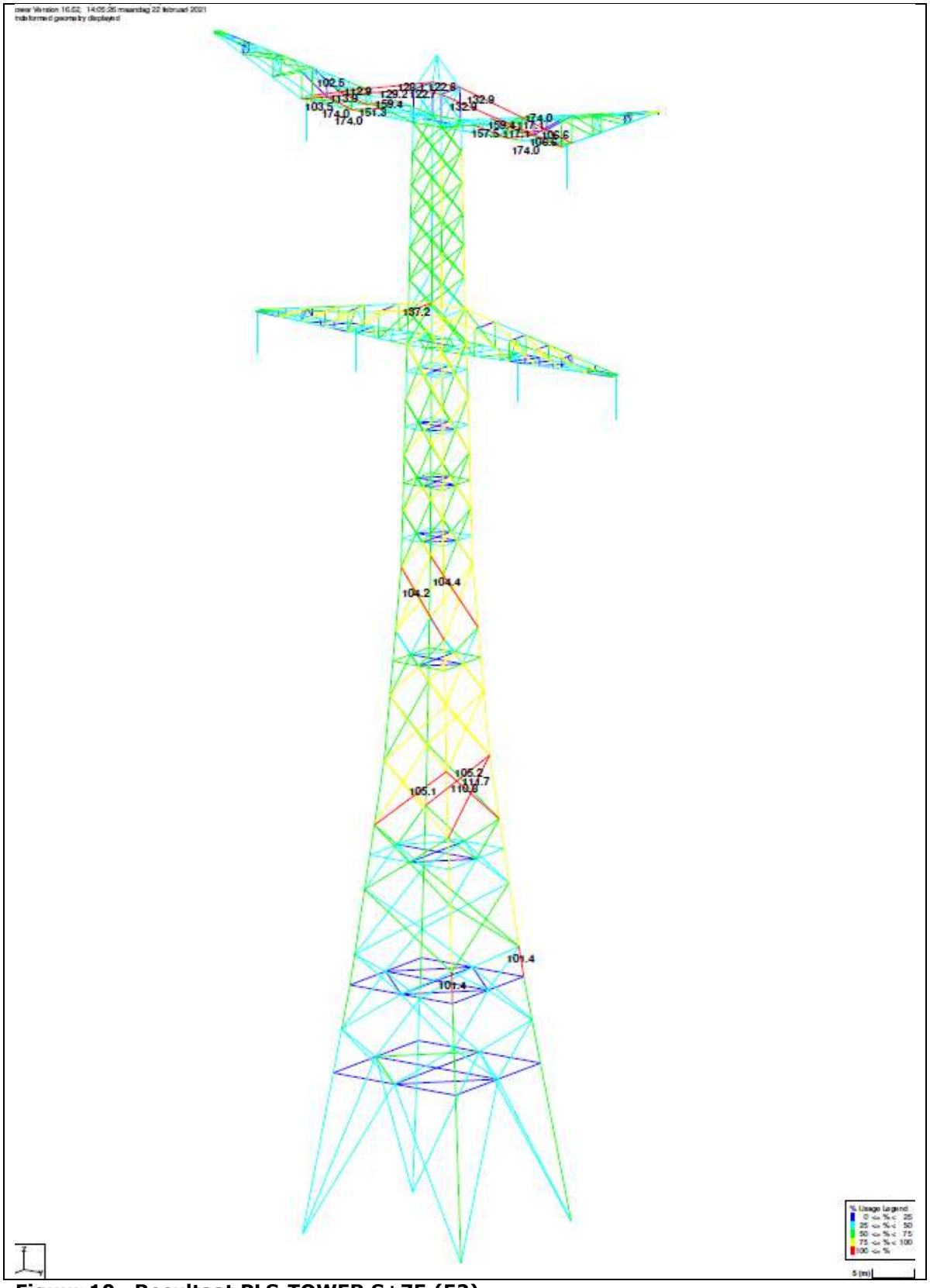
Het resultaat van de controle van de mastconstructie type S+75 en S+75T met belastingen op afkeurniveau en referentieperiode 15 jaar is weergegeven in Figuur 8 tot Figuur 11.



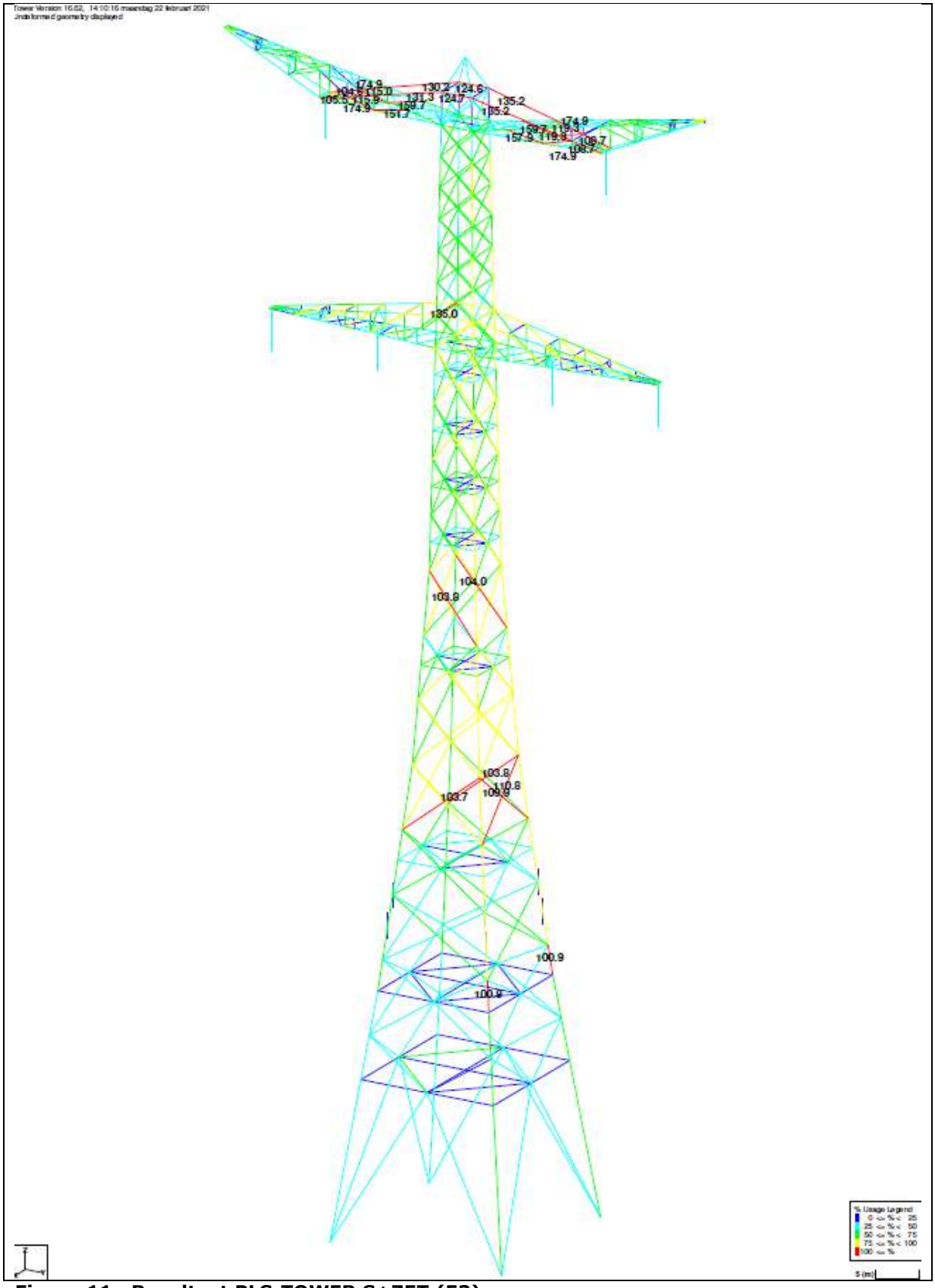

**Figuur 8 Resultaat PLS-TOWER S+75T (49)**




**Figuur 9 Resultaat PLS-TOWER S+75 (50)**




**Figuur 10 Resultaat PLS-TOWER S+75 (52)**




**Figuur 11 Resultaat PLS-TOWER S+75T (53)**

De resultaten van de controles van profielen, knikverkorters en ankers randstijl zijn opgenomen in Tabel 5.

**Tabel 5 Samenvatting controle**

| Controle van | Beoordeling | | Referentie |
|---|---|---|---|
| Profielen | | Voldoen niet | Figuur 8<br>Figuur 9<br>Figuur 10<br>Figuur 11<br>Appendix D |
| Knikverkorters | | Voldoen niet | Appendix C |
| Ankers en voetplaat | Voldoen | | Appendix D |

# 5 AANPASSINGEN

## 5.1 Inleiding

Een versterkingsvoorstel om de mast aan afkeurniveau (referentieperiode 15 jaar) te laten voldoen en nieuwe onderdelen aan verbouwniveau is uitgewerkt. In Tabel 6 zijn de benodigde aanpassingen per mast samengevat. Zwaardere maatregelen zijn nodig vanaf mast 53 (windgebied III) naar mast 49 (tussen windgebied II en III) door de verhoogde windsnelheid.

**Tabel 6 Samenvatting aanpassingen per mast**

| Aanpassingen | Mastnummers | | | |
|---|---|---|---|---|
| | 49 | 50 | 52 | 53 |
| Platen om de netto doorsnede te vergroten van trekstaven in de boventraverse | X | X | X | X |
| Vervangen van diagonalen in de boventraverse | X | X | X | X |
| Vervangen van horizontale staven in de verbinding tussen de ondertraverse en het mastlichaam | X | X | X | X |
| Vervangen van bouten in het mastlichaam boven de ondertraverse | X | X | | |
| Vervangen van bouten in een diagonaal van de ondertraverse | X | X | | |
| Vervangen van bouten in verschillende kruisverbanden in het mastlichaam | X | X | X | X |
| Vervangen van kruisverbanden in het mastlichaam | X | X | | |
| Platen om de afschuifcapaciteit van kruisverbanden te verhogen | X | X | | |
| Toevoegen van nieuwe knikverkorters aan de randstijlen | X | X | X | X |
| Vervangen van bestaande knikverkorters | X | X | X | X |

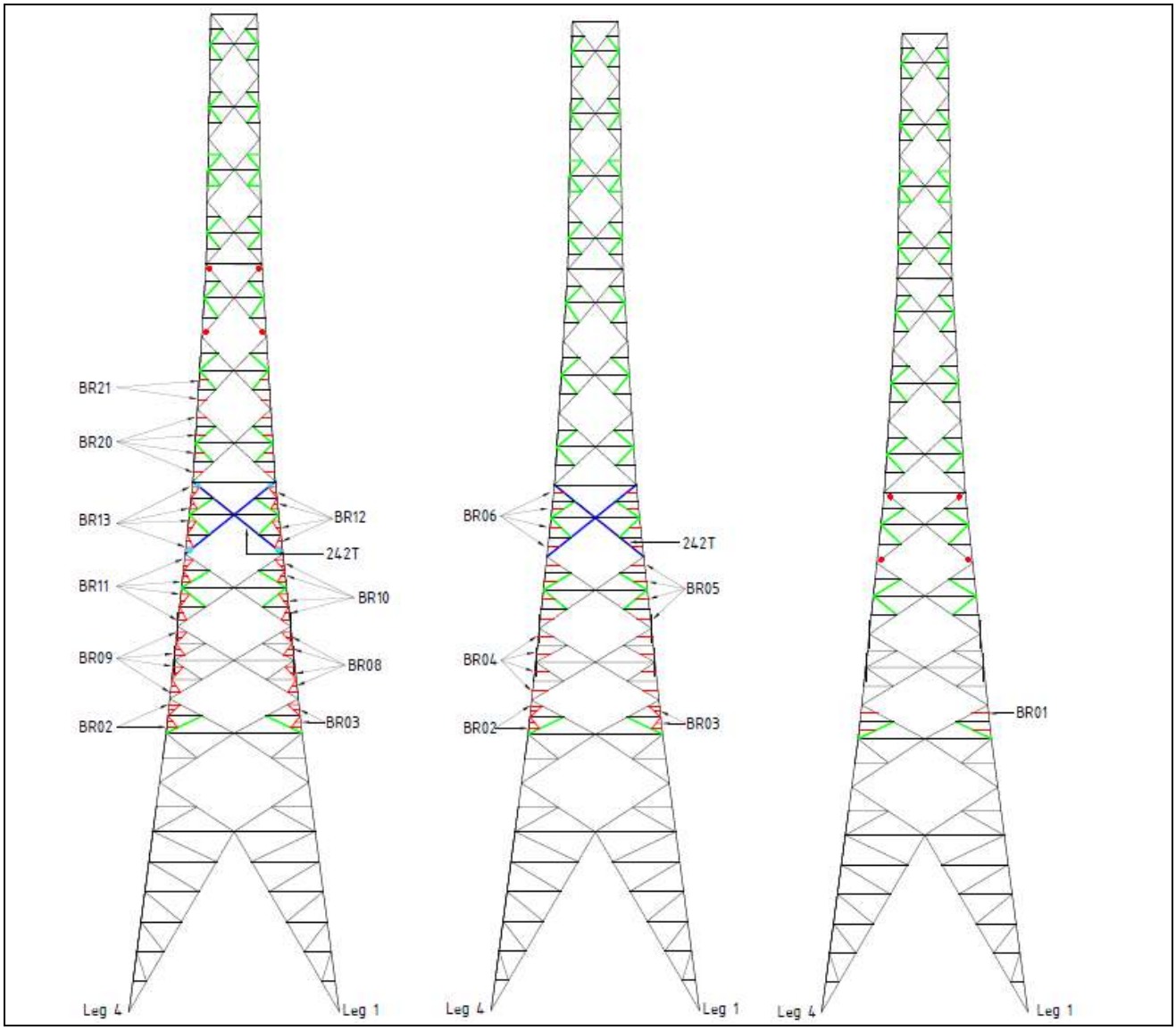
Het betreft een aandachtspunt dat de aanwezigheid van waarschuwingslichten, platforms of andere obstakels het aanbrengen van de aanpassingen kunnen bemoeilijken. Het is noodzakelijk dat er een haalbaarheidsstudie wordt uitgevoerd vóór de uitvoering van dit project.

## 5.2 Aanpassingen

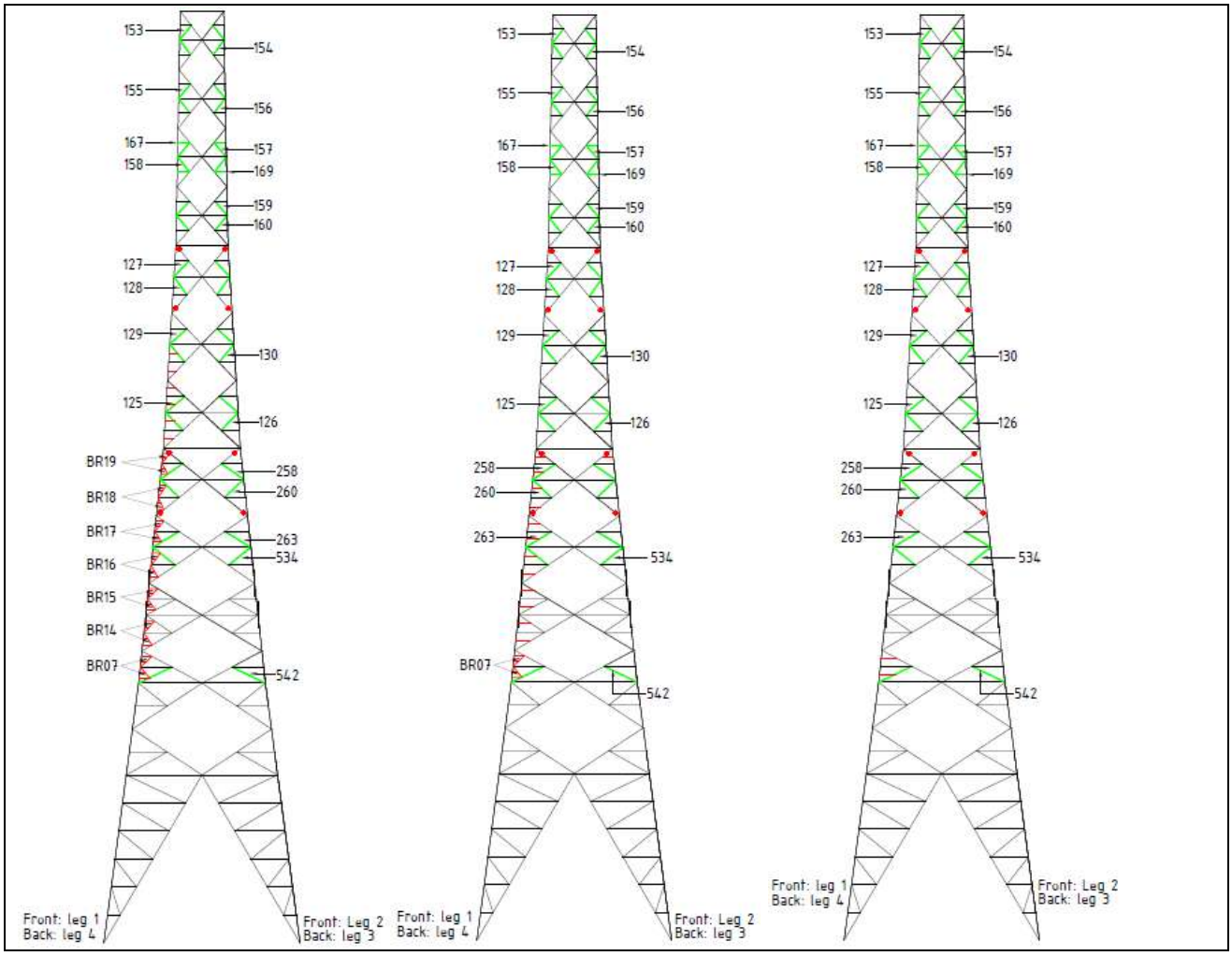
### 5.2.1 Overzicht

Conform berekening, zie Appendix B, moeten de constructie worden aangepast, zoals weergegeven in Figuur 12 tot en met Figuur 14 voor de betreffende masten. Voor afmetingen profielen en bouten, zie Appendix E.

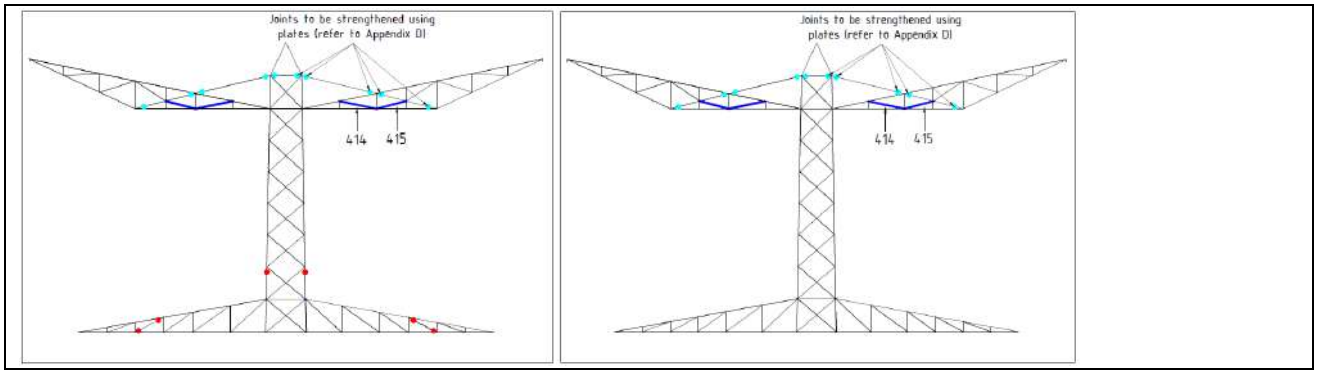
Let op de nummering van de randstijlen, zoals weergegeven in Figuur 6.




**Figuur 12 Linker zijaanzicht mast 49 (links), mast 50 (midden) en mast 52&53 (rechts)**



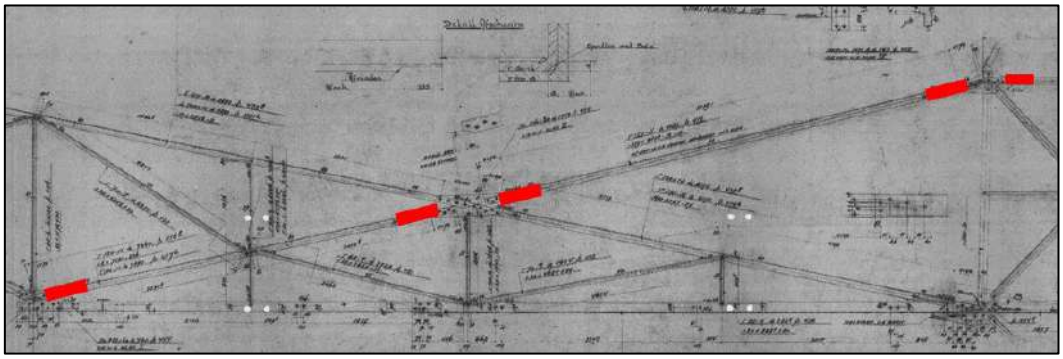

**Figuur 13 Voor/achteraanzicht mast 49 (links), mast 50 (midden) en mast 52&53 (rechts)**




**Figuur 14 Benodigde aanpassingen aan de traversen van mast 49 & 50 (links) en 52 & 53 (rechts)**

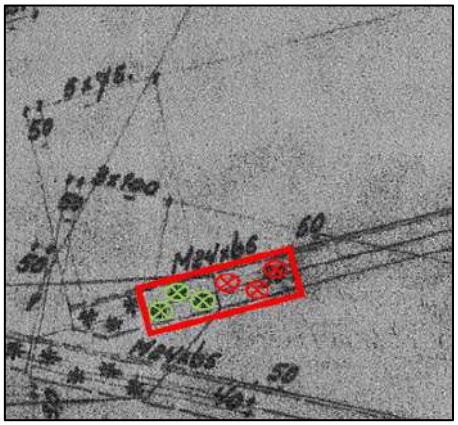
### 5.2.2 Verhogen capaciteit netto doorsnede

Voor alle S+75 masten is het nodig om de trekstaven die de boventraverse aan het mastlichaam verbindt aan te passen. De aanpassingen zijn nodig om de capaciteit van de netto doorsnede te verhogen door het toevoegen van staalplaten met een dikte van 10mm. In Figuur 15 zijn de posities van de platen weergegeven.



**Figuur 15 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 16. De nieuwe bouten zijn in het rood weergegeven en de bestaande bouten in het groen.

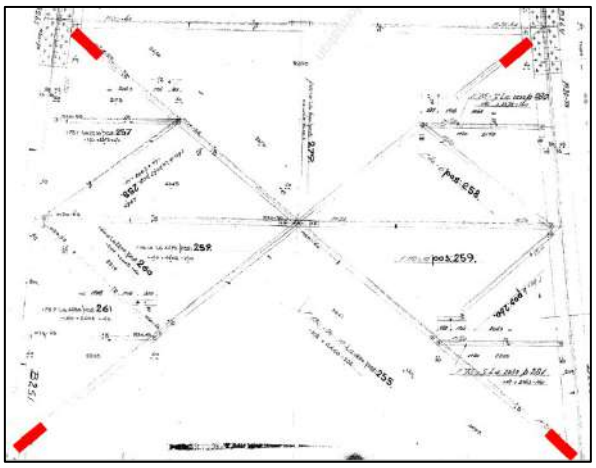


**Figuur 16 Verbinding van de plaat aan de bestaande staaf**

Voor relevante berekening van de sterkte van de platen, zie Appendix D.

### 5.2.3 Verhogen afschuifcapaciteit

Van de verbinding van de staaf P255 aan de randstijl in mast 49 en 50 moet de afschuifcapaciteit verhoogd worden. In Figuur 17 zijn de specifieke posities weergegeven.



**Figuur 17 Posities waarvoor een hogere capaciteit benodigd is**

In de bestaande situatie is er slechts één bout aanwezig in de verbinding aan de randstijl. Deze aanpassing bevat ook de toevoeging van een staalplaat van 10mm en een extra bout in het been van de bestaande diagonaal, zoals weergegeven in Figuur 18. De nieuwe bouten moeten een boutkwaliteit van 8.8 hebben.

**Figuur 18 Positie van bouten voor aanpassing afschuifcapaciteit**

### 5.2.4 Uitwisseling knikverkorters

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 staven met een grotere doorsnede, omdat de knikcontrole veelal maatgevend is. Zie de groen gekleurde staven in Figuur 12 en Figuur 13.

### 5.2.5 Toevoeging knikverkorters randstijl

Extra knikverkorters zijn nodig om de knikcapaciteit van randstijl 1 en 4 te verhogen. Dit resulteert in verschillende samenstellingen van knikverkorters voor elke zijde van de mast. Zie staven met label "BR" in Figuur 12 en Figuur 13.

De nieuwe knikverkorters zijn benodigd in het middenstuk en het broekstuk van de mast, boven de INP-kruisstaven en onder de ondertraverse. Mast 49 wordt het zwaarst belast en heeft de meeste nieuwe

knikverkorters nodig. De afmetingen van de nieuwe knikstaven zijn zo gekozen dat deze voldoende weerstand hebben tegen torsieknik. Alle nieuwe knikverkorters hebben een doorsnede van 60x6mm.

### 5.2.6 Gewicht benodigde profielen

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de aanpassingen zijn weergegeven in Tabel 7 tot en met Tabel 9. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

**Tabel 7 Gewichten profielen voor aanpassingen mast 49**

| Staaf-groep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Nr | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 414 | L70.7 | S235 | 1M16-5.6t | L90.9 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 4,68 | 227,29 |
| 415 | L65.7 | S235 | 1M16-5.6t | L80.8 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 3,79 | 147,06 |
| 109A | L200.20 | S235 | 8M30-5.6t | L200.20 | S235 | 8M30-8.8t | Bout uitgewisseld | | | |
| 212T | L80.8 | S235 | 2M20-5.6t | L100.12 | S355 | 2M20-8.8t | Profiel uitgewisseld | 2 | 4,80 | 171,89 |
| 317 | L60.6 | S235 | 1M16-5.6t | L60.6 | S235 | 1M16-8.8t | Bout uitgewisseld | | | |
| 117A | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 117B | X250.20 | S235 | 36M30-5.6t | X250.20 | S235 | 36M30-5.6t | Knikverkorter toegevoegd | | | |
| 118A | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 118B | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 119A | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 119B | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 120A | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 120B | X250.20 | S235 | 36M30-5.6t | X250.20 | S235 | 36M30-5.6t | Knikverkorter toegevoegd | | | |
| 235L | L150.100.10 | S235 | 1M30-5.6t | L150.100.10 | S235 | 1M30-8.8t | Bout uitgewisseld | | | |
| 235T | L150.100.10 | S235 | 1M30-5.6t | L150.100.10 | S235 | 1M30-8.8t | Bout uitgewisseld | | | |
| 242L | L130.90.10 | S235 | 1M24-5.6t | L130.90.10 | S235 | 1M24-8.8t | Bout uitgewisseld | | | |
| 242T | L130.90.10 | S235 | 1M24-5.6t | L130.11 | S355 | 1M24-8.8t | Profiel uitgewisseld | 4 | 12,46 | 1084,97 |
| 542 | L80.8 | S235 | 1M20-5.6t | L90.8 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 4,12 | 366,26 |
| 534 | L65.7 | S235 | 1M20-5.6t | L75.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,09 | 200,13 |
| 263 | L65.7 | S235 | 1M20-5.6t | L75.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,19 | 206,61 |
| 260 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,89 | 173,86 |
| 258 | L60.6 | S235 | 1M20-5.6t | L75.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,05 | 197,54 |
| 126 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,72 | 163,64 |
| 125 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,78 | 167,24 |
| 130 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,48 | 119,47 |
| 129 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,42 | 116,58 |
| 128 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,41 | 116,10 |
| 127 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,33 | 112,25 |
| 160 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,12 | 85,61 |
| 159 | L50.5 | S235 | 1M16-5.6t | L60.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,19 | 96,85 |
| 169 | L50.5 | S235 | 1M16-5.6t | L50.5 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 1,32 | 40,55 |
| 158 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,08 | 84,00 |
| 157 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,14 | 86,42 |
| 167 | L50.5 | S235 | 1M16-5.6t | L50.5 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 1,30 | 39,84 |
| 156 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,03 | 81,98 |
| 155 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,07 | 83,76 |
| 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 | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,07 | 83,59 |
| BR02 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,22 | 53,95 |
| BR03 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 0,61 | 26,98 |
| BR07 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,63 | 72,09 |
| BR08 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 0,54 | 47,76 |
| BR09 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 1,08 | 95,52 |
| BR14 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,67 | 74,03 |
| BR15 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,55 | 68,55 |
| BR10 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 0,47 | 41,57 |
| BR11 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 0,94 | 83,14 |
| BR16 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,61 | 71,20 |
| BR17 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,46 | 64,52 |
| BR12 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 0,40 | 35,38 |
| BR13 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 0,80 | 70,76 |
| BR18 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,56 | 68,99 |
| BR19 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,51 | 66,78 |
| BR20 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 1,04 | 91,99 |
| BR21 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 0,94 | 41,57 |
| | | | | | | | | 374 | 95,56 | 5409,05 |

## Tabel 8 Gewichten profielen voor aanpassingen mast 50

| Staaf-groep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Nr | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 414 | L70.7 | S235 | 1M16-5.6t | L90.9 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 4,68 | 227,29 |
| 415 | L65.7 | S235 | 1M16-5.6t | L80.8 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 3,79 | 147,06 |
| 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 | S235 | 1M16-8.8t | Bout uitgewisseld | | | |
| 118A | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 118B | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 119A | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 119B | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 120A | X250.20 | S235 | 32M30-5.6t | X250.20 | S235 | 32M30-5.6t | Knikverkorter toegevoegd | | | |
| 120B | X250.20 | S235 | 36M30-5.6t | X250.20 | S235 | 36M30-5.6t | Knikverkorter toegevoegd | | | |
| 235L | L150.100.10 | S235 | 1M30-5.6t | L150.100.10 | S235 | 1M30-8.8t | Bout uitgewisseld | | | |
| 242L | L130.90.10 | S235 | 1M24-5.6t | L130.90.10 | S235 | 1M24-8.8t | Bout uitgewisseld | | | |
| 242T | L130.90.10 | S235 | 1M24-5.6t | L120.10 | S355 | 1M24-8.8t | Profiel uitgewisseld | 4 | 12,46 | 1084,97 |
| 542 | L80.8 | S235 | 1M20-5.6t | L90.8 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 4,12 | 366,26 |
| 534 | L65.7 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,09 | 185,89 |
| 263 | L65.7 | S235 | 1M20-5.6t | L75.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,19 | 206,61 |
| 260 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,89 | 173,86 |
| 258 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,05 | 183,49 |
| 126 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,72 | 163,64 |
| 125 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,78 | 167,24 |
| 130 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,48 | 119,47 |
| 129 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,42 | 116,58 |
| 128 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,41 | 116,10 |
| 127 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,33 | 112,25 |
| 160 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,12 | 85,61 |
| 159 | L50.5 | S235 | 1M16-5.6t | L60.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,19 | 96,85 |
| 169 | L50.5 | S235 | 1M16-5.6t | L50.5 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 1,32 | 40,55 |
| 158 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,08 | 84,00 |
| 157 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,14 | 86,42 |
| 167 | L50.5 | S235 | 1M16-5.6t | L50.5 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 1,30 | 39,84 |
| 156 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,03 | 81,98 |
| 155 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,07 | 83,76 |
| 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 | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,07 | 83,59 |
| BR02 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,22 | 53,95 |
| BR03 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 0,61 | 26,98 |
| BR04 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 1,62 | 143,29 |
| BR05 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 1,41 | 124,71 |
| BR06 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 16 | 1,20 | 106,14 |
| BR07 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,63 | 72,09 |
| | | | | | | | | **254** | **84,2** | **4806,97** |

**Tabel 9 Gewichten profielen voor aanpassingen mast 52 en 53**

| Staaf-groep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Nr | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 414 | L70.7 | S235 | 1M16-5.6t | L90.9 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 4,68 | 227,29 |
| 415 | L65.7 | S235 | 1M16-5.6t | L80.8 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 3,79 | 147,06 |
| 212T | L80.8 | S235 | 2M20-5.6t | L100.8 | S355 | 2M20-8.8t | Profiel uitgewisseld | 2 | 4,80 | 117,41 |
| 120B | X250.20 | S235 | 36M30-5.6t | X250.20 | S235 | 36M30-5.6t | Knikverkorter toegevoegd | | | |
| 235L | L150.100.10 | S235 | 1M30-5.6t | L150.100.10 | S235 | 1M30-8.8t | Bout uitgewisseld | | | |
| 242L | L130.90.10 | S235 | 1M24-5.6t | L130.90.10 | S235 | 1M24-8.8t | Bout uitgewisseld | | | |
| 242T | L130.90.10 | S235 | 1M24-5.6t | L130.90.10 | S235 | 1M24-8.8t | Bout uitgewisseld | | | |
| 542 | L80.8 | S235 | 1M20-5.6t | L90.8 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 4,12 | 366,26 |
| 534 | L65.7 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,09 | 185,89 |
| 263 | L65.7 | S235 | 1M20-5.6t | L75.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,19 | 206,61 |
| 260 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,89 | 173,86 |
| 258 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 3,05 | 183,49 |
| 126 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,72 | 163,64 |
| 125 | L60.6 | S235 | 1M20-5.6t | L70.7 | S355 | 1M20-8.8t | Profiel uitgewisseld | 8 | 2,78 | 167,24 |
| 130 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,48 | 119,47 |
| 129 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,42 | 116,58 |
| 128 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,41 | 116,10 |
| 127 | L50.5 | S235 | 1M16-5.6t | L65.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,33 | 112,25 |
| 160 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,12 | 85,61 |
| 159 | L50.5 | S235 | 1M16-5.6t | L60.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,19 | 96,85 |
| 169 | L50.5 | S235 | 1M16-5.6t | L50.5 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 1,32 | 40,55 |
| 158 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,08 | 84,00 |
| 157 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,14 | 86,42 |
| 167 | L50.5 | S235 | 1M16-5.6t | L50.5 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 1,30 | 39,84 |
| 156 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,03 | 81,98 |
| 155 | L50.5 | S235 | 1M16-5.6t | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,07 | 83,76 |
| 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 | L55.6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 8 | 2,07 | 83,59 |
| BR01 | | | | L60.6 | S355 | 1M16-8.8t | Profiel toegevoegd | 8 | 1,83 | 80,93 |
| | | | | | | | | **186** | **65,9** | **3247,47** |

## 5.3 Eisen verificatie

De verificatie van de van toepassing zijnde eisen is uitgevoerd in onderstaande Tabel 10.

**Tabel 10 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


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 15 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | II |
| Wind speed | 21,8 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 0,85 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 142,5 m |
| Max. Span | 702 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 649 m |
| EDS Weight span | 873 m |
| Min. Weight span | 813 m |
| Max. Weight span | 1093 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-02-22 | | | |

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+75 T

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

Document name:

KIJ-GT_S+75 T_49_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+75 T
Number: 49

## Conductor loads

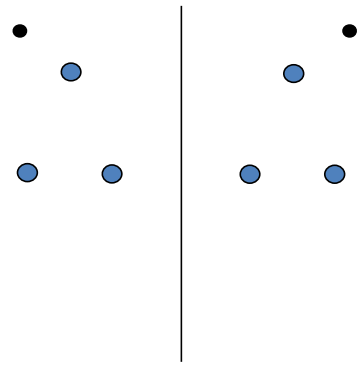
Auteur: TBR
Versie: v11.6

### General

| | |
|---|---|
| Description | S+75 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 | |
| Terrain category | 21,8 | m/s |
| Reduction factor $c_{dir}$ | II | |
| Ice region phase conductor | 0,85 | |
| Ice region earth conductor | B | |
| | B | |



Configuratie geleiders

### Conductors back

| Description | Voltage | Conductor Back | Bundle Ba | Ice region | Additional weight | Additional diameter | Catenary $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCCZ-Warsaw | 3 | B | 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 | 103,7 m | 108,0 m | 25,5 m |
| Circuit 1 | 11 | 380ct1f2 | 103,7 m | 108,0 m | 11,5 m |
| Circuit 1 | 12 | 380ct1f3 | 130,7 m | 135,0 m | 18,5 m |
| Circuit 2 | 20 | 380ct2f1 | 103,7 m | 108,0 m | -11,5 m |
| Circuit 2 | 21 | 380ct2f2 | 103,7 m | 108,0 m | -25,5 m |
| Circuit 2 | 22 | 380ct2f3 | 130,7 m | 135,0 m | -18,5 m |
| Bliksemdraad 1 | 1 | bl1 | 140,7 m | 141,0 m | 31,5 m |
| Bliksemdraad 2 | 3 | bl2 | 140,7 m | 141,0 m | -31,5 m |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**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**

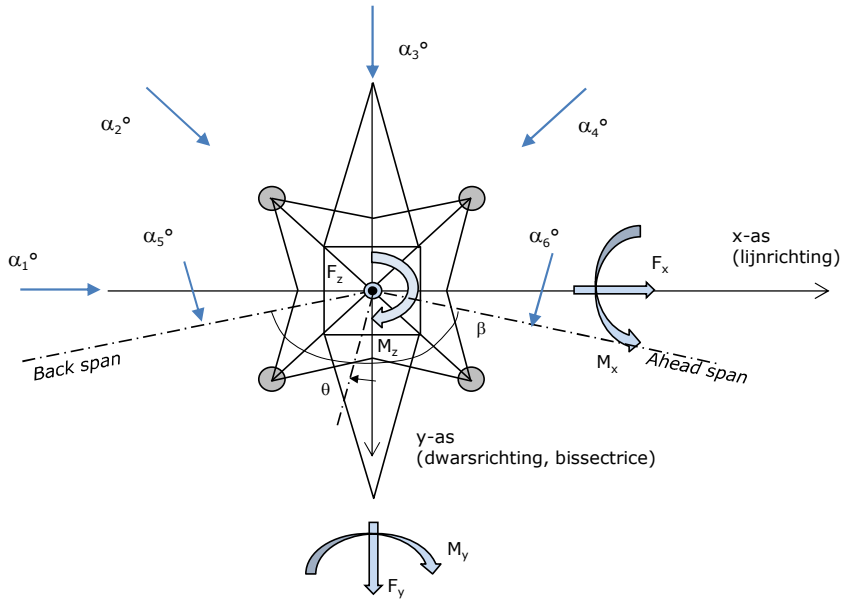
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | -1,4 | -69,2 m | 0,0 | 7,8 m |
| Circuit 1 | 11 | 380ct1f2 | -1,4 | -69,2 m | 0,0 | 2,0 m |
| Circuit 1 | 12 | 380ct1f3 | -1,4 | -80,7 m | 0,0 | 4,9 m |
| Circuit 2 | 20 | 380ct2f1 | -1,4 | -69,2 m | 0,0 | -2,0 m |
| Circuit 2 | 21 | 380ct2f2 | -1,4 | -69,2 m | 0,0 | -7,8 m |
| Circuit 2 | 22 | 380ct2f3 | -1,4 | -80,7 m | 0,0 | -4,9 m |
| Bliksemdraad 1 | 1 | bl1 | -1,4 | -87,8 m | 0,0 | 10,4 m |
| Bliksemdraad 2 | 3 | bl2 | -1,4 | -87,8 m | 0,0 | -10,4 m |

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 702,0 | 595,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 612,3 | 612,3 | m |
| Line angle | β | 180 | | ° |
| Tower orientation with respect to bis | θ | 0 | | ° |
| Section length | | 1774 | 1774 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+75 T
Number: 49

Project: KIJ-GT
Tower: S+75 T
Number: 49

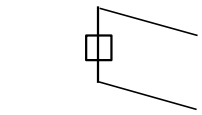
**Absence of conductors**

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

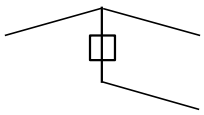
**Load situations SPLS**

Considered situations SPLS: SPLS for suspension tower not applicable

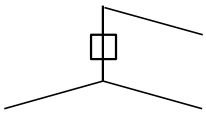
Principle of load situations:



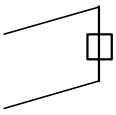
1. Ba All cts



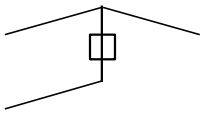
2. Ba ct1



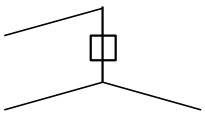
3. Ba ct2



4. Ah All cts



5. Ah ct1

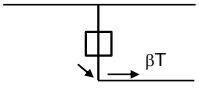


6. Ah ct2

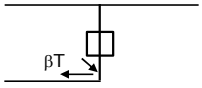
**Load situation 5a. Conductor failure**

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

Principle of load situations:




1. Ba




2. Ah

Project: KIJ-GT
Tower: S+75 T
Number: 49

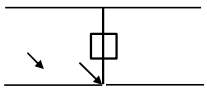
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

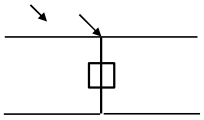
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

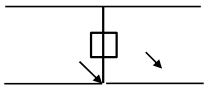
Principle of load situations:



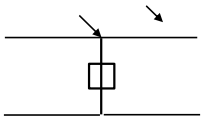
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

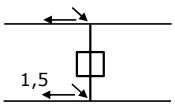
**Load situations 8. Galloping as a static load**

| 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 |

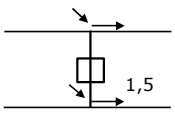
Considered situations galloping 8: None (existing structure)

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+75 T
Number: 49

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+75 T | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 142,5 | m | |
| Tower self weight | 2300,0 | 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 $G_T$ | 1,01 |
| 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 ar | 0,4 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 66,01 | 0,12 | 3,31 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 67,68 | 0,21 | 2,87 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 66,01 | 0,12 | 3,31 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 67,68 | 0,21 | 2,87 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

*Note: Surface transverse direction is reduced in calculation.*

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**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 | 0,08 | 1,00 | 27,1 | 2,2 |
| Middenstuk 2 | | | | |
| Bovenstuk 1 | | | | |
| Bovenstuk 2 | | | | |

**Input antennas**

| Description | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne 1 | 5 | 138,5 | 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 | 0,64 | 139,1 | 118,0 | 0,0 | -118,0 | 15,0 | 2086,7 | 1770,6 | 0,0 | -1770,6 |
| Middenstuk 1 | 0,87 | 168,8 | 143,3 | 0,0 | -143,3 | 43,6 | 7353,1 | 6239,3 | 0,0 | -6239,3 |
| Middenstuk 2 | 0,98 | 111,7 | 94,7 | 0,0 | -94,7 | 68,8 | 7681,6 | 6518,1 | 0,0 | -6518,1 |
| Bovenstuk 1 | 1,05 | 103,5 | 87,8 | 0,0 | -87,8 | 94,0 | 9731,1 | 8257,1 | 0,0 | -8257,1 |
| Bovenstuk 2 | 1,12 | 101,6 | 86,2 | 0,0 | -86,2 | 123,0 | 12495,0 | 10602,4 | 0,0 | -10602,4 |
| Topstuk | 1,16 | 4,9 | 4,1 | 0,0 | -4,1 | 140,5 | 684,1 | 580,5 | 0,0 | -580,5 |
| Ondertraverse | 1,09 | 77,9 | 46,2 | 0,0 | -46,2 | 108,8 | 8474,2 | 5033,4 | 0,0 | -5033,4 |
| Boventraverse | 1,15 | 118,7 | 70,5 | 0,0 | -70,5 | 137,0 | 16267,3 | 9662,3 | 0,0 | -9662,3 |
| Totaal | | 826,2 | 651,0 | 0,0 | -651,0 | | 64773,1 | 48663,7 | 0,0 | -48663,7 |

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

| Description | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 0,64 | 0,0 | 118,0 | 139,1 | 118,0 | 15,0 | 0,0 | 1770,6 | 2086,7 | 1770,6 |
| Middenstuk 1 | 0,87 | 0,0 | 143,3 | 168,8 | 143,3 | 43,6 | 0,0 | 6239,3 | 7353,1 | 6239,3 |
| Middenstuk 2 | 0,98 | 0,0 | 94,7 | 111,7 | 94,7 | 68,8 | 0,0 | 6518,1 | 7681,6 | 6518,1 |
| Bovenstuk 1 | 1,05 | 0,0 | 87,8 | 103,5 | 87,8 | 94,0 | 0,0 | 8257,1 | 9731,1 | 8257,1 |
| Bovenstuk 2 | 1,12 | 0,0 | 86,2 | 101,6 | 86,2 | 123,0 | 0,0 | 10602,4 | 12495,0 | 10602,4 |
| Topstuk | 1,16 | 0,0 | 4,1 | 4,9 | 4,1 | 140,5 | 0,0 | 580,5 | 684,1 | 580,5 |
| Ondertraverse | 1,09 | 0,0 | 46,2 | 31,1 | 46,2 | 108,8 | 0,0 | 5033,4 | 3389,7 | 5033,4 |
| Boventraverse | 1,15 | 0,0 | 70,5 | 47,5 | 70,5 | 137,0 | 0,0 | 9662,3 | 6506,9 | 9662,3 |
| Total | | 0,0 | 651,0 | 708,2 | 651,0 | | 0,0 | 48663,7 | 49928,2 | 48663,7 |

**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 | 2300 | 0 | 0 | 0 |
| Windrichting 0° | 835 | 0 | 0 | 0 | 66630 | 0 |
| Windrichting 45° | 657 | 657 | 0 | 50006 | 50006 | 0 |
| Windrichting 90° | 0 | 717 | 0 | 51637 | 0 | 0 |
| Windrichting 135° | -657 | 657 | 0 | 50006 | -50006 | 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 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,08 | 1,2 | 1,95 |
| 380ct1f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,08 | 1,2 | 1,95 |
| 380ct1f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,14 | 1,2 | 2,06 |
| 380ct2f1 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,08 | 1,2 | 1,95 |
| 380ct2f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,08 | 1,2 | 1,95 |
| 380ct2f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,14 | 1,2 | 2,06 |
| bl1 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,16 | 1,2 | 0,14 |
| bl2 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,16 | 1,2 | 0,14 |

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**Wind load back**

| Conductor | Height wind | Pressure | $G_{c\ dwars}$ | $G_{c\ trek}$ | $C_c$ | $d_{additional}$ | $w_v$ | $w_{v,section}$ | $D_{iis,additional}$ | $w_{v,iis}$ | $w_{v,iis,section}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 74,2 | 0,99 | 0,61 | 0,59 | 1,10 | 28,25 | 56,5 | 54,6 | 46,9 | 102,6 | 99,1 |
| 380ct1f2 | 74,2 | 0,99 | 0,61 | 0,59 | 1,10 | 28,25 | 56,5 | 54,6 | 46,9 | 102,6 | 99,1 |
| 380ct1f3 | 101,2 | 1,07 | 0,63 | 0,61 | 1,08 | 28,25 | 61,9 | 59,8 | 46,9 | 114,6 | 110,7 |
| 380ct2f1 | 74,2 | 0,99 | 0,61 | 0,59 | 1,10 | 28,25 | 56,5 | 54,6 | 46,9 | 102,6 | 99,1 |
| 380ct2f2 | 74,2 | 0,99 | 0,61 | 0,59 | 1,10 | 28,25 | 56,5 | 54,6 | 46,9 | 102,6 | 99,1 |
| 380ct2f3 | 101,2 | 1,07 | 0,63 | 0,61 | 1,08 | 28,25 | 61,9 | 59,8 | 46,9 | 114,6 | 110,7 |
| bl1 | 113,1 | 1,10 | 0,64 | 0,62 | 1,19 | 22,24 | 18,7 | 18,1 | 41,5 | 35,1 | 33,9 |
| bl2 | 113,1 | 1,10 | 0,64 | 0,62 | 1,19 | 22,13 | 18,6 | 18,0 | 41,4 | 35,1 | 33,9 |

**Wind load ahead**

| Conductor | Height wind | Pressure | $G_{c\ dwars}$ | $G_{c\ trek}$ | $C_c$ | $d_{additional}$ | $w_v$ | $w_{v,section}$ | $D_{iis,additional}$ | $w_{v,iis}$ | $w_{v,iis,section}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 48,5 | 0,89 | 0,58 | 0,56 | 1,13 | 28,25 | 49,4 | 47,8 | 46,9 | 87,5 | 84,6 |
| 380ct1f2 | 48,5 | 0,89 | 0,58 | 0,56 | 1,13 | 28,25 | 49,4 | 47,8 | 46,9 | 87,5 | 84,6 |
| 380ct1f3 | 69,7 | 0,98 | 0,61 | 0,59 | 1,10 | 28,25 | 55,4 | 53,6 | 46,9 | 100,3 | 96,9 |
| 380ct2f1 | 48,5 | 0,89 | 0,58 | 0,56 | 1,13 | 28,25 | 49,4 | 47,8 | 46,9 | 87,5 | 84,6 |
| 380ct2f2 | 48,5 | 0,89 | 0,58 | 0,56 | 1,13 | 28,25 | 49,4 | 47,8 | 46,9 | 87,5 | 84,6 |
| 380ct2f3 | 69,7 | 0,98 | 0,61 | 0,59 | 1,10 | 28,25 | 55,4 | 53,6 | 46,9 | 100,3 | 96,9 |
| bl1 | 77,6 | 1,01 | 0,61 | 0,59 | 1,20 | 22,24 | 16,5 | 15,9 | 41,5 | 30,8 | 29,7 |
| bl2 | 77,6 | 1,01 | 0,61 | 0,59 | 1,20 | 22,13 | 16,4 | 15,8 | 41,4 | 30,7 | 29,7 |

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**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Afkeur CC2-0 |
| Reference period | 15 jaar |

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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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**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 | -29,0 | 29,0 | 6,8 | 5,6 | 7,2 | 10,1 |
| 380ct1f1 | -105,7 | 105,7 | 21,2 | 17,2 | 26,6 | 34,8 |
| 380ct1f2 | -105,7 | 105,7 | 21,2 | 16,3 | 26,6 | 34,8 |
| 380ct1f3 | -107,6 | 107,6 | 23,2 | 18,7 | 26,6 | 37,0 |
| 380ct2f1 | -105,7 | 105,7 | 21,2 | 15,7 | 26,6 | 34,8 |
| 380ct2f2 | -105,7 | 105,7 | 21,2 | 14,8 | 26,6 | 34,8 |
| 380ct2f3 | -107,6 | 107,6 | 23,2 | 17,1 | 26,6 | 37,0 |
| bl2 | -29,0 | 29,0 | 6,7 | 4,6 | 7,2 | 10,2 |

**Min. Weight span (m)**

| Weight spa | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 872,7 | 890,1 | 872,7 |
| 380ct1f1 | 814,2 | 822,8 | 814,2 |
| 380ct1f2 | 814,2 | 822,8 | 814,2 |
| 380ct1f3 | 841,2 | 852,0 | 841,2 |
| 380ct2f1 | 814,2 | 822,8 | 814,2 |
| 380ct2f2 | 814,2 | 822,8 | 814,2 |
| 380ct2f3 | 841,2 | 852,0 | 841,2 |
| bl2 | 872,7 | 892,3 | 872,7 |

**Max. Weight span (m)**

| Weight spa | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1044,5 | 896,4 |
| 380ct1f1 | 880,5 | 824,0 |
| 380ct1f2 | 880,5 | 824,0 |
| 380ct1f3 | 934,4 | 856,1 |
| 380ct2f1 | 880,5 | 824,0 |
| 380ct2f2 | 880,5 | 824,0 |
| 380ct2f3 | 934,4 | 856,1 |
| bl2 | 1043,8 | 897,5 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | | Wind / Weight span ratio |
| Max. weight span | 1093,5 | m | 1,686 - |
| Min. weight span | 813,3 | m | 1,254 - |

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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 | 12,3 | 15,5 | -30,3 | 28,3 |
| 380ct1f1 | 51,3 | 38,4 | 61,3 | -106,8 | 104,7 |
| 380ct1f2 | 51,3 | 37,5 | 61,3 | -106,8 | 104,7 |
| 380ct1f3 | 51,3 | 41,9 | 63,6 | -108,7 | 106,5 |
| 380ct2f1 | 51,3 | 36,9 | 61,3 | -106,8 | 104,7 |
| 380ct2f2 | 51,3 | 36,1 | 61,3 | -106,8 | 104,7 |
| 380ct2f3 | 51,3 | 40,3 | 63,6 | -108,7 | 106,5 |
| bl2 | 15,0 | 11,3 | 15,5 | -30,2 | 28,4 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 8,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,8 | 40,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,2 | 40,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,5 | 41,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,2 | 40,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -0,8 | 40,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,5 | 41,6 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,3 | 8,9 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinati | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| **SLS 4** | bl1 | 3,6 | 5,5 |
| | 380ct1f1 | 17,7 | 23,0 |
| | 380ct1f2 | 17,7 | 23,0 |
| | 380ct1f3 | 17,7 | 24,3 |
| | 380ct2f1 | 17,7 | 23,0 |
| | 380ct2f2 | 17,7 | 23,0 |
| | 380ct2f3 | 17,7 | 24,3 |
| | bl2 | 3,6 | 5,5 |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**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 | 255 | 301 | 30492 | -4 | 0 |
| ULS 1a_0,9_90 | | 0 | 255 | 301 | 30492 | -4 | 0 |
| ULS 3_90 | | 0 | 136 | 404 | 16277 | -4 | 0 |
| ULS 3_0,9_90 | | 0 | 136 | 404 | 16277 | -4 | 0 |
| SLS 7 | | 0 | 0 | 262 | 0 | -3 | 0 |

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

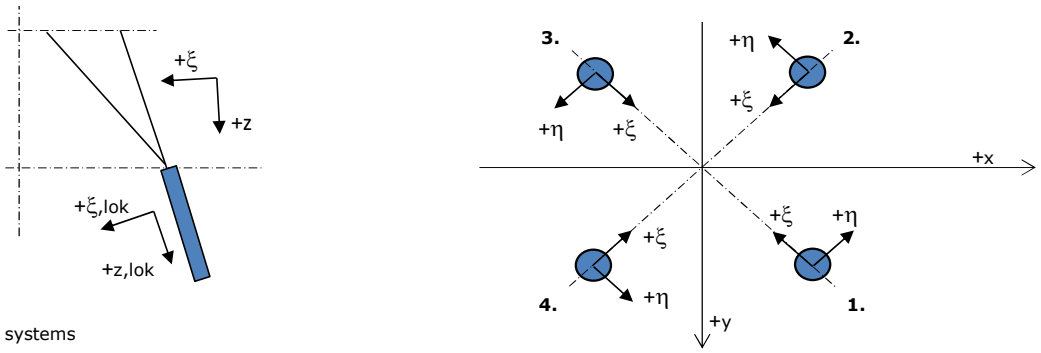
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 986 | 2716 | 83148 | -4 | 0 |
| ULS 3_90 | 0 | 355 | 2819 | 32073 | -4 | 0 |
| SLS 7 | 0 | 0 | 2562 | 0 | -3 | 0 |

**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 | 986 | 2716 | **83148** | -4 | 0 |
| ULS 1a_0,9_0,9_0 | 855 | 0 | 2306 | 0 | **68339** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 2554 | 432 | 5542 | **-1309** |
| ULS 1a_0,9_0,9_135 | -672 | 800 | 2315 | **66553** | **-51275** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 483 | 465 | **3281** | 12 | -670 | -52 | 3339 |
| 2 | ULS 1a_0 | 312 | -320 | **2184** | 6 | -447 | -35 | 2223 |
| 3 | ULS 5a Ah 12 | -97 | -127 | **801** | -21 | -158 | -7 | 815 |
| 4 | ULS 1a_135 | -483 | 465 | **3281** | -13 | -671 | -52 | 3339 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -299 | 281 | **-2028** | 13 | 411 | 28 | -2064 |
| 3 | ULS 1a_0,9_0,9_45 | 299 | 281 | **-2028** | -12 | 411 | 28 | -2063 |
| 4 | ULS 1a_0,9_0,9_0 | 129 | -137 | **-935** | -6 | 188 | 12 | -952 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| 2 | ULS 5a Ba 10 | 93 | -126 | 771 | **23** | -155 | -10 | 784 |
| 3 | ULS 5a Ba 10 | -97 | -61 | 525 | **25** | -112 | -13 | 535 |
| 4 | ULS 5a Ah 21 | -94 | 126 | 774 | **23** | -156 | -10 | 788 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 93 | 126 | 771 | **-23** | -155 | -10 | 784 |
| 2 | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| 3 | ULS 5a Ah 10 | -94 | -126 | 774 | **-23** | -156 | -10 | 788 |
| 4 | ULS 5a Ba 21 | -97 | 61 | 525 | **-25** | -112 | -13 | 535 |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -299 | 281 | **-2028** | **13** | 411 | 28 | -2064 |
| 3 | ULS 1a_0,9_0,9_45 | 299 | 281 | **-2028** | **-12** | 411 | 28 | -2063 |
| 4 | ULS 1a_0,9_0,9_0 | 129 | -137 | **-935** | **-6** | 188 | 12 | -952 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 641 | 0 | -133 | -12 | 652 |
| 2 | SLS 7 | 94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 3 | SLS 7 | -94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 4 | SLS 7 | -94 | 94 | 641 | 0 | -133 | -12 | 652 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -483 | 465 | **3281** | -13 | -671 | -52 | 3339 |
| Max. tension | ULS 1a_0,9_0,9_135 | -299 | 281 | **-2028** | 13 | 411 | 28 | -2064 |
| Max. pos. torsie | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| Max. neg. torsie | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -299 | 281 | **-2028** | **13** | 411 | 28 | -2064 |

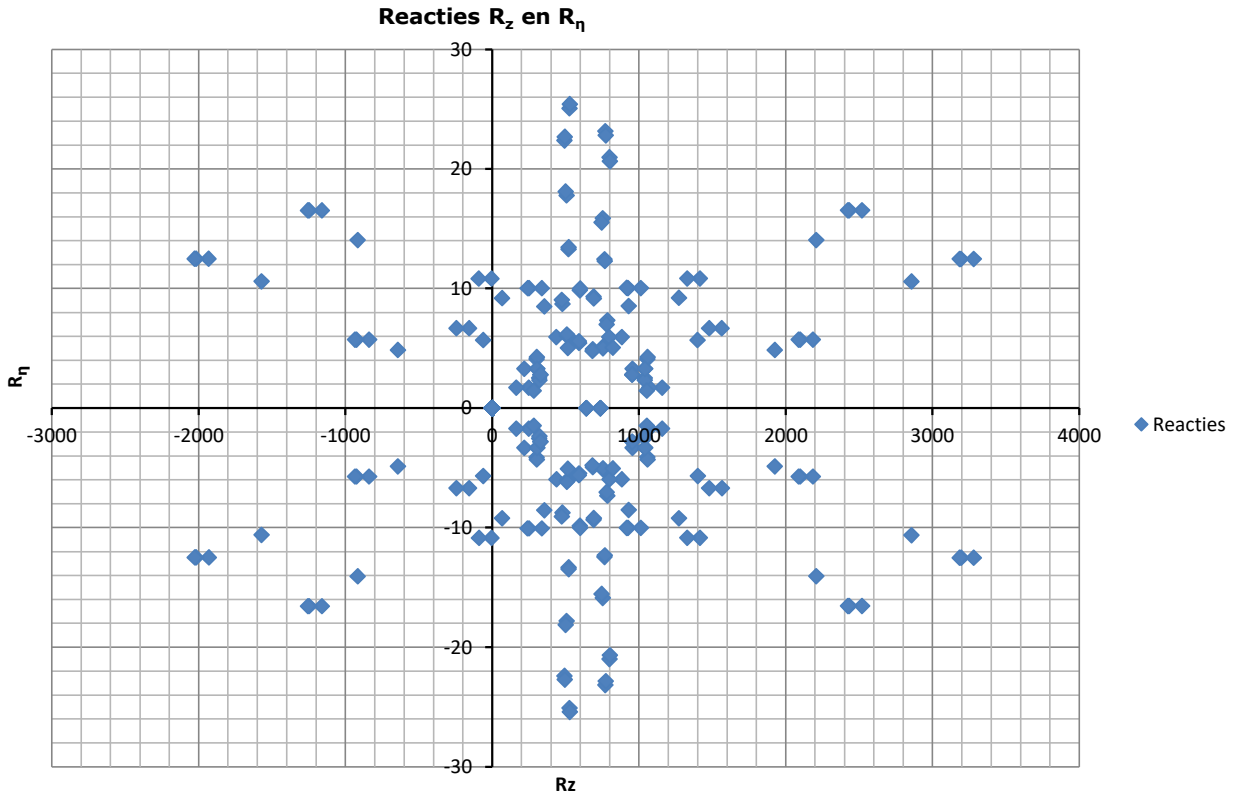
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **641** | 0 | -133 | -12 | 652 |
| 2 | SLS 1a_135 | -232 | 217 | **-1572** | 11 | 318 | 21 | -1600 |
| 3 | SLS 1a_45 | 232 | 217 | **-1572** | -11 | 318 | 21 | -1600 |
| 4 | SLS 1a_0 | 88 | -94 | **-644** | -5 | 129 | 7 | -655 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 420 | 405 | **2856** | 11 | -584 | -45 | 2906 |
| 2 | SLS 1a_0 | 275 | -282 | **1925** | 5 | -394 | -31 | 1959 |
| 3 | SLS 7 | -94 | -94 | **641** | 0 | -133 | -12 | 652 |
| 4 | SLS 1a_135 | -420 | 405 | **2856** | -11 | -584 | -45 | 2907 |

Project: KIJ-GT
Tower: S+75 T
Number: 49



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 15 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | II |
| Wind speed | 25,6 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 142,5 m |
| Max. Span | 702 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 649 m |
| EDS Weight span | 873 m |
| Min. Weight span | 811 m |
| Max. Weight span | 1346 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-02-23 | | | |

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+75 T

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

Document name:

KIJ-GT_S+75 T_49_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

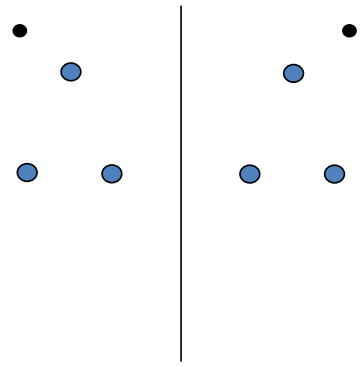
Project: KIJ-GT
Tower: S+75 T
Number: 49

## Conductor loads

Auteur: TBR
Versie: v11.6

### General

| | |
|---|---|
| Description | S+75 T |
| 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 |
| Terrain category | 25,6 m/s |
| Reduction factor $c_{dir}$ | II |
| Ice region phase conductor | 1,00 |
| Ice region earth conductor | B |
| | 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 | 103,7 m | 108,0 m | 25,5 m |
| Circuit 1 | 11 | 380ct1f2 | 103,7 m | 108,0 m | 11,5 m |
| Circuit 1 | 12 | 380ct1f3 | 130,7 m | 135,0 m | 18,5 m |
| Circuit 2 | 20 | 380ct2f1 | 103,7 m | 108,0 m | -11,5 m |
| Circuit 2 | 21 | 380ct2f2 | 103,7 m | 108,0 m | -25,5 m |
| Circuit 2 | 22 | 380ct2f3 | 130,7 m | 135,0 m | -18,5 m |
| Bliksemdraad 1 | 1 | bl1 | 140,7 m | 141,0 m | 31,5 m |
| Bliksemdraad 2 | 3 | bl2 | 140,7 m | 141,0 m | -31,5 m |

Project: KIJ-GT
Tower: S+75 T
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**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**

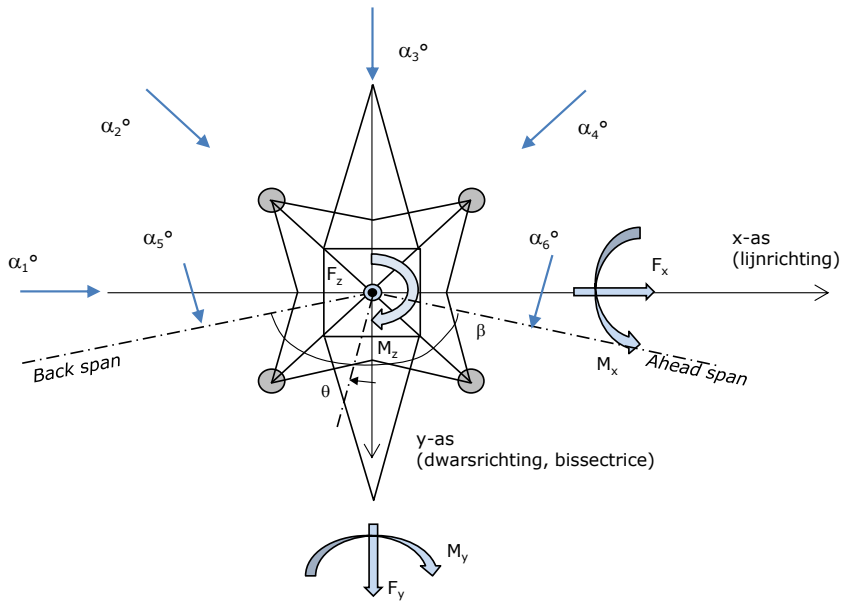
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | -1,4 | -69,2 m | 0,0 | 7,8 m |
| Circuit 1 | 11 | 380ct1f2 | -1,4 | -69,2 m | 0,0 | 2,0 m |
| Circuit 1 | 12 | 380ct1f3 | -1,4 | -80,7 m | 0,0 | 4,9 m |
| Circuit 2 | 20 | 380ct2f1 | -1,4 | -69,2 m | 0,0 | -2,0 m |
| Circuit 2 | 21 | 380ct2f2 | -1,4 | -69,2 m | 0,0 | -7,8 m |
| Circuit 2 | 22 | 380ct2f3 | -1,4 | -80,7 m | 0,0 | -4,9 m |
| Bliksemdraad 1 | 1 | bl1 | -1,4 | -87,8 m | 0,0 | 10,4 m |
| Bliksemdraad 2 | 3 | bl2 | -1,4 | -87,8 m | 0,0 | -10,4 m |

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 702,0 | 595,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 612,3 | 612,3 | m |
| Line angle | $\beta$ | 180 | | ° |
| Tower orientation with respect to bis | $\theta$ | 0 | | ° |
| Section length | | 1774 | 1774 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+75 T
Number: 49

Project: KIJ-GT
Tower: S+75 T
Number: 49

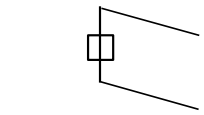
**Absence of conductors**

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

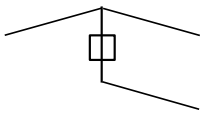
**Load situations SPLS**

Considered situations SPLS: SPLS for suspension tower not applicable

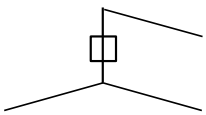
Principle of load situations:



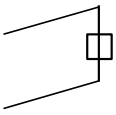
1. Ba All cts



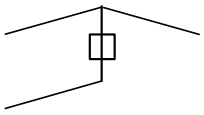
2. Ba ct1



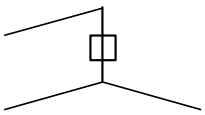
3. Ba ct2



4. Ah All cts



5. Ah ct1

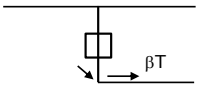


6. Ah ct2

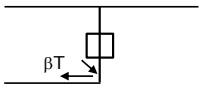
**Load situation 5a. Conductor failure**

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

Principle of load situations:




1. Ba




2. Ah

Project: KIJ-GT
Tower: S+75 T
Number: 49

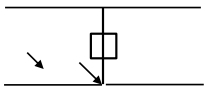
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

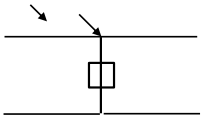
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

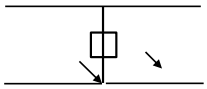
Principle of load situations:



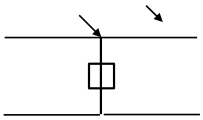
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

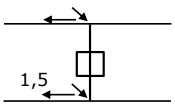
**Load situations 8. Galloping as a static load**

| 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 |

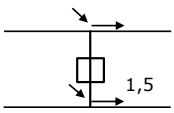
Considered situations galloping 8: None (existing structure)

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+75 T
Number: 49

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+75 T | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 142,5 | m | |
| Tower self weight | 2300,0 | 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 $G_T$ | 1,01 |
| 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 ar | 0,4 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 65,97 | 0,12 | 3,31 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 67,77 | 0,21 | 2,87 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 45,39 | 0,26 | 2,68 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,84 | 0,24 | 2,76 |
| Bovenstuk 2 | 126,90 | 5,00 | 4,26 | 19,40 | 0,019 | 89,82 | 22,34 | 0,25 | 2,73 |
| Topstuk | 138,50 | 4,26 | | 11,60 | | 24,71 | 13,20 | 0,53 | 1,92 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 65,97 | 0,12 | 3,31 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 67,77 | 0,21 | 2,87 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 45,39 | 0,26 | 2,68 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,84 | 0,24 | 2,76 |
| Bovenstuk 2 | 126,90 | 5,00 | 4,26 | 19,40 | 0,019 | 89,82 | 22,34 | 0,25 | 2,73 |
| Topstuk | 138,50 | 4,26 | | 11,60 | | 24,71 | 13,20 | 0,53 | 1,92 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

*Note: Surface transverse direction is reduced in calculation.*

Project: KIJ-GT
Tower: S+75 T
Number: 49

**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 | 0,08 | 1,00 | 27,1 | 2,2 |
| Middenstuk 2 | 0,08 | 1,00 | 23,4 | 1,9 |
| Bovenstuk 1 | 0,08 | 1,00 | 27,0 | 2,2 |
| Bovenstuk 2 | 0,08 | 1,00 | 19,4 | 1,6 |

**Input antennas**

| Description | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne 1 | 5 | 138,5 | 1,5 |
| Schotel | 4,6 | 41,5 | 1,5 |
| 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 | 0,88 | 191,7 | 162,7 | 0,0 | -162,7 | 15,0 | 2876,1 | 2440,5 | 0,0 | -2440,5 |
| Middenstuk 1 | 1,20 | 233,0 | 197,7 | 0,0 | -197,7 | 43,6 | 10149,3 | 8611,9 | 0,0 | -8611,9 |
| Middenstuk 2 | 1,35 | 163,7 | 138,9 | 0,0 | -138,9 | 68,8 | 11262,9 | 9556,9 | 0,0 | -9556,9 |
| Bovenstuk 1 | 1,45 | 143,7 | 122,0 | 0,0 | -122,0 | 94,0 | 13512,4 | 11465,6 | 0,0 | -11465,6 |
| Bovenstuk 2 | 1,53 | 93,3 | 79,1 | 0,0 | -79,1 | 117,2 | 10928,9 | 9273,5 | 0,0 | -9273,5 |
| Topstuk | 1,57 | 39,8 | 33,8 | 0,0 | -33,8 | 132,7 | 5286,4 | 4485,6 | 0,0 | -4485,6 |
| Ondertraverse | 1,50 | 107,4 | 63,8 | 0,0 | -63,8 | 108,8 | 11686,0 | 6941,1 | 0,0 | -6941,1 |
| Boventraverse | 1,59 | 163,7 | 97,3 | 0,0 | -97,3 | 137,0 | 22432,7 | 13324,3 | 0,0 | -13324,3 |
| Totaal | | 1136,4 | 895,3 | 0,0 | -895,3 | | 88134,6 | 66099,5 | 0,0 | -66099,5 |

**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 | 0,88 | 0,0 | 162,7 | 191,7 | 162,7 | 15,0 | 0,0 | 2440,5 | 2876,1 | 2440,5 |
| Middenstuk 1 | 1,20 | 0,0 | 197,7 | 233,0 | 197,7 | 43,6 | 0,0 | 8611,9 | 10149,3 | 8611,9 |
| Middenstuk 2 | 1,35 | 0,0 | 138,9 | 163,7 | 138,9 | 68,8 | 0,0 | 9556,9 | 11262,9 | 9556,9 |
| Bovenstuk 1 | 1,45 | 0,0 | 122,0 | 143,7 | 122,0 | 94,0 | 0,0 | 11465,6 | 13512,4 | 11465,6 |
| Bovenstuk 2 | 1,53 | 0,0 | 79,1 | 93,3 | 79,1 | 117,2 | 0,0 | 9273,5 | 10928,9 | 9273,5 |
| Topstuk | 1,57 | 0,0 | 33,8 | 39,8 | 33,8 | 132,7 | 0,0 | 4485,6 | 5286,4 | 4485,6 |
| Ondertraverse | 1,50 | 0,0 | 63,8 | 43,0 | 63,8 | 108,8 | 0,0 | 6941,1 | 4674,4 | 6941,1 |
| Boventraverse | 1,59 | 0,0 | 97,3 | 65,5 | 97,3 | 137,0 | 0,0 | 13324,3 | 8973,1 | 13324,3 |
| Total | | 0,0 | 895,3 | 973,8 | 895,3 | | 0,0 | 66099,5 | 67663,4 | 66099,5 |

**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 | 2300 | 0 | 0 | 0 |
| Windrichting 0° | 1157 | 0 | 0 | 0 | 91026 | 0 |
| Windrichting 45° | 909 | 909 | 0 | 68182 | 68182 | 0 |
| Windrichting 90° | 0 | 994 | 0 | 70350 | 0 | 0 |
| Windrichting 135° | -909 | 909 | 0 | 68182 | -68182 | 0 |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**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 | $w_{z,iis}$ [N/m] | $w_{z,iis,bundel}$ [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 | 106,35 | 1,50 | 1,2 | 2,69 |
| 380ct1f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,50 | 1,2 | 2,69 |
| 380ct1f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,58 | 1,2 | 2,84 |
| 380ct2f1 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,50 | 1,2 | 2,69 |
| 380ct2f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,50 | 1,2 | 2,69 |
| 380ct2f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,58 | 1,2 | 2,84 |
| bl1 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,60 | 1,2 | 0,19 |
| bl2 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,60 | 1,2 | 0,19 |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**Wind load back**

| Conductor | Height wind | Pressure | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{additional}$ | $w_y$ | $w_{y,section}$ | $D_{ijs,additional}$ | $w_{y,ijs}$ | $w_{y,ijs,section}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 74,2 | 1,37 | 0,61 | 0,59 | 1,00 | 28,25 | 71,1 | 68,7 | 46,9 | 141,5 | 136,7 |
| 380ct1f2 | 74,2 | 1,37 | 0,61 | 0,59 | 1,00 | 28,25 | 71,1 | 68,7 | 46,9 | 141,5 | 136,7 |
| 380ct1f3 | 101,2 | 1,48 | 0,63 | 0,61 | 0,98 | 28,25 | 77,4 | 74,8 | 46,9 | 158,0 | 152,6 |
| 380ct2f1 | 74,2 | 1,37 | 0,61 | 0,59 | 1,00 | 28,25 | 71,1 | 68,7 | 46,9 | 141,5 | 136,7 |
| 380ct2f2 | 74,2 | 1,37 | 0,61 | 0,59 | 1,00 | 28,25 | 71,1 | 68,7 | 46,9 | 141,5 | 136,7 |
| 380ct2f3 | 101,2 | 1,48 | 0,63 | 0,61 | 0,98 | 28,25 | 77,4 | 74,8 | 46,9 | 158,0 | 152,6 |
| bl1 | 113,1 | 1,52 | 0,64 | 0,62 | 1,11 | 22,24 | 24,1 | 23,2 | 41,5 | 48,4 | 46,8 |
| bl2 | 113,1 | 1,52 | 0,64 | 0,62 | 1,12 | 22,13 | 24,0 | 23,2 | 41,4 | 48,3 | 46,7 |

**Wind load ahead**

| Conductor | Height wind | Pressure | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{additional}$ | $w_y$ | $w_{y,section}$ | $D_{ijs,additional}$ | $w_{y,ijs}$ | $w_{y,ijs,section}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 48,5 | 1,23 | 0,58 | 0,56 | 1,04 | 28,25 | 62,7 | 60,6 | 46,9 | 120,6 | 116,6 |
| 380ct1f2 | 48,5 | 1,23 | 0,58 | 0,56 | 1,04 | 28,25 | 62,7 | 60,6 | 46,9 | 120,6 | 116,6 |
| 380ct1f3 | 69,7 | 1,35 | 0,61 | 0,59 | 1,01 | 28,25 | 69,8 | 67,5 | 46,9 | 138,3 | 133,7 |
| 380ct2f1 | 48,5 | 1,23 | 0,58 | 0,56 | 1,04 | 28,25 | 62,7 | 60,6 | 46,9 | 120,6 | 116,6 |
| 380ct2f2 | 48,5 | 1,23 | 0,58 | 0,56 | 1,04 | 28,25 | 62,7 | 60,6 | 46,9 | 120,6 | 116,6 |
| 380ct2f3 | 69,7 | 1,35 | 0,61 | 0,59 | 1,01 | 28,25 | 69,8 | 67,5 | 46,9 | 138,3 | 133,7 |
| bl1 | 77,6 | 1,39 | 0,61 | 0,59 | 1,14 | 22,24 | 21,5 | 20,8 | 41,5 | 42,4 | 41,0 |
| bl2 | 77,6 | 1,39 | 0,61 | 0,59 | 1,14 | 22,13 | 21,5 | 20,7 | 41,4 | 42,3 | 40,9 |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Afkeur CC2-0 |
| Reference period | 15 jaar |

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp | $\gamma_G$ | $\gamma_G$ | | $\gamma_Q$ | | $\gamma_a$ |
| | | °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) | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+75 T
Number: 49

**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 | 8,7 | 7,2 | 7,2 | 10,2 |
| 380ct1f1 | -111,7 | 111,7 | 26,8 | 21,8 | 26,6 | 35,4 |
| 380ct1f2 | -111,7 | 111,7 | 26,8 | 20,7 | 26,6 | 35,4 |
| 380ct1f3 | -118,2 | 118,2 | 29,2 | 23,6 | 26,6 | 37,9 |
| 380ct2f1 | -111,7 | 111,7 | 26,8 | 20,0 | 26,6 | 35,4 |
| 380ct2f2 | -111,7 | 111,7 | 26,8 | 19,0 | 26,6 | 35,4 |
| 380ct2f3 | -118,2 | 118,2 | 29,2 | 21,7 | 26,6 | 37,9 |
| bl2 | -34,8 | 34,8 | 8,7 | 6,0 | 7,2 | 10,2 |

**Min. Weight span (m)**

| Weight spar Combinatie1 | | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 872,7 | 895,7 | 872,7 |
| 380ct1f1 | 814,2 | 824,4 | 814,2 |
| 380ct1f2 | 814,2 | 824,4 | 814,2 |
| 380ct1f3 | 841,2 | 854,3 | 841,2 |
| 380ct2f1 | 814,2 | 824,4 | 814,2 |
| 380ct2f2 | 814,2 | 824,4 | 814,2 |
| 380ct2f3 | 841,2 | 854,3 | 841,2 |
| bl2 | 872,7 | 898,0 | 872,7 |

**Max. Weight span (m)**

| Weight spar Combinatie1 | | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1124,6 | 917,9 |
| 380ct1f1 | 911,9 | 832,6 |
| 380ct1f2 | 911,9 | 832,6 |
| 380ct1f3 | 975,6 | 868,9 |
| 380ct2f1 | 911,9 | 832,6 |
| 380ct2f2 | 911,9 | 832,6 |
| 380ct2f3 | 975,6 | 868,9 |
| bl2 | 1124,5 | 919,1 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | | Wind / Weight span ratio |
| Max. weight span | 1190,6 | m | 1,836 - |
| Min. weight span | 813,3 | m | 1,254 - |

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 | 15,0 | 15,9 | 15,9 | -36,3 | 33,4 |
| 380ct1f1 | 51,3 | 48,6 | 61,9 | -115,5 | 109,8 |
| 380ct1f2 | 51,3 | 47,5 | 61,9 | -115,5 | 109,8 |
| 380ct1f3 | 51,3 | 52,7 | 64,5 | -122,1 | 114,2 |
| 380ct2f1 | 51,3 | 46,8 | 61,9 | -115,5 | 109,8 |
| 380ct2f2 | 51,3 | 45,9 | 61,9 | -115,5 | 109,8 |
| 380ct2f3 | 51,3 | 50,9 | 64,5 | -122,1 | 114,2 |
| bl2 | 15,0 | 14,7 | 15,9 | -36,3 | 33,4 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 8,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,8 | 40,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,2 | 40,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,5 | 41,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,2 | 40,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -0,8 | 40,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,5 | 41,6 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,3 | 8,9 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 5,5 |
| | 380ct1f1 | 17,7 | 23,1 |
| | 380ct1f2 | 17,7 | 23,1 |
| | 380ct1f3 | 17,7 | 24,4 |
| | 380ct2f1 | 17,7 | 23,1 |
| | 380ct2f2 | 17,7 | 23,1 |
| | 380ct2f3 | 17,7 | 24,4 |
| | bl2 | 3,6 | 5,5 |

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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 | 323 | 312 | 38684 | -5 | 0 |
| ULS 1a_0,9_90 | | 0 | 323 | 312 | 38684 | -5 | 0 |
| ULS 3_90 | | 0 | 187 | 409 | 22446 | -5 | 0 |
| ULS 3_0,9_90 | | 0 | 187 | 409 | 22446 | -5 | 0 |
| SLS 7 | | 0 | 0 | 262 | 0 | -3 | 0 |

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

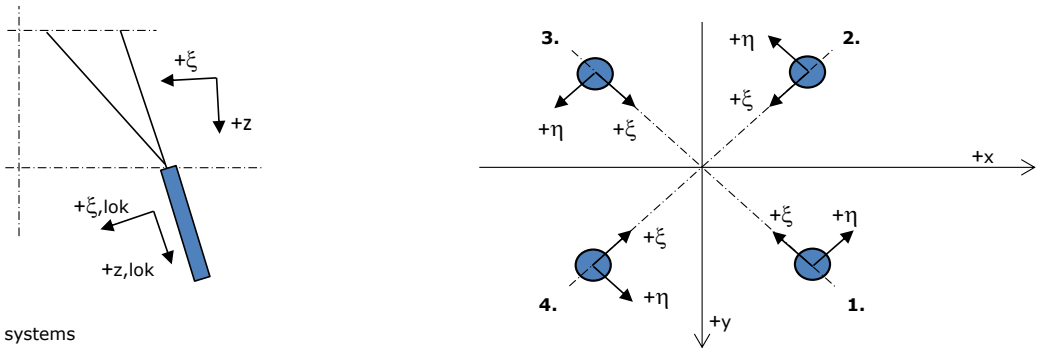
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1336 | 2727 | 110422 | -5 | 0 |
| ULS 3_90 | 0 | 491 | 2824 | 43967 | -5 | 0 |
| SLS 7 | 0 | 0 | 2562 | 0 | -3 | 0 |

**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 | 1336 | 2727 | **110422** | -5 | 0 |
| ULS 1a_0,9_0,9_0 | 1184 | 0 | 2306 | 0 | **93366** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 2554 | 432 | 5542 | **-1309** |
| ULS 1a_0,9_0,9_135 | -931 | 1092 | 2319 | **89304** | **-69916** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 621 | 599 | **4197** | 16 | -863 | -72 | 4271 |
| 2 | ULS 1a_0 | 395 | -402 | **2738** | 5 | -563 | -47 | 2786 |
| 3 | ULS 5a Ah 12 | -97 | -127 | **801** | -21 | -158 | -7 | 815 |
| 4 | ULS 1a_135 | -622 | 599 | **4198** | -16 | -863 | -71 | 4272 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -437 | 415 | **-2943** | 16 | 603 | 48 | -2995 |
| 3 | ULS 1a_0,9_0,9_45 | 437 | 415 | **-2942** | -16 | 603 | 48 | -2994 |
| 4 | ULS 1a_0,9_0,9_0 | 211 | -218 | **-1489** | -5 | 304 | 23 | -1515 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| 2 | ULS 5a Ba 10 | 93 | -126 | 771 | **23** | -155 | -10 | 784 |
| 3 | ULS 5a Ba 10 | -97 | -61 | 525 | **25** | -112 | -13 | 535 |
| 4 | ULS 5a Ah 21 | -94 | 126 | 774 | **23** | -156 | -10 | 788 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 93 | 126 | 771 | **-23** | -155 | -10 | 784 |
| 2 | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| 3 | ULS 5a Ah 10 | -94 | -126 | 774 | **-23** | -156 | -10 | 788 |
| 4 | ULS 5a Ba 21 | -97 | 61 | 525 | **-25** | -112 | -13 | 535 |

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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -437 | 415 | **-2943** | **16** | 603 | 48 | -2995 |
| 3 | ULS 1a_0,9_0,9_45 | 437 | 415 | **-2942** | **-16** | 603 | 48 | -2994 |
| 4 | ULS 1a_0,9_0,9_0 | 211 | -218 | **-1489** | **-5** | 304 | 23 | -1515 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 641 | 0 | -133 | -12 | 652 |
| 2 | SLS 7 | 94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 3 | SLS 7 | -94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 4 | SLS 7 | -94 | 94 | 641 | 0 | -133 | -12 | 652 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -622 | 599 | **4198** | -16 | -863 | -71 | 4272 |
| Max. tension | ULS 1a_0,9_0,9_135 | -437 | 415 | **-2943** | 16 | 603 | 48 | -2995 |
| Max. pos. torsie | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| Max. neg. torsie | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -437 | 415 | **-2943** | **16** | 603 | 48 | -2995 |

**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **641** | 0 | -133 | -12 | 652 |
| 2 | SLS 1a_135 | -350 | 330 | **-2349** | 13 | 481 | 38 | -2391 |
| 3 | SLS 1a_45 | 349 | 330 | **-2349** | -13 | 481 | 38 | -2390 |
| 4 | SLS 1a_0 | 157 | -163 | **-1114** | -4 | 227 | 17 | -1134 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 538 | 519 | **3634** | 13 | -747 | -62 | 3699 |
| 2 | SLS 1a_0 | 345 | -351 | **2395** | 4 | -493 | -41 | 2437 |
| 3 | SLS 7 | -94 | -94 | **641** | 0 | -133 | -12 | 652 |
| 4 | SLS 1a_135 | -538 | 519 | **3635** | -13 | -747 | -62 | 3699 |

Project: KIJ-GT
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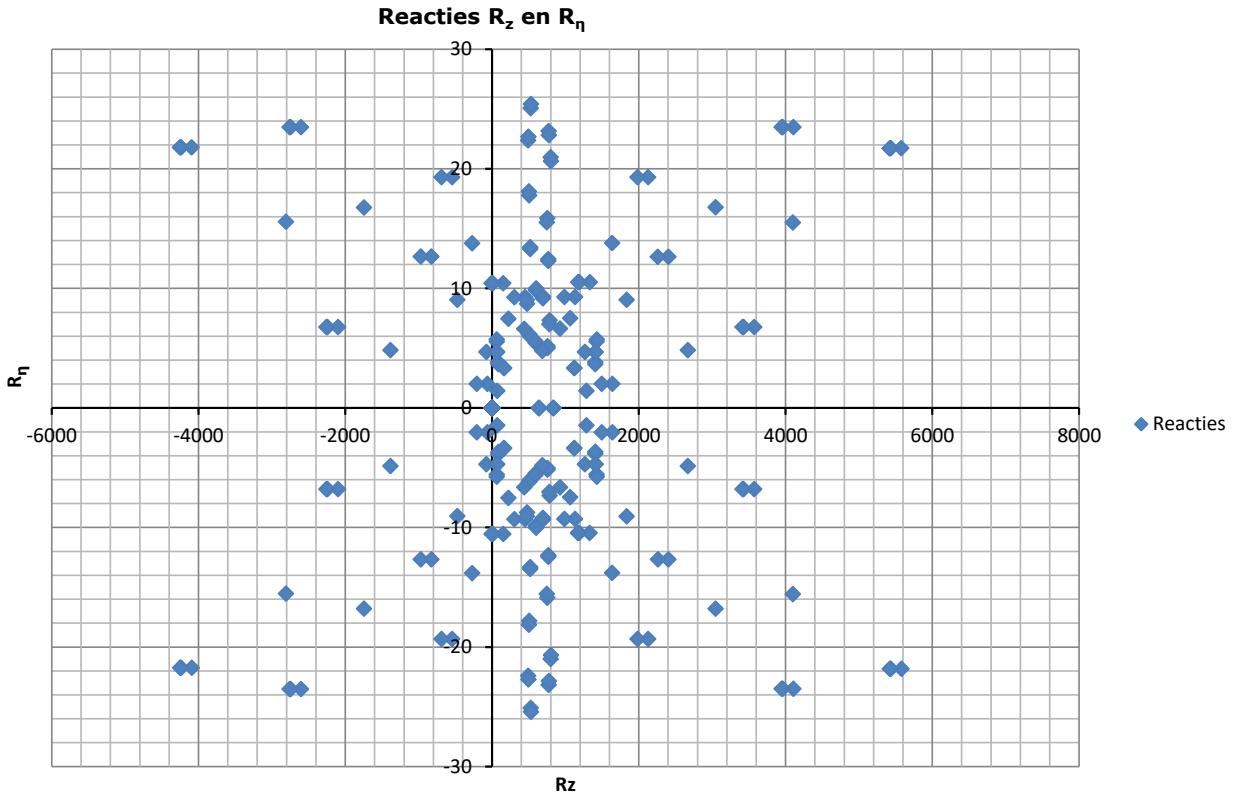


Project: KIJ-GT
Tower: S+75 T
Number: 49

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Verbouw CC2 |
| Reference period | 50 jaar |

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp | $\gamma_G$ | $\gamma_G$ | | $\gamma_Q$ | | $\gamma_a$ |
| | | °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) | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+75 T
Number: 49

**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 | -44,9 | 44,9 | 12,0 | 9,8 | 8,1 | 12,6 |
| 380ct1f1 | -142,4 | 142,4 | 36,8 | 29,7 | 33,6 | 44,7 |
| 380ct1f2 | -142,4 | 142,4 | 36,8 | 28,4 | 33,6 | 44,7 |
| 380ct1f3 | -150,3 | 150,3 | 40,0 | 32,3 | 33,6 | 48,1 |
| 380ct2f1 | -142,4 | 142,4 | 36,8 | 27,6 | 33,6 | 44,7 |
| 380ct2f2 | -142,4 | 142,4 | 36,8 | 26,3 | 33,6 | 44,7 |
| 380ct2f3 | -150,3 | 150,3 | 40,0 | 29,9 | 33,6 | 48,1 |
| bl2 | -44,9 | 44,9 | 11,9 | 8,3 | 8,0 | 12,7 |

**Min. Weight span (m)**

| Weight spar Combinatie1 | | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 872,7 | 900,1 | 872,7 |
| 380ct1f1 | 814,2 | 825,8 | 814,2 |
| 380ct1f2 | 814,2 | 825,8 | 814,2 |
| 380ct1f3 | 841,2 | 856,3 | 841,2 |
| 380ct2f1 | 814,2 | 825,8 | 814,2 |
| 380ct2f2 | 814,2 | 825,8 | 814,2 |
| 380ct2f3 | 841,2 | 856,3 | 841,2 |
| bl2 | 872,7 | 902,4 | 872,7 |

**Max. Weight span (m)**

| Weight spar Combinatie1 | | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1207,6 | 914,9 |
| 380ct1f1 | 950,6 | 832,5 |
| 380ct1f2 | 950,6 | 832,5 |
| 380ct1f3 | 1027,0 | 869,5 |
| 380ct2f1 | 950,6 | 832,5 |
| 380ct2f2 | 950,6 | 832,5 |
| 380ct2f3 | 1027,0 | 869,5 |
| bl2 | 1207,5 | 916,0 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | | Wind / Weight span ratio |
| Max. weight span | 1346,0 | m | 2,076 - |
| Min. weight span | 811,4 | m | 1,251 - |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**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 | 21,8 | 20,7 | -46,9 | 43,0 |
| 380ct1f1 | 51,3 | 66,5 | 78,3 | -146,6 | 139,7 |
| 380ct1f2 | 51,3 | 65,2 | 78,3 | -146,6 | 139,7 |
| 380ct1f3 | 51,3 | 72,3 | 81,6 | -155,9 | 144,8 |
| 380ct2f1 | 51,3 | 64,4 | 78,3 | -146,6 | 139,7 |
| 380ct2f2 | 51,3 | 63,1 | 78,3 | -146,6 | 139,7 |
| 380ct2f3 | 51,3 | 69,9 | 81,6 | -155,9 | 144,8 |
| bl2 | 15,0 | 20,3 | 20,7 | -46,8 | 43,0 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 8,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,8 | 40,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,2 | 40,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,5 | 41,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,2 | 40,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -0,8 | 40,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,5 | 41,6 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,3 | 8,9 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 5,6 |
| | 380ct1f1 | 17,7 | 23,1 |
| | 380ct1f2 | 17,7 | 23,1 |
| | 380ct1f3 | 17,7 | 24,5 |
| | 380ct2f1 | 17,7 | 23,1 |
| | 380ct2f2 | 17,7 | 23,1 |
| | 380ct2f3 | 17,7 | 24,5 |
| | bl2 | 3,6 | 5,6 |

Project: KIJ-GT
Tower: S+75 T
Number: 49

**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 | 443 | 358 | 53110 | -6 | 0 |
| ULS 1a_0,9_90 | | 0 | 443 | 358 | 53110 | -6 | 0 |
| ULS 3_90 | | 0 | 257 | 518 | 30816 | -6 | 0 |
| ULS 3_0,9_90 | | 0 | 257 | 518 | 30816 | -6 | 0 |
| SLS 7 | | 0 | 0 | 262 | 0 | -3 | 0 |

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

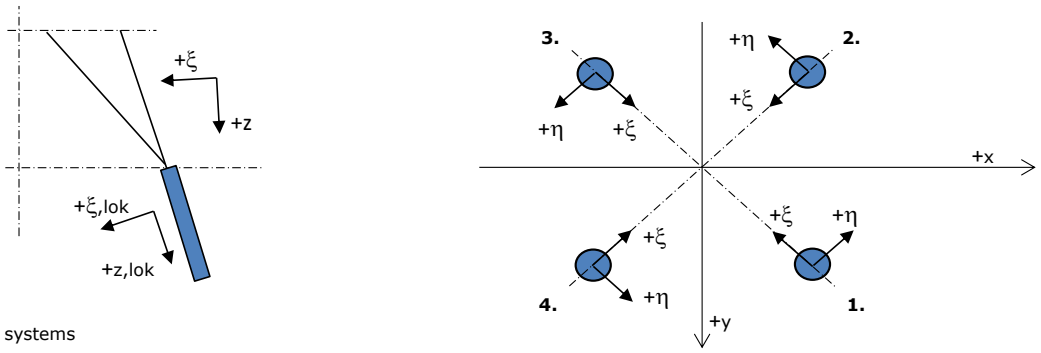
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1835 | 3003 | 151600 | -6 | 0 |
| ULS 3_90 | 0 | 674 | 3163 | 60363 | -6 | 0 |
| SLS 7 | 0 | 0 | 2562 | 0 | -3 | 0 |

**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 | 1835 | 3003 | **151600** | -6 | 0 |
| ULS 1a_0,9_0,9_0 | 1625 | 0 | 2306 | 0 | **128185** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 2554 | 432 | 5542 | **-1309** |
| ULS 1a_0,9_0,9_135 | -1278 | 1500 | 2329 | **122610** | **-95989** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 826 | 795 | **5576** | 22 | -1146 | -95 | 5675 |
| 2 | ULS 1a_0 | 514 | -524 | **3572** | 7 | -734 | -61 | 3635 |
| 3 | ULS 7 | -122 | -122 | **833** | 0 | -173 | -16 | 847 |
| 4 | ULS 1a_135 | -826 | 795 | **5577** | -22 | -1146 | -95 | 5676 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -632 | 601 | **-4254** | 22 | 872 | 70 | -4329 |
| 3 | ULS 1a_0,9_0,9_45 | 632 | 601 | **-4253** | -22 | 872 | 70 | -4328 |
| 4 | ULS 1a_0,9_0,9_0 | 322 | -331 | **-2259** | -7 | 462 | 36 | -2299 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| 2 | ULS 1a_0,9_0,9_90 | -405 | 372 | -2762 | **23** | 549 | 29 | -2810 |
| 3 | ULS 5a Ba 10 | -97 | -61 | 525 | **25** | -112 | -13 | 535 |
| 4 | ULS 5a Ah 21 | -94 | 126 | 774 | **23** | -156 | -10 | 788 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 93 | 126 | 771 | **-23** | -155 | -10 | 784 |
| 2 | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| 3 | ULS 1a_90 | 382 | 349 | -2603 | **-23** | 516 | 26 | -2649 |
| 4 | ULS 5a Ba 21 | -97 | 61 | 525 | **-25** | -112 | -13 | 535 |

Project: KIJ-GT
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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -632 | 601 | **-4254** | **22** | 872 | 70 | -4329 |
| 3 | ULS 1a_0,9_0,9_45 | 632 | 601 | **-4253** | **-22** | 872 | 70 | -4328 |
| 4 | ULS 1a_0,9_0,9_0 | 322 | -331 | **-2259** | **-7** | 462 | 36 | -2299 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 641 | 0 | -133 | -12 | 652 |
| 2 | SLS 7 | 94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 3 | SLS 7 | -94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 4 | SLS 7 | -94 | 94 | 641 | 0 | -133 | -12 | 652 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -826 | 795 | **5577** | -22 | -1146 | -95 | 5676 |
| Max. tension | ULS 1a_0,9_0,9_135 | -632 | 601 | **-4254** | 22 | 872 | 70 | -4329 |
| Max. pos. torsie | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| Max. neg. torsie | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -632 | 601 | **-4254** | **22** | 872 | 70 | -4329 |

**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **641** | 0 | -133 | -12 | 652 |
| 2 | SLS 1a_135 | -418 | 396 | **-2811** | 16 | 576 | 45 | -2860 |
| 3 | SLS 1a_45 | 418 | 396 | **-2810** | -16 | 575 | 46 | -2860 |
| 4 | SLS 1a_0 | 196 | -203 | **-1385** | -5 | 282 | 21 | -1409 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 607 | 585 | **4097** | 16 | -842 | -70 | 4169 |
| 2 | SLS 1a_0 | 384 | -391 | **2666** | 5 | -548 | -45 | 2713 |
| 3 | SLS 7 | -94 | -94 | **641** | 0 | -133 | -12 | 652 |
| 4 | SLS 1a_135 | -607 | 585 | **4098** | -16 | -842 | -70 | 4170 |

Project: KIJ-GT
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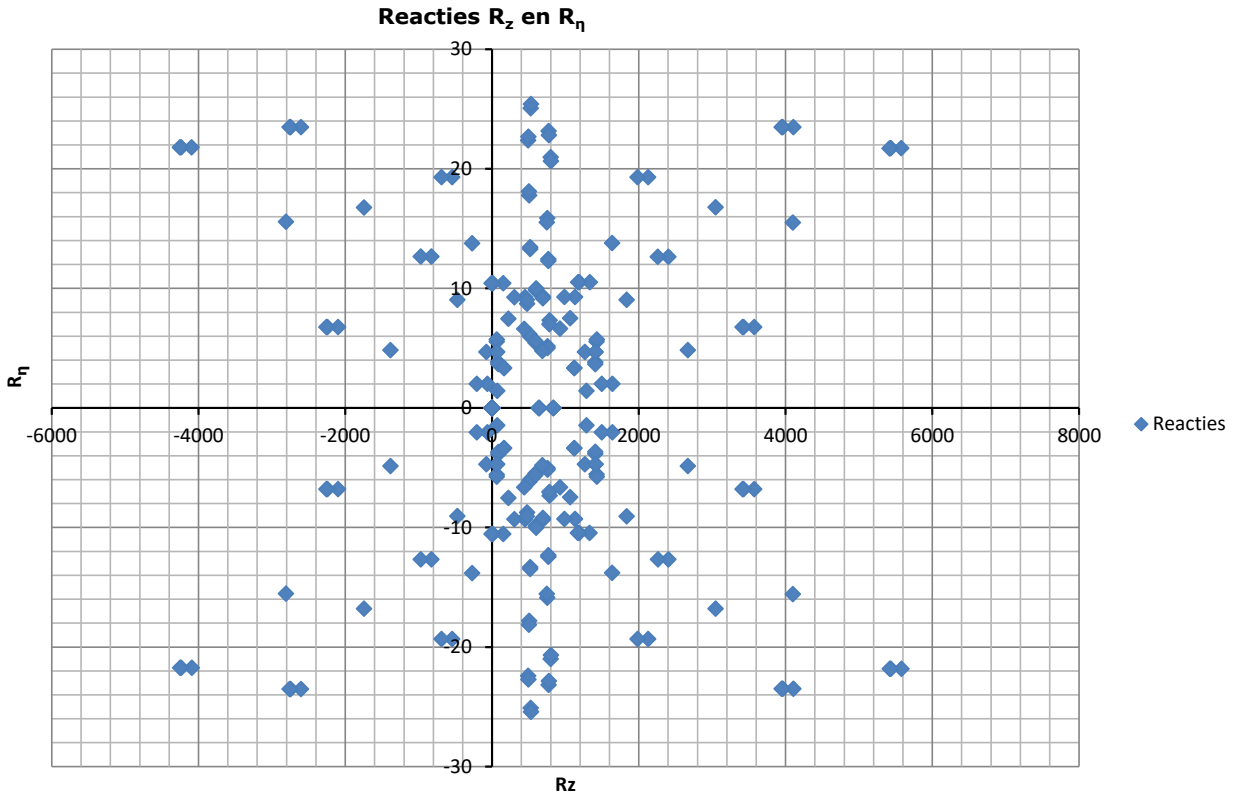
Number: 49



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 15 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 142,5 m |
| Max. Span | 701 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 628 m |
| EDS Weight span | 911 m |
| Min. Weight span | 816 m |
| Max. Weight span | 1402 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-02-23 | | | |

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+75 T

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

Document name:

KIJ-GT_S+75 T_53_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+75 T
Number: 53

## Conductor loads

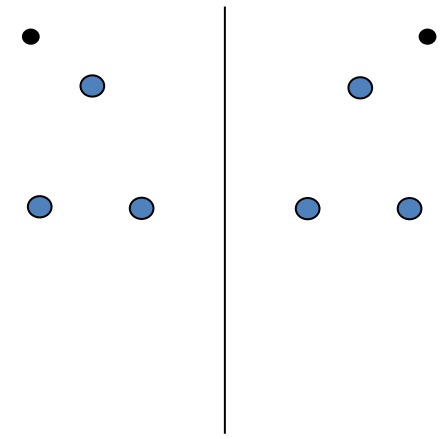
Auteur: TBR
Versie: v11.6

### General

| | |
|---|---|
| Description | S+75 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 | III |
| Terrain category | 24,5 m/s |
| Reduction factor $c_{dir}$ | II |
| Ice region phase conductor | 1,00 |
| Ice region earth conductor | B<br>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 | 103,7 m | 108,0 m | 25,5 m |
| Circuit 1 | 20 | 380ct1f2 | 103,7 m | 108,0 m | 11,5 m |
| Circuit 1 | 22 | 380ct1f3 | 130,7 m | 135,0 m | 18,5 m |
| Circuit 2 | 11 | 380ct2f1 | 103,7 m | 108,0 m | -11,5 m |
| Circuit 2 | 10 | 380ct2f2 | 103,7 m | 108,0 m | -25,5 m |
| Circuit 2 | 12 | 380ct2f3 | 130,7 m | 135,0 m | -18,5 m |
| Bliksemdraad 1 | 3 | bl1 | 140,7 m | 141,0 m | 31,5 m |
| Bliksemdraad 2 | 1 | bl2 | 140,7 m | 141,0 m | -31,5 m |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**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 | -6,0 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**

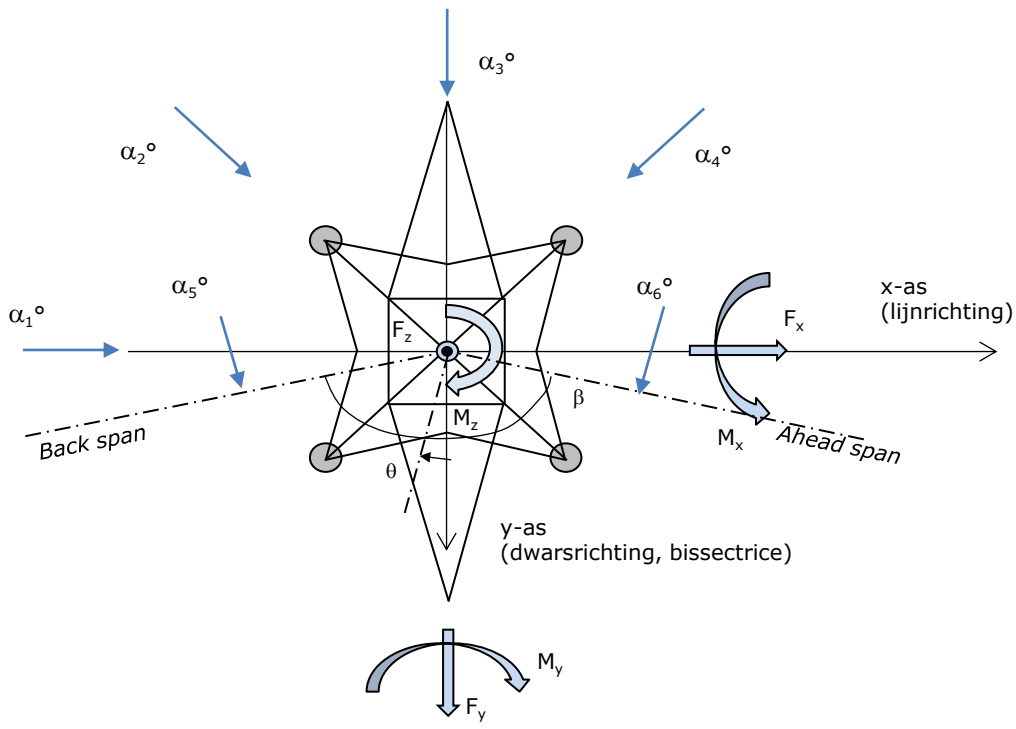
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 21 | 380ct1f1 | 0,2 | -76,0 m | 0,0 | 9,8 m |
| Circuit 1 | 20 | 380ct1f2 | 0,2 | -76,0 m | 0,0 | 2,8 m |
| Circuit 1 | 22 | 380ct1f3 | 0,2 | -91,7 m | 0,0 | 6,3 m |
| Circuit 2 | 11 | 380ct2f1 | 0,2 | -76,0 m | 0,0 | -2,8 m |
| Circuit 2 | 10 | 380ct2f2 | 0,2 | -76,0 m | 0,0 | -9,8 m |
| Circuit 2 | 12 | 380ct2f3 | 0,2 | -91,7 m | 0,0 | -6,3 m |
| Bliksemdraad 1 | 3 | bl1 | 0,2 | -98,7 m | 0,0 | 15,3 m |
| Bliksemdraad 2 | 1 | bl2 | 0,2 | -98,7 m | 0,0 | -15,3 m |

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 701,0 | 555,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 626,3 | 626,3 | m |
| Line angle | $\beta$ | 180 | | ° |
| Tower orientation with respect to bi | $\theta$ | 0 | | ° |
| Section length | | 1851 | 1851 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+75 T
Number: 53

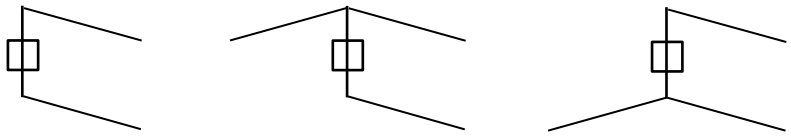
**Absence of conductors**

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

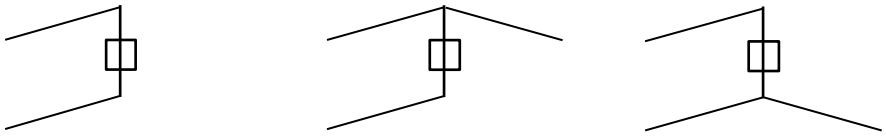
**Load situations SPLS**

Considered situations SPLS: SPLS for suspension tower not applicable

Principle of load situations:



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



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

**Load situation 5a. Conductor failure**

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

Principle of load situations:

1. Ba | 2. Ah

Project: KIJ-GT
Tower: S+75 T
Number: 53

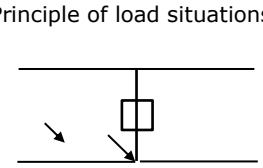
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

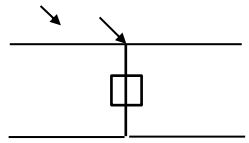
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

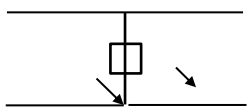
Principle of load situations:



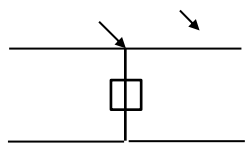
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

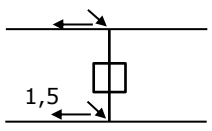
**Load situations 8. Galloping as a static load**

| 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 |

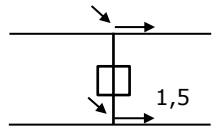
Considered situations galloping 8: None (existing structure)

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+75 T
Number: 53

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+75 T | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 142,5 | m | |
| Tower self weight | 2300,0 | 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 $G_T$ | 1,01 |
| 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] | $\Delta h$ [m] | $\Delta_x$ [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 | 68,41 | 0,12 | 3,29 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 65,51 | 0,21 | 2,90 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 68,41 | 0,12 | 3,29 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 65,51 | 0,21 | 2,90 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

*Note: Surface transverse direction is reduced in calculation.*

Project: KIJ-GT
Tower: S+75 T
Number: 53

**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 | 2,3 | 41,5 | 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 | 0,80 | 180,7 | 153,3 | 0,0 | -153,3 | 15,0 | 2710,6 | 2300,1 | 0,0 | -2300,1 |
| Middenstuk 1 | 1,09 | 208,3 | 176,7 | 0,0 | -176,7 | 43,6 | 9070,8 | 7696,9 | 0,0 | -7696,9 |
| Middenstuk 2 | 1,23 | 140,9 | 119,5 | 0,0 | -119,5 | 68,8 | 9691,2 | 8223,3 | 0,0 | -8223,3 |
| Bovenstuk 1 | 1,33 | 130,6 | 110,8 | 0,0 | -110,8 | 94,0 | 12276,8 | 10417,2 | 0,0 | -10417,2 |
| Bovenstuk 2 | 1,42 | 128,2 | 108,7 | 0,0 | -108,7 | 123,0 | 15763,8 | 13376,1 | 0,0 | -13376,1 |
| Topstuk | 1,46 | 6,1 | 5,2 | 0,0 | -5,2 | 140,5 | 863,1 | 732,3 | 0,0 | -732,3 |
| Ondertraverse | 1,38 | 98,2 | 58,3 | 0,0 | -58,3 | 108,8 | 10691,2 | 6350,2 | 0,0 | -6350,2 |
| Boventraverse | 1,45 | 149,8 | 89,0 | 0,0 | -89,0 | 137,0 | 20522,9 | 12190,0 | 0,0 | -12190,0 |
| Totaal | | 1042,8 | 821,7 | 0,0 | -821,7 | | 81590,5 | 61286,0 | 0,0 | -61286,0 |

**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 | 0,80 | 0,0 | 153,3 | 180,7 | 153,3 | 15,0 | 0,0 | 2300,1 | 2710,6 | 2300,1 |
| Middenstuk 1 | 1,09 | 0,0 | 176,7 | 208,3 | 176,7 | 43,6 | 0,0 | 7696,9 | 9070,8 | 7696,9 |
| Middenstuk 2 | 1,23 | 0,0 | 119,5 | 140,9 | 119,5 | 68,8 | 0,0 | 8223,3 | 9691,2 | 8223,3 |
| Bovenstuk 1 | 1,33 | 0,0 | 110,8 | 130,6 | 110,8 | 94,0 | 0,0 | 10417,2 | 12276,8 | 10417,2 |
| Bovenstuk 2 | 1,42 | 0,0 | 108,7 | 128,2 | 108,7 | 123,0 | 0,0 | 13376,1 | 15763,8 | 13376,1 |
| Topstuk | 1,46 | 0,0 | 5,2 | 6,1 | 5,2 | 140,5 | 0,0 | 732,3 | 863,1 | 732,3 |
| Ondertraverse | 1,38 | 0,0 | 58,3 | 39,3 | 58,3 | 108,8 | 0,0 | 6350,2 | 4276,5 | 6350,2 |
| Boventraverse | 1,45 | 0,0 | 89,0 | 59,9 | 89,0 | 137,0 | 0,0 | 12190,0 | 8209,2 | 12190,0 |
| Total | | 0,0 | 821,7 | 894,0 | 821,7 | | 0,0 | 61286,0 | 62862,1 | 61286,0 |

**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 | 2300 | 0 | 0 | 0 |
| Windrichting 0° | 1047 | 0 | 0 | 0 | 82563 | 0 |
| Windrichting 45° | 824 | 824 | 0 | 62009 | 62009 | 0 |
| Windrichting 90° | 0 | 898 | 0 | 63647 | 0 | 0 |
| Windrichting 135° | -824 | 824 | 0 | 62009 | -62009 | 0 |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 106,35 | 1,37 | 1,2 | 2,46 |
| 380ct1f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,37 | 1,2 | 2,46 |
| 380ct1f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,44 | 1,2 | 2,60 |
| 380ct2f1 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,37 | 1,2 | 2,46 |
| 380ct2f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,37 | 1,2 | 2,46 |
| 380ct2f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,44 | 1,2 | 2,60 |
| bl1 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,46 | 1,2 | 0,18 |
| bl2 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,46 | 1,2 | 0,18 |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**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 | 75,0 | 1,26 | 0,61 | 0,59 | 1,03 | 28,25 | 67,3 | 64,5 | 46,9 | 130,5 | 125,0 |
| 380ct1f2 | 75,0 | 1,26 | 0,61 | 0,59 | 1,03 | 28,25 | 67,3 | 64,5 | 46,9 | 130,5 | 125,0 |
| 380ct1f3 | 102,0 | 1,36 | 0,64 | 0,61 | 1,01 | 28,25 | 73,4 | 70,3 | 46,9 | 145,5 | 139,4 |
| 380ct2f1 | 75,0 | 1,26 | 0,61 | 0,59 | 1,03 | 28,25 | 67,3 | 64,5 | 46,9 | 130,5 | 125,0 |
| 380ct2f2 | 75,0 | 1,26 | 0,61 | 0,59 | 1,03 | 28,25 | 67,3 | 64,5 | 46,9 | 130,5 | 125,0 |
| 380ct2f3 | 102,0 | 1,36 | 0,64 | 0,61 | 1,01 | 28,25 | 73,4 | 70,3 | 46,9 | 145,5 | 139,4 |
| bl1 | 114,0 | 1,39 | 0,64 | 0,62 | 1,14 | 22,24 | 22,6 | 21,6 | 41,5 | 44,6 | 42,7 |
| bl2 | 114,0 | 1,39 | 0,64 | 0,62 | 1,14 | 22,13 | 22,5 | 21,6 | 41,4 | 44,5 | 42,6 |

**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 | 47,9 | 1,12 | 0,58 | 0,56 | 1,06 | 28,25 | 58,8 | 56,4 | 46,9 | 110,2 | 105,7 |
| 380ct1f2 | 47,9 | 1,12 | 0,58 | 0,56 | 1,06 | 28,25 | 58,8 | 56,4 | 46,9 | 110,2 | 105,7 |
| 380ct1f3 | 67,0 | 1,22 | 0,61 | 0,58 | 1,04 | 28,25 | 65,1 | 62,4 | 46,9 | 125,2 | 120,0 |
| 380ct2f1 | 47,9 | 1,12 | 0,58 | 0,56 | 1,06 | 28,25 | 58,8 | 56,4 | 46,9 | 110,2 | 105,7 |
| 380ct2f2 | 47,9 | 1,12 | 0,58 | 0,56 | 1,06 | 28,25 | 58,8 | 56,4 | 46,9 | 110,2 | 105,7 |
| 380ct2f3 | 67,0 | 1,22 | 0,61 | 0,58 | 1,04 | 28,25 | 65,1 | 62,4 | 46,9 | 125,2 | 120,0 |
| bl1 | 74,7 | 1,26 | 0,61 | 0,59 | 1,16 | 22,24 | 19,9 | 19,1 | 41,5 | 38,4 | 36,8 |
| bl2 | 74,7 | 1,26 | 0,61 | 0,59 | 1,16 | 22,13 | 19,9 | 19,0 | 41,4 | 38,3 | 36,7 |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Afkeur CC2-0 |
| Reference period | 15 jaar |

| **ULS** (strength) Load case | description | **NEN-EN50341-2-15:2019** Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
|---|---|---|---|---|---|---|---|---|
| ULS 1a | Wind | 10° | 1,05 | 1,05 | 0,00 | 1,00 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk only tower | 10° | 0,90 | 1,05 | 0,00 | 1,00 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk conductors too | 10° | 0,90 | 0,90 | 0,00 | 1,00 | 0,00 | 0,0 |
| ULS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,00 | 0,30 | 0,79 | 0,0 |
| ULS 3_0,9 | Wind+ice 0,9Gk | -5° | 0,90 | 1,05 | 0,00 | 0,30 | 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) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,87 | 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+75 T
Number: 53

**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 | -32,6 | 32,6 | 8,0 | 6,5 | 7,1 | 10,8 |
| 380ct1f1 | -109,3 | 109,3 | 24,9 | 19,4 | 26,3 | 37,1 |
| 380ct1f2 | -109,3 | 109,3 | 24,9 | 18,1 | 26,3 | 37,1 |
| 380ct1f3 | -112,0 | 112,0 | 27,1 | 20,6 | 26,3 | 40,5 |
| 380ct2f1 | -109,3 | 109,3 | 24,9 | 17,1 | 26,3 | 37,1 |
| 380ct2f2 | -109,3 | 109,3 | 24,9 | 15,9 | 26,3 | 37,1 |
| 380ct2f3 | -112,0 | 112,0 | 27,1 | 18,3 | 26,3 | 40,5 |
| bl2 | -32,6 | 32,5 | 8,0 | 4,8 | 7,1 | 10,8 |

**Min. Weight span (m)**

| Weight spar Combinatie1 | | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 910,5 | 936,4 | 910,5 |
| 380ct1f1 | 834,4 | 846,1 | 834,4 |
| 380ct1f2 | 834,4 | 846,1 | 834,4 |
| 380ct1f3 | 874,0 | 889,2 | 874,0 |
| 380ct2f1 | 834,4 | 846,1 | 834,4 |
| 380ct2f2 | 834,4 | 846,1 | 834,4 |
| 380ct2f3 | 874,0 | 889,2 | 874,0 |
| bl2 | 910,5 | 939,0 | 910,5 |

**Max. Weight span (m)**

| Weight spar Combinatie1 | | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1185,8 | 955,5 |
| 380ct1f1 | 939,8 | 852,7 |
| 380ct1f2 | 939,8 | 852,7 |
| 380ct1f3 | 1022,0 | 901,9 |
| 380ct2f1 | 939,8 | 852,7 |
| 380ct2f2 | 939,8 | 852,7 |
| 380ct2f3 | 1022,0 | 901,9 |
| bl2 | 1185,5 | 956,9 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | Wind / Weight span ratio | |
| Max. weight span | 1223,8 m | 1,949 | - |
| Min. weight span | 818,8 m | 1,304 | - |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**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 | 14,5 | 16,5 | -34,1 | 31,1 |
| 380ct1f1 | 51,3 | 44,3 | 63,4 | -111,0 | 107,6 |
| 380ct1f2 | 51,3 | 43,0 | 63,4 | -111,0 | 107,6 |
| 380ct1f3 | 51,3 | 47,7 | 66,8 | -116,1 | 110,1 |
| 380ct2f1 | 51,3 | 42,0 | 63,4 | -111,0 | 107,6 |
| 380ct2f2 | 51,3 | 40,8 | 63,4 | -111,0 | 107,6 |
| 380ct2f3 | 51,3 | 45,3 | 66,8 | -116,1 | 110,1 |
| bl2 | 15,0 | 12,8 | 16,5 | -34,1 | 31,1 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,4 | 9,3 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 1,1 | 41,2 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,3 | 41,2 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,7 | 43,1 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,3 | 41,2 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -1,1 | 41,2 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,7 | 43,1 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,4 | 9,3 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie1 | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 6,0 |
| | 380ct1f1 | 17,6 | 24,2 |
| | 380ct1f2 | 17,6 | 24,2 |
| | 380ct1f3 | 17,6 | 26,2 |
| | 380ct2f1 | 17,6 | 24,2 |
| | 380ct2f2 | 17,6 | 24,2 |
| | 380ct2f3 | 17,6 | 26,2 |
| | bl2 | 3,6 | 6,0 |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**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 | 290 | 324 | 34748 | -9 | 0 |
| ULS 1a_0,9_90 | | 0 | 290 | 316 | 34748 | -9 | 0 |
| ULS 3_90 | | 0 | 164 | 420 | 19648 | -9 | 0 |
| ULS 3_0,9_90 | | 0 | 164 | 412 | 19648 | -9 | 0 |
| SLS 7 | | 0 | 0 | 270 | 0 | -5 | 0 |

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

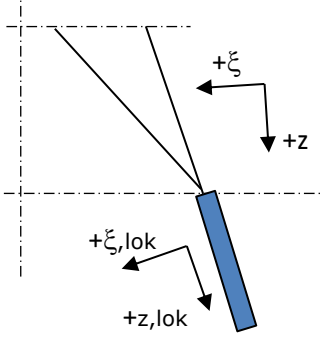
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1190 | 2739 | 98551 | -9 | 0 |
| ULS 3_90 | 0 | 434 | 2835 | 38789 | -9 | 0 |
| SLS 7 | 0 | 0 | 2570 | 0 | -5 | 0 |

