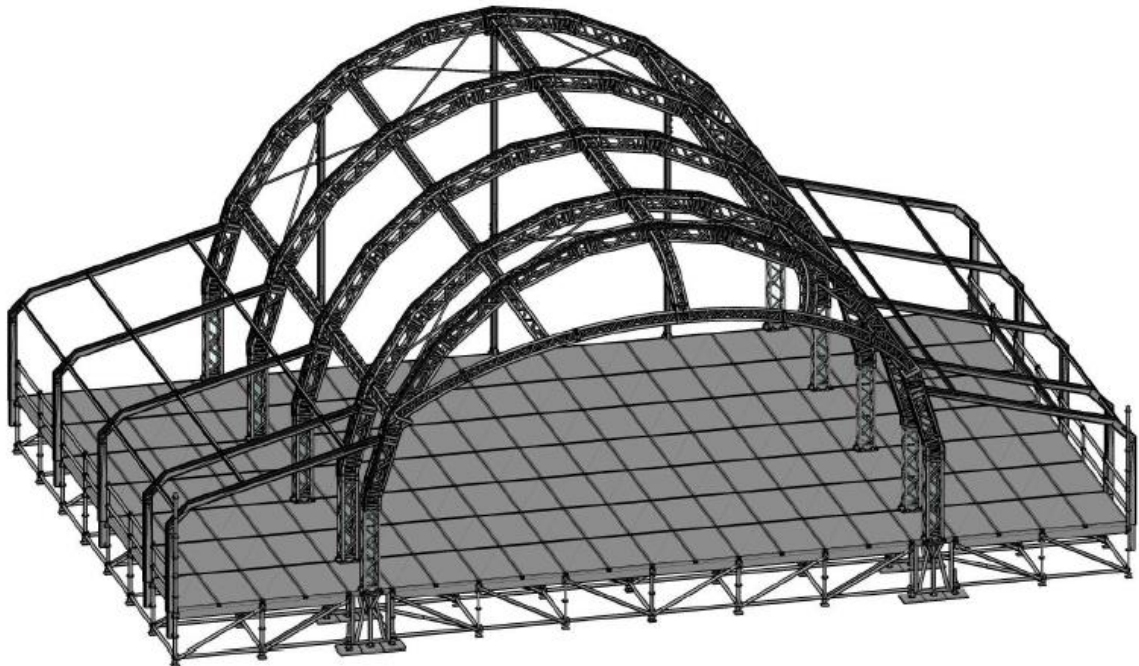


PODIUM – BOEK

ATLAS

Eekels Verhuur 112023-18



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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 podiumboek op te stellen waarin deze zaken overzichtelijk en begrijpelijk worden weergegeven, 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..

Hallenstraat 20

P.O. Box 175

5530 AB Bladel

T: +31 0 73 6136867

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 – H30V – H40V
Type zeil	PVC; artikel 8509 5240

1.2 Algemene gegevens;

Naam	Tunnel Roof 16x14 – 16x10 – 12x14 – 12x10
Type	ATLAS
Configuratie(s)	16x14 – 16x10 meter – (12x14 – 12x10 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: 16x14 – 16x10 meter – (12x14 – 12x10 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.

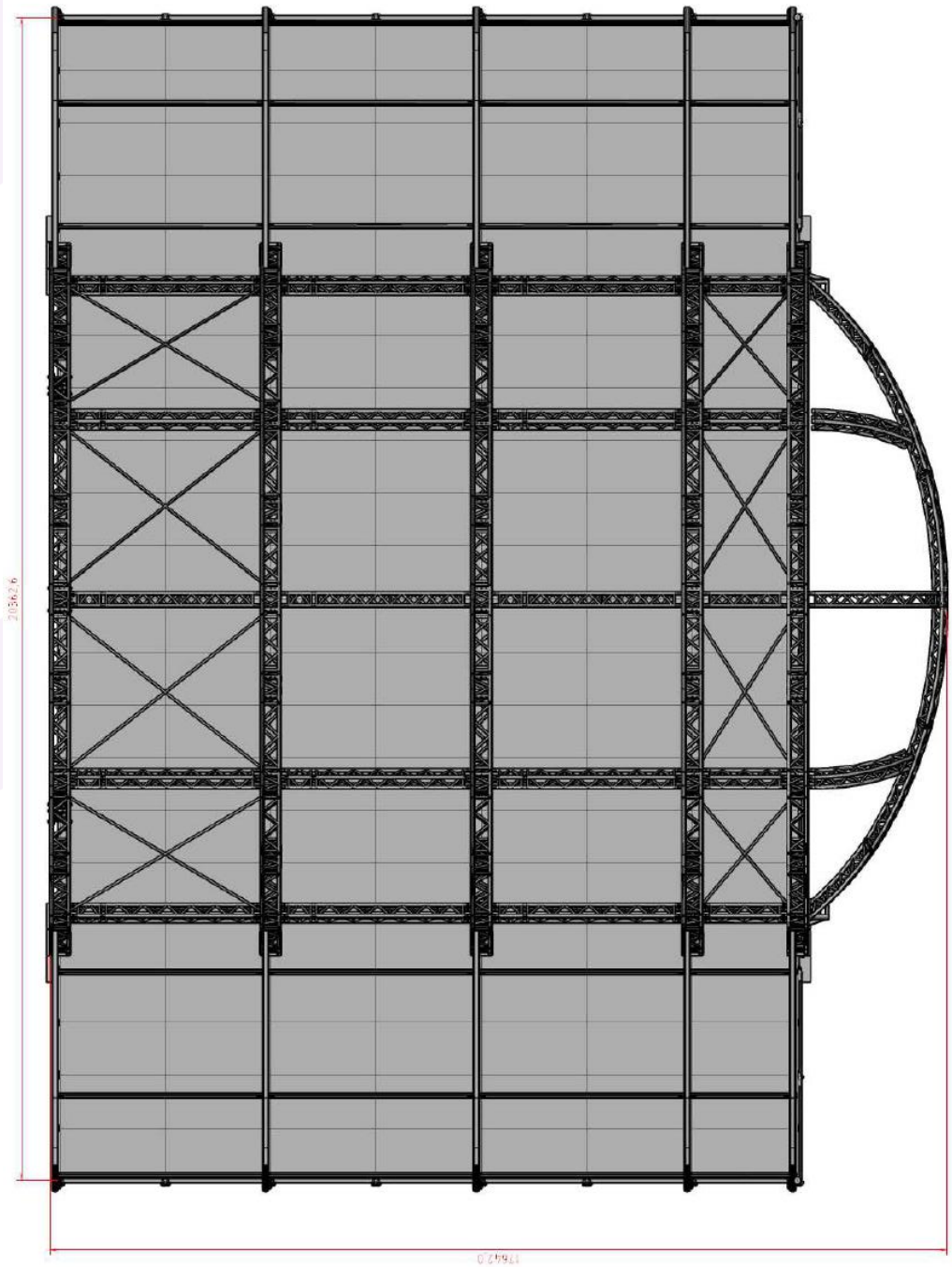
De windkracht volgens de Schaal van Beaufort (bron: KNMI). De schaal van Beaufort wordt gebruikt voor de gemiddelde windsnelheid, over minstens 10 minuten gemeten, niet voor de snelheid van rukwinden/windstoten (piekwind).

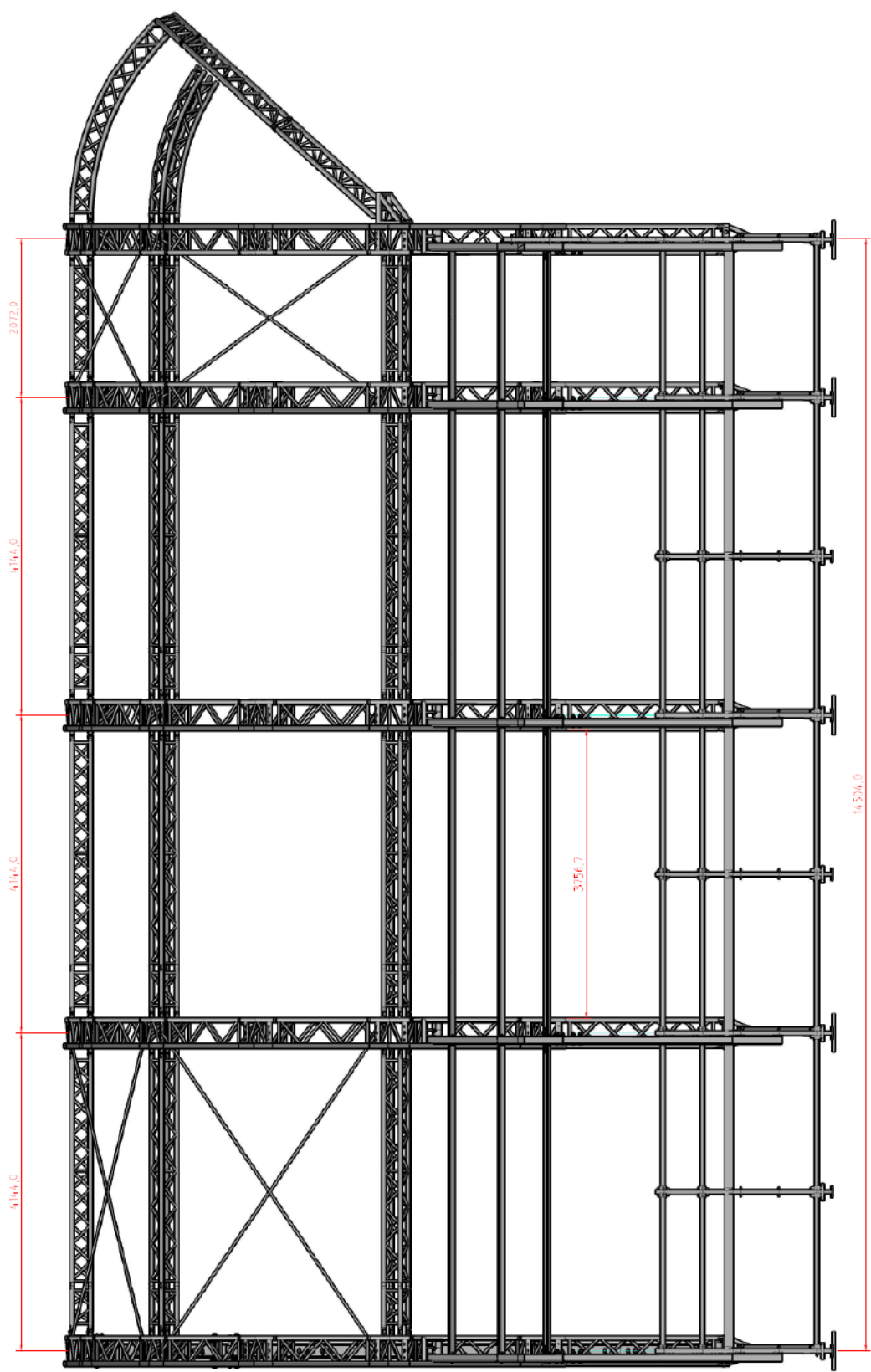
Kracht	Benaming van KNMI	Benaming in Zeevaart	Snelheid in km/h*	Snelheid in m/s*	Snelheid in knopen
0	Stil	Windstil	0-1	0-0,2	0-1
1	Zwak	Flauw en stil	1-5	0,3-1,5	1-3
2	Zwak	Flauwe koelte	6-11	1,6-3,3	4-6
3	Matig	Lichte koelte	12-19	3,4-5,4	7-10
4	Matig	Matige koelte	20-28	5,5-7,9	11-16
5	Vrij krachtig	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.

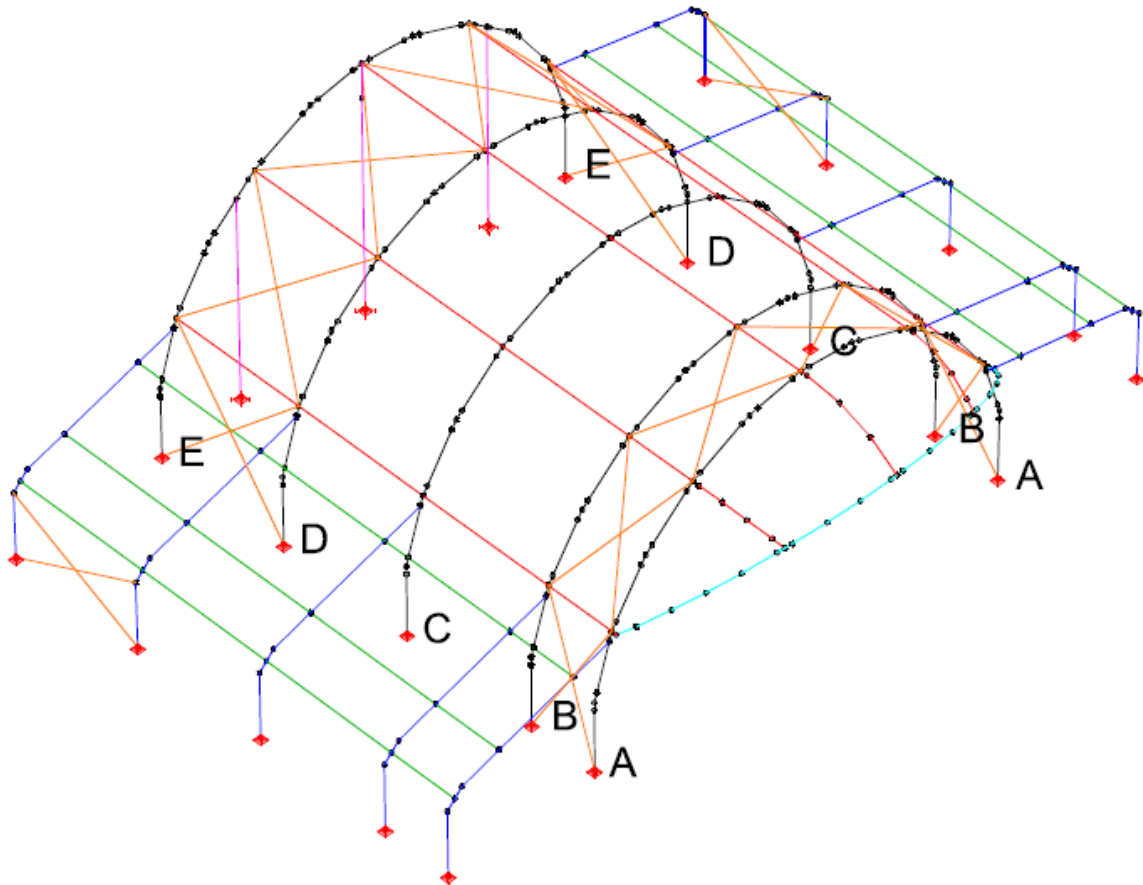
Organisator kan ook bij onder andere Meteovista en Meteoconsult gedurende de duur van het evenement een weerbewakingscontract aangaan om nog beter op de hoogte te zijn van de lokale weersomstandigheden.

6 Bijlage I: Tekening(en)





7 Bijlage II: Ballastplan



OVERVIEW BALLAST LOADS

friction coefficient $\mu = 0,40$ or better

all values in [kg]

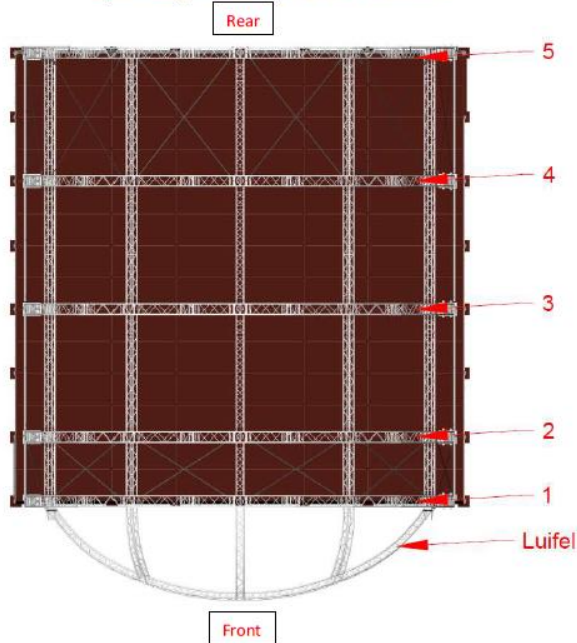
	A	B	C	D	E
16x14	3000	2200	1300	2500	2500
16x10	3000	2200	-	2500	2500

8 Bijlage III: Riggingscapaciteit

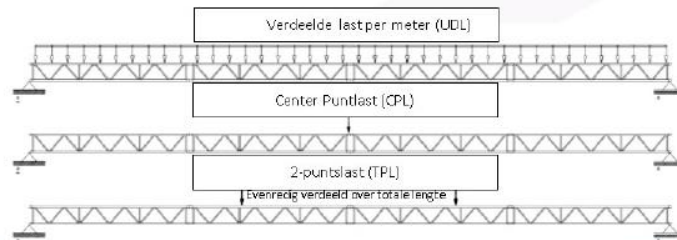


Riggingscapaciteit ATLAS 196/140

Bij uitvoering in opstelling Atlas140 vervalt truss 4



Naam	Waarde	Maximale Gebruiksbelasting per punt	
		1 t/m 5	Luifel
A. Verdeelde last per meter (UDL)	kg/m	100	20
B. Center puntlast (CPL)	kg	900	Zie A
C. 2-puntslast (TPL)	kg	800	Zie A
D. 4-puntslast (FPL)	kg	500	Zie A



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

Figuur 1

+31 497 870 136



sales@eekelsverhuur.nl



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Eekels Verhuur BV
Hallenstraat 20
5531 AB Bladel



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.

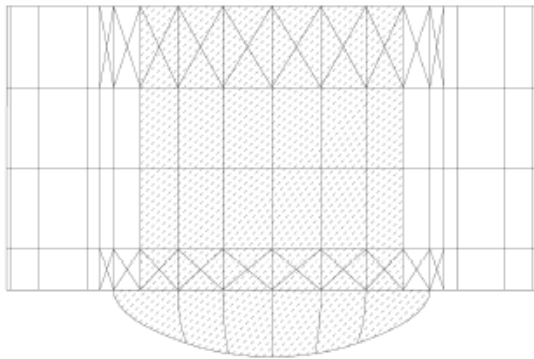
Bij vragen of twijfel over dit plan kunt u altijd contact opnemen met Eekels Verhuur B.V.

