*380kV Reconstructiemasten*

## B.10 Mastrapportage

ZUID-WEST 380 KV OOST VERBINDINGEN

# Mastrapport bestaande reconstructiemasten HB+0, HS+0 en HC+0 in GT-RLL380

**TenneT TSO B.V.**

**Meridian doc.nr.:** 002.678.00 0934573
**Rapport nr.:** 21-0888, Rev. 1
**Datum:** 2021-08-11

| | | |
|---|---|---|
| Projectnaam: | Zuid-West 380 kV Oost Verbindingen | Energy Systems |
| Rapport titel: | Mastrapport bestaande reconstructiemasten HB+0, HS+0 en HC+0 in GT-RLL380 | DNV Netherlands B.V.<br>Utrechtseweg 310-B50 |
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| Datum uitgave: | 2021-08-11 | |
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| Organisatie unit: | TDT | Handelsregister Arnhem 09006404 |
| Meridian doc.nr..: | 002.678.00 0934573 | |
| Rapport nr.: | 21-0888, Rev. 1 | |

[redacted]

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# 1 INLEIDING

In het basisontwerp van de vakwerkmasten voor de verbinding GT-RLL380 in het project Zuid-West 380 kV-Oost zijn voor het vaststellen van de haalbaarheid constructieve berekeningen uitgevoerd aan de masten en fundaties. In de Definitief Ontwerpfase, moeten berekeningen verder worden uitgewerkt om te kunnen dienen voor de benodigde vergunningsdocumentatie, voor de aanbesteding en als voorbereiding voor de uitvoeringsfase. Het DO omvat het ontwerp van de mastconstructies, de fundaties en de opstijgpunten in de verbinding.

Deze rapportage bevat de resultaten van de toetsing van de volgende bestaande masten t.b.v. de reconstructie.

**Tabel 1 - Overzicht bestaande reconstructiemasten**

| Verbinding | Mast Nr. | Masttype |
|---|---|---|
| GT-RLL | 78 | HB+0 |
| | 68 | HB+0 |
| | 26 | HS+0 |
| | 16 | HC+0 |

Deze masten zijn locatiespecifiek doorgerekend en moeten voldoen aan de belastingen uit de nieuwe situatie.

In deze rapportage zijn de toetsingen van de bovenstaande masten opgenomen. De toetsing bestaat uit controle van:

- de profielen en boutverbindingen onderdeel van de hoofddraagconstructie
- de knikverkorters
- de verbinding met de fundatie via blokdeuvels.

Buiten de scope van dit DO-rapport valt eventueel benodigde controle van de schetsplaten en overige verbindingsdetails in de constructie. Dit moet in de UO-fase worden uitgewerkt.

In hoofdstuk 2 zijn de uitgangspunten en randvoorwaarden vanuit de van toepassing zijnde normen en TenneT-specificaties opgenomen. Hoofdstuk 3 beschrijft de gevolgde aanpak van de berekening. In hoofdstuk 4 is de toetsing opgenomen. Hoofdstuk 5 bevat de eventuele aanpassingen in de mast.

# 2 UITGANGSPUNTEN EN RANDVOORWAARDEN

## 2.1 Normen

Er is gebruik gemaakt van de normen volgens Tabel 2.

**Tabel 2 Gebruikgemaakte normen, voorschriften en richtlijnen**

| Norm | Titel |
|---|---|
| NEN-EN 50341-1:2013 | "Overhead electrical lines exceeding AC 1 kV - Part 1: General requirements – Common" |
| NEN-EN 50341-2-15:2019 | "Overhead electrical lines exceeding AC 1 kV Part 2 National Normative Aspects (NNA) for THE NETHERLANDS" |
| NEN-EN 1990+A1+A1/C2:2019/NB:2019nl | "Grondslagen van het ontwerp" |
| NEN-EN 1991-1-4+A1+C2:2011/NB:2019+C1:2020 | "Deel 1-4: Windbelasting op constructies" |
| NEN-EN 1992-1-1+C2:2011/NB:2016+A1:2020 | "Eurocode 2: Ontwerp en berekening van betonconstructies, deel 1-1: algemene regels en regels voor gebouwen" |
| NEN-EN 1993-1-1+C2+A1:2016 nl | "Eurocode 3: Ontwerp en berekening van staalconstructies, deel 1-1: algemene regels en regels voor gebouwen" |
| NEN-EN 1993-3-1:2007/NB:2011 nl | "Deel 3-1: Torens, masten en schoorstenen - Torens en masten" |
| NEN-EN 1993-1-8+C2:2011/NB:2011 nl | "Ontwerp en berekening van staalconstructies, deel 1-8: ontwerp en berekening van verbindingen" |

## 2.2 TenneT-specificaties

In Tabel 3 zijn de documenten opgenomen die relevant zijn voor de berekeningen en toetsingen die binnen dit project in de mastrapportage uitgevoerd zullen worden.

**Tabel 3 Relevante documenten t.b.v. mechanische rapportages**

| Nummer | Onderwerp |
|---|---|
| PVE.05.000 v3.2 | PvE Lijnen |
| sPVE.05.001 | sPvE Lijnen |
| SPE.05.346 v1.3 | Algemene specificatie stalen masten |

## 2.3 Ontwerprapporten

Voor de achtergrond van het ontwerp wordt verwezen naar het uitgangspuntenrapport "D1.3 Uitgangspunten reconstructies", DNV GL rapport 21-0702, Meridiannummer 002.678.00 0927721.

## 2.4 Eisenverificatie

Voor de eisenverificatie wordt verwezen naar het rapport "Verificatierapport eisen reconstructies".

## 2.5 Materialen

Voor het ontwerp van de mastconstructies en fundaties wordt uitgegaan van de eigenschappen volgens Tabel 4.

**Tabel 4 Materialen aangepaste constructie**

| | |
|---|---|
| Staalsoort | S355J0 (t≤16 mm)<br>S355J2 (16<t≤40 mm) |
| Boutkwaliteit | 8.8 gerolde draad |
| Betonkwaliteit | C30/37 |
| Wapeningsstaal | B500 |

Voor de constructie geldt conform TenneT-specificatie:

- Toe te passen bouten: M16/M20/M24;
- Voor hoekstaal is de minimale afmeting L50x5 mm;
- Minimale plaatdikte 6 mm.

Indien bestaande bouten afwijkend zijn (M12) dan is het toegestaan deze door nieuwe bouten met eenzelfde diameter te vervangen.

## 2.6 Software

De gebruikte software wordt benoemd in Tabel 5.

**Tabel 5 Toegepaste software**

| Software | | Versie |
|---|---|---|
| Mastontwerp | PLS-CADD | 16.65 |
| Mastberekeningen | PLS-TOWER | 16.65 |
| Constructieve analyse | AxisVM | X5 R4h |

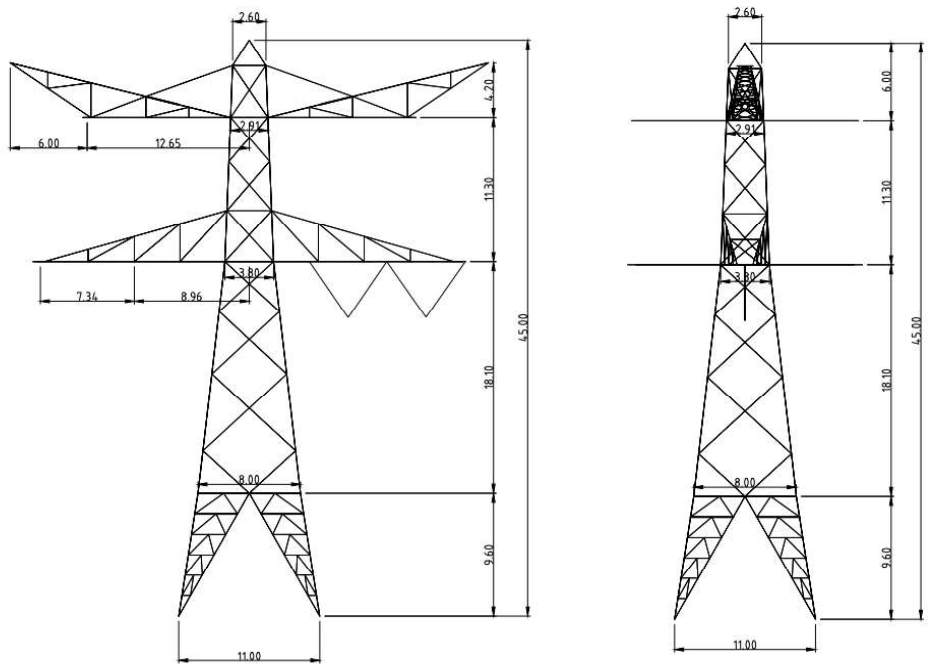
# 3 MASTONTWERP

## 3.1 Mastbeeld

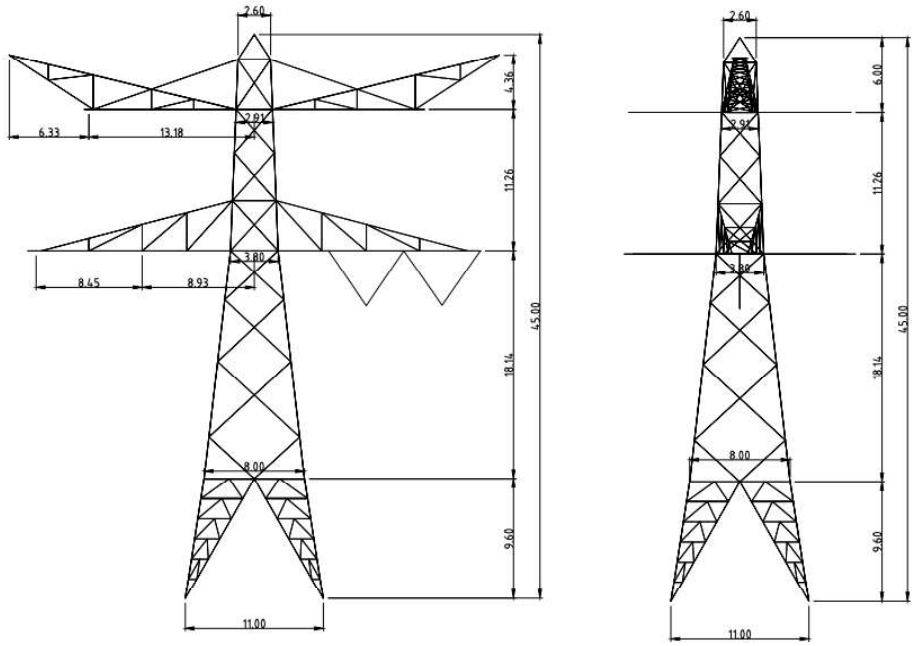
In dit hoofdstuk worden de mastbeelden weergegeven met de belangrijkste maatvoering, de figuren zijn ontleend aan de bij deze rapportage horende tekeningen van de masttypen. Het gaat om de volgende tekeningen:

- Overzichtstekening HB+0, Meridiannummer 002.678.00 0934587
- Overzichtstekening HC+0, Meridiannummer 002.678.00 0934589
- Overzichtstekening HS+0, Meridiannummer 002.678.00 0934590

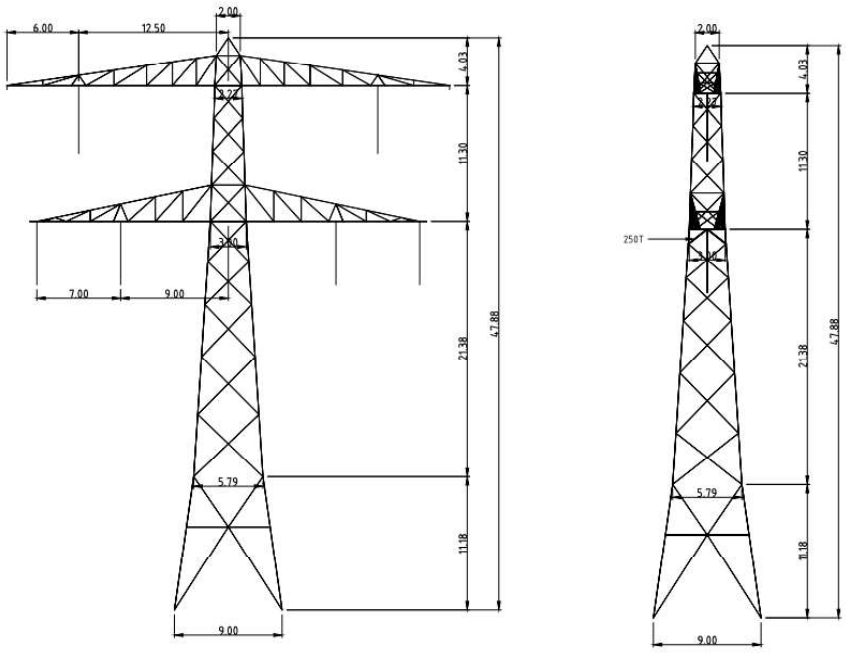
Zie in Tabel 1 de figuren van de bestaande reconstructiemasten.




*HB+0 (68 en 78)*




*HC+0 (16)*




*HS+0 (26)*

**Figuur 1 Mastbeeld masttype HB+0, HC+0 en HS+0**

## 3.2 Uitgangspunten berekening

De uitgangspunten volgens Tabel 6 zijn van toepassing.

**Tabel 6 Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2-0 |
| Betrouwbaarheidsniveau | Afkeur |
| Referentieperiode | 30 jaar |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau | Verbouw |
| Referentieperiode | 50 jaar |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

## 3.3 Mastenlijst

In Tabel 7 zijn alle bestaande reconstructiemasten in het tracé GT-RLL opgenomen. De masten zijn locatie specifiek doorgerekend.

**Tabel 7 Mastenlijst bestaande reconstructie masten in GT-RLL380**

| Mast-nummer | Masttype | Lijnhoek (°) | Wind span (m) | Weight span (m) | Hoogteverschil ba+ah (m) | Hoogte-verschil back (m) | Hoogte-verschil ahead (m) |
|---|---|---|---|---|---|---|---|
| **78** | HB+0 (78) | 174,8 | 356,7 | 378,1 | -0,3 | -4,8 | 4,5 |
| **68** | HB+0 (68) | 180,0 | 374,3 | 335,2 | -10,4 | -5,6 | -4,8 |
| **26(HS)** | HS+0 (26) | 177,3 | 343,8 | 364,3 | 5,0 | -0,4 | 5,4 |
| **16** | HC+0 (16) | 129,2 | 331,7 | 322,7 | -3,2 | 1,6 | -4,8 |

*Noot: bij de hoekmastposities is de mast geroteerd ten opzichte van de bissectrice. Zie hiervoor Appendix A.*

## 3.4 Proces stappen

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

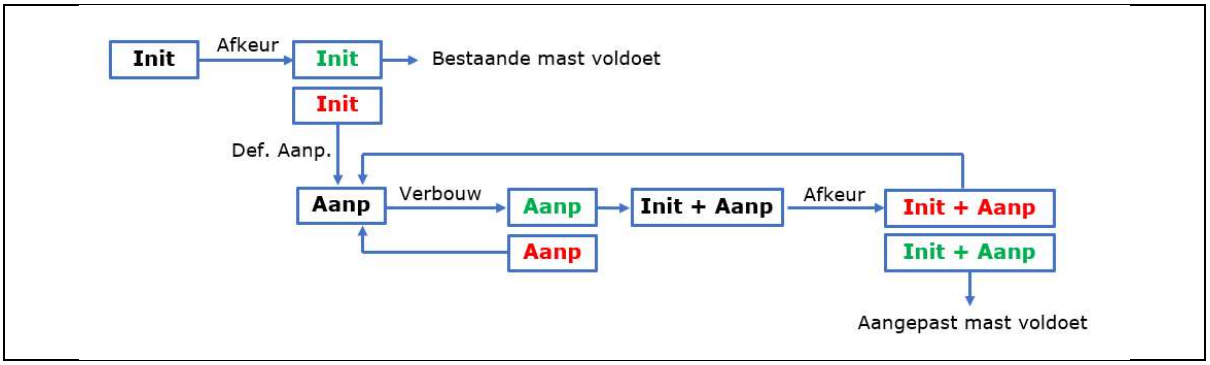
Stap 1: Toets bestaande (Init) mast op Afkeur

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 1 weergegeven.




**Figuur 1 Process diagram**

## 3.5 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV GL. Belastingen zijn locatiespecifiek. De belastingen op de mastconstructie zijn bepaald op basis van de modellering in PLS-TOWER (staafoppervlaktes). Voor de toeslagen op eigen gewicht en windoppervlakte wordt verwezen naar het uitgangspuntenrapport. 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 Appendix A.

## 3.7 Modellering

Op basis van de ontwerptekeningen is de mast in PLS-TOWER ingevoerd. De toetsing wordt per staafgroep uitgevoerd. De hoofdelementen zijn gemodelleerd, niet-dragende profielen als knikverkorters zijn weggelaten, deze worden separaat getoetst. De profielen zijn in PLS-TOWER inclusief de boutverbindingen ingevoerd en getoetst, de controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

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

De gewichts- en windbelasting op de mastconstructie wordt door PLS-TOWER automatisch bepaald. Via toeslagfactoren wordt de invloed van niet gemodelleerde elementen als knikverkorters, bordesconstructies en klimvoorzieningen meegenomen. Voor schetsplaten, zinklaag en bouten is een aanvullende toeslag op het gewicht van 20% toeslag gerekend.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep.

## 3.8 Overige controles

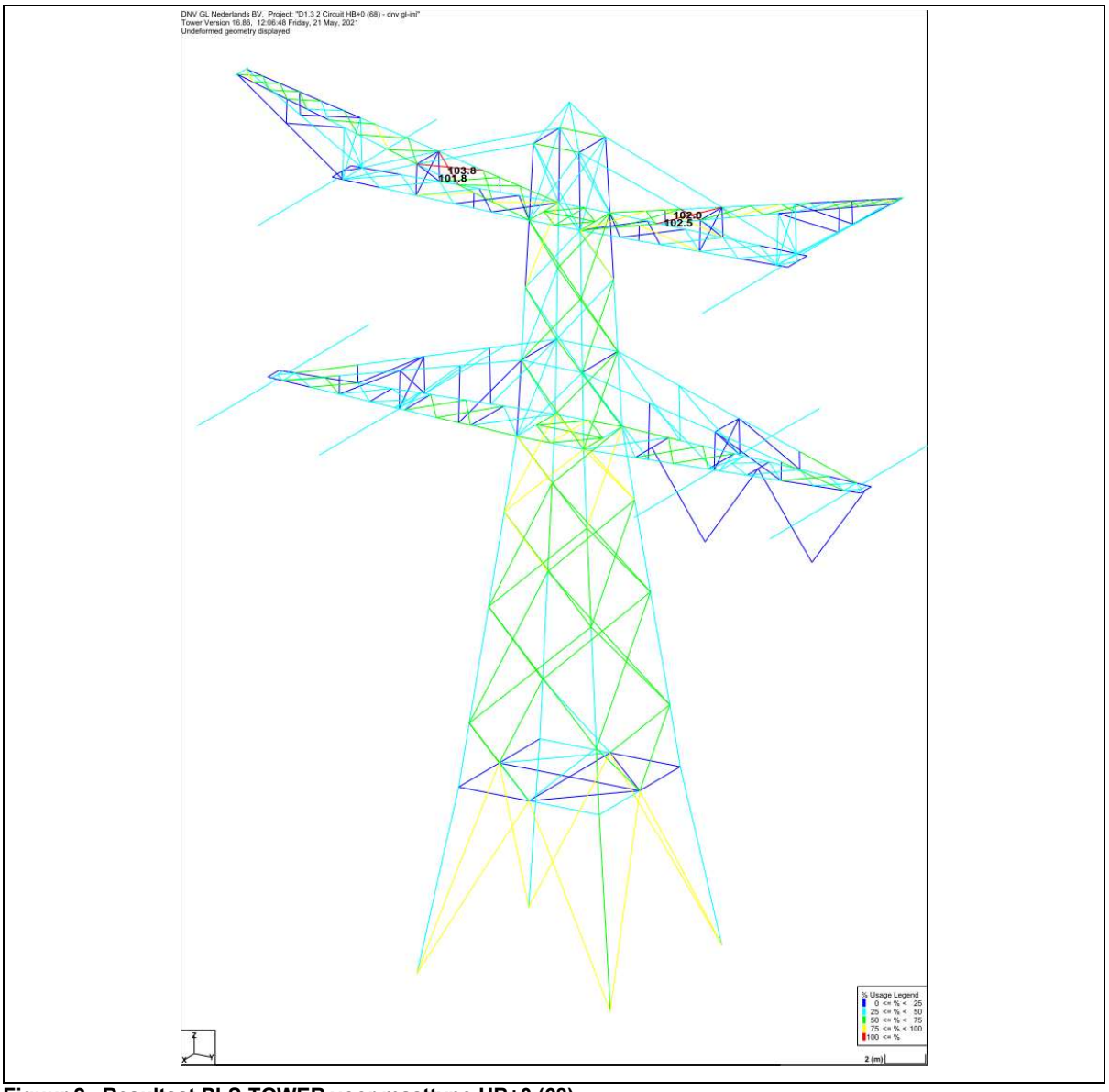
In PLS-TOWER zijn niet alle elementen getoetst. Knikverkorterprofielen en overige profielen voor beloopbaarheid worden separaat getoetst. In Appendix C is dit opgenomen. De verbinding met de fundatie bestaat uit ingestorte profielen voorzien van blokdeuvels. Dit is in Appendix D opgenomen.

# 4 TOETSING

## 4.1 Resultaat PLS-TOWER

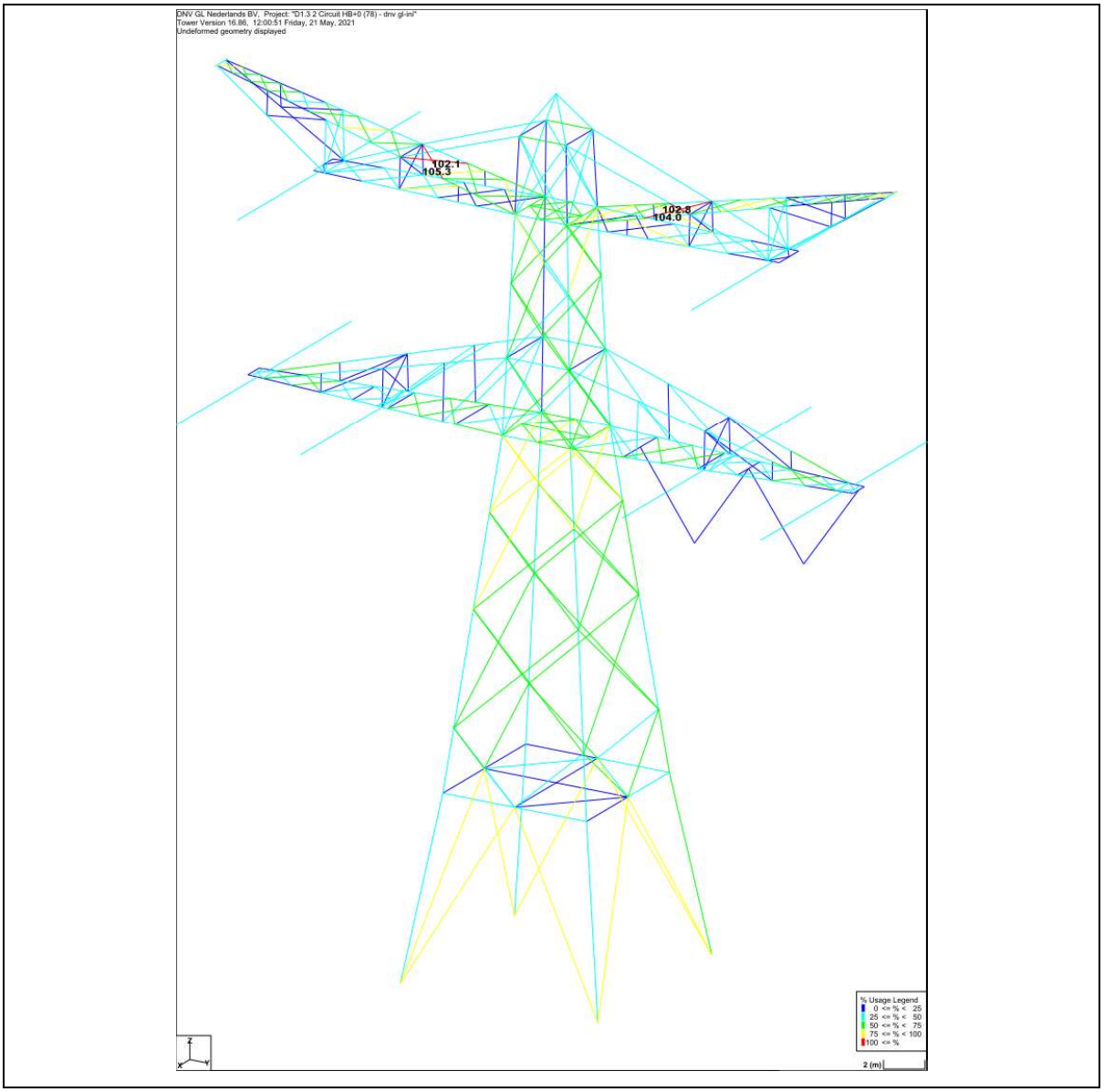
Het resultaat van de toetsing met PLS-TOWER is per masttype weergegeven in Figuur 2 tot en met Figuur 5. Voor elk masttype zijn de belastingen apart bepaald. De bestaande masten dienen in het nieuwe tracé te voldoen aan het afkeurniveau van NEN 8700 met 30 jaar referentieperiode. In dit DO is een mechanische toetsing uitgevoerd op de masten die in de toekomstige situatie de overgang zullen vormen van het bestaande tracé naar het nieuwe tracé.

De uitnutting van de constructie loopt op van blauw (0-25%) tot geel (75-100%). In het verband van de boventraverse treden overschrijdingen op. Dit wordt veroorzaakt door het uitgangspunt van ijsgebied A voor bliksemgeleiders. Door uitwisseling met nieuwe profielen kunnen overschrijdingen worden opgelost.



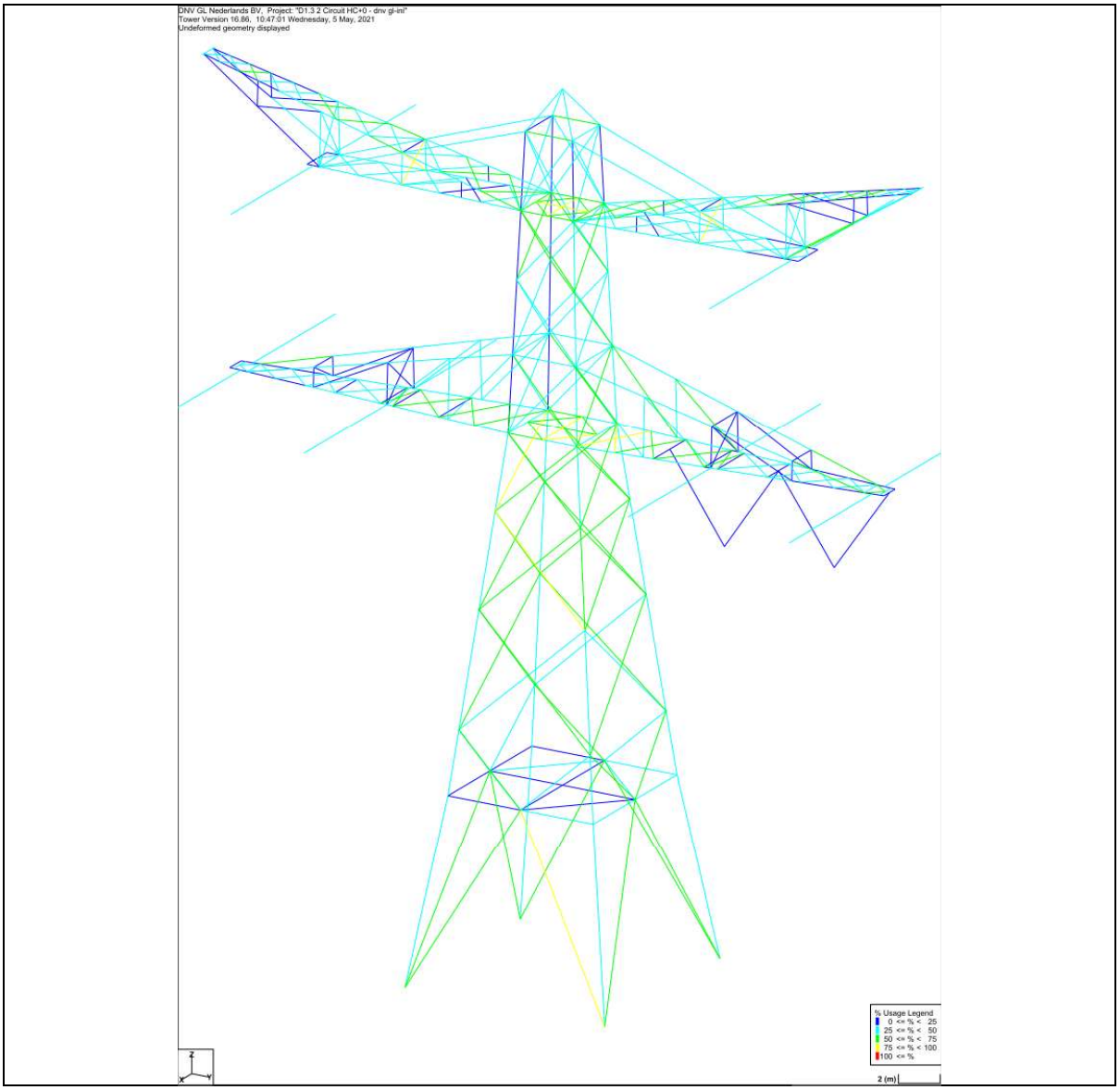

**Figuur 2 Resultaat PLS-TOWER voor masttype HB+0 (68)**

Bij mast 78 is eenzelfde overschrijding als in mast 68 aanwezig.



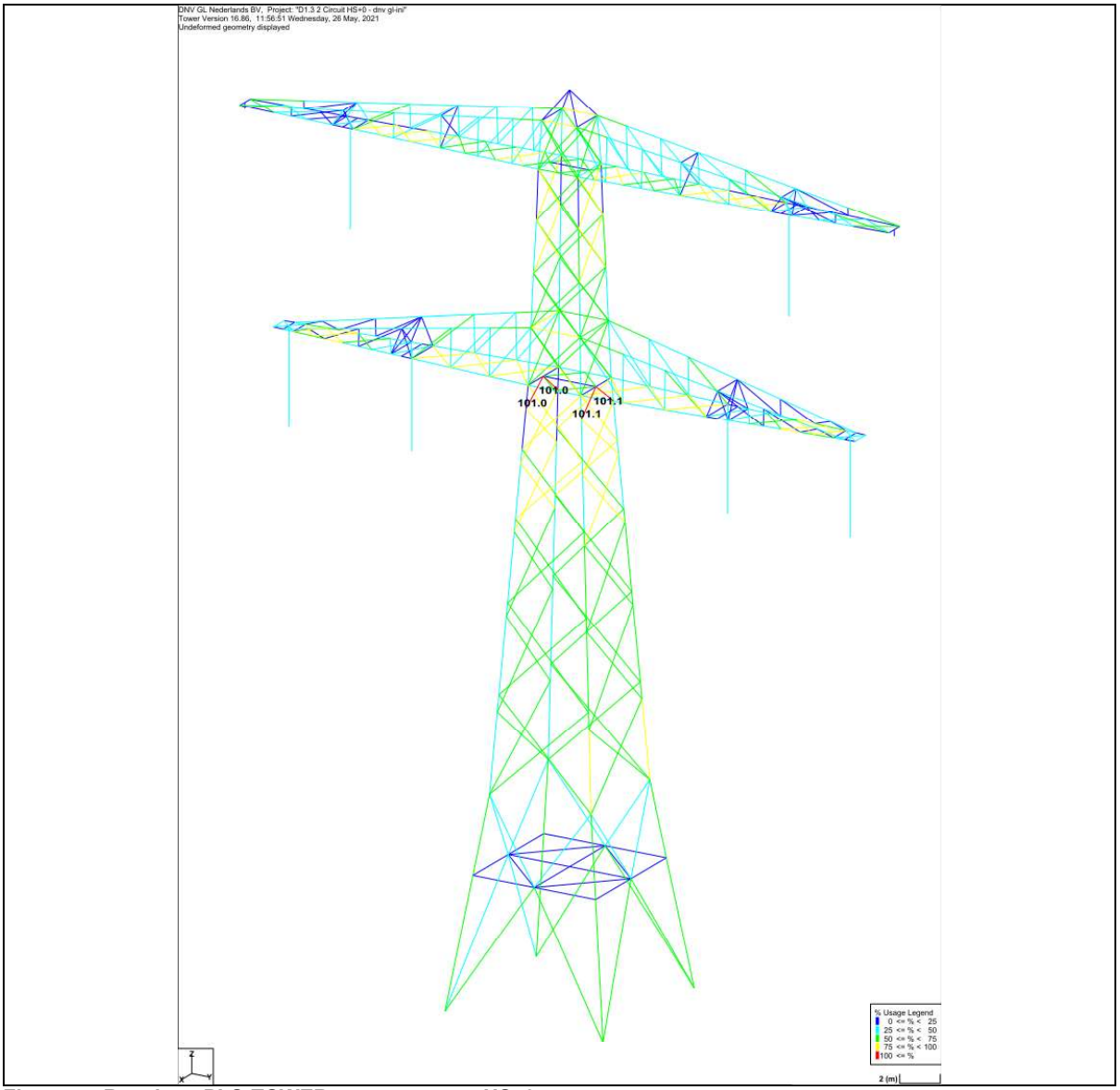

**Figuur 3 Resultaat PLS-TOWER voor masttype HB+0 (78)**

Bij mast 16 treden geen overschrijdingen op.




**Figuur 4 Resultaat PLS-TOWER voor masttype HC+0**

Bij mast 26 is een overschrijding op de sterkte van een diagonaalgroep aanwezig. Door uitwisseling met nieuwe profielen kunnen overschrijdingen worden opgelost.




**Figuur 5 Resultaat PLS-TOWER voor masttype HS+0**

## 4.2 Toetsing overige onderdelen

In Tabel 8 zijn de resultaten van de uitgevoerde toetsingen weergegeven.

**Tabel 8 Samenvatting uitgevoerde controles**

| Controle van | Beoordeling | Referentie |
|---|---|---|
| Profielen en bouten | Aanpassingen benodigd bij mast 68, 78 en 26. | Figuur 2<br>Figuur 3<br>Figuur 4<br>Figuur 5<br>Appendix B |
| Knikverkorters | Aanpassingen benodigd bij mast 68, 78 en 16. | Appendix C |
| Blokdeuvels randstijl | Voldoen | Appendix D |

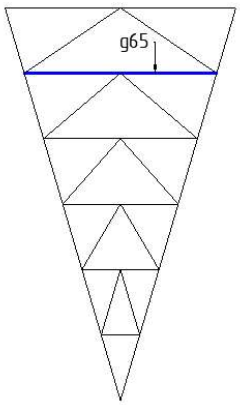
# 5 AANPASSINGEN

## 5.1 Inleiding

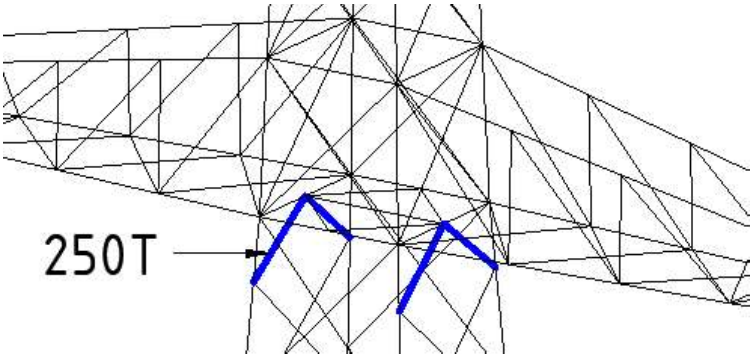
Een versterkingsvoorstel om de mast aan afkeurniveau te laten voldoen en nieuwe onderdelen aan verbouwniveau is uitgewerkt. Dit voorstel bevat de volgende maatregelen:

- Knikverkorters in pootverband vervangen (HC+0 en HB+0)
- Diagonalen in mastlichaam ter hoogte van onder traverse vervangen (HS+0)
- Horizontale diagonalen in boven traverse vervangen (HB+0)

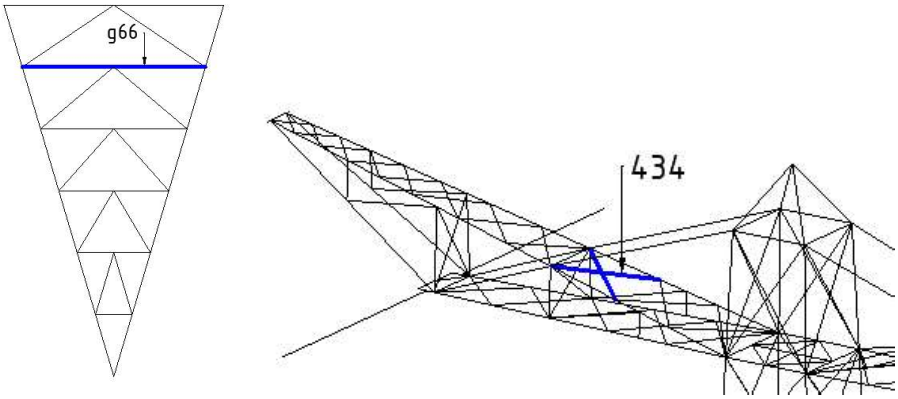
## 5.2 Aanpassingen




**Figuur 2 Knikverkorter in pootverband uitwisselen HC+0 (16)**




**Figuur 3 Diagonalen uitwisselen HS+0 (26)**




**Figuur 4 Knikverkorter in pootverband en diagonalen in boven traverse uitwisselen HB+0 (68&78)**

In Tabel 1 tot en met Tabel 3 zijn de gegevens van de toegevoegde- en uitgewisselde profielen weergegeven. De tekeningen zijn terug te vinden in Appendix E. De gewichten van de additionele bouten en platen van de versterkte verbinding zijn niet meegenomen.

**Tabel 1 Gewichten HC+0 (16) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **G65** | L50x5 | S235 | 1M16-8.8t | L70x7 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 4.63 | 139.21 |
| | | | | | | | | | 18.51 | 139.21 |

**Tabel 2 Gewichten HS+0 (26) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **250T** | L80x65x6 | S235 | 3M20-8.8t | L70x7 | S355 | 3M20-8.8t | Profiel uitgewisseld | 4 | 2.00 | 60.19 |
| | | | | | | | | | 8.00 | 60.19 |

**Tabel 3 Gewichten HB+0 (68&78) van uitgewisselde profielen**

| Staafgroep | Profiel | Materiaal | Bouten | Profiel nw. | Materiaal nw. | Bouten nw. | Maatregel | Aantal | Lengte (m) | Gewicht (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **G66** | L50x5 | S235 | 1M16-8.8t | L70x7 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 4.63 | 139.21 |
| **434** | L55x6 | S235 | 1M16-8.8t | L55x6 | S355 | 1M16-8.8t | Profiel uitgewisseld | 4 | 3.40 | 68.73 |
| | | | | | | | | | 32.13 | 207.94 |

# APPENDIX A
## Geleiderbelastingen

Hierin zijn de geleiderbelastingen opgenomen van de volgende masten:

- Masttype HB+0 (68)
- Masttype HB+0 (78)
- Masttype HC+0 (16)
- Masttype HS+0 (26)

## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24.5 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1.00 |
| Ice region | B |
| Tower type | Hoekmast |
| Tower height | 48.5 m |
| Max. Span | 396.46 m |
| Line angle | 179.95° |
| Catenary | 1375 m |
| Wind span | 373 m |
| EDS Weight span | 353 m |
| Min. Weight span | 317 m |
| Max. Weight span | 357 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-05-19 | | | |

Client:

Title:

# Berekening masttype HB+0

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

Document name:

GT-RLL380_HB+0_68_Report.pdf

Project number:

Project client number:

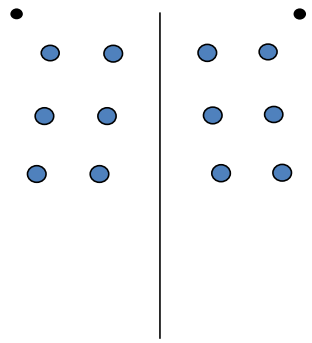
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

## Conductor loads

Auteur: TBR
Versie: v11.8

### General

| | |
|---|---|
| Description | HB+0 |
| Tower type | Hoekmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |



Configuratie geleiders

### Starting points

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

### Conductors back

| Description | Voltage | Conductor Back | Bundle Ba | Ice region | Additional weight | Additional diameter | Catenary $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | ACSR-26/7-242/39-HAWK | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW 226 | 1 | A | 2 % | 2 % | 1375 |

### Conductors ahead

| Description | Voltage | Conductor Ahead | Bundle Ah | Ice region | Additional weight | Additional diameter | Catenary $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1375 |

### Insulators *(1)*

| Description | Suspension | Weight [kN] | Length [m] | Wind area [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Afspanketting | 6.00 | 7.90 | 2.00 |
| Circuit 2 | Afspanketting | 6.00 | 7.90 | 2.00 |
| Bliksemdraad 1 | Afspanketting | 0.10 | 0.20 | 0.10 |
| Bliksemdraad 2 | Afspanketting | 0.10 | 0.20 | 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 | 27.7 m | 27.7 m | -16.3 m |
| Circuit 1 | 11 | 380ct1f2 | 27.7 m | 27.7 m | -9.0 m |
| Circuit 1 | 12 | 380ct1f3 | 39.0 m | 39.0 m | -12.7 m |
| Circuit 2 | 20 | 380ct2f1 | 27.7 m | 27.7 m | 9.0 m |
| Circuit 2 | 21 | 380ct2f2 | 27.7 m | 27.7 m | 16.3 m |
| Circuit 2 | 22 | 380ct2f3 | 39.0 m | 39.0 m | 12.7 m |
| Bliksemdraad 1 | 1 | bl1 | 43.2 m | 43.2 m | -18.7 m |
| Bliksemdraad 2 | 3 | bl2 | 43.2 m | 43.2 m | 18.7 m |

Project: GT-RLL380
Tower: HB+0
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 | 0.0 m | (negative: decrease, more weight span) |

Decrease: Niet in 0,9EG-combinaties

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

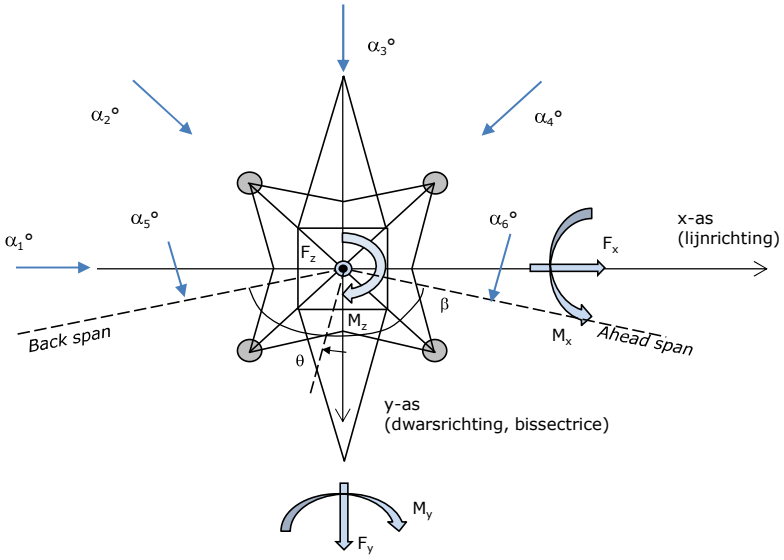
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Circuit 1 | 11 | 380ct1f2 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Circuit 1 | 12 | 380ct1f3 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Circuit 2 | 20 | 380ct2f1 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Circuit 2 | 21 | 380ct2f2 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Circuit 2 | 22 | 380ct2f3 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Bliksemdraad 1 | 1 | bl1 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Bliksemdraad 2 | 3 | bl2 | 0.0 | 5.0 m | 0.0 | 0.0 m |

**Line and tower data**

| | | Back | Ahead |
|---|---|---|---|
| | | 396.5 | 348.8 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 385.2 | 348.8 m |
| Line angle | $\beta$ | 179.95 ° | |
| Tower orientation with respect to bis | $\theta$ | -16 ° | |
| Section length | | 2305 | 349 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 ° | |
| | $\alpha_5$ | 105.975 ° | |
| | $\alpha_6$ | 106.025 ° | |

*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: GT-RLL380
Tower: HB+0
Number: 68

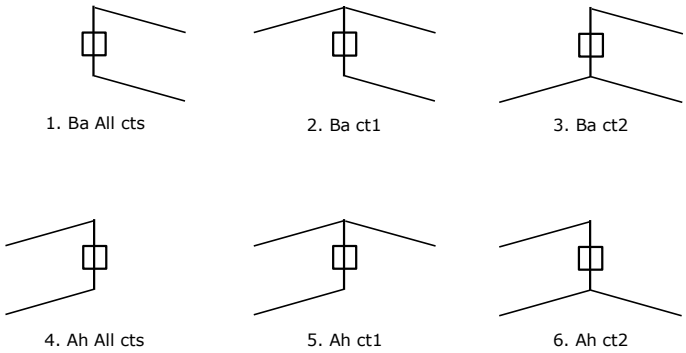
**Absence of conductors**

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

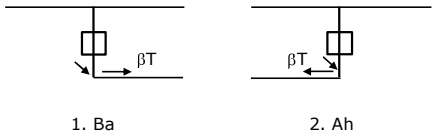
Principle of load situations:




**Load situation 5a. Conductor failure**

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

Principle of load situations:



Project: GT-RLL380
Tower: HB+0
Number: 68

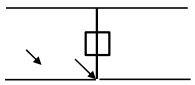
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able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

| | Phase | Earth |
|---|---|---|
| Line vehicle | 4.0 kN | 2.0 kN |
| Concentrated load cross arm | 1.0 kN | 1.0 kN |

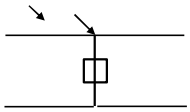
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

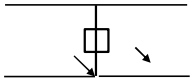
Principle of load situations:



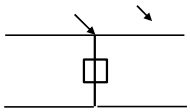
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

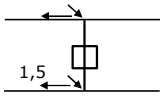
**Load situations 8. Galloping as a static load**

| 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 |

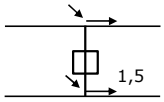
Considered situations galloping 8: None (existing structure)

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: GT-RLL380
Tower: HB+0
Number: 68

## Tower structure

### Properties

| | | |
|---|---|---|
| Tower type | Hoekmast | |
| Tower designation | HB+0 | |
| Base plate w.r.t. ground level | 0.5 | m |
| Tower height w.r.t. base plate | 48.5 | m |
| Tower self weight | 450.0 | 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 | 1.3 | 1.3 | - |

### Calculation Wind load

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

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 9.60 | 11.00 | 8.00 | 9.60 | 0.156 | 91.20 | 7.50 | 0.08 | 3.50 |
| Eerste tussenstuk | 18.90 | 8.00 | 5.84 | 9.30 | 0.116 | 64.36 | 7.88 | 0.12 | 3.29 |
| Tweede tussenstuk | 27.70 | 5.84 | 3.78 | 8.80 | 0.117 | 42.33 | 8.02 | 0.19 | 2.98 |
| Bovenstuk 1 | 35.50 | 3.78 | 3.18 | 7.80 | 0.038 | 27.14 | 5.89 | 0.22 | 2.86 |
| Bovenstuk 2 | 43.00 | 3.18 | 2.60 | 7.50 | 0.039 | 21.68 | 5.48 | 0.25 | 2.71 |
| Topstuk | 45.00 | 2.60 | | 2.00 | | 2.60 | 0.50 | 0.19 | 2.96 |
| Ondertraverse | 27.70 | 14.46 | | 4.00 | | 28.92 | 5.94 | 0.21 | 2.91 |
| Boventraverse | 39.00 | 17.19 | | 4.20 | | 36.10 | 7.84 | 0.22 | 2.86 |

### 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 | 9.60 | 11.00 | 8.00 | 9.60 | 0.156 | 91.20 | 7.50 | 0.08 | 3.50 |
| Eerste tussenstuk | 18.90 | 8.00 | 5.84 | 9.30 | 0.116 | 64.36 | 7.88 | 0.12 | 3.29 |
| Tweede tussenstuk | 27.70 | 5.84 | 3.78 | 8.80 | 0.117 | 42.33 | 8.02 | 0.19 | 2.98 |
| Bovenstuk 1 | 35.50 | 3.78 | 3.18 | 7.80 | 0.038 | 27.14 | 5.89 | 0.22 | 2.86 |
| Bovenstuk 2 | 43.00 | 3.18 | 2.60 | 7.50 | 0.039 | 21.68 | 5.48 | 0.25 | 2.71 |
| Topstuk | 45.00 | 2.60 | | 2.00 | | 2.60 | 0.50 | 0.19 | 2.96 |
| Ondertraverse | 27.70 | 14.46 | | 4.00 | | 28.92 | 5.94 | 0.21 | 2.91 |
| Boventraverse | 39.00 | 17.19 | | 4.20 | | 36.10 | 7.84 | 0.22 | 2.86 |

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

Project: GT-RLL380
Tower: HB+0
Number: 68

**Wind surface feeders telecom installations**

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

**Input antennas**

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

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

| Description | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0.70 | 18.4 | 15.6 | 0.0 | -15.6 | 4.8 | 88.3 | 74.9 | 0.0 | -74.9 |
| Eerste tussenstuk | 0.79 | 20.5 | 17.4 | 0.0 | -17.4 | 14.3 | 291.8 | 247.6 | 0.0 | -247.6 |
| Tweede tussenstuk | 0.92 | 21.9 | 18.6 | 0.0 | -18.6 | 23.3 | 511.3 | 433.8 | 0.0 | -433.8 |
| Bovenstuk 1 | 1.01 | 17.0 | 14.4 | 0.0 | -14.4 | 31.6 | 535.8 | 454.6 | 0.0 | -454.6 |
| Bovenstuk 2 | 1.06 | 15.8 | 13.4 | 0.0 | -13.4 | 39.3 | 620.8 | 526.7 | 0.0 | -526.7 |
| Topstuk | 1.10 | 1.6 | 1.4 | 0.0 | -1.4 | 44.0 | 71.6 | 60.8 | 0.0 | -60.8 |
| Ondertraverse | 0.98 | 33.8 | 20.1 | 0.0 | -20.1 | 29.0 | 982.3 | 583.4 | 0.0 | -583.4 |
| Boventraverse | 1.07 | 48.1 | 28.6 | 0.0 | -28.6 | 40.4 | 1942.6 | 1153.8 | 0.0 | -1153.8 |
| Totaal | | 177.1 | 129.5 | 0.0 | -129.5 | | 5044.3 | 3535.7 | 0.0 | -3535.7 |

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

| Description | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0.70 | 0.0 | 15.6 | 18.4 | 15.6 | 4.8 | 0.0 | 74.9 | 88.3 | 74.9 |
| Eerste tussenstuk | 0.79 | 0.0 | 17.4 | 20.5 | 17.4 | 14.3 | 0.0 | 247.6 | 291.8 | 247.6 |
| Tweede tussenstuk | 0.92 | 0.0 | 18.6 | 21.9 | 18.6 | 23.3 | 0.0 | 433.8 | 511.3 | 433.8 |
| Bovenstuk 1 | 1.01 | 0.0 | 14.4 | 17.0 | 14.4 | 31.6 | 0.0 | 454.6 | 535.8 | 454.6 |
| Bovenstuk 2 | 1.06 | 0.0 | 13.4 | 15.8 | 13.4 | 39.3 | 0.0 | 526.7 | 620.8 | 526.7 |
| Topstuk | 1.10 | 0.0 | 1.4 | 1.6 | 1.4 | 44.0 | 0.0 | 60.8 | 71.6 | 60.8 |
| Ondertraverse | 0.98 | 0.0 | 20.1 | 13.5 | 20.1 | 29.0 | 0.0 | 583.4 | 392.9 | 583.4 |
| Boventraverse | 1.07 | 0.0 | 28.6 | 19.2 | 28.6 | 40.4 | 0.0 | 1153.8 | 777.0 | 1153.8 |
| Total | | 0.0 | 129.5 | 128.0 | 129.5 | | 0.0 | 3535.7 | 3289.5 | 3535.7 |

**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 | 450 | 0 | 0 | 0 |
| Windrichting 0° | 177 | 0 | 0 | 0 | 5044 | 0 |
| Windrichting 45° | 129 | 129 | 0 | 3536 | 3536 | 0 |
| Windrichting 90° | 0 | 128 | 0 | 3289 | 0 | 0 |
| Windrichting 135° | -129 | 129 | 0 | 3536 | -3536 | 0 |

Project: GT-RLL380
Tower: HB+0
Number: 68

**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 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-05 |
| Circuit 2 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-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 | ACCC-Warsaw | 27.7 | 571.0 | 14.98 | 62700 | 1.88E-05 |
| Circuit 2 | ACCC-Warsaw | 27.7 | 571.0 | 14.98 | 62700 | 1.88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21.8 | 281.0 | 9.38 | 70165 | 1.97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21.7 | 264.0 | 9.13 | 72000 | 1.98E-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 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Circuit 2 | 3 | 2 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Bliksemdraad 1 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |

**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 | 9.6 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 9.3 | A | 15+0,4d | 23.7 | 23.7 |

**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 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct1f2 | 6.00 | 1 | 6 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct1f3 | 6.00 | 1 | 6 | 7.9 | 2.0 | 39.50 | 1.07 | 1.2 | 2.56 |
| 380ct2f1 | 6.00 | 1 | 6 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct2f2 | 6.00 | 1 | 6 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct2f3 | 6.00 | 1 | 6 | 7.9 | 2.0 | 39.50 | 1.07 | 1.2 | 2.56 |
| bl1 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 43.70 | 1.10 | 1.2 | 0.13 |
| bl2 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 43.70 | 1.10 | 1.2 | 0.13 |

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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 | 18.7 | 0.86 | 0.54 | 0.48 | 1.13 | 28.50 | 45.3 | 40.0 | 47.2 | 79.5 | 70.2 |
| 380ct1f2 | 18.7 | 0.86 | 0.54 | 0.48 | 1.13 | 28.50 | 45.3 | 40.0 | 47.2 | 79.5 | 70.2 |
| 380ct1f3 | 30.0 | 0.99 | 0.58 | 0.51 | 1.09 | 28.50 | 53.9 | 47.5 | 47.2 | 97.7 | 86.2 |
| 380ct2f1 | 18.7 | 0.86 | 0.54 | 0.48 | 1.13 | 28.50 | 45.3 | 40.0 | 47.2 | 79.5 | 70.2 |
| 380ct2f2 | 18.7 | 0.86 | 0.54 | 0.48 | 1.13 | 28.50 | 45.3 | 40.0 | 47.2 | 79.5 | 70.2 |
| 380ct2f3 | 30.0 | 0.99 | 0.58 | 0.51 | 1.09 | 28.50 | 53.9 | 47.5 | 47.2 | 97.7 | 86.2 |
| bl1 | 34.2 | 1.03 | 0.59 | 0.52 | 1.20 | 22.24 | 16.2 | 14.3 | 63.1 | 46.1 | 40.6 |
| bl2 | 34.2 | 1.03 | 0.59 | 0.52 | 1.20 | 22.13 | 16.1 | 14.2 | 63.0 | 46.0 | 40.6 |

**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 | 23.3 | 0.92 | 0.56 | 0.63 | 1.12 | 28.25 | 49.0 | 54.6 | 46.9 | 87.4 | 97.3 |
| 380ct1f2 | 23.3 | 0.92 | 0.56 | 0.63 | 1.12 | 28.25 | 49.0 | 54.6 | 46.9 | 87.4 | 97.3 |
| 380ct1f3 | 34.6 | 1.03 | 0.59 | 0.66 | 1.09 | 28.25 | 56.4 | 62.7 | 46.9 | 103.3 | 114.9 |
| 380ct2f1 | 23.3 | 0.92 | 0.56 | 0.63 | 1.12 | 28.25 | 49.0 | 54.6 | 46.9 | 87.4 | 97.3 |
| 380ct2f2 | 23.3 | 0.92 | 0.56 | 0.63 | 1.12 | 28.25 | 49.0 | 54.6 | 46.9 | 87.4 | 97.3 |
| 380ct2f3 | 34.6 | 1.03 | 0.59 | 0.66 | 1.09 | 28.25 | 56.4 | 62.7 | 46.9 | 103.3 | 114.9 |
| bl1 | 38.8 | 1.06 | 0.60 | 0.67 | 1.20 | 22.24 | 17.1 | 19.0 | 63.1 | 48.5 | 54.0 |
| bl2 | 38.8 | 1.06 | 0.60 | 0.67 | 1.20 | 22.13 | 17.0 | 18.9 | 63.0 | 48.4 | 53.9 |

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Auteur: TBR
Versie: v11.8

**Conductor loads**

**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 | 0.90 | 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 | 5238 |

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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 | -41.4 | 39.8 | 0.1 | 14.4 | 6.6 | 5.2 |
| 380ct1f1 | -103.7 | 104.3 | 1.7 | 39.4 | 21.9 | 19.3 |
| 380ct1f2 | -103.7 | 104.3 | 1.7 | 39.4 | 21.9 | 19.3 |
| 380ct1f3 | -105.9 | 106.8 | 1.7 | 43.0 | 21.9 | 19.2 |
| 380ct2f1 | -103.7 | 104.3 | 1.7 | 39.4 | 21.9 | 19.3 |
| 380ct2f2 | -103.7 | 104.3 | 1.7 | 39.4 | 21.9 | 19.3 |
| 380ct2f3 | -105.9 | 106.8 | 1.7 | 43.0 | 21.9 | 19.2 |
| bl2 | -41.7 | 39.3 | 0.1 | 14.3 | 6.6 | 5.1 |
| V-ketting 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| V-ketting 2 | 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 | 334.9 | 349.6 | 352.9 |
| 380ct1f1 | 344.3 | 350.4 | 352.9 |
| 380ct1f2 | 344.3 | 350.4 | 352.9 |
| 380ct1f3 | 342.2 | 350.3 | 352.9 |
| 380ct2f1 | 344.3 | 350.4 | 352.9 |
| 380ct2f2 | 344.3 | 350.4 | 352.9 |
| 380ct2f3 | 342.2 | 350.3 | 352.9 |
| bl2 | 334.3 | 349.6 | 352.9 |
| V-ketting 1 | | | |
| V-ketting 2 | | | |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 352.8 | 355.7 |
| 380ct1f1 | 353.0 | 353.2 |
| 380ct1f2 | 353.0 | 353.2 |
| 380ct1f3 | 352.9 | 353.2 |
| 380ct2f1 | 353.0 | 353.2 |
| 380ct2f2 | 353.0 | 353.2 |
| 380ct2f3 | 352.9 | 353.2 |
| bl2 | 352.8 | 355.8 |
| V-ketting 1 | | |
| V-ketting 2 | | |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 355.8 m | 0.955 - |
| Min. weight span | 325.6 m | 0.874 - |

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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 | 28.2 | 9.2 | 6.6 | -42.2 | 42.3 |
| 380ct1f1 | 96.1 | 33.4 | 21.9 | -106.1 | 110.3 |
| 380ct1f2 | 96.1 | 33.4 | 21.9 | -106.1 | 110.3 |
| 380ct1f3 | 96.3 | 35.8 | 21.9 | -108.1 | 113.1 |
| 380ct2f1 | 96.1 | 33.4 | 21.9 | -106.1 | 110.3 |
| 380ct2f2 | 96.1 | 33.4 | 21.9 | -106.1 | 110.3 |
| 380ct2f3 | 96.3 | 35.8 | 21.9 | -108.1 | 113.1 |
| bl2 | 28.3 | 9.1 | 6.6 | -42.5 | 41.7 |
| V-ketting 1 | 1.9 | 1.9 | 3.5 | 0.0 | |
| V-ketting 2 | 1.9 | 1.9 | 3.5 | 0.0 | |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 12.6 | 3.6 | 2.1 | -13.8 | 13.1 |
| 380ct1f1 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct1f2 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct1f3 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct2f1 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct2f2 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct2f3 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| bl2 | 12.3 | 3.5 | 2.1 | -13.7 | 12.8 |
| V-ketting 1 | 0.0 | 0.0 | 3.0 | 0.0 | |
| V-ketting 2 | 0.0 | 0.0 | 3.0 | 0.0 | |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 0.0 | 0.0 |
| | 380ct1f1 | 0.0 | 0.0 |
| | 380ct1f2 | 0.0 | 0.0 |
| | 380ct1f3 | 0.0 | 0.0 |
| | 380ct2f1 | 0.0 | 0.0 |
| | 380ct2f2 | 0.0 | 0.0 |
| | 380ct2f3 | 0.0 | 0.0 |
| | bl2 | 0.0 | 0.0 |
| | V-ketting 1 | 0.0 | |
| | V-ketting 2 | 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 | | 38 | 178 | 188 | 5889 | 1225 | -5 |
| ULS 1a_0,9_0 | | 9 | -12 | 190 | -330 | 246 | 36 |
| ULS 1a_0,9_0,9_90 | | 44 | 180 | 160 | 5939 | 1436 | -4 |
| ULS 3_0 | | 3 | -6 | 266 | -144 | 36 | -2 |
| SLS 7 | | 0 | 0 | 182 | 74 | -7 | -6 |

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

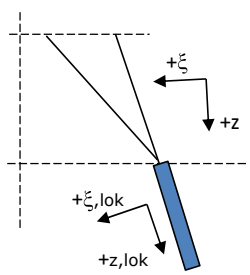
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 38 | 321 | 660 | 9562 | 1225 | -5 |
| ULS 1a_0,9_0,9_90 | 44 | 323 | 565 | 9612 | 1436 | -4 |
| SLS 7 | 0 | 0 | 632 | 74 | -7 | -6 |

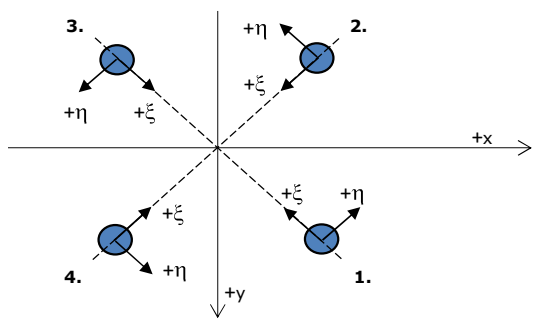
**Foundation loads, selection of load combinations based on greatest value**

| 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_106.025 | 6 | 344 | 565 | **10305** | 463 | -16 |
| SPLS 3_105.975 Ba All Cts | 578 | 252 | 611 | 7973 | **18984** | -10 |
| SPLS 6a_90 Ba Ct1 Ah Ct1 | 315 | 150 | 667 | 4923 | 10243 | **-4195** |
| SPLS 3_105.975 Ba All Cts | 578 | 252 | 611 | **7973** | **18984** | -10 |

*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 3_105.975 Ba All Cts | 249 | 270 | **1378** | -15 | -367 | -62 | 1411 |
| 2 | SPLS 1a_0 Ba All Cts | 133 | -162 | **764** | 20 | -209 | -40 | 782 |
| 3 | SPLS 3_135 Ah All Cts | -205 | -227 | **1143** | -16 | -305 | -52 | 1171 |
| 4 | SPLS 1a_135 Ah All Cts | -178 | 204 | **991** | 18 | -270 | -51 | 1015 |

**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 | -145 | -166 | **-846** | 15 | 220 | 33 | -867 |
| 2 | SPLS 1a_0,9_135 Ah All Cts | -118 | 146 | **-700** | -19 | 187 | 32 | -717 |
| 3 | SPLS 3_0,9_105.975 Ba All Cts | 191 | 211 | **-1089** | 14 | 284 | 43 | -1116 |
| 4 | SPLS 1a_0,9_0 Ba All Cts | 77 | -103 | **-480** | -18 | 127 | 21 | -492 |

**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 Ct1 Ah Ct2 | 114 | -85 | 74 | **141** | -21 | -5 | 76 |
| 2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -24 | -186 | 426 | **149** | -114 | -20 | 436 |
| 3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -8 | 193 | -505 | **142** | 131 | 19 | -517 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -10 | 213 | 583 | **143** | -158 | -29 | 597 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 63 | 261 | 856 | **-140** | -229 | -40 | 877 |
| 2 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 60 | 144 | -238 | **-145** | 60 | 7 | -244 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | -30 | -228 | 682 | **-140** | -182 | -32 | 699 |
| 4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | -96 | -119 | -75 | **-152** | 16 | -1 | -77 |

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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 Ct1 | -100 | -177 | **-766** | **55** | 196 | 27 | -785 |
| 2 | SPLS 1a_0,9_135 Ah Ct2 | -9 | 166 | **-455** | **-111** | 124 | 23 | -466 |
| 3 | SPLS 3_0,9_105.975 Ba All Cts | 191 | 211 | **-1089** | **14** | 284 | 43 | -1116 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 72 | -104 | **-475** | **-23** | 124 | 19 | -487 |

**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 | 33 | 32 | 161 | 0 | -46 | -10 | 165 |
| 2 | SLS 7 | 32 | -32 | 154 | 0 | -45 | -11 | 158 |
| 3 | SLS 7 | -31 | -32 | 155 | -1 | -45 | -11 | 159 |
| 4 | SLS 7 | -33 | 32 | 162 | 0 | -46 | -10 | 166 |

**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 3_105.975 Ba All Cts | 249 | 270 | **1378** | -15 | -367 | -62 | 1411 |
| Max. tension | SPLS 3_0,9_105.975 Ba All Cts | 191 | 211 | **-1089** | 14 | 284 | 43 | -1116 |
| Max. pos. torsie | SPLS 6a_90 Ba Ct2 Ah Ct2 | -24 | -186 | 426 | **149** | -114 | -20 | 436 |
| Max. neg. torsie | SPLS 6a_90 Ba Ct1 Ah Ct1 | -96 | -119 | -75 | **-152** | 16 | -1 | -77 |
| Comb. tension+torsie | SPLS 3_0,9_105.975 Ba All Cts | 191 | 211 | **-1089** | **14** | 284 | 43 | -1116 |

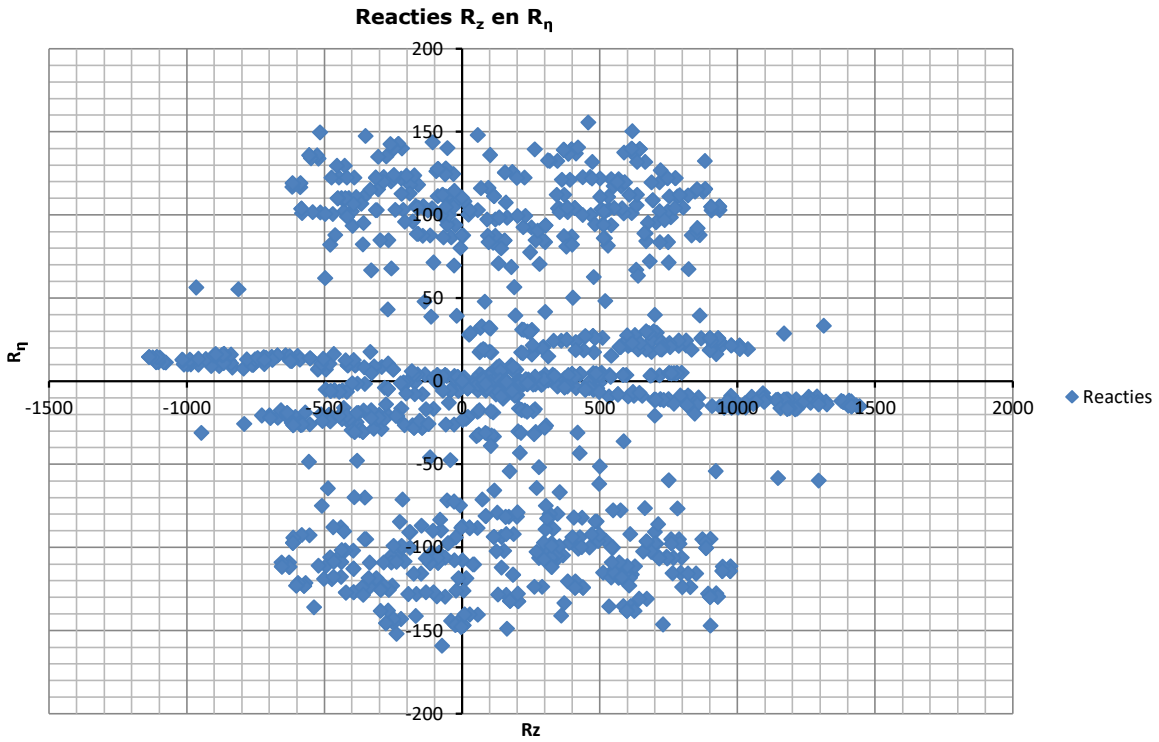
**Maximum tension load - SLS**

| 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 | 33 | 32 | **161** | 0 | -46 | -10 | 165 |
| 2 | SLS 1a_135 | -62 | 55 | **-303** | 5 | 83 | 16 | -311 |
| 3 | SLS 1a_90 | 50 | 45 | **-253** | -4 | 67 | 11 | -260 |
| 4 | SLS 1a_0 | 15 | -16 | **-80** | -1 | 21 | 4 | -81 |

**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_90 | 114 | 109 | **568** | 4 | -157 | -32 | 582 |
| 2 | SLS 1a_0 | 77 | -81 | **396** | 3 | -112 | -25 | 405 |
| 3 | SLS 7 | -31 | -32 | **155** | -1 | -45 | -11 | 159 |
| 4 | SLS 1a_135 | -127 | 118 | **618** | -7 | -173 | -36 | 633 |

Project: GT-RLL380
Tower: HB+0
Number: 68



Project: GT-RLL380
Tower: HB+0
Number: 68

**Conductor loads**

Auteur: TBR
Versie: v11.8

**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 | 0.90 | 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 | 5238 |

Project: GT-RLL380
Tower: HB+0
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 | -50.9 | 48.5 | 0.1 | 17.7 | 8.5 | 6.7 |
| 380ct1f1 | -120.5 | 121.2 | 1.7 | 47.0 | 24.7 | 21.0 |
| 380ct1f2 | -120.5 | 121.2 | 1.7 | 47.0 | 24.7 | 21.0 |
| 380ct1f3 | -123.4 | 124.3 | 1.7 | 51.5 | 24.7 | 21.0 |
| 380ct2f1 | -120.5 | 121.2 | 1.7 | 47.0 | 24.7 | 21.0 |
| 380ct2f2 | -120.5 | 121.2 | 1.7 | 47.0 | 24.7 | 21.0 |
| 380ct2f3 | -123.4 | 124.3 | 1.7 | 51.5 | 24.7 | 21.0 |
| bl2 | -51.2 | 47.8 | 0.1 | 17.5 | 8.5 | 6.7 |
| V-ketting 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| V-ketting 2 | 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 | 333.4 | 349.5 | 352.9 |
| 380ct1f1 | 343.5 | 350.3 | 352.9 |
| 380ct1f2 | 343.5 | 350.3 | 352.9 |
| 380ct1f3 | 341.2 | 350.2 | 352.9 |
| 380ct2f1 | 343.5 | 350.3 | 352.9 |
| 380ct2f2 | 343.5 | 350.3 | 352.9 |
| 380ct2f3 | 341.2 | 350.2 | 352.9 |
| bl2 | 332.8 | 349.4 | 352.9 |
| V-ketting 1 | | | |
| V-ketting 2 | | | |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 353.0 | 356.7 |
| 380ct1f1 | 353.1 | 353.7 |
| 380ct1f2 | 353.1 | 353.7 |
| 380ct1f3 | 353.1 | 353.7 |
| 380ct2f1 | 353.1 | 353.7 |
| 380ct2f2 | 353.1 | 353.7 |
| 380ct2f3 | 353.1 | 353.7 |
| bl2 | 353.0 | 356.8 |
| V-ketting 1 | | |
| V-ketting 2 | | |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 356.8 m | 0.957 - |
| Min. weight span | 317.1 m | 0.851 - |

Project: GT-RLL380
Tower: HB+0
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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 | 29.3 | 10.2 | 8.5 | -51.8 | 51.5 |
| 380ct1f1 | 101.0 | 35.3 | 24.7 | -123.2 | 128.3 |
| 380ct1f2 | 101.0 | 35.3 | 24.7 | -123.2 | 128.3 |
| 380ct1f3 | 101.2 | 39.6 | 24.7 | -125.7 | 131.8 |
| 380ct2f1 | 101.0 | 35.3 | 24.7 | -123.2 | 128.3 |
| 380ct2f2 | 101.0 | 35.3 | 24.7 | -123.2 | 128.3 |
| 380ct2f3 | 101.2 | 39.6 | 24.7 | -125.7 | 131.8 |
| bl2 | 29.3 | 10.0 | 8.5 | -52.2 | 50.8 |
| V-ketting 1 | 2.4 | 2.4 | 3.9 | 0.0 | |
| V-ketting 2 | 2.4 | 2.4 | 3.9 | 0.0 | |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 12.6 | 3.6 | 2.1 | -13.8 | 13.1 |
| 380ct1f1 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct1f2 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct1f3 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct2f1 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct2f2 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| 380ct2f3 | 60.6 | 17.4 | 15.0 | -62.7 | 63.0 |
| bl2 | 12.3 | 3.5 | 2.1 | -13.7 | 12.8 |
| V-ketting 1 | 0.0 | 0.0 | 3.0 | 0.0 | |
| V-ketting 2 | 0.0 | 0.0 | 3.0 | 0.0 | |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 0.0 | 0.0 |
| | 380ct1f1 | 0.0 | 0.0 |
| | 380ct1f2 | 0.0 | 0.0 |
| | 380ct1f3 | 0.0 | 0.0 |
| | 380ct2f1 | 0.0 | 0.0 |
| | 380ct2f2 | 0.0 | 0.0 |
| | 380ct2f3 | 0.0 | 0.0 |
| | bl2 | 0.0 | 0.0 |
| | V-ketting 1 | 0.0 | |
| | V-ketting 2 | 0.0 | |

Project: GT-RLL380
Tower: HB+0
Number: 68

**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 | | 49 | 224 | 205 | 7383 | 1578 | -6 |
| ULS 1a_0,9_0 | | 11 | -15 | 208 | -430 | 310 | 46 |
| ULS 1a_0,9_0,9_90 | | 60 | 227 | 159 | 7465 | 1928 | -5 |
| ULS 3_0 | | 2 | -8 | 311 | -207 | -3 | -1 |
| SLS 7 | | 0 | 0 | 182 | 74 | -7 | -6 |

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

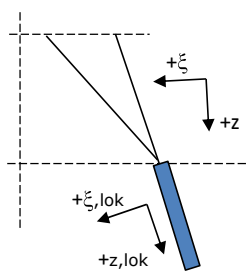
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 49 | 403 | 723 | 11988 | 1578 | -6 |
| ULS 1a_0,9_0,9_90 | 60 | 406 | 564 | 12071 | 1928 | -5 |
| SLS 7 | 0 | 0 | 632 | 74 | -7 | -6 |

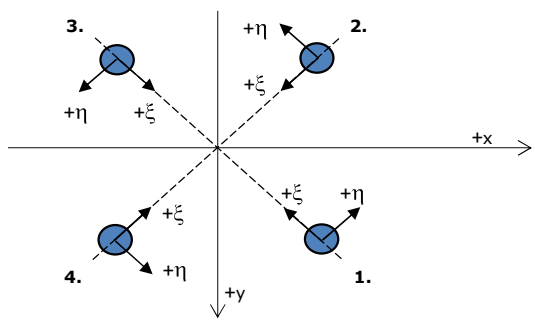
**Foundation loads, selection of load combinations based on greatest value**

| 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_106.025 | 10 | 433 | 563 | **12932** | 682 | -20 |
| SPLS 3_135 Ah All Cts | -620 | -90 | 687 | -3098 | **-19884** | -13 |
| SPLS 6a_90 Ba Ct1 Ah Ct1 | 331 | 154 | 728 | 5108 | 10731 | **-4403** |
| SPLS 3_105.975 Ba All Cts | 606 | 260 | 668 | **8229** | **19854** | -10 |

*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 3_105.975 Ba All Cts | 261 | 283 | **1444** | -15 | -384 | -65 | 1478 |
| 2 | SPLS 1a_0 Ba All Cts | 142 | -172 | **814** | 21 | -222 | -42 | 833 |
| 3 | SPLS 3_135 Ah All Cts | -218 | -241 | **1216** | -16 | -325 | -56 | 1246 |
| 4 | SPLS 1a_135 Ah All Cts | -186 | 213 | **1037** | 19 | -283 | -53 | 1062 |

**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 | -155 | -177 | **-902** | 15 | 234 | 35 | -924 |
| 2 | SPLS 1a_0,9_135 Ah All Cts | -122 | 152 | **-728** | -21 | 194 | 33 | -745 |
| 3 | SPLS 3_0,9_105.975 Ba All Cts | 199 | 220 | **-1137** | 15 | 296 | 45 | -1165 |
| 4 | SPLS 1a_0,9_0 Ba All Cts | 82 | -110 | **-513** | -20 | 136 | 22 | -525 |

**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 Ct1 Ah Ct2 | 116 | -93 | 56 | **148** | -16 | -4 | 58 |
| 2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -23 | -197 | 458 | **156** | -123 | -22 | 469 |
| 3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -11 | 200 | -517 | **150** | 134 | 20 | -529 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -12 | 224 | 617 | **150** | -167 | -31 | 632 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 67 | 275 | 902 | **-147** | -241 | -42 | 924 |
| 2 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 65 | 150 | -239 | **-152** | 60 | 7 | -244 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | -34 | -241 | 729 | **-146** | -195 | -34 | 747 |
| 4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | -102 | -124 | -74 | **-159** | 16 | -1 | -75 |

Project: GT-RLL380
Tower: HB+0
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 | SPLS 6a_90 Ah All Cts Ba Ct1 | -108 | -186 | **-813** | **55** | 208 | 28 | -833 |
| 2 | SPLS 1a_0,9_135 Ah Ct2 | -6 | 173 | **-467** | **-118** | 127 | 24 | -478 |
| 3 | SPLS 3_0,9_105.975 Ba All Cts | 199 | 220 | **-1137** | **15** | 296 | 45 | -1165 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 77 | -111 | **-508** | **-24** | 133 | 20 | -520 |

**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 | 33 | 32 | 161 | 0 | -46 | -10 | 165 |
| 2 | SLS 7 | 32 | -32 | 154 | 0 | -45 | -11 | 158 |
| 3 | SLS 7 | -31 | -32 | 155 | -1 | -45 | -11 | 159 |
| 4 | SLS 7 | -33 | 32 | 162 | 0 | -46 | -10 | 166 |

**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 3_105.975 Ba All Cts | 261 | 283 | **1444** | -15 | -384 | -65 | 1478 |
| Max. tension | SPLS 3_0,9_105.975 Ba All Cts | 199 | 220 | **-1137** | 15 | 296 | 45 | -1165 |
| Max. pos. torsie | SPLS 6a_90 Ba Ct2 Ah Ct2 | -23 | -197 | 458 | **156** | -123 | -22 | 469 |
| Max. neg. torsie | SPLS 6a_90 Ba Ct1 Ah Ct1 | -102 | -124 | -74 | **-159** | 16 | -1 | -75 |
| Comb. tension+torsie | SPLS 3_0,9_105.975 Ba All Cts | 199 | 220 | **-1137** | **15** | 296 | 45 | -1165 |

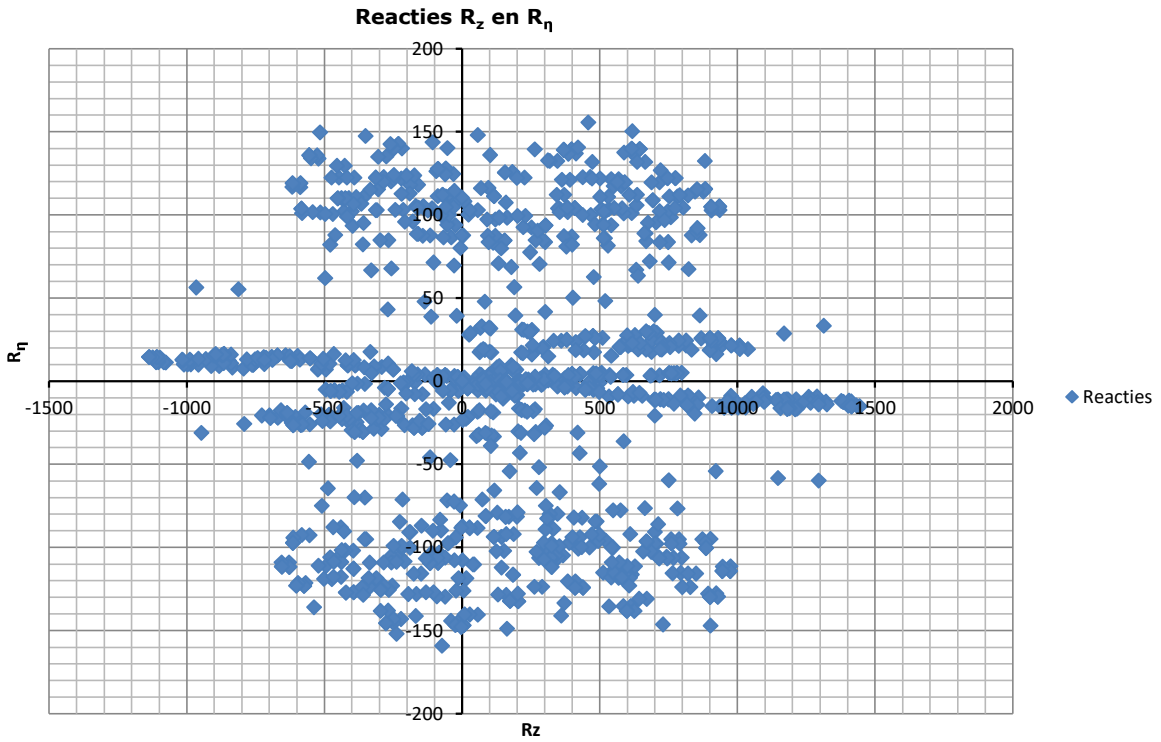
**Maximum tension load - SLS**

| 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 | 33 | 32 | **161** | 0 | -46 | -10 | 165 |
| 2 | SLS 1a_135 | -67 | 60 | **-329** | 5 | 90 | 17 | -337 |
| 3 | SLS 1a_90 | 55 | 50 | **-281** | -4 | 74 | 12 | -288 |
| 4 | SLS 1a_0 | 17 | -18 | **-94** | -1 | 25 | 5 | -96 |

**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_90 | 119 | 114 | **595** | 4 | -165 | -33 | 610 |
| 2 | SLS 1a_0 | 80 | -84 | **410** | 3 | -116 | -26 | 420 |
| 3 | SLS 7 | -31 | -32 | **155** | -1 | -45 | -11 | 159 |
| 4 | SLS 1a_135 | -132 | 123 | **644** | -7 | -180 | -38 | 660 |

Project: GT-RLL380
Tower: HB+0
Number: 68



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24.5 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1.00 |
| Ice region | B |
| Tower type | Hoekmast |
| Tower height | 48.5 m |
| Max. Span | 398 m |
| Line angle | 174.8° |
| Catenary | 1375 m |
| Wind span | 377 m |
| EDS Weight span | 377 m |
| Min. Weight span | 338 m |
| Max. Weight span | 377 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-05-21 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype HB+0

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

Document name:

GT-RLL380_HB+0_78_Report.pdf

Project number:

Project client number:

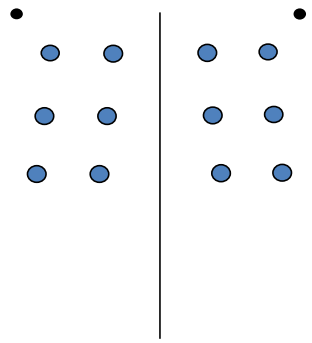
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

## Conductor loads

Auteur: TBR
Versie: v11.8

### General

| | |
|---|---|
| Description | HB+0 |
| Tower type | Hoekmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |



Configuratie geleiders

### Starting points

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

### Conductors back

| Description | Voltage | Conductor Back | Bundle Ba | Ice region | Additional weight | Additional diameter | Catenary $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1375 |

### Conductors ahead

| Description | Voltage | Conductor Ahead | Bundle Ah | Ice region | Additional weight | Additional diameter | Catenary $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | ACSR-26/7-242/39-HAWK | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW 226 | 1 | A | 2 % | 2 % | 1375 |

### Insulators *(1)*

| Description | Suspension | Weight [kN] | Length [m] | Wind area [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Afspanketting | 6.00 | 7.90 | 2.00 |
| Circuit 2 | Afspanketting | 6.00 | 7.90 | 2.00 |
| Bliksemdraad 1 | Afspanketting | 0.10 | 0.20 | 0.10 |
| Bliksemdraad 2 | Afspanketting | 0.10 | 0.20 | 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 | 27.7 m | 27.7 m | -16.3 m |
| Circuit 1 | 11 | 380ct1f2 | 27.7 m | 27.7 m | -9.0 m |
| Circuit 1 | 12 | 380ct1f3 | 39.0 m | 39.0 m | -12.7 m |
| Circuit 2 | 20 | 380ct2f1 | 27.7 m | 27.7 m | 9.0 m |
| Circuit 2 | 21 | 380ct2f2 | 27.7 m | 27.7 m | 16.3 m |
| Circuit 2 | 22 | 380ct2f3 | 39.0 m | 39.0 m | 12.7 m |
| Bliksemdraad 1 | 1 | bl1 | 43.2 m | 43.2 m | -18.7 m |
| Bliksemdraad 2 | 3 | bl2 | 43.2 m | 43.2 m | 18.7 m |

Project: GT-RLL380
Tower: HB+0
Number: 78

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

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

Decrease: Niet in 0,9EG-combinaties

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

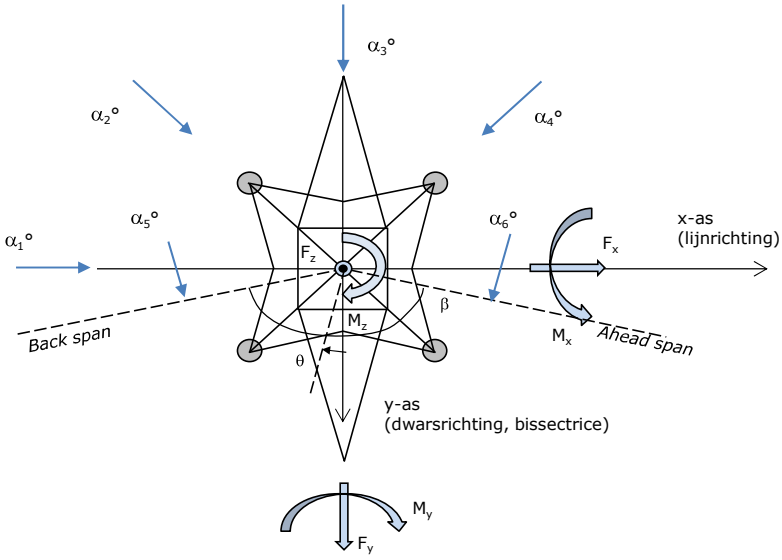
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 1 | 11 | 380ct1f2 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 1 | 12 | 380ct1f3 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 2 | 20 | 380ct2f1 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 2 | 21 | 380ct2f2 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 2 | 22 | 380ct2f3 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Bliksemdraad 1 | 1 | bl1 | 0.0 | 5.0 m | 0.0 | 0.0 m |
| Bliksemdraad 2 | 3 | bl2 | 0.0 | 5.0 m | 0.0 | 0.0 m |

**Line and tower data**

| | | Back | Ahead |
|---|---|---|---|
| | | 356.7 | 398.0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 356.7 | 387.7 m |
| Line angle | $\beta$ | 174.8 ° | |
| Tower orientation with respect to bis | $\theta$ | 13 ° | |
| Section length | | 357 | 1932 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 ° | |
| | $\alpha_5$ | 74.4 ° | |
| | $\alpha_6$ | 79.6 ° | |

*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 | 6 |
| 3 | 6 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

Project: GT-RLL380
Tower: HB+0
Number: 78

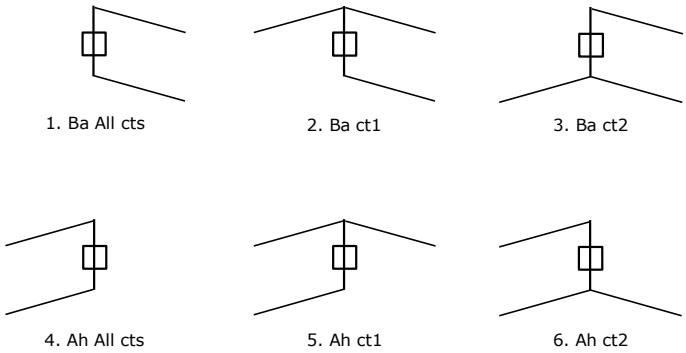
**Absence of conductors**

| | | 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

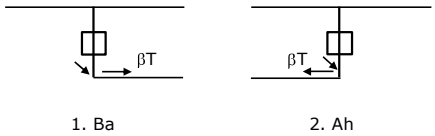
Principle of load situations:




**Load situation 5a. Conductor failure**

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

Principle of load situations:



Project: GT-RLL380
Tower: HB+0
Number: 78

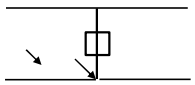
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able 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 | 4.0 kN | 2.0 kN |
| Concentrated load cross arm | 1.0 kN | 1.0 kN |

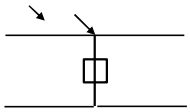
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

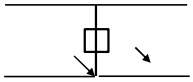
Principle of load situations:



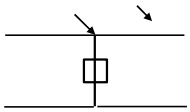
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

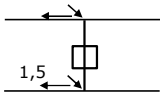
**Load situations 8. Galloping as a static load**

| 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 |

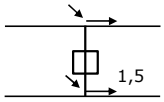
Considered situations galloping 8: None (existing structure)

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: GT-RLL380
Tower: HB+0
Number: 78

**Tower structure**

**Properties**

| | | | |
|---|---|---|---|
| Tower type | Hoekmast | | |
| Tower designation | HB+0 | | |
| Base plate w.r.t. ground level | 0.5 | m | |
| Tower height w.r.t. base plate | 48.5 | m | |
| Tower self weight | 450.0 | 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 | 1.3 | 1.3 | - |

**Calculation Wind load**

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

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 9.60 | 11.00 | 8.00 | 9.60 | 0.156 | 91.20 | 7.50 | 0.08 | 3.50 |
| Eerste tussenstuk | 18.90 | 8.00 | 5.84 | 9.30 | 0.116 | 64.36 | 7.88 | 0.12 | 3.29 |
| Tweede tussenstuk | 27.70 | 5.84 | 3.78 | 8.80 | 0.117 | 42.33 | 8.02 | 0.19 | 2.98 |
| Bovenstuk 1 | 35.50 | 3.78 | 3.18 | 7.80 | 0.038 | 27.14 | 5.89 | 0.22 | 2.86 |
| Bovenstuk 2 | 43.00 | 3.18 | 2.60 | 7.50 | 0.039 | 21.68 | 5.48 | 0.25 | 2.71 |
| Topstuk | 45.00 | 2.60 | | 2.00 | | 2.60 | 0.50 | 0.19 | 2.96 |
| Ondertraverse | 27.70 | 14.46 | | 4.00 | | 28.92 | 5.94 | 0.21 | 2.91 |
| Boventraverse | 39.00 | 17.19 | | 4.20 | | 36.10 | 7.84 | 0.22 | 2.86 |

**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 | 9.60 | 11.00 | 8.00 | 9.60 | 0.156 | 91.20 | 7.50 | 0.08 | 3.50 |
| Eerste tussenstuk | 18.90 | 8.00 | 5.84 | 9.30 | 0.116 | 64.36 | 7.88 | 0.12 | 3.29 |
| Tweede tussenstuk | 27.70 | 5.84 | 3.78 | 8.80 | 0.117 | 42.33 | 8.02 | 0.19 | 2.98 |
| Bovenstuk 1 | 35.50 | 3.78 | 3.18 | 7.80 | 0.038 | 27.14 | 5.89 | 0.22 | 2.86 |
| Bovenstuk 2 | 43.00 | 3.18 | 2.60 | 7.50 | 0.039 | 21.68 | 5.48 | 0.25 | 2.71 |
| Topstuk | 45.00 | 2.60 | | 2.00 | | 2.60 | 0.50 | 0.19 | 2.96 |
| Ondertraverse | 27.70 | 14.46 | | 4.00 | | 28.92 | 5.94 | 0.21 | 2.91 |
| Boventraverse | 39.00 | 17.19 | | 4.20 | | 36.10 | 7.84 | 0.22 | 2.86 |

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

Project: GT-RLL380
Tower: HB+0
Number: 78

**Wind surface feeders telecom installations**

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

**Input antennas**

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

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

| Description | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0.70 | 18.4 | 15.6 | 0.0 | -15.6 | 4.8 | 88.3 | 74.9 | 0.0 | -74.9 |
| Eerste tussenstuk | 0.79 | 20.5 | 17.4 | 0.0 | -17.4 | 14.3 | 291.8 | 247.6 | 0.0 | -247.6 |
| Tweede tussenstuk | 0.92 | 21.9 | 18.6 | 0.0 | -18.6 | 23.3 | 511.3 | 433.8 | 0.0 | -433.8 |
| Bovenstuk 1 | 1.01 | 17.0 | 14.4 | 0.0 | -14.4 | 31.6 | 535.8 | 454.6 | 0.0 | -454.6 |
| Bovenstuk 2 | 1.06 | 15.8 | 13.4 | 0.0 | -13.4 | 39.3 | 620.8 | 526.7 | 0.0 | -526.7 |
| Topstuk | 1.10 | 1.6 | 1.4 | 0.0 | -1.4 | 44.0 | 71.6 | 60.8 | 0.0 | -60.8 |
| Ondertraverse | 0.98 | 33.8 | 20.1 | 0.0 | -20.1 | 29.0 | 982.3 | 583.4 | 0.0 | -583.4 |
| Boventraverse | 1.07 | 48.1 | 28.6 | 0.0 | -28.6 | 40.4 | 1942.6 | 1153.8 | 0.0 | -1153.8 |
| Totaal | | 177.1 | 129.5 | 0.0 | -129.5 | | 5044.3 | 3535.7 | 0.0 | -3535.7 |

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

| Description | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0.70 | 0.0 | 15.6 | 18.4 | 15.6 | 4.8 | 0.0 | 74.9 | 88.3 | 74.9 |
| Eerste tussenstuk | 0.79 | 0.0 | 17.4 | 20.5 | 17.4 | 14.3 | 0.0 | 247.6 | 291.8 | 247.6 |
| Tweede tussenstuk | 0.92 | 0.0 | 18.6 | 21.9 | 18.6 | 23.3 | 0.0 | 433.8 | 511.3 | 433.8 |
| Bovenstuk 1 | 1.01 | 0.0 | 14.4 | 17.0 | 14.4 | 31.6 | 0.0 | 454.6 | 535.8 | 454.6 |
| Bovenstuk 2 | 1.06 | 0.0 | 13.4 | 15.8 | 13.4 | 39.3 | 0.0 | 526.7 | 620.8 | 526.7 |
| Topstuk | 1.10 | 0.0 | 1.4 | 1.6 | 1.4 | 44.0 | 0.0 | 60.8 | 71.6 | 60.8 |
| Ondertraverse | 0.98 | 0.0 | 20.1 | 13.5 | 20.1 | 29.0 | 0.0 | 583.4 | 392.9 | 583.4 |
| Boventraverse | 1.07 | 0.0 | 28.6 | 19.2 | 28.6 | 40.4 | 0.0 | 1153.8 | 777.0 | 1153.8 |
| Total | | 0.0 | 129.5 | 128.0 | 129.5 | | 0.0 | 3535.7 | 3289.5 | 3535.7 |

**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 | 450 | 0 | 0 | 0 |
| Windrichting 0° | 177 | 0 | 0 | 0 | 5044 | 0 |
| Windrichting 45° | 129 | 129 | 0 | 3536 | 3536 | 0 |
| Windrichting 90° | 0 | 128 | 0 | 3289 | 0 | 0 |
| Windrichting 135° | -129 | 129 | 0 | 3536 | -3536 | 0 |

Project: GT-RLL380
Tower: HB+0
Number: 78

**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 | ACCC-Warsaw | 27.7 | 571.0 | 14.98 | 62700 | 1.88E-05 |
| Circuit 2 | ACCC-Warsaw | 27.7 | 571.0 | 14.98 | 62700 | 1.88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21.8 | 281.0 | 9.38 | 70165 | 1.97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21.7 | 264.0 | 9.13 | 72000 | 1.98E-05 |

**Conductors ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-05 |
| Circuit 2 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-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 | 9.6 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 9.3 | A | 15+0,4d | 23.7 | 23.7 |

**Vertical load ahead**

| Circuit | Bundle [-] | Additional [%] | $w_{z,G}$ [N/m] | Ice region | Formula | [N/m] | [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Circuit 2 | 3 | 2 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Bliksemdraad 1 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |

**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 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct1f2 | 6.00 | 1 | 6 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct1f3 | 6.00 | 1 | 6 | 7.9 | 2.0 | 39.50 | 1.07 | 1.2 | 2.56 |
| 380ct2f1 | 6.00 | 1 | 6 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct2f2 | 6.00 | 1 | 6 | 7.9 | 2.0 | 28.20 | 0.97 | 1.2 | 2.33 |
| 380ct2f3 | 6.00 | 1 | 6 | 7.9 | 2.0 | 39.50 | 1.07 | 1.2 | 2.56 |
| bl1 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 43.70 | 1.10 | 1.2 | 0.13 |
| bl2 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 43.70 | 1.10 | 1.2 | 0.13 |

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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 | 20.5 | 0.88 | 0.55 | 0.61 | 1.13 | 28.25 | 46.6 | 51.9 | 46.9 | 82.3 | 91.6 |
| 380ct1f2 | 20.5 | 0.88 | 0.55 | 0.61 | 1.13 | 28.25 | 46.6 | 51.9 | 46.9 | 82.3 | 91.6 |
| 380ct1f3 | 31.8 | 1.00 | 0.59 | 0.65 | 1.09 | 28.25 | 54.7 | 60.7 | 46.9 | 99.5 | 110.6 |
| 380ct2f1 | 20.5 | 0.88 | 0.55 | 0.61 | 1.13 | 28.25 | 46.6 | 51.9 | 46.9 | 82.3 | 91.6 |
| 380ct2f2 | 20.5 | 0.88 | 0.55 | 0.61 | 1.13 | 28.25 | 46.6 | 51.9 | 46.9 | 82.3 | 91.6 |
| 380ct2f3 | 31.8 | 1.00 | 0.59 | 0.65 | 1.09 | 28.25 | 54.7 | 60.7 | 46.9 | 99.5 | 110.6 |
| bl1 | 36.0 | 1.04 | 0.60 | 0.66 | 1.20 | 22.24 | 16.5 | 18.4 | 63.1 | 47.0 | 52.2 |
| bl2 | 36.0 | 1.04 | 0.60 | 0.66 | 1.20 | 22.13 | 16.5 | 18.3 | 63.0 | 46.9 | 52.1 |

**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 | 18.6 | 0.86 | 0.54 | 0.49 | 1.13 | 28.50 | 45.2 | 40.6 | 47.2 | 79.2 | 71.2 |
| 380ct1f2 | 18.6 | 0.86 | 0.54 | 0.49 | 1.13 | 28.50 | 45.2 | 40.6 | 47.2 | 79.2 | 71.2 |
| 380ct1f3 | 29.9 | 0.99 | 0.58 | 0.52 | 1.09 | 28.50 | 53.7 | 48.3 | 47.2 | 97.5 | 87.6 |
| 380ct2f1 | 18.6 | 0.86 | 0.54 | 0.49 | 1.13 | 28.50 | 45.2 | 40.6 | 47.2 | 79.2 | 71.2 |
| 380ct2f2 | 18.6 | 0.86 | 0.54 | 0.49 | 1.13 | 28.50 | 45.2 | 40.6 | 47.2 | 79.2 | 71.2 |
| 380ct2f3 | 29.9 | 0.99 | 0.58 | 0.52 | 1.09 | 28.50 | 53.7 | 48.3 | 47.2 | 97.5 | 87.6 |
| bl1 | 36.6 | 1.04 | 0.60 | 0.54 | 1.20 | 22.24 | 16.7 | 15.0 | 63.1 | 47.3 | 42.5 |
| bl2 | 36.6 | 1.04 | 0.60 | 0.54 | 1.20 | 22.13 | 16.6 | 14.9 | 63.0 | 47.2 | 42.4 |

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**Conductor loads**

Auteur: TBR
Versie: v11.8

**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 | 0.90 | 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 | 5238 |

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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 | -39.9 | 42.4 | 14.1 | 0.1 | 5.8 | 6.1 |
| 380ct1f1 | -104.0 | 105.6 | 37.8 | 1.8 | 20.9 | 22.0 |
| 380ct1f2 | -104.0 | 105.6 | 37.8 | 1.8 | 20.9 | 22.0 |
| 380ct1f3 | -106.5 | 107.8 | 41.7 | 1.8 | 20.9 | 22.0 |
| 380ct2f1 | -104.0 | 105.6 | 37.8 | 1.8 | 20.9 | 22.0 |
| 380ct2f2 | -104.0 | 105.6 | 37.8 | 1.8 | 20.9 | 22.0 |
| 380ct2f3 | -106.5 | 107.8 | 41.7 | 1.8 | 20.9 | 22.0 |
| bl2 | -39.4 | 42.7 | 14.0 | 0.1 | 5.8 | 6.1 |
| V-ketting 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| V-ketting 2 | 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 | 349.2 | 358.0 | 360.1 |
| 380ct1f1 | 377.4 | 377.4 | 377.4 |
| 380ct1f2 | 377.4 | 377.4 | 377.4 |
| 380ct1f3 | 377.4 | 377.4 | 377.4 |
| 380ct2f1 | 377.4 | 377.4 | 377.4 |
| 380ct2f2 | 377.4 | 377.4 | 377.4 |
| 380ct2f3 | 377.4 | 377.4 | 377.4 |
| bl2 | 349.2 | 357.6 | 360.1 |
| V-ketting 1 | | | |
| V-ketting 2 | | | |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 360.1 | 362.1 |
| 380ct1f1 | 377.4 | 377.4 |
| 380ct1f2 | 377.4 | 377.4 |
| 380ct1f3 | 377.4 | 377.4 |
| 380ct2f1 | 377.4 | 377.4 |
| 380ct2f2 | 377.4 | 377.4 |
| 380ct2f3 | 377.4 | 377.4 |
| bl2 | 360.1 | 362.0 |
| V-ketting 1 | | |
| V-ketting 2 | | |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 377.4 m | 1.000 - |
| Min. weight span | 343.4 m | 0.910 - |

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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 | 28.8 | 10.1 | 6.1 | -42.2 | 42.5 |
| 380ct1f1 | 95.7 | 34.5 | 22.0 | -109.5 | 106.2 |
| 380ct1f2 | 95.7 | 34.5 | 22.0 | -109.5 | 106.2 |
| 380ct1f3 | 96.0 | 39.0 | 22.0 | -112.5 | 108.3 |
| 380ct2f1 | 95.7 | 34.5 | 22.0 | -109.5 | 106.2 |
| 380ct2f2 | 95.7 | 34.5 | 22.0 | -109.5 | 106.2 |
| 380ct2f3 | 96.0 | 39.0 | 22.0 | -112.5 | 108.3 |
| bl2 | 28.9 | 9.9 | 6.1 | -41.7 | 42.8 |
| V-ketting 1 | 1.9 | 1.9 | 3.5 | 0.0 | |
| V-ketting 2 | 1.9 | 1.9 | 3.5 | 0.0 | |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 13.5 | 3.5 | 1.9 | -13.1 | 13.8 |
| 380ct1f1 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct1f2 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct1f3 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct2f1 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct2f2 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct2f3 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| bl2 | 13.5 | 3.4 | 1.9 | -12.8 | 13.7 |
| V-ketting 1 | 0.0 | 0.0 | 3.0 | 0.0 | |
| V-ketting 2 | 0.0 | 0.0 | 3.0 | 0.0 | |

1 **Control uplift SLS-wind**

| Combinatie: | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 0.0 | 0.0 |
| | 380ct1f1 | 0.0 | 0.0 |
| | 380ct1f2 | 0.0 | 0.0 |
| | 380ct1f3 | 0.0 | 0.0 |
| | 380ct2f1 | 0.0 | 0.0 |
| | 380ct2f2 | 0.0 | 0.0 |
| | 380ct2f3 | 0.0 | 0.0 |
| | bl2 | 0.0 | 0.0 |
| | V-ketting 1 | 0.0 | |
| | V-ketting 2 | 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 | | -7 | 226 | 198 | 7449 | -221 | 5 |
| ULS 1a_0,9_0 | | 13 | 46 | 197 | 1552 | 408 | 48 |
| ULS 1a_0,9_0,9_90 | | -12 | 224 | 170 | 7380 | -379 | 4 |
| ULS 3_0 | | 16 | 66 | 277 | 2210 | 563 | 27 |
| SLS 7 | | 8 | 36 | 189 | 1214 | 269 | 6 |

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

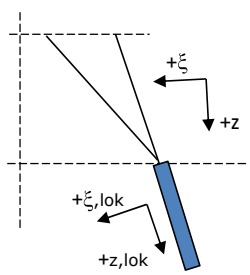
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -7 | 369 | 671 | 11123 | -221 | 5 |
| ULS 1a_0,9_0,9_90 | -12 | 367 | 575 | 11053 | -379 | 4 |
| SLS 7 | 8 | 36 | 639 | 1214 | 269 | 6 |

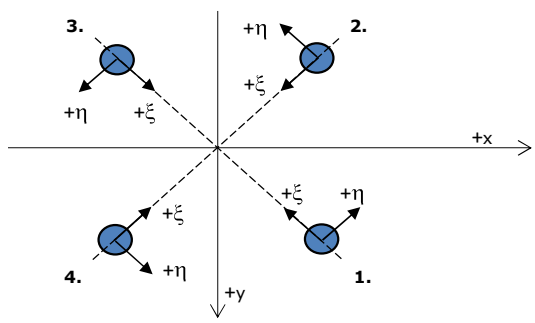
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_74.4 | 19 | 389 | 671 | **11764** | 336 | 16 |
| SPLS 3_74.4 Ba All Cts | 590 | -23 | 628 | -1015 | **19167** | 7 |
| SPLS 6a_90 Ah Ct1 Ba Ct1 | -309 | 166 | 676 | 5432 | -10053 | **4240** |
| SPLS 3_79.6 Ah All Cts | -576 | 244 | 621 | **7696** | **-18881** | 9 |

*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_45 Ba All Cts | 190 | 213 | **1048** | -16 | -285 | -54 | 1073 |
| 2 | SPLS 3_0 Ba All Cts | 203 | -225 | **1125** | 16 | -302 | -54 | 1152 |
| 3 | SPLS 3_135 Ah All Cts | -113 | -146 | **677** | -23 | -183 | -33 | 693 |
| 4 | SPLS 3_79.6 Ah All Cts | -246 | 267 | **1363** | 15 | -363 | -62 | 1396 |

**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 | -53 | -86 | **-384** | 23 | 98 | 14 | -393 |
| 2 | SPLS 3_0,9_79.6 Ah All Cts | -187 | 207 | **-1069** | -14 | 279 | 42 | -1095 |
| 3 | SPLS 1a_0,9_45 Ba All Cts | 130 | 155 | **-757** | 18 | 202 | 34 | -775 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 143 | -164 | **-828** | -15 | 217 | 34 | -848 |

**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 Ct1 Ba Ct1 | 104 | -113 | -41 | **153** | 7 | -2 | -42 |
| 2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 18 | -219 | 627 | **142** | -168 | -29 | 643 |
| 3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -43 | 161 | -325 | **144** | 83 | 11 | -333 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -65 | 265 | 873 | **141** | -234 | -41 | 894 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 28 | 229 | 677 | **-142** | -182 | -33 | 693 |
| 2 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 6 | 196 | -519 | **-143** | 134 | 20 | -532 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 31 | -182 | 395 | **-151** | -106 | -19 | 404 |
| 4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | -53 | -150 | -277 | **-144** | 69 | 7 | -283 |

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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 Ct1 | -11 | -107 | **-338** | **68** | 83 | 9 | -346 |
| 2 | SPLS 3_0,9_79.6 Ah All Cts | -187 | 207 | **-1069** | **-14** | 279 | 42 | -1095 |
| 3 | SPLS 1a_0,9_74.4 Ba Ct2 | 9 | 177 | **-489** | **119** | 132 | 24 | -501 |
| 4 | SPLS 6a_90 Ba All Cts Ah Ct1 | 86 | -168 | **-705** | **-58** | 180 | 24 | -722 |

**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 | 46 | 44 | 227 | 1 | -63 | -13 | 233 |
| 2 | SLS 7 | 23 | -26 | 117 | 2 | -35 | -9 | 120 |
| 3 | SLS 7 | -19 | -21 | 92 | -1 | -28 | -8 | 95 |
| 4 | SLS 7 | -42 | 39 | 203 | -2 | -57 | -12 | 208 |

**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 3_79.6 Ah All Cts | -246 | 267 | **1363** | 15 | -363 | -62 | 1396 |
| Max. tension | SPLS 3_0,9_79.6 Ah All Cts | -187 | 207 | **-1069** | -14 | 279 | 42 | -1095 |
| Max. pos. torsie | SPLS 6a_90 Ah Ct1 Ba Ct1 | 104 | -113 | -41 | **153** | 7 | -2 | -42 |
| Max. neg. torsie | SPLS 6a_90 Ah Ct2 Ba Ct2 | 31 | -182 | 395 | **-151** | -106 | -19 | 404 |
| Comb. tension+torsie | SPLS 3_0,9_79.6 Ah All Cts | -187 | 207 | **-1069** | **-14** | 279 | 42 | -1095 |

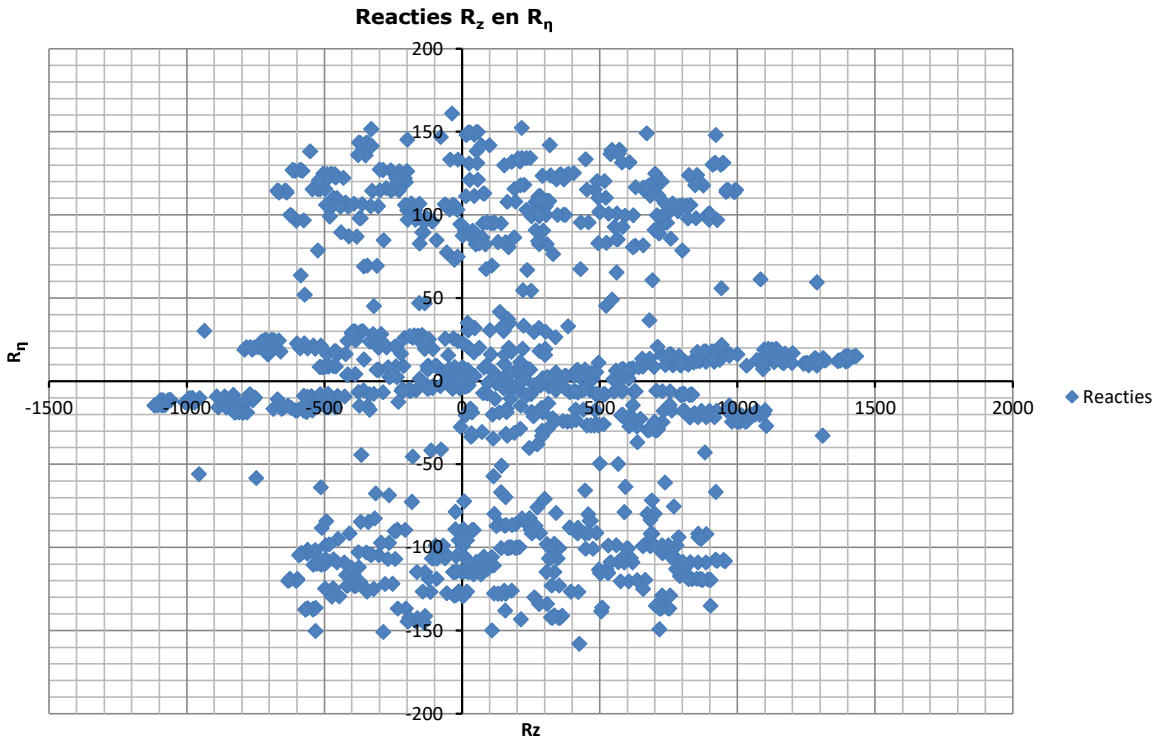
**Maximum tension load - SLS**

| 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 | 46 | 44 | **227** | 1 | -63 | -13 | 233 |
| 2 | SLS 1a_90 | -56 | 47 | **-277** | 6 | 73 | 12 | -284 |
| 3 | SLS 1a_45 | 72 | 63 | **-352** | -6 | 95 | 18 | -361 |
| 4 | SLS 1a_0 | 0 | -3 | **-7** | -2 | 2 | 0 | -8 |

**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 | 138 | 127 | **672** | 8 | -187 | -39 | 688 |
| 2 | SLS 1a_0 | 63 | -70 | **327** | 5 | -94 | -22 | 335 |
| 3 | SLS 7 | -19 | -21 | **92** | -1 | -28 | -8 | 95 |
| 4 | SLS 1a_90 | -121 | 112 | **597** | -6 | -165 | -33 | 611 |

Project: GT-RLL380
Tower: HB+0
Number: 78



Project: GT-RLL380
Tower: HB+0
Number: 78

Auteur: TBR
Versie: v11.8

## Conductor loads

**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 | 0.90 | 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 | 5238 |

Project: GT-RLL380
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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 | -48.7 | 52.1 | 17.3 | 0.1 | 7.6 | 7.9 |
| 380ct1f1 | -120.8 | 122.8 | 45.0 | 1.8 | 22.9 | 24.8 |
| 380ct1f2 | -120.8 | 122.8 | 45.0 | 1.8 | 22.9 | 24.8 |
| 380ct1f3 | -124.1 | 125.6 | 50.0 | 1.8 | 22.9 | 24.8 |
| 380ct2f1 | -120.8 | 122.8 | 45.0 | 1.8 | 22.9 | 24.8 |
| 380ct2f2 | -120.8 | 122.8 | 45.0 | 1.8 | 22.9 | 24.8 |
| 380ct2f3 | -124.1 | 125.6 | 50.0 | 1.8 | 22.9 | 24.8 |
| bl2 | -48.0 | 52.4 | 17.1 | 0.1 | 7.5 | 7.9 |
| V-ketting 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| V-ketting 2 | 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 | 348.2 | 357.9 | 360.1 |
| 380ct1f1 | 377.4 | 377.4 | 377.4 |
| 380ct1f2 | 377.4 | 377.4 | 377.4 |
| 380ct1f3 | 377.4 | 377.4 | 377.4 |
| 380ct2f1 | 377.4 | 377.4 | 377.4 |
| 380ct2f2 | 377.4 | 377.4 | 377.4 |
| 380ct2f3 | 377.4 | 377.4 | 377.4 |
| bl2 | 348.2 | 357.5 | 360.1 |
| V-ketting 1 | | | |
| V-ketting 2 | | | |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 360.3 | 362.8 |
| 380ct1f1 | 377.4 | 377.4 |
| 380ct1f2 | 377.4 | 377.4 |
| 380ct1f3 | 377.4 | 377.4 |
| 380ct2f1 | 377.4 | 377.4 |
| 380ct2f2 | 377.4 | 377.4 |
| 380ct2f3 | 377.4 | 377.4 |
| bl2 | 360.3 | 362.7 |
| V-ketting 1 | | |
| V-ketting 2 | | |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 377.4 m | 1.000 - |
| Min. weight span | 337.6 m | 0.895 - |

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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 | 29.9 | 12.4 | 7.9 | -51.5 | 52.2 |
| 380ct1f1 | 100.7 | 42.5 | 24.8 | -127.5 | 123.4 |
| 380ct1f2 | 100.7 | 42.5 | 24.8 | -127.5 | 123.4 |
| 380ct1f3 | 101.0 | 48.1 | 24.8 | -131.2 | 126.0 |
| 380ct2f1 | 100.7 | 42.5 | 24.8 | -127.5 | 123.4 |
| 380ct2f2 | 100.7 | 42.5 | 24.8 | -127.5 | 123.4 |
| 380ct2f3 | 101.0 | 48.1 | 24.8 | -131.2 | 126.0 |
| bl2 | 29.9 | 12.3 | 7.9 | -50.9 | 52.5 |
| V-ketting 1 | 2.4 | 2.4 | 3.9 | 0.0 | |
| V-ketting 2 | 2.4 | 2.4 | 3.9 | 0.0 | |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 13.5 | 3.5 | 1.9 | -13.1 | 13.8 |
| 380ct1f1 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct1f2 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct1f3 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct2f1 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct2f2 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| 380ct2f3 | 61.7 | 16.9 | 15.1 | -63.0 | 62.7 |
| bl2 | 13.5 | 3.4 | 1.9 | -12.8 | 13.7 |
| V-ketting 1 | 0.0 | 0.0 | 3.0 | 0.0 | |
| V-ketting 2 | 0.0 | 0.0 | 3.0 | 0.0 | |

1 **Control uplift SLS-wind**

| Combinatie: | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 0.0 | 0.0 |
| | 380ct1f1 | 0.0 | 0.0 |
| | 380ct1f2 | 0.0 | 0.0 |
| | 380ct1f3 | 0.0 | 0.0 |
| | 380ct2f1 | 0.0 | 0.0 |
| | 380ct2f2 | 0.0 | 0.0 |
| | 380ct2f3 | 0.0 | 0.0 |
| | bl2 | 0.0 | 0.0 |
| | V-ketting 1 | 0.0 | |
| | V-ketting 2 | 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 | | -11 | 279 | 217 | 9172 | -347 | 6 |
| ULS 1a_0,9_0 | | 14 | 52 | 216 | 1730 | 457 | 59 |
| ULS 1a_0,9_0,9_90 | | -19 | 276 | 170 | 9076 | -604 | 5 |
| ULS 3_0 | | 20 | 77 | 324 | 2581 | 699 | 33 |
| SLS 7 | | 8 | 36 | 189 | 1214 | 269 | 6 |

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

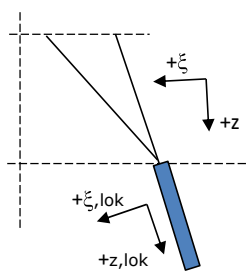
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -11 | 458 | 734 | 13778 | -347 | 6 |
| ULS 1a_0,9_0,9_90 | -19 | 455 | 575 | 13682 | -604 | 5 |
| SLS 7 | 8 | 36 | 639 | 1214 | 269 | 6 |

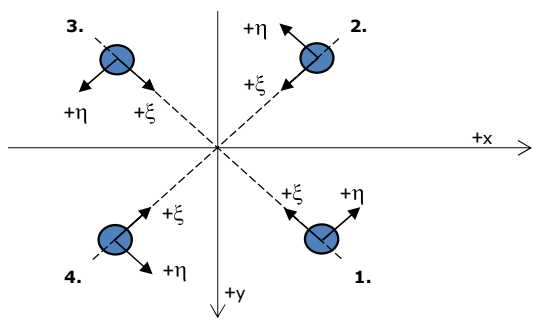
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_74.4 | 21 | 482 | 734 | **14583** | 352 | 20 |
| SPLS 3_74.4 Ba All Cts | 621 | -29 | 687 | -1188 | **20145** | 7 |
| SPLS 6a_90 Ah Ct1 Ba Ct1 | -325 | 172 | 737 | 5666 | -10540 | **4453** |
| SPLS 3_79.6 Ah All Cts | -604 | 252 | 679 | **7953** | **-19777** | 9 |

*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_45 Ba All Cts | 199 | 224 | **1100** | -18 | -299 | -56 | 1127 |
| 2 | SPLS 3_0 Ba All Cts | 216 | -240 | **1200** | 17 | -323 | -57 | 1229 |
| 3 | SPLS 3_135 Ah All Cts | -121 | -156 | **727** | -25 | -196 | -36 | 744 |
| 4 | SPLS 3_79.6 Ah All Cts | -259 | 280 | **1430** | 15 | -381 | -65 | 1465 |

**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 | -58 | -93 | **-416** | 24 | 107 | 15 | -426 |
| 2 | SPLS 3_0,9_79.6 Ah All Cts | -196 | 217 | **-1118** | -15 | 292 | 45 | -1145 |
| 3 | SPLS 1a_0,9_45 Ba All Cts | 135 | 162 | **-791** | 19 | 210 | 36 | -810 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 153 | -175 | **-886** | -16 | 232 | 37 | -907 |

**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 Ct1 Ba Ct1 | 110 | -118 | -37 | **161** | 6 | -2 | -38 |
| 2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 21 | -232 | 671 | **149** | -179 | -31 | 687 |
| 3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -48 | 167 | -331 | **152** | 84 | 11 | -339 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -70 | 279 | 921 | **148** | -247 | -43 | 943 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 31 | 242 | 716 | **-149** | -193 | -35 | 734 |
| 2 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 9 | 204 | -533 | **-150** | 138 | 20 | -546 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 31 | -193 | 425 | **-158** | -114 | -21 | 435 |
| 4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | -57 | -157 | -286 | **-151** | 71 | 8 | -293 |

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Tower: HB+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 Ct1 | -13 | -111 | **-357** | **69** | 88 | 9 | -366 |
| 2 | SPLS 3_0,9_79.6 Ah All Cts | -196 | 217 | **-1118** | **-15** | 292 | 45 | -1145 |
| 3 | SPLS 1a_0,9_74.4 Ba Ct2 | 8 | 184 | **-504** | **125** | 136 | 24 | -516 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 153 | -175 | **-886** | **-16** | 232 | 37 | -907 |

**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 | 46 | 44 | 227 | 1 | -63 | -13 | 233 |
| 2 | SLS 7 | 23 | -26 | 117 | 2 | -35 | -9 | 120 |
| 3 | SLS 7 | -19 | -21 | 92 | -1 | -28 | -8 | 95 |
| 4 | SLS 7 | -42 | 39 | 203 | -2 | -57 | -12 | 208 |

**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 3_79.6 Ah All Cts | -259 | 280 | **1430** | 15 | -381 | -65 | 1465 |
| Max. tension | SPLS 3_0,9_79.6 Ah All Cts | -196 | 217 | **-1118** | -15 | 292 | 45 | -1145 |
| Max. pos. torsie | SPLS 6a_90 Ah Ct1 Ba Ct1 | 110 | -118 | -37 | **161** | 6 | -2 | -38 |
| Max. neg. torsie | SPLS 6a_90 Ah Ct2 Ba Ct2 | 31 | -193 | 425 | **-158** | -114 | -21 | 435 |
| Comb. tension+torsie | SPLS 3_0,9_79.6 Ah All Cts | -196 | 217 | **-1118** | **-15** | 292 | 45 | -1145 |

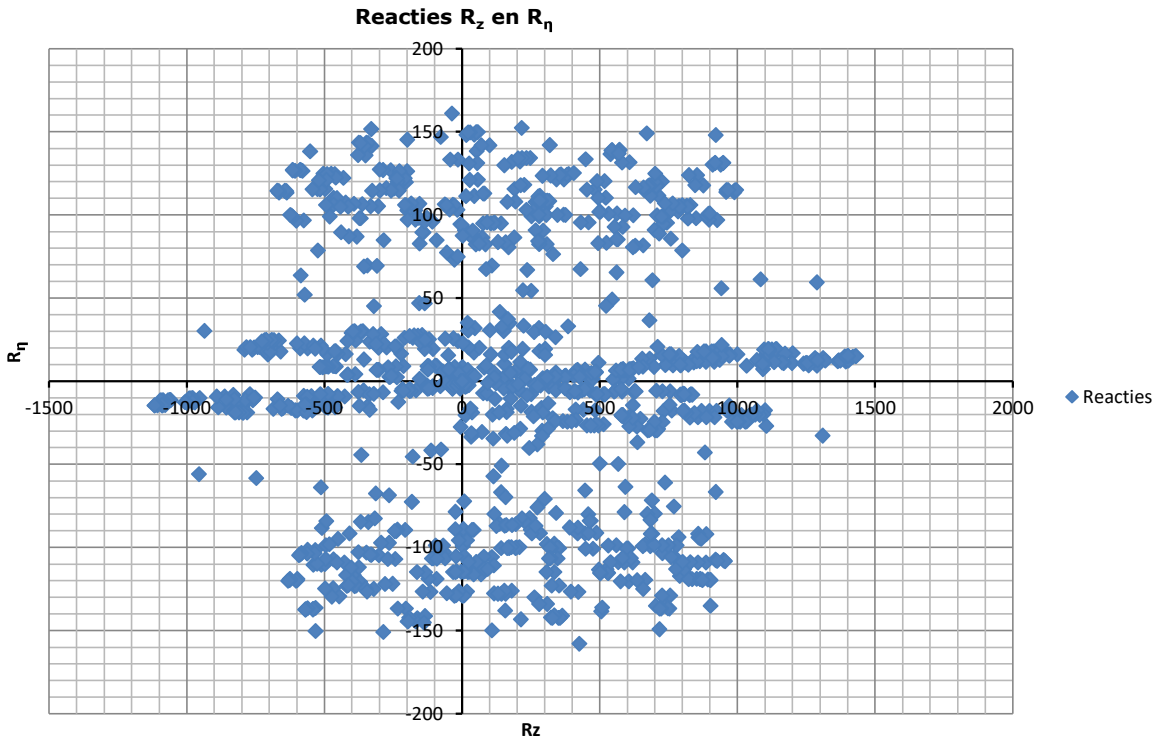
**Maximum tension load - SLS**

| 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 | 46 | 44 | **227** | 1 | -63 | -13 | 233 |
| 2 | SLS 1a_90 | -62 | 52 | **-304** | 7 | 80 | 13 | -311 |
| 3 | SLS 1a_45 | 77 | 68 | **-378** | -6 | 103 | 19 | -387 |
| 4 | SLS 1a_0 | 2 | -6 | **-20** | -3 | 6 | 1 | -20 |

**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 | 143 | 131 | **697** | 8 | -194 | -40 | 714 |
| 2 | SLS 1a_0 | 65 | -73 | **339** | 5 | -97 | -22 | 348 |
| 3 | SLS 7 | -19 | -21 | **92** | -1 | -28 | -8 | 95 |
| 4 | SLS 1a_90 | -126 | 117 | **623** | -6 | -172 | -34 | 638 |

Project: GT-RLL380
Tower: HB+0
Number: 78



## 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 | 47.875 m |
| Max. Span | 346 m |
| Line angle | 177.3° |
| Catenary | 1375 m |
| Wind span | 344 m |
| EDS Weight span | 344 m |
| Min. Weight span | 344 m |
| Max. Weight span | 344 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-05-26 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype HS

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

Document name:

GT-RLL380_HS_26_Report.pdf

Project number:

Project client number:

0.0

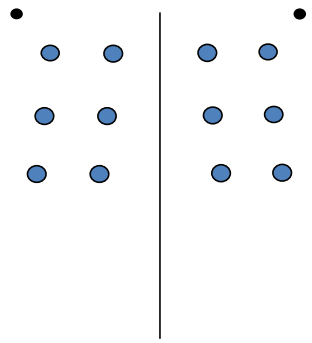
Project: GT-RLL380
Tower: HS
Number: 26

## Conductor loads

Auteur: TBR
Versie: v11.8

### General

| | |
|---|---|
| Description | HS |
| Tower type | Steunmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |



Configuratie geleiders

### Starting points

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

### Conductors back

| Description | Voltage | Conductor Back | Bundle Ba | Ice region | Additional weight | Additional diameter | Catenary $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | ACSR-26/7-242/39-HAWK | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW 226 | 1 | A | 2 % | 2 % | 1375 |

### Conductors ahead

| Description | Voltage | Conductor Ahead | Bundle Ah | Ice region | Additional weight | Additional diameter | Catenary $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | ACSR-26/7-242/39-HAWK | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW 226 | 1 | A | 2 % | 2 % | 1375 |

### Insulators *(1)*

| Description | Suspension | Weight [kN] | Length [m] | Wind area [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Halfverankering | 5.50 | 4.50 | 2.40 |
| Circuit 2 | Halfverankering | 5.50 | 4.50 | 2.40 |
| Bliksemdraad 1 | Vast (Bliksemdraad) | 0.10 | 0.20 | 0.10 |
| Bliksemdraad 2 | Vast (Bliksemdraad) | 0.10 | 0.20 | 0.10 |

*1. Properties apply to the entire isolator set*

### Suspension height and position in mast

| Circuits | Designation | Number | Suspension height | Attach point | Position in tower Horizontal distance |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 28.1 m | 32.6 m | -16.0 m |
| Circuit 1 | 11 | 380ct1f2 | 28.1 m | 32.6 m | -9.0 m |
| Circuit 1 | 12 | 380ct1f3 | 39.4 m | 43.9 m | -12.5 m |
| Circuit 2 | 20 | 380ct2f1 | 28.1 m | 32.6 m | 16.0 m |
| Circuit 2 | 21 | 380ct2f2 | 28.1 m | 32.6 m | 9.0 m |
| Circuit 2 | 22 | 380ct2f3 | 39.4 m | 43.9 m | 12.5 m |
| Bliksemdraad 1 | 1 | bl1 | 43.7 m | 43.9 m | -18.5 m |
| Bliksemdraad 2 | 3 | bl2 | 43.7 m | 43.9 m | 18.5 m |

Project: GT-RLL380
Tower: HS
Number: 26

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

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

Decrease: Niet in 0,9EG-combinaties

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

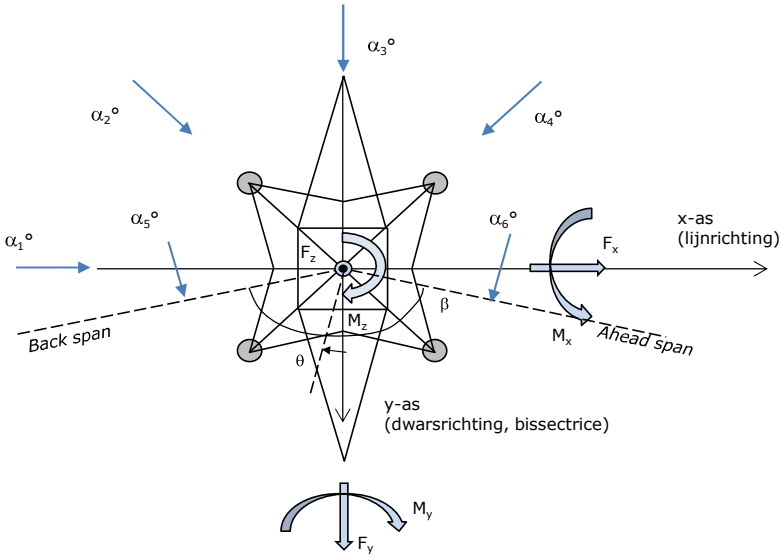
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 1 | 11 | 380ct1f2 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 1 | 12 | 380ct1f3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

**Line and tower data**

| | | Back | Ahead |
|---|---|---|---|
| | | 342.5 | 346.0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 335.9 | 335.9 m |
| Line angle | $\beta$ | 177.3 ° | |
| Tower orientation with respect to bis | $\theta$ | 0 ° | |
| Section length | | 1670 | 1670 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: GT-RLL380
Tower: HS
Number: 26

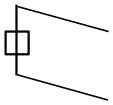
**Absence of conductors**

| | | 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 |

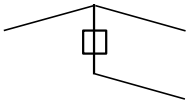
**Load situations SPLS**

Considered situations SPLS: SPLS for suspension tower not applicable

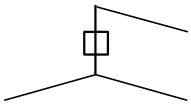
Principle of load situations:



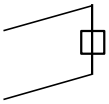
1. Ba All cts



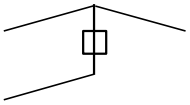
2. Ba ct1



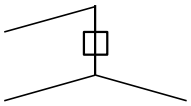
3. Ba ct2



4. Ah All cts



5. Ah ct1

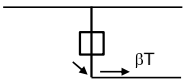


6. Ah ct2

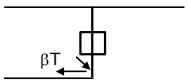
**Load situation 5a. Conductor failure**

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

Principle of load situations:




1. Ba




2. Ah

Project: GT-RLL380
Tower: HS
Number: 26

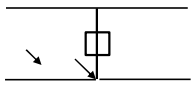
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able 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 | 4.0 kN | 2.0 kN |
| Concentrated load cross arm | 1.0 kN | 1.0 kN |

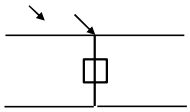
Beschouwde situaties bouw- en onderhoud 6a: 1 en 2, uitgangspunt is symmetrie tussen back / ahead.

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

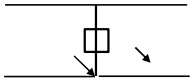
Principle of load situations:



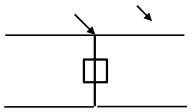
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

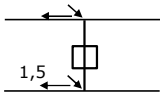
**Load situations 8. Galloping as a static load**

| 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 |

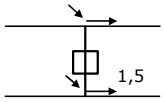
Considered situations galloping 8: 1, design assumption is symmetry back and ahead

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: GT-RLL380
Tower: HS
Number: 26

**Tower structure**

**Properties**

| | | | |
|---|---|---|---|
| Tower type | Steunmast | | |
| Tower designation | HS | | |
| Base plate w.r.t. ground level | 0.5 | m | |
| Tower height w.r.t. base plate | 47.9 | m | |
| Tower self weight | 209.0 | kN | |
| *Width and slope at foundation* | x-ri. | y-ri. | |
| Leg spread | 9.00 | 9.00 | m |
| Inclination of main leg | 0.144 | 0.144 | - |
| Horizontal force factor | 1.3 | 1.3 | - |

**Calculation Wind load**

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

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 11.18 | 9.00 | 5.79 | 11.18 | 0.144 | 82.66 | 9.27 | 0.11 | 3.34 |
| Eerste tussenstuk | 21.18 | 5.79 | 4.48 | 10.00 | 0.065 | 51.36 | 7.20 | 0.14 | 3.21 |
| Tweede tussenstuk | 32.55 | 4.48 | 3.00 | 11.37 | 0.065 | 42.55 | 7.85 | 0.18 | 3.00 |
| Bovenstuk 1 | 38.37 | 3.00 | 2.62 | 5.82 | 0.033 | 16.35 | 3.86 | 0.24 | 2.78 |
| Bovenstuk 2 | 46.38 | 2.62 | 2.00 | 8.01 | 0.039 | 18.49 | 4.45 | 0.24 | 2.76 |
| Topstuk | 47.88 | 2.00 | | | | | | | |
| Ondertraverse | 32.50 | 15.07 | | 3.00 | | 22.61 | 6.02 | 0.27 | 2.66 |
| Boventraverse | 43.80 | 17.36 | | 2.53 | | 21.92 | 6.19 | 0.28 | 2.60 |

**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 | 11.18 | 9.00 | 5.79 | 11.18 | 0.144 | 82.66 | 9.27 | 0.11 | 3.34 |
| Eerste tussenstuk | 21.18 | 5.79 | 4.48 | 10.00 | 0.065 | 51.36 | 7.20 | 0.14 | 3.21 |
| Tweede tussenstuk | 32.55 | 4.48 | 3.00 | 11.37 | 0.065 | 42.55 | 7.85 | 0.18 | 3.00 |
| Bovenstuk 1 | 38.37 | 3.00 | 2.62 | 5.82 | 0.033 | 16.35 | 3.86 | 0.24 | 2.78 |
| Bovenstuk 2 | 46.38 | 2.62 | 2.00 | 8.01 | 0.039 | 18.49 | 4.45 | 0.24 | 2.76 |
| Topstuk | | | | | | | | | |
| Ondertraverse | 32.50 | 15.07 | | 3.00 | | 22.61 | 6.02 | 0.27 | 2.66 |
| Boventraverse | 43.80 | 17.36 | | 2.53 | | 21.92 | 6.19 | 0.28 | 2.60 |

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

Project: GT-RLL380
Tower: HS
Number: 26

**Wind surface feeders telecom installations**

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

**Input antennas**

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

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

| Description | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0.70 | 21.7 | 18.4 | 0.0 | -18.4 | 5.6 | 121.5 | 103.1 | 0.0 | -103.1 |
| Eerste tussenstuk | 0.82 | 19.0 | 16.1 | 0.0 | -16.1 | 16.2 | 307.0 | 260.5 | 0.0 | -260.5 |
| Tweede tussenstuk | 0.96 | 22.5 | 19.1 | 0.0 | -19.1 | 26.9 | 605.8 | 514.0 | 0.0 | -514.0 |
| Bovenstuk 1 | 1.04 | 11.2 | 9.5 | 0.0 | -9.5 | 35.5 | 395.4 | 335.5 | 0.0 | -335.5 |
| Bovenstuk 2 | 1.09 | 13.3 | 11.3 | 0.0 | -11.3 | 42.4 | 565.7 | 480.0 | 0.0 | -480.0 |
| Topstuk | 0.70 | | | | | 0.0 | | | | |
| Ondertraverse | 1.02 | 32.6 | 19.4 | 0.0 | -19.4 | 33.5 | 1092.9 | 649.1 | 0.0 | -649.1 |
| Boventraverse | 1.10 | 35.4 | 21.0 | 0.0 | -21.0 | 44.6 | 1582.0 | 939.6 | 0.0 | -939.6 |
| Totaal | | 155.8 | 114.9 | 0.0 | -114.9 | | 4670.1 | 3281.8 | 0.0 | -3281.8 |

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

| Description | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0.70 | 0.0 | 18.4 | 21.7 | 18.4 | 5.6 | 0.0 | 103.1 | 121.5 | 103.1 |
| Eerste tussenstuk | 0.82 | 0.0 | 16.1 | 19.0 | 16.1 | 16.2 | 0.0 | 260.5 | 307.0 | 260.5 |
| Tweede tussenstuk | 0.96 | 0.0 | 19.1 | 22.5 | 19.1 | 26.9 | 0.0 | 514.0 | 605.8 | 514.0 |
| Bovenstuk 1 | 1.04 | 0.0 | 9.5 | 11.2 | 9.5 | 35.5 | 0.0 | 335.5 | 395.4 | 335.5 |
| Bovenstuk 2 | 1.09 | 0.0 | 11.3 | 13.3 | 11.3 | 42.4 | 0.0 | 480.0 | 565.7 | 480.0 |
| Topstuk | 0.70 | | | | | 0.0 | | | | |
| Ondertraverse | 1.02 | 0.0 | 19.4 | 13.0 | 19.4 | 33.5 | 0.0 | 649.1 | 437.1 | 649.1 |
| Boventraverse | 1.10 | 0.0 | 21.0 | 14.2 | 21.0 | 44.6 | 0.0 | 939.6 | 632.8 | 939.6 |
| Total | | 0.0 | 114.9 | 115.0 | 114.9 | | 0.0 | 3281.8 | 3065.2 | 3281.8 |

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

| Load / wind direction | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 209 | 0 | 0 | 0 |
| Windrichting 0° | 156 | 0 | 0 | 0 | 4670 | 0 |
| Windrichting 45° | 115 | 115 | 0 | 3282 | 3282 | 0 |
| Windrichting 90° | 0 | 115 | 0 | 3065 | 0 | 0 |
| Windrichting 135° | -115 | 115 | 0 | 3282 | -3282 | 0 |

Project: GT-RLL380
Tower: HS
Number: 26

**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 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-05 |
| Circuit 2 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-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 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-05 |
| Circuit 2 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-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 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Circuit 2 | 3 | 2 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Bliksemdraad 1 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |

**Vertical load ahead**

| Circuit | Bundle [-] | Additional [%] | $w_{z,G}$ [N/m] | Ice region | Formula | [N/m] | [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Circuit 2 | 3 | 2 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Bliksemdraad 1 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |

**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 | 5.50 | 1 | 5.5 | 4.5 | 2.4 | 30.80 | 1.00 | 1.2 | 2.87 |
| 380ct1f2 | 5.50 | 1 | 5.5 | 4.5 | 2.4 | 30.80 | 1.00 | 1.2 | 2.87 |
| 380ct1f3 | 5.50 | 1 | 5.5 | 4.5 | 2.4 | 42.10 | 1.09 | 1.2 | 3.13 |
| 380ct2f1 | 5.50 | 1 | 5.5 | 4.5 | 2.4 | 30.80 | 1.00 | 1.2 | 2.87 |
| 380ct2f2 | 5.50 | 1 | 5.5 | 4.5 | 2.4 | 30.80 | 1.00 | 1.2 | 2.87 |
| 380ct2f3 | 5.50 | 1 | 5.5 | 4.5 | 2.4 | 42.10 | 1.09 | 1.2 | 3.13 |
| bl1 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 44.25 | 1.10 | 1.2 | 0.13 |
| bl2 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 44.25 | 1.10 | 1.2 | 0.13 |

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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 | 21.4 | 0.90 | 0.56 | 0.51 | 1.12 | 28.50 | 48.2 | 43.5 | 47.2 | 85.4 | 77.0 |
| 380ct1f2 | 21.4 | 0.90 | 0.56 | 0.51 | 1.12 | 28.50 | 48.2 | 43.5 | 47.2 | 85.4 | 77.0 |
| 380ct1f3 | 32.7 | 1.01 | 0.60 | 0.54 | 1.09 | 28.50 | 56.1 | 50.5 | 47.2 | 102.5 | 92.3 |
| 380ct2f1 | 21.4 | 0.90 | 0.56 | 0.51 | 1.12 | 28.50 | 48.2 | 43.5 | 47.2 | 85.4 | 77.0 |
| 380ct2f2 | 21.4 | 0.90 | 0.56 | 0.51 | 1.12 | 28.50 | 48.2 | 43.5 | 47.2 | 85.4 | 77.0 |
| 380ct2f3 | 32.7 | 1.01 | 0.60 | 0.54 | 1.09 | 28.50 | 56.1 | 50.5 | 47.2 | 102.5 | 92.3 |
| bl1 | 37.0 | 1.05 | 0.61 | 0.55 | 1.20 | 22.24 | 16.9 | 15.2 | 63.1 | 48.1 | 43.3 |
| bl2 | 37.0 | 1.05 | 0.61 | 0.55 | 1.20 | 22.13 | 16.9 | 15.2 | 63.0 | 48.0 | 43.2 |

**Wind load ahead**

| Conductor | Height wind [m] | Pressure [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{additional}$ [mm] | $w_y$ [N/m] | $w_{y,section}$ [N/m] | $D_{ijs,additional}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,section}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 21.3 | 0.89 | 0.56 | 0.51 | 1.12 | 28.50 | 48.1 | 43.4 | 47.2 | 85.2 | 76.8 |
| 380ct1f2 | 21.3 | 0.89 | 0.56 | 0.51 | 1.12 | 28.50 | 48.1 | 43.4 | 47.2 | 85.2 | 76.8 |
| 380ct1f3 | 32.6 | 1.01 | 0.60 | 0.54 | 1.09 | 28.50 | 56.0 | 50.5 | 47.2 | 102.3 | 92.1 |
| 380ct2f1 | 21.3 | 0.89 | 0.56 | 0.51 | 1.12 | 28.50 | 48.1 | 43.4 | 47.2 | 85.2 | 76.8 |
| 380ct2f2 | 21.3 | 0.89 | 0.56 | 0.51 | 1.12 | 28.50 | 48.1 | 43.4 | 47.2 | 85.2 | 76.8 |
| 380ct2f3 | 32.6 | 1.01 | 0.60 | 0.54 | 1.09 | 28.50 | 56.0 | 50.5 | 47.2 | 102.3 | 92.1 |
| bl1 | 36.9 | 1.05 | 0.61 | 0.54 | 1.20 | 22.24 | 16.9 | 15.2 | 63.1 | 48.0 | 43.2 |
| bl2 | 36.9 | 1.05 | 0.61 | 0.54 | 1.20 | 22.13 | 16.8 | 15.2 | 63.0 | 48.0 | 43.2 |

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Tower: HS
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**Conductor loads**

Auteur: TBR
Versie: v11.8

**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 | 0.90 | 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 | 43 |
| Number of load combinations for SPLS | 0 |
| Number of load combinations for SLS | 11 |
| Number of concentrated loads | 432 |

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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.
*For Steunmast the special combination SPLS 6 don't apply.

**Maximum values for back and ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -41.2 | 41.2 | 3.9 | 3.9 | 5.6 | 5.7 |
| 380ct1f1 | -106.0 | 106.0 | 12.9 | 13.0 | 16.6 | 16.0 |
| 380ct1f2 | -106.0 | 106.0 | 12.9 | 13.0 | 16.6 | 16.0 |
| 380ct1f3 | -107.9 | 107.9 | 14.7 | 14.8 | 16.6 | 16.0 |
| 380ct2f1 | -106.0 | 106.0 | 12.9 | 13.0 | 16.6 | 16.0 |
| 380ct2f2 | -106.0 | 106.0 | 12.9 | 13.0 | 16.6 | 16.0 |
| 380ct2f3 | -107.9 | 107.9 | 14.7 | 14.8 | 16.6 | 16.0 |
| bl2 | -41.6 | 41.6 | 3.9 | 3.9 | 5.6 | 5.7 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 344.3 | 344.3 | 344.3 |
| 380ct1f1 | 344.3 | 344.3 | 344.3 |
| 380ct1f2 | 344.3 | 344.3 | 344.3 |
| 380ct1f3 | 344.3 | 344.3 | 344.3 |
| 380ct2f1 | 344.3 | 344.3 | 344.3 |
| 380ct2f2 | 344.3 | 344.3 | 344.3 |
| 380ct2f3 | 344.3 | 344.3 | 344.3 |
| bl2 | 344.3 | 344.3 | 344.3 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 344.3 | 344.3 |
| 380ct1f1 | 344.3 | 344.3 |
| 380ct1f2 | 344.3 | 344.3 |
| 380ct1f3 | 344.3 | 344.3 |
| 380ct2f1 | 344.3 | 344.3 |
| 380ct2f2 | 344.3 | 344.3 |
| 380ct2f3 | 344.3 | 344.3 |
| bl2 | 344.3 | 344.3 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 344.3 m | 1.000 - |
| Min. weight span | 344.3 m | 1.000 - |

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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 | 20.6 | 7.8 | 11.3 | -41.3 | 41.3 |
| 380ct1f1 | 50.1 | 25.9 | 31.8 | -106.1 | 106.1 |
| 380ct1f2 | 50.1 | 25.9 | 31.8 | -106.1 | 106.1 |
| 380ct1f3 | 50.1 | 29.5 | 31.8 | -108.1 | 108.1 |
| 380ct2f1 | 50.1 | 25.9 | 31.8 | -106.1 | 106.1 |
| 380ct2f2 | 50.1 | 25.9 | 31.8 | -106.1 | 106.1 |
| 380ct2f3 | 50.1 | 29.5 | 31.8 | -108.1 | 108.1 |
| bl2 | 20.6 | 7.8 | 11.3 | -41.7 | 41.6 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0.0 | 0.6 | 3.5 | -13.8 | 13.8 |
| 380ct1f1 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct1f2 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct1f3 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct2f1 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct2f2 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct2f3 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| bl2 | 0.0 | 0.6 | 3.5 | -13.7 | 13.7 |

1 **Control uplift SLS-wind**

| Combinatie: | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1.8 | 1.8 |
| | 380ct1f1 | 10.6 | 10.6 |
| | 380ct1f2 | 10.6 | 10.6 |
| | 380ct1f3 | 10.6 | 10.6 |
| | 380ct2f1 | 10.6 | 10.6 |
| | 380ct2f2 | 10.6 | 10.6 |
| | 380ct2f3 | 10.6 | 10.6 |
| | bl2 | 1.8 | 1.8 |

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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 | 178 | 141 | 6643 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 178 | 141 | 6643 | 0 | 0 |
| ULS 3_90 | | 0 | 114 | 214 | 4289 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 114 | 214 | 4289 | 0 | 0 |
| SLS 7 | | 0 | 19 | 134 | 700 | 0 | 0 |

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

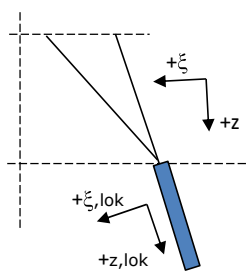
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 307 | 360 | 10066 | 0 | 0 |
| ULS 3_90 | 0 | 153 | 433 | 5316 | 0 | 0 |
| SLS 7 | 0 | 19 | 343 | 700 | 0 | 0 |

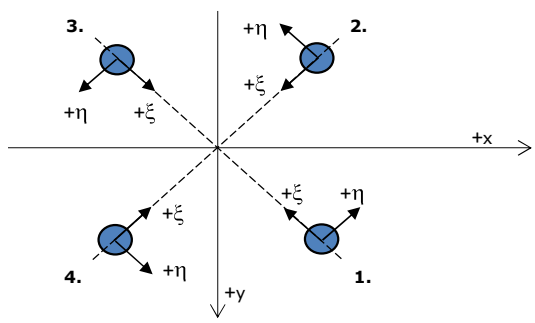
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 307 | 360 | **10066** | 0 | 0 |
| ULS 1a_0,9_0,9_0 | 179 | 17 | 309 | 638 | **5409** | 0 |
| ULS 5a Ba 10 | 50 | 17 | 343 | 768 | 1632 | **-802** |
| ULS 1a_135 | -132 | 230 | 360 | **7446** | **-3805** | 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 | 127 | 114 | **715** | 9 | -170 | -25 | 730 |
| 2 | ULS 8 Ah | 48 | -67 | **357** | 14 | -81 | -9 | 364 |
| 3 | ULS 5a Ah 22 | -6 | -52 | **179** | -33 | -41 | -4 | 183 |
| 4 | ULS 1a_135 | -127 | 114 | **715** | -9 | -170 | -25 | 730 |

**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 | ULS 5a Ah 22 | -8 | 15 | **-7** | -17 | -5 | -6 | -7 |
| 2 | ULS 1a_0,9_0,9_135 | -95 | 82 | **-544** | 9 | 125 | 15 | -555 |
| 3 | ULS 1a_0,9_0,9_45 | 95 | 82 | **-543** | -9 | 125 | 15 | -555 |
| 4 | ULS 1a_0,9_0,9_0 | 24 | -37 | **-188** | -10 | 43 | 5 | -192 |

**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 | 34 | -19 | 38 | **37** | -11 | -3 | 39 |
| 2 | ULS 5a Ba 20 | 1 | -51 | 148 | **35** | -37 | -7 | 151 |
| 3 | ULS 5a Ba 20 | -20 | 27 | -34 | **34** | 5 | -2 | -34 |
| 4 | ULS 5a Ah 10 | -14 | 60 | 219 | **32** | -52 | -8 | 224 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | ULS 5a Ba 10 | 14 | 60 | 219 | **-32** | -52 | -8 | 224 |
| 2 | ULS 5a Ah 20 | 20 | 27 | -34 | **-34** | 5 | -2 | -34 |
| 3 | ULS 5a Ah 20 | -1 | -51 | 148 | **-35** | -37 | -7 | 151 |
| 4 | ULS 5a Ba 10 | -34 | -19 | 38 | **-37** | -11 | -3 | 39 |

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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 | ULS 5a Ah 12 | 28 | -20 | **4** | **34** | -6 | -5 | 4 |
| 2 | ULS 1a_0,9_0,9_135 | -95 | 82 | **-544** | **9** | 125 | 15 | -555 |
| 3 | ULS 1a_0,9_0,9_45 | 95 | 82 | **-543** | **-9** | 125 | 15 | -555 |
| 4 | ULS 1a_0,9_0,9_0 | 24 | -37 | **-188** | **-10** | 43 | 5 | -192 |

**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 | 23 | 21 | 125 | 2 | -31 | -6 | 127 |
| 2 | SLS 7 | 9 | -11 | 47 | 2 | -14 | -5 | 48 |
| 3 | SLS 7 | -9 | -11 | 47 | -2 | -14 | -5 | 48 |
| 4 | SLS 7 | -23 | 21 | 125 | -2 | -31 | -6 | 127 |

**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 | -127 | 114 | **715** | -9 | -170 | -25 | 730 |
| Max. tension | ULS 1a_0,9_0,9_135 | -95 | 82 | **-544** | 9 | 125 | 15 | -555 |
| Max. pos. torsie | ULS 5a Ah 10 | 34 | -19 | 38 | **37** | -11 | -3 | 39 |
| Max. neg. torsie | ULS 5a Ba 10 | -34 | -19 | 38 | **-37** | -11 | -3 | 39 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -95 | 82 | **-544** | **9** | 125 | 15 | -555 |

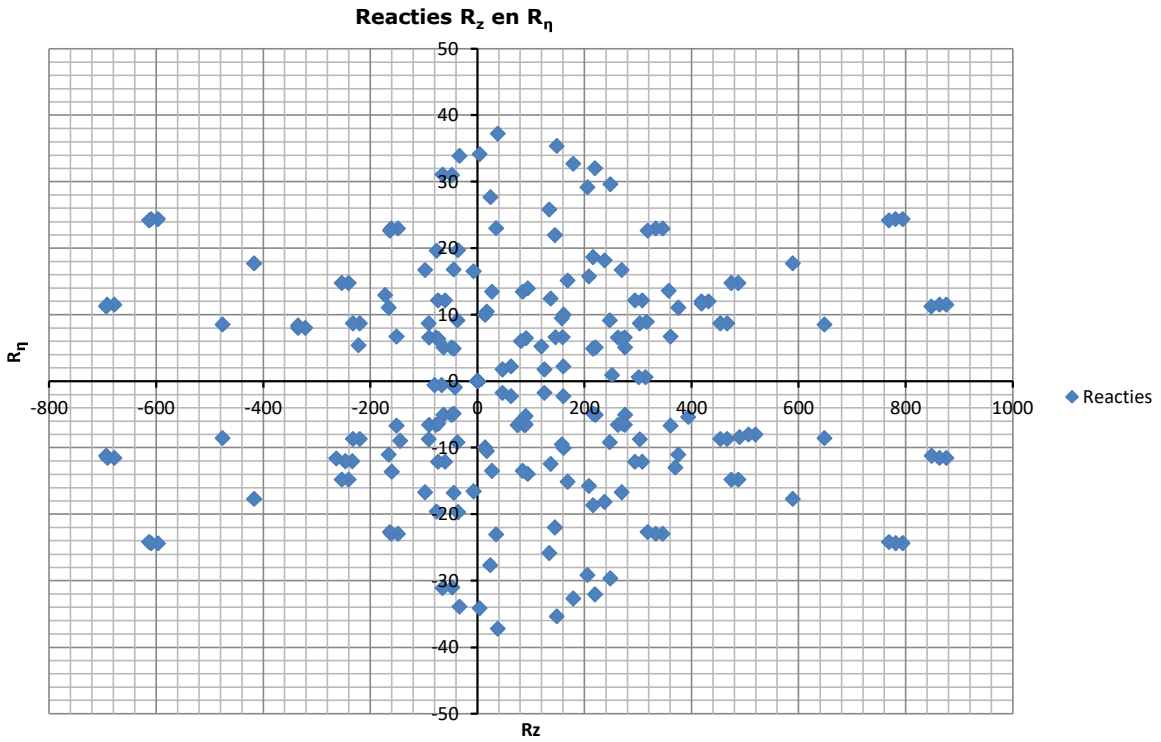
**Maximum tension load - SLS**

| 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 | 23 | 21 | **125** | 2 | -31 | -6 | 127 |
| 2 | SLS 1a_135 | -78 | 66 | **-446** | 8 | 102 | 11 | -455 |
| 3 | SLS 1a_45 | 78 | 66 | **-446** | -8 | 102 | 11 | -455 |
| 4 | SLS 1a_0 | 15 | -27 | **-129** | -9 | 29 | 3 | -132 |

**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 | 110 | 98 | **618** | 8 | -147 | -22 | 631 |
| 2 | SLS 1a_0 | 47 | -59 | **301** | 9 | -74 | -13 | 307 |
| 3 | SLS 7 | -9 | -11 | **47** | -2 | -14 | -5 | 48 |
| 4 | SLS 1a_135 | -110 | 98 | **618** | -8 | -147 | -22 | 631 |

Project: GT-RLL380
Tower: HS
Number: 26



Project: GT-RLL380
Tower: HS
Number: 26

**Conductor loads**

Auteur: TBR
Versie: v11.8

**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 | 0.90 | 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 | 43 |
| Number of load combinations for SPLS | 0 |
| Number of load combinations for SLS | 11 |
| Number of concentrated loads | 432 |

Project: GT-RLL380
Tower: HS
Number: 26

**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.
*For Steunmast the special combination SPLS 6 don't apply.

**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 | -50.2 | 50.2 | 4.8 | 4.9 | 7.3 | 7.4 |
| 380ct1f1 | -122.4 | 122.4 | 16.0 | 16.0 | 18.5 | 18.7 |
| 380ct1f2 | -122.4 | 122.4 | 16.0 | 16.0 | 18.5 | 18.7 |
| 380ct1f3 | -124.8 | 124.8 | 18.2 | 18.3 | 18.5 | 18.7 |
| 380ct2f1 | -122.4 | 122.4 | 16.0 | 16.0 | 18.5 | 18.7 |
| 380ct2f2 | -122.4 | 122.4 | 16.0 | 16.0 | 18.5 | 18.7 |
| 380ct2f3 | -124.8 | 124.8 | 18.2 | 18.3 | 18.5 | 18.7 |
| bl2 | -50.6 | 50.6 | 4.8 | 4.9 | 7.3 | 7.4 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 344.3 | 344.3 | 344.3 |
| 380ct1f1 | 344.3 | 344.3 | 344.3 |
| 380ct1f2 | 344.3 | 344.3 | 344.3 |
| 380ct1f3 | 344.3 | 344.3 | 344.3 |
| 380ct2f1 | 344.3 | 344.3 | 344.3 |
| 380ct2f2 | 344.3 | 344.3 | 344.3 |
| 380ct2f3 | 344.3 | 344.3 | 344.3 |
| bl2 | 344.3 | 344.3 | 344.3 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 344.3 | 344.3 |
| 380ct1f1 | 344.3 | 344.3 |
| 380ct1f2 | 344.3 | 344.3 |
| 380ct1f3 | 344.3 | 344.3 |
| 380ct2f1 | 344.3 | 344.3 |
| 380ct2f2 | 344.3 | 344.3 |
| 380ct2f3 | 344.3 | 344.3 |
| bl2 | 344.3 | 344.3 |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 344.3 m | 1.000 - |
| Min. weight span | 344.3 m | 1.000 - |

Project: GT-RLL380
Tower: HS
Number: 26

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

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 20.6 | 9.7 | 14.7 | -50.3 | 50.3 |
| 380ct1f1 | 50.1 | 32.0 | 37.2 | -122.6 | 122.6 |
| 380ct1f2 | 50.1 | 32.0 | 37.2 | -122.6 | 122.6 |
| 380ct1f3 | 50.1 | 36.6 | 37.2 | -125.0 | 125.0 |
| 380ct2f1 | 50.1 | 32.0 | 37.2 | -122.6 | 122.6 |
| 380ct2f2 | 50.1 | 32.0 | 37.2 | -122.6 | 122.6 |
| 380ct2f3 | 50.1 | 36.6 | 37.2 | -125.0 | 125.0 |
| bl2 | 20.6 | 9.7 | 14.7 | -50.7 | 50.7 |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0.0 | 0.6 | 3.5 | -13.8 | 13.8 |
| 380ct1f1 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct1f2 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct1f3 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct2f1 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct2f2 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| 380ct2f3 | 0.0 | 3.0 | 21.2 | -62.7 | 62.7 |
| bl2 | 0.0 | 0.6 | 3.5 | -13.7 | 13.7 |

1 **Control uplift SLS-wind**

| Combinatie: | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 1.8 | 1.8 |
| | 380ct1f1 | 10.6 | 10.6 |
| | 380ct1f2 | 10.6 | 10.6 |
| | 380ct1f3 | 10.6 | 10.6 |
| | 380ct2f1 | 10.6 | 10.6 |
| | 380ct2f2 | 10.6 | 10.6 |
| | 380ct2f3 | 10.6 | 10.6 |
| | bl2 | 1.8 | 1.8 |

Project: GT-RLL380
Tower: HS
Number: 26

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

| Combination | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | 0 | 221 | 154 | 8224 | -1 | 0 |
| ULS 1a_0,9_90 | | 0 | 221 | 154 | 8224 | -1 | 0 |
| ULS 3_90 | | 0 | 140 | 253 | 5264 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 140 | 253 | 5264 | 0 | 0 |
| SLS 7 | | 0 | 19 | 134 | 700 | 0 | 0 |

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

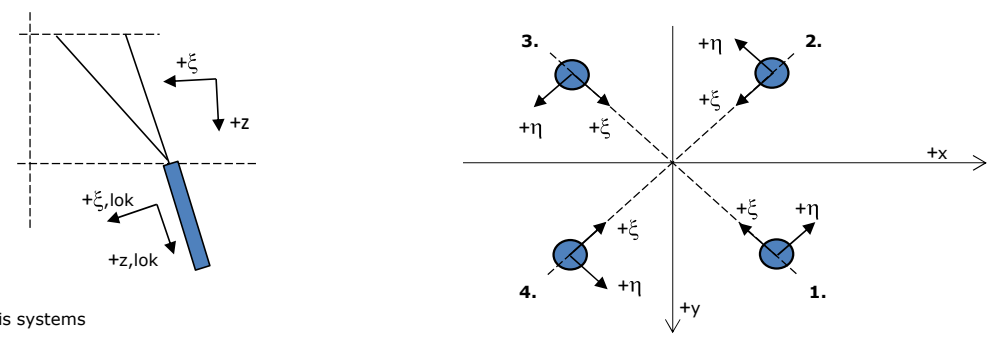
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 382 | 395 | 12516 | -1 | 0 |
| ULS 3_90 | 0 | 188 | 493 | 6551 | 0 | 0 |
| SLS 7 | 0 | 19 | 343 | 700 | 0 | 0 |

**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 | 395 | **12516** | -1 | 0 |
| ULS 1a_0 | 225 | 21 | 395 | 791 | **6781** | 0 |
| ULS 5a Ba 10 | 50 | 17 | 343 | 768 | 1632 | **-802** |
| ULS 1a_135 | -166 | 285 | 395 | **9221** | **-4770** | 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 | 155 | 139 | **876** | 12 | -208 | -30 | 894 |
| 2 | ULS 1a_0 | 66 | -83 | **431** | 12 | -106 | -18 | 440 |
| 3 | ULS 5a Ah 22 | -6 | -52 | **179** | -33 | -41 | -4 | 183 |
| 4 | ULS 1a_135 | -155 | 139 | **876** | -12 | -208 | -30 | 894 |

**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 | ULS 5a Ah 22 | -8 | 15 | **-7** | -17 | -5 | -6 | -7 |
| 2 | ULS 1a_0,9_0,9_135 | -121 | 106 | **-693** | 11 | 160 | 20 | -708 |
| 3 | ULS 1a_0,9_0,9_45 | 121 | 106 | **-693** | -11 | 160 | 20 | -707 |
| 4 | ULS 1a_0,9_0,9_0 | 35 | -52 | **-264** | -12 | 61 | 8 | -269 |

**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 | 34 | -19 | 38 | **37** | -11 | -3 | 39 |
| 2 | ULS 5a Ba 20 | 1 | -51 | 148 | **35** | -37 | -7 | 151 |
| 3 | ULS 5a Ba 20 | -20 | 27 | -34 | **34** | 5 | -2 | -34 |
| 4 | ULS 5a Ah 10 | -14 | 60 | 219 | **32** | -52 | -8 | 224 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | ULS 5a Ba 10 | 14 | 60 | 219 | **-32** | -52 | -8 | 224 |
| 2 | ULS 5a Ah 20 | 20 | 27 | -34 | **-34** | 5 | -2 | -34 |
| 3 | ULS 5a Ah 20 | -1 | -51 | 148 | **-35** | -37 | -7 | 151 |
| 4 | ULS 5a Ba 10 | -34 | -19 | 38 | **-37** | -11 | -3 | 39 |

Project: GT-RLL380
Tower: HS
Number: 26

**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 5a Ah 12 | 28 | -20 | **4** | **34** | -6 | -5 | 4 |
| 2 | ULS 1a_0,9_0,9_135 | -121 | 106 | **-693** | **11** | 160 | 20 | -708 |
| 3 | ULS 1a_0,9_0,9_45 | 121 | 106 | **-693** | **-11** | 160 | 20 | -707 |
| 4 | ULS 1a_0,9_0,9_0 | 35 | -52 | **-264** | **-12** | 61 | 8 | -269 |

**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 | 23 | 21 | 125 | 2 | -31 | -6 | 127 |
| 2 | SLS 7 | 9 | -11 | 47 | 2 | -14 | -5 | 48 |
| 3 | SLS 7 | -9 | -11 | 47 | -2 | -14 | -5 | 48 |
| 4 | SLS 7 | -23 | 21 | 125 | -2 | -31 | -6 | 127 |

**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 | -155 | 139 | **876** | -12 | -208 | -30 | 894 |
| Max. tension | ULS 1a_0,9_0,9_135 | -121 | 106 | **-693** | 11 | 160 | 20 | -708 |
| Max. pos. torsie | ULS 5a Ah 10 | 34 | -19 | 38 | **37** | -11 | -3 | 39 |
| Max. neg. torsie | ULS 5a Ba 10 | -34 | -19 | 38 | **-37** | -11 | -3 | 39 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -121 | 106 | **-693** | **11** | 160 | 20 | -708 |

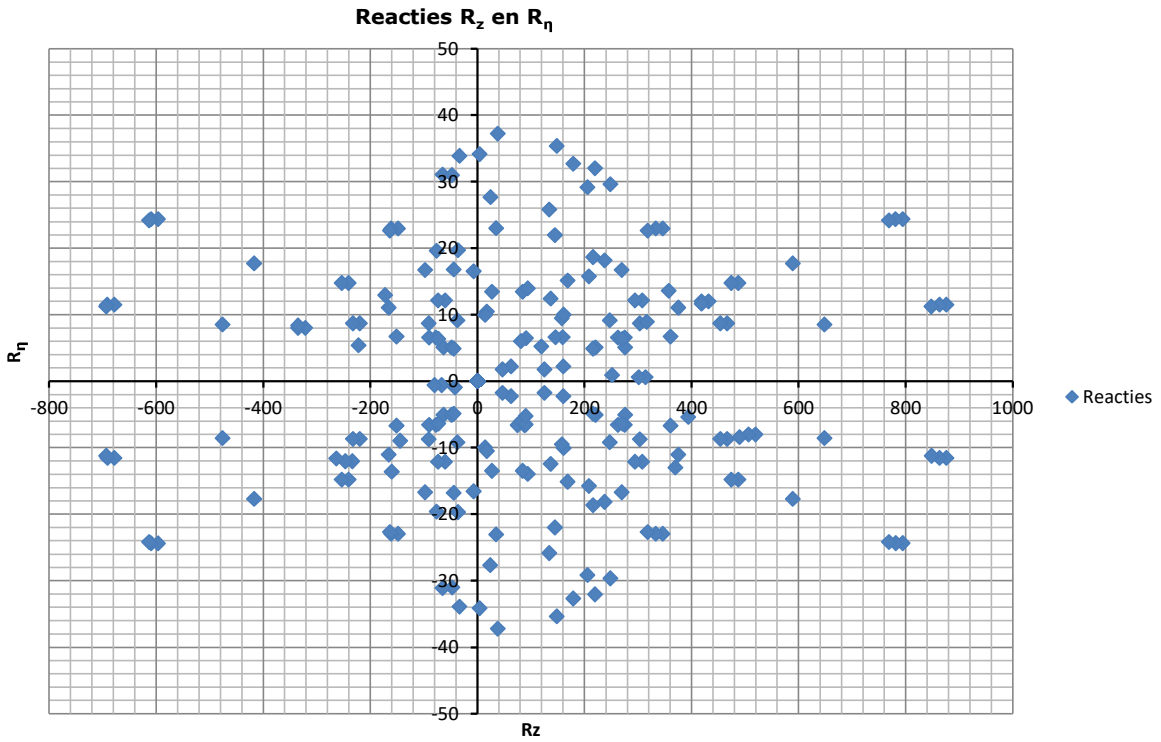
**Maximum tension load - SLS**

| 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 | 23 | 21 | **125** | 2 | -31 | -6 | 127 |
| 2 | SLS 1a_135 | -83 | 71 | **-476** | 9 | 109 | 12 | -486 |
| 3 | SLS 1a_45 | 83 | 71 | **-476** | -9 | 109 | 12 | -486 |
| 4 | SLS 1a_0 | 17 | -29 | **-144** | -9 | 33 | 3 | -147 |

**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 | 115 | 103 | **648** | 9 | -154 | -23 | 661 |
| 2 | SLS 1a_0 | 49 | -62 | **316** | 9 | -78 | -14 | 322 |
| 3 | SLS 7 | -9 | -11 | **47** | -2 | -14 | -5 | 48 |
| 4 | SLS 1a_135 | -115 | 103 | **648** | -9 | -154 | -23 | 661 |

Project: GT-RLL380
Tower: HS
Number: 26



## Content


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


## Data

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initial* | |
| Consequence class | CC2-0 |
| Reliability level | Afkeur |
| Reference period | 30 jaar |
| *After adjustment* | |
| Consequence class | CC2 |
| Reliability level | Verbouw |
| Reference period | 50 jaar |
| Wind zone | III |
| Wind speed | 24.5 m/s |
| Terrain categorie | II |
| Reduction factor Cdir | 1.00 |
| Ice region | B |
| Tower type | Hoekmast |
| Tower height | 48.5 m |
| Max. Span | 394.23 m |
| Line angle | 129.24° |
| Catenary | 1375 m |
| Wind span | 332 m |
| EDS Weight span | 332 m |
| Min. Weight span | 332 m |
| Max. Weight span | 332 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-05-05 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype HC+0

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

Document name:

GT-RLL380_HC+0_16_Report.pdf

Project number:

Project client number:

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

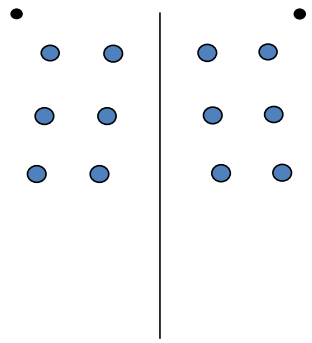
Project: GT-RLL380
Tower: HC+0
Number: 16

Auteur: TBR
Versie: v11.8

## Conductor loads

### General

| | |
|---|---|
| Description | HC+0 |
| Tower type | Hoekmast |
| Number of circuits | 2 |
| Configuration | 2-circuit-donau |
| Number of earth wires | 2 |



Configuratie geleiders

### Starting points

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

### Conductors back

| Description | Voltage | Conductor Back | Bundle Ba | Ice region | Additional weight | Additional diameter | Catenary $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | St/Al 48/7-423/37-SEP | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | ACSR-26/7-242/39-HAWK | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW 226 | 1 | A | 2 % | 2 % | 1375 |

### Conductors ahead

| Description | Voltage | Conductor Ahead | Bundle Ah | Ice region | Additional weight | Additional diameter | Catenary $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1375 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1375 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1375 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1375 |

### Insulators *(1)*

| Description | Suspension | Weight [kN] | Length [m] | Wind area [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Afspanketting | 6.00 | 7.90 | 2.40 |
| Circuit 2 | Afspanketting | 6.00 | 7.90 | 2.40 |
| Bliksemdraad 1 | Afspanketting | 0.10 | 0.20 | 0.10 |
| Bliksemdraad 2 | Afspanketting | 0.10 | 0.20 | 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 | 27.7 m | 27.7 m | -17.5 m |
| Circuit 1 | 11 | 380ct1f2 | 27.7 m | 27.7 m | -9.0 m |
| Circuit 1 | 12 | 380ct1f3 | 39.0 m | 39.0 m | -13.3 m |
| Circuit 2 | 20 | 380ct2f1 | 27.7 m | 27.7 m | 9.0 m |
| Circuit 2 | 21 | 380ct2f2 | 27.7 m | 27.7 m | 17.5 m |
| Circuit 2 | 22 | 380ct2f3 | 39.0 m | 39.0 m | 13.3 m |
| Bliksemdraad 1 | 1 | bl1 | 43.0 m | 43.0 m | -19.8 m |
| Bliksemdraad 2 | 3 | bl2 | 43.0 m | 43.0 m | 19.8 m |