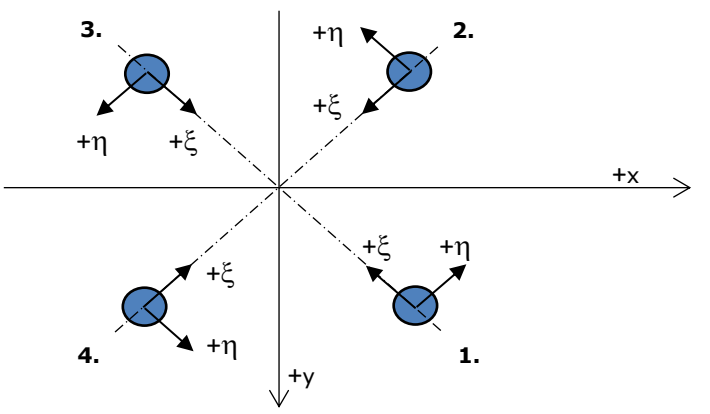
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1190 | 2739 | **98551** | -9 | 0 |
| ULS 1a_0,9_0,9_0 | 1053 | 0 | 2309 | 0 | **83253** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 2562 | 434 | 5540 | **-1309** |
| ULS 1a_0,9_0,9_135 | -829 | 975 | 2322 | **79939** | **-62515** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 566 | 546 | **3828** | 14 | -786 | -64 | 3895 |
| 2 | ULS 1a_0 | 362 | -369 | **2516** | 5 | -517 | -43 | 2561 |
| 3 | ULS 5a Ah 22 | -98 | -127 | **804** | -21 | -159 | -7 | 818 |
| 4 | ULS 1a_135 | -566 | 546 | **3829** | -14 | -786 | -64 | 3897 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -382 | 361 | **-2571** | 14 | 525 | 41 | -2616 |
| 3 | ULS 1a_0,9_0,9_45 | 381 | 361 | **-2570** | -14 | 525 | 41 | -2615 |
| 4 | ULS 1a_0,9_0,9_0 | 179 | -185 | **-1265** | -5 | 257 | 19 | -1287 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ah 10 | 98 | 62 | 531 | **26** | -112 | -12 | 541 |
| 2 | ULS 5a Ba 21 | 94 | -126 | 773 | **23** | -156 | -10 | 786 |
| 3 | ULS 5a Ba 21 | -97 | -62 | 527 | **25** | -112 | -13 | 537 |
| 4 | ULS 5a Ah 10 | -94 | 126 | 777 | **23** | -156 | -10 | 791 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 94 | 126 | 773 | **-23** | -156 | -10 | 786 |
| 2 | ULS 5a Ah 21 | 98 | -62 | 531 | **-26** | -112 | -12 | 541 |
| 3 | ULS 5a Ah 21 | -94 | -126 | 777 | **-23** | -156 | -10 | 791 |
| 4 | ULS 5a Ba 10 | -97 | 62 | 527 | **-25** | -112 | -13 | 537 |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -382 | 361 | **-2571** | **14** | 525 | 41 | -2616 |
| 3 | ULS 1a_0,9_0,9_45 | 381 | 361 | **-2570** | **-14** | 525 | 41 | -2615 |
| 4 | ULS 1a_0,9_0,9_0 | 179 | -185 | **-1265** | **-5** | 257 | 19 | -1287 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 642 | 0 | -133 | -12 | 654 |
| 2 | SLS 7 | 94 | -94 | 642 | 0 | -133 | -12 | 654 |
| 3 | SLS 7 | -94 | -94 | 643 | 0 | -133 | -12 | 654 |
| 4 | SLS 7 | -94 | 94 | 643 | 0 | -133 | -12 | 654 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -566 | 546 | **3829** | -14 | -786 | -64 | 3897 |
| Max. tension | ULS 1a_0,9_0,9_135 | -382 | 361 | **-2571** | 14 | 525 | 41 | -2616 |
| Max. pos. torsie | ULS 5a Ah 10 | 98 | 62 | 531 | **26** | -112 | -12 | 541 |
| Max. neg. torsie | ULS 5a Ah 21 | 98 | -62 | 531 | **-26** | -112 | -12 | 541 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -382 | 361 | **-2571** | **14** | 525 | 41 | -2616 |

**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **642** | 0 | -133 | -12 | 654 |
| 2 | SLS 1a_135 | -309 | 291 | **-2078** | 12 | 424 | 32 | -2115 |
| 3 | SLS 1a_45 | 309 | 291 | **-2077** | -12 | 424 | 32 | -2114 |
| 4 | SLS 1a_0 | 133 | -139 | **-949** | -4 | 193 | 14 | -966 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 498 | 480 | **3367** | 12 | -692 | -57 | 3426 |
| 2 | SLS 1a_0 | 322 | -328 | **2234** | 4 | -459 | -38 | 2273 |
| 3 | SLS 7 | -94 | -94 | **643** | 0 | -133 | -12 | 654 |
| 4 | SLS 1a_135 | -498 | 480 | **3368** | -12 | -692 | -57 | 3428 |

Project: KIJ-GT
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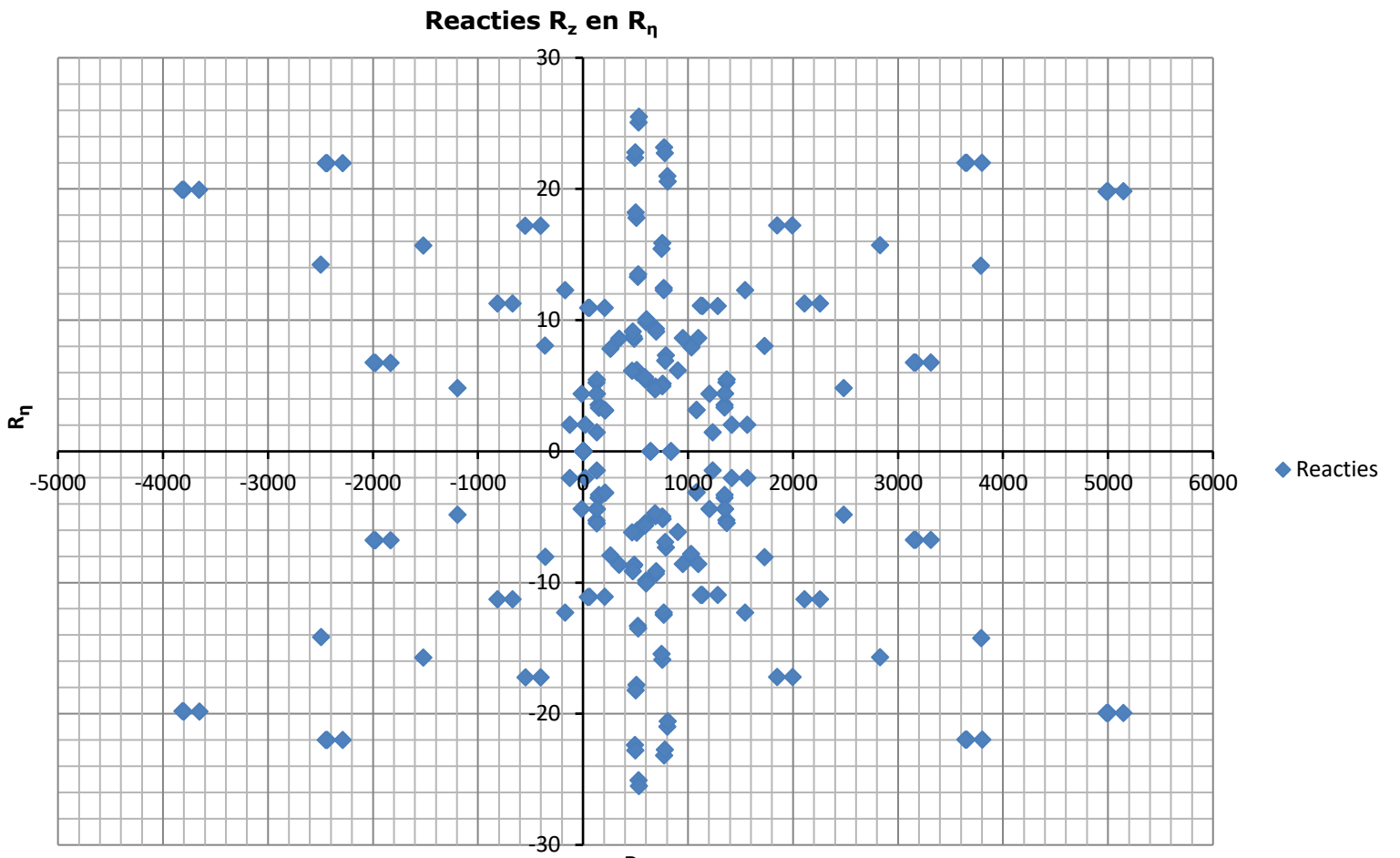


Project: KIJ-GT
Tower: S+75 T
Number: 53

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Verbouw CC2 |
| Reference period | 50 jaar |

| **ULS** (strength) Load case | description | **NEN-EN50341-2-15:2019** Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
|---|---|---|---|---|---|---|---|---|
| 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) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,15 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,15 | 1,15 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,15 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,15 | 1,15 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,15 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,15 | 1,15 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,15 | 1,15 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 1,00 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,30 | 1,00 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

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

Project: KIJ-GT
Tower: S+75 T
Number: 53

**Summary table - Conductor loads**

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

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

**Maximum values for back and ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -42,5 | 42,4 | 11,2 | 9,0 | 7,9 | 13,6 |
| 380ct1f1 | -139,6 | 139,6 | 34,8 | 26,8 | 33,2 | 46,9 |
| 380ct1f2 | -139,6 | 139,6 | 34,8 | 25,2 | 33,2 | 46,9 |
| 380ct1f3 | -143,4 | 143,4 | 37,8 | 28,7 | 33,2 | 51,4 |
| 380ct2f1 | -139,6 | 139,6 | 34,8 | 24,0 | 33,2 | 46,9 |
| 380ct2f2 | -139,6 | 139,6 | 34,8 | 22,4 | 33,2 | 46,9 |
| 380ct2f3 | -143,4 | 143,4 | 37,8 | 25,6 | 33,2 | 51,4 |
| bl2 | -42,4 | 42,4 | 11,2 | 6,7 | 7,9 | 13,6 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 910,5 | 941,1 | 910,5 |
| 380ct1f1 | 834,4 | 847,6 | 834,4 |
| 380ct1f2 | 834,4 | 847,6 | 834,4 |
| 380ct1f3 | 874,0 | 891,4 | 874,0 |
| 380ct2f1 | 834,4 | 847,6 | 834,4 |
| 380ct2f2 | 834,4 | 847,6 | 834,4 |
| 380ct2f3 | 874,0 | 891,4 | 874,0 |
| bl2 | 910,5 | 943,8 | 910,5 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1288,9 | 953,2 |
| 380ct1f1 | 986,9 | 852,9 |
| 380ct1f2 | 987,0 | 852,9 |
| 380ct1f3 | 1085,9 | 903,0 |
| 380ct2f1 | 987,0 | 852,9 |
| 380ct2f2 | 986,9 | 852,9 |
| 380ct2f3 | 1085,9 | 903,0 |
| bl2 | 1288,7 | 954,6 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | Wind / Weight span ratio | |
| Max. weight span | 1401,9 m | 2,232 | - |
| Min. weight span | 816,2 m | 1,300 | - |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**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 | 20,2 | 21,6 | -44,5 | 40,4 |
| 380ct1f1 | 51,3 | 61,6 | 80,1 | -142,1 | 137,2 |
| 380ct1f2 | 51,3 | 60,0 | 80,1 | -142,1 | 137,2 |
| 380ct1f3 | 51,3 | 66,5 | 84,6 | -149,3 | 140,7 |
| 380ct2f1 | 51,3 | 58,7 | 80,1 | -142,1 | 137,2 |
| 380ct2f2 | 51,3 | 57,2 | 80,1 | -142,1 | 137,2 |
| 380ct2f3 | 51,3 | 63,5 | 84,6 | -149,3 | 140,7 |
| bl2 | 15,0 | 17,9 | 21,6 | -44,5 | 40,3 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,4 | 9,3 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 1,1 | 41,2 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,3 | 41,2 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,7 | 43,1 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,3 | 41,2 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -1,1 | 41,2 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,7 | 43,1 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,4 | 9,3 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie1 | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 6,0 |
| | 380ct1f1 | 17,6 | 24,3 |
| | 380ct1f2 | 17,6 | 24,3 |
| | 380ct1f3 | 17,6 | 26,3 |
| | 380ct2f1 | 17,6 | 24,3 |
| | 380ct2f2 | 17,6 | 24,3 |
| | 380ct2f3 | 17,6 | 26,3 |
| | bl2 | 3,6 | 6,0 |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**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 | 405 | 373 | 48528 | -12 | 0 |
| ULS 1a_0,9_90 | | 0 | 405 | 364 | 48528 | -12 | 0 |
| ULS 3_90 | | 0 | 229 | 533 | 27440 | -12 | 0 |
| ULS 3_0,9_90 | | 0 | 229 | 523 | 27440 | -12 | 0 |
| SLS 7 | | 0 | 0 | 270 | 0 | -5 | 0 |

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

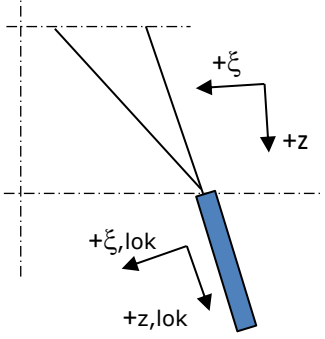
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1662 | 3018 | 137634 | -12 | 0 |
| ULS 3_90 | 0 | 606 | 3178 | 54172 | -12 | 0 |
| SLS 7 | 0 | 0 | 2570 | 0 | -5 | 0 |

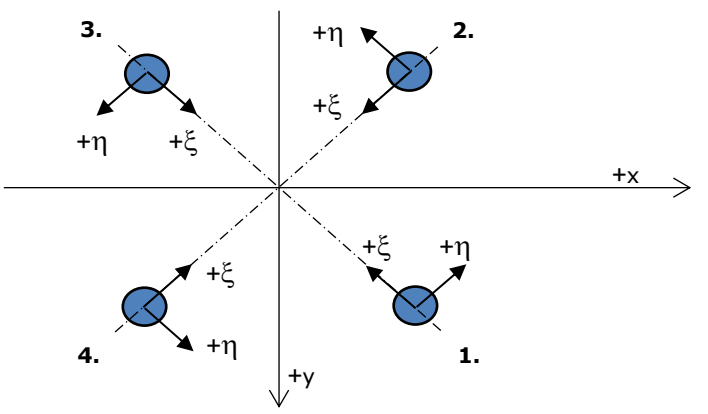
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1662 | 3018 | **137634** | -12 | 0 |
| ULS 1a_0,9_0,9_0 | 1471 | 0 | 2309 | 0 | **116270** | 0 |
| ULS 5a Ba 10 | 51 | 0 | 2562 | 434 | 5540 | **-1309** |
| ULS 1a_0,9_0,9_135 | -1158 | 1361 | 2332 | **111646** | **-87306** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 761 | 733 | **5143** | 20 | -1056 | -86 | 5234 |
| 2 | ULS 1a_0 | 476 | -486 | **3311** | 7 | -680 | -56 | 3369 |
| 3 | ULS 7 | -122 | -122 | **835** | 0 | -173 | -16 | 850 |
| 4 | ULS 1a_135 | -761 | 733 | **5145** | -20 | -1056 | -86 | 5236 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -566 | 538 | **-3818** | 20 | 781 | 61 | -3886 |
| 3 | ULS 1a_0,9_0,9_45 | 566 | 538 | **-3816** | -20 | 781 | 61 | -3884 |
| 4 | ULS 1a_0,9_0,9_0 | 283 | -293 | **-1995** | -7 | 407 | 31 | -2030 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ah 10 | 98 | 62 | 531 | **26** | -112 | -12 | 541 |
| 2 | ULS 5a Ba 21 | 94 | -126 | 773 | **23** | -156 | -10 | 786 |
| 3 | ULS 5a Ba 21 | -97 | -62 | 527 | **25** | -112 | -13 | 537 |
| 4 | ULS 5a Ah 10 | -94 | 126 | 777 | **23** | -156 | -10 | 791 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 94 | 126 | 773 | **-23** | -156 | -10 | 786 |
| 2 | ULS 5a Ah 21 | 98 | -62 | 531 | **-26** | -112 | -12 | 541 |
| 3 | ULS 5a Ah 21 | -94 | -126 | 777 | **-23** | -156 | -10 | 791 |
| 4 | ULS 5a Ba 10 | -97 | 62 | 527 | **-25** | -112 | -13 | 537 |

Project: KIJ-GT
Tower: S+75 T
Number: 53

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -566 | 538 | **-3818** | **20** | 781 | 61 | -3886 |
| 3 | ULS 1a_0,9_0,9_45 | 566 | 538 | **-3816** | **-20** | 781 | 61 | -3884 |
| 4 | ULS 1a_0,9_0,9_0 | 283 | -293 | **-1995** | **-7** | 407 | 31 | -2030 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 642 | 0 | -133 | -12 | 654 |
| 2 | SLS 7 | 94 | -94 | 642 | 0 | -133 | -12 | 654 |
| 3 | SLS 7 | -94 | -94 | 643 | 0 | -133 | -12 | 654 |
| 4 | SLS 7 | -94 | 94 | 643 | 0 | -133 | -12 | 654 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -761 | 733 | **5145** | -20 | -1056 | -86 | 5236 |
| Max. tension | ULS 1a_0,9_0,9_135 | -566 | 538 | **-3818** | 20 | 781 | 61 | -3886 |
| Max. pos. torsie | ULS 5a Ah 10 | 98 | 62 | 531 | **26** | -112 | -12 | 541 |
| Max. neg. torsie | ULS 5a Ah 21 | 98 | -62 | 531 | **-26** | -112 | -12 | 541 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -566 | 538 | **-3818** | **20** | 781 | 61 | -3886 |

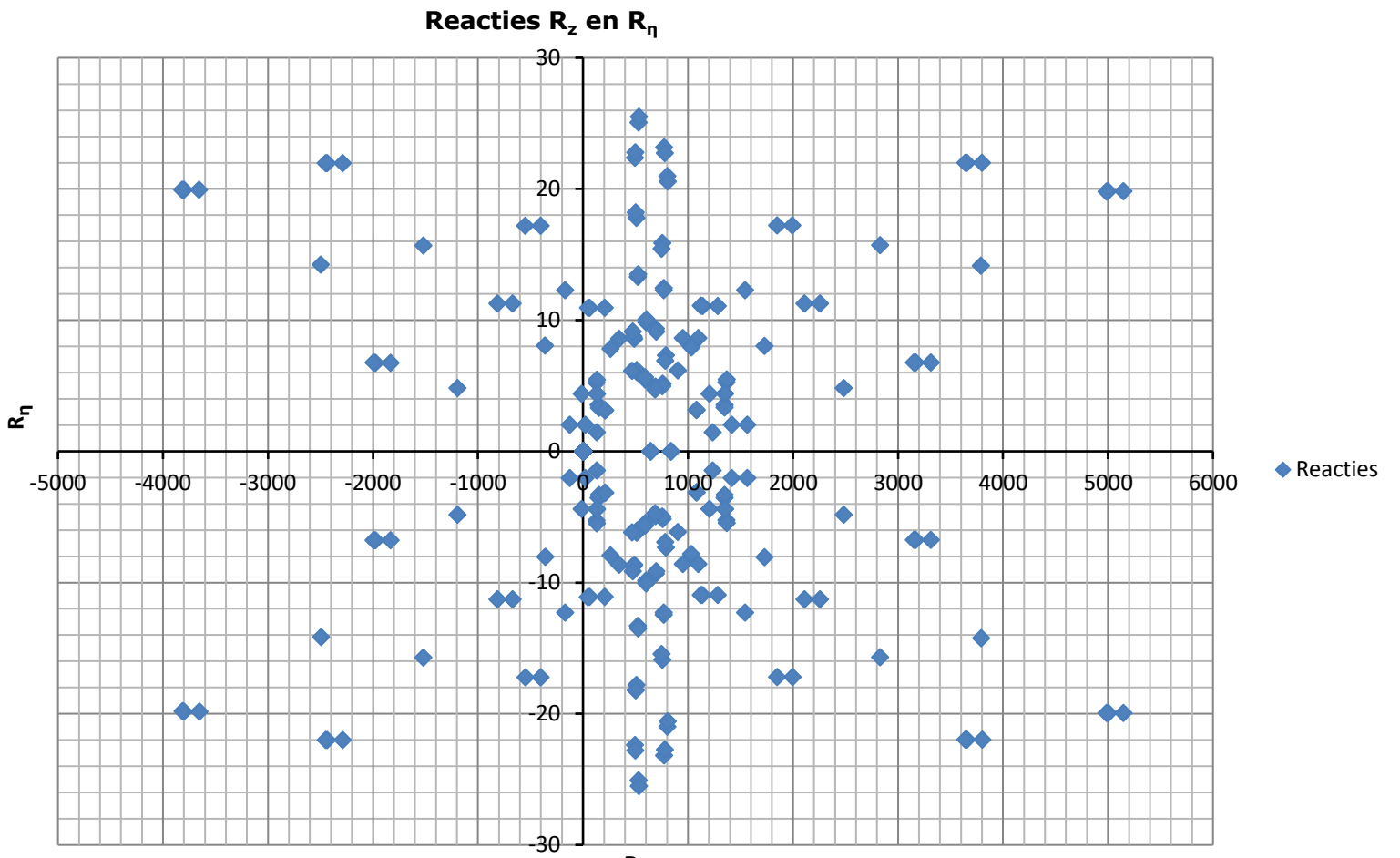
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **642** | 0 | -133 | -12 | 654 |
| 2 | SLS 1a_135 | -371 | 351 | **-2498** | 14 | 510 | 39 | -2542 |
| 3 | SLS 1a_45 | 371 | 351 | **-2497** | -14 | 510 | 39 | -2541 |
| 4 | SLS 1a_0 | 168 | -175 | **-1195** | -5 | 243 | 18 | -1216 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 560 | 540 | **3788** | 14 | -778 | -64 | 3855 |
| 2 | SLS 1a_0 | 357 | -364 | **2480** | 5 | -510 | -42 | 2523 |
| 3 | SLS 7 | -94 | -94 | **643** | 0 | -133 | -12 | 654 |
| 4 | SLS 1a_135 | -560 | 540 | **3790** | -14 | -778 | -64 | 3856 |

Project: KIJ-GT
Tower: S+75 T
Number: 53



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 15 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | II |
| Wind speed | 25,3 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 142,5 m |
| Max. Span | 702 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 649 m |
| EDS Weight span | 873 m |
| Min. Weight span | 811 m |
| Max. Weight span | 1336 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-02-23 | | | |

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+75

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

Document name:

KIJ-GT_S+75_50_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

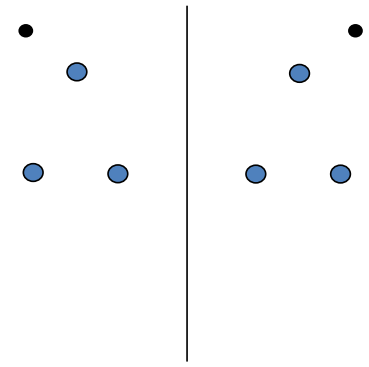
Project: KIJ-GT
Tower: S+75
Number: 50

## Conductor loads

Auteur: TBR
Versie: v11.6

### General

| | |
|---|---|
| Description | S+75 |
| 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 |
| Terrain category | 25,3 m/s |
| Reduction factor $c_{dir}$ | II |
| Ice region phase conductor | 1,00 |
| Ice region earth conductor | B |
| | 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 | 103,7 m | 108,0 m | 25,5 m |
| Circuit 1 | 11 | 380ct1f2 | 103,7 m | 108,0 m | 11,5 m |
| Circuit 1 | 12 | 380ct1f3 | 130,7 m | 135,0 m | 18,5 m |
| Circuit 2 | 20 | 380ct2f1 | 103,7 m | 108,0 m | -11,5 m |
| Circuit 2 | 21 | 380ct2f2 | 103,7 m | 108,0 m | -25,5 m |
| Circuit 2 | 22 | 380ct2f3 | 130,7 m | 135,0 m | -18,5 m |
| Bliksemdraad 1 | 1 | bl1 | 140,7 m | 141,0 m | 31,5 m |
| Bliksemdraad 2 | 3 | bl2 | 140,7 m | 141,0 m | -31,5 m |

Project: KIJ-GT
Tower: S+75
Number: 50

**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**

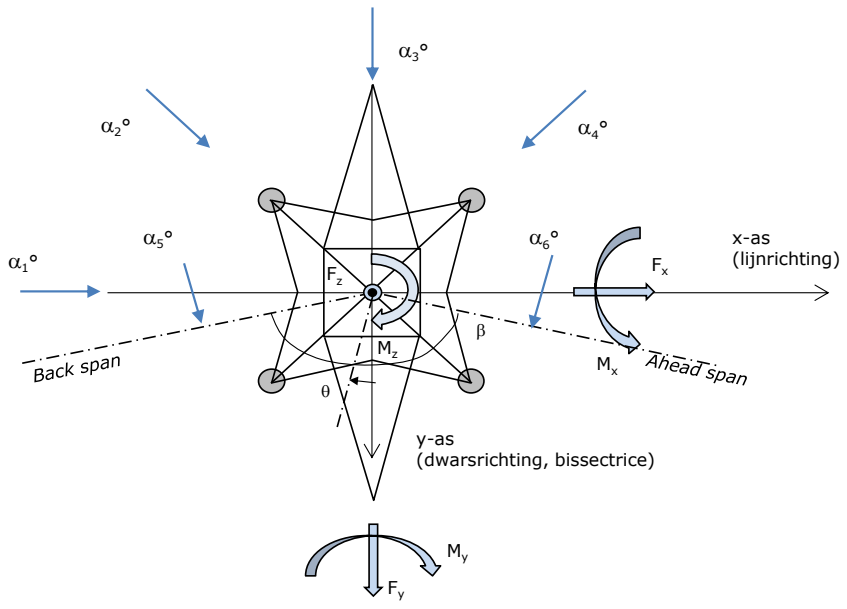
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | -1,4 | -69,2 m | 0,0 | 7,8 m |
| Circuit 1 | 11 | 380ct1f2 | -1,4 | -69,2 m | 0,0 | 2,0 m |
| Circuit 1 | 12 | 380ct1f3 | -1,4 | -80,7 m | 0,0 | 4,9 m |
| Circuit 2 | 20 | 380ct2f1 | -1,4 | -69,2 m | 0,0 | -2,0 m |
| Circuit 2 | 21 | 380ct2f2 | -1,4 | -69,2 m | 0,0 | -7,8 m |
| Circuit 2 | 22 | 380ct2f3 | -1,4 | -80,7 m | 0,0 | -4,9 m |
| Bliksemdraad 1 | 1 | bl1 | -1,4 | -87,8 m | 0,0 | 10,4 m |
| Bliksemdraad 2 | 3 | bl2 | -1,4 | -87,8 m | 0,0 | -10,4 m |

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 702,0 | 595,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 612,3 | 612,3 | m |
| Line angle | $\beta$ | 180 | | ° |
| Tower orientation with respect to bis | $\theta$ | 0 | | ° |
| Section length | | 1774 | 1774 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+75
Number: 50

Project: KIJ-GT
Tower: S+75
Number: 50

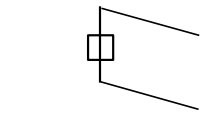
**Absence of conductors**

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

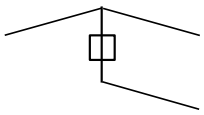
**Load situations SPLS**

Considered situations SPLS: SPLS for suspension tower not applicable

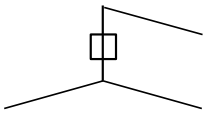
Principle of load situations:



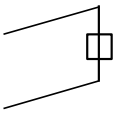
1. Ba All cts



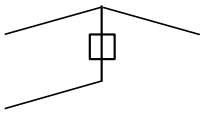
2. Ba ct1



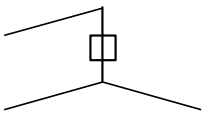
3. Ba ct2



4. Ah All cts



5. Ah ct1

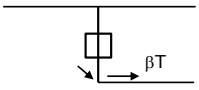


6. Ah ct2

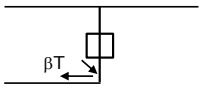
**Load situation 5a. Conductor failure**

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

Principle of load situations:




1. Ba




2. Ah

Project: KIJ-GT
Tower: S+75
Number: 50

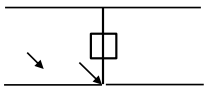
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

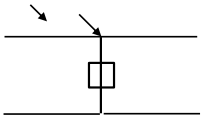
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

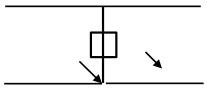
Principle of load situations:



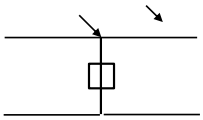
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

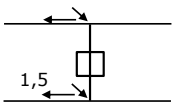
**Load situations 8. Galloping as a static load**

| 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 |

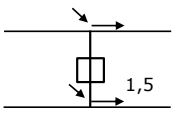
Considered situations galloping 8: None (existing structure)

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+75
Number: 50

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+75 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 142,5 | m | |
| Tower self weight | 2300,0 | 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 $G_T$ | 1,01 |
| 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 ar | 0,4 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 63,61 | 0,11 | 3,33 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 65,51 | 0,21 | 2,90 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 63,61 | 0,11 | 3,33 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 65,51 | 0,21 | 2,90 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

*Note: Surface transverse direction is reduced in calculation.*

Project: KIJ-GT
Tower: S+75
Number: 50

**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | Factor | $\Delta h$ | $A_1$ |
|---|---|---|---|---|
| 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 | 0,86 | 181,7 | 154,2 | 0,0 | -154,2 | 15,0 | 2726,0 | 2313,1 | 0,0 | -2313,1 |
| Middenstuk 1 | 1,17 | 222,4 | 188,7 | 0,0 | -188,7 | 43,6 | 9683,9 | 8217,1 | 0,0 | -8217,1 |
| Middenstuk 2 | 1,32 | 150,4 | 127,6 | 0,0 | -127,6 | 68,8 | 10346,2 | 8779,1 | 0,0 | -8779,1 |
| Bovenstuk 1 | 1,42 | 139,4 | 118,3 | 0,0 | -118,3 | 94,0 | 13106,5 | 11121,3 | 0,0 | -11121,3 |
| Bovenstuk 2 | 1,51 | 136,8 | 116,1 | 0,0 | -116,1 | 123,0 | 16829,3 | 14280,1 | 0,0 | -14280,1 |
| Topstuk | 1,56 | 6,6 | 5,6 | 0,0 | -5,6 | 140,5 | 921,4 | 781,8 | 0,0 | -781,8 |
| Ondertraverse | 1,47 | 104,9 | 62,3 | 0,0 | -62,3 | 108,8 | 11413,7 | 6779,4 | 0,0 | -6779,4 |
| Boventraverse | 1,55 | 159,9 | 95,0 | 0,0 | -95,0 | 137,0 | 21910,0 | 13013,9 | 0,0 | -13013,9 |
| Totaal | | 1102,1 | 867,7 | 0,0 | -867,7 | | 86937,0 | 65285,7 | 0,0 | -65285,7 |

**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 | 0,86 | 0,0 | 154,2 | 181,7 | 154,2 | 15,0 | 0,0 | 2313,1 | 2726,0 | 2313,1 |
| Middenstuk 1 | 1,17 | 0,0 | 188,7 | 222,4 | 188,7 | 43,6 | 0,0 | 8217,1 | 9683,9 | 8217,1 |
| Middenstuk 2 | 1,32 | 0,0 | 127,6 | 150,4 | 127,6 | 68,8 | 0,0 | 8779,1 | 10346,2 | 8779,1 |
| Bovenstuk 1 | 1,42 | 0,0 | 118,3 | 139,4 | 118,3 | 94,0 | 0,0 | 11121,3 | 13106,5 | 11121,3 |
| Bovenstuk 2 | 1,51 | 0,0 | 116,1 | 136,8 | 116,1 | 123,0 | 0,0 | 14280,1 | 16829,3 | 14280,1 |
| Topstuk | 1,56 | 0,0 | 5,6 | 6,6 | 5,6 | 140,5 | 0,0 | 781,8 | 921,4 | 781,8 |
| Ondertraverse | 1,47 | 0,0 | 62,3 | 41,9 | 62,3 | 108,8 | 0,0 | 6779,4 | 4565,5 | 6779,4 |
| Boventraverse | 1,55 | 0,0 | 95,0 | 64,0 | 95,0 | 137,0 | 0,0 | 13013,9 | 8764,0 | 13013,9 |
| Total | | 0,0 | 867,7 | 943,2 | 867,7 | | 0,0 | 65285,7 | 66942,8 | 65285,7 |

**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 | 2300 | 0 | 0 | 0 |
| Windrichting 0° | 1102 | 0 | 0 | 0 | 87806 | 0 |
| Windrichting 45° | 868 | 868 | 0 | 65939 | 65939 | 0 |
| Windrichting 90° | 0 | 943 | 0 | 67612 | 0 | 0 |
| Windrichting 135° | -868 | 868 | 0 | 65939 | -65939 | 0 |

Project: KIJ-GT
Tower: S+75
Number: 50

**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 | $w_{z,iis}$ [N/m] | $w_{z,iis,bundel}$ [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 | 106,35 | 1,46 | 1,2 | 2,63 |
| 380ct1f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,46 | 1,2 | 2,63 |
| 380ct1f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,54 | 1,2 | 2,77 |
| 380ct2f1 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,46 | 1,2 | 2,63 |
| 380ct2f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,46 | 1,2 | 2,63 |
| 380ct2f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,54 | 1,2 | 2,77 |
| bl1 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,56 | 1,2 | 0,19 |
| bl2 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,56 | 1,2 | 0,19 |

Project: KIJ-GT
Tower: S+75
Number: 50

**Wind load back**

| Conductor | Height wind | Pressure | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{additional}$ | $w_y$ | $w_{y,section}$ | $D_{ijs,additional}$ | $w_{y,ijs}$ | $w_{y,ijs,section}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 74,2 | 1,34 | 0,61 | 0,59 | 1,01 | 28,25 | 69,9 | 67,6 | 46,9 | 138,2 | 133,5 |
| 380ct1f2 | 74,2 | 1,34 | 0,61 | 0,59 | 1,01 | 28,25 | 69,9 | 67,6 | 46,9 | 138,2 | 133,5 |
| 380ct1f3 | 101,2 | 1,44 | 0,63 | 0,61 | 0,98 | 28,25 | 76,2 | 73,6 | 46,9 | 154,3 | 149,0 |
| 380ct2f1 | 74,2 | 1,34 | 0,61 | 0,59 | 1,01 | 28,25 | 69,9 | 67,6 | 46,9 | 138,2 | 133,5 |
| 380ct2f2 | 74,2 | 1,34 | 0,61 | 0,59 | 1,01 | 28,25 | 69,9 | 67,6 | 46,9 | 138,2 | 133,5 |
| 380ct2f3 | 101,2 | 1,44 | 0,63 | 0,61 | 0,98 | 28,25 | 76,2 | 73,6 | 46,9 | 154,3 | 149,0 |
| bl1 | 113,1 | 1,48 | 0,64 | 0,62 | 1,12 | 22,24 | 23,6 | 22,8 | 41,5 | 47,3 | 45,7 |
| bl2 | 113,1 | 1,48 | 0,64 | 0,62 | 1,12 | 22,13 | 23,6 | 22,8 | 41,4 | 47,2 | 45,6 |

**Wind load ahead**

| Conductor | Height wind | Pressure | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{additional}$ | $w_y$ | $w_{y,section}$ | $D_{ijs,additional}$ | $w_{y,ijs}$ | $w_{y,ijs,section}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 48,5 | 1,20 | 0,58 | 0,56 | 1,04 | 28,25 | 61,6 | 59,6 | 46,9 | 117,8 | 113,9 |
| 380ct1f2 | 48,5 | 1,20 | 0,58 | 0,56 | 1,04 | 28,25 | 61,6 | 59,6 | 46,9 | 117,8 | 113,9 |
| 380ct1f3 | 69,7 | 1,32 | 0,61 | 0,59 | 1,01 | 28,25 | 68,7 | 66,4 | 46,9 | 135,1 | 130,6 |
| 380ct2f1 | 48,5 | 1,20 | 0,58 | 0,56 | 1,04 | 28,25 | 61,6 | 59,6 | 46,9 | 117,8 | 113,9 |
| 380ct2f2 | 48,5 | 1,20 | 0,58 | 0,56 | 1,04 | 28,25 | 61,6 | 59,6 | 46,9 | 117,8 | 113,9 |
| 380ct2f3 | 69,7 | 1,32 | 0,61 | 0,59 | 1,01 | 28,25 | 68,7 | 66,4 | 46,9 | 135,1 | 130,6 |
| bl1 | 77,6 | 1,36 | 0,61 | 0,59 | 1,14 | 22,24 | 21,1 | 20,4 | 41,5 | 41,4 | 40,0 |
| bl2 | 77,6 | 1,36 | 0,61 | 0,59 | 1,14 | 22,13 | 21,1 | 20,4 | 41,4 | 41,4 | 40,0 |

Project: KIJ-GT
Tower: S+75
Number: 50

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Afkeur CC2-0 |
| Reference period | 15 jaar |

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp | $\gamma_G$ | $\gamma_G$ | | $\gamma_Q$ | | $\gamma_a$ |
| | | °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) | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+75
Number: 50

**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 | -34,4 | 34,4 | 8,6 | 7,1 | 7,2 | 10,2 |
| 380ct1f1 | -111,1 | 111,1 | 26,4 | 21,4 | 26,6 | 35,3 |
| 380ct1f2 | -111,1 | 111,1 | 26,4 | 20,4 | 26,6 | 35,3 |
| 380ct1f3 | -117,0 | 117,0 | 28,7 | 23,2 | 26,6 | 37,8 |
| 380ct2f1 | -111,1 | 111,1 | 26,4 | 19,7 | 26,6 | 35,3 |
| 380ct2f2 | -111,1 | 111,1 | 26,4 | 18,7 | 26,6 | 35,3 |
| 380ct2f3 | -117,0 | 117,0 | 28,7 | 21,4 | 26,6 | 37,8 |
| bl2 | -34,4 | 34,4 | 8,5 | 5,9 | 7,2 | 10,2 |

**Min. Weight span (m)**

| Weight spar Combinatie1 | | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 872,7 | 895,2 | 872,7 |
| 380ct1f1 | 814,2 | 824,3 | 814,2 |
| 380ct1f2 | 814,2 | 824,3 | 814,2 |
| 380ct1f3 | 841,2 | 854,1 | 841,2 |
| 380ct2f1 | 814,2 | 824,3 | 814,2 |
| 380ct2f2 | 814,2 | 824,3 | 814,2 |
| 380ct2f3 | 841,2 | 854,1 | 841,2 |
| bl2 | 872,7 | 897,5 | 872,7 |

**Max. Weight span (m)**

| Weight spar Combinatie1 | | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1118,3 | 916,0 |
| 380ct1f1 | 909,3 | 831,8 |
| 380ct1f2 | 909,3 | 831,8 |
| 380ct1f3 | 972,3 | 867,7 |
| 380ct2f1 | 909,3 | 831,8 |
| 380ct2f2 | 909,3 | 831,8 |
| 380ct2f3 | 972,3 | 867,7 |
| bl2 | 1118,2 | 917,1 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | | Wind / Weight span ratio |
| Max. weight span | 1183,0 | m | 1,824 - |
| Min. weight span | 813,3 | m | 1,254 - |

Project: KIJ-GT
Tower: S+75
Number: 50

**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 | 15,6 | 15,8 | -35,8 | 33,0 |
| 380ct1f1 | 51,3 | 47,8 | 61,9 | -114,4 | 109,3 |
| 380ct1f2 | 51,3 | 46,8 | 61,9 | -114,4 | 109,3 |
| 380ct1f3 | 51,3 | 51,9 | 64,4 | -120,9 | 113,1 |
| 380ct2f1 | 51,3 | 46,1 | 61,9 | -114,4 | 109,3 |
| 380ct2f2 | 51,3 | 45,1 | 61,9 | -114,4 | 109,3 |
| 380ct2f3 | 51,3 | 50,1 | 64,4 | -120,9 | 113,1 |
| bl2 | 15,0 | 14,5 | 15,8 | -35,8 | 32,9 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 8,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,8 | 40,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,2 | 40,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,5 | 41,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,2 | 40,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -0,8 | 40,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,5 | 41,6 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,3 | 8,9 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 5,5 |
| | 380ct1f1 | 17,7 | 23,1 |
| | 380ct1f2 | 17,7 | 23,1 |
| | 380ct1f3 | 17,7 | 24,4 |
| | 380ct2f1 | 17,7 | 23,1 |
| | 380ct2f2 | 17,7 | 23,1 |
| | 380ct2f3 | 17,7 | 24,4 |
| | bl2 | 3,6 | 5,5 |

Project: KIJ-GT
Tower: S+75
Number: 50

**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 | 318 | 311 | 38044 | -5 | 0 |
| ULS 1a_0,9_90 | | 0 | 318 | 311 | 38044 | -5 | 0 |
| ULS 3_90 | | 0 | 183 | 408 | 21923 | -5 | 0 |
| ULS 3_0,9_90 | | 0 | 183 | 408 | 21923 | -5 | 0 |
| SLS 7 | | 0 | 0 | 262 | 0 | -3 | 0 |

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

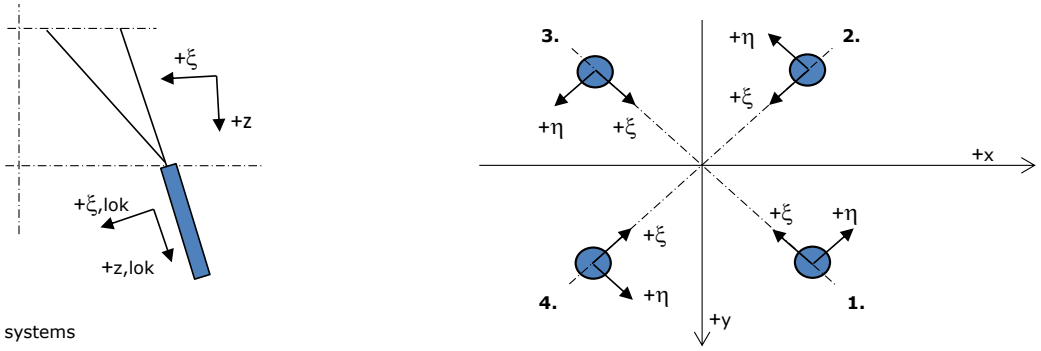
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1279 | 2726 | 106990 | -5 | 0 |
| ULS 3_90 | 0 | 471 | 2823 | 42606 | -5 | 0 |
| SLS 7 | 0 | 0 | 2562 | 0 | -3 | 0 |

**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 | 1279 | 2726 | **106990** | -5 | 0 |
| ULS 1a_0,9_0,9_0 | 1128 | 0 | 2306 | 0 | **90070** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 2554 | 432 | 5542 | **-1309** |
| ULS 1a_0,9_0,9_135 | -888 | 1047 | 2319 | **86686** | **-67620** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 602 | 580 | **4088** | 16 | -836 | -65 | 4161 |
| 2 | ULS 1a_0 | 381 | -391 | **2665** | 7 | -546 | -43 | 2712 |
| 3 | ULS 5a Ah 12 | -97 | -127 | **801** | -21 | -158 | -7 | 815 |
| 4 | ULS 1a_135 | -602 | 580 | **4089** | -16 | -836 | -65 | 4161 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -418 | 396 | **-2834** | 16 | 576 | 41 | -2884 |
| 3 | ULS 1a_0,9_0,9_45 | 418 | 396 | **-2833** | -16 | 576 | 42 | -2883 |
| 4 | ULS 1a_0,9_0,9_0 | 198 | -208 | **-1416** | -7 | 287 | 19 | -1441 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| 2 | ULS 5a Ba 10 | 93 | -126 | 771 | **23** | -155 | -10 | 784 |
| 3 | ULS 5a Ba 10 | -97 | -61 | 525 | **25** | -112 | -13 | 535 |
| 4 | ULS 5a Ah 21 | -94 | 126 | 774 | **23** | -156 | -10 | 788 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 93 | 126 | 771 | **-23** | -155 | -10 | 784 |
| 2 | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| 3 | ULS 5a Ah 10 | -94 | -126 | 774 | **-23** | -156 | -10 | 788 |
| 4 | ULS 5a Ba 21 | -97 | 61 | 525 | **-25** | -112 | -13 | 535 |

Project: KIJ-GT
Tower: S+75
Number: 50

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -418 | 396 | **-2834** | **16** | 576 | 41 | -2884 |
| 3 | ULS 1a_0,9_0,9_45 | 418 | 396 | **-2833** | **-16** | 576 | 42 | -2883 |
| 4 | ULS 1a_0,9_0,9_0 | 198 | -208 | **-1416** | **-7** | 287 | 19 | -1441 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 641 | 0 | -133 | -12 | 652 |
| 2 | SLS 7 | 94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 3 | SLS 7 | -94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 4 | SLS 7 | -94 | 94 | 641 | 0 | -133 | -12 | 652 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -602 | 580 | **4089** | -16 | -836 | -65 | 4161 |
| Max. tension | ULS 1a_0,9_0,9_135 | -418 | 396 | **-2834** | 16 | 576 | 41 | -2884 |
| Max. pos. torsie | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| Max. neg. torsie | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -418 | 396 | **-2834** | **16** | 576 | 41 | -2884 |

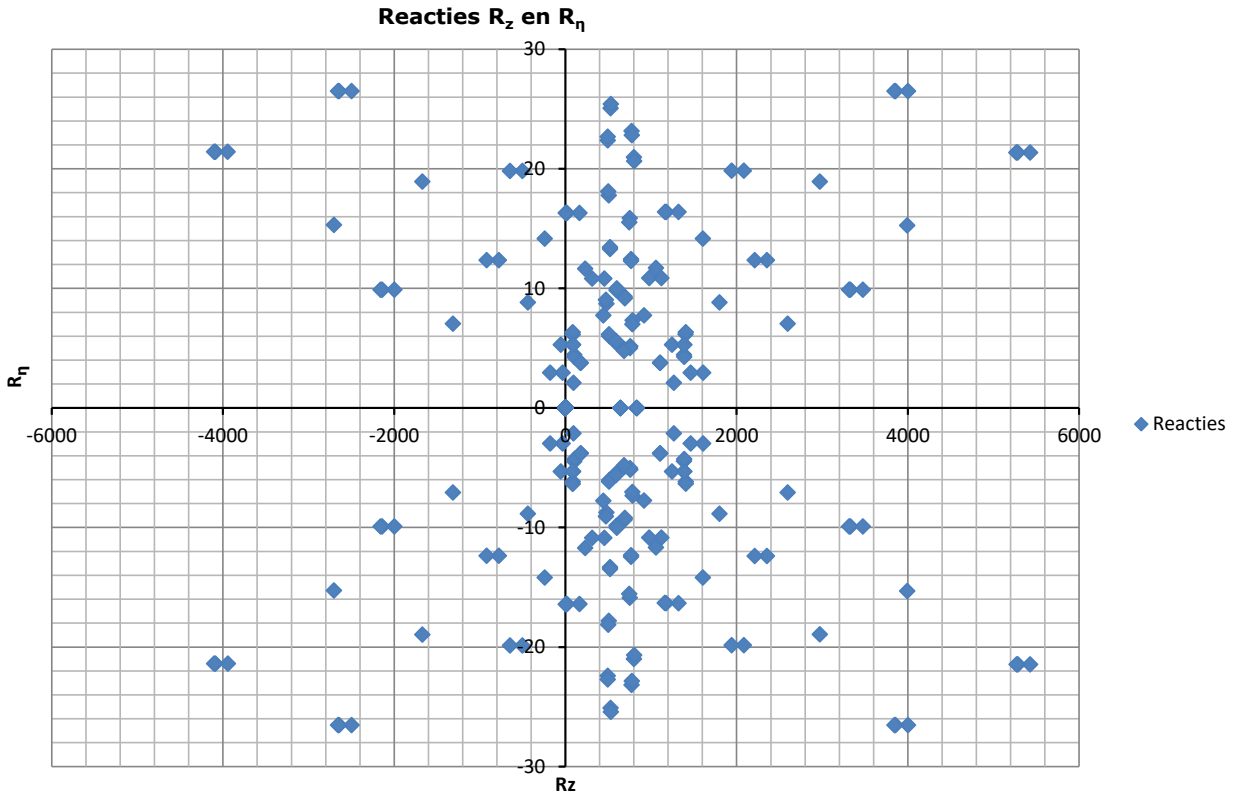
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **641** | 0 | -133 | -12 | 652 |
| 2 | SLS 1a_135 | -333 | 315 | **-2257** | 13 | 458 | 32 | -2297 |
| 3 | SLS 1a_45 | 333 | 314 | **-2257** | -13 | 458 | 32 | -2296 |
| 4 | SLS 1a_0 | 146 | -154 | **-1052** | -6 | 212 | 14 | -1071 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 522 | 503 | **3542** | 13 | -725 | -57 | 3605 |
| 2 | SLS 1a_0 | 334 | -342 | **2333** | 6 | -478 | -38 | 2374 |
| 3 | SLS 7 | -94 | -94 | **641** | 0 | -133 | -12 | 652 |
| 4 | SLS 1a_135 | -522 | 503 | **3543** | -13 | -725 | -57 | 3605 |

Project: KIJ-GT
Tower: S+75
Number: 50



Project: KIJ-GT
Tower: S+75
Number: 50

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Verbouw CC2 |
| Reference period | 50 jaar |

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp | $\gamma_G$ | $\gamma_G$ | | $\gamma_Q$ | | $\gamma_a$ |
| | | °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) | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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+75
Number: 50

**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 | -44,3 | 44,3 | 11,7 | 9,7 | 8,1 | 12,6 |
| 380ct1f1 | -141,6 | 141,6 | 36,2 | 29,2 | 33,6 | 44,7 |
| 380ct1f2 | -141,6 | 141,6 | 36,2 | 28,0 | 33,6 | 44,7 |
| 380ct1f3 | -148,6 | 148,6 | 39,4 | 31,7 | 33,6 | 47,9 |
| 380ct2f1 | -141,6 | 141,6 | 36,2 | 27,1 | 33,6 | 44,7 |
| 380ct2f2 | -141,6 | 141,6 | 36,2 | 25,9 | 33,6 | 44,7 |
| 380ct2f3 | -148,6 | 148,6 | 39,4 | 29,4 | 33,6 | 47,9 |
| bl2 | -44,3 | 44,3 | 11,7 | 8,2 | 8,0 | 12,6 |

**Min. Weight span (m)**

| Weight spar Combinatie1 | | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 872,7 | 899,5 | 872,7 |
| 380ct1f1 | 814,2 | 825,6 | 814,2 |
| 380ct1f2 | 814,2 | 825,6 | 814,2 |
| 380ct1f3 | 841,2 | 856,0 | 841,2 |
| 380ct2f1 | 814,2 | 825,6 | 814,2 |
| 380ct2f2 | 814,2 | 825,6 | 814,2 |
| 380ct2f3 | 841,2 | 856,0 | 841,2 |
| bl2 | 872,7 | 901,8 | 872,7 |

**Max. Weight span (m)**

| Weight spar Combinatie1 | | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1199,8 | 912,8 |
| 380ct1f1 | 947,3 | 831,6 |
| 380ct1f2 | 947,3 | 831,6 |
| 380ct1f3 | 1022,7 | 868,2 |
| 380ct2f1 | 947,3 | 831,6 |
| 380ct2f2 | 947,3 | 831,6 |
| 380ct2f3 | 1022,7 | 868,2 |
| bl2 | 1199,7 | 914,0 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | Wind / Weight span ratio | |
| Max. weight span | 1335,7 m | 2,060 | - |
| Min. weight span | 811,4 m | 1,251 | - |

Project: KIJ-GT
Tower: S+75
Number: 50

**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 | 21,4 | 20,7 | -46,2 | 42,4 |
| 380ct1f1 | 51,3 | 65,5 | 78,2 | -144,9 | 139,0 |
| 380ct1f2 | 51,3 | 64,2 | 78,2 | -144,9 | 139,0 |
| 380ct1f3 | 51,3 | 71,1 | 81,5 | -154,1 | 143,4 |
| 380ct2f1 | 51,3 | 63,3 | 78,2 | -144,9 | 139,0 |
| 380ct2f2 | 51,3 | 62,1 | 78,2 | -144,9 | 139,0 |
| 380ct2f3 | 51,3 | 68,8 | 81,5 | -154,1 | 143,4 |
| bl2 | 15,0 | 19,9 | 20,6 | -46,2 | 42,3 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 8,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,8 | 40,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,2 | 40,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,5 | 41,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,2 | 40,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -0,8 | 40,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,5 | 41,6 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,3 | 8,9 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 5,6 |
| | 380ct1f1 | 17,7 | 23,1 |
| | 380ct1f2 | 17,7 | 23,1 |
| | 380ct1f3 | 17,7 | 24,5 |
| | 380ct2f1 | 17,7 | 23,1 |
| | 380ct2f2 | 17,7 | 23,1 |
| | 380ct2f3 | 17,7 | 24,5 |
| | bl2 | 3,6 | 5,6 |

Project: KIJ-GT
Tower: S+75
Number: 50

**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 | 436 | 356 | 52231 | -6 | 0 |
| ULS 1a_0,9_90 | | 0 | 436 | 356 | 52231 | -6 | 0 |
| ULS 3_90 | | 0 | 251 | 517 | 30098 | -6 | 0 |
| ULS 3_0,9_90 | | 0 | 251 | 517 | 30098 | -6 | 0 |
| SLS 7 | | 0 | 0 | 262 | 0 | -3 | 0 |

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

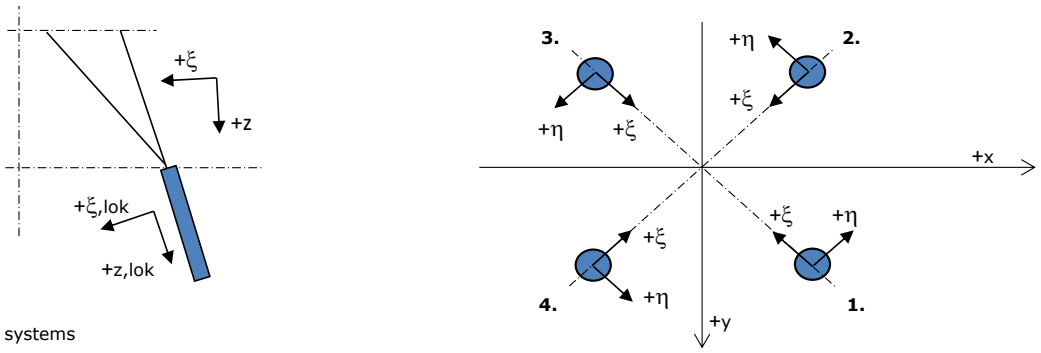
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1757 | 3001 | 146888 | -6 | 0 |
| ULS 3_90 | 0 | 647 | 3162 | 58495 | -6 | 0 |
| SLS 7 | 0 | 0 | 2562 | 0 | -3 | 0 |

**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 | 1757 | 3001 | **146888** | -6 | 0 |
| ULS 1a_0,9_0,9_0 | 1549 | 0 | 2306 | 0 | **123660** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 2554 | 432 | 5542 | **-1309** |
| ULS 1a_0,9_0,9_135 | -1219 | 1438 | 2328 | **119016** | **-92836** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 800 | 769 | **5427** | 21 | -1109 | -86 | 5523 |
| 2 | ULS 1a_0 | 495 | -509 | **3472** | 10 | -710 | -56 | 3534 |
| 3 | ULS 7 | -122 | -122 | **833** | 0 | -173 | -16 | 847 |
| 4 | ULS 1a_135 | -800 | 769 | **5428** | -21 | -1109 | -86 | 5524 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -606 | 575 | **-4105** | 21 | 835 | 61 | -4177 |
| 3 | ULS 1a_0,9_0,9_45 | 605 | 575 | **-4104** | -21 | 835 | 61 | -4176 |
| 4 | ULS 1a_0,9_0,9_0 | 303 | -317 | **-2159** | -10 | 438 | 31 | -2197 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_90 | 587 | 549 | 4000 | **27** | -803 | -49 | 4070 |
| 2 | ULS 1a_0,9_0,9_90 | -390 | 352 | -2658 | **27** | 525 | 24 | -2705 |
| 3 | ULS 5a Ba 10 | -97 | -61 | 525 | **25** | -112 | -13 | 535 |
| 4 | ULS 5a Ah 21 | -94 | 126 | 774 | **23** | -156 | -10 | 788 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 93 | 126 | 771 | **-23** | -155 | -10 | 784 |
| 2 | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| 3 | ULS 1a_90 | 367 | 329 | -2499 | **-27** | 492 | 21 | -2543 |
| 4 | ULS 1a_0,9_0,9_90 | -563 | 526 | 3842 | **-27** | -770 | -46 | 3910 |

Project: KIJ-GT
Tower: S+75
Number: 50

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -606 | 575 | **-4105** | **21** | 835 | 61 | -4177 |
| 3 | ULS 1a_0,9_0,9_45 | 605 | 575 | **-4104** | **-21** | 835 | 61 | -4176 |
| 4 | ULS 1a_0,9_0,9_0 | 303 | -317 | **-2159** | **-10** | 438 | 31 | -2197 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 641 | 0 | -133 | -12 | 652 |
| 2 | SLS 7 | 94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 3 | SLS 7 | -94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 4 | SLS 7 | -94 | 94 | 641 | 0 | -133 | -12 | 652 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -800 | 769 | **5428** | -21 | -1109 | -86 | 5524 |
| Max. tension | ULS 1a_0,9_0,9_135 | -606 | 575 | **-4105** | 21 | 835 | 61 | -4177 |
| Max. pos. torsie | ULS 1a_0,9_90 | 566 | 528 | 3856 | **27** | -773 | -46 | 3924 |
| Max. neg. torsie | ULS 1a_90 | 367 | 329 | -2499 | **-27** | 492 | 21 | -2543 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -606 | 575 | **-4105** | **21** | 835 | 61 | -4177 |

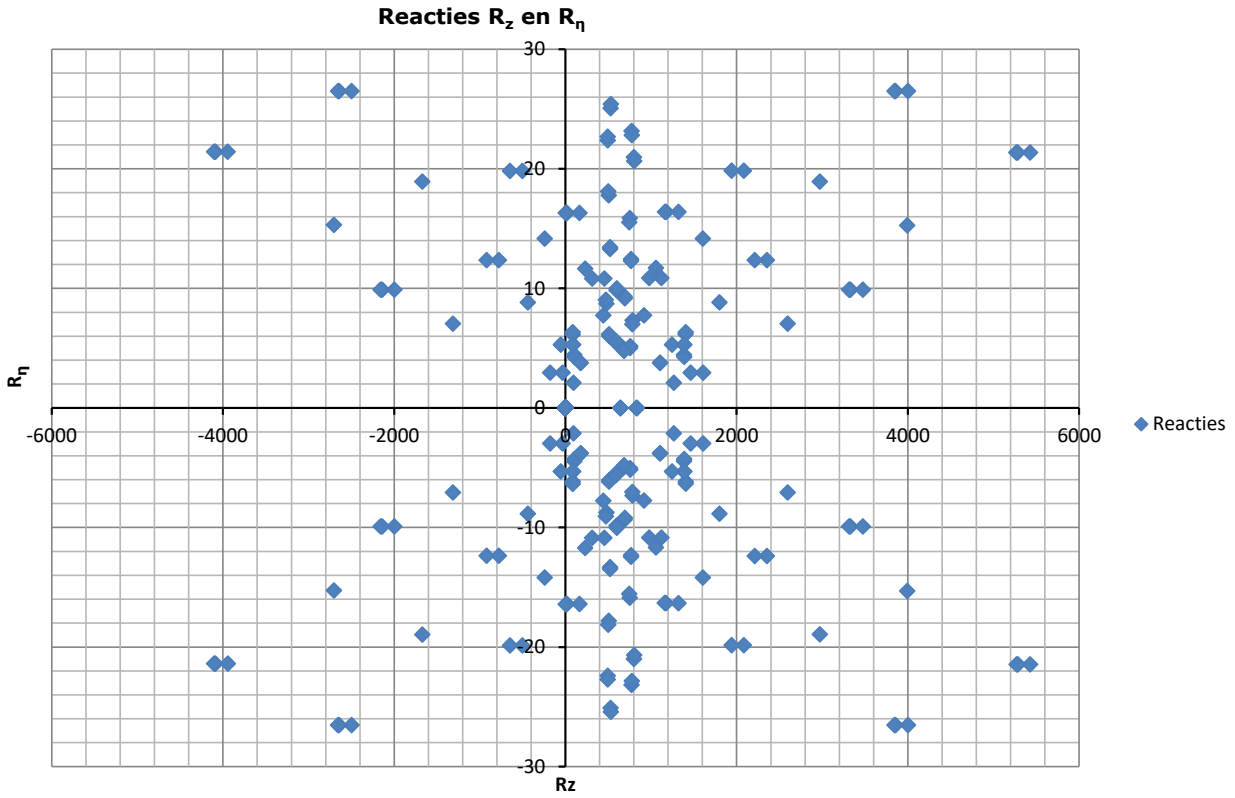
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **641** | 0 | -133 | -12 | 652 |
| 2 | SLS 1a_135 | -399 | 378 | **-2704** | 15 | 549 | 39 | -2752 |
| 3 | SLS 1a_45 | 399 | 377 | **-2704** | -15 | 549 | 39 | -2751 |
| 4 | SLS 1a_0 | 183 | -193 | **-1314** | -7 | 265 | 18 | -1337 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 588 | 566 | **3990** | 15 | -816 | -64 | 4061 |
| 2 | SLS 1a_0 | 371 | -381 | **2595** | 7 | -531 | -42 | 2640 |
| 3 | SLS 7 | -94 | -94 | **641** | 0 | -133 | -12 | 652 |
| 4 | SLS 1a_135 | -588 | 566 | **3991** | -15 | -816 | -64 | 4062 |

Project: KIJ-GT
Tower: S+75
Number: 50



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 15 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | II |
| Wind speed | 24,7 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 142,5 m |
| Max. Span | 702 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 649 m |
| EDS Weight span | 873 m |
| Min. Weight span | 811 m |
| Max. Weight span | 1314 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-02-23 | | | |

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+75

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

Document name:

KIJ-GT_S+75_52_Report.pdf

Project number:

Project client number:

0.0

Project: KIJ-GT
Tower: S+75
Number: 52

**Conductor loads**

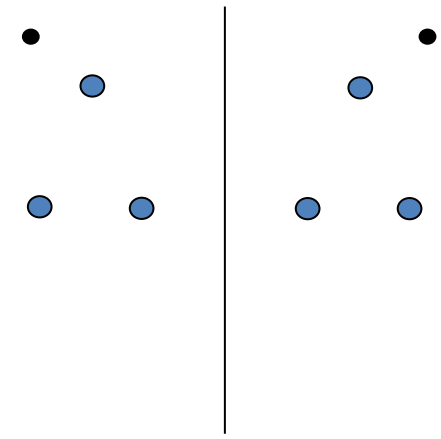
Auteur: TBR
Versie: v11.6

**General**

| | |
|---|---|
| Description | S+75 |
| 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 | |
| Terrain category | 24,7 | m/s |
| Reduction factor $c_{dir}$ | II | |
| Ice region phase conductor | 1,00 | |
| Ice region earth conductor | B | |
| | B | |



Configuratie geleiders

**Conductors back**

| Description | Voltage | Conductor Back | Bundle Ba | Ice region | Additional weight | Additional diameter | Catenary $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCCZ-Warsaw | 3 | B | 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 | 103,7 m | 108,0 m | 25,5 m |
| Circuit 1 | 11 | 380ct1f2 | 103,7 m | 108,0 m | 11,5 m |
| Circuit 1 | 12 | 380ct1f3 | 130,7 m | 135,0 m | 18,5 m |
| Circuit 2 | 20 | 380ct2f1 | 103,7 m | 108,0 m | -11,5 m |
| Circuit 2 | 21 | 380ct2f2 | 103,7 m | 108,0 m | -25,5 m |
| Circuit 2 | 22 | 380ct2f3 | 130,7 m | 135,0 m | -18,5 m |
| Bliksemdraad 1 | 1 | bl1 | 140,7 m | 141,0 m | 31,5 m |
| Bliksemdraad 2 | 3 | bl2 | 140,7 m | 141,0 m | -31,5 m |

Project: KIJ-GT
Tower: S+75
Number: 52

**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**

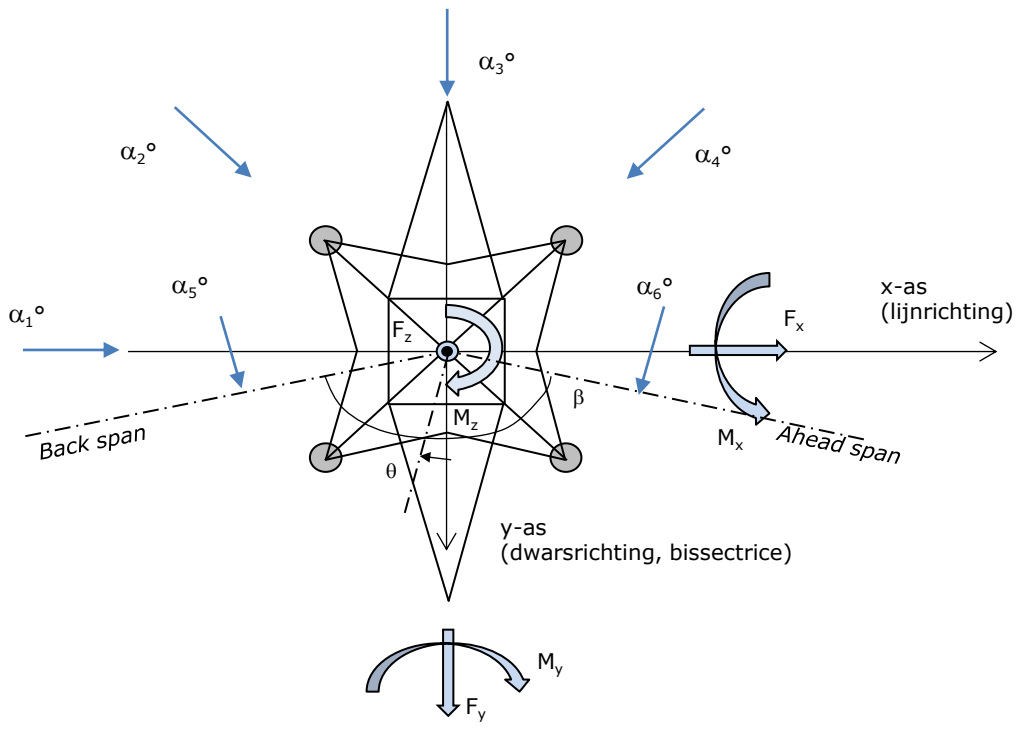
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | -1,4 | -69,2 m | 0,0 | 7,8 m |
| Circuit 1 | 11 | 380ct1f2 | -1,4 | -69,2 m | 0,0 | 2,0 m |
| Circuit 1 | 12 | 380ct1f3 | -1,4 | -80,7 m | 0,0 | 4,9 m |
| Circuit 2 | 20 | 380ct2f1 | -1,4 | -69,2 m | 0,0 | -2,0 m |
| Circuit 2 | 21 | 380ct2f2 | -1,4 | -69,2 m | 0,0 | -7,8 m |
| Circuit 2 | 22 | 380ct2f3 | -1,4 | -80,7 m | 0,0 | -4,9 m |
| Bliksemdraad 1 | 1 | bl1 | -1,4 | -87,8 m | 0,0 | 10,4 m |
| Bliksemdraad 2 | 3 | bl2 | -1,4 | -87,8 m | 0,0 | -10,4 m |

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 702,0 | 595,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 612,3 | 612,3 | m |
| Line angle | $\beta$ | 180 | | ° |
| Tower orientation with respect to bi | $\theta$ | 0 | | ° |
| Section length | | 1774 | 1774 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | - | | ° |
| | $\alpha_6$ | - | | ° |

*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+75
Number: 52

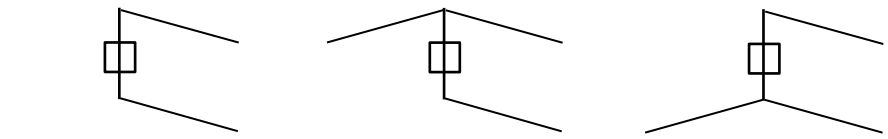
**Absence of conductors**

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

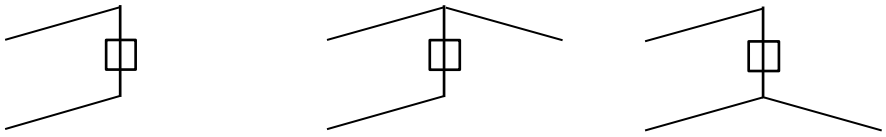
**Load situations SPLS**

Considered situations SPLS: SPLS for suspension tower not applicable

Principle of load situations:



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



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

**Load situation 5a. Conductor failure**

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

Principle of load situations:

1. Ba | 2. Ah

Project: KIJ-GT
Tower: S+75
Number: 52

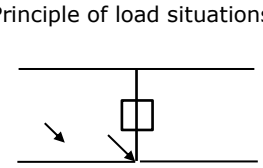
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

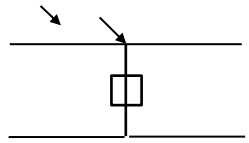
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

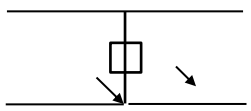
Principle of load situations:



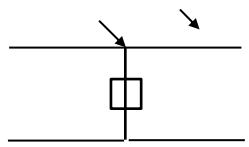
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

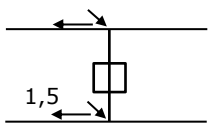
**Load situations 8. Galloping as a static load**

| 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 |

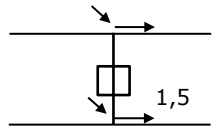
Considered situations galloping 8: None (existing structure)

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+75
Number: 52

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+75 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 142,5 | m | |
| Tower self weight | 2300,0 | 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 $G_T$ | 1,01 |
| 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] | $\Delta h$ [m] | $\Delta_x$ [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 | 63,61 | 0,11 | 3,33 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 65,51 | 0,21 | 2,90 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [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 | 63,61 | 0,11 | 3,33 |
| Middenstuk 1 | 57,10 | 14,60 | 8,85 | 27,10 | 0,106 | 317,75 | 65,51 | 0,21 | 2,90 |
| Middenstuk 2 | 80,50 | 8,85 | 6,00 | 23,40 | 0,061 | 173,75 | 41,23 | 0,24 | 2,77 |
| Bovenstuk 1 | 107,50 | 6,00 | 5,00 | 27,00 | 0,019 | 148,50 | 35,46 | 0,24 | 2,77 |
| Bovenstuk 2 | 138,50 | 5,00 | 3,83 | 31,00 | 0,019 | 136,87 | 32,73 | 0,24 | 2,77 |
| Topstuk | 142,50 | 3,83 | | 4,00 | | 7,66 | 1,40 | 0,18 | 3,01 |
| Ondertraverse | 107,50 | 23,00 | | 4,00 | | 46,00 | 14,30 | 0,31 | 2,50 |
| Boventraverse | 135,00 | 29,50 | | 6,00 | | 88,50 | 17,58 | 0,20 | 2,94 |

*Note: Surface transverse direction is reduced in calculation.*

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**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | Factor | $\Delta h$ | $A_1$ |
|---|---|---|---|---|
| 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 | 0,81 | 172,7 | 146,5 | 0,0 | -146,5 | 15,0 | 2589,8 | 2197,5 | 0,0 | -2197,5 |
| Middenstuk 1 | 1,11 | 211,3 | 179,3 | 0,0 | -179,3 | 43,6 | 9200,2 | 7806,6 | 0,0 | -7806,6 |
| Middenstuk 2 | 1,25 | 142,9 | 121,2 | 0,0 | -121,2 | 68,8 | 9829,4 | 8340,5 | 0,0 | -8340,5 |
| Bovenstuk 1 | 1,35 | 132,5 | 112,4 | 0,0 | -112,4 | 94,0 | 12451,8 | 10565,7 | 0,0 | -10565,7 |
| Bovenstuk 2 | 1,44 | 130,0 | 110,3 | 0,0 | -110,3 | 123,0 | 15988,6 | 13566,8 | 0,0 | -13566,8 |
| Topstuk | 1,48 | 6,2 | 5,3 | 0,0 | -5,3 | 140,5 | 875,4 | 742,8 | 0,0 | -742,8 |
| Ondertraverse | 1,40 | 99,6 | 59,2 | 0,0 | -59,2 | 108,8 | 10843,6 | 6440,8 | 0,0 | -6440,8 |
| Boventraverse | 1,47 | 151,9 | 90,2 | 0,0 | -90,2 | 137,0 | 20815,5 | 12363,8 | 0,0 | -12363,8 |
| Totaal | | 1047,0 | 824,4 | 0,0 | -824,4 | | 82594,3 | 62024,5 | 0,0 | -62024,5 |

**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 | 0,81 | 0,0 | 146,5 | 172,7 | 146,5 | 15,0 | 0,0 | 2197,5 | 2589,8 | 2197,5 |
| Middenstuk 1 | 1,11 | 0,0 | 179,3 | 211,3 | 179,3 | 43,6 | 0,0 | 7806,6 | 9200,2 | 7806,6 |
| Middenstuk 2 | 1,25 | 0,0 | 121,2 | 142,9 | 121,2 | 68,8 | 0,0 | 8340,5 | 9829,4 | 8340,5 |
| Bovenstuk 1 | 1,35 | 0,0 | 112,4 | 132,5 | 112,4 | 94,0 | 0,0 | 10565,7 | 12451,8 | 10565,7 |
| Bovenstuk 2 | 1,44 | 0,0 | 110,3 | 130,0 | 110,3 | 123,0 | 0,0 | 13566,8 | 15988,6 | 13566,8 |
| Topstuk | 1,48 | 0,0 | 5,3 | 6,2 | 5,3 | 140,5 | 0,0 | 742,8 | 875,4 | 742,8 |
| Ondertraverse | 1,40 | 0,0 | 59,2 | 39,9 | 59,2 | 108,8 | 0,0 | 6440,8 | 4337,4 | 6440,8 |
| Boventraverse | 1,47 | 0,0 | 90,2 | 60,8 | 90,2 | 137,0 | 0,0 | 12363,8 | 8326,2 | 12363,8 |
| Total | | 0,0 | 824,4 | 896,1 | 824,4 | | 0,0 | 62024,5 | 63598,8 | 62024,5 |

**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 | 2300 | 0 | 0 | 0 |
| Windrichting 0° | 1047 | 0 | 0 | 0 | 83420 | 0 |
| Windrichting 45° | 824 | 824 | 0 | 62645 | 62645 | 0 |
| Windrichting 90° | 0 | 896 | 0 | 64235 | 0 | 0 |
| Windrichting 135° | -824 | 824 | 0 | 62645 | -62645 | 0 |

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**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 106,35 | 1,39 | 1,2 | 2,50 |
| 380ct1f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,39 | 1,2 | 2,50 |
| 380ct1f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,46 | 1,2 | 2,63 |
| 380ct2f1 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,39 | 1,2 | 2,50 |
| 380ct2f2 | 3,00 | 1 | 3 | 4,3 | 1,5 | 106,35 | 1,39 | 1,2 | 2,50 |
| 380ct2f3 | 3,00 | 1 | 3 | 4,3 | 1,5 | 133,35 | 1,46 | 1,2 | 2,63 |
| bl1 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,48 | 1,2 | 0,18 |
| bl2 | 0,20 | 1 | 0,2 | 0,3 | 0,1 | 141,35 | 1,48 | 1,2 | 0,18 |

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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 | 74,2 | 1,27 | 0,61 | 0,59 | 1,02 | 28,25 | 67,5 | 65,2 | 46,9 | 131,3 | 126,8 |
| 380ct1f2 | 74,2 | 1,27 | 0,61 | 0,59 | 1,02 | 28,25 | 67,5 | 65,2 | 46,9 | 131,3 | 126,8 |
| 380ct1f3 | 101,2 | 1,37 | 0,63 | 0,61 | 1,00 | 28,25 | 73,6 | 71,1 | 46,9 | 146,6 | 141,6 |
| 380ct2f1 | 74,2 | 1,27 | 0,61 | 0,59 | 1,02 | 28,25 | 67,5 | 65,2 | 46,9 | 131,3 | 126,8 |
| 380ct2f2 | 74,2 | 1,27 | 0,61 | 0,59 | 1,02 | 28,25 | 67,5 | 65,2 | 46,9 | 131,3 | 126,8 |
| 380ct2f3 | 101,2 | 1,37 | 0,63 | 0,61 | 1,00 | 28,25 | 73,6 | 71,1 | 46,9 | 146,6 | 141,6 |
| bl1 | 113,1 | 1,41 | 0,64 | 0,62 | 1,13 | 22,24 | 22,7 | 21,9 | 41,5 | 45,0 | 43,4 |
| bl2 | 113,1 | 1,41 | 0,64 | 0,62 | 1,13 | 22,13 | 22,7 | 21,9 | 41,4 | 44,9 | 43,3 |

**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 | 48,5 | 1,14 | 0,58 | 0,56 | 1,06 | 28,25 | 59,4 | 57,4 | 46,9 | 111,9 | 108,2 |
| 380ct1f2 | 48,5 | 1,14 | 0,58 | 0,56 | 1,06 | 28,25 | 59,4 | 57,4 | 46,9 | 111,9 | 108,2 |
| 380ct1f3 | 69,7 | 1,25 | 0,61 | 0,59 | 1,03 | 28,25 | 66,3 | 64,1 | 46,9 | 128,4 | 124,0 |
| 380ct2f1 | 48,5 | 1,14 | 0,58 | 0,56 | 1,06 | 28,25 | 59,4 | 57,4 | 46,9 | 111,9 | 108,2 |
| 380ct2f2 | 48,5 | 1,14 | 0,58 | 0,56 | 1,06 | 28,25 | 59,4 | 57,4 | 46,9 | 111,9 | 108,2 |
| 380ct2f3 | 69,7 | 1,25 | 0,61 | 0,59 | 1,03 | 28,25 | 66,3 | 64,1 | 46,9 | 128,4 | 124,0 |
| bl1 | 77,6 | 1,29 | 0,61 | 0,59 | 1,16 | 22,24 | 20,3 | 19,6 | 41,5 | 39,4 | 38,0 |
| bl2 | 77,6 | 1,29 | 0,61 | 0,59 | 1,16 | 22,13 | 20,2 | 19,6 | 41,4 | 39,3 | 38,0 |

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**Conductor loads** Auteur: TBR Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Afkeur CC2-0 |
| Reference period | 15 jaar |

| **ULS** (strength) Load case | description | **NEN-EN50341-2-15:2019** Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
|---|---|---|---|---|---|---|---|---|
| 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) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,87 | 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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**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 | -33,4 | 33,4 | 8,2 | 6,8 | 7,2 | 10,2 |
| 380ct1f1 | -110,0 | 110,0 | 25,4 | 20,7 | 26,6 | 35,2 |
| 380ct1f2 | -110,0 | 110,0 | 25,4 | 19,6 | 26,6 | 35,2 |
| 380ct1f3 | -114,4 | 114,4 | 27,7 | 22,4 | 26,6 | 37,7 |
| 380ct2f1 | -110,0 | 110,0 | 25,4 | 19,0 | 26,6 | 35,2 |
| 380ct2f2 | -110,0 | 110,0 | 25,4 | 18,0 | 26,6 | 35,2 |
| 380ct2f3 | -114,4 | 114,4 | 27,7 | 20,6 | 26,6 | 37,7 |
| bl2 | -33,4 | 33,4 | 8,2 | 5,7 | 7,2 | 10,2 |

**Min. Weight span (m)**

| Weight spar Combinatie1 | | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 872,7 | 894,3 | 872,7 |
| 380ct1f1 | 814,2 | 824,0 | 814,2 |
| 380ct1f2 | 814,2 | 824,0 | 814,2 |
| 380ct1f3 | 841,2 | 853,7 | 841,2 |
| 380ct2f1 | 814,2 | 824,0 | 814,2 |
| 380ct2f2 | 814,2 | 824,0 | 814,2 |
| 380ct2f3 | 841,2 | 853,7 | 841,2 |
| bl2 | 872,7 | 896,5 | 872,7 |

**Max. Weight span (m)**

| Weight spar Combinatie1 | | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1105,0 | 911,9 |
| 380ct1f1 | 903,9 | 830,1 |
| 380ct1f2 | 903,9 | 830,1 |
| 380ct1f3 | 965,3 | 865,3 |
| 380ct2f1 | 903,9 | 830,1 |
| 380ct2f2 | 903,9 | 830,1 |
| 380ct2f3 | 965,3 | 865,3 |
| bl2 | 1104,8 | 913,0 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | Wind / Weight span ratio | |
| Max. weight span | 1166,9 m | 1,799 | - |
| Min. weight span | 813,3 m | 1,254 | - |

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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 | 15,0 | 15,8 | -34,8 | 32,1 |
| 380ct1f1 | 51,3 | 46,1 | 61,8 | -111,9 | 108,3 |
| 380ct1f2 | 51,3 | 45,1 | 61,8 | -111,9 | 108,3 |
| 380ct1f3 | 51,3 | 50,1 | 64,2 | -118,2 | 111,1 |
| 380ct2f1 | 51,3 | 44,4 | 61,8 | -111,9 | 108,3 |
| 380ct2f2 | 51,3 | 43,4 | 61,8 | -111,9 | 108,3 |
| 380ct2f3 | 51,3 | 48,3 | 64,2 | -118,2 | 111,1 |
| bl2 | 15,0 | 13,9 | 15,8 | -34,7 | 32,0 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 8,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,8 | 40,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,2 | 40,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,5 | 41,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,2 | 40,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -0,8 | 40,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,5 | 41,6 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,3 | 8,9 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie1 | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 5,5 |
| | 380ct1f1 | 17,7 | 23,0 |
| | 380ct1f2 | 17,7 | 23,0 |
| | 380ct1f3 | 17,7 | 24,4 |
| | 380ct2f1 | 17,7 | 23,0 |
| | 380ct2f2 | 17,7 | 23,0 |
| | 380ct2f3 | 17,7 | 24,4 |
| | bl2 | 3,6 | 5,5 |

Project: KIJ-GT
Tower: S+75
Number: 52

**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 | 306 | 309 | 36673 | -5 | 0 |
| ULS 1a_0,9_90 | | 0 | 306 | 309 | 36673 | -5 | 0 |
| ULS 3_90 | | 0 | 174 | 407 | 20827 | -5 | 0 |
| ULS 3_0,9_90 | | 0 | 174 | 407 | 20827 | -5 | 0 |
| SLS 7 | | 0 | 0 | 262 | 0 | -3 | 0 |

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

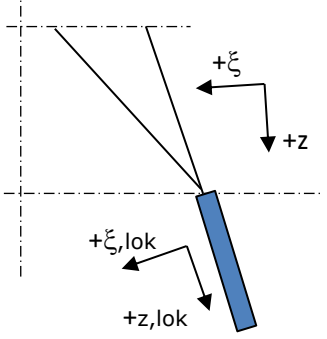
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1220 | 2724 | 102175 | -5 | 0 |
| ULS 3_90 | 0 | 448 | 2822 | 40478 | -5 | 0 |
| SLS 7 | 0 | 0 | 2562 | 0 | -3 | 0 |

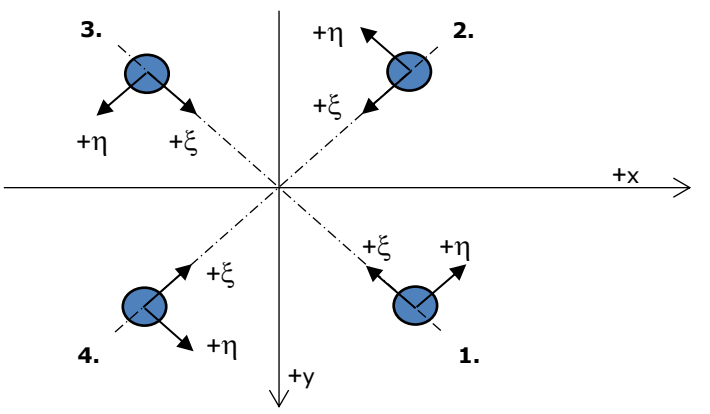
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1220 | 2724 | **102175** | -5 | 0 |
| ULS 1a_0,9_0,9_0 | 1072 | 0 | 2306 | 0 | **85571** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 2554 | 432 | 5542 | **-1309** |
| ULS 1a_0,9_0,9_135 | -844 | 997 | 2318 | **82620** | **-64242** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 578 | 557 | **3924** | 15 | -802 | -62 | 3993 |
| 2 | ULS 1a_0 | 367 | -376 | **2566** | 7 | -525 | -42 | 2611 |
| 3 | ULS 5a Ah 12 | -97 | -127 | **801** | -21 | -158 | -7 | 815 |
| 4 | ULS 1a_135 | -578 | 557 | **3924** | -15 | -802 | -62 | 3994 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -394 | 373 | **-2670** | 15 | 542 | 39 | -2717 |
| 3 | ULS 1a_0,9_0,9_45 | 394 | 373 | **-2669** | -15 | 542 | 39 | -2716 |
| 4 | ULS 1a_0,9_0,9_0 | 183 | -193 | **-1317** | -7 | 266 | 18 | -1340 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| 2 | ULS 5a Ba 10 | 93 | -126 | 771 | **23** | -155 | -10 | 784 |
| 3 | ULS 5a Ba 10 | -97 | -61 | 525 | **25** | -112 | -13 | 535 |
| 4 | ULS 5a Ah 21 | -94 | 126 | 774 | **23** | -156 | -10 | 788 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 93 | 126 | 771 | **-23** | -155 | -10 | 784 |
| 2 | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| 3 | ULS 5a Ah 10 | -94 | -126 | 774 | **-23** | -156 | -10 | 788 |
| 4 | ULS 5a Ba 21 | -97 | 61 | 525 | **-25** | -112 | -13 | 535 |

Project: KIJ-GT
Tower: S+75
Number: 52

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -394 | 373 | **-2670** | **15** | 542 | 39 | -2717 |
| 3 | ULS 1a_0,9_0,9_45 | 394 | 373 | **-2669** | **-15** | 542 | 39 | -2716 |
| 4 | ULS 1a_0,9_0,9_0 | 183 | -193 | **-1317** | **-7** | 266 | 18 | -1340 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 641 | 0 | -133 | -12 | 652 |
| 2 | SLS 7 | 94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 3 | SLS 7 | -94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 4 | SLS 7 | -94 | 94 | 641 | 0 | -133 | -12 | 652 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -578 | 557 | **3924** | -15 | -802 | -62 | 3994 |
| Max. tension | ULS 1a_0,9_0,9_135 | -394 | 373 | **-2670** | 15 | 542 | 39 | -2717 |
| Max. pos. torsie | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| Max. neg. torsie | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -394 | 373 | **-2670** | **15** | 542 | 39 | -2717 |

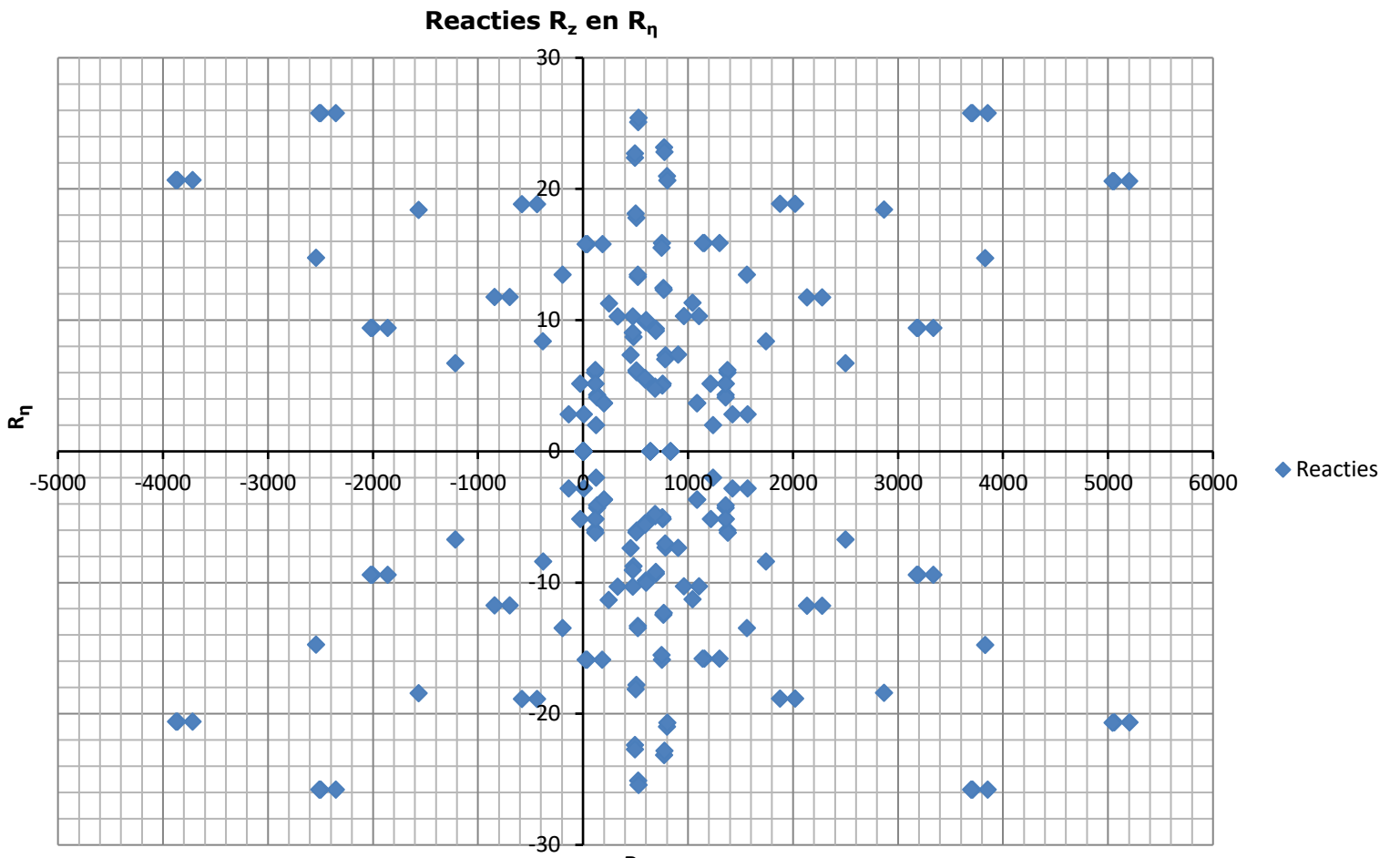
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **641** | 0 | -133 | -12 | 652 |
| 2 | SLS 1a_135 | -313 | 295 | **-2117** | 13 | 429 | 30 | -2155 |
| 3 | SLS 1a_45 | 313 | 295 | **-2117** | -13 | 429 | 30 | -2154 |
| 4 | SLS 1a_0 | 134 | -142 | **-968** | -6 | 195 | 12 | -985 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 501 | 483 | **3402** | 13 | -696 | -54 | 3462 |
| 2 | SLS 1a_0 | 322 | -330 | **2249** | 6 | -461 | -37 | 2288 |
| 3 | SLS 7 | -94 | -94 | **641** | 0 | -133 | -12 | 652 |
| 4 | SLS 1a_135 | -501 | 483 | **3403** | -13 | -696 | -54 | 3463 |

Project: KIJ-GT
Tower: S+75
Number: 52



Project: KIJ-GT
Tower: S+75
Number: 52

**Conductor loads**

Auteur: TBR
Versie: v11.6

**Starting points**

| | |
|---|---|
| Consequence class | Verbouw CC2 |
| Reference period | 50 jaar |

| **ULS** (strength) Load case | description | **NEN-EN50341-2-15:2019** Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
|---|---|---|---|---|---|---|---|---|
| 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) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,15 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,15 | 1,15 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,15 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,15 | 1,15 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,15 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,15 | 1,15 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,15 | 1,15 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 1,00 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,30 | 1,00 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

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

Project: KIJ-GT
Tower: S+75
Number: 52

**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 | -43,0 | 43,0 | 11,3 | 9,3 | 8,0 | 12,5 |
| 380ct1f1 | -140,0 | 140,0 | 34,9 | 28,2 | 33,6 | 44,5 |
| 380ct1f2 | -140,0 | 140,0 | 34,9 | 26,9 | 33,6 | 44,5 |
| 380ct1f3 | -145,0 | 145,0 | 38,0 | 30,6 | 33,6 | 47,7 |
| 380ct2f1 | -140,0 | 140,0 | 34,9 | 26,1 | 33,6 | 44,5 |
| 380ct2f2 | -140,0 | 140,0 | 34,9 | 24,9 | 33,6 | 44,5 |
| 380ct2f3 | -145,0 | 145,0 | 38,0 | 28,4 | 33,6 | 47,7 |
| bl2 | -42,9 | 42,9 | 11,3 | 7,9 | 8,0 | 12,5 |

**Min. Weight span (m)**

| Weight spar Combinatie1 | | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 872,7 | 898,2 | 872,7 |
| 380ct1f1 | 814,2 | 825,2 | 814,2 |
| 380ct1f2 | 814,2 | 825,2 | 814,2 |
| 380ct1f3 | 841,2 | 855,5 | 841,2 |
| 380ct2f1 | 814,2 | 825,2 | 814,2 |
| 380ct2f2 | 814,2 | 825,2 | 814,2 |
| 380ct2f3 | 841,2 | 855,5 | 841,2 |
| bl2 | 872,7 | 900,5 | 872,7 |

**Max. Weight span (m)**

| Weight spar Combinatie1 | | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 1183,2 | 908,6 |
| 380ct1f1 | 940,1 | 829,7 |
| 380ct1f2 | 940,2 | 829,7 |
| 380ct1f3 | 1013,6 | 865,4 |
| 380ct2f1 | 940,2 | 829,7 |
| 380ct2f2 | 940,1 | 829,7 |
| 380ct2f3 | 1013,6 | 865,4 |
| bl2 | 1183,1 | 909,8 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | | |
|---|---|---|---|
| For all conductors | | Wind / Weight span ratio | |
| Max. weight span | 1313,7 m | 2,026 | - |
| Min. weight span | 811,4 m | 1,251 | - |

Project: KIJ-GT
Tower: S+75
Number: 52

**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 | 20,6 | 20,6 | -44,8 | 41,1 |
| 380ct1f1 | 51,3 | 63,1 | 78,1 | -142,4 | 137,6 |
| 380ct1f2 | 51,3 | 61,9 | 78,1 | -142,4 | 137,6 |
| 380ct1f3 | 51,3 | 68,6 | 81,3 | -150,3 | 141,6 |
| 380ct2f1 | 51,3 | 61,0 | 78,1 | -142,4 | 137,6 |
| 380ct2f2 | 51,3 | 59,8 | 78,1 | -142,4 | 137,6 |
| 380ct2f3 | 51,3 | 66,4 | 81,3 | -150,3 | 141,6 |
| bl2 | 15,0 | 19,1 | 20,6 | -44,8 | 41,1 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,3 | 8,9 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,8 | 40,3 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,2 | 40,3 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,5 | 41,6 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | -0,2 | 40,3 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | -0,8 | 40,3 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | -0,5 | 41,6 | -64,2 | 64,2 |
| bl2 | 0,0 | -0,3 | 8,9 | -15,0 | 15,0 |

1 **Control uplift SLS-wind**

| Combinatie1 | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,6 | 5,5 |
| | 380ct1f1 | 17,7 | 23,1 |
| | 380ct1f2 | 17,7 | 23,1 |
| | 380ct1f3 | 17,7 | 24,5 |
| | 380ct2f1 | 17,7 | 23,1 |
| | 380ct2f2 | 17,7 | 23,1 |
| | 380ct2f3 | 17,7 | 24,5 |
| | bl2 | 3,6 | 5,6 |

Project: KIJ-GT
Tower: S+75
Number: 52

**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 | 420 | 353 | 50348 | -6 | 0 |
| ULS 1a_0,9_90 | | 0 | 420 | 353 | 50348 | -6 | 0 |
| ULS 3_90 | | 0 | 238 | 516 | 28595 | -6 | 0 |
| ULS 3_0,9_90 | | 0 | 238 | 516 | 28595 | -6 | 0 |
| SLS 7 | | 0 | 0 | 262 | 0 | -3 | 0 |

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

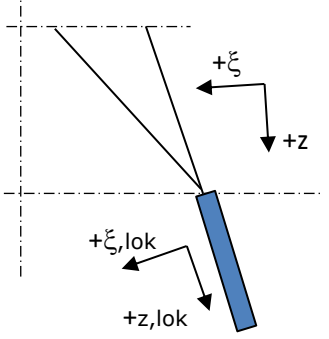
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1675 | 2998 | 140277 | -6 | 0 |
| ULS 3_90 | 0 | 615 | 3161 | 55573 | -6 | 0 |
| SLS 7 | 0 | 0 | 2562 | 0 | -3 | 0 |

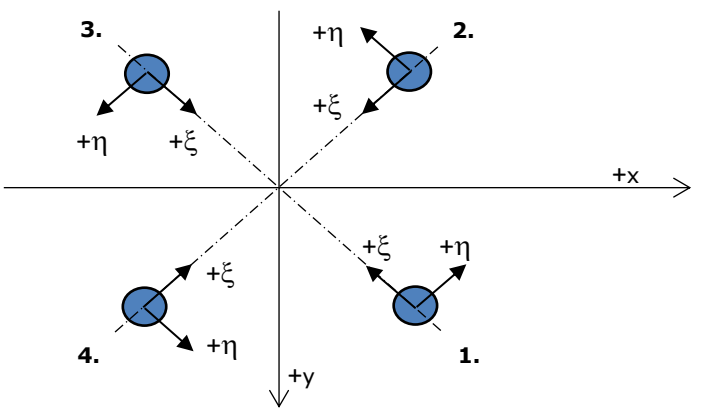
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 1675 | 2998 | **140277** | -6 | 0 |
| ULS 1a_0,9_0,9_0 | 1472 | 0 | 2306 | 0 | **117483** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 2554 | 432 | 5542 | **-1309** |
| ULS 1a_0,9_0,9_135 | -1158 | 1369 | 2327 | **113434** | **-88199** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 766 | 737 | **5201** | 21 | -1063 | -82 | 5292 |
| 2 | ULS 1a_0 | 476 | -489 | **3336** | 9 | -682 | -53 | 3395 |
| 3 | ULS 7 | -122 | -122 | **833** | 0 | -173 | -16 | 847 |
| 4 | ULS 1a_135 | -766 | 737 | **5202** | -21 | -1063 | -82 | 5293 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -572 | 543 | **-3879** | 21 | 789 | 57 | -3948 |
| 3 | ULS 1a_0,9_0,9_45 | 572 | 543 | **-3878** | -21 | 789 | 57 | -3946 |
| 4 | ULS 1a_0,9_0,9_0 | 283 | -297 | **-2023** | -9 | 410 | 29 | -2058 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_0,9_90 | 544 | 508 | 3709 | **26** | -744 | -44 | 3775 |
| 2 | ULS 1a_0,9_0,9_90 | -368 | 332 | -2512 | **26** | 495 | 22 | -2557 |
| 3 | ULS 5a Ba 10 | -97 | -61 | 525 | **25** | -112 | -13 | 535 |
| 4 | ULS 5a Ah 21 | -94 | 126 | 774 | **23** | -156 | -10 | 788 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 21 | 93 | 126 | 771 | **-23** | -155 | -10 | 784 |
| 2 | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| 3 | ULS 1a_90 | 345 | 309 | -2354 | **-26** | 462 | 19 | -2395 |
| 4 | ULS 1a_0,9_0,9_90 | -542 | 505 | 3695 | **-26** | -741 | -44 | 3760 |

Project: KIJ-GT
Tower: S+75
Number: 52

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -572 | 543 | **-3879** | **21** | 789 | 57 | -3948 |
| 3 | ULS 1a_0,9_0,9_45 | 572 | 543 | **-3878** | **-21** | 789 | 57 | -3946 |
| 4 | ULS 1a_0,9_0,9_0 | 283 | -297 | **-2023** | **-9** | 410 | 29 | -2058 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | 641 | 0 | -133 | -12 | 652 |
| 2 | SLS 7 | 94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 3 | SLS 7 | -94 | -94 | 641 | 0 | -133 | -12 | 652 |
| 4 | SLS 7 | -94 | 94 | 641 | 0 | -133 | -12 | 652 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -766 | 737 | **5202** | -21 | -1063 | -82 | 5293 |
| Max. tension | ULS 1a_0,9_0,9_135 | -572 | 543 | **-3879** | 21 | 789 | 57 | -3948 |
| Max. pos. torsie | ULS 1a_0,9_90 | 544 | 508 | 3709 | **26** | -744 | -44 | 3775 |
| Max. neg. torsie | ULS 1a_90 | 345 | 309 | -2354 | **-26** | 462 | 19 | -2395 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -572 | 543 | **-3879** | **21** | 789 | 57 | -3948 |

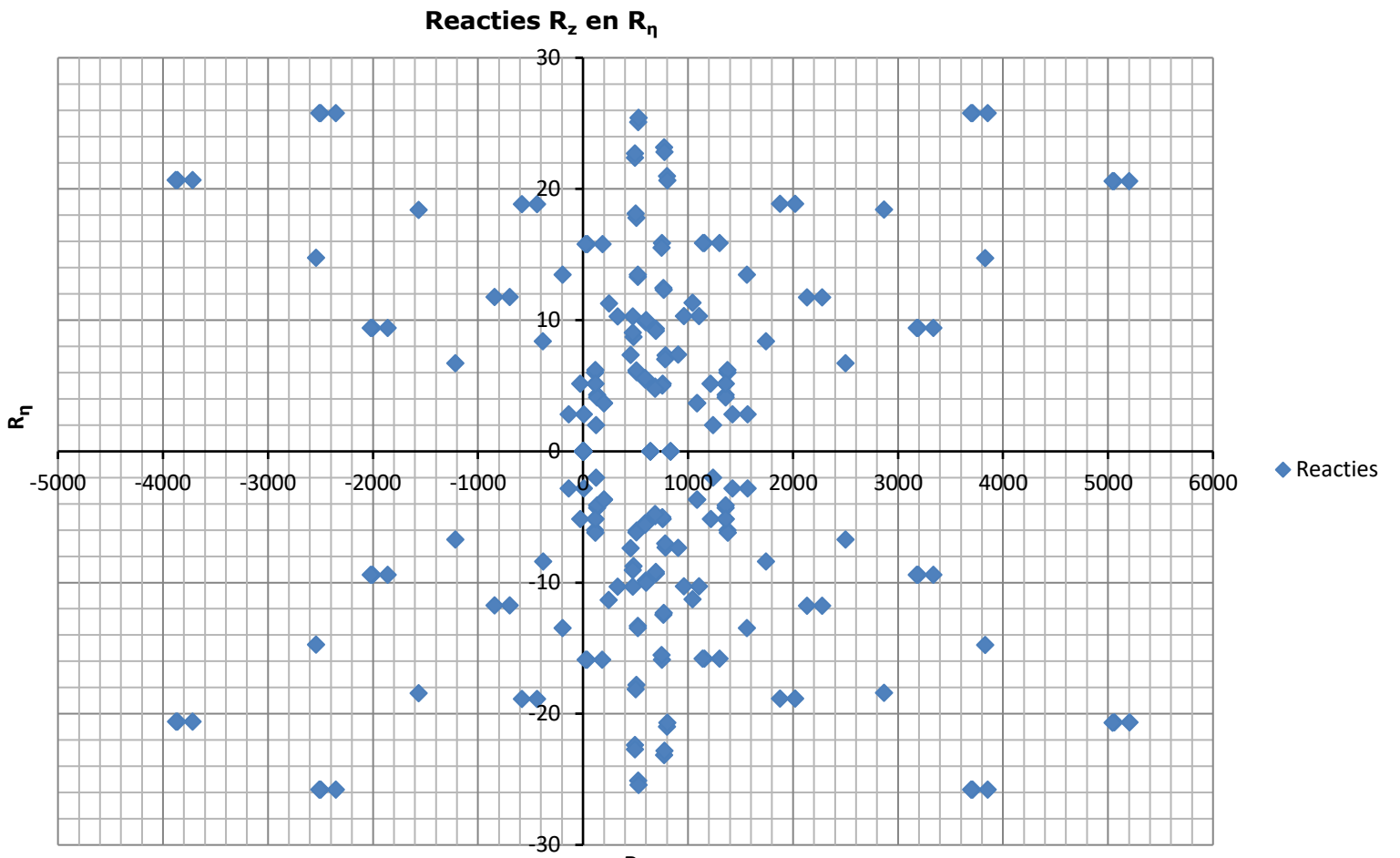
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 94 | 94 | **641** | 0 | -133 | -12 | 652 |
| 2 | SLS 1a_135 | -375 | 355 | **-2543** | 15 | 516 | 37 | -2588 |
| 3 | SLS 1a_45 | 375 | 354 | **-2542** | -15 | 516 | 37 | -2587 |
| 4 | SLS 1a_0 | 169 | -178 | **-1216** | -7 | 245 | 16 | -1237 |

**Maximum compression load - SLS**

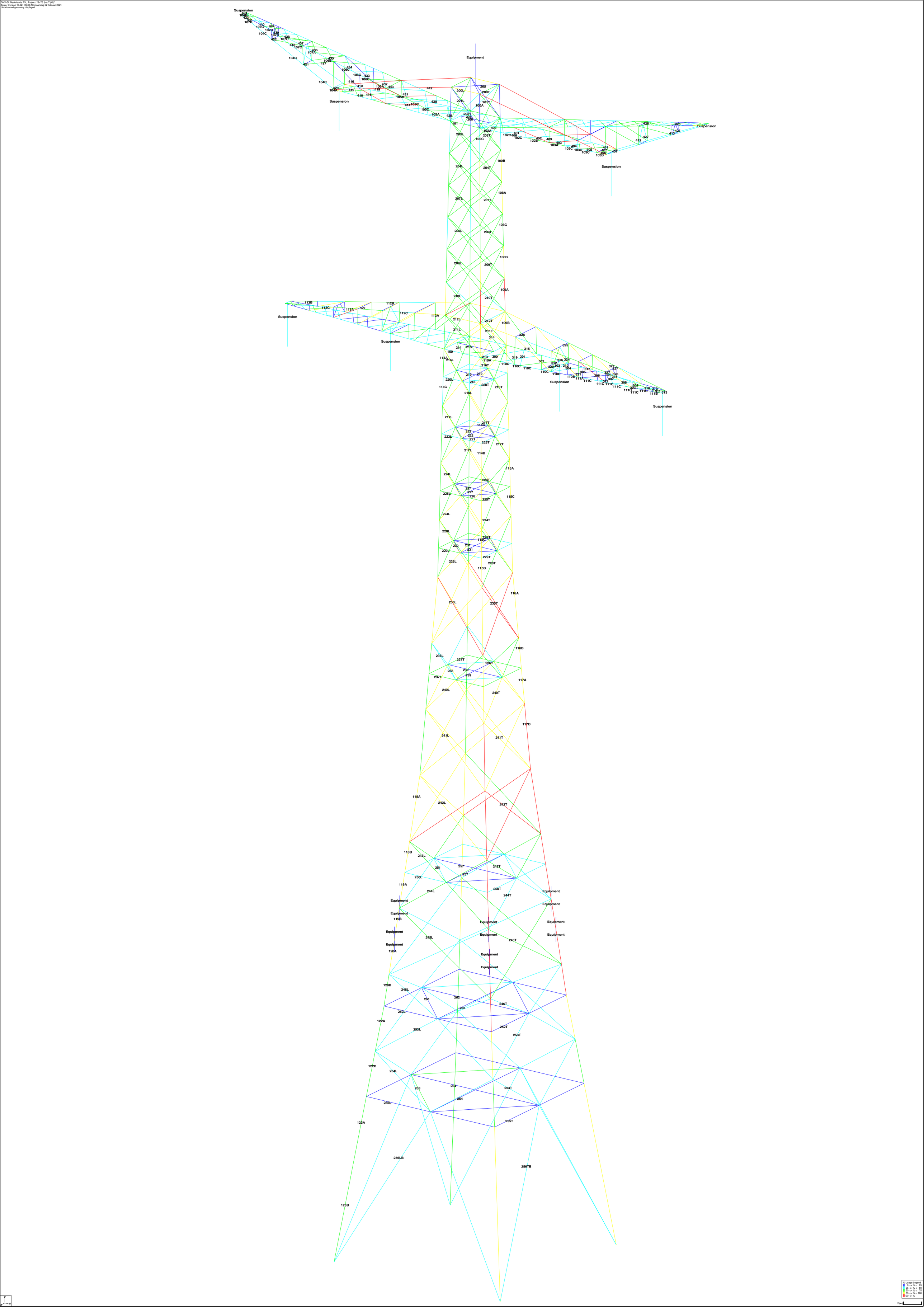
| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 564 | 543 | **3829** | 15 | -783 | -61 | 3896 |
| 2 | SLS 1a_0 | 357 | -366 | **2497** | 7 | -511 | -40 | 2541 |
| 3 | SLS 7 | -94 | -94 | **641** | 0 | -133 | -12 | 652 |
| 4 | SLS 1a_135 | -564 | 543 | **3830** | -15 | -783 | -61 | 3897 |

Project: KIJ-GT
Tower: S+75
Number: 52



# APPENDIX B UITVOER PLS-TOWER

DNV GL Nederlands BV, Project: "S+75 (hv) T (49)"
Tower Version 16.62, 09:34:18 maandag 22 februari 2021
Undeformed geometry displayed