WIND MANAGEMENT

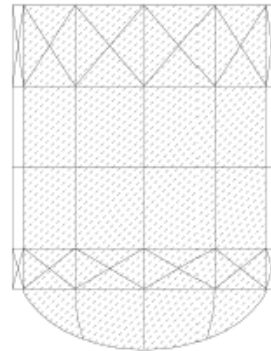
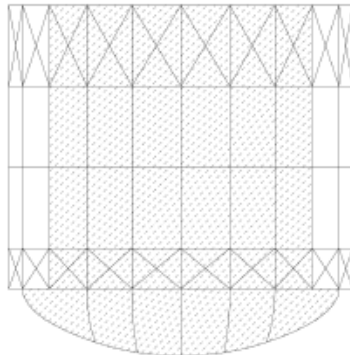
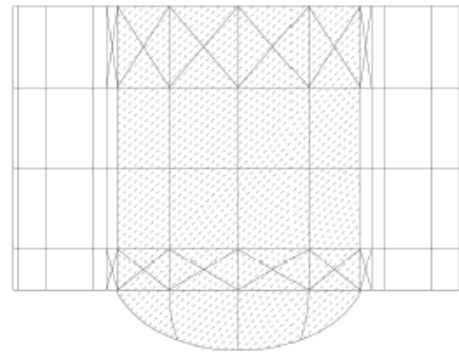
The construction is calculated to withstand peak gust wind speed up to 20 m/s (wind force 8).

Above peak gust wind speed of 20 m/s measured in a height of 10m the canopy of the rear wall, sidestages, sides and parts of the roof must be removed. Only the shaded area can be kept enclosed with canopy

16x14 / 16x10



12x14 / 12x10



If the peak gust wind speed is measured in a height less than 10m the canopies must be removed at 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 wall canopies and partly removed side wall canopies is calculated according to DIN EN 13814. It is calculated with a wind pressure of 0,44/0,625 kN/m².

10 Bijlage V: Zeilcertificaat



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/m ²	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	
Hafffestigkeit	20 N/cm	PA 09.03 (item)	
Kältebeständigkeit.	-40 °C	DIN EN 1876-1	
Wärmebeständigkeit	+70 °C	PA 07.04 (item)	
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.

11 Bijlage VI: Berekening

STRUCTURAL ANALYSIS

PROJECT-NO.:	16079	
PROJECT:	STAGEROOF TUNNELROOF 16x14, 16x10, 12x14, 12x10m GIOVANNI EEKELS	
CUSTOMER/ AUFTRAGGEBER:	PROLYTE GROUP	
	Industriepark 9 9531 PA Leek The Netherlands	

PREPARED/AUFGESTELLT:  DIPL.-ING. STEFAN KRASENBRINK	DATE/DATUM: 10.04.2016 PAGES/SEITEN: 1 – 231
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. DIE STATISCHE BERECHNUNG IST AUSSCHLIESSLICH AUFGESTELLT FÜR DEN OBEN GENANNTEN AUFTRAGGEBER. EINE WEITERGABE AN DRITTE IST NUR MIT VORHERIGER GENEHMIGUNG DES AUFSTELLERS MÖGLICH. EINE VERÖFFENTLICHUNG JEGLICHER ART IST NICHT GESTATTET.	

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SPARKASSE AACHEN
IBAN: DE90 3905 0000 0000 0234 08
BIC: AACSD33

HANDELSREGISTER AACHEN ■ HRA 8099 ■ AMTSGERICHT AACHEN ■ UST-ID-NR.: DE 283641951
GESCHÄFTSFÜHRER: KRASENBRINK + BASTIANS VERWALTUNGSGESELLSCHAFT MBH
PERSÖNLICH HAFTENDE GESELLSCHAFTER: KRASENBRINK+BASTIANS VERWALTUNGSGESELLSCHAFT MBH ■ LOTHRINGERSTR. 37 ■ 52062 AACHEN ■ HANDELSREGISTER AACHEN ■ HRB 17597 ■ AMTSGERICHT AACHEN

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PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

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PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

1 PREAMBLE

1.1 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
steel wires/ Drahtseile aus Stahldraht

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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1.2 SUPPORTINGS DOCUMENTS

Technical data of the used truss system

PROLYTE H30D
 H30V
 H40V

Technical data of the used scaffolding system LAYHER-ALLROUND

1.3 CONSTRUCTION ELEMENTS

roof girder: Prolyte H40V main bow
 Alloy: EN AW-6082 T6 (AlMgSi1 F31)

compression member roof:
 Prolyte H30V
 Alloy: EN AW-6082 T6 (AlMgSi1 F31)

border girder cantilever roof:
 Prolyte H30D
 Alloy: EN AW-6082 T6 (AlMgSi1 F31)

guy wires: 10mm - 1770 N/mm² max.force: 17 kN

The specifications of the steel cables given in the report are only examples. Equal wires are possible.

baseadapter: steel S235 (St 37-2)

podium: Layher Allround

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1.4 GENERAL PRELIMINARY REMARKS

This report covers a tunnel stage roof structure for Prolyte Group.

The roof can be assembled in the 4 sizes 16x14m, 16x10m, 12x14 and 12x10m. The maximum height is approx. 11,40m. Alternatively each size can be build up with side stages made from keder profiles as well.

16x14m
16x14m + sidestage

16x10m
16x10m + sidestage

12x14m
12x14m + sidestage

12x10m
12x10m + sidestage

The stage roof is considered to be a temporarily demountable structure and not a permanent building.

The whole structural framework consists of aluminium trusses made by the company Prolyte and are made from aluminium AlMgSi1 F31/ EN AW 6082 T6.

The roof area is enclosed with canopies. In case of side stages, these are closed on three sides with canopies as well.

The rear wall canopies are fixed at the vertical keder profiles and on the lower part of the rear bow.

The side stage canopies are fixed on the keder profiles.

The structure is stiffened by means of guy wires in between the front bows and the rear bows. Guy wires need to be adequately tensioned before use.

The roof is always build up upon a layher-podium with system heigths of either 1,0m or 1,50m.

The security against sliding and overturning is ensured by means of balast loads (see chapter 1.9)

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1.5 TERMS OF USE

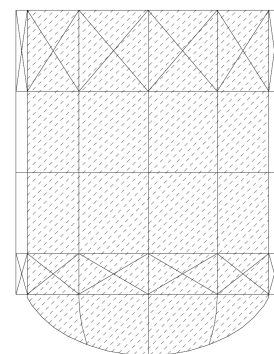
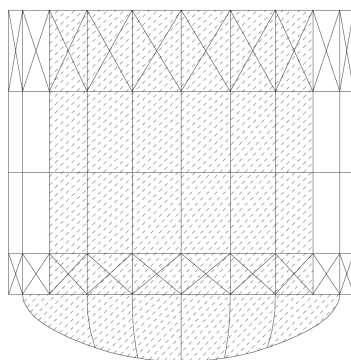
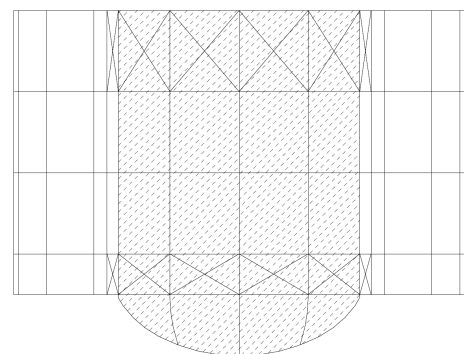
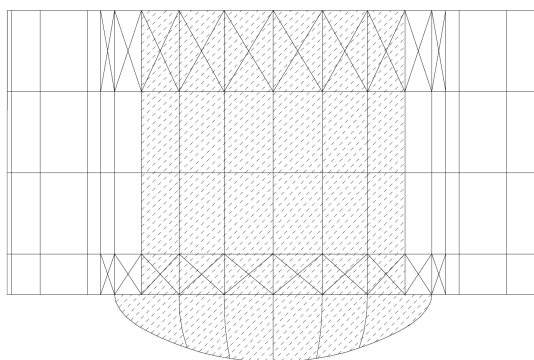
WIND MANAGEMENT

The construction is calculated to withstand peak gust wind speed up to **20 m/s** (wind force 8).

Above peak gust wind speed of 20 m/s measured in a height of 10m the canopy of the rear wall, sidestages, sides and parts of the roof must be removed. Only the shaded area can be kept enclosed with canopy

16x14 / 16x10

12x14 / 12x10



If the peak gust wind speed is measured in a height less than 10m the canopies must be removed at 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 wall canopies and partly removed side wall canopies is calculated according to DIN EN 13814. It is calculated with a wind pressure of 0,44/0,625 kN/m².

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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

The construction may be used with the payloads shown in chapter 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 has to be locked to the construction in such a way that it can not slide or fall off.

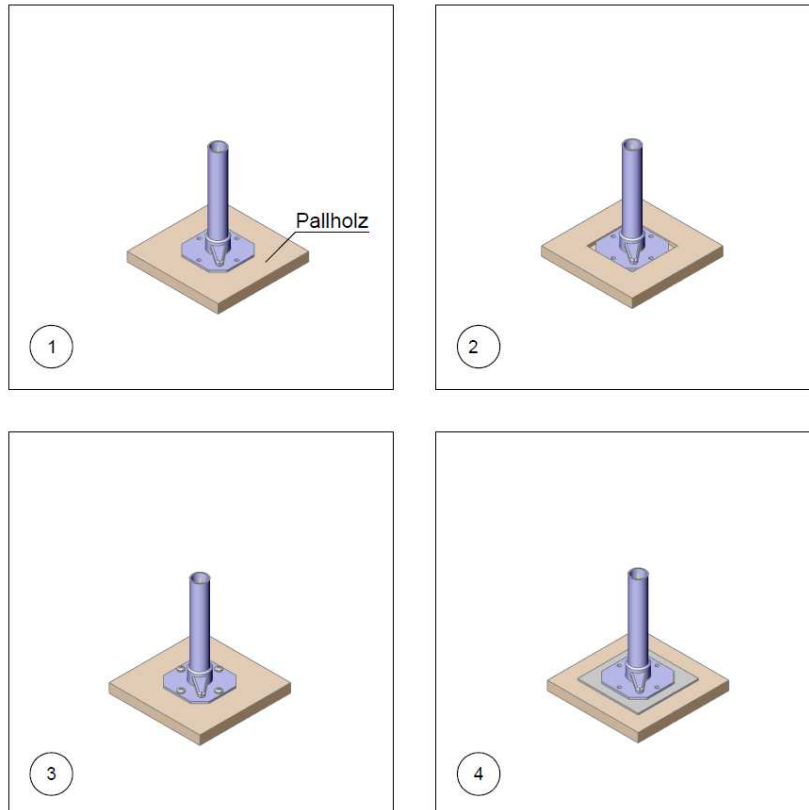
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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TIMBER SPREADER

drivable surface: timber spreader 300x300x20mm

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 $\mu = 0,40$
- 2: Spindle on timber spreader, embeded $\mu = 0,60$
- 3: Spindle on timber spreader, screwed $\mu = 0,60$
- 4: Spindle on rubber mat $\mu = 0,60$

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.

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1.6 LOADING ASSUMPTIONS

1.6.1 WINDLOADS

load assumption according to DIN EN 13814 and DIN EN 1991-4

wind speed according to DIN EN 13814:

average wind $v_{ref} = v_b = 15 \text{ m/s}$

for the terrain III follows wind speed of:

$h < 8\text{m}$	$v_p = 1,27 \times 15 \times (8/10)^{0,155}$	$= 18,40 \text{ m/s}$
$8 < h < 20\text{m}$	$v_p = 1,27 \times 15 \times (20/10)^{0,155}$	$= 21,21 \text{ m/s}$
$20 < h < 35\text{m}$	$v_p = 1,27 \times 15 \times (35/10)^{0,155}$	$= 23,13 \text{ m/s}$
$35 < h < 50\text{m}$	$v_p = 1,27 \times 15 \times (50/10)^{0,155}$	$= 24,44 \text{ m/s}$

in due to this there could be calculated the following velocity pressures:

$h < 8\text{m}$	$q_p = 18,40^2/1600 = 0,21 \text{ kN/m}^2$
$8 < h < 20\text{m}$	$q_p = 21,21^2/1600 = 0,28 \text{ kN/m}^2$
$20 < h < 35\text{m}$	$q_p = 23,13^2/1600 = 0,33 \text{ kN/m}^2$
$35 < h < 50\text{m}$	$q_p = 24,44^2/1600 = 0,38 \text{ kN/m}^2$

the following wind pressures are be required:

Table out of DIN EN 13814

Table 1 — Wind pressure values for amusement devices

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

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Load case „in service“:

$$h = 0 \leq 8\text{m}: q = 0,20 \text{ kN/m}^2$$

$$h = 8 \leq 20\text{m}: q = 0,30 \text{ kN/m}^2$$

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 .

$$h = 0 \leq 8 \text{ m}: q_p = 0,35 / 0,8 = 0,4375 \text{ kN/m}^2$$

$$h = 8 \leq 20 \text{ m}: q_p = 0,50 / 0,8 = 0,625 \text{ kN/m}^2$$

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

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BEAUFORT SCALE				
BEAUFORT NUMBER [BEAUFORT]	WIND SPEED [m/s]	WIND PRESSURE Q [kN/m ²]	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	Gentle 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 wind.
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.

$V \text{ [m/s]} = v \text{ [km/h]} / 3.6$

$q \text{ [kN/m}^2\text{]} = V^2 / 1600$

Note:

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

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1.6.2 MEMBRANE TENSION

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

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

$$\text{with } Z_z = 0.5 * 0.4 * 5.0 / 2 = 0.50 \text{ kN/m}$$

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

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

1.6.3 SNOW LOADING

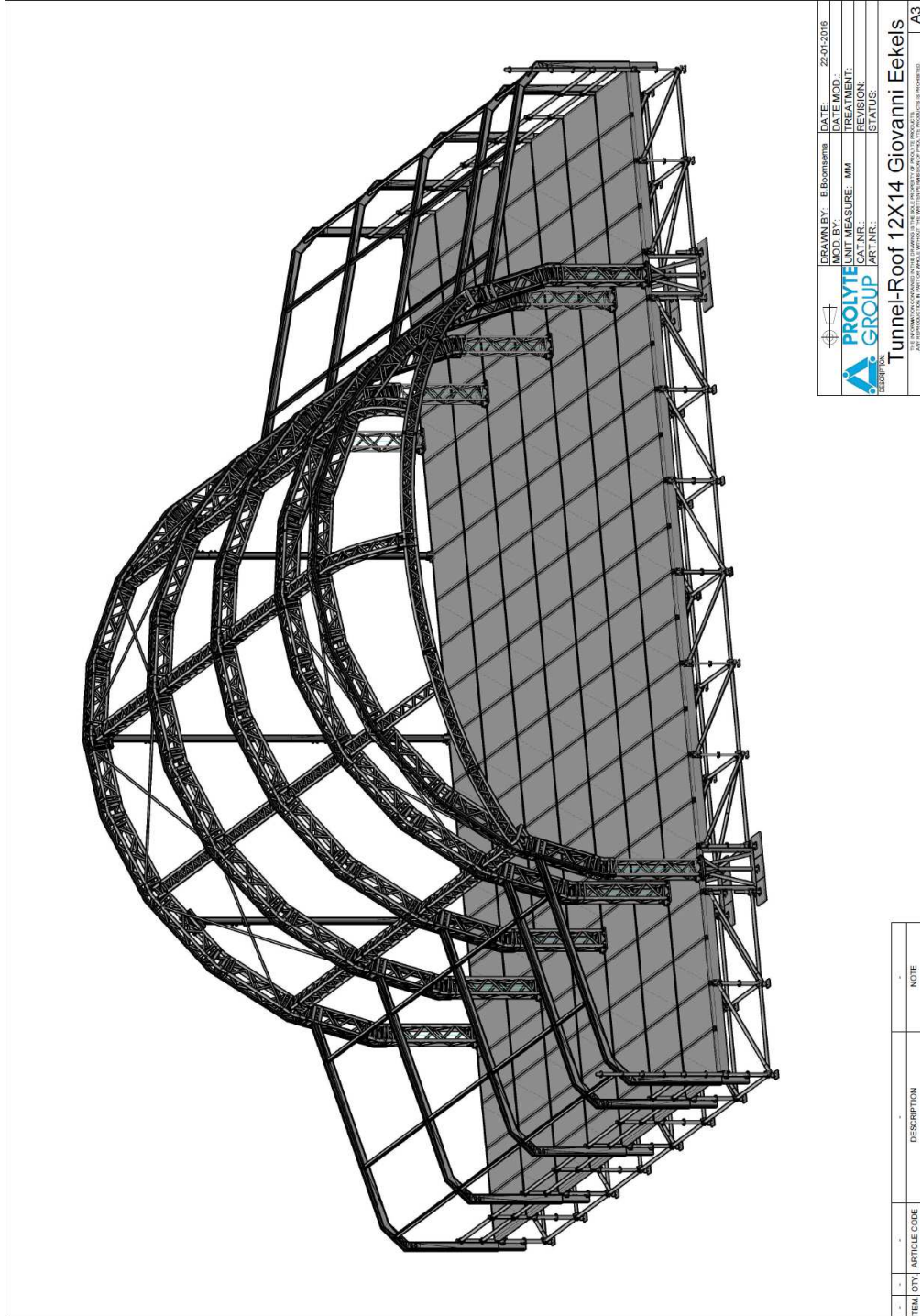
Snow loads are not taken into account.

Building up of the structure shall only be made in appropriate weather conditions or the roof shall be kept free from snow.

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1.7 DRAWINGS

Exemplary the size 12x14 is shown.