Project: GT-RLL380
Tower: HC+0
Number: 16

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

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

Decrease: Niet in 0,9EG-combinaties

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

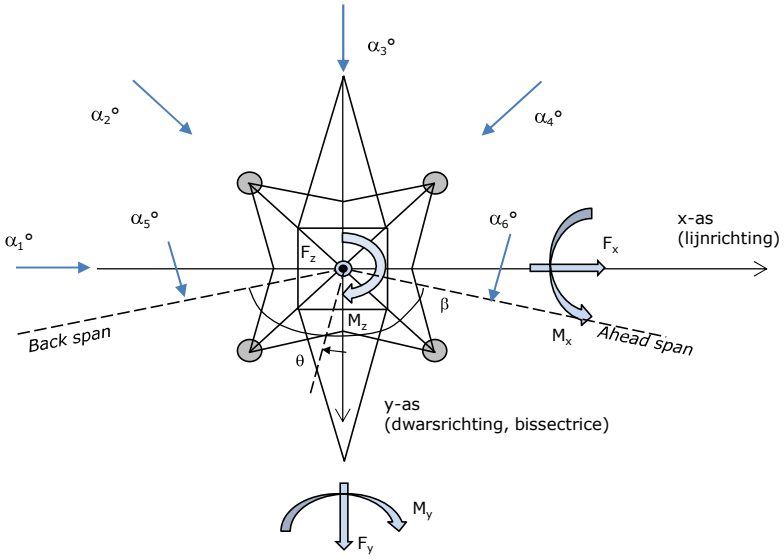
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 1 | 11 | 380ct1f2 | 0.0 | 0.0 m | 0.0 | 0.0 m |
| Circuit 1 | 12 | 380ct1f3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

**Line and tower data**

| | | Back | Ahead |
|---|---|---|---|
| | | 394.2 | 269.1 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 392.9 | 269.1 m |
| Line angle | $\beta$ | 129.24 ° | |
| Tower orientation with respect to bis | $\theta$ | -5 ° | |
| Section length | | 2748 | 269 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 ° | |
| | $\alpha_5$ | 69.62 ° | |
| | $\alpha_6$ | 120.38 ° | |

*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: GT-RLL380
Tower: HC+0
Number: 16

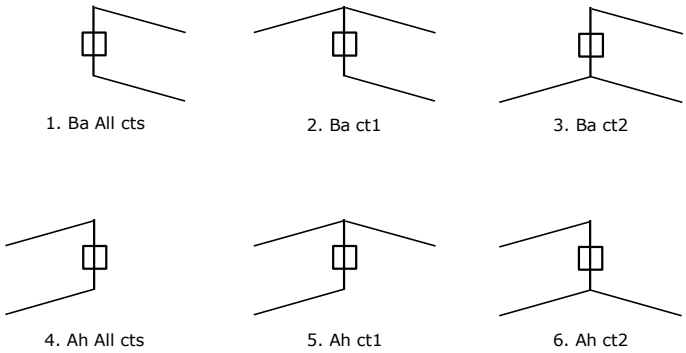
**Absence of conductors**

| | | 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

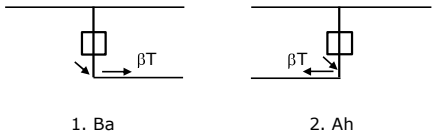
Principle of load situations:




**Load situation 5a. Conductor failure**

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

Principle of load situations:



Project: GT-RLL380
Tower: HC+0
Number: 16

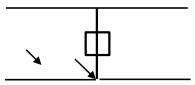
**Load situations LC6. Construction and maintenance**
Under 6a, the load due to the presence of a line verhicle or line bicycle in combination with point load on the traverse is assesed.
Combination 6b does not contain any loads in conductor or on traverse. This combination has been added to be able 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 | 4.0 kN | 2.0 kN |
| Concentrated load cross arm | 1.0 kN | 1.0 kN |

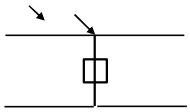
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

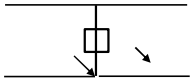
Principle of load situations:



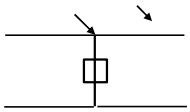
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

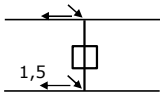
**Load situations 8. Galloping as a static load**

| 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 |

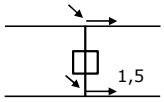
Considered situations galloping 8: None (existing structure)

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: GT-RLL380
Tower: HC+0
Number: 16

**Tower structure**

**Properties**

| | | | |
|---|---|---|---|
| Tower type | Hoekmast | | |
| Tower designation | HC+0 | | |
| Base plate w.r.t. ground level | 0.5 | m | |
| Tower height w.r.t. base plate | 48.5 | m | |
| Tower self weight | 500.0 | 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 | 1.3 | 1.3 | - |

**Calculation Wind load**

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

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

| Description | h [m] | $b_1$ [m] | $b_2$ [m] | $\Delta h$ [m] | $\Delta_x$ [m] | $A_0$ [$m^2$] | $A_1$ [$m^2$] | $\chi = A_1/A_0$ [-] | $C_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 9.60 | 11.00 | 8.00 | 9.60 | 0.156 | 91.20 | 7.50 | 0.08 | 3.50 |
| Eerste tussenstuk | 18.90 | 8.00 | 5.84 | 9.30 | 0.116 | 64.36 | 7.90 | 0.12 | 3.29 |
| Tweede tussenstuk | 27.70 | 5.84 | 3.78 | 8.80 | 0.117 | 42.33 | 8.00 | 0.19 | 2.98 |
| Bovenstuk 1 | 35.50 | 3.78 | 3.18 | 7.80 | 0.038 | 27.14 | 5.90 | 0.22 | 2.86 |
| Bovenstuk 2 | 43.00 | 3.18 | 2.60 | 7.50 | 0.039 | 21.68 | 5.10 | 0.24 | 2.78 |
| Topstuk | 45.00 | 2.60 | | 2.00 | | 2.60 | 0.50 | 0.19 | 2.96 |
| Ondertraverse | 27.70 | 15.54 | | 4.00 | | 31.08 | 7.25 | 0.23 | 2.79 |
| Boventraverse | 39.00 | 18.05 | | 4.20 | | 37.91 | 8.47 | 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 | 9.60 | 11.00 | 8.00 | 9.60 | 0.156 | 91.20 | 7.50 | 0.08 | 3.50 |
| Eerste tussenstuk | 18.90 | 8.00 | 5.84 | 9.30 | 0.116 | 64.36 | 7.90 | 0.12 | 3.29 |
| Tweede tussenstuk | 27.70 | 5.84 | 3.78 | 8.80 | 0.117 | 42.33 | 8.00 | 0.19 | 2.98 |
| Bovenstuk 1 | 35.50 | 3.78 | 3.18 | 7.80 | 0.038 | 27.14 | 5.90 | 0.22 | 2.86 |
| Bovenstuk 2 | 43.00 | 3.18 | 2.60 | 7.50 | 0.039 | 21.68 | 5.10 | 0.24 | 2.78 |
| Topstuk | 45.00 | 2.60 | | 2.00 | | 2.60 | 0.50 | 0.19 | 2.96 |
| Ondertraverse | 27.70 | 15.54 | | 4.00 | | 31.08 | 7.25 | 0.23 | 2.79 |
| Boventraverse | 39.00 | 18.05 | | 4.20 | | 37.91 | 8.47 | 0.22 | 2.83 |

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

Project: GT-RLL380
Tower: HC+0
Number: 16

**Wind surface feeders telecom installations**

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

**Input antennas**

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

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

| Description | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0.70 | 18.4 | 15.6 | 0.0 | -15.6 | 4.8 | 88.3 | 74.9 | 0.0 | -74.9 |
| Eerste tussenstuk | 0.79 | 20.5 | 17.4 | 0.0 | -17.4 | 14.3 | 292.4 | 248.1 | 0.0 | -248.1 |
| Tweede tussenstuk | 0.92 | 21.9 | 18.6 | 0.0 | -18.6 | 23.3 | 510.2 | 432.9 | 0.0 | -432.9 |
| Bovenstuk 1 | 1.01 | 17.0 | 14.4 | 0.0 | -14.4 | 31.6 | 536.5 | 455.2 | 0.0 | -455.2 |
| Bovenstuk 2 | 1.06 | 15.1 | 12.8 | 0.0 | -12.8 | 39.3 | 592.9 | 503.1 | 0.0 | -503.1 |
| Topstuk | 1.10 | 1.6 | 1.4 | 0.0 | -1.4 | 44.0 | 71.6 | 60.8 | 0.0 | -60.8 |
| Ondertraverse | 0.98 | 39.6 | 23.5 | 0.0 | -23.5 | 29.0 | 1150.2 | 683.2 | 0.0 | -683.2 |
| Boventraverse | 1.07 | 51.5 | 30.6 | 0.0 | -30.6 | 40.4 | 2078.8 | 1234.7 | 0.0 | -1234.7 |
| Totaal | | 185.6 | 134.3 | 0.0 | -134.3 | | 5320.9 | 3693.0 | 0.0 | -3693.0 |

**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 | 0.70 | 0.0 | 15.6 | 18.4 | 15.6 | 4.8 | 0.0 | 74.9 | 88.3 | 74.9 |
| Eerste tussenstuk | 0.79 | 0.0 | 17.4 | 20.5 | 17.4 | 14.3 | 0.0 | 248.1 | 292.4 | 248.1 |
| Tweede tussenstuk | 0.92 | 0.0 | 18.6 | 21.9 | 18.6 | 23.3 | 0.0 | 432.9 | 510.2 | 432.9 |
| Bovenstuk 1 | 1.01 | 0.0 | 14.4 | 17.0 | 14.4 | 31.6 | 0.0 | 455.2 | 536.5 | 455.2 |
| Bovenstuk 2 | 1.06 | 0.0 | 12.8 | 15.1 | 12.8 | 39.3 | 0.0 | 503.1 | 592.9 | 503.1 |
| Topstuk | 1.10 | 0.0 | 1.4 | 1.6 | 1.4 | 44.0 | 0.0 | 60.8 | 71.6 | 60.8 |
| Ondertraverse | 0.98 | 0.0 | 23.5 | 15.8 | 23.5 | 29.0 | 0.0 | 683.2 | 460.1 | 683.2 |
| Boventraverse | 1.07 | 0.0 | 30.6 | 20.6 | 30.6 | 40.4 | 0.0 | 1234.7 | 831.5 | 1234.7 |
| Total | | 0.0 | 134.3 | 131.0 | 134.3 | | 0.0 | 3693.0 | 3383.5 | 3693.0 |

**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 | 500 | 0 | 0 | 0 |
| Windrichting 0° | 186 | 0 | 0 | 0 | 5321 | 0 |
| Windrichting 45° | 134 | 134 | 0 | 3693 | 3693 | 0 |
| Windrichting 90° | 0 | 131 | 0 | 3384 | 0 | 0 |
| Windrichting 135° | -134 | 134 | 0 | 3693 | -3693 | 0 |

Project: GT-RLL380
Tower: HC+0
Number: 16

**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 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-05 |
| Circuit 2 | St/Al 48/7-423/37-SEP | 27.9 | 460.5 | 14.90 | 64835 | 2.03E-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 | ACCC-Warsaw | 27.7 | 571.0 | 14.98 | 62700 | 1.88E-05 |
| Circuit 2 | ACCC-Warsaw | 27.7 | 571.0 | 14.98 | 62700 | 1.88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21.8 | 281.0 | 9.38 | 70165 | 1.97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21.7 | 264.0 | 9.13 | 72000 | 1.98E-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 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Circuit 2 | 3 | 2 | 45.6 | B | 4+0,2d | 9.6 | 28.8 |
| Bliksemdraad 1 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 10.0 | A | 15+0,4d | 23.7 | 23.7 |

**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 | 9.6 | A | 15+0,4d | 23.7 | 23.7 |
| Bliksemdraad 2 | 1 | 2 | 9.3 | A | 15+0,4d | 23.7 | 23.7 |

**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 | 7.9 | 2.4 | 28.20 | 0.97 | 1.2 | 2.80 |
| 380ct1f2 | 6.00 | 1 | 6 | 7.9 | 2.4 | 28.20 | 0.97 | 1.2 | 2.80 |
| 380ct1f3 | 6.00 | 1 | 6 | 7.9 | 2.4 | 39.50 | 1.07 | 1.2 | 3.07 |
| 380ct2f1 | 6.00 | 1 | 6 | 7.9 | 2.4 | 28.20 | 0.97 | 1.2 | 2.80 |
| 380ct2f2 | 6.00 | 1 | 6 | 7.9 | 2.4 | 28.20 | 0.97 | 1.2 | 2.80 |
| 380ct2f3 | 6.00 | 1 | 6 | 7.9 | 2.4 | 39.50 | 1.07 | 1.2 | 3.07 |
| bl1 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 43.50 | 1.09 | 1.2 | 0.13 |
| bl2 | 0.10 | 1 | 0.1 | 0.2 | 0.1 | 43.50 | 1.09 | 1.2 | 0.13 |

Project: GT-RLL380
Tower: HC+0
Number: 16

**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 | 18.8 | 0.86 | 0.55 | 0.47 | 1.13 | 28.50 | 46.1 | 39.5 | 47.2 | 80.9 | 69.3 |
| 380ct1f2 | 18.8 | 0.86 | 0.55 | 0.47 | 1.13 | 28.50 | 46.1 | 39.5 | 47.2 | 80.9 | 69.3 |
| 380ct1f3 | 30.1 | 0.99 | 0.59 | 0.51 | 1.09 | 28.50 | 54.8 | 46.8 | 47.2 | 99.4 | 85.0 |
| 380ct2f1 | 18.8 | 0.86 | 0.55 | 0.47 | 1.13 | 28.50 | 46.1 | 39.5 | 47.2 | 80.9 | 69.3 |
| 380ct2f2 | 18.8 | 0.86 | 0.55 | 0.47 | 1.13 | 28.50 | 46.1 | 39.5 | 47.2 | 80.9 | 69.3 |
| 380ct2f3 | 30.1 | 0.99 | 0.59 | 0.51 | 1.09 | 28.50 | 54.8 | 46.8 | 47.2 | 99.4 | 85.0 |
| bl1 | 34.1 | 1.02 | 0.60 | 0.51 | 1.20 | 22.24 | 16.5 | 14.1 | 63.1 | 46.7 | 39.9 |
| bl2 | 34.1 | 1.02 | 0.60 | 0.51 | 1.20 | 22.13 | 16.4 | 14.0 | 63.0 | 46.7 | 39.9 |

**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 | 23.8 | 0.92 | 0.57 | 0.65 | 1.12 | 28.25 | 50.2 | 57.3 | 46.9 | 89.5 | 102.2 |
| 380ct1f2 | 23.8 | 0.92 | 0.57 | 0.65 | 1.12 | 28.25 | 50.2 | 57.3 | 46.9 | 89.5 | 102.2 |
| 380ct1f3 | 35.1 | 1.03 | 0.60 | 0.69 | 1.09 | 28.25 | 57.5 | 65.5 | 46.9 | 105.5 | 120.2 |
| 380ct2f1 | 23.8 | 0.92 | 0.57 | 0.65 | 1.12 | 28.25 | 50.2 | 57.3 | 46.9 | 89.5 | 102.2 |
| 380ct2f2 | 23.8 | 0.92 | 0.57 | 0.65 | 1.12 | 28.25 | 50.2 | 57.3 | 46.9 | 89.5 | 102.2 |
| 380ct2f3 | 35.1 | 1.03 | 0.60 | 0.69 | 1.09 | 28.25 | 57.5 | 65.5 | 46.9 | 105.5 | 120.2 |
| bl1 | 39.1 | 1.06 | 0.61 | 0.70 | 1.20 | 22.24 | 17.4 | 19.8 | 63.1 | 49.4 | 56.2 |
| bl2 | 39.1 | 1.06 | 0.61 | 0.70 | 1.20 | 22.13 | 17.3 | 19.7 | 63.0 | 49.3 | 56.2 |

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Auteur: TBR
Versie: v11.8

**Conductor loads**

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

| **ULS** (strength) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load case | description | Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $Q_{pk}$ | $\gamma_Q$ $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| 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 | 0.90 | 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 | 5238 |

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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 | -38.6 | 33.2 | 17.7 | 22.1 | 6.5 | 5.1 |
| 380ct1f1 | -97.2 | 91.8 | 42.8 | 59.7 | 21.8 | 18.8 |
| 380ct1f2 | -97.2 | 91.8 | 42.8 | 59.7 | 21.8 | 18.8 |
| 380ct1f3 | -98.6 | 93.8 | 46.6 | 64.4 | 21.8 | 18.8 |
| 380ct2f1 | -97.2 | 91.8 | 42.8 | 59.7 | 21.8 | 18.8 |
| 380ct2f2 | -97.2 | 91.8 | 42.8 | 59.7 | 21.8 | 18.8 |
| 380ct2f3 | -98.6 | 93.8 | 46.6 | 64.4 | 21.8 | 18.8 |
| bl2 | -38.8 | 32.7 | 17.8 | 21.8 | 6.5 | 5.0 |
| V-ketting 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| V-ketting 2 | 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 | 331.7 | 331.7 | 331.7 |
| 380ct1f1 | 331.7 | 331.7 | 331.7 |
| 380ct1f2 | 331.7 | 331.7 | 331.7 |
| 380ct1f3 | 331.7 | 331.7 | 331.7 |
| 380ct2f1 | 331.7 | 331.7 | 331.7 |
| 380ct2f2 | 331.7 | 331.7 | 331.7 |
| 380ct2f3 | 331.7 | 331.7 | 331.7 |
| bl2 | 331.7 | 331.7 | 331.7 |
| V-ketting 1 | | | |
| V-ketting 2 | | | |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 331.7 | 331.7 |
| 380ct1f1 | 331.7 | 331.7 |
| 380ct1f2 | 331.7 | 331.7 |
| 380ct1f3 | 331.7 | 331.7 |
| 380ct2f1 | 331.7 | 331.7 |
| 380ct2f2 | 331.7 | 331.7 |
| 380ct2f3 | 331.7 | 331.7 |
| bl2 | 331.7 | 331.7 |
| V-ketting 1 | | |
| V-ketting 2 | | |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 331.7 m | 1.000 - |
| Min. weight span | 331.7 m | 1.000 - |

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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 | 26.9 | 37.8 | 6.5 | -42.3 | 39.8 |
| 380ct1f1 | 90.8 | 98.6 | 21.8 | -106.1 | 109.4 |
| 380ct1f2 | 90.8 | 98.6 | 21.8 | -106.1 | 109.4 |
| 380ct1f3 | 90.9 | 101.4 | 21.8 | -108.0 | 112.0 |
| 380ct2f1 | 90.8 | 98.6 | 21.8 | -106.1 | 109.4 |
| 380ct2f2 | 90.8 | 98.6 | 21.8 | -106.1 | 109.4 |
| 380ct2f3 | 90.9 | 101.4 | 21.8 | -108.0 | 112.0 |
| bl2 | 27.0 | 37.6 | 6.5 | -42.6 | 39.2 |
| V-ketting 1 | 1.9 | 1.9 | 3.5 | 0.0 | |
| V-ketting 2 | 1.9 | 1.9 | 3.5 | 0.0 | |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 11.3 | 6.6 | 2.1 | -13.8 | 13.1 |
| 380ct1f1 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct1f2 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct1f3 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct2f1 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct2f2 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct2f3 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| bl2 | 11.0 | 6.5 | 2.1 | -13.7 | 12.8 |
| V-ketting 1 | 0.0 | 0.0 | 3.0 | 0.0 | |
| V-ketting 2 | 0.0 | 0.0 | 3.0 | 0.0 | |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 0.0 | 0.0 |
| | 380ct1f1 | 0.0 | 0.0 |
| | 380ct1f2 | 0.0 | 0.0 |
| | 380ct1f3 | 0.0 | 0.0 |
| | 380ct2f1 | 0.0 | 0.0 |
| | 380ct2f2 | 0.0 | 0.0 |
| | 380ct2f3 | 0.0 | 0.0 |
| | bl2 | 0.0 | 0.0 |
| | V-ketting 1 | 0.0 | |
| | V-ketting 2 | 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 | | -14 | 609 | 185 | 19885 | -478 | -5 |
| ULS 1a_0,9_0 | | 2 | 367 | 184 | 11921 | 72 | 41 |
| ULS 1a_0,9_0,9_90 | | -5 | 580 | 158 | 18969 | -183 | -4 |
| ULS 3_0 | | -50 | 585 | 254 | 19224 | -1713 | 0 |
| SLS 7 | | -30 | 345 | 176 | 11187 | -976 | -6 |

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

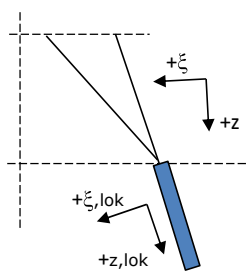
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -14 | 755 | 710 | 23664 | -478 | -5 |
| ULS 1a_0,9_0,9_90 | -5 | 727 | 608 | 22748 | -183 | -4 |
| SLS 7 | -30 | 345 | 676 | 11187 | -976 | -6 |

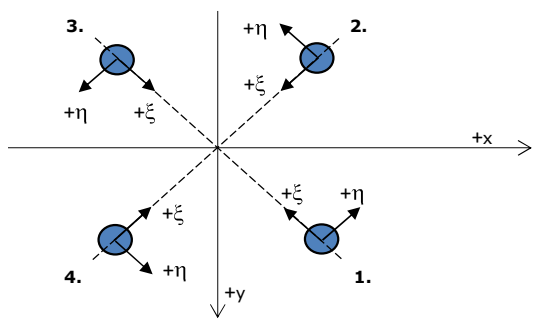
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_120.38 | 33 | 756 | 710 | **23729** | 1739 | -29 |
| SPLS 3_135 Ah All Cts | -536 | 241 | 681 | 7609 | **-17087** | -13 |
| SPLS 6a_90 Ba Ct1 Ah Ct1 | 286 | 416 | 715 | 13524 | 9285 | **-4331** |
| SPLS 3_120.38 Ba All Cts | 500 | 393 | 657 | **12588** | **16482** | -14 |

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

**Support reactions per leg**




Axis systems

**Maximum compression load**

| Index | Combination | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 3_120.38 Ba All Cts | 274 | 284 | **1486** | -7 | -395 | -67 | 1522 |
| 2 | SPLS 1a_0 Ba All Cts | 101 | -133 | **601** | 23 | -166 | -33 | 616 |
| 3 | SPLS 3_135 Ah All Cts | -98 | -132 | **601** | -24 | -163 | -30 | 615 |
| 4 | SPLS 3_69.62 Ah All Cts | -245 | 260 | **1342** | 11 | -358 | -61 | 1374 |

**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 | -34 | -67 | **-280** | 23 | 71 | 9 | -287 |
| 2 | SPLS 3_0,9_69.62 Ah All Cts | -180 | 195 | **-1020** | -11 | 265 | 40 | -1045 |
| 3 | SPLS 3_0,9_120.38 Ba All Cts | 212 | 221 | **-1175** | 6 | 306 | 46 | -1204 |
| 4 | SPLS 1a_0,9_0 Ba All Cts | 40 | -70 | **-296** | -21 | 78 | 13 | -303 |

**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 Ct1 Ah Ct2 | 223 | 9 | 615 | **152** | -164 | -28 | 630 |
| 2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -112 | -116 | 2 | **161** | -3 | -2 | 2 |
| 3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 59 | 252 | -842 | **136** | 219 | 33 | -862 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -130 | 306 | 1152 | **125** | -308 | -54 | 1180 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 134 | 325 | 1216 | **-135** | -324 | -56 | 1245 |
| 2 | SPLS 6a_90 Ah Ct2 Ah Ct1 | -3 | 183 | -500 | **-127** | 132 | 21 | -512 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 79 | -130 | 126 | **-147** | -36 | -8 | 129 |
| 4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | -188 | -44 | 371 | **-164** | -102 | -20 | 380 |

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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 Ct1 | 10 | -84 | **-222** | **66** | 52 | 3 | -227 |
| 2 | SPLS 3_0,9_90 Ah Ct1 | -243 | 79 | **-881** | **116** | 228 | 33 | -903 |
| 3 | SPLS 3_0,9_120.38 Ba Ct1 | 259 | 92 | **-969** | **-118** | 248 | 34 | -993 |
| 4 | SPLS 1a_0,9_0 Ba All Cts | 40 | -70 | **-296** | **-21** | 78 | 13 | -303 |

**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 | 130 | 112 | 633 | 13 | -171 | -31 | 648 |
| 2 | SLS 7 | -76 | 61 | -384 | 11 | 97 | 12 | -393 |
| 3 | SLS 7 | 62 | 43 | -295 | -13 | 74 | 9 | -302 |
| 4 | SLS 7 | -145 | 129 | 722 | -11 | -194 | -35 | 739 |

**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 3_120.38 Ba All Cts | 274 | 284 | **1486** | -7 | -395 | -67 | 1522 |
| Max. tension | SPLS 3_0,9_120.38 Ba All Cts | 212 | 221 | **-1175** | 6 | 306 | 46 | -1204 |
| Max. pos. torsie | SPLS 6a_90 Ba Ct2 Ah Ct2 | -112 | -116 | 2 | **161** | -3 | -2 | 2 |
| Max. neg. torsie | SPLS 6a_90 Ba Ct1 Ah Ct1 | -188 | -44 | 371 | **-164** | -102 | -20 | 380 |
| Comb. tension+torsie | SPLS 3_0,9_120.38 Ba Ct1 | 259 | 92 | **-969** | **-118** | 248 | 34 | -993 |

**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 | 130 | 112 | **633** | 13 | -171 | -31 | 648 |
| 2 | SLS 3_90 | -174 | 145 | **-875** | 21 | 225 | 32 | -896 |
| 3 | SLS 1a_90 | 157 | 129 | **-769** | -20 | 203 | 33 | -787 |
| 4 | SLS 1a_0 | -95 | 77 | **461** | -13 | -122 | -20 | 472 |

**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_90 | 226 | 198 | **1107** | 19 | -300 | -55 | 1133 |
| 2 | SLS 1a_0 | -28 | 7 | **-123** | 15 | 25 | -2 | -126 |
| 3 | SLS 7 | 62 | 43 | **-295** | -13 | 74 | 9 | -302 |
| 4 | SLS 3_90 | -250 | 219 | **1244** | -22 | -332 | -57 | 1274 |

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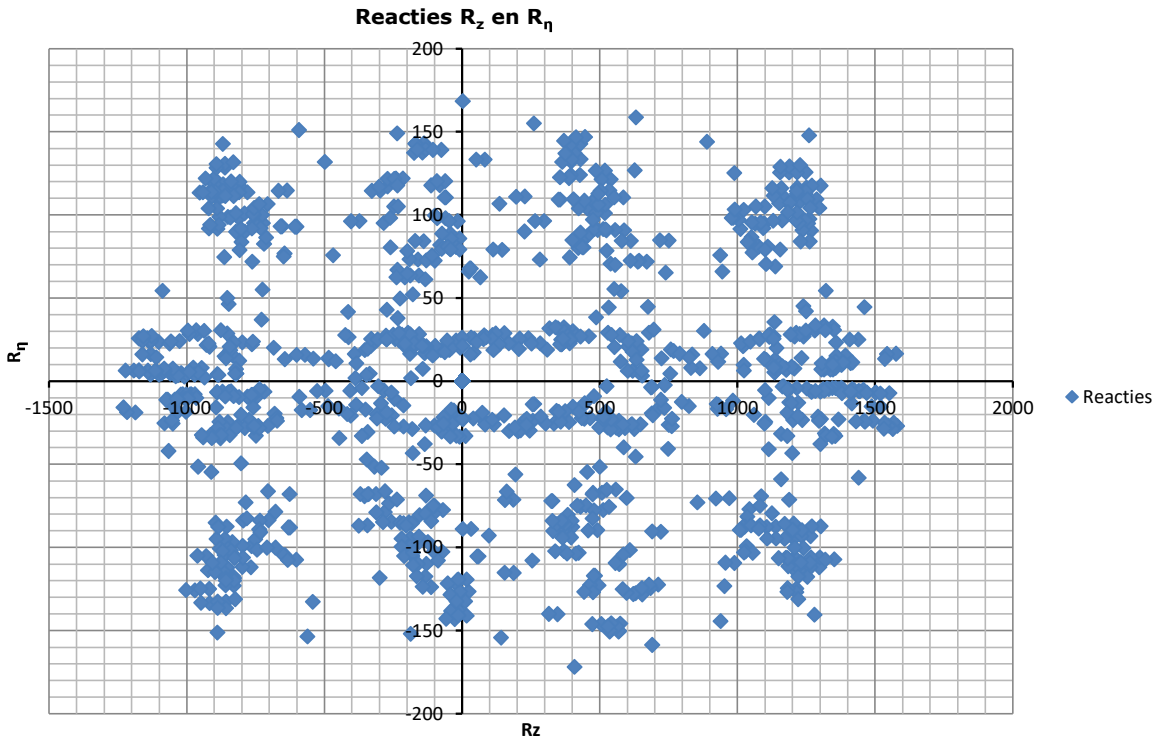
Tower: HC+0
Number: 16



Project: GT-RLL380
Tower: HC+0
Number: 16

Auteur: TBR
Versie: v11.8

**Conductor loads**

**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 | 0.90 | 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 | 5238 |

Project: GT-RLL380
Tower: HC+0
Number: 16

**Summary table - Conductor loads**

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

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

**Maximum values for back and ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -47.4 | 39.7 | 21.8 | 26.6 | 8.5 | 5.7 |
| 380ct1f1 | -112.8 | 105.3 | 50.3 | 69.9 | 24.6 | 20.5 |
| 380ct1f2 | -112.8 | 105.3 | 50.3 | 69.9 | 24.6 | 20.5 |
| 380ct1f3 | -114.6 | 107.7 | 55.4 | 75.8 | 24.6 | 20.5 |
| 380ct2f1 | -112.8 | 105.3 | 50.3 | 69.9 | 24.6 | 20.5 |
| 380ct2f2 | -112.8 | 105.3 | 50.3 | 69.9 | 24.6 | 20.5 |
| 380ct2f3 | -114.6 | 107.7 | 55.4 | 75.8 | 24.6 | 20.5 |
| bl2 | -47.7 | 39.2 | 21.9 | 26.3 | 8.4 | 5.7 |
| V-ketting 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| V-ketting 2 | 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 | 331.7 | 331.7 | 331.7 |
| 380ct1f1 | 331.7 | 331.7 | 331.7 |
| 380ct1f2 | 331.7 | 331.7 | 331.7 |
| 380ct1f3 | 331.7 | 331.7 | 331.7 |
| 380ct2f1 | 331.7 | 331.7 | 331.7 |
| 380ct2f2 | 331.7 | 331.7 | 331.7 |
| 380ct2f3 | 331.7 | 331.7 | 331.7 |
| bl2 | 331.7 | 331.7 | 331.7 |
| V-ketting 1 | | | |
| V-ketting 2 | | | |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 331.7 | 331.7 |
| 380ct1f1 | 331.7 | 331.7 |
| 380ct1f2 | 331.7 | 331.7 |
| 380ct1f3 | 331.7 | 331.7 |
| 380ct2f1 | 331.7 | 331.7 |
| 380ct2f2 | 331.7 | 331.7 |
| 380ct2f3 | 331.7 | 331.7 |
| bl2 | 331.7 | 331.7 |
| V-ketting 1 | | |
| V-ketting 2 | | |

| Envelop of weight span over all combinations (incl. 0,9 combinations) | | |
|---|---|---|
| For all conductors | | Wind / Weight span ratio |
| Max. weight span | 331.7 m | 1.000 - |
| Min. weight span | 331.7 m | 1.000 - |

Project: GT-RLL380
Tower: HC+0
Number: 16

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

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 27.9 | 46.1 | 8.5 | -52.0 | 47.7 |
| 380ct1f1 | 94.7 | 114.5 | 24.6 | -123.3 | 125.7 |
| 380ct1f2 | 94.7 | 114.5 | 24.6 | -123.3 | 125.7 |
| 380ct1f3 | 94.8 | 118.0 | 24.6 | -125.7 | 129.0 |
| 380ct2f1 | 94.7 | 114.5 | 24.6 | -123.3 | 125.7 |
| 380ct2f2 | 94.7 | 114.5 | 24.6 | -123.3 | 125.7 |
| 380ct2f3 | 94.8 | 118.0 | 24.6 | -125.7 | 129.0 |
| bl2 | 28.0 | 45.9 | 8.4 | -52.3 | 47.1 |
| V-ketting 1 | 2.4 | 2.4 | 3.9 | 0.0 | |
| V-ketting 2 | 2.4 | 2.4 | 3.9 | 0.0 | |

**EDS-loads conductor**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 11.3 | 6.6 | 2.1 | -13.8 | 13.1 |
| 380ct1f1 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct1f2 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct1f3 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct2f1 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct2f2 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| 380ct2f3 | 54.4 | 31.9 | 15.0 | -62.7 | 63.0 |
| bl2 | 11.0 | 6.5 | 2.1 | -13.7 | 12.8 |
| V-ketting 1 | 0.0 | 0.0 | 3.0 | 0.0 | |
| V-ketting 2 | 0.0 | 0.0 | 3.0 | 0.0 | |

1 **Control uplift SLS-wind**

| Combinatie | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 0.0 | 0.0 |
| | 380ct1f1 | 0.0 | 0.0 |
| | 380ct1f2 | 0.0 | 0.0 |
| | 380ct1f3 | 0.0 | 0.0 |
| | 380ct2f1 | 0.0 | 0.0 |
| | 380ct2f2 | 0.0 | 0.0 |
| | 380ct2f3 | 0.0 | 0.0 |
| | bl2 | 0.0 | 0.0 |
| | V-ketting 1 | 0.0 | |
| | V-ketting 2 | 0.0 | |

Project: GT-RLL380
Tower: HC+0
Number: 16

**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 | | -17 | 711 | 202 | 23232 | -574 | -6 |
| ULS 1a_0,9_0 | | 8 | 400 | 201 | 12991 | 267 | 52 |
| ULS 1a_0,9_0,9_90 | | -2 | 670 | 158 | 21898 | -101 | -5 |
| ULS 3_0 | | -68 | 677 | 297 | 22267 | -2335 | 1 |
| SLS 7 | | -30 | 345 | 176 | 11187 | -976 | -6 |

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

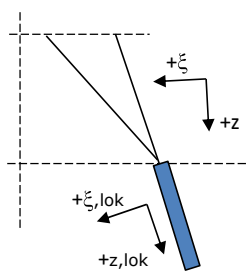
| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -17 | 894 | 777 | 27969 | -574 | -6 |
| ULS 1a_0,9_0,9_90 | -2 | 853 | 608 | 26635 | -101 | -5 |
| SLS 7 | -30 | 345 | 676 | 11187 | -976 | -6 |

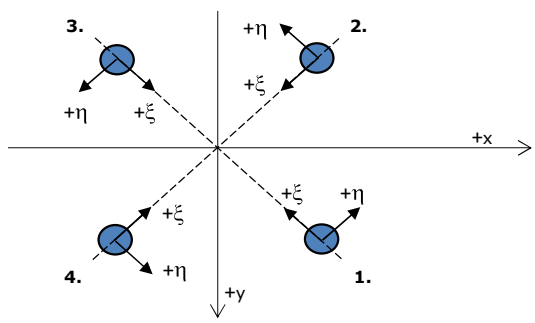
**Foundation loads, selection of load combinations based on greatest value**

| Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -17 | 894 | 777 | **27969** | -574 | -6 |
| SPLS 3_135 Ah All Cts | -570 | 253 | 744 | 8017 | **-18165** | -13 |
| SPLS 6a_90 Ba Ct1 Ah Ct1 | 296 | 438 | 780 | 14269 | 9595 | **-4536** |
| ULS 1a_0,9_0,9_120.38 | 95 | 848 | 608 | **26522** | **3899** | -36 |

*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_120.38 | 309 | 286 | **1576** | 16 | -421 | -73 | 1614 |
| 2 | SPLS 1a_0 Ba All Cts | 106 | -141 | **633** | 24 | -175 | -35 | 648 |
| 3 | SPLS 3_135 Ah All Cts | -106 | -143 | **647** | -26 | -176 | -33 | 663 |
| 4 | ULS 3_90 | -316 | 278 | **1580** | -27 | -420 | -71 | 1618 |

**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 | -38 | -73 | **-308** | 25 | 78 | 10 | -315 |
| 2 | ULS 3_0,9_90 | -233 | 197 | **-1175** | 26 | 304 | 45 | -1203 |
| 3 | ULS 1a_0,9_0,9_120.38 | 239 | 216 | **-1231** | -16 | 322 | 50 | -1260 |
| 4 | SPLS 1a_0,9_0 Ba All Cts | 42 | -74 | **-310** | -22 | 82 | 13 | -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 | SPLS 6a_90 Ah Ct1 Ah Ct2 | 231 | 7 | 631 | **159** | -168 | -29 | 646 |
| 2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | -117 | -121 | 2 | **169** | -3 | -3 | 2 |
| 3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 59 | 261 | -870 | **143** | 227 | 34 | -891 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -140 | 324 | 1227 | **130** | -328 | -57 | 1256 |

**Maximum torsional load (negative)**

| 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] |
|---|---|---|---|---|---|---|---|---|
| Index | Combination | | | | | | | |
| 1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 142 | 341 | 1280 | **-140** | -341 | -59 | 1311 |
| 2 | SPLS 6a_90 Ah Ct2 Ah Ct1 | -7 | 195 | -543 | **-133** | 143 | 23 | -556 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 81 | -138 | 140 | **-154** | -40 | -9 | 144 |
| 4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | -201 | -43 | 407 | **-172** | -112 | -22 | 417 |

Project: GT-RLL380
Tower: HC+0
Number: 16

**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 Ct1 | 8 | -87 | **-235** | **67** | 55 | 4 | -241 |
| 2 | SPLS 3_0,9_90 Ah Ct1 | -256 | 84 | **-932** | **122** | 241 | 35 | -954 |
| 3 | SPLS 3_0,9_120.38 Ba Ct1 | 271 | 93 | **-1003** | **-126** | 257 | 36 | -1027 |
| 4 | SPLS 1a_0,9_0 Ba All Cts | 42 | -74 | **-310** | **-22** | 82 | 13 | -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 | 130 | 112 | 633 | 13 | -171 | -31 | 648 |
| 2 | SLS 7 | -76 | 61 | -384 | 11 | 97 | 12 | -393 |
| 3 | SLS 7 | 62 | 43 | -295 | -13 | 74 | 9 | -302 |
| 4 | SLS 7 | -145 | 129 | 722 | -11 | -194 | -35 | 739 |

**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 3_90 | -316 | 278 | **1580** | -27 | -420 | -71 | 1618 |
| Max. tension | ULS 1a_0,9_0,9_120.38 | 239 | 216 | **-1231** | -16 | 322 | 50 | -1260 |
| Max. pos. torsie | SPLS 6a_90 Ba Ct2 Ah Ct2 | -117 | -121 | 2 | **169** | -3 | -3 | 2 |
| Max. neg. torsie | SPLS 6a_90 Ba Ct1 Ah Ct1 | -201 | -43 | 407 | **-172** | -112 | -22 | 417 |
| Comb. tension+torsie | SPLS 3_0,9_120.38 Ba Ct1 | 271 | 93 | **-1003** | **-126** | 257 | 36 | -1027 |

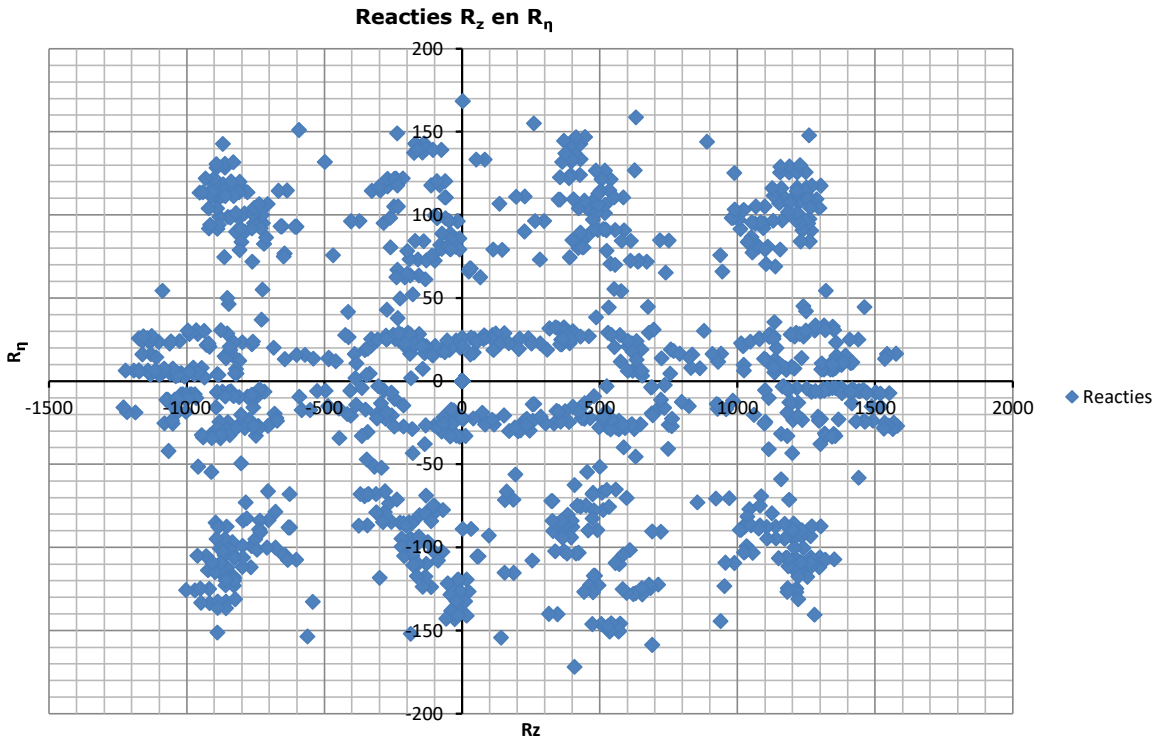
**Maximum tension load - SLS**

| 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 | 130 | 112 | **633** | 13 | -171 | -31 | 648 |
| 2 | SLS 3_90 | -185 | 154 | **-929** | 22 | 239 | 34 | -951 |
| 3 | SLS 1a_90 | 164 | 136 | **-803** | -20 | 212 | 34 | -823 |
| 4 | SLS 1a_0 | -92 | 74 | **445** | -13 | -117 | -19 | 456 |

**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_90 | 233 | 204 | **1141** | 20 | -309 | -57 | 1169 |
| 2 | SLS 1a_0 | -25 | 3 | **-107** | 15 | 20 | -3 | -110 |
| 3 | SLS 7 | 62 | 43 | **-295** | -13 | 74 | 9 | -302 |
| 4 | SLS 3_90 | -261 | 229 | **1303** | -23 | -347 | -59 | 1335 |

Project: GT-RLL380
Tower: HC+0
Number: 16



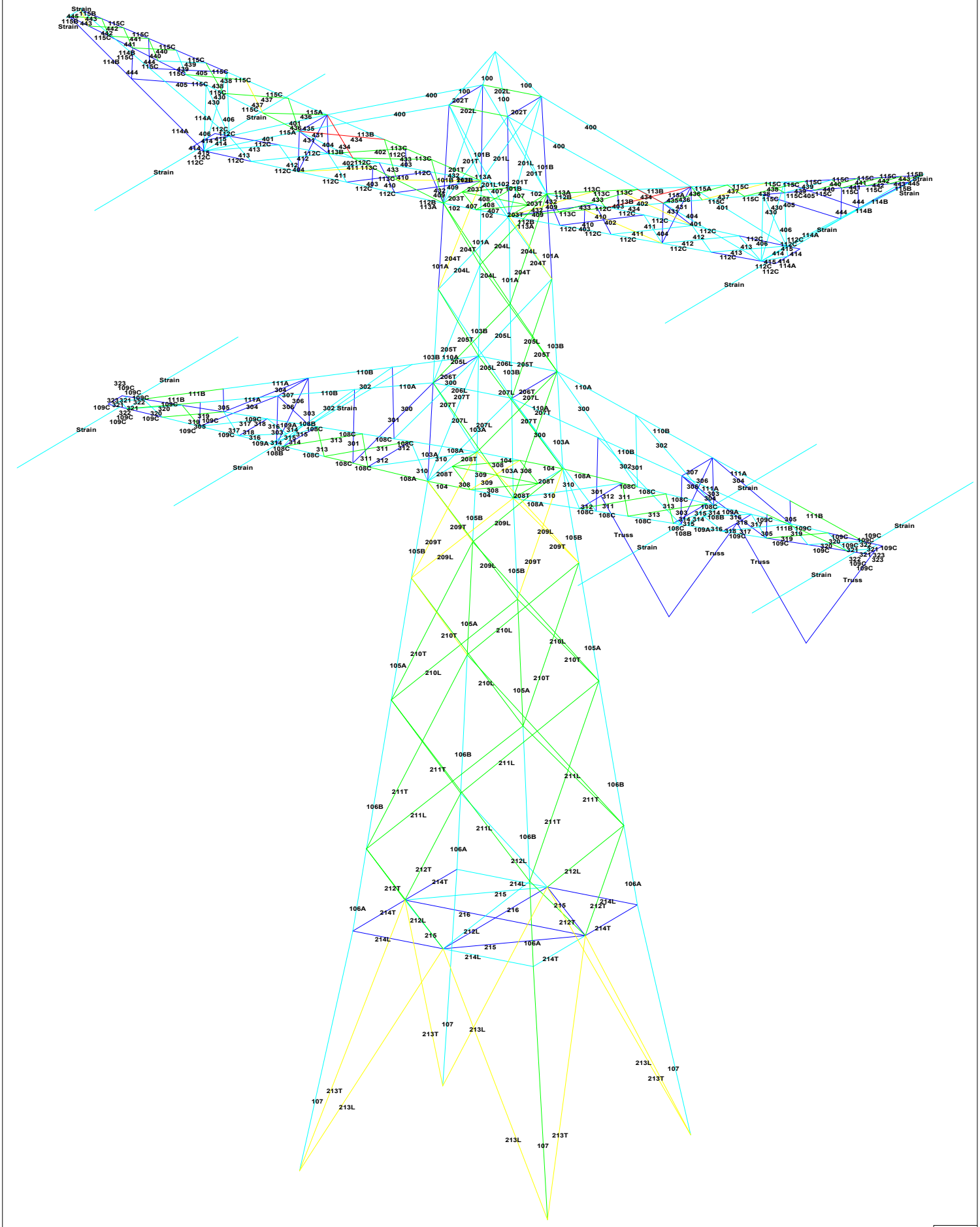
# APPENDIX B
# Resultaten PLS-TOWER

Deze Appendix bevat de resultaten uit PLS-TOWER voor de verschillende masten.

Resultaten opgenomen voor:

- Masttype HB+0 (68)
- Masttype HB+0 (78)
- Masttype HC+0 (16)
- Masttype HS+0 (26)

DNV GL Nederlands BV, Project: "D1.3.2 Circuit HB+0 (68) - dnv gl-inf"
Tower Version 16.86, 12:05:58 Friday, 21 May, 2021
Undeformed geometry displayed



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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | BVNSTK - Top cap | 90x90x6# | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 152 | -24.3 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 87.0 | 120.6 | 103.7 | 0.28 | | 23.2 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 127.9 | 120.6 | 89.6 | 0.26 | |
| 101A | BVNSTK - Main member | 120x120x8 | S355 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 77 | -142.3 | SPLS 6a_90 Ba All Cts Ah Ct2 | 416.4 | 813.3 | 846.7 | 0.34 | | 107.9 | SPLS 3_0_9_105.975 Ba All Cts | 516.5 | 813.3 | 723.7 | 0.21 | |
| 101B | BVNSTK - Main member | 120x120x8 | S355 | 6M20-8.8t | 0.52 | 0.52 | 0.52 | 88 | -62.1 | SPLS 6a_90 Ba Ct1 Ah Ct2 | 364.8 | 564.5 | 705.6 | 0.17 | | 24.6 | SPLS 3_0_9_106.025 Ba All Cts | 539.1 | 564.5 | 705.6 | 0.05 | |
| 102 | Cross profile (main member for crossarm | 150x150x14 | S355 | 9M24-8.8t | 1.00 | 2.00 | 1.00 | 64 | -498.6 | SPLS 3_106.025 Ba All Cts | 1076.0 | 1148.8 | 2222.6 | 0.46 | | 376.8 | SPLS 3_0_9_106.025 Ba All Cts | 1019.2 | 1148.8 | 1899.7 | 0.37 | |
| 103A | DerdeTSNK - Main member | 150x150x12 | S355 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 72 | -333.9 | SPLS 3_106.025 Ba All Cts | 858.1 | 1621.5 | 1270.1 | 0.39 | | 269.5 | SPLS 3_0_9_106.025 Ba All Cts | 1007.6 | 1621.5 | 1150.7 | 0.27 | |
| 103B | DerdeTSNK - Main member | 150x150x12 | S355 | 10M24-8.8t | 0.52 | 0.52 | 0.52 | 67 | -388.3 | SPLS 3_105.975 Ba All Cts | 902.5 | 1336.5 | 2116.8 | 0.43 | | 283.8 | SPLS 3_0_9_106.025 Ba All Cts | 1007.6 | 1336.5 | 1809.2 | 0.28 | |
| 104 | Cross profile (main member for crossarm | 160x160x15 | S355 | 14M24-8.8t | 1.00 | 2.00 | 1.00 | 77 | -545.9 | SPLS 6a_90 Ah All Cts Ba Ct2 | 1082.6 | 1628.9 | 3704.4 | 0.50 | | 340.2 | SPLS 3_0_9_105.975 Ba All Cts | 1207.8 | 1628.9 | 3166.2 | 0.28 | |
| 105A | TweedeTSNK - Main member | 160x160x17 | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 44 | -957.6 | SPLS 3_105.975 Ba All Cts | 1617.6 | 2660.2 | 2998.8 | 0.59 | | 763.8 | SPLS 3_0_9_105.975 Ba All Cts | 1519.2 | 2660.2 | 2563.1 | 0.50 | |
| 105B | TweedeTSNK - Main member | 160x160x17 | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 35 | -794.5 | SPLS 3_105.975 Ba All Cts | 1698.4 | 2672.9 | 2998.8 | 0.47 | | 618.8 | SPLS 3_0_9_105.975 Ba All Cts | 1519.2 | 2672.9 | 2563.1 | 0.41 | |
| 106A | EersteTSNK - Main member | 200x200x20 | S355 | 14M24-8.8t | 0.50 | 0.50 | 0.50 | 43 | -1287.3 | SPLS 3_105.975 Ba All Cts | 2395.3 | 3746.0 | 4939.2 | 0.54 | | 1067.0 | SPLS 3_0_9_105.975 Ba All Cts | 2328.5 | 3746.0 | 3841.6 | 0.46 | |
| 106B | EersteTSNK - Main member | 200x200x20 | S355 | 14M24-8.8t | 0.28 | 0.28 | 0.28 | 43 | -1191.5 | SPLS 3_105.975 Ba All Cts | 2395.2 | 3694.6 | 4939.2 | 0.50 | | 990.7 | SPLS 3_0_9_105.975 Ba All Cts | 2328.5 | 3694.6 | 4221.5 | 0.43 | |
| 107 | BRKSTK - Main member | 200x200x20 | S355 | 14M24-8.8t | 0.17 | 0.17 | 0.17 | 42 | -1312.4 | SPLS 3_105.975 Ba All Cts | 2406.1 | 3746.0 | 4939.2 | 0.55 | | 1067.0 | SPLS 3_0_9_105.975 Ba All Cts | 2328.5 | 3746.0 | 3841.6 | 0.46 | |
| 108A | Eerste DWSRM - Main member 1 bottom | 160x160x15 | S355 | 14M24-8.8t | 0.54 | 1.25 | 0.54 | 72 | -641.1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 1157.2 | 1628.9 | 3704.4 | 0.55 | | 436.7 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1207.8 | 1628.9 | 3166.2 | 0.36 | |
| 108B | Eerste DWSRM - Main member 1 bottom | 160x160x15 | S355 | 10M24-8.8t | 2.15 | 12.93 | 2.15 | 74 | -370.1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 1129.8 | 1355.5 | 2646.0 | 0.33 | | 218.9 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1372.7 | 1355.5 | 2261.5 | 0.16 | |
| 108C | Eerste DWSRM - Main member 1 bottom | 160x160x15 | S355 | | 2.90 | 4.96 | 2.90 | 72 | -588.1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 1156.9 | 0.0 | 0.0 | 0.51 | | 349.4 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1658.2 | 0.0 | 0.0 | 0.21 | |
| 109A | Eerste DWSRM - Main member 2 bottom | 150x150x14 | S355 | 10M24-8.8t | 1.00 | 2.42 | 1.00 | 79 | -364.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 910.6 | 1355.5 | 2469.6 | 0.40 | | 207.9 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1159.3 | 1355.5 | 2110.8 | 0.18 | |
| 109C | Eerste DWSRM - Main member 2 bottom | 150x150x14 | S355 | | 1.00 | 1.96 | 1.00 | 79 | -308.4 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 910.7 | 0.0 | 0.0 | 0.34 | | 149.2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1425.0 | 0.0 | 0.0 | 0.10 | |
| 110A | Eerste DWSRM - Main member 1 top | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 160 | 0.0 | | 144.5 | 542.2 | 414.7 | 0.00 | | 140.7 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 343.3 | 542.2 | 354.5 | 0.41 | |
| 110B | Eerste DWSRM - Main member 1 top | 120x120x8 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 156 | 0.0 | | 149.0 | 813.3 | 622.1 | 0.00 | | 105.3 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 379.5 | 813.3 | 531.7 | 0.28 | |
| 111A | Eerste DWSRM - Main member 2 top | 90x90x8 | S235 | 5M24-8.8t | 1.00 | 1.00 | 1.00 | 213 | 0.0 | | 72.2 | 677.8 | 518.4 | 0.00 | | 102.7 | ULS 3_0 | 252.5 | 677.8 | 443.1 | 0.41 | |
| 111B | Eerste DWSRM - Main member 2 top | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 201 | 0.0 | | 78.6 | 406.7 | 311.0 | 0.00 | | 102.7 | ULS 3_0 | 185.9 | 406.7 | 264.8 | 0.55 | |
| 112B | Tweede DWSRM - Main member (bottom | 150x150x12 | S355 | 9M24-8.8t | 1.00 | 1.47 | 1.00 | 75 | -341.7 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 831.8 | 1148.8 | 1905.1 | 0.41 | | 174.9 | SPLS 3_0_9_105.975 Ba Ct1 | 889.1 | 1148.8 | 1628.3 | 0.20 | |
| 112C | Tweede DWSRM - Main member (bottom | 150x150x12 | S355 | | 1.90 | 2.90 | 1.90 | 75 | -317.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 832.0 | 0.0 | 0.0 | 0.38 | | 134.9 | SPLS 3_0_9_106.025 Ba Ct2 | 1235.4 | 0.0 | 0.0 | 0.11 | |
| 113A | Tweede DWSRM - Main member (top) 1 | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.52 | 1.00 | 94 | -239.5 | SPLS 6a_90 Ba All Cts Ah Ct1 | 352.4 | 677.8 | 777.6 | 0.68 | | 230.7 | SPLS 6a_90 Ah All Cts Ba Ct1 | 494.8 | 677.8 | 664.6 | 0.47 | |
| 113B | Tweede DWSRM - Main member (top) 1 | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.37 | 1.00 | 108 | -162.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 325.5 | 677.8 | 777.6 | 0.50 | | 166.5 | SPLS 6a_90 Ah Ct1 Ba Ct1 | 494.8 | 677.8 | 664.6 | 0.34 | |
| 113C | Tweede DWSRM - Main member (top) 1 | 120x120x12 | S235 | | 1.82 | 2.92 | 1.82 | 92 | -212.8 | SPLS 6a_90 Ba All Cts Ah Ct1 | 352.2 | 0.0 | 0.0 | 0.60 | | 205.0 | SPLS 6a_90 Ah All Cts Ba Ct1 | 646.3 | 0.0 | 0.0 | 0.32 | |
| 114A | Tweede DWSRM - Main member (bottom | 120x120x8 | S235 | 2M24-8.8t | 1.87 | 1.00 | 1.00 | 205 | -34.9 | ULS 3_0 | 79.4 | 271.1 | 207.4 | 0.44 | | 0.0 | | 337.1 | 271.1 | 177.2 | 0.00 | |
| 114B | Tweede DWSRM - Main member (bottom | 120x120x8 | S235 | 2M24-8.8t | 2.15 | 1.00 | 1.00 | 205 | -29.1 | ULS 3_0 | 79.4 | 271.1 | 207.4 | 0.37 | | 1.4 | ULS 1a_0_9_0_105.975 | 226.0 | 271.1 | 177.2 | 0.01 | |
| 115A | Tweede DWSRM - Main member (top) 2 | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 2.57 | 1.00 | 121 | -155.4 | SPLS 3_0_9_106.025 Ba All Cts | 309.9 | 677.8 | 777.6 | 0.50 | | 174.5 | SPLS 6a_90 Ah All Cts Ba Ct1 | 494.8 | 677.8 | 664.6 | 0.35 | |
| 115B | Tweede DWSRM - Main member (top) 2 | 120x120x12 | S235 | 4M24-8.8t | 1.00 | 3.19 | 1.00 | 83 | -20.7 | SPLS 3_0_9_105.975 Ba All Cts | 470.9 | 540.5 | 622.1 | 0.04 | | 37.3 | ULS 3_105.975 | 494.8 | 540.5 | 425.4 | 0.09 | |
| 115C | Tweede DWSRM - Main member (top) 2 | 120x120x12 | S235 | | 1.00 | 2.36 | 1.00 | 121 | -135.1 | SPLS 3_0_9_106.025 Ba All Cts | 309.8 | 0.0 | 0.0 | 0.44 | | 150.4 | SPLS 6a_90 Ah All Cts Ba Ct1 | 646.3 | 0.0 | 0.0 | 0.23 | |
| 201L | BVNSTK - Crossing diagonal | 100x100x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 131 | -58.0 | SPLS 3_106.025 Ba Ct1 | 150.4 | 188.2 | 172.8 | 0.39 | | 46.3 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 179.9 | 188.2 | 157.1 | 0.29 | |
| 201T | BVNSTK - Crossing diagonal | 90x90x8 | S235 | 1M24-8.8t | 0.53 | 0.53 | 0.53 | 146 | -42.0 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 95.3 | 135.6 | 103.7 | 0.44 | | 12.3 | SPLS 3_0_9_105.975 Ba Ct1 | 147.5 | 135.6 | 88.6 | 0.14 | |
| 202L | BVNSTK - Horizontal | 100x100x8 | S235 | 4M20-8.8t | 1.00 | 1.00 | 1.00 | 133 | 0.0 | | 148.9 | 376.3 | 345.6 | 0.00 | | 129.1 | SPLS 6a_90 Ah All Cts Ba Ct1 | 212.2 | 376.3 | 305.4 | 0.61 | |
| 202T | BVNSTK - Horizontal | 75x75x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 177 | 0.0 | | 47.0 | 60.3 | 51.8 | 0.00 | | 9.7 | SPLS 6a_90 Ba Ct1 Ah Ct2 | 98.5 | 60.3 | 44.8 | 0.22 | |
| 203T | BVNSTK - Horizontal | 90x90x8 | S235 | 4M24-8.8t | 1.00 | 2.00 | 1.00 | 106 | -83.9 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 157.5 | 542.2 | 414.7 | 0.53 | | 142.6 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 252.5 | 542.2 | 354.5 | 0.56 | |
| 204L | BVNSTK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 83 | -286.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 502.8 | 813.3 | 933.1 | 0.57 | | 233.9 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 456.2 | 813.3 | 674.5 | 0.51 | |
| 204T | BVNSTK - Crossing diagonal | 130x130x11 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | -276.7 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 353.4 | 677.8 | 712.8 | 0.78 | | 258.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 367.2 | 677.8 | 543.2 | 0.70 | |
| 205L | DerdeTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | -214.2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 474.1 | 677.8 | 777.6 | 0.45 | | 261.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 677.8 | 568.7 | 0.57 | |
| 205T | DerdeTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | -236.3 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 474.1 | 677.8 | 777.6 | 0.50 | | 251.3 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 677.8 | 568.7 | 0.55 | |
| 206L | DerdeTSNK - Horizontal | 120x120x12 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | -16.5 | SPLS 1a_0_9_0_9_135 Ah All Cts | 232.0 | 813.3 | 933.1 | 0.07 | | 203.9 | SPLS 3_135 Ah All Cts | 494.8 | 813.3 | 797.5 | 0.41 | |
| 206T | DerdeTSNK - Horizontal | 120x120x12 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | -26.9 | ULS 1a_0_9_0_9_106.025 | 232.0 | 406.7 | 466.6 | 0.12 | | 69.0 | ULS 1a_106.025 | 494.8 | 406.7 | 398.8 | 0.17 | |
| 207L | DerdeTSNK - Crossing diagonal | 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | -315.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 517.8 | 942.9 | 1270.1 | 0.61 | | 251.4 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 525.6 | 942.9 | 910.4 | 0.48 | |
| 207T | DerdeTSNK - Crossing diagonal | 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | -283.4 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 517.8 | 942.9 | 1270.1 | 0.55 | | 205.5 | SPLS 3_0_9_106.025 Ba Ct1 | 525.6 | 942.9 | 910.4 | 0.39 | |
| 208T | DerdeTSNK - Horizontal | 100x100x8 | S235 | 5M20-8.8t | 1.00 | 1.90 | 1.00 | 118 | -53.6 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 159.2 | 470.4 | 432.0 | 0.34 | | 187.4 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 356.1 | 470.4 | 392.7 | 0.53 | |
| 209L | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | -373.8 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 530.9 | 1063.0 | 1244.2 | 0.70 | | 395.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 1063.0 | 886.1 | 0.87 | |
| 209T | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | -437.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 530.9 | 1063.0 | 1244.2 | 0.82 | | 400.3 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 1063.0 | 886.1 | 0.88 | |
| 210L | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | -326.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 463.5 | 813.3 | 933.1 | 0.70 | | 303.3 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 456.2 | 813.3 | 674.5 | 0.66 | |
| 210T | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | -326.8 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 463.5 | 813.3 | 933.1 | 0.71 | | 354.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 813.3 | 674.5 | 0.78 | |
| 211L | EersteTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | -246.0 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 393.4 | 677.8 | 777.6 | 0.63 | | 262.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 677.8 | 568.7 | 0.58 | |
| 211T | EersteTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | -286.0 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 392.1 | 677.8 | 777.6 | 0.73 | | 260.0 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 677.8 | 568.7 | 0.57 | |
| 212L | EersteTSNK - Diagonal bracing | 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | -218.1 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 392.9 | 542.2 | 622.1 | 0.56 | | 201.5 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 456.2 | 542.2 | 462.8 | 0.44 | |
| 212T | EersteTSNK - Diagonal bracing | 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | -211.8 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 392.9 | 542.2 | 622.1 | 0.54 | | 230.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 456.2 | 542.2 | 462.8 | 0.51 | |
| 213L | BRKSTK - Diagonal 1 | 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | -303.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 379.2 | 810.8 | 855.4 | 0.80 | | 285.3 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 346.4 | 810.8 | 685.0 | 0.82 | |
| 213T | BRKSTK - Diagonal 1 | 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | -291.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 379.2 | 810.8 | 855.4 | 0.77 | | 294.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 346.4 | 810.8 | 685.0 | 0.85 | |
| 214L | BRKSTK - Horizontal | 120x120x8 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 168 | -49.8 | SPLS 3_105.975 Ba All Cts | 135.6 | 271.1 | 207.4 | 0.37 | | 32.9 | SPLS 3_0_9_105.975 Ba All Cts | 226.0 | 271.1 | 177.2 | 0.19 | |
| 214T | BRKSTK - Horizontal | 120x120x11 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 170 | -53.1 | SPLS 3_105.975 Ba All Cts | 181.1 | 271.1 | 285.1 | 0.29 | | 36.4 | SPLS 3_0_9_105.975 Ba All Cts | 306.2 | 271.1 | 243.7 | 0.15 | |
| 215 | BRKSTK - Diagonal 2 | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 311 | -4.7 | ULS 1a_45 | 13.8 | 60.3 | 51.8 | 0.34 | | 3.7 | ULS 1a_0_9_0_9_45 | 72.6 | 60.3 | 44.8 | 0.08 | |
| 216 | BRKSTK - Crossing diagonal | 80x80x6# | S235 | 1M20-8.8t | 0.50 | 1.00 | 0.50 | 324 | -1.3 | SPLS 6a_90 Ah Ct2 Ah Ct1 | 17.3 | 94.1 | 64.8 | 0.07 | | 0.0 | | 100.2 | 94.1 | 58.9 | 0.00 | |
| 300 | Eerste DWSRM - Diagonal bracing | 80x80x6# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 341 | 0.0 | | 23.5 | 188.2 | 129.6 | 0.00 | | 29.9 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 105.8 | 188.2 | 114.6 | 0.28 | |
| 301 | Eerste DWSRM - Vertical bracing | 90x90x8 | S235 | 1M20-8.8t | 1.00 | 1.00 | 1.00 | 169 | -20.4 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 79.6 | 94.1 | 86.4 | 0.26 | | 0.0 | | 156.7 | 94.1 | 86.4 | 0.00 | |
| 302 | Eerste DWSRM - Diagonal bracing | 75x75x6 | S235 | 3M20-8.8t | 1.00 | 1.00 | 1.00 | 316 | 0.0 | | 24.6 | 282.2 | 194.4 | 0.00 | | 45.9 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 114.0 | 282.2 | 165.4 | 0.40 | |
| 303 | Eerste DWSRM - Vertical bracing | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 186 | -4.4 | ULS 3_135 | 30.3 | 60.3 | 51.8 | 0.15 | | 0.0 | | 55.3 | 60.3 | 39.2 | 0.00 | |
| 304 | Eerste DWSRM - Diagonal bracing | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 335 | 0.0 | | 15.6 | 60.3 | 51.8 | 0.00 | | 7.3 | SPLS 3_106.025 Ah All Cts | 81.2 | 60.3 | 44.8 | 0.16 | |
| 305 | Eerste DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 99 | -1.0 | SPLS 6a_90 Ah All Cts Ba Ct1 | 49.1 | 60.3 | 43.2 | 0.02 | | 0.0 | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 306 | Eerste DWSRM - Internal bracing (A-A) | 50x50x5 | S235 | 1M16-8.8t | 0.52 | 0.52 | 0.52 | 168 | -0.9 | SPLS 1a_0_9_0_9_0 Ah All Cts | 27.8 | 60.3 | 43.2 | 0.03 | | 5.2 | ULS 3_0_9_135 | 37.4 | 60.3 | 25.7 | 0.20 | |
| 307 | Eerste DWSRM - Internal bracing (A-A) | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 200 | -4.1 | ULS 3_0_9_106.025 | 31.4 | 60.3 | 51.8 | 0.13 | | 0.0 | | 72.6 | 60.3 | 44.8 | 0.00 | |
| 308 | Eerste DWSRM - Diaphragm diagonal | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 113 | -157.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 213.3 | 406.7 | 311.0 | 0.74 | | 180.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 263.0 | 406.7 | 265.8 | 0.69 | |
| 309 | Eerste DWSRM - Diaphragm crossing dia | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 196 | -17.2 | SPLS 1a_106.025 Ba All Cts | 22.5 | 60.3 | 43.2 | 0.76 | | 0.0 | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 310 | Eerste DWSRM - Crossing diagonal | 120x120x8 | S235 | 2M24-8.8t | 0.54 | 0.54 | 0.54 | 101 | -96.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 234.9 | 271.1 | 207.4 | 0.46 | | 36.1 | SPLS 6a_90 Ba All Cts Ah Ct2 | 257.1 | 271.1 | 177.2 | 0.20 | |
| 311 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.55 | 0.55 | 0.55 | 131 | -69.9 | SPLS 6a_90 Ba All Cts Ah Ct2 | 119.7 | 282.2 | 259.2 | 0.58 | | 68.3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 162.8 | 282.2 | 223.4 | 0.42 | |
| 312 | Eerste DWSRM - Horizontal | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 83 | 0.0 | | 566.5 | 188.2 | 216.0 | 0.00 | | 32.4 | ULS 1a_106.025 | 556.1 | 188.2 | 216.0 | 0.17 | |
| 313 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.54 | 0.54 | 0.54 | 116 | -82.4 | SPLS 6a_90 Ba All Cts Ah Ct2 | 136.2 | 282.2 | 259.2 | 0.60 | | 83.9 | SPLS 6a_90 Ba All Cts Ah Ct2 | 162.8 | 282.2 | 223.4 | 0.52 | |
| 314 | Eerste DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 137 | 0.0 | | 176.5 | 188.2 | 323.4 | 0.00 | | 50.9 | SPLS 6a_90 Ba All Cts Ah Ct2 | 401.4 | 188.2 | 323.4 | 0.27 | |
| 315 | Eerste DWSRM - Crossing diagonal | 65x65x7 | S235 | 2M16-8.8t | 0.52 | 0.52 | 0.52 | 107 | -44.9 | SPLS 6a_90 Ba All Cts Ah Ct2 | 103.9 | 120.6 | 121.0 | 0.43 | | 47.3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 100.0 | 120.6 | 104.5 | 0.47 | |
| 316 | Eerste DWSRM - Diagonal | 75x75x7# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 126 | -37.8 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 103.9 | 188.2 | 151.2 | 0.36 | | 37.8 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 113.4 | 188.2 | 131.2 | 0.33 | |
| 317 | Eerste DWSRM - Crossing diagonal | 65x65x7 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 119 | -39.3 | SPLS 6a_90 Ba All Cts Ah Ct2 | 93.5 | 180.9 | 181.4 | 0.42 | | 38.6 | SPLS 6a_90 Ba All Cts Ah Ct2 | 116.7 | 180.9 | 156.8 | 0.33 | |
| 318 | Eerste DWSRM - Horizontal | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 55 | -2.7 | ULS 1a_135 | 685.6 | 188.2 | 216.0 | 0.01 | | 0.2 | SPLS 1a_0_9_0 Ah Ct2 | 766.1 | 188.2 | 0.0 | 0.00 | |
| 319 | Eerste DWSRM - Crossing diagonal | 65x65x6 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 109 | -48.2 | SPLS 6a_90 Ba All Cts Ah Ct2 | 88.3 | 180.9 | 155.5 | 0.55 | | 49.6 | SPLS 6a_90 Ba All Cts Ah Ct2 | 101.1 | 180.9 | 134.4 | 0.49 | |
| 320 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.56 | 0.56 | 0.56 | 77 | -71.5 | SPLS 6a_90 Ba All Cts Ah Ct2 | 186.1 | 282.2 | 259.2 | 0.38 | | 65.7 | SPLS 6a_90 Ba All Cts Ah Ct2 | 157.3 | 282.2 | 207.1 | 0.42 | |
| 321 | Eerste DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 62 | 0.0 | | 373.4 | 188.2 | 323.4 | 0.00 | | 74.6 | ULS 3_105.975 | 401.4 | 188.2 | 323.4 | 0.40 | |
| 322 | Eerste DWSRM - Diagonal | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 73 | -32.3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 117.6 | 180.9 | 155.5 | 0.27 | | 32.4 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 101.1 | 180.9 | 134.4 | 0.32 | |
| 323 | Eerste DWSRM - Horizontal | 100x100x12 | S235 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 55 | -18.1 | ULS 3_106.025 | 398.5 | 271.1 | 311.0 | 0.07 | | 0.0 | | 225.6 | 271.1 | 212.7 | 0.00 | |
| 400 | Tweede DWSRM - Diagonal bracing | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 302 | -0.8 | SPLS 1a_0_9_0_9_105.975 Ba All C | 57.4 | 542.2 | 414.7 | 0.01 | | 160.7 | SPLS 6a_90 Ah All Cts Ba Ct1 | 343.3 | 542.2 | 354.5 | 0.47 | |

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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 401 | Tweede DWSRM - Diagonal bracing | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 193 | **0.0** | | 113.0 | 542.2 | 414.7 | 0.00 | | **126.3** | ULS 3_0 | 343.3 | 542.2 | 354.5 | 0.37 | |
| 402 | Tweede DWSRM - Diagonal bracing | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 326 | **-10.1** | ULS 5a Ba 12 | 12.9 | 60.3 | 51.8 | 0.78 | | **0.0** | | 55.3 | 60.3 | 39.2 | 0.00 | |
| 403 | Tweede DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 82 | **0.0** | | 55.5 | 60.3 | 43.2 | 0.00 | | **2.7** | ULS 5a Ah 22 | 37.4 | 60.3 | 25.7 | 0.11 | |
| 404 | Tweede DWSRM - Vertical bracing | 65x65x6 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 132 | **-10.2** | SPLS 6a_90 Ah All Cts Ba Ct1 | 73.0 | 120.6 | 103.7 | 0.14 | | **9.8** | SPLS 3_105.975 Ba All Cts | 80.5 | 120.6 | 89.5 | 0.12 | |
| 405 | Tweede DWSRM - Diagonal bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 350 | **0.0** | | 9.2 | 60.3 | 43.2 | 0.00 | | **5.4** | ULS 3_0 | 37.4 | 60.3 | 25.7 | 0.21 | |
| 406 | Tweede DWSRM - Vertical bracing | 55x55x6 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 161 | **-13.1** | SPLS 6a_90 Ah All Cts Ba Ct1 | 29.1 | 60.3 | 51.8 | 0.45 | | **6.3** | SPLS 6a_90 Ah All Cts Ba Ct1 | 55.3 | 60.3 | 39.2 | 0.16 | |
| 407 | Tweede DWSRM - Diagonal diaphragm | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 87 | **-151.4** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 265.1 | 406.7 | 311.0 | 0.57 | | **167.5** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 263.0 | 406.7 | 265.8 | 0.64 | |
| 408 | Tweede DWSRM - Crossing diagonal diap | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 193 | **-12.0** | ULS 7 | 16.9 | 60.3 | 43.2 | 0.71 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 409 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 119 | **-31.8** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 132.3 | 188.2 | 172.8 | 0.24 | | **17.7** | SPLS 6a_90 Ba All Cts Ah Ct2 | 138.0 | 188.2 | 152.8 | 0.13 | |
| 410 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 114 | **-22.5** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 138.2 | 188.2 | 172.8 | 0.16 | | **35.1** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 167.8 | 188.2 | 157.1 | 0.22 | |
| 411 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 111 | **-38.3** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 141.6 | 188.2 | 172.8 | 0.27 | | **25.9** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 174.4 | 188.2 | 157.1 | 0.17 | |
| 412 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 105 | **-49.4** | SPLS 6a_90 Ba All Cts Ah Ct2 | 149.6 | 282.2 | 259.2 | 0.33 | | **51.7** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 162.8 | 282.2 | 223.4 | 0.32 | |
| 413 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 101 | **-62.2** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 154.7 | 282.2 | 259.2 | 0.40 | | **57.5** | SPLS 6a_90 Ba All Cts Ah Ct2 | 162.8 | 282.2 | 223.4 | 0.35 | |
| 414 | Tweede DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 104 | **-0.3** | SPLS 1a_0,9_135 Ah All Cts | 242.4 | 188.2 | 323.4 | 0.00 | | **62.6** | ULS 3_106.025 | 401.4 | 188.2 | 323.4 | 0.33 | |
| 415 | Tweede DWSRM - Diagonal | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 93 | **-25.2** | SPLS 6a_90 Ba All Cts Ah Ct2 | 100.7 | 180.9 | 155.5 | 0.25 | | **25.3** | SPLS 6a_90 Ba All Cts Ah Ct2 | 101.1 | 180.9 | 134.4 | 0.25 | |
| 430 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.55 | 0.55 | 0.55 | 166 | **-12.6** | SPLS 6a_90 Ah All Cts Ba Ct1 | 35.1 | 60.3 | 51.8 | 0.36 | | **11.3** | SPLS 6a_90 Ah All Cts Ba Ct1 | 55.3 | 60.3 | 39.2 | 0.29 | |
| 431 | Tweede DWSRM - Crossing diagonal | 65x65x6 | S235 | 2M16-8.8t | 0.51 | 0.51 | 0.51 | 114 | **-12.1** | SPLS 3_0,9_105.975 Ba All Cts | 84.6 | 120.6 | 103.7 | 0.14 | | **19.3** | SPLS 6a_90 Ba All Cts Ah Ct2 | 86.7 | 120.6 | 89.6 | 0.22 | |
| 432 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 177 | **-24.5** | SPLS 6a_90 Ah All Cts Ba Ct1 | 32.2 | 60.3 | 51.8 | 0.76 | | **20.9** | SPLS 6a_90 Ah All Cts Ba Ct1 | 55.3 | 60.3 | 39.2 | 0.53 | |
| 433 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 164 | **-24.7** | SPLS 6a_90 Ah All Cts Ba Ct1 | 35.7 | 60.3 | 51.8 | 0.69 | | **27.0** | SPLS 6a_90 Ah All Cts Ba Ct1 | 55.3 | 60.3 | 39.2 | 0.69 | |
| 434 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.54 | 0.54 | 0.54 | 173 | **-34.5** | SPLS 6a_90 Ah All Cts Ba Ct1 | 33.2 | 60.3 | 51.8 | 1.04 | knik | **31.8** | SPLS 6a_90 Ah All Cts Ba Ct1 | 55.3 | 60.3 | 39.2 | 0.81 | |
| 435 | Tweede DWSRM - Horizontal | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 173 | **-3.2** | ULS 3_106.025 | 41.7 | 60.3 | 51.8 | 0.08 | | **0.0** | | 81.2 | 60.3 | 44.8 | 0.00 | |
| 436 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 145 | **-15.6** | SPLS 6a_90 Ah All Cts Ba Ct1 | 33.2 | 60.3 | 43.2 | 0.47 | | **15.7** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.61 | |
| 437 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 143 | **-20.0** | SPLS 6a_90 Ah All Cts Ba Ct1 | 33.9 | 60.3 | 43.2 | 0.59 | | **19.8** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.77 | |
| 438 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-16.1** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 43.2 | 0.43 | | **16.7** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.65 | |
| 439 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 107 | **-10.6** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 46.0 | 60.3 | 43.2 | 0.24 | | **10.5** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.41 | |
| 440 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 97 | **-13.7** | SPLS 6a_90 Ah All Cts Ba Ct1 | 49.8 | 60.3 | 43.2 | 0.32 | | **13.4** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.52 | |
| 441 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 88 | **-14.6** | SPLS 6a_90 Ah All Cts Ba Ct1 | 53.6 | 60.3 | 43.2 | 0.34 | | **14.9** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.58 | |
| 442 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 77 | **-16.7** | SPLS 6a_90 Ah All Cts Ba Ct1 | 56.7 | 60.3 | 43.2 | 0.39 | | **15.7** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.61 | |
| 443 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 73 | **-18.2** | SPLS 6a_90 Ah All Cts Ba Ct1 | 58.0 | 60.3 | 43.2 | 0.42 | | **19.8** | SPLS 6a_90 Ah All Cts Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.77 | |
| 444 | Tweede DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 128 | **-2.4** | SPLS 1a_106.025 Ba All Cts | 38.4 | 60.3 | 43.2 | 0.06 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 445 | Tweede DWSRM - Horizontal | 160x65x7.5(I | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 47 | **0.0** | | 443.0 | 188.2 | 162.0 | 0.00 | | **39.0** | ULS 3_0,9_106.025 | 547.9 | 188.2 | 130.9 | 0.30 | |

DNV

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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1,0 |

**ZW380 Oost**
**HB+0**
**68**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | BVNSTK - Top c | 90x90x6# | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 152 | **-24.3** | SPLS 6a_90 Ah Ct2 Ah | 87.0 | 120.6 | 103.7 | 0.28 | | **23.2** | SPLS 6a_90 Ah Ct2 Ah | 127.9 | 120.6 | 89.6 | 0.26 |
| 101A | BVNSTK - Main | 120x120x8 | S355 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 77 | **-142.3** | SPLS 6a_90 Ba All Cts | 416.4 | 813.3 | 846.7 | 0.34 | | **107.9** | SPLS 3_0_9_105.975 B | 516.5 | 813.3 | 723.7 | 0.21 |
| 101B | BVNSTK - Main | 120x120x8 | S355 | 6M20-8.8t | 0.52 | 0.52 | 0.52 | 88 | **-62.1** | SPLS 6a_90 Ba Ct1 Ah | 364.8 | 564.5 | 705.6 | 0.17 | | **24.6** | SPLS 3_0_9_106.025 B | 539.1 | 564.5 | 705.6 | 0.05 |
| 102 | Cross profile (m | 150x150x14 | S355 | 9M24-8.8t | 1.00 | 2.00 | 1.00 | 64 | **-498.6** | SPLS 3_106.025 Ba All | 1076.0 | 1148.8 | 2222.6 | 0.46 | | **376.8** | SPLS 3_0_9_106.025 B | 1019.2 | 1148.8 | 1899.7 | 0.37 |
| 103A | DerdeTSNK - M | 150x150x12 | S355 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 72 | **-333.9** | SPLS 3_106.025 Ba All | 858.1 | 1621.5 | 1270.1 | 0.39 | | **269.5** | SPLS 3_0_9_106.025 B | 1007.6 | 1621.5 | 1150.7 | 0.27 |
| 103B | DerdeTSNK - M | 150x150x12 | S355 | 10M24-8.8t | 0.52 | 0.52 | 0.52 | 67 | **-388.3** | SPLS 3_105.975 Ba All | 902.5 | 1336.5 | 2116.8 | 0.43 | | **283.8** | SPLS 3_0_9_106.025 B | 1007.6 | 1336.5 | 1809.2 | 0.28 |
| 104 | Cross profile (m | 160x160x15# | S355 | 14M24-8.8t | 1.00 | 2.00 | 1.00 | 77 | **-545.9** | SPLS 6a_90 Ah All Cts | 1082.6 | 1628.9 | 3704.4 | 0.50 | | **340.2** | SPLS 3_0_9_105.975 B | 1207.8 | 1628.9 | 3166.2 | 0.28 |
| 105A | TweedeTSNK - | 160x160x17# | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 44 | **-957.6** | SPLS 3_105.975 Ba All | 1617.6 | 2660.2 | 2998.8 | 0.59 | | **763.8** | SPLS 3_0_9_105.975 B | 1519.2 | 2660.2 | 2563.1 | 0.50 |
| 105B | TweedeTSNK - | 160x160x17# | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 35 | **-794.5** | SPLS 3_105.975 Ba All | 1698.4 | 2672.9 | 2998.8 | 0.47 | | **618.8** | SPLS 3_0_9_105.975 B | 1519.2 | 2672.9 | 2563.1 | 0.41 |
| 106A | EersteTSNK - M | 200x200x20 | S355 | 14M24-8.8t | 0.50 | 0.50 | 0.50 | 43 | **-1287.3** | SPLS 3_105.975 Ba All | 2395.3 | 3746.0 | 4939.2 | 0.54 | | **1067.0** | SPLS 3_0_9_105.975 B | 2328.5 | 3746.0 | 3841.6 | 0.46 |
| 106B | EersteTSNK - M | 200x200x20 | S355 | 14M24-8.8t | 0.28 | 0.28 | 0.28 | 43 | **-1191.5** | SPLS 3_105.975 Ba All | 2395.2 | 3694.6 | 4939.2 | 0.50 | | **990.7** | SPLS 3_0_9_105.975 B | 2328.5 | 3694.6 | 4221.5 | 0.43 |
| 107 | BRKSTK - Main | 200x200x20 | S355 | 14M24-8.8t | 0.17 | 0.17 | 0.17 | 42 | **-1312.4** | SPLS 3_105.975 Ba All | 2406.1 | 3746.0 | 4939.2 | 0.55 | | **1067.0** | SPLS 3_0_9_105.975 B | 2328.5 | 3746.0 | 3841.6 | 0.46 |
| 108A | Eerste DWSRM | 160x160x15# | S355 | 14M24-8.8t | 0.54 | 1.25 | 0.54 | 72 | **-641.1** | SPLS 6a_90 Ba Ct1 Ah | 1157.2 | 1628.9 | 3704.4 | 0.55 | | **436.7** | SPLS 6a_90 Ba Ct2 Ah | 1207.8 | 1628.9 | 3166.2 | 0.36 |
| 108B | Eerste DWSRM | 160x160x15# | S355 | 10M24-8.8t | 2.15 | 12.93 | 2.15 | 74 | **-370.1** | SPLS 6a_90 Ba Ct1 Ah | 1129.8 | 1355.5 | 2646.0 | 0.33 | | **218.9** | SPLS 6a_90 Ba Ct2 Ah | 1372.7 | 1355.5 | 2261.5 | 0.16 |
| 108C | Eerste DWSRM | 160x160x15# | S355 | | 2.90 | 4.96 | 2.90 | 72 | **-588.1** | SPLS 6a_90 Ba Ct1 Ah | 1156.9 | 0.0 | 0.0 | 0.51 | | **349.4** | SPLS 6a_90 Ba Ct2 Ah | 1658.2 | 0.0 | 0.0 | 0.21 |
| 109A | Eerste DWSRM | 150x150x14 | S355 | 10M24-8.8t | 1.00 | 2.42 | 1.00 | 79 | **-364.2** | SPLS 6a_90 Ba Ct1 Ah | 910.6 | 1355.5 | 2469.6 | 0.40 | | **207.9** | SPLS 6a_90 Ba Ct2 Ah | 1159.3 | 1355.5 | 2110.8 | 0.18 |
| 109C | Eerste DWSRM | 150x150x14 | S355 | | 1.00 | 1.96 | 1.00 | 79 | **-308.4** | SPLS 6a_90 Ah Ct2 Ba | 910.7 | 0.0 | 0.0 | 0.34 | | **149.2** | SPLS 6a_90 Ba Ct2 Ah | 1425.0 | 0.0 | 0.0 | 0.10 |
| 110A | Eerste DWSRM | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 160 | **0.0** | | 144.5 | 542.2 | 414.7 | 0.00 | | **140.7** | SPLS 6a_90 Ba Ct1 Ba | 343.3 | 542.2 | 354.5 | 0.41 |
| 110B | Eerste DWSRM | 120x120x8 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 156 | **0.0** | | 149.0 | 813.3 | 622.1 | 0.00 | | **105.3** | SPLS 6a_90 Ba Ct1 Ba | 379.5 | 813.3 | 531.7 | 0.28 |
| 111A | Eerste DWSRM | 90x90x8 | S235 | 5M24-8.8t | 1.00 | 1.00 | 1.00 | 213 | **0.0** | | 72.2 | 677.8 | 518.4 | 0.00 | | **102.7** | ULS 3_0 | 252.5 | 677.8 | 443.1 | 0.41 |
| 111B | Eerste DWSRM | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 201 | **0.0** | | 78.6 | 406.7 | 311.0 | 0.00 | | **102.7** | ULS 3_0 | 185.9 | 406.7 | 264.8 | 0.55 |
| 112B | Tweede DWSRM | 150x150x12 | S355 | 9M24-8.8t | 1.00 | 1.47 | 1.00 | 75 | **-341.7** | SPLS 6a_90 Ba Ct1 Ah | 831.8 | 1148.8 | 1905.1 | 0.41 | | **174.9** | SPLS 3_0_9_105.975 B | 889.1 | 1148.8 | 1628.3 | 0.20 |
| 112C | Tweede DWSRM | 150x150x12 | S355 | | 1.90 | 2.90 | 1.90 | 75 | **-317.5** | SPLS 6a_90 Ba Ct1 Ah | 832.0 | 0.0 | 0.0 | 0.38 | | **134.9** | SPLS 3_0_9_106.025 B | 1235.4 | 0.0 | 0.0 | 0.11 |
| 113A | Tweede DWSRM | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.52 | 1.00 | 94 | **-239.5** | SPLS 6a_90 Ba All Cts | 352.4 | 677.8 | 777.6 | 0.68 | | **230.7** | SPLS 6a_90 Ah All Cts | 494.8 | 677.8 | 664.6 | 0.47 |
| 113B | Tweede DWSRM | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.37 | 1.00 | 108 | **-162.2** | SPLS 6a_90 Ba Ct1 Ah | 325.5 | 677.8 | 777.6 | 0.50 | | **166.5** | SPLS 6a_90 Ah Ct1 Ba | 494.8 | 677.8 | 664.6 | 0.34 |
| 113C | Tweede DWSRM | 120x120x12 | S235 | | 1.82 | 2.92 | 1.82 | 92 | **-212.8** | SPLS 6a_90 Ba All Cts | 352.2 | 0.0 | 0.0 | 0.60 | | **205.0** | SPLS 6a_90 Ah All Cts | 646.3 | 0.0 | 0.0 | 0.32 |
| 114A | Tweede DWSRM | 120x120x8 | S235 | 2M24-8.8t | 1.87 | 1.00 | 1.00 | 205 | **-34.9** | ULS 3_0 | 79.4 | 271.1 | 207.4 | 0.44 | | **0.0** | | 337.1 | 271.1 | 177.2 | 0.00 |
| 114B | Tweede DWSRM | 120x120x8 | S235 | 2M24-8.8t | 2.15 | 1.00 | 1.00 | 205 | **-29.1** | ULS 3_0 | 79.4 | 271.1 | 207.4 | 0.37 | | **1.4** | ULS 1a_0_9_0_9_105.9 | 226.0 | 271.1 | 177.2 | 0.01 |
| 115A | Tweede DWSRM | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 2.57 | 1.00 | 121 | **-155.4** | SPLS 3_0_9_106.025 B | 309.9 | 677.8 | 777.6 | 0.50 | | **174.5** | SPLS 6a_90 Ah All Cts | 494.8 | 677.8 | 664.6 | 0.35 |
| 115B | Tweede DWSRM | 120x120x12 | S235 | 4M24-8.8t | 1.00 | 3.19 | 1.00 | 83 | **-20.7** | SPLS 3_0_9_105.975 B | 470.9 | 540.5 | 622.1 | 0.04 | | **37.3** | ULS 3_105.975 | 494.8 | 540.5 | 425.4 | 0.09 |
| 115C | Tweede DWSRM | 120x120x12 | S235 | | 1.00 | 2.36 | 1.00 | 121 | **-135.1** | SPLS 3_0_9_106.025 B | 309.8 | 0.0 | 0.0 | 0.44 | | **150.4** | SPLS 6a_90 Ah All Cts | 646.3 | 0.0 | 0.0 | 0.23 |
| 201L | BVNSTK - Cross | 100x100x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-58.0** | SPLS 3_106.025 Ba Ct | 150.4 | 188.2 | 172.8 | 0.39 | | **46.3** | SPLS 6a_90 Ba Ct1 Ba | 179.9 | 188.2 | 157.1 | 0.29 |
| 201T | BVNSTK - Cross | 90x90x8 | S235 | 1M24-8.8t | 0.53 | 0.53 | 0.53 | 146 | **-42.0** | SPLS 6a_90 Ba Ct1 Ba | 95.3 | 135.6 | 103.7 | 0.44 | | **12.3** | SPLS 3_0_9_105.975 B | 147.5 | 135.6 | 88.6 | 0.14 |
| 202L | BVNSTK - Horiz | 100x100x8 | S235 | 4M20-8.8t | 1.00 | 1.00 | 1.00 | 133 | **0.0** | | 148.9 | 376.3 | 345.6 | 0.00 | | **129.1** | SPLS 6a_90 Ah All Cts | 212.2 | 376.3 | 305.4 | 0.61 |
| 202T | BVNSTK - Horiz | 75x75x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 177 | **0.0** | | 47.0 | 60.3 | 51.8 | 0.00 | | **9.7** | SPLS 6a_90 Ba Ct1 Ah | 98.5 | 60.3 | 44.8 | 0.22 |
| 203T | BVNSTK - Horiz | 90x90x8 | S235 | 4M24-8.8t | 1.00 | 2.00 | 1.00 | 106 | **-83.9** | SPLS 6a_90 Ah Ct2 Ah | 157.5 | 542.2 | 414.7 | 0.53 | | **142.6** | SPLS 6a_90 Ah Ct2 Ah | 252.5 | 542.2 | 354.5 | 0.56 |
| 204L | BVNSTK - Cross | 150x150x12 | S235 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 83 | **-286.6** | SPLS 6a_90 Ba Ct1 Ah | 502.8 | 813.3 | 933.1 | 0.57 | | **233.9** | SPLS 6a_90 Ba Ct2 Ah | 456.2 | 813.3 | 674.5 | 0.51 |
| 204T | BVNSTK - Cross | 130x130x11 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-276.7** | SPLS 6a_90 Ba Ct1 Ah | 353.4 | 677.8 | 712.8 | 0.78 | | **258.4** | SPLS 6a_90 Ba Ct1 Ah | 367.2 | 677.8 | 543.2 | 0.70 |
| 205L | DerdeTSNK - Cr | 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | **-214.2** | SPLS 6a_90 Ba Ct2 Ah | 474.1 | 677.8 | 777.6 | 0.45 | | **261.2** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 677.8 | 568.7 | 0.57 |
| 205T | DerdeTSNK - Cr | 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | **-236.3** | SPLS 6a_90 Ba Ct1 Ah | 474.1 | 677.8 | 777.6 | 0.50 | | **251.3** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 677.8 | 568.7 | 0.55 |
| 206L | DerdeTSNK - Hi | 120x120x12 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | **-16.5** | SPLS 1a_0_9_0_9_135 | 232.0 | 813.3 | 933.1 | 0.07 | | **203.9** | SPLS 3_135 Ah All Cts | 494.8 | 813.3 | 797.5 | 0.41 |
| 206T | DerdeTSNK - Hi | 120x120x12 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | **-26.9** | ULS 1a_0_9_0_9_106.0 | 232.0 | 406.7 | 466.6 | 0.12 | | **69.0** | ULS 1a_106.025 | 494.8 | 406.7 | 398.8 | 0.17 |
| 207L | DerdeTSNK - Cr | 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-315.5** | SPLS 6a_90 Ba Ct1 Ah | 517.8 | 942.9 | 1270.1 | 0.61 | | **251.4** | SPLS 6a_90 Ba Ct2 Ah | 525.6 | 942.9 | 910.4 | 0.48 |
| 207T | DerdeTSNK - Cr | 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-283.4** | SPLS 6a_90 Ba Ct2 Ah | 517.8 | 942.9 | 1270.1 | 0.55 | | **205.5** | SPLS 3_0_9_106.025 B | 525.6 | 942.9 | 910.4 | 0.39 |
| 208T | DerdeTSNK - Hi | 100x100x8 | S235 | 5M20-8.8t | 1.00 | 1.90 | 1.00 | 118 | **-53.6** | SPLS 6a_90 Ah Ct2 Ah | 159.2 | 470.4 | 432.0 | 0.34 | | **187.4** | SPLS 6a_90 Ah Ct2 Ah | 356.1 | 470.4 | 392.7 | 0.53 |
| 209L | TweedeTSNK - | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | **-373.8** | SPLS 6a_90 Ah Ct2 Ah | 530.9 | 1063.0 | 1244.2 | 0.70 | | **395.6** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 1063.0 | 886.1 | 0.87 |
| 209T | TweedeTSNK - | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | **-437.9** | SPLS 6a_90 Ba Ct1 Ah | 530.9 | 1063.0 | 1244.2 | 0.82 | | **400.3** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 1063.0 | 886.1 | 0.88 |
| 210L | TweedeTSNK - | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | **-326.5** | SPLS 6a_90 Ba Ct1 Ah | 463.5 | 813.3 | 933.1 | 0.70 | | **303.3** | SPLS 6a_90 Ah Ct2 Ah | 456.2 | 813.3 | 674.5 | 0.66 |
| 210T | TweedeTSNK - | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | **-326.8** | SPLS 6a_90 Ba Ct1 Ah | 463.5 | 813.3 | 933.1 | 0.71 | | **354.5** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 813.3 | 674.5 | 0.78 |
| 211L | EersteTSNK - C | 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | **-246.0** | SPLS 6a_90 Ba Ct2 Ah | 393.4 | 677.8 | 777.6 | 0.63 | | **262.6** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 677.8 | 568.7 | 0.58 |
| 211T | EersteTSNK - C | 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | **-286.0** | SPLS 6a_90 Ba Ct1 Ah | 392.1 | 677.8 | 777.6 | 0.73 | | **260.0** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 677.8 | 568.7 | 0.57 |
| 212L | EersteTSNK - D | 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | **-218.1** | SPLS 6a_90 Ba Ct1 Ah | 392.9 | 542.2 | 622.1 | 0.56 | | **201.5** | SPLS 6a_90 Ba Ct2 Ah | 456.2 | 542.2 | 462.8 | 0.44 |
| 212T | EersteTSNK - D | 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | **-211.8** | SPLS 6a_90 Ah Ct2 Ba | 392.9 | 542.2 | 622.1 | 0.54 | | **230.6** | SPLS 6a_90 Ba Ct1 Ah | 456.2 | 542.2 | 462.8 | 0.51 |
| 213L | BRKSTK - Diag | 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | **-303.6** | SPLS 6a_90 Ba Ct1 Ah | 379.2 | 810.8 | 855.4 | 0.80 | | **285.3** | SPLS 6a_90 Ah Ct2 Ah | 346.4 | 810.8 | 685.0 | 0.82 |
| 213T | BRKSTK - Diag | 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | **-291.9** | SPLS 6a_90 Ba Ct1 Ah | 379.2 | 810.8 | 855.4 | 0.77 | | **294.4** | SPLS 6a_90 Ba Ct1 Ah | 346.4 | 810.8 | 685.0 | 0.85 |
| 214L | BRKSTK - Horiz | 120x120x8 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 168 | **-49.8** | SPLS 3_105.975 Ba All | 135.6 | 271.1 | 207.4 | 0.37 | | **32.9** | SPLS 3_0_9_105.975 B | 226.0 | 271.1 | 177.2 | 0.19 |
| 214T | BRKSTK - Horiz | 120x120x11 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 170 | **-53.1** | SPLS 3_105.975 Ba All | 181.1 | 271.1 | 285.1 | 0.29 | | **36.4** | SPLS 3_0_9_105.975 B | 306.2 | 271.1 | 243.7 | 0.15 |
| 215 | BRKSTK - Diag | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 311 | **-4.7** | ULS 1a_45 | 13.8 | 60.3 | 51.8 | 0.34 | | **3.7** | ULS 1a_0_9_0_9_45 | 72.6 | 60.3 | 44.8 | 0.08 |
| 216 | BRKSTK - Cross | 80x80x6# | S235 | 1M20-8.8t | 0.50 | 1.00 | 0.50 | 324 | **-1.3** | SPLS 6a_90 Ah Ct2 Ah | 17.3 | 94.1 | 64.8 | 0.07 | | **0.0** | | 100.2 | 94.1 | 58.9 | 0.00 |
| 300 | Eerste DWSRM | 80x80x6# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 341 | **0.0** | | 23.5 | 188.2 | 129.6 | 0.00 | | **29.9** | SPLS 6a_90 Ba Ct1 Ba | 105.8 | 188.2 | 114.6 | 0.28 |
| 301 | Eerste DWSRM | 90x90x8 | S235 | 1M20-8.8t | 1.00 | 1.00 | 1.00 | 169 | **-20.4** | SPLS 6a_90 Ah Ct2 Ba | 79.6 | 94.1 | 86.4 | 0.26 | | **0.0** | | 156.7 | 94.1 | 86.4 | 0.00 |
| 302 | Eerste DWSRM | 75x75x6 | S235 | 3M20-8.8t | 1.00 | 1.00 | 1.00 | 316 | **0.0** | | 24.6 | 282.2 | 194.4 | 0.00 | | **45.9** | SPLS 6a_90 Ah Ct2 Ba | 114.0 | 282.2 | 165.4 | 0.40 |
| 303 | Eerste DWSRM | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 186 | **-4.4** | ULS 3_135 | 30.3 | 60.3 | 51.8 | 0.15 | | **0.0** | | 55.3 | 60.3 | 39.2 | 0.00 |
| 304 | Eerste DWSRM | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 335 | **0.0** | | 15.6 | 60.3 | 51.8 | 0.00 | | **7.3** | SPLS 3_106.025 Ah All | 81.2 | 60.3 | 44.8 | 0.16 |
| 305 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 99 | **-1.0** | SPLS 6a_90 Ah All Cts | 49.1 | 60.3 | 43.2 | 0.02 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 306 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.52 | 0.52 | 0.52 | 168 | **-0.9** | SPLS 1a_0_9_0_9_0 Ah | 27.8 | 60.3 | 43.2 | 0.03 | | **5.2** | ULS 3_0_9_135 | 37.4 | 60.3 | 25.7 | 0.20 |
| 307 | Eerste DWSRM | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 200 | **-4.1** | ULS 3_0_9_106.025 | 31.4 | 60.3 | 51.8 | 0.13 | | **0.0** | | 72.6 | 60.3 | 44.8 | 0.00 |
| 308 | Eerste DWSRM | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 113 | **-157.9** | SPLS 6a_90 Ba Ct1 Ah | 213.3 | 406.7 | 311.0 | 0.74 | | **180.4** | SPLS 6a_90 Ba Ct1 Ah | 263.0 | 406.7 | 265.8 | 0.69 |
| 309 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 196 | **-17.2** | SPLS 1a_106.025 Ba A | 22.5 | 60.3 | 43.2 | 0.76 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 310 | Eerste DWSRM | 120x120x8 | S235 | 2M24-8.8t | 0.54 | 0.54 | 0.54 | 101 | **-96.4** | SPLS 6a_90 Ba Ct1 Ah | 234.9 | 271.1 | 207.4 | 0.46 | | **36.1** | SPLS 6a_90 Ba All Cts | 257.1 | 271.1 | 177.2 | 0.20 |
| 311 | Eerste DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.55 | 0.55 | 0.55 | 131 | **-69.9** | SPLS 6a_90 Ba All Cts | 119.7 | 282.2 | 259.2 | 0.58 | | **68.3** | SPLS 6a_90 Ba Ct2 Ah | 162.8 | 282.2 | 223.4 | 0.42 |
| 312 | Eerste DWSRM | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 83 | **0.0** | | 566.5 | 188.2 | 216.0 | 0.00 | | **32.4** | ULS 1a_106.025 | 556.1 | 188.2 | 216.0 | 0.17 |
| 313 | Eerste DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.54 | 0.54 | 0.54 | 116 | **-82.4** | SPLS 6a_90 Ba All Cts | 136.2 | 282.2 | 259.2 | 0.60 | | **83.9** | SPLS 6a_90 Ba All Cts | 162.8 | 282.2 | 223.4 | 0.52 |
| 314 | Eerste DWSRM | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 137 | **0.0** | | 176.5 | 188.2 | 323.4 | 0.00 | | **50.9** | SPLS 6a_90 Ba All Cts | 401.4 | 188.2 | 323.4 | 0.27 |
| 315 | Eerste DWSRM | 65x65x7 | S235 | 2M16-8.8t | 0.52 | 0.52 | 0.52 | 107 | **-44.9** | SPLS 6a_90 Ba All Cts | 103.9 | 120.6 | 121.0 | 0.43 | | **47.3** | SPLS 6a_90 Ba Ct2 Ah | 100.0 | 120.6 | 104.5 | 0.47 |
| 316 | Eerste DWSRM | 75x75x7# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 126 | **-37.8** | SPLS 6a_90 Ba Ct2 Ah | 103.9 | 188.2 | 151.2 | 0.36 | | **37.8** | SPLS 6a_90 Ba Ct2 Ah | 113.4 | 188.2 | 131.2 | 0.33 |
| 317 | Eerste DWSRM | 65x65x7 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 119 | **-39.3** | SPLS 6a_90 Ba All Cts | 93.5 | 180.9 | 181.4 | 0.42 | | **38.6** | SPLS 6a_90 Ba All Cts | 116.7 | 180.9 | 156.8 | 0.33 |
| 318 | Eerste DWSRM | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 55 | **-2.7** | ULS 1a_135 | 685.6 | 188.2 | 216.0 | 0.01 | | **0.2** | SPLS 1a_0_9_0 Ah Ct2 | 766.1 | 188.2 | 0.0 | 0.00 |
| 319 | Eerste DWSRM | 65x65x6 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 109 | **-48.2** | SPLS 6a_90 Ba All Cts | 88.3 | 180.9 | 155.5 | 0.55 | | **49.6** | SPLS 6a_90 Ba All Cts | 101.1 | 180.9 | 134.4 | 0.49 |
| 320 | Eerste DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.56 | 0.56 | 0.56 | 77 | **-71.5** | SPLS 6a_90 Ba All Cts | 186.1 | 282.2 | 259.2 | 0.38 | | **65.7** | SPLS 6a_90 Ba All Cts | 157.3 | 282.2 | 207.1 | 0.42 |
| 321 | Eerste DWSRM | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 62 | **0.0** | | 373.4 | 188.2 | 323.4 | 0.00 | | **74.6** | ULS 3_105.975 | 401.4 | 188.2 | 323.4 | 0.40 |

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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**68**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 322 | Eerste DWSRM | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 73 | **-32.3** | SPLS 6a_90 Ba Ct2 Ah | 117.6 | 180.9 | 155.5 | 0.27 | | **32.4** | SPLS 6a_90 Ba Ct2 Ah | 101.1 | 180.9 | 134.4 | 0.32 |
| 323 | Eerste DWSRM | 100x100x12 | S235 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 55 | **-18.1** | ULS 3_106.025 | 398.5 | 271.1 | 311.0 | 0.07 | | **0.0** | | 225.6 | 271.1 | 212.7 | 0.00 |
| 400 | Tweede DWSRM | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 302 | **-0.8** | SPLS 1a_0,9_0,9_105. | 57.4 | 542.2 | 414.7 | 0.01 | | **160.7** | SPLS 6a_90 Ah All Cts | 343.3 | 542.2 | 354.5 | 0.47 |
| 401 | Tweede DWSRM | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 193 | **0.0** | | 113.0 | 542.2 | 414.7 | 0.00 | | **126.3** | ULS 3_0 | 343.3 | 542.2 | 354.5 | 0.37 |
| 402 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 326 | **-10.1** | ULS 5a Ba 12 | 12.9 | 60.3 | 51.8 | 0.78 | | **0.0** | | 55.3 | 60.3 | 39.2 | 0.00 |
| 403 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 82 | **0.0** | | 55.5 | 60.3 | 43.2 | 0.00 | | **2.7** | ULS 5a Ah 22 | 37.4 | 60.3 | 25.7 | 0.11 |
| 404 | Tweede DWSRM | 65x65x6 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 132 | **-10.2** | SPLS 6a_90 Ah All Cts | 73.0 | 120.6 | 103.7 | 0.14 | | **9.8** | SPLS 3_105.975 Ba All | 80.5 | 120.6 | 89.5 | 0.12 |
| 405 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 350 | **0.0** | | 9.2 | 60.3 | 43.2 | 0.00 | | **5.4** | ULS 3_0 | 37.4 | 60.3 | 25.7 | 0.21 |
| 406 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 161 | **-13.1** | SPLS 6a_90 Ah All Cts | 29.1 | 60.3 | 51.8 | 0.45 | | **6.3** | SPLS 6a_90 Ah All Cts | 55.3 | 60.3 | 39.2 | 0.16 |
| 407 | Tweede DWSRM | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 87 | **-151.4** | SPLS 6a_90 Ba Ct1 Ah | 265.1 | 406.7 | 311.0 | 0.57 | | **167.5** | SPLS 6a_90 Ba Ct1 Ah | 263.0 | 406.7 | 265.8 | 0.64 |
| 408 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 193 | **-12.0** | ULS 7 | 16.9 | 60.3 | 43.2 | 0.71 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 409 | Tweede DWSRM | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 119 | **-31.8** | SPLS 6a_90 Ba Ct1 Ah | 132.3 | 188.2 | 172.8 | 0.24 | | **17.7** | SPLS 6a_90 Ba All Cts | 138.0 | 188.2 | 152.8 | 0.13 |
| 410 | Tweede DWSRM | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 114 | **-22.5** | SPLS 6a_90 Ba Ct2 Ah | 138.2 | 188.2 | 172.8 | 0.16 | | **35.1** | SPLS 6a_90 Ba Ct1 Ah | 167.8 | 188.2 | 157.1 | 0.22 |
| 411 | Tweede DWSRM | 80x80x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 111 | **-38.3** | SPLS 6a_90 Ba Ct1 Ah | 141.6 | 188.2 | 172.8 | 0.27 | | **25.9** | SPLS 6a_90 Ba Ct2 Ah | 174.4 | 188.2 | 157.1 | 0.17 |
| 412 | Tweede DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 105 | **-49.4** | SPLS 6a_90 Ba All Cts | 149.6 | 282.2 | 259.2 | 0.33 | | **51.7** | SPLS 6a_90 Ba Ct2 Ah | 162.8 | 282.2 | 223.4 | 0.32 |
| 413 | Tweede DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 101 | **-62.2** | SPLS 6a_90 Ba Ct2 Ah | 154.7 | 282.2 | 259.2 | 0.40 | | **57.5** | SPLS 6a_90 Ba All Cts | 162.8 | 282.2 | 223.4 | 0.35 |
| 414 | Tweede DWSRM | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 104 | **-0.3** | SPLS 1a_0,9_135 Ah A | 242.4 | 188.2 | 323.4 | 0.00 | | **62.6** | ULS 3_106.025 | 401.4 | 188.2 | 323.4 | 0.33 |
| 415 | Tweede DWSRM | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 93 | **-25.2** | SPLS 6a_90 Ba All Cts | 100.7 | 180.9 | 155.5 | 0.25 | | **25.3** | SPLS 6a_90 Ba All Cts | 101.1 | 180.9 | 134.4 | 0.25 |
| 430 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.55 | 0.55 | 0.55 | 166 | **-12.6** | SPLS 6a_90 Ah All Cts | 35.1 | 60.3 | 51.8 | 0.36 | | **11.3** | SPLS 6a_90 Ah All Cts | 55.3 | 60.3 | 39.2 | 0.29 |
| 431 | Tweede DWSRM | 65x65x6 | S235 | 2M16-8.8t | 0.51 | 0.51 | 0.51 | 114 | **-12.1** | SPLS 3_0,9_105.975 B | 84.6 | 120.6 | 103.7 | 0.14 | | **19.3** | SPLS 6a_90 Ba All Cts | 86.7 | 120.6 | 89.6 | 0.22 |
| 432 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 177 | **-24.5** | SPLS 6a_90 Ah All Cts | 32.2 | 60.3 | 51.8 | 0.76 | | **20.9** | SPLS 6a_90 Ah All Cts | 55.3 | 60.3 | 39.2 | 0.53 |
| 433 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 164 | **-24.7** | SPLS 6a_90 Ah All Cts | 35.7 | 60.3 | 51.8 | 0.69 | | **27.0** | SPLS 6a_90 Ah All Cts | 55.3 | 60.3 | 39.2 | 0.69 |
| 434 | Tweede DWSRM | 55x55x6 | **S355** | 1M16-8.8t | 0.54 | 0.54 | 0.54 | 173 | **-34.5** | SPLS 6a_90 Ah All Cts | 37.7 | 60.3 | 70.6 | 0.91 | | **31.8** | SPLS 6a_90 Ah All Cts | 75.3 | 60.3 | 53.4 | 0.60 |
| 435 | Tweede DWSRM | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 173 | **-3.2** | ULS 3_106.025 | 41.7 | 60.3 | 51.8 | 0.08 | | **0.0** | | 81.2 | 60.3 | 44.8 | 0.00 |
| 436 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 145 | **-15.6** | SPLS 6a_90 Ah All Cts | 33.2 | 60.3 | 43.2 | 0.47 | | **15.7** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 25.7 | 0.61 |
| 437 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 143 | **-20.0** | SPLS 6a_90 Ah All Cts | 33.9 | 60.3 | 43.2 | 0.59 | | **19.8** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 25.7 | 0.77 |
| 438 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-16.1** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 43.2 | 0.43 | | **16.7** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 25.7 | 0.65 |
| 439 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 107 | **-10.6** | SPLS 6a_90 Ah Ct1 Ba | 46.0 | 60.3 | 43.2 | 0.24 | | **10.5** | SPLS 6a_90 Ah Ct1 Ba | 37.4 | 60.3 | 25.7 | 0.41 |
| 440 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 97 | **-13.7** | SPLS 6a_90 Ah All Cts | 49.8 | 60.3 | 43.2 | 0.32 | | **13.4** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 25.7 | 0.52 |
| 441 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 88 | **-14.6** | SPLS 6a_90 Ah All Cts | 53.6 | 60.3 | 43.2 | 0.34 | | **14.9** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 25.7 | 0.58 |
| 442 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 77 | **-16.7** | SPLS 6a_90 Ah All Cts | 56.7 | 60.3 | 43.2 | 0.39 | | **15.7** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 25.7 | 0.61 |
| 443 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 73 | **-18.2** | SPLS 6a_90 Ah All Cts | 58.0 | 60.3 | 43.2 | 0.42 | | **19.8** | SPLS 6a_90 Ah All Cts | 37.4 | 60.3 | 25.7 | 0.77 |
| 444 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 128 | **-2.4** | SPLS 1a_106.025 Ba A | 38.4 | 60.3 | 43.2 | 0.06 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 445 | Tweede DWSRM | 160x65x7.5(UN | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 47 | **0.0** | | 443.0 | 188.2 | 162.0 | 0.00 | | **39.0** | ULS 3_0,9_106.025 | 547.9 | 188.2 | 130.9 | 0.30 |

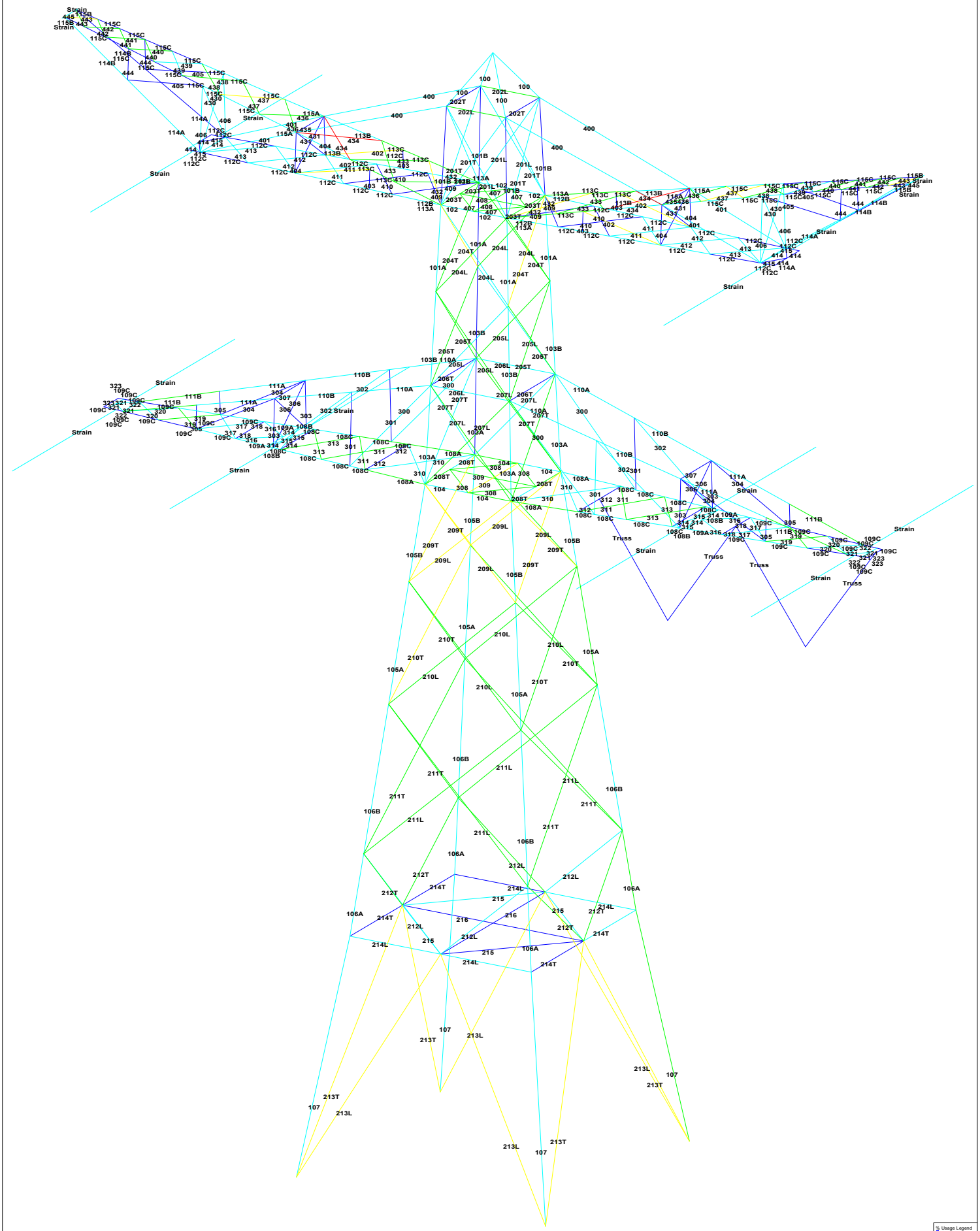
## Assessment of groups for strengthened mast (verbouw level)

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**68**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 434 | Tweede DWSRM | 55x55x6 | **S355** | 1M16-8.8t | 0.54 | 0.54 | 0.54 | 173 | **-36.2** | SPLS 6a_90 Ah All Cts | 37.7 | 60.3 | 70.6 | 0.96 | | **33.2** | SPLS 6a_90 Ah All Cts | 75.3 | 60.3 | 53.4 | 0.62 |

DNV GL Nederlands BV, Project: "D1.3.2 Circuit HB+0 (78) - dnv gl-inf"
Tower Version 16.86, 12:01:38 Friday, 21 May, 2021
Undeformed geometry displayed



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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**78**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | BVNSTK - Top cap | 90x90x6# | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 152 | **-24.1** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 87.0 | 120.6 | 103.7 | 0.28 | | **23.0** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 127.9 | 120.6 | 89.6 | 0.26 | |
| 101A | BVNSTK - Main member | 120x120x8 | S355 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 77 | **-143.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 416.4 | 813.3 | 846.7 | 0.34 | | **106.1** | SPLS 3_0_9_79.6 Ah All Cts | 516.5 | 813.3 | 723.7 | 0.21 | |
| 101B | BVNSTK - Main member | 120x120x8 | S355 | 6M20-8.8t | 0.52 | 0.52 | 0.52 | 88 | **-63.4** | SPLS 6a_90 Ah Ct1 Ba Ct2 | 364.8 | 564.5 | 705.6 | 0.17 | | **23.0** | SPLS 3_0_9_74.4 Ah All Cts | 539.1 | 564.5 | 705.6 | 0.04 | |
| 102 | Cross profile (main member for crossarm | 150x150x14 | S355 | 9M24-8.8t | 1.00 | 2.00 | 1.00 | 64 | **-500.5** | SPLS 3_74.4 Ba All Cts | 1076.0 | 1148.8 | 2222.6 | 0.47 | | **371.4** | SPLS 3_0_9_79.6 Ah All Cts | 1019.2 | 1148.8 | 1899.7 | 0.36 | |
| 103A | DerdeTSNK - Main member | 150x150x12 | S355 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 72 | **-334.4** | SPLS 3_79.6 Ah All Cts | 858.1 | 1621.5 | 1270.1 | 0.39 | | **266.1** | SPLS 3_0_9_79.6 Ah All Cts | 1007.6 | 1621.5 | 1150.7 | 0.26 | |
| 103B | DerdeTSNK - Main member | 150x150x12 | S355 | 10M24-8.8t | 0.52 | 0.52 | 0.52 | 67 | **-387.4** | SPLS 3_79.6 Ah All Cts | 902.5 | 1336.5 | 2116.8 | 0.43 | | **279.9** | SPLS 3_0_9_79.6 Ah All Cts | 1007.6 | 1336.5 | 1809.2 | 0.28 | |
| 104 | Cross profile (main member for crossarm | 160x160x15 | S355 | 14M24-8.8t | 1.00 | 2.00 | 1.00 | 77 | **-550.6** | SPLS 6a_90 Ba All Cts Ah Ct2 | 1082.6 | 1628.9 | 3704.4 | 0.51 | | **334.7** | SPLS 3_0_9_79.6 Ah All Cts | 1207.8 | 1628.9 | 3166.2 | 0.28 | |
| 105A | TweedeTSNK - Main member | 160x160x17 | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 44 | **-952.2** | SPLS 3_79.6 Ah All Cts | 1617.6 | 2660.2 | 2998.8 | 0.59 | | **753.4** | SPLS 3_0_9_79.6 Ah All Cts | 1519.2 | 2660.2 | 2563.1 | 0.50 | |
| 105B | TweedeTSNK - Main member | 160x160x17 | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 35 | **-791.4** | SPLS 3_79.6 Ah All Cts | 1698.4 | 2672.9 | 2998.8 | 0.47 | | **610.2** | SPLS 3_0_9_79.6 Ah All Cts | 1519.2 | 2672.9 | 2563.1 | 0.40 | |
| 106A | EersteTSNK - Main member | 200x200x20 | S355 | 14M24-8.8t | 0.50 | 0.50 | 0.50 | 43 | **-1278.0** | SPLS 3_79.6 Ah All Cts | 2395.3 | 3746.0 | 4939.2 | 0.53 | | **1052.7** | SPLS 3_0_9_79.6 Ah All Cts | 2328.5 | 3746.0 | 3841.6 | 0.45 | |
| 106B | EersteTSNK - Main member | 200x200x20 | S355 | 14M24-8.8t | 0.28 | 0.28 | 0.28 | 43 | **-1183.2** | SPLS 3_79.6 Ah All Cts | 2395.2 | 3694.6 | 4939.2 | 0.49 | | **977.0** | SPLS 3_0_9_79.6 Ah All Cts | 2328.5 | 3694.6 | 4221.5 | 0.42 | |
| 107 | BRKSTK - Main member | 200x200x20 | S355 | 14M24-8.8t | 0.17 | 0.17 | 0.17 | 42 | **-1302.9** | SPLS 3_79.6 Ah All Cts | 2406.1 | 3746.0 | 4939.2 | 0.54 | | **1052.5** | SPLS 3_0_9_79.6 Ah All Cts | 2328.5 | 3746.0 | 3841.6 | 0.45 | |
| 108A | Eerste DWSRM - Main member 1 bottom | 160x160x15 | S355 | 14M24-8.8t | 0.54 | 1.25 | 0.54 | 72 | **-645.4** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 1157.2 | 1628.9 | 3704.4 | 0.56 | | **433.2** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 1207.8 | 1628.9 | 3166.2 | 0.36 | |
| 108B | Eerste DWSRM - Main member 1 bottom | 160x160x15 | S355 | 10M24-8.8t | 2.15 | 12.93 | 2.15 | 74 | **-373.1** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 1129.8 | 1355.5 | 2646.0 | 0.33 | | **216.4** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 1372.7 | 1355.5 | 2261.5 | 0.16 | |
| 108C | Eerste DWSRM - Main member 1 bottom | 160x160x15 | S355 | | 2.90 | 4.96 | 2.90 | 72 | **-592.7** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 1156.9 | 0.0 | 0.0 | 0.51 | | **346.2** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 1658.2 | 0.0 | 0.0 | 0.21 | |
| 109A | Eerste DWSRM - Main member 2 bottom | 150x150x14 | S355 | 10M24-8.8t | 1.00 | 2.42 | 1.00 | 79 | **-367.3** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 910.6 | 1355.5 | 2469.6 | 0.40 | | **205.4** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 1159.3 | 1355.5 | 2110.8 | 0.18 | |
| 109C | Eerste DWSRM - Main member 2 bottom | 150x150x14 | S355 | | 1.00 | 1.96 | 1.00 | 79 | **-310.5** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 910.7 | 0.0 | 0.0 | 0.34 | | **147.1** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 1425.0 | 0.0 | 0.0 | 0.10 | |
| 110A | Eerste DWSRM - Main member 1 top | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 160 | **0.0** | | 144.5 | 542.2 | 414.7 | 0.00 | | **141.6** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 343.3 | 542.2 | 354.5 | 0.41 | |
| 110B | Eerste DWSRM - Main member 1 top | 120x120x8 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 156 | **0.0** | | 149.0 | 813.3 | 622.1 | 0.00 | | **106.3** | SPLS 6a_90 Ba Ct1 Ah Ct2 | 379.5 | 813.3 | 531.7 | 0.28 | |
| 111A | Eerste DWSRM - Main member 2 top | 90x90x8 | S235 | 5M24-8.8t | 1.00 | 1.00 | 1.00 | 213 | **0.0** | | 72.2 | 677.8 | 518.4 | 0.00 | | **104.8** | SPLS 6a_90 Ba Ct1 Ah Ct2 | 252.5 | 677.8 | 443.1 | 0.42 | |
| 111B | Eerste DWSRM - Main member 2 top | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 201 | **0.0** | | 78.6 | 406.7 | 311.0 | 0.00 | | **104.8** | SPLS 6a_90 Ba Ct1 Ah Ct2 | 185.9 | 406.7 | 264.8 | 0.56 | |
| 112B | Tweede DWSRM - Main member (bottom | 150x150x12 | S355 | 9M24-8.8t | 1.00 | 1.47 | 1.00 | 75 | **-343.3** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 831.8 | 1148.8 | 1905.1 | 0.41 | | **168.8** | SPLS 3_0_9_79.6 Ah Ct2 | 889.1 | 1148.8 | 1628.3 | 0.19 | |
| 112C | Tweede DWSRM - Main member (bottom | 150x150x12 | S355 | | 1.90 | 2.90 | 1.90 | 75 | **-319.5** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 832.0 | 0.0 | 0.0 | 0.38 | | **129.5** | SPLS 3_0_9_79.6 Ah Ct2 | 1235.4 | 0.0 | 0.0 | 0.10 | |
| 113A | Tweede DWSRM - Main member (top) 1 | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.52 | 1.00 | 94 | **-239.5** | SPLS 6a_90 Ah All Cts Ba Ct1 | 352.4 | 677.8 | 777.6 | 0.68 | | **233.4** | SPLS 6a_90 Ba All Cts Ah Ct1 | 494.8 | 677.8 | 664.6 | 0.47 | |
| 113B | Tweede DWSRM - Main member (top) 1 | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.37 | 1.00 | 108 | **-161.6** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 325.5 | 677.8 | 777.6 | 0.50 | | **168.7** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 494.8 | 677.8 | 664.6 | 0.34 | |
| 113C | Tweede DWSRM - Main member (top) 1 | 120x120x12 | S235 | | 1.82 | 2.92 | 1.82 | 92 | **-212.5** | SPLS 6a_90 Ah All Cts Ba Ct1 | 352.2 | 0.0 | 0.0 | 0.60 | | **207.2** | SPLS 6a_90 Ba All Cts Ah Ct1 | 646.3 | 0.0 | 0.0 | 0.32 | |
| 114A | Tweede DWSRM - Main member (bottom | 120x120x8 | S235 | 2M24-8.8t | 1.87 | 1.00 | 1.00 | 205 | **-34.7** | ULS 3_74.4 | 79.4 | 271.1 | 207.4 | 0.44 | | **0.0** | | 337.1 | 271.1 | 177.2 | 0.00 | |
| 114B | Tweede DWSRM - Main member (bottom | 120x120x8 | S235 | 2M24-8.8t | 2.15 | 1.00 | 1.00 | 205 | **-28.8** | ULS 3_74.4 | 79.4 | 271.1 | 207.4 | 0.36 | | **0.0** | ULS 1a_0_9_0_9_74.4 | 226.0 | 271.1 | 177.2 | 0.00 | |
| 115A | Tweede DWSRM - Main member (top) 2 | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 2.57 | 1.00 | 121 | **-153.4** | SPLS 3_0_9_79.6 Ah All Cts | 309.9 | 677.8 | 777.6 | 0.50 | | **176.6** | SPLS 6a_90 Ba All Cts Ah Ct1 | 494.8 | 677.8 | 664.6 | 0.36 | |
| 115B | Tweede DWSRM - Main member (top) 2 | 120x120x12 | S235 | 4M24-8.8t | 1.00 | 3.19 | 1.00 | 83 | **-18.9** | SPLS 3_0_9_74.4 Ah All Cts | 470.9 | 540.5 | 622.1 | 0.04 | | **38.9** | ULS 3_74.4 | 494.8 | 540.5 | 425.4 | 0.09 | |
| 115C | Tweede DWSRM - Main member (top) 2 | 120x120x12 | S235 | | 1.00 | 2.36 | 1.00 | 121 | **-132.5** | SPLS 3_0_9_79.6 Ah All Cts | 309.8 | 0.0 | 0.0 | 0.43 | | **152.4** | SPLS 6a_90 Ba All Cts Ah Ct1 | 646.3 | 0.0 | 0.0 | 0.24 | |
| 201L | BVNSTK - Crossing diagonal | 100x100x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-57.9** | SPLS 3_79.6 Ah Ct1 | 150.4 | 188.2 | 172.8 | 0.38 | | **46.9** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 179.9 | 188.2 | 157.1 | 0.30 | |
| 201T | BVNSTK - Crossing diagonal | 90x90x8 | S235 | 1M24-8.8t | 0.53 | 0.53 | 0.53 | 146 | **-42.7** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 95.3 | 135.6 | 103.7 | 0.45 | | **12.0** | SPLS 3_0_9_79.6 Ah Ct1 | 147.5 | 135.6 | 88.6 | 0.14 | |
| 202L | BVNSTK - Horizontal | 100x100x8 | S235 | 4M20-8.8t | 1.00 | 1.00 | 1.00 | 133 | **0.0** | | 148.9 | 376.3 | 345.6 | 0.00 | | **129.4** | SPLS 6a_90 Ba All Cts Ah Ct1 | 212.2 | 376.3 | 305.4 | 0.61 | |
| 202T | BVNSTK - Horizontal | 75x75x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 177 | **0.0** | | 47.0 | 60.3 | 51.8 | 0.00 | | **9.8** | SPLS 6a_90 Ah Ct1 Ba Ct2 | 98.5 | 60.3 | 44.8 | 0.22 | |
| 203T | BVNSTK - Horizontal | 90x90x8 | S235 | 4M24-8.8t | 1.00 | 2.00 | 1.00 | 106 | **-84.4** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 157.5 | 542.2 | 414.7 | 0.54 | | **143.4** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 252.5 | 542.2 | 354.5 | 0.57 | |
| 204L | BVNSTK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 83 | **-290.9** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 502.8 | 813.3 | 933.1 | 0.58 | | **238.9** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 456.2 | 813.3 | 674.5 | 0.52 | |
| 204T | BVNSTK - Crossing diagonal | 130x130x11 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-276.8** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 353.4 | 677.8 | 712.8 | 0.78 | | **258.5** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 367.2 | 677.8 | 543.2 | 0.70 | |
| 205L | DerdeTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | **-218.7** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 474.1 | 677.8 | 777.6 | 0.46 | | **265.1** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 456.2 | 677.8 | 568.7 | 0.58 | |
| 205T | DerdeTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | **-236.4** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 474.1 | 677.8 | 777.6 | 0.50 | | **251.4** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 456.2 | 677.8 | 568.7 | 0.55 | |
| 206L | DerdeTSNK - Horizontal | 120x120x12 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | **-15.7** | SPLS 1a_0_9_45 Ba All Cts | 232.0 | 813.3 | 933.1 | 0.07 | | **204.4** | SPLS 3_45 Ba All Cts | 494.8 | 813.3 | 797.5 | 0.41 | |
| 206T | DerdeTSNK - Horizontal | 120x120x12 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | **-33.6** | ULS 1a_0_9_74.4 | 232.0 | 406.7 | 466.6 | 0.14 | | **76.2** | ULS 1a_74.4 | 494.8 | 406.7 | 398.8 | 0.19 | |
| 207L | DerdeTSNK - Crossing diagonal | 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-315.7** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 517.8 | 942.9 | 1270.1 | 0.61 | | **253.8** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 525.6 | 942.9 | 910.4 | 0.48 | |
| 207T | DerdeTSNK - Crossing diagonal | 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-289.3** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 517.8 | 942.9 | 1270.1 | 0.56 | | **210.3** | SPLS 3_0_9_79.6 Ah Ct1 | 525.6 | 942.9 | 910.4 | 0.40 | |
| 208T | DerdeTSNK - Horizontal | 100x100x8 | S235 | 5M20-8.8t | 1.00 | 1.90 | 1.00 | 118 | **-53.5** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 159.2 | 470.4 | 432.0 | 0.34 | | **186.9** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 356.1 | 470.4 | 392.7 | 0.52 | |
| 209L | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | **-379.9** | SPLS 6a_90 Ba Ct2 Ba Ct1 | 530.9 | 1063.0 | 1244.2 | 0.72 | | **400.8** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 456.2 | 1063.0 | 886.1 | 0.88 | |
| 209T | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | **-439.1** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 530.9 | 1063.0 | 1244.2 | 0.83 | | **402.5** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 456.2 | 1063.0 | 886.1 | 0.88 | |
| 210L | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | **-330.7** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 463.5 | 813.3 | 933.1 | 0.71 | | **308.8** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 456.2 | 813.3 | 674.5 | 0.68 | |
| 210T | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | **-329.2** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 463.5 | 813.3 | 933.1 | 0.71 | | **355.5** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 456.2 | 813.3 | 674.5 | 0.78 | |
| 211L | EersteTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | **-251.8** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 393.4 | 677.8 | 777.6 | 0.64 | | **266.0** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 456.2 | 677.8 | 568.7 | 0.58 | |
| 211T | EersteTSNK - Crossing diagonal | 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | **-286.9** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 392.1 | 677.8 | 777.6 | 0.73 | | **262.7** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 456.2 | 677.8 | 568.7 | 0.58 | |
| 212L | EersteTSNK - Diagonal bracing | 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | **-220.8** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 392.9 | 542.2 | 622.1 | 0.56 | | **206.0** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 456.2 | 542.2 | 462.8 | 0.45 | |
| 212T | EersteTSNK - Diagonal bracing | 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | **-214.7** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 392.9 | 542.2 | 622.1 | 0.55 | | **231.5** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 456.2 | 542.2 | 462.8 | 0.51 | |
| 213L | BRKSTK - Diagonal 1 | 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | **-306.0** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 379.2 | 810.8 | 855.4 | 0.81 | | **285.8** | SPLS 6a_90 Ba Ct2 Ah Ct1 | 346.4 | 810.8 | 685.0 | 0.83 | |
| 213T | BRKSTK - Diagonal 1 | 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | **-291.9** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 379.2 | 810.8 | 855.4 | 0.77 | | **295.7** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 346.4 | 810.8 | 685.0 | 0.85 | |
| 214L | BRKSTK - Horizontal | 120x120x8 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 168 | **-49.4** | SPLS 3_79.6 Ah All Cts | 135.6 | 271.1 | 207.4 | 0.36 | | **32.5** | SPLS 3_0_9_79.6 Ah All Cts | 226.0 | 271.1 | 177.2 | 0.18 | |
| 214T | BRKSTK - Horizontal | 120x120x11 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 170 | **-52.6** | SPLS 3_79.6 Ah All Cts | 181.1 | 271.1 | 285.1 | 0.29 | | **35.8** | SPLS 3_0_9_79.6 Ah All Cts | 306.2 | 271.1 | 243.7 | 0.15 | |
| 215 | BRKSTK - Diagonal 2 | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 311 | **-4.6** | SPLS 1a_135 Ba Ct2 | 13.8 | 60.3 | 51.8 | 0.33 | | **3.6** | ULS 1a_0_9_0_9_135 | 72.6 | 60.3 | 44.8 | 0.08 | |
| 216 | BRKSTK - Crossing diagonal | 80x80x6# | S235 | 1M20-8.8t | 0.50 | 1.00 | 0.50 | 324 | **-1.3** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 17.2 | 94.1 | 64.8 | 0.07 | | **0.0** | | 100.2 | 94.1 | 58.9 | 0.00 | |
| 300 | Eerste DWSRM - Diagonal bracing | 80x80x6# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 341 | **0.0** | | 23.5 | 188.2 | 129.6 | 0.00 | | **29.8** | SPLS 6a_90 Ah Ct1 Ah Ct2 | 105.8 | 188.2 | 114.6 | 0.28 | |
| 301 | Eerste DWSRM - Vertical bracing | 90x90x8 | S235 | 1M20-8.8t | 1.00 | 1.00 | 1.00 | 169 | **-20.4** | SPLS 6a_90 Ba All Cts Ah Ct2 | 79.6 | 94.1 | 86.4 | 0.26 | | **0.0** | | 156.7 | 94.1 | 86.4 | 0.00 | |
| 302 | Eerste DWSRM - Diagonal bracing | 75x75x6 | S235 | 3M20-8.8t | 1.00 | 1.00 | 1.00 | 316 | **0.0** | | 24.6 | 282.2 | 194.4 | 0.00 | | **46.0** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 114.0 | 282.2 | 165.4 | 0.40 | |
| 303 | Eerste DWSRM - Vertical bracing | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 186 | **-4.4** | ULS 3_45 | 30.3 | 60.3 | 51.8 | 0.15 | | **0.0** | | 55.3 | 60.3 | 39.2 | 0.00 | |
| 304 | Eerste DWSRM - Diagonal bracing | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 335 | **0.0** | | 15.6 | 60.3 | 51.8 | 0.00 | | **7.3** | SPLS 3_74.4 Ba All Cts | 81.2 | 60.3 | 44.8 | 0.16 | |
| 305 | Eerste DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 99 | **-1.0** | SPLS 6a_90 Ah All Cts Ba Ct1 | 49.1 | 60.3 | 43.2 | 0.02 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 306 | Eerste DWSRM - Internal bracing (A-A) | 50x50x5 | S235 | 1M16-8.8t | 0.52 | 0.52 | 0.52 | 168 | **-0.8** | SPLS 1a_0_9_0_9_0 Ah All Cts | 27.8 | 60.3 | 43.2 | 0.03 | | **5.3** | ULS 3_0_9_45 | 37.4 | 60.3 | 25.7 | 0.20 | |
| 307 | Eerste DWSRM - Internal bracing (A-A) | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 200 | **-4.1** | ULS 3_0_9_74.4 | 31.4 | 60.3 | 51.8 | 0.13 | | **0.0** | | 72.6 | 60.3 | 44.8 | 0.00 | |
| 308 | Eerste DWSRM - Diaphragm diagonal | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 113 | **-158.2** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 213.3 | 406.7 | 311.0 | 0.74 | | **180.7** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 263.0 | 406.7 | 265.8 | 0.69 | |
| 309 | Eerste DWSRM - Diaphragm crossing dia | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 196 | **-17.0** | SPLS 1a_74.4 Ah All Cts | 22.5 | 60.3 | 43.2 | 0.76 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 310 | Eerste DWSRM - Crossing diagonal | 120x120x8 | S235 | 2M24-8.8t | 0.54 | 0.54 | 0.54 | 101 | **-96.1** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 234.9 | 271.1 | 207.4 | 0.46 | | **35.6** | SPLS 6a_90 Ah All Cts Ba Ct2 | 257.1 | 271.1 | 177.2 | 0.20 | |
| 311 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.55 | 0.55 | 0.55 | 131 | **-69.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 119.7 | 282.2 | 259.2 | 0.58 | | **68.0** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 162.8 | 282.2 | 223.4 | 0.42 | |
| 312 | Eerste DWSRM - Horizontal | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 83 | **0.0** | | 566.5 | 188.2 | 216.0 | 0.00 | | **33.3** | ULS 1a_74.4 | 556.1 | 188.2 | 216.0 | 0.18 | |
| 313 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.54 | 0.54 | 0.54 | 116 | **-82.0** | SPLS 6a_90 Ah All Cts Ba Ct2 | 136.2 | 282.2 | 259.2 | 0.60 | | **83.4** | SPLS 6a_90 Ah All Cts Ba Ct2 | 162.8 | 282.2 | 223.4 | 0.51 | |
| 314 | Eerste DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 137 | **0.0** | | 176.5 | 188.2 | 323.4 | 0.00 | | **50.7** | SPLS 6a_90 Ah All Cts Ba Ct2 | 401.4 | 188.2 | 323.4 | 0.27 | |
| 315 | Eerste DWSRM - Crossing diagonal | 65x65x7 | S235 | 2M16-8.8t | 0.52 | 0.52 | 0.52 | 107 | **-44.8** | SPLS 6a_90 Ah All Cts Ba Ct2 | 103.9 | 120.6 | 121.0 | 0.43 | | **47.0** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 100.0 | 120.6 | 104.5 | 0.47 | |
| 316 | Eerste DWSRM - Diagonal | 75x75x7# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 126 | **-37.6** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 103.9 | 188.2 | 151.2 | 0.36 | | **37.5** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 113.4 | 188.2 | 131.2 | 0.33 | |
| 317 | Eerste DWSRM - Crossing diagonal | 65x65x7 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 119 | **-39.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 93.5 | 180.9 | 181.4 | 0.42 | | **38.3** | SPLS 6a_90 Ah All Cts Ba Ct2 | 116.7 | 180.9 | 156.8 | 0.33 | |
| 318 | Eerste DWSRM - Horizontal | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 55 | **-2.7** | ULS 1a_45 | 685.6 | 188.2 | 216.0 | 0.01 | | **0.1** | SPLS 1a_0_9_0 Ba Ct2 | 766.1 | 188.2 | 0.0 | 0.00 | |
| 319 | Eerste DWSRM - Crossing diagonal | 65x65x6 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 109 | **-47.8** | SPLS 6a_90 Ah All Cts Ba Ct2 | 88.3 | 180.9 | 155.5 | 0.54 | | **49.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 101.1 | 180.9 | 134.4 | 0.49 | |
| 320 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.56 | 0.56 | 0.56 | 77 | **-71.4** | SPLS 6a_90 Ah All Cts Ba Ct2 | 186.1 | 282.2 | 259.2 | 0.38 | | **65.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 157.3 | 282.2 | 207.1 | 0.41 | |
| 321 | Eerste DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 62 | **0.0** | | 373.4 | 188.2 | 323.4 | 0.00 | | **74.6** | ULS 3_74.4 | 401.4 | 188.2 | 323.4 | 0.40 | |
| 322 | Eerste DWSRM - Diagonal | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 73 | **-32.0** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 117.6 | 180.9 | 155.5 | 0.27 | | **32.1** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 101.1 | 180.9 | 134.4 | 0.32 | |
| 323 | Eerste DWSRM - Horizontal | 100x100x12 | S235 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 55 | **-18.3** | ULS 3_74.4 | 398.5 | 271.1 | 311.0 | 0.07 | | **0.0** | | 225.6 | 271.1 | 212.7 | 0.00 | |
| 400 | Tweede DWSRM - Diagonal bracing | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 302 | **0.0** | | 57.4 | 542.2 | 414.7 | 0.00 | | **161.6** | SPLS 6a_90 Ah All Cts Ba Ct2 | 343.3 | 542.2 | 354.5 | 0.47 | |

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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**78**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 401 | Tweede DWSRM - Diagonal bracing | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 193 | **0.0** | | 113.0 | 542.2 | 414.7 | 0.00 | | **127.6** | ULS 3_90 | 343.3 | 542.2 | 354.5 | 0.37 | |
| 402 | Tweede DWSRM - Diagonal bracing | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 326 | **-10.2** | ULS 5a Ah 12 | 12.9 | 60.3 | 51.8 | 0.79 | | **0.0** | | 55.3 | 60.3 | 39.2 | 0.00 | |
| 403 | Tweede DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 82 | **0.0** | | 55.5 | 60.3 | 43.2 | 0.00 | | **2.8** | ULS 5a Ah 12 | 37.4 | 60.3 | 25.7 | 0.11 | |
| 404 | Tweede DWSRM - Vertical bracing | 65x65x6 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 132 | **-10.4** | SPLS 6a_90 Ba All Cts Ah Ct1 | 73.0 | 120.6 | 103.7 | 0.14 | | **9.6** | SPLS 3_79.6 Ah All Cts | 80.5 | 120.6 | 89.5 | 0.12 | |
| 405 | Tweede DWSRM - Diagonal bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 350 | **0.0** | | 9.2 | 60.3 | 43.2 | 0.00 | | **5.5** | ULS 3_74.4 | 37.4 | 60.3 | 25.7 | 0.22 | |
| 406 | Tweede DWSRM - Vertical bracing | 55x55x6 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 161 | **-13.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 29.1 | 60.3 | 51.8 | 0.45 | | **6.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 55.3 | 60.3 | 39.2 | 0.16 | |
| 407 | Tweede DWSRM - Diagonal diaphragm | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 87 | **-151.9** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 265.1 | 406.7 | 311.0 | 0.57 | | **167.9** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 263.0 | 406.7 | 265.8 | 0.64 | |
| 408 | Tweede DWSRM - Crossing diagonal diap | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 193 | **-11.9** | ULS 7 | 16.9 | 60.3 | 43.2 | 0.70 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 409 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 119 | **-31.5** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 132.3 | 188.2 | 172.8 | 0.24 | | **17.4** | SPLS 6a_90 Ah All Cts Ba Ct2 | 138.0 | 188.2 | 152.8 | 0.13 | |
| 410 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 114 | **-22.2** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 138.2 | 188.2 | 172.8 | 0.16 | | **34.7** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 167.8 | 188.2 | 157.1 | 0.22 | |
| 411 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 111 | **-37.9** | SPLS 6a_90 Ah Ct1 Ba Ct1 | 141.6 | 188.2 | 172.8 | 0.27 | | **25.6** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 174.4 | 188.2 | 157.1 | 0.16 | |
| 412 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 105 | **-48.7** | SPLS 6a_90 Ah All Cts Ba Ct2 | 149.6 | 282.2 | 259.2 | 0.33 | | **51.1** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 162.8 | 282.2 | 223.4 | 0.31 | |
| 413 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 101 | **-61.6** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 154.7 | 282.2 | 259.2 | 0.40 | | **56.7** | SPLS 6a_90 Ah All Cts Ba Ct2 | 162.8 | 282.2 | 223.4 | 0.35 | |
| 414 | Tweede DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 104 | **-0.3** | SPLS 1a_0.9_45 Ba All Cts | 242.4 | 188.2 | 323.4 | 0.00 | | **63.2** | ULS 3_74.4 | 401.4 | 188.2 | 323.4 | 0.34 | |
| 415 | Tweede DWSRM - Diagonal | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 93 | **-25.1** | SPLS 6a_90 Ah All Cts Ba Ct2 | 100.7 | 180.9 | 155.5 | 0.25 | | **25.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 101.1 | 180.9 | 134.4 | 0.25 | |
| 430 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.55 | 0.55 | 0.55 | 166 | **-12.6** | SPLS 6a_90 Ah All Cts Ba Ct2 | 35.1 | 60.3 | 51.8 | 0.36 | | **11.2** | SPLS 6a_90 Ba All Cts Ah Ct1 | 55.3 | 60.3 | 39.2 | 0.29 | |
| 431 | Tweede DWSRM - Crossing diagonal | 65x65x6 | S235 | 2M16-8.8t | 0.51 | 0.51 | 0.51 | 114 | **-11.8** | SPLS 3_0.9_79.6 Ah All Cts | 84.6 | 120.6 | 103.7 | 0.14 | | **19.6** | SPLS 6a_90 Ba All Cts Ah Ct1 | 86.7 | 120.6 | 89.6 | 0.23 | |
| 432 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 177 | **-24.9** | SPLS 6a_90 Ba All Cts Ah Ct1 | 32.2 | 60.3 | 51.8 | 0.77 | | **21.0** | SPLS 6a_90 Ba All Cts Ah Ct1 | 55.3 | 60.3 | 39.2 | 0.54 | |
| 433 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 164 | **-24.8** | SPLS 6a_90 Ba All Cts Ah Ct1 | 35.7 | 60.3 | 51.8 | 0.70 | | **27.4** | SPLS 6a_90 Ba All Cts Ah Ct1 | 55.3 | 60.3 | 39.2 | 0.70 | |
| 434 | Tweede DWSRM - Crossing diagonal | 55x55x6 | S235 | 1M16-8.8t | 0.54 | 0.54 | 0.54 | 173 | **-35.0** | SPLS 6a_90 Ba All Cts Ah Ct1 | 33.2 | 60.3 | 51.8 | 1.05 | knik | **32.0** | SPLS 6a_90 Ba All Cts Ah Ct1 | 55.3 | 60.3 | 39.2 | 0.81 | |
| 435 | Tweede DWSRM - Horizontal | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 173 | **-3.4** | ULS 3_74.4 | 41.7 | 60.3 | 51.8 | 0.08 | | **0.0** | | 81.2 | 60.3 | 44.8 | 0.00 | |
| 436 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 145 | **-15.7** | SPLS 6a_90 Ba All Cts Ah Ct1 | 33.2 | 60.3 | 43.2 | 0.47 | | **15.7** | SPLS 6a_90 Ba All Cts Ah Ct1 | 37.4 | 60.3 | 25.7 | 0.61 | |
| 437 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 143 | **-20.0** | SPLS 6a_90 Ba All Cts Ah Ct1 | 33.9 | 60.3 | 43.2 | 0.59 | | **19.9** | SPLS 6a_90 Ba All Cts Ah Ct1 | 37.4 | 60.3 | 25.7 | 0.77 | |
| 438 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-16.3** | SPLS 6a_90 Ba All Cts Ah Ct1 | 37.4 | 60.3 | 43.2 | 0.43 | | **16.8** | SPLS 6a_90 Ba All Cts Ah Ct1 | 37.4 | 60.3 | 25.7 | 0.65 | |
| 439 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 107 | **-10.8** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 46.0 | 60.3 | 43.2 | 0.25 | | **10.7** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 37.4 | 60.3 | 25.7 | 0.42 | |
| 440 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 97 | **-13.9** | SPLS 6a_90 Ba All Cts Ah Ct1 | 49.8 | 60.3 | 43.2 | 0.32 | | **13.6** | SPLS 6a_90 Ba All Cts Ah Ct1 | 37.4 | 60.3 | 25.7 | 0.53 | |
| 441 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 88 | **-14.8** | SPLS 6a_90 Ba All Cts Ah Ct1 | 53.6 | 60.3 | 43.2 | 0.34 | | **15.1** | SPLS 6a_90 Ba All Cts Ah Ct1 | 37.4 | 60.3 | 25.7 | 0.59 | |
| 442 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 77 | **-16.9** | SPLS 6a_90 Ba All Cts Ah Ct1 | 56.7 | 60.3 | 43.2 | 0.39 | | **16.0** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 37.4 | 60.3 | 25.7 | 0.62 | |
| 443 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 73 | **-18.6** | SPLS 6a_90 Ba All Cts Ah Ct1 | 58.0 | 60.3 | 43.2 | 0.43 | | **20.0** | SPLS 6a_90 Ba All Cts Ah Ct1 | 37.4 | 60.3 | 25.7 | 0.78 | |
| 444 | Tweede DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 128 | **-2.5** | SPLS 1a_74.4 Ah All Cts | 38.4 | 60.3 | 43.2 | 0.06 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 445 | Tweede DWSRM - Horizontal | 160x65x7.5(I | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 47 | **0.0** | | 443.0 | 188.2 | 162.0 | 0.00 | | **39.5** | ULS 3_0.9_74.4 | 547.9 | 188.2 | 130.9 | 0.30 | |

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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1,0 |

**ZW380 Oost**
**HB+0**
**78**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | BVNSTK - | Top c 90x90x6# | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 152 | **-24.1** | SPLS 6a_90 Ah Ct1 Ba | 87.0 | 120.6 | 103.7 | 0.28 | | **23.0** | SPLS 6a_90 Ah Ct1 Ba | 127.9 | 120.6 | 89.6 | 0.26 |
| 101A | BVNSTK - | Main 120x120x8 | S355 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 77 | **-143.5** | SPLS 6a_90 Ah All Cts | 416.4 | 813.3 | 846.7 | 0.34 | | **106.1** | SPLS 3_0_9_79.6 Ah Al | 516.5 | 813.3 | 723.7 | 0.21 |
| 101B | BVNSTK - | Main 120x120x8 | S355 | 6M20-8.8t | 0.52 | 0.52 | 0.52 | 88 | **-63.4** | SPLS 6a_90 Ah Ct1 Ba | 364.8 | 564.5 | 705.6 | 0.17 | | **23.0** | SPLS 3_0_9_74.4 Ah Al | 539.1 | 564.5 | 705.6 | 0.04 |
| 102 | Cross profile (m | 150x150x14 | S355 | 9M24-8.8t | 1.00 | 2.00 | 1.00 | 64 | **-500.5** | SPLS 3_74.4 Ba All Cts | 1076.0 | 1148.8 | 2222.6 | 0.47 | | **371.4** | SPLS 3_0_9_79.6 Ah Al | 1019.2 | 1148.8 | 1899.7 | 0.36 |
| 103A | DerdeTSNK - | M 150x150x12 | S355 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 72 | **-334.4** | SPLS 3_79.6 Ah All Cts | 858.1 | 1621.5 | 1270.1 | 0.39 | | **266.1** | SPLS 3_0_9_79.6 Ah Al | 1007.6 | 1621.5 | 1150.7 | 0.26 |
| 103B | DerdeTSNK - | M 150x150x12 | S355 | 10M24-8.8t | 0.52 | 0.52 | 0.52 | 67 | **-387.4** | SPLS 3_79.6 Ah All Cts | 902.5 | 1336.5 | 2116.8 | 0.43 | | **279.9** | SPLS 3_0_9_79.6 Ah Al | 1007.6 | 1336.5 | 1809.2 | 0.28 |
| 104 | Cross profile (m | 160x160x15# | S355 | 14M24-8.8t | 1.00 | 2.00 | 1.00 | 77 | **-550.6** | SPLS 6a_90 Ba All Cts | 1082.6 | 1628.9 | 3704.4 | 0.51 | | **334.7** | SPLS 3_0_9_79.6 Ah Al | 1207.8 | 1628.9 | 3166.2 | 0.28 |
| 105A | TweedeTSNK - | 160x160x17# | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 44 | **-952.2** | SPLS 3_79.6 Ah All Cts | 1617.6 | 2660.2 | 2998.8 | 0.59 | | **753.4** | SPLS 3_0_9_79.6 Ah Al | 1519.2 | 2660.2 | 2563.1 | 0.50 |
| 105B | TweedeTSNK - | 160x160x17# | S355 | 10M24-8.8t | 0.28 | 0.28 | 0.28 | 35 | **-791.4** | SPLS 3_79.6 Ah All Cts | 1698.4 | 2672.9 | 2998.8 | 0.47 | | **610.2** | SPLS 3_0_9_79.6 Ah Al | 1519.2 | 2672.9 | 2563.1 | 0.40 |
| 106A | EersteTSNK - | M 200x200x20 | S355 | 14M24-8.8t | 0.50 | 0.50 | 0.50 | 43 | **-1278.0** | SPLS 3_79.6 Ah All Cts | 2395.3 | 3746.0 | 4939.2 | 0.53 | | **1052.7** | SPLS 3_0_9_79.6 Ah Al | 2328.5 | 3746.0 | 3841.6 | 0.45 |
| 106B | EersteTSNK - | M 200x200x20 | S355 | 14M24-8.8t | 0.28 | 0.28 | 0.28 | 43 | **-1183.2** | SPLS 3_79.6 Ah All Cts | 2395.2 | 3694.6 | 4939.2 | 0.49 | | **977.0** | SPLS 3_0_9_79.6 Ah Al | 2328.5 | 3694.6 | 4221.5 | 0.42 |
| 107 | BRKSTK - | Main 200x200x20 | S355 | 14M24-8.8t | 0.17 | 0.17 | 0.17 | 42 | **-1302.9** | SPLS 3_79.6 Ah All Cts | 2406.1 | 3746.0 | 4939.2 | 0.54 | | **1052.5** | SPLS 3_0_9_79.6 Ah Al | 2328.5 | 3746.0 | 3841.6 | 0.45 |
| 108A | Eerste DWSRM | 160x160x15# | S355 | 14M24-8.8t | 0.54 | 1.25 | 0.54 | 72 | **-645.4** | SPLS 6a_90 Ah Ct1 Ba | 1157.2 | 1628.9 | 3704.4 | 0.56 | | **433.2** | SPLS 6a_90 Ah Ct2 Ba | 1207.8 | 1628.9 | 3166.2 | 0.36 |
| 108B | Eerste DWSRM | 160x160x15# | S355 | 10M24-8.8t | 2.15 | 12.93 | 2.15 | 74 | **-373.1** | SPLS 6a_90 Ah Ct1 Ba | 1129.8 | 1355.5 | 2646.0 | 0.33 | | **216.4** | SPLS 6a_90 Ah Ct2 Ba | 1372.7 | 1355.5 | 2261.5 | 0.16 |
| 108C | Eerste DWSRM | 160x160x15# | S355 | | 2.90 | 4.96 | 2.90 | 72 | **-592.7** | SPLS 6a_90 Ah Ct1 Ba | 1156.9 | 0.0 | 0.0 | 0.51 | | **346.2** | SPLS 6a_90 Ah Ct2 Ba | 1658.2 | 0.0 | 0.0 | 0.21 |
| 109A | Eerste DWSRM | 150x150x14 | S355 | 10M24-8.8t | 1.00 | 2.42 | 1.00 | 79 | **-367.3** | SPLS 6a_90 Ah Ct1 Ba | 910.6 | 1355.5 | 2469.6 | 0.40 | | **205.4** | SPLS 6a_90 Ah Ct2 Ba | 1159.3 | 1355.5 | 2110.8 | 0.18 |
| 109C | Eerste DWSRM | 150x150x14 | S355 | | 1.00 | 1.96 | 1.00 | 79 | **-310.5** | SPLS 6a_90 Ah Ct1 Ba | 910.7 | 0.0 | 0.0 | 0.34 | | **147.1** | SPLS 6a_90 Ah Ct2 Ba | 1425.0 | 0.0 | 0.0 | 0.10 |
| 110A | Eerste DWSRM | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 160 | **0.0** | | 144.5 | 542.2 | 414.7 | 0.00 | | **141.6** | SPLS 6a_90 Ah Ct1 Ah | 343.3 | 542.2 | 354.5 | 0.41 |
| 110B | Eerste DWSRM | 120x120x8 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 156 | **0.0** | | 149.0 | 813.3 | 622.1 | 0.00 | | **106.3** | SPLS 6a_90 Ba Ct1 Ah | 379.5 | 813.3 | 531.7 | 0.28 |
| 111A | Eerste DWSRM | 90x90x8 | S235 | 5M24-8.8t | 1.00 | 1.00 | 1.00 | 213 | **0.0** | | 72.2 | 677.8 | 518.4 | 0.00 | | **104.8** | SPLS 6a_90 Ba Ct1 Ah | 252.5 | 677.8 | 443.1 | 0.42 |
| 111B | Eerste DWSRM | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 201 | **0.0** | | 78.6 | 406.7 | 311.0 | 0.00 | | **104.8** | SPLS 6a_90 Ba Ct1 Ah | 185.9 | 406.7 | 264.8 | 0.56 |
| 112B | Tweede DWSRM | 150x150x12 | S355 | 9M24-8.8t | 1.00 | 1.47 | 1.00 | 75 | **-343.3** | SPLS 6a_90 Ah Ct1 Ba | 831.8 | 1148.8 | 1905.1 | 0.41 | | **168.8** | SPLS 3_0_9_79.6 Ah Cl | 889.1 | 1148.8 | 1628.3 | 0.19 |
| 112C | Tweede DWSRM | 150x150x12 | S355 | | 1.90 | 2.90 | 1.90 | 75 | **-319.5** | SPLS 6a_90 Ah Ct1 Ba | 832.0 | 0.0 | 0.0 | 0.38 | | **129.5** | SPLS 3_0_9_79.6 Ah Cl | 1235.4 | 0.0 | 0.0 | 0.10 |
| 113A | Tweede DWSRM | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.52 | 1.00 | 94 | **-239.5** | SPLS 6a_90 Ah All Cts | 352.4 | 677.8 | 777.6 | 0.68 | | **233.4** | SPLS 6a_90 Ba All Cts | 494.8 | 677.8 | 664.6 | 0.47 |
| 113B | Tweede DWSRM | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 1.37 | 1.00 | 108 | **-161.6** | SPLS 6a_90 Ah Ct1 Ba | 325.5 | 677.8 | 777.6 | 0.50 | | **168.7** | SPLS 6a_90 Ba Ct1 Ah | 494.8 | 677.8 | 664.6 | 0.34 |
| 113C | Tweede DWSRM | 120x120x12 | S235 | | 1.82 | 2.92 | 1.82 | 92 | **-212.5** | SPLS 6a_90 Ah All Cts | 352.2 | 0.0 | 0.0 | 0.60 | | **207.2** | SPLS 6a_90 Ba All Cts | 646.3 | 0.0 | 0.0 | 0.32 |
| 114A | Tweede DWSRM | 120x120x8 | S235 | 2M24-8.8t | 1.87 | 1.00 | 1.00 | 205 | **-34.7** | ULS 3_74.4 | 79.4 | 271.1 | 207.4 | 0.44 | | **0.0** | | 337.1 | 271.1 | 177.2 | 0.00 |
| 114B | Tweede DWSRM | 120x120x8 | S235 | 2M24-8.8t | 2.15 | 1.00 | 1.00 | 205 | **-28.8** | ULS 3_74.4 | 79.4 | 271.1 | 207.4 | 0.36 | | **0.0** | ULS 1a_0_9_0_9_74.4 | 226.0 | 271.1 | 177.2 | 0.00 |
| 115A | Tweede DWSRM | 120x120x12 | S235 | 5M24-8.8t | 1.00 | 2.57 | 1.00 | 121 | **-153.4** | SPLS 3_0_9_79.6 Ah Al | 309.9 | 677.8 | 777.6 | 0.50 | | **176.6** | SPLS 6a_90 Ba All Cts | 494.8 | 677.8 | 664.6 | 0.36 |
| 115B | Tweede DWSRM | 120x120x12 | S235 | 4M24-8.8t | 1.00 | 3.19 | 1.00 | 83 | **-18.9** | SPLS 3_0_9_74.4 Ah Al | 470.9 | 540.5 | 622.1 | 0.04 | | **38.9** | ULS 3_74.4 | 494.8 | 540.5 | 425.4 | 0.09 |
| 115C | Tweede DWSRM | 120x120x12 | S235 | | 1.00 | 2.36 | 1.00 | 121 | **-132.5** | SPLS 3_0_9_79.6 Ah Al | 309.8 | 0.0 | 0.0 | 0.43 | | **152.4** | SPLS 6a_90 Ba All Cts | 646.3 | 0.0 | 0.0 | 0.24 |
| 201L | BVNSTK - | Cross 100x100x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-57.9** | SPLS 3_79.6 Ah Ct1 | 150.4 | 188.2 | 172.8 | 0.38 | | **46.9** | SPLS 6a_90 Ah Ct1 Ah | 179.9 | 188.2 | 157.1 | 0.30 |
| 201T | BVNSTK - | Cross 90x90x8 | S235 | 1M24-8.8t | 0.53 | 0.53 | 0.53 | 146 | **-42.7** | SPLS 6a_90 Ah Ct1 Ah | 95.3 | 135.6 | 103.7 | 0.45 | | **12.0** | SPLS 3_0_9_79.6 Ah Cl | 147.5 | 135.6 | 88.6 | 0.14 |
| 202L | BVNSTK - | Horiz 100x100x8 | S235 | 4M20-8.8t | 1.00 | 1.00 | 1.00 | 133 | **0.0** | | 148.9 | 376.3 | 345.6 | 0.00 | | **129.4** | SPLS 6a_90 Ba All Cts | 212.2 | 376.3 | 305.4 | 0.61 |
| 202T | BVNSTK - | Horiz 75x75x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 177 | **0.0** | | 47.0 | 60.3 | 51.8 | 0.00 | | **9.8** | SPLS 6a_90 Ah Ct1 Ba | 98.5 | 60.3 | 44.8 | 0.22 |
| 203T | BVNSTK - | Horiz 90x90x8 | S235 | 4M24-8.8t | 1.00 | 2.00 | 1.00 | 106 | **-84.4** | SPLS 6a_90 Ah Ct1 Ah | 157.5 | 542.2 | 414.7 | 0.54 | | **143.4** | SPLS 6a_90 Ah Ct1 Ah | 252.5 | 542.2 | 354.5 | 0.57 |
| 204L | BVNSTK - | Cross 150x150x12 | S235 | 6M24-8.8t | 0.53 | 0.53 | 0.53 | 83 | **-290.9** | SPLS 6a_90 Ah Ct1 Ba | 502.8 | 813.3 | 933.1 | 0.58 | | **238.9** | SPLS 6a_90 Ah Ct2 Ba | 456.2 | 813.3 | 674.5 | 0.52 |
| 204T | BVNSTK - | Cross 130x130x11 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-276.8** | SPLS 6a_90 Ah Ct1 Ba | 353.4 | 677.8 | 712.8 | 0.78 | | **258.5** | SPLS 6a_90 Ah Ct1 Ba | 367.2 | 677.8 | 543.2 | 0.70 |
| 205L | DerdeTSNK - | Cr 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | **-218.7** | SPLS 6a_90 Ah Ct2 Ba | 474.1 | 677.8 | 777.6 | 0.46 | | **265.1** | SPLS 6a_90 Ah Ct1 Ba | 456.2 | 677.8 | 568.7 | 0.58 |
| 205T | DerdeTSNK - | Cr 150x150x12 | S235 | 5M24-8.8t | 0.53 | 0.53 | 0.53 | 91 | **-236.4** | SPLS 6a_90 Ah Ct1 Ba | 474.1 | 677.8 | 777.6 | 0.50 | | **251.4** | SPLS 6a_90 Ah Ct1 Ba | 456.2 | 677.8 | 568.7 | 0.55 |
| 206L | DerdeTSNK - | Hi 120x120x12 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | **-15.7** | SPLS 1a_0_9_45 Ba All | 232.0 | 813.3 | 933.1 | 0.07 | | **204.4** | SPLS 3_45 Ba All Cts | 494.8 | 813.3 | 797.5 | 0.41 |
| 206T | DerdeTSNK - | Hi 120x120x12 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | **-33.6** | ULS 1a_0_9_74.4 | 232.0 | 406.7 | 466.6 | 0.14 | | **76.2** | ULS 1a_74.4 | 494.8 | 406.7 | 398.8 | 0.19 |
| 207L | DerdeTSNK - | Cr 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-315.7** | SPLS 6a_90 Ah Ct1 Ba | 517.8 | 942.9 | 1270.1 | 0.61 | | **253.8** | SPLS 6a_90 Ah Ct2 Ba | 525.6 | 942.9 | 910.4 | 0.48 |
| 207T | DerdeTSNK - | Cr 150x150x14 | S235 | 7M24-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-289.3** | SPLS 6a_90 Ah Ct2 Ba | 517.8 | 942.9 | 1270.1 | 0.56 | | **210.3** | SPLS 3_0_9_79.6 Ah Cl | 525.6 | 942.9 | 910.4 | 0.40 |
| 208T | DerdeTSNK - | Hi 100x100x8 | S235 | 5M20-8.8t | 1.00 | 1.90 | 1.00 | 118 | **-53.5** | SPLS 6a_90 Ah Ct1 Ah | 159.2 | 470.4 | 432.0 | 0.34 | | **186.9** | SPLS 6a_90 Ah Ct1 Ah | 356.1 | 470.4 | 392.7 | 0.52 |
| 209L | TweedeTSNK - | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | **-379.9** | SPLS 6a_90 Ba Ct2 Ba | 530.9 | 1063.0 | 1244.2 | 0.72 | | **400.8** | SPLS 6a_90 Ah Ct1 Ba | 456.2 | 1063.0 | 886.1 | 0.88 |
| 209T | TweedeTSNK - | 150x150x12 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | **-439.1** | SPLS 6a_90 Ah Ct1 Ba | 530.9 | 1063.0 | 1244.2 | 0.83 | | **402.5** | SPLS 6a_90 Ba Ct2 Ah | 456.2 | 1063.0 | 886.1 | 0.88 |
| 210L | TweedeTSNK - | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | **-330.7** | SPLS 6a_90 Ah Ct1 Ba | 463.5 | 813.3 | 933.1 | 0.71 | | **308.8** | SPLS 6a_90 Ah Ct2 Ba | 456.2 | 813.3 | 674.5 | 0.68 |
| 210T | TweedeTSNK - | 150x150x12 | S235 | 6M24-8.8t | 0.29 | 0.55 | 0.29 | 87 | **-329.2** | SPLS 6a_90 Ba Ct2 Ah | 463.5 | 813.3 | 933.1 | 0.71 | | **355.5** | SPLS 6a_90 Ah Ct1 Ba | 456.2 | 813.3 | 674.5 | 0.78 |
| 211L | EersteTSNK - | C 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | **-251.8** | SPLS 6a_90 Ah Ct2 Ba | 393.4 | 677.8 | 777.6 | 0.64 | | **266.0** | SPLS 6a_90 Ah Ct1 Ba | 456.2 | 677.8 | 568.7 | 0.58 |
| 211T | EersteTSNK - | C 150x150x12 | S235 | 5M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | **-286.9** | SPLS 6a_90 Ah Ct1 Ba | 392.1 | 677.8 | 777.6 | 0.73 | | **262.7** | SPLS 6a_90 Ba Ct2 Ah | 456.2 | 677.8 | 568.7 | 0.58 |
| 212L | EersteTSNK - | D 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | **-220.8** | SPLS 6a_90 Ah Ct1 Ba | 392.9 | 542.2 | 622.1 | 0.56 | | **206.0** | SPLS 6a_90 Ah Ct2 Ba | 456.2 | 542.2 | 462.8 | 0.45 |
| 212T | EersteTSNK - | D 150x150x12 | S235 | 4M24-8.8t | 1.00 | 0.50 | 0.50 | 107 | **-214.7** | SPLS 6a_90 Ba Ct2 Ah | 392.9 | 542.2 | 622.1 | 0.55 | | **231.5** | SPLS 6a_90 Ah Ct1 Ba | 456.2 | 542.2 | 462.8 | 0.51 |
| 213L | BRKSTK - | Diag 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | **-306.0** | SPLS 6a_90 Ah Ct1 Ba | 379.2 | 810.8 | 855.4 | 0.81 | | **285.8** | SPLS 6a_90 Ba Ct2 Ba | 346.4 | 810.8 | 685.0 | 0.83 |
| 213T | BRKSTK - | Diag 120x120x11 | S235 | 6M24-8.8t | 0.17 | 0.18 | 0.17 | 80 | **-291.9** | SPLS 6a_90 Ah Ct1 Ba | 379.2 | 810.8 | 855.4 | 0.77 | | **295.7** | SPLS 6a_90 Ah Ct1 Ba | 346.4 | 810.8 | 685.0 | 0.85 |
| 214L | BRKSTK - | Horiz 120x120x8 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 168 | **-49.4** | SPLS 3_79.6 Ah All Cts | 135.6 | 271.1 | 207.4 | 0.36 | | **32.5** | SPLS 3_0_9_79.6 Ah Al | 226.0 | 271.1 | 177.2 | 0.18 |
| 214T | BRKSTK - | Horiz 120x120x11 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 170 | **-52.6** | SPLS 3_79.6 Ah All Cts | 181.1 | 271.1 | 285.1 | 0.29 | | **35.8** | SPLS 3_0_9_79.6 Ah Al | 306.2 | 271.1 | 243.7 | 0.15 |
| 215 | BRKSTK - | Diag 60x60x6 | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 311 | **-4.6** | SPLS 1a_135 Ba Ct2 | 13.8 | 60.3 | 51.8 | 0.33 | | **3.6** | ULS 1a_0_9_0_9_135 | 72.6 | 60.3 | 44.8 | 0.08 |
| 216 | BRKSTK - | Cross 80x80x6# | S235 | 1M20-8.8t | 0.50 | 1.00 | 0.50 | 324 | **-1.3** | SPLS 6a_90 Ah Ct1 Ah | 17.2 | 94.1 | 64.8 | 0.07 | | **0.0** | | 100.2 | 94.1 | 58.9 | 0.00 |
| 300 | Eerste DWSRM | 80x80x6# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 341 | **0.0** | | 23.5 | 188.2 | 129.6 | 0.00 | | **29.8** | SPLS 6a_90 Ah Ct1 Ah | 105.8 | 188.2 | 114.6 | 0.28 |
| 301 | Eerste DWSRM | 90x90x8 | S235 | 1M20-8.8t | 1.00 | 1.00 | 1.00 | 169 | **-20.4** | SPLS 6a_90 Ba All Cts | 79.6 | 94.1 | 86.4 | 0.26 | | **0.0** | | 156.7 | 94.1 | 86.4 | 0.00 |
| 302 | Eerste DWSRM | 75x75x6 | S235 | 3M20-8.8t | 1.00 | 1.00 | 1.00 | 316 | **0.0** | | 24.6 | 282.2 | 194.4 | 0.00 | | **46.0** | SPLS 6a_90 Ba Ct2 Ah | 114.0 | 282.2 | 165.4 | 0.40 |
| 303 | Eerste DWSRM | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 186 | **-4.4** | ULS 3_45 | 30.3 | 60.3 | 51.8 | 0.15 | | **0.0** | | 55.3 | 60.3 | 39.2 | 0.00 |
| 304 | Eerste DWSRM | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 335 | **0.0** | | 15.6 | 60.3 | 51.8 | 0.00 | | **7.3** | SPLS 3_74.4 Ba All Cts | 81.2 | 60.3 | 44.8 | 0.16 |
| 305 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 99 | **-1.0** | SPLS 6a_90 Ah All Cts | 49.1 | 60.3 | 43.2 | 0.02 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 306 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.52 | 0.52 | 0.52 | 168 | **-0.8** | SPLS 1a_0_9_0_9_0 Ah | 27.8 | 60.3 | 43.2 | 0.03 | | **5.3** | ULS 3_0_9_45 | 37.4 | 60.3 | 25.7 | 0.20 |
| 307 | Eerste DWSRM | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 200 | **-4.1** | ULS 3_0_9_74.4 | 31.4 | 60.3 | 51.8 | 0.13 | | **0.0** | | 72.6 | 60.3 | 44.8 | 0.00 |
| 308 | Eerste DWSRM | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 113 | **-158.2** | SPLS 6a_90 Ah Ct1 Ba | 213.3 | 406.7 | 311.0 | 0.74 | | **180.7** | SPLS 6a_90 Ah Ct1 Ba | 263.0 | 406.7 | 265.8 | 0.69 |
| 309 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 196 | **-17.0** | SPLS 1a_74.4 Ah All Ct | 22.5 | 60.3 | 43.2 | 0.76 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 310 | Eerste DWSRM | 120x120x8 | S235 | 2M24-8.8t | 0.54 | 0.54 | 0.54 | 101 | **-96.1** | SPLS 6a_90 Ah Ct1 Ba | 234.9 | 271.1 | 207.4 | 0.46 | | **35.6** | SPLS 6a_90 Ah All Cts | 257.1 | 271.1 | 177.2 | 0.20 |
| 311 | Eerste DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.55 | 0.55 | 0.55 | 131 | **-69.5** | SPLS 6a_90 Ah All Cts | 119.7 | 282.2 | 259.2 | 0.58 | | **68.0** | SPLS 6a_90 Ah Ct2 Ba | 162.8 | 282.2 | 223.4 | 0.42 |
| 312 | Eerste DWSRM | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 83 | **0.0** | | 566.5 | 188.2 | 216.0 | 0.00 | | **33.3** | ULS 1a_74.4 | 556.1 | 188.2 | 216.0 | 0.18 |
| 313 | Eerste DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.54 | 0.54 | 0.54 | 116 | **-82.0** | SPLS 6a_90 Ah All Cts | 136.2 | 282.2 | 259.2 | 0.60 | | **83.4** | SPLS 6a_90 Ah All Cts | 162.8 | 282.2 | 223.4 | 0.51 |
| 314 | Eerste DWSRM | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 137 | **0.0** | | 176.5 | 188.2 | 323.4 | 0.00 | | **50.7** | SPLS 6a_90 Ah All Cts | 401.4 | 188.2 | 323.4 | 0.27 |
| 315 | Eerste DWSRM | 65x65x7 | S235 | 2M16-8.8t | 0.52 | 0.52 | 0.52 | 107 | **-44.8** | SPLS 6a_90 Ah All Cts | 103.9 | 120.6 | 121.0 | 0.43 | | **47.0** | SPLS 6a_90 Ah Ct2 Ba | 100.0 | 120.6 | 104.5 | 0.47 |
| 316 | Eerste DWSRM | 75x75x7# | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 126 | **-37.6** | SPLS 6a_90 Ah Ct2 Ba | 103.9 | 188.2 | 151.2 | 0.36 | | **37.5** | SPLS 6a_90 Ah Ct2 Ba | 113.4 | 188.2 | 131.2 | 0.33 |
| 317 | Eerste DWSRM | 65x65x7 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 119 | **-39.2** | SPLS 6a_90 Ah All Cts | 93.5 | 180.9 | 181.4 | 0.42 | | **38.3** | SPLS 6a_90 Ah All Cts | 116.7 | 180.9 | 156.8 | 0.33 |
| 318 | Eerste DWSRM | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 55 | **-2.7** | ULS 1a_45 | 685.6 | 188.2 | 216.0 | 0.01 | | **0.1** | SPLS 1a_0_9_0 Ba Ct2 | 766.1 | 188.2 | 0.0 | 0.00 |
| 319 | Eerste DWSRM | 65x65x6 | S235 | 3M16-8.8t | 0.55 | 0.55 | 0.55 | 109 | **-47.8** | SPLS 6a_90 Ah All Cts | 88.3 | 180.9 | 155.5 | 0.54 | | **49.5** | SPLS 6a_90 Ah All Cts | 101.1 | 180.9 | 134.4 | 0.49 |
| 320 | Eerste DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.56 | 0.56 | 0.56 | 77 | **-71.4** | SPLS 6a_90 Ah All Cts | 186.1 | 282.2 | 259.2 | 0.38 | | **65.2** | SPLS 6a_90 Ah All Cts | 157.3 | 282.2 | 207.1 | 0.41 |
| 321 | Eerste DWSRM | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 62 | **0.0** | | 373.4 | 188.2 | 323.4 | 0.00 | | **74.6** | ULS 3_74.4 | 401.4 | 188.2 | 323.4 | 0.40 |