Suspension
Equipment
Suspension
Suspension
Suspension

DNV·GL

# Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**49**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-105.4** | ULS 1a_90 | 550.6 | 508.3 | 777.6 | 0.21 | | **0.0** | | 624.7 | 508.3 | 664.6 | 0.00 | | 0.21 |
| 100B | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 67 | **-453.6** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.89 | | **228.9** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.45 | | 0.89 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-268.9** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.48 | | **87.1** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.13 | | 0.48 |
| 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 | | **343.6** | ULS 3_45 | 346.4 | 506.7 | 677.1 | 0.99 | | 0.99 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-87.7** | ULS 3_90 | 190.2 | 117.6 | 237.6 | 0.75 | | **0.0** | | 360.5 | 117.6 | 237.6 | 0.00 | | 0.75 |
| 201L | BVNSTK - CD 1 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-39.6** | ULS 1a_0,9_0,9_45 | 263.5 | 169.4 | 285.1 | 0.23 | | **50.9** | ULS 1a_45 | 306.2 | 169.4 | 243.7 | 0.30 | | 0.30 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-54.1** | ULS 5a Ah 22 | 182.4 | 84.7 | 142.6 | 0.64 | | **0.0** | | 297.8 | 84.7 | 121.8 | 0.00 | | 0.64 |
| 101 | BVNSTK - lower horiz lower CA front | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 2.00 | 1.00 | 65 | **-682.7** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.64 | | **13.5** | ULS 1a_0,9_0,9_0 | 1548.5 | 1066.2 | 2623.9 | 0.01 | | 0.64 |
| 202T | BVNSTK - lower horiz lower CA side | 100x100x8 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 131 | **-2.8** | ULS 5a Ah 22 | 143.1 | 235.2 | 345.6 | 0.02 | | **77.8** | ULS 5a Ah 22 | 310.5 | 235.2 | 279.3 | 0.33 | | 0.33 |
| 203L | BVNSTK - CD 2 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-104.6** | ULS 1a_90 | 265.5 | 169.4 | 285.1 | 0.62 | | **67.1** | ULS 1a_0,9_0,9_90 | 291.2 | 169.4 | 229.3 | 0.40 | | 0.62 |
| 203T | BVNSTK - CD 2 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-89.8** | 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 | | 0.60 |
| 204L | BVNSTK - CD 3 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-68.5** | ULS 1a_0,9_0,9_90 | 260.7 | 169.4 | 285.1 | 0.40 | | **102.5** | ULS 1a_90 | 291.2 | 169.4 | 229.3 | 0.60 | | 0.60 |
| 204T | BVNSTK - CD 3 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-96.6** | ULS 5a Ah 22 | 260.7 | 169.4 | 285.1 | 0.57 | | **86.1** | ULS 5a Ba 12 | 291.2 | 169.4 | 229.3 | 0.51 | | 0.57 |
| 205 | BVNSTK - Diaphragm diagonal | 110x110x10 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-47.3** | ULS 5a Ah 12 | 205.7 | 117.6 | 216.0 | 0.40 | | **49.5** | ULS 5a Ba 12 | 262.5 | 117.6 | 174.5 | 0.42 | | 0.42 |
| 206 | BVNSTK - Diaphragm horiz | 70x70x7 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 294 | **-2.4** | ULS 3_90 | 23.9 | 58.8 | 75.6 | 0.10 | | **0.0** | | 76.6 | 58.8 | 51.8 | 0.00 | | 0.10 |
| 400 | Tweede DWSRM - CD under 1 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 167 | **-17.9** | ULS 5a Ah 22 | 71.4 | 58.8 | 86.4 | 0.30 | | **14.8** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.25 | | 0.30 |
| 401 | Tweede DWSRM - CD under 2 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 155 | **-18.1** | ULS 5a Ba 12 | 78.4 | 58.8 | 86.4 | 0.31 | | **21.4** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.36 | | 0.36 |
| 402 | Tweede DWSRM - CD under 3 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-23.9** | ULS 5a Ah 22 | 84.2 | 58.8 | 86.4 | 0.41 | | **21.6** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.41 |
| 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 | | **21.7** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.39 |
| 404 | Tweede DWSRM - CD under 5 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 111 | **-21.4** | ULS 5a Ah 22 | 113.3 | 58.8 | 86.4 | 0.36 | | **29.5** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.50 | | 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 | | **21.8** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.65 |
| 406 | Tweede DWSRM - CD under 7 | 80x80x8 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-37.9** | ULS 5a Ba 12 | 142.3 | 58.8 | 86.4 | 0.65 | | **8.6** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.15 | | 0.65 |
| 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 | | **42.1** | ULS 5a Ba 12 | 1626.6 | 117.6 | 0.0 | 0.36 | | 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 | | **6.3** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.29 | | 0.29 |
| 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 | | **15.0** | ULS 7 | 37.4 | 37.7 | 22.0 | 0.68 | | 0.68 |
| 410 | Tweede DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 171 | **-6.2** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.21 | | **9.0** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.41 | | 0.41 |
| 411 | Tweede DWSRM - front vert 4 | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 287 | **-13.1** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.72 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.72 |
| 412 | Tweede DWSRM - front vert 5 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 231 | **-11.7** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.66 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.66 |
| 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 | | 0.20 |
| 102A | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 1.46 | 1.00 | 80 | **-487.4** | ULS 5a Ba 12 | 1211.0 | 1066.2 | 3265.9 | 0.46 | | **0.0** | | 1548.5 | 1066.2 | 2791.4 | 0.00 | | 0.46 |
| 102B | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 8M24-5.6t | 1.00 | 1.53 | 1.00 | 77 | **-467.7** | ULS 3_135 | 1237.8 | 677.8 | 1866.2 | 0.69 | | **0.0** | | 1548.5 | 677.8 | 1595.1 | 0.00 | | 0.69 |
| 102C | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | | 1.89 | 2.89 | 1.00 | 75 | **-474.4** | ULS 3_0 | 1257.1 | 0.0 | 0.0 | 0.38 | | **0.0** | | 1623.9 | 0.0 | 0.0 | 0.00 | | 0.38 |
| 103A | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 8M24-5.6t | 1.00 | 1.82 | 1.00 | 67 | **-451.9** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.67 | | **0.0** | | 1220.3 | 677.8 | 1417.8 | 0.00 | | 0.67 |
| 103B | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 7M24-5.6t | 3.10 | 1.00 | 1.00 | 68 | **-435.8** | ULS 3_90 | 1055.4 | 574.5 | 1451.5 | 0.76 | | **0.0** | | 828.7 | 574.5 | 1343.7 | 0.00 | | 0.76 |
| 103C | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | | 5.59 | ### | 1.00 | 68 | **-452.7** | ULS 3_135 | 1055.8 | 0.0 | 0.0 | 0.43 | | **0.0** | | 1301.9 | 0.0 | 0.0 | 0.00 | | 0.43 |
| 414 | Tweede DWSRM - front diag 1 | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **-30.6** | ULS 1a_0 | 18.6 | 37.7 | 60.5 | 1.65 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.65 |
| 415 | Tweede DWSRM - front diag 2 | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 301 | **-37.2** | ULS 7 | 21.4 | 37.7 | 60.5 | 1.74 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.74 |
| 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 | | 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 | | **21.7** | ULS 1a_45 | 84.7 | 37.7 | 44.8 | 0.58 | | 0.58 |
| 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 | | **27.9** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.74 | | 0.74 |
| 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 | | **406.9** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 1.17 | nettodsn. | 1.17 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-16.2** | ULS 1a_0,9_90 | 35.4 | 37.7 | 51.8 | 0.46 | | **5.6** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 41.4 | 0.15 | | 0.46 |
| 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 | 0.01 | | 0.01 |
| 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 | | 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 | | **1.5** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 31.7 | 0.05 | | 0.05 |
| 104A | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | ### | 1.00 | 103 | **-105.2** | ULS 3_45 | 413.3 | 169.4 | 259.2 | 0.62 | | **0.0** | | 343.1 | 169.4 | 208.5 | 0.00 | | 0.62 |
| 104B | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | 9.78 | 1.00 | 102 | **-71.2** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.42 | | **0.0** | | 431.8 | 169.4 | 221.5 | 0.00 | | 0.42 |
| 104C | Tweede DWSRM - main member raised | 150x150x10 | S235 | | 1.00 | 1.01 | 1.00 | 152 | **-104.4** | ULS 3_45 | 221.6 | 0.0 | 0.0 | 0.47 | | **0.0** | | 688.6 | 0.0 | 0.0 | 0.00 | | 0.47 |
| 424 | Tweede DWSRM - horiz at end of raised | HEB160 | S235 | 2M16-5.6t | 2.00 | 2.00 | 2.00 | 22 | **-8.8** | ULS 5a Ba 1 | 1077.2 | 75.4 | 138.2 | 0.12 | | **6.3** | ULS 5a Ah 1 | 1296.6 | 75.4 | 11.9 | 0.53 | | 0.53 |
| 425 | Tweede DWSRM - raised DS A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 132 | **-4.5** | ULS 1a_135 | 37.2 | 37.7 | 43.2 | 0.12 | | **2.6** | ULS 1a_0,9_135 | 37.4 | 37.7 | 22.0 | 0.12 | | 0.12 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.2** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | | **1.3** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.06 | | 0.06 |
| 427 | Tweede DWSRM - raised DS B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-4.4** | ULS 5a Ah 22 | 16.1 | 37.7 | 43.2 | 0.27 | | **2.3** | ULS 5a Ah 22 | 37.4 | 37.7 | 22.0 | 0.11 | | 0.27 |
| 428 | Tweede DWSRM - raised DS B-B horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 120 | **-5.1** | ULS 1a_45 | 43.6 | 37.7 | 43.2 | 0.14 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.14 |
| 429 | Tweede DWSRM - CD top 1 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 208 | **-15.9** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.43 | | **18.9** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.50 | | 0.50 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-18.2** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.48 | | **15.4** | ULS 1a_0,9_0,9_0 | 84.7 | 37.7 | 44.8 | 0.41 | | 0.48 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-15.0** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.40 | | **17.8** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.47 | | 0.47 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-14.6** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.39 | | **17.6** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.52 | | 0.52 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-16.6** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.44 | | **13.3** | ULS 1a_0,9_0,9_0 | 55.3 | 37.7 | 33.6 | 0.40 | | 0.44 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-13.0** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.34 | | **17.0** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.51 | | 0.51 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-17.9** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.70 | | **13.0** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.59 | | 0.70 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-11.3** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.35 | | **16.5** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.75 | | 0.75 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-11.4** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.35 | | **15.3** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.69 | | 0.69 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-14.2** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.38 | | **10.3** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.47 | | 0.47 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-9.1** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.24 | | **13.6** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.62 | | 0.62 |
| 440 | Tweede DWSRM - CD top 11 | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-11.7** | ULS 5a Ba 1 | 42.8 | 37.7 | 43.2 | 0.31 | | **8.6** | ULS 5a Ah 1 | 37.4 | 37.7 | 22.0 | 0.39 | | 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 1 | 47.4 | 37.7 | 43.2 | 0.27 | | **14.3** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.65 | | 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 | | **462.0** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 1.33 | nettodsn. | 1.33 |
| 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 | | 0.62 |
| 105A | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.00 | 1.47 | 1.00 | 124 | **-217.3** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.70 | | **215.0** | ULS 1a_0,9_0 | 410.9 | 506.7 | 738.6 | 0.52 | | 0.70 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-154.8** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.50 | | **200.8** | ULS 1a_0 | 615.9 | 508.3 | 797.5 | 0.39 | | 0.50 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-193.1** | ULS 1a_0 | 312.3 | 0.0 | 0.0 | 0.62 | | **224.7** | ULS 1a_0 | 705.0 | 0.0 | 0.0 | 0.32 | | 0.62 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-90.2** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.48 | | **234.8** | ULS 1a_0 | 362.9 | 593.0 | 775.4 | 0.65 | | 0.65 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-34.7** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.22 | | **155.4** | ULS 1a_45 | 362.9 | 338.9 | 443.1 | 0.46 | | 0.46 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-68.3** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.37 | | **216.9** | ULS 1a_0 | 451.2 | 0.0 | 0.0 | 0.48 | | 0.48 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-17.6** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.17 | | **132.4** | ULS 1a_45 | 228.6 | 235.2 | 302.4 | 0.58 | | 0.58 |
| 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 | | **66.0** | ULS 1a_45 | 196.1 | 75.4 | 121.0 | 0.88 | | 0.88 |
| 107C | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | | 2.17 | 1.00 | 1.00 | 142 | **-19.3** | ULS 5a Ah 1 | 100.0 | 0.0 | 0.0 | 0.19 | | **86.8** | ULS 1a_45 | 279.7 | 0.0 | 0.0 | 0.31 | | 0.31 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.1** | ULS 5a Ah 1 | 37.3 | 37.7 | 43.2 | 0.22 | | **11.2** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.51 | | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16 | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-606.3** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.89 | | **395.2** | ULS 1a_0,9_0,9_45 | 1220.3 | 677.8 | 1417.8 | 0.58 | | 0.89 |
| 108B | Elfde TSNSTK - Main member | 180x180x16 | S235 | 12M24-5.6t | 0.51 | 0.51 | 0.51 | 56 | **-943.2** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.94 | | **718.3** | ULS 1a_0,9_0,9_45 | 1220.3 | 999.7 | 2126.8 | 0.72 | | 0.94 |
| 108C | Elfde TSNSTK - Main member | 180x180x16 | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-790.5** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.70 | | **541.8** | ULS 1a_0,9_0,9_45 | 1301.9 | 0.0 | 0.0 | 0.42 | | 0.70 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-105.3** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.62 | | **72.4** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.43 | | 0.62 |
| 207T | Elfde TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-82.6** | ULS 5a Ba 12 | 255.9 | 169.4 | 285.1 | 0.49 | | **92.0** | ULS 5a Ah 22 | 306.2 | 169.4 | 236.8 | 0.54 | | 0.54 |
| 208L | Elfde TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-72.7** | ULS 1a_0,9_0,9_90 | 251.2 | 169.4 | 285.1 | 0.43 | | **104.9** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.62 | | 0.62 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.3** | ULS 5a Ah 22 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.0** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.52 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-108.2** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.64 | | **72.3** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.43 | | 0.64 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-76.4** | ULS 5a Ba 12 | 243.6 | 169.4 | 285.1 | 0.45 | | **85.7** | ULS 5a Ah 22 | 306.2 | 169.4 | 236.8 | 0.51 | | 0.51 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | 8M30-5.6t | 0.52 | 0.52 | 0.52 | 52 | **-1138.7** | ULS 1a_45 | 1590.7 | 1077.1 | 2592.0 | 1.06 | afschuiving | **859.6** | ULS 1a_0,9_0,9_45 | 1638.1 | 1077.1 | 2094.5 | 0.80 | | 1.06 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6t | 0.52 | 0.52 | 0.52 | 53 | **-1323.9** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.84 | | **891.2** | ULS 1a_0,9_0,9_45 | 1638.1 | 1588.8 | 3194.2 | 0.56 | | 0.84 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-73.5** | ULS 1a_0,9_0,9_90 | 238.9 | 169.4 | 285.1 | 0.43 | | **112.3** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.66 | | 0.66 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**49**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-88.7** | ULS 1a_0 | 238.9 | 169.4 | 285.1 | 0.52 | | **78.5** | ULS 1a_0,9_0,9_0 | 306.2 | 169.4 | 236.8 | 0.46 | | 0.52 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-121.8** | ULS 1a_0,9_0,9_45 | 230.6 | 169.4 | 285.1 | 0.72 | | **144.0** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.85 | | 0.85 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-130.4** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.77 | | **90.5** | ULS 1a_0,9_0,9_45 | 306.2 | 169.4 | 236.8 | 0.53 | | 0.77 |
| 212L | Tiende TSNSTK - upper horiz lower CA fi | 150x150x10 | S235 | 7M24-5.6t | 1.00 | 1.00 | 1.00 | 162 | **0.0** | | 222.3 | 578.2 | 907.2 | 0.00 | | **385.9** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.92 | | 0.92 |
| 212T | Tiende TSNSTK - upper horiz lower CA s | 80x80x8 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 308 | **-53.9** | ULS 1a_90 | 36.4 | 117.6 | 172.8 | 1.48 | knik | **37.0** | ULS 1a_0,9_0,9_90 | 212.5 | 117.6 | 139.6 | 0.31 | | 1.48 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 2.00 | 1.00 | 82 | **-431.1** | ULS 5a Ba 21 | 1194.7 | 906.5 | 2799.4 | 0.48 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.48 |
| 213 | Tiende TSNSTK - lower horiz lower CA si | 110x110x10 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 148 | **-8.9** | ULS 5a Ah 21 | 168.8 | 235.2 | 432.0 | 0.05 | | **87.5** | ULS 5a Ah 21 | 433.4 | 235.2 | 349.1 | 0.37 | | 0.37 |
| 214 | Tiende TSNSTK - Diaphragm diagonal | 130x130x12 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 139 | **-60.8** | ULS 5a Ba 10 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.8** | ULS 5a Ba 10 | 379.7 | 117.6 | 209.5 | 0.53 | | 0.53 |
| 215 | Tiende TSNSTK - Diaphragm horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 321 | **-2.3** | ULS 3_0 | 27.3 | 58.8 | 86.4 | 0.09 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.09 |
| 300 | Eerste DWSRM - CD under 1 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 146 | **-21.2** | ULS 5a Ba 11 | 106.2 | 58.8 | 86.4 | 0.36 | | **19.3** | ULS 5a Ah 11 | 179.7 | 58.8 | 69.8 | 0.33 | | 0.36 |
| 301 | Eerste DWSRM - CD under 2 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 136 | **-21.0** | ULS 5a Ah 11 | 116.1 | 58.8 | 86.4 | 0.36 | | **26.5** | ULS 5a Ba 20 | 179.7 | 58.8 | 69.8 | 0.45 | | 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 | 0.39 | | 0.56 |
| 303 | Eerste DWSRM - CD under 4 | 100x100x8 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-27.5** | ULS 5a Ba 11 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 11 | 179.7 | 58.8 | 69.8 | 0.29 | | 0.47 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-14.3** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.27 | | **10.2** | ULS 1a_0,9_0,9_0 | 86.7 | 58.8 | 59.5 | 0.17 | | 0.27 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-11.2** | ULS 1a_0,9_0,9_0 | 59.5 | 58.8 | 75.6 | 0.19 | | **12.7** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.22 | | 0.22 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 21 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 21 | 86.7 | 58.8 | 59.5 | 0.21 | | 0.22 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 21 | 70.4 | 58.8 | 75.6 | 0.25 | | **16.5** | ULS 5a Ba 21 | 86.7 | 58.8 | 59.5 | 0.28 | | 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 21 | 61.4 | 58.8 | 64.8 | 0.30 | | **17.3** | ULS 5a Ah 21 | 65.7 | 58.8 | 44.4 | 0.39 | | 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 21 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.53 | | 0.53 |
| 310 | Eerste DWSRM - CD under 11 | 65x65x7 | S235 | 2M20-5.6t | 0.56 | 0.56 | 0.56 | 95 | **-32.0** | ULS 5a Ba 10 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 10 | 99.4 | 117.6 | 104.2 | 0.26 | | 0.28 |
| 311 | Eerste DWSRM - CD under 12 | 65x65x7 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 72 | **-36.3** | ULS 5a Ba 10 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 10 | 86.7 | 58.8 | 59.5 | 0.35 | | 0.62 |
| 312 | Eerste DWSRM - 1st & 2nd horiz under | HEB240 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-18.4** | ULS 5a Ah 11 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | ULS 5a Ba 20 | 2249.6 | 117.6 | 0.0 | 0.28 | | 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 21 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.6** | ULS 5a Ba 21 | 1626.6 | 117.6 | 0.0 | 0.27 | | 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 | | **70.7** | ULS 3_135 | 99.4 | 117.6 | 119.1 | 0.71 | | 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 | | **93.6** | ULS 3_0 | 99.4 | 117.6 | 119.1 | 0.94 | | 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 | | **34.2** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 | | 0.91 |
| 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 | | **38.0** | ULS 1a_0 | 72.6 | 37.7 | 38.4 | 1.01 | afschuiving | 1.01 |
| 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 | | **37.0** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.98 | | 0.98 |
| 319 | Eerste DWSRM - front vert 1 | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-42.4** | ULS 3_0 | 91.7 | 58.8 | 86.4 | 0.72 | | **0.0** | | 179.7 | 58.8 | 69.8 | 0.00 | | 0.72 |
| 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 | | 0.61 |
| 321 | Eerste DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-14.0** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.59 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.59 |
| 322 | Eerste DWSRM - front vert 4 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 112 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **0.0** | | 44.9 | 37.7 | 26.5 | 0.00 | | 0.23 |
| 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 | | 0.10 |
| 324 | Eerste DWSRM - Doorsnede A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 306 | **-6.2** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.54 | | **3.8** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.17 | | 0.54 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.4** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.2** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.10 | | 0.11 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.4** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.24 | | **2.9** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.13 | | 0.24 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.9** | ULS 1a_0,9_0,9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.8** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.08 | | 0.08 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 1.70 | 1.00 | 71 | **-488.3** | ULS 1a_135 | 1289.1 | 906.5 | 2799.4 | 0.54 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.54 |
| 110B | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 8M24-5.6t | 2.53 | 1.40 | 1.00 | 57 | **-337.9** | ULS 5a Ba 10 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.3** | ULS 5a Ah 10 | 1548.5 | 677.8 | 1595.1 | 0.01 | | 0.50 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-479.3** | ULS 1a_135 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.2** | ULS 5a Ah 10 | 1623.9 | 0.0 | 0.0 | 0.01 | | 0.37 |
| 111A | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | 8M24-5.6t | 3.53 | 6.36 | 1.00 | 72 | **-313.5** | ULS 5a Ba 10 | 869.0 | 677.8 | 1555.2 | 0.46 | | **31.9** | ULS 5a Ah 10 | 1008.5 | 677.8 | 1329.2 | 0.05 | | 0.46 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-196.0** | ULS 3_90 | 869.3 | 0.0 | 0.0 | 0.23 | | **0.0** | | 1097.7 | 0.0 | 0.0 | 0.00 | | 0.23 |
| 111C | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 1.80 | 1.00 | 1.00 | 72 | **-299.5** | ULS 5a Ba 10 | 869.1 | 0.0 | 0.0 | 0.34 | | **26.4** | ULS 5a Ah 10 | 1097.7 | 0.0 | 0.0 | 0.02 | | 0.34 |
| 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 | | **364.7** | ULS 3_90 | 422.8 | 504.1 | 796.6 | 0.86 | | 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 | | **261.7** | ULS 3_45 | 615.9 | 423.6 | 664.6 | 0.62 | | 0.62 |
| 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 | | **287.9** | ULS 3_90 | 705.0 | 0.0 | 0.0 | 0.41 | | 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 | | **235.1** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.57 | | 0.57 |
| 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 | | **200.5** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.69 | | 0.69 |
| 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 | | **200.1** | ULS 3_135 | 496.3 | 0.0 | 0.0 | 0.40 | | 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 | | 0.02 |
| 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 | | 0.00 |
| 114A | Negende TSNSTK - Main member | 250x250x22 | S235 | 14M30-5.6t | 0.52 | 0.52 | 0.52 | 35 | **-1719.2** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.91 | | **1242.5** | ULS 1a_0,9_0,9_45 | 2373.8 | 1885.0 | 4032.0 | 0.66 | | 0.91 |
| 114B | Negende TSNSTK - Main member | 250x250x22 | S235 | 18M30-5.6t | 0.52 | 0.52 | 0.52 | 36 | **-2164.7** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.92 | | **1649.8** | ULS 1a_0,9_0,9_45 | 2373.8 | 2423.5 | 4626.7 | 0.70 | | 0.92 |
| 114C | Negende TSNSTK - Main member | 250x250x22 | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-2161.8** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.91 | | **1653.5** | ULS 1a_0,9_0,9_45 | 2493.4 | 0.0 | 0.0 | 0.66 | | 0.91 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-248.2** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.92 | | **220.2** | ULS 1a_0,9_0,9_90 | 250.2 | 269.3 | 314.2 | 0.88 | | 0.92 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-177.3** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.66 | | **171.0** | ULS 1a_0,9_0 | 250.2 | 269.3 | 314.2 | 0.68 | | 0.68 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-226.2** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.84 | | **231.9** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.93 | | 0.93 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-179.6** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.67 | | **167.2** | ULS 1a_0,9_0,9_0 | 250.2 | 269.3 | 314.2 | 0.67 | | 0.67 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.3** | ULS 5a Ah 10 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 10 | 109.4 | 75.4 | 89.6 | 0.15 | | 0.32 |
| 219 | Negende TSNSTK - Diaphragm K CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 239 | **-0.3** | 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 | | 0.01 |
| 220L | Negende TSNSTK - Diaphragm K horiz fr | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-15.4** | ULS 1a_0,9_45 | 43.6 | 37.7 | 60.5 | 0.41 | | **15.3** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.41 | | 0.41 |
| 220T | Negende TSNSTK - Diaphragm K horiz s | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-12.3** | ULS 1a_0,9_0,9_135 | 43.6 | 37.7 | 60.5 | 0.33 | | **17.3** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.46 | | 0.46 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.6** | ULS 1a_0,9_0,9_135 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.9** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 | | 0.05 |
| 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_0,9_90 | 90.2 | 113.0 | 100.9 | 0.00 | | 0.01 |
| 223L | Negende TSNSTK - Diaphragm L horiz fr | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-18.3** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.49 | | **18.8** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.50 | | 0.50 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-18.2** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.48 | | **18.4** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.49 | | 0.49 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-239.6** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.89 | | **220.8** | ULS 1a_0,9_0,9_90 | 348.4 | 269.3 | 314.2 | 0.82 | | 0.89 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-180.5** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.67 | | **175.9** | ULS 1a_0,9_0 | 348.4 | 269.3 | 314.2 | 0.65 | | 0.67 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-25.6** | ULS 1a_0,9_0,9_45 | 55.7 | 37.7 | 60.5 | 0.68 | | **26.6** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.71 | | 0.71 |
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-25.2** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.67 | | **27.1** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.72 | | 0.72 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-2.1** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.07 | | **4.9** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.06 | | 0.07 |
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | | 0.01 |
| 228L | Achtste TSNSTK - Diag fr 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-225.5** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.84 | | **219.2** | ULS 1a_0,9_90 | 347.2 | 269.3 | 261.8 | 0.84 | | 0.84 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-187.7** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.70 | | **172.2** | ULS 1a_0,9_0,9_135 | 347.2 | 269.3 | 261.8 | 0.66 | | 0.70 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-18.9** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.50 | | **17.6** | ULS 1a_45 | 142.8 | 37.7 | 51.2 | 0.47 | | 0.50 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-19.3** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.51 | | **18.1** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.48 | | 0.51 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-3.4** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.12 | | **6.7** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.09 | | 0.12 |
| 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 | | 0.01 |
| 115A | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2649.8** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.83 | | **2117.8** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.59 | | 0.83 |
| 115B | Achtste TSNSTK - Main member | 200x200x20 | S235 | 28M30-5.6t | 0.52 | 0.52 | 1.05 | 47 | **-3064.3** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.96 | | **2493.9** | ULS 1a_0,9_0,9_45 | 3615.8 | 3628.5 | 6542.8 | 0.69 | | 0.96 |
| 115C | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-3060.4** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.96 | | **2498.4** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.70 | | 0.96 |
| 116A | Zevende TSNSTK - Main member | 250x250x20 | S235 | 28M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3346.0** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.92 | | **2772.0** | ULS 1a_0,9_0,9_45 | 4683.7 | 3628.5 | 7330.9 | 0.76 | | 0.92 |
| 116B | Zevende TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.60 | 60 | **-3713.9** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 1.00 | | **3028.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.74 | | 1.00 |
| 117A | Zesde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 59 | **-3729.3** | ULS 1a_45 | 3738.1 | 4075.1 | 10368.0 | 1.00 | | **3009.1** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.74 | | 1.00 |
| 117B | Zesde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3836.2** | ULS 1a_135 | 3722.2 | 4503.7 | 11664.0 | 1.03 | knik | **3104.2** | ULS 1a_0,9_0,9_45 | 4341.6 | 4503.7 | 9425.5 | 0.72 | | 1.03 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.25 | 0.25 | 0.73 | 60 | **-3923.2** | ULS 1a_45 | 3731.6 | 4075.1 | 10368.0 | 1.05 | knik | **3183.1** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.78 | | 1.05 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-4004.4** | ULS 1a_45 | 3755.7 | 4075.1 | 10368.0 | 1.07 | knik | **3179.4** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.78 | | 1.07 |
| 119A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 60 | **-4017.3** | ULS 1a_45 | 3732.3 | 4075.1 | 10368.0 | 1.08 | knik | **3161.4** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.78 | | 1.08 |
| 119B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3979.5** | ULS 1a_45 | 3740.5 | 4075.1 | 10368.0 | 1.06 | knik | **3114.5** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.76 | | 1.06 |
| 120A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.38 | 60 | **-3990.6** | ULS 1a_45 | 3723.6 | 4075.1 | 10368.0 | 1.07 | knik | **3107.5** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.76 | | 1.07 |
| 120B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.50 | 0.50 | 1.54 | 60 | **-4077.5** | ULS 1a_45 | 3730.6 | 4503.7 | 11664.0 | 1.09 | knik | **3162.7** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 0.70 | | 1.09 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**49**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-4121.8** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.76 | | **3156.3** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.55 | | 0.76 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-4073.3** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.75 | | **3019.6** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.53 | | 0.75 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 65 | **-4110.6** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.76 | | **2978.3** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.52 | | 0.76 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 66 | **-4137.9** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.76 | | **2957.6** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.52 | | 0.76 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-150.8** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 1.12 | afschuiving | **108.0** | ULS 1a_0,9_0,9_45 | 193.0 | 134.6 | 130.9 | 0.82 | | 1.12 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-136.6** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 1.01 | afschuiving | **103.0** | ULS 1a_0,9_0,9_45 | 193.0 | 134.6 | 130.9 | 0.79 | | 1.01 |
| 236L | Zevende TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 135 | **-71.7** | ULS 1a_0,9_0,9_45 | 197.0 | 169.4 | 259.2 | 0.42 | | **99.0** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.58 | | 0.58 |
| 236T | Zevende TSNSTK - Diag si 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 137 | **-67.8** | ULS 1a_0,9_0,9_45 | 194.1 | 169.4 | 259.2 | 0.40 | | **89.0** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.53 | | 0.53 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-36.0** | ULS 1a_0,9_0,9_45 | 87.9 | 58.8 | 86.4 | 0.61 | | **32.4** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.55 | | 0.61 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-36.1** | ULS 1a_0,9_0,9_135 | 87.9 | 58.8 | 86.4 | 0.61 | | **32.5** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.55 | | 0.61 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-7.3** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.29 | | **16.0** | ULS 1a_0,9_45 | 133.6 | 58.8 | 69.8 | 0.27 | | 0.29 |
| 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 | | 0.03 |
| 240L | Zesde TSNSTK - Diag fr 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-112.3** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.83 | | **117.2** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.90 | | 0.90 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 138 | **-106.9** | ULS 1a_45 | 159.4 | 134.6 | 162.0 | 0.79 | | **107.5** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.82 | | 0.82 |
| 241L | Zesde TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-121.4** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.90 | | **108.2** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.83 | | 0.90 |
| 241T | Zesde TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-114.5** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.85 | | **103.5** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.79 | | 0.85 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-97.0** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.15 | afschuiving | **50.8** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.60 | | 1.15 |
| 242T | Vijfde TSNSTK - CD 1 side | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-103.0** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.22 | knik, afschuiving | **55.0** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.65 | | 1.22 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.5** | ULS 5a Ah 10 | 106.8 | 84.7 | 129.6 | 0.35 | | **57.6** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.68 | | 0.68 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-31.8** | ULS 1a_0,9_0,9_135 | 106.8 | 84.7 | 129.6 | 0.37 | | **61.7** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.73 | | 0.73 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-42.9** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.5** | ULS 5a Ah 21 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.51 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-40.0** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.47 | | **35.4** | ULS 5a Ba 21 | 184.3 | 84.7 | 110.8 | 0.42 | | 0.47 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-43.3** | ULS 1a_45 | 77.2 | 84.7 | 129.6 | 0.56 | | **34.2** | ULS 1a_0,9_0,9_135 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.56 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-45.0** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.58 | | **34.1** | ULS 1a_0,9_0,9_90 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.58 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-27.1** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.46 | | **24.4** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.42 | | 0.46 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-27.4** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.47 | | **24.8** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.42 | | 0.47 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-8.3** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.36 | | **14.8** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.25 | | 0.36 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-30.4** | ULS 1a_0,9_0,9_135 | 80.2 | 84.7 | 129.6 | 0.38 | | **35.0** | ULS 1a_45 | 184.3 | 84.7 | 110.8 | 0.41 | | 0.41 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-28.0** | ULS 1a_0,9_0,9_45 | 80.2 | 84.7 | 129.6 | 0.35 | | **33.7** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.40 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-83.6** | ULS 1a_135 | 897.2 | 538.6 | 1425.6 | 0.16 | | **49.4** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.09 | | 0.16 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-83.4** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.15 | | **49.5** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.09 | | 0.15 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-64.2** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.38 | | **28.7** | ULS 1a_0,9_90 | 760.6 | 169.4 | 354.5 | 0.17 | | 0.38 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-52.7** | ULS 1a_135 | 361.1 | 169.4 | 414.7 | 0.31 | | **20.4** | ULS 1a_0,9_45 | 760.6 | 169.4 | 354.5 | 0.12 | | 0.31 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-47.2** | ULS 1a_0,9_135 | 361.1 | 169.4 | 414.7 | 0.28 | | **70.1** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.41 | | 0.41 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-48.9** | ULS 1a_0,9_45 | 361.1 | 169.4 | 414.7 | 0.29 | | **71.7** | ULS 1a_135 | 692.4 | 169.4 | 354.5 | 0.42 | | 0.42 |
| 255L | Broekstuk - Horizontal front | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-37.4** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.22 | | **19.7** | ULS 1a_0,9_135 | 692.4 | 169.4 | 354.5 | 0.12 | | 0.22 |
| 255T | Broekstuk - Horizontal side | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-37.6** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.22 | | **19.9** | ULS 1a_0,9_45 | 692.4 | 169.4 | 354.5 | 0.12 | | 0.22 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-58.3** | ULS 1a_45 | 290.1 | 169.4 | 259.2 | 0.34 | | **29.0** | ULS 1a_0,9_0,9_135 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.34 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-64.0** | ULS 5a Ba 22 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.8** | ULS 5a Ba 22 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.38 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-11.1** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.25 | | **13.4** | ULS 1a_0,9_135 | 347.3 | 176.4 | 222.5 | 0.08 | | 0.25 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.3 | 117.6 | 172.8 | 0.04 | | **0.0** | | 277.0 | 117.6 | 139.6 | 0.00 | | 0.04 |
| 263 | Broekstuk - Diag D-D | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 403 | **-14.0** | ULS 1a_45 | 20.7 | 58.8 | 86.4 | 0.68 | | **11.9** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.20 | | 0.68 |
| 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 | | 0.21 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 232 | **0.0** | | 117.3 | 0.0 | 0.0 | 0.00 | | **131.0** | ULS 3_90 | 599.7 | 0.0 | 0.0 | 0.22 | | 0.22 |
| 257 | Vierde TSNSTK - Doorsnede B-B CD | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 464 | **-0.7** | ULS 7 | 13.1 | 58.8 | 86.4 | 0.05 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.05 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**49**

| Group Label | Description | Profile | Steel Qual | Bolts | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling | ar (Comp) | aring (Comp) | U.C. (Comp) | ance (Comp) | Tension | Load Case (Tension) | Net Section | ar (Tens) | g (Tens) | U.C. (Tens) | Exceedance (Tens) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-105.9** | ULS 1a_90 | 550.6 | 508.3 | 777.6 | 0.21 | | **0.0** | | 624.7 | 508.3 | 664.6 | 0.00 | | 0.21 |
| 100B | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 67 | **-455.5** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.90 | | **229.2** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.45 | | 0.90 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-270.8** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.48 | | **87.8** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.13 | | 0.48 |
| 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 | | **345.9** | ULS 3_45 | 346.4 | 506.7 | 677.1 | 0.62 | | 0.62 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-88.3** | ULS 3_90 | 190.2 | 117.6 | 237.6 | 0.75 | | **0.0** | | 360.5 | 117.6 | 237.6 | 0.00 | | 0.75 |
| 201L | BVNSTK - CD 1 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-39.8** | ULS 1a_0,9_0,9_45 | 263.5 | 169.4 | 285.1 | 0.23 | | **51.2** | ULS 1a_45 | 306.2 | 169.4 | 243.7 | 0.30 | | 0.30 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-54.4** | ULS 5a Ah 22 | 182.1 | 84.7 | 142.6 | 0.64 | | **0.0** | | 297.8 | 84.7 | 121.8 | 0.00 | | 0.64 |
| 101 | BVNSTK - lower horiz lower CA front | 200x200x18 | S235 | 14M24-5.6 | 1.00 | 2.00 | 1.00 | 65 | **-688.4** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.65 | | **13.6** | ULS 1a_0,9_0,9_0 | 1548.5 | 1066.2 | 2623.9 | 0.01 | | 0.65 |
| 202T | BVNSTK - lower horiz lower CA side | 100x100x8 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 131 | **-2.3** | ULS 5a Ah 22 | 143.1 | 235.2 | 345.6 | 0.02 | | **78.2** | ULS 5a Ah 22 | 310.5 | 235.2 | 279.3 | 0.33 | | 0.33 |
| 203L | BVNSTK - CD 2 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-104.7** | ULS 1a_90 | 265.5 | 169.4 | 285.1 | 0.62 | | **67.2** | ULS 1a_0,9_0,9_90 | 291.2 | 169.4 | 229.3 | 0.40 | | 0.62 |
| 203T | BVNSTK - CD 2 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-90.0** | 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 | | 0.60 |
| 204L | BVNSTK - CD 3 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-68.6** | ULS 1a_0,9_0,9_90 | 260.7 | 169.4 | 285.1 | 0.40 | | **102.7** | ULS 1a_90 | 291.2 | 169.4 | 229.3 | 0.61 | | 0.61 |
| 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 | | **86.3** | ULS 5a Ba 12 | 291.2 | 169.4 | 229.3 | 0.51 | | 0.57 |
| 205 | BVNSTK - Diaphragm diagonal | 110x110x10 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-47.3** | ULS 5a Ah 12 | 205.7 | 117.6 | 216.0 | 0.40 | | **49.5** | ULS 5a Ba 12 | 262.5 | 117.6 | 174.5 | 0.42 | | 0.42 |
| 206 | BVNSTK - Diaphragm horiz | 70x70x7 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 294 | **-2.4** | ULS 3_90 | 23.9 | 58.8 | 75.6 | 0.10 | | **0.0** | | 76.6 | 58.8 | 51.8 | 0.00 | | 0.10 |
| 400 | Tweede DWSRM - CD under 1 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 167 | **-17.9** | ULS 5a Ah 22 | 71.4 | 58.8 | 86.4 | 0.30 | | **14.8** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.25 | | 0.30 |
| 401 | Tweede DWSRM - CD under 2 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 155 | **-18.1** | ULS 5a Ba 12 | 78.4 | 58.8 | 86.4 | 0.31 | | **21.4** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.36 | | 0.36 |
| 402 | Tweede DWSRM - CD under 3 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-23.9** | ULS 5a Ah 22 | 84.2 | 58.8 | 86.4 | 0.41 | | **21.6** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.41 |
| 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 | | **21.7** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.39 |
| 404 | Tweede DWSRM - CD under 5 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 111 | **-21.4** | ULS 5a Ah 22 | 113.3 | 58.8 | 86.4 | 0.36 | | **29.5** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.50 | | 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 | | **21.8** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.65 |
| 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 | | **8.5** | ULS 5a Ah 22 | 110.6 | 58.8 | 69.8 | 0.14 | | 0.65 |
| 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 | | **42.2** | ULS 5a Ba 12 | 1626.6 | 117.6 | 0.0 | 0.36 | | 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 | | **6.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.31 | | 0.31 |
| 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 | | 0.69 |
| 410 | Tweede DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 171 | **-6.4** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.21 | | **9.4** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.43 | | 0.43 |
| 411 | Tweede DWSRM - front vert 4 | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 287 | **-13.3** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.73 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.73 |
| 412 | Tweede DWSRM - front vert 5 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 231 | **-11.8** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.67 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.67 |
| 413 | Tweede DWSRM - front vert 6 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 114 | **-7.7** | ULS 7 | 43.2 | 37.7 | 43.2 | 0.20 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.20 |
| 102A | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 14M24-5.6 | 1.00 | 1.46 | 1.00 | 80 | **-489.2** | ULS 5a Ba 12 | 1211.0 | 1066.2 | 3265.9 | 0.46 | | **0.0** | | 1548.5 | 1066.2 | 2791.4 | 0.00 | | 0.46 |
| 102B | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 8M24-5.6t | 1.00 | 1.53 | 1.00 | 77 | **-469.8** | ULS 3_135 | 1237.8 | 677.8 | 1866.2 | 0.69 | | **0.0** | | 1548.5 | 677.8 | 1595.1 | 0.00 | | 0.69 |
| 102C | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | | 1.89 | 2.89 | 1.00 | 75 | **-476.6** | ULS 3_0 | 1257.1 | 0.0 | 0.0 | 0.38 | | **0.0** | | 1623.9 | 0.0 | 0.0 | 0.00 | | 0.38 |
| 103A | Tweede DWSRM - Main member 2 | 180x180x16# | S235 | 8M24-5.6t | 1.00 | 1.82 | 1.00 | 67 | **-453.9** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.67 | | **0.0** | | 1220.3 | 677.8 | 1417.8 | 0.00 | | 0.67 |
| 103B | Tweede DWSRM - Main member 2 | 180x180x16# | S235 | 7M24-5.6t | 3.10 | 1.00 | 1.00 | 68 | **-437.7** | ULS 3_90 | 1055.4 | 574.5 | 1451.5 | 0.76 | | **0.0** | | 828.7 | 574.5 | 1343.7 | 0.00 | | 0.76 |
| 103C | Tweede DWSRM - Main member 2 | 180x180x16# | S235 | | 5.59 | ### | 1.00 | 68 | **-454.8** | ULS 3_135 | 1055.8 | 0.0 | 0.0 | 0.43 | | **0.0** | | 1301.9 | 0.0 | 0.0 | 0.00 | | 0.43 |
| 414 | Tweede DWSRM - front diag 1 | **90x90x9** | **S355** | **1M16-8.8I** | 1.00 | 1.00 | 1.00 | 266 | **-32.5** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.65 | | **0.0** | | 148.2 | 60.3 | 78.4 | 0.00 | | 0.65 |
| 415 | Tweede DWSRM - front diag 2 | **80x80x8** | **S355** | **1M16-8.8I** | 1.00 | 1.00 | 1.00 | 243 | **-38.8** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.84 | | **0.0** | | 131.7 | 60.3 | 69.7 | 0.00 | | 0.84 |
| 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 | | 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 | | **22.0** | ULS 1a_45 | 84.7 | 37.7 | 44.8 | 0.58 | | 0.58 |
| 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 | | **28.2** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.75 | | 0.75 |
| 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 | | **409.6** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 0.74 | | 0.74 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-16.2** | ULS 1a_0,9_90 | 35.4 | 37.7 | 51.8 | 0.46 | | **5.6** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 41.4 | 0.15 | | 0.46 |
| 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 | | 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 | | 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 | | **1.5** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 31.7 | 0.05 | | 0.05 |
| 104A | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | ### | 1.00 | 103 | **-106.0** | ULS 3_45 | 413.3 | 169.4 | 259.2 | 0.63 | | **0.0** | | 343.1 | 169.4 | 208.5 | 0.00 | | 0.63 |
| 104B | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | 9.78 | 1.00 | 102 | **-71.7** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.42 | | **0.0** | | 431.8 | 169.4 | 221.5 | 0.00 | | 0.42 |
| 104C | Tweede DWSRM - main member raised | 150x150x10 | S235 | | 1.00 | 1.01 | 1.00 | 152 | **-105.2** | ULS 3_45 | 221.6 | 0.0 | 0.0 | 0.47 | | **0.0** | | 688.6 | 0.0 | 0.0 | 0.00 | | 0.47 |
| 424 | Tweede DWSRM - horiz at end of raised | HEB160 | S235 | 2M16-5.6t | 2.00 | 2.00 | 2.00 | 22 | **-8.8** | ULS 5a Ba 1 | 1077.2 | 75.4 | 138.2 | 0.12 | | **6.3** | ULS 5a Ah 1 | 1296.6 | 75.4 | 11.9 | 0.53 | | 0.53 |
| 425 | Tweede DWSRM - raised DS A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 132 | **-4.6** | ULS 1a_135 | 37.2 | 37.7 | 43.2 | 0.12 | | **2.6** | ULS 1a_0,9_135 | 37.4 | 37.7 | 22.0 | 0.12 | | 0.12 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.2** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | | **1.3** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.06 | | 0.06 |
| 427 | Tweede DWSRM - raised DS B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-4.4** | ULS 5a Ah 22 | 16.1 | 37.7 | 43.2 | 0.27 | | **2.3** | ULS 5a Ah 22 | 37.4 | 37.7 | 22.0 | 0.11 | | 0.27 |
| 428 | Tweede DWSRM - raised DS B-B horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 120 | **-5.1** | ULS 1a_45 | 43.6 | 37.7 | 43.2 | 0.14 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.14 |
| 429 | Tweede DWSRM - CD top 1 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 208 | **-16.1** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.43 | | **19.1** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.51 | | 0.51 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-18.3** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.49 | | **15.5** | ULS 1a_0,9_0,9_0 | 84.7 | 37.7 | 44.8 | 0.41 | | 0.49 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-15.1** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.40 | | **18.0** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.48 | | 0.48 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-14.7** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.39 | | **17.8** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.53 | | 0.53 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-16.7** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.44 | | **13.4** | ULS 1a_0,9_0,9_0 | 55.3 | 37.7 | 33.6 | 0.40 | | 0.44 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-13.1** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.35 | | **17.2** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.51 | | 0.51 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-18.0** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.71 | | **13.1** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.59 | | 0.71 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-11.4** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.35 | | **16.6** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.75 | | 0.75 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-11.5** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.35 | | **15.4** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.70 | | 0.70 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-14.4** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.38 | | **10.4** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.47 | | 0.47 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-9.2** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.24 | | **13.7** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.62 | | 0.62 |
| 440 | Tweede DWSRM - CD top 11 | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-11.7** | ULS 5a Ba 1 | 42.8 | 37.7 | 43.2 | 0.31 | | **8.6** | ULS 5a Ah 1 | 37.4 | 37.7 | 22.0 | 0.39 | | 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 1 | 47.4 | 37.7 | 43.2 | 0.27 | | **14.3** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.65 | | 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 | 0.84 | | 0.84 |
| 443 | Tweede DWSRM - diag top "CD" | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 260 | **-13.2** | ULS 3_90 | 21.3 | 37.7 | 51.8 | 0.62 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.62 |
| 105A | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | 6M24-5.6t | 1.00 | 1.47 | 1.00 | 124 | **-220.0** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.71 | | **215.6** | ULS 1a_0,9_0 | 410.9 | 506.7 | 738.6 | 0.52 | | 0.71 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-156.0** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.51 | | **202.7** | ULS 1a_0 | 615.9 | 508.3 | 797.5 | 0.40 | | 0.51 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-195.6** | ULS 1a_0 | 312.3 | 0.0 | 0.0 | 0.63 | | **226.8** | ULS 1a_0 | 705.0 | 0.0 | 0.0 | 0.32 | | 0.63 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-90.9** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.48 | | **237.0** | ULS 1a_0 | 362.9 | 593.0 | 775.4 | 0.65 | | 0.65 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-35.0** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.22 | | **156.6** | ULS 1a_45 | 362.9 | 338.9 | 443.1 | 0.46 | | 0.46 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-68.9** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.37 | | **218.9** | ULS 1a_0 | 451.2 | 0.0 | 0.0 | 0.49 | | 0.49 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-17.7** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.17 | | **133.4** | ULS 1a_45 | 228.6 | 235.2 | 302.4 | 0.58 | | 0.58 |
| 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 | | **66.5** | ULS 1a_45 | 196.1 | 75.4 | 121.0 | 0.88 | | 0.88 |
| 107C | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | | 2.17 | 1.00 | 1.00 | 142 | **-19.0** | ULS 5a Ah 1 | 100.0 | 0.0 | 0.0 | 0.19 | | **87.4** | ULS 1a_45 | 279.7 | 0.0 | 0.0 | 0.31 | | 0.31 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.0** | ULS 5a Ah 1 | 37.3 | 37.7 | 43.2 | 0.22 | | **11.2** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.51 | | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16# | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-609.5** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.90 | | **397.3** | ULS 1a_0,9_0,9_45 | 1220.3 | 677.8 | 1417.8 | 0.59 | | 0.90 |

DNV·GL

## Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**49**

| Group Label | Description | Profile | Steel Qual | Bolts | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling | ear (Comp) | aring (Comp) | U.C. (Comp) | ance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | g (Tens) | U.C. (Tens) | Exceedance (Tens) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 108B | Elfde TSNSTK - Main member | 180x180x16# | S235 | 12M24-5.6 | 0.51 | 0.51 | 0.51 | 56 | **-947.8** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.95 | | **721.9** | ULS 1a_0_9_0_45 | 1220.3 | 999.7 | 2126.8 | 0.72 | | 0.95 |
| 108C | Elfde TSNSTK - Main member | 180x180x16# | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-793.6** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.70 | | **543.2** | ULS 1a_0_9_0_45 | 1301.9 | 0.0 | 0.0 | 0.42 | | 0.70 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-105.4** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.62 | | **72.4** | ULS 1a_0_9_0_90 | 306.2 | 169.4 | 236.8 | 0.43 | | 0.62 |
| 207T | Elfde TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-82.8** | 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 | | 0.54 |
| 208L | Elfde TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-72.8** | ULS 1a_0_9_0_90 | 251.2 | 169.4 | 285.1 | 0.43 | | **105.0** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.62 | | 0.62 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.0** | ULS 5a Ah 22 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.2** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.52 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-108.3** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.64 | | **72.4** | ULS 1a_0_9_0_90 | 306.2 | 169.4 | 236.8 | 0.43 | | 0.64 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-76.8** | ULS 5a Ba 12 | 243.6 | 169.4 | 285.1 | 0.45 | | **85.3** | ULS 5a Ah 22 | 306.2 | 169.4 | 236.8 | 0.50 | | 0.50 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | **8M30-8.8** | 0.52 | 0.52 | 0.52 | 52 | **-1143.0** | ULS 1a_45 | 1590.7 | 1723.4 | 2592.0 | 0.72 | | **861.7** | ULS 1a_0_9_0_45 | 1638.1 | 1723.4 | 2094.5 | 0.53 | | 0.72 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6 | 0.52 | 0.52 | 0.52 | 53 | **-1326.5** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.84 | | **890.6** | ULS 1a_0_9_0_45 | 1638.1 | 1588.8 | 3194.2 | 0.56 | | 0.84 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-73.6** | ULS 1a_0_9_0_90 | 238.9 | 169.4 | 285.1 | 0.43 | | **112.4** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.66 | | 0.66 |
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-88.7** | ULS 1a_0 | 238.9 | 169.4 | 285.1 | 0.52 | | **79.2** | ULS 1a_0_9_0_0 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.52 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-122.4** | ULS 1a_0_9_0_45 | 230.6 | 169.4 | 285.1 | 0.72 | | **144.3** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.85 | | 0.85 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-134.7** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.79 | | **97.4** | ULS 1a_0_9_0_45 | 306.2 | 169.4 | 236.8 | 0.58 | | 0.79 |
| 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 | | **386.2** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.92 | | 0.92 |
| 212T | Tiende TSNSTK - upper horiz lower CA si | **100x100x12** | **S215** | **2M20-8.8** | 1.00 | 1.00 | 1.00 | 247 | **-63.7** | ULS 1a_90 | 92.6 | 188.2 | 259.2 | 0.69 | | **43.7** | ULS 1a_0_9_0_90 | 404.4 | 188.2 | 209.5 | 0.23 | | 0.69 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6 | 1.00 | 2.00 | 1.00 | 82 | **-431.0** | ULS 5a Ba 21 | 1194.7 | 906.5 | 2799.4 | 0.48 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.48 |
| 213 | Tiende TSNSTK - lower horiz lower CA si | 110x110x10 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 148 | **-9.6** | ULS 5a Ah 21 | 168.8 | 235.2 | 432.0 | 0.06 | | **86.7** | ULS 5a Ah 21 | 433.4 | 235.2 | 349.1 | 0.37 | | 0.37 |
| 214 | Tiende TSNSTK - Diaphragm diagonal | 130x130x12# | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 139 | **-60.8** | ULS 5a Ba 10 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.7** | ULS 5a Ba 10 | 379.7 | 117.6 | 209.5 | 0.53 | | 0.53 |
| 215 | Tiende TSNSTK - Diaphragm horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 321 | **-2.3** | ULS 3_0 | 27.3 | 58.8 | 86.4 | 0.08 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.08 |
| 300 | Eerste DWSRM - CD under 1 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 146 | **-21.3** | ULS 5a Ba 11 | 106.2 | 58.8 | 86.4 | 0.36 | | **19.2** | ULS 5a Ah 11 | 179.7 | 58.8 | 69.8 | 0.33 | | 0.36 |
| 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 | | 0.45 |
| 302 | Eerste DWSRM - CD under 3 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 128 | **-32.9** | 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 | | 0.56 |
| 303 | Eerste DWSRM - CD under 4 | 100x100x8 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-27.5** | ULS 5a Ba 11 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 11 | 179.7 | 58.8 | 69.8 | 0.29 | | 0.47 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-14.3** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.27 | | **10.2** | ULS 1a_0_9_0_0 | 86.7 | 58.8 | 59.5 | 0.17 | | 0.27 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-11.2** | ULS 1a_0_9_0_9_0 | 59.5 | 58.8 | 75.6 | 0.19 | | **12.7** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.22 | | 0.22 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 21 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 21 | 86.7 | 58.8 | 59.5 | 0.21 | | 0.22 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 21 | 70.4 | 58.8 | 75.6 | 0.25 | | **16.5** | ULS 5a Ba 21 | 86.7 | 58.8 | 59.5 | 0.28 | | 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 21 | 61.4 | 58.8 | 64.8 | 0.30 | | **17.3** | ULS 5a Ah 21 | 65.7 | 58.8 | 44.4 | 0.39 | | 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 21 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.53 | | 0.53 |
| 310 | Eerste DWSRM - CD under 11 | 65x65x7 | S235 | 2M20-5.6t | 0.56 | 0.56 | 0.56 | 95 | **-32.0** | ULS 5a Ba 10 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 10 | 99.4 | 117.6 | 104.2 | 0.26 | | 0.28 |
| 311 | Eerste DWSRM - CD under 12 | 65x65x7 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 72 | **-36.3** | ULS 5a Ba 10 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 10 | 86.7 | 58.8 | 59.5 | 0.35 | | 0.62 |
| 312 | Eerste DWSRM - 1st & 2nd horiz under | HEB240 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-18.4** | ULS 5a Ah 11 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | ULS 5a Ba 20 | 2249.6 | 117.6 | 0.0 | 0.28 | | 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 21 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.6** | ULS 5a Ba 21 | 1626.6 | 117.6 | 0.0 | 0.27 | | 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 | | **70.7** | ULS 3_135 | 99.4 | 117.6 | 119.1 | 0.71 | | 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 | | **93.6** | ULS 3_0 | 99.4 | 117.6 | 119.1 | 0.94 | | 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 | | **34.2** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 | | 0.91 |
| 317 | Eerste DWSRM - front diag 4 | 60x60x6 | S235 | **1M16-8.8** | 1.00 | 1.00 | 1.00 | 338 | **0.0** | | 14.0 | 60.3 | 51.8 | 0.00 | | **38.0** | ULS 1a_0 | 72.6 | 60.3 | 38.4 | 0.99 | | 0.99 |
| 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 | | **37.0** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.98 | | 0.98 |
| 319 | Eerste DWSRM - front vert 1 | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-42.4** | ULS 3_0 | 91.7 | 58.8 | 86.4 | 0.72 | | **0.0** | | 179.7 | 58.8 | 69.8 | 0.00 | | 0.72 |
| 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 | | 0.61 |
| 321 | Eerste DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-14.0** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.59 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.59 |
| 322 | Eerste DWSRM - front vert 4 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 112 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **0.0** | | 44.9 | 37.7 | 26.5 | 0.00 | | 0.23 |
| 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 | | 0.10 |
| 324 | Eerste DWSRM - Doorsnede A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 306 | **-6.2** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.54 | | **3.8** | ULS 1a_0_9_0 | 37.4 | 37.7 | 22.0 | 0.17 | | 0.54 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.4** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.2** | ULS 1a_0_9_0 | 37.4 | 37.7 | 22.0 | 0.10 | | 0.11 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.4** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.24 | | **2.9** | ULS 1a_0_9_0_9_0 | 37.4 | 37.7 | 22.0 | 0.13 | | 0.24 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.9** | ULS 1a_0_9_0_9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.8** | ULS 1a_0_9_0_9_0 | 37.4 | 37.7 | 22.0 | 0.08 | | 0.08 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6 | 1.00 | 1.70 | 1.00 | 71 | **-488.1** | ULS 1a_135 | 1289.1 | 906.5 | 2799.4 | 0.54 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.54 |
| 110B | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 8M24-5.6t | 2.53 | 1.40 | 1.00 | 57 | **-337.9** | ULS 5a Ba 10 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.3** | ULS 5a Ah 10 | 1548.5 | 677.8 | 1595.1 | 0.01 | | 0.50 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-479.5** | ULS 1a_135 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.2** | ULS 5a Ah 10 | 1623.9 | 0.0 | 0.0 | 0.01 | | 0.37 |
| 111A | Eerste DWSRM - Main member bottom 1 | 160x160x15# | S235 | 8M24-5.6t | 3.53 | 6.36 | 1.00 | 72 | **-313.5** | ULS 5a Ba 10 | 869.0 | 677.8 | 1555.2 | 0.46 | | **31.9** | ULS 5a Ah 10 | 1008.5 | 677.8 | 1329.2 | 0.05 | | 0.46 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15# | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-196.0** | ULS 3_90 | 869.3 | 0.0 | 0.0 | 0.23 | | **0.0** | | 1097.7 | 0.0 | 0.0 | 0.00 | | 0.23 |
| 111C | Eerste DWSRM - Main member bottom 1 | 160x160x15# | S235 | | 1.80 | 1.00 | 1.00 | 72 | **-299.5** | ULS 5a Ba 10 | 869.1 | 0.0 | 0.0 | 0.34 | | **26.4** | ULS 5a Ah 10 | 1097.7 | 0.0 | 0.0 | 0.02 | | 0.34 |
| 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 | | **364.7** | ULS 3_90 | 422.8 | 504.1 | 796.6 | 0.86 | | 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 | | **261.7** | ULS 3_45 | 615.9 | 423.6 | 664.6 | 0.62 | | 0.62 |
| 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 | | **287.9** | ULS 3_90 | 705.0 | 0.0 | 0.0 | 0.41 | | 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 | | **235.1** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.57 | | 0.57 |
| 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 | | **200.5** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.69 | | 0.69 |
| 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 | | **200.1** | ULS 3_135 | 496.3 | 0.0 | 0.0 | 0.40 | | 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 | | 0.01 |
| 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 | | 0.00 |
| 114A | Negende TSNSTK - Main member | 250x250x22# | S235 | 14M30-5.6 | 0.52 | 0.52 | 0.52 | 35 | **-1726.4** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.92 | | **1247.1** | ULS 1a_0_9_0_45 | 2373.8 | 1885.0 | 4032.0 | 0.66 | | 0.92 |
| 114B | Negende TSNSTK - Main member | 250x250x22# | S235 | 18M30-5.6 | 0.52 | 0.52 | 0.52 | 36 | **-2171.4** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.92 | | **1654.5** | ULS 1a_0_9_0_45 | 2373.8 | 2423.5 | 4626.7 | 0.70 | | 0.92 |
| 114C | Negende TSNSTK - Main member | 250x250x22# | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-2168.4** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.91 | | **1658.2** | ULS 1a_0_9_0_45 | 2493.4 | 0.0 | 0.0 | 0.67 | | 0.91 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-248.5** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.92 | | **220.4** | ULS 1a_0_9_0_90 | 250.2 | 269.3 | 314.2 | 0.88 | | 0.92 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-177.7** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.66 | | **171.6** | ULS 1a_0_9_0 | 250.2 | 269.3 | 314.2 | 0.69 | | 0.69 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-226.4** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.84 | | **232.2** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.93 | | 0.93 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-180.3** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.67 | | **167.5** | ULS 1a_0_9_0_9_0 | 250.2 | 269.3 | 314.2 | 0.67 | | 0.67 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.3** | ULS 5a Ah 10 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 10 | 109.4 | 75.4 | 89.6 | 0.15 | | 0.32 |
| 219 | Negende TSNSTK - Diaphragm K CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 239 | **-0.3** | 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 | | 0.01 |
| 220L | Negende TSNSTK - Diaphragm K horiz fr | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-15.5** | ULS 1a_0_9_45 | 43.6 | 37.7 | 60.5 | 0.41 | | **15.4** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.41 | | 0.41 |
| 220T | Negende TSNSTK - Diaphragm K horiz si | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-12.4** | ULS 1a_0_9_0_9_135 | 43.6 | 37.7 | 60.5 | 0.33 | | **17.4** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.46 | | 0.46 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.6** | ULS 1a_0 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.9** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 | | 0.05 |
| 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_0_9_90 | 90.2 | 113.0 | 100.9 | 0.00 | | 0.01 |
| 223L | Negende TSNSTK - Diaphragm L horiz fr | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-18.4** | ULS 1a_0_9_0_9_45 | 49.1 | 37.7 | 60.5 | 0.49 | | **18.9** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.50 | | 0.50 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-18.2** | ULS 1a_0_9_0_9_45 | 49.1 | 37.7 | 60.5 | 0.48 | | **18.4** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.49 | | 0.49 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-239.9** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.89 | | **221.0** | ULS 1a_0_9_0_9_90 | 348.4 | 269.3 | 314.2 | 0.82 | | 0.89 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-180.8** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.67 | | **176.5** | ULS 1a_0_9_0 | 348.4 | 269.3 | 314.2 | 0.66 | | 0.67 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-25.7** | ULS 1a_0_9_0_9_45 | 55.7 | 37.7 | 60.5 | 0.68 | | **26.7** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.71 | | 0.71 |

DNV·GL

## Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**49**

| Group Label | Description | Profile | Steel Qual | Bolts | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling | ear (Comp) | aring (Comp) | U.C. (Comp) | ance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | g (Tens) | U.C. (Tens) | Exceedance (Tens) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-25.3** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.67 | | **27.3** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.72 | | 0.72 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-2.1** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.07 | | **4.9** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.07 | | 0.07 |
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | | 0.01 |
| 228L | Achtste TSNSTK - Diag fr 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-225.7** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.84 | | **219.4** | ULS 1a_0,9_90 | 347.2 | 269.3 | 261.8 | 0.84 | | 0.84 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-189.3** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.70 | | **172.9** | ULS 1a_0,9_0,9_135 | 347.2 | 269.3 | 261.8 | 0.66 | | 0.70 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-19.0** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.50 | | **17.7** | ULS 1a_45 | 142.8 | 37.7 | 51.2 | 0.47 | | 0.50 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-19.2** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.51 | | **17.8** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.47 | | 0.51 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-3.4** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.12 | | **6.8** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.09 | | 0.12 |
| 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 | | 0.01 |
| 115A | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2658.8** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.84 | | **2124.1** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.59 | | 0.84 |
| 115B | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | 28M30-5.6 | 0.52 | 0.52 | 1.05 | 47 | **-3072.6** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.97 | | **2500.2** | ULS 1a_0,9_0,9_45 | 3615.8 | 3628.5 | 6542.8 | 0.69 | | 0.97 |
| 115C | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-3068.7** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.97 | | **2504.6** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.70 | | 0.97 |
| 116A | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 28M30-5.6 | 0.25 | 0.25 | 0.74 | 60 | **-3356.6** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.93 | | **2779.3** | ULS 1a_0,9_0,9_45 | 4683.7 | 3628.5 | 7330.9 | 0.77 | | 0.93 |
| 116B | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6 | 0.50 | 0.50 | 1.60 | 60 | **-3722.5** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 1.00 | | **3034.6** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.74 | | 1.00 |
| 117A | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6 | 0.50 | 0.50 | **1.19** | 52 | **-3737.9** | ULS 1a_45 | 3917.4 | 4075.1 | 10368.0 | 0.95 | | **3015.4** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.74 | | 0.95 |
| 117B | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6 | 0.25 | 0.25 | **0.64** | 52 | **-3847.1** | ULS 1a_135 | 3918.8 | 4503.7 | 11664.0 | 0.98 | | **3111.8** | ULS 1a_0,9_0,9_45 | 4341.6 | 4503.7 | 9425.5 | 0.72 | | 0.98 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6 | 0.25 | 0.25 | **0.53** | 43 | **-3930.8** | ULS 1a_45 | 4105.5 | 4075.1 | 10368.0 | 0.96 | | **3188.7** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.78 | | 0.96 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6 | 0.50 | 0.50 | **1.15** | 44 | **-4014.8** | ULS 1a_45 | 4100.5 | 4075.1 | 10368.0 | 0.99 | | **3185.9** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.78 | | 0.99 |
| 119A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6 | 0.50 | 0.50 | **1.00** | 44 | **-4028.0** | ULS 1a_45 | 4094.5 | 4075.1 | 10368.0 | 0.99 | | **3167.7** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.78 | | 0.99 |
| 119B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6 | 0.50 | 0.50 | **1.15** | 44 | **-3987.7** | ULS 1a_45 | 4091.3 | 4075.1 | 10368.0 | 0.98 | | **3119.1** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.77 | | 0.98 |
| 120A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6 | 0.50 | 0.50 | **1.03** | 45 | **-3998.8** | ULS 1a_45 | 4075.4 | 4075.1 | 10368.0 | 0.98 | | **3112.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.76 | | 0.98 |
| 120B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6 | 0.50 | 0.50 | **1.12** | 43 | **-4086.8** | ULS 1a_45 | 4103.3 | 4503.7 | 11664.0 | 1.00 | | **3167.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 0.70 | | 1.00 |
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6 | 0.50 | 0.50 | 1.55 | 65 | **-4131.1** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.76 | | **3161.5** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.55 | | 0.76 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6 | 0.50 | 0.50 | 1.55 | 65 | **-4081.1** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.75 | | **3023.8** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.53 | | 0.75 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6 | 0.33 | 0.33 | 0.85 | 65 | **-4118.4** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.76 | | **2982.4** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.52 | | 0.76 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6 | 0.33 | 0.33 | 0.85 | 66 | **-4145.7** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.76 | | **2961.7** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.52 | | 0.76 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz fr | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz si | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz in | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | **1M30-8.8l** | 0.55 | 0.27 | 0.27 | 127 | **-151.2** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 0.93 | | **108.1** | ULS 1a_0,9_0,9_45 | 193.0 | 215.4 | 130.9 | 0.83 | | 0.93 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | **1M30-8.8l** | 0.55 | 0.27 | 0.27 | 127 | **-134.9** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 0.83 | | **102.3** | ULS 1a_0,9_0,9_45 | 193.0 | 215.4 | 130.9 | 0.78 | | 0.83 |
| 236L | Zevende TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 135 | **-71.8** | ULS 1a_0,9_0,9_45 | 197.0 | 169.4 | 259.2 | 0.42 | | **99.3** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.59 | | 0.59 |
| 236T | Zevende TSNSTK - Diag si 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 137 | **-66.9** | ULS 1a_0,9_0,9_45 | 194.1 | 169.4 | 259.2 | 0.40 | | **87.4** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.52 | | 0.52 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz fr | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-36.1** | ULS 1a_0,9_0,9_45 | 87.9 | 58.8 | 86.4 | 0.61 | | **32.5** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.55 | | 0.61 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz si | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-35.9** | ULS 1a_0,9_0,9_135 | 87.9 | 58.8 | 86.4 | 0.61 | | **32.1** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.55 | | 0.61 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-7.3** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.29 | | **15.9** | ULS 1a_0,9_45 | 133.6 | 58.8 | 69.8 | 0.27 | | 0.29 |
| 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 | | 0.03 |
| 240L | Zesde TSNSTK - Diag fr 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-112.4** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.84 | | **117.3** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.90 | | 0.90 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 138 | **-106.2** | ULS 1a_45 | 159.4 | 134.6 | 162.0 | 0.79 | | **105.9** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.81 | | 0.81 |
| 241L | Zesde TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-121.6** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.90 | | **108.4** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.83 | | 0.90 |
| 241T | Zesde TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-112.0** | ULS 1a_0,9_45 | 145.1 | 134.6 | 162.0 | 0.83 | | **102.5** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.78 | | 0.83 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | **1M24-8.8l** | 0.55 | 0.27 | 0.27 | 176 | **-97.4** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 0.99 | | **50.9** | ULS 1a_0,9_0,9_45 | 184.3 | 135.6 | 110.8 | 0.46 | | 0.99 |
| 242T | Vijfde TSNSTK - CD 1 side | **130x130x11** | **S355** | **1M24-8.8l** | 0.55 | 0.27 | 0.27 | 172 | **-106.0** | ULS 1a_135 | 143.3 | 271.1 | 194.0 | 0.74 | | **56.8** | ULS 1a_0,9_0,9_45 | 276.0 | 271.1 | 165.8 | 0.34 | | 0.74 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.0** | ULS 5a Ah 10 | 106.8 | 84.7 | 129.6 | 0.34 | | **57.9** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.68 | | 0.68 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-33.0** | ULS 1a_0,9_0,9_135 | 106.8 | 84.7 | 129.6 | 0.39 | | **64.1** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.76 | | 0.76 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-43.1** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.5** | ULS 5a Ah 21 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.51 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-39.4** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.47 | | **37.9** | ULS 1a_0,9_90 | 184.3 | 84.7 | 110.8 | 0.45 | | 0.47 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-43.3** | ULS 1a_45 | 77.2 | 84.7 | 129.6 | 0.56 | | **34.2** | ULS 1a_0,9_0,9_135 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.56 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-47.2** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.61 | | **35.5** | ULS 1a_0,9_0,9_90 | 184.3 | 84.7 | 110.8 | 0.42 | | 0.61 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-27.2** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.46 | | **24.5** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.42 | | 0.46 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-27.3** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.46 | | **24.4** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.42 | | 0.46 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-8.3** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.36 | | **14.9** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.25 | | 0.36 |
| 257 | Vierde TSNSTK - Doorsnede B-B CD | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 464 | **-0.7** | ULS 7 | 13.1 | 58.8 | 86.4 | 0.05 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.05 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-30.4** | ULS 1a_0,9_0,9_135 | 80.2 | 84.7 | 129.6 | 0.38 | | **34.9** | ULS 1a_45 | 184.3 | 84.7 | 110.8 | 0.41 | | 0.41 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-28.3** | ULS 1a_0,9_0,9_45 | 80.2 | 84.7 | 129.6 | 0.35 | | **34.5** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.41 | | 0.41 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-83.8** | ULS 1a_135 | 897.2 | 538.6 | 1425.6 | 0.16 | | **49.5** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.09 | | 0.16 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-83.4** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.15 | | **49.5** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.09 | | 0.15 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-64.4** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.38 | | **28.8** | ULS 1a_0,9_90 | 760.6 | 169.4 | 354.5 | 0.17 | | 0.38 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-53.5** | ULS 1a_135 | 361.1 | 169.4 | 414.7 | 0.32 | | **21.7** | ULS 1a_0,9_45 | 760.6 | 169.4 | 354.5 | 0.13 | | 0.32 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-47.4** | ULS 1a_0,9_135 | 361.1 | 169.4 | 414.7 | 0.28 | | **70.3** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.41 | | 0.41 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-50.0** | ULS 1a_0,9_45 | 361.1 | 169.4 | 414.7 | 0.29 | | **72.4** | ULS 1a_135 | 692.4 | 169.4 | 354.5 | 0.43 | | 0.43 |
| 255L | Broekstuk - Horizontal front | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-37.5** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.22 | | **19.8** | ULS 1a_0,9_135 | 692.4 | 169.4 | 354.5 | 0.12 | | 0.22 |
| 255T | Broekstuk - Horizontal side | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-37.6** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.22 | | **19.9** | ULS 1a_0,9_45 | 692.4 | 169.4 | 354.5 | 0.12 | | 0.22 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-58.2** | ULS 1a_45 | 290.1 | 169.4 | 259.2 | 0.34 | | **28.9** | ULS 1a_0,9_0,9_135 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.34 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-64.1** | ULS 5a Ba 22 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.6** | ULS 5a Ba 22 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.38 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-11.1** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.25 | | **13.4** | ULS 1a_0,9_135 | 347.3 | 176.4 | 222.5 | 0.08 | | 0.25 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.2 | 117.6 | 172.8 | 0.04 | | **0.0** | | 277.0 | 117.6 | 139.6 | 0.00 | | 0.04 |
| 263 | Broekstuk - Diag D-D | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 403 | **-14.0** | ULS 1a_45 | 20.7 | 58.8 | 86.4 | 0.68 | | **11.9** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.20 | | 0.68 |
| 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 | | 0.21 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 232 | **0.0** | | 117.3 | 0.0 | 0.0 | 0.00 | | **131.8** | ULS 3_90 | 599.7 | 0.0 | 0.0 | 0.22 | | 0.22 |

**Notes:**
**1) Groups 200L, 419 and 442 failed under net section capacity and were strengthened by placing a plate over the joint. Refer to Appendix D for the calculations and explanation.**
**2) Group 242T failed under shear at the afkeur level. A plate was used to place the bolt in double shear.**

DNV·GL

# Assessment of groups for strengthened mast (verbouw level)

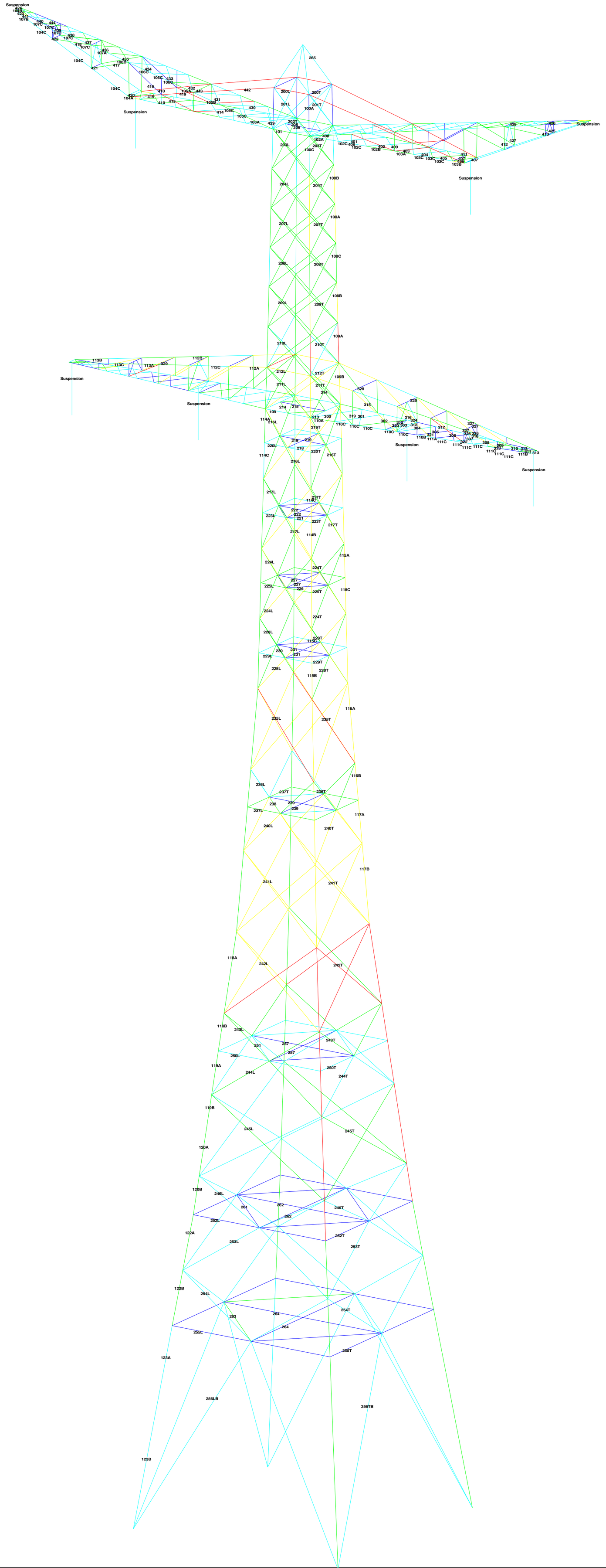
Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**49**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | mpression | Load Case (Compres | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | Notes | Tension | Load Case (Tension) | Net Section | hear (Tens) | earing (Tens) | U.C. (Tens) | Notes2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 414 | Tweede DWSRM - fr | **90x90x9** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 266 | **-38.0** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.76 | | **0.0** | | 148.2 | 60.3 | 78.4 | 0.00 | |
| 415 | Tweede DWSRM - fr | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 243 | **-43.9** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.95 | | **0.0** | | 131.7 | 60.3 | 69.7 | 0.00 | |
| 109A | Tiende TSNSTK - M | 200x200x20 | S235 | **8M30-8.8t** | 0.52 | 0.52 | 0.52 | 52 | **-1531.5** | ULS 1a_45 | 1590.7 | 1723.4 | 2592.0 | 0.96 | | **1230.6** | ULS 1a_0,9_0,9_45 | 1638.1 | 1723.4 | 2094.5 | 0.75 | |
| 212T | Tiende TSNSTK - up | **100x100x12** | **S355** | **2M20-8.8t** | 1.00 | 1.00 | 1.00 | 247 | **-84.7** | ULS 1a_90 | 103.5 | 188.2 | 352.8 | 0.82 | | **63.4** | ULS 1a_0,9_0,9_90 | 550.4 | 188.2 | 285.1 | 0.34 | |
| 317 | Eerste DWSRM - fro | 60x60x6 | S235 | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 338 | **0.0** | | 14.0 | 60.3 | 51.8 | 0.00 | | **43.5** | ULS 1a_0 | 72.6 | 60.3 | 38.4 | 1.13 | (2) |
| 117A | Zesde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.19** | 52 | **-5037.8** | ULS 1a_45 | 3917.4 | 4075.1 | 10368.0 | 1.29 | (3) | **4260.4** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.05 | |
| 117B | Zesde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 36M30-5.6t | 0.25 | 0.25 | **0.64** | 52 | **-5182.7** | ULS 1a_135 | 3918.8 | 4503.7 | 11664.0 | 1.32 | (3) | **4396.2** | ULS 1a_0,9_0,9_45 | 4341.6 | 4503.7 | 9425.5 | 1.01 | |
| 118A | Vijfde TSNSTK - Mai | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.25 | 0.25 | **0.53** | 43 | **-5296.2** | ULS 1a_45 | 4105.5 | 4075.1 | 10368.0 | 1.30 | (3) | **4502.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.11 | |
| 118B | Vijfde TSNSTK - Mai | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.15** | 44 | **-5397.6** | ULS 1a_45 | 4100.5 | 4075.1 | 10368.0 | 1.32 | (3) | **4514.7** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.11 | |
| 119A | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.00** | 44 | **-5411.8** | ULS 1a_45 | 4094.5 | 4075.1 | 10368.0 | 1.33 | (3) | **4494.4** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.10 | |
| 119B | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.15** | 44 | **-5350.0** | ULS 1a_45 | 4091.3 | 4075.1 | 10368.0 | 1.31 | (3) | **4432.6** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 1.09 | |
| 120A | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.03** | 45 | **-5362.4** | ULS 1a_45 | 4075.4 | 4075.1 | 10368.0 | 1.32 | (3) | **4426.0** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.09 | |
| 120B | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 36M30-5.6t | 0.50 | 0.50 | **1.12** | 43 | **-5479.5** | ULS 1a_45 | 4103.3 | 4503.7 | 11664.0 | 1.34 | (3) | **4506.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 1.00 | |
| 235L | Zevende TSNSTK - ( | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-204.0** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 1.26 | (1) | **153.5** | ULS 1a_0,9_0,9_45 | 193.0 | 215.4 | 130.9 | 1.17 | |
| 235T | Zevende TSNSTK - ( | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-182.2** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 1.12 | (1) | **144.6** | ULS 1a_0,9_0,9_45 | 193.0 | 215.4 | 130.9 | 1.10 | |
| 242L | Vijfde TSNSTK - CD | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-131.5** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 1.34 | (1) | **74.0** | ULS 1a_0,9_0,9_45 | 184.3 | 135.6 | 110.8 | 0.67 | |
| 242T | Vijfde TSNSTK - CD | **130x130x11** | **S355** | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 172 | **-143.0** | ULS 1a_135 | 143.3 | 271.1 | 194.0 | 1.00 | | **82.3** | ULS 1a_0,9_0,9_45 | 276.0 | 271.1 | 165.8 | 0.50 | |

**Notes:**
**1) Groups 235L/T and 242L exhibit failure in buckling at the verbouw level which is not relevant since the failure at the afkeur level was due to shear.**
**2) Group 317 exhibits rupture failure at the verbouw level which is not relevant since the failure at the afkeur level was due to shear.**
**3) Groups 117A/B, 118A/B, 119A/B, 120A/B exhibit failure under buckling at both the afkeur and verbouw level. This is not a cause for concern as additional redundant members were added to fulfil the afkeur loads. In this case fulfilling the verbouw loads is not necessary.**
**4) Groups 200L, 419 and 442 which failed under net section at the afkeur level are not listed in this table. A separate calculation is provided in Appendix D which illustrates the capacity of the member and the plate used for strengthening.**

DNV GL Nederlands BV, Project: "S+75 (hv) int"
Tower Version 16.62, 11-22:58 maandag 22 februari 2021
Undeformed geometry displayed



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# Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**50**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-121.1** | ULS 5a Ah 22 | 550.6 | 508.3 | 777.6 | 0.24 | | **0.0** | | 624.7 | 508.3 | 664.6 | 0.00 | | 0.24 |
| 100B | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 67 | **-432.1** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.85 | | **209.4** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.41 | | 0.85 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-255.8** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.45 | | **76.8** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.11 | | 0.45 |
| 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 | | **425.3** | ULS 3_45 | 346.4 | 506.7 | 677.1 | 1.23 | nettodsn. | 1.23 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-5.7** | ULS 1a_0,9_90 | 190.2 | 117.6 | 237.6 | 0.05 | | **5.4** | ULS 1a_90 | 360.5 | 117.6 | 237.6 | 0.05 | | 0.05 |
| 201L | BVNSTK - CD 1 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-34.6** | ULS 5a Ah 22 | 263.5 | 169.4 | 285.1 | 0.20 | | **58.8** | ULS 1a_45 | 306.2 | 169.4 | 243.7 | 0.35 | | 0.35 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-38.9** | ULS 1a_45 | 159.5 | 84.7 | 142.6 | 0.46 | | **0.0** | | 297.8 | 84.7 | 121.8 | 0.00 | | 0.46 |
| 101 | BVNSTK - lower horiz lower CA front | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 2.00 | 1.00 | 65 | **-682.7** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.64 | | **0.0** | | 1548.5 | 1066.2 | 2623.9 | 0.00 | | 0.64 |
| 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 | | **77.5** | ULS 5a Ah 22 | 310.5 | 235.2 | 279.3 | 0.33 | | 0.33 |
| 203L | BVNSTK - CD 2 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-99.8** | ULS 1a_90 | 265.5 | 169.4 | 285.1 | 0.59 | | **65.6** | ULS 5a Ah 22 | 291.2 | 169.4 | 229.3 | 0.39 | | 0.59 |
| 203T | BVNSTK - CD 2 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-90.4** | ULS 5a Ba 12 | 265.5 | 169.4 | 285.1 | 0.53 | | **101.4** | ULS 5a Ah 22 | 291.2 | 169.4 | 229.3 | 0.60 | | 0.60 |
| 204L | BVNSTK - CD 3 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-63.9** | ULS 1a_0,9_0,9_90 | 260.7 | 169.4 | 285.1 | 0.38 | | **98.0** | ULS 1a_90 | 291.2 | 169.4 | 229.3 | 0.58 | | 0.58 |
| 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 | | **86.8** | ULS 5a Ba 12 | 291.2 | 169.4 | 229.3 | 0.51 | | 0.57 |
| 205 | BVNSTK - Diaphragm diagonal | 110x110x10 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-54.8** | ULS 5a Ah 12 | 205.7 | 117.6 | 216.0 | 0.47 | | **56.3** | ULS 5a Ba 22 | 262.5 | 117.6 | 174.5 | 0.48 | | 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 | | 0.07 |
| 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 | | 0.31 |
| 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 | | 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 22 | 84.2 | 58.8 | 86.4 | 0.41 | | **21.4** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.36 | | 0.41 |
| 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 | | 0.39 |
| 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 | | 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 | | 0.65 |
| 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 | | 0.65 |
| 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 | | **42.1** | ULS 5a Ba 12 | 1626.6 | 117.6 | 0.0 | 0.36 | | 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 | | **6.1** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.28 | | 0.28 |
| 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 | | 0.68 |
| 410 | Tweede DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 171 | **-6.2** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.20 | | **8.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.41 | | 0.41 |
| 411 | Tweede DWSRM - front vert 4 | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 287 | **-13.1** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.72 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.72 |
| 412 | Tweede DWSRM - front vert 5 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 231 | **-11.7** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.66 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.66 |
| 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 | | 0.20 |
| 102A | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 1.46 | 1.00 | 80 | **-489.7** | ULS 5a Ba 12 | 1211.0 | 1066.2 | 3265.9 | 0.46 | | **0.0** | | 1548.5 | 1066.2 | 2791.4 | 0.00 | | 0.46 |
| 102B | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 8M24-5.6t | 1.00 | 1.53 | 1.00 | 77 | **-467.3** | ULS 3_135 | 1237.8 | 677.8 | 1866.2 | 0.69 | | **0.0** | | 1548.5 | 677.8 | 1595.1 | 0.00 | | 0.69 |
| 102C | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | | 1.89 | 2.89 | 1.00 | 75 | **-474.3** | ULS 3_0 | 1257.1 | 0.0 | 0.0 | 0.38 | | **0.0** | | 1623.9 | 0.0 | 0.0 | 0.00 | | 0.38 |
| 103A | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 8M24-5.6t | 1.00 | 1.82 | 1.00 | 67 | **-451.5** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.67 | | **0.0** | | 1220.3 | 677.8 | 1417.8 | 0.00 | | 0.67 |
| 103B | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 7M24-5.6t | 3.10 | 1.00 | 1.00 | 68 | **-435.4** | ULS 3_90 | 1055.4 | 574.5 | 1451.5 | 0.76 | | **0.0** | | 828.7 | 574.5 | 1343.7 | 0.00 | | 0.76 |
| 103C | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | | 5.59 | ### | 1.00 | 68 | **-452.3** | ULS 3_135 | 1055.8 | 0.0 | 0.0 | 0.43 | | **0.0** | | 1301.9 | 0.0 | 0.0 | 0.00 | | 0.43 |
| 414 | Tweede DWSRM - front diag 1 | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **-29.9** | ULS 1a_0 | 18.6 | 37.7 | 60.5 | 1.61 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.61 |
| 415 | Tweede DWSRM - front diag 2 | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 301 | **-37.2** | ULS 7 | 21.4 | 37.7 | 60.5 | 1.74 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.74 |
| 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 | | 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 | | **21.7** | ULS 1a_45 | 84.7 | 37.7 | 44.8 | 0.57 | | 0.57 |
| 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 | | **27.7** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.74 | | 0.74 |
| 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 | | **406.4** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 1.17 | nettodsn. | 1.17 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-16.1** | ULS 1a_0,9_90 | 35.4 | 37.7 | 51.8 | 0.46 | | **5.5** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 41.4 | 0.15 | | 0.46 |
| 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 | 0.01 | | 0.01 |
| 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_45 | 44.9 | 37.7 | 34.4 | 0.02 | | 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 | | **1.5** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 31.7 | 0.05 | | 0.05 |
| 104A | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | ### | 1.00 | 103 | **-105.1** | ULS 3_45 | 413.3 | 169.4 | 259.2 | 0.62 | | **0.0** | | 343.1 | 169.4 | 208.5 | 0.00 | | 0.62 |
| 104B | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | 9.78 | 1.00 | 102 | **-70.6** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.42 | | **0.0** | | 431.8 | 169.4 | 221.5 | 0.00 | | 0.42 |
| 104C | Tweede DWSRM - main member raised | 150x150x10 | S235 | | 1.00 | 1.01 | 1.00 | 152 | **-104.2** | ULS 3_45 | 221.6 | 0.0 | 0.0 | 0.47 | | **0.0** | | 688.6 | 0.0 | 0.0 | 0.00 | | 0.47 |
| 424 | Tweede DWSRM - horiz at end of raised | HEB160 | S235 | 2M16-5.6t | 2.00 | 2.00 | 2.00 | 22 | **-8.8** | ULS 5a Ba 1 | 1077.2 | 75.4 | 138.2 | 0.12 | | **6.3** | ULS 5a Ah 1 | 1296.6 | 75.4 | 11.9 | 0.53 | | 0.53 |
| 425 | Tweede DWSRM - raised DS A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 132 | **-4.4** | ULS 1a_135 | 37.2 | 37.7 | 43.2 | 0.12 | | **2.5** | ULS 1a_0,9_135 | 37.4 | 37.7 | 22.0 | 0.11 | | 0.12 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.2** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | | **1.3** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.06 | | 0.06 |
| 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 | | 0.26 |
| 428 | Tweede DWSRM - raised DS B-B horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 120 | **-5.1** | ULS 1a_45 | 43.6 | 37.7 | 43.2 | 0.13 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.13 |
| 429 | Tweede DWSRM - CD top 1 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 208 | **-15.8** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.42 | | **18.2** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.48 | | 0.48 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-17.5** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.46 | | **15.1** | ULS 1a_0,9_0,9_0 | 84.7 | 37.7 | 44.8 | 0.40 | | 0.46 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-14.8** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.39 | | **17.2** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.46 | | 0.46 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-14.2** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.38 | | **17.2** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.51 | | 0.51 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-16.2** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.43 | | **12.9** | ULS 1a_0,9_0,9_0 | 55.3 | 37.7 | 33.6 | 0.38 | | 0.43 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-12.6** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.33 | | **16.7** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.50 | | 0.50 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-17.5** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.69 | | **12.6** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.57 | | 0.69 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-11.0** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.34 | | **16.2** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.73 | | 0.73 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-11.1** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.34 | | **14.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.68 | | 0.68 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-13.9** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.37 | | **10.0** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.45 | | 0.45 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-8.8** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.23 | | **13.4** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.61 | | 0.61 |
| 440 | Tweede DWSRM - CD top 11 | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-11.7** | ULS 5a Ba 1 | 42.8 | 37.7 | 43.2 | 0.31 | | **8.6** | ULS 5a Ah 1 | 37.4 | 37.7 | 22.0 | 0.39 | | 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 1 | 47.4 | 37.7 | 43.2 | 0.27 | | **14.3** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.65 | | 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 | | **461.4** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 1.33 | nettodsn. | 1.33 |
| 443 | Tweede DWSRM - diag top "CD" | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 260 | **-12.9** | ULS 3_90 | 21.3 | 37.7 | 51.8 | 0.61 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.61 |
| 105A | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.00 | 1.47 | 1.00 | 124 | **-211.2** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.68 | | **210.4** | ULS 1a_0,9_0 | 410.9 | 506.7 | 738.6 | 0.51 | | 0.68 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-150.2** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.49 | | **196.7** | ULS 1a_0 | 615.9 | 508.3 | 797.5 | 0.39 | | 0.49 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-187.9** | ULS 1a_0 | 312.3 | 0.0 | 0.0 | 0.60 | | **219.7** | ULS 1a_0 | 705.0 | 0.0 | 0.0 | 0.31 | | 0.60 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-86.2** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.46 | | **231.0** | ULS 1a_0 | 362.9 | 593.0 | 775.4 | 0.64 | | 0.64 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-32.4** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.21 | | **153.2** | ULS 1a_45 | 362.9 | 338.9 | 443.1 | 0.45 | | 0.45 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-64.8** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.35 | | **213.6** | ULS 1a_0 | 451.2 | 0.0 | 0.0 | 0.47 | | 0.47 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-15.9** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.16 | | **130.7** | ULS 1a_45 | 228.6 | 235.2 | 302.4 | 0.57 | | 0.57 |
| 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 | | **65.4** | ULS 1a_45 | 196.1 | 75.4 | 121.0 | 0.87 | | 0.87 |
| 107C | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | | 2.17 | 1.00 | 1.00 | 142 | **-19.2** | ULS 5a Ah 1 | 100.0 | 0.0 | 0.0 | 0.19 | | **85.6** | ULS 1a_45 | 279.7 | 0.0 | 0.0 | 0.31 | | 0.31 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.1** | ULS 5a Ah 1 | 37.3 | 37.7 | 43.2 | 0.22 | | **11.2** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.51 | | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16 | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-575.4** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.85 | | **367.7** | ULS 1a_0,9_0,9_45 | 1220.3 | 677.8 | 1417.8 | 0.54 | | 0.85 |
| 108B | Elfde TSNSTK - Main member | 180x180x16 | S235 | 12M24-5.6t | 0.51 | 0.51 | 0.51 | 56 | **-895.8** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.90 | | **674.1** | ULS 1a_0,9_0,9_45 | 1220.3 | 999.7 | 2126.8 | 0.67 | | 0.90 |
| 108C | Elfde TSNSTK - Main member | 180x180x16 | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-751.9** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.66 | | **505.5** | ULS 1a_0,9_0,9_45 | 1301.9 | 0.0 | 0.0 | 0.39 | | 0.66 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-100.7** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.59 | | **67.8** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.40 | | 0.59 |
| 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 | | 0.54 |
| 208L | Elfde TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-68.2** | ULS 1a_0,9_0,9_90 | 251.2 | 169.4 | 285.1 | 0.40 | | **100.5** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.59 | | 0.59 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.3** | ULS 5a Ah 12 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.6** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.52 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-103.8** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.61 | | **67.9** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.40 | | 0.61 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-77.0** | ULS 5a Ba 12 | 243.6 | 169.4 | 285.1 | 0.45 | | **85.7** | ULS 5a Ah 12 | 306.2 | 169.4 | 236.8 | 0.51 | | 0.51 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | 8M30-5.6t | 0.52 | 0.52 | 0.52 | 52 | **-1084.0** | ULS 1a_45 | 1590.7 | 1077.1 | 2592.0 | 1.01 | afschuiving | **807.2** | ULS 1a_0,9_0,9_45 | 1638.1 | 1077.1 | 2094.5 | 0.75 | | 1.01 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6t | 0.52 | 0.52 | 0.52 | 53 | **-1264.8** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.80 | | **834.3** | ULS 1a_0,9_0,9_45 | 1638.1 | 1588.8 | 3194.2 | 0.53 | | 0.80 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-69.1** | ULS 1a_0,9_0,9_90 | 238.9 | 169.4 | 285.1 | 0.41 | | **108.0** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.64 | | 0.64 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**50**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-83.9** | ULS 1a_0 | 238.9 | 169.4 | 285.1 | 0.50 | | **74.3** | ULS 1a_0,9_0,9_0 | 306.2 | 169.4 | 236.8 | 0.44 | | 0.50 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-115.6** | ULS 1a_0,9_0,9_45 | 230.6 | 169.4 | 285.1 | 0.68 | | **137.9** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.81 | | 0.81 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-125.2** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.74 | | **85.3** | ULS 1a_0,9_0,9_45 | 306.2 | 169.4 | 236.8 | 0.50 | | 0.74 |
| 212L | Tiende TSNSTK - upper horiz lower CA fi | 150x150x10 | S235 | 7M24-5.6t | 1.00 | 1.00 | 1.00 | 162 | **0.0** | | 222.3 | 578.2 | 907.2 | 0.00 | | **384.8** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.92 | | 0.92 |
| 212T | Tiende TSNSTK - upper horiz lower CA s | 80x80x8 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 308 | **-51.8** | ULS 1a_90 | 36.4 | 117.6 | 172.8 | 1.42 | knik | **34.4** | ULS 1a_0,9_0,9_90 | 212.5 | 117.6 | 139.6 | 0.29 | | 1.42 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 2.00 | 1.00 | 82 | **-431.3** | ULS 5a Ba 20 | 1194.7 | 906.5 | 2799.4 | 0.48 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.48 |
| 213 | Tiende TSNSTK - lower horiz lower CA si | 110x110x10 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 148 | **-8.9** | ULS 5a Ah 10 | 168.8 | 235.2 | 432.0 | 0.05 | | **87.5** | ULS 5a Ah 20 | 433.4 | 235.2 | 349.1 | 0.37 | | 0.37 |
| 214 | Tiende TSNSTK - Diaphragm diagonal | 130x130x12 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 139 | **-60.8** | ULS 5a Ba 20 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.7** | ULS 5a Ba 20 | 379.7 | 117.6 | 209.5 | 0.53 | | 0.53 |
| 215 | Tiende TSNSTK - Diaphragm horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 321 | **-2.3** | ULS 3_135 | 27.3 | 58.8 | 86.4 | 0.09 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.09 |
| 300 | Eerste DWSRM - CD under 1 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 146 | **-21.2** | ULS 5a Ba 11 | 106.2 | 58.8 | 86.4 | 0.36 | | **19.3** | ULS 5a Ba 21 | 179.7 | 58.8 | 69.8 | 0.33 | | 0.36 |
| 301 | Eerste DWSRM - CD under 2 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 136 | **-21.0** | ULS 5a Ah 21 | 116.1 | 58.8 | 86.4 | 0.36 | | **26.5** | ULS 5a Ba 11 | 179.7 | 58.8 | 69.8 | 0.45 | | 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 21 | 123.5 | 58.8 | 86.4 | 0.56 | | **22.6** | ULS 5a Ah 21 | 179.7 | 58.8 | 69.8 | 0.39 | | 0.56 |
| 303 | Eerste DWSRM - CD under 4 | 100x100x8 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-27.5** | ULS 5a Ba 11 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 21 | 179.7 | 58.8 | 69.8 | 0.29 | | 0.47 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-14.0** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.27 | | **9.9** | ULS 1a_0,9_0,9_0 | 86.7 | 58.8 | 59.5 | 0.17 | | 0.27 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.9** | ULS 1a_0,9_0,9_0 | 59.5 | 58.8 | 75.6 | 0.19 | | **12.4** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.21 | | 0.21 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 10 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.21 | | 0.22 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 20 | 70.4 | 58.8 | 75.6 | 0.25 | | **16.5** | ULS 5a Ba 10 | 86.7 | 58.8 | 59.5 | 0.28 | | 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 20 | 65.7 | 58.8 | 44.4 | 0.39 | | 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 20 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.53 | | 0.53 |
| 310 | Eerste DWSRM - CD under 11 | 65x65x7 | S235 | 2M20-5.6t | 0.56 | 0.56 | 0.56 | 95 | **-32.0** | ULS 5a Ba 10 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 20 | 99.4 | 117.6 | 104.2 | 0.26 | | 0.28 |
| 311 | Eerste DWSRM - CD under 12 | 65x65x7 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 72 | **-36.3** | ULS 5a Ba 10 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.35 | | 0.62 |
| 312 | Eerste DWSRM - 1st & 2nd horiz under | HEB240 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-18.5** | ULS 5a Ba 21 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | ULS 5a Ba 11 | 2249.6 | 117.6 | 0.0 | 0.28 | | 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 20 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.6** | ULS 5a Ba 20 | 1626.6 | 117.6 | 0.0 | 0.27 | | 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 | | **70.6** | ULS 3_135 | 99.4 | 117.6 | 119.1 | 0.71 | | 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 | | **93.5** | ULS 3_0 | 99.4 | 117.6 | 119.1 | 0.94 | | 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 | | **34.3** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 | | 0.91 |
| 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 | | **37.9** | ULS 1a_0 | 72.6 | 37.7 | 38.4 | 1.01 | afschuiving | 1.01 |
| 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 | | **37.0** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.98 | | 0.98 |
| 319 | Eerste DWSRM - front vert 1 | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-42.4** | ULS 3_0 | 91.7 | 58.8 | 86.4 | 0.72 | | **0.0** | | 179.7 | 58.8 | 69.8 | 0.00 | | 0.72 |
| 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 | | 0.61 |
| 321 | Eerste DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-14.0** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.58 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.58 |
| 322 | Eerste DWSRM - front vert 4 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 112 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **0.0** | | 44.9 | 37.7 | 26.5 | 0.00 | | 0.23 |
| 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 | | 0.10 |
| 324 | Eerste DWSRM - Doorsnede A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 306 | **-6.1** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.53 | | **3.7** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.17 | | 0.53 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.3** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.2** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.10 | | 0.11 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.3** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.24 | | **2.7** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.12 | | 0.24 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.9** | ULS 1a_0,9_0,9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.7** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.08 | | 0.08 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 1.70 | 1.00 | 71 | **-484.8** | ULS 1a_135 | 1289.1 | 906.5 | 2799.4 | 0.53 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.53 |
| 110B | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 8M24-5.6t | 2.53 | 1.40 | 1.00 | 57 | **-337.9** | ULS 5a Ba 10 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.3** | ULS 5a Ah 20 | 1548.5 | 677.8 | 1595.1 | 0.01 | | 0.50 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-476.3** | ULS 5a Ba 20 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.2** | ULS 5a Ah 20 | 1623.9 | 0.0 | 0.0 | 0.01 | | 0.37 |
| 111A | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | 8M24-5.6t | 3.53 | 6.36 | 1.00 | 72 | **-313.5** | ULS 5a Ba 10 | 869.0 | 677.8 | 1555.2 | 0.46 | | **31.9** | ULS 5a Ah 20 | 1008.5 | 677.8 | 1329.2 | 0.05 | | 0.46 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-195.6** | ULS 3_90 | 869.3 | 0.0 | 0.0 | 0.23 | | **0.0** | | 1097.7 | 0.0 | 0.0 | 0.00 | | 0.23 |
| 111C | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 1.80 | 1.00 | 1.00 | 72 | **-299.5** | ULS 5a Ba 10 | 869.1 | 0.0 | 0.0 | 0.34 | | **26.4** | ULS 5a Ah 20 | 1097.7 | 0.0 | 0.0 | 0.02 | | 0.34 |
| 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 | | **364.5** | ULS 3_90 | 422.8 | 504.1 | 796.6 | 0.86 | | 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 | | **261.6** | ULS 3_135 | 615.9 | 423.6 | 664.6 | 0.62 | | 0.62 |
| 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 | | **287.7** | ULS 3_90 | 705.0 | 0.0 | 0.0 | 0.41 | | 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 | | **234.9** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.57 | | 0.57 |
| 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 | | **200.3** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.69 | | 0.69 |
| 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 | | **200.0** | ULS 3_135 | 496.3 | 0.0 | 0.0 | 0.40 | | 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 | | 0.02 |
| 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 | | 0.00 |
| 114A | Negende TSNSTK - Main member | 250x250x22 | S235 | 14M30-5.6t | 0.52 | 0.52 | 0.52 | 35 | **-1644.8** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.87 | | **1171.2** | ULS 1a_0,9_0,9_45 | 2373.8 | 1885.0 | 4032.0 | 0.62 | | 0.87 |
| 114B | Negende TSNSTK - Main member | 250x250x22 | S235 | 18M30-5.6t | 0.52 | 0.52 | 0.52 | 36 | **-2075.8** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.88 | | **1563.2** | ULS 1a_0,9_0,9_45 | 2373.8 | 2423.5 | 4626.7 | 0.66 | | 0.88 |
| 114C | Negende TSNSTK - Main member | 250x250x22 | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-2072.8** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.87 | | **1566.8** | ULS 1a_0,9_0,9_45 | 2493.4 | 0.0 | 0.0 | 0.63 | | 0.87 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-240.4** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.89 | | **212.5** | ULS 1a_0,9_0,9_90 | 250.2 | 269.3 | 314.2 | 0.85 | | 0.89 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-170.1** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.63 | | **163.8** | ULS 1a_0,9_0 | 250.2 | 269.3 | 314.2 | 0.65 | | 0.65 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-218.6** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.81 | | **224.4** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.90 | | 0.90 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-172.6** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.64 | | **160.2** | ULS 1a_0,9_0,9_0 | 250.2 | 269.3 | 314.2 | 0.64 | | 0.64 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.4** | ULS 5a Ah 20 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 20 | 109.4 | 75.4 | 89.6 | 0.15 | | 0.32 |
| 219 | Negende TSNSTK - Diaphragm K CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 239 | **-0.3** | 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 | | 0.01 |
| 220L | Negende TSNSTK - Diaphragm K horiz fr | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-14.6** | ULS 1a_0,9_45 | 43.6 | 37.7 | 60.5 | 0.39 | | **14.8** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.39 | | 0.39 |
| 220T | Negende TSNSTK - Diaphragm K horiz s | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-11.5** | ULS 1a_0,9_0,9_135 | 43.6 | 37.7 | 60.5 | 0.30 | | **16.8** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.45 | | 0.45 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.7** | ULS 1a_0,9_0,9_135 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.7** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 | | 0.05 |
| 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 | | 0.00 |
| 223L | Negende TSNSTK - Diaphragm L horiz fr | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-17.2** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.46 | | **18.3** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.48 | | 0.48 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-17.1** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.45 | | **17.9** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.47 | | 0.47 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-232.2** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.86 | | **213.5** | ULS 1a_0,9_0,9_90 | 348.4 | 269.3 | 314.2 | 0.79 | | 0.86 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-173.6** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.64 | | **169.0** | ULS 1a_0,9_0 | 348.4 | 269.3 | 314.2 | 0.63 | | 0.64 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-24.3** | ULS 1a_0,9_0,9_45 | 55.7 | 37.7 | 60.5 | 0.64 | | **25.7** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.68 | | 0.68 |
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-23.9** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.63 | | **26.1** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.69 | | 0.69 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-2.0** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.07 | | **4.7** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.06 | | 0.07 |
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | | 0.01 |
| 228L | Achtste TSNSTK - Diag fr 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-218.5** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.81 | | **212.4** | ULS 1a_0,9_90 | 347.2 | 269.3 | 261.8 | 0.81 | | 0.81 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-181.2** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.67 | | **165.9** | ULS 1a_0,9_0,9_135 | 347.2 | 269.3 | 261.8 | 0.63 | | 0.67 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-17.9** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.47 | | **17.2** | ULS 1a_135 | 142.8 | 37.7 | 51.2 | 0.46 | | 0.47 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-18.3** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.48 | | **17.6** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.47 | | 0.48 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-3.1** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.11 | | **6.4** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.08 | | 0.11 |
| 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 | | 0.01 |
| 115A | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2544.1** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.80 | | **2014.9** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.56 | | 0.80 |
| 115B | Achtste TSNSTK - Main member | 200x200x20 | S235 | 28M30-5.6t | 0.52 | 0.52 | 1.05 | 47 | **-2945.7** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.93 | | **2378.3** | ULS 1a_0,9_0,9_45 | 3615.8 | 3628.5 | 6542.8 | 0.66 | | 0.93 |
| 115C | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2941.7** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.93 | | **2382.7** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.66 | | 0.93 |
| 116A | Zevende TSNSTK - Main member | 250x250x20 | S235 | 28M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3220.4** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.89 | | **2648.7** | ULS 1a_0,9_0,9_45 | 4683.7 | 3628.5 | 7330.9 | 0.73 | | 0.89 |
| 116B | Zevende TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.60 | 60 | **-3578.9** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 0.96 | | **2896.8** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 | | 0.96 |
| 117A | Zesde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 59 | **-3594.4** | ULS 1a_45 | 3738.1 | 4075.1 | 10368.0 | 0.96 | | **2877.8** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 | | 0.96 |
| 117B | Zesde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3702.1** | ULS 1a_135 | 3722.2 | 4503.7 | 11664.0 | 0.99 | | **2973.0** | ULS 1a_0,9_0,9_45 | 4341.6 | 4503.7 | 9425.5 | 0.68 | | 0.99 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.25 | 0.25 | 0.73 | 60 | **-3788.7** | ULS 1a_45 | 3731.6 | 4075.1 | 10368.0 | 1.02 | knik | **3051.6** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.75 | | 1.02 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3871.5** | ULS 1a_45 | 3755.7 | 4075.1 | 10368.0 | 1.03 | knik | **3049.7** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.75 | | 1.03 |
| 119A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 60 | **-3884.5** | ULS 1a_45 | 3732.3 | 4075.1 | 10368.0 | 1.04 | knik | **3031.8** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.74 | | 1.04 |
| 119B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3850.0** | ULS 1a_45 | 3740.5 | 4075.1 | 10368.0 | 1.03 | knik | **2988.1** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.73 | | 1.03 |
| 120A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.38 | 60 | **-3860.0** | ULS 1a_45 | 3723.6 | 4075.1 | 10368.0 | 1.04 | knik | **2981.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.73 | | 1.04 |
| 120B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.50 | 0.50 | 1.54 | 60 | **-3943.4** | ULS 1a_45 | 3730.6 | 4503.7 | 11664.0 | 1.06 | knik | **3033.4** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 0.67 | | 1.06 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**50**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3986.8** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.73 | | **3026.5** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.53 | | 0.73 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3941.9** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.72 | | **2893.9** | ULS 1a_0,9_0,9_135 | 7183.8 | 5723.4 | 6460.1 | 0.51 | | 0.72 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 65 | **-3979.2** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.73 | | **2852.7** | ULS 1a_0,9_0,9_135 | 7183.8 | 5723.4 | 6460.1 | 0.50 | | 0.73 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 66 | **-4006.5** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.74 | | **2832.0** | ULS 1a_0,9_0,9_135 | 7183.8 | 5723.4 | 6460.1 | 0.49 | | 0.74 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-146.7** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 1.09 | afschuiving | **104.4** | ULS 1a_0,9_0,9_45 | 193.0 | 134.6 | 130.9 | 0.80 | | 1.09 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-132.8** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 0.99 | | **99.7** | ULS 1a_0,9_0,9_45 | 193.0 | 134.6 | 130.9 | 0.76 | | 0.99 |
| 236L | Zevende TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 135 | **-69.8** | ULS 1a_0,9_0,9_45 | 197.0 | 169.4 | 259.2 | 0.41 | | **96.6** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.57 | | 0.57 |
| 236T | Zevende TSNSTK - Diag si 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 137 | **-65.9** | ULS 1a_0,9_0,9_45 | 194.1 | 169.4 | 259.2 | 0.39 | | **86.8** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.51 | | 0.51 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-34.3** | ULS 1a_0,9_0,9_45 | 87.9 | 58.8 | 86.4 | 0.58 | | **31.5** | ULS 1a_135 | 179.7 | 58.8 | 69.8 | 0.54 | | 0.58 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-34.5** | ULS 1a_0,9_0,9_135 | 87.9 | 58.8 | 86.4 | 0.59 | | **31.6** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.54 | | 0.59 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-7.1** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.28 | | **15.3** | ULS 1a_0,9_45 | 133.6 | 58.8 | 69.8 | 0.26 | | 0.28 |
| 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 | | 0.03 |
| 240L | Zesde TSNSTK - Diag fr 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-109.6** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.81 | | **113.8** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.87 | | 0.87 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-104.4** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.78 | | **104.4** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.80 | | 0.80 |
| 241L | Zesde TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-117.9** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.88 | | **105.4** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.81 | | 0.88 |
| 241T | Zesde TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-111.2** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.83 | | **101.0** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.77 | | 0.83 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-92.6** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.09 | afschuiving | **47.4** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.56 | | 1.09 |
| 242T | Vijfde TSNSTK - CD 1 side | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-98.5** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.16 | afschuiving | **51.4** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.61 | | 1.16 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.5** | ULS 5a Ah 10 | 106.8 | 84.7 | 129.6 | 0.35 | | **54.6** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.64 | | 0.64 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.4** | ULS 1a_0,9_0,9_45 | 106.8 | 84.7 | 129.6 | 0.35 | | **58.7** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.69 | | 0.69 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-42.9** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.6** | ULS 5a Ah 20 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.51 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-40.0** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.47 | | **35.4** | ULS 5a Ba 20 | 184.3 | 84.7 | 110.8 | 0.42 | | 0.47 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-41.5** | ULS 1a_135 | 77.2 | 84.7 | 129.6 | 0.54 | | **32.5** | ULS 1a_0,9_0,9_135 | 184.3 | 84.7 | 110.8 | 0.38 | | 0.54 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-43.2** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.56 | | **32.7** | ULS 1a_0,9_0,9_90 | 184.3 | 84.7 | 110.8 | 0.39 | | 0.56 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-26.0** | ULS 1a_0,9_0,9_135 | 100.3 | 58.8 | 118.8 | 0.44 | | **24.1** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.41 | | 0.44 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-26.3** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.45 | | **24.5** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.42 | | 0.45 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-8.0** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.35 | | **14.2** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.24 | | 0.35 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-28.3** | ULS 1a_0,9_0,9_135 | 80.2 | 84.7 | 129.6 | 0.35 | | **33.0** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.39 | | 0.39 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-26.9** | ULS 1a_0,9_0,9_45 | 80.2 | 84.7 | 129.6 | 0.34 | | **31.5** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.37 | | 0.37 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-80.4** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.15 | | **47.1** | ULS 1a_0,9_0,9_45 | 1494.6 | 538.6 | 960.0 | 0.09 | | 0.15 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-80.2** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.15 | | **47.1** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.09 | | 0.15 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-62.3** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.37 | | **27.0** | ULS 1a_0,9_90 | 760.6 | 169.4 | 354.5 | 0.16 | | 0.37 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-51.5** | ULS 5a Ah 12 | 361.1 | 169.4 | 414.7 | 0.30 | | **19.0** | ULS 1a_0,9_135 | 760.6 | 169.4 | 354.5 | 0.11 | | 0.30 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-45.1** | ULS 1a_0,9_45 | 361.1 | 169.4 | 414.7 | 0.27 | | **67.5** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.40 | | 0.40 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-47.0** | ULS 1a_0,9_135 | 361.1 | 169.4 | 414.7 | 0.28 | | **69.0** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.41 | | 0.41 |
| 255L | Broekstuk - Horizontal front | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-36.2** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.21 | | **19.2** | ULS 1a_0,9_45 | 692.4 | 169.4 | 354.5 | 0.11 | | 0.21 |
| 255T | Broekstuk - Horizontal side | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-36.4** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.21 | | **19.4** | ULS 1a_0,9_45 | 692.4 | 169.4 | 354.5 | 0.11 | | 0.21 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-57.4** | ULS 1a_135 | 290.1 | 169.4 | 259.2 | 0.34 | | **27.2** | ULS 1a_0,9_0,9_135 | 431.8 | 169.4 | 221.5 | 0.16 | | 0.34 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-63.9** | ULS 5a Ba 22 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.7** | ULS 5a Ah 12 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.38 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-10.7** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.24 | | **12.8** | ULS 1a_0,9_135 | 347.3 | 176.4 | 222.5 | 0.07 | | 0.24 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.3 | 117.6 | 172.8 | 0.04 | | **0.0** | | 277.0 | 117.6 | 139.6 | 0.00 | | 0.04 |
| 263 | Broekstuk - Diag D-D | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 403 | **-13.7** | ULS 1a_135 | 20.7 | 58.8 | 86.4 | 0.66 | | **11.5** | ULS 1a_0,9_45 | 179.7 | 58.8 | 69.8 | 0.20 | | 0.66 |
| 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 | | 0.21 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 412 | **-15.7** | ULS 5a Ba 12 | 46.6 | 0.0 | 0.0 | 0.34 | | **15.0** | ULS 5a Ba 12 | 599.7 | 0.0 | 0.0 | 0.03 | | 0.34 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**50**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-121.8** | ULS 5a Ah 22 | 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 | **-434.1** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.85 | **209.8** | ULS 1a_0,9_0,9_45 | | 624.7 | 508.3 | 664.6 | 0.41 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-257.6** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.46 | **77.3** | ULS 1a_0,9_0,9_45 | | 688.6 | 0.0 | 0.0 | 0.11 |
| 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 | **428.2** | ULS 3_45 | | 346.4 | 506.7 | 677.1 | 0.77 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-5.8** | ULS 1a_0,9_90 | 190.2 | 117.6 | 237.6 | 0.05 | **5.5** | 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 | **-34.4** | ULS 5a Ah 22 | 263.5 | 169.4 | 285.1 | 0.20 | **59.1** | ULS 1a_45 | | 306.2 | 169.4 | 243.7 | 0.35 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-39.2** | ULS 1a_45 | 159.4 | 84.7 | 142.6 | 0.46 | **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 | **-688.4** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.65 | **0.0** | | | 1548.5 | 1066.2 | 2623.9 | 0.00 |
| 202T | BVNSTK - lower horiz lower CA side | 100x100x8 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 131 | **-12.8** | ULS 5a Ah 22 | 143.1 | 235.2 | 345.6 | 0.09 | **77.8** | 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 | **-100.0** | ULS 1a_90 | 265.5 | 169.4 | 285.1 | 0.59 | **65.6** | ULS 5a Ah 22 | | 291.2 | 169.4 | 229.3 | 0.39 |
| 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 | **101.2** | 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 | **-64.0** | ULS 1a_0,9_0,9_90 | 260.7 | 169.4 | 285.1 | 0.38 | **98.1** | ULS 1a_90 | | 291.2 | 169.4 | 229.3 | 0.58 |
| 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 12 | 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 22 | 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 | **-38.1** | 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 | **-38.2** | ULS 5a Ba 12 | 142.3 | 58.8 | 86.4 | 0.65 | **8.6** | 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 | **42.2** | 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 | **6.7** | 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 | **15.1** | 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 | **-6.4** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.21 | **9.4** | ULS 1a_0 | | 37.4 | 37.7 | 22.0 | 0.43 |
| 411 | Tweede DWSRM - front vert 4 | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 287 | **-13.2** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.72 | **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 | **-11.8** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.67 | **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 | **-7.7** | 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 | **-491.5** | ULS 5a Ba 12 | 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 | **-469.5** | 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 | **-476.6** | ULS 3_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 | **-453.6** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.67 | **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 | **-437.4** | 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 | ### | 1.00 | 68 | **-454.4** | 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 | **90x90x9** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 266 | **-31.9** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.64 | **0.0** | | | 148.2 | 60.3 | 78.4 | 0.00 |
| 415 | Tweede DWSRM - front diag 2 | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 243 | **-38.8** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.84 | **0.0** | | | 131.7 | 60.3 | 69.7 | 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 | **21.9** | ULS 1a_45 | | 84.7 | 37.7 | 44.8 | 0.58 |
| 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 | **28.0** | ULS 1a_0 | | 84.7 | 37.7 | 44.8 | 0.74 |
| 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 | **409.2** | ULS 3_90 | | 346.4 | 506.7 | 677.1 | 0.74 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-16.1** | ULS 1a_0,9_90 | 35.4 | 37.7 | 51.8 | 0.46 | **5.5** | ULS 1a_0,9_0,9_90 | | 44.9 | 37.7 | 41.4 | 0.15 |
| 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_45 | | 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 | **1.5** | 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 | ### | 1.00 | 103 | **-105.9** | ULS 3_45 | 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 | **-71.1** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.42 | **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 | **-105.0** | ULS 3_45 | 221.6 | 0.0 | 0.0 | 0.47 | **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 | **-8.8** | ULS 5a Ba 1 | 1077.2 | 75.4 | 138.2 | 0.12 | **6.3** | ULS 5a Ah 1 | | 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 | **-4.5** | ULS 1a_135 | 37.2 | 37.7 | 43.2 | 0.12 | **2.5** | ULS 1a_0,9_135 | | 37.4 | 37.7 | 22.0 | 0.11 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.2** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | **1.3** | ULS 1a_0 | | 37.4 | 37.7 | 22.0 | 0.06 |
| 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 | **-5.1** | ULS 1a_45 | 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 | **-15.9** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.43 | **18.4** | ULS 1a_0 | | 84.7 | 37.7 | 44.8 | 0.49 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-17.7** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.47 | **15.3** | ULS 1a_0,9_0,9_0 | | 84.7 | 37.7 | 44.8 | 0.41 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-14.9** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.40 | **17.3** | ULS 1a_0 | | 84.7 | 37.7 | 44.8 | 0.46 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-14.3** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.38 | **17.4** | ULS 1a_0 | | 55.3 | 37.7 | 33.6 | 0.52 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-16.3** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.43 | **13.0** | ULS 1a_0,9_0,9_0 | | 55.3 | 37.7 | 33.6 | 0.39 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-12.7** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.34 | **16.8** | ULS 1a_0 | | 55.3 | 37.7 | 33.6 | 0.50 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-17.7** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.70 | **12.7** | ULS 1a_0,9_0,9_0 | | 37.4 | 37.7 | 22.0 | 0.58 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-11.1** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.34 | **16.3** | ULS 1a_0 | | 37.4 | 37.7 | 22.0 | 0.74 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-11.2** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.34 | **15.1** | ULS 1a_0 | | 37.4 | 37.7 | 22.0 | 0.68 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-14.1** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.37 | **10.1** | ULS 1a_0,9_0,9_0 | | 37.4 | 37.7 | 22.0 | 0.46 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-8.9** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.24 | **13.5** | ULS 1a_0 | | 37.4 | 37.7 | 22.0 | 0.61 |
| 440 | Tweede DWSRM - CD top 11 | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-11.7** | ULS 5a Ba 1 | 42.8 | 37.7 | 43.2 | 0.31 | **8.5** | ULS 5a Ah 1 | | 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 1 | 47.4 | 37.7 | 43.2 | 0.27 | **14.3** | ULS 5a Ba 1 | | 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 | **464.4** | ULS 3_90 | | 346.4 | 506.7 | 677.1 | 0.83 |
| 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 | **-213.9** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.69 | **211.0** | ULS 1a_0,9_0 | | 410.9 | 506.7 | 738.6 | 0.51 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-151.4** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.49 | **198.6** | ULS 1a_0 | | 615.9 | 508.3 | 797.5 | 0.39 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-190.4** | ULS 1a_0 | 312.3 | 0.0 | 0.0 | 0.61 | **221.8** | ULS 1a_0 | | 705.0 | 0.0 | 0.0 | 0.31 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-86.9** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.46 | **233.1** | ULS 1a_0 | | 362.9 | 593.0 | 775.4 | 0.64 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-32.8** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.21 | **154.4** | ULS 1a_45 | | 362.9 | 338.9 | 443.1 | 0.46 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-65.4** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.35 | **215.6** | ULS 1a_0 | | 451.2 | 0.0 | 0.0 | 0.48 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-16.1** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.16 | **131.7** | ULS 1a_45 | | 228.6 | 235.2 | 302.4 | 0.58 |
| 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 | **65.8** | ULS 1a_45 | | 196.1 | 75.4 | 121.0 | 0.87 |
| 107C | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | | 2.17 | 1.00 | 1.00 | 142 | **-19.0** | ULS 5a Ah 1 | 100.0 | 0.0 | 0.0 | 0.19 | **86.2** | ULS 1a_45 | | 279.7 | 0.0 | 0.0 | 0.31 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.0** | ULS 5a Ah 1 | 37.3 | 37.7 | 43.2 | 0.22 | **11.2** | ULS 5a Ba 1 | | 37.4 | 37.7 | 22.0 | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16# | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-578.5** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.85 | **369.6** | ULS 1a_0,9_0,9_45 | | 1220.3 | 677.8 | 1417.8 | 0.55 |
| 108B | Elfde TSNSTK - Main member | 180x180x16# | S235 | 12M24-5.6t | 0.51 | 0.51 | 0.51 | 56 | **-900.2** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.90 | **677.4** | ULS 1a_0,9_0,9_45 | | 1220.3 | 999.7 | 2126.8 | 0.68 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**50**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 108C | Elfde TSNSTK - Main member | 180x180x16# | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-755.1** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.66 | | **507.1** | ULS 1a_0,9_0,9_45 | 1301.9 | 0.0 | 0.0 | 0.39 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-100.9** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.60 | | **67.9** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.40 |
| 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 | **-68.3** | ULS 1a_0,9_0,9_90 | 251.2 | 169.4 | 285.1 | 0.40 | | **100.7** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.59 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.1** | ULS 5a Ah 12 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.8** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.47 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-103.9** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.61 | | **68.0** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.40 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-77.3** | ULS 5a Ba 12 | 243.6 | 169.4 | 285.1 | 0.46 | | **85.4** | ULS 5a Ah 12 | 306.2 | 169.4 | 236.8 | 0.50 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | **8M30-8.8t** | 0.52 | 0.52 | 0.52 | 52 | **-1088.3** | ULS 1a_45 | 1590.7 | 1723.4 | 2592.0 | 0.68 | | **809.5** | ULS 1a_0,9_0,9_45 | 1638.1 | 1723.4 | 2094.5 | 0.49 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6t | 0.52 | 0.52 | 0.52 | 53 | **-1268.0** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.80 | | **834.7** | ULS 1a_0,9_0,9_45 | 1638.1 | 1588.8 | 3194.2 | 0.53 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-69.2** | ULS 1a_0,9_0,9_90 | 238.9 | 169.4 | 285.1 | 0.41 | | **108.1** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.64 |
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-84.0** | ULS 1a_0 | 238.9 | 169.4 | 285.1 | 0.50 | | **75.0** | ULS 1a_0,9_0,9_0 | 306.2 | 169.4 | 236.8 | 0.44 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-116.2** | ULS 1a_0,9_0,9_45 | 230.6 | 169.4 | 285.1 | 0.69 | | **138.2** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.82 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-128.3** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.76 | | **90.4** | ULS 1a_0,9_0,9_45 | 306.2 | 169.4 | 236.8 | 0.53 |
| 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 | | **385.0** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.92 |
| 212T | Tiende TSNSTK - upper horiz lower CA si | **100x100x10** | **S355** | **2M20-8.8t** | 1.00 | 1.00 | 1.00 | 246 | **-58.9** | ULS 1a_90 | 88.2 | 188.2 | 294.0 | 0.67 | | **39.1** | ULS 1a_0,9_0,9_90 | 466.5 | 188.2 | 237.6 | 0.21 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 2.00 | 1.00 | 82 | **-431.1** | ULS 5a Ba 20 | 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 | **-9.4** | ULS 5a Ah 10 | 168.8 | 235.2 | 432.0 | 0.06 | | **86.9** | ULS 5a Ah 20 | 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 20 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.7** | ULS 5a Ba 20 | 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 | **-2.3** | ULS 3_135 | 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 Ba 11 | 106.2 | 58.8 | 86.4 | 0.36 | | **19.2** | ULS 5a Ba 21 | 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 21 | 116.1 | 58.8 | 86.4 | 0.36 | | **26.6** | ULS 5a Ba 11 | 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 21 | 123.5 | 58.8 | 86.4 | 0.56 | | **22.6** | ULS 5a Ah 21 | 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 | **-27.5** | ULS 5a Ba 11 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 21 | 179.7 | 58.8 | 69.8 | 0.29 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-14.0** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.27 | | **9.9** | ULS 1a_0,9_0,9_0 | 86.7 | 58.8 | 59.5 | 0.17 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.9** | ULS 1a_0,9_0,9_0 | 59.5 | 58.8 | 75.6 | 0.19 | | **12.4** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.21 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 10 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.21 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 20 | 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 20 | 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 20 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | 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 | **-32.0** | ULS 5a Ba 10 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 20 | 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 | **-36.3** | ULS 5a Ba 10 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.35 |
| 312 | Eerste DWSRM - 1st & 2nd horiz under | HEB240 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-18.5** | ULS 5a Ba 21 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | 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 20 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.6** | ULS 5a Ba 20 | 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 | | **70.6** | 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 | | **93.5** | 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 | | **34.3** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 |
| 317 | Eerste DWSRM - front diag 4 | 60x60x6 | S235 | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 338 | **0.0** | | 14.0 | 60.3 | 51.8 | 0.00 | | **37.9** | ULS 1a_0 | 72.6 | 60.3 | 38.4 | 0.99 |
| 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 | | **37.0** | 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 | **-42.4** | 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 | **-14.0** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.58 | | **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 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **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 | **-6.1** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.53 | | **3.7** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.17 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.3** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.2** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.10 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.3** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.24 | | **2.7** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.12 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.9** | ULS 1a_0,9_0,9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.7** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.08 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 1.70 | 1.00 | 71 | **-484.7** | ULS 1a_135 | 1289.1 | 906.5 | 2799.4 | 0.53 | | **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 | **-337.9** | ULS 5a Ba 10 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.3** | ULS 5a Ah 20 | 1548.5 | 677.8 | 1595.1 | 0.01 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-476.4** | ULS 5a Ba 20 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.2** | ULS 5a Ah 20 | 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 | **-313.5** | ULS 5a Ba 10 | 869.0 | 677.8 | 1555.2 | 0.46 | | **31.9** | ULS 5a Ah 20 | 1008.5 | 677.8 | 1329.2 | 0.05 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15# | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-195.6** | 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 | **-299.5** | ULS 5a Ba 10 | 869.1 | 0.0 | 0.0 | 0.34 | | **26.4** | ULS 5a Ah 20 | 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 | | **364.5** | 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 | | **261.6** | ULS 3_135 | 615.9 | 423.6 | 664.6 | 0.62 |
| 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 | | **287.7** | 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 | | **234.9** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.57 |
| 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 | | **200.3** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.69 |
| 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 | | **200.0** | 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 | 14M30-5.6t | 0.52 | 0.52 | 0.52 | 35 | **-1651.3** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.88 | | **1175.6** | ULS 1a_0,9_0,9_45 | 2373.8 | 1885.0 | 4032.0 | 0.62 |
| 114B | Negende TSNSTK - Main member | 250x250x22# | S235 | 18M30-5.6t | 0.52 | 0.52 | 0.52 | 36 | **-2082.5** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.88 | | **1568.0** | ULS 1a_0,9_0,9_45 | 2373.8 | 2423.5 | 4626.7 | 0.66 |
| 114C | Negende TSNSTK - Main member | 250x250x22# | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-2079.6** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.88 | | **1571.7** | ULS 1a_0,9_0,9_45 | 2493.4 | 0.0 | 0.0 | 0.63 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-240.7** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.89 | | **212.8** | ULS 1a_0,9_0,9_90 | 250.2 | 269.3 | 314.2 | 0.85 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-170.6** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.63 | | **164.3** | ULS 1a_0,9_0 | 250.2 | 269.3 | 314.2 | 0.66 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-218.9** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.81 | | **224.7** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.90 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-173.1** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.64 | | **160.7** | ULS 1a_0,9_0,9_0 | 250.2 | 269.3 | 314.2 | 0.64 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.3** | ULS 5a Ah 20 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 20 | 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 | **-0.3** | 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 | **-14.7** | ULS 1a_0,9_45 | 43.6 | 37.7 | 60.5 | 0.39 | | **14.8** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.39 |
| 220T | Negende TSNSTK - Diaphragm K horiz si | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-11.6** | ULS 1a_0,9_0,9_135 | 43.6 | 37.7 | 60.5 | 0.31 | | **16.9** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.45 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.6** | ULS 1a_0,9_0,9_135 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.7** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 |
| 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 | **-17.3** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.46 | | **18.3** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.49 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-17.1** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.46 | | **17.9** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.47 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-232.5** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.86 | | **213.7** | ULS 1a_0,9_0,9_90 | 348.4 | 269.3 | 314.2 | 0.79 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-174.0** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.65 | | **169.5** | ULS 1a_0,9_0 | 348.4 | 269.3 | 314.2 | 0.63 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-24.4** | ULS 1a_0,9_0,9_45 | 55.7 | 37.7 | 60.5 | 0.65 | | **25.8** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.68 |
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-24.0** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.64 | | **26.2** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.70 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-2.0** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.07 | | **4.7** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.06 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**50**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | **-218.7** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.81 | | **212.6** | ULS 1a_0_9_90 | 347.2 | 269.3 | 261.8 | 0.81 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-182.1** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.68 | | **166.5** | ULS 1a_0_9_0_9_135 | 347.2 | 269.3 | 261.8 | 0.64 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-18.0** | ULS 1a_0_9_0_9_45 | 61.0 | 37.7 | 69.1 | 0.48 | | **17.2** | ULS 1a_135 | 142.8 | 37.7 | 51.2 | 0.46 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-18.3** | ULS 1a_0_9_0_9_45 | 61.0 | 37.7 | 69.1 | 0.48 | | **17.4** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.46 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-3.1** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.11 | | **6.4** | 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(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2552.4** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.80 | | **2021.0** | ULS 1a_0_9_0_9_45 | 3588.5 | 0.0 | 0.0 | 0.56 |
| 115B | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | 28M30-5.6t | 0.52 | 0.52 | 1.05 | 47 | **-2954.0** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.93 | | **2384.7** | ULS 1a_0_9_0_9_45 | 3615.8 | 3628.5 | 6542.8 | 0.66 |
| 115C | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2950.1** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.93 | | **2389.1** | ULS 1a_0_9_0_9_45 | 3588.5 | 0.0 | 0.0 | 0.67 |
| 116A | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 28M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3229.7** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.89 | | **2655.7** | ULS 1a_0_9_0_9_45 | 4683.7 | 3628.5 | 7330.9 | 0.73 |
| 116B | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.60 | 60 | **-3587.7** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 0.96 | | **2903.5** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 |
| 117A | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 59 | **-3603.2** | ULS 1a_45 | 3738.1 | 4075.1 | 10368.0 | 0.96 | | **2884.6** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 |
| 117B | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3711.6** | ULS 1a_135 | 3722.2 | 4503.7 | 11664.0 | 1.00 | | **2980.1** | ULS 1a_0_9_0_9_45 | 4341.6 | 4503.7 | 9425.5 | 0.69 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.25 | 0.25 | **0.64** | 52 | **-3796.8** | ULS 1a_45 | 3918.4 | 4075.1 | 10368.0 | 0.97 | | **3057.8** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.75 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.37** | 52 | **-3880.3** | ULS 1a_45 | 3919.4 | 4075.1 | 10368.0 | 0.99 | | **3055.8** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.75 |
| 119A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.19** | 52 | **-3893.3** | ULS 1a_45 | 3917.8 | 4075.1 | 10368.0 | 0.99 | | **3037.9** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.75 |
| 119B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.36** | 52 | **-3857.4** | ULS 1a_45 | 3917.8 | 4075.1 | 10368.0 | 0.98 | | **2993.1** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.73 |
| 120A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.20** | 52 | **-3867.4** | ULS 1a_45 | 3918.4 | 4075.1 | 10368.0 | 0.99 | | **2986.2** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.73 |
| 120B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6t | 0.50 | 0.50 | **1.12** | 43 | **-3950.9** | ULS 1a_45 | 4103.3 | 4503.7 | 11664.0 | 0.96 | | **3038.4** | ULS 1a_0_9_0_9_45 | 4683.7 | 4503.7 | 9425.5 | 0.67 |
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3994.4** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.73 | | **3031.5** | ULS 1a_0_9_0_9_45 | 7183.8 | 5723.4 | 6460.1 | 0.53 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3948.4** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.73 | | **2897.9** | ULS 1a_0_9_0_9_135 | 7183.8 | 5723.4 | 6460.1 | 0.51 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 65 | **-3985.7** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.73 | | **2856.8** | ULS 1a_0_9_0_9_135 | 7183.8 | 5723.4 | 6460.1 | 0.50 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 66 | **-4013.0** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.74 | | **2836.1** | ULS 1a_0_9_0_9_135 | 7183.8 | 5723.4 | 6460.1 | 0.50 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz fr | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz si | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz in | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-147.1** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 0.91 | | **104.6** | ULS 1a_0_9_0_9_45 | 193.0 | 215.4 | 130.9 | 0.80 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-132.2** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 0.98 | | **99.4** | ULS 1a_0_9_0_9_45 | 193.0 | 134.6 | 130.9 | 0.76 |
| 236L | Zevende TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 135 | **-69.9** | ULS 1a_0_9_0_9_45 | 197.0 | 169.4 | 259.2 | 0.41 | | **96.8** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.57 |
| 236T | Zevende TSNSTK - Diag si 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 137 | **-65.6** | ULS 1a_0_9_0_9_45 | 194.1 | 169.4 | 259.2 | 0.39 | | **86.2** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.51 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz fr | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-34.4** | ULS 1a_0_9_0_9_45 | 87.9 | 58.8 | 86.4 | 0.59 | | **31.6** | ULS 1a_135 | 179.7 | 58.8 | 69.8 | 0.54 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz si | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-34.5** | ULS 1a_0_9_0_9_135 | 87.9 | 58.8 | 86.4 | 0.59 | | **31.5** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.53 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-7.1** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.28 | | **15.3** | ULS 1a_0_9_45 | 133.6 | 58.8 | 69.8 | 0.26 |
| 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 | **-109.7** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.82 | | **114.0** | ULS 1a_0_9_45 | 193.0 | 134.6 | 130.9 | 0.87 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-104.1** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.77 | | **103.8** | ULS 1a_0_9_45 | 193.0 | 134.6 | 130.9 | 0.79 |
| 241L | Zesde TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-118.1** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.88 | | **105.5** | ULS 1a_0_9_0_9_135 | 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 | **-110.3** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.82 | | **100.6** | ULS 1a_0_9_0_9_135 | 193.0 | 134.6 | 130.9 | 0.77 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-93.0** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 0.94 | | **47.7** | ULS 1a_0_9_0_9_45 | 184.3 | 135.6 | 110.8 | 0.43 |
| 242T | Vijfde TSNSTK - CD 1 side | **120x120x10** | **S355** | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 187 | **-99.9** | ULS 1a_135 | 108.1 | 135.6 | 176.4 | 0.92 | | **52.3** | ULS 1a_0_9_0_9_45 | 250.9 | 135.6 | 150.8 | 0.39 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.3** | ULS 5a Ah 10 | 106.8 | 84.7 | 129.6 | 0.35 | | **54.9** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.65 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-30.0** | ULS 1a_0_9_0_9_45 | 106.8 | 84.7 | 129.6 | 0.35 | | **59.8** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.71 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-43.0** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.6** | ULS 5a Ah 20 | 184.3 | 84.7 | 110.8 | 0.40 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-39.8** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.47 | | **35.6** | ULS 5a Ba 20 | 184.3 | 84.7 | 110.8 | 0.42 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-41.4** | ULS 1a_135 | 77.2 | 84.7 | 129.6 | 0.54 | | **32.4** | ULS 1a_0_9_0_9_135 | 184.3 | 84.7 | 110.8 | 0.38 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-44.0** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.57 | | **33.3** | ULS 1a_0_9_0_9_90 | 184.3 | 84.7 | 110.8 | 0.39 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-26.0** | ULS 1a_0_9_0_9_135 | 100.3 | 58.8 | 118.8 | 0.44 | | **24.1** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.41 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-26.3** | ULS 1a_0_9_0_9_45 | 100.3 | 58.8 | 118.8 | 0.45 | | **24.4** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.41 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-8.0** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.34 | | **14.2** | ULS 1a_0_9_135 | 179.7 | 58.8 | 69.8 | 0.24 |
| 257 | Vierde TSNSTK - Doorsnede B-B CD | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 464 | **-0.7** | ULS 7 | 13.1 | 58.8 | 86.4 | 0.05 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-28.1** | ULS 1a_0_9_0_9_135 | 80.2 | 84.7 | 129.6 | 0.35 | | **32.8** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.39 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-26.9** | ULS 1a_0_9_0_9_45 | 80.2 | 84.7 | 129.6 | 0.33 | | **31.8** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.37 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-80.5** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.15 | | **47.2** | ULS 1a_0_9_0_9_45 | 1494.6 | 538.6 | 960.0 | 0.09 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-80.3** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.15 | | **47.1** | ULS 1a_0_9_0_9_135 | 1494.6 | 538.6 | 960.0 | 0.09 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-62.6** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.37 | | **27.3** | ULS 1a_0_9_90 | 760.6 | 169.4 | 354.5 | 0.16 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-51.7** | ULS 1a_45 | 361.1 | 169.4 | 414.7 | 0.31 | | **19.7** | ULS 1a_0_9_135 | 760.6 | 169.4 | 354.5 | 0.12 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-45.4** | ULS 1a_0_9_45 | 361.1 | 169.4 | 414.7 | 0.27 | | **67.9** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.40 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-47.6** | ULS 1a_0_9_135 | 361.1 | 169.4 | 414.7 | 0.28 | | **69.5** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.41 |
| 255L | Broekstuk - Horizontal front | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-36.3** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.21 | | **19.3** | ULS 1a_0_9_45 | 692.4 | 169.4 | 354.5 | 0.11 |
| 255T | Broekstuk - Horizontal side | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-36.4** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.22 | | **19.4** | ULS 1a_0_9_45 | 692.4 | 169.4 | 354.5 | 0.11 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-57.1** | ULS 1a_135 | 290.1 | 169.4 | 259.2 | 0.34 | | **26.9** | ULS 1a_0_9_0_9_135 | 431.8 | 169.4 | 221.5 | 0.16 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-63.9** | ULS 5a Ba 22 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.7** | ULS 5a Ah 12 | 431.8 | 169.4 | 221.5 | 0.17 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-10.7** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.24 | | **12.9** | ULS 1a_0_9_135 | 347.3 | 176.4 | 222.5 | 0.07 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.3 | 117.6 | 172.8 | 0.04 | | **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 | **-13.7** | ULS 1a_135 | 20.7 | 58.8 | 86.4 | 0.66 | | **11.5** | ULS 1a_0_9_45 | 179.7 | 58.8 | 69.8 | 0.20 |
| 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 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 412 | **-15.7** | ULS 5a Ba 12 | 46.6 | 0.0 | 0.0 | 0.34 | | **15.0** | ULS 5a Ba 12 | 599.7 | 0.0 | 0.0 | 0.03 |

