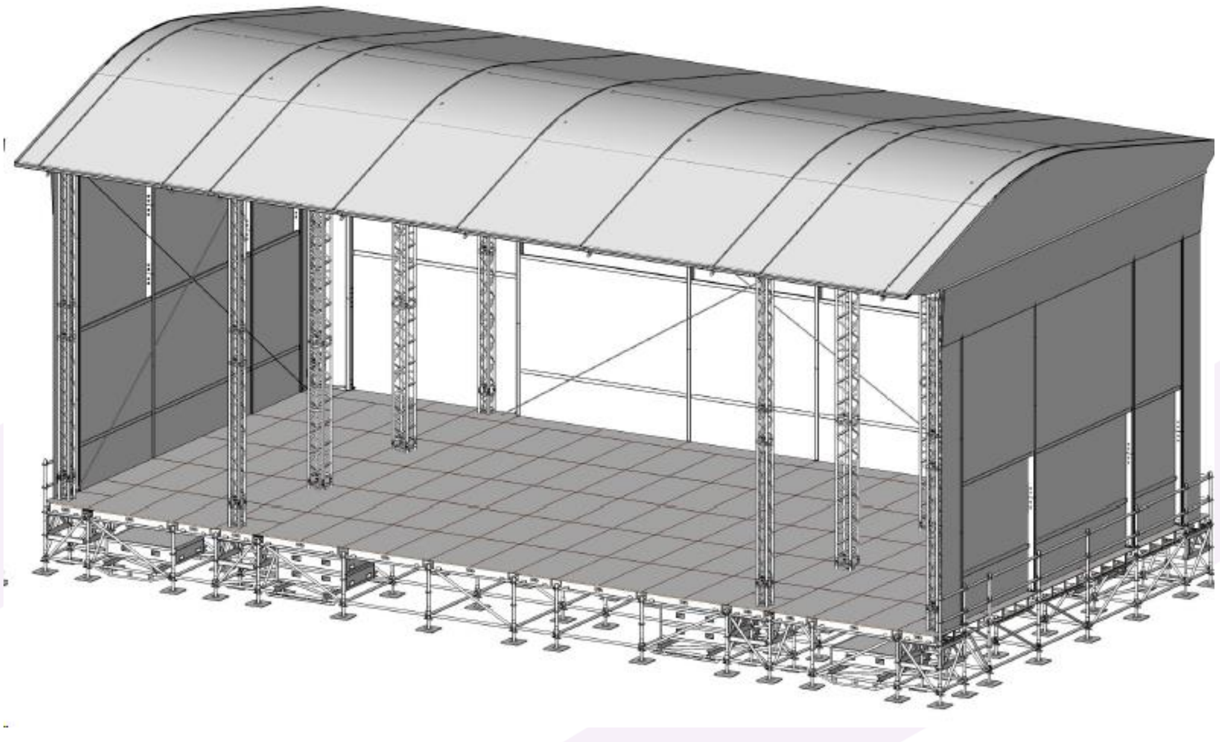
PODIUM – BOEK XLT

Eekels Verhuur 112023-19



Inhoudsopgave

Voorwoord

Opdrachtgevers en organisatoren, alsmede gemeentelijke diensten hebben behoefte aan handvatten voor de beoordeling van kwaliteit en specificaties van overdekte podia die tijdelijk geplaatst worden. Met als doel het inzichtelijk krijgen van waar gehuurde overdekte podia aan moeten voldoen op gebied van onder meer brandveiligheid- en constructieve veiligheid. Een van de is om een podium-boek op te stellen waarin deze zaken overzichtelijk en begrijpelijk worden weergeven, dit op een vergelijkbare manier hoe een tentboek wordt samengesteld.

In het veld worden diverse termen gebruikt voor het overdekken van een podium; kap, dak, stage, overkapping. In essentie betreft het in dit bouwboek een podium wat voorzien is van een constructie welke zorgdraagt voor (gedeeltelijke) beschutting van de elementen.

In de bijlagen komen zaken aan de orde als tekeningen, kwaliteitsverklaringen, constructieve berekenen en andere informatie welke verder relevant is.
In de normen welke gaan over de overdekte podia worden kwaliteitsverklaringen, constructieve berekeningen en andere relevante stukken genoemd. Hierin staat gesteld dat deze stukken niet in de Nederlandse taal opgesteld hoeven te zijn, eventuele aanvullende toelichtingen en handleidingen wel. Het voorwoord en handleidingen die minimaal in het podium-boek moeten staan worden gezien als toelichting. Andere zaken dan de toelichting(en) in het podium-boek mogen in het Duits, Frans of Engels aangeleverd worden.

Het gebruik van het overdekte podium is geen onderwerp van het podium-boek.

Binnen het NEN lopen nog een aantal andere trajecten die te maken hebben met evenementen, allemaal beginnende met: 8020-

Een aantal, al dan niet Europese, algemeen gehanteerde normen en richtlijnen die te maken hebben met overdekte podia welke tijdelijk geplaatst worden zijn o.a.:

NPR 8020-50	Evenementen – Podiumconstructies – Verantwoordelijkheden
NPR 8020-51	Evenementen – Podiumconstructies – Belastingen en constructieve uitgangspunten

NEN-EN 13814	Machines en constructies op kermisterreinen en amusementsparken – Veiligheid
NEN-EN 1990	Grondslagen van het constructief ontwerp
NEN-EN 1991	Belastingen op constructies
NEN-EN 1993	Staalconstructies

Bovenstaande normen- en richtlijnen refereren o.a. aan de Eurocodes NEN-EN 1991-1-4/NB;

Deel 1: Belastingen op constructies
Deel 1-4: Algemene belastingen – Windbelasting.

Een tijdelijk geplaatst overdekt podium is in beginsel geen bouwwerk in de zin van het bouwbesluit. Hieruit voortvloeiende kan er daarom niet automatisch naar het bouwbesluit of andere zaken worden gekeken als het gaat om beoordeling van een tijdelijk geplaatst overdekt podium. Hier moeten dus ook de eerder genoemde normen- en richtlijnen naast gehouden worden.

Keuringsrapporten voor zeil, bijvoorbeeld bepaald volgens B1 of M1, zijn doorgaans voorzien van een geldigheidsdatum. Deze datum heeft alleen betrekking op het productieproces van het zeil en niet op het product. Het zegt niets over het (brand)verloop van de kwaliteit van het materiaal. Zeil dat voldoet aan de gestelde eisen blijft zelfdovend. Dit gegeven is mede onderschreven door het LNB, cluster brandveilig gebruik.

Overdekte podia zijn onder te verdelen in:

- (gedeeltelijk) met zijwanden van harde panelen of zeil
- zonder zijwanden
- voorzien van meer bouwlagen

Het gebruik van dit podium-boek is slechts voorbehouden aan Eekels Verhuur B.V..
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5530 AB Bladel
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E: info@eekelsverhuur.nl
I: www.eekelsverhuur.nl

NOODNUMMER: +31 0 467 870 112

1. Algemene informatie

In dit hoofdstuk worden alle gegevens van de fabrikant en algemene gegevens overdekte podia indien deze buiten Europa is geproduceerd, tevens naam van importeur.

1.1 Algemene gegevens fabrikant(en);

Zeil	**POLYMAR – FR COLOR 700**
Constructie	Prolyte H30D – H40V – H30V/S40T – S52F
Type zeil	PVC; artikel 8509 5240

1.2 Algemene gegevens;

Naam	**XLT ROOF**
Type	XLT
Configuratie(s)	22x11 meter

2 Gegevens verhuurder of leverancier

Hieronder wordt alle huidige en relevante informatie weergegeven van de verhuurder/leverancier.

Rechtsvorm	Besloten Vennootschap
Handelsnaam	Eekels Verhuur B.V.
Bezoekadres	Hallenstraat 20 5531 AB BLADEL
Postadres	P.O. Box 175 5530 AD BLADEL
Telefoonnummer	0031 73 6136867
Website	www.eekelsverhuur.nl
Mailadres	info@eekelsverhuur.nl
K.v.K. nummer	84151722
Omzetbelasting nummer	NL863114192B01
Bank	Rabobank de Kempen
IBAN Rekening nummer	NL43RABO0374476608
BIC	RABONL2U

3 Algemene technische gegevens van de overdekte podia

Waar dient de huurder ten alle tijden rekening mee te houden bij de ingebruikname van het overdekte podium.

3.1 Algemeen

- Geen sneeuw- en/of hagelbelasting gerekend
- Podiumvloer is geschikt voor een belasting tot 750 kg/m2
- Obstakels moeten ten minste 0,5 meter van het doek verwijderd zijn (zowel binnen als buiten).

3.2 Bijzonderheden

Voor de berekeningen is aangehouden:

- Onbebouwde omgeving;
- Tekeningen volgens het bouwboek;
- Toetsing volgens NEN-EN 13814;
- Afmeting van de constructie: 22x11 meter

4 Basis instandhouding- en ontruimingsprotocol

Er zijn zaken welke in basis ten alle tijden van toepassing zijn bij een overdekt podium.

- De constructie van de overdekte podia mogen na oplevering nooit zo worden aangetast dat de constructieve veiligheid in het geding komt.
- Organisator moet grondankers, ballast, windverbanden, spanbanden, palen, wandpanelen, zeilen of andere zaken na losmaken voor welk doel dan ook direct weer terugplaatsen/vastmaken.
- Bij het verlaten van het terrein en/of afsluiten van dagelijkse werkzaamheden en/of na afloop van het evenement moet organisator waar mogelijk de toegang tot het overdekte podia sluiten of niet toegankelijk maken.
- Het overdekte podia moet(en) te allen tijde door organisator sneeuw- en of hagelvrij gehouden worden.
- Cumulatie van water, z.g. waterzakken, moeten door organisator direct verwijderd worden, indien dit niet lukt moet verhuurder meteen verwittigd worden.
- Eventuele loskomende grondverankering of verschuivende ballast moet door organisator direct gemeld worden aan verhuurder.
- Voor opgave gemiddelde wind in Bft. en windstoten. (piekwind) in relatie tot de grenswaarden, het sluiten of buiten gebruik stellen van het overdekte podium zie windtabel(len) elders in dit stuk. Daarbij dienen de beheersmaatregelen uit bijlage 4 in acht genomen te worden.
- Equipotentiaalverbinding. Al het blootliggende metaalwerk binnen een structuur dat in contact zou kunnen komen met een bron van elektrische stroom moet op adequate wijze geaard zijn. Er moet rekening worden gehouden met de mate van blootstelling en het risico op blikseminslag en, waar van toepassing, moet de constructie voldoende worden beschermd. Advies over verlichtingsniveaus voor normaal en noodgebruik valt buiten het toepassingsgebied van deze norm en is elders beschikbaar.
- Blikseminslag in de constructie die voldoet aan gestelde (brandveiligheidseisen levert geen schade op aan de overdekte podia).
- Bij acute dreiging van zwaar onweer gepaard gaande met z.g. valwind en/of hagel moet het overdekte podium en directe omgeving ontruimd-, en indien mogelijk gesloten worden. Het overdekte podium is hierin van ondergeschikt belang.
- Organisator moet het lokale weer tijdens het evenement adequaat bewaken en actie ondernemen waar eigen organisatieprotocollen of overdekte podiumspecificaties dit aangeven.

5 Verklaring weeromstandigheden

Met welke weersomstandigheden dient de huurder rekening te houden.

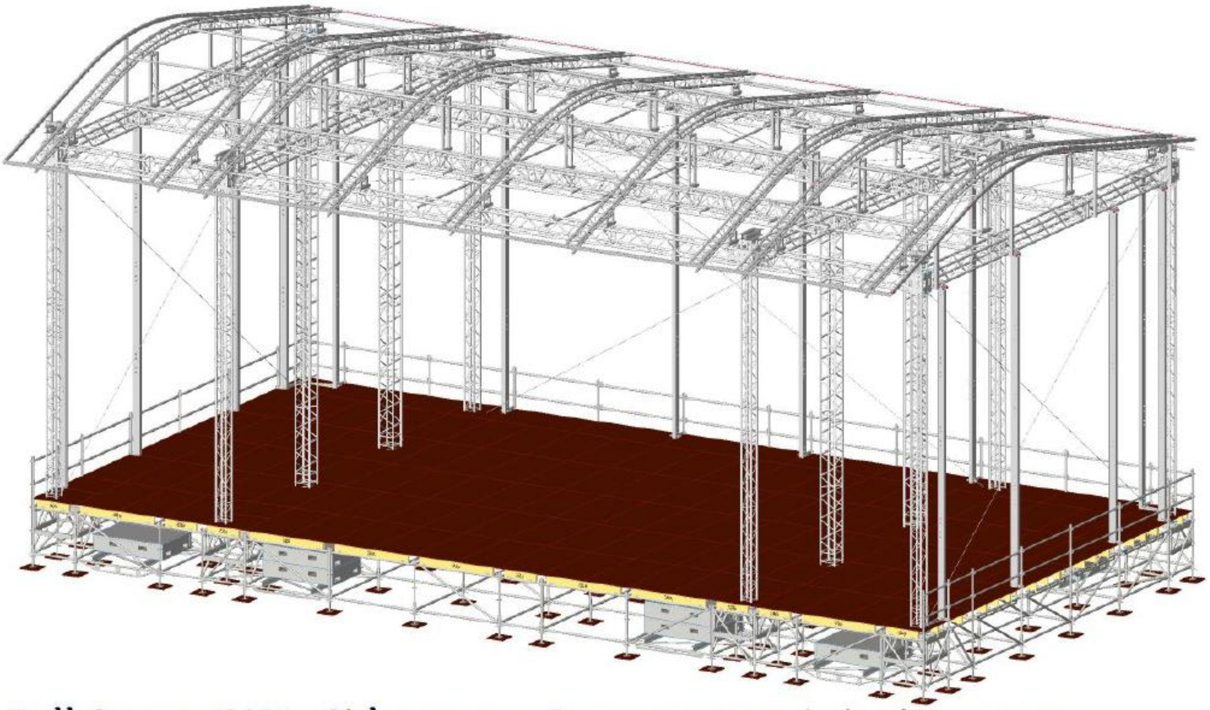
- Een constructie wordt berekend op een stuwdruk (de windbelasting per m2). De stuwdruk ontstaat door de windsnelheid. De windsnelheid is opgebouwd uit een stationair deel en een turbulent deel. Hierdoor ontstaan er pieken in de windsnelheid.
- Windsnelheid wordt standaard gemeten op 10 meter hoogte in het vrije veld, zonder obstakels. Er kan gesproken worden over een piekwindsnelheid, een 10-minuten gemiddelde windsnelheid of een uurgemiddelde windsnelheid. Hoe langer de tijd is, hoe lager het gemiddelde.
- De in de berekeningen gehanteerde beaufort-windschaal wordt in Nederland weergegeven in een 10-minuten **gemiddelde windsnelheid** op 10 meter hoogte in het vrije veld.
- **De stuwdruk waarop een overkapping berekend is, is bepalend voor de sterkte van de overkapping. Het gaat er dus om dat op de juiste manier wordt vastgesteld welke windsnelheid moet worden aangehouden om te kunnen bepalen of de stuwdruk overschreden wordt.**
- Als er niet op locatie gemeten wordt, moet gebruik worden gemaakt van de dichtstbijzijnde meteostation en moet de 10-minuten-gemiddelde windsnelheid op 10 meter hoogte worden opgevraagd. Als de grens-10 minutengemiddelde snelheid wordt bereikt, is de grens-stuwdruk bereikt. De opgegeven waarden gelden voor onbebouwd terrein (buiten de bebouwde kom) en niet voor het strand.
- Onderscheid tussen gemiddelde- en piekwindsnelheid in acht nemen.

De windkracht volgens de Schaal van Beaufort (bron: KNMI). De schaal van Beaufort wordt gebruikt voor de gemiddelde windsnelheid, over minstens 10 minuten gemeten, níet voor de snelheid van rukwinden/windstoten(piekwind).

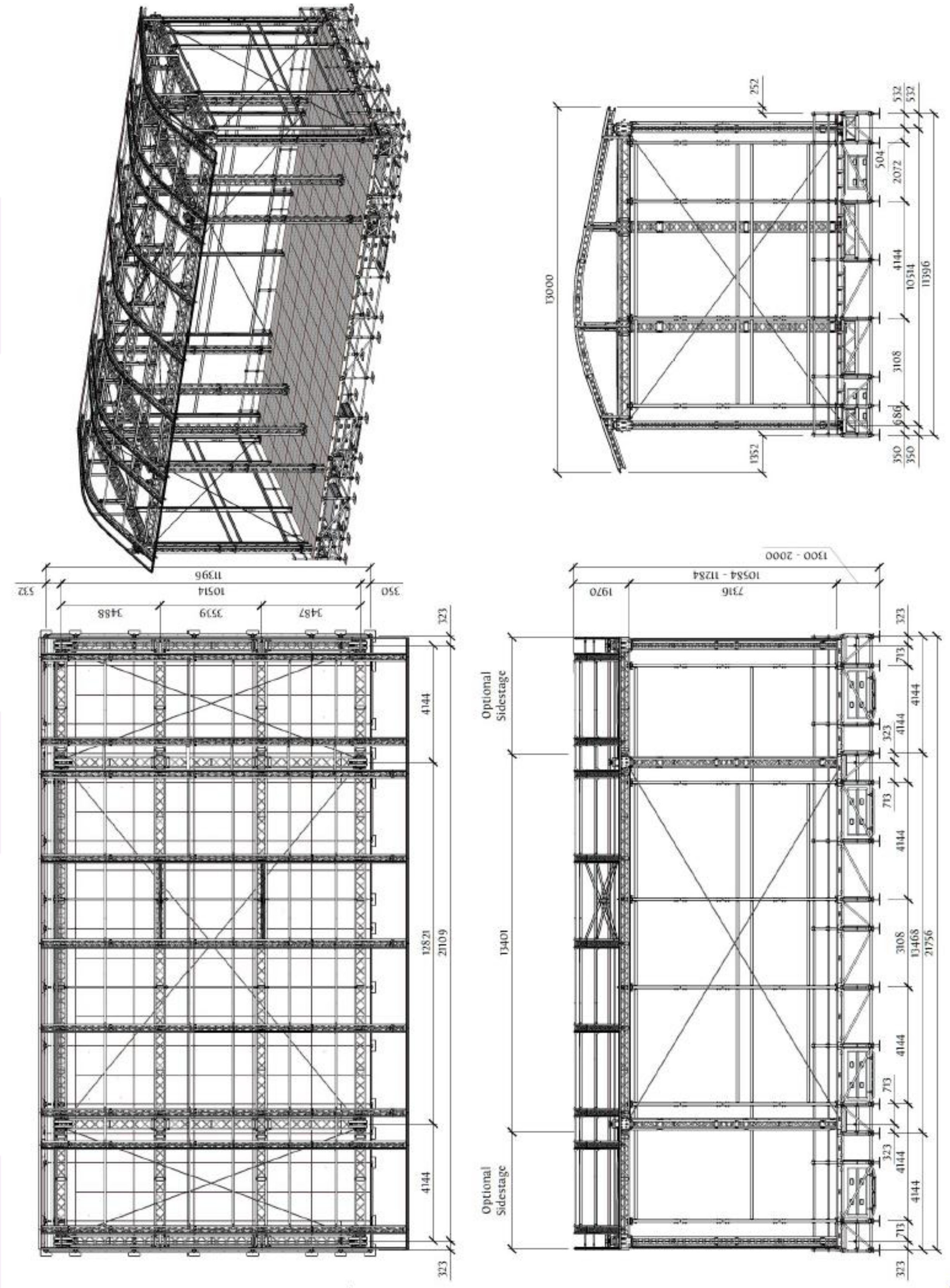
Kracht	**Benaming van KNMI**	**Benaming in Zeevaart**	**Snelheid in km/h***	**Snelheid in m/s***	**Snelheid in knopen**
0	Stil	Windstil	0-1	0-0,2	0-1
1	Zwak	Flauw en stil	1-5	0,3-1,5	1-3
2	Zwak	Flauwe koelte	6-11	1,6-3,3	4-6
3	Matig	Lichte koelte	12-19	3,4-5,4	7-10
4	Matig	Matige koelte	20-28	5,5-7,9	11-16
5	Vrij krachtig	Frisse bries	29-38	8,0-10,7	17-21
6	Vrij krachtig	Stijve bries	39-49	10,8-13,8	22-27
7	Hard	Harde wind	50-61	13,9-17,1	28-33
8	Stormachtig		62-74	17,2-20,7	34-40
9	Storm		75-88	20,8-24,4	41-47
10	Zware storm		89-102	24,5-28,4	48-55
11	Zeer zware storm / orkaanachtig		103-117	28,5-32,6	56-63
12	Orkaan		>117	>32,7	>63

De Nederlandse weerstations onder andere vinden op: www.meteovista.nl, www.knmi.nl, www.meteoconsult.nl en www.meteostation.nl.
Organisator kan ook bij onder andere Meteovista en Meteoconsult gedurende de duur van het evenement een weerbewakingscontract aangaan om nog beter op de hoogte te zijn van de lokale weersomstandigheden.

6 Bijlage I: Tekening(en)



Full Setup (HD): Sidestage + Extra towers / rigging truss


13000
Optional Sidestage
Optional Sidestage
13401
1300 - 2000
10584 - 11284
7316
1970
11396
10514
3488
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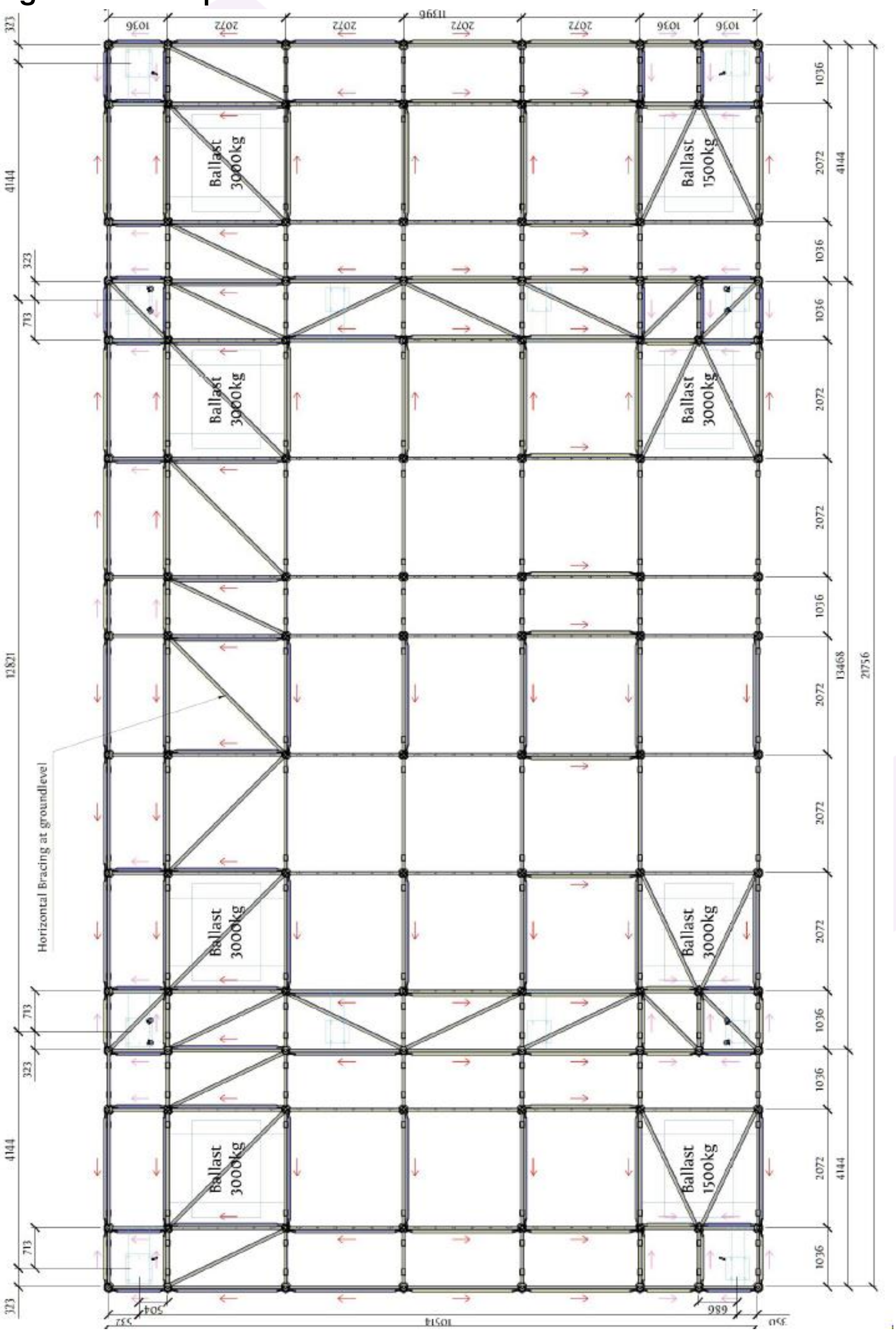
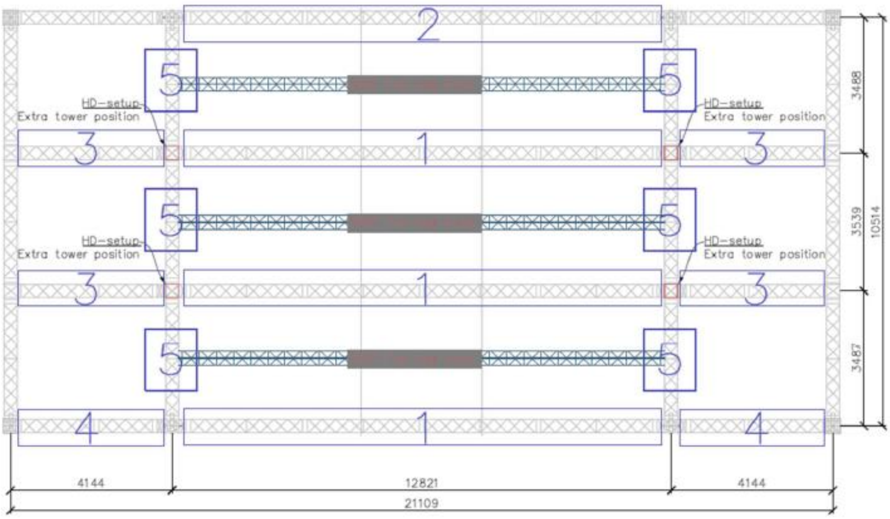
12821
21109
13468
21756

7 Bijlage II: Ballastplan



8 Bijlage III: Riggingscapaciteit

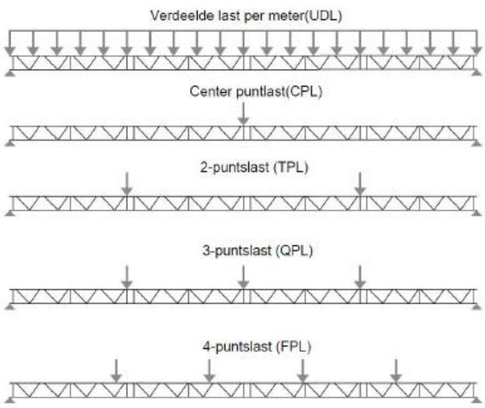
Riggingscapaciteit XLT 22x11 Heavy duty(12 masten)



Naam	Waarde	Maximale Gebruiksbelasting per punt HD setup				
		1	2	3	4	5
A. Verdeelde last per meter (UDL)	kg/m	80	50	25	Zie CPL	Zie CPL
B. Center puntlast (CPL)	kg	510	320	100	1000kg	1000kg
C. 2-puntslast (TPL)	kg	385	240	50	500kg	Zie CPL
C. 3-puntslast (QPL)	kg	255	160	Zie CPL	Zie CPL	Zie CPL

Zie figuur 2 voor alternatieve setup.

Let op:
Bij Dynamische lasten dient een extra veiligheidsfactor gehanteerd te worden in overleg met constructeur Eekels verhuur!



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9 Bijlage IV: Beheersmaatregelen (WMP; Wind Management Plan)

In dit Beheersplan wordt kort omschreven welke stappen bij welke windsnelheid gezet dienen te worden. De waarde waarbij deze stappen gezet dienen te worden verschillen per windgebied.

Hieronder een opsomming van de 10-minuten gemiddelde windsnelheid per locatie (omschreven in de NEN-EN 1991-1-4:2005)

In de bovenstaande hoofdstukken is uitgelegd hoe de berekening is opgebouwd. Conform de Geldende normen dient dan het onderstaande Beheersingsplan toegepast te worden.

1. Zij- en achterzeilen dienen verwijderd te zijn bij het bereiken van onderstaande waarde;

Gebied	10 minuten gemiddelde windsnelheid (m/s)	Beaufort (Bft)	Piekwindsnelheid (m/s)	Stuwdruk (kN/m^2)
Kust	11,3 m/s	6	20 m/s	0.20 kN/m^2
Onbebouwd	14,9m/s	7	20 m/s	0.20 kN/m^2
Bebouwd	15,9 m/s	7	20 m/s	0.20 kN/m^2

2. Het podium dient UIT-SERVICE (out-service) gesteld te zijn bij het bereiken van onderstaande waarde;
   - Tevens dient de directe omgeving ontruimd te zijn

Gebied	10 minuten gemiddelde windsnelheid (m/s)	Beaufort (Bft)	Piekwindsnelheid (m/s)	Stuwdruk (kN/m^2)
Kust	15,9	7	31m/s	0.4375 kN/m^2
Onbebouwd	20,1	8	31m/s	0.4375 kN/m^2
Bebouwd	22,8	9	31m/s	0.4375 kN/m^2

3. Bij acute dreiging van zwaar onweer gepaard gaande met z.g. valwind en/of hagel moet de constructie en directe omgeving ontruimd-, en indien mogelijk, gesloten worden. De overkapping is hierin van ondergeschikt belang.

NOTE; de 10-minuten gemiddelde windsnelheid wordt alleen weergegeven als referentie windsnelheid. Acties omtrent de constructie dienen ondernomen te worden aan de hand van de piekwindsnelheid.

Bij vragen of twijfel over dit plan kunt u altijd contact opnemen met Eekels Verhuur B.V.

10 Bijlage V: Zeilcertificaat

MEHLER TEXNOLOGIES
A Low&Bonar solution

Technisches Datenblatt Nr.: **1017.14**

Produkt: POLYMAR® FR COLOR 700

Artikel Nr.: 8509 5240

Beschichtung und Ausrüstung				
Beschichtungsart	**PVC**			
Ausrüstung	**beidseitig mit Acryllack, mikrobiozid, UV-geschützt**			
Brennverhalten	**BS 7837, D.M. 26.06.84 (UNI 9177): CL. 2, DIN 4102: B1, NFP 92507: M2, GOST: G1, NFPA 701 Test 2, EN 13501-1: B-s2-d0**			
zu Brennverhalten	**stets die Aktualität der FR-Zulassung, sowie länderspezifische Gültigkeit prüfen**			
Gesamtgewicht		**680**	g/m²	DIN EN ISO 2286-2
Reißkraft Kette/Schuss		**3000 / 3000**	N/50 mm	DIN EN ISO 1421/V1
Weiterreißfestigkeit Kette/Schuss		**300 / 300**	N	DIN 53363
Haftfestigkeit		**20**	N/cm	PA 09.03 (intern)
Kältebeständigkeit.		**-40**	°C	DIN EN 1876-1
Wärmebeständigkeit		**+70**	°C	PA 07.04 (intern)
Lichtechtheit		**>6**	Note, Value	DIN EN ISO 105 B02
Knickfestigkeit	keine Risse	**100000 x**		DIN 53359 A
Trägergewebe				
Material		**PES**		DIN EN ISO 2076
Fadenstärke		**1100**	dtex	DIN EN ISO 2060
Bindung		**L 1/1**		ISO 3572

Bei den technischen Daten handelt es sich um ca. Werte, die auf Basis von ermittelten Durchschnittswerten erstellt wurden. Aus fertigungstechnischen Gründen sind Abweichungen bis zu -5% möglich. Diese technischen Angaben entsprechen dem heutigen Stand der Kenntnisse und sollen über unsere Produkte ohne Rechtsverbindlichkeit informieren. Diese Daten gelten für neue Ware. Einsatzvorschläge entbinden den Käufer nicht, selbst zu prüfen, ob das Material für den von ihm gewünschten Einsatz geeignet ist.

VL/LB:

QM-071/3-08/00 EA/007-06/98 Datum 17.05.2019

11 Bijlage VI: Berekening

BERATENDE

KRASENBRINK + BASTIANS INGENIEURE

PartG mbB

STRUCTURAL ANALYSIS

PROJECT-NO.:	**20184**	
PROJECT:	**STAGEROOF** **XLT-ROOF 12x10m WITH SIDESTAGES**	
CUSTOMER:	EEKELS VERHUUR	

PREPARED: DIPL.-ING. OLIVER SPORYS	DATE/DATUM: **28.07.2022** PAGES/SEITEN: **1 – 178**
THE STRUCTURAL ANALYSIS IS ONLY PREPARED FOR THE AFOREMENTIONED CUSTOMER. IF THIS CALCULATION SHOULD BE PASSED TO A THIRD PARTY A PERMISSION OF THE ORIGINATOR IS NEEDED. ANY PUPLICATION OF THIS REPORT IS NOT ALLOWED.	

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BIC: AACSDE33

PARTNERSCHAFTSREGISTER ESSEN ■ PR 4531 ■ AMTSGERICHT ESSEN ■ UST-ID-NR.: DE 326061303

CONTENTS

1 PREAMBLE

1.1 APPLICABLE STANDARDS

DIN EN 1990 / Eurocode 0
Grundlagen der Tragwerkplanung
Basis of structural design

DIN EN 1991 / Eurocode 1
Einwirkungen auf Tragwerke
Actions on structures

DIN EN 1992 / Eurocode 2
Bemessung und Konstruktion von Stahlbeton und Spannbetontragwerken
Design of concrete structures

DIN EN 1993 / Eurocode 3
Bemessung und Konstruktion von Stahlbauten
Design of steel structures

DIN EN 1993 / Eurocode 5
Bemessung und Konstruktion von Holzbauten
Design of timber structures

DIN EN 1997 / Eurocode 7
Entwurf, Berechnung und Bemessung in der Geotechnik
Geotechnical design

DIN EN 1999 / Eurocode 9
Bemessung und Konstruktion von Aluminiumtragwerken
Design of aluminium structures

DIN EN 13782
Fliegende Bauten – Zelte - Sicherheit
Temporary structures – Tents - Safety

DIN EN 13814
Fliegende Bauten und Anlagen für Veranstaltungsplätze und Vergnügungsparks
Fairground and amusement park machinery and structures - safety

DIN EN 12385-4
Drahtseile aus Stahldraht/ Steel wire ropes

Or equivalent national versions of the aforementioned standards.
(e.g. NEN EN 1990)

1.2 SUPPORTING DOCUMENTS

Technical data of the used truss systems

Separate structural reports have been made by the Engineering office Krasenbrink+ Bastians for determining permissibly loads and resisting internal forces of Prolyte truss systems.

Technical data of the used scaffolding system Layher-Allround. (K2000+ or LW)

1.3 CONSTRUCTION ELEMENTS

Roof girders:	Prolyte H30D Alloy: EN AW-6082 T6 (AlMgSi1 F31)
Main girders:	Prolyte H40V Alloy: EN AW-6082 T6 (AlMgSi1 F31)
Columns:	Prolyte H30V/ S40T (additional in HD-setup) Alloy: EN AW-6082 T6 (AlMgSi1 F31)
Rigging trusses:	Prolyte S52F (or similar) Alloy: EN AW-6082 T6 (AlMgSi1 F31)
Compression members:	Tube 48 x 3mm Alloy: EN AW-6082 T6 (AlMgSi1 F31) Tube 48,3 x 3,2mm steel (S235 JR)
Keder:	170x88x3mm Alloy: EN AW-6082 T6 (AlMgSi1 F31)
Podium:	LAYHER Allround scaffolding system (K2000+ or LW) Steel: S235 JR(H)
Guy wires:	Ø8 / 12mm, e.g. wire class 6 x 7, 1770 N/mm² with steel inlay The specifications of the steel cables are only examples. Equal constructions are possible.

1.4 GENERAL PRELIMINARY REMARKS

This structural analysis covers the stage roof structure XLT-Roof for 360 Events.

The roof will be assembled in the size of 21,75 x 11,40m and it is built on a podium of Layher Allround scaffolding system. Including a 1,50m (system height) podium the total height of the stage is max. 11,30m.
Including a 1m(system height) podium the total height of the stage is max. 10,60m.
The roof must always be build up with sidestages. A build up without sidestages is not allowed.

The stage roof is considered to be a temporary demountable structure and not a permanent building.
The whole structural-framework of the roof consists of aluminium trusses H30D, H40V that are made by the company Prolyte. The towers are made out of Prolyte H30V with optional additional towers Prolyte S40T (HD-setup).

The roof area, rear and side walls are closed with canopies. The wall canopies are fixed in keder profiles 170x88x3mm and are attached with special adapters to the trusses and the podium.

The structure is stiffened by means of guy wires in roof, rear wall and side walls. Guy wires need to be adequately tensioned before use.

The roof is always build up with ballast loads. (see chapt. 1.9)

Optionally additional rigging trusses (S52F or similar) can be mounted. For that case special load setups are given in chapter 1.8.

1.5 TERMS OF USE

WIND MANAGEMENT

LOAD CASE " IN SERVICE"

The construction is calculated to withstand peak gust wind speed up to **20 m/s**. Above peak gust wind speed of 20 m/s measured in a height of 10m the rear and side wall canopies must be removed from the structure as well as the PA-load in the optional wings. If the peak gust wind speed is measured in a height less than 10m all aforementioned canopies and PA must be removed at peak gust wind speed of **18 m/s**.
The wind speed has to be measured at the top of the structure in an unobstructed surrounding area.

LOAD CASE " OUT OF SERVICE"

The construction with removed rear and side wall canopies and PA-load is calculated according to DIN EN 13814. It is calculated with a wind pressure of 0,625 kN/m².

SNOWLOAD

Snow loads are not taken into account.
The set up of the structure shall only be made in appropriate weather conditions or the roof shall be kept free of snow (e.g. heating).

PAYLOADS

Payloads may be inserted in the construction. (see chapt. 1.8)

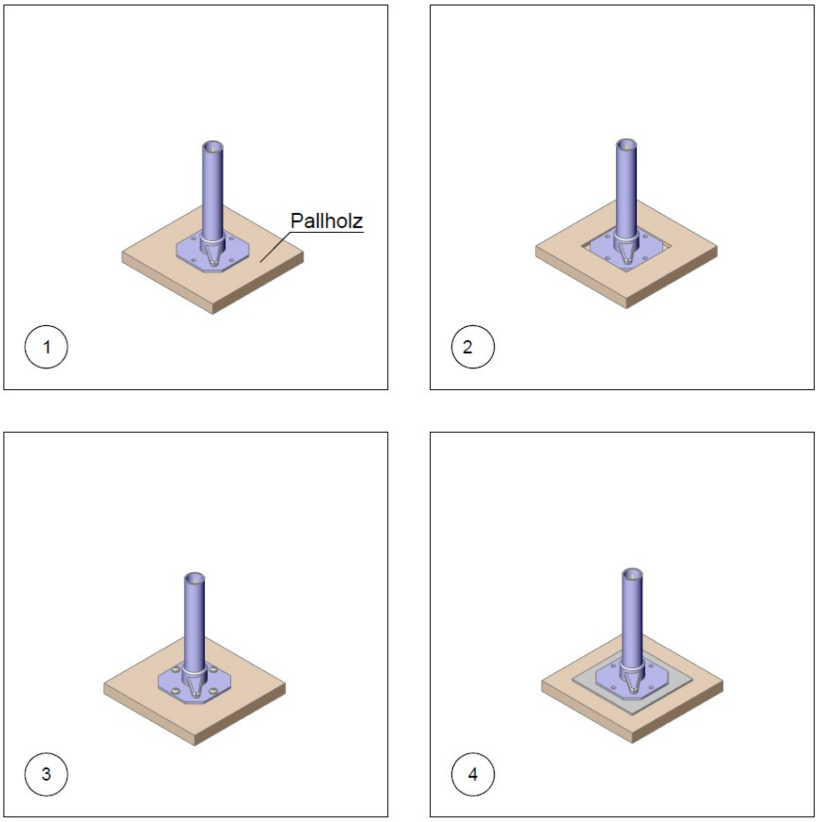
BALLAST

To secure the construction against overturning, sliding and lifting there has to be ballast positioned on the construction.
The necessary ballast is shown in chapter 1.9.
The ballast will be placed force-fitted on the bottom level of the Layher Podium without the usage of Layher Base Collars or it must be placed on a separate level +0,50m.

TIMBER SPREADER

drivable surface: timber spreader 400x400x30mm

In the case of softened soil there have to be chosen appropriate timber spreaders. (Proof in individual case)
Possible execution according to the required friction coefficient:



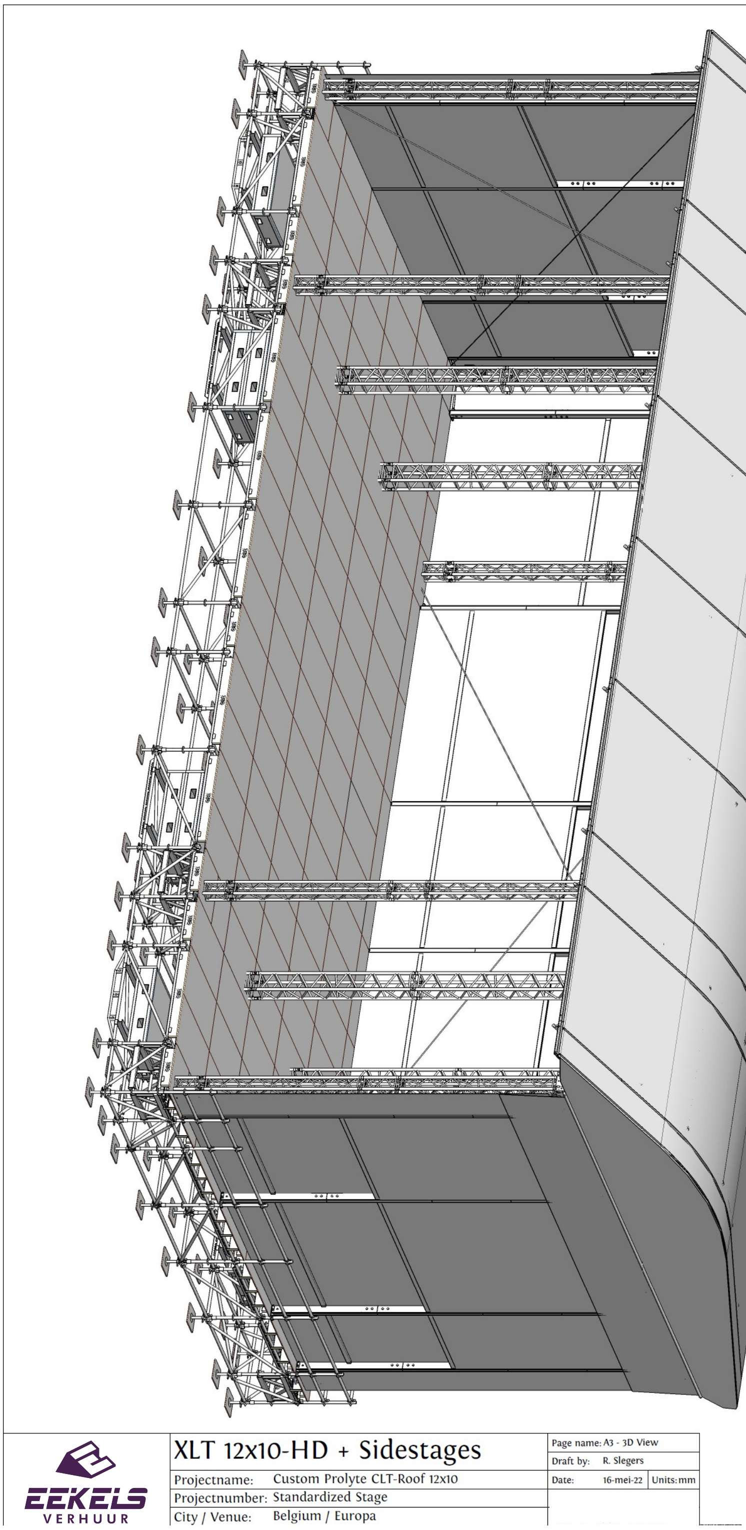
friction coefficient μ

1:	Spindle on timber spreader	μ = 0,40
2:	Spindle on timber spreader, embedded	μ = 0,60
3:	Spindle on timber spreader, screwed	μ = 0,60
4:	Spindle on rubber mat	μ = 0,60

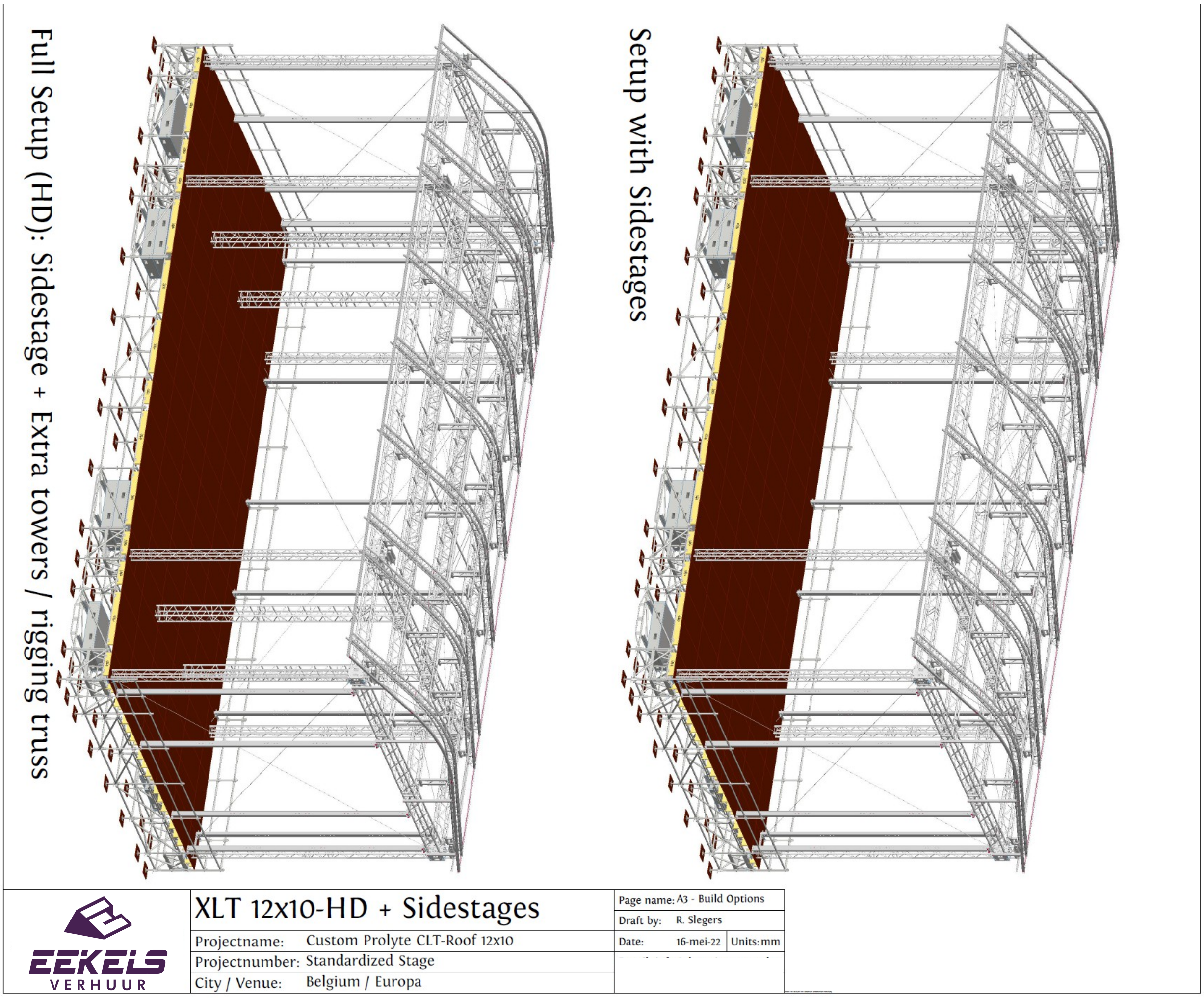
The timber spreader is laying on asphalt, concrete, paving, sand, gravel

Attention: if there is one timber spreader mounted on one another, they have to be screwed when a friction coefficient of 0,6 is required.

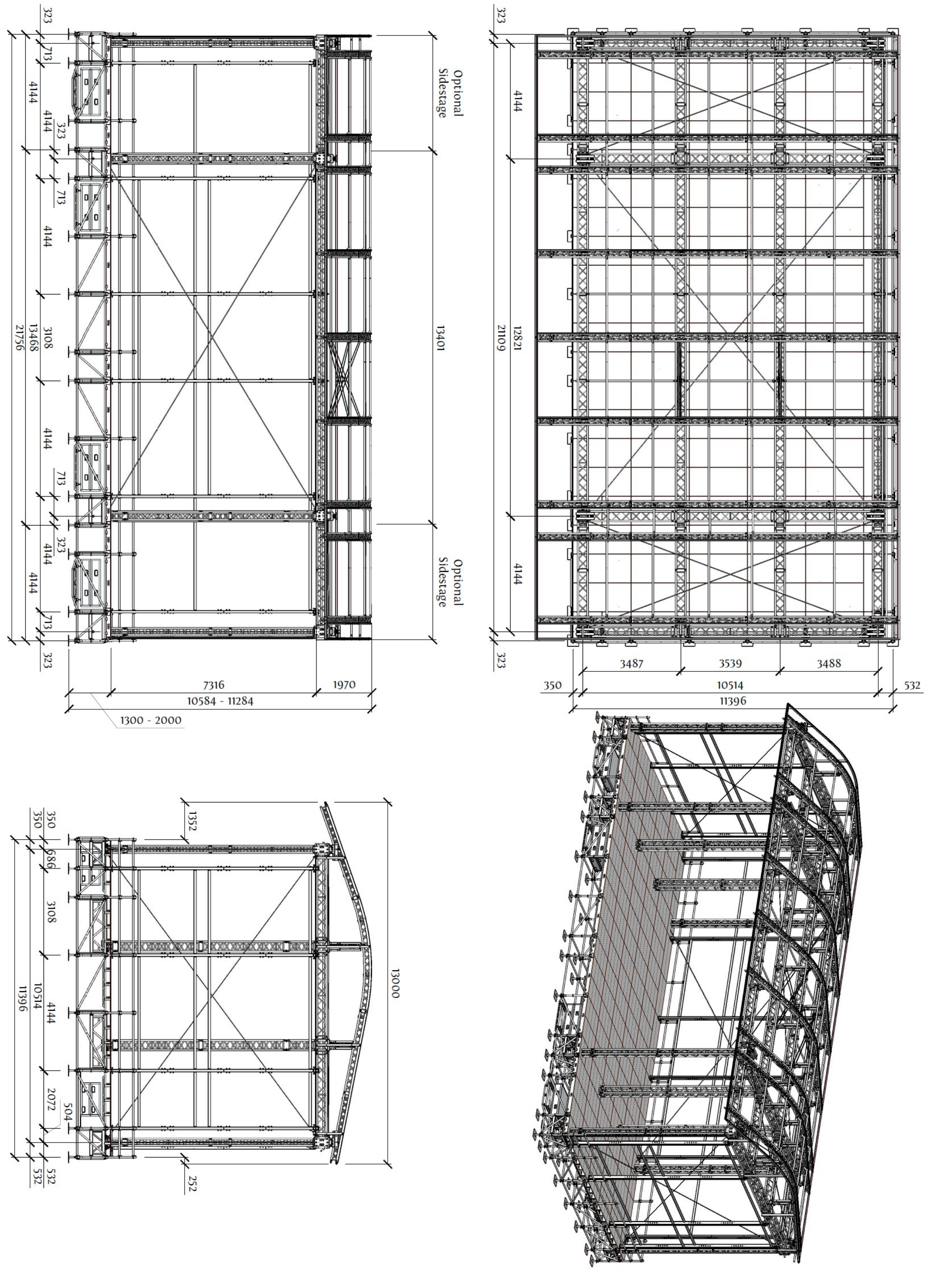
1.6 DRAWINGS



Drawn here with a 1,0m-Podium and in the HD-setup version with 4 additional towers S40T.

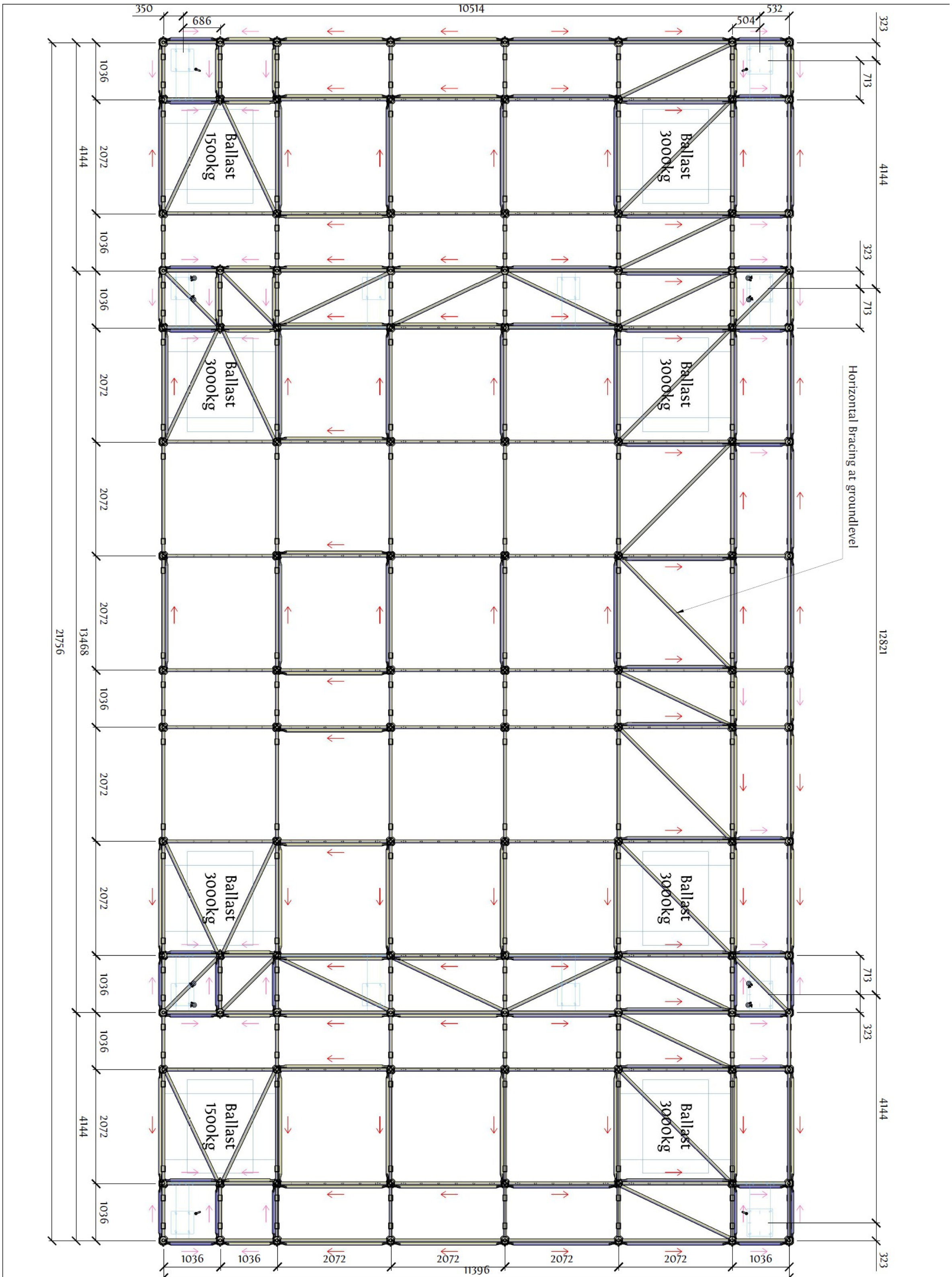


Only the versions with sidestages are possible for this roof!

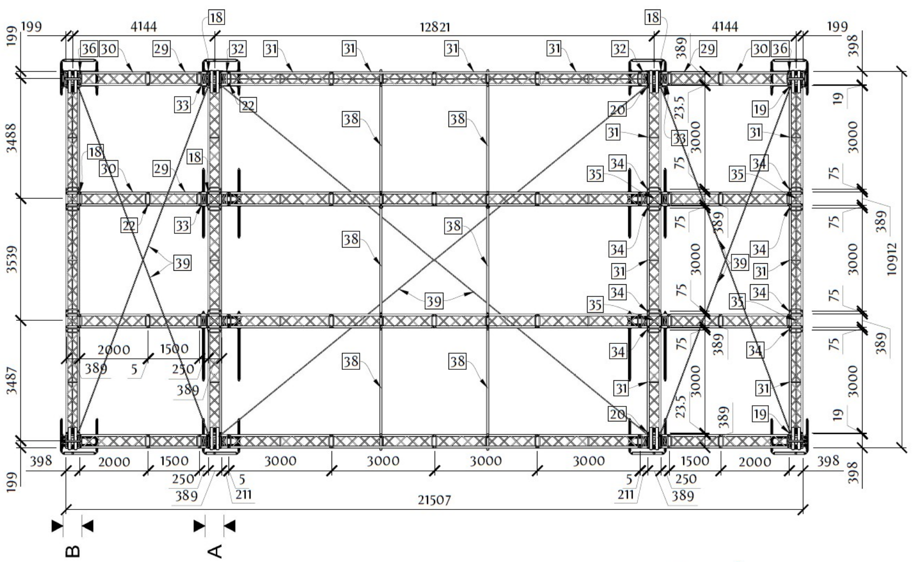


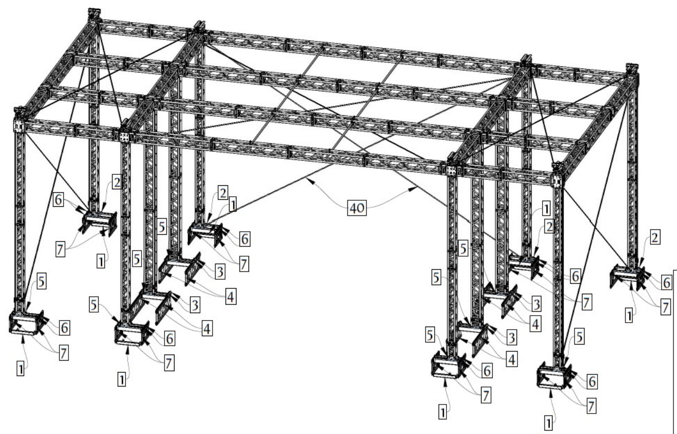
EEKELS VERHUUR	XLT 12x10-HD + Sidestages	Page name: A3 - Dimensions
		Draft by: R. Slegers
	Projectname: Custom Prolyte CLT-Roof 12x10	Date: 16-mei-22 Units: mm
	Projectnumber: Standardized Stage	
	City / Venue: Belgium / Europa	

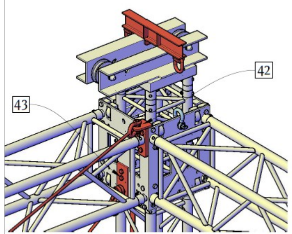
PROJECT:	PROJECT-NO.:
XLT-ROOF 12x10m WITH SIDESTAGES	**20184**
CUSTOMER/AUFTRAGGEBER:	DATE/DATUM:
EEKELS VERHUUR	**28.07.2022**



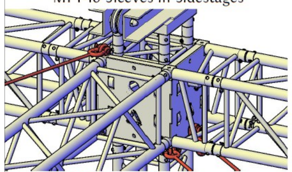
EEKELS VERHUUR	XLT 12x10-HD + Sidestages	Page name: A3 - Layher Allround Stage
	Projectname: Custom Prolyte CLT-Roof 12x10	Draft by: R. Slegers
	Projectnumber: Standardized Stage	Date: 16-mei-22 Units: mm
	City / Venue: Belgium / Europa	



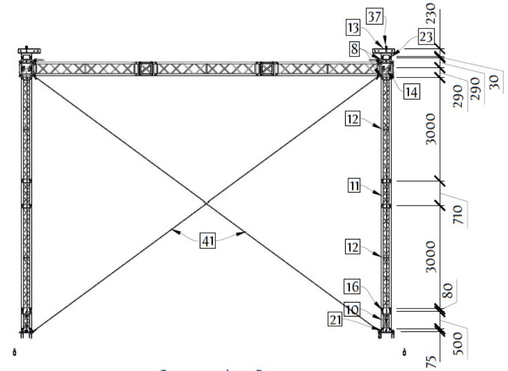




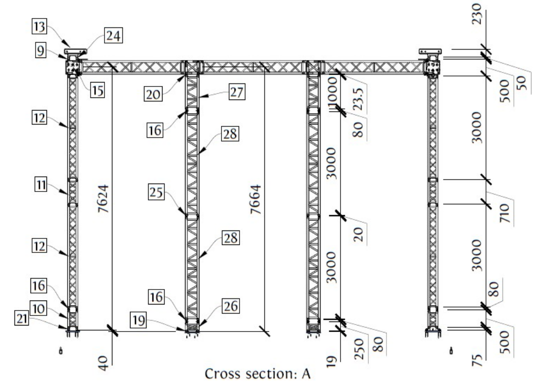
MPT-10 Sleeves in Sidestages



HD Sleeves in Center



Cross section: B



Cross section: A

ITEM	COUNT	NAME	DISCRIPTION
1	4	360XLT - Hijsligger_2T-Front	Ledger for attaching Hoist
2	4	Prolyte UniBase - Baseplate	Prolyte Base-Adapterplatte
3	8	Prolyte UniBase - Crossbeam 103	Prolyte Base-Trussträger 1036mm
4	8	Prolyte UniBase - Girder 207	Prolyte Base-Gitterträger 2072mm
5	10	Layher Universal Base - Adapterplaat B16	Adapterplatte 390
6	16	Layher Universal Base - Tussenligger 103	Trussträger 1036mm
7	16	Layher Universal Base - Tralieligger 103	Basement Gitterträger 1036mm
8	8	PROLYTE - H30V-L29	SQUARE H30 LENGTH 29 CM
9	4	PROLYTE - H30V-L050-HT-DH + HT-DH-PIN	HT-TOWER - Deadhang Truss + Pin
10	8	PROLYTE - H30V-L050	SQUARE H30 LENGTH 50 CM
11	8	PROLYTE - H30V-L071	SQUARE H30 LENGTH 71 CM
12	16	PROLYTE - H30V-L300	SQUARE H30 LENGTH 300 CM
13	8	PROLYTE - MPT-009	MPT-TOWER Topsection

ITEM	COUNT	NAME	DISCRIPTION
14	4	PROLYTE - MPT-010	MPT-TOWER - Sleeve module
15	4	PROLYTE - HT-010	HT-TOWER - Sleeve module
16	64	PROLYTE - CCS6-H	Hinge for MPT-TOWER
17	304	PROLYTE - CCS6-600	Coupler 600 (30/40 Series)
18	48	PROLYTE - CCS6-652S	Half Coupler, 0mm offset, M12
19	32	PROLYTE - CCS6-602	Half Coupler, 19mm offset, M12
20	32	PROLYTE - CCS6-652-23,5	Half Coupler, 23.5mm offset, M12
21	32	PROLYTE - CCS6-651	Coupler 600 FEM 75mm offset, M12
22	48	PROLYTE - CCS6-S05	Spacer 600 L=5mm (30/40 Series)
23	16	PROLYTE - CCS6-S30	Spacer 600 L=30mm (30/40 Series)
24	16	PROLYTE - CCS6-S50	Spacer 600 L=50mm (30/40 Series)
25	16	PROLYTE - CCS6-S20	Spacer 600 L=20mm (30/40 Series)
26	4	PROLYTE - S40T-L025	SQUARE S40T LENGTH 25 CM

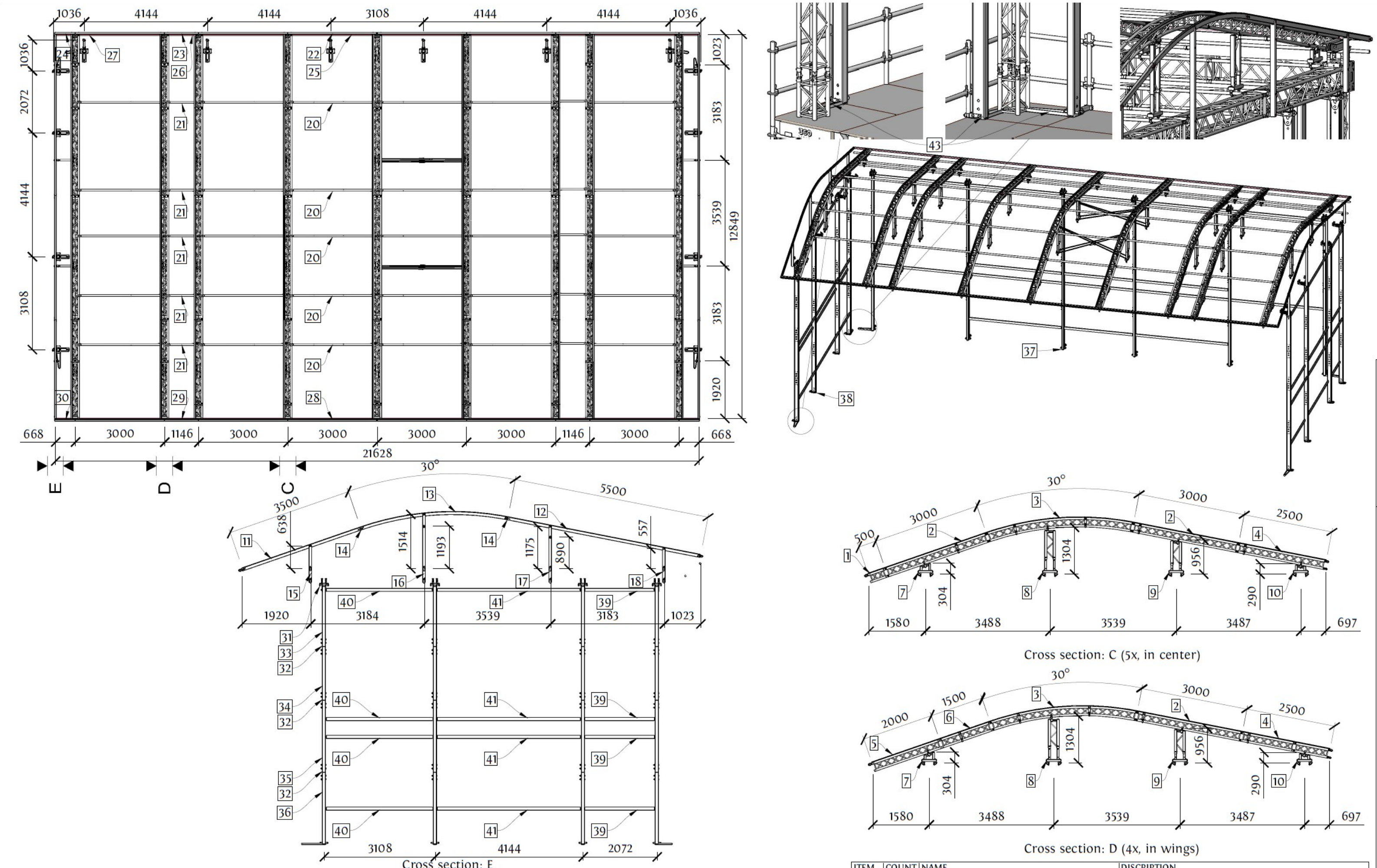
ITEM	COUNT	NAME	DISCRIPTION
27	4	PROLYTE - S40T-L100	SQUARE S40T LENGTH 100 CM
28	8	PROLYTE - S40T-L300	SQUARE S40T LENGTH 300 CM
29	8	PROLYTE - H40V-L150	SQUARE H40V LENGTH 150 CM
30	8	PROLYTE - H40V-L200	SQUARE H40V LENGTH 200 CM
31	28	PROLYTE - H40V-L300	SQUARE H40V LENGTH 300 CM
32	8	PROLYTE - H40V-L025	SQUARE H40V LENGTH 025 CM
33	8	PROLYTE - BOX-40V-A-001	Attachment BOX 40V L=211mm
34	8	PROLYTE - BOX-40V-ATT	Attachment BOX 40V L=75mm
35	8	PROLYTE - BOX-40V	Boxcorner 40V
36	16	PROLYTE - CCS6-650	Half Coupler, 0mm offset, M12
37	4	360XLT MPT-010_DH	Custom Deadhang beam for MPT topsection
38	6	Scaffolding Tube Ø48.3x3.2 S235 + 2x CLP-P535	Press-tube + clamps for H40V
39	6	Guying Wire Set 2T (roof)	Connected with M12 in HT-Sleeve cube
40	2	Guying Wire Set 2T (backwall)	Connected with M16 in HT-Sleeve plate
41	4	Guying Wire Set 2T (sidewalls)	Connected with M20 in MPT-Sleeve
42	4	360XLT MPT-010_Plate_Right/Left + 2xM12	Roof guy-wire connector for MPT-Sleeve
43	4	360XLT MPT-010_Plate_Bottom + 2xM12	Wall guy-wire connector for MPT-Sleeve

EEKELS VERHUUR

XLT 12x10-HD + Sidestages

Projectname:	Custom Prolyte CLT-Roof 12x10
Projectnumber:	Standardized Stage
City / Venue:	Belgium / Europa

Page name: A3 - Grid		
Draft by:	R. Slegers	
Date:	16-mei-22	Units: mm



ITEM	COUNT	NAME	DISCRIPTION
1	5	PROLYTE - CLT-Z-H30D-L050-K	H30D Length 50cm with keder
2	14	PROLYTE - CLT-Z-H30D-L300-K	H30D Length 300cm with keder
3	9	PROLYTE - CLT-Z-H30D-ARC-R0800-30	H30D arc R=8m-30deg. with keder
4	9	PROLYTE - CLT-Z-H30D-L250-K	H30D Length 250cm with keder
5	4	PROLYTE - CLT-Z-H30D-L200-K	H30D Length 200cm with keder
6	4	PROLYTE - CLT-Z-H30D-L150-K	H30D Length 150cm with keder
7	9	PROLYTE - CLT-ATT-001	Connector for CLT-Z-H30D / H40V
8	9	PROLYTE - CLT-ATT-002	Connector for CLT-Z-H30D / H40V
9	9	PROLYTE - CLT-ATT-003	Connector for CLT-Z-H30D / H40V
10	9	PROLYTE - CLT-ATT-004	Connector for CLT-Z-H30D / H40V
11	2	360XLT-KP-83x48-L350	Roof - keder profile Length 350cm
12	2	360XLT-KP-83x48-L550	Roof - keder profile Length 550cm
13	2	360XLT-KP-83x48-ARC-R0800-30	Roof - keder profile arc R=8m-30deg.
14	4	360XLT-KP-83x48-Con	connector for KP-83x48 +4 x M12

ITEM	COUNT	NAME	DISCRIPTION
15	2	360XLT-ATT-011	Connector for KP-83x48 / H40V
16	2	360XLT-ATT-012	Connector for KP-83x48 / H40V & CLT-ATT-001
17	2	360XLT-ATT-013	Connector for KP-83x48 / H40V & CLT-ATT-001
18	2	360XLT-ATT-014	Connector for KP-83x48 / H40V
19	120	PROLYTE - CCS6-600	Coupler 600 (30/40 Series)
20	30	CLT-T-50-PRESS-L271	Press-tube for H30D
21	10	CLT-T-50-PRESS-L86	Press-tube for H30D
22	6	CLT-50x50x4-001	profile for roof-canopy tensioning at backside
23	2	CLT-50x50x4-003	profile for roof-canopy tensioning at backside
24	2	360XLT-50x50x4-004	profile for roof-canopy tensioning at backside
25	4	360XLT-R48-001	profile for roof-canopy tensioning at backside
26	2	360XLT-R48-002	profile for roof-canopy tensioning at backside
27	2	360XLT-R48-004A/B	profile for roof-canopy tensioning at backside
28	6	CLT-80x60-KEDAR-02	connection for roof-canopy at frontside

ITEM	COUNT	NAME	DISCRIPTION
29	2	CLT-80x60-KEDAR-03	connection for roof-canopy at frontside
30	2	360XLT-80x60-KEDAR-04	connection for roof-canopy at frontside
31	14	360XLT-KP-170x88-TOP-ADAP	KEDER TOP ADAPTER WITH FIXED PULLEYS
32	42	PROLYTE - Z-IT-CONN-BEAM + 4xACC-LP-30	Connection for KP-170x88 profiles
33	14	360XLT-KP-170X88-L168-01	Keder Prof. 170x88 L=168cm
34	14	PROLYTE - KP-170x88-L150-01	Keder Prof. 170x88 L=150cm
35	14	PROLYTE - KP-170x88-L200-01	Keder Prof. 170x88 L=200cm
36	14	360XLT-KP-170x88-L200-Bottom + ACC-LP-30	Bottom Keder Prof. 170x88 L=200cm
37	6	360XLT-KP-170x88-Bottomfix_Back	Connection Keder Prof. on standard
38	8	360XLT-KP-170x88-Bottomfix_Side	Connection Keder Prof. on standard
39	8	360XLT-Zeillat_2.07m	canopy batten
40	12	360XLT-Zeillat_3.10m	canopy batten
41	20	360XLT-Zeillat_4.14m	canopy batten
42	4	Lashing-strap 2T	Guying for CLT-ATT-002 & CLT-ATT-003
43	6	Lashing-strap 2T	fixation KP-170x88-Bottomfix against membrane-tension

EEKELS VERHUUR

XLT 12x10-HD + Sidestages

Projectname: Custom Prolyte CLT-Roof 12x10
Projectnumber: Standardized Stage
City / Venue: Belgium / Europa

Page name: A3 - Roof
Draft by: R. Slegers
Date: 16-mei-22 | Units: mm

PROJECT:
XLT-ROOF 12x10m WITH SIDESTAGES

PROJECT-NO.:
20184

CUSTOMER/AUFTRAGGEBER:
EEKELS VERHUUR

DATE/DATUM:
28.07.2022

1.7 LOADING ASSUMPTION

General:
Before erection, use and disassembling of the roof, weather reports should be gathered

1.7.1 WINDLOADS

load assumption according to DIN EN 13814

Table 1 — Wind pressure values for amusement devices

Height of the structure	Pressure $q_{eq} = q_{ref} \times ce(ze) \times c_d$ (kN/m^2) for reference wind speed	
	$v_{ref} \leq$ 15 m/s (in service)	$v_{ref,0} \leq$ 28 m/s (out of service)
0 ≤ 8 m	0,20	0,35
8 ≤ 20 m	0,30	0,50
20 ≤ 35 m	0,35	0,90
35 ≤ 50 m	0,40	1,00

Load case „in service“:

h = 0 ≤ 8m: q = 0,20 kN/m²
h = 8 ≤ 20m: q = 0,30 kN/m²

Load case „out of service“:

Column 3 of table 1 - DIN EN 13814:

The factor c_{tem} = 0,80 according to DIN EN 13814 is recalculated, therefore there aren't planned any additional reinforcements .

h = 0 ≤ 8 m: q_p = 0,35/ 0,8 = 0,440 kN/m²
h = 8 ≤ 20 m: q_p = 0,50/ 0,8 = 0,625 kN/m²

Valid for areas with $v_{b,0}$ = 28m/s / category III

BEAUFORT SCALE				
BEAUFORT NUMBER [BEAUFORT]	WIND SPEED [m/s]	WIND PRESSURE Q [kN/m²]	DESCRIPTION	EFFECTS FROM WIND
0	0-0.2	≈ 0	Calm	Calm. Smoke rises vertically.
1	0.3-1.5	≤ 0.001	Very light	Direction of wind shown by smoke drift but not by wind vanes.
2	1.6-3.3	≤ 0.007	Light breeze	Wind felt on face. Leaves rustle.Ordinary wind vane moved by wind.
3	3.4-5.4	≤ 0.02	Gentile breeze	Leaves and smaller twigs in constant motion, wind extends light flag.
4	5.5-7.9	≤ 0.04	Moderate breeze	Dust and loose paper raised. Small branches begin to move.
5	8.0-10.7	≤ 0.07	Fresh breeze	Small trees in leaves start to sway.
6	10.8-13.8	≤ 0.12	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	13.9-17.1	≤ 0.18	Near gale	Whole trees in motion. Inconvenient to walk against winst.
8	17.2-20.7	≤ 0.27	Gale	Twigs break from trees. Difficult to walk.
9	20.8-24.4	≤ 0.37	Strong gale	Slight structural damage. Chimney pots and slates removed.
10	24.5-28.4	≤ 0.50	Storm	Trees uprooted. Considerable structural damage.
11	28.5-32.6	≤ 0.67	Violent storm	Widespread structural damage. (seldomly in inland)
12	32.7-36.9	≤ 0.85	Hurricane	Massive and widespread structural damage.