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

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**78**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 322 | Eerste DWSRM | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 73 | **-32.0** | SPLS 6a_90 Ba Ct1 Ah | 117.6 | 180.9 | 155.5 | 0.27 | | **32.1** | SPLS 6a_90 Ah Ct2 Ba | 101.1 | 180.9 | 134.4 | 0.32 |
| 323 | Eerste DWSRM | 100x100x12 | S235 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 55 | **-18.3** | ULS 3_74.4 | 398.5 | 271.1 | 311.0 | 0.07 | | **0.0** | | 225.6 | 271.1 | 212.7 | 0.00 |
| 400 | Tweede DWSRM | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 302 | **0.0** | | 57.4 | 542.2 | 414.7 | 0.00 | | **161.6** | SPLS 6a_90 Ah All Cts | 343.3 | 542.2 | 354.5 | 0.47 |
| 401 | Tweede DWSRM | 120x120x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 193 | **0.0** | | 113.0 | 542.2 | 414.7 | 0.00 | | **127.6** | ULS 3_90 | 343.3 | 542.2 | 354.5 | 0.37 |
| 402 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 326 | **-10.2** | ULS 5a Ah 12 | 12.9 | 60.3 | 51.8 | 0.79 | | **0.0** | | 55.3 | 60.3 | 39.2 | 0.00 |
| 403 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 82 | **0.0** | | 55.5 | 60.3 | 43.2 | 0.00 | | **2.8** | ULS 5a Ah 12 | 37.4 | 60.3 | 25.7 | 0.11 |
| 404 | Tweede DWSRM | 65x65x6 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 132 | **-10.4** | SPLS 6a_90 Ba All Cts | 73.0 | 120.6 | 103.7 | 0.14 | | **9.6** | SPLS 3_79.6 Ah All Cts | 80.5 | 120.6 | 89.5 | 0.12 |
| 405 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 350 | **0.0** | | 9.2 | 60.3 | 43.2 | 0.00 | | **5.5** | ULS 3_74.4 | 37.4 | 60.3 | 25.7 | 0.22 |
| 406 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 161 | **-13.2** | SPLS 6a_90 Ah All Cts | 29.1 | 60.3 | 51.8 | 0.45 | | **6.2** | SPLS 6a_90 Ah All Cts | 55.3 | 60.3 | 39.2 | 0.16 |
| 407 | Tweede DWSRM | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 87 | **-151.9** | SPLS 6a_90 Ah Ct1 Ba | 265.1 | 406.7 | 311.0 | 0.57 | | **167.9** | SPLS 6a_90 Ah Ct1 Ba | 263.0 | 406.7 | 265.8 | 0.64 |
| 408 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 193 | **-11.9** | ULS 7 | 16.9 | 60.3 | 43.2 | 0.70 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 409 | Tweede DWSRM | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 119 | **-31.5** | SPLS 6a_90 Ah Ct1 Ba | 132.3 | 188.2 | 172.8 | 0.24 | | **17.4** | SPLS 6a_90 Ah All Cts | 138.0 | 188.2 | 152.8 | 0.13 |
| 410 | Tweede DWSRM | 80x80x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 114 | **-22.2** | SPLS 6a_90 Ah Ct2 Ba | 138.2 | 188.2 | 172.8 | 0.16 | | **34.7** | SPLS 6a_90 Ah Ct1 Ba | 167.8 | 188.2 | 157.1 | 0.22 |
| 411 | Tweede DWSRM | 80x80x8 | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 111 | **-37.9** | SPLS 6a_90 Ah Ct1 Ba | 141.6 | 188.2 | 172.8 | 0.27 | | **25.6** | SPLS 6a_90 Ah Ct2 Ba | 174.4 | 188.2 | 157.1 | 0.16 |
| 412 | Tweede DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 105 | **-48.7** | SPLS 6a_90 Ah All Cts | 149.6 | 282.2 | 259.2 | 0.33 | | **51.1** | SPLS 6a_90 Ah Ct2 Ba | 162.8 | 282.2 | 223.4 | 0.31 |
| 413 | Tweede DWSRM | 80x80x8 | S235 | 3M20-8.8t | 0.53 | 0.53 | 0.53 | 101 | **-61.6** | SPLS 6a_90 Ah Ct2 Ba | 154.7 | 282.2 | 259.2 | 0.40 | | **56.7** | SPLS 6a_90 Ah All Cts | 162.8 | 282.2 | 223.4 | 0.35 |
| 414 | Tweede DWSRM | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 104 | **-0.3** | SPLS 1a_0,9_45 Ba All | 242.4 | 188.2 | 323.4 | 0.00 | | **63.2** | ULS 3_74.4 | 401.4 | 188.2 | 323.4 | 0.34 |
| 415 | Tweede DWSRM | 65x65x6 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 93 | **-25.1** | SPLS 6a_90 Ah All Cts | 100.7 | 180.9 | 155.5 | 0.25 | | **25.2** | SPLS 6a_90 Ah All Cts | 101.1 | 180.9 | 134.4 | 0.25 |
| 430 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.55 | 0.55 | 0.55 | 166 | **-12.6** | SPLS 6a_90 Ah All Cts | 35.1 | 60.3 | 51.8 | 0.36 | | **11.2** | SPLS 6a_90 Ba All Cts | 55.3 | 60.3 | 39.2 | 0.29 |
| 431 | Tweede DWSRM | 65x65x6 | S235 | 2M16-8.8t | 0.51 | 0.51 | 0.51 | 114 | **-11.8** | SPLS 3_0,9_79.6 Ah Al | 84.6 | 120.6 | 103.7 | 0.14 | | **19.6** | SPLS 6a_90 Ba All Cts | 86.7 | 120.6 | 89.6 | 0.23 |
| 432 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 177 | **-24.9** | SPLS 6a_90 Ba All Cts | 32.2 | 60.3 | 51.8 | 0.77 | | **21.0** | SPLS 6a_90 Ba All Cts | 55.3 | 60.3 | 39.2 | 0.54 |
| 433 | Tweede DWSRM | 55x55x6 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 164 | **-24.8** | SPLS 6a_90 Ba All Cts | 35.7 | 60.3 | 51.8 | 0.70 | | **27.4** | SPLS 6a_90 Ba All Cts | 55.3 | 60.3 | 39.2 | 0.70 |
| 434 | Tweede DWSRM | 55x55x6 | **S355** | 1M16-8.8t | 0.54 | 0.54 | 0.54 | 173 | **-35.0** | SPLS 6a_90 Ba All Cts | 37.7 | 60.3 | 70.6 | 0.93 | | **32.0** | SPLS 6a_90 Ba All Cts | 75.3 | 60.3 | 53.4 | 0.60 |
| 435 | Tweede DWSRM | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 173 | **-3.4** | ULS 3_74.4 | 41.7 | 60.3 | 51.8 | 0.08 | | **0.0** | | 81.2 | 60.3 | 44.8 | 0.00 |
| 436 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 145 | **-15.7** | SPLS 6a_90 Ba All Cts | 33.2 | 60.3 | 43.2 | 0.47 | | **15.7** | SPLS 6a_90 Ba All Cts | 37.4 | 60.3 | 25.7 | 0.61 |
| 437 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 143 | **-20.0** | SPLS 6a_90 Ba All Cts | 33.9 | 60.3 | 43.2 | 0.59 | | **19.9** | SPLS 6a_90 Ba All Cts | 37.4 | 60.3 | 25.7 | 0.77 |
| 438 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-16.3** | SPLS 6a_90 Ba All Cts | 37.4 | 60.3 | 43.2 | 0.43 | | **16.8** | SPLS 6a_90 Ba All Cts | 37.4 | 60.3 | 25.7 | 0.65 |
| 439 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 107 | **-10.8** | SPLS 6a_90 Ba Ct1 Ah | 46.0 | 60.3 | 43.2 | 0.25 | | **10.7** | SPLS 6a_90 Ba Ct1 Ah | 37.4 | 60.3 | 25.7 | 0.42 |
| 440 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 97 | **-13.9** | SPLS 6a_90 Ba All Cts | 49.8 | 60.3 | 43.2 | 0.32 | | **13.6** | SPLS 6a_90 Ba All Cts | 37.4 | 60.3 | 25.7 | 0.53 |
| 441 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 88 | **-14.8** | SPLS 6a_90 Ba All Cts | 53.6 | 60.3 | 43.2 | 0.34 | | **15.1** | SPLS 6a_90 Ba All Cts | 37.4 | 60.3 | 25.7 | 0.59 |
| 442 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 77 | **-16.9** | SPLS 6a_90 Ba All Cts | 56.7 | 60.3 | 43.2 | 0.39 | | **16.0** | SPLS 6a_90 Ba Ct2 Ah | 37.4 | 60.3 | 25.7 | 0.62 |
| 443 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 73 | **-18.6** | SPLS 6a_90 Ba All Cts | 58.0 | 60.3 | 43.2 | 0.43 | | **20.0** | SPLS 6a_90 Ba All Cts | 37.4 | 60.3 | 25.7 | 0.78 |
| 444 | Tweede DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 128 | **-2.5** | SPLS 1a_74.4 Ah All Ct | 38.4 | 60.3 | 43.2 | 0.06 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 |
| 445 | Tweede DWSRM | 160x65x7.5(UN | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 47 | **0.0** | | 443.0 | 188.2 | 162.0 | 0.00 | | **39.5** | ULS 3_0,9_74.4 | 547.9 | 188.2 | 130.9 | 0.30 |

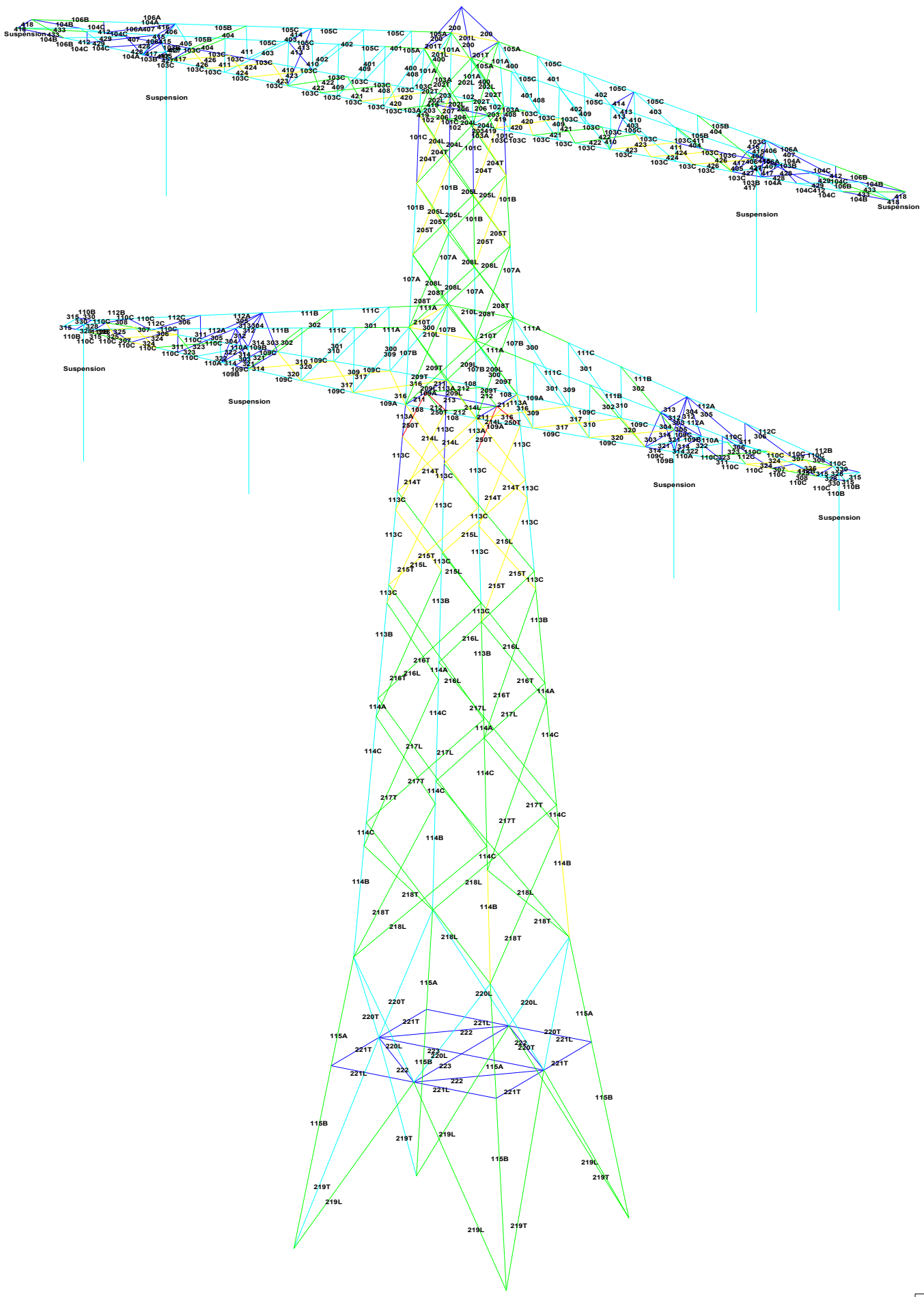
## Assessment of groups for strengthened mast (verbouw level)

| | |
|---|---|
| Date | 21-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HB+0**
**78**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 434 | Tweede DWSRM | 55x55x6 | **S355** | 1M16-8.8t | 0,54 | 0,54 | 0,54 | 173 | **-36,7** | SPLS 6a_90 Ba All Cts | 37,7 | 60,3 | 70,6 | 0,97 | | **33,4** | SPLS 6a_90 Ba All Cts | 75,3 | 60,3 | 53,4 | 0,63 |

DNV GL Nederlands BV, Project: "D1.3 2 Circuit HS+0 - dnv gl-ini"
Tower Version 16.86, 11:58:14 Wednesday, 26 May, 2021
Undeformed geometry displayed



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

| | |
|---|---|
| Date | 26-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HS+0**
**26**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 200 | BVNSTK - Top cap | 90x90x6# | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 115 | -13.0 | ULS 5a Ba 22 | 118.0 | 120.6 | 103.7 | 0.13 | | 12.6 | ULS 5a Ba 22 | 127.9 | 120.6 | 103.7 | 0.12 | |
| 201L | BVNSTK - First horiz front | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 114 | 0.0 | | 156.7 | 406.7 | 311.0 | 0.00 | | 141.4 | ULS 3_0 | 185.9 | 406.7 | 264.8 | 0.76 | |
| 201T | BVNSTK - First horiz side | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 189 | 0.0 | | 26.3 | 60.3 | 86.4 | 0.00 | | 5.2 | ULS 5a Ah 12 | 92.2 | 60.3 | 0.0 | 0.09 | |
| 202L | BVNSTK - First CD front | 60x60x5 | S235 | 1M16-8.8t | 0.51 | 0.51 | 0.51 | 144 | -21.0 | ULS 5a Ah 22 | 40.5 | 60.3 | 43.2 | 0.52 | | 14.8 | ULS 5a Ah 22 | 60.5 | 60.3 | 0.0 | 0.34 | |
| 202T | BVNSTK - First CD side | 55x55x5 | S235 | 1M16-8.8t | 0.51 | 1.00 | 0.51 | 199 | -13.3 | ULS 6a_90 Ba Ct2 | 19.8 | 60.3 | 86.4 | 0.67 | | 0.2 | ULS 5a Ah 12 | 92.2 | 60.3 | 0.0 | 0.00 | |
| 101A | BVNSTK - Main member | 90x90x6# | S355 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 141 | -39.6 | ULS 5a Ah 22 | 92.9 | 813.3 | 635.0 | 0.43 | | 8.5 | ULS 5a Ah 22 | 263.9 | 813.3 | 0.0 | 0.03 | |
| 101C | BVNSTK - Main member | 90x90x6# | S355 | | 0.50 | 0.50 | 0.50 | 76 | -55.6 | ULS 1a_135 | 236.9 | 0.0 | 0.0 | 0.23 | | 27.7 | ULS 5a Ah 12 | 376.3 | 0.0 | 0.0 | 0.07 | |
| 101B | BVNSTK - Main member | 90x90x6# | S355 | 4M24-8.8t | 0.50 | 0.50 | 0.50 | 77 | -126.6 | ULS 1a_135 | 232.6 | 542.2 | 423.4 | 0.54 | | 73.0 | ULS 1a_0,9_0,9_135 | 263.9 | 542.2 | 0.0 | 0.28 | |
| 102 | BVNSTK - Cross profile | 120x120x10 | S355 | 7M24-8.8t | 1.00 | 2.00 | 1.00 | 62 | -308.9 | ULS 8 Ah | 509.0 | 877.7 | 1234.8 | 0.61 | | 86.6 | ULS 8 Ah | 540.4 | 877.7 | 1234.8 | 0.16 | |
| 203 | BVNSTK - Second horiz side | 75x75x6 | S355 | 3M20-8.8t | 1.00 | 1.00 | 1.00 | 99 | -46.3 | ULS 5a Ah 22 | 130.5 | 282.2 | 264.6 | 0.35 | | 71.3 | ULS 5a Ba 12 | 213.8 | 282.2 | 0.0 | 0.33 | |
| 204L | BVNSTK - Second CD front | 100x100x8 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 93 | -109.3 | ULS 5a Ba 12 | 207.3 | 406.7 | 311.0 | 0.53 | | 115.0 | ULS 5a Ah 22 | 211.1 | 406.7 | 270.6 | 0.54 | |
| 204T | BVNSTK - Second CD side | 100x100x6 | S235 | 3M20-8.8t | 0.51 | 0.51 | 0.51 | 93 | -125.1 | ULS 5a Ba 22 | 156.7 | 282.2 | 194.4 | 0.80 | | 110.7 | ULS 5a Ah 22 | 161.9 | 282.2 | 176.2 | 0.68 | |
| 205L | BVNSTK - Third CD front | 100x100x6 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 97 | -105.2 | ULS 5a Ah 22 | 151.5 | 406.7 | 233.3 | 0.69 | | 97.3 | ULS 5a Ba 12 | 161.1 | 406.7 | 202.9 | 0.60 | |
| 205T | BVNSTK - Third CD side | 100x100x6 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 97 | -100.1 | ULS 5a Ah 22 | 151.5 | 406.7 | 233.3 | 0.66 | | 112.2 | ULS 5a Ba 12 | 147.5 | 406.7 | 174.4 | 0.76 | |
| 206 | BVNSTK - Diaphragm diagonal | 75x75x6 | S355 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 109 | -69.0 | ULS 5a Ah 22 | 124.5 | 188.2 | 176.4 | 0.55 | | 67.0 | ULS 5a Ba 12 | 131.5 | 188.2 | 166.4 | 0.51 | |
| 207 | BVNSTK - Diaphragm horiz | 55x55x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 214 | -0.3 | ULS 3_0,9_0 | 24.3 | 60.3 | 117.6 | 0.01 | | 2.8 | ULS 5a Ah 12 | 125.4 | 60.3 | 0.0 | 0.05 | |
| 419 | Tweede DWSRM - Diag under | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 147 | -13.0 | ULS 5a Ba 12 | 32.9 | 60.3 | 43.2 | 0.40 | | 20.0 | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.54 | |
| 420 | Tweede DWSRM - CD under 1 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 147 | -25.3 | ULS 5a Ah 12 | 32.9 | 60.3 | 43.2 | 0.77 | | 19.3 | ULS 5a Ba 12 | 37.4 | 60.3 | 0.0 | 0.52 | |
| 421 | Tweede DWSRM - CD under 2 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 147 | -21.8 | ULS 5a Ba 12 | 32.8 | 60.3 | 43.2 | 0.66 | | 25.8 | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.69 | |
| 422 | Tweede DWSRM - CD under 3 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 131 | -25.5 | ULS 5a Ah 12 | 37.2 | 60.3 | 43.2 | 0.68 | | 23.1 | ULS 5a Ba 12 | 37.4 | 60.3 | 0.0 | 0.62 | |
| 423 | Tweede DWSRM - CD under 4 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 136 | -27.9 | ULS 5a Ba 12 | 35.9 | 60.3 | 43.2 | 0.78 | | 28.1 | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.75 | |
| 424 | Tweede DWSRM - CD under 5 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 133 | -31.5 | ULS 5a Ah 22 | 36.7 | 60.3 | 43.2 | 0.86 | | 32.0 | ULS 5a Ba 12 | 37.4 | 60.3 | 0.0 | 0.85 | |
| 426 | Tweede DWSRM - CD under 7 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 123 | -33.9 | ULS 5a Ba 12 | 40.0 | 60.3 | 43.2 | 0.85 | | 32.4 | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.86 | |
| 427 | Tweede DWSRM - CD under 8 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 104 | -14.4 | ULS 5a Ah 12 | 47.0 | 60.3 | 43.2 | 0.33 | | 10.2 | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.27 | |
| 428 | Tweede DWSRM - CD under 9 | 50x50x5 | S355 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 111 | -12.7 | ULS 8 Ah | 53.7 | 60.3 | 58.8 | 0.24 | | 10.7 | ULS 8 Ah | 51.0 | 60.3 | 0.0 | 0.21 | |
| 429 | Tweede DWSRM - CD under 10 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 125 | -14.9 | ULS 8 Ah | 39.4 | 60.3 | 43.2 | 0.38 | | 17.2 | ULS 8 Ah | 37.4 | 60.3 | 0.0 | 0.46 | |
| 433 | Tweede DWSRM - CD under 14 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 125 | -21.2 | ULS 8 Ah | 39.2 | 60.3 | 43.2 | 0.54 | | 18.0 | ULS 8 Ah | 37.4 | 60.3 | 0.0 | 0.48 | |
| 400 | Tweede DWSRM - Front diag 1 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 312 | 0.0 | | 11.1 | 60.3 | 43.2 | 0.00 | | 12.9 | ULS 3_0 | 37.4 | 60.3 | 0.0 | 0.34 | |
| 401 | Tweede DWSRM - Front diag 2 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 313 | 0.0 | | 11.1 | 60.3 | 43.2 | 0.00 | | 15.3 | ULS 3_0 | 37.4 | 60.3 | 0.0 | 0.41 | |
| 402 | Tweede DWSRM - Front diag 3 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 303 | 0.0 | | 11.6 | 60.3 | 43.2 | 0.00 | | 18.0 | ULS 3_0 | 37.4 | 60.3 | 0.0 | 0.48 | |
| 403 | Tweede DWSRM - Front diag 4 | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 330 | 0.0 | | 12.7 | 120.6 | 86.4 | 0.00 | | 26.2 | ULS 3_0 | 52.4 | 120.6 | 70.4 | 0.50 | |
| 404 | Tweede DWSRM - Front diag 5 | 55x55x5 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 253 | 0.0 | | 21.5 | 180.9 | 259.2 | 0.00 | | 36.3 | ULS 3_0 | 55.2 | 180.9 | 219.8 | 0.66 | |
| 405 | Tweede DWSRM - Front diag 6 | 55x55x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 99 | -19.4 | ULS 8 Ah | 67.6 | 120.6 | 172.8 | 0.29 | | 4.7 | ULS 5a Ah 12 | 47.3 | 120.6 | 145.2 | 0.10 | |
| 406 | Tweede DWSRM - Front diag 7 | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 109 | -7.5 | ULS 5a Ah 12 | 56.5 | 120.6 | 86.4 | 0.13 | | 20.7 | ULS 8 Ah | 52.4 | 120.6 | 70.4 | 0.39 | |
| 407 | Tweede DWSRM - Front diag 8 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 322 | 0.0 | | 10.6 | 60.3 | 43.2 | 0.00 | | 6.8 | ULS 8 Ah | 37.4 | 60.3 | 0.0 | 0.18 | |
| 408 | Tweede DWSRM - Front vert 1 | 60x60x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 195 | -10.5 | ULS 3_0 | 27.3 | 60.3 | 43.2 | 0.38 | | 0.0 | | 60.5 | 60.3 | 0.0 | 0.00 | |
| 409 | Tweede DWSRM - Front vert 2 | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 189 | -10.8 | ULS 3_0 | 26.3 | 60.3 | 86.4 | 0.41 | | 0.0 | | 92.2 | 60.3 | 0.0 | 0.00 | |
| 410 | Tweede DWSRM - Front vert 3 | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 159 | -11.4 | ULS 3_0 | 32.9 | 60.3 | 86.4 | 0.35 | | 0.0 | | 92.2 | 60.3 | 0.0 | 0.00 | |
| 411 | Tweede DWSRM - Front vert 4 | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 133 | -13.4 | ULS 3_0 | 43.3 | 60.3 | 58.8 | 0.31 | | 0.0 | | 51.0 | 60.3 | 0.0 | 0.00 | |
| 412 | Tweede DWSRM - Front vert 5 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 45 | -0.7 | ULS 3_90 | 65.7 | 60.3 | 43.2 | 0.02 | | 0.0 | | 37.4 | 60.3 | 0.0 | 0.00 | |
| 413 | Tweede DWSRM - Doorsnede A-A CD | 50x50x5 | S355 | 1M16-8.8t | 0.52 | 0.52 | 0.52 | 131 | -1.4 | ULS 1a_0,9_0 | 44.1 | 60.3 | 58.8 | 0.03 | | 1.5 | ULS 1a_0,9_0,9_0 | 51.0 | 60.3 | 0.0 | 0.03 | |
| 414 | Tweede DWSRM - Doorsnede A-A horiz | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 174 | -0.5 | ULS 5a Ah 12 | 30.1 | 60.3 | 58.8 | 0.02 | | 0.2 | ULS 1a_0,9_90 | 51.0 | 60.3 | 0.0 | 0.00 | |
| 415 | Tweede DWSRM - Doorsende B-B CD | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 91 | 0.0 | | 52.4 | 60.3 | 43.2 | 0.00 | | 2.7 | ULS 1a_0 | 37.4 | 60.3 | 0.0 | 0.07 | |
| 416 | Tweede DWSRM - Doorsnede B-B horiz | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 142 | -2.0 | ULS 3_0 | 39.7 | 60.3 | 58.8 | 0.05 | | 0.0 | | 51.0 | 60.3 | 0.0 | 0.00 | |
| 417 | Tweede DWSRM - Conductor horiz | HEB160 | S355 | | 2.00 | 2.00 | 2.00 | 36 | -25.3 | ULS 5a Ah 12 | 1339.8 | 0.0 | 0.0 | 0.02 | | 7.4 | ULS 1a_90 | 1714.6 | 271.1 | 0.0 | 0.03 | |
| 418 | Tweede DWSRM - Conductor horiz | 110x110x10 | S355 | 2M16-8.8t | 2.00 | 2.00 | 2.00 | 49 | -9.7 | ULS 8 Ah | 544.1 | 120.6 | 235.2 | 0.08 | | 11.2 | ULS 8 Ah | 471.2 | 120.6 | 0.0 | 0.09 | |
| 103A | Tweede DWSRM - Main member bottom | 120x120x10 | S355 | 7M24-8.8t | 1.72 | 1.00 | 1.00 | 42 | -320.7 | ULS 8 Ah | 730.5 | 877.7 | 1234.8 | 0.44 | | 159.3 | ULS 5a Ah 22 | 540.4 | 877.7 | 1234.8 | 0.29 | |
| 103B | Tweede DWSRM - Main member bottom | 120x120x10 | S355 | 4M24-8.8t | 2.00 | 2.00 | 2.00 | 51 | -94.9 | ULS 8 Ah | 690.2 | 542.2 | 705.6 | 0.18 | | 37.7 | ULS 8 Ah | 635.0 | 542.2 | 0.0 | 0.07 | |
| 103C | Tweede DWSRM - Main member bottom | 120x120x10 | S355 | | 2.09 | 1.68 | 1.00 | 54 | -298.7 | ULS 8 Ah | 672.0 | 0.0 | 0.0 | 0.44 | | 144.1 | ULS 5a Ah 22 | 823.6 | 0.0 | 0.0 | 0.17 | |
| 104A | Tweede DWSRM - Main member bottom | 100x100x6 | S355 | 4M24-8.8t | 1.60 | 1.00 | 1.00 | 78 | -82.4 | ULS 8 Ah | 243.3 | 542.2 | 423.4 | 0.34 | | 34.3 | ULS 8 Ah | 306.2 | 542.2 | 0.0 | 0.11 | |
| 104B | Tweede DWSRM - Main member bottom | 100x100x6 | S355 | | 1.50 | 1.00 | 1.00 | 102 | -42.6 | ULS 3_90 | 182.8 | 0.0 | 0.0 | 0.23 | | 0.0 | | 418.9 | 0.0 | 0.0 | 0.00 | |
| 104C | Tweede DWSRM - Main member bottom | 100x100x6 | S355 | | 3.00 | 1.90 | 1.00 | 98 | -58.1 | ULS 8 Ah | 192.7 | 0.0 | 0.0 | 0.30 | | 17.3 | ULS 8 Ah | 418.9 | 0.0 | 0.0 | 0.04 | |
| 105A | Tweede DWSRM - Main member top 1 | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 3.48 | 1.00 | 215 | 0.0 | | 68.3 | 406.7 | 311.0 | 0.00 | | 135.4 | ULS 3_0 | 185.9 | 406.7 | 264.8 | 0.73 | |
| 105B | Tweede DWSRM - Main member top 1 | 90x90x8 | S235 | 4M16-8.8t | 1.00 | 1.93 | 1.00 | 209 | 0.0 | | 71.0 | 241.2 | 276.5 | 0.00 | | 61.2 | ULS 3_0 | 285.6 | 241.2 | 0.0 | 0.25 | |
| 105C | Tweede DWSRM - Main member top 1 | 90x90x8 | S235 | | 1.00 | 2.08 | 1.00 | 209 | 0.0 | | 71.0 | 0.0 | 0.0 | 0.00 | | 125.7 | ULS 3_0 | 326.7 | 0.0 | 0.0 | 0.38 | |
| 106A | Tweede DWSRM - Main member top 2 | 60x60x5 | S235 | 4M16-8.8t | 2.00 | 1.00 | 1.00 | 333 | 0.0 | | 14.6 | 241.2 | 172.8 | 0.00 | | 43.2 | ULS 3_0 | 103.7 | 241.2 | 0.0 | 0.42 | |
| 106B | Tweede DWSRM - Main member top 2 | 60x60x5 | S235 | 3M16-8.8t | 1.00 | 2.00 | 1.00 | 333 | 0.0 | | 14.6 | 180.9 | 129.6 | 0.00 | | 43.2 | ULS 3_0 | 76.8 | 180.9 | 113.5 | 0.56 | |
| 107A | Derde TSNSTK - Main member | 100x100x10 | S355 | 4M24-8.8t | 0.50 | 0.50 | 0.50 | 72 | -175.1 | ULS 1a_135 | 471.3 | 542.2 | 705.6 | 0.37 | | 129.1 | ULS 1a_0,9_0,9_135 | 493.9 | 542.2 | 0.0 | 0.26 | |
| 107B | Derde TSNSTK - Main member | 100x100x10 | S355 | 7M24-8.8t | 0.50 | 0.50 | 0.50 | 77 | -213.6 | ULS 1a_135 | 447.2 | 948.9 | 1234.8 | 0.48 | | 124.2 | ULS 1a_0,9_0,9_135 | 493.9 | 948.9 | 0.0 | 0.25 | |
| 208L | Derde TSNSTK - First CD front | 100x100x6 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 101 | -86.9 | ULS 5a Ba 12 | 146.1 | 406.7 | 233.3 | 0.59 | | 93.9 | ULS 5a Ah 22 | 161.1 | 406.7 | 198.9 | 0.58 | |
| 208T | Derde TSNSTK - First CD side | 100x100x6 | S235 | 2M24-8.8t | 0.51 | 0.51 | 0.51 | 101 | -101.3 | ULS 5a Ba 12 | 146.1 | 271.1 | 155.5 | 0.69 | | 90.1 | ULS 5a Ah 22 | 138.4 | 271.1 | 137.8 | 0.65 | |
| 209L | Derde TSNSTK - Second CD front | 100x100x8 | S235 | 2M24-8.8t | 0.51 | 0.51 | 0.51 | 109 | -96.5 | ULS 5a Ba 12 | 182.3 | 271.1 | 207.4 | 0.53 | | 90.3 | ULS 5a Ah 22 | 181.4 | 271.1 | 183.7 | 0.50 | |
| 209T | Derde TSNSTK - Second CD side | 100x100x8 | S235 | 3M20-8.8t | 0.51 | 0.51 | 0.51 | 109 | -99.0 | ULS 5a Ba 22 | 182.3 | 282.2 | 259.2 | 0.54 | | 81.9 | ULS 5a Ah 12 | 212.2 | 282.2 | 234.9 | 0.39 | |
| 210L | Derde TSNSTK - First horiz front | 100x100x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 143 | 0.0 | | 136.5 | 542.2 | 414.7 | 0.00 | | 158.8 | ULS 8 Ah | 211.1 | 542.2 | 357.4 | 0.75 | |
| 210T | Derde TSNSTK - First horiz side | 60x60x6 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 240 | -24.2 | ULS 1a_0,9_90 | 26.5 | 60.3 | 70.6 | 0.91 | | 35.2 | ULS 1a_90 | 98.8 | 60.3 | 0.0 | 0.58 | |
| 108 | Derde TSNSTK - Cross profile ondertrave | 150x150x12 | S355 | 7M24-8.8t | 1.00 | 2.00 | 1.00 | 65 | -253.9 | ULS 5a Ba 21 | 739.5 | 848.0 | 1481.8 | 0.34 | | 56.3 | ULS 5a Ah 10 | 869.3 | 848.0 | 1481.8 | 0.07 | |
| 211 | Derde TSNSTK - Second horiz side | 80x80x8 | S355 | 5M24-8.8t | 1.00 | 1.00 | 1.00 | 96 | -43.4 | ULS 5a Ah 12 | 201.6 | 677.8 | 705.6 | 0.22 | | 67.3 | ULS 5a Ba 22 | 287.2 | 677.8 | 0.0 | 0.23 | |
| 212 | Derde TSNSTK - Diaphragm diagonal | 90x90x6# | S355 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 119 | -73.2 | ULS 5a Ah 21 | 135.5 | 271.1 | 211.7 | 0.54 | | 73.8 | ULS 5a Ah 21 | 166.3 | 271.1 | 197.5 | 0.44 | |
| 213 | Derde TSNSTK - Diaphragm horiz | 60x60x6 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 256 | -0.7 | ULS 3_90 | 23.7 | 60.3 | 70.6 | 0.03 | | 0.0 | | 98.8 | 60.3 | 0.0 | 0.00 | |
| 316 | Eerste DWSRM - CD under 1 | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 183 | -23.5 | ULS 5a Ba 11 | 27.4 | 60.3 | 86.4 | 0.86 | | 21.3 | ULS 5a Ah 20 | 92.2 | 60.3 | 0.0 | 0.35 | |
| 317 | Eerste DWSRM - CD under 2 | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 172 | -25.7 | ULS 5a Ah 20 | 29.8 | 60.3 | 86.4 | 0.86 | | 28.7 | ULS 5a Ba 11 | 92.2 | 60.3 | 0.0 | 0.48 | |
| 320 | Eerste DWSRM - CD under 5 | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 161 | -34.1 | ULS 5a Ba 11 | 36.5 | 60.3 | 86.4 | 0.93 | | 29.6 | ULS 5a Ah 20 | 92.2 | 60.3 | 0.0 | 0.49 | |
| 321 | Eerste DWSRM - CD under 6 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 129 | -13.2 | ULS 5a Ba 10 | 38.0 | 60.3 | 43.2 | 0.35 | | 9.4 | ULS 5a Ah 10 | 46.1 | 60.3 | 0.0 | 0.22 | |
| 322 | Eerste DWSRM - CD under 7 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 120 | -17.2 | ULS 5a Ah 10 | 40.9 | 60.3 | 43.2 | 0.42 | | 17.7 | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.47 | |
| 323 | Eerste DWSRM - CD under 8 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 133 | -25.0 | ULS 5a Ba 10 | 36.7 | 60.3 | 43.2 | 0.68 | | 23.6 | ULS 5a Ah 10 | 37.4 | 60.3 | 0.0 | 0.63 | |
| 324 | Eerste DWSRM - CD under 9 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 125 | -29.7 | ULS 5a Ah 10 | 39.4 | 60.3 | 43.2 | 0.75 | | 31.0 | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.83 | |
| 325 | Eerste DWSRM - CD under 10 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 94 | -28.3 | ULS 5a Ah 10 | 51.1 | 60.3 | 43.2 | 0.66 | | 30.0 | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.80 | |
| 328 | Eerste DWSRM - CD under 13 | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 89 | -20.9 | ULS 5a Ba 10 | 53.1 | 60.3 | 43.2 | 0.48 | | 13.2 | ULS 5a Ah 10 | 37.4 | 60.3 | 0.0 | 0.35 | |
| 314 | Eerste DWSRM - Conductor horiz | HEB160 | S355 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 50 | -25.3 | ULS 5a Ah 11 | 1307.5 | 271.1 | 282.2 | 0.09 | | 25.2 | ULS 5a Ba 20 | 1714.6 | 271.1 | 0.0 | 0.09 | |
| 315 | Eerste DWSRM - Conductor horiz | HEB160 | S355 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 26 | -70.6 | ULS 3_90 | 1520.0 | 271.1 | 282.2 | 0.26 | | 0.0 | | 1714.6 | 271.1 | 0.0 | 0.00 | |
| 330 | | HEB160 | S355 | | 2.00 | 2.00 | 2.00 | 28 | 0.0 | | 1402.4 | 0.0 | 0.0 | 0.00 | | 146.5 | ULS 3_90 | 1927.7 | 0.0 | 0.0 | 0.08 | |
| 300 | Eerste DWSRM - Front diag 1 | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 362 | 0.0 | | 9.6 | 60.3 | 86.4 | 0.00 | | 17.0 | ULS 3_90 | 92.2 | 60.3 | 0.0 | 0.28 | |
| 301 | Eerste DWSRM - Front diag 2 | 55x55x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 321 | 0.0 | | 14.7 | 120.6 | 172.8 | 0.00 | | 21.7 | ULS 3_135 | 47.3 | 120.6 | 145.2 | 0.46 | |
| 302 | Eerste DWSRM - Front diag 3 | 55x55x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 290 | 0.0 | | 17.3 | 120.6 | 172.8 | 0.00 | | 29.2 | ULS 3_0 | 47.3 | 120.6 | 145.2 | 0.62 | |

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

| | |
|---|---|
| Date | 26-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HS+0**
**26**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 303 | Eerste DWSRM - Front diag 4 | 60x60x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 133 | **-11.7** | ULS 5a Ah 12 | 55.3 | 120.6 | 86.4 | 0.21 | | **0.0** | | 70.6 | 120.6 | 79.6 | 0.00 | |
| 304 | Eerste DWSRM - Front diag 5 | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 161 | **0.0** | | 36.7 | 120.6 | 86.4 | 0.00 | | **10.3** | ULS 5a Ah 22 | 56.2 | 120.6 | 68.4 | 0.18 | |
| 305 | Eerste DWSRM - Front diag 6 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 301 | **0.0** | | 11.8 | 60.3 | 43.2 | 0.00 | | **5.5** | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.15 | |
| 306 | Eerste DWSRM - Front diag 7 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 229 | **0.0** | | 18.0 | 60.3 | 43.2 | 0.00 | | **6.2** | ULS 5a Ah 21 | 37.4 | 60.3 | 0.0 | 0.16 | |
| 307 | Eerste DWSRM - Front diag 8 | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 100 | **-5.3** | ULS 3_135 | 60.5 | 120.6 | 86.4 | 0.09 | | **0.0** | | 48.7 | 120.6 | 67.0 | 0.00 | |
| 308 | Eerste DWSRM - Front diag 9 | 65x65x7 | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 77 | **0.0** | | 131.8 | 188.2 | 151.2 | 0.00 | | **16.3** | ULS 3_135 | 82.5 | 188.2 | 111.9 | 0.20 | |
| 309 | Eerste DWSRM - Front vert 1 | 70x70x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 183 | **-13.5** | ULS 3_135 | 41.7 | 60.3 | 51.8 | 0.32 | | **0.0** | | 89.9 | 60.3 | 0.0 | 0.00 | |
| 310 | Eerste DWSRM - Front vert 2 | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 166 | **-15.5** | ULS 3_0 | 44.3 | 60.3 | 51.8 | 0.35 | | **0.0** | | 81.2 | 60.3 | 0.0 | 0.00 | |
| 311 | Eerste DWSRM - Front vert 3 | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 95 | **-1.9** | ULS 5a Ah 21 | 50.7 | 60.3 | 43.2 | 0.04 | | **0.0** | | 37.4 | 60.3 | 0.0 | 0.00 | |
| 312 | Eerste DWSRM - Doorsnede A-A CD | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 128 | **0.0** | ULS 1a_0_9_0_9_0 | 38.2 | 60.3 | 43.2 | 0.00 | | **3.4** | ULS 1a_0 | 37.4 | 60.3 | 0.0 | 0.09 | |
| 313 | Eerste DWSRM - Doorsnede A-A horiz | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 199 | **-2.1** | ULS 3_90 | 24.6 | 60.3 | 58.8 | 0.08 | | **0.0** | | 51.0 | 60.3 | 0.0 | 0.00 | |
| 109A | Eerste DWSRM - Main member 1 bottom | 150x150x12 | S355 | 7M24-8.8t | 1.00 | 1.00 | 1.00 | 78 | **-308.7** | ULS 5a Ba 10 | 798.9 | 848.0 | 1481.8 | 0.39 | | **123.4** | ULS 5a Ah 21 | 869.3 | 848.0 | 1481.8 | 0.15 | |
| 109B | Eerste DWSRM - Main member 1 bottom | 150x150x12 | S355 | 6M24-8.8t | 2.00 | 2.00 | 2.00 | 41 | **-205.6** | ULS 5a Ba 10 | 1103.1 | 813.3 | 1270.1 | 0.25 | | **97.0** | ULS 5a Ah 21 | 1007.6 | 813.3 | 0.0 | 0.12 | |
| 109C | Eerste DWSRM - Main member 1 bottom | 150x150x12 | S355 | | 1.00 | 1.00 | 1.00 | 78 | **-284.3** | ULS 5a Ba 10 | 798.9 | 0.0 | 0.0 | 0.36 | | **112.2** | ULS 5a Ah 21 | 1235.4 | 0.0 | 0.0 | 0.09 | |
| 110A | Eerste DWSRM - Main member 2 bottom | 100x100x10 | S355 | 6M24-8.8t | 1.68 | 1.00 | 1.00 | 64 | **-188.5** | ULS 5a Ba 10 | 514.0 | 813.3 | 1058.4 | 0.37 | | **83.1** | ULS 5a Ah 21 | 493.9 | 813.3 | 0.0 | 0.17 | |
| 110B | Eerste DWSRM - Main member 2 bottom | 100x100x10 | S355 | | 1.00 | 2.06 | 1.00 | 39 | **-5.6** | ULS 5a Ah 21 | 615.7 | 0.0 | 0.0 | 0.01 | | **6.2** | ULS 5a Ba 10 | 681.6 | 0.0 | 0.0 | 0.01 | |
| 110C | Eerste DWSRM - Main member 2 bottom | 100x100x10 | S355 | | 4.23 | 1.66 | 1.00 | 147 | **-117.2** | ULS 5a Ba 10 | 154.5 | 0.0 | 0.0 | 0.76 | | **62.0** | ULS 5a Ah 21 | 681.6 | 0.0 | 0.0 | 0.09 | |
| 111A | Eerste DWSRM - Main member 1 top | 100x100x8 | S235 | 4M24-8.8t | 1.00 | 3.17 | 1.00 | 254 | **0.0** | | 59.6 | 542.2 | 414.7 | 0.00 | | **142.5** | ULS 3_135 | 211.1 | 542.2 | 357.4 | 0.68 | |
| 111B | Eerste DWSRM - Main member 1 top | 100x100x8 | S235 | 4M24-8.8t | 1.00 | 2.62 | 1.00 | 254 | **0.0** | | 59.7 | 542.2 | 414.7 | 0.00 | | **107.2** | ULS 8 Ah | 293.9 | 542.2 | 0.0 | 0.36 | |
| 111C | Eerste DWSRM - Main member 1 top | 100x100x8 | S235 | | 1.00 | 3.07 | 1.00 | 236 | **0.0** | | 66.5 | 0.0 | 0.0 | 0.00 | | **128.5** | ULS 3_0 | 364.3 | 0.0 | 0.0 | 0.35 | |
| 112A | Eerste DWSRM - Main member 2 top | 80x80x8 | S235 | 4M24-8.8t | 1.00 | 2.76 | 1.00 | 295 | **0.0** | | 37.7 | 542.2 | 414.7 | 0.00 | | **95.2** | ULS 3_0 | 211.0 | 542.2 | 0.0 | 0.45 | |
| 112B | Eerste DWSRM - Main member 2 top | 80x80x8 | S235 | 3M24-8.8t | 1.00 | 4.59 | 1.00 | 295 | **0.0** | | 37.7 | 406.7 | 311.0 | 0.00 | | **73.1** | ULS 8 Ah | 147.2 | 406.7 | 226.5 | 0.50 | |
| 112C | Eerste DWSRM - Main member 2 top | 80x80x8 | S235 | | 1.00 | 2.38 | 1.00 | 295 | **0.0** | | 37.7 | 0.0 | 0.0 | 0.00 | | **91.8** | ULS 3_0 | 289.1 | 0.0 | 0.0 | 0.32 | |
| 113A | Tweede TSNSTK - Main member | 150x150x12 | S355 | 8M24-8.8t | 1.20 | 1.62 | 1.00 | 43 | **-328.2** | ULS 1a_135 | 1086.7 | 1084.4 | 1693.4 | 0.30 | | **212.1** | ULS 1a_0_9_0_9_135 | 1007.6 | 1084.4 | 0.0 | 0.21 | |
| 113B | Tweede TSNSTK - Main member | 150x150x12 | S355 | 12M24-8.8t | 0.56 | 0.62 | 0.56 | 71 | **-543.1** | ULS 1a_135 | 871.3 | 1618.2 | 2540.2 | 0.62 | | **407.7** | ULS 1a_0_9_0_9_135 | 1007.6 | 1618.2 | 0.0 | 0.40 | |
| 113C | Tweede TSNSTK - Main member | 150x150x12 | S355 | | 3.93 | 4.07 | 1.00 | 62 | **-498.6** | ULS 1a_135 | 945.1 | 0.0 | 0.0 | 0.53 | | **370.2** | ULS 1a_0_9_0_9_135 | 1235.4 | 0.0 | 0.0 | 0.30 | |
| 214L | Tweede TSNSTK - CD 1 front | 100x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 78 | **-100.2** | ULS 5a Ah 21 | 170.3 | 282.2 | 324.0 | 0.59 | | **94.1** | ULS 5a Ah 21 | 111.2 | 282.2 | 275.6 | 0.85 | |
| 214T | Tweede TSNSTK - CD 1 side | 100x65x7* | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 78 | **-92.7** | ULS 5a Ba 10 | 166.1 | 282.2 | 226.8 | 0.56 | | **95.6** | ULS 5a Ba 21 | 111.4 | 282.2 | 187.9 | 0.86 | |
| 215L | Tweede TSNSTK - CD 2 front | 100x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 86 | **-81.1** | ULS 5a Ah 21 | 159.5 | 282.2 | 324.0 | 0.51 | | **85.2** | ULS 5a Ah 21 | 111.2 | 282.2 | 275.6 | 0.77 | |
| 215T | Tweede TSNSTK - CD 2 side | 100x65x7* | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 92 | **-89.6** | ULS 5a Ba 21 | 149.2 | 282.2 | 226.8 | 0.60 | | **86.2** | ULS 5a Ah 10 | 111.4 | 282.2 | 187.9 | 0.77 | |
| 216L | Tweede TSNSTK - CD 3 front | 100x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 102 | **-77.1** | ULS 5a Ah 21 | 140.1 | 282.2 | 324.0 | 0.55 | | **73.0** | ULS 5a Ah 21 | 111.2 | 282.2 | 275.6 | 0.66 | |
| 216T | Tweede TSNSTK - CD 3 side | 90x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 116 | **-78.8** | ULS 5a Ah 10 | 116.6 | 282.2 | 226.8 | 0.68 | | **81.7** | ULS 5a Ba 21 | 131.9 | 282.2 | 192.9 | 0.62 | |
| 114A | Eerste TSNSTK - Main member | 150x150x14 | S355 | 12M24-8.8t | 3.93 | 4.07 | 1.00 | 62 | **-592.7** | ULS 1a_135 | 1087.4 | 1618.2 | 2963.5 | 0.55 | | **449.8** | ULS 1a_0_9_0_9_135 | 1159.3 | 1618.2 | 0.0 | 0.39 | |
| 114B | Eerste TSNSTK - Main member | 150x150x14 | S355 | 14M24-8.8t | 0.60 | 0.78 | 0.60 | 88 | **-708.7** | ULS 1a_135 | 801.0 | 1847.3 | 3457.4 | 0.88 | | **561.3** | ULS 1a_0_9_0_9_135 | 1159.3 | 1847.3 | 0.0 | 0.48 | |
| 114C | Eerste TSNSTK - Main member | 150x150x14 | S355 | | 3.93 | 4.07 | 1.00 | 80 | **-666.1** | ULS 1a_135 | 895.0 | 0.0 | 0.0 | 0.74 | | **523.5** | ULS 1a_0_9_0_9_135 | 1425.0 | 0.0 | 0.0 | 0.37 | |
| 217L | Eerste TSNSTK - CD 1 front | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.25 | 0.25 | 114 | **-62.8** | ULS 5a Ah 21 | 126.8 | 188.2 | 216.0 | 0.49 | | **65.5** | ULS 5a Ah 21 | 96.5 | 188.2 | 190.1 | 0.68 | |
| 217T | Eerste TSNSTK - CD 1 side | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.25 | 0.25 | 117 | **-72.1** | ULS 5a Ba 21 | 123.0 | 188.2 | 216.0 | 0.59 | | **68.3** | ULS 5a Ah 10 | 96.5 | 188.2 | 190.1 | 0.71 | |
| 218L | Eerste TSNSTK - CD 2 front | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.26 | 0.26 | 126 | **-56.6** | ULS 5a Ah 21 | 114.2 | 188.2 | 216.0 | 0.50 | | **53.5** | ULS 5a Ah 21 | 94.3 | 188.2 | 187.4 | 0.57 | |
| 218T | Eerste TSNSTK - CD 2 side | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.26 | 0.26 | 117 | **-54.1** | ULS 5a Ah 10 | 123.3 | 188.2 | 216.0 | 0.44 | | **56.8** | ULS 5a Ba 21 | 94.3 | 188.2 | 187.4 | 0.60 | |
| 115A | BRKSTK - Main member | 150x150x12 | S355 | 14M24-8.8t | 0.33 | 0.33 | 0.33 | 48 | **-648.9** | ULS 1a_135 | 1057.5 | 1834.5 | 2963.5 | 0.61 | | **522.7** | ULS 1a_0_9_135 | 1007.6 | 1834.5 | 0.0 | 0.52 | |
| 115B | BRKSTK - Main member | 150x150x12 | S355 | 14M24-8.8t | 0.20 | 0.20 | 0.20 | 48 | **-651.6** | ULS 1a_135 | 1052.1 | 1860.2 | 2963.5 | 0.62 | | **520.0** | ULS 1a_0_9_135 | 1007.6 | 1860.2 | 0.0 | 0.52 | |
| 219L | BRKSTK - Main leg diagonal front | 80x80x8 | S235 | 3M20-8.8t | 0.20 | 0.33 | 0.20 | 114 | **-74.6** | ULS 5a Ba 21 | 130.8 | 282.2 | 259.2 | 0.57 | | **59.1** | ULS 5a Ah 10 | 162.8 | 282.2 | 223.4 | 0.36 | |
| 219T | BRKSTK - Main leg diagonal side | 80x80x8 | S235 | 3M20-8.8t | 0.20 | 0.33 | 0.20 | 114 | **-89.2** | ULS 1a_90 | 130.8 | 282.2 | 259.2 | 0.68 | | **74.1** | ULS 1a_0_9_0_9_90 | 162.8 | 282.2 | 223.4 | 0.46 | |
| 220L | BRKSTK - First diagonal above diaphragr | 120x120x10 | S355 | 2M20-8.8t | 1.00 | 0.33 | 0.33 | 139 | **-71.1** | ULS 5a Ba 21 | 234.4 | 188.2 | 294.0 | 0.38 | | **57.9** | ULS 5a Ah 10 | 374.2 | 188.2 | 294.0 | 0.31 | |
| 220T | BRKSTK - First diagonal above diaphragr | 120x120x10 | S235 | 2M20-8.8t | 1.00 | 0.33 | 0.33 | 139 | **-89.8** | ULS 1a_90 | 199.4 | 188.2 | 216.0 | 0.48 | | **77.1** | ULS 1a_0_9_0_9_90 | 274.9 | 188.2 | 216.0 | 0.41 | |
| 221L | BRKSTK - Diaphragm horiz front | 65x65x6 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 284 | **-3.3** | ULS 1a_135 | 21.9 | 60.3 | 70.6 | 0.15 | | **0.8** | ULS 1a_0_9_0_9_45 | 110.5 | 60.3 | 0.0 | 0.01 | |
| 221T | BRKSTK - Diaphragm horiz side | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 284 | **-3.3** | ULS 1a_135 | 20.3 | 60.3 | 51.8 | 0.17 | | **1.1** | ULS 1a_0_9_0_9_0 | 81.2 | 60.3 | 0.0 | 0.02 | |
| 222 | BRKSTK - Diaphragm diagonal | 75x75x6 | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 216 | **-1.3** | ULS 1a_0 | 29.1 | 60.3 | 51.8 | 0.05 | | **2.4** | ULS 1a_0_9_135 | 98.5 | 60.3 | 0.0 | 0.05 | |
| 223 | BRKSTK - Diaphragm CD | 65x65x6 | S355 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 284 | **-0.4** | ULS 1a_90 | 21.9 | 60.3 | 70.6 | 0.02 | | **0.0** | | 110.5 | 60.3 | 0.0 | 0.00 | |
| 250T | Tweede TSNSTK - Truss 1 side | 80x65x6 | S235 | 3M20-8.8t | 1.00 | 0.50 | 0.50 | 80 | **-99.5** | ULS 5a Ba 21 | 118.7 | 282.2 | 194.4 | 0.84 | | **96.6** | ULS 5a Ba 21 | 95.6 | 282.2 | 161.0 | 1.01 | nettodsn. |

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

| | |
|---|---|
| Date | 26-05-21 |
| Author | KCh |
| Version | 1,0 |

**ZW380 Oost**
**HS+0**
**26**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 200 | BVNSTK - Top c | 90x90x6# | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 115 | **-13.1** | ULS 5a Ba 22 | 118.0 | 120.6 | 103.7 | 0.13 | | **12.6** | ULS 5a Ba 22 | 127.9 | 120.6 | 103.7 | 0.12 |
| 201L | BVNSTK - First | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 114 | **0.0** | | 156.7 | 406.7 | 311.0 | 0.00 | | **141.4** | ULS 3_0 | 185.9 | 406.7 | 264.8 | 0.76 |
| 201T | BVNSTK - First | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 189 | **0.0** | | 26.3 | 60.3 | 86.4 | 0.00 | | **5.2** | ULS 5a Ah 12 | 92.2 | 60.3 | 0.0 | 0.09 |
| 202L | BVNSTK - First | 60x60x5 | S235 | 1M16-8.8t | 0.51 | 0.51 | 0.51 | 144 | **-21.0** | ULS 5a Ah 22 | 40.5 | 60.3 | 43.2 | 0.52 | | **14.8** | ULS 5a Ah 22 | 60.5 | 60.3 | 0.0 | 0.34 |
| 202T | BVNSTK - First | 55x55x5 | S235 | 1M16-8.8t | 0.51 | 1.00 | 0.51 | 199 | **-13.3** | ULS 6a_90 Ba Ct2 | 19.8 | 60.3 | 86.4 | 0.67 | | **0.2** | ULS 5a Ah 12 | 92.2 | 60.3 | 0.0 | 0.00 |
| 101A | BVNSTK - Main | 90x90x6# | S355 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 141 | **-39.7** | ULS 5a Ah 22 | 92.9 | 813.3 | 635.0 | 0.43 | | **8.6** | ULS 5a Ah 22 | 263.9 | 813.3 | 0.0 | 0.03 |
| 101C | BVNSTK - Main | 90x90x6# | S355 | | 0.50 | 0.50 | 0.50 | 76 | **-55.6** | ULS 1a_135 | 236.9 | 0.0 | 0.0 | 0.23 | | **27.7** | ULS 5a Ah 12 | 376.3 | 0.0 | 0.0 | 0.07 |
| 101B | BVNSTK - Main | 90x90x6# | S355 | 4M24-8.8t | 0.50 | 0.50 | 0.50 | 77 | **-126.6** | ULS 1a_135 | 232.6 | 542.2 | 423.4 | 0.54 | | **73.0** | ULS 1a_0,9_0,9_135 | 263.9 | 542.2 | 0.0 | 0.28 |
| 102 | BVNSTK - Cross | 120x120x10 | S355 | 7M24-8.8t | 1.00 | 2.00 | 1.00 | 62 | **-308.9** | ULS 8 Ah | 509.0 | 877.7 | 1234.8 | 0.61 | | **86.6** | ULS 8 Ah | 540.4 | 877.7 | 1234.8 | 0.16 |
| 203 | BVNSTK - Seco | 75x75x6 | S355 | 3M20-8.8t | 1.00 | 2.00 | 1.00 | 99 | **-46.3** | ULS 5a Ah 22 | 130.5 | 282.2 | 264.6 | 0.35 | | **71.3** | ULS 5a Ba 12 | 213.8 | 282.2 | 0.0 | 0.33 |
| 204L | BVNSTK - Seco | 100x100x8 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 93 | **-109.4** | ULS 5a Ba 12 | 207.3 | 406.7 | 311.0 | 0.53 | | **115.0** | ULS 5a Ah 22 | 211.1 | 406.7 | 270.6 | 0.55 |
| 204T | BVNSTK - Seco | 100x100x6 | S235 | 3M20-8.8t | 0.51 | 0.51 | 0.51 | 93 | **-125.1** | ULS 5a Ba 22 | 156.7 | 282.2 | 194.4 | 0.80 | | **110.7** | ULS 5a Ah 22 | 161.9 | 282.2 | 176.2 | 0.68 |
| 205L | BVNSTK - Third | 100x100x6 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 97 | **-105.2** | ULS 5a Ah 22 | 151.5 | 406.7 | 233.3 | 0.69 | | **97.3** | ULS 5a Ba 12 | 161.1 | 406.7 | 202.9 | 0.60 |
| 205T | BVNSTK - Third | 100x100x6 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 97 | **-100.0** | ULS 5a Ah 22 | 151.5 | 406.7 | 233.3 | 0.66 | | **112.2** | ULS 5a Ba 12 | 147.5 | 406.7 | 174.4 | 0.76 |
| 206 | BVNSTK - Diapl | 75x75x6 | S355 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 109 | **-69.0** | ULS 5a Ah 22 | 124.5 | 188.2 | 176.4 | 0.55 | | **66.9** | ULS 5a Ba 12 | 131.5 | 188.2 | 166.4 | 0.51 |
| 207 | BVNSTK - Diapl | 55x55x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 214 | **-0.3** | ULS 3_0,9_0 | 24.3 | 60.3 | 117.6 | 0.01 | | **2.8** | ULS 5a Ah 12 | 125.4 | 60.3 | 0.0 | 0.05 |
| 419 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 147 | **-13.0** | ULS 5a Ba 12 | 32.9 | 60.3 | 43.2 | 0.40 | | **20.0** | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.54 |
| 420 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 147 | **-25.3** | ULS 5a Ah 12 | 32.9 | 60.3 | 43.2 | 0.77 | | **19.3** | ULS 5a Ba 12 | 37.4 | 60.3 | 0.0 | 0.52 |
| 421 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 147 | **-21.8** | ULS 5a Ba 12 | 32.8 | 60.3 | 43.2 | 0.66 | | **25.8** | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.69 |
| 422 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 131 | **-25.5** | ULS 5a Ah 12 | 37.2 | 60.3 | 43.2 | 0.68 | | **23.1** | ULS 5a Ba 12 | 37.4 | 60.3 | 0.0 | 0.62 |
| 423 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 136 | **-27.9** | ULS 5a Ba 12 | 35.9 | 60.3 | 43.2 | 0.78 | | **28.1** | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.75 |
| 424 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 133 | **-31.5** | ULS 5a Ah 22 | 36.7 | 60.3 | 43.2 | 0.86 | | **32.0** | ULS 5a Ba 12 | 37.4 | 60.3 | 0.0 | 0.85 |
| 426 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 123 | **-33.9** | ULS 5a Ba 12 | 40.0 | 60.3 | 43.2 | 0.85 | | **32.4** | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.86 |
| 427 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 104 | **-14.4** | ULS 5a Ah 12 | 47.0 | 60.3 | 43.2 | 0.33 | | **10.2** | ULS 5a Ah 12 | 37.4 | 60.3 | 0.0 | 0.27 |
| 428 | Tweede DWSRK | 50x50x5 | S355 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 111 | **-12.7** | ULS 8 Ah | 53.7 | 60.3 | 58.8 | 0.24 | | **10.7** | ULS 8 Ah | 51.0 | 60.3 | 0.0 | 0.21 |
| 429 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 125 | **-14.9** | ULS 8 Ah | 39.4 | 60.3 | 43.2 | 0.38 | | **17.2** | ULS 8 Ah | 37.4 | 60.3 | 0.0 | 0.46 |
| 433 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 125 | **-21.2** | ULS 8 Ah | 39.2 | 60.3 | 43.2 | 0.54 | | **18.0** | ULS 8 Ah | 37.4 | 60.3 | 0.0 | 0.48 |
| 400 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 312 | **0.0** | | 11.1 | 60.3 | 43.2 | 0.00 | | **12.9** | ULS 3_0 | 37.4 | 60.3 | 0.0 | 0.34 |
| 401 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 313 | **0.0** | | 11.1 | 60.3 | 43.2 | 0.00 | | **15.3** | ULS 3_0 | 37.4 | 60.3 | 0.0 | 0.41 |
| 402 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 303 | **0.0** | | 11.6 | 60.3 | 43.2 | 0.00 | | **18.0** | ULS 3_0 | 37.4 | 60.3 | 0.0 | 0.48 |
| 403 | Tweede DWSRK | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 330 | **0.0** | | 12.7 | 120.6 | 86.4 | 0.00 | | **26.2** | ULS 3_0 | 52.4 | 120.6 | 70.4 | 0.50 |
| 404 | Tweede DWSRK | 55x55x5 | S235 | 3M16-8.8t | 1.00 | 1.00 | 1.00 | 253 | **0.0** | | 21.5 | 180.9 | 259.2 | 0.00 | | **36.3** | ULS 3_0 | 55.2 | 180.9 | 219.8 | 0.66 |
| 405 | Tweede DWSRK | 55x55x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 99 | **-19.4** | ULS 8 Ah | 67.6 | 120.6 | 172.8 | 0.29 | | **4.7** | ULS 5a Ah 12 | 47.3 | 120.6 | 145.2 | 0.10 |
| 406 | Tweede DWSRK | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 109 | **-7.5** | ULS 5a Ah 12 | 56.5 | 120.6 | 86.4 | 0.13 | | **20.7** | ULS 8 Ah | 52.4 | 120.6 | 70.4 | 0.39 |
| 407 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 322 | **0.0** | | 10.6 | 60.3 | 43.2 | 0.00 | | **6.8** | ULS 8 Ah | 37.4 | 60.3 | 0.0 | 0.18 |
| 408 | Tweede DWSRK | 60x60x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 195 | **-10.5** | ULS 3_0 | 27.3 | 60.3 | 43.2 | 0.38 | | **0.0** | | 60.5 | 60.3 | 0.0 | 0.00 |
| 409 | Tweede DWSRK | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 189 | **-10.8** | ULS 3_0 | 26.3 | 60.3 | 86.4 | 0.41 | | **0.0** | | 92.2 | 60.3 | 0.0 | 0.00 |
| 410 | Tweede DWSRK | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 159 | **-11.4** | ULS 3_0 | 32.9 | 60.3 | 86.4 | 0.35 | | **0.0** | | 92.2 | 60.3 | 0.0 | 0.00 |
| 411 | Tweede DWSRK | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 133 | **-13.4** | ULS 3_0 | 43.3 | 60.3 | 58.8 | 0.31 | | **0.0** | | 51.0 | 60.3 | 0.0 | 0.00 |
| 412 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 45 | **-0.7** | ULS 3_90 | 65.7 | 60.3 | 43.2 | 0.02 | | **0.0** | | 37.4 | 60.3 | 0.0 | 0.00 |
| 413 | Tweede DWSRK | 50x50x5 | S355 | 1M16-8.8t | 0.52 | 0.52 | 0.52 | 131 | **-1.4** | ULS 1a_0,9_0 | 44.1 | 60.3 | 58.8 | 0.03 | | **1.5** | ULS 1a_0,9_0,9_0 | 51.0 | 60.3 | 0.0 | 0.03 |
| 414 | Tweede DWSRK | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 174 | **-0.5** | ULS 5a Ah 12 | 30.1 | 60.3 | 58.8 | 0.02 | | **0.2** | ULS 1a_0,9_90 | 51.0 | 60.3 | 0.0 | 0.00 |
| 415 | Tweede DWSRK | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 91 | **0.0** | | 52.4 | 60.3 | 43.2 | 0.00 | | **2.7** | ULS 1a_0 | 37.4 | 60.3 | 0.0 | 0.07 |
| 416 | Tweede DWSRK | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 142 | **-2.0** | ULS 3_0 | 39.7 | 60.3 | 58.8 | 0.05 | | **0.0** | | 51.0 | 60.3 | 0.0 | 0.00 |
| 417 | Tweede DWSRK | HEB160 | S355 | | 2.00 | 2.00 | 2.00 | 36 | **-25.3** | ULS 5a Ah 12 | 1339.8 | 0.0 | 0.0 | 0.02 | | **7.4** | ULS 1a_90 | 1714.6 | 271.1 | 0.0 | 0.03 |
| 418 | Tweede DWSRK | 110x110x10 | S355 | 2M16-8.8t | 2.00 | 2.00 | 2.00 | 49 | **-9.7** | ULS 8 Ah | 544.1 | 120.6 | 235.2 | 0.08 | | **11.2** | ULS 8 Ah | 471.2 | 120.6 | 0.0 | 0.09 |
| 103A | Tweede DWSRK | 120x120x10 | S355 | 7M24-8.8t | 1.72 | 1.00 | 1.00 | 42 | **-320.7** | ULS 8 Ah | 730.5 | 877.7 | 1234.8 | 0.44 | | **159.3** | ULS 5a Ah 22 | 540.4 | 877.7 | 1234.8 | 0.29 |
| 103B | Tweede DWSRK | 120x120x10 | S355 | 4M24-8.8t | 2.00 | 2.00 | 2.00 | 51 | **-94.9** | ULS 8 Ah | 690.2 | 542.2 | 705.6 | 0.18 | | **37.7** | ULS 8 Ah | 635.0 | 542.2 | 0.0 | 0.07 |
| 103C | Tweede DWSRK | 120x120x10 | S355 | | 2.09 | 1.68 | 1.00 | 54 | **-298.7** | ULS 8 Ah | 672.0 | 0.0 | 0.0 | 0.44 | | **144.1** | ULS 5a Ah 22 | 823.6 | 0.0 | 0.0 | 0.17 |
| 104A | Tweede DWSRK | 100x100x6 | S355 | 4M24-8.8t | 1.60 | 1.00 | 1.00 | 78 | **-82.4** | ULS 8 Ah | 243.3 | 542.2 | 423.4 | 0.34 | | **34.3** | ULS 8 Ah | 306.2 | 542.2 | 0.0 | 0.11 |
| 104B | Tweede DWSRK | 100x100x6 | S355 | | 1.50 | 1.00 | 1.00 | 102 | **-42.6** | ULS 3_90 | 182.8 | 0.0 | 0.0 | 0.23 | | **0.0** | | 418.9 | 0.0 | 0.0 | 0.00 |
| 104C | Tweede DWSRK | 100x100x6 | S355 | | 3.00 | 1.90 | 1.00 | 98 | **-58.1** | ULS 8 Ah | 192.7 | 0.0 | 0.0 | 0.30 | | **17.3** | ULS 8 Ah | 418.9 | 0.0 | 0.0 | 0.04 |
| 105A | Tweede DWSRK | 90x90x8 | S235 | 3M24-8.8t | 1.00 | 3.48 | 1.00 | 215 | **0.0** | | 68.3 | 406.7 | 311.0 | 0.00 | | **135.4** | ULS 3_0 | 185.9 | 406.7 | 264.8 | 0.73 |
| 105B | Tweede DWSRK | 90x90x8 | S235 | 4M16-8.8t | 1.00 | 1.93 | 1.00 | 209 | **0.0** | | 71.0 | 241.2 | 276.5 | 0.00 | | **61.2** | ULS 3_0 | 285.6 | 241.2 | 0.0 | 0.25 |
| 105C | Tweede DWSRK | 90x90x8 | S235 | | 1.00 | 2.08 | 1.00 | 209 | **0.0** | | 71.0 | 0.0 | 0.0 | 0.00 | | **125.7** | ULS 3_0 | 326.7 | 0.0 | 0.0 | 0.38 |
| 106A | Tweede DWSRK | 60x60x5 | S235 | 4M16-8.8t | 2.00 | 1.00 | 1.00 | 333 | **0.0** | | 14.6 | 241.2 | 172.8 | 0.00 | | **43.2** | ULS 3_0 | 103.7 | 241.2 | 0.0 | 0.42 |
| 106B | Tweede DWSRK | 60x60x5 | S235 | 3M16-8.8t | 1.00 | 2.00 | 1.00 | 333 | **0.0** | | 14.6 | 180.9 | 129.6 | 0.00 | | **43.2** | ULS 3_0 | 76.8 | 180.9 | 113.5 | 0.56 |
| 107A | Derde TSNSTK | 100x100x10 | S355 | 4M24-8.8t | 0.50 | 0.50 | 0.50 | 72 | **-175.1** | ULS 1a_135 | 471.3 | 542.2 | 705.6 | 0.37 | | **129.1** | ULS 1a_0,9_0,9_135 | 493.9 | 542.2 | 0.0 | 0.26 |
| 107B | Derde TSNSTK | 100x100x10 | S355 | 7M24-8.8t | 0.50 | 0.50 | 0.50 | 77 | **-213.6** | ULS 1a_135 | 447.2 | 948.9 | 1234.8 | 0.48 | | **124.2** | ULS 1a_0,9_0,9_135 | 493.9 | 948.9 | 0.0 | 0.25 |
| 208L | Derde TSNSTK | 100x100x6 | S235 | 3M24-8.8t | 0.51 | 0.51 | 0.51 | 101 | **-86.9** | ULS 5a Ba 12 | 146.1 | 406.7 | 233.3 | 0.59 | | **94.0** | ULS 5a Ah 22 | 161.1 | 406.7 | 198.9 | 0.58 |
| 208T | Derde TSNSTK | 100x100x6 | S235 | 2M24-8.8t | 0.51 | 0.51 | 0.51 | 101 | **-101.2** | ULS 5a Ba 12 | 146.1 | 271.1 | 155.5 | 0.69 | | **90.1** | ULS 5a Ah 22 | 138.4 | 271.1 | 137.8 | 0.65 |
| 209L | Derde TSNSTK | 100x100x8 | S235 | 2M24-8.8t | 0.51 | 0.51 | 0.51 | 109 | **-96.6** | ULS 5a Ba 12 | 182.3 | 271.1 | 207.4 | 0.53 | | **90.4** | ULS 5a Ah 22 | 181.4 | 271.1 | 183.7 | 0.50 |
| 209T | Derde TSNSTK | 100x100x8 | S235 | 3M20-8.8t | 0.51 | 0.51 | 0.51 | 109 | **-98.9** | ULS 5a Ba 22 | 182.3 | 282.2 | 259.2 | 0.54 | | **81.9** | ULS 5a Ah 12 | 212.2 | 282.2 | 234.9 | 0.39 |
| 210L | Derde TSNSTK | 100x100x8 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 143 | **0.0** | | 136.5 | 542.2 | 414.7 | 0.00 | | **158.8** | ULS 8 Ah | 211.1 | 542.2 | 357.4 | 0.75 |
| 210T | Derde TSNSTK | 60x60x6 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 240 | **-24.2** | ULS 1a_0,9_90 | 26.5 | 60.3 | 70.6 | 0.91 | | **35.2** | ULS 1a_90 | 98.8 | 60.3 | 0.0 | 0.58 |
| 108 | Derde TSNSTK | 150x150x12 | S355 | 7M24-8.8t | 1.00 | 2.00 | 1.00 | 65 | **-254.0** | ULS 5a Ba 21 | 739.5 | 848.0 | 1481.8 | 0.34 | | **56.4** | ULS 5a Ah 10 | 869.3 | 848.0 | 1481.8 | 0.07 |
| 211 | Derde TSNSTK | 80x80x8 | S355 | 5M24-8.8t | 1.00 | 1.00 | 1.00 | 96 | **-43.5** | ULS 5a Ah 12 | 201.6 | 677.8 | 705.6 | 0.22 | | **67.5** | ULS 5a Ba 22 | 287.2 | 677.8 | 0.0 | 0.24 |
| 212 | Derde TSNSTK | 90x90x6# | S355 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 119 | **-73.3** | ULS 5a Ah 21 | 135.5 | 271.1 | 211.7 | 0.54 | | **73.9** | ULS 5a Ah 21 | 166.3 | 271.1 | 197.5 | 0.44 |
| 213 | Derde TSNSTK | 60x60x6 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 256 | **-0.7** | ULS 3_90 | 23.7 | 60.3 | 70.6 | 0.03 | | **0.0** | | 98.8 | 60.3 | 0.0 | 0.00 |
| 316 | Eerste DWSRM | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 183 | **-23.5** | ULS 5a Ba 11 | 27.4 | 60.3 | 86.4 | 0.86 | | **21.3** | ULS 5a Ah 20 | 92.2 | 60.3 | 0.0 | 0.35 |
| 317 | Eerste DWSRM | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 172 | **-25.7** | ULS 5a Ah 20 | 29.8 | 60.3 | 86.4 | 0.86 | | **28.7** | ULS 5a Ba 11 | 92.2 | 60.3 | 0.0 | 0.48 |
| 320 | Eerste DWSRM | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 161 | **-34.1** | ULS 5a Ba 11 | 36.5 | 60.3 | 86.4 | 0.93 | | **29.6** | ULS 5a Ah 20 | 92.2 | 60.3 | 0.0 | 0.49 |
| 321 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 129 | **-13.2** | ULS 5a Ba 10 | 38.0 | 60.3 | 43.2 | 0.35 | | **9.4** | ULS 5a Ah 10 | 46.1 | 60.3 | 0.0 | 0.22 |
| 322 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 120 | **-17.2** | ULS 5a Ah 10 | 40.9 | 60.3 | 43.2 | 0.42 | | **17.7** | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.47 |
| 323 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 133 | **-25.0** | ULS 5a Ba 10 | 36.7 | 60.3 | 43.2 | 0.68 | | **23.6** | ULS 5a Ah 10 | 37.4 | 60.3 | 0.0 | 0.63 |
| 324 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 125 | **-29.7** | ULS 5a Ah 10 | 39.4 | 60.3 | 43.2 | 0.75 | | **31.0** | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.83 |
| 325 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 94 | **-28.3** | ULS 5a Ah 10 | 51.1 | 60.3 | 43.2 | 0.66 | | **30.0** | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.80 |
| 328 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 89 | **-20.9** | ULS 5a Ba 10 | 53.1 | 60.3 | 43.2 | 0.48 | | **13.2** | ULS 5a Ah 10 | 37.4 | 60.3 | 0.0 | 0.35 |
| 314 | Eerste DWSRM | HEB160 | S355 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 50 | **-25.3** | ULS 5a Ah 11 | 1307.5 | 271.1 | 282.2 | 0.09 | | **25.2** | ULS 5a Ba 20 | 1714.6 | 271.1 | 0.0 | 0.09 |
| 315 | Eerste DWSRM | HEB160 | S355 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 26 | **-70.6** | ULS 3_90 | 1520.0 | 271.1 | 282.2 | 0.26 | | **0.0** | | 1714.6 | 271.1 | 0.0 | 0.00 |
| 330 | 0 | HEB160 | S355 | | 2.00 | 2.00 | 2.00 | 28 | **0.0** | | 1402.4 | 0.0 | 0.0 | 0.00 | | **146.5** | ULS 3_90 | 1927.7 | 0.0 | 0.0 | 0.08 |

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

| | |
|---|---|
| Date | 26-05-21 |
| Author | KCh |
| Version | 1,0 |

**ZW380 Oost**
**HS+0**
**26**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300 | Eerste DWSRM | 55x55x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 362 | **0.0** | | 9.6 | 60.3 | 86.4 | 0.00 | | **17.0** | ULS 3_90 | 92.2 | 60.3 | 0.0 | 0.28 |
| 301 | Eerste DWSRM | 55x55x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 321 | **0.0** | | 14.7 | 120.6 | 172.8 | 0.00 | | **21.7** | ULS 3_135 | 47.3 | 120.6 | 145.2 | 0.46 |
| 302 | Eerste DWSRM | 55x55x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 290 | **0.0** | | 17.3 | 120.6 | 172.8 | 0.00 | | **29.2** | ULS 3_0 | 47.3 | 120.6 | 145.2 | 0.62 |
| 303 | Eerste DWSRM | 60x60x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 133 | **-11.7** | ULS 5a Ah 12 | 55.3 | 120.6 | 86.4 | 0.21 | | **0.0** | | 70.6 | 120.6 | 79.6 | 0.00 |
| 304 | Eerste DWSRM | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 161 | **0.0** | | 36.7 | 120.6 | 86.4 | 0.00 | | **10.3** | ULS 5a Ah 22 | 56.2 | 120.6 | 68.4 | 0.18 |
| 305 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 301 | **0.0** | | 11.8 | 60.3 | 43.2 | 0.00 | | **5.5** | ULS 5a Ba 10 | 37.4 | 60.3 | 0.0 | 0.15 |
| 306 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 229 | **0.0** | | 18.0 | 60.3 | 43.2 | 0.00 | | **6.2** | ULS 5a Ah 21 | 37.4 | 60.3 | 0.0 | 0.16 |
| 307 | Eerste DWSRM | 50x50x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 100 | **-5.3** | ULS 3_135 | 60.5 | 120.6 | 86.4 | 0.09 | | **0.0** | | 48.7 | 120.6 | 67.0 | 0.00 |
| 308 | Eerste DWSRM | 65x65x7 | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 77 | **0.0** | | 131.8 | 188.2 | 151.2 | 0.00 | | **16.3** | ULS 3_135 | 82.5 | 188.2 | 111.9 | 0.20 |
| 309 | Eerste DWSRM | 70x70x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 183 | **-13.5** | ULS 3_135 | 41.7 | 60.3 | 51.8 | 0.32 | | **0.0** | | 89.9 | 60.3 | 0.0 | 0.00 |
| 310 | Eerste DWSRM | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 166 | **-15.5** | ULS 3_0 | 44.3 | 60.3 | 51.8 | 0.35 | | **0.0** | | 81.2 | 60.3 | 0.0 | 0.00 |
| 311 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 95 | **-1.9** | ULS 5a Ah 21 | 50.7 | 60.3 | 43.2 | 0.04 | | **0.0** | | 37.4 | 60.3 | 0.0 | 0.00 |
| 312 | Eerste DWSRM | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 128 | **0.0** | ULS 1a_0_9_0,9_0 | 38.2 | 60.3 | 43.2 | 0.00 | | **3.4** | ULS 1a_0 | 37.4 | 60.3 | 0.0 | 0.09 |
| 313 | Eerste DWSRM | 50x50x5 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 199 | **-2.1** | ULS 3_90 | 24.6 | 60.3 | 58.8 | 0.08 | | **0.0** | | 51.0 | 60.3 | 0.0 | 0.00 |
| 109A | Eerste DWSRM | 150x150x12 | S355 | 7M24-8.8t | 1.00 | 1.00 | 1.00 | 78 | **-308.7** | ULS 5a Ba 10 | 798.9 | 848.0 | 1481.8 | 0.39 | | **123.4** | ULS 5a Ah 21 | 869.3 | 848.0 | 1481.8 | 0.15 |
| 109B | Eerste DWSRM | 150x150x12 | S355 | 6M24-8.8t | 2.00 | 2.00 | 2.00 | 41 | **-205.5** | ULS 5a Ba 10 | 1103.1 | 813.3 | 1270.1 | 0.25 | | **97.0** | ULS 5a Ah 21 | 1007.6 | 813.3 | 0.0 | 0.12 |
| 109C | Eerste DWSRM | 150x150x12 | S355 | | 1.00 | 1.00 | 1.00 | 78 | **-284.3** | ULS 5a Ba 10 | 798.9 | 0.0 | 0.0 | 0.36 | | **112.2** | ULS 5a Ah 21 | 1235.4 | 0.0 | 0.0 | 0.09 |
| 110A | Eerste DWSRM | 100x100x10 | S355 | 6M24-8.8t | 1.68 | 1.00 | 1.00 | 64 | **-188.4** | ULS 5a Ba 10 | 514.0 | 813.3 | 1058.4 | 0.37 | | **83.1** | ULS 5a Ah 21 | 493.9 | 813.3 | 0.0 | 0.17 |
| 110B | Eerste DWSRM | 100x100x10 | S355 | | 1.00 | 2.06 | 1.00 | 39 | **-5.6** | ULS 5a Ah 21 | 615.7 | 0.0 | 0.0 | 0.01 | | **6.2** | ULS 5a Ba 10 | 681.6 | 0.0 | 0.0 | 0.01 |
| 110C | Eerste DWSRM | 100x100x10 | S355 | | 4.23 | 1.66 | 1.00 | 147 | **-117.2** | ULS 5a Ba 10 | 154.5 | 0.0 | 0.0 | 0.76 | | **61.9** | ULS 5a Ah 21 | 681.6 | 0.0 | 0.0 | 0.09 |
| 111A | Eerste DWSRM | 100x100x8 | S235 | 4M24-8.8t | 1.00 | 3.17 | 1.00 | 254 | **0.0** | | 59.6 | 542.2 | 414.7 | 0.00 | | **142.5** | ULS 3_135 | 211.1 | 542.2 | 357.4 | 0.68 |
| 111B | Eerste DWSRM | 100x100x8 | S235 | 4M24-8.8t | 1.00 | 2.62 | 1.00 | 254 | **0.0** | | 59.7 | 542.2 | 414.7 | 0.00 | | **107.2** | ULS 8 Ah | 293.9 | 542.2 | 0.0 | 0.36 |
| 111C | Eerste DWSRM | 100x100x8 | S235 | | 1.00 | 3.07 | 1.00 | 236 | **0.0** | | 66.5 | 0.0 | 0.0 | 0.00 | | **128.5** | ULS 3_0 | 364.3 | 0.0 | 0.0 | 0.35 |
| 112A | Eerste DWSRM | 80x80x8 | S235 | 4M24-8.8t | 1.00 | 2.76 | 1.00 | 295 | **0.0** | | 37.7 | 542.2 | 414.7 | 0.00 | | **95.2** | ULS 3_0 | 211.0 | 542.2 | 0.0 | 0.45 |
| 112B | Eerste DWSRM | 80x80x8 | S235 | 3M24-8.8t | 1.00 | 4.59 | 1.00 | 295 | **0.0** | | 37.7 | 406.7 | 311.0 | 0.00 | | **73.1** | ULS 8 Ah | 147.2 | 406.7 | 226.5 | 0.50 |
| 112C | Eerste DWSRM | 80x80x8 | S235 | | 1.00 | 2.38 | 1.00 | 295 | **0.0** | | 37.7 | 0.0 | 0.0 | 0.00 | | **91.8** | ULS 3_0 | 289.1 | 0.0 | 0.0 | 0.32 |
| 113A | Tweede TSNSTI | 150x150x12 | S355 | 8M24-8.8t | 1.20 | 1.62 | 1.00 | 43 | **-328.2** | ULS 1a_135 | 1086.7 | 1084.4 | 1693.4 | 0.30 | | **212.0** | ULS 1a_0_9_0,9_135 | 1007.6 | 1084.4 | 0.0 | 0.21 |
| 113B | Tweede TSNSTI | 150x150x12 | S355 | 12M24-8.8t | 0.56 | 0.62 | 0.56 | 71 | **-543.1** | ULS 1a_135 | 871.3 | 1618.2 | 2540.2 | 0.62 | | **407.6** | ULS 1a_0_9_0,9_135 | 1007.6 | 1618.2 | 0.0 | 0.40 |
| 113C | Tweede TSNSTI | 150x150x12 | S355 | | 3.93 | 4.07 | 1.00 | 62 | **-498.6** | ULS 1a_135 | 945.1 | 0.0 | 0.0 | 0.53 | | **370.1** | ULS 1a_0_9_0,9_135 | 1235.4 | 0.0 | 0.0 | 0.30 |
| 214L | Tweede TSNSTI | 100x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 78 | **-100.2** | ULS 5a Ah 21 | 170.3 | 282.2 | 324.0 | 0.59 | | **94.0** | ULS 5a Ah 21 | 111.2 | 282.2 | 275.6 | 0.85 |
| 214T | Tweede TSNSTI | 100x65x7* | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 78 | **-92.6** | ULS 5a Ba 10 | 166.1 | 282.2 | 226.8 | 0.56 | | **95.5** | ULS 5a Ba 21 | 111.4 | 282.2 | 187.9 | 0.86 |
| 215L | Tweede TSNSTI | 100x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 86 | **-81.0** | ULS 5a Ah 21 | 159.5 | 282.2 | 324.0 | 0.51 | | **85.1** | ULS 5a Ah 21 | 111.2 | 282.2 | 275.6 | 0.77 |
| 215T | Tweede TSNSTI | 100x65x7* | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 92 | **-89.7** | ULS 5a Ba 21 | 149.2 | 282.2 | 226.8 | 0.60 | | **86.3** | ULS 5a Ah 10 | 111.4 | 282.2 | 187.9 | 0.77 |
| 216L | Tweede TSNSTI | 100x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 102 | **-77.1** | ULS 5a Ah 21 | 140.1 | 282.2 | 324.0 | 0.55 | | **72.9** | ULS 5a Ah 21 | 111.2 | 282.2 | 275.6 | 0.66 |
| 216T | Tweede TSNSTI | 90x75x7 | S235 | 3M20-8.8t | 0.53 | 0.25 | 0.25 | 116 | **-78.9** | ULS 5a Ah 10 | 116.6 | 282.2 | 226.8 | 0.68 | | **81.7** | ULS 5a Ba 21 | 131.9 | 282.2 | 192.9 | 0.62 |
| 114A | Eerste TSNSTK | 150x150x14 | S355 | 12M24-8.8t | 3.93 | 4.07 | 1.00 | 62 | **-592.6** | ULS 1a_135 | 1087.4 | 1618.2 | 2963.5 | 0.54 | | **449.7** | ULS 1a_0_9_0,9_135 | 1159.3 | 1618.2 | 0.0 | 0.39 |
| 114B | Eerste TSNSTK | 150x150x14 | S355 | 14M24-8.8t | 0.60 | 0.78 | 0.60 | 88 | **-708.6** | ULS 1a_135 | 801.0 | 1847.3 | 3457.4 | 0.88 | | **561.1** | ULS 1a_0_9_0,9_135 | 1159.3 | 1847.3 | 0.0 | 0.48 |
| 114C | Eerste TSNSTK | 150x150x14 | S355 | | 3.93 | 4.07 | 1.00 | 80 | **-666.0** | ULS 1a_135 | 895.0 | 0.0 | 0.0 | 0.74 | | **523.3** | ULS 1a_0_9_0,9_135 | 1425.0 | 0.0 | 0.0 | 0.37 |
| 217L | Eerste TSNSTK | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.25 | 0.25 | 114 | **-62.7** | ULS 5a Ah 21 | 126.8 | 188.2 | 216.0 | 0.49 | | **65.4** | ULS 5a Ah 21 | 96.5 | 188.2 | 190.1 | 0.68 |
| 217T | Eerste TSNSTK | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.25 | 0.25 | 117 | **-72.1** | ULS 5a Ba 21 | 123.0 | 188.2 | 216.0 | 0.59 | | **68.4** | ULS 5a Ah 10 | 96.5 | 188.2 | 190.1 | 0.71 |
| 218L | Eerste TSNSTK | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.26 | 0.26 | 126 | **-56.6** | ULS 5a Ah 21 | 114.2 | 188.2 | 216.0 | 0.50 | | **53.5** | ULS 5a Ah 21 | 94.3 | 188.2 | 187.4 | 0.57 |
| 218T | Eerste TSNSTK | 100x75x7 | S235 | 2M20-8.8t | 0.53 | 0.26 | 0.26 | 117 | **-54.1** | ULS 5a Ah 10 | 123.3 | 188.2 | 216.0 | 0.44 | | **56.9** | ULS 5a Ba 21 | 94.3 | 188.2 | 187.4 | 0.60 |
| 115A | BRKSTK - Main | 150x150x12 | S355 | 14M24-8.8t | 0.33 | 0.33 | 0.33 | 48 | **-648.8** | ULS 1a_135 | 1057.5 | 1834.5 | 2963.5 | 0.61 | | **522.5** | ULS 1a_0_9_135 | 1007.6 | 1834.5 | 0.0 | 0.52 |
| 115B | BRKSTK - Main | 150x150x12 | S355 | 14M24-8.8t | 0.20 | 0.20 | 0.20 | 48 | **-651.4** | ULS 1a_135 | 1052.1 | 1860.2 | 2963.5 | 0.62 | | **519.9** | ULS 1a_0_9_135 | 1007.6 | 1860.2 | 0.0 | 0.52 |
| 219L | BRKSTK - Main | 80x80x8 | S235 | 3M20-8.8t | 0.20 | 0.33 | 0.20 | 114 | **-74.6** | ULS 5a Ba 21 | 130.8 | 282.2 | 259.2 | 0.57 | | **59.1** | ULS 5a Ah 10 | 162.8 | 282.2 | 223.4 | 0.36 |
| 219T | BRKSTK - Main | 80x80x8 | S235 | 3M20-8.8t | 0.20 | 0.33 | 0.20 | 114 | **-89.2** | ULS 1a_90 | 130.8 | 282.2 | 259.2 | 0.68 | | **74.1** | ULS 1a_0_9_0,9_90 | 162.8 | 282.2 | 223.4 | 0.46 |
| 220L | BRKSTK - First | 120x120x10 | S355 | 2M20-8.8t | 1.00 | 0.33 | 0.33 | 139 | **-71.1** | ULS 5a Ba 21 | 234.4 | 188.2 | 294.0 | 0.38 | | **57.9** | ULS 5a Ah 10 | 374.2 | 188.2 | 294.0 | 0.31 |
| 220T | BRKSTK - First | 120x120x10 | S235 | 2M20-8.8t | 1.00 | 0.33 | 0.33 | 139 | **-89.8** | ULS 1a_90 | 199.4 | 188.2 | 216.0 | 0.48 | | **77.1** | ULS 1a_0_9_0,9_90 | 274.9 | 188.2 | 216.0 | 0.41 |
| 221L | BRKSTK - Diagh | 65x65x6 | S355 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 284 | **-3.3** | ULS 1a_135 | 21.9 | 60.3 | 70.6 | 0.15 | | **0.8** | ULS 1a_0_9_0,9_45 | 110.5 | 60.3 | 0.0 | 0.01 |
| 221T | BRKSTK - Diagh | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 284 | **-3.3** | ULS 1a_135 | 20.3 | 60.3 | 51.8 | 0.17 | | **1.1** | ULS 1a_0_9_0,9_0 | 81.2 | 60.3 | 0.0 | 0.02 |
| 222 | BRKSTK - Diagh | 75x75x6 | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 216 | **-1.3** | ULS 1a_0 | 29.1 | 60.3 | 51.8 | 0.05 | | **2.4** | ULS 1a_0_9_135 | 98.5 | 60.3 | 0.0 | 0.05 |
| 223 | BRKSTK - Diagh | 65x65x6 | S355 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 284 | **-0.4** | ULS 1a_90 | 21.9 | 60.3 | 70.6 | 0.02 | | **0.0** | | 110.5 | 60.3 | 0.0 | 0.00 |
| 250T | Tweede TSNSTI | **70x70x7** | **S355** | 3M20-8.8t | 1.00 | 0.50 | 0.50 | 94 | **-99.9** | ULS 5a Ba 21 | 148.3 | 282.2 | 308.7 | 0.67 | | **97.0** | ULS 5a Ba 21 | 165.3 | 282.2 | 280.6 | 0.59 |

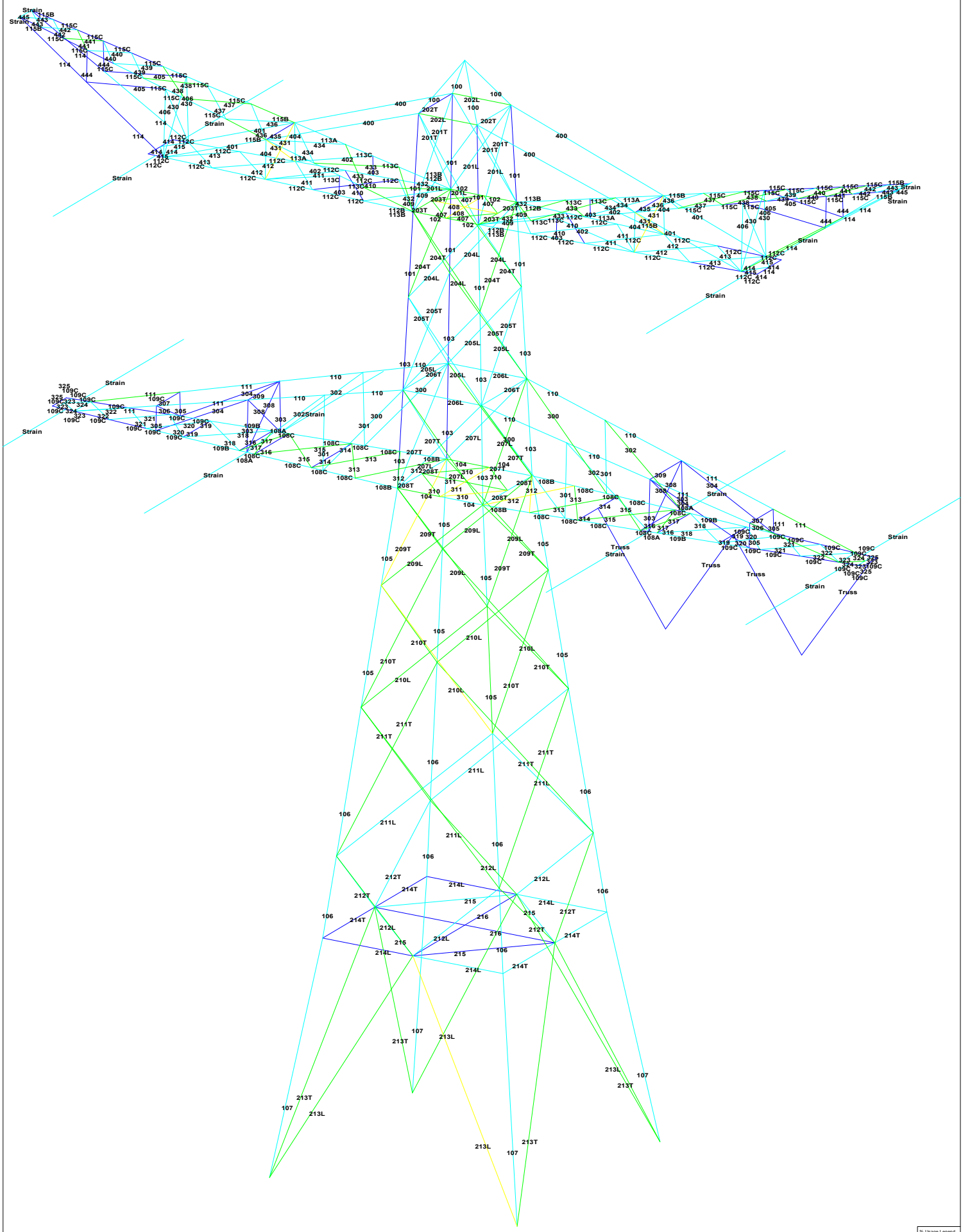
## Assessment of groups for strengthened mast (verbouw level)

| | |
|---|---|
| Date | 26-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HS+0**
**26**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250T | Tweede TSNSTr | **70x70x7** | **S355** | 3M20-8.8t | 1,00 | 0,50 | 0,50 | 94 | **-99,9** | ULS 5a Ba 21 | 148,3 | 282,2 | 308,7 | 0,67 | | **97,0** | ULS 5a Ba 21 | 165,3 | 282,2 | 280,6 | 0,59 |

DNV GL Nederlands BV, Project: "D1.3 2 Circuit HC+0 - dnv gl-int"
Tower Version 16.86, 10:48:26 Wednesday, 5 May, 2021
Undeformed geometry displayed



DNV·GL

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

Date 05-05-21
Author KCh
Version 1.0

**ZW380 Oost**
**HC+0**
**16**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | BVNSTK - Top cap | 90x90x6# | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 152 | -28.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 87.0 | 120.6 | 103.7 | 0.33 | | 27.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 127.9 | 120.6 | 89.6 | 0.31 | |
| 101 | BVNSTK - Main member | 120x120x10 | S355 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 77 | -171.8 | ULS 3_90 | 541.5 | 813.3 | 1058.4 | 0.32 | | 142.5 | PLS 3_0_9_120.38 Ba Ct1 | 635.0 | 813.3 | 904.6 | 0.22 | |
| 102 | Cross profile (main member for crossarm | 150x150x12 | S355 | 6M24-8.8t | 1.00 | 2.00 | 1.00 | 63 | -480.7 | SPLS 6a_90 Ah All Cts Ba Ct1 | 936.0 | 806.5 | 1270.1 | 0.60 | | 316.3 | S 3_0_9_120.38 Ba All Cts | 889.1 | 806.5 | 1085.5 | 0.39 | |
| 103 | DerdeTSNK - Main member | 150x150x15 | S355 | 8M24-8.8t | 0.52 | 0.52 | 0.52 | 71 | -402.7 | ULS 3_90 | 1070.2 | 2166.8 | 2116.8 | 0.38 | | 301.2 | S 3_0_9_120.38 Ba All Cts | 1241.9 | 2168.8 | 1917.8 | 0.24 | |
| 104 | Cross profile-main member for crossarm | 150x150x14 | S355 | 16M24-8.8t | 1.00 | 1.60 | 1.00 | 66 | -543.3 | SPLS 6a_90 Ah All Cts Ba Ct1 | 1048.9 | 1755.4 | 3951.4 | 0.52 | | 308.4 | S 6a_90 Ba All Cts Ah Ct1 | 1019.2 | 1755.4 | 3377.2 | 0.30 | |
| 105 | TweedeTSNK - Main member | 200x200x16 | S355 | 14M24-8.8t | 0.28 | 0.28 | 0.28 | 35 | -1030.3 | SPLS 3_120.38 Ba All Cts | 2021.8 | 3694.6 | 3951.4 | 0.51 | | 818.1 | S 3_0_9_120.38 Ba All Cts | 1886.8 | 3694.6 | 3377.2 | 0.43 | |
| 106 | EersteTSNK - Main member | 200x200x24* | S355 | 18M24-8.8t | 0.50 | 0.50 | 0.50 | 43 | -1381.1 | SPLS 3_120.38 Ba All Cts | 2836.5 | 4684.2 | 7620.5 | 0.49 | | 1142.9 | S 3_0_9_120.38 Ba All Cts | 2756.1 | 4684.2 | 6513.2 | 0.41 | |
| 107 | BRKSTK - Main member | 200x200x24* | S355 | 18M24-8.8t | 0.17 | 0.17 | 0.17 | 42 | -1408.2 | SPLS 3_120.38 Ba All Cts | 2849.8 | 4684.2 | 7620.5 | 0.49 | | 1142.1 | S 3_0_9_120.38 Ba All Cts | 2756.1 | 4684.2 | 6513.2 | 0.41 | |
| 108A | Eerste DWSRM - Main member 1 bottom | 180x180x16 | S355 | 10M24-8.8t | 2.00 | 12.14 | 2.00 | 77 | -411.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 1285.3 | 1355.5 | 2822.4 | 0.32 | | 228.1 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1661.0 | 1355.5 | 2412.3 | 0.17 | |
| 108B | Eerste DWSRM - Main member 1 bottom | 180x180x16 | S355 | 16M24-8.8t | 1.00 | 1.77 | 1.00 | 64 | -710.3 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 1484.9 | 1755.4 | 4515.8 | 0.48 | | 435.1 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1444.1 | 1755.4 | 3859.7 | 0.30 | |
| 108C | Eerste DWSRM - Main member 1 bottom | 180x180x16 | S355 | | 1.36 | 2.31 | 1.00 | 63 | -667.0 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 1489.2 | 0.0 | 0.0 | 0.45 | | 373.7 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1966.7 | 0.0 | 0.0 | 0.19 | |
| 109B | Eerste DWSRM - Main member 2 bottom | 160x160x15 | S355 | 10M24-8.8t | 1.00 | 1.61 | 1.00 | 87 | -367.8 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 949.7 | 1355.5 | 2646.0 | 0.39 | | 194.4 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1372.7 | 1355.5 | 2261.5 | 0.14 | |
| 109C | Eerste DWSRM - Main member 2 bottom | 160x160x15 | S355 | | 1.36 | 3.37 | 1.00 | 87 | -327.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 949.4 | 0.0 | 0.0 | 0.34 | | 141.2 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 1658.2 | 0.0 | 0.0 | 0.09 | |
| 110 | Eerste DWSRM - Main member 1 top | 120x120x8 | S235 | 5M24-8.8t | 1.00 | 1.00 | 1.00 | 155 | 0.0 | | 150.8 | 677.8 | 518.4 | 0.00 | | 147.8 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 343.3 | 542.2 | 354.5 | 0.43 | |
| 111 | Eerste DWSRM - Main member 2 top | 100x100x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 202 | 0.0 | | 87.3 | 406.7 | 311.0 | 0.00 | | 109.1 | SPLS 6a_90 Ba Ct1 Ah Ct2 | 211.1 | 406.7 | 265.8 | 0.52 | |
| 112B | Tweede DWSRM - Main member (bottom | 150x150x12 | S355 | 6M24-8.8t | 1.00 | 1.49 | 1.00 | 77 | -334.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 814.0 | 806.5 | 1270.1 | 0.41 | | 125.9 | PLS 3_0_9_120.38 Ba Ct2 | 889.1 | 806.5 | 1085.5 | 0.16 | |
| 112C | Tweede DWSRM - Main member (bottom | 150x150x12 | S355 | | 1.00 | 1.92 | 1.00 | 101 | -237.7 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 571.2 | 0.0 | 0.0 | 0.42 | | 94.8 | PLS 3_0_9_120.38 Ba Ct2 | 1235.4 | 0.0 | 0.0 | 0.08 | |
| 113A | Tweede DWSRM - Main member (top) 1 | 150x150x12 | S235 | 6M24-8.8t | 1.00 | 1.54 | 1.00 | 77 | -172.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 508.0 | 813.3 | 933.1 | 0.34 | | 176.4 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 653.2 | 813.3 | 797.5 | 0.27 | |
| 113B | Tweede DWSRM - Main member (top) 1 | 150x150x12 | S235 | 6M24-8.8t | 1.00 | 1.46 | 1.00 | 78 | -262.4 | SPLS 6a_90 Ba All Cts Ah Ct1 | 516.5 | 806.5 | 933.1 | 0.51 | | 253.2 | S 6a_90 Ah All Cts Ba Ct2 | 653.2 | 806.5 | 797.5 | 0.39 | |
| 113C | Tweede DWSRM - Main member (top) 1 | 150x150x12 | S235 | | 1.00 | 3.00 | 1.00 | 75 | -230.6 | SPLS 6a_90 Ba All Cts Ah Ct1 | 508.2 | 0.0 | 0.0 | 0.45 | | 219.2 | S 6a_90 Ah All Cts Ba Ct2 | 817.8 | 0.0 | 0.0 | 0.27 | |
| 114 | Tweede DWSRM - Main member (bottom | 120x120x8 | S235 | 1M24-8.8t | 1.00 | 2.00 | 1.00 | 231 | -41.5 | ULS 3_69.62 | 57.0 | 135.6 | 103.7 | 0.73 | | 4.5 | ULS 1a_0_9_0_9_120.38 | 216.6 | 135.6 | 88.6 | 0.05 | |
| 115B | Tweede DWSRM - Main member (top) 2 | 130x130x12 | S235 | 4M24-8.8t | 1.00 | 2.49 | 1.00 | 120 | -166.9 | SPLS 6a_90 Ba All Cts Ah Ct1 | 302.0 | 542.2 | 622.1 | 0.55 | | 182.5 | S 6a_90 Ah All Cts Ba Ct2 | 549.5 | 542.2 | 531.7 | 0.34 | |
| 115C | Tweede DWSRM - Main member (top) 2 | 130x130x12 | S235 | | 1.00 | 2.45 | 1.00 | 120 | -143.3 | SPLS 6a_90 Ba All Cts Ah Ct1 | 301.8 | 0.0 | 0.0 | 0.47 | | 157.5 | S 6a_90 Ah All Cts Ba Ct2 | 705.0 | 0.0 | 0.0 | 0.22 | |
| 201L | BVNSTK - Crossing diagonal | 120x120x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 106 | -75.9 | SPLS 3_120.38 Ba Ct1 | 225.7 | 188.2 | 172.8 | 0.44 | | 63.7 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 223.1 | 188.2 | 157.1 | 0.41 | |
| 201T | BVNSTK - Crossing diagonal | 100x100x8 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 129 | -48.5 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 153.6 | 188.2 | 172.8 | 0.32 | | 14.4 | SPLS 3_0_9_90 Ba Ct1 | 179.9 | 188.2 | 157.1 | 0.09 | |
| 202L | BVNSTK - Horizontal | 100x100x8 | S235 | 4M20-8.8t | 1.00 | 1.00 | 1.00 | 133 | 0.0 | | 148.9 | 376.3 | 345.6 | 0.00 | | 145.8 | S 6a_90 Ah All Cts Ba Ct2 | 212.2 | 376.3 | 310.9 | 0.69 | |
| 202T | BVNSTK - Horizontal | 75x75x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 177 | 0.0 | | 47.0 | 60.3 | 51.8 | 0.00 | | 12.2 | ULS 3_90 | 98.5 | 60.3 | 44.8 | 0.27 | |
| 203T | BVNSTK - Horizontal | 90x90x8 | S235 | 4M24-8.8t | 1.00 | 2.00 | 1.00 | 106 | -83.3 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 157.7 | 542.2 | 414.7 | 0.53 | | 148.3 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 252.5 | 542.2 | 354.5 | 0.59 | |
| 204L | BVNSTK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 82 | -330.6 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 510.0 | 813.3 | 933.1 | 0.65 | | 274.3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 653.2 | 813.3 | 797.5 | 0.42 | |
| 204T | BVNSTK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 82 | -281.8 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 510.0 | 813.3 | 933.1 | 0.55 | | 256.7 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 653.2 | 813.3 | 797.5 | 0.39 | |
| 205L | DerdeTSNK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 89 | -250.6 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 481.7 | 813.3 | 933.1 | 0.52 | | 301.0 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 653.2 | 813.3 | 797.5 | 0.46 | |
| 205T | DerdeTSNK - Crossing diagonal | 150x150x12 | S235 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 89 | -234.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 481.7 | 813.3 | 933.1 | 0.49 | | 255.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 653.2 | 813.3 | 797.5 | 0.39 | |
| 206L | DerdeTSNK - Horizontal | 120x120x12 | S235 | 6M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | 0.0 | | 232.0 | 813.3 | 933.1 | 0.00 | | 198.0 | S 6a_90 Ah All Cts Ba Ct1 | 494.8 | 813.3 | 797.5 | 0.40 | |
| 206T | DerdeTSNK - Horizontal | 120x120x12 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 148 | -69.6 | ULS 3_0_9_90 | 232.0 | 406.7 | 466.6 | 0.30 | | 126.8 | ULS 3_90 | 494.8 | 406.7 | 398.8 | 0.32 | |
| 207L | DerdeTSNK - Crossing diagonal | 150x150x15 | S235 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 96 | -340.0 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 561.8 | 813.3 | 1166.4 | 0.61 | | 278.9 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 802.1 | 813.3 | 996.9 | 0.35 | |
| 207T | DerdeTSNK - Crossing diagonal | 150x150x15 | S235 | 6M24-8.8t | 0.52 | 0.52 | 0.52 | 96 | -342.1 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 561.8 | 813.3 | 1166.4 | 0.61 | | 234.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 802.1 | 813.3 | 996.9 | 0.29 | |
| 208T | DerdeTSNK - Horizontal | 120x120x8 | S235 | 5M24-8.8t | 1.00 | 2.00 | 1.00 | 102 | -56.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 220.4 | 677.8 | 518.4 | 0.26 | | 189.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 379.5 | 677.8 | 443.1 | 0.50 | |
| 209L | TweedeTSNK - Crossing diagonal | 150x150x14 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | -450.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 612.4 | 1063.0 | 1451.5 | 0.74 | | 454.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 748.8 | 1063.0 | 1240.6 | 0.61 | |
| 209T | TweedeTSNK - Crossing diagonal | 150x150x14 | S235 | 8M24-8.8t | 0.29 | 0.55 | 0.29 | 70 | -464.0 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 612.4 | 1063.0 | 1451.5 | 0.76 | | 407.4 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 748.8 | 1063.0 | 1240.6 | 0.54 | |
| 210L | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 7M24-8.8t | 0.28 | 0.55 | 0.28 | 87 | -375.8 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 465.3 | 942.9 | 1088.6 | 0.81 | | 361.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 653.2 | 942.9 | 930.5 | 0.55 | |
| 210T | TweedeTSNK - Crossing diagonal | 150x150x12 | S235 | 7M24-8.8t | 0.28 | 0.55 | 0.28 | 87 | -335.5 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 465.3 | 942.9 | 1088.6 | 0.72 | | 376.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 653.2 | 942.9 | 930.5 | 0.58 | |
| 211L | EersteTSNK - Crossing diagonal | 150x150x14 | S235 | 6M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | -289.7 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 452.5 | 813.3 | 1088.6 | 0.64 | | 301.8 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 748.8 | 813.3 | 930.5 | 0.40 | |
| 211T | EersteTSNK - Crossing diagonal | 150x150x14 | S235 | 6M24-8.8t | 0.28 | 0.55 | 0.28 | 107 | -305.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 452.5 | 813.3 | 1088.6 | 0.68 | | 269.4 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 748.8 | 813.3 | 930.5 | 0.36 | |
| 212L | EersteTSNK - Diagonal bracing | 150x150x12 | S235 | 5M24-8.8t | 0.51 | 1.00 | 0.51 | 107 | -249.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 392.8 | 677.8 | 777.6 | 0.64 | | 234.9 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 653.2 | 677.8 | 664.6 | 0.36 | |
| 212T | EersteTSNK - Diagonal bracing | 150x150x12 | S235 | 5M24-8.8t | 0.51 | 1.00 | 0.51 | 107 | -223.6 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 392.8 | 677.8 | 777.6 | 0.57 | | 248.8 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 653.2 | 677.8 | 664.6 | 0.38 | |
| 213L | BRKSTK - Diagonal 1 | 120x120x12 | S235 | 6M24-8.8t | 0.17 | 0.17 | 0.17 | 79 | -322.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 410.1 | 810.8 | 933.1 | 0.79 | | 291.3 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 494.8 | 810.8 | 797.5 | 0.59 | |
| 213T | BRKSTK - Diagonal 1 | 120x120x12 | S235 | 6M24-8.8t | 0.17 | 0.17 | 0.17 | 79 | -296.1 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 410.1 | 810.8 | 933.1 | 0.72 | | 310.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 494.8 | 810.8 | 797.5 | 0.63 | |
| 214L | BRKSTK - Horizontal | 120x120x10 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 169 | -53.8 | SPLS 3_120.38 Ba All Cts | 165.6 | 271.1 | 259.2 | 0.32 | | 35.8 | S 3_0_9_120.38 Ba All Cts | 278.4 | 271.1 | 221.5 | 0.16 | |
| 214T | BRKSTK - Horizontal | 120x120x10 | S235 | 2M24-8.8t | 1.00 | 1.00 | 1.00 | 169 | -56.4 | SPLS 3_120.38 Ba All Cts | 165.6 | 271.1 | 259.2 | 0.34 | | 39.2 | S 3_0_9_120.38 Ba All Cts | 278.4 | 271.1 | 221.5 | 0.18 | |
| 215 | BRKSTK - Diagonal 2 | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 311 | -4.3 | ULS 1a_0 | 13.8 | 60.3 | 51.8 | 0.31 | | 2.9 | ULS 1a_0_9_0_9_45 | 72.6 | 60.3 | 44.8 | 0.06 | |
| 216 | BRKSTK - Crossing diagonal | 80x80x6# | S235 | 1M16-8.8t | 1.00 | 0.50 | 0.50 | 324 | -1.2 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 16.2 | 60.3 | 51.8 | 0.08 | | 0.0 | | 107.1 | 60.3 | 44.8 | 0.00 | |
| 300 | Eerste DWSRM - Diagonal bracing | 80x80x6# | S235 | 1M24-8.8t | 1.00 | 1.00 | 1.00 | 340 | 0.0 | | 18.9 | 135.6 | 77.8 | 0.00 | | 30.1 | SPLS 6a_90 Ba Ct1 Ba Ct2 | 93.3 | 135.6 | 59.8 | 0.50 | |
| 301 | Eerste DWSRM - Vertical bracing | 80x80x8 | S235 | 1M24-8.8t | 1.00 | 1.00 | 1.00 | 195 | -21.1 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 57.9 | 135.6 | 103.7 | 0.36 | | 0.0 | | 124.4 | 135.6 | 88.6 | 0.00 | |
| 302 | Eerste DWSRM - Diagonal bracing | 70x70x6 | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 342 | 0.0 | | 20.2 | 188.2 | 129.6 | 0.00 | | 44.5 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 88.8 | 188.2 | 110.3 | 0.50 | |
| 303 | Eerste DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 218 | -5.1 | ULS 3_135 | 24.1 | 60.3 | 43.2 | 0.21 | | 0.0 | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 304 | Eerste DWSRM - Diagonal bracing | 70x70x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 347 | 0.0 | | 15.8 | 60.3 | 51.8 | 0.00 | | 10.4 | SPLS 3_135 Ah All Cts | 89.9 | 60.3 | 44.8 | 0.23 | |
| 305 | Eerste DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 103 | -1.3 | ULS 1a_45 | 47.3 | 60.3 | 43.2 | 0.03 | | 0.0 | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 306 | Eerste DWSRM - Internal bracing (B-B) | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 217 | -0.9 | SPLS 1a_135 Ba All Cts | 19.5 | 60.3 | 43.2 | 0.05 | | 1.1 | SPLS 1a_0 Ah All Cts | 37.4 | 60.3 | 22.0 | 0.05 | |
| 307 | Eerste DWSRM - Internal bracing (B-B) | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 186 | -0.5 | ULS 1a_0 | 24.2 | 60.3 | 43.2 | 0.02 | | 0.4 | SPLS 1a_135 Ba All Cts | 60.5 | 60.3 | 37.3 | 0.01 | |
| 308 | Eerste DWSRM - Internal bracing (A-A) | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 170 | 0.0 | | 27.4 | 60.3 | 43.2 | 0.00 | | 5.0 | ULS 3_0_9_0 | 37.4 | 60.3 | 25.7 | 0.20 | |
| 309 | Eerste DWSRM - Internal bracing (A-A) | 60x60x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 208 | -3.8 | ULS 3_0_9_120.38 | 29.8 | 60.3 | 51.8 | 0.13 | | 0.0 | | 72.6 | 60.3 | 44.8 | 0.00 | |
| 310 | Eerste DWSRM - Diaphragm diagonal | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 113 | -160.4 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 213.5 | 406.7 | 311.0 | 0.75 | | 186.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 263.0 | 406.7 | 265.8 | 0.71 | |
| 311 | Eerste DWSRM - Diaphragm crossing dia | 55x55x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 179 | -22.0 | ULS 7 | 28.2 | 60.3 | 86.4 | 0.78 | | 0.0 | | 92.2 | 60.3 | 86.4 | 0.00 | |
| 312 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 1M24-8.8t | 0.54 | 0.54 | 0.54 | 143 | -68.1 | SPLS 6a_90 Ba All Cts Ah Ct2 | 86.7 | 135.6 | 103.7 | 0.79 | | 42.6 | S 6a_90 Ba All Cts Ah Ct2 | 124.4 | 135.6 | 88.6 | 0.48 | |
| 313 | Eerste DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M24-8.8t | 0.53 | 0.53 | 0.53 | 132 | -53.3 | SPLS 6a_90 Ba All Cts Ah Ct2 | 119.2 | 271.1 | 207.4 | 0.45 | | 75.0 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 135.4 | 271.1 | 170.0 | 0.55 | |
| 314 | Eerste DWSRM - Horizontal | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 78 | -11.5 | ULS 1a_120.38 | 585.6 | 188.2 | 216.0 | 0.06 | | 4.2 | SPLS 6a_90 Ba Ct2 Ah Ct1 | 499.5 | 188.2 | 213.8 | 0.02 | |
| 315 | Eerste DWSRM - Crossing diagonal | 90x90x8 | S235 | 2M24-8.8t | 0.53 | 0.53 | 0.53 | 118 | -90.9 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 150.5 | 271.1 | 207.4 | 0.60 | | 84.5 | S 6a_90 Ba All Cts Ah Ct2 | 170.7 | 271.1 | 177.2 | 0.50 | |
| 316 | Eerste DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 186 | 0.0 | | 120.8 | 188.2 | 323.4 | 0.00 | | 41.6 | ULS 3_120.38 | 401.4 | 188.2 | 323.4 | 0.22 | |
| 317 | Eerste DWSRM - Crossing diagonal | 65x65x6 | S235 | 2M16-8.8t | 0.51 | 0.51 | 0.51 | 112 | -33.6 | SPLS 6a_90 Ba All Cts Ah Ct2 | 86.1 | 120.6 | 103.7 | 0.39 | | 47.8 | S 6a_90 Ba All Cts Ah Ct2 | 86.7 | 120.6 | 89.6 | 0.55 | |
| 318 | Eerste DWSRM - Crossing diagonal | 90x90x8 | S235 | 2M24-8.8t | 0.55 | 0.55 | 0.55 | 110 | -46.5 | SPLS 6a_90 Ba All Cts Ah Ct1 | 161.7 | 271.1 | 207.4 | 0.29 | | 32.5 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 173.9 | 271.1 | 177.2 | 0.19 | |
| 319 | Eerste DWSRM - Horizontal | HEA160 | S235 | 2M20-8.8t | 2.00 | 2.00 | 2.00 | 53 | -2.1 | ULS 1a_0_9_0_9_120.38 | 694.4 | 188.2 | 216.0 | 0.01 | | 11.0 | ULS 3_90 | 471.3 | 188.2 | 196.4 | 0.06 | |
| 320 | Eerste DWSRM - Crossing diagonal | 70x70x6 | S235 | 2M20-8.8t | 0.54 | 0.54 | 0.54 | 103 | -36.9 | SPLS 6a_90 Ba All Cts Ah Ct2 | 100.1 | 188.2 | 129.6 | 0.37 | | 37.6 | S 6a_90 Ba All Cts Ah Ct2 | 106.9 | 188.2 | 117.8 | 0.35 | |
| 321 | Eerste DWSRM - Crossing diagonal | 70x70x6 | S235 | 2M20-8.8t | 0.55 | 0.55 | 0.55 | 96 | -48.9 | SPLS 6a_90 Ba All Cts Ah Ct2 | 105.7 | 188.2 | 129.6 | 0.46 | | 48.5 | S 6a_90 Ba All Cts Ah Ct2 | 117.5 | 188.2 | 117.8 | 0.41 | |
| 322 | Eerste DWSRM - Crossing diagonal | 75x75x7# | S235 | 3M20-8.8t | 0.56 | 0.56 | 0.56 | 82 | -68.8 | SPLS 6a_90 Ba All Cts Ah Ct2 | 149.5 | 282.2 | 226.8 | 0.46 | | 64.7 | S 6a_90 Ba All Cts Ah Ct2 | 133.8 | 282.2 | 183.3 | 0.48 | |
| 323 | Eerste DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 62 | 0.0 | | 374.2 | 188.2 | 323.4 | 0.00 | | 72.1 | ULS 3_90 | 401.4 | 188.2 | 323.4 | 0.38 | |
| 324 | Eerste DWSRM - Diagonal | 60x60x5 | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 86 | -32.5 | SPLS 6a_90 Ba All Cts Ah Ct2 | 82.4 | 188.2 | 108.0 | 0.39 | | 32.6 | S 6a_90 Ba All Cts Ah Ct2 | 61.5 | 188.2 | 83.2 | 0.53 | |
| 325 | Eerste DWSRM - Horizontal | 100x100x12 | S235 | 2M24-8.8t | 2.00 | 2.00 | 2.00 | 55 | -21.1 | ULS 3_135 | 398.6 | 271.1 | 311.0 | 0.08 | | 0.0 | | 225.6 | 271.1 | 228.6 | 0.00 | |
| 400 | Tweede DWSRM - Diagonal bracing | 130x130x14 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 285 | -8.6 | SPLS 3_0_9_120.38 Ba All Cts | 84.2 | 542.2 | 518.4 | 0.10 | | 186.3 | S 6a_90 Ah All Cts Ba Ct2 | 463.7 | 542.2 | 443.1 | 0.42 | |
| 401 | Tweede DWSRM - Diagonal bracing | 130x130x14 | S235 | 4M24-8.8t | 1.00 | 1.00 | 1.00 | 192 | 0.0 | | 152.4 | 542.2 | 518.4 | 0.00 | | 150.5 | ULS 3_120.38 | 463.7 | 542.2 | 443.1 | 0.34 | |
| 402 | Tweede DWSRM - Diagonal bracing | 80x80x6# | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 218 | -12.5 | SPLS 6a_90 Ba Ct1 Ah Ct1 | 37.9 | 60.3 | 51.8 | 0.33 | | 0.0 | | 107.1 | 60.3 | 44.8 | 0.00 | |
| 403 | Tweede DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 83 | 0.0 | | 55.2 | 60.3 | 43.2 | 0.00 | | 3.2 | SPLS 6a_90 Ah Ct1 Ba Ct1 | 37.4 | 60.3 | 25.7 | 0.12 | |
| 404 | Tweede DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 166 | -10.0 | SPLS 6a_90 Ah All Cts Ba Ct2 | 28.2 | 60.3 | 43.2 | 0.36 | | 11.0 | S 6a_90 Ba All Cts Ah Ct2 | 37.4 | 60.3 | 25.7 | 0.43 | |
| 405 | Tweede DWSRM - Diagonal bracing | 75x75x6 | S235 | 1M24-8.8t | 1.00 | 1.00 | 1.00 | 246 | 0.0 | | 29.3 | 135.6 | 77.8 | 0.00 | | 6.4 | ULS 3_90 | 84.7 | 135.6 | 56.0 | 0.11 | |
| 406 | Tweede DWSRM - Vertical bracing | 80x80x6# | S235 | 1M20-8.8t | 1.00 | 1.00 | 1.00 | 173 | -16.1 | SPLS 6a_90 Ah All Cts Ba Ct2 | 52.2 | 94.1 | 64.8 | 0.31 | | 7.8 | S 6a_90 Ah All Cts Ba Ct2 | 100.2 | 94.1 | 58.9 | 0.13 | |

DNV·GL

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

| | |
|---|---|
| Date | 05-05-21 |
| Author | KCh |
| Version | 1.0 |

**ZW380 Oost**
**HC+0**
**16**

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 407 | Tweede DWSRM - Diagonal diaphragm | 120x120x8 | S235 | 3M24-8.8t | 1.00 | 1.00 | 1.00 | 86 | **-154.8** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 265.3 | 406.7 | 311.0 | 0.58 | | **172.5** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 263.0 | 406.7 | 265.8 | 0.66 | |
| 408 | Tweede DWSRM - Crossing diagonal diap | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 1.00 | 0.50 | 193 | **-15.7** | ULS 7 | 20.3 | 60.3 | 43.2 | 0.77 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 409 | Tweede DWSRM - Crossing diagonal | 70x70x6 | S235 | 2M20-8.8t | 0.54 | 0.54 | 0.54 | 142 | **-25.7** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 71.9 | 188.2 | 129.6 | 0.36 | | **15.3** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 88.8 | 188.2 | 110.3 | 0.17 | |
| 410 | Tweede DWSRM - Crossing diagonal | 70x70x6 | S235 | 2M20-8.8t | 0.52 | 0.52 | 0.52 | 134 | **-20.1** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 77.0 | 188.2 | 129.6 | 0.26 | | **28.6** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 117.5 | 188.2 | 117.8 | 0.24 | |
| 411 | Tweede DWSRM - Crossing diagonal | 80x80x6# | S235 | 2M20-8.8t | 0.53 | 0.53 | 0.53 | 108 | **-30.2** | SPLS 6a_90 Ba Ct1 Ah Ct1 | 111.3 | 188.2 | 129.6 | 0.27 | | **22.6** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 143.9 | 188.2 | 117.8 | 0.19 | |
| 412 | Tweede DWSRM - Crossing diagonal | 80x80x6# | S235 | 2M24-8.8t | 0.53 | 0.53 | 0.53 | 109 | **-48.9** | SPLS 6a_90 Ba All Cts Ah Ct2 | 110.0 | 271.1 | 155.5 | 0.44 | | **49.4** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 136.2 | 271.1 | 132.9 | 0.37 | |
| 413 | Tweede DWSRM - Crossing diagonal | 80x80x8 | S235 | 2M24-8.8t | 0.53 | 0.53 | 0.53 | 102 | **-58.6** | SPLS 6a_90 Ba Ct2 Ah Ct2 | 152.9 | 271.1 | 207.4 | 0.38 | | **55.4** | S 6a_90 Ba All Cts Ah Ct2 | 168.0 | 271.1 | 177.2 | 0.33 | |
| 414 | Tweede DWSRM - Horizontal | 100x65x11 | S355 | 2M20-8.8t | 1.00 | 2.00 | 1.00 | 103 | **0.0** | SPLS 1a_0.9_0 Ba All Cts | 245.2 | 188.2 | 323.4 | 0.00 | | **56.1** | ULS 3_120.38 | 401.4 | 188.2 | 323.4 | 0.30 | |
| 415 | Tweede DWSRM - Diagonal | 55x55x5 | S235 | 2M16-8.8t | 1.00 | 1.00 | 1.00 | 112 | **-25.5** | SPLS 6a_90 Ba All Cts Ah Ct2 | 60.8 | 120.6 | 172.8 | 0.42 | | **25.6** | S 6a_90 Ba All Cts Ah Ct2 | 71.0 | 120.6 | 130.8 | 0.36 | |
| 430 | Tweede DWSRM - Crossing diagonal A-A | 60x60x5 | S235 | 1M20-8.8t | 0.50 | 0.50 | 0.50 | 140 | **-14.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 42.0 | 94.1 | 54.0 | 0.34 | | **13.1** | S 6a_90 Ah All Cts Ba Ct2 | 54.7 | 94.1 | 41.6 | 0.32 | |
| 431 | Tweede DWSRM - Crossing diagonal B-B | 50x50x5 | S235 | 1M16-8.8t | 0.50 | 0.50 | 0.50 | 143 | **-14.2** | SPLS 6a_90 Ba All Cts Ah Ct2 | 33.9 | 60.3 | 43.2 | 0.42 | | **20.1** | S 6a_90 Ba All Cts Ah Ct2 | 37.4 | 60.3 | 25.7 | 0.78 | |
| 432 | Tweede DWSRM - Crossing diagonal | 65x65x6 | S235 | 1M20-8.8t | 0.52 | 0.52 | 0.52 | 153 | **-29.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 48.9 | 94.1 | 64.8 | 0.60 | | **24.0** | S 6a_90 Ah All Cts Ba Ct2 | 74.3 | 94.1 | 57.4 | 0.42 | |
| 433 | Tweede DWSRM - Crossing diagonal | 65x65x6 | S235 | 1M20-8.8t | 0.52 | 0.52 | 0.52 | 148 | **-29.4** | SPLS 6a_90 Ah All Cts Ba Ct2 | 50.9 | 94.1 | 64.8 | 0.58 | | **33.3** | S 6a_90 Ah All Cts Ba Ct2 | 74.3 | 94.1 | 57.4 | 0.58 | |
| 434 | Tweede DWSRM - Crossing diagonal | 70x70x6 | S235 | 2M20-8.8t | 0.50 | 0.50 | 0.50 | 118 | **-36.9** | SPLS 6a_90 Ah All Cts Ba Ct2 | 88.1 | 188.2 | 129.6 | 0.42 | | **33.4** | S 6a_90 Ah All Cts Ba Ct2 | 90.9 | 188.2 | 91.6 | 0.37 | |
| 435 | Tweede DWSRM - Horizontal | 65x65x6 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 178 | **-4.5** | ULS 3_90 | 40.2 | 60.3 | 51.8 | 0.11 | | **0.0** | | 81.2 | 60.3 | 44.8 | 0.00 | |
| 436 | Tweede DWSRM - Crossing diagonal | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 141 | **-14.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 38.2 | 60.3 | 86.4 | 0.37 | | **15.0** | S 6a_90 Ah All Cts Ba Ct2 | 92.2 | 60.3 | 65.4 | 0.25 | |
| 437 | Tweede DWSRM - Crossing diagonal | 55x55x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 134 | **-21.3** | SPLS 6a_90 Ah All Cts Ba Ct2 | 40.5 | 60.3 | 86.4 | 0.53 | | **21.1** | S 6a_90 Ah All Cts Ba Ct2 | 92.2 | 60.3 | 65.4 | 0.35 | |
| 438 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 140 | **-17.0** | SPLS 6a_90 Ah All Cts Ba Ct2 | 34.8 | 60.3 | 43.2 | 0.49 | | **17.7** | S 6a_90 Ah All Cts Ba Ct2 | 37.4 | 60.3 | 25.7 | 0.69 | |
| 439 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 109 | **-10.3** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 45.0 | 60.3 | 43.2 | 0.24 | | **10.1** | SPLS 6a_90 Ah Ct2 Ba Ct2 | 37.4 | 60.3 | 25.7 | 0.39 | |
| 440 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 98 | **-13.3** | SPLS 6a_90 Ah All Cts Ba Ct2 | 49.5 | 60.3 | 43.2 | 0.31 | | **13.2** | S 6a_90 Ah All Cts Ba Ct2 | 37.4 | 60.3 | 25.7 | 0.51 | |
| 441 | Tweede DWSRM - Crossing diagonal | 50x50x5 | S235 | 1M16-8.8t | 0.53 | 0.53 | 0.53 | 89 | **-14.1** | SPLS 6a_90 Ah All Cts Ba Ct2 | 53.1 | 60.3 | 43.2 | 0.33 | | **14.4** | S 6a_90 Ah All Cts Ba Ct2 | 37.4 | 60.3 | 25.7 | 0.56 | |
| 442 | Tweede DWSRM - Crossing diagonal | 60x60x5 | S235 | 1M20-8.8t | 0.53 | 0.53 | 0.53 | 68 | **-17.1** | SPLS 6a_90 Ah All Cts Ba Ct2 | 71.8 | 94.1 | 54.0 | 0.32 | | **16.1** | S 6a_90 Ah All Cts Ba Ct2 | 54.7 | 94.1 | 41.6 | 0.39 | |
| 443 | Tweede DWSRM - Crossing diagonal | 60x60x5 | S235 | 1M20-8.8t | 0.53 | 0.53 | 0.53 | 60 | **-17.6** | SPLS 6a_90 Ah All Cts Ba Ct2 | 74.3 | 94.1 | 54.0 | 0.33 | | **19.2** | S 6a_90 Ah All Cts Ba Ct2 | 54.7 | 94.1 | 41.6 | 0.46 | |
| 444 | Tweede DWSRM - Vertical bracing | 50x50x5 | S235 | 1M16-8.8t | 1.00 | 1.00 | 1.00 | 131 | **-2.8** | ULS 7 | 37.3 | 60.3 | 43.2 | 0.07 | | **0.0** | | 37.4 | 60.3 | 25.7 | 0.00 | |
| 445 | Tweede DWSRM - UNP Member | 160x65x7.5(t | S235 | 2M20-8.8t | 1.00 | 1.00 | 1.00 | 47 | **0.0** | | 443.0 | 188.2 | 162.0 | 0.00 | | **33.7** | ULS 3_0.9_120.38 | 547.9 | 188.2 | 127.6 | 0.26 | |

# APPENDIX C
# Knikverkorters

Niet in PLS-TOWER gemodelleerde elementen in de constructie worden aanvullend getoetst. Hieronder vallen de knikverkorters van de randstijl en profielen onderdeel van stabiliteitsverbanden. De staven worden getoetst op:

- voldoende trek- of druksterkte als steungevend profiel voor randstijl, 1% van de knikcapaciteit van de randstijl;
- slankheid
- klimbelasting

Profielen uit horizontaalverbanden van het onderstuk zijn in PLS-TOWER aanwezig maar worden in deze Appendix aanvullend getoetst op buiging.

Indien bestaande profielen niet voldoen ten aanzien van slankheid, dan wordt deze overschrijding geaccepteerd, aangezien dit niet de sterkte van de mast beïnvloed.

## Knikverkorters initial construction (afkeur)

Date: 2021-05-20
Author: K Chan
Version: 1.8

ZW380 Oost
HB+0
68&78

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g34 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.574 | 0 | 59 | **24.1** | **0.14** | 61.8 | 60.3 | 30.3 | 31.7 | 0.72 | 0.79 | | |
| g20 | Broekstuk | Enkele staaf | L75x7 | S235 | M16 | 8.8 | 1.71 | 73 | 117 | **24.1** | **0.00** | 88.9 | 60.3 | 44.8 | 104.8 | 2.27 | 0.54 | | |
| g33 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.98 | 0 | 101 | **24.1** | **0.25** | 48.3 | 60.3 | 30.3 | 31.7 | 0.72 | 0.79 | | |
| g30 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.24 | 0 | 127 | **24.1** | **0.31** | 38.5 | 60.3 | 30.3 | 31.7 | 0.72 | 0.79 | | |
| g18 | Broekstuk | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 1.93 | 57 | 180 | **24.1** | **0.00** | 33.1 | 60.3 | 37.8 | 55.3 | 1.03 | 0.73 | | |
| g29 | Broekstuk | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 1.91 | 0 | 178 | **24.1** | **0.48** | 33.8 | 60.3 | 37.8 | 55.3 | 1.03 | 0.71 | | |
| g16 | Broekstuk | Enkele staaf | L60x6 | S235 | M16 | 8.8 | 2.34 | 44 | 200 | **24.1** | **0.00** | 31.5 | 60.3 | 38.4 | 72.6 | 1.24 | 0.76 | | |
| g28 | Broekstuk | Enkele staaf | L65x6 | S235 | M16 | 8.8 | 2.57 | 0 | 203 | **24.1** | **0.64** | 33.6 | 60.3 | 38.4 | 72.6 | 1.46 | 0.72 | | |
| g14 | Broekstuk | Enkele staaf | L65x6 | S235 | M16 | 8.8 | 2.85 | 35 | 224 | **24.1** | **0.00** | 29.1 | 60.3 | 38.4 | 72.6 | 1.46 | 0.83 | | |
| g27 | Broekstuk | Enkele staaf | L75x6 | S235 | M16 | 8.8 | 3.24 | 0 | 220 | **24.1** | **0.81** | 34.7 | 60.3 | 38.4 | 89.9 | 1.96 | 0.69 | | |
| g12 | Broekstuk | Enkele staaf | L75x6 | S235 | M16 | 8.8 | 3.19 | 29 | 217 | **24.1** | **0.70** | 35.5 | 60.3 | 38.4 | 89.9 | 1.96 | 0.68 | | |
| g74 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.84 | 0 | 86 | **3.8** | **0.21** | 54.4 | 60.3 | 30.3 | 31.7 | 0.72 | 0.29 | | |
| g72 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 1.75 | 0 | 115 | **3.8** | **0.22** | 32.9 | 60.3 | 30.3 | 31.7 | 0.54 | 0.42 | | |
| g70 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 2.73 | 0 | 180 | **3.8** | **0.34** | 20.2 | 60.3 | 30.3 | 31.7 | 0.54 | 0.66 | | |
| g68 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 3.68 | 0 | 243 | **3.8** | **0.46** | 13.7 | 60.3 | 30.3 | 31.7 | 0.54 | 0.89 | | |
| g66 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 4.63 | 0 | 306 | **3.8** | **0.58** | 9.8 | 60.3 | 30.3 | 31.7 | 0.54 | 1.11 | Bending | |
| g73 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.90 | 77 | 195 | **3.8** | **0.00** | 22.6 | 60.3 | 30.3 | 31.7 | 0.72 | 0.17 | | |
| g71 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.04 | 64 | 210 | **3.8** | **0.00** | 20.4 | 60.3 | 30.3 | 31.7 | 0.72 | 0.19 | | |
| g69 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.28 | 53 | 234 | **3.8** | **0.00** | 17.4 | 60.3 | 30.3 | 31.7 | 0.72 | 0.22 | | |
| g67 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.59 | 45 | 266 | **3.8** | **0.00** | 14.3 | 60.3 | 30.3 | 31.7 | 0.72 | 0.27 | | |
| g65 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.87 | 36 | 295 | **3.8** | **0.00** | 12.2 | 60.3 | 30.3 | 31.7 | 0.72 | 0.31 | | |
| g37 | Tussenschot +9,6n | Enkele staaf | L120x8 | S235 | M24 | 8.8 | 3.83 | 0 | 162 | **24.1** | **0.96** | 113.8 | 135.6 | 149.5 | 365.5 | 7.71 | 0.21 | | |
| g36 | Tussenschot +9,6n | Kniksteun en verticale steun | L60x6 | S235 | M16 | 8.8 | 5.29 | 0 | 291 | **1.8** | **0.66** | 15.2 | 60.3 | 38.4 | 72.6 | 0.93 | 0.74 | | |
| g35 | Tussenschot +9,6n | Kruisende staaf halverwege | L80x6 | S235 | M20 | 8.8 | 7.85 | 0 | 321 | **1.8** | **0.98** | 17.7 | 94.1 | 52.4 | 100.2 | 2.2 | 0.44 | | |
| g92 | Tussenstuk1 | Enkele staaf | L65x6 | S235 | M16 | 8.8 | 2.45 | 43 | 193 | **24.0** | **0.00** | 36.0 | 60.3 | 38.4 | 72.6 | 1.46 | 0.67 | | |
| g100 | Tussenstuk1 | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 1.89 | 0 | 176 | **24.0** | **0.47** | 34.2 | 60.3 | 37.8 | 55.3 | 1.03 | 0.70 | | |
| g98 | Tussenstuk1 | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 1.56 | 0 | 145 | **24.0** | **0.39** | 43.6 | 60.3 | 37.8 | 55.3 | 1.03 | 0.63 | | |
| g91 | Tussenstuk1 | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 2.11 | 48 | 197 | **24.0** | **0.00** | 29.5 | 60.3 | 37.8 | 55.3 | 1.03 | 0.81 | | |
| g96 | Tussenstuk1 | Enkele staaf | L75x6 | S235 | M16 | 8.8 | 2.99 | 0 | 203 | **24.0** | **0.75** | 38.9 | 60.3 | 38.4 | 89.9 | 1.96 | 0.62 | | |
| g87 | Tussenstuk1 | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 2.18 | 39 | 203 | **24.0** | **0.00** | 28.1 | 60.3 | 37.8 | 55.3 | 1.03 | 0.85 | | |
| g95 | Tussenstuk1 | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 1.52 | 0 | 142 | **24.0** | **0.38** | 44.9 | 60.3 | 37.8 | 55.3 | 1.0 | 0.63 | | |
| g180 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.28 | 0 | 132 | **17.0** | **0.32** | 37.1 | 60.3 | 30.3 | 31.7 | 0.7 | 0.56 | | |
| g171 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.72 | 47 | 177 | **17.0** | **0.00** | 25.9 | 60.3 | 30.3 | 31.7 | 0.72 | 0.66 | | |
| g179 | Tussenstuk2 | Enkele staaf | L55x6 | S235 | M16 | 8.8 | 2.41 | 0 | 225 | **17.0** | **0.60** | 24.3 | 60.3 | 37.8 | 55.3 | 1.03 | 0.70 | | |
| g168 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.79 | 39 | 183 | **17.0** | 0.00 | 24.7 | 60.3 | 30.3 | 31.7 | 0.7 | 0.69 | | |
| g178 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.25 | 0 | 128 | **17.0** | 0.31 | 38.3 | 60.3 | 30.3 | 31.7 | 0.7 | 0.56 | | |
| g176 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.05 | 0 | 107 | **17.0** | 0.26 | 45.6 | 60.3 | 30.3 | 31.7 | 0.7 | 0.56 | | |
| g166 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.37 | 46 | 141 | **17.0** | 0.00 | 34.4 | 60.3 | 30.3 | 31.7 | 0.7 | 0.56 | | |
| g175 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.90 | 0 | 196 | **17.0** | **0.48** | 22.6 | 60.3 | 30.3 | 31.7 | 0.72 | 0.75 | | |
| g163 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.44 | 39 | 147 | **17.0** | **0.00** | 32.6 | 60.3 | 30.3 | 31.7 | 0.72 | 0.56 | | |
| g174 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.99 | 0 | 102 | **17.0** | 0.25 | 47.8 | 60.3 | 30.3 | 31.7 | 0.7 | 0.56 | | |
| g133 | Bovenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.66 | 0 | 170 | **9.0** | 0.41 | 27.3 | 60.3 | 30.3 | 31.7 | 0.7 | 0.58 | | |

## Knikverkorters initial construction (afkeur)

Date: 2021-05-20
Author: K Chan
Version: 1.8

ZW380 Oost
HB+0
68&78

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g130 | Bovenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.50 | 0 | 154 | **9.0** | **0.38** | 30.9 | 60.3 | 30.3 | 31.7 | 0.7 | 0.52 | | |
| g215 | Bovenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.39 | 0 | 143 | **4.2** | **0.35** | 33.9 | 60.3 | 30.3 | 31.7 | 0.7 | 0.48 | | |
| g213 | Bovenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.29 | 0 | 132 | **4.2** | **0.32** | 37.1 | 60.3 | 30.3 | 31.7 | 0.7 | 0.45 | | |

## Knikverkorters adjusted construction (verbouw)

ZW380 Oost
HB+0
68&78

Date: 2021-05-20
Author: K. Chan
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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g66 | Pootverband | Kniksteun en vert | **L70x7** | **S355** | M16 | 8.8 | 4.63 | 0 | 218 | **3.8** | **0.75** | 35.3 | 60.3 | 61.0 | 170.1 | 2.99 | 0.35 | | Profile exchanged |

## Knikverkorters initial construction (afkeur)

Date: 2021-05-26
Author: K Chan
Version: 1.8

ZW380 Oost
HS+0
26

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g46 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.65 | 0 | 67 | **10.6** | **0.16** | 59.7 | 60.3 | 30.3 | 31.7 | 0.72 | 0.35 | | |
| g29 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.53 | 68 | 158 | **10.6** | **0.00** | 30.1 | 60.3 | 30.3 | 31.7 | 0.72 | 0.35 | | |
| g42 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.35 | 0 | 139 | **10.6** | **0.34** | 35.1 | 60.3 | 30.3 | 31.7 | 0.72 | 0.47 | | |
| g26 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.85 | 50 | 190 | **10.6** | 0.00 | 23.5 | 60.3 | 30.3 | 31.7 | 0.7 | 0.45 | | |
| g38 | Broekstuk | Enkele staaf | L55x5 | S235 | M16 | 8.8 | 2.05 | 0 | 191 | **10.6** | **0.51** | 25.8 | 60.3 | 31.5 | 46.1 | 0.87 | 0.59 | | |
| g23 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.34 | 37 | 240 | **10.6** | **0.00** | 16.7 | 60.3 | 30.3 | 31.7 | 0.72 | 0.63 | | |
| g36 | Broekstuk | Enkele staaf | L60x6 | S235 | M16 | 8.8 | 2.75 | 0 | 235 | **10.6** | **0.69** | 24.9 | 60.3 | 38.4 | 72.6 | 1.24 | 0.55 | | |
| g20 | Broekstuk | Enkele staaf | L55x5 | S235 | M16 | 8.8 | 2.92 | 29 | 272 | **10.6** | **0.64** | 15.3 | 60.3 | 31.5 | 46.1 | 0.87 | 0.74 | | |
| g17 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.81 | 28 | 288 | **10.6** | **0.62** | 12.6 | 60.3 | 30.3 | 31.7 | 0.72 | 0.86 | | |
| g34 | Broekstuk | Enkele staaf | L60x6 | S235 | M16 | 8.8 | 2.27 | 0 | 194 | **10.6** | **0.57** | 32.9 | 60.3 | 38.4 | 72.6 | 1.24 | 0.46 | | |
| g14 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.95 | 47 | 200 | **10.6** | **0.00** | 21.9 | 60.3 | 30.3 | 31.7 | 0.72 | 0.48 | | |
| g30 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.10 | 0 | 113 | **10.6** | **0.27** | 43.7 | 60.3 | 30.3 | 31.7 | 0.72 | 0.38 | | |
| g127 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.48 | 0 | 152 | **1.3** | **0.37** | 31.3 | 60.3 | 30.3 | 31.7 | 0.72 | 0.52 | | |
| g125 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 3.16 | 0 | 209 | **1.3** | **0.39** | 16.8 | 60.3 | 30.3 | 31.7 | 0.54 | 0.76 | | |
| g126 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.86 | 75 | 294 | **1.3** | **0.00** | 12.2 | 60.3 | 30.3 | 31.7 | 0.72 | 0.11 | | |
| g124 | Pootverband | Enkele staaf | L55x5 | S235 | M16 | 8.8 | 3.09 | 59 | 288 | **1.3** | **0.00** | 14.0 | 60.3 | 31.5 | 46.1 | 0.87 | 0.09 | | |
| g122 | Tussenschot +7m | Enkele staaf | L65x6 | S235 | M16 | 8.8 | 3.44 | 0 | 271 | **10.6** | **0.86** | 21.8 | 60.3 | 38.4 | 72.6 | 1.46 | 0.59 | | |
| g120 | Tussenschot +7m | Kniksteun en verticale steun | L75x6 | S235 | M16 | 8.8 | 4.65 | 0 | 204 | **0.2** | **0.58** | 31.6 | 60.3 | 38.4 | 89.9 | 1.54 | 0.40 | | |
| g121 | Tussenschot +7m | Kruisende staaf halverwege | L65x6 | S235 | M16 | 8.8 | 6.86 | 0 | 348 | **0.2** | **0.86** | 12.6 | 60.3 | 38.4 | 72.6 | 1.46 | 0.59 | | |
| g100 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.29 | 0 | 133 | **10.9** | **0.32** | 36.9 | 60.3 | 30.3 | 31.7 | 0.72 | 0.45 | | |
| g90 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.89 | 50 | 194 | **10.9** | **0.00** | 22.8 | 60.3 | 30.3 | 31.7 | 0.72 | 0.48 | | |
| g98 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 2.57 | 0 | 218 | **10.9** | **0.64** | 23.4 | 60.3 | 32.0 | 60.5 | 1.05 | 0.61 | | |
| g88 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.83 | 48 | 188 | **10.9** | **0.00** | 23.8 | 60.3 | 30.3 | 31.7 | 0.72 | 0.46 | | |
| g87 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.71 | 50 | 176 | **10.9** | **0.00** | 26.1 | 60.3 | 30.3 | 31.7 | 0.72 | 0.42 | | |
| g97 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 2.24 | 0 | 191 | **10.9** | **0.56** | 28.4 | 60.3 | 32.0 | 60.5 | 1.1 | 0.53 | | |
| g85 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.64 | 50 | 169 | **10.9** | **0.00** | 27.6 | 60.3 | 30.3 | 31.7 | 0.72 | 0.39 | | |
| g96* | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.73 | 43 | 178 | **10.9** | **0.00** | 25.7 | 60.3 | 30.3 | 31.7 | 0.72 | 0.42 | | |
| g104 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 2.58 | 0 | 220 | **10.9** | **0.65** | 23.1 | 60.3 | 32.0 | 60.5 | 1.05 | 0.61 | | |
| g95 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.70 | 43 | 175 | **10.9** | **0.00** | 26.3 | 60.3 | 30.3 | 31.7 | 0.72 | 0.41 | | |
| g93 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.77 | 50 | 182 | **10.9** | **0.00** | 25.0 | 60.3 | 30.3 | 31.7 | 0.72 | 0.44 | | |
| g102 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 2.29 | 0 | 195 | **10.9** | **0.57** | 27.5 | 60.3 | 32.0 | 60.5 | 1.05 | 0.55 | | |
| g92 | Tussenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.70 | 50 | 174 | **10.9** | **0.00** | 26.4 | 60.3 | 30.3 | 31.7 | 0.7 | 0.41 | | |
| g164 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.54 | 51 | 159 | **11.0** | **0.00** | 29.9 | 60.3 | 30.3 | 31.7 | 0.7 | 0.37 | | |
| g177 | Tussenstuk2 | Enkele staaf | L55x5 | S235 | M16 | 8.8 | 1.95 | 0 | 182 | **11.0** | **0.49** | 27.7 | 60.3 | 31.5 | 46.1 | 0.87 | 0.56 | | |
| g162 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.46 | 52 | 150 | **11.0** | **0.00** | 31.9 | 60.3 | 30.3 | 31.7 | 0.72 | 0.36 | | |
| g161 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.30 | 50 | 134 | **11.0** | 0.00 | 36.5 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g176 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.69 | 0 | 173 | **11.0** | 0.42 | 26.6 | 60.3 | 30.3 | 31.7 | 0.7 | 0.59 | | |
| g159 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.24 | 51 | 127 | **11.0** | 0.00 | 38.7 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g158 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.20 | 53 | 123 | **11.0** | 0.00 | 40.1 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g175 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.46 | 0 | 150 | **11.0** | **0.36** | 32.0 | 60.3 | 30.3 | 31.7 | 0.72 | 0.51 | | |
| g156 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.12 | 54 | 115 | **11.0** | **0.00** | 42.9 | 60.3 | 30.3 | 31.7 | 0.72 | 0.36 | | |
| g174* | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.56 | 51 | 160 | **11.0** | 0.00 | 29.5 | 60.3 | 30.3 | 31.7 | 0.7 | 0.37 | | |

## Knikverkorters initial construction (afkeur)

Date: 2021-05-26
Author: K Chan
Version: 1.8

ZW380 Oost
HS+0
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| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Net Section Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g183 | Tussenstuk2 | Enkele staaf | L55x5 | S235 | M16 | 8.8 | 1.99 | 0 | 186 | **11.0** | 0.50 | 26.9 | 60.3 | 31.5 | 46.1 | 0.9 | 0.57 | | |
| g173 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.48 | 51 | 152 | **11.0** | 0.00 | 31.4 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g171 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.31 | 50 | 135 | **11.0** | 0.00 | 36.2 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g181 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.73 | 0 | 178 | **11.0** | 0.43 | 25.7 | 60.3 | 30.3 | 31.7 | 0.7 | 0.60 | | |
| g170 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.25 | 50 | 128 | **11.0** | 0.00 | 38.2 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g168 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.10 | 48 | 113 | **11.0** | 0.00 | 43.5 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g179 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.52 | 0 | 157 | **11.0** | 0.38 | 30.3 | 60.3 | 30.3 | 31.7 | 0.7 | 0.53 | | |
| g167 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.05 | 48 | 107 | **11.0** | 0.00 | 45.6 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g165 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.79 | 29 | 81 | **11.0** | 0.17 | 55.7 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |
| g308 | Bovenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.34 | 0 | 137 | **4.7** | 0.33 | 35.5 | 60.3 | 30.3 | 31.7 | 0.7 | 0.46 | | |
| g306 | Bovenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.23 | 0 | 126 | **4.7** | **0.31** | 38.8 | 60.3 | 30.3 | 31.7 | 0.7 | 0.43 | | |
| g304 | Bovenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.14 | 0 | 117 | **2.4** | **0.29** | 42.0 | 60.3 | 30.3 | 31.7 | 0.7 | 0.40 | | |
| g302 | Bovenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.04 | 0 | 107 | **2.4** | **0.26** | 45.8 | 60.3 | 30.3 | 31.7 | 0.7 | 0.36 | | |

## Knikverkorters initial construction (afkeur)

Date: 2021-05-11
Author: K Chan
Version: 1.8

ZW380 Oost
HC+0
16

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g40 | Broekstuk | Enkele staaf | L60x5 | S235 | M20 | 8.8 | 0.575 | 0 | 49 | **28.5** | **0.14** | 78.3 | 94.1 | 39.6 | 40.3 | 1.05 | 0.72 | | |
| g30 | Broekstuk | Enkele staaf | L75x7 | S235 | M20 | 8.8 | 1.49 | 84 | 102 | **28.5** | **0.00** | 100.7 | 94.1 | 61.1 | 96.8 | 2.27 | 0.47 | | |
| g39 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.03 | 0 | 106 | **28.5** | **0.26** | 46.3 | 60.3 | 30.3 | 31.7 | 0.72 | 0.94 | | |
| g36 | Broekstuk | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.27 | 0 | 130 | **28.5** | **0.32** | 37.6 | 60.3 | 30.3 | 31.7 | 0.72 | 0.94 | | |
| g27 | Broekstuk | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 1.93 | 56 | 164 | **28.5** | **0.00** | 34.6 | 60.3 | 32.0 | 60.5 | 1.05 | 0.89 | | |
| g35 | Broekstuk | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 1.93 | 0 | 164 | **28.5** | **0.48** | 34.7 | 60.3 | 32.0 | 60.5 | 1.05 | 0.89 | | |
| g24 | Broekstuk | Enkele staaf | L60x6 | S235 | M16 | 8.8 | 2.34 | 43 | 200 | **28.5** | **0.00** | 31.5 | 60.3 | 38.4 | 72.6 | 1.24 | 0.91 | | |
| g34 | Broekstuk | Enkele staaf | L65x6 | S235 | M16 | 8.8 | 2.59 | 0 | 204 | **28.5** | **0.65** | 33.4 | 60.3 | 38.4 | 72.6 | 1.46 | 0.85 | | |
| g21 | Broekstuk | Enkele staaf | L70x6 | S235 | M16 | 8.8 | 2.85 | 34 | 207 | **28.5** | **0.00** | 35.2 | 60.3 | 38.4 | 89.9 | 1.71 | 0.81 | | |
| g33 | Broekstuk | Enkele staaf | L75x6 | S235 | M16 | 8.8 | 3.24 | 0 | 221 | **28.5** | **0.81** | 34.6 | 60.3 | 38.4 | 89.9 | 1.96 | 0.82 | | |
| g18 | Broekstuk | Enkele staaf | L75x7 | S235 | M16 | 8.8 | 3.18 | 29 | 217 | **28.5** | **0.70** | 41.0 | 60.3 | 44.8 | 104.8 | 2.27 | 0.70 | | |
| g69 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.88 | 0 | 91 | **4.1** | **0.22** | 52.4 | 60.3 | 30.3 | 31.7 | 0.72 | 0.31 | | |
| g68 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 1.82 | 0 | 120 | **4.1** | **0.23** | 31.7 | 60.3 | 30.3 | 31.7 | 0.54 | 0.44 | | |
| g67 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 2.76 | 0 | 182 | **4.1** | **0.34** | 20.0 | 60.3 | 30.3 | 31.7 | 0.54 | 0.66 | | |
| g66 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 3.69 | 0 | 244 | **4.1** | **0.46** | 13.6 | 60.3 | 30.3 | 31.7 | 0.54 | 0.89 | | |
| g65 | Pootverband | Kniksteun en verticale steun | L50x5 | S235 | M16 | 8.8 | 4.63 | 0 | 306 | **4.1** | **0.58** | 9.8 | 60.3 | 30.3 | 31.7 | 0.54 | 1.11 | Bending | |
| g64 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.88 | 76 | 193 | **4.1** | **0.00** | 22.9 | 60.3 | 30.3 | 31.7 | 0.72 | 0.18 | | |
| g63 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.03 | 63 | 209 | **4.1** | **0.00** | 20.6 | 60.3 | 30.3 | 31.7 | 0.72 | 0.20 | | |
| g62 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.27 | 53 | 233 | **4.1** | **0.00** | 17.5 | 60.3 | 30.3 | 31.7 | 0.72 | 0.24 | | |
| g61 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.58 | 44 | 265 | **4.1** | **0.00** | 14.4 | 60.3 | 30.3 | 31.7 | 0.72 | 0.28 | | |
| g60 | Pootverband | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 2.85 | 36 | 293 | **4.1** | **0.00** | 12.3 | 60.3 | 30.3 | 31.7 | 0.72 | 0.33 | | |
| g15 | Tussenschot +9,6n | Enkele staaf | L120x10 | S235 | M16 | 8.8 | 3.84 | 0 | 162 | **28.5** | **0.96** | 140.9 | 60.3 | 64.0 | 293.8 | 8.49 | 0.47 | | |
| g17 | Tussenschot +9,6n | Kniksteun en verticale steun | L60x6 | S235 | M16 | 8.8 | 5.28 | 0 | 291 | **1.7** | **0.66** | 15.2 | 60.3 | 38.4 | 72.6 | 0.93 | 0.74 | | |
| g14 | Tussenschot +9,6n | Kruisende staaf halverwege | L80x6 | S235 | M16 | 8.8 | 7.84 | 0 | 321 | **1.7** | **0.98** | 17.8 | 60.3 | 38.4 | 107.1 | 2.2 | 0.44 | | |
| g94 | Tussenstuk1 | Enkele staaf | L65x6 | S235 | M16 | 8.8 | 2.43 | 45 | 192 | **28.4** | **0.00** | 36.4 | 60.3 | 38.4 | 72.6 | 1.46 | 0.78 | | |
| g99 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 1.89 | 0 | 161 | **28.4** | **0.47** | 35.6 | 60.3 | 32.0 | 60.5 | 1.05 | 0.89 | | |
| g97 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 1.56 | 0 | 133 | **28.4** | **0.39** | 44.8 | 60.3 | 32.0 | 60.5 | 1.05 | 0.89 | | |
| g90 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 2.11 | 48 | 179 | **28.4** | **0.00** | 30.9 | 60.3 | 32.0 | 60.5 | 1.05 | 0.92 | | |
| g96 | Tussenstuk1 | Enkele staaf | L70x6 | S235 | M16 | 8.8 | 3.00 | 0 | 218 | **28.4** | **0.75** | 32.7 | 60.3 | 38.4 | 89.9 | 1.71 | 0.87 | | |
| g89 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 2.18 | 39 | 185 | **28.4** | **0.00** | 29.5 | 60.3 | 32.0 | 60.5 | 1.05 | 0.96 | | |
| g95 | Tussenstuk1 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 1.52 | 0 | 129 | **28.4** | **0.38** | 46.0 | 60.3 | 32.0 | 60.5 | 1.1 | 0.89 | | |
| g144 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.24 | 0 | 128 | **20.2** | **0.31** | 38.4 | 60.3 | 30.3 | 31.7 | 0.7 | 0.67 | | |
| g137 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.69 | 48 | 174 | **20.2** | **0.00** | 26.5 | 60.3 | 30.3 | 31.7 | 0.72 | 0.76 | | |
| g143 | Tussenstuk2 | Enkele staaf | L60x5 | S235 | M16 | 8.8 | 2.37 | 0 | 202 | **20.2** | **0.59** | 26.2 | 60.3 | 32.0 | 60.5 | 1.05 | 0.77 | | |
| g133 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.76 | 39 | 180 | **20.2** | 0.00 | 25.2 | 60.3 | 30.3 | 31.7 | 0.7 | 0.80 | | |
| g142 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.21 | 0 | 124 | **20.2** | 0.30 | 39.7 | 60.3 | 30.3 | 31.7 | 0.7 | 0.67 | | |
| g140 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.99 | 0 | 102 | **20.2** | 0.25 | 47.9 | 60.3 | 30.3 | 31.7 | 0.7 | 0.67 | | |
| g132 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.35 | 48 | 138 | **20.2** | 0.00 | 35.2 | 60.3 | 30.3 | 31.7 | 0.7 | 0.67 | | |
| g139 | Tussenstuk2 | Enkele staaf | L55x5 | S235 | M16 | 8.8 | 1.87 | 0 | 174 | **20.2** | **0.47** | 29.3 | 60.3 | 31.5 | 46.1 | 0.87 | 0.69 | | |
| g130 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.41 | 40 | 144 | **20.2** | **0.00** | 33.5 | 60.3 | 30.3 | 31.7 | 0.72 | 0.67 | | |
| g138 | Tussenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 0.95 | 0 | 98 | **20.2** | 0.24 | 49.5 | 60.3 | 30.3 | 31.7 | 0.7 | 0.67 | | |
| g178 | Bovenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.65 | 0 | 170 | **11.1** | 0.41 | 27.4 | 60.3 | 30.3 | 31.7 | 0.7 | 0.57 | | |

## Knikverkorters initial construction (afkeur)

Date: 2021-05-11
Author: K Chan
Version: 1.8

ZW380 Oost
HC+0
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| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Net Section Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g176 | Bovenstuk1 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.50 | 0 | 154 | **11.1** | **0.37** | 31.0 | 60.3 | 30.3 | 31.7 | 0.7 | 0.52 | | |
| g309 | Bovenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.40 | 0 | 143 | **5.4** | **0.35** | 33.8 | 60.3 | 30.3 | 31.7 | 0.7 | 0.49 | | |
| g307 | Bovenstuk2 | Enkele staaf | L50x5 | S235 | M16 | 8.8 | 1.26 | 0 | 129 | **5.4** | **0.32** | 37.9 | 60.3 | 30.3 | 31.7 | 0.7 | 0.44 | | |

## Knikverkorters adjusted construction (verbouw)

Date: 2021-05-11
Author: K. Chan
Version: 1.8

ZW380 Oost
HC+0
16

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g65 | Pootverband | Kniksteun en vert | **L70x7** | **S355** | M16 | 8.8 | 4.63 | 0 | 218 | **4.1** | **0.75** | 35.3 | 60.3 | 61.0 | 170.1 | 2.99 | 0.35 | | Profile exchanged |

# APPENDIX D
# Blokdeuvels

De belastingen op de fundatie uit Appendix A zijn uitgangspunt voor de berekening van de ingestorte rand met blokdeuvels. De belastingen in de richting van de randstijl zijn van toepassing. In de tabellen is dit opgenomen in de laatste kolom $R_{z,lok}$. De controles zijn uitgevoerd met een spreadsheet. Vanwege de helling van de drukdiagonaal wordt per krachtsrichting bepaald hoeveel deuvels effectief zijn.

Voor de berekening van de blokdeuvels zijn de masttypen als volgt samengevoegd:

- Masttype HB+0 (68 & 78)
- Masttype HC+0
- Masttype HS+0

De blokdeuvels worden getoetst op de maatgevende belasting per masttype. De belastingen waaraan getoetst worden zijn onderstaand weergegeven.