**Notes:**
**1) Groups 200L, 419 and 442 failed under net section capacity and were strengthened by placing a plate over the joint. Refer to Appendix D for the calculations and explanation.**
**2) Group 242T failed under shear at the afkeur level. A plate was used to place the bolt in double shear.**

DNV·GL

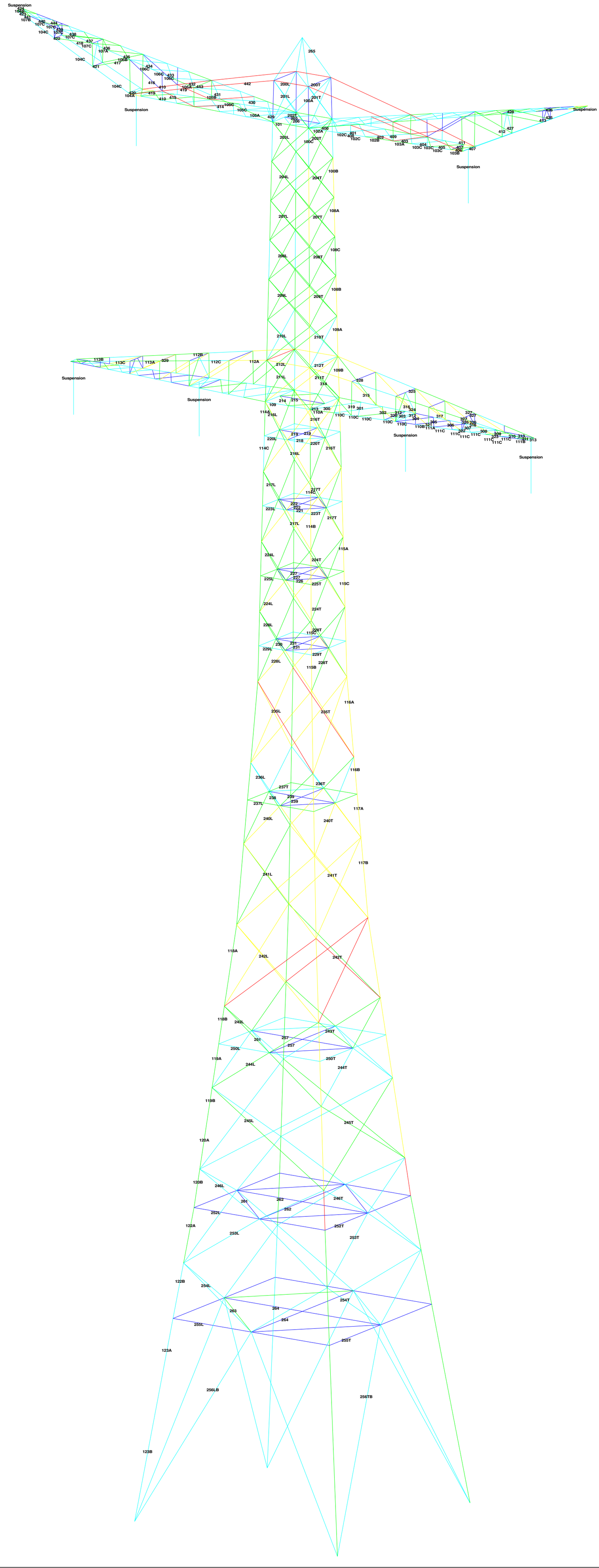
# Assessment of groups for strengthened mast (verbouw level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**50**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | mpression | Load Case (Compres | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | hear (Tens) | earing (Tens) | U.C. (Tens) | Opm.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 414 | Tweede DWSRM - fr | **90x90x9** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 266 | **-37.2** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.74 | | **0.0** | | 148.2 | 60.3 | 78.4 | 0.00 | |
| 415 | Tweede DWSRM - fr | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 243 | **-43.9** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.95 | | **0.0** | | 131.7 | 60.3 | 69.7 | 0.00 | |
| 109A | Tiende TSNSTK - M | 200x200x20 | S235 | **8M30-8.8t** | 0.52 | 0.52 | 0.52 | 52 | **-1458.2** | ULS 1a_45 | 1590.7 | 1723.4 | 2592.0 | 0.92 | | **1160.2** | ULS 1a_0,9_0,9_45 | 1638.1 | 1723.4 | 2094.5 | 0.71 | |
| 212T | Tiende TSNSTK - up | **100x100x10** | **S355** | **2M20-8.8t** | 1.00 | 1.00 | 1.00 | 246 | **-78.1** | ULS 1a_90 | 88.2 | 188.2 | 294.0 | 0.89 | | **57.1** | ULS 1a_0,9_0,9_90 | 466.5 | 188.2 | 237.6 | 0.30 | |
| 317 | Eerste DWSRM - fro | 60x60x6 | S235 | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 338 | **0.0** | | 14.0 | 60.3 | 51.8 | 0.00 | | **43.3** | ULS 1a_0 | 72.6 | 60.3 | 38.4 | 1.13 | (2) |
| 118A | Vijfde TSNSTK - Mai | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.25 | 0.25 | **0.64** | 52 | **-5117.5** | ULS 1a_45 | 3918.4 | 4075.1 | 10368.0 | 1.31 | (3) | **4328.0** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.06 | |
| 118B | Vijfde TSNSTK - Mai | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.37** | 52 | **-5221.1** | ULS 1a_45 | 3919.4 | 4075.1 | 10368.0 | 1.33 | (3) | **4342.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.07 | |
| 119A | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.19** | 52 | **-5235.2** | ULS 1a_45 | 3917.8 | 4075.1 | 10368.0 | 1.34 | (3) | **4322.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.06 | |
| 119B | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.36** | 52 | **-5178.5** | ULS 1a_45 | 3917.8 | 4075.1 | 10368.0 | 1.32 | (3) | **4264.5** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.05 | |
| 120A | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 32M30-5.6t | 0.50 | 0.50 | **1.20** | 52 | **-5189.7** | ULS 1a_45 | 3918.4 | 4075.1 | 10368.0 | 1.32 | (3) | **4258.0** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 1.04 | |
| 120B | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 36M30-5.6t | 0.50 | 0.50 | **1.12** | 43 | **-5302.0** | ULS 1a_45 | 4103.3 | 4503.7 | 11664.0 | 1.29 | (3) | **4335.0** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 0.96 | |
| 235L | Zevende TSNSTK - I | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-198.6** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 1.23 | (1) | **148.9** | ULS 1a_0,9_0,9_45 | 193.0 | 215.4 | 130.9 | 1.14 | |
| 242L | Vijfde TSNSTK - CD | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-125.3** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 1.27 | (1) | **69.6** | ULS 1a_0,9_0,9_45 | 184.3 | 135.6 | 110.8 | 0.63 | |
| 242T | Vijfde TSNSTK - CD | **130x130x11** | **S355** | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 172 | **-136.6** | ULS 1a_135 | 143.3 | 271.1 | 194.0 | 0.95 | | **77.6** | ULS 1a_0,9_0,9_45 | 276.0 | 271.1 | 165.8 | 0.47 | |

**Notes:**
**1) Groups 235L and 242L exhibit failure in buckling at the verbouw level which is not relevant since the failure at the afkeur level was due to shear.**
**2) Group 317 exhibits rupture failure at the verbouw level which is not relevant since the failure at the afkeur level was due to shear.**
**3) Groups 118A/B, 119A/B, 120A/B exhibit failure under buckling at both the afkeur and verbouw level. This is not a cause for concern as additional redundant members were added to fulfil the afkeur loads. In this case fulfilling the verbouw loads is not necessary.**
**4) Groups 200L, 419 and 442 which failed under net section at the afkeur level are not listed in this table. A separate calculation is provided in Appendix D which illustrates the capacity of the member and the plate used for strengthening.**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% Usage Legend
0 <= % < 25
25 <= % < 50
50 <= % < 75
75 <= % < 100
100 <= %
2 (m)

DNV·GL

# Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**52**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-121.1** | ULS 5a Ah 22 | 550.6 | 508.3 | 777.6 | 0.24 | | **0.0** | | 624.7 | 508.3 | 664.6 | 0.00 | | 0.24 |
| 100B | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 67 | **-417.5** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.82 | | **194.9** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.38 | | 0.82 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-248.4** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.44 | | **69.3** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.10 | | 0.44 |
| 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 | | **424.9** | ULS 3_45 | 346.4 | 506.7 | 677.1 | 1.23 | nettodsn. | 1.23 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-5.4** | ULS 1a_0,9_90 | 190.2 | 117.6 | 237.6 | 0.05 | | **5.1** | ULS 1a_90 | 360.5 | 117.6 | 237.6 | 0.04 | | 0.05 |
| 201L | BVNSTK - CD 1 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-34.6** | ULS 5a Ah 22 | 263.5 | 169.4 | 285.1 | 0.20 | | **56.7** | ULS 1a_45 | 306.2 | 169.4 | 243.7 | 0.33 | | 0.33 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-38.5** | ULS 5a Ah 22 | 166.0 | 84.7 | 142.6 | 0.45 | | **0.0** | | 297.8 | 84.7 | 121.8 | 0.00 | | 0.45 |
| 101 | BVNSTK - lower horiz lower CA front | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 2.00 | 1.00 | 65 | **-667.4** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.63 | | **0.0** | | 1548.5 | 1066.2 | 2623.9 | 0.00 | | 0.63 |
| 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 | | **77.5** | ULS 5a Ah 22 | 310.5 | 235.2 | 279.3 | 0.33 | | 0.33 |
| 203L | BVNSTK - CD 2 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-99.5** | ULS 5a Ah 22 | 265.5 | 169.4 | 285.1 | 0.59 | | **65.6** | ULS 5a Ah 22 | 291.2 | 169.4 | 229.3 | 0.39 | | 0.59 |
| 203T | BVNSTK - CD 2 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-90.4** | ULS 5a Ba 12 | 265.5 | 169.4 | 285.1 | 0.53 | | **101.4** | ULS 5a Ah 22 | 291.2 | 169.4 | 229.3 | 0.60 | | 0.60 |
| 204L | BVNSTK - CD 3 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-63.5** | ULS 5a Ah 22 | 260.7 | 169.4 | 285.1 | 0.37 | | **94.6** | ULS 1a_90 | 291.2 | 169.4 | 229.3 | 0.56 | | 0.56 |
| 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 | | **86.8** | ULS 5a Ba 12 | 291.2 | 169.4 | 229.3 | 0.51 | | 0.57 |
| 205 | BVNSTK - Diaphragm diagonal | 110x110x10 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-54.8** | ULS 5a Ah 12 | 205.7 | 117.6 | 216.0 | 0.47 | | **56.3** | ULS 5a Ba 22 | 262.5 | 117.6 | 174.5 | 0.48 | | 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 | | 0.07 |
| 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 | | 0.31 |
| 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 | | 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 22 | 84.2 | 58.8 | 86.4 | 0.41 | | **21.4** | ULS 5a Ba 12 | 110.6 | 58.8 | 69.8 | 0.36 | | 0.41 |
| 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 | | 0.39 |
| 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 | | 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 | | 0.65 |
| 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 | | 0.65 |
| 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 | | **42.1** | ULS 5a Ba 12 | 1626.6 | 117.6 | 0.0 | 0.36 | | 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 | | **6.0** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.27 | | 0.27 |
| 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 | | 0.68 |
| 410 | Tweede DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 171 | **-6.2** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.20 | | **8.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.40 | | 0.40 |
| 411 | Tweede DWSRM - front vert 4 | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 287 | **-13.0** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.71 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.71 |
| 412 | Tweede DWSRM - front vert 5 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 231 | **-11.6** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.65 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.65 |
| 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 | | 0.20 |
| 102A | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 1.46 | 1.00 | 80 | **-489.7** | ULS 5a Ba 12 | 1211.0 | 1066.2 | 3265.9 | 0.46 | | **0.0** | | 1548.5 | 1066.2 | 2791.4 | 0.00 | | 0.46 |
| 102B | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 8M24-5.6t | 1.00 | 1.53 | 1.00 | 77 | **-465.9** | ULS 3_135 | 1237.8 | 677.8 | 1866.2 | 0.69 | | **0.0** | | 1548.5 | 677.8 | 1595.1 | 0.00 | | 0.69 |
| 102C | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | | 1.89 | 2.89 | 1.00 | 75 | **-473.0** | ULS 3_0 | 1257.1 | 0.0 | 0.0 | 0.38 | | **0.0** | | 1623.9 | 0.0 | 0.0 | 0.00 | | 0.38 |
| 103A | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 8M24-5.6t | 1.00 | 1.82 | 1.00 | 67 | **-450.5** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.66 | | **0.0** | | 1220.3 | 677.8 | 1417.8 | 0.00 | | 0.66 |
| 103B | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 7M24-5.6t | 3.10 | 1.00 | 1.00 | 68 | **-434.6** | ULS 3_90 | 1055.4 | 574.5 | 1451.5 | 0.76 | | **0.0** | | 828.7 | 574.5 | 1343.7 | 0.00 | | 0.76 |
| 103C | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | | 5.59 | ### | 1.00 | 68 | **-451.4** | ULS 3_135 | 1055.8 | 0.0 | 0.0 | 0.43 | | **0.0** | | 1301.9 | 0.0 | 0.0 | 0.00 | | 0.43 |
| 414 | Tweede DWSRM - front diag 1 | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **-29.6** | ULS 1a_0 | 18.6 | 37.7 | 60.5 | 1.59 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.59 |
| 415 | Tweede DWSRM - front diag 2 | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 301 | **-37.2** | ULS 7 | 21.4 | 37.7 | 60.5 | 1.74 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.74 |
| 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 | | 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 | | **21.5** | ULS 1a_45 | 84.7 | 37.7 | 44.8 | 0.57 | | 0.57 |
| 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 | | **27.4** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.73 | | 0.73 |
| 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 | | **405.5** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 1.17 | nettodsn. | 1.17 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-15.7** | ULS 1a_0,9_90 | 35.4 | 37.7 | 51.8 | 0.44 | | **5.2** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 41.4 | 0.14 | | 0.44 |
| 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 | 0.01 | | 0.01 |
| 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 7 | 44.9 | 37.7 | 34.4 | 0.02 | | 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 | | **1.4** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 31.7 | 0.05 | | 0.05 |
| 104A | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | ### | 1.00 | 103 | **-104.7** | ULS 3_45 | 413.3 | 169.4 | 259.2 | 0.62 | | **0.0** | | 343.1 | 169.4 | 208.5 | 0.00 | | 0.62 |
| 104B | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | 9.78 | 1.00 | 102 | **-69.4** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.41 | | **0.0** | | 431.8 | 169.4 | 221.5 | 0.00 | | 0.41 |
| 104C | Tweede DWSRM - main member raised | 150x150x10 | S235 | | 1.00 | 1.01 | 1.00 | 152 | **-103.8** | ULS 3_45 | 221.6 | 0.0 | 0.0 | 0.47 | | **0.0** | | 688.6 | 0.0 | 0.0 | 0.00 | | 0.47 |
| 424 | Tweede DWSRM - horiz at end of raised | HEB160 | S235 | 2M16-5.6t | 2.00 | 2.00 | 2.00 | 22 | **-8.8** | ULS 5a Ba 1 | 1077.2 | 75.4 | 138.2 | 0.12 | | **6.3** | ULS 5a Ah 1 | 1296.6 | 75.4 | 11.9 | 0.53 | | 0.53 |
| 425 | Tweede DWSRM - raised DS A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 132 | **-4.3** | ULS 1a_0 | 37.2 | 37.7 | 43.2 | 0.11 | | **2.3** | ULS 1a_0,9_135 | 37.4 | 37.7 | 22.0 | 0.10 | | 0.11 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.1** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | | **1.2** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.05 | | 0.05 |
| 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 | | 0.26 |
| 428 | Tweede DWSRM - raised DS B-B horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 120 | **-5.0** | ULS 1a_45 | 43.6 | 37.7 | 43.2 | 0.13 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.13 |
| 429 | Tweede DWSRM - CD top 1 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 208 | **-14.9** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.40 | | **17.4** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.46 | | 0.46 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-16.7** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.44 | | **14.4** | ULS 1a_0,9_0,9_0 | 84.7 | 37.7 | 44.8 | 0.38 | | 0.44 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-14.0** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.37 | | **16.4** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.44 | | 0.44 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-13.4** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.36 | | **16.5** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.49 | | 0.49 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-15.5** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.41 | | **12.2** | ULS 1a_0,9_0,9_0 | 55.3 | 37.7 | 33.6 | 0.36 | | 0.41 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-11.9** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.31 | | **16.0** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.48 | | 0.48 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-16.8** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.66 | | **11.9** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.54 | | 0.66 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-10.3** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.32 | | **15.5** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.70 | | 0.70 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.5** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.32 | | **14.3** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.65 | | 0.65 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-13.4** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.35 | | **9.4** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.43 | | 0.43 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-8.3** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.22 | | **12.8** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.58 | | 0.58 |
| 440 | Tweede DWSRM - CD top 11 | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-11.7** | ULS 5a Ba 1 | 42.8 | 37.7 | 43.2 | 0.31 | | **8.6** | ULS 5a Ah 1 | 37.4 | 37.7 | 22.0 | 0.39 | | 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 1 | 47.4 | 37.7 | 43.2 | 0.27 | | **14.3** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.65 | | 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. | 1.33 |
| 443 | Tweede DWSRM - diag top "CD" | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 260 | **-12.9** | ULS 3_90 | 21.3 | 37.7 | 51.8 | 0.60 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.60 |
| 105A | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.00 | 1.47 | 1.00 | 124 | **-200.7** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.65 | | **200.4** | ULS 1a_0,9_0 | 410.9 | 506.7 | 738.6 | 0.49 | | 0.65 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-141.7** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.46 | | **188.3** | ULS 1a_0 | 615.9 | 508.3 | 797.5 | 0.37 | | 0.46 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-178.4** | ULS 1a_0 | 312.3 | 0.0 | 0.0 | 0.57 | | **210.3** | ULS 1a_0 | 705.0 | 0.0 | 0.0 | 0.30 | | 0.57 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-78.6** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.42 | | **223.6** | ULS 1a_0 | 362.9 | 593.0 | 775.4 | 0.62 | | 0.62 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-28.1** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.18 | | **148.9** | ULS 1a_45 | 362.9 | 338.9 | 443.1 | 0.44 | | 0.44 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-58.2** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.31 | | **207.2** | ULS 1a_0 | 451.2 | 0.0 | 0.0 | 0.46 | | 0.46 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-12.7** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.12 | | **127.3** | ULS 1a_45 | 228.6 | 235.2 | 302.4 | 0.56 | | 0.56 |
| 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 | | **64.1** | ULS 1a_45 | 196.1 | 75.4 | 121.0 | 0.85 | | 0.85 |
| 107C | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | | 2.17 | 1.00 | 1.00 | 142 | **-19.2** | ULS 5a Ah 1 | 100.0 | 0.0 | 0.0 | 0.19 | | **83.4** | ULS 1a_45 | 279.7 | 0.0 | 0.0 | 0.30 | | 0.30 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.1** | ULS 5a Ah 1 | 37.3 | 37.7 | 43.2 | 0.22 | | **11.2** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.51 | | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16 | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-553.7** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.82 | | **346.3** | ULS 1a_0,9_0,9_45 | 1220.3 | 677.8 | 1417.8 | 0.51 | | 0.82 |
| 108B | Elfde TSNSTK - Main member | 180x180x16 | S235 | 12M24-5.6t | 0.51 | 0.51 | 0.51 | 56 | **-859.6** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.86 | | **638.2** | ULS 1a_0,9_0,9_45 | 1220.3 | 999.7 | 2126.8 | 0.64 | | 0.86 |
| 108C | Elfde TSNSTK - Main member | 180x180x16 | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-722.9** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.64 | | **476.9** | ULS 1a_0,9_0,9_45 | 1301.9 | 0.0 | 0.0 | 0.37 | | 0.64 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-97.1** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.57 | | **64.3** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.38 | | 0.57 |
| 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 | | 0.54 |
| 208L | Elfde TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-64.7** | ULS 1a_0,9_0,9_90 | 251.2 | 169.4 | 285.1 | 0.38 | | **96.9** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.57 | | 0.57 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.3** | ULS 5a Ah 12 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.6** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.52 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-100.0** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.59 | | **64.3** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.38 | | 0.59 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-77.0** | ULS 5a Ba 12 | 243.6 | 169.4 | 285.1 | 0.45 | | **85.7** | ULS 5a Ah 12 | 306.2 | 169.4 | 236.8 | 0.51 | | 0.51 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | 8M30-5.6t | 0.52 | 0.52 | 0.52 | 52 | **-1040.4** | ULS 1a_45 | 1590.7 | 1077.1 | 2592.0 | 0.97 | | **763.8** | ULS 1a_0,9_0,9_45 | 1638.1 | 1077.1 | 2094.5 | 0.71 | | 0.97 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6t | 0.52 | 0.52 | 0.52 | 53 | **-1216.7** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.77 | | **786.2** | ULS 1a_0,9_0,9_45 | 1638.1 | 1588.8 | 3194.2 | 0.49 | | 0.77 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-65.4** | ULS 1a_0,9_0,9_90 | 238.9 | 169.4 | 285.1 | 0.39 | | **104.2** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.61 | | 0.61 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**52**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-82.9** | ULS 5a Ah 12 | 238.9 | 169.4 | 285.1 | 0.49 | | **73.2** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.43 | | 0.49 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-109.7** | ULS 1a_0,9_0,9_45 | 230.6 | 169.4 | 285.1 | 0.65 | | **131.9** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.78 | | 0.78 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-120.4** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.71 | | **80.4** | ULS 1a_0,9_0,9_45 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.71 |
| 212L | Tiende TSNSTK - upper horiz lower CA fi | 150x150x10 | S235 | 7M24-5.6t | 1.00 | 1.00 | 1.00 | 162 | **0.0** | | 222.3 | 578.2 | 907.2 | 0.00 | | **383.9** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.91 | | 0.91 |
| 212T | Tiende TSNSTK - upper horiz lower CA s | 80x80x8 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 308 | **-49.9** | ULS 1a_90 | 36.4 | 117.6 | 172.8 | 1.37 | knik | **32.6** | ULS 1a_0,9_0,9_90 | 212.5 | 117.6 | 139.6 | 0.28 | | 1.37 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 2.00 | 1.00 | 82 | **-431.3** | ULS 5a Ba 20 | 1194.7 | 906.5 | 2799.4 | 0.48 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.48 |
| 213 | Tiende TSNSTK - lower horiz lower CA si | 110x110x10 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 148 | **-8.9** | ULS 5a Ah 10 | 168.8 | 235.2 | 432.0 | 0.05 | | **87.5** | ULS 5a Ah 20 | 433.4 | 235.2 | 349.1 | 0.37 | | 0.37 |
| 214 | Tiende TSNSTK - Diaphragm diagonal | 130x130x12 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 139 | **-60.8** | ULS 5a Ba 20 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.7** | ULS 5a Ba 20 | 379.7 | 117.6 | 209.5 | 0.53 | | 0.53 |
| 215 | Tiende TSNSTK - Diaphragm horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 321 | **-2.3** | ULS 3_135 | 27.3 | 58.8 | 86.4 | 0.09 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.09 |
| 300 | Eerste DWSRM - CD under 1 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 146 | **-21.2** | ULS 5a Ba 11 | 106.2 | 58.8 | 86.4 | 0.36 | | **19.3** | ULS 5a Ba 21 | 179.7 | 58.8 | 69.8 | 0.33 | | 0.36 |
| 301 | Eerste DWSRM - CD under 2 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 136 | **-21.0** | ULS 5a Ah 21 | 116.1 | 58.8 | 86.4 | 0.36 | | **26.5** | ULS 5a Ba 11 | 179.7 | 58.8 | 69.8 | 0.45 | | 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 21 | 123.5 | 58.8 | 86.4 | 0.56 | | **22.6** | ULS 5a Ah 21 | 179.7 | 58.8 | 69.8 | 0.39 | | 0.56 |
| 303 | Eerste DWSRM - CD under 4 | 100x100x8 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-27.5** | ULS 5a Ba 11 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 21 | 179.7 | 58.8 | 69.8 | 0.29 | | 0.47 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-13.4** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.26 | | **9.3** | ULS 1a_0,9_0,9_0 | 86.7 | 58.8 | 59.5 | 0.16 | | 0.26 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.4** | ULS 1a_0,9_0,9_0 | 59.5 | 58.8 | 75.6 | 0.18 | | **11.8** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.20 | | 0.20 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 10 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.21 | | 0.22 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 20 | 70.4 | 58.8 | 75.6 | 0.25 | | **16.5** | ULS 5a Ba 10 | 86.7 | 58.8 | 59.5 | 0.28 | | 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 20 | 65.7 | 58.8 | 44.4 | 0.39 | | 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 20 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.53 | | 0.53 |
| 310 | Eerste DWSRM - CD under 11 | 65x65x7 | S235 | 2M20-5.6t | 0.56 | 0.56 | 0.56 | 95 | **-32.0** | ULS 5a Ba 10 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 20 | 99.4 | 117.6 | 104.2 | 0.26 | | 0.28 |
| 311 | Eerste DWSRM - CD under 12 | 65x65x7 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 72 | **-36.3** | ULS 5a Ba 10 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.35 | | 0.62 |
| 312 | Eerste DWSRM - 1st & 2nd horiz under | HEB240 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-18.5** | ULS 5a Ba 21 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | ULS 5a Ba 11 | 2249.6 | 117.6 | 0.0 | 0.28 | | 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 20 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.6** | ULS 5a Ba 20 | 1626.6 | 117.6 | 0.0 | 0.27 | | 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 | | **70.5** | ULS 3_135 | 99.4 | 117.6 | 119.1 | 0.71 | | 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 | | **93.4** | ULS 3_0 | 99.4 | 117.6 | 119.1 | 0.94 | | 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 | | **34.3** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 | | 0.91 |
| 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 | | **37.6** | ULS 1a_0 | 72.6 | 37.7 | 38.4 | 1.00 | | 1.00 |
| 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 | | **37.0** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.98 | | 0.98 |
| 319 | Eerste DWSRM - front vert 1 | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-42.3** | ULS 3_0 | 91.7 | 58.8 | 86.4 | 0.72 | | **0.0** | | 179.7 | 58.8 | 69.8 | 0.00 | | 0.72 |
| 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 | | 0.61 |
| 321 | Eerste DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-13.9** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.58 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.58 |
| 322 | Eerste DWSRM - front vert 4 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 112 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **0.0** | | 44.9 | 37.7 | 26.5 | 0.00 | | 0.23 |
| 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 | | 0.10 |
| 324 | Eerste DWSRM - Doorsnede A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 306 | **-5.8** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.51 | | **3.5** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.16 | | 0.51 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.2** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.1** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.09 | | 0.11 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.1** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.23 | | **2.5** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.11 | | 0.23 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.8** | ULS 1a_0,9_0,9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.6** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.07 | | 0.07 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 1.70 | 1.00 | 71 | **-480.8** | ULS 5a Ba 20 | 1289.1 | 906.5 | 2799.4 | 0.53 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.53 |
| 110B | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 8M24-5.6t | 2.53 | 1.40 | 1.00 | 57 | **-337.9** | ULS 5a Ba 10 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.3** | ULS 5a Ah 20 | 1548.5 | 677.8 | 1595.1 | 0.01 | | 0.50 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-476.3** | ULS 5a Ba 20 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.2** | ULS 5a Ah 20 | 1623.9 | 0.0 | 0.0 | 0.01 | | 0.37 |
| 111A | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | 8M24-5.6t | 3.53 | 6.36 | 1.00 | 72 | **-313.5** | ULS 5a Ba 10 | 869.0 | 677.8 | 1555.2 | 0.46 | | **31.9** | ULS 5a Ah 20 | 1008.5 | 677.8 | 1329.2 | 0.05 | | 0.46 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-194.6** | ULS 3_90 | 869.3 | 0.0 | 0.0 | 0.22 | | **0.0** | | 1097.7 | 0.0 | 0.0 | 0.00 | | 0.22 |
| 111C | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 1.80 | 1.00 | 1.00 | 72 | **-299.5** | ULS 5a Ba 10 | 869.1 | 0.0 | 0.0 | 0.34 | | **26.4** | ULS 5a Ah 20 | 1097.7 | 0.0 | 0.0 | 0.02 | | 0.34 |
| 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 | | **364.1** | ULS 3_90 | 422.8 | 504.1 | 796.6 | 0.86 | | 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 | | **261.3** | ULS 3_135 | 615.9 | 423.6 | 664.6 | 0.62 | | 0.62 |
| 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 | | **287.4** | ULS 3_90 | 705.0 | 0.0 | 0.0 | 0.41 | | 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 | | **234.6** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.57 | | 0.57 |
| 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 | | **199.9** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.69 | | 0.69 |
| 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 | | **199.6** | ULS 3_135 | 496.3 | 0.0 | 0.0 | 0.40 | | 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 | | 0.02 |
| 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 | | 0.00 |
| 114A | Negende TSNSTK - Main member | 250x250x22 | S235 | 14M30-5.6t | 0.52 | 0.52 | 0.52 | 35 | **-1579.7** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.84 | | **1106.9** | ULS 1a_0,9_0,9_45 | 2373.8 | 1885.0 | 4032.0 | 0.59 | | 0.84 |
| 114B | Negende TSNSTK - Main member | 250x250x22 | S235 | 18M30-5.6t | 0.52 | 0.52 | 0.52 | 36 | **-1992.3** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.84 | | **1479.7** | ULS 1a_0,9_0,9_45 | 2373.8 | 2423.5 | 4626.7 | 0.62 | | 0.84 |
| 114C | Negende TSNSTK - Main member | 250x250x22 | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-1989.3** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.84 | | **1483.3** | ULS 1a_0,9_0,9_45 | 2493.4 | 0.0 | 0.0 | 0.59 | | 0.84 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-230.8** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.86 | | **203.1** | ULS 1a_0,9_0,9_90 | 250.2 | 269.3 | 314.2 | 0.81 | | 0.86 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-161.9** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.60 | | **155.7** | ULS 1a_0,9_0 | 250.2 | 269.3 | 314.2 | 0.62 | | 0.62 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-209.2** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.78 | | **215.1** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.86 | | 0.86 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-164.4** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.61 | | **152.2** | ULS 1a_0,9_0,9_0 | 250.2 | 269.3 | 314.2 | 0.61 | | 0.61 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.4** | ULS 5a Ah 20 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 20 | 109.4 | 75.4 | 89.6 | 0.15 | | 0.32 |
| 219 | Negende TSNSTK - Diaphragm K CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 239 | **-0.3** | 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 | | 0.01 |
| 220L | Negende TSNSTK - Diaphragm K horiz fr | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-13.8** | ULS 1a_0,9_45 | 43.6 | 37.7 | 60.5 | 0.37 | | **14.2** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.38 | | 0.38 |
| 220T | Negende TSNSTK - Diaphragm K horiz s | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-10.7** | ULS 1a_0,9_0,9_135 | 43.6 | 37.7 | 60.5 | 0.28 | | **16.3** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.43 | | 0.43 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.6** | ULS 1a_135 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.5** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 | | 0.05 |
| 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 | | 0.00 |
| 223L | Negende TSNSTK - Diaphragm L horiz fr | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-16.2** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.43 | | **17.7** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.47 | | 0.47 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-16.1** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.43 | | **17.3** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.46 | | 0.46 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-222.7** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.83 | | **204.0** | ULS 1a_0,9_0,9_90 | 348.4 | 269.3 | 314.2 | 0.76 | | 0.83 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-165.2** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.61 | | **160.6** | ULS 1a_0,9_0 | 348.4 | 269.3 | 314.2 | 0.60 | | 0.61 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-22.9** | ULS 1a_0,9_0,9_45 | 55.7 | 37.7 | 60.5 | 0.61 | | **24.8** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.66 | | 0.66 |
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-22.6** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.60 | | **25.2** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.67 | | 0.67 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-1.9** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.06 | | **4.4** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.06 | | 0.06 |
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | | 0.01 |
| 228L | Achtste TSNSTK - Diag fr 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-209.1** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.78 | | **203.2** | ULS 1a_0,9_90 | 347.2 | 269.3 | 261.8 | 0.78 | | 0.78 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-172.9** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.64 | | **157.8** | ULS 1a_0,9_0,9_135 | 347.2 | 269.3 | 261.8 | 0.60 | | 0.64 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-16.8** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.44 | | **16.7** | ULS 1a_135 | 142.8 | 37.7 | 51.2 | 0.44 | | 0.44 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-17.2** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.46 | | **17.0** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.45 | | 0.46 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-2.8** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.10 | | **5.9** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.08 | | 0.10 |
| 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 | | **0.2** | ULS 1a_0,9_90 | 75.4 | 113.0 | 100.9 | 0.00 | | 0.01 |
| 115A | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2439.1** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.77 | | **1910.3** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.53 | | 0.77 |
| 115B | Achtste TSNSTK - Main member | 200x200x20 | S235 | 28M30-5.6t | 0.52 | 0.52 | 1.05 | 47 | **-2823.0** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.89 | | **2256.1** | ULS 1a_0,9_0,9_45 | 3615.8 | 3628.5 | 6542.8 | 0.62 | | 0.89 |
| 115C | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2819.0** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.89 | | **2260.5** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.63 | | 0.89 |
| 116A | Zevende TSNSTK - Main member | 250x250x20 | S235 | 28M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3085.4** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.85 | | **2513.4** | ULS 1a_0,9_0,9_45 | 4683.7 | 3628.5 | 7330.9 | 0.69 | | 0.85 |
| 116B | Zevende TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.60 | 60 | **-3429.2** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 0.92 | | **2747.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.67 | | 0.92 |
| 117A | Zesde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 59 | **-3444.8** | ULS 1a_45 | 3738.1 | 4075.1 | 10368.0 | 0.92 | | **2729.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.67 | | 0.92 |
| 117B | Zesde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3547.7** | ULS 1a_135 | 3722.2 | 4503.7 | 11664.0 | 0.95 | | **2819.3** | ULS 1a_0,9_0,9_45 | 4341.6 | 4503.7 | 9425.5 | 0.65 | | 0.95 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.25 | 0.25 | 0.73 | 60 | **-3630.3** | ULS 1a_45 | 3731.6 | 4075.1 | 10368.0 | 0.97 | | **2893.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 | | 0.97 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3711.2** | ULS 1a_45 | 3755.7 | 4075.1 | 10368.0 | 0.99 | | **2889.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 | | 0.99 |
| 119A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 60 | **-3724.3** | ULS 1a_45 | 3732.3 | 4075.1 | 10368.0 | 1.00 | | **2872.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.70 | | 1.00 |
| 119B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3691.8** | ULS 1a_45 | 3740.5 | 4075.1 | 10368.0 | 0.99 | | **2829.8** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.69 | | 0.99 |
| 120A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.38 | 60 | **-3701.8** | ULS 1a_45 | 3723.6 | 4075.1 | 10368.0 | 0.99 | | **2822.8** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.69 | | 0.99 |
| 120B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.50 | 0.50 | 1.54 | 60 | **-3781.6** | ULS 1a_45 | 3730.6 | 4503.7 | 11664.0 | 1.01 | knik | **2871.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 0.64 | | 1.01 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**52**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3824.2** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.70 | | **2864.3** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.50 | | 0.70 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3783.2** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.70 | | **2735.7** | ULS 1a_0,9_0,9_135 | 7183.8 | 5723.4 | 6460.1 | 0.48 | | 0.70 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 65 | **-3820.6** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.70 | | **2694.9** | ULS 1a_0,9_0,9_135 | 7183.8 | 5723.4 | 6460.1 | 0.47 | | 0.70 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 66 | **-3847.8** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.71 | | **2674.1** | ULS 1a_0,9_0,9_135 | 7183.8 | 5723.4 | 6460.1 | 0.47 | | 0.71 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-140.6** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 1.04 | afschuiving | **98.8** | ULS 1a_0,9_0,9_45 | 193.0 | 134.6 | 130.9 | 0.75 | | 1.04 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-127.3** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 0.95 | | **94.5** | ULS 1a_0,9_0,9_45 | 193.0 | 134.6 | 130.9 | 0.72 | | 0.95 |
| 236L | Zevende TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 135 | **-66.1** | ULS 1a_0,9_0,9_45 | 197.0 | 169.4 | 259.2 | 0.39 | | **92.5** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.55 | | 0.55 |
| 236T | Zevende TSNSTK - Diag si 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 137 | **-62.7** | ULS 5a Ba 20 | 194.1 | 169.4 | 259.2 | 0.37 | | **83.1** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.49 | | 0.49 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.4** | ULS 1a_0,9_0,9_45 | 87.9 | 58.8 | 86.4 | 0.55 | | **30.3** | ULS 1a_135 | 179.7 | 58.8 | 69.8 | 0.52 | | 0.55 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.6** | ULS 1a_0,9_0,9_135 | 87.9 | 58.8 | 86.4 | 0.56 | | **30.5** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.52 | | 0.56 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-6.8** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.27 | | **14.3** | ULS 1a_0,9_45 | 133.6 | 58.8 | 69.8 | 0.24 | | 0.27 |
| 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 | | 0.03 |
| 240L | Zesde TSNSTK - Diag fr 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-104.7** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.78 | | **108.2** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.83 | | 0.83 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-99.7** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.74 | | **99.2** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.76 | | 0.76 |
| 241L | Zesde TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-112.3** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.83 | | **100.4** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.77 | | 0.83 |
| 241T | Zesde TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-106.0** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.79 | | **96.3** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.74 | | 0.79 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-89.1** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.05 | afschuiving | **44.7** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.53 | | 1.05 |
| 242T | Vijfde TSNSTK - CD 1 side | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-94.6** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.12 | afschuiving | **48.4** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.57 | | 1.12 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.5** | ULS 5a Ah 10 | 106.8 | 84.7 | 129.6 | 0.35 | | **52.6** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.62 | | 0.62 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-27.7** | ULS 1a_0,9_0,9_45 | 106.8 | 84.7 | 129.6 | 0.33 | | **56.4** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.67 | | 0.67 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-42.9** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.6** | ULS 5a Ah 20 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.51 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-40.0** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.47 | | **35.4** | ULS 5a Ba 20 | 184.3 | 84.7 | 110.8 | 0.42 | | 0.47 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-39.4** | ULS 1a_135 | 77.2 | 84.7 | 129.6 | 0.51 | | **31.2** | ULS 5a Ah 10 | 184.3 | 84.7 | 110.8 | 0.37 | | 0.51 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-41.4** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.54 | | **31.2** | ULS 1a_0,9_0,9_90 | 184.3 | 84.7 | 110.8 | 0.37 | | 0.54 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.5** | ULS 1a_0,9_0,9_135 | 100.3 | 58.8 | 118.8 | 0.42 | | **23.3** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.40 | | 0.42 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.8** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.42 | | **23.7** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.40 | | 0.42 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-7.8** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.34 | | **13.4** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.23 | | 0.34 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-26.6** | ULS 1a_0,9_0,9_135 | 80.2 | 84.7 | 129.6 | 0.33 | | **31.3** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.37 | | 0.37 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-25.5** | ULS 1a_0,9_0,9_45 | 80.2 | 84.7 | 129.6 | 0.32 | | **30.2** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.36 | | 0.36 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-77.0** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.6** | ULS 1a_0,9_0,9_45 | 1494.6 | 538.6 | 960.0 | 0.08 | | 0.14 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-76.9** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.5** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.08 | | 0.14 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-60.9** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.36 | | **25.6** | ULS 1a_0,9_90 | 760.6 | 169.4 | 354.5 | 0.15 | | 0.36 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-51.5** | ULS 5a Ah 12 | 361.1 | 169.4 | 414.7 | 0.30 | | **17.3** | ULS 1a_0,9_135 | 760.6 | 169.4 | 354.5 | 0.10 | | 0.30 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-43.1** | ULS 1a_0,9_45 | 361.1 | 169.4 | 414.7 | 0.25 | | **64.9** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.38 | | 0.38 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-44.7** | ULS 1a_0,9_135 | 361.1 | 169.4 | 414.7 | 0.26 | | **66.1** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.39 | | 0.39 |
| 255L | Broekstuk - Horizontal front | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.6** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.20 | | **18.3** | ULS 1a_0,9_45 | 692.4 | 169.4 | 354.5 | 0.11 | | 0.20 |
| 255T | Broekstuk - Horizontal side | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.7** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.21 | | **18.5** | ULS 1a_0,9_45 | 692.4 | 169.4 | 354.5 | 0.11 | | 0.21 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-56.4** | ULS 5a Ah 20 | 290.1 | 169.4 | 259.2 | 0.33 | | **25.4** | ULS 5a Ah 20 | 431.8 | 169.4 | 221.5 | 0.15 | | 0.33 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-63.9** | ULS 5a Ba 22 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.7** | ULS 5a Ah 12 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.38 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-10.4** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.23 | | **12.0** | ULS 1a_0,9_135 | 347.3 | 176.4 | 222.5 | 0.07 | | 0.23 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.3 | 117.6 | 172.8 | 0.04 | | **0.0** | | 277.0 | 117.6 | 139.6 | 0.00 | | 0.04 |
| 263 | Broekstuk - Diag D-D | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 403 | **-13.2** | ULS 1a_135 | 20.7 | 58.8 | 86.4 | 0.64 | | **10.8** | ULS 1a_0,9_45 | 179.7 | 58.8 | 69.8 | 0.18 | | 0.64 |
| 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 | | 0.21 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 412 | **-15.7** | ULS 5a Ba 12 | 46.6 | 0.0 | 0.0 | 0.34 | | **15.0** | ULS 5a Ba 12 | 599.7 | 0.0 | 0.0 | 0.03 | | 0.34 |
| 257 | Vierde TSNSTK - Doorsnede B-B CD | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 464 | **-0.7** | ULS 7 | 13.1 | 58.8 | 86.4 | 0.05 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.05 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**52**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-121.8** | ULS 5a Ah 22 | 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 | **-419.6** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.83 | | **195.4** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.38 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-250.0** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.44 | | **69.6** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.10 |
| 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 | | **427.7** | ULS 3_45 | 346.4 | 506.7 | 677.1 | 0.77 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-5.5** | ULS 1a_0,9_90 | 190.2 | 117.6 | 237.6 | 0.05 | | **5.2** | ULS 1a_90 | 360.5 | 117.6 | 237.6 | 0.04 |
| 201L | BVNSTK - CD 1 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-34.4** | ULS 5a Ah 22 | 263.5 | 169.4 | 285.1 | 0.20 | | **57.0** | ULS 1a_45 | 306.2 | 169.4 | 243.7 | 0.34 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-38.6** | ULS 5a Ah 22 | 165.8 | 84.7 | 142.6 | 0.46 | | **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 | **-673.0** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.63 | | **0.0** | | 1548.5 | 1066.2 | 2623.9 | 0.00 |
| 202T | BVNSTK - lower horiz lower CA side | 100x100x8 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 131 | **-12.8** | ULS 5a Ah 22 | 143.1 | 235.2 | 345.6 | 0.09 | | **77.8** | 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 | **-99.5** | ULS 5a Ah 22 | 265.5 | 169.4 | 285.1 | 0.59 | | **65.6** | ULS 5a Ah 22 | 291.2 | 169.4 | 229.3 | 0.39 |
| 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 | **-63.4** | ULS 5a Ah 22 | 260.7 | 169.4 | 285.1 | 0.37 | | **94.7** | ULS 1a_90 | 291.2 | 169.4 | 229.3 | 0.56 |
| 204T | BVNSTK - CD 3 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-96.4** | 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 12 | 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 22 | 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 | **-38.1** | 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 | **-38.2** | ULS 5a Ba 12 | 142.3 | 58.8 | 86.4 | 0.65 | | **8.6** | 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 | | **42.2** | 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 | | **15.1** | 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 | **-6.4** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.21 | | **9.3** | ULS 1a_0 | 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 | **-13.1** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.72 | | **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 | **-11.7** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.66 | | **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 | **-7.7** | 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 | **-491.5** | ULS 5a Ba 12 | 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 | **-468.1** | 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 | **-475.2** | ULS 3_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 | **-452.5** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.67 | | **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 | **-436.6** | 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 | ### | 1.00 | 68 | **-453.5** | 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 | **90x90x9** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 266 | **-31.5** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.63 | | **0.0** | | 148.2 | 60.3 | 78.4 | 0.00 |
| 415 | Tweede DWSRM - front diag 2 | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 243 | **-38.8** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.84 | | **0.0** | | 131.7 | 60.3 | 69.7 | 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 | | **21.8** | ULS 1a_45 | 84.7 | 37.7 | 44.8 | 0.58 |
| 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 | | **27.7** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.73 |
| 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 | | **408.2** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 0.73 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-15.7** | ULS 1a_0,9_90 | 35.4 | 37.7 | 51.8 | 0.44 | | **5.2** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 41.4 | 0.14 |
| 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 | 0.01 |
| 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 7 | 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 | | **1.4** | 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 | ### | 1.00 | 103 | **-105.5** | ULS 3_45 | 413.3 | 169.4 | 259.2 | 0.62 | | **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 | **-69.8** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.41 | | **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 | **-104.7** | ULS 3_45 | 221.6 | 0.0 | 0.0 | 0.47 | | **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 | **-8.8** | ULS 5a Ba 1 | 1077.2 | 75.4 | 138.2 | 0.12 | | **6.3** | ULS 5a Ah 1 | 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 | **-4.3** | ULS 1a_0 | 37.2 | 37.7 | 43.2 | 0.12 | | **2.3** | ULS 1a_0,9_135 | 37.4 | 37.7 | 22.0 | 0.10 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.2** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | | **1.2** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.05 |
| 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 | **-5.0** | ULS 1a_45 | 43.6 | 37.7 | 43.2 | 0.13 | | **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 | **-15.1** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.40 | | **17.6** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.47 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-16.8** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.45 | | **14.5** | ULS 1a_0,9_0,9_0 | 84.7 | 37.7 | 44.8 | 0.38 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-14.1** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.37 | | **16.6** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.44 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-13.5** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.36 | | **16.6** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.49 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-15.6** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.41 | | **12.3** | ULS 1a_0,9_0,9_0 | 55.3 | 37.7 | 33.6 | 0.37 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-12.0** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.32 | | **16.1** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.48 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-16.9** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.67 | | **12.0** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.54 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-10.4** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.32 | | **15.6** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.71 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.6** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.32 | | **14.4** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.65 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-13.5** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.36 | | **9.5** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.43 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-8.3** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.22 | | **12.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.59 |
| 440 | Tweede DWSRM - CD top 11 | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-11.7** | ULS 5a Ba 1 | 42.8 | 37.7 | 43.2 | 0.31 | | **8.5** | ULS 5a Ah 1 | 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 1 | 47.4 | 37.7 | 43.2 | 0.27 | | **14.3** | ULS 5a Ba 1 | 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 | | **463.4** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 0.83 |
| 443 | Tweede DWSRM - diag top "CD" | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 260 | **-12.9** | 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 | **-203.3** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.65 | | **200.8** | ULS 1a_0,9_0 | 410.9 | 506.7 | 738.6 | 0.49 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-142.8** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.46 | | **190.2** | ULS 1a_0 | 615.9 | 508.3 | 797.5 | 0.37 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-180.8** | ULS 1a_0 | 312.3 | 0.0 | 0.0 | 0.58 | | **212.3** | ULS 1a_0 | 705.0 | 0.0 | 0.0 | 0.30 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-79.3** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.42 | | **225.6** | ULS 1a_0 | 362.9 | 593.0 | 775.4 | 0.62 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-28.4** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.18 | | **150.1** | ULS 1a_45 | 362.9 | 338.9 | 443.1 | 0.44 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-58.7** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.32 | | **209.1** | ULS 1a_0 | 451.2 | 0.0 | 0.0 | 0.46 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-12.8** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.12 | | **128.3** | ULS 1a_45 | 228.6 | 235.2 | 302.4 | 0.56 |
| 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 | | **64.6** | ULS 1a_45 | 196.1 | 75.4 | 121.0 | 0.86 |
| 107C | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | | 2.17 | 1.00 | 1.00 | 142 | **-19.0** | ULS 5a Ah 1 | 100.0 | 0.0 | 0.0 | 0.19 | | **83.9** | ULS 1a_45 | 279.7 | 0.0 | 0.0 | 0.30 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.0** | ULS 5a Ah 1 | 37.3 | 37.7 | 43.2 | 0.22 | | **11.2** | ULS 5a Ba 1 | 37.4 | 37.7 | 22.0 | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16# | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-556.6** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.82 | | **347.9** | ULS 1a_0,9_0,9_45 | 1220.3 | 677.8 | 1417.8 | 0.51 |
| 108B | Elfde TSNSTK - Main member | 180x180x16# | S235 | 12M24-5.6t | 0.51 | 0.51 | 0.51 | 56 | **-863.7** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.86 | | **641.0** | ULS 1a_0,9_0,9_45 | 1220.3 | 999.7 | 2126.8 | 0.64 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**52**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 108C | Elfde TSNSTK - Main member | 180x180x16# | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-726.2** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.64 | | **478.6** | ULS 1a_0,9_0,9_45 | 1301.9 | 0.0 | 0.0 | 0.37 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-97.3** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.57 | | **64.4** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.38 |
| 207T | Elfde TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-83.4** | ULS 5a Ba 12 | 255.9 | 169.4 | 285.1 | 0.49 | | **91.8** | 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 | **-64.8** | ULS 1a_0,9_0,9_90 | 251.2 | 169.4 | 285.1 | 0.38 | | **97.1** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.57 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.2** | ULS 5a Ah 12 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.7** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.47 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-100.2** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.59 | | **64.4** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.38 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-77.2** | ULS 5a Ba 12 | 243.6 | 169.4 | 285.1 | 0.46 | | **85.5** | ULS 5a Ah 12 | 306.2 | 169.4 | 236.8 | 0.50 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | 8M30-5.6t | 0.52 | 0.52 | 0.52 | 52 | **-1044.7** | ULS 1a_45 | 1590.7 | 1077.1 | 2592.0 | 0.97 | | **766.3** | ULS 1a_0,9_0,9_45 | 1638.1 | 1077.1 | 2094.5 | 0.71 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6t | 0.52 | 0.52 | 0.52 | 53 | **-1220.5** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.77 | | **788.0** | ULS 1a_0,9_0,9_45 | 1638.1 | 1588.8 | 3194.2 | 0.50 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-65.5** | ULS 1a_0,9_0,9_90 | 238.9 | 169.4 | 285.1 | 0.39 | | **104.3** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.62 |
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-82.7** | ULS 5a Ah 12 | 238.9 | 169.4 | 285.1 | 0.49 | | **73.4** | ULS 5a Ba 12 | 306.2 | 169.4 | 236.8 | 0.43 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-110.2** | ULS 1a_0,9_0,9_45 | 230.6 | 169.4 | 285.1 | 0.65 | | **132.2** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.78 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-122.1** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.72 | | **83.2** | ULS 1a_0,9_0,9_45 | 306.2 | 169.4 | 236.8 | 0.49 |
| 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 | | **384.0** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.91 |
| 212T | Tiende TSNSTK - upper horiz lower CA si | **100x100x8** | **S355** | **2M20-8.8t** | 1.00 | 1.00 | 1.00 | 245 | **-53.7** | ULS 1a_90 | 71.8 | 188.2 | 235.2 | 0.75 | | **35.1** | ULS 1a_0,9_0,9_90 | 377.0 | 188.2 | 190.1 | 0.19 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 2.00 | 1.00 | 82 | **-431.2** | ULS 5a Ba 20 | 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 | **-9.2** | ULS 5a Ah 10 | 168.8 | 235.2 | 432.0 | 0.05 | | **87.2** | ULS 5a Ah 20 | 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 20 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.7** | ULS 5a Ba 20 | 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 | **-2.3** | ULS 3_135 | 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 Ba 11 | 106.2 | 58.8 | 86.4 | 0.36 | | **19.3** | ULS 5a Ba 21 | 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 | **-21.0** | ULS 5a Ah 21 | 116.1 | 58.8 | 86.4 | 0.36 | | **26.6** | ULS 5a Ba 11 | 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 21 | 123.5 | 58.8 | 86.4 | 0.56 | | **22.6** | ULS 5a Ah 21 | 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 | **-27.5** | ULS 5a Ba 11 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 21 | 179.7 | 58.8 | 69.8 | 0.29 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-13.4** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.26 | | **9.3** | ULS 1a_0,9_0,9_0 | 86.7 | 58.8 | 59.5 | 0.16 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.4** | ULS 1a_0,9_0,9_0 | 59.5 | 58.8 | 75.6 | 0.18 | | **11.8** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.20 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 10 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.21 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 20 | 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 20 | 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 20 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | 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 | **-32.0** | ULS 5a Ba 10 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 20 | 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 | **-36.3** | ULS 5a Ba 10 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 20 | 86.7 | 58.8 | 59.5 | 0.35 |
| 312 | Eerste DWSRM - 1st & 2nd horiz under | HEB240 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-18.5** | ULS 5a Ba 21 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | 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 20 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.6** | ULS 5a Ba 20 | 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 | | **70.5** | 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 | | **93.4** | 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 | | **34.3** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 |
| 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 | | **37.6** | ULS 1a_0 | 72.6 | 37.7 | 38.4 | 1.00 |
| 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 | | **37.0** | 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 | **-42.3** | 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 | **-13.9** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.58 | | **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 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **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 | **-5.8** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.51 | | **3.5** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.16 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.2** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.1** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.09 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.1** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.23 | | **2.5** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.11 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.8** | ULS 1a_0,9_0,9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.6** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.07 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 1.70 | 1.00 | 71 | **-480.8** | ULS 5a Ba 20 | 1289.1 | 906.5 | 2799.4 | 0.53 | | **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 | **-337.9** | ULS 5a Ba 10 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.3** | ULS 5a Ah 20 | 1548.5 | 677.8 | 1595.1 | 0.01 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-476.3** | ULS 5a Ba 20 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.2** | ULS 5a Ah 20 | 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 | **-313.5** | ULS 5a Ba 10 | 869.0 | 677.8 | 1555.2 | 0.46 | | **31.9** | ULS 5a Ah 20 | 1008.5 | 677.8 | 1329.2 | 0.05 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15# | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-194.6** | ULS 3_90 | 869.3 | 0.0 | 0.0 | 0.22 | | **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 | **-299.5** | ULS 5a Ba 10 | 869.1 | 0.0 | 0.0 | 0.34 | | **26.4** | ULS 5a Ah 20 | 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 | | **364.1** | 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 | | **261.3** | ULS 3_135 | 615.9 | 423.6 | 664.6 | 0.62 |
| 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 | | **287.4** | 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 | | **234.6** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.57 |
| 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 | | **199.9** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.69 |
| 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 | | **199.6** | 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 | 0.02 | | **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 | 14M30-5.6t | 0.52 | 0.52 | 0.52 | 35 | **-1585.5** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.84 | | **1111.1** | ULS 1a_0,9_0,9_45 | 2373.8 | 1885.0 | 4032.0 | 0.59 |
| 114B | Negende TSNSTK - Main member | 250x250x22# | S235 | 18M30-5.6t | 0.52 | 0.52 | 0.52 | 36 | **-1998.8** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.85 | | **1484.5** | ULS 1a_0,9_0,9_45 | 2373.8 | 2423.5 | 4626.7 | 0.63 |
| 114C | Negende TSNSTK - Main member | 250x250x22# | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-1995.9** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.84 | | **1488.1** | ULS 1a_0,9_0,9_45 | 2493.4 | 0.0 | 0.0 | 0.60 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-231.1** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.86 | | **203.4** | ULS 1a_0,9_0,9_90 | 250.2 | 269.3 | 314.2 | 0.81 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-162.4** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.60 | | **156.1** | ULS 1a_0,9_0 | 250.2 | 269.3 | 314.2 | 0.62 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-209.5** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.78 | | **215.3** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.86 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-164.8** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.61 | | **152.6** | ULS 1a_0,9_0,9_0 | 250.2 | 269.3 | 314.2 | 0.61 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.4** | ULS 5a Ah 20 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 20 | 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 | **-0.3** | 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 | **-13.8** | ULS 1a_0,9_45 | 43.6 | 37.7 | 60.5 | 0.37 | | **14.3** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.38 |
| 220T | Negende TSNSTK - Diaphragm K horiz si | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-10.8** | ULS 1a_0,9_0,9_135 | 43.6 | 37.7 | 60.5 | 0.29 | | **16.3** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.43 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.6** | ULS 1a_135 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.5** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 |
| 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 | **-16.2** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.43 | | **17.7** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.47 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-16.1** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.43 | | **17.3** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.46 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-222.9** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.83 | | **204.3** | ULS 1a_0,9_0,9_90 | 348.4 | 269.3 | 314.2 | 0.76 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-165.6** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.62 | | **161.0** | ULS 1a_0,9_0 | 348.4 | 269.3 | 314.2 | 0.60 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-23.0** | ULS 1a_0,9_0,9_45 | 55.7 | 37.7 | 60.5 | 0.61 | | **24.8** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.66 |
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-22.6** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.60 | | **25.2** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.67 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-1.9** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.06 | | **4.4** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.06 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**52**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | **-209.3** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.78 | | **203.4** | ULS 1a_0_9_90 | 347.2 | 269.3 | 261.8 | 0.78 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-173.3** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.64 | | **158.1** | ULS 1a_0_9_0_9_135 | 347.2 | 269.3 | 261.8 | 0.60 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-16.8** | ULS 1a_0_9_0_9_45 | 61.0 | 37.7 | 69.1 | 0.45 | | **16.7** | ULS 1a_135 | 142.8 | 37.7 | 51.2 | 0.44 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-17.2** | ULS 1a_0_9_0_9_45 | 61.0 | 37.7 | 69.1 | 0.46 | | **17.0** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.45 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-2.8** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.10 | | **5.9** | 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 | | **0.2** | ULS 1a_0_9_90 | 75.4 | 113.0 | 100.9 | 0.00 |
| 115A | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2446.6** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.77 | | **1916.2** | ULS 1a_0_9_0_9_45 | 3588.5 | 0.0 | 0.0 | 0.53 |
| 115B | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | 28M30-5.6t | 0.52 | 0.52 | 1.05 | 47 | **-2831.0** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.89 | | **2262.5** | ULS 1a_0_9_0_9_45 | 3615.8 | 3628.5 | 6542.8 | 0.63 |
| 115C | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2827.0** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.89 | | **2266.8** | ULS 1a_0_9_0_9_45 | 3588.5 | 0.0 | 0.0 | 0.63 |
| 116A | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 28M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3093.6** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.85 | | **2520.1** | ULS 1a_0_9_0_9_45 | 4683.7 | 3628.5 | 7330.9 | 0.69 |
| 116B | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.60 | 60 | **-3437.8** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 0.92 | | **2754.8** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.68 |
| 117A | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 59 | **-3453.4** | ULS 1a_45 | 3738.1 | 4075.1 | 10368.0 | 0.92 | | **2736.0** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.67 |
| 117B | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3556.0** | ULS 1a_135 | 3722.2 | 4503.7 | 11664.0 | 0.96 | | **2825.9** | ULS 1a_0_9_0_9_45 | 4341.6 | 4503.7 | 9425.5 | 0.65 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.25 | 0.25 | 0.73 | 60 | **-3638.4** | ULS 1a_45 | 3731.6 | 4075.1 | 10368.0 | 0.98 | | **2900.2** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3719.0** | ULS 1a_45 | 3755.7 | 4075.1 | 10368.0 | 0.99 | | **2895.9** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 |
| 119A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 60 | **-3732.0** | ULS 1a_45 | 3732.3 | 4075.1 | 10368.0 | 1.00 | | **2878.2** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.71 |
| 119B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3699.0** | ULS 1a_45 | 3740.5 | 4075.1 | 10368.0 | 0.99 | | **2835.4** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.70 |
| 120A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.38 | 60 | **-3709.0** | ULS 1a_45 | 3723.6 | 4075.1 | 10368.0 | 1.00 | | **2828.5** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.69 |
| 120B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6t | 0.50 | 0.50 | **1.34** | 52 | **-3788.7** | ULS 1a_45 | 3918.1 | 4503.7 | 11664.0 | 0.97 | | **2877.3** | ULS 1a_0_9_0_9_45 | 4683.7 | 4503.7 | 9425.5 | 0.64 |
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3831.4** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.70 | | **2869.7** | ULS 1a_0_9_0_9_45 | 7183.8 | 5723.4 | 6460.1 | 0.50 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3789.7** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.70 | | **2740.6** | ULS 1a_0_9_0_9_135 | 7183.8 | 5723.4 | 6460.1 | 0.48 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 65 | **-3827.1** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.70 | | **2699.7** | ULS 1a_0_9_0_9_135 | 7183.8 | 5723.4 | 6460.1 | 0.47 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 66 | **-3854.4** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.71 | | **2678.9** | ULS 1a_0_9_0_9_135 | 7183.8 | 5723.4 | 6460.1 | 0.47 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz fr | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz si | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz in | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-140.9** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 0.87 | | **99.0** | ULS 1a_0_9_0_9_45 | 193.0 | 215.4 | 130.9 | 0.76 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-127.4** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 0.95 | | **94.5** | 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 | **-66.2** | ULS 1a_0_9_0_9_45 | 197.0 | 169.4 | 259.2 | 0.39 | | **92.6** | ULS 1a_135 | 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 | **-62.7** | ULS 5a Ba 20 | 194.1 | 169.4 | 259.2 | 0.37 | | **83.0** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.49 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz fr | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.5** | ULS 1a_0_9_0_9_45 | 87.9 | 58.8 | 86.4 | 0.55 | | **30.4** | ULS 1a_135 | 179.7 | 58.8 | 69.8 | 0.52 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz si | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.7** | ULS 1a_0_9_0_9_135 | 87.9 | 58.8 | 86.4 | 0.56 | | **30.5** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.52 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-6.8** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.27 | | **14.4** | ULS 1a_0_9_45 | 133.6 | 58.8 | 69.8 | 0.24 |
| 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 | **-104.8** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.78 | | **108.4** | ULS 1a_0_9_45 | 193.0 | 134.6 | 130.9 | 0.83 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-99.7** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.74 | | **99.2** | ULS 1a_0_9_45 | 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 | **-112.5** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.84 | | **100.5** | ULS 1a_0_9_0_9_135 | 193.0 | 134.6 | 130.9 | 0.77 |
| 241T | Zesde TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-106.0** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.79 | | **96.2** | ULS 1a_0_9_0_9_135 | 193.0 | 134.6 | 130.9 | 0.74 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-89.4** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 0.91 | | **44.9** | ULS 1a_0_9_0_9_45 | 184.3 | 135.6 | 110.8 | 0.41 |
| 242T | Vijfde TSNSTK - CD 1 side | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-95.0** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 0.97 | | **48.8** | ULS 1a_0_9_0_9_45 | 184.3 | 135.6 | 110.8 | 0.44 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.5** | ULS 5a Ah 10 | 106.8 | 84.7 | 129.6 | 0.35 | | **52.8** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.62 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-27.9** | ULS 1a_0_9_0_9_45 | 106.8 | 84.7 | 129.6 | 0.33 | | **56.7** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.67 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-42.9** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.6** | ULS 5a Ah 20 | 184.3 | 84.7 | 110.8 | 0.40 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-40.0** | ULS 5a Ah 10 | 87.5 | 84.7 | 129.6 | 0.47 | | **35.4** | ULS 5a Ba 20 | 184.3 | 84.7 | 110.8 | 0.42 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-39.4** | ULS 1a_135 | 77.2 | 84.7 | 129.6 | 0.51 | | **31.2** | ULS 5a Ah 10 | 184.3 | 84.7 | 110.8 | 0.37 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-41.4** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.54 | | **31.3** | ULS 1a_0_9_0_9_90 | 184.3 | 84.7 | 110.8 | 0.37 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.6** | ULS 1a_0_9_0_9_135 | 100.3 | 58.8 | 118.8 | 0.42 | | **23.3** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.40 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.8** | ULS 1a_0_9_0_9_45 | 100.3 | 58.8 | 118.8 | 0.42 | | **23.7** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.40 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-7.8** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.34 | | **13.4** | ULS 1a_0_9_135 | 179.7 | 58.8 | 69.8 | 0.23 |
| 257 | Vierde TSNSTK - Doorsnede B-B CD | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 464 | **-0.7** | ULS 7 | 13.1 | 58.8 | 86.4 | 0.05 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-26.6** | ULS 1a_0_9_0_9_135 | 80.2 | 84.7 | 129.6 | 0.33 | | **31.3** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.37 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-25.3** | ULS 1a_0_9_0_9_45 | 80.2 | 84.7 | 129.6 | 0.32 | | **30.0** | ULS 5a Ba 20 | 184.3 | 84.7 | 110.8 | 0.35 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-77.2** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.7** | ULS 1a_0_9_0_9_45 | 1494.6 | 538.6 | 960.0 | 0.08 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-77.0** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.6** | ULS 1a_0_9_0_9_135 | 1494.6 | 538.6 | 960.0 | 0.08 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-61.1** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.36 | | **25.8** | ULS 1a_0_9_90 | 760.6 | 169.4 | 354.5 | 0.15 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-51.5** | ULS 5a Ah 12 | 361.1 | 169.4 | 414.7 | 0.30 | | **17.6** | ULS 1a_0_9_135 | 760.6 | 169.4 | 354.5 | 0.10 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-43.3** | ULS 1a_0_9_45 | 361.1 | 169.4 | 414.7 | 0.26 | | **65.1** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.38 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-45.0** | ULS 1a_0_9_135 | 361.1 | 169.4 | 414.7 | 0.27 | | **66.4** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.39 |
| 255L | Broekstuk - Horizontal front | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.6** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.20 | | **18.4** | ULS 1a_0_9_45 | 692.4 | 169.4 | 354.5 | 0.11 |
| 255T | Broekstuk - Horizontal side | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.8** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.21 | | **18.5** | ULS 1a_0_9_45 | 692.4 | 169.4 | 354.5 | 0.11 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-56.4** | ULS 5a Ah 20 | 290.1 | 169.4 | 259.2 | 0.33 | | **25.3** | ULS 5a Ah 20 | 431.8 | 169.4 | 221.5 | 0.15 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-63.9** | ULS 5a Ba 22 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.7** | ULS 5a Ah 12 | 431.8 | 169.4 | 221.5 | 0.17 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-10.4** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.23 | | **12.1** | ULS 1a_0_9_135 | 347.3 | 176.4 | 222.5 | 0.07 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.5 | 117.6 | 172.8 | 0.04 | | **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 | **-13.2** | ULS 1a_135 | 20.7 | 58.8 | 86.4 | 0.64 | | **10.8** | ULS 1a_0_9_45 | 179.7 | 58.8 | 69.8 | 0.18 |
| 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 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 412 | **-15.7** | ULS 5a Ba 12 | 46.6 | 0.0 | 0.0 | 0.34 | | **15.0** | ULS 5a Ba 12 | 599.7 | 0.0 | 0.0 | 0.03 |

**Notes:**
**1) Groups 200L, 419 and 442 failed under net section capacity and were strengthened by placing a plate over the joint. Refer to Appendix D for the calculations and explanation.**

DNV·GL

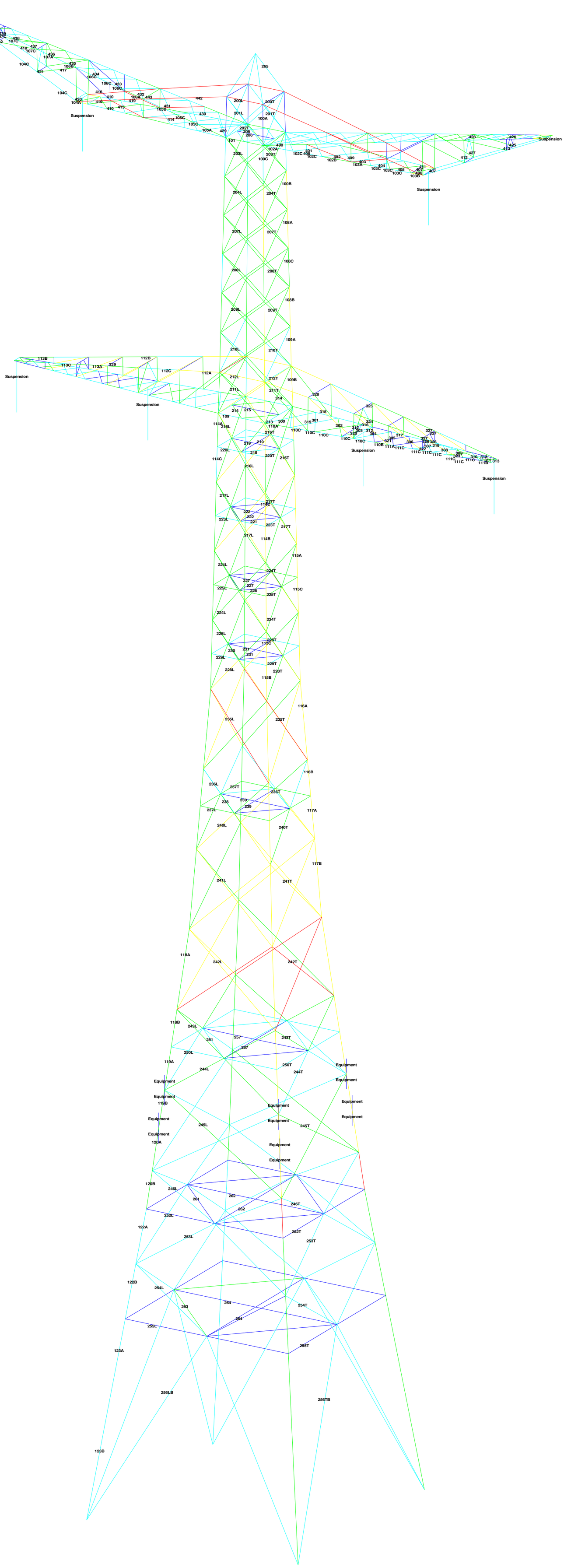
# Assessment of groups for strengthened mast (verbouw level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75**
**52**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | mpression | Load Case (Compres | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | hear (Tens) | earing (Tens) | U.C. (Tens) | Opm.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 414 | Tweede DWSRM - fr | **90x90x9** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 266 | **-36.6** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.73 | | **0.0** | | 148.2 | 60.3 | 78.4 | 0.00 | |
| 415 | Tweede DWSRM - fr | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 243 | **-43.9** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.95 | | **0.0** | | 131.7 | 60.3 | 69.7 | 0.00 | |
| 212T | Tiende TSNSTK - up | **100x100x8** | **S355** | **2M20-8.8t** | 1.00 | 1.00 | 1.00 | 245 | **-71.0** | ULS 1a_90 | 71.8 | 188.2 | 235.2 | 0.99 | | **51.2** | ULS 1a_0,9_0,9_90 | 377.0 | 188.2 | 190.1 | 0.27 | |
| 120B | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 36M30-5.6t | 0.50 | 0.50 | **1.34** | 52 | **-5069.4** | ULS 1a_45 | 3918.1 | 4503.7 | 11664.0 | 1.29 | (2) | **4104.9** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 0.91 | |
| 235L | Zevende TSNSTK - ( | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-189.6** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 1.17 | (1) | **141.1** | ULS 1a_0,9_0,9_45 | 193.0 | 215.4 | 130.9 | 1.08 | |
| 242L | Vijfde TSNSTK - CD | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-120.0** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 1.22 | (1) | **66.1** | ULS 1a_0,9_0,9_45 | 184.3 | 135.6 | 110.8 | 0.60 | |
| 242T | Vijfde TSNSTK - CD | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-127.8** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 1.30 | (1) | **71.4** | ULS 1a_0,9_0,9_45 | 184.3 | 135.6 | 110.8 | 0.64 | |

**Notes:**
**1) Groups 235L and 242L/T exhibit failure in buckling at the verbouw level which is not relevant since the failure at the afkeur level was due to shear.**
**2) Group 120B exhibits failure under buckling at both the afkeur and verbouw level. This is not a cause for concern as additional redundant members were added to fulfil the afkeur loads. In this case fulfilling the verbouw loads is not necessary.**
**3) Groups 200L, 419 and 442 which failed under net section at the afkeur level are not listed in this table. A separate calculation is provided in Appendix D which illustrates the capacity of the member and the plate used for strengthening.**


Suspension
104B
423
441
107B
440
107C
444
107C
104C
422
438
107C
418
437
107C
436
107A
104C
435
106B
421
417
434
106C
106C
433
106C
104C
416
420
104A
419
410
410
415
432
106A
443
419
442
431
105B
430
414
105C
105C
105A
429
265
200L
200T
201L
201T
100A
202T
205
206
101
Suspension
400
102A
203L
203T
100C
102C
401
408
102C
102B
409
103A
403
404
103C
103C
405
103C
411
407
406
103B
407
Suspension
428
426
425
413
427
412
Suspension
100B
204L
204T
108A
207L
207T
108C
208L
208T
108B
209L
209T
109A
210L
210T
113B
113C
113A
329
112B
112C
112A
212L
212T
109B
211L
211T
314
328
325
315
214
215
109
213
300
319
301
110A
110C
110C
110C
302
312
303
320
304
316
324
317
305
321
306
327
427
326
307
318
308
309
323
310
313
311
313
111B
111C
111C
111C
111C
111C
111C
111A
111C
110B
110C
110C
Suspension
Suspension
114A
216L
216T
219
219
220L
218
220T
216T
114C
216L
217L
217T
114C
222
222
223L
221
223T
217T
217L
114B
115A
224L
224T
227
227
225L
226
225T
115C
224L
224T
228L
226T
115C
230
231
231
229L
229T
228L
228T
115B
116A
235L
235T
116B
236L
237T
236T
239
238
239
237L
117A
240L
240T
117B
241L
241T
118A
242L
242T
118B
243L
257
243T
251
257
250L
250T
119A
244L
244T
Equipment
Equipment
Equipment
Equipment
119B
Equipment
Equipment
Equipment
Equipment
Equipment
245L
245T
Equipment
120A
Equipment
Equipment
120B
246L
262
246T
261
262
252L
122A
253L
252T
253T
122B
254L
264
254T
263
264
255L
255T
123A
256LB
256TB
123B

% Usage Legend
0 <= % < 25
25 <= % < 50
50 <= % < 75
75 <= % < 100
100 <= %
2 (m)

DNV·GL

# Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**53**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-123.5** | ULS 5a Ah 12 | 550.6 | 508.3 | 777.6 | 0.24 | | **0.0** | | 624.7 | 508.3 | 664.6 | 0.00 | | 0.24 |
| 100B | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 67 | **-416.4** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.82 | | **191.7** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.38 | | 0.82 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-248.6** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.44 | | **67.7** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.10 | | 0.44 |
| 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 | | **431.8** | ULS 3_45 | 346.4 | 506.7 | 677.1 | 1.25 | nettodsn. | 1.25 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-5.3** | ULS 1a_0,9_90 | 190.2 | 117.6 | 237.6 | 0.05 | | **5.0** | ULS 1a_90 | 360.5 | 117.6 | 237.6 | 0.04 | | 0.05 |
| 201L | BVNSTK - CD 1 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-36.8** | ULS 5a Ah 12 | 263.5 | 169.4 | 285.1 | 0.22 | | **56.9** | ULS 1a_45 | 306.2 | 169.4 | 243.7 | 0.34 | | 0.34 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-39.1** | ULS 5a Ah 12 | 165.2 | 84.7 | 142.6 | 0.46 | | **0.0** | | 297.8 | 84.7 | 121.8 | 0.00 | | 0.46 |
| 101 | BVNSTK - lower horiz lower CA front | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 2.00 | 1.00 | 65 | **-672.1** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.63 | | **0.0** | | 1548.5 | 1066.2 | 2623.9 | 0.00 | | 0.63 |
| 202T | BVNSTK - lower horiz lower CA side | 100x100x8 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 131 | **-13.4** | ULS 5a Ah 12 | 143.1 | 235.2 | 345.6 | 0.09 | | **78.2** | ULS 5a Ah 12 | 310.5 | 235.2 | 279.3 | 0.33 | | 0.33 |
| 203L | BVNSTK - CD 2 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-99.8** | ULS 5a Ah 12 | 265.5 | 169.4 | 285.1 | 0.59 | | **65.6** | ULS 5a Ah 12 | 291.2 | 169.4 | 229.3 | 0.39 | | 0.59 |
| 203T | BVNSTK - CD 2 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-90.4** | ULS 5a Ba 22 | 265.5 | 169.4 | 285.1 | 0.53 | | **101.5** | ULS 5a Ah 12 | 291.2 | 169.4 | 229.3 | 0.60 | | 0.60 |
| 204L | BVNSTK - CD 3 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-63.5** | ULS 5a Ah 12 | 260.7 | 169.4 | 285.1 | 0.37 | | **94.7** | ULS 5a Ah 12 | 291.2 | 169.4 | 229.3 | 0.56 | | 0.56 |
| 204T | BVNSTK - CD 3 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-96.6** | ULS 5a Ah 12 | 260.7 | 169.4 | 285.1 | 0.57 | | **86.8** | ULS 5a Ba 22 | 291.2 | 169.4 | 229.3 | 0.51 | | 0.57 |
| 205 | BVNSTK - Diaphragm diagonal | 110x110x10 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-54.8** | ULS 5a Ba 12 | 205.7 | 117.6 | 216.0 | 0.47 | | **56.4** | ULS 5a Ba 12 | 262.5 | 117.6 | 174.5 | 0.48 | | 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 | | 0.07 |
| 400 | Tweede DWSRM - CD under 1 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 167 | **-18.4** | ULS 5a Ah 12 | 71.4 | 58.8 | 86.4 | 0.31 | | **14.3** | ULS 5a Ba 22 | 110.6 | 58.8 | 69.8 | 0.24 | | 0.31 |
| 401 | Tweede DWSRM - CD under 2 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 155 | **-17.8** | ULS 5a Ba 22 | 78.4 | 58.8 | 86.4 | 0.30 | | **21.8** | ULS 5a Ah 12 | 110.6 | 58.8 | 69.8 | 0.37 | | 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 22 | 110.6 | 58.8 | 69.8 | 0.36 | | 0.41 |
| 403 | Tweede DWSRM - CD under 4 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 118 | **-23.1** | ULS 5a Ba 22 | 107.3 | 58.8 | 86.4 | 0.39 | | **21.9** | ULS 5a Ah 12 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.39 |
| 404 | Tweede DWSRM - CD under 5 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 111 | **-21.5** | ULS 5a Ah 12 | 113.3 | 58.8 | 86.4 | 0.37 | | **29.6** | ULS 5a Ba 22 | 110.6 | 58.8 | 69.8 | 0.50 | | 0.50 |
| 405 | Tweede DWSRM - CD under 6 | 80x80x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 108 | **-38.1** | ULS 5a Ba 22 | 116.1 | 58.8 | 86.4 | 0.65 | | **21.9** | ULS 5a Ah 12 | 110.6 | 58.8 | 69.8 | 0.37 | | 0.65 |
| 406 | Tweede DWSRM - CD under 7 | 80x80x8 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-38.3** | ULS 5a Ba 22 | 142.3 | 58.8 | 86.4 | 0.65 | | **8.6** | ULS 5a Ah 12 | 110.6 | 58.8 | 69.8 | 0.15 | | 0.65 |
| 407 | Tweede DWSRM - Horiz 1&2 under | HEB200 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 41 | **-10.7** | ULS 5a Ah 12 | 1434.3 | 117.6 | 324.0 | 0.09 | | **42.6** | ULS 5a Ba 22 | 1626.6 | 117.6 | 0.0 | 0.36 | | 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 | | **6.0** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.27 | | 0.27 |
| 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 | | 0.68 |
| 410 | Tweede DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 171 | **-6.2** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.21 | | **8.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.40 | | 0.40 |
| 411 | Tweede DWSRM - front vert 4 | 60x60x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 287 | **-13.0** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.71 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.71 |
| 412 | Tweede DWSRM - front vert 5 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 231 | **-11.6** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.65 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.65 |
| 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 | | 0.20 |
| 102A | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 14M24-5.6t | 1.00 | 1.46 | 1.00 | 80 | **-495.0** | ULS 5a Ba 22 | 1211.0 | 1066.2 | 3265.9 | 0.46 | | **0.0** | | 1548.5 | 1066.2 | 2791.4 | 0.00 | | 0.46 |
| 102B | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | 8M24-5.6t | 1.00 | 1.53 | 1.00 | 77 | **-474.2** | ULS 3_135 | 1237.8 | 677.8 | 1866.2 | 0.70 | | **0.0** | | 1548.5 | 677.8 | 1595.1 | 0.00 | | 0.70 |
| 102C | Tweede DWSRM - Main member 1 | 200x200x18 | S235 | | 1.89 | 2.89 | 1.00 | 75 | **-481.0** | ULS 3_0 | 1257.1 | 0.0 | 0.0 | 0.38 | | **0.0** | | 1623.9 | 0.0 | 0.0 | 0.00 | | 0.38 |
| 103A | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 8M24-5.6t | 1.00 | 1.82 | 1.00 | 67 | **-458.5** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.68 | | **0.0** | | 1220.3 | 677.8 | 1417.8 | 0.00 | | 0.68 |
| 103B | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | 7M24-5.6t | 3.10 | 1.00 | 1.00 | 68 | **-443.1** | ULS 3_90 | 1055.4 | 574.5 | 1451.5 | 0.77 | | **0.0** | | 828.7 | 574.5 | 1343.7 | 0.00 | | 0.77 |
| 103C | Tweede DWSRM - Main member 2 | 180x180x16 | S235 | | 5.59 | ### | 1.00 | 68 | **-459.5** | ULS 3_135 | 1055.8 | 0.0 | 0.0 | 0.44 | | **0.0** | | 1301.9 | 0.0 | 0.0 | 0.00 | | 0.44 |
| 414 | Tweede DWSRM - front diag 1 | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **-29.6** | ULS 1a_0 | 18.6 | 37.7 | 60.5 | 1.60 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.60 |
| 415 | Tweede DWSRM - front diag 2 | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 301 | **-37.4** | ULS 7 | 21.4 | 37.7 | 60.5 | 1.75 | knik | **0.0** | | 84.7 | 37.7 | 44.8 | 0.00 | | 1.75 |
| 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 | | 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 | | **21.5** | ULS 1a_45 | 84.7 | 37.7 | 44.8 | 0.57 | | 0.57 |
| 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 | | **27.4** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.73 | | 0.73 |
| 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 | | **413.1** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 1.19 | nettodsn. | 1.19 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-15.4** | ULS 1a_90 | 35.4 | 37.7 | 51.8 | 0.43 | | **4.3** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 41.4 | 0.11 | | 0.43 |
| 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 | | **0.5** | ULS 1a_90 | 44.9 | 37.7 | 39.7 | 0.01 | | 0.01 |
| 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 7 | 44.9 | 37.7 | 34.4 | 0.02 | | 0.02 |
| 423 | Tweede DWSRM - raised horiz under 4 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 87 | **0.0** | ULS 1a_0,9_0,9_90 | 74.7 | 37.7 | 51.8 | 0.00 | | **1.4** | ULS 1a_90 | 44.9 | 37.7 | 31.7 | 0.04 | | 0.04 |
| 104A | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | ### | 1.00 | 103 | **-106.0** | ULS 3_45 | 413.3 | 169.4 | 259.2 | 0.63 | | **0.0** | | 343.1 | 169.4 | 208.5 | 0.00 | | 0.63 |
| 104B | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | 9.78 | 1.00 | 102 | **-70.4** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.42 | | **0.0** | | 431.8 | 169.4 | 221.5 | 0.00 | | 0.42 |
| 104C | Tweede DWSRM - main member raised | 150x150x10 | S235 | | 1.00 | 1.01 | 1.00 | 152 | **-105.1** | ULS 3_45 | 221.6 | 0.0 | 0.0 | 0.47 | | **0.0** | | 688.6 | 0.0 | 0.0 | 0.00 | | 0.47 |
| 424 | Tweede DWSRM - horiz at end of raised | HEB160 | S235 | 2M16-5.6t | 2.00 | 2.00 | 2.00 | 22 | **-8.8** | 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 | | 0.53 |
| 425 | Tweede DWSRM - raised DS A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 132 | **-4.3** | ULS 1a_0 | 37.2 | 37.7 | 43.2 | 0.11 | | **2.3** | ULS 1a_0,9_135 | 37.4 | 37.7 | 22.0 | 0.10 | | 0.11 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.1** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | | **1.2** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.05 | | 0.05 |
| 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 12 | 16.1 | 37.7 | 43.2 | 0.26 | | **2.2** | ULS 5a Ah 12 | 37.4 | 37.7 | 22.0 | 0.10 | | 0.26 |
| 428 | Tweede DWSRM - raised DS B-B horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 120 | **-5.0** | ULS 1a_45 | 43.6 | 37.7 | 43.2 | 0.13 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.13 |
| 429 | Tweede DWSRM - CD top 1 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 208 | **-14.9** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.40 | | **17.4** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.46 | | 0.46 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-16.7** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.44 | | **14.3** | ULS 1a_0,9_0,9_0 | 84.7 | 37.7 | 44.8 | 0.38 | | 0.44 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-14.0** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.37 | | **16.5** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.44 | | 0.44 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-13.4** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.36 | | **16.5** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.49 | | 0.49 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-15.5** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.41 | | **12.2** | ULS 1a_0,9_0,9_0 | 55.3 | 37.7 | 33.6 | 0.36 | | 0.41 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-11.9** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.31 | | **16.0** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.48 | | 0.48 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-16.8** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.66 | | **11.8** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.54 | | 0.66 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-10.3** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.32 | | **15.5** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.70 | | 0.70 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.5** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.32 | | **14.3** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.65 | | 0.65 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-13.4** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.36 | | **9.4** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.43 | | 0.43 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-8.3** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.22 | | **12.9** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.58 | | 0.58 |
| 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 | | 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 | | 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 | | **468.2** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 1.35 | nettodsn. | 1.35 |
| 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 | 0.61 | | **0.0** | | 55.3 | 37.7 | 33.6 | 0.00 | | 0.61 |
| 105A | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.00 | 1.47 | 1.00 | 124 | **-200.2** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.64 | | **200.5** | ULS 1a_0,9_0 | 410.9 | 506.7 | 738.6 | 0.49 | | 0.64 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-141.5** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.46 | | **188.8** | ULS 1a_0 | 615.9 | 508.3 | 797.5 | 0.37 | | 0.46 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12 | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-178.1** | ULS 1a_0,9_0,9_0 | 312.3 | 0.0 | 0.0 | 0.57 | | **210.8** | ULS 1a_0 | 705.0 | 0.0 | 0.0 | 0.30 | | 0.57 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-78.3** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.42 | | **224.2** | ULS 1a_0 | 362.9 | 593.0 | 775.4 | 0.62 | | 0.62 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-27.8** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.18 | | **149.6** | ULS 1a_45 | 362.9 | 338.9 | 443.1 | 0.44 | | 0.44 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-57.9** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.31 | | **207.9** | ULS 1a_0 | 451.2 | 0.0 | 0.0 | 0.46 | | 0.46 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-11.9** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.12 | | **127.9** | ULS 1a_45 | 228.6 | 235.2 | 302.4 | 0.56 | | 0.56 |
| 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 | | **64.7** | ULS 1a_45 | 196.1 | 75.4 | 121.0 | 0.86 | | 0.86 |
| 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 | | **84.0** | ULS 1a_45 | 279.7 | 0.0 | 0.0 | 0.30 | | 0.30 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.1** | ULS 5a Ah 3 | 37.3 | 37.7 | 43.2 | 0.22 | | **11.3** | ULS 5a Ba 3 | 37.4 | 37.7 | 22.0 | 0.51 | | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16 | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-550.8** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.81 | | **341.6** | ULS 1a_0,9_0,9_45 | 1220.3 | 677.8 | 1417.8 | 0.50 | | 0.81 |
| 108B | Elfde TSNSTK - Main member | 180x180x16 | S235 | 12M24-5.6t | 0.51 | 0.51 | 0.51 | 56 | **-853.9** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.85 | | **630.8** | ULS 1a_0,9_0,9_45 | 1220.3 | 999.7 | 2126.8 | 0.63 | | 0.85 |
| 108C | Elfde TSNSTK - Main member | 180x180x16 | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-718.9** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.63 | | **470.8** | ULS 1a_0,9_0,9_45 | 1301.9 | 0.0 | 0.0 | 0.36 | | 0.63 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-95.4** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.56 | | **62.0** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.37 | | 0.56 |
| 207T | Elfde TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-83.3** | ULS 5a Ba 22 | 255.9 | 169.4 | 285.1 | 0.49 | | **92.0** | ULS 5a Ah 22 | 306.2 | 169.4 | 236.8 | 0.54 | | 0.54 |
| 208L | Elfde TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-62.5** | ULS 1a_0,9_0,9_90 | 251.2 | 169.4 | 285.1 | 0.37 | | **95.2** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.56 | | 0.56 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.4** | ULS 5a Ah 22 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.6** | ULS 5a Ba 22 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.52 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-98.4** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.58 | | **62.2** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.37 | | 0.58 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-77.0** | ULS 5a Ba 22 | 243.6 | 169.4 | 285.1 | 0.45 | | **85.8** | ULS 5a Ah 22 | 306.2 | 169.4 | 236.8 | 0.51 | | 0.51 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | 8M30-5.6t | 0.52 | 0.52 | 0.52 | 52 | **-1033.8** | ULS 1a_45 | 1590.7 | 1077.1 | 2592.0 | 0.96 | | **755.0** | ULS 1a_0,9_0,9_45 | 1638.1 | 1077.1 | 2094.5 | 0.70 | | 0.96 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6t | 0.52 | 0.52 | 0.52 | 53 | **-1210.5** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.77 | | **776.5** | ULS 1a_0,9_0,9_45 | 1638.1 | 1588.8 | 3194.2 | 0.49 | | 0.77 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-63.3** | ULS 1a_0,9_0,9_90 | 238.9 | 169.4 | 285.1 | 0.37 | | **102.7** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.61 | | 0.61 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**53**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-83.0** | ULS 5a Ah 22 | 238.9 | 169.4 | 285.1 | 0.49 | | **73.2** | ULS 5a Ba 22 | 306.2 | 169.4 | 236.8 | 0.43 | | 0.49 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-108.9** | ULS 1a_0,9_0,9_45 | 230.6 | 169.4 | 285.1 | 0.64 | | **131.4** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.78 | | 0.78 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-119.9** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.71 | | **79.6** | ULS 1a_0,9_0,9_45 | 306.2 | 169.4 | 236.8 | 0.47 | | 0.71 |
| 212L | Tiende TSNSTK - upper horiz lower CA fi | 150x150x10 | S235 | 7M24-5.6t | 1.00 | 1.00 | 1.00 | 162 | **0.0** | | 222.3 | 578.2 | 907.2 | 0.00 | | **389.0** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.93 | | 0.93 |
| 212T | Tiende TSNSTK - upper horiz lower CA s | 80x80x8 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 308 | **-49.1** | ULS 1a_90 | 36.4 | 117.6 | 172.8 | 1.35 | knik | **31.4** | ULS 1a_0,9_0,9_90 | 212.5 | 117.6 | 139.6 | 0.27 | | 1.35 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 2.00 | 1.00 | 82 | **-435.4** | ULS 5a Ba 11 | 1194.7 | 906.5 | 2799.4 | 0.48 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.48 |
| 213 | Tiende TSNSTK - lower horiz lower CA si | 110x110x10 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 148 | **-8.9** | ULS 5a Ah 21 | 168.8 | 235.2 | 432.0 | 0.05 | | **88.0** | ULS 5a Ah 21 | 433.4 | 235.2 | 349.1 | 0.37 | | 0.37 |
| 214 | Tiende TSNSTK - Diaphragm diagonal | 130x130x12 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 139 | **-60.8** | ULS 5a Ba 11 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.7** | ULS 5a Ba 11 | 379.7 | 117.6 | 209.5 | 0.53 | | 0.53 |
| 215 | Tiende TSNSTK - Diaphragm horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 321 | **-2.4** | ULS 3_90 | 27.3 | 58.8 | 86.4 | 0.09 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 | | 0.09 |
| 300 | Eerste DWSRM - CD under 1 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 146 | **-21.2** | ULS 5a Ah 20 | 106.2 | 58.8 | 86.4 | 0.36 | | **19.3** | ULS 5a Ba 10 | 179.7 | 58.8 | 69.8 | 0.33 | | 0.36 |
| 301 | Eerste DWSRM - CD under 2 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 136 | **-20.9** | ULS 5a Ah 10 | 116.1 | 58.8 | 86.4 | 0.36 | | **26.6** | ULS 5a Ba 20 | 179.7 | 58.8 | 69.8 | 0.45 | | 0.45 |
| 302 | Eerste DWSRM - CD under 3 | 100x100x8 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 128 | **-32.9** | ULS 5a Ba 10 | 123.5 | 58.8 | 86.4 | 0.56 | | **22.6** | ULS 5a Ah 10 | 179.7 | 58.8 | 69.8 | 0.38 | | 0.56 |
| 303 | Eerste DWSRM - CD under 4 | 100x100x8 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-27.5** | ULS 5a Ba 20 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 10 | 179.7 | 58.8 | 69.8 | 0.29 | | 0.47 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-13.3** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.26 | | **9.3** | ULS 1a_0,9_0,9_0 | 86.7 | 58.8 | 59.5 | 0.16 | | 0.26 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.4** | ULS 1a_0,9_0,9_0 | 59.5 | 58.8 | 75.6 | 0.18 | | **11.8** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.20 | | 0.20 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 21 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 11 | 86.7 | 58.8 | 59.5 | 0.21 | | 0.22 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 11 | 70.4 | 58.8 | 75.6 | 0.25 | | **16.5** | ULS 5a Ba 21 | 86.7 | 58.8 | 59.5 | 0.28 | | 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 21 | 61.4 | 58.8 | 64.8 | 0.30 | | **17.3** | ULS 5a Ah 11 | 65.7 | 58.8 | 44.4 | 0.39 | | 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 11 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.53 | | 0.53 |
| 310 | Eerste DWSRM - CD under 11 | 65x65x7 | S235 | 2M20-5.6t | 0.56 | 0.56 | 0.56 | 95 | **-32.1** | ULS 5a Ba 21 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 11 | 99.4 | 117.6 | 104.2 | 0.26 | | 0.28 |
| 311 | Eerste DWSRM - CD under 12 | 65x65x7 | S235 | 1M20-5.6t | 0.55 | 0.55 | 0.55 | 72 | **-36.5** | ULS 5a Ba 21 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 11 | 86.7 | 58.8 | 59.5 | 0.36 | | 0.62 |
| 312 | Eerste DWSRM - 1st & 2nd horiz under | HEB240 | S235 | 2M20-5.6t | 2.00 | 2.00 | 2.00 | 56 | **-18.4** | ULS 5a Ba 10 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | ULS 5a Ba 20 | 2249.6 | 117.6 | 0.0 | 0.28 | | 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 11 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.8** | ULS 5a Ba 11 | 1626.6 | 117.6 | 0.0 | 0.27 | | 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 | | **71.3** | ULS 3_135 | 99.4 | 117.6 | 119.1 | 0.72 | | 0.72 |
| 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 | | **94.6** | ULS 3_0 | 99.4 | 117.6 | 119.1 | 0.95 | | 0.95 |
| 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 | | **34.3** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 | | 0.91 |
| 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 | | **37.5** | ULS 1a_0 | 72.6 | 37.7 | 38.4 | 1.00 | | 1.00 |
| 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 | | **37.2** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.99 | | 0.99 |
| 319 | Eerste DWSRM - front vert 1 | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-42.9** | ULS 3_0 | 91.7 | 58.8 | 86.4 | 0.73 | | **0.0** | | 179.7 | 58.8 | 69.8 | 0.00 | | 0.73 |
| 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 | | 0.61 |
| 321 | Eerste DWSRM - front vert 3 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-13.9** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.58 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.58 |
| 322 | Eerste DWSRM - front vert 4 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 112 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **0.0** | | 44.9 | 37.7 | 26.5 | 0.00 | | 0.23 |
| 323 | Eerste DWSRM - front vert 5 | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 63 | **-3.7** | ULS 3_90 | 60.9 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | | 0.10 |
| 324 | Eerste DWSRM - Doorsnede A-A diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 306 | **-5.8** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.51 | | **3.5** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.16 | | 0.51 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.2** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.1** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.09 | | 0.11 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.1** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.23 | | **2.5** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.11 | | 0.23 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz to | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.8** | ULS 1a_0,9_0,9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.6** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.07 | | 0.07 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 1.70 | 1.00 | 71 | **-485.1** | ULS 5a Ba 11 | 1289.1 | 906.5 | 2799.4 | 0.54 | | **0.0** | | 1548.5 | 906.5 | 2392.6 | 0.00 | | 0.54 |
| 110B | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 8M24-5.6t | 2.53 | 1.40 | 1.00 | 57 | **-341.2** | ULS 5a Ba 21 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.7** | ULS 5a Ah 11 | 1548.5 | 677.8 | 1595.1 | 0.01 | | 0.50 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-480.7** | ULS 5a Ba 11 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.6** | ULS 5a Ah 11 | 1623.9 | 0.0 | 0.0 | 0.01 | | 0.37 |
| 111A | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | 8M24-5.6t | 3.53 | 6.36 | 1.00 | 72 | **-316.7** | ULS 5a Ba 21 | 869.0 | 677.8 | 1555.2 | 0.47 | | **32.4** | ULS 5a Ah 11 | 1008.5 | 677.8 | 1329.2 | 0.05 | | 0.47 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-198.3** | ULS 3_90 | 869.3 | 0.0 | 0.0 | 0.23 | | **0.0** | | 1097.7 | 0.0 | 0.0 | 0.00 | | 0.23 |
| 111C | Eerste DWSRM - Main member bottom 1 | 160x160x15 | S235 | | 1.80 | 1.00 | 1.00 | 72 | **-302.7** | ULS 5a Ba 21 | 869.1 | 0.0 | 0.0 | 0.35 | | **26.8** | ULS 5a Ah 11 | 1097.7 | 0.0 | 0.0 | 0.02 | | 0.35 |
| 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 | | **370.0** | ULS 3_90 | 422.8 | 504.1 | 796.6 | 0.88 | | 0.88 |
| 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 | | **265.7** | ULS 3_90 | 615.9 | 423.6 | 664.6 | 0.63 | | 0.63 |
| 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 | | **292.2** | ULS 3_90 | 705.0 | 0.0 | 0.0 | 0.41 | | 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 | | **238.9** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.58 | | 0.58 |
| 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 | | **204.1** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.70 | | 0.70 |
| 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 | | **203.7** | ULS 3_135 | 496.3 | 0.0 | 0.0 | 0.41 | | 0.41 |
| 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 | | 0.02 |
| 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 | | 0.00 |
| 114A | Negende TSNSTK - Main member | 250x250x22 | S235 | 14M30-5.6t | 0.52 | 0.52 | 0.52 | 35 | **-1570.1** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.83 | | **1093.9** | ULS 1a_0,9_0,9_45 | 2373.8 | 1885.0 | 4032.0 | 0.58 | | 0.83 |
| 114B | Negende TSNSTK - Main member | 250x250x22 | S235 | 18M30-5.6t | 0.52 | 0.52 | 0.52 | 36 | **-1978.5** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.84 | | **1462.2** | ULS 1a_0,9_0,9_45 | 2373.8 | 2423.5 | 4626.7 | 0.62 | | 0.84 |
| 114C | Negende TSNSTK - Main member | 250x250x22 | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-1975.6** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.83 | | **1465.8** | ULS 1a_0,9_0,9_45 | 2493.4 | 0.0 | 0.0 | 0.59 | | 0.83 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-225.0** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.84 | | **197.0** | ULS 1a_0,9_0,9_90 | 250.2 | 269.3 | 314.2 | 0.79 | | 0.84 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-161.8** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.60 | | **155.6** | ULS 1a_0,9_0 | 250.2 | 269.3 | 314.2 | 0.62 | | 0.62 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-203.5** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.76 | | **209.5** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.84 | | 0.84 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-164.4** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.61 | | **152.1** | ULS 1a_0,9_0,9_0 | 250.2 | 269.3 | 314.2 | 0.61 | | 0.61 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.4** | ULS 5a Ah 21 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 11 | 109.4 | 75.4 | 89.6 | 0.15 | | 0.32 |
| 219 | Negende TSNSTK - Diaphragm K CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 239 | **-0.3** | 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 | | 0.01 |
| 220L | Negende TSNSTK - Diaphragm K horiz fr | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-13.7** | ULS 1a_0,9_45 | 43.6 | 37.7 | 60.5 | 0.36 | | **14.2** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.38 | | 0.38 |
| 220T | Negende TSNSTK - Diaphragm K horiz s | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-10.5** | ULS 1a_0,9_0,9_135 | 43.6 | 37.7 | 60.5 | 0.28 | | **16.2** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.43 | | 0.43 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.6** | ULS 1a_135 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.5** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 | | 0.05 |
| 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 | | 0.00 |
| 223L | Negende TSNSTK - Diaphragm L horiz fr | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-16.0** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.42 | | **17.7** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.47 | | 0.47 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-15.8** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.42 | | **17.2** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.46 | | 0.46 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-217.5** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.81 | | **198.7** | ULS 1a_0,9_0,9_90 | 348.4 | 269.3 | 314.2 | 0.74 | | 0.81 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-165.2** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.61 | | **160.6** | ULS 1a_0,9_0 | 348.4 | 269.3 | 314.2 | 0.60 | | 0.61 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-22.7** | ULS 1a_0,9_0,9_45 | 55.7 | 37.7 | 60.5 | 0.60 | | **24.7** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.66 | | 0.66 |
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-22.2** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.59 | | **24.7** | ULS 1a_90 | 114.9 | 37.7 | 44.8 | 0.66 | | 0.66 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-1.9** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.06 | | **4.4** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.06 | | 0.06 |
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | | 0.01 |
| 228L | Achtste TSNSTK - Diag fr 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-204.3** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.76 | | **198.4** | ULS 1a_0,9_90 | 347.2 | 269.3 | 261.8 | 0.76 | | 0.76 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-172.4** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.64 | | **157.2** | ULS 1a_0,9_0,9_135 | 347.2 | 269.3 | 261.8 | 0.60 | | 0.64 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-16.6** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.44 | | **16.7** | ULS 1a_45 | 142.8 | 37.7 | 51.2 | 0.44 | | 0.44 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-16.9** | ULS 1a_0,9_0,9_45 | 61.0 | 37.7 | 69.1 | 0.45 | | **16.7** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.44 | | 0.45 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-2.8** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.10 | | **5.9** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.08 | | 0.10 |
| 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 | | **0.2** | ULS 1a_0,9_90 | 75.4 | 113.0 | 100.9 | 0.00 | | 0.01 |
| 115A | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2420.7** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.76 | | **1888.3** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.53 | | 0.76 |
| 115B | Achtste TSNSTK - Main member | 200x200x20 | S235 | 28M30-5.6t | 0.52 | 0.52 | 1.05 | 47 | **-2801.2** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.88 | | **2230.7** | ULS 1a_0,9_0,9_45 | 3615.8 | 3628.5 | 6542.8 | 0.62 | | 0.88 |
| 115C | Achtste TSNSTK - Main member | 200x200x20 | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2797.2** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.88 | | **2235.1** | ULS 1a_0,9_0,9_45 | 3588.5 | 0.0 | 0.0 | 0.62 | | 0.88 |
| 116A | Zevende TSNSTK - Main member | 250x250x20 | S235 | 28M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3061.5** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.84 | | **2485.8** | ULS 1a_0,9_0,9_45 | 4683.7 | 3628.5 | 7330.9 | 0.69 | | 0.84 |
| 116B | Zevende TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.60 | 60 | **-3403.4** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 0.91 | | **2718.3** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.67 | | 0.91 |
| 117A | Zesde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 59 | **-3419.1** | ULS 1a_45 | 3738.1 | 4075.1 | 10368.0 | 0.91 | | **2699.5** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.66 | | 0.91 |
| 117B | Zesde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3521.7** | ULS 1a_45 | 3722.2 | 4503.7 | 11664.0 | 0.95 | | **2789.8** | ULS 1a_0,9_0,9_45 | 4341.6 | 4503.7 | 9425.5 | 0.64 | | 0.95 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.25 | 0.25 | 0.73 | 60 | **-3604.8** | ULS 1a_45 | 3731.6 | 4075.1 | 10368.0 | 0.97 | | **2864.8** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.70 | | 0.97 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3686.4** | ULS 1a_45 | 3755.7 | 4075.1 | 10368.0 | 0.98 | | **2861.2** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.70 | | 0.98 |
| 119A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 60 | **-3699.5** | ULS 1a_45 | 3732.3 | 4075.1 | 10368.0 | 0.99 | | **2843.6** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.70 | | 0.99 |
| 119B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3669.7** | ULS 1a_45 | 3740.5 | 4075.1 | 10368.0 | 0.98 | | **2803.3** | ULS 1a_0,9_0,9_135 | 4683.7 | 4075.1 | 8378.2 | 0.69 | | 0.98 |
| 120A | Vierde TSNSTK - Main member | 250x250x20 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.38 | 60 | **-3680.8** | ULS 1a_45 | 3723.6 | 4075.1 | 10368.0 | 0.99 | | **2796.2** | ULS 1a_0,9_0,9_45 | 4683.7 | 4075.1 | 8378.2 | 0.69 | | 0.99 |
| 120B | Vierde TSNSTK - Main member | 250x250x20 | S235 | 36M30-5.6t | 0.50 | 0.50 | 1.54 | 60 | **-3764.2** | ULS 1a_45 | 3730.6 | 4503.7 | 11664.0 | 1.01 | knik | **2848.4** | ULS 1a_0,9_0,9_45 | 4683.7 | 4503.7 | 9425.5 | 0.63 | | 1.01 |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**53**