V [m/s] = v[km/h] / 3.6 q[kN/m²] = V² /1600

Note:
Beaufort scale is based on average wind speed. Measures at the structure shall be executed according gust wind speed.

1.7.2 MEMBRANE TENSION

By applying a dynamic loading q = 0.50 KN/m^2 with its aerodynamic coefficient c_{pe} = 0.40 and regarding a span of l = 5.00 m a resulting membrane tension of Z = 0.80 kN/m is derived.

$Z=(Z_y{}^2+Z_z{}^2)^{1/2}$ = 0.80 kN/m

with Z_z=0.5*0.4*5.0/2=0.50 kN/m

$Z_y=(Z^2-Z_z{}^2)^{1/2}=(0.80^2-0.50^2)^{1/2}$=0.624

Z_y/Z_z=0.624/0.50=1.25 = 1 / 0.8

1.7.3 SNOW LOADING

Snow loads are not taken into account.
Building up of the structure shall only be made in appropriate weather conditions or the roof shall be kept free from snow.

1.8 PERMISSIBLE PAYLOADS

On following pages allowable pay loads of the structure and different possible configurations for equipment such as illumination(spots) and sounding are displayed. If the preparing loading configuration differ from these set up`s, please inform the Engineering office Krasenbrink+Bastians.

Loads up to 100 kg can be fastened at any position of the chord. Loads more than 100 kg have to be positioned at the node or adequate proofs have to be carried out. Loads shall be equally distributed over the trusses main chords.

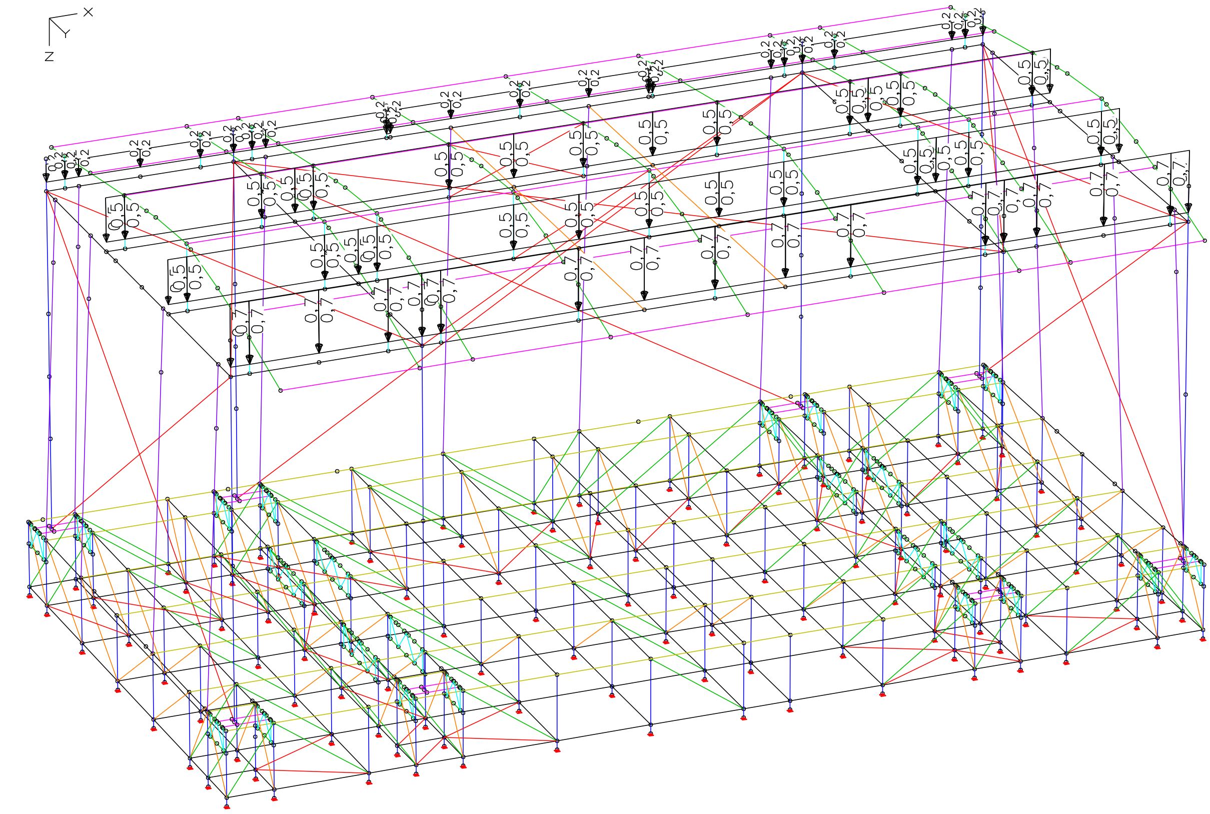
All given values are static loads. To consider dynamic affecting the loads have to be decreased with a factor of minimum 1,2.

Optionally additional rigging trusses (e.g. S52F) can be mounted. For that case special load setups are given in chapter 6. (HD-Setup)

For all loading scenarios the PA-load can always be combined with.

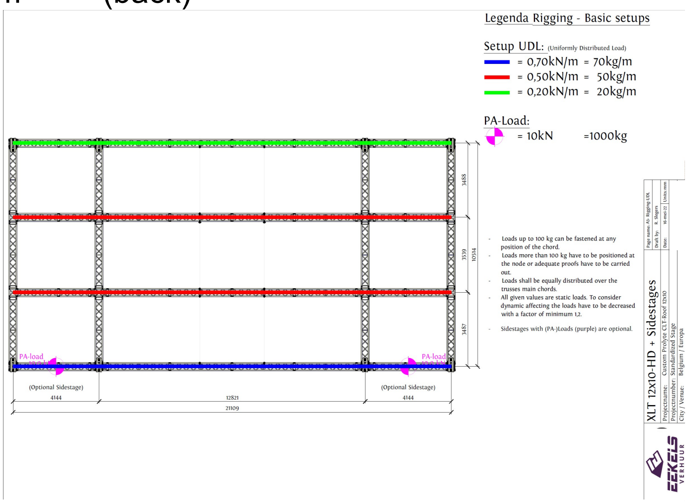
Types of Loading:

Distributed Load [kN/m]

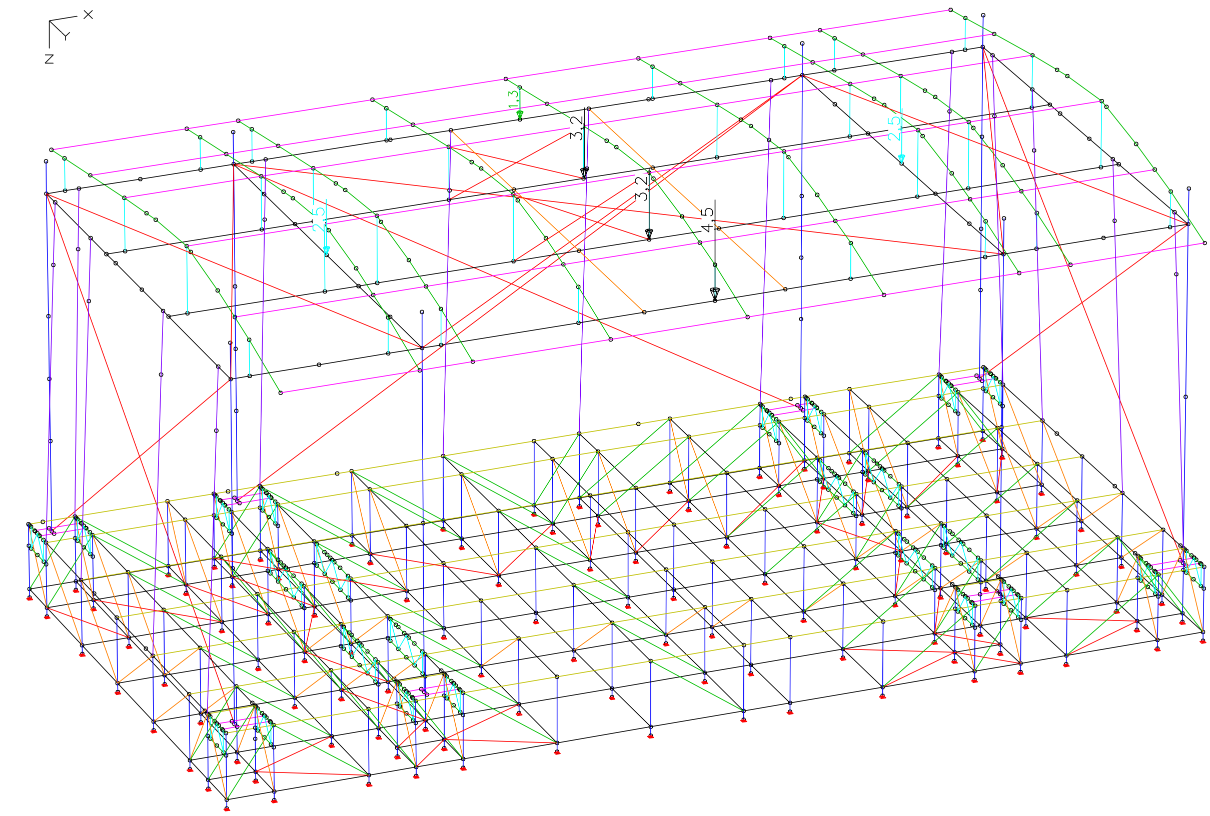


LC 4: Load, distributed payload – Basic setup

0,70 kN/m = 70 kg/m (front)
0,50 kN/m = 50 kg/m (centre)
0,20 kN/m = 20 kg/m (back)

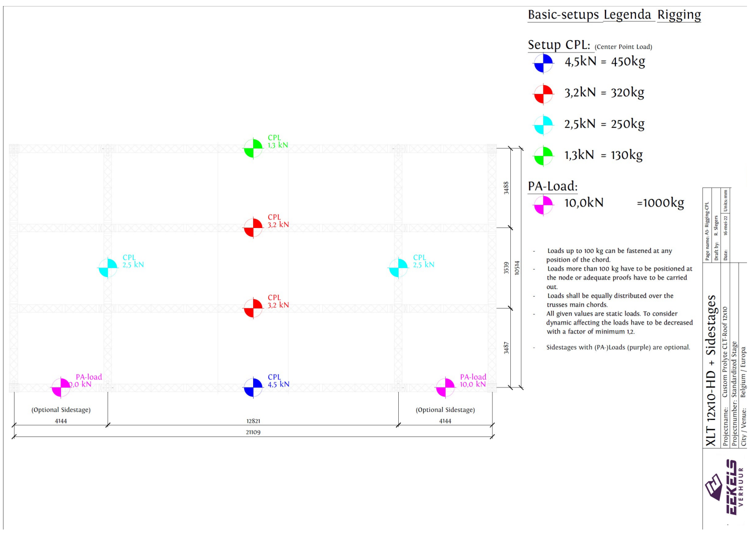


Centre Point Load [kN]

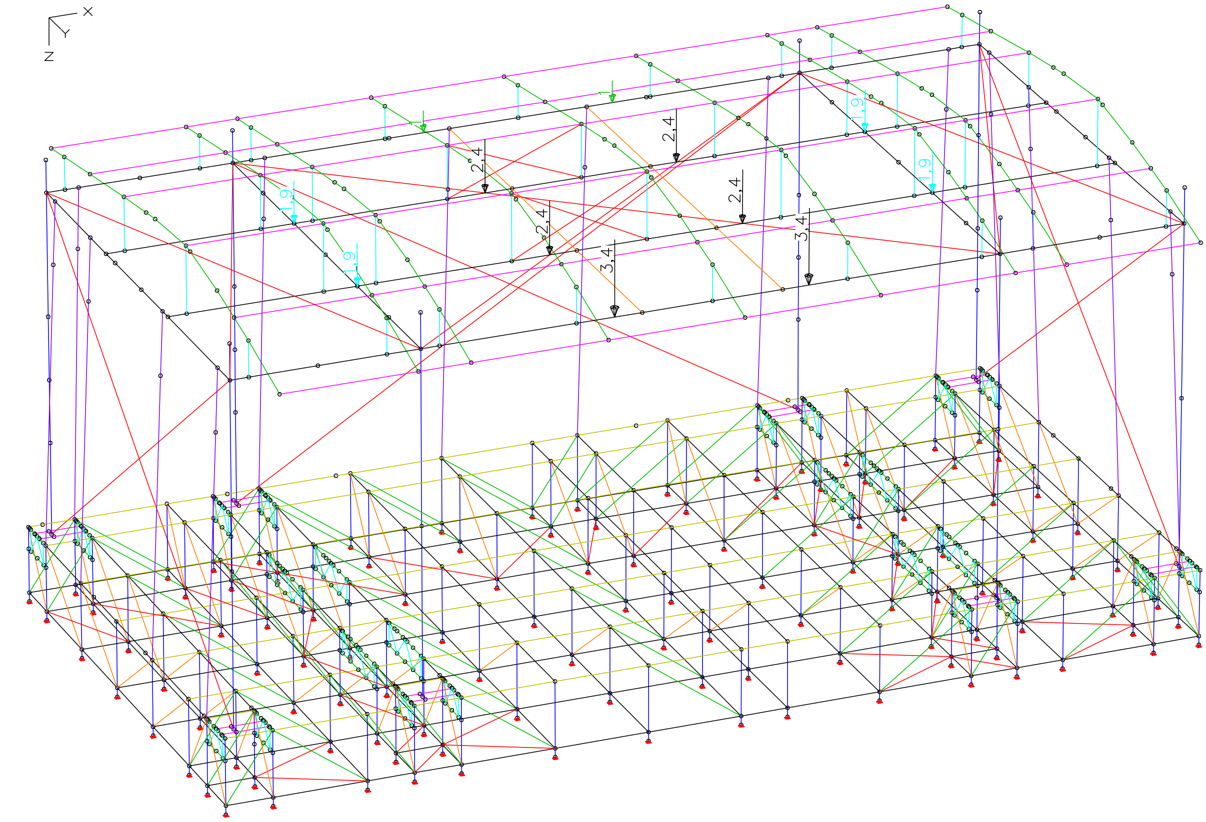


LC 5: Load, CPL payload - Basic setup

4,50 kN = 450 kg
3,20 kN = 320 kg
2,50 kN = 250 kg
1,30 kN = 130 kg

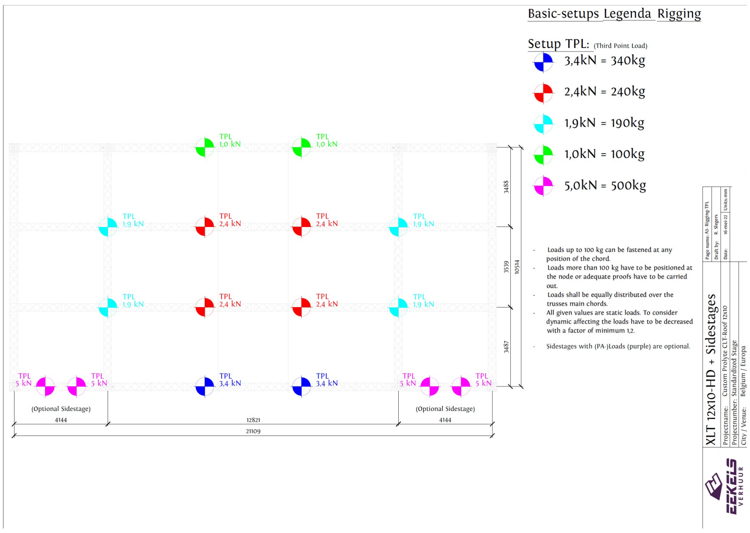


Third Point Load [kN]

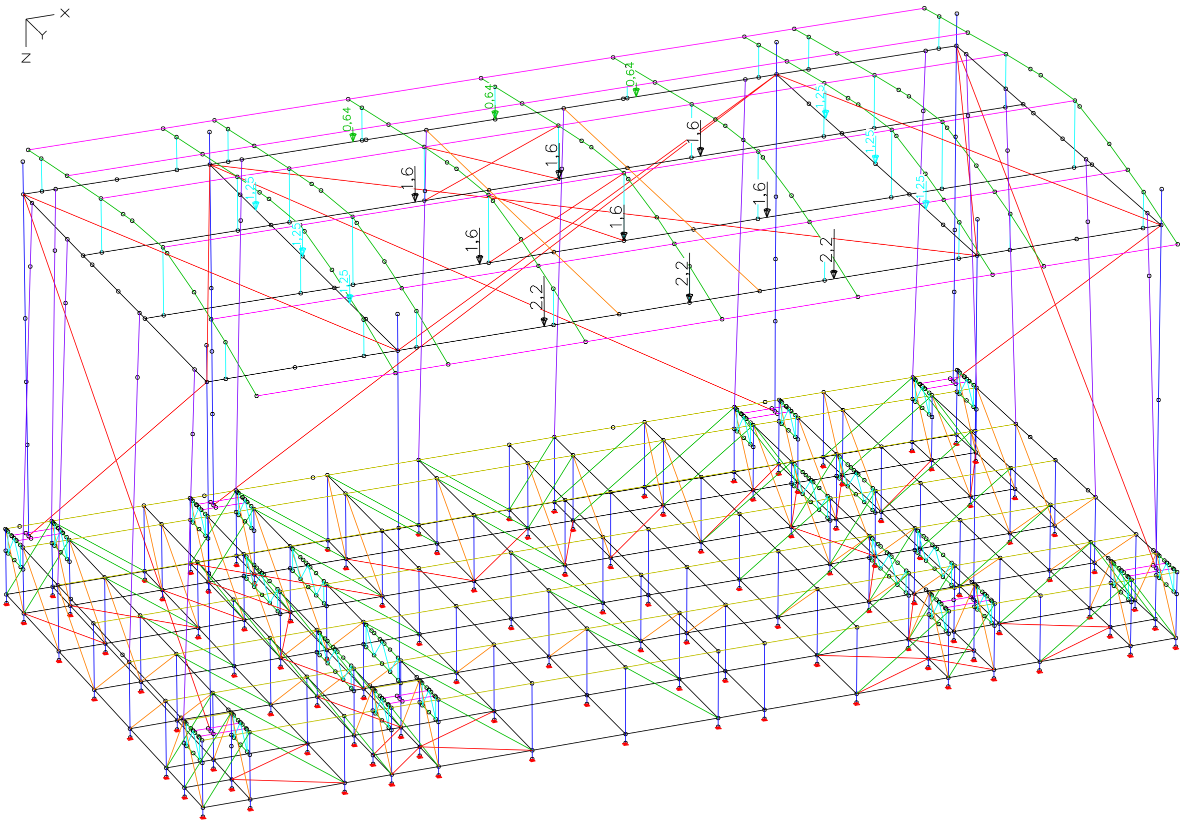


LC 6: Load, 3rdPL payload – Basic setup

3,40 kN = 340 kg
2,40 kN = 240 kg
1,90 kN = 190 kg
1,0 kN = 100 kg

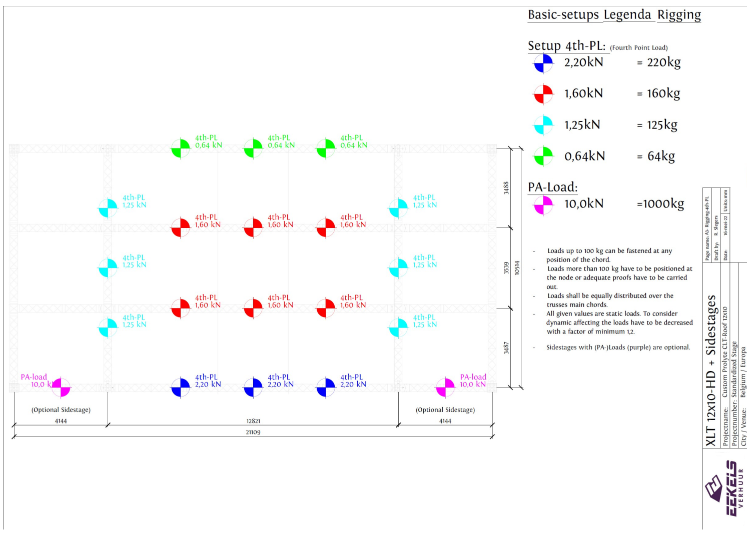


Fourth Point Load [kN]

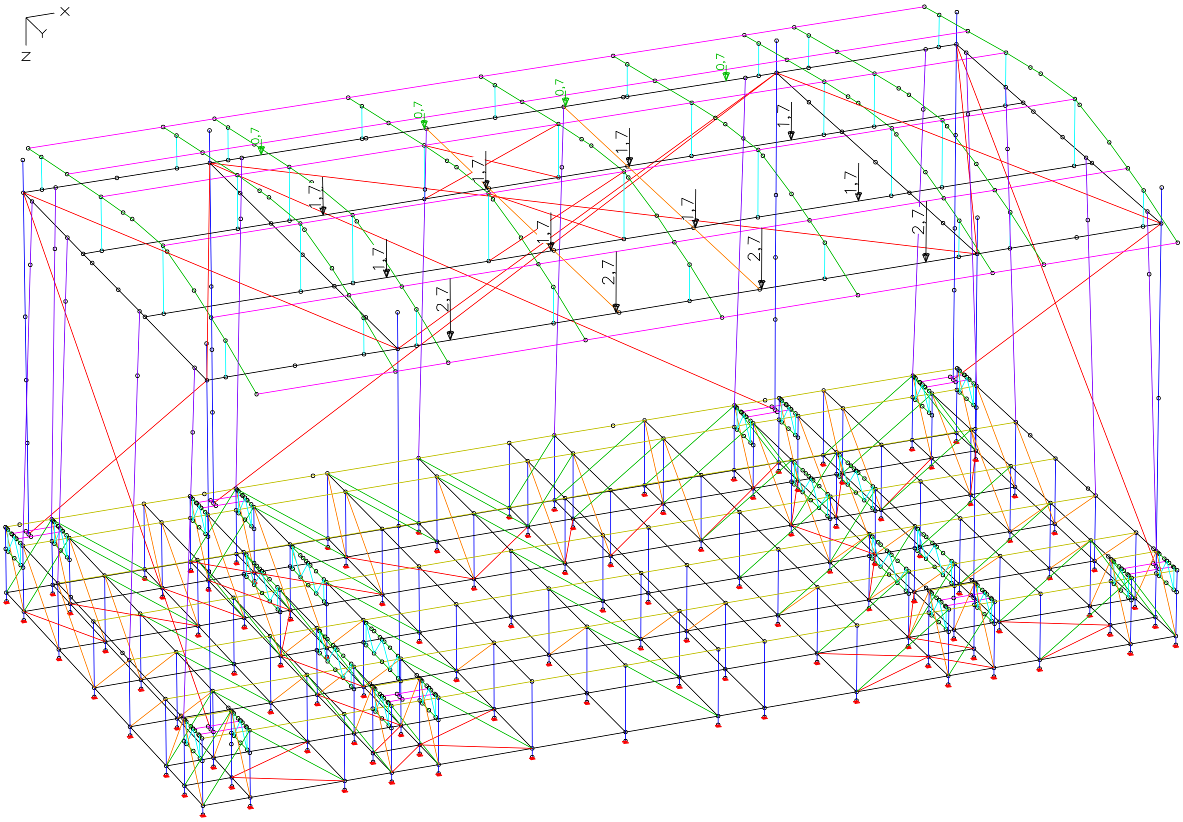


LC 7: Load, 4thPL payload – Basic setup

2,20 kN = 220 kg
1,60 kN = 160 kg
1,25 kN = 125 kg
0,64 kN = 64 kg

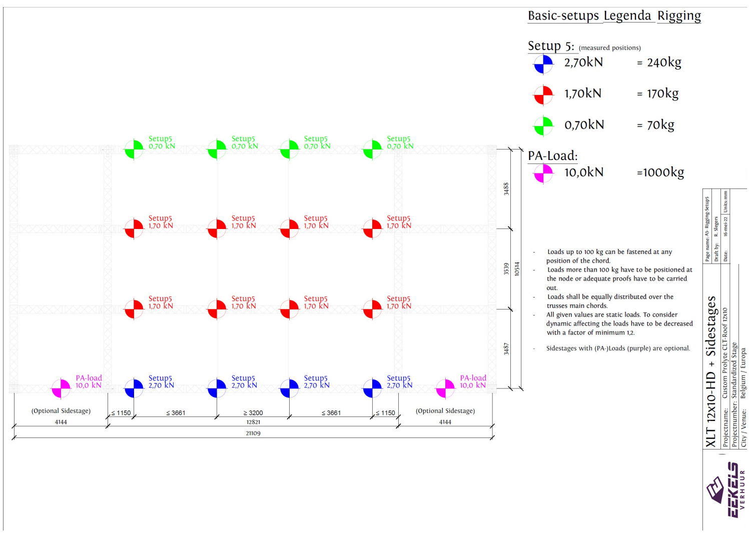


Fifth Point Load [kN]

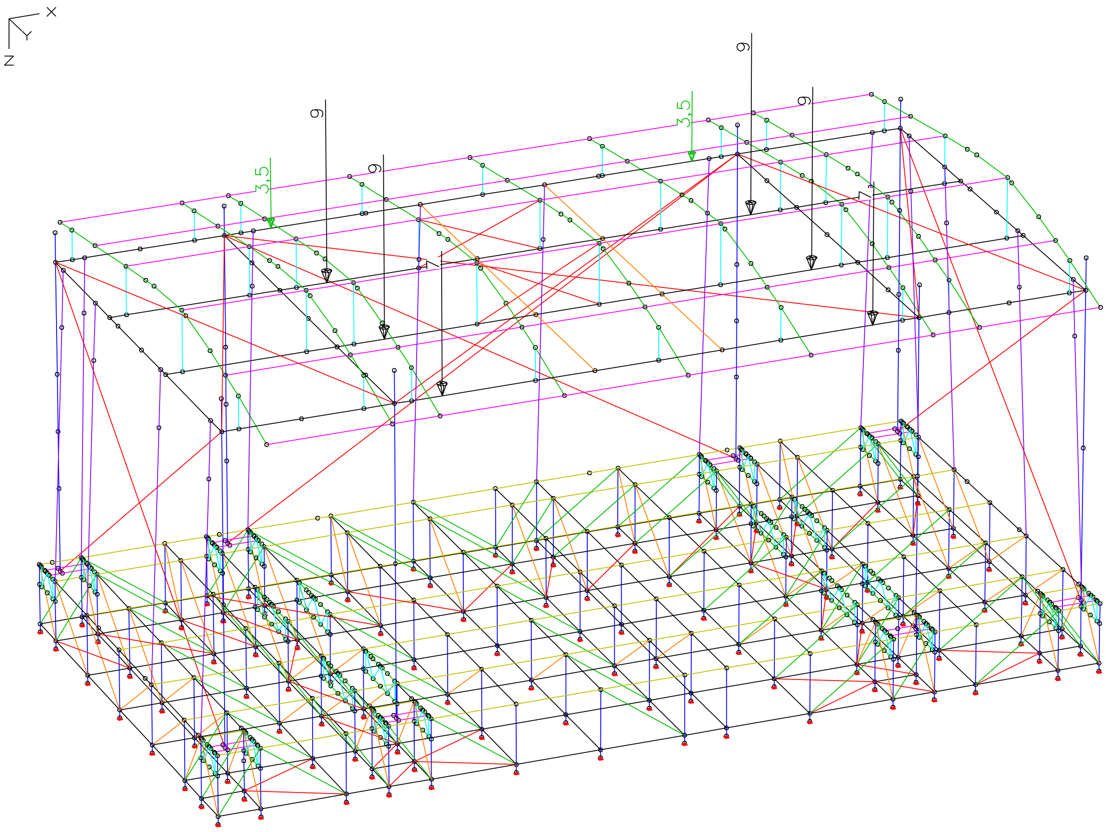


LC 8: Load, 5thPL payload – Basic setup

2,70 kN = 270 kg
1,70 kN = 170 kg
0,70 kN = 70 kg

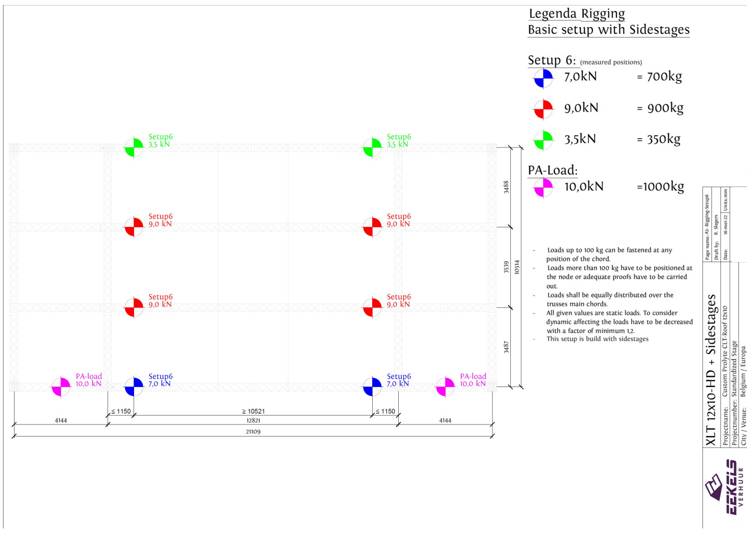


Special Point Load [kN]

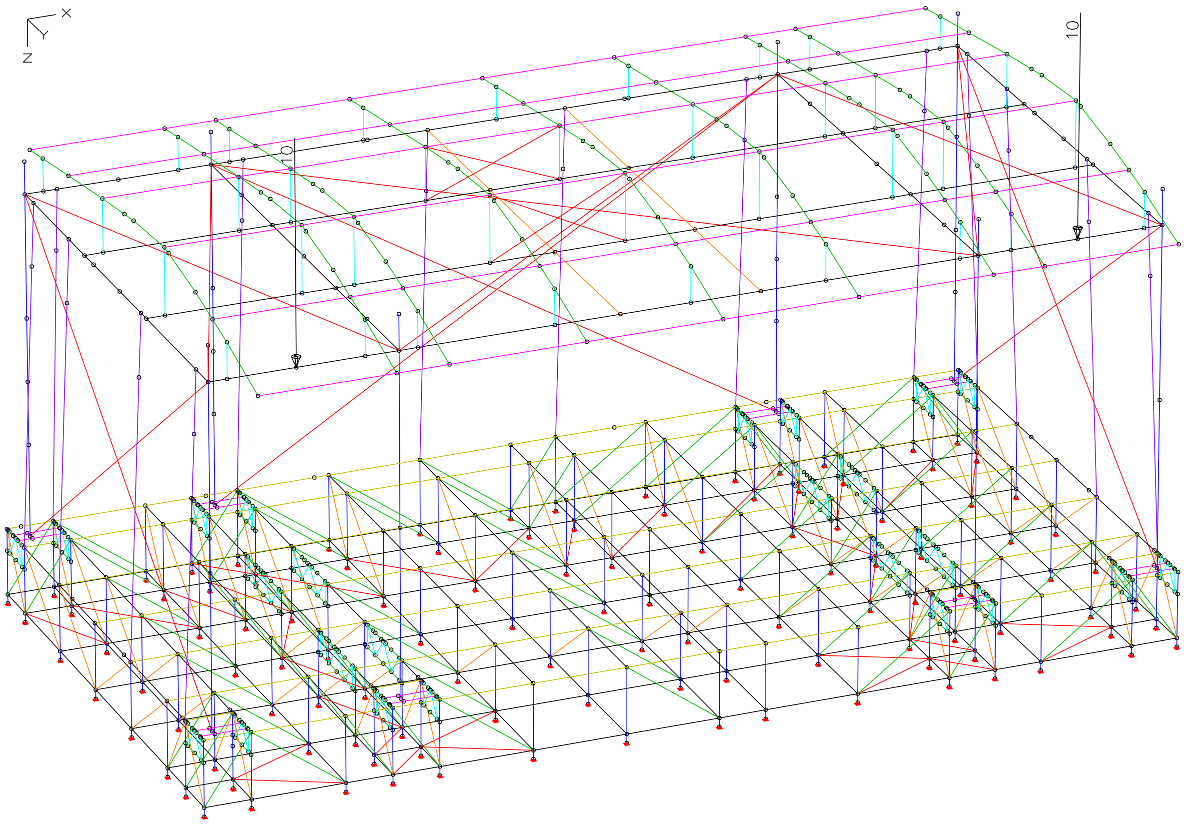


LC 22: Load, special payload – Basic setup

7,0 kN = 700 kg
9,0 kN = 900 kg
3,50 kN = 350 kg



PA Load [kN]



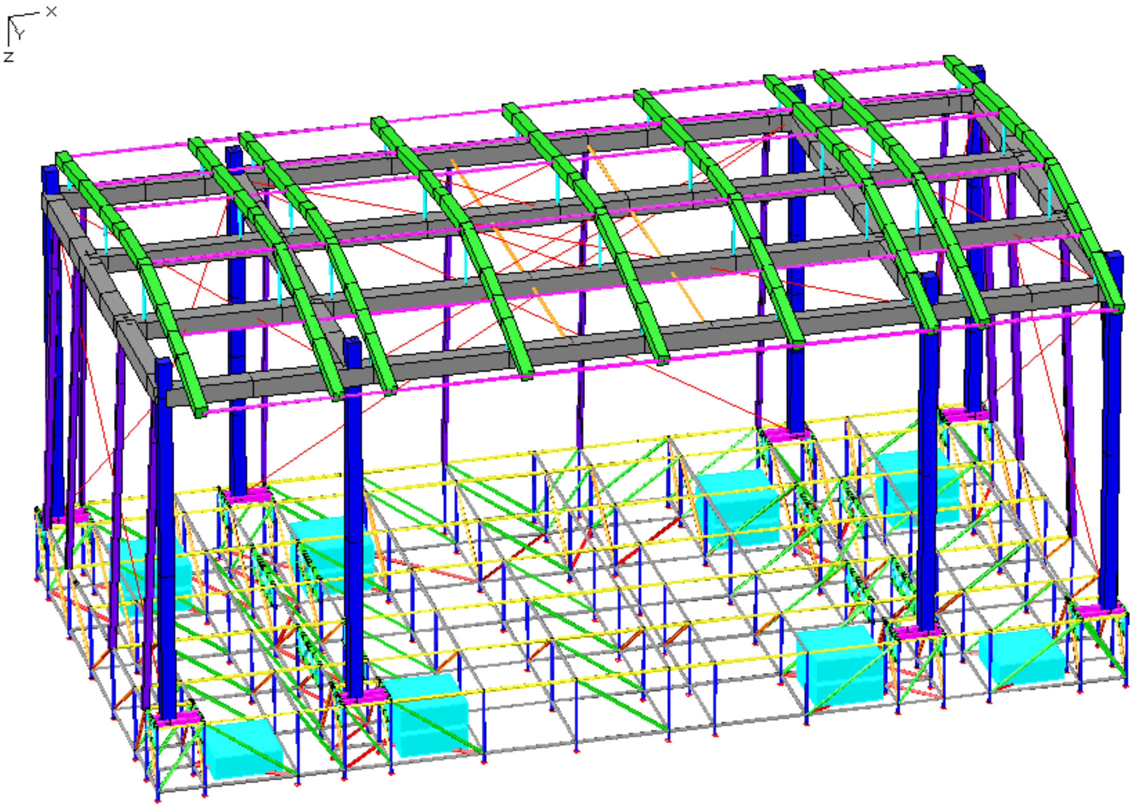
LC 9: Load, PA load

10 kN = 1000 kg (can also be 2 x 500 kg with a distance)

1.9 NECESSARY BALLAST LOADS

Ballast Overview

friction coefficient μ = 0,60



The ballast is displayed schematically as preferred by the customer.

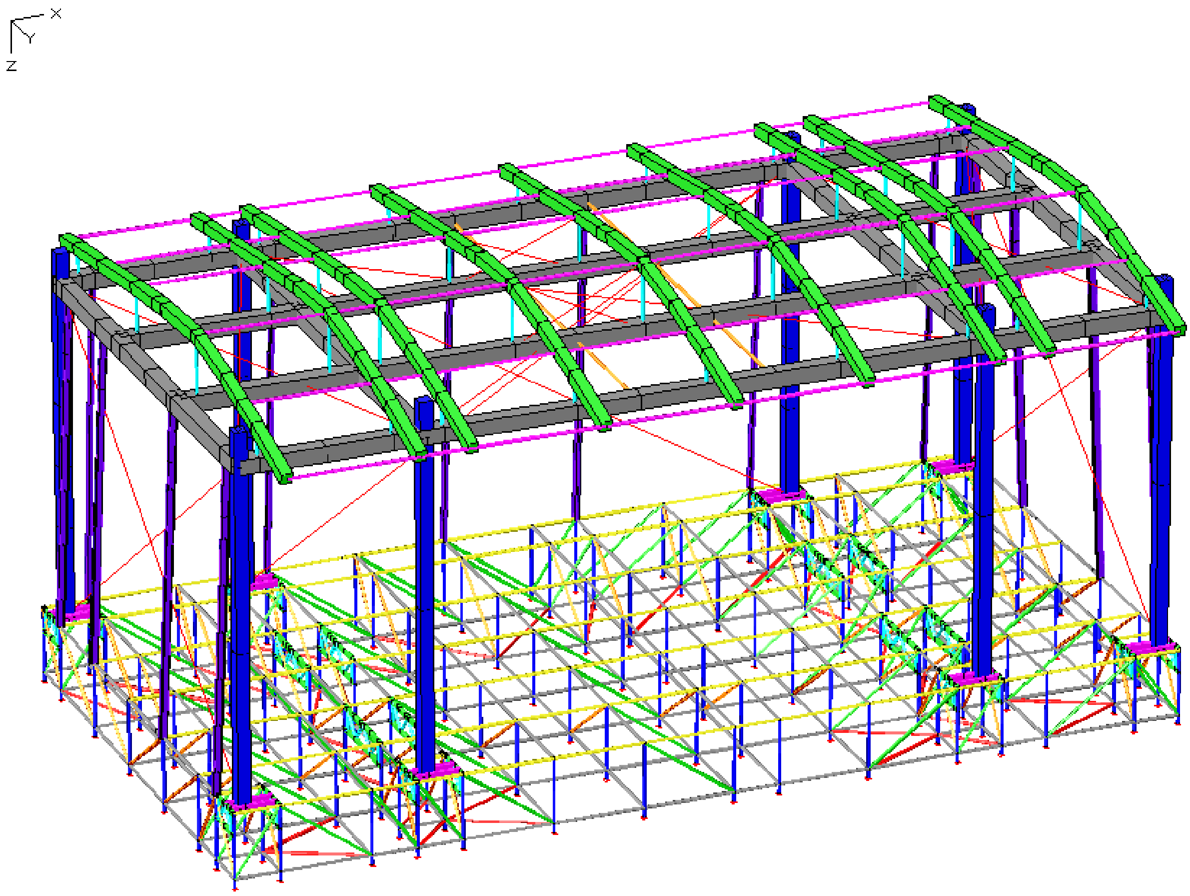
light blue block: 1500 kg (stapled for 3000 kg)

The ballast will be placed force-fitted on the bottom level of the Layher Podium without the usage of Layher Base Collars or it must be placed on a separate level +0,50m.

STRUCTURAL CALCULATION

2 STATICAL SYSTEM 12x10m – BASIC SETUP

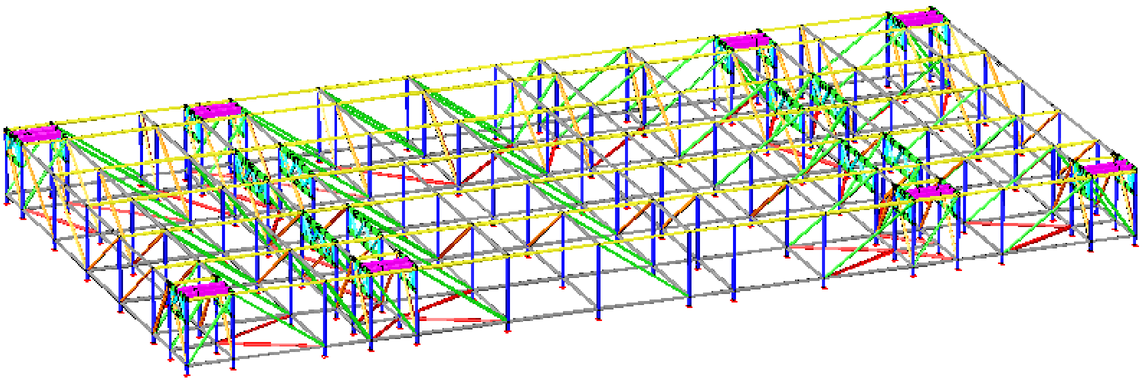
Isometric:

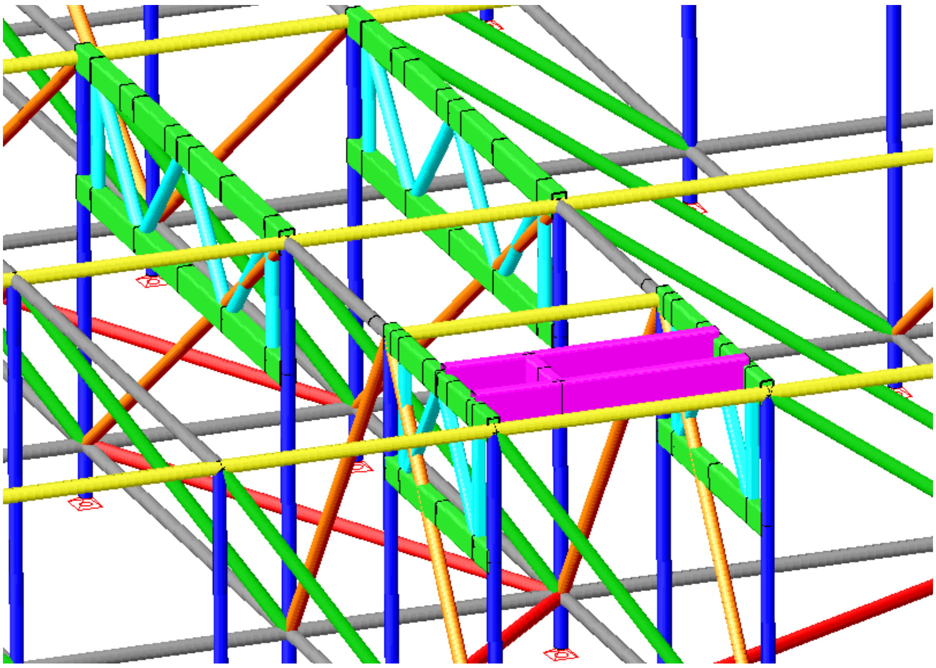


The trusses are shown in a simplified view.

grey:	PROLYTE H40V
blue:	PROLYTE H30V
green:	PROLYTE H30D
pink:	pipe Ø48x3 (aluminium)
orange:	pressure tubes Ø48,3x3,2 (steel)
dark violett	Keder 170x88x3m (EN AW 6082 T6)
red:	guy wires

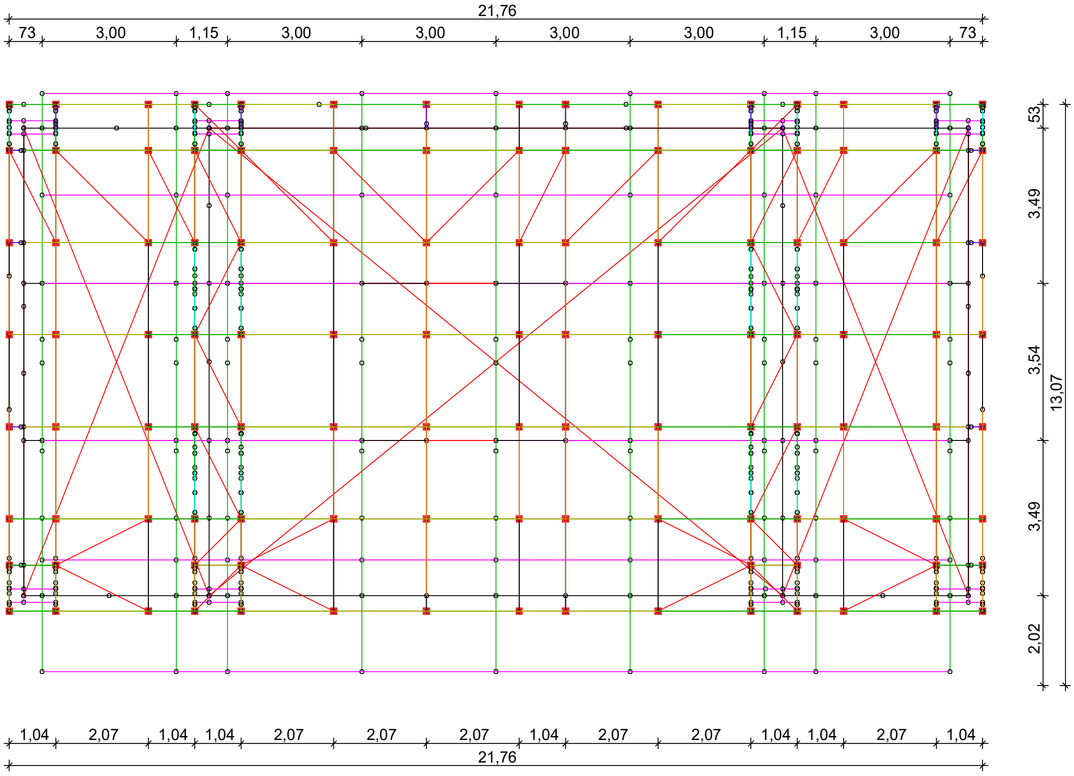
Layher:



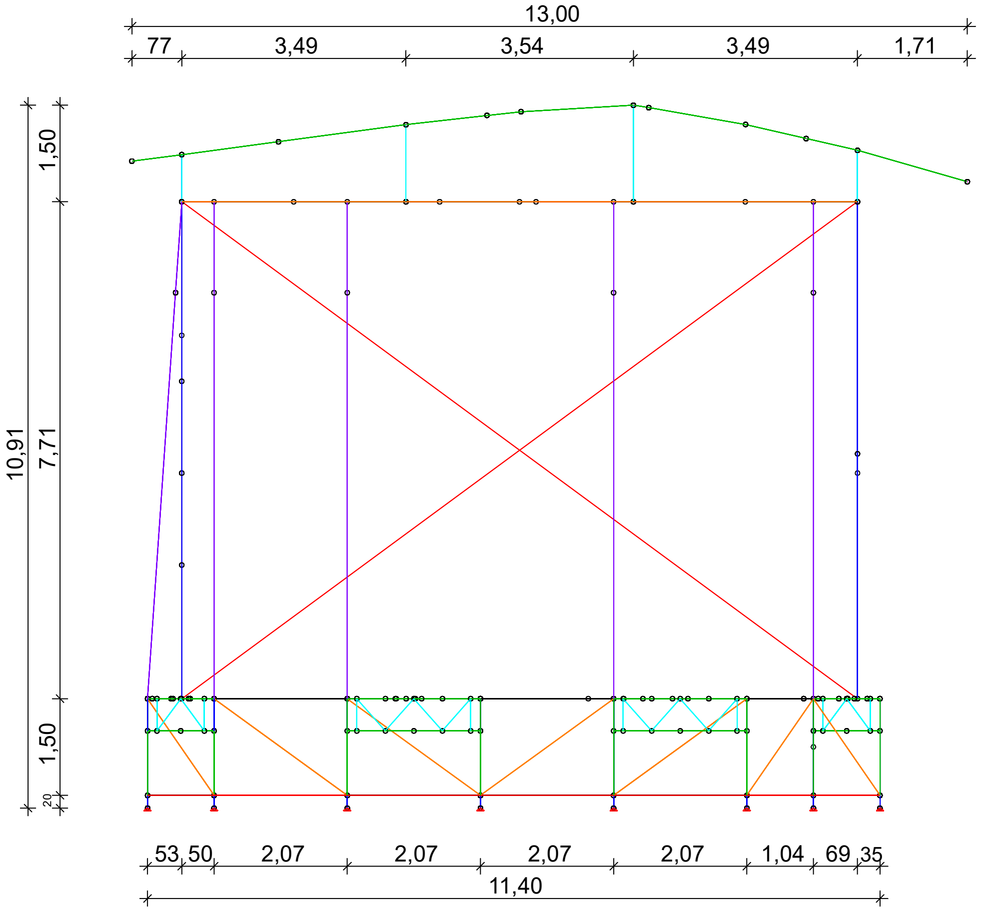


Ledger (light yellow)	Ø48,3x3,2mm	(S235 JR)
Podium beam (black)	Layher O-ledgers bridging or LW	
Bottom beam (black)	Ø48,3x3,2mm	(S235 JR)
Column (blue)	Ø48,3x3,2mm	(S235 JR R_h = 320 N/mm²)
Diagonal (orange,light blue,grey)	Ø48,3x3,2mm	(S235 JR)
Base truss girders (pink)	RHS 150x50x5mm	(S355 JR)
Base lattice girders	Universal Base or Prolyte	(steel)

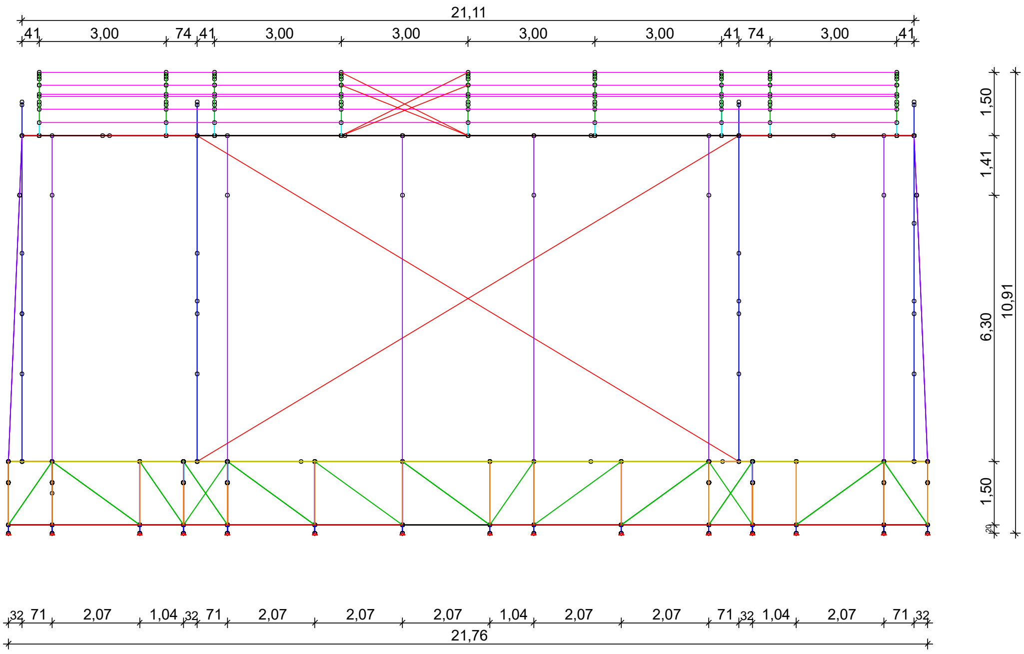
top view roof/ podium:



side view:


13,00
77
3,49
3,54
3,49
1,71
10,91
1,50
7,71
1,50
20
53
50
2,07
2,07
2,07
2,07
1,04
69
35
11,40

front view:


21,11
41
3,00
74
41
3,00
3,00
3,00
3,00
41
74
3,00
41
1,50
1,41
6,30
10,91
1,50
32
71
2,07
1,04
32
71
2,07
2,07
2,07
1,04
2,07
2,07
71
32
1,04
2,07
71
32
21,76

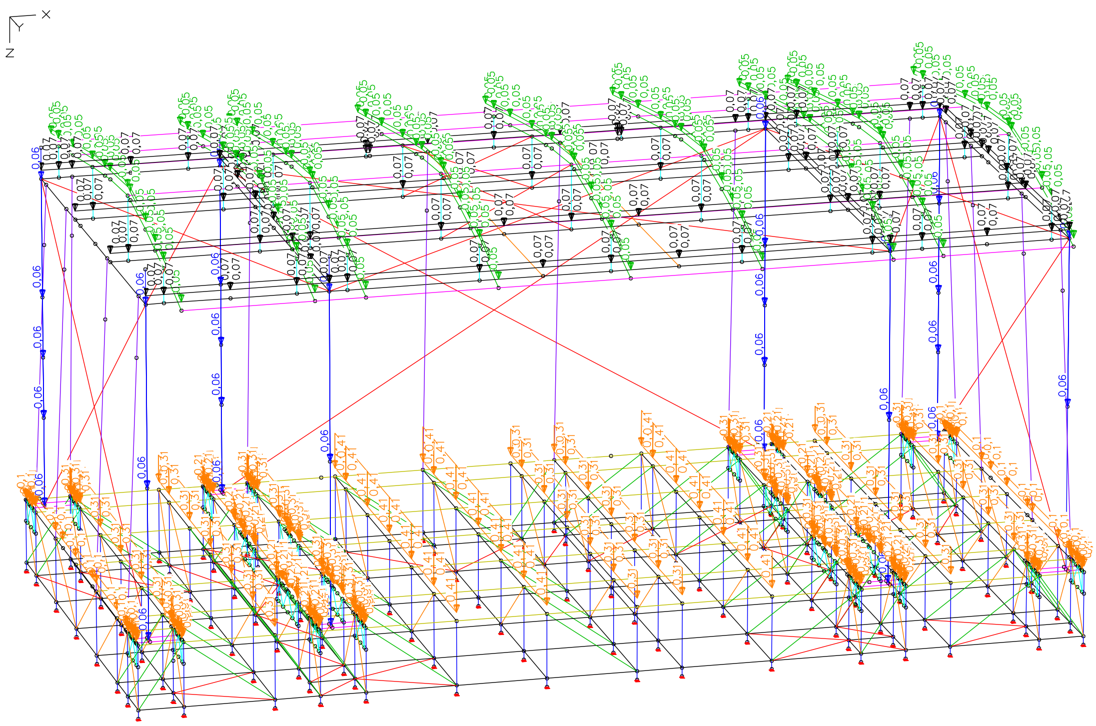
3 LOADING

Load case1: dead weight

H30D:	0,05 kN/m	(green)
H30V:	0,06 kN/m	(blue)
H40V:	0,07 kN/m	(grey)

Podium decks	g = 0,20 kN/m²:
0,20 x 2,072	= 0,41 kN/m
0,20 x (2,072+1,036)/2	= 0,311 kN/m
0,20 x 1,036	= 0,21 kN/m
0,20 x 1,036/ 2	= 0,104 kN/m

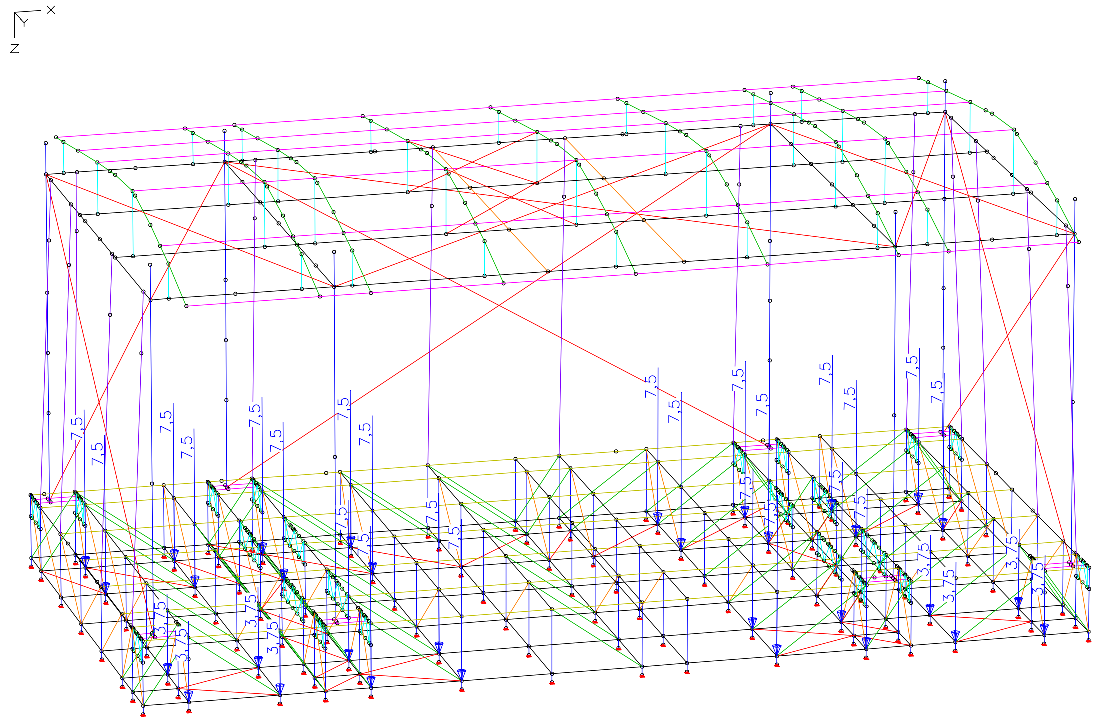
Layher tubes and other components are considered via specific weight and cross section by the software Infograph



LC 1: Load, dead weight

Load case 2: ballast

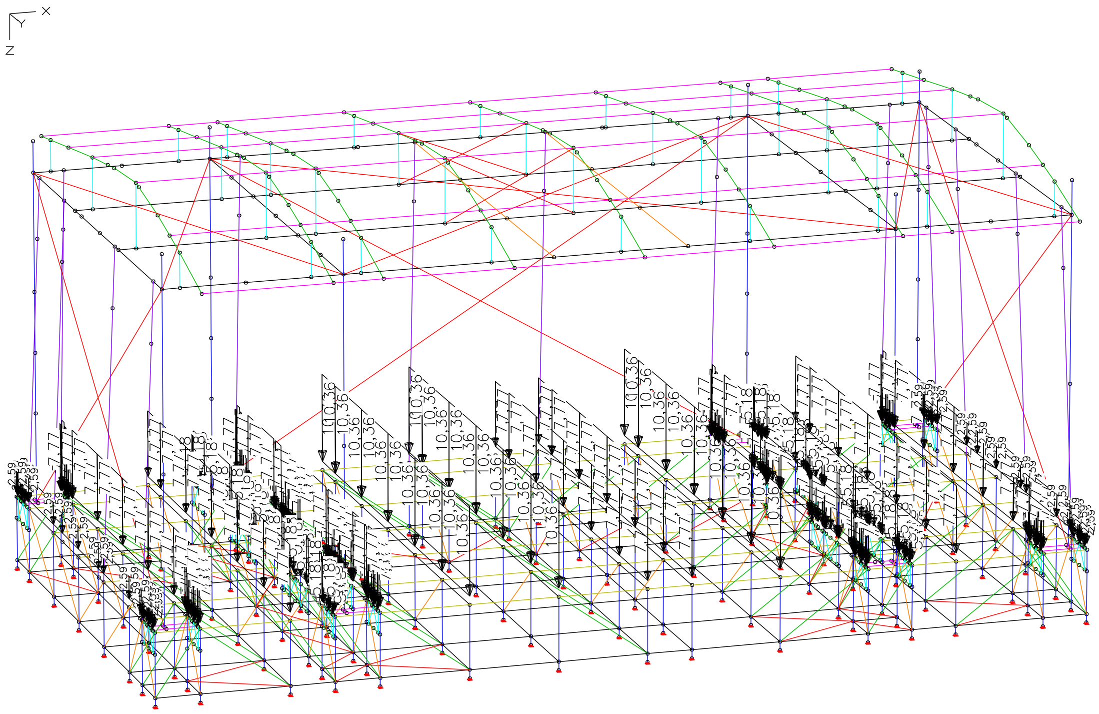
3000 kg = 4 x 7,5 kN
1500 kg = 4 x 3,75 kN