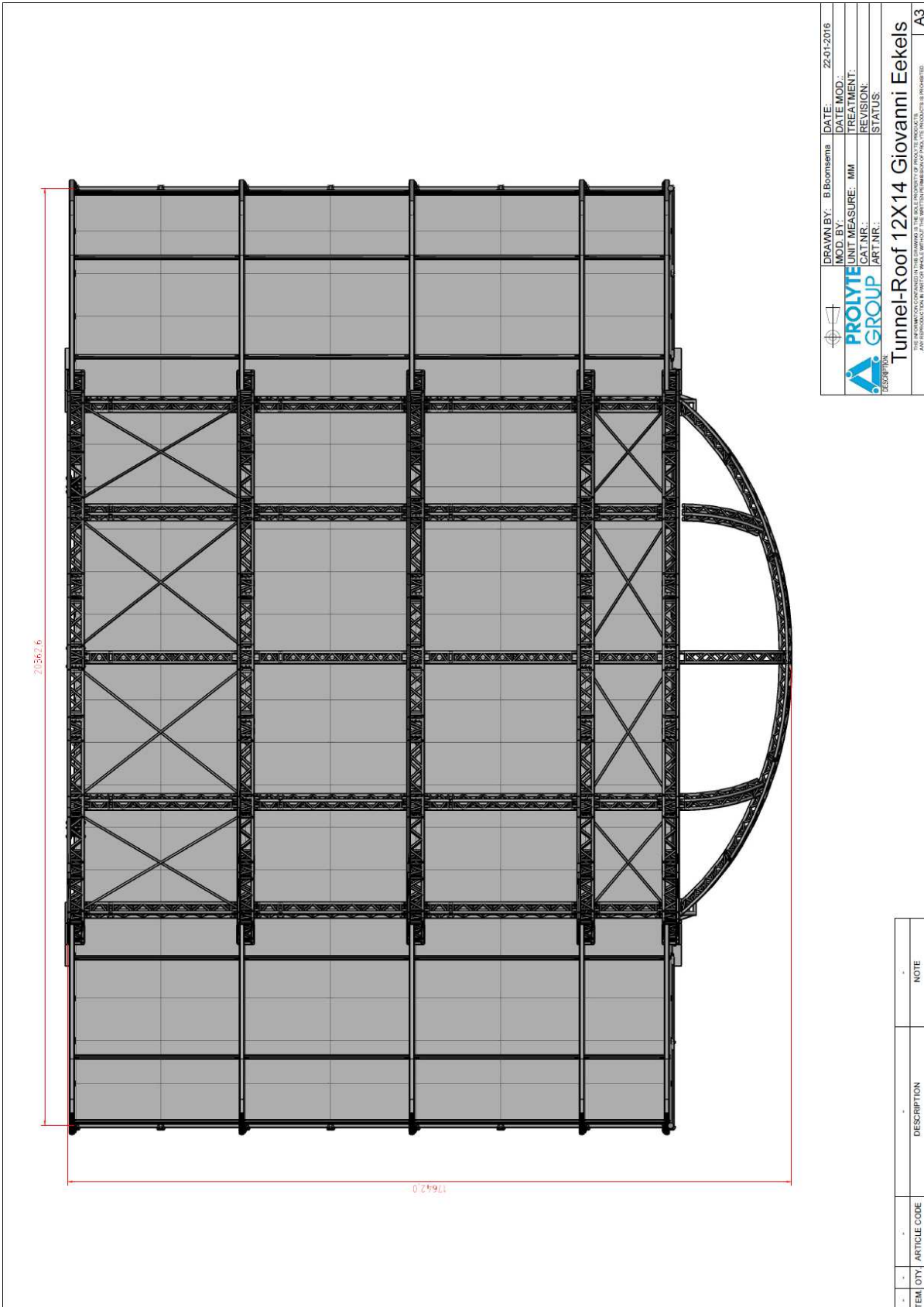
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CAT. NR.:	STATUS: 1
ART. NR.:	

PROLYTE GROUP
 TUNNEL-ROOF 12X14 Giovanni Eekels

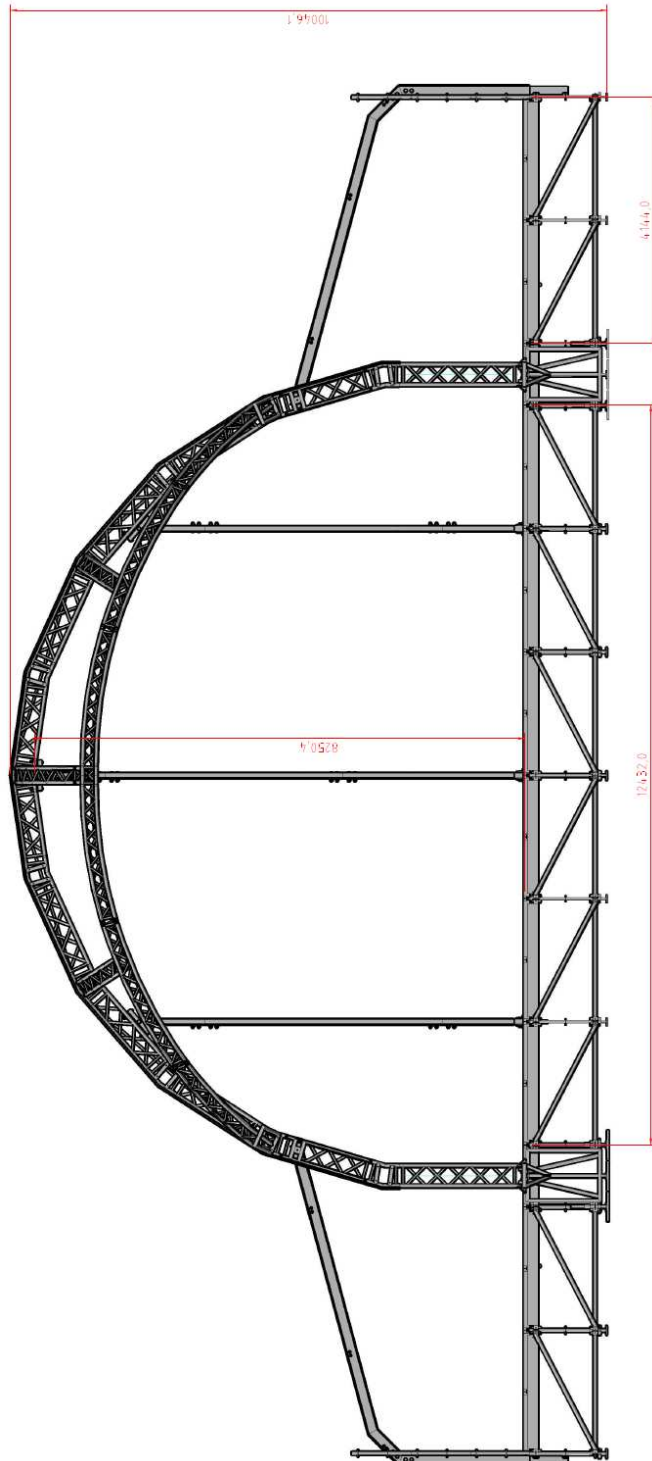
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ITEM / QTY / ARTICLE CODE	DESCRIPTION	NOTE

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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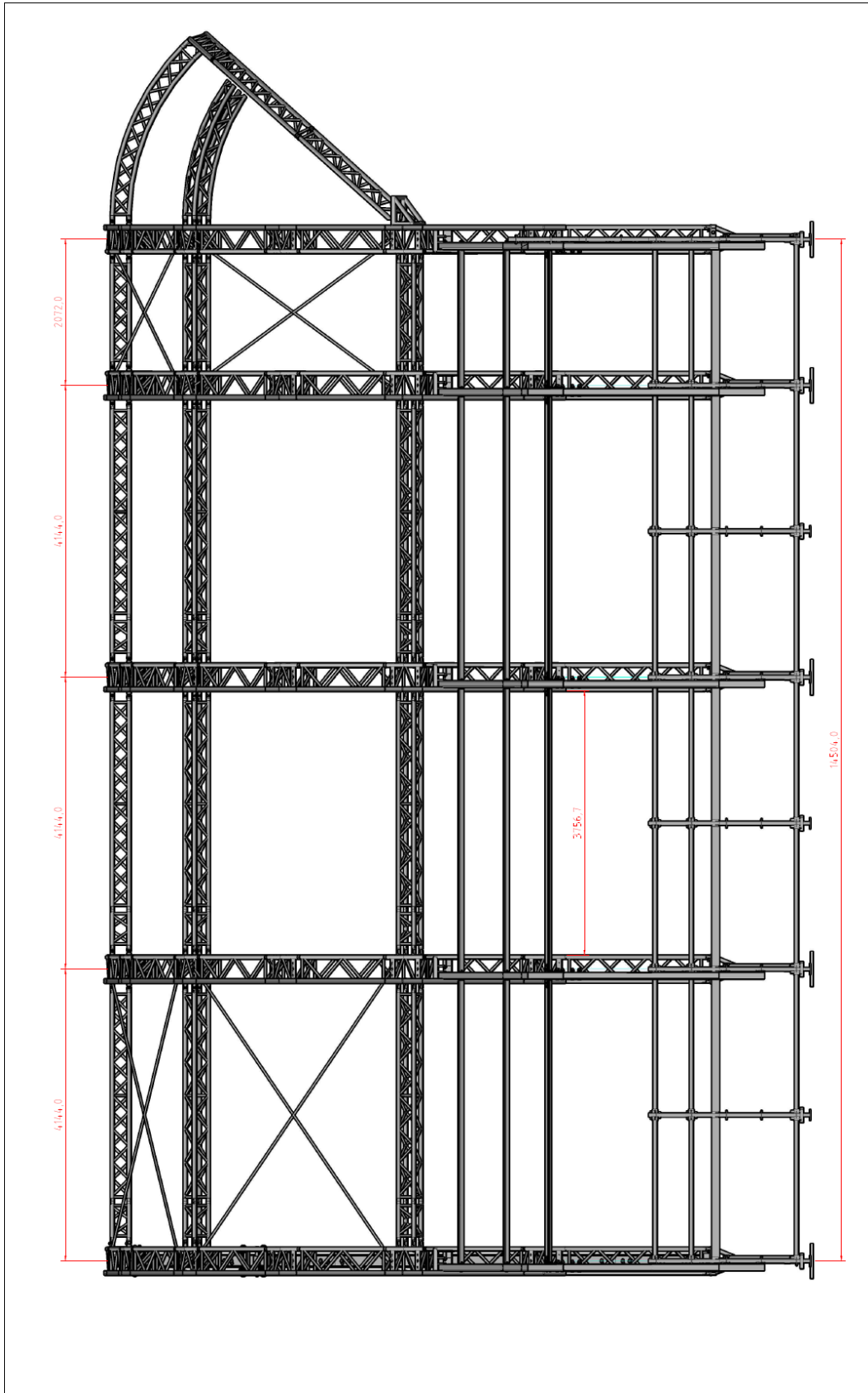
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016




DRAWN BY: B Boomsma	DATE: 22-01-2016
MOD. BY:	DATE MOD.:
UNIT MEASURE: MM	TREATMENT:
CAT. NR.:	REVISION:
ART. NR.:	STATUS:
	
Tunnel-Roof 12X14 Giovanni Eekels	
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ITEM	QTY	ARTICLE CODE	DESCRIPTION	NOTE

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CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



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MOD. BY:	DATE MOD.:
UNIT MEASURE: MM	TREATMENT:
CAT. NR.:	REVISION:
ART. NR.:	STATUS:
	
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ITEM	QTY	ARTICLE CODE	DESCRIPTION	NOTE

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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 ups, please inform Prolyte or the Engineering office Krasenbrink+Bastians.

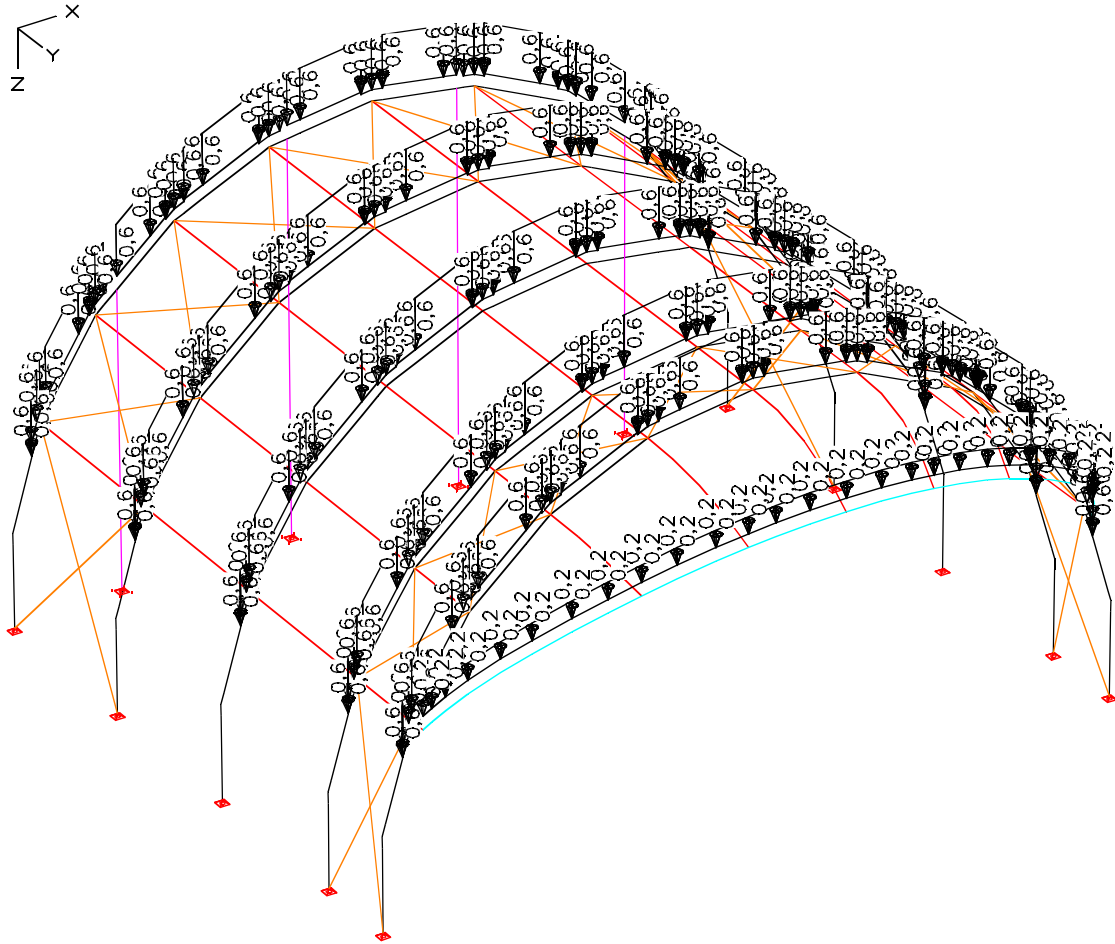
Loads up to 100 kg can be fastened at any position of the chord. Loads more than 100 kg have to be positioned at the node or adequate proofs have to be carried out. Loads shall be equally distributed over the trusses main chords.

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

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System 16x14/16x10

**distributed load
[kN/m]**

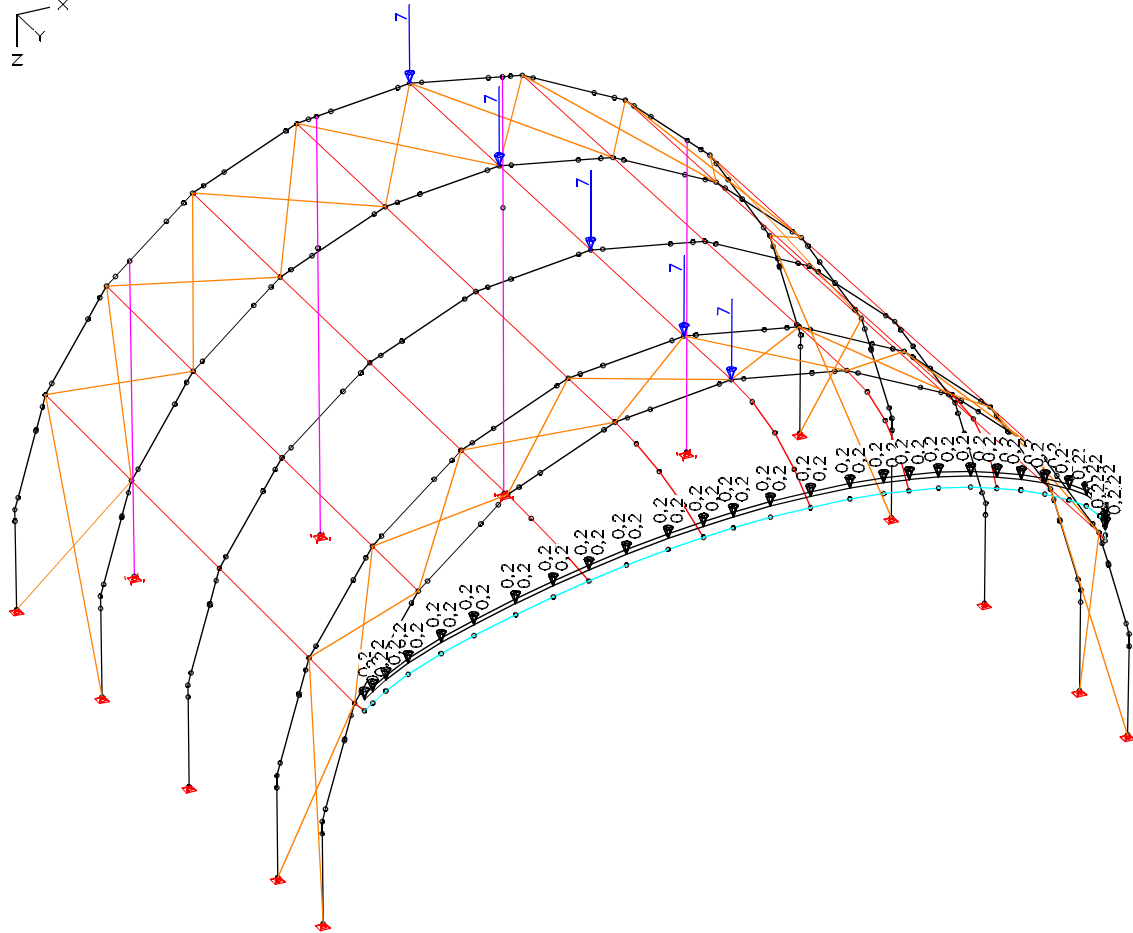


0,10 kN/m = 10 kg/m

	front	rear	center	cantilever roof
	60 kg/m	60 kg/m	60 kg/m	20 kg/m

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center point load
[kN]