| 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) | U.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3806.8** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.70 | | **2840.7** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.50 | | 0.70 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3770.3** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.69 | | **2716.5** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.47 | | 0.69 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 65 | **-3807.7** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.70 | | **2675.7** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.47 | | 0.70 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 66 | **-3834.9** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.71 | | **2654.9** | ULS 1a_0,9_0,9_45 | 7183.8 | 5723.4 | 6460.1 | 0.46 | | 0.71 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 | | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-140.1** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 1.04 | afschuiving | **98.2** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.75 | | 1.04 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-126.2** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 0.94 | | **93.4** | ULS 1a_0,9_0,9_45 | 193.0 | 134.6 | 130.9 | 0.71 | | 0.94 |
| 236L | Zevende TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 135 | **-65.7** | ULS 1a_0,9_0,9_135 | 197.0 | 169.4 | 259.2 | 0.39 | | **92.1** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.54 | | 0.54 |
| 236T | Zevende TSNSTK - Diag si 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 137 | **-62.7** | ULS 5a Ba 11 | 194.1 | 169.4 | 259.2 | 0.37 | | **82.5** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.49 | | 0.49 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.2** | ULS 1a_0,9_0,9_45 | 87.9 | 58.8 | 86.4 | 0.55 | | **30.3** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.52 | | 0.55 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.2** | ULS 1a_0,9_0,9_135 | 87.9 | 58.8 | 86.4 | 0.55 | | **30.2** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.51 | | 0.55 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-6.8** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.27 | | **14.2** | ULS 1a_0,9_45 | 133.6 | 58.8 | 69.8 | 0.24 | | 0.27 |
| 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 | | 0.03 |
| 240L | Zesde TSNSTK - Diag fr 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-104.1** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.77 | | **107.6** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.82 | | 0.82 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 140 | **-99.2** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.74 | | **98.6** | ULS 1a_0,9_45 | 193.0 | 134.6 | 130.9 | 0.75 | | 0.75 |
| 241L | Zesde TSNSTK - CD 1 front | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-111.9** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.83 | | **100.1** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.76 | | 0.83 |
| 241T | Zesde TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-105.2** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.78 | | **95.5** | ULS 1a_0,9_0,9_135 | 193.0 | 134.6 | 130.9 | 0.73 | | 0.78 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-88.0** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.04 | afschuiving | **43.5** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.51 | | 1.04 |
| 242T | Vijfde TSNSTK - CD 1 side | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 176 | **-93.9** | ULS 1a_135 | 98.5 | 84.7 | 129.6 | 1.11 | afschuiving | **47.6** | ULS 1a_0,9_0,9_45 | 184.3 | 84.7 | 110.8 | 0.56 | | 1.11 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.7** | ULS 5a Ah 21 | 106.8 | 84.7 | 129.6 | 0.35 | | **51.7** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.61 | | 0.61 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-27.2** | ULS 1a_0,9_0,9_135 | 106.8 | 84.7 | 129.6 | 0.32 | | **55.9** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.66 | | 0.66 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 | | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 | | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 | | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-43.1** | ULS 5a Ah 21 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.7** | ULS 5a Ah 11 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.51 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-40.0** | ULS 5a Ah 21 | 87.5 | 84.7 | 129.6 | 0.47 | | **35.4** | ULS 5a Ba 11 | 184.3 | 84.7 | 110.8 | 0.42 | | 0.47 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-41.6** | ULS 1a_45 | 77.2 | 84.7 | 129.6 | 0.54 | | **32.9** | ULS 1a_0,9_0,9_135 | 184.3 | 84.7 | 110.8 | 0.39 | | 0.54 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-40.9** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.53 | | **30.5** | ULS 1a_0,9_0,9_90 | 184.3 | 84.7 | 110.8 | 0.36 | | 0.53 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.3** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.41 | | **23.0** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.39 | | 0.41 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.4** | ULS 1a_0,9_0,9_45 | 100.3 | 58.8 | 118.8 | 0.42 | | **23.3** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.40 | | 0.42 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-8.2** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.36 | | **13.3** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.23 | | 0.36 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-29.3** | ULS 1a_0,9_0,9_135 | 80.2 | 84.7 | 129.6 | 0.37 | | **33.9** | ULS 1a_45 | 184.3 | 84.7 | 110.8 | 0.40 | | 0.40 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-26.4** | ULS 1a_0,9_0,9_45 | 80.2 | 84.7 | 129.6 | 0.33 | | **32.0** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.38 | | 0.38 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-76.9** | ULS 1a_135 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.3** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.08 | | 0.14 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22 | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-76.8** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.4** | ULS 1a_0,9_0,9_135 | 1494.6 | 538.6 | 960.0 | 0.08 | | 0.14 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-56.6** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.33 | | **21.1** | ULS 1a_0,9_90 | 760.6 | 169.4 | 354.5 | 0.12 | | 0.33 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-51.5** | ULS 5a Ba 12 | 361.1 | 169.4 | 414.7 | 0.30 | | **15.8** | ULS 5a Ba 12 | 760.6 | 169.4 | 354.5 | 0.09 | | 0.30 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-40.9** | ULS 1a_0,9_135 | 361.1 | 169.4 | 414.7 | 0.24 | | **62.5** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.37 | | 0.37 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-43.1** | ULS 1a_0,9_45 | 361.1 | 169.4 | 414.7 | 0.25 | | **64.5** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.38 | | 0.38 |
| 255L | Broekstuk - Horizontal front | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.3** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.20 | | **18.3** | ULS 1a_0,9_135 | 692.4 | 169.4 | 354.5 | 0.11 | | 0.20 |
| 255T | Broekstuk - Horizontal side | 180x180x16 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.5** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.20 | | **18.4** | ULS 1a_0,9_45 | 692.4 | 169.4 | 354.5 | 0.11 | | 0.20 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-59.0** | ULS 1a_45 | 290.1 | 169.4 | 259.2 | 0.35 | | **29.1** | ULS 1a_0,9_0,9_135 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.35 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-64.0** | ULS 5a Ba 12 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.8** | ULS 5a Ba 12 | 431.8 | 169.4 | 221.5 | 0.17 | | 0.38 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-10.7** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.24 | | **12.0** | ULS 1a_0,9_135 | 347.3 | 176.4 | 222.5 | 0.07 | | 0.24 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.5 | 117.6 | 172.8 | 0.04 | | **0.0** | | 277.0 | 117.6 | 139.6 | 0.00 | | 0.04 |
| 263 | Broekstuk - Diag D-D | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 403 | **-13.3** | ULS 1a_45 | 20.7 | 58.8 | 86.4 | 0.64 | | **10.8** | ULS 1a_0,9_135 | 179.7 | 58.8 | 69.8 | 0.18 | | 0.64 |
| 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 | | 0.21 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 412 | **-15.7** | ULS 5a Ba 22 | 46.6 | 0.0 | 0.0 | 0.34 | | **15.0** | ULS 5a Ba 22 | 599.7 | 0.0 | 0.0 | 0.03 | | 0.34 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**53**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main Member | 150x150x10 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 70 | **-124.1** | ULS 5a Ah 12 | 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 | **-418.5** | ULS 1a_45 | 563.0 | 508.3 | 777.6 | 0.82 | | **192.2** | ULS 1a_0,9_0,9_45 | 624.7 | 508.3 | 664.6 | 0.38 |
| 100C | BVNSTK - Main Member | 150x150x10 | S235 | | 0.52 | 0.52 | 0.52 | 67 | **-250.2** | ULS 1a_45 | 563.0 | 0.0 | 0.0 | 0.44 | | **68.1** | ULS 1a_0,9_0,9_45 | 688.6 | 0.0 | 0.0 | 0.10 |
| 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 | | **434.7** | ULS 3_45 | 346.4 | 506.7 | 677.1 | 0.78 |
| 200T | BVNSTK - first horiz from top side | 120x120x11 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 164 | **-5.4** | ULS 1a_0,9_90 | 190.2 | 117.6 | 237.6 | 0.05 | | **5.0** | ULS 1a_90 | 360.5 | 117.6 | 237.6 | 0.04 |
| 201L | BVNSTK - CD 1 from top front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-36.7** | ULS 5a Ah 12 | 263.5 | 169.4 | 285.1 | 0.22 | | **57.2** | ULS 1a_45 | 306.2 | 169.4 | 243.7 | 0.34 |
| 201T | BVNSTK - CD 1 from top side | 120x120x11 | S235 | 1M24-5.6t | 1.00 | 0.52 | 0.52 | 153 | **-39.3** | ULS 5a Ah 12 | 165.0 | 84.7 | 142.6 | 0.46 | | **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 | **-677.7** | ULS 1a_0 | 1338.3 | 1066.2 | 3265.9 | 0.64 | | **0.0** | | 1548.5 | 1066.2 | 2623.9 | 0.00 |
| 202T | BVNSTK - lower horiz lower CA side | 100x100x8 | S235 | 4M20-5.6t | 1.00 | 2.00 | 1.00 | 131 | **-13.1** | ULS 5a Ah 12 | 143.1 | 235.2 | 345.6 | 0.09 | | **78.5** | ULS 5a Ah 12 | 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 | **-99.9** | ULS 5a Ah 12 | 265.5 | 169.4 | 285.1 | 0.59 | | **65.5** | ULS 5a Ah 12 | 291.2 | 169.4 | 229.3 | 0.39 |
| 203T | BVNSTK - CD 2 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 123 | **-90.5** | ULS 5a Ba 22 | 265.5 | 169.4 | 285.1 | 0.53 | | **101.4** | ULS 5a Ah 12 | 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 | **-63.4** | ULS 5a Ah 12 | 260.7 | 169.4 | 285.1 | 0.37 | | **94.7** | ULS 5a Ah 12 | 291.2 | 169.4 | 229.3 | 0.56 |
| 204T | BVNSTK - CD 3 from top side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 125 | **-96.5** | ULS 5a Ah 12 | 260.7 | 169.4 | 285.1 | 0.57 | | **86.9** | ULS 5a Ba 22 | 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 Ba 12 | 205.7 | 117.6 | 216.0 | 0.47 | | **56.4** | ULS 5a Ba 12 | 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 | 0.08 | | **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 | **-18.4** | ULS 5a Ah 12 | 71.4 | 58.8 | 86.4 | 0.31 | | **14.3** | ULS 5a Ba 22 | 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 | **-17.7** | ULS 5a Ba 22 | 78.4 | 58.8 | 86.4 | 0.30 | | **21.9** | ULS 5a Ah 12 | 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 | **-24.2** | ULS 5a Ah 12 | 84.2 | 58.8 | 86.4 | 0.41 | | **21.4** | ULS 5a Ba 22 | 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 22 | 107.3 | 58.8 | 86.4 | 0.39 | | **21.8** | ULS 5a Ah 12 | 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 12 | 113.3 | 58.8 | 86.4 | 0.37 | | **29.6** | ULS 5a Ba 22 | 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 | **-38.2** | ULS 5a Ba 22 | 116.1 | 58.8 | 86.4 | 0.65 | | **21.8** | ULS 5a Ah 12 | 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 | **-38.4** | ULS 5a Ba 22 | 142.3 | 58.8 | 86.4 | 0.65 | | **8.5** | ULS 5a Ah 12 | 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 12 | 1434.3 | 117.6 | 324.0 | 0.09 | | **42.7** | ULS 5a Ba 22 | 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 | | **15.1** | 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 | **-6.4** | ULS 1a_45 | 30.4 | 37.7 | 43.2 | 0.21 | | **9.4** | ULS 1a_0 | 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 | **-13.1** | ULS 1a_135 | 18.3 | 37.7 | 51.8 | 0.72 | | **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 | **-11.7** | ULS 1a_45 | 17.7 | 37.7 | 43.2 | 0.66 | | **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 | **-7.7** | 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 | **-496.9** | ULS 5a Ba 22 | 1211.0 | 1066.2 | 3265.9 | 0.47 | | **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 | **-476.3** | ULS 3_135 | 1237.8 | 677.8 | 1866.2 | 0.70 | | **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 | **-483.2** | ULS 3_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 | **-460.5** | ULS 3_135 | 1063.9 | 677.8 | 1658.9 | 0.68 | | **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 | **-445.0** | ULS 3_90 | 1055.4 | 574.5 | 1451.5 | 0.77 | | **0.0** | | 828.7 | 574.5 | 1343.7 | 0.00 |
| 103C | Tweede DWSRM - Main member 2 | 180x180x16# | S235 | | 5.59 | ### | 1.00 | 68 | **-461.6** | ULS 3_135 | 1055.8 | 0.0 | 0.0 | 0.44 | | **0.0** | | 1301.9 | 0.0 | 0.0 | 0.00 |
| 414 | Tweede DWSRM - front diag 1 | **90x90x9** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 266 | **-31.5** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.63 | | **0.0** | | 148.2 | 60.3 | 78.4 | 0.00 |
| 415 | Tweede DWSRM - front diag 2 | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 243 | **-39.0** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.84 | | **0.0** | | 131.7 | 60.3 | 69.7 | 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 | | **21.8** | ULS 1a_45 | 84.7 | 37.7 | 44.8 | 0.58 |
| 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 | | **27.7** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.73 |
| 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 | | **415.8** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 0.75 |
| 420 | Tweede DWSRM - raised horiz under 1 | 75x50x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 189 | **-15.4** | ULS 1a_90 | 35.4 | 37.7 | 51.8 | 0.43 | | **4.3** | ULS 1a_0,9_0,9_90 | 44.9 | 37.7 | 41.4 | 0.11 |
| 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 | 0.01 |
| 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 7 | 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 | **0.0** | ULS 1a_0,9_0,9_90 | 74.7 | 37.7 | 51.8 | 0.00 | | **1.4** | ULS 1a_90 | 44.9 | 37.7 | 31.7 | 0.04 |
| 104A | Tweede DWSRM - main member raised | 150x150x10 | S235 | 2M24-5.6t | 1.00 | ### | 1.00 | 103 | **-106.8** | ULS 3_45 | 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 | **-70.9** | ULS 1a_45 | 416.7 | 169.4 | 259.2 | 0.42 | | **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 | **-105.9** | ULS 3_45 | 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 | **-8.8** | 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 | **-4.3** | ULS 1a_0 | 37.2 | 37.7 | 43.2 | 0.12 | | **2.3** | ULS 1a_0,9_135 | 37.4 | 37.7 | 22.0 | 0.10 |
| 426 | Tweede DWSRM - raised DS A-A horiz | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 70 | **-1.2** | ULS 1a_0,9_0 | 69.2 | 37.7 | 43.2 | 0.03 | | **1.2** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.05 |
| 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 12 | 16.1 | 37.7 | 43.2 | 0.26 | | **2.1** | ULS 5a Ah 12 | 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 | **-5.0** | ULS 1a_45 | 43.6 | 37.7 | 43.2 | 0.13 | | **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 | **-15.1** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 60.5 | 0.40 | | **17.6** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.47 |
| 430 | Tweede DWSRM - CD top 2 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 196 | **-16.9** | ULS 1a_0 | 40.9 | 37.7 | 60.5 | 0.45 | | **14.5** | ULS 1a_0,9_0,9_0 | 84.7 | 37.7 | 44.8 | 0.38 |
| 431 | Tweede DWSRM - CD top 3 | 65x65x7 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 188 | **-14.1** | ULS 1a_0,9_0,9_0 | 43.2 | 37.7 | 60.5 | 0.37 | | **16.6** | ULS 1a_0 | 84.7 | 37.7 | 44.8 | 0.44 |
| 432 | Tweede DWSRM - CD top 4 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 175 | **-13.5** | ULS 1a_0,9_0,9_0 | 37.8 | 37.7 | 51.8 | 0.36 | | **16.7** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.50 |
| 433 | Tweede DWSRM - CD top 5 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 162 | **-15.6** | ULS 1a_0 | 41.8 | 37.7 | 51.8 | 0.42 | | **12.3** | ULS 1a_0,9_0,9_0 | 55.3 | 37.7 | 33.6 | 0.37 |
| 434 | Tweede DWSRM - CD top 6 | 60x60x6 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 161 | **-12.0** | ULS 1a_0,9_0,9_0 | 42.0 | 37.7 | 51.8 | 0.32 | | **16.1** | ULS 1a_0 | 55.3 | 37.7 | 33.6 | 0.48 |
| 435 | Tweede DWSRM - CD top 7 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 180 | **-16.9** | ULS 1a_0 | 25.4 | 37.7 | 43.2 | 0.67 | | **11.9** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.54 |
| 436 | Tweede DWSRM - CD top 8 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 148 | **-10.4** | ULS 1a_0,9_0,9_0 | 32.6 | 37.7 | 43.2 | 0.32 | | **15.7** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.71 |
| 437 | Tweede DWSRM - CD top 9 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.6** | ULS 1a_0,9_0,9_0 | 32.8 | 37.7 | 43.2 | 0.32 | | **14.5** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.66 |
| 438 | Tweede DWSRM - CD top 10 | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 124 | **-13.5** | ULS 1a_0 | 39.8 | 37.7 | 43.2 | 0.36 | | **9.5** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.43 |
| 439 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 106 | **-8.3** | ULS 1a_0,9_0,9_0 | 46.0 | 37.7 | 43.2 | 0.22 | | **13.0** | ULS 1a_0 | 37.4 | 37.7 | 22.0 | 0.59 |
| 440 | Tweede DWSRM - CD top 11 | 50x50x5 | S235 | 1M16-5.6t | 0.54 | 0.54 | 0.54 | 115 | **-11.8** | 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 | | **471.3** | ULS 3_90 | 346.4 | 506.7 | 677.1 | 0.85 |
| 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 | **-202.8** | ULS 1a_0 | 310.9 | 506.7 | 933.1 | 0.65 | | **201.0** | ULS 1a_0,9_0 | 410.9 | 506.7 | 738.6 | 0.49 |
| 105B | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | 6M24-5.6t | 1.50 | 1.00 | 1.00 | 123 | **-142.6** | ULS 1a_0,9_0,9_0 | 308.4 | 508.3 | 933.1 | 0.46 | | **190.6** | ULS 1a_0 | 615.9 | 508.3 | 797.5 | 0.38 |
| 105C | Tweede DWSRM - Main member top 1 | 130x130x12# | S235 | | 3.12 | 2.05 | 1.00 | 116 | **-180.4** | ULS 1a_0,9_0,9_0 | 312.3 | 0.0 | 0.0 | 0.58 | | **212.8** | ULS 1a_0 | 705.0 | 0.0 | 0.0 | 0.30 |
| 106A | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 7M24-5.6t | 1.00 | 1.48 | 1.00 | 130 | **-79.0** | ULS 1a_0,9_0,9_0 | 188.5 | 593.0 | 907.2 | 0.42 | | **226.3** | ULS 1a_0 | 362.9 | 593.0 | 775.4 | 0.62 |
| 106B | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | 4M24-5.6t | 1.00 | 1.77 | 1.00 | 145 | **-28.1** | ULS 1a_0,9_0,9_0 | 157.6 | 338.9 | 518.4 | 0.18 | | **150.7** | ULS 1a_45 | 362.9 | 338.9 | 443.1 | 0.44 |
| 106C | Tweede DWSRM - Main member top 2 | 100x100x10 | S235 | | 2.02 | 3.23 | 1.00 | 126 | **-58.4** | ULS 1a_0,9_0,9_0 | 185.0 | 0.0 | 0.0 | 0.32 | | **209.8** | ULS 1a_0 | 451.2 | 0.0 | 0.0 | 0.46 |
| 107A | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | 4M20-5.6t | 2.31 | 1.00 | 1.00 | 139 | **-12.0** | ULS 1a_0,9_0,9_135 | 102.5 | 235.2 | 302.4 | 0.12 | | **128.9** | ULS 1a_45 | 228.6 | 235.2 | 302.4 | 0.56 |
| 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 | | **65.2** | ULS 1a_45 | 196.1 | 75.4 | 121.0 | 0.86 |
| 107C | Tweede DWSRM - Main member top 3 | 100x75x7 | S235 | | 2.17 | 1.00 | 1.00 | 142 | **-19.0** | ULS 5a Ah 3 | 100.0 | 0.0 | 0.0 | 0.19 | | **84.5** | ULS 1a_45 | 279.7 | 0.0 | 0.0 | 0.30 |
| 444 | Tweede DWSRM - diag top "CD" | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 131 | **-8.0** | ULS 5a Ah 3 | 37.3 | 37.7 | 43.2 | 0.22 | | **11.3** | ULS 5a Ba 3 | 37.4 | 37.7 | 22.0 | 0.51 |
| 108A | Elfde TSNSTK - Main member | 180x180x16# | S235 | 8M24-5.6t | 0.51 | 0.51 | 0.51 | 55 | **-553.7** | ULS 1a_45 | 1135.8 | 677.8 | 1658.9 | 0.82 | | **343.2** | ULS 1a_0,9_0,9_45 | 1220.3 | 677.8 | 1417.8 | 0.51 |
| 108B | Elfde TSNSTK - Main member | 180x180x16# | S235 | 12M24-5.6t | 0.51 | 0.51 | 0.51 | 56 | **-858.0** | ULS 1a_45 | 1127.4 | 999.7 | 2488.3 | 0.86 | | **633.6** | ULS 1a_0,9_0,9_45 | 1220.3 | 999.7 | 2126.8 | 0.63 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**53**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 108C | Elfde TSNSTK - Main member | 180x180x16# | S235 | | 0.51 | 0.51 | 0.51 | 55 | **-722.2** | ULS 1a_45 | 1135.8 | 0.0 | 0.0 | 0.64 | | **472.5** | ULS 1a_0,9_0,9_45 | 1301.9 | 0.0 | 0.0 | 0.36 |
| 207L | Elfde TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-95.6** | ULS 1a_90 | 255.9 | 169.4 | 285.1 | 0.56 | | **62.1** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.37 |
| 207T | Elfde TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 127 | **-83.4** | ULS 5a Ba 22 | 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 | **-62.5** | ULS 1a_0,9_0,9_90 | 251.2 | 169.4 | 285.1 | 0.37 | | **95.4** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.56 |
| 208T | Elfde TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 130 | **-88.2** | ULS 5a Ah 22 | 251.2 | 169.4 | 285.1 | 0.52 | | **79.7** | ULS 5a Ba 22 | 306.2 | 169.4 | 236.8 | 0.47 |
| 209L | Elfde TSNSTK - CD 3 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-98.6** | ULS 1a_90 | 243.6 | 169.4 | 285.1 | 0.58 | | **62.2** | ULS 1a_0,9_0,9_90 | 306.2 | 169.4 | 236.8 | 0.37 |
| 209T | Elfde TSNSTK - CD 3 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 133 | **-77.1** | ULS 5a Ba 22 | 243.6 | 169.4 | 285.1 | 0.46 | | **85.6** | ULS 5a Ah 22 | 306.2 | 169.4 | 236.8 | 0.51 |
| 109A | Tiende TSNSTK - Main member | 200x200x20 | S235 | 8M30-5.6t | 0.52 | 0.52 | 0.52 | 52 | **-1038.1** | ULS 1a_45 | 1590.7 | 1077.1 | 2592.0 | 0.96 | | **757.5** | ULS 1a_0,9_0,9_45 | 1638.1 | 1077.1 | 2094.5 | 0.70 |
| 109B | Tiende TSNSTK - Main member | 200x200x20 | S235 | 12M30-5.6t | 0.52 | 0.52 | 0.52 | 53 | **-1214.4** | ULS 1a_45 | 1580.5 | 1588.8 | 3888.0 | 0.77 | | **778.3** | ULS 1a_0,9_0,9_45 | 1638.1 | 1588.8 | 3194.2 | 0.49 |
| 210L | Tiende TSNSTK - CD 1 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-63.4** | ULS 1a_0,9_0,9_90 | 238.9 | 169.4 | 285.1 | 0.37 | | **102.9** | ULS 1a_90 | 306.2 | 169.4 | 236.8 | 0.61 |
| 210T | Tiende TSNSTK - CD 1 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 136 | **-82.8** | ULS 5a Ah 22 | 238.9 | 169.4 | 285.1 | 0.49 | | **73.4** | ULS 5a Ba 22 | 306.2 | 169.4 | 236.8 | 0.43 |
| 211L | Tiende TSNSTK - CD 2 front | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-109.4** | ULS 1a_0,9_0,9_45 | 230.6 | 169.4 | 285.1 | 0.65 | | **131.7** | ULS 1a_45 | 306.2 | 169.4 | 236.8 | 0.78 |
| 211T | Tiende TSNSTK - CD 2 side | 120x120x11 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 140 | **-121.6** | ULS 1a_45 | 230.6 | 169.4 | 285.1 | 0.72 | | **82.4** | ULS 1a_0,9_0,9_45 | 306.2 | 169.4 | 236.8 | 0.49 |
| 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 | | **389.1** | ULS 3_0 | 420.0 | 578.2 | 778.3 | 0.93 |
| 212T | Tiende TSNSTK - upper horiz lower CA si | **100x100x8** | **S355** | **2M20-8.8t** | 1.00 | 1.00 | 1.00 | 245 | **-52.8** | ULS 1a_90 | 71.8 | 188.2 | 235.2 | 0.74 | | **33.8** | ULS 1a_0,9_0,9_90 | 377.0 | 188.2 | 190.1 | 0.18 |
| 109 | Tiende TSNSTK - lower horiz lower CA fr | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 2.00 | 1.00 | 82 | **-435.3** | ULS 5a Ba 11 | 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 | **-9.1** | ULS 5a Ah 21 | 168.8 | 235.2 | 432.0 | 0.05 | | **87.7** | 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 11 | 272.8 | 117.6 | 259.2 | 0.52 | | **62.7** | ULS 5a Ba 11 | 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 | **-2.3** | ULS 3_90 | 27.3 | 58.8 | 86.4 | 0.09 | | **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 | | **19.3** | ULS 5a Ba 10 | 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 10 | 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 | **-32.9** | ULS 5a Ba 10 | 123.5 | 58.8 | 86.4 | 0.56 | | **22.6** | ULS 5a Ah 10 | 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 | **-27.5** | ULS 5a Ba 20 | 157.9 | 58.8 | 86.4 | 0.47 | | **17.3** | ULS 5a Ah 10 | 179.7 | 58.8 | 69.8 | 0.29 |
| 304 | Eerste DWSRM - CD under 5 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 163 | **-13.3** | ULS 1a_135 | 52.2 | 58.8 | 75.6 | 0.26 | | **9.3** | ULS 1a_0,9_0,9_0 | 86.7 | 58.8 | 59.5 | 0.16 |
| 305 | Eerste DWSRM - CD under 6 | 65x65x7 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 147 | **-10.4** | ULS 1a_0,9_0,9_0 | 59.5 | 58.8 | 75.6 | 0.18 | | **11.8** | ULS 1a_0 | 86.7 | 58.8 | 59.5 | 0.20 |
| 306 | Eerste DWSRM - CD under 7 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 138 | **-12.9** | ULS 5a Ba 21 | 64.1 | 58.8 | 75.6 | 0.22 | | **12.4** | ULS 5a Ah 11 | 86.7 | 58.8 | 59.5 | 0.21 |
| 307 | Eerste DWSRM - CD under 8 | 65x65x7 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 126 | **-14.6** | ULS 5a Ah 11 | 70.4 | 58.8 | 75.6 | 0.25 | | **16.5** | ULS 5a Ba 21 | 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 21 | 61.4 | 58.8 | 64.8 | 0.30 | | **17.3** | ULS 5a Ah 11 | 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 11 | 65.5 | 58.8 | 64.8 | 0.37 | | **23.4** | ULS 5a Ba 21 | 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 | **-32.1** | ULS 5a Ba 21 | 114.4 | 117.6 | 151.2 | 0.28 | | **26.1** | ULS 5a Ah 11 | 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 | **-36.5** | ULS 5a Ba 21 | 105.7 | 58.8 | 75.6 | 0.62 | | **20.9** | ULS 5a Ah 11 | 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 | **-18.4** | ULS 5a Ba 10 | 1771.8 | 117.6 | 367.2 | 0.16 | | **33.0** | 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 11 | 1583.1 | 117.6 | 324.0 | 0.18 | | **31.8** | ULS 5a Ba 11 | 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 | | **71.3** | ULS 3_135 | 99.4 | 117.6 | 119.1 | 0.72 |
| 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 | | **94.6** | ULS 3_0 | 99.4 | 117.6 | 119.1 | 0.95 |
| 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 | | **34.3** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.91 |
| 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 | | **37.5** | ULS 1a_0 | 72.6 | 37.7 | 38.4 | 1.00 |
| 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 | | **37.2** | ULS 7 | 72.6 | 37.7 | 38.4 | 0.99 |
| 319 | Eerste DWSRM - front vert 1 | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 165 | **-42.9** | ULS 3_0 | 91.7 | 58.8 | 86.4 | 0.73 | | **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 | **-13.9** | ULS 1a_0 | 23.9 | 37.7 | 43.2 | 0.58 | | **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 | **-8.7** | ULS 1a_135 | 63.5 | 37.7 | 51.8 | 0.23 | | **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 | **-3.7** | 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 | **-5.8** | ULS 1a_0 | 11.5 | 37.7 | 43.2 | 0.51 | | **3.5** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.16 |
| 325 | Eerste DWSRM - Doorsnede A-A horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.00 | 1.00 | 219 | **-2.2** | ULS 1a_0 | 20.7 | 37.7 | 43.2 | 0.11 | | **2.1** | ULS 1a_0,9_0 | 37.4 | 37.7 | 22.0 | 0.09 |
| 326 | Eerste DWSRM - Doorsnede B-B diag | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 156 | **-7.1** | ULS 1a_0 | 30.6 | 37.7 | 43.2 | 0.23 | | **2.5** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.11 |
| 327 | Eerste DWSRM - Doorsnede B-B horiz top | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 2.49 | 1.00 | 142 | **-1.8** | ULS 1a_0,9_0,9_0 | 36.2 | 37.7 | 43.2 | 0.05 | | **1.6** | ULS 1a_0,9_0,9_0 | 37.4 | 37.7 | 22.0 | 0.07 |
| 110A | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | 12M24-5.6t | 1.00 | 1.70 | 1.00 | 71 | **-485.1** | ULS 5a Ba 11 | 1289.1 | 906.5 | 2799.4 | 0.54 | | **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 | **-341.2** | ULS 5a Ba 21 | 1398.2 | 677.8 | 1866.2 | 0.50 | | **7.7** | ULS 5a Ah 11 | 1548.5 | 677.8 | 1595.1 | 0.01 |
| 110C | Eerste DWSRM - Main member bottom 1 | 200x200x18 | S235 | | 2.42 | 1.40 | 1.00 | 71 | **-480.7** | ULS 5a Ba 11 | 1289.3 | 0.0 | 0.0 | 0.37 | | **19.6** | ULS 5a Ah 11 | 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 | **-316.7** | ULS 5a Ba 21 | 869.0 | 677.8 | 1555.2 | 0.47 | | **32.4** | ULS 5a Ah 11 | 1008.5 | 677.8 | 1329.2 | 0.05 |
| 111B | Eerste DWSRM - Main member bottom 1 | 160x160x15# | S235 | | 2.89 | 1.00 | 1.00 | 72 | **-198.3** | 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 | **-302.7** | ULS 5a Ba 21 | 869.1 | 0.0 | 0.0 | 0.35 | | **26.8** | ULS 5a Ah 11 | 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 | | **370.0** | ULS 3_90 | 422.8 | 504.1 | 796.6 | 0.88 |
| 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 | | **265.7** | ULS 3_90 | 615.9 | 423.6 | 664.6 | 0.63 |
| 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 | | **292.2** | 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 | | **238.9** | ULS 3_135 | 412.6 | 423.6 | 553.8 | 0.58 |
| 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 | | **204.1** | ULS 3_135 | 291.3 | 423.6 | 553.8 | 0.70 |
| 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 | | **203.7** | ULS 3_135 | 496.3 | 0.0 | 0.0 | 0.41 |
| 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 | 0.02 | | **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 | 14M30-5.6t | 0.52 | 0.52 | 0.52 | 35 | **-1575.9** | ULS 1a_45 | 2373.4 | 1885.0 | 4989.6 | 0.84 | | **1098.1** | ULS 1a_0,9_0,9_45 | 2373.8 | 1885.0 | 4032.0 | 0.58 |
| 114B | Negende TSNSTK - Main member | 250x250x22# | S235 | 18M30-5.6t | 0.52 | 0.52 | 0.52 | 36 | **-1985.1** | ULS 1a_45 | 2358.2 | 2423.5 | 6415.2 | 0.84 | | **1467.1** | ULS 1a_0,9_0,9_45 | 2373.8 | 2423.5 | 4626.7 | 0.62 |
| 114C | Negende TSNSTK - Main member | 250x250x22# | S235 | | 0.52 | 0.52 | 0.52 | 35 | **-1982.1** | ULS 1a_45 | 2373.0 | 0.0 | 0.0 | 0.84 | | **1470.7** | ULS 1a_0,9_0,9_45 | 2493.4 | 0.0 | 0.0 | 0.59 |
| 216L | Negende TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-225.2** | ULS 1a_90 | 355.4 | 269.3 | 388.8 | 0.84 | | **197.2** | ULS 1a_0,9_0,9_90 | 250.2 | 269.3 | 314.2 | 0.79 |
| 216T | Negende TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 103 | **-162.4** | ULS 1a_0 | 355.4 | 269.3 | 388.8 | 0.60 | | **156.1** | ULS 1a_0,9_0 | 250.2 | 269.3 | 314.2 | 0.62 |
| 217L | Negende TSNSTK - Diag fr 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-203.7** | ULS 1a_90 | 350.2 | 269.3 | 388.8 | 0.76 | | **209.7** | ULS 1a_90 | 250.2 | 269.3 | 314.2 | 0.84 |
| 217T | Negende TSNSTK - Diag si 2 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 104 | **-164.8** | ULS 1a_0 | 350.2 | 269.3 | 388.8 | 0.61 | | **152.5** | ULS 1a_0,9_0,9_0 | 250.2 | 269.3 | 314.2 | 0.61 |
| 218 | Negende TSNSTK - Diaphragm K diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 266 | **-11.4** | ULS 5a Ah 21 | 35.0 | 75.4 | 121.0 | 0.32 | | **11.2** | ULS 5a Ah 11 | 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 | **-0.3** | 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 | **-13.7** | ULS 1a_0,9_45 | 43.6 | 37.7 | 60.5 | 0.36 | | **14.2** | ULS 1a_135 | 94.8 | 37.7 | 44.8 | 0.38 |
| 220T | Negende TSNSTK - Diaphragm K horiz si | 65x65x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 203 | **-10.6** | ULS 1a_0,9_0,9_135 | 43.6 | 37.7 | 60.5 | 0.28 | | **16.2** | ULS 1a_45 | 94.8 | 37.7 | 44.8 | 0.43 |
| 221 | Negende TSNSTK - Diaphragm L diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 279 | **-1.6** | ULS 1a_135 | 32.5 | 75.4 | 121.0 | 0.05 | | **3.5** | ULS 1a_45 | 109.4 | 75.4 | 89.6 | 0.05 |
| 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 | **-16.1** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.43 | | **17.7** | ULS 1a_45 | 104.8 | 37.7 | 44.8 | 0.47 |
| 223T | Negende TSNSTK - Diaphragm L horiz si | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-15.9** | ULS 1a_0,9_0,9_45 | 49.1 | 37.7 | 60.5 | 0.42 | | **17.2** | ULS 1a_135 | 104.8 | 37.7 | 44.8 | 0.46 |
| 224L | Achtste TSNSTK - Diag fr 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-217.7** | ULS 1a_90 | 345.0 | 269.3 | 388.8 | 0.81 | | **198.9** | ULS 1a_0,9_0,9_90 | 348.4 | 269.3 | 314.2 | 0.74 |
| 224T | Achtste TSNSTK - Diag si 1 above horiz | 150x100x12 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 106 | **-165.6** | ULS 1a_0 | 345.0 | 269.3 | 388.8 | 0.61 | | **161.0** | ULS 1a_0,9_0 | 348.4 | 269.3 | 314.2 | 0.60 |
| 225L | Achtste TSNSTK - Diaphragm M horiz fr | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-22.8** | ULS 1a_0,9_0,9_45 | 55.7 | 37.7 | 60.5 | 0.60 | | **24.8** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.66 |
| 225T | Achtste TSNSTK - Diaphragm M horiz si | 75x75x7# | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 191 | **-22.3** | ULS 1a_0,9_0,9_135 | 55.7 | 37.7 | 60.5 | 0.59 | | **24.8** | ULS 1a_45 | 114.9 | 37.7 | 44.8 | 0.66 |
| 226 | Achtste TSNSTK - Diaphragm M diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 292 | **-1.9** | ULS 1a_90 | 30.2 | 75.4 | 121.0 | 0.06 | | **4.4** | ULS 1a_135 | 109.4 | 75.4 | 89.6 | 0.06 |

DNV·GL

# Assessment of groups for strengthened mast (afkeur level)

Date 22-2-2021
Author MKh
Version 1.0

**KIJ-GT380**
**S+75T**
**53**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | Comp | Load Case (Comp) | Buckling | Shear (Comp) | Bearing (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | Shear (Tens) | Bearing (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 227 | Achtste TSNSTK - Diaphragm M CD | 100x50x6 | S235 | 3M16-5.6t | 0.50 | 0.50 | 0.50 | 263 | **-0.3** | 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 | **-204.5** | ULS 1a_90 | 353.4 | 269.3 | 324.0 | 0.76 | | **198.5** | ULS 1a_0_9_90 | 347.2 | 269.3 | 261.8 | 0.76 |
| 228T | Achtste TSNSTK - Diag si 2 above horiz | 150x150x10 | S235 | 2M30-5.6t | 1.00 | 0.51 | 0.51 | 99 | **-172.8** | ULS 1a_45 | 353.4 | 269.3 | 324.0 | 0.64 | | **157.5** | ULS 1a_0_9_0_9_135 | 347.2 | 269.3 | 261.8 | 0.60 |
| 229L | Achtste TSNSTK - Diaphragm N horiz fr | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-16.7** | ULS 1a_0_9_0_9_45 | 61.0 | 37.7 | 69.1 | 0.44 | | **16.7** | ULS 1a_45 | 142.8 | 37.7 | 51.2 | 0.44 |
| 229T | Achtste TSNSTK - Diaphragm N horiz si | 80x80x8 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **-16.9** | ULS 1a_0_9_0_9_45 | 61.0 | 37.7 | 69.1 | 0.45 | | **16.7** | ULS 1a_90 | 142.8 | 37.7 | 51.2 | 0.44 |
| 230 | Achtste TSNSTK - Diaphragm N diag | 70x70x7 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 305 | **-2.8** | ULS 1a_135 | 28.2 | 75.4 | 121.0 | 0.10 | | **5.9** | 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 | | **0.2** | ULS 1a_0_9_90 | 75.4 | 113.0 | 100.9 | 0.00 |
| 115A | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2428.2** | ULS 1a_45 | 3173.7 | 0.0 | 0.0 | 0.77 | | **1894.1** | ULS 1a_0_9_0_9_45 | 3588.5 | 0.0 | 0.0 | 0.53 |
| 115B | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | 28M30-5.6t | 0.52 | 0.52 | 1.05 | 47 | **-2809.2** | ULS 1a_45 | 3176.0 | 3628.5 | 9072.0 | 0.88 | | **2237.1** | ULS 1a_0_9_0_9_45 | 3615.8 | 3628.5 | 6542.8 | 0.62 |
| 115C | Achtste TSNSTK - Main member | 200x200x20(12,0.5) | S235 | | 0.50 | 0.50 | 1.10 | 47 | **-2805.3** | ULS 1a_45 | 3172.9 | 0.0 | 0.0 | 0.88 | | **2241.4** | ULS 1a_0_9_0_9_45 | 3588.5 | 0.0 | 0.0 | 0.62 |
| 116A | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 28M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3069.7** | ULS 1a_45 | 3722.2 | 3628.5 | 9072.0 | 0.85 | | **2492.5** | ULS 1a_0_9_0_9_45 | 4683.7 | 3628.5 | 7330.9 | 0.69 |
| 116B | Zevende TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.60 | 60 | **-3412.1** | ULS 1a_45 | 3725.4 | 4075.1 | 10368.0 | 0.92 | | **2725.1** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.67 |
| 117A | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 59 | **-3427.7** | ULS 1a_45 | 3738.1 | 4075.1 | 10368.0 | 0.92 | | **2706.4** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.66 |
| 117B | Zesde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6t | 0.25 | 0.25 | 0.74 | 60 | **-3529.9** | ULS 1a_45 | 3722.2 | 4503.7 | 11664.0 | 0.95 | | **2796.4** | ULS 1a_0_9_0_9_45 | 4341.6 | 4503.7 | 9425.5 | 0.64 |
| 118A | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.25 | 0.25 | 0.73 | 60 | **-3612.8** | ULS 1a_45 | 3731.6 | 4075.1 | 10368.0 | 0.97 | | **2871.2** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.70 |
| 118B | Vijfde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3694.2** | ULS 1a_45 | 3755.7 | 4075.1 | 10368.0 | 0.98 | | **2867.3** | ULS 1a_0_9_0_9_135 | 4683.7 | 4075.1 | 8378.2 | 0.70 |
| 119A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.36 | 60 | **-3707.3** | ULS 1a_45 | 3732.3 | 4075.1 | 10368.0 | 0.99 | | **2849.7** | ULS 1a_0_9_0_9_135 | 4683.7 | 4075.1 | 8378.2 | 0.70 |
| 119B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.55 | 59 | **-3677.0** | ULS 1a_45 | 3740.5 | 4075.1 | 10368.0 | 0.98 | | **2808.9** | ULS 1a_0_9_0_9_135 | 4683.7 | 4075.1 | 8378.2 | 0.69 |
| 120A | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 32M30-5.6t | 0.50 | 0.50 | 1.38 | 60 | **-3688.0** | ULS 1a_45 | 3723.6 | 4075.1 | 10368.0 | 0.99 | | **2801.8** | ULS 1a_0_9_0_9_45 | 4683.7 | 4075.1 | 8378.2 | 0.69 |
| 120B | Vierde TSNSTK - Main member | 250x250x20#(12,0.5 | S235 | 36M30-5.6t | 0.50 | 0.50 | **1.34** | 52 | **-3771.3** | ULS 1a_45 | 3918.1 | 4503.7 | 11664.0 | 0.96 | | **2853.8** | ULS 1a_0_9_0_9_45 | 4683.7 | 4503.7 | 9425.5 | 0.63 |
| 122A | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3813.9** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.70 | | **2846.1** | ULS 1a_0_9_0_9_45 | 7183.8 | 5723.4 | 6460.1 | 0.50 |
| 122B | Eerste TSNSTK - Main member | INP 450 | S235 | 36M24-5.6t | 0.50 | 0.50 | 1.55 | 65 | **-3776.8** | ULS 1a_45 | 5440.8 | 5723.4 | 7558.3 | 0.69 | | **2721.3** | ULS 1a_0_9_0_9_45 | 7183.8 | 5723.4 | 6460.1 | 0.48 |
| 123A | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 65 | **-3814.2** | ULS 1a_45 | 5437.9 | 5723.4 | 7558.3 | 0.70 | | **2680.6** | ULS 1a_0_9_0_9_45 | 7183.8 | 5723.4 | 6460.1 | 0.47 |
| 123B | Broekstuk - Main member | INP 450 | S235 | 36M24-5.6t | 0.33 | 0.33 | 0.85 | 66 | **-3841.4** | ULS 1a_45 | 5424.0 | 5723.4 | 7558.3 | 0.71 | | **2659.8** | ULS 1a_0_9_0_9_45 | 7183.8 | 5723.4 | 6460.1 | 0.46 |
| 232L | Zevende TSNSTK - Doorsnede B-B horiz fr | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 |
| 232T | Zevende TSNSTK - Doorsnede B-B horiz si | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 2.00 | 1.00 | 196 | **0.0** | | 86.6 | 117.6 | 172.8 | 0.00 | | **0.0** | ULS 1a_0 | 190.7 | 117.6 | 139.6 | 0.00 |
| 233 | Zevende TSNSTK - Doorsnede B-B diag | 75x75x7# | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 289 | **0.0** | | 26.8 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 |
| 234 | Zevende TSNSTK - Doorsnede B-B horiz in | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 385 | **0.0** | | 20.2 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 133.6 | 58.8 | 69.8 | 0.00 |
| 235L | Zevende TSNSTK - CD 1 front | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-140.4** | ULS 1a_135 | 163.7 | 215.4 | 162.0 | 0.87 | | **98.4** | ULS 1a_0_9_0_9_135 | 193.0 | 215.4 | 130.9 | 0.75 |
| 235T | Zevende TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 127 | **-126.3** | ULS 1a_135 | 163.7 | 134.6 | 162.0 | 0.94 | | **93.4** | ULS 1a_0_9_0_9_45 | 193.0 | 134.6 | 130.9 | 0.71 |
| 236L | Zevende TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 135 | **-65.8** | ULS 1a_0_9_0_9_135 | 197.0 | 169.4 | 259.2 | 0.39 | | **92.3** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.54 |
| 236T | Zevende TSNSTK - Diag si 1 above horiz | 130x90x10 | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 137 | **-62.7** | ULS 5a Ba 11 | 194.1 | 169.4 | 259.2 | 0.37 | | **82.4** | ULS 1a_135 | 194.6 | 169.4 | 221.5 | 0.49 |
| 237L | Zevende TSNSTK - Doorsnede A-A horiz fr | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.3** | ULS 1a_0_9_0_9_45 | 87.9 | 58.8 | 86.4 | 0.55 | | **30.4** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.52 |
| 237T | Zevende TSNSTK - Doorsnede A-A horiz si | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 186 | **-32.2** | ULS 1a_0_9_0_9_135 | 87.9 | 58.8 | 86.4 | 0.55 | | **30.2** | ULS 1a_45 | 179.7 | 58.8 | 69.8 | 0.51 |
| 238 | Zevende TSNSTK - Doorsnede A-A diag | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 335 | **-6.8** | ULS 1a_0 | 25.4 | 58.8 | 86.4 | 0.27 | | **14.2** | ULS 1a_0_9_45 | 133.6 | 58.8 | 69.8 | 0.24 |
| 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 | **-104.2** | ULS 1a_135 | 157.6 | 134.6 | 162.0 | 0.77 | | **107.8** | ULS 1a_0_9_45 | 193.0 | 134.6 | 130.9 | 0.82 |
| 240T | Zesde TSNSTK - Diag si 1 below horiz | 150x100x10 | S235 | 1M30-5.6t | 1.00 | 0.52 | 0.52 | 138 | **-99.2** | ULS 1a_45 | 159.4 | 134.6 | 162.0 | 0.74 | | **98.6** | ULS 1a_0_9_45 | 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 | **-112.1** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.83 | | **100.2** | ULS 1a_0_9_0_9_135 | 193.0 | 134.6 | 130.9 | 0.77 |
| 241T | Zesde TSNSTK - CD 1 side | 150x100x10 | S235 | 1M30-5.6t | 0.55 | 0.27 | 0.27 | 143 | **-105.2** | ULS 1a_45 | 145.1 | 134.6 | 162.0 | 0.78 | | **95.4** | ULS 1a_0_9_0_9_135 | 193.0 | 134.6 | 130.9 | 0.73 |
| 242L | Vijfde TSNSTK - CD 1 front | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-88.3** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 0.90 | | **43.7** | ULS 1a_0_9_0_9_45 | 184.3 | 135.6 | 110.8 | 0.39 |
| 242T | Vijfde TSNSTK - CD 1 side | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-94.3** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 0.96 | | **47.9** | ULS 1a_0_9_0_9_45 | 184.3 | 135.6 | 110.8 | 0.43 |
| 243L | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-29.7** | ULS 5a Ah 21 | 106.8 | 84.7 | 129.6 | 0.35 | | **51.9** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.61 |
| 243T | Vijfde TSNSTK - Diag fr 1 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 184 | **-27.5** | ULS 1a_0_9_0_9_135 | 106.8 | 84.7 | 129.6 | 0.32 | | **56.3** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.66 |
| 247L | Vijfde TSNSTK - Doorsnede A-A horiz fr | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 |
| 247T | Vijfde TSNSTK - Doorsnede A-A horiz si | 120x120x11 | S235 | 1M30-5.6t | 1.00 | 2.00 | 1.00 | 242 | **0.0** | | 95.0 | 134.6 | 178.2 | 0.00 | | **0.0** | ULS 1a_0 | 275.6 | 134.6 | 144.0 | 0.00 |
| 248 | Vijfde TSNSTK - Doorsnede A-A diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 319 | **0.0** | | 34.6 | 58.8 | 86.4 | 0.00 | | **0.0** | ULS 1a_0 | 179.7 | 58.8 | 69.8 | 0.00 |
| 249 | Vijfde TSNSTK - Doorsnede A-A CD | 75x75x7# | S235 | 1M20-5.6t | 0.50 | 0.50 | 0.50 | 301 | **0.0** | | 25.0 | 58.8 | 75.6 | 0.00 | | **0.0** | ULS 1a_0 | 106.8 | 58.8 | 61.1 | 0.00 |
| 244L | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-43.1** | ULS 5a Ah 21 | 87.5 | 84.7 | 129.6 | 0.51 | | **33.7** | ULS 5a Ah 11 | 184.3 | 84.7 | 110.8 | 0.40 |
| 244T | Vierde TSNSTK - Diag fr 1 below horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 213 | **-40.0** | ULS 5a Ah 21 | 87.5 | 84.7 | 129.6 | 0.47 | | **35.4** | ULS 5a Ba 11 | 184.3 | 84.7 | 110.8 | 0.42 |
| 245L | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-41.6** | ULS 1a_45 | 77.2 | 84.7 | 129.6 | 0.54 | | **32.9** | ULS 1a_0_9_0_9_135 | 184.3 | 84.7 | 110.8 | 0.39 |
| 245T | Vierde TSNSTK - CD 1 front | 130x90x10 | S235 | 1M24-5.6t | 0.55 | 0.27 | 0.27 | 214 | **-40.9** | ULS 1a_90 | 77.2 | 84.7 | 129.6 | 0.53 | | **30.6** | ULS 1a_0_9_0_9_90 | 184.3 | 84.7 | 110.8 | 0.36 |
| 250L | Vierde TSNSTK - Doorsnede B-B horiz fr | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.4** | ULS 1a_0_9_0_9_45 | 100.3 | 58.8 | 118.8 | 0.41 | | **23.1** | ULS 1a_45 | 310.5 | 58.8 | 96.0 | 0.39 |
| 250T | Vierde TSNSTK - Doorsnede B-B horiz si | 120x120x11 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 240 | **-24.5** | ULS 1a_0_9_0_9_45 | 100.3 | 58.8 | 118.8 | 0.42 | | **23.3** | ULS 1a_135 | 310.5 | 58.8 | 96.0 | 0.40 |
| 251 | Vierde TSNSTK - Doorsnede B-B diag | 100x100x8 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 407 | **-8.2** | ULS 1a_45 | 23.1 | 58.8 | 86.4 | 0.35 | | **13.3** | ULS 1a_0_9_135 | 179.7 | 58.8 | 69.8 | 0.23 |
| 257 | Vierde TSNSTK - Doorsnede B-B CD | 80x80x8 | S235 | 1M20-5.6t | 1.00 | 0.50 | 0.50 | 464 | **-0.7** | ULS 7 | 13.1 | 58.8 | 86.4 | 0.05 | | **0.0** | | 133.6 | 58.8 | 69.8 | 0.00 |
| 246L | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-29.3** | ULS 1a_0_9_0_9_135 | 80.2 | 84.7 | 129.6 | 0.37 | | **33.9** | ULS 1a_45 | 184.3 | 84.7 | 110.8 | 0.40 |
| 246T | Vierde TSNSTK - Diag fr 2 above horiz | 130x90x10 | S235 | 1M24-5.6t | 1.00 | 0.55 | 0.55 | 226 | **-26.2** | ULS 1a_0_9_0_9_45 | 80.2 | 84.7 | 129.6 | 0.33 | | **31.8** | ULS 1a_135 | 184.3 | 84.7 | 110.8 | 0.38 |
| 252L | Eerste TSNSTK - Horizontal front | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-77.0** | ULS 1a_135 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.4** | ULS 1a_0_9_0_9_135 | 1494.6 | 538.6 | 960.0 | 0.08 |
| 252T | Eerste TSNSTK - Horizontal side | 250x250x22# | S235 | 4M30-5.6t | 1.00 | 1.00 | 1.00 | 148 | **-77.0** | ULS 1a_45 | 897.2 | 538.6 | 1425.6 | 0.14 | | **44.5** | ULS 1a_0_9_0_9_135 | 1494.6 | 538.6 | 960.0 | 0.08 |
| 253L | Eerste TSNSTK - Diag fr 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-56.7** | ULS 1a_90 | 361.1 | 169.4 | 414.7 | 0.33 | | **21.2** | ULS 1a_0_9_90 | 760.6 | 169.4 | 354.5 | 0.13 |
| 253T | Eerste TSNSTK - Diag si 2 below horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-51.5** | ULS 5a Ba 12 | 361.1 | 169.4 | 414.7 | 0.30 | | **16.0** | ULS 1a_0_9_45 | 760.6 | 169.4 | 354.5 | 0.09 |
| 254L | Eerste TSNSTK - Diag fr 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-41.1** | ULS 1a_0_9_135 | 361.1 | 169.4 | 414.7 | 0.24 | | **62.6** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.37 |
| 254T | Eerste TSNSTK - Diag si 1 above horiz | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 0.52 | 0.52 | 175 | **-43.4** | ULS 1a_0_9_45 | 361.1 | 169.4 | 414.7 | 0.26 | | **64.8** | ULS 1a_45 | 692.4 | 169.4 | 354.5 | 0.38 |
| 255L | Broekstuk - Horizontal front | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.3** | ULS 1a_45 | 231.7 | 169.4 | 414.7 | 0.20 | | **18.3** | ULS 1a_0_9_135 | 692.4 | 169.4 | 354.5 | 0.11 |
| 255T | Broekstuk - Horizontal side | 180x180x16# | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 247 | **-34.5** | ULS 1a_135 | 231.7 | 169.4 | 414.7 | 0.20 | | **18.4** | ULS 1a_0_9_45 | 692.4 | 169.4 | 354.5 | 0.11 |
| 256LB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-58.9** | ULS 1a_45 | 290.1 | 169.4 | 259.2 | 0.35 | | **29.0** | ULS 1a_0_9_0_9_135 | 431.8 | 169.4 | 221.5 | 0.17 |
| 256TB | Broekstuk - Lower part | 150x150x10 | S235 | 2M24-5.6t | 0.17 | 0.25 | 0.17 | 127 | **-64.0** | ULS 5a Ba 12 | 290.1 | 169.4 | 259.2 | 0.38 | | **28.8** | ULS 5a Ba 12 | 431.8 | 169.4 | 221.5 | 0.17 |
| 261 | Eerste TSNSTK - Diag C-C* | UNP200 | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 482 | **-10.7** | ULS 1a_45 | 44.3 | 176.4 | 275.4 | 0.24 | | **12.0** | ULS 1a_0_9_135 | 347.3 | 176.4 | 222.5 | 0.07 |
| 262 | Eerste TSNSTK - CD C-C | 100x100x8 | S235 | 2M20-5.6t | 1.00 | 0.50 | 0.50 | 477 | **-0.8** | ULS 7 | 21.5 | 117.6 | 172.8 | 0.04 | | **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 | **-13.3** | ULS 1a_45 | 20.7 | 58.8 | 86.4 | 0.64 | | **10.8** | ULS 1a_0_9_135 | 179.7 | 58.8 | 69.8 | 0.18 |
| 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 |
| 265 | Top* | 120x120x11 | S235 | | 2.00 | 2.00 | 2.00 | 412 | **-15.7** | ULS 5a Ba 22 | 46.6 | 0.0 | 0.0 | 0.34 | | **15.0** | ULS 5a Ba 22 | 599.7 | 0.0 | 0.0 | 0.03 |

**Notes:**
**1) Groups 200L, 419 and 442 failed under net section capacity and were strengthened by placing a plate over the joint. Refer to Appendix D for the calculations and explanation.**

DNV·GL

## Assessment of groups for strengthened mast (verbouw level)

| | |
|---|---|
| Date | 22-2-2021 |
| Author | MKh |
| Version | 1.0 |

**KIJ-GT380**
**S+75T**
**53**

| Group Label | Description | Profile | Steel Quality | Bolts | RLX | RLY | RLZ | Slenderness | mpression | Load Case (Compres | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | Exceedance (Comp) | Tension | Load Case (Tension) | Net Section | hear (Tens) | earing (Tens) | U.C. (Tens) | Opm.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 414 | Tweede DWSRM - fr | **90x90x9** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 266 | **-36.9** | ULS 1a_0 | 50.0 | 60.3 | 105.8 | 0.74 | | **0.0** | | 148.2 | 60.3 | 78.4 | 0.00 | |
| 415 | Tweede DWSRM - fr | **80x80x8** | **S355** | **1M16-8.8t** | 1.00 | 1.00 | 1.00 | 243 | **-44.1** | ULS 7 | 46.2 | 60.3 | 94.1 | 0.95 | | **0.0** | | 131.7 | 60.3 | 69.7 | 0.00 | |
| 212T | Tiende TSNSTK - up | **100x100x8** | **S355** | **2M20-8.8t** | 1.00 | 1.00 | 1.00 | 245 | **-70.8** | ULS 1a_90 | 71.8 | 188.2 | 235.2 | 0.99 | | **50.5** | ULS 1a_0,9_0,9_90 | 377.0 | 188.2 | 190.1 | 0.27 | |
| 120B | Vierde TSNSTK - Ma | 250x250x20#(12,0.5) | S235 | 36M30-5.6t | 0.50 | 0.50 | **1.34** | 52 | **-5117.4** | ULS 1a_135 | 3918.1 | 4503.7 | 11664.0 | 1.31 | (2) | **4145.8** | ULS 1a_0,9_0,9_135 | 4683.7 | 4503.7 | 9425.5 | 0.92 | |
| 235L | Zevende TSNSTK - ( | 150x100x10 | S235 | **1M30-8.8t** | 0.55 | 0.27 | 0.27 | 127 | **-191.6** | ULS 1a_45 | 163.7 | 215.4 | 162.0 | 1.18 | (1) | **143.0** | ULS 1a_0,9_0,9_45 | 193.0 | 215.4 | 130.9 | 1.09 | |
| 242L | Vijfde TSNSTK - CD | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-120.4** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 1.22 | (1) | **65.6** | ULS 1a_0,9_0,9_135 | 184.3 | 135.6 | 110.8 | 0.59 | |
| 242T | Vijfde TSNSTK - CD | 130x90x10 | S235 | **1M24-8.8t** | 0.55 | 0.27 | 0.27 | 176 | **-128.6** | ULS 1a_135 | 98.5 | 135.6 | 129.6 | 1.31 | (1) | **71.5** | ULS 1a_0,9_0,9_45 | 184.3 | 135.6 | 110.8 | 0.65 | |

**Notes:**
**1) Groups 235L and 242L/T exhibit failure in buckling at the verbouw level which is not relevant since the failure at the afkeur level was due to shear.**
**2) Group 120B exhibits failure under buckling at both the afkeur and verbouw level. This is not a cause for concern as additional redundant members were added to fulfil the afkeur loads. In this case fulfilling the verbouw loads is not necessary.**
**3) Groups 200L, 419 and 442 which failed under net section at the afkeur level are not listed in this table. A separate calculation is provided in Appendix D which illustrates the capacity of the member and the plate used for strengthening.**

# APPENDIX C TOETSING KNIKVERKORTERS

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T
Mast 49

| 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 | **54.0** | **0.29** | 93.0 | 58.8 | 59.0 | 76.6 | 1.69 | 0.92 | | |
| 620 | Onderstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.09 | 77 | 198 | **54.0** | **0.00** | 56.8 | 58.8 | 69.8 | 133.6 | 2.95 | 0.95 | | |
| 618 | Onderstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 2.62 | 0 | 133 | **54.0** | **0.65** | 118.8 | 58.8 | 69.8 | 179.7 | 4.76 | 0.92 | | |
| 616 | Onderstuk | Enkele staaf | L100.10 | S235 | M20 | 5.6 | 3.79 | 54 | 194 | **54.0** | **0.00** | 91.4 | 58.8 | 87.3 | 224.6 | 5.79 | 0.92 | | |
| 614 | Onderstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.07 | 0 | 189 | **54.0** | **1.02** | 104.5 | 58.8 | 87.3 | 253.4 | 7.07 | 0.92 | | |
| 612 | Onderstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.79 | 40 | 222 | **54.0** | **0.00** | 82.8 | 58.8 | 87.3 | 253.4 | 7.07 | 0.92 | | |
| 610 | Onderstuk | Enkele staaf | L130.12 | S235 | M20 | 5.6 | 5.52 | 0 | 217 | **54.0** | **1.38** | 121.8 | 58.8 | 104.7 | 442.4 | 11.85 | 0.92 | | |
| 608 | Onderstuk | Enkele staaf | L120.11 | S235 | M20 | 5.6 | 5.99 | 31 | 254 | **54.0** | **0.00** | 81.3 | 58.8 | 96.0 | 310.5 | 9.27 | 0.92 | | |
| 606 | Onderstuk | Enkele staaf | L150.10 | S235 | M20 | 5.6 | 6.89 | 0 | 232 | **54.0** | **1.72** | 107.3 | 58.8 | 87.3 | 368.6 | 14.71 | 0.92 | | |
| 604 | Onderstuk | Enkele staaf | L150.10 | S235 | M20 | 5.6 | 7.22 | 25 | 243 | **54.0** | **1.64** | 100.0 | 58.8 | 87.3 | 368.6 | 14.71 | 0.92 | | |
| 360 | Onderstuk | Enkele staaf | L180.16 | S235 | M24 | 5.6 | 8.42 | 0 | 241 | **54.0** | **2.11** | 192.8 | 84.7 | 177.2 | 986.1 | 30.45 | 0.64 | | |
| 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 | **54.0** | **0.00** | 60.6 | 84.7 | 110.8 | 213.1 | 5.79 | 0.89 | | |
| 367 | 1e Tussenstuk | Enkele staaf | L110.10 | S235 | M24 | 5.6 | 4.08 | 0 | 189 | **54.0** | **1.02** | 104.2 | 84.7 | 110.8 | 241.9 | 7.07 | 0.64 | | |
| 364 | 1e Tussenstuk | Enkele staaf | L100.10 | S235 | M24 | 5.6 | 3.37 | 0 | 172 | **54.0** | **0.84** | 107.1 | 84.7 | 110.8 | 213.1 | 5.79 | 0.64 | | |
| 362 | 1e Tussenstuk | Enkele staaf | L100.8 | S235 | M24 | 5.6 | 3.84 | 43 | 195 | **54.0** | **0.00** | 73.2 | 84.7 | 88.6 | 170.5 | 4.76 | 0.74 | | |
| 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 | | |
| 542 | 2e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 4.12 | 25 | 264 | **41.0** | **0.93** | 37.0 | 58.8 | 69.8 | 133.6 | 2.95 | 1.11 | Buckling | |
| 541 | 2e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.45 | 0 | 175 | **41.0** | **0.86** | 84.7 | 58.8 | 69.8 | 179.7 | 4.76 | 0.70 | | |
| 586 | 2e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.11 | 0 | 158 | **41.0** | **0.78** | 96.9 | 58.8 | 69.8 | 179.7 | 4.76 | 0.70 | | |
| 539 | 2e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.45 | 37 | 221 | **41.0** | **0.00** | 48.4 | 58.8 | 69.8 | 133.6 | 2.95 | 0.85 | | |
| 583 | 3e Tussenstuk | Enkele staaf | L150.10 | S235 | M24 | 5.6 | 5.98 | 0 | 202 | **41.0** | **1.50** | 131.9 | 84.7 | 110.8 | 357.1 | 14.71 | 0.48 | | |
| 537 | 3e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.67 | 31 | 235 | **41.0** | **0.00** | 44.2 | 58.8 | 69.8 | 133.6 | 2.95 | 0.93 | | |
| 536 | 3e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.03 | 0 | 154 | **41.0** | **0.76** | 100.1 | 58.8 | 69.8 | 179.7 | 4.76 | 0.70 | | |
| 584 | 3e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 2.62 | 0 | 168 | **41.0** | **0.66** | 71.0 | 58.8 | 69.8 | 133.6 | 2.95 | 0.70 | | |
| 534 | 3e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 3.09 | 41 | 245 | **41.0** | **0.00** | 29.4 | 58.8 | 59.0 | 76.6 | 1.69 | 1.40 | Buckling | |
| 529 | Tussenschot | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 7.56 | 0 | 384 | **1.0** | **1.89** | 25.5 | 58.8 | 69.8 | 179.7 | 4.8 | 0.40 | | |
| 530 | Tussenschot | Kruisende staaf halverwege | L80.8 | S235 | M20 | 5.6 | 10.94 | 0 | 451 | **1.0** | **1.37** | 13.7 | 58.8 | 69.8 | 133.6 | 3.0 | 0.46 | | |
| 263 | 4e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 3.19 | 36 | 253 | **41.0** | **0.00** | 28.0 | 58.8 | 59.0 | 76.6 | 1.7 | 1.46 | Buckling | |
| 262 | 4e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 2.67 | 0 | 171 | **41.0** | **0.67** | 69.2 | 58.8 | 69.8 | 133.6 | 3.0 | 0.70 | | |
| 281 | 4e Tussenstuk | Enkele staaf | L75.7 | S235 | M20 | 5.6 | 2.28 | 0 | 156 | **41.0** | **0.57** | 64.3 | 58.8 | 61.1 | 96.8 | 2.3 | 0.70 | | |
| 260 | 4e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.89 | 43 | 247 | **41.0** | **0.00** | 23.1 | 58.8 | 47.5 | 48.4 | 1.2 | 1.78 | Buckling | |
| 259 | 4e Tussenstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.50 | 0 | 208 | **41.0** | **1.12** | 90.9 | 58.8 | 87.3 | 253.4 | 7.1 | 0.70 | | |
| 258 | 4e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 3.05 | 36 | 261 | **41.0** | **0.00** | 21.2 | 58.8 | 47.5 | 48.4 | 1.2 | 1.93 | Buckling | |

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T
Mast 49

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 257 | 4e Tussenstuk | Enkele staaf | L75.7 | S235 | M20 | 5.6 | 2.26 | 0 | 154 | **41.0** | **0.56** | 65.2 | 58.8 | 61.1 | 96.8 | 2.3 | 0.70 | | |
| 252 | Tussenschot | Kniksteun op 0,5L | L120.11 | S235 | M30 | 5.6 | 8.32 | 0 | 227 | **41.0** | **2.08** | 79.5 | 134.6 | 156.0 | 275.6 | 9.3 | 0.52 | | |
| 254 | Tussenschot | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 5.87 | 0 | 298 | **1.0** | **1.47** | 38.6 | 58.8 | 69.8 | 179.7 | 4.8 | 0.31 | | |
| 253 | Tussenschot | Kruisende staaf halverwege | L75.7 | S235 | M20 | 5.6 | 8.54 | 0 | 375 | **1.0** | **1.07** | 15.1 | 58.8 | 61.1 | 96.8 | 2.3 | 0.47 | | |
| 119 | 5e Tussenstuk | Enkele staaf | L70.7 | S235 | M20 | 5.6 | 1.97 | 0 | 144 | **39.2** | **0.49** | 65.5 | 58.8 | 61.1 | 96.8 | 2.0 | 0.67 | | |
| 126 | 5e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.72 | 46 | 233 | **39.2** | **0.00** | 25.3 | 58.8 | 47.5 | 48.4 | 1.2 | 1.55 | Buckling | |
| 114 | 5e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.88 | 0 | 197 | **39.2** | **0.97** | 72.1 | 58.8 | 69.8 | 179.7 | 4.8 | 0.67 | | |
| 125 | 5e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.78 | 41 | 238 | **39.2** | **0.00** | 24.5 | 58.8 | 47.5 | 48.4 | 1.2 | 1.60 | Buckling | |
| 120 | 5e Tussenstuk | Enkele staaf | L70.7 | S235 | M20 | 5.6 | 1.95 | 0 | 143 | **39.2** | **0.49** | 66.3 | 58.8 | 61.1 | 96.8 | 2.0 | 0.67 | | |
| 121 | 5e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 1.65 | 0 | 131 | **39.2** | **0.41** | 67.8 | 58.8 | 59.0 | 76.6 | 1.7 | 0.67 | | |
| 130 | 5e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.48 | 57 | 255 | **39.2** | **0.00** | 15.3 | 37.7 | 30.3 | 31.7 | 0.7 | 2.56 | Buckling Bolt Bearing Net sect | |
| 115 | 5e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.43 | 0 | 174 | **39.2** | **0.86** | 85.4 | 58.8 | 69.8 | 179.7 | 4.8 | 0.67 | | |
| 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 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.42 | 46 | 249 | **37.3** | **0.00** | 15.9 | 37.7 | 30.3 | 31.7 | 0.7 | 2.35 | Buckling Bearing Net section | |
| 122 | 6e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 1.73 | 0 | 137 | **37.3** | **0.43** | 64.3 | 58.8 | 59.0 | 76.6 | 1.7 | 0.63 | | |
| 124 | 6e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 1.48 | 0 | 127 | **37.3** | **0.37** | 55.8 | 58.8 | 47.5 | 48.4 | 1.2 | 0.78 | | |
| 128 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.41 | 56 | 248 | **37.3** | **0.00** | 16.0 | 37.7 | 30.3 | 31.7 | 0.7 | 2.33 | Buckling Bearing Net section | |
| 112 | 6e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 2.94 | 0 | 149 | **37.3** | **0.74** | 103.8 | 58.8 | 69.8 | 179.7 | 4.8 | 0.63 | | |
| 127 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.33 | 47 | 239 | **37.3** | **0.00** | 16.8 | 37.7 | 30.3 | 31.7 | 0.7 | 2.22 | Buckling Bearing Net section | |
| 123 | 6e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 1.49 | 0 | 127 | **37.3** | **0.37** | 55.4 | 58.8 | 47.5 | 48.4 | 1.2 | 0.78 | | |
| 111 | 6e Tussenstuk | Kniksteun op 0,5L | L100.8 | S235 | M20 | 5.6 | 5.47 | 0 | 178 | **37.3** | **1.37** | 66.6 | 58.8 | 69.8 | 179.7 | 4.8 | 0.63 | | |
| 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 | 7e Tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.38 | 0 | 118 | **31.8** | **0.35** | 60.0 | 37.7 | 38.4 | 72.6 | 1.2 | 0.84 | | |
| 160 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.12 | 54 | 218 | **31.8** | **0.00** | 19.4 | 37.7 | 30.3 | 31.7 | 0.7 | 1.64 | Buckling Bearing Net section | |
| 171 | 7e Tussenstuk | Enkele staaf | L80.8 | S235 | M16 | 5.6 | 2.67 | 0 | 171 | **31.8** | **0.67** | 69.2 | 37.7 | 51.2 | 142.8 | 3.0 | 0.84 | | |
| 159 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.19 | 29 | 225 | **31.8** | **0.48** | 18.5 | 37.7 | 30.3 | 31.7 | 0.7 | 1.72 | Buckling Bearing Net section | |
| 170 | 7e Tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.38 | 0 | 118 | **31.8** | **0.35** | 60.0 | 37.7 | 38.4 | 72.6 | 1.2 | 0.84 | | |
| 169 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.32 | 0 | 136 | **31.8** | **0.33** | 36.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.05 | Bearing Net section | |
| 158 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.08 | 51 | 214 | **31.8** | **0.00** | 19.9 | 37.7 | 30.3 | 31.7 | 0.7 | 1.60 | Buckling Bearing Net section | |
| 182 | 7e Tussenstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 2.58 | 0 | 176 | **31.8** | **0.65** | 54.9 | 37.7 | 44.8 | 104.8 | 2.3 | 0.84 | | |
| 157 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.14 | 50 | 220 | **31.8** | **0.00** | 19.1 | 37.7 | 30.3 | 31.7 | 0.7 | 1.66 | Buckling Bearing Net section | |
| 167 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.30 | 0 | 133 | **31.8** | **0.32** | 36.7 | 37.7 | 30.3 | 31.7 | 0.7 | 1.05 | Bearing Net section | |
| 166 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.20 | 0 | 123 | **23.8** | **0.30** | 39.9 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 156 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.03 | 55 | 209 | **23.8** | **0.00** | 20.6 | 37.7 | 30.3 | 31.7 | 0.7 | 1.15 | Buckling | |
| 165 | 8e Tussenstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 2.42 | 0 | 177 | **23.8** | **0.60** | 50.7 | 37.7 | 44.8 | 104.8 | 2.0 | 0.63 | | |
| 155 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.07 | 51 | 213 | **23.8** | **0.00** | 20.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.19 | Buckling | |
| 164 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.22 | 0 | 125 | **23.8** | **0.31** | 39.2 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 163 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.18 | 0 | 121 | **23.8** | **0.29** | 40.7 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 154 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.00 | 55 | 205 | **23.8** | **0.00** | 21.1 | 37.7 | 30.3 | 31.7 | 0.7 | 1.13 | Buckling | |

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T
Mast 49

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 162 | 8e Tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.29 | 0 | 182 | **23.8** | **0.57** | 45.2 | 37.7 | 44.8 | 84.7 | 1.7 | 0.63 | | |
| 153 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.07 | 53 | 213 | **23.8** | **0.00** | 20.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.19 | Buckling | |
| 161 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.16 | 0 | 119 | **23.8** | **0.29** | 41.3 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 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 | 9e 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 | 9e 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 | 10e 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 | 10e 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 | 10e 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 | 11e 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 | 11e 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 | 11e 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 | | |

DNV-GL

## Knikverkorters adjusted construction (verbouw)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T
Mast 49

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 542 | 2e Tussenstuk | Enkele staaf | L90.8 | S355 | M20 | 8.8 | 4.12 | 25 | 234 | 41.0 | 1.21 | 55.4 | 94.1 | 95.0 | 276.0 | 5.70 | 0.74 | | Profile exchanged |
| 534 | 3e Tussenstuk | Enkele staaf | L75.7 | S355 | M20 | 8.8 | 3.09 | 41 | 211 | 41.0 | 0.0 | 47.4 | 94.1 | 83.2 | 159.2 | 3.4 | 0.87 | | Profile exchanged |
| 263 | 4e Tussenstuk | Enkele staaf | L75.7 | S355 | M20 | 8.8 | 3.19 | 36 | 218 | 41.0 | 0.0 | 45.1 | 94.1 | 83.2 | 159.2 | 3.4 | 0.91 | | Profile exchanged |
| 260 | 4e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.89 | 43 | 212 | 41.0 | 0.0 | 43.8 | 94.1 | 83.2 | 131.7 | 2.99 | 0.94 | | Profile exchanged |
| 258 | 4e Tussenstuk | Enkele staaf | L75.7 | S355 | M20 | 8.8 | 3.05 | 36 | 208 | 41.0 | 0.0 | 48.3 | 94.1 | 83.2 | 159.2 | 3.44 | 0.85 | | Profile exchanged |
| 126 | 5e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.72 | 46 | 199 | 39.2 | 0.0 | 48.1 | 94.1 | 83.2 | 131.7 | 3.0 | 0.81 | | Profile exchanged |
| 125 | 5e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.78 | 41 | 204 | 39.2 | 0.0 | 46.5 | 94.1 | 83.2 | 131.7 | 2.99 | 0.84 | | Profile exchanged |
| 130 | 5e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.48 | 57 | 196 | 39.2 | 0.0 | 39.6 | 60.3 | 52.3 | 122.3 | 2.2 | 0.99 | | Profile exchanged |
| 129 | 6e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.42 | 46 | 191 | 37.3 | 0.00 | 41.1 | 60.3 | 52.3 | 122.3 | 2.20 | 0.91 | | Profile exchanged |
| 128 | 6e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.41 | 56 | 190 | 37.3 | 0.00 | 41.3 | 60.3 | 52.3 | 122.3 | 2.20 | 0.90 | | Profile exchanged |
| 127 | 6e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.33 | 47 | 184 | 37.3 | 0.00 | 43.5 | 60.3 | 52.3 | 122.3 | 2.20 | 0.86 | | Profile exchanged |
| 160 | 7e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.12 | 54 | 198 | 31.8 | 0.00 | 32.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.97 | | Profile exchanged |
| 159 | 7e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 2.19 | 29 | 187 | 31.8 | 0.62 | 38.8 | 60.3 | 52.3 | 98.8 | 1.88 | 0.82 | | Profile exchanged |
| 169 | 7e Tussenstuk | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.32 | 0 | 136 | 31.8 | 0.43 | 42.3 | 60.3 | 41.9 | 51.0 | 1.08 | 0.76 | | Profile exchanged |
| 158 | 7e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.08 | 51 | 194 | 31.8 | 0.00 | 33.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.95 | | Profile exchanged |
| 157 | 7e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.14 | 50 | 200 | 31.8 | 0.00 | 32.1 | 60.3 | 51.5 | 75.3 | 1.56 | 0.99 | | Profile exchanged |
| 167 | 7e Tussenstuk | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.30 | 0 | 133 | 31.8 | 0.42 | 43.3 | 60.3 | 41.9 | 51.0 | 1.08 | 0.76 | | Profile exchanged |
| 156 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.03 | 55 | 190 | 23.8 | 0.00 | 34.8 | 60.3 | 51.5 | 75.3 | 1.56 | 0.68 | | Profile exchanged |
| 155 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.07 | 51 | 194 | 23.8 | 0.00 | 33.7 | 60.3 | 51.5 | 75.3 | 1.56 | 0.70 | | Profile exchanged |
| 154 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.00 | 55 | 187 | 23.8 | 0.00 | 35.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.67 | | Profile exchanged |
| 153 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.07 | 53 | 193 | 23.8 | 0.00 | 33.8 | 60.3 | 51.5 | 75.3 | 1.56 | 0.70 | | Profile exchanged |
| BR02 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.22 | 0 | 104 | 41.0 | 0.40 | 83.2 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR03 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.61 | 0 | 52 | 41.0 | 0.20 | 131.3 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR07 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.63 | 52 | 139 | 41.0 | 0.00 | 58.7 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR08 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.54 | 0 | 46 | 41.0 | 0.18 | 135.7 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR09 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.08 | 0 | 92 | 41.0 | 0.35 | 94.2 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR14 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.67 | 56 | 143 | 41.0 | 0.00 | 56.7 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR15 | 3e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.55 | 52 | 133 | 41.0 | 0.00 | 62.7 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR10 | 3e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.47 | 0 | 40 | 41.0 | 0.15 | 140.1 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR11 | 3e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.94 | 0 | 80 | 41.0 | 0.31 | 106.6 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR16 | 3e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.61 | 61 | 138 | 41.0 | 0.00 | 59.7 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR17 | 4e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.46 | 56 | 125 | 41.0 | 0.00 | 67.6 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR12 | 4e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.40 | 0 | 34 | 41.0 | 0.13 | 144.4 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR13 | 4e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.80 | 0 | 68 | 41.0 | 0.26 | 119.2 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR18 | 4e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.56 | 65 | 133 | 41.0 | 0.00 | 62.2 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR19 | 4e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.51 | 52 | 129 | 41.0 | 0.00 | 64.8 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR20 | 5e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.04 | 0 | 89 | 39.2 | 0.34 | 97.6 | 60.3 | 52.3 | 98.8 | 1.88 | 0.75 | | Profile added |
| BR21 | 5e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.94 | 0 | 80 | 39.2 | 0.31 | 106.6 | 60.3 | 52.3 | 98.8 | 1.88 | 0.75 | | Profile added |

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75
Mast 50

| 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 | **54.0** | **0.29** | 93.0 | 58.8 | 59.0 | 76.6 | 1.69 | 0.92 | | |
| 620 | Onderstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.09 | 77 | 198 | **54.0** | **0.00** | 56.8 | 58.8 | 69.8 | 133.6 | 2.95 | 0.95 | | |
| 618 | Onderstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 2.62 | 0 | 133 | **54.0** | **0.65** | 118.8 | 58.8 | 69.8 | 179.7 | 4.76 | 0.92 | | |
| 616 | Onderstuk | Enkele staaf | L100.10 | S235 | M20 | 5.6 | 3.79 | 54 | 194 | **54.0** | **0.00** | 91.4 | 58.8 | 87.3 | 224.6 | 5.79 | 0.92 | | |
| 614 | Onderstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.07 | 0 | 189 | **54.0** | **1.02** | 104.5 | 58.8 | 87.3 | 253.4 | 7.07 | 0.92 | | |
| 612 | Onderstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.79 | 40 | 222 | **54.0** | **0.00** | 82.8 | 58.8 | 87.3 | 253.4 | 7.07 | 0.92 | | |
| 610 | Onderstuk | Enkele staaf | L130.12 | S235 | M20 | 5.6 | 5.52 | 0 | 217 | **54.0** | **1.38** | 121.8 | 58.8 | 104.7 | 442.4 | 11.85 | 0.92 | | |
| 608 | Onderstuk | Enkele staaf | L120.11 | S235 | M20 | 5.6 | 5.99 | 31 | 254 | **54.0** | **0.00** | 81.3 | 58.8 | 96.0 | 310.5 | 9.27 | 0.92 | | |
| 606 | Onderstuk | Enkele staaf | L150.10 | S235 | M20 | 5.6 | 6.89 | 0 | 232 | **54.0** | **1.72** | 107.3 | 58.8 | 87.3 | 368.6 | 14.71 | 0.92 | | |
| 604 | Onderstuk | Enkele staaf | L150.10 | S235 | M20 | 5.6 | 7.22 | 25 | 243 | **54.0** | **1.64** | 100.0 | 58.8 | 87.3 | 368.6 | 14.71 | 0.92 | | |
| 360 | Onderstuk | Enkele staaf | L180.16 | S235 | M24 | 5.6 | 8.42 | 0 | 241 | **54.0** | **2.11** | 192.8 | 84.7 | 177.2 | 986.1 | 30.45 | 0.64 | | |
| 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 | **54.0** | **0.00** | 60.6 | 84.7 | 110.8 | 213.1 | 5.79 | 0.89 | | |
| 367 | 1e Tussenstuk | Enkele staaf | L110.10 | S235 | M24 | 5.6 | 4.08 | 0 | 189 | **54.0** | **1.02** | 104.2 | 84.7 | 110.8 | 241.9 | 7.07 | 0.64 | | |
| 364 | 1e Tussenstuk | Enkele staaf | L100.10 | S235 | M24 | 5.6 | 3.37 | 0 | 172 | **54.0** | **0.84** | 107.1 | 84.7 | 110.8 | 213.1 | 5.79 | 0.64 | | |
| 362 | 1e Tussenstuk | Enkele staaf | L100.8 | S235 | M24 | 5.6 | 3.84 | 43 | 195 | **54.0** | **0.00** | 73.2 | 84.7 | 88.6 | 170.5 | 4.76 | 0.74 | | |
| 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 | | |
| 542 | 2e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 4.12 | 25 | 264 | **41.0** | **0.93** | 37.0 | 58.8 | 69.8 | 133.6 | 2.95 | 1.11 | Buckling | |
| 541 | 2e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.45 | 0 | 175 | **41.0** | **0.86** | 84.7 | 58.8 | 69.8 | 179.7 | 4.76 | 0.70 | | |
| 586 | 2e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.11 | 0 | 158 | **41.0** | **0.78** | 96.9 | 58.8 | 69.8 | 179.7 | 4.76 | 0.70 | | |
| 539 | 2e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.45 | 37 | 221 | **41.0** | **0.00** | 48.4 | 58.8 | 69.8 | 133.6 | 2.95 | 0.85 | | |
| 583 | 3e Tussenstuk | Enkele staaf | L150.10 | S235 | M24 | 5.6 | 5.98 | 0 | 202 | **39.2** | **1.50** | 131.9 | 84.7 | 110.8 | 357.1 | 14.71 | 0.46 | | |
| 537 | 3e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.67 | 31 | 235 | **39.2** | **0.00** | 44.2 | 58.8 | 69.8 | 133.6 | 2.95 | 0.89 | | |
| 536 | 3e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.03 | 0 | 154 | **39.2** | **0.76** | 100.1 | 58.8 | 69.8 | 179.7 | 4.76 | 0.67 | | |
| 584 | 3e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 2.62 | 0 | 168 | **39.2** | **0.66** | 71.0 | 58.8 | 69.8 | 133.6 | 2.95 | 0.67 | | |
| 534 | 3e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 3.09 | 41 | 245 | **39.2** | **0.00** | 29.4 | 58.8 | 59.0 | 76.6 | 1.69 | 1.33 | Buckling | |
| 529 | Tussenschot | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 7.56 | 0 | 384 | **1.0** | **1.89** | 25.5 | 58.8 | 69.8 | 179.7 | 4.8 | 0.40 | | |
| 530 | Tussenschot | Kruisende staaf halverwege | L80.8 | S235 | M20 | 5.6 | 10.94 | 0 | 451 | **1.0** | **1.37** | 13.7 | 58.8 | 69.8 | 133.6 | 3.0 | 0.46 | | |
| 263 | 4e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 3.19 | 36 | 253 | **39.2** | **0.00** | 28.0 | 58.8 | 59.0 | 76.6 | 1.7 | 1.40 | Buckling | |
| 262 | 4e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 2.67 | 0 | 171 | **39.2** | **0.67** | 69.2 | 58.8 | 69.8 | 133.6 | 3.0 | 0.67 | | |
| 281 | 4e Tussenstuk | Enkele staaf | L75.7 | S235 | M20 | 5.6 | 2.28 | 0 | 156 | **39.2** | **0.57** | 64.3 | 58.8 | 61.1 | 96.8 | 2.3 | 0.67 | | |
| 260 | 4e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.89 | 43 | 247 | **39.2** | **0.00** | 23.1 | 58.8 | 47.5 | 48.4 | 1.2 | 1.70 | Buckling | |
| 259 | 4e Tussenstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.50 | 0 | 208 | **39.2** | **1.12** | 90.9 | 58.8 | 87.3 | 253.4 | 7.1 | 0.67 | | |
| 258 | 4e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 3.05 | 36 | 261 | **39.2** | **0.00** | 21.2 | 58.8 | 47.5 | 48.4 | 1.2 | 1.85 | Buckling | |

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75
Mast 50

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 257 | 4e Tussenstuk | Enkele staaf | L75.7 | S235 | M20 | 5.6 | 2.26 | 0 | 154 | **39.2** | **0.56** | 65.2 | 58.8 | 61.1 | 96.8 | 2.3 | 0.67 | | |
| 252 | Tussenschot | Kniksteun op 0,5L | L120.11 | S235 | M30 | 5.6 | 8.32 | 0 | 227 | **39.2** | **2.08** | 79.5 | 134.6 | 156.0 | 275.6 | 9.3 | 0.49 | | |
| 254 | Tussenschot | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 5.87 | 0 | 298 | **1.0** | **1.47** | 38.6 | 58.8 | 69.8 | 179.7 | 4.8 | 0.31 | | |
| 253 | Tussenschot | Kruisende staaf halverwege | L75.7 | S235 | M20 | 5.6 | 8.54 | 0 | 375 | **1.0** | **1.07** | 15.1 | 58.8 | 61.1 | 96.8 | 2.3 | 0.47 | | |
| 119 | 5e Tussenstuk | Enkele staaf | L70.7 | S235 | M20 | 5.6 | 1.97 | 0 | 144 | **37.4** | **0.49** | 65.5 | 58.8 | 61.1 | 96.8 | 2.0 | 0.64 | | |
| 126 | 5e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.72 | 46 | 233 | **37.4** | **0.00** | 25.3 | 58.8 | 47.5 | 48.4 | 1.2 | 1.48 | Buckling | |
| 114 | 5e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.88 | 0 | 197 | **37.4** | **0.97** | 72.1 | 58.8 | 69.8 | 179.7 | 4.8 | 0.64 | | |
| 125 | 5e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.78 | 41 | 238 | **37.4** | **0.00** | 24.5 | 58.8 | 47.5 | 48.4 | 1.2 | 1.53 | Buckling | |
| 120 | 5e Tussenstuk | Enkele staaf | L70.7 | S235 | M20 | 5.6 | 1.95 | 0 | 143 | **37.4** | **0.49** | 66.3 | 58.8 | 61.1 | 96.8 | 2.0 | 0.64 | | |
| 121 | 5e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 1.65 | 0 | 131 | **37.4** | **0.41** | 67.8 | 58.8 | 59.0 | 76.6 | 1.7 | 0.64 | | |
| 130 | 5e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.48 | 57 | 255 | **37.4** | **0.00** | 15.3 | 37.7 | 30.3 | 31.7 | 0.7 | 2.44 | Buckling Bearing Net section | |
| 115 | 5e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.43 | 0 | 174 | **37.4** | **0.86** | 85.4 | 58.8 | 69.8 | 179.7 | 4.8 | 0.64 | | |
| 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 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.42 | 46 | 249 | **37.3** | **0.00** | 15.9 | 37.7 | 30.3 | 31.7 | 0.7 | 2.35 | Buckling Bearing Net section | |
| 122 | 6e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 1.73 | 0 | 137 | **37.3** | **0.43** | 64.3 | 58.8 | 59.0 | 76.6 | 1.7 | 0.63 | | |
| 124 | 6e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 1.48 | 0 | 127 | **37.3** | **0.37** | 55.8 | 58.8 | 47.5 | 48.4 | 1.2 | 0.78 | | |
| 128 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.41 | 56 | 248 | **37.3** | **0.00** | 16.0 | 37.7 | 30.3 | 31.7 | 0.7 | 2.33 | Buckling Bearing Net section | |
| 112 | 6e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 2.94 | 0 | 149 | **37.3** | **0.74** | 103.8 | 58.8 | 69.8 | 179.7 | 4.8 | 0.63 | | |
| 127 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.33 | 47 | 239 | **37.3** | **0.00** | 16.8 | 37.7 | 30.3 | 31.7 | 0.7 | 2.22 | Buckling Bearing Net section | |
| 123 | 6e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 1.49 | 0 | 127 | **37.3** | **0.37** | 55.4 | 58.8 | 47.5 | 48.4 | 1.2 | 0.78 | | |
| 111 | 6e Tussenstuk | Kniksteun op 0,5L | L100.8 | S235 | M20 | 5.6 | 5.47 | 0 | 178 | **37.3** | **1.37** | 66.6 | 58.8 | 69.8 | 179.7 | 4.8 | 0.63 | | |
| 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 | 7e Tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.38 | 0 | 118 | **31.8** | **0.35** | 60.0 | 37.7 | 38.4 | 72.6 | 1.2 | 0.84 | | |
| 160 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.12 | 54 | 218 | **31.8** | **0.00** | 19.4 | 37.7 | 30.3 | 31.7 | 0.7 | 1.64 | Buckling Bearing Net section | |
| 171 | 7e Tussenstuk | Enkele staaf | L80.8 | S235 | M16 | 5.6 | 2.67 | 0 | 171 | **31.8** | **0.67** | 69.2 | 37.7 | 51.2 | 142.8 | 3.0 | 0.84 | | |
| 159 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.19 | 29 | 225 | **31.8** | **0.48** | 18.5 | 37.7 | 30.3 | 31.7 | 0.7 | 1.72 | Buckling Bearing Net section | |
| 170 | 7e Tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.38 | 0 | 118 | **31.8** | **0.35** | 60.0 | 37.7 | 38.4 | 72.6 | 1.2 | 0.84 | | |
| 169 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.32 | 0 | 136 | **31.8** | **0.33** | 36.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.05 | Bearing Net section | |
| 158 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.08 | 51 | 214 | **31.8** | **0.00** | 19.9 | 37.7 | 30.3 | 31.7 | 0.7 | 1.60 | Buckling Bearing Net section | |
| 182 | 7e Tussenstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 2.58 | 0 | 176 | **31.8** | **0.65** | 54.9 | 37.7 | 44.8 | 104.8 | 2.3 | 0.84 | | |
| 157 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.14 | 50 | 220 | **31.8** | **0.00** | 19.1 | 37.7 | 30.3 | 31.7 | 0.7 | 1.66 | Buckling Bearing Net section | |
| 167 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.30 | 0 | 133 | **31.8** | **0.32** | 36.7 | 37.7 | 30.3 | 31.7 | 0.7 | 1.05 | Bearing Net section | |
| 166 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.20 | 0 | 123 | **23.8** | **0.30** | 39.9 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 156 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.03 | 55 | 209 | **23.8** | **0.00** | 20.6 | 37.7 | 30.3 | 31.7 | 0.7 | 1.15 | Buckling | |
| 165 | 8e Tussenstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 2.42 | 0 | 177 | **23.8** | **0.60** | 50.7 | 37.7 | 44.8 | 104.8 | 2.0 | 0.63 | | |
| 155 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.07 | 51 | 213 | **23.8** | **0.00** | 20.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.19 | Buckling | |
| 164 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.22 | 0 | 125 | **23.8** | **0.31** | 39.2 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 163 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.18 | 0 | 121 | **23.8** | **0.29** | 40.7 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 154 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.00 | 55 | 205 | **23.8** | **0.00** | 21.1 | 37.7 | 30.3 | 31.7 | 0.7 | 1.13 | Buckling | |

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75
Mast 50

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 162 | 8e Tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.29 | 0 | 182 | **23.8** | **0.57** | 45.2 | 37.7 | 44.8 | 84.7 | 1.7 | 0.63 | | |
| 153 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.07 | 53 | 213 | **23.8** | **0.00** | 20.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.19 | Buckling | |
| 161 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.16 | 0 | 119 | **23.8** | **0.29** | 41.3 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 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 | 9e 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 | 9e 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 | 10e 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 | 10e 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 | 10e 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 | 11e 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 | 11e 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 | 11e 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 | | |

DNV-GL

## Knikverkorters adjusted construction (verbouw)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75
Mast 50

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 542 | 2e Tussenstuk | Enkele staaf | L90.8 | S355 | M20 | 8.8 | 4.12 | 25 | 234 | **41.0** | **1.21** | 55.4 | 94.1 | 95.0 | 276.0 | 5.70 | 0.74 | | Profile exchanged |
| 534 | 3e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 3.09 | 41 | 226 | **39.2** | **0.0** | 39.5 | 94.1 | 83.2 | 131.7 | 3.0 | 0.99 | | Profile exchanged |
| 263 | 4e Tussenstuk | Enkele staaf | L75.7 | S355 | M20 | 8.8 | 3.19 | 36 | 218 | **39.2** | **0.0** | 45.1 | 94.1 | 83.2 | 159.2 | 3.4 | 0.87 | | Profile exchanged |
| 260 | 4e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.89 | 43 | 212 | **39.2** | **0.0** | 43.8 | 94.1 | 83.2 | 131.7 | 2.99 | 0.89 | | Profile exchanged |
| 258 | 4e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 3.05 | 36 | 224 | **39.2** | **0.0** | 40.3 | 94.1 | 83.2 | 131.7 | 2.99 | 0.97 | | Profile exchanged |
| 126 | 5e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.72 | 46 | 199 | **37.4** | **0.0** | 48.1 | 94.1 | 83.2 | 131.7 | 3.0 | 0.78 | | Profile exchanged |
| 125 | 5e Tussenstuk | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.78 | 41 | 204 | **37.4** | **0.0** | 46.5 | 94.1 | 83.2 | 131.7 | 2.99 | 0.80 | | Profile exchanged |
| 130 | 5e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.48 | 57 | 196 | **37.4** | **0.0** | 39.6 | 60.3 | 52.3 | 122.3 | 2.2 | 0.94 | | Profile exchanged |
| 129 | 6e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.42 | 46 | 191 | **37.3** | **0.00** | 41.1 | 60.3 | 52.3 | 122.3 | 2.20 | 0.91 | | Profile exchanged |
| 128 | 6e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.41 | 56 | 190 | **37.3** | **0.00** | 41.3 | 60.3 | 52.3 | 122.3 | 2.20 | 0.90 | | Profile exchanged |
| 127 | 6e Tussenstuk | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.33 | 47 | 184 | **37.3** | **0.00** | 43.5 | 60.3 | 52.3 | 122.3 | 2.20 | 0.86 | | Profile exchanged |
| 160 | 7e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.12 | 54 | 198 | **31.8** | **0.00** | 32.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.97 | | Profile exchanged |
| 159 | 7e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 2.19 | 29 | 187 | **31.8** | **0.62** | 38.8 | 60.3 | 52.3 | 98.8 | 1.88 | 0.82 | | Profile exchanged |
| 169 | 7e Tussenstuk | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.32 | 0 | 136 | **31.8** | **0.43** | 42.3 | 60.3 | 41.9 | 51.0 | 1.08 | 0.76 | | Profile exchanged |
| 158 | 7e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.08 | 51 | 194 | **31.8** | **0.00** | 33.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.95 | | Profile exchanged |
| 157 | 7e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.14 | 50 | 200 | **31.8** | **0.00** | 32.1 | 60.3 | 51.5 | 75.3 | 1.56 | 0.99 | | Profile exchanged |
| 167 | 7e Tussenstuk | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.30 | 0 | 133 | **31.8** | **0.42** | 43.3 | 60.3 | 41.9 | 51.0 | 1.08 | 0.76 | | Profile exchanged |
| 156 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.03 | 55 | 190 | **23.8** | **0.00** | 34.8 | 60.3 | 51.5 | 75.3 | 1.56 | 0.68 | | Profile exchanged |
| 155 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.07 | 51 | 194 | **23.8** | **0.00** | 33.7 | 60.3 | 51.5 | 75.3 | 1.56 | 0.70 | | Profile exchanged |
| 154 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.00 | 55 | 187 | **23.8** | **0.00** | 35.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.67 | | Profile exchanged |
| 153 | 8e Tussenstuk | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.07 | 53 | 193 | **23.8** | **0.00** | 33.8 | 60.3 | 51.5 | 75.3 | 1.56 | 0.70 | | Profile exchanged |
| BR02 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.22 | 0 | 104 | **41.0** | **0.40** | 83.2 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR03 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 0.61 | 0 | 52 | **41.0** | **0.20** | 131.3 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |
| BR04 | 3e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.62 | 0 | 139 | **39.2** | **0.53** | 59.2 | 60.3 | 52.3 | 98.8 | 1.88 | 0.75 | | Profile added |
| BR05 | 4e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.41 | 0 | 121 | **39.2** | **0.46** | 70.5 | 60.3 | 52.3 | 98.8 | 1.88 | 0.75 | | Profile added |
| BR06 | 5e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.20 | 0 | 103 | **39.2** | **0.39** | 84.7 | 60.3 | 52.3 | 98.8 | 1.88 | 0.75 | | Profile added |
| BR07 | 2e Tussenstuk | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.63 | 52 | 139 | **41.0** | 0.00 | 58.7 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T and S+75
Masts 52 & 53

| 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 | **54.0** | **0.29** | 93.0 | 58.8 | 59.0 | 76.6 | 1.69 | 0.92 | | |
| 620 | Onderstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.09 | 77 | 198 | **54.0** | **0.00** | 56.8 | 58.8 | 69.8 | 133.6 | 2.95 | 0.95 | | |
| 618 | Onderstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 2.62 | 0 | 133 | **54.0** | **0.65** | 118.8 | 58.8 | 69.8 | 179.7 | 4.76 | 0.92 | | |
| 616 | Onderstuk | Enkele staaf | L100.10 | S235 | M20 | 5.6 | 3.79 | 54 | 194 | **54.0** | **0.00** | 91.4 | 58.8 | 87.3 | 224.6 | 5.79 | 0.92 | | |
| 614 | Onderstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.07 | 0 | 189 | **54.0** | **1.02** | 104.5 | 58.8 | 87.3 | 253.4 | 7.07 | 0.92 | | |
| 612 | Onderstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.79 | 40 | 222 | **54.0** | **0.00** | 82.8 | 58.8 | 87.3 | 253.4 | 7.07 | 0.92 | | |
| 610 | Onderstuk | Enkele staaf | L130.12 | S235 | M20 | 5.6 | 5.52 | 0 | 217 | **54.0** | **1.38** | 121.8 | 58.8 | 104.7 | 442.4 | 11.85 | 0.92 | | |
| 608 | Onderstuk | Enkele staaf | L120.11 | S235 | M20 | 5.6 | 5.99 | 31 | 254 | **54.0** | **0.00** | 81.3 | 58.8 | 96.0 | 310.5 | 9.27 | 0.92 | | |
| 606 | Onderstuk | Enkele staaf | L150.10 | S235 | M20 | 5.6 | 6.89 | 0 | 232 | **54.0** | **1.72** | 107.3 | 58.8 | 87.3 | 368.6 | 14.71 | 0.92 | | |
| 604 | Onderstuk | Enkele staaf | L150.10 | S235 | M20 | 5.6 | 7.22 | 25 | 243 | **54.0** | **1.64** | 100.0 | 58.8 | 87.3 | 368.6 | 14.71 | 0.92 | | |
| 360 | Onderstuk | Enkele staaf | L180.16 | S235 | M24 | 5.6 | 8.42 | 0 | 241 | **54.0** | **2.11** | 192.8 | 84.7 | 177.2 | 986.1 | 30.45 | 0.64 | | |
| 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 | **54.0** | **0.00** | 60.6 | 84.7 | 110.8 | 213.1 | 5.79 | 0.89 | | |
| 367 | 1e Tussenstuk | Enkele staaf | L110.10 | S235 | M24 | 5.6 | 4.08 | 0 | 189 | **54.0** | **1.02** | 104.2 | 84.7 | 110.8 | 241.9 | 7.07 | 0.64 | | |
| 364 | 1e Tussenstuk | Enkele staaf | L100.10 | S235 | M24 | 5.6 | 3.37 | 0 | 172 | **54.0** | **0.84** | 107.1 | 84.7 | 110.8 | 213.1 | 5.79 | 0.64 | | |
| 362 | 1e Tussenstuk | Enkele staaf | L100.8 | S235 | M24 | 5.6 | 3.84 | 43 | 195 | **54.0** | **0.00** | 73.2 | 84.7 | 88.6 | 170.5 | 4.76 | 0.74 | | |
| 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 | | |
| 542 | 2e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 4.12 | 25 | 264 | **39.2** | **0.93** | 37.0 | 58.8 | 69.8 | 133.6 | 2.95 | 1.06 | Buckling | |
| 541 | 2e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.45 | 0 | 175 | **39.2** | **0.86** | 84.7 | 58.8 | 69.8 | 179.7 | 4.76 | 0.67 | | |
| 586 | 2e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.11 | 0 | 158 | **39.2** | **0.78** | 96.9 | 58.8 | 69.8 | 179.7 | 4.76 | 0.67 | | |
| 539 | 2e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.45 | 37 | 221 | **39.2** | **0.00** | 48.4 | 58.8 | 69.8 | 133.6 | 2.95 | 0.81 | | |
| 583 | 2e Tussenstuk | Enkele staaf | L150.10 | S235 | M24 | 5.6 | 5.98 | 0 | 202 | **37.4** | **1.50** | 131.9 | 84.7 | 110.8 | 357.1 | 14.71 | 0.44 | | |
| 537 | 3e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 3.67 | 31 | 235 | **37.4** | **0.00** | 44.2 | 58.8 | 69.8 | 133.6 | 2.95 | 0.85 | | |
| 536 | 3e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.03 | 0 | 154 | **37.4** | **0.76** | 100.1 | 58.8 | 69.8 | 179.7 | 4.76 | 0.64 | | |
| 584 | 3e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 2.62 | 0 | 168 | **37.4** | **0.66** | 71.0 | 58.8 | 69.8 | 133.6 | 2.95 | 0.64 | | |
| 534 | 3e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 3.09 | 41 | 245 | **37.4** | **0.00** | 29.4 | 58.8 | 59.0 | 76.6 | 1.69 | 1.27 | Buckling | |
| 529 | Tussenschot | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 7.56 | 0 | 384 | **1.0** | **1.89** | 25.5 | 58.8 | 69.8 | 179.7 | 4.8 | 0.40 | | |
| 530 | Tussenschot | Kruisende staaf halverwege | L80.8 | S235 | M20 | 5.6 | 10.94 | 0 | 451 | **1.0** | **1.37** | 13.7 | 58.8 | 69.8 | 133.6 | 3.0 | 0.46 | | |
| 263 | 4e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 3.19 | 36 | 253 | **37.6** | **0.00** | 28.0 | 58.8 | 59.0 | 76.6 | 1.7 | 1.34 | Buckling | |
| 262 | 4e Tussenstuk | Enkele staaf | L80.8 | S235 | M20 | 5.6 | 2.67 | 0 | 171 | **37.6** | **0.67** | 69.2 | 58.8 | 69.8 | 133.6 | 3.0 | 0.64 | | |
| 281 | 4e Tussenstuk | Enkele staaf | L75.7 | S235 | M20 | 5.6 | 2.28 | 0 | 156 | **37.6** | **0.57** | 64.3 | 58.8 | 61.1 | 96.8 | 2.3 | 0.64 | | |
| 260 | 4e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.89 | 43 | 247 | **37.6** | **0.00** | 23.1 | 58.8 | 47.5 | 48.4 | 1.2 | 1.63 | Buckling | |
| 259 | 4e Tussenstuk | Enkele staaf | L110.10 | S235 | M20 | 5.6 | 4.50 | 0 | 208 | **37.6** | **1.12** | 90.9 | 58.8 | 87.3 | 253.4 | 7.1 | 0.64 | | |
| 258 | 4e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 3.05 | 36 | 261 | **37.6** | **0.00** | 21.2 | 58.8 | 47.5 | 48.4 | 1.2 | 1.77 | Buckling | |

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T and S+75
Masts 52 & 53

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 257 | 4e Tussenstuk | Enkele staaf | L75.7 | S235 | M20 | 5.6 | 2.26 | 0 | 154 | **37.6** | **0.56** | 65.2 | 58.8 | 61.1 | 96.8 | 2.3 | 0.64 | | |
| 252 | Tussenschot | Kniksteun op 0,5L | L120.11 | S235 | M30 | 5.6 | 8.32 | 0 | 227 | **37.6** | **2.08** | 79.5 | 134.6 | 156.0 | 275.6 | 9.3 | 0.47 | | |
| 254 | Tussenschot | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 5.87 | 0 | 298 | **1.0** | **1.47** | 38.6 | 58.8 | 69.8 | 179.7 | 4.8 | 0.31 | | |
| 253 | Tussenschot | Kruisende staaf halverwege | L75.7 | S235 | M20 | 5.6 | 8.54 | 0 | 375 | **1.0** | **1.07** | 15.1 | 58.8 | 61.1 | 96.8 | 2.3 | 0.47 | | |
| 119 | 5e Tussenstuk | Enkele staaf | L70.7 | S235 | M20 | 5.6 | 1.97 | 0 | 144 | **37.4** | **0.49** | 65.5 | 58.8 | 61.1 | 96.8 | 2.0 | 0.64 | | |
| 126 | 5e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.72 | 46 | 233 | **37.4** | **0.00** | 25.3 | 58.8 | 47.5 | 48.4 | 1.2 | 1.48 | Buckling | |
| 114 | 5e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.88 | 0 | 197 | **37.4** | **0.97** | 72.1 | 58.8 | 69.8 | 179.7 | 4.8 | 0.64 | | |
| 125 | 5e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 2.78 | 41 | 238 | **37.4** | **0.00** | 24.5 | 58.8 | 47.5 | 48.4 | 1.2 | 1.53 | Buckling | |
| 120 | 5e Tussenstuk | Enkele staaf | L70.7 | S235 | M20 | 5.6 | 1.95 | 0 | 143 | **37.4** | **0.49** | 66.3 | 58.8 | 61.1 | 96.8 | 2.0 | 0.64 | | |
| 121 | 5e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 1.65 | 0 | 131 | **37.4** | **0.41** | 67.8 | 58.8 | 59.0 | 76.6 | 1.7 | 0.64 | | |
| 130 | 5e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.48 | 57 | 255 | **37.4** | **0.00** | 15.3 | 37.7 | 30.3 | 31.7 | 0.7 | 2.44 | Buckling Bearing Net section | |
| 115 | 5e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 3.43 | 0 | 174 | **37.4** | **0.86** | 85.4 | 58.8 | 69.8 | 179.7 | 4.8 | 0.64 | | |
| 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 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.42 | 46 | 249 | **37.3** | **0.00** | 15.9 | 37.7 | 30.3 | 31.7 | 0.7 | 2.35 | Buckling Bearing Net section | |
| 122 | 6e Tussenstuk | Enkele staaf | L65.7 | S235 | M20 | 5.6 | 1.73 | 0 | 137 | **37.3** | **0.43** | 64.3 | 58.8 | 59.0 | 76.6 | 1.7 | 0.63 | | |
| 124 | 6e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 1.48 | 0 | 127 | **37.3** | **0.37** | 55.8 | 58.8 | 47.5 | 48.4 | 1.2 | 0.78 | | |
| 128 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.41 | 56 | 248 | **37.3** | **0.00** | 16.0 | 37.7 | 30.3 | 31.7 | 0.7 | 2.33 | Buckling Bearing Net section | |
| 112 | 6e Tussenstuk | Enkele staaf | L100.8 | S235 | M20 | 5.6 | 2.94 | 0 | 149 | **37.3** | **0.74** | 103.8 | 58.8 | 69.8 | 179.7 | 4.8 | 0.63 | | |
| 127 | 6e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.33 | 47 | 239 | **37.3** | **0.00** | 16.8 | 37.7 | 30.3 | 31.7 | 0.7 | 2.22 | Buckling Bearing Net section | |
| 123 | 6e Tussenstuk | Enkele staaf | L60.6 | S235 | M20 | 5.6 | 1.49 | 0 | 127 | **37.3** | **0.37** | 55.4 | 58.8 | 47.5 | 48.4 | 1.2 | 0.78 | | |
| 111 | 6e Tussenstuk | Kniksteun op 0,5L | L100.8 | S235 | M20 | 5.6 | 5.47 | 0 | 178 | **37.3** | **1.37** | 66.6 | 58.8 | 69.8 | 179.7 | 4.8 | 0.63 | | |
| 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 | 7e Tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.38 | 0 | 118 | **31.8** | **0.35** | 60.0 | 37.7 | 38.4 | 72.6 | 1.2 | 0.84 | | |
| 160 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.12 | 54 | 218 | **31.8** | **0.00** | 19.4 | 37.7 | 30.3 | 31.7 | 0.7 | 1.64 | Buckling Bearing Net section | |
| 171 | 7e Tussenstuk | Enkele staaf | L80.8 | S235 | M16 | 5.6 | 2.67 | 0 | 171 | **31.8** | **0.67** | 69.2 | 37.7 | 51.2 | 142.8 | 3.0 | 0.84 | | |
| 159 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.19 | 29 | 225 | **31.8** | **0.48** | 18.5 | 37.7 | 30.3 | 31.7 | 0.7 | 1.72 | Buckling Bearing Net section | |
| 170 | 7e Tussenstuk | Enkele staaf | L60.6 | S235 | M16 | 5.6 | 1.38 | 0 | 118 | **31.8** | **0.35** | 60.0 | 37.7 | 38.4 | 72.6 | 1.2 | 0.84 | | |
| 169 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.32 | 0 | 136 | **31.8** | **0.33** | 36.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.05 | Bearing Net section | |
| 158 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.08 | 51 | 214 | **31.8** | **0.00** | 19.9 | 37.7 | 30.3 | 31.7 | 0.7 | 1.60 | Buckling Bearing Net section | |
| 182 | 7e Tussenstuk | Enkele staaf | L75.7 | S235 | M16 | 5.6 | 2.58 | 0 | 176 | **31.8** | **0.65** | 54.9 | 37.7 | 44.8 | 104.8 | 2.3 | 0.84 | | |
| 157 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.14 | 50 | 220 | **31.8** | **0.00** | 19.1 | 37.7 | 30.3 | 31.7 | 0.7 | 1.66 | Buckling Bearing Net section | |
| 167 | 7e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.30 | 0 | 133 | **31.8** | **0.32** | 36.7 | 37.7 | 30.3 | 31.7 | 0.7 | 1.05 | Bearing Net section | |
| 166 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.20 | 0 | 123 | **23.8** | **0.30** | 39.9 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 156 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.03 | 55 | 209 | **23.8** | **0.00** | 20.6 | 37.7 | 30.3 | 31.7 | 0.7 | 1.15 | Buckling | |
| 165 | 8e Tussenstuk | Enkele staaf | L70.7 | S235 | M16 | 5.6 | 2.42 | 0 | 177 | **23.8** | **0.60** | 50.7 | 37.7 | 44.8 | 104.8 | 2.0 | 0.63 | | |
| 155 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.07 | 51 | 213 | **23.8** | **0.00** | 20.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.19 | Buckling | |
| 164 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.22 | 0 | 125 | **23.8** | **0.31** | 39.2 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 163 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.18 | 0 | 121 | **23.8** | **0.29** | 40.7 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 154 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.00 | 55 | 205 | **23.8** | **0.00** | 21.1 | 37.7 | 30.3 | 31.7 | 0.7 | 1.13 | Buckling | |

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# Knikverkorters initial construction (afkeur)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T and S+75
Masts 52 & 53

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 162 | 8e Tussenstuk | Enkele staaf | L65.7 | S235 | M16 | 5.6 | 2.29 | 0 | 182 | **23.8** | **0.57** | 45.2 | 37.7 | 44.8 | 84.7 | 1.7 | 0.63 | | |
| 153 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 2.07 | 53 | 213 | **23.8** | **0.00** | 20.0 | 37.7 | 30.3 | 31.7 | 0.7 | 1.19 | Buckling | |
| 161 | 8e Tussenstuk | Enkele staaf | L50.5 | S235 | M16 | 5.6 | 1.16 | 0 | 119 | **23.8** | **0.29** | 41.3 | 37.7 | 30.3 | 31.7 | 0.7 | 0.78 | | |
| 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 | 9e 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 | 9e 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 | 10e 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 | 10e 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 | 10e 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 | 11e 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 | 11e 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 | 11e 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 | | |

DNV·GL

## Knikverkorters adjusted construction (verbouw)

Date: 2021-02-23
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+75T and S+75
Masts 52 & 53

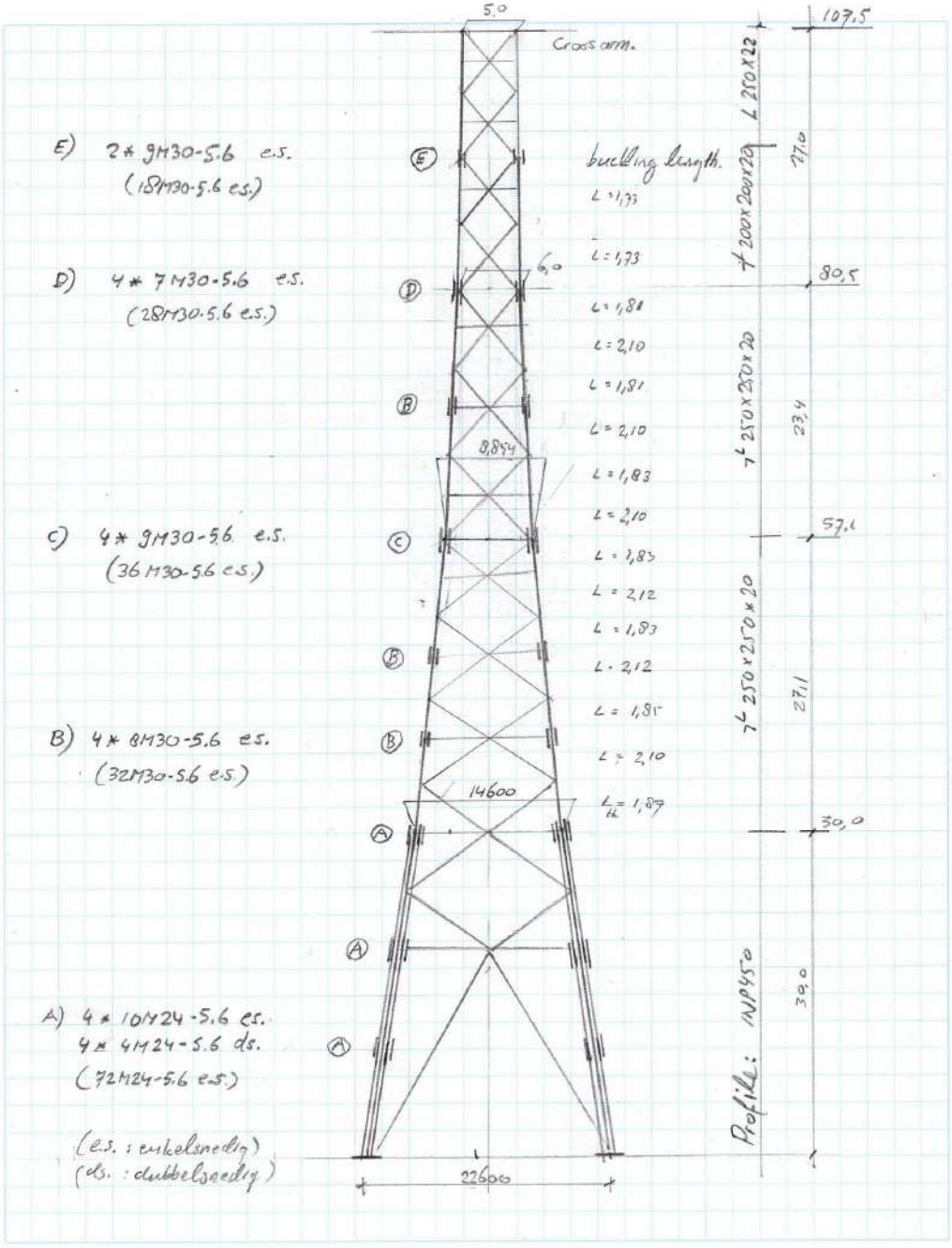
| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness (-) | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Block Tearing Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | Mitigation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 542 | 2e Tussenstu | Enkele staaf | L90.8 | S355 | M20 | 8.8 | 4.12 | 25 | 234 | 39.2 | 1.21 | 55.4 | 94.1 | 95.0 | 276.0 | 5.70 | 0.71 | | Profile exchanged |
| 534 | 3e Tussenstu | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 3.09 | 41 | 226 | 37.4 | 0.0 | 39.5 | 94.1 | 83.2 | 131.7 | 3.0 | 0.95 | | Profile exchanged |
| 263 | 4e Tussenstu | Enkele staaf | L75.7 | S355 | M20 | 8.8 | 3.19 | 36 | 218 | 37.6 | 0.0 | 45.1 | 94.1 | 83.2 | 159.2 | 3.4 | 0.83 | | Profile exchanged |
| 260 | 4e Tussenstu | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.89 | 43 | 212 | 37.6 | 0.0 | 43.8 | 94.1 | 83.2 | 131.7 | 2.99 | 0.86 | | Profile exchanged |
| 258 | 4e Tussenstu | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 3.05 | 36 | 224 | 37.6 | 0.0 | 40.3 | 94.1 | 83.2 | 131.7 | 2.99 | 0.93 | | Profile exchanged |
| 126 | 5e Tussenstu | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.72 | 46 | 199 | 37.4 | 0.0 | 48.1 | 94.1 | 83.2 | 131.7 | 3.0 | 0.78 | | Profile exchanged |
| 125 | 5e Tussenstu | Enkele staaf | L70.7 | S355 | M20 | 8.8 | 2.78 | 41 | 204 | 37.4 | 0.0 | 46.5 | 94.1 | 83.2 | 131.7 | 2.99 | 0.80 | | Profile exchanged |
| 130 | 5e Tussenstu | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.48 | 57 | 196 | 37.4 | 0.0 | 39.6 | 60.3 | 52.3 | 122.3 | 2.2 | 0.94 | | Profile exchanged |
| 129 | 6e Tussenstu | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.42 | 46 | 191 | 37.3 | 0.00 | 41.1 | 60.3 | 52.3 | 122.3 | 2.20 | 0.91 | | Profile exchanged |
| 128 | 6e Tussenstu | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.41 | 56 | 190 | 37.3 | 0.00 | 41.3 | 60.3 | 52.3 | 122.3 | 2.20 | 0.90 | | Profile exchanged |
| 127 | 6e Tussenstu | Enkele staaf | L65.6 | S355 | M16 | 8.8 | 2.33 | 47 | 184 | 37.3 | 0.00 | 43.5 | 60.3 | 52.3 | 122.3 | 2.20 | 0.86 | | Profile exchanged |
| 160 | 7e Tussenstu | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.12 | 54 | 198 | 31.8 | 0.00 | 32.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.97 | | Profile exchanged |
| 159 | 7e Tussenstu | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 2.19 | 29 | 187 | 31.8 | 0.62 | 38.8 | 60.3 | 52.3 | 98.8 | 1.88 | 0.82 | | Profile exchanged |
| 169 | 7e Tussenstu | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.32 | 0 | 136 | 31.8 | 0.43 | 42.3 | 60.3 | 41.9 | 51.0 | 1.08 | 0.76 | | Profile exchanged |
| 158 | 7e Tussenstu | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.08 | 51 | 194 | 31.8 | 0.00 | 33.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.95 | | Profile exchanged |
| 157 | 7e Tussenstu | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.14 | 50 | 200 | 31.8 | 0.00 | 32.1 | 60.3 | 51.5 | 75.3 | 1.56 | 0.99 | | Profile exchanged |
| 167 | 7e Tussenstu | Enkele staaf | L50.5 | S355 | M16 | 8.8 | 1.30 | 0 | 133 | 31.8 | 0.42 | 43.3 | 60.3 | 41.9 | 51.0 | 1.08 | 0.76 | | Profile exchanged |
| 156 | 8e Tussenstu | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.03 | 55 | 190 | 23.8 | 0.00 | 34.8 | 60.3 | 51.5 | 75.3 | 1.56 | 0.68 | | Profile exchanged |
| 155 | 8e Tussenstu | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.07 | 51 | 194 | 23.8 | 0.00 | 33.7 | 60.3 | 51.5 | 75.3 | 1.56 | 0.70 | | Profile exchanged |
| 154 | 8e Tussenstu | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.00 | 55 | 187 | 23.8 | 0.00 | 35.6 | 60.3 | 51.5 | 75.3 | 1.56 | 0.67 | | Profile exchanged |
| 153 | 8e Tussenstu | Enkele staaf | L55.6 | S355 | M16 | 8.8 | 2.07 | 53 | 193 | 23.8 | 0.00 | 33.8 | 60.3 | 51.5 | 75.3 | 1.56 | 0.70 | | Profile exchanged |
| BR01 | 2e Tussenstu | Enkele staaf | L60.6 | S355 | M16 | 8.8 | 1.83 | 0 | 157 | 39.2 | 0.59 | 50.2 | 60.3 | 52.3 | 98.8 | 1.88 | 0.78 | | Profile added |

# APPENDIX D TOETSING ANKERS & OVERIGE BEREKENINGEN

# CAPACITY OF MAIN LEG

The main leg of the structure is composed of cruciform sections over a large part of the height of the structure. The capacity of the bolted connections and the buckling capacity has been checked into more detail than what the software package PLS-TOWER offers.

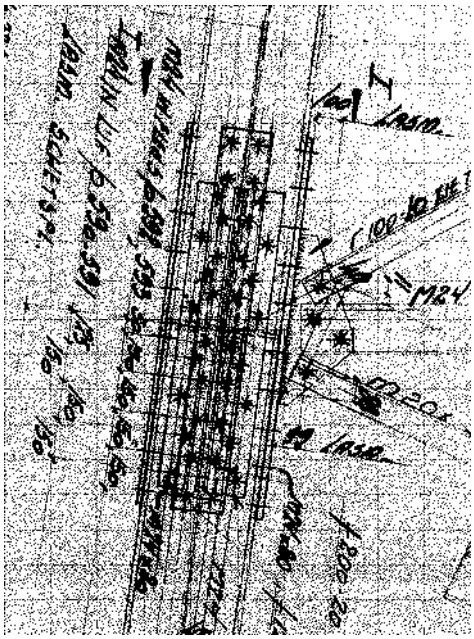
Main reason is the torsional buckling mode which is not included in PLS-TOWER and the strength of the bolted connections in the INP450 sections. Additionally the bolted connections in the angle cruciforms have been verified too.




**Figuur 1 Scheme of lower part tower S+75 with bolted connections and profiles**

# 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 two plate connections within the connection will be checked with a spreadsheet.

- Capacity of bolts

M24-5.6: $F_{v,Rd}$ = 84,7 kN. Due to the length the bolts in the flange are considered 95% effective.

| | | |
|---|---|---|
| Flanges: | 4 x 10 x 84,7 x 0,95 = | 3219 kN |
| Web: | 4 x 8 x 2 x 84,7 = | 2710 kN |
| Total | | 5928 kN |

- Bearing capacity

Not decisive, see spreadsheet output next page.

- Total capacity for compression

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.

| | | |
|---|---|---|
| Flanges: | 4 x 805 = | 3219 kN |
| Web: | 4 x 678 = | 2710 kN |
| Total (compression): | | 5930 kN |
| Flanges: | 4 x 767 = | 3070 kN |
| Web: | 4 x 678 = | 2710 kN |
| Total (tension): | | 5780 kN |

The bolt capacity is with a slight difference decisive.

- 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.

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/mm$^2$ |

| ***Belasting*** | $F_{t,Ed}$ = | **847** kN |
|---|---|---|
| ***Resultaat*** | | |
| *Sterkte van de verbinding* | | |
| Boutverbinding: | UC. = | **1,05 Niet OK** |
| Nettodoorsnede: | UC. = | **1,10 Niet OK** |

***Vervormingscapaciteit***

Voorwaarde: $N_{pl;Rd} / N_{u;Rd} < 1,00$ 1,23 => Nee

***Doorsnede strip***

| | | |
|---|---|---|
| $A_{bruto}$ = b x t = | 4000 | mm$^2$ |
| $A_{net}$ = (b - $nd_g$)t = | 2960 | mm$^2$ |
| $f_u$ = | 360 | N/mm$^2$ |
| $\gamma_{m0}$ = | 1,00 | - |
| $\gamma_{m2}$ = | 1,25 | - |
| $N_{u;Rd}$ = a x 0,9 x $A_{net}$ x $f_u$ / $\gamma_{m2}$ = | **767** | kN |
| *Vloeien van brutodoorsnede* | | |
| $N_{pl;Rd}$ = a x A x $f_y$ / $\gamma_{m0}$ = | **940** | kN |

***Stuik strip***

| | | |
|---|---|---|
| Factor $f_{ub}$ / $f_u$ = | 2,13 | |
| | 1,00 | |
| Eindbout $\alpha_d$ = $e_1$ / 3$d_0$ = | 0,51 | |
| $k_1$ = 2,8$e_2$ / $d_0$ - 1,7 = | 4,22 | |
| $k_1$ = 1,4$p_2$ / $d_0$ - 1,7 = | 3,15 | |
| $k_1$ = | 2,50 | |
| $F_{b;Rd}$ = a x $k_1\alpha_b f_u$ d t / $\gamma_{M2}$ = | 177 | kN |
| Tussenbt $\alpha_d$ = $p_1$ / 3$d_0$ - $^1/_4$ = | 1,67 | |
| $k_1$ = 2,8$e_2$ / $d_0$ - 1,7 = | 4,22 | |
| $k_1$ = 1,4$p_2$ / $d_0$ - 1,7 = | 3,15 | |
| $k_1$ = | 2,50 | |
| $F_{b;Rd}$ = a x $k_1\alpha_b f_u$ d t / $\gamma_{M2}$ = | 346 | 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 |

***Afschuiving bouten***

| | | |
|---|---|---|
| Afschuifdoorsnede door: | | Schacht |
| Factor boutkwaliteit | $\alpha_v$ = | 0,60 - |
| Factor fabricage | $\alpha_{red}$ = | 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: | | 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 | 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 | |

$\Sigma F_{Rd}$ = 402,4 kN

Min. $F_{Rd}$ = 80,5 kN

***Resultaat boutverbinding***

Elastisch $\frac{F_{v,Ed}}{\text{min. } F_{v,Rd}} = \frac{84,7}{80} = 1,05$ ***Niet OK***

Plastisch $\frac{F_{t,Ed}}{\Sigma F_{Rd}} = \frac{847,0}{402,4 \text{ x } 2} = 1,05$ ***Niet OK***

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***

| | | |
|---|---|---|
| $A_{bruto} = b \times t$ = | 1920 | mm$^2$ |
| $A_{net} = (b - nd_g)t$ = | 1504 | mm$^2$ |
| $f_u$ = | 360 | N/mm$^2$ |
| $\gamma_{m0}$ = | 1,00 | - |
| $\gamma_{m2}$ = | 1,25 | - |
| $N_{u;Rd} = a \times 0,9 \times A_{net} \times f_u / \gamma_{m2}$ = | **780** | kN |
| *Vloeien van brutodoorsnede* | | |
| $N_{pl;Rd} = a \times A \times f_y / \gamma_{m0}$ = | **902** | kN |

***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 | |
| $F_{b;Rd} = a \times k_1 \alpha_b f_u d t / \gamma_{M2}$ = | | 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 | |
| $F_{b;Rd} = a \times k_1 \alpha_b f_u d t / \gamma_{M2}$ = | | 393 | 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 |

***Afschuiving bouten***

| | | | |
|---|---|---|---|
| Afschuifdoorsnede door: | | Schacht | |
| Factor boutkwaliteit | $\alpha_v$ = | 0,60 | - |
| Factor fabricage | $\alpha_{red}$ = | 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 | |
| | | | | | | $\Sigma F_{Rd}$ = | 677,8 | kN |
| | | | | | | Min. $F_{Rd}$ = | 169,4 | kN |

***Resultaat boutverbinding***

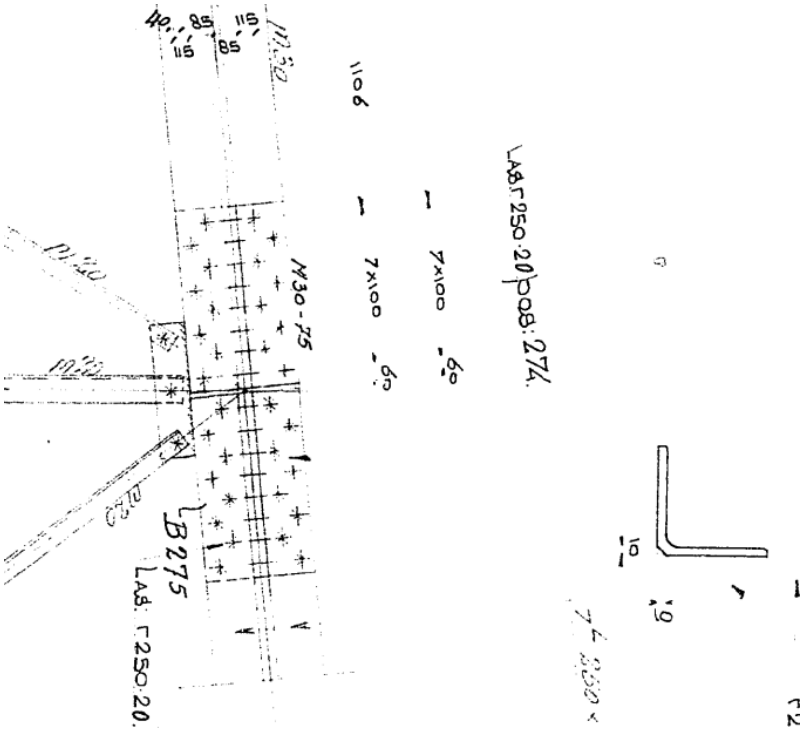
Elastisch $\dfrac{F_{v,Ed}}{\text{min. } F_{v,Rd}} = \dfrac{169,5}{169} = 1,00$ ***OK***

Plastisch $\dfrac{F_{t,Ed}}{\Sigma F_{Rd}} = \dfrac{678,0}{677,8 \times 1} = 1,00$ ***NVT***

## 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 to check the main leg.

The buckling capacity can be increased by adding redundants. Three solutions have been investigated.