LC 2: Load, ballast

Load case 3: payload podium

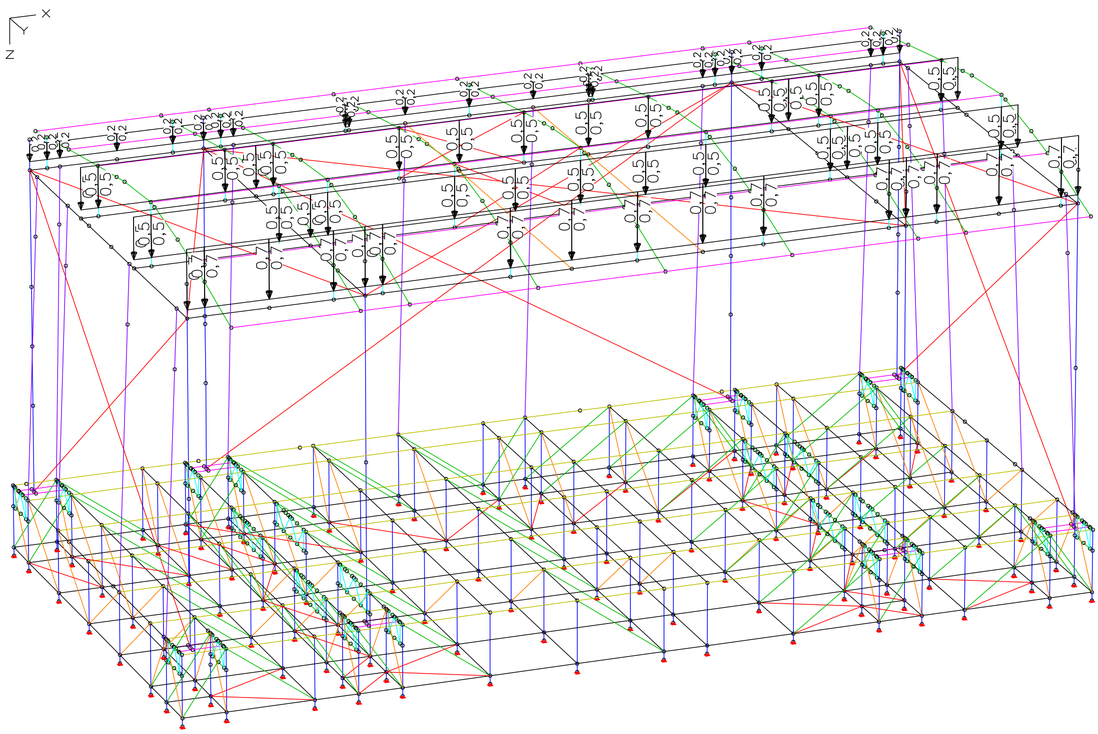
500 kg/m²	5,0 x (2,072+1,036)/ 2	= 7,77 kN/m
	5,0 x 2,072	= 10,36 kN/m
	5,0 x 1,036/ 2	= 2,59 kN/m



LC 3: Load, payload podium

Load case 4: distributed load – basic setup

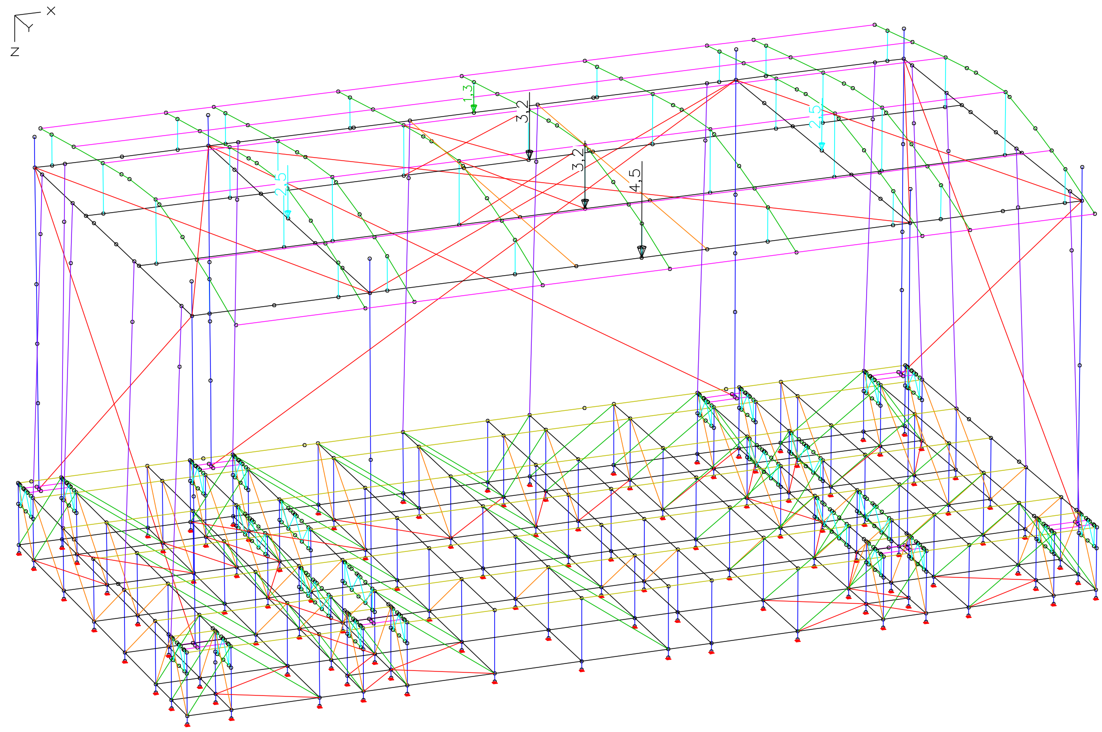
see chpt. 1.8



LC 4: Load, distributed payload – Basic setup

Load case 5: **C**entre Point Load – basic setup

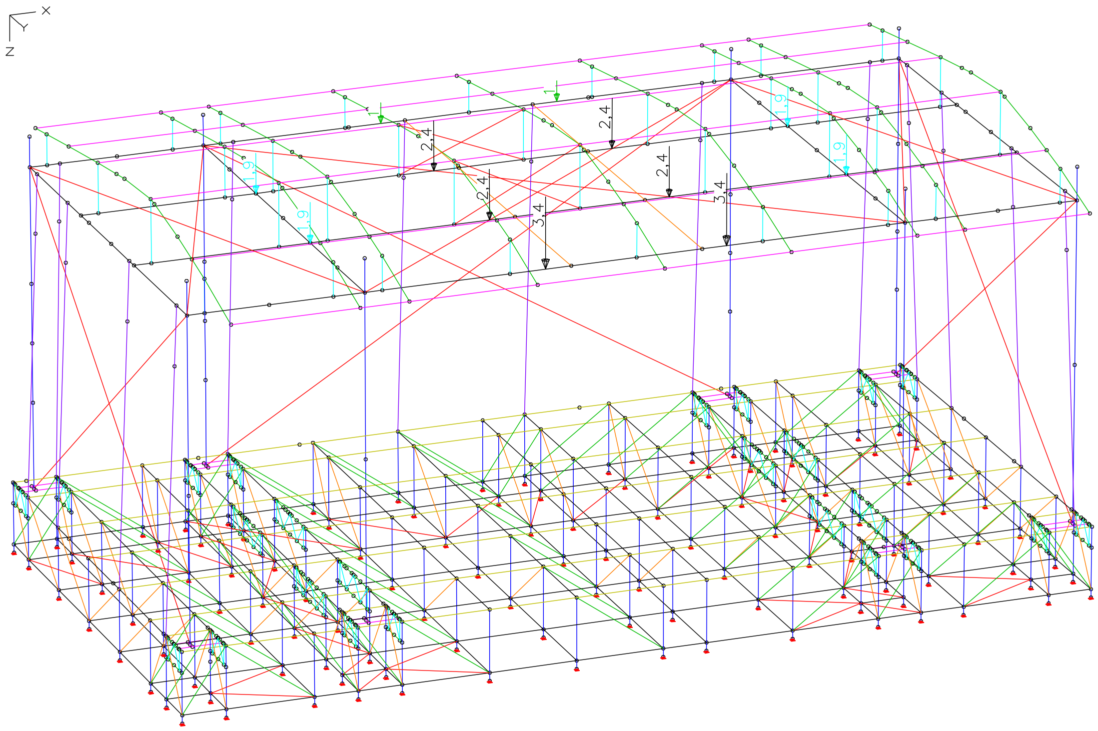
see chpt. 1.8



LC 5: Load, CPL payload – Basic setup

Load case 6: Third Point Load – basic setup

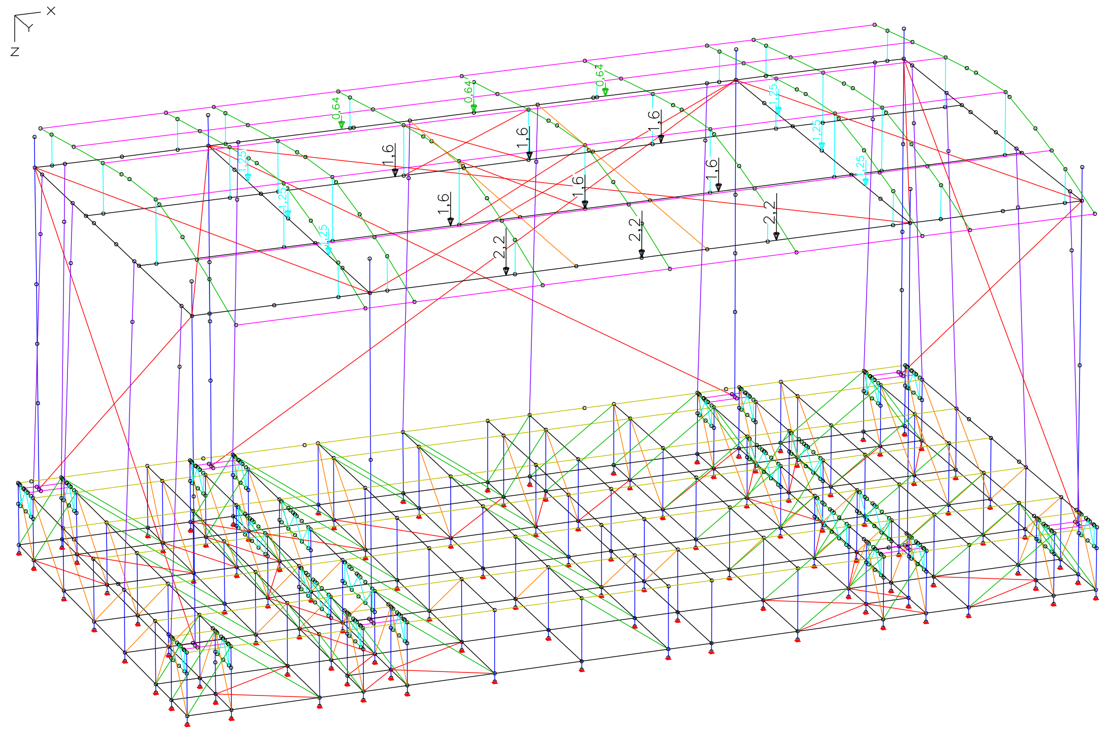
see chpt. 1.8



LC 6: Load, 3rdPL payload – Basic setup

Load case 7: Fourth Point Load – basic setup

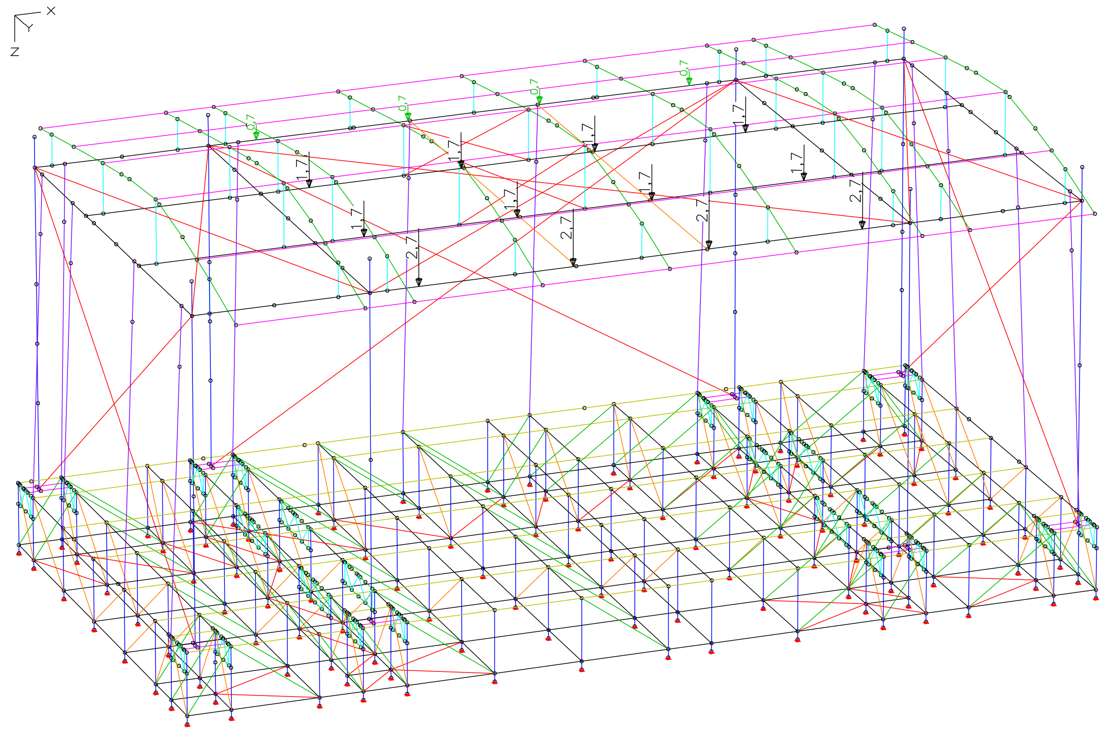
see chpt. 1.8



LC 7: Load, 4thPL payload – Basic setup

Load case 8: Fifth Point Load – basic setup

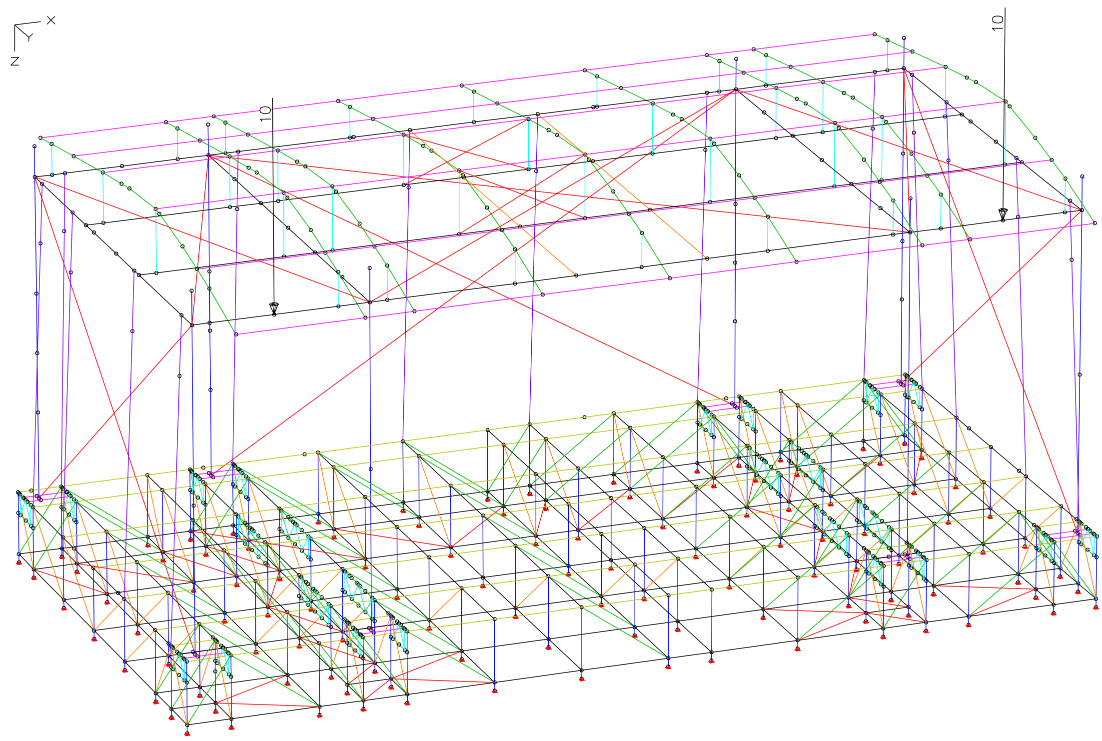
see chpt. 1.8



LC 8: Load, 5thPL payload – Basic setup

Load case 9: PA-load

see chpt. 1.8



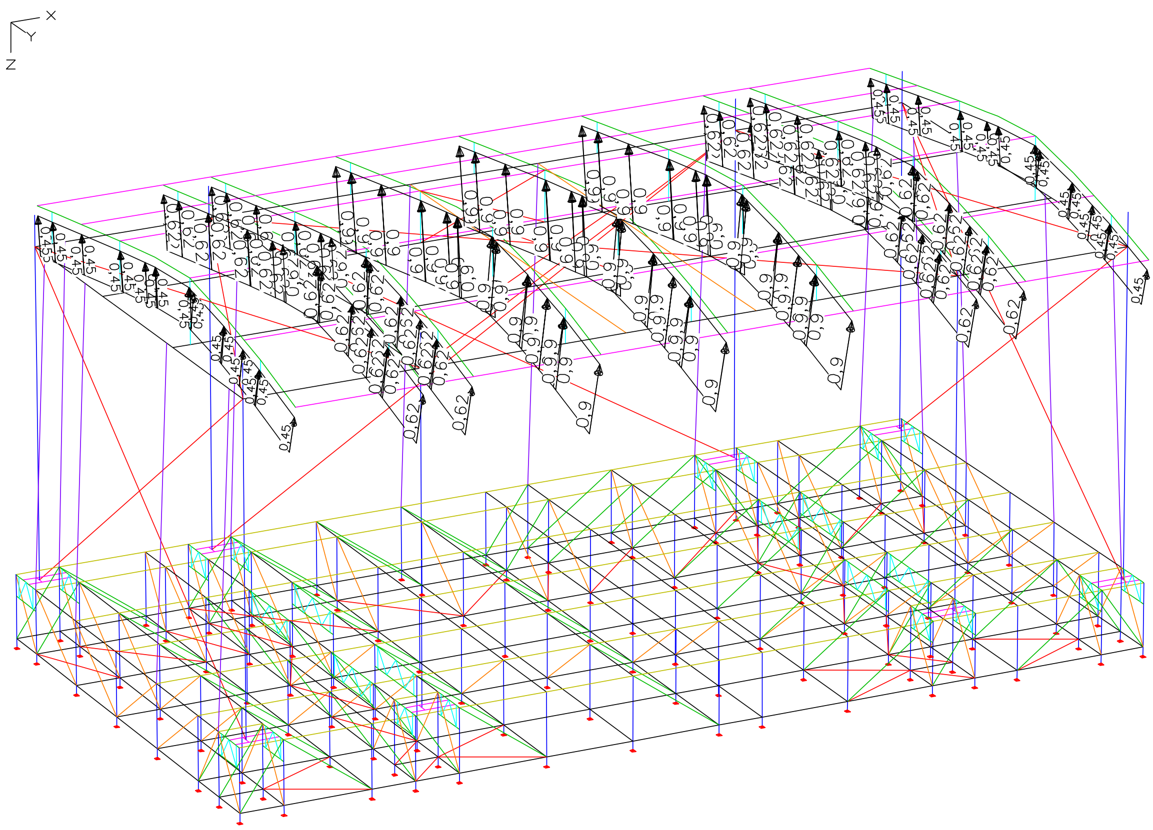
LC 9: Load, PA load

(can also be 2 x 500 kg with a distance)

Load case 10: wind roof

q_b = 0.30 kN/m c_{pe}= 1.00

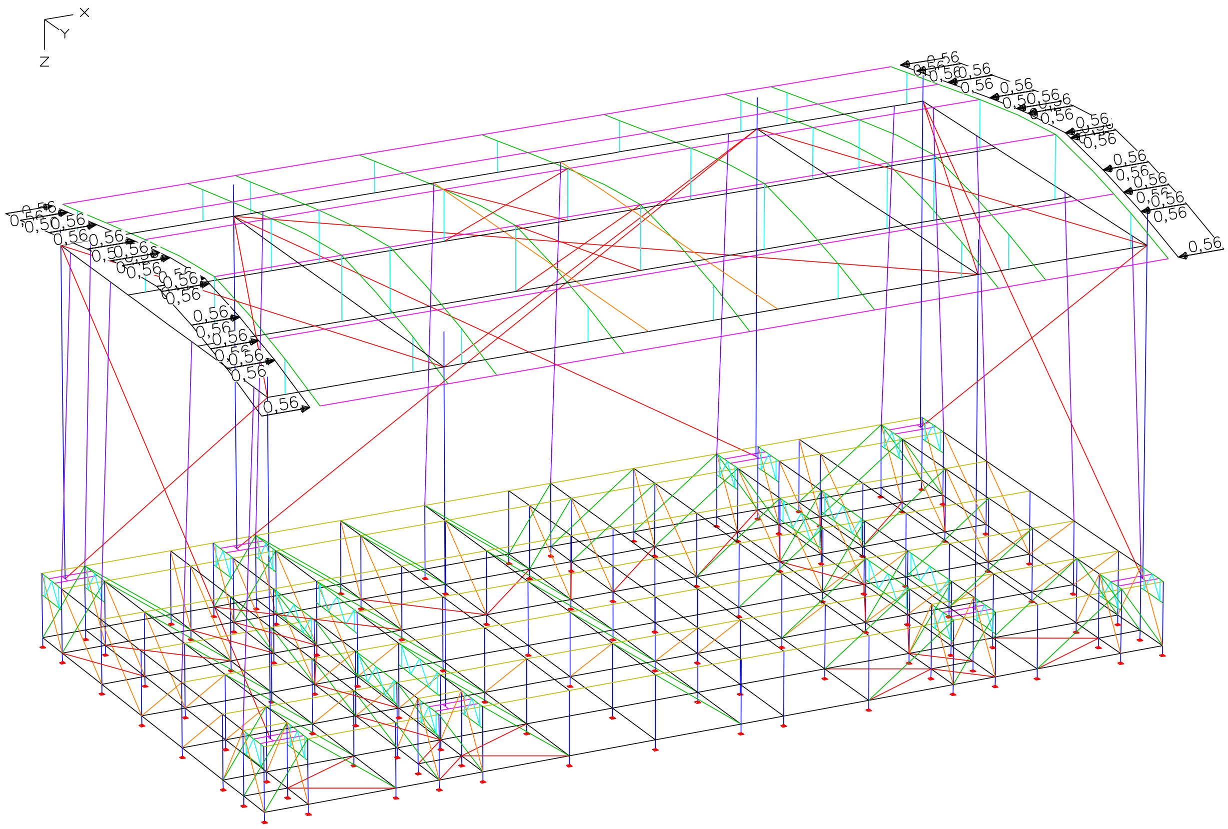
w_1 = 0,30 x 1,0 x 3,0 = 0,90 kN/m
w_2 = 0,30 x 1,0 x (3,0+1,15)/2 = 0,621 kN/m
w_3 = 0,30 x 1,0 x 3,0/2 = 0,45 kN/m



LC 10: Load, wind load – roof area

load case 11: **m**embrane tension roof

z_1 = 0,45/ 0,8 = 0,5625 kN/m



LC 11: Load, membrane tension – roof

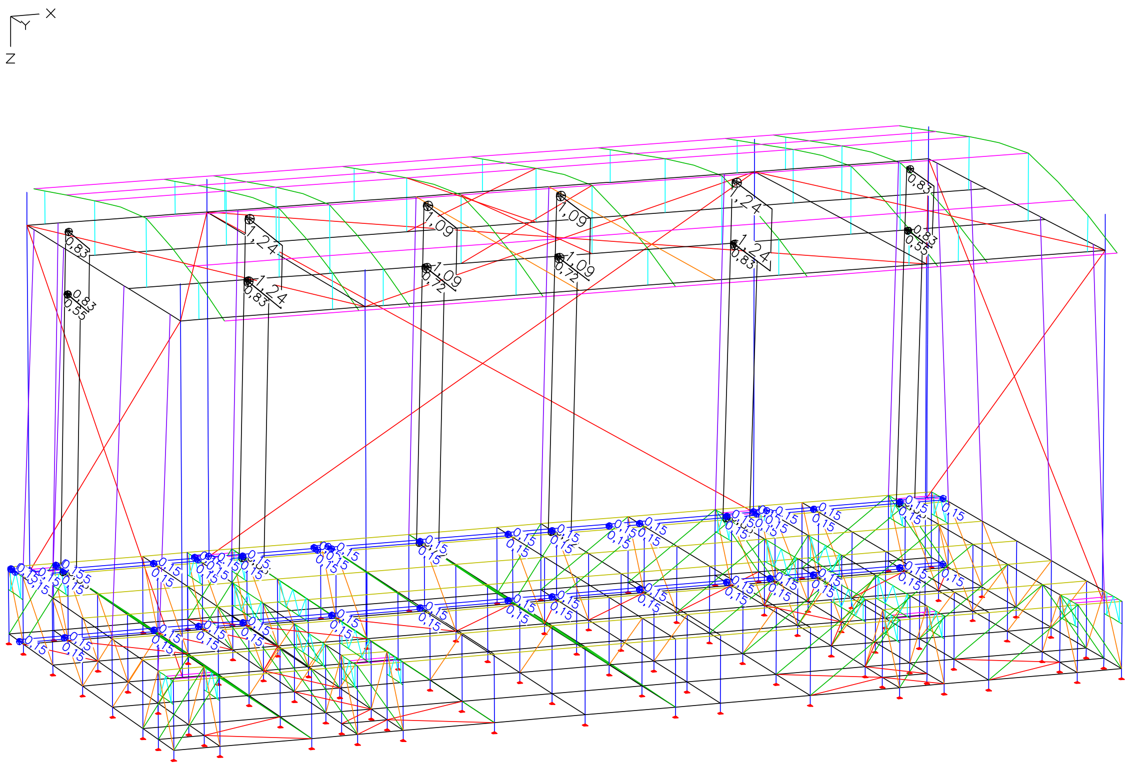
Load case 12: wind rear wall

q = 0,30 or 0,20 kN/m² c_{pe}= 1.00

on keders:

w_1 = 1,0 x 0,20 x (4,14+3,11)/2 = 0,725 kN/m
w_2 = 1,0 x 0,30 x (4,14+3,11)/2 = 1,0875 kN/m
w_3 = 1,0 x 0,20 x 4,14 = 0,83 kN/m
w_4 = 1,0 x 0,30 x 4,14 = 1,242 kN/m
w_5 = 1,0 x 0,20 x (4,14/2 + 0,72) = 0,55 kN/m
w_6 = 1,0 x 0,30 x (4,14/2 + 0,72) = 0,837 kN/

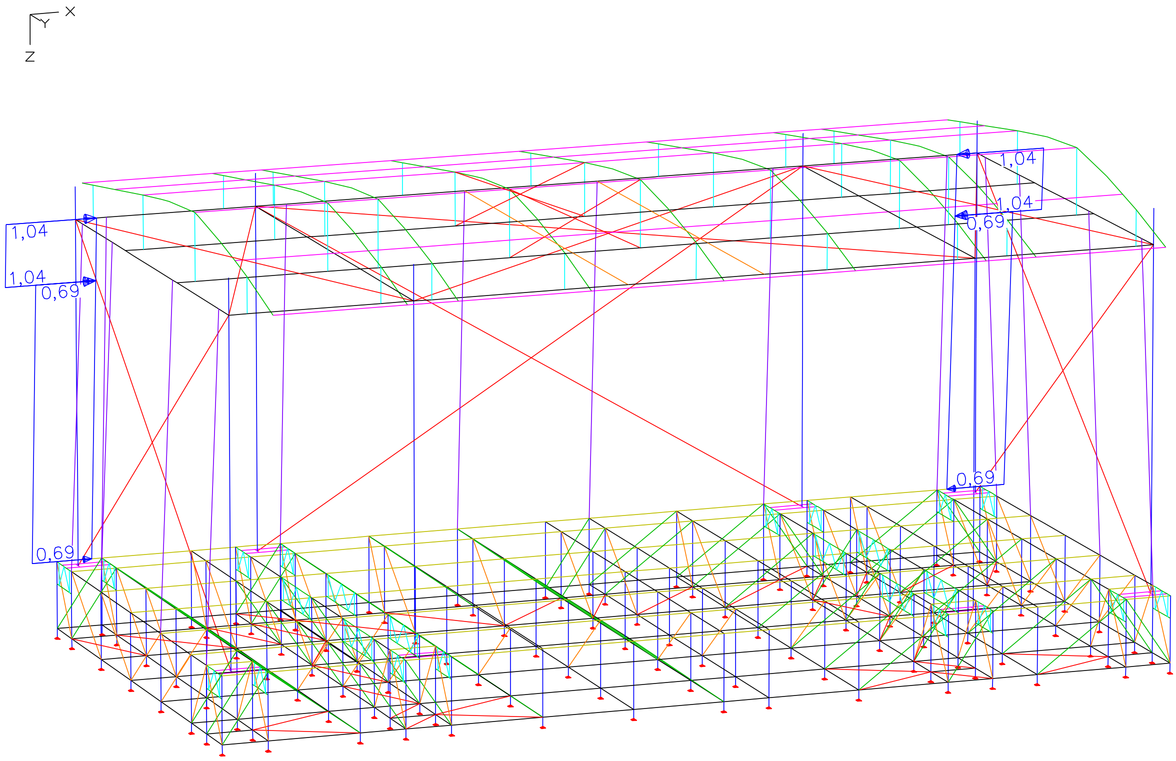
on podium: w_7 = 1,0 x 0,20 x 1,5/2 = 0,15 kN/m



LC 12: Load, wind – rear wall

Load case 13: **m**embrane tension rear wall

z_1 = 0,55/ 0,8 = 0,6875 kN/m
z_2 = 0,83/ 0,8 = 1,0375 kN/m



LC 13: Load, membrane tension – rear wall

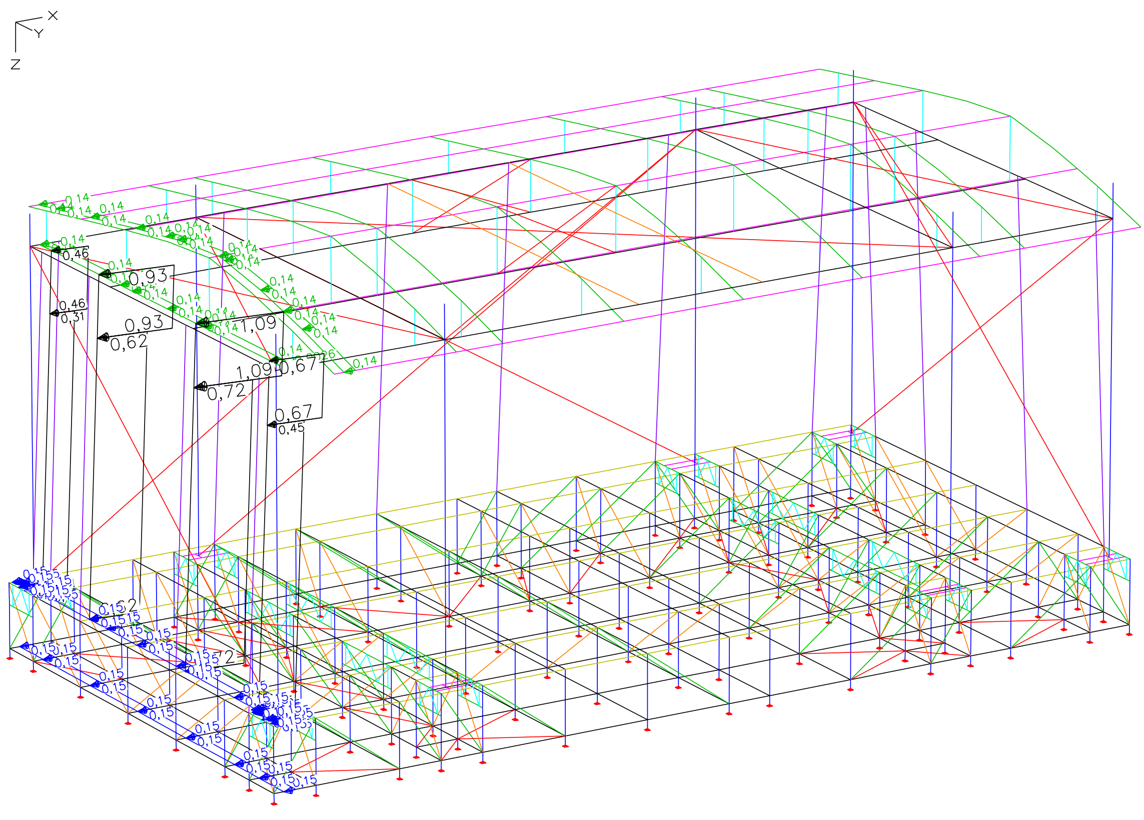
Load case 14: wind left side

q = 0,30 or 0,20 kN/m² c_{pe}= 1.00

on keders:
w_1 = 1,0 x 0,20 x (3,11/2 + 0,69) = 0,448 kN/m
w_2 = 1,0 x 0,30 x (3,11/2 + 0,69) = 0,672 kN/m
w_3 = 1,0 x 0,20 x ((4,14+3,11)/2 = 0,725 kN/m
w_4 = 1,0 x 0,30 x ((4,14+3,11)/2 = 1,0875 kN/m
w_5 = 1,0 x 0,20 x ((4,14+2,07)/2 = 0,621 kN/m
w_6 = 1,0 x 0,30 x ((4,14+2,07)/2 = 0,932 kN/m
w_7 = 1,0 x 0,20 x (2,07/2 + 0,50) = 0,307 kN/m
w_8 = 1,0 x 0,30 x (2,07/2 + 0,50) = 0,461 kN/m

on gable:
average height = (0,40 + 1,50)/ 2 = 0,95 m
w_9 = 1,0 x 0,30 x 0,95/ 2 = 0,143 kN/m (triangular shape)

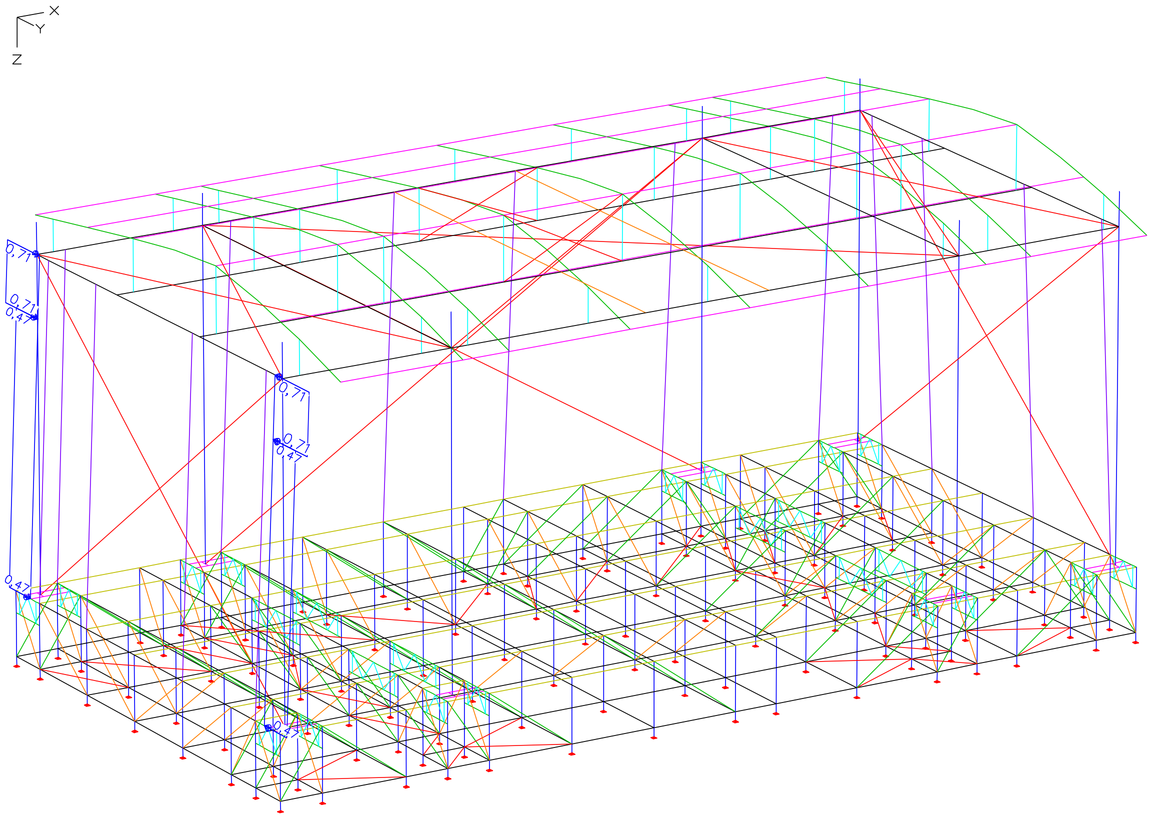
on podium:
w_{10} = 1,0 x 0,20 x 1,5/2 = 0,15 kN/m



LC 14: Load, wind – left side

Load case 15: **m**embrane tension left side

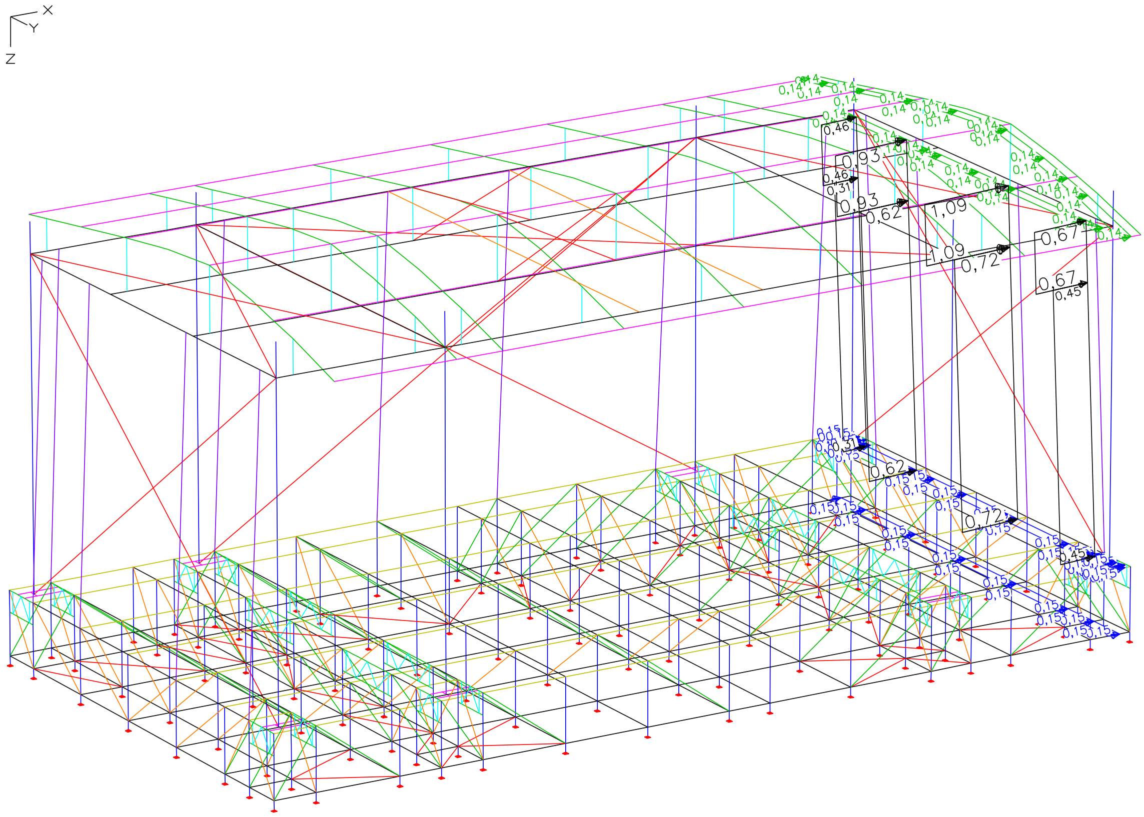
z_1 = (0,448+0,307)/2 / 0,8 = 0,471 kN/m
z_2 = (0,672+0,461)/2/ 0,8 = 0,708 kN/m



LC 15: Load, membrane tension – left side

Load case 16: wind right side

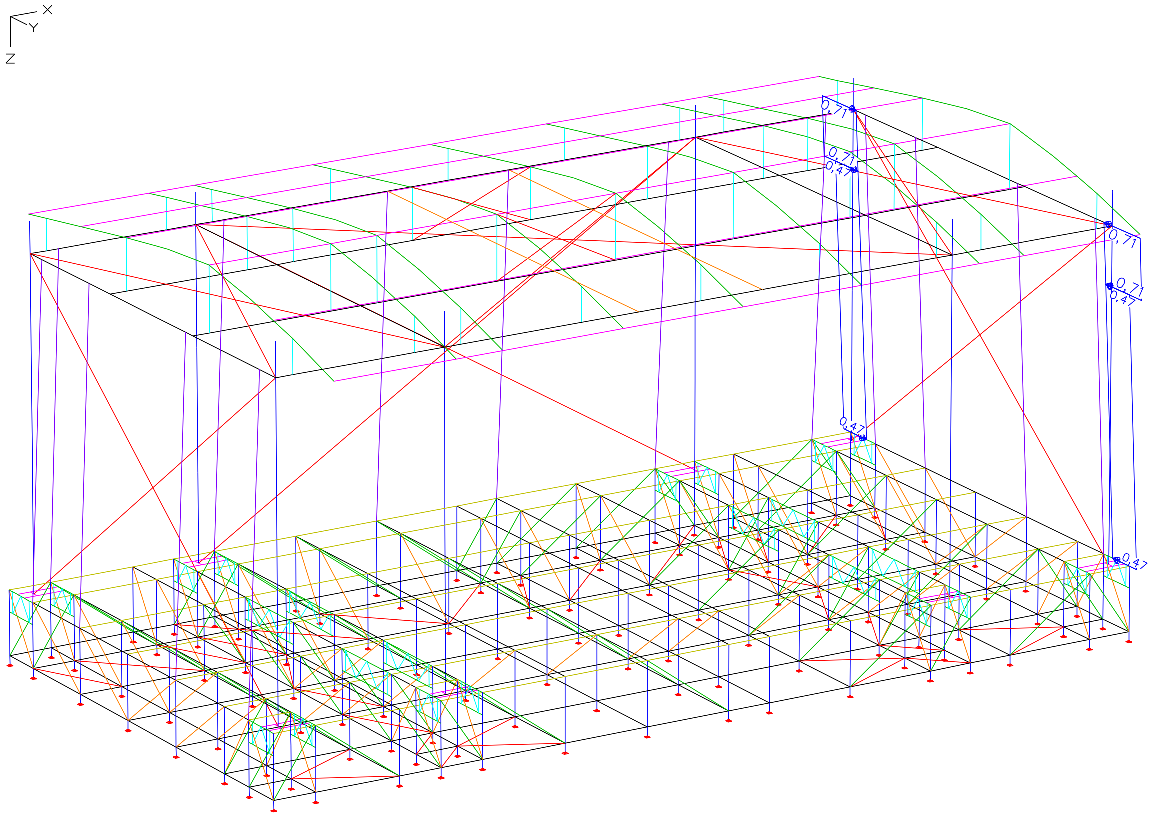
see LC 14



LC 16: Load, wind – right side

Load case 17: membrane tension right side

see LC 15



LC 17: Load, membrane tension – right side

Load case 18: wind on podium

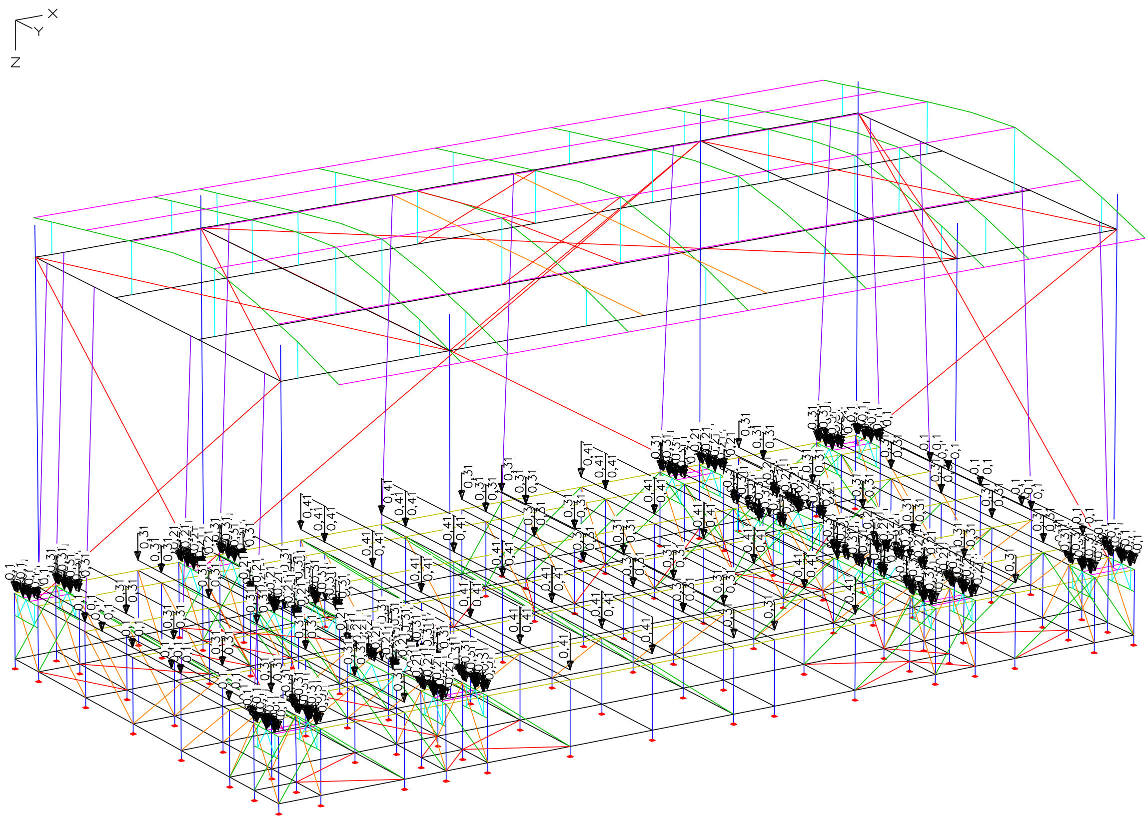
$q = 0{,}20\ kN/m^2$ $c_{pe} = 1{,}0$

$w_1 = 1{,}0 \times 0{,}20 \times 2{,}072 = 0{,}41\ kN/m$

$w_2 = 1{,}0 \times 0{,}20 \times (2{,}072+1{,}036)/2 = 0{,}311\ kN/m$

$w_3 = 1{,}0 \times 0{,}20 \times 1{,}036 = 0{,}21\ kN/m$

$w_4 = 1{,}0 \times 0{,}20 \times 1{,}036/\ 2 = 0{,}104\ kN/m$



LC 18: Load, wind on podium top

Load case 20: wind trusses y-direction

$q = 0{,}625\ kN/m^2$ $c_{pe} = 1{,}30$

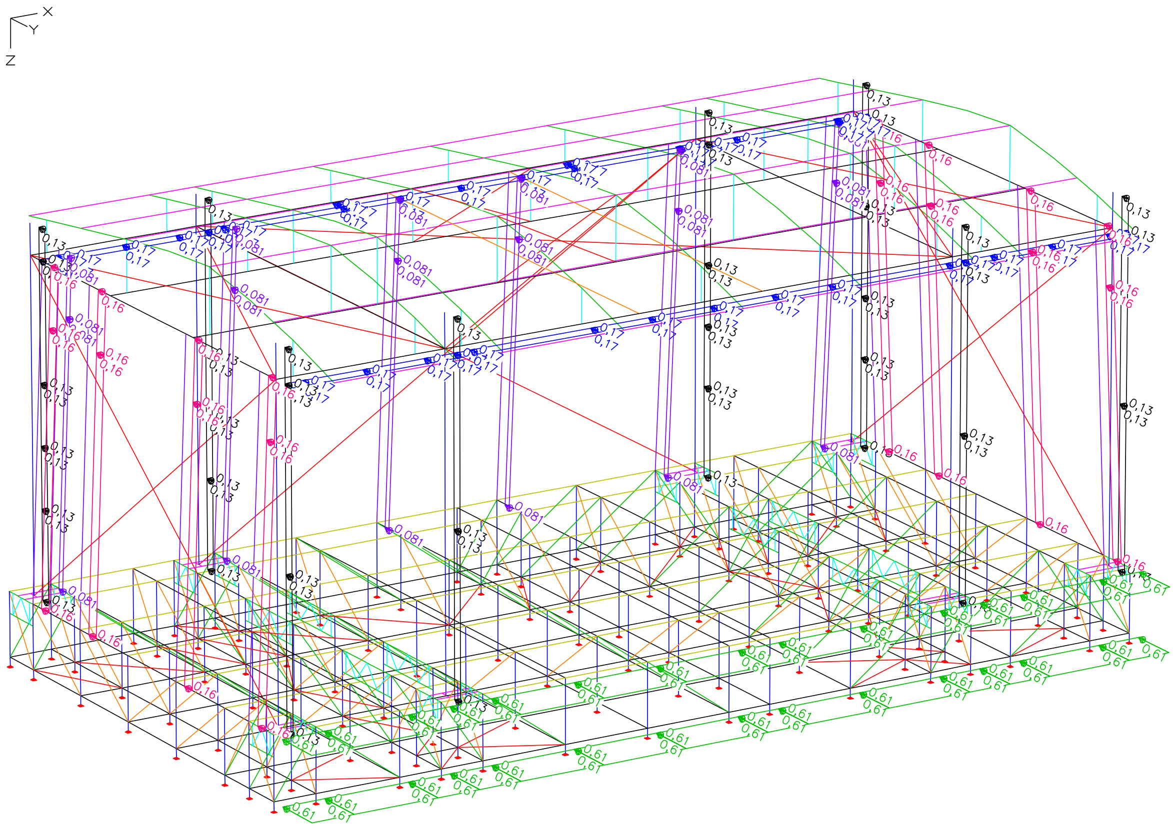
on podium: $w_1 = 1{,}30 \times 0{,}625 \times 1{,}50/2 = 0{,}609\ kN/m$

on H30V: $w_2 = 1{,}30 \times 0{,}625 \times 0{,}50 \times 0{,}30 = 0{,}125\ kN/m$

on H40V/S40T: $w_3 = 1{,}30 \times 0{,}625 \times 0{,}50 \times 0{,}40 = 0{,}1625\ kN/m$

on keders: $w_4 = 1{,}30 \times 0{,}625 \times 0{,}10 = 0{,}081\ kN/m$

$w_5 = 1{,}30 \times 0{,}625 \times 0{,}20 = 0{,}1625\ kN/m$

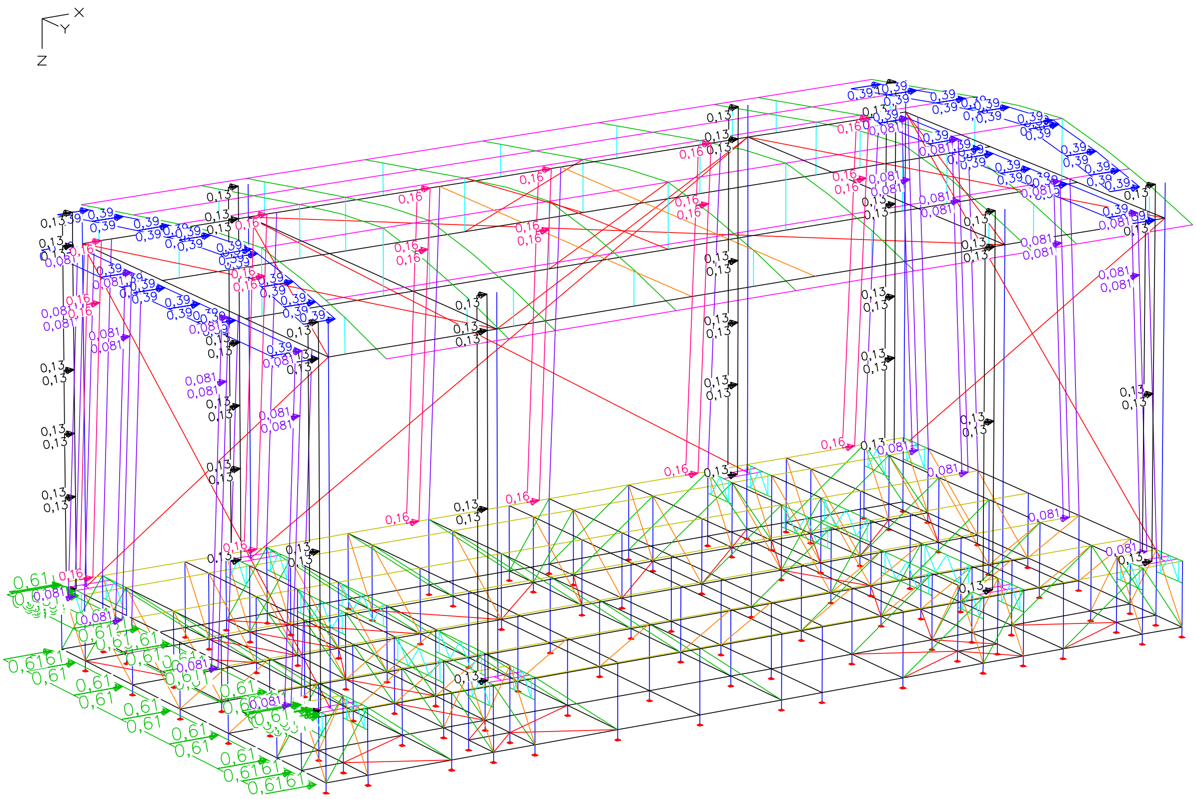


LC 20: Load, wind trusses y-direction

Load case 21: wind trusses x-direction

see LC 20

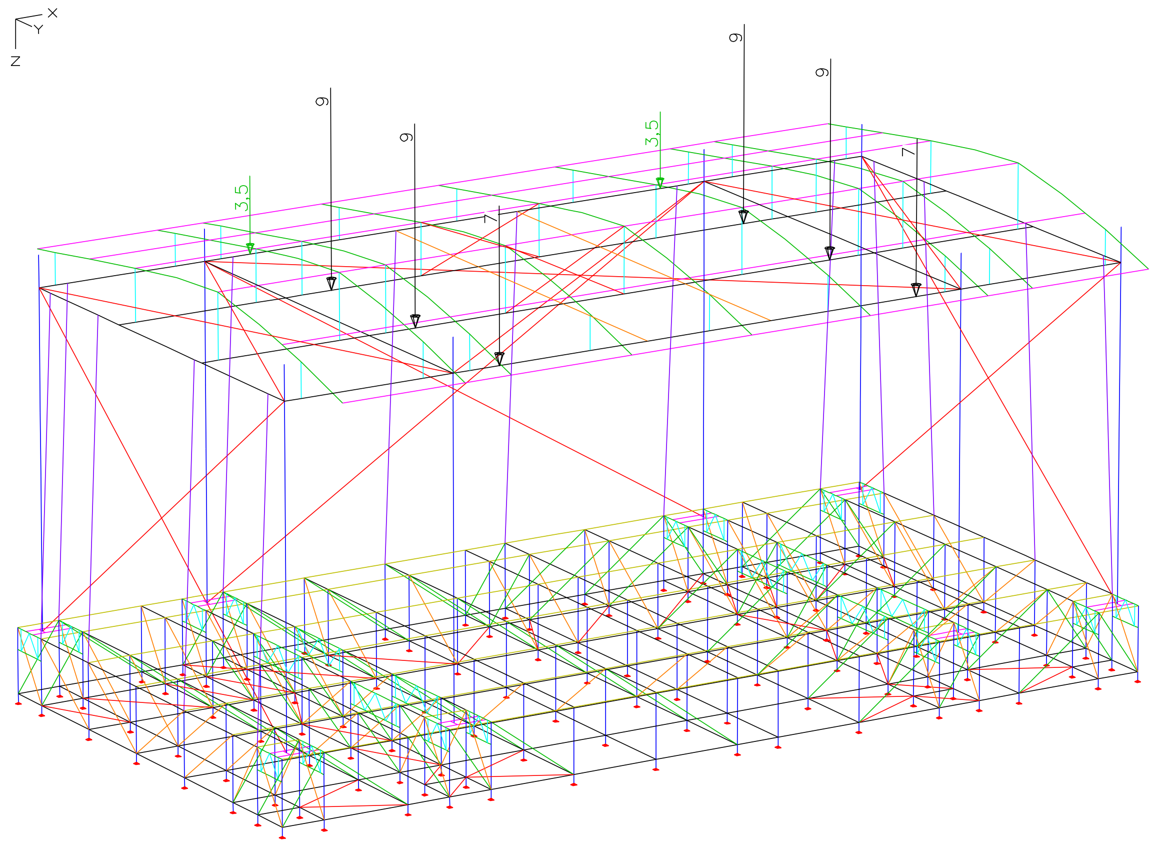
on gable: w_6 = 1,30 x 0,625 x 0,95/ 2 = 0,386 kN/m



LC 21: Load, wind trusses x–direction

Load case 22: special payload – basic setup

see cpt. 1.8



LC 22: Load, special payload – Basic setup

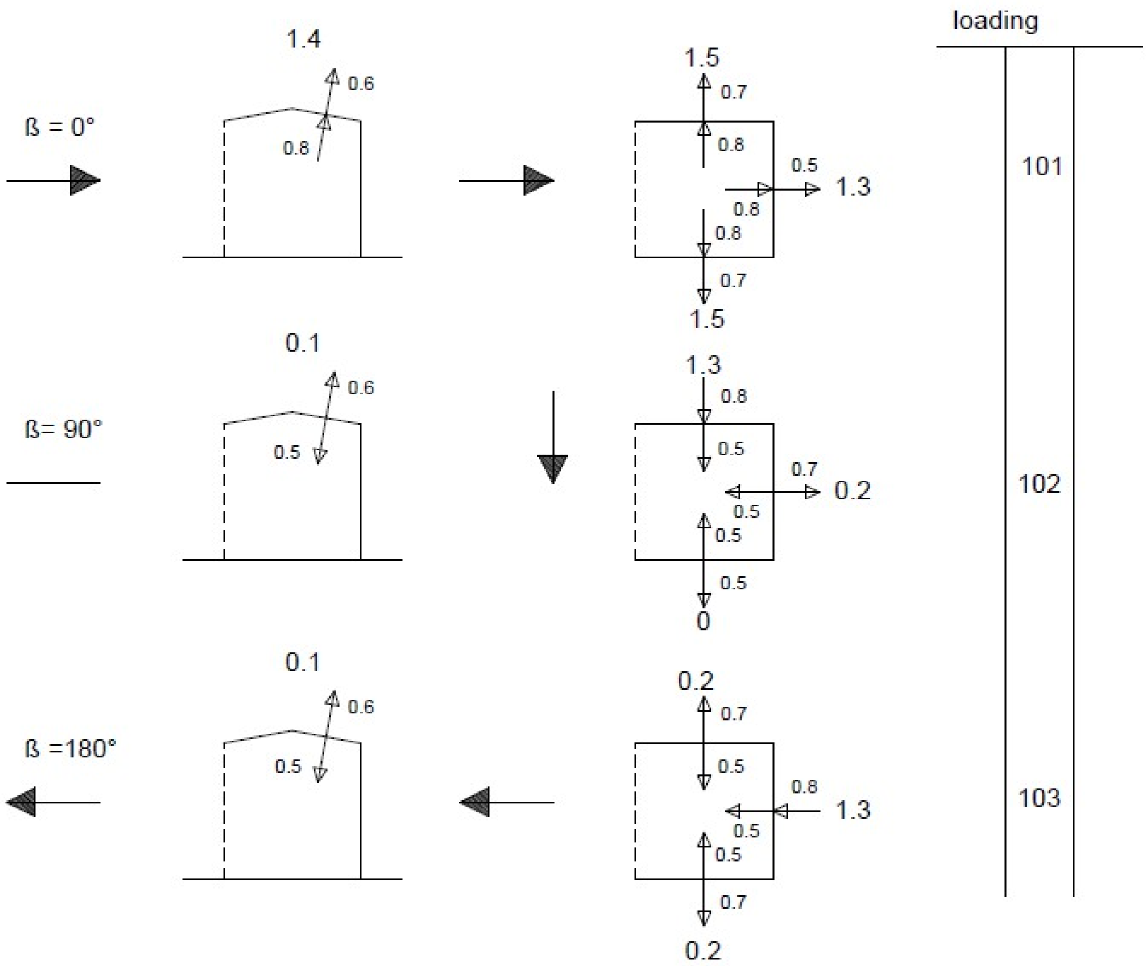
To regard various wind directions, each single wind loading scenario will be multiplied with a factor based on the weighting c_{pe}– value according to the direction of wind:

LC 100: g + p
dead weight + ballast + payloads

1. roof, back wall and sides enclosed with fully closed canvas wall + dead weight/ ballast
   LC101-103
   (LC201-203 dead weight/ ballast + wind on podium top + payloads)

2. roof enclosed with fully closed canvas wall, back wall and sides removed + dead weight/ ballast
   LC 301-303
   (LC401-403 dead weight/ ballast + payloads)

1. roof, back wall and sides enclosed: fully closed canvas wall for roof and walls



load case 100 **g + p (deadweight + ballast + payload)**

load case 1+2	=	1,0
load case 3	=	1,0
load case 4	=	1,0
load case 9	=	1,0

load case 101 **Wind in service ß = 0° + g**

load case 10-11	=	1,40
load case 12-13	=	1,30
load case 14-17	=	1,50
load case 18	=	0,80
load case 1+2	=	1,0

load case 102 **Wind in service ß = 90° + g**

load case 10-11	=	0,10
load case 12-13	=	0,20
load case 14	=	-1,30
load case 15	=	1,30
load case 18	=	-0,50
load case 1+2	=	1,0

load case 103 **Wind in service ß = 180° + g**

load case 10-11	=	0,10
load case 12	=	-1,30
load case 13	=	1,30
load case 14-17	=	0,20
load case 18	=	-0,50
load case 1+2	=	1,0

load case 201 **Wind in service ß = 0° +g+p**

load case 10-11	=	1,40
load case 12-13	=	1,30
load case 14-17	=	1,50
load case 18	=	0,80
load case 1+2	=	1,0
load case 3	=	1,0
load case 4	=	1,0
load case 9	=	1,0

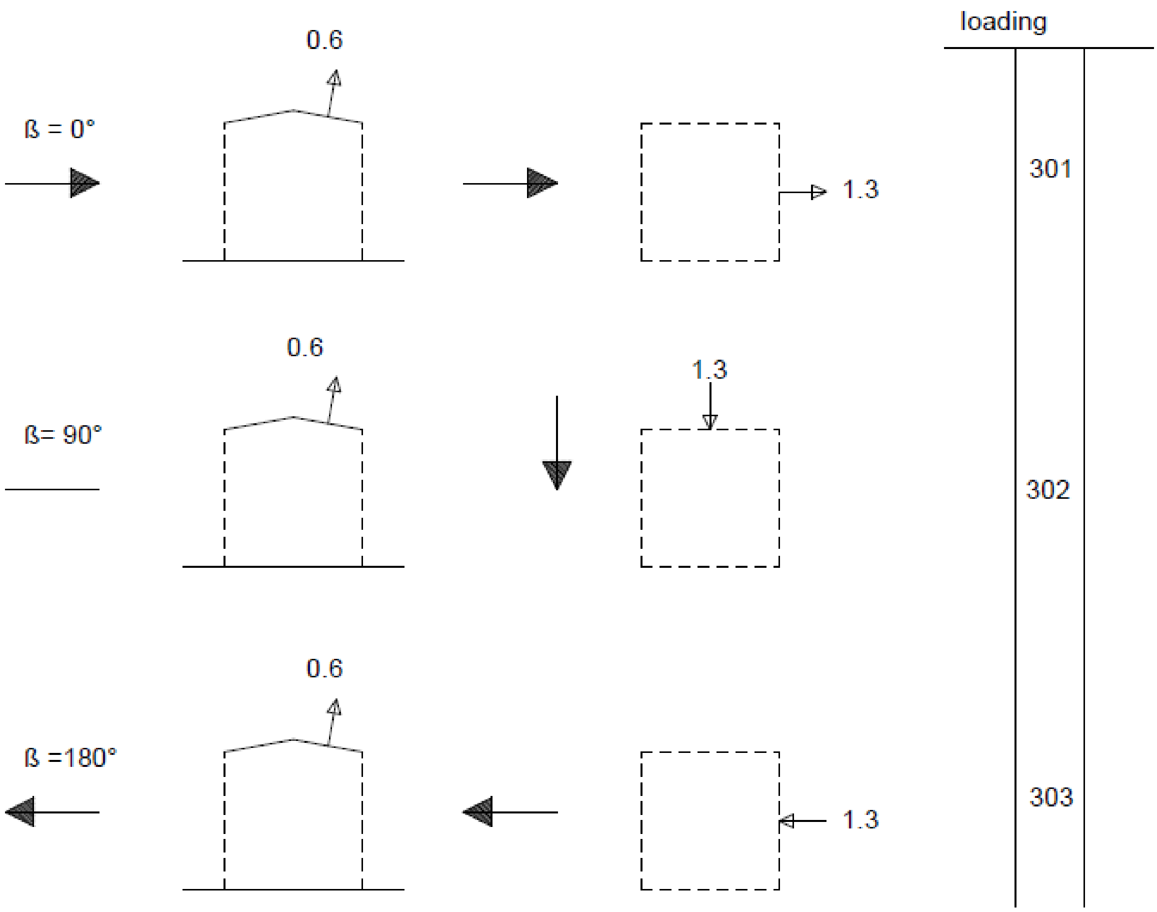
load case 202 **Wind in service ß = 90° +g+p**

load case 10-11	=	0,10
load case 12-13	=	0,20
load case 14	=	-1,30
load case 15	=	1,30
load case 18	=	-0,50
load case 1+2	=	1,0
load case 3	=	1,0
load case 4	=	1,0
load case 9	=	1,0

load case 203 **Wind in service ß = 180° +g+p**

load case 10-11	=	0,10
load case 12	=	-1,30
load case 13	=	1,30
load case 14-17	=	0,20
load case 18	=	-0,50
load case 1+2	=	1,0
load case 3	=	1,0
load case 4	=	1,0
load case 9	=	1,0

2. roof closed, wall canopy removed



load case 301 **Wind out of service ß = 0° +g**

load case 10-11	0,6 x 0,625 / 0,3	=	1,25
load case 20		=	1,00
load case 1+2		=	1,0

load case 302 **Wind out of service ß = 90° +g**

load case 10-11	0,6 x 0,625/ 0,3	=	1,25
load case 21		=	1,00
load case 1+2		=	1,0

load case 303 **Wind out of service ß = 180° +g**

load case 10-11	0,6 x 0,625 / 0,3	=	1,25
load case 20		=	- 1,00
load case 1+2		=	1,0

load case 401 **Wind out of service ß = 0° +g+p**

load case 10-11	0,6 x 0,625 / 0,3	=	1,25
load case 20		=	1,00
load case 1+2		=	1,0
load case 3+4		=	1,0

load case 402 **Wind out of service ß = 90° +g+p**

load case 10-11	0,6 x 0,625/ 0,3	=	1,25
load case 21		=	1,00
load case 1+2		=	1,0
load case 3+4		=	1,0

load case 403 **Wind out of service ß = 180° +g+p**

load case 10-11	0,6 x 0,625 / 0,3	=	1,25
load case 20		=	- 1,00
load case 1+2		=	1,0
load case 3+4		=	1,0

The system is calculated with supports with planned tension loss. All dead weights and the ballast loads (LC 1+2) and the payloads (LC3+4+(9)) are incorporated into the insert load cases and all redirections of forces inside the Layher Podium are calculated directly in the system.