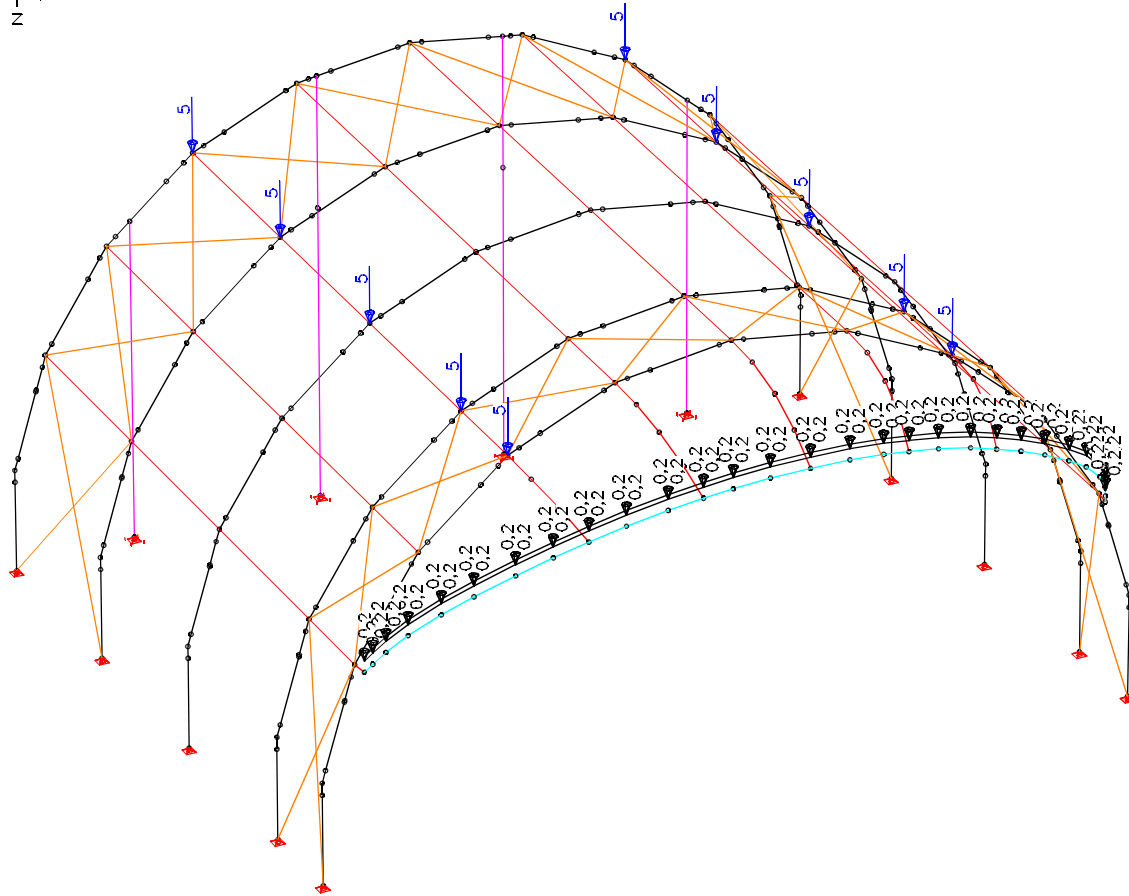


0,10 kN = 10 kg

	front	rear	center	cantilever roof
	700 kg	700 kg	700 kg	20 kg/m

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third point load
[kN]

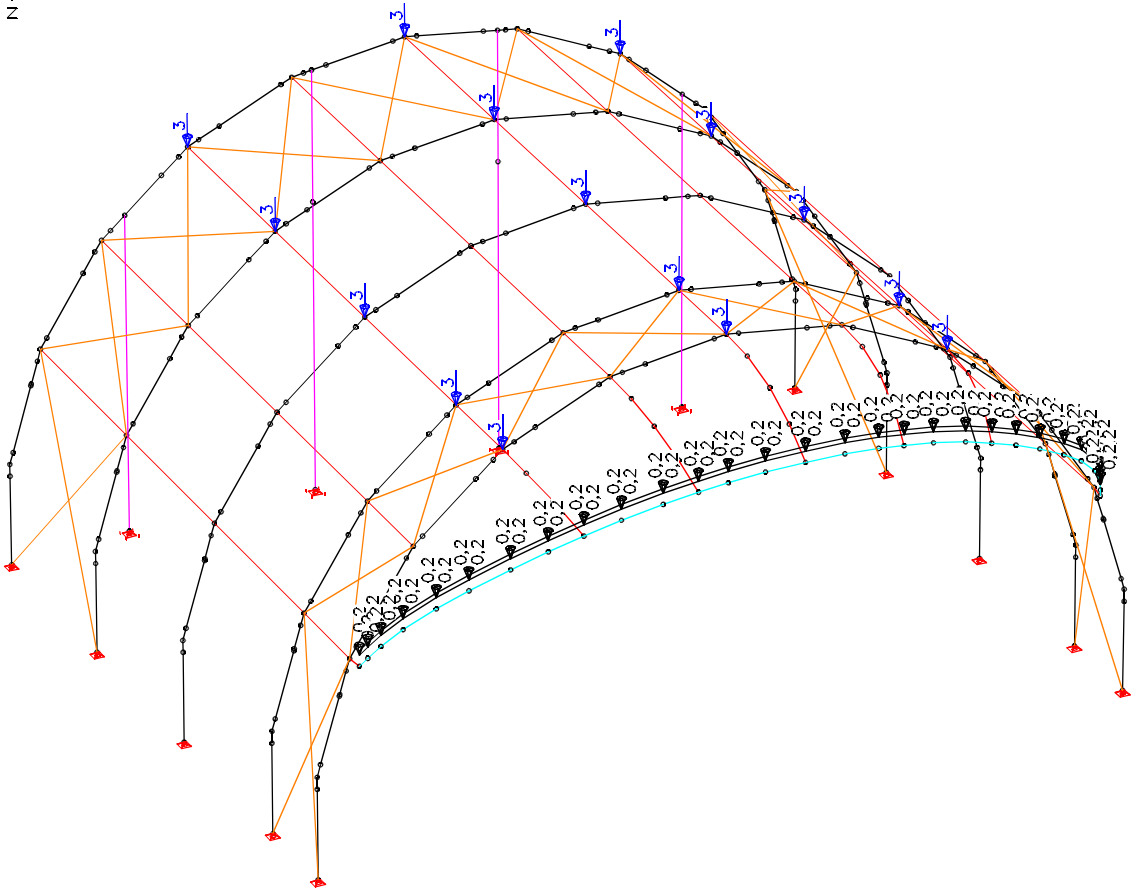


0,10 kN = 10 kg

	front	rear	center	cantilever roof
	500 kg	500 kg	500 kg	20 kg/m

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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fourth point load
[kN]



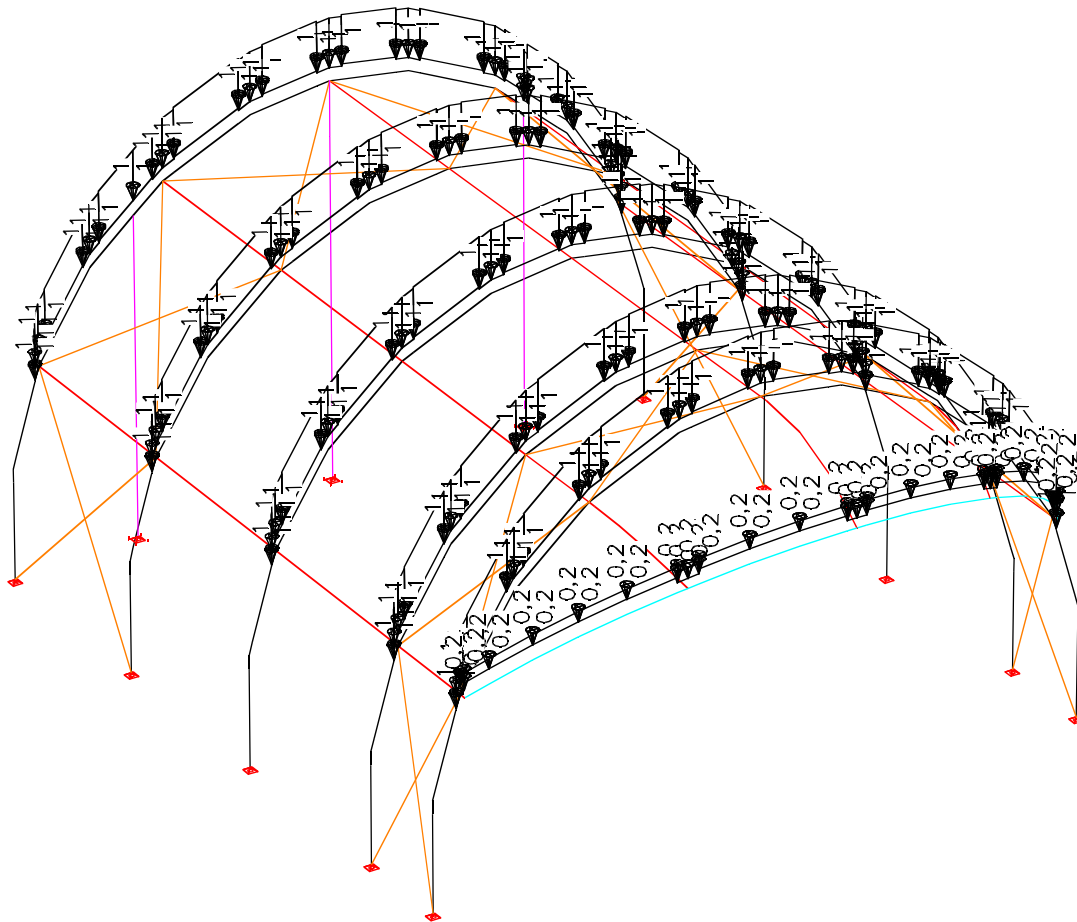
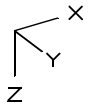
0,10 kN = 10 kg

	front	rear	center	cantilever roof
	300 kg	300 kg	300 kg	20 kg/m

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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System 12x14/12x10

distributed load
[kN/m]

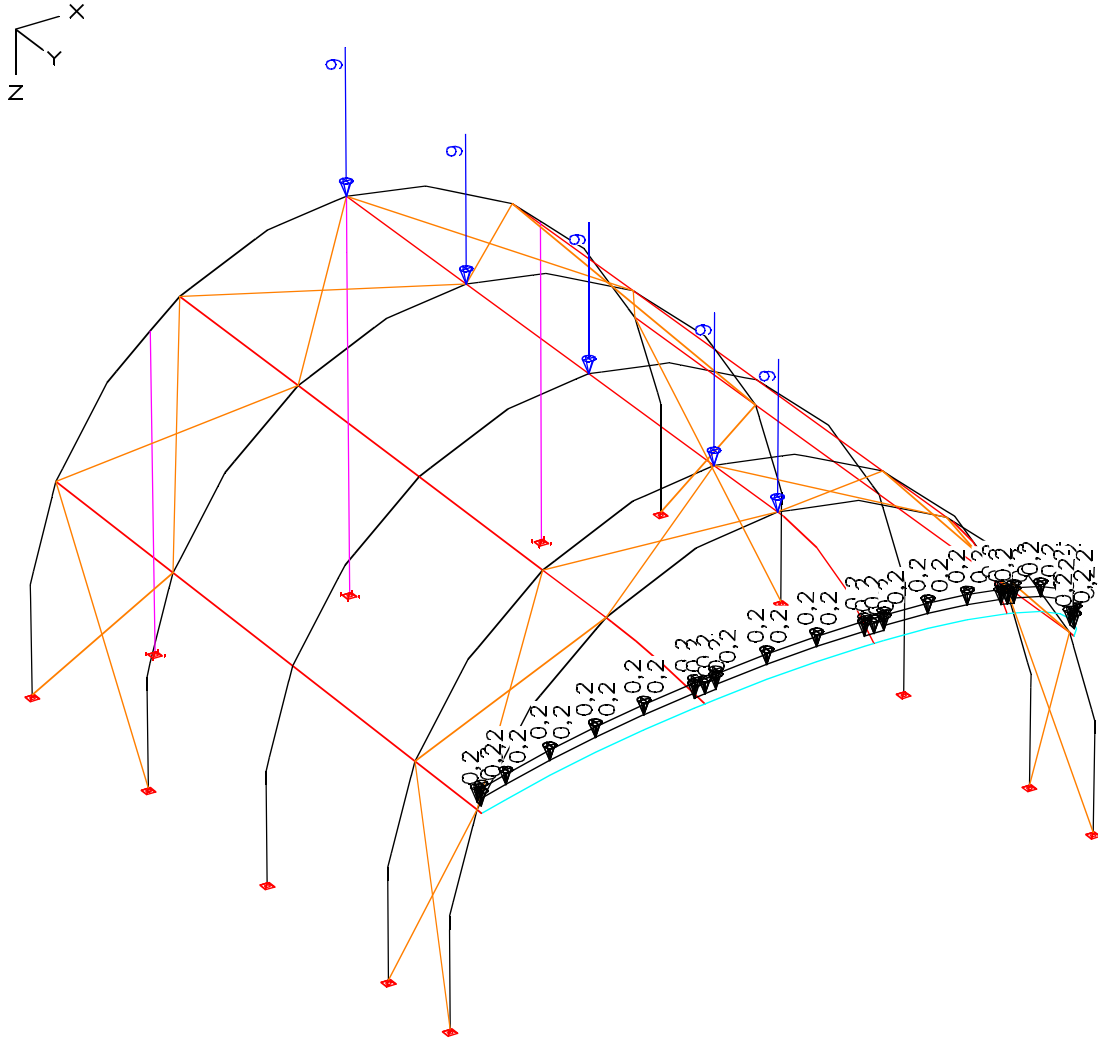


0,10 kN/m = 10 kg/m

	front	rear	center	cantilever roof
	100 kg/m	100 kg/m	100 kg/m	20 kg/m

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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center point load
[kN]

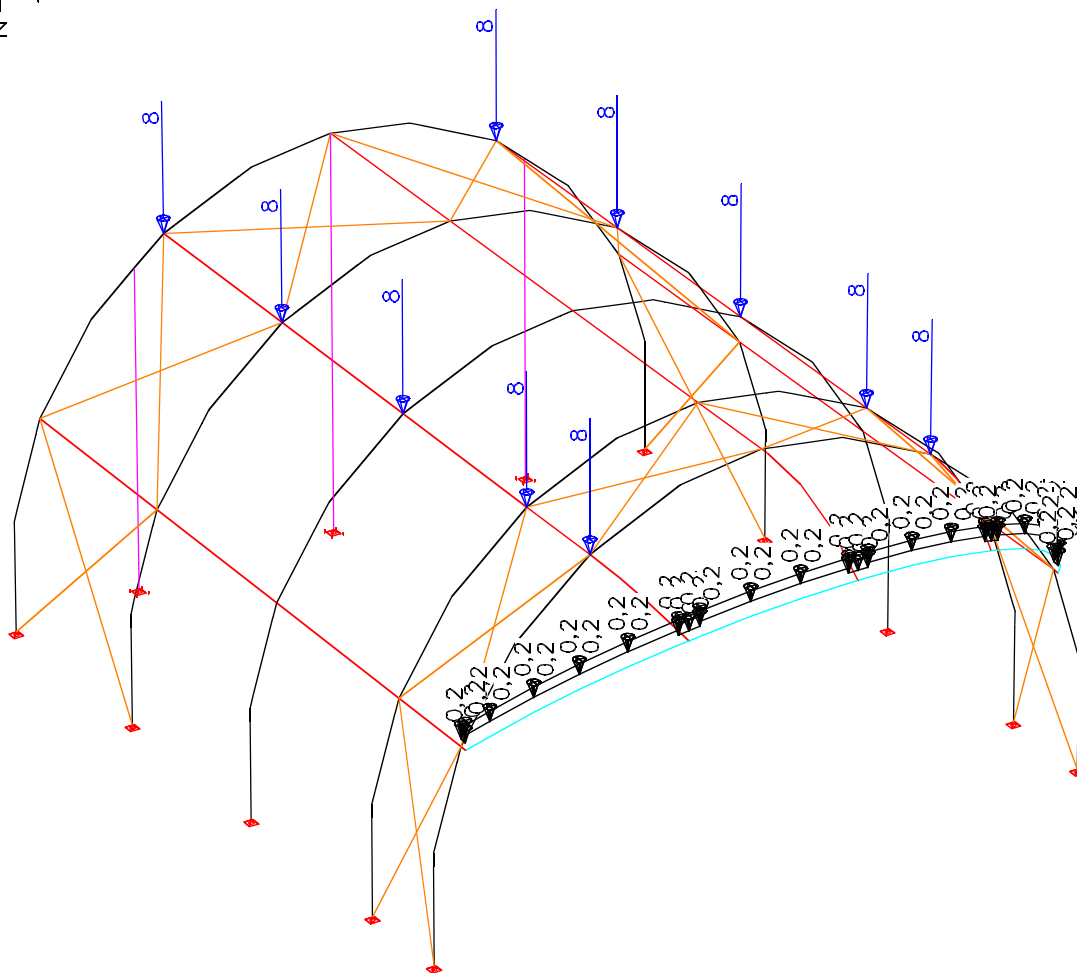
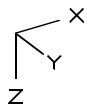


0,10 kN = 10 kg

	front	rear	center	cantilever roof
	900 kg	900 kg	900 kg	20 kg/m

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third point load
[kN]