**Figuur 3 Splice connection XEA 250x250x20**

Five calculations with spreadsheet have been performed.

- connection (B) $L_{buc}$ = 2,12 m (maximum buckling length)
- connection (B) $L_{buc}$ = 1,87 m (group 120B)
- connection (B) $L_{buc}$ = 1,06 m (with two added redundants each panel)
- connection (B) $L_{buc}$ = 0,7 m (with three added redundants each panel)
- connection (B) $L_{buc}$ = 0,62 m (with three added redundants each panel, Group 120B)

Project: KIJ-GT
Mast: S+75

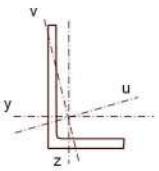
DNV·GL

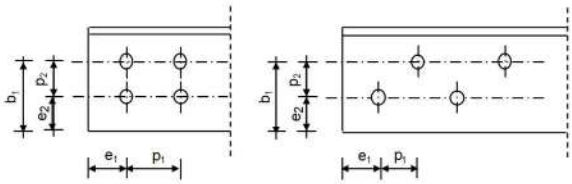
## Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-02-18
Auteur: TBR
Versie: 2.9

| | | | | |
|---|---|---|---|---|
| ***Member name*** | **Randstijl, verbinding "B", L=2,12 m** | ***Conclusion*** | | |
| ***Section*** | **XEA 250.250.20** | U.C. | (compression) | **1.00** **< 1,0 OK** |
| | | U.C. | (tension) | **0.73** **< 1,0 OK** |




| | | | | | |
|---|---|---|---|---|---|
| Steel grade | | **S235** | | | |
| ***Member loads*** | | | | | |
| Compressive force | $N_{Ed}$ = | **3705** kN | | | |
| Tensile force | | **-2964** 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 | | **0.5** kN | | | |
| Member angle to horizontal | | **0** ° | | | |
| Bending around axis | | y-axis | | | |
| ***Geometry*** | | | | | |
| System length y-axis | $L_{y,buc}$ = | 2.12 m | | | |
| System length z-axis | $L_{z,buc}$ = | 2.12 m | | | |
| System length v-axis | $L_{v,buc}$ = | 2.12 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 | $e_1$ = | 55 mm | | Ok |
| Separation distance // | $p_1$ = | 80 mm | | Ok |
| Separation distance \| | $p_2$ = | 100 mm | | Ok |
| End distance ⌟ | $e_2$ = | 40 mm | | Ok |
| Double strap or single strap | | Single | | |
| Tie plate | $b_p$ = | 230 mm | | OK |
| | $t_p$ = | 20 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 | $\gamma_{M0}$ = | 1.00 | | |
| | $\gamma_{M1}$ = | 1.00 | | |
| | $\gamma_{M2}$ = | 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 $F_{Ed}$ $L_{pr}$ = | | 0.40 kNm | | |
| U.C. = | | **0.00** | **< 1,00 OK** | |

***Results stability***

| | | $\lambda_{eff,rel}$ | $\lambda_{eff}$ | $\lambda_{eff,mod}$ | $\chi_{buc}$ | $\eta$ | $N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$ | |
|---|---|---|---|---|---|---|---|---|
| $L_{y,buc}$ = | 2.12 m | 0.22 | 1,00 I | 0.22 | 0.99 | 1 | 4526 | 0.82 |
| $L_{z,buc}$ = | 2.12 m | 0.22 | 1,00 I | 0.22 | 0.99 | 1 | 4526 | 0.82 |
| $L_{v,buc}$ = | 2.12 m | 0.23 | 0,10+0,80 | 0.23 | 0.99 | 1 | 4503 | 0.82 |
| $L_{tk,buc}$ = | 2.12 m | 0.65 | | | 0.81 | 1 | 3705 | 1.00 |

***Bolted connection***

| Compression | | $F_{Rd}$ (kN) | U.C. | | Tension | | $F_{Rd}$ (kN) | U.C. | |
|---|---|---|---|---|---|---|---|---|---|
| *Cross section angle* | $F_{u;Rd}$ = | 4556 | 0.81 | | *Net section angle* | $F_{u;Rd}$ = | 4077 | 0.73 | |
| *Cross section tie plate* | $F_{u;Rd}$ = | 4324 | 0.86 | | *Net section tie plate* | $F_{u;Rd}$ = | 4085 | 0.73 | |
| *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.86 | | *Block shear* | $F_{u;Rd}$ = | 6475 | 0.46 | |
| *Bearing strength* | $F_{b;Rd}$ = | 7715 | 0.48 | | *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.69 | |
| *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.86 | elastisch | *Bearing strength* | $F_{b;Rd}$ = | 7401 | 0.40 | |
| | | | | | *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.69 | elastisch |

Project: KIJ-GT
Mast: S+75

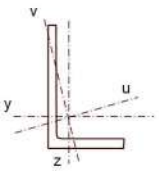
DNV·GL

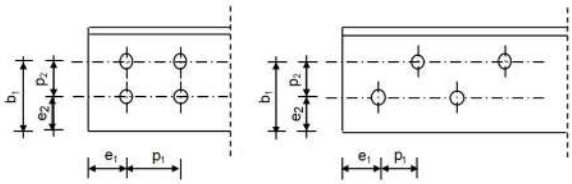
## Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-02-18
Auteur: TBR
Versie: 2.9

| | | | | |
|---|---|---|---|---|
| ***Member name*** | **Randstijl, verbinding "D", L=1,73 m** | ***Conclusion*** | | |
| ***Section*** | **XEA 200.200.20** | U.C. | (compression) | **1.00** **< 1,0 OK** |
| | | U.C. | (tension) | **0.83** **< 1,0 OK** |




Steel grade **S235**

***Member loads***

| | | | |
|---|---|---|---|
| Compressive force | $N_{Ed}$ = | **3165** | kN |
| Tensile force | | **-2532** | 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 | **0.5** | 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 |

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 | $e_1$ = | 55 mm | Ok |
| Separation distance // | $p_1$ = | 100 mm | Ok |
| Separation distance \| | $p_2$ = | 65 mm | Ok |
| End distance ⊥ | $e_2$ = | 40 mm | Ok |
| Double strap or single strap | | Single | |
| Tie plate | $b_p$ = | 180 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 | $\gamma_{M0}$ = | 1.00 | |
| | $\gamma_{M1}$ = | 1.00 | |
| | $\gamma_{M2}$ = | 1.25 | |
| *Shear strength bolt* | $F_{v;b;Rd}$ = | 134.6 kN | |

***Slenderness*** $\lambda_{max} = L / i$ 23 -
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***

| | | $\lambda_{eff,rel}$ | $\lambda_{eff}$ | $\lambda_{eff,mod}$ | $\chi_{buc}$ | $\eta$ | $N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$ | |
|---|---|---|---|---|---|---|---|---|
| $L_{y,buc}$ = | 1.73 m | 0.22 | 1,00 I | 0.22 | 0.99 | 1 | 3580 | 0.88 |
| $L_{z,buc}$ = | 1.73 m | 0.22 | 1,00 I | 0.22 | 0.99 | 1 | 3580 | 0.88 |
| $L_{v,buc}$ = | 1.73 m | 0.24 | 0,10+0,80 | 0.24 | 0.99 | 1 | 3556 | 0.89 |
| $L_{tk,buc}$ = | 1.73 m | 0.51 | | | 0.88 | 1 | 3180 | 1.00 |

***Bolted connection***

| Compression | | $F_{Rd}$ (kN) | U.C. | | Tension | | $F_{Rd}$ (kN) | U.C. | |
|---|---|---|---|---|---|---|---|---|---|
| *Cross section angle* | $F_{u;Rd}$ = | 3607 | 0.88 | | *Net section angle* | $F_{u;Rd}$ = | 3294 | 0.77 | |
| *Cross section tie plate* | $F_{u;Rd}$ = | 3384 | 0.94 | | *Net section tie plate* | $F_{u;Rd}$ = | 3048 | 0.83 | |
| *Shear strength* | $F_{v;Rd}$ = | 3770 | 0.84 | | *Block shear* | $F_{u;Rd}$ = | 6864 | 0.37 | |
| *Bearing strength* | $F_{b;Rd}$ = | 9194 | 0.34 | | *Shear strength* | $F_{v;Rd}$ = | 3770 | 0.67 | |
| *Combined effect* | $F_{v;Rd}$ = | 3770 | 0.84 | elastisch | *Bearing strength* | $F_{b;Rd}$ = | 8531 | 0.30 | |
| | | | | | *Combined effect* | $F_{v;Rd}$ = | 3770 | 0.67 | elastisch |

Project: KIJ-GT
Mast: S+75

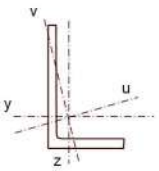
DNV·GL

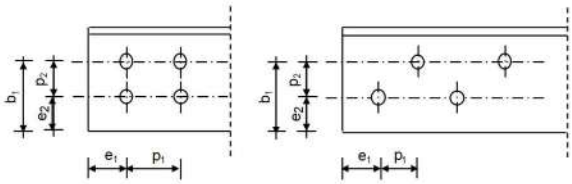
## Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-02-18
Auteur: TBR
Versie: 2.9

| | | | |
|---|---|---|---|
| ***Member name*** | **Randstijl, verbinding "B", L=1,06 m** | ***Conclusion*** | |
| ***Section*** | **XEA 250.250.20** | U.C. (compression) | **1.00** **< 1,0 OK** |
| | | U.C. (tension) | **0.77** **< 1,0 OK** |




Steel grade **S235**

***Member loads***

| | | | |
|---|---|---|---|
| Compressive force | $N_{Ed}$ = | **3910** | kN |
| Tensile force | | **-3128** | 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 | **0.5** | kN |
| Member angle to horizontal | **0** | ° |
| Bending around axis | y-axis | |

***Geometry***

| | | | |
|---|---|---|---|
| System length y-axis | $L_{y,buc}$ = | 1.06 | m |
| System length z-axis | $L_{z,buc}$ = | 2.12 | m |
| System length v-axis | $L_{v,buc}$ = | 2.12 | 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 | $e_1$ = | 55 mm | Ok |
| Separation distance // | $p_1$ = | 80 mm | Ok |
| Separation distance \| | $p_2$ = | 100 mm | Ok |
| End distance ⊥ | $e_2$ = | 40 mm | Ok |
| Double strap or single strap | | Single | |
| Tie plate | $b_p$ = | 230 mm | OK |
| | $t_p$ = | 20 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 | $\gamma_{M0}$ = | 1.00 | |
| | $\gamma_{M1}$ = | 1.00 | |
| | $\gamma_{M2}$ = | 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***

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0.20 kNm
U.C. = **0.00** **< 1,00 OK**

***Results stability***

| | | $\lambda_{eff,rel}$ | $\lambda_{eff}$ | $\lambda_{eff,mod}$ | $\chi_{buc}$ | $\eta$ | $N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$ | |
|---|---|---|---|---|---|---|---|---|
| $L_{y,buc}$ = | 1.06 m | 0.11 | 1,00 I | 0.11 | 1.00 | 1 | 4556 | 0.86 |
| $L_{z,buc}$ = | 2.12 m | 0.22 | 1,00 I | 0.22 | 0.99 | 1 | 4526 | 0.86 |
| $L_{v,buc}$ = | 2.12 m | 0.23 | 0,10+0,80 | 0.23 | 0.99 | 1 | 4503 | 0.87 |
| $L_{tk,buc}$ = | 1.06 m | 0.56 | | | 0.86 | 1 | 3912 | 1.00 |

***Bolted connection***

| Compression | | $F_{Rd}$ (kN) | U.C. | | Tension | | $F_{Rd}$ (kN) | U.C. | |
|---|---|---|---|---|---|---|---|---|---|
| *Cross section angle* | $F_{u;Rd}$ = | 4556 | 0.86 | | *Net section angle* | $F_{u;Rd}$ = | 4077 | 0.77 | |
| *Cross section tie plate* | $F_{u;Rd}$ = | 4324 | 0.90 | | *Net section tie plate* | $F_{u;Rd}$ = | 4085 | 0.77 | |
| *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.91 | | *Block shear* | $F_{u;Rd}$ = | 6475 | 0.48 | |
| *Bearing strength* | $F_{b;Rd}$ = | 7715 | 0.51 | | *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.73 | |
| *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.91 | elastisch | *Bearing strength* | $F_{b;Rd}$ = | 7401 | 0.42 | |
| | | | | | *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.73 | elastisch |

Project: KIJ-GT
Mast: S+75

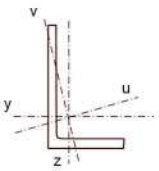
DNV·GL

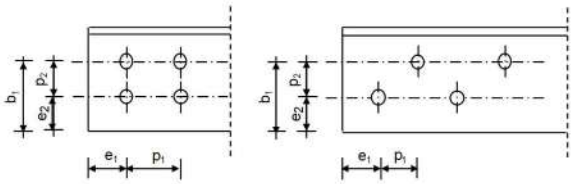
## Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-02-18
Auteur: TBR
Versie: 2.9

| | | | | |
|---|---|---|---|---|
| ***Member name*** | **Randstijl, verbinding "B", L=0,7 m** | ***Conclusion*** | | |
| ***Section*** | **XEA 250.250.20** | U.C. | (compression) | **1.00** **< 1,0 OK** |
| | | U.C. | (tension) | **0.80** **< 1,0 OK** |




| | | | | | |
|---|---|---|---|---|---|
| Steel grade | | **S235** | | | |
| ***Member loads*** | | | | | |
| Compressive force | $N_{Ed}$ = | **4100** kN | | | |
| Tensile force | | **-3280** 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 | | **0.5** kN | | | |
| Member angle to horizontal | | **0** ° | | | |
| Bending around axis | | y-axis | | | |
| ***Geometry*** | | | | | |
| System length y-axis | $L_{y,buc}$ = | 0.70 m | | | |
| System length z-axis | $L_{z,buc}$ = | 2.12 m | | | |
| System length v-axis | $L_{v,buc}$ = | 2.12 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 | $e_1$ = | 55 mm | | Ok |
| Separation distance // | $p_1$ = | 80 mm | | Ok |
| Separation distance \| | $p_2$ = | 100 mm | | Ok |
| End distance ⌟ | $e_2$ = | 40 mm | | Ok |
| Double strap or single strap | | Single | | |
| Tie plate | $b_p$ = | 230 mm | | OK |
| | $t_p$ = | 20 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 | $\gamma_{M0}$ = | 1.00 | | |
| | $\gamma_{M1}$ = | 1.00 | | |
| | $\gamma_{M2}$ = | 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 $F_{Ed}$ $L_{pr}$ = 0.13 kNm
U.C. = **0.00** **< 1,00 OK**

***Results stability***

| | | $\lambda_{eff,rel}$ | $\lambda_{eff}$ | $\lambda_{eff,mod}$ | $\chi_{buc}$ | $\eta$ | $N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$ | |
|---|---|---|---|---|---|---|---|---|
| $L_{y,buc}$ = | 0.70 m | 0.07 | 1,00 I | 0.07 | 1.00 | 1 | 4556 | 0.90 |
| $L_{z,buc}$ = | 2.12 m | 0.22 | 1,00 I | 0.22 | 0.99 | 1 | 4526 | 0.91 |
| $L_{v,buc}$ = | 2.12 m | 0.23 | 0,10+0,80 | 0.23 | 0.99 | 1 | 4503 | 0.91 |
| $L_{tk,buc}$ = | 0.70 m | 0.46 | | | 0.90 | 1 | 4104 | 1.00 |

***Bolted connection***

| Compression | | $F_{Rd}$ (kN) | U.C. | | Tension | | $F_{Rd}$ (kN) | U.C. | |
|---|---|---|---|---|---|---|---|---|---|
| *Cross section angle* | $F_{u;Rd}$ = | 4556 | 0.90 | | *Net section angle* | $F_{u;Rd}$ = | 4077 | 0.80 | |
| *Cross section tie plate* | $F_{u;Rd}$ = | 4324 | 0.95 | | *Net section tie plate* | $F_{u;Rd}$ = | 4085 | 0.80 | |
| *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.95 | | *Block shear* | $F_{u;Rd}$ = | 6475 | 0.51 | |
| *Bearing strength* | $F_{b;Rd}$ = | 7715 | 0.53 | | *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.76 | |
| *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.95 | elastisch | *Bearing strength* | $F_{b;Rd}$ = | 7401 | 0.44 | |
| | | | | | *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.76 | elastisch |

Project: KIJ-GT
Mast: S+75

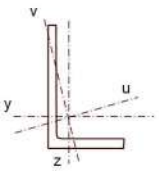
DNV·GL

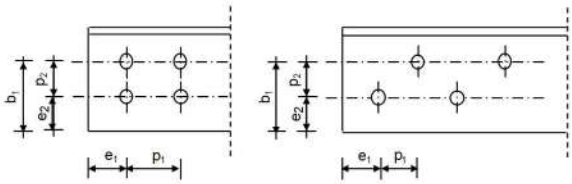
## Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-02-18
Auteur: TBR
Versie: 2.9

| | | | | |
|---|---|---|---|---|
| ***Member name*** | **Randstijl, verbinding "B", L=0,62 m** | ***Conclusion*** | | |
| ***Section*** | **XEA 250.250.20** | U.C. | (compression) | **1.00** **< 1,0 OK** |
| | | U.C. | (tension) | **0.82** **< 1,0 OK** |




Steel grade **S235**

***Member loads***

| | | | |
|---|---|---|---|
| Compressive force | $N_{Ed}$ = | **4160** | kN |
| Tensile force | | **-3328** | 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 | **0.5** | kN |
| Member angle to horizontal | **0** | ° |
| Bending around axis | y-axis | |

***Geometry***

| | | | |
|---|---|---|---|
| System length y-axis | $L_{y,buc}$ = | 0.62 | m |
| System length z-axis | $L_{z,buc}$ = | 1.87 | m |
| System length v-axis | $L_{v,buc}$ = | 1.87 | 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 | $e_1$ = | 55 mm | Ok |
| Separation distance // | $p_1$ = | 80 mm | Ok |
| Separation distance \| | $p_2$ = | 100 mm | Ok |
| End distance ⊥ | $e_2$ = | 40 mm | Ok |
| Double strap or single strap | | Single | |
| Tie plate | $b_p$ = | 230 mm | OK |
| | $t_p$ = | 20 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 | $\gamma_{M0}$ = | 1.00 | |
| | $\gamma_{M1}$ = | 1.00 | |
| | $\gamma_{M2}$ = | 1.25 | |
| *Shear strength bolt* | $F_{v;b;Rd}$ = | 134.6 kN | |

***Slenderness*** $\lambda_{max} = L / i$ 19 -
Allowed: 120 **OK**

***Bending due to vertical construction load***

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0.12 kNm
U.C. = **0.00** **< 1,00 OK**

***Results stability***

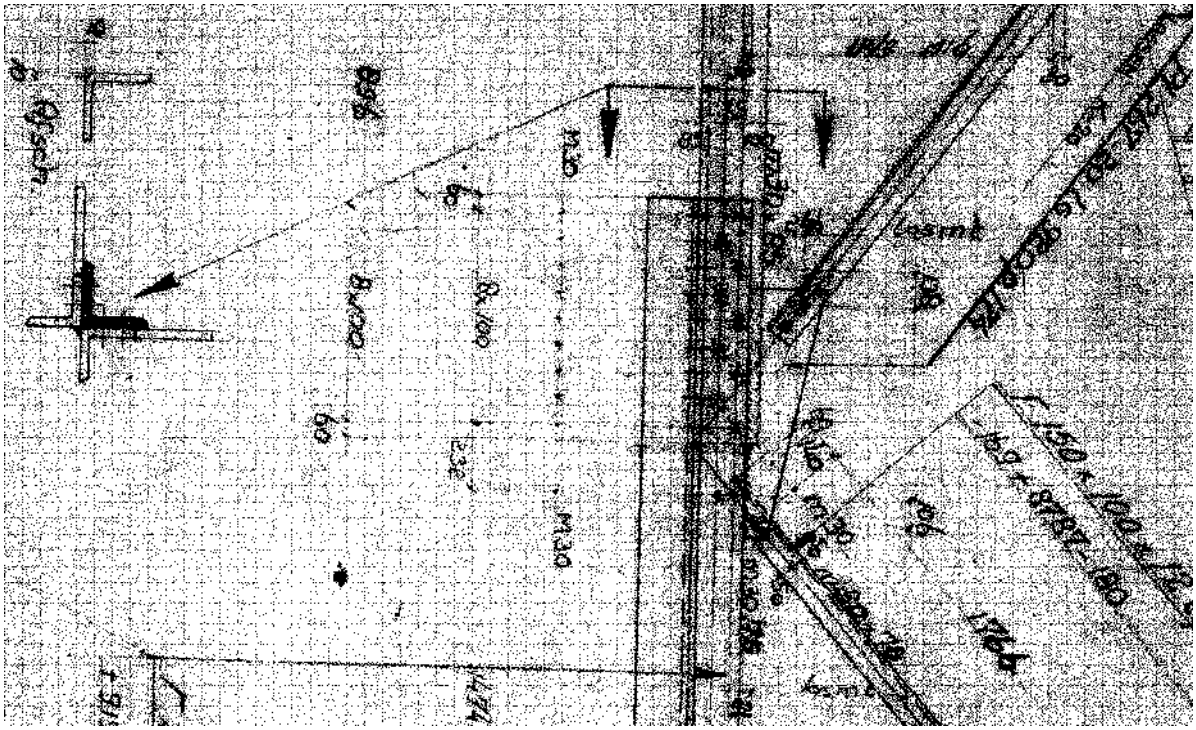
| | | $\lambda_{eff,rel}$ | $\lambda_{eff}$ | $\lambda_{eff,mod}$ | $\chi_{buc}$ | $\eta$ | $N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$ | |
|---|---|---|---|---|---|---|---|---|
| $L_{y,buc}$ = | 0.62 m | 0.06 | 1,00 I | 0.06 | 1.00 | 1 | 4556 | 0.91 |
| $L_{z,buc}$ = | 1.87 m | 0.19 | 1,00 I | 0.19 | 1.00 | 1 | 4556 | 0.91 |
| $L_{v,buc}$ = | 1.87 m | 0.21 | 0,10+0,80 | 0.21 | 1.00 | 1 | 4548 | 0.91 |
| $L_{tk,buc}$ = | 0.62 m | 0.43 | | | 0.91 | 1 | 4164 | 1.00 |

***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* | $F_{u;Rd}$ = | 4077 | 0.82 | |
| *Cross section tie plate* | $F_{u;Rd}$ = | 4324 | 0.96 | | *Net section tie plate* | $F_{u;Rd}$ = | 4085 | 0.81 | |
| *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.97 | | *Block shear* | $F_{u;Rd}$ = | 6475 | 0.51 | |
| *Bearing strength* | $F_{b;Rd}$ = | 7715 | 0.54 | | *Shear strength* | $F_{v;Rd}$ = | 4308 | 0.77 | |
| *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.97 | elastisch | *Bearing strength* | $F_{b;Rd}$ = | 7401 | 0.45 | |
| | | | | | *Combined effect* | $F_{v;Rd}$ = | 4308 | 0.77 | elastisch |

## Connection (E)

The transition from XEA to EA-section is checked additionally.



**Figuur 4  Transition from XEA200x200x20 to EA 250x250x22**

Project: KIJ-GT
Mast: S+75

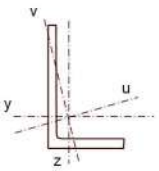
DNV·GL

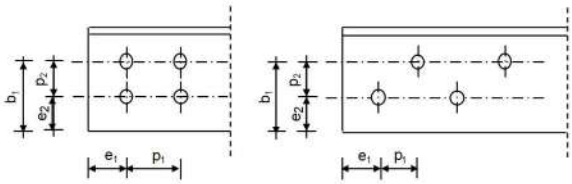
## Angle check

NEN-EN 1993-1-1 and EN 1993-3-1

Datum: 2021-02-18
Auteur: TBR
Versie: 2,9

| | | | | |
|---|---|---|---|---|
| ***Member name*** | **Randstijl, verbinding "E", L=1,73 m** | ***Conclusion*** | | |
| ***Section*** | **L250x22** | U.C. | (compression) | **1,00 < 1,0 OK** |
| | | U.C. | (tension) | **0,79 < 1,0 OK** |




Steel grade **S235**

***Member loads***

| | | | |
|---|---|---|---|
| Compressive force | $N_{Ed}$ = | **2320** | kN |
| Tensile force | | **-1856** | 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 | **0,5** | 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 |

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 | $e_1$ = | 55 mm | Ok |
| Separation distance // | $p_1$ = | 100 mm | Ok |
| Separation distance \| | $p_2$ = | 65 mm | Ok |
| End distance ⊥ | $e_2$ = | 40 mm | Ok |
| Double strap or single strap | | Single | |
| Tie plate | $b_p$ = | 270 mm | OK |
| | $t_p$ = | 20 mm | Niet 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 | $\gamma_{M0}$ = | 1,00 | |
| | $\gamma_{M1}$ = | 1,00 | |
| | $\gamma_{M2}$ = | 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***

$M_{y,Ed} = 1/4\ F_{Ed}\ L_{pr}$ = 0,32 kNm
U.C. = **0,00 < 1,00 OK**

***Results stability***

| | | $\lambda_{eff,rel}$ | $\lambda_{eff}$ | $\lambda_{eff,mod}$ | $\chi_{buc}$ | $\eta$ | $N_{b,Rd} = \eta\chi A f_y / \gamma_{M1}$ | |
|---|---|---|---|---|---|---|---|---|
| $L_{y,buc}$ = | 1,73 m | 0,24 | 1,00 I | 0,24 | 0,99 | 1 | 2446 | 0,95 |
| $L_{z,buc}$ = | 1,73 m | 0,24 | 1,00 I | 0,24 | 0,99 | 1 | 2446 | 0,95 |
| $L_{v,buc}$ = | 1,73 m | 0,37 | 0,10+0,80 | 0,37 | 0,94 | 1 | 2323 | 1,00 |
| $L_{tk,buc}$ = | - m | - | | | - | - | - | 0,00 |

***Bolted connection***

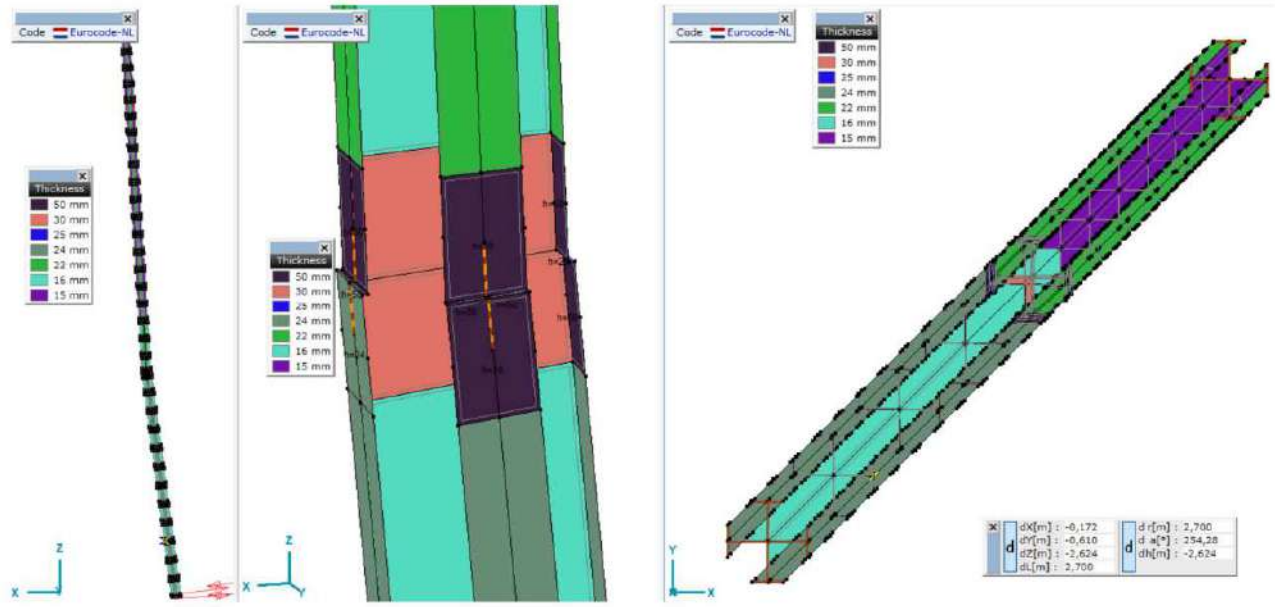
| Compression | | $F_{Rd}$ (kN) | U.C. | | Tension | | $F_{Rd}$ (kN) | U.C. | |
|---|---|---|---|---|---|---|---|---|---|
| *Cross section angle* | $F_{u;Rd}$ = | 2481 | 0,93 | | *Net section angle* | $F_{u;Rd}$ = | 2361 | 0,79 | |
| *Cross section tie plate* | $F_{u;Rd}$ = | 2538 | 0,91 | | *Net section tie plate* | $F_{u;Rd}$ = | 2457 | 0,76 | |
| *Shear strength* | $F_{v;Rd}$ = | 2424 | 0,96 | | *Block shear* | $F_{u;Rd}$ = | 4772 | 0,39 | |
| *Bearing strength* | $F_{b;Rd}$ = | 5911 | 0,39 | | *Shear strength* | $F_{v;Rd}$ = | 2424 | 0,77 | |
| *Combined effect* | $F_{v;Rd}$ = | 2424 | 0,96 | elastisch | *Bearing strength* | $F_{b;Rd}$ = | 5579 | 0,33 | |
| | | | | | *Combined effect* | $F_{v;Rd}$ = | 2424 | 0,77 | elastisch |

## Torsional buckling capacity of INP450

The main leg from foundation to 30 m height is a composed cruciform section of two INP450 profiles. The buckling capacity is similarly to double angle cruciforms determined by torsional buckling. The capacity has been checked using the theoretical method, using a spreadsheet (next page). Additionally use have been made of the findings of the FEM-analysis for structure S+95 in KIJ-GT which shares the same INP450 main leg.

The FEM-study showed an n-value of 2,4 in combination with an applied load of 6000 kN. This yields together with curve b (weak axis) a capacity of 5400 kN.

The cross section properties of INP450 section were calculated with the software AxisVM, since torsional moment of inertia is dependent on plate thickness and thickness varies in the cross section. The calculation with the spreadsheet shows a slightly higher capacity of 5400/0,93=5806 kN. The difference is caused by the flexible supports provided by redundants that were modelled in the FEM-analysis. In PLS-TOWER the lower capacity of 5400 kN is used.




**Figuur 5 FEM-analysis that was performed for tower S+95**

# Torsieknik

Versie: 1.4

| *Onderwerp* | Randstijl S+75 | *Toetsing* | | |
|---|---|---|---|---|
| *Profiel* | INP450x2 | U.C. | **1,00** | **Voldoet** |

***Normaalkracht***

$N_{Ed}$ = **5400,0** kN

| | | |
|---|---|---|
| Staalsoort | **S235** | |
| Doorsnedeklasse: | **1** | **Geldig** |
| Gewicht | 2,29 | kN/m |

Doorsnedegrootheden

| $I_y$ | $I_z$ | A | $W_{y;pl}$ | $W_{y;el}$ |
|---|---|---|---|---|
| $10^4$ mm$^4$ | $10^4$ mm$^4$ | mm$^4$ | $10^3$ mm$^3$ | $10^3$ mm$^3$ |
| 48000 | 48000 | 29152 | 2737,8 | 2112 |

| $I_t$ | $I_{wa}$ |
|---|---|
| $10^4$ mm$^4$ | mm$^4$ |
| 407 | 1,8E+12 |

***Geometrie***

| | | |
|---|---|---|
| $l_{sys}$ | 3,20 | m |
| $l_{y;buc}$ = | 3,20 | m |
| $l_{z;buc}$ = | 3,20 | m |
| $l_{st;y}$ | 3,20 | m |
| Steun 1 | Gaffel | |
| Steun 2 | Gaffel | |
| Classificatie | Geschoord | |

***Doorsnedecapaciteit***

| | | | |
|---|---|---|---|
| $N_{pl;d} = A \times f_{y;d}$ = | | 6851 | kN |
| $M_{y;Rd} = W_y \times f_{y;d}$ = | (Plastisch) | 643,4 | kNm |

***Knikstabiliteit y-as***

| | | | |
|---|---|---|---|
| $\lambda_{y;rel} = l_{buc} / (i_y \times \lambda_{euler})$ | | 0,27 | - |
| $\chi_{y;buc}$ = | (kromme b) | 0,98 | - |
| U.C. | | **0,81** | **Voldoet** |

***Knikstabiliteit z-as***

| | | | |
|---|---|---|---|
| $\lambda_{z;rel} = l_{buc} / (i_z \times \lambda_{euler})$ | | 0,27 | - |
| $\chi_{z;buc}$ = | (kromme b) | 0,98 | - |
| U.C. | | **0,81** | **Voldoet** |

***Torsieknikstabiliteit***

| | | | |
|---|---|---|---|
| $i_0^2 = i_y^2 + i_z^2 + y_0^2$ = | | 32931 | mm$^2$ |
| $\beta = 1 - y_0^2/i_0^2$ = | | 1,000 | - |
| $F_{y;E} = \pi^2 E I_y / l_y^2$ = | | 97154 | kN |
| $F_{t;E} = 1/i_0^2 (G_d I_t + \pi^2 E I_{wa}/l_{t;buc})$ = | | 21079 | kN |
| $F_{tk;E} = {}^1/_{2\beta}((F_{y;E}+F_{t;E}) + \sqrt{(F_{y;E}+F_{t;E})^2 - 4\beta^2 F_{y;E} F_{t;E}})$ | | | |
| $F_{tk;E}$ = | | 21079 | kN |
| $\lambda_{tk;rel} = \sqrt{N_{c;u;d} / F_{tk;E}}$ = | | 0,57 | - |
| $\chi_{z;buc}$ = | (kromme b) | 0,85 | - |
| $N_{Ed} / \chi_{tk;E} N_{c;u;d}$ = | | **0,93** | - |

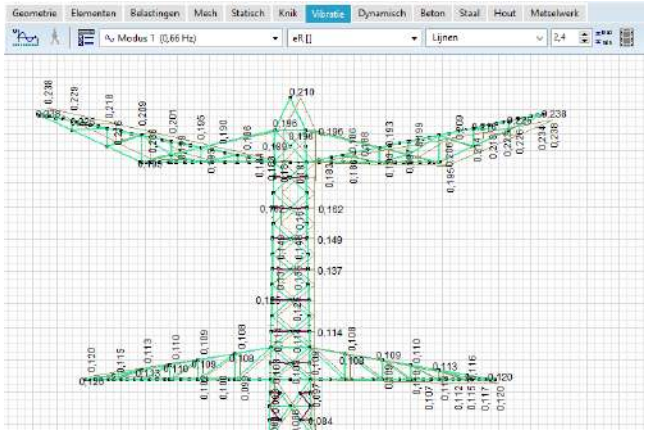
| **Buckling length with FEM-software** | | |
|---|---|---|
| n-value | 2,4 | |
| $N_{Ed}$ = | 6000 | kN |
| $N_{cr;E} = n \times N_{Ed}$ = | 14400 | kN |
| $N_{pl,Rd}$ = | 6851 | kN |
| $\lambda_{rel} = \sqrt{N_{pl;Rd} / N_{cr;E}}$ = | 0,69 | - |
| $\chi_{buc}$ = (curve b) | 0,79 | - |
| $N_{b,Rd} = \chi A f_y / \gamma_{M1}$ = | **5408** | kN |
| U.C. = | 1,00 | **Voldoet** |

## 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+75

$f_e$ = 0,66 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": $\delta_s$ = 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+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 $\chi$ (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+75 T

$c_s c_d = 1 + 2\, k_p\, I_v(z_s)\, \sqrt{(B^2+R^2)} / 1+7I_v(z)$ **1,01** -

| | | |
|---|---|---|
| $k_p$ | piekfactor | |
| $I_v$ | turbulentieintensiteit | 0,165072 |
| $B^2$ | 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 |
| $\nu = n_1 \sqrt{(R^2 / (B^2+R^2))} \geq 0{,}08$ | 0,48 | - |

Achtergrondresponsiefactor $B^2$

| | | |
|---|---|---|
| b = | 6,00 | m |
| d = | 6,00 | m |
| h = | 142,5 | m |
| $z_s = h$ = | 85,5 | |
| $L(z_s) = L_t (z_s / z_t)^{\alpha}$ | 181,8 | m |
| $L_t$ = | 300 | m (referentielengteschaal) |
| $z_t$ = | 200 | m (referentiehoogte zmax) |
| $\alpha = 0{,}67 + 0{,}05\ln(z_0)$ = | 0,59 | |
| $B^2$ = | 0,46 | |

Resonantieresponsfactor $R^2$

| | | |
|---|---|---|
| $R^2 = \pi^2 / 2\delta \times S_L K_s$ = | 0,4955 | |
| $\delta = \delta_s + \delta_a + \delta_d$ = | 0,04 | |
| Type constructie | Stalen toren, bout met hoge weerstand | |
| $\delta_s$ = | 0,03 | |
| $\delta_a = c_f r b v_m(z_s) / 2 n_1 m_e$ = | 0,01305 | |
| $c_f$ = | 0,66 | (krachtcoefficient windrichting) |
| $n_1$ = | 0,66 | (berekend AxisVM) |
| $m_e$ | 1614,0 | (equivalente massa) |
| $\delta_d$ = | 0,0 | |
| $S_L$ | 0,0580374 | (dimensieloze spectrale dichtheidsfunctie) |
| $f_L$ = | 3,6 | |
| $K_s$ | 0,0745 | (afmetingsreductiefunctie) |
| $\psi_y$ = | 1,4 | |
| $\psi_z$ = | 41,0 | |
| $c_y = c_z$ = | 11,5 | |
| $G_y$ | 0,50 | |
| $G_z$ | 0,28 | |
| $K_y$ | 1 | |
| $K_z$ | 1,67 | |

# NET SECTION CAPACITY IMPROVEMENT

The improvement of net section capacity is required on the following members of masts 49, 50 and 53:

- 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.

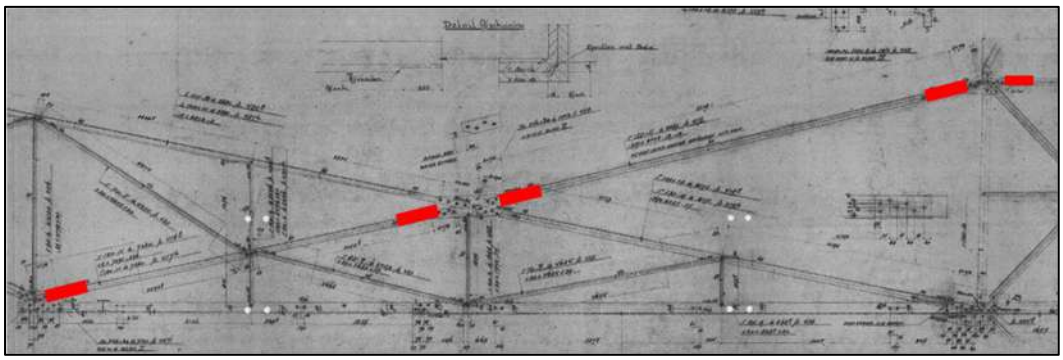


**Figure D.1 Locations requiring net section capacity modification**

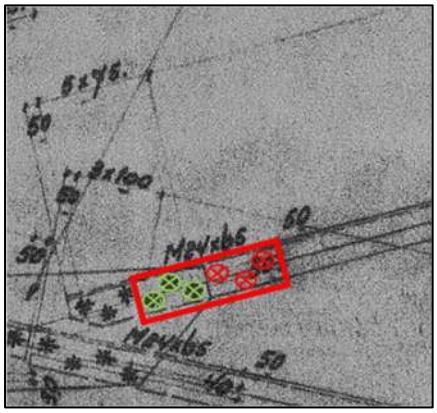


**Figure D.2 Proposed positions of bolts for the net section capacity modification**

Force in the member should ultimately be less than net section capacity of 346.40 kN:

Force in member P415 under afkeur loads = 461.40 kN

Assume plate dimensions are 120 mm width x 10 mm thick

Cross-sectional area of the plate = 1200 $mm^2$

Cross-sectional area of member P415 (over which the force acts) = (120 + 60) x 11 = 1980 $mm^2$

Total cross-sectional area = 1200 + 1980 = 3180 $mm^2$

Force on the plate = 1200/3180 x 461.4 = 174.11 kN

Force in the member = 461.40 – 174.11 = 287.29 < 346.40 kN **(member fulfils afkeur loads)**

Calculation of PLS Tower override value (afkeur):

1980/3180 x F = 346.40

F = 556.34 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.

$\alpha_d$ = 50/(3 x 26) = 0.64 (end bolt), $\alpha_d$ = 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 10 / 1.25 = 110.59 kN > 174.11/3 = 58.04 kN **(plate has sufficient thickness)**

Total bearing cap = 110.59 x 3 = 331.77 kN

Check net section capacity of plate:

Assume similar bolt spacing as the member

$A_{net1}$ = 120 x 10 – 26 x 10 = 940 $mm^2$

$A_{net2}$ = 120 x 10 – 2 x 26 x 10 + ($75^2$/ (4 x 30)) x 10 = 1148.75 $mm^2$

Net section capacity = 0.9 x 940 x 360 / 1.25 = 243.65 kN > 174.11 kN **(net section capacity is sufficient)**

Check plate fulfils verbouw:

Force in the member due to verbouw loads = 543.11 kN

Force in the plate = 1200/3180 x 543.11 = 204.94 kN

204.94 < 243.65 & 331.77 **(plate fulfils verbouw)**

## SHEAR CAPACITY IMPROVEMENT

An improvement of shear capacity is required on member P255 of masts 49 and 50. At the verbouw level, member P255 on mast 49 is subjected to a force of 146 kN. After modification, an M24-8.8 bolt in double shear will carry the load. The figures below depict the locations where the modification is required and the proposed bolt arrangement. Both bolts should be new bolts with grade 8.8.

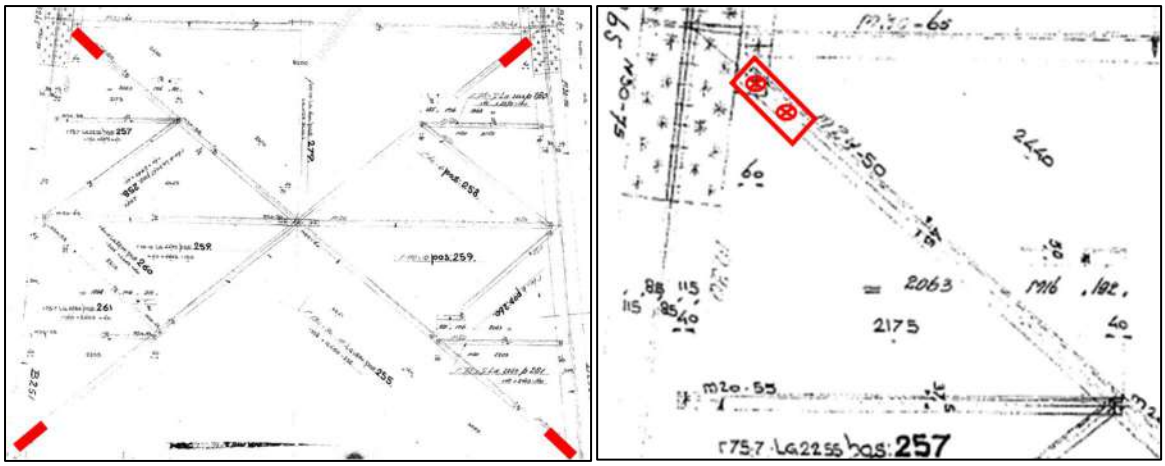



**Figure D.3 Locations requiring shear capacity modification (left) and proposed bolt positions (right)**

Check shear capacity of the joint:

Capacity of 1 x M24-8.8 (double shear) = 135.6 x 2 = 271.2 kN > 146 kN (**shear capacity of joint is ok**)

Check force in the plate:

Force in member P255 under verbouw loads = 146 kN

Assume plate dimensions are 90 mm width x 10 mm thick

Cross-sectional area of the plate = 900 $mm^2$

Cross-sectional area of member P255 (over which the force acts) = 2 x 45 x 10 = 900 $mm^2$

Total cross-sectional area = 900 + 900 = 1800 $mm^2$

Force on the plate = 900/1800 x 146 = 73 kN

Check bearing capacity of the plate:

Assume bolt end distance on plate = 50 mm, bolt short edge distance on plate = 45 mm and S235 steel.

$K_1$ = (2 x 50/ 26 – 3) x (45/26) – 3 x (50/26) + 7 = 2.69 > 2.5

$K_1$ = 2.5

$\alpha_d$ = 50 / 3 x 26 = 0.64

Bearing capacity = 2.5 x 0.64 x 360 x 24 x 10 / 1.25 = 110.59 kN > 73 kN **(bearing capacity is sufficient)**

Check net section capacity of the plate:

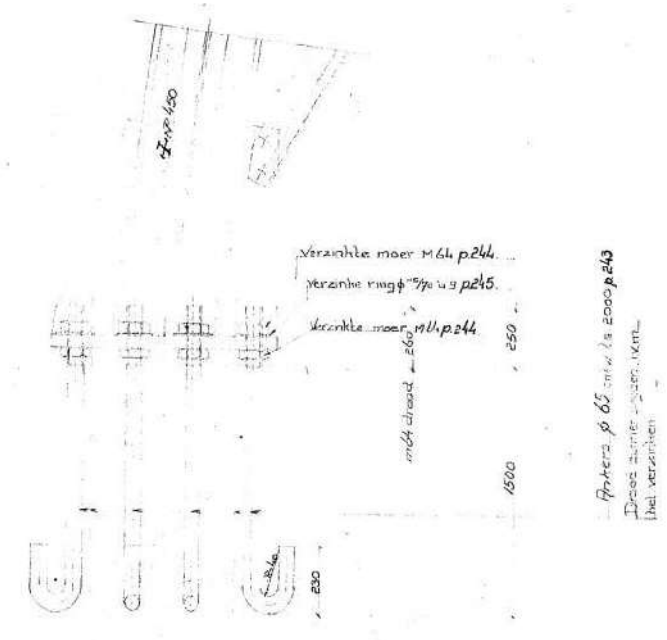
$A_{net}$ = 900 – 26 x 10 = 640 $mm^2$

Net section capacity = 0.9 x 640 x 360 / 1.25 = 165.89 kN> 73 kN **(net section capacity is sufficient)**

# ANCHORS S+75

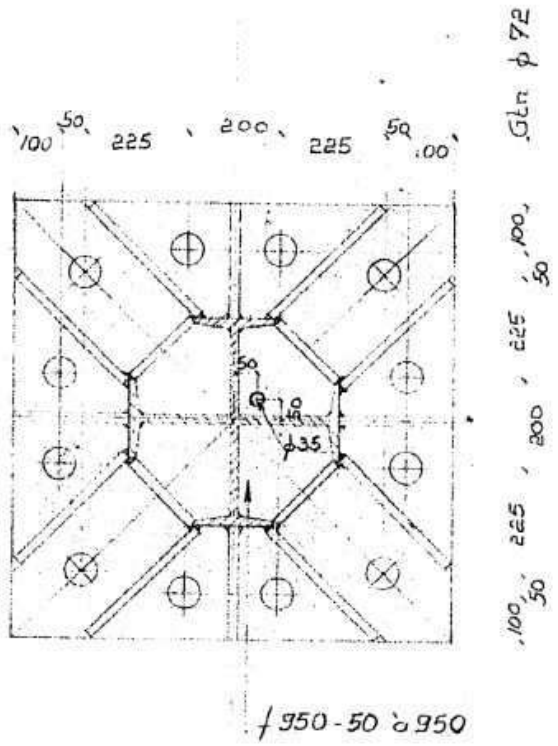
12 anchor bolts M64 have been applied. The figures below are used of tower structure S+75. The tower legs are connected to the foundation with a foot plate 950x950x50 mm and 12 anchors with diameter 65 mm.

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**




**Figuur 3 Voetplaat**

## Loads

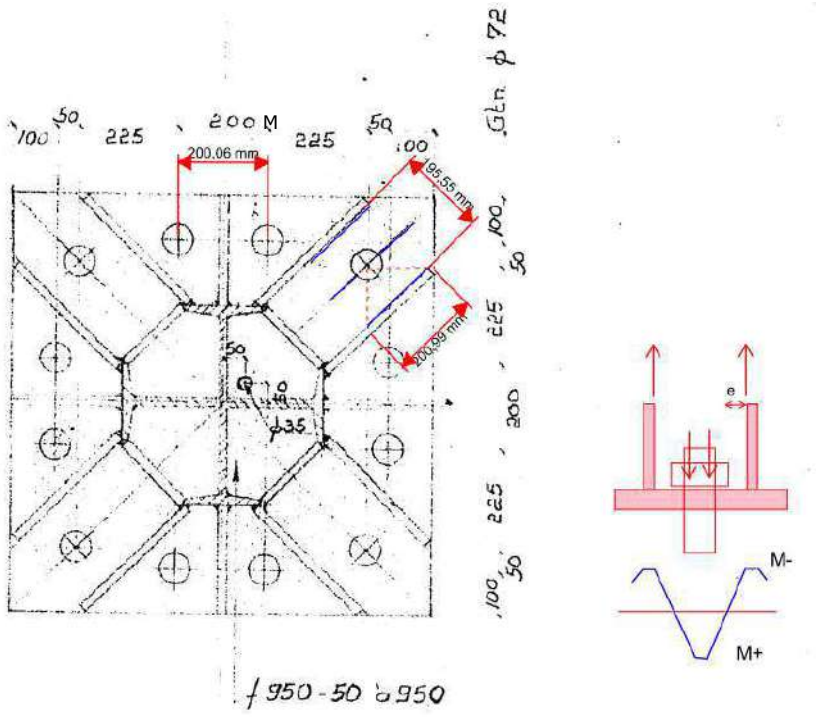
The loads coming from the tower are based on S+75 structure number 49 in wind zone II:

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_135 | -622 | 599 | **4198** | -16 | -863 | -71 | 4272 |
| Max. tension | ULS 1a_0,9_0,9_135 | -437 | 415 | **-2943** | 16 | 603 | 48 | -2995 |
| Max. pos. torsie | ULS 5a Ah 21 | 97 | 61 | 529 | **25** | -112 | -12 | 538 |
| Max. neg. torsie | ULS 5a Ah 10 | 97 | -61 | 528 | **-25** | -112 | -12 | 538 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -437 | 415 | **-2943** | **16** | 603 | 48 | -2995 |

## 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. = 278 / 588 = 0,47 ≤ 1,00 OK

Conclusion: The foot plates of tower structure S+75 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: $4198 / 0{,}95^2 \times 10^{-3} = 4{,}7$ N/mm$^2$

U.C. = 4,7 / 13,33 = 0,35 ≤ 1,00 OK

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

Project: Krimpen - Geertruidenberg 380

Date: 23-2-2021
Version: 2.6

# Anchors

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

| ***Subject:*** | **S+75 II (49)** | ***Checks:*** | | |
|---|---|---|---|---|
| | | Anchor bolt to tension | 0,42 | ***OK*** |
| | | Anchor bolt to shear | 0,27 | ***OK*** |
| | | Dowel ("schieter") | 0,53 | ***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 = | **2943** | kN |
| Shear force | $F_{H,Ed}$ = | **863** | kN |
| Number of anchors for tension | | 12 | |
| Number of anchors for shear | | 12 | |
| $F_{T;Ed} = T / n$ = | | 245,3 | kN |
| $F_{v;Ed} = F_{H,Ed} / n$ = | | 71,9 | kN |

### *Anchor properties*

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

*Capacity per anchor*

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

### *Foot plate*

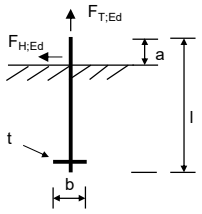
$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

| | | | |
|---|---|---|---|
| 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")*

$$\frac{\sigma_b'}{f_{cd}} = \frac{15,2}{40,0} = 0,38 \quad \textit{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{245}{460} = 0,53 \quad \textit{OK}$$




### *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 = | **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 | $q = F_{T,Ed} / b_{eff}$ = | 986 | kN/m |
| Concrete pressure | $\sigma_b' = q / d_S$ = | 15,2 | MPa |
| *Shear stress in dowel* | | | |
| Load | $F_{T,Ed}$ = | 245 | kN |
| Allowable | $F_{v,Rd} = f_{yd} / \sqrt{3} \times A_s$ = | 460 | kN |

### *Capacity of foot plate*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{245,3}{587,5} = 0,42 \quad \textit{OK}$$

### *Capacity of anchor for tension*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{245,3}{655,1} = 0,37 \quad \textit{OK}$$

### *Check foot plate for tension*

$$\frac{T}{n \times F_{t;Rd}} = \frac{2943,0}{7050,0} = 0,42 \quad \textit{OK}$$

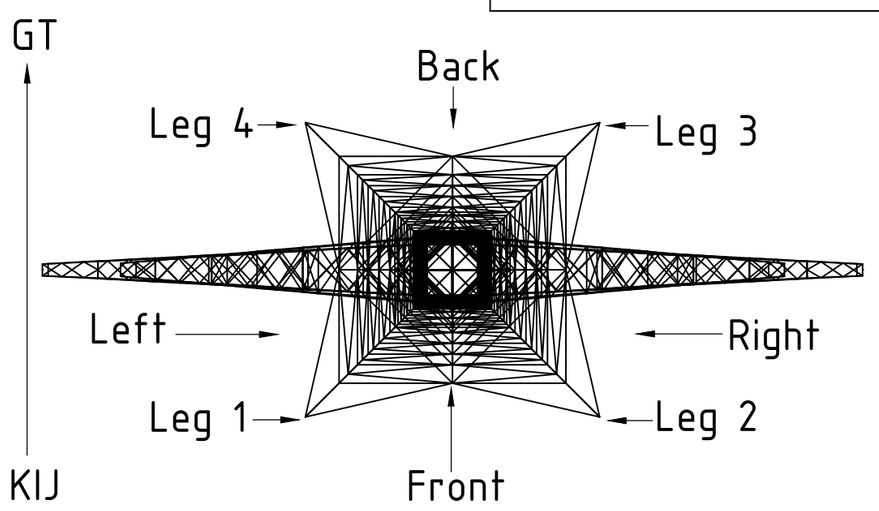
### *Check anchor for shear*

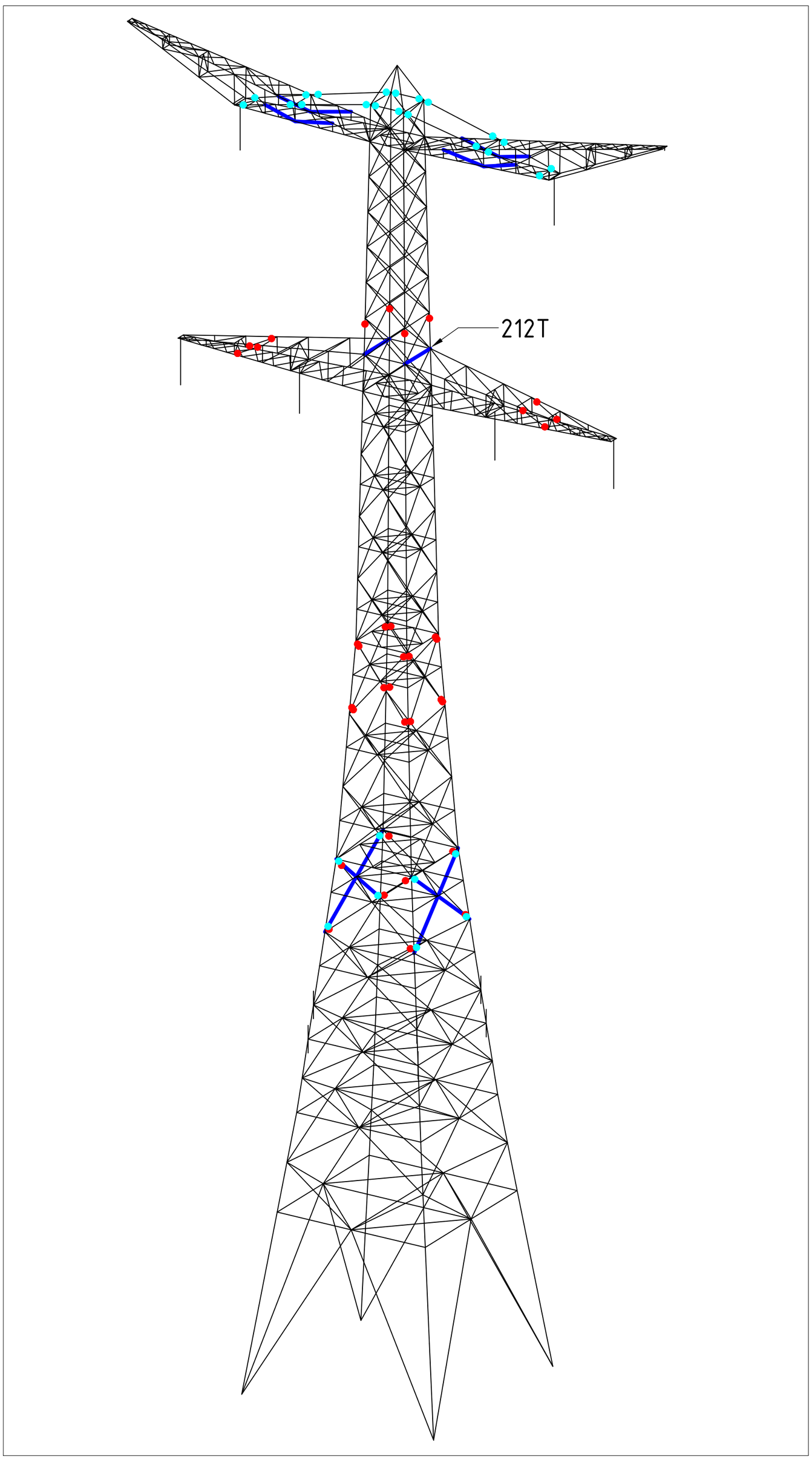
$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{71,9}{267,9} = 0,27 \quad \textit{OK}$$

# APPENDIX E TEKENINGEN

| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (new) |
| 414 | EA | L70x7 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L90x9 | S355 t<=40 | M16-8.8t-NEN2012 |
| 415 | EA | L65x7 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L80x8 | S355 t<=40 | M16-8.8t-NEN2012 |
| 212T | EA | L80x8 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L100x12 | S355 t<=40 | M20-8.8t-NEN2012 |
| 242T | UA | L130x90x10 | S235 t<=40 | M24-5.6t-NEN2012 | EA | L130x11 | S355 t<=40 | M24-8.8t-NEN2012 |

Structure Orientation




Overview

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-035

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | Description: Modifications overview for mast type S+75 (mast 49) Page 1 of 4 |
| Drawn by: | MuK | 16-2-2021 | Units: | m | Revision: 01 |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 18-2-2021 | 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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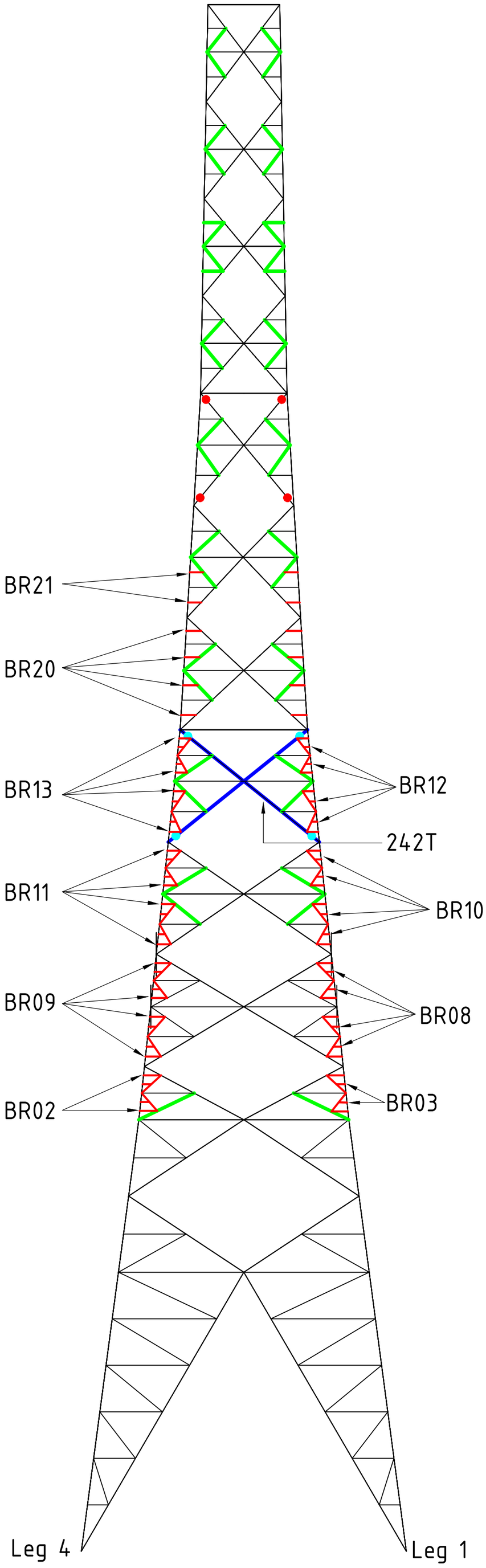
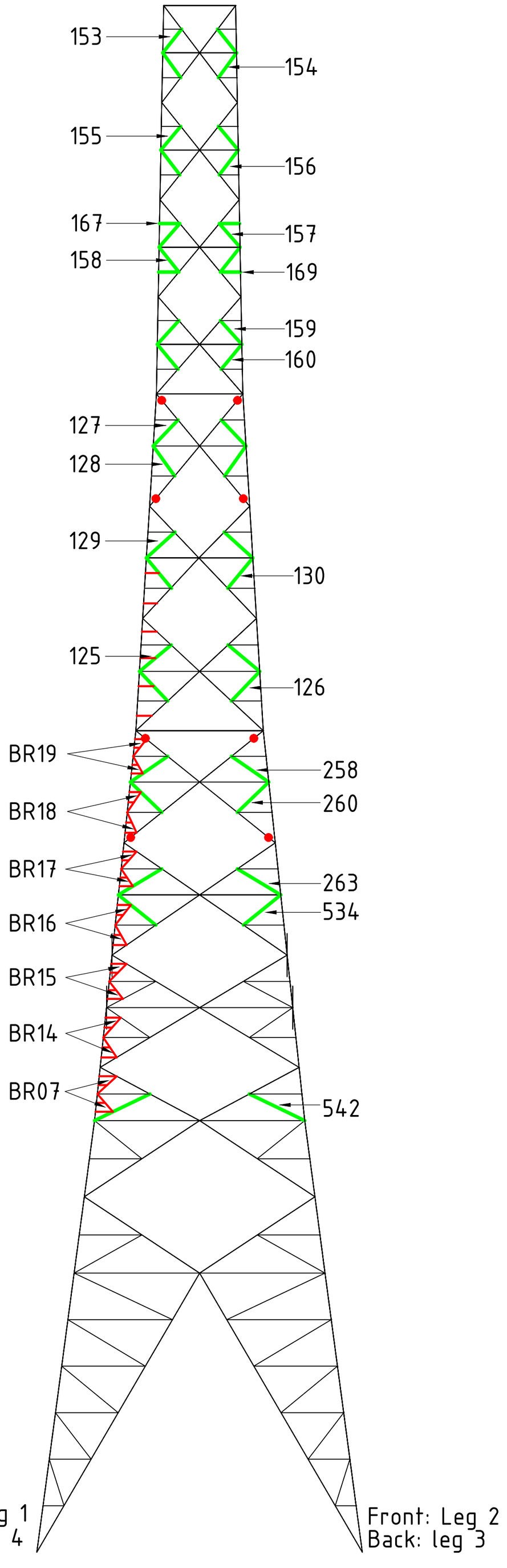



Left View




Front/ Back View

* Refer to the structure orientation diagram on page 1 for leg and face labels
* No new redundant members (BRx) should be added to the right face

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

DNV·GL

Projectname:
Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.:
10166260-035

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | |
| Drawn by: | MuK | 16-2-2021 | Units: | m | |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | |
| Approved by: | JHu | 18-2-2021 | Company: | TenneT | |

Description:
Modifications overview for mast type S+75 (mast 49)
Page 2 of 4

Revision: 01

Format: A2

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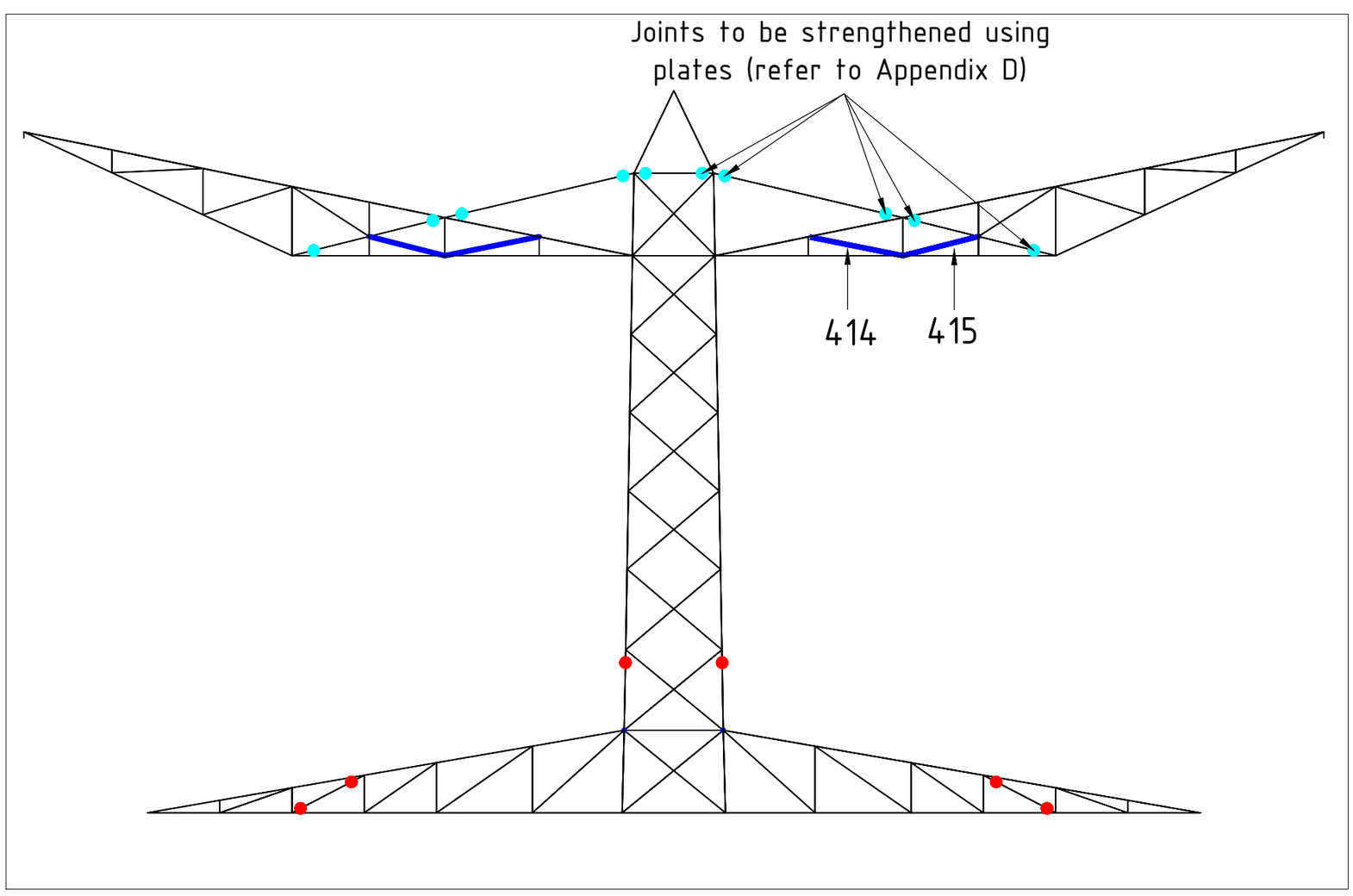
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (new) |
| 542 | EA | L80x8 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L90x8 | S355 t<=40 | M20-8.8t-NEN2012 |
| 534 | EA | L65x7 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L75x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 263 | EA | L65x7 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L75x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 260 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 258 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L75x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 126 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 125 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 130 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 129 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 128 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 127 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 160 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 159 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 169 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L50x5 | S355 t<=40 | M16-8.8t-NEN2012 |
| 158 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 157 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 167 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L50x5 | S355 t<=40 | M16-8.8t-NEN2012 |
| 156 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 155 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 156 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 155 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 154 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 153 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR02 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR03 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR07 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR08 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR09 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR10 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR11 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR12 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR13 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR14 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR15 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR16 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR17 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR18 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR19 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR20 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR21 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |




Front View Crossarms

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-035

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | Description: Modifications overview for mast type S+75 (mast 49) Page 3 of 4 |
| Drawn by: | MuK | 16-2-2021 | Units: | m | Revision: 01 |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 18-2-2021 | Company: | TenneT | |

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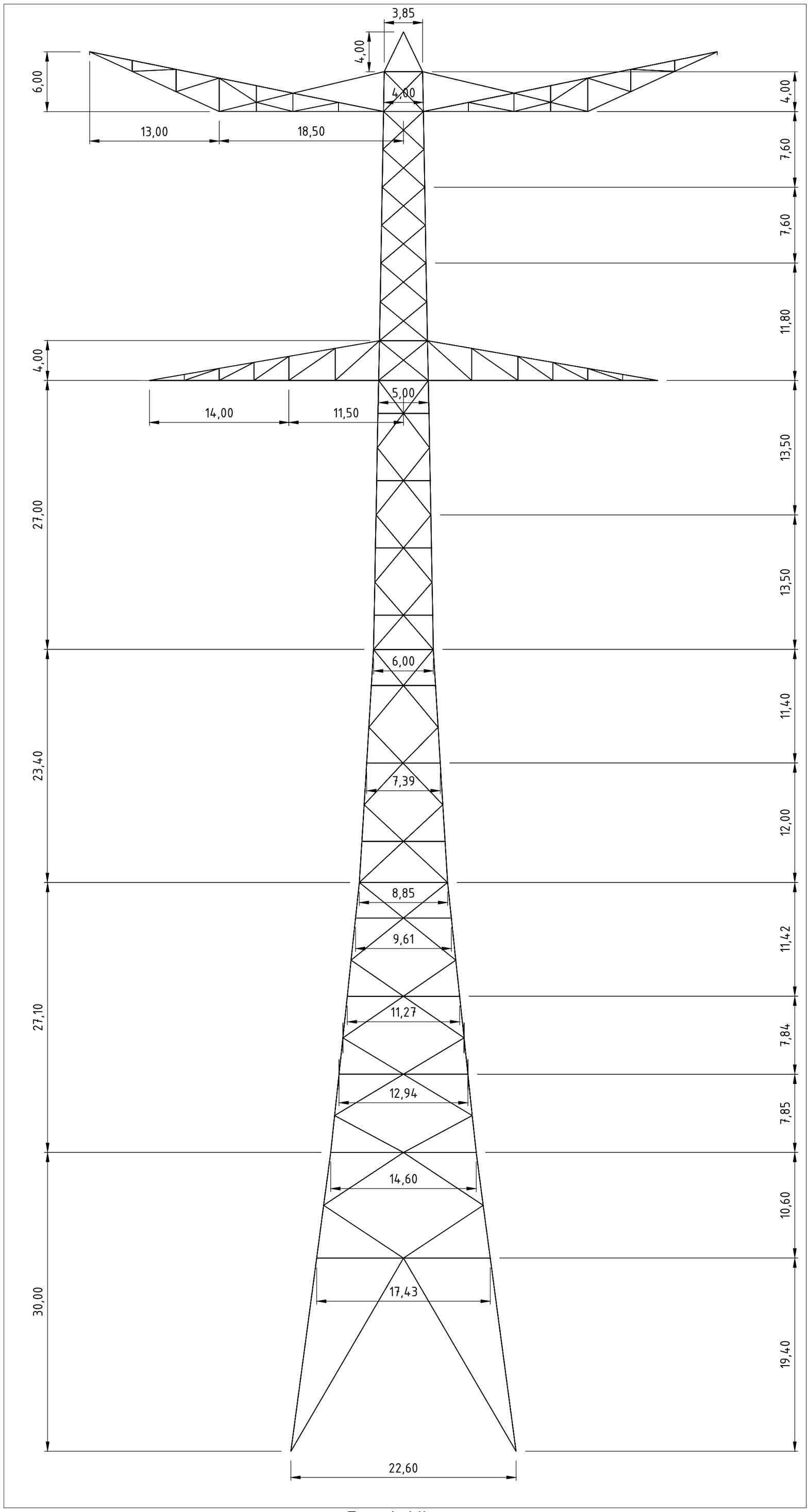
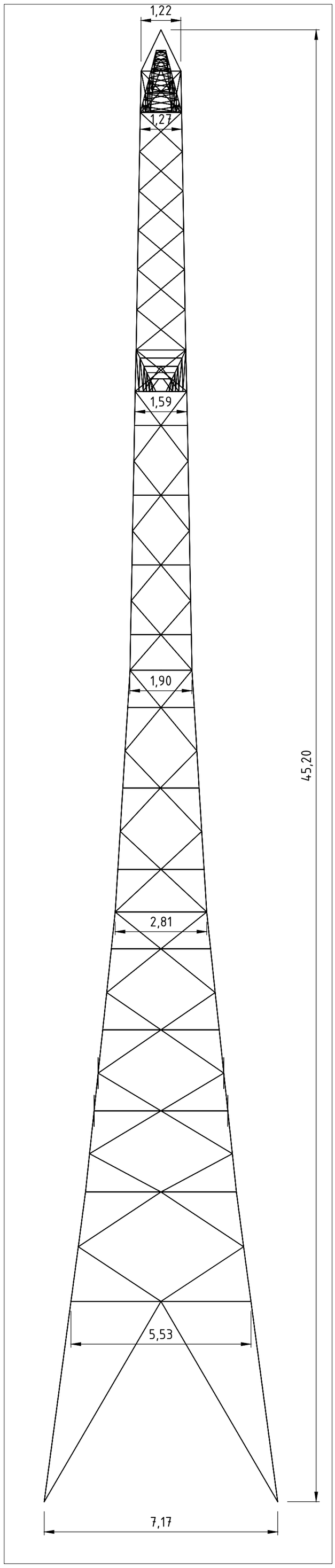



Front View




Side View

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-035

| | | | | | |
|---|---|---|---|---|---|
| Design state: FINAL | | Scale: - | Description: Modifications overview for mast type S+75 (mast 49) Page 4 of 4 | Revision: 01 |
| Drawn by: MuK | 16-2-2021 | Units: m | | |
| Checked by: TBR | 17-2-2021 | Project no: 10166260 | | Format: A2 |
| Approved by: JHu | 18-2-2021 | Company: TenneT | | |

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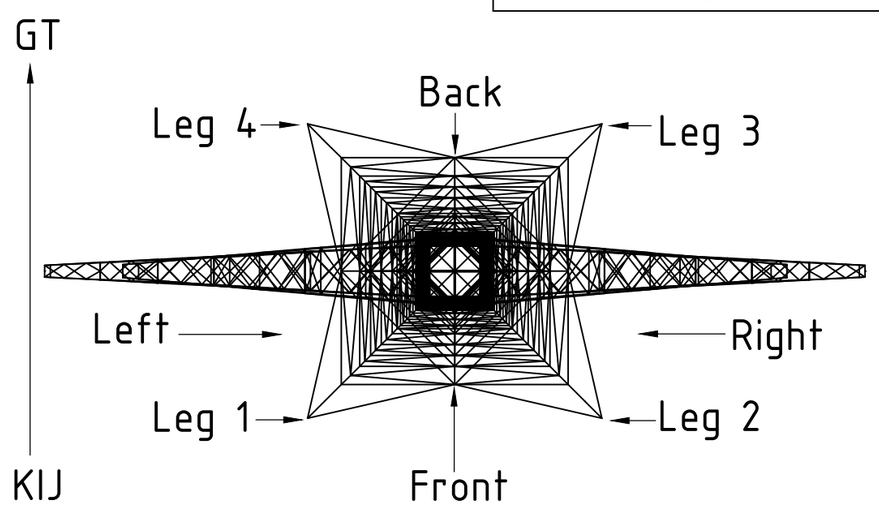
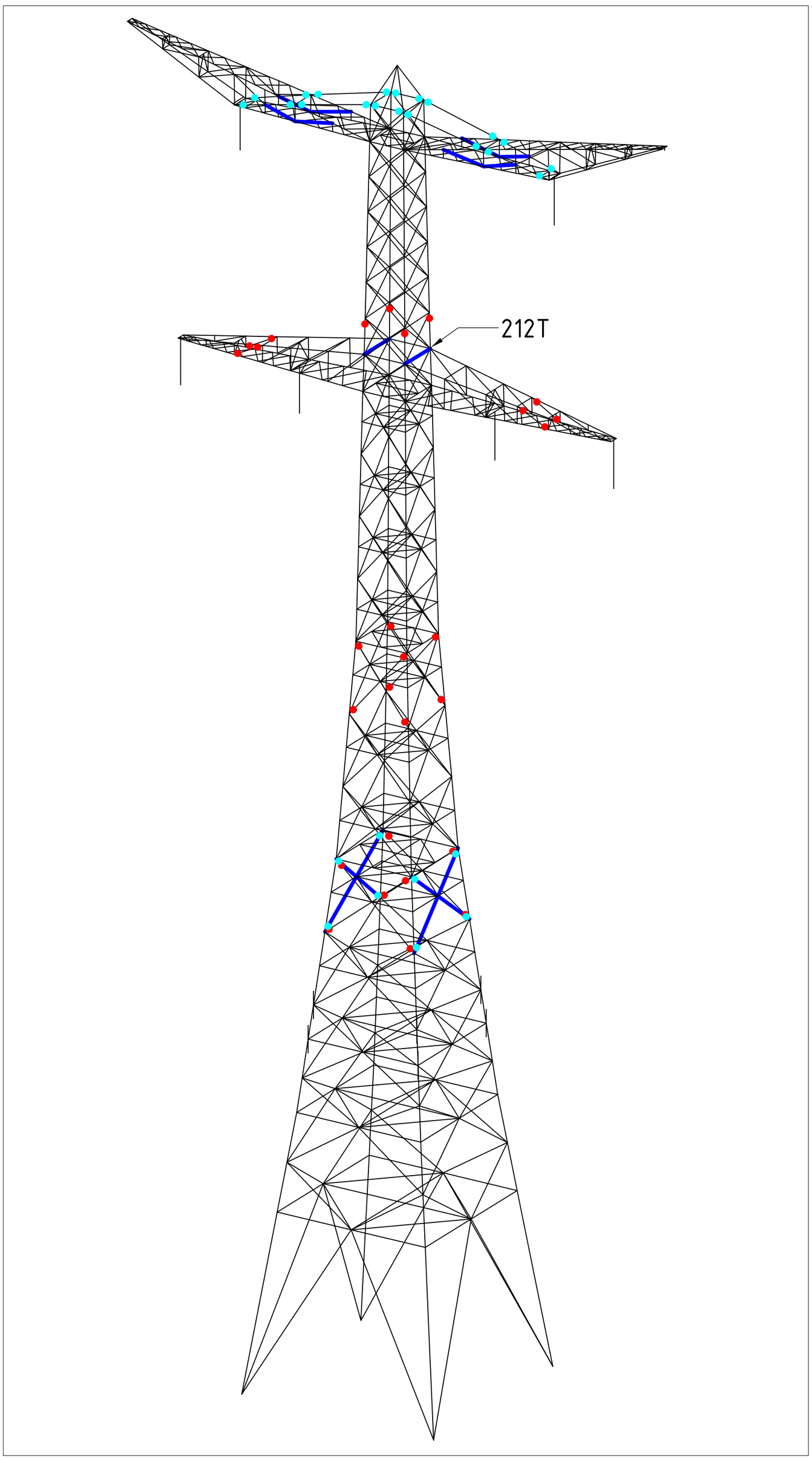
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (new) |
| 414 | EA | L70x7 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L90x9 | S355 t<=40 | M16-8.8t-NEN2012 |
| 415 | EA | L65x7 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L80x8 | S355 t<=40 | M16-8.8t-NEN2012 |
| 212T | EA | L80x8 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L100x10 | S355 t<=40 | M20-8.8t-NEN2012 |
| 242T | UA | L130x90x10 | S235 t<=40 | M24-5.6t-NEN2012 | EA | L130x11 | S355 t<=40 | M24-8.8t-NEN2012 |

Structure Orientation




Overview

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-034

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | |
| Drawn by: | MuK | 16-2-2021 | Units: | m | |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | |
| Approved by: | JHu | 18-2-2021 | Company: | TenneT | |

Description: Modifications overview for mast type S+75 (mast 50) Page 1 of 4

Revision: 01

Format: A2

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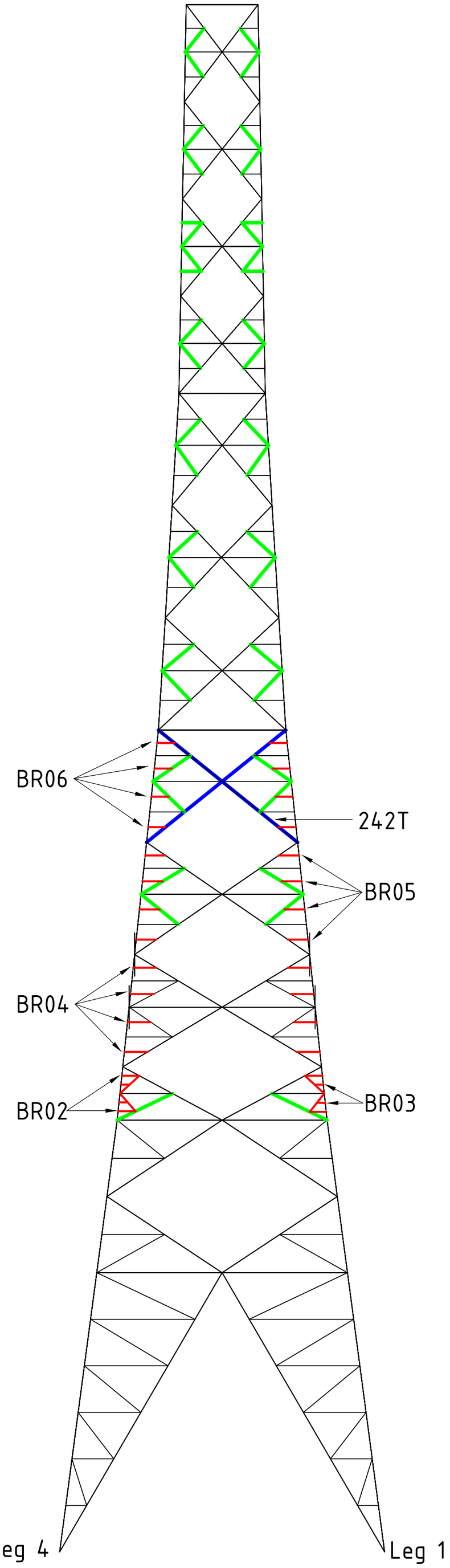
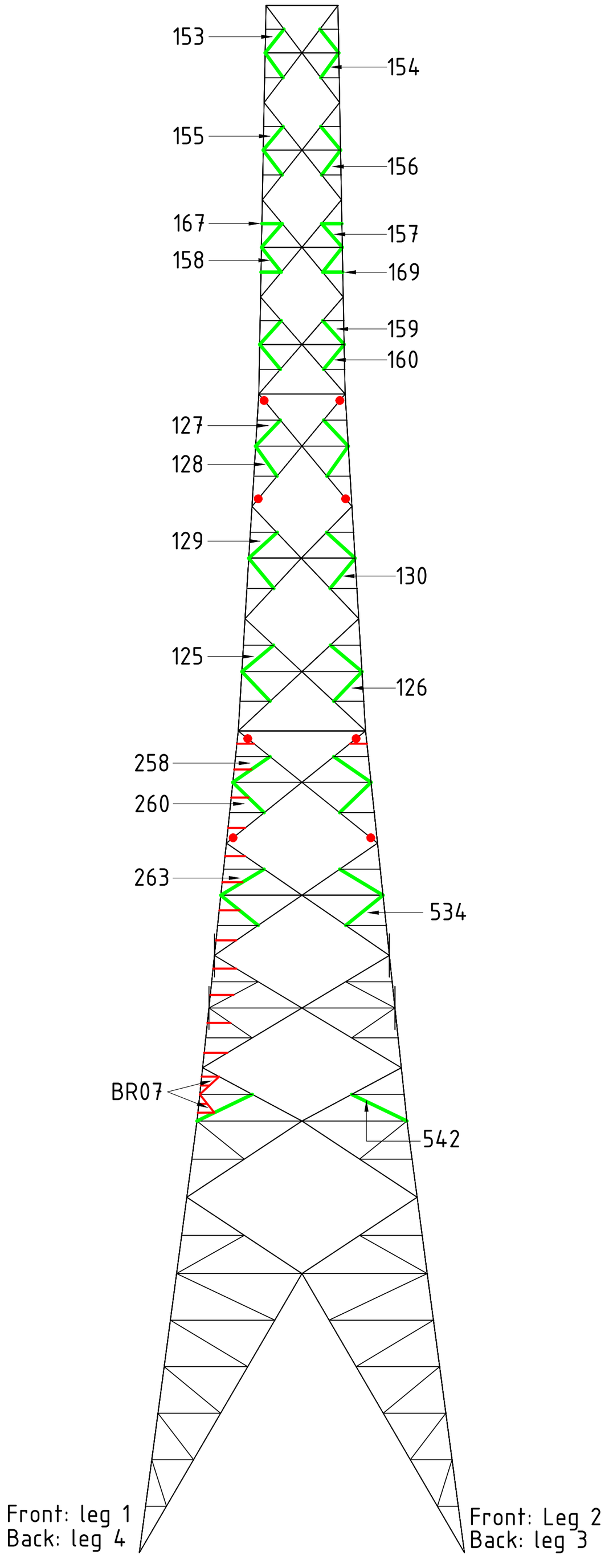



Left View




Front/ Back View

* Refer to the structure orientation diagram on page 1 for leg and face labels
* No new redundant members (BRx) should be added to the right face

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-034

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | |
| Drawn by: | MuK | 16-2-2021 | Units: | m | Description: Modifications overview for mast type S+75 (mast 50) Page 2 of 4 |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | Revision: 01 |
| Approved by: | JHu | 18-2-2021 | Company: | TenneT | Format: A2 |

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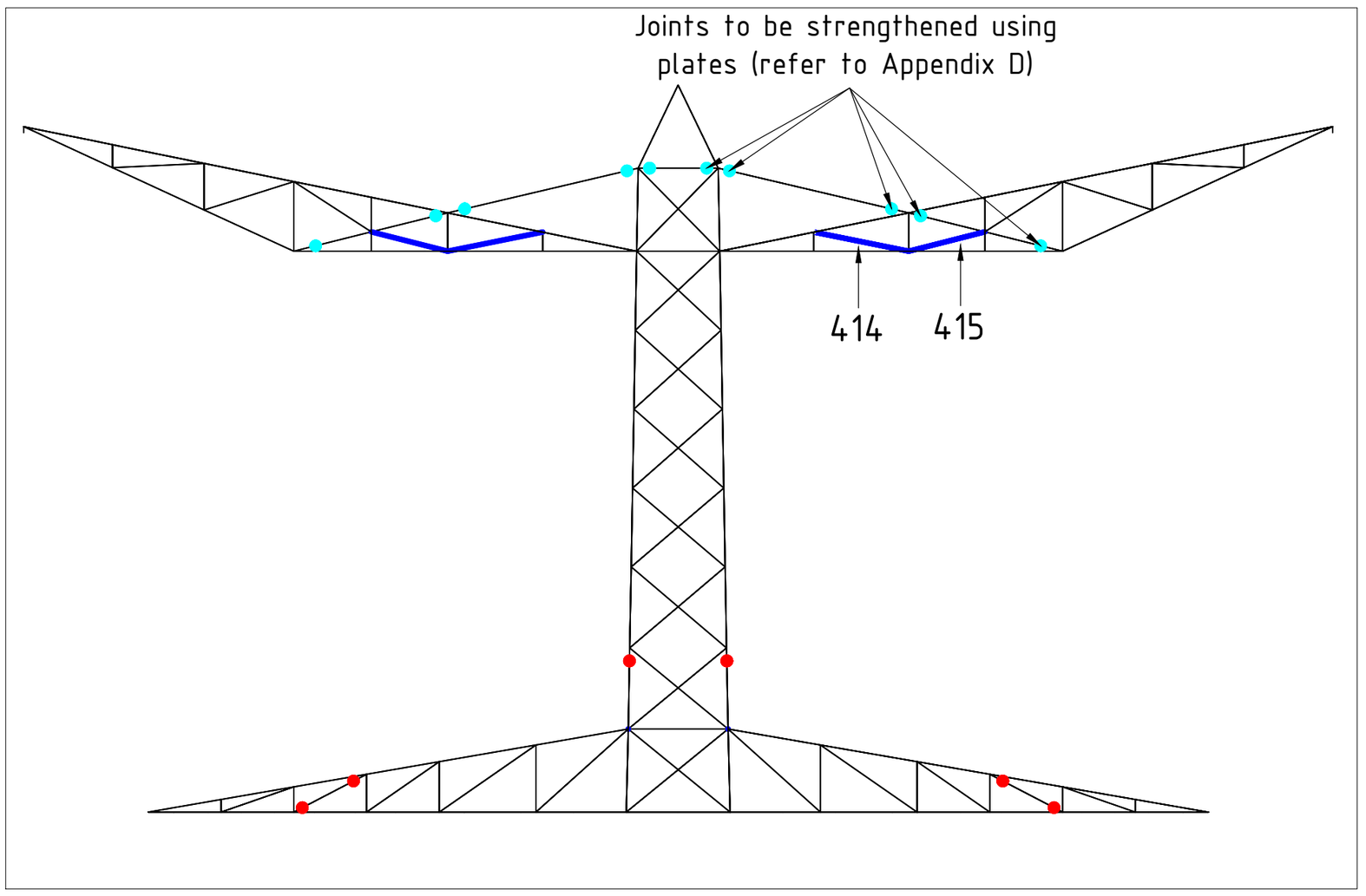
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (new) |
| 542 | EA | L80x8 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L90x8 | S355 t<=40 | M20-8.8t-NEN2012 |
| 534 | EA | L65x7 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 263 | EA | L65x7 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L75x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 260 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 258 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 126 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 125 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 130 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 129 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 128 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 127 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 160 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 159 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 169 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L50x5 | S355 t<=40 | M16-8.8t-NEN2012 |
| 158 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 157 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 167 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L50x5 | S355 t<=40 | M16-8.8t-NEN2012 |
| 156 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 155 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 154 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 153 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR02 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR03 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR04 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR05 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR06 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| BR07 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |




Front View Crossarms

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-034

| | | | | | |
|---|---|---|---|---|---|
| Design state: FINAL | | Scale: - | Description: Modifications overview for mast type S+75 (mast 50) Page 3 of 4 | Revision: 01 |
| Drawn by: MuK | 16-2-2021 | Units: m | | |
| Checked by: TBR | 17-2-2021 | Project no: 10166260 | | Format: A2 |
| Approved by: JHu | 18-2-2021 | Company: TenneT | | |

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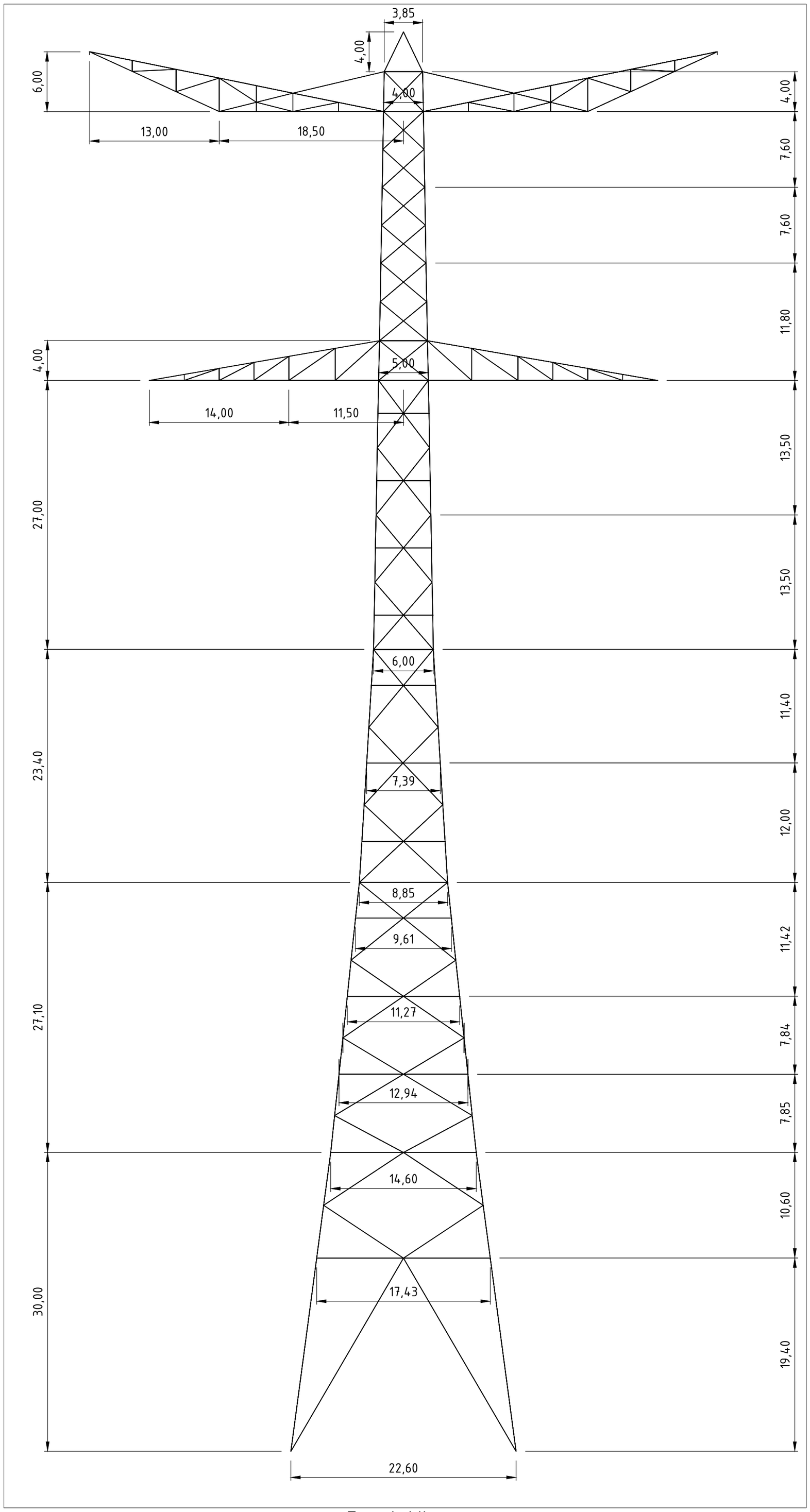
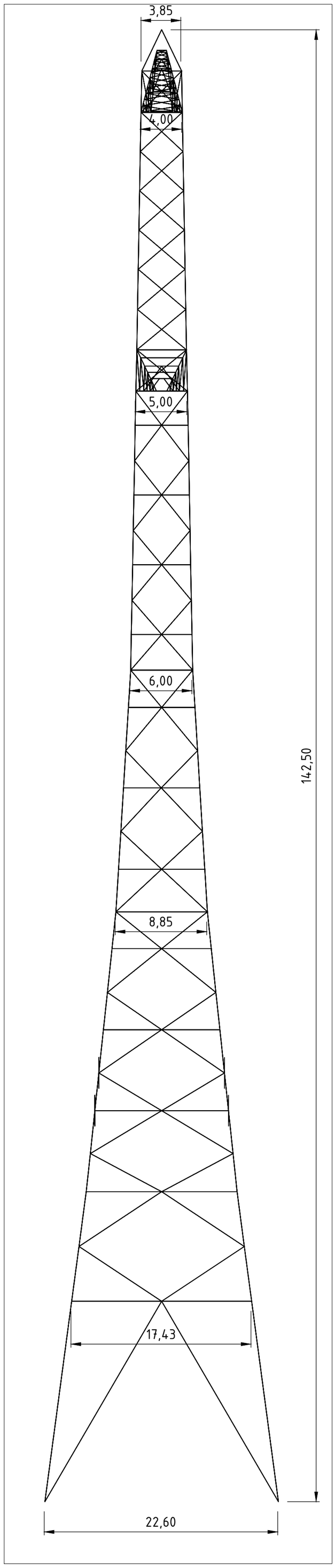



Front View




Side View

## Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-034

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | Revision: 01 |
| Drawn by: | MuK | 16-2-2021 | Units: | m | |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 18-2-2021 | Company: | TenneT | |

Description: Modifications overview for mast type S+75 (mast 50) Page 4 of 4

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| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
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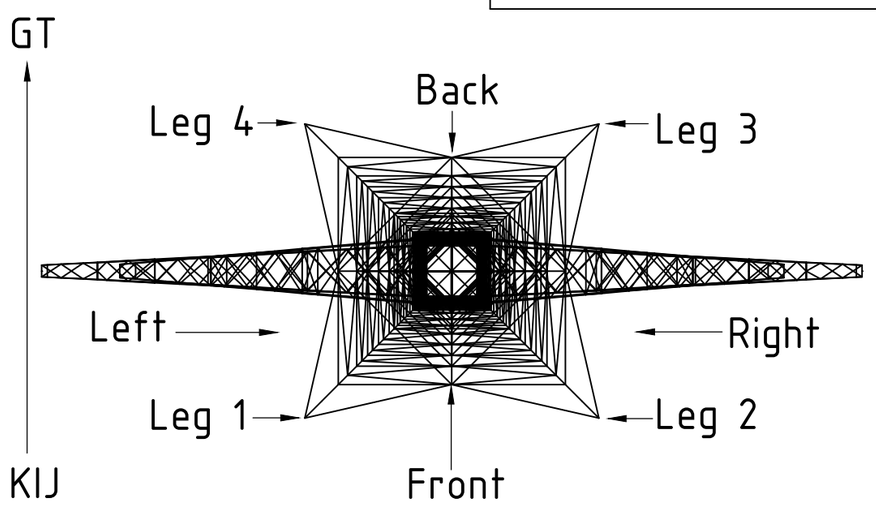
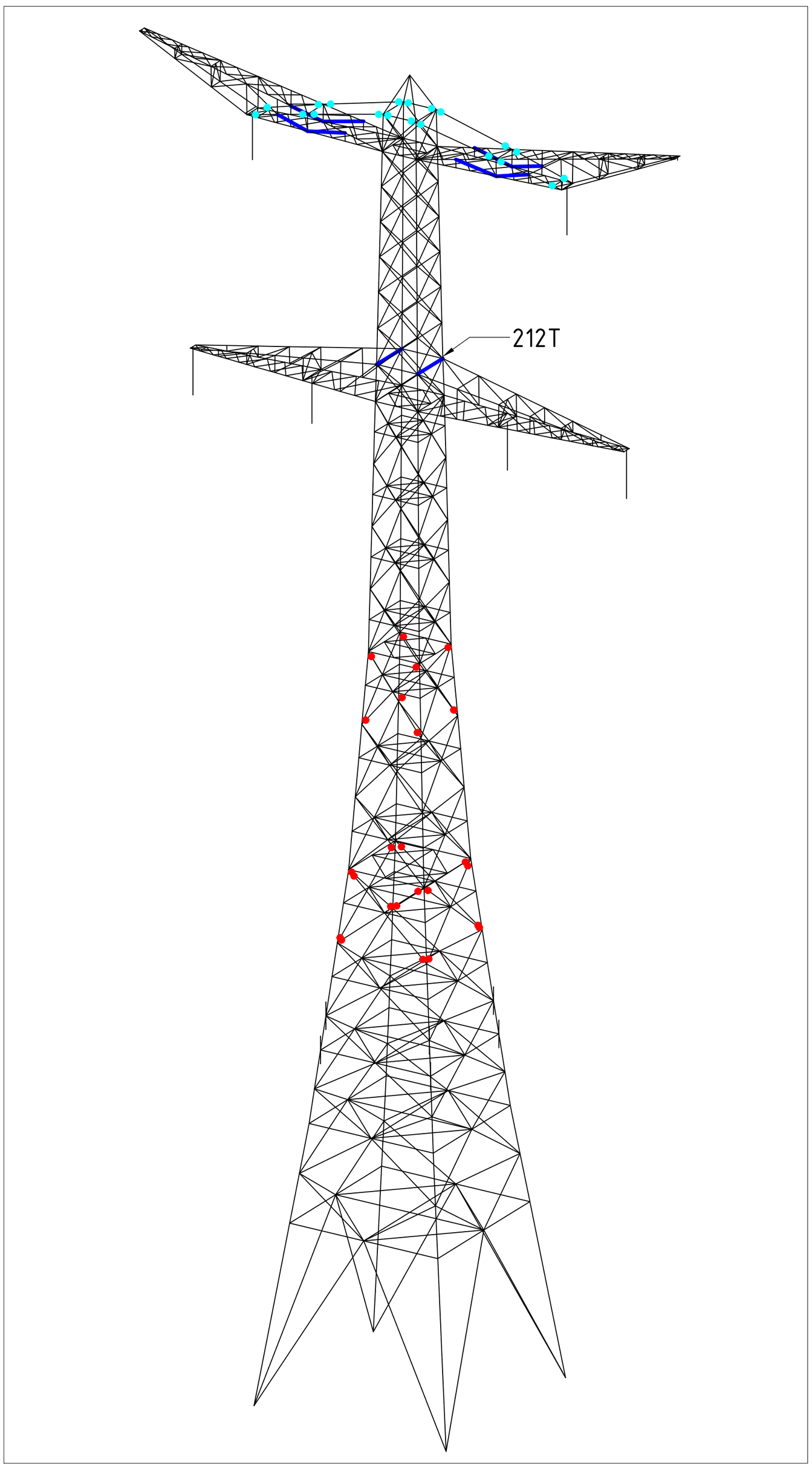
| 415 | EA | L65x7 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L80x8 | S355 t<=40 | M16-8.8t-NEN2012 |
| 212T | EA | L80x8 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L100x8 | S355 t<=40 | M20-8.8t-NEN2012 |

Structure Orientation




Overview

Notes and legend:

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

New redundant member
Profile exchanged
Redundant exchanged
Strengthening of joint using plates
Bolt exchanged

| | | |
|---|---|---|
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| 00 | 20-9-2020 | Version 1.0 |

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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-033

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | Description: Modifications overview for mast type S+75T (mast 53) and S+75 (mast 52) Page 1 of 4 |
| Drawn by: | MuK | 16-2-2021 | Units: | m | Revision: 01 |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 18-2-2021 | Company: | TenneT | |

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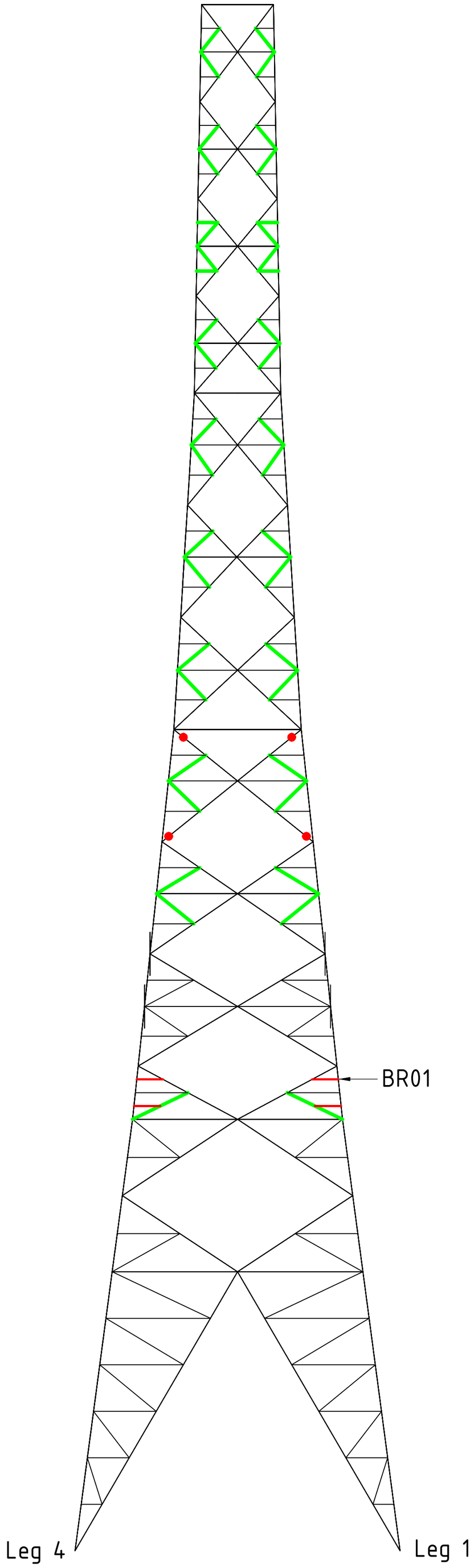
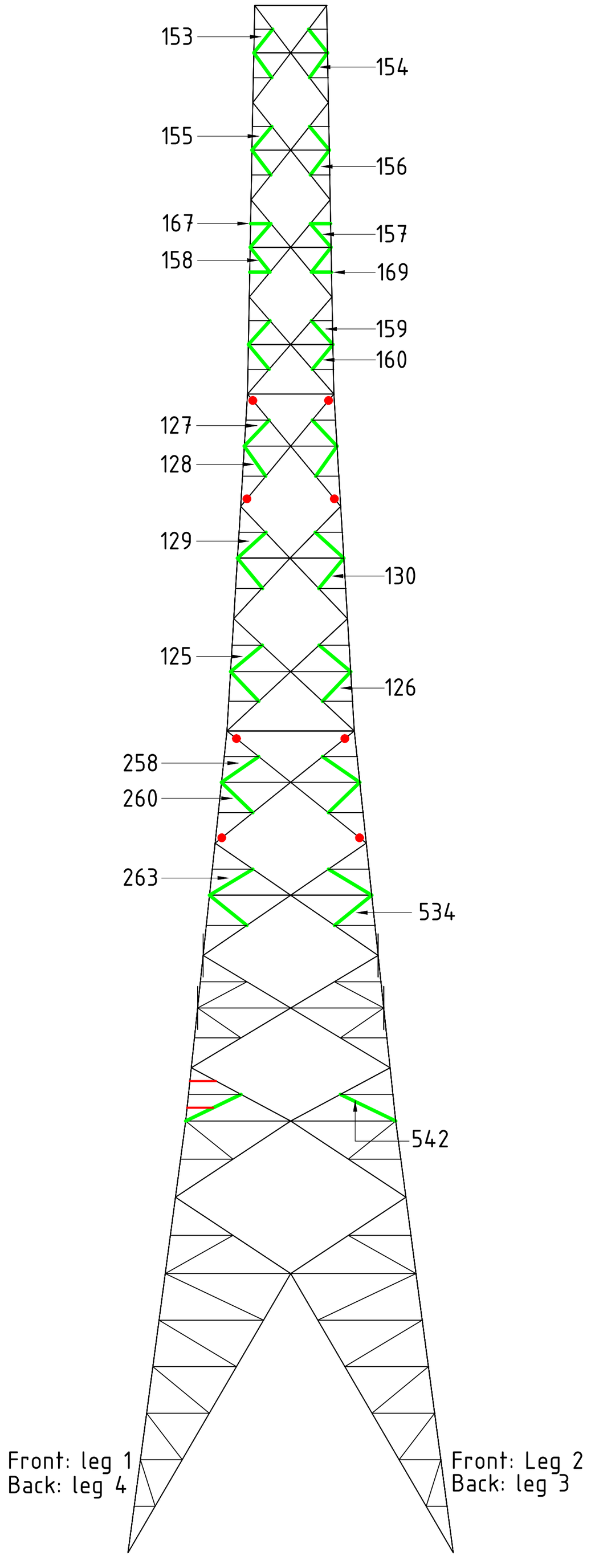



Left View




Front/ Back View

* Refer to the structure orientation diagram on page 1 for leg and face labels
* No new redundant members (BR01) should be added to the right face

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
| 00 | 20-9-2020 | Version 1.0 |

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Projectname:
Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.:
10166260-033

| | | | | | |
|---|---|---|---|---|---|
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| Drawn by: | MuK | 16-2-2021 | Units: | m | |
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| Approved by: | JHu | 18-2-2021 | Company: | TenneT | |

Description:
Modifications overview for mast type S+75T (mast 53) and S+75 (mast 52)
Page 2 of 4

Revision: 01

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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) |
| 542 | EA | L80x8 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L90x8 | S355 t<=40 | M20-8.8t-NEN2012 |
| 534 | EA | L65x7 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 263 | EA | L65x7 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L75x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 260 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 258 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 126 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 125 | EA | L60x6 | S235 t<=40 | M20-5.6t-NEN2012 | EA | L70x7 | S355 t<=40 | M20-8.8t-NEN2012 |
| 130 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 129 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M16-8.8t-NEN2012 |
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| 158 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
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| 167 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L50x5 | S355 t<=40 | M16-8.8t-NEN2012 |
| 156 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 155 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
| 154 | EA | L50x5 | S235 t<=40 | M16-5.6t-NEN2012 | EA | L55x6 | S355 t<=40 | M16-8.8t-NEN2012 |
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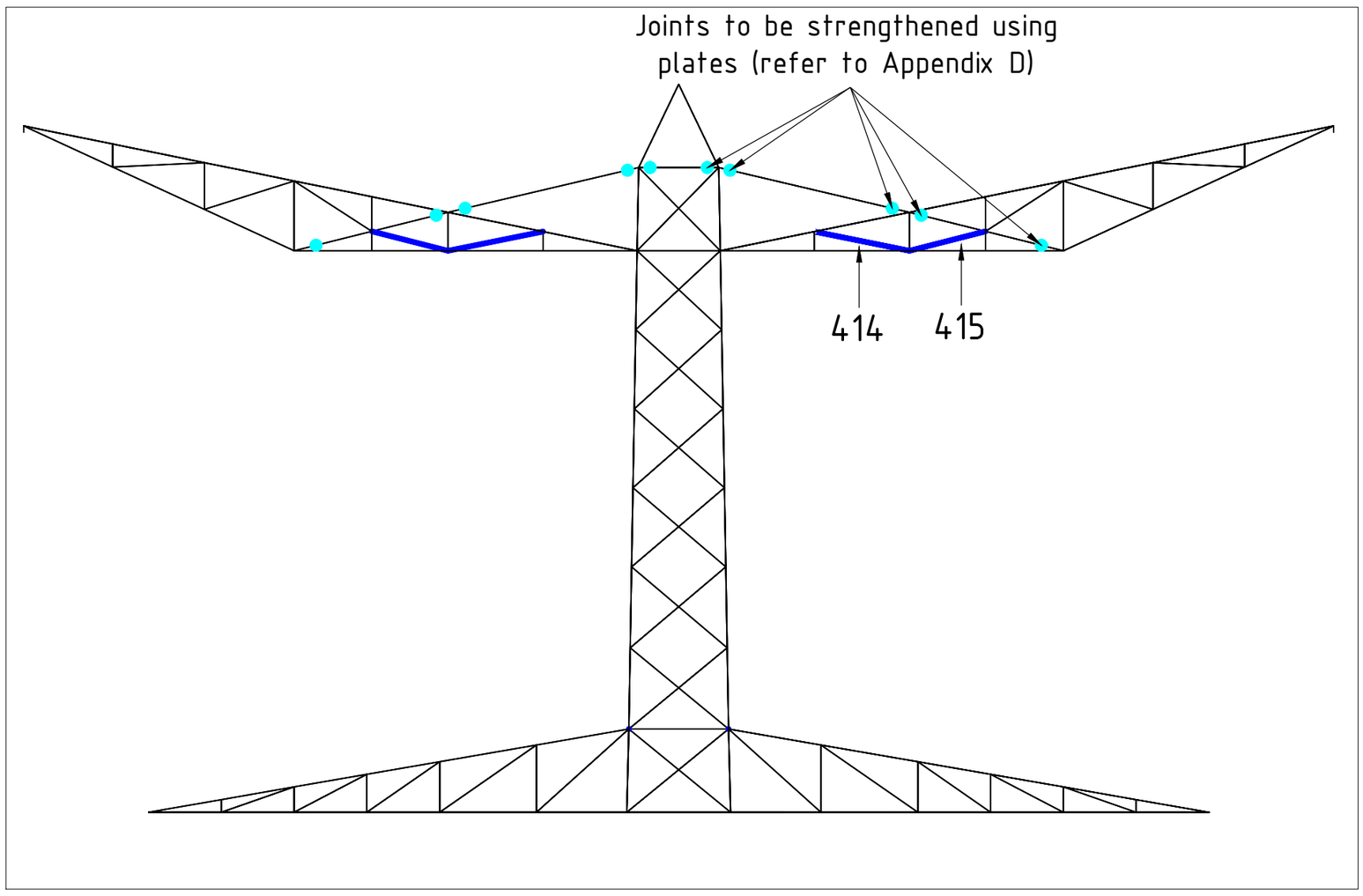
| BR01 | | | | | EA | L60x6 | S355 t<=40 | M16-8.8t-NEN2012 |




Front View Crossarms

Notes and legend:

- **New redundants according to drawing**
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- **All changes are symmetrical unless otherwise indicated**
- **Material quality t ≤ 16mm S355J0**
- **Material quality t > 16mm S355J2**
- **Bolt quality 8.8 rolled**

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-033

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|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | |
| Drawn by: | MuK | 16-2-2021 | Units: | m | |
| Checked by: | TBR | 17-2-2021 | Project no: | 10166260 | |
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Description: Modifications overview for mast type S+75T (mast 53) and S+75 (mast 52)
Page 3 of 4

Revision: 01

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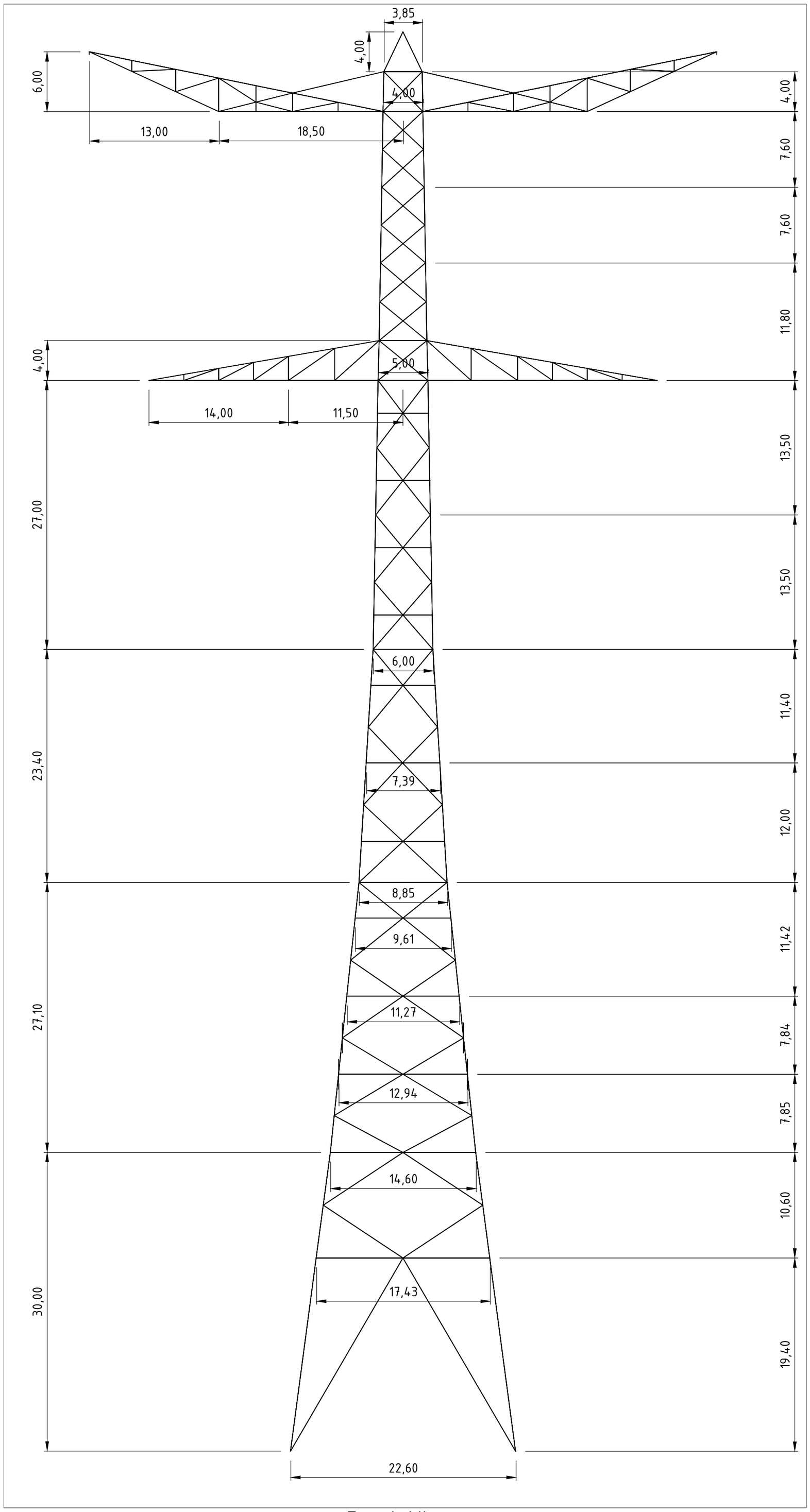
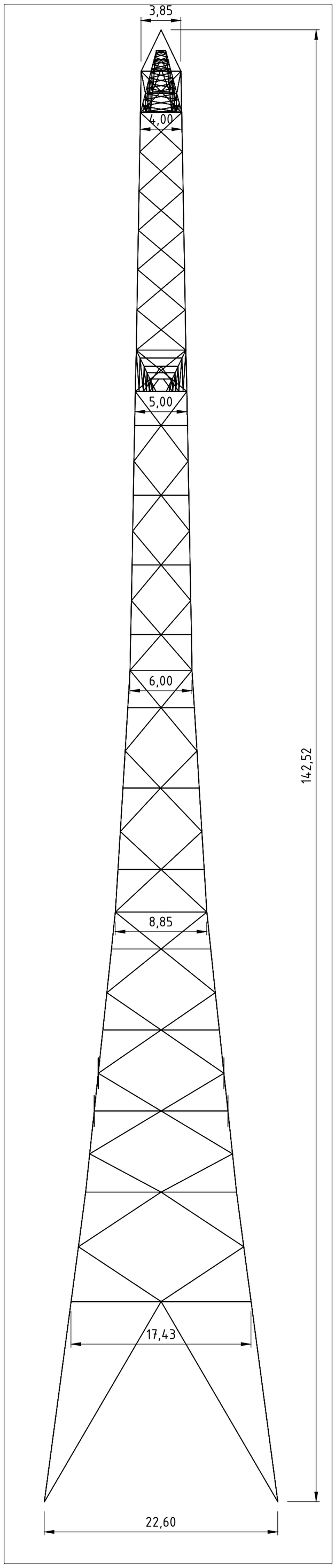



Front View




Side View

Notes and legend:

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

**New redundant member**
**Profile exchanged**
**Redundant exchanged**
**Strengthening of joint using plates**
**Bolt exchanged**

| | | |
|---|---|---|
| 01 | 16-2-2021 | Version 2.0 - Modifications according to loads based on 15 year return period |
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Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-033

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | |
| Drawn by: | MuK | 16-2-2021 | Units: | m | |
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| Approved by: | JHu | 18-2-2021 | Company: | TenneT | |

Description: Modifications overview for mast type S+75T (mast 53) and S+75 (mast 52)
Page 4 of 4

Revision: 01

Format: A2

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# APPENDIX F DOCUMENTEN TNO

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TenneT TSO B.V.
T.a.v. de heer T. van der Wekken
Utrechtseweg 310
6812 AR ARNHEM

**Datum**
18 februari 2021

**Onze referentie**
Rapport TNO 2021 R10305

**E-mail**
ijsbrand.vanstraalen@tno.nl

**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.

Op opdrachten aan TNO zijn de Algemene Voorwaarden voor opdrachten aan TNO, zoals gedeponeerd bij de Griffie van de Rechtbank Den Haag en de Kamer van Koophandel Den Haag van toepassing. Deze algemene voorwaarden kunt u tevens vinden op www.tno.nl.
Op verzoek zenden wij u deze toe.

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 $\beta_{15} = 1{,}1$ (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 $\beta$ volgt uit de definitie $P = \Phi(-\beta)$.
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 |
| $\beta_1$ | 2,8 | 3,0 |
| $\beta_{15}$ | 1,8 | 2,1 |

Uit deze nadere analyse volgt dat de betrouwbaarheidsindex $\beta_{15}$ (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 $\beta_{15}$ = 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 $\beta_{15}$ = 2,0 voor CC2-0 (van toepassing is voor de beschouwde drie masten) en voor verbouw geldt dat $\beta_{15}$ = 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.