The shown load cases are combined in load case combinations for the calculation.

NOTICE:

Load case combination 91-94 with incorporate partial safety factors γ_Q = 1,35 for variable loads on the safe side.
The values for the partial safety factors are given in the DIN EN 13814 for fairground and amusement park machinery and structures.

load case combinations with characteristic values:

LCC 81: LC(101-103)
LCC 82: LC(201-203)
LCC 83: LC(301-303)
LCC 84: LC(401-403)

LCC85: LCC(81-84)

load case combinations with design values:

LCC 91: 1,35 x LC(101-103)
LCC 91: 1,35 x LC(201-203)
LCC 93: 1,35 x LC(301-303)
LCC 91: 1,35 x LC(401-403)

LCC95: LCC(91-94)

4 CALCULATION

System characteristics

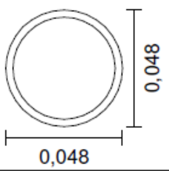
951 Nodes
1703 Elements
113 Supports
0 Link elements
15 Material properties
15 Section properties
34 Load cases
10 LC Combinations
0 Tendon groups

1703 Beams
0 Slabs
0 Plains
0 Shells
0 Cables
0 Solids
0 Spring elements

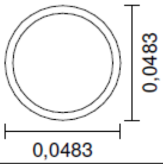
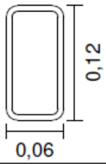
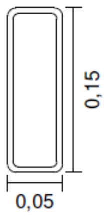
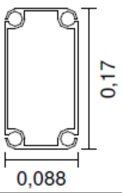
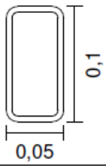
Result location in area elements: Node
5 Result locations in beam elements

Rotated element systems
0 Element systems
0 Internal force systems
0 Reinforcement systems

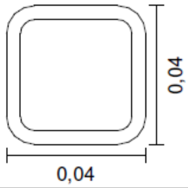
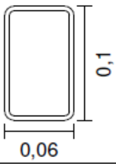
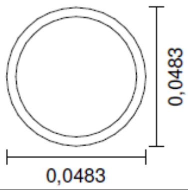
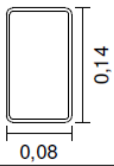
Section properties

1	Beam	H40V Area [m^2] Moments of inertia [m4]	 A Ix Iz	 = 1,696e-03 = 1,000e-05 = 4,180e-05	 Iy = 4,180e-05 Iyz = 0,000e+00
2	Beam	H30V Area [m^2] Moments of inertia [m4]	 A Ix Iz	 = 1,696e-03 = 1,000e-05 = 2,096e-05	 Iy = 2,096e-05 Iyz = 0,000e+00
3	Beam	H30D Area [m^2] Moments of inertia [m4]	 A Ix Iz	 = 1,272e-03 = 1,000e-05 = 1,048e-05	 Iy = 1,057e-05 Iyz = 0,000e+00
4	Tension member	Seil Area [m^2]	 A	 = 5,000e-05	
5	Polygon 	Rohr Centroid [m] Area [m^2] Moments of inertia [m4] Main axis angle [Grad]	 ys A Ix Iy Iz Phi	 = -0,000 = 4,2140e-04 = 2,1272e-07 = 1,0645e-07 = 1,0645e-07 = 0,000	 zs = -0,000 I1 = 1,0645e-07 I2 = 1,0645e-07 Iyz = 0,0000e+00

Section properties

6	Library section 	RO 48,3 x 3,2 (MSH); Rohr 48,3x3,2 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 4,5300e-04 Moments of inertia [m4] Ix = 2,3200e-07 Iy = 1,1600e-07 I1 = 1,1600e-07 Iz = 1,1600e-07 I2 = 1,1600e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00
7	Library section 	RRO 120 x 60 x 6 (EN 10219-2); Traversenträger Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,9200e-03 Moments of inertia [m4] Ix = 2,8000e-06 Iy = 3,2800e-06 I1 = 3,2800e-06 Iz = 1,0900e-06 I2 = 1,0900e-06 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00
8	Polygon 	truss girder 1m 150x50x5mm Centroid [m] ys = 0,000 zs = -0,025 Area [m²] A = 1,8707e-03 Moments of inertia [m4] Ix = 2,3367e-06 Iy = 4,7437e-06 I1 = 4,7437e-06 Iz = 7,9555e-07 I2 = 7,9555e-07 Main axis angle [Grad] Phi = -0,000 Iyz = 0,0000e+00 Averaging of the lateral force shear stress over section width Specified cross-section class according to 1993-1-1: 3
10	Beam	S40T Area [m²] A = 2,312e-03 Moments of inertia [m4] Ix = 6,500e-05 Iy = 5,699e-05 Iz = 3,500e-05 Iyz = 0,000e+00
11	Polygon 	Keder 170x88 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,9554e-03 Moments of inertia [m4] Ix = 4,2491e-06 Iy = 7,9022e-06 I1 = 7,9022e-06 Iz = 2,3673e-06 I2 = 2,3673e-06 Main axis angle [Grad] Phi = -0,016 Iyz = 1,5251e-09 Averaging of the lateral force shear stress over section width
12	Library section 	RRO 100 x 50 x 5 (EN 10219-2); chord framework-girder 1m 100x50x5 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,3400e-03 Moments of inertia [m4] Ix = 1,3500e-06 Iy = 1,5800e-06 I1 = 1,5800e-06 Iz = 5,2500e-07 I2 = 5,2500e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00

Section properties

13	Library section 	QRO 40 x 40 x 4 (EN 10219-2); diagonals framework-girder 1m 40x40x4 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 5,3500e-04 Moments of inertia [m4] Ix = 1,9440e-07 Iy = 1,1100e-07 I1 = 1,1100e-07 Iz = 1,1100e-07 I2 = 1,1100e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00 Averaging of the lateral force shear stress over section width
14	Library section 	RRO 100 x 60 x 4 (EN 10219-2); chord framework-girder 2m 100x60x4 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,1700e-03 Moments of inertia [m4] Ix = 1,5600e-06 Iy = 1,5300e-06 I1 = 1,5300e-06 Iz = 6,8700e-07 I2 = 6,8700e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00
15	Library section 	RO 48,3 x 3,2 (MSH); diagonals framework-girder 2m Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 4,5300e-04 Moments of inertia [m4] Ix = 2,3200e-07 Iy = 1,1600e-07 I1 = 1,1600e-07 Iz = 1,1600e-07 I2 = 1,1600e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00 Averaging of the lateral force shear stress over section width
16	Library section 	RRO 140 x 80 x 4 (EN 10219-2); truss girder 2m 140x80x4 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,6500e-03 Moments of inertia [m4] Ix = 4,1200e-06 Iy = 4,3000e-06 I1 = 4,3000e-06 Iz = 1,8000e-06 I2 = 1,8000e-06 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00

Material properties

	No.	Type	E-Modu. [MN/m²]	G-Modu. [MN/m²]	Poiss. ratio	alpha.t [1/K]	gamma [kN/m³]	Miscellaneous
1	1	Frei	70000	27000	0,20	1,00e-05	0,000	
2	2	Frei	70000	27000	0,20	1,00e-05	0,000	
3	3	Frei	70000	27000	0,20	1,00e-05	0,000	
4	4	S235	210000	81000	0,30	1,20e-05	78,500	
5	5	Frei	70000	27000	0,20	1,00e-05	27,000	fc = 1e+06 [MN/m²] ft = 1e+06
6	6	S235-EN	210000	81000	0,30	1,20e-05	78,500	
7	7	S235-EN	210000	81000	0,30	1,20e-05	78,500	
8	8	S355-EN	210000	81000	0,30	1,20e-05	78,500	
9	10	Frei	70000	27000	0,20	1,00e-05	0,000	

Material properties

	No.	Type	E-Modu. [MN/m²]	G-Modu. [MN/m²]	Poiss. ratio	alpha.t [1/K]	gamma [kN/m³]	Miscellaneous
10	11	Frei	70000	27000	0,30	1,00e-05	27,000	fc = 1e+06 [MN/m²] ft = 1e+06
11	12	S355-EN	210000	81000	0,30	1,20e-05	78,500	
12	13	S235-EN	210000	81000	0,30	1,20e-05	78,500	
13	14	S235-EN	210000	81000	0,30	1,20e-05	78,500	
14	15	S235-EN	210000	81000	0,30	1,20e-05	78,500	
15	16	S355-EN	210000	81000	0,30	1,20e-05	78,500	

List of load cases

LC.	Label
1	dead weight
2	ballast
3	payload podium
4	distributed payload - Basic setup
5	CPL payload - Basic setup
6	3rdPL payload - Basic setup
7	4thPL payload - Basic setup
8	5thPL payload - Basic setup
9	PA load
10	wind load - roof area
11	membrane tension - roof
12	wind - rear wall
13	membrane tension - rear wall
14	wind - left side
15	membrane tension - left side
16	wind - right side
17	membrane tension - right side
18	wind on podium top
20	wind trusses y-direction
21	wind trusses x-direction
22	special payload - Basic setup
100	g+p
101	wind ß = 0° +g
102	wind ß = 90° +g
103	wind ß = 180° +g
201	wind ß = 0° +g+p
202	wind ß = 90° +g+p
203	wind ß = 180° +g+p
301	wind ß = 0° only roof +g
302	wind ß = 90° only roof +g
303	wind ß = 180° only roof +g
401	wind ß = 0° only roof +g+p
402	wind ß = 90° only roof +g+p
403	wind ß = 180° only roof +g+p

Load case combination 81

1. Variable exclusive action		Factor
100	g+p	1,000
101	wind ß = 0° +g	1,000
102	wind ß = 90° +g	1,000
103	wind ß = 180° +g	1,000

Load case combination 82

1. Variable exclusive action		Factor
201	wind ß = 0° +g+p	1,000
202	wind ß = 90° +g+p	1,000
203	wind ß = 180° +g+p	1,000

Load case combination 83

1. Variable exclusive action		Factor
301	wind ß = 0° only roof +g	1,000
302	wind ß = 90° only roof +g	1,000
303	wind ß = 180° only roof +g	1,000

Load case combination 84

1. Variable exclusive action		Factor
401	wind ß = 0° only roof +g+p	1,000
402	wind ß = 90° only roof +g+p	1,000
403	wind ß = 180° only roof +g+p	1,000

Load case combination 85

1. Variable exclusive action		Factor
K81	[Unnamed]	1,000
K82	[Unnamed]	1,000
K83	[Unnamed]	1,000
K84	[Unnamed]	1,000

Load case combination 91

1. Variable exclusive action		Factor
100	g+p	1,350
101	wind ß = 0° +g	1,350
102	wind ß = 90° +g	1,350
103	wind ß = 180° +g	1,350

Load case combination 92

1. Variable exclusive action		Factor
201	wind ß = 0° +g+p	1,350
202	wind ß = 90° +g+p	1,350
203	wind ß = 180° +g+p	1,350

Load case combination 93

1. Variable exclusive action		Factor
301	wind ß = 0° only roof +g	1,350
302	wind ß = 90° only roof +g	1,350
303	wind ß = 180° only roof +g	1,350

Load case combination 94

1. Variable exclusive action		Factor
401	wind ß = 0° only roof +g+p	1,350
402	wind ß = 90° only roof +g+p	1,350
403	wind ß = 180° only roof +g+p	1,350

Load case combination 95

1. Variable exclusive action		Factor
K91	[Unnamed]	1,000
K92	[Unnamed]	1,000
K93	[Unnamed]	1,000
K94	[Unnamed]	1,000

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	dead weight	0,000	0,000	130,671
	Support reactions	0,000	-0,000	130,671
2	ballast	-0,000	0,000	210,000
	Support reactions	-0,000	-0,000	210,019
3	payload podium	0,000	0,000	1239,657
	Support reactions	0,000	-0,000	1239,657
4	distributed payload - Basic setup	0,000	0,000	40,117
	Support reactions	-0,000	-0,000	40,140
5	CPL payload - Basic setup	0,000	0,000	17,200
	Support reactions	0,000	-0,000	17,217

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
6	3rdPL payload - Basic setup	0,000	0,000	26,000
	Support reactions	0,000	-0,000	26,022
7	4thPL payload - Basic setup	0,000	0,000	25,620
	Support reactions	0,000	-0,000	25,640
8	5thPL payload - Basic setup	0,000	0,000	27,200
	Support reactions	0,000	0,000	27,201
9	PA load	0,000	0,000	20,000
	Support reactions	0,000	-0,000	20,000
11	membrane tension - roof	0,000	0,000	0,000
	Support reactions	-0,000	-0,000	0,004
13	membrane tension - rear wall	0,000	-0,000	-0,000
	Support reactions	-0,000	-0,000	0,000
15	membrane tension - left side	0,000	-0,000	0,000
	Support reactions	0,000	0,000	0,004
17	membrane tension - right side	0,000	0,000	0,000
	Support reactions	0,000	-0,000	0,004
18	wind on podium top	0,000	0,000	49,586
	Support reactions	0,000	-0,000	49,586
22	special payload - Basic setup	0,000	0,000	57,000
	Support reactions	0,000	-0,000	57,042
100	g+p	-0,000	0,000	1640,444
	Support reactions	-0,000	0,000	1640,444
101	wind ß = 0° +g	-0,041	-51,852	264,004
	Support reactions	-0,041	-51,852	264,004
102	wind ß = 90° +g	31,847	-8,201	308,421
	Support reactions	31,847	-8,201	308,469
103	wind ß = 180° +g	-0,005	54,760	310,836
	Support reactions	-0,005	54,760	311,386
201	wind ß = 0° +g+p	-0,041	-51,852	1563,777
	Support reactions	-0,041	-51,852	1563,777
202	wind ß = 90° +g+p	31,847	-8,201	1608,195
	Support reactions	31,847	-8,201	1608,195
203	wind ß = 180° +g+p	-0,005	54,760	1610,609
	Support reactions	-0,005	54,760	1610,609
301	wind ß = 0° only roof +g	-0,000	-53,382	241,351

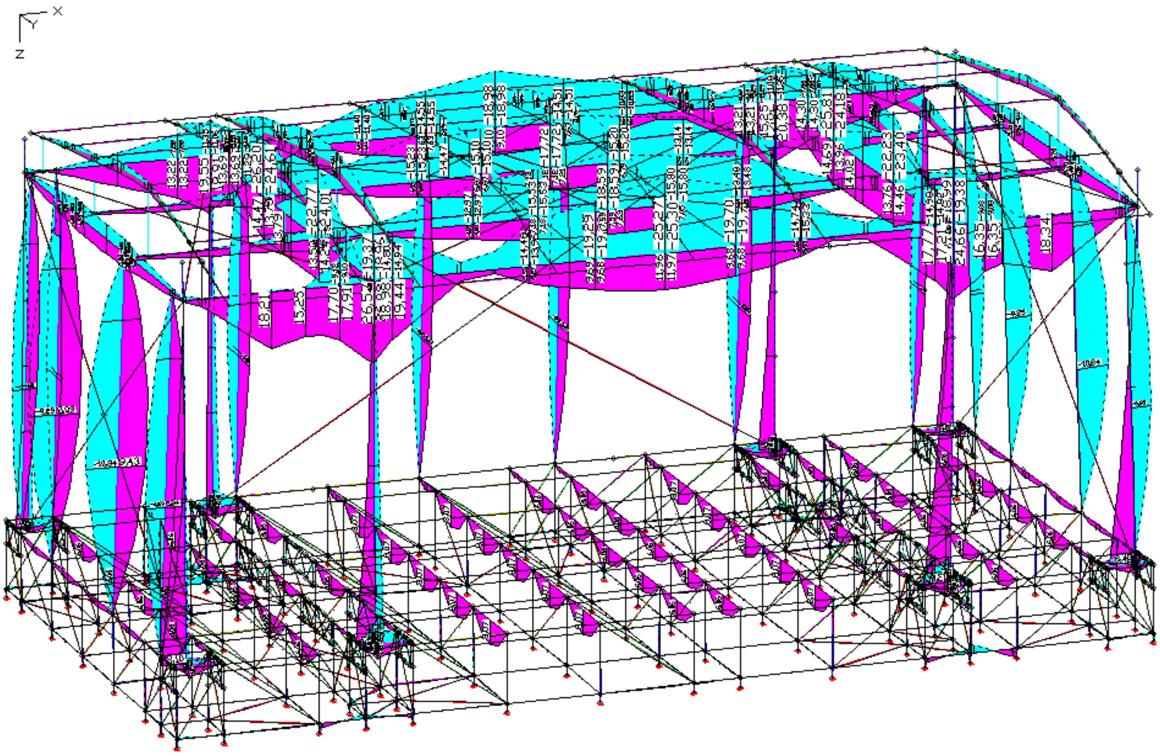
Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
	Support reactions	0,000	-53,382	241,351
302	wind ß = 90° only roof +g	51,215	2,423	241,609
	Support reactions	51,215	2,423	241,609
303	wind ß = 180° only roof +g	0,000	58,229	241,868
	Support reactions	-0,000	58,229	241,868
401	wind ß = 0° only roof +g+p	-0,000	-53,382	1521,124
	Support reactions	0,000	-53,382	1521,124
402	wind ß = 90° only roof +g+p	51,215	2,423	1521,383
	Support reactions	51,215	2,423	1521,383
403	wind ß = 180° only roof +g+p	0,000	58,229	1521,641
	Support reactions	0,000	58,229	1521,641

design internal forces

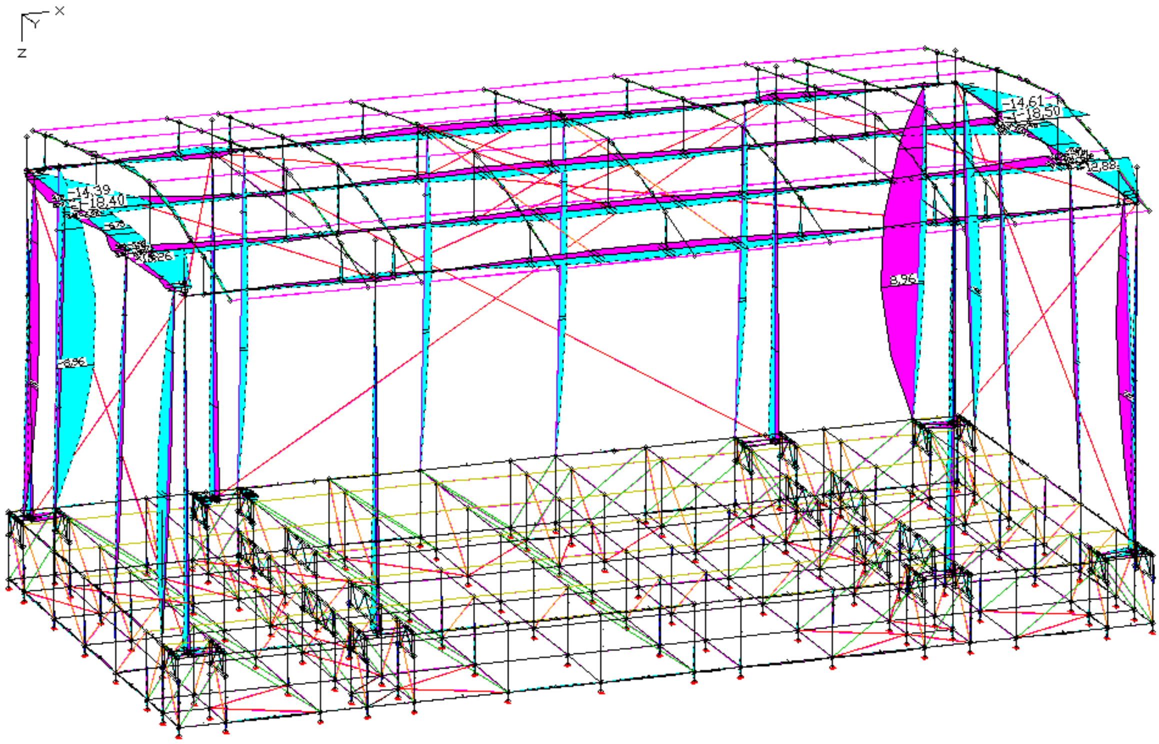
load case combination 95:

$M_{y,Ed}$



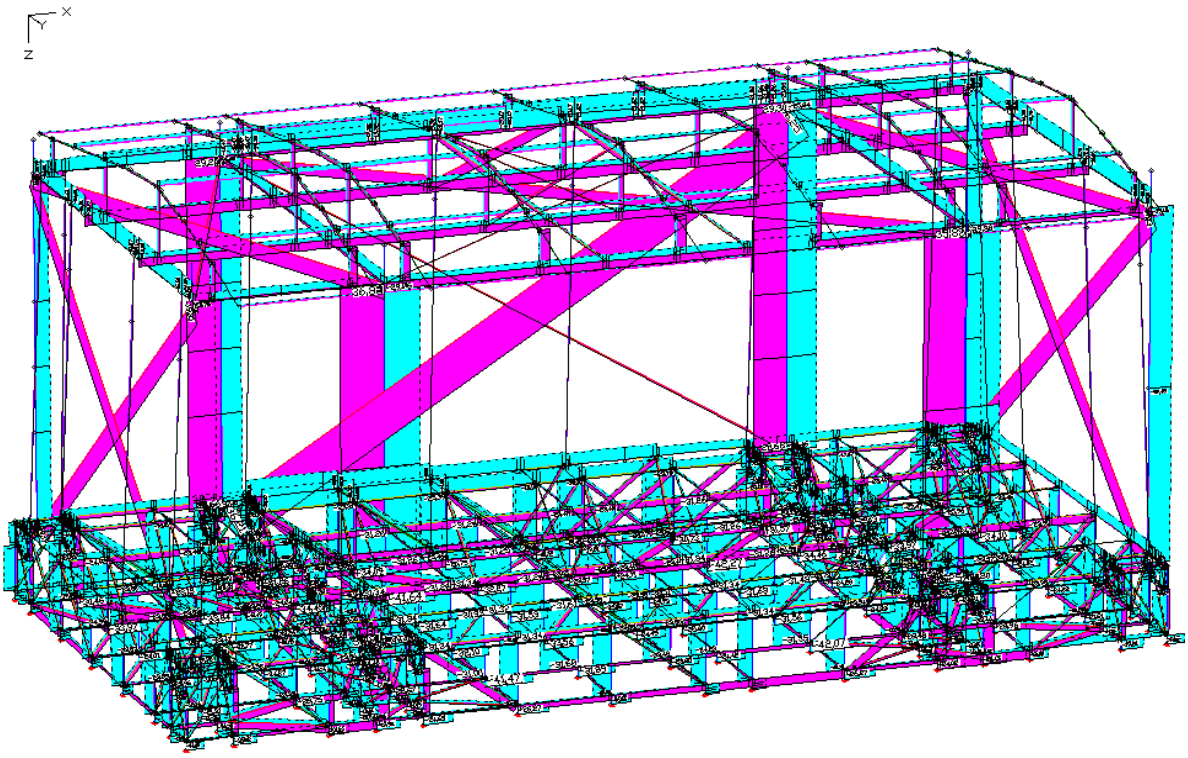
LCC 95: Internal forces min,max My [kNm]
Value range (overall system, min/max): -26,20/26,57 [kNm]

$M_{z,Ed}$



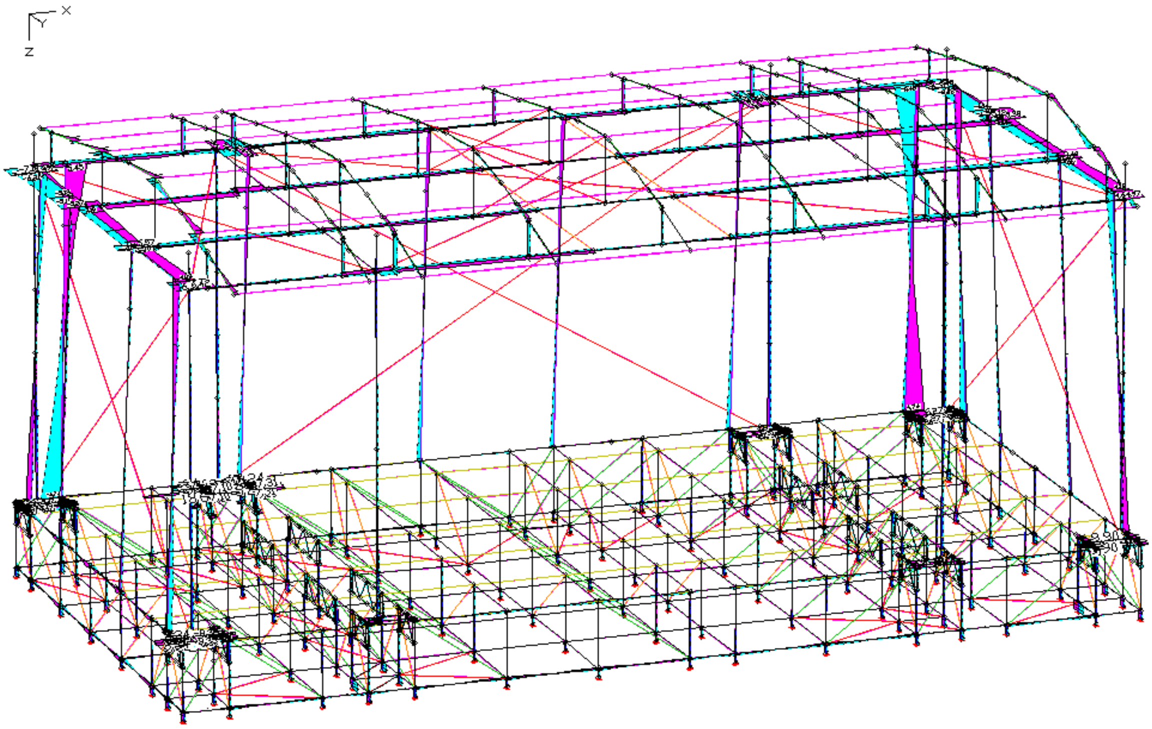
LCC 95: Internal forces min,max Mz [kNm]
Value range (overall system, min/max): -18,50/10,74 [kNm]

N_{Ed}



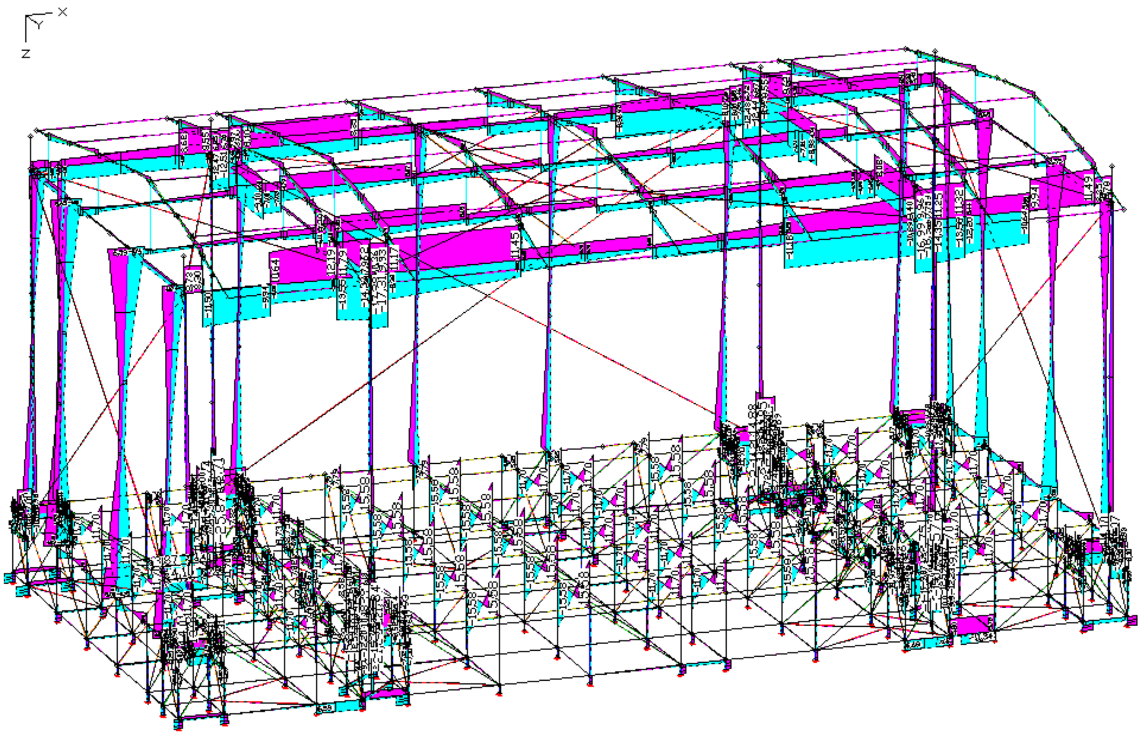
LCC 95: Internal forces min,max Nx [kN]
Value range (overall system, min/max): -42,27/36,88 [kN]

$V_{y,Ed}$



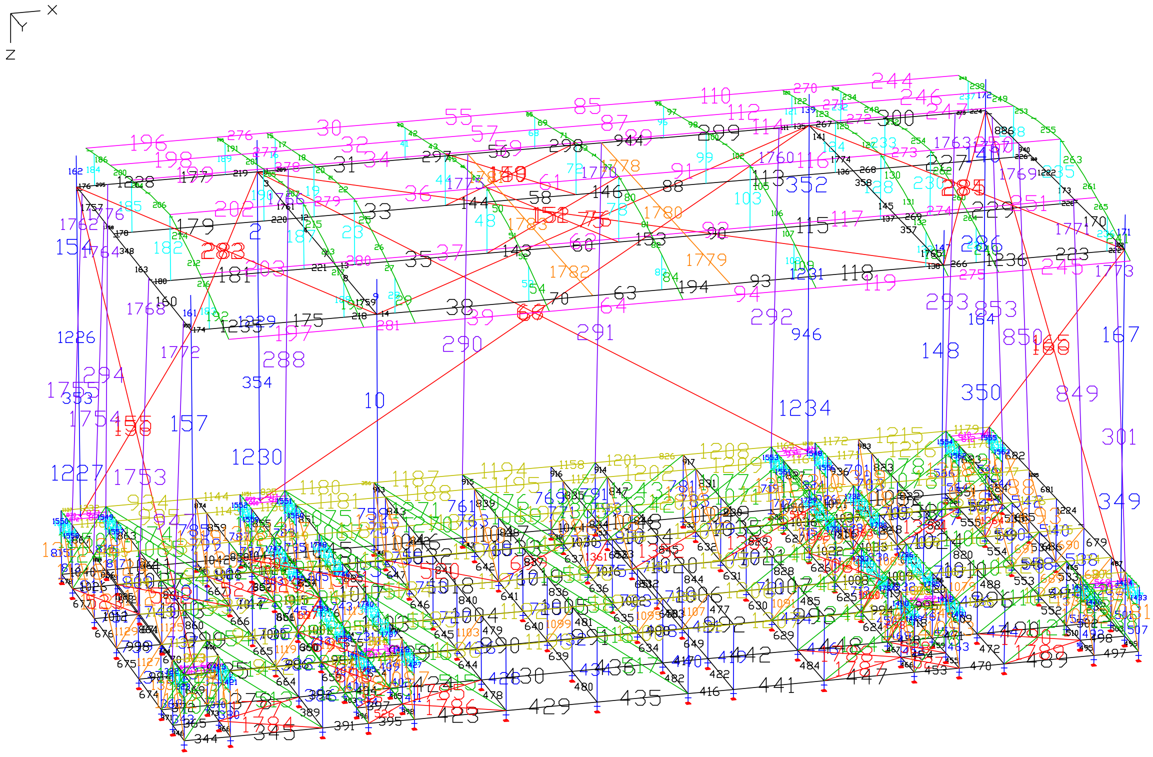
LCC 95: Internal forces min,max Qy [kN]
Value range (overall system, min/max): -15,24/18,63 [kN]

$V_{z,Ed}$



LCC 95: Internal forces min,max Qz [kN]
Value range (overall system, min/max): -25,87/22,75 [kN]

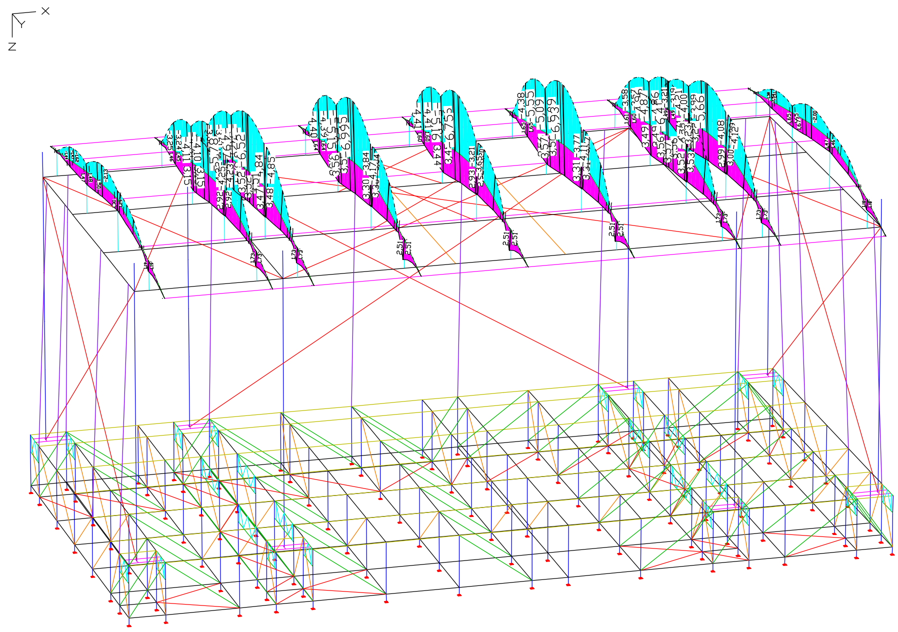
5 PROOFS



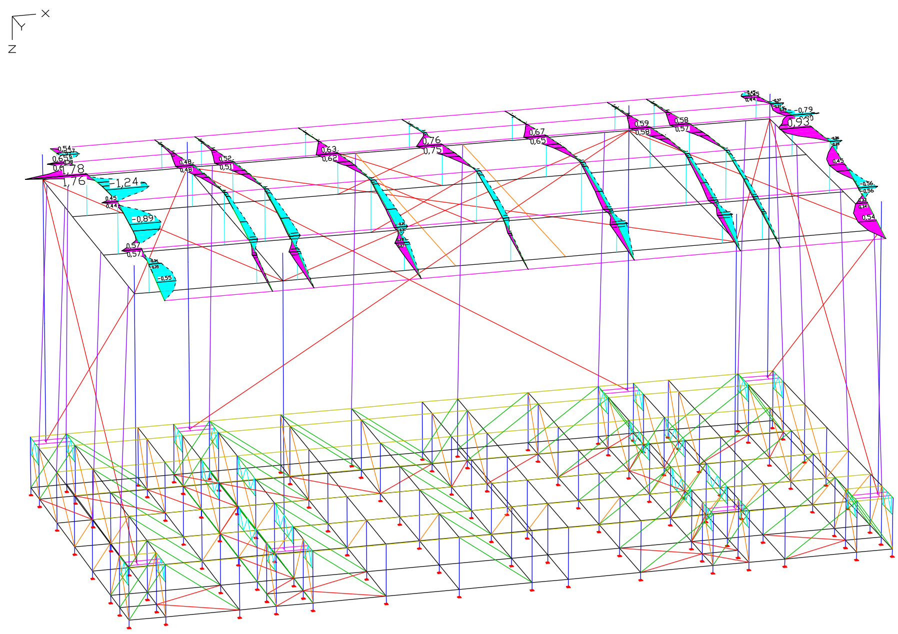
Element numbers

5.1 RAFTER - H30D

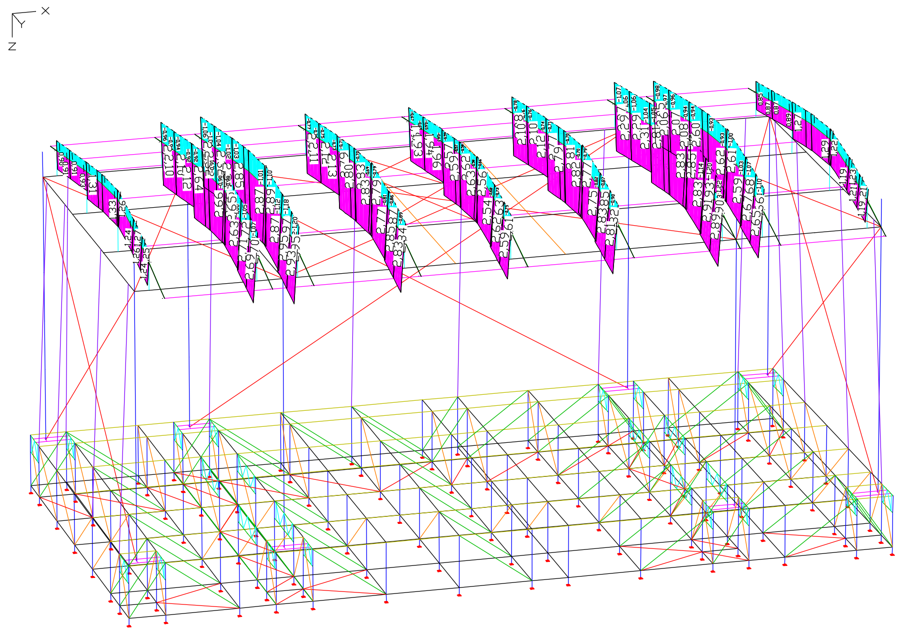
LCC 95



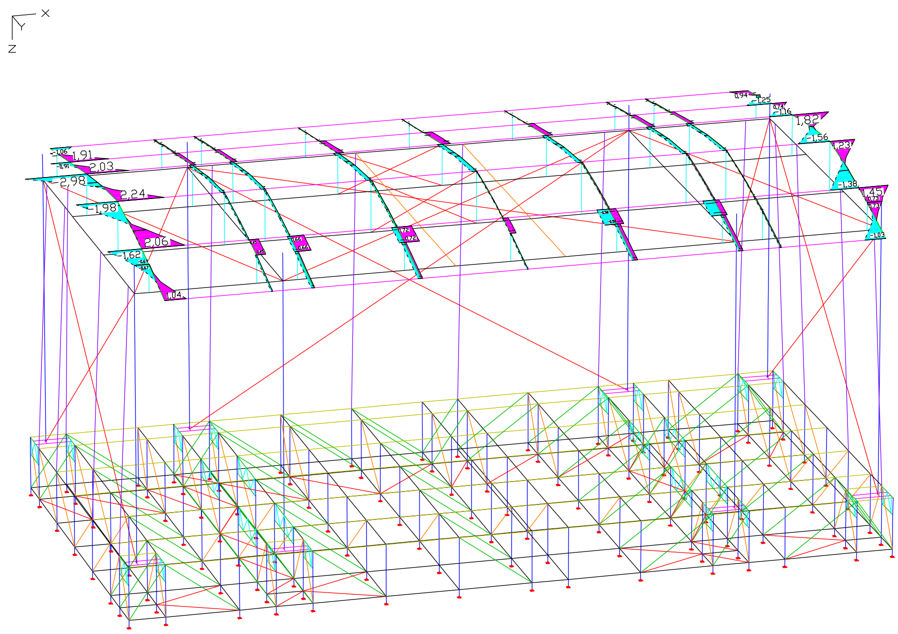
LCC 95: Selected Internal forces min,max My [kNm]
Value range (subsystem, min/max): -6,99/3,57 [kNm]



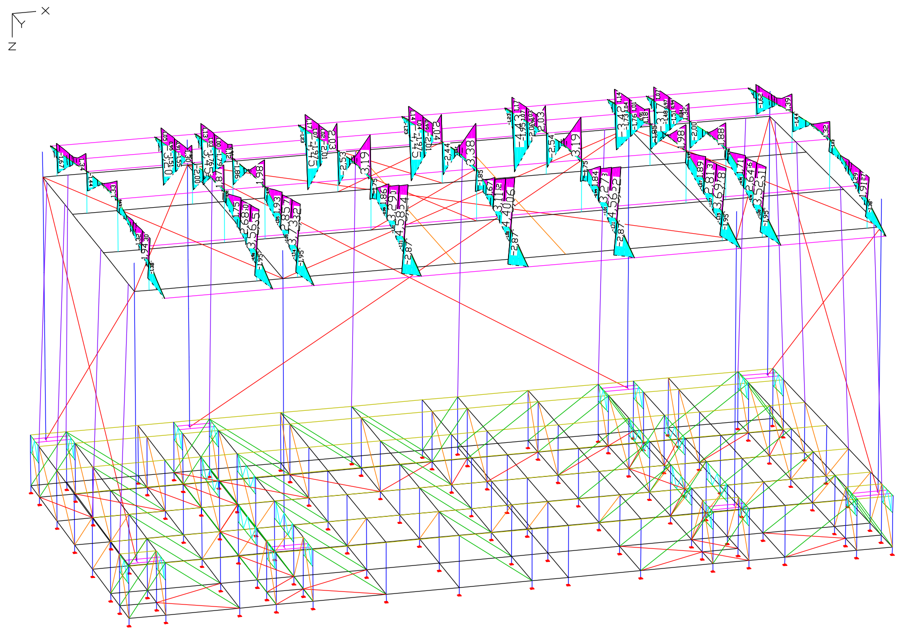
LCC 95: Selected Internal forces min,max Mz [kNm]
Value range (subsystem, min/max): -1,24/1,78 [kNm]



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -1,23/2,97 [kN]



LCC 95: Selected Internal forces min,max Qy [kN]
Value range (subsystem, min/max): -2,98/2,24 [kN]



LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): -4,45/4,58 [kN]

Internal forces element 46

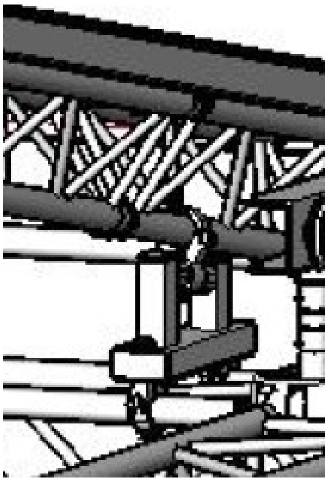
Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-0,70	3,52	0,01	0,01	-0,08	-0,00
	"	2,80	-6,99	-0,02	0,00	0,05	-0,01
	"	2,80	-6,99	-0,02	0,00	0,05	-0,01
	"	-0,70	3,52	0,01	0,01	-0,08	-0,00
	"	2,80	-6,99	-0,02	0,00	0,05	-0,01
	"	1,98	-3,85	0,31	-0,20	0,01	-0,02
	"	2,44	-6,20	0,30	-0,20	0,14	-0,02
	"	2,31	-4,40	-0,01	0,01	-0,02	-0,01
	"	1,98	-3,77	-0,01	0,01	-0,08	-0,00
	"	2,44	-6,20	0,30	-0,20	0,14	-0,02
	"	2,44	-6,20	0,30	-0,20	0,14	-0,02
	"	-0,00	0,18	-0,00	-0,01	0,03	0,01

single chord:
N_{Ed} = 6,99/ 0,207 + 2,80/ 3 = 34,70 kN < 50,22 kN

Proof against buckling not decisive.

attachment rafter on top of H40V to H30D:

max. N_{Ed} = 7,84 kN



bending in chord (hollow section Ø48x3mm:

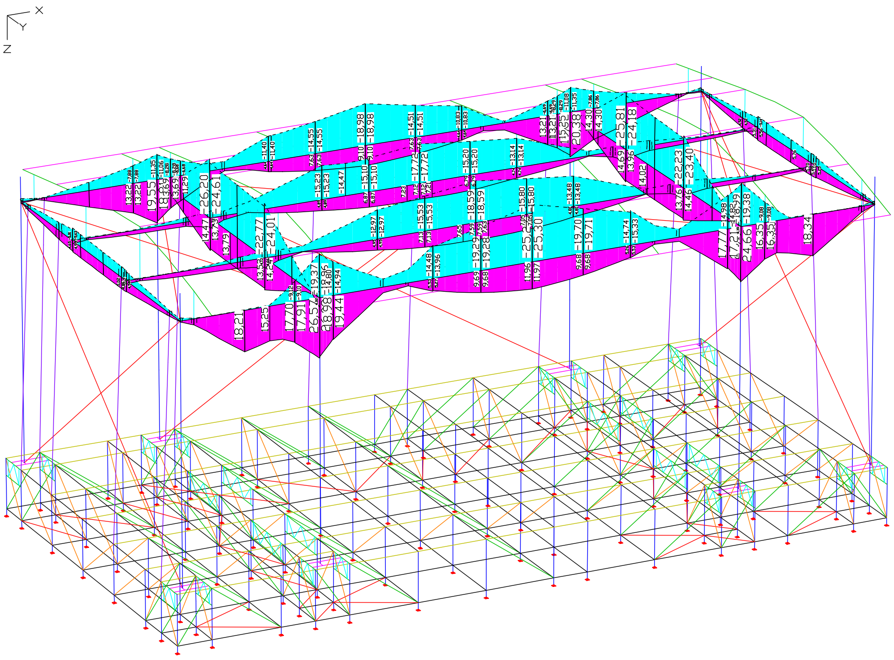
M_{Ed} = 7,84 x 0,19/ 4 = 0,372 kNm
M_{Rd} = 4,493 x 25/ 1,1/ 100 = 1,02 kNm

N_{Ek} = 7,84/ 1,35 = 5,81 kN < 7,50 kN → clamps SWL 750 kg

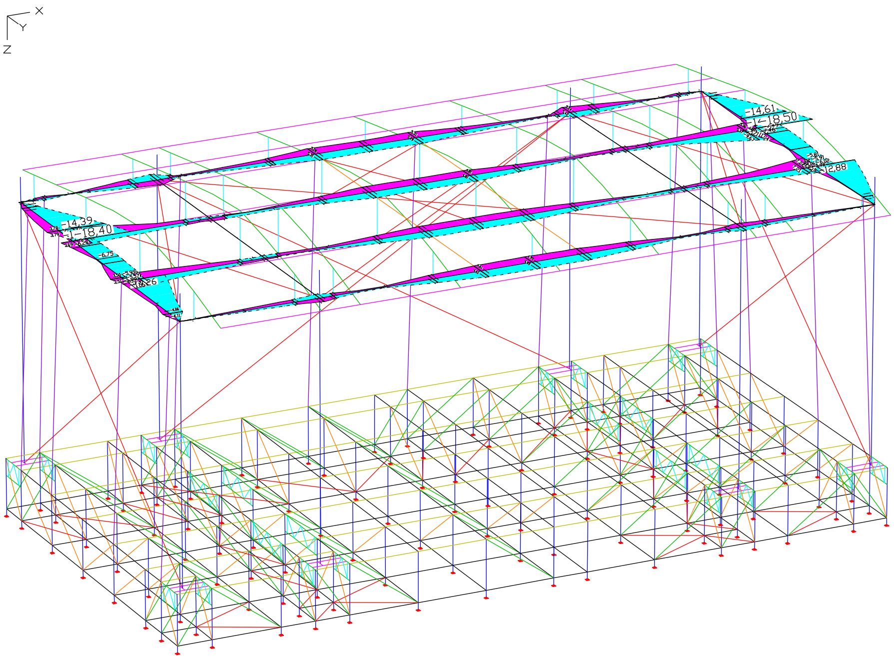
Attachment to truss chord must be near the nodes of the diagonals.

5.2 ROOF GIRDER H40V

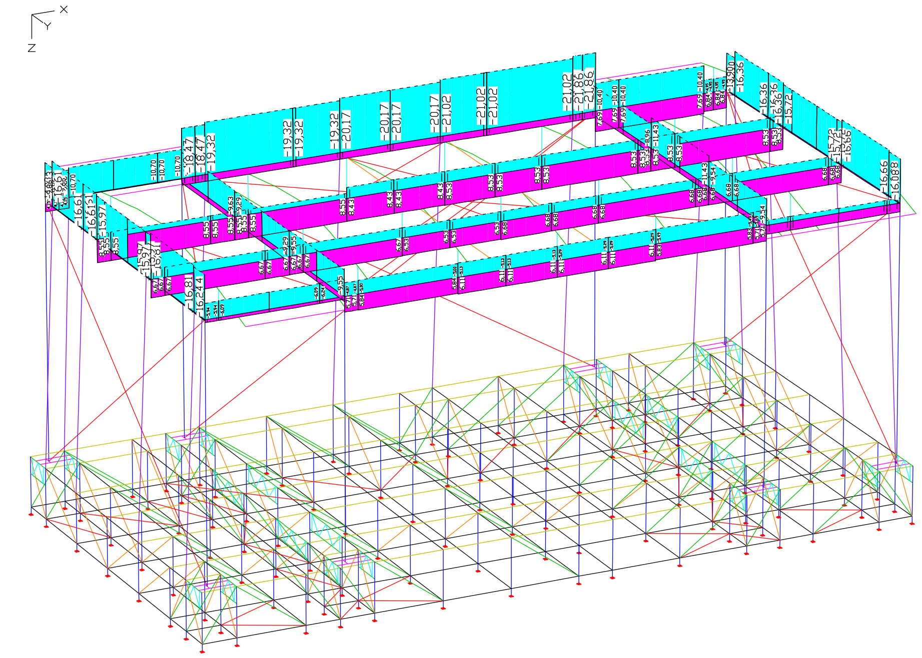
LCC 95



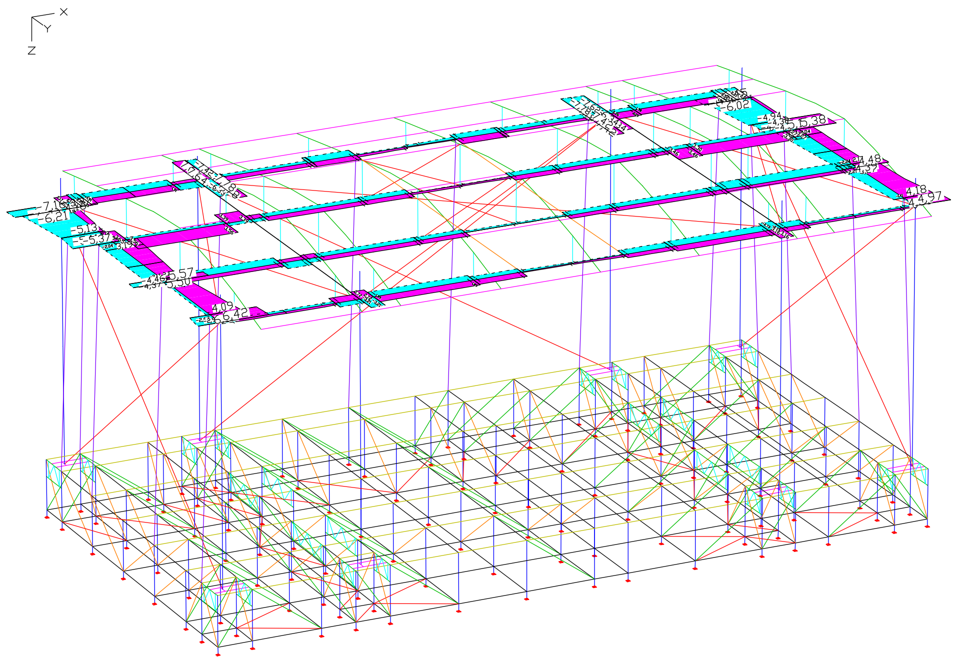
LCC 95: Selected Internal forces min,max My [kNm]
Value range (overall system, min/max): −26.20/26.57 [kNm]



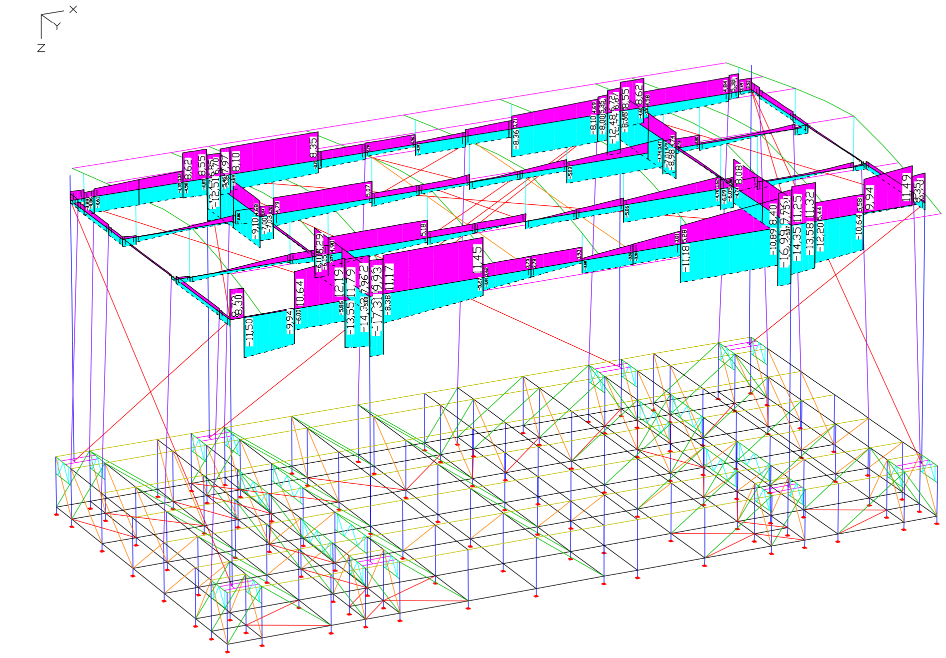
LCC 95: Selected Internal forces min,max Mz [kNm]
Value range (overall system, min/max): −18.50/10.74 [kNm]



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -21.86/8.55 [kN]



LCC 95: Selected Internal forces min,max Qy [kN]
Value range (subsystem, min/max): -7.78/7.78 [kN]



LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): -17.31/12.19 [kN]

side truss

Internal forces element 1761

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-9,63	-22,73	0,00	0,00	-7,86	0,66
	'	1,76	14,47	0,00	0,00	4,68	-0,30
	'	-5,44	-26,20	-0,00	0,00	-9,10	0,74
	'	1,76	14,47	0,00	0,00	4,68	-0,30
	'	0,00	0,00	0,00	0,00	0,00	0,00
	'	0,00	0,00	0,00	0,00	0,00	0,00
	'	0,00	0,00	0,00	0,00	0,00	0,00
	'	0,00	0,00	0,00	0,00	0,00	0,00
	'	-5,44	-26,20	-0,00	0,00	-9,10	0,74
	'	1,76	14,47	0,00	0,00	4,68	-0,30
	'	1,76	14,47	0,00	0,00	4,68	-0,30
	'	-5,44	-26,20	-0,00	0,00	-9,10	0,74

chord:
N_{Ed} = 26,20/ (2x0,339) + 5,44/ 4 = 40,01 kN < 50,22 kN

M+Q-Interaction:

$Q_{Ed,res}$ = 9,10 kN
$\Delta M_{Q,res}$ = 9,10/ 4 x 0,05 = 0,114 kNm

equation 6.43: DIN EN 1999-1-1

$$\left(\frac{N_{Ed}}{\omega_0 N_{Rd}}\right)^{\psi} + \left[\left(\frac{M_{y,Ed}}{\omega_0 M_{y,Rd}}\right)^{1,7} + \left(\frac{M_{z,Ed}}{\omega_0 M_{z,Rd}}\right)^{1,7}\right]^{0,6} \leq 1,00 \qquad (6.43)$$

ψ = 1,30
$M_{y,,z,Rd}$ = 1,25 x W_{el} x 0,80 x 0,64 x 290/ 1,25
= 1,25 x 4,493 x 0,80 x 0,64 x 290/ 1,25 x 10^{-3}= 0,667 kNm

η = $(40{,}01/ 50{,}22)^{1,3}$ + $[(0{,}114/ 0{,}667)^{1,7}]^{0,6}$ = 0,91 < 1,0

rear truss

Internal forces element 56

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-20,17	-15,52	-0,68	0,37	1,79	0,29
	'	2,51	-12,78	4,45	0,39	2,52	0,29
	'	2,08	-18,98	4,40	0,57	2,92	0,41
	'	-0,06	9,10	0,10	-0,26	-0,66	-0,18
	'	-10,40	3,65	-5,17	-0,02	0,04	-0,01
	'	2,51	-12,78	4,45	0,39	2,52	0,29
	'	-14,07	7,57	0,86	-0,31	-0,49	-0,15
	'	2,08	-18,98	4,40	0,57	2,92	0,41
	'	-0,06	9,10	0,10	-0,26	-0,66	-0,18
	'	2,08	-18,98	4,40	0,57	2,92	0,41
	'	-0,06	9,10	0,10	-0,26	-0,66	-0,18
	'	2,08	-18,98	4,40	0,57	2,92	0,41

chord:

N_{Ed} = (15,52+0,68)/ (2x0,339) + 20,17/ 4 = 28,94 kN < 50,22 kN

proof against buckling: see next page

L_{cr} = 12,0m $i_{y,z}$ = 15,70 cm

Geometrie			Traverse		
Stützenlänge	L [m]	12	Trägheitsradius	i_y [cm]	15,7
Knicklängenbeiwert	β_y	1		i_z [cm]	15,7
	β_z	1			
Materialeigenschaften			Belastung		
nach Tabelle 3.2b	f_o	250	N_{Ed} [kN]	20,17	
	f_u	290	$M_{y,Ed}$ [kNm]	15,52	
	$\rho_{u,haz}$	0,64	$M_{z,Ed}$ [kNm]	0,68	
	BC	A			

In Anlehnung an DIN 1999-1-1, Kapitel 6.3.3.4 erfolgt der Nachweis an der Stelle des Querschnitts mit der kleinsten Tragfähigkeit:

Belastbarkeit aus Traversenberechnung:

N_{Rd}	= 200,9 kN
$M_{y,Rd}$	= 34,05 kNm
$M_{z,Rd}$	= 34,05 kNm

Nachweis Biegeknicken

$L_{cr,y}$	1 x 12 = 12 m		$L_{cr,z}$	1 x 12 = 12 m
α	0,20	$\bar{\lambda}_0$	0,10	

Die Gurtrohre sind alle der Querschnittsklasse 3, oder besser, zuzuordnen, somit gilt: $A_{eff} = A$

$$\bar{\lambda} = \frac{L_{cr}}{i} \times \frac{1}{\pi} \times \sqrt{\frac{A_{eff}}{A} \times \frac{f_o}{E}} = \frac{L_{cr}}{i \times \pi} \times \sqrt{\frac{f_o}{E}}$$

$\bar{\lambda}_y$ = 12 / (0,157 x π) x √(250 / 70000) = 1,454

$\bar{\lambda}_z$ = 12 / (0,157 x π) x √(250 / 70000) = 1,454

$$\phi = 0{,}5 \times (1 + \alpha \times (\bar{\lambda} - \bar{\lambda}_2) + \bar{\lambda}^2)$$

ϕ_y = 0,5 x (1 + 0,2 x (1,454 - 0,1) + 1,454² = 1,692

ϕ_z = 0,5 x (1 + 0,2 x (1,454 - 0,1) + 1,454² = 1,692

$$\chi = \frac{1}{\phi + \sqrt{\phi^2 - \bar{\lambda}^2}}$$

χ_y = 1 / (1,692 + √(1,692² - 1,454²) = 0,391

χ_z = 1 / (1,692 + √(1,692² - 1,454²) = 0,391

χ_{min} = 0,391

ω_0 ist bereits in der Traversenberechnung berücksichtigt und wird deshalb zu 1 gesetzt.

$$\left(\frac{N_{Ed}}{\chi_{min} \times N_{Rd}}\right)^{\psi_c} + \left[\left(\frac{M_{y,Ed}}{M_{y,Rd}}\right)^{1,7} + \left(\frac{M_{z,Ed}}{M_{z,Rd}}\right)^{1,7}\right]^{0,6} \leqslant 1$$

mit ψ_c = 0,8:

(20,17 / (0,391 x 200,9))^0,8 + [(15,52 / 34,05)^1,7 + (0,68 / 34,05)^1,7]^0,6 = 0,787 < 1

front truss

Internal forces element 14

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-4,87	-1,25	0,14	-0,03	0,81	0,22
	'	5,71	-16,84	-3,31	2,72	8,96	1,31
	'	-0,04	-18,96	-0,55	1,08	10,36	1,45
	'	-2,22	26,08	3,39	-3,21	-17,28	-2,18
	'	5,71	-16,84	-3,31	2,72	8,96	1,31
	'	-2,22	26,08	3,39	-3,21	-17,28	-2,18
	'	-2,22	26,08	3,39	-3,21	-17,28	-2,18
	'	5,71	-16,84	-3,31	2,72	8,96	1,31
	'	-2,22	26,08	3,39	-3,21	-17,28	-2,18
	'	-0,04	-18,96	-0,55	1,08	10,36	1,45
	'	-2,22	26,08	3,39	-3,21	-17,28	-2,18
	'	-0,04	-18,96	-0,55	1,08	10,36	1,45

chord:
at cut end: $M_{y,Ed}$ = 26,08 - 0,25x27,28 = 21,76 kNm
$M_{z,Ed}$ = 3,39 – 0,25 x 3,21 = 2,59 kNm
N_{Ed} = (21,76+2,59)/ (2x0,339) + 2,22/ 4 = 36,47 kN < 50,22 kN

M+Q-Interaction:

$Q_{Ed,res}$ = $(3,21^2+17,28^2)^{1/2}$ = 17,58 kN
$\Delta M_{Q,res}$ = 17,58/ 4 x 0,05 = 0,219 kNm

equation 6.43: DIN EN 1999-1-1

$$\left(\frac{N_{Ed}}{\omega_0 N_{Rd}}\right)^{\psi} + \left[\left(\frac{M_{y,Ed}}{\omega_0 M_{y,Rd}}\right)^{1,7} + \left(\frac{M_{z,Ed}}{\omega_0 M_{z,Rd}}\right)^{1,7}\right]^{0,6} \leq 1,00 \qquad (6.43)$$

ψ = 1,30
$M_{y,,z,Rd}$ = 1,25 x W_{el} x 0,80 x 0,64 x 290/ 1,25
= 1,25 x 4,493 x 0,80 x 0,64 x 290/ 1,25 x 10^{-3}= 0,667 kNm

$\eta = (36,47/\ 50,22)^{1,3} + [(0,219/\ 0,667)^{1,7}]^{0,6} = 0,98 < 1,0$

centre trusses

Internal forces element 153

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-3,60	6,33	0,72	-0,38	-0,42	-0,05
	'	6,68	-11,29	4,55	0,02	-2,22	0,02
	'	6,65	-18,59	4,57	0,03	-1,87	0,04
	'	0,01	7,59	-0,00	-0,03	-0,25	-0,05
	'	2,71	6,20	-5,20	-0,03	-0,40	-0,05
	'	6,65	-18,59	4,57	0,03	-1,87	0,04
	'	-0,60	-7,45	-0,54	-0,45	-1,80	-0,02
	'	6,65	-18,59	4,57	0,03	-1,87	0,04
	'	6,68	-11,29	4,55	0,02	-2,22	0,02
	'	0,00	0,00	0,00	0,00	0,00	0,00
	'	-3,60	6,33	0,72	-0,38	-0,42	-0,05
	'	6,65	-18,59	4,57	0,03	-1,87	0,04

chord:
N_{Ed} = (18,59+4,57)/ (2x0,339) + 6,68/ 4 = 35,83 kN < 50,22 kN

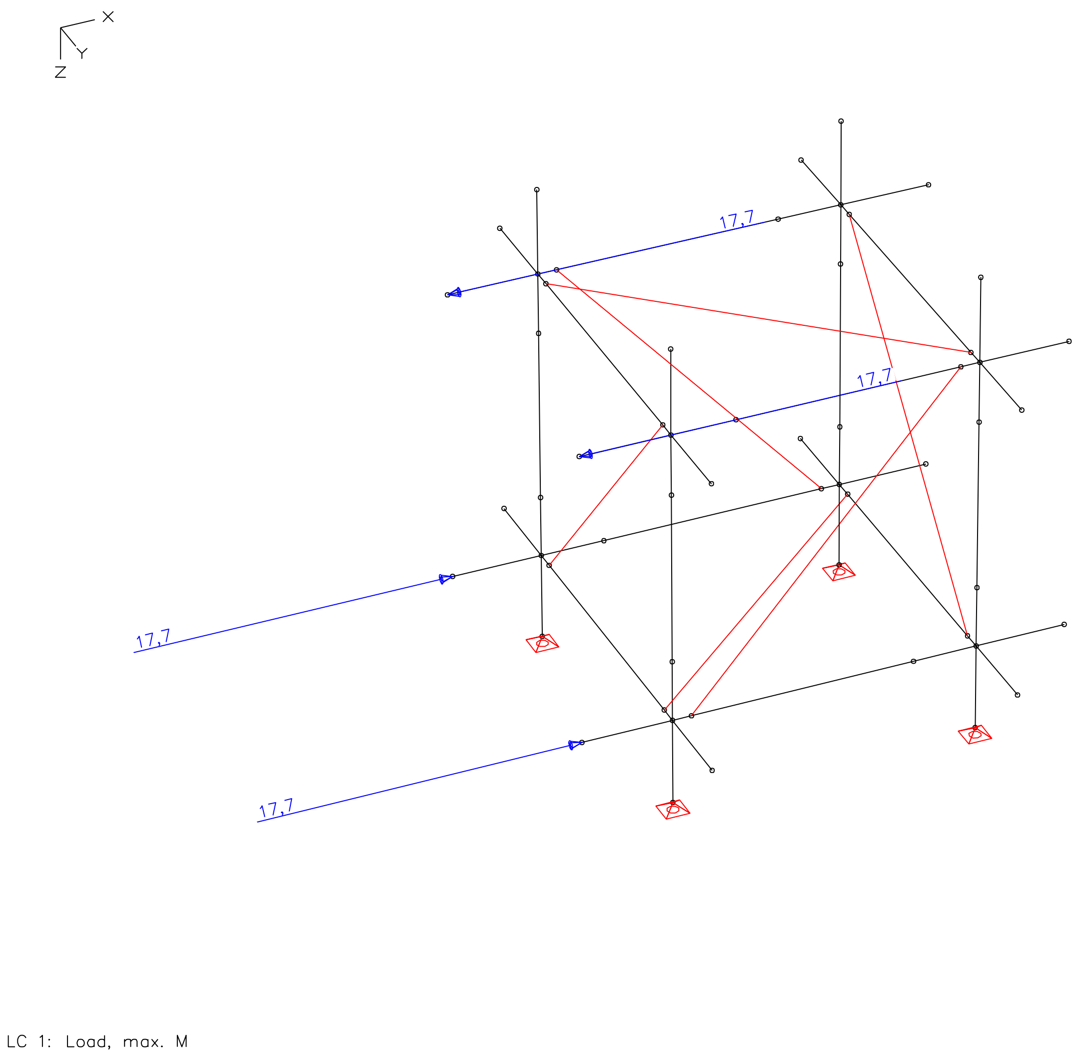
5.3 BOXCORNER H40V

max. $M_{z,Ed}$ = 12,26 kNm – 2,09 x (0,389/2) = 11,85 kNm (moment in cut end)