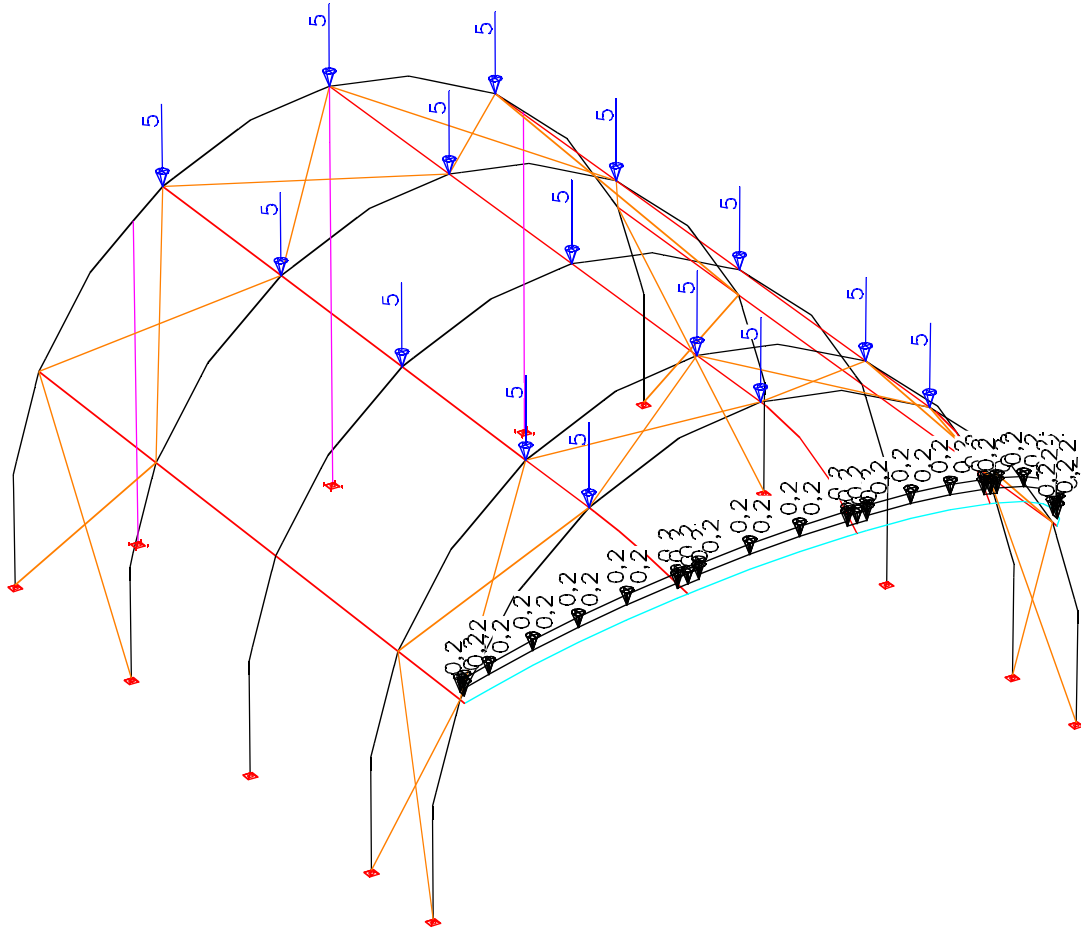
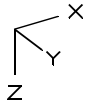


0,10 kN = 10 kg

	front	rear	center	cantilever roof
	800 kg	800 kg	800 kg	20 kg/m

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fourth point load
[kN]



0,10 kN = 10 kg

	front	rear	center	cantilever roof
	500 kg	500 kg	500 kg	20 kg/m

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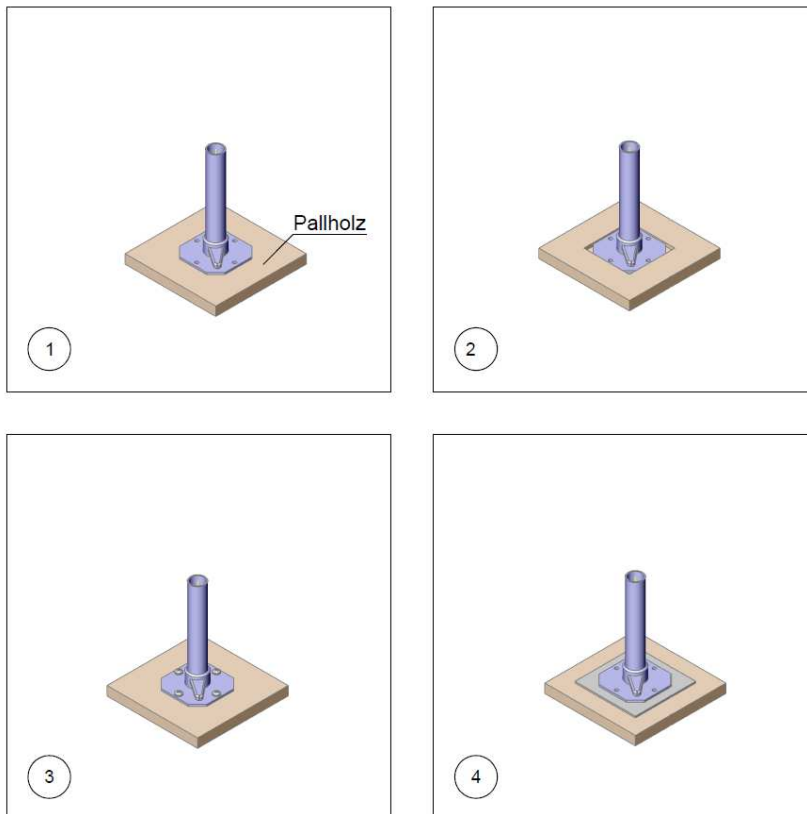
1.9 NECESSARY BALLAST LOADS

Preamble

The roof is build up upon a layher-podium.

The ballast loads must be place force-fitted within the layher structure.

Possible execution according to the required friction coefficient:



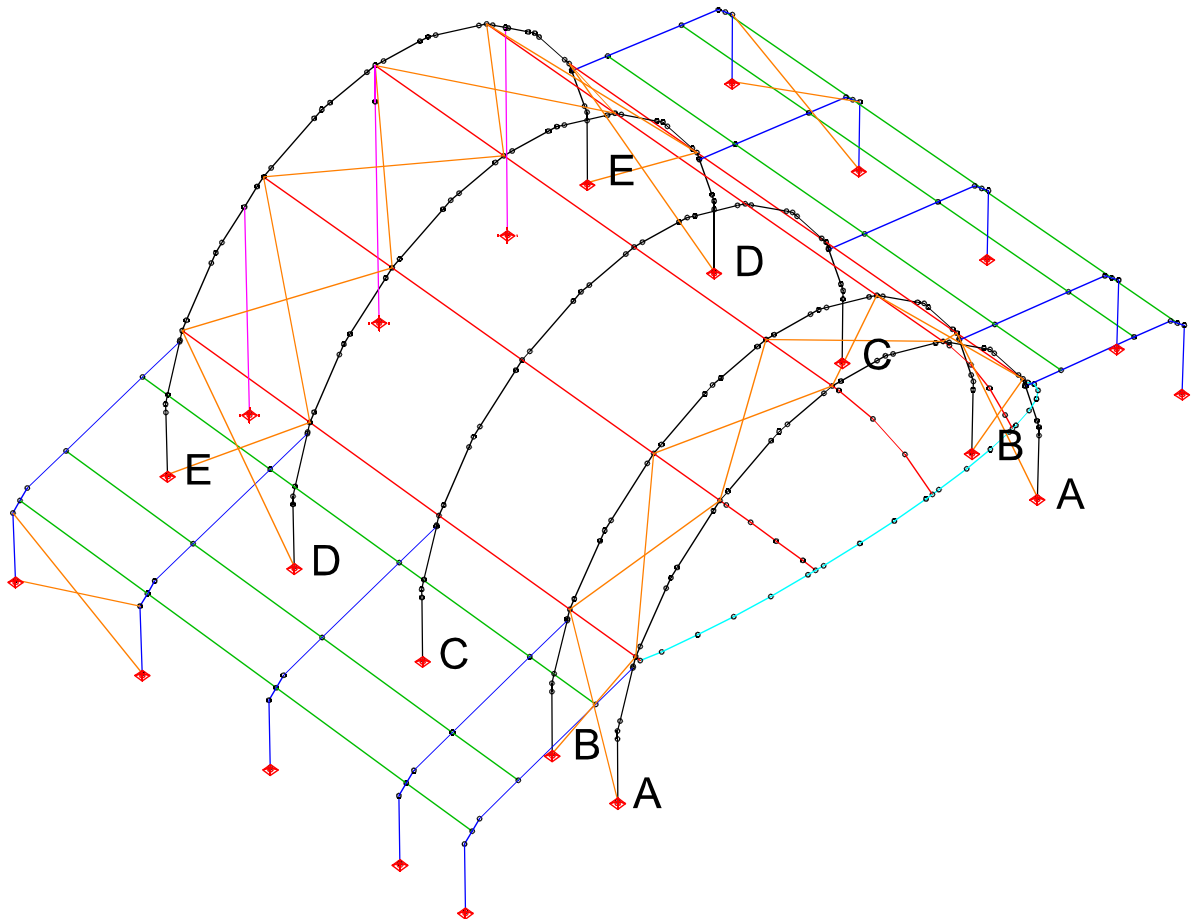
friction coefficient μ

- | | | |
|----|--------------------------------------|--------------|
| 1: | Spindle on timber spreader | $\mu = 0,40$ |
| 2: | Spindle on timber spreader, embedded | $\mu = 0,60$ |
| 3: | Spindle on timber spreader, screwed | $\mu = 0,60$ |
| 4: | Spindle on rubber mat | $\mu = 0,60$ |

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

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ballast load labels



OVERVIEW BALLAST LOADS

friction coefficient $\mu = 0,40$ or better

all values in [kg]

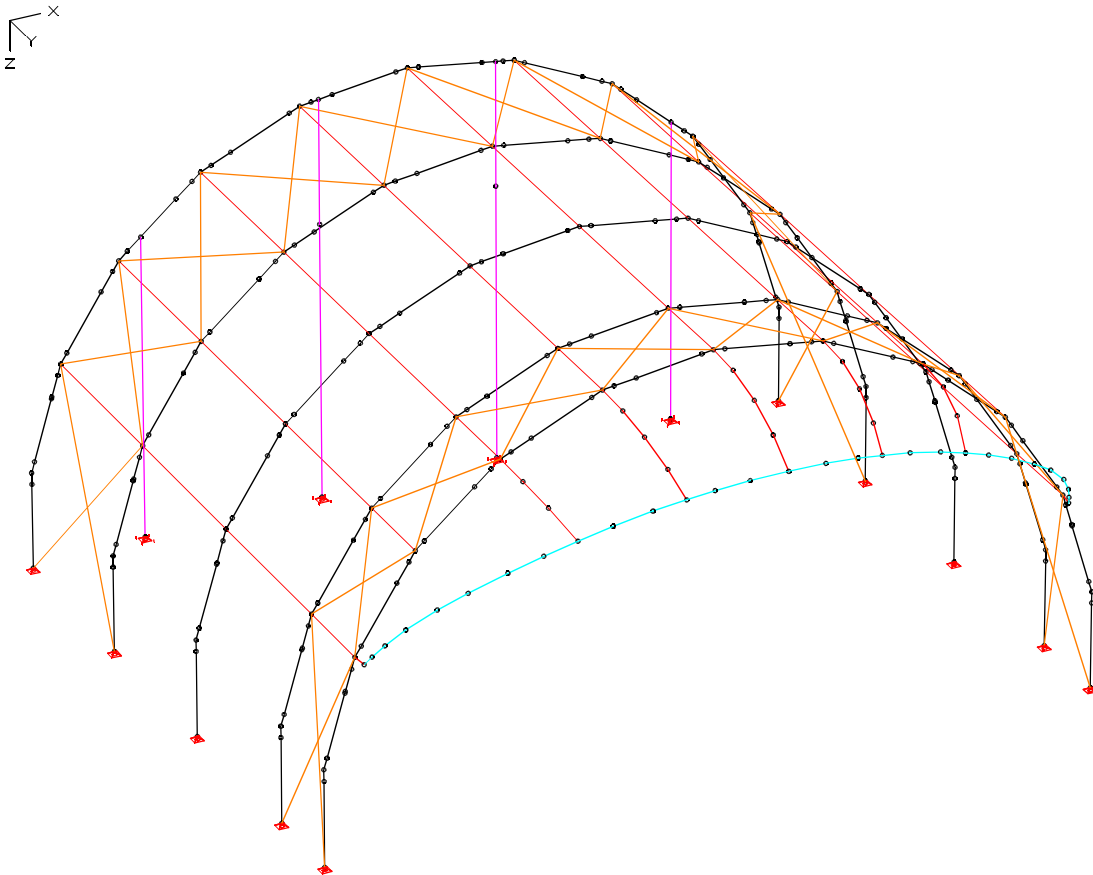
	A	B	C	D	E
16x14	3000	2200	1300	2500	2500
16x10	3000	2200	-	2500	2500
12x14	2200	2000	1300	2200	1800
12x10	2200	2000	-	2200	1800

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

2 SYTEM 16x14m – without sidestages

2.1 Structural system

isometric:



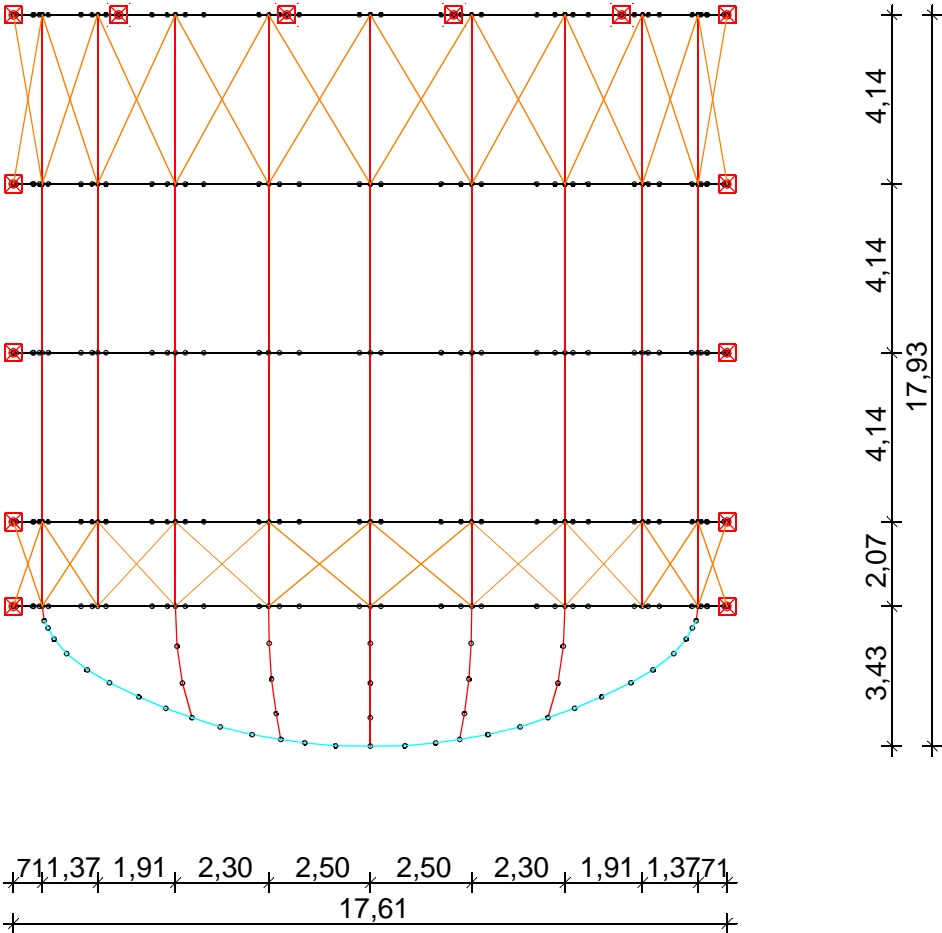
PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
16079

CUSTOMER/AUFTRAGGEBER:
Polyte Group

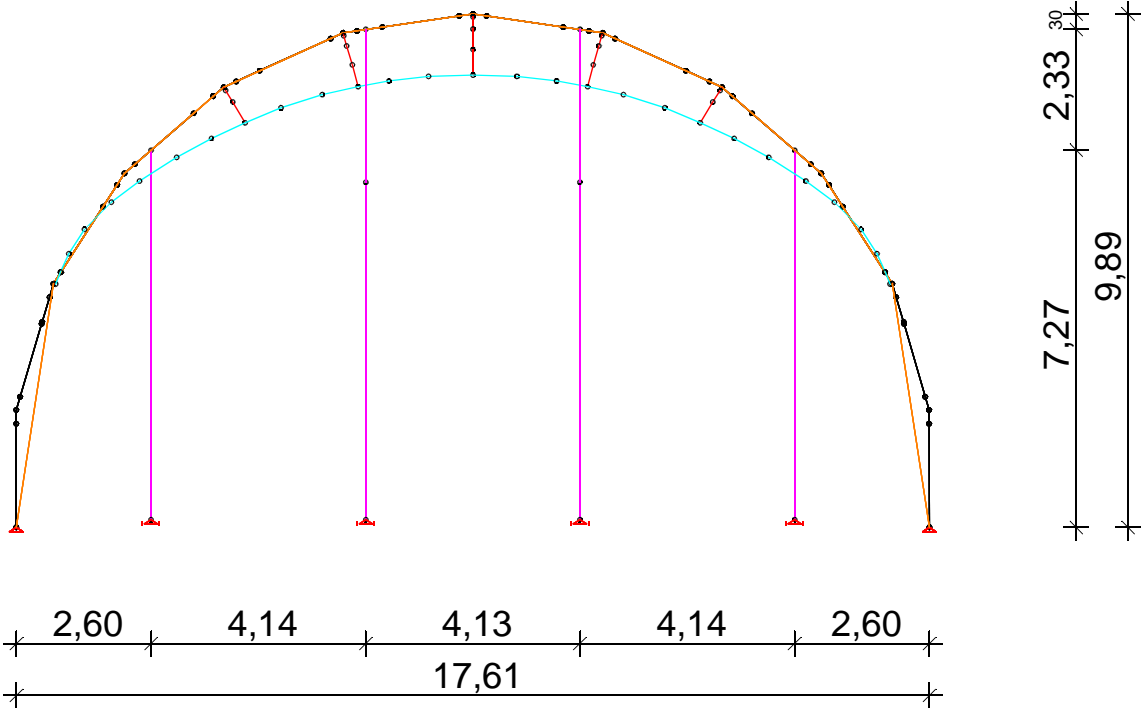
DATE/DATUM:
10.04.2016

top view:



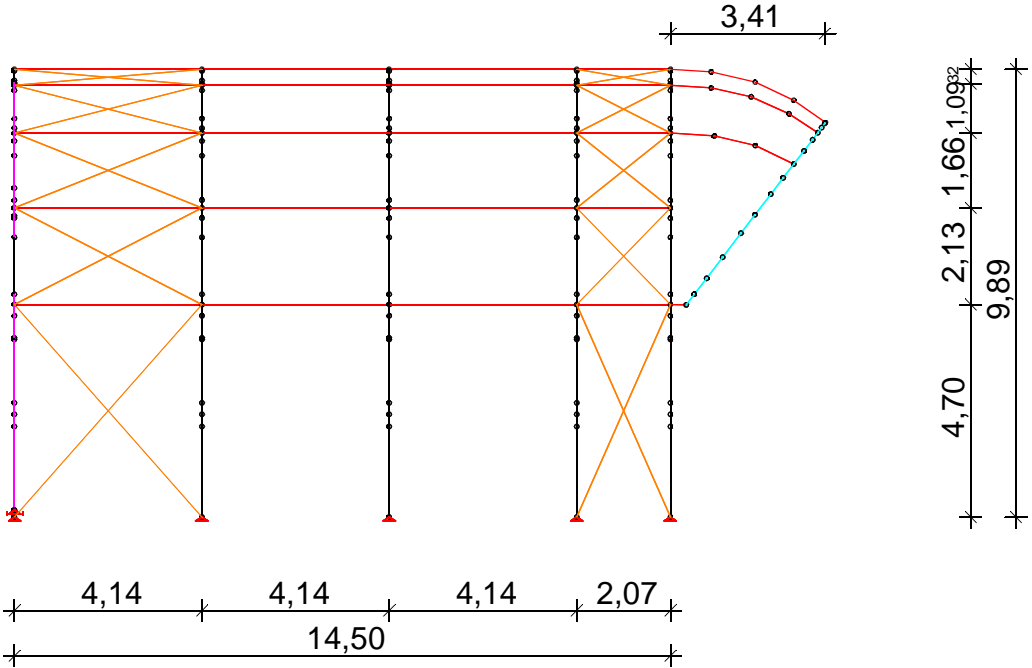
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

front view:



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

side view:



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

2.2 LOADING

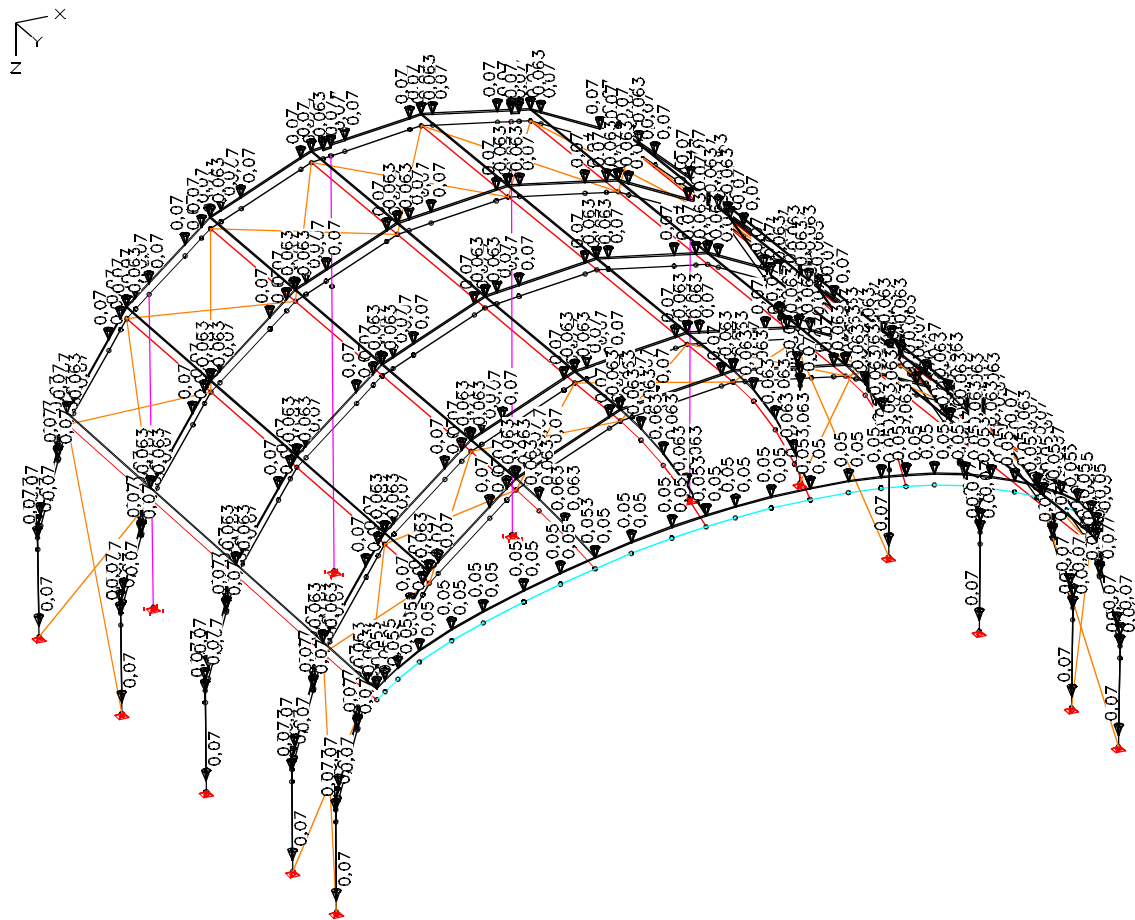
load case 1: dead weight truss

H30D: 0,050 kN/m

H30V: 0,063 kN/m

H40V: 0,070 kN/m

keder profile is taken into account by the software Infograph

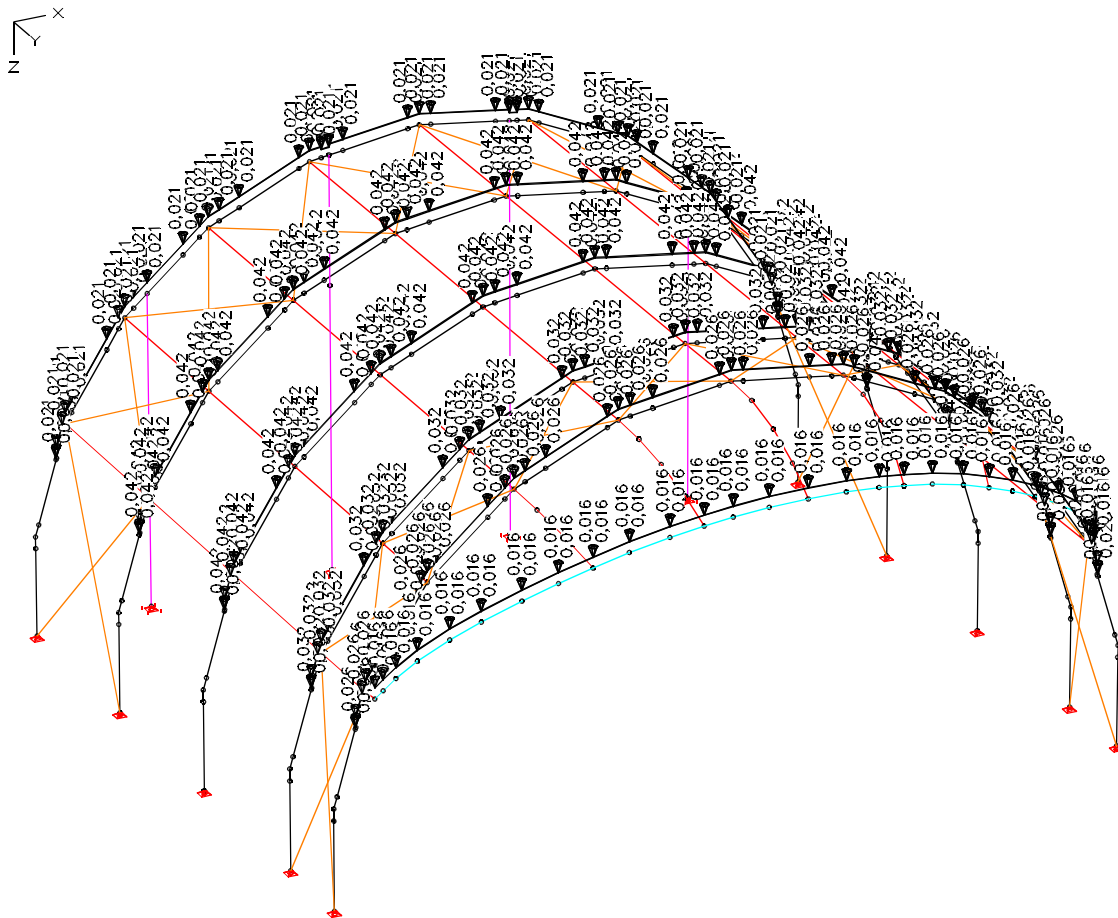


LC 1: Load, deadweight

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 2: canopy 1kg/m²

4,14/2 x 0,01	= 0,021 kN/m
4,14 x 0,01	= 0,042 kN/m
(4,14+2,07)/2 x 0,01	= 0,032 kN/m
2,07/2 x 0,01	= 0,01 kN/m
3,20/ 2	= 0,016 kN/m



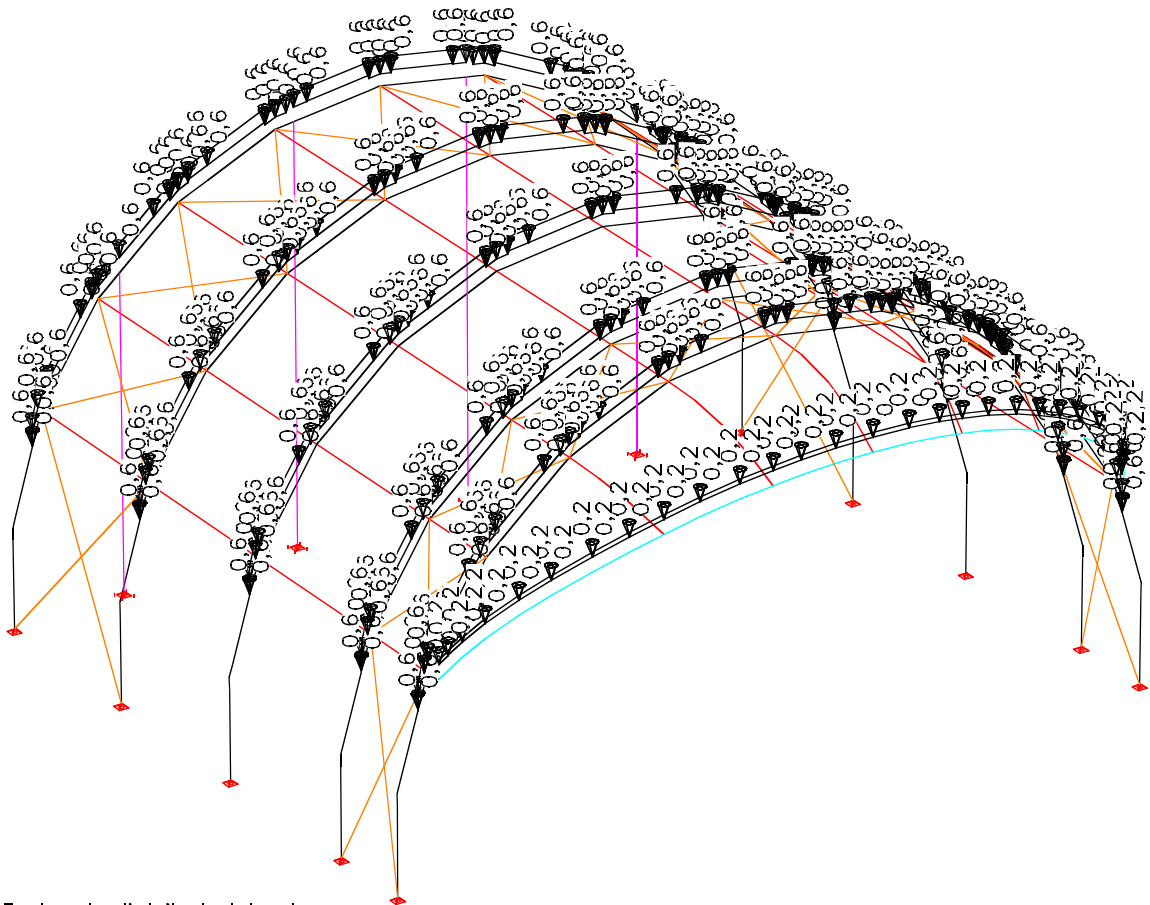
LC 2: Load, canopy 1kg/m²

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 3: distributed load

0,60 kN/m on bows

0,20 kN/m on cantilever roof

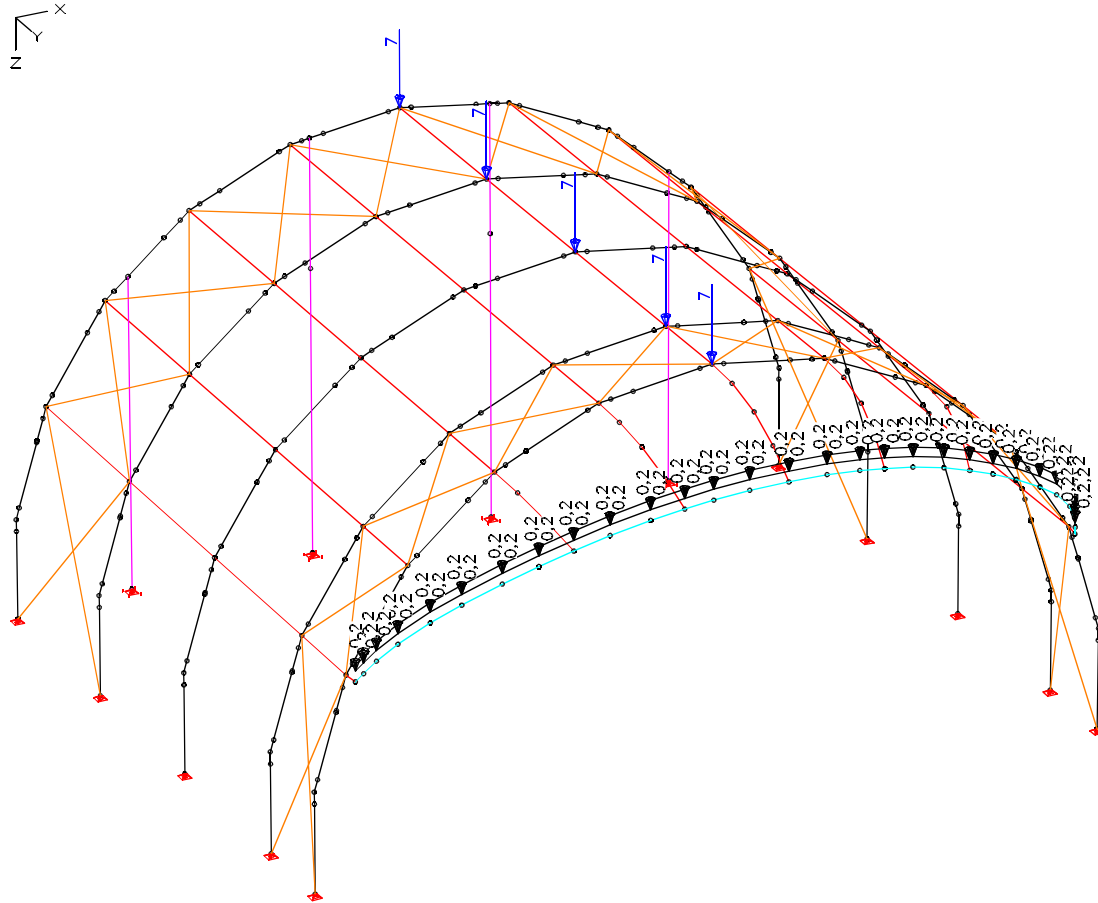


LC 3: Load, distributed load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 4: centre point load

7,0 kN in centre points of bows
0,20 kN/m on cantilever roof

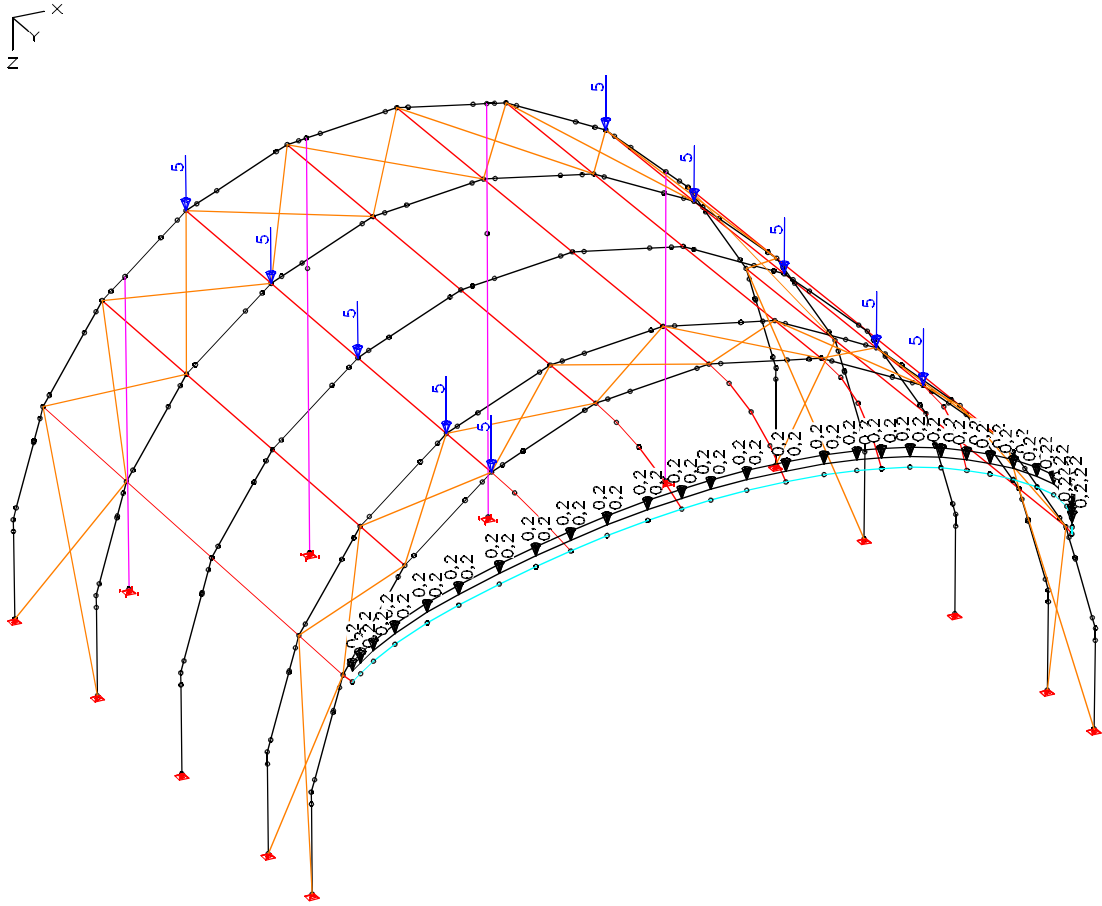


LC 4: Load, centre point load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 5: third point load