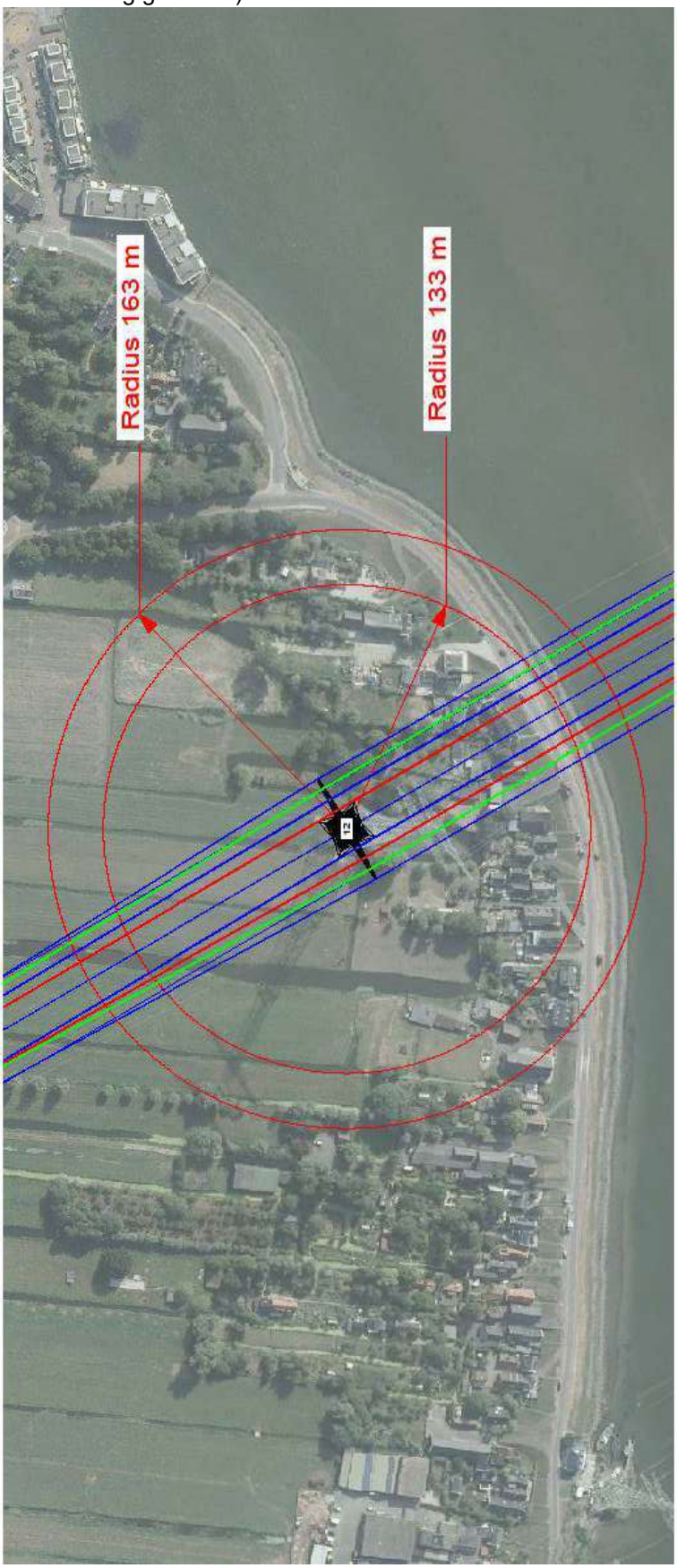
## Referenties

[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

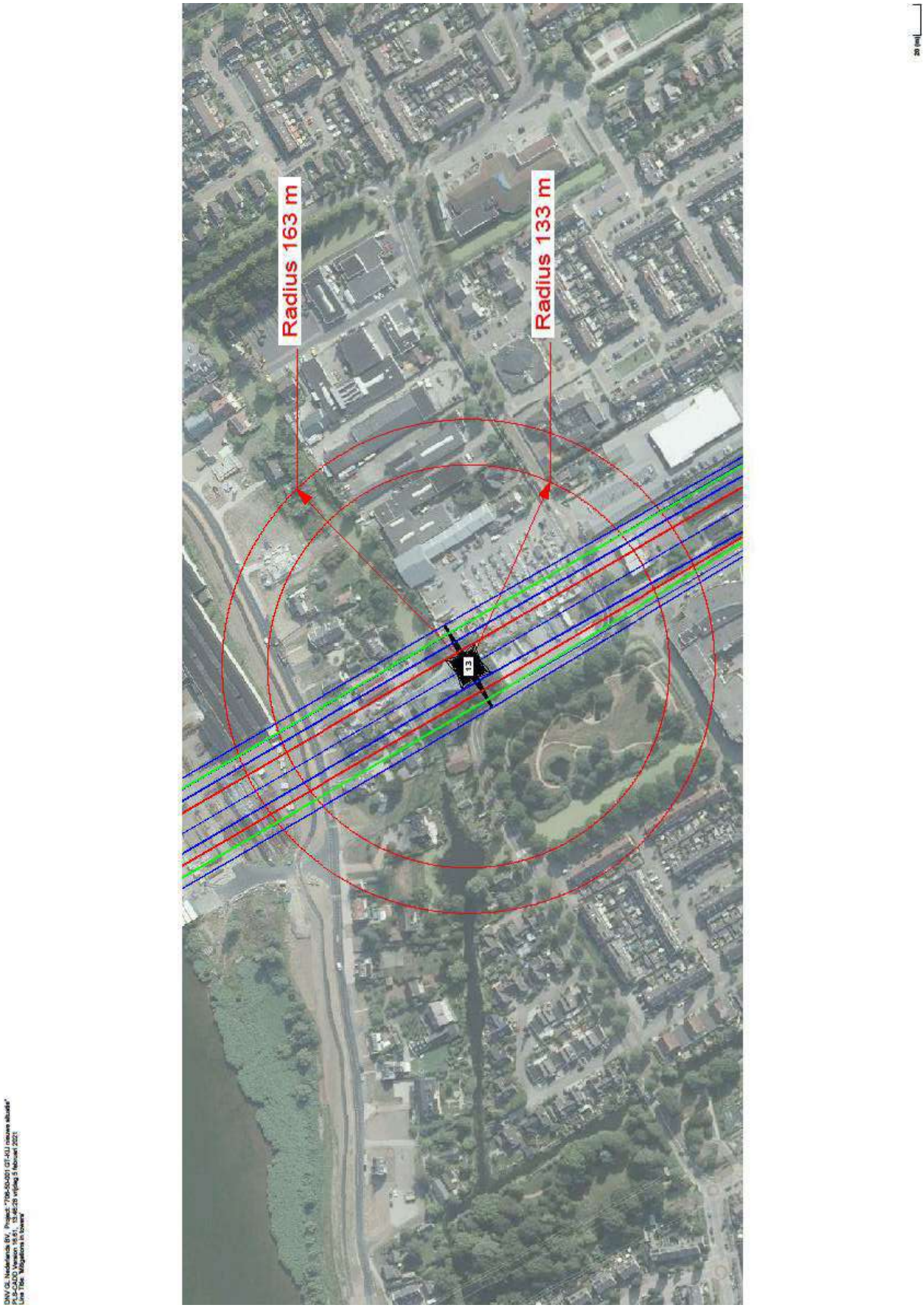
**Bijlage – Overzicht van gebieden waar masten kunnen neerkomen**
(4 pagina's)

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)

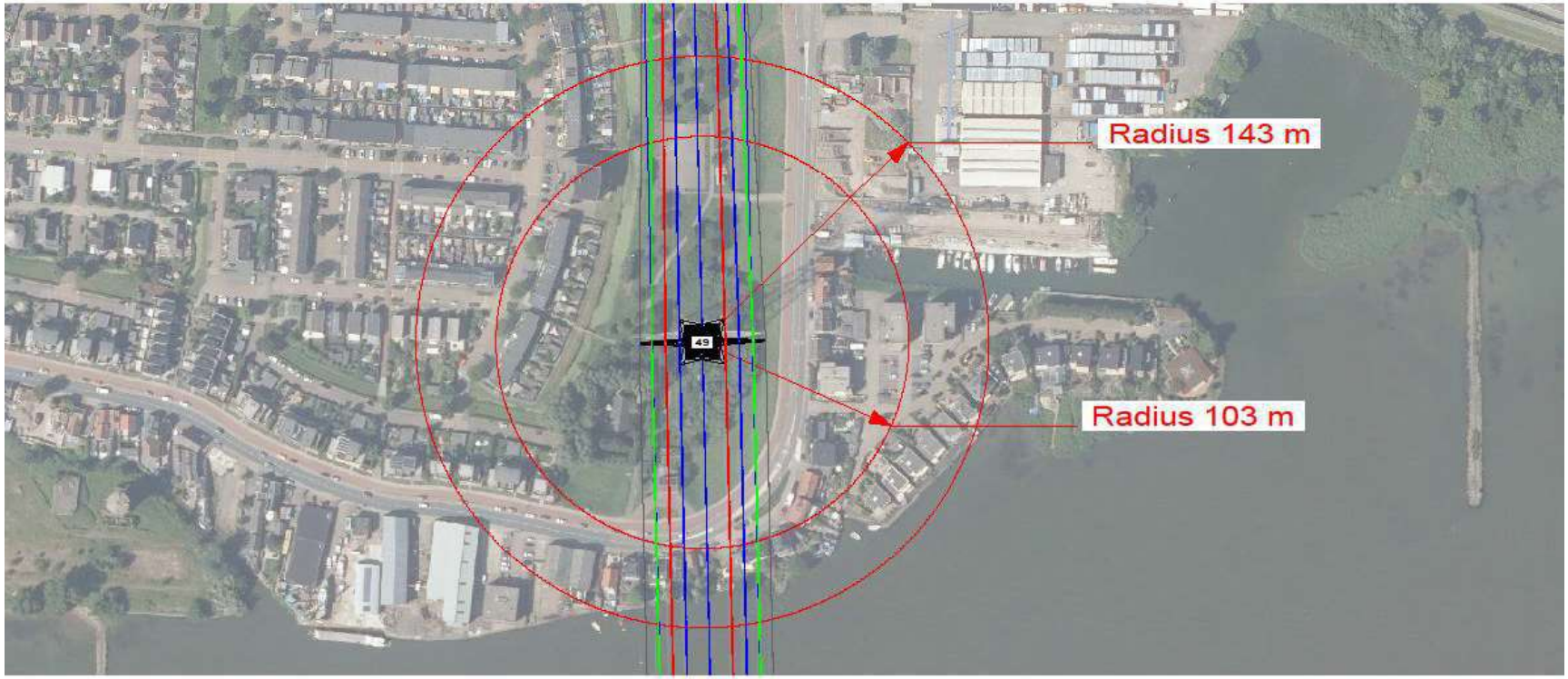



Mast 13 (afbeelding is kwart slag gedraaid)




Mast 49 (afbeelding is kwart slag gedraaid)

DNV GL Nederlands BV, Project: "706-50-001 GT-KLI nieuwe situatie"
PLS-CADD Version 16.61, 13:53:02 vrijdag 5 februari 2021
Line Title: 'Mitigations in towers'




20 (m)

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Op opdrachten aan TNO zijn de Algemene Voorwaarden voor opdrachten aan TNO, zoals gedeponeerd bij de Griffie van de Rechtbank Den Haag en de Kamer van Koophandel Den Haag van toepassing. Deze algemene voorwaarden kunt u tevens vinden op www.tno.nl.
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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 $\phi$ (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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ValidSigned by Tom Basten on 09-02-2021

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Research Manager Structural Dynamics

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Bijlage 22 Rapportage Mastconstructie S+9

DNV·GL

"TOETSING EN HERONTWERP MASTEN EN FUNDATIES BBB380"

# KIJ-GT380 – Rapportage mast S+9

## TenneT TSO B.V.

**Meridian doc. nr.:** 002.589.40 0916505
**Rapport nr.:** 21-1077 Rev.0
**Datum:** 2021-07-02

| | | |
|---|---|---|
| Projectnaam: | "Toetsing en herontwerp masten en fundaties BBB380" | DNV GL - Energy<br>Energy Advisory |
| Rapport titel: | KIJ-GT380 – Rapportage mast S+9 | Postbus 9035 |
| Klant: | TenneT TSO B.V. | 6800 ET ARNHEM |
| Contactpersoon: | [redacted] | |
| Datum: | 2021-07-02 | |
| Project nr.: | 10166260 | [redacted] |
| Organisatie unit: | TDT | [redacted] |
| Meridian doc.nr.: | 002.589.40 0916505 | |
| Rapport nr.: | 21-1077 Rev.0 | |

| Geschreven door: | Beoordeeld door: | Goedgekeurd door: |
|---|---|---|
| [redacted] | | |

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|---|---|---|---|---|---|
| 0 | 2021-07-02 | Eerste uitgave | [redacted] | [redacted] | [redacted] |

DNV GL Netherlands B.V.

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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+9 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+9.

### 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.

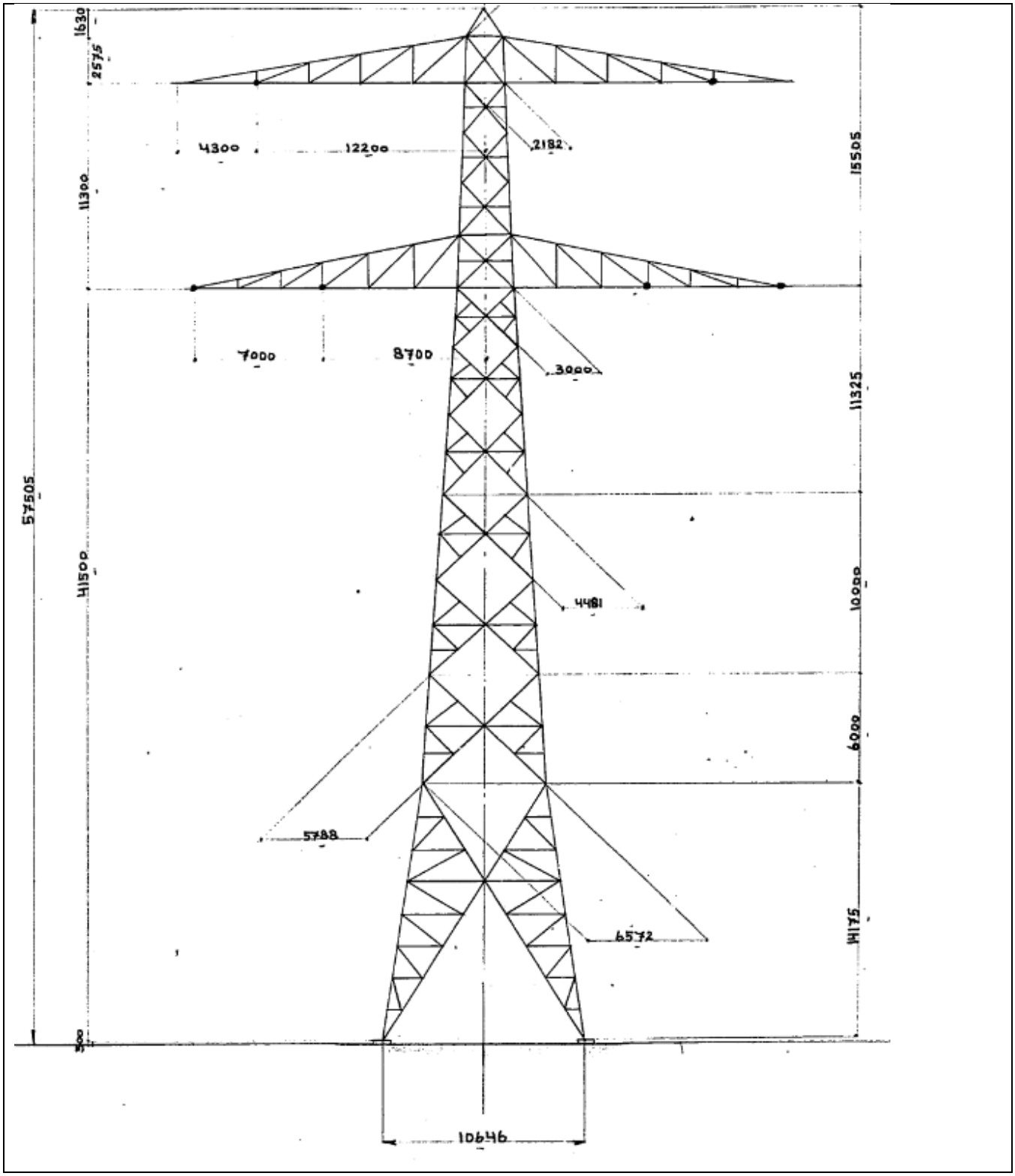
**Tabel 1 Relevante eisen**

| 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".<br><br>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+9 getoetst. In de verbinding KIJ-GT komt maar één mast voor van het type S+9 (mast 80), de gegevens van de mast zijn in Tabel 2 weergegeven. De berekening van de geleiderbelastingen is in dit geval locatie specifiek uitgevoerd.

**Tabel 2 Mastnummers**

| Mastnummer | Masttype | Maatgevend mastnummer | Wind span (m) | Weight span (m) | Hoogteverschil |
|---|---|---|---|---|---|
| 80 | S+9 | 80 | 362 | 437 | 17.8 |

## 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 | 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:

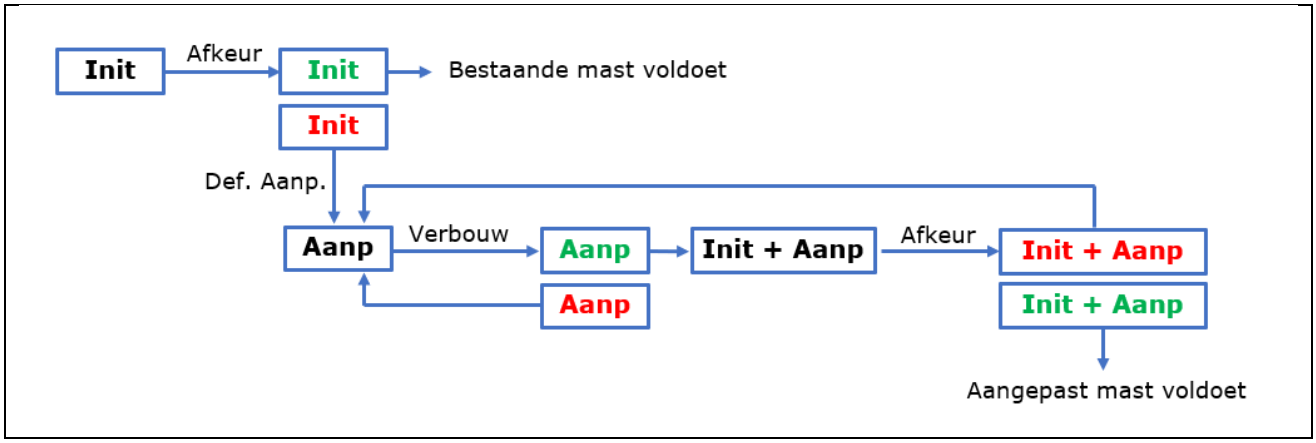
Stap 1: Toets bestaande (Init) mast op Afkeur

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 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

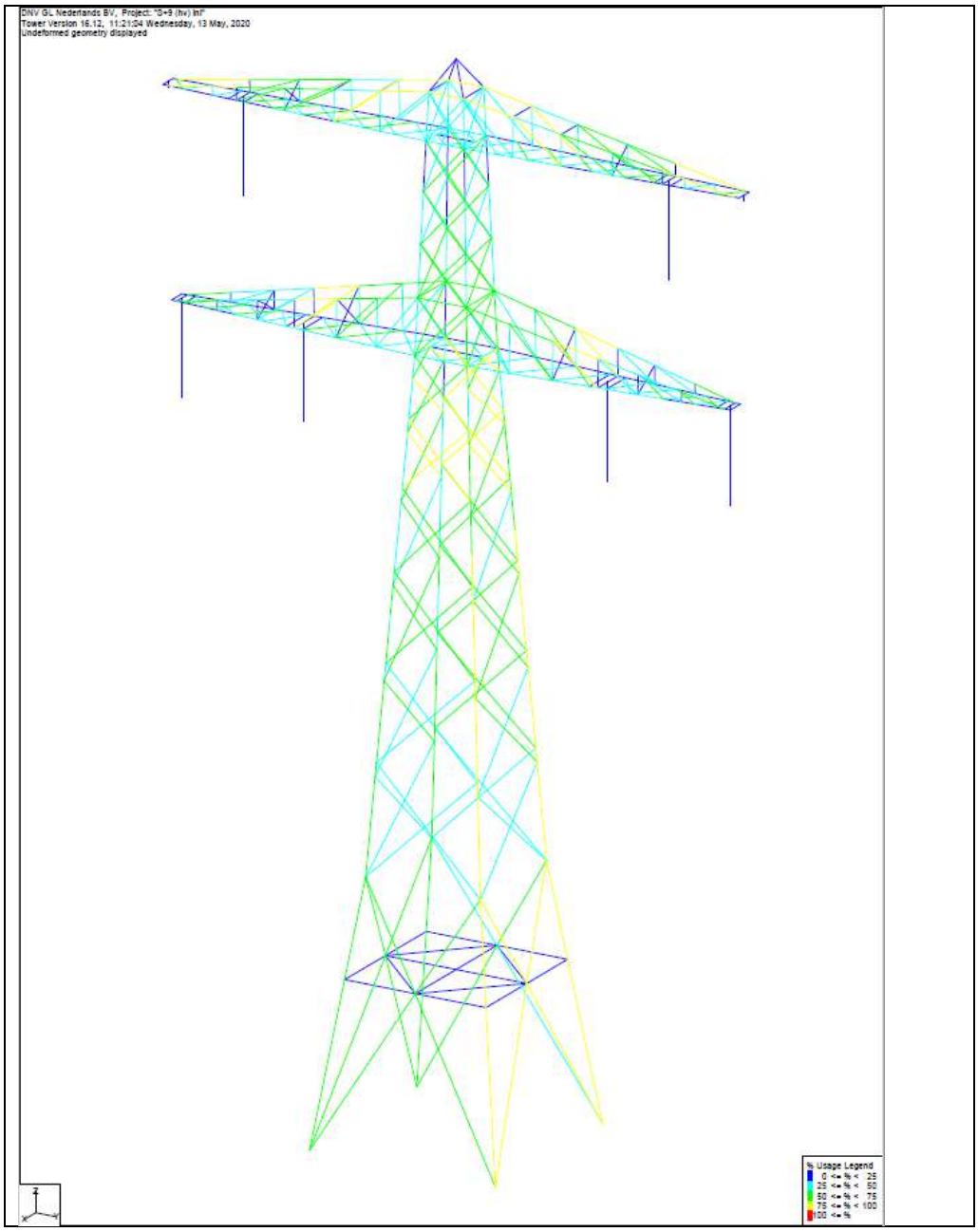
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten 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+9 met belastingen op afkeurniveau is weergegeven in onderstaande figuren.




**Figuur 3 Resultaat PLS-TOWER S+9 (80)**

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 | | Figuur 3 |
| Knikverkorters | | **Voldoen niet** | Appendix C |
| Blokdeuvels | Voldoen | | Appendix D |

# 5 AANPASSINGEN

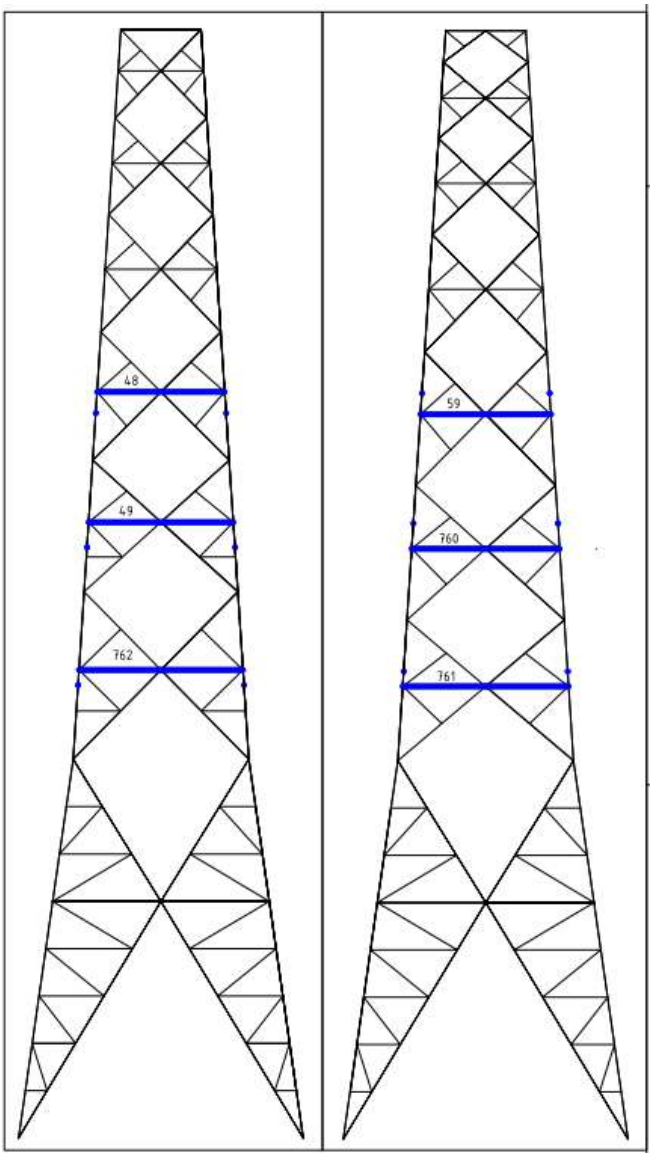
## 5.1 Inleiding

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

- Knikverkorters vervangen.

## 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 Vervanging van knikverkorters voor S+9 (80), vooraanzicht (links) en zijaanzicht (rechts)**

Een overzicht van het nettogewicht van de profielen die nodig zijn voor de versterkingen/aanpassingen is voor mast 80 gegeven in Tabel 5. Het gewicht van eventueel benodigde schetsplaten is niet meegenomen.

**Tabel 5 Gewichten S+9 (80) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **762** | L50.5 | S235 | 1M12-5.6t | L65.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 3.00 | 72.26 |
| **761** | L50.5 | S235 | 1M12-5.6t | L65.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 3.03 | 73.06 |
| **760** | L45.5 | S235 | 1M12-5.6t | L60.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.70 | 59.70 |
| **49** | L45.5 | S235 | 1M12-5.6t | L55.6 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.64 | 53.31 |
| **48** | L45.5 | S235 | 1M12-5.6t | L50.5 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.32 | 35.64 |
| **59** | L45.5 | S235 | 1M12-5.6t | L50.5 | S355 | 1M12-8.8t | Profiel uitgewisseld | 4 | 2.37 | 36.40 |
| | | | | | | | | 24 | 16.06 | 330.37 |

## 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 CONDUCTOR LOADS

## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 1,00 |
| Ice region | B |
| Tower type | Steunmast |
| Tower height | 57 m |
| Max. Span | 406 m |
| Line angle | 180° |
| Catenary | 1400 m |
| Wind span | 363 m |
| EDS Weight span | 439 m |
| Min. Weight span | 429 m |
| Max. Weight span | 538 m |

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

Client: TenneT Taking power further

DNV·GL

Title:

# Berekening masttype S+9

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

Document name:

KIJ-GT_S+9_80_Report.pdf

Project number:

Project client number:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

Project: KIJ-GT
Tower: S+9
Number: 80

**Conductor loads**

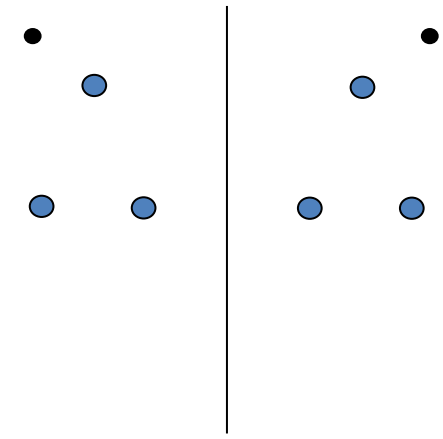
Auteur: TBR
Versie: v11.3

**General**

| | |
|---|---|
| Description | S+9 |
| 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 | 37,2 m | 41,5 m | -15,5 m |
| Circuit 1 | 11 | 380ct1f2 | 37,2 m | 41,5 m | -8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 48,5 m | 52,8 m | -12,2 m |
| Circuit 2 | 20 | 380ct2f1 | 37,2 m | 41,5 m | 8,7 m |
| Circuit 2 | 21 | 380ct2f2 | 37,2 m | 41,5 m | 15,5 m |
| Circuit 2 | 22 | 380ct2f3 | 48,5 m | 52,8 m | 12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 52,3 m | 52,8 m | -16,5 m |
| Bliksemdraad 2 | 3 | bl2 | 52,3 m | 52,8 m | 16,5 m |

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

Project: KIJ-GT
Tower: S+9
Number: 80

**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**

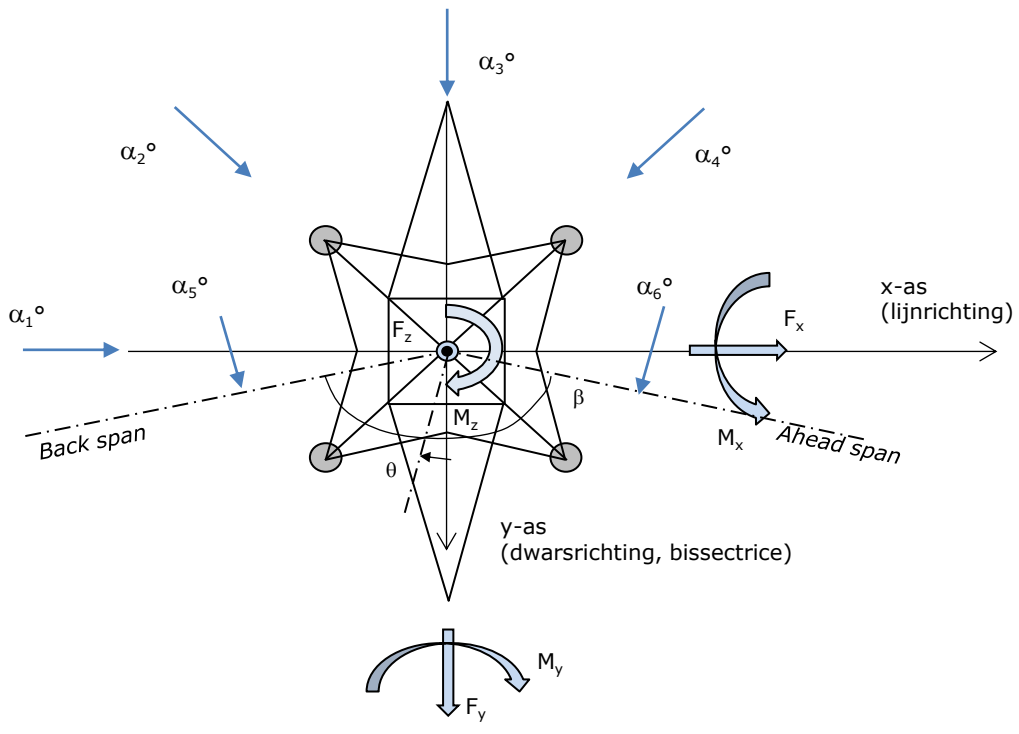
| | | | Hoogteverschil | | | Richtingsverandering | | |
|---|---|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | | Δy_back | Δy_ahead | |
| Circuit 1 | 10 | 380ct1f1 | -9,1 | -9,4 | m | 0,0 | 0,0 | m |
| Circuit 1 | 11 | 380ct1f2 | -9,1 | -9,4 | m | 0,0 | 0,0 | m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

**Line and tower data**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 406,0 | 319,0 | m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 357,3 | 357,3 | m |
| Line angle | $\beta$ | 180 | ° | |
| Tower orientation with respect to bi | $\theta$ | 0 | ° | |
| Section length | | 1720 | 1720 | m |
| Height bottom of tower to ground level | | 0,5 | m | |
| Wind directions considered | $\alpha_1$ | 0 | ° | |
| Wind directions according to: | $\alpha_2$ | 45 | ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | ° | |
| | $\alpha_4$ | 135 | ° | |
| | $\alpha_5$ | - | ° | |
| | $\alpha_6$ | - | ° | |

*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+9
Number: 80

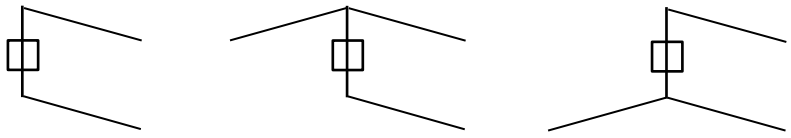
**Absence of conductors**

| | | 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 |

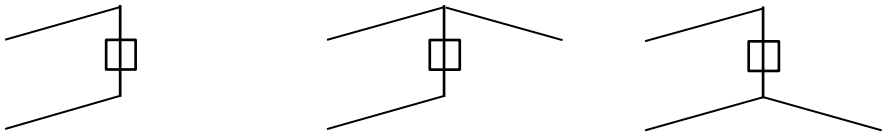
**Load situations SPLS**

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+9
Number: 80

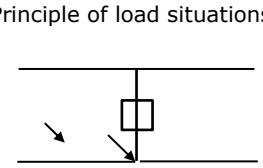
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

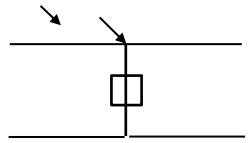
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

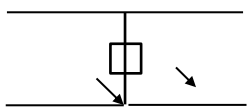
Principle of load situations:



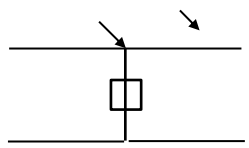
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

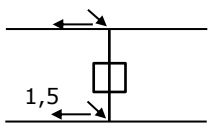
**Load situations 8. Galloping as a static load**

| 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 |

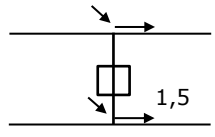
Considered situations galloping 8: None (existing structure)

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+9
Number: 80

## Tower structure

### Properties

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | S+9 | | |
| Base plate w.r.t. ground level | 0,5 | m | |
| Tower height w.r.t. base plate | 57,0 | m | |
| Tower self weight | 275,0 | kN | |
| | | | |
| *Width and slope at foundation* | x-ri. | y-ri. | |
| Leg spread | 10,65 | 10,65 | 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] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 10,65 | 6,57 | 14,18 | 0,144 | 122,08 | 12,50 | 0,10 | 3,39 |
| Middenstuk 1 | 30,18 | 6,57 | 4,48 | 16,00 | 0,065 | 88,42 | 10,24 | 0,12 | 3,33 |
| Middenstuk 2 | 41,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 47,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,54 | 0,28 | 2,62 |
| Bovenstuk 2 | 55,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 57,01 | 2,00 | | 1,63 | | 1,63 | 0,40 | 0,25 | 2,74 |
| Ondertraverse | 41,50 | 14,20 | | 3,05 | | 21,66 | 4,78 | 0,22 | 2,84 |
| Boventraverse | 52,80 | 15,40 | | 2,58 | | 19,87 | 4,77 | 0,24 | 2,76 |

**Properties tower sections transverse direction (side view, xz plane)**

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 14,18 | 10,65 | 6,57 | 14,18 | 0,144 | 122,08 | 12,50 | 0,10 | 3,39 |
| Middenstuk 1 | 30,18 | 6,57 | 4,48 | 16,00 | 0,065 | 88,42 | 10,24 | 0,12 | 3,33 |
| Middenstuk 2 | 41,50 | 4,48 | 3,00 | 11,32 | 0,065 | 42,34 | 7,51 | 0,18 | 3,03 |
| Bovenstuk 1 | 47,37 | 3,00 | 2,58 | 5,87 | 0,036 | 16,38 | 4,54 | 0,28 | 2,62 |
| Bovenstuk 2 | 55,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,34 | 4,99 | 0,27 | 2,64 |
| Topstuk | 57,01 | 2,00 | | 1,63 | | 1,63 | 0,40 | 0,25 | 2,74 |
| Ondertraverse | 41,50 | 14,20 | | 3,05 | | 21,66 | 4,78 | 0,22 | 2,84 |
| Boventraverse | 52,80 | 15,40 | | 2,58 | | 19,87 | 4,77 | 0,24 | 2,76 |

*Note: Surface transverse direction is reduced in calculation.*

Project: KIJ-GT
Tower: S+9
Number: 80

**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | $\Delta$h | $A_1$ |
|---|---|---|---|
| Broekstuk 1 | | | |
| Middenstuk 1 | | | |
| Middenstuk 2 | | | |
| Bovenstuk 1 | | | |
| Bovenstuk 2 | | | |

**Input antennas**

| Description | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne o.t. | | | |

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

| Description | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk 1 | 0,70 | 29,7 | 25,2 | 0,0 | -25,2 | 7,1 | 210,9 | 178,9 | 0,0 | -178,9 |
| Middenstuk 1 | 0,91 | 30,8 | 26,2 | 0,0 | -26,2 | 22,2 | 683,9 | 580,3 | 0,0 | -580,3 |
| Middenstuk 2 | 1,04 | 23,6 | 20,1 | 0,0 | -20,1 | 35,8 | 847,4 | 719,0 | 0,0 | -719,0 |
| Bovenstuk 1 | 1,10 | 13,1 | 11,1 | 0,0 | -11,1 | 44,4 | 581,3 | 493,3 | 0,0 | -493,3 |
| Bovenstuk 2 | 1,14 | 15,0 | 12,8 | 0,0 | -12,8 | 51,4 | 773,0 | 655,9 | 0,0 | -655,9 |
| Topstuk | 1,17 | 1,3 | 1,1 | 0,0 | -1,1 | 56,2 | 72,2 | 61,2 | 0,0 | -61,2 |
| Ondertraverse | 1,09 | 29,6 | 17,6 | 0,0 | -17,6 | 42,5 | 1256,7 | 746,4 | 0,0 | -746,4 |
| Boventraverse | 1,16 | 30,5 | 18,1 | 0,0 | -18,1 | 53,7 | 1635,4 | 971,4 | 0,0 | -971,4 |
| Totaal | | 173,7 | 132,1 | 0,0 | -132,1 | | 6060,7 | 4406,5 | 0,0 | -4406,5 |

**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 | 0,70 | 0,0 | 25,2 | 29,7 | 25,2 | 7,1 | 0,0 | 178,9 | 210,9 | 178,9 |
| Middenstuk 1 | 0,91 | 0,0 | 26,2 | 30,8 | 26,2 | 22,2 | 0,0 | 580,3 | 683,9 | 580,3 |
| Middenstuk 2 | 1,04 | 0,0 | 20,1 | 23,6 | 20,1 | 35,8 | 0,0 | 719,0 | 847,4 | 719,0 |
| Bovenstuk 1 | 1,10 | 0,0 | 11,1 | 13,1 | 11,1 | 44,4 | 0,0 | 493,3 | 581,3 | 493,3 |
| Bovenstuk 2 | 1,14 | 0,0 | 12,8 | 15,0 | 12,8 | 51,4 | 0,0 | 655,9 | 773,0 | 655,9 |
| Topstuk | 1,17 | 0,0 | 1,1 | 1,3 | 1,1 | 56,2 | 0,0 | 61,2 | 72,2 | 61,2 |
| Ondertraverse | 1,09 | 0,0 | 17,6 | 11,8 | 17,6 | 42,5 | 0,0 | 746,4 | 502,7 | 746,4 |
| Boventraverse | 1,16 | 0,0 | 18,1 | 12,2 | 18,1 | 53,7 | 0,0 | 971,4 | 654,2 | 971,4 |
| Total | | 0,0 | 132,1 | 137,6 | 132,1 | | 0,0 | 4406,5 | 4325,5 | 4406,5 |

**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 | 275 | 0 | 0 | 0 |
| Windrichting 0° | 174 | 0 | 0 | 0 | 6061 | 0 |
| Windrichting 45° | 132 | 132 | 0 | 4406 | 4406 | 0 |
| Windrichting 90° | 0 | 138 | 0 | 4325 | 0 | 0 |
| Windrichting 135° | -132 | 132 | 0 | 4406 | -4406 | 0 |

Project: KIJ-GT
Tower: S+9
Number: 80

**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 | 39,85 | 1,07 | 1,2 | 1,28 |
| 380ct1f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 39,85 | 1,07 | 1,2 | 1,28 |
| 380ct1f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 51,15 | 1,14 | 1,2 | 1,37 |
| 380ct2f1 | 2,00 | 1 | 2 | 4,3 | 1,0 | 39,85 | 1,07 | 1,2 | 1,28 |
| 380ct2f2 | 2,00 | 1 | 2 | 4,3 | 1,0 | 39,85 | 1,07 | 1,2 | 1,28 |
| 380ct2f3 | 2,00 | 1 | 2 | 4,3 | 1,0 | 51,15 | 1,14 | 1,2 | 1,37 |
| bl1 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 53,05 | 1,15 | 1,2 | 0,07 |
| bl2 | 0,10 | 1 | 0,1 | 0,5 | 0,1 | 53,05 | 1,15 | 1,2 | 0,07 |

Project: KIJ-GT
Tower: S+9
Number: 80

**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 | 23,3 | 0,92 | 0,56 | 0,51 | 1,12 | 28,25 | 49,2 | 44,5 | 46,9 | 87,7 | 79,3 |
| 380ct1f2 | 23,3 | 0,92 | 0,56 | 0,51 | 1,12 | 28,25 | 49,2 | 44,5 | 46,9 | 87,7 | 79,3 |
| 380ct1f3 | 34,6 | 1,03 | 0,60 | 0,54 | 1,09 | 28,25 | 56,6 | 51,1 | 46,9 | 103,7 | 93,7 |
| 380ct2f1 | 23,3 | 0,92 | 0,56 | 0,51 | 1,12 | 28,25 | 49,2 | 44,5 | 46,9 | 87,7 | 79,3 |
| 380ct2f2 | 23,3 | 0,92 | 0,56 | 0,51 | 1,12 | 28,25 | 49,2 | 44,5 | 46,9 | 87,7 | 79,3 |
| 380ct2f3 | 34,6 | 1,03 | 0,60 | 0,54 | 1,09 | 28,25 | 56,6 | 51,1 | 46,9 | 103,7 | 93,7 |
| bl1 | 39,1 | 1,06 | 0,61 | 0,55 | 1,20 | 22,24 | 17,2 | 15,5 | 41,5 | 32,1 | 29,0 |
| bl2 | 39,1 | 1,06 | 0,61 | 0,55 | 1,20 | 22,13 | 17,1 | 15,5 | 41,4 | 32,0 | 29,0 |

**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 | 26,9 | 0,96 | 0,58 | 0,52 | 1,11 | 28,25 | 51,9 | 46,9 | 46,9 | 93,3 | 84,4 |
| 380ct1f2 | 26,9 | 0,96 | 0,58 | 0,52 | 1,11 | 28,25 | 51,9 | 46,9 | 46,9 | 93,3 | 84,4 |
| 380ct1f3 | 38,2 | 1,06 | 0,60 | 0,55 | 1,08 | 28,25 | 58,5 | 52,8 | 46,9 | 107,9 | 97,5 |
| 380ct2f1 | 26,9 | 0,96 | 0,58 | 0,52 | 1,11 | 28,25 | 51,9 | 46,9 | 46,9 | 93,3 | 84,4 |
| 380ct2f2 | 26,9 | 0,96 | 0,58 | 0,52 | 1,11 | 28,25 | 51,9 | 46,9 | 46,9 | 93,3 | 84,4 |
| 380ct2f3 | 38,2 | 1,06 | 0,60 | 0,55 | 1,08 | 28,25 | 58,5 | 52,8 | 46,9 | 107,9 | 97,5 |
| bl1 | 42,6 | 1,09 | 0,61 | 0,55 | 1,20 | 22,24 | 17,7 | 16,0 | 41,5 | 33,2 | 30,0 |
| bl2 | 42,6 | 1,09 | 0,61 | 0,55 | 1,20 | 22,13 | 17,7 | 16,0 | 41,4 | 33,2 | 30,0 |

Project: KIJ-GT
Tower: S+9
Number: 80

**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 °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,05 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk only tower | 10° | 0,90 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk conductors too | 10° | 0,90 | 0,90 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 3_0,9 | Wind+ice 0,9Gk | -5° | 0,90 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 4_0,9 | Cold+wind 0,9Gk | -20° | 0,90 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 5a | Torsional loads | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinal loads | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Construction + maintenance | 5° | 1,05 | 1,05 | 1,20 | 0,22 | 0,00 | 0,0 |
| ULS 6_0,9 | Construction + maintenance | 5° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,15 | 1,15 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (strength, for angle towers: absence of conductors) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,94 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,28 | 0,88 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Number of wind directions | 4 |
| Number of load combinations for ULS | 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+9
Number: 80

**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 | -29,2 | 29,2 | 3,9 | 3,2 | 6,2 | 5,4 |
| bl2 | -29,5 | 29,5 | 3,9 | 3,2 | 6,2 | 5,4 |
| 380ct1f1 | -110,0 | 110,0 | 11,9 | 10,0 | 18,9 | 16,4 |
| 380ct1f2 | -110,0 | 110,0 | 11,9 | 10,0 | 18,9 | 16,4 |
| 380ct1f3 | -111,9 | 111,9 | 13,6 | 11,2 | 18,9 | 16,4 |
| 380ct2f1 | -110,0 | 110,0 | 11,9 | 10,0 | 18,9 | 16,4 |
| 380ct2f2 | -110,0 | 110,0 | 11,9 | 10,0 | 18,9 | 16,4 |
| 380ct2f3 | -111,9 | 111,9 | 13,6 | 11,2 | 18,9 | 16,4 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 438,7 | 450,9 | 438,7 |
| bl2 | 438,7 | 453,4 | 438,7 |
| 380ct1f1 | 435,1 | 444,1 | 435,1 |
| 380ct1f2 | 435,1 | 444,1 | 435,1 |
| 380ct1f3 | 435,1 | 444,5 | 435,1 |
| 380ct2f1 | 435,1 | 444,1 | 435,1 |
| 380ct2f2 | 435,1 | 444,1 | 435,1 |
| 380ct2f3 | 435,1 | 444,5 | 435,1 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 495,6 | 442,5 |
| bl2 | 495,6 | 443,3 |
| 380ct1f1 | 463,5 | 437,8 |
| 380ct1f2 | 463,5 | 437,8 |
| 380ct1f3 | 470,0 | 439,1 |
| 380ct2f1 | 463,5 | 437,8 |
| 380ct2f2 | 463,5 | 437,8 |
| 380ct2f3 | 470,0 | 439,1 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 513,3 m | 1,416 - |
| Min. weight span | 430,1 m | 1,186 - |

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 | 15,0 | 7,1 | 9,0 | -31,9 | 31,9 |
| bl2 | 15,0 | 7,1 | 9,0 | -32,0 | 32,0 |
| 380ct1f1 | 51,3 | 21,8 | 35,3 | -109,6 | 110,3 |
| 380ct1f2 | 51,3 | 21,8 | 35,3 | -109,6 | 110,3 |
| 380ct1f3 | 51,3 | 24,8 | 35,4 | -111,6 | 112,2 |
| 380ct2f1 | 51,3 | 21,8 | 35,3 | -109,6 | 110,3 |
| 380ct2f2 | 51,3 | 21,8 | 35,3 | -109,6 | 110,3 |
| 380ct2f3 | 51,3 | 24,8 | 35,4 | -111,6 | 112,2 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 4,5 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 4,5 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 2,5 | 2,1 |
| | bl2 | 2,5 | 2,2 |
| | 380ct1f1 | 11,9 | 10,4 |
| | 380ct1f2 | 11,9 | 10,4 |
| | 380ct1f3 | 11,9 | 10,4 |
| | 380ct2f1 | 11,9 | 10,4 |
| | 380ct2f2 | 11,9 | 10,4 |
| | 380ct2f3 | 11,9 | 10,4 |

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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 | 151 | 158 | 6992 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 151 | 158 | 6992 | 0 | 0 |
| ULS 3_90 | | 0 | 80 | 229 | 3712 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 80 | 229 | 3712 | 0 | 0 |
| SLS 7 | | 0 | 0 | 141 | 1 | 0 | 0 |

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

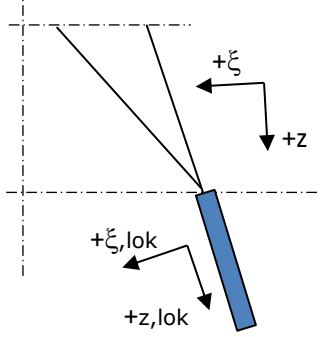
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 305 | 446 | 11823 | 0 | 0 |
| ULS 3_90 | 0 | 126 | 517 | 5161 | 0 | 0 |
| SLS 7 | 0 | 0 | 416 | 1 | 0 | 0 |

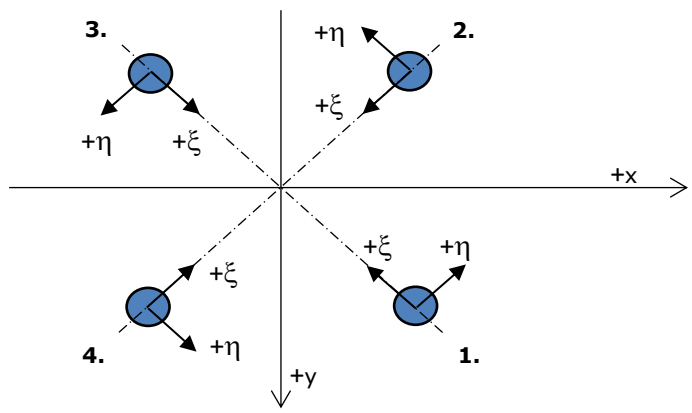
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 305 | 446 | **11823** | 0 | 0 |
| ULS 1a_0,9_0,9_0 | 196 | 0 | 374 | 1 | **6876** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 413 | -166 | 2131 | **796** |
| ULS 1a_45 | 149 | 225 | 439 | **8502** | **4997** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 140 | 126 | **744** | 10 | -188 | -36 | 759 |
| 2 | ULS 1a_0 | 71 | -87 | **432** | 11 | -112 | -24 | 441 |
| 3 | ULS 7 | -24 | -24 | **119** | 0 | -34 | -10 | 122 |
| 4 | ULS 1a_135 | -140 | 126 | **744** | -10 | -188 | -36 | 759 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -99 | 84 | **-540** | 10 | 129 | 20 | -551 |
| 3 | ULS 1a_0,9_0,9_45 | 99 | 84 | **-540** | -10 | 129 | 20 | -551 |
| 4 | ULS 1a_0,9_0,9_0 | 30 | -46 | **-229** | -11 | 54 | 7 | -234 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_90 | 134 | 99 | 667 | **25** | -165 | -29 | 680 |
| 2 | ULS 5a Ba 21 | 16 | -60 | 211 | **30** | -54 | -11 | 215 |
| 3 | ULS 5a Ba 21 | -28 | 18 | 11 | **33** | -7 | -5 | 11 |
| 4 | ULS 5a Ba 21 | 12 | 19 | -5 | **22** | -5 | -6 | -5 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 17 | 60 | 211 | **-30** | -54 | -11 | 215 |
| 2 | ULS 5a Ba 10 | 51 | -22 | 195 | **-20** | -52 | -12 | 199 |
| 3 | ULS 1a_90 | 89 | 54 | -444 | **-25** | 101 | 11 | -453 |
| 4 | ULS 5a Ba 10 | -28 | -18 | 11 | **-33** | -7 | -5 | 11 |

Project: KIJ-GT
Tower: S+9
Number: 80

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -99 | 84 | **-540** | **10** | 129 | 20 | -551 |
| 3 | ULS 1a_0,9_0,9_45 | 99 | 84 | **-540** | **-10** | 129 | 20 | -551 |
| 4 | ULS 1a_0,9_0,9_0 | 30 | -46 | **-229** | **-11** | 54 | 7 | -234 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 21 | 21 | 104 | 0 | -30 | -8 | 106 |
| 2 | SLS 7 | 21 | -21 | 104 | 0 | -30 | -8 | 106 |
| 3 | SLS 7 | -21 | -21 | 104 | 0 | -30 | -8 | 106 |
| 4 | SLS 7 | -21 | 21 | 104 | 0 | -30 | -8 | 106 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 140 | 126 | **744** | 10 | -188 | -36 | 759 |
| Max. tension | ULS 1a_0,9_0,9_45 | 99 | 84 | **-540** | -10 | 129 | 20 | -551 |
| Max. pos. torsie | ULS 5a Ba 21 | -28 | 18 | 11 | **33** | -7 | -5 | 11 |
| Max. neg. torsie | ULS 5a Ba 10 | -28 | -18 | 11 | **-33** | -7 | -5 | 11 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 99 | 84 | **-540** | **-10** | 129 | 20 | -551 |

**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 21 | 21 | **104** | 0 | -30 | -8 | 106 |
| 2 | SLS 1a_135 | -78 | 66 | **-431** | 8 | 102 | 15 | -440 |
| 3 | SLS 1a_45 | 78 | 66 | **-431** | -8 | 102 | 15 | -440 |
| 4 | SLS 1a_0 | 21 | -34 | **-169** | -9 | 39 | 4 | -172 |

**Maximum compression load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 120 | 108 | **640** | 8 | -162 | -32 | 653 |
| 2 | SLS 1a_0 | 62 | -76 | **377** | 9 | -98 | -21 | 384 |
| 3 | SLS 7 | -21 | -21 | **104** | 0 | -30 | -8 | 106 |
| 4 | SLS 1a_135 | -120 | 108 | **640** | -8 | -162 | -32 | 653 |

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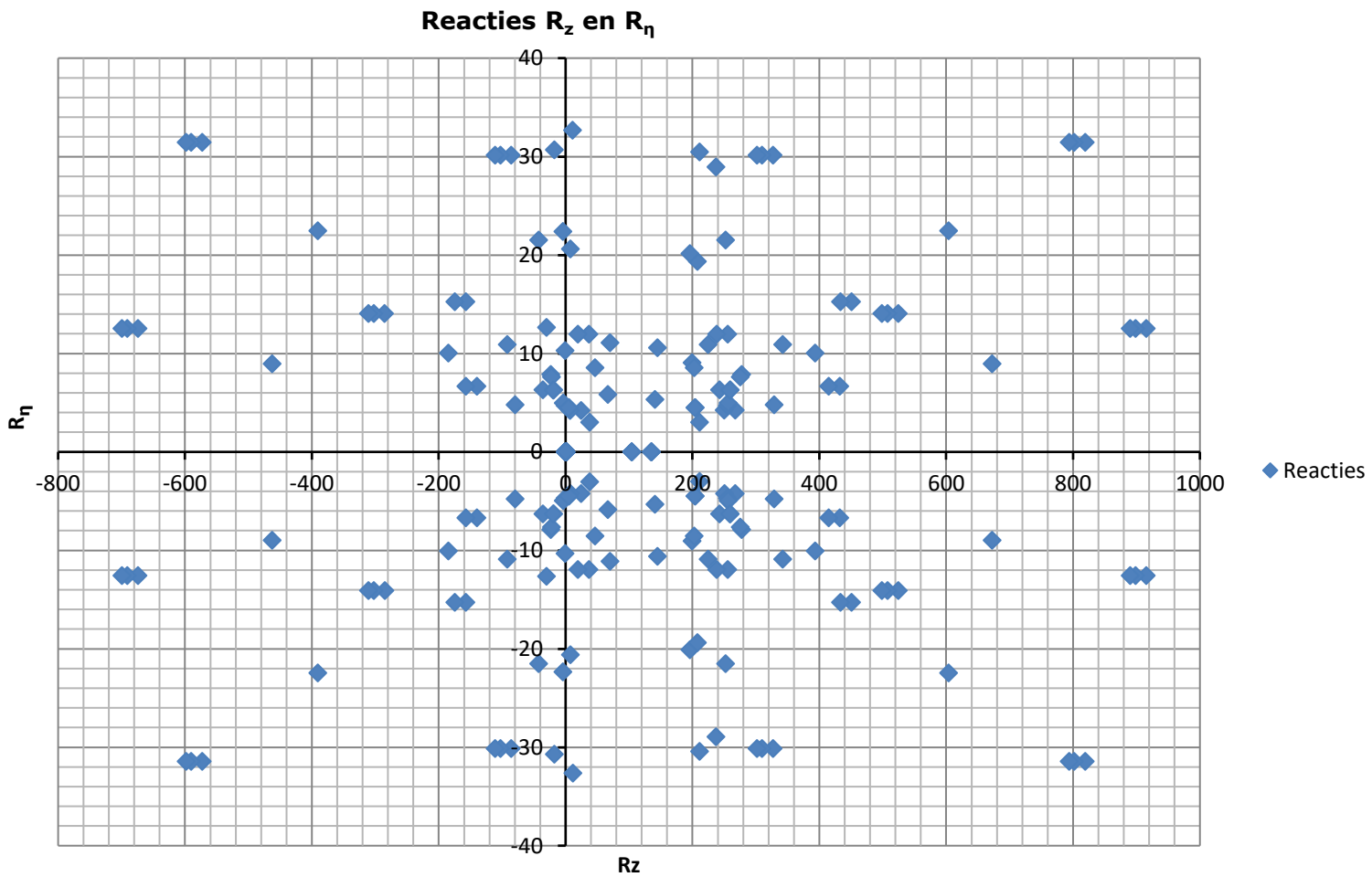


Project: KIJ-GT
Tower: S+9
Number: 80

**Conductor loads**

Auteur: TBR
Versie: v11.3

**Starting points**

| | |
|---|---|
| Consequence class | Verbouw CC2 |
| Reference period | 50 jaar |

| **ULS** (strength) Load case | description | NEN-EN50341-2-15:2019 Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
|---|---|---|---|---|---|---|---|---|
| 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) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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 |

Project: KIJ-GT
Tower: S+9
Number: 80

**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 | -34,1 | 34,1 | 4,9 | 4,0 | 6,8 | 5,8 |
| bl2 | -34,4 | 34,4 | 4,9 | 4,0 | 6,8 | 5,8 |
| 380ct1f1 | -127,7 | 127,7 | 14,9 | 12,5 | 22,3 | 19,3 |
| 380ct1f2 | -127,7 | 127,7 | 14,9 | 12,5 | 22,3 | 19,3 |
| 380ct1f3 | -130,1 | 130,1 | 17,0 | 14,0 | 22,3 | 19,3 |
| 380ct2f1 | -127,7 | 127,7 | 14,9 | 12,5 | 22,3 | 19,3 |
| 380ct2f2 | -127,7 | 127,7 | 14,9 | 12,5 | 22,3 | 19,3 |
| 380ct2f3 | -130,1 | 130,1 | 17,0 | 14,0 | 22,3 | 19,3 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 438,7 | 451,3 | 438,7 |
| bl2 | 438,7 | 453,7 | 438,7 |
| 380ct1f1 | 435,1 | 444,3 | 435,1 |
| 380ct1f2 | 435,1 | 444,3 | 435,1 |
| 380ct1f3 | 435,1 | 444,7 | 435,1 |
| 380ct2f1 | 435,1 | 444,3 | 435,1 |
| 380ct2f2 | 435,1 | 444,3 | 435,1 |
| 380ct2f3 | 435,1 | 444,7 | 435,1 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 504,8 | 440,0 |
| bl2 | 504,8 | 440,8 |
| 380ct1f1 | 469,1 | 436,2 |
| 380ct1f2 | 469,1 | 436,2 |
| 380ct1f3 | 476,7 | 437,6 |
| 380ct2f1 | 469,1 | 436,2 |
| 380ct2f2 | 469,1 | 436,2 |
| 380ct2f3 | 476,7 | 437,6 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 538,1 m | 1,484 - |
| Min. weight span | 429,1 m | 1,184 - |

Project: KIJ-GT
Tower: S+9
Number: 80

**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 | 8,9 | 10,0 | -34,2 | 34,2 |
| bl2 | 15,0 | 8,9 | 10,0 | -34,3 | 34,5 |
| 380ct1f1 | 51,3 | 27,4 | 41,5 | -127,3 | 128,1 |
| 380ct1f2 | 51,3 | 27,4 | 41,5 | -127,3 | 128,1 |
| 380ct1f3 | 51,3 | 31,1 | 41,6 | -129,8 | 130,5 |
| 380ct2f1 | 51,3 | 27,4 | 41,5 | -127,3 | 128,1 |
| 380ct2f2 | 51,3 | 27,4 | 41,5 | -127,3 | 128,1 |
| 380ct2f3 | 51,3 | 31,1 | 41,6 | -129,8 | 130,5 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 4,5 | -15,0 | 15,0 |
| bl2 | 0,0 | 0,0 | 4,5 | -15,0 | 15,0 |
| 380ct1f1 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct1f2 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct1f3 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct2f1 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct2f2 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |
| 380ct2f3 | 0,0 | 0,0 | 21,9 | -64,2 | 64,2 |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 2,5 | 2,1 |
| | bl2 | 2,5 | 2,2 |
| | 380ct1f1 | 11,9 | 10,4 |
| | 380ct1f2 | 11,9 | 10,4 |
| | 380ct1f3 | 11,9 | 10,5 |
| | 380ct2f1 | 11,9 | 10,4 |
| | 380ct2f2 | 11,9 | 10,4 |
| | 380ct2f3 | 11,9 | 10,5 |

Project: KIJ-GT
Tower: S+9
Number: 80

**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 | 189 | 175 | 8766 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 189 | 175 | 8766 | 0 | 0 |
| ULS 3_90 | | 0 | 100 | 269 | 4654 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 100 | 269 | 4654 | 0 | 0 |
| SLS 7 | | 0 | 0 | 141 | 1 | 0 | 0 |

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

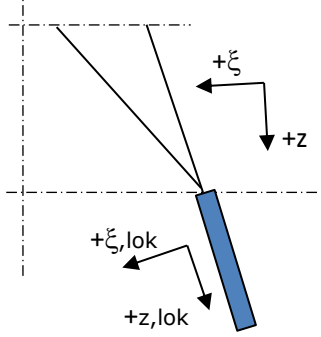
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 382 | 491 | 14821 | 0 | 0 |
| ULS 3_90 | 0 | 158 | 586 | 6470 | 0 | 0 |
| SLS 7 | 0 | 0 | 416 | 1 | 0 | 0 |

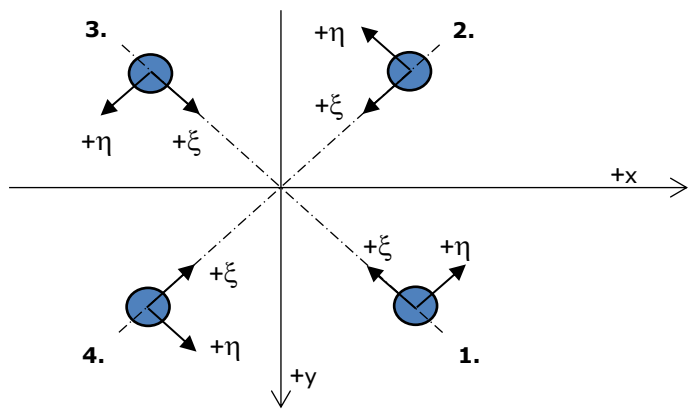
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 382 | 491 | **14821** | 0 | 0 |
| ULS 1a_0 | 246 | 0 | 478 | 1 | **8620** | 0 |
| ULS 5a Ba 21 | 51 | 0 | 413 | -166 | 2131 | **796** |
| ULS 1a_45 | 187 | 282 | 482 | **10658** | **6265** | 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] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 172 | 154 | **915** | 13 | -230 | -44 | 934 |
| 2 | ULS 1a_0 | 86 | -105 | **524** | 14 | -135 | -29 | 535 |
| 3 | ULS 7 | -27 | -27 | **135** | 0 | -38 | -11 | 138 |
| 4 | ULS 1a_135 | -172 | 154 | **915** | -13 | -230 | -44 | 934 |

**Maximum tension load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -128 | 111 | **-700** | 13 | 169 | 27 | -714 |
| 3 | ULS 1a_0,9_0,9_45 | 128 | 111 | **-700** | -13 | 169 | 27 | -714 |
| 4 | ULS 1a_0,9_0,9_0 | 43 | -63 | **-311** | -14 | 74 | 11 | -318 |

**Maximum torsional load (positive)**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_90 | 165 | 120 | 819 | **31** | -201 | -35 | 836 |
| 2 | ULS 1a_90 | -115 | 71 | -573 | **31** | 132 | 15 | -585 |
| 3 | ULS 5a Ba 21 | -28 | 18 | 11 | **33** | -7 | -5 | 11 |
| 4 | ULS 5a Ba 21 | 12 | 19 | -5 | **22** | -5 | -6 | -5 |

**Maximum torsional load (negative)**

| Index<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 5a Ba 10 | 17 | 60 | 211 | **-30** | -54 | -11 | 215 |
| 2 | ULS 5a Ba 10 | 51 | -22 | 195 | **-20** | -52 | -12 | 199 |
| 3 | ULS 1a_90 | 115 | 71 | -573 | **-31** | 132 | 15 | -585 |
| 4 | ULS 5a Ba 10 | -28 | -18 | 11 | **-33** | -7 | -5 | 11 |

Project: KIJ-GT
Tower: S+9
Number: 80

**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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 | -128 | 111 | **-700** | **13** | 169 | 27 | -714 |
| 3 | ULS 1a_0,9_0,9_45 | 128 | 111 | **-700** | **-13** | 169 | 27 | -714 |
| 4 | ULS 1a_0,9_0,9_0 | 43 | -63 | **-311** | **-14** | 74 | 11 | -318 |

**Permanent load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 21 | 21 | 104 | 0 | -30 | -8 | 106 |
| 2 | SLS 7 | 21 | -21 | 104 | 0 | -30 | -8 | 106 |
| 3 | SLS 7 | -21 | -21 | 104 | 0 | -30 | -8 | 106 |
| 4 | SLS 7 | -21 | 21 | 104 | 0 | -30 | -8 | 106 |

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 172 | 154 | **915** | 13 | -230 | -44 | 934 |
| Max. tension | ULS 1a_0,9_0,9_45 | 128 | 111 | **-700** | -13 | 169 | 27 | -714 |
| Max. pos. torsie | ULS 5a Ba 21 | -28 | 18 | 11 | **33** | -7 | -5 | 11 |
| Max. neg. torsie | ULS 5a Ba 10 | -28 | -18 | 11 | **-33** | -7 | -5 | 11 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 128 | 111 | **-700** | **-13** | 169 | 27 | -714 |

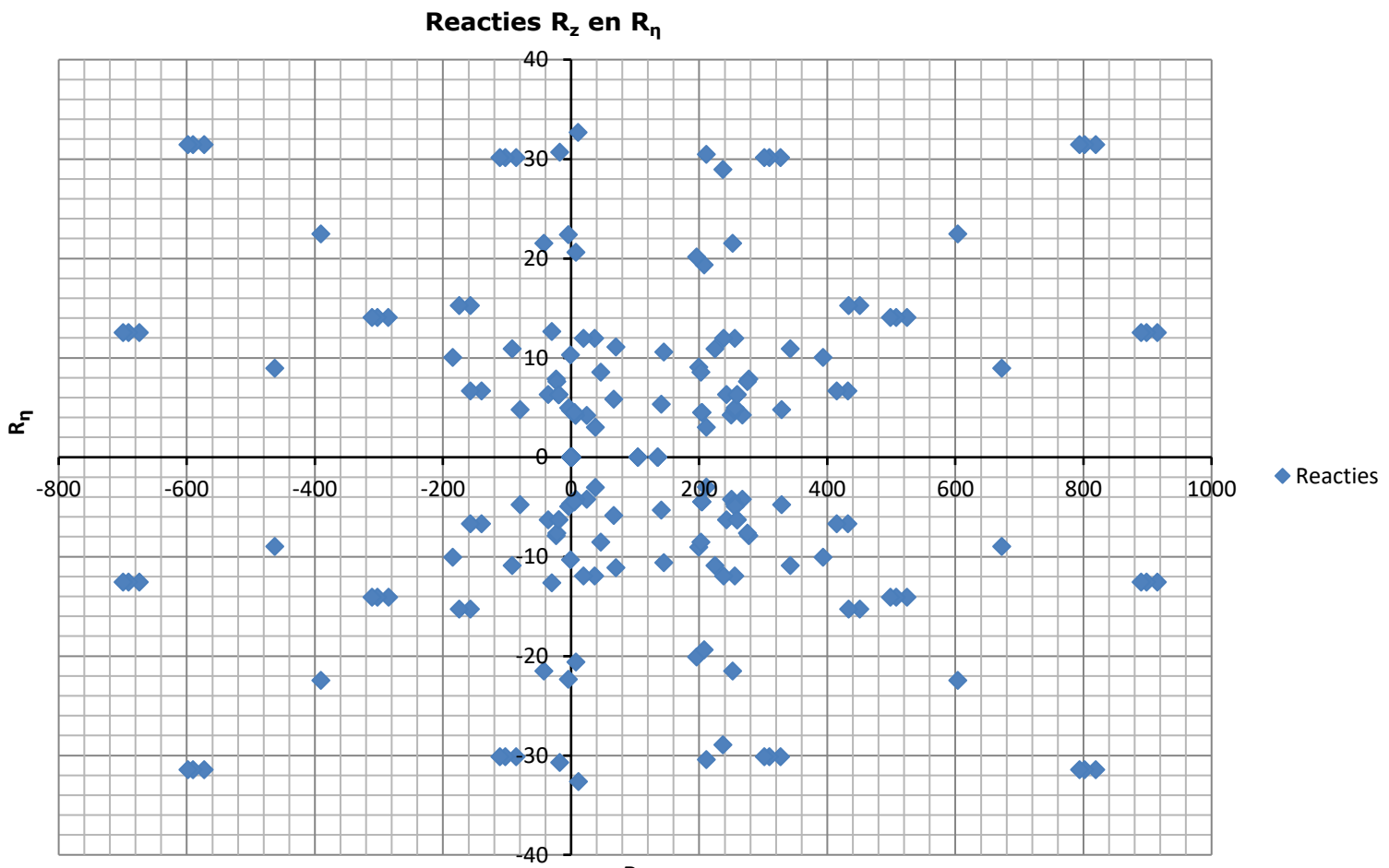
**Maximum tension load - SLS**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 21 | 21 | **104** | 0 | -30 | -8 | 106 |
| 2 | SLS 1a_135 | -84 | 72 | **-463** | 9 | 110 | 16 | -473 |
| 3 | SLS 1a_45 | 84 | 72 | **-463** | -9 | 110 | 16 | -473 |
| 4 | SLS 1a_0 | 23 | -37 | **-185** | -10 | 43 | 5 | -189 |

**Maximum compression load - SLS**

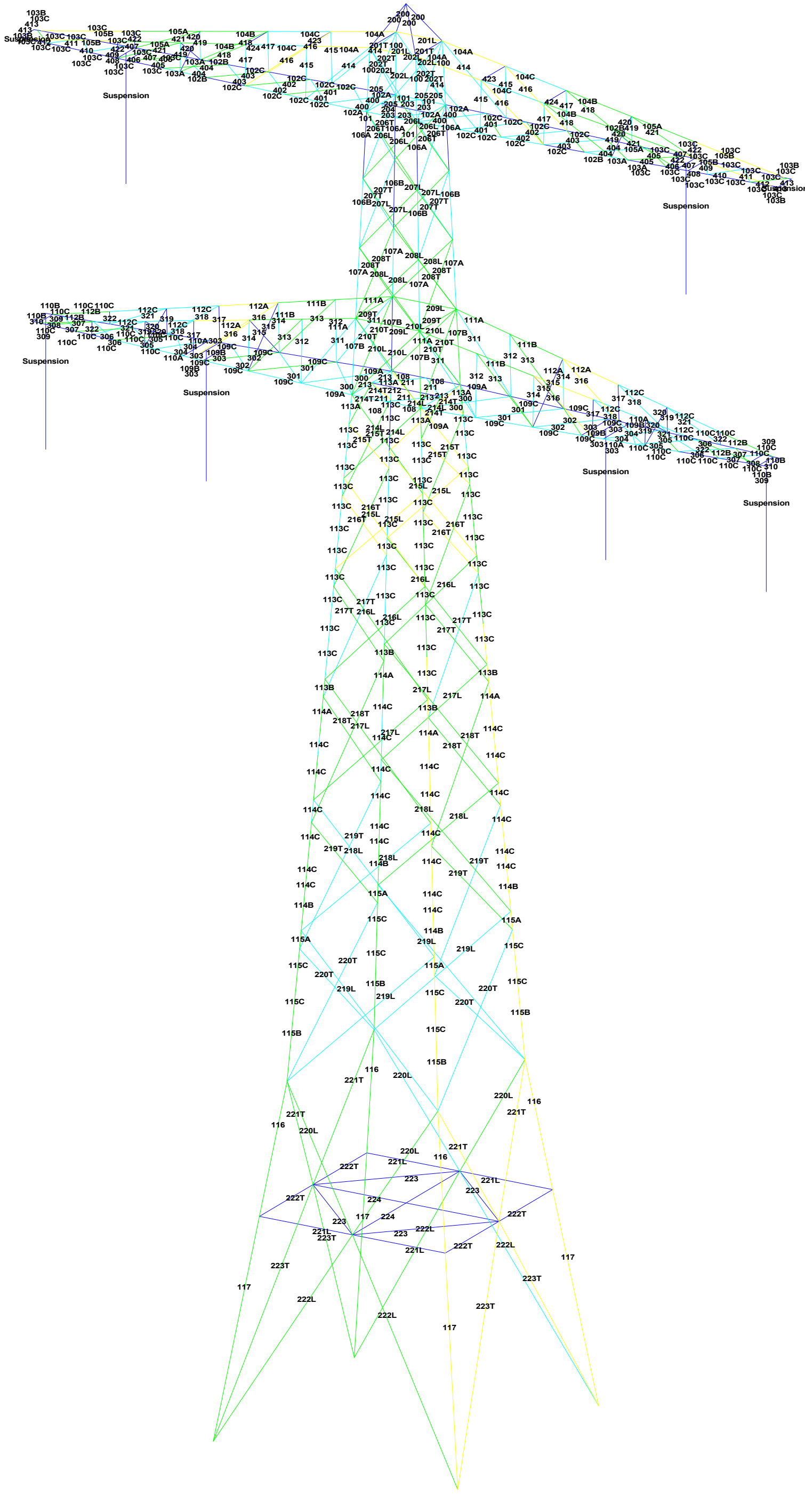
| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 1a_45 | 126 | 114 | **672** | 9 | -170 | -33 | 686 |
| 2 | SLS 1a_0 | 65 | -79 | **393** | 10 | -102 | -22 | 401 |
| 3 | SLS 7 | -21 | -21 | **104** | 0 | -30 | -8 | 106 |
| 4 | SLS 1a_135 | -126 | 114 | **672** | -9 | -170 | -33 | 686 |

Project: KIJ-GT
Tower: S+9
Number: 80



# APPENDIX B PLS-TOWER OUTPUT

DNV GL Nederlands BV, Project: "S+9 (hv) ini"
Tower Version 16.12, 11:20:15 Wednesday, 13 May, 2020
Undeformed geometry displayed



DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 19-5-2020
Author TBR
Version 1.0

**KIJ-GT380**
**S+9**
**Mast 80**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 117 | | 180x180x16# | S235 | 10M24-5.6t | 0.20 | 0.20 | 0.20 | 51 | **-664.2** | ULS 1a_135 | 1156.6 | 839.3 | 2073.6 | 0.79 | | **513.6** | ULS 1a_0,9_0,9_135 | 1220.3 | 839.3 | 1772.3 | 0.61 | |
| 116 | | 180x180x16# | S235 | 10M24-5.6t | 0.33 | 0.33 | 0.33 | 51 | **-659.4** | ULS 1a_135 | 1156.1 | 839.3 | 2073.6 | 0.79 | | **518.0** | ULS 1a_0,9_0,9_135 | 1220.3 | 839.3 | 1701.4 | 0.62 | |
| 115A | | 160x160x15# | S235 | 10M24-5.6t | 3.34 | 3.35 | 2.78 | 65 | **-691.9** | ULS 1a_135 | 907.6 | 839.3 | 1944.0 | 0.82 | | **523.9** | ULS 1a_0,9_0,9_135 | 1008.5 | 839.3 | 1661.5 | 0.62 | |
| 115B | | 160x160x15# | S235 | 10M24-5.6t | 0.64 | 1.09 | 0.53 | 65 | **-725.9** | ULS 1a_135 | 906.2 | 839.3 | 1944.0 | 0.87 | | **555.1** | ULS 1a_0,9_0,9_135 | 1008.5 | 839.3 | 1661.5 | 0.66 | |
| 115C | | 160x160x15# | S235 | | 1.85 | 1.56 | 1.30 | 75 | **-724.0** | ULS 1a_135 | 848.4 | 0.0 | 0.0 | 0.85 | | **556.6** | ULS 1a_0,9_0,9_135 | 1097.7 | 0.0 | 0.0 | 0.51 | |
| 114A | | 150x150x14 | S235 | 8M24-5.6t | 1.74 | 1.81 | 1.45 | 76 | **-577.7** | ULS 1a_135 | 722.2 | 677.8 | 1451.5 | 0.85 | | **421.9** | ULS 1a_0,9_0,9_135 | 851.7 | 677.8 | 1240.6 | 0.62 | |
| 114B | | 150x150x14 | S235 | 10M24-5.6t | 1.20 | 2.51 | 1.00 | 89 | **-645.1** | ULS 1a_135 | 655.0 | 839.3 | 1814.4 | 0.99 | | **481.6** | ULS 1a_0,9_0,9_135 | 851.7 | 839.3 | 1550.8 | 0.57 | |
| 114C | | 150x150x14 | S235 | | 1.90 | 1.89 | 1.57 | 82 | **-642.2** | ULS 1a_135 | 692.2 | 0.0 | 0.0 | 0.93 | | **483.8** | ULS 1a_0,9_0,9_135 | 943.3 | 0.0 | 0.0 | 0.51 | |
| 113A | | 150x150x12 | S235 | 6M24-5.6t | 1.55 | 1.19 | 1.29 | 52 | **-298.6** | ULS 1a_135 | 725.1 | 508.3 | 933.1 | 0.59 | | **174.7** | ULS 1a_0,9_0,9_135 | 740.3 | 508.3 | 797.5 | 0.34 | |
| 113B | | 150x150x12 | S235 | 8M24-5.6t | 3.79 | 3.99 | 3.16 | 75 | **-541.4** | ULS 1a_135 | 630.8 | 677.8 | 1244.2 | 0.86 | | **387.1** | ULS 1a_0,9_0,9_135 | 740.3 | 677.8 | 1063.4 | 0.57 | |
| 113C | | 150x150x12 | S235 | | 1.71 | 1.71 | 1.43 | 80 | **-487.2** | ULS 1a_135 | 608.0 | 0.0 | 0.0 | 0.80 | | **343.1** | ULS 1a_0,9_0,9_135 | 817.8 | 0.0 | 0.0 | 0.42 | |
| 107A | | 100x100x12 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 76 | **-162.9** | ULS 1a_135 | 410.3 | 338.9 | 622.1 | 0.48 | | **106.8** | ULS 1a_0,9_0,9_135 | 426.6 | 338.9 | 531.7 | 0.32 | |
| 107B | | 100x100x12 | S235 | 6M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-203.0** | ULS 1a_135 | 391.5 | 508.3 | 933.1 | 0.52 | | **105.2** | ULS 1a_0,9_0,9_135 | 426.6 | 508.3 | 781.6 | 0.25 | |
| 106A | | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 79 | **-58.4** | ULS 1a_135 | 245.7 | 338.9 | 414.7 | 0.24 | | **21.5** | ULS 5a Ba 22 | 252.5 | 338.9 | 297.7 | 0.09 | |
| 106B | | 90x90x8 | S235 | 4M24-5.6t | 0.52 | 0.52 | 0.52 | 82 | **-116.8** | ULS 1a_135 | 239.6 | 338.9 | 414.7 | 0.49 | | **62.3** | ULS 1a_0,9_0,9_135 | 252.5 | 338.9 | 354.5 | 0.25 | |
| 100 | | 90x90x8 | S235 | 5M16-5.6t | 1.00 | 1.00 | 1.00 | 146 | **-45.7** | ULS 5a Ba 22 | 112.9 | 188.4 | 345.6 | 0.40 | | **0.0** | | 285.6 | 188.4 | 298.7 | 0.00 | |
| 200 | | 100x100x6 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 110 | **-8.1** | ULS 5a Ba 12 | 136.5 | 75.4 | 103.7 | 0.11 | | **8.0** | ULS 5a Ba 12 | 144.1 | 75.4 | 76.8 | 0.11 | |
| 111A | | 90x90x9 | S235 | 3M24-5.6t | 1.00 | 2.00 | 1.00 | 181 | **0.0** | | 95.9 | 254.2 | 349.9 | 0.00 | | **147.9** | ULS 3_90 | 205.3 | 254.2 | 299.1 | 0.72 | |
| 111B | | 90x90x9 | S235 | 3M24-5.6t | 1.00 | 2.00 | 1.00 | 180 | **0.0** | | 96.4 | 254.2 | 349.9 | 0.00 | | **130.4** | ULS 3_90 | 205.3 | 254.2 | 299.1 | 0.64 | |
| 112A | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 1.88 | 1.00 | 227 | **0.0** | | 42.7 | 176.4 | 226.8 | 0.00 | | **103.2** | ULS 3_90 | 125.5 | 176.4 | 155.3 | 0.82 | |
| 112B | | 70x70x7 | S235 | 3M20-5.6t | 1.00 | 2.00 | 1.00 | 232 | **0.0** | | 41.4 | 176.4 | 226.8 | 0.00 | | **89.7** | ULS 3_45 | 125.5 | 176.4 | 155.3 | 0.71 | |
| 112C | | 70x70x7 | S235 | | 1.00 | 2.14 | 1.00 | 227 | **0.0** | | 42.7 | 0.0 | 0.0 | 0.00 | | **98.7** | ULS 3_45 | 220.9 | 0.0 | 0.0 | 0.45 | |
| 110A | | 120x120x13 | S235 | 6M24-5.6t | 1.64 | 1.00 | 1.00 | 61 | **-193.6** | ULS 5a Ba 21 | 596.8 | 508.3 | 1010.9 | 0.38 | | **103.0** | ULS 5a Ba 21 | 602.4 | 508.3 | 864.0 | 0.20 | |
| 110B | | 120x120x13 | S235 | | 1.00 | 1.00 | 1.00 | 13 | **-0.4** | ULS 1a_0,9_0,9_90 | 705.0 | 0.0 | 0.0 | 0.00 | | **0.4** | ULS 1a_90 | 705.0 | 0.0 | 0.0 | 0.00 | |
| 110C | | 120x120x13 | S235 | | 1.71 | 1.29 | 1.00 | 66 | **-161.0** | ULS 5a Ba 21 | 578.0 | 0.0 | 0.0 | 0.28 | | **79.8** | ULS 5a Ba 10 | 705.0 | 0.0 | 0.0 | 0.11 | |
| 109A | | 150x100x16 | S235 | 11M24-5.6t | 1.00 | 0.52 | 0.52 | 56 | **-307.9** | ULS 5a Ba 10 | 774.5 | 931.9 | 2281.0 | 0.40 | | **138.1** | ULS 5a Ba 21 | 767.8 | 931.9 | 1384.2 | 0.18 | |
| 109B | | 150x100x16 | S235 | 6M24-5.6t | 4.78 | 1.00 | 1.00 | 47 | **-208.8** | ULS 5a Ba 10 | 809.2 | 508.3 | 1244.2 | 0.41 | | **118.0** | ULS 5a Ba 21 | 767.8 | 508.3 | 1063.4 | 0.23 | |
| 109C | | 150x100x16 | S235 | | 1.00 | 0.52 | 0.52 | 58 | **-282.5** | ULS 5a Ba 21 | 764.8 | 0.0 | 0.0 | 0.37 | | **127.6** | ULS 5a Ba 10 | 891.6 | 0.0 | 0.0 | 0.14 | |
| 104A | | 100x65x9* | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 204 | **0.0** | | 78.6 | 235.2 | 388.8 | 0.00 | | **126.6** | ULS 3_90 | 144.1 | 235.2 | 266.2 | 0.88 | |
| 104B | | 100x65x9* | S235 | 3M20-5.6t | 1.00 | 1.00 | 1.00 | 211 | **0.0** | | 74.7 | 176.4 | 291.6 | 0.00 | | **89.5** | ULS 3_45 | 172.4 | 176.4 | 199.6 | 0.52 | |
| 104C | | 100x65x9* | S235 | | 1.00 | 1.00 | 1.00 | 196 | **0.0** | | 82.7 | 0.0 | 0.0 | 0.00 | | **112.8** | ULS 3_90 | 332.5 | 0.0 | 0.0 | 0.34 | |
| 105A | | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 2.43 | 1.00 | 379 | **0.0** | | 14.1 | 117.6 | 129.6 | 0.00 | | **42.1** | ULS 6a_90 Ba Ct1 | 103.7 | 117.6 | 62.1 | 0.68 | |
| 105B | | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.70 | 1.00 | 379 | **0.0** | | 14.1 | 117.6 | 129.6 | 0.00 | | **42.1** | ULS 6a_90 Ba Ct1 | 64.3 | 117.6 | 46.6 | 0.90 | |
| 103A | | 120x120x11 | S235 | 6M24-5.6t | 4.00 | 2.64 | 1.00 | 77 | **-139.6** | ULS 5a Ba 12 | 458.3 | 508.3 | 855.4 | 0.30 | | **38.8** | ULS 5a Ba 22 | 513.2 | 508.3 | 731.1 | 0.08 | |
| 103B | | 120x120x11 | S235 | 2M16-5.6t | 1.00 | 1.88 | 1.00 | 7 | **-3.9** | ULS 1a_90 | 599.7 | 75.4 | 190.1 | 0.05 | | **3.9** | ULS 1a_90 | 429.4 | 75.4 | 190.1 | 0.05 | |
| 103C | | 120x120x11 | S235 | | 1.71 | 1.00 | 1.00 | 77 | **-106.0** | ULS 5a Ba 1 | 458.5 | 0.0 | 0.0 | 0.23 | | **17.4** | ULS 5a Ba 1 | 599.7 | 0.0 | 0.0 | 0.03 | |
| 102A | | 150x150x14 | S235 | 9M24-5.6t | 1.50 | 1.00 | 1.00 | 62 | **-311.1** | ULS 5a Ba 12 | 794.3 | 762.5 | 1633.0 | 0.41 | | **163.1** | ULS 5a Ba 22 | 851.7 | 762.5 | 990.9 | 0.21 | |
| 102B | | 150x150x14 | S235 | 6M24-5.6t | 2.52 | 1.61 | 1.00 | 63 | **-150.5** | ULS 5a Ba 12 | 786.3 | 508.3 | 1088.6 | 0.30 | | **27.7** | ULS 5a Ba 22 | 851.7 | 508.3 | 930.5 | 0.05 | |
| 102C | | 150x150x14 | S235 | | 2.00 | 3.01 | 1.00 | 59 | **-282.7** | ULS 5a Ba 12 | 804.7 | 0.0 | 0.0 | 0.35 | | **140.0** | ULS 5a Ba 22 | 943.3 | 0.0 | 0.0 | 0.15 | |
| 222L | | 120x80x8 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 120 | **-75.1** | ULS 5a Ba 10 | 165.1 | 117.6 | 172.8 | 0.64 | | **50.7** | ULS 5a Ba 21 | 144.6 | 117.6 | 136.1 | 0.43 | |
| 220L | | 130x65x10 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 154 | **-72.1** | ULS 5a Ba 10 | 144.6 | 117.6 | 216.0 | 0.61 | | **52.6** | ULS 5a Ba 21 | 138.9 | 117.6 | 170.1 | 0.45 | |
| 219L | | 100x75x9 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 148 | **-47.2** | ULS 5a Ba 21 | 120.4 | 117.6 | 194.4 | 0.40 | | **46.4** | ULS 5a Ba 10 | 149.4 | 117.6 | 157.1 | 0.39 | |
| 218L | | 100x75x8 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 129 | **-52.8** | ULS 5a Ba 10 | 127.3 | 117.6 | 172.8 | 0.45 | | **52.5** | ULS 5a Ba 21 | 128.6 | 117.6 | 104.7 | 0.50 | |
| 217L | | 100x75x7 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 116 | **-61.3** | ULS 5a Ba 21 | 124.6 | 117.6 | 151.2 | 0.52 | | **61.1** | ULS 5a Ba 10 | 115.4 | 117.6 | 106.9 | 0.57 | |
| 216L | | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 104 | **-72.3** | ULS 5a Ba 10 | 137.9 | 169.4 | 181.4 | 0.52 | | **71.2** | ULS 5a Ba 21 | 100.4 | 169.4 | 101.5 | 0.71 | |
| 215L | | 100x75x7 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 88 | **-78.9** | ULS 5a Ba 21 | 157.4 | 169.4 | 181.4 | 0.50 | | **80.2** | ULS 5a Ba 10 | 98.2 | 169.4 | 101.5 | 0.82 | |
| 214L | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 79 | **-94.7** | ULS 5a Ba 10 | 192.8 | 169.4 | 207.4 | 0.56 | | **90.8** | ULS 5a Ba 21 | 125.9 | 169.4 | 116.0 | 0.78 | |
| 210L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-92.9** | ULS 5a Ba 12 | 177.9 | 169.4 | 207.4 | 0.55 | | **90.8** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.54 | |
| 208L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 103 | **-87.2** | ULS 5a Ba 12 | 190.8 | 169.4 | 207.4 | 0.51 | | **93.3** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.55 | |
| 207L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-104.3** | ULS 5a Ba 22 | 198.3 | 169.4 | 207.4 | 0.62 | | **97.6** | ULS 5a Ba 12 | 181.4 | 169.4 | 177.2 | 0.58 | |
| 206L | | 100x100x8 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-109.1** | ULS 5a Ba 12 | 207.7 | 169.4 | 207.4 | 0.64 | | **115.3** | ULS 5a Ba 22 | 181.4 | 169.4 | 177.2 | 0.68 | |
| 202L | | 70x70x7 | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 129 | **-26.6** | ULS 5a Ba 22 | 74.3 | 84.7 | 90.7 | 0.36 | | **20.4** | ULS 5a Ba 22 | 88.7 | 84.7 | 64.2 | 0.32 | |
| 223T | | 120x80x8 | S235 | 2M20-5.6t | 0.33 | 0.20 | 0.20 | 120 | **-90.4** | ULS 1a_90 | 165.1 | 117.6 | 172.8 | 0.77 | | **66.5** | ULS 1a_0,9_0,9_90 | 144.6 | 117.6 | 136.1 | 0.57 | |
| 221T | | 130x65x10 | S235 | 2M20-5.6t | 1.00 | 0.33 | 0.33 | 154 | **-88.3** | ULS 1a_90 | 144.6 | 117.6 | 216.0 | 0.75 | | **69.3** | ULS 1a_0,9_0,9_90 | 138.9 | 117.6 | 170.1 | 0.59 | |
| 220T | | 100x75x9 | S235 | 2M20-5.6t | 0.53 | 0.27 | 0.27 | 139 | **-51.2** | ULS 5a Ba 21 | 131.0 | 117.6 | 194.4 | 0.44 | | **50.4** | ULS 5a Ba 10 | 135.9 | 117.6 | 117.8 | 0.43 | |
| 219T | | 100x75x9 | S235 | 2M20-5.6t | 0.53 | 0.27 | 0.27 | 127 | **-58.6** | ULS 5a Ba 10 | 143.7 | 117.6 | 194.4 | 0.50 | | **58.8** | ULS 5a Ba 21 | 141.0 | 117.6 | 117.8 | 0.50 | |
| 218T | | 100x75x9 | S235 | 2M20-5.6t | 0.54 | 0.27 | 0.27 | 120 | **-71.3** | ULS 5a Ba 21 | 151.3 | 117.6 | 194.4 | 0.61 | | **69.9** | ULS 5a Ba 10 | 146.1 | 117.6 | 137.5 | 0.59 | |
| 217T | | 100x75x9 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 105 | **-80.6** | ULS 5a Ba 10 | 171.3 | 169.4 | 233.3 | 0.48 | | **81.4** | ULS 5a Ba 21 | 124.1 | 169.4 | 130.6 | 0.66 | |
| 216T | | 100x75x8 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 89 | **-89.9** | ULS 5a Ba 21 | 177.8 | 169.4 | 207.4 | 0.53 | | **88.0** | ULS 5a Ba 10 | 110.7 | 169.4 | 116.0 | 0.79 | |
| 215T | | 100x75x9 | S235 | 2M24-5.6t | 0.54 | 0.27 | 0.27 | 75 | **-94.4** | ULS 5a Ba 10 | 219.1 | 169.4 | 233.3 | 0.56 | | **96.3** | ULS 5a Ba 10 | 119.9 | 169.4 | 130.6 | 0.80 | |
| 214T | | 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 | | **97.3** | ULS 5a Ba 10 | 121.3 | 169.4 | 130.6 | 0.80 | |
| 210T | | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-99.8** | ULS 5a Ba 12 | 219.3 | 169.4 | 259.2 | 0.59 | | **81.1** | ULS 5a Ba 22 | 224.3 | 169.4 | 221.5 | 0.48 | |
| 208T | | 100x100x10 | S235 | 2M24-5.6t | 0.52 | 0.52 | 0.52 | 104 | **-98.6** | ULS 5a Ba 12 | 235.3 | 169.4 | 259.2 | 0.58 | | **98.2** | ULS 5a Ba 22 | 224.3 | 169.4 | 221.5 | 0.58 | |
| 207T | | 100x100x10 | S235 | 3M24-5.6t | 0.52 | 0.52 | 0.52 | 99 | **-110.1** | ULS 5a Ba 22 | 244.6 | 254.2 | 388.8 | 0.45 | | **109.9** | ULS 5a Ba 12 | 261.1 | 254.2 | 332.3 | 0.43 | |
| 206T | | 100x100x10 | S235 | 3M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-122.4** | ULS 5a Ba 12 | 256.2 | 254.2 | 388.8 | 0.48 | | **122.5** | ULS 5a Ba 22 | 261.1 | 254.2 | 332.3 | 0.48 | |
| 202T | | 50x50x5 | S235 | 1M16-5.6t | 0.53 | 0.53 | 0.53 | 181 | **-11.3** | ULS 5a Ba 22 | 25.1 | 37.7 | 43.2 | 0.45 | | **5.3** | ULS 5a Ba 22 | 37.4 | 37.7 | 22.0 | 0.24 | |
| 221L | | 90x90x9 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 230 | **-3.8** | ULS 1a_90 | 64.4 | 37.7 | 77.8 | 0.10 | | **1.1** | ULS 1a_0,9_0,9_135 | 186.6 | 37.7 | 57.6 | 0.03 | |
| 222T | | 90x90x9 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 230 | **-3.4** | ULS 1a_45 | 64.4 | 37.7 | 77.8 | 0.09 | | **1.4** | ULS 1a_0,9_0,9_0 | 186.6 | 37.7 | 57.6 | 0.04 | |
| 223 | | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 270 | **-2.0** | ULS 1a_135 | 23.1 | 37.7 | 60.5 | 0.09 | | **2.9** | ULS 1a_0,9_0,9_45 | 104.8 | 37.7 | 44.8 | 0.08 | |
| 224 | | 70x70x7 | S235 | 1M16-5.6t | 1.00 | 0.50 | 0.50 | 382 | **-0.2** | ULS 1a_90 | 9.5 | 37.7 | 60.5 | 0.02 | | **0.0** | | 104.8 | 37.7 | 44.8 | 0.00 | |
| 108 | | 150x100x16 | S235 | 11M24-5.6t | 2.00 | 1.00 | 1.00 | 70 | **-254.1** | ULS 5a Ba 10 | 714.3 | 931.9 | 2281.0 | 0.36 | | **66.1** | ULS 5a Ba 10 | 767.8 | 931.9 | 1384.2 | 0.09 | |
| 213 | | 100x75x7 | S235 | 4M24-5.6t | 1.00 | 1.00 | 1.00 | 94 | **-42.7** | ULS 5a Ba 22 | 157.6 | 338.9 | 362.9 | 0.27 | | **69.1** | ULS 5a Ba 12 | 214.1 | 338.9 | 290.1 | 0.32 | |
| 211 | | 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 | |
| 212 | | 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 | |
| 209L | | 90x90x9 | S235 | 3M24-5.6t | 1.00 | 1.00 | 1.00 | 158 | **0.0** | | 120.2 | 254.2 | 349.9 | 0.00 | | **160.0** | ULS 3_0 | 216.8 | 254.2 | 269.2 | 0.74 | |
| 209T | | 70x70x7 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 204 | **-24.3** | ULS 1a_0,9_0,9_90 | 41.6 | 58.8 | 75.6 | 0.59 | | **32.9** | ULS 1a_90 | 96.8 | 58.8 | 61.1 | 0.56 | |
| 101 | | 150x100x12 | S235 | 9M24-5.6t | 2.00 | 1.00 | 1.00 | 51 | **-259.2** | ULS 5a Ba 22 | 601.1 | 762.5 | 1399.7 | 0.43 | | **85.1** | ULS 5a Ba 22 | 582.2 | 762.5 | 849.4 | 0.15 | |
| 205 | | 100x75x7 | S235 | 4M24-5.6t | 2.00 | 1.00 | 1.00 | 69 | **-48.9** | ULS 5a Ba 22 | 182.6 | 338.9 | 362.9 | 0.27 | | **64.9** | ULS 5a Ba 22 | 214.1 | 338.9 | 351.0 | 0.30 | |
| 203 | | 80x80x8 | S235 | 2M24-5.6t | 1.00 | 1.00 | 1.00 | 99 | **-76.0** | ULS 5a Ba 12 | 156.9 | 169.4 | 207.4 | 0.48 | | **76.0** | ULS 5a Ba 12 | 206.0 | 169.4 | 159.5 | 0.48 | |
| 204 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 225 | **-0.4** | ULS 3_90 | 18.5 | 37.7 | 43.2 | 0.02 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |
| 201L | | 80x80x8 | S235 | 4M20-5.6t | 1.00 | 1.00 | 1.00 | 128 | **0.0** | | 122.6 | 235.2 | 345.6 | 0.00 | | **134.1** | ULS 3_90 | 168.3 | 235.2 | 244.4 | 0.80 | |
| 201T | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 206 | **-2.4** | ULS 6a_90 Ba Ct2 | 21.0 | 37.7 | 43.2 | 0.11 | | **0.1** | ULS 5a Ba 22 | 37.4 | 37.7 | 22.0 | 0.01 | |
| 312 | | 70x70x7 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 187 | **-15.4** | ULS 3_135 | 47.2 | 58.8 | 75.6 | 0.33 | | **0.0** | | 96.8 | 58.8 | 45.8 | 0.00 | |

DNV·GL

## Assessment of groups for initial mast (afkeur level)

Date 19-5-2020
Author TBR
Version 1.0

**KIJ-GT380**
**S+9**
**Mast 80**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 314 | | 65x65x7 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 161 | **-16.8** | ULS 3_45 | 53.1 | 58.8 | 75.6 | 0.32 | | **0.0** | | 76.6 | 58.8 | 38.8 | 0.00 | |
| 317 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 154 | **-3.1** | ULS 5a Ba 10 | 31.0 | 37.7 | 43.2 | 0.10 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 319 | | 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 | |
| 322 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 53 | **-1.2** | ULS 3_90 | 63.5 | 37.7 | 43.2 | 0.03 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 311 | | 60x60x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 332 | **0.0** | | 14.4 | 58.8 | 64.8 | 0.00 | | **18.7** | ULS 3_45 | 65.7 | 58.8 | 44.4 | 0.42 | |
| 313 | | 60x60x6 | S235 | 1M20-5.6t | 1.00 | 1.00 | 1.00 | 298 | **0.0** | | 17.2 | 58.8 | 64.8 | 0.00 | | **25.6** | ULS 3_135 | 65.7 | 58.8 | 44.4 | 0.58 | |
| 316 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 332 | **0.0** | | 12.6 | 75.4 | 86.4 | 0.00 | | **34.3** | ULS 3_90 | 52.4 | 75.4 | 44.1 | 0.78 | |
| 318 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 274 | **0.0** | | 13.7 | 37.7 | 43.2 | 0.00 | | **6.9** | ULS 5a Ba 10 | 37.4 | 37.7 | 22.0 | 0.31 | |
| 321 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 269 | **0.0** | | 14.1 | 37.7 | 43.2 | 0.00 | | **10.1** | ULS 3_45 | 37.4 | 37.7 | 22.0 | 0.46 | |
| 315 | | 45x45x5 | S235 | 1M12-5.6t | 0.52 | 0.52 | 0.52 | 180 | **-1.1** | ULS 1a_0 | 22.7 | 20.2 | 32.4 | 0.06 | | **1.0** | 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 | **-1.0** | ULS 1a_0 | 38.2 | 20.2 | 32.4 | 0.05 | | **0.9** | 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 | **-24.1** | ULS 5a Ba 20 | 66.6 | 58.8 | 75.6 | 0.41 | | **22.3** | ULS 5a Ba 11 | 96.8 | 58.8 | 53.5 | 0.42 | |
| 301 | | 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 | | **29.7** | ULS 5a Ba 20 | 96.8 | 58.8 | 53.5 | 0.55 | |
| 302 | | 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 | | **30.3** | ULS 5a Ba 11 | 88.7 | 84.7 | 44.9 | 0.67 | |
| 304 | | 60x60x6 | S235 | 1M20-5.6t | 0.53 | 0.53 | 0.53 | 104 | **-18.1** | ULS 5a Ba 21 | 67.8 | 58.8 | 64.8 | 0.31 | | **17.7** | ULS 5a Ba 21 | 65.7 | 58.8 | 44.4 | 0.40 | |
| 305 | | 60x60x6 | S235 | 1M20-5.6t | 0.54 | 0.54 | 0.54 | 112 | **-24.8** | ULS 5a Ba 10 | 63.0 | 58.8 | 64.8 | 0.42 | | **24.6** | ULS 5a Ba 10 | 65.7 | 58.8 | 44.4 | 0.55 | |
| 306 | | 75x50x7 | S235 | 1M24-5.6t | 0.55 | 0.55 | 0.55 | 113 | **-29.7** | ULS 5a Ba 10 | 73.4 | 84.7 | 90.7 | 0.40 | | **30.1** | ULS 5a Ba 10 | 98.8 | 84.7 | 58.0 | 0.52 | |
| 307 | | 75x50x7 | S235 | 1M24-5.6t | 0.54 | 0.54 | 0.54 | 87 | **-37.5** | ULS 5a Ba 21 | 86.9 | 84.7 | 90.7 | 0.44 | | **36.2** | ULS 5a Ba 21 | 98.8 | 84.7 | 58.0 | 0.62 | |
| 303 | | HEB160 | S235 | | 2.00 | 2.00 | 2.00 | 50 | **-26.0** | ULS 5a Ba 20 | 918.5 | 0.0 | 0.0 | 0.03 | | **25.3** | ULS 5a Ba 11 | 1276.1 | 0.0 | 0.0 | 0.02 | |
| 308 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 27 | **-0.6** | 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 | **-26.6** | 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 | |
| 415 | | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 198 | **-9.1** | ULS 3_0 | 27.7 | 37.7 | 51.8 | 0.33 | | **0.0** | | 55.3 | 37.7 | 28.0 | 0.00 | |
| 417 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 170 | **-10.1** | ULS 3_0 | 27.4 | 37.7 | 43.2 | 0.37 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 419 | | 75x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 107 | **-12.3** | ULS 3_45 | 55.1 | 37.7 | 43.2 | 0.33 | | **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 5a Ba 12 | 58.8 | 37.7 | 43.2 | 0.01 | | **0.0** | | 37.4 | 37.7 | 18.4 | 0.00 | |
| 414 | | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 359 | **0.0** | | 11.0 | 37.7 | 51.8 | 0.00 | | **14.4** | ULS 3_0 | 55.3 | 37.7 | 33.6 | 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 | | **17.7** | ULS 3_0 | 37.4 | 37.7 | 22.0 | 0.80 | |
| 418 | | 50x50x5 | S235 | 2M16-5.6t | 1.00 | 1.00 | 1.00 | 344 | **0.0** | | 11.9 | 75.4 | 86.4 | 0.00 | | **27.3** | ULS 3_0 | 56.2 | 75.4 | 44.1 | 0.62 | |
| 421 | | 60x60x6 | S235 | 2M20-5.6t | 1.00 | 1.00 | 1.00 | 259 | **0.0** | | 26.8 | 117.6 | 129.6 | 0.00 | | **52.5** | ULS 3_90 | 77.4 | 117.6 | 88.7 | 0.68 | |
| 420 | | 45x45x5 | S235 | 1M12-5.6t | 0.52 | 0.52 | 0.52 | 112 | **-1.2** | ULS 1a_0,9_0,9_0 | 39.4 | 20.2 | 32.4 | 0.06 | | **1.1** | ULS 1a_0,9_0,9_0 | 37.4 | 20.2 | 23.7 | 0.06 | |
| 400 | | 60x60x6 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 124 | **-21.2** | ULS 5a Ba 22 | 57.2 | 58.8 | 64.8 | 0.37 | | **19.5** | ULS 5a Ba 12 | 65.7 | 58.8 | 44.4 | 0.44 | |
| 401 | | 60x60x6 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 119 | **-23.2** | ULS 5a Ba 12 | 59.6 | 58.8 | 64.8 | 0.39 | | **24.1** | ULS 5a Ba 22 | 65.7 | 58.8 | 44.4 | 0.54 | |
| 402 | | 60x60x6 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 114 | **-26.3** | ULS 5a Ba 22 | 61.9 | 58.8 | 64.8 | 0.45 | | **25.8** | ULS 5a Ba 12 | 65.7 | 58.8 | 44.4 | 0.58 | |
| 403 | | 60x60x6 | S235 | 1M20-5.6t | 0.52 | 0.52 | 0.52 | 108 | **-29.3** | ULS 5a Ba 12 | 65.0 | 58.8 | 64.8 | 0.50 | | **28.7** | ULS 5a Ba 22 | 65.7 | 58.8 | 44.4 | 0.65 | |
| 404 | | 70x70x7 | S235 | 1M24-5.6t | 0.52 | 0.52 | 0.52 | 93 | **-32.3** | ULS 5a Ba 22 | 101.1 | 84.7 | 90.7 | 0.38 | | **34.2** | ULS 5a Ba 12 | 88.7 | 84.7 | 51.3 | 0.67 | |
| 405 | | 75x50x7 | S235 | 1M24-5.6t | 0.53 | 0.53 | 0.53 | 108 | **-41.5** | ULS 5a Ba 12 | 76.0 | 84.7 | 90.7 | 0.55 | | **38.3** | ULS 5a Ba 22 | 98.8 | 84.7 | 58.0 | 0.66 | |
| 409 | | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 143 | **-5.5** | ULS 1a_135 | 42.3 | 37.7 | 51.8 | 0.14 | | **15.9** | ULS 5a Ba 1 | 63.9 | 37.7 | 38.4 | 0.42 | |
| 410 | | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 141 | **-16.4** | ULS 5a Ba 1 | 42.9 | 37.7 | 51.8 | 0.43 | | **4.7** | ULS 1a_135 | 63.9 | 37.7 | 38.4 | 0.12 | |
| 411 | | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 136 | **-3.7** | ULS 1a_135 | 44.8 | 37.7 | 51.8 | 0.10 | | **17.0** | ULS 5a Ba 1 | 63.9 | 37.7 | 38.4 | 0.45 | |
| 412 | | 55x55x6 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 141 | **-19.2** | ULS 5a Ba 1 | 43.1 | 37.7 | 51.8 | 0.51 | | **3.2** | ULS 1a_0,9_0,9_135 | 63.9 | 37.7 | 38.4 | 0.09 | |
| 406 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 34 | **-1.6** | ULS 1a_0,9_0,9_90 | 989.4 | 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 | 33 | **-26.4** | ULS 5a Ba 12 | 993.0 | 0.0 | 0.0 | 0.03 | | **25.1** | ULS 5a Ba 22 | 1276.1 | 0.0 | 0.0 | 0.02 | |
| 408 | | HEB160 | S235 | | 1.00 | 1.00 | 1.00 | 32 | **-6.9** | ULS 5a Ba 1 | 996.6 | 0.0 | 0.0 | 0.01 | | **4.0** | ULS 1a_135 | 1276.1 | 0.0 | 0.0 | 0.00 | |
| 413 | | HEB160 | S235 | 2M16-5.6t | 2.00 | 2.00 | 2.00 | 25 | **-1.5** | ULS 1a_135 | 1067.2 | 75.4 | 138.2 | 0.02 | | **14.2** | ULS 5a Ba 1 | 1296.6 | 75.4 | 66.6 | 0.21 | |
| 423 | | 50x50x5 | S235 | 1M16-5.6t | 1.00 | 1.00 | 1.00 | 188 | **0.0** | ULS 1a_90 | 23.9 | 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 | 170 | **0.0** | ULS 3_90 | 27.4 | 37.7 | 43.2 | 0.00 | | **0.0** | | 37.4 | 37.7 | 22.0 | 0.00 | |

# APPENDIX C REDUNDANT MEMBERS CHECK

DNV·GL

# Knikverkorters initial construction (afkeur)

Date: 2020-05-18
Author: Muhammed Khan
Version: 1.8

KIJ-GT
S+9
80

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 840 | Onderstuk | Single member | L45.5 | S235 | M12 | 5.6 | 0.73 | 0 | 83 | **11.6** | **0.18** | 49.3 | 20.2 | 25.7 | 51.8 | 0.57 | 0.57 | | |
| 3868 | Onderstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.87 | 77 | 215 | **11.6** | **0.00** | 17.7 | 20.2 | 25.7 | 51.8 | 0.57 | 0.65 | | |
| 3838 | Onderstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.54 | 0 | 177 | **11.6** | **0.38** | 23.3 | 20.2 | 25.7 | 51.8 | 0.57 | 0.67 | | |
| 846 | Onderstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.21 | 55 | 254 | **11.6** | **0.00** | 13.8 | 20.2 | 25.7 | 51.8 | 0.57 | 0.84 | | |
| 836 | Onderstuk | Single member | L50.5 | S235 | M12 | 5.6 | 2.30 | 0 | 236 | **11.6** | **0.58** | 17.2 | 20.2 | 25.7 | 66.2 | 0.72 | 0.80 | | |
| 845 | Onderstuk | Single member | L50.5 | S235 | M16 | 5.6 | 2.70 | 41 | 277 | **11.6** | **0.00** | 13.4 | 37.7 | 33.6 | 37.4 | 0.72 | 0.86 | | |
| 834 | Onderstuk | Single member | L60.6 | S235 | M16 | 5.6 | 3.11 | 0 | 266 | **11.6** | **0.78** | 20.6 | 37.7 | 44.8 | 72.6 | 1.24 | 0.63 | | |
| 844 | Onderstuk | Single member | L60.6 | S235 | M16 | 5.6 | 3.36 | 32 | 287 | **11.6** | **0.00** | 18.2 | 37.7 | 44.8 | 72.6 | 1.24 | 0.63 | | |
| 843 | Onderstuk | Single member | L60.6 | S235 | M16 | 5.6 | 3.30 | 32 | 282 | **11.6** | **0.00** | 18.8 | 37.7 | 44.8 | 72.6 | 1.24 | 0.62 | | |
| 831 | Onderstuk | Single member | L60.6 | S235 | M16 | 5.6 | 2.58 | 0 | 221 | **11.6** | **0.65** | 27.3 | 37.7 | 44.8 | 72.6 | 1.24 | 0.52 | | |
| 841 | Onderstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.35 | 51 | 270 | **11.6** | **0.00** | 12.5 | 20.2 | 25.7 | 51.8 | 0.57 | 0.92 | | |
| 829 | Onderstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.22 | 0 | 140 | **11.6** | **0.31** | 31.1 | 20.2 | 25.7 | 51.8 | 0.57 | 0.57 | | |
| 854 | Pootverband | Single member | L60.6 | S235 | M16 | 5.6 | 1.80 | 0 | 154 | **1.7** | **0.45** | 44.6 | 37.7 | 44.8 | 72.6 | 1.24 | 0.36 | | |
| 852 | Pootverband | Single member | L60.6 | S235 | M16 | 5.6 | 3.41 | 76 | 292 | **1.7** | **0.00** | 17.8 | 37.7 | 44.8 | 72.6 | 1.24 | 0.09 | | |
| 853 | Pootverband | Buckling and vertical support on 0.5L | L60.6 | S235 | M16 | 5.6 | 3.66 | 0 | 201 | **1.7** | **0.46** | 25.3 | 37.7 | 44.8 | 72.6 | 0.93 | 0.51 | | |
| 851 | Pootverband | Single member | L60.6 | S235 | M16 | 5.6 | 3.67 | 61 | 314 | **1.7** | **0.00** | 15.8 | 37.7 | 44.8 | 72.6 | 1.24 | 0.10 | | |
| 849 | Tussenschot | Buckling and vertical support on 0.5L | L70.7 | S235 | M16 | 5.6 | 5.56 | 0 | 262 | **0.6** | **0.70** | 24.1 | 37.7 | 52.3 | 125.0 | 1.48 | 0.49 | | |
| 848 | Tussenschot | Crossing member | L70.7 | S235 | M16 | 5.6 | 8.06 | 0 | 380 | **0.6** | **1.01** | 13.8 | 37.7 | 52.3 | 125.0 | 1.98 | 0.51 | | |
| 763 | 1e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.41 | 0 | 162 | **9.1** | **0.35** | 26.0 | 20.2 | 25.7 | 51.8 | 0.57 | 0.62 | | |
| 769 | 1e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.15 | 50 | 247 | **9.1** | **0.00** | 14.4 | 20.2 | 25.7 | 51.8 | 0.57 | 0.63 | | |
| 762 | 1e tussenstuk | Single member | L50.5 | S235 | M12 | 5.6 | 3.00 | 0 | 308 | **9.1** | **0.75** | 11.3 | 20.2 | 25.7 | 66.2 | 0.72 | 1.04 | Bending | |
| 768 | 1e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.04 | 41 | 234 | **9.1** | **0.00** | 15.6 | 20.2 | 25.7 | 51.8 | 0.57 | 0.58 | | |
| 767 | 1e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.97 | 44 | 226 | **9.1** | **0.00** | 16.4 | 20.2 | 25.7 | 51.8 | 0.57 | 0.55 | | |
| 761 | 1e tussenstuk | Single member | L50.5 | S235 | M12 | 5.6 | 3.03 | 0 | 312 | **9.1** | **0.76** | 11.1 | 20.2 | 25.7 | 66.2 | 0.72 | 1.06 | Bending | |
| 766 | 1e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.92 | 35 | 221 | **9.1** | **0.00** | 17.0 | 20.2 | 25.7 | 51.8 | 0.57 | 0.53 | | |
| 765 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.93 | 49 | 222 | **7.9** | **0.00** | 16.9 | 20.2 | 25.7 | 51.8 | 0.57 | 0.47 | | |
| 760 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.70 | 0 | 310 | **7.9** | **0.68** | 10.1 | 20.2 | 25.7 | 51.8 | 0.57 | 1.18 | Bending | |
| 764 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.83 | 40 | 210 | **7.9** | **0.00** | 18.3 | 20.2 | 25.7 | 51.8 | 0.57 | 0.43 | | |
| 50 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.24 | 0 | 142 | **7.9** | **0.31** | 30.5 | 20.2 | 25.7 | 51.8 | 0.57 | 0.54 | | |
| 47 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.83 | 49 | 210 | **7.9** | **0.00** | 18.3 | 20.2 | 25.7 | 51.8 | 0.57 | 0.43 | | |
| 49 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.64 | 0 | 303 | **7.9** | **0.66** | 10.4 | 20.2 | 25.7 | 51.8 | 0.57 | 1.15 | Bending | |
| 46 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.79 | 40 | 206 | **7.9** | **0.00** | 18.9 | 20.2 | 25.7 | 51.8 | 0.57 | 0.42 | | |
| 45 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.66 | 51 | 191 | **7.9** | **0.00** | 21.0 | 20.2 | 25.7 | 51.8 | 0.57 | 0.39 | | |
| 48 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.32 | 0 | 266 | **7.9** | **0.58** | 12.8 | 20.2 | 25.7 | 51.8 | 0.57 | 1.01 | Bending | |
| 44 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.60 | 41 | 184 | **7.9** | **0.00** | 22.1 | 20.2 | 25.7 | 51.8 | 0.57 | 0.39 | | |
| 56 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.71 | 51 | 196 | **7.9** | **0.00** | 20.1 | 20.2 | 25.7 | 51.8 | 0.57 | 0.39 | | |
| 59 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.37 | 0 | 272 | **7.9** | **0.59** | 12.4 | 20.2 | 25.7 | 51.8 | 0.57 | 1.04 | Bending | |
| 55 | 2e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.65 | 42 | 190 | **7.9** | **0.00** | 21.1 | 20.2 | 25.7 | 51.8 | 0.57 | 0.39 | | |
| 346 | 2e tussenstuk | Crossing member | L100.50.6 | S235 | M16 | 5.6 | 7.04 | 0 | 331 | **7.9** | **0.88** | 18.3 | 37.7 | 40.4 | 44.9 | 3.24 | 0.43 | | |
| 80 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.49 | 52 | 171 | **7.5** | **0.00** | 24.3 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 83 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.02 | 0 | 232 | **7.5** | **0.51** | 15.8 | 20.2 | 25.7 | 51.8 | 0.57 | 0.88 | | |
| 79 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.42 | 42 | 163 | **7.5** | **0.00** | 25.8 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 78 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.25 | 51 | 144 | **7.5** | **0.00** | 30.2 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 82 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.76 | 0 | 202 | **7.5** | **0.44** | 19.3 | 20.2 | 25.7 | 51.8 | 0.57 | 0.77 | | |
| 77 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.19 | 41 | 137 | **7.5** | **0.00** | 32.0 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 76 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.13 | 53 | 130 | **7.5** | **0.00** | 33.9 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 81 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.53 | 0 | 176 | **7.5** | **0.38** | 23.4 | 20.2 | 25.7 | 51.8 | 0.57 | 0.67 | | |
| 75 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.06 | 43 | 122 | **7.5** | **0.00** | 36.2 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 96 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.50 | 52 | 172 | **7.5** | **0.00** | 24.0 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 99 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 2.06 | 0 | 237 | **7.5** | **0.52** | 15.3 | 20.2 | 25.7 | 51.8 | 0.57 | 0.90 | | |
| 95 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.43 | 42 | 164 | **7.5** | **0.00** | 25.6 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 94 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.26 | 50 | 145 | **7.5** | **0.00** | 29.9 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 98 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.80 | 0 | 207 | **7.5** | **0.45** | 18.7 | 20.2 | 25.7 | 51.8 | 0.57 | 0.79 | | |
| 93 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.21 | 40 | 139 | **7.5** | **0.00** | 31.4 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 92 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.05 | 46 | 120 | **7.5** | **0.00** | 36.8 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 97 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.60 | 0 | 183 | **7.5** | **0.40** | 22.1 | 20.2 | 25.7 | 51.8 | 0.57 | 0.70 | | |
| 91 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 1.01 | 37 | 116 | **7.5** | **0.00** | 38.0 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |
| 90 | 3e tussenstuk | Single member | L45.5 | S235 | M12 | 5.6 | 0.96 | 42 | 110 | **7.5** | **0.00** | 39.9 | 20.2 | 25.7 | 51.8 | 0.57 | 0.37 | | |

DNV·GL

**Knikverkorters adjusted construction (verbouw)**

Date: 2020-05-18
Author: Muhammed Khan
Version: 1.8

KIJ-GT

S+9

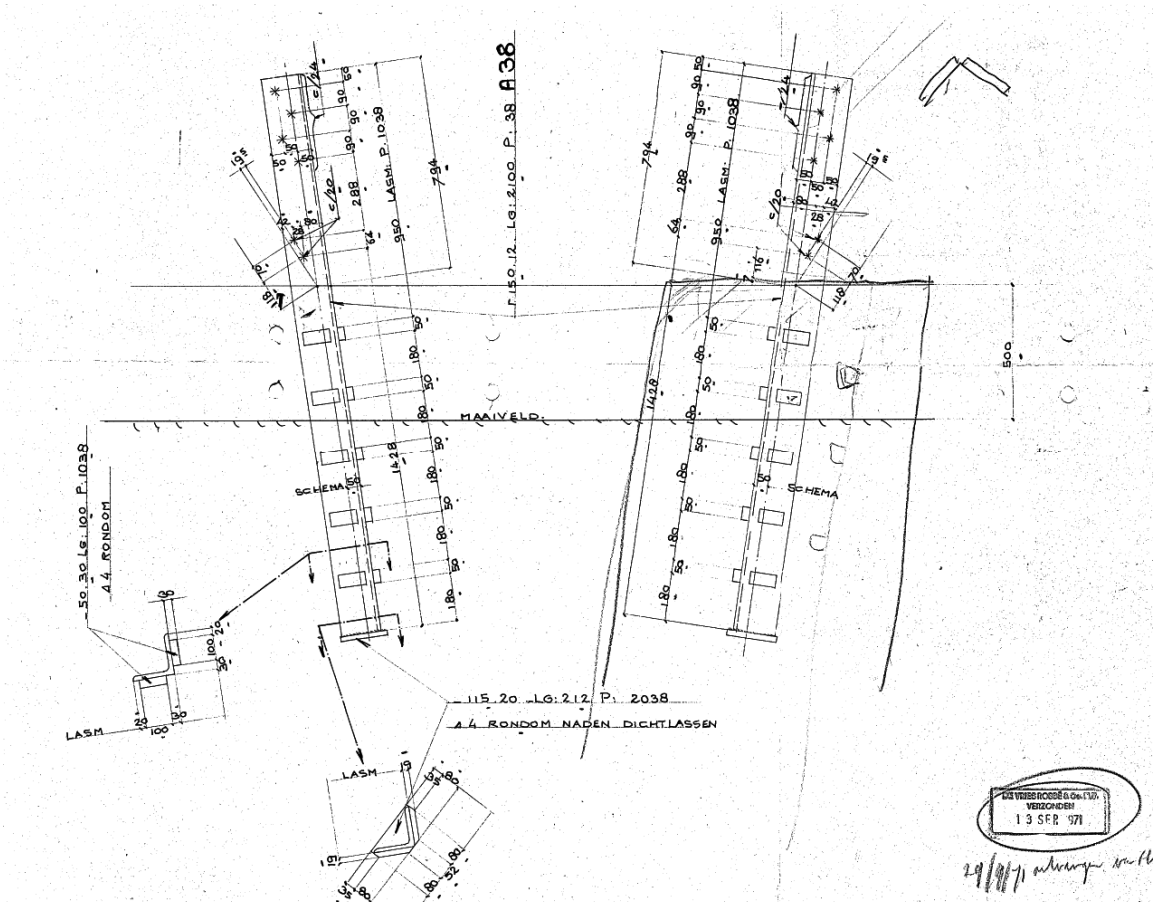
80

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 762 | 1e tussenstuk | Single member | **L65.6** | **S355** | M12 | **8.8** | 3.00 | 0 | 237 | **9.1** | **0.98** | 29.5 | 32.3 | 42.0 | 178.8 | 2.20 | 0.44 | | Profile exchanged |
| 761 | 1e tussenstuk | Single member | **L65.6** | **S355** | M12 | **8.8** | 3.03 | 0 | 239 | **9.1** | **0.99** | 29.0 | 32.3 | 42.0 | 178.8 | 2.20 | 0.45 | | Profile exchanged |
| 760 | 2e tussenstuk | Single member | **L60.6** | **S355** | M12 | **8.8** | 2.70 | 0 | 231 | **7.9** | **0.88** | 28.1 | 32.3 | 42.0 | 155.2 | 1.88 | 0.47 | | Profile exchanged |
| 49 | 2e tussenstuk | Single member | **L55.6** | **S355** | M12 | **8.8** | 2.64 | 0 | 246 | **7.9** | **0.86** | 23.1 | 32.3 | 42.0 | 131.7 | 1.56 | 0.55 | | Profile exchanged |
| 48 | 2e tussenstuk | Single member | **L50.5** | **S355** | M12 | **8.8** | 2.32 | 0 | 238 | **7.9** | **0.75** | 18.6 | 32.3 | 35.0 | 90.2 | 1.08 | 0.70 | | Profile exchanged |
| 59 | 2e tussenstuk | Single member | **L50.5** | **S355** | M12 | **8.8** | 2.37 | 0 | 244 | **7.9** | **0.77** | 18.0 | 32.3 | 35.0 | 90.2 | 1.08 | 0.71 | | Profile exchanged |

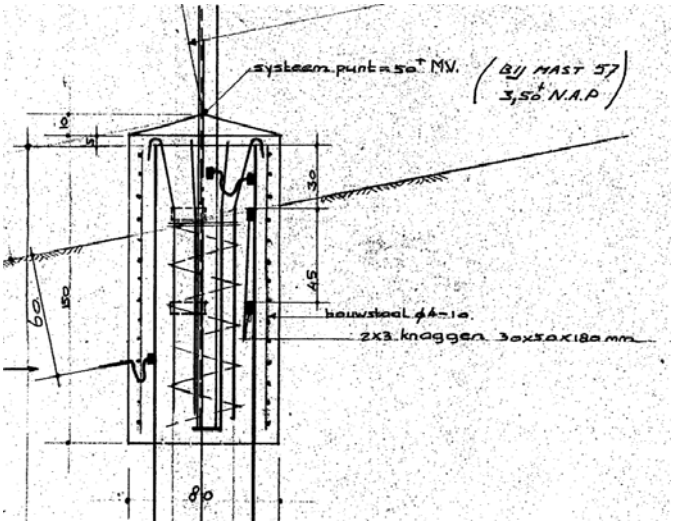
# APPENDIX D CHECK SHEAR BLOCKS

## SHEAR BLOCKS S+9

The stub of the tower leg is connected with shear blocks, the concrete plug is connected with shear blocks inside the pile. There are no dedicated drawings for S+9. The number and dimensions of the blocks of S+0 are used.