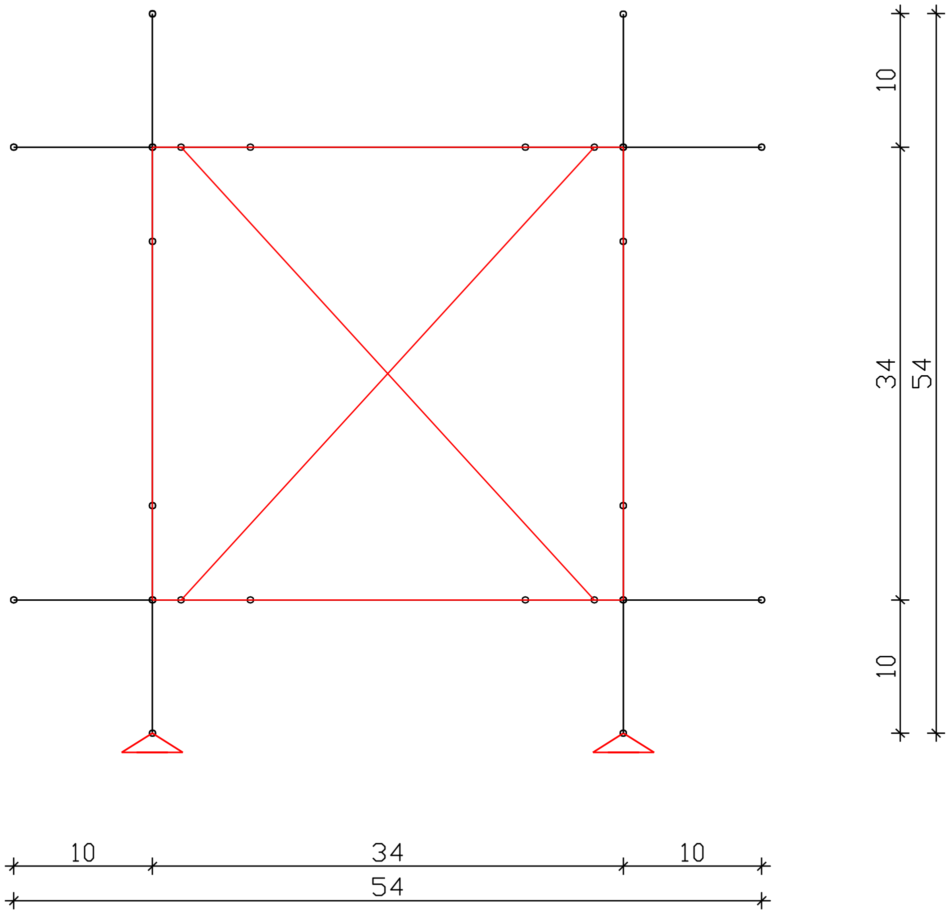
The proof is done for a maximal bending moment in the corner of M_{Ed} = 12,0 kNm.

each chord:
$N_{Ed,chord}$ = 12,0/ (2x0,339) = 17,70 kN

system:



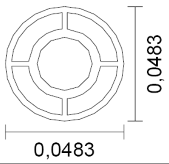
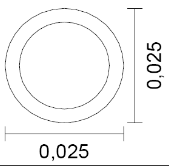
front view:



System characteristics

56 Nodes
66 Beams
4 Supports
0 Link elements
2 Material properties
2 Section properties
1 Load cases
0 Load case combinations
5 Result locations in beam elements

Section properties

1	Polygon 	Centroid [m] Area [m²] Moments of inertia [m4] Main axis angle [Grad] Ignore Iyz im member stiffnes.	ys A Ix Iy Iz Phi	= -12,597 = 7,0098e-04 = 2,3513e-07 = 1,2564e-07 = 1,2564e-07 = 0,000	zs = -0,009 Iyz = 0,0000e+00 I1 = 1,2564e-07 I2 = 1,2564e-07
2	Polygon 	Centroid [m] Area [m²] Moments of inertia [m4] Main axis angle [Grad] Ignore Iyz im member stiffnes.	ys A Ix Iy Iz Phi	= -0,000 = 2,0602e-04 = 2,5217e-08 = 1,2614e-08 = 1,2614e-08 = 0,000	zs = -0,000 Iyz = 0,0000e+00 I1 = 1,2614e-08 I2 = 1,2614e-08

Material Properties

	No.	Type	E-Modu. [MN/m²]	GModule [MN/m²]	alpha.t [1/K]	gamma [kN/m³]	Miscellaneous
1	1	Frei	70000	27000	1,00e-05	27,000	fc = 1e+006 [MN/m²] ft = 1e+006
2	2	Frei	70000	27000	1,00e-05	27,000	fc = 1e+006 [MN/m²] ft = 1e+006

List of load cases

LC.	Label
1	max. M

Sum of installed loads and support reactions

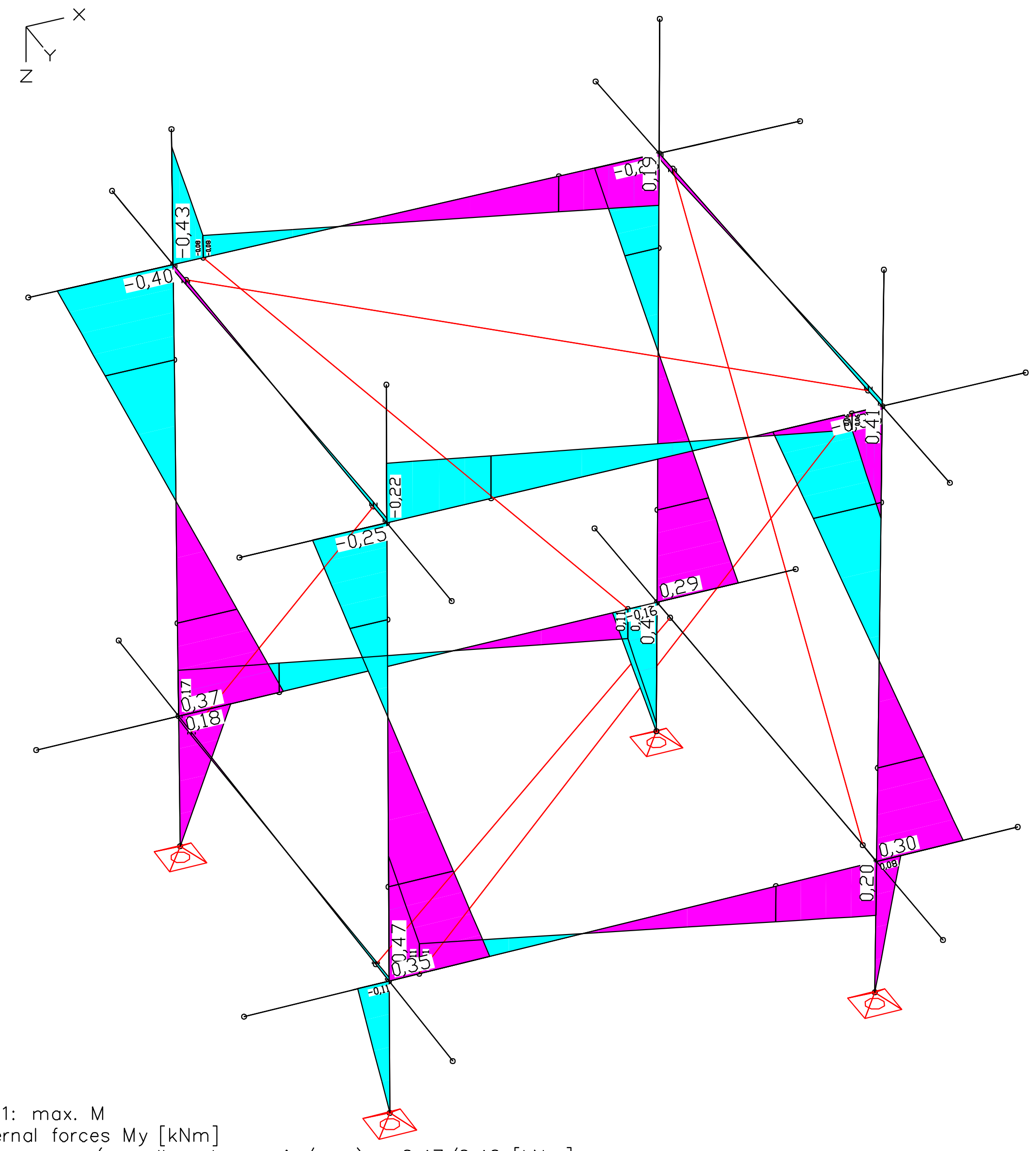
LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	max. M Support reactions	0,000 -0,000	0,000 -0,000	0,000 -0,000

Load data load case 1: max. M

LTF = Load-time function

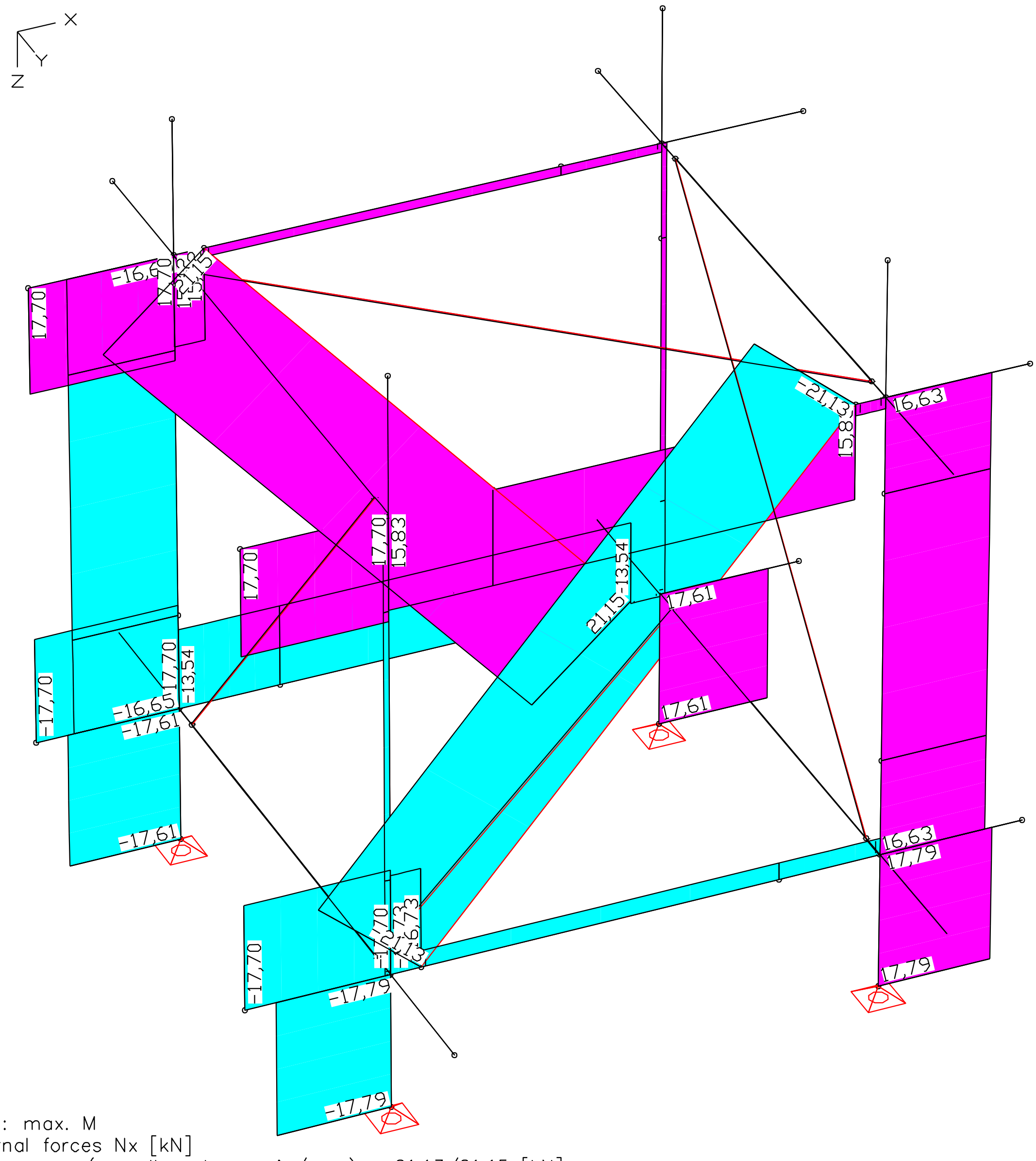
No.	Nodal load (KNL) Node from	to	Px [kN]	Py [kN]	Pz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]	LTF
1	12	12	-17,70	0,00	0,00	0,00	0,00	0,00	
2	11	11	17,70	0,00	0,00	0,00	0,00	0,00	
3	10	10	17,70	0,00	0,00	0,00	0,00	0,00	
4	9	9	-17,70	0,00	0,00	0,00	0,00	0,00	

$M_{y,Ed}$



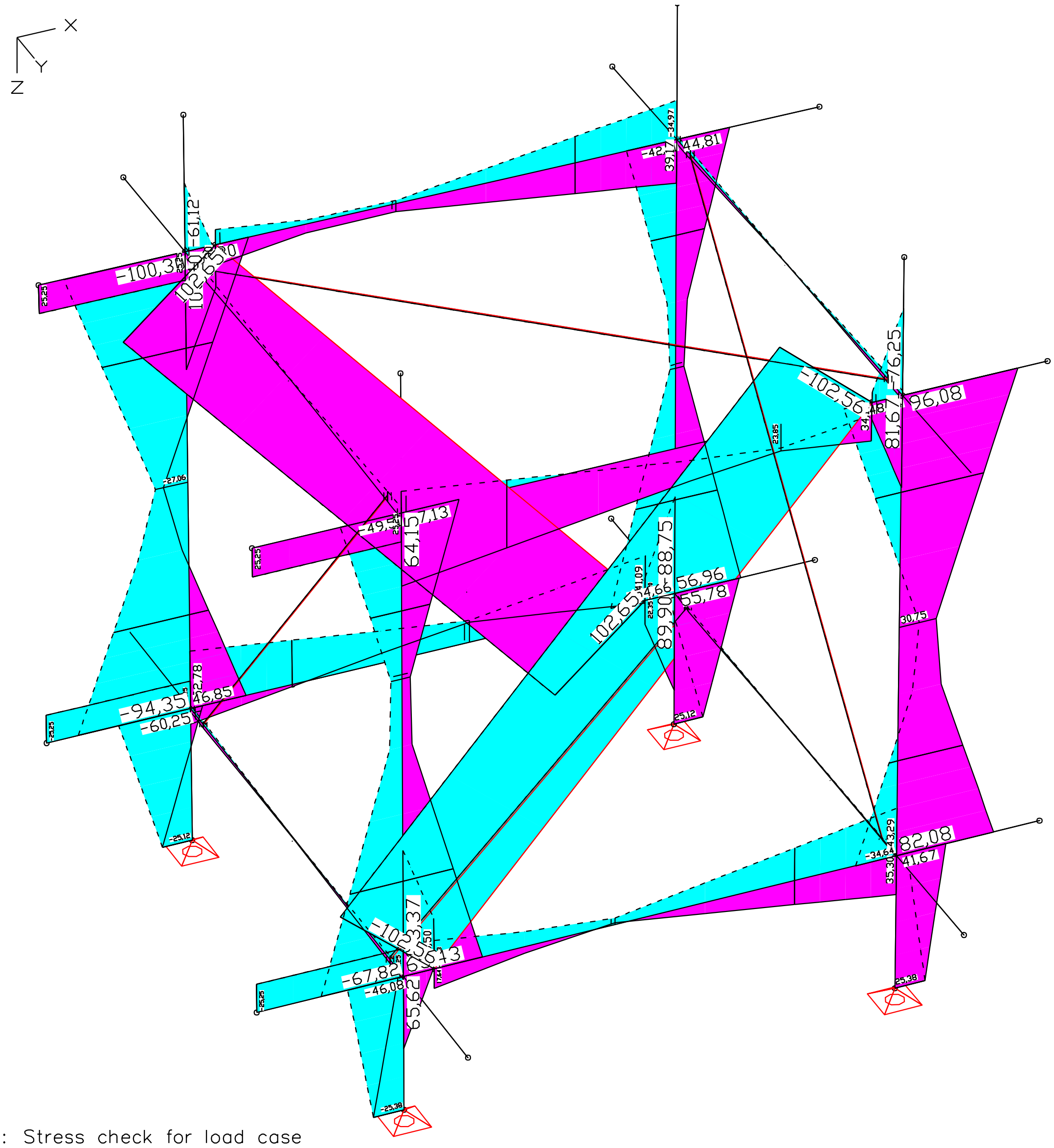
LC 1: max. M
Internal forces My [kNm]
Value range (overall system, min/max): −0,47/0,46 [kNm]

N_{Ed}



LC 1: max. M
Internal forces Nx [kN]
Value range (overall system, min/max): −21,13/21,15 [kN]

$N_{Rd,\ diagonal}$ = 2,073 x 11,84 = 24,54 kN (25x3mm, heat affected zone) stress:



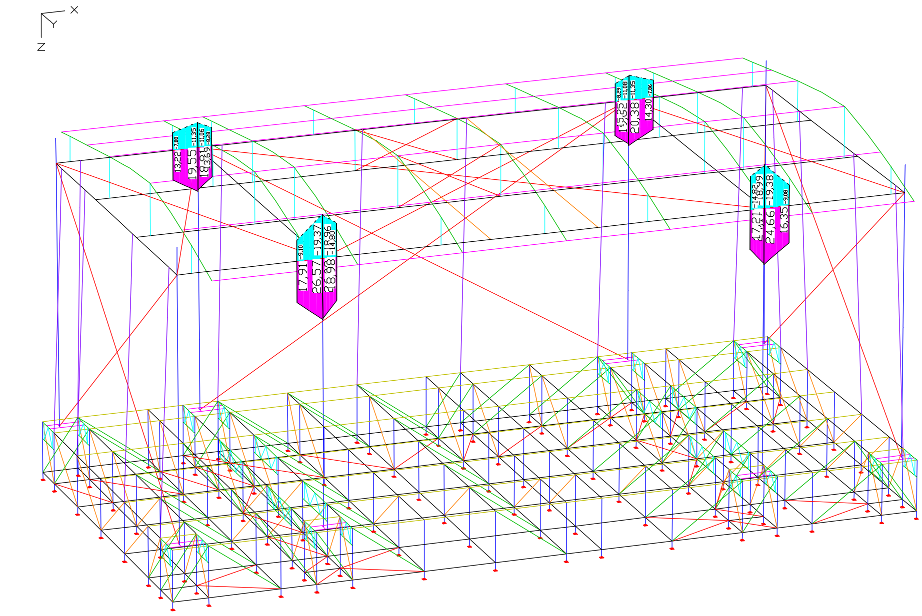
LC 1: Stress check for load case
Stresses (in structure) min,max Sigma.x [MN/m²]
Value range (overall system, min/max): −113,37/105,10 [MN/m²]

$\sigma_{Ed,} < \sigma_{Rd,HAZ}$ = 185 x 0,8 / 1,25 = 118,40 MN/m² [stress in heat affected zone]

5.4 SLEEVE BLOCK (HT)

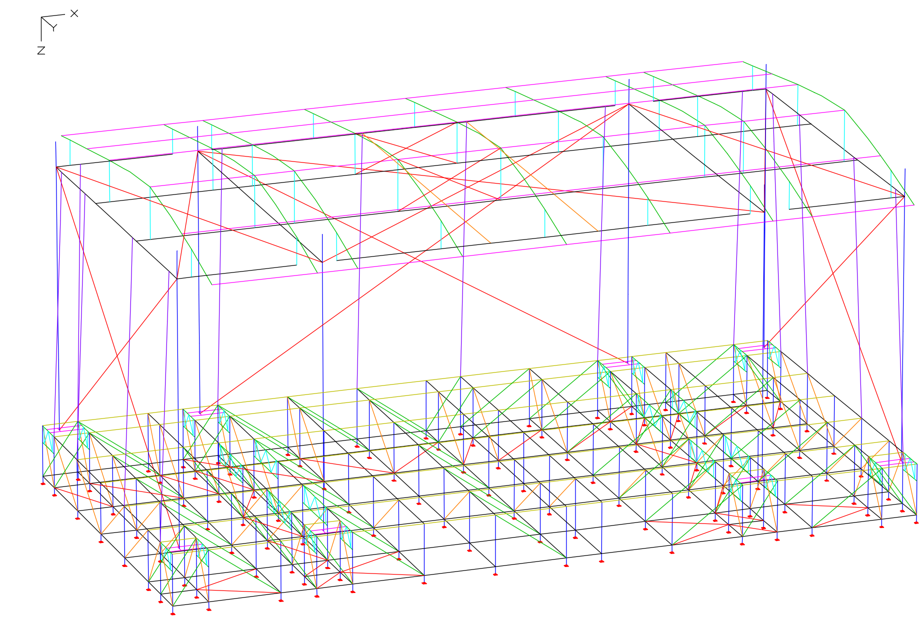
HT-Sleeves are used only on the inner main towers.

$M_{y.Ed}$



LCC 95: Selected Internal forces min,max My [kNm]
Value range (subsystem, min/max): -19,38/26,57 [kNm]

$V_{z.Ed}$



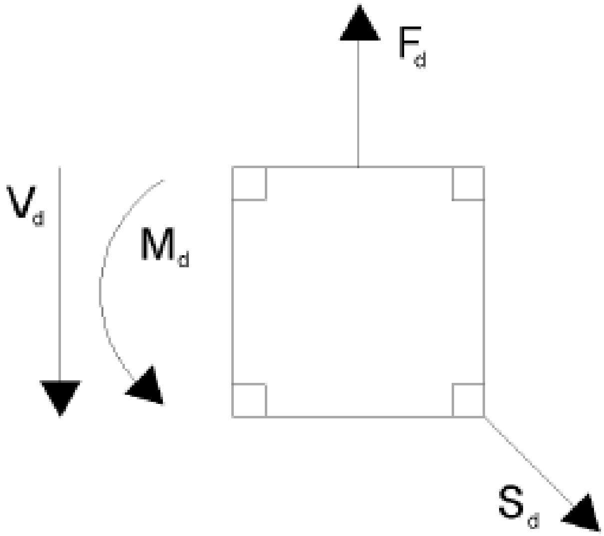
LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): -17,31/11,79 [kN]

at cut end: M_{Ed} = 21,76 kNm < 22,0 kNm

V_{zd} = 17,28 kN ≤ 17,23 kN

The capacity of the Sleeveblock is sufficient, see next page.

Permissible design loads / zulässige Beanspruchbarkeiten



F_{Rd} = total load at deadhang / Gesamtlast Sicherung

S_{Rd} = force guy wire / Kraft aus Aussteifungsseil

$V_{z,Rd}$ = Transversal force truss / Querkraft Traverse

M_{Rd} = Bending moment truss / Biegemoment Traverse

max. F_{Rd} = 50,00 kN

max. S_{Rd} = 25,00 kN

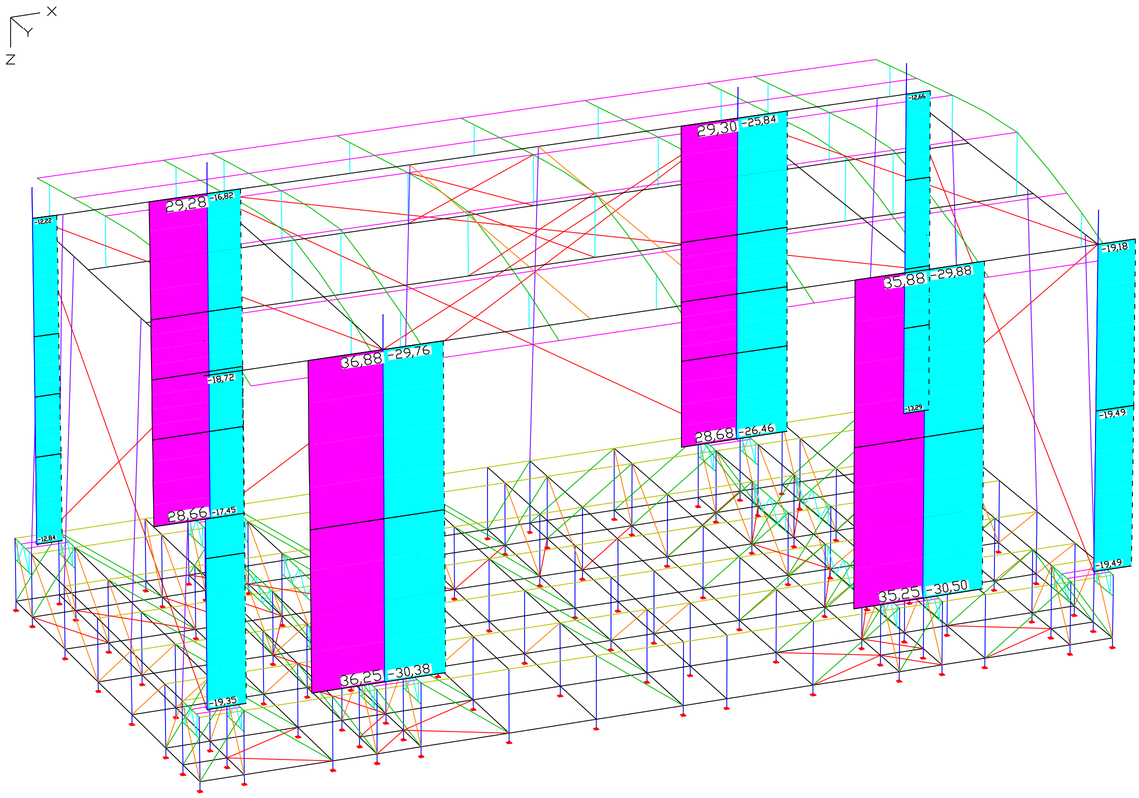
max. $V_{z,Rd}$ = 18,94 kN

max. M_{Rd} = 32,95 kN

Interaction between $V_{z,Rd}$ and M_{Rd}: (due to truss)

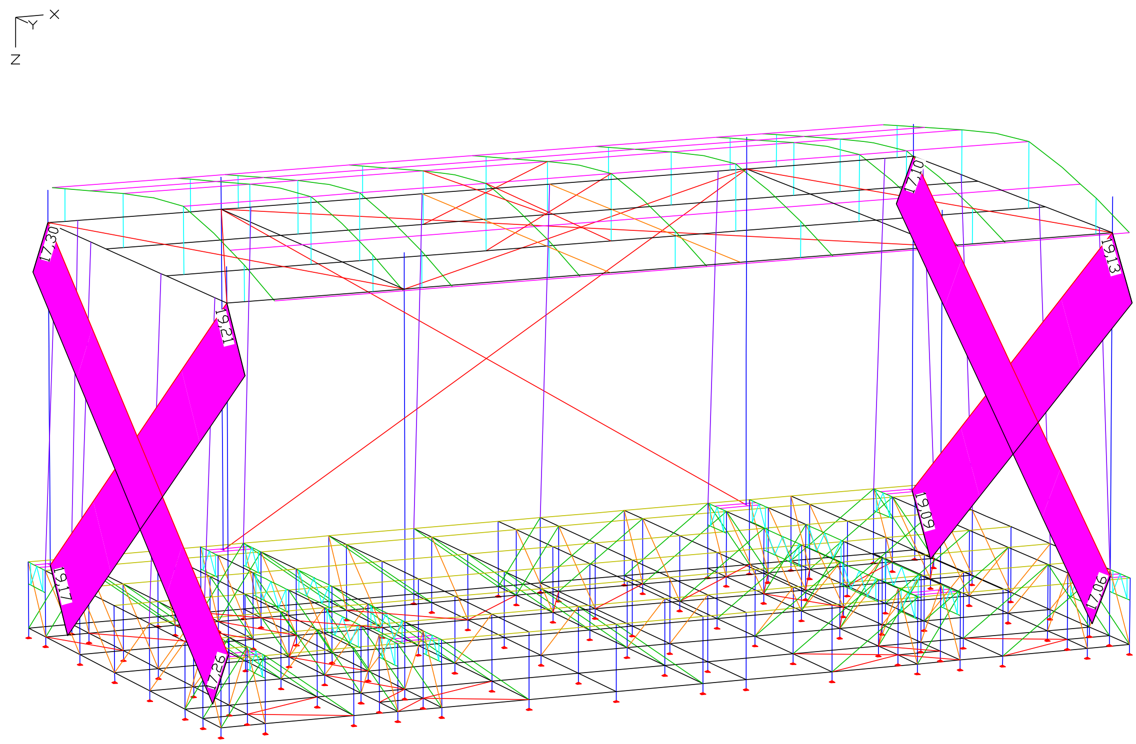
bending moment/ Biegemoment M_{Rd}	transversal force/ Querkraft $V_{z,Rd}$
[kNm]	[kN]
≤ 20,00	18,94
21,00	18,80
22,00	17,23
23,00	15,66
24,00	14,08
25,00	12,51
26,00	10,94
27,00	9,36
28,00	7,79
29,00	6,22
30,00	4,64
31,00	3,07
32,00	1,50
32,95	0,00

All given values are design loads



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): −30,50/36,88 [kN]

F_d = 30,50 kN < 50,0 kN



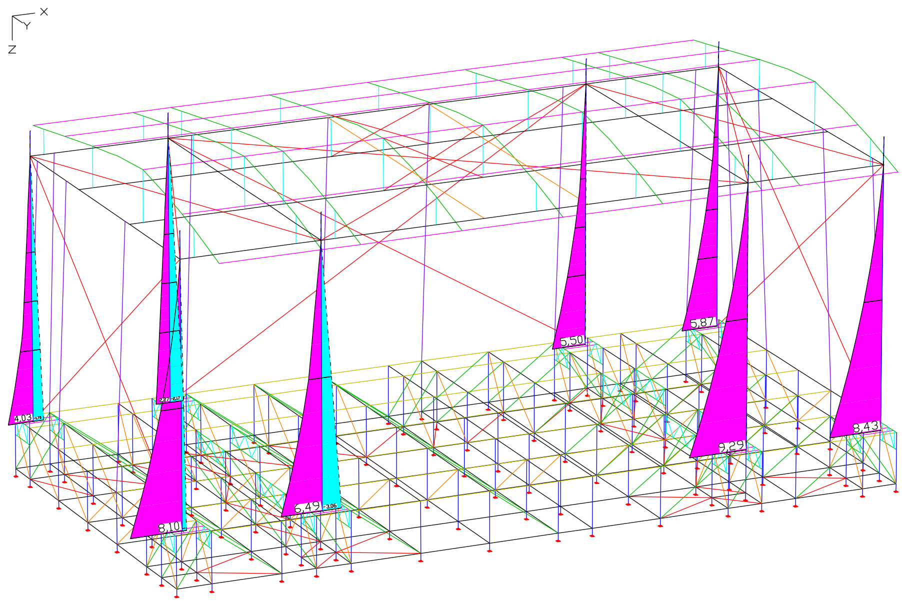
LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): 0,00/19,21 [kN]

S_d < 25,0 kN

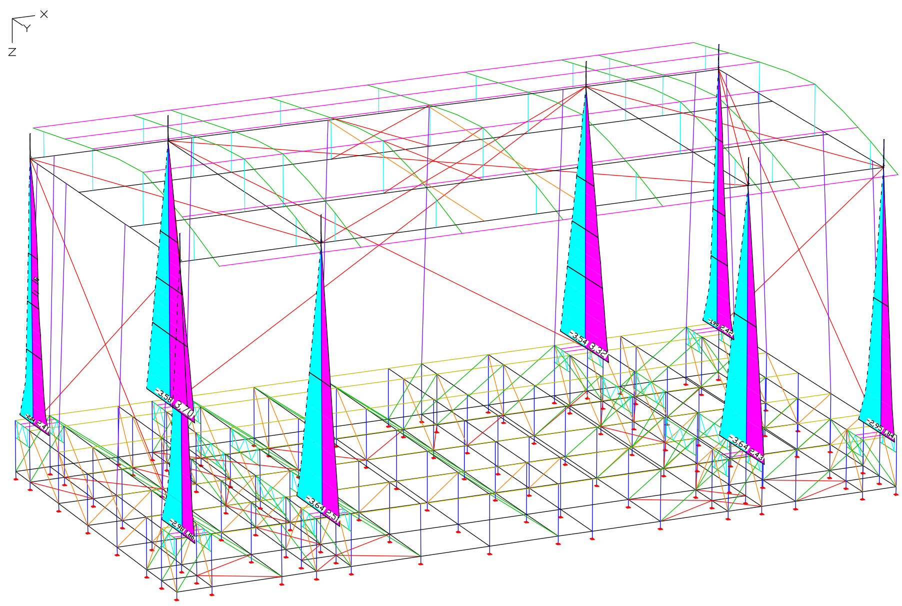
(no guy wire at decisive front HT-Sleeve)

MPT-Sleeves (“old”) on the outside towers of the sidewings with no further proofs.

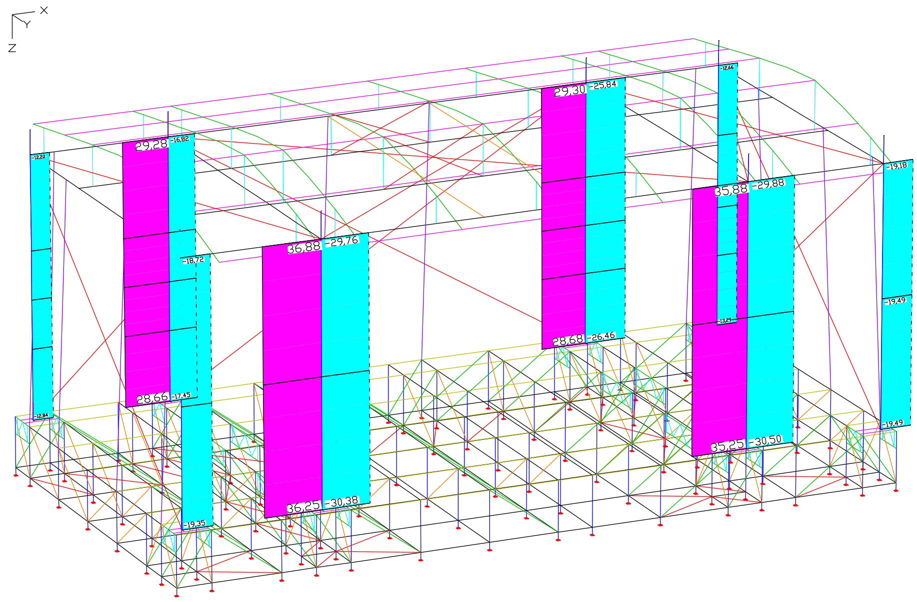
5.5 COLUMNS



LCC 95: Selected Internal forces min,max My [kNm]
Value range (subsystem, min/max): −3,06/9,29 [kNm]



LCC 95: Selected Internal forces min,max Mz [kNm]
Value range (subsystem, min/max): −3,64/3,70 [kNm]



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -30,50/36,88 [kN]

Internal forces element 347

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-30,50	0,16	0,03	0,00	0,02	-0,00
	'	35,25	4,10	1,07	0,14	0,53	-0,14
	'	14,21	-0,01	-3,64	-1,12	-0,00	0,09
	'	30,62	9,29	-0,93	-0,12	1,86	0,09
	'	14,21	-0,01	-3,64	-1,12	-0,00	0,09
	'	12,13	0,37	2,43	0,32	0,05	-0,14
	'	14,21	-0,01	-3,64	-1,12	-0,00	0,09
	'	14,24	0,53	2,29	0,95	0,07	-0,06
	'	14,21	-0,01	-3,64	-1,12	-0,00	0,09
	'	30,62	9,29	-0,93	-0,12	1,86	0,09
	'	35,25	4,10	1,07	0,14	0,53	-0,14
	'	-3,18	0,10	-3,46	-0,45	0,01	0,15

chord:

$N_{Ed,chord}$ = (9,29+0,93)/ (2x0,239) + 30,62/ 4 = 29,04 kN < 50,22 kN

proof against buckling:

Geometrie			Traverse		
Stützenlänge	L [m]	7	Trägheitsradius	i_y [cm]	11,12
Knicklängenbeiwert	β_y	1		i_z [cm]	11,12
	β_z	1			
Materialeigenschaften			Belastung		
nach Tabelle 3.2b	f_o	250	N_{Ed} [kN]		30,5
	f_u	290	$M_{y,Ed}$ [kNm]		0,16
	$\rho_{u,haz}$	0,64	$M_{z,Ed}$ [kNm]		0,03
	BC	A			

In Anlehnung an DIN 1999-1-1, Kapitel 6.3.3.4 erfolgt der Nachweis an der Stelle des Querschnitts mit der kleinsten Tragfähigkeit:

Belastbarkeit aus Traversenberechnung:

N_{Rd} = 200,9 kN
$M_{y,Rd}$ = 24,00 kNm
$M_{z,Rd}$ = 24,00 kNm

Nachweis Biegeknicken

$L_{cr,y}$ 1 x 7 = 7 m $L_{cr,z}$ 1 x 7 = 7 m
α 0,20 $\bar{\lambda}_0$ 0,10

Die Gurtrohre sind alle der Querschnittsklasse 3, oder besser, zuzuordnen, somit gilt: $A_{eff} = A$

$$\bar{\lambda} = \frac{L_{cr}}{i} \times \frac{1}{\pi} \times \sqrt{\frac{A_{eff}}{A} \times \frac{f_o}{E}} = \frac{L_{cr}}{i \times \pi} \times \sqrt{\frac{f_o}{E}}$$

$\bar{\lambda}_y$ = 7 / (0,1112 x π) x √(250 / 70000) = 1,197
$\bar{\lambda}_z$ = 7 / (0,1112 x π) x √(250 / 70000) = 1,197

$$\phi = 0{,}5 \times (1 + \alpha \times (\bar{\lambda} - \bar{\lambda}_2) + \bar{\lambda}^2)$$

ϕ_y = 0,5 x (1 + 0,2 x (1,197 - 0,1) + 1,197² = 1,326
ϕ_z = 0,5 x (1 + 0,2 x (1,197 - 0,1) + 1,197² = 1,326

$$\chi = \frac{1}{\phi + \sqrt{\phi^2 - \bar{\lambda}^2}}$$

χ_y = 1 / (1,326 + √(1,326² - 1,197²) = 0,527
χ_z = 1 / (1,326 + √(1,326² - 1,197²) = 0,527
χ_{min} = 0,527

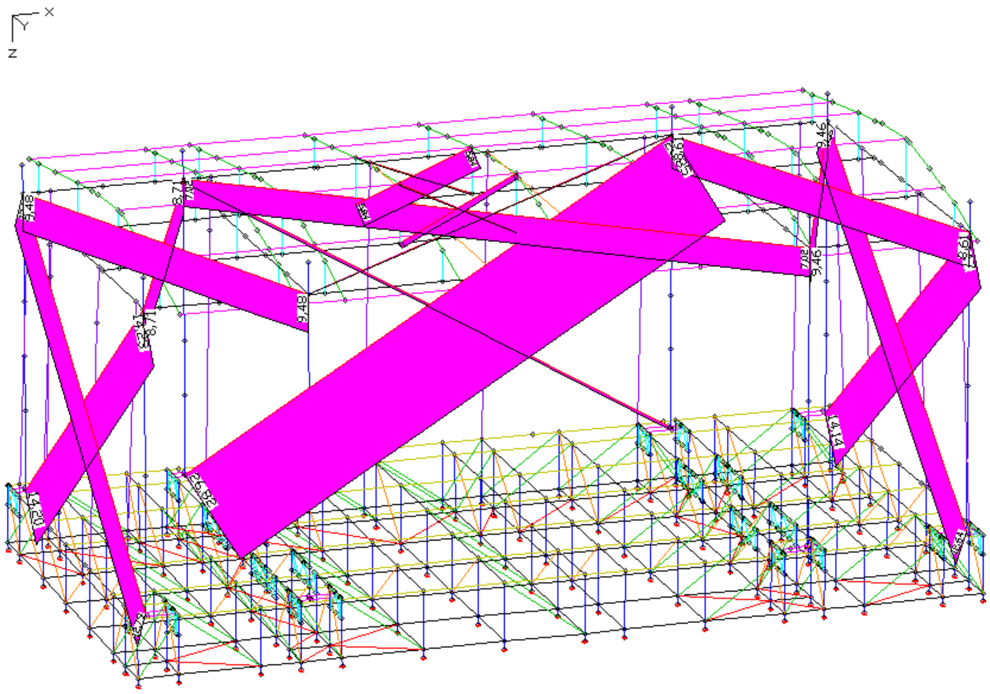
ω_0 ist bereits in der Traversenberechnung berücksichtigt und wird deshalb zu 1 gesetzt.

$$\left(\frac{N_{Ed}}{\chi_{min} \times N_{Rd}}\right)^{\psi_c} + \left[\left(\frac{M_{y,Ed}}{M_{y,Rd}}\right)^{1,7} + \left(\frac{M_{z,Ed}}{M_{z,Rd}}\right)^{1,7}\right]^{0,6} \leqslant 1$$

mit ψ_c = 0,8:
(30,5 / (0,527 x 200,9))^0,8 + [(0,16 / 24)^1,7 + (0,03 / 24)^1,7]^0,6 = 0,376 < 1

5.6 GUY WIRES

LCC85



LCC 85: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): 0,00/26,85 [kN]

wall wires: max. N_{Ek} = 26,82 kN

Ø 12 mm z.B. wire class 6x7 1770 N/mm² with steel inlay DIN 12385
ultimate load 91,5 kN Safety factor: γ = 3,0

91,5/ 3 = 30,5 kN > 26,82 kN

Attachments of the wall wires directly on the Sleeve blocks and on the Base sections over shackles. (welded on or bolted through)

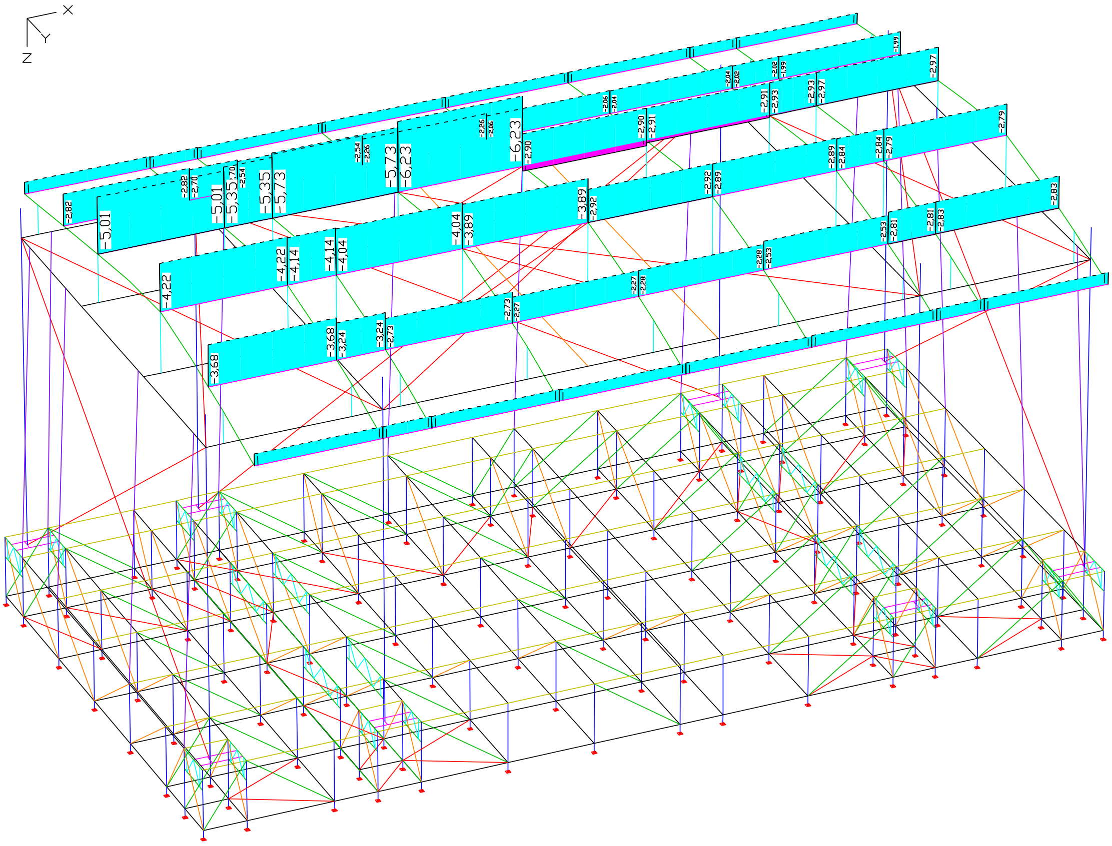
roof wires: max. N_{Ek} = 9,48 kN

Ø 8 mm z.B. wire class 6x7 1770 N/mm² with steel inlay DIN 12385
ultimate load 40,7 kN Safety factor: γ = 3,0
40,7/ 3 = 13,57 kN > 9,48 kN

Attachments of the roof wires bolted directly in the nodes of the Sleeve blocks. The specifications of the steel cables are only examples. Equal constructions are possible.

5.7 COMPRESSION STRUTS

pipe Ø48x3mm (aluminium)



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): −6.23/0.44 [kN]

N_{Ed} = -6,23 kN buckling length: ~ 2,71 m

The connection of the compression struts is placed near the nodes of the rafters H30D.

$i_{y,z}$ = 1,595 cm; A = 4,241 cm²

buckling length: ~ 2,71 m

$N_{b,Rd} = \chi \times A_{eff} \times f_0 / \gamma_{M1}$

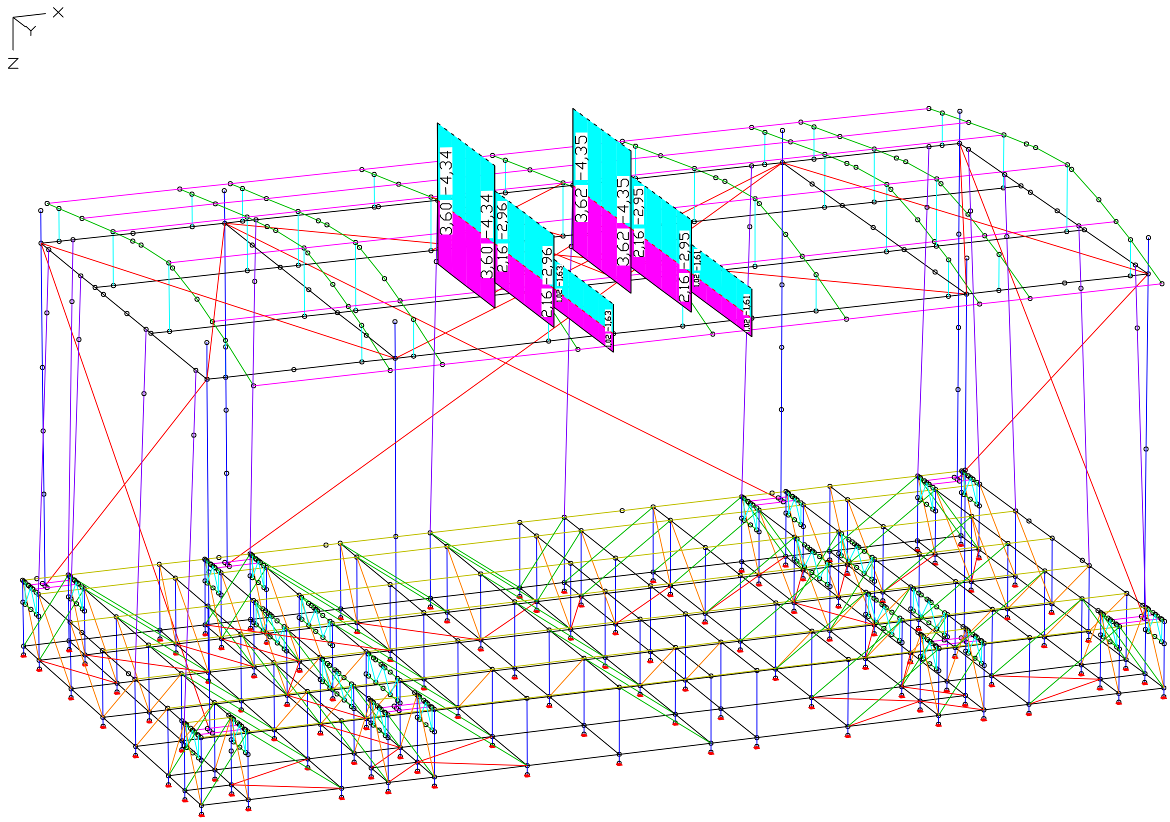
$\bar{\lambda} = L_{cr} / (i \times \pi) \times \sqrt{(A_{eff} \times f_0)/A \times E)} = 271/(1{,}595 \times 3{,}14) \times \sqrt{(250/70000)} = 3{,}221$

$\Phi = 0{,}5 \times (1 + \alpha \times (\bar{\lambda} - \bar{\lambda}_0) + \bar{\lambda}^2) = 0{,}5 \times (1+0{,}2 \times (3{,}221 - 0{,}10) + 3{,}221^2) = 6{,}0$

$\chi = 1/ (\Phi + \sqrt{(\Phi^2 - \bar{\lambda}^2)}) = 1/(6{,}0 + \sqrt{(6{,}0^2 - 3{,}221^2)}) = 0{,}09$

$N_{b,Rd} = 0{,}09 \times 4{,}241 \times 25{,}0/ 1{,}1 = 8{,}67$ kN > 6,23 kN

pipes Ø48,3x3,2 (steel S235 JR)



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): −4,35/3,62 [kN]

$i_{y,z}$ = 1,599 cm; A = 4,534 cm² KSL c: $\alpha = 0{,}49$

buckling length: ~ 3,0 m

$N_{b,Rd} = \chi \times A \times f_y / \gamma_{M1}$

$\bar{\lambda} = L_{cr} / (i \times \lambda_1) = 300/(1{,}599 \times 93{,}9) = 1{,}999$

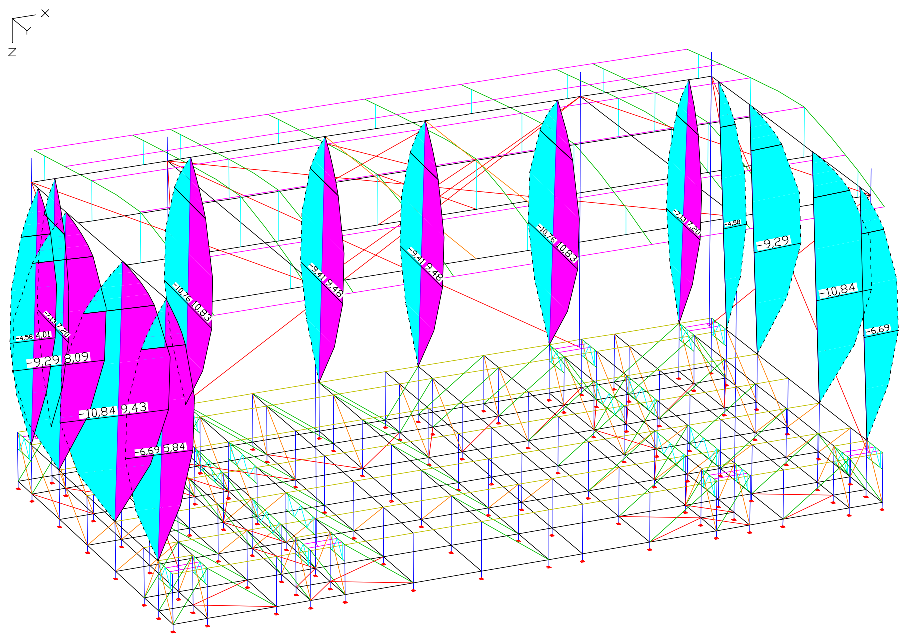
$\Phi = 0{,}5 \times (1 + \alpha \times (\bar{\lambda} - 0{,}20) + \bar{\lambda}^2) = 2{,}939$

$\chi = 1/ (\Phi + \sqrt{(\Phi^2 - \bar{\lambda}^2)}) = 0{,}196$

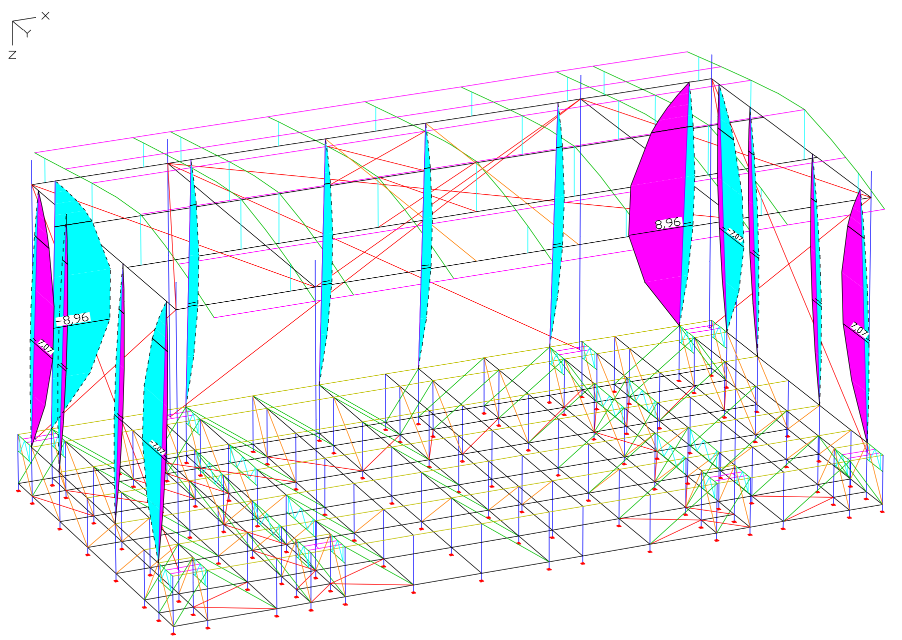
$N_{b,Rd} = 0{,}196 \times 4{,}534 \times 10^2 \times 235/ 1{,}1 \times 10^{-3} = 18{,}99$ kN > 4,34 kN

The connection of the compression struts is placed near the nodes of the grid H40V.

5.8 KEDER PROFILES 170x88x3mm

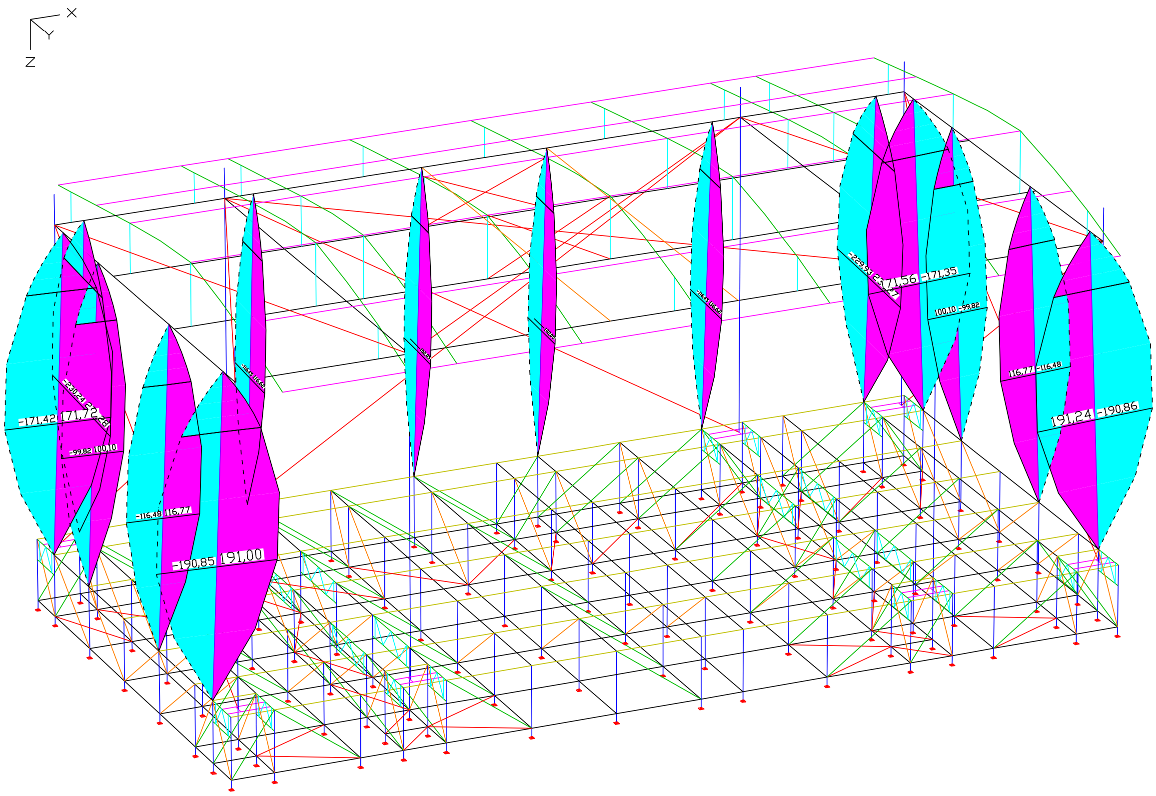


LCC 95: Selected Internal forces min,max My [kNm]
Value range (subsystem, min/max): −10,84/10,83 [kNm]



LCC 95: Selected Internal forces min,max Mz [kNm]
Value range (subsystem, min/max): −8,96/8,96 [kNm]

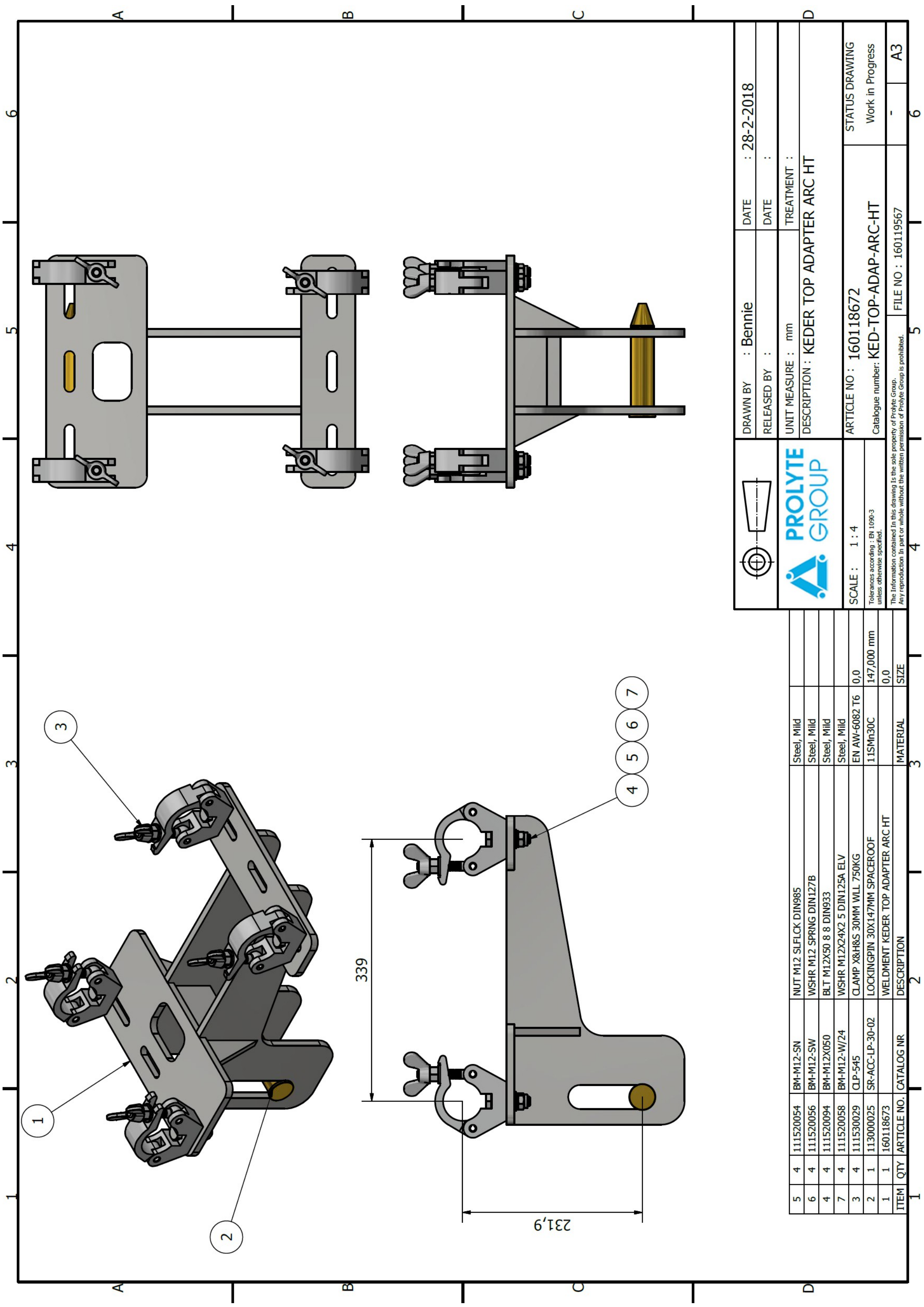
stresses

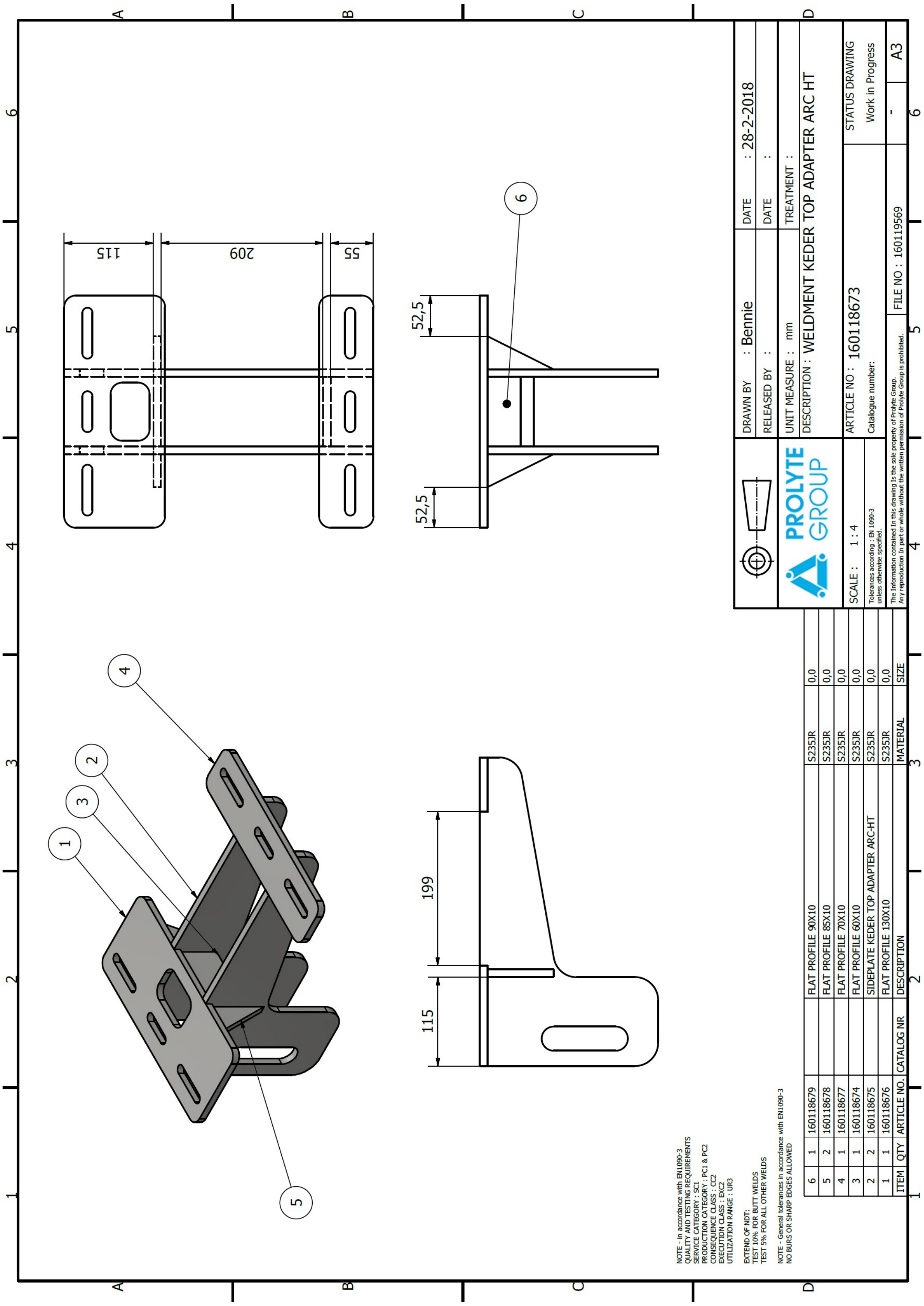


LCC 95: Selected Stresses (general – elastic, directly from internal forces) min,max Sigma.x [MN/m²]
Value range (subsystem, min/max): –230,24/230,28 [MN/m²]

~ 250/1,1 = 227,3 N/mm² (1,01<1,03)

Keder Top Adapter




115
209
55
52,5
52,5
6
199
115
1
2
3
4
5
NOTE - in accordance with EN1090-3
QUALITY AND TESTING REQUIREMENTS
SERVICE CATEGORY : SC1
PRODUCTION CATEGORY : PC1 & PC2
CONSEQUENCE CLASS : CC2
EXECUTION CLASS : EXC2
UTILIZATION RANGE : UR3
EXTEND OF NDT:
TEST 10% FOR BUTT WELDS
TEST 5% FOR ALL OTHER WELDS
NOTE - General tolerances in accordance with EN1090-3
NO BURS OR SHARP EDGES ALLOWED
ITEM | QTY | ARTICLE NO. | CATALOG NR | DESCRIPTION | MATERIAL | SIZE
6 | 1 | 160118679 | | FLAT PROFILE 90X10 | S235JR | 0,0
5 | 2 | 160118678 | | FLAT PROFILE 85X10 | S235JR | 0,0
4 | 1 | 160118677 | | FLAT PROFILE 70X10 | S235JR | 0,0
3 | 1 | 160118674 | | FLAT PROFILE 60X10 | S235JR | 0,0
2 | 2 | 160118675 | | SIDEPLATE KEDER TOP ADAPTER ARC-HT | S235JR | 0,0
1 | 1 | 160118676 | | FLAT PROFILE 130X10 | S235JR | 0,0
DRAWN BY : Bennie
DATE : 28-2-2018
RELEASED BY :
DATE :
UNIT MEASURE : mm
TREATMENT :
DESCRIPTION : WELDMENT KEDER TOP ADAPTER ARC HT
PROLYTE GROUP
SCALE : 1 : 4
ARTICLE NO : 160118673
Catalogue number:
STATUS DRAWING
Work in Progress
Tolerances according : EN 1090-3
unless otherwise specified.
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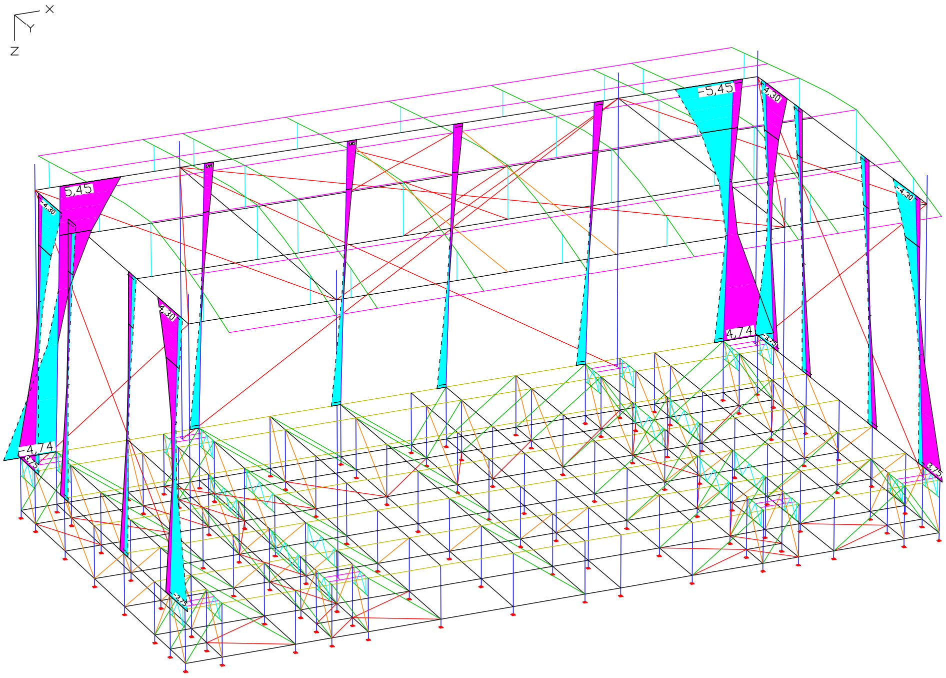
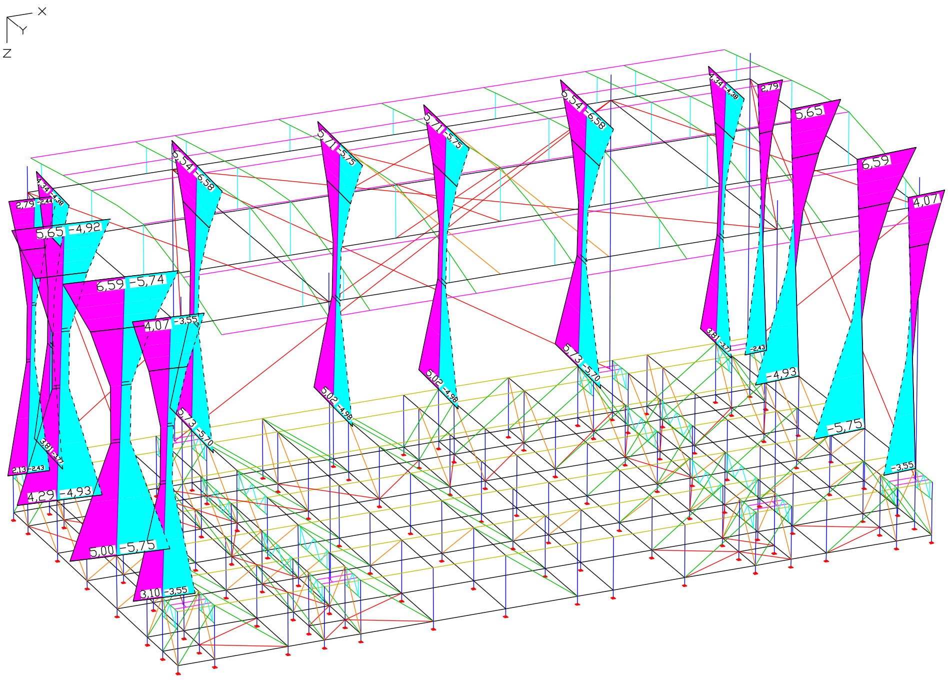
FILE NO : 160119569
-
A3

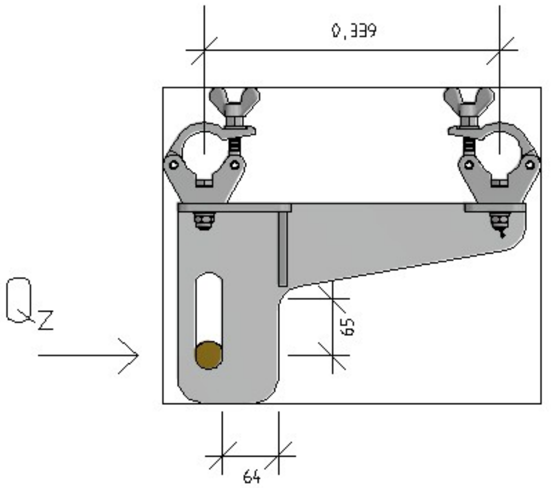


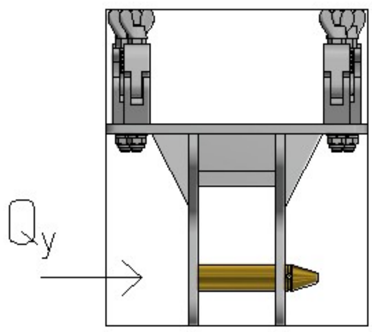
LCC 95: Selected Internal forces min,max Qy [kN]
Value range (subsystem, min/max): −5,45/5,45 [kN]



LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): −6,58/6,59 [kN]

Sheet No 2:





$Q_{z,Ed}$ = 4,38 kN
$Q_{y,Ed}$ = 5,45 kN

$W_{y,pl}$ = 1,0 x 6,4²/4 = 10,25 cm³
$W_{z,pl}$ = 1,0² x 6,4/4 = 1,61 cm³

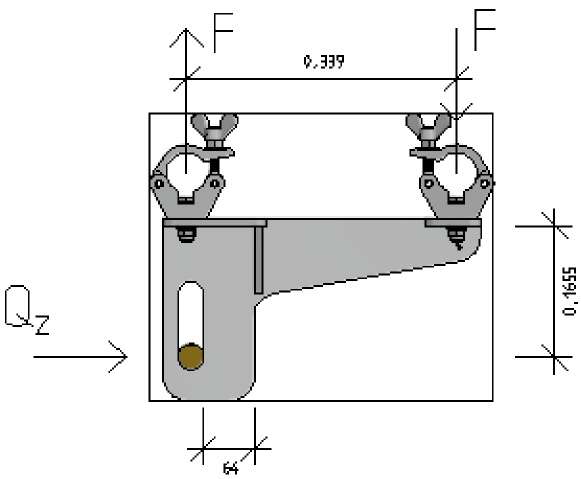
$M_{y,Rd}$ = 10,25 x 23,5 = 241,0 kNcm
$M_{z,Ed}$ = 1,61 x 23,5 = 37,8 kNcm

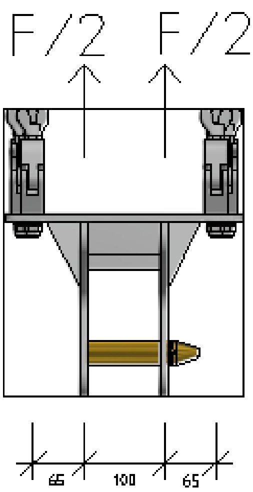
$M_{y,Ed}$ = 4,38/2 x 6,5 = 14,24 kNcm
$M_{z,Ed}$ = 5,45 x 6,5 = 35,43 kNcm

14,24/241 + 32,96/ 37,8 = 0,059 + 0,937 = 0,996 < 1,0

Values at the cut end of the keder profiles are actually smaller.