**Masttype HB+0 (68 & 78)**

**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 3_105.975 Ba All Cts | 249 | 270 | **1378** | -15 | -367 | -62 | 1411 |
| Max. tension | SPLS 3_0,9_105.975 Ba All Cts | 191 | 211 | **-1089** | 14 | 284 | 43 | -1116 |
| Max. pos. torsie | SPLS 6a_90 Ba Ct2 Ah Ct2 | -24 | -186 | 426 | **149** | -114 | -20 | 436 |
| Max. neg. torsie | SPLS 6a_90 Ba Ct1 Ah Ct1 | -96 | -119 | -75 | **-152** | 16 | -1 | -77 |
| Comb. tension+torsie | SPLS 3_0,9_105.975 Ba All Cts | 191 | 211 | **-1089** | **14** | 284 | 43 | -1116 |

**Masttype HC+0**

**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 3_120.38 Ba All Cts | 274 | 284 | **1486** | -7 | -395 | -67 | 1522 |
| Max. tension | SPLS 3_0,9_120.38 Ba All Cts | 212 | 221 | **-1175** | 6 | 306 | 46 | -1204 |
| Max. pos. torsie | SPLS 6a_90 Ba Ct2 Ah Ct2 | -112 | -116 | 2 | **161** | -3 | -2 | 2 |
| Max. neg. torsie | SPLS 6a_90 Ba Ct1 Ah Ct1 | -188 | -44 | 371 | **-164** | -102 | -20 | 380 |
| Comb. tension+torsie | SPLS 3_0,9_120.38 Ba Ct1 | 259 | 92 | **-969** | **-118** | 248 | 34 | -993 |

**Masttype HS+0**

**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 | -127 | 114 | **715** | -9 | -170 | -25 | 730 |
| Max. tension | ULS 1a_0,9_0,9_135 | -95 | 82 | **-544** | 9 | 125 | 15 | -555 |
| Max. pos. torsie | ULS 5a Ah 10 | 34 | -19 | 38 | **37** | -11 | -3 | 39 |
| Max. neg. torsie | ULS 5a Ba 10 | -34 | -19 | 38 | **-37** | -11 | -3 | 39 |
| Comb. tension+torsie | ULS 1a_0,9_0,9_135 | -95 | 82 | **-544** | **9** | 125 | 15 | -555 |

Project: ZW380-Oost
Mast: HB+0 (68&78)

## Shear blocks

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

Datum: 2021-05-25
Auteur: TBR
Versie: 1.4

| ***Load*** | | | | ***Results*** | | | |
|---|---|---|---|---|---|---|---|
| Compression | $F_{Ed,c}$ | **1411** | kN | Compression | U.C. | 0.81 | < 1,00 OK |
| Tension | $F_{Ed,t}$ | **1116** | kN | Tension | U.C. | 0.81 | < 1,00 OK |

***Main leg***

| | | | |
|---|---|---|---|
| Profile | | **L200.20** | |
| Steel material | | S355 | |
| Cross section | | 7635 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 2710 | kN |
| Width | b | 200 | mm |
| Thickness | t | 20 | mm |
| Length in concrete | | 1500 | mm |

***Shear blocks main leg***

| | | | |
|---|---|---|---|
| Width | b | 30 | mm |
| Thickness | h | 30 | mm |
| Length | L | 200 | mm |
| Welds | a | 4 | mm |
| c.t.c. separation | s | 240 | mm |
| Number for compr. | $n_c$ | 11 | - |
| Number for tension | $n_t$ | 11 | - |

***Foot plate***

| | | | |
|---|---|---|---|
| Thickness | t | 30 | mm |
| Ext. length | m | 30 | mm |
| Welds | a | 5 | mm |

***Pile***

| | | | |
|---|---|---|---|
| Name | | Buispaal | |
| Diameter | | 609 | mm |
| Thickness | | 10 | mm |
| Cross section | | 18818 | $mm^2$ |
| Steel material | | S355 | |
| Capacity | | 6680 | kN |
| Concrete strength | | C30/37 | |

***Shear blocks pile***

| | | | |
|---|---|---|---|
| Width | b | 30 | mm |
| Thickness | h | 30 | mm |
| Length | L | 750 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 300 | mm |
| Number for compr. | $n_c$ | 6 | - |
| Number for tension | $n_t$ | 6 | - |

***Design value concrete strength***

| | | | |
|---|---|---|---|
| Material factor | $\gamma_c$ | 1.5 | |
| Add. mat. factor | $\gamma_m$ | 1.25 | - |
| $f_{cd}$ = | | 16.0 | $N/mm^2$ |

***Steel tower stub***

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

***Capacity shear blocks main leg***

| | | |
|---|---|---|
| $A_{f1}$ = | 6000 | $mm^2$ |
| $A_{f2}$ = | 20448 | $mm^2$ |
| Slope | 1: 5 | |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.85 | |
| $f_{jd} = C_A \times f_{cd}$ = | 29.5 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | 1949 | kN |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | 1949 | kN |

***Capacity foot plate***

| | | |
|---|---|---|
| $k_d$ = | 1.73 | - |
| $f_{jd} = C_A \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $c = t\sqrt{(f_{yd} / 3f_{jd})}$ = | 60 | mm |
| m* = min(c,m) = | 30 | mm |
| Type foot plate | Extending | |
| Effective for | Compr. and tension | |
| $A_{p,c}$ = | 35235 | $mm^2$ |
| $F_{Rd,c} = A_{p,druk} \times f_{jd}$ = | 976 | kN |
| $A_{p,t}$ = | 27600 | $mm^2$ |
| $F_{Rd,t} = A_{p,t} \times f_{jd}$ = | 765 | kN |

***Capacities***

| | | |
|---|---|---|
| $F_{rd,c,plate}$ = | 956 | kN |
| $F_{rd,blocks,c}$ = | 1949 | kN |
| $F_{rd,c} = F_{rd,blck}+F_{rd,footplate}$ = | **2905** | kN |
| U.C. compression | 0.49 | < 1,00 OK |
| Welds foot plate (see next page) | 956 | kN |
| $F_{rd,t}$ = min. (welds / foot plate) = | 765 | kN |
| $F_{rd,blocks,t}$ = | 1949 | kN |
| $F_{rd,t} = F_{rd,blck}+F_{rd,footplate}$ = | **2714** | kN |
| U.C. tension | 0.41 | < 1,00 OK |
| U.C. welds | 0.81 | < 1,00 OK |

***Capacity shear blocks pile***

| | | |
|---|---|---|
| $A_{f1}$ = | 22500 | $mm^2$ |
| $A_{f2}$ = | 67500 | $mm^2$ |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.73 | - |
| $f_{jd} = k_d \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | **3741** | kN |
| U.C. compression | 0.38 | < 1,00 OK |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | **3741** | kN |
| U.C. tension | 0.30 | < 1,00 OK |
| U.C. welds | 0.49 | < 1,00 OK |

***"Splitting" of pile***

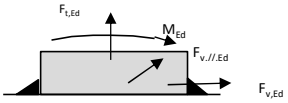
| | | | |
|---|---|---|---|
| Spread of forces | | 45 | ° |
| Length force flow | | 1206 | mm |
| Splitting force | | 463 | kN/m |
| Yield strength wall | $f_{yd}$ = | 355 | $N/mm^2$ |
| Capacity tubular pile | | 7100 | kN/m |
| U.C. | | 0.07 | < 1,00 OK |

Project: ZW380-Oost
Mast: HB+0 (68&78)

## Welds of shear blocks of main leg

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 30 | mm | a = | 4 | mm |
| Grade | S355 | | l = | 200 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |



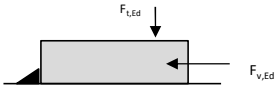

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ = | 0 | $N/mm^2$ |
| $F_{t,Ed}$ = | **0** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ = | 94 | $N/mm^2$ |
| $F_{v,Ed} = F_{rd,c} / n$ = | **213** | kN | | 94 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | $b^* = b + 2/3a\sqrt{2}$ | 33.8 | mm |
| $M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **3.19** | kNm | $\sigma_1 = \tau_1 = 0{,}706 M_{Ed} / al\ b^*$ = | 83 | $N/mm^2$ |
| | | | $\tau_{//} = F_{w//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 355 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 355 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.81** OK |
| $\sigma_1$ = | 177 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.50** OK |

## Welds of shear blocks of pile

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 30 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 750 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |




| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ = | 35 | $N/mm^2$ |
| $F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **374** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ = | 71 | $N/mm^2$ |
| $F_{v,Ed}$ = | **748** | kN | | 106 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | | | |
| $M_{Ed}$ = | **0.00** | kNm | | | |
| | | | $\tau_{//} = F_{w//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 212 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 212 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.49** OK |
| $\sigma_1$ = | 106 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.30** OK |

## Welds of foot plate

| | | | |
|---|---|---|---|
| $f_u / \beta_w \gamma_{M2}$ = | | 436 | $N/mm^2$ |
| Weld size | a = | 5 | mm |
| Length | $l = 2b + 2b - t$ = | 760 | mm |
| Capacity | $F_{Rd} = a \times l \times f_{w,d} / \sqrt{3}$ = | **956** | kN |

Project: ZW380-Oost
Mast: HS+0 (26)

## Shear blocks

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

Datum: 2021-05-26
Auteur: TBR
Versie: 1.4

| ***Load*** | | | | ***Results*** | | | |
|---|---|---|---|---|---|---|---|
| Compression | $F_{Ed,c}$ | **730** | kN | Compression | U.C. | 0.69 | < 1,00 OK |
| Tension | $F_{Ed,t}$ | **555** | kN | Tension | U.C. | 0.69 | < 1,00 OK |

***Main leg***

| | | | |
|---|---|---|---|
| Profile | | **L150.12** | |
| Steel material | | S355 | |
| Cross section | | 3480 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 1235 | kN |
| Width | b | 150 | mm |
| Thickness | t | 12 | mm |
| Length in concrete | | 1400 | mm |

***Shear blocks main leg***

| | | | |
|---|---|---|---|
| Width | b | 30 | mm |
| Thickness | h | 30 | mm |
| Length | L | 130 | mm |
| Welds | a | 4 | mm |
| c.t.c. separation | s | 150 | mm |
| Number for compr. | $n_c$ | 18 | - |
| Number for tension | $n_t$ | 18 | - |

***Foot plate***

| | | | |
|---|---|---|---|
| Thickness | t | 30 | mm |
| Ext. length | m | 30 | mm |
| Welds | a | 5 | mm |

***Pile***

| | | | |
|---|---|---|---|
| Name | | Buispaal | |
| Diameter | | 609 | mm |
| Thickness | | 10 | mm |
| Cross section | | 18818 | $mm^2$ |
| Steel material | | S355 | |
| Capacity | | 6680 | kN |
| Concrete strength | | C30/37 | |

***Shear blocks pile***

| | | | |
|---|---|---|---|
| Width | b | 30 | mm |
| Thickness | h | 30 | mm |
| Length | L | 450 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 300 | mm |
| Number for compr. | $n_c$ | 5 | - |
| Number for tension | $n_t$ | 5 | - |

***Design value concrete strength***

| | | | |
|---|---|---|---|
| Material factor | $\gamma_c$ | 1.5 | |
| Add. mat. factor | $\gamma_m$ | 1.25 | - |
| $f_{cd}$ = | | 16.0 | $N/mm^2$ |

***Steel tower stub***

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

***Capacity shear blocks main leg***

| | | |
|---|---|---|
| $A_{f1}$ = | 3900 | $mm^2$ |
| $A_{f2}$ = | 9612 | $mm^2$ |
| Slope | 1: 5 | |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.57 | |
| $f_{jd} = C_A \times f_{cd}$ = | 25.1 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | 1763 | kN |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | 1763 | kN |

***Capacity foot plate***

| | | |
|---|---|---|
| $k_d$ = | 1.73 | - |
| $f_{jd} = C_A \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $c = t\sqrt{(f_{yd} / 3f_{jd})}$ = | 65 | mm |
| m* = min(c,m) = | 30 | mm |
| Type foot plate | Extending | |
| Effective for | Compr. and tension | |
| $A_{p,c}$ = | 25080 | $mm^2$ |
| $F_{Rd,c} = A_{p,druk} \times f_{jd}$ = | 695 | kN |
| $A_{p,t}$ = | 21600 | $mm^2$ |
| $F_{Rd,t} = A_{p,t} \times f_{jd}$ = | 599 | kN |

***Capacities***

| | | |
|---|---|---|
| $F_{rd,c,plate}$ = | 695 | kN |
| $F_{rd,blocks,c}$ = | 1763 | kN |
| $F_{rd,c} = F_{rd,blck}+F_{rd,footplate}$ = | **2458** | kN |
| U.C. compression | 0.30 | < 1,00 OK |
| Welds foot plate (see next page) | 724 | kN |
| $F_{rd,t}$ = min. (welds / foot plate) = | 599 | kN |
| $F_{rd,blocks,t}$ = | 1763 | kN |
| $F_{rd,t} = F_{rd,blck}+F_{rd,footplate}$ = | **2362** | kN |
| U.C. tension | 0.23 | < 1,00 OK |
| U.C. welds | 0.69 | < 1,00 OK |

***Capacity shear blocks pile***

| | | |
|---|---|---|
| $A_{f1}$ = | 13500 | $mm^2$ |
| $A_{f2}$ = | 40500 | $mm^2$ |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.73 | - |
| $f_{jd} = k_d \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | **1871** | kN |
| U.C. compression | 0.39 | < 1,00 OK |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | **1871** | kN |
| U.C. tension | 0.30 | < 1,00 OK |
| U.C. welds | 0.49 | < 1,00 OK |

***"Splitting" of pile***

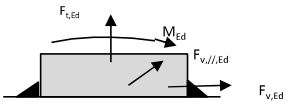
| | | | |
|---|---|---|---|
| Spread of forces | | 45 | ° |
| Length force flow | | 1106 | mm |
| Splitting force | | 251 | kN/m |
| Yield strength wall | $f_{yd}$ = | 355 | $N/mm^2$ |
| Capacity tubular pile | | 7100 | kN/m |
| U.C. | | 0.04 | < 1,00 OK |

Project: ZW380-Oost
Mast: HS+0 (26)

## Welds of shear blocks of main leg

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 30 | mm | a = | 4 | mm |
| Grade | S355 | | l = | 130 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |



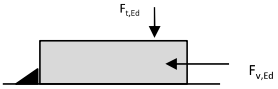

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ = | 0 | $N/mm^2$ |
| $F_{t,Ed}$ = | **0** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ = | 80 | $N/mm^2$ |
| $F_{v,Ed} = F_{rd,c} / n$ = | **118** | kN | | 80 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | $b^* = b + 2/3a\sqrt{2}$ | 33.8 | mm |
| $M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **1.76** | kNm | $\sigma_1 = \tau_1 = 0{,}706 M_{Ed} / al\ b^*$ = | 71 | $N/mm^2$ |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 302 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 302 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.69** OK |
| $\sigma_1$ = | 151 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.43** OK |

## Welds of shear blocks of pile

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 30 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 450 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |




| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ = | 35 | $N/mm^2$ |
| $F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **224** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ = | 71 | $N/mm^2$ |
| $F_{v,Ed}$ = | **449** | kN | | 106 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | | | |
| $M_{Ed}$ = | **0.00** | kNm | | | |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 212 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 212 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.49** OK |
| $\sigma_1$ = | 106 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.30** OK |

## Welds of foot plate

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

Project: ZW380-Oost
Mast: HC+0 (16)

## Shear blocks

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

Datum: 2021-05-25
Auteur: TBR
Versie: 1.4

| ***Load*** | | | | ***Results*** | | | |
|---|---|---|---|---|---|---|---|
| Compression | $F_{Ed,c}$ | **1522** | kN | Compression | U.C. | 0.82 | < 1,00 OK |
| Tension | $F_{Ed,t}$ | **1204** | kN | Tension | U.C. | 0.82 | < 1,00 OK |

***Main leg***

| | | | |
|---|---|---|---|
| Profile | | **L200.24** | |
| Steel material | | S355 | |
| Cross section | | 9059 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 3216 | kN |
| Width | b | 200 | mm |
| Thickness | t | 24 | mm |
| Length in concrete | | 1500 | mm |

***Shear blocks main leg***

| | | | |
|---|---|---|---|
| Width | b | 30 | mm |
| Thickness | h | 30 | mm |
| Length | L | 222.5 | mm |
| Welds | a | 4 | mm |
| c.t.c. separation | s | 200 | mm |
| Number for compr. | $n_c$ | 12 | - |
| Number for tension | $n_t$ | 12 | - |

***Foot plate***

| | | | |
|---|---|---|---|
| Thickness | t | 30 | mm |
| Ext. length | m | 30 | mm |
| Welds | a | 5 | mm |

***Pile***

| | | | |
|---|---|---|---|
| Name | | Buispaal | |
| Diameter | | 609 | mm |
| Thickness | | 10 | mm |
| Cross section | | 18818 | $mm^2$ |
| Steel material | | S355 | |
| Capacity | | 6680 | kN |
| Concrete strength | | C30/37 | |

***Shear blocks pile***

| | | | |
|---|---|---|---|
| Width | b | 30 | mm |
| Thickness | h | 30 | mm |
| Length | L | 750 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 300 | mm |
| Number for compr. | $n_c$ | 6 | - |
| Number for tension | $n_t$ | 6 | - |

***Design value concrete strength***

| | | | |
|---|---|---|---|
| Material factor | $\gamma_c$ | 1.5 | |
| Add. mat. factor | $\gamma_m$ | 1.25 | - |
| $f_{cd}$ = | | 16.0 | $N/mm^2$ |

***Steel tower stub***

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

***Capacity shear blocks main leg***

| | | |
|---|---|---|
| $A_{f1}$ = | 6675 | $mm^2$ |
| $A_{f2}$ = | 18592 | $mm^2$ |
| Slope | 1: 5 | |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.67 | |
| $f_{jd} = C_A \times f_{cd}$ = | 26.7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | 2139 | kN |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | 2139 | kN |

***Capacity foot plate***

| | | |
|---|---|---|
| $k_d$ = | 1.73 | - |
| $f_{jd} = C_A \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $c = t\sqrt{(f_{yd} / 3f_{jd})}$ = | 63 | mm |
| m* = min(c,m) = | 30 | mm |
| Type foot plate | Extending | |
| Effective for | Compr. and tension | |
| $A_{p,c}$ = | 36659 | $mm^2$ |
| $F_{Rd,c} = A_{p,druk} \times f_{jd}$ = | 1016 | kN |
| $A_{p,t}$ = | 27600 | $mm^2$ |
| $F_{Rd,t} = A_{p,t} \times f_{jd}$ = | 765 | kN |

***Capacities***

| | | |
|---|---|---|
| $F_{rd,c,plate}$ = | 946 | kN |
| $F_{rd,blocks,c}$ = | 2139 | kN |
| $F_{rd,c} = F_{rd,blck}+F_{rd,footplate}$ = | **3084** | kN |
| U.C. compression | 0.49 | < 1,00 OK |
| Welds foot plate (see next page) | 946 | kN |
| $F_{rd,t}$ = min. (welds / foot plate) = | 765 | kN |
| $F_{rd,blocks,t}$ = | 2139 | kN |
| $F_{rd,t} = F_{rd,blck}+F_{rd,footplate}$ = | **2904** | kN |
| U.C. tension | 0.41 | < 1,00 OK |
| U.C. welds | 0.82 | < 1,00 OK |

***Capacity shear blocks pile***

| | | |
|---|---|---|
| $A_{f1}$ = | 22500 | $mm^2$ |
| $A_{f2}$ = | 67500 | $mm^2$ |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.73 | - |
| $f_{jd} = k_d \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | **3741** | kN |
| U.C. compression | 0.41 | < 1,00 OK |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | **3741** | kN |
| U.C. tension | 0.32 | < 1,00 OK |
| U.C. welds | 0.49 | < 1,00 OK |

***"Splitting" of pile***

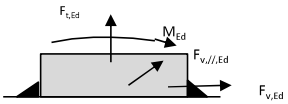
| | | | |
|---|---|---|---|
| Spread of forces | | 45 | ° |
| Length force flow | | 1206 | mm |
| Splitting force | | 499 | kN/m |
| Yield strength wall | $f_{yd}$ = | 355 | $N/mm^2$ |
| Capacity tubular pile | | 7100 | kN/m |
| U.C. | | 0.07 | < 1,00 OK |

Project: ZW380-Oost
Mast: HC+0 (16)

## Welds of shear blocks of main leg

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 30 | mm | a = | 4 | mm |
| Grade | S355 | | l = | 200 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |



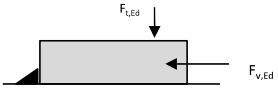

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ = | 0 | $N/mm^2$ |
| $F_{t,Ed}$ = | **0** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ = | 95 | $N/mm^2$ |
| $F_{v,Ed} = F_{rd,c} / n$ = | **214** | kN | | 95 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | $b^* = b + 2/3a\sqrt{2}$ | 33.8 | mm |
| $M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **3.21** | kNm | $\sigma_1 = \tau_1 = 0{,}706 M_{Ed} / al\ b^*$ = | 84 | $N/mm^2$ |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 357 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 357 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.82** OK |
| $\sigma_1$ = | 178 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.51** OK |

## Welds of shear blocks of pile

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 30 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 750 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |




| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ = | 35 | $N/mm^2$ |
| $F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **374** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ = | 71 | $N/mm^2$ |
| $F_{v,Ed}$ = | **748** | kN | | 106 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | | | |
| $M_{Ed}$ = | **0.00** | kNm | | | |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 212 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 212 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.49** OK |
| $\sigma_1$ = | 106 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.30** OK |

## Welds of foot plate

| | | | |
|---|---|---|---|
| $f_u / \beta_w \gamma_{M2}$ = | | 436 | $N/mm^2$ |
| Weld size | a = | 5 | mm |
| Length | l = 2b+ 2b - t = | 752 | mm |
| Capacity | $F_{Rd} = a \times l \times f_{w,d} / \sqrt{3}$ = | **946** | kN |

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## B.11 Mastrapportage

ZUID-WEST 380 KV OOST VERBINDINGEN

# Mastrapportage GT-RLL HA+0/n en HA+5/n

TenneT TSO B.V.

**Meridian doc.nr.:** 002.678.00.0934571
**Rapport nr.:** 21-0886, Rev. 2
**Datum:** 21-09-2021

| | |
|---|---|
| DATUM: | 01-10-2021 |
| STATUS TENNET: | DEFINITIEF |
| REVISIE TENNET: | 1.0 |

| | | |
|---|---|---|
| Projectnaam: | Zuid-West 380 kV Oost Verbindingen | Energy Systems |
| Rapport titel: | Mastrapportage GT-RLL HA+0/n en HA+5/n | DNV Netherlands B.V. |
| Klant: | TenneT TSO B.V. | Utrechtseweg 310-B50 |
| Contactpersoon klant: | [redacted] | 6812 AR Arnhem |
| Datum uitgave: | 21-09-2021 | |
| Project nr.: | 10124719 | |
| Organisatie unit: | TDT | Tel: 026 356 9111 |
| Meridian doc.nr..: | 002.678.00.0934571 | Handelsregister Arnhem 09006404 |
| Rapport nr.: | 21-0886, Rev. 2 | |

[redacted]

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*Specificatie distributie: --

| Rev. | Datum | Reden van uitgave | Auteur | Beoordelaar | Goedkeuder |
|---|---|---|---|---|---|
| 0 | 07-06-2021 | Eerste uitgave | [redacted] | | |
| 1.0 | 28-07-2021 | Tweede uitgave | | | |
| 2.0 | 21-09-2021 | RFA commentaar verwerkt | | | |

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# 1 INLEIDING

In het basisontwerp van de vakwerkmasten voor de verbinding RLL-TLB380 in het project Zuid-West 380 kV-Oost zijn voor het vaststellen van de haalbaarheid constructieve berekeningen uitgevoerd aan de masten en fundaties. In de Definitief Ontwerpfase, moeten berekeningen verder worden uitgewerkt om te kunnen dienen voor de benodigde vergunningsdocumentatie, voor de aanbesteding en als voorbereiding voor de uitvoeringsfase. Het DO omvat het ontwerp van de mastconstructies, de fundaties en de opstijgpunten in de verbinding.

Deze rapportage bevat de resultaten van de toetsing van masttype HA+0/n en HA+5/n t.b.v de reconstructie. Deze mast is gebaseerd op de bestaande HA+0/n en HA+5/n masten uit de verbinding GT-RLL380 met de aanpassingen om te voldoen aan de belasting uit de nieuwe situatie.

In deze rapportage is de toetsing van de mast van de steunmast HA+5/n opgenomen. De toetsing bestaat uit controle van:

- de profielen en boutverbindingen onderdeel van de hoofddraagconstructie
- de knikverkorters
- de liggers voor de isolatorkettingen
- de verbinding met de fundatie via blokdeuvels
- de toetsing op galloping

Buiten de scope van dit DO-rapport valt de controle van de schetsplaten en overige verbindingsdetails in de constructie. Dit moet in de UO-fase worden uitgewerkt. Ook de voorzieningen voor de high-step rail en bordessen vallen onder uitwerking in UO-fase.

In hoofdstuk 2 zijn de uitgangspunten en randvoorwaarden vanuit de van toepassing zijnde normen en TenneT-specificaties opgenomen. Hoofdstuk 3 beschrijft de gevolgde aanpak van de berekening. In hoofdstuk 4 is de toetsing opgenomen.

# 2 UITGANGSPUNTEN EN RANDVOORWAARDEN

## 2.1 Normen

Er is gebruik gemaakt van de normen volgens Tabel 1.

**Tabel 1 Gebruikgemaakte normen, voorschriften en richtlijnen**

| Norm | Titel |
|---|---|
| NEN-EN 50341-1:2013 | “Overhead electrical lines exceeding AC 1 kV - Part 1: General requirements – Common” |
| NEN-EN 50341-2-15:2019 | “Overhead electrical lines exceeding AC 1 kV Part 2 National Normative Aspects (NNA) for THE NETHERLANDS” |
| NEN-EN 1990+A1+A1/C2:2019/NB:2019nl | “Grondslagen van het ontwerp” |
| NEN-EN 1991-1-4+A1+C2:2011/NB:2019+C1:2020 | “Deel 1-4: Windbelasting op constructies” |
| NEN-EN 1992-1-1+C2:2011/NB:2016+A1:2020 | “Eurocode 2: Ontwerp en berekening van betonconstructies, deel 1-1: algemene regels en regels voor gebouwen” |
| NEN-EN 1993-1-1+C2+A1:2016 nl | “Eurocode 3: Ontwerp en berekening van staalconstructies, deel 1-1: algemene regels en regels voor gebouwen” |
| NEN-EN 1993-3-1:2007/NB:2011 nl | “Deel 3-1: Torens, masten en schoorstenen - Torens en masten” |
| NEN-EN 1993-1-8+C2:2011/NB:2011 nl | “Ontwerp en berekening van staalconstructies, deel 1-8: ontwerp en berekening van verbindingen” |

## 2.2 TenneT-specificaties

In Tabel 2 zijn de documenten opgenomen die relevant zijn voor de berekeningen en toetsingen die binnen dit project in de mastrapportage uitgevoerd zullen worden.

**Tabel 2 Relevante documenten t.b.v. mechanische rapportages**

| Nummer | Onderwerp |
|---|---|
| PVE.05.000 v3.2 | PvE Lijnen |
| sPVE.05.001 | sPvE Lijnen |
| SPE.05.346 v1.3 | Algemene specificatie stalen masten |

## 2.3 Eisenverificatie

Voor de eisenverificatie wordt verwezen naar het rapport “Verificatierapport eisen reconstructies”.

## 2.4 Ontwerprapporten

Voor de achtergrond van het ontwerp wordt verwezen naar het uitgangspuntenrapport “D1.3 Uitgangspunten reconstructies”, DNV GL rapport 21-0702, Meridiannummer 002.678.00 0927721.

## 2.5 Materialen

Voor het ontwerp van de mastconstructies en fundaties wordt uitgegaan van de eigenschappen volgens Tabel 3.

**Tabel 3 Materialen aangepaste constructie**

| | |
|---|---|
| Staalsoort | S355J0 (t≤16 mm)<br>S355J2 (16<t≤40 mm) |
| Boutkwaliteit | 8.8 gerolde draad |
| Betonkwaliteit | C30/37 |
| Wapeningsstaal | B500 |

Voor de constructie geldt conform TenneT-specificatie:

- Toe te passen bouten: M16/M20/M24;
- Voor hoekstaal is de minimale afmeting L50x5 mm;
- Minimale plaatdikte 6 mm.

Mocht het noodzakelijk zijn M30 toe te passen, bij grote plaatdiktes is dit als afwijking door TenneT toegestaan.

## 2.6 Software

De gebruikte software wordt benoemd in Tabel 4.

**Tabel 4 Toegepaste software**

| Software | | Versie |
|---|---|---|
| Mastontwerp | PLS-CADD | 16.65 |
| Mastberekeningen | PLS-TOWER | 16.65 |
| Constructieve analyse | AxisVM | X5 R4h |

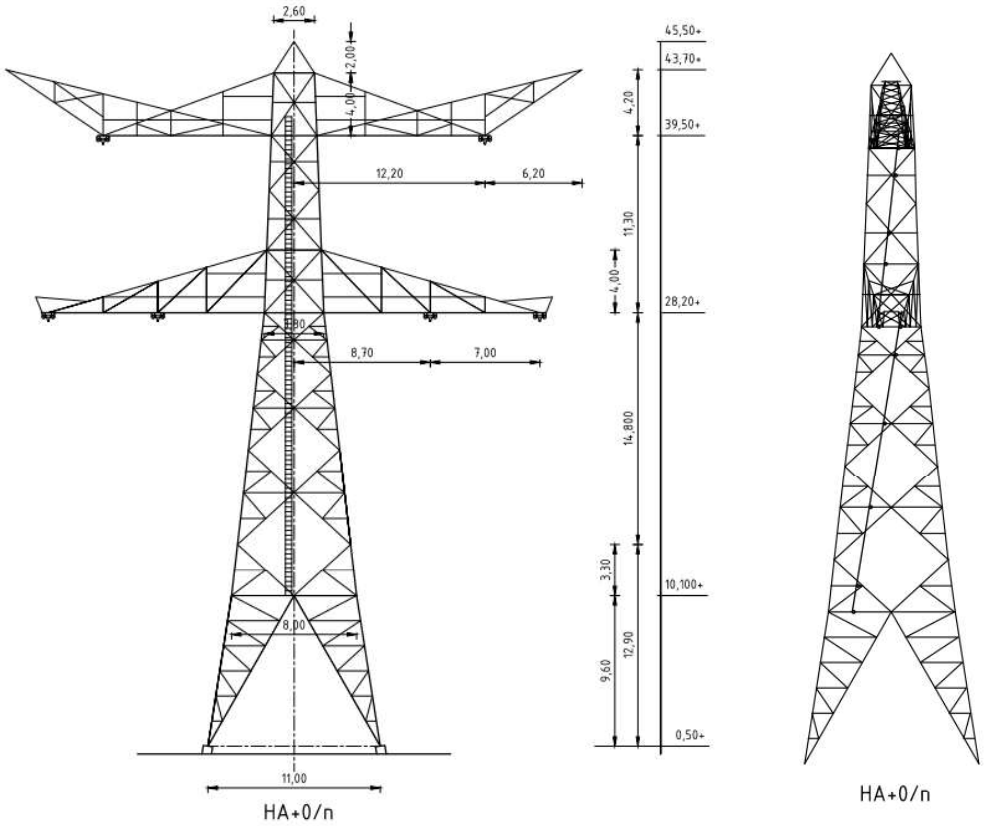
# 3 MASTONTWERP

## 3.1 Mastbeelden

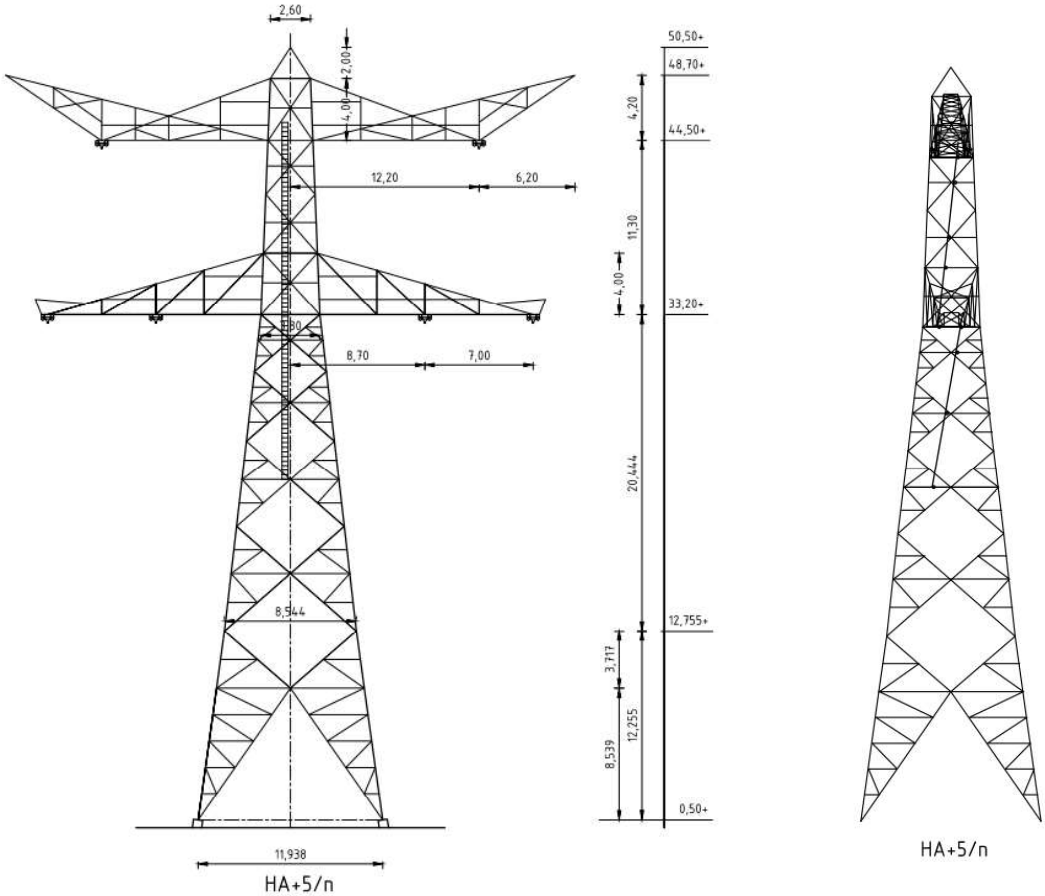
In dit hoofdstuk worden de mastbeelden weergegeven met de belangrijkste maatvoering, de figuren zijn ontleend aan de bij deze rapportage horende tekeningen van de masttypen. Het gaat om de volgende tekeningen:

- Overzichtstekening HA+0/n, Meridiannummer 002.678.00 0934585
- Overzichtstekening HA+5/n, Meridiannummer 002.678.00 0934586.

Masttype reconstructie HA+0/n en HA+5/n is een hoekmast voor twee circuits 380 kV.




**Figuur 1 Mastbeeld masttype HA+0/n**




**Figuur 2 Mastbeeld masttype HA+5/n**

## 3.2 Verschillen HA+0_n en HA+5_n

Masttype HA+0_n en HA+5_n delen dezelfde mastkop. Dat wil zeggen het mastgedeelte boven het niveau van de ondertraverse; de traverses en het bovenstuk van het mastlichaam.

Het onderstuk met de drie diagonaalkruisen tussen ondertraverse en broekstuk is ogenschijnlijk gelijk uitgevoerd, echter de geometrie (hellingsverandering) verschilt tussen beide masttypes. In dit mastgedeelte bevindt zich een horizontaalverband dat in beide types op een verschillende positie zit. Bij masttype HA+5 begint de ladder bij dat verband.

Het broekstuk van masttype HA+5 is afwijkend van vorm dan dat van HA+0, het loopt vanaf de fundatie tot het knooppunt met de hoofddiagonaal (12,755+ in bovenstaande figuur) terwijl het zich bij HA+0 tot het niveau van 10,100+ bevindt. De hellingsverandering bij masttype HA+5 is bij de overgang broekstuk -tussenstuk erg klein. In de UO-fase moet hier aandacht aan worden besteed dat dit niet gemist wordt.

## 3.3 Uitgangspunten berekening

De uitgangspunten volgens Tabel 5 zijn van toepassing.

**Tabel 5 Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 50 jaar |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

## 3.4 Mastenlijst

In Tabel 6 tot en met Tabel 7 zijn alle masten in het tracé van het type HA+0/n en HA+5/n opgenomen. De mast met grootste wind span is vetgedrukt aangegeven. Het masttype zal niet met deze wind en weight span worden berekend maar met generieke wind en weight span, zie uitgangspuntenrapport.

**Tabel 6 Mastenlijst HA+0/n**

| Mast-nummer | Masttype | Lijnhoek (°) | Wind span (m) | Weight span (m) | Hoogteverschil ba+ah (m) | Hoogte-verschil back (m) | Hoogte-verschil ahead (m) |
|---|---|---|---|---|---|---|---|
| 76N | HA+0/n | 172,4 | 355,5 | 336,1 | -4,9 | -4,5 | -0,4 |
| 73N | HA+0/n | 180,0 | 368,5 | 253,3 | -32,8 | -0,3 | -32,5 |
| **25N** | HA+0/n | 170,2 | 335,0 | 313,8 | -5,2 | -5,4 | 0,2 |
| 24N | HA+0/n | 180,0 | 335,6 | 333,1 | -0,6 | -0,2 | -0,4 |
| 16AN | HA+0/n | 180,0 | 233,3 | 214,2 | -3,1 | -1,6 | -1,6 |

**Tabel 7 Mastenlijst HA+5**

| Mast-nummer | Masttype | Lijnhoek (°) | Wind span (m) | Weight span (m) | Hoogteverschil ba+ah (m) | Hoogte-verschil back (m) | Hoogte-verschil ahead (m) |
|---|---|---|---|---|---|---|---|
| 70N | HA+5/n | 180,0 | 297,1 | 165,3 | -28,1 | -27,5 | -0,6 |
| **18N** | HA+5/n | 164,5 | 363,2 | 396,7 | 8,7 | 4,5 | 4,2 |

## 3.5 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV GL. De belastingen op de mastconstructie zijn bepaald op basis van de modellering in PLS-TOWER (staafoppervlaktes). Voor de toeslagen op eigen gewicht en windoppervlakte wordt verwezen naar het uitgangspuntenrapport. 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 Appendix A.

## 3.7 Modellering

Op basis van de ontwerptekeningen is de mast in PLS-TOWER ingevoerd. De toetsing wordt per staafgroep uitgevoerd. De hoofdelementen zijn gemodelleerd, niet-dragende profielen als knikverkorters zijn weggelaten, deze worden separaat getoetst. De profielen zijn in PLS-TOWER inclusief de boutverbindingen ingevoerd en getoetst, de controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

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

De gewichts- en windbelasting op de mastconstructie wordt door PLS-TOWER automatisch bepaald. Via toeslagfactoren wordt de invloed van niet gemodelleerde elementen als knikverkorters, bordesconstructies en klimvoorzieningen meegenomen. Voor schetsplaten, zinklaag en bouten is een aanvullende toeslag op het gewicht van 20% toeslag gerekend.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep.

## 3.8 Overige controles

In PLS-TOWER zijn niet alle elementen getoetst. Knikverkorterprofielen en overige profielen voor beloopbaarheid worden separaat getoetst. In Appendix C is dit opgenomen. De verbinding met de fundatie bestaat uit ingestorte profielen voorzien van blokdeuvels. Dit is in Appendix D opgenomen. De liggers van isolatorkettingen zijn gebaseerd op Moldaumasten en hebben geen aanvullende controle op buiging nodig vanwege aanmerkelijk lagere belastingen. Appendix E is derhalve niet ingevuld bij dit masttype maar vanwege consistentie met andere rapporten hier opgenomen. Appendix F omvat de toetsing op galloping.

## 3.9 Mastgewicht

Het totale mastgewicht per masttype is met de uitgangspunten van paragraaf 3.6 bepaald op:

Het gewicht van masttype HA+0/n is bepaald op 46,3 ton.

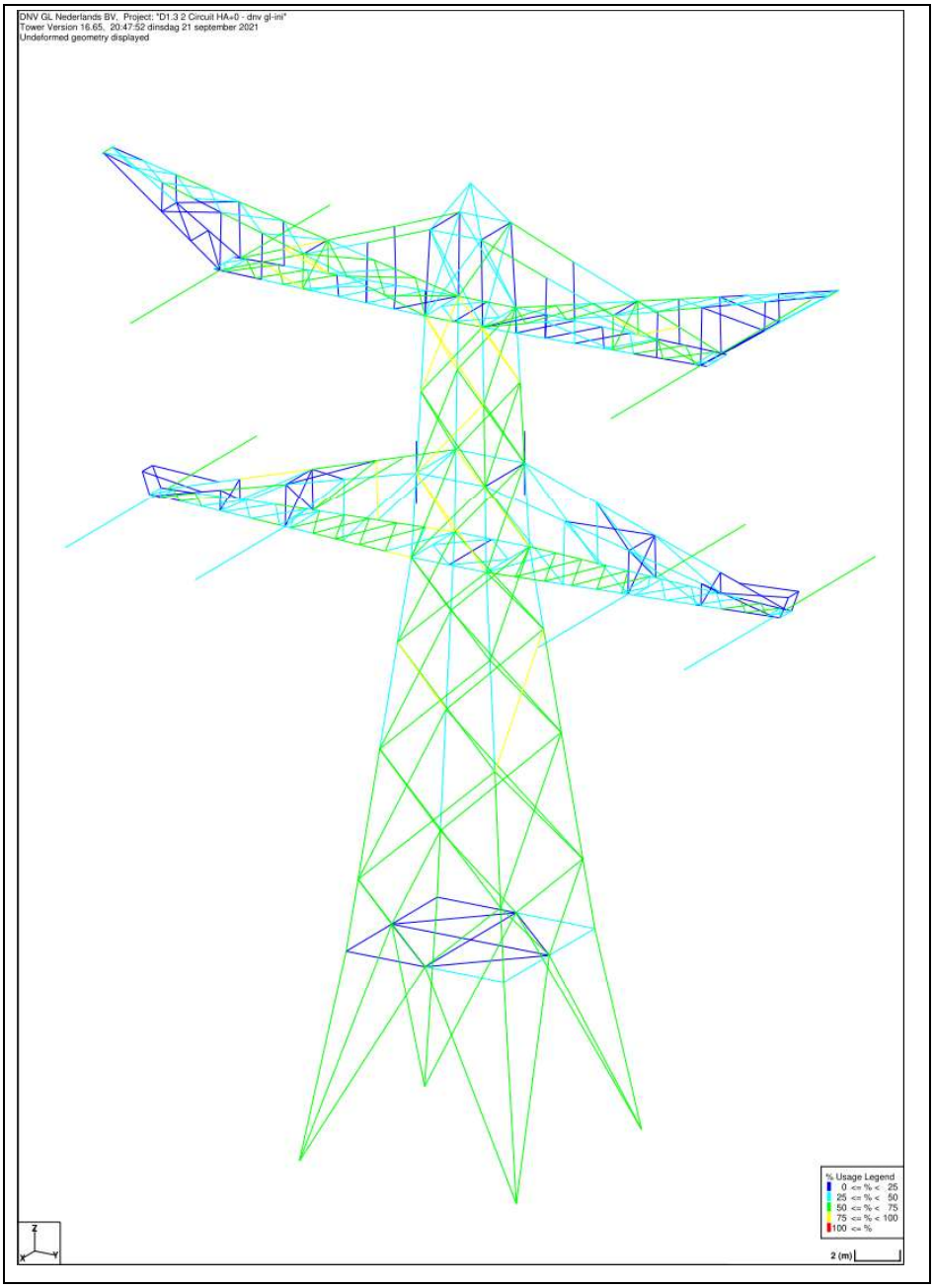
Het gewicht van masttype HA+5/n is bepaald op 50,3 ton.

# 4 TOETSING

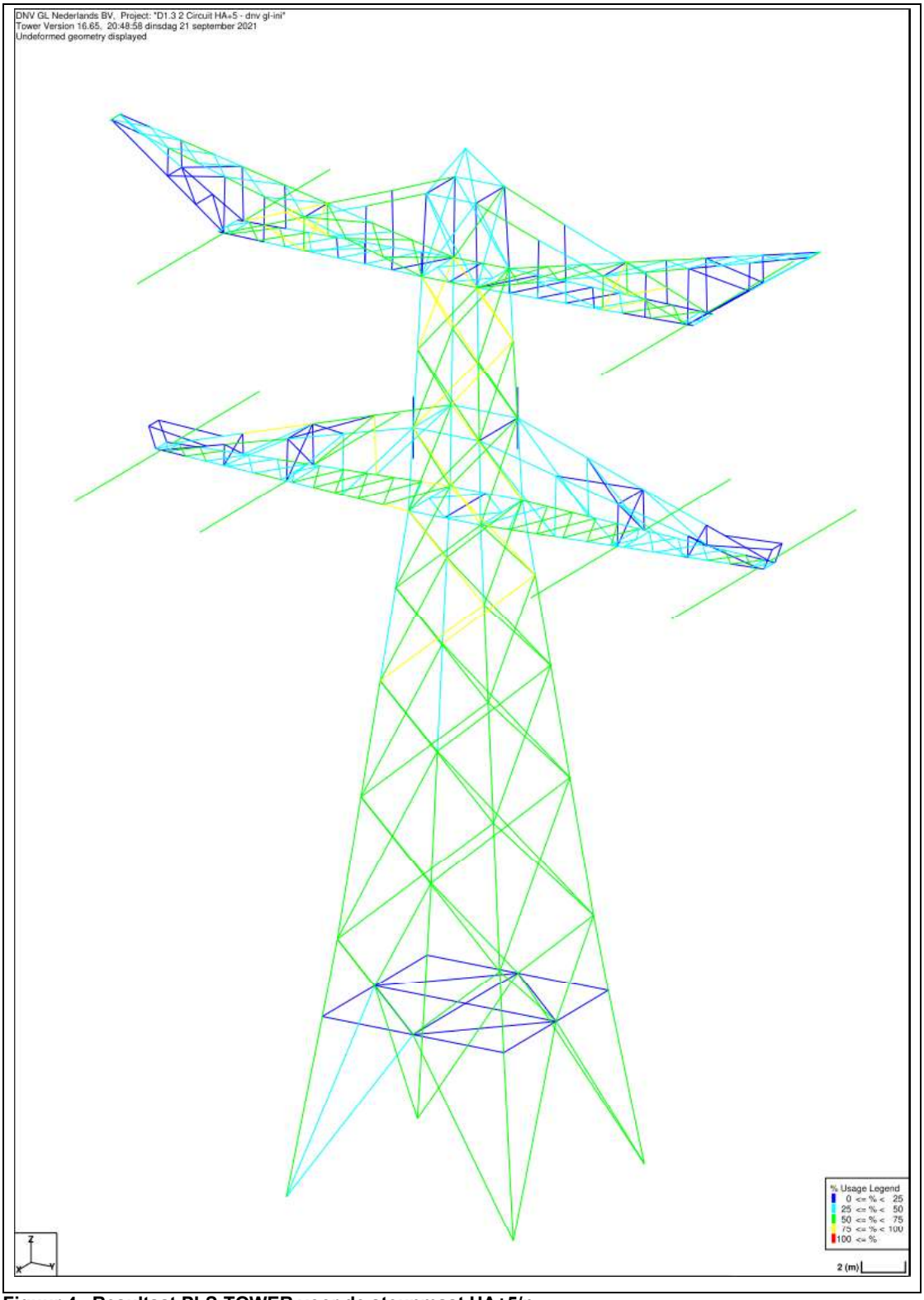
## 4.1 Resultaat PLS-TOWER

Het resultaat van de toetsing met PLS-TOWER is per masttype weergegeven in Figuur 3 en Figuur 4. Voor elk masttype zijn de belastingen apart bepaald. Alléén voor masttype HA+5/n, bepalend voor het ontwerp van de mastkop, zijn deze ook inclusief afspannen.

De uitnutting van de constructie loopt op van blauw (0-25%) tot geel (75-100%). Uit de figuur wordt geconcludeerd dat alle profielen en boutverbindingen voldoen.




**Figuur 3 Resultaat PLS-TOWER voor de steunmast HA+0/n**




**Figuur 4 Resultaat PLS-TOWER voor de steunmast HA+5/n**

## 4.2 Toetsing overige onderdelen

In Tabel 8 zijn de resultaten van de uitgevoerde toetsingen weergegeven.

**Tabel 8 Samenvatting uitgevoerde controles**

| Controle van | Beoordeling | Referentie |
|---|---|---|
| Profielen | Voldoen | Figuur 4<br>Figuur 3<br>Appendix B |
| Knikverkorters | Voldoen | Appendix C |
| Blokdeuvels randstijl | Voldoen | Appendix D |
| Galloping | Voldoet | Appendix F |

# APPENDIX A
# Geleiderbelastingen

Geleiderbelastingen opgenomen:

- Masttype HA+0/n
- Masttype HA+5/n

## Inhoud


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


## Gegevens

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initieel* | |
| Gevolgklasse | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 50 jaar |
| *Na aanpassing* | |
| Gevolgklasse | n.v.t. |
| Betrouwbaarheidsniveau | n.v.t. |
| Referentieperiode | n.v.t. |
| Windgebied | III |
| Windsnelheid | 24,5 m/s |
| Terreincategorie | II |
| Reductie factor Cdir | 1,00 |
| IJsgebied | B |
| Masttype | Hoekmast |
| Masthoogte | 45 m |
| Max. veldlengte | 400 m |
| Lijnhoek | 160° |
| Trekparameter | 1600 m |
| Wind span | 400 m |
| EDS Weight span | 440 m |
| Min. Weight span | 7 m |
| Max. Weight span | 488 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-07-26 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype HA+0_n

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

Document name:

GT-RLL380_HA+0_n_25N_Report.pdf

Project number:

Project client number:

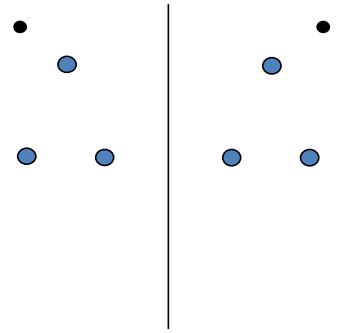
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

## Geleiderbelastingen

Auteur: TBR
Versie: v12.0

**Algemeen**

| | |
|---|---|
| Benaming | HA+0_n |
| Masttype | Hoekmast |
| Aantal circuits | 2 |
| Configuratie | 2-circuit-donau |
| Aantal bliksemgeleiders | 2 |



Configuratie geleiders

**Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau initieel | Nieuwbouw |
| Referentieperiode initieel | 50 jaar |
| | CC2 |
| Betrouwbaarheidsniveau na aanpassing | n.v.t. |
| | 50 jaar |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 m/s |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

**Geleiders Back**

| Omschrijving | Spanning | Geleider Back | Bundel Ba | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Geleiders Ahead

| Omschrijving | Spanning | Geleider Ahead | Bundel Ah | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Isolatoren *(1)*

| Omschrijving | Ophanging | Gewicht [kN] | Lengte [m] | Windopp. [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Afspanketting | 6,00 | 7,90 | 2,00 |
| Circuit 2 | Afspanketting | 6,00 | 7,90 | 2,00 |
| Bliksemdraad 1 | Afspanketting | 0,10 | 0,20 | 0,10 |
| Bliksemdraad 2 | Afspanketting | 0,10 | 0,20 | 0,10 |

1. Eigenschappen gelden voor geheel van de isolatorset

**Ophanghoogte en positie in mast**

| Circuits | Aanduiding | Nummer | Ophanghoogte | Aangrijppunt | Positie in mast Horizontale afstand |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 27,7 m | 27,7 m | -15,7 m |
| Circuit 1 | 11 | 380ct1f2 | 27,7 m | 27,7 m | -8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 39,0 m | 39,0 m | -12,2 m |
| Circuit 2 | 20 | 380ct2f1 | 27,7 m | 27,7 m | 8,7 m |
| Circuit 2 | 21 | 380ct2f2 | 27,7 m | 27,7 m | 15,7 m |
| Circuit 2 | 22 | 380ct2f3 | 39,0 m | 39,0 m | 12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 43,2 m | 43,2 m | -18,4 m |
| Bliksemdraad 2 | 3 | bl2 | 43,2 m | 43,2 m | 18,4 m |

Project: GT-RLL380
Tower: HA+0_n
Number: 25N

**Hoogteaanpassing naastgelegen masten** (aanpassing wind- en weight span)

| | Back | Ahead | |
|---|---|---|---|
| Verhoging voor windbelasting | 32,0 m | 0,0 m | (positief: omhoog) |
| Verlaging voor verticale belasting | -5,0 m | -5,0 m | (negatief: omlaag, grotere weight span) |

Verlaging: Niet in 0,9EG-combinaties

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

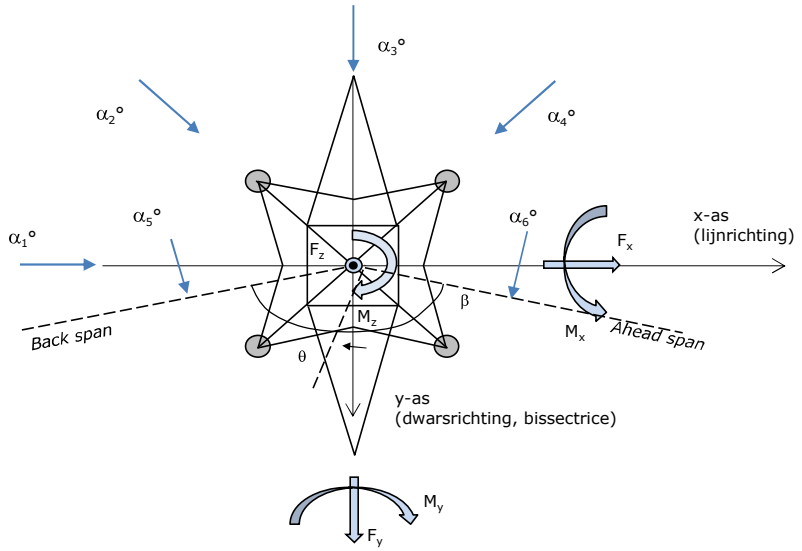
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Lijn- en mastgegevens**

| | | Back | Ahead |
|---|---|---|---|
| | | 400,0 | 400,0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 400,0 | 400,0 m |
| Lijnhoek | $\beta$ | 160 ° | |
| Rotatie mast t.o.v. bissectrice | $\theta$ | 0 ° | |
| Vaklengte | | 400 | 400 m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 m | |
| Beschouwde windrichtingen | $\alpha_1$ | 0 ° | |
| Windrichtingen volgens: | $\alpha_2$ | 45 ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 ° | |
| | $\alpha_4$ | 135 ° | |
| | $\alpha_5$ | 80 ° | |
| | $\alpha_6$ | 100 ° | |

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

Windrichtingen en positieve richtingen belastingen




| Beschouwd aantal windrichtingen | |
|---|---|
| 1a | 6 |
| 3 | 6 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

Project: GT-RLL380
Tower: HA+0_n
Number: 25N

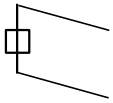
**Geleiderafval**

| | | 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 |

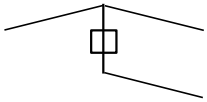
**Belastingsituaties SPLS**

Beschouwde situaties SPLS: 1 t/m 6, alle mogelijke situaties.

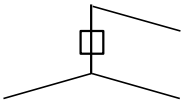
Principe belastingssituaties:



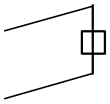
1. Ba All cts



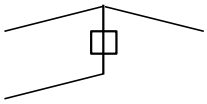
2. Ba ct1



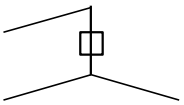
3. Ba ct2



4. Ah All cts



5. Ah ct1

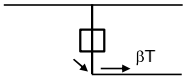


6. Ah ct2

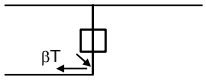
**Belastingsituaties 5a. Geleiderbreuk**

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

Principe belastingssituaties:




1. Ba




2. Ah

Project: GT-RLL380
Tower: HA+0_n
Number: 25N

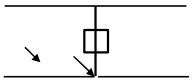
**Belastingsituaties 6. Bouw- en onderhoud**
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht.
Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate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

| | Fase | Bliksem |
|---|---|---|
| Lijnwagen | 4,0 kN | 2,0 kN |
| Puntlast op traverse | 1,0 kN | 1,0 kN |

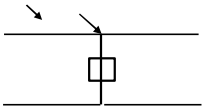
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

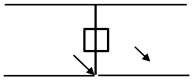
Principe belastingssituaties:



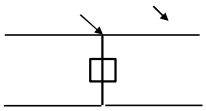
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

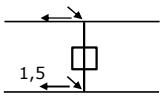
**Belastingsituaties 8. Lijndansen als statische belasting**

| Geleider | | |
|---|---|---|
| Steunmast fase | 0,866 W | 1,5 W |
| Steunmast bliksem | 1,5 EDS | 1,5 W |
| Hoekmast fase en bliksem | 1,5 EDS | 1,5 W |

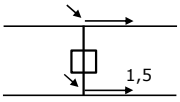
Beschouwde situaties lijndansen 8: Geen (bestaande constructie)

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:




1. Ba




2. Ah

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

Project: GT-RLL380
Tower: HA+0_n
Number: 25N

## Mastconstructie

### Eigenschappen

| | | | |
|---|---|---|---|
| Masttype | Hoekmast | | |
| Mastbenaming | HA+0_n | | |
| Voetplaat t.o.v. maaiveld | 0,5 | | m |
| Masthoogte t.o.v. voetplaat | 45,0 | | m |
| Gewicht mast | 455,0 | | kN |
| | | | |
| *Breedte en helling mast bij fundatie* | x-ri. | y-ri. | |
| Pootsprei | 11,00 | 11,00 | m |
| Helling van de randstijl | 0,156 | 0,156 | - |
| Factor spatkracht | 1,3 | 1,3 | - |

### Berekening windbelasting

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

### Eigenschappen mastsecties langsrichting (vooraanzicht, yz-vlak)

| Omschrijving | 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 | 9,60 | 11,00 | 8,00 | 9,60 | 0,156 | 91,20 | 15,71 | 0,17 | 3,05 |
| Tussenstuk1 | 18,90 | 8,00 | 5,84 | 9,30 | 0,116 | 64,37 | 13,16 | 0,20 | 2,91 |
| Tussenstuk2 | 27,70 | 5,84 | 3,80 | 8,80 | 0,116 | 42,42 | 11,52 | 0,27 | 2,64 |
| Bovenstuk1 | 35,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 8,91 | 0,34 | 2,40 |
| Bovenstuk2 | 43,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 5,97 | 0,29 | 2,57 |
| Topstuk | 45,00 | 2,60 | | 2,00 | | 2,60 | 0,40 | 0,15 | 3,14 |
| Ondertraverse | 27,70 | 14,20 | | 4,00 | | 28,40 | 6,76 | 0,24 | 2,77 |
| Boventraverse | 39,00 | 16,94 | | 4,20 | | 35,57 | 8,36 | 0,23 | 2,78 |

### Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)

| Omschrijving | 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 | 9,60 | 11,00 | 8,00 | 9,60 | 0,156 | 91,20 | 15,71 | 0,17 | 3,05 |
| Tussenstuk1 | 18,90 | 8,00 | 5,84 | 9,30 | 0,116 | 64,37 | 13,16 | 0,20 | 2,91 |
| Tussenstuk2 | 27,70 | 5,84 | 3,80 | 8,80 | 0,116 | 42,42 | 11,52 | 0,27 | 2,64 |
| Bovenstuk1 | 35,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 8,91 | 0,34 | 2,40 |
| Bovenstuk2 | 43,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 5,97 | 0,29 | 2,57 |
| Topstuk | 45,00 | 2,60 | | 2,00 | | 2,60 | 0,40 | 0,15 | 3,14 |
| Ondertraverse | 27,70 | 14,20 | | 4,00 | | 28,40 | 6,76 | 0,24 | 2,77 |
| Boventraverse | 39,00 | 16,94 | | 4,20 | | 35,57 | 8,36 | 0,23 | 2,78 |

*NB: oppervlakte traverse dwarsrichting van de tabel wordt in berekening gereduceerd.*
*NB: oppervlakte traverse per zijde, dus helft van totaal van twee traverses.*

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**Windoppervlak feeders telecominstallaties**

| Onderdeel | A ($m^2$/m) | Factor | Δh | $A_1$ |
|---|---|---|---|---|
| Broekstuk | 0,20 | 0,71 | 9,6 | 1,4 |
| Tussenstuk1 | 0,20 | 0,71 | 9,3 | 1,3 |
| Tussenstuk2 | 0,20 | 0,71 | 8,8 | 1,2 |
| Bovenstuk1 | 0,20 | 0,71 | 7,8 | 1,1 |
| Bovenstuk2 | | | | |

**Invoer antennes**

| Omschrijving | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne top | | | |
| Antenne o.t. | 4,6 | 31,7 | 1,5 |

**Belastingen mastsectie langsrichting (x-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 33,6 | 28,5 | 0,0 | -28,5 | 4,8 | 161,5 | 137,0 | 0,0 | -137,0 |
| Tussenstuk1 | 0,79 | 30,2 | 25,7 | 0,0 | -25,7 | 14,3 | 430,9 | 365,6 | 0,0 | -365,6 |
| Tussenstuk2 | 0,92 | 27,9 | 23,7 | 0,0 | -23,7 | 23,3 | 651,0 | 552,4 | 0,0 | -552,4 |
| Bovenstuk1 | 1,01 | 21,5 | 18,3 | 0,0 | -18,3 | 31,6 | 680,1 | 577,1 | 0,0 | -577,1 |
| Bovenstuk2 | 1,06 | 16,4 | 13,9 | 0,0 | -13,9 | 39,3 | 642,6 | 545,3 | 0,0 | -545,3 |
| Topstuk | 1,10 | 1,4 | 1,2 | 0,0 | -1,2 | 44,0 | 60,8 | 51,6 | 0,0 | -51,6 |
| Ondertraverse | 0,98 | 36,7 | 21,8 | 0,0 | -21,8 | 29,0 | 1065,5 | 632,9 | 0,0 | -632,9 |
| Boventraverse | 1,07 | 49,9 | 29,6 | 0,0 | -29,6 | 40,4 | 2016,5 | 1197,8 | 0,0 | -1197,8 |
| Totaal | | 217,7 | 162,7 | 0,0 | -162,7 | | 5709,0 | 4059,7 | 0,0 | -4059,7 |

**Belastingen mastsectie dwarsrichting (y-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 0,0 | 28,5 | 33,6 | 28,5 | 4,8 | 0,0 | 137,0 | 161,5 | 137,0 |
| Tussenstuk1 | 0,79 | 0,0 | 25,7 | 30,2 | 25,7 | 14,3 | 0,0 | 365,6 | 430,9 | 365,6 |
| Tussenstuk2 | 0,92 | 0,0 | 23,7 | 27,9 | 23,7 | 23,3 | 0,0 | 552,4 | 651,0 | 552,4 |
| Bovenstuk1 | 1,01 | 0,0 | 18,3 | 21,5 | 18,3 | 31,6 | 0,0 | 577,1 | 680,1 | 577,1 |
| Bovenstuk2 | 1,06 | 0,0 | 13,9 | 16,4 | 13,9 | 39,3 | 0,0 | 545,3 | 642,6 | 545,3 |
| Topstuk | 1,10 | 0,0 | 1,2 | 1,4 | 1,2 | 44,0 | 0,0 | 51,6 | 60,8 | 51,6 |
| Ondertraverse | 0,98 | 0,0 | 21,8 | 14,7 | 21,8 | 29,0 | 0,0 | 632,9 | 426,2 | 632,9 |
| Boventraverse | 1,07 | 0,0 | 29,6 | 20,0 | 29,6 | 40,4 | 0,0 | 1197,8 | 806,6 | 1197,8 |
| Totaal | | 0,0 | 162,7 | 165,7 | 162,7 | | 0,0 | 4059,7 | 3859,7 | 4059,7 |

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

| Belasting / windrichting | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 455 | 0 | 0 | 0 |
| Windrichting 0° | 225 | 0 | 0 | 0 | 5929 | 0 |
| Windrichting 45° | 168 | 168 | 0 | 4215 | 4215 | 0 |
| Windrichting 90° | 0 | 173 | 0 | 4079 | 0 | 0 |
| Windrichting 135° | -168 | 168 | 0 | 4215 | -4215 | 0 |

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**Tussenresultaten geleiderbelastingen**

**Geleiders back**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Geleiders ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Verticale belasting back**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Verticale belasting ahead**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Isolatoren**

| Geleider | $G_{isolator}$ [kN] | Aantal - | $F_{v,iso}$ [kN] | Lengte [m] | Windopp. [m$^2$] | Windhoogte [m] | Stuwdruk [kN/m$^2$] | Vormfactor [-] | $F_{h,iso}$ [kN] |
|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 6,00 | 1 | 6 | 7,9 | 2,0 | 28,20 | 0,97 | 1,2 | 2,33 |
| 380ct1f2 | 6,00 | 1 | 6 | 7,9 | 2,0 | 28,20 | 0,97 | 1,2 | 2,33 |
| 380ct1f3 | 6,00 | 1 | 6 | 7,9 | 2,0 | 39,50 | 1,07 | 1,2 | 2,56 |
| 380ct2f1 | 6,00 | 1 | 6 | 7,9 | 2,0 | 28,20 | 0,97 | 1,2 | 2,33 |
| 380ct2f2 | 6,00 | 1 | 6 | 7,9 | 2,0 | 28,20 | 0,97 | 1,2 | 2,33 |
| 380ct2f3 | 6,00 | 1 | 6 | 7,9 | 2,0 | 39,50 | 1,07 | 1,2 | 2,56 |
| bl1 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 43,70 | 1,10 | 1,2 | 0,13 |
| bl2 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 43,70 | 1,10 | 1,2 | 0,13 |

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**Windbelasting back**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 35,9 | 1,04 | 0,59 | 0,65 | 1,09 | 28,25 | 56,5 | 62,2 | 46,9 | 103,8 | 114,2 |
| 380ct1f2 | 35,9 | 1,04 | 0,59 | 0,65 | 1,09 | 28,25 | 56,5 | 62,2 | 46,9 | 103,8 | 114,2 |
| 380ct1f3 | 47,2 | 1,12 | 0,61 | 0,67 | 1,06 | 28,25 | 61,8 | 68,0 | 46,9 | 115,8 | 127,3 |
| 380ct2f1 | 35,9 | 1,04 | 0,59 | 0,65 | 1,09 | 28,25 | 56,5 | 62,2 | 46,9 | 103,8 | 114,2 |
| 380ct2f2 | 35,9 | 1,04 | 0,59 | 0,65 | 1,09 | 28,25 | 56,5 | 62,2 | 46,9 | 103,8 | 114,2 |
| 380ct2f3 | 47,2 | 1,12 | 0,61 | 0,67 | 1,06 | 28,25 | 61,8 | 68,0 | 46,9 | 115,8 | 127,3 |
| bl1 | 51,4 | 1,14 | 0,62 | 0,68 | 1,18 | 22,24 | 18,6 | 20,5 | 63,1 | 53,7 | 59,0 |
| bl2 | 51,4 | 1,14 | 0,62 | 0,68 | 1,19 | 22,13 | 18,6 | 20,4 | 63,0 | 53,6 | 58,9 |

**Windbelasting ahead**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 19,9 | 0,88 | 0,54 | 0,60 | 1,13 | 28,25 | 45,8 | 50,4 | 46,9 | 80,6 | 88,8 |
| 380ct1f2 | 19,9 | 0,88 | 0,54 | 0,60 | 1,13 | 28,25 | 45,8 | 50,4 | 46,9 | 80,6 | 88,8 |
| 380ct1f3 | 31,2 | 1,00 | 0,58 | 0,64 | 1,10 | 28,25 | 53,9 | 59,3 | 46,9 | 98,0 | 107,8 |
| 380ct2f1 | 19,9 | 0,88 | 0,54 | 0,60 | 1,13 | 28,25 | 45,8 | 50,4 | 46,9 | 80,6 | 88,8 |
| 380ct2f2 | 19,9 | 0,88 | 0,54 | 0,60 | 1,13 | 28,25 | 45,8 | 50,4 | 46,9 | 80,6 | 88,8 |
| 380ct2f3 | 31,2 | 1,00 | 0,58 | 0,64 | 1,10 | 28,25 | 53,9 | 59,3 | 46,9 | 98,0 | 107,8 |
| bl1 | 35,4 | 1,03 | 0,59 | 0,65 | 1,20 | 22,24 | 16,3 | 17,9 | 63,1 | 46,3 | 50,9 |
| bl2 | 35,4 | 1,03 | 0,59 | 0,65 | 1,20 | 22,13 | 16,2 | 17,9 | 63,0 | 46,2 | 50,9 |

*NB: belastingen $w_v$ gelden voor bundel*

Project: GT-RLL380
Masttype: HA+0_n
Mast: 25N

**Geleiderbelastingen**

Auteur: TBR
Versie: v12.0

**Uitgangspunten**

| | |
|---|---|
| Betrouwbaarheidsniveau | Nieuwbouw CC2 |
| Referentieperiode | 50 jaar |

| **ULS** (bezwijksterkte) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belastingsgeval | omschrijving | 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° | 1,20 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk alleen mast | 10° | 0,90 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk ook geleider | 10° | 0,90 | 0,90 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 5a | Torsiebelastingen | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinale belastingen | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,50 | 0,30 | 0,00 | 0,0 |
| ULS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,35 | 1,35 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,20 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 0,90 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (controle van de vervormingen, vermoeiing, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 1,00 | 0,0 | 0,0 |
| SLS 3 | Wind+ijs | -5° | 1,00 | 1,00 | 0,0 | 0,30 | 1,00 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 6 | Bouw en onderhoud | 5° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 7 | PB (EDS, geen wind) | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Aantal windrichtingen | 6 |
| Aantal belastingcombinaties ULS | 54 |
| Aantal belastingcombinaties SPLS | 222 |
| Aantal belastingcombinaties SLS | 15 |
| Aantal knooplasten | 4656 |

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Masttype: HA+0_n
Mast: 25N

**Samenvattingstabellen geleiderbelastingen**

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

**Maximale waarden voor back en ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -62,0 | 60,7 | 15,9 | 15,0 | 10,3 | 10,3 |
| bl2 | -61,2 | 59,9 | 15,8 | 14,8 | 10,2 | 10,2 |
| 380ct1f1 | -156,9 | 151,6 | 46,7 | 40,5 | 28,8 | 28,7 |
| 380ct1f2 | -156,9 | 151,6 | 46,7 | 40,5 | 28,8 | 28,7 |
| 380ct1f3 | -160,0 | 155,5 | 49,8 | 45,2 | 28,8 | 28,8 |
| 380ct2f1 | -156,9 | 151,6 | 46,7 | 40,5 | 28,8 | 28,7 |
| 380ct2f2 | -156,9 | 151,6 | 46,7 | 40,5 | 28,8 | 28,7 |
| 380ct2f3 | -160,0 | 155,5 | 49,8 | 45,2 | 28,8 | 28,8 |

**Min. Weight span (m)**

| Weight sp: | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 440,1 | 447,2 | 440,0 |
| bl2 | 440,1 | 447,4 | 440,0 |
| 380ct1f1 | 440,0 | 445,4 | 440,0 |
| 380ct1f2 | 440,0 | 445,4 | 440,0 |
| 380ct1f3 | 440,0 | 445,7 | 440,0 |
| 380ct2f1 | 440,0 | 445,4 | 440,0 |
| 380ct2f2 | 440,0 | 445,4 | 440,0 |
| 380ct2f3 | 440,0 | 445,7 | 440,0 |

**Max. Weight span (m)**

| Weight sp: | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 486,7 | 433,4 |
| bl2 | 487,9 | 433,2 |
| 380ct1f1 | 464,4 | 440,2 |
| 380ct1f2 | 464,4 | 440,2 |
| 380ct1f3 | 469,2 | 441,1 |
| 380ct2f1 | 464,4 | 440,2 |
| 380ct2f2 | 464,4 | 440,2 |
| 380ct2f3 | 469,2 | 441,1 |

| Omhullende weight span over alle combinaties (incl. 0,9 combinaties) | | |
|---|---|---|
| Voor alle geleiders | | Wind / Weight span verhouding |
| Max. weight span | 487,9 m | 1,220 - |
| Min. weight span | 7,4 m | 0,018 - |

Project: GT-RLL380
Masttype: HA+0_n
Mast: 25N

**Maximale waarden back+ahead span** **Maximale waarden trekkracht geleider**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 35,3 | 30,5 | 10,3 | -63,9 | 62,4 |
| bl2 | 34,8 | 30,2 | 10,2 | -63,0 | 61,5 |
| 380ct1f1 | 118,3 | 85,2 | 28,8 | -161,2 | 155,4 |
| 380ct1f2 | 118,3 | 85,2 | 28,8 | -161,2 | 155,4 |
| 380ct1f3 | 119,9 | 92,7 | 28,8 | -164,5 | 159,6 |
| 380ct2f1 | 118,3 | 85,2 | 28,8 | -161,2 | 155,4 |
| 380ct2f2 | 118,3 | 85,2 | 28,8 | -161,2 | 155,4 |
| 380ct2f3 | 119,9 | 92,7 | 28,8 | -164,5 | 159,6 |

**EDS-belastingen geleiders**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 15,1 | 2,7 | 2,2 | -15,3 | 15,3 |
| bl2 | 14,7 | 2,6 | 2,1 | -14,9 | 14,9 |
| 380ct1f1 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f2 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f3 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct2f1 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct2f2 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct2f3 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |

**Controle uplift SLS-wind**

| Combinati | 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 |

Project: GT-RLL380
Masttype: HA+0_n
Mast: 25N

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

| Combinatie | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | -96 | 574 | 252 | 18745 | -3026 | 0 |
| ULS 1a_0,9_0 | | 1 | 192 | 184 | 6198 | 37 | 0 |
| ULS 1a_0,9_0,9_90 | | -104 | 557 | 95 | 18191 | -3294 | 0 |
| ULS 3_0 | | 1 | 344 | 384 | 11300 | 23 | 0 |
| SLS 7 | | 0 | 163 | 202 | 5260 | 0 | 0 |

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

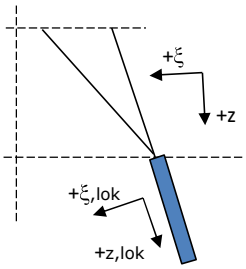
| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -96 | 833 | 798 | 24864 | -3026 | 0 |
| ULS 1a_0,9_0,9_90 | -104 | 816 | 504 | 24310 | -3294 | 0 |
| SLS 7 | 0 | 163 | 657 | 5260 | 0 | 0 |

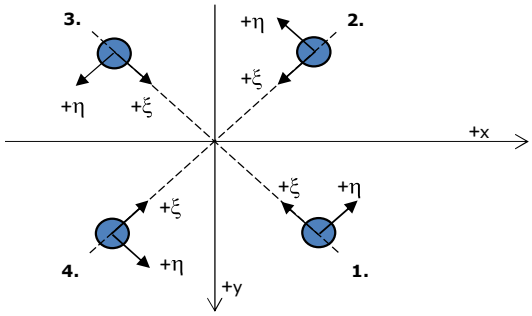
**Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde**

| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_90 | -96 | 833 | 557 | **24865** | -3026 | 0 |
| SPLS 3_90 Ah All Cts | -770 | 235 | 726 | 7105 | **-25083** | 8 |
| SPLS 3_80 Ba Ct1 | 345 | 304 | 772 | 9916 | 11108 | **-4957** |
| SPLS 1a_0,9_90 Ah All Cts | -694 | 338 | 510 | **9784** | **-22511** | 7 |

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

**Oplegreacties op fundering per randstijl**




Assenstelsels

**Maximale drukbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 3_90 Ba All Cts | 283 | 314 | **1576** | -22 | -422 | -74 | 1614 |
| 2 | SPLS 3_0 Ba All Cts | 187 | -223 | **1071** | 25 | -290 | -53 | 1097 |
| 3 | SPLS 3_90 Ah All Cts | -164 | -209 | **999** | -32 | -264 | -43 | 1023 |
| 4 | SPLS 3_80 Ah All Cts | -294 | 328 | **1646** | 24 | -440 | -76 | 1686 |

**Maximale trekbelasting**

| Stijl | Combinatie | $R_x$ [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_90 Ah All Cts | -100 | -147 | **-688** | 33 | 175 | 23 | -705 |
| 2 | SPLS 1a_0,9_90 Ah All Cts | -238 | 266 | **-1341** | -20 | 357 | 60 | -1373 |
| 3 | SPLS 3_0,9_90 Ba All Cts | 217 | 247 | **-1250** | 22 | 328 | 52 | -1280 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 120 | -157 | **-745** | -26 | 196 | 31 | -763 |

**Maximale torsiebelasting (positief)**

| Stijl | Combinatie | $R_x$ [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 Ba Ct1 | 125 | -128 | -29 | **179** | 2 | -4 | -29 |
| 2 | SPLS 3_0,9_80 Ba Ct2 | -81 | -169 | 233 | **177** | -62 | -10 | 238 |
| 3 | SPLS 6a_90 Ba Ct2 Ah Ct2 | 10 | 247 | -695 | **168** | 182 | 28 | -711 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -97 | 329 | 1124 | **164** | -301 | -53 | 1151 |

**Maximale torsiebelasting (negatief)**

| Stijl Index | Combinatie 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 Ba Ct1 Ah Ct1 | 94 | 328 | 1112 | **-165** | -298 | -53 | 1139 |
| 2 | SPLS 6a_90 Ah Ct2 Ba Ct2 | -13 | 249 | -707 | **-167** | 185 | 29 | -724 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 40 | -208 | 444 | **-175** | -118 | -20 | 454 |
| 4 | SPLS 3_80 Ba Ct1 | -157 | -100 | 139 | **-182** | -40 | -10 | 142 |

Project: GT-RLL380
Masttype: HA+0_n
Mast: 25N

**Combinatie Ftrek+Fhor**

| Stijl | Combinatie | $R_x$ [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_90 Ah All Cts | -100 | -147 | **-688** | **33** | 175 | 23 | -705 |
| 2 | SPLS 3_0,9_80 Ah All Cts | -232 | 264 | **-1336** | **-23** | 351 | 55 | -1368 |
| 3 | SPLS 3_0,9_90 Ba All Cts | 217 | 247 | **-1250** | **22** | 328 | 52 | -1280 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 120 | -157 | **-745** | **-26** | 196 | 31 | -763 |

**Permanente belasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 82 | 74 | 403 | 5 | -110 | -21 | 413 |
| 2 | SLS 7 | -15 | 7 | -75 | 5 | 16 | -1 | -77 |
| 3 | SLS 7 | 15 | 7 | -75 | -5 | 16 | -1 | -77 |
| 4 | SLS 7 | -82 | 74 | 403 | -5 | -110 | -21 | 413 |

**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 3_80 Ah All Cts | -294 | 328 | **1646** | 24 | -440 | -76 | 1686 |
| Max. trek | SPLS 1a_0,9_90 Ah All Cts | -238 | 266 | **-1341** | -20 | 357 | 60 | -1373 |
| Max. pos. torsie | SPLS 6a_90 Ah Ct1 Ba Ct1 | 125 | -128 | -29 | **179** | 2 | -4 | -29 |
| Max. neg. torsie | SPLS 3_80 Ba Ct1 | -157 | -100 | 139 | **-182** | -40 | -10 | 142 |
| Comb. trek+torsie | SPLS 3_0,9_80 Ah All Cts | -232 | 264 | **-1336** | **-23** | 351 | 55 | -1368 |

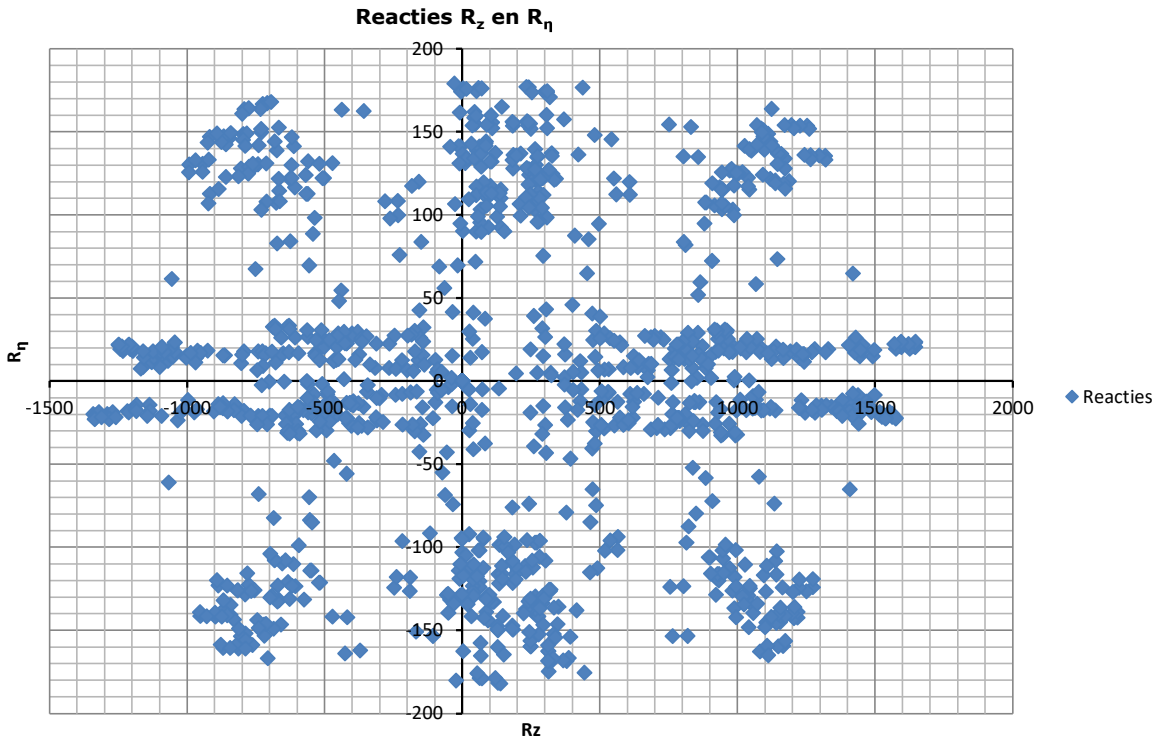
**Maximale trekbelasting SLS**

| Stijl | Combinatie | $R_x$ [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_80 Ah All Cts | -98 | -146 | **-682** | 33 | 173 | 22 | -698 |
| 2 | SPLS 3_0,9_80 Ah All Cts | -232 | 264 | **-1336** | -23 | 351 | 55 | -1368 |
| 3 | SPLS 1a_0,9_100 Ba Ct2 | 61 | 262 | **-859** | 142 | 228 | 39 | -880 |
| 4 | SPLS 3_0,9_100 Ba Ct2 | 81 | 108 | **43** | 134 | -19 | -10 | 44 |

**Maximale drukbelasting SLS**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_100 Ba Ct2 | 318 | 137 | **1172** | 128 | -321 | -62 | 1200 |
| 2 | SPLS 3_100 Ba Ct2 | -63 | -178 | **318** | 171 | -81 | -11 | 326 |
| 3 | SPLS 3_80 Ah All Cts | -162 | -208 | **993** | -33 | -262 | -42 | 1016 |
| 4 | SPLS 3_80 Ah All Cts | -294 | 328 | **1646** | 24 | -440 | -76 | 1686 |

Project: GT-RLL380
Masttype: HA+0_n
Mast: 25N



## Inhoud


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


## Gegevens

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initieel* | |
| Gevolgklasse | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 15 jaar |
| *Na aanpassing* | |
| Gevolgklasse | n.v.t. |
| Betrouwbaarheidsniveau | n.v.t. |
| Referentieperiode | n.v.t. |
| Windgebied | III |
| Windsnelheid | 24,5 m/s |
| Terreincategorie | II |
| Reductie factor Cdir | 1,00 |
| IJsgebied | B |
| Masttype | Hoekmast |
| Masthoogte | 50 m |
| Max. veldlengte | 400 m |
| Lijnhoek | 160° |
| Trekparameter | 1600 m |
| Wind span | 400 m |
| EDS Weight span | 440 m |
| Min. Weight span | 53 m |
| Max. Weight span | 479 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-07-26 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype HA_n (bouwfase)

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

Document name:

GT-RLL380_HA_n (bouwfase)_18N_Report.pdf

Project number:

Project client number:

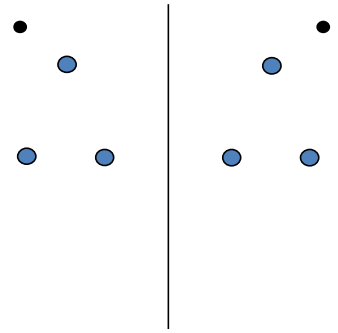
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

## Geleiderbelastingen

Auteur: TBR
Versie: v12.0

**Algemeen**

| | |
|---|---|
| Benaming | HA_n (bouwfase) |
| Masttype | Hoekmast |
| Aantal circuits | 1 |
| Configuratie | 2-circuit-donau |
| Aantal bliksemgeleiders | 1 |



Configuratie geleiders

**Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau initieel | Nieuwbouw |
| Referentieperiode initieel | 15 jaar |
| | CC2 |
| Betrouwbaarheidsniveau na aanpassing | n.v.t. |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 m/s |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

**Geleiders Back**

| Omschrijving | Spanning | Geleider Back | Bundel Ba | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |

Geleiders Ahead

| Omschrijving | Spanning | Geleider Ahead | Bundel Ah | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |

Isolatoren *(1)*

| Omschrijving | Ophanging | Gewicht [kN] | Lengte [m] | Windopp. [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Afspanketting | 6,00 | 7,90 | 2,00 |
| Bliksemdraad 1 | Afspanketting | 0,10 | 0,20 | 0,10 |

1. Eigenschappen gelden voor geheel van de isolatorset

**Ophanghoogte en positie in mast**

| Circuits | Aanduiding | Nummer | Ophanghoogte | Aangrijppunt | Positie in mast Horizontale afstand |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 32,7 m | 32,7 m | -15,7 m |
| Circuit 1 | 11 | 380ct1f2 | 32,7 m | 32,7 m | -8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 44,0 m | 44,0 m | -12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 48,2 m | 48,2 m | -18,4 m |

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

**Hoogteaanpassing naastgelegen masten** (aanpassing wind- en weight span)

| | Back | Ahead | |
|---|---|---|---|
| Verhoging voor windbelasting | 32,0 m | 0,0 m | (positief: omhoog) |
| Verlaging voor verticale belasting | -5,0 m | -5,0 m | (negatief: omlaag, grotere weight span) |

Verlaging: Niet in 0,9EG-combinaties

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

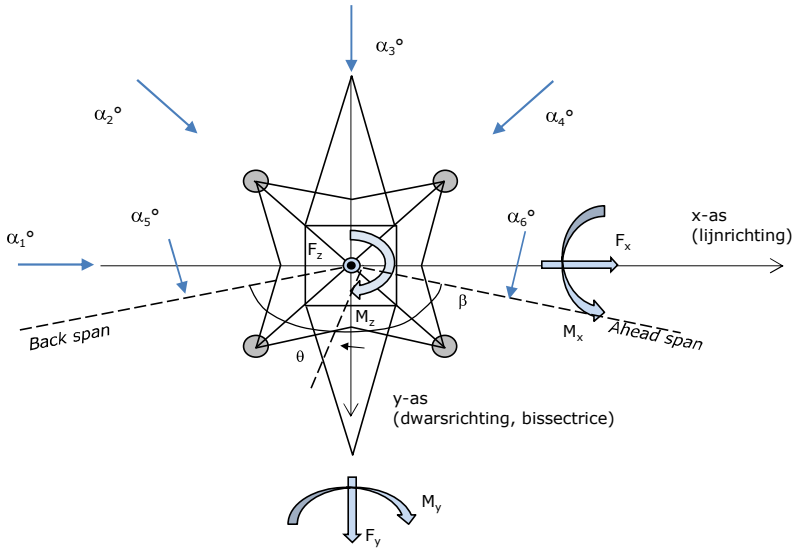
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Bliksemdraad 1 | 1 | bl1 | 0,0 | 0,0 m | 0,0 | 0,0 m |

**Lijn- en mastgegevens**

| | | Back | Ahead |
|---|---|---|---|
| | | 400,0 | 400,0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 400,0 | 400,0 m |
| Lijnhoek | $\beta$ | 160 ° | |
| Rotatie mast t.o.v. bissectrice | $\theta$ | 0 ° | |
| Vaklengte | | 400 | 400 m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 m | |
| Beschouwde windrichtingen | $\alpha_1$ | 0 ° | |
| Windrichtingen volgens: | $\alpha_2$ | 80 ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 ° | |
| | $\alpha_4$ | 100 ° | |
| | $\alpha_5$ | 225 ° | |
| | $\alpha_6$ | 270 ° | |

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

Windrichtingen en positieve richtingen belastingen




| Beschouwd aantal windrichtingen | |
|---|---|
| 1a | 6 |
| 3 | 6 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

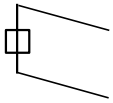
**Geleiderafval**

| | | 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 |
| Bliksemdraad 1 | bl1 | 1 | 0 | 1 | 0 | 1 | 0 |

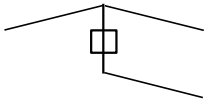
**Belastingsituaties SPLS**

Beschouwde situaties SPLS: 1 t/m 6, alle mogelijke situaties.

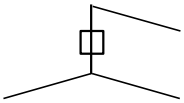
Principe belastingssituaties:



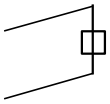
1. Ba All cts



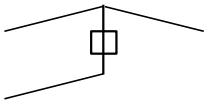
2. Ba ct1



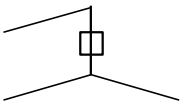
3. Ba ct2



4. Ah All cts



5. Ah ct1

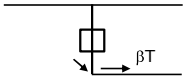


6. Ah ct2

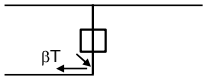
**Belastingsituaties 5a. Geleiderbreuk**

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

Principe belastingssituaties:




1. Ba




2. Ah

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

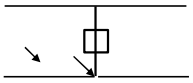
**Belastingsituaties 6. Bouw- en onderhoud**
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht.
Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate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

| | Fase | Bliksem |
|---|---|---|
| Lijnwagen | 4,0 kN | 2,0 kN |
| Puntlast op traverse | 1,0 kN | 1,0 kN |

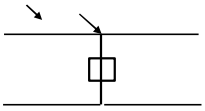
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

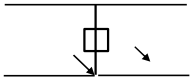
Principe belastingssituaties:



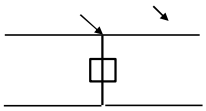
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

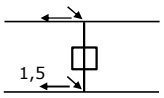
**Belastingsituaties 8. Lijndansen als statische belasting**

| Geleider | | |
|---|---|---|
| Steunmast fase | 0,866 W | 1,5 W |
| Steunmast bliksem | 1,5 EDS | 1,5 W |
| Hoekmast fase en bliksem | 1,5 EDS | 1,5 W |

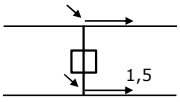
Beschouwde situaties lijndansen 8: 1 en 2, alle mogelijke situaties.

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:




1. Ba




2. Ah

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

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

## Mastconstructie

### Eigenschappen

| | | | |
|---|---|---|---|
| Masttype | Hoekmast | | |
| Mastbenaming | HA_n (bouwfase) | | |
| Voetplaat t.o.v. maaiveld | 0,5 | | m |
| Masthoogte t.o.v. voetplaat | 50,0 | | m |
| Gewicht mast | 492,0 | | kN |
| | | | |
| *Breedte en helling mast bij fundatie* | x-ri. | y-ri. | |
| Pootsprei | 11,58 | 11,58 | m |
| Helling van de randstijl | 0,399 | 0,399 | - |
| Factor spatkracht | 1,3 | 1,3 | - |

### Berekening windbelasting

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

### Eigenschappen mastsecties langsrichting (vooraanzicht, yz-vlak)

| Omschrijving | 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 | 8,54 | 11,58 | 4,77 | 8,54 | 0,399 | 69,81 | 13,53 | 0,19 | 2,96 |
| Tussenstuk1 | 19,03 | 4,77 | 6,96 | 10,49 | -0,104 | 61,52 | 13,15 | 0,21 | 2,87 |
| Tussenstuk2 | 32,70 | 6,96 | 3,80 | 13,67 | 0,116 | 73,54 | 16,36 | 0,22 | 2,83 |
| Bovenstuk1 | 40,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 7,84 | 0,30 | 2,54 |
| Bovenstuk2 | 48,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 4,92 | 0,24 | 2,77 |
| Topstuk | 50,00 | 2,60 | | 2,00 | | 2,60 | 0,43 | 0,17 | 3,09 |
| Ondertraverse | 32,70 | 14,20 | | 4,00 | | 28,40 | 6,40 | 0,23 | 2,82 |
| Boventraverse | 44,00 | 16,94 | | 4,20 | | 35,57 | 7,96 | 0,22 | 2,83 |

### Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)

| Omschrijving | 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 | 8,54 | 11,58 | 4,77 | 8,54 | 0,399 | 69,81 | 13,53 | 0,19 | 2,96 |
| Tussenstuk1 | 19,03 | 4,77 | 6,96 | 10,49 | -0,104 | 61,52 | 13,15 | 0,21 | 2,87 |
| Tussenstuk2 | 32,70 | 6,96 | 3,80 | 13,67 | 0,116 | 73,54 | 16,36 | 0,22 | 2,83 |
| Bovenstuk1 | 40,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 7,84 | 0,30 | 2,54 |
| Bovenstuk2 | 48,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 4,92 | 0,24 | 2,77 |
| Topstuk | 50,00 | 2,60 | | 2,00 | | 2,60 | 0,43 | 0,17 | 3,09 |
| Ondertraverse | 32,70 | 14,20 | | 4,00 | | 28,40 | 6,40 | 0,23 | 2,82 |
| Boventraverse | 44,00 | 16,94 | | 4,20 | | 35,57 | 7,96 | 0,22 | 2,83 |

*NB: oppervlakte traverse dwarsrichting van de tabel wordt in berekening gereduceerd.*
*NB: oppervlakte traverse per zijde, dus helft van totaal van twee traverses.*

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

**Windoppervlak feeders telecominstallaties**

| Onderdeel | A ($m^2$/m) | Factor | Δh | $A_1$ |
|---|---|---|---|---|
| Broekstuk | 0,20 | 0,71 | 8,5 | 1,2 |
| Tussenstuk1 | 0,20 | 0,71 | 10,5 | 1,5 |
| Tussenstuk2 | 0,20 | 0,71 | 13,7 | 1,9 |
| Bovenstuk1 | 0,20 | 0,71 | 7,8 | 1,1 |
| Bovenstuk2 | | | | |

**Invoer antennes**

| Omschrijving | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne top | | | |
| Antenne o.t. | 4,6 | 31,7 | 1,5 |

**Belastingen mastsectie langsrichting (x-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 28,1 | 5,0 | 0,0 | -5,0 | 4,3 | 119,8 | 21,3 | 0,0 | -21,3 |
| Tussenstuk1 | 0,78 | 29,5 | 5,2 | 0,0 | -5,2 | 13,8 | 406,5 | 72,2 | 0,0 | -72,2 |
| Tussenstuk2 | 0,95 | 43,9 | 7,8 | 0,0 | -7,8 | 25,9 | 1136,4 | 201,9 | 0,0 | -201,9 |
| Bovenstuk1 | 1,05 | 20,9 | 3,7 | 0,0 | -3,7 | 36,6 | 763,2 | 135,6 | 0,0 | -135,6 |
| Bovenstuk2 | 1,10 | 15,0 | 2,7 | 0,0 | -2,7 | 44,3 | 663,6 | 117,9 | 0,0 | -117,9 |
| Topstuk | 1,13 | 1,5 | 0,3 | 0,0 | -0,3 | 49,0 | 73,3 | 13,0 | 0,0 | -13,0 |
| Ondertraverse | 1,02 | 37,0 | 2,7 | 0,0 | -2,7 | 34,0 | 1259,1 | 93,6 | 0,0 | -93,6 |
| Boventraverse | 1,11 | 49,9 | 3,7 | 0,0 | -3,7 | 45,4 | 2264,4 | 168,2 | 0,0 | -168,2 |
| Totaal | | 225,7 | 31,1 | 0,0 | -31,1 | | 6686,3 | 823,9 | 0,0 | -823,9 |

**Belastingen mastsectie dwarsrichting (y-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 0,0 | 28,3 | 28,1 | 28,3 | 4,3 | 0,0 | 120,8 | 119,8 | 120,8 |
| Tussenstuk1 | 0,78 | 0,0 | 29,7 | 29,5 | 29,7 | 13,8 | 0,0 | 409,7 | 406,5 | 409,7 |
| Tussenstuk2 | 0,95 | 0,0 | 44,3 | 43,9 | 44,3 | 25,9 | 0,0 | 1145,3 | 1136,4 | 1145,3 |
| Bovenstuk1 | 1,05 | 0,0 | 21,0 | 20,9 | 21,0 | 36,6 | 0,0 | 769,2 | 763,2 | 769,2 |
| Bovenstuk2 | 1,10 | 0,0 | 15,1 | 15,0 | 15,1 | 44,3 | 0,0 | 668,9 | 663,6 | 668,9 |
| Topstuk | 1,13 | 0,0 | 1,5 | 1,5 | 1,5 | 49,0 | 0,0 | 73,9 | 73,3 | 73,9 |
| Ondertraverse | 1,02 | 0,0 | 15,6 | 14,8 | 15,6 | 34,0 | 0,0 | 530,5 | 503,6 | 530,5 |
| Boventraverse | 1,11 | 0,0 | 21,0 | 20,0 | 21,0 | 45,4 | 0,0 | 954,1 | 905,8 | 954,1 |
| Totaal | | 0,0 | 176,5 | 173,6 | 176,5 | | 0,0 | 4672,4 | 4572,3 | 4672,4 |

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

| Belasting / windrichting | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 492 | 0 | 0 | 0 |
| Windrichting 0° | 233 | 0 | 0 | 0 | 6906 | 0 |
| Windrichting 80° | 32 | 183 | 0 | 4889 | 862 | 0 |
| Windrichting 90° | 0 | 181 | 0 | 4792 | 0 | 0 |
| Windrichting 100° | -32 | 183 | 0 | 4889 | -862 | 0 |

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

**Tussenresultaten geleiderbelastingen**

**Geleiders back**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |

**Geleiders ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |

**Verticale belasting back**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45,8 | B | 4+0,2d | 9,5 | 28,6 |
| Bliksemdraad 1 | 1 | 2 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |

**Verticale belasting ahead**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45,8 | B | 4+0,2d | 9,5 | 28,6 |
| Bliksemdraad 1 | 1 | 2 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |

**Isolatoren**

| Geleider | $G_{isolator}$ [kN] | Aantal - | $F_{v,iso}$ [kN] | Lengte [m] | Windopp. [m$^2$] | Windhoogte [m] | Stuwdruk [kN/m$^2$] | Vormfactor [-] | $F_{h,iso}$ [kN] |
|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct1f2 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct1f3 | 6,00 | 1 | 6 | 7,9 | 2,0 | 44,50 | 1,10 | 1,2 | 2,64 |
| bl1 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 48,70 | 1,13 | 1,2 | 0,14 |

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

**Windbelasting back**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct1f2 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct1f3 | 52,2 | 1,15 | 0,62 | 0,68 | 1,06 | 28,25 | 63,8 | 70,1 | 46,9 | 120,4 | 132,3 |
| bl1 | 56,4 | 1,17 | 0,63 | 0,69 | 1,18 | 22,24 | 19,2 | 21,1 | 63,1 | 55,6 | 61,1 |

**Windbelasting ahead**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct1f2 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct1f3 | 36,2 | 1,04 | 0,59 | 0,65 | 1,08 | 28,25 | 56,7 | 62,4 | 46,9 | 104,2 | 114,6 |
| bl1 | 40,4 | 1,07 | 0,60 | 0,66 | 1,20 | 22,24 | 17,2 | 18,9 | 63,1 | 48,8 | 53,7 |

*NB: belastingen $w_v$ gelden voor bundel*

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

**Geleiderbelastingen**

Auteur: TBR
Versie: v12.0

**Uitgangspunten**

| | |
|---|---|
| Betrouwbaarheidsniveau | Nieuwbouw CC2 |
| Referentieperiode | 15 jaar |

| **ULS** (bezwijksterkte) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belastingsgeval | omschrijving | 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° | 1,20 | 1,20 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk alleen mast | 10° | 0,90 | 1,20 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk ook geleider | 10° | 0,90 | 0,90 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,00 | 0,38 | 1,07 | 0,0 |
| ULS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,00 | 0,38 | 1,07 | 0,0 |
| ULS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 5a | Torsiebelastingen | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinale belastingen | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,50 | 0,25 | 0,00 | 0,0 |
| ULS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,35 | 1,35 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,20 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 0,90 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (controle van de vervormingen, vermoeiing, EDS) | | | | | | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,87 | 0,0 | 0,0 |
| SLS 3 | Wind+ijs | -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 | Bouw en onderhoud | 5° | 1,00 | 1,00 | 0,0 | 0,17 | 0,0 | 0,0 |
| SLS 7 | PB (EDS, geen wind) | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Aantal windrichtingen | 6 |
| Aantal belastingcombinaties ULS | 54 |
| Aantal belastingcombinaties SPLS | 210 |
| Aantal belastingcombinaties SLS | 15 |
| Aantal knooplasten | 2232 |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

**Samenvattingstabellen geleiderbelastingen**

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

**Maximale waarden voor back en ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -51,7 | 50,3 | 13,2 | 12,5 | 7,6 | 7,6 |
| 380ct1f1 | -143,3 | 138,9 | 42,1 | 37,6 | 27,3 | 27,3 |
| 380ct1f2 | -143,3 | 138,9 | 42,1 | 37,6 | 27,3 | 27,3 |
| 380ct1f3 | -145,9 | 142,1 | 44,4 | 40,9 | 27,3 | 27,3 |

**Min. Weight span (m)**

| Weight sp: | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 440,1 | 446,7 | 440,0 |
| 380ct1f1 | 440,0 | 445,3 | 440,0 |
| 380ct1f2 | 440,0 | 445,3 | 440,0 |
| 380ct1f3 | 440,0 | 445,5 | 440,0 |

**Max. Weight span (m)**

| Weight sp: | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 479,0 | 437,2 |
| 380ct1f1 | 460,3 | 441,4 |
| 380ct1f2 | 460,3 | 441,4 |
| 380ct1f3 | 463,7 | 442,2 |

| Omhullende weight span over alle combinaties (incl. 0,9 combinaties) | | |
|---|---|---|
| Voor alle geleiders | | Wind / Weight span verhouding |
| Max. weight span | 479,0 m | 1,197 - |
| Min. weight span | 53,5 m | 0,134 - |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

**Maximale waarden back+ahead span** **Maximale waarden trekkracht geleider**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 36,0 | 25,4 | 7,6 | -52,2 | 50,7 |
| 380ct1f1 | 118,9 | 77,9 | 27,3 | -144,7 | 140,3 |
| 380ct1f2 | 118,9 | 77,9 | 27,3 | -144,7 | 140,3 |
| 380ct1f3 | 122,0 | 83,4 | 27,3 | -147,5 | 143,5 |

**EDS-belastingen geleiders**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 15,1 | 2,7 | 2,2 | -15,3 | 15,3 |
| 380ct1f1 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f2 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f3 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |

**Controle uplift SLS-wind**

| Combinati | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| **SLS 4** | bl1 | 0,0 | 0,0 |
| | 380ct1f1 | 0,0 | 0,0 |
| | 380ct1f2 | 0,0 | 0,0 |
| | 380ct1f3 | 0,0 | 0,0 |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

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

| Combinatie | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | -34 | 261 | 125 | 8246 | -1257 | 432 |
| ULS 1a_0,9_0 | | 1 | 96 | 92 | 2438 | 20 | -7 |
| ULS 1a_0,9_0,9_90 | | -38 | 251 | 51 | 8820 | -1391 | 479 |
| ULS 3_0 | | 0 | 152 | 171 | 3556 | 11 | -4 |
| SLS 7 | | 0 | 82 | 101 | 1784 | 0 | 0 |

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

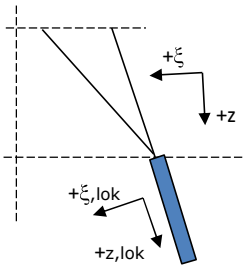
| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -34 | 487 | 715 | 14250 | -1257 | 432 |
| ULS 1a_0,9_0,9_90 | -38 | 477 | 494 | 14824 | -1391 | 479 |
| SLS 7 | 0 | 82 | 593 | 1784 | 0 | 0 |

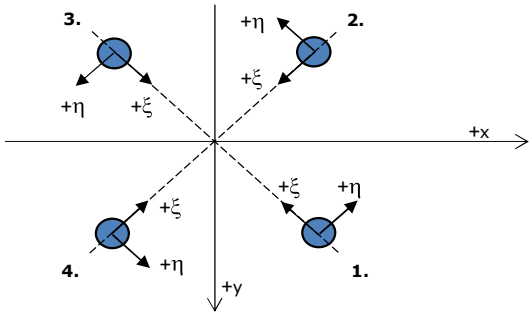
**Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde**

| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_90 | -34 | 487 | 520 | **14858** | -1257 | 432 |
| SPLS 1a_225 Ah All Cts | -458 | -106 | 673 | -3774 | **-15883** | 4076 |
| SPLS 3_270 Ah All Cts | -396 | -15 | 680 | -953 | -14874 | **5050** |
| SPLS 1a_0,9_100 Ah All Cts | -365 | 242 | 493 | **6901** | **-13402** | 4311 |

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

**Oplegreacties op fundering per randstijl**




Assenstelsels

**Maximale drukbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_80 Ba All Cts | 226 | 522 | **991** | -209 | -528 | 31 | 1138 |
| 2 | SPLS 1a_270 Ba All Cts | 356 | -312 | **896** | -31 | -472 | 33 | 1028 |
| 3 | SPLS 1a_225 Ah All Cts | -374 | -381 | **1017** | -5 | -534 | 39 | 1168 |
| 4 | SPLS 1a_100 Ah All Cts | -231 | 541 | **1027** | 219 | -546 | 34 | 1179 |

**Maximale trekbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_0,9_225 Ah All Cts | -38 | -406 | **-708** | 260 | 314 | -85 | -813 |
| 2 | SPLS 1a_0,9_100 Ah All Cts | -275 | 203 | **-753** | 51 | 338 | -86 | -865 |
| 3 | SPLS 1a_0,9_80 Ba All Cts | 250 | 189 | **-695** | -43 | 310 | -82 | -798 |
| 4 | SPLS 1a_0,9_270 Ba All Cts | 11 | -346 | **-595** | -237 | 252 | -83 | -683 |

**Maximale torsiebelasting (positief)**

| Stijl | Combinatie | $R_x$ [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_80 Ah All Cts | 177 | -329 | -309 | **358** | 108 | -66 | -354 |
| 2 | ULS 1a_0,9_0,9_80 | -292 | 69 | -576 | **158** | 255 | -70 | -661 |
| 3 | ULS 1a_0 | 27 | 126 | -286 | **70** | 108 | -53 | -329 |
| 4 | SPLS 1a_225 Ah All Cts | -29 | 504 | 691 | **336** | -377 | 13 | 793 |

**Maximale torsiebelasting (negatief)**

| Stijl Index | Combinatie 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_270 Ba All Cts | 56 | 507 | 741 | **-318** | -398 | 20 | 851 |
| 2 | ULS 1a_225 | 115 | 55 | 8 | **-120** | -42 | -38 | 9 |
| 3 | ULS 1a_0,9_0,9_100 | 251 | 28 | -455 | **-158** | 197 | -60 | -522 |
| 4 | SPLS 3_0,9_100 Ba All Cts | -167 | -307 | -298 | **-335** | 99 | -69 | -342 |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

**Combinatie Ftrek+Fhor**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_0,9_225 Ah All Cts | -38 | -406 | **-708** | **260** | 314 | -85 | -813 |
| 2 | ULS 1a_0,9_0,9_80 | -292 | 69 | **-576** | **158** | 255 | -70 | -661 |
| 3 | ULS 1a_0,9_0,9_100 | 251 | 28 | **-455** | **-158** | 197 | -60 | -522 |
| 4 | SPLS 3_0,9_270 Ba All Cts | -57 | -358 | **-522** | **-294** | 213 | -82 | -600 |

**Permanente belasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 117 | 97 | 225 | 14 | -151 | -24 | 259 |
| 2 | SLS 7 | 37 | -56 | 71 | 14 | -66 | -26 | 82 |
| 3 | SLS 7 | -37 | -56 | 71 | -14 | -66 | -26 | 82 |
| 4 | SLS 7 | -117 | 97 | 225 | -14 | -151 | -24 | 259 |

**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_100 Ah All Cts | -231 | 541 | **1027** | 219 | -546 | 34 | 1179 |
| Max. trek | SPLS 1a_0,9_100 Ah All Cts | -275 | 203 | **-753** | 51 | 338 | -86 | -865 |
| Max. pos. torsie | SPLS 3_0,9_80 Ah All Cts | 177 | -329 | -309 | **358** | 108 | -66 | -354 |
| Max. neg. torsie | SPLS 3_0,9_100 Ba All Cts | -167 | -307 | -298 | **-335** | 99 | -69 | -342 |
| Comb. trek+torsie | SPLS 1a_0,9_225 Ah All Cts | -38 | -406 | **-708** | **260** | 314 | -85 | -813 |

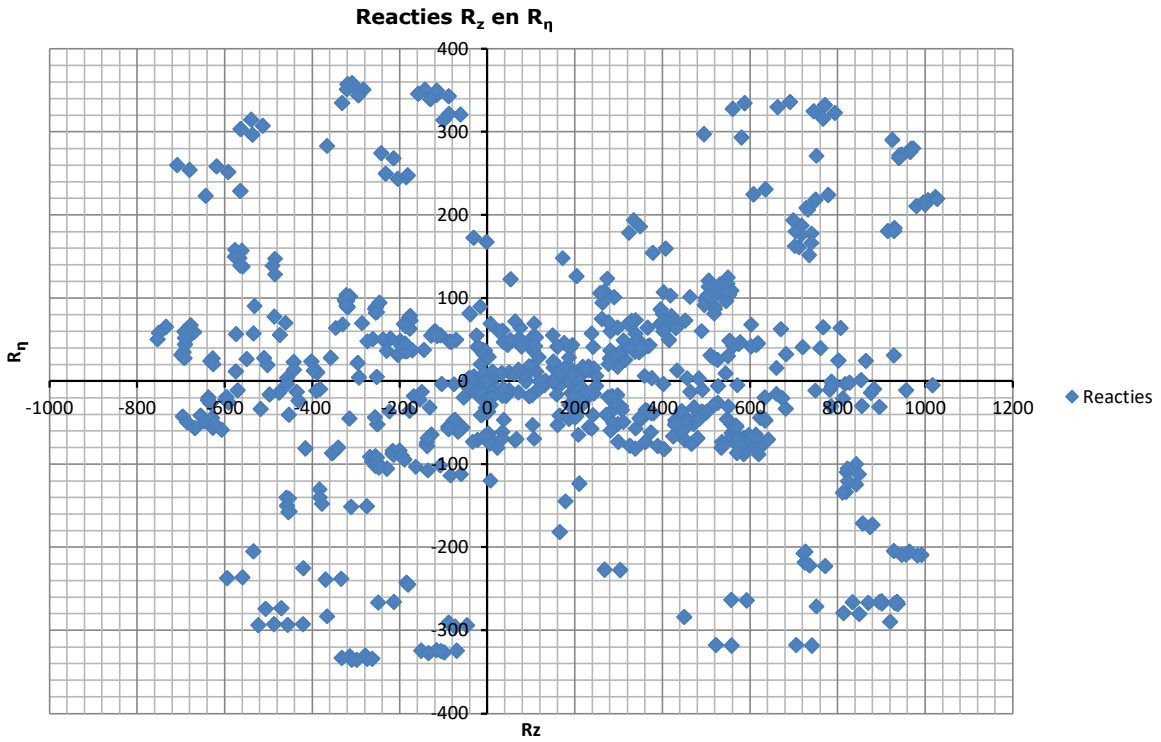
**Maximale trekbelasting SLS**

| Stijl | Combinatie | $R_x$ [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_100 Ah All Cts | 167 | -329 | **-321** | 351 | 115 | -66 | -368 |
| 2 | SPLS 1a_0,9_100 Ah All Cts | -275 | 203 | **-753** | 51 | 338 | -86 | -865 |
| 3 | SPLS 1a_0,9_80 Ba Ct2 | 140 | 11 | **-268** | -91 | 107 | -44 | -308 |
| 4 | SLS 1a_0 | -67 | -37 | **-33** | -73 | -21 | -40 | -38 |

**Maximale drukbelasting SLS**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_80 Ba Ct2 | 308 | 154 | **557** | 109 | -327 | -13 | 640 |
| 2 | SLS 1a_0 | 87 | -190 | **330** | 73 | -196 | -10 | 379 |
| 3 | SPLS 3_100 Ah All Cts | -205 | -272 | **635** | -48 | -338 | 20 | 729 |
| 4 | SPLS 1a_100 Ah All Cts | -231 | 541 | **1027** | 219 | -546 | 34 | 1179 |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N



## Belastinggeval - afspannen

Date: 2021-07-27
Author: TBR
Version: 1.1

RLL-TLB
HA_n

Invoergegevens

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

| | | | Hoogteverschil | | | Richtingsverandering | | |
|---|---|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Dh_back | Dh_ahead | | Dy_back | Dy_ahead | |
| Circuit 1 | 10 | 380ct1f1 | -32,7 | 0,0 | m | 0,0 | 0,0 | m |
| Circuit 1 | 11 | 380ct1f2 | -32,7 | 0,0 | m | 0,0 | 0,0 | m |
| Circuit 1 | 12 | 380ct1f3 | -44,0 | 0,0 | m | 0,0 | 0,0 | m |
| Bliksemdraad 1 | 1 | bl1 | -48,2 | 0,0 | m | 0,0 | 0,0 | m |

**Lijn- en mastgegevens**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 66,0 | 400,0 | m |
| Ruling span √(SL3/SL) | | 66,0 | 400,0 | m |
| Lijnhoek | β | 180 | ° | |
| Rotatie mast t.o.v. bissectrice | θ | 10 | ° | |
| Vaklengte | | 66 | 400 | m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 | m | |
| Beschouwde windrichtingen | a1 | 0 | ° | |
| Windrichtingen volgens: | a2 | 45 | ° | |
| *Geleiderbelastingen* | a3 | 90 | ° | |
| | a4 | 135 | ° | |
| | a5 | 80 | ° | |
| | a6 | 80 | ° | |

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

In onderstaande tabel zijn de optredende belastingen weergegeven, voor deze situatie geldt:
- belasting op geleider 1 en 10 t/m 12 zijn permanent aanwezig
- van de belasting op de overige geleiders is er telkens één aanwezig per belastingcombinatie

Uitvoer geleiderbelastingen

| Belastingcombi | nummer | Fxtotaal | Fytotaal | Fztotaal | Ftrekahead | Ftrekback |
|---|---|---|---|---|---|---|
| **ULS 6b_90** | 13 | **-83,5** | **15,8** | **57,6** | 0,0 | -85,0 |
| | 10 | **88,8** | **-12,4** | **19,3** | 89,6 | 0,0 |
| | 14 | **-83,5** | **15,8** | **57,6** | 0,0 | -85,0 |
| | 11 | **88,8** | **-12,4** | **19,3** | 89,6 | 0,0 |
| | 15 | **-83,6** | **15,8** | **72,2** | 0,0 | -85,0 |
| | 12 | **89,5** | **-12,2** | **19,3** | 90,2 | 0,0 |
| | 4 | **-17,4** | **3,3** | **14,8** | 0,0 | -17,7 |
| | 1 | **19,2** | **-2,4** | **2,7** | 19,4 | 0,0 |

## Inhoud


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


## Gegevens

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initieel* | |
| Gevolgklasse | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 50 jaar |
| *Na aanpassing* | |
| Gevolgklasse | n.v.t. |
| Betrouwbaarheidsniveau | n.v.t. |
| Referentieperiode | n.v.t. |
| Windgebied | III |
| Windsnelheid | 24,5 m/s |
| Terreincategorie | II |
| Reductie factor Cdir | 1,00 |
| IJsgebied | B |
| Masttype | Hoekmast |
| Masthoogte | 50 m |
| Max. veldlengte | 400 m |
| Lijnhoek | 160° |
| Trekparameter | 1600 m |
| Wind span | 400 m |
| EDS Weight span | 440 m |
| Min. Weight span | -1 m |
| Max. Weight span | 490 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-07-26 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype HA+5_n

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

Document name:

GT-RLL380_HA+5_n_18N_Report.pdf

Project number:

Project client number:

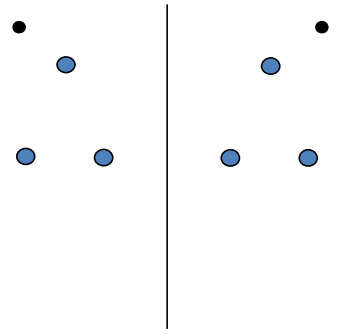
0.0

## Geleiderbelastingen

Auteur: TBR
Versie: v12.0

**Algemeen**

| | |
|---|---|
| Benaming | HA+5_n |
| Masttype | Hoekmast |
| Aantal circuits | 2 |
| Configuratie | 2-circuit-donau |
| Aantal bliksemgeleiders | 2 |



Configuratie geleiders

**Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau initieel | Nieuwbouw |
| Referentieperiode initieel | 50 jaar |
| | CC2 |
| Betrouwbaarheidsniveau na aanpassing | n.v.t. |
| | 50 jaar |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 m/s |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

**Geleiders Back**

| Omschrijving | Spanning | Geleider Back | Bundel Ba | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Geleiders Ahead

| Omschrijving | Spanning | Geleider Ahead | Bundel Ah | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Isolatoren *(1)*

| Omschrijving | Ophanging | Gewicht [kN] | Lengte [m] | Windopp. [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Afspanketting | 6,00 | 7,90 | 2,00 |
| Circuit 2 | Afspanketting | 6,00 | 7,90 | 2,00 |
| Bliksemdraad 1 | Afspanketting | 0,10 | 0,20 | 0,10 |
| Bliksemdraad 2 | Afspanketting | 0,10 | 0,20 | 0,10 |

1. Eigenschappen gelden voor geheel van de isolatorset

**Ophanghoogte en positie in mast**

| Circuits | Aanduiding | Nummer | Ophanghoogte | Aangrijppunt | Positie in mast Horizontale afstand |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 32,7 m | 32,7 m | -15,7 m |
| Circuit 1 | 11 | 380ct1f2 | 32,7 m | 32,7 m | -8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 44,0 m | 44,0 m | -12,2 m |
| Circuit 2 | 20 | 380ct2f1 | 32,7 m | 32,7 m | 8,7 m |
| Circuit 2 | 21 | 380ct2f2 | 32,7 m | 32,7 m | 15,7 m |
| Circuit 2 | 22 | 380ct2f3 | 44,0 m | 44,0 m | 12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 48,2 m | 48,2 m | -18,4 m |
| Bliksemdraad 2 | 3 | bl2 | 48,2 m | 48,2 m | 18,4 m |

Project: GT-RLL380
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**Hoogteaanpassing naastgelegen masten** (aanpassing wind- en weight span)

| | Back | Ahead | |
|---|---|---|---|
| Verhoging voor windbelasting | 32,0 m | 0,0 m | (positief: omhoog) |
| Verlaging voor verticale belasting | -5,0 m | -5,0 m | (negatief: omlaag, grotere weight span) |
| Verlaging: Niet in 0,9EG-combinaties | | | |

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

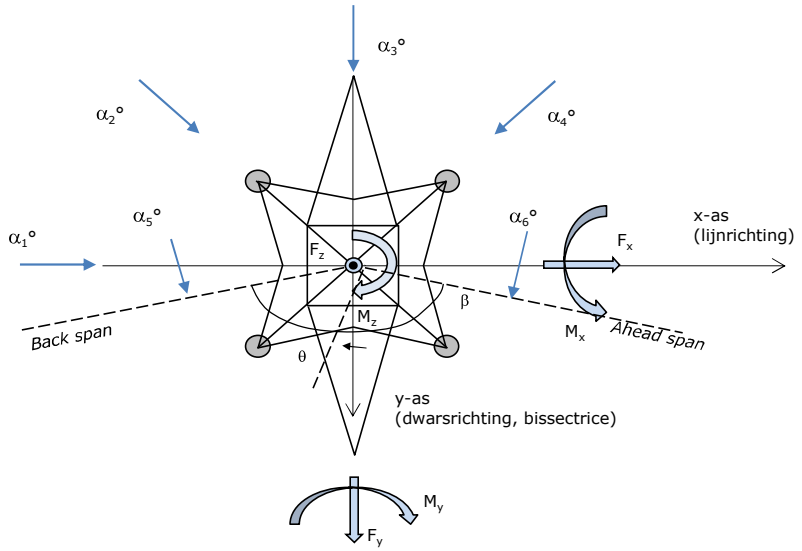
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Lijn- en mastgegevens**

| | | Back | Ahead |
|---|---|---|---|
| | | 400,0 | 400,0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 400,0 | 400,0 m |
| Lijnhoek | $\beta$ | 160 ° | |
| Rotatie mast t.o.v. bissectrice | $\theta$ | 0 ° | |
| Vaklengte | | 400 | 400 m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 m | |
| Beschouwde windrichtingen | $\alpha_1$ | 0 ° | |
| Windrichtingen volgens: | $\alpha_2$ | 45 ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 ° | |
| | $\alpha_4$ | 135 ° | |
| | $\alpha_5$ | 80 ° | |
| | $\alpha_6$ | 100 ° | |

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

Windrichtingen en positieve richtingen belastingen




| Beschouwd aantal windrichtingen | |
|---|---|
| 1a | 6 |
| 3 | 6 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

Project: GT-RLL380
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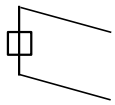
**Geleiderafval**

| | | 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 |

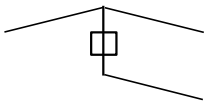
**Belastingsituaties SPLS**

Beschouwde situaties SPLS: 1 t/m 6, alle mogelijke situaties.

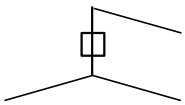
Principe belastingssituaties:



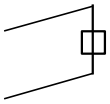
1. Ba All cts



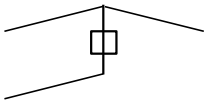
2. Ba ct1



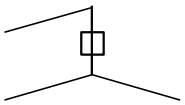
3. Ba ct2



4. Ah All cts



5. Ah ct1

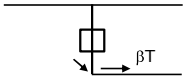


6. Ah ct2

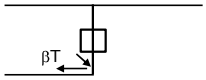
**Belastingsituaties 5a. Geleiderbreuk**

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

Principe belastingssituaties:




1. Ba




2. Ah

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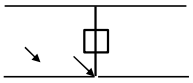
**Belastingsituaties 6. Bouw- en onderhoud**
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht.
Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate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

| | Fase | Bliksem |
|---|---|---|
| Lijnwagen | 4,0 kN | 2,0 kN |
| Puntlast op traverse | 1,0 kN | 1,0 kN |

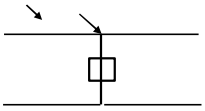
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

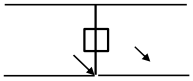
Principe belastingssituaties:



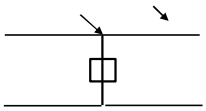
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

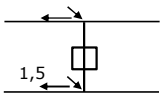
**Belastingsituaties 8. Lijndansen als statische belasting**

| Geleider | | |
|---|---|---|
| Steunmast fase | 0,866 W | 1,5 W |
| Steunmast bliksem | 1,5 EDS | 1,5 W |
| Hoekmast fase en bliksem | 1,5 EDS | 1,5 W |

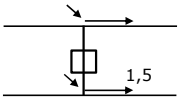
Beschouwde situaties lijndansen 8: 1 en 2, alle mogelijke situaties.

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:




1. Ba




2. Ah

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

Project: GT-RLL380
Tower: HA+5_n
Number: 18N

## Mastconstructie

### Eigenschappen

| | | | |
|---|---|---|---|
| Masttype | Hoekmast | | |
| Mastbenaming | HA+5_n | | |
| Voetplaat t.o.v. maaiveld | 0,5 | | m |
| Masthoogte t.o.v. voetplaat | 50,0 | | m |
| Gewicht mast | 492,0 | | kN |
| *Breedte en helling mast bij fundatie* | x-ri. | y-ri. | |
| Pootsprei | 11,94 | 11,94 | m |
| Helling van de randstijl | 0,135 | 0,135 | - |
| Factor spatkracht | 1,3 | 1,3 | - |

### Berekening windbelasting

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

### Eigenschappen mastsecties langsrichting (vooraanzicht, yz-vlak)

| Omschrijving | 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 | 12,25 | 11,94 | 8,63 | 12,25 | 0,135 | 125,97 | 18,34 | 0,15 | 3,18 |
| Tussenstuk1 | 24,56 | 8,63 | 5,68 | 12,31 | 0,120 | 88,08 | 15,61 | 0,18 | 3,03 |
| Tussenstuk2 | 32,70 | 5,68 | 3,80 | 8,14 | 0,116 | 38,59 | 12,57 | 0,33 | 2,45 |
| Bovenstuk1 | 40,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 8,91 | 0,34 | 2,40 |
| Bovenstuk2 | 48,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 5,97 | 0,29 | 2,57 |
| Topstuk | 50,00 | 2,60 | | 2,00 | | 2,60 | 0,40 | 0,15 | 3,14 |
| Ondertraverse | 32,70 | 14,20 | | 4,00 | | 28,40 | 6,76 | 0,24 | 2,77 |
| Boventraverse | 44,00 | 16,94 | | 4,20 | | 35,57 | 8,36 | 0,23 | 2,78 |

### Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)

| Omschrijving | 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 | 12,25 | 11,94 | 8,63 | 12,25 | 0,135 | 125,97 | 18,34 | 0,15 | 3,18 |
| Tussenstuk1 | 24,56 | 8,63 | 5,68 | 12,31 | 0,120 | 88,08 | 15,61 | 0,18 | 3,03 |
| Tussenstuk2 | 32,70 | 5,68 | 3,80 | 8,14 | 0,116 | 38,59 | 12,57 | 0,33 | 2,45 |
| Bovenstuk1 | 40,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 8,91 | 0,34 | 2,40 |
| Bovenstuk2 | 48,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 5,97 | 0,29 | 2,57 |
| Topstuk | 50,00 | 2,60 | | 2,00 | | 2,60 | 0,40 | 0,15 | 3,14 |
| Ondertraverse | 32,70 | 14,20 | | 4,00 | | 28,40 | 6,76 | 0,24 | 2,77 |
| Boventraverse | 44,00 | 16,94 | | 4,20 | | 35,57 | 8,36 | 0,23 | 2,78 |

*NB: oppervlakte traverse dwarsrichting van de tabel wordt in berekening gereduceerd.*
*NB: oppervlakte traverse per zijde, dus helft van totaal van twee traverses.*

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Tower: HA+5_n
Number: 18N

**Windoppervlak feeders telecominstallaties**

| Onderdeel | A ($m^2$/m) | Factor | Δh | $A_1$ |
|---|---|---|---|---|
| Broekstuk | 0,20 | 0,71 | 12,3 | 1,7 |
| Tussenstuk1 | 0,20 | 0,71 | 12,3 | 1,7 |
| Tussenstuk2 | 0,20 | 0,71 | 8,1 | 1,2 |
| Bovenstuk1 | 0,20 | 0,71 | 7,8 | 1,1 |
| Bovenstuk2 | | | | |

**Invoer antennes**

| Omschrijving | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne top | | | |
| Antenne o.t. | 4,6 | 31,7 | 1,5 |

**Belastingen mastsectie langsrichting (x-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 40,9 | 34,7 | 0,0 | -34,7 | 6,1 | 250,4 | 212,5 | 0,0 | -212,5 |
| Tussenstuk1 | 0,86 | 40,5 | 34,4 | 0,0 | -34,4 | 18,4 | 745,3 | 632,4 | 0,0 | -632,4 |
| Tussenstuk2 | 0,98 | 30,0 | 25,4 | 0,0 | -25,4 | 28,6 | 858,5 | 728,5 | 0,0 | -728,5 |
| Bovenstuk1 | 1,05 | 22,4 | 19,0 | 0,0 | -19,0 | 36,6 | 819,9 | 695,7 | 0,0 | -695,7 |
| Bovenstuk2 | 1,10 | 16,9 | 14,3 | 0,0 | -14,3 | 44,3 | 748,1 | 634,8 | 0,0 | -634,8 |
| Topstuk | 1,13 | 1,4 | 1,2 | 0,0 | -1,2 | 49,0 | 69,7 | 59,1 | 0,0 | -59,1 |
| Ondertraverse | 1,02 | 38,4 | 22,8 | 0,0 | -22,8 | 34,0 | 1306,0 | 775,7 | 0,0 | -775,7 |
| Boventraverse | 1,11 | 51,5 | 30,6 | 0,0 | -30,6 | 45,4 | 2337,9 | 1388,6 | 0,0 | -1388,6 |
| Totaal | | 242,0 | 182,4 | 0,0 | -182,4 | | 7135,8 | 5127,3 | 0,0 | -5127,3 |

**Belastingen mastsectie dwarsrichting (y-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 0,0 | 34,7 | 40,9 | 34,7 | 6,1 | 0,0 | 212,5 | 250,4 | 212,5 |
| Tussenstuk1 | 0,86 | 0,0 | 34,4 | 40,5 | 34,4 | 18,4 | 0,0 | 632,4 | 745,3 | 632,4 |
| Tussenstuk2 | 0,98 | 0,0 | 25,4 | 30,0 | 25,4 | 28,6 | 0,0 | 728,5 | 858,5 | 728,5 |
| Bovenstuk1 | 1,05 | 0,0 | 19,0 | 22,4 | 19,0 | 36,6 | 0,0 | 695,7 | 819,9 | 695,7 |
| Bovenstuk2 | 1,10 | 0,0 | 14,3 | 16,9 | 14,3 | 44,3 | 0,0 | 634,8 | 748,1 | 634,8 |
| Topstuk | 1,13 | 0,0 | 1,2 | 1,4 | 1,2 | 49,0 | 0,0 | 59,1 | 69,7 | 59,1 |
| Ondertraverse | 1,02 | 0,0 | 22,8 | 15,3 | 22,8 | 34,0 | 0,0 | 775,7 | 522,4 | 775,7 |
| Boventraverse | 1,11 | 0,0 | 30,6 | 20,6 | 30,6 | 45,4 | 0,0 | 1388,6 | 935,1 | 1388,6 |
| Totaal | | 0,0 | 182,4 | 188,0 | 182,4 | | 0,0 | 5127,3 | 4949,5 | 5127,3 |

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

| Belasting / windrichting | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 492 | 0 | 0 | 0 |
| Windrichting 0° | 249 | 0 | 0 | 0 | 7355 | 0 |
| Windrichting 45° | 187 | 187 | 0 | 5283 | 5283 | 0 |
| Windrichting 90° | 0 | 195 | 0 | 5169 | 0 | 0 |
| Windrichting 135° | -187 | 187 | 0 | 5283 | -5283 | 0 |

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**Tussenresultaten geleiderbelastingen**

**Geleiders back**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Geleiders ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Verticale belasting back**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Verticale belasting ahead**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Isolatoren**

| Geleider | $G_{isolator}$ [kN] | Aantal - | $F_{v,iso}$ [kN] | Lengte [m] | Windopp. [m$^2$] | Windhoogte [m] | Stuwdruk [kN/m$^2$] | Vormfactor [-] | $F_{h,iso}$ [kN] |
|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct1f2 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct1f3 | 6,00 | 1 | 6 | 7,9 | 2,0 | 44,50 | 1,10 | 1,2 | 2,64 |
| 380ct2f1 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct2f2 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct2f3 | 6,00 | 1 | 6 | 7,9 | 2,0 | 44,50 | 1,10 | 1,2 | 2,64 |
| bl1 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 48,70 | 1,13 | 1,2 | 0,14 |
| bl2 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 48,70 | 1,13 | 1,2 | 0,14 |

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**Windbelasting back**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct1f2 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct1f3 | 52,2 | 1,15 | 0,62 | 0,68 | 1,06 | 28,25 | 63,8 | 70,1 | 46,9 | 120,4 | 132,3 |
| 380ct2f1 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct2f2 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct2f3 | 52,2 | 1,15 | 0,62 | 0,68 | 1,06 | 28,25 | 63,8 | 70,1 | 46,9 | 120,4 | 132,3 |
| bl1 | 56,4 | 1,17 | 0,63 | 0,69 | 1,18 | 22,24 | 19,2 | 21,1 | 63,1 | 55,6 | 61,1 |
| bl2 | 56,4 | 1,17 | 0,63 | 0,69 | 1,18 | 22,13 | 19,2 | 21,1 | 63,0 | 55,5 | 61,0 |

**Windbelasting ahead**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct1f2 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct1f3 | 36,2 | 1,04 | 0,59 | 0,65 | 1,08 | 28,25 | 56,7 | 62,4 | 46,9 | 104,2 | 114,6 |
| 380ct2f1 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct2f2 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct2f3 | 36,2 | 1,04 | 0,59 | 0,65 | 1,08 | 28,25 | 56,7 | 62,4 | 46,9 | 104,2 | 114,6 |
| bl1 | 40,4 | 1,07 | 0,60 | 0,66 | 1,20 | 22,24 | 17,2 | 18,9 | 63,1 | 48,8 | 53,7 |
| bl2 | 40,4 | 1,07 | 0,60 | 0,66 | 1,20 | 22,13 | 17,1 | 18,8 | 63,0 | 48,8 | 53,6 |

*NB: belastingen $w_v$ gelden voor bundel*

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Mast: 18N

**Geleiderbelastingen**

Auteur: TBR
Versie: v12.0

**Uitgangspunten**

| | |
|---|---|
| Betrouwbaarheidsniveau | Nieuwbouw CC2 |
| Referentieperiode | 50 jaar |

| **ULS** (bezwijksterkte) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belastingsgeval | omschrijving | Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $Q_{pk}$ | $\gamma_Q$ $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,20 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk alleen mast | 10° | 0,90 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk ook geleider | 10° | 0,90 | 0,90 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 5a | Torsiebelastingen | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinale belastingen | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,50 | 0,30 | 0,00 | 0,0 |
| ULS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,35 | 1,35 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders) | | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,20 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 0,90 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (controle van de vervormingen, vermoeiing, EDS) | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 1,00 | 0,0 | 0,0 |
| SLS 3 | Wind+ijs | -5° | 1,00 | 1,00 | 0,0 | 0,30 | 1,00 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 6 | Bouw en onderhoud | 5° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 7 | PB (EDS, geen wind) | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Aantal windrichtingen | 6 |
| Aantal belastingcombinaties ULS | 72 |
| Aantal belastingcombinaties SPLS | 222 |
| Aantal belastingcombinaties SLS | 15 |
| Aantal knooplasten | 4944 |

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**Samenvattingstabellen geleiderbelastingen**

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

**Maximale waarden voor back en ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -62,4 | 61,1 | 16,1 | 15,3 | 10,3 | 10,3 |
| bl2 | -61,6 | 60,3 | 16,0 | 15,2 | 10,3 | 10,2 |
| 380ct1f1 | -158,3 | 153,4 | 48,3 | 42,9 | 28,8 | 28,8 |
| 380ct1f2 | -158,3 | 153,4 | 48,3 | 42,9 | 28,8 | 28,8 |
| 380ct1f3 | -161,3 | 157,0 | 51,1 | 46,9 | 28,9 | 28,8 |
| 380ct2f1 | -158,3 | 153,4 | 48,3 | 42,9 | 28,8 | 28,8 |
| 380ct2f2 | -158,3 | 153,4 | 48,3 | 42,9 | 28,8 | 28,8 |
| 380ct2f3 | -161,3 | 157,0 | 51,1 | 46,9 | 28,9 | 28,8 |

**Min. Weight span (m)**

| Weight sp: | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 440,1 | 447,4 | 440,0 |
| bl2 | 440,1 | 447,6 | 440,0 |
| 380ct1f1 | 440,0 | 445,6 | 440,0 |
| 380ct1f2 | 440,0 | 445,6 | 440,0 |
| 380ct1f3 | 440,0 | 445,8 | 440,0 |
| 380ct2f1 | 440,0 | 445,6 | 440,0 |
| 380ct2f2 | 440,0 | 445,6 | 440,0 |
| 380ct2f3 | 440,0 | 445,8 | 440,0 |

**Max. Weight span (m)**

| Weight sp: | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 489,1 | 433,6 |
| bl2 | 490,4 | 433,4 |
| 380ct1f1 | 466,7 | 440,7 |
| 380ct1f2 | 466,7 | 440,7 |
| 380ct1f3 | 470,9 | 441,5 |
| 380ct2f1 | 466,7 | 440,7 |
| 380ct2f2 | 466,7 | 440,7 |
| 380ct2f3 | 470,9 | 441,5 |

| Omhullende weight span over alle combinaties (incl. 0,9 combinaties) | | |
|---|---|---|
| Voor alle geleiders | | Wind / Weight span verhouding |
| Max. weight span | 490,4 m | 1,226 - |
| Min. weight span | -1,5 m | -0,004 - |

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**Maximale waarden back+ahead span** **Maximale waarden trekkracht geleider**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 36,0 | 31,1 | 10,3 | -64,3 | 62,9 |
| bl2 | 35,5 | 30,8 | 10,3 | -63,4 | 62,0 |
| 380ct1f1 | 118,5 | 89,1 | 28,8 | -162,7 | 157,4 |
| 380ct1f2 | 118,5 | 89,1 | 28,8 | -162,7 | 157,4 |
| 380ct1f3 | 121,2 | 95,7 | 28,9 | -165,9 | 161,3 |
| 380ct2f1 | 118,5 | 89,1 | 28,8 | -162,7 | 157,4 |
| 380ct2f2 | 118,5 | 89,1 | 28,8 | -162,7 | 157,4 |
| 380ct2f3 | 121,2 | 95,7 | 28,9 | -165,9 | 161,3 |

**EDS-belastingen geleiders**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 15,1 | 2,7 | 2,2 | -15,3 | 15,3 |
| bl2 | 14,7 | 2,6 | 2,1 | -14,9 | 14,9 |
| 380ct1f1 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f2 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f3 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct2f1 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct2f2 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct2f3 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |

**Controle uplift SLS-wind**

| Combinati | 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 |

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

| Combinatie | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | -84 | 598 | 252 | 22476 | -3073 | 0 |
| ULS 1a_0,9_0 | | 1 | 192 | 184 | 7158 | 46 | 0 |
| ULS 1a_0,9_0,9_90 | | -91 | 581 | 93 | 21866 | -3323 | 0 |
| ULS 3_0 | | 1 | 344 | 384 | 13021 | 28 | 0 |
| SLS 7 | | 0 | 163 | 202 | 6076 | 0 | 0 |

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

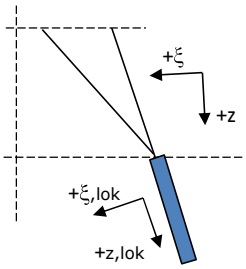
| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -84 | 890 | 843 | 30230 | -3073 | 0 |
| ULS 1a_0,9_0,9_90 | -91 | 873 | 535 | 29620 | -3323 | 0 |
| SLS 7 | 0 | 163 | 694 | 6076 | 0 | 0 |

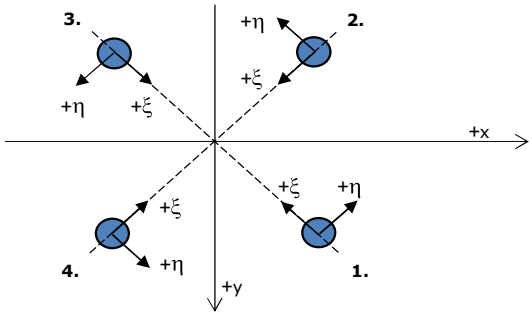
**Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde**

| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_90 | -84 | 890 | 589 | **30231** | -3073 | 0 |
| SPLS 3_90 Ah All Cts | -779 | 247 | 770 | 8483 | **-29292** | 8 |
| SPLS 3_80 Ba Ct1 | 352 | 317 | 816 | 11712 | 13048 | **-5022** |
| SPLS 1a_0,9_90 Ah All Cts | -704 | 361 | 542 | **11839** | **-26354** | 7 |

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

**Oplegreacties op fundering per randstijl**




Assenstelsels

**Maximale drukbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_90 Ba All Cts | 283 | 304 | **1709** | -15 | -415 | -88 | 1740 |
| 2 | SPLS 3_0 Ba All Cts | 189 | -204 | **1147** | 11 | -278 | -59 | 1167 |
| 3 | SPLS 3_90 Ah All Cts | -166 | -187 | **1064** | -15 | -250 | -47 | 1083 |
| 4 | SPLS 1a_90 Ah All Cts | -296 | 317 | **1789** | 15 | -434 | -92 | 1821 |

**Maximale trekbelasting**

| Stijl | Combinatie | $R_x$ [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_90 Ah All Cts | -108 | -130 | **-734** | 15 | 168 | 28 | -748 |
| 2 | SPLS 1a_0,9_90 Ah All Cts | -239 | 260 | **-1464** | -15 | 353 | 73 | -1491 |
| 3 | SPLS 1a_0,9_90 Ba All Cts | 224 | 244 | **-1370** | 14 | 331 | 69 | -1395 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 128 | -144 | **-801** | -11 | 192 | 39 | -816 |

**Maximale torsiebelasting (positief)**

| Stijl | Combinatie | $R_x$ [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 Ba Ct1 | 108 | -112 | -26 | **156** | 2 | -3 | -26 |
| 2 | SPLS 3_0,9_80 Ba Ct2 | -71 | -149 | 240 | **155** | -55 | -9 | 244 |
| 3 | SPLS 3_80 Ba Ct2 | 24 | 244 | -783 | **155** | 190 | 40 | -797 |
| 4 | SPLS 6a_90 Ah Ct1 Ba Ct1 | -98 | 309 | 1200 | **150** | -288 | -59 | 1222 |

**Maximale torsiebelasting (negatief)**

| Stijl Index | Combinatie 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_80 Ba Ct1 | 93 | 308 | 1173 | **-152** | -283 | -59 | 1194 |
| 2 | SPLS 6a_90 Ah Ct2 Ba Ct2 | -21 | 236 | -762 | **-152** | 182 | 36 | -776 |
| 3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 32 | -184 | 461 | **-153** | -108 | -20 | 470 |
| 4 | SPLS 3_80 Ba Ct1 | -139 | -86 | 148 | **-159** | -38 | -9 | 151 |

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Mast: 18N

**Combinatie Ftrek+Fhor**

| Stijl | Combinatie | $R_x$ [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_90 Ah All Cts | -108 | -130 | **-734** | **15** | 168 | 28 | -748 |
| 2 | SPLS 1a_0,9_90 Ah All Cts | -239 | 260 | **-1464** | **-15** | 353 | 73 | -1491 |
| 3 | SPLS 1a_0,9_90 Ba All Cts | 224 | 244 | **-1370** | **14** | 331 | 69 | -1395 |
| 4 | SPLS 3_0,9_0 Ba All Cts | 128 | -144 | **-801** | **-11** | 192 | 39 | -816 |

**Permanente belasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 75 | 71 | 428 | 3 | -104 | -22 | 436 |
| 2 | SLS 7 | -14 | 10 | -81 | 3 | 17 | 2 | -83 |
| 3 | SLS 7 | 14 | 10 | -81 | -3 | 17 | 2 | -83 |
| 4 | SLS 7 | -75 | 71 | 428 | -3 | -104 | -22 | 436 |

**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_90 Ah All Cts | -296 | 317 | **1789** | 15 | -434 | -92 | 1821 |
| Max. trek | SPLS 1a_0,9_90 Ah All Cts | -239 | 260 | **-1464** | -15 | 353 | 73 | -1491 |
| Max. pos. torsie | SPLS 6a_90 Ah Ct1 Ba Ct1 | 108 | -112 | -26 | **156** | 2 | -3 | -26 |
| Max. neg. torsie | SPLS 3_80 Ba Ct1 | -139 | -86 | 148 | **-159** | -38 | -9 | 151 |
| Comb. trek+torsie | SPLS 1a_0,9_90 Ah All Cts | -239 | 260 | **-1464** | **-15** | 353 | 73 | -1491 |

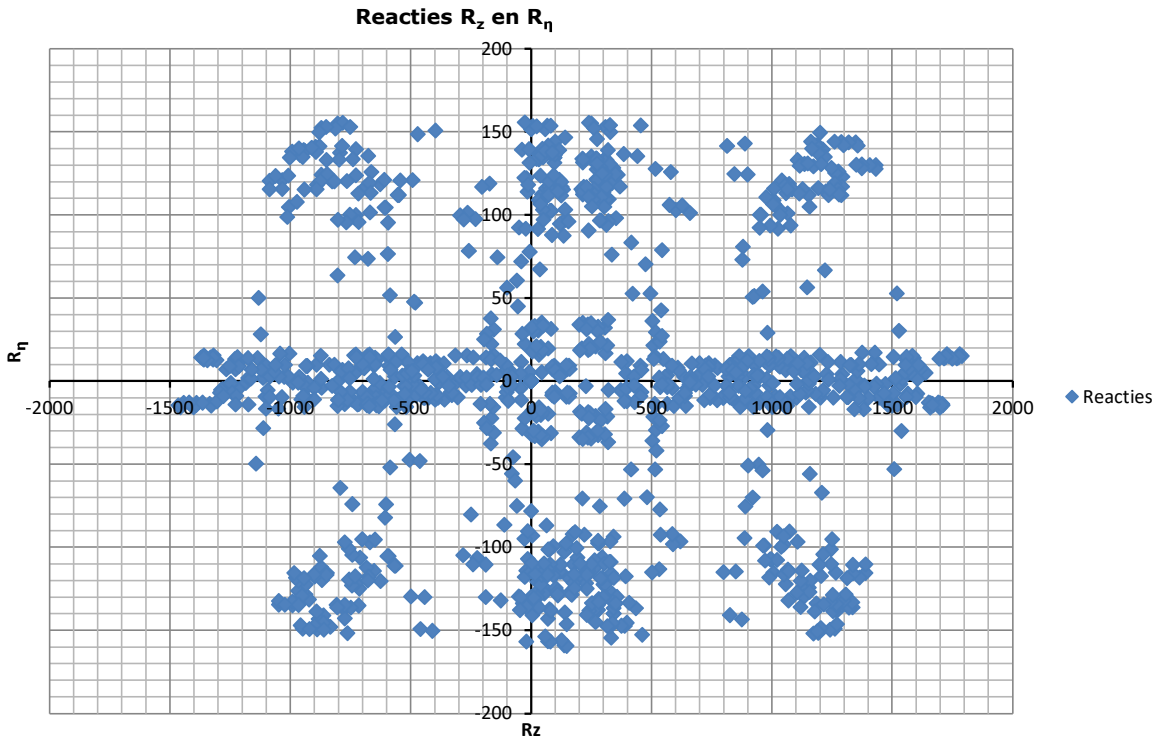
**Maximale trekbelasting SLS**

| Stijl | Combinatie | $R_x$ [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_80 Ah All Cts | -106 | -129 | **-727** | 16 | 166 | 27 | -740 |
| 2 | SPLS 1a_0,9_80 Ah All Cts | -236 | 258 | **-1455** | -16 | 350 | 72 | -1482 |
| 3 | SPLS 1a_0,9_100 Ba Ct2 | 68 | 260 | **-958** | 136 | 232 | 49 | -975 |
| 4 | SPLS 3_0,9_100 Ba Ct2 | 82 | 108 | **50** | 135 | -19 | -9 | 51 |

**Maximale drukbelasting SLS**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_100 Ba Ct2 | 307 | 141 | **1291** | 117 | -317 | -70 | 1315 |
| 2 | SPLS 3_100 Ba Ct2 | -54 | -158 | **329** | 150 | -73 | -10 | 335 |
| 3 | SPLS 3_80 Ah All Cts | -164 | -186 | **1057** | -16 | -248 | -46 | 1076 |
| 4 | SPLS 1a_80 Ah All Cts | -293 | 316 | **1780** | 16 | -430 | -90 | 1812 |

Project: GT-RLL380
Masttype: HA+5_n
Mast: 18N



## Inhoud


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


## Gegevens

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initieel* | |
| Gevolgklasse | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 15 jaar |
| *Na aanpassing* | |
| Gevolgklasse | n.v.t. |
| Betrouwbaarheidsniveau | n.v.t. |
| Referentieperiode | n.v.t. |
| Windgebied | III |
| Windsnelheid | 24,5 m/s |
| Terreincategorie | II |
| Reductie factor Cdir | 1,00 |
| IJsgebied | B |
| Masttype | Hoekmast |
| Masthoogte | 50 m |
| Max. veldlengte | 400 m |
| Lijnhoek | 160° |
| Trekparameter | 1600 m |
| Wind span | 400 m |
| EDS Weight span | 440 m |
| Min. Weight span | 53 m |
| Max. Weight span | 479 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-07-26 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype HA_n (bouwfase)

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

Document name:

GT-RLL380_HA_n (bouwfase)_18N_Report.pdf

Project number:

Project client number:

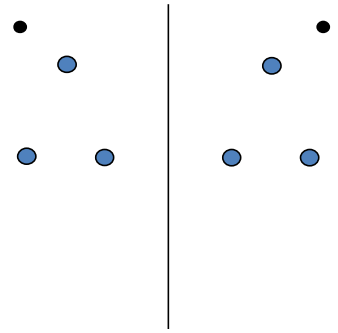
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | | | | |

## Geleiderbelastingen

Auteur: TBR
Versie: v12.0

**Algemeen**

| | |
|---|---|
| Benaming | HA_n (bouwfase) |
| Masttype | Hoekmast |
| Aantal circuits | 1 |
| Configuratie | 2-circuit-donau |
| Aantal bliksemgeleiders | 1 |



Configuratie geleiders

**Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau initieel | Nieuwbouw |
| Referentieperiode initieel | 15 jaar |
| | CC2 |
| Betrouwbaarheidsniveau na aanpassing | n.v.t. |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 m/s |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

**Geleiders Back**

| Omschrijving | Spanning | Geleider Back | Bundel Ba | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |

Geleiders Ahead

| Omschrijving | Spanning | Geleider Ahead | Bundel Ah | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |

Isolatoren *(1)*

| Omschrijving | Ophanging | Gewicht [kN] | Lengte [m] | Windopp. [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Afspanketting | 6,00 | 7,90 | 2,00 |
| Bliksemdraad 1 | Afspanketting | 0,10 | 0,20 | 0,10 |

1. Eigenschappen gelden voor geheel van de isolatorset

**Ophanghoogte en positie in mast**

| Circuits | Aanduiding | Nummer | Ophanghoogte | Aangrijppunt | Positie in mast Horizontale afstand |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 32,7 m | 32,7 m | -15,7 m |
| Circuit 1 | 11 | 380ct1f2 | 32,7 m | 32,7 m | -8,7 m |
| Circuit 1 | 12 | 380ct1f3 | 44,0 m | 44,0 m | -12,2 m |
| Bliksemdraad 1 | 1 | bl1 | 48,2 m | 48,2 m | -18,4 m |

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

**Hoogteaanpassing naastgelegen masten** (aanpassing wind- en weight span)

| | Back | Ahead | |
|---|---|---|---|
| Verhoging voor windbelasting | 32,0 m | 0,0 m | (positief: omhoog) |
| Verlaging voor verticale belasting | -5,0 m | -5,0 m | (negatief: omlaag, grotere weight span) |

Verlaging: Niet in 0,9EG-combinaties

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

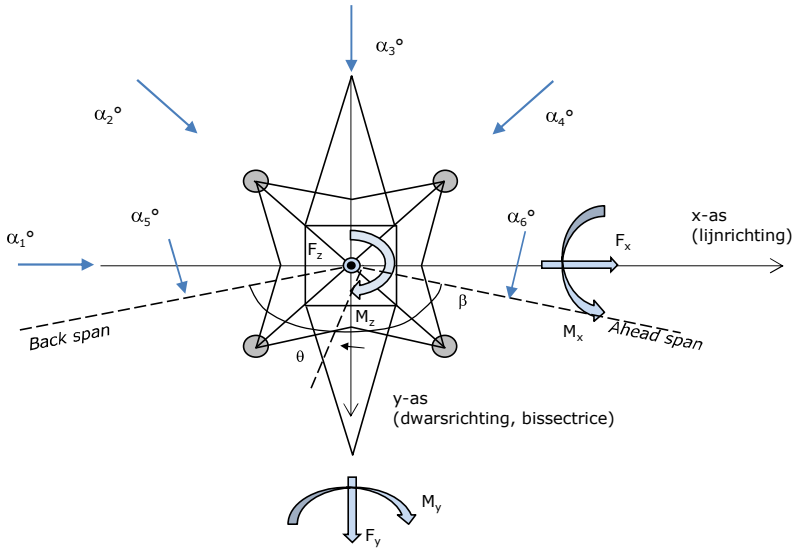
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Bliksemdraad 1 | 1 | bl1 | 0,0 | 0,0 m | 0,0 | 0,0 m |

**Lijn- en mastgegevens**

| | | Back | Ahead |
|---|---|---|---|
| | | 400,0 | 400,0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 400,0 | 400,0 m |
| Lijnhoek | $\beta$ | 160 ° | |
| Rotatie mast t.o.v. bissectrice | $\theta$ | 0 ° | |
| Vaklengte | | 400 | 400 m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 m | |
| Beschouwde windrichtingen | $\alpha_1$ | 0 ° | |
| Windrichtingen volgens: | $\alpha_2$ | 80 ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 ° | |
| | $\alpha_4$ | 100 ° | |
| | $\alpha_5$ | 225 ° | |
| | $\alpha_6$ | 270 ° | |

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

Windrichtingen en positieve richtingen belastingen




| Beschouwd aantal windrichtingen | |
|---|---|
| 1a | 6 |
| 3 | 6 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

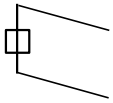
**Geleiderafval**

| | | 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 |
| Bliksemdraad 1 | bl1 | 1 | 0 | 1 | 0 | 1 | 0 |

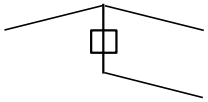
**Belastingsituaties SPLS**

Beschouwde situaties SPLS: 1 t/m 6, alle mogelijke situaties.

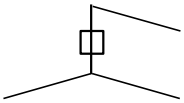
Principe belastingssituaties:



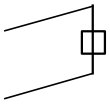
1. Ba All cts



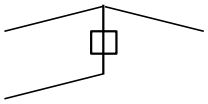
2. Ba ct1



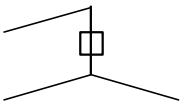
3. Ba ct2



4. Ah All cts



5. Ah ct1

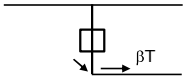


6. Ah ct2

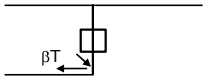
**Belastingsituaties 5a. Geleiderbreuk**

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

Principe belastingssituaties:




1. Ba




2. Ah

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

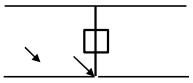
**Belastingsituaties 6. Bouw- en onderhoud**
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht.
Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate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

| | Fase | Bliksem |
|---|---|---|
| Lijnwagen | 4,0 kN | 2,0 kN |
| Puntlast op traverse | 1,0 kN | 1,0 kN |

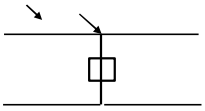
Beschouwde situaties bouw- en onderhoud 6a: 1 t/m 4, alle mogelijke situaties.

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

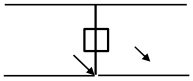
Principe belastingssituaties:



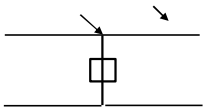
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

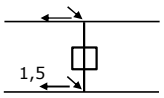
**Belastingsituaties 8. Lijndansen als statische belasting**

| Geleider | | |
|---|---|---|
| Steunmast fase | 0,866 W | 1,5 W |
| Steunmast bliksem | 1,5 EDS | 1,5 W |
| Hoekmast fase en bliksem | 1,5 EDS | 1,5 W |

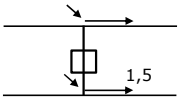
Beschouwde situaties lijndansen 8: 1 en 2, alle mogelijke situaties.

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:




1. Ba




2. Ah

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

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

## Mastconstructie

### Eigenschappen

| | | | |
|---|---|---|---|
| Masttype | Hoekmast | | |
| Mastbenaming | HA_n (bouwfase) | | |
| Voetplaat t.o.v. maaiveld | 0,5 | | m |
| Masthoogte t.o.v. voetplaat | 50,0 | | m |
| Gewicht mast | 492,0 | | kN |
| | | | |
| *Breedte en helling mast bij fundatie* | x-ri. | y-ri. | |
| Pootsprei | 11,58 | 11,58 | m |
| Helling van de randstijl | 0,399 | 0,399 | - |
| Factor spatkracht | 1,3 | 1,3 | - |

### Berekening windbelasting

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

### Eigenschappen mastsecties langsrichting (vooraanzicht, yz-vlak)

| Omschrijving | 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 | 8,54 | 11,58 | 4,77 | 8,54 | 0,399 | 69,81 | 13,53 | 0,19 | 2,96 |
| Tussenstuk1 | 19,03 | 4,77 | 6,96 | 10,49 | -0,104 | 61,52 | 13,15 | 0,21 | 2,87 |
| Tussenstuk2 | 32,70 | 6,96 | 3,80 | 13,67 | 0,116 | 73,54 | 16,36 | 0,22 | 2,83 |
| Bovenstuk1 | 40,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 7,84 | 0,30 | 2,54 |
| Bovenstuk2 | 48,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 4,92 | 0,24 | 2,77 |
| Topstuk | 50,00 | 2,60 | | 2,00 | | 2,60 | 0,43 | 0,17 | 3,09 |
| Ondertraverse | 32,70 | 14,20 | | 4,00 | | 28,40 | 6,40 | 0,23 | 2,82 |
| Boventraverse | 44,00 | 16,94 | | 4,20 | | 35,57 | 7,96 | 0,22 | 2,83 |

### Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)

| Omschrijving | 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 | 8,54 | 11,58 | 4,77 | 8,54 | 0,399 | 69,81 | 13,53 | 0,19 | 2,96 |
| Tussenstuk1 | 19,03 | 4,77 | 6,96 | 10,49 | -0,104 | 61,52 | 13,15 | 0,21 | 2,87 |
| Tussenstuk2 | 32,70 | 6,96 | 3,80 | 13,67 | 0,116 | 73,54 | 16,36 | 0,22 | 2,83 |
| Bovenstuk1 | 40,50 | 3,80 | 2,91 | 7,80 | 0,057 | 26,18 | 7,84 | 0,30 | 2,54 |
| Bovenstuk2 | 48,00 | 2,91 | 2,60 | 7,50 | 0,021 | 20,68 | 4,92 | 0,24 | 2,77 |
| Topstuk | 50,00 | 2,60 | | 2,00 | | 2,60 | 0,43 | 0,17 | 3,09 |
| Ondertraverse | 32,70 | 14,20 | | 4,00 | | 28,40 | 6,40 | 0,23 | 2,82 |
| Boventraverse | 44,00 | 16,94 | | 4,20 | | 35,57 | 7,96 | 0,22 | 2,83 |

*NB: oppervlakte traverse dwarsrichting van de tabel wordt in berekening gereduceerd.*
*NB: oppervlakte traverse per zijde, dus helft van totaal van twee traverses.*

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

**Windoppervlak feeders telecominstallaties**

| Onderdeel | A ($m^2$/m) | Factor | Δh | $A_1$ |
|---|---|---|---|---|
| Broekstuk | 0,20 | 0,71 | 8,5 | 1,2 |
| Tussenstuk1 | 0,20 | 0,71 | 10,5 | 1,5 |
| Tussenstuk2 | 0,20 | 0,71 | 13,7 | 1,9 |
| Bovenstuk1 | 0,20 | 0,71 | 7,8 | 1,1 |
| Bovenstuk2 | | | | |

**Invoer antennes**

| Omschrijving | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne top | | | |
| Antenne o.t. | 4,6 | 31,7 | 1,5 |

**Belastingen mastsectie langsrichting (x-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 28,1 | 5,0 | 0,0 | -5,0 | 4,3 | 119,8 | 21,3 | 0,0 | -21,3 |
| Tussenstuk1 | 0,78 | 29,5 | 5,2 | 0,0 | -5,2 | 13,8 | 406,5 | 72,2 | 0,0 | -72,2 |
| Tussenstuk2 | 0,95 | 43,9 | 7,8 | 0,0 | -7,8 | 25,9 | 1136,4 | 201,9 | 0,0 | -201,9 |
| Bovenstuk1 | 1,05 | 20,9 | 3,7 | 0,0 | -3,7 | 36,6 | 763,2 | 135,6 | 0,0 | -135,6 |
| Bovenstuk2 | 1,10 | 15,0 | 2,7 | 0,0 | -2,7 | 44,3 | 663,6 | 117,9 | 0,0 | -117,9 |
| Topstuk | 1,13 | 1,5 | 0,3 | 0,0 | -0,3 | 49,0 | 73,3 | 13,0 | 0,0 | -13,0 |
| Ondertraverse | 1,02 | 37,0 | 2,7 | 0,0 | -2,7 | 34,0 | 1259,1 | 93,6 | 0,0 | -93,6 |
| Boventraverse | 1,11 | 49,9 | 3,7 | 0,0 | -3,7 | 45,4 | 2264,4 | 168,2 | 0,0 | -168,2 |
| Totaal | | 225,7 | 31,1 | 0,0 | -31,1 | | 6686,3 | 823,9 | 0,0 | -823,9 |

**Belastingen mastsectie dwarsrichting (y-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 0,0 | 28,3 | 28,1 | 28,3 | 4,3 | 0,0 | 120,8 | 119,8 | 120,8 |
| Tussenstuk1 | 0,78 | 0,0 | 29,7 | 29,5 | 29,7 | 13,8 | 0,0 | 409,7 | 406,5 | 409,7 |
| Tussenstuk2 | 0,95 | 0,0 | 44,3 | 43,9 | 44,3 | 25,9 | 0,0 | 1145,3 | 1136,4 | 1145,3 |
| Bovenstuk1 | 1,05 | 0,0 | 21,0 | 20,9 | 21,0 | 36,6 | 0,0 | 769,2 | 763,2 | 769,2 |
| Bovenstuk2 | 1,10 | 0,0 | 15,1 | 15,0 | 15,1 | 44,3 | 0,0 | 668,9 | 663,6 | 668,9 |
| Topstuk | 1,13 | 0,0 | 1,5 | 1,5 | 1,5 | 49,0 | 0,0 | 73,9 | 73,3 | 73,9 |
| Ondertraverse | 1,02 | 0,0 | 15,6 | 14,8 | 15,6 | 34,0 | 0,0 | 530,5 | 503,6 | 530,5 |
| Boventraverse | 1,11 | 0,0 | 21,0 | 20,0 | 21,0 | 45,4 | 0,0 | 954,1 | 905,8 | 954,1 |
| Totaal | | 0,0 | 176,5 | 173,6 | 176,5 | | 0,0 | 4672,4 | 4572,3 | 4672,4 |

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

| Belasting / windrichting | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 492 | 0 | 0 | 0 |
| Windrichting 0° | 233 | 0 | 0 | 0 | 6906 | 0 |
| Windrichting 80° | 32 | 183 | 0 | 4889 | 862 | 0 |
| Windrichting 90° | 0 | 181 | 0 | 4792 | 0 | 0 |
| Windrichting 100° | -32 | 183 | 0 | 4889 | -862 | 0 |

Project: GT-RLL380
Tower: HA_n (bouwfase)
Number: 18N

**Tussenresultaten geleiderbelastingen**

**Geleiders back**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |

**Geleiders ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |

**Verticale belasting back**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45,8 | B | 4+0,2d | 9,5 | 28,6 |
| Bliksemdraad 1 | 1 | 2 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |

**Verticale belasting ahead**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45,8 | B | 4+0,2d | 9,5 | 28,6 |
| Bliksemdraad 1 | 1 | 2 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |

**Isolatoren**

| Geleider | $G_{isolator}$ [kN] | Aantal - | $F_{v,iso}$ [kN] | Lengte [m] | Windopp. [m$^2$] | Windhoogte [m] | Stuwdruk [kN/m$^2$] | Vormfactor [-] | $F_{h,iso}$ [kN] |
|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct1f2 | 6,00 | 1 | 6 | 7,9 | 2,0 | 33,20 | 1,02 | 1,2 | 2,44 |
| 380ct1f3 | 6,00 | 1 | 6 | 7,9 | 2,0 | 44,50 | 1,10 | 1,2 | 2,64 |
| bl1 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 48,70 | 1,13 | 1,2 | 0,14 |

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Tower: HA_n (bouwfase)
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**Windbelasting back**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct1f2 | 40,9 | 1,08 | 0,60 | 0,66 | 1,08 | 28,25 | 59,0 | 64,9 | 46,9 | 109,4 | 120,4 |
| 380ct1f3 | 52,2 | 1,15 | 0,62 | 0,68 | 1,06 | 28,25 | 63,8 | 70,1 | 46,9 | 120,4 | 132,3 |
| bl1 | 56,4 | 1,17 | 0,63 | 0,69 | 1,18 | 22,24 | 19,2 | 21,1 | 63,1 | 55,6 | 61,1 |

**Windbelasting ahead**

| Geleider | hoogte wind | Stuwdruk | $G_{c\_dwars}$ | $G_{c\_trek}$ | $C_c$ | $d_{toeslag}$ | $w_y$ | $w_{y,vak}$ | $D_{ijs,toeslag}$ | $w_{y,ijs}$ | $w_{y,ijs,vak}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [m] | [kN/m$^2$] | [-] | [-] | [-] | [mm] | [N/m] | [N/m] | [mm] | [N/m] | [N/m] |
| 380ct1f1 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct1f2 | 24,9 | 0,94 | 0,56 | 0,62 | 1,11 | 28,25 | 49,7 | 54,8 | 46,9 | 89,0 | 98,0 |
| 380ct1f3 | 36,2 | 1,04 | 0,59 | 0,65 | 1,08 | 28,25 | 56,7 | 62,4 | 46,9 | 104,2 | 114,6 |
| bl1 | 40,4 | 1,07 | 0,60 | 0,66 | 1,20 | 22,24 | 17,2 | 18,9 | 63,1 | 48,8 | 53,7 |

*NB: belastingen $w_v$ gelden voor bundel*

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

**Geleiderbelastingen**

Auteur: TBR
Versie: v12.0

**Uitgangspunten**

| | |
|---|---|
| Betrouwbaarheidsniveau | Nieuwbouw CC2 |
| Referentieperiode | 15 jaar |

| **ULS** (bezwijksterkte) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belastingsgeval | omschrijving | 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° | 1,20 | 1,20 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk alleen mast | 10° | 0,90 | 1,20 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk ook geleider | 10° | 0,90 | 0,90 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,00 | 0,38 | 1,07 | 0,0 |
| ULS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,00 | 0,38 | 1,07 | 0,0 |
| ULS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 5a | Torsiebelastingen | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinale belastingen | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,50 | 0,25 | 0,00 | 0,0 |
| ULS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,35 | 1,35 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** (Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders) | | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,20 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 0,90 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** (controle van de vervormingen, vermoeiing, EDS) | | | | | | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,87 | 0,0 | 0,0 |
| SLS 3 | Wind+ijs | -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 | Bouw en onderhoud | 5° | 1,00 | 1,00 | 0,0 | 0,17 | 0,0 | 0,0 |
| SLS 7 | PB (EDS, geen wind) | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Aantal windrichtingen | 6 |
| Aantal belastingcombinaties ULS | 54 |
| Aantal belastingcombinaties SPLS | 210 |
| Aantal belastingcombinaties SLS | 15 |
| Aantal knooplasten | 2232 |

Project: GT-RLL380
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Mast: 18N

**Samenvattingstabellen geleiderbelastingen**

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

**Maximale waarden voor back en ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -51,7 | 50,3 | 13,2 | 12,5 | 7,6 | 7,6 |
| 380ct1f1 | -143,3 | 138,9 | 42,1 | 37,6 | 27,3 | 27,3 |
| 380ct1f2 | -143,3 | 138,9 | 42,1 | 37,6 | 27,3 | 27,3 |
| 380ct1f3 | -145,9 | 142,1 | 44,4 | 40,9 | 27,3 | 27,3 |

**Min. Weight span (m)**

| Weight sp: | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 440,1 | 446,7 | 440,0 |
| 380ct1f1 | 440,0 | 445,3 | 440,0 |
| 380ct1f2 | 440,0 | 445,3 | 440,0 |
| 380ct1f3 | 440,0 | 445,5 | 440,0 |

**Max. Weight span (m)**

| Weight sp: | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 479,0 | 437,2 |
| 380ct1f1 | 460,3 | 441,4 |
| 380ct1f2 | 460,3 | 441,4 |
| 380ct1f3 | 463,7 | 442,2 |

| Omhullende weight span over alle combinaties (incl. 0,9 combinaties) | | |
|---|---|---|
| Voor alle geleiders | | Wind / Weight span verhouding |
| Max. weight span | 479,0 m | 1,197 - |
| Min. weight span | 53,5 m | 0,134 - |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

**Maximale waarden back+ahead span** **Maximale waarden trekkracht geleider**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 36,0 | 25,4 | 7,6 | -52,2 | 50,7 |
| 380ct1f1 | 118,9 | 77,9 | 27,3 | -144,7 | 140,3 |
| 380ct1f2 | 118,9 | 77,9 | 27,3 | -144,7 | 140,3 |
| 380ct1f3 | 122,0 | 83,4 | 27,3 | -147,5 | 143,5 |

**EDS-belastingen geleiders**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 15,1 | 2,7 | 2,2 | -15,3 | 15,3 |
| 380ct1f1 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f2 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |
| 380ct1f3 | 72,2 | 12,7 | 16,1 | -73,3 | 73,3 |

**Controle uplift SLS-wind**

| Combinati | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| **SLS 4** | bl1 | 0,0 | 0,0 |
| | 380ct1f1 | 0,0 | 0,0 |
| | 380ct1f2 | 0,0 | 0,0 |
| | 380ct1f3 | 0,0 | 0,0 |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

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

| Combinatie | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | -34 | 261 | 125 | 8246 | -1257 | 432 |
| ULS 1a_0,9_0 | | 1 | 96 | 92 | 2438 | 20 | -7 |
| ULS 1a_0,9_0,9_90 | | -38 | 251 | 51 | 8820 | -1391 | 479 |
| ULS 3_0 | | 0 | 152 | 171 | 3556 | 11 | -4 |
| SLS 7 | | 0 | 82 | 101 | 1784 | 0 | 0 |

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

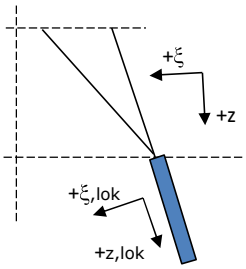
| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | -34 | 487 | 715 | 14250 | -1257 | 432 |
| ULS 1a_0,9_0,9_90 | -38 | 477 | 494 | 14824 | -1391 | 479 |
| SLS 7 | 0 | 82 | 593 | 1784 | 0 | 0 |

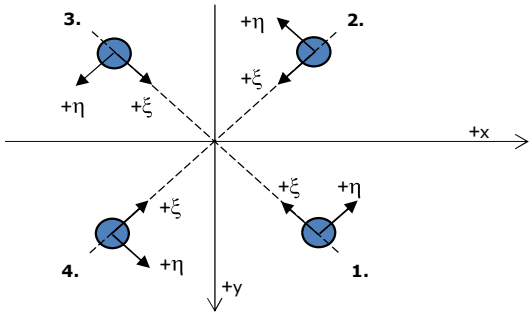
**Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde**

| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_90 | -34 | 487 | 520 | **14858** | -1257 | 432 |
| SPLS 1a_225 Ah All Cts | -458 | -106 | 673 | -3774 | **-15883** | 4076 |
| SPLS 3_270 Ah All Cts | -396 | -15 | 680 | -953 | -14874 | **5050** |
| SPLS 1a_0,9_100 Ah All Cts | -365 | 242 | 493 | **6901** | **-13402** | 4311 |

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

**Oplegreacties op fundering per randstijl**




Assenstelsels

**Maximale drukbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_80 Ba All Cts | 226 | 522 | **991** | -209 | -528 | 31 | 1138 |
| 2 | SPLS 1a_270 Ba All Cts | 356 | -312 | **896** | -31 | -472 | 33 | 1028 |
| 3 | SPLS 1a_225 Ah All Cts | -374 | -381 | **1017** | -5 | -534 | 39 | 1168 |
| 4 | SPLS 1a_100 Ah All Cts | -231 | 541 | **1027** | 219 | -546 | 34 | 1179 |

**Maximale trekbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_0,9_225 Ah All Cts | -38 | -406 | **-708** | 260 | 314 | -85 | -813 |
| 2 | SPLS 1a_0,9_100 Ah All Cts | -275 | 203 | **-753** | 51 | 338 | -86 | -865 |
| 3 | SPLS 1a_0,9_80 Ba All Cts | 250 | 189 | **-695** | -43 | 310 | -82 | -798 |
| 4 | SPLS 1a_0,9_270 Ba All Cts | 11 | -346 | **-595** | -237 | 252 | -83 | -683 |

**Maximale torsiebelasting (positief)**

| Stijl | Combinatie | $R_x$ [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_80 Ah All Cts | 177 | -329 | -309 | **358** | 108 | -66 | -354 |
| 2 | ULS 1a_0,9_0,9_80 | -292 | 69 | -576 | **158** | 255 | -70 | -661 |
| 3 | ULS 1a_0 | 27 | 126 | -286 | **70** | 108 | -53 | -329 |
| 4 | SPLS 1a_225 Ah All Cts | -29 | 504 | 691 | **336** | -377 | 13 | 793 |

**Maximale torsiebelasting (negatief)**

| Stijl Index | Combinatie 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_270 Ba All Cts | 56 | 507 | 741 | **-318** | -398 | 20 | 851 |
| 2 | ULS 1a_225 | 115 | 55 | 8 | **-120** | -42 | -38 | 9 |
| 3 | ULS 1a_0,9_0,9_100 | 251 | 28 | -455 | **-158** | 197 | -60 | -522 |
| 4 | SPLS 3_0,9_100 Ba All Cts | -167 | -307 | -298 | **-335** | 99 | -69 | -342 |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N

**Combinatie Ftrek+Fhor**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_0,9_225 Ah All Cts | -38 | -406 | **-708** | **260** | 314 | -85 | -813 |
| 2 | ULS 1a_0,9_0,9_80 | -292 | 69 | **-576** | **158** | 255 | -70 | -661 |
| 3 | ULS 1a_0,9_0,9_100 | 251 | 28 | **-455** | **-158** | 197 | -60 | -522 |
| 4 | SPLS 3_0,9_270 Ba All Cts | -57 | -358 | **-522** | **-294** | 213 | -82 | -600 |

**Permanente belasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 117 | 97 | 225 | 14 | -151 | -24 | 259 |
| 2 | SLS 7 | 37 | -56 | 71 | 14 | -66 | -26 | 82 |
| 3 | SLS 7 | -37 | -56 | 71 | -14 | -66 | -26 | 82 |
| 4 | SLS 7 | -117 | 97 | 225 | -14 | -151 | -24 | 259 |

**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_100 Ah All Cts | -231 | 541 | **1027** | 219 | -546 | 34 | 1179 |
| Max. trek | SPLS 1a_0,9_100 Ah All Cts | -275 | 203 | **-753** | 51 | 338 | -86 | -865 |
| Max. pos. torsie | SPLS 3_0,9_80 Ah All Cts | 177 | -329 | -309 | **358** | 108 | -66 | -354 |
| Max. neg. torsie | SPLS 3_0,9_100 Ba All Cts | -167 | -307 | -298 | **-335** | 99 | -69 | -342 |
| Comb. trek+torsie | SPLS 1a_0,9_225 Ah All Cts | -38 | -406 | **-708** | **260** | 314 | -85 | -813 |

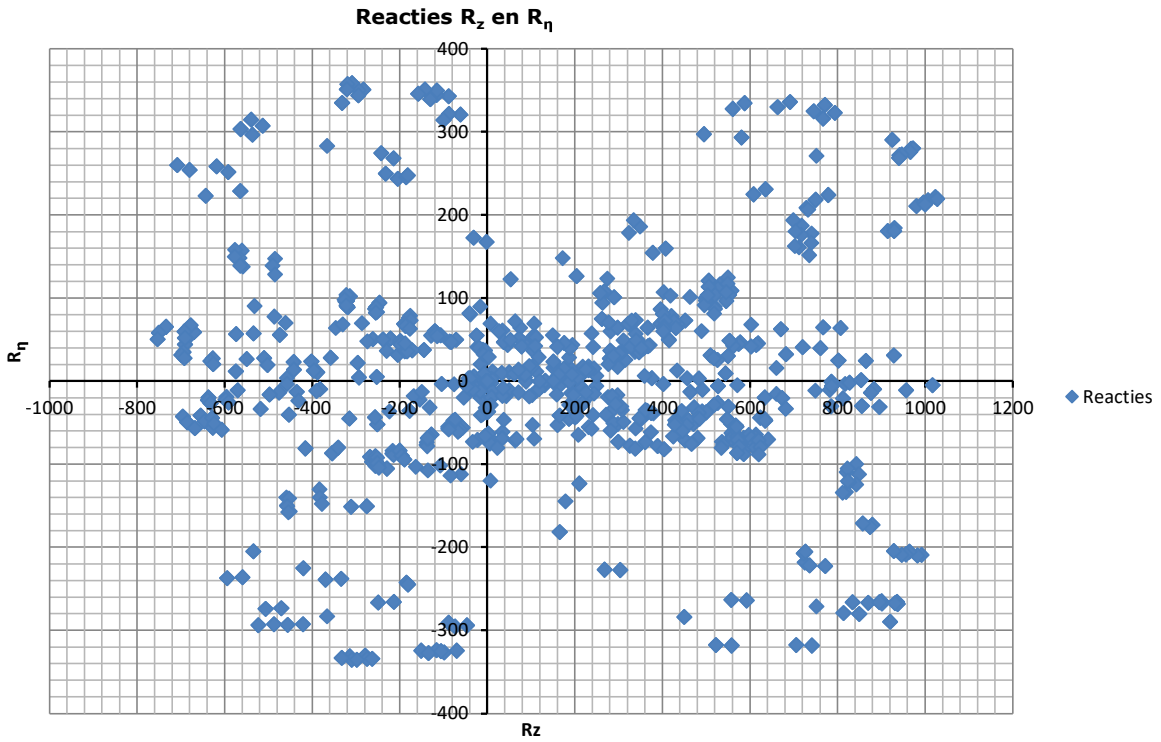
**Maximale trekbelasting SLS**

| Stijl | Combinatie | $R_x$ [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_100 Ah All Cts | 167 | -329 | **-321** | 351 | 115 | -66 | -368 |
| 2 | SPLS 1a_0,9_100 Ah All Cts | -275 | 203 | **-753** | 51 | 338 | -86 | -865 |
| 3 | SPLS 1a_0,9_80 Ba Ct2 | 140 | 11 | **-268** | -91 | 107 | -44 | -308 |
| 4 | SLS 1a_0 | -67 | -37 | **-33** | -73 | -21 | -40 | -38 |

**Maximale drukbelasting SLS**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SPLS 1a_80 Ba Ct2 | 308 | 154 | **557** | 109 | -327 | -13 | 640 |
| 2 | SLS 1a_0 | 87 | -190 | **330** | 73 | -196 | -10 | 379 |
| 3 | SPLS 3_100 Ah All Cts | -205 | -272 | **635** | -48 | -338 | 20 | 729 |
| 4 | SPLS 1a_100 Ah All Cts | -231 | 541 | **1027** | 219 | -546 | 34 | 1179 |

Project: GT-RLL380
Masttype: HA_n (bouwfase)
Mast: 18N



## Belastinggeval - afspannen

Date: 2021-07-27
Author: TBR
Version: 1.1

RLL-TLB
HA_n

Invoergegevens

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

| | | | Hoogteverschil | | | Richtingsverandering | | |
|---|---|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Dh_back | Dh_ahead | | Dy_back | Dy_ahead | |
| Circuit 1 | 10 | 380ct1f1 | -32,7 | 0,0 | m | 0,0 | 0,0 | m |
| Circuit 1 | 11 | 380ct1f2 | -32,7 | 0,0 | m | 0,0 | 0,0 | m |
| Circuit 1 | 12 | 380ct1f3 | -44,0 | 0,0 | m | 0,0 | 0,0 | m |
| Bliksemdraad 1 | 1 | bl1 | -48,2 | 0,0 | m | 0,0 | 0,0 | m |

**Lijn- en mastgegevens**

| | | Back | Ahead | |
|---|---|---|---|---|
| | | 66,0 | 400,0 | m |
| Ruling span √(SL3/SL) | | 66,0 | 400,0 | m |
| Lijnhoek | β | 180 | ° | |
| Rotatie mast t.o.v. bissectrice | θ | 10 | ° | |
| Vaklengte | | 66 | 400 | m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 | m | |
| Beschouwde windrichtingen | a1 | 0 | ° | |
| Windrichtingen volgens: | a2 | 45 | ° | |
| *Geleiderbelastingen* | a3 | 90 | ° | |
| | a4 | 135 | ° | |
| | a5 | 80 | ° | |
| | a6 | 80 | ° | |

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

In onderstaande tabel zijn de optredende belastingen weergegeven, voor deze situatie geldt:
- belasting op geleider 1 en 10 t/m 12 zijn permanent aanwezig
- van de belasting op de overige geleiders is er telkens één aanwezig per belastingcombinatie

Uitvoer geleiderbelastingen

| Belastingcombi | nummer | Fxtotaal | Fytotaal | Fztotaal | Ftrekahead | Ftrekback |
|---|---|---|---|---|---|---|
| **ULS 6b_90** | 13 | **-83,5** | **15,8** | **57,6** | 0,0 | -85,0 |
| | 10 | **88,8** | **-12,4** | **19,3** | 89,6 | 0,0 |
| | 14 | **-83,5** | **15,8** | **57,6** | 0,0 | -85,0 |
| | 11 | **88,8** | **-12,4** | **19,3** | 89,6 | 0,0 |
| | 15 | **-83,6** | **15,8** | **72,2** | 0,0 | -85,0 |
| | 12 | **89,5** | **-12,2** | **19,3** | 90,2 | 0,0 |
| | 4 | **-17,4** | **3,3** | **14,8** | 0,0 | -17,7 |
| | 1 | **19,2** | **-2,4** | **2,7** | 19,4 | 0,0 |

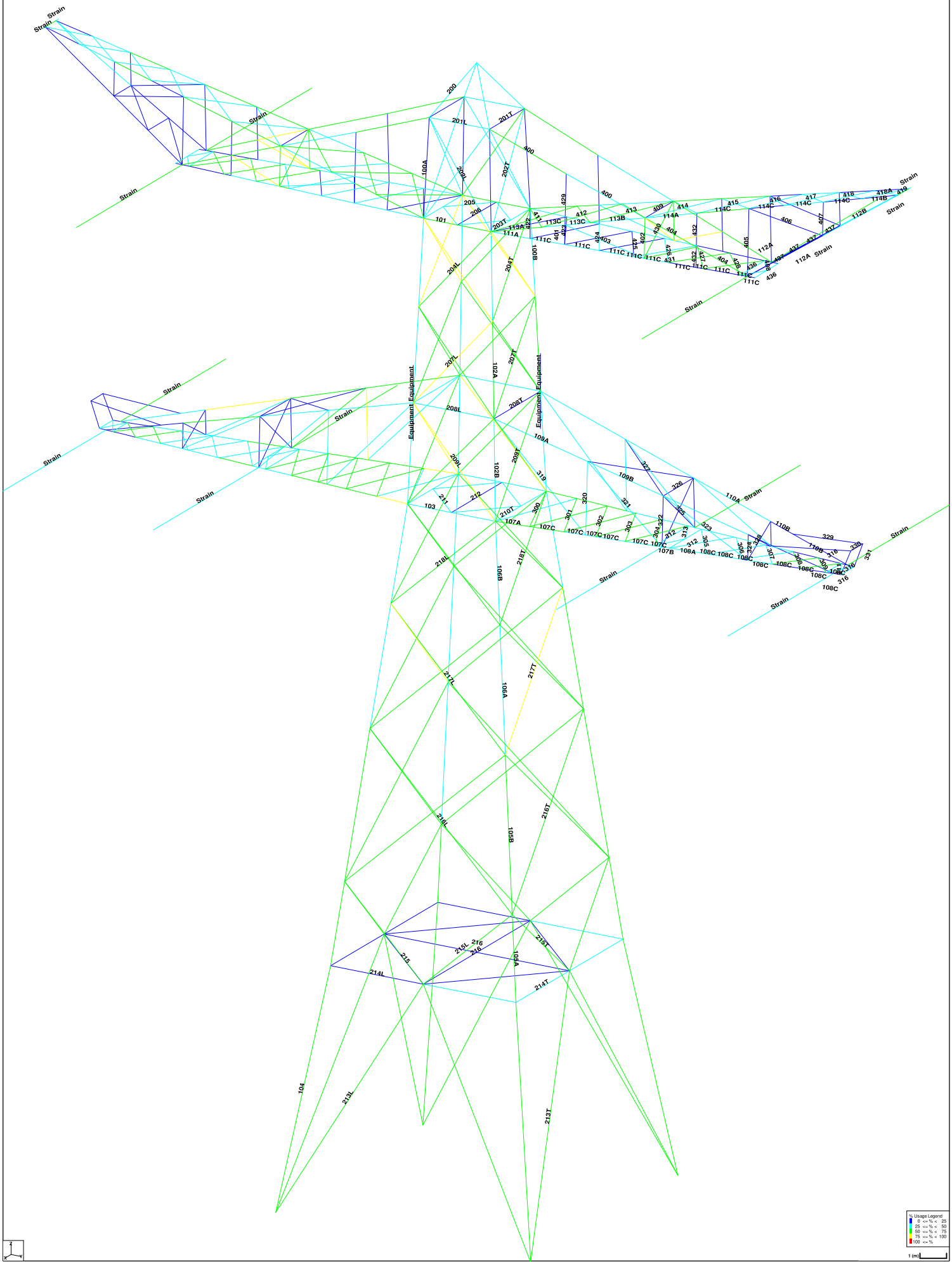
# APPENDIX B
# Resultaten PLS tower

Deze Appendix bevat de resultaten uit PLS Tower voor de verschillende masttypen. De samenstelling van de bovenstukken zijn voor alle masttypen gelijk. De resultaten van het bovenstuk zijn dan ook alleen opgenomen van het maatgevende masttype HA+5/n. De resultaten van het onderstuk zijn voor alle masten opgenomen.