**Figuur 1 The inserted stub with shear blocks**




**Figuur 2 Pile with shear blocks**

## Loads

The loads coming from the tower are based on S+9 structure number 80 in wind zone III:

**Envelope of load combinations for all of the legs**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. pressure | ULS 1a_45 | 140 | 126 | **744** | 10 | -188 | -36 | 759 |
| Max. tension | ULS 1a_0,9_0,9_45 | 99 | 84 | **-540** | -10 | 129 | 20 | -551 |
| Max. pos. torsie | ULS 5a Ba 21 | -28 | 18 | 11 | **33** | -7 | -5 | 11 |
| Max. neg. torsie | ULS 5a Ba 10 | -28 | -18 | 11 | **-33** | -7 | -5 | 11 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_45 | 99 | 84 | **-540** | **-10** | 129 | 20 | -551 |

In the spreadsheet the shear blocks 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 cylinder tests.

See output of spreadsheet: the connection is OK.

Project: KIJ-GT380
Mast: S+9

# 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 | $F_{Ed,druk}$ | 746 | kN | Compression | U.C. | 0,85 | < 1,00 OK |
| Tension | $F_{Ed,trek}$ | 542 | kN | Tension | U.C. | 0,91 | < 1,00 OK |

### *Hoekstijl*

| | | | |
|---|---|---|---|
| Profile | | **L180.16** | |
| Steel material | | S235 | |
| Cross section | | 5540 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 1302 | kN |
| Width | b | 180 | mm |
| Thickness | t | 16 | mm |
| Length in concrete | | 1350 | 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 | $\gamma_c$ | 1,5 | |
| Add. mat. factor | $\gamma_m$ | 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 | |
| $A_{p,trek}$ = | 12862 | $mm^2$ |
| $F_{Rd} = A_{p,trek} \times f_{jd}$ = | 238 | kN |
| Welds foot plate | 572 | kN |
| $A_{p,druk}$ = | 18402 | $mm^2$ |
| $F_{Rd} = A_{p,druk} \times f_{jd}$ = | 340 | 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 | | 1098 | mm |
| Splitting force | | 247 | 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*

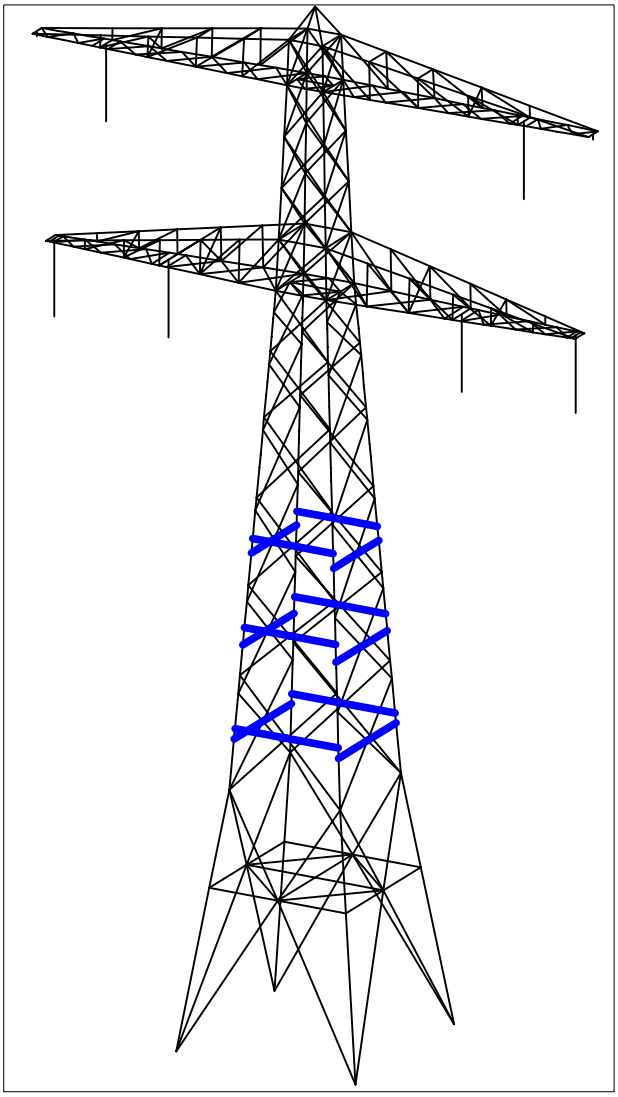
| | | |
|---|---|---|
| Main leg for tension | 777 | kN |
| Tubular pile for tension | 599 | kN |
| Main leg for compression | 879 | kN |
| Tubular pile for compression | 939 | kN |

### *Check of welds*

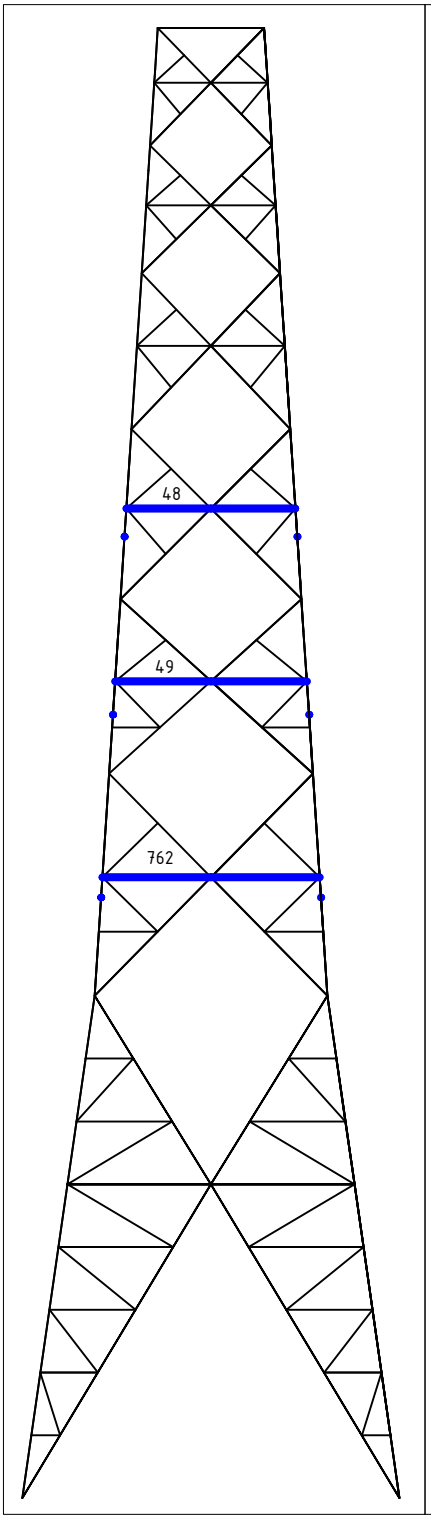
| | | |
|---|---|---|
| Shear block main leg | 0,33 | < 1,00 OK |
| Shear block pile | 0,40 | < 1,00 OK |

# APPENDIX E DRAWINGS

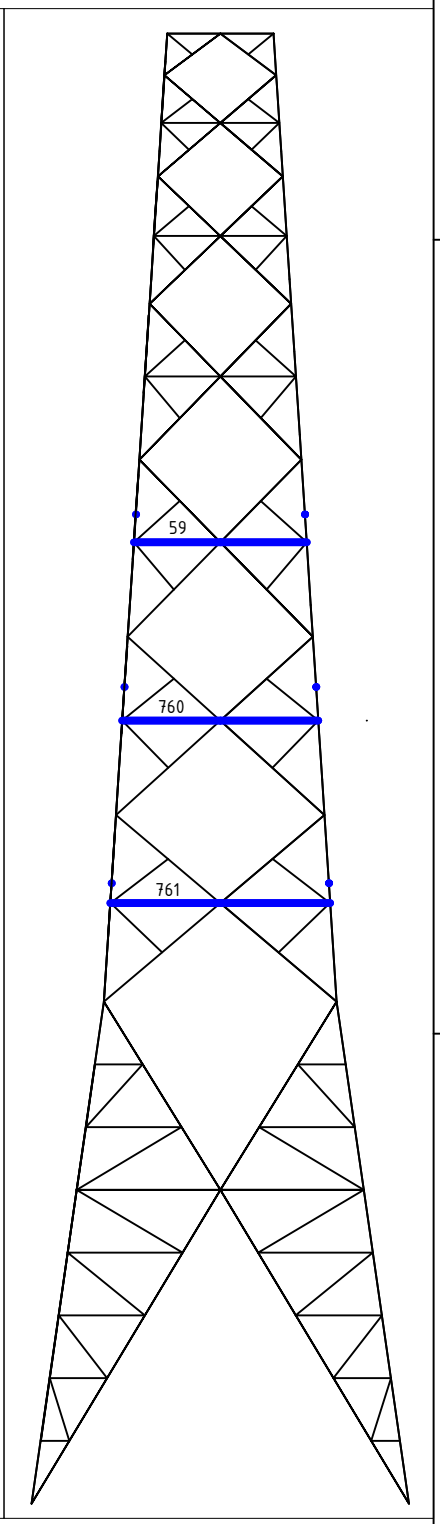
| Initial Profiles and Bolts | | | | | Final Profiles and Bolts | | | |
|---|---|---|---|---|---|---|---|---|
| Group label | Profile type (ini) | Profile size (ini) | Steel quality (ini) | Bolt size and quality (ini) | Profile type (new) | Profile size (new) | Steel quality (new) | Bolt size and quality (new) |
| 48 | EA | L45x5 | S235 t<=40 | M12-5.6t-NEN2012 | EA | L50x5 | S355 t<=40 | M12-8.8t-NEN2012 |
| 49 | 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 |
| 762 | EA | L50x5 | S235 t<=40 | M12-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M12-8.8t-NEN2012 |
| 761 | EA | L50x5 | S235 t<=40 | M12-5.6t-NEN2012 | EA | L65x6 | S355 t<=40 | M12-8.8t-NEN2012 |
| 760 | EA | L45x5 | S235 t<=40 | M12-5.6t-NEN2012 | EA | L60x6 | 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 | 19-5-2020 | Version 1.0 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-011

| | | | |
|---|---|---|---|
| Design state: FINAL | | Scale: - | |
| Drawn by: MuK | 25-11-2020 | Units: m | |
| Checked by: TBR | 25-11-2020 | Project no: 10166260 | |
| Approved by: JHu | 25-11-2020 | Company: TenneT | |

Description: Modifications overview for mast type S+9 (mast 80)

Revision: 01

Format: A2

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

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Bijlage 23 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<br>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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| 0 | 2021-07-05 | Eerste uitgave | [redacted] | [redacted] | [redacted] |

DNV GL Netherlands B.V.

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# 1 INLEIDING

## 1.1 Inleiding

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

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

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

Om te komen tot een DO waarmee de werkzaamheden kunnen worden gestart is door TenneT aan DNV 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.

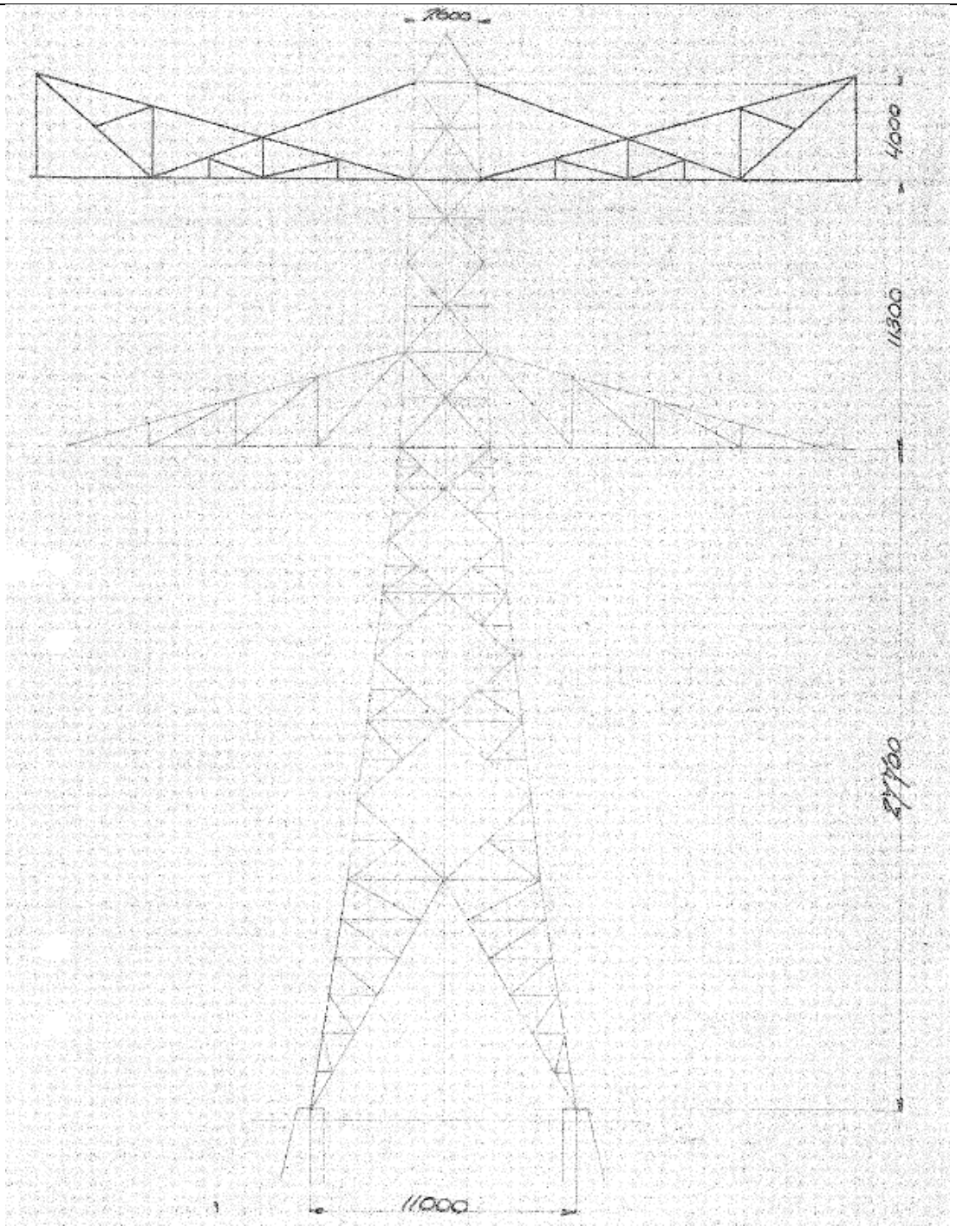
**Tabel 1 Relevante eisen**

| 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".<br><br>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<br>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:

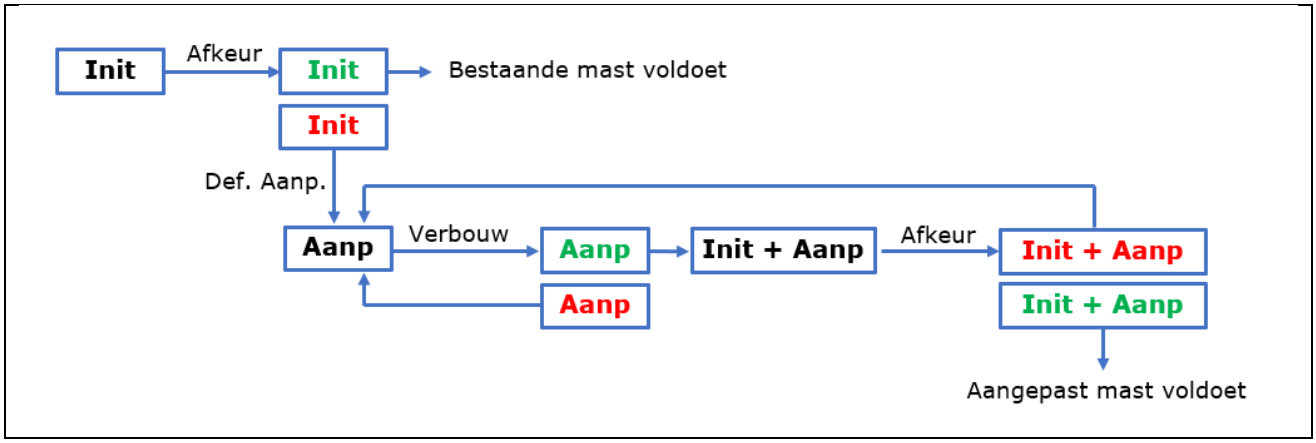
Stap 1: Toets bestaande (Init) mast op Afkeur

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

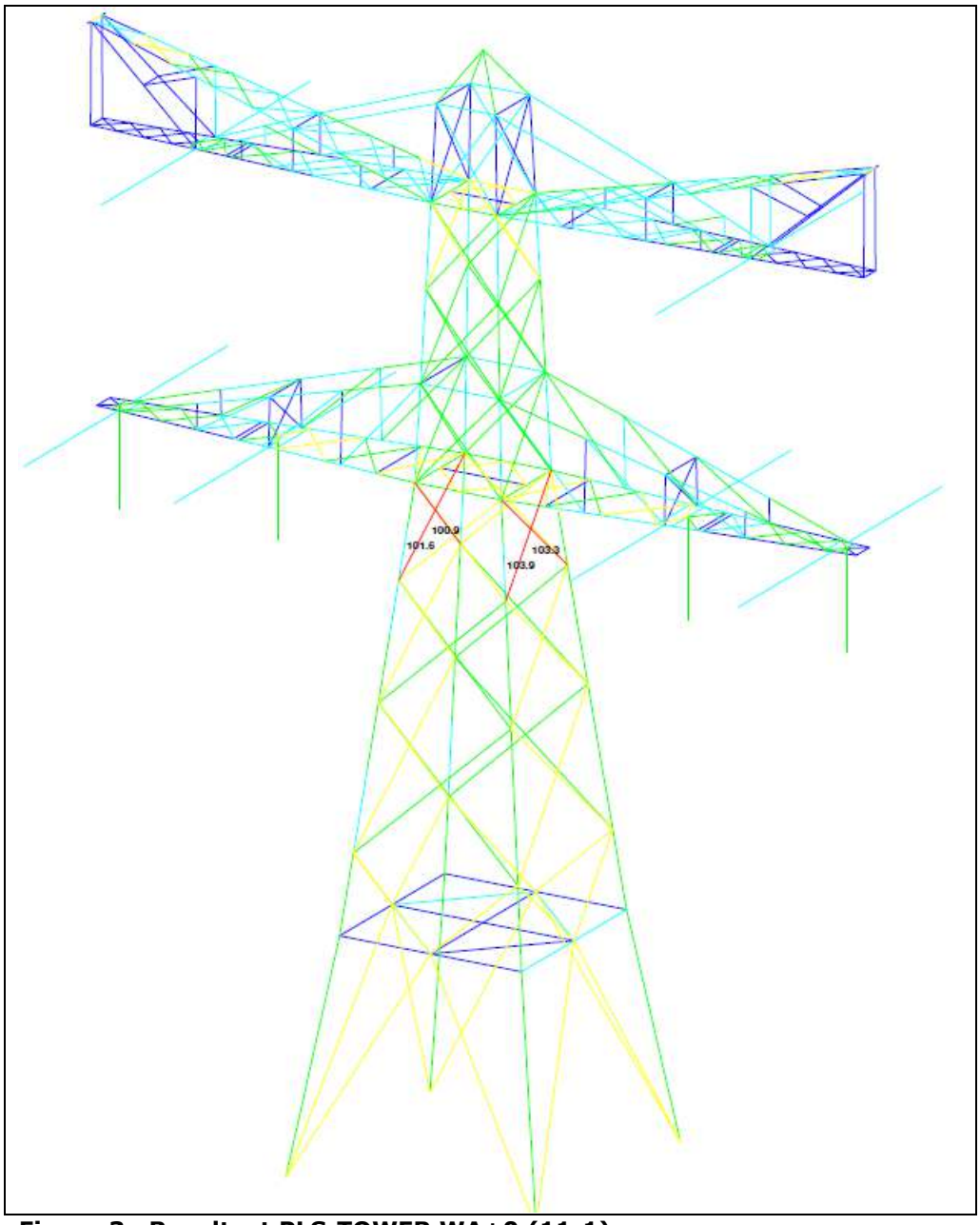
Op basis van de as-built tekeningen is de mast in PLS-TOWER ingevoerd. De hoofdelementen zijn gemodelleerd. Niet-dragende profielen als knikverkorters zijn weggelaten en worden separaat getoetst. De profielen inclusief de boutverbindingen zijn in PLS-TOWER ingevoerd en getoetst. Controle van de schetsplaten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

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

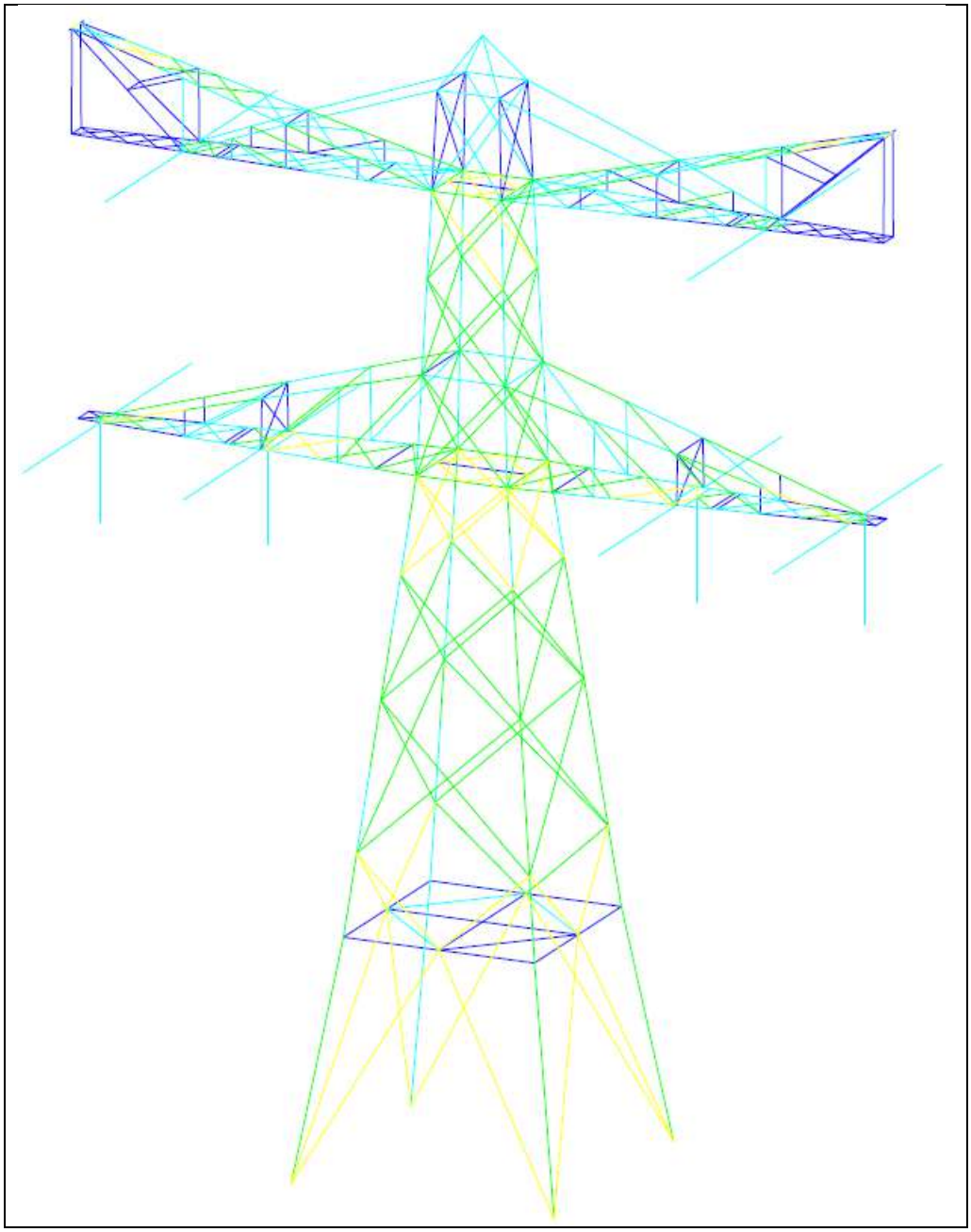
Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep en de toetsing wordt per staafgroep uitgevoerd. Ingeval dat een element uit een groep is overbelast, geldt dit voor alle elementen uit de betreffende groep.

# 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<br>Figuur 4 |
| Knikverkorters | Voldoen | | Appendix C |
| Ankers en voetplaat | Voldoen | | Appendix D |

# 5 AANPASSINGEN

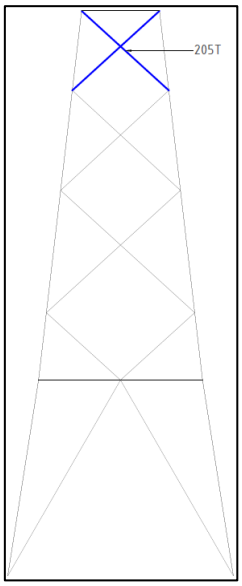
## 5.1 Inleiding

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).

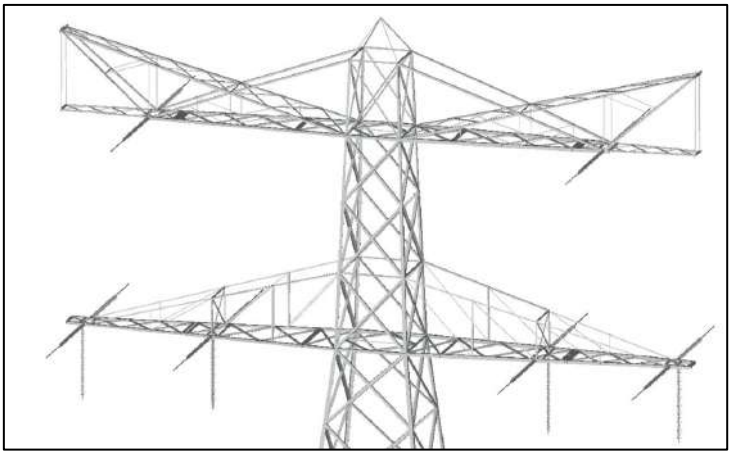
## 5.2 Aanpassingen

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.

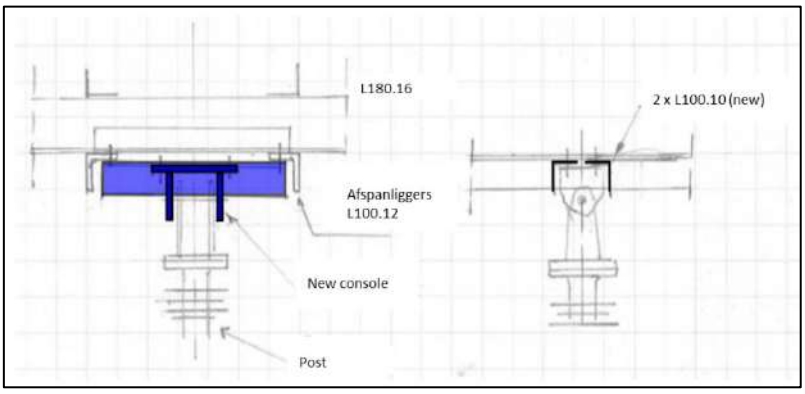



**Figuur 5 Zij-aanzicht tussenstuk met te vervangen kruisdiagonalen**

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


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | 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 |

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

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

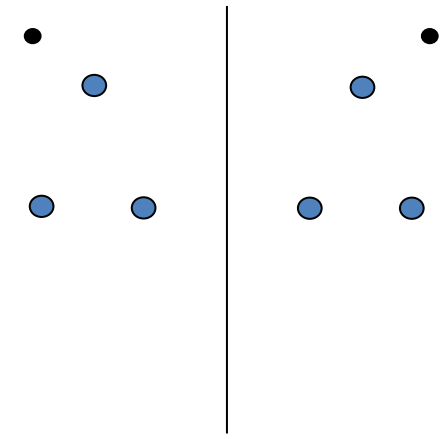
Auteur: TBR
Versie: v11.3

### General

| | |
|---|---|
| Description | WA+0 II |
| Tower type | Hoekmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |

### 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 |



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 | 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**

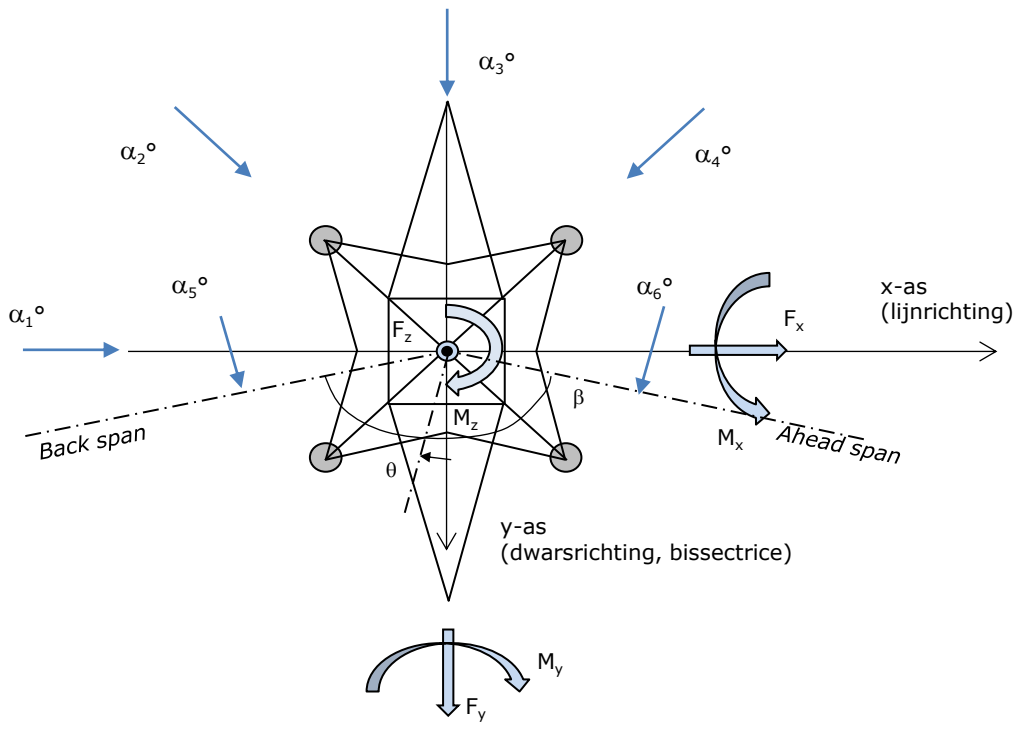
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | $\Delta$h_back | $\Delta$h_ahead | $\Delta$y_back | $\Delta$y_ahead |
| Circuit 1 | 10 | 380ct1f1 | 6,5 | 19,3 m | 0,0 | -1,8 m |
| Circuit 1 | 11 | 380ct1f2 | 6,5 | 19,3 m | 0,0 | -0,8 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 | $\beta$ | 180 | ° | |
| Tower orientation with respect to bis | $\theta$ | 0 | ° | |
| Section length | | 1107 | 2418 | m |
| Height bottom of tower to ground level | | 0,5 | m | |
| Wind directions considered | $\alpha_1$ | 0 | ° | |
| Wind directions according to: | $\alpha_2$ | 45 | ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | ° | |
| | $\alpha_4$ | 135 | ° | |
| | $\alpha_5$ | 75 | ° | |
| | $\alpha_6$ | 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

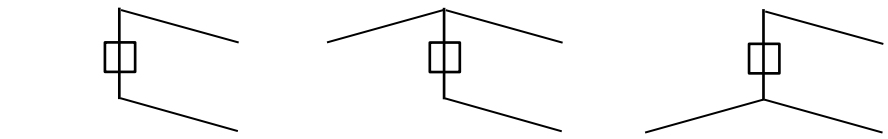
**Absence of conductors**

| | | 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 |

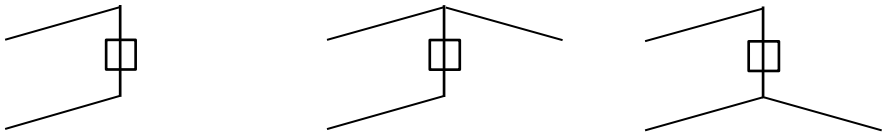
**Load situations SPLS**

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

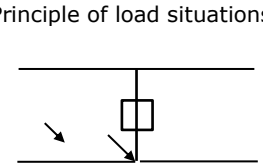
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

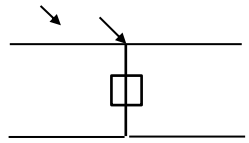
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

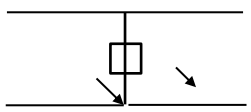
Principle of load situations:



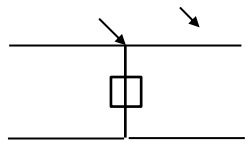
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

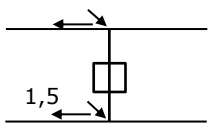
**Load situations 8. Galloping as a static load**

| 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 |

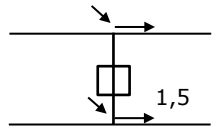
Considered situations galloping 8: None (existing structure)

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] | $\Delta h$ [m] | $\Delta_x$ [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] | $\Delta h$ [m] | $\Delta_x$ [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) | $\Delta$h | $A_1$ |
|---|---|---|---|
| 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 | 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 | $p_w$ [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 | 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 | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [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 |

Project: KIJ-GT
Tower: WA+0 II
Number: 11-1

**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
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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 |

Project: KIJ-GT
Tower: WA+0 II
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 °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,05 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk only tower | 10° | 0,90 | 1,05 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk conductors too | 10° | 0,90 | 0,90 | 0,00 | 1,12 | 0,00 | 0,0 |
| ULS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 3_0,9 | Wind+ice 0,9Gk | -5° | 0,90 | 1,05 | 0,00 | 0,34 | 0,97 | 0,0 |
| ULS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 4_0,9 | Cold+wind 0,9Gk | -20° | 0,90 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 5a | Torsional loads | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinal loads | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Construction + maintenance | 5° | 1,05 | 1,05 | 1,20 | 0,22 | 0,00 | 0,0 |
| ULS 6_0,9 | Construction + maintenance | 5° | 1,05 | 1,05 | 0,00 | 0,22 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,15 | 1,15 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (strength, for angle towers: absence of conductors) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,05 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,05 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,05 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,05 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,05 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,05 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,05 | 1,05 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,05 | 1,05 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,94 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,28 | 0,88 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,19 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Number of wind directions | 6 |
| Number of load combinations for ULS | 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 | -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**

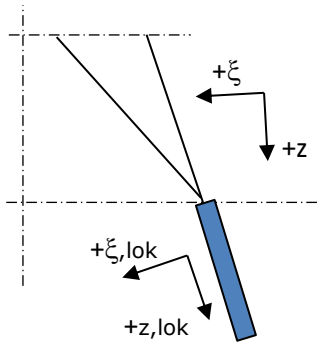
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 47 | 367 | 463 | 10246 | 1491 | 6 |
| ULS 1a_0,9_0,9_90 | 45 | 367 | 390 | 10246 | 1441 | 6 |
| SLS 7 | 0 | 0 | 467 | 0 | 0 | 0 |

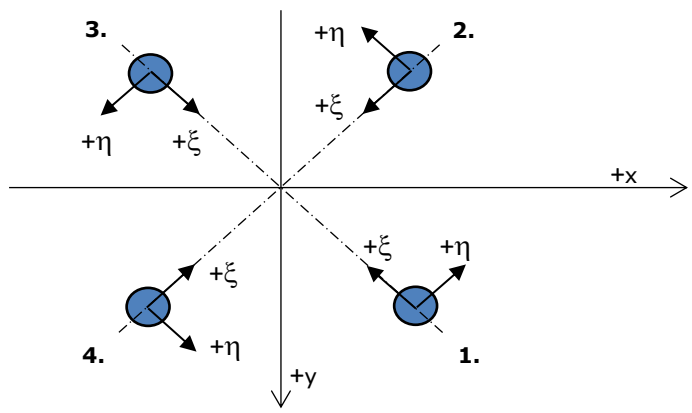
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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 |

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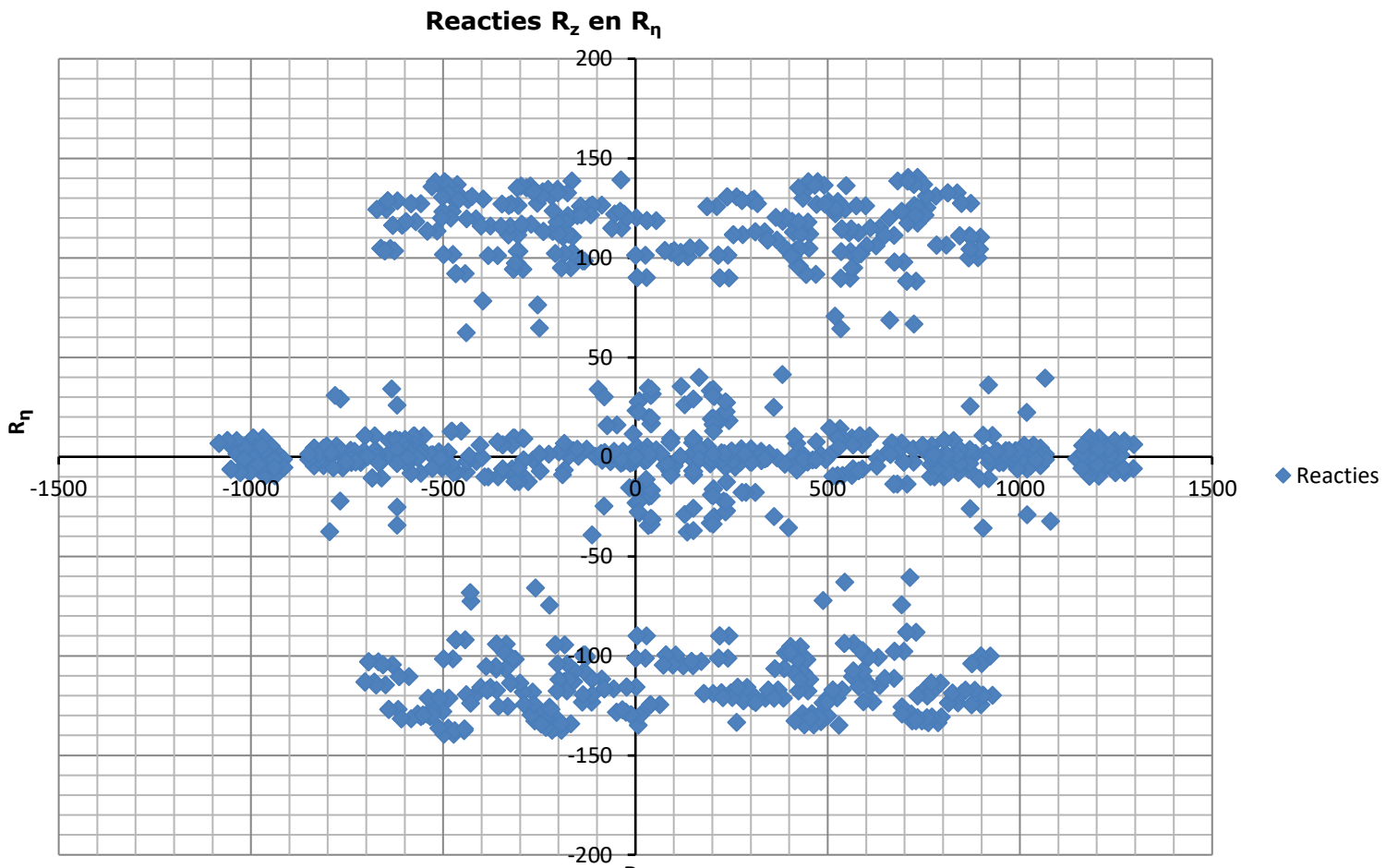

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**Conductor loads**

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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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 |

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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 | -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 - |

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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 | 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
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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**

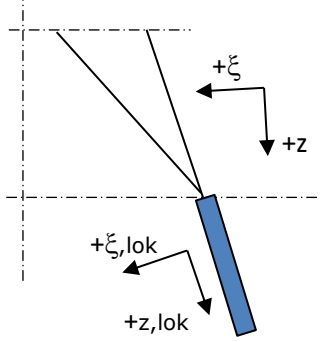
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 66 | 457 | 501 | 12761 | 2120 | 7 |
| ULS 1a_0,9_0,9_90 | 64 | 457 | 379 | 12761 | 2036 | 7 |
| SLS 7 | 0 | 0 | 467 | 0 | 0 | 0 |

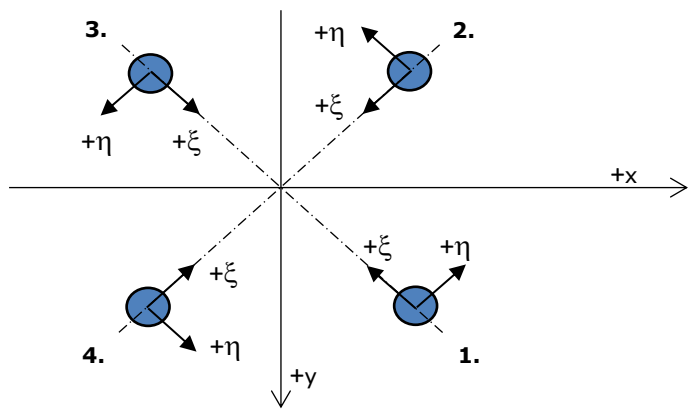
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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
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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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
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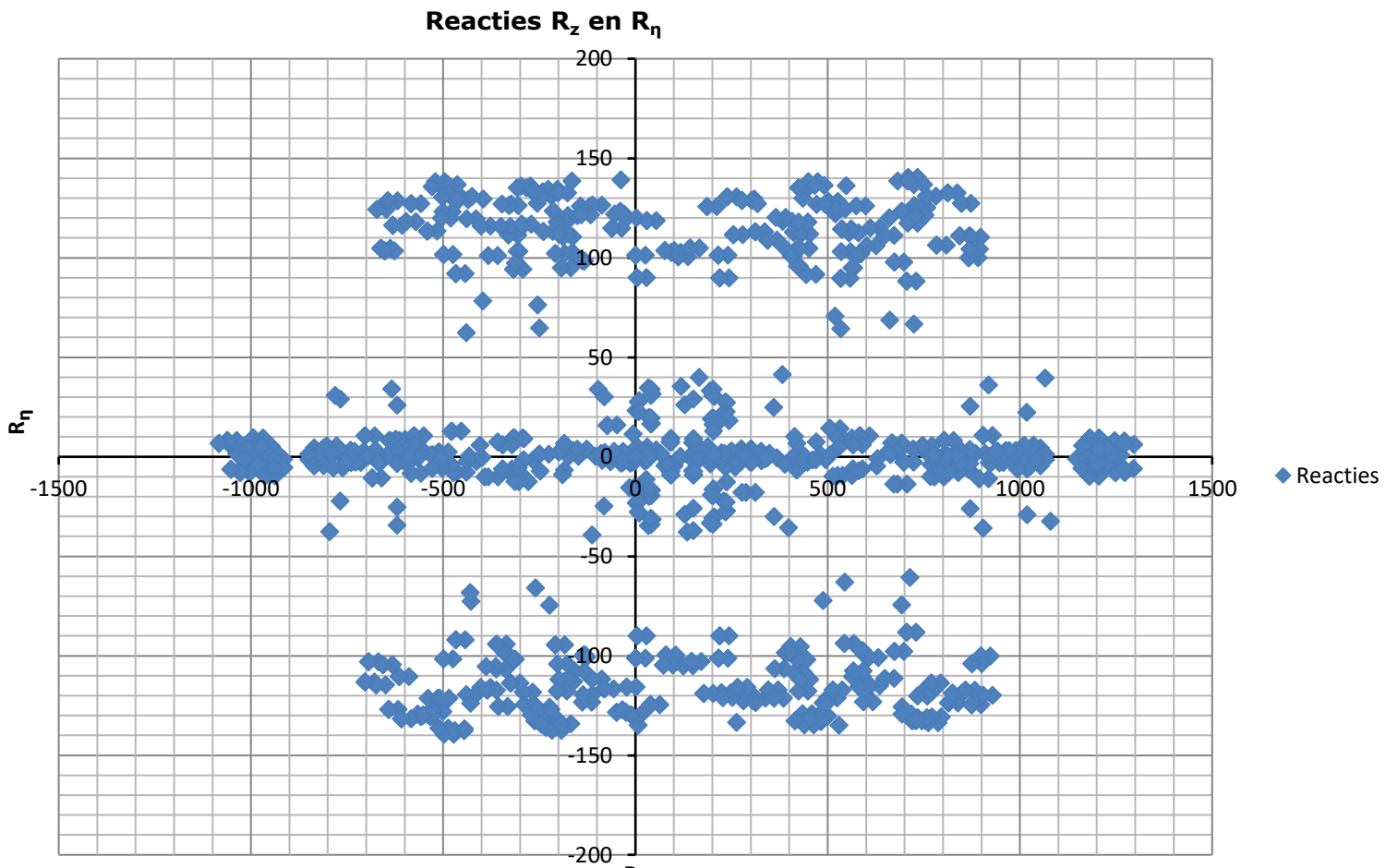


## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24,5 m/s |
| Terrain categorie | II |
| Reduction factor $C_{dir}$ | 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

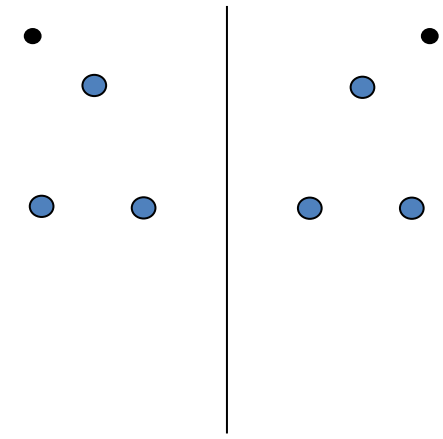
Auteur: TBR
Versie: v11.3

### General

| | |
|---|---|
| Description | WA+0 |
| Tower type | Hoekmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |

### 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 | 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**

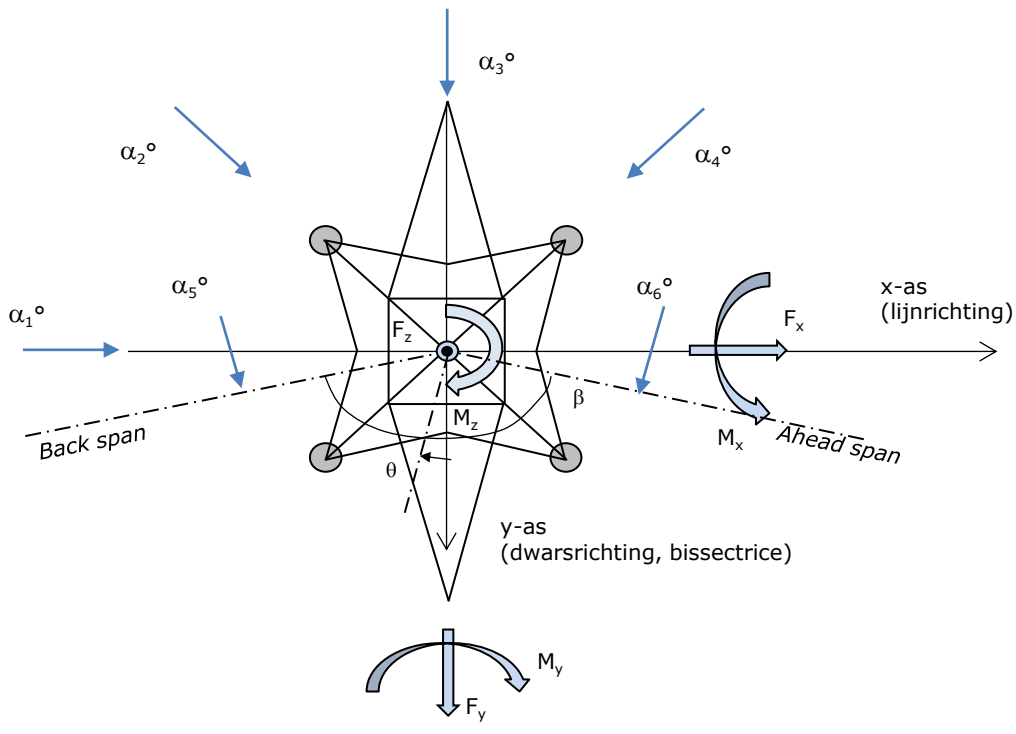
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 18,4 | 0,4 m | -1,8 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 18,4 | 0,4 m | -0,8 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3 | 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 | $\beta$ | 180 | | ° |
| Tower orientation with respect to bis | $\theta$ | 0 | | ° |
| Section length | | 2580 | 3064 | m |
| Height bottom of tower to ground level | | 0,5 | | m |
| Wind directions considered | $\alpha_1$ | 0 | | ° |
| Wind directions according to: | $\alpha_2$ | 45 | | ° |
| *Geleiderbelastingen* | $\alpha_3$ | 90 | | ° |
| | $\alpha_4$ | 135 | | ° |
| | $\alpha_5$ | 75 | | ° |
| | $\alpha_6$ | 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

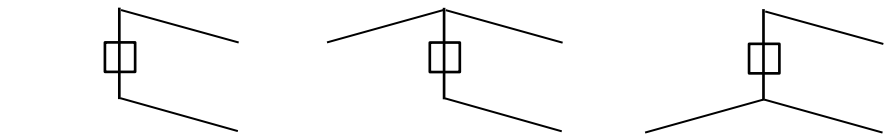
**Absence of conductors**

| | | 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 |

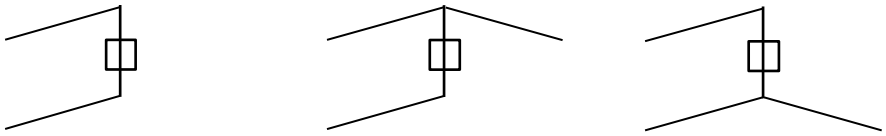
**Load situations SPLS**

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

Project: KIJ-GT
Tower: WA+0
Number: 61

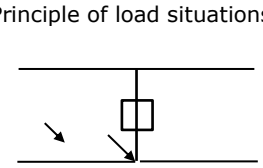
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

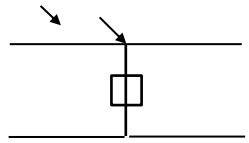
Considered situations construction and maintenance 6a: 1 up to 4, all possible situations

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

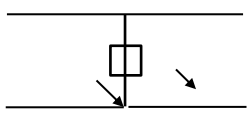
Principle of load situations:



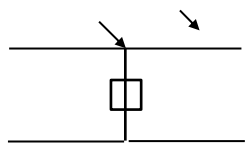
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

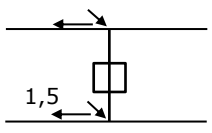
**Load situations 8. Galloping as a static load**

| 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 |

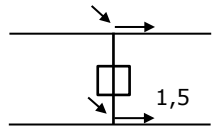
Considered situations galloping 8: None (existing structure)

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] | $\Delta h$ [m] | $\Delta_x$ [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] | $\Delta h$ [m] | $\Delta_x$ [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
Number: 61

**Wind surface feeders telecom installations**

| Part | A ($m^2$/m) | ∆h | $A_1$ |
|---|---|---|---|
| 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 | 0,70 | 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 | $p_w$ [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 | 0,70 | 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 | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [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
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**Intermediate results for conductor loads**

**Conductors back**

| Circuit | Geleider | Diameter [mm] | A [$mm^2$] | G [N/m] | E [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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 [$N/mm^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| 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
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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 | 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 | $\gamma_G$ | $\gamma_G$ | $\gamma_Q$ | | | $\gamma_a$ |
| | | °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) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| 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**

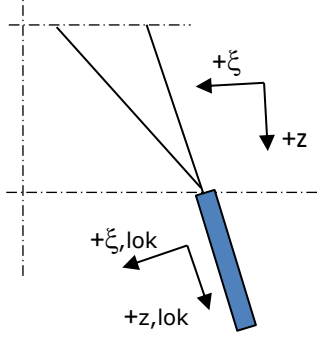
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -42 | 328 | 533 | 9320 | -1341 | -3 |
| ULS 1a_0,9_0,9_90 | -46 | 328 | 454 | 9320 | -1471 | -3 |
| SLS 7 | 0 | 0 | 516 | 0 | 0 | 0 |

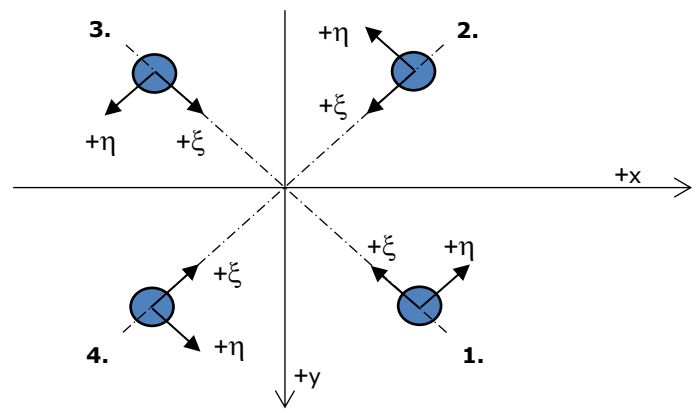
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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 |

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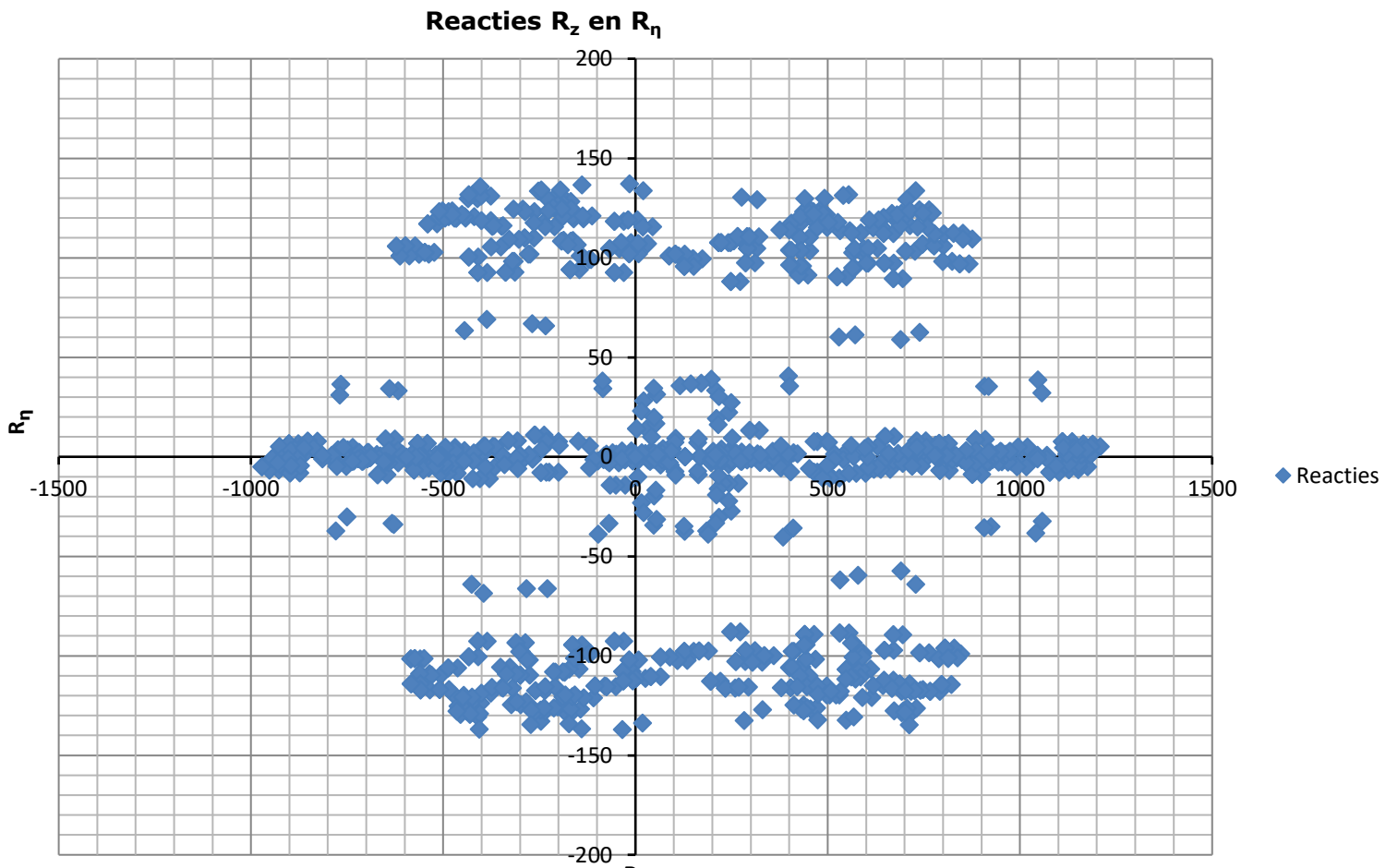

Project: KIJ-GT
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**Conductor loads**

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 | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| 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) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,15 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 1,15 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ice | -5° | 1,15 | 1,15 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ice 0,9 | -5° | 0,90 | 1,15 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Cold+wind | -20° | 1,15 | 1,15 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Cold+wind 0,9 | -20° | 0,90 | 1,15 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Maintenance | 5° | 1,15 | 1,15 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Maintenance | 5° | 1,15 | 1,15 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (deformations, fatigue, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 1,00 | 0,0 | 0,0 |
| SLS 3 | Wind+ice | -5° | 1,00 | 1,00 | 0,0 | 0,30 | 1,00 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 6 | Maintenance | 5° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 7 | EDS, no wind | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Number of wind directions | 6 |
| Number of load combinations for ULS | 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 - |

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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 | 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 | |

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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 | | -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**

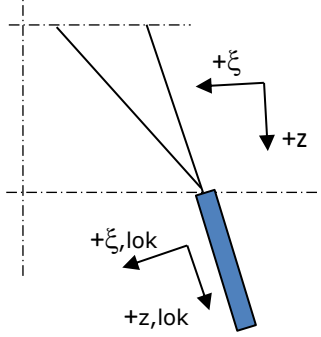
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -54 | 411 | 582 | 11684 | -1716 | -4 |
| ULS 1a_0,9_0,9_90 | -61 | 411 | 450 | 11684 | -1940 | -4 |
| SLS 7 | 0 | 0 | 516 | 0 | 0 | 0 |

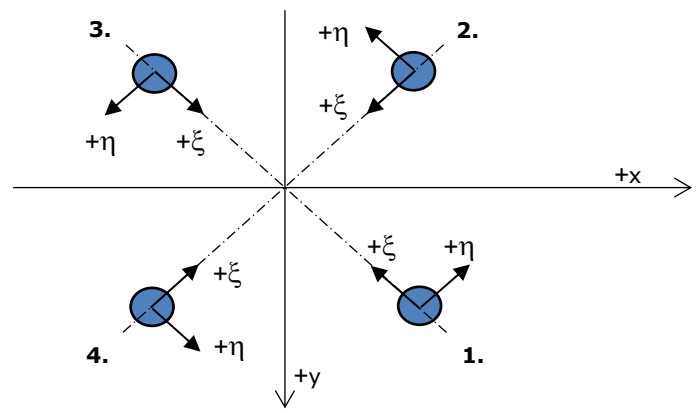
**Foundation loads, selection of load combinations based on greatest value**

| 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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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<br>Index | Combination<br>Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [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 |

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Tower: WA+0
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**Combination Ftensile+Fhor**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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] | $R_\eta$ [kN] | $R_\xi$ [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 |

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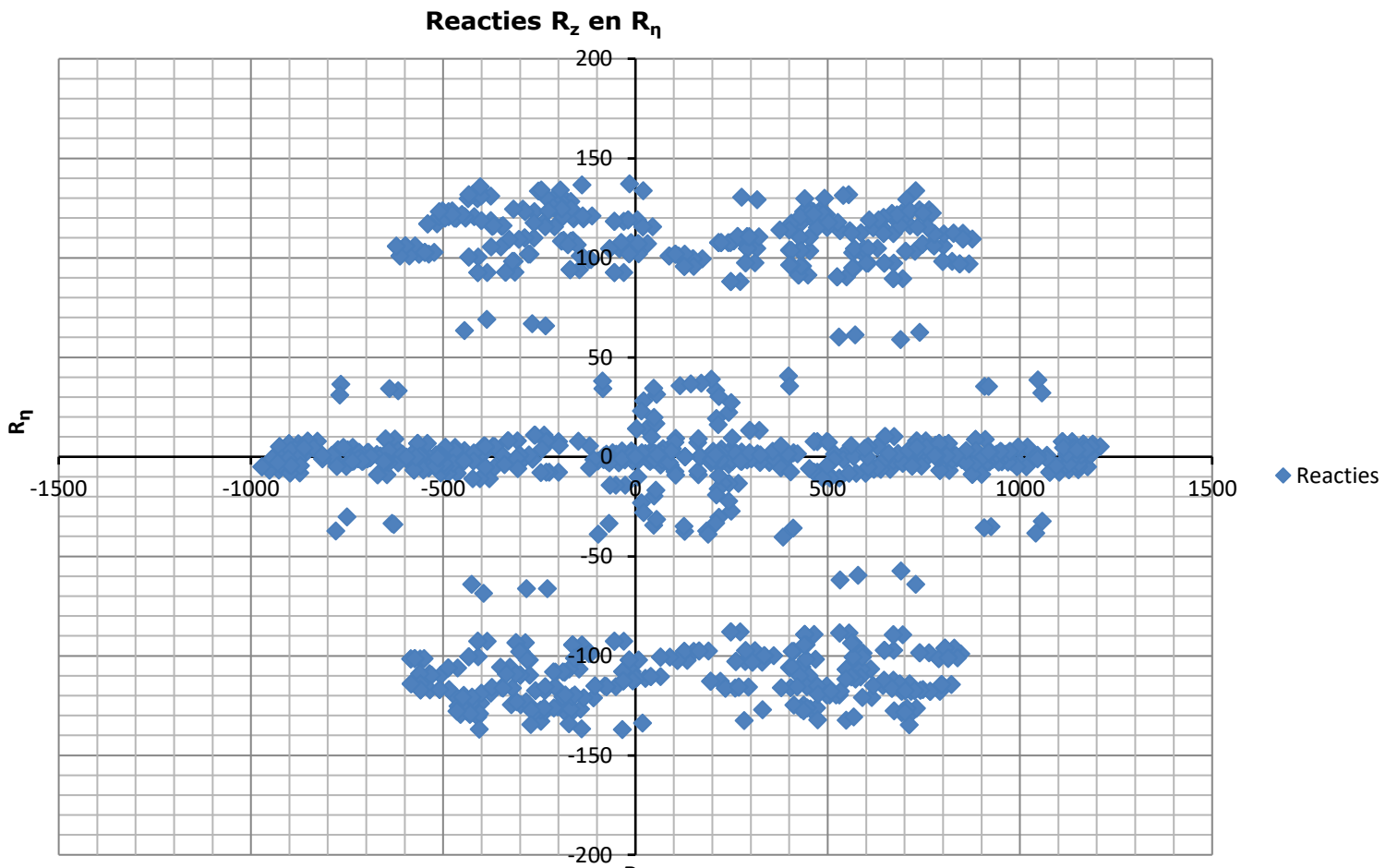
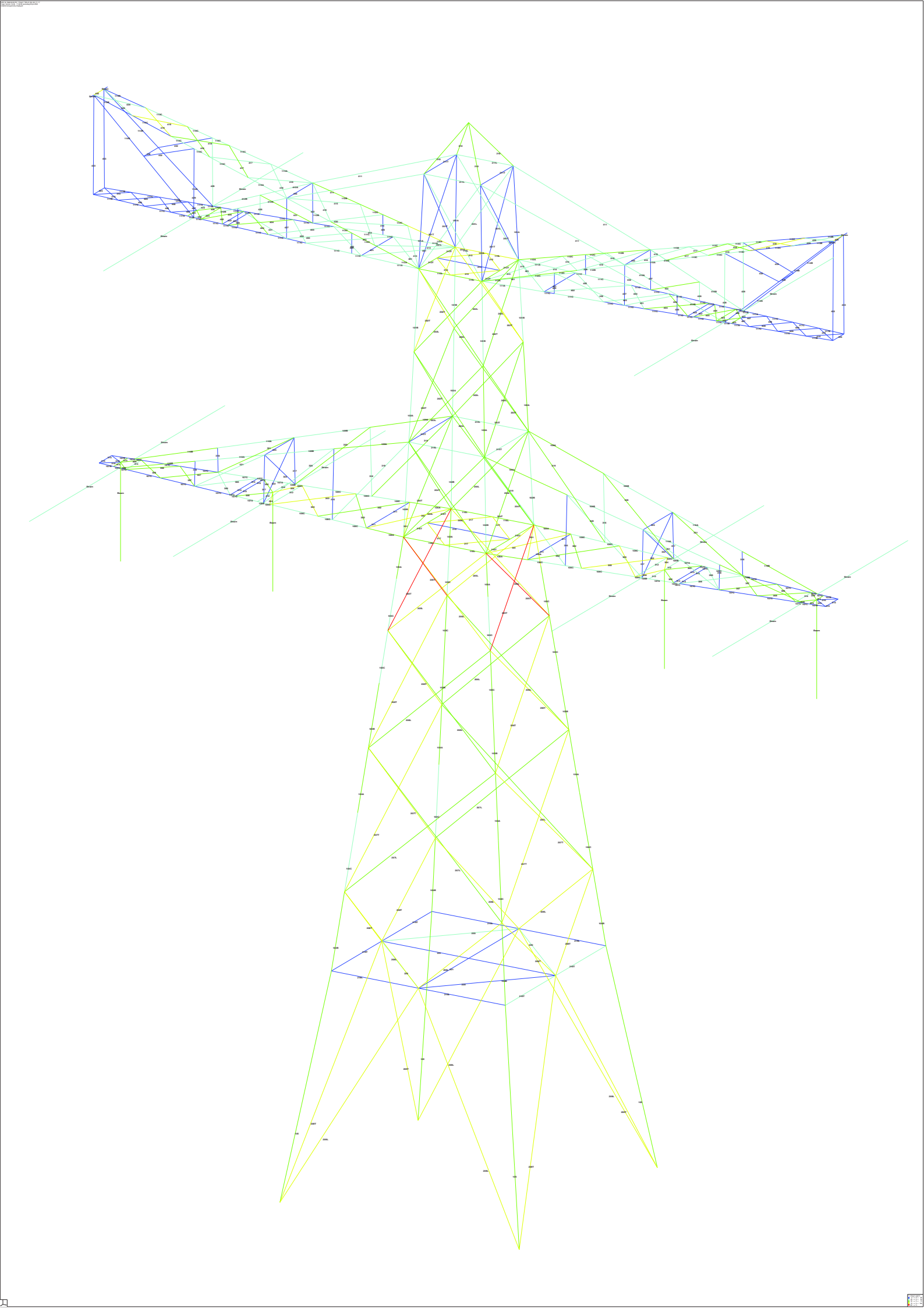


# APPENDIX B PLS-TOWER OUTPUT



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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 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** | SPLS 6a_90 Ah Ct2 Ba Ct2 | | 66.1 | 75.4 | 67.2 | 0.50 | |
| 421 | Dwarsliggers onderregel tweede dwarsarm | 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 Ct1 | | 766.1 | 117.6 | 0.0 | 0.04 | |
| 422 | Dwarsliggers onderregel tweede dwarsarm | 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 Ct1 | | 766.1 | 117.6 | 0.0 | 0.02 | |
| 423 | Dwarsliggers onderregel tweede dwarsarm | 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 dwarsarm | 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** | SPLS 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 Cts | 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 Cts | 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 Cts | 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 Cts | 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 Cts | 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 Cts | 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 tusse | 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 | 2030.6 | 1599.1 | 1993.8 | 0.58 |
| 104C | Leg eerste tusse | 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 | 2061.0 | 0.0 | 0.0 | 0.45 |
| 104B | Leg eerste tusse | 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 | 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 | 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_0,9_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 broe | 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 broe | 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 Cts | 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 Cts | 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 on | 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 on | 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 on | 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 on | 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 |

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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 315 | Dwarsligger onc | 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 twe | 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 twe | 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 twe | 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 twe | 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 |

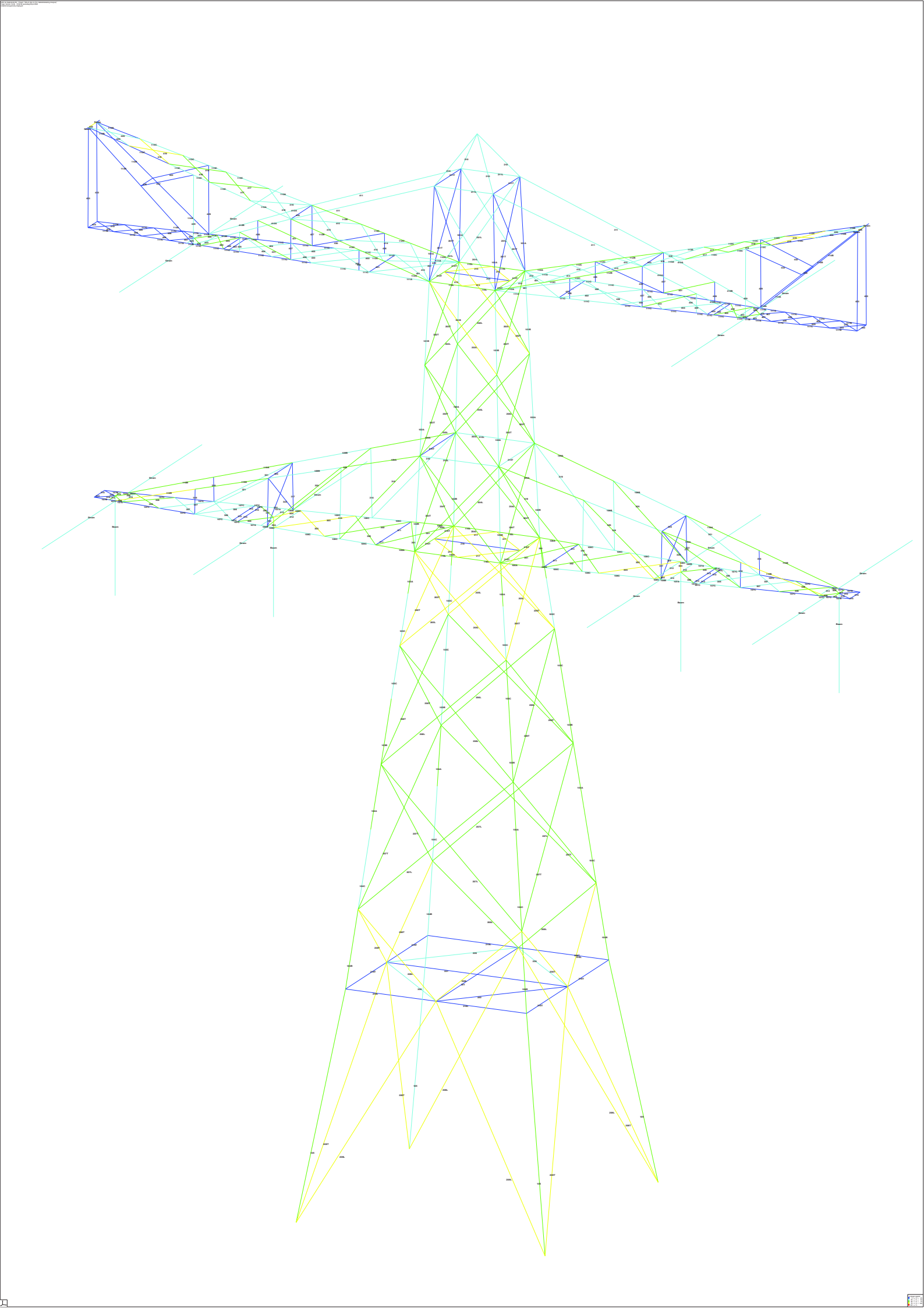
DNV·GL

## 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

## 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 Ba 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 Ba Ct2 Ah 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 dwarsar | 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 dwarsar | 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 dwarsar | 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 dwarsar | 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

DNV·GL

# 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 | |

DNV·GL

## 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 | |
| 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 | |

# 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.

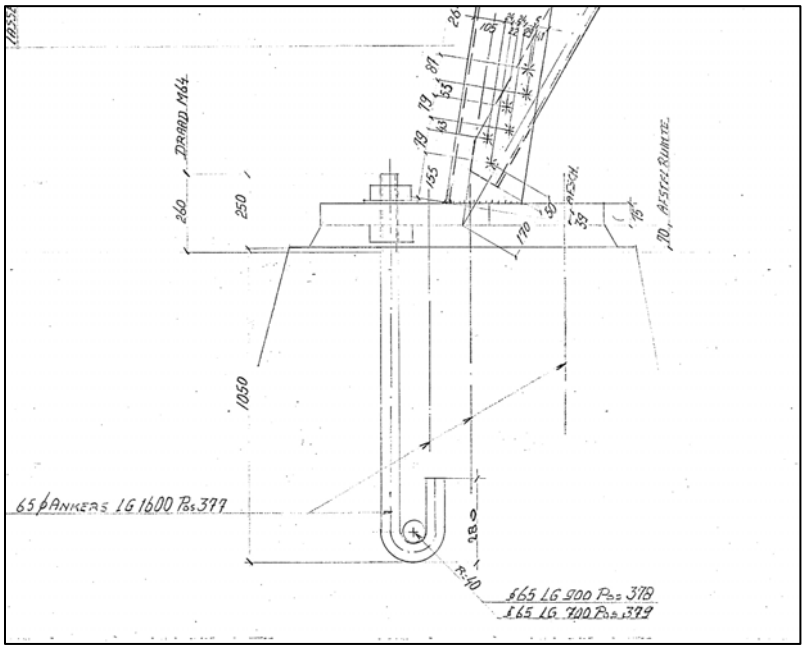



**Figure 1 Anchor detail mast 11-1**

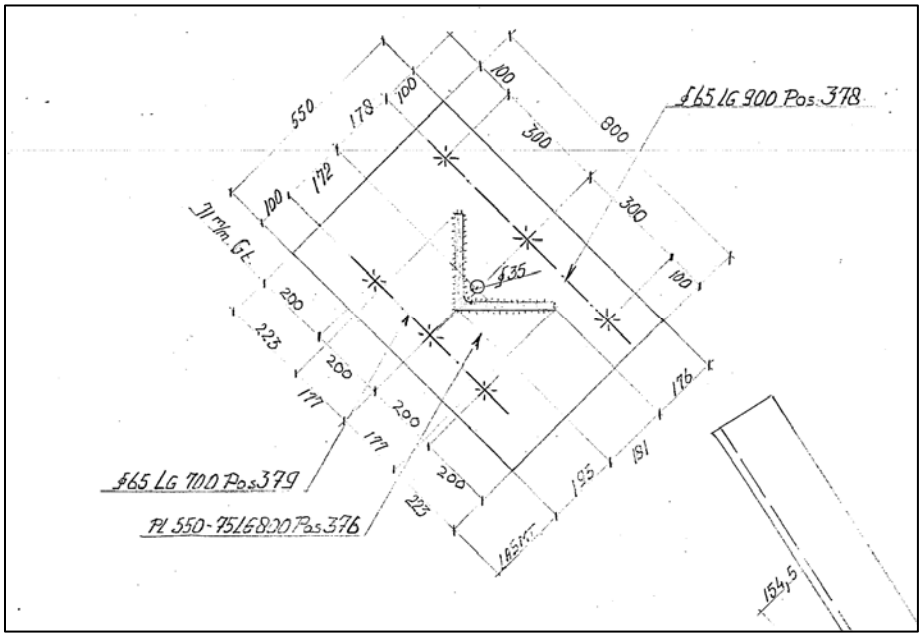



**Figure 2 Anchor footplate mast 11-1**

[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.

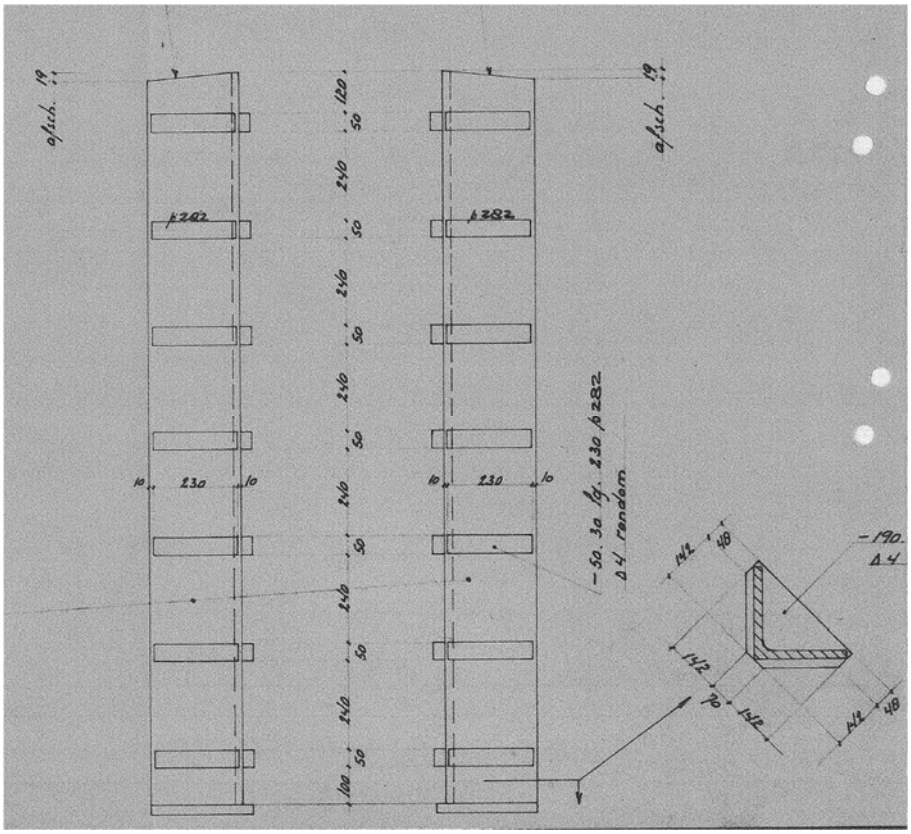
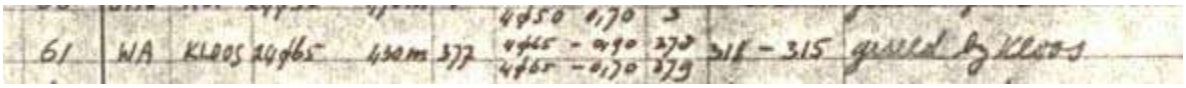


**Figure 3 Blokdeuvels (shear blocks) drawing available for mast 61**

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] | $R_\eta$ [kN] | $R_\xi$ [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 |

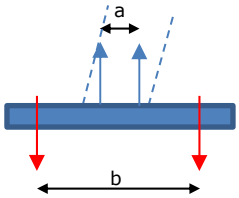
The loads generated on the tower are based on WA+0 structure number 61 in wind zone III:

**Omhullenden ongeacht stijl**

| Belasting | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [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

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 | |
| $\gamma_{Mb}$ | 1,25 | - |
| $\alpha_{red;2}$ | 0,85 | - |
| $\alpha_b = 0,44 - 0,0003 f_{yb}$ = | 0,37 | - |

*Capacity per anchor*

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

### *Foot plate*

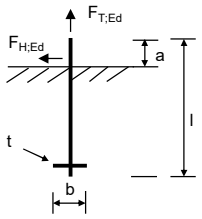
$F_{t,Rd}$: the tensile force in the anchors when yielding of foot plate is reached.

| | | | |
|---|---|---|---|
| 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")*

$$\frac{\sigma_b'}{f_{cd}} = \frac{11,6}{40,0} = 0,29 \quad \textit{OK}$$

$$\frac{F_{T,Ed}}{F_{v;Rd}} = \frac{176}{460} = 0,38 \quad \textit{OK}$$




### *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 = | **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 | $q = F_{T,Ed} / b_{eff}$ = | 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*

$$\frac{F_{T,Ed}}{F_{t;Rd}} = \frac{176,3}{673,6} = 0,26 \quad \textit{OK}$$

### *Capacity of anchor for tension*

$$\frac{F_{T,Ed}}{F_{T;Rd}} = \frac{176,3}{655,1} = 0,27 \quad \textit{OK}$$

### *Check foot plate for tension*

$$\frac{T}{n \times F_{t;Rd}} = \frac{1058,0}{4041,3} = 0,26 \quad \textit{OK}$$

### *Check anchor for shear*

$$\frac{F_{v,Ed}}{F_{v;Rd}} = \frac{50,7}{267,9} = 0,19 \quad \textit{OK}$$

# 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:

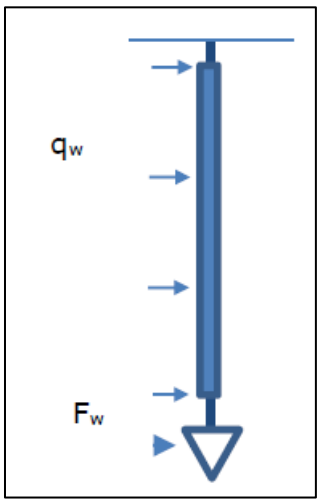



**Figure 1: Diagrammatic representation of the loads on the post insulator**

## 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 = $\underline{0.29\ kN/m}$

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

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

$Re = 43.45 \times 0.036 / (15 \times 10^{-6}) = 104280$

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

Then calculate $F_w$ based on a supported length of 9 m and a structural factor of 1:

$F_w = 9 \times 1 \times 0.9 \times 3 \times 0.036 \times 1.18 = 1.032$ 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:

$M_{ED} = 1.4 \times 6.45 = 9.03$ kNm

$V_{ED} = 1.4 \times (1.032 + 3.5 \times 0.29) = 2.87$ kN

## 2. Assessment of the pin

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

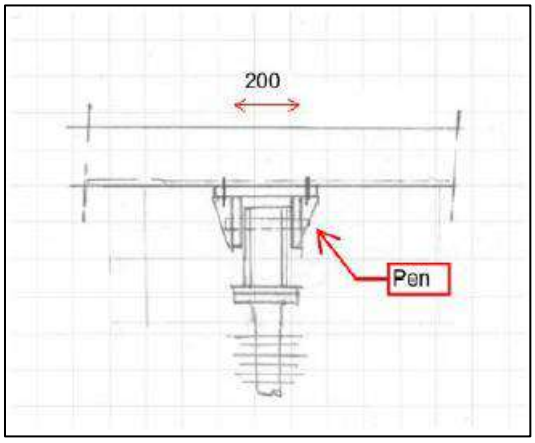



**Figure 2: Post insulator attachment mechanism**

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.

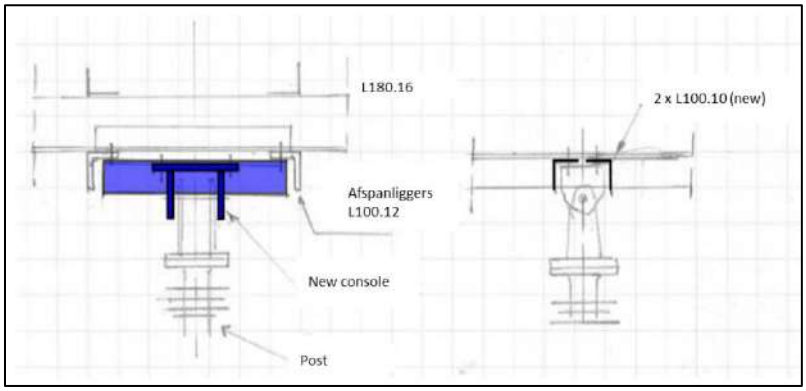



**Figure 3: Overview of the new members required for attachment**

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 |
| $\gamma_{m2}$ | 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**

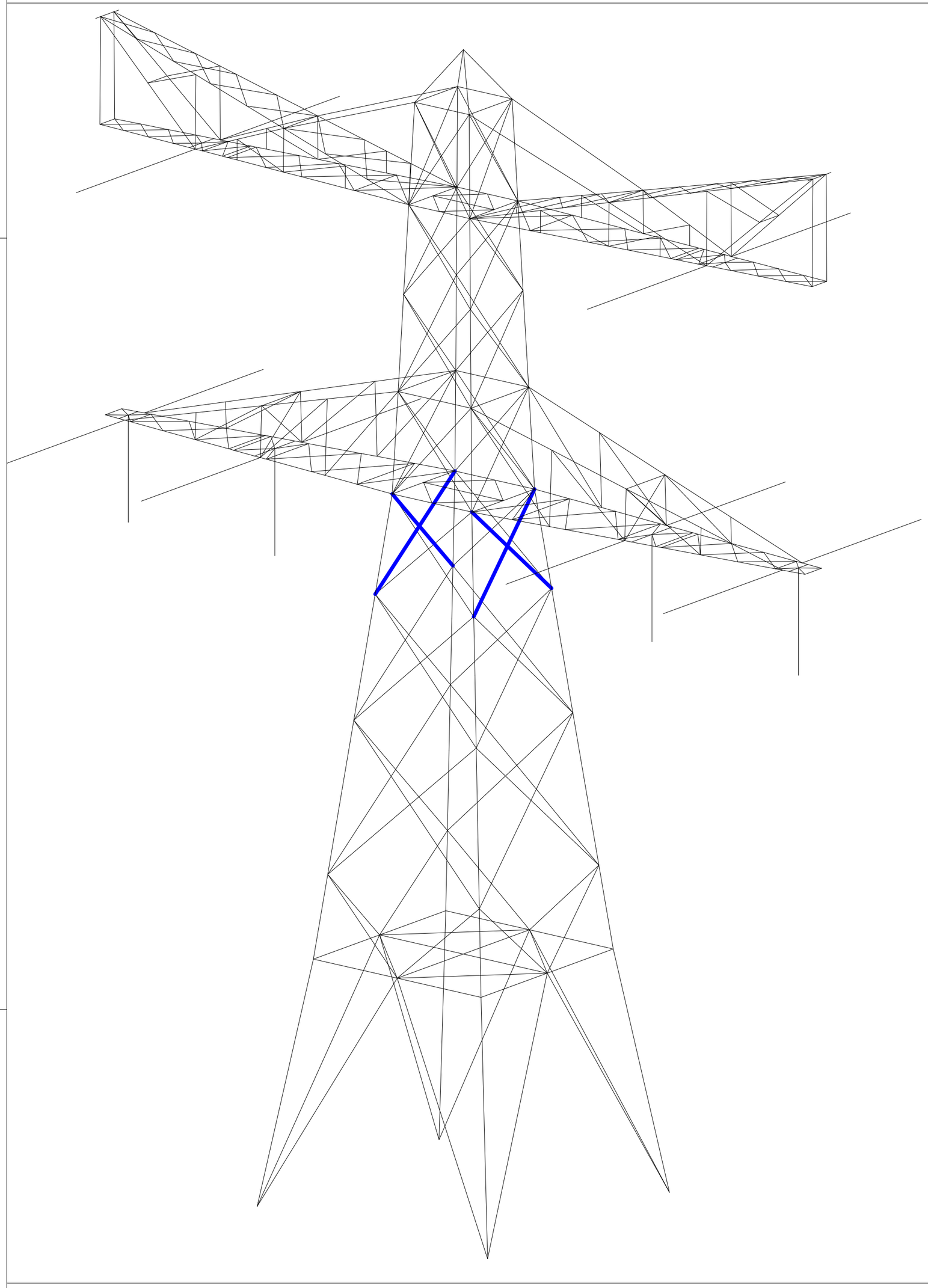
$M_{Ed} = F_{Ed}\,e$ = 0.95 kNm
$M_{Rd} = 1{,}5\,W_{el}\,f_{yp} / \gamma_{m0}$ = 1.47 kNm

U.C. = 0.65 < 1,0 OK

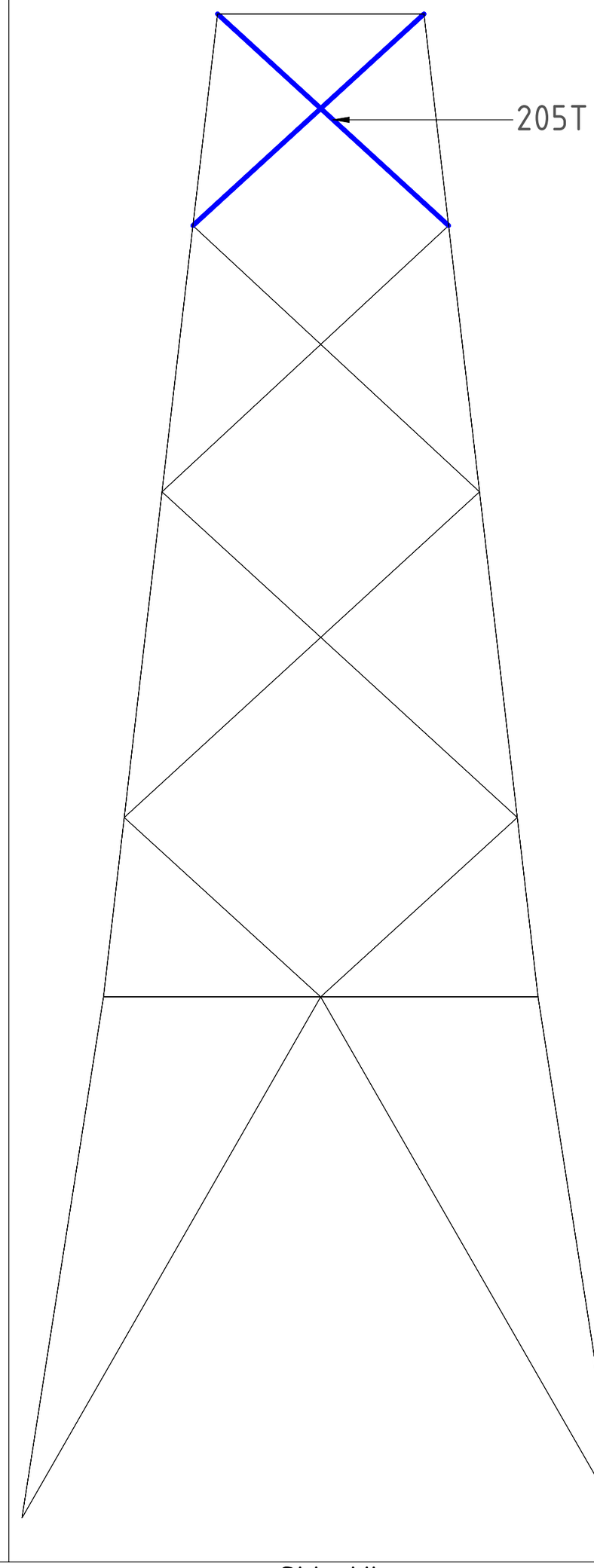
$(M_{Ed} / M_{Rd})2 + (F_{v,Ed} / F_{v,Rd})^2$ = 0.48 < 1,0 OK

# 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 |

DNV·GL

Projectname: Mast constructions KIJ - GT 380 kV

Third angle projection:

Drawing no.: 10166260-021

| | | | | | |
|---|---|---|---|---|---|
| Design state: | FINAL | | Scale: | - | Description: Modifications overview for mast type WA+0 (mast 11-1) |
| Drawn by: | MuK | 29-7-2020 | Units: | m | Revision: 00 |
| Checked by: | TBR | 29-7-2020 | Project no: | 10166260 | Format: A2 |
| Approved by: | JHu | 29-7-2020 | 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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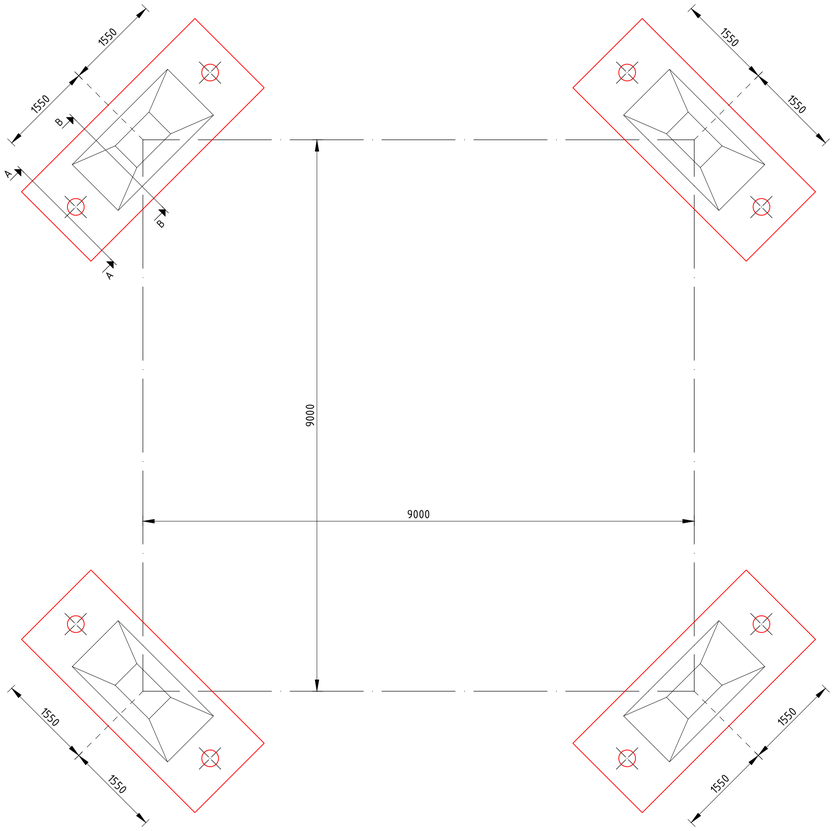
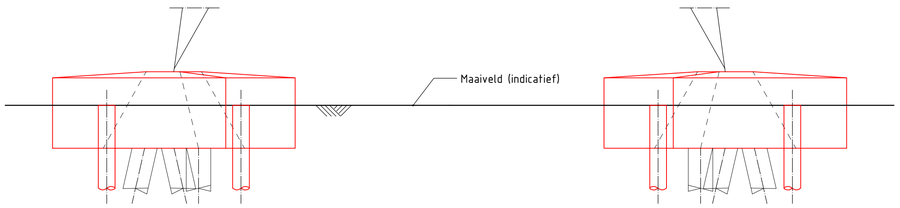
DNV GL is een wereldwijd bedrijf voor kwaliteitsborging en risicobeheer. Vanuit haar streven leven, bezit en het milieu te beschermen stelt DNV GL organisaties in staat de veiligheid en duurzaamheid van hun activiteiten te bevorderen. DNV GL biedt classificering en technische borging, naast software 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 24 Fundatietekeningen rapportage S+0, S+3, S+6 en S+9



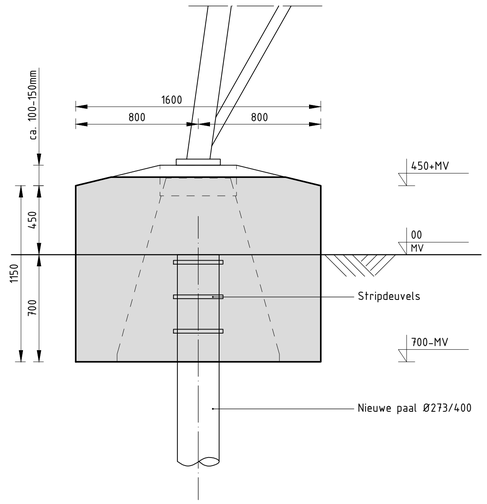

## Palenplan
schaal 1:50



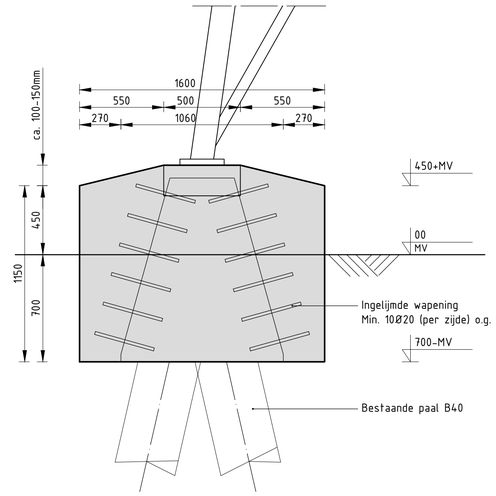

## Langsdoorsnede
schaal 1:50

| 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 |

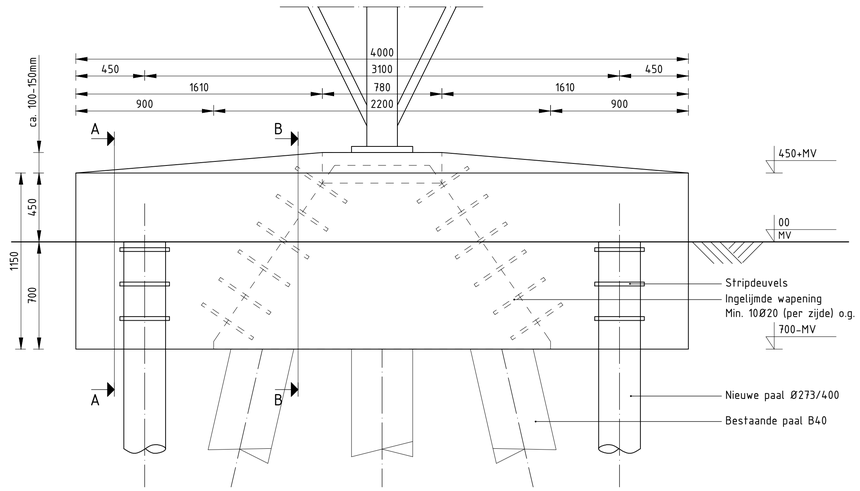
## Overzichtstabel




## 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

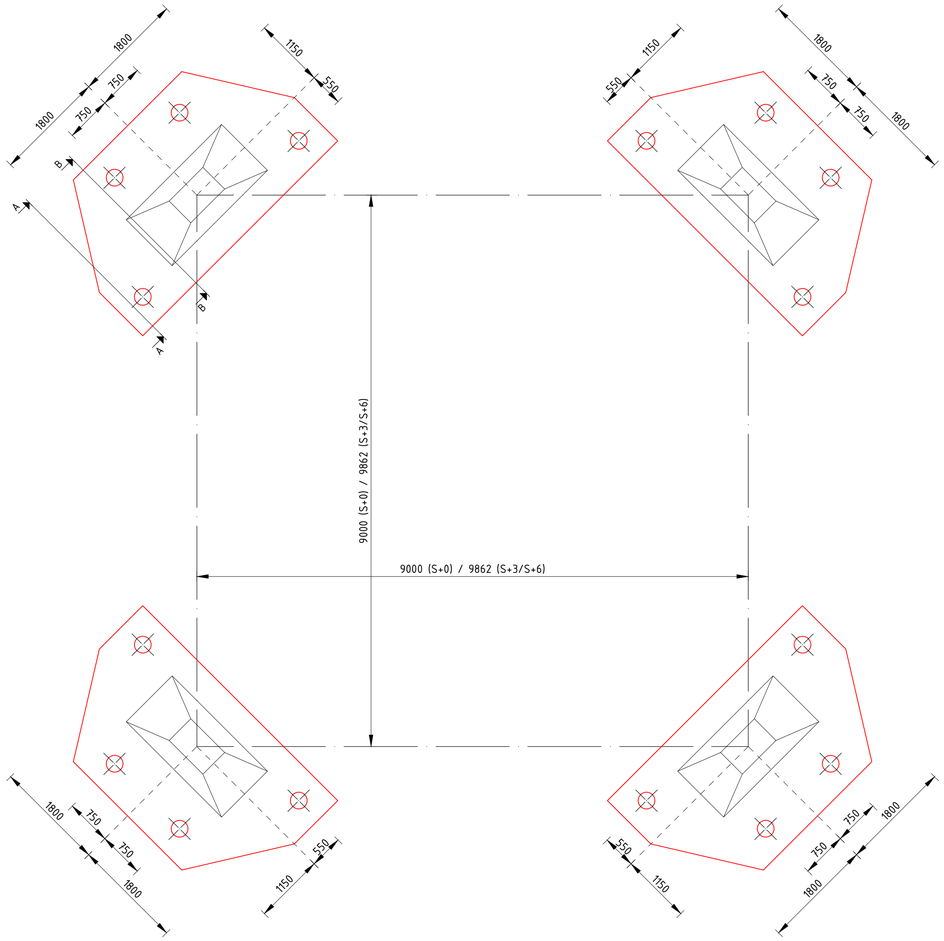
| | | | | | |
|---|---|---|---|---|---|
| Design state: | Definitief | | Scale: | 1:20 / 1:50 | |
| Drawn by: | MRE | 7-7-2021 | Units: | mm | |
| Checked by: | TBO | 7-7-2021 | Project no: | 10166262 | |
| Approved by: | JHU | 7-7-2021 | Client: | TenneT | |

Description: Verbinding KIJ-GT380
Principetekening fundatie 3P+2P

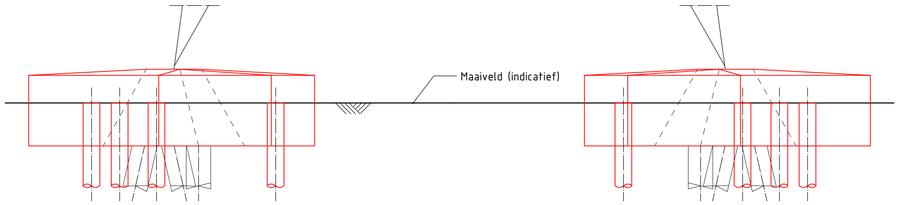
Revision: 3.0

Format: A1

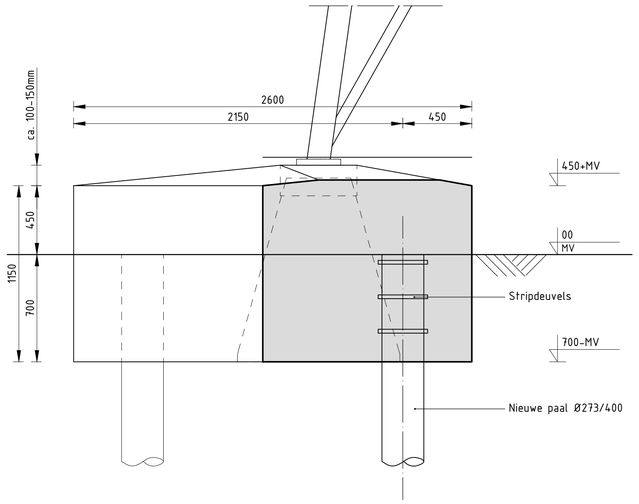
© 2020, filename: KIJ-GT - principe tekening.dwg



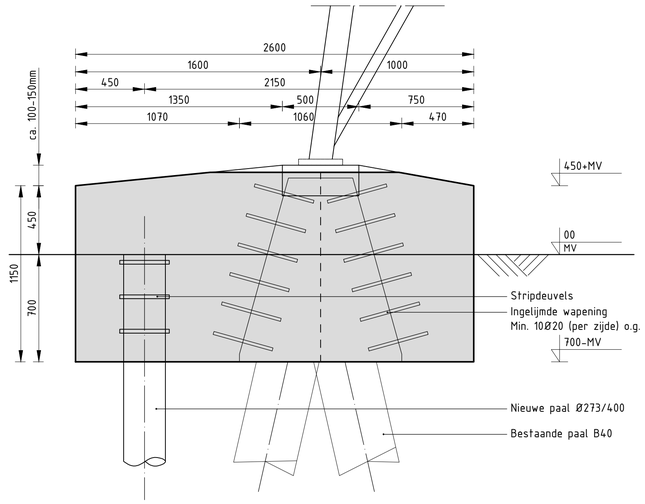

## Palenplan
schaal 1:50



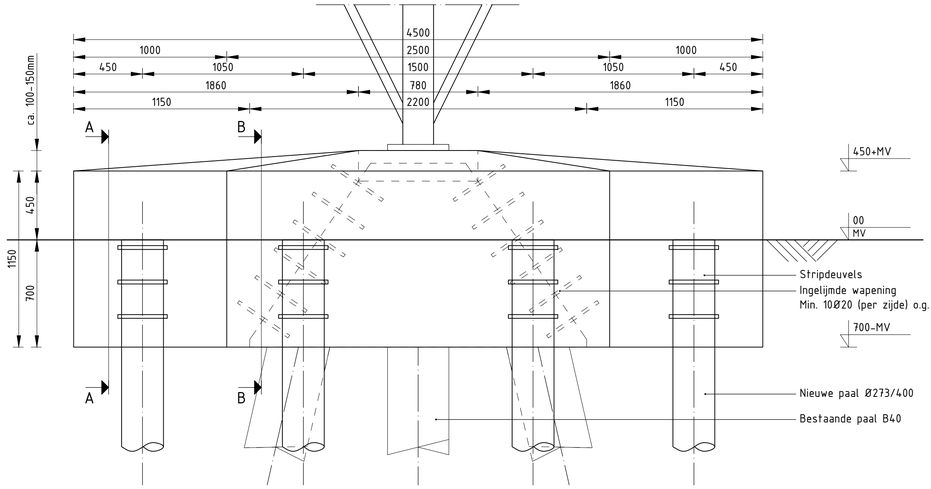

## Langsdoorsnede
schaal 1:50




## 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

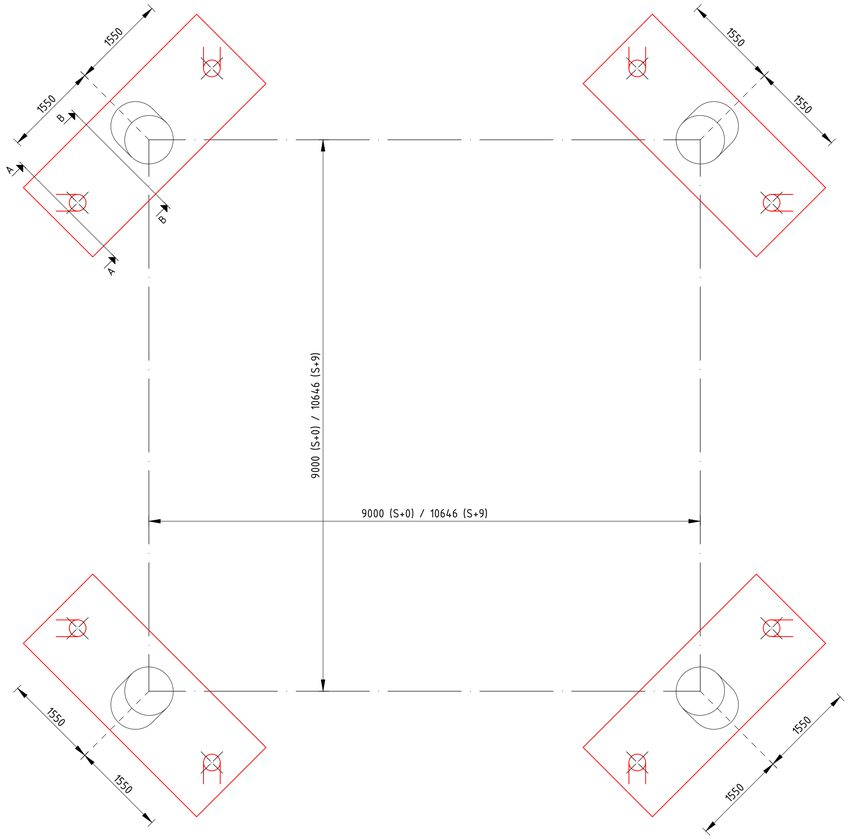
Projectname: BBB380 - Modelleren funderingen

Third angle projection:

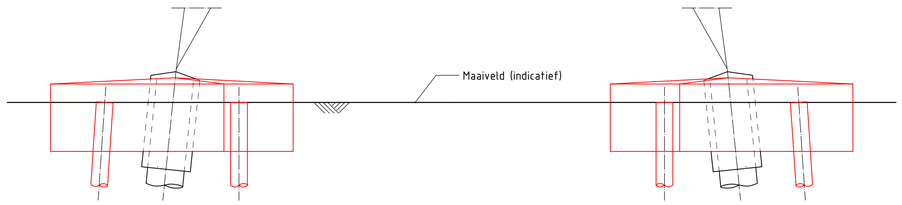
Drawing no.: 10166262-032-201 002.589.40 0945016

| | | | | | |
|---|---|---|---|---|---|
| Design state: Definitief | | Scale: | 1:20 / 1:50 | Description: Verbinding KIJ-GT380 Principetekening fundatie 3P+4P | Revision: 3.0 |
| Drawn by: MRE | 7-7-2021 | Units: | mm | | |
| Checked by: TBO | 7-7-2021 | Project no: | 10166262 | | Format: A1 |
| Approved by: JHU | 7-7-2021 | Client: | TenneT | | |

© 2020, filename: KIJ-GT - principe tekeningdwg



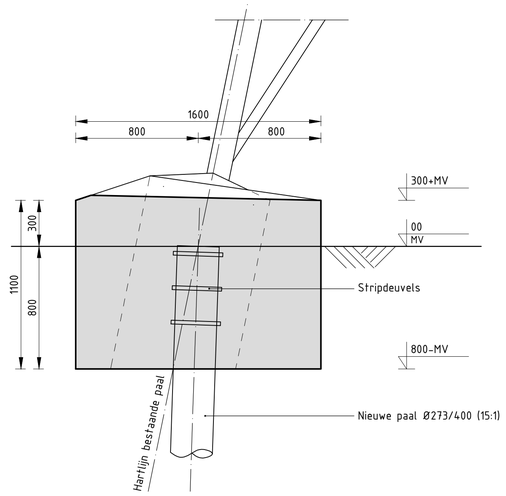

## Palenplan
schaal 1:50



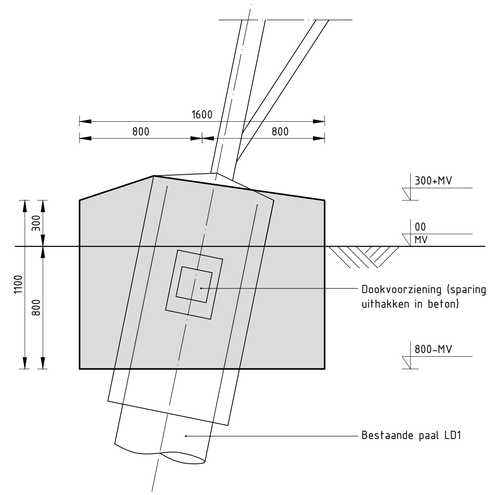

## Langsdoorsnede
schaal 1:50

| 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 |

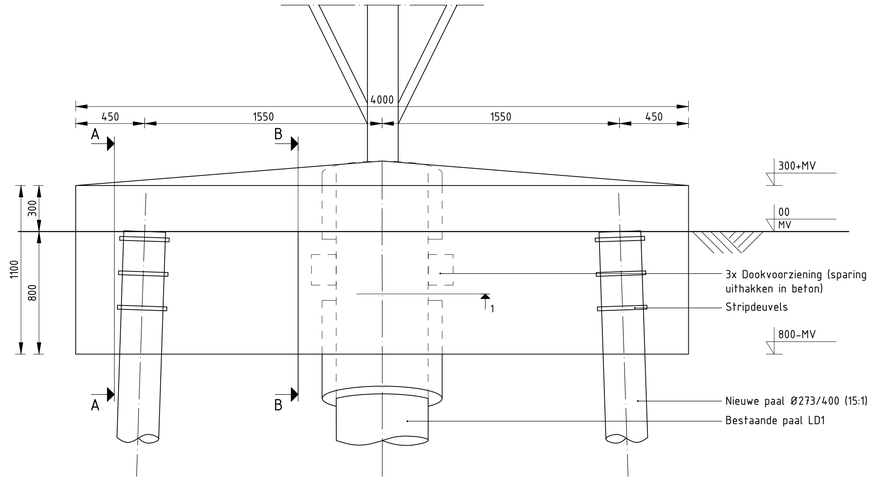
## Overzichtstabel



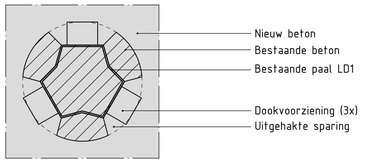

## Doorsnede A-A
schaal 1:20




## 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 | |
| Drawn by: | MRE | 7-7-2021 | Units: | mm | |
| Checked by: | TBO | 7-7-2021 | Project no: | 10166262 | |
| Approved by: | JHJ | 7-7-2021 | Client: | TenneT | |

Description: Verbinding KIJ-GT380 Principetekening fundatie 1P+2P - type 1

Revision: 3.0

Format: A1

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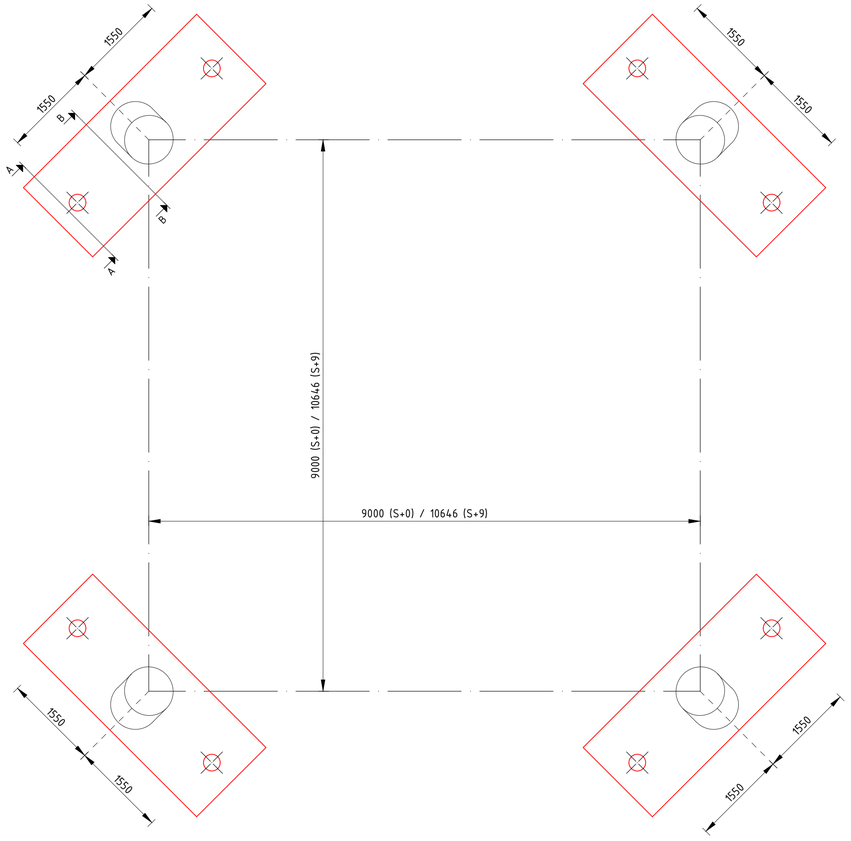
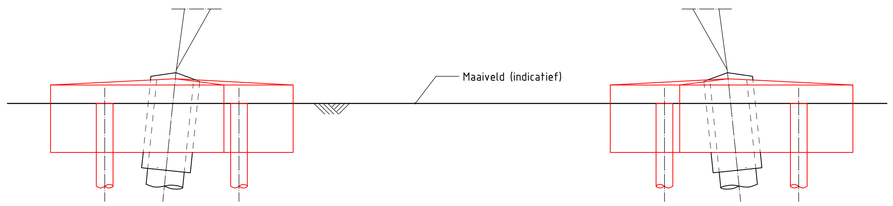


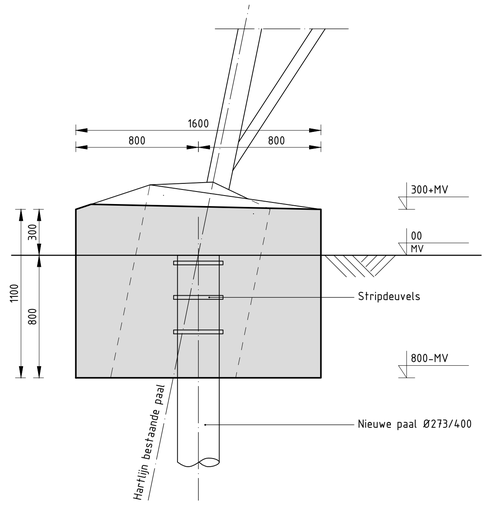

## Palenplan
schaal 1:50



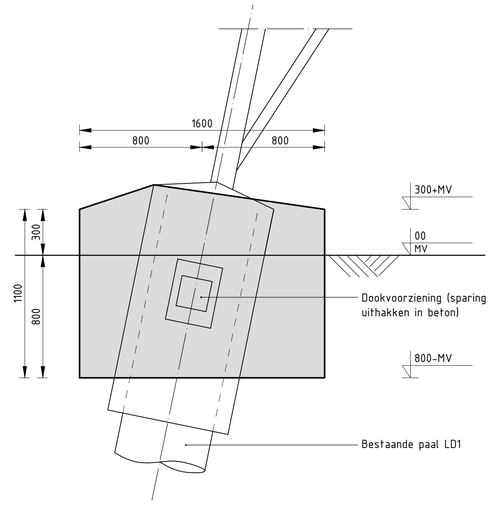

## Langsdoorsnede
schaal 1:50

| Mastnr. | Masttype | Aantal | Paaltype | Paallengte (m) | b.k. paal t.o.v. NAP (m) | PPN t.o.v. NAP (m) | Schoorstand | Staalkwaliteit |
|---|---|---|---|---|---|---|---|---|
| 62 | S+0 | 8 | SI-paal 273/400 | 17.21 | 1.21 | -16.0 | - | S355 |

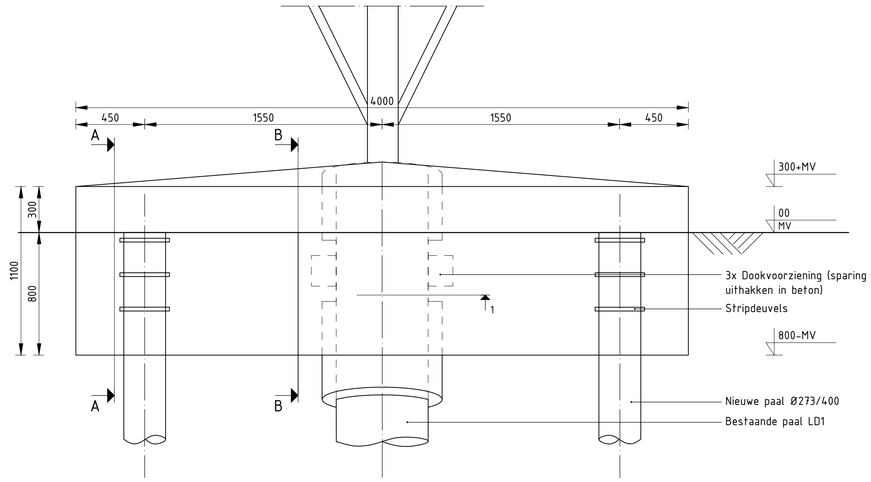
## Overzichtstabel




## 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 hoogtelligging i.h.w. controleren

- Voor palenplan en langsdoorsnede:
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  - 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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