Sheet No 4:





$Q_{z,Ed}$ = 6,59 kN

$M_{Ed,Pos2}$ = 6,59 x 0,1655 = 1,091 kNm

F/2 = 1,091/ (2 x 0,339) = 1,61 kN

$W_y = 1{,}0^2 \times 5{,}7/6 = 0{,}95\ cm^3$

$M_{y,Rd}$ = 0,95 x 23,5 = 0,22 kNm

$M_{Ed,Pos4}$ = 1,61 x 0,065 = 0,105 kNm

0,105/ 0,22 = 0,477 < 1,0

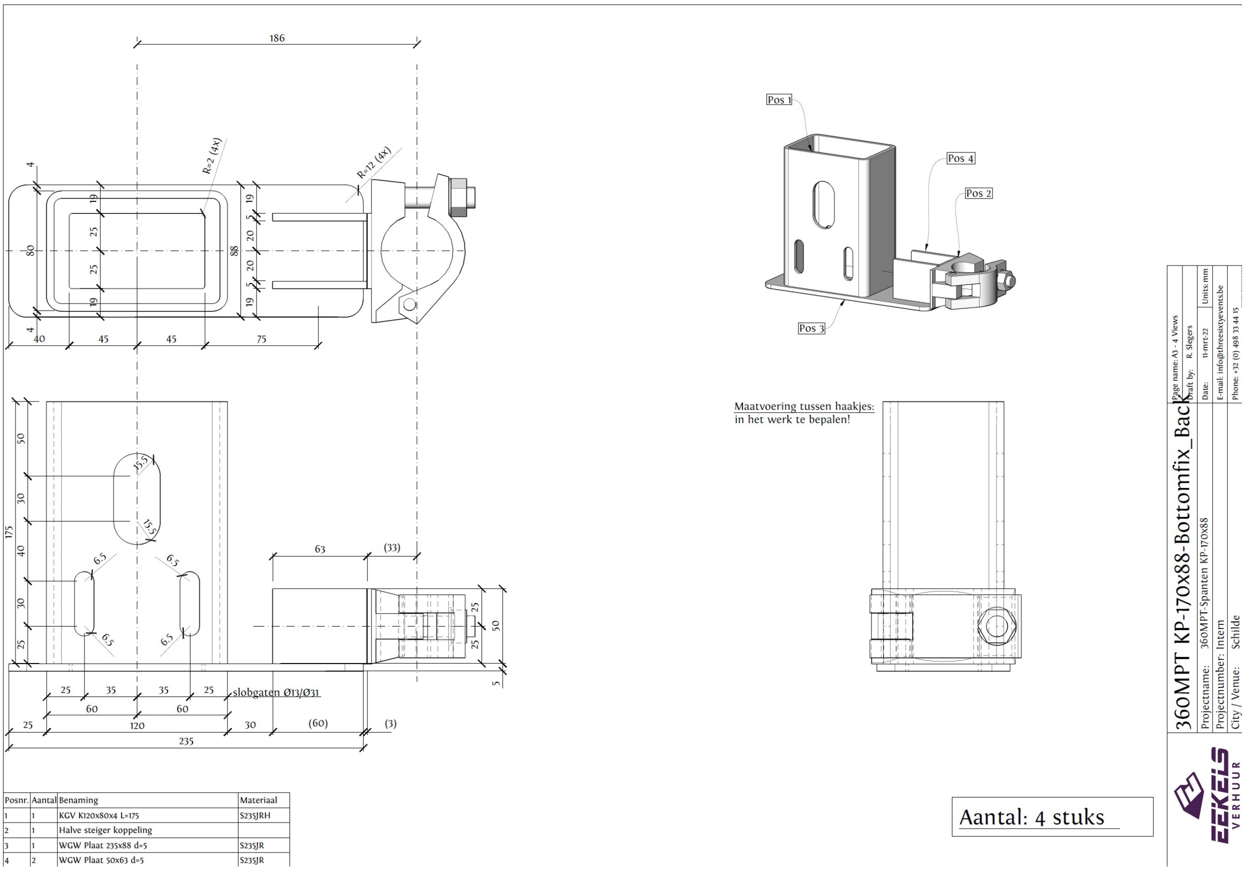
Proof of local bending in truss chord:

$N_{Ed,chord}$ = (4,23+3,45)/ (2x0,339) + 15,72/ 4 = 15,26 kN < 50,22 kN

$Q_{z,Ed}$ = 6,59 kN
M_{Ed} = 6,59/2 x 40/65 x 0,25 = 0,507 kNm

$\sigma_{Ed} = 15{,}26/\ 4{,}241 + 0{,}507 \times 100/\ 4{,}493 = 14{,}88\ kN/cm^2 < 25/\ 1{,}1 = 22{,}72\ kN/cm^2$

Keder Bottom Adapter



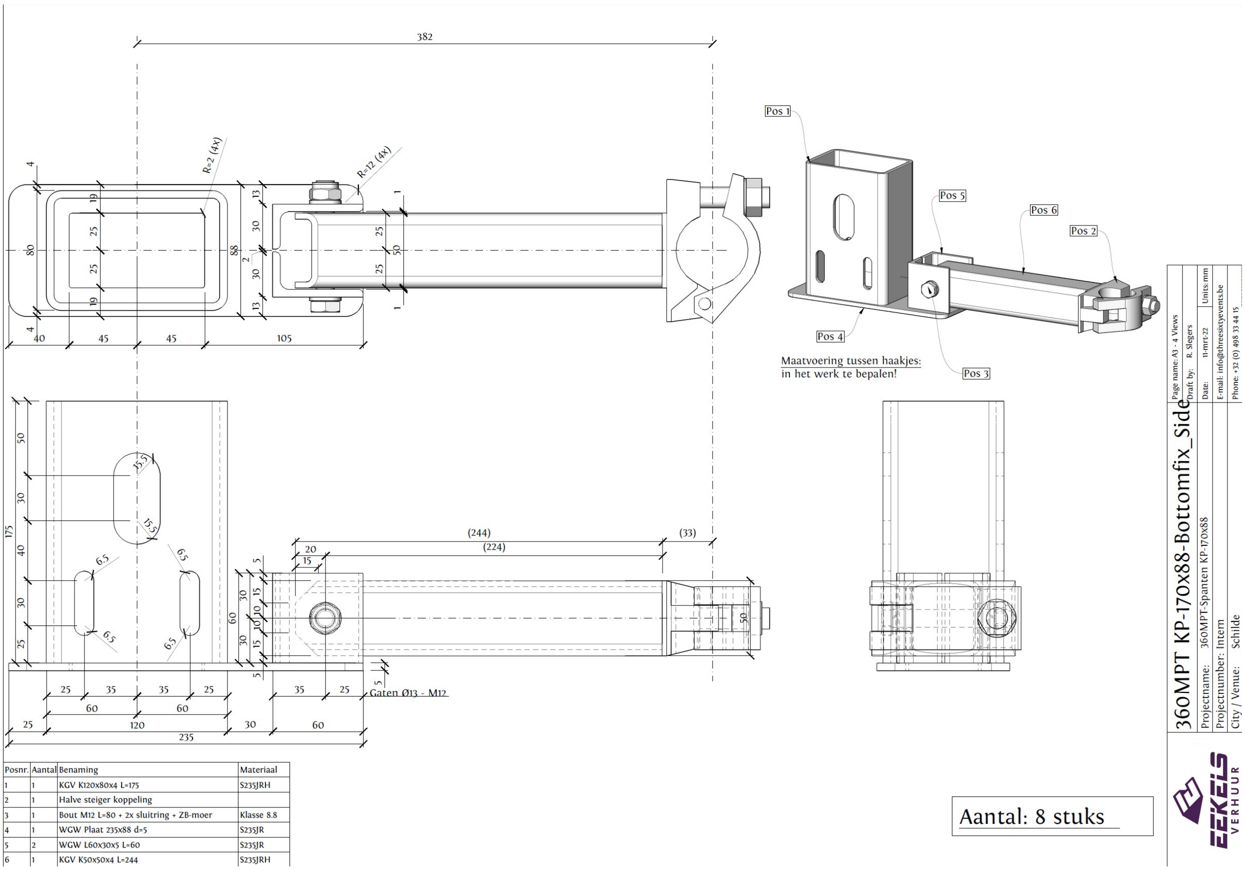
$Q_{y,Ed}$ = 3,75 kN

The horizontal force from membrane tension on the edge keders is constructively secured by fixing the keder bottoms with straps horizontally to the towers.

$Q_{z,Ed}$ = 5,75 kN

The horizontal force is lead over the fixed adapter (welded) into the Layher columns.

Set off to layher plate: h = 23,7 cm
M_{Ed} = 4,85 x 0,237 = 1,36 kNm
< M_{Rd} = 4,73 x 32,0 = 1,51 kNm



$Q_{y,Ed}$ = 4,74 kN

The horizontal force from membrane tension on the edge keders is constructively secured by fixing the keder bottoms with straps horizontally to the towers.

$Q_{z,Ed}$ = 5,73 kN

The horizontal force is lead over the fixed adapter (bolted, M12, 8.8) into the Layher columns.

$F_{v,Rd}$ = 2,5 x 0,513 x 36 x 1,3 x 2x 0,4/ 1,25 = 38,41 kN > 5,73 kN

with α_b = 20/ (3x13) = 0,513 and k_1 = 2,5

Set off to layher plate: h = 23,7 cm

M_{Ed} = 5,73 x 0,237 = 1,35 kNm

< M_{Rd} = 4,73 x 32,0 = 1,51 kNm

no further proof

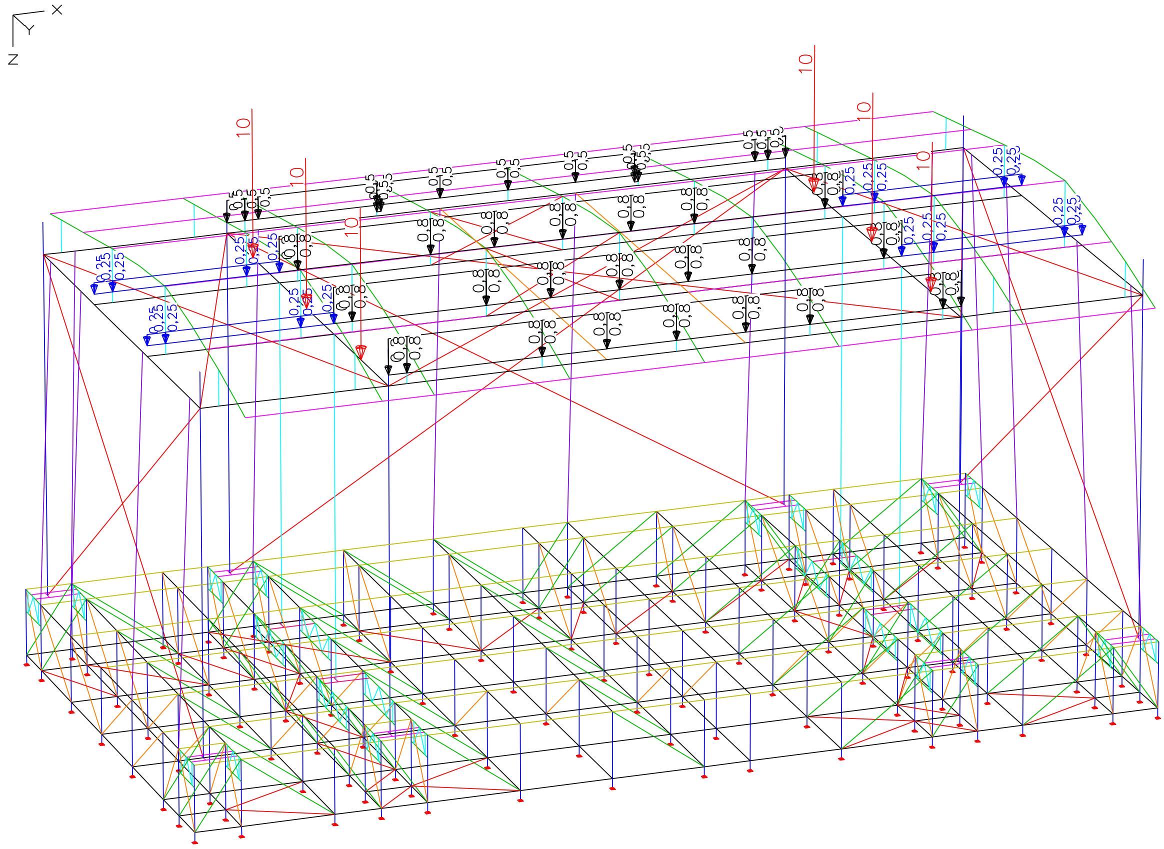
6 HD-SETUP WITH ADDITIONAL TOWERS - PROOFS

Optionally the roof is build up as an HD-setup with four additional towers beneath the inner boxcorners of the H40V-grid. The four towers are made from Prolyte S40T trusses and are sectionally build up during lifting of the roof. On the bottom they rest on 2,07x1,03m universal bases. (Prolyte)

The payload cases are adapted in the following. All other load cases remain the same as well as the calculation itself.

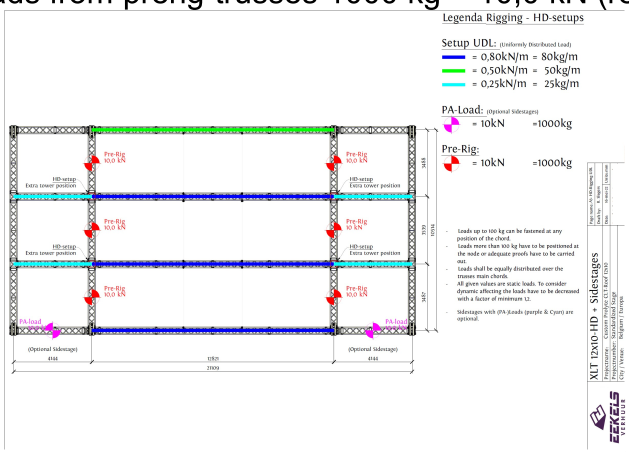
The internal design values are shown and proofs are carried out again where necessary due to higher utilization.

Load case 4: distributed load – HD-setup

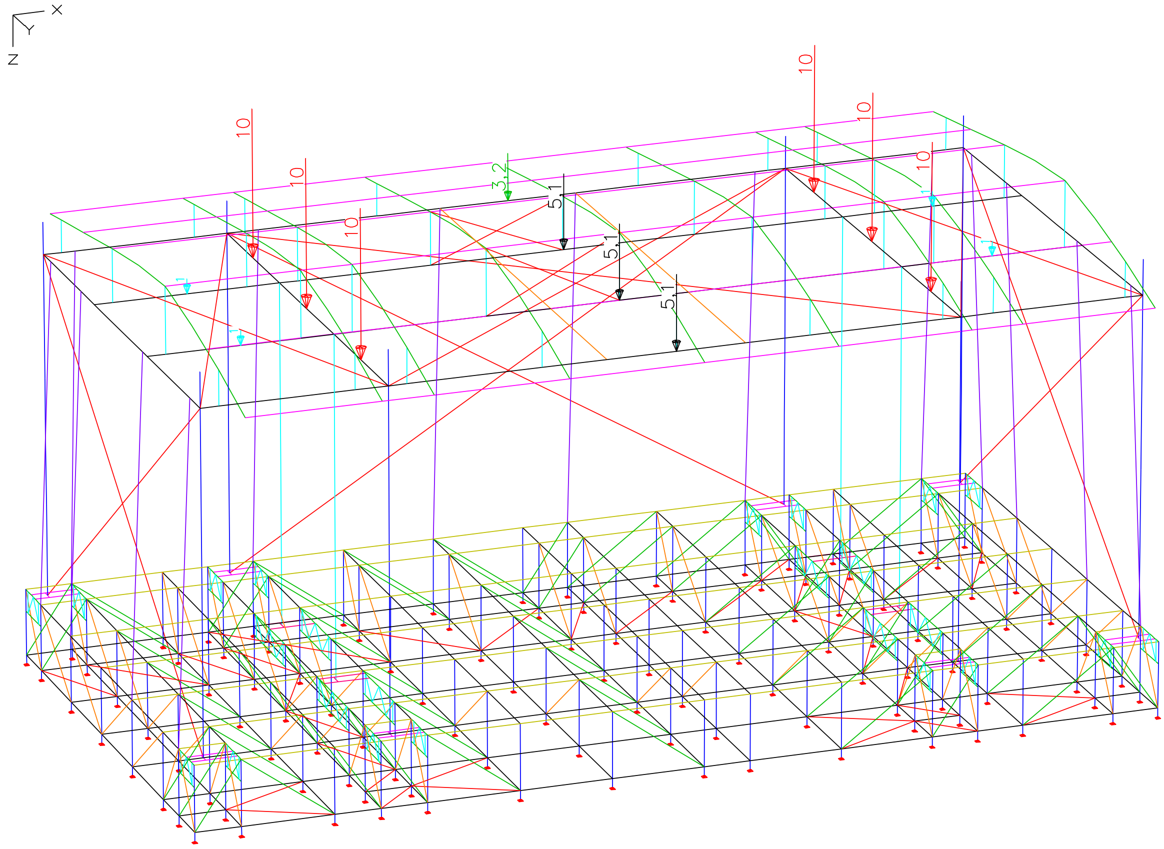


LC 4: Load, distributed payload – HD setup

0,80 kN/m = 80 kg/m (front, centre)
0,50 kN/m = 50 kg/m (back)
0,25 kN/m = 25 kg/m (centre wings)
single centre point loads from prerig-trusses 1000 kg = 10,0 kN (red)

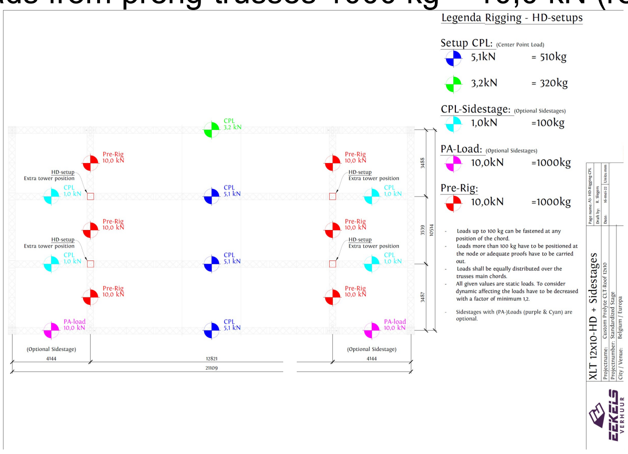


Load case 5: centre point load – HD-setup

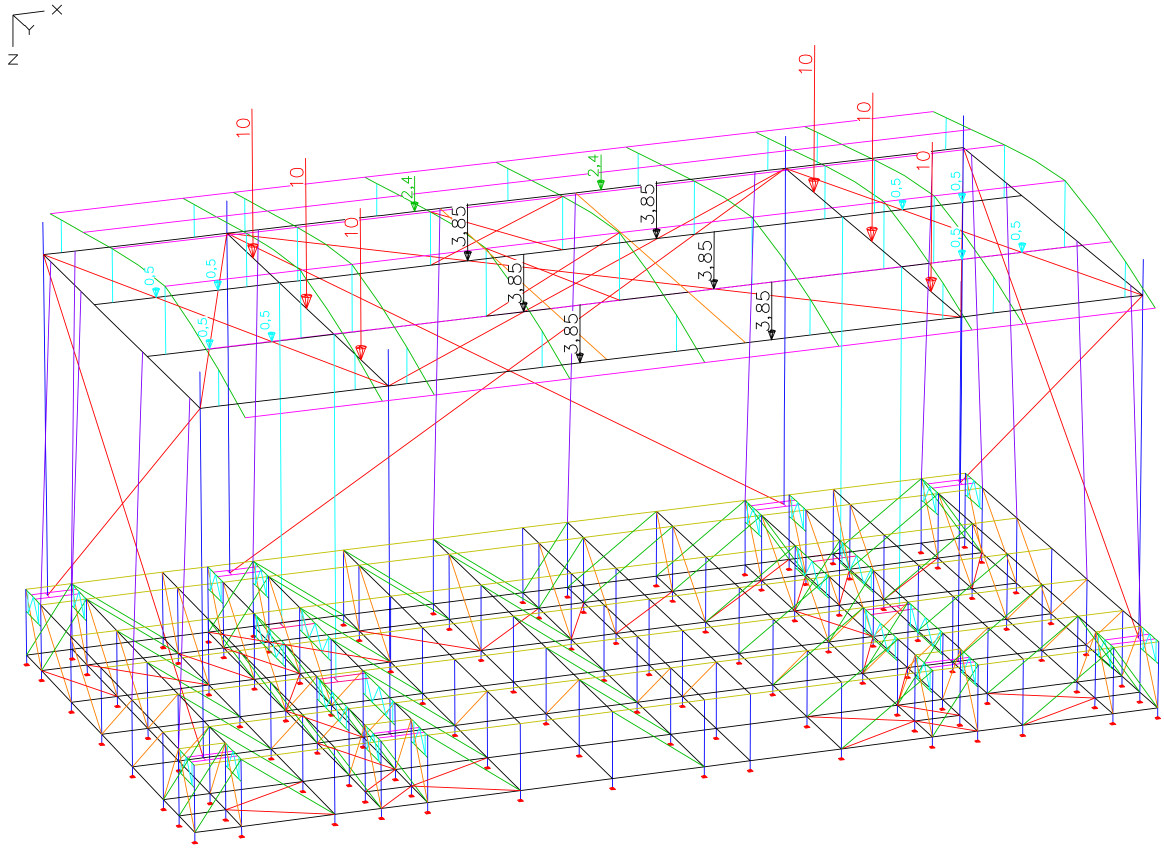


LC 5: Load, CPL payload – HD setup

5,10 kN = 510 kg
3,20 kN = 320 kg
1,00 kN = 100 kg
single centre point loads from prerig-trusses 1000 kg = 10,0 kN (red)

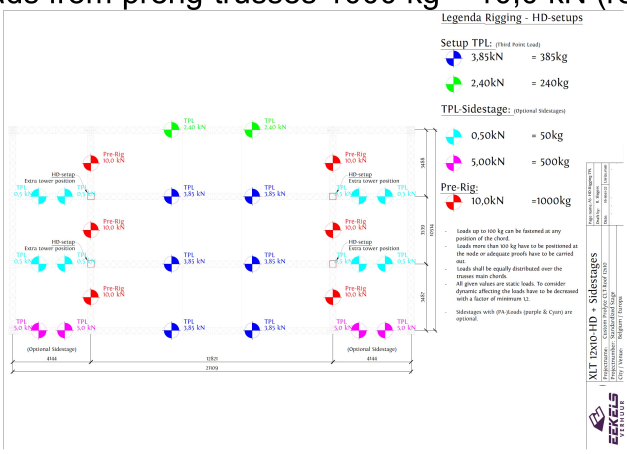


Load case 6: third point load – HD-setup

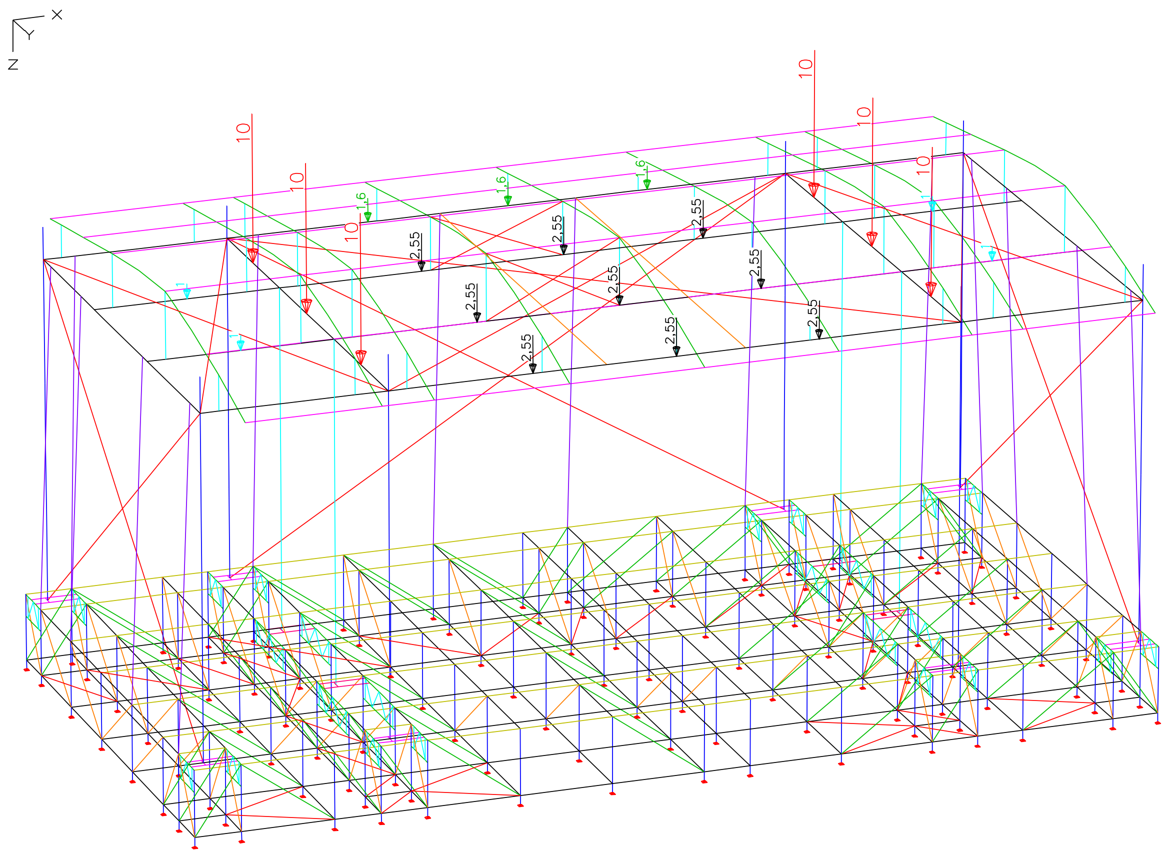


LC 6: Load, 3rdPL payload – HD setup

3,85 kN = 385 kg
2,40 kN = 240 kg
0,50 kN = 50 kg
single centre point loads from prerig-trusses 1000 kg = 10,0 kN (red)

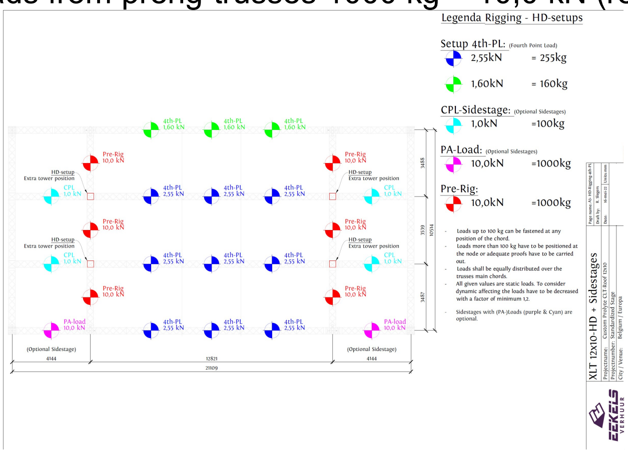


Load case 7: fourth point load – HD-setup

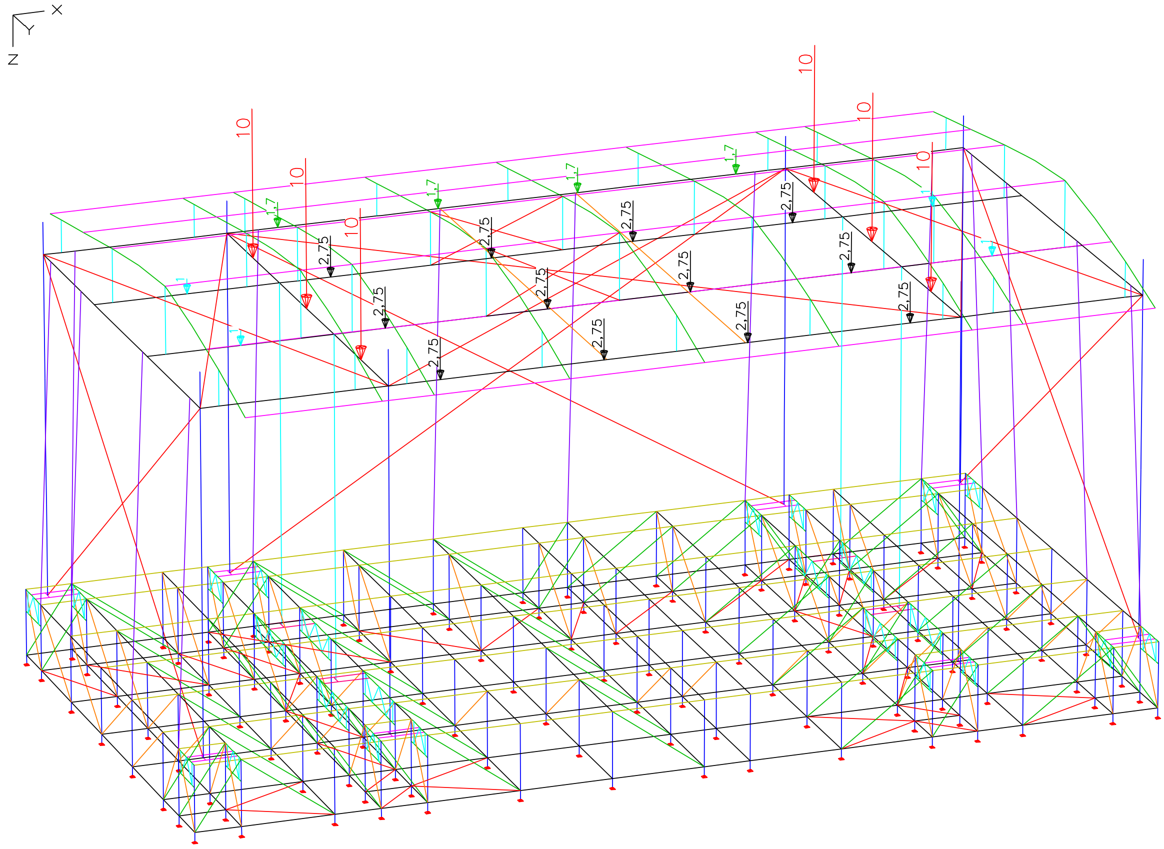


LC 7: Load, 4thPL payload – HD setup

2,55 kN = 255 kg
1,60 kN = 160 kg
1,0 kN = 100 kg
single centre point loads from prerig-trusses 1000 kg = 10,0 kN (red)

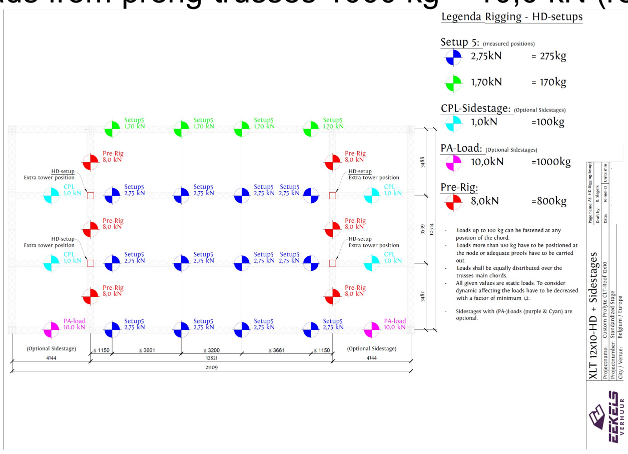


Load case 8: fifth point load – HD-setup

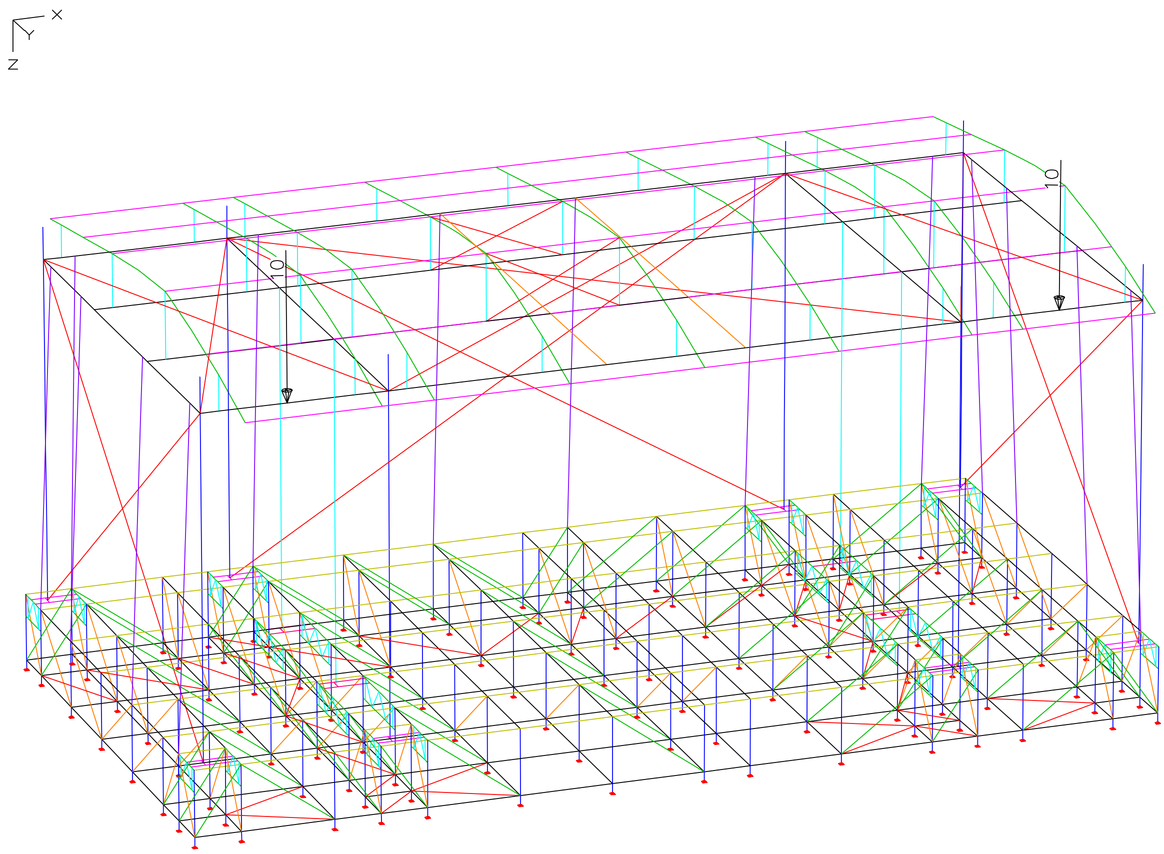


LC 8: Load, 5thPL payload – HD setup

2,75 kN = 275 kg
1,70 kN = 170 kg
1,00 kN = 100 kg
single centre point loads from prerig-trusses 1000 kg = 10,0 kN (red)



Load case 9: PA Load



LC 9: Load, PA load

10 kN = 1000 kg (can also be 2 x 500 kg with a distance)

CALCULATION

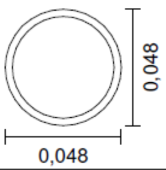
System characteristics

967	Nodes		
1735	Elements	1735	Beams
113	Supports	0	Slabs
0	Link elements	0	Plains
16	Material properties	0	Shells
16	Section properties	0	Cables
33	Load cases	0	Solids
10	LC Combinations	0	Spring elements
0	Tendon groups		

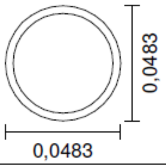
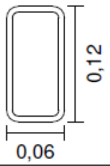
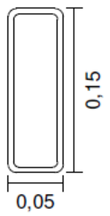
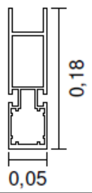
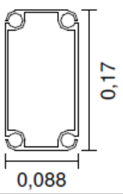
Result location in area elements: Node
5 Result locations in beam elements

Rotated element systems
0 Element systems
0 Internal force systems
0 Reinforcement systems

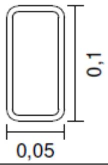
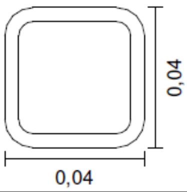
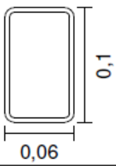
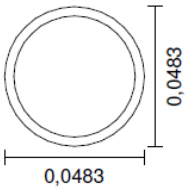
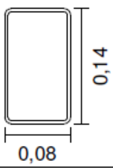
Section properties

1	Beam	H40V Area [m²] Moments of inertia [m4]	 A Ix Iz	 = 1,696e-03 = 1,000e-05 = 4,180e-05	 Iy Iyz	 = 4,180e-05 = 0,000e+00
2	Beam	H30V Area [m²] Moments of inertia [m4]	 A Ix Iz	 = 1,696e-03 = 1,000e-05 = 2,096e-05	 Iy Iyz	 = 2,096e-05 = 0,000e+00
3	Beam	H30D Area [m²] Moments of inertia [m4]	 A Ix Iz	 = 1,272e-03 = 1,000e-05 = 1,048e-05	 Iy Iyz	 = 1,057e-05 = 0,000e+00
4	Tension member	Seil Area [m²]	 A	 = 5,000e-05		
5	Polygon  	Rohr Centroid [m] Area [m²] Moments of inertia [m4] Main axis angle [Grad]	 ys A Ix Iy Iz Phi	 = -0,000 = 4,2140e-04 = 2,1272e-07 = 1,0645e-07 = 1,0645e-07 = 0,000	 zs I1 I2 Iyz	 = -0,000 = 1,0645e-07 = 1,0645e-07 = 0,0000e+00

Section properties

6	Library section 	RO 48,3 x 3,2 (MSH); Rohr 48,3x3,2 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 4,5300e-04 Moments of inertia [m4] Ix = 2,3200e-07 Iy = 1,1600e-07 I1 = 1,1600e-07 Iz = 1,1600e-07 I2 = 1,1600e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00
7	Library section 	RRO 120 x 60 x 6 (EN 10219-2); Traversenträger Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,9200e-03 Moments of inertia [m4] Ix = 2,8000e-06 Iy = 3,2800e-06 I1 = 3,2800e-06 Iz = 1,0900e-06 I2 = 1,0900e-06 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00
8	Polygon 	truss girder 1m 150x50x5mm Centroid [m] ys = 0,000 zs = -0,025 Area [m²] A = 1,8707e-03 Moments of inertia [m4] Ix = 2,3367e-06 Iy = 4,7437e-06 I1 = 4,7437e-06 Iz = 7,9555e-07 I2 = 7,9555e-07 Main axis angle [Grad] Phi = -0,000 Iyz = 0,0000e+00 Averaging of the lateral force shear stress over section width Specified cross-section class according to 1993-1-1: 3
9	Polygon 	Eventträger Centroid [m] ys = 0,025 zs = 0,091 Area [m²] A = 2,2534e-03 Moments of inertia [m4] Ix = 1,4467e-06 Iy = 6,5621e-06 I1 = 6,5621e-06 Iz = 8,8820e-07 I2 = 8,8820e-07 Main axis angle [Grad] Phi = -0,000 Iyz = 0,0000e+00 Averaging of the lateral force shear stress over section width
10	Beam	S40T Area [m²] A = 2,312e-03 Moments of inertia [m4] Ix = 6,500e-05 Iy = 5,699e-05 Iz = 3,500e-05 Iyz = 0,000e+00
11	Polygon 	Keder 170x88 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,9554e-03 Moments of inertia [m4] Ix = 4,2491e-06 Iy = 7,9022e-06 I1 = 7,9022e-06 Iz = 2,3673e-06 I2 = 2,3673e-06 Main axis angle [Grad] Phi = -0,016 Iyz = 1,5251e-09 Averaging of the lateral force shear stress over section width

Section properties

12	Library section 	RRO 100 x 50 x 5 (EN 10219-2); chord framework-girder 1m 100x50x5 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,3400e-03 Moments of inertia [m4] Ix = 1,3500e-06 Iy = 1,5800e-06 I1 = 1,5800e-06 Iz = 5,2500e-07 I2 = 5,2500e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00
13	Library section 	QRO 40 x 40 x 4 (EN 10219-2); diagonals framework-girder 1m 40x40x4 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 5,3500e-04 Moments of inertia [m4] Ix = 1,9440e-07 Iy = 1,1100e-07 I1 = 1,1100e-07 Iz = 1,1100e-07 I2 = 1,1100e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00 Averaging of the lateral force shear stress over section width
14	Library section 	RRO 100 x 60 x 4 (EN 10219-2); chord framework-girder 2m 100x60x4 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,1700e-03 Moments of inertia [m4] Ix = 1,5600e-06 Iy = 1,5300e-06 I1 = 1,5300e-06 Iz = 6,8700e-07 I2 = 6,8700e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00
15	Library section 	RO 48,3 x 3,2 (MSH); diagonals framework-girder 2m Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 4,5300e-04 Moments of inertia [m4] Ix = 2,3200e-07 Iy = 1,1600e-07 I1 = 1,1600e-07 Iz = 1,1600e-07 I2 = 1,1600e-07 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00 Averaging of the lateral force shear stress over section width
16	Library section 	RRO 140 x 80 x 4 (EN 10219-2); truss girder 2m 140x80x4 Centroid [m] ys = 0,000 zs = 0,000 Area [m²] A = 1,6500e-03 Moments of inertia [m4] Ix = 4,1200e-06 Iy = 4,3000e-06 I1 = 4,3000e-06 Iz = 1,8000e-06 I2 = 1,8000e-06 Main axis angle [Grad] Phi = 0,000 Iyz = 0,0000e+00

Material properties

	No.	Type	E-Modu. [MN/m²]	G-Modu. [MN/m²]	Poiss. ratio	alpha.t [1/K]	gamma [kN/m³]	Miscellaneous
1	1	Frei	70000	27000	0,20	1,00e-05	0,000	
2	2	Frei	70000	27000	0,20	1,00e-05	0,000	
3	3	Frei	70000	27000	0,20	1,00e-05	0,000	
4	4	S235	210000	81000	0,30	1,20e-05	78,500	

Material properties

	No.	Type	E-Modu. [MN/m²]	G-Modu. [MN/m²]	Poiss. ratio	alpha.t [1/K]	gamma [kN/m³]	Miscellaneous
5	5	Frei	70000	27000	0,20	1,00e-05	27,000	fc = 1e+06 [MN/m²] ft = 1e+06
6	6	S235-EN	210000	81000	0,30	1,20e-05	78,500	
7	7	S235-EN	210000	81000	0,30	1,20e-05	78,500	
8	8	S355-EN	210000	81000	0,30	1,20e-05	78,500	
9	9	Frei	70000	27000	0,30	1,20e-05	27,000	fc = 235 [MN/m²] ft = 235
10	10	Frei	70000	27000	0,20	1,00e-05	0,000	
11	11	Frei	70000	27000	0,30	1,00e-05	27,000	fc = 1e+06 [MN/m²] ft = 1e+06
12	12	S355-EN	210000	81000	0,30	1,20e-05	78,500	
13	13	S235-EN	210000	81000	0,30	1,20e-05	78,500	
14	14	S235-EN	210000	81000	0,30	1,20e-05	78,500	
15	15	S235-EN	210000	81000	0,30	1,20e-05	78,500	
16	16	S355-EN	210000	81000	0,30	1,20e-05	78,500	

List of load cases

LC.	Label
1	dead weight
2	ballast
3	live load podium
4	distributed payload - HD setup
5	CPL payload - HD setup
6	3rdPL payload - HD setup
7	4thPL payload - HD setup
8	5thPL payload - HD setup
9	PA load
10	wind load - roof area
11	membrane tension - roof
12	wind - rear wall
13	membrane tension - rear wall
14	wind - left side
15	membrane tension - left side
16	wind - right side
17	membrane tension - right side
18	wind on podium top
20	wind trusses y-direction
21	wind trusses x-direction
100	g+p
101	wind ß = 0° +g
102	wind ß = 90° +g
103	wind ß = 180° +g
201	wind ß = 0° +g+p

LC.	Label
202	wind ß = 90° +g+p
203	wind ß = 180° +g+p
301	wind ß = 0° only roof +g
302	wind ß = 90° only roof +g
303	wind ß = 180° only roof +g
401	wind ß = 0° only roof +g+p
402	wind ß = 90° only roof +g+p
403	wind ß = 180° only roof +g+p

Load case combination 81

1. Variable exclusive action		Factor
100	g+p	1,000
101	wind ß = 0° +g	1,000
102	wind ß = 90° +g	1,000
103	wind ß = 180° +g	1,000

Load case combination 82

1. Variable exclusive action		Factor
201	wind ß = 0° +g+p	1,000
202	wind ß = 90° +g+p	1,000
203	wind ß = 180° +g+p	1,000

Load case combination 83

1. Variable exclusive action		Factor
301	wind ß = 0° only roof +g	1,000
302	wind ß = 90° only roof +g	1,000
303	wind ß = 180° only roof +g	1,000

Load case combination 84

1. Variable exclusive action		Factor
401	wind ß = 0° only roof +g+p	1,000
402	wind ß = 90° only roof +g+p	1,000
403	wind ß = 180° only roof +g+p	1,000

Load case combination 85

1. Variable exclusive action		Factor
K81	[Unnamed]	1,000
K82	[Unnamed]	1,000
K83	[Unnamed]	1,000

Load case combination 85

1. Variable exclusive action		Factor
K84	[Unnamed]	1,000

Load case combination 91

1. Variable exclusive action		Factor
100	g+p	1,350
101	wind ß = 0° +g	1,350
102	wind ß = 90° +g	1,350
103	wind ß = 180° +g	1,350

Load case combination 92

1. Variable exclusive action		Factor
201	wind ß = 0° +g+p	1,350
202	wind ß = 90° +g+p	1,350
203	wind ß = 180° +g+p	1,350

Load case combination 93

1. Variable exclusive action		Factor
301	wind ß = 0° only roof +g	1,350
302	wind ß = 90° only roof +g	1,350
303	wind ß = 180° only roof +g	1,350

Load case combination 94

1. Variable exclusive action		Factor
401	wind ß = 0° only roof +g+p	1,350
402	wind ß = 90° only roof +g+p	1,350
403	wind ß = 180° only roof +g+p	1,350

Load case combination 95

1. Variable exclusive action		Factor
K91	[Unnamed]	1,000
K92	[Unnamed]	1,000
K93	[Unnamed]	1,000
K94	[Unnamed]	1,000

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	dead weight	0,000	0,000	135,601
	Support reactions	-0,000	-0,000	135,601
2	ballast	-0,000	0,000	210,000
	Support reactions	-0,000	-0,000	210,002
3	live load podium	0,000	0,000	1239,657
	Support reactions	0,000	-0,000	1239,657
4	distributed payload - HD setup	0,000	0,000	101,325
	Support reactions	0,000	-0,000	101,325
5	CPL payload - HD setup	0,000	0,000	82,500
	Support reactions	-0,000	-0,000	82,500
6	3rdPL payload - HD setup	0,000	0,000	91,900
	Support reactions	0,000	-0,000	91,900
7	4thPL payload - HD setup	0,000	0,000	91,750
	Support reactions	0,000	-0,000	91,750
8	5thPL payload - HD setup	0,000	0,000	103,800
	Support reactions	0,000	-0,000	103,800
9	PA load	0,000	0,000	20,000
	Support reactions	0,000	-0,000	20,001
11	membrane tension - roof	0,000	0,000	0,000
	Support reactions	0,000	-0,000	0,001
13	membrane tension - rear wall	0,000	-0,000	-0,000
	Support reactions	-0,000	-0,000	0,000
15	membrane tension - left side	0,000	-0,000	0,000
	Support reactions	-0,000	0,000	0,000
17	membrane tension - right side	0,000	0,000	0,000
	Support reactions	0,000	0,000	0,006
18	wind on podium top	0,000	0,000	49,586
	Support reactions	0,000	-0,000	49,586
100	g+p	-0,000	0,000	1706,583
	Support reactions	0,000	0,000	1706,583
101	wind ß = 0° +g	-0,041	-51,852	268,934
	Support reactions	-0,041	-51,852	268,934
102	wind ß = 90° +g	31,847	-8,201	313,351
	Support reactions	31,847	-8,201	313,351
103	wind ß = 180° +g	-0,005	54,760	315,766

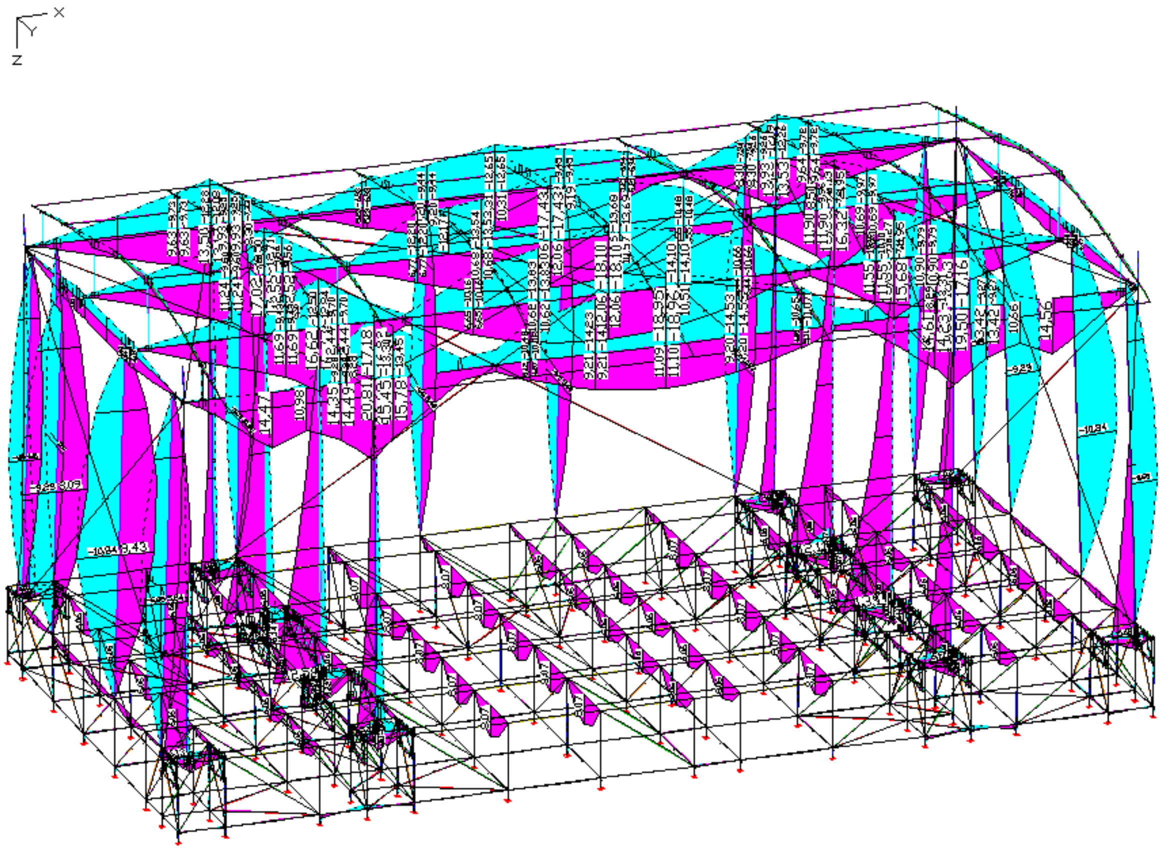
Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
	Support reactions	-0,005	54,760	316,000
201	wind ß = 0° +g+p	-0,041	-51,852	1629,916
	Support reactions	-0,041	-51,852	1629,916
202	wind ß = 90° +g+p	31,847	-8,201	1674,333
	Support reactions	31,847	-8,201	1674,333
203	wind ß = 180° +g+p	-0,005	54,760	1676,748
	Support reactions	-0,005	54,760	1676,881
301	wind ß = 0° only roof +g	-0,000	-58,532	246,280
	Support reactions	0,000	-58,532	246,483
302	wind ß = 90° only roof +g	43,355	2,423	246,539
	Support reactions	43,355	2,423	246,539
303	wind ß = 180° only roof +g	0,000	63,379	246,797
	Support reactions	-0,000	63,379	247,197
401	wind ß = 0° only roof +g+p	-0,000	-58,532	1587,262
	Support reactions	0,000	-58,532	1587,262
402	wind ß = 90° only roof +g+p	43,355	2,423	1587,521
	Support reactions	43,355	2,423	1587,521
403	wind ß = 180° only roof +g+p	0,000	63,379	1587,779
	Support reactions	0,000	63,379	1587,779

design internal forces

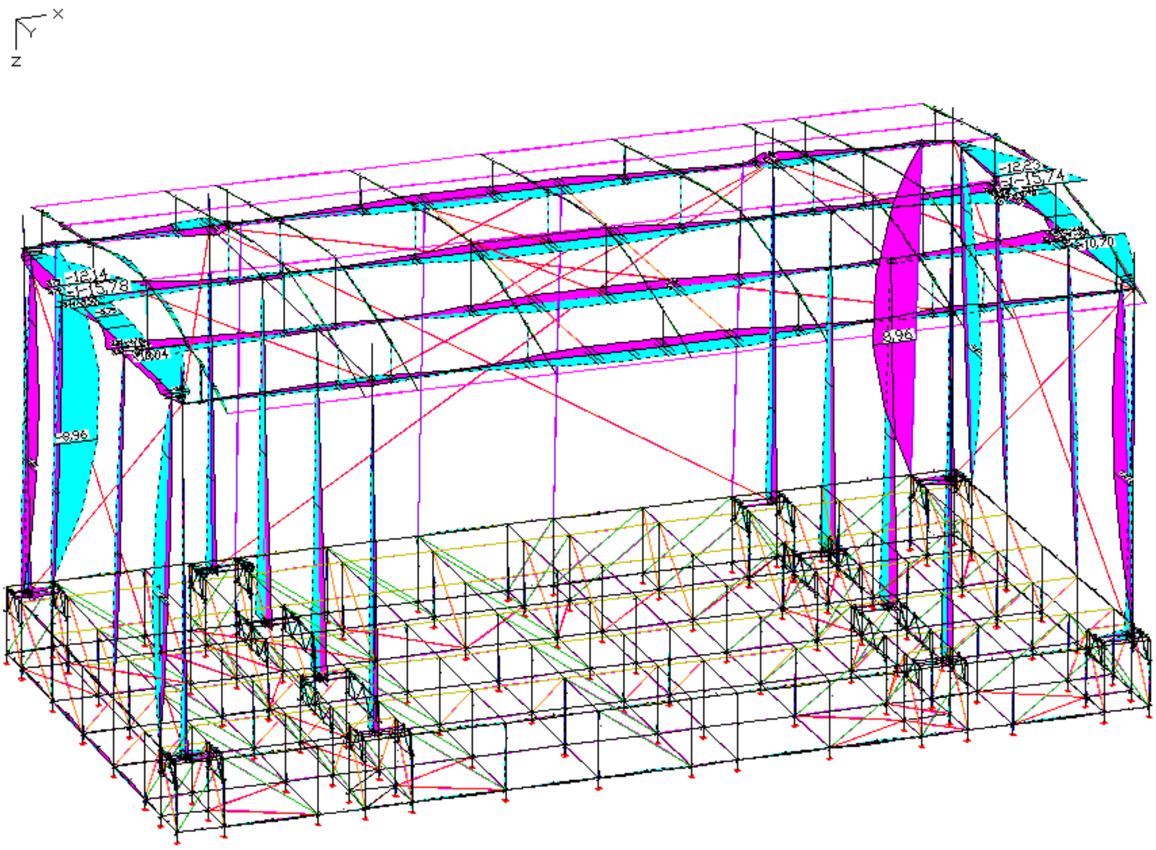
load case combination 95:

$M_{y,Ed}$



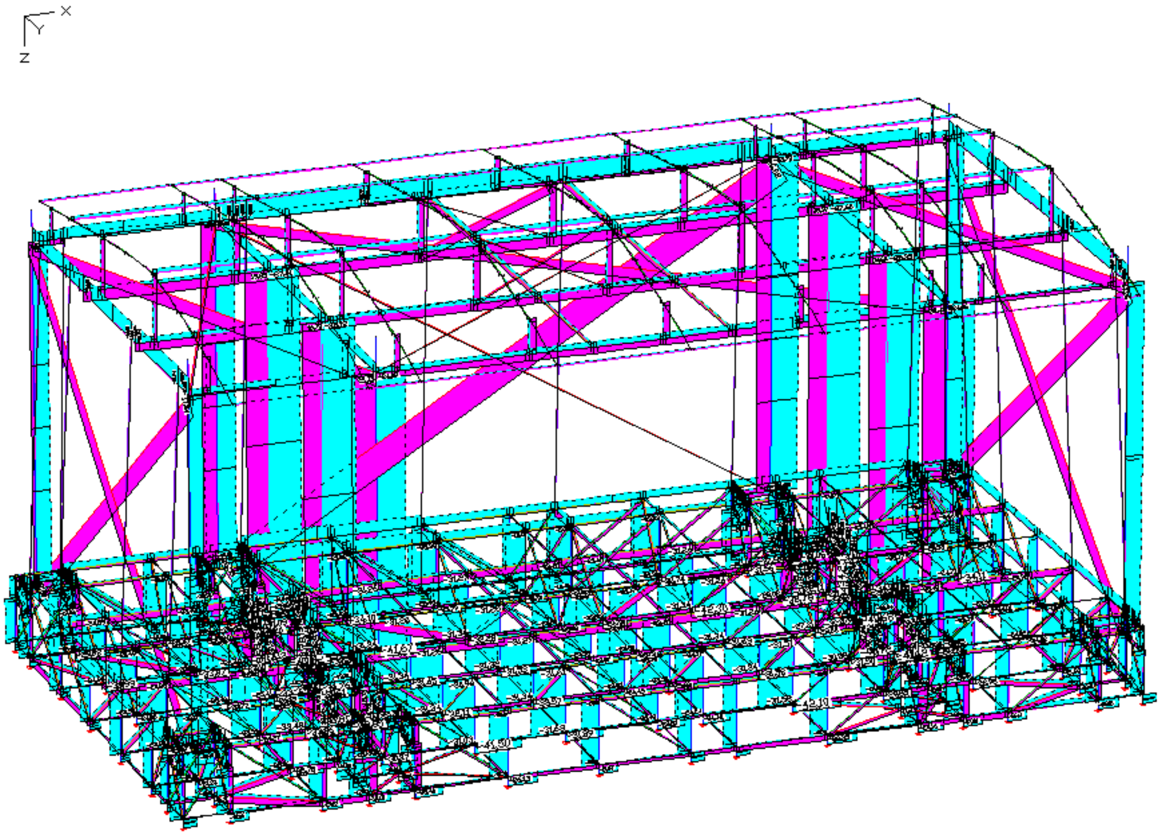
LCC 95: Internal forces min,max My [kNm]
Value range (overall system, min/max): -18,96/20,81 [kNm]

$M_{z,Ed}$



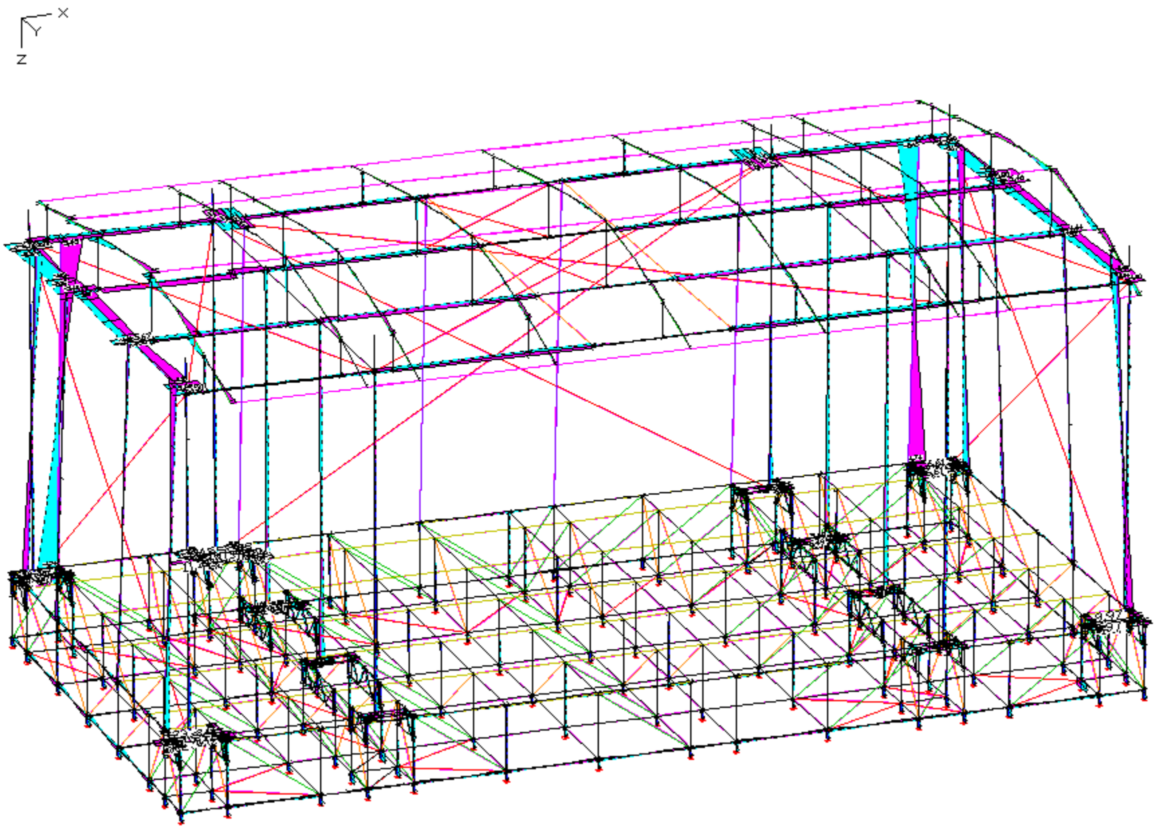
LCC 95: Internal forces min,max Mz [kNm]
Value range (overall system, min/max): -15,78/9,15 [kNm]

N_{Ed}



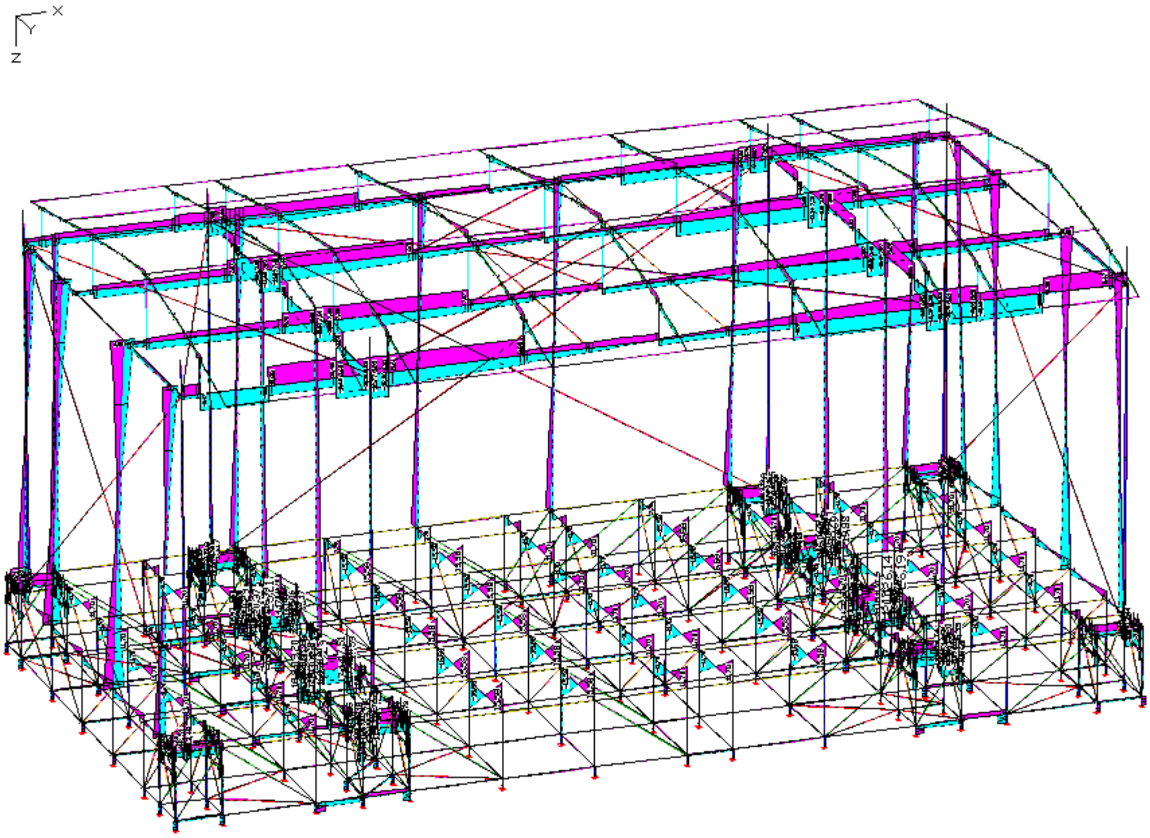
LCC 95: Internal forces min,max Nx [kN]
Value range (overall system, min/max): -42,62/34,25 [kN]

$V_{y,Ed}$



LCC 95: Internal forces min,max Qy [kN]
Value range (overall system, min/max): -12,08/11,45 [kN]

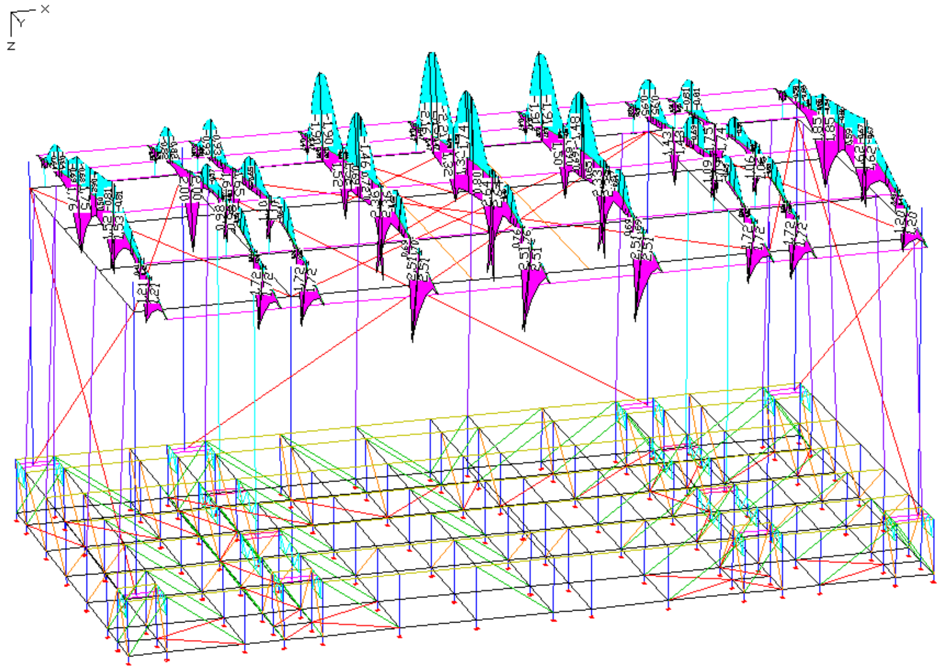
$V_{z,Ed}$



LCC 95: Internal forces min,max Qz [kN]
Value range (overall system, min/max): -18,21/26,19 [kN]

PROOFS

6.1 RAFTER - H30D

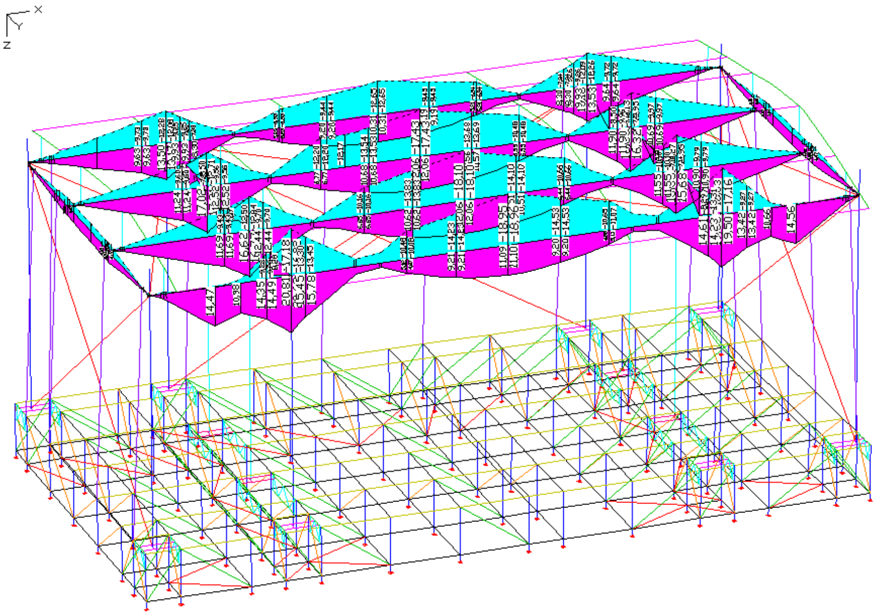


LCC 95: Selected Internal forces min,max My [kNm]
Value range (subsystem, min/max): -2,21/2,64 [kNm]

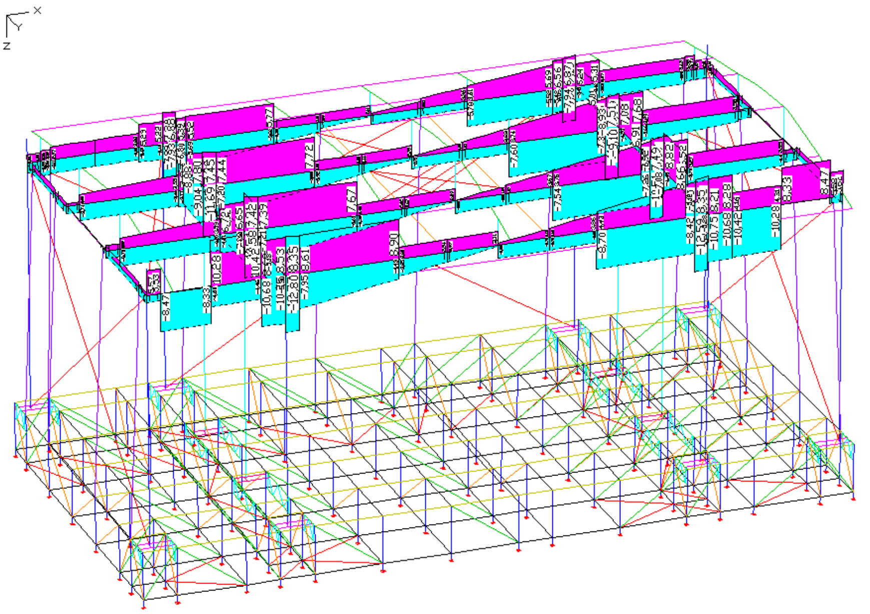
The internal forces are smaller than in the basic version of the roof.