Resultaten opgenomen voor:

- Masttype HA+0/n
- Masttype HA+5/n

DNV GL Nederlands BV, Project: "D1.3.2 Circuit HA-0 - dnv gl-inl"
Tower Version 16.65, 14:00:07 dinsdag 21 september 2021
Undeformed geometry displayed



# Assessment of angle groups

Date 21-9-2021
Author BJT
Version 4.3

**GT-RLL**
**HA+0_n**

| Group Label | Description | Type | Profile | Steel Quali | Bolts | #sh.pl | e1 | e2 | p1 | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main member | EA | 120x120x12 | S355 | | 1 | 35 | 25 | 55 | 0,51 | 0,51 | 0,51 | 87 | **-126.5** | ULS 6b_90_(afspannen)_12 | 558,4 |
| 100B | BVNSTK - Main member | EA | 120x120x12 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 78 | **-218.3** | ULS 6b_90_(afspannen)_12 | 635,9 |
| 101 | BVNSTK - Horizontal front (cross profil | EA | 160x160x15 | S355 | 10M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 59 | **-633.5** | SPLS 3_80 Ah All Cts | 1300,4 |
| 102A | Derde TSNSTK - Main member | EA | 160x160x15 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 63 | **-452.3** | SPLS 3_90 Ah All Cts | 1261,4 |
| 102B | Derde TSNSTK - Main member | EA | 160x160x15 | S355 | 8M24-8,8t | 2 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 66 | **-488.6** | SPLS 3_90 Ah All Cts | 1222,7 |
| 103 | Derde TSNSTK - Horizontal front (cross | EA | 180x180x16 | S355 | 13M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 69 | **-685.2** | SPLS 3_80 Ah All Cts | 1409,8 |
| 104 | BRKSTK - Main member | EA | 200x200x20 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,17 | 0,17 | 0,17 | 43 | **-1578.0** | SPLS 3_90 Ah All Cts | 2395,5 |
| 105A | Eerste TSNSTK - Main member | EA | 200x200x20 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,50 | 0,50 | 0,50 | 43 | **-1546.7** | SPLS 3_90 Ah All Cts | 2395,3 |
| 105B | Eerste TSNSTK - Main member | EA | 200x200x20 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 42 | **-1443.4** | SPLS 3_90 Ah All Cts | 2406,2 |
| 106A | Tweede TSNSTK - Main member | EA | 200x200x18 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 34 | **-1139.2** | SPLS 3_90 Ah All Cts | 2266,9 |
| 106B | Tweede TSNSTK - Main member | EA | 200x200x18 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 27 | **-957.1** | SPLS 3_90 Ah All Cts | 2344,8 |
| 107A | Eerste DWSRM - Main member bottom 1 | EA | 160x160x15 | S355 | 10M24-8,8t | 1 | 55 | 40 | 80 | 2,90 | 1,00 | 1,00 | 83 | **-795.1** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 1000,7 |
| 107B | Eerste DWSRM - Main member bottom 1 | EA | 180x180x16 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 11,67 | 2,00 | 1,00 | 64 | **-423.2** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 1481,9 |
| 107C | Eerste DWSRM - Main member bottom 1 | EA | 160x160x15 | S355 | | | | | | 2,90 | 1,00 | 1,00 | 83 | **-749.2** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 1002,4 |
| 108A | Eerste DWSRM - Main member bottom 2 | EA | 150x150x12 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 2,50 | 1,00 | 1,00 | 82 | **-409.4** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 759,1 |
| 108C | Eerste DWSRM - Main member bottom 2 | EA | 150x150x12 | S355 | | | | | | 2,50 | 1,00 | 1,00 | 74 | **-367.9** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 841,6 |
| 109A | Eerste DWSRM - Main member top 1 | EA | 110x110x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 0,90 | 167 | **-24.1** | ULS 8 Ah_(bouw) | 174,8 |
| 109B | Eerste DWSRM - Main member top 1 | EA | 110x110x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 150 | **-19.3** | ULS 8 Ah_(bouw) | 202,8 |
| 110A | Eerste DWSRM - Main member top 2 | EA | 100x100x8 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 0,90 | 168 | **-16.3** | ULS 8 Ah_(bouw) | 127,7 |
| 110B | Eerste DWSRM - Main member top 2 | EA | 100x100x8 | S355 | | 1 | 55 | 40 | 80 | 1,20 | 1,20 | 1,00 | 132 | **-15.9** | ULS 8 Ah_(bouw) | 176,1 |
| 111A | Tweede DWSRM - Main member bottom | EA | 150x150x12 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 1,89 | 1,00 | 1,00 | 67 | **-428.3** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 902,2 |
| 111C | Tweede DWSRM - Main member bottom | EA | 150x150x12 | S355 | | | | | | 10,07 | 4,54 | 1,00 | 94 | **-339.1** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 635,0 |
| 112A | Tweede DWSRM - Main member under r | EA | 100x100x8 | S355 | | 1 | | | | 1,00 | 1,00 | 1,00 | 96 | **-50.0** | ULS 6b_90_(afspannen)_1 | 255,2 |
| 112B | Tweede DWSRM - Main member under r | EA | 100x100x8 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 191 | **-42.3** | ULS 6b_90_(afspannen)_1 | 105,3 |
| 113A | Tweede DWSRM - Main member top 1 | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,46 | 1,00 | 1,00 | 92 | **-281.9** | SPLS 3_80 Ah All Cts | 395,5 |
| 113B | Tweede DWSRM - Main member top 1 | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,56 | 1,00 | 1,00 | 100 | **-169.7** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 343,8 |
| 113C | Tweede DWSRM - Main member top 1 | EA | 120x120x10 | S355 | | | | | | 3,18 | 2,08 | 1,00 | 87 | **-236.0** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 396,3 |
| 114A | Tweede DWSRM - Main member top 2 | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,82 | 1,00 | 1,00 | 111 | **-182.4** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 309,4 |
| 114B | Tweede DWSRM - Main member top 2 | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,53 | 1,00 | 1,00 | 67 | **-38.2** | SPLS 3_0,9_80 Ah All Cts | 491,5 |
| 114C | Tweede DWSRM - Main member top 2 | EA | 120x120x10 | S355 | | | | | | 2,22 | 1,00 | 1,00 | 135 | **-163.5** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 243,3 |
| 200 | BVNSTK - Top cap | EA | 80x80x6 | S355 | 2M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 171 | **-23.6** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 75,5 |
| 201L | BVNSTK - Horizontal front | EA | 100x100x10 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 133 | **-10.8** | ULS 8 Ba 12_(bouw) | 216,2 |
| 201T | BVNSTK - Horizontal side | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 1,00 | 1,00 | 164 | **-10.2** | ULS 6b_90_(afspannen)_12 | 64,3 |
| 202L | BVNSTK - CD front | EA | 100x100x8 | S355 | 2M24-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 129 | **-118.5** | ULS 6b_90_(afspannen)_12 | 182,1 |
| 202T | BVNSTK - CD side | EA | 80x80x8 | S355 | 2M24-8,8t | 1 | 45 | 35 | 70 | 1,00 | 0,52 | 0,52 | 200 | **-20.0** | ULS 6b_90_(afspannen)_12 | 48,6 |
| 203T | BVNSTK - Horizontal side | EA | 100x100x10 | S355 | 5M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 2,00 | 1,00 | 96 | **-138.2** | SPLS 3_80 Ah All Cts_(bouw) | 298,2 |
| 204L | BVNSTK - CD front | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 95 | **-342.8** | SPLS 3_80 Ba Ct1 | 497,1 |
| 204T | BVNSTK - CD side | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 95 | **-326.7** | SPLS 3_270 Ah All Cts_(bouw) | 497,1 |
| 205 | BVNSTK - Diagonal for crossarm diaphra | EA | 120x120x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 88 | **-190.5** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 492,2 |
| 206 | BVNSTK - CD for crossarm diaphragm | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,50 | 0,50 | 0,50 | 150 | **0.0** | ULS 8 Ah 10_(bouw) | 36,9 |
| 207L | Derde TSNSTK - CD front | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 104 | **-273.9** | SPLS 3_0,9_80 Ba Ct2 | 455,2 |
| 207T | Derde TSNSTK - CD side | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 104 | **-291.2** | SPLS 3_0,9_270 Ah All Cts_(bouw) | 455,2 |
| 208L | Derde TSNSTK - Horizontal front | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 148 | **-13.0** | ULS 8 Ba 12_(bouw) | 228,3 |
| 208T | Derde TSNSTK - Horizontal side | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 148 | **-68.3** | ULS 1a_0,9_90 | 228,3 |
| 209L | Derde TSNSTK - CD front | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 111 | **-337.3** | SPLS 3_90 Ah Ct1 | 422,6 |
| 209T | Derde TSNSTK - CD side | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 111 | **-305.7** | SPLS 3_270 Ah All Cts_(bouw) | 422,6 |
| 210T | Derde TSNSTK - Horizontal side | EA | 120x120x10 | S355 | 6M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 2,00 | 1,00 | 104 | **-142.0** | SPLS 6a_90 Ah All Cts Ba Ct1_(bou | 332,9 |
| 211 | Derde TSNSTK - Diagonal for crossarm ( | EA | 130x130x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 106 | **-191.3** | SPLS 3_270 Ah All Cts_(bouw) | 444,9 |
| 212 | Derde TSNSTK - CD for crossarm diaphr | EA | 55x55x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,50 | 0,50 | 0,50 | 179 | **0.0** | | 35,9 |
| 213L | BRKSTK - Main diagonal | EA | 150x150x14 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,17 | 0,17 | 0,17 | 65 | **-386.7** | SPLS 3_80 Ah All Cts_(bouw) | 904,1 |
| 213T | BRKSTK - Main diagonal | EA | 150x150x14 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,17 | 0,17 | 0,17 | 65 | **-355.5** | SPLS 3_80 Ba Ct2 | 904,1 |
| 214L | BRKSTK - Diaphragm horizontal | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 169 | **-59.9** | SPLS 3_90 Ah All Cts | 188,4 |
| 214T | BRKSTK - Diaphragm horizontal | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 169 | **-64.9** | SPLS 3_80 Ah All Cts | 188,4 |
| 215 | BRKSTK - Diaphragm diagonal | EA | 80x80x8 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 0,50 | 0,50 | 233 | **-8.2** | ULS 1a_45 | 41,9 |
| 215L | Eerste TSNSTK - First diag from bottom | EA | 150x150x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 107 | **-266.8** | SPLS 3_80 Ah All Cts_(bouw) | 483,1 |
| 215T | Eerste TSNSTK - First diag from bottom | EA | 150x150x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,52 | 0,52 | 107 | **-267.9** | SPLS 3_80 Ba Ct2 | 483,1 |
| 216 | BRKSTK - Diaphragm CD | EA | 70x70x6 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,50 | 0,50 | 0,50 | 292 | **-1.1** | SPLS 3_80 Ba Ct2 | 22,5 |
| 216L | Eerste TSNSTK - First CD from bottom | EA | 150x150x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 108 | **-325.1** | SPLS 3_80 Ba Ct2 | 475,4 |
| 216T | Eerste TSNSTK - First CD from bottom | EA | 150x150x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 108 | **-325.9** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 475,4 |
| 217L | Tweede TSNSTK - First CD from bottom | EA | 140x140x13 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 94 | **-397.6** | SPLS 3_80 Ah All Cts_(bouw) | 557,3 |
| 217T | Tweede TSNSTK - First CD from bottom | EA | 140x140x13 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 94 | **-407.7** | SPLS 3_270 Ah All Cts_(bouw) | 557,3 |
| 218L | Tweede TSNSTK - Second CD from botto | EA | 140x140x13 | S355 | 5M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 75 | **-486.0** | SPLS 3_80 Ba Ct2 | 676,1 |
| 218T | Tweede TSNSTK - Second CD from botto | EA | 140x140x13 | S355 | 5M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 75 | **-497.9** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 676,1 |
| 300 | Eerste DWSRM CD 1 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 128 | **-57.1** | SPLS 3_0,9_80 Ah All Cts | 111,3 |
| 301 | Eerste DWSRM CD 2 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 120 | **-67.7** | SPLS 3_0,9_270 Ah All Cts_(bouw) | 121,0 |
| 302 | Eerste DWSRM CD 3 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 110 | **-71.6** | SPLS 3_0,9_80 Ah Ct2 | 133,0 |
| 303 | Eerste DWSRM CD 4 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 102 | **-79.5** | SPLS 3_0,9_80 Ah Ct2 | 145,5 |
| 304 | Eerste DWSRM CD 5 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 95 | **-84.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 156,7 |
| 305 | Eerste DWSRM CD 6 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 102 | **-36.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 99,6 |
| 306 | Eerste DWSRM CD 7 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,53 | 0,53 | 0,53 | 91 | **-41.8** | SPLS 6a_90 Ah All Cts Ba Ct2 | 139,5 |
| 307 | Eerste DWSRM CD 8 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 84 | **-46.9** | SPLS 6a_90 Ah All Cts Ba Ct2 | 120,4 |
| 308 | Eerste DWSRM CD 9 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 74 | **-58.4** | SPLS 6a_90 Ah All Cts Ba Ct2 | 133,2 |
| 309 | Eerste DWSRM CD 10 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 65 | **-67.2** | SPLS 6a_90 Ah All Cts Ba Ct2 | 143,0 |
| 311 | Eerste DWSRM CD 12 under | EA | 70x70x6 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 49 | **-25.7** | SPLS 3_80 Ah Ct1 | 156,8 |
| 312 | Eerste DWSRM 2&3 horiz under | DEA | 150x150x14 (not co | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 2,00 | 1,00 | 52 | **-17.1** | SPLS 3_0,9_90 Ah Ct2 | 1924,3 |
| 313 | Eerste DWSRM Diag between horiz 4&5 | EA | 80x80x8 | S355 | 1M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 89 | **-57.1** | SPLS 3_0,9_270 Ah All Cts_(bouw) | 173,4 |
| 314 | Eerste DWSRM Horiz 3&4 | HEA | HEA160 | S355 | | 1 | 45 | 35 | 70 | 0,00 | 0,00 | 0,00 | 0 | **0.0** | | 0,0 |
| 316 | Eerste DWSRM horiz 6&7 | DEA | 150x150x14 (not co | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 1,00 | 1,00 | 38 | **-0.1** | ULS 8 Ah_(bouw) | 2235,4 |
| 319 | 1ste DWSRM front bracing 1 | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,35 | 1,00 | 0,35 | 261 | **-1.4** | ULS 8 Ah_(bouw) | 32,8 |
| 320 | 1ste DWSRM front bracing 2 | EA | 70x70x6 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,60 | 1,00 | 0,60 | 136 | **-43.1** | ULS 6b_90_(afspannen)_11 | 56,5 |
| 321 | 1ste DWSRM front bracing 3 | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,60 | 1,00 | 0,60 | 172 | **-2.7** | ULS 8 Ah_(bouw) | 48,8 |
| 322 | 1ste DWSRM front bracing 4 | EA | 70x70x6 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,50 | 1,00 | 0,50 | 94 | **-7.5** | SPLS 3_80 Ah Ct1 | 83,7 |
| 323 | 1ste DWSRM front bracing 5 | EA | 70x70x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,50 | 1,00 | 0,50 | 190 | **-1.4** | ULS 8 Ba 10_(bouw) | 36,9 |
| 324 | 1ste DWSRM front bracing 6 | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 104 | **-5.8** | ULS 1a_0 | 58,3 |
| 325 | 1ste DWSRM section BB CD | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,51 | 0,51 | 0,51 | 163 | **-10.3** | ULS 1a_0 | 33,0 |
| 326 | 1ste DWSRM section BB horiz | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 195 | **-3.8** | ULS 3_90 | 36,6 |
| 327 | 1ste DWSRM section horiz on top | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,55 | 0,55 | 0,55 | 194 | **-6.3** | SPLS 3_80 Ah All Cts | 36,9 |
| 328 | 1ste DWSRM diag on top | EA | 50x50x5 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 205 | **-6.4** | ULS 1a_0 | 29,5 |
| 329 | 1ste DWSRM preekstoel leuning | EA | 70x70x7 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 236 | **-1.5** | ULS 1a_0 | 46,1 |
| 330 | 1ste DWSRM preekstoel ligger | UA | 100x50x6 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 84 | **-0.1** | ULS 1a_90 | 144,3 |
| 331 | 1ste DWSRM preekstoel stijl | EA | 50x50x5 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 111 | **-1.6** | SPLS 1a_0 Ah All Cts | 67,4 |
| 400 | Tweede DWSRM - Main diagonal from tc | EA | 120x120x10 | S355 | 3M24-8,8t | 1 | 45 | 35 | 70 | 2,00 | 1,00 | 1,00 | 193 | **-26.5** | SPLS 3_0,9_80 Ah All Cts | 149,6 |
| 401 | Tweede DWSRM - Vertical front | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 79 | **-8.8** | ULS 1a_0 | 75,2 |
| 402 | Tweede DWSRM - Vertical front | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 164 | **-17.1** | SPLS 6a_90 Ah All Cts Ba Ct2 | 32,7 |

| Group Label | Shear (Comp) | aring (Comp) | U.C. (Comp) | eedance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | ring (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|
| 100A | 0,0 | 0,0 | 0,23 | | **61.3** | ULS 6b_90_(afspannen)_12 | 976,3 | 0,0 | 0,0 | 0,06 |
| 100B | 813,3 | 1270,1 | 0,34 | | **134.4** | SPLS 3_0,9_80 Ah Ct1 | 750,1 | 813,3 | 1194,1 | 0,18 |
| 101 | 1253,9 | 2646,0 | 0,51 | | **509.8** | SPLS 3_0,9_80 Ah All Cts | 916,5 | 1253,9 | 2462,0 | 0,56 |
| 102A | 813,3 | 1587,6 | 0,56 | | **342.7** | SPLS 3_0,9_90 Ah All Cts | 1372,7 | 813,3 | 1492,6 | 0,42 |
| 102B | 2168,8 | 2116,8 | 0,40 | | **348.3** | SPLS 3_0,9_90 Ah All Cts | 1372,7 | 2168,8 | 1990,2 | 0,25 |
| 103 | 1541,9 | 3669,1 | 0,49 | | **471.9** | SPLS 3_0,9_80 Ah All Cts | 1097,0 | 1541,9 | 3413,2 | 0,43 |
| 104 | 3199,0 | 4233,6 | 0,66 | | **1293.3** | SPLS 3_0,9_90 Ah All Cts | 2328,5 | 3199,0 | 3980,3 | 0,56 |
| 105A | 3199,0 | 4233,6 | 0,65 | | **1292.8** | SPLS 3_0,9_90 Ah All Cts | 2328,5 | 3199,0 | 3980,3 | 0,56 |
| 105B | 3199,0 | 4233,6 | 0,60 | | **1193.8** | SPLS 3_0,9_90 Ah All Cts | 2328,5 | 3199,0 | 3980,3 | 0,51 |
| 106A | 2711,0 | 3175,2 | 0,50 | | **926.8** | SPLS 3_0,9_90 Ah All Cts | 2107,6 | 2711,0 | 2985,2 | 0,44 |
| 106B | 2711,0 | 3175,2 | 0,41 | | **731.1** | SPLS 3_0,9_90 Ah All Cts | 2107,6 | 2711,0 | 2985,2 | 0,35 |
| 107A | 1253,9 | 2646,0 | 0,79 | | **534.8** | SPLS 3_0,9_80 Ah Ct2 | 916,5 | 1253,9 | 2462,0 | 0,58 |
| 107B | 1084,4 | 2257,9 | 0,39 | | **271.2** | SPLS 3_0,9_80 Ah Ct2 | 1661,0 | 1084,4 | 2122,8 | 0,25 |
| 107C | 0,0 | 0,0 | 0,75 | | **488.1** | SPLS 3_0,9_80 Ah Ct2 | 1658,2 | 0,0 | 0,0 | 0,29 |
| 108A | 1084,4 | 1693,4 | 0,54 | | **248.9** | SPLS 3_0,9_80 Ah Ct2 | 1007,6 | 1084,4 | 1592,1 | 0,25 |
| 108C | 0,0 | 0,0 | 0,44 | | **232.2** | SPLS 3_0,9_80 Ah Ct2 | 1235,4 | 0,0 | 0,0 | 0,19 |
| 109A | 542,2 | 705,6 | 0,14 | | **208.0** | ULS 6b_90_(afspannen)_10 | 396,5 | 542,2 | 657,6 | 0,52 |
| 109B | 542,2 | 705,6 | 0,10 | | **200.2** | ULS 6b_90_(afspannen)_10 | 340,8 | 542,2 | 657,6 | 0,59 |
| 110A | 542,2 | 564,5 | 0,13 | | **184.9** | ULS 6b_90_(afspannen)_10 | 242,8 | 542,2 | 526,0 | 0,76 |
| 110B | 0,0 | 0,0 | 0,09 | | **185.7** | ULS 6b_90_(afspannen)_10 | 550,3 | 0,0 | 0,0 | 0,34 |
| 111A | 1039,2 | 1693,4 | 0,47 | | **273.7** | SPLS 3_0,9_270 Ah All Cts_(bouv | 678,2 | 1039,2 | 1576,1 | 0,40 |
| 111C | 0,0 | 0,0 | 0,53 | | **253.0** | SPLS 3_0,9_270 Ah All Cts_(bouv | 1235,4 | 0,0 | 0,0 | 0,20 |
| 112A | 0,0 | 0,0 | 0,20 | | **6.7** | ULS 1a_0,9_0,9_80 | 550,3 | 0,0 | 0,0 | 0,01 |
| 112B | 271,1 | 282,2 | 0,40 | | **10.6** | ULS 1a_0,9_0,9_80 | 246,8 | 271,1 | 263,7 | 0,04 |
| 113A | 542,2 | 705,6 | 0,71 | | **256.3** | SPLS 3_80 Ah All Cts | 441,0 | 542,2 | 657,6 | 0,58 |
| 113B | 542,2 | 705,6 | 0,49 | | **149.9** | SPLS 3_0,9_270 Ah All Cts_(bouv | 441,0 | 542,2 | 657,6 | 0,34 |
| 113C | 0,0 | 0,0 | 0,60 | | **208.4** | SPLS 3_270 Ah All Cts_(bouw) | 823,6 | 0,0 | 0,0 | 0,25 |
| 114A | 542,2 | 705,6 | 0,59 | | **184.6** | SPLS 3_270 Ah All Cts_(bouw) | 441,0 | 542,2 | 657,6 | 0,42 |
| 114B | 271,1 | 352,8 | 0,14 | | **47.4** | ULS 3_90 | 378,9 | 271,1 | 329,6 | 0,17 |
| 114C | 0,0 | 0,0 | 0,67 | | **164.8** | SPLS 3_270 Ah All Cts_(bouw) | 823,6 | 0,0 | 0,0 | 0,20 |
| 200 | 120,6 | 141,1 | 0,31 | | **23.5** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 152,2 | 120,6 | 106,8 | 0,22 |
| 201L | 406,7 | 529,2 | 0,05 | | **167.6** | ULS 3_80 | 355,4 | 406,7 | 493,6 | 0,47 |
| 201T | 188,2 | 176,4 | 0,16 | | **9.7** | ULS 6b_90_(afspannen)_12 | 152,6 | 188,2 | 160,4 | 0,06 |
| 202L | 271,1 | 282,2 | 0,65 | | **110.0** | ULS 6b_90_(afspannen)_12 | 246,8 | 271,1 | 263,7 | 0,45 |
| 202T | 271,1 | 282,2 | 0,41 | | **22.3** | ULS 8 Ba_(bouw) | 188,0 | 271,1 | 263,7 | 0,12 |
| 203T | 470,4 | 735,0 | 0,46 | | **146.6** | SPLS 3_80 Ah All Cts_(bouw) | 599,8 | 470,4 | 668,2 | 0,31 |
| 204L | 406,7 | 635,0 | 0,84 | | **298.9** | SPLS 3_0,9_80 Ba Ct2 | 575,5 | 406,7 | 592,3 | 0,73 |
| 204T | 406,7 | 635,0 | 0,80 | | **318.7** | SPLS 3_0,9_270 Ah All Cts_(bouv | 575,5 | 406,7 | 592,3 | 0,78 |
| 205 | 542,2 | 846,7 | 0,39 | | **190.9** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 522,0 | 542,2 | 789,1 | 0,37 |
| 206 | 60,3 | 58,8 | 0,00 | | **0.3** | ULS 3_0 | 62,7 | 60,3 | 44,5 | 0,01 |
| 207L | 406,7 | 635,0 | 0,67 | | **312.8** | SPLS 3_80 Ba Ct1 | 575,5 | 406,7 | 592,3 | 0,77 |
| 207T | 406,7 | 635,0 | 0,72 | | **296.9** | SPLS 3_270 Ah All Cts_(bouw) | 575,5 | 406,7 | 592,3 | 0,73 |
| 208L | 542,2 | 705,6 | 0,06 | | **184.1** | ULS 3_0 | 441,0 | 542,2 | 657,6 | 0,42 |
| 208T | 542,2 | 705,6 | 0,30 | | **79.4** | ULS 1a_90 | 441,0 | 542,2 | 657,6 | 0,18 |
| 209L | 406,7 | 635,0 | 0,83 | | **325.4** | SPLS 3_270 Ah All Cts_(bouw) | 575,5 | 406,7 | 592,3 | 0,80 |
| 209T | 406,7 | 635,0 | 0,75 | | **283.2** | SPLS 3_0,9_90 Ah Ct1 | 575,5 | 406,7 | 592,3 | 0,70 |
| 210T | 557,4 | 882,0 | 0,43 | | **153.4** | SPLS 3_80 Ba Ct2 | 408,7 | 557,4 | 801,8 | 0,38 |
| 211 | 542,2 | 846,7 | 0,43 | | **191.2** | SPLS 6a_90 Ah All Cts Ba Ct1_(bc | 575,5 | 542,2 | 789,1 | 0,35 |
| 212 | 60,3 | 70,6 | 0,00 | | **1.2** | ULS 3_0 | 75,3 | 60,3 | 53,4 | 0,02 |
| 213L | 542,2 | 987,8 | 0,71 | | **348.9** | SPLS 3_80 Ba Ct2 | 781,4 | 542,2 | 920,6 | 0,64 |
| 213T | 542,2 | 987,8 | 0,66 | | **338.5** | SPLS 3_0,9_80 Ba Ct1 | 781,4 | 542,2 | 920,6 | 0,62 |
| 214L | 271,1 | 352,8 | 0,32 | | **38.7** | SPLS 3_0,9_90 Ah All Cts | 378,9 | 271,1 | 329,6 | 0,14 |
| 214T | 271,1 | 352,8 | 0,34 | | **42.9** | SPLS 3_0,9_80 Ah All Cts | 378,9 | 271,1 | 329,6 | 0,16 |
| 215 | 94,1 | 117,6 | 0,20 | | **6.4** | ULS 1a_0,9_0,9_135 | 150,5 | 94,1 | 106,9 | 0,07 |
| 215L | 406,7 | 635,0 | 0,66 | | **264.8** | SPLS 3_80 Ba Ct2 | 678,2 | 406,7 | 592,3 | 0,65 |
| 215T | 406,7 | 635,0 | 0,66 | | **262.7** | SPLS 3_0,9_80 Ba Ct1 | 678,2 | 406,7 | 592,3 | 0,65 |
| 216 | 94,1 | 88,2 | 0,05 | | **0.0** | ULS 8 Ah 11_(bouw) | 112,9 | 94,1 | 80,2 | 0,00 |
| 216L | 542,2 | 846,7 | 0,68 | | **321.7** | SPLS 3_80 Ah All Cts_(bouw) | 678,2 | 542,2 | 789,1 | 0,59 |
| 216T | 542,2 | 846,7 | 0,69 | | **325.7** | SPLS 3_80 Ba Ct2 | 678,2 | 542,2 | 789,1 | 0,60 |
| 217L | 542,2 | 917,3 | 0,73 | | **397.4** | SPLS 3_80 Ba Ct2 | 681,4 | 542,2 | 854,8 | 0,73 |
| 217T | 542,2 | 917,3 | 0,75 | | **403.9** | SPLS 3_0,9_80 Ah All Cts_(bouw) | 681,4 | 542,2 | 854,8 | 0,75 |
| 218L | 677,8 | 1146,6 | 0,72 | | **478.1** | SPLS 3_80 Ah All Cts_(bouw) | 681,4 | 677,8 | 1068,0 | 0,71 |
| 218T | 677,8 | 1146,6 | 0,74 | | **498.1** | SPLS 3_270 Ah All Cts_(bouw) | 681,4 | 677,8 | 1068,0 | 0,74 |
| 300 | 188,2 | 176,4 | 0,51 | | **56.7** | SPLS 6a_90 Ah All Cts Ba Ct2 | 126,7 | 188,2 | 124,7 | 0,45 |
| 301 | 188,2 | 176,4 | 0,56 | | **67.5** | SPLS 3_0,9_80 Ah Ct2 | 126,7 | 188,2 | 124,7 | 0,54 |
| 302 | 188,2 | 176,4 | 0,54 | | **71.9** | SPLS 3_0,9_80 Ah Ct2 | 126,7 | 188,2 | 124,7 | 0,58 |
| 303 | 188,2 | 176,4 | 0,55 | | **78.1** | SPLS 3_0,9_80 Ah Ct2 | 126,7 | 188,2 | 124,7 | 0,63 |
| 304 | 188,2 | 176,4 | 0,54 | | **83.4** | SPLS 3_0,9_80 Ah Ct2 | 126,7 | 188,2 | 124,7 | 0,67 |
| 305 | 188,2 | 176,4 | 0,36 | | **33.9** | SPLS 3_0,9_90 Ah Ct2 | 106,3 | 188,2 | 124,7 | 0,32 |
| 306 | 188,2 | 176,4 | 0,30 | | **41.6** | SPLS 6a_90 Ah All Cts Ba Ct2 | 106,3 | 188,2 | 124,7 | 0,39 |
| 307 | 188,2 | 176,4 | 0,39 | | **47.4** | SPLS 6a_90 Ah All Cts Ba Ct2 | 106,3 | 188,2 | 124,7 | 0,45 |
| 308 | 188,2 | 176,4 | 0,44 | | **58.1** | SPLS 6a_90 Ah All Cts Ba Ct2 | 106,3 | 188,2 | 124,7 | 0,55 |
| 309 | 188,2 | 176,4 | 0,47 | | **62.8** | SPLS 3_0,9_80 Ah All Cts | 106,3 | 188,2 | 124,7 | 0,59 |
| 311 | 94,1 | 88,2 | 0,29 | | **26.4** | SPLS 3_0,9_80 Ah All Cts | 265,8 | 94,1 | 62,4 | 0,42 |
| 312 | 188,2 | 823,2 | 0,09 | | **86.6** | ULS 3_90 | 2203,0 | 188,2 | 748,4 | 0,46 |
| 313 | 135,6 | 141,1 | 0,42 | | **49.8** | SPLS 3_0,9_80 Ah Ct2 | 169,3 | 135,6 | 132,7 | 0,38 |
| 314 | 0,0 | 0,0 | 0,00 | | **0.0** | | 0,0 | 0,0 | 0,0 | 0,00 |
| 316 | 188,2 | 823,2 | 0,00 | | **85.8** | ULS 3_90 | 2203,0 | 188,2 | 748,4 | 0,46 |
| 319 | 188,2 | 176,4 | 0,04 | | **63.6** | ULS 6b_90_(afspannen)_11 | 128,1 | 188,2 | 160,4 | 0,50 |
| 320 | 94,1 | 88,2 | 0,76 | | **1.1** | ULS 8 Ah_(bouw) | 112,9 | 94,1 | 80,2 | 0,01 |
| 321 | 188,2 | 176,4 | 0,06 | | **89.6** | ULS 6b_90_(afspannen)_11 | 152,6 | 188,2 | 160,4 | 0,59 |
| 322 | 94,1 | 88,2 | 0,09 | | **1.1** | ULS 8 Ah_(bouw) | 112,9 | 94,1 | 80,2 | 0,01 |
| 323 | 60,3 | 70,6 | 0,04 | | **19.0** | ULS 6b_90_(afspannen)_10 | 75,3 | 60,3 | 53,4 | 0,36 |
| 324 | 60,3 | 58,8 | 0,10 | | **5.8** | ULS 1a_0 | 62,7 | 60,3 | 44,5 | 0,13 |
| 325 | 60,3 | 58,8 | 0,31 | | **10.3** | ULS 1a_0 | 62,7 | 60,3 | 44,5 | 0,23 |
| 326 | 60,3 | 70,6 | 0,10 | | **0.5** | ULS 7_(bouw) | 75,3 | 60,3 | 53,4 | 0,01 |
| 327 | 60,3 | 70,6 | 0,17 | | **7.9** | SPLS 3_80 Ah All Cts | 75,3 | 60,3 | 53,4 | 0,15 |
| 328 | 0,0 | 0,0 | 0,22 | | **6.4** | ULS 1a_0 | 170,4 | 0,0 | 0,0 | 0,04 |
| 329 | 0,0 | 0,0 | 0,03 | | **1.5** | ULS 1a_0 | 333,7 | 0,0 | 0,0 | 0,00 |
| 330 | 0,0 | 0,0 | 0,00 | | **0.0** | ULS 1a_0,9_0,9_100_(bouw) | 308,9 | 0,0 | 0,0 | 0,00 |
| 331 | 0,0 | 0,0 | 0,02 | | **0.3** | ULS 8 Ba 10_(bouw) | 170,4 | 0,0 | 0,0 | 0,00 |
| 400 | 406,7 | 529,2 | 0,18 | | **212.2** | ULS 6b_90_(afspannen)_12 | 416,2 | 406,7 | 336,9 | 0,63 |
| 401 | 60,3 | 58,8 | 0,15 | | **8.8** | ULS 1a_0 | 62,7 | 60,3 | 44,5 | 0,20 |
| 402 | 60,3 | 58,8 | 0,52 | | **26.4** | SPLS 3_80 Ah All Cts | 62,7 | 60,3 | 44,5 | 0,59 |

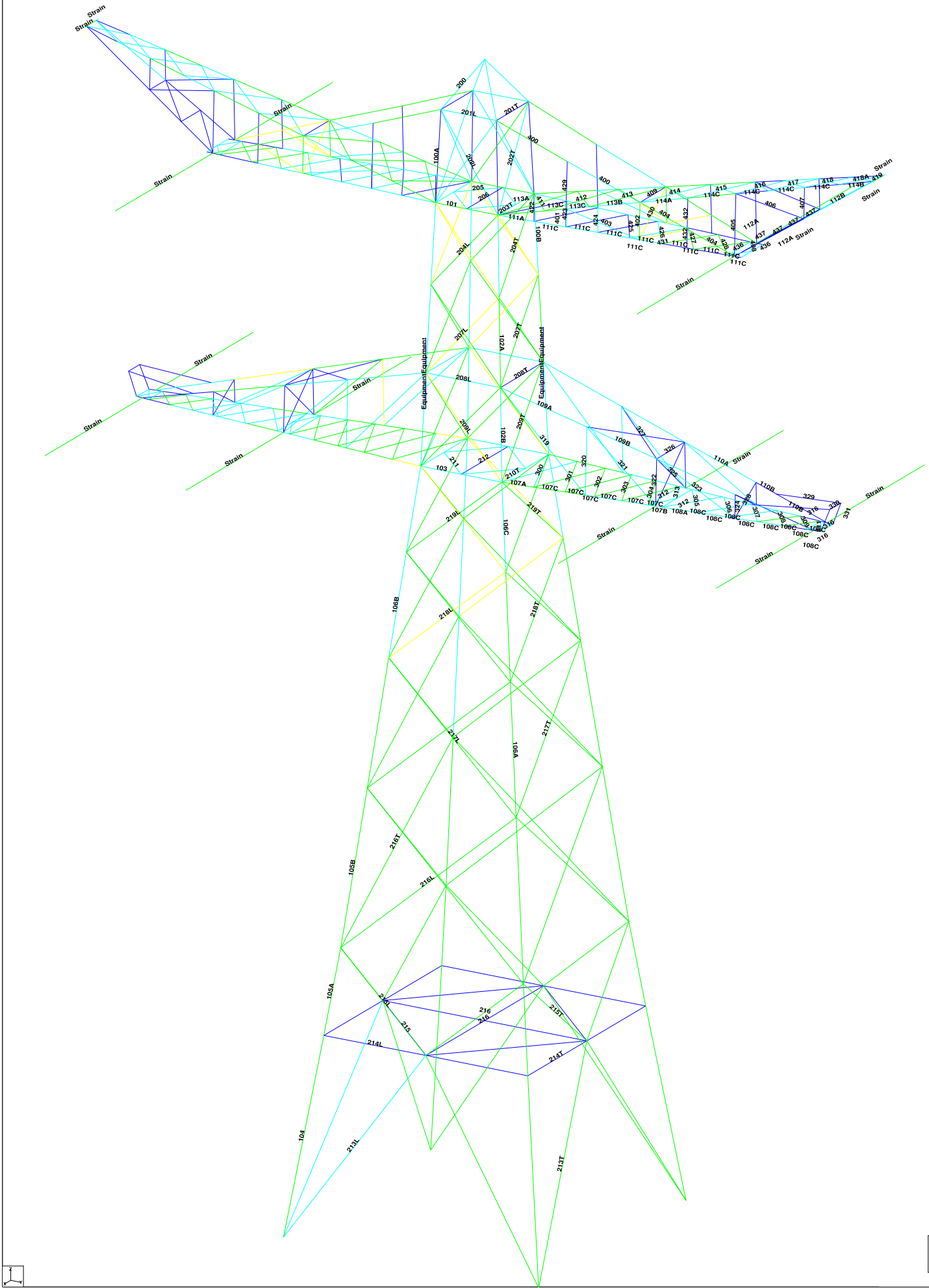
## Assessment of angle groups

Date 21-9-2021
Author BJT
Version 4.3

**GT-RLL**
**HA+0_n**

| Group Label | Description | Type | Profile | Steel Quali | Bolts | #sh. | ple1 | e2 | p1 | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | eedance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | ıring (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 403 | Tweede DWSRM - Vertical front | EA | 70x70x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 250 | **-13.3** | ULS 6b_90_(afspannen)_10 | 29.1 | 60.3 | 70.6 | 0.46 | | **8.1** | ULS 8 Ah_(bouw) | 75.3 | 60.3 | 53.4 | 0.15 |
| 404 | Tweede DWSRM - Vertical front | EA | 90x90x9 | S355 | 3M24-8.8t | 1 | 45 | 35 | 70 | 2.00 | 1.00 | 1.00 | 169 | **-4.2** | ULS 8 Ah 1_(bouw) | 119.8 | 406.7 | 476.3 | 0.03 | | **223.8** | ULS 6b_90_(afspannen)_12 | 279.4 | 406.7 | 444.2 | 0.80 |
| 405 | Tweede DWSRM - Diagonal front | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 228 | **-3.1** | SPLS 3_80 Ah All Cts | 28.7 | 60.3 | 70.6 | 0.11 | | **0.7** | ULS 8 Ba_(bouw) | 75.3 | 60.3 | 53.4 | 0.01 |
| 406 | Tweede DWSRM - Diagonal front | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 270 | **0.0** | ULS 8 Ah 1_(bouw) | 21.9 | 60.3 | 70.6 | 0.00 | | **4.8** | ULS 3_80 | 75.3 | 60.3 | 53.4 | 0.09 |
| 407 | Tweede DWSRM - Diagonal front | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 137 | **-4.3** | ULS 1a_0 | 41.6 | 60.3 | 58.8 | 0.10 | | **4.3** | ULS 1a_0 | 62.7 | 60.3 | 44.5 | 0.10 |
| 408 | Tweede DWSRM - under diag | EA | 60x60x6 | S355 | 2M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 93 | **-33.3** | SPLS 3_80 Ah Ct1 | 116.5 | 120.6 | 141.1 | 0.29 | | **21.2** | SPLS 3_0.9_80 Ah Ct1 | 106.5 | 120.6 | 106.8 | 0.20 |
| 409 | Tweede DWSRM - horiz on top | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 181 | **-4.3** | ULS 3_90 | 40.9 | 60.3 | 70.6 | 0.10 | | **0.2** | ULS 8 Ah_(bouw) | 75.3 | 60.3 | 53.4 | 0.00 |
| 411 | Tweede DWSRM - CD top | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 0.53 | 0.53 | 0.53 | 137 | **-38.4** | SPLS 3_90 Ah All Cts | 70.7 | 94.1 | 88.2 | 0.54 | | **38.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 112.9 | 94.1 | 80.2 | 0.48 |
| 412 | Tweede DWSRM - CD top | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 0.53 | 0.53 | 0.53 | 126 | **-44.1** | SPLS 6a_90 Ah All Cts Ba Ct2 | 78.0 | 94.1 | 88.2 | 0.57 | | **43.2** | SPLS 3_90 Ah All Cts | 112.9 | 94.1 | 80.2 | 0.54 |
| 413 | Tweede DWSRM - CD top | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 0.53 | 0.53 | 0.53 | 126 | **-53.9** | SPLS 3_80 Ah All Cts | 78.2 | 94.1 | 88.2 | 0.69 | | **54.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 112.9 | 94.1 | 80.2 | 0.68 |
| 414 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 163 | **-11.7** | SPLS 3_270 Ah All Cts_(bouw) | 33.0 | 60.3 | 58.8 | 0.35 | | **11.3** | SPLS 3_270 Ah All Cts_(bouw) | 152.9 | 60.3 | 44.5 | 0.26 |
| 415 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 154 | **-14.2** | SPLS 3_270 Ah All Cts_(bouw) | 35.8 | 60.3 | 58.8 | 0.40 | | **14.1** | SPLS 3_270 Ah All Cts_(bouw) | 152.9 | 60.3 | 44.5 | 0.32 |
| 416 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 115 | **-14.4** | SPLS 3_270 Ah All Cts_(bouw) | 51.7 | 60.3 | 58.8 | 0.28 | | **14.1** | SPLS 3_270 Ah All Cts_(bouw) | 152.9 | 60.3 | 44.5 | 0.32 |
| 417 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 116 | **-18.6** | SPLS 3_270 Ah All Cts_(bouw) | 51.1 | 60.3 | 58.8 | 0.36 | | **18.7** | SPLS 3_270 Ah All Cts_(bouw) | 152.9 | 60.3 | 44.5 | 0.42 |
| 418 | Tweede DWSRM - CD top | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 89 | **-25.2** | SPLS 3_80 Ah All Cts | 97.9 | 60.3 | 70.6 | 0.42 | | **24.4** | SPLS 3_270 Ah All Cts_(bouw) | 228.1 | 60.3 | 53.4 | 0.46 |
| 418A | Tweede DWSRM - CD top | EA | 60x60x6 | S355 | 2M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 82 | **-32.1** | SPLS 3_0.9_80 Ah All Cts_(bouw) | 104.8 | 120.6 | 141.1 | 0.31 | | **32.5** | SPLS 3_80 Ah All Cts | 106.5 | 120.6 | 106.8 | 0.31 |
| 419 | Tweede DWSRM - CD UNP top | UNP | UNP160 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 1.00 | 1.00 | 1.00 | 42 | **-0.2** | ULS 7_(bouw) | 398.0 | 94.1 | 110.3 | 0.00 | | **59.7** | ULS 3_0.9_90 | 141.1 | 94.1 | 100.2 | 0.63 |
| 422 | Tweede DWSRM - CD under 1 | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 124 | **-19.3** | SPLS 3_0.9_270 Ah All Cts_(bouw) | 79.9 | 94.1 | 88.2 | 0.24 | | **19.2** | SPLS 3_0.9_270 Ah All Cts_(bouw | 265.8 | 94.1 | 80.2 | 0.24 |
| 423 | Tweede DWSRM - CD under 2 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 115 | **-23.1** | SPLS 3_0.9_270 Ah All Cts_(bouw) | 87.2 | 188.2 | 176.4 | 0.26 | | **22.7** | SPLS 3_0.9_270 Ah All Cts_(bouw | 128.1 | 188.2 | 160.4 | 0.18 |
| 424 | Tweede DWSRM - CD under 3 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 110 | **-24.4** | SPLS 3_0.9_270 Ah All Cts_(bouw) | 91.8 | 188.2 | 176.4 | 0.27 | | **24.8** | SPLS 3_0.9_270 Ah All Cts_(bouw | 128.1 | 188.2 | 160.4 | 0.19 |
| 425 | Tweede DWSRM - CD under 4 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 105 | **-24.2** | SPLS 3_0.9_270 Ah All Cts_(bouw) | 96.6 | 188.2 | 176.4 | 0.25 | | **23.3** | SPLS 3_0.9_270 Ah All Cts_(bouw | 128.1 | 188.2 | 160.4 | 0.18 |
| 426 | Tweede DWSRM - CD under 5 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 100 | **-51.0** | SPLS 3_0.9_270 Ah All Cts_(bouw) | 101.6 | 188.2 | 176.4 | 0.50 | | **50.0** | SPLS 3_0.9_270 Ah All Cts_(bouw | 128.1 | 188.2 | 160.4 | 0.39 |
| 427 | Tweede DWSRM - CD under 6 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 96 | **-66.3** | SPLS 3_0.9_80 Ah All Cts | 106.7 | 188.2 | 176.4 | 0.62 | | **67.2** | SPLS 3_270 Ah All Cts_(bouw) | 128.1 | 188.2 | 160.4 | 0.53 |
| 428 | Tweede DWSRM - CD under 7 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 93 | **-74.5** | SPLS 3_270 Ah All Cts_(bouw) | 109.2 | 188.2 | 176.4 | 0.68 | | **70.4** | SPLS 3_0.9_270 Ah All Cts_(bouw | 128.1 | 188.2 | 160.4 | 0.55 |
| 429 | Tweede DWSRM - CD under 8 | EA | 70x70x7 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 148 | **-8.8** | ULS 1a_0 | 73.7 | 60.3 | 82.3 | 0.15 | | **8.8** | ULS 1a_0 | 87.8 | 60.3 | 62.3 | 0.15 |
| 430 | 2e DWSRM diag verband | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 122 | **-38.2** | SPLS 3_80 Ah All Cts | 69.3 | 60.3 | 70.6 | 0.63 | | **41.5** | SPLS 6a_90 Ah All Cts Ba Ct2 | 75.3 | 60.3 | 53.4 | 0.78 |
| 431 | 2e DWSRM knieksteun | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 238 | **-16.3** | ULS 6b_90_(afspannen)_12 | 18.6 | 60.3 | 58.8 | 0.88 | | **3.5** | ULS 8 Ah 12_(bouw) | 152.9 | 60.3 | 44.5 | 0.08 |
| 432 | 2e DWSRM knieksteun | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.60 | 1.00 | 1.00 | 141 | **-5.9** | ULS 1a_0 | 32.0 | 60.3 | 58.8 | 0.18 | | **5.9** | ULS 1a_0 | 152.9 | 60.3 | 44.5 | 0.13 |
| 436 | Tweede DWSRM - Horizontal under | DEA | 150x150x14 (not co | S355 | 3M20-8.8t | 1 | 45 | 35 | 70 | 1.00 | 2.00 | 1.00 | 38 | **-1.4** | ULS 1a_22S_(bouw) | 2147.5 | 282.2 | 1234.8 | 0.01 | | **97.7** | ULS 3_90 | 2203.0 | 282.2 | 1122.5 | 0.35 |
| 437 | Tweede DWSRM - diagonaal kattenoor | EA | 55x55x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 222 | **-6.0** | ULS 6b_90_(afspannen)_12 | 26.0 | 60.3 | 70.6 | 0.23 | | **7.6** | ULS 6b_90_(afspannen)_10 | 75.3 | 60.3 | 53.4 | 0.14 |

DNV GL Nederlands BV, Project: "D1.3.2 Circuit HA+5 - dnv gl-ini"
Tower Version 16.65, 14:05:00 dinsdag 21 september 2021
Undeformed geometry displayed



DNV

## Assessment of angle groups

Date 21-9-2021
Author BJT
Version 4,3

**GT-RLL**
**HA+5_n**

| Group Label | Description | Type | Profile | Steel Qual | Bolts | #sh.pl | e1 | e2 | p1 | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | eedance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | ring (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100A | BVNSTK - Main member | EA | 120x120x12 | S355 | | 1 | 35 | 25 | 55 | 0,51 | 0,51 | 0,51 | 87 | -126,5 | ULS 6b_90_(afspannen)_12 | 558,4 | 0,0 | 0,0 | 0,23 | | 61,3 | ULS 6b_90_(afspannen)_12 | 976,3 | 0,0 | 0,0 | 0,06 |
| 100B | BVNSTK - Main member | EA | 120x120x12 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 78 | -218,4 | ULS 6b_90_(afspannen)_12 | 635,9 | 813,3 | 1270,1 | 0,34 | | 136,8 | SPLS 3_0,9_80 Ah Ct1 | 750,1 | 813,3 | 1194,1 | 0,18 |
| 101 | BVNSTK - Horizontal front (cross profil | EA | 160x160x15 | S355 | 10M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 59 | -641,2 | SPLS 3_80 Ah All Cts | 1300,4 | 1253,9 | 2646,0 | 0,51 | | 517,9 | SPLS 3_0,9_80 Ah All Cts | 916,5 | 1253,9 | 2462,0 | 0,57 |
| 102A | Derde TSNSTK - Main member | EA | 160x160x15 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 63 | -457,3 | SPLS 3_90 Ah All Cts | 1261,4 | 813,3 | 1587,6 | 0,56 | | 348,1 | SPLS 3_0,9_80 Ah All Cts | 1372,7 | 813,3 | 1492,6 | 0,43 |
| 102B | Derde TSNSTK - Main member | EA | 160x160x15 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 66 | -506,3 | SPLS 3_90 Ah All Cts | 1222,7 | 1084,4 | 2116,8 | 0,47 | | 363,0 | SPLS 3_0,9_90 Ah All Cts | 1372,7 | 1084,4 | 1990,2 | 0,33 |
| 103 | Derde TSNSTK - Horizontal front (cross | EA | 180x180x16 | S355 | 13M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 69 | -582,2 | SPLS 3_80 Ah All Cts | 1409,8 | 1541,9 | 3669,1 | 0,41 | | 397,6 | SPLS 3_0,9_80 Ah All Cts | 1097,0 | 1541,9 | 3413,2 | 0,36 |
| 104 | BRKSTK - Main member | EA | 200x200x20 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,17 | 0,17 | 0,17 | 38 | -1671,0 | SPLS 1a_90 Ah All Cts | 2462,4 | 3199,0 | 4233,6 | 0,68 | | 1383,7 | SPLS 1a_0,9_90 Ah All Cts | 2328,5 | 3199,0 | 3980,3 | 0,59 |
| 105A | Eerste TSNSTK - Main member | EA | 200x200x20 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,50 | 0,50 | 0,50 | 48 | -1659,1 | SPLS 1a_90 Ah All Cts | 2313,8 | 3199,0 | 4233,6 | 0,72 | | 1389,7 | SPLS 1a_0,9_90 Ah All Cts | 2328,5 | 3199,0 | 3980,3 | 0,60 |
| 105B | Eerste TSNSTK - Main member | EA | 200x200x20 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 47 | -1630,6 | SPLS 3_90 Ah All Cts | 2326,6 | 3199,0 | 4233,6 | 0,70 | | 1353,4 | SPLS 3_0,9_90 Ah All Cts | 2328,5 | 3199,0 | 3980,3 | 0,58 |
| 106A | Tweede TSNSTK - Main member | EA | 200x200x18 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 39 | -1339,3 | SPLS 3_90 Ah All Cts | 2214,7 | 2711,0 | 3175,2 | 0,60 | | 1109,5 | SPLS 3_0,9_90 Ah All Cts | 2107,6 | 2711,0 | 2985,2 | 0,53 |
| 106B | Tweede TSNSTK - Main member | EA | 200x200x18 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 31 | -1244,7 | SPLS 3_90 Ah All Cts | 2300,1 | 2711,0 | 3175,2 | 0,54 | | 1001,5 | SPLS 3_0,9_90 Ah All Cts | 2107,6 | 2711,0 | 2985,2 | 0,48 |
| 106C | Tweede TSNSTK - Main member | EA | 200x200x18 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 26 | -832,0 | SPLS 3_90 Ah All Cts | 2363,0 | 2711,0 | 3175,2 | 0,35 | | 646,4 | SPLS 3_0,9_90 Ah All Cts | 2107,6 | 2711,0 | 2985,2 | 0,31 |
| 107A | Eerste DWSRM - Main member bottom : | EA | 160x160x15 | S355 | 10M24-8,8t | 1 | 55 | 40 | 80 | 2,90 | 1,00 | 1,00 | 83 | -795,8 | SPLS 6a_90 Ah All Cts Ba Ct1_(bouw | 1000,7 | 1253,9 | 2646,0 | 0,80 | | 542,6 | SPLS 3_0,9_80 Ah Ct2 | 916,5 | 1253,9 | 2462,0 | 0,59 |
| 107B | Eerste DWSRM - Main member bottom : | EA | 180x180x16 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 11,67 | 2,00 | 1,00 | 64 | -423,6 | SPLS 6a_90 Ah All Cts Ba Ct1_(bouw | 1481,9 | 1084,4 | 2257,9 | 0,39 | | 275,9 | SPLS 3_0,9_80 Ah Ct2 | 1661,0 | 1084,4 | 2122,8 | 0,25 |
| 107C | Eerste DWSRM - Main member bottom : | EA | 160x160x15 | S355 | | | | | | 2,90 | 1,00 | 1,00 | 83 | -749,8 | SPLS 6a_90 Ah All Cts Ba Ct1_(bouw | 1002,4 | 0,0 | 0,0 | 0,75 | | 497,0 | SPLS 3_0,9_80 Ah Ct2 | 1658,2 | 0,0 | 0,0 | 0,30 |
| 108A | Eerste DWSRM - Main member bottom ; | EA | 150x150x12 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 2,50 | 1,00 | 1,00 | 82 | -409,8 | SPLS 6a_90 Ah All Cts Ba Ct1_(bouw | 759,1 | 1084,4 | 1693,4 | 0,54 | | 253,3 | SPLS 3_0,9_80 Ah Ct2 | 1007,6 | 1084,4 | 1592,1 | 0,25 |
| 108C | Eerste DWSRM - Main member bottom ; | EA | 150x150x12 | S355 | | | | | | 2,50 | 1,00 | 1,00 | 74 | -368,2 | SPLS 6a_90 Ah All Cts Ba Ct1_(bouw | 841,6 | 0,0 | 0,0 | 0,44 | | 236,4 | SPLS 3_0,9_80 Ah Ct2 | 1235,4 | 0,0 | 0,0 | 0,19 |
| 109A | Eerste DWSRM - Main member top 1 | EA | 110x110x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 0,90 | 167 | -23,5 | ULS 8 Ah_(bouw) | 174,8 | 542,2 | 705,6 | 0,13 | | 207,7 | ULS 6b_90_(afspannen)_10 | 396,5 | 542,2 | 657,6 | 0,52 |
| 109B | Eerste DWSRM - Main member top 1 | EA | 110x110x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 150 | -18,8 | ULS 8 Ah_(bouw) | 202,8 | 542,2 | 705,6 | 0,09 | | 199,9 | ULS 6b_90_(afspannen)_10 | 340,8 | 542,2 | 657,6 | 0,59 |
| 110A | Eerste DWSRM - Main member top 2 | EA | 100x100x8 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 186 | -15,9 | ULS 8 Ah_(bouw) | 109,6 | 542,2 | 564,5 | 0,14 | | 184,7 | ULS 6b_90_(afspannen)_10 | 242,8 | 542,2 | 526,0 | 0,76 |
| 110B | Eerste DWSRM - Main member top 2 | EA | 100x100x8 | S355 | | 1 | 55 | 40 | 80 | 1,50 | 1,50 | 1,50 | 199 | -15,5 | ULS 8 Ah_(bouw) | 99,6 | 0,0 | 0,0 | 0,16 | | 185,5 | ULS 6b_90_(afspannen)_10 | 550,3 | 0,0 | 0,0 | 0,34 |
| 111A | Tweede DWSRM - Main member bottom | EA | 150x150x12 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 1,89 | 1,00 | 1,00 | 67 | -428,3 | SPLS 6a_90 Ah All Cts Ba Ct1_(bouw | 902,2 | 1039,2 | 1693,4 | 0,47 | | 273,8 | SPLS 3_0,9_270 Ah All Cts_(bouw | 678,2 | 1039,2 | 1576,1 | 0,40 |
| 111C | Tweede DWSRM - Main member bottom | EA | 150x150x12 | S355 | | | | | | 10,07 | 4,54 | 1,00 | 94 | -339,0 | SPLS 6a_90 Ah All Cts Ba Ct1_(bouw | 635,0 | 0,0 | 0,0 | 0,53 | | 253,1 | SPLS 3_0,9_270 Ah All Cts_(bouw | 1235,4 | 0,0 | 0,0 | 0,20 |
| 112A | Tweede DWSRM - Main member under r | EA | 100x100x8 | S355 | | 1 | | | | 1,00 | 1,00 | 1,00 | 96 | -50,0 | ULS 6b_90_(afspannen)_1 | 255,2 | 0,0 | 0,0 | 0,20 | | 7,2 | ULS 1a_0,9_0,9_80 | 550,3 | 0,0 | 0,0 | 0,01 |
| 112B | Tweede DWSRM - Main member under r | EA | 100x100x8 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 191 | -42,4 | ULS 6b_90_(afspannen)_1 | 105,3 | 271,1 | 282,2 | 0,40 | | 11,0 | ULS 1a_0,9_0,9_80 | 246,8 | 271,1 | 263,7 | 0,04 |
| 113A | Tweede DWSRM - Main member top 1 | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,46 | 1,00 | 1,00 | 92 | -286,6 | SPLS 3_80 Ah All Cts | 395,5 | 542,2 | 705,6 | 0,72 | | 260,8 | SPLS 3_80 Ah All Cts | 441,0 | 542,2 | 657,6 | 0,59 |
| 113B | Tweede DWSRM - Main member top 1 | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,56 | 1,00 | 1,00 | 100 | -169,7 | SPLS 3_0,9_80 Ah All Cts_(bouw) | 343,8 | 542,2 | 705,6 | 0,49 | | 149,9 | SPLS 3_0,9_270 Ah All Cts_(bouw | 441,0 | 542,2 | 657,6 | 0,34 |
| 113C | Tweede DWSRM - Main member top 1 | EA | 120x120x10 | S355 | | | | | | 3,18 | 2,08 | 1,00 | 87 | -238,2 | SPLS 3_0,9_80 Ah All Cts | 396,3 | 0,0 | 0,0 | 0,60 | | 209,4 | SPLS 3_80 Ah All Cts | 823,6 | 0,0 | 0,0 | 0,25 |
| 114A | Tweede DWSRM - Main member top 2 | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,82 | 1,00 | 1,00 | 111 | -183,5 | SPLS 3_0,9_80 Ah All Cts | 309,4 | 542,2 | 705,6 | 0,59 | | 185,5 | SPLS 3_80 Ah All Cts | 441,0 | 542,2 | 657,6 | 0,42 |
| 114B | Tweede DWSRM - Main member top 2 | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,53 | 1,00 | 1,00 | 67 | -39,2 | SPLS 3_0,9_80 Ah All Cts | 491,5 | 271,1 | 352,8 | 0,14 | | 47,8 | ULS 3_90 | 726,8 | 271,1 | 331,7 | 0,18 |
| 114C | Tweede DWSRM - Main member top 2 | EA | 120x120x10 | S355 | | | | | | 2,22 | 1,00 | 1,00 | 135 | -164,6 | SPLS 3_0,9_80 Ah All Cts | 243,3 | 0,0 | 0,0 | 0,68 | | 165,7 | SPLS 3_80 Ah All Cts | 823,6 | 0,0 | 0,0 | 0,20 |
| 200 | BVNSTK - Top cap | EA | 80x80x6 | S355 | 2M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 171 | -23,6 | SPLS 3_0,9_80 Ah All Cts_(bouw) | 75,5 | 120,6 | 141,1 | 0,31 | | 23,5 | SPLS 3_0,9_80 Ah All Cts_(bouw) | 152,2 | 120,6 | 106,8 | 0,22 |
| 201L | BVNSTK - Horizontal front | EA | 100x100x10 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 133 | -10,8 | ULS 8 Ba 12 | 216,2 | 406,7 | 529,2 | 0,05 | | 167,6 | ULS 3_80 | 355,4 | 406,7 | 493,6 | 0,47 |
| 201T | BVNSTK - Horizontal side | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 1,00 | 1,00 | 164 | -10,2 | ULS 6b_90_(afspannen)_12 | 80,3 | 188,2 | 176,4 | 0,13 | | 9,7 | ULS 6b_90_(afspannen)_12 | 152,6 | 188,2 | 160,4 | 0,06 |
| 202L | BVNSTK - CD front | EA | 100x100x8 | S355 | 2M24-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 129 | -118,5 | ULS 6b_90_(afspannen)_12 | 182,1 | 271,1 | 282,2 | 0,65 | | 110,0 | ULS 6b_90_(afspannen)_12 | 246,8 | 271,1 | 263,7 | 0,45 |
| 202T | BVNSTK - CD side | EA | 80x80x8 | S355 | 2M24-8,8t | 1 | 45 | 35 | 70 | 1,00 | 0,52 | 0,52 | 200 | -41,7 | ULS 6b_90_(afspannen)_12 | 101,5 | 271,1 | 282,2 | 0,41 | | 22,3 | ULS 8 Ba_(bouw) | 188,0 | 271,1 | 263,7 | 0,12 |
| 203T | BVNSTK - Horizontal side | EA | 100x100x10 | S355 | 5M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 2,00 | 1,00 | 96 | -138,0 | SPLS 3_80 Ah All Cts_(bouw) | 298,2 | 470,4 | 735,0 | 0,46 | | 146,4 | SPLS 3_80 Ah All Cts_(bouw) | 599,8 | 470,4 | 668,2 | 0,31 |
| 204L | BVNSTK - CD front | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 95 | -347,7 | SPLS 3_80 Ba Ct1 | 497,1 | 406,7 | 635,0 | 0,86 | | 303,6 | SPLS 3_0,9_80 Ba Ct2 | 575,5 | 406,7 | 592,3 | 0,75 |
| 204T | BVNSTK - CD side | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 95 | -326,4 | SPLS 3_270 Ah All Cts_(bouw) | 497,1 | 406,7 | 635,0 | 0,80 | | 318,5 | SPLS 3_0,9_270 Ah All Cts_(bouw | 575,5 | 406,7 | 592,3 | 0,78 |
| 205 | BVNSTK - Diagonal for crossarm diaphra | EA | 120x120x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 88 | -190,2 | SPLS 3_0,9_80 Ah All Cts_(bouw) | 492,2 | 542,2 | 846,7 | 0,39 | | 190,6 | SPLS 3_0,9_80 Ah All Cts_(bouw) | 522,0 | 542,2 | 789,1 | 0,37 |
| 206 | BVNSTK - CD for crossarm diaphragm | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,50 | 0,50 | 0,50 | 150 | 0,0 | ULS 8 Ah 10 | 36,9 | 60,3 | 58,8 | 0,00 | | 0,3 | ULS 3_0 | 62,7 | 60,3 | 44,5 | 0,01 |
| 207L | Derde TSNSTK - CD front | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 104 | -278,3 | SPLS 3_0,9_80 Ba Ct2 | 455,2 | 406,7 | 635,0 | 0,68 | | 317,2 | SPLS 3_80 Ba Ct1 | 575,5 | 406,7 | 592,3 | 0,78 |
| 207T | Derde TSNSTK - CD side | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 104 | -291,0 | SPLS 3_0,9_270 Ah All Cts_(bouw) | 455,2 | 406,7 | 635,0 | 0,72 | | 296,5 | SPLS 3_270 Ah All Cts_(bouw) | 575,5 | 406,7 | 592,3 | 0,73 |
| 208L | Derde TSNSTK - Horizontal front | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 148 | -12,6 | ULS 8 Ba 12 | 228,3 | 542,2 | 705,6 | 0,06 | | 183,6 | ULS 3_0 | 441,0 | 542,2 | 657,6 | 0,42 |
| 208T | Derde TSNSTK - Horizontal side | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 148 | -62,4 | ULS 1a_0,9_90 | 228,3 | 542,2 | 705,6 | 0,27 | | 70,6 | ULS 1a_90 | 441,0 | 542,2 | 657,6 | 0,16 |
| 209L | Derde TSNSTK - CD front | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 111 | -337,7 | SPLS 3_90 Ah Ct1 | 422,6 | 406,7 | 635,0 | 0,83 | | 322,3 | SPLS 3_270 Ah All Cts_(bouw) | 575,5 | 406,7 | 592,3 | 0,79 |
| 209T | Derde TSNSTK - CD side | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 111 | -303,6 | SPLS 3_270 Ah All Cts_(bouw) | 422,6 | 406,7 | 635,0 | 0,75 | | 282,6 | SPLS 3_0,9_90 Ah Ct1 | 575,5 | 406,7 | 592,3 | 0,70 |
| 210T | Derde TSNSTK - Horizontal side | EA | 120x120x10 | S355 | 6M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 2,00 | 1,00 | 104 | -138,1 | SPLS 3_80 Ba Ct1 | 332,9 | 557,4 | 882,0 | 0,41 | | 179,8 | SPLS 3_80 Ba Ct1 | 408,7 | 557,4 | 801,8 | 0,44 |
| 211 | Derde TSNSTK - Diagonal for crossarm ( | EA | 130x130x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 106 | -192,5 | SPLS 3_270 Ah All Cts_(bouw) | 444,9 | 542,2 | 846,7 | 0,43 | | 192,4 | SPLS 6a_90 Ah All Cts Ba Ct1_(bc | 575,5 | 542,2 | 789,1 | 0,35 |
| 212 | Derde TSNSTK - CD for crossarm diaphr | EA | 55x55x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,50 | 0,50 | 0,50 | 179 | 0,0 | | 35,9 | 60,3 | 70,6 | 0,00 | | 1,7 | ULS 3_90 | 75,3 | 60,3 | 53,4 | 0,03 |
| 213L | BRKSTK - Main diagonal | EA | 150x150x14 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,20 | 0,20 | 0,20 | 71 | -310,1 | SPLS 3_80 Ah All Cts_(bouw) | 847,5 | 542,2 | 987,8 | 0,57 | | 273,0 | SPLS 3_80 Ba Ct2 | 781,4 | 542,2 | 920,6 | 0,50 |
| 213T | BRKSTK - Main diagonal | EA | 150x150x14 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,20 | 0,20 | 0,20 | 71 | -281,5 | SPLS 3_80 Ba Ct2 | 847,5 | 542,2 | 987,8 | 0,52 | | 263,9 | SPLS 3_0,9_80 Ba Ct1 | 781,4 | 542,2 | 920,6 | 0,49 |
| 214L | BRKSTK - Diaphragm horizontal | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 202 | -10,0 | SPLS 3_90 Ah All Cts | 145,2 | 271,1 | 352,8 | 0,07 | | 2,0 | ULS 1a_0,9_0,9_225_(bouw) | 378,9 | 271,1 | 329,6 | 0,01 |
| 214T | BRKSTK - Diaphragm horizontal | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 202 | -12,8 | SPLS 3_80 Ah All Cts | 145,2 | 271,1 | 352,8 | 0,09 | | 3,8 | ULS 1a_0,9_0,9_45 | 378,9 | 271,1 | 329,6 | 0,01 |
| 215 | BRKSTK - Diaphragm diagonal | EA | 100x100x8 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 0,50 | 0,50 | 220 | -5,3 | ULS 1a_0,9_0,9_45 | 57,2 | 94,1 | 117,6 | 0,09 | | 4,6 | ULS 1a_0,9_135 | 150,5 | 94,1 | 106,9 | 0,05 |
| 215L | Eerste TSNSTK - First diag from bottom | EA | 150x150x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 123 | -248,1 | SPLS 3_80 Ah All Cts_(bouw) | 408,9 | 406,7 | 635,0 | 0,61 | | 219,7 | SPLS 3_80 Ba Ct2 | 678,2 | 406,7 | 592,3 | 0,54 |
| 215T | Eerste TSNSTK - First diag from bottom | EA | 150x150x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,52 | 0,52 | 123 | -224,5 | SPLS 3_80 Ba Ct2 | 408,9 | 406,7 | 635,0 | 0,55 | | 212,4 | SPLS 3_0,9_80 Ba Ct1 | 678,2 | 406,7 | 592,3 | 0,52 |
| 216 | BRKSTK - Diaphragm CD | EA | 100x100x8 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,50 | 0,50 | 0,50 | 243 | -0,7 | SPLS 3_270 Ah All Cts_(bouw) | 58,0 | 94,1 | 117,6 | 0,01 | | 0,0 | | 150,5 | 94,1 | 106,9 | 0,00 |
| 216L | Eerste TSNSTK - First CD from bottom | EA | 150x150x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 126 | -273,4 | SPLS 3_80 Ba Ct2 | 399,8 | 542,2 | 846,7 | 0,68 | | 284,9 | SPLS 3_0,9_80 Ba Ct1 | 678,2 | 542,2 | 789,1 | 0,53 |
| 216T | Eerste TSNSTK - First CD from bottom | EA | 150x150x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 126 | -271,0 | SPLS 3_80 Ba Ct1 | 399,8 | 542,2 | 846,7 | 0,68 | | 271,2 | SPLS 3_270 Ah All Cts_(bouw) | 678,2 | 542,2 | 789,1 | 0,50 |
| 217L | Tweede TSNSTK - First CD from bottom | EA | 140x140x13 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 110 | -348,4 | SPLS 3_0,9_80 Ba Ct1 | 474,1 | 542,2 | 917,3 | 0,73 | | 329,1 | SPLS 3_80 Ba Ct2 | 681,4 | 542,2 | 854,8 | 0,61 |
| 217T | Tweede TSNSTK - First CD from bottom | EA | 140x140x13 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 110 | -334,3 | SPLS 3_270 Ah All Cts_(bouw) | 474,1 | 542,2 | 917,3 | 0,71 | | 327,8 | SPLS 3_0,9_80 Ba Ct1 | 681,4 | 542,2 | 854,8 | 0,60 |
| 218L | Tweede TSNSTK - Second CD from botto | EA | 140x140x13 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 89 | -401,7 | SPLS 3_80 Ba Ct2 | 585,1 | 542,2 | 917,3 | 0,74 | | 419,4 | SPLS 3_0,9_80 Ba Ct1 | 681,4 | 542,2 | 854,8 | 0,77 |
| 218T | Tweede TSNSTK - Second CD from botto | EA | 140x140x13 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 89 | -402,3 | SPLS 3_80 Ba Ct1 | 585,1 | 542,2 | 917,3 | 0,74 | | 404,5 | SPLS 3_270 Ah All Cts_(bouw) | 681,4 | 542,2 | 854,8 | 0,75 |
| 219L | Tweede TSNSTK - Third CD from bottom | EA | 140x140x13 | S355 | 5M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 73 | -512,1 | SPLS 3_0,9_80 Ba Ct1 | 692,7 | 677,8 | 1146,6 | 0,76 | | 485,6 | SPLS 3_80 Ba Ct2 | 681,4 | 677,8 | 1068,0 | 0,72 |
| 219T | Tweede TSNSTK - Third CD from bottom | EA | 140x140x13 | S355 | 5M24-8,8t | 1 | 55 | 40 | 80 | 0,28 | 0,56 | 0,28 | 73 | -494,3 | SPLS 3_270 Ah All Cts_(bouw) | 692,7 | 677,8 | 1146,6 | 0,73 | | 488,4 | SPLS 3_80 Ba Ct1 | 681,4 | 677,8 | 1068,0 | 0,72 |
| 300 | Eerste DWSRM CD 1 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 128 | -56,2 | SPLS 3_0,9_80 Ah All Cts | 111,3 | 188,2 | 176,4 | 0,51 | | 60,1 | SPLS 3_0,9_80 Ah All Cts | 126,7 | 188,2 | 124,7 | 0,48 |
| 301 | Eerste DWSRM CD 2 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 120 | -69,9 | SPLS 3_0,9_80 Ah Ct2 | 121,0 | 188,2 | 176,4 | 0,58 | | 66,7 | SPLS 3_0,9_80 Ah Ct2 | 126,7 | 188,2 | 124,7 | 0,53 |
| 302 | Eerste DWSRM CD 3 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 110 | -71,9 | SPLS 3_0,9_80 Ah Ct2 | 133,0 | 188,2 | 176,4 | 0,54 | | 73,5 | SPLS 3_0,9_80 Ah Ct2 | 126,7 | 188,2 | 124,7 | 0,59 |
| 303 | Eerste DWSRM CD 4 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 102 | -80,7 | SPLS 3_0,9_80 Ah Ct2 | 145,5 | 188,2 | 176,4 | 0,55 | | 79,1 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 126,7 | 188,2 | 124,7 | 0,63 |
| 304 | Eerste DWSRM CD 5 under | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 95 | -85,9 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 156,7 | 188,2 | 176,4 | 0,55 | | 84,5 | SPLS 3_0,9_80 Ah Ct2 | 126,7 | 188,2 | 124,7 | 0,68 |
| 305 | Eerste DWSRM CD 6 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,52 | 0,52 | 0,52 | 102 | -36,4 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 99,6 | 188,2 | 176,4 | 0,37 | | 34,4 | SPLS 3_0,9_80 Ah Ct2 | 106,3 | 188,2 | 124,7 | 0,32 |
| 306 | Eerste DWSRM CD 7 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,53 | 0,53 | 0,53 | 91 | -42,3 | SPLS 3_0,9_80 Ah Ct2 | 139,5 | 188,2 | 176,4 | 0,30 | | 41,9 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 106,3 | 188,2 | 124,7 | 0,39 |
| 307 | Eerste DWSRM CD 8 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 84 | -46,9 | SPLS 6a_90 Ah All Cts Ba Ct2 | 120,4 | 188,2 | 176,4 | 0,39 | | 47,7 | SPLS 3_0,9_80 Ah All Cts | 106,3 | 188,2 | 124,7 | 0,45 |
| 308 | Eerste DWSRM CD 9 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 74 | -58,8 | SPLS 3_0,9_80 Ah All Cts | 133,2 | 188,2 | 176,4 | 0,44 | | 58,2 | SPLS 6a_90 Ah All Cts Ba Ct2 | 106,3 | 188,2 | 124,7 | 0,55 |
| 309 | Eerste DWSRM CD 10 under | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 65 | -67,3 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 143,0 | 188,2 | 176,4 | 0,47 | | 63,6 | SPLS 3_0,9_80 Ah All Cts | 106,3 | 188,2 | 124,7 | 0,60 |
| 311 | Eerste DWSRM CD 12 under | EA | 70x70x6 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,55 | 0,55 | 0,55 | 49 | -26,3 | SPLS 3_80 Ah Ct1 | 156,8 | 94,1 | 88,2 | 0,30 | | 27,0 | SPLS 3_0,9_80 Ah All Cts | 265,8 | 94,1 | 62,4 | 0,43 |
| 312 | Eerste DWSRM 2&3 horiz under | DEA | 150x150x14 (not co | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 2,00 | 1,00 | 52 | -17,3 | SPLS 3_0,9_90 Ah Ct2 | 1924,3 | 188,2 | 823,2 | 0,09 | | 87,6 | ULS 3_90 | 2203,0 | 188,2 | 748,4 | 0,47 |
| 313 | Eerste DWSRM Diag between horiz 4&5 | EA | 80x80x8 | S355 | 1M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 89 | -57,9 | SPLS 6a_90 Ah Ct2 Ba Ct2 | 173,4 | 135,6 | 141,1 | 0,43 | | 50,5 | SPLS 3_0,9_80 Ah Ct2 | 169,3 | 135,6 | 132,7 | 0,38 |
| 314 | Eerste DWSRM Horiz 3&4 | HEA | HEA160 | S355 | | 1 | 45 | 35 | 70 | 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 |
| 316 | Eerste DWSRM horiz 6&7 | DEA | 150x150x14 (not co | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 1,00 | 1,00 | 38 | -0,1 | ULS 8 Ah_(bouw) | 2235,4 | 188,2 | 823,2 | 0,00 | | 86,6 | ULS 3_90 | 2203,0 | 188,2 | 748,4 | 0,46 |
| 319 | 1ste DWSRM front bracing 1 | EA | 70x70x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,35 | 1,00 | 0,35 | 261 | -1,1 | ULS 8 Ah_(bouw) | 32,8 | 188,2 | 176,4 | 0,03 | | 63,6 | ULS 6b_90_(afspannen)_11 | 128,1 | 188,2 | 160,4 | 0,50 |
| 320 | 1ste DWSRM front bracing 2 | EA | 70x70x6 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,60 | 1,00 | 0,60 | 136 | -43,1 | ULS 6b_90_(afspannen)_11 | 56,5 | 94,1 | 88,2 | 0,76 | | 1,2 | ULS 8 Ah_(bouw) | 112,9 | 94,1 | 80,2 | 0,01 |
| 321 | 1ste DWSRM front bracing 3 | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 0,60 | 1,00 | 0,60 | 172 | -2,7 | ULS 8 Ah_(bouw) | 48,8 | 188,2 | 176,4 | 0,06 | | 89,6 | ULS 6b_90_(afspannen)_11 | 152,6 | 188,2 | 160,4 | 0,59 |
| 322 | 1ste DWSRM front bracing 4 | EA | 70x70x6 | S355 | 1M20-8,8t | 1 | 45 | 35 | 70 | 0,50 | 1,00 | 0,50 | 94 | -7,5 | SPLS 3_80 Ah Ct1 | 83,7 | 94,1 | 88,2 | 0,09 | | 1,0 | ULS 8 Ah_(bouw) | 112,9 | 94,1 | 80,2 | 0,01 |
| 323 | 1ste DWSRM front bracing 5 | EA | 70x70x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,50 | 1,00 | 0,50 | 190 | -1,4 | ULS 8 Ba 10 | 36,9 | 60,3 | 70,6 | 0,04 | | 19,0 | ULS 6b_90_(afspannen)_10 | 75,3 | 60,3 | 53,4 | 0,36 |
| 324 | 1ste DWSRM front bracing 6 | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 104 | -5,8 | ULS 1a_0 | 58,3 | 60,3 | 58,8 | 0,10 | | 5,8 | ULS 1a_0 | 62,7 | 60,3 | 44,5 | 0,13 |
| 325 | 1ste DWSRM section BB CD | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,51 | 0,51 | 0,51 | 163 | -10,3 | ULS 1a_0 | 33,0 | 60,3 | 58,8 | 0,31 | | 10,3 | ULS 1a_0 | 62,7 | 60,3 | 44,5 | 0,23 |
| 326 | 1ste DWSRM section BB horiz | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 195 | -3,9 | ULS 3_90 | 36,6 | 60,3 | 70,6 | 0,11 | | 0,5 | ULS 7_(bouw) | 75,3 | 60,3 | 53,4 | 0,01 |
| 327 | 1ste DWSRM section horiz on top | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 25 | 55 | 0,55 | 0,55 | 0,55 | 194 | -6,1 | SPLS 3_80 Ah All Cts | 36,9 | 60,3 | 70,6 | 0,17 | | 7,7 | SPLS 3_80 Ah All Cts | 75,3 | 60,3 | 53,4 | 0,15 |
| 328 | 1ste DWSRM diag on top | EA | 50x50x5 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 205 | -6,4 | ULS 1a_0 | 29,5 | 0,0 | 0,0 | 0,22 | | 6,4 | ULS 1a_0 | 170,4 | 0,0 | 0,0 | 0,04 |
| 329 | 1ste DWSRM preekstoel leuning | EA | 70x70x7 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 236 | -1,5 | ULS 1a_0 | 46,1 | 0,0 | 0,0 | 0,03 | | 1,5 | ULS 1a_0 | 333,7 | 0,0 | 0,0 | 0,00 |
| 330 | 1ste DWSRM preekstoel ligger | UA | 100x50x6 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 84 | -0,1 | ULS 1a_90 | 144,3 | 0,0 | 0,0 | 0,00 | | 0,0 | ULS 1a_0,9_0,9_100_(bouw) | 308,9 | 0,0 | 0,0 | 0,00 |
| 331 | 1ste DWSRM preekstoel stijl | EA | 50x50x5 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 111 | -1,6 | SPLS 1a_0 Ah All Cts | 67,4 | 0,0 | 0,0 | 0,02 | | 0,3 | ULS 8 Ba 10 | 170,4 | 0,0 | 0,0 | 0,00 |

## Assessment of angle groups

Date 21-9-2021
Author BJT
Version 4.3

**GT-RLL**
**HA+5_n**

| Group Label | Description | Type | Profile | Steel Qual | Bolts | #sh. | pl | e1 | e2 | p1 | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compression) | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | edance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | uring (Tens) | U.C. (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 400 | Tweede DWSRM - Main diagonal from tc | EA | 120x120x10 | S355 | 3M24-8.8t | 1 | 45 | 35 | 70 | 2.00 | 1.00 | 1.00 | 193 | **-28.1** | SPLS 3_0_9_80 Ah All Cts | 149.6 | 406.7 | 529.2 | 0.19 | | **212.2** | ULS 6b_90_(afspannen)_12 | 416.2 | 406.7 | 336.9 | 0.63 |
| 401 | Tweede DWSRM - Vertical front | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 79 | **-8.8** | ULS 1a_0 | 75.2 | 60.3 | 58.8 | 0.15 | | **8.8** | ULS 1a_0 | 62.7 | 60.3 | 44.5 | 0.20 |
| 402 | Tweede DWSRM - Vertical front | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 164 | **-17.3** | SPLS 3_0_9_100 Ba All Cts | 32.7 | 60.3 | 58.8 | 0.53 | | **26.6** | SPLS 3_80 Ah All Cts | 62.7 | 60.3 | 44.5 | 0.60 |
| 403 | Tweede DWSRM - Vertical front | EA | 70x70x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 250 | **-13.2** | ULS 6b_90_(afspannen)_10 | 29.1 | 60.3 | 70.6 | 0.45 | | **8.1** | ULS 8 Ah_(bouw) | 75.3 | 60.3 | 53.4 | 0.15 |
| 404 | Tweede DWSRM - Vertical front | EA | 90x90x9 | S355 | 3M24-8.8t | 1 | 45 | 35 | 70 | 2.00 | 1.00 | 1.00 | 169 | **-4.2** | ULS 8 Ah 1 | 119.8 | 406.7 | 476.3 | 0.03 | | **223.8** | ULS 6b_90_(afspannen)_12 | 263.7 | 406.7 | 303.2 | 0.85 |
| 405 | Tweede DWSRM - Diagonal front | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 228 | **-3.2** | SPLS 3_80 Ah All Cts | 28.7 | 60.3 | 70.6 | 0.11 | | **0.7** | ULS 8 Ba_(bouw) | 75.3 | 60.3 | 53.4 | 0.01 |
| 406 | Tweede DWSRM - Diagonal front | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 270 | **0.0** | ULS 8 Ah 1 | 21.9 | 60.3 | 70.6 | 0.00 | | **4.8** | ULS 3_80 | 75.3 | 60.3 | 53.4 | 0.09 |
| 407 | Tweede DWSRM - Diagonal front | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 137 | **-4.4** | ULS 1a_0 | 41.6 | 60.3 | 58.8 | 0.11 | | **4.4** | ULS 1a_0 | 62.7 | 60.3 | 44.5 | 0.10 |
| 408 | Tweede DWSRM - under diag | EA | 60x60x6 | S355 | 2M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 93 | **-33.8** | SPLS 3_80 Ah Ct1 | 116.5 | 120.6 | 141.1 | 0.29 | | **21.5** | SPLS 3_0_9_80 Ah Ct1 | 106.5 | 120.6 | 106.8 | 0.20 |
| 409 | Tweede DWSRM - horiz on top | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 181 | **-4.3** | ULS 3_90 | 40.9 | 60.3 | 70.6 | 0.11 | | **0.2** | ULS 8 Ah_(bouw) | 75.3 | 60.3 | 53.4 | 0.00 |
| 411 | Tweede DWSRM - CD top | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 0.53 | 0.53 | 0.53 | 137 | **-38.8** | SPLS 3_90 Ah All Cts | 70.7 | 94.1 | 88.2 | 0.55 | | **38.8** | SPLS 3_90 Ah All Cts | 112.9 | 94.1 | 80.2 | 0.48 |
| 412 | Tweede DWSRM - CD top | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 0.53 | 0.53 | 0.53 | 126 | **-44.4** | SPLS 3_80 Ah All Cts | 78.0 | 94.1 | 88.2 | 0.57 | | **43.7** | SPLS 3_90 Ah All Cts | 112.9 | 94.1 | 80.2 | 0.54 |
| 413 | Tweede DWSRM - CD top | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 0.53 | 0.53 | 0.53 | 126 | **-54.5** | SPLS 3_80 Ah All Cts | 78.2 | 94.1 | 88.2 | 0.70 | | **55.0** | SPLS 3_80 Ah All Cts | 112.9 | 94.1 | 80.2 | 0.69 |
| 414 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 163 | **-11.7** | SPLS 3_270 Ah All Cts_(bouw) | 33.0 | 60.3 | 58.8 | 0.35 | | **11.4** | SPLS 3_90 Ah All Cts | 152.9 | 60.3 | 44.5 | 0.26 |
| 415 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 154 | **-14.2** | SPLS 3_270 Ah All Cts_(bouw) | 35.8 | 60.3 | 58.8 | 0.40 | | **14.1** | SPLS 3_80 Ah All Cts | 152.9 | 60.3 | 44.5 | 0.32 |
| 416 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 115 | **-14.5** | SPLS 3_80 Ah All Cts | 51.7 | 60.3 | 58.8 | 0.28 | | **14.1** | SPLS 3_270 Ah All Cts_(bouw) | 152.9 | 60.3 | 44.5 | 0.32 |
| 417 | Tweede DWSRM - CD top | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 116 | **-18.6** | SPLS 3_270 Ah All Cts_(bouw) | 51.1 | 60.3 | 58.8 | 0.36 | | **19.0** | SPLS 3_80 Ah All Cts | 152.9 | 60.3 | 44.5 | 0.43 |
| 418 | Tweede DWSRM - CD top | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 89 | **-25.6** | SPLS 3_80 Ah All Cts | 97.9 | 60.3 | 70.6 | 0.43 | | **24.4** | SPLS 3_80 Ah All Cts | 228.1 | 60.3 | 53.4 | 0.46 |
| 418A | Tweede DWSRM - CD top | EA | 60x60x6 | S355 | 2M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 82 | **-32.1** | SPLS 3_0_9_80 Ah All Cts_(bouw) | 104.8 | 120.6 | 141.1 | 0.31 | | **33.1** | SPLS 3_80 Ah All Cts | 106.5 | 120.6 | 106.8 | 0.31 |
| 419 | Tweede DWSRM - CD UNP top | UNP | UNP160 | S355 | 1M20-8.8t | 1 | 45 | 35 | 70 | 1.00 | 1.00 | 1.00 | 42 | **-0.2** | ULS 7_(bouw) | 398.0 | 94.1 | 110.3 | 0.00 | | **60.1** | ULS 3_0_9_90 | 141.1 | 94.1 | 100.2 | 0.64 |
| 422 | Tweede DWSRM - CD under 1 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 124 | **-19.3** | SPLS 3_0_9_270 Ah All Cts_(bouw) | 79.9 | 188.2 | 176.4 | 0.24 | | **19.2** | SPLS 3_0_9_270 Ah All Cts_(bouw | 106.3 | 188.2 | 124.7 | 0.18 |
| 423 | Tweede DWSRM - CD under 2 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 115 | **-23.1** | SPLS 3_0_9_270 Ah All Cts_(bouw) | 87.2 | 188.2 | 176.4 | 0.26 | | **22.7** | SPLS 3_0_9_270 Ah All Cts_(bouw | 106.3 | 188.2 | 124.7 | 0.21 |
| 424 | Tweede DWSRM - CD under 3 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 110 | **-24.4** | SPLS 3_0_9_270 Ah All Cts_(bouw) | 91.8 | 188.2 | 176.4 | 0.27 | | **24.8** | SPLS 3_0_9_270 Ah All Cts_(bouw | 106.3 | 188.2 | 124.7 | 0.23 |
| 425 | Tweede DWSRM - CD under 4 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 105 | **-24.2** | SPLS 3_0_9_270 Ah All Cts_(bouw) | 96.6 | 188.2 | 176.4 | 0.25 | | **23.3** | SPLS 3_0_9_270 Ah All Cts_(bouw | 106.3 | 188.2 | 124.7 | 0.22 |
| 426 | Tweede DWSRM - CD under 5 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 100 | **-51.0** | SPLS 3_0_9_270 Ah All Cts_(bouw) | 127.0 | 188.2 | 176.4 | 0.40 | | **50.0** | SPLS 3_0_9_270 Ah All Cts_(bouw | 106.3 | 188.2 | 124.7 | 0.47 |
| 427 | Tweede DWSRM - CD under 6 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 96 | **-67.0** | SPLS 3_0_9_80 Ah All Cts | 133.4 | 188.2 | 176.4 | 0.50 | | **67.7** | SPLS 3_80 Ah All Cts | 106.3 | 188.2 | 124.7 | 0.64 |
| 428 | Tweede DWSRM - CD under 7 | EA | 70x70x6 | S355 | 2M20-8.8t | 1 | 45 | 35 | 70 | 0.52 | 0.52 | 0.52 | 93 | **-74.5** | SPLS 3_270 Ah All Cts_(bouw) | 136.6 | 188.2 | 176.4 | 0.55 | | **71.0** | SPLS 3_0_9_80 Ah All Cts | 106.3 | 188.2 | 124.7 | 0.67 |
| 429 | Tweede DWSRM - CD under 8 | EA | 70x70x7 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 148 | **-8.8** | ULS 1a_0 | 73.7 | 60.3 | 82.3 | 0.15 | | **8.8** | ULS 1a_0 | 87.8 | 60.3 | 62.3 | 0.15 |
| 430 | 2e DWSRM diag verband | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.53 | 0.53 | 0.53 | 122 | **-38.6** | SPLS 3_80 Ah All Cts | 69.3 | 60.3 | 70.6 | 0.64 | | **41.6** | SPLS 3_80 Ah All Cts | 75.3 | 60.3 | 53.4 | 0.78 |
| 431 | 2e DWSRM kniksteun | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 238 | **-16.3** | ULS 6b_90_(afspannen)_12 | 18.6 | 60.3 | 58.8 | 0.88 | | **3.5** | ULS 8 Ah 12 | 152.9 | 60.3 | 44.5 | 0.08 |
| 432 | 2e DWSRM kniksteun | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.60 | 1.00 | 1.00 | 141 | **-5.9** | ULS 1a_0 | 32.0 | 60.3 | 58.8 | 0.19 | | **5.9** | ULS 1a_0 | 152.9 | 60.3 | 44.5 | 0.13 |
| 436 | Tweede DWSRM - Horizontal under | DEA | 150x150x14 (not co | S355 | 3M20-8.8t | 1 | 45 | 35 | 70 | 1.00 | 2.00 | 1.00 | 38 | **-1.5** | ULS 1a_225_(bouw) | 2147.5 | 282.2 | 1234.8 | 0.01 | | **98.5** | ULS 3_90 | 2203.0 | 282.2 | 1122.5 | 0.35 |
| 437 | Tweede DWSRM - diagonaal kattenoor | EA | 55x55x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 1.00 | 1.00 | 1.00 | 222 | **-6.0** | ULS 6b_90_(afspannen)_12 | 26.0 | 60.3 | 70.6 | 0.23 | | **7.6** | ULS 6b_90_(afspannen)_10 | 75.3 | 60.3 | 53.4 | 0.14 |

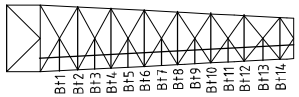
# APPENDIX C
# Knikverkorters

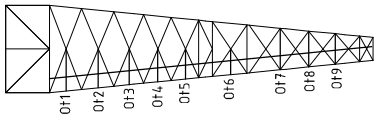
Niet in PLS-TOWER gemodelleerde elementen in de constructie worden aanvullend getoetst. Hieronder vallen de knikverkorters van de randstijl en profielen onderdeel van stabiliteitsverbanden. De staven worden getoetst op:

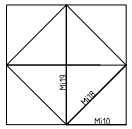
- voldoende trek- of druksterkte als steungevend profiel voor randstijl, 1% van de knikcapaciteit van de randstijl;
- slankheid;
- klimbelasting

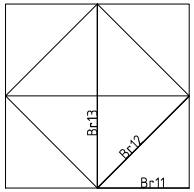
Voor de beloopbaarheid zijn staven in de traverse aanwezig. Deze zijn niet constructief (voorzien van slobgaten) en worden enkel getoetst op de klimbelasting van 1,0 kN. Zie hoofdstuk 4.2.5 en 5.7.2. van het uitgangspuntenrapport.

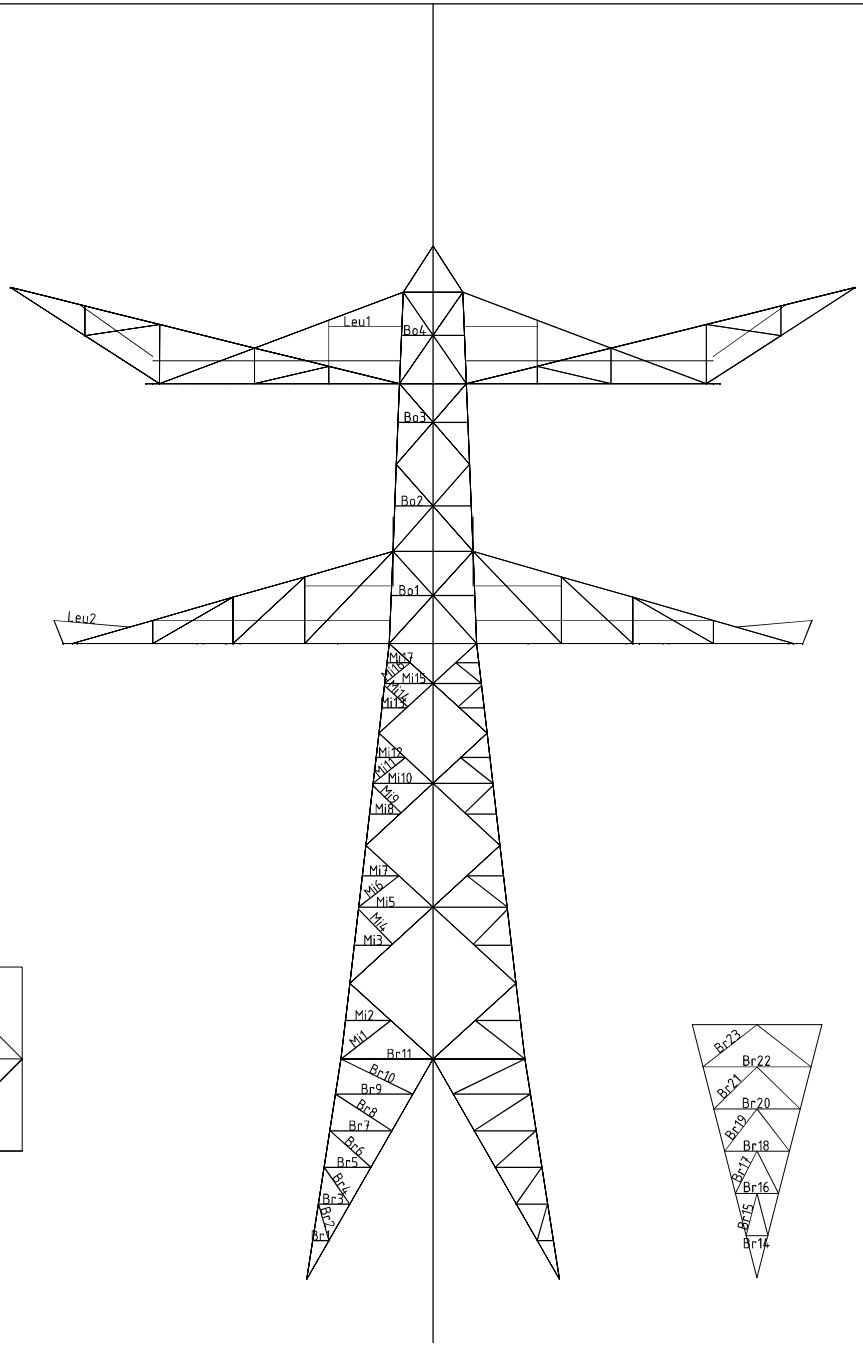
# Overzicht knikverkorters - HA+0_n



DNV·GL

## Knikverkorters

Date: 2021-06-07
Author: BJT
Version: 1.8

ZWO
HA+0_n

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Br1 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 0,704 | 0 | 72 | **26,1** | **0,26** | 80,3 | 60,3 | 41,3 | 43,1 | 0,81 | 0,63 | | |
| Br2 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,660 | 74 | 171 | **26,1** | **0,00** | 30,9 | 60,3 | 41,3 | 43,1 | 0,81 | 0,84 | | |
| Br3 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,370 | 0 | 141 | **26,1** | **0,51** | 40,3 | 60,3 | 41,3 | 43,1 | 0,81 | 0,65 | | |
| Br4 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,950 | 55 | 167 | **26,1** | **0,00** | 45,9 | 60,3 | 52,3 | 98,8 | 1,40 | 0,57 | | |
| Br5 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,030 | 0 | 174 | **26,1** | **0,76** | 43,3 | 60,3 | 52,3 | 98,8 | 1,40 | 0,60 | | |
| Br6 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,400 | 42 | 205 | **26,1** | **0,00** | 33,8 | 60,3 | 52,3 | 98,8 | 1,40 | 0,77 | | |
| Br7 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,700 | 0 | 231 | **26,1** | **1,01** | 28,1 | 60,3 | 52,3 | 98,8 | 1,40 | 0,93 | | |
| Br8 | Broekstuk | Enkele staaf | L70.7 | S355J0 | M16 | 8.8 | 2,920 | 33 | 214 | **26,1** | **0,00** | 43,1 | 60,3 | 61,0 | 142,7 | 2,23 | 0,61 | | |
| Br9 | Broekstuk | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 3,360 | 0 | 214 | **26,1** | **1,26** | 43,0 | 60,3 | 52,3 | 145,8 | 2,68 | 0,61 | | |
| Br10 | Broekstuk | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 3,470 | 26 | 221 | **26,1** | **1,17** | 40,9 | 60,3 | 52,3 | 145,8 | 2,68 | 0,64 | | |
| Br11 | Tussenschot +9,6r | Enkele staaf | L100.8 | S355J0 | M16 | 8.8 | 4,000 | 0 | 203 | **0,0** | **1,50** | 77,0 | 60,3 | 69,7 | 257,2 | 5,49 | 0,29 | | |
| Br12 | Tussenschot +9,6r | Kniksteun op 0,5L | L80.8 | S355J0 | M16 | 8.8 | 5,650 | 0 | 233 | **0,0** | **2,12** | 41,9 | 60,3 | 69,7 | 194,4 | 4,46 | 0,47 | | |
| Br13 | Tussenschot +9,6r | Kruisende staaf halverwege | L90.9 | S355J0 | M16 | 8.8 | 8,000 | 0 | 228 | **0,0** | **1,50** | 64,5 | 60,3 | 78,4 | 254,0 | 6,37 | 0,24 | | |
| Mi1 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,730 | 37 | 234 | **0,0** | **0,00** | 27,6 | 60,3 | 52,3 | 98,8 | 1,40 | 0,00 | | |
| Mi2 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,960 | 0 | 168 | **26,2** | **0,74** | 45,6 | 60,3 | 52,3 | 98,8 | 1,40 | 0,57 | | |
| Mi3 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,600 | 0 | 137 | **26,2** | **0,60** | 60,2 | 60,3 | 52,3 | 98,8 | 1,40 | 0,50 | | |
| Mi4 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,120 | 45 | 181 | **26,2** | **0,00** | 40,7 | 60,3 | 52,3 | 98,8 | 1,40 | 0,64 | | |
| Mi5 | Tussenstuk1 | Enkele staaf | L70.7 | S355J0 | M16 | 8.8 | 3,320 | 0 | 243 | **26,2** | **1,25** | 35,2 | 60,3 | 61,0 | 142,7 | 2,23 | 0,74 | | |
| Mi6 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,210 | 38 | 189 | **26,2** | **0,00** | 38,3 | 60,3 | 52,3 | 98,8 | 1,40 | 0,69 | | |
| Mi7 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,590 | 0 | 136 | **26,2** | **0,60** | 60,7 | 60,3 | 52,3 | 98,8 | 1,40 | 0,50 | | |
| Mi8 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,310 | 0 | 112 | **26,2** | **0,49** | 76,9 | 60,3 | 52,3 | 98,8 | 1,40 | 0,50 | | |
| Mi9 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,710 | 45 | 146 | **26,2** | **0,00** | 55,1 | 60,3 | 52,3 | 98,8 | 1,40 | 0,50 | | |
| Mi10 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,600 | 0 | 222 | **26,2** | **0,98** | 29,8 | 60,3 | 52,3 | 98,8 | 1,40 | 0,88 | | |
| Mi11 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,800 | 38 | 154 | **26,2** | **0,00** | 51,4 | 60,3 | 52,3 | 98,8 | 1,40 | 0,51 | | |
| Mi12 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,280 | 0 | 110 | **26,2** | **0,48** | 78,9 | 60,3 | 52,3 | 98,8 | 1,40 | 0,50 | | |
| Mi13 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,060 | 0 | 91 | **26,2** | **0,40** | 95,9 | 60,3 | 52,3 | 98,8 | 1,40 | 0,50 | | |
| Mi14 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,360 | 42 | 116 | **26,2** | **0,00** | 73,6 | 60,3 | 52,3 | 98,8 | 1,40 | 0,50 | | |
| Mi15 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,100 | 0 | 180 | **26,2** | **0,79** | 41,3 | 60,3 | 52,3 | 98,8 | 1,40 | 0,64 | | |
| Mi16 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,430 | 39 | 122 | **26,2** | **0,00** | 69,3 | 60,3 | 52,3 | 98,8 | 1,4 | 0,50 | | |
| Mi17 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,010 | 0 | 86 | **26,2** | **0,38** | 100,2 | 60,3 | 52,3 | 98,8 | 1,4 | 0,50 | | |
| Mi18 | Tussenschot 21,6 r | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 3,680 | 0 | 234 | **0,0** | **1,38** | 37,3 | 60,3 | 52,3 | 145,8 | 2,68 | 0,54 | | |
| Mi19 | Tussenschot 21,6 r | Kruisende staaf halverwege | L80.6 | S355J0 | M16 | 8.8 | 5,210 | 0 | 166 | **0,0** | **0,98** | 62,8 | 60,3 | 52,3 | 145,8 | 3,40 | 0,29 | | |
| Bo1 | Bovenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,810 | 0 | 186 | **12,2** | **0,68** | 27,2 | 60,3 | 41,3 | 43,1 | 0,8 | 0,87 | | |
| Bo2 | Bovenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,660 | 0 | 171 | **12,2** | **0,62** | 30,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,79 | | |
| Bo3 | Bovenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,520 | 0 | 156 | **6,4** | **0,57** | 35,0 | 60,3 | 41,3 | 43,1 | 0,8 | 0,73 | | |
| Bo4 | Bovenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,370 | 0 | 141 | **6,4** | **0,51** | 40,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,65 | | |
| Ot1 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,836 | 0 | 189 | **0,0** | **0,69** | 26,7 | 60,3 | 41,3 | 43,1 | 0,8 | 0,88 | | |
| Ot2 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,730 | 0 | 178 | **0,0** | **0,65** | 29,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,83 | | |
| Ot3 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,610 | 0 | 165 | **0,0** | **0,60** | 32,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,77 | | |
| Ot4 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,470 | 0 | 151 | **0,0** | **0,55** | 36,7 | 60,3 | 41,3 | 43,1 | 0,8 | 0,70 | | |
| Ot5 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,330 | 0 | 137 | **0,0** | **0,50** | 41,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,64 | | |

DNV·GL

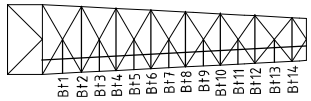
**Knikverkorters**

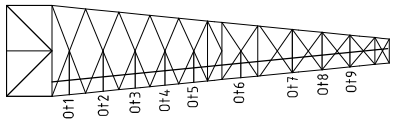
Date: 2021-06-07
Author: BJT
Version: 1.8

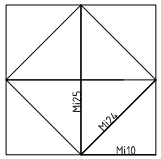
ZWO
HA+0_n

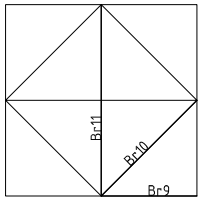
| Posnr. | Section | Schematization | Profile | Steel Quality | Bolt | Quality | Length (m) | Angle (°) | Slenderness | Normal Force (kN) | Moment (kNm) | Buckling Cap. (kN) | Shear Cap. Bolt (kN) | Bearing Cap. (kN) | Net Section Cap. (kN) | Moment Cap. (kNm) | Highest U.C. | Exceedance Type | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ot6 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,020 | 0 | 105 | **0,0** | **0,38** | 57,5 | 60,3 | 41,3 | 43,1 | 0,8 | 0,49 | | |
| Ot7 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,910 | 0 | 196 | **0,0** | **0,72** | 25,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,91 | | |
| Ot8 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,660 | 0 | 171 | **0,0** | **0,62** | 30,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,79 | | |
| Ot9 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,450 | 0 | 149 | **0,0** | **0,54** | 37,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,69 | | |
| Ot10 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,320 | 0 | 136 | **0,0** | **0,50** | 42,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,63 | | |
| Bt1 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,420 | 0 | 146 | **0,0** | **0,53** | 38,4 | 60,3 | 41,3 | 43,1 | 0,8 | 0,68 | | |
| Bt2 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,760 | 0 | 236 | **0,0** | **1,04** | 27,1 | 60,3 | 52,3 | 98,8 | 1,4 | 0,76 | | |
| Bt3 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,340 | 0 | 138 | **0,0** | **0,50** | 41,5 | 60,3 | 41,3 | 43,1 | 0,8 | 0,64 | | |
| Bt4 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,620 | 0 | 224 | **0,0** | **0,98** | 29,5 | 60,3 | 52,3 | 98,8 | 1,4 | 0,72 | | |
| Bt5 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,270 | 0 | 130 | **0,0** | **0,48** | 44,4 | 60,3 | 41,3 | 43,1 | 0,8 | 0,61 | | |
| Bt6 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,490 | 0 | 213 | **0,0** | **0,93** | 31,9 | 60,3 | 52,3 | 98,8 | 1,4 | 0,69 | | |
| Bt7 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,210 | 0 | 124 | **0,0** | **0,45** | 47,2 | 60,3 | 41,3 | 43,1 | 0,8 | 0,58 | | |
| Bt8 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,350 | 0 | 201 | **0,0** | **0,88** | 34,9 | 60,3 | 52,3 | 98,8 | 1,4 | 0,65 | | |
| Bt9 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,142 | 0 | 117 | **0,0** | **0,43** | 50,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,55 | | |
| Bt10 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,220 | 0 | 190 | **0,0** | **0,83** | 38,0 | 60,3 | 52,3 | 98,8 | 1,4 | 0,61 | | |
| Bt11 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,070 | 0 | 110 | **0,0** | **0,40** | 54,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,51 | | |
| Bt12 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 2,080 | 0 | 214 | **0,0** | **0,78** | 22,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,99 | | |

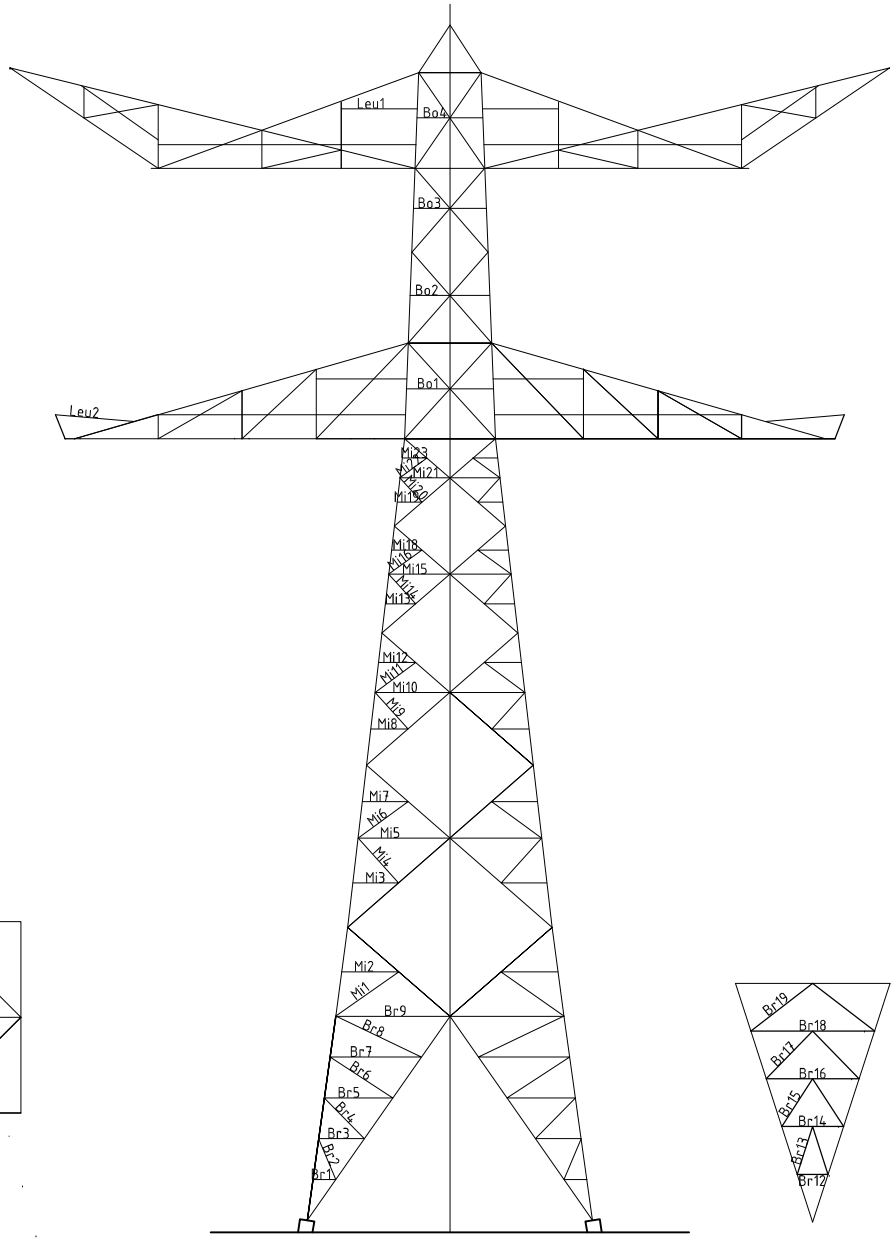
# Overzicht knikverkorters - HA+5



DNV·GL

## Knikverkorters initial construction (afkeur)

Date: 2021-06-07
Author: BJT
Version: 1.8

ZWO
HA+5_n

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Br1 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 0,950 | 0 | 98 | **24,3** | **0,36** | 62,0 | 60,3 | 41,3 | 43,1 | 0,81 | 0,59 | | |
| Br2 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,850 | 67 | 190 | **24,3** | **0,00** | 26,4 | 60,3 | 41,3 | 43,1 | 0,81 | 0,92 | | |
| Br3 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,910 | 0 | 196 | **24,3** | **0,72** | 25,1 | 60,3 | 41,3 | 43,1 | 0,81 | 0,97 | | |
| Br4 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,390 | 45 | 204 | **24,3** | **0,00** | 34,0 | 60,3 | 52,3 | 98,8 | 1,40 | 0,71 | | |
| Br5 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,860 | 0 | 245 | **24,3** | **1,07** | 25,6 | 60,3 | 52,3 | 98,8 | 1,40 | 0,95 | | |
| Br6 | Broekstuk | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 3,130 | 33 | 199 | **24,3** | **0,00** | 47,9 | 60,3 | 52,3 | 145,8 | 2,68 | 0,51 | | |
| Br7 | Broekstuk | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 3,810 | 0 | 242 | **24,3** | **1,43** | 35,3 | 60,3 | 52,3 | 145,8 | 2,68 | 0,69 | | |
| Br8 | Broekstuk | Enkele staaf | L90.9 | S355J0 | M16 | 8.8 | 3,970 | 26 | 226 | **24,3** | **1,34** | 65,2 | 60,3 | 78,4 | 254,0 | 4,73 | 0,40 | | |
| Br9 | Broekstuk | Enkele staaf | L120.10 | S355J0 | M16 | 8.8 | 4,770 | 0 | 201 | **24,3** | **1,79** | 117,4 | 60,3 | 87,1 | 399,8 | 9,77 | 0,40 | | |
| Br10 | Tussenschot +9,6r | Knieksteun op 0,5L | L100.8 | S355J0 | M16 | 8.8 | 6,740 | 0 | 219 | **0,0** | **2,53** | 57,8 | 60,3 | 69,7 | 257,2 | 7,19 | 0,35 | | |
| Br11 | Tussenschot +9,6r | Kruisende staaf halverwege | L100.8 | S355J0 | M16 | 8.8 | 9,540 | 0 | 242 | **0,0** | **1,79** | 58,5 | 60,3 | 69,7 | 257,2 | 7,19 | 0,25 | | |
| Br12 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 1,300 | 0 | 134 | **8,5** | **0,49** | 43,1 | 60,3 | 41,3 | 43,1 | 0,81 | 0,62 | | |
| Br13 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 2,100 | 72 | 216 | **8,5** | **0,00** | 21,7 | 60,3 | 41,3 | 43,1 | 0,81 | 0,39 | | |
| Br14 | Broekstuk | Knieksteun op 0,5L | L50.5 | S355J0 | M16 | 8.8 | 2,580 | 0 | 170 | **8,5** | **0,97** | 25,3 | 60,3 | 41,3 | 43,1 | 1,08 | 0,89 | | |
| Br15 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8.8 | 2,380 | 57 | 245 | **8,5** | **0,00** | 17,8 | 60,3 | 41,3 | 43,1 | 0,81 | 0,47 | | |
| Br16 | Broekstuk | Knieksteun op 0,5L | L60.6 | S355J0 | M16 | 8.8 | 3,870 | 0 | 213 | **8,5** | **1,45** | 26,8 | 60,3 | 52,3 | 98,8 | 1,88 | 0,77 | | |
| Br17 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,780 | 46 | 238 | **8,5** | **0,00** | 26,8 | 60,3 | 52,3 | 98,8 | 1,40 | 0,32 | | |
| Br18 | Broekstuk | Knieksteun op 0,5L | L70.7 | S355J0 | M16 | 8.8 | 5,170 | 0 | 243 | **8,5** | **1,94** | 30,0 | 60,3 | 61,0 | 142,7 | 2,99 | 0,65 | | |
| Br19 | Broekstuk | Enkele staaf | L70.7 | S355J0 | M16 | 8.8 | 3,260 | 38 | 239 | **8,5** | **0,00** | 36,2 | 60,3 | 61,0 | 142,7 | 2,23 | 0,23 | | |
| Mi1 | Tussenstuk1 | Enkele staaf | L70.7 | S355J0 | M16 | 8.8 | 3,220 | 35 | 236 | **23,3** | **0,00** | 37,0 | 60,3 | 61,0 | 142,7 | 2,23 | 0,63 | | |
| Mi2 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,380 | 0 | 204 | **23,3** | **0,89** | 34,2 | 60,3 | 52,3 | 98,8 | 1,40 | 0,68 | | |
| Mi3 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,900 | 0 | 163 | **23,3** | **0,71** | 47,6 | 60,3 | 52,3 | 98,8 | 1,40 | 0,53 | | |
| Mi4 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,520 | 48 | 216 | **23,3** | **0,00** | 31,3 | 60,3 | 52,3 | 98,8 | 1,40 | 0,74 | | |
| Mi5 | Tussenstuk1 | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 3,830 | 0 | 243 | **23,3** | **1,44** | 35,0 | 60,3 | 52,3 | 145,8 | 2,68 | 0,66 | | |
| Mi6 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,580 | 36 | 221 | **23,3** | **0,00** | 30,2 | 60,3 | 52,3 | 98,8 | 1,40 | 0,77 | | |
| Mi7 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,910 | 0 | 163 | **23,3** | **0,72** | 47,3 | 60,3 | 52,3 | 98,8 | 1,40 | 0,53 | | |
| Mi8 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,550 | 0 | 133 | **23,6** | **0,58** | 62,7 | 60,3 | 52,3 | 98,8 | 1,40 | 0,45 | | |
| Mi9 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,060 | 48 | 176 | **23,6** | **0,00** | 42,4 | 60,3 | 52,3 | 98,8 | 1,40 | 0,56 | | |
| Mi10 | Tussenstuk2 | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 3,130 | 0 | 199 | **23,6** | **1,17** | 47,9 | 60,3 | 52,3 | 145,8 | 2,68 | 0,49 | | |
| Mi11 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,100 | 36 | 180 | **23,6** | **0,00** | 41,3 | 60,3 | 52,3 | 98,8 | 1,40 | 0,57 | | |
| Mi12 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,550 | 0 | 133 | **23,6** | **0,58** | 62,7 | 60,3 | 52,3 | 98,8 | 1,40 | 0,45 | | |
| Mi13 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,260 | 0 | 108 | **23,6** | **0,47** | 80,3 | 60,3 | 52,3 | 98,8 | 1,40 | 0,45 | | |
| Mi14 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,670 | 48 | 143 | **23,6** | **0,00** | 56,9 | 60,3 | 52,3 | 98,8 | 1,40 | 0,45 | | |
| Mi15 | Tussenstuk2 | Enkele staaf | L80.6 | S355J0 | M16 | 8.8 | 2,560 | 0 | 163 | **23,6** | **0,96** | 64,3 | 60,3 | 52,3 | 145,8 | 2,68 | 0,45 | | |
| Mi16 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,710 | 36 | 146 | **23,6** | **0,00** | 55,1 | 60,3 | 52,3 | 98,8 | 1,40 | 0,45 | | |
| Mi17 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,270 | 0 | 109 | **23,6** | **0,48** | 79,6 | 60,3 | 52,3 | 98,8 | 1,40 | 0,45 | | |
| Mi18 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,030 | 0 | 88 | **23,6** | **0,39** | 98,5 | 60,3 | 52,3 | 98,8 | 1,4 | 0,45 | | |
| Mi19 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,370 | 48 | 117 | **23,6** | **0,00** | 73,0 | 60,3 | 52,3 | 98,8 | 1,4 | 0,45 | | |
| Mi20 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 2,100 | 0 | 180 | **23,6** | **0,79** | 41,3 | 60,3 | 52,3 | 98,8 | 1,4 | 0,58 | | |
| Mi21 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,400 | 36 | 120 | **23,6** | **0,00** | 71,1 | 60,3 | 52,3 | 98,8 | 1,4 | 0,45 | | |
| Mi22 | Tussenstuk2 | Enkele staaf | L60.6 | S355J0 | M16 | 8.8 | 1,030 | 0 | 88 | **23,6** | **0,39** | 98,5 | 60,3 | 52,3 | 98,8 | 1,4 | 0,45 | | |

DNV·GL

## Knikverkorters initial construction (afkeur)

Date: 2021-06-07
Author: BJT
Version: 1.8

ZWO
HA+5_n

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mi24 | Tussenschot +21,1 | Enkele staaf | L90.8 | S355J0 | M16 | 8,8 | 4,400 | 0 | 250 | **0,0** | **1,65** | 49,9 | 60,3 | 69,7 | 225,8 | 4,3 | 0,40 | | |
| Mi25 | Tussenschot +21,1 | Kruisende staaf halverwege | L90.8 | S355J0 | M16 | 8,8 | 6,260 | 0 | 178 | **0,0** | **1,17** | 84,3 | 60,3 | 69,7 | 225,8 | 5,7 | 0,21 | | |
| Bo1 | Bovenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,810 | 0 | 186 | **12,2** | **0,68** | 27,2 | 60,3 | 41,3 | 43,1 | 0,8 | 0,87 | | |
| Bo2 | Bovenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,660 | 0 | 171 | **12,2** | **0,62** | 30,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,79 | | |
| Bo3 | Bovenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,520 | 0 | 156 | **6,4** | **0,57** | 35,0 | 60,3 | 41,3 | 43,1 | 0,8 | 0,73 | | |
| Bo4 | Bovenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,370 | 0 | 141 | **6,4** | **0,51** | 40,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,65 | | |
| Ot1 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,830 | 0 | 188 | **0,0** | **0,69** | 26,8 | 60,3 | 41,3 | 43,1 | 0,8 | 0,87 | | |
| Ot2 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,690 | 0 | 174 | **0,0** | **0,63** | 30,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,81 | | |
| Ot3 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,550 | 0 | 159 | **0,0** | **0,58** | 34,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,74 | | |
| Ot4 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,430 | 0 | 147 | **0,0** | **0,54** | 38,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,68 | | |
| Ot5 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,320 | 0 | 136 | **0,0** | **0,50** | 42,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,63 | | |
| Ot6 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,115 | 0 | 115 | **0,0** | **0,42** | 52,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,53 | | |
| Ot7 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,790 | 0 | 184 | **0,0** | **0,67** | 27,7 | 60,3 | 41,3 | 43,1 | 0,8 | 0,86 | | |
| Ot8 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,556 | 0 | 160 | **0,0** | **0,58** | 33,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,74 | | |
| Ot9 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,330 | 0 | 137 | **0,0** | **0,50** | 41,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,64 | | |
| | | | | | | | | | | | | | | | | | | | |
| Bt1 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,420 | 0 | 146 | **0,0** | **0,53** | 38,4 | 60,3 | 41,3 | 43,1 | 0,8 | 0,68 | | |
| Bt2 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,760 | 0 | 236 | **0,0** | **1,04** | 27,1 | 60,3 | 52,3 | 98,8 | 1,4 | 0,76 | | |
| Bt3 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,340 | 0 | 138 | **0,0** | **0,50** | 41,5 | 60,3 | 41,3 | 43,1 | 0,8 | 0,64 | | |
| Bt4 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,610 | 0 | 223 | **0,0** | **0,98** | 29,6 | 60,3 | 52,3 | 98,8 | 1,4 | 0,72 | | |
| Bt5 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,260 | 0 | 129 | **0,0** | **0,47** | 44,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,60 | | |
| Bt6 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,490 | 0 | 213 | **0,0** | **0,93** | 31,9 | 60,3 | 52,3 | 98,8 | 1,4 | 0,69 | | |
| Bt7 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,210 | 0 | 124 | **0,0** | **0,45** | 47,2 | 60,3 | 41,3 | 43,1 | 0,8 | 0,58 | | |
| Bt8 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,350 | 0 | 201 | **0,0** | **0,88** | 34,9 | 60,3 | 52,3 | 98,8 | 1,4 | 0,65 | | |
| Bt9 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,142 | 0 | 117 | **0,0** | **0,43** | 50,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,55 | | |
| Bt10 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,220 | 0 | 190 | **0,0** | **0,83** | 38,0 | 60,3 | 52,3 | 98,8 | 1,4 | 0,61 | | |
| Bt11 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,070 | 0 | 110 | **0,0** | **0,40** | 54,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,51 | | |
| Bt12 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 2,080 | 0 | 214 | **0,0** | **0,78** | 22,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,99 | | |
| Bt13 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 0,950 | 0 | 98 | **0,0** | **0,36** | 62,0 | 60,3 | 41,3 | 43,1 | 0,8 | 0,45 | | |
| Bt14 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,822 | 0 | 187 | **0,0** | **0,68** | 27,0 | 60,3 | 41,3 | 43,1 | 0,8 | 0,87 | | |
| | | | | | | | | | | | | | | | | | | | |
| Leu1 | Boventraverse | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 3,180 | 0 | 233 | **0,0** | **1,19** | 37,7 | 60,3 | 61,0 | 142,7 | 2,2 | 0,55 | | |
| Leu2 | Ondertraverse | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 3,300 | 0 | 242 | **0,0** | **1,24** | 35,5 | 60,3 | 61,0 | 142,7 | 2,2 | 0,57 | | |

# APPENDIX D
# Blokdeuvels

De belastingen op de fundatie uit Appendix A zijn uitgangspunt voor de berekening van de ingestorte rand met blokdeuvels. De belastingen in de richting van de randstijl zijn van toepassing. In de tabellen is dit opgenomen in de laatste kolom $R_{z,lok}$. De controles zijn uitgevoerd met een spreadsheet. Vanwege de helling van de drukdiagonaal wordt per krachtsrichting bepaald hoeveel deuvels effectief zijn. Hierdoor kunnen het aantal deuvels in de berekening

Voor de berekening van de blokdeuvels zijn de masttypen als volgt samengevoegd:

- Masttype HA+0/n
- Masttype HA+5/n

De blokdeuvels worden getoetst op de maatgevende belasting per samenvoeging van masttypen (hoogste mast is maatgevend). De belastingen waaraan getoetst worden zijn onderstaand weergegeven.

**Masttype HA+0/n**

**Omhullenden ongeacht stijl**

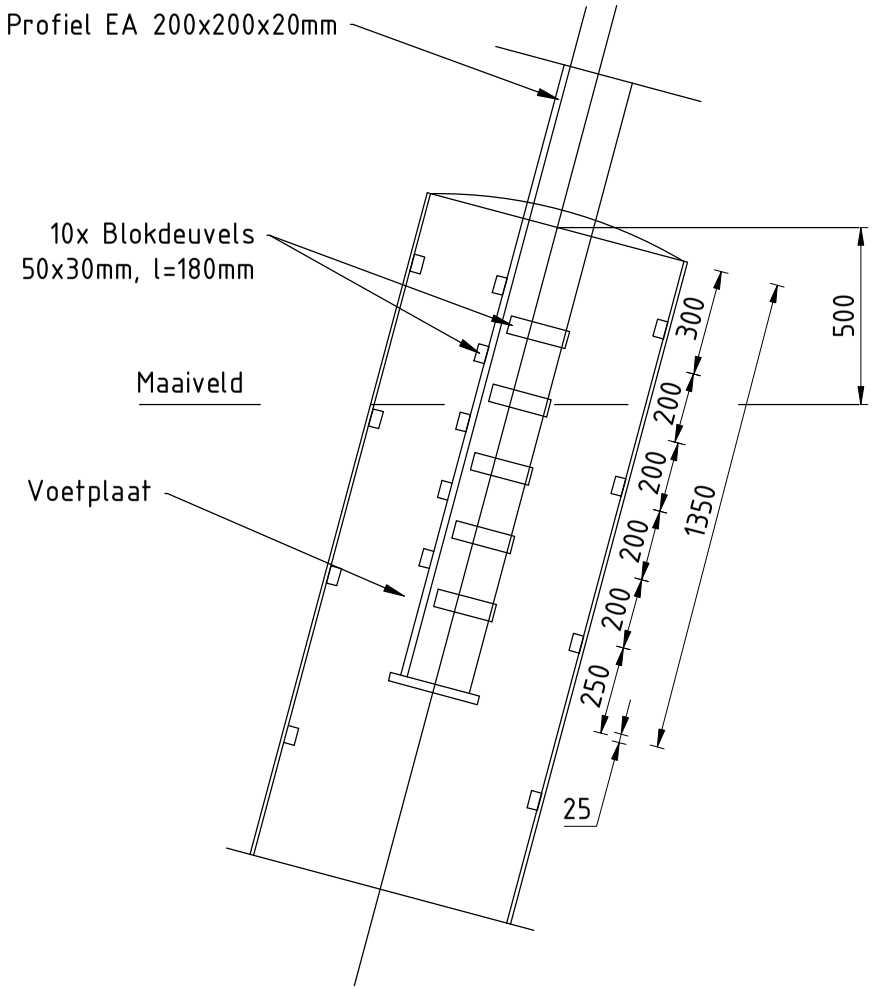
| Belasting | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| Max. druk | SPLS 3_80 Ah All Cts | -294 | 328 | **1646** | 24 | -440 | -76 | 1686 |
| Max. trek | SPLS 1a_0,9_90 Ah All Cts | -238 | 266 | **-1341** | -20 | 357 | 60 | -1373 |
| Max. pos. torsie | SPLS 6a_90 Ah Ct1 Ba Ct1 | 125 | -128 | -29 | **179** | 2 | -4 | -29 |
| Max. neg. torsie | SPLS 3_80 Ba Ct1 | -157 | -100 | 139 | **-182** | -40 | -10 | 142 |
| Comb. trek+torsie | SPLS 3_0,9_80 Ah All Cts | -232 | 264 | **-1336** | **-23** | 351 | 55 | -1368 |

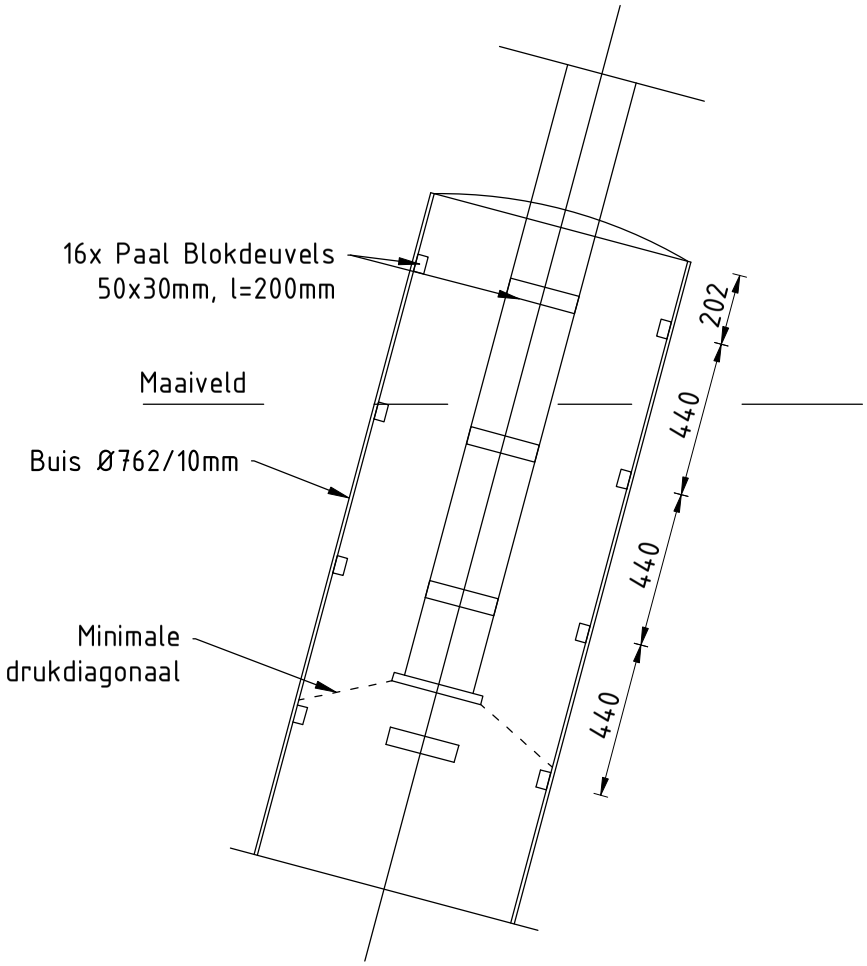
**Masttype HA+5/n**

**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_90 Ah All Cts | -296 | 317 | **1789** | 15 | -434 | -92 | 1821 |
| Max. trek | SPLS 1a_0,9_90 Ah All Cts | -239 | 260 | **-1464** | -15 | 353 | 73 | -1491 |
| Max. pos. torsie | SPLS 6a_90 Ah Ct1 Ba Ct1 | 108 | -112 | -26 | **156** | 2 | -3 | -26 |
| Max. neg. torsie | SPLS 3_80 Ba Ct1 | -139 | -86 | 148 | **-159** | -38 | -9 | 151 |
| Comb. trek+torsie | SPLS 1a_0,9_90 Ah All Cts | -239 | 260 | **-1464** | **-15** | 353 | 73 | -1491 |

# Principe blokdeuvels - HA+0+5/n 2ct




Algemene opmerkingen

- Aarding niet aangegeven
- Spiraalwapening niet aangegeven

Project: GT-RLL
Mast: HA+0_n

## Shear blocks

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

Datum: 2021-07-26
Auteur: BJT
Versie: 1.4

| ***Load*** | | | | ***Results*** | | | |
|---|---|---|---|---|---|---|---|
| Compression | $F_{Ed,c}$ | **1646** | kN | Compression | U.C. | 0.81 | < 1,00 OK |
| Tension | $F_{Ed,t}$ | **1341** | kN | Tension | U.C. | 0.73 | < 1,00 OK |

***Main leg***

| | | | |
|---|---|---|---|
| Profile | | **L200.20** | |
| Steel material | | S355 | |
| Cross section | | 7635 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 2710 | kN |
| Width | b | 200 | mm |
| Thickness | t | 20 | mm |
| Length in concrete | | 1350 | mm |

***Shear blocks main leg***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 170 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 200 | mm |
| Number for compr. | $n_c$ | 8 | - |
| Number for tension | $n_t$ | 8 | - |

***Foot plate***

| | | | |
|---|---|---|---|
| Thickness | t | 25 | mm |
| Ext. length | m | 30 | mm |
| Welds | a | 5 | mm |

***Pile***

| | | | |
|---|---|---|---|
| Name | | Buispaal | |
| Diameter | | 762 | mm |
| Thickness | | 10 | mm |
| Cross section | | 23625 | $mm^2$ |
| Steel material | | S355 | |
| Capacity | | 8387 | kN |
| Concrete strength | | C30/37 | |

***Shear blocks pile***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 200 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 520 | mm |
| Number for compr. | $n_c$ | 16 | - |
| Number for tension | $n_t$ | 16 | - |

***Design value concrete strength***

| | | | |
|---|---|---|---|
| Material factor | $\gamma_c$ | 1.5 | |
| Add. mat. factor | $\gamma_m$ | 1.25 | - |
| $f_{cd}$ = | | 16.0 | $N/mm^2$ |

***Steel tower stub***

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

***Capacity shear blocks main leg***

| | | |
|---|---|---|
| $A_{f1}$ = | 5100 | $mm^2$ |
| $A_{f2}$ = | 13800 | $mm^2$ |
| Slope | 1: 5 | |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.64 | |
| $f_{jd} = C_A \times f_{cd}$ = | 26.3 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | 1074 | kN |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | 1074 | kN |

***Capacity foot plate***

| | | |
|---|---|---|
| $k_d$ = | 1.73 | - |
| $f_{jd} = C_A \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $c = t\sqrt{(f_{yd} / 3f_{jd})}$ = | 53 | mm |
| m* = min(c,m) = | 30 | mm |
| Type foot plate | Extending | |
| Effective for | Compr. and tension | |
| $A_{p,c}$ = | 35235 | $mm^2$ |
| $F_{Rd,c} = A_{p,druk} \times f_{jd}$ = | 976 | kN |
| $A_{p,t}$ = | 27600 | $mm^2$ |
| $F_{Rd,t} = A_{p,t} \times f_{jd}$ = | 765 | kN |

***Capacities***

| | | |
|---|---|---|
| $F_{rd,c,plate}$ = | 956 | kN |
| $F_{rd,blocks,c}$ = | 1074 | kN |
| $F_{rd,c} = F_{rd,blck}+F_{rd,footplate}$ = | **2029** | kN |
| U.C. compression | 0.81 | < 1,00 OK |
| Welds foot plate (see next page) | 956 | kN |
| $F_{rd,t}$ = min. (welds / foot plate) = | 765 | kN |
| $F_{rd,blocks,t}$ = | 1074 | kN |
| $F_{rd,t} = F_{rd,blck}+F_{rd,footplate}$ = | **1839** | kN |
| U.C. tension | 0.73 | < 1,00 OK |
| U.C. welds | 0.48 | < 1,00 OK |

***Capacity shear blocks pile***

| | | |
|---|---|---|
| $A_{f1}$ = | 6000 | $mm^2$ |
| $A_{f2}$ = | 18000 | $mm^2$ |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.73 | - |
| $f_{jd} = k_d \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | **2660** | kN |
| U.C. compression | 0.62 | < 1,00 OK |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | **2660** | kN |
| U.C. tension | 0.50 | < 1,00 OK |
| U.C. welds | 0.42 | < 1,00 OK |

***"Splitting" of pile***

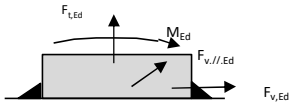
| | | | |
|---|---|---|---|
| Spread of forces | | 45 | ° |
| Length force flow | | 979 | mm |
| Splitting force | | 685 | kN/m |
| Yield strength wall | $f_{yd}$ = | 355 | $N/mm^2$ |
| Capacity tubular pile | | 7100 | kN/m |
| U.C. | | 0.10 | < 1,00 OK |

Project: GT-RLL
Mast: HA+0_n

## Welds of shear blocks of main leg

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 170 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |



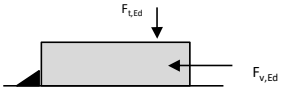

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ = | 0 | $N/mm^2$ |
| $F_{t,Ed}$ = | **0** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ = | 67 | $N/mm^2$ |
| $F_{v,Ed} = F_{rd,c} / n$ = | **161** | kN | | 67 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | $b^* = b + 2/3a\sqrt{2}$ | 54.7 | mm |
| $M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **2.42** | kNm | $\sigma_1 = \tau_1 = 0{,}706M_{Ed} / al\ b^*$ = | 37 | $N/mm^2$ |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 207 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 207 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.48** OK |
| $\sigma_1$ = | 104 | $N/mm^2$ | ≤ | $0{,}9f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.29** OK |

## Welds of shear blocks of pile

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 200 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |



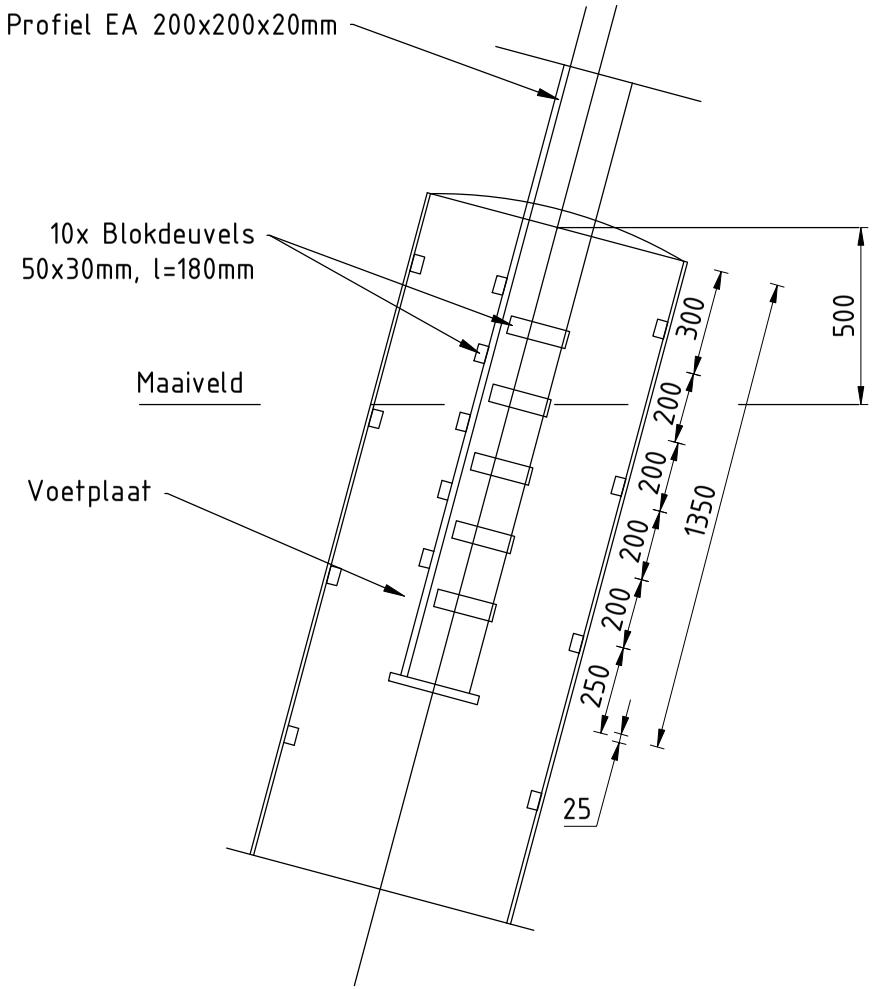

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ = | 21 | $N/mm^2$ |
| $F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **60** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ = | 71 | $N/mm^2$ |
| $F_{v,Ed}$ = | **200** | kN | | 92 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | | | |
| $M_{Ed}$ = | **0.00** | kNm | | | |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 183 | $N/mm^2$ |

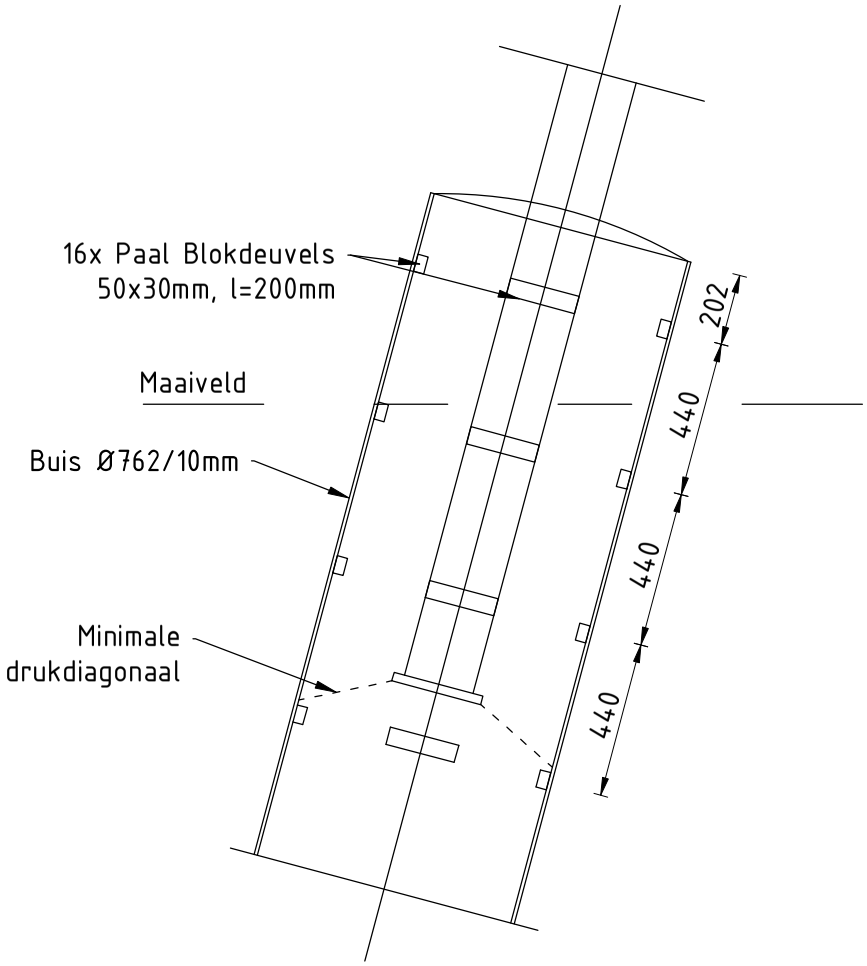
| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 183 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.42** OK |
| $\sigma_1$ = | 92 | $N/mm^2$ | ≤ | $0{,}9f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.26** OK |

## Welds of foot plate

| | | | |
|---|---|---|---|
| $f_u / \beta_w \gamma_{M2}$ = | | 436 | $N/mm^2$ |
| Weld size | a = | 5 | mm |
| Length | l = 2b+ 2b - t = | 760 | mm |
| Capacity | $F_{Rd} = a \times l \times f_{w,d} / \sqrt{3}$ = | **956** | kN |

# Principe blokdeuvels - HA+0+5/n 2ct




Algemene opmerkingen

- Aarding niet aangegeven
- Spiraalwapening niet aangegeven

Project: GT-RLL
Mast: HA+5_n

## Shear blocks

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

Datum: 2021-07-26
Auteur: BJT
Versie: 1.4

| ***Load*** | | | | ***Results*** | | | |
|---|---|---|---|---|---|---|---|
| Compression | $F_{Ed,c}$ | **1789** | kN | Compression | U.C. | 0.88 | < 1,00 OK |
| Tension | $F_{Ed,t}$ | **1464** | kN | Tension | U.C. | 0.80 | < 1,00 OK |

***Main leg***

| | | | |
|---|---|---|---|
| Profile | | **L200.20** | |
| Steel material | | S355 | |
| Cross section | | 7635 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 2710 | kN |
| Width | b | 200 | mm |
| Thickness | t | 20 | mm |
| Length in concrete | | 1350 | mm |

***Shear blocks main leg***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 170 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 200 | mm |
| Number for compr. | $n_c$ | 8 | - |
| Number for tension | $n_t$ | 8 | - |

***Foot plate***

| | | | |
|---|---|---|---|
| Thickness | t | 25 | mm |
| Ext. length | m | 30 | mm |
| Welds | a | 5 | mm |

***Pile***

| | | | |
|---|---|---|---|
| Name | | Buispaal | |
| Diameter | | 762 | mm |
| Thickness | | 10 | mm |
| Cross section | | 23625 | $mm^2$ |
| Steel material | | S355 | |
| Capacity | | 8387 | kN |
| Concrete strength | | C30/37 | |

***Shear blocks pile***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 200 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 520 | mm |
| Number for compr. | $n_c$ | 16 | - |
| Number for tension | $n_t$ | 16 | - |

***Design value concrete strength***

| | | | |
|---|---|---|---|
| Material factor | $\gamma_c$ | 1.5 | |
| Add. mat. factor | $\gamma_m$ | 1.25 | - |
| $f_{cd}$ = | | 16.0 | $N/mm^2$ |

***Steel tower stub***

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

***Capacity shear blocks main leg***

| | | |
|---|---|---|
| $A_{f1}$ = | 5100 | $mm^2$ |
| $A_{f2}$ = | 13800 | $mm^2$ |
| Slope | 1: 5 | |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.64 | |
| $f_{jd} = C_A \times f_{cd}$ = | 26.3 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | 1074 | kN |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | 1074 | kN |

***Capacity foot plate***

| | | |
|---|---|---|
| $k_d$ = | 1.73 | - |
| $f_{jd} = C_A \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $c = t\sqrt{(f_{yd} / 3f_{jd})}$ = | 53 | mm |
| m* = min(c,m) = | 30 | mm |
| Type foot plate | Extending | |
| Effective for | Compr. and tension | |
| $A_{p,c}$ = | 35235 | $mm^2$ |
| $F_{Rd,c} = A_{p,druk} \times f_{jd}$ = | 976 | kN |
| $A_{p,t}$ = | 27600 | $mm^2$ |
| $F_{Rd,t} = A_{p,t} \times f_{jd}$ = | 765 | kN |

***Capacities***

| | | |
|---|---|---|
| $F_{rd,c,plate}$ = | 956 | kN |
| $F_{rd,blocks,c}$ = | 1074 | kN |
| $F_{rd,c} = F_{rd,blck}+F_{rd,footplate}$ = | **2029** | kN |
| U.C. compression | 0.88 | < 1,00 OK |
| Welds foot plate (see next page) | 956 | kN |
| $F_{rd,t}$ = min. (welds / foot plate) = | 765 | kN |
| $F_{rd,blocks,t}$ = | 1074 | kN |
| $F_{rd,t} = F_{rd,blck}+F_{rd,footplate}$ = | **1839** | kN |
| U.C. tension | 0.80 | < 1,00 OK |
| U.C. welds | 0.48 | < 1,00 OK |

***Capacity shear blocks pile***

| | | |
|---|---|---|
| $A_{f1}$ = | 6000 | $mm^2$ |
| $A_{f2}$ = | 18000 | $mm^2$ |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.73 | - |
| $f_{jd} = k_d \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | **2660** | kN |
| U.C. compression | 0.67 | < 1,00 OK |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | **2660** | kN |
| U.C. tension | 0.55 | < 1,00 OK |
| U.C. welds | 0.42 | < 1,00 OK |

***"Splitting" of pile***

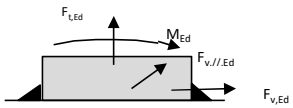
| | | | |
|---|---|---|---|
| Spread of forces | | 45 | ° |
| Length force flow | | 979 | mm |
| Splitting force | | 748 | kN/m |
| Yield strength wall | $f_{yd}$ = | 355 | $N/mm^2$ |
| Capacity tubular pile | | 7100 | kN/m |
| U.C. | | 0.11 | < 1,00 OK |

Project: GT-RLL
Mast: HA+5_n

## Welds of shear blocks of main leg

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 170 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |



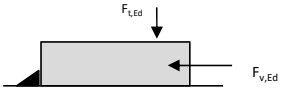

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ = | 0 | $N/mm^2$ |
| $F_{t,Ed}$ = | **0** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ = | 67 | $N/mm^2$ |
| $F_{v,Ed} = F_{rd,c} / n$ = | **161** | kN | | 67 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | $b^* = b + 2/3a\sqrt{2}$ | 54.7 | mm |
| $M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **2.42** | kNm | $\sigma_1 = \tau_1 = 0{,}706M_{Ed} / al\ b^*$ = | 37 | $N/mm^2$ |
| | | | $\tau_{//} = F_{w//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 207 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 207 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.48** OK |
| $\sigma_1$ = | 104 | $N/mm^2$ | ≤ | $0{,}9f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.29** OK |

## Welds of shear blocks of pile

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 200 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |




| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ = | 21 | $N/mm^2$ |
| $F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **60** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ = | 71 | $N/mm^2$ |
| $F_{v,Ed}$ = | **200** | kN | | 92 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | | | |
| $M_{Ed}$ = | **0.00** | kNm | | | |
| | | | $\tau_{//} = F_{w//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 183 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 183 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.42** OK |
| $\sigma_1$ = | 92 | $N/mm^2$ | ≤ | $0{,}9f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.26** OK |

## Welds of foot plate

| | | | |
|---|---|---|---|
| $f_u / \beta_w \gamma_{M2}$ = | | 436 | $N/mm^2$ |
| Weld size | a = | 5 | mm |
| Length | l = 2b+ 2b - t = | 760 | mm |
| Capacity | $F_{Rd} = a \times l \times f_{w,d} / \sqrt{3}$ = | **956** | kN |

# APPENDIX E
## Liggers

Niet van toepassing voor dit masttype.

# APPENDIX F
# Galloping

### Uitgangspunten

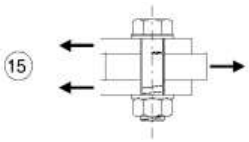
In het uitgangspuntendocument is beschreven dat wordt uitgegaan van een materiaalfactor voor vermoeiing $\gamma_{mf}$ = 1,15. Dit komt overeen met de “Safe-life methode” met “Low consequence” van tabel 3.1 van NEN-EN 1993-1-9 of met “Damage tolerant” en “High consequence”.

| Assessment method | Consequence of failure | |
|---|---|---|
| | Low consequence | High consequence |
| Damage tolerant | 1,00 | 1,15 |
| Safe life | 1,15 | 1,35 |

Voor staven met gatverzwakking met bouten in ruime gaten geldt volgens fig. 8.1 van NEN-EN 1993-1-9 categorie 50, met m=3

| | | | |
|---|---|---|---|
| 50 | | 13) One sided or double covered symmetrical connection with non-preloaded bolts in normal clearance holes.<br>No load reversals. | 13) ... net cross-section. |

Voor niet voorgespannen bouten belast op afschuiving geldt volgens fig. 8.1 van NEN-EN 1993-1-9 categorie 100, met m=5.

| | | | |
|---|---|---|---|
| 100<br>m=5 |  | Bolts in single or double shear<br>Thread not in the shear plane 15)<br>- Fitted bolts<br>- normal bolts without load reversal (bolts of grade 5.6, 8.8 or 10.9) | 15)<br>$\Delta\tau$ calculated on the shank area of the bolt. |

Het belastingsspectrum is in de NNA (NEN-EN 50341-2-15) als volgt gedefinieerd.

**Table 4.11/NL.1 Load spectra line galloping for tension supports**

| Load spectra line galloping for tension supports | | Number of load cycles in 50 years | |
|---|---|---|---|
| Number | Peak-to-peak load | Ice region A | Ice region B |
| 1 | 2·EDS | 7.000 | 3.000 |
| 2 | 1,5·EDS | 36.000 | 17.000 |
| 3 | 1,0·EDS | 125.000 | 65.000 |
| 4 | 0,5·EDS | 482.000 | 265.000 |

### Aanpak

De vier belastingen van 0,5 tot 2,0EDS hebben een vaste onderlinge verhouding. Aangezien het aantal wisselingen zich in het m=3 gebied van de vermoeiingskromme bevindt vanwege n < 2 x $10^6$, kan een relatie worden afgeleid tussen de grootte van de spanningswissel met bijvoorbeeld 1,0EDS en de spanningswisseling die bij 2 x $10^6$ wisselingen op basis van het spectrum nog net toelaatbaar is. Dit staat bekend als de equivalente spanningen methode. Via de factor lambda kan de spanningswisseling worden berekend.

$$\lambda = \left[\frac{\sum \Delta\sigma_i^m \cdot n_i}{2 \cdot 10^6}\right]^{\frac{1}{m}}$$

Toepassen van de formule voor een spanning van 1 N/mm$^2$ bij 1,0EDS levert:

| Helling | m=3 | | m=5 | |
|---|---|---|---|---|
| IJsgebied | A | B | A | B |
| Wisseling | $\sigma_i^m$ x $n_i$ | $\sigma_i^m$ x $n_i$ | $\sigma_i^m$ x $n_i$ | $\sigma_i^m$ x $n_i$ |
| 2,0EDS | 5,60E+04 | 2,40E+04 | 2,24E+05 | 9,60E+04 |
| 1,5EDS | 1,22E+05 | 5,74E+04 | 2,73E+05 | 1,29E+05 |
| 1,0EDS | 1,25E+05 | 6,50E+04 | 1,25E+05 | 6,50E+04 |
| 0,5EDS | 6,03E+04 | 3,31E+04 | 1,51E+04 | 8,28E+03 |
| $\Sigma\sigma_i^m$ x $n_i$ | 3,63E+05 | 1,80E+05 | 6,37E+05 | 2,98E+05 |
| $\lambda = (\Sigma\sigma x n_i/2x10^6)^{1/m}$ | 0,57 | 0,45 | 0,80 | 0,68 |

Voor ijsgebied A is de toelaatbare spanningswisseling bij 1,0 EDS en 125.000 wisselingen dus 1/0,57 (175%) van de toelaatbare spanningswisseling bij een aantal wisselingen van 2,0 x $10^6$. Er kan ook worden gesteld dat als de spanningswisselingen van 1,0 EDS 363.000 maal voorkomen, dezelfde schade wordt behaald als de vier niveaus afzonderlijk. Deze aanpak is gehanteerd.

- In de berekening van de mast wordt telkens één afspanpunt van de geleiders belast met een trekkracht in lijnrichting van 1,0 EDS.
- Het aantal wisselingen dat deze trekkracht voorkomt wordt vergroot om het hele spectrum te vervangen, dit is afhankelijk van ijsgebied en m-factor.
- Voor iedere staaf in de constructie wordt de schade berekend als gevolg van de trekkracht voor elke geleider.
- De schade wordt gesommeerd over alle geleiders.
- De toetsing is uitgedrukt als de verhouding tussen de optredende spanningswisseling bij n = 2 x $10^6$ wisselingen en de toelaatbare spanningswisseling (43 MPa voor het staalprofiel en 87 MPa voor de bout).

**Resultaten**

In de tabellen zijn de resultaten van mast HA+5/n gegeven. Vanwege de exponentiële invloed van het spanningsniveau heeft de verdeling van de U.C.'s een grote variatie. Het meest zwaar belast zijn de diagonalen in het ondervlak van de traverse in de nabijheid van de afspanpunten en de randen van de traverse. De conclusie is dat de staven en bouten voldoen.