7,0 kN in third points of bows
0,20 kN/m on cantilever roof

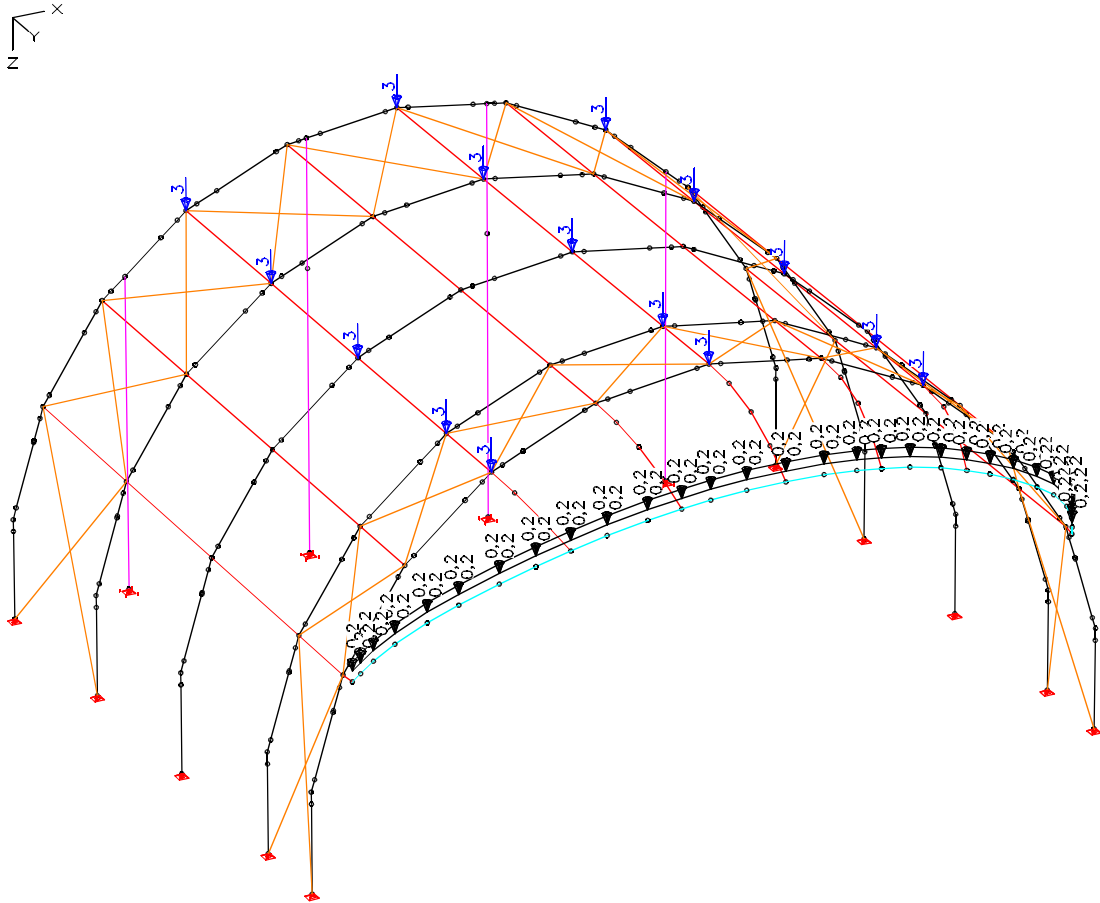


LC 5: Load, third point load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 6: fourth point load

3,0 kN in fourth points of bows
0,20 kN/m on cantilever roof



LC 6: Load, fourth point load

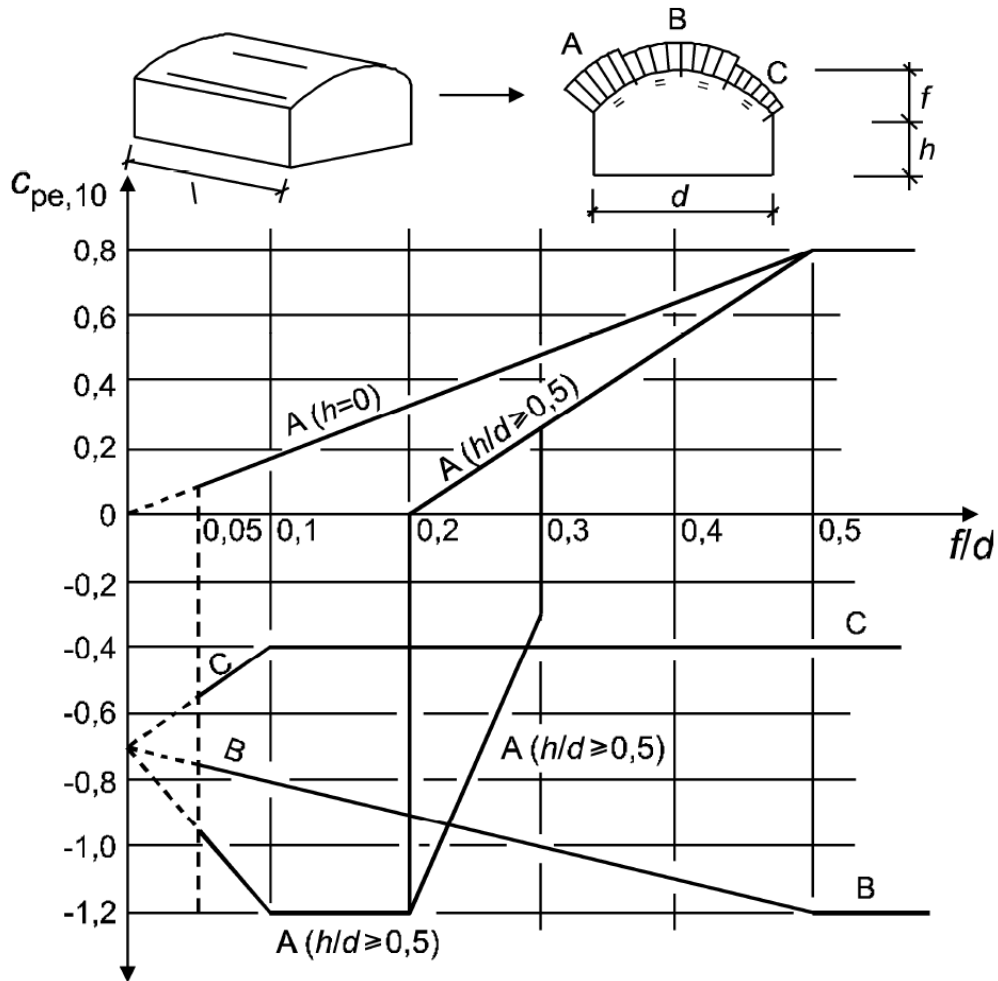
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Preliminary remarks windloading

7.2.8 Gekrümmte Dächer und Kuppeln

(1) Dieser Abschnitt gilt für kreiszylindrische Dächer und für Kuppeln.

ANMERKUNG Die für kreiszylindrische Dächer und Kuppeln anzusetzenden $c_{pe,10}$ - und $c_{pe,1}$ -Werte können in Nationalen Anhang angegeben werden. Die empfohlenen $c_{pe,10}$ -Werte sind für verschiedene Bereiche in Bild 7.11 und 7.12 angegeben. Die Bezugshöhe ist $z_e = h + f$.



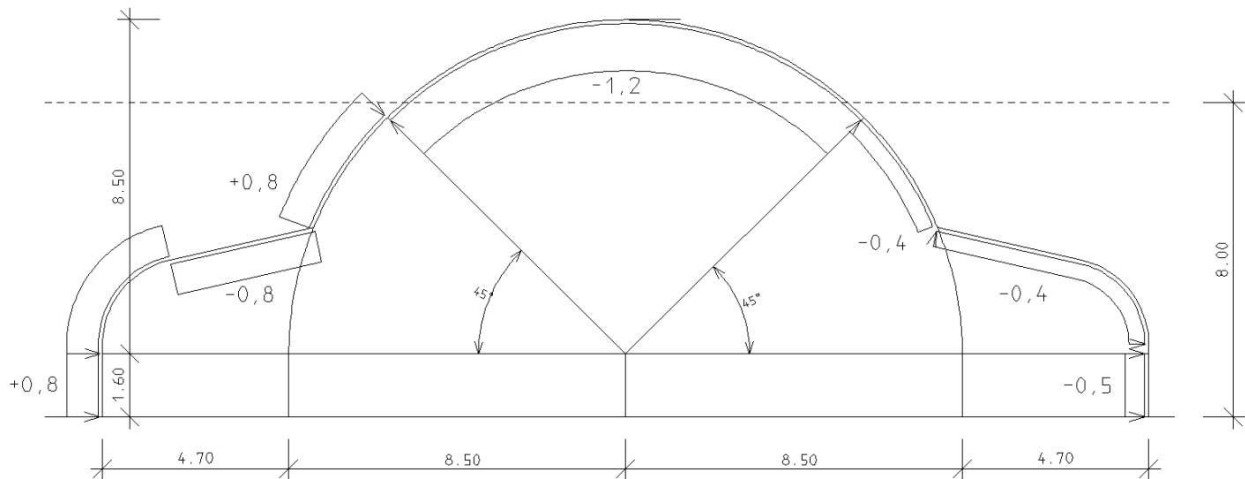
☐ Für Bereich A:

- für $0 < h/d < 0,5$ ist der $c_{pe,10}$ -Wert durch lineare Interpolation zu ermitteln;
- für $0,2 \leq f/d \leq 0,3$ und $h/d \geq 0,5$ müssen zwei $c_{pe,10}$ -Werte berücksichtigt werden;
- das Diagramm gilt nicht für Flachdächer. ☐

$h = 0 \text{ m};$ $f = 9,90 \text{ m};$ $d = 17,61 \text{ m}$
 $f/d = 0,562$
 $A = 0,8$ $B = -1,2$ $C = -0,4$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

wind from side



For w_1 : $c_{pe} = +0,8$, $q = 0,20/ 0,30$

For w_2 : $c_{pe} = -1,2$, $q = 0,20/ 0,30$

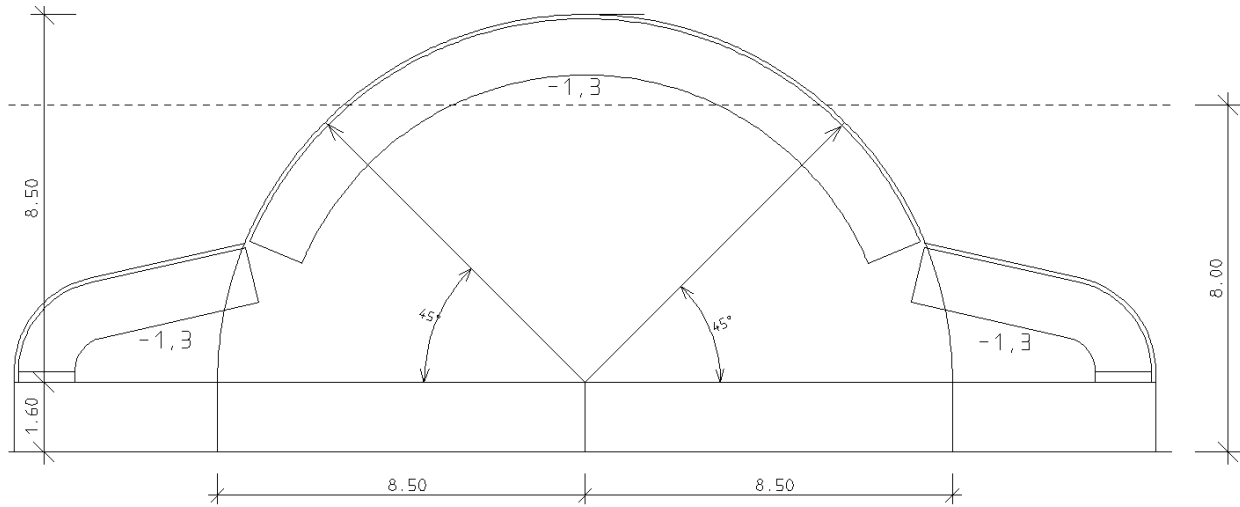
For w_3 : $c_{pe} = -0,4$, $q = 0,20$

At the same time a wind suction from inside the roof has to be considered.

For w_6 : $c_{pe} = +0.5$, $q = 0,20/ 0,30$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Wind from front side on the inner and outer side of the roof



A constant inner pressure will be considered

For w_5 : $c_{pe} = 1,3$, $q = 0,20/ 0,30$

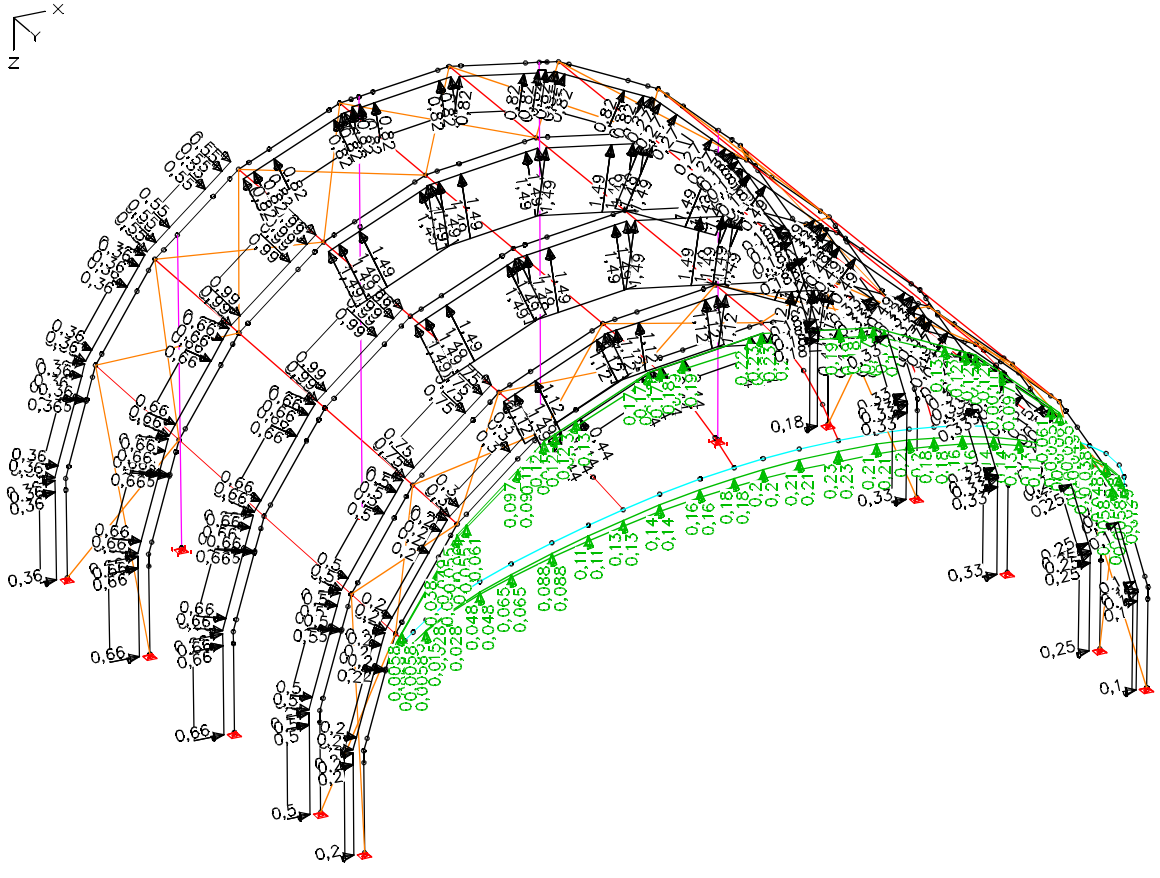
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 10: wind roof outer side

$$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +0,80/ -1,20/ -0,40/ -0,60$$

$w_1 = 0,80 \times 0,20 \times (4,14/2 + 0,20)$	$= 0,363 \text{ kN/m}$
$w_2 = 0,80 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,545 \text{ kN/m}$
$w_3 = 1,20 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,818 \text{ kN/m}$
$w_4 = 0,40 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,273 \text{ kN/m}$
$w_5 = 0,40 \times 0,20 \times (4,14/2 + 0,20)$	$= 0,182 \text{ kN/m}$
$w_6 = 0,80 \times 0,20 \times 4,14$	$= 0,662 \text{ kN/m}$
$w_7 = 0,80 \times 0,30 \times 4,14$	$= 0,994 \text{ kN/m}$
$w_8 = 1,20 \times 0,30 \times 4,14$	$= 1,491 \text{ kN/m}$
$w_9 = 0,40 \times 0,30 \times 4,14$	$= 0,497 \text{ kN/m}$
$w_{10} = 0,40 \times 0,20 \times 4,14$	$= 0,331 \text{ kN/m}$
$w_{11} = 0,80 \times 0,20 \times (4,14+2,07)/2$	$= 0,497 \text{ kN/m}$
$w_{12} = 0,80 \times 0,30 \times (4,14+2,07)/2$	$= 0,745 \text{ kN/m}$
$w_{13} = 1,20 \times 0,30 \times (4,14+2,07)/2$	$= 1,119 \text{ kN/m}$
$w_{14} = 0,40 \times 0,30 \times (4,14+2,07)/2$	$= 0,373 \text{ kN/m}$
$w_{15} = 0,40 \times 0,20 \times (4,14+2,07)/2$	$= 0,249 \text{ kN/m}$
$w_{16} = 0,80 \times 0,20 \times (2,07/2 + 0,20)$	$= 0,198 \text{ kN/m}$
$w_{17} = 0,80 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,296 \text{ kN/m}$
$w_{18} = 1,20 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,444 \text{ kN/m}$
$w_{19} = 0,40 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,148 \text{ kN/m}$
$w_{20} = 0,40 \times 0,20 \times (2,07/2 + 0,20)$	$= 0,100 \text{ kN/m}$
$w_{21} = 0,60 \times 0,25 \times 3,00/2$	$= 0,230 \text{ kN/m (cantilever roof)}$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