The proofs are sufficiently done in chapter 5.

6.2 ROOF GIRDER H40V



LCC 95: Selected Internal forces min,max My [kNm]
Value range (overall system, min/max): -18,96/20,81 [kNm]



LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): -12,80/10,42 [kN]

The internal forces are smaller than in the basic version of the roof.

The proofs are sufficiently done in chapter 5.

6.3 BOXCORNER H40V

The internal forces are smaller than in the basic version of the roof.

The proofs are sufficiently done in chapter 5.

6.4 SLEEVE BLOCK (HT)

The internal forces are smaller than in the basic version of the roof.

The proofs are sufficiently done in chapter 5.

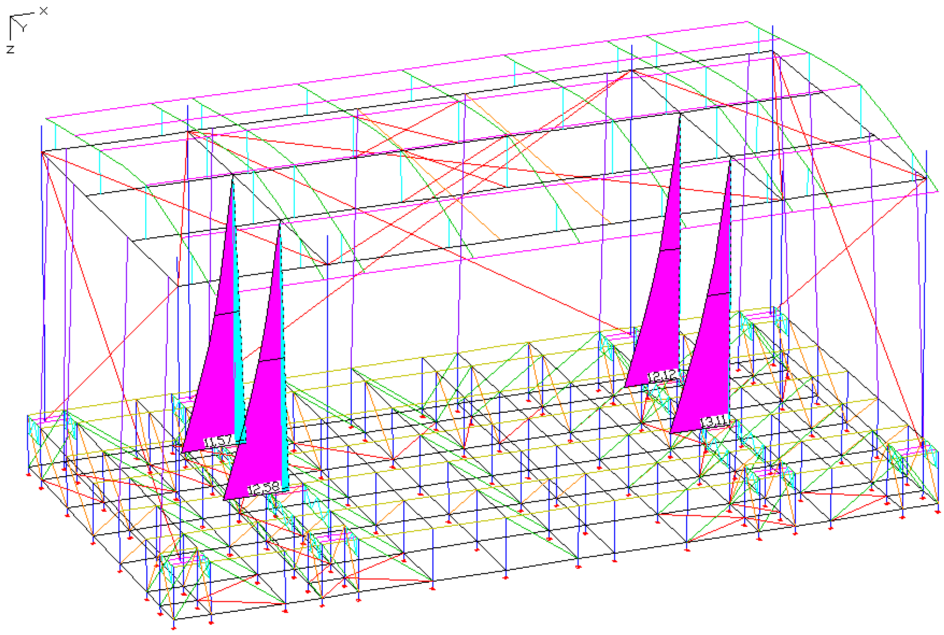
6.5 COLUMNS

H30V:

The internal forces are smaller than in the basic version of the roof.

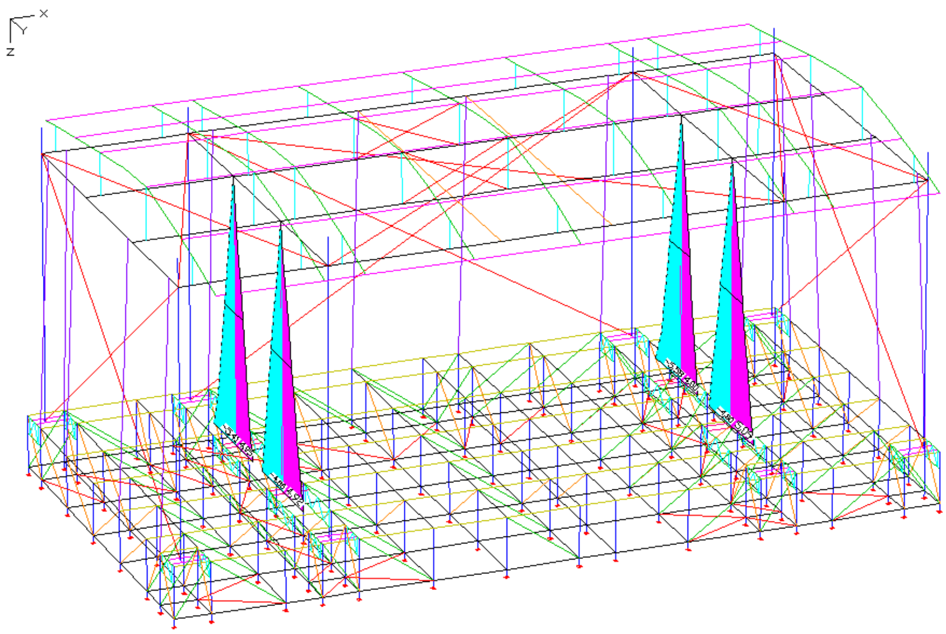
The proofs are sufficiently done in chapter 5.

S40T:

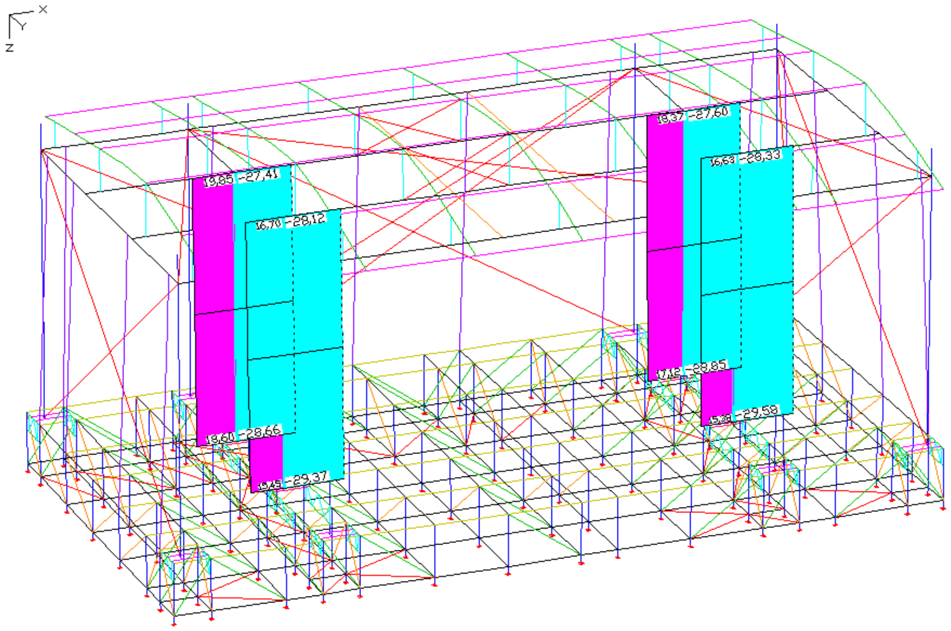


LCC 95: Selected Internal forces min,max My [kNm]
Value range (subsystem, min/max): -2,30/13,11 [kNm]

(could have also been calculated as pendulum rod)



LCC 95: Selected Internal forces min,max Mz [kNm]
Value range (subsystem, min/max): -5,58/5,09 [kNm]



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -29,58/19,85 [kN]

chord:

$N_{Ed,chord}$ = (13,11+0,81)/ (2x0,339) + 11,85/ 4 = 23,49 kN < 53,70 kN

proof against buckling:

Geometrie			Traverse		
Stützenlänge	L [m]	7	Trägheitsradius	i [cm]	12,3
Knicklängenbeiwert	β	1			

Materialeigenschaften			Belastung	
nach Tabelle 3.2b	f_o	250	N_{Ed} [kN]	11,85
	f_u	290	$M_{y,Ed}$ [kNm]	13,11
	$\rho_{u,haz}$	0,64	$M_{z,Ed}$ [kNm]	0,81
	BC	A		

In Anlehnung an DIN 1999-1-1, Kapitel 6.3.3.4 erfolgt der Nachweis an der Stelle des Querschnitts mit der kleinsten Tragfähigkeit:

Belastbarkeit aus Traversenberechnung:

N_{Rd} = 214,8 kN
$M_{y,Rd}$ = 36,41 kNm
$M_{z,Rd}$ = 36,41 kNm

Nachweis Biegeknicken

L_{cr} 1 x 7 = 7 m
α 0,20 $\bar{\lambda}_0$ 0,10

Die Gurtrohre sind alle der Querschnittsklasse 3, oder besser, zuzuordnen, somit gilt: $A_{eff} = A$

$$\bar{\lambda} = \frac{L_{cr}}{i} \times \frac{1}{\pi} \times \sqrt{\frac{A_{eff}}{A} \times \frac{f_o}{E}} = \frac{L_{cr}}{i \times \pi} \times \sqrt{\frac{f_o}{E}}$$

$\bar{\lambda}$ = 7 / (0,123 x π) x √(250 / 70000) = 1,083

$$\phi = 0,5 \times (1 + \alpha \times (\bar{\lambda} - \bar{\lambda}_2) + \bar{\lambda}^2)$$

ϕ = 0,5 x (1 + 0,2 x (1,083 - 0,1) x 1,083²) = 1,185

$$\chi = \frac{1}{\phi + \sqrt{\phi^2 - \lambda^2}}$$

χ = 1 / (1,185 + √(1,185² - 1,083²) = 0,6

ω_0 ist bereits in der Traversenberechnung berücksichtigt und wird deshalb zu 1 gesetzt.

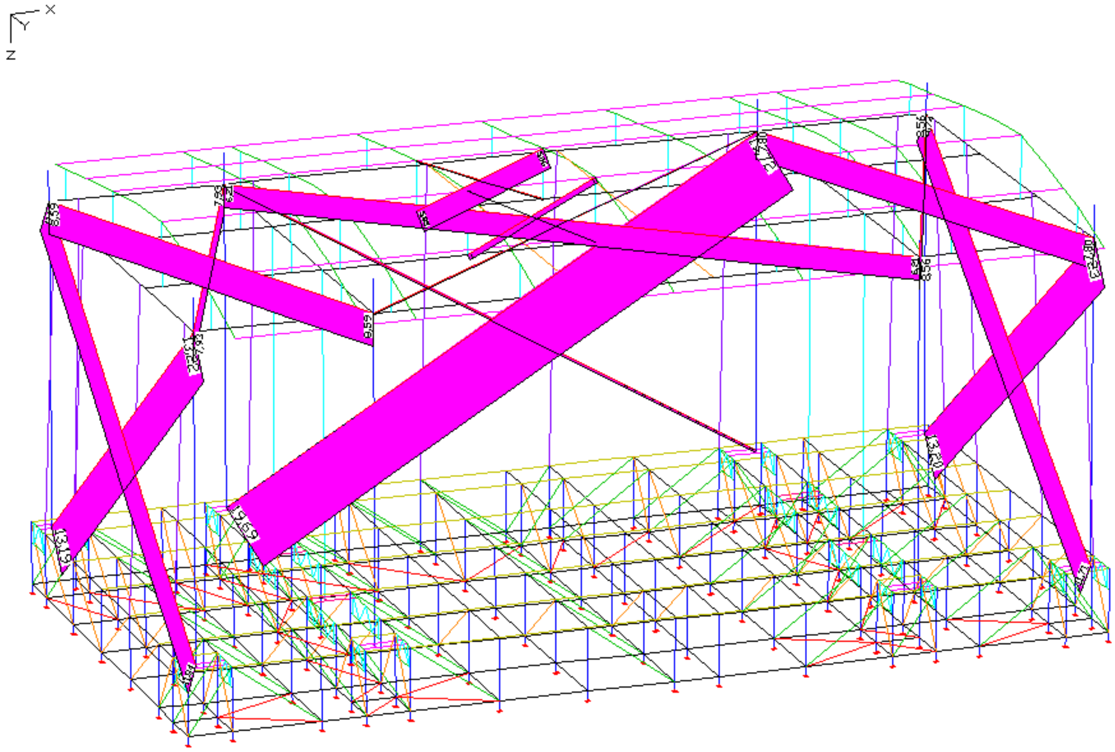
$$\left(\frac{N_{Ed}}{\chi_{min} \times N_{Rd}}\right)^{\psi_c} + \left[\left(\frac{M_{y,Ed}}{M_{y,Rd}}\right)^{1,7} + \left(\frac{M_{z,Ed}}{M_{z,Rd}}\right)^{1,7}\right]^{0,6} \leqslant 1$$

mit ψ_c = 0,8:

(11,85 / (0,6 x 214,8))^0,8 + [(13,11 / 36,41)^1,7 + (0,81 / 36,41)^1,7]^0,6 = 0,503 < 1

6.6 GUY WIRES

LCC85



LCC 85: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -0,01/19,72 [kN]

The internal forces are smaller than in the basic version of the roof.

The proofs are sufficiently done in chapter 5.

6.7 COMPRESSION STRUTS

The internal forces are smaller than in the basic version of the roof.

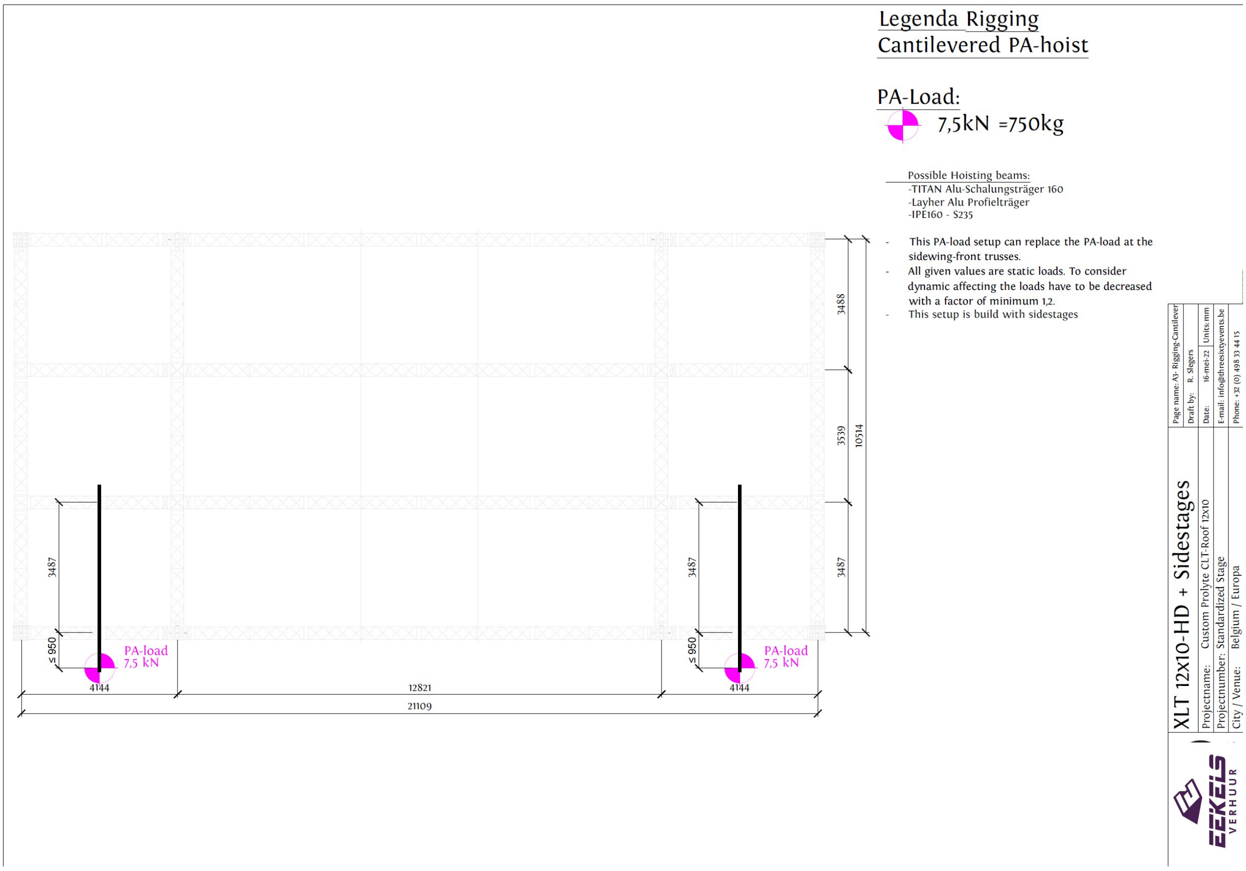
The proofs are sufficiently done in chapter 5.

6.8 KEDER PROFILES 170x88x3mm

The internal forces are smaller or the same than in the basic version of the roof.

The proofs are sufficiently done in chapter 5.

7 CANTILEVERED PA-LOAD



Calculation made by hand, dead weight of beam neglected.

bending of IPE 160 beam (steel S235 JR):

$M_{y,Ed}$ = 1,35 x 7,50 x 0,95 = 9,62 kNm
$W_{y,el}$ = 109 cm³
σ_{Ed} = 9,62 x 10³/ 109 = 88,25 N/mm² < 235 N/mm²

front support:
A = 7,50 x (0,95+3,48)/ 3,48 = 9,54 kN < 10,0 kN (PA-Load from LC9)

rear support:
B = 9,54- 7,5 = 2,04 kN (lifting force)

The rear support must be constructively secured for lifting forces approx. F = 2,50 kN.
Other beam types are possible but must be proven separately.

8 LAYHER PODIUM

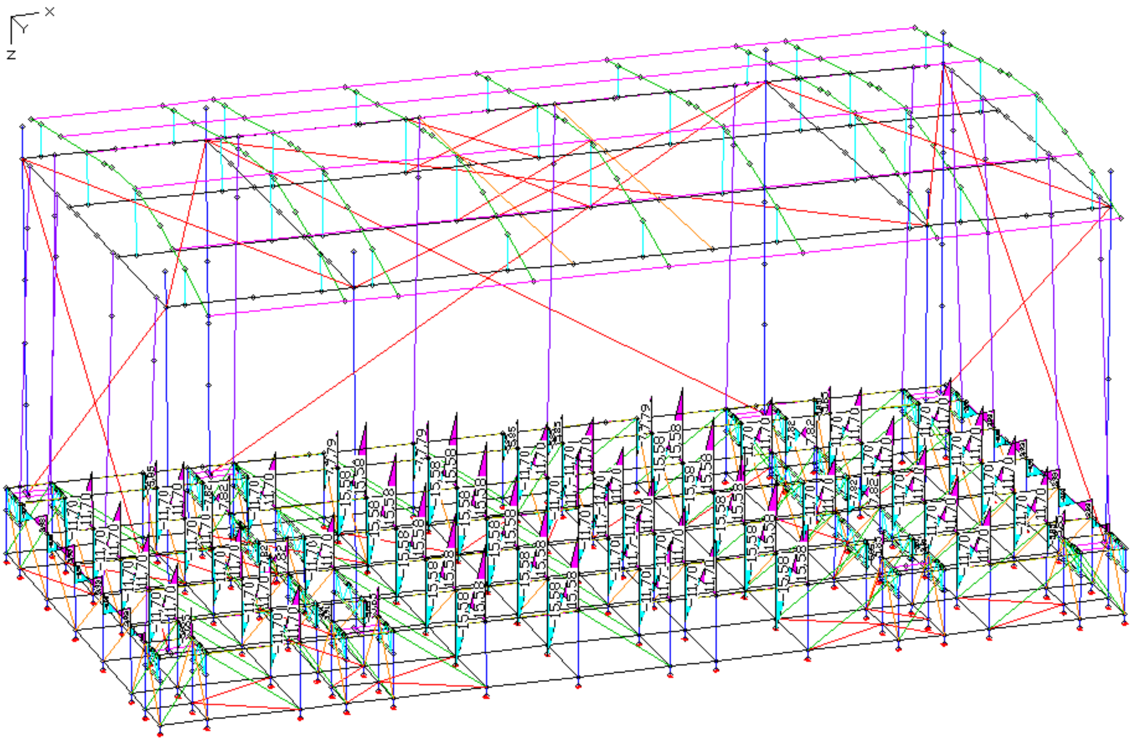
The platform flooring and the platform girder consist of Layher system components. The components must be designed for a payload of 350 kg/m² or 500 kg/m² with an own structural analysis.

vertical loads: wind + payload V

horizontal loads: wind + V/10

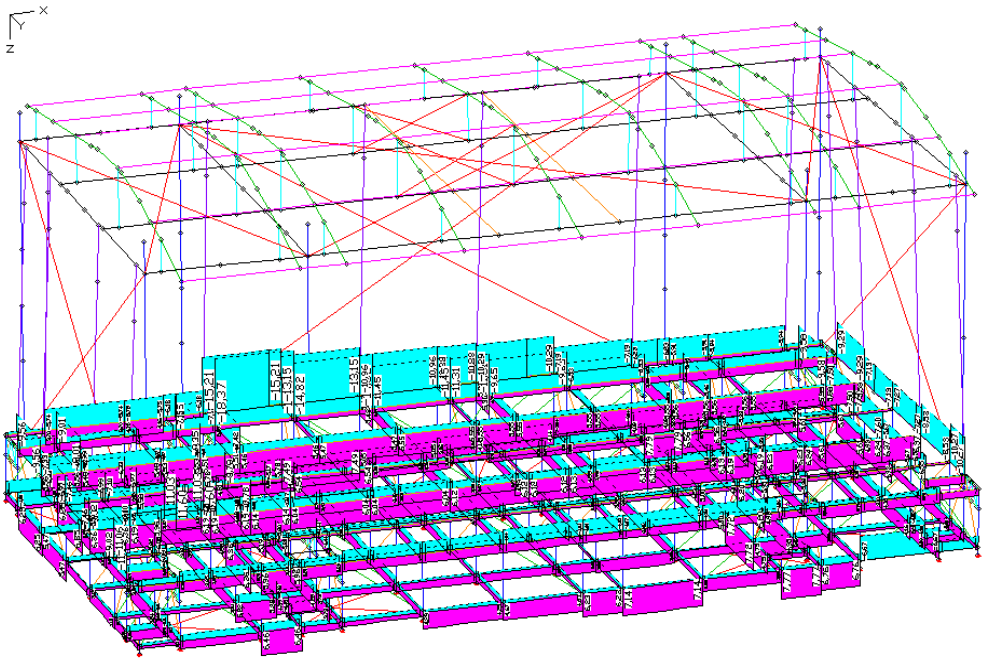
In the following a Layher-Podium with a system height of 1,5m is calculated.
A comparative calculation of a 1,0m system height podium is carried out and all proofs are fulfilled as well.

Ledgers



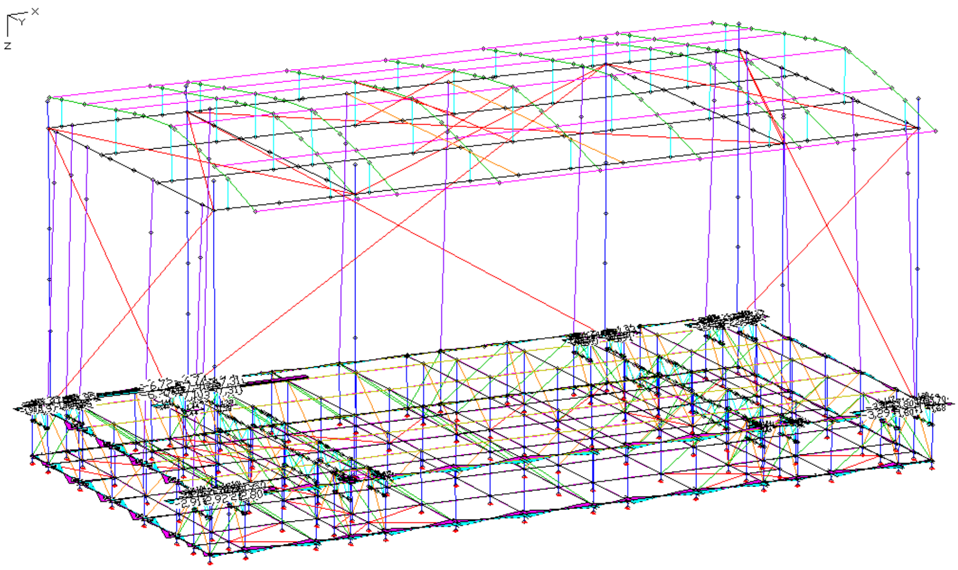
LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): -15,58/15,58 [kN]

< 26,4 kN = $V_{z,Rd}$



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -18,37/11,60 [kN]

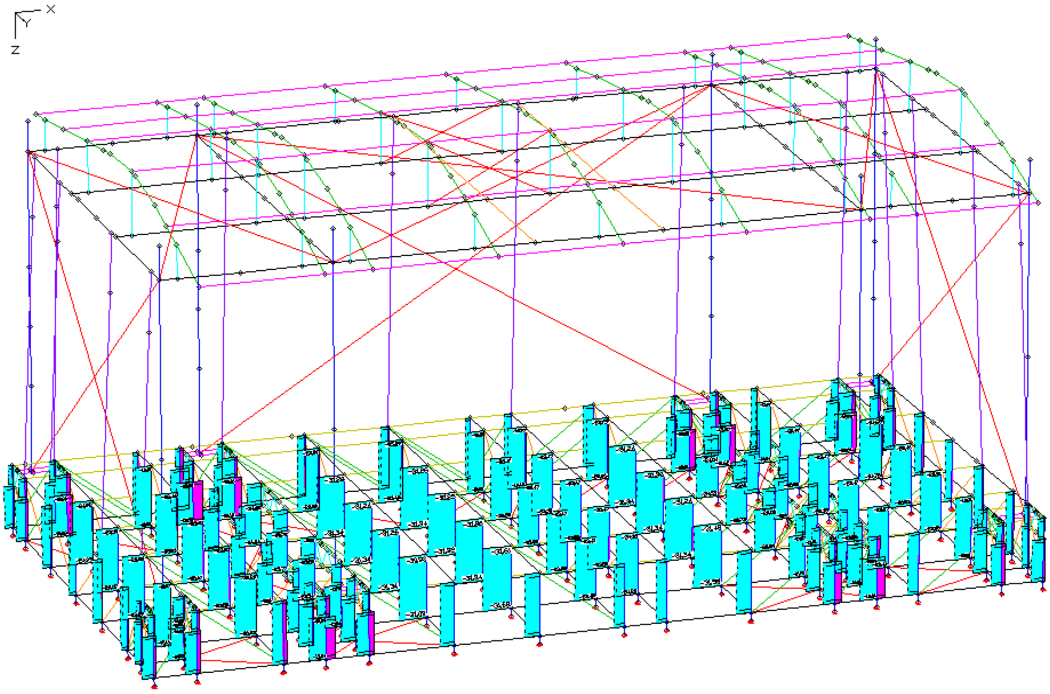
< 31,0 kN = N_{rd}



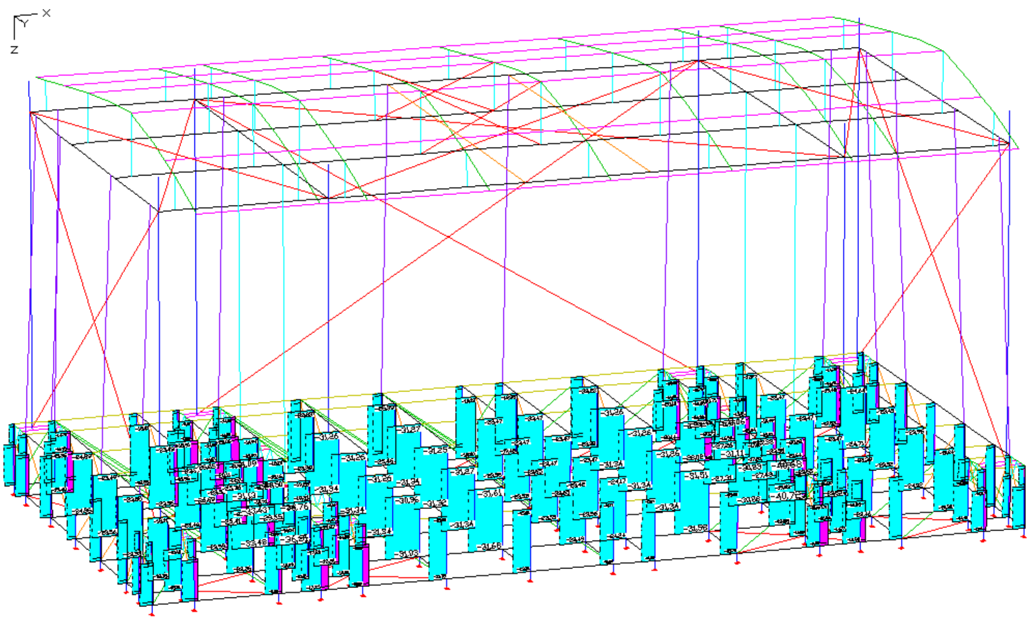
LCC 95: Selected Internal forces min,max Qy [kN]
Value range (subsystem, min/max): -6,74/7,31 [kN]

< 10,0 kN = $V_{y,Rd}$

Columns



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -31,68/10,68 [kN]



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -40,72/9,35 [kN]

column: Ø48,3x3,2 mm S235 JRH, R_h = 320 N/mm²
(A = 4,53 cm², W_{el} = 4,80 cm³, i = 1,6 cm)

length 1,5 m
buckling length: 0,9 x 1,50 = 1,35m

$\lambda = 135/ 1,6 = 84,4$

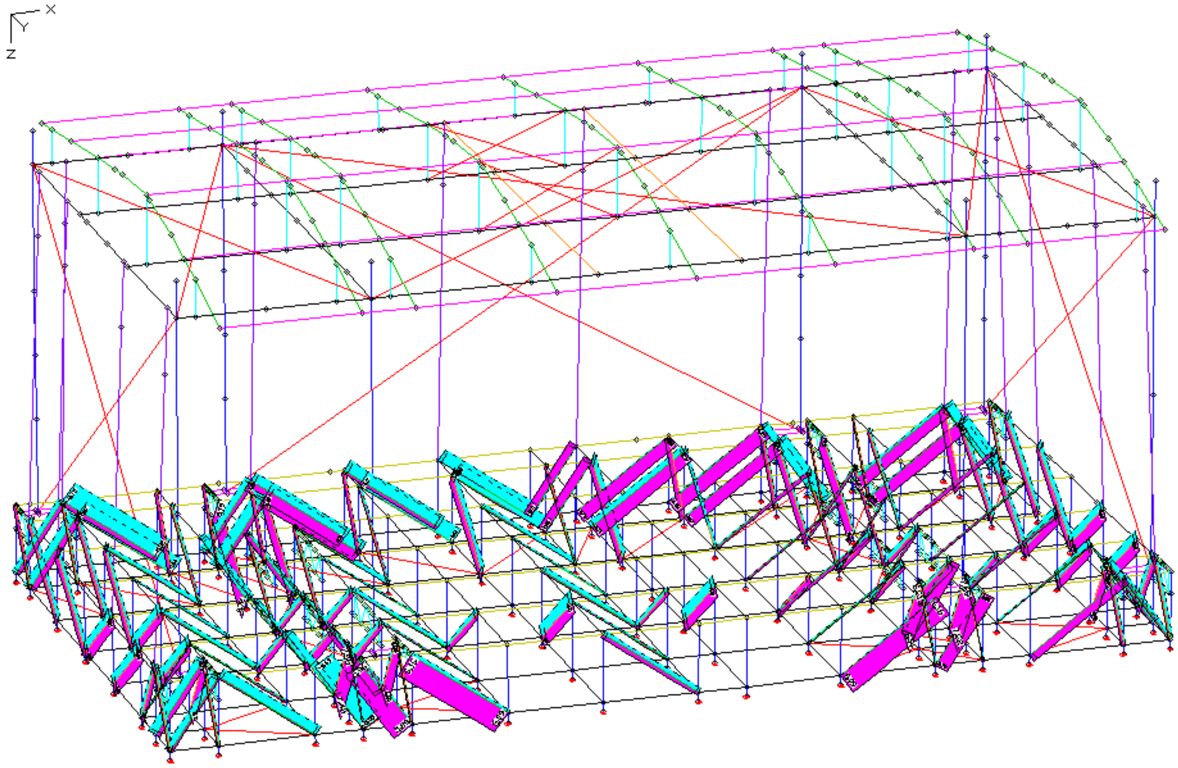
$\lambda_1 = 93,9 \times (235/320)^{1/2} = 80,5$

$\bar{\lambda} = 84,4/ 80,5 = 1,048$

buckling curve c: $\chi = 0,52$

$N_{Rd} = 4,53 \times 32/1,1 \times 0,52 = 68,53$ kN > 31,68 kN

Diagonal braces vertical:



LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -5,82/8,79 [kN]

additional force due to stabilisation load V/10:

V/ 10 = 1,35 x 5,0 x 2,072 x 11,39/ 10 = 15,93 kN

D = 15,93 / cos 36,9° / 2 = 9,96 kN

maximum system length:2,072 m height: 1,5 m

N_{Rd} = -15,5 kN (pressure), N_{Rd} = +27,3 kN (tension)

N_{Ed} = (-3,69) + (-9,96) = -13,65 kN < -15,5 kN

N_{Ed} = 18,75 kN < 27,3 kN

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Tabelle 7: Beanspruchbarkeiten der Vertikaldiagonalen

<table>
<tr><th rowspan="5">H [mm]</th><th rowspan="5">L [mm]</th><th colspan="12">Anschlusskopf</th></tr>
<tr><th colspan="3">„K2000+“</th><th colspan="3">„Variante II“</th><th colspan="3">„Variante IB“</th><th colspan="3">„Variante IC“</th></tr>
<tr><th colspan="12">Lochscheibe</th></tr>
<tr><th>„K2000+“</th><th>„Variante II“</th><th>„Variante I“</th><th>„K2000+“</th><th>„Variante II“</th><th>„Variante I“</th><th>„K2000+“</th><th>„Variante II“</th><th>„Variante I“</th><th>„K2000+“</th><th>„Variante II“</th><th>„Variante I“</th></tr>
<tr><th colspan="12">Zug-Normalkraft $N^{(+)}_{V,Rd}$ [kN]</th></tr>
<tr><td rowspan="6">500</td><td>732</td><td>26,2</td><td rowspan="6">13,5</td><td rowspan="6">6,6</td><td colspan="9" rowspan="2">---</td></tr>
<tr><td>1088</td><td>25,8</td></tr>
<tr><td>1572</td><td>24,1</td><td>8,4</td><td>8,4</td><td>6,6</td><td>7,8</td><td>7,8</td><td>6,6</td><td>6,6</td><td>6,6</td><td>6,6</td></tr>
<tr><td>2072</td><td>23,5</td><td colspan="9">---</td></tr>
<tr><td>2572</td><td>23,2</td><td>8,4</td><td>8,4</td><td>6,6</td><td>7,8</td><td>7,8</td><td>6,6</td><td>6,6</td><td>6,6</td><td>6,6</td></tr>
<tr><td>3072</td><td>23,1</td><td colspan="9">---</td></tr>
<tr><td rowspan="6">1000</td><td>732</td><td>21,7</td><td rowspan="6">13,5</td><td rowspan="6">6,6</td><td colspan="9" rowspan="2">---</td></tr>
<tr><td>1088</td><td>24,3</td></tr>
<tr><td>1572</td><td>27,6</td><td rowspan="4">8,4</td><td rowspan="4">8,4</td><td rowspan="4">6,6</td><td rowspan="4">7,8</td><td rowspan="4">7,8</td><td rowspan="4">6,6</td><td rowspan="4">6,6</td><td rowspan="4">6,6</td><td rowspan="4">6,6</td></tr>
<tr><td>2072</td><td>25,7</td></tr>
<tr><td>2572</td><td>24,6</td></tr>
<tr><td>3072</td><td>24,1</td></tr>
<tr><td rowspan="6">1500</td><td>732</td><td>19,8</td><td rowspan="6">13,5</td><td rowspan="6">6,6</td><td colspan="9" rowspan="2">---</td></tr>
<tr><td>1088</td><td>22,0</td></tr>
<tr><td>1572</td><td>24,4</td><td>8,4</td><td>8,4</td><td>6,6</td><td>7,8</td><td>7,8</td><td>6,6</td><td>6,6</td><td>6,6</td><td>6,6</td></tr>
<tr><td>2072</td><td>27,3</td><td colspan="9">---</td></tr>
<tr><td>2572</td><td>26,8</td><td>8,4</td><td>8,4</td><td>6,6</td><td>7,8</td><td>7,8</td><td>6,6</td><td>6,6</td><td>6,6</td><td>6,6</td></tr>
<tr><td>3072</td><td>25,6</td><td colspan="9">---</td></tr>
<tr><td rowspan="9">2000</td><td>732</td><td>18,0</td><td rowspan="9">13,5</td><td rowspan="9">6,6</td><td>8,4</td><td>8,4</td><td>6,6</td><td>7,8</td><td>7,8</td><td>6,6</td><td>6,6</td><td>6,6</td><td>6,6</td></tr>
<tr><td>1036</td><td>20,8</td><td colspan="9">---</td></tr>
<tr><td>1088</td><td>21,2</td><td rowspan="8">8,4</td><td rowspan="8">8,4</td><td rowspan="8">6,6</td><td rowspan="8">7,8</td><td rowspan="8">7,8</td><td rowspan="8">6,6</td><td rowspan="8">6,6</td><td rowspan="8">6,6</td><td rowspan="8">6,6</td></tr>
<tr><td>1400</td><td>22,0</td></tr>
<tr><td>1572</td><td>22,6</td></tr>
<tr><td>2072</td><td>24,5</td></tr>
<tr><td>2572</td><td>26,7</td></tr>
<tr><td>3072</td><td>27,6</td></tr>
<tr><td>4144</td><td>25,5</td></tr>
<tr><td>2500</td><td>6144</td><td>24,7</td><td>13,5</td><td>6,6</td></tr>
</table>

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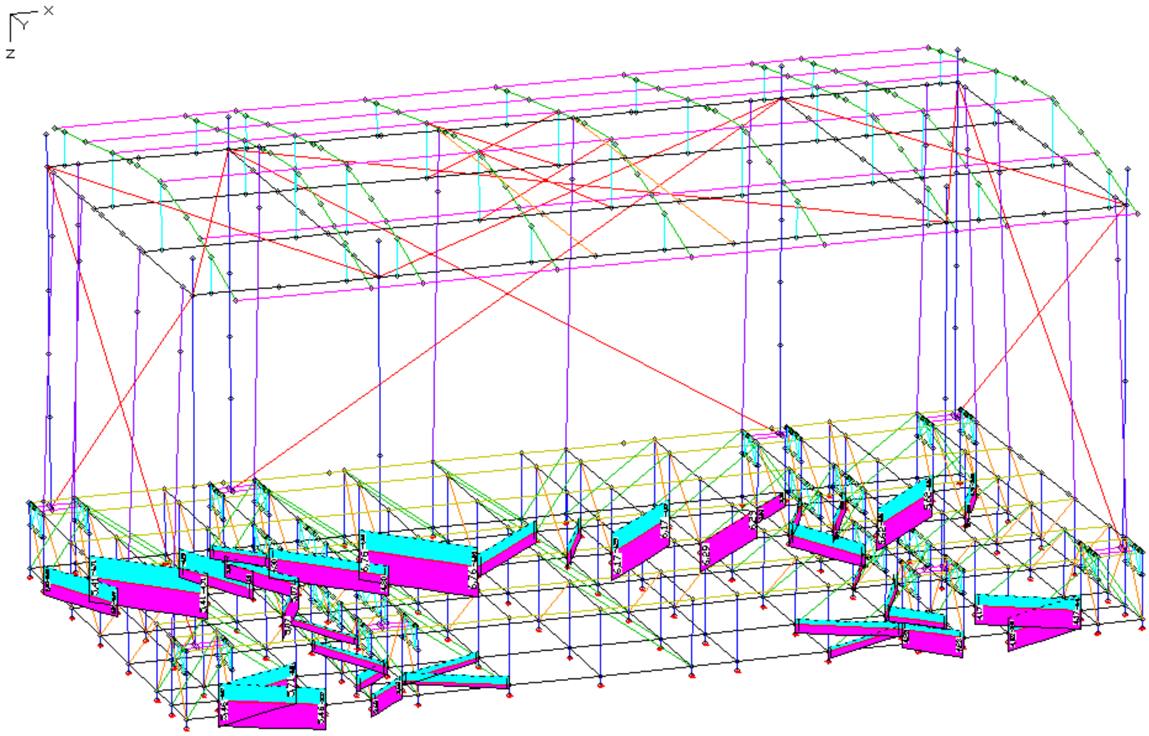
Tabelle 7: (Fortsetzung)

H [mm]	L [mm]	Anschlusskopf „K2000+“			„Variante II“			„Variante IB“			„Variante IC“		
		Lochscheibe											
		„K2000+“	„Variante II“	„Variante I“	„K2000+“	„Variante II“	„Variante I“	„K2000+“	„Variante II“	„Variante I“	„K2000+“	„Variante II“	„Variante I“
		Druck-Normalkraft $N^{(-)}_{V,Rd}$ [kN]											
500	732	21,1	13,3	6,6	---								
	1088	17,2	13,3										
	1572	16,1	12,4		8,4	8,4	6,6	7,8	7,8	6,6	6,6	6,6	6,6
	2072	15,7	12,1		---								
	2572	15,2	11,9		8,4	8,4	6,6	7,8	7,8	6,6	6,6	6,6	6,6
	3072	11,5	11,2		---								
1000	732	20,0	13,5	6,6	---								
	1088	23,1	13,5										
	1572	18,7	13,5		8,4	8,4	6,6	7,8	7,8	6,6	6,6	6,6	6,6
	2072	17,1	13,2										
	2572	14,0	12,7										
	3072	10,8	10,5										
1500	732	17,8	12,5	6,6	---								
	1088	20,4	13,5										
	1572	19,3	13,5		8,4	8,4	6,6	7,8	7,8	6,6	6,6	6,6	6,6
	2072	15,5	13,5		---								
	2572	12,3	11,9		8,4	8,4	6,6	7,8	7,8	6,6	6,6	6,6	6,6
	3072	9,7	9,6		---								
2000	732	16,6	12,2	6,6	8,4	8,4	6,6	7,8	7,8	6,6	6,6	6,6	6,6
	1036	17,9	12,8		---								
	1088	17,7	12,9		8,4	8,4	6,6	7,8	7,8	6,6	6,6	6,6	6,6
	1400	16,3	13,5										
	1572	15,4	13,5										
	2072	12,8	12,4										
	2572	10,5	10,2										
	3072	8,5	8,3										
	4144	5,4	5,3	5,3	5,3	5,3	5,3	4,1	4,1	4,1	4,1	4,1	4,1
2500	6144	2,2	2,1	2,1	2,1	2,1	2,1	1,6	1,6	1,6	1,6	1,6	1,6
L, H	siehe Anlage A, Seite 4												

Diagonal braces horizontal:



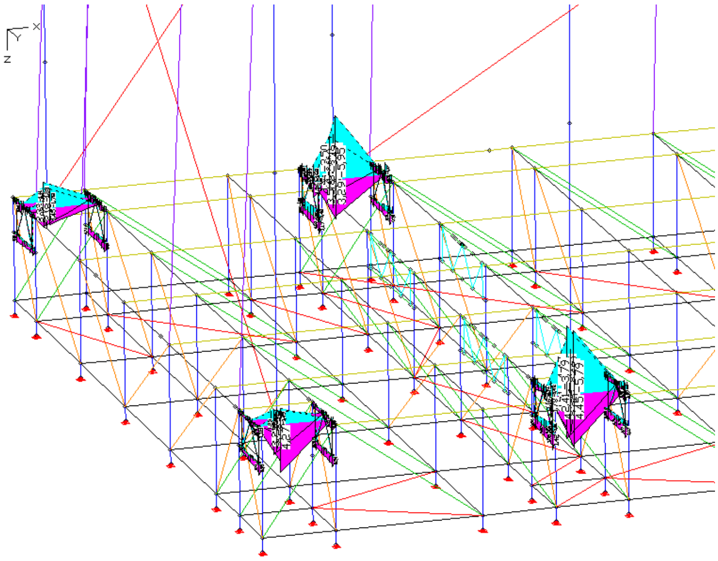
LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -4,71/6,76 [kN]

< 31,0 kN = N_{Rd}

Bases

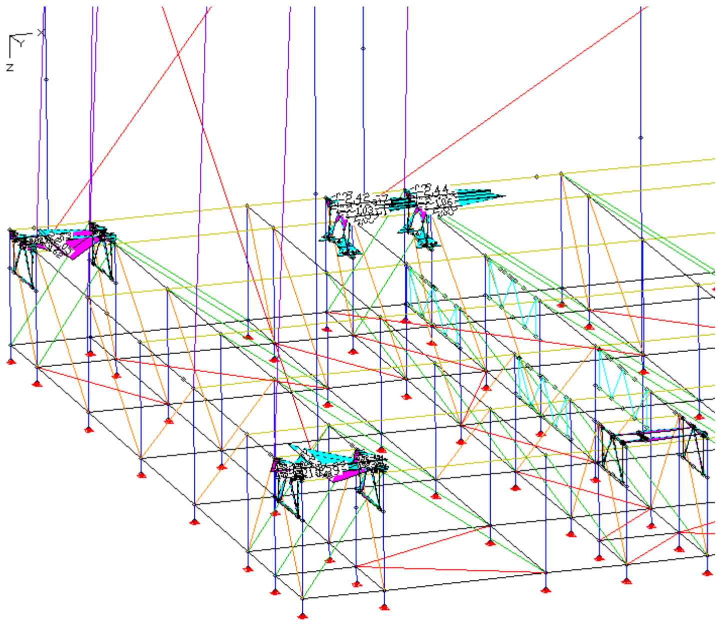
1,036x1,036m

$M_{y,Ed}$

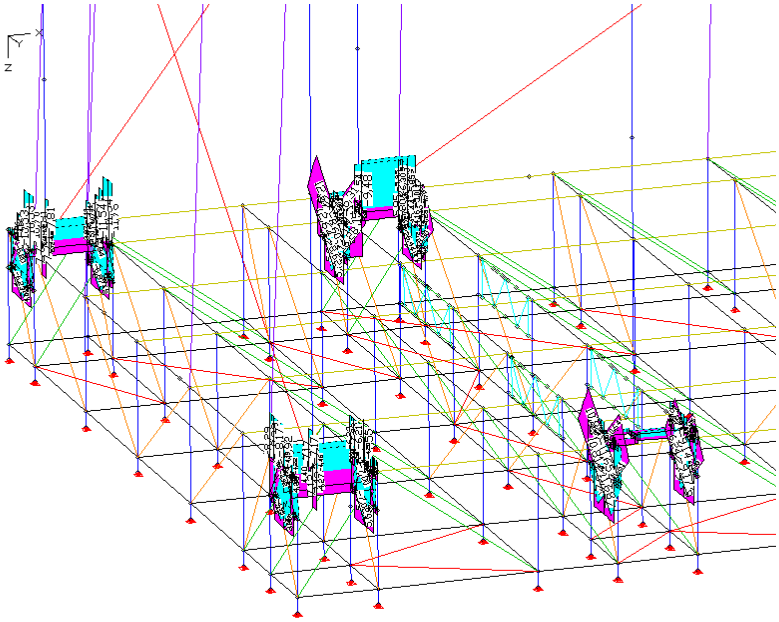


(only one side shown)

$M_{z,Ed}$

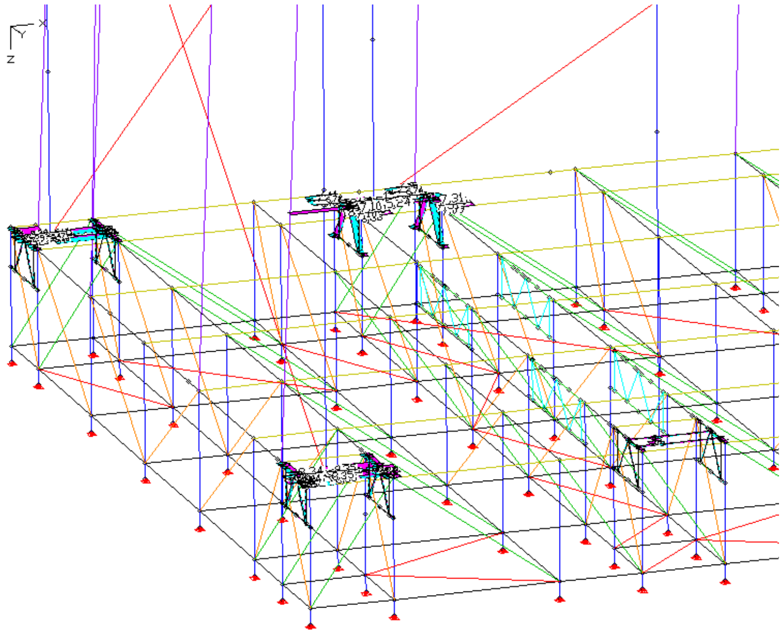


$N_{x,Ed}$



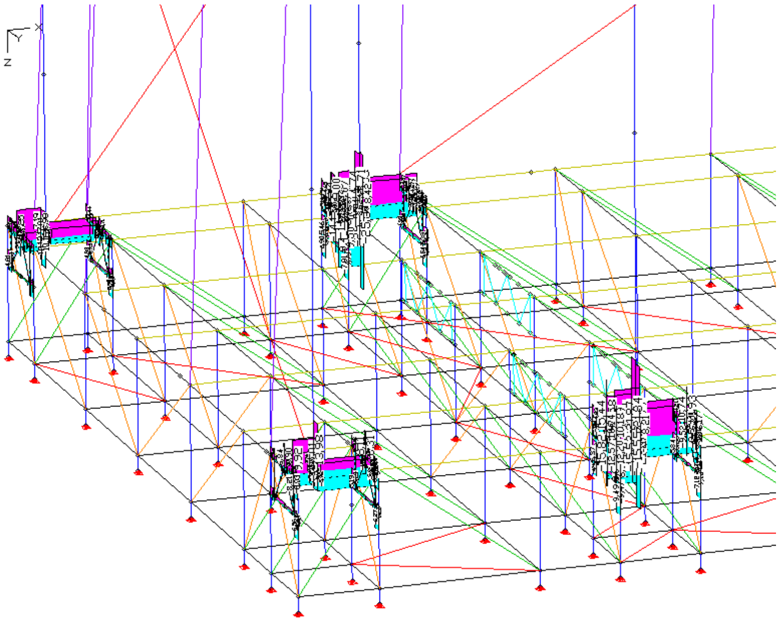
LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -12,94/16,31 [kN]

$V_{y,Ed}$



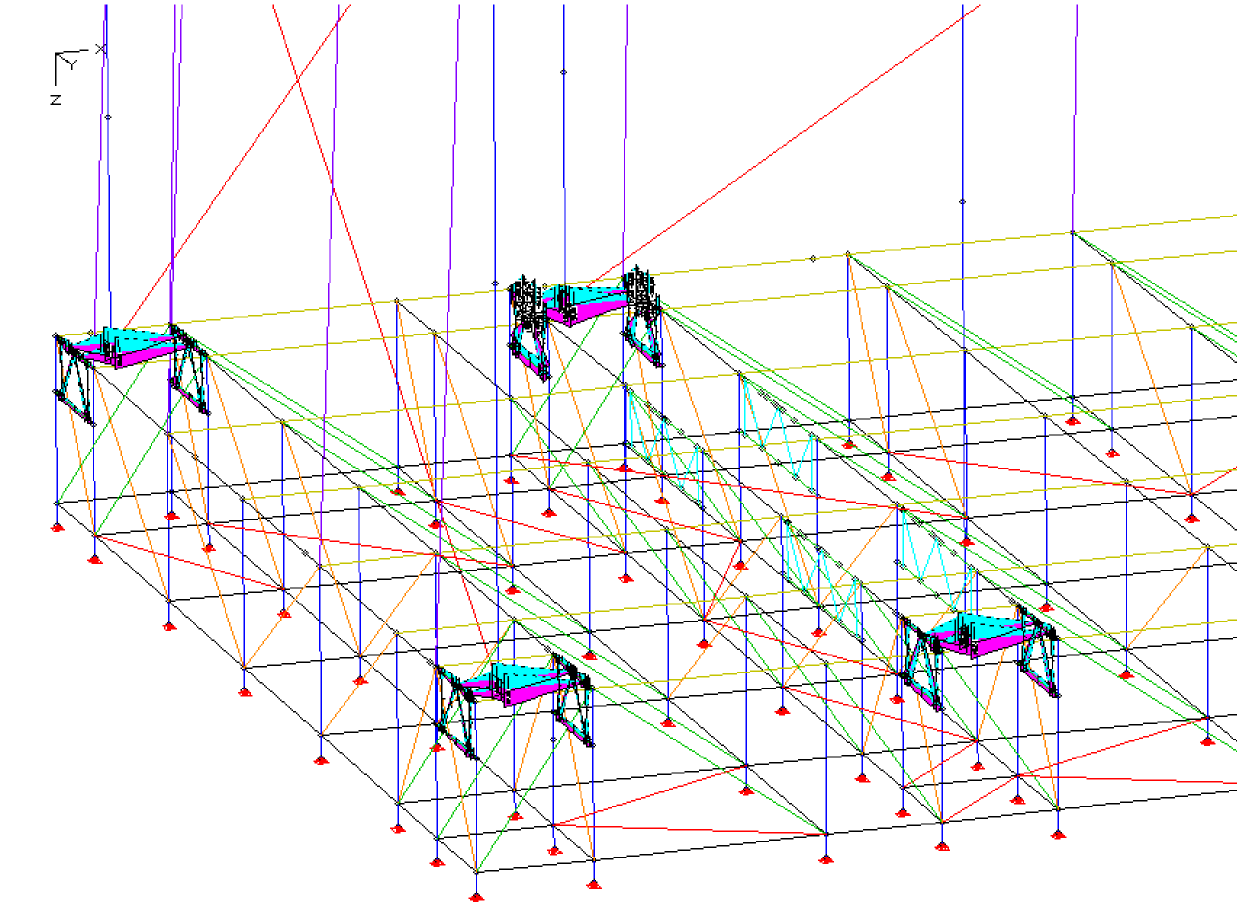
LCC 95: Selected Internal forces min,max Qy [kN]
Value range (subsystem, min/max): -15,24/18,63 [kN]

$V_{z,Ed}$



LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): -25,87/22,75 [kN]

stresses

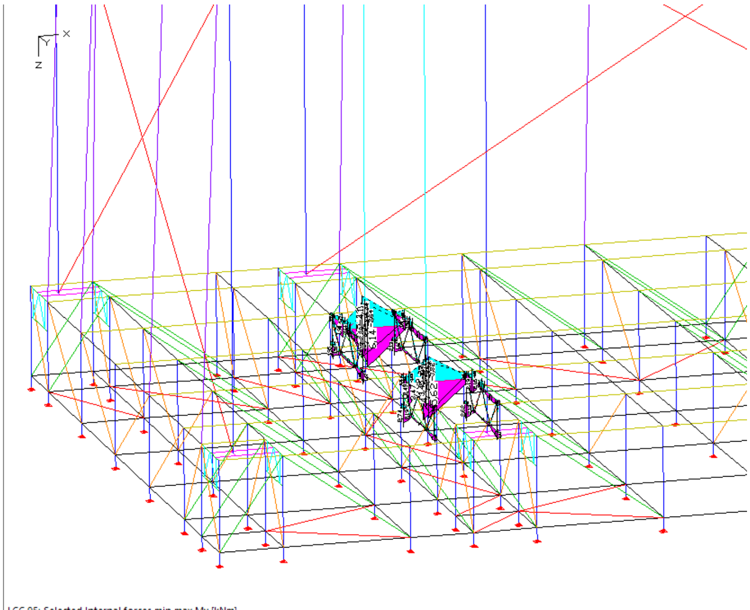


LCC 95: Selected Stresses (general - elastic, directly from internal forces) min,max Sigma.x [MN/m²]
Value range (subsystem, min/max): -162,74/157,81 [MN/m²]

< 235 MN/m²

20,72x1,036m

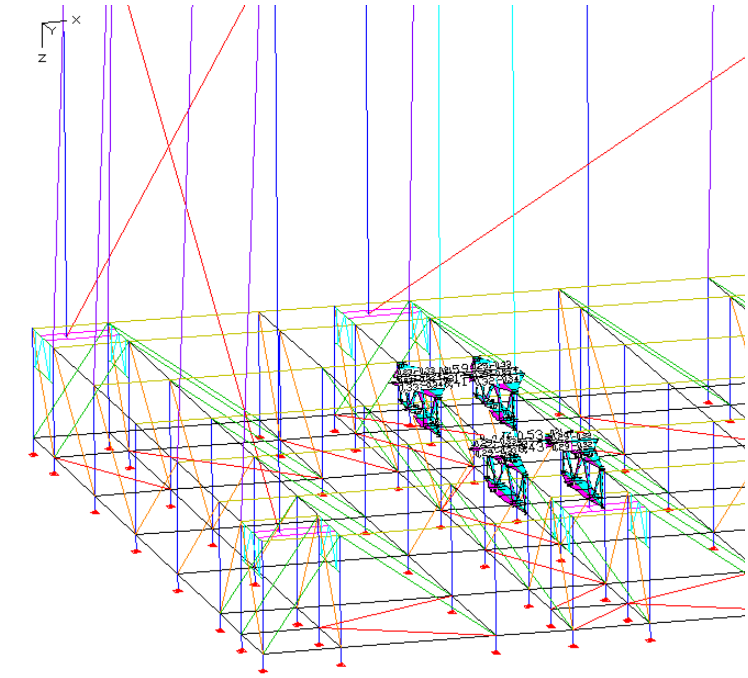
$M_{y,Ed}$



LCC 95: Selected Internal forces min,max My [kNm]
Value range (subsystem, min/max): -6,17/6,54 [kNm]

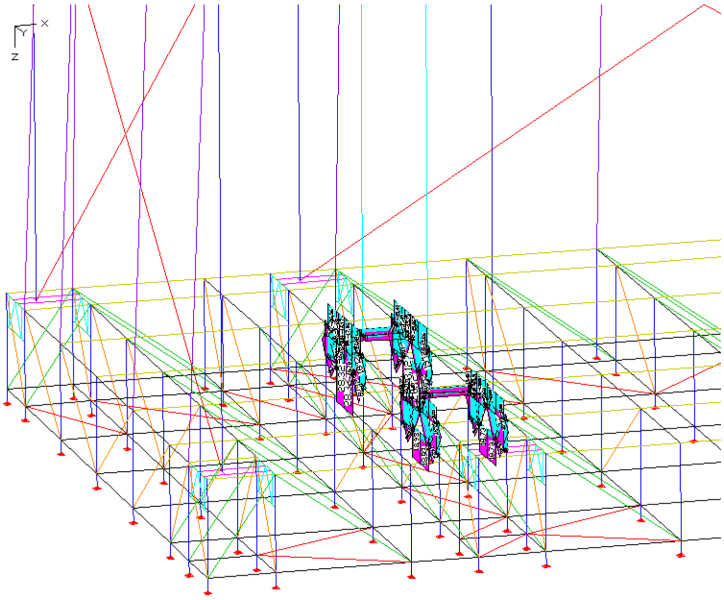
(only one side shown)

$M_{z,Ed}$



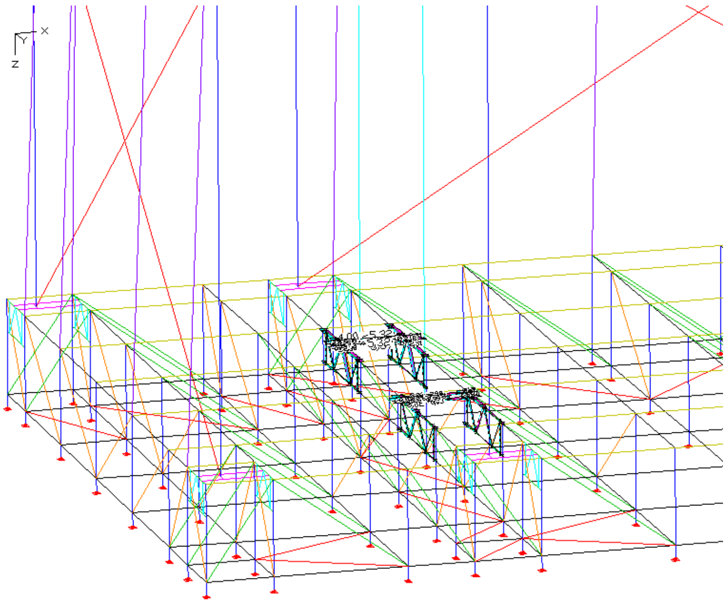
LCC 95: Selected Internal forces min,max Mz [kNm]
Value range (subsystem, min/max): -0,54/0,59 [kNm]