## Check galloping

Datum: 27-7-2021
Auteur: TBR
Versie: 1.0

**GT-RLL**
**HA_n**

| | | | | | Controle netto oppervlak profiel | | | | | | | Controle boutdoorsnede | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Omschrijving** | **Profiel** | **Aantal bouten** | **Bout** | **ΔF;o [kN]** | **Brutto [mm2]** | **Netto [mm2]** | **Δσi;o [Mpa]** | **DC;o [Mpa]** | **Δσ;c;o [Mpa]** | **UC opp.** | **ΔF;b [kN]** | **Opp. Bout [mm2]** | **Δσ;i;b [Mpa]** | **DC;b [Mpa]** | **Δσ;c;b [Mpa]** | **UC bout** |
| **100A** | **BVNSTK - Main member** | 120x120x12 | **0** | | 11,0 | 2750 | 2750 | 4,0 | 50 | 43 | 0,09 | 16,5 | 0 | 0,0 | 100 | 87 | 0,00 |
| **100B** | **BVNSTK - Main member** | 120x120x12 | **6** | M24 | 22,5 | 2750 | 2438 | 9,2 | 50 | 43 | 0,21 | 32,7 | 452 | 12,0 | 100 | 87 | 0,14 |
| **101** | **BVNSTK - Horizontal front (cross** | 160x160x15 | **10** | M24 | 79,9 | 4671 | 4281 | 18,7 | 50 | 43 | 0,43 | 116,5 | 452 | 25,8 | 100 | 87 | 0,30 |
| **102A** | **Derde TSNSTK - Main member** | 160x160x15 | **6** | M24 | 44,7 | 4671 | 4281 | 10,4 | 50 | 43 | 0,24 | 65,4 | 452 | 24,1 | 100 | 87 | 0,28 |
| **102B** | **Derde TSNSTK - Main member** | 160x160x15 | **8** | M24 | 53,0 | 4671 | 4281 | 12,4 | 50 | 43 | 0,28 | 75,2 | 452 | 20,8 | 100 | 87 | 0,24 |
| **103** | **Derde TSNSTK - Horizontal front** | 180x180x16 | **13** | M24 | 83,9 | 5540 | 5124 | 16,4 | 50 | 43 | 0,38 | 122,0 | 452 | 20,8 | 100 | 87 | 0,24 |
| **104** | **BRKSTK - Main member** | 200x200x20 | **12** | M24 | 109,1 | 7640 | 7120 | 15,3 | 50 | 43 | 0,35 | 132,8 | 452 | 24,5 | 100 | 87 | 0,28 |
| **105A** | **Eerste TSNSTK - Main member** | 200x200x20 | **12** | M24 | 108,9 | 7640 | 7120 | 15,3 | 50 | 43 | 0,35 | 132,6 | 452 | 24,5 | 100 | 87 | 0,28 |
| **105B** | **Eerste TSNSTK - Main member** | 200x200x20 | **12** | M24 | 108,8 | 7640 | 7120 | 15,3 | 50 | 43 | 0,35 | 135,1 | 452 | 24,9 | 100 | 87 | 0,29 |
| **106A** | **Tweede TSNSTK - Main member** | 200x200x18 | **10** | M24 | 92,9 | 6910 | 6442 | 14,4 | 50 | 43 | 0,33 | 119,9 | 452 | 26,5 | 100 | 87 | 0,31 |
| **106B** | **Tweede TSNSTK - Main member** | 200x200x18 | **10** | M24 | 91,0 | 6910 | 6442 | 14,1 | 50 | 43 | 0,32 | 121,1 | 452 | 26,8 | 100 | 87 | 0,31 |
| **106C** | **Tweede TSNSTK - Main member** | 200x200x18 | **10** | M24 | 75,3 | 6910 | 6442 | 11,7 | 50 | 43 | 0,27 | 104,1 | 452 | 23,0 | 100 | 87 | 0,26 |
| **107A** | **Eerste DWSRM - Main member bo** | 160x160x15 | **10** | M24 | 128,9 | 4671 | 4281 | 30,1 | 50 | 43 | 0,69 | 189,9 | 452 | 42,0 | 100 | 87 | 0,48 |
| **107B** | **Eerste DWSRM - Main member bo** | 180x180x16 | **8** | M24 | 99,5 | 5540 | 5124 | 19,4 | 50 | 43 | 0,45 | 151,9 | 452 | 42,0 | 100 | 87 | 0,48 |
| **107C** | **Eerste DWSRM - Main member bo** | 160x160x15 | **0** | | 123,6 | 4671 | 4671 | 26,5 | 50 | 43 | 0,61 | 183,8 | 0 | 0,0 | 100 | 87 | 0,00 |
| **108A** | **Eerste DWSRM - Main member bo** | 150x150x12 | **8** | M24 | 93,9 | 3480 | 3168 | 29,7 | 50 | 43 | 0,68 | 143,4 | 452 | 39,7 | 100 | 87 | 0,46 |
| **108C** | **Eerste DWSRM - Main member bo** | 150x150x12 | **0** | | 89,6 | 3480 | 3480 | 25,8 | 50 | 43 | 0,59 | 136,8 | 0 | 0,0 | 100 | 87 | 0,00 |
| **109A** | **Eerste DWSRM - Main member to** | 110x110x10 | **4** | M24 | 13,4 | 2112 | 1852 | 7,3 | 50 | 43 | 0,17 | 20,0 | 452 | 11,1 | 100 | 87 | 0,13 |
| **109B** | **Eerste DWSRM - Main member to** | 110x110x10 | **4** | M24 | 12,8 | 2112 | 1852 | 6,9 | 50 | 43 | 0,16 | 19,2 | 452 | 10,6 | 100 | 87 | 0,12 |
| **110A** | **Eerste DWSRM - Main member to** | 100x100x8 | **4** | M24 | 12,7 | 1550 | 1342 | 9,4 | 50 | 43 | 0,22 | 19,2 | 452 | 10,6 | 100 | 87 | 0,12 |
| **110B** | **Eerste DWSRM - Main member to** | 100x100x8 | **0** | | 12,6 | 1550 | 1550 | 8,1 | 50 | 43 | 0,19 | 19,1 | 0 | 0,0 | 100 | 87 | 0,00 |
| **111A** | **Tweede DWSRM - Main member l** | 150x150x12 | **8** | M24 | 90,9 | 3480 | 3168 | 28,7 | 50 | 43 | 0,66 | 138,7 | 452 | 38,4 | 100 | 87 | 0,44 |
| **111C** | **Tweede DWSRM - Main member l** | 150x150x12 | **0** | | 85,9 | 3480 | 3480 | 24,7 | 50 | 43 | 0,57 | 131,1 | 0 | 0,0 | 100 | 87 | 0,00 |
| **112A** | **Tweede DWSRM - Main member u** | 100x100x8 | **0** | | 4,4 | 1550 | 1550 | 2,8 | 50 | 43 | 0,07 | 6,5 | 0 | 0,0 | 100 | 87 | 0,00 |
| **112B** | **Tweede DWSRM - Main member u** | 100x100x8 | **2** | M24 | 3,5 | 1550 | 1342 | 2,6 | 50 | 43 | 0,06 | 5,3 | 452 | 5,9 | 100 | 87 | 0,07 |
| **113A** | **Tweede DWSRM - Main member t** | 120x120x10 | **4** | M24 | 47,8 | 2320 | 2060 | 23,2 | 50 | 43 | 0,53 | 66,0 | 452 | 36,5 | 100 | 87 | 0,42 |
| **113B** | **Tweede DWSRM - Main member t** | 120x120x10 | **4** | M24 | 41,1 | 2320 | 2060 | 20,0 | 50 | 43 | 0,46 | 57,8 | 452 | 31,9 | 100 | 87 | 0,37 |
| **113C** | **Tweede DWSRM - Main member t** | 120x120x10 | **0** | | 45,1 | 2320 | 2320 | 19,4 | 50 | 43 | 0,45 | 63,3 | 0 | 0,0 | 100 | 87 | 0,00 |
| **114A** | **Tweede DWSRM - Main member t** | 120x120x10 | **4** | M24 | 39,4 | 2320 | 2060 | 19,1 | 50 | 43 | 0,44 | 55,4 | 452 | 30,6 | 100 | 87 | 0,35 |
| **114B** | **Tweede DWSRM - Main member t** | 120x120x10 | **5** | M24 | 6,5 | 2320 | 2060 | 3,2 | 50 | 43 | 0,07 | 9,2 | 452 | 4,0 | 100 | 87 | 0,05 |
| **114C** | **Tweede DWSRM - Main member t** | 120x120x10 | **0** | | 35,2 | 2320 | 2320 | 15,2 | 50 | 43 | 0,35 | 49,5 | 0 | 0,0 | 100 | 87 | 0,00 |
| **200** | **BVNSTK - Top cap** | 80x80x6 | **2** | M16 | 8,4 | 940 | 832 | 10,1 | 50 | 43 | 0,23 | 11,7 | 201 | 29,2 | 100 | 87 | 0,34 |
| **201L** | **BVNSTK - Horizontal front** | 100x100x10 | **3** | M24 | 13,7 | 1920 | 1660 | 8,3 | 50 | 43 | 0,19 | 19,1 | 452 | 14,1 | 100 | 87 | 0,16 |
| **201T** | **BVNSTK - Horizontal side** | 80x80x6 | **2** | M20 | 0,6 | 940 | 808 | 0,8 | 50 | 43 | 0,02 | 0,9 | 314 | 1,4 | 100 | 87 | 0,02 |
| **202L** | **BVNSTK - CD front** | 100x100x8 | **2** | M24 | 13,4 | 1550 | 1342 | 10,0 | 50 | 43 | 0,23 | 19,2 | 452 | 21,2 | 100 | 87 | 0,24 |

## Check galloping

Datum: 27-7-2021
Auteur: TBR
Versie: 1.0

**GT-RLL**
**HA_n**

| | | | | | Controle netto oppervlak profiel | | | | | | | Controle boutdoorsnede | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Omschrijving** | **Profiel** | **Aantal bouten** | **Bout** | **ΔF;o [kN]** | **Brutto [mm2]** | **Netto [mm2]** | **Δσi;o [Mpa]** | **DC;o [Mpa]** | **Δσ;c;o [Mpa]** | **UC opp.** | **ΔF;b [kN]** | **Opp. Bout [mm2]** | **Δσ;i;b [Mpa]** | **DC;b [Mpa]** | **Δσ;c;b [Mpa]** | **UC bout** |
| **202T** | **BVNSTK - CD side** | 80x80x8 | **2** | M24 | 8,6 | 1230 | 1022 | 8,4 | 50 | 43 | 0,19 | 12,2 | 452 | 13,5 | 100 | 87 | 0,16 |
| **203T** | **BVNSTK - Horizontal side** | 100x100x10 | **5** | M20 | 29,5 | 1920 | 1700 | 17,4 | 50 | 43 | 0,40 | 40,2 | 314 | 25,6 | 100 | 87 | 0,29 |
| **204L** | **BVNSTK - CD front** | 130x130x12 | **3** | M24 | 66,8 | 3000 | 2688 | 24,8 | 50 | 43 | 0,57 | 92,1 | 452 | 68,0 | 100 | 87 | 0,78 |
| **204T** | **BVNSTK - CD side** | 130x130x12 | **3** | M24 | 65,6 | 3000 | 2688 | 24,4 | 50 | 43 | 0,56 | 94,2 | 452 | 69,5 | 100 | 87 | 0,80 |
| **205** | **BVNSTK - Diagonal for crossarm** | 120x120x12 | **4** | M24 | 39,5 | 2750 | 2438 | 16,2 | 50 | 43 | 0,37 | 53,6 | 452 | 29,6 | 100 | 87 | 0,34 |
| **206** | **BVNSTK - CD for crossarm diaphr** | 50x50x5 | **1** | M16 | 0,0 | 480 | 390 | 0,0 | 50 | 43 | 0,00 | 0,0 | 201 | 0,1 | 100 | 87 | 0,00 |
| **207L** | **Derde TSNSTK - CD front** | 130x130x12 | **3** | M24 | 60,9 | 3000 | 2688 | 22,6 | 50 | 43 | 0,52 | 83,9 | 452 | 61,9 | 100 | 87 | 0,71 |
| **207T** | **Derde TSNSTK - CD side** | 130x130x12 | **3** | M24 | 59,8 | 3000 | 2688 | 22,2 | 50 | 43 | 0,51 | 85,8 | 452 | 63,3 | 100 | 87 | 0,73 |
| **208L** | **Derde TSNSTK - Horizontal front** | 120x120x10 | **4** | M24 | 8,7 | 2320 | 2060 | 4,2 | 50 | 43 | 0,10 | 10,6 | 452 | 5,9 | 100 | 87 | 0,07 |
| **208T** | **Derde TSNSTK - Horizontal side** | 120x120x10 | **4** | M24 | 2,1 | 2320 | 2060 | 1,0 | 50 | 43 | 0,02 | 3,1 | 452 | 1,7 | 100 | 87 | 0,02 |
| **209L** | **Derde TSNSTK - CD front** | 130x130x12 | **3** | M24 | 51,4 | 3000 | 2688 | 19,1 | 50 | 43 | 0,44 | 74,4 | 452 | 54,9 | 100 | 87 | 0,63 |
| **209T** | **Derde TSNSTK - CD side** | 130x130x12 | **3** | M24 | 54,0 | 3000 | 2688 | 20,1 | 50 | 43 | 0,46 | 78,1 | 452 | 57,6 | 100 | 87 | 0,66 |
| **210T** | **Derde TSNSTK - Horizontal side** | 120x120x10 | **6** | M20 | 32,3 | 2320 | 2100 | 15,4 | 50 | 43 | 0,35 | 43,5 | 314 | 23,1 | 100 | 87 | 0,27 |
| **211** | **Derde TSNSTK - Diagonal for cros** | 130x130x12 | **4** | M24 | 44,2 | 3000 | 2688 | 16,4 | 50 | 43 | 0,38 | 59,7 | 452 | 33,0 | 100 | 87 | 0,38 |
| **212** | **Derde TSNSTK - CD for crossarm** | 55x55x6 | **1** | M16 | 0,0 | 600 | 492 | 0,1 | 50 | 43 | 0,00 | 0,1 | 201 | 0,3 | 100 | 87 | 0,00 |
| **213L** | **BRKSTK - Main diagonal** | 150x150x14 | **4** | M24 | 37,4 | 4014 | 3650 | 10,2 | 50 | 43 | 0,24 | 47,0 | 452 | 26,0 | 100 | 87 | 0,30 |
| **213T** | **BRKSTK - Main diagonal** | 150x150x14 | **4** | M24 | 37,3 | 4014 | 3650 | 10,2 | 50 | 43 | 0,23 | 46,4 | 452 | 25,7 | 100 | 87 | 0,30 |
| **214L** | **BRKSTK - Diaphragm horizontal** | 120x120x10 | **2** | M24 | 0,4 | 2320 | 2060 | 0,2 | 50 | 43 | 0,00 | 0,5 | 452 | 0,6 | 100 | 87 | 0,01 |
| **214T** | **BRKSTK - Diaphragm horizontal** | 120x120x10 | **2** | M24 | 0,5 | 2320 | 2060 | 0,3 | 50 | 43 | 0,01 | 0,7 | 452 | 0,7 | 100 | 87 | 0,01 |
| **215** | **BRKSTK - Diaphragm diagonal** | 100x100x8 | **1** | M20 | 0,2 | 1550 | 1374 | 0,2 | 50 | 43 | 0,00 | 0,3 | 314 | 1,0 | 100 | 87 | 0,01 |
| **215L** | **Eerste TSNSTK - First diag from b** | 150x150x12 | **3** | M24 | 29,3 | 3480 | 3168 | 9,2 | 50 | 43 | 0,21 | 37,4 | 452 | 27,6 | 100 | 87 | 0,32 |
| **215T** | **Eerste TSNSTK - First diag from b** | 150x150x12 | **3** | M24 | 28,6 | 3480 | 3168 | 9,0 | 50 | 43 | 0,21 | 35,7 | 452 | 26,4 | 100 | 87 | 0,30 |
| **216** | **BRKSTK - Diaphragm CD** | 100x100x8 | **1** | M20 | 0,0 | 1550 | 1374 | 0,0 | 50 | 43 | 0,00 | 0,0 | 314 | 0,0 | 100 | 87 | 0,00 |
| **216L** | **Eerste TSNSTK - First CD from bo** | 150x150x12 | **4** | M24 | 35,5 | 3480 | 3168 | 11,2 | 50 | 43 | 0,26 | 44,8 | 452 | 24,8 | 100 | 87 | 0,29 |
| **216T** | **Eerste TSNSTK - First CD from bo** | 150x150x12 | **4** | M24 | 36,0 | 3480 | 3168 | 11,4 | 50 | 43 | 0,26 | 45,3 | 452 | 25,0 | 100 | 87 | 0,29 |
| **217L** | **Tweede TSNSTK - First CD from b** | 140x140x13 | **4** | M24 | 43,4 | 3521 | 3183 | 13,6 | 50 | 43 | 0,31 | 54,8 | 452 | 30,3 | 100 | 87 | 0,35 |
| **217T** | **Tweede TSNSTK - First CD from b** | 140x140x13 | **4** | M24 | 44,0 | 3521 | 3183 | 13,8 | 50 | 43 | 0,32 | 55,4 | 452 | 30,6 | 100 | 87 | 0,35 |
| **218L** | **Tweede TSNSTK - Second CD fror** | 140x140x13 | **4** | M24 | 53,1 | 3521 | 3183 | 16,7 | 50 | 43 | 0,38 | 67,0 | 452 | 37,1 | 100 | 87 | 0,43 |
| **218T** | **Tweede TSNSTK - Second CD fror** | 140x140x13 | **4** | M24 | 53,8 | 3521 | 3183 | 16,9 | 50 | 43 | 0,39 | 67,6 | 452 | 37,4 | 100 | 87 | 0,43 |
| **219L** | **Tweede TSNSTK - Third CD from** | 140x140x13 | **5** | M24 | 64,6 | 3521 | 3183 | 20,3 | 50 | 43 | 0,47 | 81,6 | 452 | 36,1 | 100 | 87 | 0,42 |
| **219T** | **Tweede TSNSTK - Third CD from** | 140x140x13 | **5** | M24 | 65,5 | 3521 | 3183 | 20,6 | 50 | 43 | 0,47 | 82,4 | 452 | 36,5 | 100 | 87 | 0,42 |
| **300** | **Eerste DWSRM CD 1 under** | 80x80x6 | **2** | M20 | 14,1 | 940 | 808 | 17,5 | 50 | 43 | 0,40 | 19,6 | 314 | 31,3 | 100 | 87 | 0,36 |
| **301** | **Eerste DWSRM CD 2 under** | 80x80x6 | **2** | M20 | 16,5 | 940 | 808 | 20,5 | 50 | 43 | 0,47 | 23,0 | 314 | 36,6 | 100 | 87 | 0,42 |
| **302** | **Eerste DWSRM CD 3 under** | 80x80x6 | **2** | M20 | 17,8 | 940 | 808 | 22,0 | 50 | 43 | 0,51 | 24,7 | 314 | 39,4 | 100 | 87 | 0,45 |
| **303** | **Eerste DWSRM CD 4 under** | 80x80x6 | **2** | M20 | 19,6 | 940 | 808 | 24,2 | 50 | 43 | 0,56 | 27,2 | 314 | 43,4 | 100 | 87 | 0,50 |

## Check galloping

Datum: 27-7-2021
Auteur: TBR
Versie: 1.0

**GT-RLL**
**HA_n**

| | | | | | Controle netto oppervlak profiel | | | | | | | Controle boutdoorsnede | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Omschrijving** | **Profiel** | **Aantal bouten** | **Bout** | **ΔF;o [kN]** | **Brutto [mm2]** | **Netto [mm2]** | **Δσi;o [Mpa]** | **DC;o [Mpa]** | **Δσ;c;o [Mpa]** | **UC opp.** | **ΔF;b [kN]** | **Opp. Bout [mm2]** | **Δσ;i;b [Mpa]** | **DC;b [Mpa]** | **Δσ;c;b [Mpa]** | **UC bout** |
| **304** | **Eerste DWSRM CD 5 under** | 80x80x6 | **2** | M20 | 20,6 | 940 | 808 | 25,5 | 50 | 43 | 0,59 | 28,6 | 314 | 45,6 | 100 | 87 | 0,52 |
| **305** | **Eerste DWSRM CD 6 under** | 70x70x6 | **2** | M20 | 9,7 | 810 | 678 | 14,2 | 50 | 43 | 0,33 | 14,7 | 314 | 23,5 | 100 | 87 | 0,27 |
| **306** | **Eerste DWSRM CD 7 under** | 70x70x6 | **2** | M20 | 11,4 | 810 | 678 | 16,9 | 50 | 43 | 0,39 | 17,4 | 314 | 27,8 | 100 | 87 | 0,32 |
| **307** | **Eerste DWSRM CD 8 under** | 70x70x6 | **2** | M20 | 12,9 | 810 | 678 | 19,1 | 50 | 43 | 0,44 | 19,7 | 314 | 31,4 | 100 | 87 | 0,36 |
| **308** | **Eerste DWSRM CD 9 under** | 70x70x6 | **2** | M20 | 15,9 | 810 | 678 | 23,5 | 50 | 43 | 0,54 | 24,3 | 314 | 38,7 | 100 | 87 | 0,44 |
| **309** | **Eerste DWSRM CD 10 under** | 70x70x6 | **2** | M20 | 18,2 | 810 | 678 | 26,9 | 50 | 43 | 0,62 | 27,8 | 314 | 44,3 | 100 | 87 | 0,51 |
| **311** | **Eerste DWSRM CD 12 under** | 70x70x6 | **1** | M20 | 7,4 | 810 | 678 | 11,0 | 50 | 43 | 0,25 | 11,4 | 314 | 36,2 | 100 | 87 | 0,42 |
| **312** | **Eerste DWSRM 2&3 horiz under** | 150x150x14 (not coupled) | **2** | M20 | 19,4 | 8028 | 7720 | 2,5 | 50 | 43 | 0,06 | 27,0 | 314 | 43,0 | 100 | 87 | 0,49 |
| **313** | **Eerste DWSRM Diag between hor** | 80x80x8 | **1** | M24 | 11,6 | 1230 | 1022 | 11,3 | 50 | 43 | 0,26 | 15,5 | 452 | 34,3 | 100 | 87 | 0,39 |
| **316** | **Eerste DWSRM horiz 6&7** | 150x150x14 (not coupled) | **2** | M20 | 8,7 | 8028 | 7720 | 1,1 | 50 | 43 | 0,03 | 13,3 | 314 | 21,2 | 100 | 87 | 0,24 |
| **319** | **1ste DWSRM front bracing 1** | 70x70x6 | **2** | M20 | 5,1 | 810 | 678 | 7,5 | 50 | 43 | 0,17 | 7,1 | 314 | 11,3 | 100 | 87 | 0,13 |
| **320** | **1ste DWSRM front bracing 2** | 70x70x6 | **1** | M20 | 3,6 | 810 | 678 | 5,3 | 50 | 43 | 0,12 | 5,1 | 314 | 16,1 | 100 | 87 | 0,19 |
| **321** | **1ste DWSRM front bracing 3** | 80x80x6 | **2** | M20 | 7,6 | 940 | 808 | 9,4 | 50 | 43 | 0,22 | 10,7 | 314 | 17,0 | 100 | 87 | 0,20 |
| **322** | **1ste DWSRM front bracing 4** | 70x70x6 | **1** | M20 | 0,7 | 810 | 678 | 1,0 | 50 | 43 | 0,02 | 0,9 | 314 | 2,9 | 100 | 87 | 0,03 |
| **323** | **1ste DWSRM front bracing 5** | 70x70x6 | **1** | M16 | 1,7 | 810 | 702 | 2,4 | 50 | 43 | 0,06 | 2,6 | 201 | 12,9 | 100 | 87 | 0,15 |
| **324** | **1ste DWSRM front bracing 6** | 50x50x5 | **1** | M16 | 0,2 | 480 | 390 | 0,4 | 50 | 43 | 0,01 | 0,3 | 201 | 1,3 | 100 | 87 | 0,01 |
| **325** | **1ste DWSRM section BB CD** | 50x50x5 | **1** | M16 | 1,0 | 480 | 390 | 2,4 | 50 | 43 | 0,06 | 1,3 | 201 | 6,6 | 100 | 87 | 0,08 |
| **326** | **1ste DWSRM section BB horiz** | 60x60x6 | **1** | M16 | 0,5 | 690 | 582 | 0,9 | 50 | 43 | 0,02 | 0,7 | 201 | 3,6 | 100 | 87 | 0,04 |
| **327** | **1ste DWSRM section horiz on top** | 60x60x6 | **1** | M16 | 1,2 | 690 | 582 | 2,0 | 50 | 43 | 0,05 | 1,5 | 201 | 7,6 | 100 | 87 | 0,09 |
| **328** | **1ste DWSRM diag on top** | 50x50x5 | **0** | | 0,2 | 480 | 480 | 0,3 | 50 | 43 | 0,01 | 0,2 | 0 | 0,0 | 100 | 87 | 0,00 |
| **329** | **1ste DWSRM preekstoel leuning** | 70x70x7 | **0** | | 0,3 | 940 | 940 | 0,3 | 50 | 43 | 0,01 | 0,4 | 0 | 0,0 | 100 | 87 | 0,00 |
| **330** | **1ste DWSRM preekstoel ligger** | 100x50x6 | **0** | | 0,0 | 870 | 870 | 0,0 | 50 | 43 | 0,00 | 0,0 | 0 | 0,0 | 100 | 87 | 0,00 |
| **331** | **1ste DWSRM preekstoel stijl** | 50x50x5 | **0** | | 0,2 | 480 | 480 | 0,3 | 50 | 43 | 0,01 | 0,2 | 0 | 0,0 | 100 | 87 | 0,00 |
| **400** | **Tweede DWSRM - Main diagonal** | 120x120x10 | **3** | M24 | 23,2 | 2320 | 2060 | 11,3 | 50 | 43 | 0,26 | 35,5 | 452 | 26,2 | 100 | 87 | 0,30 |
| **401** | **Tweede DWSRM - Vertical front** | 50x50x5 | **1** | M16 | 0,7 | 480 | 390 | 1,8 | 50 | 43 | 0,04 | 1,0 | 201 | 5,2 | 100 | 87 | 0,06 |
| **402** | **Tweede DWSRM - Vertical front** | 50x50x5 | **1** | M16 | 4,5 | 480 | 390 | 11,5 | 50 | 43 | 0,26 | 6,8 | 201 | 33,9 | 100 | 87 | 0,39 |
| **403** | **Tweede DWSRM - Vertical front** | 70x70x6 | **1** | M16 | 3,5 | 810 | 702 | 4,9 | 50 | 43 | 0,11 | 5,2 | 201 | 26,1 | 100 | 87 | 0,30 |
| **404** | **Tweede DWSRM - Vertical front** | 90x90x9 | **3** | M24 | 9,2 | 1539 | 1305 | 7,0 | 50 | 43 | 0,16 | 12,8 | 452 | 9,5 | 100 | 87 | 0,11 |
| **405** | **Tweede DWSRM - Diagonal front** | 60x60x6 | **1** | M16 | 0,2 | 690 | 582 | 0,3 | 50 | 43 | 0,01 | 0,3 | 201 | 1,3 | 100 | 87 | 0,02 |
| **406** | **Tweede DWSRM - Diagonal front** | 60x60x6 | **1** | M16 | 0,0 | 690 | 582 | 0,1 | 50 | 43 | 0,00 | 0,1 | 201 | 0,3 | 100 | 87 | 0,00 |
| **407** | **Tweede DWSRM - Diagonal front** | 50x50x5 | **1** | M16 | 0,1 | 480 | 390 | 0,1 | 50 | 43 | 0,00 | 0,1 | 201 | 0,4 | 100 | 87 | 0,00 |
| **408** | **Tweede DWSRM - under diag** | 60x60x6 | **2** | M16 | 8,5 | 690 | 582 | 14,6 | 50 | 43 | 0,34 | 13,0 | 201 | 32,2 | 100 | 87 | 0,37 |
| **409** | **Tweede DWSRM - horiz on top** | 60x60x6 | **1** | M16 | 0,1 | 690 | 582 | 0,2 | 50 | 43 | 0,01 | 0,2 | 201 | 1,1 | 100 | 87 | 0,01 |
| **411** | **Tweede DWSRM - CD top** | 70x70x6 | **1** | M20 | 7,3 | 810 | 678 | 10,8 | 50 | 43 | 0,25 | 11,1 | 314 | 35,2 | 100 | 87 | 0,40 |
| **412** | **Tweede DWSRM - CD top** | 70x70x6 | **1** | M20 | 8,4 | 810 | 678 | 12,4 | 50 | 43 | 0,28 | 12,7 | 314 | 40,4 | 100 | 87 | 0,46 |

## Check galloping

Datum: 27-7-2021
Auteur: TBR
Versie: 1.0

**GT-RLL**
**HA_n**

| | | | | | Controle netto oppervlak profiel | | | | | | | Controle boutdoorsnede | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Omschrijving** | **Profiel** | **Aantal bouten** | **Bout** | **ΔF;o [kN]** | **Brutto [mm2]** | **Netto [mm2]** | **Δσi;o [Mpa]** | **DC;o [Mpa]** | **Δσ;c;o [Mpa]** | **UC opp.** | **ΔF;b [kN]** | **Opp. Bout [mm2]** | **Δσ;i;b [Mpa]** | **DC;b [Mpa]** | **Δσ;c;b [Mpa]** | **UC bout** |
| **413** | **Tweede DWSRM - CD top** | 70x70x6 | **1** | M20 | 10,4 | 810 | 678 | 15,3 | 50 | 43 | 0,35 | 15,6 | 314 | 49,8 | 100 | 87 | 0,57 |
| **414** | **Tweede DWSRM - CD top** | 50x50x5 | **1** | M16 | 2,4 | 480 | 390 | 6,2 | 50 | 43 | 0,14 | 3,4 | 201 | 16,9 | 100 | 87 | 0,19 |
| **415** | **Tweede DWSRM - CD top** | 50x50x5 | **1** | M16 | 3,1 | 480 | 390 | 7,9 | 50 | 43 | 0,18 | 4,3 | 201 | 21,5 | 100 | 87 | 0,25 |
| **416** | **Tweede DWSRM - CD top** | 50x50x5 | **1** | M16 | 3,1 | 480 | 390 | 7,9 | 50 | 43 | 0,18 | 4,3 | 201 | 21,6 | 100 | 87 | 0,25 |
| **417** | **Tweede DWSRM - CD top** | 50x50x5 | **1** | M16 | 4,1 | 480 | 390 | 10,5 | 50 | 43 | 0,24 | 5,7 | 201 | 28,6 | 100 | 87 | 0,33 |
| **418** | **Tweede DWSRM - CD top** | 60x60x6 | **1** | M16 | 5,2 | 690 | 582 | 9,0 | 50 | 43 | 0,21 | 7,3 | 201 | 36,5 | 100 | 87 | 0,42 |
| **418A** | **Tweede DWSRM - CD top** | 60x60x6 | **2** | M16 | 7,7 | 690 | 582 | 13,3 | 50 | 43 | 0,31 | 10,9 | 201 | 27,0 | 100 | 87 | 0,31 |
| **419** | **Tweede DWSRM - CD UNP top** | UNP160 | **1** | M20 | 4,2 | 2400 | 2235 | 1,9 | 50 | 43 | 0,04 | 5,9 | 314 | 18,7 | 100 | 87 | 0,22 |
| **422** | **Tweede DWSRM - CD under 1** | 70x70x6 | **2** | M20 | 5,1 | 810 | 678 | 7,5 | 50 | 43 | 0,17 | 7,7 | 314 | 12,3 | 100 | 87 | 0,14 |
| **423** | **Tweede DWSRM - CD under 2** | 70x70x6 | **2** | M20 | 5,8 | 810 | 678 | 8,6 | 50 | 43 | 0,20 | 8,9 | 314 | 14,1 | 100 | 87 | 0,16 |
| **424** | **Tweede DWSRM - CD under 3** | 70x70x6 | **2** | M20 | 6,3 | 810 | 678 | 9,3 | 50 | 43 | 0,21 | 9,6 | 314 | 15,3 | 100 | 87 | 0,18 |
| **425** | **Tweede DWSRM - CD under 4** | 70x70x6 | **2** | M20 | 6,1 | 810 | 678 | 9,0 | 50 | 43 | 0,21 | 9,3 | 314 | 14,7 | 100 | 87 | 0,17 |
| **426** | **Tweede DWSRM - CD under 5** | 70x70x6 | **2** | M20 | 13,3 | 810 | 678 | 19,7 | 50 | 43 | 0,45 | 20,4 | 314 | 32,4 | 100 | 87 | 0,37 |
| **427** | **Tweede DWSRM - CD under 6** | 70x70x6 | **2** | M20 | 17,7 | 810 | 678 | 26,0 | 50 | 43 | 0,60 | 26,9 | 314 | 42,9 | 100 | 87 | 0,49 |
| **428** | **Tweede DWSRM - CD under 7** | 70x70x6 | **2** | M20 | 19,3 | 810 | 678 | 28,5 | 50 | 43 | 0,66 | 29,5 | 314 | 46,9 | 100 | 87 | 0,54 |
| **429** | **Tweede DWSRM - CD under 8** | 70x70x7 | **1** | M16 | 0,7 | 940 | 814 | 0,8 | 50 | 43 | 0,02 | 1,0 | 201 | 5,0 | 100 | 87 | 0,06 |
| **430** | **2e DWSRM diag verband** | 60x60x6 | **1** | M16 | 8,8 | 690 | 582 | 15,2 | 50 | 43 | 0,35 | 13,5 | 201 | 67,0 | 100 | 87 | 0,77 |
| **431** | **2e DWSRM kniksteun** | 50x50x5 | **1** | M16 | 2,4 | 480 | 390 | 6,1 | 50 | 43 | 0,14 | 3,6 | 201 | 17,9 | 100 | 87 | 0,21 |
| **432** | **2e DWSRM kniksteun** | 50x50x5 | **1** | M16 | 1,3 | 480 | 390 | 3,4 | 50 | 43 | 0,08 | 2,0 | 201 | 10,0 | 100 | 87 | 0,11 |
| **436** | **Tweede DWSRM - Horizontal und** | 150x150x14 (not coupled) | **3** | M20 | 14,1 | 8028 | 7720 | 1,8 | 50 | 43 | 0,04 | 21,5 | 314 | 22,8 | 100 | 87 | 0,26 |
| **437** | **Tweede DWSRM - diagonaal katt** | 55x55x6 | **1** | M16 | 2,8 | 600 | 492 | 5,7 | 50 | 43 | 0,13 | 4,1 | 201 | 20,2 | 100 | 87 | 0,23 |

## About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

## B.12 Mastrapportage

ZUID-WEST 380 KV OOST VERBINDINGEN

# Mastrapportage GT-RLL S+0/n

TenneT TSO B.V.

**Meridian doc.nr.:** 002.678.00 0934574
**Rapport nr.:** 21-0889, Rev. 1
**Datum:** 06-08-2021

| | |
|---|---|
| DATUM: | 01-10-2021 |
| STATUS TENNET: | DEFINITIEF |
| REVISIE TENNET: | 1.0 |

| | | |
|---|---|---|
| Projectnaam: | Zuid-West 380 kV Oost Verbindingen | Energy Systems |
| Rapport titel: | Mastrapportage GT-RLL S+0/n | DNV Netherlands B.V. |
| Klant: | TenneT TSO B.V. | Utrechtseweg 310-B50 |
| Contactpersoon klant: | [redacted] | 6812 AR Arnhem |
| Datum uitgave: | 06-08-2021 | |
| Project nr.: | 10124719 | |
| Organisatie unit: | TDT | Tel: 026 356 9111 |
| Meridian doc.nr..: | 002.678.00 0934574 | Handelsregister Arnhem 09006404 |
| Rapport nr.: | 21-0889, Rev. 1 | |

[redacted]

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|---|---|---|---|---|---|
| 0 | 18-06-2021 | Eerste uitgave | [redacted] | | |
| 1 | 06-08-2021 | Aanpassingen n.a.v. RFA | | | |

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# 1 INLEIDING

In het basisontwerp van de vakwerkmasten voor de verbinding GT-RLL380 in het project Zuid-West 380 kV-Oost zijn voor het vaststellen van de haalbaarheid constructieve berekeningen uitgevoerd aan de masten en fundaties. In de Definitief Ontwerpfase, moeten berekeningen verder worden uitgewerkt om te kunnen dienen voor de benodigde vergunningsdocumentatie, voor de aanbesteding en als voorbereiding voor de uitvoeringsfase. Het DO omvat het ontwerp van de mastconstructies, de fundaties en de opstijgpunten in de verbinding.

Deze rapportage bevat de resultaten van de toetsing van masttype S+0/n voor de reconstructie. Deze mast is gebaseerd op het bestaande S+0 masttype uit de verbinding GT-RLL380 met de aanpassingen om te voldoen aan de belasting uit de nieuwe situatie en de huidige ontwerpeisen van TenneT.

In deze rapportage is de toetsing van de mast van de steunmast S+0/n opgenomen. De toetsing bestaat uit controle van:

- de profielen en boutverbindingen onderdeel van de hoofddraagconstructie
- de knikverkorters
- de verbinding met de fundatie via blokdeuvels
- de liggers voor de isolatorkettingen.

Buiten de scope van dit DO-rapport valt de controle van de schetsplaten en overige verbindingsdetails in de constructie. Dit moet in de UO-fase worden uitgewerkt. Ook de voorzieningen voor de bordessen vallen onder uitwerking in UO-fase.

In hoofdstuk 2 zijn de uitgangspunten en randvoorwaarden vanuit de van toepassing zijnde normen en TenneT-specificaties opgenomen. Hoofdstuk 3 beschrijft de gevolgde aanpak van de berekening. In hoofdstuk 4 is de toetsing opgenomen.

# 2 UITGANGSPUNTEN EN RANDVOORWAARDEN

## 2.1 Normen

Er is gebruik gemaakt van de normen volgens Tabel 1.

**Tabel 1 Gebruikgemaakte normen, voorschriften en richtlijnen**

| Norm | Titel |
|---|---|
| NEN-EN 50341-1:2013 | "Overhead electrical lines exceeding AC 1 kV - Part 1: General requirements – Common" |
| NEN-EN 50341-2-15:2019 | "Overhead electrical lines exceeding AC 1 kV Part 2 National Normative Aspects (NNA) for THE NETHERLANDS" |
| NEN-EN 1990+A1+A1/C2:2019/NB:2019nl | "Grondslagen van het ontwerp" |
| NEN-EN 1991-1-4+A1+C2:2011/NB:2019+C1:2020 | "Deel 1-4: Windbelasting op constructies" |
| NEN-EN 1992-1-1+C2:2011/NB:2016+A1:2020 | "Eurocode 2: Ontwerp en berekening van betonconstructies, deel 1-1: algemene regels en regels voor gebouwen" |
| NEN-EN 1993-1-1+C2+A1:2016 nl | "Eurocode 3: Ontwerp en berekening van staalconstructies, deel 1-1: algemene regels en regels voor gebouwen" |
| NEN-EN 1993-3-1:2007/NB:2011 nl | "Deel 3-1: Torens, masten en schoorstenen - Torens en masten" |
| NEN-EN 1993-1-8+C2:2011/NB:2011 nl | "Ontwerp en berekening van staalconstructies, deel 1-8: ontwerp en berekening van verbindingen" |

## 2.2 TenneT-specificaties

In Tabel 2 zijn de documenten opgenomen die relevant zijn voor de berekeningen en toetsingen die binnen dit project in de mastrapportage uitgevoerd zullen worden.

**Tabel 2 Relevante documenten t.b.v. mechanische rapportages**

| Nummer | Onderwerp |
|---|---|
| PVE.05.000 v3.2 | PvE Lijnen |
| sPVE.05.001 | sPvE Lijnen |
| SPE.05.346 v1.3 | Algemene specificatie stalen masten |

## 2.3 Eisenverificatie

Voor de eisenverificatie wordt verwezen naar het rapport "Verificatierapport eisen reconstructies".

## 2.4 Ontwerprapporten

Voor de achtergrond van het ontwerp wordt verwezen naar het uitgangspuntenrapport "D1.3 Uitgangspunten reconstructies", DNV GL rapport 21-0702, Meridiannummer 002.678.00 0927721.

## 2.5 Materialen

Voor het ontwerp van de mastconstructies en fundaties wordt uitgegaan van de eigenschappen volgens Tabel 3.

**Tabel 3 Materialen aangepaste constructie**

| | |
|---|---|
| Staalsoort | S355J0 (t≤16 mm)<br>S355J2 (16<t≤40 mm) |
| Boutkwaliteit | 8.8 gerolde draad |
| Betonkwaliteit | C30/37 |
| Wapeningsstaal | B500 |

Voor de constructie geldt conform TenneT-specificatie:

- Toe te passen bouten: M16/M20/M24
- Voor hoekstaal is de minimale afmeting L50x5 mm
- Minimale plaatdikte 6 mm.

Mocht het noodzakelijk zijn M30 toe te passen, bij grote plaatdiktes is dit als afwijking door TenneT toegestaan.

## 2.6 Software

De gebruikte software wordt benoemd in Tabel 4.

**Tabel 4 Toegepaste software**

| Software | | Versie |
|---|---|---|
| Mastontwerp | PLS-CADD | 16.65 |
| Mastberekeningen | PLS-TOWER | 16.65 |
| Constructieve analyse | AxisVM | X5 R4h |

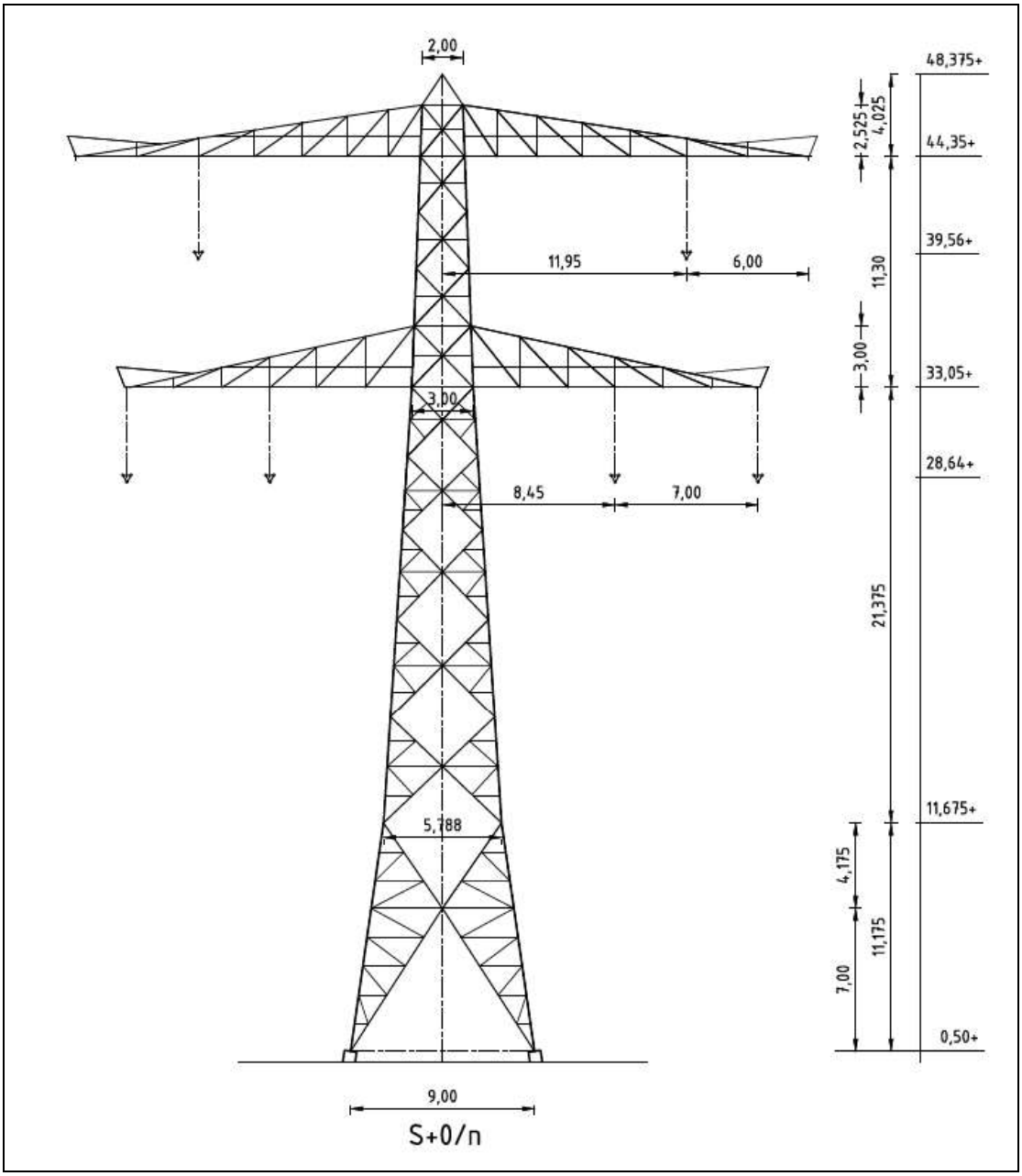
# 3 MASTONTWERP

## 3.1 Mastbeelden

In dit hoofdstuk worden de mastbeelden weergegeven met de belangrijkste maatvoering, de figuren zijn ontleend aan de bij deze rapportage horende tekeningen van de masttypen. Het gaat om de volgende tekeningen:

- Overzichtstekening S+0/n, Meridiannummer 002.678.00 0934591
- Principedetails GT-RLL, Meridiannummer 002.678.00 0935108.

Masttype reconstructie S+0/n is een steunmast voor twee circuits 380 kV.




**Figuur 1 Mastbeeld masttype S+0/n**

## 3.2 Uitgangspunten berekening

De uitgangspunten volgens Tabel 5 zijn van toepassing.

**Tabel 5 Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 50 jaar |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

## 3.3 Mastenlijst

In Tabel 6 tot en met Tabel 7 zijn alle masten in het tracé van het type S+0/n opgenomen. De mast met grootste wind span is vetgedrukt aangegeven. Het masttype zal niet met deze wind en weight span worden berekend maar met generieke wind en weight span, zie uitgangspuntenrapport.

**Tabel 6 Mastenlijst HA+0**

| Mast-nummer | Masttype | Lijnhoek (°) | Wind span (m) | Weight span (m) | Hoogteverschil ba+ah (m) | Hoogte-verschil back (m) | Hoogte-verschil ahead (m) |
|---|---|---|---|---|---|---|---|
| 75N | S+0_n | 180,0 | 355,1 | 358,1 | 0,8 | 0,4 | 0,3 |
| 74N | S+0_n | 180,0 | 347,1 | 347,0 | 0,0 | -0,3 | 0,3 |
| 23N | S+0_n | 180,0 | 357,1 | 359,1 | 0,5 | 0,4 | 0,1 |
| **22N** | S+0_n | 180,0 | 378,2 | 378,1 | 0,0 | -0,1 | 0,1 |
| 21N | S+0_n | 180,0 | 367,0 | 366,2 | -0,2 | -0,1 | -0,1 |
| 20N | S+0_n | 180,0 | 354,6 | 353,8 | -0,2 | 0,1 | -0,3 |
| 19N | S+0_n | 180,0 | 367,7 | 352,1 | -4,2 | 0,3 | -4,5 |

## 3.4 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV GL. De belastingen op de mastconstructie zijn bepaald op basis van de modellering in PLS-TOWER (staafoppervlaktes). Voor de toeslagen op eigen gewicht en windoppervlakte wordt verwezen naar het uitgangspuntenrapport. In Appendix A zijn de resultaten van de geleiderbelastingen samengevat.

## 3.5 Reacties op de fundering

De oplegreacties op de fundering worden ontleend aan de uitvoer van het geleiderbelastingenprogramma. Zie Appendix A.

## 3.6 Modellering

Op basis van de ontwerptekeningen is de mast in PLS-TOWER ingevoerd. De toetsing wordt per staafgroep uitgevoerd. De hoofdelementen zijn gemodelleerd, niet-dragende profielen als knikverkorters zijn weggelaten, deze worden separaat getoetst. De profielen zijn in PLS-TOWER inclusief de boutverbindingen ingevoerd en getoetst, de controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

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

De gewichts- en windbelasting op de mastconstructie wordt door PLS-TOWER automatisch bepaald. Via toeslagfactoren wordt de invloed van niet gemodelleerde elementen als knikverkorters, bordesconstructies en klimvoorzieningen meegenomen. Voor schetsplaten, zinklaag en bouten is een aanvullende toeslag op het gewicht van 20% toeslag gerekend.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep.

## 3.7 Overige controles

In PLS-TOWER zijn niet alle elementen getoetst. Knikverkorterprofielen en overige profielen voor beloopbaarheid worden separaat getoetst. In Appendix C is dit opgenomen. De verbinding met de fundatie bestaat uit ingestorte profielen voorzien van blokdeuvels. Dit is in Appendix D opgenomen. De liggers van isolatorkettingen worden belast op buiging. Deze zijn hierop onderzocht, dit is in Appendix E opgenomen.

## 3.8 Mastgewicht

Het totale mastgewicht per masttype is met de uitgangspunten van paragraaf 3.6 bepaald op:

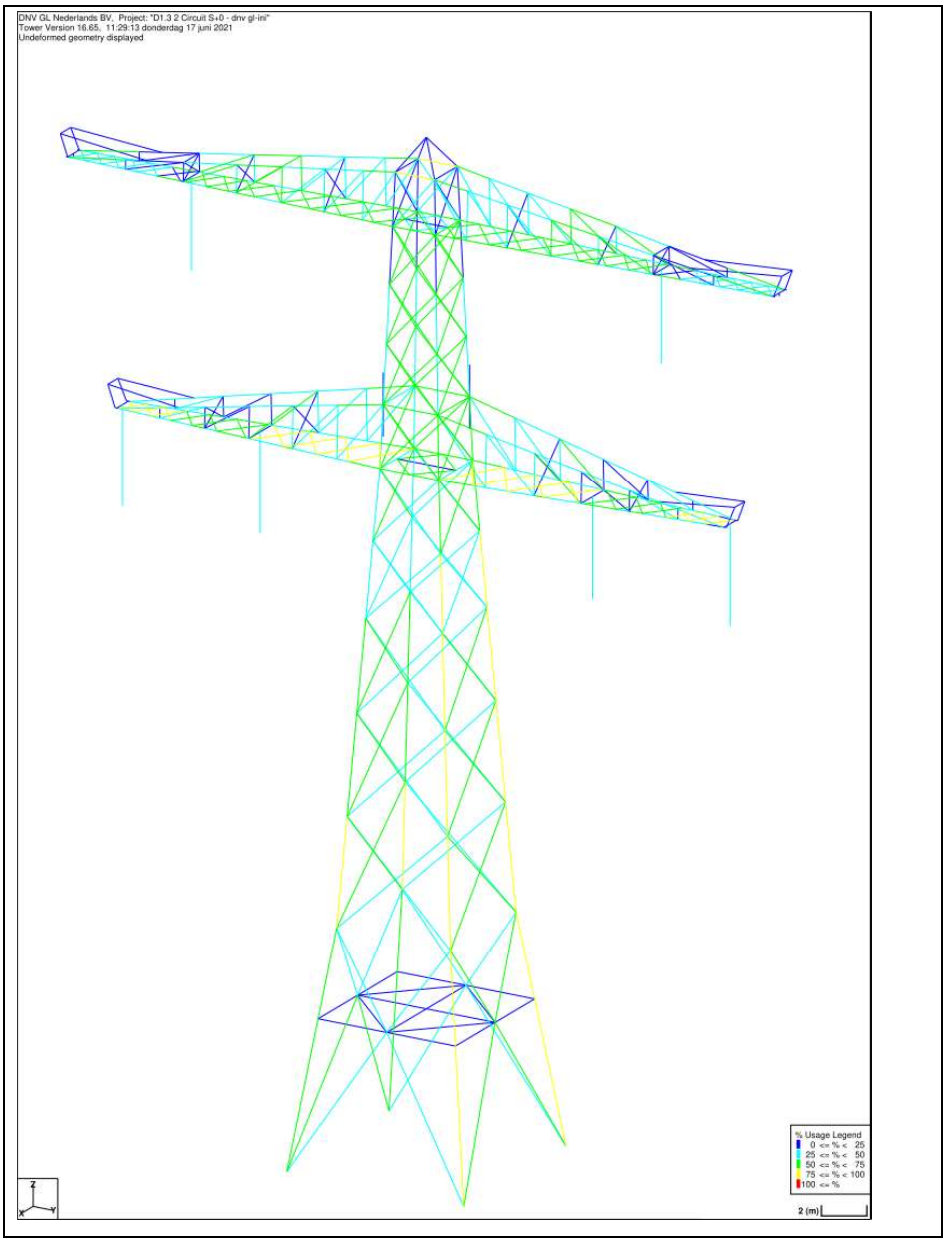
Het gewicht van masttype S+0/n is bepaald op 25,7 ton.

# 4 TOETSING

## 4.1 Resultaat PLS-TOWER

Het resultaat van de toetsing met PLS-TOWER is per masttype weergegeven in Figuur 3 en Figuur 4. Voor elk masttype zijn de belastingen apart bepaald. Alléén voor masttype S+0/n, bepalend voor het ontwerp van de mastkop, zijn deze ook inclusief afspannen.

De uitnutting van de constructie loopt op van blauw (0-25%) tot geel (75-100%). Uit de figuur wordt geconcludeerd dat alle profielen en boutverbindingen voldoen.




**Figuur 2 Resultaat PLS-TOWER voor de steunmast S+0/n**

## 4.2 Toetsing overige onderdelen

In Tabel 8 zijn de resultaten van de uitgevoerde toetsingen weergegeven.

**Tabel 7 Samenvatting uitgevoerde controles**

| Controle van | Beoordeling | Referentie |
|---|---|---|
| Profielen | Voldoen | Figuur 4<br>Figuur 3<br>Appendix B |
| Knikverkorters | Voldoen | Appendix C |
| Blokdeuvels randstijl | Voldoen | Appendix D |
| Liggers | Voldoet | Appendix E |

# APPENDIX A
# Geleiderbelastingen

Geleiderbelastingen opgenomen:

- Masttype S+0/n.

## Inhoud


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


## Gegevens

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initieel* | |
| Gevolgklasse | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 50 jaar |
| *Na aanpassing* | |
| Gevolgklasse | n.v.t. |
| Betrouwbaarheidsniveau | n.v.t. |
| Referentieperiode | n.v.t. |
| Windgebied | III |
| Windsnelheid | 24,5 m/s |
| Terreincategorie | II |
| Reductie factor Cdir | 1,00 |
| IJsgebied | B |
| Masttype | Steunmast |
| Masthoogte | 47,875 m |
| Max. veldlengte | 400 m |
| Lijnhoek | 180° |
| Trekparameter | 1600 m |
| Wind span | 400 m |
| EDS Weight span | 440 m |
| Min. Weight span | 294 m |
| Max. Weight span | 482 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-06-16 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype S+0

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

Document name:

GT-RLL380_S+0_22N_Report.pdf

Project number:

Project client number:

0.0

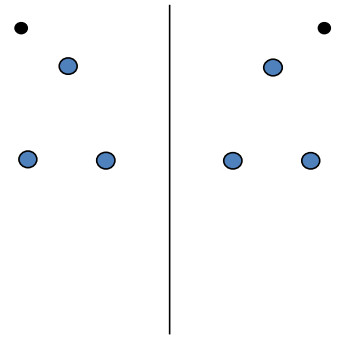
Project: GT-RLL380
Tower: S+0
Number: 22N

## Geleiderbelastingen

Auteur: TBR
Versie: v11.9

**Algemeen**

| | |
|---|---|
| Benaming | S+0 |
| Masttype | Steunmast |
| Aantal circuits | 2 |
| Configuratie | 2-circuit-donau |
| Aantal bliksemgeleiders | 2 |



Configuratie geleiders

**Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau initieel | Nieuwbouw |
| Referentieperiode initieel | 50 jaar |
| | 0 |
| Betrouwbaarheidsniveau na aanpassing | n.v.t. |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 m/s |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

**Geleiders Back**

| Omschrijving | Spanning | Geleider Back | Bundel Ba | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Geleiders Ahead

| Omschrijving | Spanning | Geleider Ahead | Bundel Ah | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Isolatoren *(1)*

| Omschrijving | Ophanging | Gewicht [kN] | Lengte [m] | Windopp. [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Halfverankering | 5,00 | 4,50 | 2,40 |
| Circuit 2 | Halfverankering | 5,00 | 4,50 | 2,40 |
| Bliksemdraad 1 | Vast (Bliksemdraad) | 0,10 | 0,20 | 0,10 |
| Bliksemdraad 2 | Vast (Bliksemdraad) | 0,10 | 0,20 | 0,10 |

1. Eigenschappen gelden voor geheel van de isolatorset

**Ophanghoogte en positie in mast**

| Circuits | Aanduiding | Nummer | Ophanghoogte | Aangrijppunt | Positie in mast Horizontale afstand |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 28,1 m | 32,6 m | -15,5 m |
| Circuit 1 | 11 | 380ct1f2 | 28,1 m | 32,6 m | -8,5 m |
| Circuit 1 | 12 | 380ct1f3 | 39,4 m | 43,9 m | -12,0 m |
| Circuit 2 | 20 | 380ct2f1 | 28,1 m | 32,6 m | 8,5 m |
| Circuit 2 | 21 | 380ct2f2 | 28,1 m | 32,6 m | 15,5 m |
| Circuit 2 | 22 | 380ct2f3 | 39,4 m | 43,9 m | 12,0 m |
| Bliksemdraad 1 | 1 | bl1 | 43,7 m | 43,9 m | -18,0 m |
| Bliksemdraad 2 | 3 | bl2 | 43,7 m | 43,9 m | 18,0 m |

Project: GT-RLL380
Tower: S+0
Number: 22N

**Hoogteaanpassing naastgelegen masten** (aanpassing wind- en weight span)

| | Back | Ahead | |
|---|---|---|---|
| Verhoging voor windbelasting | 5,0 m | 5,0 m | (positief: omhoog) |
| Verlaging voor verticale belasting | -5,0 m | -5,0 m | (negatief: omlaag, grotere weight span) |

Verlaging: Niet in 0,9EG-combinaties

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

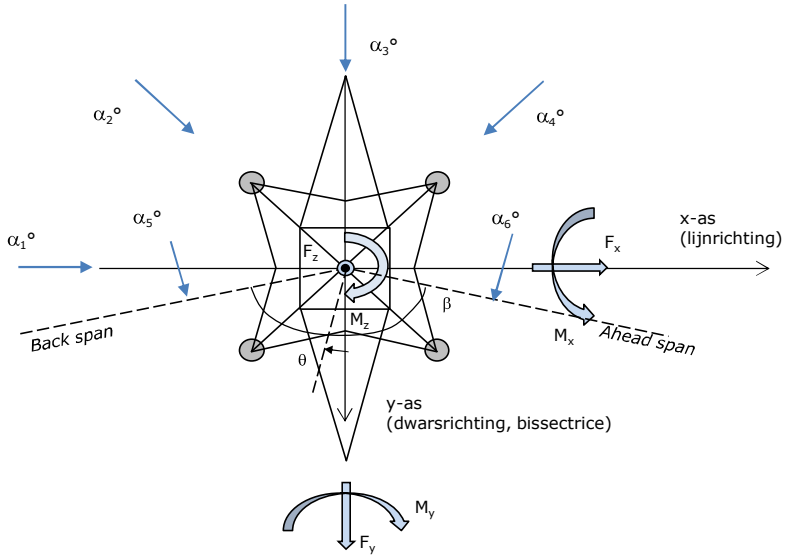
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Lijn- en mastgegevens**

| | | Back | Ahead |
|---|---|---|---|
| | | 400,0 | 400,0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 400,0 | 400,0 m |
| Lijnhoek | $\beta$ | 180 ° | |
| Rotatie mast t.o.v. bissectrice | $\theta$ | 0 ° | |
| Vaklengte | | 800 | 800 m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 m | |
| Beschouwde windrichtingen | $\alpha_1$ | 0 ° | |
| Windrichtingen volgens: | $\alpha_2$ | 45 ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 ° | |
| | $\alpha_4$ | 135 ° | |
| | $\alpha_5$ | - ° | |
| | $\alpha_6$ | - ° | |

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

Windrichtingen en positieve richtingen belastingen




| Beschouwd aantal windrichtingen | |
|---|---|
| 1a | 4 |
| 3 | 4 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

Project: GT-RLL380
Tower: S+0
Number: 22N

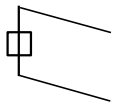
**Geleiderafval**

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

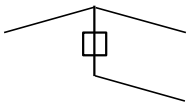
**Belastingsituaties SPLS**

Beschouwde situaties SPLS: SPLS voor steunmast niet van toepassing

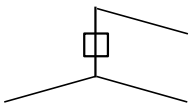
Principe belastingssituaties:



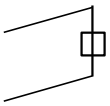
1. Ba All cts



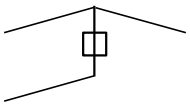
2. Ba ct1



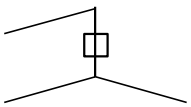
3. Ba ct2



4. Ah All cts



5. Ah ct1

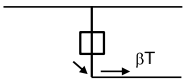


6. Ah ct2

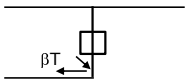
**Belastingsituaties 5a. Geleiderbreuk**

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

Principe belastingssituaties:




1. Ba




2. Ah

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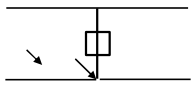
**Belastingsituaties 6. Bouw- en onderhoud**
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht. Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate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

| | Fase | Bliksem |
|---|---|---|
| Lijnwagen | 4,0 kN | 2,0 kN |
| Puntlast op traverse | 1,0 kN | 1,0 kN |

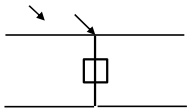
Beschouwde situaties bouw- en onderhoud 6a: 1 en 2, uitgangspunt is symmetrie tussen back / ahead.

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

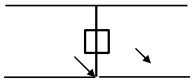
Principe belastingssituaties:



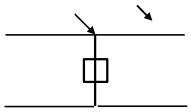
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

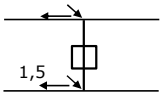
**Belastingsituaties 8. Lijndansen als statische belasting**

| Geleider | | |
|---|---|---|
| Steunmast fase | 0,866 W | 1,5 W |
| Steunmast bliksem | 1,5 EDS | 1,5 W |
| Hoekmast fase en bliksem | 1,5 EDS | 1,5 W |

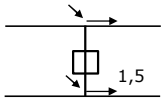
Beschouwde situaties lijndansen 8: 1 en 2, alle mogelijke situaties.

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:




1. Ba




2. Ah

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

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**Mastconstructie**

**Eigenschappen**

| | | | |
|---|---|---|---|
| Masttype | Steunmast | | |
| Mastbenaming | S+0 | | |
| Voetplaat t.o.v. maaiveld | 0,5 | m | |
| Masthoogte t.o.v. voetplaat | 47,9 | m | |
| Gewicht mast | 230,0 | kN | |
| *Breedte en helling mast bij fundatie* | x-ri. | y-ri. | |
| Pootsprei | 9,00 | 9,00 | m |
| Helling van de randstijl | 0,137 | 0,137 | - |
| Factor spatkracht | 1,3 | 1,3 | - |

**Berekening windbelasting**

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

**Eigenschappen mastsecties langsrichting (vooraanzicht, yz-vlak)**

| Omschrijving | 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 | 11,75 | 9,00 | 5,79 | 11,75 | 0,137 | 86,88 | 13,28 | 0,15 | 3,14 |
| Tussenstuk1 | 21,18 | 5,79 | 4,48 | 9,43 | 0,069 | 48,41 | 8,82 | 0,18 | 3,01 |
| Tussenstuk2 | 32,55 | 4,48 | 3,00 | 11,38 | 0,065 | 42,57 | 9,07 | 0,21 | 2,87 |
| Bovenstuk 1 | 38,37 | 3,00 | 2,58 | 5,82 | 0,036 | 16,23 | 4,53 | 0,28 | 2,61 |
| Bovenstuk 2 | 46,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,33 | 4,25 | 0,23 | 2,79 |
| Topstuk | 47,88 | 2,00 | | 1,50 | | 1,50 | 0,29 | 0,19 | 2,97 |
| Ondertraverse | 32,55 | 14,05 | | 3,00 | | 21,07 | 5,48 | 0,26 | 2,68 |
| Boventraverse | 43,85 | 16,94 | | 2,53 | | 21,39 | 6,29 | 0,29 | 2,55 |

**Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)**

| Omschrijving | 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 | 11,75 | 9,00 | 5,79 | 11,75 | 0,137 | 86,88 | 13,28 | 0,15 | 3,14 |
| Tussenstuk1 | 21,18 | 5,79 | 4,48 | 9,43 | 0,069 | 48,41 | 8,82 | 0,18 | 3,01 |
| Tussenstuk2 | 32,55 | 4,48 | 3,00 | 11,38 | 0,065 | 42,57 | 9,07 | 0,21 | 2,87 |
| Bovenstuk 1 | 38,37 | 3,00 | 2,58 | 5,82 | 0,036 | 16,23 | 4,53 | 0,28 | 2,61 |
| Bovenstuk 2 | 46,38 | 2,58 | 2,00 | 8,01 | 0,036 | 18,33 | 4,25 | 0,23 | 2,79 |
| Topstuk | 47,88 | 2,00 | | 1,50 | | 1,50 | 0,29 | 0,19 | 2,97 |
| Ondertraverse | 32,55 | 14,05 | | 3,00 | | 21,07 | 5,48 | 0,26 | 2,68 |
| Boventraverse | 43,85 | 16,94 | | 2,53 | | 21,39 | 6,29 | 0,29 | 2,55 |

*NB: oppervlakte traverse dwarsrichting wordt in berekening gereduceerd.*

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**Windoppervlak feeders telecominstallaties**

| Onderdeel | A ($m^2$/m) | Factor | $\Delta h$ | $A_1$ |
|---|---|---|---|---|
| Broekstuk | 0,20 | 0,71 | 11,8 | 1,7 |
| Tussenstuk1 | 0,20 | 0,71 | 9,4 | 1,3 |
| Tussenstuk2 | 0,20 | 0,71 | 11,4 | 1,6 |
| Bovenstuk 1 | 0,20 | 0,71 | 5,8 | 0,8 |
| Bovenstuk 2 | | | | |

**Invoer antennes**

| Omschrijving | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne top | | | |
| Antenne o.t. | 4,6 | 35,5 | 1,5 |

**Belastingen mastsectie langsrichting (x-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 29,3 | 24,8 | 0,0 | -24,8 | 5,9 | 172,0 | 145,9 | 0,0 | -145,9 |
| Tussenstuk1 | 0,83 | 21,9 | 18,6 | 0,0 | -18,6 | 16,5 | 361,1 | 306,4 | 0,0 | -306,4 |
| Tussenstuk2 | 0,96 | 25,0 | 21,2 | 0,0 | -21,2 | 26,9 | 670,9 | 569,3 | 0,0 | -569,3 |
| Bovenstuk 1 | 1,04 | 12,3 | 10,4 | 0,0 | -10,4 | 35,5 | 436,2 | 370,1 | 0,0 | -370,1 |
| Bovenstuk 2 | 1,09 | 12,9 | 11,0 | 0,0 | -11,0 | 42,4 | 547,6 | 464,6 | 0,0 | -464,6 |
| Topstuk | 1,12 | 1,0 | 0,8 | 0,0 | -0,8 | 47,1 | 45,0 | 38,2 | 0,0 | -38,2 |
| Ondertraverse | 1,02 | 30,0 | 17,8 | 0,0 | -17,8 | 33,6 | 1005,9 | 597,4 | 0,0 | -597,4 |
| Boventraverse | 1,10 | 35,5 | 21,1 | 0,0 | -21,1 | 44,7 | 1585,0 | 941,4 | 0,0 | -941,4 |
| Totaal | | 167,8 | 125,7 | 0,0 | -125,7 | | 4823,5 | 3433,3 | 0,0 | -3433,3 |

**Belastingen mastsectie dwarsrichting (y-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 0,0 | 24,8 | 29,3 | 24,8 | 5,9 | 0,0 | 145,9 | 172,0 | 145,9 |
| Tussenstuk1 | 0,83 | 0,0 | 18,6 | 21,9 | 18,6 | 16,5 | 0,0 | 306,4 | 361,1 | 306,4 |
| Tussenstuk2 | 0,96 | 0,0 | 21,2 | 25,0 | 21,2 | 26,9 | 0,0 | 569,3 | 670,9 | 569,3 |
| Bovenstuk 1 | 1,04 | 0,0 | 10,4 | 12,3 | 10,4 | 35,5 | 0,0 | 370,1 | 436,2 | 370,1 |
| Bovenstuk 2 | 1,09 | 0,0 | 11,0 | 12,9 | 11,0 | 42,4 | 0,0 | 464,6 | 547,6 | 464,6 |
| Topstuk | 1,12 | 0,0 | 0,8 | 1,0 | 0,8 | 47,1 | 0,0 | 38,2 | 45,0 | 38,2 |
| Ondertraverse | 1,02 | 0,0 | 17,8 | 12,0 | 17,8 | 33,6 | 0,0 | 597,4 | 402,3 | 597,4 |
| Boventraverse | 1,10 | 0,0 | 21,1 | 14,2 | 21,1 | 44,7 | 0,0 | 941,4 | 634,0 | 941,4 |
| Totaal | | 0,0 | 125,7 | 128,5 | 125,7 | | 0,0 | 3433,3 | 3269,0 | 3433,3 |

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

| Belasting / windrichting | $F_x$ [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° | 175 | 0 | 0 | 0 | 5077 | 0 |
| Windrichting 45° | 131 | 131 | 0 | 3613 | 3613 | 0 |
| Windrichting 90° | 0 | 136 | 0 | 3523 | 0 | 0 |
| Windrichting 135° | -131 | 131 | 0 | 3613 | -3613 | 0 |

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**Tussenresultaten geleiderbelastingen**

**Geleiders back**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Geleiders ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Verticale belasting back**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Verticale belasting ahead**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Isolatoren**

| Geleider | $G_{isolator}$ [kN] | Aantal - | $F_{v,iso}$ [kN] | Lengte [m] | Windopp. [m$^2$] | Windhoogte [m] | Stuwdruk [kN/m$^2$] | Vormfactor [-] | $F_{h,iso}$ [kN] |
|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 5,00 | 1 | 5 | 4,5 | 2,4 | 30,80 | 1,00 | 1,2 | 2,87 |
| 380ct1f2 | 5,00 | 1 | 5 | 4,5 | 2,4 | 30,80 | 1,00 | 1,2 | 2,87 |
| 380ct1f3 | 5,00 | 1 | 5 | 4,5 | 2,4 | 42,10 | 1,09 | 1,2 | 3,13 |
| 380ct2f1 | 5,00 | 1 | 5 | 4,5 | 2,4 | 30,80 | 1,00 | 1,2 | 2,87 |
| 380ct2f2 | 5,00 | 1 | 5 | 4,5 | 2,4 | 30,80 | 1,00 | 1,2 | 2,87 |
| 380ct2f3 | 5,00 | 1 | 5 | 4,5 | 2,4 | 42,10 | 1,09 | 1,2 | 3,13 |
| bl1 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 44,25 | 1,10 | 1,2 | 0,13 |
| bl2 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 44,25 | 1,10 | 1,2 | 0,13 |

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**Windbelasting back**

| Geleider | hoogte wind [m] | Stuwdruk [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{toeslag}$ [mm] | $w_y$ [N/m] | $w_{y,vak}$ [N/m] | $D_{ijs,toeslag}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,vak}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct1f2 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct1f3 | 34,0 | 1,02 | 0,59 | 0,59 | 1,09 | 28,25 | 55,5 | 55,5 | 46,9 | 101,6 | 101,6 |
| 380ct2f1 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct2f2 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct2f3 | 34,0 | 1,02 | 0,59 | 0,59 | 1,09 | 28,25 | 55,5 | 55,5 | 46,9 | 101,6 | 101,6 |
| bl1 | 38,3 | 1,06 | 0,60 | 0,60 | 1,20 | 22,24 | 16,8 | 16,8 | 63,1 | 47,8 | 47,8 |
| bl2 | 38,3 | 1,06 | 0,60 | 0,60 | 1,20 | 22,13 | 16,8 | 16,8 | 63,0 | 47,7 | 47,7 |

**Windbelasting ahead**

| Geleider | hoogte wind [m] | Stuwdruk [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{toeslag}$ [mm] | $w_y$ [N/m] | $w_{y,vak}$ [N/m] | $D_{ijs,toeslag}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,vak}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct1f2 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct1f3 | 34,0 | 1,02 | 0,59 | 0,59 | 1,09 | 28,25 | 55,5 | 55,5 | 46,9 | 101,6 | 101,6 |
| 380ct2f1 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct2f2 | 22,7 | 0,91 | 0,56 | 0,56 | 1,12 | 28,25 | 48,1 | 48,1 | 46,9 | 85,6 | 85,6 |
| 380ct2f3 | 34,0 | 1,02 | 0,59 | 0,59 | 1,09 | 28,25 | 55,5 | 55,5 | 46,9 | 101,6 | 101,6 |
| bl1 | 38,3 | 1,06 | 0,60 | 0,60 | 1,20 | 22,24 | 16,8 | 16,8 | 63,1 | 47,8 | 47,8 |
| bl2 | 38,3 | 1,06 | 0,60 | 0,60 | 1,20 | 22,13 | 16,8 | 16,8 | 63,0 | 47,7 | 47,7 |

Project: GT-RLL380
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Mast: 22N

**Geleiderbelastingen**

Auteur: TBR
Versie: v11.9

**Uitgangspunten**

| | |
|---|---|
| Betrouwbaarheidsniveau | Nieuwbouw CC2 |
| Referentieperiode | 50 jaar |

| **ULS** (bezwijksterkte) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belastingsgeval | omschrijving | Temp °C | $\gamma_G$ $G_{k,mast}$ | $\gamma_G$ $G_{k,geleider}$ | $Q_{pk}$ | $\gamma_Q$ $Q_{wk}$ | $Q_{ik}$ | $\gamma_a$ $A_k$ |
| ULS 1a | Wind | 10° | 1,20 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk alleen mast | 10° | 0,90 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk ook geleider | 10° | 0,90 | 0,90 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 5a | Torsiebelastingen | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinale belastingen | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,50 | 0,30 | 0,00 | 0,0 |
| ULS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,35 | 1,35 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** | (Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders) | | | $\gamma_G$ $G_k$ | $\gamma_Q$ $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,20 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 0,90 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** | (controle van de vervormingen, vermoeiing, EDS) | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 1,00 | 0,0 | 0,0 |
| SLS 3 | Wind+ijs | -5° | 1,00 | 1,00 | 0,0 | 0,30 | 1,00 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 6 | Bouw en onderhoud | 5° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 7 | PB (EDS, geen wind) | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

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

Project: GT-RLL380
Masttype: S+0
Mast: 22N

**Samenvattingstabellen geleiderbelastingen**

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

**Maximale waarden voor back en ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -61,8 | 61,8 | 5,2 | 5,2 | 10,2 | 10,2 |
| 380ct1f1 | -154,8 | 154,8 | 16,6 | 16,6 | 24,5 | 24,5 |
| 380ct1f2 | -154,8 | 154,8 | 16,6 | 16,6 | 24,5 | 24,5 |
| 380ct1f3 | -158,2 | 158,2 | 19,0 | 19,0 | 24,6 | 24,6 |
| 380ct2f1 | -154,8 | 154,8 | 16,6 | 16,6 | 24,5 | 24,5 |
| 380ct2f2 | -154,8 | 154,8 | 16,6 | 16,6 | 24,5 | 24,5 |
| 380ct2f3 | -158,2 | 158,2 | 19,0 | 19,0 | 24,6 | 24,6 |
| bl2 | -61,0 | 61,0 | 5,1 | 5,1 | 10,2 | 10,2 |

**Min. Weight span (m)**

| Weight sp | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 440,0 | 446,7 | 440,0 |
| 380ct1f1 | 440,0 | 445,2 | 440,0 |
| 380ct1f2 | 440,0 | 445,2 | 440,0 |
| 380ct1f3 | 440,0 | 445,5 | 440,0 |
| 380ct2f1 | 440,0 | 445,2 | 440,0 |
| 380ct2f2 | 440,0 | 445,2 | 440,0 |
| 380ct2f3 | 440,0 | 445,5 | 440,0 |
| bl2 | 440,0 | 446,9 | 440,0 |

**Max. Weight span (m)**

| Weight sp | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 481,0 | 432,8 |
| 380ct1f1 | 460,0 | 439,5 |
| 380ct1f2 | 460,0 | 439,5 |
| 380ct1f3 | 464,9 | 440,4 |
| 380ct2f1 | 460,0 | 439,5 |
| 380ct2f2 | 460,0 | 439,5 |
| 380ct2f3 | 464,9 | 440,4 |
| bl2 | 482,1 | 432,7 |

Omhullende weight span over alle combinaties (incl. 0,9 combinaties)

| Voor alle geleiders | | | Wind / Weight span verhouding | |
|---|---|---|---|---|
| Max. weight span | 482,1 | m | 1,205 | - |
| Min. weight span | 293,8 | m | 0,734 | - |

Project: GT-RLL380
Masttype: S+0
Mast: 22N

**Maximale waarden back+ahead span** **Maximale waarden trekkracht geleider**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 22,9 | 10,3 | 20,5 | -61,8 | 61,8 |
| 380ct1f1 | 58,7 | 33,2 | 49,0 | -154,8 | 154,8 |
| 380ct1f2 | 58,7 | 33,2 | 49,0 | -154,8 | 154,8 |
| 380ct1f3 | 58,7 | 38,0 | 49,1 | -158,2 | 158,2 |
| 380ct2f1 | 58,7 | 33,2 | 49,0 | -154,8 | 154,8 |
| 380ct2f2 | 58,7 | 33,2 | 49,0 | -154,8 | 154,8 |
| 380ct2f3 | 58,7 | 38,0 | 49,1 | -158,2 | 158,2 |
| bl2 | 22,3 | 10,3 | 20,3 | -61,0 | 61,0 |

**EDS-belastingen geleiders**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 4,3 | -15,3 | 15,3 |
| 380ct1f1 | 0,0 | 0,0 | 25,2 | -73,3 | 73,3 |
| 380ct1f2 | 0,0 | 0,0 | 25,2 | -73,3 | 73,3 |
| 380ct1f3 | 0,0 | 0,0 | 25,2 | -73,3 | 73,3 |
| 380ct2f1 | 0,0 | 0,0 | 25,2 | -73,3 | 73,3 |
| 380ct2f2 | 0,0 | 0,0 | 25,2 | -73,3 | 73,3 |
| 380ct2f3 | 0,0 | 0,0 | 25,2 | -73,3 | 73,3 |
| bl2 | 0,0 | 0,0 | 4,2 | -14,9 | 14,9 |

**Controle uplift SLS-wind**

| Combinati | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| **SLS 4** | bl1 | 2,2 | 2,2 |
| | 380ct1f1 | 12,7 | 12,7 |
| | 380ct1f2 | 12,7 | 12,7 |
| | 380ct1f3 | 12,7 | 12,7 |
| | 380ct2f1 | 12,7 | 12,7 |
| | 380ct2f2 | 12,7 | 12,7 |
| | 380ct2f3 | 12,7 | 12,7 |
| | bl2 | 2,1 | 2,1 |

Project: GT-RLL380
Masttype: S+0
Mast: 22N

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

| Combinatie | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | 0 | 229 | 200 | 8550 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 229 | 155 | 8551 | 0 | 0 |
| ULS 3_90 | | 0 | 123 | 335 | 4656 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 123 | 282 | 4657 | 0 | 0 |
| SLS 7 | | 0 | 0 | 160 | -2 | 0 | 0 |

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

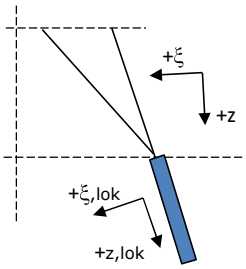
| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 433 | 476 | 13835 | 0 | 0 |
| ULS 3_90 | 0 | 185 | 611 | 6242 | 0 | 0 |
| SLS 7 | 0 | 0 | 390 | -2 | 0 | 0 |

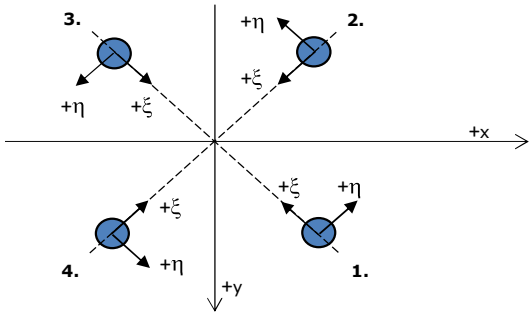
**Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde**

| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_0,9_90 | 0 | 433 | 319 | **13835** | 0 | 0 |
| ULS 1a_0 | 269 | 0 | 467 | -2 | **7876** | 0 |
| ULS 5a Ba 10 | 59 | 0 | 387 | 154 | 1910 | **-906** |
| ULS 1a_0,9_0,9_45 | 201 | 316 | 326 | **9899** | **5603** | 0 |

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

**Oplegreacties op fundering per randstijl**




Assenstelsels

**Maximale drukbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 169 | 155 | **979** | 10 | -229 | -40 | 997 |
| 2 | ULS 1a_0 | 88 | -98 | **554** | 7 | -132 | -25 | 565 |
| 3 | ULS 8 Ba | -58 | -77 | **435** | -13 | -96 | -11 | 444 |
| 4 | ULS 1a_135 | -169 | 155 | **979** | -10 | -229 | -40 | 997 |

**Maximale trekbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 8 Ba | -17 | -37 | **-208** | 14 | 38 | -2 | -212 |
| 2 | ULS 1a_0,9_0,9_135 | -134 | 120 | **-780** | 10 | 179 | 29 | -794 |
| 3 | ULS 1a_0,9_0,9_45 | 134 | 120 | **-780** | -10 | 179 | 29 | -794 |
| 4 | ULS 1a_0,9_0,9_0 | 53 | -63 | **-355** | -7 | 82 | 13 | -362 |

**Maximale torsiebelasting (positief)**

| Stijl | Combinatie | $R_x$ [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 | 29 | -27 | -1 | **40** | -2 | -2 | -1 |
| 2 | ULS 5a Ba 21 | 8 | -61 | 212 | **37** | -49 | -8 | 216 |
| 3 | ULS 5a Ba 21 | -29 | 27 | 0 | **40** | -2 | -2 | 0 |
| 4 | ULS 5a Ah 10 | -8 | 61 | 212 | **37** | -49 | -8 | 215 |

**Maximale torsiebelasting (negatief)**

| Stijl Index | Combinatie 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 | 8 | 61 | 212 | **-37** | -49 | -8 | 215 |
| 2 | ULS 5a Ah 21 | 29 | 27 | 0 | **-40** | -2 | -2 | 0 |
| 3 | ULS 5a Ah 21 | -8 | -61 | 212 | **-37** | -49 | -8 | 216 |
| 4 | ULS 5a Ba 10 | -29 | -27 | -1 | **-40** | -2 | -2 | -1 |

Project: GT-RLL380
Masttype: S+0
Mast: 22N

**Combinatie Ftrek+Fhor**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 8 Ba | -17 | -37 | **-208** | **14** | 38 | -2 | -212 |
| 2 | ULS 1a_0,9_0,9_135 | -134 | 120 | **-780** | **10** | 179 | 29 | -794 |
| 3 | ULS 1a_0,9_0,9_45 | 134 | 120 | **-780** | **-10** | 179 | 29 | -794 |
| 4 | ULS 1a_0,9_0,9_0 | 53 | -63 | **-355** | **-7** | 82 | 13 | -362 |

**Permanente belasting**

| Stijl | Combinatie | $R_x$ [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 | 97 | 0 | -24 | -6 | 99 |
| 2 | SLS 7 | 17 | -17 | 97 | 0 | -24 | -6 | 99 |
| 3 | SLS 7 | -17 | -17 | 97 | 0 | -24 | -6 | 99 |
| 4 | SLS 7 | -17 | 17 | 97 | 0 | -24 | -6 | 99 |

**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 | 169 | 155 | **979** | 10 | -229 | -40 | 997 |
| Max. trek | ULS 1a_0,9_0,9_45 | 134 | 120 | **-780** | -10 | 179 | 29 | -794 |
| Max. pos. torsie | ULS 5a Ba 21 | -29 | 27 | 0 | **40** | -2 | -2 | 0 |
| Max. neg. torsie | ULS 5a Ah 21 | 29 | 27 | 0 | **-40** | -2 | -2 | 0 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_45 | 134 | 120 | **-780** | **-10** | 179 | 29 | -794 |

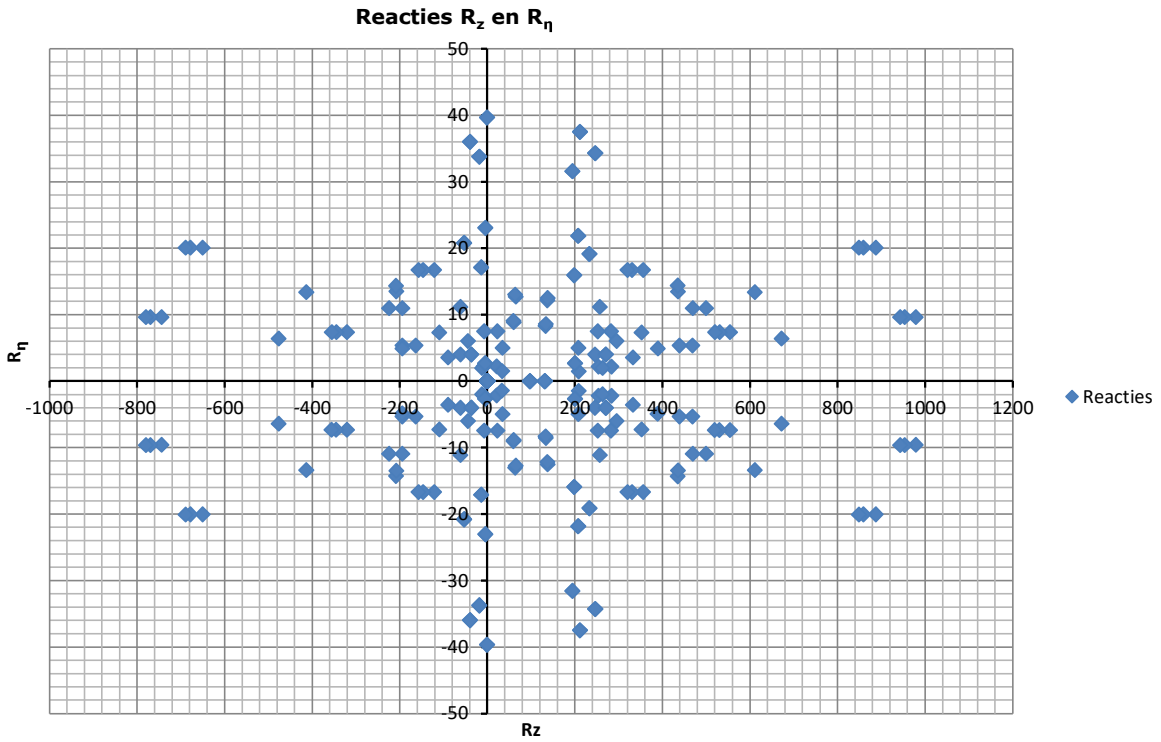
**Maximale trekbelasting SLS**

| Stijl | Combinatie | $R_x$ [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 | **97** | 0 | -24 | -6 | 99 |
| 2 | SLS 1a_135 | -81 | 72 | **-476** | 6 | 109 | 16 | -485 |
| 3 | SLS 1a_45 | 81 | 72 | **-476** | -6 | 109 | 16 | -485 |
| 4 | SLS 1a_0 | 28 | -35 | **-194** | -5 | 44 | 6 | -198 |

**Maximale drukbelasting SLS**

| Stijl | Combinatie | $R_x$ [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 | 116 | 107 | **672** | 6 | -158 | -28 | 684 |
| 2 | SLS 1a_0 | 62 | -69 | **389** | 5 | -93 | -18 | 396 |
| 3 | SLS 7 | -17 | -17 | **97** | 0 | -24 | -6 | 99 |
| 4 | SLS 1a_135 | -116 | 107 | **672** | -6 | -158 | -28 | 684 |

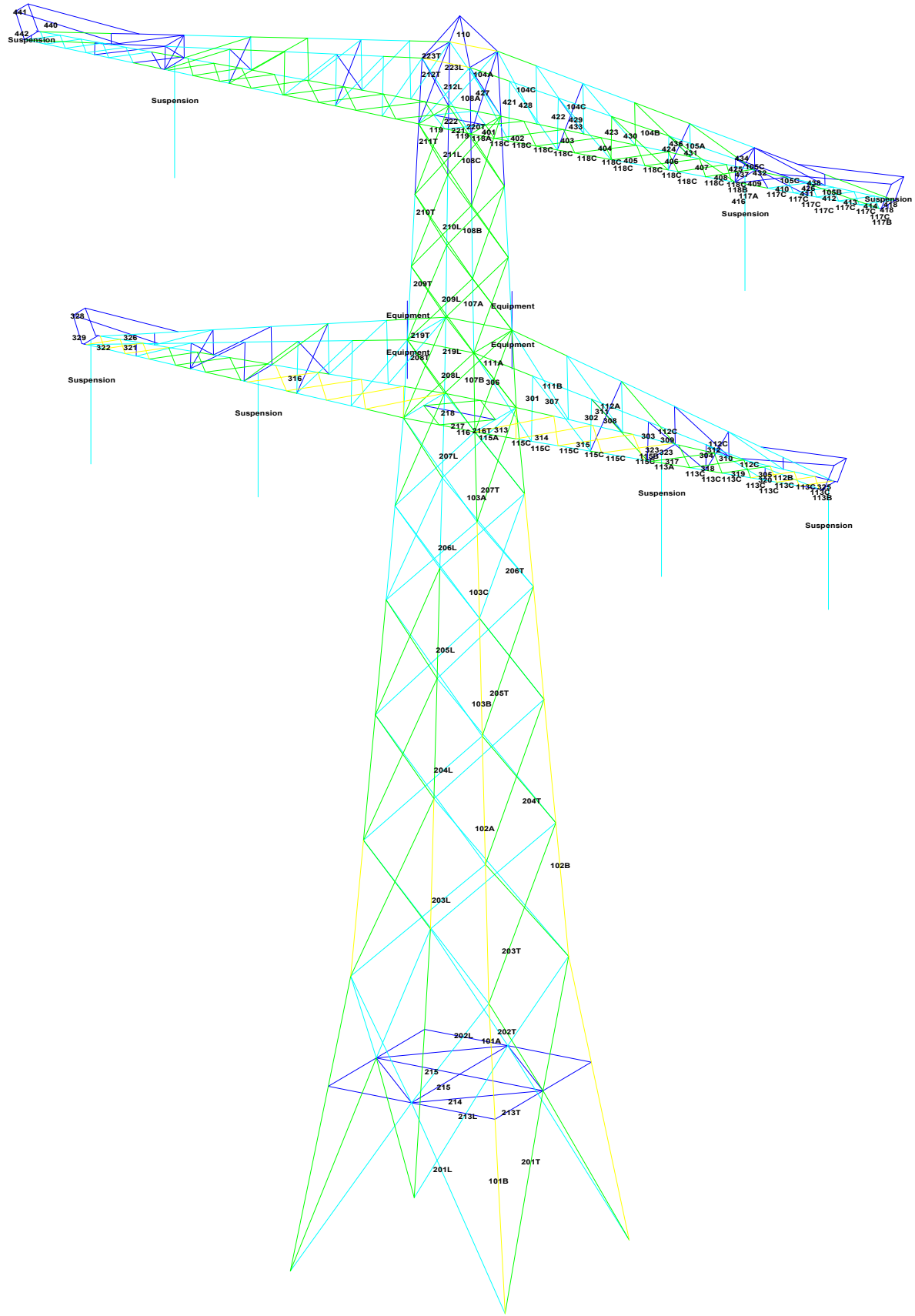
Project: GT-RLL380
Masttype: S+0
Mast: 22N



# APPENDIX B
# Resultaten PLS tower

Deze Appendix bevat de resultaten voor de toetsing van profielen en bouten uit PLS Tower voor masttype S+0/n.

DNV GL Nederlands BV, Project: "D1.3 2 Circuit S+0 - dnv gl-ini"
Tower Version 16.72, 17:42:45 dinsdag 15 juni 2021
Undeformed geometry displayed




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

1 (m)

## Assessment of angle groups

Date 16-6-2021
Author BJT
Version 4.3

**GT-RLL**
**S+0/n**

| Group Label | Description | Type | Profile | Steel Quali | Bolts | #sh.pl | e1 | e2 | p1 | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compress | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | eedance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | tring (Tens) | U.C. (Tens) | ance (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101A | BRKSTK - Main member | EA | 150x150x12 | S355 | 8M24-8.8t | 2 | 50 | 60 | 80 | 0.33 | 0.33 | 0.33 | 48 | **-875.4** | ULS 1a_45 | 1054.2 | 2168.8 | 1693.4 | 0.83 | | **716.1** | ULS 1a_0.9_0.9_135 | 1007.6 | 2168.8 | 1447.4 | 0.71 | |
| 101B | BRKSTK - Main member | EA | 150x150x12 | S355 | 8M24-8.8t | 2 | 50 | 60 | 80 | 0.20 | 0.20 | 0.20 | 48 | **-880.3** | ULS 1a_45 | 1052.1 | 2168.8 | 1693.4 | 0.84 | | **712.0** | ULS 1a_0.9_0.9_135 | 1007.6 | 2168.8 | 1447.4 | 0.71 | |
| 102A | Eerste TSNK - Main member | EA | 150x150x12 | S355 | 8M24-8.8t | 1 | 55 | 50 | 80 | 0.25 | 0.25 | 0.25 | 41 | **-814.7** | ULS 1a_135 | 1102.6 | 1084.4 | 1693.4 | 0.75 | | **637.5** | ULS 1a_0.9_0.9_45 | 1007.6 | 1084.4 | 1592.1 | 0.63 | |
| 102B | Eerste TSNK - Main member | EA | 150x150x12 | S355 | 8M24-8.8t | 2 | 50 | 60 | 90 | 0.25 | 0.25 | 0.25 | 44 | **-936.1** | ULS 1a_45 | 1080.6 | 2168.8 | 1693.4 | 0.87 | | **759.5** | ULS 1a_0.9_0.9_135 | 1007.6 | 2168.8 | 1447.4 | 0.75 | |
| 103A | Tweede TSNK - Main member | EA | 130x130x12 | S355 | 6M24-8.8t | 2 | 50 | 60 | 80 | 0.55 | 0.55 | 0.55 | 73 | **-468.5** | ULS 1a_135 | 730.2 | 1626.6 | 1270.1 | 0.64 | | **318.3** | ULS 1a_0.9_0.9_45 | 838.3 | 1626.6 | 1085.5 | 0.38 | |
| 103B | Tweede TSNK - Main member | EA | 130x130x12 | S355 | 8M24-8.8t | 2 | 55 | 50 | 80 | 0.25 | 0.25 | 0.25 | 43 | **-711.4** | ULS 1a_135 | 935.9 | 2168.8 | 1693.4 | 0.76 | | **546.1** | ULS 1a_0.9_0.9_45 | 838.3 | 2168.8 | 1592.1 | 0.65 | |
| 103C | Tweede TSNK - Main member | EA | 130x130x12 | S355 | | | | | | 0.50 | 0.50 | 0.50 | 71 | **-581.6** | ULS 1a_135 | 744.5 | 0.0 | 0.0 | 0.78 | | **421.1** | ULS 1a_0.9_0.9_45 | 1065.0 | 0.0 | 0.0 | 0.40 | |
| 104A | Tweede DWSARM - main top 1 | EA | 100x100x8 | S355 | 4M24-8.8t | 1 | 50 | 45 | 80 | 2.22 | 1.00 | 1.00 | 121 | **0.0** | | 186.4 | 542.2 | 564.5 | 0.00 | | **214.0** | ULS 3_90 | 287.3 | 542.2 | 482.5 | 0.74 | |
| 104B | Tweede DWSARM - main top 1 | EA | 90x90x8 | S355 | 4M24-8.8t | 1 | 50 | 45 | 80 | 2.00 | 1.00 | 1.00 | 174 | **0.0** | | 104.3 | 542.2 | 564.5 | 0.00 | | **151.2** | ULS 3_0 | 253.1 | 542.2 | 482.5 | 0.60 | |
| 104C | Tweede DWSARM - main top 1 | EA | 100x100x8 | S355 | | | | | | 2.10 | 1.00 | 1.00 | 153 | **0.0** | | 138.8 | 0.0 | 0.0 | 0.00 | | **199.9** | ULS 3_90 | 550.3 | 0.0 | 0.0 | 0.36 | |
| 105A | Tweede DWSARM - main top 2 | EA | 90x90x8 | S355 | 4M24-8.8t | 1 | 50 | 45 | 80 | 1.00 | 1.00 | 1.00 | 158 | **0.0** | | 124.6 | 542.2 | 564.5 | 0.00 | | **93.4** | ULS 3_0 | 253.1 | 542.2 | 482.5 | 0.37 | |
| 105B | Tweede DWSARM - main top 2 | EA | 90x90x8 | S355 | 2M16-8.8t | 1 | 35 | 45 | 55 | 1.00 | 1.00 | 1.00 | 167 | **0.0** | | 114.8 | 120.6 | 188.2 | 0.00 | | **83.7** | ULS 3_0 | 227.9 | 120.6 | 162.6 | 0.69 | |
| 105C | Tweede DWSARM - main top 2 | EA | 90x90x8 | S355 | | | | | | 1.00 | 1.00 | 1.00 | 66 | **0.0** | | 308.3 | 0.0 | 0.0 | 0.00 | | **84.3** | ULS 3_0 | 493.5 | 0.0 | 0.0 | 0.17 | |
| 107A | BVNSTK - Main member 1 | EA | 100x100x10 | S355 | 4M24-8.8t | 1 | 50 | 45 | 80 | 0.50 | 0.50 | 0.50 | 72 | **-225.0** | ULS 1a_45 | 471.2 | 542.2 | 705.6 | 0.48 | | **164.9** | ULS 1a_0.9_0.9_135 | 585.6 | 542.2 | 603.1 | 0.30 | |
| 107B | BVNSTK - Main member 1 | EA | 100x100x10 | S355 | 6M24-8.8t | 1 | 60 | 45 | 100 | 0.52 | 0.52 | 0.52 | 80 | **-277.8** | ULS 1a_135 | 429.3 | 813.3 | 1058.4 | 0.65 | | **176.9** | ULS 1a_0.9_0.9_135 | 493.9 | 813.3 | 1058.4 | 0.36 | |
| 108A | BVNSTK - Main member 2 | EA | 100x100x8 | S355 | 6M24-8.8t | 1 | 50 | 45 | 80 | 0.50 | 0.50 | 0.50 | 65 | **-51.0** | ULS 5a Ah 22 | 412.1 | 813.3 | 846.7 | 0.12 | | **0.2** | ULS 5a Ah 22 | 473.5 | 813.3 | 723.7 | 0.00 | |
| 108B | BVNSTK - Main member 2 | EA | 100x100x8 | S355 | 4M24-8.8t | 1 | 50 | 45 | 80 | 0.50 | 0.50 | 0.50 | 71 | **-168.8** | ULS 1a_45 | 387.2 | 542.2 | 564.5 | 0.44 | | **104.8** | ULS 1a_0.9_0.9_135 | 473.5 | 542.2 | 482.5 | 0.22 | |
| 108C | BVNSTK - Main member 2 | EA | 100x100x8 | S355 | | | | | | 0.50 | 0.50 | 0.50 | 69 | **-72.9** | ULS 1a_135 | 393.4 | 0.0 | 0.0 | 0.19 | | **25.0** | ULS 5a Ba 22 | 550.3 | 0.0 | 0.0 | 0.05 | |
| 110 | Top | EA | 80x80x8 | S355 | 2M16-8.8t | 1 | 35 | 45 | 55 | 1.00 | 1.00 | 1.00 | 132 | **-12.2** | ULS 5a Ah 22 | 140.1 | 120.6 | 188.2 | 0.10 | | **12.1** | ULS 5a Ah 22 | 198.7 | 120.6 | 162.6 | 0.10 | |
| 111A | Eerste DWSARM - main top 1 | EA | 100x100x8 | S355 | 4M20-8.8t | 1 | 45 | 45 | 70 | 2.00 | 1.00 | 1.00 | 160 | **0.0** | | 130.7 | 376.3 | 470.4 | 0.00 | | **196.0** | ULS 3_45 | 298.7 | 376.3 | 427.6 | 0.66 | |
| 111B | Eerste DWSARM - main top 1 | EA | 100x100x8 | S355 | 4M20-8.8t | 1 | 45 | 50 | 70 | 2.00 | 1.00 | 1.00 | 159 | **0.0** | | 131.4 | 376.3 | 470.4 | 0.00 | | **175.1** | ULS 3_90 | 484.7 | 376.3 | 427.6 | 0.46 | |
| 112A | Eerste DWSARM - main top 2 | EA | 90x90x8 | S355 | 4M20-8.8t | 1 | 45 | 40 | 70 | 2.00 | 1.00 | 1.00 | 172 | **0.0** | | 105.5 | 376.3 | 470.4 | 0.00 | | **140.0** | ULS 3_90 | 428.3 | 376.3 | 427.6 | 0.37 | |
| 112B | Eerste DWSARM - main top 2 | EA | 90x90x8 | S355 | 3M20-8.8t | 1 | 45 | 40 | 70 | 2.00 | 1.00 | 1.00 | 163 | **0.0** | | 113.5 | 282.2 | 352.8 | 0.00 | | **129.8** | ULS 3_45 | 263.9 | 282.2 | 320.7 | 0.49 | |
| 112C | Eerste DWSARM - main top 2 | EA | 90x90x8 | S355 | | | | | | 1.00 | 1.00 | 1.00 | 56 | **0.0** | | 339.1 | 0.0 | 0.0 | 0.00 | | **135.9** | ULS 3_0 | 493.5 | 0.0 | 0.0 | 0.28 | |
| 113A | Eerste DWSARM - main bottom 1 | EA | 100x100x10 | S355 | 6M24-8.8t | 1 | 50 | 60 | 80 | 1.00 | 1.72 | 1.00 | 88 | **-224.9** | ULS 5a Ba 21 | 384.3 | 813.3 | 1058.4 | 0.59 | | **117.0** | ULS 5a Ba 21 | 493.9 | 813.3 | 904.6 | 0.24 | |
| 113B | Eerste DWSARM - main bottom 1 | EA | 110x110x10 | S355 | | | | | | 2.00 | 2.00 | 1.00 | 6 | **-1.2** | ULS 5a Ah 21 | 749.8 | 0.0 | 0.0 | 0.00 | | **0.5** | ULS 5a Ah 21 | 749.8 | 0.0 | 0.0 | 0.00 | |
| 113C | Eerste DWSARM - main bottom 1 | EA | 100x100x10 | S355 | | | | | | 2.46 | 4.40 | 1.00 | 95 | **-194.0** | ULS 5a Ba 21 | 346.8 | 0.0 | 0.0 | 0.56 | | **93.0** | ULS 5a Ah 10 | 681.6 | 0.0 | 0.0 | 0.14 | |
| 115A | Eerste DWSARM - main bottom 2 | EA | 120x120x12 | S355 | 7M24-8.8t | 1 | 55 | 50 | 80 | 1.00 | 1.43 | 1.00 | 70 | **-347.4** | ULS 5a Ah 10 | 689.6 | 925.1 | 1481.8 | 0.50 | | **154.6** | ULS 5a Ba 21 | 455.2 | 925.1 | 1393.1 | 0.34 | |
| 115B | Eerste DWSARM - main bottom 3 | EA | 120x120x11 | S355 | 6M24-8.8t | 1 | 50 | 65 | 80 | 2.00 | 11.71 | 1.00 | 48 | **-240.0** | ULS 5a Ba 21 | 773.1 | 813.3 | 1164.2 | 0.31 | | **130.5** | ULS 5a Ba 21 | 698.5 | 813.3 | 995.1 | 0.19 | |
| 115C | Eerste DWSARM - main bottom 3 | EA | 120x120x12 | S355 | | | | | | 5.69 | 7.80 | 1.00 | 97 | **-293.9** | ULS 5a Ah 10 | 481.6 | 0.0 | 0.0 | 0.61 | | **150.9** | ULS 5a Ah 10 | 976.3 | 0.0 | 0.0 | 0.15 | |
| 116 | Eerste DWSARM - main bottom 4 | EA | 120x120x12 | S355 | 7M24-8.8t | 1 | 55 | 50 | 80 | 2.00 | 1.00 | 1.00 | 82 | **-277.3** | ULS 5a Ba 10 | 492.3 | 925.1 | 1481.8 | 0.56 | | **78.0** | ULS 5a Ba 10 | 455.2 | 925.1 | 1393.1 | 0.17 | |
| 117A | Tweede DWSARM - main bottom 1 | EA | 90x90x8 | S355 | 4M24-8.8t | 1 | 50 | 50 | 80 | 1.00 | 2.63 | 1.00 | 115 | **-104.0** | ULS 8 Ah | 181.4 | 542.2 | 564.5 | 0.57 | | **29.8** | ULS 8 Ah | 343.6 | 542.2 | 482.5 | 0.09 | |
| 117B | Tweede DWSARM - main bottom 1 | EA | 90x90x8 | S355 | | | | | | 2.00 | 2.00 | 1.00 | 6 | **-0.2** | ULS 1a_0.9_0.9_90 | 493.5 | 0.0 | 0.0 | 0.00 | | **0.2** | ULS 1a_90 | 493.5 | 0.0 | 0.0 | 0.00 | |
| 117C | Tweede DWSARM - main bottom 1 | EA | 90x90x8 | S355 | | | | | | 1.00 | 2.84 | 1.00 | 109 | **-98.4** | ULS 3_45 | 200.6 | 0.0 | 0.0 | 0.49 | | **13.9** | ULS 8 Ah | 493.5 | 0.0 | 0.0 | 0.03 | |
| 118A | Tweede DWSARM - main bottom 2 | EA | 110x110x10 | S355 | 10M24-8.8t | | 55 | 50 | 80 | 1.00 | 1.58 | 1.00 | 46 | **-378.4** | ULS 8 Ah | 649.0 | 1253.9 | 1764.0 | 0.58 | | **188.0** | ULS 5a Ba 22 | 340.8 | 1253.9 | 1658.5 | 0.55 | |
| 118B | Tweede DWSARM - main bottom 3 | EA | 110x110x10 | S355 | 4M24-8.8t | 1 | 50 | 50 | 80 | 2.00 | 15.35 | 1.00 | 68 | **-112.5** | ULS 8 Ah | 541.0 | 542.2 | 705.6 | 0.21 | | **36.8** | ULS 8 Ah | 561.7 | 542.2 | 603.1 | 0.07 | |
| 118C | Tweede DWSARM - main bottom 3 | EA | 110x110x10 | S355 | | | | | | 2.16 | 2.57 | 1.00 | 67 | **-333.4** | ULS 8 Ah | 547.4 | 0.0 | 0.0 | 0.61 | | **157.7** | ULS 5a Ba 22 | 749.8 | 0.0 | 0.0 | 0.21 | |
| 119 | Tweede DWSARM - main bottom 4 | EA | 120x120x10 | S355 | 6M24-8.8t | 1 | 50 | 50 | 160 | 2.00 | 1.00 | 1.00 | 59 | **-358.5** | ULS 8 Ba | 520.9 | 806.5 | 1058.4 | 0.69 | | **98.7** | ULS 8 Ba | 385.4 | 806.5 | 995.1 | 0.26 | |
| 201T | BRSTK - Diagonal 1 | EA | 90x90x8 | S355 | 2M20-8.8t | 1 | 45 | 45 | 65 | 0.20 | 0.20 | 0.20 | 95 | **-112.4** | ULS 1a_90 | 229.9 | 188.2 | 235.2 | 0.60 | | **96.5** | ULS 1a_0.9_0.9_90 | 216.3 | 188.2 | 213.8 | 0.51 | |
| 202T | BRSTK - Diagonal 2 | EA | 110x110x10 | S355 | 2M24-8.8t | 1 | 55 | 55 | 80 | 1.00 | 0.33 | 0.33 | 152 | **-112.4** | ULS 1a_90 | 190.7 | 271.1 | 352.8 | 0.59 | | **100.7** | ULS 1a_0.9_0.9_90 | 340.7 | 271.1 | 331.7 | 0.37 | |
| 203T | Eerste TSNK - Crossing Diagonal 1 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 143 | **-67.9** | ULS 5a Ah 10 | 135.7 | 271.1 | 282.2 | 0.50 | | **69.3** | ULS 5a Ba 21 | 217.4 | 271.1 | 265.4 | 0.32 | |
| 204T | Eerste TSNK - Crossing Diagonal 2 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 129 | **-80.9** | ULS 5a Ba 21 | 155.0 | 271.1 | 282.2 | 0.52 | | **78.9** | ULS 5a Ah 10 | 217.4 | 271.1 | 265.4 | 0.36 | |
| 205T | Tweede TSNK - Crossing Diagonal 1 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 116 | **-93.1** | ULS 5a Ah 10 | 176.7 | 271.1 | 282.2 | 0.53 | | **93.9** | ULS 5a Ba 21 | 217.4 | 271.1 | 265.4 | 0.43 | |
| 206T | Tweede TSNK - Crossing Diagonal 2 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 98 | **-104.1** | ULS 5a Ba 21 | 211.5 | 271.1 | 282.2 | 0.49 | | **102.7** | ULS 5a Ah 10 | 217.4 | 271.1 | 265.4 | 0.47 | |
| 207T | Tweede TSNK - Crossing Diagonal 3 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 88 | **-121.0** | ULS 5a Ah 10 | 233.1 | 271.1 | 282.2 | 0.52 | | **122.1** | ULS 5a Ba 21 | 217.4 | 271.1 | 265.4 | 0.56 | |
| 208T | BVNSTK - Crossing Diagonal 1 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 123 | **-110.2** | ULS 5a Ah 12 | 172.9 | 406.7 | 423.4 | 0.64 | | **89.9** | ULS 5a Ba 22 | 253.1 | 406.7 | 398.0 | 0.36 | |
| 209T | BVNSTK - Crossing Diagonal 2 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 115 | **-110.0** | ULS 5a Ah 12 | 187.6 | 406.7 | 423.4 | 0.59 | | **109.7** | ULS 5a Ba 22 | 253.1 | 406.7 | 398.0 | 0.43 | |
| 210T | BVNSTK - Crossing Diagonal 3 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 110 | **-123.1** | ULS 5a Ba 22 | 197.7 | 406.7 | 423.4 | 0.62 | | **122.5** | ULS 5a Ah 12 | 253.1 | 406.7 | 398.0 | 0.48 | |
| 211T | BVNSTK - Crossing Diagonal 4 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 105 | **-138.0** | ULS 5a Ah 12 | 208.5 | 406.7 | 423.4 | 0.66 | | **138.3** | ULS 5a Ba 22 | 253.1 | 406.7 | 398.0 | 0.55 | |
| 212T | BVNSTK - Crossing Diagonal 5 | EA | 60x60x6 | S355 | 2M16-8.8t | 1 | 35 | 35 | 55 | 0.52 | 0.52 | 0.52 | 146 | **-15.1** | ULS 5a Ah 22 | 69.1 | 120.6 | 141.1 | 0.22 | | **8.5** | ULS 5a Ah 22 | 106.5 | 120.6 | 122.0 | 0.08 | |
| 201L | BRSTK - Diagonal 3 | EA | 90x90x8 | S355 | 2M20-8.8t | 1 | 45 | 45 | 65 | 0.20 | 0.20 | 0.20 | 95 | **-83.0** | ULS 5a Ba 10 | 229.9 | 188.2 | 235.2 | 0.44 | | **64.0** | ULS 5a Ah 21 | 216.3 | 188.2 | 213.8 | 0.34 | |
| 202L | BRSTK - Diagonal 4 | EA | 110x110x10 | S355 | 2M24-8.8t | 1 | 55 | 55 | 80 | 1.00 | 0.33 | 0.33 | 152 | **-78.5** | ULS 5a Ba 10 | 190.7 | 271.1 | 352.8 | 0.41 | | **63.3** | ULS 5a Ah 21 | 340.7 | 271.1 | 331.7 | 0.23 | |
| 203L | Eerste TSNK - Crossing Diagonal 3 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 143 | **-65.1** | ULS 1a_90 | 135.7 | 271.1 | 282.2 | 0.48 | | **61.1** | ULS 1a_0.9_0.9_90 | 217.4 | 271.1 | 265.4 | 0.28 | |
| 204L | Eerste TSNK - Crossing Diagonal 4 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 129 | **-69.1** | ULS 1a_0.9_0.9_90 | 155.0 | 271.1 | 282.2 | 0.45 | | **70.7** | ULS 5a Ah 21 | 217.4 | 271.1 | 265.4 | 0.33 | |
| 205L | Tweede TSNK - Crossing Diagonal 4 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 116 | **-83.4** | ULS 5a Ah 21 | 176.7 | 271.1 | 282.2 | 0.47 | | **78.3** | ULS 5a Ah 21 | 217.4 | 271.1 | 265.4 | 0.36 | |
| 206L | Tweede TSNK - Crossing Diagonal 5 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 98 | **-87.1** | ULS 5a Ah 21 | 211.5 | 271.1 | 282.2 | 0.41 | | **91.9** | ULS 5a Ah 21 | 217.4 | 271.1 | 265.4 | 0.42 | |
| 207L | Tweede TSNK - Crossing Diagonal 6 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.25 | 0.25 | 88 | **-108.3** | ULS 5a Ah 21 | 233.1 | 271.1 | 282.2 | 0.46 | | **101.6** | ULS 5a Ah 21 | 217.4 | 271.1 | 265.4 | 0.47 | |
| 208L | BVNSTK - Crossing Diagonal 6 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 123 | **-115.1** | ULS 5a Ba 12 | 172.9 | 406.7 | 423.4 | 0.67 | | **96.0** | ULS 5a Ah 22 | 253.1 | 406.7 | 398.0 | 0.38 | |
| 209L | BVNSTK - Crossing Diagonal 7 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 115 | **-102.3** | ULS 5a Ba 12 | 187.6 | 406.7 | 423.4 | 0.55 | | **104.1** | ULS 5a Ah 22 | 253.1 | 406.7 | 398.0 | 0.41 | |
| 210L | BVNSTK - Crossing Diagonal 8 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 110 | **-116.5** | ULS 5a Ah 22 | 197.7 | 406.7 | 423.4 | 0.59 | | **114.4** | ULS 5a Ba 12 | 253.1 | 406.7 | 398.0 | 0.45 | |
| 211L | BVNSTK - Crossing Diagonal 9 | EA | 90x90x8 | S355 | 3M24-8.8t | 1 | 55 | 45 | 80 | 0.52 | 0.52 | 0.52 | 105 | **-129.4** | ULS 5a Ba 12 | 208.5 | 406.7 | 423.4 | 0.62 | | **130.1** | ULS 5a Ah 22 | 253.1 | 406.7 | 398.0 | 0.51 | |
| 212L | BVNSTK - Crossing Diagonal 10 | EA | 60x60x6 | S355 | 2M16-8.8t | 1 | 35 | 35 | 55 | 0.52 | 0.52 | 0.52 | 146 | **-28.3** | ULS 5a Ba 22 | 69.1 | 120.6 | 141.1 | 0.41 | | **18.6** | ULS 5a Ah 22 | 106.5 | 120.6 | 122.0 | 0.18 | |
| 213T | BRSTK - Horizontal 1 | EA | 80x80x6 | S355 | 2M16-8.8t | 1 | 35 | 35 | 65 | 1.00 | 1.00 | 1.00 | 220 | **-15.7** | ULS 1a_0 | 51.7 | 120.6 | 141.1 | 0.30 | | **15.7** | ULS 1a_0 | 173.9 | 120.6 | 122.0 | 0.13 | |
| 213L | BRSTK - Horizontal 2 | EA | 80x80x6 | S355 | 2M16-8.8t | 1 | 35 | 35 | 65 | 1.00 | 1.00 | 1.00 | 220 | **-15.7** | ULS 1a_0 | 51.7 | 120.6 | 141.1 | 0.30 | | **15.7** | ULS 1a_0 | 173.9 | 120.6 | 122.0 | 0.13 | |
| 214 | BRSTK - Diagonal | EA | 70x70x7 | S355 | 1M16-8.8t | 1 | 35 | 40 | | 0.50 | 1.00 | 0.50 | 233 | **-2.1** | ULS 1a_90 | 32.0 | 60.3 | 82.3 | 0.07 | | **4.5** | ULS 1a_0.9_0.9_135 | 170.1 | 60.3 | 71.1 | 0.07 | |
| 215 | BRSTK - Crossing diagonal | DEA | 80x80x6 (not coupl | S355 | 1M16-8.8t | 1 | 35 | 35 | | 0.50 | 0.50 | 0.50 | 220 | **-0.8** | ULS 1a_90 | 82.7 | 60.3 | 70.6 | 0.01 | | **0.0** | | 122.3 | 60.3 | 61.0 | 0.00 | |
| 216T | Tweede TSNK - Horizontal 1 | EA | 90x90x9 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 2.00 | 1.00 | 1.00 | 110 | **-46.4** | ULS 5a Ah 21 | 207.0 | 271.1 | 317.5 | 0.22 | | **76.6** | ULS 5a Ah 21 | 240.0 | 271.1 | 298.5 | 0.32 | |
| 217 | Tweede TSNK - Diagonal | EA | 80x80x8 | S355 | 2M24-8.8t | 1 | 55 | 50 | 80 | 1.00 | 1.00 | 1.00 | 136 | **-83.4** | ULS 5a Ba 10 | 135.0 | 271.1 | 282.2 | 0.62 | | **83.5** | ULS 5a Ba 10 | 188.0 | 271.1 | 265.4 | 0.44 | |
| 218 | Tweede TSNK - Horizontal 2 | EA | 70x70x6 | S355 | 1M16-8.8t | 1 | 35 | 35 | | 1.00 | 1.00 | 1.00 | 219 | **-0.7** | ULS 3_0 | 35.8 | 60.3 | 70.6 | 0.02 | | **0.0** | | 122.3 | 60.3 | 61.0 | 0.00 | |
| 219L | BVNSTK - Horizontal 1 | EA | 100x100x10 | S355 | 4M24-8.8t | 1 | 55 | 50 | 80 | 0.90 | 0.90 | 0.90 | 128 | **0.0** | | 226.7 | 542.2 | 705.6 | 0.00 | | **228.4** | ULS 3_0 | 355.4 | 542.2 | 663.4 | 0.64 | |
| 219T | BVNSTK - Horizontal 2 | EA | 80x80x8 | S355 | 1M20-8.8t | 1 | 45 | 40 | | 0.90 | 0.90 | 0.90 | 161 | **-41.3** | ULS 1a_0.9_0.9_90 | 86.3 | 94.1 | 117.6 | 0.48 | | **49.1** | ULS 1a_90 | 181.9 | 94.1 | 106.9 | 0.52 | |
| 220T | BVNSTK - Horizontal 3 | EA | 70x70x7 | S355 | 2M20-8.8t | 1 | 50 | 37.5 | 70 | 2.00 | 1.00 | 1.00 | 103 | **-68.0** | ULS 5a Ba 22 | 135.7 | 188.2 | 205.8 | 0.50 | | **76.3** | ULS 5a Ah 12 | 148.5 | 188.2 | 205.8 | 0.51 | |
| 221 | BVNSTK - Diagonal 1 | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 45 | 80 | 1.00 | 1.00 | 1.00 | 88 | **-82.8** | ULS 5a Ba 22 | 248.8 | 271.1 | 282.2 | 0.33 | | **81.6** | ULS 5a Ba 22 | 217.4 | 271.1 | 265.4 | 0.38 | |
| 222 | BVNSTK - Horizontal 4 | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 187 | **-6.8** | ULS 3_90 | 39.0 | 60.3 | 70.6 | 0.17 | | **0.0** | | 75.3 | 60.3 | 53.4 | 0.00 | |
| 223L | BVNSTK - Horizontal 5 | EA | 100x100x8 | S355 | 4M24-8.8t | 1 | 50 | 45 | 80 | 1.00 | 1.00 | 1.00 | 102 | **0.0** | | 239.0 | 542.2 | 564.5 | 0.00 | | **222.5** | ULS 3_0 | 287.3 | 542.2 | 482.5 | 0.77 | |
| 223T | BVNSTK - Horizontal 6 | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | | 1.00 | 1.00 | 1.00 | 146 | **-2.6** | ULS 6a_90 Ba Ct2 | 64.8 | 94.1 | 88.2 | 0.04 | | **0.6** | ULS 5a Ba 22 | 112.9 | 94.1 | 80.2 | 0.01 | |
| 301 | Eerste DWSARM - Vertical 1 | EA | 60x60x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | | 0.60 | 1.00 | 0.60 | 137 | **-19.4** | ULS 3_0 | 47.8 | 94.1 | 88.2 | 0.41 | | **0.0** | | 112.9 | 94.1 | 80.2 | 0.00 | |
| 302 | Eerste DWSARM - Vertical 2 | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 1.00 | 0.50 | 0.50 | 109 | **-21.9** | ULS 3_135 | 61.8 | 60.3 | 70.6 | 0.36 | | **0.0** | | 98.8 | 60.3 | 61.0 | 0.00 | |
| 303 | Eerste DWSARM - Vertical 3 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 153 | **-3.0** | ULS 1a_0 | 36.0 | 60.3 | 58.8 | 0.08 | | **0.0** | | 62.7 | 60.3 | 44.5 | 0.00 | |
| 304 | Eerste DWSARM - Vertical 4 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 25 | 22 | | 1.00 | 1.00 | 1.00 | 101 | **-2.6** | ULS 1a_0 | 59.8 | 60.3 | 58.8 | 0.04 | | **0.0** | | 51.0 | 60.3 | 25.0 | 0.00 | |
| 305 | Eerste DWSARM - Vertical 4 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 48 | **-1.6** | ULS 3_45 | 93.2 | 60.3 | 58.8 | 0.03 | | **0.0** | | 62.7 | 60.3 | 44.5 | 0.00 | |
| 306 | Eerste DWSARM - Diagonal 1 | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | | 0.50 | 1.00 | 0.50 | 180 | **0.0** | | 39.7 | 94.1 | 88.2 | 0.00 | | **24.7** | ULS 3_135 | 112.9 | 94.1 | 80.2 | 0.31 | |
| 307 | Eerste DWSARM - Diagonal 2 | EA | 70x70x6 | S355 | 1M20-8.8t | 1 | 45 | 35 | | 0.60 | 1.00 | 0.60 | 161 | **0.0** | | 45.7 | 94.1 | 88.2 | 0.00 | | **32.8** | ULS 3_0 | 112.9 | 94.1 | 80.2 | 0.41 | |
| 308 | Eerste DWSARM - Diagonal 3 | EA | 55x55x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 1.00 | 0.50 | 0.50 | 183 | **0.0** | | 28.7 | 60.3 | 70.6 | 0.00 | | **42.9** | ULS 3_135 | 192.9 | 60.3 | 61.0 | 0.71 | |
| 309 | Eerste DWSARM - Diagonal 4 | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 1.00 | 0.70 | 0.70 | 166 | **0.0** | | 41.8 | 60.3 | 70.6 | 0.00 | | **7.4** | ULS 1a_0 | 228.1 | 60.3 | 61.0 | 0.12 | |
| 310 | Eerste DWSARM - Diagonal 5 | EA | 70x70x6 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 1.00 | 1.00 | 1.00 | 188 | **0.0** | | 45.3 | 60.3 | 70.6 | 0.00 | | **10.5** | ULS 5a Ah 21 | 275.2 | 60.3 | 42.0 | 0.25 | |
| 311 | Eerste DWSARM - Internal bracing 1 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 161 | **-8.0** | ULS 1a_0 | 33.5 | 60.3 | 58.8 | 0.24 | | **8.0** | ULS 1a_0 | 62.7 | 60.3 | 44.5 | 0.18 | |
| 312 | Eerste DWSARM - Internal bracing 2 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 102 | **-5.2** | ULS 1a_0 | 59.0 | 60.3 | 58.8 | 0.09 | | **5.2** | ULS 1a_0 | 51.0 | 60.3 | 35.0 | 0.15 | |
| 313 | Eerste DWSARM - Crossing diagonal 1 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 178 | **-22.8** | ULS 5a Ba 20 | 29.0 | 60.3 | 58.8 | 0.78 | | **23.1** | ULS 5a Ah 11 | 152.9 | 60.3 | 35.0 | 0.66 | |
| 314 | Eerste DWSARM - Crossing diagonal 2 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 169 | **-27.0** | ULS 5a Ah 11 | 31.4 | 60.3 | 58.8 | 0.86 | | **26.4** | ULS 5a Ba 20 | 152.9 | 60.3 | 35.0 | 0.75 | |
| 315 | Eerste DWSARM - Crossing diagonal 3 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 159 | **-29.7** | ULS 5a Ba 20 | 34.1 | 60.3 | 58.8 | 0.87 | | **31.2** | ULS 5a Ah 11 | 152.9 | 60.3 | 35.0 | 0.89 | |
| 316 | Eerste DWSARM - Crossing diagonal 4 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 147 | **-36.4** | ULS 5a Ba 11 | 38.0 | 60.3 | 58.8 | 0.96 | | **33.8** | ULS 5a Ah 20 | 152.9 | 60.3 | 35.0 | 0.96 | |

## Assessment of angle groups

Date 16-6-2021
Author BJT
Version 4.3

**GT-RLL**
**S+0/n**

| Group Label | Description | Type | Profile | Steel Quali | Bolts | #sh.pl | e1 | e2 | p1 | RLX | RLY | RLZ | Slenderness | Compression | Load Case (Compress | Buckling | Shear (Comp) | aring (Comp) | U.C. (Comp) | eedance (Comp) | Tension | Load Case (Tension) | Net Section | ear (Tens) | aring (Tens) | U.C. (Tens) | ance (Tens) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 317 | Eerste DWSARM - Crossing diagonal 5 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 131 | **-21.9** | ULS 5a Ah 21 | 44.4 | 60.3 | 58.8 | 0.49 | | **19.7** | ULS 5a Ah 21 | 152.9 | 60.3 | 35.0 | 0.56 | |
| 318 | Eerste DWSARM - Crossing diagonal 6 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 114 | **-21.8** | ULS 5a Ba 10 | 52.5 | 60.3 | 58.8 | 0.42 | | **23.1** | ULS 5a Ba 10 | 152.9 | 60.3 | 35.0 | 0.66 | |
| 319 | Eerste DWSARM - Crossing diagonal 7 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 101 | **-25.5** | ULS 5a Ah 21 | 59.6 | 60.3 | 58.8 | 0.43 | | **24.6** | ULS 5a Ah 21 | 152.9 | 60.3 | 35.0 | 0.70 | |
| 320 | Eerste DWSARM - Crossing diagonal 8 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 91 | **-28.1** | ULS 5a Ah 21 | 66.1 | 60.3 | 58.8 | 0.48 | | **28.2** | ULS 5a Ah 21 | 152.9 | 60.3 | 35.0 | 0.80 | |
| 321 | Eerste DWSARM - Crossing diagonal 9 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 81 | **-30.7** | ULS 5a Ba 10 | 73.9 | 60.3 | 58.8 | 0.52 | | **31.3** | ULS 5a Ba 10 | 152.9 | 60.3 | 35.0 | 0.89 | |
| 322 | Eerste DWSARM - Crossing diagonal 10 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.52 | 0.52 | 0.52 | 72 | **-34.3** | ULS 5a Ba 21 | 80.2 | 60.3 | 58.8 | 0.58 | | **32.9** | ULS 5a Ah 21 | 152.9 | 60.3 | 35.0 | 0.94 | |
| 323 | Eerste DWSRM - Horiz for conductor 1 | HEM | HEM160 | S355 | 2M20-8.8t | 1 | 45 | 45 | 70 | 2.00 | 1.00 | 1.00 | 28 | **-27.2** | ULS 5a Ah 20 | 2787.2 | 188.2 | 676.2 | 0.14 | | **31.5** | ULS 5a Ba 11 | 1486.8 | 188.2 | 464.5 | 0.17 | |
| 325 | Eerste DWSRM - Horiz for conductor 2 | HEB | HEB160 | S355 | 2M20-8.8t | 1 | 45 | 45 | 70 | 2.00 | 1.00 | 1.00 | 15 | **-29.1** | ULS 5a Ba 10 | 1561.3 | 188.2 | 235.2 | 0.15 | | **30.1** | ULS 5a Ba 21 | 992.3 | 188.2 | 213.8 | 0.16 | |
| 326 | Eerste DWSRM - Preekstoel 1 | EA | 70x70x7 | S355 | | | | | | 1.00 | 1.00 | 0.70 | 193 | **-0.9** | ULS 5a Ah 21 | 63.0 | 0.0 | 0.0 | 0.01 | | **1.6** | ULS 5a Ba 10 | 333.7 | 0.0 | 0.0 | 0.00 | |
| 328 | Eerste DWSRM - Preekstoel 2 | UA | 100x50x6 | S355 | | | | | | 1.00 | 1.00 | 1.00 | 82 | **-0.1** | ULS 1a_90 | 146.8 | 0.0 | 0.0 | 0.00 | | **0.0** | | 308.9 | 0.0 | 0.0 | 0.00 | |
| 329 | Eerste DWSRM - Preekstoel 3 | EA | 50x50x5 | S355 | | | | | | 1.00 | 1.00 | 1.00 | 111 | **-1.1** | ULS 5a Ah 21 | 67.3 | 0.0 | 0.0 | 0.02 | | **0.1** | ULS 5a Ah 21 | 170.4 | 0.0 | 0.0 | 0.00 | |
| 401 | Tweede DWSRM - Diagonal under | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 149 | **-25.2** | ULS 5a Ah 22 | 37.5 | 60.3 | 58.8 | 0.67 | | **19.5** | ULS 5a Ah 22 | 62.7 | 60.3 | 44.5 | 0.44 | |
| 402 | Tweede DWSRM - CD under 1 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 143 | **-25.8** | ULS 5a Ba 22 | 39.5 | 60.3 | 58.8 | 0.65 | | **28.6** | ULS 5a Ah 12 | 152.9 | 60.3 | 44.5 | 0.64 | |
| 403 | Tweede DWSRM - CD under 2 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 135 | **-28.7** | ULS 5a Ba 22 | 42.6 | 60.3 | 58.8 | 0.67 | | **26.9** | ULS 5a Ah 22 | 152.9 | 60.3 | 44.5 | 0.60 | |
| 404 | Tweede DWSRM - CD under 3 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 128 | **-29.5** | ULS 5a Ba 22 | 45.6 | 60.3 | 58.8 | 0.65 | | **30.0** | ULS 5a Ba 22 | 152.9 | 60.3 | 44.5 | 0.67 | |
| 405 | Tweede DWSRM - CD under 4 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | 55 | 0.52 | 0.52 | 0.52 | 118 | **-30.6** | ULS 5a Ba 22 | 56.7 | 60.3 | 58.8 | 0.54 | | **30.6** | ULS 5a Ah 12 | 152.9 | 60.3 | 44.5 | 0.69 | |
| 406 | Tweede DWSRM - CD under 5 | EA | 50x50x5 | S355 | 2M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 114 | **-33.6** | ULS 5a Ah 12 | 52.5 | 120.6 | 117.6 | 0.64 | | **32.7** | ULS 5a Ba 22 | 66.2 | 120.6 | 89.0 | 0.49 | |
| 407 | Tweede DWSRM - CD under 6 | EA | 50x50x5 | S355 | 2M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 103 | **-32.9** | ULS 5a Ah 22 | 58.5 | 120.6 | 117.6 | 0.56 | | **34.3** | ULS 5a Ba 12 | 66.2 | 120.6 | 89.0 | 0.52 | |
| 408 | Tweede DWSRM - CD under 7 | EA | 50x50x5 | S355 | 2M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 97 | **-36.2** | ULS 5a Ba 12 | 62.1 | 120.6 | 117.6 | 0.58 | | **34.1** | ULS 5a Ah 22 | 66.2 | 120.6 | 89.0 | 0.51 | |
| 409 | Tweede DWSRM - CD under 8 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 98 | **-12.3** | ULS 8 Ah | 61.8 | 60.3 | 58.8 | 0.21 | | **10.2** | ULS 8 Ah | 62.7 | 60.3 | 44.5 | 0.23 | |
| 410 | Tweede DWSRM - CD under 9 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 89 | **-11.0** | ULS 8 Ah | 67.5 | 60.3 | 58.8 | 0.19 | | **12.4** | ULS 8 Ah | 62.7 | 60.3 | 44.5 | 0.28 | |
| 411 | Tweede DWSRM - CD under 10 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 83 | **-12.6** | ULS 8 Ba | 72.0 | 60.3 | 58.8 | 0.21 | | **11.7** | ULS 8 Ah | 62.7 | 60.3 | 44.5 | 0.26 | |
| 412 | Tweede DWSRM - CD under 11 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 79 | **-12.7** | ULS 8 Ba | 75.2 | 60.3 | 58.8 | 0.22 | | **12.9** | ULS 8 Ba | 62.7 | 60.3 | 44.5 | 0.29 | |
| 413 | Tweede DWSRM - CD under 12 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 75 | **-13.5** | ULS 8 Ba | 78.5 | 60.3 | 58.8 | 0.23 | | **13.8** | ULS 8 Ba | 62.7 | 60.3 | 44.5 | 0.31 | |
| 414 | Tweede DWSRM - CD under 13 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.52 | 0.52 | 0.52 | 71 | **-14.0** | ULS 8 Ba | 81.3 | 60.3 | 58.8 | 0.24 | | **13.5** | ULS 8 Ah | 62.7 | 60.3 | 44.5 | 0.30 | |
| 416 | Tweede DWSRM - Horiz for conductor 2 | HEB | HEB160 | S355 | 2M20-8.8t | 1 | 45 | 45 | 70 | 2.00 | 1.00 | 1.00 | 21 | **-27.8** | ULS 5a Ba 22 | 1515.1 | 188.2 | 235.2 | 0.15 | | **31.2** | ULS 5a Ah 12 | 959.1 | 188.2 | 213.8 | 0.17 | |
| 418 | Tweede DWSRM - Horiz for conductor 4 | HEB | HEB160 | S355 | 1M16-8.8t | 1 | 47 | 60 | | 1.00 | 2.00 | 1.00 | 15 | **-11.5** | ULS 8 Ah | 1405.4 | 60.3 | 94.1 | 0.19 | | **11.8** | ULS 8 Ba | 319.9 | 60.3 | 94.1 | 0.20 | |
| 421 | Tweede DWSRM - Vert front 1 | EA | 55x55x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.60 | 0.60 | 137 | **-15.1** | ULS 3_0 | 41.4 | 60.3 | 70.6 | 0.37 | | **0.0** | | 75.3 | 60.3 | 53.4 | 0.00 | |
| 422 | Tweede DWSRM - Vert front 2 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.50 | 0.50 | 131 | **-15.5** | ULS 3_0 | 35.0 | 60.3 | 58.8 | 0.44 | | **0.0** | | 62.7 | 60.3 | 44.5 | 0.00 | |
| 423 | Tweede DWSRM - Vert front 3 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 170 | **-17.2** | ULS 3_0 | 31.0 | 60.3 | 58.8 | 0.55 | | **0.0** | | 62.7 | 60.3 | 44.5 | 0.00 | |
| 424 | Tweede DWSRM - Vert front 4 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.76 | 0.76 | 102 | **-19.7** | ULS 3_45 | 53.9 | 60.3 | 58.8 | 0.36 | | **0.0** | | 62.7 | 60.3 | 44.5 | 0.00 | |
| 425 | Tweede DWSRM - Vert front 5 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 91 | **-2.0** | ULS 1a_0 | 66.2 | 60.3 | 58.8 | 0.03 | | **0.0** | | 62.7 | 60.3 | 44.5 | 0.00 | |
| 426 | Tweede DWSRM - Vert front 6 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 45 | **-1.5** | ULS 3_45 | 94.9 | 60.3 | 58.8 | 0.02 | | **0.0** | | 62.7 | 60.3 | 44.5 | 0.00 | |
| 427 | Tweede DWSRM - Diag front 1 | EA | 55x55x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.60 | 0.60 | 182 | **0.0** | | 29.0 | 60.3 | 70.6 | 0.00 | | **17.8** | ULS 3_0 | 75.3 | 60.3 | 53.4 | 0.33 | |
| 428 | Tweede DWSRM - Diag front 2 | EA | 55x55x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.55 | 0.55 | 183 | **0.0** | | 28.8 | 60.3 | 70.6 | 0.00 | | **22.3** | ULS 3_0 | 75.3 | 60.3 | 53.4 | 0.42 | |
| 429 | Tweede DWSRM - Diag front 3 | EA | 55x55x6 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.50 | 0.50 | 178 | **0.0** | | 29.8 | 60.3 | 70.6 | 0.00 | | **26.2** | ULS 3_0 | 75.3 | 60.3 | 53.4 | 0.49 | |
| 430 | Tweede DWSRM - Diag front 4 | EA | 70x70x7 | S355 | 1M20-8.8t | 1 | 35 | 35 | | 1.00 | 0.70 | 0.70 | 148 | **0.0** | | 66.0 | 94.1 | 102.9 | 0.00 | | **36.9** | ULS 3_0 | 131.7 | 94.1 | 72.8 | 0.51 | |
| 431 | Tweede DWSRM - Diag front 5 | EA | 70x70x6 | S355 | 2M16-8.8t | 1 | 35 | 35 | 55 | 1.00 | 0.76 | 0.76 | 169 | **0.0** | | 66.2 | 120.6 | 141.1 | 0.00 | | **64.4** | ULS 3_45 | 128.4 | 120.6 | 122.0 | 0.53 | |
| 432 | Tweede DWSRM - Diag front 6 | EA | 70x70x6 | S355 | 2M16-8.8t | 1 | 35 | 35 | 55 | 1.00 | 1.00 | 1.00 | 228 | **0.0** | | 41.9 | 120.6 | 141.1 | 0.00 | | **10.2** | ULS 1a_135 | 128.4 | 120.6 | 122.0 | 0.08 | |
| 433 | Tweede DWSRM - Horiz top 1 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.50 | 0.50 | 0.50 | 140 | **-7.1** | ULS 1a_0 | 40.6 | 60.3 | 58.8 | 0.18 | | **7.1** | ULS 1a_0 | 51.0 | 60.3 | 35.0 | 0.20 | |
| 434 | Tweede DWSRM - Horiz top 2 | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 1.00 | 1.00 | 1.00 | 140 | **0.0** | | 40.4 | 60.3 | 58.8 | 0.00 | | **0.4** | ULS 1a_135 | 51.0 | 60.3 | 35.0 | 0.01 | |
| 436 | Tweede DWSRM - Doorsnede A-A diag | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.50 | 0.50 | 0.50 | 105 | **-6.1** | ULS 1a_0 | 57.4 | 60.3 | 58.8 | 0.11 | | **6.1** | ULS 1a_0 | 51.0 | 60.3 | 35.0 | 0.17 | |
| 437 | Tweede DWSRM - Doorsnede B-B diag | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 0.50 | 0.50 | 0.50 | 85 | **-3.4** | ULS 1a_0 | 70.5 | 60.3 | 58.8 | 0.06 | | **3.4** | ULS 1a_0 | 51.0 | 60.3 | 35.0 | 0.10 | |
| 438 | Tweede DWSRM - Doorsnede C-C diag | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 22 | | 1.00 | 1.00 | 1.00 | 132 | **-0.6** | ULS 1a_0.9_0.9_135 | 43.8 | 60.3 | 58.8 | 0.01 | | **0.7** | ULS 1a_0.9_0.9_0 | 51.0 | 60.3 | 35.0 | 0.02 | |
| 440 | Tweede DWSRM - preekstoel 1 | EA | 70x70x7 | S355 | | | | | | 1.00 | 1.00 | 0.67 | 225 | **-0.8** | ULS 8 Ba | 49.7 | 0.0 | 0.0 | 0.02 | | **1.4** | ULS 8 Ba | 333.7 | 0.0 | 0.0 | 0.00 | |
| 441 | Tweede DWSRM - preekstoel 2 | UA | 100x50x6 | S355 | | | | | | 1.00 | 1.00 | 1.00 | 84 | **-0.1** | ULS 3_90 | 144.3 | 0.0 | 0.0 | 0.00 | | **0.0** | | 308.9 | 0.0 | 0.0 | 0.00 | |
| 442 | Tweede DWSRM - preekstoel 3 | EA | 50x50x5 | S355 | | | | | | 1.00 | 1.00 | 1.00 | 111 | **-0.9** | ULS 8 Ah | 67.4 | 0.0 | 0.0 | 0.01 | | **0.1** | ULS 8 Ba | 170.4 | 0.0 | 0.0 | 0.00 | |

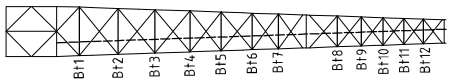
# APPENDIX C
# Knikverkorters

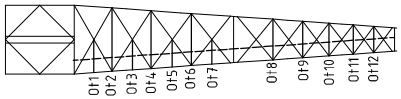
Niet in PLS-TOWER gemodelleerde elementen in de constructie worden aanvullend getoetst. Hieronder vallen de knikverkorters van de randstijl en profielen onderdeel van stabiliteitsverbanden. De staven worden getoetst op:

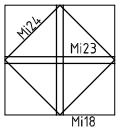
- voldoende trek- of druksterkte als steungevend profiel voor randstijl, 1% van de knikcapaciteit van de randstijl;
- slankheid;
- klimbelasting.

Voor de beloopbaarheid zijn staven in de traverse aanwezig. Deze zijn niet constructief (voorzien van slobgaten) en worden enkel getoetst op de klimbelasting van 1,0 kN. Zie hoofdstuk 4.2.5 en 5.7.2. van het uitgangspuntenrapport.

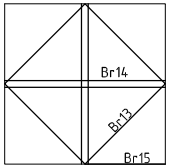
# Overzicht knikverkorters - S+0_n



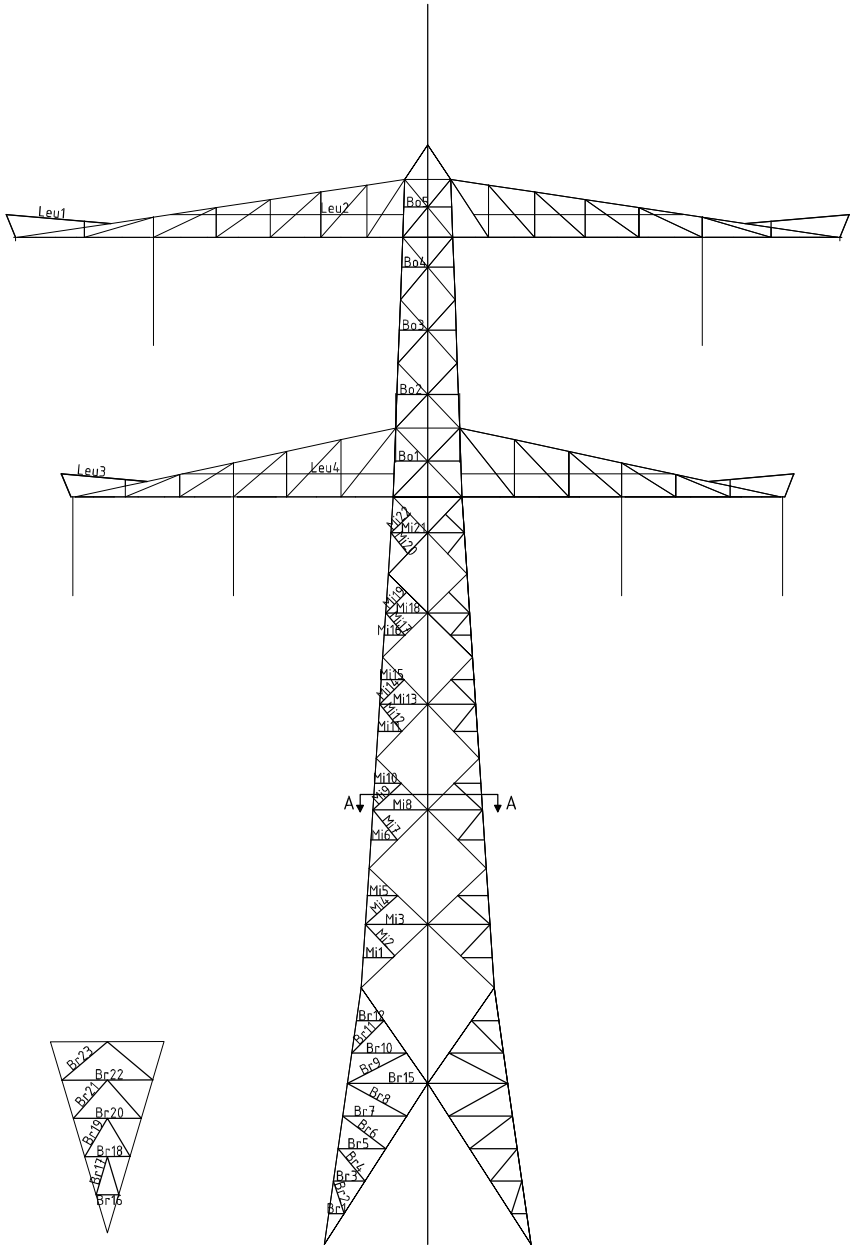




Aanzicht A-A









DNV·GL

## Knikverkorters initial construction (afkeur)

Date: 2021-06-14
Author: BJT
Version: 1,8

ZWO
S+0_n

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Br1 | Broekstuk | Enkele staaf | L55.6 | S355J0 | M16 | 8,8 | 0,670 | 0 | 63 | **10,4** | **0,25** | 112,6 | 60,3 | 51,5 | 75,3 | 1,15 | 0,23 | | |
| Br2 | Broekstuk | Enkele staaf | L55.6 | S355J0 | M16 | 8,8 | 1,480 | 72 | 138 | **10,4** | **0,00** | 54,3 | 60,3 | 51,5 | 75,3 | 1,15 | 0,20 | | |
| Br3 | Broekstuk | Enkele staaf | L55.6 | S355J0 | M16 | 8,8 | 1,376 | 0 | 128 | **10,4** | **0,52** | 59,6 | 60,3 | 51,5 | 75,3 | 1,15 | 0,46 | | |
| Br4 | Broekstuk | Enkele staaf | L55.6 | S355J0 | M16 | 8,8 | 1,837 | 50 | 171 | **10,4** | **0,00** | 40,3 | 60,3 | 51,5 | 75,3 | 1,15 | 0,26 | | |
| Br5 | Broekstuk | Enkele staaf | L55.6 | S355J0 | M16 | 8,8 | 2,080 | 0 | 194 | **10,4** | **0,78** | 33,6 | 60,3 | 51,5 | 75,3 | 1,15 | 0,70 | | |
| Br6 | Broekstuk | Enkele staaf | L55.6 | S355J0 | M16 | 8,8 | 2,350 | 37 | 219 | **10,4** | **0,00** | 27,8 | 60,3 | 51,5 | 75,3 | 1,15 | 0,37 | | |
| Br7 | Broekstuk | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 2,788 | 0 | 204 | **10,4** | **1,05** | 46,3 | 60,3 | 61,0 | 142,7 | 2,23 | 0,49 | | |
| Br8 | Broekstuk | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 2,940 | 29 | 215 | **10,4** | **0,96** | 42,6 | 60,3 | 61,0 | 142,7 | 2,23 | 0,45 | | |
| Br9 | Broekstuk | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 2,890 | 28 | 212 | **10,4** | **0,96** | 43,8 | 60,3 | 61,0 | 142,7 | 2,23 | 0,44 | | |
| Br10 | Broekstuk | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 2,380 | 0 | 174 | **10,4** | **0,89** | 58,6 | 60,3 | 61,0 | 142,7 | 2,23 | 0,41 | | |
| Br11 | Broekstuk | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 2,000 | 45 | 147 | **10,4** | **0,00** | 74,8 | 60,3 | 61,0 | 142,7 | 2,23 | 0,17 | | |
| Br12 | Broekstuk | Knieksteun op 0,5L | L70.7 | S355J0 | M16 | 8,8 | 1,200 | 0 | 57 | **10,4** | **0,45** | 143,3 | 60,3 | 61,0 | 142,7 | 2,99 | 0,17 | | |
| Br13 | Tussenschot +6,68 | Knieksteun op 0,5L | L70.7 | S355J0 | M16 | 8,8 | 4,940 | 0 | 233 | **0,0** | **1,85** | 32,1 | 60,3 | 61,0 | 142,7 | 2,99 | 0,62 | | |
| Br14 | Tussenschot +6,68 | Kruisende staaf halverwege | L80.6 | S355J0 | M16 | 8,8 | 7,000 | 0 | 223 | **0,0** | **1,31** | 40,3 | 60,3 | 52,3 | 145,8 | 3,40 | 0,39 | | |
| Br15 | Tussenschot +6,68 | Enkele staaf | L80.6 | S355J0 | M16 | 8,8 | 3,500 | 0 | 223 | **0,0** | **1,31** | 40,3 | 60,3 | 52,3 | 145,8 | 2,68 | 0,51 | | |
| Br16 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 0,980 | 0 | 101 | **2,3** | **0,37** | 60,0 | 60,3 | 41,3 | 43,1 | 0,81 | 0,47 | | |
| Br17 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,730 | | 178 | **2,3** | **0,65** | 29,1 | 60,3 | 41,3 | 43,1 | 0,81 | 0,83 | | |
| Br18 | Broekstuk | Knieksteun op 0,5L | L50.5 | S355J0 | M16 | 8,8 | 1,970 | 0 | 130 | **2,3** | **0,74** | 35,3 | 60,3 | 41,3 | 43,1 | 1,08 | 0,68 | | |
| Br19 | Broekstuk | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,930 | | 198 | **2,3** | **0,72** | 24,7 | 60,3 | 41,3 | 43,1 | 0,81 | 0,92 | | |
| Br20 | Broekstuk | Knieksteun op 0,5L | L60.6 | S355J0 | M16 | 8,8 | 2,960 | 0 | 163 | **2,3** | **1,11** | 38,6 | 60,3 | 52,3 | 98,8 | 1,88 | 0,59 | | |
| Br21 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,220 | | 190 | **2,3** | **0,83** | 38,0 | 60,3 | 52,3 | 98,8 | 1,40 | 0,61 | | |
| Br22 | Broekstuk | Knieksteun op 0,5L | L60.6 | S355J0 | M16 | 8,8 | 3,950 | 0 | 217 | **2,3** | **1,48** | 26,0 | 60,3 | 52,3 | 98,8 | 1,88 | 0,79 | | |
| Br23 | Broekstuk | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,580 | | 221 | **2,3** | **0,97** | 30,2 | 60,3 | 52,3 | 98,8 | 1,40 | 0,71 | | |
| Mi1 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,290 | 0 | 133 | **10,8** | **0,48** | 43,6 | 60,3 | 41,3 | 43,1 | 0,81 | 0,62 | | |
| Mi2 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,870 | 47 | 192 | **10,8** | **0,00** | 25,9 | 60,3 | 41,3 | 43,1 | 0,81 | 0,42 | | |
| Mi3 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,710 | 0 | 232 | **10,8** | **1,02** | 27,9 | 60,3 | 52,3 | 98,8 | 1,40 | 0,75 | | |
| Mi4 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,880 | 41 | 193 | **10,8** | **0,00** | 25,7 | 60,3 | 41,3 | 43,1 | 0,81 | 0,42 | | |
| Mi5 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,320 | 0 | 136 | **10,8** | **0,50** | 42,3 | 60,3 | 41,3 | 43,1 | 0,81 | 0,63 | | |
| Mi6 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,154 | 0 | 119 | **10,8** | **0,43** | 50,0 | 60,3 | 41,3 | 43,1 | 0,81 | 0,55 | | |
| Mi7 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,690 | 51 | 174 | **10,8** | **0,00** | 30,1 | 60,3 | 41,3 | 43,1 | 0,81 | 0,36 | | |
| Mi8 | Tussenstuk1 | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,388 | 0 | 204 | **10,8** | **0,90** | 34,0 | 60,3 | 52,3 | 98,8 | 1,40 | 0,66 | | |
| Mi9 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,690 | 43 | 174 | **10,8** | **0,00** | 30,1 | 60,3 | 41,3 | 43,1 | 0,81 | 0,36 | | |
| Mi10 | Tussenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,169 | 0 | 120 | **9,4** | **0,44** | 49,2 | 60,3 | 41,3 | 43,1 | 0,81 | 0,56 | | |
| Mi11 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,030 | 0 | 106 | **9,4** | **0,39** | 56,9 | 60,3 | 41,3 | 43,1 | 0,81 | 0,49 | | |
| Mi12 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,520 | 41 | 156 | **9,4** | **0,00** | 35,0 | 60,3 | 41,3 | 43,1 | 0,81 | 0,27 | | |
| Mi13 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 2,088 | 0 | 215 | **9,4** | **0,78** | 21,9 | 60,3 | 41,3 | 43,1 | 0,81 | 1,00 | | |
| Mi14 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,511 | 45 | 155 | **9,4** | **0,00** | 35,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,26 | | |
| Mi15 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,030 | 0 | 106 | **9,4** | **0,39** | 56,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,49 | | |
| Mi16 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 0,902 | 0 | 93 | **9,4** | **0,34** | 65,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,43 | | |
| Mi17 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,287 | 49 | 132 | **9,4** | **0,00** | 43,7 | 60,3 | 41,3 | 43,1 | 0,8 | 0,23 | | |
| Mi18 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,829 | 0 | 188 | **9,4** | **0,69** | 26,8 | 60,3 | 41,3 | 43,1 | 0,8 | 0,87 | | |

DNV·GL

## Knikverkorters initial construction (afkeur)

Date: 2021-06-14
Author: BJT
Version: 1,8

ZWO
S+0_n

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mi19 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,282 | 45 | 132 | **9,4** | **0,00** | 43,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,23 | | |
| Mi20 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,166 | 51 | 120 | **9,4** | **0,00** | 49,4 | 60,3 | 41,3 | 43,1 | 0,8 | 0,23 | | |
| Mi21 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,600 | 0 | 164 | **9,4** | **0,60** | 32,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,76 | | |
| Mi22 | Tussenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,158 | 44 | 119 | **9,4** | **0,00** | 49,8 | 60,3 | 41,3 | 43,1 | 0,8 | 0,23 | | |
| Mi23 | Tussenstuk2 | Kruisende staaf halverwege | L50.5 | S355J0 | M16 | 8,8 | 4,770 | 0 | 245 | **9,4** | **0,89** | 17,8 | 60,3 | 41,3 | 43,1 | 1,1 | 0,82 | | |
| Mi24 | Tussenstuk2 | Enkele staaf | L70.7 | S355J0 | M16 | 8,8 | 3,370 | 0 | 247 | **9,4** | **1,26** | 34,4 | 60,3 | 61,0 | 142,7 | 2,2 | 0,59 | | |
| Bo1 | Bovenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,440 | 0 | 148 | **4,7** | **0,54** | 37,7 | 60,3 | 41,3 | 43,1 | 0,8 | 0,69 | | |
| Bo2 | Bovenstuk1 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,338 | 0 | 137 | **4,7** | **0,50** | 41,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,64 | | |
| Bo3 | Bovenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,237 | 0 | 127 | **3,9** | **0,46** | 45,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,59 | | |
| Bo4 | Bovenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,138 | 0 | 117 | **3,9** | **0,43** | 50,8 | 60,3 | 41,3 | 43,1 | 0,8 | 0,54 | | |
| Bo5 | Bovenstuk2 | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,040 | 0 | 107 | **3,9** | **0,39** | 56,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,50 | | |
| Ot1 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,440 | 0 | 148 | **0,0** | **0,54** | 37,7 | 60,3 | 41,3 | 43,1 | 0,8 | 0,69 | | |
| Ot2 | Ondertraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,760 | 0 | 236 | **0,0** | **1,04** | 27,1 | 60,3 | 52,3 | 98,8 | 1,4 | 0,76 | | |
| Ot3 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,320 | 0 | 136 | **0,0** | **0,50** | 42,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,63 | | |
| Ot4 | Ondertraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,530 | 0 | 216 | **0,0** | **0,95** | 31,1 | 60,3 | 52,3 | 98,8 | 1,4 | 0,70 | | |
| Ot5 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,196 | 0 | 123 | **0,0** | **0,45** | 47,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,57 | | |
| Ot6 | Ondertraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,270 | 0 | 194 | **0,0** | **0,85** | 36,7 | 60,3 | 52,3 | 98,8 | 1,4 | 0,63 | | |
| Ot7 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,070 | 0 | 110 | **0,0** | **0,40** | 54,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,51 | | |
| Ot8 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,760 | 0 | 181 | **0,0** | **0,66** | 28,4 | 60,3 | 41,3 | 43,1 | 0,8 | 0,84 | | |
| Ot9 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,590 | 0 | 163 | **0,0** | **0,60** | 32,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,76 | | |
| Ot10 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,430 | 0 | 147 | **0,0** | **0,54** | 38,1 | 60,3 | 41,3 | 43,1 | 0,8 | 0,68 | | |
| Ot11 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,280 | 0 | 132 | **0,0** | **0,48** | 44,0 | 60,3 | 41,3 | 43,1 | 0,8 | 0,61 | | |
| Ot12 | Ondertraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,150 | 0 | 118 | **0,0** | **0,43** | 50,2 | 60,3 | 41,3 | 43,1 | 0,8 | 0,55 | | |
| Bt1 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,110 | 0 | 181 | **0,0** | **0,79** | 41,0 | 60,3 | 52,3 | 98,8 | 1,4 | 0,58 | | |
| Bt2 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 2,000 | 0 | 171 | **0,0** | **0,75** | 44,3 | 60,3 | 52,3 | 98,8 | 1,4 | 0,55 | | |
| Bt3 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 1,890 | 0 | 162 | **0,0** | **0,71** | 48,0 | 60,3 | 52,3 | 98,8 | 1,4 | 0,52 | | |
| Bt4 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 1,780 | 0 | 152 | **0,0** | **0,67** | 52,2 | 60,3 | 52,3 | 98,8 | 1,4 | 0,49 | | |
| Bt5 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,680 | 0 | 173 | **0,0** | **0,63** | 30,4 | 60,3 | 41,3 | 43,1 | 0,8 | 0,80 | | |
| Bt6 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,580 | 0 | 162 | **0,0** | **0,59** | 33,2 | 60,3 | 41,3 | 43,1 | 0,8 | 0,76 | | |
| Bt7 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,510 | 0 | 155 | **0,0** | **0,57** | 35,3 | 60,3 | 41,3 | 43,1 | 0,8 | 0,72 | | |
| Bt8 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,330 | 0 | 137 | **0,0** | **0,50** | 41,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,64 | | |
| Bt9 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,260 | 0 | 129 | **0,0** | **0,47** | 44,9 | 60,3 | 41,3 | 43,1 | 0,8 | 0,60 | | |
| Bt10 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,210 | 0 | 124 | **0,0** | **0,45** | 47,2 | 60,3 | 41,3 | 43,1 | 0,8 | 0,58 | | |
| Bt11 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,140 | 0 | 117 | **0,0** | **0,43** | 50,7 | 60,3 | 41,3 | 43,1 | 0,8 | 0,54 | | |
| Bt12 | Boventraverse | Enkele staaf | L50.5 | S355J0 | M16 | 8,8 | 1,070 | 0 | 110 | **0,0** | **0,40** | 54,6 | 60,3 | 41,3 | 43,1 | 0,8 | 0,51 | | |
| | | | | | | | | | | | | | | | | | | | |
| Leu1 | Boventraverse | Kniksteun op 0,5L | L70.7 | S355J0 | M16 | 8,8 | 4,560 | 0 | 215 | **0,0** | **1,71** | 36,0 | 60,3 | 61,0 | 142,7 | 3,0 | 0,57 | | |
| Leu2 | Boventraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 1,150 | 0 | 98 | **0,0** | **0,43** | 88,5 | 60,3 | 52,3 | 98,8 | 1,4 | 0,32 | | |
| Leu3 | Ondertraverse | Kniksteun op 0,5L | L70.7 | S355J0 | M16 | 8,8 | 3,740 | 0 | 176 | **0,0** | **1,40** | 47,4 | 60,3 | 61,0 | 142,7 | 3,0 | 0,47 | | |
| Leu4 | Ondertraverse | Enkele staaf | L60.6 | S355J0 | M16 | 8,8 | 1,150 | 0 | 98 | **0,0** | **0,43** | 88,5 | 60,3 | 52,3 | 98,8 | 1,4 | 0,32 | | |

# APPENDIX D
# Blokdeuvels

De belastingen op de fundatie uit Appendix A zijn uitgangspunt voor de berekening van de ingestorte rand met blokdeuvels. De belastingen in de richting van de randstijl zijn van toepassing. In de tabellen is dit opgenomen in de laatste kolom $R_{z,lok}$. De controles zijn uitgevoerd met een spreadsheet. Vanwege de helling van de drukdiagonaal wordt per krachtsrichting bepaald hoeveel deuvels effectief zijn. Hierdoor kunnen het aantal deuvels in de berekening anders zijn dan op tekening.

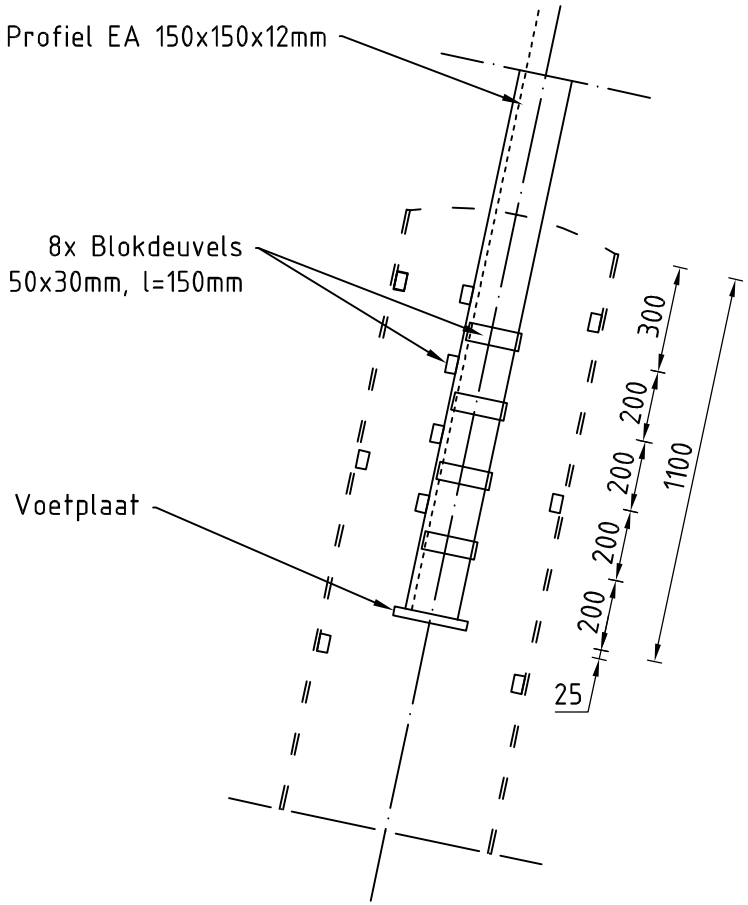
De belastingen waaraan getoetst worden zijn onderstaand weergegeven.

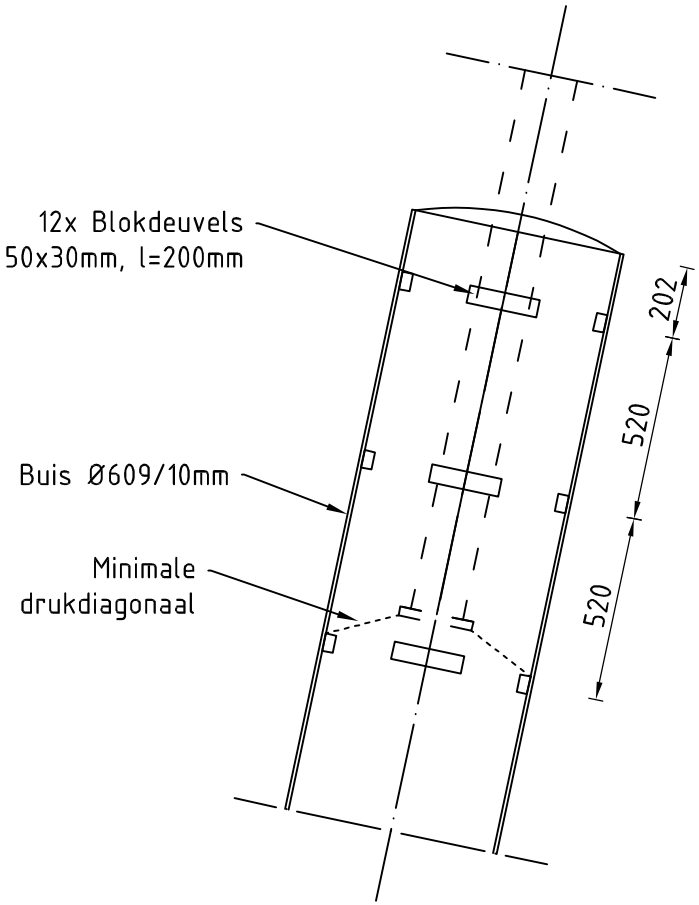
**Masttype S+0/n**

**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 | 169 | 155 | **979** | 10 | -229 | -40 | 997 |
| Max. trek | ULS 1a_0,9_0,9_45 | 134 | 120 | **-780** | -10 | 179 | 29 | -794 |
| Max. pos. torsie | ULS 5a Ba 21 | -29 | 27 | 0 | **40** | -2 | -2 | 0 |
| Max. neg. torsie | ULS 5a Ah 21 | 29 | 27 | 0 | **-40** | -2 | -2 | 0 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_45 | 134 | 120 | **-780** | **-10** | 179 | 29 | -794 |

# Principe blokdeuvels - S+0/n




Algemene opmerkingen

- Aarding niet aangegeven
- Spiraalwapening niet aangegeven

Project: GT-RLL
Mast: S+0_n

## Shear blocks

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

Datum: 2021-06-17
Auteur: BJT
Versie: 1.4

| ***Load*** | | | | ***Results*** | | | |
|---|---|---|---|---|---|---|---|
| Compression | $F_{Ed,c}$ | **997** | kN | Compression | U.C. | 0,75 | < 1,00 OK |
| Tension | $F_{Ed,t}$ | **794** | kN | Tension | U.C. | 0,60 | < 1,00 OK |

***Main leg***

| | | | |
|---|---|---|---|
| Profile | | **L150.12** | |
| Steel material | | S355 | |
| Cross section | | 3480 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 1235 | kN |
| Width | b | 150 | mm |
| Thickness | t | 12 | mm |
| Length in concrete | | 1100 | mm |

***Shear blocks main leg***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 150 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 200 | mm |
| Number for compr. | $n_c$ | 6 | - |
| Number for tension | $n_t$ | 6 | - |

***Foot plate***

| | | | |
|---|---|---|---|
| Thickness | t | 25 | mm |
| Ext. length | m | 30 | mm |
| Welds | a | 5 | mm |

***Pile***

| | | | |
|---|---|---|---|
| Name | | Buispaal | |
| Diameter | | 609 | mm |
| Thickness | | 10 | mm |
| Cross section | | 18818 | $mm^2$ |
| Steel material | | S355 | |
| Capacity | | 6680 | kN |
| Concrete strength | | C30/37 | |

***Shear blocks pile***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 200 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 520 | mm |
| Number for compr. | $n_c$ | 8 | - |
| Number for tension | $n_t$ | 8 | - |

***Design value concrete strength***

| | | | |
|---|---|---|---|
| Material factor | $\gamma_c$ | 1,5 | |
| Add. mat. factor | $\gamma_m$ | 1,25 | - |
| $f_{cd}$ = | | 16,0 | $N/mm^2$ |

***Steel tower stub***

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

***Capacity shear blocks main leg***

| | | |
|---|---|---|
| $A_{f1}$ = | 4500 | $mm^2$ |
| $A_{f2}$ = | 12600 | $mm^2$ |
| Slope | 1: 5 | |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1,67 | |
| $f_{jd} = C_A \times f_{cd}$ = | 26,8 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | 723 | kN |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | 723 | kN |

***Capacity foot plate***

| | | |
|---|---|---|
| $k_d$ = | 1,73 | - |
| $f_{jd} = C_A \times f_{cd}$ = | 27,7 | $N/mm^2$ |
| $c = t\sqrt{(f_{yd} / 3f_{jd})}$ = | 53 | mm |
| m* = min(c,m) = | 30 | mm |
| Type foot plate | Extending | |
| Effective for | Compr. and tension | |
| $A_{p,c}$ = | 25080 | $mm^2$ |
| $F_{Rd,c} = A_{p,druk} \times f_{jd}$ = | 695 | kN |
| $A_{p,t}$ = | 21600 | $mm^2$ |
| $F_{Rd,t} = A_{p,t} \times f_{jd}$ = | 599 | kN |

***Capacities***

| | | |
|---|---|---|
| $F_{rd,c,plate}$ = | 695 | kN |
| $F_{rd,blocks,c}$ = | 723 | kN |
| $F_{rd,c} = F_{rd,blck}+F_{rd,footplate}$ = | **1418** | kN |
| U.C. compression | 0,70 | < 1,00 OK |
| Welds foot plate (see next page) | 724 | kN |
| $F_{rd,t}$ = min. (welds / foot plate) = | 599 | kN |
| $F_{rd,blocks,t}$ = | 723 | kN |
| $F_{rd,t} = F_{rd,blck}+F_{rd,footplate}$ = | **1321** | kN |
| U.C. tension | 0,60 | < 1,00 OK |
| U.C. welds | 0,48 | < 1,00 OK |

***Capacity shear blocks pile***

| | | |
|---|---|---|
| $A_{f1}$ = | 6000 | $mm^2$ |
| $A_{f2}$ = | 18000 | $mm^2$ |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1,73 | - |
| $f_{jd} = k_d \times f_{cd}$ = | 27,7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | **1330** | kN |
| U.C. compression | 0,75 | < 1,00 OK |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | **1330** | kN |
| U.C. tension | 0,60 | < 1,00 OK |
| U.C. welds | 0,42 | < 1,00 OK |

***"Splitting" of pile***

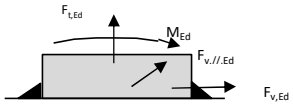
| | | | |
|---|---|---|---|
| Spread of forces | | 45 | ° |
| Length force flow | | 806 | mm |
| Splitting force | | 493 | kN/m |
| Yield strength wall | $f_{yd}$ = | 355 | $N/mm^2$ |
| Capacity tubular pile | | 7100 | kN/m |
| U.C. | | 0,07 | < 1,00 OK |

Project: GT-RLL
Mast: S+0_n

## Welds of shear blocks of main leg

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 150 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0,9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1,25 | - |



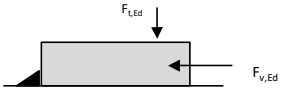

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1,2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ = | 0 | $N/mm^2$ |
| $F_{t,Ed}$ = | **0** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ = | 68 | $N/mm^2$ |
| $F_{v,Ed} = F_{rd,c} / n$ = | **145** | kN | | 68 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | $b^* = b + 2/3a\sqrt{2}$ | 54,7 | mm |
| $M_{Ed}$ = 1/2 b / h x $F_{v,Ed}$ = | **2,17** | kNm | $\sigma_1 = \tau_1 = 0{,}706M_{Ed} / al\, b^*$ = | 37 | $N/mm^2$ |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 211 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 211 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0,48** OK |
| $\sigma_1$ = | 105 | $N/mm^2$ | ≤ | $0{,}9f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0,30** OK |

## Welds of shear blocks of pile

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 200 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0,9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1,25 | - |




| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1,2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ = | 21 | $N/mm^2$ |
| $F_{t,Ed}$ = 1/2 b / h x $F_{v,Ed}$ = | **60** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ = | 71 | $N/mm^2$ |
| $F_{v,Ed}$ = | **200** | kN | | 92 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | | | |
| $M_{Ed}$ = | **0,00** | kNm | | | |
| | | | $\tau_{//} = F_{v//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 183 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 183 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0,42** OK |
| $\sigma_1$ = | 92 | $N/mm^2$ | ≤ | $0{,}9f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0,26** OK |

## Welds of foot plate

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

# APPENDIX E

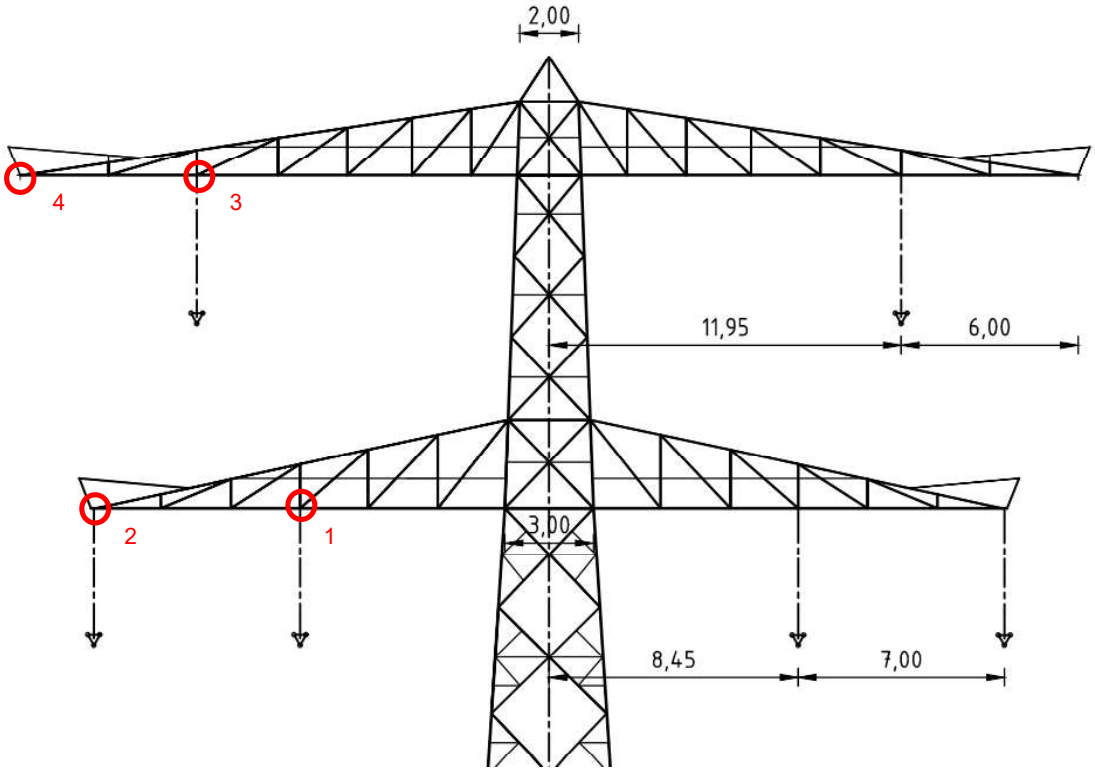
## Liggers

De liggers uit HE-profiel voor de isolatoren zijn met het programma AxisVM op buiging gecontroleerd.

# BEREKENING DRAAGLIGGERS S+0_N

De volgende onderdelen worden berekend:

- De liggers (op torsie belast) waaraan de isolatorkettingen worden opgehangen.



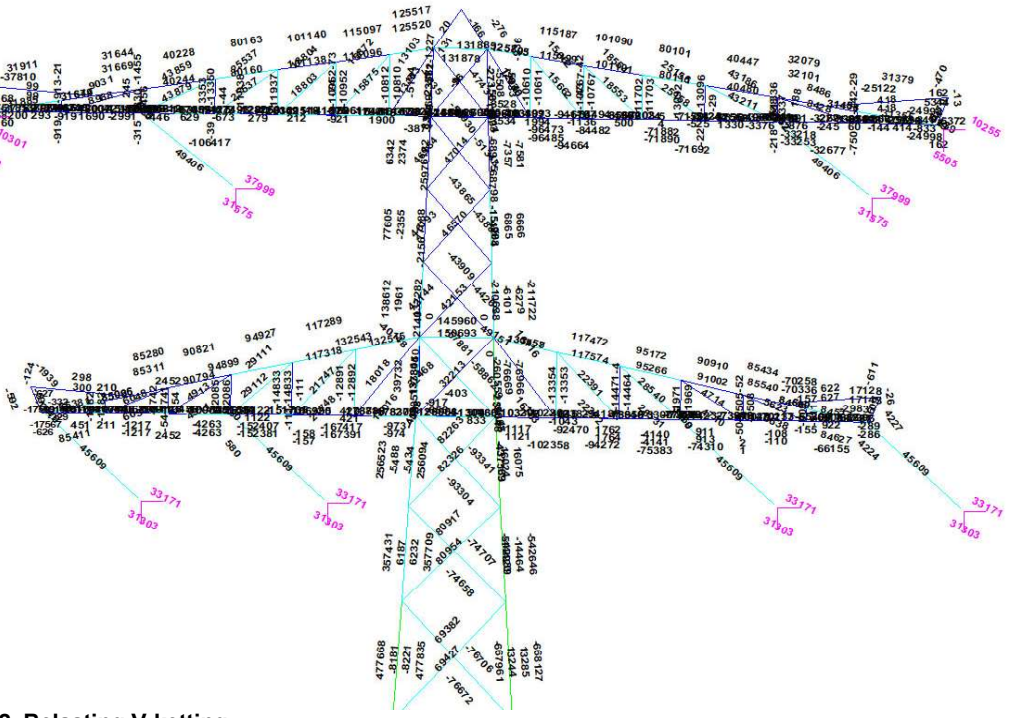

**Figuur 1 Overzicht liggers en afmetingen**

In onderstaande tabel zijn de lengte van de liggers en de optredende krachten met bijbehorende hoek opgenomen.

**Tabel 1 Gegevens liggers en belasting V-ketting**

| Beam | Type | b | Lengte | Fy | Fz. | Hoek | Kracht |
|---|---|---|---|---|---|---|---|
| | | *[m]* | *[m]* | *[m]* | *[m]* | *[°]* | *[kN]* |
| 1 | HEM160 | 0,16 | 2,01 | 33,2 | 31,3 | 46,7 | 45,6 |
| 2 | HEB160 | 0,16 | 1,01 | 33,2 | 31,3 | 46,7 | 45,6 |
| 3 | HEB160 | 0,16 | 1,43 | 38,0 | 31,6 | 50,3 | 49,4 |
| 4 | HEB160 | 0,16 | 1,01 | 10,3 | 5,6 | 28,5 | 11,7 |

Onderstaand zijn de optredende belastingen weergegeven. Load case ULS 1a_90 is maatgevend (wind loodrecht). In load case 3 met ijs is de verticale belasting groter maar de torsie kleiner.



**Figuur 2 Belasting V-ketting**

## 1.1 Berekening liggers

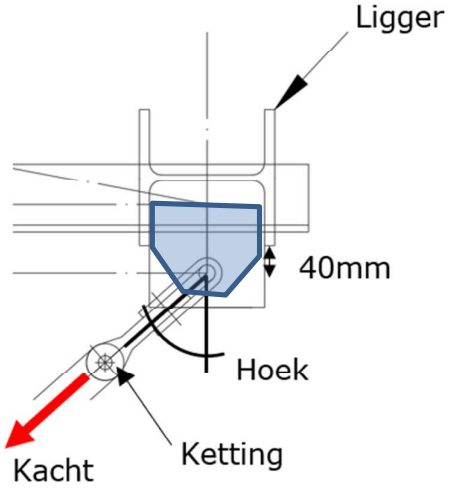
In figuur 3 is het schema van het aangrijpen van de kracht op de ligger weergegeven.

De kracht grijpt excentrisch op de ligger aan onder een hoek (tabel 1). De excentriciteit t.o.v. het hart van het profiel is aangenomen op 40mm plus de halve breedte van het profiel.

De liggers worden getoetst op de combinatie van een dubbel buigend moment en torsie. De controle wordt uitgevoerd middels een excelsheet. Resulaten:

- Beam1 → UC = 0,88
- Beam2 → UC = 0,91
- Beam3 → UC = 0,90
- Beam4 → UC = 0,75

Alle liggers voldoen, voor berekening zie uitvoer spreadsheet.




**Figuur 3 Schema aangrijpen kracht**

Project: GT-RLL
Mast: S+0_n

## Steel beams in torsion

*Calculation of unrestrained beams with eccentric load*

Datum: 2021-06-15
Auteur: TBR
Versie: 1.1

| ***Load*** | | ***Beam 1 BT*** | ***Beam 2 OT*** | ***Beam 3*** | ***Beam 4*** | | |
|---|---|---|---|---|---|---|---|
| Force on insulator | | 45,6 | 45,6 | 49,4 | 11,7 | | *kN* |
| Angle of insulator (to vertical) | | 46,7 | 46,7 | 50,3 | 61,5 | | *o* |
| Horizontal force in direction of | | y-as | y-as | y-as | y-as | | |
| Horizontal force | $F_h$ | 33,2 | 33,2 | 38,0 | 10,3 | | *kN* |
| Vertical force | $F_v$ | 31,3 | 31,3 | 31,6 | 5,6 | | *kN* |
| Eccentricity of force (below beam) | e | 40 | 40 | 40 | 40 | | *mm* |
| Torsional moment | T | 4,1 | 4,0 | 4,6 | 1,2 | | *kNm* |
| ***Beams*** | | | | | | | |
| Beam length | L | 2010 | 1010 | 1430 | 1010 | | *mm* |
| Yield stress | $f_y$ | 355 | 355 | 355 | 355 | | *Mpa* |
| Elastic modulus | E | 210000 | 210000 | 210000 | 210000 | | *Mpa* |
| Shear modulus | G | 81000 | 81000 | 81000 | 81000 | | *Mpa* |
| Profile | | HEM 160 | HEB 160 | HEB 160 | HEB 160 | | |
| | | HEM160 | HEB160 | HEB160 | HEB160 | | |
| Height | h | 180 | 160 | 160 | 160 | | *mm* |
| Width | b | 166 | 160 | 160 | 160 | | *mm* |
| Web thickness | $t_w$ | 14,0 | 8,0 | 8,0 | 8,0 | | *mm* |
| Flange thickness | $t_f$ | 23,0 | 13,0 | 13,0 | 13,0 | | *mm* |
| Torsional constant | $I_t$ | 161 | 31 | 31 | 31 | $\cdot 10^4$ | $mm^4$ |
| Warping constant | $I_{wa}$ | 108054 | 47943 | 47943 | 47943 | $\cdot 10^6$ | $mm^6$ |
| Moment of inertia | $I_y$ | 5098 | 2492 | 2492 | 2492 | $\cdot 10^4$ | $mm^4$ |
| | $I_z$ | 1759 | 889 | 889 | 889 | $\cdot 10^4$ | $mm^4$ |
| Flange stiffness | $I_f = I_z / 2 =$ | 879 | 445 | 445 | 445 | | $mm^3$ |
| Moment of resistance | $W_{y,el}$ | 566 | 311 | 311 | 311 | $\cdot 10^3$ | $mm^3$ |
| | $W_{z,el}$ | 212 | 111 | 111 | 111 | $\cdot 10^3$ | $mm^3$ |
| Torsional bending constant | d | 418 | 630 | 630 | 630 | | *mm* |
| | L/d | 4,8 | 1,6 | 2,3 | 1,6 | | |
| | α | 0,5 | 0,5 | 0,5 | 0,5 | | |

**Calculation of second derivative of angular deflection ϕ'':**

| | | | | | |
|---|---|---|---|---|---|
| $A = T / (G \cdot I_t \cdot d) =$ | 7,51E-08 | 2,49E-07 | 2,86E-07 | 7,73E-08 | |
| $B = \sinh(\alpha \cdot L / d) =$ | 5,50E+00 | 8,89E-01 | 1,39E+00 | 8,89E-01 | |
| $C = \tanh(L/d) =$ | 1,00E+00 | 9,22E-01 | 9,79E-01 | 9,22E-01 | |
| $D = \cosh(\alpha \cdot L / d) =$ | 5,59E+00 | 1,34E+00 | 1,72E+00 | 1,34E+00 | |
| $F = \sinh(0.5 \cdot L / d) =$ | 5,50E+00 | 8,89E-01 | 1,39E+00 | 8,89E-01 | |
| $H = (B / C - D) \cdot F =$ | -4,92E-01 | -3,32E-01 | -4,06E-01 | -3,32E-01 | |
| $X = A \cdot H =$ | -3,70E-08 | -8,29E-08 | -1,16E-07 | -2,57E-08 | |
| $Y = X \cdot G \cdot I_t \cdot d / T =$ | -4,92E-01 | -3,32E-01 | -4,06E-01 | -3,32E-01 | |
| $\phi'' = Y \cdot T / (G \cdot I_t \cdot d) =$ | -3,70E-08 | -8,29E-08 | -1,16E-07 | -2,57E-08 | $rad/mm^2$ |

Project: GT-RLL
Mast: S+0_n

## Steel beams in torsion

*Calculation of unrestrained beams with eccentric load*

Datum: 2021-06-15
Auteur: TBR
Versie: 1.1

| | | | | | | |
|---|---|---|---|---|---|---|
| **Acting moments:** | | | | | | |
| $M_{w,Ed} = E \cdot I_f \cdot (h-t_f) \cdot \phi'' / 2 =$ | | 5,4 | 5,7 | 8,0 | 1,8 | *kNm* |
| $M_{y,Ed} = 1/4 \cdot F \cdot L =$ | | 16,7 | 8,4 | 13,6 | 2,6 | *kNm* |
| $M_{z,Ed} = 1/4 \cdot F \cdot L =$ | | 15,7 | 7,9 | 11,3 | 1,4 | *kNm* |
| **Capacities of beams:** | | | | | | |
| $M_{w,Rd} = W_{z,el} \cdot f_y / 2 =$ | | 37,6 | 19,7 | 19,7 | 19,7 | *kNm* |
| $M_{y,Rd} = W_{y,el} \cdot f_y =$ | | 201,1 | 110,6 | 110,6 | 110,6 | *kNm* |
| $M_{z,Rd} = W_{z,el} \cdot f_y =$ | | 75,2 | 39,5 | 39,5 | 39,5 | *kNm* |
| **Combined check of beam:** | | | | | | |
| UC | | 0,43 | 0,56 | 0,81 | 0,15 | |
| **Displacements:** | | | | | | |
| Factor $F_{ed} / F_k$ | | 1,2 | 1,2 | 1,2 | 1,2 | |
| Displacement y-direction | $u_y$ | 0,44 | 0,11 | 0,37 | 0,04 | *mm* |
| Relative displacement | rel. | 4600 | 8904 | 3878 | 28738 | - |
| Displacement z-direction | $u_z$ | 1,19 | 0,30 | 0,86 | 0,05 | *mm* |
| Relative displacement | rel. | 1684 | 3372 | 1667 | 18887 | - |

# APPENDIX F
## Galloping

Niet van toepassing voor dit masttype.

## About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

## B.13 Mastrapportage

ZUID-WEST 380 KV OOST VERBINDINGEN

# Mastrapportage GT-RLL S+32/n

TenneT TSO B.V.

**Meridian doc.nr.:** 002.678.00 0934575
**Rapport nr.:** 21-0890, Rev. 0
**Datum:** 2021-07-16

| | | |
|---|---|---|
| Projectnaam: | Zuid-West 380 kV Oost Verbindingen | Energy Systems |
| Rapport titel: | Mastrapportage GT-RLL S+32/n | DNV Netherlands B.V. |
| Klant: | TenneT TSO B.V., | Utrechtseweg 310-B50 |
| Contactpersoon klant: | [redacted] | 6812 AR Arnhem |
| Datum uitgave: | 2021-07-16 | |
| Project nr.: | 10124719 | |
| Organisatie unit: | TDT | Tel: 026 356 9111 |
| Meridian doc.nr..: | 002.678.00 0934575 | Handelsregister Arnhem 09006404 |
| Rapport nr.: | 21-0890, Rev. 0 | |

[redacted]

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| Rev. | Datum | Reden van uitgave | Auteur | Beoordelaar | Goedkeuder |
|---|---|---|---|---|---|
| 0 | 2021-07-16 | Eerste uitgave | [redacted] | | |

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# 1 INLEIDING

In het basisontwerp van de vakwerkmasten voor de verbinding GT-RLL380 in het project Zuid-West 380 kV-Oost zijn voor het vaststellen van de haalbaarheid constructieve berekeningen uitgevoerd aan de masten en fundaties. In de Definitief Ontwerpfase, moeten berekeningen verder worden uitgewerkt om te kunnen dienen voor de benodigde vergunningsdocumentatie, voor de aanbesteding en als voorbereiding voor de uitvoeringsfase. Het DO omvat het ontwerp van de mastconstructies, de fundaties en de opstijgpunten in de verbinding.

Deze rapportage bevat de resultaten van de toetsing van masttype S+32/n voor de reconstructie. Deze mast is gebaseerd op het bestaande S+24 masttype uit de verbinding GT-RLL380 met de aanpassingen om te voldoen aan de belasting uit de nieuwe situatie en de huidige ontwerpeisen van TenneT.

In deze rapportage is de toetsing van de mast van de steunmast S+32/n opgenomen. De toetsing bestaat uit controle van:

- de profielen en boutverbindingen onderdeel van de hoofddraagconstructie;
- de knikverkorters;
- de verbinding met de fundatie via blokdeuvels;
- de liggers voor de isolatorkettingen.

Buiten de scope van dit DO-rapport valt de controle van de schetsplaten en overige verbindingsdetails in de constructie. Dit moet in de UO-fase worden uitgewerkt. Ook de voorzieningen voor de bordessen vallen onder uitwerking in UO-fase.

In hoofdstuk 2 zijn de uitgangspunten en randvoorwaarden vanuit de van toepassing zijnde normen en TenneT-specificaties opgenomen. Hoofdstuk 3 beschrijft de gevolgde aanpak van de berekening. In hoofdstuk 4 is de toetsing opgenomen.

# 2 UITGANGSPUNTEN EN RANDVOORWAARDEN

## 2.1 Normen

Er is gebruik gemaakt van de normen volgens Tabel 1.

**Tabel 1 Gebruikgemaakte normen, voorschriften en richtlijnen**

| Norm | Titel |
|---|---|
| NEN-EN 50341-1:2013 | “Overhead electrical lines exceeding AC 1 kV - Part 1: General requirements – Common” |
| NEN-EN 50341-2-15:2019 | “Overhead electrical lines exceeding AC 1 kV Part 2 National Normative Aspects (NNA) for THE NETHERLANDS” |
| NEN-EN 1990+A1+A1/C2:2019/NB:2019nl | “Grondslagen van het ontwerp” |
| NEN-EN 1991-1-4+A1+C2:2011/NB:2019+C1:2020 | “Deel 1-4: Windbelasting op constructies” |
| NEN-EN 1992-1-1+C2:2011/NB:2016+A1:2020 | “Eurocode 2: Ontwerp en berekening van betonconstructies, deel 1-1: algemene regels en regels voor gebouwen” |
| NEN-EN 1993-1-1+C2+A1:2016 nl | “Eurocode 3: Ontwerp en berekening van staalconstructies, deel 1-1: algemene regels en regels voor gebouwen” |
| NEN-EN 1993-3-1:2007/NB:2011 nl | “Deel 3-1: Torens, masten en schoorstenen - Torens en masten” |
| NEN-EN 1993-1-8+C2:2011/NB:2011 nl | “Ontwerp en berekening van staalconstructies, deel 1-8: ontwerp en berekening van verbindingen” |

## 2.2 TenneT-specificaties

In Tabel 2 zijn de documenten opgenomen die relevant zijn voor de berekeningen en toetsingen die binnen dit project in de mastrapportage uitgevoerd zullen worden.

**Tabel 2 Relevante documenten t.b.v. mechanische rapportages**

| Nummer | Onderwerp |
|---|---|
| PVE.05.000 v3.2 | PvE Lijnen |
| sPVE.05.001 | sPvE Lijnen |
| SPE.05.346 v1.3 | Algemene specificatie stalen masten |

## 2.3 Eisenverificatie

Voor de eisenverificatie wordt verwezen naar het rapport “Verificatierapport eisen reconstructies”.

## 2.4 Ontwerprapporten

Voor de achtergrond van het ontwerp wordt verwezen naar het uitgangspuntenrapport “D1.3 Uitgangspunten reconstructies”, DNV GL rapport 21-0702, Meridiannummer 002.678.00 0927721.

## 2.5 Materialen

Voor het ontwerp van de mastconstructies en fundaties wordt uitgegaan van de eigenschappen volgens Tabel 3.

**Tabel 3 Materialen aangepaste constructie**

| | |
|---|---|
| Staalsoort | S355J0 (t≤16 mm)<br>S355J2 (16<t≤40 mm) |
| Boutkwaliteit | 8.8 gerolde draad |
| Betonkwaliteit | C30/37 |
| Wapeningsstaal | B500 |

Voor de constructie geldt conform TenneT-specificatie:

- Toe te passen bouten: M16/M20/M24;
- Voor hoekstaal is de minimale afmeting L50x5 mm;
- Minimale plaatdikte 6 mm.

Mocht het noodzakelijk zijn M30 toe te passen, bij grote plaatdiktes is dit als afwijking door TenneT toegestaan.

## 2.6 Software

De gebruikte software wordt benoemd in Tabel 4.

**Tabel 4 Toegepaste software**

| Software | | Versie |
|---|---|---|
| Mastontwerp | PLS-CADD | 16.65 |
| Mastberekeningen | PLS-TOWER | 16.65 |
| Constructieve analyse | AxisVM | X5 R4h |

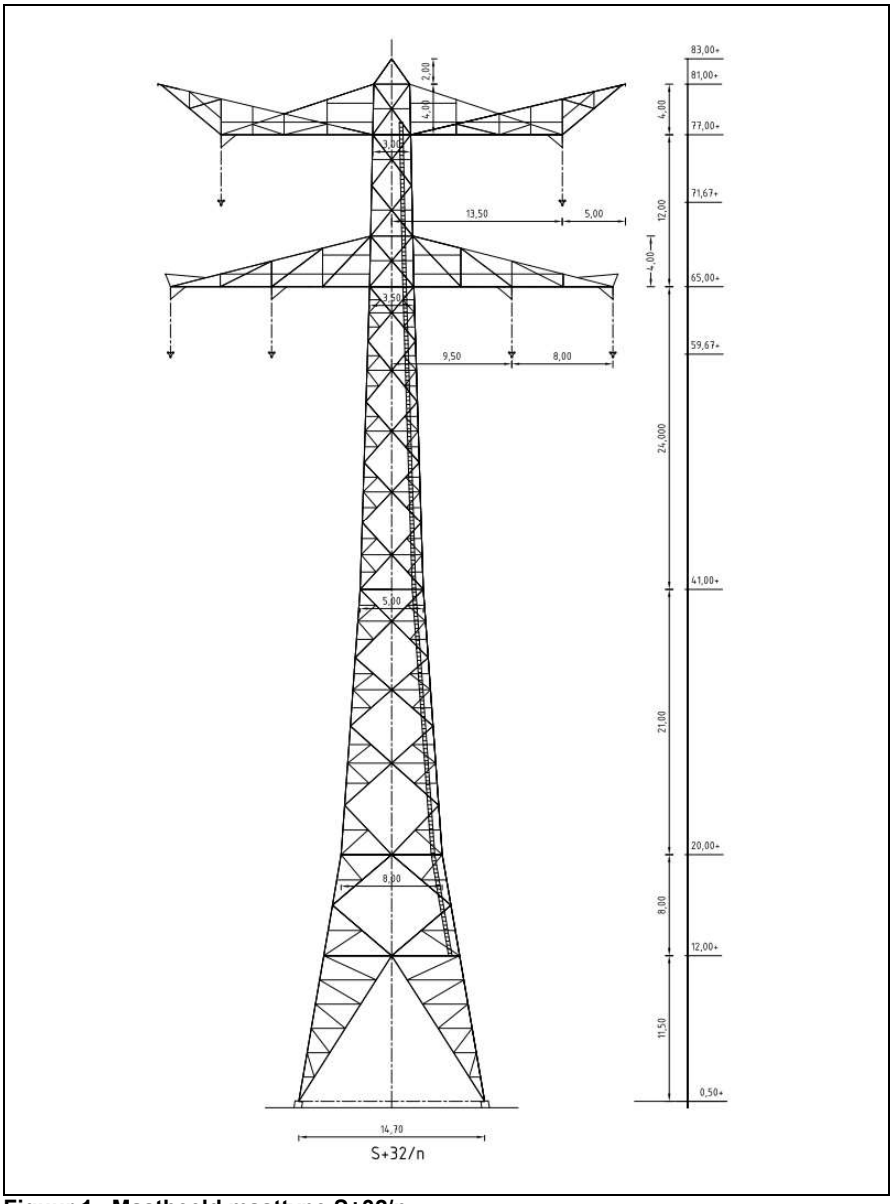
# 3 MASTONTWERP

## 3.1 Mastbeelden

In dit hoofdstuk worden het mastbeeld weergegeven met de belangrijkste maatvoering, voor volledige tekeningen van het masttype wordt verwezen naar onderstaande tekeningen:

- Mastbeeldentekening nieuwbouwmasten GT-RLL, Meridiannummer 002.678.00 0928568
- Overzichtstekening S+32/n, Meridiannummer 002.678.00 0934592
- Principedetails GT-RLL, Meridiannummer 002.678.00 0935108

Masttype reconstructie S+32/n is een steunmast voor twee circuits 380 kV.




**Figuur 1 Mastbeeld masttype S+32/n**

## 3.2 Uitgangspunten berekening

De uitgangspunten volgens Tabel 5 zijn van toepassing.

**Tabel 5 Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 50 jaar |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

## 3.3 Mastenlijst

In Tabel 6 zijn alle masten in het tracé van het type S+32/n opgenomen. De mast met grootste wind span is vetgedrukt aangegeven. Het masttype zal niet met deze wind en weight span worden berekend maar met generieke wind en weight span, zie uitgangspuntenrapport.

**Tabel 6 Mastenlijst S+32/n**

| Mast-nummer | Masttype | Lijnhoek (°) | Wind span (m) | Weight span (m) | Hoogteverschil ba+ah (m) | Hoogte-verschil back (m) | Hoogte-verschil ahead (m) |
|---|---|---|---|---|---|---|---|
| **72N** | S+32_n | 180,0 | 397.2 | 511.6 | 32.6 | 32.5 | 0,1 |
| 71N | S+32_n | 180,0 | 346,9 | 475,5 | 27.4 | -0.1 | 27.5 |

## 3.4 Geleiderbelastingen

De berekening is uitgevoerd met het geleiderbelastingprogramma van DNV. De belastingen op de mastconstructie zijn bepaald op basis van de modellering in PLS-TOWER (staafoppervlaktes). Voor de toeslagen op eigen gewicht en windoppervlakte wordt verwezen naar het uitgangspuntenrapport. In Appendix A zijn de resultaten van de geleiderbelastingen samengevat.

## 3.5 Reacties op de fundering

De oplegreacties op de fundering worden ontleend aan de uitvoer van het geleiderbelastingenprogramma. Zie Appendix A.

## 3.6 Modellering

Op basis van de ontwerptekeningen is de mast in PLS-TOWER ingevoerd. De toetsing wordt per staafgroep uitgevoerd. De hoofdelementen zijn gemodelleerd, niet-dragende profielen als knikverkorters zijn weggelaten, deze worden separaat getoetst. De profielen zijn in PLS-TOWER inclusief de boutverbindingen ingevoerd en getoetst, de controle van de schetsplaten en andere detailverbindingen valt buiten de scope.

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

De gewichts- en windbelasting op de mastconstructie wordt door PLS-TOWER automatisch bepaald. Via toeslagfactoren wordt de invloed van niet gemodelleerde elementen als knikverkorters, bordesconstructies en

klimvoorzieningen meegenomen. Voor schetsplaten, zinklaag en bouten is een aanvullende toeslag op het gewicht van 15% toeslag gerekend.

Diagonalen in voor- en achtervlak respectievelijk de twee zijvlakken zijn samengenomen in een groep.

## 3.7 Overige controles

In PLS-TOWER zijn niet alle elementen getoetst. Knikverkorterprofielen en overige profielen voor beloopbaarheid worden separaat getoetst. In Appendix C is dit opgenomen. De verbinding met de fundatie bestaat uit ingestorte profielen voorzien van blokdeuvels. Dit is in Appendix D opgenomen. De liggers van isolatorkettingen worden belast op buiging. Deze zijn hierop onderzocht, dit is in Appendix E opgenomen.

## 3.8 Mastgewicht

Het totale mastgewicht per masttype is met de uitgangspunten van paragraaf 3.6 bepaald op:

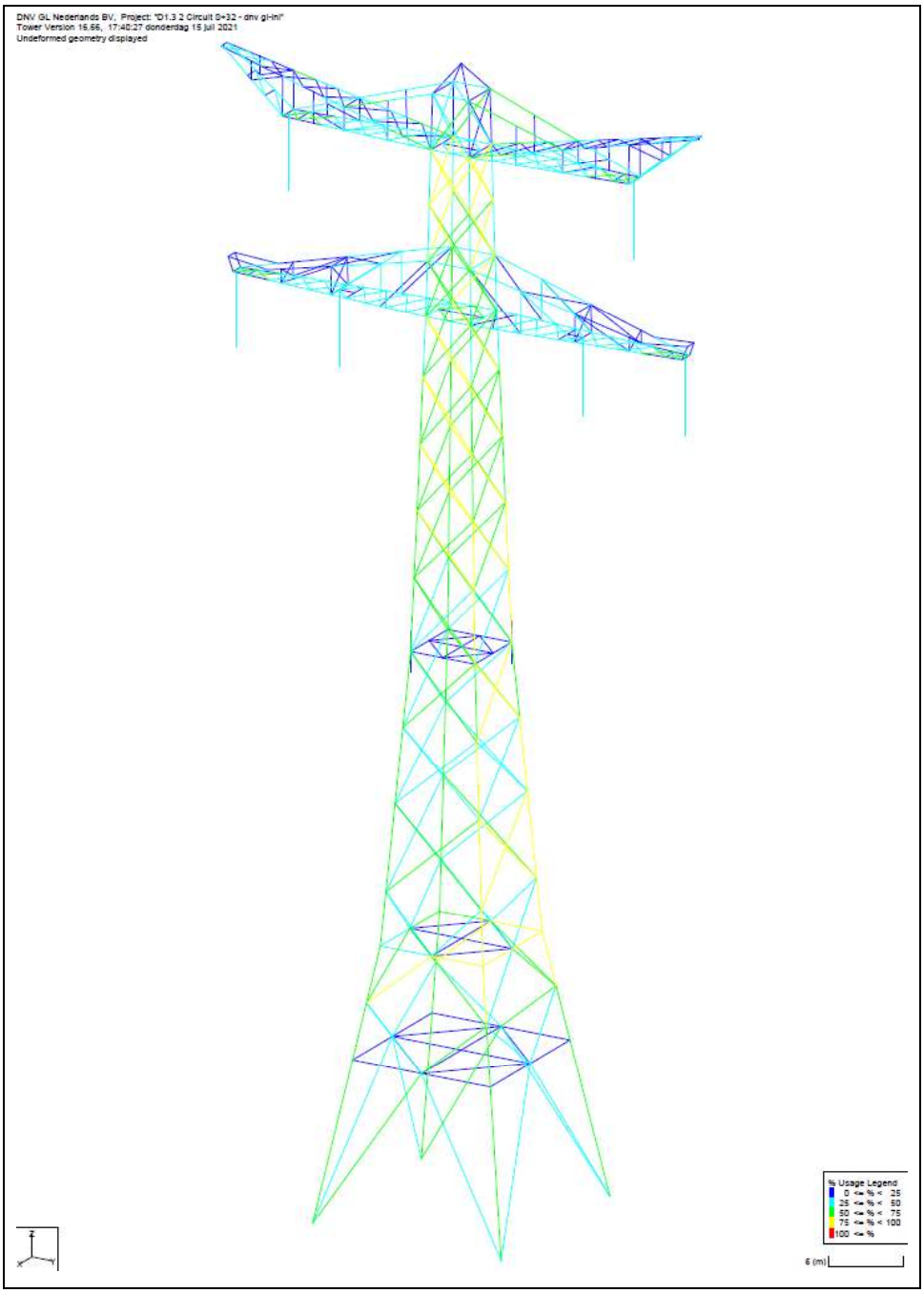
- Masttype S+32/n: 71,7 ton.

# 4 TOETSING

## 4.1 Resultaat PLS-TOWER

Het resultaat van de toetsing met PLS-TOWER is weergegeven in Figuur 2. De belastingen zijn bepaald voor het masttype S+32/n, inclusief bouwfase.

De uitnutting van de constructie loopt op van blauw (0-25%) tot geel (75-100%). Uit de figuur wordt geconcludeerd dat alle profielen en boutverbindingen voldoen.




**Figuur 2 Resultaat PLS-TOWER voor de steunmast S+32/n**

## 4.2 Toetsing overige onderdelen

In Tabel 7 zijn de resultaten van de uitgevoerde toetsingen weergegeven.

**Tabel 7 Samenvatting uitgevoerde controles**

| Controle van | Beoordeling | Referentie |
|---|---|---|
| Profielen | Voldoen | Figuur 2<br>Appendix B |
| Knikverkorters | Voldoen | Appendix C |
| Blokdeuvels randstijl | Voldoen | Appendix D |
| Liggers | Voldoet | Appendix E |

# APPENDIX A
# Geleiderbelastingen

Geleiderbelastingen opgenomen:

- Masttype S+32/n
- Masttype S+32/n bouwfase

## Inhoud


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


## Gegevens

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initieel* | |
| Gevolgklasse | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 50 jaar |
| *Na aanpassing* | |
| Gevolgklasse | n.v.t. |
| Betrouwbaarheidsniveau | n.v.t. |
| Referentieperiode | n.v.t. |
| Windgebied | III |
| Windsnelheid | 24,5 m/s |
| Terreincategorie | II |
| Reductie factor Cdir | 1,00 |
| IJsgebied | B |
| Masttype | Steunmast |
| Masthoogte | 82,5 m |
| Max. veldlengte | 400 m |
| Lijnhoek | 180° |
| Trekparameter | 1600 m |
| Wind span | 400 m |
| EDS Weight span | 528 m |
| Min. Weight span | 400 m |
| Max. Weight span | 704 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-07-16 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype S+32

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

Document name:

GT-RLL380_S+32_72N_Report.pdf

Project number:

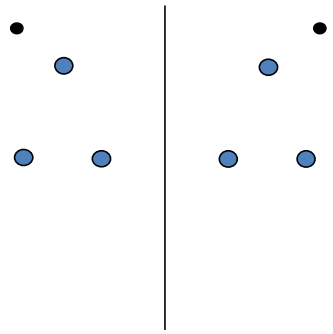
Project client number:

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

## Geleiderbelastingen

**Algemeen**

| | |
|---|---|
| Benaming | S+32 |
| Masttype | Steunmast |
| Aantal circuits | 2 |
| Configuratie | 2-circuit-donau |
| Aantal bliksemgeleiders | 2 |



Configuratie geleiders

**Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau initieel | Nieuwbouw |
| Referentieperiode initieel | 50 jaar |
| | 0 |
| Betrouwbaarheidsniveau na aanpassing | n.v.t. |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 m/s |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

**Geleiders Back**

| Omschrijving | Spanning | Geleider Back | Bundel Ba | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Geleiders Ahead

| Omschrijving | Spanning | Geleider Ahead | Bundel Ah | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | OPGW AFL-226/38 | 1 | A | 2 % | 2 % | 1600 |

Isolatoren *(1)*

| Omschrijving | Ophanging | Gewicht [kN] | Lengte [m] | Windopp. [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Halfverankering | 5,60 | 4,50 | 2,40 |
| Circuit 2 | Halfverankering | 5,60 | 4,50 | 2,40 |
| Bliksemdraad 1 | Vast (Bliksemdraad) | 0,10 | 0,20 | 0,10 |
| Bliksemdraad 2 | Vast (Bliksemdraad) | 0,10 | 0,20 | 0,10 |

1. Eigenschappen gelden voor geheel van de isolatorset

**Ophanghoogte en positie in mast**

| Circuits | Aanduiding | Nummer | Ophanghoogte | Aangrijppunt | Positie in mast Horizontale afstand |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 60,0 m | 64,5 m | -17,5 m |
| Circuit 1 | 11 | 380ct1f2 | 60,0 m | 64,5 m | -9,5 m |
| Circuit 1 | 12 | 380ct1f3 | 72,0 m | 76,5 m | -13,5 m |
| Circuit 2 | 20 | 380ct2f1 | 60,0 m | 64,5 m | 9,5 m |
| Circuit 2 | 21 | 380ct2f2 | 60,0 m | 64,5 m | 17,5 m |
| Circuit 2 | 22 | 380ct2f3 | 72,0 m | 76,5 m | 13,5 m |
| Bliksemdraad 1 | 1 | bl1 | 80,3 m | 80,5 m | -18,5 m |
| Bliksemdraad 2 | 3 | bl2 | 80,3 m | 80,5 m | 18,5 m |

Project: GT-RLL380
Tower: S+32
Number: 72N

**Hoogteaanpassing naastgelegen masten** (aanpassing wind- en weight span)

| | Back | Ahead | |
|---|---|---|---|
| Verhoging voor windbelasting | 0,0 m | 0,0 m | (positief: omhoog) |
| Verlaging voor verticale belasting | -32,0 m | 0,0 m | (negatief: omlaag, grotere weight span) |

Verlaging: Niet in 0,9EG-combinaties

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

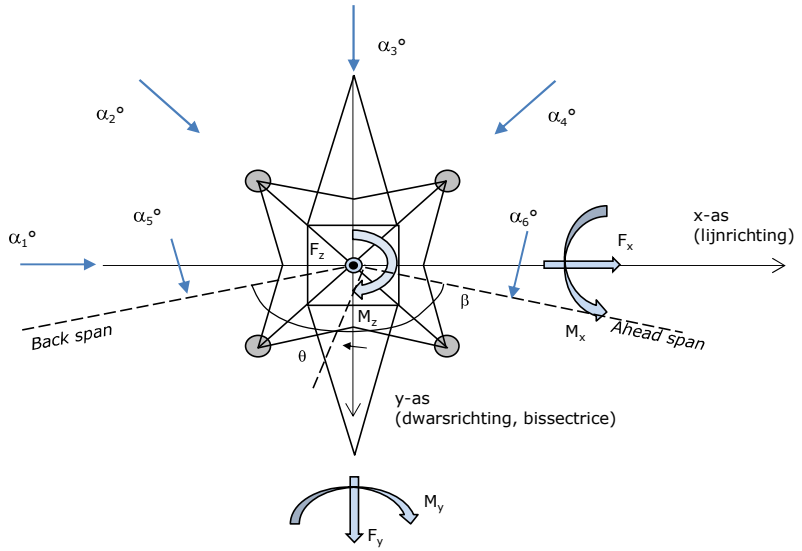
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Lijn- en mastgegevens**

| | | Back | Ahead |
|---|---|---|---|
| | | 400,0 | 400,0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 400,0 | 400,0 m |
| Lijnhoek | $\beta$ | 180 ° | |
| Rotatie mast t.o.v. bissectrice | $\theta$ | 0 ° | |
| Vaklengte | | 800 | 800 m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 m | |
| Beschouwde windrichtingen | $\alpha_1$ | 0 ° | |
| Windrichtingen volgens: | $\alpha_2$ | 45 ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 ° | |
| | $\alpha_4$ | 135 ° | |
| | $\alpha_5$ | - ° | |
| | $\alpha_6$ | - ° | |

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

Windrichtingen en positieve richtingen belastingen




| Beschouwd aantal windrichtingen | |
|---|---|
| 1a | 4 |
| 3 | 4 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

Project: GT-RLL380
Tower: S+32
Number: 72N

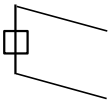
**Geleiderafval**

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

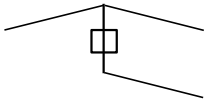
**Belastingsituaties SPLS**

Beschouwde situaties SPLS: SPLS voor steunmast niet van toepassing

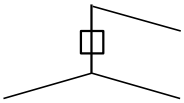
Principe belastingssituaties:



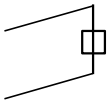
1. Ba All cts



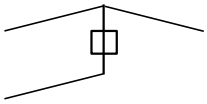
2. Ba ct1



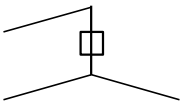
3. Ba ct2



4. Ah All cts



5. Ah ct1

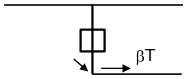


6. Ah ct2

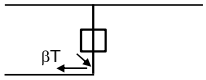
**Belastingsituaties 5a. Geleiderbreuk**

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

Principe belastingssituaties:




1. Ba




2. Ah

Project: GT-RLL380
Tower: S+32
Number: 72N

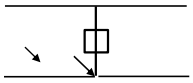
**Belastingsituaties 6. Bouw- en onderhoud**
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht.
Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate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

| | Fase | Bliksem |
|---|---|---|
| Lijnwagen | 4,0 kN | 2,0 kN |
| Puntlast op traverse | 1,0 kN | 1,0 kN |

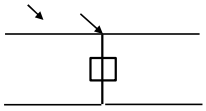
Beschouwde situaties bouw- en onderhoud 6a: 1 en 2, uitgangspunt is symmetrie tussen back / ahead.

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

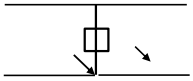
Principe belastingssituaties:



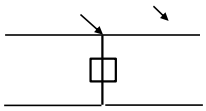
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

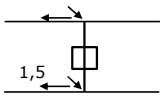
**Belastingsituaties 8. Lijndansen als statische belasting**

| Geleider | | |
|---|---|---|
| Steunmast fase | 0,866 W | 1,5 W |
| Steunmast bliksem | 1,5 EDS | 1,5 W |
| Hoekmast fase en bliksem | 1,5 EDS | 1,5 W |

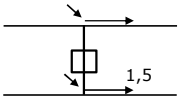
Beschouwde situaties lijndansen 8: 1 en 2, alle mogelijke situaties.

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:




1. Ba




2. Ah

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

Project: GT-RLL380
Tower: S+32
Number: 72N

## Mastconstructie

### Eigenschappen

| | | | |
|---|---|---|---|
| Masttype | Steunmast | | |
| Mastbenaming | S+32 | | |
| Voetplaat t.o.v. maaiveld | 0,5 | | m |
| Masthoogte t.o.v. voetplaat | 82,5 | | m |
| Gewicht mast | 703,7 | | kN |
| *Breedte en helling mast bij fundatie* | x-ri. | y-ri. | |
| Pootsprei | 14,70 | 14,70 | m |
| Helling van de randstijl | 0,172 | 0,172 | - |
| Factor spatkracht | 1,1 | 1,1 | - |

### Berekening windbelasting

| | |
|---|---|
| Dynamische invloed $G_T$ | 1,05 |
| Windbelasting overhoeks op mastlichaam evenredig met: | (A1C1sin^2(phi)+A2C2cos^2(phi)) |
| Windbelasting overhoeks op traverse evenredig met: | (A1C1sin^2(phi)+A2C2cos^2(phi)) |
| Vergroting wind overhoeks mastlichaam | (1+0,2sin^2(2phi)) |
| Vergroting wind overhoeks traverse | (1+0,2sin^2(2phi)) |
| Factor wind evenwijdig t.o.v. haaks op traverse | 0,4 |

### Eigenschappen mastsecties langsrichting (vooraanzicht, yz-vlak)

| Omschrijving | 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 | 19,50 | 14,70 | 8,00 | 19,50 | 0,172 | 221,33 | 37,50 | 0,17 | 3,07 |
| Eerste tussenstuk | 40,50 | 8,00 | 5,00 | 21,00 | 0,071 | 136,50 | 26,74 | 0,20 | 2,95 |
| Tweede tussenstuk | 64,50 | 5,00 | 3,50 | 24,00 | 0,031 | 102,00 | 22,19 | 0,22 | 2,86 |
| Bovenstuk 1 | 72,50 | 3,50 | 3,17 | 8,00 | 0,021 | 26,67 | 6,27 | 0,24 | 2,78 |
| Bovenstuk 2 | 80,50 | 3,17 | 2,83 | 8,00 | 0,021 | 24,00 | 5,86 | 0,24 | 2,75 |
| Topstuk | 82,50 | 2,83 | | 2,00 | | 2,83 | 0,41 | 0,15 | 3,18 |
| Ondertraverse | 64,50 | 15,75 | | 4,00 | | 31,50 | 8,71 | 0,28 | 2,62 |
| Boventraverse | 76,50 | 17,00 | | 4,00 | | 34,00 | 9,30 | 0,27 | 2,63 |

### Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)

| Omschrijving | 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 | 19,50 | 14,70 | 8,00 | 19,50 | 0,172 | 221,33 | 37,50 | 0,17 | 3,07 |
| Eerste tussenstuk | 40,50 | 8,00 | 5,00 | 21,00 | 0,071 | 136,50 | 26,74 | 0,20 | 2,95 |
| Tweede tussenstuk | 64,50 | 5,00 | 3,50 | 24,00 | 0,031 | 102,00 | 22,19 | 0,22 | 2,86 |
| Bovenstuk 1 | 72,50 | 3,50 | 3,17 | 8,00 | 0,021 | 26,67 | 6,27 | 0,24 | 2,78 |
| Bovenstuk 2 | 80,50 | 3,17 | 2,83 | 8,00 | 0,021 | 24,00 | 5,86 | 0,24 | 2,75 |
| Topstuk | 82,50 | 2,83 | | 2,00 | | 2,83 | 0,41 | 0,15 | 3,18 |
| Ondertraverse | 64,50 | 15,75 | | 4,00 | | 31,50 | 8,71 | 0,28 | 2,62 |
| Boventraverse | 76,50 | 17,00 | | 4,00 | | 34,00 | 9,30 | 0,27 | 2,63 |

*NB: oppervlakte traverse dwarsrichting van de tabel wordt in berekening gereduceerd.*
*NB: oppervlakte traverse per zijde, dus helft van totaal van twee traverses.*

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**Windoppervlak feeders telecominstallaties**

| Onderdeel | A ($m^2$/m) | Factor | Δh | $A_1$ |
|---|---|---|---|---|
| Broekstuk | 0,20 | 0,71 | 19,5 | 2,8 |
| Eerste tussenstuk | 0,20 | 0,71 | 21,0 | 3,0 |
| Tweede tussenstuk | | | | |
| Bovenstuk 1 | | | | |
| Bovenstuk 2 | | | | |

**Invoer antennes**

| Omschrijving | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne top | | | |
| Antenne o.t. | 4,7 | 40,5 | 1,5 |

**Belastingen mastsectie langsrichting (x-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 80,7 | 68,4 | 0,0 | -68,4 | 9,8 | 786,4 | 667,2 | 0,0 | -667,2 |
| Eerste tussenstuk | 0,99 | 77,9 | 66,1 | 0,0 | -66,1 | 30,0 | 2338,2 | 1984,0 | 0,0 | -1984,0 |
| Tweede tussenstuk | 1,15 | 72,9 | 61,8 | 0,0 | -61,8 | 52,5 | 3825,5 | 3246,0 | 0,0 | -3246,0 |
| Bovenstuk 1 | 1,23 | 21,5 | 18,2 | 0,0 | -18,2 | 68,5 | 1472,8 | 1249,7 | 0,0 | -1249,7 |
| Bovenstuk 2 | 1,26 | 20,3 | 17,3 | 0,0 | -17,3 | 76,5 | 1556,0 | 1320,3 | 0,0 | -1320,3 |
| Topstuk | 1,28 | 1,7 | 1,4 | 0,0 | -1,4 | 81,5 | 137,0 | 116,3 | 0,0 | -116,3 |
| Ondertraverse | 1,22 | 55,6 | 33,0 | 0,0 | -33,0 | 65,8 | 3661,0 | 2174,5 | 0,0 | -2174,5 |
| Boventraverse | 1,27 | 62,2 | 36,9 | 0,0 | -36,9 | 77,8 | 4839,1 | 2874,3 | 0,0 | -2874,3 |
| Totaal | | 392,8 | 303,3 | 0,0 | -303,3 | | 18615,8 | 13632,3 | 0,0 | -13632,3 |

**Belastingen mastsectie dwarsrichting (y-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 0,0 | 68,4 | 80,7 | 68,4 | 9,8 | 0,0 | 667,2 | 786,4 | 667,2 |
| Eerste tussenstuk | 0,99 | 0,0 | 66,1 | 77,9 | 66,1 | 30,0 | 0,0 | 1984,0 | 2338,2 | 1984,0 |
| Tweede tussenstuk | 1,15 | 0,0 | 61,8 | 72,9 | 61,8 | 52,5 | 0,0 | 3246,0 | 3825,5 | 3246,0 |
| Bovenstuk 1 | 1,23 | 0,0 | 18,2 | 21,5 | 18,2 | 68,5 | 0,0 | 1249,7 | 1472,8 | 1249,7 |
| Bovenstuk 2 | 1,26 | 0,0 | 17,3 | 20,3 | 17,3 | 76,5 | 0,0 | 1320,3 | 1556,0 | 1320,3 |
| Topstuk | 1,28 | 0,0 | 1,4 | 1,7 | 1,4 | 81,5 | 0,0 | 116,3 | 137,0 | 116,3 |
| Ondertraverse | 1,22 | 0,0 | 33,0 | 22,2 | 33,0 | 65,8 | 0,0 | 2174,5 | 1464,4 | 2174,5 |
| Boventraverse | 1,27 | 0,0 | 36,9 | 24,9 | 36,9 | 77,8 | 0,0 | 2874,3 | 1935,6 | 2874,3 |
| Totaal | | 0,0 | 303,3 | 322,1 | 303,3 | | 0,0 | 13632,3 | 13515,8 | 13632,3 |

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

| Belasting / windrichting | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 704 | 0 | 0 | 0 |
| Windrichting 0° | 400 | 0 | 0 | 0 | 19869 | 0 |
| Windrichting 45° | 309 | 309 | 0 | 14542 | 14542 | 0 |
| Windrichting 90° | 0 | 330 | 0 | 14514 | 0 | 0 |
| Windrichting 135° | -309 | 309 | 0 | 14542 | -14542 | 0 |

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**Tussenresultaten geleiderbelastingen**

**Geleiders back**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Geleiders ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | OPGW AFL-226/38 | 21,7 | 264,0 | 9,13 | 72000 | 1,98E-05 |

**Verticale belasting back**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Verticale belasting ahead**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 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 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 1 | 2 | 9,3 | A | 15+0,4d | 23,7 | 23,7 |

**Isolatoren**

| Geleider | $G_{isolator}$ [kN] | Aantal - | $F_{v,iso}$ [kN] | Lengte [m] | Windopp. [m$^2$] | Windhoogte [m] | Stuwdruk [kN/m$^2$] | Vormfactor [-] | $F_{h,iso}$ [kN] |
|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 62,75 | 1,20 | 1,2 | 3,47 |
| 380ct1f2 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 62,75 | 1,20 | 1,2 | 3,47 |
| 380ct1f3 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 74,75 | 1,26 | 1,2 | 3,62 |
| 380ct2f1 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 62,75 | 1,20 | 1,2 | 3,47 |
| 380ct2f2 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 62,75 | 1,20 | 1,2 | 3,47 |
| 380ct2f3 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 74,75 | 1,26 | 1,2 | 3,62 |
| bl1 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 80,90 | 1,28 | 1,2 | 0,15 |
| bl2 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 80,90 | 1,28 | 1,2 | 0,15 |

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**Windbelasting back**

| Geleider | hoogte wind [m] | Stuwdruk [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{toeslag}$ [mm] | $w_y$ [N/m] | $w_{y,vak}$ [N/m] | $D_{ijs,toeslag}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,vak}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f2 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f3 | 64,2 | 1,21 | 0,64 | 0,64 | 1,04 | 28,25 | 67,9 | 67,9 | 46,9 | 130,2 | 130,2 |
| 380ct2f1 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct2f2 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct2f3 | 64,2 | 1,21 | 0,64 | 0,64 | 1,04 | 28,25 | 67,9 | 67,9 | 46,9 | 130,2 | 130,2 |
| bl1 | 72,5 | 1,25 | 0,65 | 0,65 | 1,16 | 22,24 | 20,8 | 20,8 | 63,1 | 61,0 | 61,0 |
| bl2 | 72,5 | 1,25 | 0,65 | 0,65 | 1,17 | 22,13 | 20,8 | 20,8 | 63,0 | 61,0 | 61,0 |

**Windbelasting ahead**

| Geleider | hoogte wind [m] | Stuwdruk [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{toeslag}$ [mm] | $w_y$ [N/m] | $w_{y,vak}$ [N/m] | $D_{ijs,toeslag}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,vak}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f2 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f3 | 64,2 | 1,21 | 0,64 | 0,64 | 1,04 | 28,25 | 67,9 | 67,9 | 46,9 | 130,2 | 130,2 |
| 380ct2f1 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct2f2 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct2f3 | 64,2 | 1,21 | 0,64 | 0,64 | 1,04 | 28,25 | 67,9 | 67,9 | 46,9 | 130,2 | 130,2 |
| bl1 | 72,5 | 1,25 | 0,65 | 0,65 | 1,16 | 22,24 | 20,8 | 20,8 | 63,1 | 61,0 | 61,0 |
| bl2 | 72,5 | 1,25 | 0,65 | 0,65 | 1,17 | 22,13 | 20,8 | 20,8 | 63,0 | 61,0 | 61,0 |

*NB: belastingen $w_v$ gelden voor bundel*

Project: GT-RLL380
Masttype: S+32
Mast: 72N

**Geleiderbelastingen**

Auteur: TBR
Versie: v12.0

**Uitgangspunten**

| | |
|---|---|
| Betrouwbaarheidsniveau | Nieuwbouw CC2 |
| Referentieperiode | 50 jaar |

| **ULS** (bezwijksterkte) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belastingsgeval | omschrijving | 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° | 1,20 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk alleen mast | 10° | 0,90 | 1,20 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk ook geleider | 10° | 0,90 | 0,90 | 0,00 | 1,50 | 0,00 | 0,0 |
| ULS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,00 | 0,45 | 1,50 | 0,0 |
| ULS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 5a | Torsiebelastingen | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinale belastingen | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,50 | 0,30 | 0,00 | 0,0 |
| ULS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,00 | 0,30 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,35 | 1,35 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** | (Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders) | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,20 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 0,90 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** | (controle van de vervormingen, vermoeiing, EDS) | | | | | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 1,00 | 0,0 | 0,0 |
| SLS 3 | Wind+ijs | -5° | 1,00 | 1,00 | 0,0 | 0,30 | 1,00 | 0,0 |
| SLS 4 | Wind | -20° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 6 | Bouw en onderhoud | 5° | 1,00 | 1,00 | 0,0 | 0,20 | 0,0 | 0,0 |
| SLS 7 | PB (EDS, geen wind) | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

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

Project: GT-RLL380
Masttype: S+32
Mast: 72N

**Samenvattingstabellen geleiderbelastingen**

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

**Maximale waarden voor back en ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -64,3 | 64,3 | 6,4 | 6,4 | 14,6 | 9,5 |
| bl2 | -63,4 | 63,4 | 6,3 | 6,3 | 14,5 | 9,4 |
| 380ct1f1 | -162,7 | 162,7 | 21,7 | 21,7 | 36,0 | 22,9 |
| 380ct1f2 | -162,7 | 162,7 | 21,7 | 21,7 | 36,0 | 22,9 |
| 380ct1f3 | -165,3 | 165,3 | 23,1 | 23,1 | 36,2 | 22,9 |
| 380ct2f1 | -162,7 | 162,7 | 21,7 | 21,7 | 36,0 | 22,9 |
| 380ct2f2 | -162,7 | 162,7 | 21,7 | 21,7 | 36,0 | 22,9 |
| 380ct2f3 | -165,3 | 165,3 | 23,1 | 23,1 | 36,2 | 22,9 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 528,0 | 553,1 | 528,0 |
| bl2 | 528,0 | 553,7 | 528,0 |
| 380ct1f1 | 528,0 | 546,6 | 528,0 |
| 380ct1f2 | 528,0 | 546,6 | 528,0 |
| 380ct1f3 | 528,0 | 547,2 | 528,0 |
| 380ct2f1 | 528,0 | 546,6 | 528,0 |
| 380ct2f2 | 528,0 | 546,6 | 528,0 |
| 380ct2f3 | 528,0 | 547,2 | 528,0 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 699,4 | 509,3 |
| bl2 | 704,1 | 508,7 |
| 380ct1f1 | 625,9 | 532,9 |
| 380ct1f2 | 625,9 | 532,9 |
| 380ct1f3 | 635,0 | 535,0 |
| 380ct2f1 | 625,9 | 532,9 |
| 380ct2f2 | 625,9 | 532,9 |
| 380ct2f3 | 635,0 | 535,0 |

| Omhullende weight span over alle combinaties (incl. 0,9 combinaties) | | |
|---|---|---|
| Voor alle geleiders | | Wind / Weight span verhouding |
| Max. weight span | 704,1 m | 1,760 - |
| Min. weight span | 400,0 m | 1,000 - |

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**Maximale waarden back+ahead span** **Maximale waarden trekkracht geleider**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 22,9 | 12,7 | 24,1 | -64,3 | 64,3 |
| bl2 | 22,3 | 12,7 | 23,9 | -63,4 | 63,4 |
| 380ct1f1 | 58,7 | 43,5 | 58,9 | -162,7 | 162,7 |
| 380ct1f2 | 58,7 | 43,5 | 58,9 | -162,7 | 162,7 |
| 380ct1f3 | 58,7 | 46,2 | 59,1 | -165,3 | 165,3 |
| 380ct2f1 | 58,7 | 43,5 | 58,9 | -162,7 | 162,7 |
| 380ct2f2 | 58,7 | 43,5 | 58,9 | -162,7 | 162,7 |
| 380ct2f3 | 58,7 | 46,2 | 59,1 | -165,3 | 165,3 |

**EDS-belastingen geleiders**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 5,1 | -15,3 | 15,3 |
| bl2 | 0,0 | 0,0 | 5,0 | -14,9 | 14,9 |
| 380ct1f1 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 380ct1f2 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 380ct1f3 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 380ct2f1 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 380ct2f2 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 380ct2f3 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |

**Controle uplift SLS-wind**

| Combinatie: | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,4 | 2,0 |
| | bl2 | 3,3 | 1,9 |
| | 380ct1f1 | 18,7 | 12,0 |
| | 380ct1f2 | 18,7 | 12,0 |
| | 380ct1f3 | 18,7 | 12,0 |
| | 380ct2f1 | 18,7 | 12,0 |
| | 380ct2f2 | 18,7 | 12,0 |
| | 380ct2f3 | 18,7 | 12,0 |

Project: GT-RLL380
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Mast: 72N

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

| Combinatie | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | 0 | 292 | 264 | 20330 | 0 | 0 |
| ULS 1a_0,9_90 | | 0 | 292 | 182 | 20331 | 0 | 0 |
| ULS 3_90 | | 0 | 165 | 402 | 11602 | 0 | 0 |
| ULS 3_0,9_90 | | 0 | 165 | 313 | 11603 | 0 | 0 |
| SLS 7 | | 0 | 0 | 189 | -2 | 0 | 0 |

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

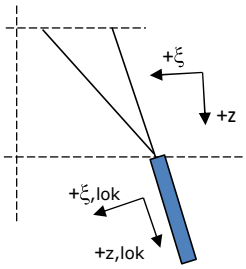
| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 786 | 1109 | 42100 | 0 | 0 |
| ULS 3_90 | 0 | 313 | 1246 | 18133 | 0 | 0 |
| SLS 7 | 0 | 0 | 893 | -2 | 0 | 0 |

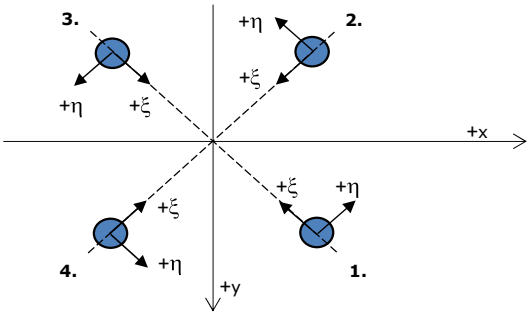
**Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde**

| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_0,9_0,9_90 | 0 | 786 | 770 | **42102** | 0 | 0 |
| ULS 1a_0 | 609 | 0 | 1070 | -3 | **30383** | 0 |
| ULS 5a Ba 10 | 59 | 0 | 886 | 261 | 3784 | **-1027** |
| ULS 1a_0,9_0,9_45 | 469 | 615 | 770 | **32435** | **22223** | 0 |

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

**Oplegreacties op fundering per randstijl**




Assenstelsels

**Maximale drukbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 377 | 348 | **2130** | 20 | -513 | 5 | 2192 |
| 2 | ULS 1a_0 | 203 | -246 | **1301** | 30 | -317 | -1 | 1339 |
| 3 | ULS 8 Ba | -89 | -124 | **660** | -25 | -151 | 9 | 679 |
| 4 | ULS 1a_135 | -377 | 348 | **2130** | -20 | -513 | 5 | 2192 |

**Maximale trekbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 8 Ba | 3 | -33 | **-175** | 26 | 21 | -21 | -180 |
| 2 | ULS 1a_0,9_0,9_135 | -289 | 260 | **-1667** | 20 | 389 | -16 | -1715 |
| 3 | ULS 1a_0,9_0,9_45 | 289 | 260 | **-1667** | -20 | 389 | -16 | -1715 |
| 4 | ULS 1a_0,9_0,9_0 | 116 | -159 | **-841** | -30 | 194 | -10 | -866 |

**Maximale torsiebelasting (positief)**

| Stijl | Combinatie | $R_x$ [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 | 128 | 47 | 540 | **57** | -124 | 7 | 555 |
| 2 | ULS 1a_0,9_0,9_45 | -55 | -25 | -155 | **57** | 21 | -17 | -159 |
| 3 | ULS 5a Ba 21 | -46 | 0 | 102 | **33** | -33 | -8 | 105 |
| 4 | ULS 5a Ah 10 | -40 | 84 | 357 | **31** | -88 | -1 | 367 |

**Maximale torsiebelasting (negatief)**

| Stijl Index | Combinatie 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 | 203 | 246 | 1301 | **-30** | -317 | -1 | 1339 |
| 2 | ULS 5a Ah 21 | 46 | 0 | 100 | **-32** | -33 | -9 | 103 |
| 3 | ULS 1a_0,9_0,9_135 | 55 | -25 | -155 | **-57** | 21 | -17 | -159 |
| 4 | ULS 1a_0,9_0,9_45 | -128 | 47 | 540 | **-57** | -124 | 7 | 555 |

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**Combinatie Ftrek+Fhor**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 8 Ba | 3 | -33 | **-175** | **26** | 21 | -21 | -180 |
| 2 | ULS 1a_0,9_0,9_135 | -289 | 260 | **-1667** | **20** | 389 | -16 | -1715 |
| 3 | ULS 1a_0,9_0,9_45 | 289 | 260 | **-1667** | **-20** | 389 | -16 | -1715 |
| 4 | ULS 1a_0,9_0,9_0 | 116 | -159 | **-841** | **-30** | 194 | -10 | -866 |

**Permanente belasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 42 | 42 | 223 | 0 | -60 | -5 | 230 |
| 2 | SLS 7 | 42 | -42 | 223 | 0 | -60 | -5 | 230 |
| 3 | SLS 7 | -42 | -42 | 223 | 0 | -60 | -5 | 230 |
| 4 | SLS 7 | -42 | 42 | 223 | 0 | -60 | -5 | 230 |

**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 | 348 | **2130** | 20 | -513 | 5 | 2192 |
| Max. trek | ULS 1a_0,9_0,9_45 | 289 | 260 | **-1667** | -20 | 389 | -16 | -1715 |
| Max. pos. torsie | ULS 1a_0,9_0,9_45 | -55 | -25 | -155 | **57** | 21 | -17 | -159 |
| Max. neg. torsie | ULS 1a_0,9_0,9_135 | 55 | -25 | -155 | **-57** | 21 | -17 | -159 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_45 | 289 | 260 | **-1667** | **-20** | 389 | -16 | -1715 |

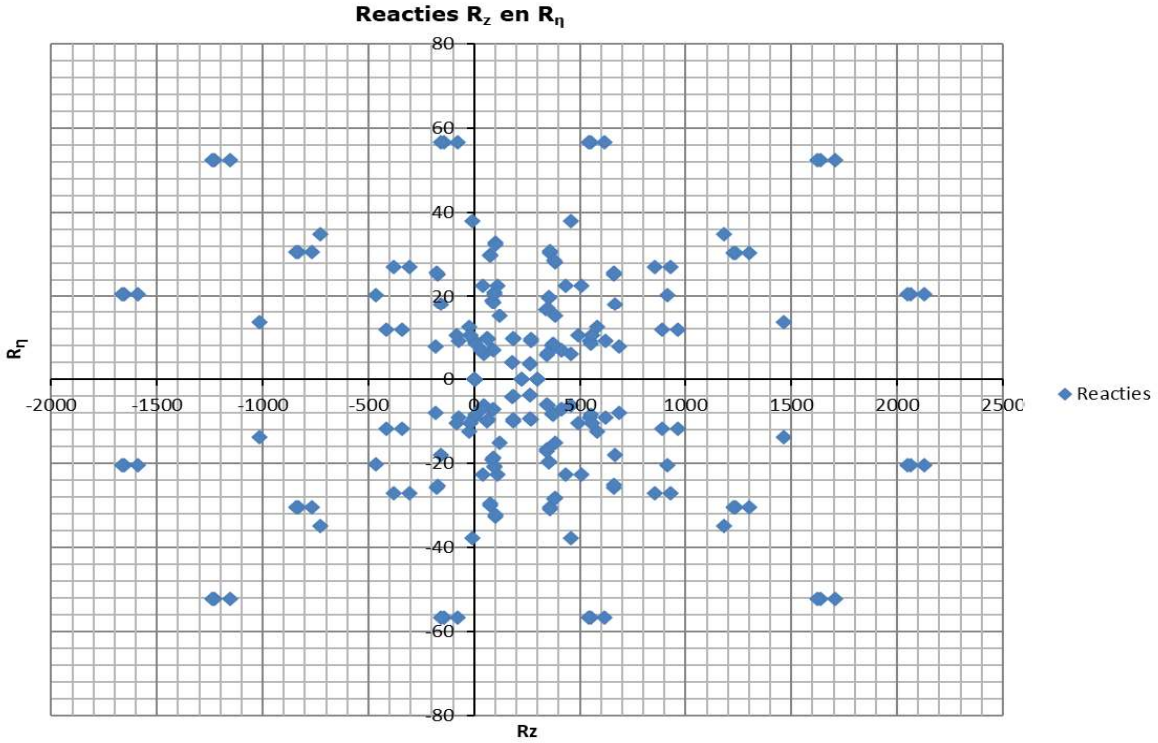
**Maximale trekbelasting SLS**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 42 | 42 | **223** | 0 | -60 | -5 | 230 |
| 2 | SLS 1a_135 | -175 | 155 | **-1014** | 14 | 233 | -13 | -1044 |
| 3 | SLS 1a_45 | 175 | 155 | **-1014** | -14 | 233 | -13 | -1044 |
| 4 | SLS 1a_0 | 59 | -88 | **-466** | -20 | 104 | -9 | -479 |

**Maximale drukbelasting SLS**

| Stijl | Combinatie | $R_x$ [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 | 260 | 240 | **1465** | 14 | -354 | 2 | 1507 |
| 2 | SLS 1a_0 | 144 | -172 | **912** | 20 | -223 | -2 | 939 |
| 3 | SLS 7 | -42 | -42 | **223** | 0 | -60 | -5 | 230 |
| 4 | SLS 1a_135 | -260 | 240 | **1465** | -14 | -354 | 2 | 1507 |

Project: GT-RLL380
Masttype: S+32
Mast: 72N



## Inhoud


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


## Gegevens

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| *Initieel* | |
| Gevolgklasse | CC2 |
| Betrouwbaarheidsniveau | Nieuwbouw |
| Referentieperiode | 15 jaar |
| *Na aanpassing* | |
| Gevolgklasse | n.v.t. |
| Betrouwbaarheidsniveau | n.v.t. |
| Referentieperiode | n.v.t. |
| Windgebied | III |
| Windsnelheid | 24,5 m/s |
| Terreincategorie | II |
| Reductie factor Cdir | 1,00 |
| IJsgebied | B |
| Masttype | Steunmast |
| Masthoogte | 82,5 m |
| Max. veldlengte | 400 m |
| Lijnhoek | 180° |
| Trekparameter | 1600 m |
| Wind span | 400 m |
| EDS Weight span | 528 m |
| Min. Weight span | 0 m |
| Max. Weight span | 665 m |

| ISSUE | DATE | REVISION | CHK'D | APP'D |
|---|---|---|---|---|
| 0.0 | 2021-07-16 | | | |

Client: TenneT Taking power further

DNV

Title:

# Berekening masttype S+32 (bouwfase)

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

Document name:

GT-RLL380_S+32 (bouwfase)_72N_Report.pdf

Project number:

Project client number:

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

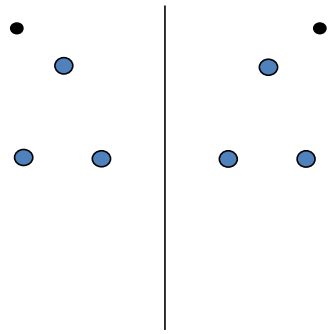
Project: GT-RLL380
Tower: S+32 (bouwfase)
Number: 72N

Auteur: TBR
Versie: v12.0

## Geleiderbelastingen

**Algemeen**

| | |
|---|---|
| Benaming | S+32 (bouwfase) |
| Masttype | Steunmast |
| Aantal circuits | 2 |
| Configuratie | 2-circuit-donau |
| Aantal bliksemgeleiders | 2 |



Configuratie geleiders

**Uitgangspunten**

| | |
|---|---|
| Norm | NEN-EN50341-2-15:2019 |
| Gevolgklasse initieel | CC2 |
| Betrouwbaarheidsniveau initieel | Nieuwbouw |
| Referentieperiode initieel | 15 jaar |
| | 0 |
| Betrouwbaarheidsniveau na aanpassing | n.v.t. |
| Windgebied | III |
| Windsnelheid (m/s) | 24,5 m/s |
| Terreincategorie | II |
| Reductiefactor $c_{dir}$ | 1,00 |
| IJsgebied fasegeleider | B |
| IJsgebied bliksemgeleider | A |

**Geleiders Back**

| Omschrijving | Spanning | Geleider Back | Bundel Ba | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{back}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 0 kV | 0 | 0 | 0 | 0 % | 0 % | 0 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | 0 | 0 | 0 | 0 % | 0 % | 0 |

Geleiders Ahead

| Omschrijving | Spanning | Geleider Ahead | Bundel Ah | IJsgebied | Toeslag gewicht | Toeslag diameter | Intrekwaarden $P_{ahead}$ |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 380 kV | ACCC-Warsaw | 3 | B | 2 % | 2 % | 1600 |
| Circuit 2 | 0 kV | 0 | 0 | 0 | 0 % | 0 % | 0 |
| Bliksemdraad 1 | | AACSR 241-AL3-39-A20SA | 1 | A | 2 % | 2 % | 1600 |
| Bliksemdraad 2 | | 0 | 0 | 0 | 0 % | 0 % | 0 |

Isolatoren *(1)*

| Omschrijving | Ophanging | Gewicht [kN] | Lengte [m] | Windopp. [$m^2$] |
|---|---|---|---|---|
| Circuit 1 | Halfverankering | 5,60 | 4,50 | 2,40 |
| Circuit 2 | Halfverankering | 5,60 | 4,50 | 2,40 |
| Bliksemdraad 1 | Vast (Bliksemdraad) | 0,10 | 0,20 | 0,10 |
| Bliksemdraad 2 | Vast (Bliksemdraad) | 0,10 | 0,20 | 0,10 |

1. Eigenschappen gelden voor geheel van de isolatorset

**Ophanghoogte en positie in mast**

| Circuits | Aanduiding | Nummer | Ophanghoogte | Aangrijppunt | Positie in mast Horizontale afstand |
|---|---|---|---|---|---|
| Circuit 1 | 10 | 380ct1f1 | 60,0 m | 64,5 m | -17,5 m |
| Circuit 1 | 11 | 380ct1f2 | 60,0 m | 64,5 m | -9,5 m |
| Circuit 1 | 12 | 380ct1f3 | 72,0 m | 76,5 m | -13,5 m |
| Circuit 2 | 20 | 0ct2f1 | -4,5 m | 0,0 m | 0,0 m |
| Circuit 2 | 21 | 0ct2f2 | -4,5 m | 0,0 m | 0,0 m |
| Circuit 2 | 22 | 0ct2f3 | -4,5 m | 0,0 m | 0,0 m |
| Bliksemdraad 1 | 1 | bl1 | 80,3 m | 80,5 m | -18,5 m |
| Bliksemdraad 2 | 3 | bl2 | -0,2 m | 0,0 m | 0,0 m |

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**Hoogteaanpassing naastgelegen masten** (aanpassing wind- en weight span)

| | Back | Ahead | |
|---|---|---|---|
| Verhoging voor windbelasting | 0,0 m | 0,0 m | (positief: omhoog) |
| Verlaging voor verticale belasting | -32,0 m | 0,0 m | (negatief: omlaag, grotere weight span) |

Verlaging: Niet in 0,9EG-combinaties

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

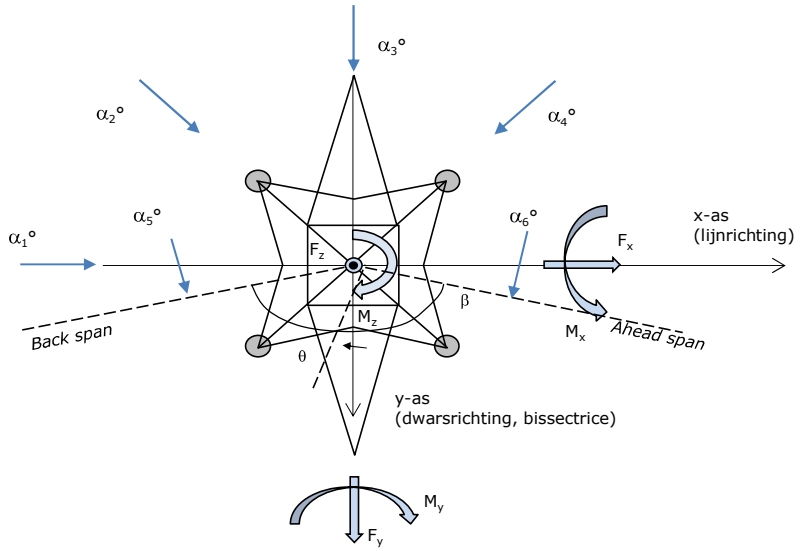
| | | | Hoogteverschil | | Richtingsverandering | |
|---|---|---|---|---|---|---|
| Circuits | Aanduiding | Nummer | Δh_back | Δh_ahead | Δy_back | Δy_ahead |
| Circuit 1 | 10 | 380ct1f1 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 11 | 380ct1f2 | 0,0 | 0,0 m | 0,0 | 0,0 m |
| Circuit 1 | 12 | 380ct1f3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

**Lijn- en mastgegevens**

| | | Back | Ahead |
|---|---|---|---|
| | | 400,0 | 400,0 m |
| Ruling span $\sqrt{(\Sigma L^3/\Sigma L)}$ | | 400,0 | 400,0 m |
| Lijnhoek | $\beta$ | 180 ° | |
| Rotatie mast t.o.v. bissectrice | $\theta$ | 0 ° | |
| Vaklengte | | 800 | 800 m |
| Hoogte onderkant mast t.o.v. maaiveld | | 0,5 m | |
| Beschouwde windrichtingen | $\alpha_1$ | 0 ° | |
| Windrichtingen volgens: | $\alpha_2$ | 45 ° | |
| *Geleiderbelastingen* | $\alpha_3$ | 90 ° | |
| | $\alpha_4$ | 135 ° | |
| | $\alpha_5$ | 225 ° | |
| | $\alpha_6$ | 270 ° | |

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

Windrichtingen en positieve richtingen belastingen




| Beschouwd aantal windrichtingen | |
|---|---|
| 1a | 6 |
| 3 | 6 |
| 4 | 1 |
| 6 | 1 |
| Overig | 1 |

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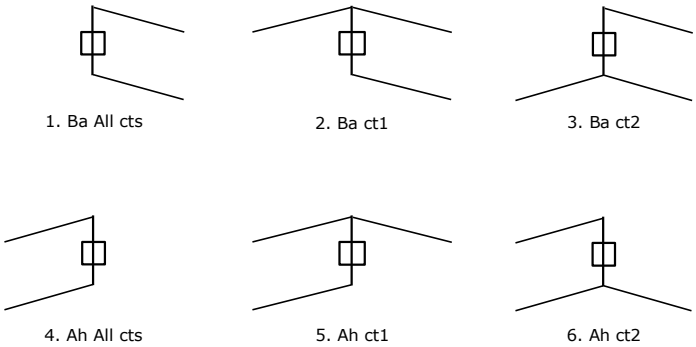
**Geleiderafval**

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

**Belastingsituaties SPLS**

Beschouwde situaties SPLS: SPLS voor steunmast niet van toepassing

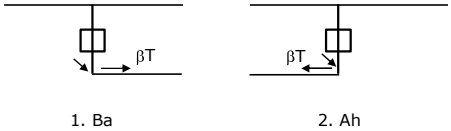
Principe belastingssituaties:




**Belastingsituaties 5a. Geleiderbreuk**

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

Principe belastingssituaties:



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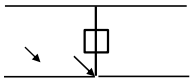
**Belastingsituaties 6. Bouw- en onderhoud**
Onder 6a wordt de belasting door aanwezigheid lijnwagen of lijnfiets in combinatie met puntlast op traverse in rekening gebracht.
Combinatie 6b bevat geen belastingen in geleider of op traverse. Deze combinatie is toegevoegd om te kunnen combineren met separate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

| | Fase | Bliksem |
|---|---|---|
| Lijnwagen | 4,0 kN | 2,0 kN |
| Puntlast op traverse | 1,0 kN | 1,0 kN |

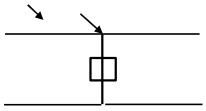
Beschouwde situaties bouw- en onderhoud 6a: 1 en 2, uitgangspunt is symmetrie tussen back / ahead.

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

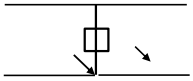
Principe belastingssituaties:



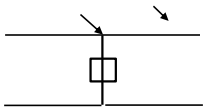
1. Ba Ct1



2. Ba Ct2



3. Ah Ct1



4. Ah Ct2

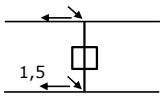
**Belastingsituaties 8. Lijndansen als statische belasting**

| Geleider | | |
|---|---|---|
| Steunmast fase | 0,866 W | 1,5 W |
| Steunmast bliksem | 1,5 EDS | 1,5 W |
| Hoekmast fase en bliksem | 1,5 EDS | 1,5 W |

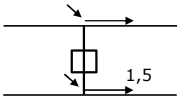
Beschouwde situaties lijndansen 8: 1 en 2, alle mogelijke situaties.

Belasting tegelijk aanwezig in alle geleiders van het circuit.

Principe belastingssituaties:




1. Ba




2. Ah

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

Project: GT-RLL380
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## Mastconstructie

### Eigenschappen

| | | | |
|---|---|---|---|
| Masttype | Steunmast | | |
| Mastbenaming | S+32 (bouwfase) | | |
| Voetplaat t.o.v. maaiveld | 0,5 | | m |
| Masthoogte t.o.v. voetplaat | 82,5 | | m |
| Gewicht mast | 703,7 | | kN |
| | | | |
| *Breedte en helling mast bij fundatie* | x-ri. | y-ri. | |
| Pootsprei | 14,70 | 14,70 | m |
| Helling van de randstijl | 0,172 | 0,172 | - |
| Factor spatkracht | 1,1 | 1,1 | - |

### Berekening windbelasting

| | |
|---|---|
| Dynamische invloed $G_T$ | 1,05 |
| Windbelasting overhoeks op mastlichaam evenredig met: | (A1C1sin^2(phi)+A2C2cos^2(phi)) |
| Windbelasting overhoeks op traverse evenredig met: | (A1C1sin^2(phi)+A2C2cos^2(phi)) |
| Vergroting wind overhoeks mastlichaam | (1+0,2sin^2(2phi)) |
| Vergroting wind overhoeks traverse | (1+0,2sin^2(2phi)) |
| Factor wind evenwijdig t.o.v. haaks op traverse | 0,4 |

### Eigenschappen mastsecties langsrichting (vooraanzicht, yz-vlak)

| Omschrijving | 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 | 19,50 | 14,70 | 8,00 | 19,50 | 0,172 | 221,33 | 37,50 | 0,17 | 3,07 |
| Eerste tussenstuk | 40,50 | 8,00 | 5,00 | 21,00 | 0,071 | 136,50 | 26,74 | 0,20 | 2,95 |
| Tweede tussenstuk | 64,50 | 5,00 | 3,50 | 24,00 | 0,031 | 102,00 | 22,19 | 0,22 | 2,86 |
| Bovenstuk 1 | 72,50 | 3,50 | 3,17 | 8,00 | 0,021 | 26,67 | 6,27 | 0,24 | 2,78 |
| Bovenstuk 2 | 80,50 | 3,17 | 2,83 | 8,00 | 0,021 | 24,00 | 5,86 | 0,24 | 2,75 |
| Topstuk | 82,50 | 2,83 | | 2,00 | | 2,83 | 0,41 | 0,15 | 3,18 |
| Ondertraverse | 64,50 | 15,75 | | 4,00 | | 31,50 | 8,71 | 0,28 | 2,62 |
| Boventraverse | 76,50 | 17,00 | | 4,00 | | 34,00 | 9,30 | 0,27 | 2,63 |

### Eigenschappen mastsecties dwarsrichting (zijaanzicht, xz-vlak)

| Omschrijving | 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 | 19,50 | 14,70 | 8,00 | 19,50 | 0,172 | 221,33 | 37,50 | 0,17 | 3,07 |
| Eerste tussenstuk | 40,50 | 8,00 | 5,00 | 21,00 | 0,071 | 136,50 | 26,74 | 0,20 | 2,95 |
| Tweede tussenstuk | 64,50 | 5,00 | 3,50 | 24,00 | 0,031 | 102,00 | 22,19 | 0,22 | 2,86 |
| Bovenstuk 1 | 72,50 | 3,50 | 3,17 | 8,00 | 0,021 | 26,67 | 6,27 | 0,24 | 2,78 |
| Bovenstuk 2 | 80,50 | 3,17 | 2,83 | 8,00 | 0,021 | 24,00 | 5,86 | 0,24 | 2,75 |
| Topstuk | 82,50 | 2,83 | | 2,00 | | 2,83 | 0,41 | 0,15 | 3,18 |
| Ondertraverse | 64,50 | 15,75 | | 4,00 | | 31,50 | 8,71 | 0,28 | 2,62 |
| Boventraverse | 76,50 | 17,00 | | 4,00 | | 34,00 | 9,30 | 0,27 | 2,63 |

*NB: oppervlakte traverse dwarsrichting van de tabel wordt in berekening gereduceerd.*
*NB: oppervlakte traverse per zijde, dus helft van totaal van twee traverses.*

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**Windoppervlak feeders telecominstallaties**

| Onderdeel | A ($m^2$/m) | Factor | Δh | $A_1$ |
|---|---|---|---|---|
| Broekstuk | 0,20 | 0,71 | 19,5 | 2,8 |
| Eerste tussenstuk | 0,20 | 0,71 | 21,0 | 3,0 |
| Tweede tussenstuk | | | | |
| Bovenstuk 1 | | | | |
| Bovenstuk 2 | | | | |

**Invoer antennes**

| Omschrijving | A ($m^2$) | h (m) | $C_f$ (m) |
|---|---|---|---|
| Antenne top | | | |
| Antenne o.t. | 4,7 | 40,5 | 1,5 |

**Belastingen mastsectie langsrichting (x-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{x1}$ [kN] | $F_{x2}$ [kN] | $F_{x3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{y1}$ [kNm] | $M_{y2}$ [kNm] | $M_{y3}$ [kNm] | $M_{y4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 80,7 | 68,4 | 0,0 | -68,4 | 9,8 | 786,4 | 667,2 | 0,0 | -667,2 |
| Eerste tussenstuk | 0,99 | 77,9 | 66,1 | 0,0 | -66,1 | 30,0 | 2338,2 | 1984,0 | 0,0 | -1984,0 |
| Tweede tussenstuk | 1,15 | 72,9 | 61,8 | 0,0 | -61,8 | 52,5 | 3825,5 | 3246,0 | 0,0 | -3246,0 |
| Bovenstuk 1 | 1,23 | 21,5 | 18,2 | 0,0 | -18,2 | 68,5 | 1472,8 | 1249,7 | 0,0 | -1249,7 |
| Bovenstuk 2 | 1,26 | 20,3 | 17,3 | 0,0 | -17,3 | 76,5 | 1556,0 | 1320,3 | 0,0 | -1320,3 |
| Topstuk | 1,28 | 1,7 | 1,4 | 0,0 | -1,4 | 81,5 | 137,0 | 116,3 | 0,0 | -116,3 |
| Ondertraverse | 1,22 | 55,6 | 33,0 | 0,0 | -33,0 | 65,8 | 3661,0 | 2174,5 | 0,0 | -2174,5 |
| Boventraverse | 1,27 | 62,2 | 36,9 | 0,0 | -36,9 | 77,8 | 4839,1 | 2874,3 | 0,0 | -2874,3 |
| Totaal | | 392,8 | 303,3 | 0,0 | -303,3 | | 18615,8 | 13632,3 | 0,0 | -13632,3 |

**Belastingen mastsectie dwarsrichting (y-richting) per windrichting**

| Omschrijving | $p_w$ [kN/$m^2$] | $F_{y1}$ [kN] | $F_{y2}$ [kN] | $F_{y3}$ [kN] | $F_{x4}$ [kN] | $h_{ef}$ [m] | $M_{x1}$ [kNm] | $M_{x2}$ [kNm] | $M_{x3}$ [kNm] | $M_{x4}$ [kNm] |
|---|---|---|---|---|---|---|---|---|---|---|
| Broekstuk | 0,70 | 0,0 | 68,4 | 80,7 | 68,4 | 9,8 | 0,0 | 667,2 | 786,4 | 667,2 |
| Eerste tussenstuk | 0,99 | 0,0 | 66,1 | 77,9 | 66,1 | 30,0 | 0,0 | 1984,0 | 2338,2 | 1984,0 |
| Tweede tussenstuk | 1,15 | 0,0 | 61,8 | 72,9 | 61,8 | 52,5 | 0,0 | 3246,0 | 3825,5 | 3246,0 |
| Bovenstuk 1 | 1,23 | 0,0 | 18,2 | 21,5 | 18,2 | 68,5 | 0,0 | 1249,7 | 1472,8 | 1249,7 |
| Bovenstuk 2 | 1,26 | 0,0 | 17,3 | 20,3 | 17,3 | 76,5 | 0,0 | 1320,3 | 1556,0 | 1320,3 |
| Topstuk | 1,28 | 0,0 | 1,4 | 1,7 | 1,4 | 81,5 | 0,0 | 116,3 | 137,0 | 116,3 |
| Ondertraverse | 1,22 | 0,0 | 33,0 | 22,2 | 33,0 | 65,8 | 0,0 | 2174,5 | 1464,4 | 2174,5 |
| Boventraverse | 1,27 | 0,0 | 36,9 | 24,9 | 36,9 | 77,8 | 0,0 | 2874,3 | 1935,6 | 2874,3 |
| Totaal | | 0,0 | 303,3 | 322,1 | 303,3 | | 0,0 | 13632,3 | 13515,8 | 13632,3 |

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

| Belasting / windrichting | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| Permanente belasting | 0 | 0 | 704 | 0 | 0 | 0 |
| Windrichting 0° | 400 | 0 | 0 | 0 | 19869 | 0 |
| Windrichting 45° | 309 | 309 | 0 | 14542 | 14542 | 0 |
| Windrichting 90° | 0 | 330 | 0 | 14514 | 0 | 0 |
| Windrichting 135° | -309 | 309 | 0 | 14542 | -14542 | 0 |

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**Tussenresultaten geleiderbelastingen**

**Geleiders back**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | 0 | | | | | |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | 0 | | | | | |

**Geleiders ahead**

| Circuit | Geleider | Diameter [mm] | A [mm$^2$] | G [N/m] | E [N/mm$^2$] | $\alpha$T [-] |
|---|---|---|---|---|---|---|
| Circuit 1 | ACCC-Warsaw | 27,7 | 571,0 | 14,98 | 62700 | 1,88E-05 |
| Circuit 2 | 0 | | | | | |
| Bliksemdraad 1 | AACSR 241-AL3-39-A20SA | 21,8 | 281,0 | 9,38 | 70165 | 1,97E-05 |
| Bliksemdraad 2 | 0 | | | | | |

**Verticale belasting back**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45,8 | B | 4+0,2d | 9,5 | 28,6 |
| Circuit 2 | 0 | 0 | | 0 | | | |
| Bliksemdraad 1 | 1 | 2 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 0 | 0 | | 0 | | | |

**Verticale belasting ahead**

| Circuit | Bundel [-] | Toeslag [%] | $w_{z,G}$ [N/m] | IJsgebied | Formule | $w_{z,ijs}$ [N/m] | $w_{z,ijs,bundel}$ [N/m] |
|---|---|---|---|---|---|---|---|
| Circuit 1 | 3 | 2 | 45,8 | B | 4+0,2d | 9,5 | 28,6 |
| Circuit 2 | 0 | 0 | | 0 | | | |
| Bliksemdraad 1 | 1 | 2 | 9,6 | A | 15+0,4d | 23,7 | 23,7 |
| Bliksemdraad 2 | 0 | 0 | | 0 | | | |

**Isolatoren**

| Geleider | $G_{isolator}$ [kN] | Aantal - | $F_{v,iso}$ [kN] | Lengte [m] | Windopp. [m$^2$] | Windhoogte [m] | Stuwdruk [kN/m$^2$] | Vormfactor [-] | $F_{h,iso}$ [kN] |
|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 62,75 | 1,20 | 1,2 | 3,47 |
| 380ct1f2 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 62,75 | 1,20 | 1,2 | 3,47 |
| 380ct1f3 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | 74,75 | 1,26 | 1,2 | 3,62 |
| 0ct2f1 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | -1,75 | 0,49 | 1,2 | 1,42 |
| 0ct2f2 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | -1,75 | 0,49 | 1,2 | 1,42 |
| 0ct2f3 | 5,60 | 1 | 5,6 | 4,5 | 2,4 | -1,75 | 0,49 | 1,2 | 1,42 |
| bl1 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 80,90 | 1,28 | 1,2 | 0,15 |
| bl2 | 0,10 | 1 | 0,1 | 0,2 | 0,1 | 0,40 | 0,49 | 1,2 | 0,06 |

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**Windbelasting back**

| Geleider | hoogte wind [m] | Stuwdruk [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{toeslag}$ [mm] | $w_y$ [N/m] | $w_{y,vak}$ [N/m] | $D_{ijs,toeslag}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,vak}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f2 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f3 | 64,2 | 1,21 | 0,64 | 0,64 | 1,04 | 28,25 | 67,9 | 67,9 | 46,9 | 130,2 | 130,2 |
| 0ct2f1 | | | | | | | | | | | |
| 0ct2f2 | | | | | | | | | | | |
| 0ct2f3 | | | | | | | | | | | |
| bl1 | 72,5 | 1,25 | 0,65 | 0,65 | 1,16 | 22,24 | 20,8 | 20,8 | 63,1 | 61,0 | 61,0 |
| bl2 | | | | | | | | | | | |

**Windbelasting ahead**

| Geleider | hoogte wind [m] | Stuwdruk [kN/m$^2$] | $G_{c\_dwars}$ [-] | $G_{c\_trek}$ [-] | $C_c$ [-] | $d_{toeslag}$ [mm] | $w_y$ [N/m] | $w_{y,vak}$ [N/m] | $D_{ijs,toeslag}$ [mm] | $w_{y,ijs}$ [N/m] | $w_{y,ijs,vak}$ [N/m] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 380ct1f1 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f2 | 52,2 | 1,15 | 0,62 | 0,62 | 1,06 | 28,25 | 63,8 | 63,8 | 46,9 | 120,4 | 120,4 |
| 380ct1f3 | 64,2 | 1,21 | 0,64 | 0,64 | 1,04 | 28,25 | 67,9 | 67,9 | 46,9 | 130,2 | 130,2 |
| 0ct2f1 | | | | | | | | | | | |
| 0ct2f2 | | | | | | | | | | | |
| 0ct2f3 | | | | | | | | | | | |
| bl1 | 72,5 | 1,25 | 0,65 | 0,65 | 1,16 | 22,24 | 20,8 | 20,8 | 63,1 | 61,0 | 61,0 |
| bl2 | | | | | | | | | | | |

*NB: belastingen $w_v$ gelden voor bundel*

Project: GT-RLL380
Masttype: S+32 (bouwfase)
Mast: 72N

**Geleiderbelastingen**

Auteur: TBR
Versie: v12.0

**Uitgangspunten**

| | |
|---|---|
| Betrouwbaarheidsniveau | Nieuwbouw CC2 |
| Referentieperiode | 15 jaar |

| **ULS** (bezwijksterkte) | | **NEN-EN50341-2-15:2019** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Belastingsgeval | omschrijving | 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° | 1,20 | 1,20 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 1a_0,9 | Wind 0,9Gk alleen mast | 10° | 0,90 | 1,20 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 1a_0,9_0,9 | Wind 0,9Gk ook geleider | 10° | 0,90 | 0,90 | 0,00 | 1,25 | 0,00 | 0,0 |
| ULS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,00 | 0,38 | 1,07 | 0,0 |
| ULS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,00 | 0,38 | 1,07 | 0,0 |
| ULS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 5a | Torsiebelastingen | 10° | 1,00 | 1,00 | 1,00 | 0,00 | 0,00 | 1,0 |
| ULS 5b | Longitudinale belastingen | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| ULS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,50 | 0,25 | 0,00 | 0,0 |
| ULS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,00 | 0,25 | 0,00 | 0,0 |
| ULS 7 | Permanent | 10° | 1,35 | 1,35 | 0,00 | 0,00 | 0,00 | 0,0 |
| ULS 8 | Special | 10° | 1,00 | 1,00 | 0,00 | 0,00 | 0,00 | 1,0 |
| **SPLS** | (Bezwijksterkte, enkel voor hoekmasten: afwezigheid geleiders) | | | $\gamma_G$ | $\gamma_Q$ | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SPLS 1a | Wind | 10° | 1,20 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9 | Wind 0,9 | 10° | 0,90 | 1,20 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 1a_0,9_0,9 | Wind 0,9 | 10° | 0,90 | 0,90 | 0,0 | 0,78 | 0,00 | 0,0 |
| SPLS 3 | Wind+ijs | -5° | 1,20 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 3_0,9 | Wind+ijs 0,9 | -5° | 0,90 | 1,20 | 0,0 | 0,36 | 0,34 | 0,0 |
| SPLS 4 | Koude+wind | -20° | 1,20 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 4_0,9 | Koude+wind 0,9 | -20° | 0,90 | 1,20 | 0,0 | 0,24 | 0,00 | 0,0 |
| SPLS 6 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 1,2 | 0,24 | 0,0 | 0,0 |
| SPLS 6_0,9 | Bouw en onderhoud | 5° | 1,20 | 1,20 | 0,0 | 0,24 | 0,0 | 0,0 |
| **SLS** | (controle van de vervormingen, vermoeiing, EDS) | | | | | | | |
| | | | | $G_k$ | $Q_{pk}$ | $Q_{wk}$ | $Q_{ik}$ | $A_k$ |
| SLS 1a | Wind | 10° | 1,00 | 1,00 | 0,0 | 0,87 | 0,0 | 0,0 |
| SLS 3 | Wind+ijs | -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 | Bouw en onderhoud | 5° | 1,00 | 1,00 | 0,0 | 0,17 | 0,0 | 0,0 |
| SLS 7 | PB (EDS, geen wind) | 10° | 1,00 | 1,00 | 0,0 | 0,00 | 0,0 | 0,0 |

| | |
|---|---|
| Aantal windrichtingen | 6 |
| Aantal belastingcombinaties ULS | 54 |
| Aantal belastingcombinaties SPLS | 0 |
| Aantal belastingcombinaties SLS | 15 |
| Aantal knooplasten | 552 |

Project: GT-RLL380
Masttype: S+32 (bouwfase)
Mast: 72N

**Samenvattingstabellen geleiderbelastingen**

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

**Maximale waarden voor back en ahead span**

| Geleider | Fx_ba [kN] | Fx_ah [kN] | Fy_ba [kN] | Fy_ah [kN] | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|---|---|---|
| bl1 | -52,2 | 52,2 | 5,3 | 5,3 | 11,1 | 6,9 |
| bl2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,8 | 0,8 |
| 380ct1f1 | -144,7 | 144,7 | 18,2 | 18,2 | 32,1 | 20,5 |
| 380ct1f2 | -144,7 | 144,7 | 18,2 | 18,2 | 32,1 | 20,5 |
| 380ct1f3 | -146,9 | 146,9 | 19,3 | 19,3 | 32,2 | 20,5 |
| 0ct2f1 | -0,2 | 0,2 | 0,9 | 0,9 | 4,1 | 4,1 |
| 0ct2f2 | -0,2 | 0,2 | 0,9 | 0,9 | 4,1 | 4,1 |
| 0ct2f3 | -0,2 | 0,2 | 0,9 | 0,9 | 4,1 | 4,1 |

**Min. Weight span (m)**

| Weight spar | Combinatie1 | | |
|---|---|---|---|
| Geleider | SLS 1a | SLS 4 | SLS 7 |
| bl1 | 528,0 | 550,6 | 528,0 |
| bl2 | 0,0 | 0,0 | 0,0 |
| 380ct1f1 | 528,0 | 545,5 | 528,0 |
| 380ct1f2 | 528,0 | 545,5 | 528,0 |
| 380ct1f3 | 528,0 | 545,9 | 528,0 |
| 0ct2f1 | 0,0 | 0,0 | 0,0 |
| 0ct2f2 | 0,0 | 0,0 | 0,0 |
| 0ct2f3 | 0,0 | 0,0 | 0,0 |

**Max. Weight span (m)**

| Weight spar | Combinatie1 | |
|---|---|---|
| Geleider | ULS 1a | ULS 3 |
| bl1 | 664,9 | 521,5 |
| bl2 | 0,0 | 0,0 |
| 380ct1f1 | 603,0 | 535,2 |
| 380ct1f2 | 603,0 | 535,2 |
| 380ct1f3 | 610,5 | 537,2 |
| 0ct2f1 | 0,0 | 0,0 |
| 0ct2f2 | 0,0 | 0,0 |
| 0ct2f3 | 0,0 | 0,0 |

| Omhullende weight span over alle combinaties (incl. 0,9 combinaties) | | |
|---|---|---|
| Voor alle geleiders | | Wind / Weight span verhouding |
| Max. weight span | 664,9 m | 1,662 - |
| Min. weight span | 0,0 m | 0,000 - |

Project: GT-RLL380
Masttype: S+32 (bouwfase)
Mast: 72N

**Maximale waarden back+ahead span** **Maximale waarden trekkracht geleider**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 22,9 | 10,6 | 18,0 | -52,2 | 52,2 |
| bl2 | 0,1 | 0,1 | 1,6 | 0,0 | 0,0 |
| 380ct1f1 | 58,7 | 36,3 | 52,6 | -144,7 | 144,7 |
| 380ct1f2 | 58,7 | 36,3 | 52,6 | -144,7 | 144,7 |
| 380ct1f3 | 58,7 | 38,6 | 52,7 | -146,9 | 146,9 |
| 0ct2f1 | 0,4 | 1,8 | 8,2 | 0,0 | 0,0 |
| 0ct2f2 | 0,4 | 1,8 | 8,2 | 0,0 | 0,0 |
| 0ct2f3 | 0,4 | 1,8 | 8,2 | 0,0 | 0,0 |

**EDS-belastingen geleiders**

| Geleider | Fx [kN] | Fy [kN] | Fz [kN] | Ft_ba [kN] | Ft_ah [kN] |
|---|---|---|---|---|---|
| bl1 | 0,0 | 0,0 | 5,1 | -15,3 | 15,3 |
| bl2 | 0,0 | 0,0 | 0,1 | 0,0 | 0,0 |
| 380ct1f1 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 380ct1f2 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 380ct1f3 | 0,0 | 0,0 | 29,8 | -73,3 | 73,3 |
| 0ct2f1 | 0,0 | 0,0 | 5,6 | 0,0 | 0,0 |
| 0ct2f2 | 0,0 | 0,0 | 5,6 | 0,0 | 0,0 |
| 0ct2f3 | 0,0 | 0,0 | 5,6 | 0,0 | 0,0 |

**Controle uplift SLS-wind**

| Combinatie: | Geleider | Fz_ba [kN] | Fz_ah [kN] |
|---|---|---|---|
| SLS 4 | bl1 | 3,4 | 2,0 |
| | bl2 | 0,1 | 0,1 |
| | 380ct1f1 | 18,6 | 12,0 |
| | 380ct1f2 | 18,6 | 12,0 |
| | 380ct1f3 | 18,7 | 12,0 |
| | 0ct2f1 | 2,8 | 2,8 |
| | 0ct2f2 | 2,8 | 2,8 |
| | 0ct2f3 | 2,8 | 2,8 |

Project: GT-RLL380
Masttype: S+32 (bouwfase)
Mast: 72N

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

| Combinatie | Combination | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|---|
| ULS 1a_90 | | 0 | 127 | 148 | 6729 | 0 | 0 |
| ULS 1a_0,9_0 | | 5 | 0 | 111 | -1250 | 242 | -48 |
| ULS 1a_0,9_0,9_90 | | 0 | 127 | 83 | 7556 | 0 | 0 |
| ULS 3_0 | | 1 | 0 | 192 | -2407 | 73 | -14 |
| SLS 7 | | 0 | 0 | 111 | -1302 | 0 | 0 |

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

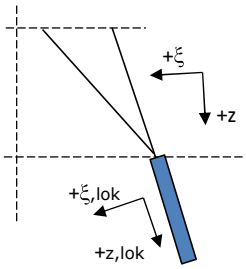
| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_90 | 0 | 540 | 993 | 24916 | 0 | 0 |
| ULS 1a_0,9_0,9_90 | 0 | 540 | 717 | 25743 | 0 | 0 |
| SLS 7 | 0 | 0 | 815 | -1302 | 0 | 0 |

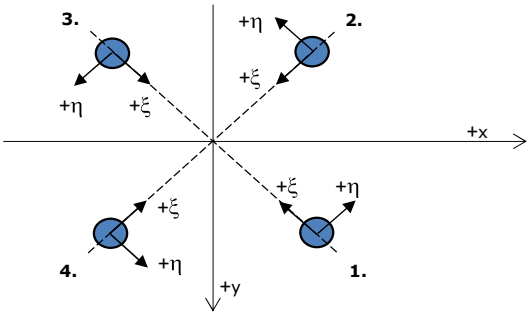
**Fundatiebelastingen, selectie belastingcombinaties op basis grootste waarde**

| Combinatie | $F_x$ [kN] | $F_y$ [kN] | $F_z$ [kN] | $M_x$ [kNm] | $M_y$ [kNm] | $M_z$ [kNm] |
|---|---|---|---|---|---|---|
| ULS 1a_270 | 0 | -540 | 993 | **-28445** | 0 | 0 |
| ULS 1a_0 | 507 | 0 | 978 | -1556 | **25139** | -48 |
| ULS 8 Ah | 86 | 0 | 854 | -1839 | 6155 | **-1273** |
| ULS 1a_225 | -390 | -454 | 983 | **-24285** | **-18393** | 34 |

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

**Oplegreacties op fundering per randstijl**




Assenstelsels

**Maximale drukbelasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 1a_45 | 279 | 279 | **1587** | 0 | -394 | -9 | 1633 |
| 2 | ULS 1a_270 | 230 | -182 | **1216** | -34 | -291 | 4 | 1251 |
| 3 | ULS 1a_225 | -301 | -278 | **1697** | 16 | -409 | 3 | 1747 |
| 4 | ULS 1a_135 | -279 | 279 | **1587** | 0 | -394 | -9 | 1633 |

**Maximale trekbelasting**

| Stijl | Combinatie | $R_x$ [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_225 | -215 | -197 | **-1253** | -13 | 292 | -13 | -1289 |
| 2 | ULS 1a_0,9_0,9_135 | -204 | 197 | **-1185** | 5 | 284 | -4 | -1220 |
| 3 | ULS 1a_0,9_0,9_45 | 204 | 197 | **-1185** | -5 | 284 | -4 | -1220 |
| 4 | ULS 1a_0,9_270 | 144 | -100 | **-764** | 31 | 173 | -13 | -786 |

**Maximale torsiebelasting (positief)**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | ULS 8 Ba | 29 | -21 | -58 | **35** | -6 | -20 | -60 |
| 2 | ULS 1a_0,9_0,9_45 | -8 | -38 | 66 | **32** | -21 | -5 | 68 |
| 3 | ULS 1a_270 | -230 | -182 | 1216 | **34** | -291 | 4 | 1251 |
| 4 | ULS 8 Ba | -28 | 102 | 360 | **52** | -92 | -4 | 371 |

**Maximale torsiebelasting (negatief)**

| Stijl Index | Combinatie 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 8 Ah | 28 | 102 | 360 | **-52** | -92 | -4 | 371 |
| 2 | ULS 1a_225 | 104 | -42 | 446 | **-44** | -104 | 5 | 459 |
| 3 | ULS 1a_0,9_0,9_135 | 8 | -38 | 66 | **-32** | -21 | -5 | 68 |
| 4 | ULS 8 Ah | -29 | -21 | -58 | **-35** | -6 | -20 | -60 |

Project: GT-RLL380
Masttype: S+32 (bouwfase)
Mast: 72N

**Combinatie Ftrek+Fhor**

| Stijl | Combinatie | $R_x$ [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_225 | -215 | -197 | **-1253** | **-13** | 292 | -13 | -1289 |
| 2 | ULS 1a_0,9_0,9_135 | -204 | 197 | **-1185** | **5** | 284 | -4 | -1220 |
| 3 | ULS 1a_0,9_0,9_45 | 204 | 197 | **-1185** | **-5** | 284 | -4 | -1220 |
| 4 | ULS 1a_0,9_270 | 144 | -100 | **-764** | **31** | 173 | -13 | -786 |

**Permanente belasting**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 30 | 39 | 160 | -6 | -49 | -10 | 164 |
| 2 | SLS 7 | 47 | -39 | 248 | -6 | -60 | 0 | 255 |
| 3 | SLS 7 | -47 | -39 | 248 | 6 | -60 | 0 | 255 |
| 4 | SLS 7 | -30 | 39 | 160 | 6 | -49 | -10 | 164 |

**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_225 | -301 | -278 | **1697** | 16 | -409 | 3 | 1747 |
| Max. trek | ULS 1a_0,9_225 | -215 | -197 | **-1253** | -13 | 292 | -13 | -1289 |
| Max. pos. torsie | ULS 8 Ba | -28 | 102 | 360 | **52** | -92 | -4 | 371 |
| Max. neg. torsie | ULS 8 Ah | 28 | 102 | 360 | **-52** | -92 | -4 | 371 |
| Comb. trek+torsie | ULS 1a_0,9_225 | -215 | -197 | **-1253** | **-13** | 292 | -13 | -1289 |

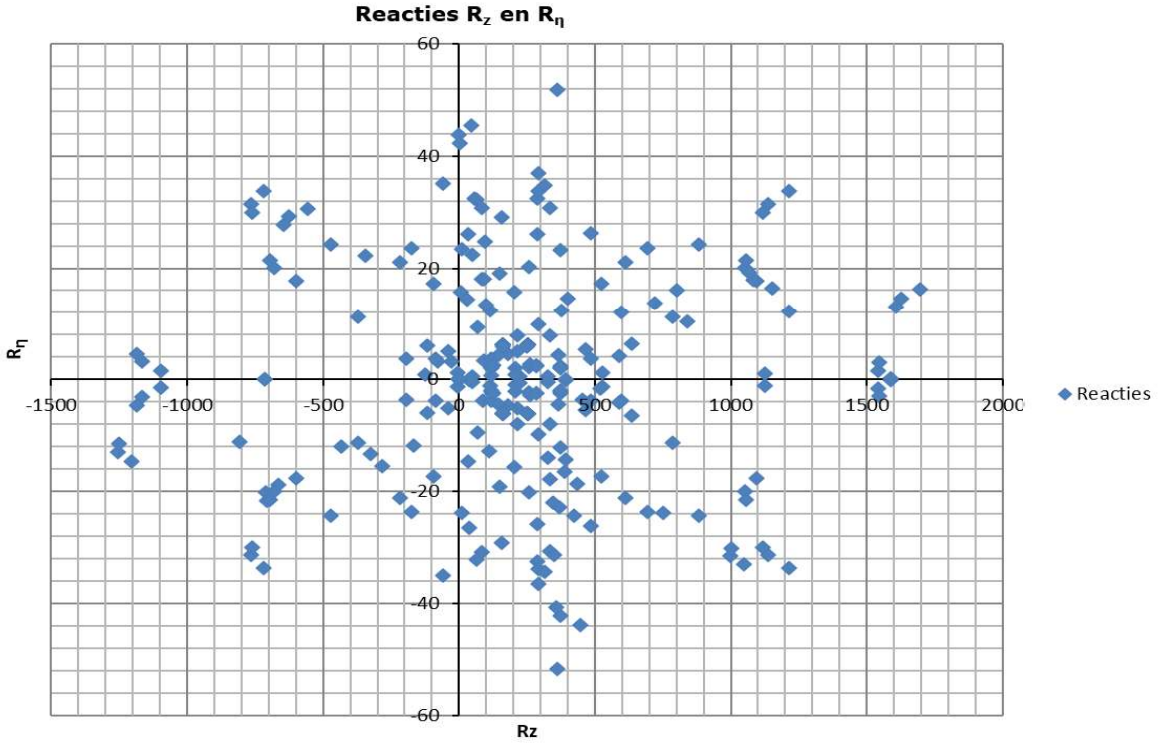
**Maximale trekbelasting SLS**

| Stijl | Combinatie | $R_x$ [kN] | $R_y$ [kN] | $R_z$ [kN] | $R_\eta$ [kN] | $R_\xi$ [kN] | $R_{\xi,lok}$ [kN] | $R_{z,lok}$ [kN] |
|---|---|---|---|---|---|---|---|---|
| 1 | SLS 7 | 30 | 39 | **160** | -6 | -49 | -10 | 164 |
| 2 | SLS 1a_135 | -121 | 121 | **-715** | 0 | 171 | -2 | -736 |
| 3 | SLS 1a_45 | 121 | 121 | **-715** | 0 | 171 | -2 | -736 |
| 4 | SLS 1a_0 | 57 | -74 | **-432** | -12 | 92 | -13 | -444 |

**Maximale drukbelasting SLS**

| Stijl | Combinatie | $R_x$ [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 | 198 | 199 | **1124** | -1 | -281 | -8 | 1157 |
| 2 | SLS 1a_0 | 135 | -150 | **839** | 10 | -201 | 3 | 864 |
| 3 | SLS 7 | -47 | -39 | **248** | 6 | -60 | 0 | 255 |
| 4 | SLS 1a_135 | -198 | 199 | **1124** | 1 | -281 | -8 | 1157 |

Project: GT-RLL380
Masttype: S+32 (bouwfase)
Mast: 72N



# Dynamische factor CsCd

Masttype S+32_n is hoger dan 60 m en daardoor moet de dynamische factor berekend worden.

De procedure van NEN-EN 50341-2-15 artikel 4.4.3.1 is gevolgd.

Gemiddelde breedte is genomen op het niveau van de ondertraverse: 3,5 m.

Hoogte van de mast voor de turbulentie-intensiteit is genomen op 60% van de hoogte volgens NEN-EN 1991-1-4 clause 6.3.1.

Voor de resonantiefactor $R^2$ zijn de volgende uitgangspunten gebruikt:

Logaritmische demping volgens NEN-EN 1991-1-4 Appendix F: “stalen Bruggen en vakwerktorens, bouten met hoge kwaliteit”: $\delta_s$ = 0,030.

Equivalente massa $m_e$ is genomen als de massa per eenheid van lengte. Deze is berekend door het mastgewicht te delen door de totale hoogte.

Factoren $K_y$ and $K_z$ op basis van parabolische vervormingslijn.

$G_y$ = 1/2

$G_z$ = 5/18

De drag coefficient is genomen als het product van het product of $\chi$ (solidity ratio) en $C_t$ (drag factor voor een open vakwerk). $C_f$ = 0,24 x 2,8 = 0,67.

Peak factor is gezet op 3,5 volgens NEN-EN 50341-2-15.

Zie verder uitvoer.

De berekende waarde voor $c_sC_d$ bedraagt <u>1,05</u>.

***Bouwwerkfactor $c_s c_d$***

| | | | |
|---|---|---|---|
| $c_s c_d = 1 + 2\, k_p\, I_v(z_s)\, \sqrt{(B^2+R^2)} / 1+7I_v(z)$ | | 1,05 | - |
| $k_p$ | piekfactor | | |
| $I_v$ | turbulentieintensiteit | 0,166051 | |
| $B^2$ | achtergrondresponsiefactor, brengt het volledige gebrek aan correlatie in rekening | | |
| $R^2$ | resonantieresponsfactor | | |
| $z_s$ | referentiehoogte, temnminste gelijk aan zmin | | |

Piekfactor kp

| | | |
|---|---|---|
| $k_p = \sqrt{(2\ln(\nu T))} + 0{,}6 / \sqrt{(2\ln(\nu T))} \geq 3{,}0$ | 3,50 | - |
| $T =$ | 600 | s |
| $\nu = n_1 \sqrt{(R^2 / (B^2+R^2))} \geq 0{,}08$ | 0,56 | - |

Achtergrondresponsiefactor $B^2$

| | | | |
|---|---|---|---|
| $b =$ | 3,50 | m | |
| $d =$ | 3,50 | m | |
| $h =$ | 82,5 | m | |
| $z_s = h =$ | 49,5 | m | |
| $L(z_s) = L_t\, (z_s / z_t)^{\alpha}$ | 131,7 | m | |
| $L_t =$ | 300 | m | (referentielengteschaal) |
| $z_t =$ | 200 | m | (referentiehoogte zmax) |
| $\alpha = 0{,}67 + 0{,}05\ln(z_0) =$ | 0,59 | | |
| $B^2 =$ | 0,52 | | |

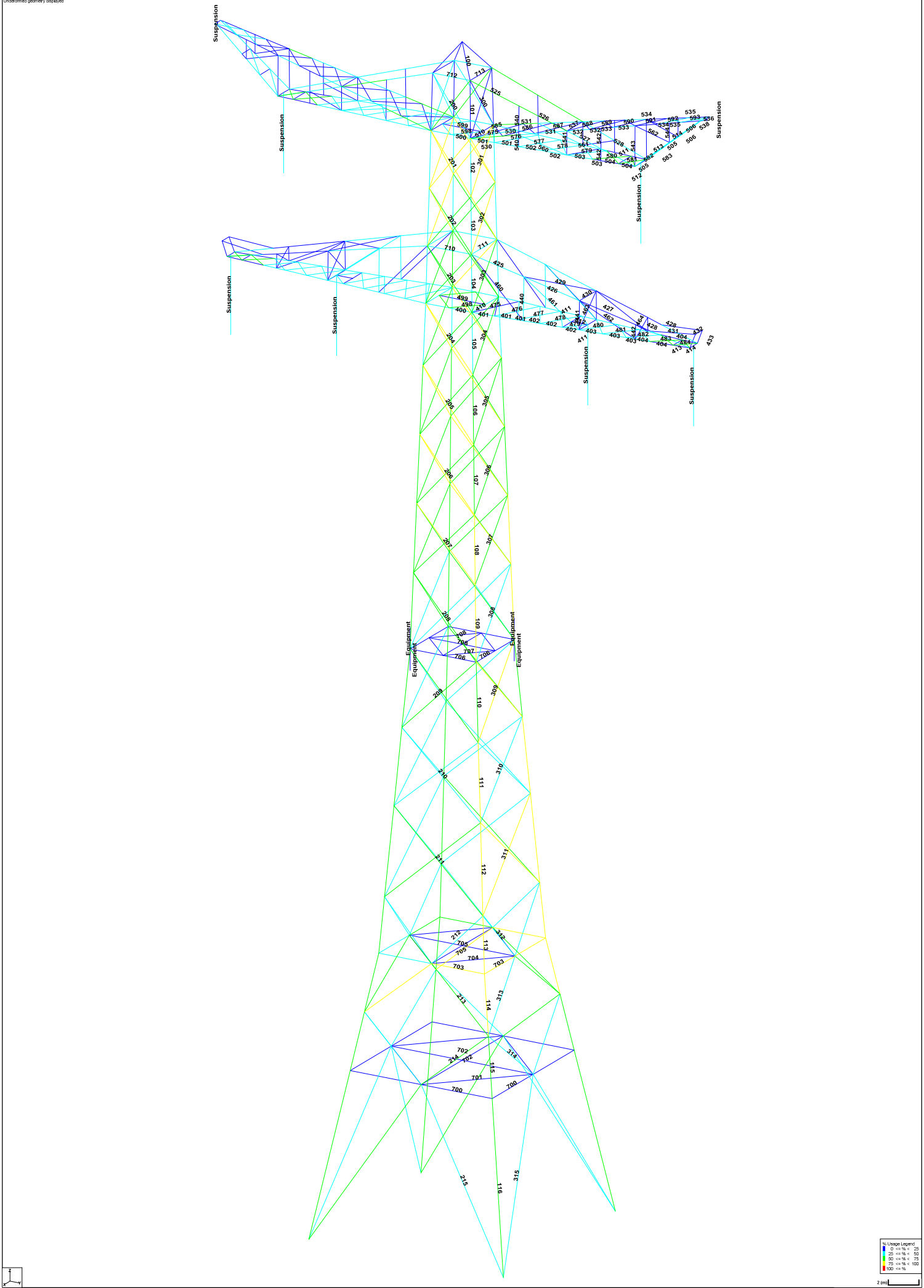
Resonantieresponsfactor $R^2$

| | | |
|---|---|---|
| $R^2 = \pi^2 / 2\delta \times S_L K_s =$ | 0,7747 | |
| $\delta = \delta_s + \delta_a + \delta_d =$ | 0,05 | |
| Type constructie | Stalen toren, bout met hoge weerstand | |
| $\delta_s =$ | 0,03 | |
| $\delta_a = c_f r b v_m(z_s) / 2 n_1 m_e =$ | 0,01995 | |
| $c_f =$ | 0,67 | (krachtcoefficient windrichting, solidity x cf) |
| $n_1 =$ | 0,73 | (eigenfrequentie, benaderd met $f_e = 60 / h$) |
| $m_e$ | 853,0 | (equivalente massa) |
| $\delta_d =$ | 0,0 | |
| $S_L$ | 0,0614765 | (dimensieloze spectrale dichtheidsfunctie) |
| $f_L =$ | 3,3 | |
| $K_s$ | 0,1276 | (afmetingsreductiefunctie) |
| $\psi_y =$ | 1,0 | |
| $\psi_z =$ | 23,4 | |
| $c_y = c_z =$ | 11,5 | |
| $G_y$ | 0,50 | |
| $G_z$ | 0,28 | |
| $K_y$ | 1 | |
| $K_z$ | 1,67 | |

# APPENDIX B
# Resultaten PLS tower

Deze Appendix bevat de resultaten voor de toetsing van profielen en bouten uit PLS Tower voor masttype S+32/n.

DNV GL Nederlands BV, Project: "D1/3.2 Circuit 5+32 - dnv glim"
Tower Version 16.66, 17:44:02 donderdag 15 juli 2021
Undeformed geometry displayed



DNV

## Assessment of angle groups

Date 15-7-2021
Author JSN
Version 1,0

**GT-RLL**
**S+32/n**

| Group Label | Description | Type | Profile | Steel Quality | Bolts | #sh.planes | e1 | e2 | p1 | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | Main leg | EA | 80x80x6 | S355 | 2M20-8,8t | 1 | 45 | 40 | 70 | 1,00 | 1,00 | 1,00 | 178 | **-17,0** | ULS 5a Ah 12 | 71,1 | 188,2 | 176,4 | 0,24 | | **16,9** | ULS 5a Ah 12 | 152,6 | 188,2 | 160,4 | 0,11 | |
| 101 | Main leg | EA | 120x120x12 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 89 | **-108,8** | ULS 3_225_Bouwfase | 545,4 | 542,2 | 846,7 | 0,20 | | **53,0** | ULS 3_225_Bouwfase | 750,1 | 542,2 | 796,1 | 0,10 | |
| 102 | Main leg | EA | 120x120x12 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 89 | **-232,1** | ULS 3_225_Bouwfase | 545,4 | 813,3 | 1270,1 | 0,43 | | **153,3** | ULS 1a_225_Bouwfase | 750,1 | 813,3 | 1194,1 | 0,20 | |
| 103 | Main leg | EA | 150x150x12 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 71 | **-345,8** | ULS 1a_225_Bouwfase | 871,2 | 813,3 | 1270,1 | 0,43 | | **242,5** | ULS 1a_225_Bouwfase | 1007,6 | 813,3 | 1194,1 | 0,30 | |
| 104 | Main leg | EA | 150x150x12 | S355 | 8M24-8,8t | 2 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 71 | **-463,1** | ULS 1a_225_Bouwfase | 871,2 | 2168,8 | 1693,4 | 0,53 | | **331,1** | ULS 1a_225_Bouwfase | 1007,6 | 2168,8 | 1592,1 | 0,33 | |
| 105 | Main leg | EA | 180x180x16 | S355 | 8M24-8,8t | 2 | 55 | 40 | 80 | 0,26 | 0,26 | 0,26 | 32 | **-763,7** | ULS 1a_225_Bouwfase | 1841,8 | 2168,8 | 2257,9 | 0,41 | | **565,9** | ULS 1a_225_Bouwfase | 1661,0 | 2168,8 | 2122,8 | 0,34 | |
| 106 | Main leg | EA | 180x180x16 | S355 | 8M24-8,8t | 2 | 55 | 40 | 80 | 0,26 | 0,26 | 0,26 | 35 | **-1093,7** | ULS 1a_45 | 1808,1 | 2168,8 | 2257,9 | 0,60 | | **836,1** | ULS 1a_0,9_0,9_135 | 1661,0 | 2168,8 | 2122,8 | 0,50 | |
| 107 | Main leg | EA | 180x180x16 | S355 | 8M24-8,8t | 2 | 55 | 40 | 80 | 0,26 | 0,26 | 0,26 | 35 | **-1317,7** | ULS 1a_45 | 1808,1 | 2168,8 | 2257,9 | 0,73 | | **1070,0** | ULS 1a_0,9_0,9_135 | 1661,0 | 2168,8 | 2122,8 | 0,64 | |
| 108 | Main leg | EA | 200x200x18 | S355 | 8M24-8,8t | 2 | 55 | 40 | 80 | 0,26 | 0,26 | 0,26 | 32 | **-1629,5** | ULS 1a_45 | 2293,6 | 2168,8 | 2540,2 | 0,75 | | **1355,9** | ULS 1a_0,9_0,9_135 | 2107,6 | 2168,8 | 2388,2 | 0,64 | |
| 109 | Main leg | EA | 200x200x18 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,26 | 0,26 | 0,26 | 35 | **-1818,5** | ULS 1a_45 | 2255,4 | 2711,0 | 3175,2 | 0,81 | | **1560,7** | ULS 1a_0,9_0,9_135 | 2107,6 | 2711,0 | 2985,2 | 0,74 | |
| 110 | Main leg | EA | 200x200x24 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 38 | **-1996,7** | ULS 1a_135 | 2921,9 | 2711,0 | 4233,6 | 0,74 | | **1719,4** | ULS 1a_0,9_0,9_45 | 2756,1 | 2711,0 | 3980,3 | 0,63 | |
| 111 | Main leg | EA | 200x200x24 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 38 | **-2221,6** | ULS 1a_135 | 2921,9 | 2711,0 | 4233,6 | 0,82 | | **1888,2** | ULS 1a_0,9_0,9_45 | 2756,1 | 2711,0 | 3980,3 | 0,70 | |
| 112 | Main leg | EA | 250x250x24 | S355 | 10M24-8,8t | 2 | 55 | 40 | 80 | 0,27 | 0,27 | 0,27 | 35 | **-2242,6** | ULS 1a_135 | 3765,1 | 2711,0 | 4233,6 | 0,83 | | **1938,4** | ULS 1a_0,9_0,9_45 | 3614,1 | 2711,0 | 3980,3 | 0,72 | |
| 113 | Main leg | EA | 250x250x24 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,50 | 0,50 | 0,50 | 40 | **-2426,0** | ULS 1a_45 | 3661,9 | 3199,0 | 5080,3 | 0,76 | | **2076,8** | ULS 1a_0,9_0,9_45 | 3614,1 | 3199,0 | 4776,4 | 0,65 | |
| 114 | Main leg | EA | 250x250x24 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,50 | 0,50 | 0,50 | 42 | **-2498,4** | ULS 1a_45 | 3620,4 | 3199,0 | 5080,3 | 0,78 | | **2106,8** | ULS 1a_0,9_0,9_45 | 3614,1 | 3199,0 | 4776,4 | 0,66 | |
| 115 | Main leg | EA | 250x250x24 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,50 | 0,50 | 0,50 | 42 | **-2278,5** | ULS 1a_135 | 3620,4 | 3199,0 | 5080,3 | 0,71 | | **1852,1** | ULS 1a_0,9_0,9_135 | 3614,1 | 3199,0 | 4776,4 | 0,58 | |
| 116 | Main leg | EA | 250x250x24 | S355 | 12M24-8,8t | 2 | 55 | 40 | 80 | 0,17 | 0,17 | 0,17 | 40 | **-2287,8** | ULS 1a_135 | 3656,5 | 3199,0 | 5080,3 | 0,72 | | **1839,4** | ULS 1a_0,9_0,9_135 | 3614,1 | 3199,0 | 4776,4 | 0,58 | |
| 200 | Diag front face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 146 | **-107,2** | ULS 3_225_Bouwfase | 153,4 | 271,1 | 317,5 | 0,70 | | **94,5** | ULS 3_225_Bouwfase | 240,0 | 271,1 | 296,7 | 0,39 | |
| 201 | Diag front face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 149 | **-121,9** | ULS 5a Ba 22 | 149,3 | 271,1 | 317,5 | 0,82 | | **102,8** | ULS 5a Ba 22 | 240,0 | 271,1 | 296,7 | 0,43 | |
| 202 | Diag front face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 152 | **-94,7** | ULS 5a Ba 22 | 145,3 | 271,1 | 317,5 | 0,65 | | **112,0** | ULS 5a Ba 22 | 240,0 | 271,1 | 296,7 | 0,47 | |
| 203 | Diag front face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 140 | **-164,4** | ULS 1a_225_Bouwfase | 202,4 | 271,1 | 352,8 | 0,81 | | **174,1** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,64 | |
| 204 | Diag front face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 107 | **-166,4** | ULS 1a_90 | 212,6 | 271,1 | 317,5 | 0,78 | | **153,3** | ULS 1a_0,9_0,9_90 | 240,0 | 271,1 | 296,7 | 0,64 | |
| 205 | Diag front face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 118 | **-153,6** | ULS 1a_0,9_0,9_90 | 190,7 | 271,1 | 317,5 | 0,81 | | **162,7** | ULS 1a_90 | 240,0 | 271,1 | 296,7 | 0,68 | |
| 206 | Diag front face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 122 | **-152,3** | ULS 1a_90 | 183,9 | 271,1 | 317,5 | 0,83 | | **140,0** | ULS 1a_0,9_0,9_90 | 240,0 | 271,1 | 296,7 | 0,58 | |
| 207 | Diag front face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 126 | **-134,1** | ULS 1a_0,9_0,9_90 | 177,1 | 271,1 | 317,5 | 0,76 | | **139,5** | ULS 1a_90 | 240,0 | 271,1 | 296,7 | 0,58 | |
| 208 | Diag front face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 123 | **-143,2** | ULS 1a_90 | 227,2 | 271,1 | 352,8 | 0,63 | | **128,6** | ULS 1a_0,9_0,9_90 | 305,3 | 271,1 | 329,6 | 0,47 | |
| 209 | Diag front face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,27 | 0,27 | 251 | **-47,1** | ULS 1a_0 | 82,1 | 271,1 | 352,8 | 0,57 | | **91,1** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,34 | |
| 210 | Diag front face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,54 | 0,27 | 0,27 | 146 | **-75,6** | ULS 8 Ba_Bouwfase | 182,9 | 271,1 | 352,8 | 0,41 | | **91,2** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,34 | |
| 211 | Diag front face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,27 | 0,27 | 310 | **-33,2** | ULS 1a_0 | 58,9 | 271,1 | 352,8 | 0,56 | | **67,6** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,25 | |
| 212 | Diag front face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 178 | **-66,2** | ULS 8 Ba_Bouwfase | 139,4 | 271,1 | 352,8 | 0,47 | | **74,5** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,27 | |
| 213 | Diag front face | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 169 | **-152,9** | ULS 1a_90 | 180,8 | 271,1 | 352,8 | 0,85 | | **141,4** | ULS 1a_0,9_90 | 378,9 | 271,1 | 329,6 | 0,52 | |
| 214 | Diag front face | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 169 | **-116,7** | ULS 1a_90 | 180,8 | 271,1 | 352,8 | 0,65 | | **115,9** | ULS 1a_90 | 378,9 | 271,1 | 329,6 | 0,43 | |
| 215 | Diag front face | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,17 | 0,17 | 0,17 | 97 | **-141,5** | ULS 1a_90 | 375,3 | 271,1 | 352,8 | 0,59 | | **128,5** | ULS 1a_0,9_90 | 378,9 | 271,1 | 329,6 | 0,47 | |
| 300 | Diag side face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,52 | 0,52 | 181 | **-33,4** | ULS 3_225_Bouwfase | 113,2 | 271,1 | 317,5 | 0,29 | | **15,5** | ULS 3_225_Bouwfase | 240,0 | 271,1 | 296,7 | 0,06 | |
| 301 | Diag side face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 149 | **-119,7** | ULS 5a Ah 12 | 149,3 | 271,1 | 317,5 | 0,80 | | **124,7** | ULS 5a Ba 22 | 240,0 | 271,1 | 296,7 | 0,52 | |
| 302 | Diag side face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 152 | **-114,9** | ULS 5a Ba 22 | 145,3 | 271,1 | 317,5 | 0,79 | | **110,1** | ULS 5a Ah 12 | 240,0 | 271,1 | 296,7 | 0,46 | |
| 303 | Diag side face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,52 | 0,52 | 140 | **-135,5** | ULS 8 Ba_Bouwfase | 202,4 | 271,1 | 352,8 | 0,67 | | **91,9** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,34 | |
| 304 | Diag side face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 107 | **-170,0** | ULS 8 Ba_Bouwfase | 212,6 | 271,1 | 317,5 | 0,80 | | **157,0** | ULS 8 Ba_Bouwfase | 240,0 | 271,1 | 296,7 | 0,65 | |
| 305 | Diag side face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 118 | **-149,6** | ULS 8 Ba_Bouwfase | 190,7 | 271,1 | 317,5 | 0,78 | | **161,1** | ULS 8 Ba_Bouwfase | 240,0 | 271,1 | 296,7 | 0,67 | |
| 306 | Diag side face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 122 | **-143,5** | ULS 8 Ba_Bouwfase | 183,9 | 271,1 | 317,5 | 0,78 | | **132,3** | ULS 8 Ba_Bouwfase | 240,0 | 271,1 | 296,7 | 0,55 | |
| 307 | Diag side face | EA | 90x90x9 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 126 | **-118,7** | ULS 8 Ba_Bouwfase | 177,1 | 271,1 | 317,5 | 0,67 | | **128,8** | ULS 8 Ba_Bouwfase | 240,0 | 271,1 | 296,7 | 0,54 | |
| 308 | Diag side face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,52 | 0,26 | 0,26 | 123 | **-123,3** | ULS 8 Ba_Bouwfase | 227,2 | 271,1 | 352,8 | 0,54 | | **111,9** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,41 | |
| 309 | Diag side face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,27 | 0,27 | 251 | **-65,1** | ULS 1a_90 | 82,2 | 271,1 | 352,8 | 0,79 | | **85,6** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,32 | |
| 310 | Diag side face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,27 | 0,27 | 270 | **-34,7** | ULS 1a_0,9_0,9_90 | 73,3 | 271,1 | 352,8 | 0,47 | | **76,6** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,28 | |
| 311 | Diag side face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,27 | 0,27 | 310 | **-44,9** | ULS 1a_90 | 58,6 | 271,1 | 352,8 | 0,77 | | **61,6** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,23 | |
| 312 | Diag side face | EA | 100x100x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 178 | **-58,9** | ULS 8 Ba_Bouwfase | 139,4 | 271,1 | 352,8 | 0,42 | | **61,2** | ULS 8 Ba_Bouwfase | 305,3 | 271,1 | 329,6 | 0,23 | |
| 313 | Diag side face | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 169 | **-94,1** | ULS 1a_45 | 180,8 | 271,1 | 352,8 | 0,52 | | **87,3** | ULS 1a_0,9_45 | 378,9 | 271,1 | 329,6 | 0,32 | |
| 314 | Diag side face | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 0,50 | 0,50 | 169 | **-79,7** | ULS 1a_45 | 180,8 | 271,1 | 352,8 | 0,44 | | **87,2** | ULS 1a_0,9_0,9_45 | 378,9 | 271,1 | 329,6 | 0,32 | |
| 315 | Diag side face | EA | 120x120x10 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 0,17 | 0,17 | 0,17 | 97 | **-90,7** | ULS 8 Ba_Bouwfase | 375,3 | 271,1 | 352,8 | 0,38 | | **93,7** | ULS 8 Ba_Bouwfase | 378,9 | 271,1 | 329,6 | 0,35 | |
| 400 | Horizontal lower ca. | EA | 160x160x15 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 71 | **-274,4** | ULS 5a Ah 10 | 934,9 | 1039,2 | 2116,8 | 0,29 | | **57,5** | ULS 5a Ba 21 | 916,5 | 1039,2 | 1970,1 | 0,06 | |
| 401 | Lower chord lower ca. | EA | 160x160x15 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 2,27 | 1,00 | 1,00 | 76 | **-349,0** | ULS 5a Ah 21 | 891,7 | 1039,2 | 2116,8 | 0,39 | | **131,2** | ULS 5a Ba 10 | 916,5 | 1039,2 | 1970,1 | 0,14 | |
| 402 | Lower chord lower ca. | EA | 160x160x15 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 3,38 | 3,38 | 1,00 | 82 | **-311,8** | ULS 5a Ah 21 | 834,9 | 0,0 | 0,0 | 0,37 | | **101,9** | ULS 5a Ba 10 | 1372,7 | 813,3 | 1492,6 | 0,13 | |
| 403 | Lower chord lower ca. | EA | 150x150x12 | S355 | 6M24-8,8t | 1 | 55 | 40 | 80 | 2,39 | 1,00 | 1,00 | 89 | **-239,7** | ULS 5a Ah 21 | 582,9 | 813,3 | 1270,1 | 0,41 | | **118,9** | ULS 5a Ba 10 | 1007,6 | 813,3 | 1194,1 | 0,15 | |
| 404 | Lower chord lower ca. | EA | 150x150x12 | S355 | | | | | | 3,82 | 3,82 | 1,00 | 86 | **-168,5** | ULS 5a Ah 21 | 600,0 | 0,0 | 0,0 | 0,28 | | **70,2** | ULS 5a Ba 10 | 1235,4 | 0,0 | 0,0 | 0,06 | |
| 410 | Horizontal lower ca. | EA | 100x100x8 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 114 | **-52,8** | ULS 8 Ba_Bouwfase | 199,3 | 271,1 | 282,2 | 0,27 | | **76,7** | ULS 5a Ba 21 | 246,8 | 271,1 | 263,7 | 0,31 | |
| 411 | Beam lower ca. | HEB | HEB160 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 2,00 | 1,00 | 1,00 | 36 | **-11,2** | ULS 1a_0,9_0,9_90 | 1385,6 | 188,2 | 235,2 | 0,06 | | **16,8** | ULS 1a_90 | 959,1 | 188,2 | 213,8 | 0,09 | |
| 412 | Beam lower ca. | HEB | HEB160 | S355 | | | | | | 1,00 | 1,00 | 1,00 | 30 | **-11,1** | ULS 1a_90 | 1390,1 | 0,0 | 0,0 | 0,01 | | **10,9** | ULS 1a_90 | 1927,7 | 0,0 | 0,0 | 0,01 | |
| 413 | Beam lower ca. | HEB | HEB160 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 1,00 | 1,00 | 29 | **0,0** | | 1493,8 | 188,2 | 235,2 | 0,00 | | **14,3** | ULS 3_90 | 959,1 | 188,2 | 213,8 | 0,08 | |
| 414 | Beam lower ca. | HEB | HEB160 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 2,00 | 2,00 | 2,00 | 25 | **-26,7** | ULS 5a Ba 10 | 1530,7 | 188,2 | 235,2 | 0,14 | | **33,0** | ULS 5a Ah 10 | 959,1 | 188,2 | 213,8 | 0,18 | |
| 425 | Upper chord lower ca. | EA | 120x120x10 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 167 | **-17,5** | ULS 8 Ba_Bouwfase | 193,0 | 406,7 | 529,2 | 0,09 | | **201,5** | ULS 3_90 | 441,0 | 406,7 | 493,6 | 0,50 | |
| 426 | Upper chord lower ca. | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 177 | **-12,6** | ULS 8 Ba_Bouwfase | 177,6 | 542,2 | 705,6 | 0,07 | | **149,3** | ULS 3_90 | 635,0 | 542,2 | 663,4 | 0,28 | |
| 427 | Upper chord lower ca. | EA | 120x120x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 178 | **-9,8** | ULS 8 Ba_Bouwfase | 175,1 | 542,2 | 705,6 | 0,06 | | **134,6** | ULS 3_90 | 635,0 | 542,2 | 663,4 | 0,25 | |
| 428 | Upper chord lower ca. | EA | 120x120x10 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 3,54 | 3,54 | 3,54 | 172 | **-9,7** | ULS 8 Ba_Bouwfase | 184,1 | 0,0 | 0,0 | 0,05 | | **134,1** | ULS 3_90 | 441,0 | 406,7 | 493,6 | 0,33 | |
| 429 | Stabiltity bracing lower ca. | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 0,56 | 0,56 | 0,56 | 232 | **-2,8** | ULS 5a Ah 22 | 31,5 | 60,3 | 70,6 | 0,09 | | **4,2** | ULS 5a Ah 22 | 98,8 | 60,3 | 61,0 | 0,07 | |
| 430 | Stabiltity bracing lower ca. | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | | 1,00 | 1,00 | 1,00 | 225 | **-0,4** | ULS 8 Ba_Bouwfase | 20,4 | 60,3 | 58,8 | 0,02 | | **0,6** | ULS 7_Bouwfase | 62,7 | 60,3 | 44,5 | 0,01 | |
| 431 | Hand rail | EA | 70x70x7 | S355 | 1M16-8,8t | 1 | 35 | 35 | | 1,00 | 1,00 | 1,00 | 238 | **-0,4** | ULS 1a_0,9_0,9_135 | 36,4 | 60,3 | 82,3 | 0,01 | | **1,3** | ULS 1a_45 | 142,7 | 60,3 | 71,1 | 0,02 | |
| 432 | Hand rail | UA | 100x50x6 | S355 | 2M16-8,8t | 1 | 35 | 25 | 55 | 1,00 | 1,00 | 1,00 | 84 | **-0,2** | ULS 1a_90 | 156,1 | 120,6 | 141,1 | 0,00 | | **0,0** | ULS 1a_0,9_270_Bouwfase | 84,5 | 120,6 | 106,8 | 0,00 | |
| 433 | Hand rail | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 1,00 | 1,00 | 1,00 | 92 | **-2,3** | ULS 1a_0 | 94,3 | 60,3 | 70,6 | 0,04 | | **0,2** | ULS 8 Ba_Bouwfase | 98,8 | 60,3 | 61,0 | 0,00 | |
| 440 | Vertical side face lower ca. | EA | 80x80x6 | S355 | 1M20-8,8t | 1 | 45 | 40 | | 1,00 | 0,67 | 0,67 | 128 | **-26,6** | ULS 3_0 | 73,7 | 94,1 | 88,2 | 0,36 | | **1,2** | ULS 8 Ba_Bouwfase | 136,4 | 94,1 | 80,2 | 0,02 | |
| 441 | Vertical side face lower ca. | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 1,00 | 1,00 | 1,00 | 173 | **-6,1** | ULS 1a_0 | 43,6 | 60,3 | 70,6 | 0,14 | | **0,8** | ULS 8 Ba_Bouwfase | 98,8 | 60,3 | 61,0 | 0,01 | |
| 442 | Vertical side face lower ca. | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | | 1,00 | 1,00 | 1,00 | 102 | **-3,7** | ULS 1a_45 | 59,0 | 60,3 | 58,8 | 0,06 | | **0,0** | ULS 8 Ba_Bouwfase | 62,7 | 60,3 | 44,5 | 0,00 | |
| 460 | Diag side face lower ca. | EA | 100x100x8 | S355 | 2M20-8,8t | 1 | 45 | 40 | 70 | 1,00 | 0,38 | 0,38 | 181 | **-0,4** | ULS 8 Ba_Bouwfase | 109,9 | 188,2 | 235,2 | 0,00 | | **42,5** | ULS 3_45 | 259,5 | 188,2 | 213,8 | 0,23 | |
| 461 | Diag side face lower ca. | EA | 100x100x8 | S355 | 2M20-8,8t | 1 | 45 | 40 | 70 | 1,00 | 0,67 | 0,67 | 173 | **-3,1** | ULS 8 Ba_Bouwfase | 122,5 | 188,2 | 235,2 | 0,03 | | **62,9** | ULS 3_0 | 259,5 | 188,2 | 213,8 | 0,33 | |
| 462 | Diag side face lower ca. | EA | 90x90x8 | S355 | 1M20-8,8t | 1 | 45 | 40 | | 1,00 | 0,51 | 0,51 | 166 | **-0,4** | ULS 8 Ba_Bouwfase | 75,6 | 94,1 | 117,6 | 0,01 | | **21,1** | ULS 1a_0 | 181,9 | 94,1 | 106,9 | 0,22 | |
| 463 | Stabiltity bracing lower ca. | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | | 1,00 | 0,52 | 0,52 | 199 | **-3,1** | ULS 1a_0 | 33,5 | 60,3 | 58,8 | 0,09 | | **1,4** | ULS 1a_0,9_0,9_0 | 62,7 | 60,3 | 44,5 | 0,03 | |
| 464 | Stabiltity bracing lower ca. | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | | 0,51 | 0,51 | 0,51 | 99 | **-1,8** | ULS 1a_0,9_0,9_0 | 68,7 | 60,3 | 58,8 | 0,03 | | **1,8** | ULS 1a_0,9_0,9_0 | 62,7 | 60,3 | 44,5 | 0,04 | |
| 475 | Diag lower plane lower ca. | EA | 70x70x7 | S355 | 1M20-8,8t | 1 | 45 | 35 | | 0,52 | 0,52 | 0,52 | 143 | **-19,3** | ULS 5a Ba 20 | 86,7 | 94,1 | 102,9 | 0,22 | | **23,5** | ULS 5a Ah 11_Bouwfase | 131,7 | 94,1 | 93,5 | 0,25 | |
| 476 | Diag lower plane lower ca. | EA | 70x70x7 | S355 | 1M20-8,8t | 1 | 45 | 35 | | 0,53 | 0,53 | 0,53 | 137 | **-26,1** | ULS 5a Ah 11_Bouwfase | 92,0 | 94,1 | 102,9 | 0,28 | | **23,0** | ULS 5a Ba 20 | 131,7 | 94,1 | 93,5 | 0,25 | |
| 477 | Diag lower plane lower ca. | EA | 70x70x7 | S355 | 1M20-8,8t | 1 | 45 | 35 | | 0,53 | 0,53 | 0,53 | 128 | **-25,5** | ULS 5a Ba 20 | 100,2 | 94,1 | 102,9 | 0,27 | | **28,4** | ULS 5a Ah 11_Bouwfase | 131,7 | 94,1 | 93,5 | 0,30 | |
| 478 | Diag lower plane lower ca. | EA | 70x70x7 | S355 | 1M20-8,8t | 1 | 45 | 35 | | 0,53 | 0,53 | 0,53 | 119 | **-31,1** | ULS 5a Ah 11_Bouwfase | 109,2 | 94,1 | 102,9 | 0,33 | | **27,4** | ULS 5a Ba 20 | 131,7 | 94,1 | 93,5 | 0,29 | |
| 479 | Diag lower plane lower ca. | EA | 70x70x7 | S355 | 1M20-8,8t | 1 | 45 | 35 | | 1,00 | 1,00 | 1,00 | 126 | **-31,5** | ULS 5a Ah 11_Bouwfase | 90,6 | 94,1 | 102,9 | 0,35 | | **26,7** | ULS 5a Ba 20 | 131,7 | 94,1 | 93,5 | 0,29 | |
| 480 | Diag lower plane lower ca. | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 0,54 | 0,54 | 0,54 | 126 | **-17,4** | ULS 5a Ah 21 | 75,1 | 60,3 | 70,6 | 0,29 | | **16,6** | ULS 5a Ba 21 | 98,8 | 60,3 | 61,0 | 0,28 | |
| 481 | Diag lower plane lower ca. | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 0,54 | 0,54 | 0,54 | 116 | **-21,3** | ULS 5a Ah 21 | 82,6 | 60,3 | 70,6 | 0,35 | | **21,2** | ULS 5a Ba 10 | 98,8 | 60,3 | 61,0 | 0,35 | |
| 482 | Diag lower plane lower ca. | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 0,55 | 0,55 | 0,55 | 110 | **-26,3** | ULS 5a Ba 21 | 88,6 | 60,3 | 70,6 | 0,44 | | **27,6** | ULS 5a Ah 21 | 98,8 | 60,3 | 61,0 | 0,46 | |
| 483 | Diag lower plane lower ca. | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 0,56 | 0,56 | 0,56 | 103 | **-38,5** | ULS 5a Ah 10 | 94,6 | 60,3 | 70,6 | 0,64 | | **34,8** | ULS 5a Ba 10 | 98,8 | 60,3 | 61,0 | 0,58 | |
| 484 | Diag lower plane lower ca. | EA | 60x60x6 | S355 | 1M16-8,8t | 1 | 35 | 30 | | 0,55 | 0,55 | 0,55 | 76 | **-42,0** | ULS 5a Ah 21 | 124,7 | 60,3 | 70,6 | 0,70 | | **32,6** | ULS 5a Ba 21 | 98,8 | 60,3 | 61,0 | 0,54 | |
| 498 | Plan bracing lower ca. | EA | 90x90x8 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,00 | 1,00 | 141 | **-76,9** | ULS 5a Ba 21 | 146,1 | 271,1 | 282,2 | 0,53 | | **78,1** | ULS 5a Ah 10 | 217,4 | 271,1 | 263,7 | 0,36 | |
| 499 | Plan bracing lower ca. | DEA | 80x80x6 (not coupled) | S355 | 1M20-8,8t | 1 | 45 | 40 | | 1,00 | 1,00 | 1,00 | 220 | **-1,9** | ULS 3_90 | 82,5 | 94,1 | 88,2 | 0,02 | | **0,0** | | 136,4 | 94,1 | 80,2 | 0,00 | |
| 500 | Horizontal top ca. | EA | 150x150x14 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 66 | **-319,9** | ULS 8 Ah | 850,7 | 1039,2 | 1975,7 | 0,38 | | **112,3** | ULS 8 Ba_Bouwfase | 781,4 | 1039,2 | 1838,8 | 0,14 | |
| 501 | Lower chord top ca. | EA | 150x150x12 | S355 | 8M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 76 | **-250,1** | ULS 5a Ah 12 | 661,4 | 1039,2 | 1693,4 | 0,38 | | **96,0** | ULS 5a Ba 22 | 678,2 | 1039,2 | 1576,1 | 0,14 | |
| 502 | Lower chord top ca. | EA | 150x150x12 | S355 | | | | | | 1,00 | 2,00 | 1,00 | 76 | **-210,3** | ULS 3_45 | 661,4 | 0,0 | 0,0 | 0,32 | | **54,2** | ULS 5a Ba 22 | 1235,4 | 0,0 | 0,0 | 0,04 | |
| 503 | Lower chord top ca. | EA | 150x150x12 | S355 | | | | | | 1,00 | 1,32 | 1,00 | 64 | **-207,8** | ULS 3_45 | 785,8 | 0,0 | 0,0 | 0,26 | | **1,8** | ULS 8 Ba_Bouwfase | 1235,4 | 0,0 | 0,0 | 0,00 | |
| 504 | Lower chord top ca. | EA | 150x150x12 | S355 | | | | | | 1,93 | 1,93 | 1,00 | 54 | **-199,0** | ULS 3_45 | 818,9 | 0,0 | 0,0 | 0,24 | | **1,7** | ULS 8 Ba_Bouwfase | 1235,4 | 0,0 | 0,0 | 0,00 | |
| 505 | Earth peak lower chord | EA | 80x80x8 | S355 | 2M20-8,8t | 1 | 45 | 40 | 70 | 1,76 | 1,00 | 1,00 | 134 | **-40,7** | ULS 3_90 | 130,6 | 188,2 | 235,2 | 0,31 | | **0,5** | ULS 8 Ba_Bouwfase | 199,1 | 188,2 | 213,8 | 0,00 | |
| 506 | Earth peak lower chord | EA | 80x80x8 | S355 | 2M20-8,8t | 1 | 45 | 40 | 70 | 1,18 | 1,00 | 1,00 | 158 | **-37,7** | ULS 3_90 | 110,3 | 188,2 | 235,2 | 0,34 | | **1,4** | ULS 5a Ah 22 | 436,7 | 0,0 | 0,0 | 0,00 | |
| 510 | Horizontal top ca. | EA | 100x100x8 | S355 | 2M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 2,00 | 1,00 | 98 | **-54,4** | ULS 8 Ba_Bouwfase | 235,4 | 271,1 | 282,2 | 0,23 | | **60,6** | ULS 8 Ba_Bouwfase | 246,8 | 271,1 | 263,7 | 0,25 | |
| 511 | Beam top ca. | HEB | HEB160 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 1,00 | 1,00 | 1,00 | 41 | **0,0** | ULS 8 Ba_Bouwfase | 1393,3 | 188,2 | 235,2 | 0,00 | | **17,1** | ULS 3_90 | 959,1 | 188,2 | 213,8 | 0,09 | |
| 512 | Beam top ca. | HEB | HEB160 | S355 | 2M20-8,8t | 1 | 45 | 35 | 70 | 2,00 | 2,00 | 2,00 | 37 | **-26,1** | ULS 5a Ba 22 | 1426,1 | 188,2 | 235,2 | 0,14 | | **34,2** | ULS 5a Ah 12 | 959,1 | 188,2 | 213,8 | 0,18 | |
| 513 | Earth peak horizontal | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | | 1,00 | 1,00 | 1,00 | 135 | **-2,7** | ULS 1a_135 | 42,5 | 60,3 | 58,8 | 0,06 | | **2,8** | ULS 1a_0,9_0,9_0 | 62,7 | 60,3 | 44,5 | 0,06 | |
| 514 | Earth peak horizontal | EA | 50x50x5 | S355 | 1M16-8,8t | 1 | 35 | 25 | | 1,00 | 1,00 | 1,00 | 114 | **-2,3** | ULS 5a Ba 22 | 52,3 | 60,3 | 58,8 | 0,04 | | **2,3** | ULS 5a Ah 22 | 62,7 | 60,3 | 44,5 | 0,05 | |
| 525 | Upper chord top ca. | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,98 | 1,00 | 1,00 | 189 | **-1,2** | ULS 8 Ba_Bouwfase | 199,8 | 406,7 | 635,0 | 0,01 | | **210,5** | ULS 3_90 | 575,5 | 406,7 | 592,3 | 0,52 | |
| 526 | Upper chord top ca. | EA | 130x130x12 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 2,02 | 1,00 | 1,00 | 189 | **-1,3** | ULS 8 Ba_Bouwfase | 199,8 | 406,7 | 635,0 | 0,01 | | **210,7** | ULS 3_90 | 575,5 | 406,7 | 592,3 | 0,52 | |
| 527 | Upper chord top ca. | EA | 120x120x10 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 2,00 | 1,00 | 1,00 | 143 | **-1,3** | ULS 8 Ba_Bouwfase | 226,1 | 406,7 | 529,2 | 0,01 | | **196,8** | ULS 3_90 | 441,0 | 406,7 | 493,6 | 0,48 | |
| 528 | Upper chord top ca. | EA | 120x120x10 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 2,00 | 1,00 | 1,00 | 143 | **-1,3** | ULS 8 Ba_Bouwfase | 226,0 | 406,7 | 529,2 | 0,01 | | **183,9** | ULS 3_90 | 441,0 | 406,7 | 493,6 | 0,45 | |
| 530 | Earth peak upper chord | EA | 100x100x10 | S355 | 3M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,50 | 1,00 | 123 | **-132,9** | ULS 8 Ba | 236,3 | 406,7 | 529,2 | 0,56 | | **127,9** | ULS 8 Ba_Bouwfase | 355,4 | 406,7 | 493,6 | 0,36 | |
| 531 | Earth peak upper chord | EA | 100x100x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 3,00 | 2,00 | 1,00 | 119 | **-117,7** | ULS 8 Ba | 236,3 | 0,0 | 0,0 | 0,50 | | **118,3** | ULS 8 Ba_Bouwfase | 493,9 | 542,2 | 663,4 | 0,24 | |
| 532 | Earth peak upper chord | EA | 100x100x10 | S355 | 4M24-8,8t | 1 | 55 | 40 | 80 | 1,00 | 1,50 | 1,00 | 88 | **-97,5** | ULS 8 Ba_Bouwfase | 335,9 | 542,2 | 705,6 | 0,29 | | **118,1** | ULS 8 Ba | 493,9 | 542,2 | 663,4 | 0,24 | |
| 533 | Earth peak upper chord | EA | 100x100x10 | S355 | | | | | | 1,00 | 3,00 | 1,00 | 169 | **-77,6** | ULS 8 Ba_Bouwfase | 149,8 | 0,0 | 0,0 | 0,52 | | **109,1** | ULS 8 Ba | 681,6 | 0,0 | 0,0 | 0,16 | |
| 534 | Earth peak upper chord | EA | 100x100x10 | S355 | | | | | | 1,00 | 1,50 | 1,00 | 88 | **-62,0** | ULS 8 Ba_Bouwfase | 335,1 | 0,0 | 0,0 | 0,19 | | **80,1** | ULS 8 Ba | 681,6 | 0,0 | 0,0 | 0,12 | |

## Assessment of angle groups

Date 15-7-2021
Author JSN
Version 1.0

**GT-RLL**
**S+32/n**

| Group Label | Description | Type | Profile | Steel Quality | Bolts | #sh.planes | e1 | e2 | p1 | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S35 | Earth peak upper chord | EA | 100x100x10 | S355 | | | | | | 2.68 | 2.00 | 1.00 | 76 | **-40.8** | ULS 8 Ba_Bouwfase | 368.0 | 0.0 | 0.0 | 0.11 | | **59.3** | ULS 8 Ba | 681.6 | 0.0 | 0.0 | 0.09 | |
| S36 | Earth peak upper chord | EA | 100x100x10 | S355 | 2M16-8.8t | 1 | 35 | 25 | 55 | 6.20 | 1.00 | 1.00 | 56 | **-21.6** | ULS 8 Ah | 443.4 | 120.6 | 235.2 | 0.18 | | **19.1** | ULS 8 Ba_Bouwfase | 318.3 | 120.6 | 178.0 | 0.16 | |
| S37 | Stability bracing top ca. | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 216 | **-2.5** | ULS 3_90 | 21.7 | 60.3 | 58.8 | 0.12 | | **0.3** | ULS 1a_0_0_0_90 | 62.7 | 60.3 | 44.5 | 0.01 | |
| S38 | Earth peak beam | HEB | HEB160 | S355 | 2M16-8.8t | 1 | 35 | 25 | 55 | 2.00 | 2.00 | 2.00 | 20 | **-11.8** | ULS 8 Ah | 1567.5 | 120.6 | 188.2 | 0.10 | | **11.3** | ULS 8 Ba_Bouwfase | 940.6 | 120.6 | 142.4 | 0.09 | |
| S40 | Vertical side face top ca. | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 205 | **-2.0** | ULS 3_90 | 23.5 | 60.3 | 58.8 | 0.08 | | **2.4** | ULS 3_135 | 62.7 | 60.3 | 44.5 | 0.05 | |
| S41 | Vertical side face top ca. | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 170 | **0.0** | ULS 8 Ba_Bouwfase | 31.0 | 60.3 | 58.8 | 0.00 | | **7.2** | ULS 7 | 62.7 | 60.3 | 44.5 | 0.16 | |
| S42 | Vertical side face top ca. | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 146 | **-2.8** | ULS 3_90 | 38.5 | 60.3 | 58.8 | 0.07 | | **3.6** | ULS 3_0 | 62.7 | 60.3 | 44.5 | 0.08 | |
| S43 | Vertical side face top ca. | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.65 | 0.65 | 188 | **-3.4** | ULS 1a_90_Bouwfase | 22.3 | 60.3 | 58.8 | 0.15 | | **0.6** | ULS 8 Ba_Bouwfase | 62.7 | 60.3 | 44.5 | 0.01 | |
| S44 | Vertical side face top ca. | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 137 | **-2.1** | ULS 7_Bouwfase | 41.6 | 60.3 | 58.8 | 0.05 | | **0.6** | ULS 8 Ba_Bouwfase | 62.7 | 60.3 | 44.5 | 0.01 | |
| S60 | Diag side face top ca. | EA | 80x80x6 | S355 | 1M16-8.8t | 1 | 35 | 40 | | 1.00 | 1.00 | 1.00 | 227 | **-14.6** | ULS 3_135 | 39.3 | 60.3 | 70.6 | 0.37 | | **0.0** | | 145.8 | 60.3 | 61.0 | 0.00 | |
| S61 | Diag side face top ca. | EA | 80x80x6 | S355 | 1M16-8.8t | 1 | 35 | 40 | | 1.00 | 1.00 | 1.00 | 165 | **-13.6** | ULS 3_0 | 63.2 | 60.3 | 70.6 | 0.23 | | **0.1** | ULS 8 Ba_Bouwfase | 145.8 | 60.3 | 61.0 | 0.00 | |
| S62 | Earth peak diag side face | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 0.60 | 0.60 | 173 | **-0.7** | ULS 8 Ba_Bouwfase | 24.8 | 60.3 | 58.8 | 0.03 | | **4.3** | ULS 1a_270_Bouwfase | 62.7 | 60.3 | 44.5 | 0.10 | |
| S75 | Diag lower plane top ca. | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.52 | 0.52 | 0.52 | 150 | **-16.2** | ULS 5a Ba 22 | 59.7 | 60.3 | 70.6 | 0.27 | | **15.6** | ULS 5a Ah 12 | 96.8 | 60.3 | 61.0 | 0.26 | |
| S76 | Diag lower plane top ca. | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.53 | 0.53 | 0.53 | 145 | **-19.1** | ULS 5a Ah 12 | 62.7 | 60.3 | 70.6 | 0.32 | | **19.4** | ULS 5a Ba 22 | 98.8 | 60.3 | 61.0 | 0.32 | |
| S77 | Diag lower plane top ca. | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.53 | 0.53 | 0.53 | 137 | **-21.1** | ULS 5a Ba 22 | 67.7 | 60.3 | 70.6 | 0.35 | | **21.2** | ULS 5a Ah 12 | 98.8 | 60.3 | 61.0 | 0.35 | |
| S78 | Diag lower plane top ca. | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.53 | 0.53 | 0.53 | 129 | **-24.6** | ULS 5a Ah 12 | 73.0 | 60.3 | 70.6 | 0.41 | | **23.6** | ULS 5a Ba 22 | 98.8 | 60.3 | 61.0 | 0.39 | |
| S79 | Diag lower plane top ca. | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.53 | 0.53 | 0.53 | 125 | **-27.8** | ULS 5a Ba 22 | 75.7 | 60.3 | 70.6 | 0.46 | | **30.1** | ULS 5a Ah 12 | 98.8 | 60.3 | 61.0 | 0.50 | |
| S80 | Diag lower plane top ca. | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.54 | 0.54 | 0.54 | 120 | **-37.2** | ULS 5a Ah 12 | 79.7 | 60.3 | 70.6 | 0.62 | | **32.9** | ULS 5a Ba 22 | 98.8 | 60.3 | 61.0 | 0.55 | |
| S81 | Diag lower plane top ca. | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.53 | 0.53 | 0.53 | 90 | **-38.9** | ULS 5a Ah 12 | 108.2 | 60.3 | 70.6 | 0.61 | | **26.8** | ULS 5a Ba 22 | 98.8 | 60.3 | 61.0 | 0.45 | |
| S82 | Earth peak diag lower plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 240 | **-6.7** | ULS 1a_0 | 18.4 | 60.3 | 58.8 | 0.37 | | **5.7** | ULS 1a_135 | 62.7 | 60.3 | 44.5 | 0.13 | |
| S83 | Earth peak diag lower plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 1.00 | 1.00 | 1.00 | 228 | **-7.7** | ULS 5a Ah 22 | 20.0 | 60.3 | 58.8 | 0.39 | | **7.6** | ULS 5a Ba 22 | 62.7 | 60.3 | 44.5 | 0.17 | |
| S85 | Earth peak diag upper plane | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.53 | 0.53 | 0.53 | 169 | **-9.8** | ULS 1a_0_9_0_9_0 | 50.7 | 60.3 | 70.6 | 0.19 | | **9.9** | ULS 1a_0 | 98.8 | 60.3 | 61.0 | 0.16 | |
| S86 | Earth peak diag upper plane | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.53 | 0.53 | 0.53 | 159 | **-9.7** | ULS 1a_0 | 55.4 | 60.3 | 70.6 | 0.18 | | **9.5** | ULS 1a_0_9_0_9_0 | 98.8 | 60.3 | 61.0 | 0.16 | |
| S87 | Earth peak diag upper plane | EA | 60x60x6 | S355 | 1M16-8.8t | 1 | 35 | 30 | | 0.54 | 0.54 | 0.54 | 152 | **-9.4** | ULS 1a_0_9_0_9_0 | 58.9 | 60.3 | 70.6 | 0.16 | | **9.7** | ULS 1a_0 | 98.8 | 60.3 | 61.0 | 0.16 | |
| S88 | Earth peak diag upper plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.53 | 0.53 | 0.53 | 143 | **-7.5** | ULS 1a_0 | 44.4 | 60.3 | 58.8 | 0.17 | | **7.4** | ULS 1a_0 | 62.7 | 60.3 | 44.5 | 0.17 | |
| S89 | Earth peak diag upper plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.54 | 0.54 | 0.54 | 137 | **-7.2** | ULS 8 Ba | 47.0 | 60.3 | 58.8 | 0.15 | | **7.0** | ULS 8 Ba_Bouwfase | 62.7 | 60.3 | 44.5 | 0.16 | |
| S90 | Earth peak diag upper plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.54 | 0.54 | 0.54 | 129 | **-8.6** | ULS 8 Ba_Bouwfase | 51.0 | 60.3 | 58.8 | 0.17 | | **8.6** | ULS 8 Ba | 62.7 | 60.3 | 44.5 | 0.19 | |
| S91 | Earth peak diag upper plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.55 | 0.55 | 0.55 | 123 | **-10.9** | ULS 8 Ba | 53.7 | 60.3 | 58.8 | 0.20 | | **10.9** | ULS 8 Ba_Bouwfase | 62.7 | 60.3 | 44.5 | 0.25 | |
| S92 | Earth peak diag upper plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.55 | 0.55 | 0.55 | 116 | **-14.9** | ULS 8 Ba | 57.7 | 60.3 | 58.8 | 0.26 | | **14.5** | ULS 8 Ba_Bouwfase | 62.7 | 60.3 | 44.5 | 0.33 | |
| S93 | Earth peak diag upper plane | EA | 50x50x5 | S355 | 1M16-8.8t | 1 | 35 | 25 | | 0.56 | 0.56 | 0.56 | 112 | **-20.5** | ULS 8 Ba_Bouwfase | 60.2 | 60.3 | 58.8 | 0.35 | | **21.2** | ULS 8 Ba | 62.7 | 60.3 | 44.5 | 0.48 | |
| S98 | Plan bracing top ca. | EA | 90x90x8 | S355 | 2M24-8.8t | 1 | 55 | 40 | 80 | 1.00 | 1.00 | 1.00 | 121 | **-62.3** | ULS 8 Ba_Bouwfase | 177.5 | 271.1 | 282.2 | 0.35 | | **62.3** | ULS 8 Ba_Bouwfase | 217.4 | 271.1 | 263.7 | 0.29 | |
| S99 | Plan bracing top ca. | DEA | 80x80x6 (not coupled) | S355 | 1M20-8.8t | 1 | 45 | 40 | | 1.00 | 1.00 | 1.00 | 189 | **-0.5** | ULS 3_0 | 104.4 | 94.1 | 88.2 | 0.01 | | **0.0** | | 136.4 | 94.1 | 80.2 | 0.00 | |
| 700 | Hor. plan bracing hip structure | EA | 110x110x10 | S355 | 2M20-8.8t | 1 | 45 | 40 | 70 | 1.00 | 1.00 | 1.00 | 249 | **-19.0** | ULS 1a_0_9_0_9_135 | 95.4 | 188.2 | 294.0 | 0.20 | | **8.8** | ULS 1a_0_9_135 | 357.3 | 188.2 | 267.3 | 0.05 | |
| 701 | Hor. plan bracing hip structure | EA | 100x100x8 | S355 | 1M20-8.8t | 1 | 45 | 40 | | 1.00 | 0.50 | 0.50 | 248 | **-5.5** | ULS 1a_45 | 48.0 | 94.1 | 117.6 | 0.12 | | **7.2** | ULS 1a_0_9_135 | 181.9 | 94.1 | 106.9 | 0.08 | |
| 702 | Hor. plan bracing hip structure | DEA | 110x110x10 (not coupled) | S355 | 1M20-8.8t | 1 | 45 | 40 | | 0.50 | 0.50 | 0.50 | 249 | **-1.4** | ULS 7_Bouwfase | 171.7 | 94.1 | 147.0 | 0.01 | | **0.0** | | 227.4 | 94.1 | 133.6 | 0.00 | |
| 703 | 2nd plan bracing | EA | 130x130x12 | S355 | 3M24-8.8t | 1 | 55 | 40 | 80 | 1.00 | 1.00 | 1.00 | 157 | **-225.0** | ULS 1a_45 | 270.3 | 406.7 | 635.0 | 0.88 | | **172.6** | ULS 1a_0_9_0_9_135 | 575.5 | 406.7 | 592.3 | 0.42 | |
| 704 | 2nd plan bracing | EA | 120x120x10 | S355 | 1M20-8.8t | 1 | 45 | 40 | | 1.00 | 1.00 | 1.00 | 240 | **-11.2** | ULS 1a_45 | 89.0 | 94.1 | 147.0 | 0.13 | | **18.3** | ULS 1a_0_9_135 | 227.4 | 94.1 | 133.6 | 0.19 | |
| 705 | 2nd plan bracing | DEA | 80x80x6 (not coupled) | S355 | 1M20-8.8t | 1 | 45 | 40 | | 0.50 | 0.50 | 0.50 | 252 | **-0.9** | ULS 7_Bouwfase | 75.1 | 94.1 | 88.2 | 0.01 | | **0.0** | ULS 8 Ba_Bouwfase | 136.4 | 94.1 | 80.2 | 0.00 | |
| 706 | plan bracing | EA | 100x100x8 | S355 | 2M24-8.8t | 1 | 55 | 40 | 80 | 2.00 | 1.00 | 1.00 | 163 | **-7.9** | ULS 1a_0_9_45 | 126.6 | 271.1 | 282.2 | 0.06 | | **13.2** | ULS 1a_135 | 246.8 | 271.1 | 263.7 | 0.05 | |
| 707 | plan bracing | EA | 80x80x6 | S355 | 1M20-8.8t | 1 | 45 | 40 | | 1.00 | 1.00 | 1.00 | 222 | **-5.1** | ULS 1a_135 | 50.8 | 94.1 | 88.2 | 0.10 | | **10.4** | ULS 1a_135 | 136.4 | 94.1 | 80.2 | 0.13 | |
| 708 | plan bracing | DEA | 70x70x6 (not coupled) | S355 | 1M20-8.8t | 1 | 45 | 35 | | 0.50 | 0.50 | 0.50 | 182 | **0.0** | ULS 1a_90 | 106.3 | 94.1 | 88.2 | 0.00 | | **0.0** | ULS 1a_0_9_90 | 112.9 | 94.1 | 80.2 | 0.00 | |
| 710 | Horizontal top of lower ca. | EA | 120x120x12 | S355 | 4M24-8.8t | 1 | 55 | 40 | 80 | 1.00 | 1.00 | 1.00 | 142 | **0.0** | | 285.7 | 542.2 | 846.7 | 0.00 | | **236.6** | ULS 3_0 | 522.0 | 542.2 | 789.1 | 0.45 | |
| 711 | Horizontal top of lower ca. | EA | 100x100x8 | S355 | 2M24-8.8t | 1 | 55 | 40 | 80 | 1.00 | 1.00 | 1.00 | 170 | **-43.8** | ULS 1a_0_9_90 | 125.3 | 271.1 | 282.2 | 0.35 | | **48.0** | ULS 1a_90 | 246.8 | 271.1 | 263.7 | 0.19 | |
| 712 | Horizontal top of top ca. | EA | 130x130x12 | S355 | 3M24-8.8t | 1 | 55 | 40 | 80 | 1.00 | 1.00 | 1.00 | 112 | **0.0** | | 419.4 | 406.7 | 635.0 | 0.00 | | **199.4** | ULS 3_45 | 575.5 | 406.7 | 592.3 | 0.49 | |
| 713 | Horizontal top of top ca. | EA | 80x80x6 | S355 | 2M20-8.8t | 1 | 45 | 40 | 70 | 1.00 | 1.00 | 1.00 | 178 | **-11.9** | ULS 3_225_Bouwfase | 71.0 | 188.2 | 176.4 | 0.17 | | **9.0** | ULS 3_225_Bouwfase | 152.6 | 188.2 | 160.4 | 0.06 | |

# APPENDIX C
# Knikverkorters

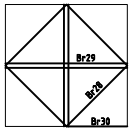
Niet in PLS-TOWER gemodelleerde elementen in de constructie worden aanvullend getoetst. Hieronder vallen de knikverkorters van de randstijl en profielen onderdeel van stabiliteitsverbanden. De staven worden getoetst op:

- voldoende trek- of druksterkte als steungevend profiel voor randstijl, 1% van de knikcapaciteit van de randstijl;
- slankheid;
- klimbelasting.

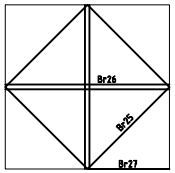
Profielen uit horizontaalverbanden van het onderstuk zijn in PLS-TOWER aanwezig maar worden in deze Appendix aanvullend getoetst op buiging. Profielafmeting en boutverbinding uit PLS-TOWER is leidend.

Overzicht knikverkorters - S+32_n

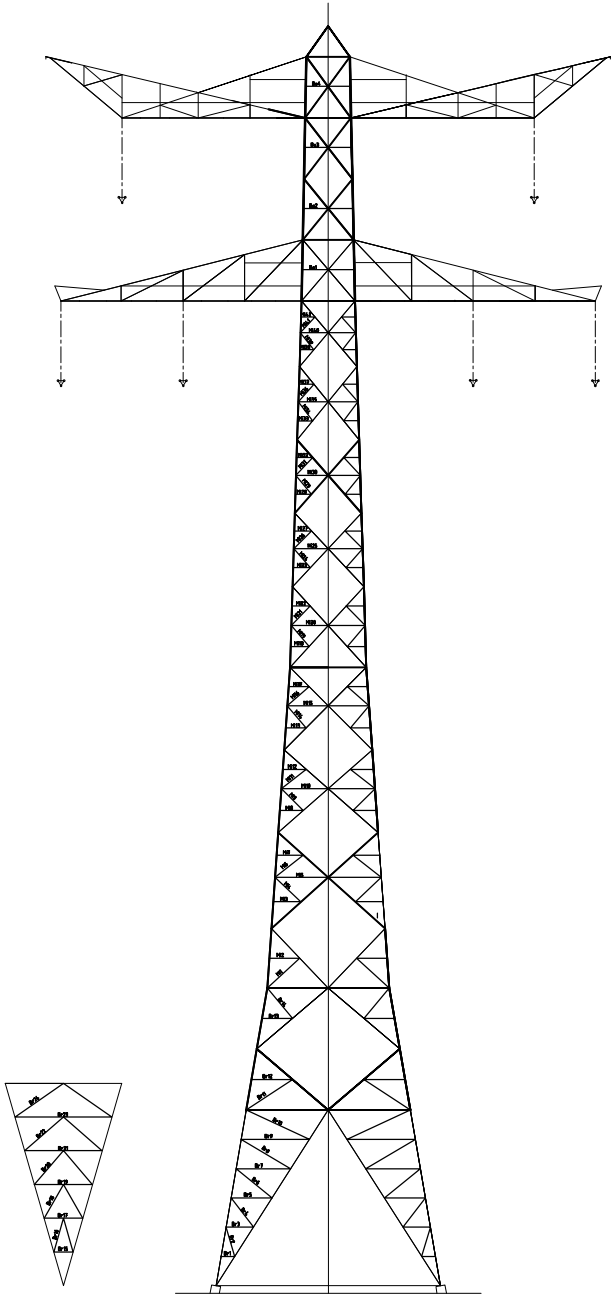
Tussenschot +41m




Tussenschot +20m




Tussenschot +12m



De ondervlakken van de traverses worden niet weergegeven omdat daar geen knikverkorters aanwezig zijn. Voor de beloopbaarheid worden de traverses voorzien van kruip ladders.