$N_{x,Ed}$



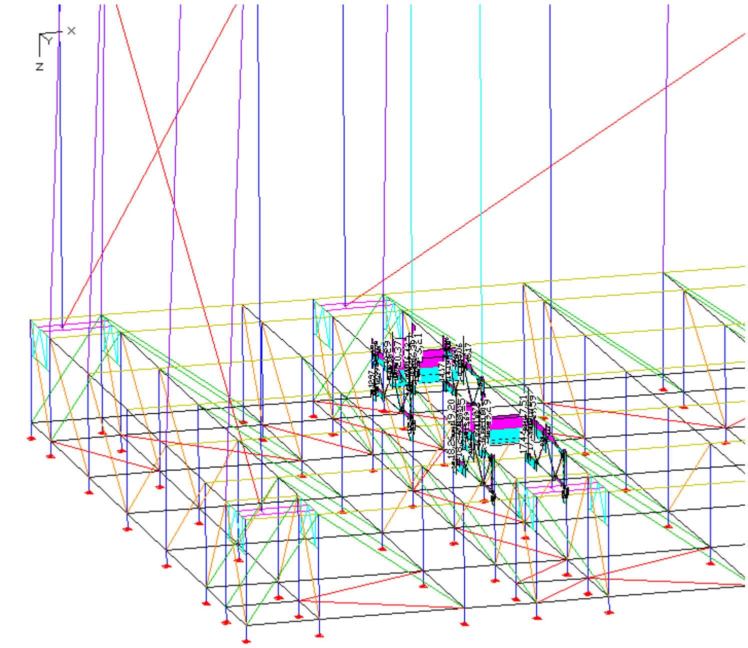
LCC 95: Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -25,15/34,25 [kN]

$V_{y,Ed}$



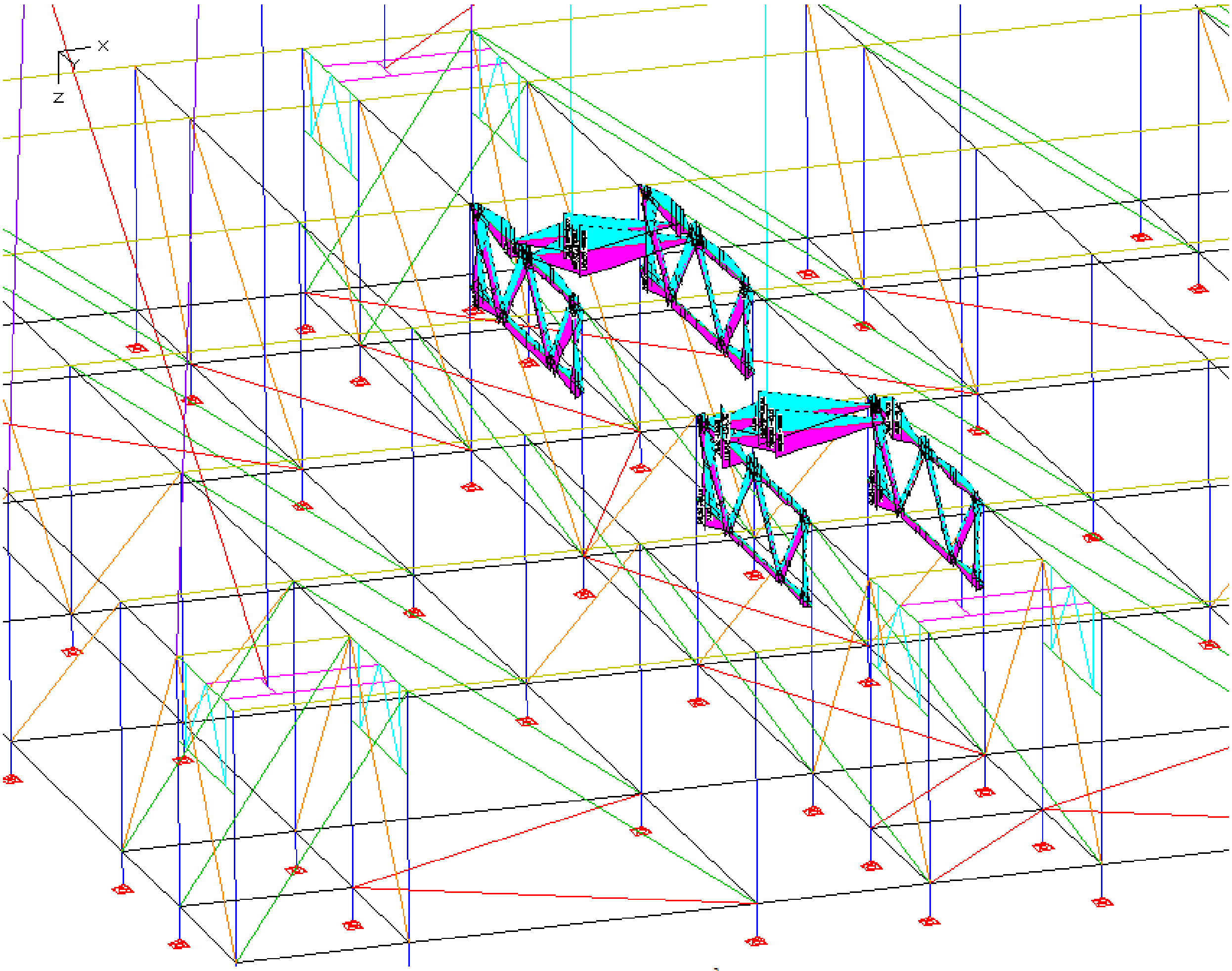
LCC 95: Selected Internal forces min,max Qy [kN]
Value range (subsystem, min/max): -5,37/5,51 [kN]

$V_{z,Ed}$



LCC 95: Selected Internal forces min,max Qz [kN]
Value range (overall system, min/max): -18,21/26,19 [kN]

stresses



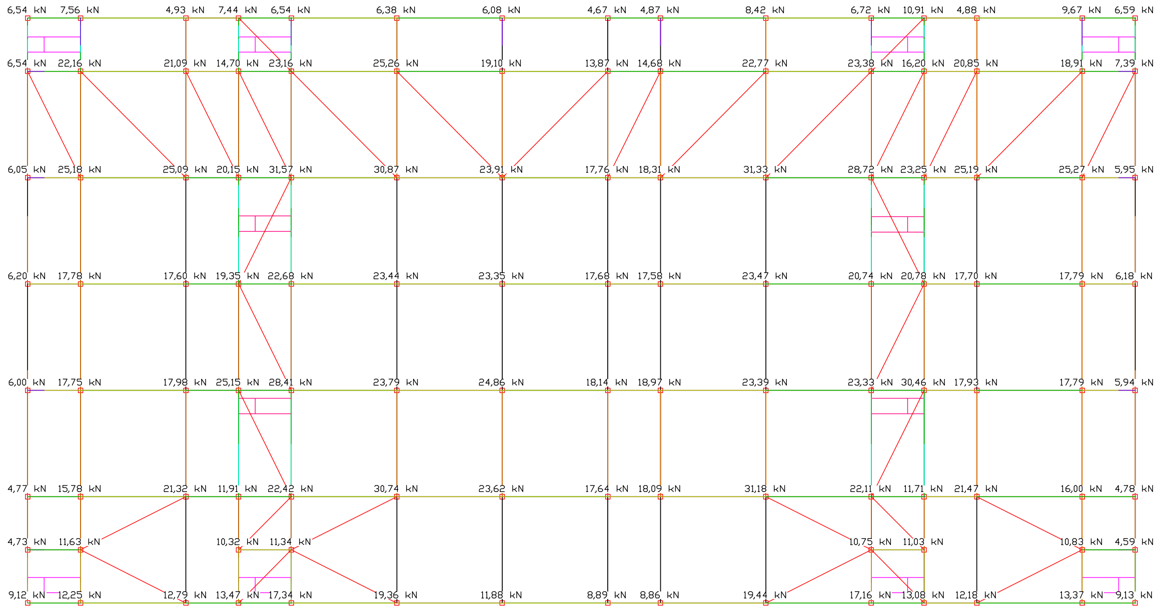
LCC 95: Selected Stresses (general - elastic, directly from internal forces) min,max Sigma.x [MN/m²]
Value range (subsystem, min/max): -178,47/114,17 [MN/m²]

< 235 MN/m²

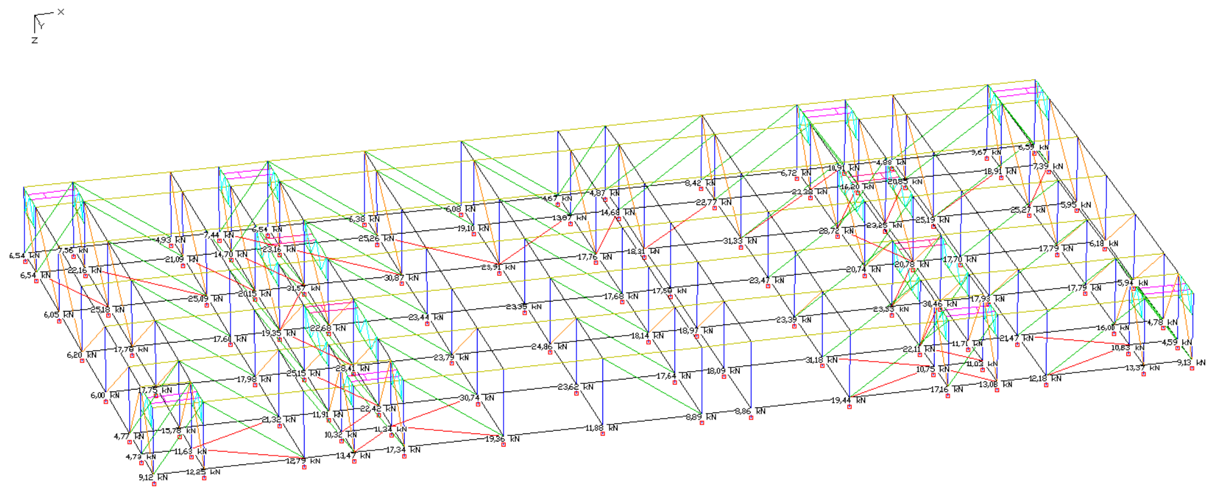
no further proof

9 SUPPORT REACTIONS, BALLAST LOADS

LCC 85:



LCC 85: Support reactions in the system of the support lines max Rz(I). 2,95 [kN/m] =



LCC 85: Support reactions in the system of the support lines max Rz(I) [kN/m]

spindle heights:

$R_{x,y}$ < 3,0 kN
R_z < 32,0 kN

Base plate 60: → **h ≤ 10 cm**

Base Plate 60 solid: → **h ≤ 25 cm**

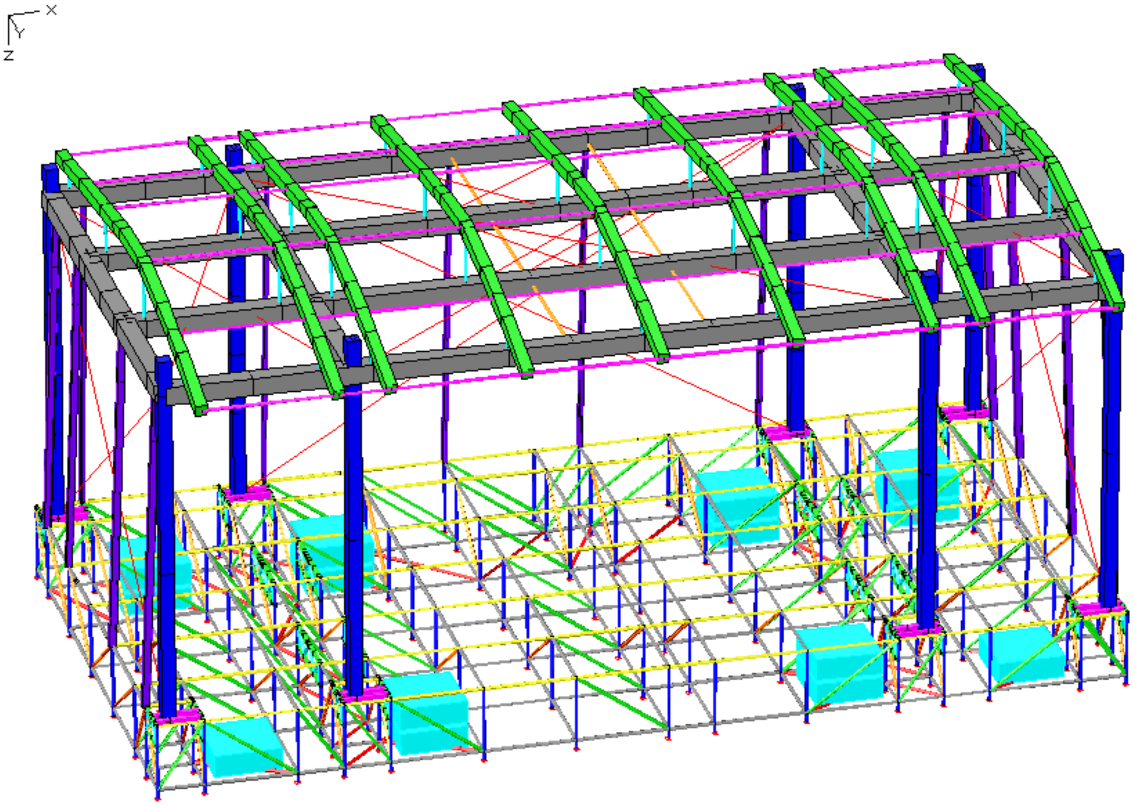
underpinning:

timber spreader 400 x 400 x 30mm

32/ (0,40 x 0,40) = 200 kN/m² ≤ 200 kN/m²

Ballast Overview

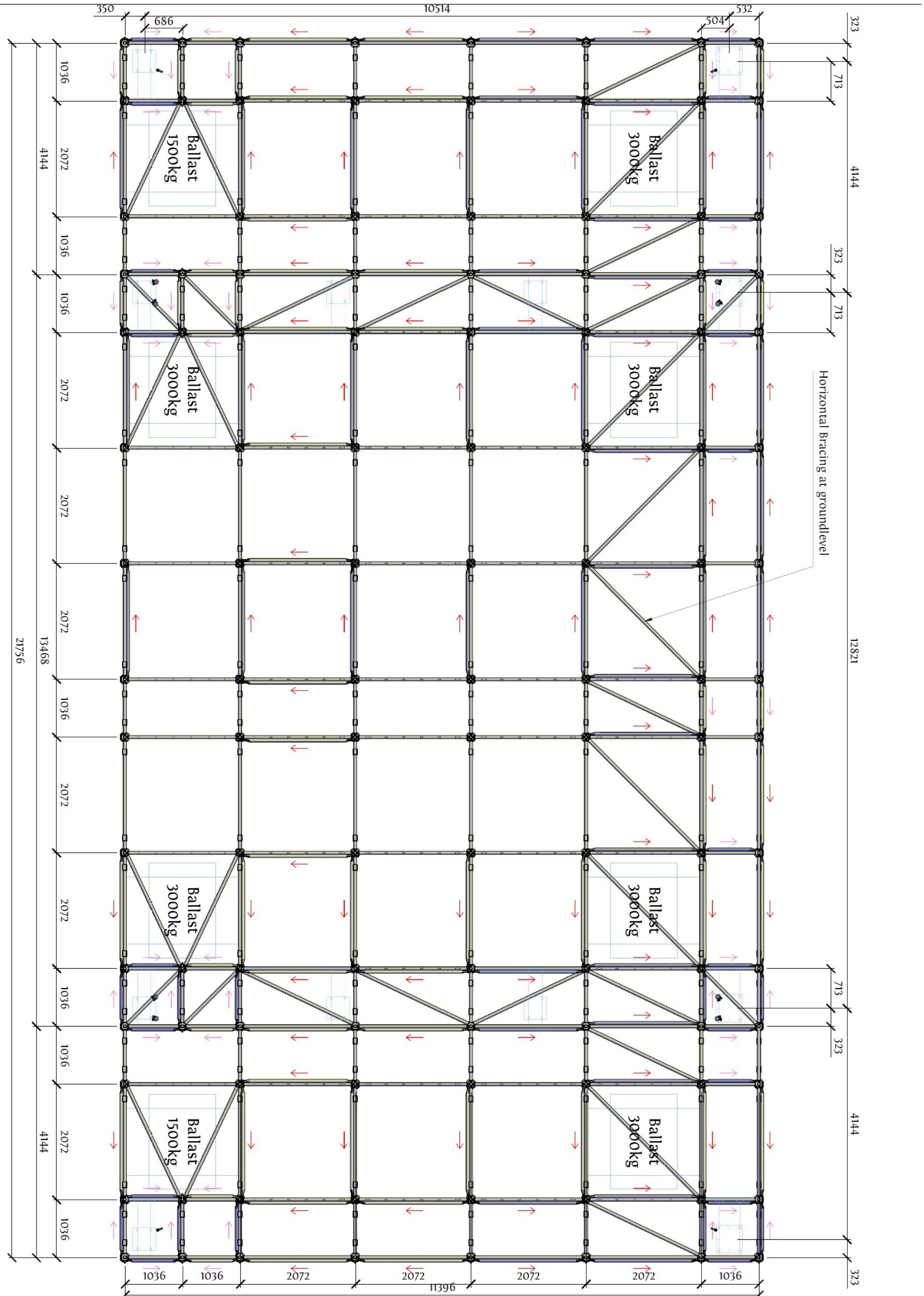
friction coefficient μ = 0,40 (or 0,60)



The ballast is displayed schematically as preferred by the customer.

light blue block: 1500 kg (stapled for 3000 kg)

The ballast will be placed force-fitted on the bottom level of the Layher Podium without the usage of Layher Base Collars or it must be placed on a separate level +0,50m.



XLT 12x10-HD + Sidestages

Projectname:	Custom Prolyte CLT-Roof 12x10
Projectnumber:	Standardized Stage
City / Venue:	Belgium / Europa

Page name:	A3 - Layher Allround Stage
Draft by:	R. Slegers
Date:	16-mei-22 Units: mm

EEKELS VERHUUR

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	dead weight	0,000	0,000	130,671
	Support reactions	0,000	-0,000	130,671
2	ballast	-0,000	0,000	210,000
	Support reactions	-0,000	-0,000	210,019
3	payload podium	0,000	0,000	1239,657
	Support reactions	0,000	-0,000	1239,657
4	distributed payload - Basic setup	0,000	0,000	40,117
	Support reactions	-0,000	-0,000	40,140
5	CPL payload - Basic setup	0,000	0,000	17,200
	Support reactions	0,000	-0,000	17,217
6	3rdPL payload - Basic setup	0,000	0,000	26,000
	Support reactions	0,000	-0,000	26,022
7	4thPL payload - Basic setup	0,000	0,000	25,620
	Support reactions	0,000	-0,000	25,640
8	5thPL payload - Basic setup	0,000	0,000	27,200
	Support reactions	0,000	0,000	27,201
9	PA load	0,000	0,000	20,000
	Support reactions	0,000	-0,000	20,000
11	membrane tension - roof	0,000	0,000	0,000
	Support reactions	-0,000	-0,000	0,004
13	membrane tension - rear wall	0,000	-0,000	-0,000
	Support reactions	-0,000	-0,000	0,000
15	membrane tension - left side	0,000	-0,000	0,000
	Support reactions	0,000	0,000	0,004
17	membrane tension - right side	0,000	0,000	0,000
	Support reactions	0,000	-0,000	0,004
18	wind on podium top	0,000	0,000	49,586
	Support reactions	0,000	-0,000	49,586
22	special payload - Basic setup	0,000	0,000	57,000
	Support reactions	0,000	-0,000	57,042
100	g+p	-0,000	0,000	1640,444
	Support reactions	-0,000	0,000	1640,444
101	wind ß = 0° +g	-0,041	-51,852	264,004
	Support reactions	-0,041	-51,852	264,004
102	wind ß = 90° +g	31,847	-8,201	308,421

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
	Support reactions	31,847	-8,201	308,469
103	wind ß = 180° +g	-0,005	54,760	310,836
	Support reactions	-0,005	54,760	311,386
201	wind ß = 0° +g+p	-0,041	-51,852	1563,777
	Support reactions	-0,041	-51,852	1563,777
202	wind ß = 90° +g+p	31,847	-8,201	1608,195
	Support reactions	31,847	-8,201	1608,195
203	wind ß = 180° +g+p	-0,005	54,760	1610,609
	Support reactions	-0,005	54,760	1610,609
301	wind ß = 0° only roof +g	-0,000	-53,382	241,351
	Support reactions	0,000	-53,382	241,351
302	wind ß = 90° only roof +g	51,215	2,423	241,609
	Support reactions	51,215	2,423	241,609
303	wind ß = 180° only roof +g	0,000	58,229	241,868
	Support reactions	-0,000	58,229	241,868
401	wind ß = 0° only roof +g+p	-0,000	-53,382	1521,124
	Support reactions	0,000	-53,382	1521,124
402	wind ß = 90° only roof +g+p	51,215	2,423	1521,383
	Support reactions	51,215	2,423	1521,383
403	wind ß = 180° only roof +g+p	0,000	58,229	1521,641
	Support reactions	0,000	58,229	1521,641

Podium height h≤1,50m

Proof against sliding for whole system:

Due to the calculation of the structure with supports with tension loss, the single wind load cases could not be calculated. The resulting lifting wind loads therefore must be calculated backwards.

LC 101: decisive

dead weight:	G = 130,6 kN	
ballast:	B = 210 kN	(14x15,0 kN)
wind lifting:	W_V = 264,0 – 130,6 – 210 - 0,8 x 49,6 = -116,3 kN	
wind horizontal:	W_H = 51,85 kN	

μ = 0,6: (130,6+210)/(51,85/ 0,6 + 116,3) = 1,68 > 1,20
μ = 0,4: (130,6+210)/(51,85/ 0,4 + 116,3) = 1,38 > 1,20

LC 303:

dead weight:	G = 130,6 kN	
ballast:	B = 210 kN	(14x15,0 kN)
wind lifting:	W_V = 241,4 – 130,6 – 210 = -99,2 kN	
wind horizontal:	W_H = 53,4 kN	

μ = 0,6: (130,6+210)/(53,4/ 0,6 + 99,2) = 1,80 > 1,20
μ = 0,4: (130,6+210)/(53,4/ 0,4 + 99,2) = 1,46 > 1,20

Proof against tilting for whole system:

LC 101:

Area podium A = 247 m²

wind on podium: W_{V1} = 0,2 x 0,8 x 247 = 39,52 kN

wind lifting: W_{V2} = -116,3 kN

wind horizontal: W_H = 51,85 kN

M_{tilt} = 116,3 x 11,4/2 + 51,85 x 11,30/ 2 = 955,9 kNm

M_{stand} = (130,6+39,52) x 11,40/2 + 4 x 30 x 2,072 + 6 x 15 x 9,32 = 2057,1 kNm

2057,1/ 955,9 = 2,15 > 1,20

LC 303:

wind lifting: W_{V2} = -99,2 kN

wind horizontal: sum W_H = 53,4 kN
W_{Gable} = 7,05 kN (in height 9,60 m)
W_{truss} = 20,64 kN (in height ~5,5 m)
W_{podium} = 25,71 kN (in height 1,0 m)

M_{tilt} = 99,2 x 11,4/2 + 7,05 x 9,60 + 20,64 x 5,50 + 25,71 x 1,0 = 772,4 kNm

M_{stand} = 130,6 x 11,40/ 2 + 4 x 30 x 2,072 + 6 x 15 x 9,32 = 1831,8 kNm

1831,8/ 772,4 = 2,37 > 1,20

The chosen ballast is sufficient. The ballast will be placed force-fitted on the bottom level of the Layher Podium without the usage of Layher Base Collars or it must be placed on a separate level +0,50m.

10 TRUSS AND SCAFFOLDING DATA

PROLYTE H40V

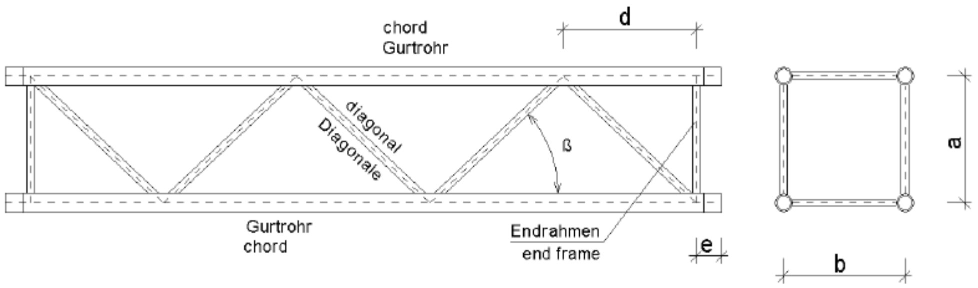
DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE 6,9 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm²]	W [cm³]	I [cm⁴]	I_T [cm⁴]	i [cm]
chords/ Gurte	48,000	3,000	4,241	4,493	10,783	21,566	1,595
diagonals vertical/ Diagonale vertikal	20,000	2,000	1,131	0,464	0,464	0,927	0,640
diagonals horizontal/ Diagonale horizontal	20,000	2,000	1,131	0,464	0,464	0,927	0,640
end frame/ Endrahmen	20,000	2,000	1,131	0,464	0,464	0,927	0,640

TRUSS GEOMETRY/ TRAVERSENGEOMETRIE

Height / Höhe	a [cm]	33,90
Width / Breite	b [cm]	33,90
Distance diagonals vertical / Abstand Diagonalen vertikal	d[cm]	33,90
Angle diagonals vertical / Winkel Diagonalen vertikal	$ß_V$	45,00
Distance diagonals horizontal /Abstand Diagonalen horizontal	d[cm]	33,90
Angle diagonals horizontal / Winkel Diagonalen horizontal	$ß_H$	45,00
	e[cm]	5,00



CROSS SECTION TRUSS/ QUERSCHNITTSWERTE GESAMTTRAVERSE

$A = 4 \times A_{\text{single tube/Einzelrohr}}$

$I = 0{,}85 \times (4 \times I_{\text{single tube/Einzelrohr}} + 4 \times A_{\text{single tube/Einzelrohr}} \times (a/2)^2)$

$i = (I / A)^{1/2}$

The moments of inertia are reduced for 15% due to the resilient connection between chords and diagonals./
Die Trägheitsmomente werden aufgrund der nachgiebigen Verbindung Gurte-Diagonalen um 15 % abgemindert.

A [cm²]	I_y [cm⁴]	I_z [cm⁴]	i_y [cm]	i_z [cm]	I_T [cm⁴]
16,96	4179,54	4179,54	15,70	15,70	900

PROLYTE H40V

MATERIAL

Characteristic values of 0,2% proof strength f_o, and ultimate tensile strength f_u
according to EC9/ charakteristische Werte für Streckgrenze f_0 und Zugfestigkeit f_u gemäß EC9
(see tab. 3.2b; 8.8(1) / siehe Tabelle 3.2b; 8.8(1))

EN AW 6082 T6	[N/mm²]	normal stress/ Normalspannung	shear stress/ Schubspannung
		$\sigma_{R.d} = f / \gamma_{(M1,M2)}$	$\tau_{R.d} = f / (\gamma_{(M1,M2)} \times \sqrt{3})$
f_o: t > 5mm	260,0	236,4	136,5
f_u: t > 5mm	310,0	248,0	
f_o: t < 5mm	250,0	227,3	131,2
f_u: t < 5mm	290,0	232,0	
$f_{o,haz}$	125,0	113,6	65,6
$f_{u,haz}$	185,0	148,0	
$f_w^{(1)}$	190,0	152,0	87,8

All welding seams are done in TIG, according to tab. 3.2b, note 4 $\rho_{i,haz}$ has to be multiplied by 0,8 /
Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist $\rho_{i,haz}$ mit dem Faktor 0,8 zu multiplizieren.
Partial safety factors for ultimate limit states/ Teilsicherheitsbeiwerte für Grenzzustände der Tragfähigkeit

γ_{M1}	1,10
γ_{M2}	1,25
γ_{MW}	1,25

(see tab. 6.1/ siehe Tabelle 6.1)

SUMMARY / ZUSAMMENFASSUNG

normal force chord / Normalkraft Gurte:	$N_{R,d}$ = +-	**50,22 kN**
normal force in the fittings / Normalkraft Verbinder:	$N_{R,d}$ = +-	**52,58 kN**
normal force diagonal vertical / Normalkraft Diagonale vertikal:	$N_{R,d}$ = +-	**13,39 kN**
normal force diagonal horizontal / Normalkraft Diagonale horizontal:	$N_{R,d}$ = +-	**13,39 kN**

DESIGN INTERNAL FORCES COMPLETE TRUSS / BEMESSUNGSSCHNITTGRÖSSEN GESAMTTRAVERSE

bending moment/Biegemoment:	$M_{y,R,d} = 2 \times N_{R,d,chord\ tube/Gurtrohr} \times$	0,339 =	**34,05 kNm**
bending moment/Biegemoment:	$M_{z,R,d} = 2 \times N_{R,d,chord\ tube/Gurtrohr} \times$	0,339 =	**34,05 kNm**
normal force/Normalkraft:	$N_{R,d} = 4 \times N_{R,d,chord\ tube/Gurtrohr} =$		**200,86 kN**
transversal force/Querkraft	$V_{z,R,d} = 2 \times N_{R,d,diagonal} \times \sin$	45,00 ° =	**18,94 kN**
transversal force/Querkraft	$V_{y,R,d} = 2 \times N_{R,d,diagonal} \times \sin$	45,00 ° =	**18,94 kN**

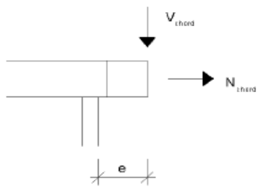
The values shown above are design values. "Permissible loads" or "Working loads" are optained by dividing the stress capacity by 1.5. /
Die oben angegebenen Werte sind Design-Werte. "Zulässige Lasten" bzw. "Gebrauchslasten" erhält man durch Division der Beanspruchbarkeit durch 1,5.

INTERACTION MOMENT-TRANSVERSAL FORCE / MOMENTEN-QUERKRAFT-INTERAKTION

In case of occurance of bending moment and transversal force the following term has to be analysed:
Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

$V_{d,chor-/Gurt} = 0,25 \times V_{d,total/gesamt}$

$M_{d,chord/Gurt} = V_{d,chord/Gurt} \times e$ e* = 5,00



according to term / nach Gl. (6.43):

$\eta = (N_{chord/Gurt,Ed} / N_{Rd})^{1,3} + M_{chord/Gurt,Ed} / M_{Rd} \leq 1$

PROJECT:	PROJECT-NO.:
XLT-ROOF 12x10m WITH SIDESTAGES	**20184**
CUSTOMER/AUFTRAGGEBER:	DATE/DATUM:
EEKELS VERHUUR	**28.07.2022**

PROLYTE H30V

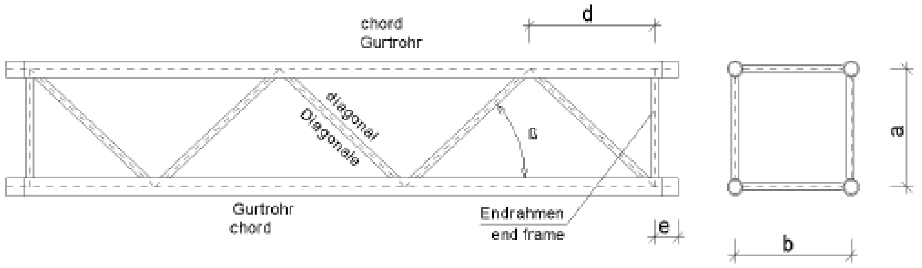
DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE 6,3 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm²]	W [cm³]	I [cm⁴]	I_T [cm⁴]	i [cm]
chords/ Gurte	48,000	3,000	4,241	4,493	10,783	21,566	1,595
diagonals vertical/ Diagonale vertikal	16,000	2,000	0,880	0,275	0,220	0,440	0,500
diagonals horizontal/ Diagonale horizontal	16,000	2,000	0,880	0,275	0,220	0,440	0,500
end frame/ Endrahmen	16,000	2,000	0,880	0,275	0,220	0,440	0,500

TRUSS GEOMETRY/ TRAVERSENGEOMETRIE

Height / Höhe	a [cm]	23,90
Width / Breite	b [cm]	23,90
Distance diagonals vertical / Abstand Diagonalen vertikal	d[cm]	23,90
Angle diagonals vertical / Winkel Diagonalen vertikal	$ß_V$	45,00
Distance diagonals horizontal /Abstand Diagonalen horizontal	d[cm]	23,90
Angle diagonals horizontal / Winkel Diagonalen horizontal	$ß_H$	45,00
	e[cm]	5,00



CROSS SECTION TRUSS/ QUERSCHNITTSWERTE GESAMTTRAVERSE

$A = 4 \times A_{single\ tube/Einzelrohr}$

$I = 0,85 \times (4xI_{single\ tube/Einzelrohr} + 4x\ A_{single\ tube/Einzelrohr} \times (a/2)^2)$

$i = (I / A)^{1/2}$

The moments of inertia are reduced for 15% due to the resilient connection between chords and diagonals./
Die Trägheitsmomente werden aufgrund der nachgiebigen Verbindung Gurte-Diagonalen um 15 % abgemindert.

A [cm²]	I_y [cm⁴]	I_z [cm⁴]	i_y [cm]	i_z [cm]	I_T [cm⁴]
16,96	2095,86	2095,86	11,12	11,12	500

PROLYTE H30V

MATERIAL

Characteristic values of 0,2% proof strength f_o, and ultimate tensile strength f_u
according to EC9/ charakteristische Werte für Streckgrenze f_o und Zugfestigkeit f_u gemäß EC9
(see tab. 3.2b; 8.8[1] / siehe Tabelle 3.2b; 8.8[1])

EN AW 6082 T6	[N/mm²]	normal stress/ Normalspannung	shear stress/ Schubspannung
		$\sigma_{R,d} = f / \gamma_{(M1,M2)}$	$\tau_{R,d} = f / (\gamma_{(M1,M2)} \times \sqrt{3})$
f_o: t > 5mm	260,0	236,4	136,5
f_u: t > 5mm	310,0	248,0	
f_o: t < 5mm	250,0	227,3	131,2
f_u: t < 5mm	290,0	232,0	
$f_{o,haz}$	125,0	113,6	65,6
$f_{u,haz}$	185,0	148,0	
$f_w^{(1)}$	190,0	152,0	87,8

All welding seams are done in TIG, according to tab. 3.2b, note 4 $\rho_{u,haz}$ has to be multiplied by 0,8 /
Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist $\rho_{u,haz}$ mit dem Faktor 0,8 zu multiplizieren.

Partial safety factors for ultimate limit states/ Teilsicherheitsbeiwerte für Grenzzustände der Tragfähigkeit

γ_{M1}	1,10
γ_{M2}	1,25
γ_{MW}	1,25

(see tab. 6.1/ siehe Tabelle 6.1)

SUMMARY / ZUSAMMENFASSUNG

normal force chord / Normalkraft Gurte:	$N_{R,d}$ = +-	**50,22 kN**
normal force in the fittings / Normalkraft Verbinder:	$N_{R,d}$ = +-	**52,58 kN**
normal force diagonal vertical / Normalkraft Diagonale vertikal:	$N_{R,d}$ = +-	**10,42 kN**
normal force diagonal horizontal / Normalkraft Diagonale horizontal:	$N_{R,d}$ = +-	**10,42 kN**

DESIGN INTERNAL FORCES COMPLETE TRUSS / BEMESSUNGSSCHNITTGRÖSSEN GESAMTTRAVERSE

bending moment/Biegemoment:	$M_{y,R,d} = 2 \times N_{R,d,chord\ tube/Gurtrohr} \times$	0,239 =	**24,00 kNm**
bending moment/Biegemoment:	$M_{z,R,d} = 2 \times N_{R,d,chord\ tube/Gurtrohr} \times$	0,239 =	**24,00 kNm**
normal force/Normalkraft:	$N_{R,d} = 4 \times N_{R,d,chord\ tube/Gurtrohr} =$		**200,86 kN**
transversal force/Querkraft	$V_{z,R,d} = 2 \times N_{R,d,diagonal} \times \sin$	45,00 ° =	**14,73 kN**
transversal force/Querkraft	$V_{y,R,d} = 2 \times N_{R,d,diagonal} \times \sin$	45,00 ° =	**14,73 kN**

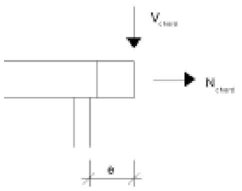
The values shown above are design values. "Permissible loads" or "Working loads" are optained by dividing the stress capacity by 1.5. /
Die oben angegebenen Werte sind Design-Werte. "Zulässige Lasten" bzw. "Gebrauchslasten" erhält man durch Division der Beanspruchbarkeit durch 1,5.

INTERACTION MOMENT-TRANSVERSAL FORCE / MOMENTEN-QUERKRAFT-INTERAKTION

In case of occurance of bending moment and transversal force the following term has to be analysed:
Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

$V_{d,chor-/Gurt} = 0,25 \times V_{d,total/gesamt}$

$M_{d,chord/Gurt} = V_{d,chord/Gurt} \times e$ e' = 5,00



according to term / nach Gl. (6.43):

$\eta = (N_{chord/Gurt,Ed} / N_{Rd})^{1,3} + M_{chord/Gurt,Ed} / M_{Rd} \leq 1$

PROLYTE H30D

DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE

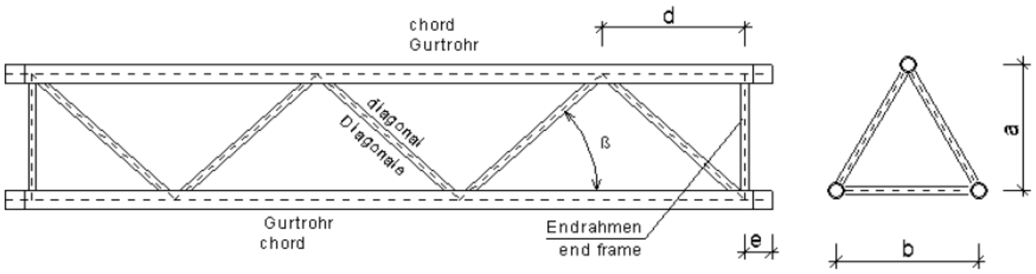
5,0 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm²]	W [cm³]	I [cm⁴]	I_T [cm⁴]	i [cm]
chords/ Gurte	48,000	3,000	4,241	4,493	10,783	21,566	1,595
diagonals vertical/ Diagonale vertikal	16,000	2,000	0,880	0,275	0,220	0,440	0,500
diagonals horizontal/ Diagonale horizontal	16,000	2,000	0,880	0,275	0,220	0,440	0,500
end frame/ Endrahmen	16,000	2,000	0,880	0,275	0,220	0,440	0,500

TRUSS GEOMETRY/ TRAVERSENGEOMETRIE

Height / Höhe	a [cm]	20,70
Width / Breite	b [cm]	23,90
Distance diagonals vertical / Abstand Diagonalen vertikal	d[cm]	23,90
Angle diagonals vertical / Winkel Diagonalen vertikal	$ß_V$	45,00
Distance diagonals horizontal /Abstand Diagonalen horizontal	d[cm]	23,90
Angle diagonals horizontal / Winkel Diagonalen horizontal	$ß_H$	45,00
	e[cm]	5,00



CROSS SECTION TRUSS/ QUERSCHNITTSWERTE GESAMTTRAVERSE

$A = 3 \times A_{single\ tube/Einzelrohr}$

$I_y = 0{,}85 \times (3xI_{single\ tube/Einzelrohr} + A_{single\ tube/Einzelrohr} \times (2 \times (a/3)^2 + (2a/3)^2)$

$I_z = 0{,}85 \times (3xI_{single\ tube/Einzelrohr} + 2 \times A_{single\ tube/Einzelrohr} \times (b/2)^2)$

$i = (I / A)^{1/2}$

The moments of inertia are reduced for 15% due to the resilient connection between chords and diagonals./
Die Trägheitsmomente werden aufgrund der nachgiebigen Verbindung Gurte-Diagonalen um 15 % abgemindert.

A [cm²]	I_y [cm⁴]	I_z [cm⁴]	i_y [cm]	i_z [cm]	I_T [cm⁴]
12,72	1057,29	1057,10	9,12	9,11	150

PROLYTE H30D

MATERIAL

Characteristic values of 0,2% proof strength f_o, and ultimate tensile strength f_u according to EC9/ charakteristische Werte für Streckgrenze f_o und Zugfestigkeit f_u gemäß EC9 (see tab. 3.2b; 8.8[1] / siehe Tabelle 3.2b; 8.8[1])

EN AW 6082 T6	[N/mm²]	normal stress/ Normalspannung	shear stress/ Schubspannung
		$\sigma_{R,d} = f / \gamma_{(M1,M2)}$	$\tau_{R,d} = f / (\gamma_{(M1,M2)} \times \sqrt{3})$
f_o: t > 5mm	260,0	236,4	136,5
f_u: t > 5mm	310,0	248,0	
f_o: t < 5mm	250,0	227,3	131,2
f_u: t < 5mm	290,0	232,0	
$f_{o,haz}$	125,0	113,6	65,6
$f_{u,haz}$	185,0	148,0	
$f_w^{(1)}$	190,0	152,0	87,8

All welding seams are done in TIG, according to tab. 3.2b, note 4 $\rho_{i,haz}$ has to be multiplied by 0,8 /
Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist $\rho_{i,haz}$ mit dem Faktor 0,8 zu multiplizieren.

Partial safety factors for ultimate limit states/ Teilsicherheitsbeiwerte für Grenzzustände der Tragfähigkeit

γ_{M1}	1,10
γ_{M2}	1,25
γ_{MW}	1,25

(see tab. 6.1/ siehe Tabelle 6.1)

SUMMARY / ZUSAMMENFASSUNG

normal force chord / Normalkraft Gurte:	$N_{R,d}$ = +-	**50,22 kN**
normal force in the fittings / Normalkraft Verbinder:	$N_{R,d}$ = +-	**52,58 kN**
normal force diagonal vertical / Normalkraft Diagonale vertikal:	$N_{R,d}$ = +-	**10,42 kN**
normal force diagonal horizontal / Normalkraft Diagonale horizontal:	$N_{R,d}$ = +-	**10,42 kN**

DESIGN INTERNAL FORCES COMPLETE TRUSS / BEMESSUNGSSCHNITTGRÖSSEN GESAMTTRAVERSE

bending moment/Biegemoment:	$M_{y,R,d} = N_{R,d,chord\ tube/Gurtrohr} \times$	0,207 =	**10,39 kNm**
bending moment/Biegemoment:	$M_{z,R,d} = N_{R,d,chord\ tube/Gurtrohr} \times$	0,239 =	**12,00 kNm**
normal force/Normalkraft:	$N_{R,d} = 3 \times N_{R,d,chord\ tube/Gurtrohr}$ =		**150,65 kN**
transversal force/Querkraft	$V_{z,R,d} = 2 \times N_{R,d,diagonal} \times$ sin 60° x sin	45,00 ° =	**12,76 kN**
transversal force/Querkraft	$V_{y,R,d} = N_{R,d,diagonal} \times$ sin	45,00 ° =	**7,36 kN**

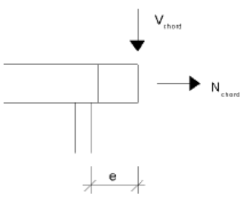
The values shown above are design values. "Permissible loads" or "Working loads" are optained by dividing the stress capacity by 1.5. /
Die oben angegebenen Werte sind Design-Werte. "Zulässige Lasten" bzw. "Gebrauchslasten" erhält man durch Division der Beanspruchbarkeit durch 1,5.

INTERACTION MOMENT-TRANSVERSAL FORCE / MOMENTEN-QUERKRAFT-INTERAKTION

In case of occurance of bending moment and transversal force the following term has to be analysed:
Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

$V_{d,chor-/Gurt} = (1/3) \times V_{d,total/gesamt}$

$M_{d,chord/Gurt} = V_{d,chord/Gurt} \times e$ $e^* = 5,00$



according to term / nach Gl. (6.43):

$\eta = (N_{chord/Gurt,Ed} / N_{Rd})^{1,3} + M_{chord/Gurt,Ed} / M_{Rd} \leq 1$

PROLYTE S40T

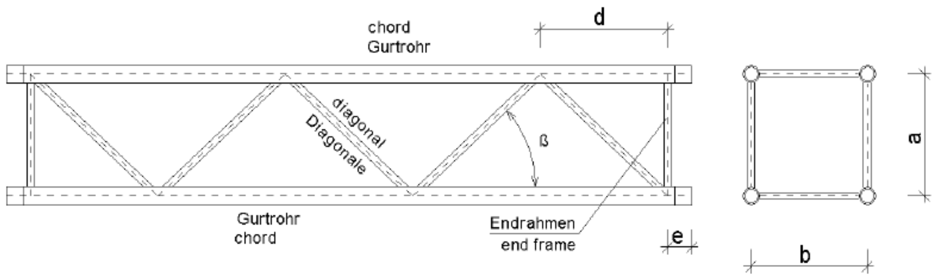
DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE 12,0 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm²]	W [cm³]	I [cm⁴]	I_T [cm⁴]	i [cm]
chords/ Gurte	50,000	4,000	5,781	6,162	15,405	30,810	1,632
diagonals vertical/ Diagonale vertikal	25,000	3,000	2,073	1,022	1,278	2,556	0,785
diagonals horizontal/ Diagonale horizontal	25,000	3,000	2,073	1,022	1,278	2,556	0,785
end frame/ Endrahmen	30,000	3,000	2,545	1,565	2,347	4,695	0,960

TRUSS GEOMETRY/ TRAVERSENGEOMETRIE

Height / Höhe	a [cm]	33,90
Width / Breite	b [cm]	33,90
Distance diagonals vertical / Abstand Diagonalen vertikal	d[cm]	33,90
Angle diagonals vertical / Winkel Diagonalen vertikal	$ß_V$	45,00
Distance diagonals horizontal /Abstand Diagonalen horizontal	d[cm]	33,90
Angle diagonals horizontal / Winkel Diagonalen horizontal	$ß_H$	45,00
	e[cm]	6,00



CROSS SECTION TRUSS/ QUERSCHNITTSWERTE GESAMTTRAVERSE

$A = 4 \times A_{single\ tube/Einzelrohr}$

$I = 0,85 \times (4xI_{single\ tube/Einzelrohr} + 4x\ A_{single\ tube/Einzelrohr} \times (a/2)^2)$

$i = (I / A)^{1/2}$

The moments of inertia are reduced for 15% due to the resilient connection between chords and diagonals./
Die Trägheitsmomente werden aufgrund der nachgiebigen Verbindung Gurte-Diagonalen um 15 % abgemindert.

A [cm²]	I_y [cm⁴]	I_z [cm⁴]	i_y [cm]	i_z [cm]	I_T [cm⁴]
23,12	5698,96	3500,00	15,70	12,30	650

PROLYTE S40T

MATERIAL

Characteristic values of 0,2% proof strength f_o, and ultimate tensile strength f_u
according to EC9/ charakteristische Werte für Streckgrenze f_0 und Zugfestigkeit f_u gemäß EC9
(see tab. 3.2b; 8.8[1] / siehe Tabelle 3.2b; 8.8[1])

EN AW 6082 T6	[N/mm²]	normal stress/ Normalspannung	shear stress/ Schubspannung
		$\sigma_{R,d} = f / \gamma_{(M1,M2)}$	$\tau_{R,d} = f / (\gamma_{(M1,M2)} \times \sqrt{3})$
f_o: t > 5mm	260,0	236,4	136,5
f_u: t > 5mm	310,0	248,0	
f_o: t < 5mm	250,0	227,3	131,2
f_u: t < 5mm	290,0	232,0	
$f_{o,haz}$	125,0	113,6	65,6
$f_{u,haz}$	185,0	148,0	
$f_w^{(1)}$	190,0	152,0	87,8

All welding seams are done in TIG, according to tab. 3.2b, note 4 $\rho_{i,haz}$ has to be multiplied by 0,8 /
Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist $\rho_{i,haz}$ mit dem Faktor 0,8 zu multiplizieren.
Partial safety factors for ultimate limit states/ Teilsicherheitsbeiwerte für Grenzzustände der Tragfähigkeit

γ_{M1}	1,10
γ_{M2}	1,25
γ_{MW}	1,25

(see tab. 6.1/ siehe Tabelle 6.1)

SUMMARY / ZUSAMMENFASSUNG

normal force chord / Normalkraft Gurte:	$N_{R,d}$ = +-	**68,44 kN**
normal force in the fittings / Normalkraft Verbinder:	$N_{R,d}$ = +-	**53,70 kN**
normal force diagonal vertical / Normalkraft Diagonale vertikal:	$N_{R,d}$ = +-	**24,55 kN**
normal force diagonal horizontal / Normalkraft Diagonale horizontal:	$N_{R,d}$ = +-	**24,55 kN**

DESIGN INTERNAL FORCES COMPLETE TRUSS / BEMESSUNGSSCHNITTGRÖSSEN GESAMTTRAVERSE

bending moment/Biegemoment:	$M_{y,R,d} = 2 \times N_{R,d,chord\ tube/Gurtrohr} \times$	0,339 =	**36,41 kNm**
normal force/Normalkraft:	$N_{R,d} = 4 \times N_{R,d,chord\ tube/Gurtrohr} =$		**214,80 kN**
transversal force/Querkraft	$V_{z,R,d} = 2 \times N_{R,d,diagonal} \times \sin$	45,00 ° =	**34,72 kN**

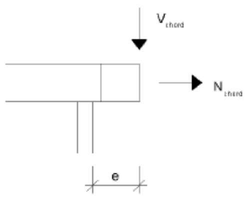
The values shown above are design values. "Permissible loads" or "Working loads" are optained by dividing the stress capacity by 1.5. /
Die oben angegebenen Werte sind Design-Werte. "Zulässige Lasten" bzw. "Gebrauchslasten" erhält man durch Division der Beanspruchbarkeit durch 1,5.

INTERACTION MOMENT-TRANSVERSAL FORCE / MOMENTEN-QUERKRAFT-INTERAKTION

In case of occurance of bending moment and transversal force the following term has to be analysed:
Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

$V_{d,chor-/Gurt} = 0,25 \times V_{d,total/gesamt}$

$M_{d,chord/Gurt} = V_{d,chord/Gurt} \times e$ $\qquad$ $e^* = 6,00$



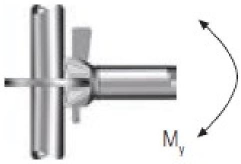
according to term / nach Gl. (6.43):

$\eta = (N_{chord/Gurt,Ed} / N_{Rd})^{1,3} + M_{chord/Gurt,Ed} / M_{Rd} \leq 1$

On the following pages extracts from the catalogue of the firm Layher are shown.

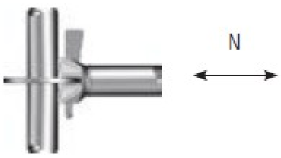
Z-8.22-64: K 2000+

Bending moment



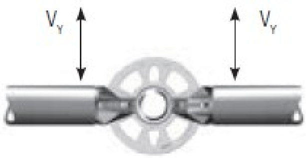
Bending moment
$M_{y,Rd} = \pm 101.0$ kNcm

Normal force

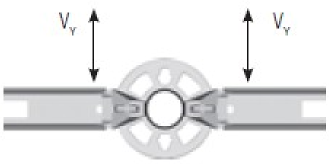


$N_{Rd} = \pm 31.0$ kN

Horizontal lateral force

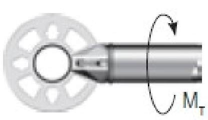


O-ledger: $V_{y,Rd} = \pm 10.0$ kN



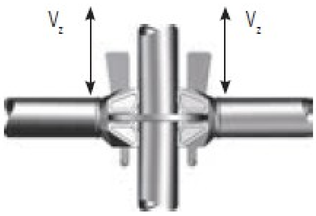
U-ledger: $V_{y,Rd} = \pm 5.9$ kN

Torsional moment



$M_{T,Rd} = \pm 52.5$ kNcm

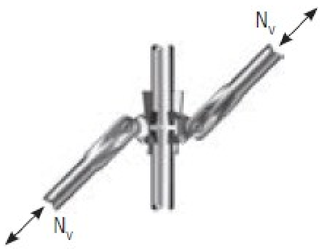
Vertical lateral force



Vertical lateral force, single connection
Vz, Rd = ± 26.4 kN

Vertical lateral force per rosette
∑ Vz, Rd = ± 105.6 kN

Normal force, diagonal braces



Load-bearing capacities of the vertical diagonal braces for bay height 2.00 m for **K 2000+:**

	Pressure								Tension
Bay length [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07	4.14	all bay lenth
$N_{V,Rd}$ [kN]	-16.1	-16.8	-15.5	-14.8	-12.4	-10.2	-8.3	-5.3	+17.9

K 2000+ components can be mixed with components from the LW, Variant II and Variant I versions. See the approvals Z-8.22-64 and Z-8.22-949 for load-bearing capacities.

Rd = stress capacity,
(incorporates part safety coefficient γM)

*"Permissible loads" or "working loads" are obtained by dividing the load-bearing capacity by 1.5 (= γF)

LOADING CAPACITY TABLES

ALLROUND STEEL, ALL THE GIVEN LOADS ARE WORKING LOADS.

K 2000+

on K 2000+ standards

Tab. 3 Load-bearing capacity of O-ledger K 2000+

Ledger length (system dimension) [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Evenly distributed line load (q) [kN/m]	22.1	10.4	6.5	5.3	3.1	2.1	1.5
Individual load (P) in bay centre [kN]	7.4	5.2	4.2	3.8	3.0	2.4	2.1

Tab. 4 Load-bearing capacity of diagonal braces, LW H = 2.00 m

Bay length [m]	Load-bearing capacity perm. D [kN]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Diagonal brace dia. 48 mm		+11.9 - 10.7	+11.9 - 11.2	+11.9 - 10.3	+11.9 - 9.9	+11.9 - 8.3	+11.9 - 6.8	+11.9 - 5.5

Tab. 5 Load-bearing capacity of diag. braces, K 2000+ H = 2.00 m

Bay length [m]	Load-bearing capacity perm. D [kN]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Diagonal brace dia. 48 mm		+11.9 - 10.7	+11.9 - 11.2	+11.9 - 10.3	+11.9 - 9.9	+11.9 - 8.3	+11.9 - 6.8	+11.9 - 5.5

VARIANT II

at Variant II standards

Tab. 6 Load-bearing capacity of O-ledger Variant II

Ledger length (system dimension) [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Evenly distributed line load (q) [kN/m]	22.1	8.8	4.6	3.5	1.8	1.1	0.7
Individual load (P) in bay centre [kN]	7.4	5.2	4.1	3.5	2.4	1.8	1.4

Tab. 7 Load-bearing capacity of diag.l braces, Variant II H = 2.00 m

Bay length [m]	Load-bearing capacity perm. D [kN]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Diagonal brace dia. 48 mm		± 5.6	± 5.6	± 5.6	± 5.6	± 5.6	± 5.6	± 5.6

K 2000+

on K 2000+ standards

Tab. 8 Load-bearing capacity of U-lattice beams, K 2000+

Beam length [m]	2.07	2.57	3.07	4.14	5.14	6.14
Evenly distributed line load (q) [kN/m]*	17.3	12.5	10.2	7.3	5.2	4.3
Individual load (P) in bay centre [kN]*	25.1	26.6	8.2[1] / 19.5[2]	16.2	15.9	10.9

[1] Individual load exactly in the centre of the lattice beam (= between the two central posts)
[2] Individual load above one of the central posts

Tab. 9 Load-bearing capacity of U/O horizontal bridging ledger

Ledger type [m]	U 1.57	U 2.07	U 2.57	U 3.07	O 1.57	O 2.07	O 2.57	O 3.07
Evenly distributed line load (q) [kN/m]	15.2	8.7	5.1	3.6	14.5	8.6	5.4	3.6
Individual load (P) in bay centre [kN]	8.0	6.9	5.3	5.2	10.6	6.9	4.6	3.6

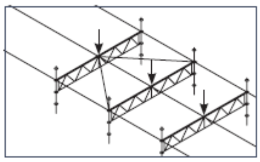
* Lattice beam laid out over the whole area of the series decks, secured with lift-off preventer. Alternatively the top chords of the lattice beam – except for the U-lattice beam 2.57 m – can also be braced by a combination of tubes and couplers connected to the lattice beam posts. Example: Bracing the 4.14 metre lattice beam, see diagram below.

K 2000+

on K 2000+ standards

Tab. 10 Load-bearing capacity of O-lattice beams, K 2000+

Beam length [m]	2.07	2.57	3.07	4.14	5.14	6.14
Evenly distributed line load (q) [kN/m]*	16.7	12.7	10.1	7.3	3.7	3.1
Individual load (P) in bay centre [kN]*	25.4	26.7	11.2[1] / 23.3[2]	25.9	13.9	9.4



Bracing the 4.14 m lattice beam

LIGHTWEIGHT, K 2000+ AND VARIANT II

Tab. 11 a Load-bearing capacity of U/O-ledger LW reinforced

Ledger type	U-LW-V					O-LW-V					
Length [m]	1.40	1.57	2.07	2.57	3.07	1.09	1.40	1.57	2.07	2.57	3.07
Evenly distributed line load (q) [kN/m]	17.1	17.7	13.0	8.4	5.0	21.4	17.1	17.7	13.0	8.4	5.0
Individual load (P) in bay centre [kN]	19.2	17.1	12.9	10.4	8.7	19.6	19.2	17.1	12.9	10.4	8.7

Tab. 11 b Load-bearing capacity of U-ledger (U), reinforced ledger (V), O-ledger (O)

Ledger type and length [m]	U 0.73	U-V 1.09	U-V 1.40	O-V 1.09	O-V 1.29	U-LW 1.09	U-LW 1.40
Evenly distributed line load (q) [kN/m]	19.0	17.3	10.4	21.8	15.6	17.5	10.8
Individual load (P) in bay centre [kN]	6.1	8.8	6.8	11.0	9.3	8.6	6.4

LOADING CAPACITY TABLES

ALLROUND ALUMINIUM, ALL THE GIVEN LOADS ARE WORKING LOADS.

Tab. 29 Inner standard 2.00 m level height

Bay width [m]	0.73		1.09	1.57	2.07	2.57	3.07
Diagonal bracing	A	B	A, B	A, B	A, B	B	B
Permissible vertical load V_I [kN]	15.5	13.7	14.7	14.6	14.4	14.2	14.0

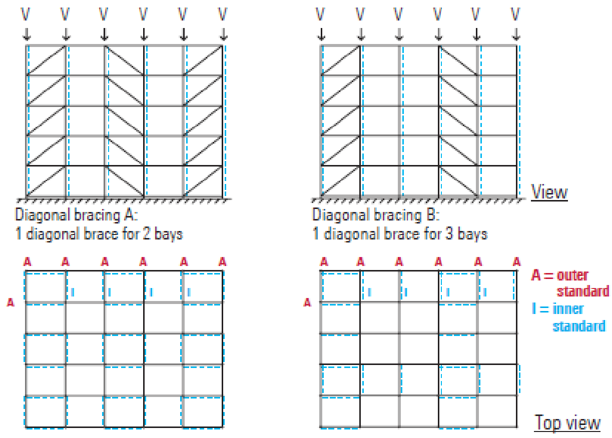
Tab. 30 Outer standard 2.00 m level height

Bay width [m]	0.73		1.09	1.57	2.07	2.57	3.07
Diagonal bracing	A	B	B	B	B	B	B
Permissible vertical load V_A [kN]	13.5	11.5	12.5	12.5	12.1	11.9	11.7

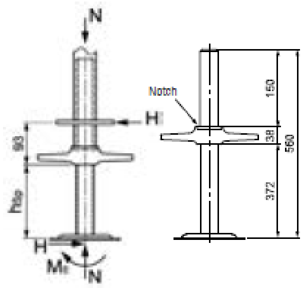
Tab. 31 Load-bearing capacity of aluminium U-ledger (U) and U-ledger reinforced (U-V)

Ledger type and length [m]	0.73 (U)	1.09 (U-V)	1.40 (U-V)
Evenly distributed line load (q) [kN/m]	17.8	10.7	8.4
Individual load (P) in bay centre [kN]	5.9	7.2	5.7

Load-bearing capacity of the aluminium Allround standard



BASE PLATE 60



Substitute cross-sectional values of the spindle

A = 3.84 cm²
W_{el} = 2.61 cm³
W_{pl} = 3.26 cm³
I = 3.74 cm⁴

Material: EN 10219-S235JRH
→ Rolled thread: $f_{y,k}$ = 280.0 N/mm²

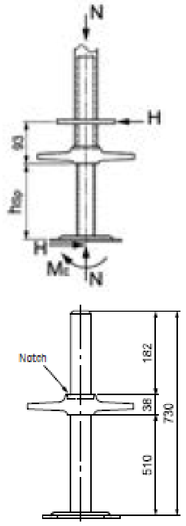
Tab. 12 Base plate loading

Spindle extension length h_{sp} [cm]	Permissible vertical spindle load N [kN]* with simultaneous effect of a horizontal load H [kN]: H = 0.0		H = 0.5		H = 1.0		H = 1.5		H = 2.0		H = 2.5		H = 3.0		H = 3.5		H = 4.0		H = 4.5		H = 5.0		H = 5.5		H = 6.0		Perm. Horizontal load H [kN] if N = 0
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	
0	39	53	39	51	39	51	39	51	39	50	39	49	39	49	38	–	38	–	37	–	36	–	36	–	35	–	26.3
5	39	52	39	51	39	50	39	48	38	–	37	–	36	–	35	–	34	–	33	–	32	–	31	–	30	–	7.8
10	39	51	39	49	38	–	37	–	36	–	34	–	33	–	30	–	29	–	28	–	26	–	25	–	–	–	4.6
15	39	49	38	–	36	–	35	–	33	–	31	–	29	–	–	–	–	–	–	–	–	–	–	–	–	–	3.2
20	38	–	36	–	34	–	32	–	29	–	27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.5
25	37	–	34	–	31	–	28	–	23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.0
30	35	–	31	–	27	–	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.7
35	32	–	27	–	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.5
37	30	–	25	–	17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.4

*The permissible vertical loads are calculated by application of the calculation model according to DIN EN 12811-1, para. 10.2.3.2. To obtain the bending stiffness of the upright tube, the internal force components from second-order theory and the maximum load-bearing capacity of the uprights, the following birdcage scaffolding with configuration dimension 2.57 x 2.57 m was considered:
2.00 m level height for compression forces in the standard $N_1 \leq 39$ kN
1.50 m level height for compression forces in the standard 39 kN < $N_2 \leq 54$ kN

(–) With this combination of spindle extension length and horizontal load, the bending stress capacity of the spindle is exceeded.

BASE PLATE 80 REINFORCED



Tab. 13 Base plate loading																																							
Spindle extension length h_{sp} [cm]	Permissible vertical spindle load N [kN]* with simultaneous effect of a horizontal load H [kN]																																						Perm. Horizontal load H [kN] if N = 0
	H = 0			H = 0.5			H = 1.0			H = 1.5			H = 2.0			H = 2.5			H = 3.0			H = 3.5			H = 4.0			H = 4.5			H = 5.0			H = 5.5			H = 6.0			
	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	
0	39	54	69	39	54	69	39	54	68	39	54	68	39	53	–	39	53		39	53	–	39	52	–	38	–	–	38	–	–	38	–	–	38	–	–	38	–	–	30.0
5	39	54	68	39	53	–	39	53	–	39	52	–	38	–	–	38	–	–	38	–	–	37	–	–	37	–	–	37	–	–	35	–	–	35	–	–	34	–	–	8.9
10	39	53	–	39	52	–	38	–	–	38	–	–	38	–	–	38	–	–	36	–	–	35	–	–	34	–	–	32	–	–	29	–	–	29	–	–	–	–	–	5.2
15	39	53	–	38	–	–	38	–	–	37	–	–	36	–	–	35	–	–	33	–	–	31	–	–	29	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.7
20	38	–	–	38	–	–	37	–	–	36	–	–	33	–	–	31	–	–	28	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.8
25	38	–	–	37	–	–	35	–	–	33	–	–	30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.3
30	37	–	–	36	–	–	33	–	–	28	–	–	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.0
35	36	–	–	33	–	–	27	–	–	17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.7
40	34	–	–	30	–	–	23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.5
45	32	–	–	26	–	–	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.3
51	27	–	–	18	–	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.2

*The permissible vertical loads are calculated by application of the calculation model according to DIN EN 12811-1, para. 10.2.3.2. To obtain the bending stiffness of the upright tube, the internal force components from second-order theory and the maximum load-bearing capacity of the uprights, the following birdcage scaffolding with configuration dimension 2.57 x 2.57 m was considered:
2.00 m level height for compression forces in the standard $N_1 \leq 39$ kN
1.50 m level height for compression forces in the standard 39 kN < $N_2 \leq 54$ kN
1.00 m level height for compression forces in the standard 54 kN < $N_3 \leq 76$ kN

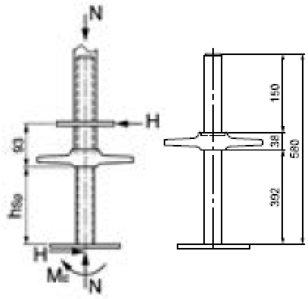
(–) With this combination of spindle extension length and horizontal load, the bending stress capacity of the spindle is exceeded.

Substitute cross-sectional values of the spindle

A	= 4.71 cm²
W_{el}	= 2.97 cm³
W_{pl}	= 3.71 cm³
I	= 4.29 cm⁴

Material: EN 10219-S235JRH
→ Rolled thread: $f_{y,k}$ = 280.0 N/mm²

BASE PLATE 60 SOLID



Tab. 14 Base plate loading																										
Spindle extension length h_{sp} [cm]	Permissible vertical spindle load N [kN]* with simultaneous effect of a horizontal load H [kN]																									Perm. Horizontal load H [kN] if N = 0
	H = 0		H = 0.5		H = 1.0		H = 1.5		H = 2.0		H = 2.5		H = 3.0		H = 3.5		H = 4.0		H = 4.5		H = 5.0		H = 5.5		H = 6.0		
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	
0	54	69	54	69	54	68	54	67	53	–	53	–	53	–	52	–	52	–	51	–	51	–	50	–	50	–	43.6
5	54	68	53	–	53	–	52	–	52	–	51	–	50	–	49	–	48	–	48	–	47	–	46	–	45	–	14.1
10	53	–	53	–	52	–	49	–	49	–	48	–	47	–	46	–	45	–	44	–	42	–	41	–	40	–	8.4
15	53	–	51	–	50	–	48	–	47	–	47	–	44	–	43	–	41	–	39	–	38	–	36	–	34	–	6.0
20	51	–	50	–	48	–	46	–	44	–	42	–	40	–	38	–	36	–	35	–	–	–	–	–	–	–	4.7
25	50	–	48	–	45	–	43	–	41	–	39	–	37	–	34	–	–	–	–	–	–	–	–	–	–	–	3.8
30	48	–	45	–	43	–	40	–	38	–	34	–	15	–		–	–	–	–	–	–	–	–	–	–	–	3.2
35	45	–	42	–	40	–	36	–	27	–	12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.8
39	42	–	39	–	35	–	25	–	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.5

*The permissible vertical loads are calculated by application of the calculation model according to DIN EN 12811-1, para. 10.2.3.2. To obtain the bending stiffness of the upright tube, the internal force components from second-order theory and the maximum load-bearing capacity of the uprights, the following birdcage scaffolding with configuration dimension 2.57 x 2.57 m was considered:
2.00 m level height for compression forces in the standard $N_1 \leq 39$ kN
1.50 m level height for compression forces in the standard 39 kN < $N_2 \leq 54$ kN

(–) With this combination of spindle extension length and horizontal load, the bending stress capacity of the spindle is exceeded.

Substitute cross-sectional values of the spindle

A	= 8.80 cm²
W_{el}	= 3.84 cm³
W_{pl}	= 4.79 cm³
I	= 6.51 cm⁴

Material: EN 10025-2-S355J2
→ Rolled thread: f_{yk} = 360,0 N/mm²