## Redundant members

Date: 2021-07-15
Author: JSN
Version: 1.9

GT-RLL
S+32_n

| 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. | Max. usage | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Br1 | Broekstuk | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 0.90 | 0 | 92 | **36.6** | **0.34** | 65.6 | 60.3 | 41.3 | 43.1 | 0.81 | 0.89 | Bearing | |
| Br2 | Broekstuk | Enkele staaf | L60x6 | S355J0 | M16 | 8.8 | 2.00 | 73 | 171 | **36.6** | **0.00** | 44.3 | 60.3 | 52.3 | 98.8 | 1.40 | 0.83 | Buckling | |
| Br3 | Broekstuk | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 1.79 | 0 | 167 | **36.6** | **0.67** | 41.8 | 60.3 | 51.5 | 75.3 | 1.15 | 0.88 | Buckling | |
| Br4 | Broekstuk | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.41 | 52 | 176 | **36.6** | **0.00** | 50.1 | 60.3 | 52.3 | 122.3 | 1.99 | 0.73 | Buckling | |
| Br5 | Broekstuk | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.69 | 0 | 196 | **36.6** | **1.01** | 42.7 | 60.3 | 52.3 | 122.3 | 1.99 | 0.86 | Buckling | |
| Br6 | Broekstuk | Enkele staaf | L70x7 | S355J0 | M16 | 8.8 | 3.04 | 39 | 223 | **36.6** | **0.00** | 40.5 | 60.3 | 61.0 | 142.7 | 2.23 | 0.90 | Buckling | |
| Br7 | Broekstuk | Enkele staaf | L80x6 | S355J0 | M16 | 8.8 | 3.58 | 0 | 228 | **36.6** | **1.34** | 38.9 | 60.3 | 52.3 | 145.8 | 2.68 | 0.94 | Buckling | |
| Br8 | Broekstuk | Enkele staaf | L80x8 | S355J0 | M16 | 8.8 | 3.78 | 30 | 242 | **36.6** | **1.23** | 46.4 | 60.3 | 69.7 | 194.4 | 3.33 | 0.79 | Buckling | |
| Br9 | Broekstuk | Enkele staaf | L100x8 | S355J0 | M16 | 8.8 | 4.48 | 0 | 227 | **36.6** | **1.68** | 64.7 | 60.3 | 69.7 | 257.2 | 5.49 | 0.61 | shear | |
| Br10 | Broekstuk | Enkele staaf | L100x8 | S355J0 | M16 | 8.8 | 4.57 | 24 | 232 | **36.6** | **1.57** | 62.6 | 60.3 | 69.7 | 257.2 | 5.49 | 0.61 | shear | |
| Br11 | Broekstuk | Enkele staaf | L80x6 | S355J0 | M16 | 8.8 | 3.63 | 33 | 231 | **36.3** | **0.00** | 38.1 | 60.3 | 52.3 | 145.8 | 2.68 | 0.95 | Buckling | |
| Br12 | Broekstuk | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.69 | 0 | 196 | **36.3** | **1.01** | 42.7 | 60.3 | 52.3 | 122.3 | 1.99 | 0.85 | Buckling | |
| Br13 | Broekstuk | Enkele staaf | L60x6 | S355J0 | M16 | 8.8 | 2.00 | 0 | 171 | **36.3** | **0.75** | 44.3 | 60.3 | 52.3 | 98.8 | 1.40 | 0.82 | Buckling | |
| Br14 | Broekstuk | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.60 | 50 | 189 | **36.3** | **0.00** | 44.9 | 60.3 | 52.3 | 122.3 | 1.99 | 0.81 | Buckling | |
| Br15 | Broekstuk | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.27 | 0 | 130 | **3.8** | **0.47** | 44.6 | 60.3 | 41.3 | 43.1 | 0.81 | 0.61 | Bending | |
| Br16 | Broekstuk | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 2.30 | 74 | 236 | **3.8** | **0.00** | 18.9 | 60.3 | 41.3 | 43.1 | 0.81 | 0.20 | Buckling | |
| Br17 | Broekstuk | Kniksteun op 0,5L | L50x5 | S355J0 | M16 | 8.8 | 2.53 | 0 | 167 | **3.8** | **0.95** | 25.9 | 60.3 | 41.3 | 43.1 | 1.08 | 0.88 | Bending | |
| Br18 | Broekstuk | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 2.55 | 60 | 238 | **3.8** | **0.00** | 24.5 | 60.3 | 51.5 | 75.3 | 1.15 | 0.15 | Buckling | |
| Br19 | Broekstuk | Kniksteun op 0,5L | L55x6 | S355J0 | M16 | 8.8 | 3.80 | 0 | 229 | **3.8** | **1.43** | 22.0 | 60.3 | 51.5 | 75.3 | 1.56 | 0.91 | Bending | |
| Br20 | Broekstuk | Enkele staaf | L60x6 | S355J0 | M16 | 8.8 | 2.91 | 49 | 249 | **3.8** | **0.00** | 24.9 | 60.3 | 52.3 | 98.8 | 1.40 | 0.15 | Buckling | |
| Br21 | Broekstuk | Kniksteun op 0,5L | L70x6 | S355J0 | M16 | 8.8 | 5.07 | 0 | 238 | **3.8** | **1.90** | 26.9 | 60.3 | 52.3 | 122.3 | 2.58 | 0.74 | Bending | |
| Br22 | Broekstuk | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 3.36 | 41 | 245 | **3.8** | **0.00** | 30.1 | 60.3 | 52.3 | 122.3 | 1.99 | 0.13 | Buckling | |
| Br23 | Broekstuk | Kniksteun op 0,5L | L90x8 | S355J0 | M16 | 8.8 | 6.33 | 0 | 231 | **3.8** | **2.38** | 47.9 | 60.3 | 69.7 | 225.8 | 5.70 | 0.42 | Bending | |
| Br24 | Broekstuk | Enkele staaf | L80x6 | S355J0 | M16 | 8.8 | 3.86 | 34 | 245 | **3.8** | **0.00** | 34.5 | 60.3 | 52.3 | 145.8 | 2.68 | 0.11 | Buckling | |
| Br25 | Tussenschot +12m | Kniksteun op 0,5L | L100x8 | S355J0 | M16 | 8.8 | 7.60 | 0 | 247 | **0.0** | **2.85** | 48.5 | 60.3 | 69.7 | 257.2 | 7.19 | 0.40 | Bending | 1 |
| Br26 | Tussenschot +12m | Kruisende staaf halverwege | L110x10 | S355J0 | M16 | 8.8 | 10.75 | 0 | 249 | **0.0** | **2.02** | 76.2 | 60.3 | 87.1 | 360.6 | 10.69 | 0.19 | Bending | 1 |
| Br27 | Tussenschot +12m | Enkele staaf | L110x10 | S355J0 | M16 | 8.8 | 5.37 | 0 | 249 | **0.0** | **2.02** | 76.2 | 60.3 | 87.1 | 360.6 | 8.0 | 0.26 | Bending | 1 |
| Br28 | Tussenschot +20m | Enkele staaf | L120x10 | S355J0 | M16 | 8.8 | 5.66 | 0 | 238 | **0.0** | **2.12** | 90.0 | 60.3 | 87.1 | 399.8 | 9.8 | 0.23 | Bending | 1 |
| Br29 | Tussenschot +20m | Kruisende staaf halverwege | L80x6 | S355J0 | M16 | 8.8 | 8.00 | 0 | 254 | **0.0** | **1.50** | 32.6 | 60.3 | 52.3 | 145.8 | 3.4 | 0.44 | Bending | 1, 2 |
| Br30 | Tussenschot +20m | Enkele staaf | L130x12 | S355J0 | M16 | 8.8 | 4.00 | 0 | 157 | **0.0** | **1.50** | 216.9 | 60.3 | 104.5 | 620.9 | 13.4 | 0.12 | Bending | 1 |
| Mi1 | Tussenstuk1 | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.90 | 42 | 211 | **36.7** | **0.00** | 38.1 | 60.3 | 52.3 | 122.3 | 2.0 | 0.96 | Buckling | |
| Mi2 | Tussenstuk1 | Enkele staaf | L60x6 | S355J0 | M16 | 8.8 | 2.00 | 0 | 171 | **36.7** | **0.75** | 44.3 | 60.3 | 52.3 | 98.8 | 1.4 | 0.83 | Buckling | |
| Mi3 | Tussenstuk1 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 1.80 | 0 | 168 | **37.7** | **0.68** | 41.5 | 60.3 | 51.5 | 75.3 | 1.2 | 0.91 | Buckling | |
| Mi4 | Tussenstuk1 | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.32 | 43 | 169 | **37.7** | **0.00** | 53.0 | 60.3 | 52.3 | 122.3 | 2.0 | 0.72 | Bearing | |
| Mi5 | Tussenstuk1 | Enkele staaf | L80x6 | S355J0 | M16 | 8.8 | 3.48 | 0 | 221 | **37.7** | **1.31** | 40.7 | 60.3 | 52.3 | 145.8 | 2.7 | 0.93 | Buckling | |
| Mi6 | Tussenstuk1 | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.36 | 38 | 172 | **37.7** | **0.00** | 51.7 | 60.3 | 52.3 | 122.3 | 2.0 | 0.73 | Buckling | |
| Mi7 | Tussenstuk1 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 1.74 | 0 | 162 | **37.7** | **0.65** | 43.6 | 60.3 | 51.5 | 75.3 | 1.2 | 0.87 | Buckling | |
| Mi8 | Tussenstuk1 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.53 | 0 | 158 | **29.3** | **0.57** | 34.6 | 60.3 | 41.3 | 43.1 | 0.8 | 0.85 | Buckling | |
| Mi9 | Tussenstuk1 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 2.03 | 45 | 189 | **29.3** | **0.00** | 34.9 | 60.3 | 51.5 | 75.3 | 1.2 | 0.84 | Buckling | |
| Mi10 | Tussenstuk1 | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 3.07 | 0 | 224 | **29.3** | **1.15** | 34.8 | 60.3 | 52.3 | 122.3 | 2.0 | 0.84 | Buckling | |
| Mi11 | Tussenstuk1 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 2.06 | 38 | 192 | **29.3** | **0.00** | 34.1 | 60.3 | 51.5 | 75.3 | 1.2 | 0.86 | Buckling | |
| Mi12 | Tussenstuk1 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.53 | 0 | 158 | **29.3** | **0.57** | 34.6 | 60.3 | 41.3 | 43.1 | 0.8 | 0.85 | Buckling | |
| Mi13 | Tussenstuk1 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.34 | 0 | 138 | **29.3** | **0.50** | 41.5 | 60.3 | 41.3 | 43.1 | 0.8 | 0.71 | Bearing | |
| Mi14 | Tussenstuk1 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 1.90 | 49 | 178 | **29.3** | **0.00** | 38.3 | 60.3 | 51.5 | 75.3 | 1.2 | 0.77 | Buckling | |
| Mi15 | Tussenstuk1 | Enkele staaf | L70x6 | S355J0 | M16 | 8.8 | 2.68 | 0 | 195 | **29.3** | **1.00** | 42.9 | 60.3 | 52.3 | 122.3 | 2.0 | 0.68 | Buckling | |
| Mi16 | Tussenstuk1 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 1.90 | 41 | 178 | **29.3** | **0.00** | 38.3 | 60.3 | 51.5 | 75.3 | 1.2 | 0.77 | Buckling | |
| Mi17 | Tussenstuk1 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.34 | 0 | 138 | **29.3** | **0.50** | 41.5 | 60.3 | 41.3 | 43.1 | 0.8 | 0.71 | Bearing | |

## Redundant members

Date: 2021-07-15
Author: JSN
Version: 1.9

GT-RLL
S+32_n

| 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. | Max. usage | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mi18 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.21 | 0 | 124 | **22.6** | **0.45** | 47.4 | 60.3 | 41.3 | 43.1 | 0.8 | 0.58 | Bending | |
| Mi19 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.80 | 49 | 185 | **22.6** | **0.00** | 27.5 | 60.3 | 41.3 | 43.1 | 0.8 | 0.82 | Buckling | |
| Mi20 | Tussenstuk2 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 2.41 | 0 | 225 | **22.6** | **0.90** | 26.7 | 60.3 | 51.5 | 75.3 | 1.2 | 0.85 | Buckling | |
| Mi21 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.79 | 45 | 184 | **22.6** | **0.00** | 27.8 | 60.3 | 41.3 | 43.1 | 0.8 | 0.81 | Buckling | |
| Mi22 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.21 | 0 | 124 | **22.6** | **0.45** | 47.4 | 60.3 | 41.3 | 43.1 | 0.8 | 0.58 | Bending | |
| Mi23 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.13 | 0 | 116 | **23.0** | **0.42** | 51.4 | 60.3 | 41.3 | 43.1 | 0.8 | 0.56 | Bearing | |
| Mi24 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.65 | 48 | 170 | **23.0** | **0.00** | 31.2 | 60.3 | 41.3 | 43.1 | 0.8 | 0.74 | Buckling | |
| Mi25 | Tussenstuk2 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 2.25 | 0 | 210 | **23.0** | **0.85** | 29.7 | 60.3 | 51.5 | 75.3 | 1.2 | 0.77 | Buckling | |
| Mi26 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.64 | 44 | 169 | **23.0** | **0.00** | 31.3 | 60.3 | 41.3 | 43.1 | 0.8 | 0.73 | Buckling | |
| Mi27 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.13 | 0 | 116 | **23.0** | **0.42** | 51.4 | 60.3 | 41.3 | 43.1 | 0.8 | 0.56 | Bearing | |
| Mi28 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.05 | 0 | 108 | **18.1** | **0.39** | 55.6 | 60.3 | 41.3 | 43.1 | 0.8 | 0.50 | Bending | |
| Mi29 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.60 | 50 | 165 | **18.1** | **0.00** | 32.5 | 60.3 | 41.3 | 43.1 | 0.8 | 0.56 | Buckling | |
| Mi30 | Tussenstuk2 | Enkele staaf | L55x6 | S355J0 | M16 | 8.8 | 2.11 | 0 | 197 | **18.1** | **0.79** | 33.0 | 60.3 | 51.5 | 75.3 | 1.2 | 0.71 | Bending | |
| Mi31 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.59 | 46 | 163 | **18.1** | **0.00** | 32.9 | 60.3 | 41.3 | 43.1 | 0.8 | 0.55 | Buckling | |
| Mi32 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.05 | 0 | 108 | **18.1** | **0.39** | 55.6 | 60.3 | 41.3 | 43.1 | 0.8 | 0.50 | Bending | |
| Mi33 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 0.98 | 0 | 100 | **18.1** | **0.37** | 60.2 | 60.3 | 41.3 | 43.1 | 0.8 | 0.47 | Bending | |
| Mi34 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.56 | 53 | 160 | **18.1** | **0.00** | 33.7 | 60.3 | 41.3 | 43.1 | 0.8 | 0.54 | Buckling | |
| Mi35 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.96 | 0 | 201 | **18.1** | **0.73** | 24.3 | 60.3 | 41.3 | 43.1 | 0.8 | 0.93 | Bending | |
| Mi36 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.54 | 48 | 158 | **18.1** | **0.00** | 34.5 | 60.3 | 41.3 | 43.1 | 0.8 | 0.52 | Buckling | |
| Mi37 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 0.98 | 0 | 100 | **18.1** | **0.37** | 60.2 | 60.3 | 41.3 | 43.1 | 0.8 | 0.47 | Bending | |
| Mi38 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 0.91 | 0 | 93 | **18.5** | **0.34** | 64.9 | 60.3 | 41.3 | 43.1 | 0.8 | 0.45 | Bearing | |
| Mi39 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.42 | 52 | 145 | **18.5** | **0.00** | 38.6 | 60.3 | 41.3 | 43.1 | 0.8 | 0.48 | Buckling | |
| Mi40 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.81 | 0 | 186 | **18.5** | **0.68** | 27.1 | 60.3 | 41.3 | 43.1 | 0.8 | 0.87 | Bending | |
| Mi41 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.40 | 47 | 144 | **18.5** | **0.00** | 39.3 | 60.3 | 41.3 | 43.1 | 0.8 | 0.47 | Buckling | |
| Mi42 | Tussenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 0.91 | 0 | 93 | **18.5** | **0.34** | 64.9 | 60.3 | 41.3 | 43.1 | 0.8 | 0.45 | Bearing | |
| Mi43 | Tussenschot +41m | Enkele staaf | L80x6 | S355J0 | M16 | 8.8 | 3.54 | 0 | 225 | **0.0** | **1.33** | 39.7 | 60.3 | 52.3 | 145.8 | 2.7 | 0.52 | Bending | 1 |
| Mi44 | Tussenschot +41m | Kruisende staaf halverwege | L70x6 | S355J0 | M16 | 8.8 | 5.00 | 0 | 182 | **0.0** | **0.94** | 47.5 | 60.3 | 52.3 | 122.3 | 2.6 | 0.36 | Bending | 1 |
| Mi45 | Tussenschot +41m | Kniksteun op 0,5L | L100x8 | S355J0 | M16 | 8.8 | 5.00 | 0 | 162 | **0.0** | **1.88** | 86.9 | 60.3 | 69.7 | 257.2 | 7.2 | 0.26 | Bending | 1 |
| Bo1 | Bovenstuk1 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.70 | 0 | 175 | **8.8** | **0.64** | 29.9 | 60.3 | 41.3 | 43.1 | 0.8 | 0.81 | Bending | |
| Bo2 | Bovenstuk1 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.62 | 0 | 166 | **8.8** | **0.61** | 32.0 | 60.3 | 41.3 | 43.1 | 0.8 | 0.77 | Bending | |
| Bo3 | Bovenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.54 | 0 | 158 | **5.5** | **0.58** | 34.4 | 60.3 | 41.3 | 43.1 | 0.8 | 0.74 | Bending | |
| Bo4 | Bovenstuk2 | Enkele staaf | L50x5 | S355J0 | M16 | 8.8 | 1.46 | 0 | 150 | **5.5** | **0.55** | 37.0 | 60.3 | 41.3 | 43.1 | 0.8 | 0.70 | Bending | |

1) Ook gecontroleerd in PLS-TOWER
2) In werkelijkheid is de staaf korter omdat die verbonden is met een knoopplaat. Daarom zal de slankheid in werkelijkheid niet groter zijn dan de maximale toelaatbare slankheid van 250.

# APPENDIX D
## Blokdeuvels

De belastingen op de fundatie uit Appendix A zijn uitgangspunt voor de berekening van de ingestorte rand met blokdeuvels. De belastingen in de richting van de randstijl zijn van toepassing. In de tabellen is dit opgenomen in de laatste kolom $R_{z,lok}$. De controles zijn uitgevoerd met een spreadsheet. Vanwege de helling van de drukdiagonaal wordt per krachtsrichting bepaald hoeveel deuvels effectief zijn.

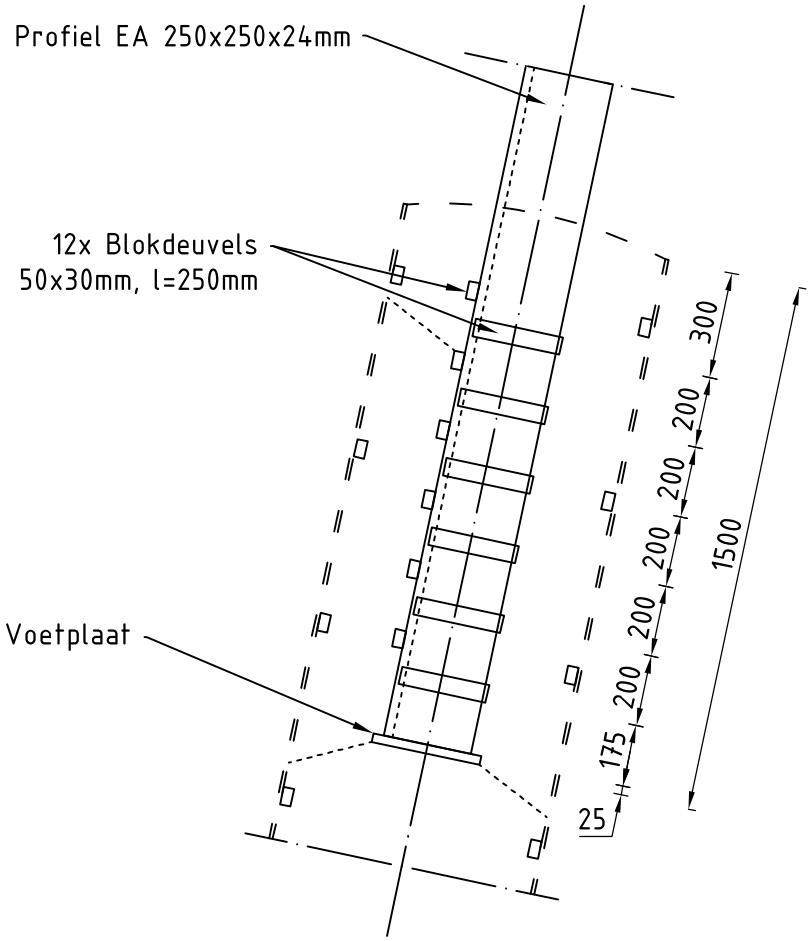
De belastingen waaraan getoetst worden zijn onderstaand weergegeven.

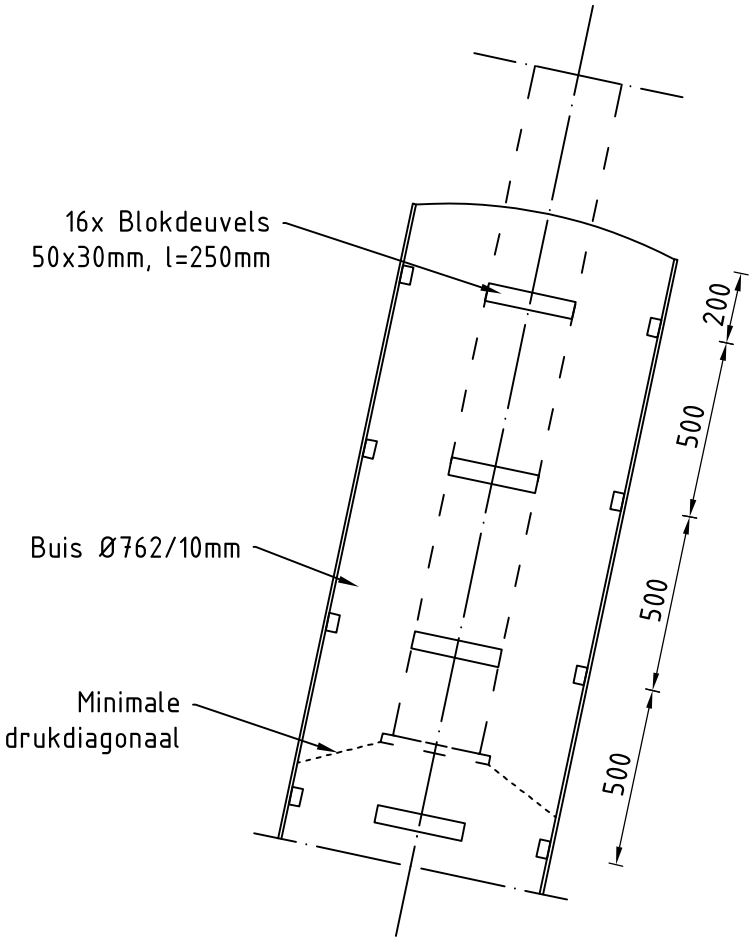
**Masttype S+32/n**

**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 | 348 | **2130** | 20 | -513 | 5 | 2192 |
| Max. trek | ULS 1a_0,9_0,9_45 | 289 | 260 | **-1667** | -20 | 389 | -16 | -1715 |
| Max. pos. torsie | ULS 1a_0,9_0,9_45 | -55 | -25 | -155 | **57** | 21 | -17 | -159 |
| Max. neg. torsie | ULS 1a_0,9_0,9_135 | 55 | -25 | -155 | **-57** | 21 | -17 | -159 |
| Comb. trek+torsie | ULS 1a_0,9_0,9_45 | 289 | 260 | **-1667** | **-20** | 389 | -16 | -1715 |

# Principe blokdeuvels - S+32/n




Algemene opmerkingen

- Aarding niet aangegeven
- Spiraalwapening niet aangegeven

Project: GT-RLL
Mast: S+32_n

## Shear blocks

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

Datum: 2021-07-15
Auteur: JSN
Versie: 1.4

| ***Load*** | | | | ***Results*** | | | |
|---|---|---|---|---|---|---|---|
| Compression | $F_{Ed,c}$ | **2192** | kN | Compression | U.C. | 0.88 | < 1,00 OK |
| Tension | $F_{Ed,t}$ | **1715** | kN | Tension | U.C. | 0.69 | < 1,00 OK |

***Main leg***

| | | | |
|---|---|---|---|
| Profile | | **L250.24** | |
| Steel material | | S355 | |
| Cross section | | 11467 | $mm^2$ |
| Axial capacity | $N_{pl}$ | 4071 | kN |
| Width | b | 250 | mm |
| Thickness | t | 24 | mm |
| Length in concrete | | 1500 | mm |

***Shear blocks main leg***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 250 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 200 | mm |
| Number for compr. | $n_c$ | 10 | - |
| Number for tension | $n_t$ | 10 | - |

***Foot plate***

| | | | |
|---|---|---|---|
| Thickness | t | 25 | mm |
| Ext. length | m | 30 | mm |
| Welds | a | 5 | mm |

***Pile***

| | | |
|---|---|---|
| Name | Buispaal | |
| Diameter | 762 | mm |
| Thickness | 10 | mm |
| Cross section | 23625 | $mm^2$ |
| Steel material | S355 | |
| Capacity | 8387 | kN |
| Concrete strength | C30/37 | |

***Shear blocks pile***

| | | | |
|---|---|---|---|
| Width | b | 50 | mm |
| Thickness | h | 30 | mm |
| Length | L | 250 | mm |
| Welds | a | 5 | mm |
| c.t.c. separation | s | 500 | mm |
| Number for compr. | $n_c$ | 12 | - |
| Number for tension | $n_t$ | 12 | - |

***Design value concrete strength***

| | | | |
|---|---|---|---|
| Material factor | $\gamma_c$ | 1.5 | |
| Add. mat. factor | $\gamma_m$ | 1.25 | - |
| $f_{cd}$ = | | 16.0 | $N/mm^2$ |

***Steel tower stub***

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

***Capacity shear blocks main leg***

| | | |
|---|---|---|
| $A_{f1}$ = | 7500 | $mm^2$ |
| $A_{f2}$ = | 18600 | $mm^2$ |
| Slope | 1: 5 | |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.57 | |
| $f_{jd} = C_A \times f_{cd}$ = | 25.2 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | 1890 | kN |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | 1890 | kN |

***Capacity foot plate***

| | | |
|---|---|---|
| $k_d$ = | 1.73 | - |
| $f_{jd} = C_A \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $c = t\sqrt{(f_{yd} / 3f_{jd})}$ = | 54 | mm |
| m* = min(c,m) = | 30 | mm |
| Type foot plate | Extending | |
| Effective for | Compr. and tension | |
| $A_{p,c}$ = | 45067 | $mm^2$ |
| $F_{Rd,c} = A_{p,druk} \times f_{jd}$ = | 1249 | kN |
| $A_{p,t}$ = | 33600 | $mm^2$ |
| $F_{Rd,t} = A_{p,t} \times f_{jd}$ = | 931 | kN |

***Capacities***

| | | |
|---|---|---|
| $F_{rd,c,plate}$ = | 1197 | kN |
| $F_{rd,blocks,c}$ = | 1890 | kN |
| $F_{rd,c} = F_{rd,blck}+F_{rd,footplate}$ = | **3087** | kN |
| U.C. compression | 0.71 | < 1,00 OK |
| Welds foot plate (see next page) | 1197 | kN |
| $F_{rd,t}$ = min. (welds / foot plate) = | 931 | kN |
| $F_{rd,blocks,t}$ = | 1890 | kN |
| $F_{rd,t} = F_{rd,blck}+F_{rd,footplate}$ = | **2821** | kN |
| U.C. tension | 0.61 | < 1,00 OK |
| U.C. welds | 0.46 | < 1,00 OK |

***Capacity shear blocks pile***

| | | |
|---|---|---|
| $A_{f1}$ = | 7500 | $mm^2$ |
| $A_{f2}$ = | 22500 | $mm^2$ |
| $C_A = \sqrt{(A_{f2}/A_{f1})}$ = | 1.73 | - |
| $f_{jd} = k_d \times f_{cd}$ = | 27.7 | $N/mm^2$ |
| $F_{Rd,c} = n_c \times A_{f1} \times f_{jd}$ = | **2494** | kN |
| U.C. compression | 0.88 | < 1,00 OK |
| $F_{Rd,t} = n_t \times A_{f1} \times f_{jd}$ = | **2494** | kN |
| U.C. tension | 0.69 | < 1,00 OK |
| U.C. welds | 0.42 | < 1,00 OK |

***"Splitting" of pile***

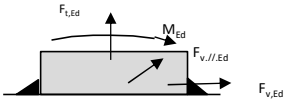
| | | | |
|---|---|---|---|
| Spread of forces | | 45 | ° |
| Length force flow | | 1129 | mm |
| Splitting force | | 760 | kN/m |
| Yield strength wall | $f_{yd}$ = | 355 | $N/mm^2$ |
| Capacity tubular pile | | 7100 | kN/m |
| U.C. | | 0.11 | < 1,00 OK |

Project: GT-RLL
Mast: S+32_n

## Welds of shear blocks of main leg

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 250 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |



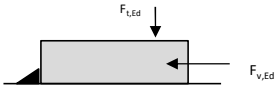

| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 4al$ = | 0 | $N/mm^2$ |
| $F_{t,Ed}$ = | **0** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 4al$ = | 64 | $N/mm^2$ |
| $F_{v,Ed} = F_{rd,c} / n$ = | **227** | kN | | 64 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | $b^* = b + 2/3a\sqrt{2}$ | 54.7 | mm |
| $M_{Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **3.40** | kNm | $\sigma_1 = \tau_1 = 0{,}706 M_{Ed} / al\ b^*$ = | 35 | $N/mm^2$ |
| | | | $\tau_{//} = F_{w//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 199 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 199 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.46** OK |
| $\sigma_1$ = | 99 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.28** OK |

## Welds of shear blocks of pile

*Out-of-plane loading*

| ***Plate*** | | | ***Welds*** | | |
|---|---|---|---|---|---|
| t = | 50 | mm | a = | 5 | mm |
| Grade | S355 | | l = | 250 | mm |
| $f_{yd}$ = | 355 | $N/mm^2$ | $\beta_w$ = | 0.9 | - |
| $f_u$ = | 490 | $N/mm^2$ | $\gamma_{M2}$ = | 1.25 | - |




| ***Member forces*** | | | ***Stress components*** | | |
|---|---|---|---|---|---|
| Factor | 1.2 | | $\sigma_1 = \tau_1 = F_{t,Ed} \sqrt{2} / 2al$ = | 21 | $N/mm^2$ |
| $F_{t,Ed} = 1/2\ b / h \times F_{v,Ed}$ = | **75** | kN | $\sigma_1 = \tau_1 = F_{v,Ed} \sqrt{2} / 2al$ = | 71 | $N/mm^2$ |
| $F_{v,Ed}$ = | **249** | kN | | 92 | $N/mm^2$ |
| $F_{v//,Ed}$ = | **0** | kN | | | |
| $M_{Ed}$ = | **0.00** | kNm | | | |
| | | | $\tau_{//} = F_{w//,Ed} / 2al$ = | 0 | $N/mm^2$ |
| | | | $\sigma_{vw,Ed} = \sqrt{(\sigma_1^2 + 3\tau_1^2 + 3\tau_{//}^2)}$ = | 183 | $N/mm^2$ |

| ***Check*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_{vw,Ed}$ = | 183 | $N/mm^2$ | ≤ | $f_u / \beta_w \gamma_{M2}$ = | 436 | $N/mm^2$ | U.C. = | **0.42** OK |
| $\sigma_1$ = | 92 | $N/mm^2$ | ≤ | $0{,}9 f_u / \gamma_{M2}$ = | 353 | $N/mm^2$ | U.C. = | **0.26** OK |

## Welds of foot plate

| | | | |
|---|---|---|---|
| $f_u / \beta_w \gamma_{M2}$ = | | 436 | $N/mm^2$ |
| Weld size | a = | 5 | mm |
| Length | $l = 2b + 2b - t$ = | 952 | mm |
| Capacity | $F_{Rd} = a \times l \times f_{w,d} / \sqrt{3}$ = | **1197** | kN |

# APPENDIX E
## Liggers

De liggers uit HE-profiel voor de isolatoren zijn met het programma AxisVM op buiging gecontroleerd.

# 1 INTRODUCTION

The beams for insulators of tower 2-circuit S+32_n tower in the “ZWO-project” is investigated in the following report. The PLS-tower model of the tower with its insulator configuration is shown in Figure 1. The insulators are vertical suspension insulators that are attached via triangular assemblees, which lower the application point of the insulator to the cross arm.

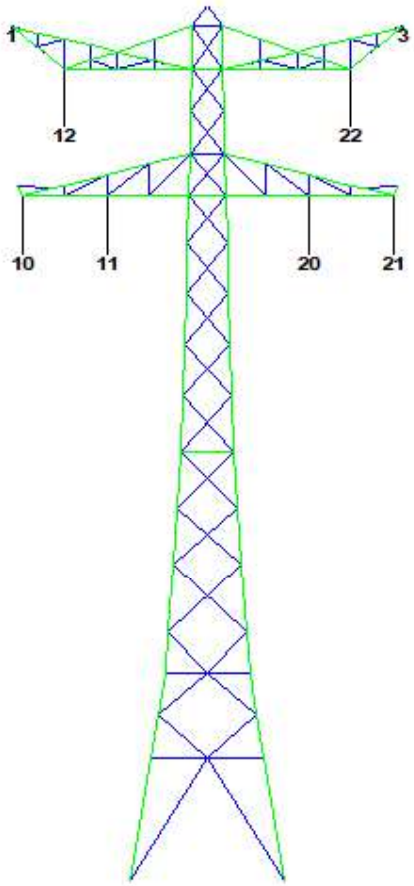



**Figure 1 (a) S+32 PLS tower model**

Figure 1 was taken from the PLS-Tower application for visualization. The insulators ID’s: 10-12 and 20-22 are shown in black in the figure. The earth wire location is indicated by 1 and 3. The following report explores the effect of bending in the bottom chord of the cross-arms and beams housing the insulators for the S+32 tower. The report highlights the geometry and the loading on the cross arm. The parts of the tower are analysed in isolation with the rest of the tower body. The individual parts of the tower under focus are shown in Figure 2. Axis VM report is attached as “ Appendix – report AXIS-VM”.

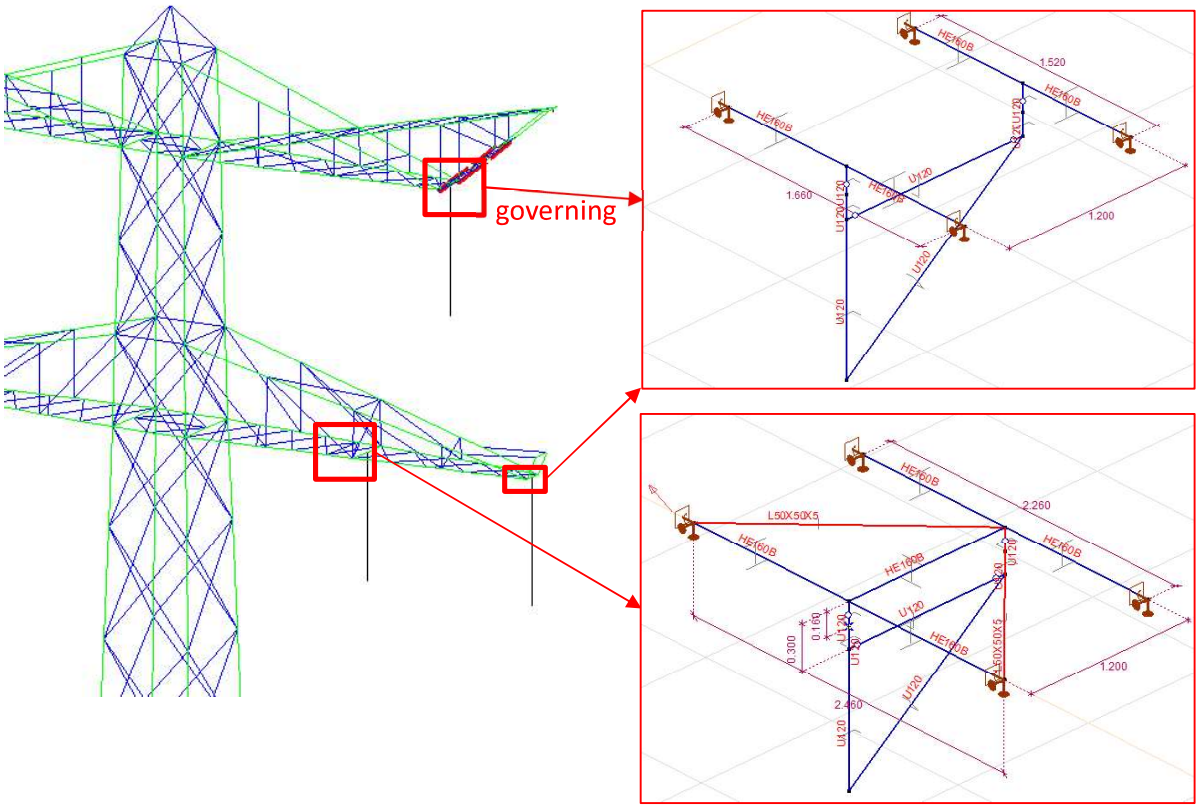



**Figure 2 Location of the v-ketting insulator assembly in S+32 tower**

Figure 2 shows a side view of the location of the insulators supports in the cross-arms. The insulator support for 20 and 22 are governing. The insulator 21 has support scheme similar to insulator 21. The local axis VM models are shown inin the right.

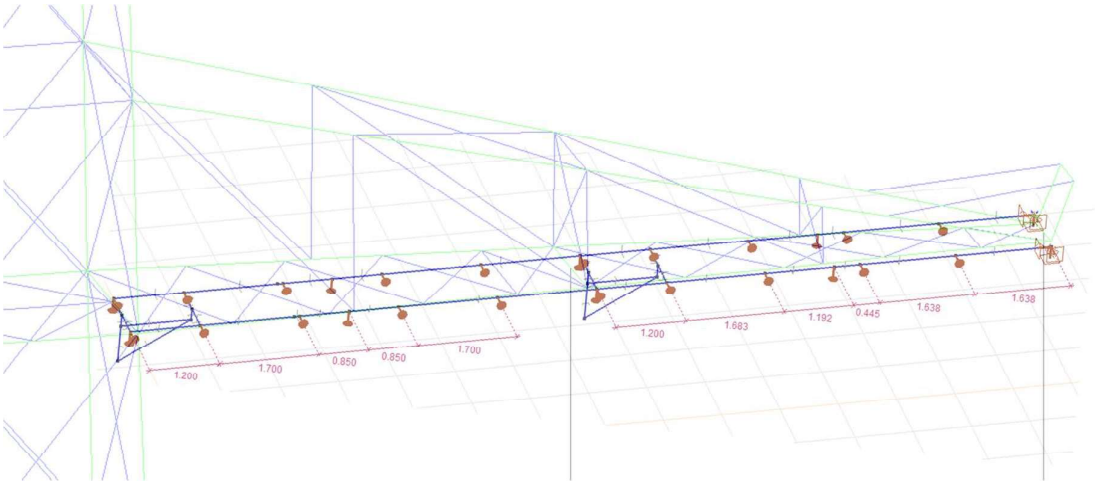
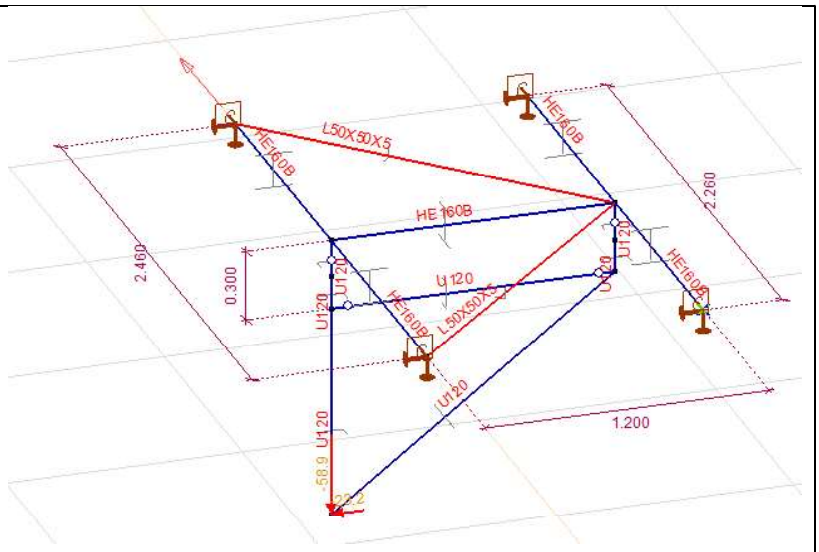
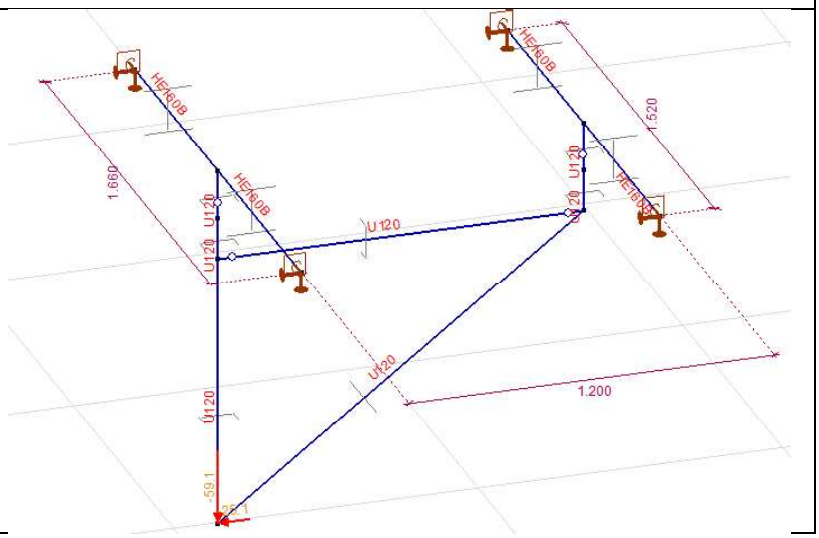


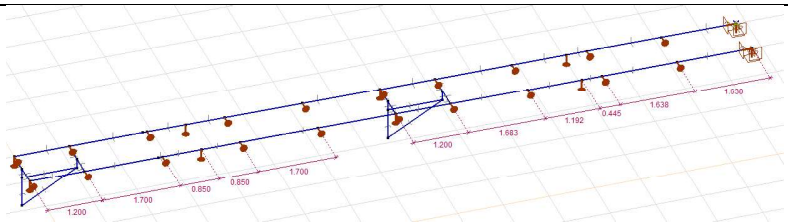

**Figure 3 Superimposed axis VM model on the tower image of the bottom cross arm**

Figure 3 shows the simplified axisVM model of the bottom chord superimposed on the image of the cross arm from PLS tower pre processing. This is done to corelate the positions of the supports in the axis VM model explained in the later section. The upper cross arm has span smaller span the lower cross arm. Hence its not critical and thus not shown in the current report.

# 2 GEOMETRY

The details of the geometry of the individual parts are given in the table below.

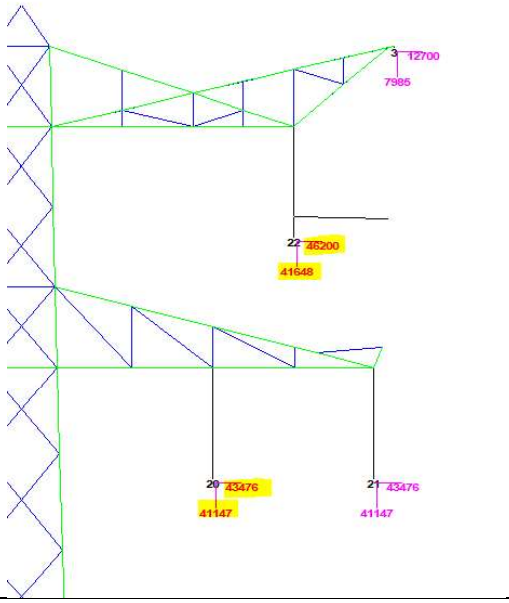
| | |
|---|---|
| **Insulator 20:** The insulator is supported via a triangular assembly of UNP 120 sections. The longitudnal hinge is at a distance of 160 mm from the plane of bottom chord. Furthermore additional K brace ( L50x5) and HEB 160 members is added between HEB members supported on the bottom chord. This is done to reduce the torsion in the beam. The lengths of the primary HEB beams at the bottom chord is taken from the PLS tower model. Supports are given at the end of the primary HEB beams for translation and torsion. This is done in consideration with the end plate connecting the HEB profile and bottom chord. |   |
| **Insulator 22:** The beams housing the insulator are similar to insulator 20. Insulator 21 has similar supporting schemes. |   |

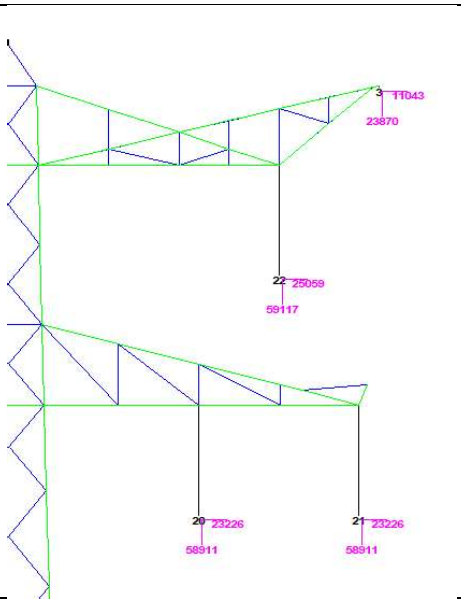
| | |
|---|---|
| **Bottom chord:** The bottom chord is modelled in isoaltion. Horizontal supports are added at the loaction of horizontal braces. Vertical supports are given at the location of vertical in the cross arms. |   |

# 3 LOADING

The loads are applied in the Axis VM model for the critical load cases. The loads are in conjunction with the loads applied in the PLS Tower model for the existing model. The loads are applied at the tip of the insulator housing beams. 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. 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. The conductor failure in conductor 20, 21 and 22 along with failure in earth conductor is simulated in Axis VM simulation. Table 2 shows the details of the individual load cases.

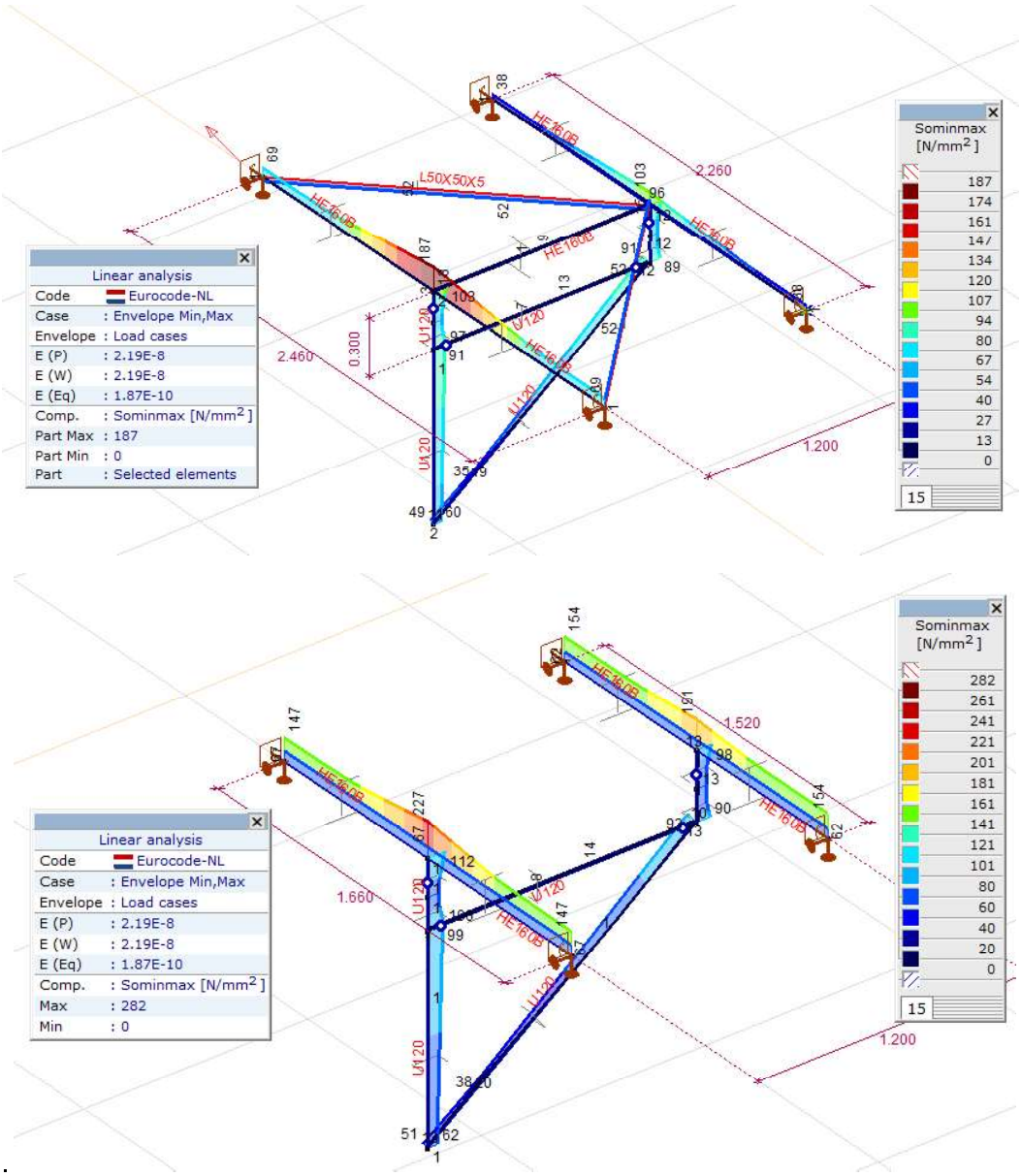
**Table 1 Details of load cases**

| Sr. No. | Load Case | Particular | The load applied in the PLS tower model |
|---|---|---|---|
| 1 | 03 ULA _1a_90: | 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 and horizontal insulators. The loads governs the stresses in bottom chord due to bending action. |  |
| 2 | 15 ULA 3_90 max – vertical load): | Wind + ice + s.f : The horizontal load is smaller comapred to 1a_90. This load has higher vertical loads. | |


3 11043
23870
22 25059
59117
20 23226
58911
21 23226
58911

# 4 RESULTS

The stresses in the insulator housing schemes are shown in Figure 4. Max stress of 187 MPa develops in the HEB profile for insulator 20. Max stress of 227 MPa develops in the HEB profile for insulator 22. A detailed view of the parts is given in the table below.




.

**Figure 4 Max stress for the insulator attachment assemblies.**

Figure 5 shows the max stress in the bottom chord of the lower cross arm. The load case 3_90 is critical as it has maximum vertical load. The max stress is 177 MPa.

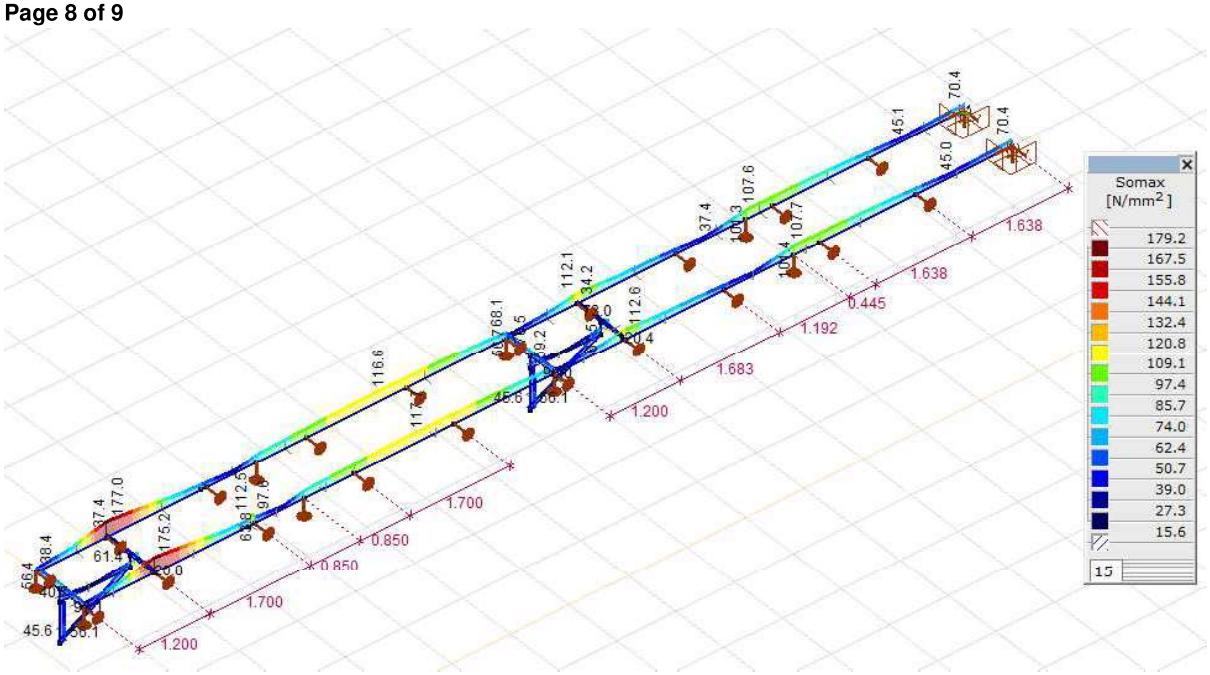



**Figure 5 Max stress in bottom chord**

| Particulars | Stress (MPa) | Permissible stress (MPa) | U.C. |
|---|---|---|---|
| Insulator 20 | 187 | 355 | 0.53 |
| Insulator 22 | 227 | 355 | 0.64 |
| Bottom chord | 179 | 355 | 0.50 |

# 5 CONCLUSION

The existing suspension towers of the S+32 serie is to be replaced by a new tower. The main structure of the tower has been checked via the PLS tower application. The structure is further checked in AxisVM locally as the bending in the structure is neglected in the PLS tower. The report explains the geometry and loading assumptions for the beams housing the insulator assembly in the 2 circuits S+32-tower in the ZWO-project. The loading is taken from PLS tower visualization. The loads on the beams housing the insulators and the supporting bottom chord and tower leg members are checked against the yield stress.

The initial check with same design of beams as existing tower showed considerable over-utilizations in the beams at the inner phase of the lower cross arm. The design was modified with additional K brace from L50x5 and HEB 160 between the primary HEB profiles between the bottom chord.

The max stress bottom chord is 179 MPa, with a usage of 0.50. The max stress across the UNP and HEB-profiles is 227 MPa (peak value) with the usage of 0.64. Thus the structure is considered safe.

# Project: DLE

## Constructeur: DNV GL - Energy

AxisVM X6 R1h · Registered to DNV GL - Energy
Ligger kruisingmast_1.axs

## Rapport

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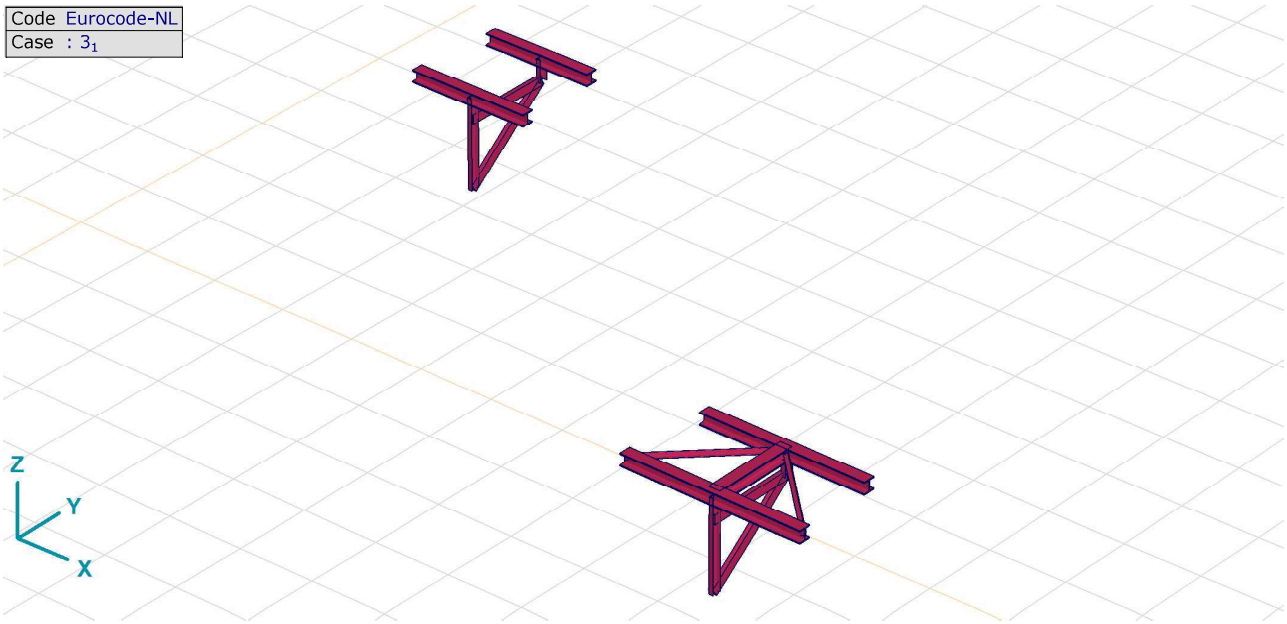
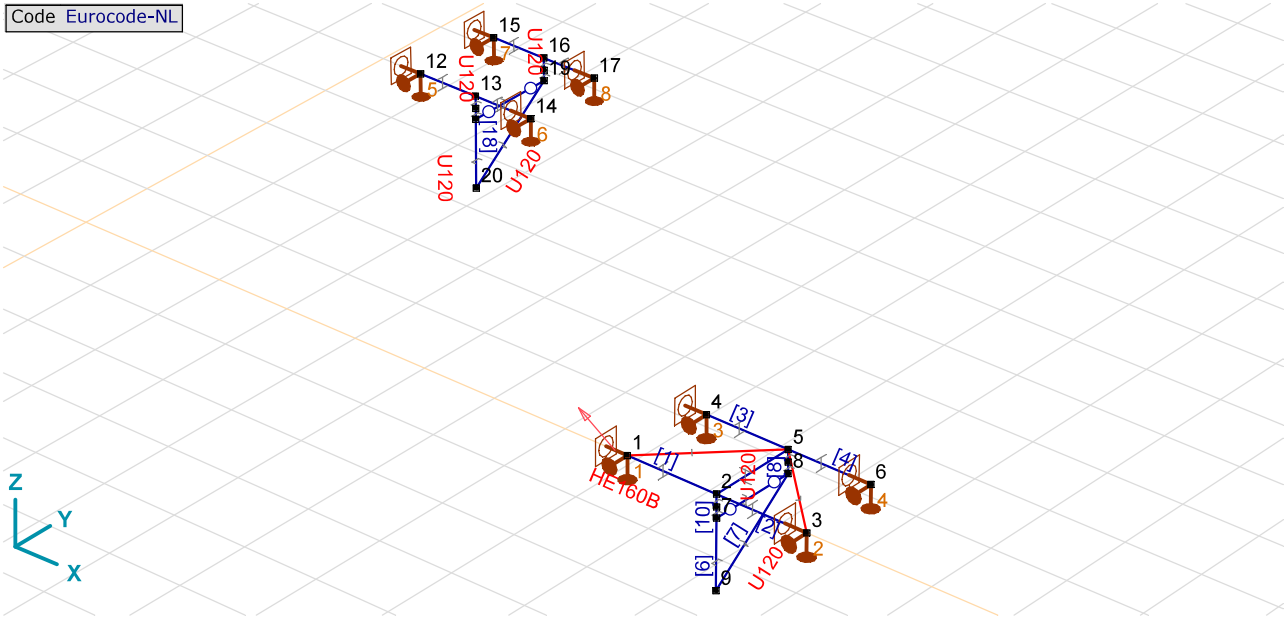
# Project: DLE

Constructeur: DNV GL - Energy
Model: **Ligger kruisingmast_1.axs** 7/15/2021 Page 3




*render*




*Nummering en profielen*

## Cross-sections

| | Name | Drawing | Process | Shape | h [mm] | b [mm] | tw [mm] | tf [mm] | $r_1$ [mm] | $r_2$ [mm] | $r_3$ [mm] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | HE 160 B | | Rolled | I | 160.0 | 160.0 | 8.0 | 13.0 | 15.0 | 0 | 0 |
| 2 | U 120 | | Rolled | U | 120.0 | 55.0 | 7.0 | 9.0 | 9.0 | 4.5 | 0 |
| 3 | L 50X 50X 5 | | Rolled | L | 50.0 | 50.0 | 5.0 | 5.0 | 7.0 | 3.5 | 0 |

| | Name | Ax [mm²] | Ay [mm²] | Az [mm²] | Ix [mm⁴] | Iy [mm⁴] | Iz [mm⁴] | Iyz [mm⁴] |
|---|---|---|---|---|---|---|---|---|
| 1 | HE 160 B | 5426.04 | 3754.44 | 1237.48 | 317826.300 | 2.492E+07 | 8892444.000 | 0 |
| 2 | U 120 | 1698.73 | 617.80 | 752.09 | 41830.660 | 3643327.000 | 430614.100 | 0 |
| 3 | L 50X 50X 5 | 480.28 | 210.38 | 213.29 | 4408.870 | 109629.100 | 109629.100 | −64162.800 |

| | Name | $I_1$ [mm⁴] | $I_2$ [mm⁴] | α [°] | Iω [mm⁶] | $W_{1,el,t}$ [mm³] | $W_{1,el,b}$ [mm³] |
|---|---|---|---|---|---|---|---|
| 1 | HE 160 B | 2.492E+07 | 8892443.000 | 0 | 4.7E+10 | 311542.700 | 311542.700 |
| 2 | U 120 | 3643327.000 | 430614.100 | 0 | 8.9E+08 | 60722.120 | 60722.120 |
| 3 | L 50X 50X 5 | 173791.900 | 45466.320 | 45.00 | 678722 | 4915.578 | 4915.578 |

| | Name | $W_{2,el,t}$ [mm³] | $W_{2,el,b}$ [mm³] | $W_{1,pl}$ [mm³] | $W_{2,pl}$ [mm³] | $i_y$ [mm] | $i_z$ [mm] | Hy [mm] | Hz [mm] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | HE 160 B | 111155.500 | 111155.500 | 354020.600 | 169972.200 | 67.8 | 40.5 | 160.0 | 160.0 |
| 2 | U 120 | 11058.300 | 26813.420 | 72702.590 | 21257.590 | 46.3 | 15.9 | 55.0 | 120.0 |
| 3 | L 50X 50X 5 | 2584.399 | 2290.666 | 7830.310 | 4045.387 | 15.1 | 15.1 | 50.0 | 50.0 |

| | Name | $y_G$ [mm] | $z_G$ [mm] | $y_s$ [mm] | $z_s$ [mm] | $\beta_y$ [mm] | $\beta_z$ [mm] | $\beta_w$ [] | S.p. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | HE 160 B | 80.0 | 80.0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 2 | U 120 | 16.1 | 60.0 | −29.6 | 0 | 0 | 122.3 | 0 | 8 |
| 3 | L 50X 50X 5 | 14.0 | 14.0 | −11.0 | −11.0 | 45.0 | 45.0 | 0 | 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; **$\beta_y$, $\beta_z$, $\beta_w$:** Wagner's coefficient; **S.p.:** Stress calculation points;

## Nodes

| | X [m] | Y [m] | Z [m] |
|---|---|---|---|
| 1 | 7.870 | 0 | 0 |
| 2 | 9.100 | 0 | 0 |
| 3 | 10.330 | 0 | 0 |
| 4 | 7.970 | 1.200 | 0 |
| 5 | 9.100 | 1.200 | 0 |
| 6 | 10.230 | 1.200 | 0 |
| 7 | 9.100 | 0 | −0.300 |
| 8 | 9.100 | 1.200 | −0.300 |
| 9 | 9.100 | 0 | −1.200 |
| 10 | 9.100 | 1.200 | −0.160 |
| 11 | 9.100 | 0 | −0.160 |
| 12 | 0.570 | 5.000 | 0 |
| 13 | 1.400 | 5.000 | 0 |
| 14 | 2.230 | 5.000 | 0 |
| 15 | 0.640 | 6.200 | 0 |
| 16 | 1.400 | 6.200 | 0 |
| 17 | 2.160 | 6.200 | 0 |
| 18 | 1.400 | 5.000 | −0.300 |
| 19 | 1.400 | 6.200 | −0.300 |
| 20 | 1.400 | 5.000 | −1.200 |
| 21 | 1.400 | 6.200 | −0.160 |
| 22 | 1.400 | 5.000 | −0.160 |

## Nodal supports

| | Node | X [m] | Y [m] | Z [m] | Type | $Name_x$ | $K_x$ [kN/m] | $K_{xV}$ [kN/m] | $Name_y$ | $K_y$ [kN/m] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 7.870 | 0 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |
| 2 | 3 | 10.330 | 0 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |
| 3 | 4 | 7.970 | 1.200 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |
| 4 | 6 | 10.230 | 1.200 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |
| 5 | 12 | 0.570 | 5.000 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |
| 6 | 14 | 2.230 | 5.000 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |
| 7 | 15 | 0.640 | 6.200 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |
| 8 | 17 | 2.160 | 6.200 | 0 | Glob. | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Translational | 1E+10 |

| | Node | $K_{yV}$ [kN/m] | $Name_z$ | $K_z$ [kN/m] | $K_{zV}$ [kN/m] | $Name_{xx}$ | $K_{xx}$ [kNm/rad] | $K_{xxV}$ [kNm/rad] | $Name_{yy}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |
| 2 | 3 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |
| 3 | 4 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |
| 4 | 6 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |
| 5 | 12 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |
| 6 | 14 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |
| 7 | 15 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |
| 8 | 17 | 1E+10 | Rigid - Translational | 1E+10 | 1E+10 | Rigid - Rotational | 1E+10 | 1E+10 | — |

| | Node | $K_{yy}$ [kNm/rad] | $K_{yyV}$ [kNm/rad] | $Name_{zz}$ | $K_{zz}$ [kNm/rad] | $K_{zzV}$ [kNm/rad] |
|---|---|---|---|---|---|---|
| 1 | 1 | – | – | — | – | – |
| 2 | 3 | – | – | — | – | – |
| 3 | 4 | – | – | — | – | – |
| 4 | 6 | – | – | — | – | – |
| 5 | 12 | – | – | — | – | – |
| 6 | 14 | – | – | — | – | – |
| 7 | 15 | – | – | — | – | – |
| 8 | 17 | – | – | — | – | – |

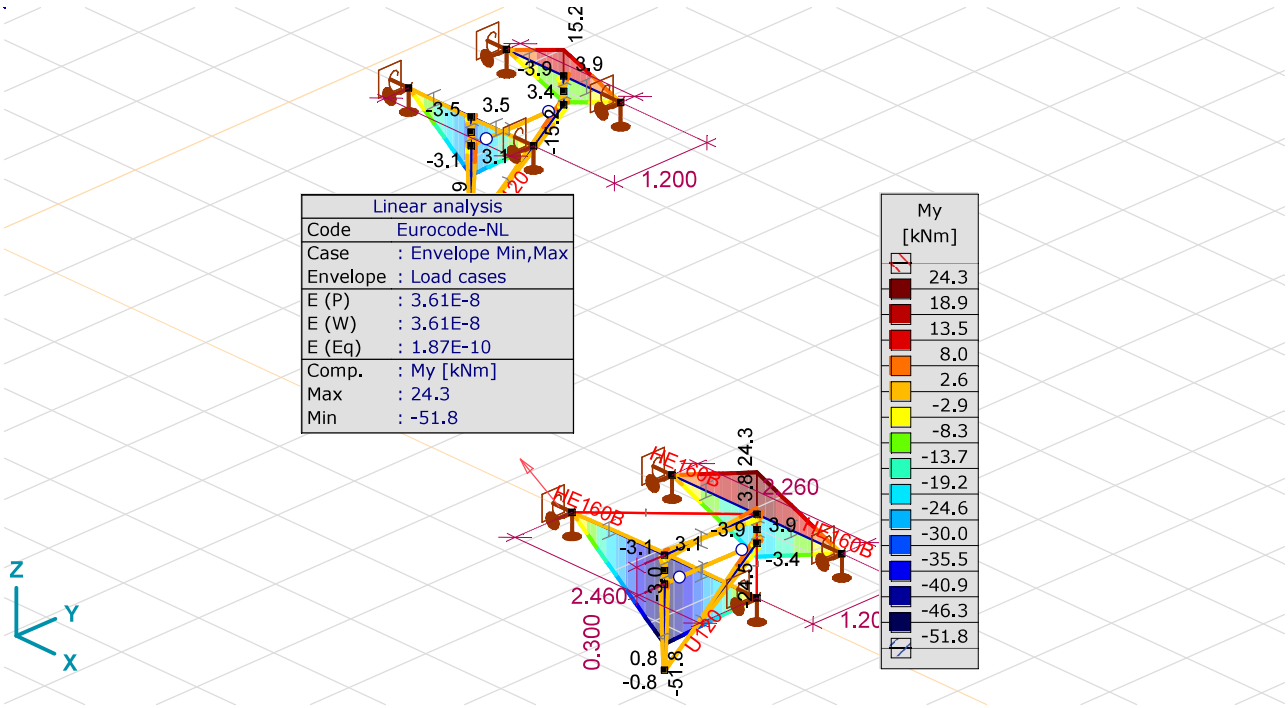
**Node:** Supported node; **Type:** Support type; **$K_x$, $K_y$, $K_z$, $K_{xx}$, $K_{yy}$, $K_{zz}$:** Initial stiffness;

Beam internal forces [Linear, Envelope (Load cases)]

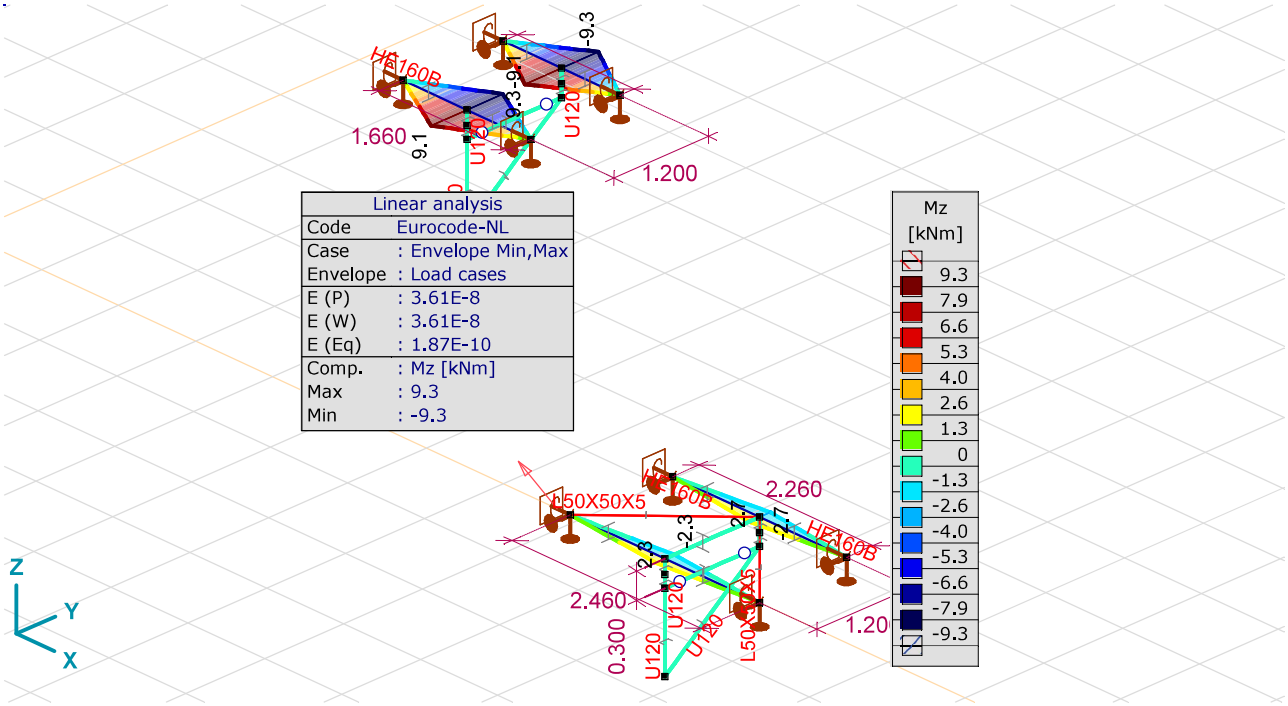
| Ext. | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Nx [kN]* | *Vy [kN]* | *Vz [kN]* |
|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 2 | U 120 | Nx | min | 1a | 0 | (20) | **−63.0** | 0 | −2.8 |
| 18 | 2 | U 120 | | max | 1a | 0 | (20) | **81.7** | 0 | 2.5 |
| 22 | 2 | U 120 | | max | 1a | 0 | (22) | **81.7** | 0 | −21.8 |
| 23 | 2 | U 120 | | max | 1a | 0 | (18) | **81.7** | 0 | −21.8 |
| 15 | 1 | HE 160 B | Tx | min | 1a_1 | 0 | (15) | 0 | −12.2 | −20.0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | 0 | −12.2 | −20.0 |
| 15 | 1 | HE 160 B | | max | 1a | 0 | (15) | 0 | 12.2 | 20.0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 0 | 12.2 | 20.0 |
| 1 | 1 | HE 160 B | My | min | 1a | 1.230 | (2) | 0 | 1.9 | −42.1 |
| 2 | 1 | HE 160 B | | min | 1a | 0 | (2) | 0 | −1.9 | 42.1 |
| 3 | 1 | HE 160 B | | max | 1a | 1.130 | (5) | 0 | 2.4 | 21.5 |
| 4 | 1 | HE 160 B | | max | 1a | 0 | (5) | 0 | −2.4 | −21.5 |
| 15 | 1 | HE 160 B | Mz | min | 1a | 0.760 | (16) | 0 | 12.2 | 20.0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | 0 | −12.2 | −20.0 |
| 15 | 1 | HE 160 B | | max | 1a_1 | 0.760 | (16) | 0 | −12.2 | −20.0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 0 | 12.2 | 20.0 |

| Ext. | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Tx [kNm]* | *My [kNm]* | *Mz [kNm]* | *B [kNm²]* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 2 | U 120 | Nx | min | 1a | 0 | (20) | 0 | 0.8 | 0 | 0 |
| 18 | 2 | U 120 | | max | 1a | 0 | (20) | 0 | 0.8 | 0 | 0 |
| 22 | 2 | U 120 | | max | 1a | 0 | (22) | 0 | 0 | 0 | 0 |
| 23 | 2 | U 120 | | max | 1a | 0 | (18) | 0 | 3.1 | 0 | 0 |
| 15 | 1 | HE 160 B | Tx | min | 1a_1 | 0 | (15) | **−1.9** | 0 | 0 | 0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | **−1.9** | 15.2 | −9.3 | 0 |
| 15 | 1 | HE 160 B | | max | 1a | 0 | (15) | **1.9** | 0 | 0 | 0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | **1.9** | −15.2 | 9.3 | 0 |
| 1 | 1 | HE 160 B | My | min | 1a | 1.230 | (2) | 0.1 | **−51.8** | −2.3 | 0 |
| 2 | 1 | HE 160 B | | min | 1a | 0 | (2) | −0.1 | **−51.8** | −2.3 | 0 |
| 3 | 1 | HE 160 B | | max | 1a | 1.130 | (5) | 0.1 | **24.3** | −2.7 | 0 |
| 4 | 1 | HE 160 B | | max | 1a | 0 | (5) | −0.1 | **24.3** | −2.7 | 0 |
| 15 | 1 | HE 160 B | Mz | min | 1a | 0.760 | (16) | 1.9 | 15.2 | **−9.3** | 0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | −1.9 | 15.2 | **−9.3** | 0 |
| 15 | 1 | HE 160 B | | max | 1a_1 | 0.760 | (16) | −1.9 | −15.2 | **9.3** | 0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 1.9 | −15.2 | **9.3** | 0 |

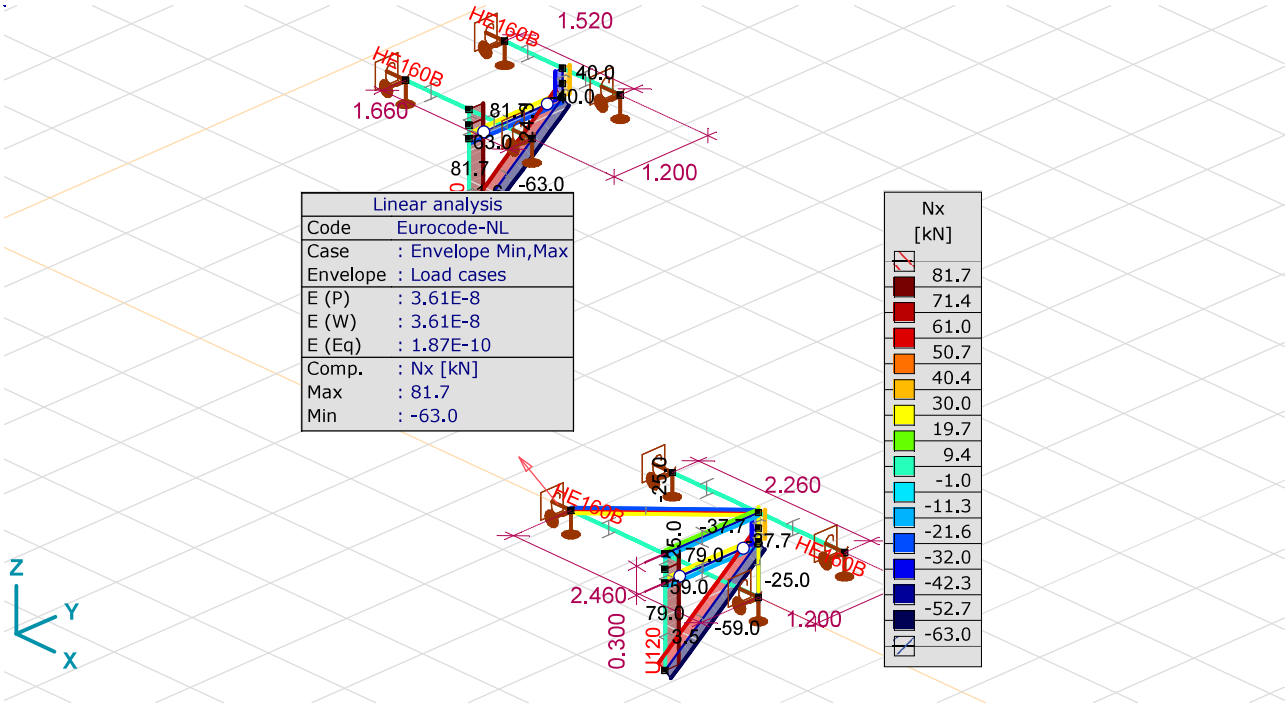
**Sh.:** Cross-section; **C:** Extremal component; **min. max.:** Extreme type; **Case:** Load case of extreme; **Loc.:** Cross-section local x position on the beam; **Nx:** Axial force; **Vy:** Shear force in local y direction; **Vz:** Shear force in local z direction; **Tx:** Torsional moment; **My:**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



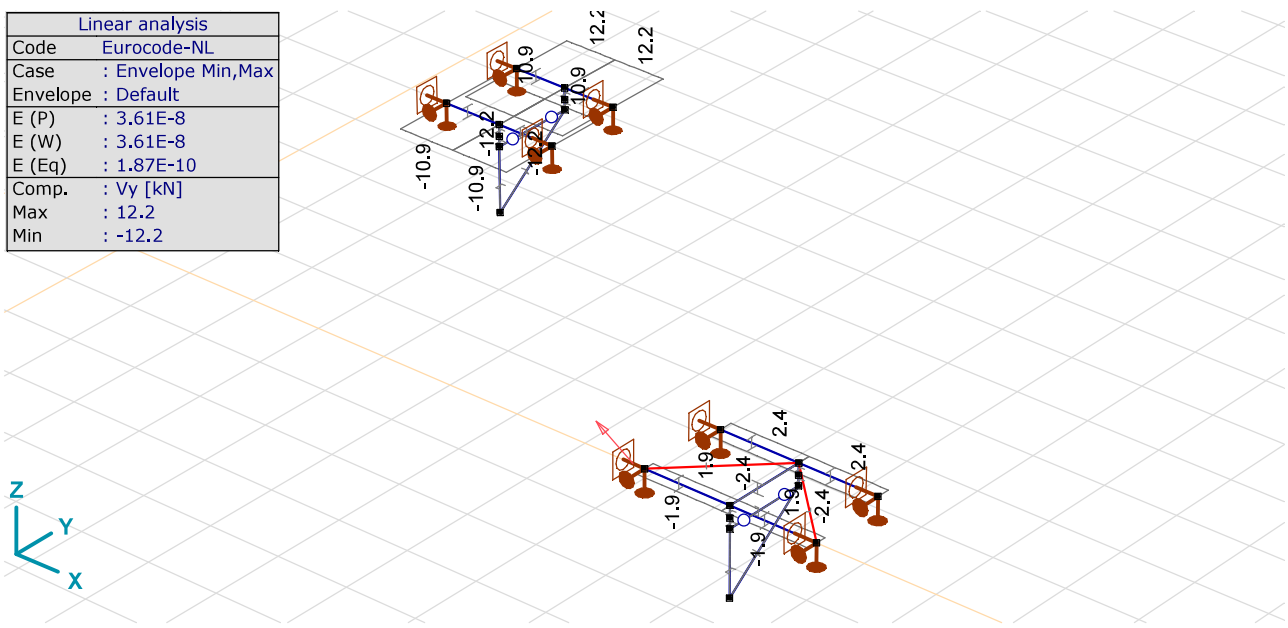

*[I], Linear, Envelope (Load cases), My [kNm], Filled diagram*




*[I], Linear, Envelope (Load cases), Mz [kNm], Filled diagram*



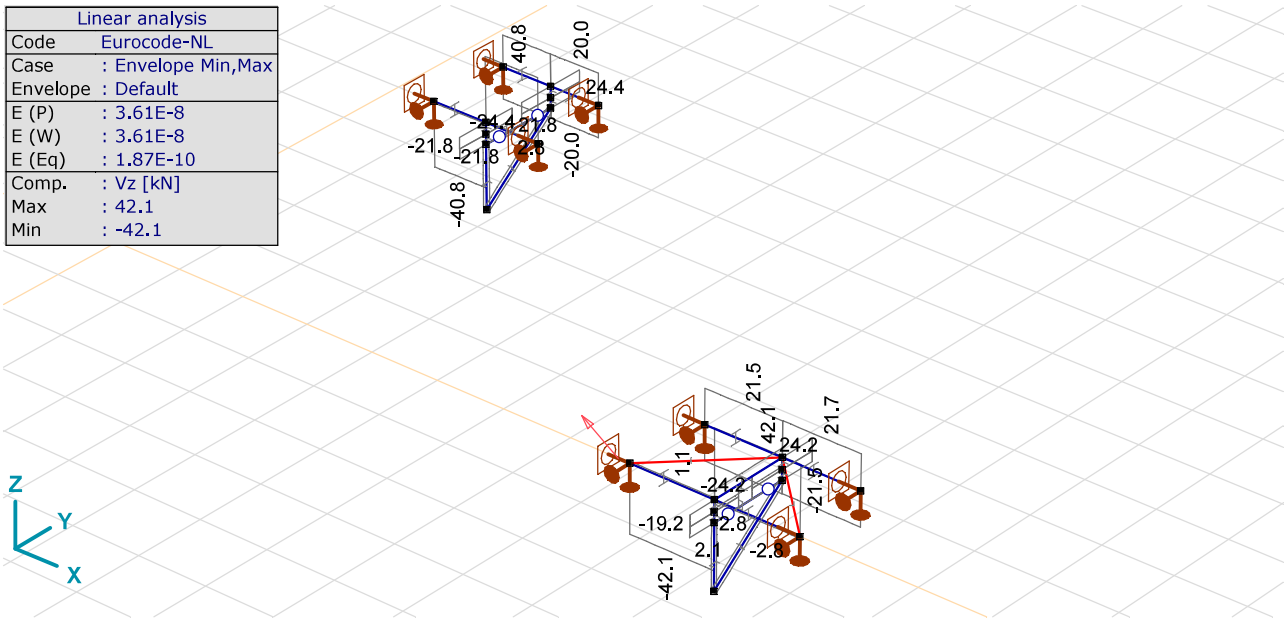

*[I], Linear, Envelope (Load cases), Nx [kN], Filled diagram*



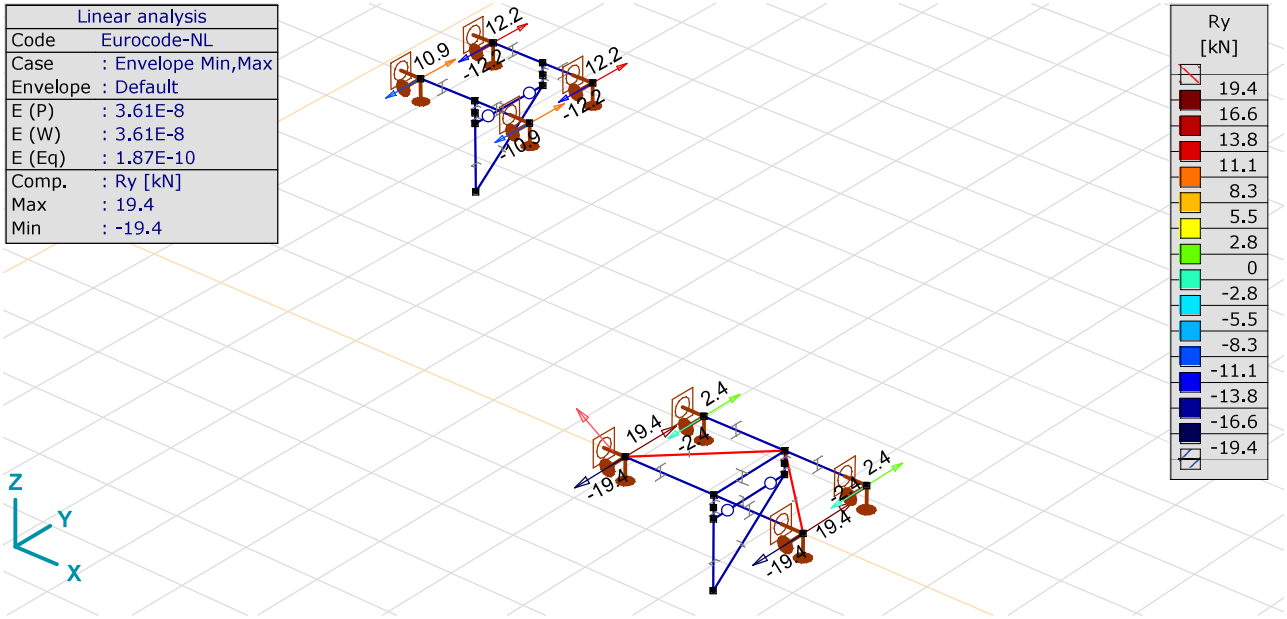

*[I], Linear, Envelope (Default), Vy [kN], Diagram*

# Project: DLE

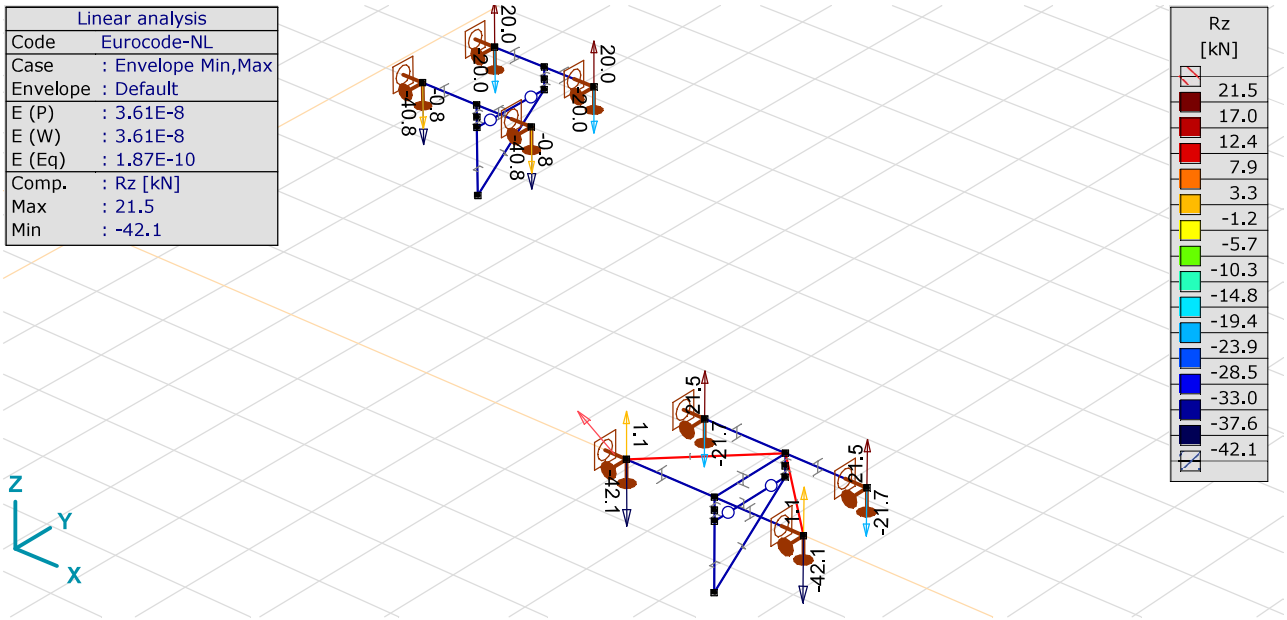
Constructeur: DNV GL - Energy
Model: **Ligger kruisingmast_1.axs** 7/15/2021 Page 9




*[I], Linear, Envelope (Default), Vz [kN], Diagram*




*[I], Linear, Envelope (Default), Ry [kN] (nodal supp.), Diagram*




*[I], Linear, Envelope (Default), Rz [kN] (nodal supp.), Diagram*

Beam internal forces [Linear, Envelope (Default), HE 160 B]

| | Sh. | Cross-section name | C | min. max. | Case | Loc. [m] | Node | Nx [kN] | Vy [kN] | Vz [kN] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | HE 160 B | | | | L=1.230 | | | | |
| | | | Nx | min | 1a | 0 | (1) | **0** | 1.9 | −42.1 |
| | | | | max | 1a_1 | 0 | (1) | **0** | −1.9 | 1.1 |
| | | | Vy | min | 1a_1 | 0 | (1) | 0 | **−1.9** | 1.1 |
| | | | | max | 1a | 0 | (1) | 0 | **1.9** | −42.1 |
| | | | Vz | min | 1a | 0 | (1) | 0 | 1.9 | **−42.1** |
| | | | | max | 1a_1 | 0 | (1) | 0 | −1.9 | **1.1** |
| | | | Tx | min | 1a_1 | 0 | (1) | 0 | −1.9 | 1.1 |
| | | | | max | 1a | 0 | (1) | 0 | 1.9 | −42.1 |
| | | | My | min | 1a | 1.230 | (2) | 0 | 1.9 | −42.1 |
| | | | | max | 1a_1 | 1.230 | (2) | 0 | −1.9 | 1.1 |
| | | | Mz | min | 1a | 1.230 | (2) | 0 | 1.9 | −42.1 |
| | | | | max | 1a_1 | 1.230 | (2) | 0 | −1.9 | 1.1 |
| 2 | 1 | HE 160 B | | | | L=1.230 | | | | |
| | | | Nx | min | 1a | 0 | (2) | **0** | −1.9 | 42.1 |

| | Sh. | Cross-section name | C | min. max. | Case | Loc. [m] | Node | Tx [kNm] | My [kNm] | Mz [kNm] | B [kNm²] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | HE 160 B | | | | L=1.230 | | | | | |
| | | | Nx | min | 1a | 0 | (1) | 0.1 | 0 | 0 | 0 |
| | | | | max | 1a_1 | 0 | (1) | 0 | 0 | 0 | 0 |
| | | | Vy | min | 1a_1 | 0 | (1) | 0 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (1) | 0.1 | 0 | 0 | 0 |
| | | | Vz | min | 1a | 0 | (1) | 0.1 | 0 | 0 | 0 |
| | | | | max | 1a_1 | 0 | (1) | 0 | 0 | 0 | 0 |
| | | | Tx | min | 1a_1 | 0 | (1) | **0** | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (1) | **0.1** | 0 | 0 | 0 |
| | | | My | min | 1a | 1.230 | (2) | 0.1 | **−51.8** | −2.3 | 0 |
| | | | | max | 1a_1 | 1.230 | (2) | 0 | **1.3** | 2.3 | 0 |
| | | | Mz | min | 1a | 1.230 | (2) | 0.1 | −51.8 | **−2.3** | 0 |
| | | | | max | 1a_1 | 1.230 | (2) | 0 | 1.3 | **2.3** | 0 |
| 2 | 1 | HE 160 B | | | | L=1.230 | | | | | |
| | | | Nx | min | 1a | 0 | (2) | −0.1 | −51.8 | −2.3 | 0 |

Beam internal forces [Linear, Envelope (Default), HE 160 B]

| | Sh. | Cross-section name | C | min. max. | Case | Loc. [m] | Node | Nx [kN] | Vy [kN] | Vz [kN] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | max | 1a_1 | 0 | (2) | **0** | 1.9 | −1.1 |
| | | | Vy | min | 1a | 0 | (2) | 0 | **−1.9** | 42.1 |
| | | | | max | 1a_1 | 0 | (2) | 0 | **1.9** | −1.1 |
| | | | Vz | min | 1a_1 | 0 | (2) | 0 | 1.9 | **−1.1** |
| | | | | max | 1a | 0 | (2) | 0 | −1.9 | **42.1** |
| | | | Tx | min | 1a | 0 | (2) | 0 | −1.9 | 42.1 |
| | | | | max | 1a_1 | 0 | (2) | 0 | 1.9 | −1.1 |
| | | | My | min | 1a | 0 | (2) | 0 | −1.9 | 42.1 |
| | | | | max | 1a_1 | 0 | (2) | 0 | 1.9 | −1.1 |
| | | | Mz | min | 1a | 0 | (2) | 0 | −1.9 | 42.1 |
| | | | | max | 1a_1 | 0 | (2) | 0 | 1.9 | −1.1 |
| 3 | 1 | HE 160 B | | | | L=1.130 | | | | |
| | | | Nx | min | 1a | 0 | (4) | **0** | 2.4 | 21.5 |
| | | | | max | 1a | 0 | (4) | **0** | 2.4 | 21.5 |
| | | | Vy | min | 1a_1 | 0 | (4) | 0 | **−2.4** | −21.7 |
| | | | | max | 1a | 0 | (4) | 0 | **2.4** | 21.5 |
| | | | Vz | min | 1a_1 | 0 | (4) | 0 | −2.4 | **−21.7** |
| | | | | max | 1a | 0 | (4) | 0 | 2.4 | **21.5** |
| | | | Tx | min | 1a_1 | 0 | (4) | 0 | −2.4 | −21.7 |
| | | | | max | 1a | 0 | (4) | 0 | 2.4 | 21.5 |
| | | | My | min | 1a_1 | 1.130 | (5) | 0 | −2.4 | −21.7 |
| | | | | max | 1a | 1.130 | (5) | 0 | 2.4 | 21.5 |
| | | | Mz | min | 1a | 1.130 | (5) | 0 | 2.4 | 21.5 |
| | | | | max | 1a_1 | 1.130 | (5) | 0 | −2.4 | −21.7 |
| 4 | 1 | HE 160 B | | | | L=1.130 | | | | |
| | | | Nx | min | 1a | 0 | (5) | **0** | −2.4 | −21.5 |
| | | | | max | 1a | 0 | (5) | **0** | −2.4 | −21.5 |

| | Sh. | Cross-section name | C | min. max. | Case | Loc. [m] | Node | Tx [kNm] | My [kNm] | Mz [kNm] | B [kNm²] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | max | 1a_1 | 0 | (2) | 0 | 1.3 | 2.3 | 0 |
| | | | Vy | min | 1a | 0 | (2) | −0.1 | −51.8 | −2.3 | 0 |
| | | | | max | 1a_1 | 0 | (2) | 0 | 1.3 | 2.3 | 0 |
| | | | Vz | min | 1a_1 | 0 | (2) | 0 | 1.3 | 2.3 | 0 |
| | | | | max | 1a | 0 | (2) | −0.1 | −51.8 | −2.3 | 0 |
| | | | Tx | min | 1a | 0 | (2) | **−0.1** | −51.8 | −2.3 | 0 |
| | | | | max | 1a_1 | 0 | (2) | **0** | 1.3 | 2.3 | 0 |
| | | | My | min | 1a | 0 | (2) | −0.1 | **−51.8** | −2.3 | 0 |
| | | | | max | 1a_1 | 0 | (2) | 0 | **1.3** | 2.3 | 0 |
| | | | Mz | min | 1a | 0 | (2) | −0.1 | −51.8 | **−2.3** | 0 |
| | | | | max | 1a_1 | 0 | (2) | 0 | 1.3 | **2.3** | 0 |
| 3 | 1 | HE 160 B | | | | L=1.130 | | | | | |
| | | | Nx | min | 1a | 0 | (4) | 0.1 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (4) | 0.1 | 0 | 0 | 0 |
| | | | Vy | min | 1a_1 | 0 | (4) | 0 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (4) | 0.1 | 0 | 0 | 0 |
| | | | Vz | min | 1a_1 | 0 | (4) | 0 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (4) | 0.1 | 0 | 0 | 0 |
| | | | Tx | min | 1a_1 | 0 | (4) | **0** | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (4) | **0.1** | 0 | 0 | 0 |
| | | | My | min | 1a_1 | 1.130 | (5) | 0 | **−24.5** | 2.7 | 0 |
| | | | | max | 1a | 1.130 | (5) | 0.1 | **24.3** | −2.7 | 0 |
| | | | Mz | min | 1a | 1.130 | (5) | 0.1 | 24.3 | **−2.7** | 0 |
| | | | | max | 1a_1 | 1.130 | (5) | 0 | −24.5 | **2.7** | 0 |
| 4 | 1 | HE 160 B | | | | L=1.130 | | | | | |
| | | | Nx | min | 1a | 0 | (5) | −0.1 | 24.3 | −2.7 | 0 |
| | | | | max | 1a | 0 | (5) | −0.1 | 24.3 | −2.7 | 0 |

Beam internal forces [Linear, Envelope (Default), HE 160 B]

| | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Nx [kN]* | *Vy [kN]* | *Vz [kN]* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Vy | min | 1a | 0 | (5) | 0 | **−2.4** | −21.5 |
| | | | | max | 1a_1 | 0 | (5) | 0 | **2.4** | 21.7 |
| | | | Vz | min | 1a | 0 | (5) | 0 | −2.4 | **−21.5** |
| | | | | max | 1a_1 | 0 | (5) | 0 | 2.4 | **21.7** |
| | | | Tx | min | 1a | 0 | (5) | 0 | −2.4 | −21.5 |
| | | | | max | 1a_1 | 0 | (5) | 0 | 2.4 | 21.7 |
| | | | My | min | 1a_1 | 0 | (5) | 0 | 2.4 | 21.7 |
| | | | | max | 1a | 0 | (5) | 0 | −2.4 | −21.5 |
| | | | Mz | min | 1a | 0 | (5) | 0 | −2.4 | −21.5 |
| | | | | max | 1a_1 | 0 | (5) | 0 | 2.4 | 21.7 |
| 12 | 1 | HE 160 B | | | | L=1.200 | | | | |
| | | | Nx | min | 1a | 0 | (2) | **−15.5** | 0 | −5.4 |
| | | | | max | 1a_1 | 0 | (2) | **15.5** | 0 | 5.7 |
| | | | Vy | min | 1a | 0 | (2) | −15.5 | **0** | −5.4 |
| | | | | max | 1a_1 | 0 | (2) | 15.5 | **0** | 5.7 |
| | | | Vz | min | 1a | 0 | (2) | −15.5 | 0 | **−5.4** |
| | | | | max | 1a_1 | 0 | (2) | 15.5 | 0 | **5.7** |
| | | | Tx | min | 1a | 0 | (2) | −15.5 | 0 | −5.4 |
| | | | | max | 1a_1 | 0 | (2) | 15.5 | 0 | 5.7 |
| | | | My | min | 1a | 1.200 | (5) | −15.5 | 0 | −5.4 |
| | | | | max | 1a_1 | 1.200 | (5) | 15.5 | 0 | 5.7 |
| | | | Mz | min | 1a | 0 | (2) | −15.5 | 0 | −5.4 |
| | | | | max | 1a | 1.200 | (5) | −15.5 | 0 | −5.4 |
| 13 | 1 | HE 160 B | | | | L=0.830 | | | | |
| | | | Nx | min | 1a | 0 | (12) | **0** | 10.9 | −40.8 |
| | | | | max | 1a | 0 | (12) | **0** | 10.9 | −40.8 |
| | | | Vy | min | 1a_1 | 0 | (12) | 0 | **−10.9** | −0.8 |

| | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Tx [kNm]* | *My [kNm]* | *Mz [kNm]* | *B [kNm²]* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Vy | min | 1a | 0 | (5) | −0.1 | 24.3 | −2.7 | 0 |
| | | | | max | 1a_1 | 0 | (5) | 0 | −24.5 | 2.7 | 0 |
| | | | Vz | min | 1a | 0 | (5) | −0.1 | 24.3 | −2.7 | 0 |
| | | | | max | 1a_1 | 0 | (5) | 0 | −24.5 | 2.7 | 0 |
| | | | Tx | min | 1a | 0 | (5) | **−0.1** | 24.3 | −2.7 | 0 |
| | | | | max | 1a_1 | 0 | (5) | **0** | −24.5 | 2.7 | 0 |
| | | | My | min | 1a_1 | 0 | (5) | 0 | **−24.5** | 2.7 | 0 |
| | | | | max | 1a | 0 | (5) | −0.1 | **24.3** | −2.7 | 0 |
| | | | Mz | min | 1a | 0 | (5) | −0.1 | 24.3 | **−2.7** | 0 |
| | | | | max | 1a_1 | 0 | (5) | 0 | −24.5 | **2.7** | 0 |
| 12 | 1 | HE 160 B | | | | L=1.200 | | | | | |
| | | | Nx | min | 1a | 0 | (2) | 0 | 2.8 | 0 | 0 |
| | | | | max | 1a_1 | 0 | (2) | 0 | −3.0 | 0 | 0 |
| | | | Vy | min | 1a | 0 | (2) | 0 | 2.8 | 0 | 0 |
| | | | | max | 1a_1 | 0 | (2) | 0 | −3.0 | 0 | 0 |
| | | | Vz | min | 1a | 0 | (2) | 0 | 2.8 | 0 | 0 |
| | | | | max | 1a_1 | 0 | (2) | 0 | −3.0 | 0 | 0 |
| | | | Tx | min | 1a | 0 | (2) | **0** | 2.8 | 0 | 0 |
| | | | | max | 1a_1 | 0 | (2) | **0** | −3.0 | 0 | 0 |
| | | | My | min | 1a | 1.200 | (5) | 0 | **−3.6** | 0 | 0 |
| | | | | max | 1a_1 | 1.200 | (5) | 0 | **3.8** | 0 | 0 |
| | | | Mz | min | 1a | 0 | (2) | 0 | 2.8 | **0** | 0 |
| | | | | max | 1a | 1.200 | (5) | 0 | −3.6 | **0** | 0 |
| 13 | 1 | HE 160 B | | | | L=0.830 | | | | | |
| | | | Nx | min | 1a | 0 | (12) | 1.7 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (12) | 1.7 | 0 | 0 | 0 |
| | | | Vy | min | 1a_1 | 0 | (12) | −1.7 | 0 | 0 | 0 |

Beam internal forces [Linear, Envelope (Default), HE 160 B]

| | Sh. | Cross-section name | C | min. max. | Case | Loc. [m] | Node | Nx [kN] | Vy [kN] | Vz [kN] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | max | 1a | 0 | (12) | 0 | **10.9** | −40.8 |
| | | | Vz | min | 1a | 0 | (12) | 0 | 10.9 | **−40.8** |
| | | | | max | 1a_1 | 0 | (12) | 0 | −10.9 | **−0.8** |
| | | | Tx | min | 1a_1 | 0 | (12) | 0 | −10.9 | −0.8 |
| | | | | max | 1a | 0 | (12) | 0 | 10.9 | −40.8 |
| | | | My | min | 1a | 0.830 | (13) | 0 | 10.9 | −40.8 |
| | | | | max | 1a_1 | 0 | (12) | 0 | −10.9 | −0.8 |
| | | | Mz | min | 1a | 0.830 | (13) | 0 | 10.9 | −40.8 |
| | | | | max | 1a_1 | 0.830 | (13) | 0 | −10.9 | −0.8 |
| 14 | 1 | HE 160 B | | | | L=0.830 | | | | |
| | | | Nx | min | 1a | 0 | (13) | **0** | −10.9 | 40.8 |
| | | | | max | 1a | 0 | (13) | **0** | −10.9 | 40.8 |
| | | | Vy | min | 1a | 0 | (13) | 0 | **−10.9** | 40.8 |
| | | | | max | 1a_1 | 0 | (13) | 0 | **10.9** | 0.8 |
| | | | Vz | min | 1a_1 | 0 | (13) | 0 | 10.9 | **0.8** |
| | | | | max | 1a | 0 | (13) | 0 | −10.9 | **40.8** |
| | | | Tx | min | 1a | 0 | (13) | 0 | −10.9 | 40.8 |
| | | | | max | 1a_1 | 0 | (13) | 0 | 10.9 | 0.8 |
| | | | My | min | 1a | 0 | (13) | 0 | −10.9 | 40.8 |
| | | | | max | 1a | 0.830 | (14) | 0 | −10.9 | 40.8 |
| | | | Mz | min | 1a | 0 | (13) | 0 | −10.9 | 40.8 |
| | | | | max | 1a_1 | 0 | (13) | 0 | 10.9 | 0.8 |
| 15 | 1 | HE 160 B | | | | L=0.760 | | | | |
| | | | Nx | min | 1a | 0 | (15) | **0** | 12.2 | 20.0 |
| | | | | max | 1a | 0 | (15) | **0** | 12.2 | 20.0 |
| | | | Vy | min | 1a_1 | 0 | (15) | 0 | **−12.2** | −20.0 |
| | | | | max | 1a | 0 | (15) | 0 | **12.2** | 20.0 |

| | Sh. | Cross-section name | C | min. max. | Case | Loc. [m] | Node | Tx [kNm] | My [kNm] | Mz [kNm] | B [kNm$^2$] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | max | 1a | 0 | (12) | 1.7 | 0 | 0 | 0 |
| | | | Vz | min | 1a | 0 | (12) | 1.7 | 0 | 0 | 0 |
| | | | | max | 1a_1 | 0 | (12) | −1.7 | 0 | 0 | 0 |
| | | | Tx | min | 1a_1 | 0 | (12) | **−1.7** | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (12) | **1.7** | 0 | 0 | 0 |
| | | | My | min | 1a | 0.830 | (13) | 1.7 | **−33.9** | −9.1 | 0 |
| | | | | max | 1a_1 | 0 | (12) | −1.7 | **0** | 0 | 0 |
| | | | Mz | min | 1a | 0.830 | (13) | 1.7 | −33.9 | **−9.1** | 0 |
| | | | | max | 1a_1 | 0.830 | (13) | −1.7 | −0.7 | **9.1** | 0 |
| 14 | 1 | HE 160 B | | | | L=0.830 | | | | | |
| | | | Nx | min | 1a | 0 | (13) | −1.7 | −33.9 | −9.1 | 0 |
| | | | | max | 1a | 0 | (13) | −1.7 | −33.9 | −9.1 | 0 |
| | | | Vy | min | 1a | 0 | (13) | −1.7 | −33.9 | −9.1 | 0 |
| | | | | max | 1a_1 | 0 | (13) | 1.7 | −0.7 | 9.1 | 0 |
| | | | Vz | min | 1a_1 | 0 | (13) | 1.7 | −0.7 | 9.1 | 0 |
| | | | | max | 1a | 0 | (13) | −1.7 | −33.9 | −9.1 | 0 |
| | | | Tx | min | 1a | 0 | (13) | **−1.7** | −33.9 | −9.1 | 0 |
| | | | | max | 1a_1 | 0 | (13) | **1.7** | −0.7 | 9.1 | 0 |
| | | | My | min | 1a | 0 | (13) | −1.7 | **−33.9** | −9.1 | 0 |
| | | | | max | 1a | 0.830 | (14) | −1.7 | **0** | 0 | 0 |
| | | | Mz | min | 1a | 0 | (13) | −1.7 | −33.9 | **−9.1** | 0 |
| | | | | max | 1a_1 | 0 | (13) | 1.7 | −0.7 | **9.1** | 0 |
| 15 | 1 | HE 160 B | | | | L=0.760 | | | | | |
| | | | Nx | min | 1a | 0 | (15) | 1.9 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (15) | 1.9 | 0 | 0 | 0 |
| | | | Vy | min | 1a_1 | 0 | (15) | −1.9 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (15) | 1.9 | 0 | 0 | 0 |

Beam internal forces [Linear, Envelope (Default), HE 160 B]

| | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Nx [kN]* | *Vy [kN]* | *Vz [kN]* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Vz | min | 1a_1 | 0 | (15) | 0 | −12.2 | **−20.0** |
| | | | | max | 1a | 0 | (15) | 0 | 12.2 | **20.0** |
| | | | Tx | min | 1a_1 | 0 | (15) | 0 | −12.2 | −20.0 |
| | | | | max | 1a | 0 | (15) | 0 | 12.2 | 20.0 |
| | | | My | min | 1a_1 | 0.760 | (16) | 0 | −12.2 | −20.0 |
| | | | | max | 1a | 0.760 | (16) | 0 | 12.2 | 20.0 |
| | | | Mz | min | 1a | 0.760 | (16) | 0 | 12.2 | 20.0 |
| | | | | max | 1a_1 | 0.760 | (16) | 0 | −12.2 | −20.0 |
| 16 | 1 | HE 160 B | | | | L=0.760 | | | | |
| | | | Nx | min | 1a | 0 | (16) | **0** | −12.2 | −20.0 |
| | | | | max | 1a | 0 | (16) | **0** | −12.2 | −20.0 |
| | | | Vy | min | 1a | 0 | (16) | 0 | **−12.2** | −20.0 |
| | | | | max | 1a_1 | 0 | (16) | 0 | **12.2** | 20.0 |
| | | | Vz | min | 1a | 0 | (16) | 0 | −12.2 | **−20.0** |
| | | | | max | 1a_1 | 0 | (16) | 0 | 12.2 | **20.0** |
| | | | Tx | min | 1a | 0 | (16) | 0 | −12.2 | −20.0 |
| | | | | max | 1a_1 | 0 | (16) | 0 | 12.2 | 20.0 |
| | | | My | min | 1a_1 | 0 | (16) | 0 | 12.2 | 20.0 |
| | | | | max | 1a | 0 | (16) | 0 | −12.2 | −20.0 |
| | | | Mz | min | 1a | 0 | (16) | 0 | −12.2 | −20.0 |
| | | | | max | 1a_1 | 0 | (16) | 0 | 12.2 | 20.0 |
| Ext. | | | | | | | | | | |
| 12 | 1 | HE 160 B | Nx | min | 1a | 0 | (2) | **−15.5** | 0 | −5.4 |
| 12 | 1 | HE 160 B | | max | 1a_1 | 0 | (2) | **15.5** | 0 | 5.7 |
| 15 | 1 | HE 160 B | Vy | min | 1a_1 | 0 | (15) | 0 | **−12.2** | −20.0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | 0 | **−12.2** | −20.0 |
| 15 | 1 | HE 160 B | | max | 1a | 0 | (15) | 0 | **12.2** | 20.0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 0 | **12.2** | 20.0 |

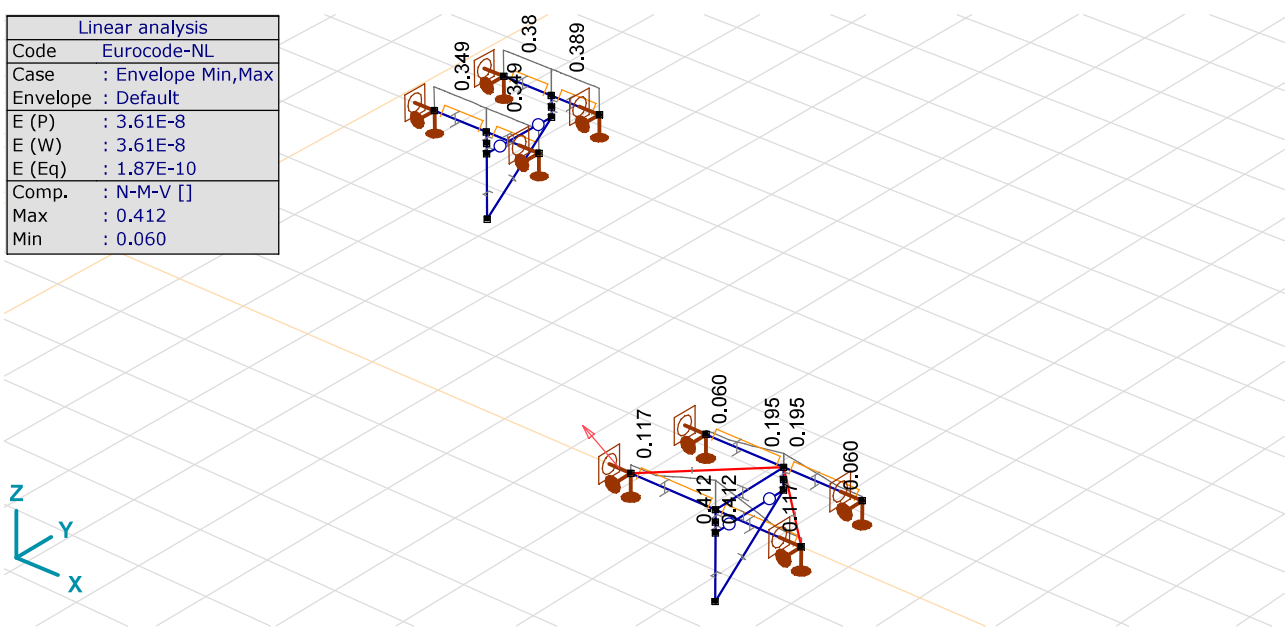
| | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Tx [kNm]* | *My [kNm]* | *Mz [kNm]* | *B [kNm²]* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Vz | min | 1a_1 | 0 | (15) | −1.9 | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (15) | 1.9 | 0 | 0 | 0 |
| | | | Tx | min | 1a_1 | 0 | (15) | **−1.9** | 0 | 0 | 0 |
| | | | | max | 1a | 0 | (15) | **1.9** | 0 | 0 | 0 |
| | | | My | min | 1a_1 | 0.760 | (16) | −1.9 | **−15.2** | 9.3 | 0 |
| | | | | max | 1a | 0.760 | (16) | 1.9 | **15.2** | −9.3 | 0 |
| | | | Mz | min | 1a | 0.760 | (16) | 1.9 | 15.2 | **−9.3** | 0 |
| | | | | max | 1a_1 | 0.760 | (16) | −1.9 | −15.2 | **9.3** | 0 |
| 16 | 1 | HE 160 B | | | | L=0.760 | | | | | |
| | | | Nx | min | 1a | 0 | (16) | −1.9 | 15.2 | −9.3 | 0 |
| | | | | max | 1a | 0 | (16) | −1.9 | 15.2 | −9.3 | 0 |
| | | | Vy | min | 1a | 0 | (16) | −1.9 | 15.2 | −9.3 | 0 |
| | | | | max | 1a_1 | 0 | (16) | 1.9 | −15.2 | 9.3 | 0 |
| | | | Vz | min | 1a | 0 | (16) | −1.9 | 15.2 | −9.3 | 0 |
| | | | | max | 1a_1 | 0 | (16) | 1.9 | −15.2 | 9.3 | 0 |
| | | | Tx | min | 1a | 0 | (16) | **−1.9** | 15.2 | −9.3 | 0 |
| | | | | max | 1a_1 | 0 | (16) | **1.9** | −15.2 | 9.3 | 0 |
| | | | My | min | 1a_1 | 0 | (16) | 1.9 | **−15.2** | 9.3 | 0 |
| | | | | max | 1a | 0 | (16) | −1.9 | **15.2** | −9.3 | 0 |
| | | | Mz | min | 1a | 0 | (16) | −1.9 | 15.2 | **−9.3** | 0 |
| | | | | max | 1a_1 | 0 | (16) | 1.9 | −15.2 | **9.3** | 0 |
| Ext. | | | | | | | | | | | |
| 12 | 1 | HE 160 B | Nx | min | 1a | 0 | (2) | 0 | 2.8 | 0 | 0 |
| 12 | 1 | HE 160 B | | max | 1a_1 | 0 | (2) | 0 | −3.0 | 0 | 0 |
| 15 | 1 | HE 160 B | Vy | min | 1a_1 | 0 | (15) | −1.9 | 0 | 0 | 0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | −1.9 | 15.2 | −9.3 | 0 |
| 15 | 1 | HE 160 B | | max | 1a | 0 | (15) | 1.9 | 0 | 0 | 0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 1.9 | −15.2 | 9.3 | 0 |

Beam internal forces [Linear, Envelope (Default), HE 160 B]

| | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Nx [kN]* | *Vy [kN]* | *Vz [kN]* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | HE 160 B | Vz | min | 1a | 0 | (1) | 0 | 1.9 | **−42.1** |
| 2 | 1 | HE 160 B | | max | 1a | 0 | (2) | 0 | −1.9 | **42.1** |
| 15 | 1 | HE 160 B | Tx | min | 1a_1 | 0 | (15) | 0 | −12.2 | −20.0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | 0 | −12.2 | −20.0 |
| 15 | 1 | HE 160 B | | max | 1a | 0 | (15) | 0 | 12.2 | 20.0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 0 | 12.2 | 20.0 |
| 1 | 1 | HE 160 B | My | min | 1a | 1.230 | (2) | 0 | 1.9 | −42.1 |
| 2 | 1 | HE 160 B | | min | 1a | 0 | (2) | 0 | −1.9 | 42.1 |
| 3 | 1 | HE 160 B | | max | 1a | 1.130 | (5) | 0 | 2.4 | 21.5 |
| 4 | 1 | HE 160 B | | max | 1a | 0 | (5) | 0 | −2.4 | −21.5 |
| 15 | 1 | HE 160 B | Mz | min | 1a | 0.760 | (16) | 0 | 12.2 | 20.0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | 0 | −12.2 | −20.0 |
| 15 | 1 | HE 160 B | | max | 1a_1 | 0.760 | (16) | 0 | −12.2 | −20.0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 0 | 12.2 | 20.0 |

| | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Tx [kNm]* | *My [kNm]* | *Mz [kNm]* | *B [kNm²]* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | HE 160 B | Vz | min | 1a | 0 | (1) | 0.1 | 0 | 0 | 0 |
| 2 | 1 | HE 160 B | | max | 1a | 0 | (2) | −0.1 | −51.8 | −2.3 | 0 |
| 15 | 1 | HE 160 B | Tx | min | 1a_1 | 0 | (15) | **−1.9** | 0 | 0 | 0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | **−1.9** | 15.2 | −9.3 | 0 |
| 15 | 1 | HE 160 B | | max | 1a | 0 | (15) | **1.9** | 0 | 0 | 0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | **1.9** | −15.2 | 9.3 | 0 |
| 1 | 1 | HE 160 B | My | min | 1a | 1.230 | (2) | 0.1 | **−51.8** | −2.3 | 0 |
| 2 | 1 | HE 160 B | | min | 1a | 0 | (2) | −0.1 | **−51.8** | −2.3 | 0 |
| 3 | 1 | HE 160 B | | max | 1a | 1.130 | (5) | 0.1 | **24.3** | −2.7 | 0 |
| 4 | 1 | HE 160 B | | max | 1a | 0 | (5) | −0.1 | **24.3** | −2.7 | 0 |
| 15 | 1 | HE 160 B | Mz | min | 1a | 0.760 | (16) | 1.9 | 15.2 | **−9.3** | 0 |
| 16 | 1 | HE 160 B | | min | 1a | 0 | (16) | −1.9 | 15.2 | **−9.3** | 0 |
| 15 | 1 | HE 160 B | | max | 1a_1 | 0.760 | (16) | −1.9 | −15.2 | **9.3** | 0 |
| 16 | 1 | HE 160 B | | max | 1a_1 | 0 | (16) | 1.9 | −15.2 | **9.3** | 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;



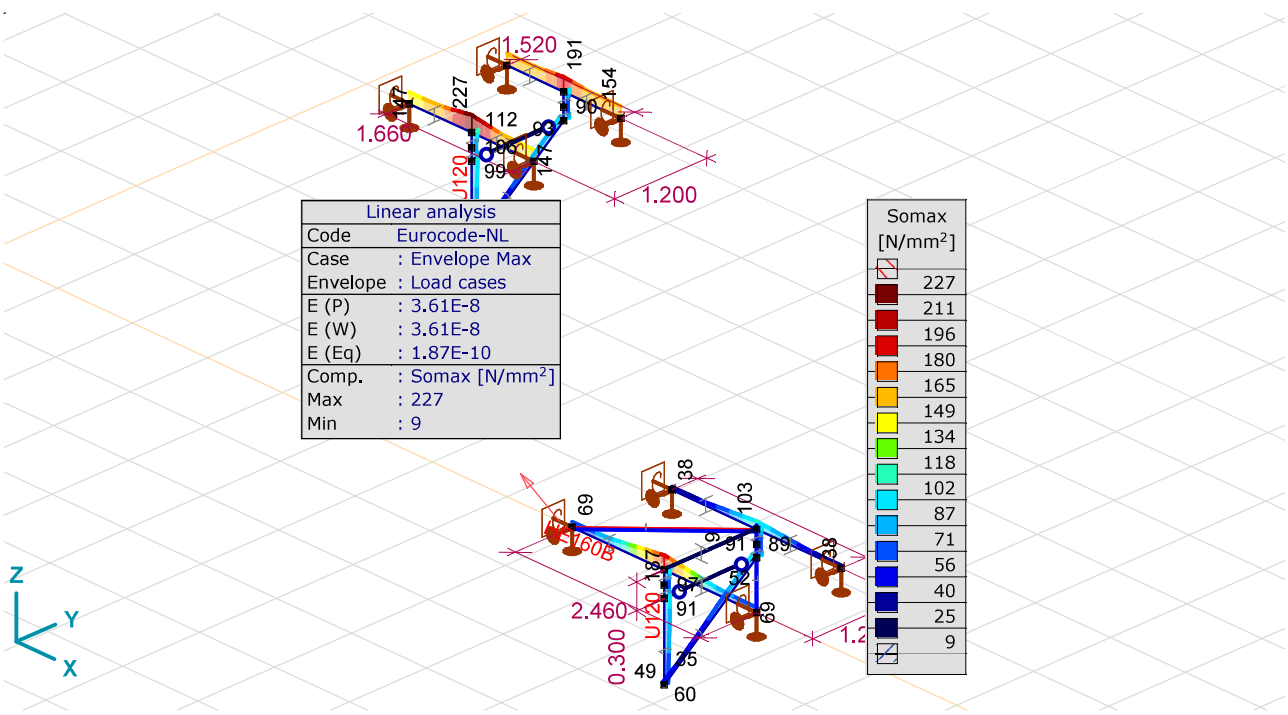

*[Stl], Linear, Envelope (Default), N-M-V [], Diagram*

Beam stresses [Linear, Envelope (Load cases)]

| Ext. | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Smin [N/mm²]* | *Smax [N/mm²]* | *Vmin [N/mm²]* | *Vmax [N/mm²]* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 1 | HE 160 B | Somin | min | 1a | 0.360 | | −6 | 0 | 0 | 5 |
| 13 | 1 | HE 160 B | | max | 1a | 0.830 | (13) | −190 | 190 | 71 | 85 |
| 14 | 1 | HE 160 B | | max | 1a | 0 | (13) | −190 | 190 | 71 | 85 |
| 1 | 1 | HE 160 B | Somax | min | 1a_1 | 0 | (1) | 0 | 0 | 2 | 3 |
| 2 | 1 | HE 160 B | | min | 1a_1 | 1.230 | (3) | 0 | 0 | 2 | 3 |
| 13 | 1 | HE 160 B | | max | 1a | 0.830 | (13) | −190 | 190 | 71 | 85 |
| 14 | 1 | HE 160 B | | max | 1a | 0 | (13) | −190 | 190 | 71 | 85 |

| Ext. | *Sh.* | *Cross-section name* | *C* | *min. max.* | *Case* | *Loc. [m]* | *Node* | *Somin [N/mm²]* | *Somax [N/mm²]* | *Vymean [N/mm²]* | *Vzmean [N/mm²]* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 1 | HE 160 B | Somin | min | 1a | 0.360 | | **0** | 9 | 0 | −1 |
| 13 | 1 | HE 160 B | | max | 1a | 0.830 | (13) | **127** | 227 | 2 | −8 |
| 14 | 1 | HE 160 B | | max | 1a | 0 | (13) | **127** | 227 | −2 | 8 |
| 1 | 1 | HE 160 B | Somax | min | 1a_1 | 0 | (1) | 3 | **4** | 0 | 0 |
| 2 | 1 | HE 160 B | | min | 1a_1 | 1.230 | (3) | 3 | **4** | 0 | 0 |
| 13 | 1 | HE 160 B | | max | 1a | 0.830 | (13) | 127 | **227** | 2 | −8 |
| 14 | 1 | HE 160 B | | max | 1a | 0 | (13) | 127 | **227** | −2 | 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;




*[I], Linear, Envelope Max (Load cases), Somax [N/mm^2], Filled diagram*

# Project: DLE

## Constructeur: DNV GL - Energy

AxisVM X6 R1h · Registered to DNV GL - Energy
bottom_chord_s+32_check.axs

## Rapport

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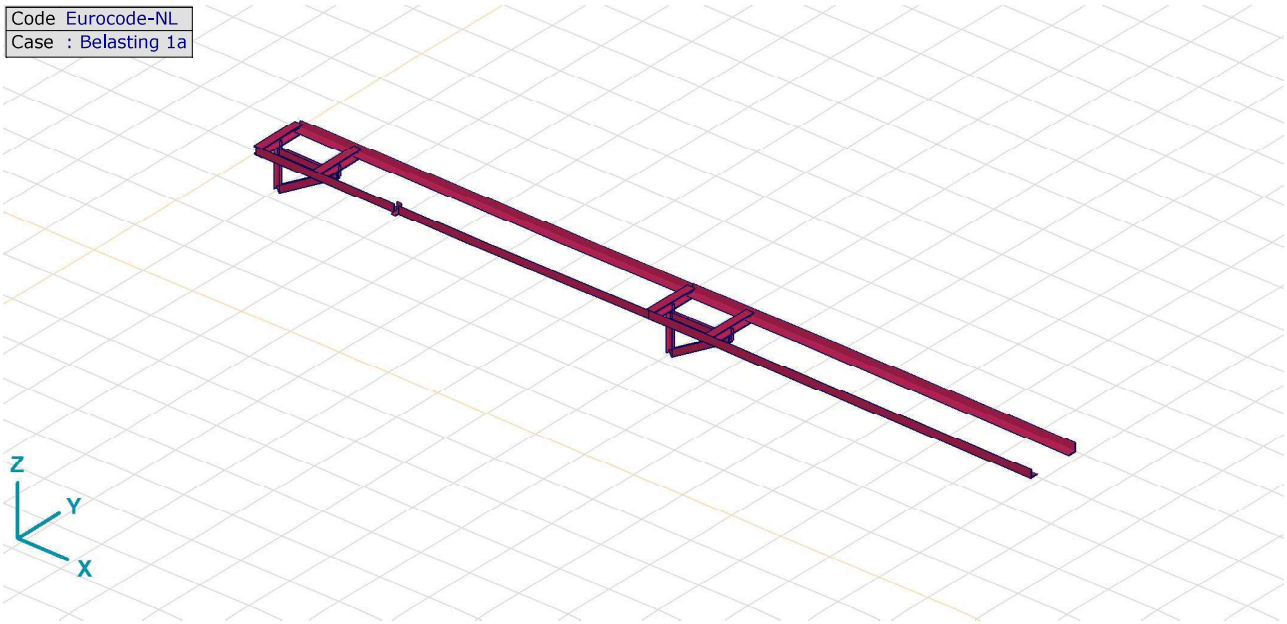



*Tekening render*

## Cross-sections

| | Name | Drawing | Process | Shape | h [mm] | b [mm] | tw [mm] | tf [mm] | $r_1$ [mm] | $r_2$ [mm] | $r_3$ [mm] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | L 160X160X15 | | Rolled | L | 160.0 | 160.0 | 15.0 | 15.0 | 17.0 | 8.5 | 0 |
| 2 | L 150X150X12 | | Rolled | L | 150.0 | 150.0 | 12.0 | 12.0 | 16.0 | 8.0 | 0 |
| 3 | L 180X180X16 | | Rolled | L | 180.0 | 180.0 | 16.0 | 16.0 | 18.0 | 9.0 | 0 |
| 4 | HE 160 B | | Rolled | I | 160.0 | 160.0 | 8.0 | 13.0 | 15.0 | 0 | 0 |
| 5 | U 120 | | Rolled | U | 120.0 | 55.0 | 7.0 | 9.0 | 9.0 | 4.5 | 0 |

| | Name | Ax [mm²] | Ay [mm²] | Az [mm²] | Ix [mm⁴] | Iy [mm⁴] | Iz [mm⁴] | Iyz [mm⁴] |
|---|---|---|---|---|---|---|---|---|
| 1 | L 160X160X15 | 4606.15 | 2011.73 | 2029.76 | 365558.200 | 1.099E+07 | 1.099E+07 | −6461627.000 |
| 2 | L 150X150X12 | 3483.60 | 1505.64 | 1521.61 | 179274.100 | 7368515.000 | 7368513.000 | −4334081.000 |
| 3 | L 180X180X16 | 5538.93 | 2403.86 | 2433.89 | 499973.800 | 1.682E+07 | 1.682E+07 | −9905372.000 |
| 4 | HE 160 B | 5426.04 | 3754.44 | 1237.48 | 317826.300 | 2.492E+07 | 8892444.000 | 0 |
| 5 | U 120 | 1698.73 | 617.80 | 752.09 | 41830.660 | 3643327.000 | 430614.100 | 0 |

| | Name | $I_1$ [mm⁴] | $I_2$ [mm⁴] | α [°] | Iω [mm⁶] | $W_{1,el,t}$ [mm³] | $W_{1,el,b}$ [mm³] |
|---|---|---|---|---|---|---|---|
| 1 | L 160X160X15 | 1.745E+07 | 4525910.000 | 45.00 | 6.2E+08 | 154230.300 | 154230.300 |
| 2 | L 150X150X12 | 1.17E+07 | 3034433.000 | 45.00 | 2.7E+08 | 110333.100 | 110333.100 |
| 3 | L 180X180X16 | 2.673E+07 | 6917778.000 | 45.00 | 1.1E+09 | 209999.100 | 209999.100 |
| 4 | HE 160 B | 2.492E+07 | 8892443.000 | 0 | 4.7E+10 | 311542.700 | 311542.700 |
| 5 | U 120 | 3643327.000 | 430614.100 | 0 | 8.9E+08 | 60722.120 | 60722.120 |

| | Name | $W_{2,el,t}$ [mm³] | $W_{2,el,b}$ [mm³] | $W_{1,pl}$ [mm³] | $W_{2,pl}$ [mm³] | $i_y$ [mm] | $i_z$ [mm] | Hy [mm] | Hz [mm] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | L 160X160X15 | 79787.940 | 71275.720 | 243874.600 | 124879.600 | 48.8 | 48.8 | 160.0 | 160.0 |
| 2 | L 150X150X12 | 57321.540 | 52048.100 | 173526.600 | 89044.110 | 46.0 | 46.0 | 150.0 | 150.0 |
| 3 | L 180X180X16 | 108387.800 | 97377.670 | 331133.400 | 169336.000 | 55.1 | 55.1 | 180.0 | 180.0 |
| 4 | HE 160 B | 111155.500 | 111155.500 | 354020.600 | 169972.200 | 67.8 | 40.5 | 160.0 | 160.0 |
| 5 | U 120 | 11058.300 | 26813.420 | 72702.590 | 21257.590 | 46.3 | 15.9 | 55.0 | 120.0 |

| | Name | $y_G$ [mm] | $z_G$ [mm] | $y_s$ [mm] | $z_s$ [mm] | $\beta_y$ [mm] | $\beta_z$ [mm] | $\beta_w$ [] | S.p. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | L 160X160X15 | 44.9 | 44.9 | −36.2 | −36.2 | 146.2 | 146.2 | 0 | 4 |
| 2 | L 150X150X12 | 41.2 | 41.2 | −34.2 | −34.2 | 138.8 | 138.8 | 0 | 4 |
| 3 | L 180X180X16 | 50.2 | 50.2 | −41.0 | −41.0 | 165.5 | 165.5 | 0 | 4 |
| 4 | HE 160 B | 80.0 | 80.0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 5 | U 120 | 16.1 | 60.0 | −29.6 | 0 | 0 | 122.3 | 0 | 8 |

**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; **$\beta_y$, $\beta_z$, $\beta_w$:** Wagner's coefficient; **S.p.:** Stress calculation points;

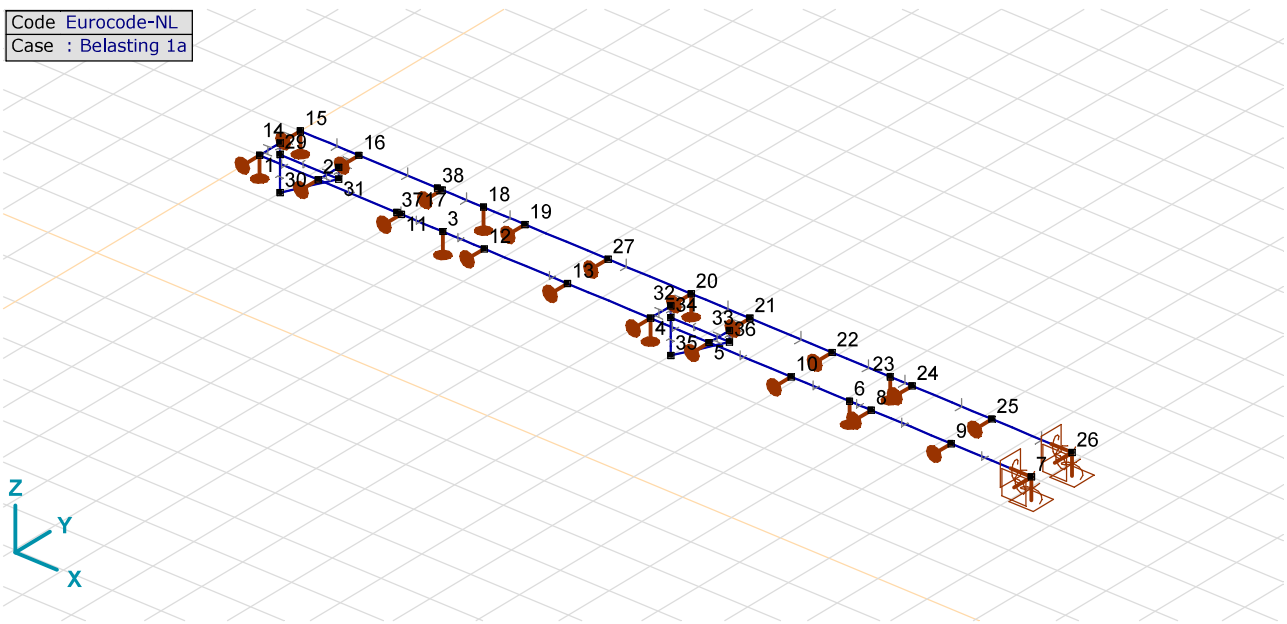
## Materials

| | *Name* | *Type* | *National design code* | *Material code* | *Model* | *$E_x$ [N/mm²]* | *$E_y$ [N/mm²]* |
|---|---|---|---|---|---|---|---|
| 1 | S 235 | Steel | Eurocode-NL | 10025-2 | Linear | 210000 | 210000 |

| | *Name* | *ν* | *$\alpha_T$ [1/°C]* | *ρ [kg/m³]* | *Material color* | *Contour color* | *Texture* | *$P_1$* | *$P_2$* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | S 235 | 0.30 | 1.2E-5 | 7850 | | | Steel | $f_y$[N/mm²] = 235.00 | $f_u$[N/mm²] = 360.00 |

| | *Name* | *$P_3$* | *$P_4$* | *$P_5$* | *$P_6$* | *$P_7$* | *$P_8$* | *$P_9$* | *$P_{10}$* | *$P_{11}$* | *$P_{12}$* | *$P_{13}$* | *$P_{14}$* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S 235 | $f_y^*$[N/mm²] = 215.00 | $f_u^*$[N/mm²] = 360.00 | | | | | | | | | | |

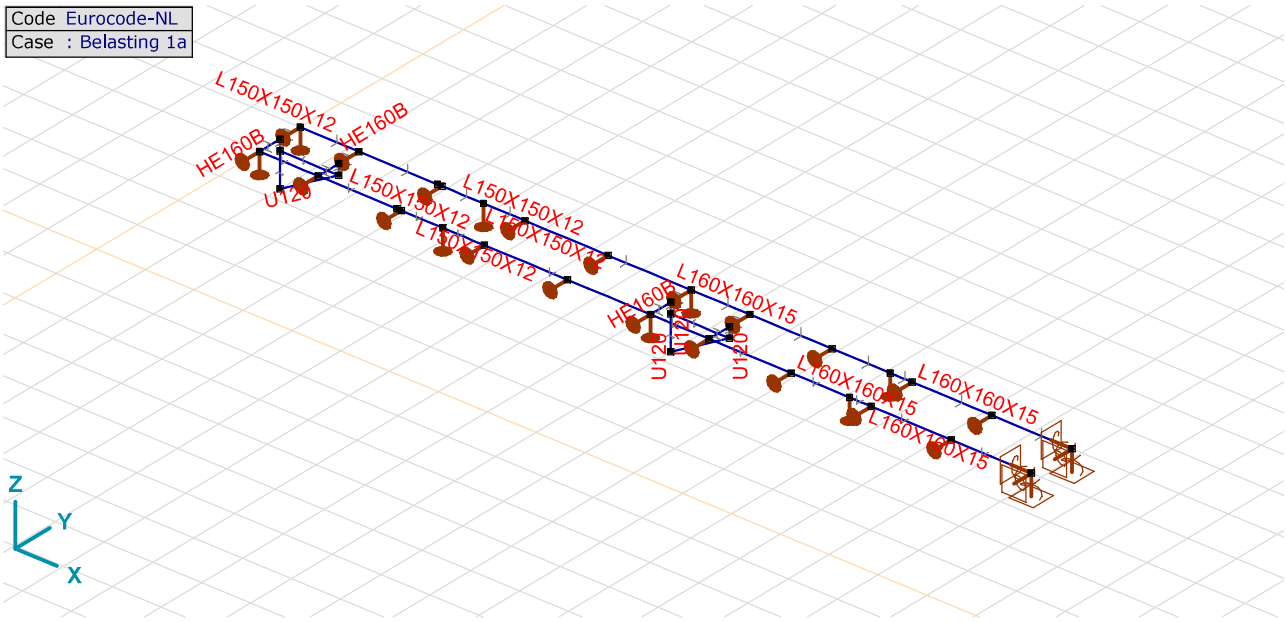
**Name:** Material name; **Type:** Type of material; **Model:** Material model; **$E_x$:** Young's modulus of elasticity in local x direction; **$E_y$:** Young's modulus of elasticity in local y direction; **ν:** Poisson's ratio; **$\alpha_T$:** Thermal expansion coefficient; **ρ:** Density; **Contour 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;



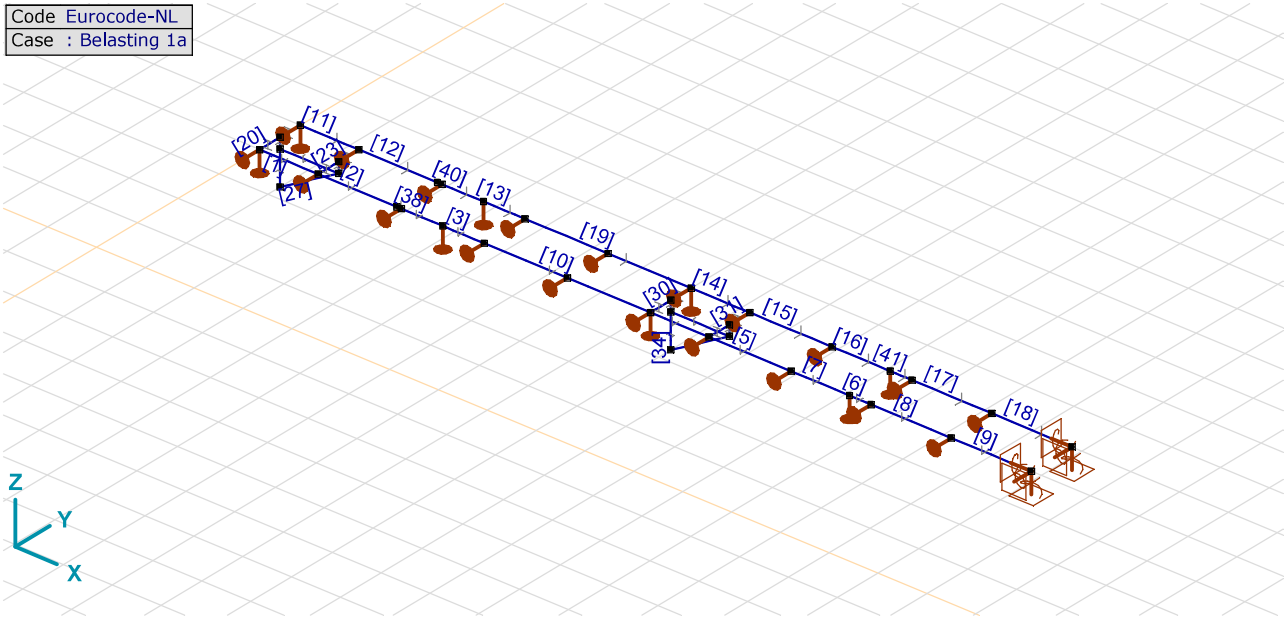

*Tekening knopen*

## Nodes

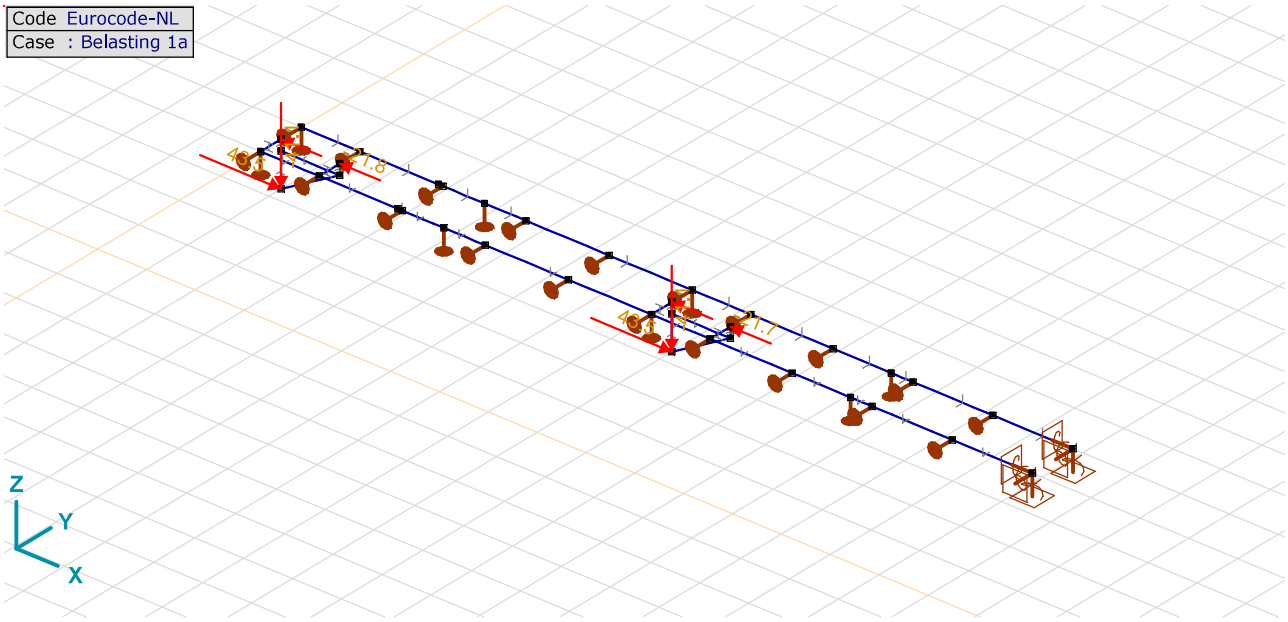
| | *X [m]* | *Y [m]* | *Z [m]* |
|---|---|---|---|
| 1 | 0 | 4.000 | 0 |
| 2 | 1.200 | 4.000 | 0 |
| 3 | 3.750 | 4.000 | 0 |
| 4 | 8.000 | 4.000 | 0 |
| 5 | 9.200 | 4.000 | 0 |
| 6 | 12.075 | 4.000 | 0 |
| 7 | 15.796 | 4.000 | 0 |
| 8 | 12.520 | 4.000 | 0 |
| 9 | 14.158 | 4.000 | 0 |
| 10 | 10.883 | 4.000 | 0 |
| 11 | 2.900 | 4.000 | 0 |
| 12 | 4.600 | 4.000 | 0 |
| 13 | 6.300 | 4.000 | 0 |
| 14 | 0 | 4.500 | 0 |
| 15 | 0 | 5.000 | 0 |
| 16 | 1.200 | 5.000 | 0 |
| 17 | 2.900 | 5.000 | 0 |
| 18 | 3.750 | 5.000 | 0 |
| 19 | 4.600 | 5.000 | 0 |
| 20 | 8.000 | 5.000 | 0 |
| 21 | 9.200 | 5.000 | 0 |
| 22 | 10.883 | 5.000 | 0 |
| 23 | 12.075 | 5.000 | 0 |
| 24 | 12.520 | 5.000 | 0 |
| 25 | 14.158 | 5.000 | 0 |
| 26 | 15.796 | 5.000 | 0 |
| 27 | 6.300 | 5.000 | 0 |
| 28 | 1.200 | 4.500 | 0 |
| 29 | 0 | 4.500 | −0.210 |
| 30 | 0 | 4.500 | −0.900 |
| 31 | 1.200 | 4.500 | −0.210 |
| 32 | 8.000 | 4.500 | 0 |
| 33 | 9.200 | 4.500 | 0 |
| 34 | 8.000 | 4.500 | −0.210 |
| 35 | 8.000 | 4.500 | −0.900 |
| 36 | 9.200 | 4.500 | −0.210 |
| 37 | 2.808 | 4.000 | 0 |
| 38 | 2.808 | 5.000 | 0 |



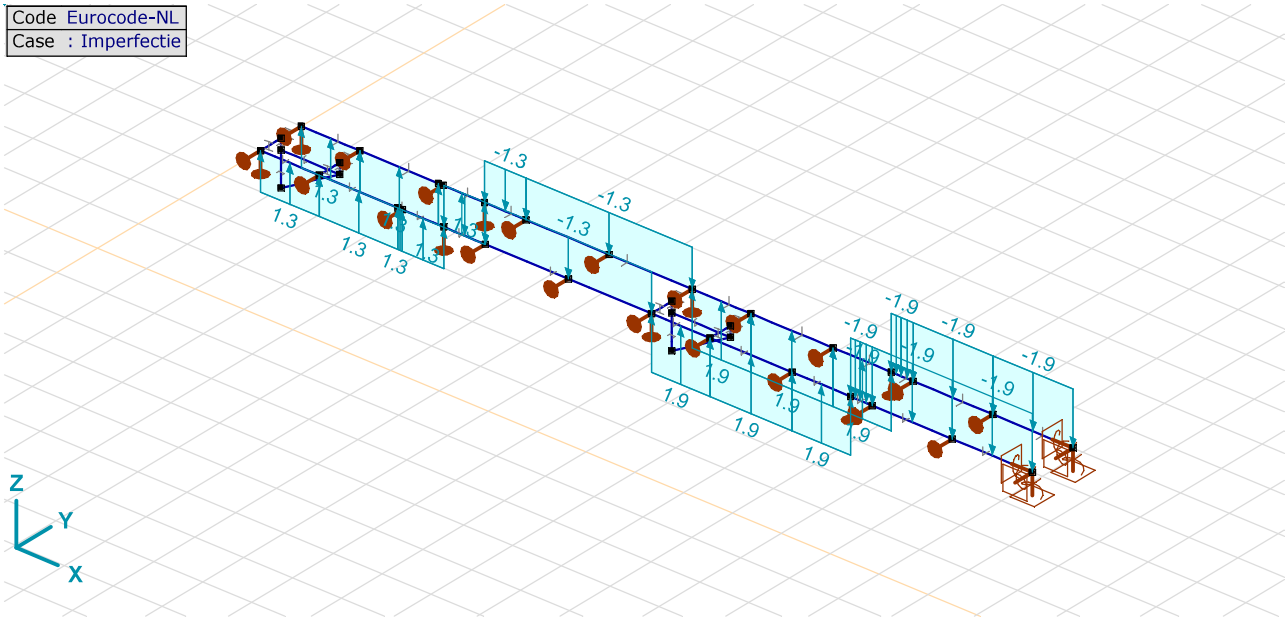

*Tekening profielen*



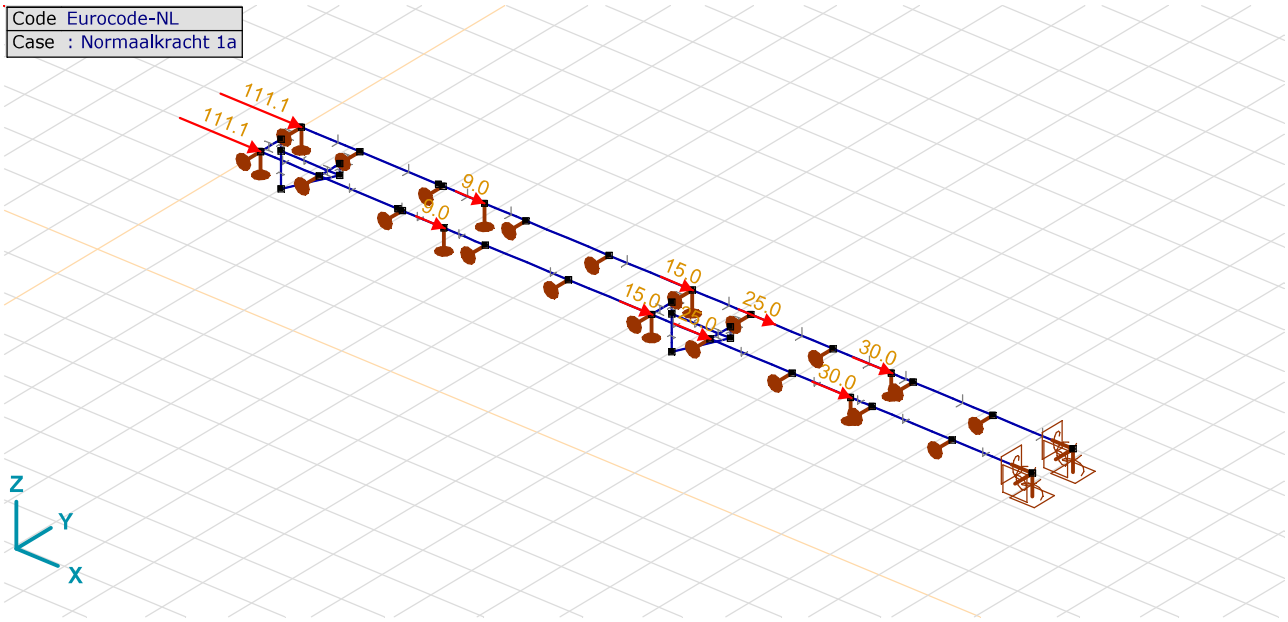

*Tekening staven*




*Belasting 1a*




*Imperfectie*

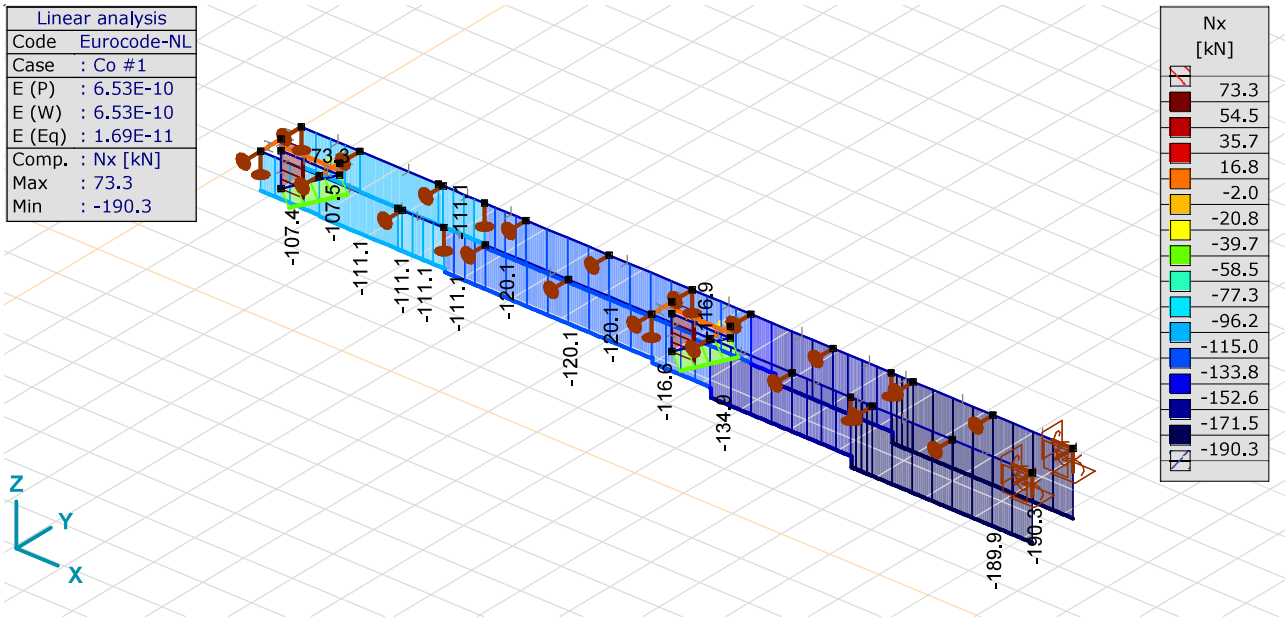



*Normaalkracht 1a*

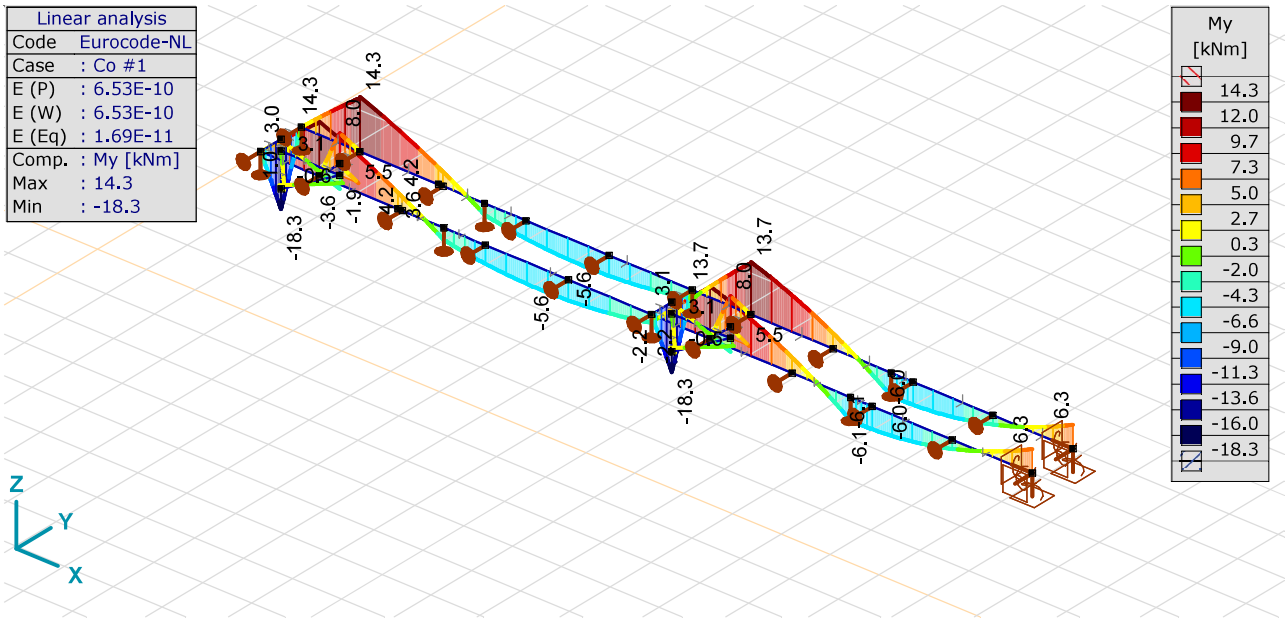
## Custom load combinations by load cases

| | *Name* | *Type* | *Belasting 1a* | *Normaalkracht 1a* | *Imperfectie* | *Comment* |
|---|---|---|---|---|---|---|
| 1 | Co #1 | ULS | 1.00 | 1.00 | 1.00 | |

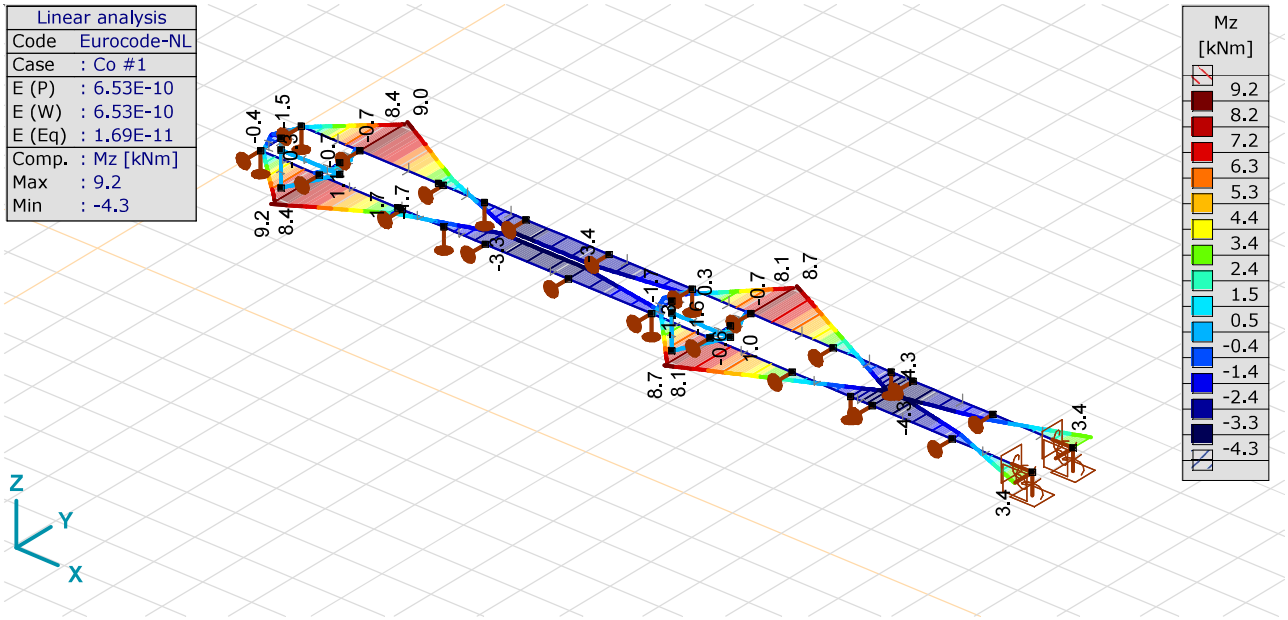
**Name:** Load combination name; **Type:** Load combination type; **Belasting 1a, Normaalkracht 1a, Imperfectie:** Factor;



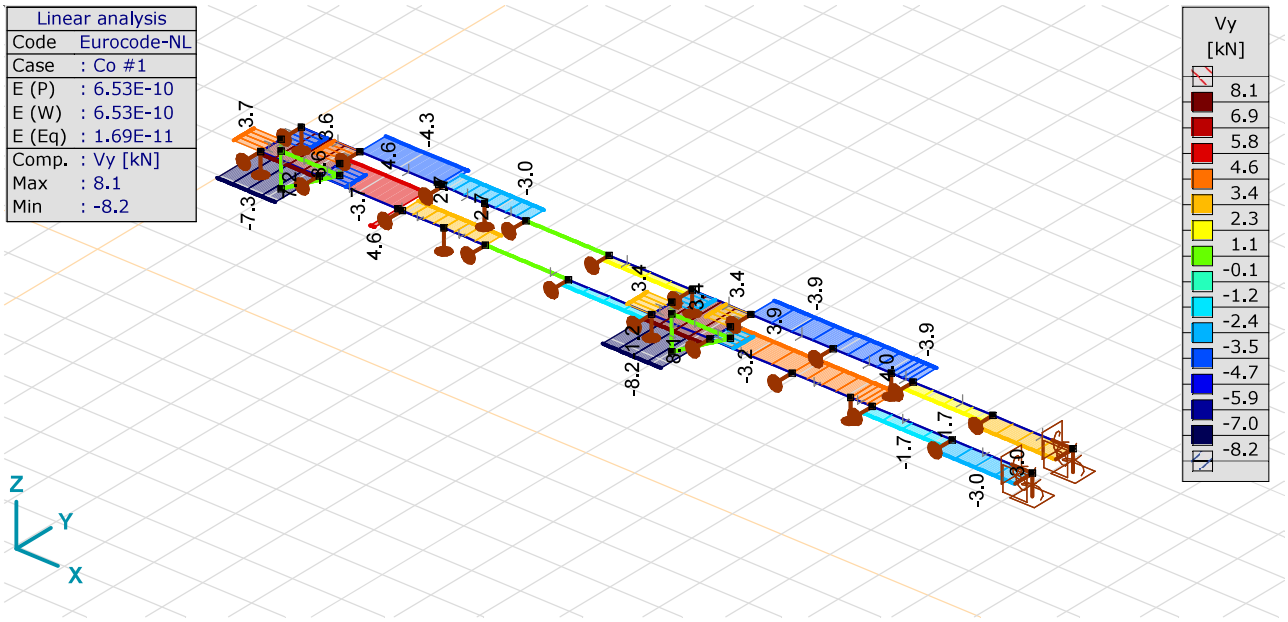

*[I], Linear, Co #1 (ULS), Nx [kN], Filled diagram*



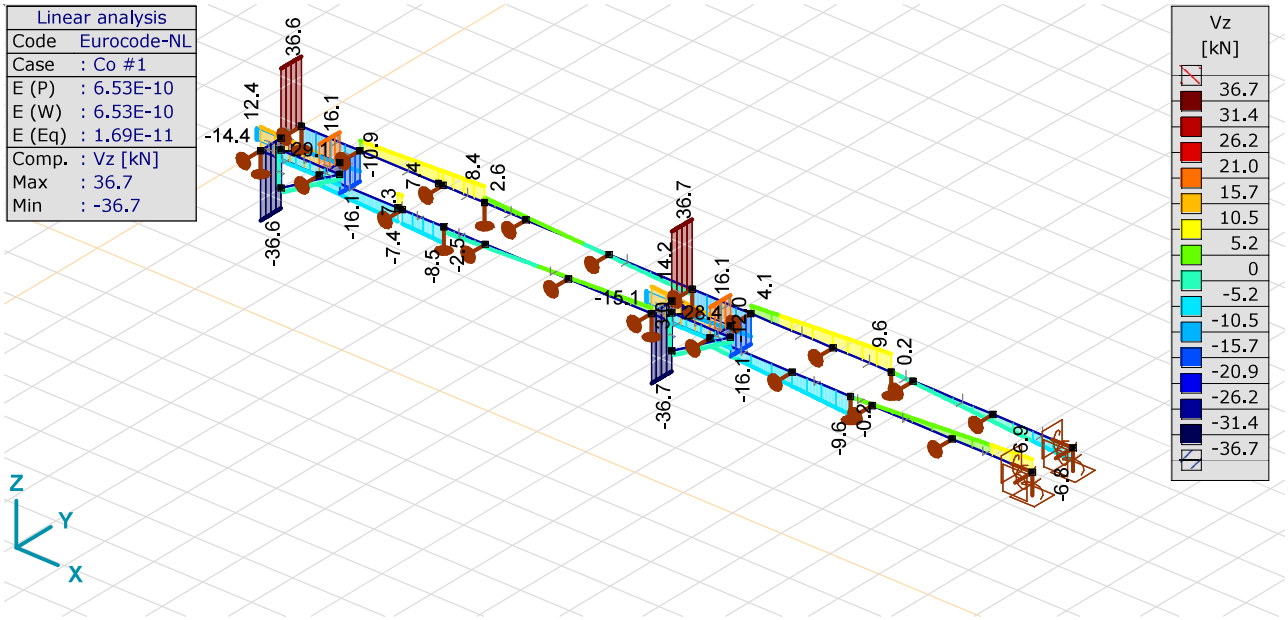

*[I], Linear, Co #1 (ULS), My [kNm], Filled diagram*




*[I], Linear, Co #1 (ULS), Mz [kNm], Filled diagram*

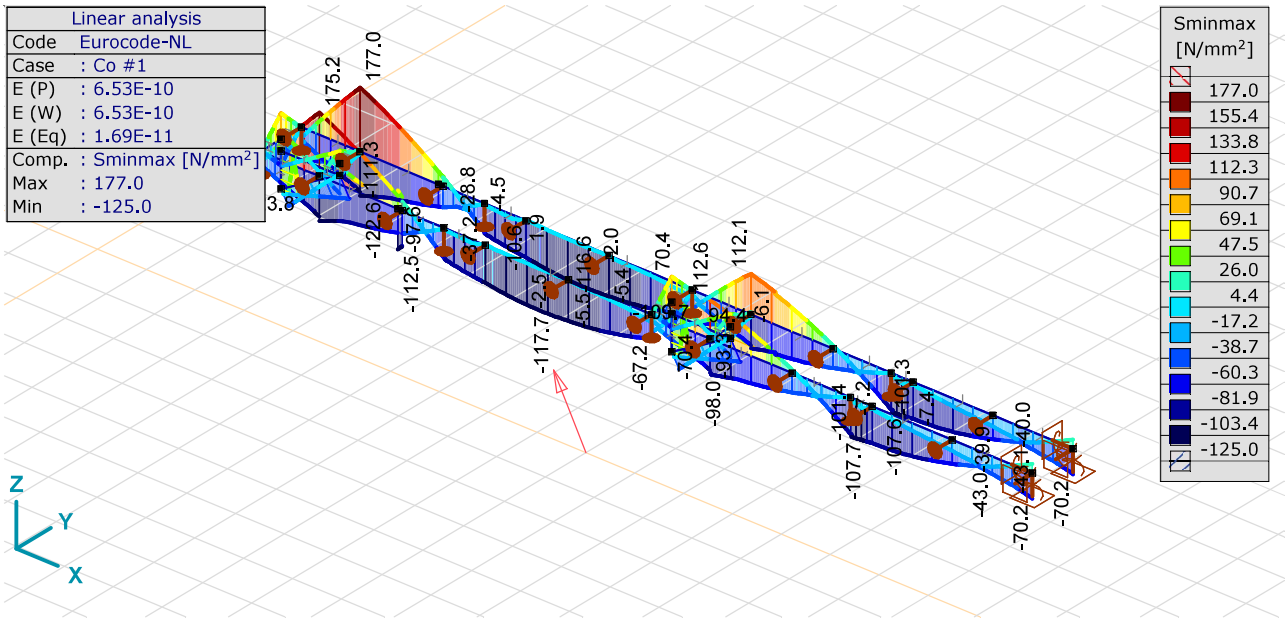



*[I], Linear, Co #1 (ULS), Vy [kN], Filled diagram*

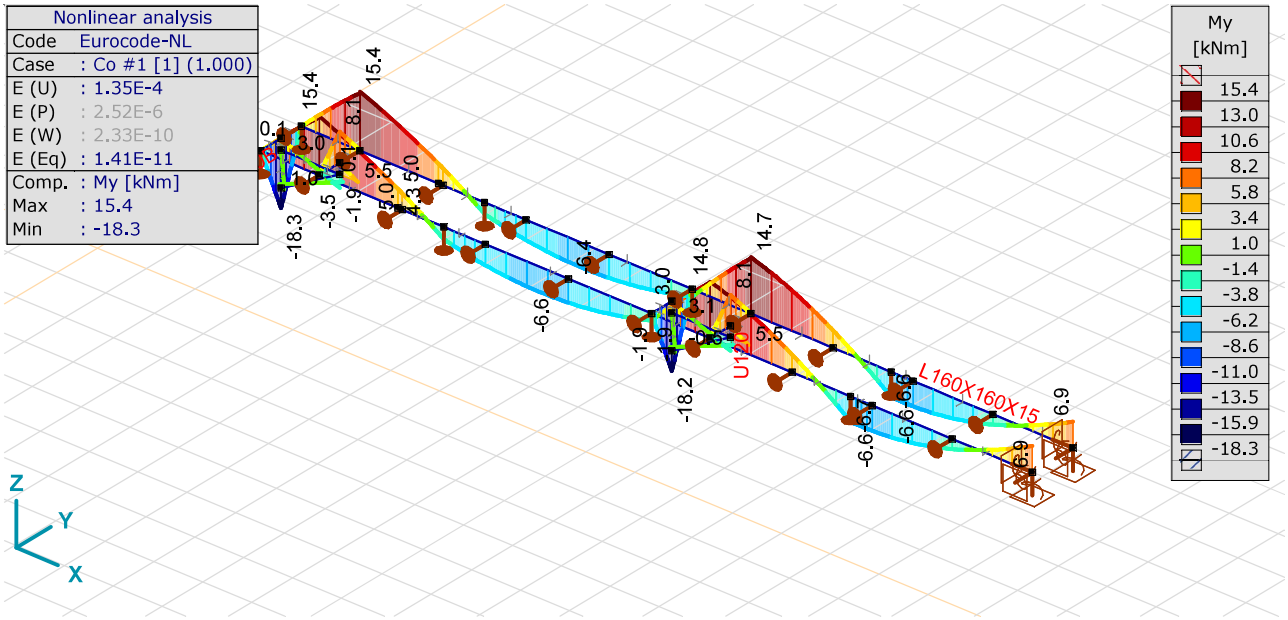



*[I], Linear, Co #1 (ULS), Vz [kN], Filled diagram*

**Project: DLE**
Constructeur: DNV GL - Energy
Model: **bottom_chord_s+32_check.axs** 7/15/2021 Page 11



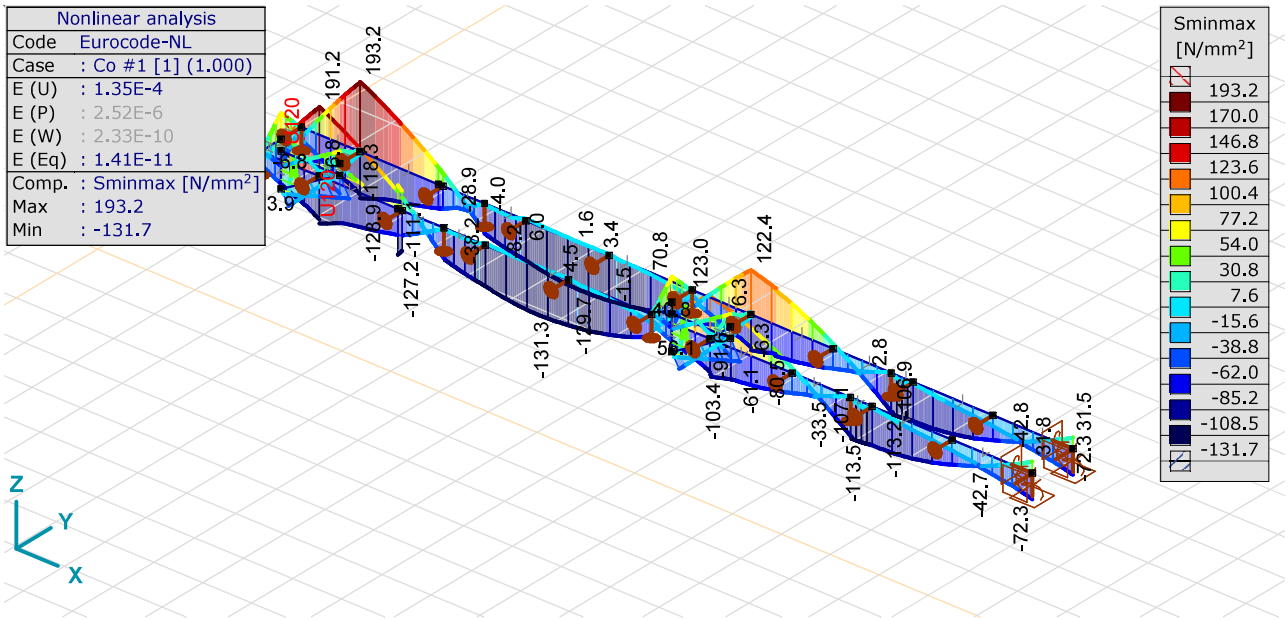

*[I], Linear, Co #1 (ULS), Sminmax [N/mm^2], Filled diagram*




*[II], Nonlin., Co #1 [1] (1.000), Initial deflection, My [kNm], Filled diagram*

# Project: DLE

Constructeur: DNV GL - Energy
Model: **bottom_chord_s+32_check.axs** 7/15/2021 Page 12




*[II], Nonlin., Co #1 [1] (1.000), Initial deflection, Sminmax [N/mm^2], Filled diagram*

# APPENDIX F
## Galloping

Niet van toepassing voor dit masttype.

## About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.