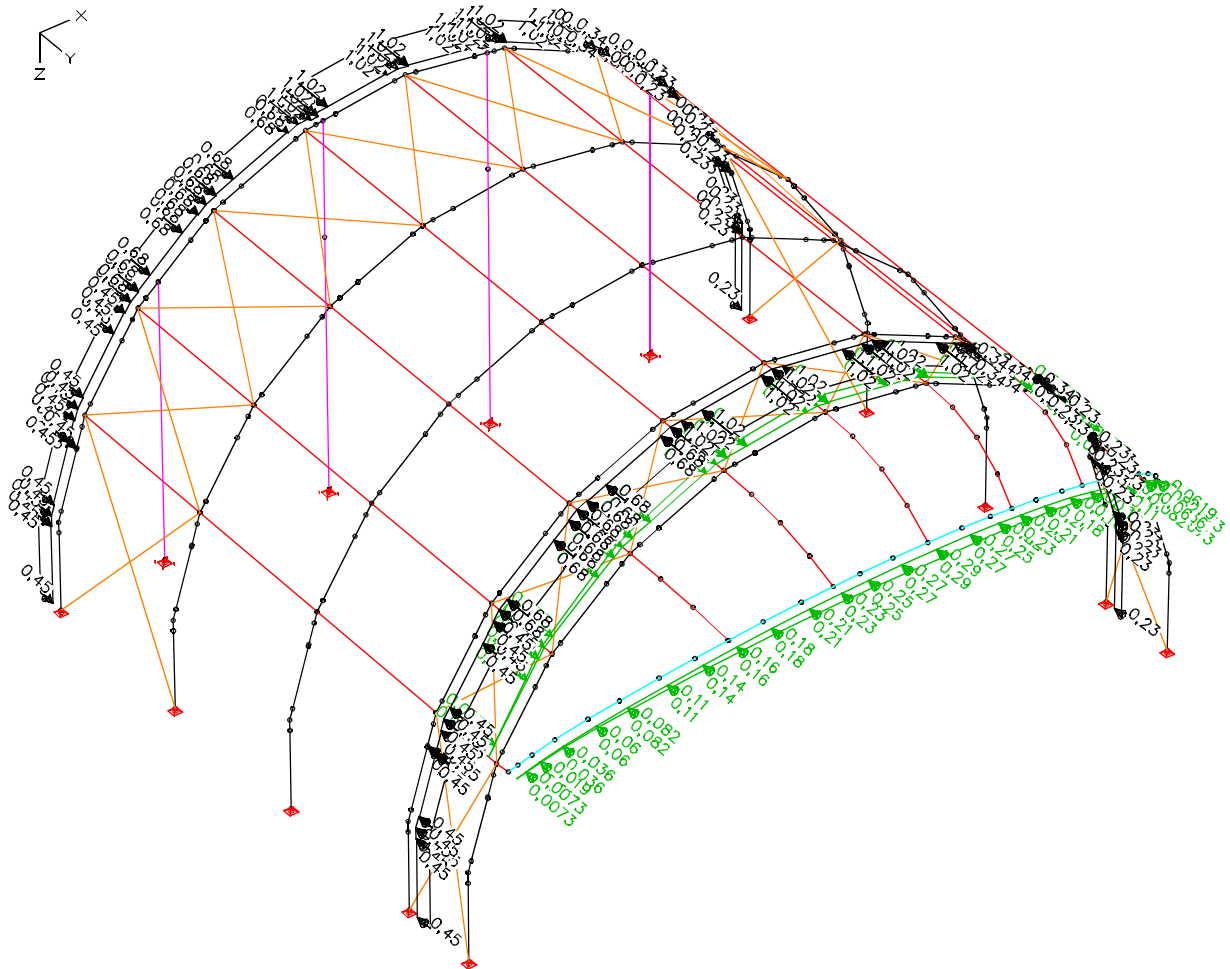


LC 10: Load, wind roof outer side

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 11: membrane tension for LC 10

- 0,363/ 0,80 = 0,454 kN/m
- 0,545/ 0,80 = 0,680 kN/m
- 0,818/ 0,80 = 1,023 kN/m
- 0,273/ 0,80 = 0,340 kN/m
- 0,182/ 0,80 = 0,227 kN/m
- 0,230/ 0,80 = 0,287 kN/m



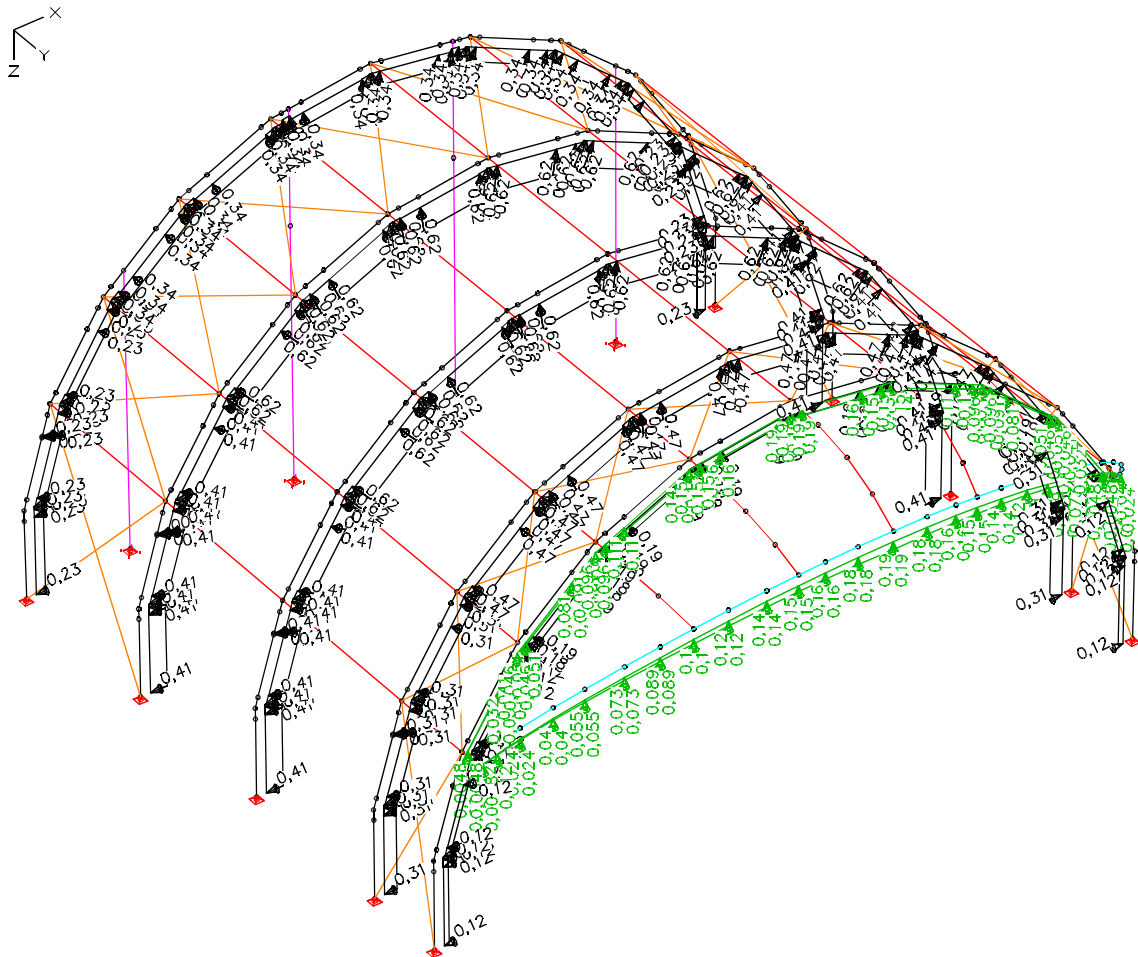
LC 11: Load, membrane tension for LC 10

<p>PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS</p>	<p>PROJECT-NO.: 16079</p>
<p>CUSTOMER/AUFTRAGGEBER: Polyte Group</p>	<p>DATE/DATUM: 10.04.2016</p>

load case 12: wind roof inner side

$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +0,50$

$w_1 = 0,50 \times 0,20 \times (4,14/2 + 0,20)$	= 0,227 kN/m
$w_2 = 0,50 \times 0,30 \times (4,14/2 + 0,20)$	= 0,341 kN/m
$w_6 = 0,50 \times 0,20 \times 4,14$	= 0,414 kN/m
$w_7 = 0,50 \times 0,30 \times 4,14$	= 0,621 kN/m
$w_{11} = 0,50 \times 0,20 \times (4,14+2,07)/2$	= 0,311 kN/m
$w_{12} = 0,50 \times 0,30 \times (4,14+2,07)/2$	= 0,467 kN/m
$w_{16} = 0,50 \times 0,20 \times (2,07/2 + 0,20)$	= 0,124 kN/m
$w_{17} = 0,50 \times 0,30 \times (2,07/2 + 0,20)$	= 0,185 kN/m
$w_{21} = 0,50 \times 0,25 \times 3,00/2$	= 0,188 kN/m (cantilever roof)



LC 12: Load, wind roof inner side

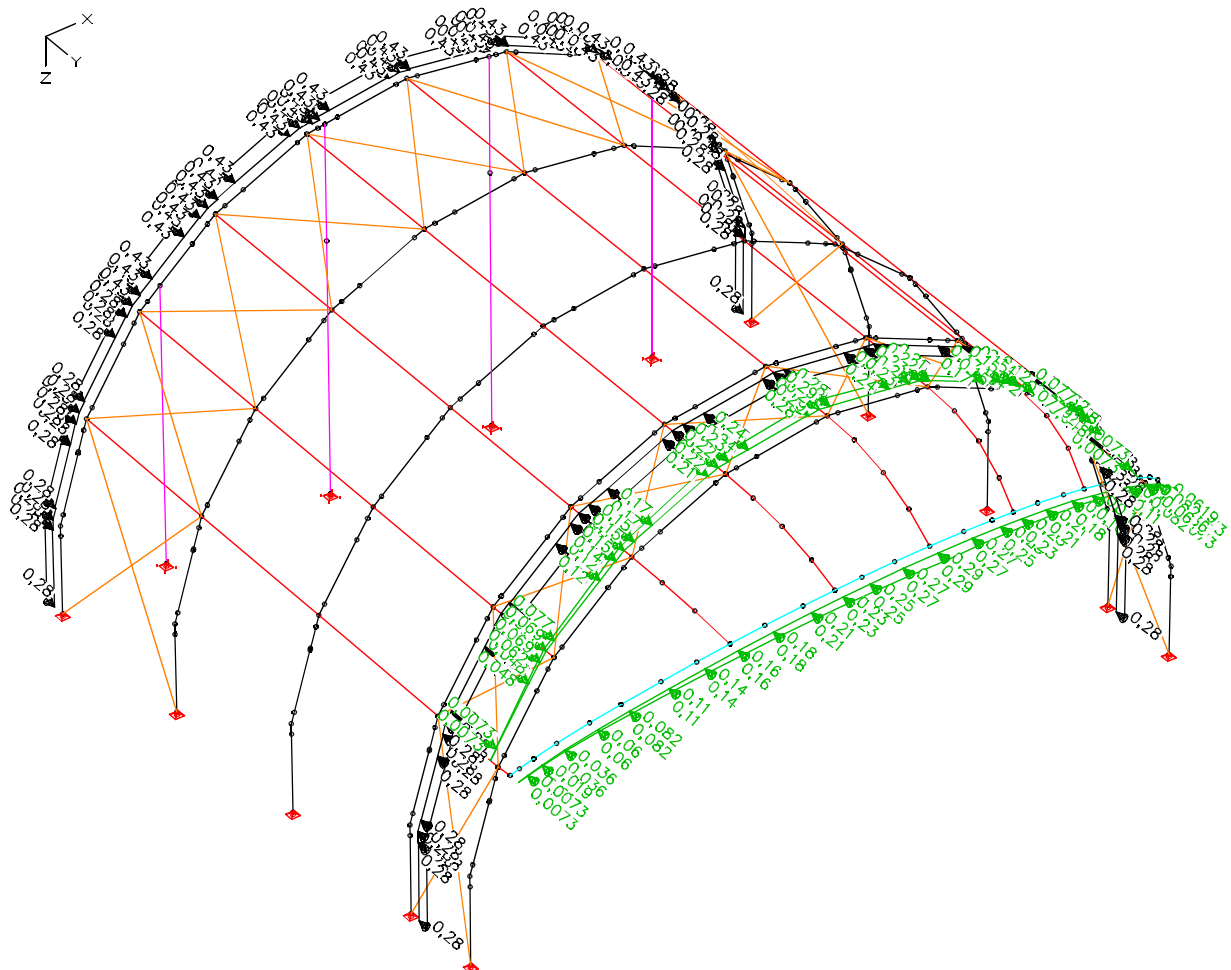
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 13: membrane tension for LC 12

$$0,227 / 0,80 = 0,284 \text{ kN/m}$$

$$0,341 / 0,80 = 0,426 \text{ kN/m}$$

$$0,188 / 0,80 = 0,235 \text{ kN/m}$$

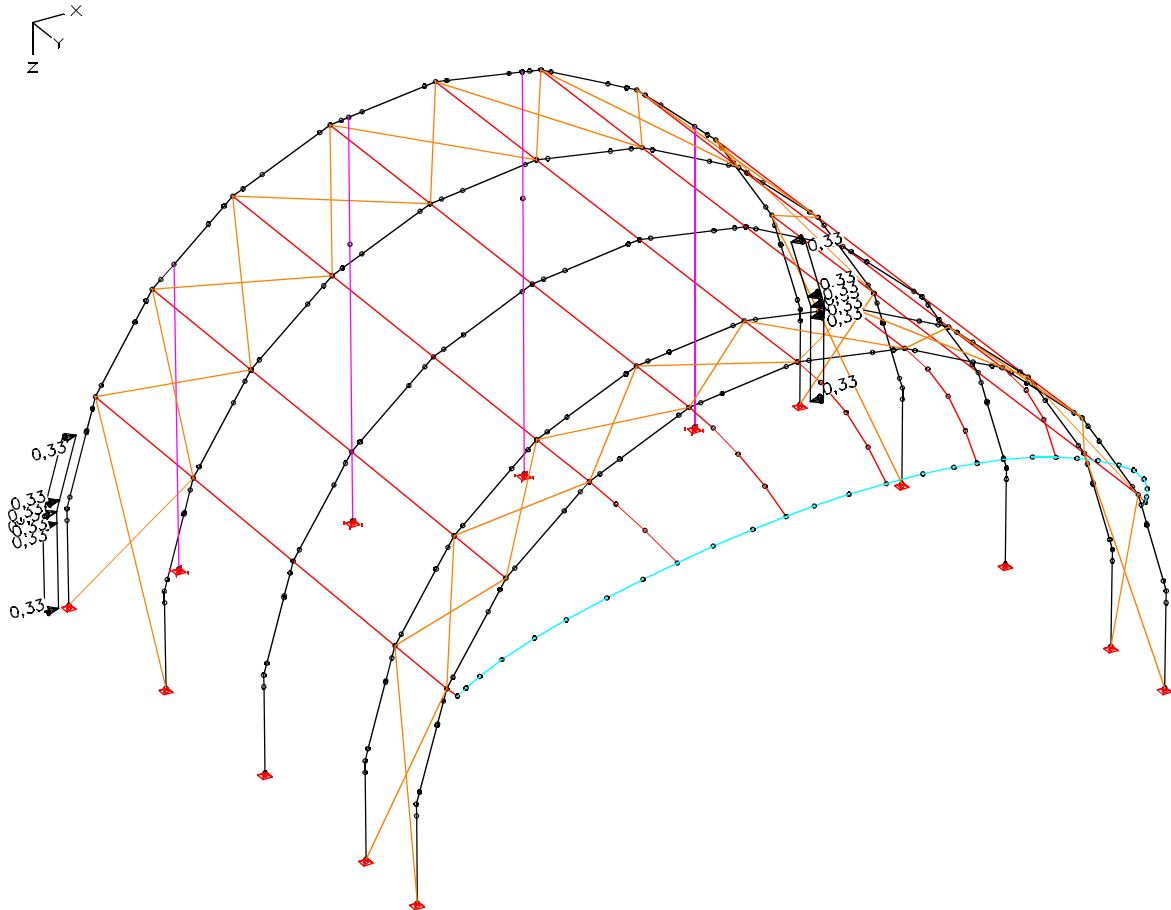


LC 13: Load, membrane tension for LC 12

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 15: membrane tension for LC 14

$$0,26 / 0,80 = 0,325 \text{ kN/m}$$

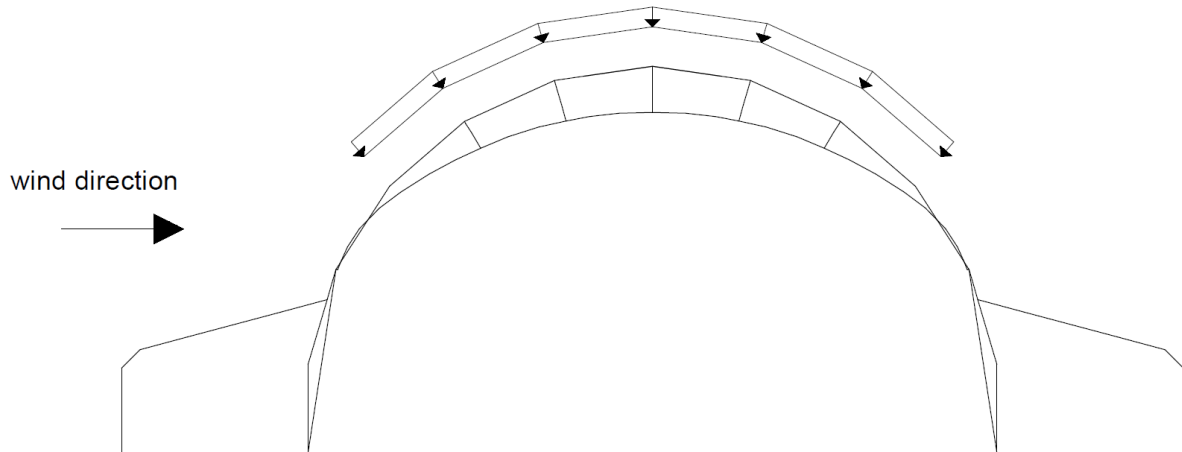


LC 15: Load, membrane tension rear wall

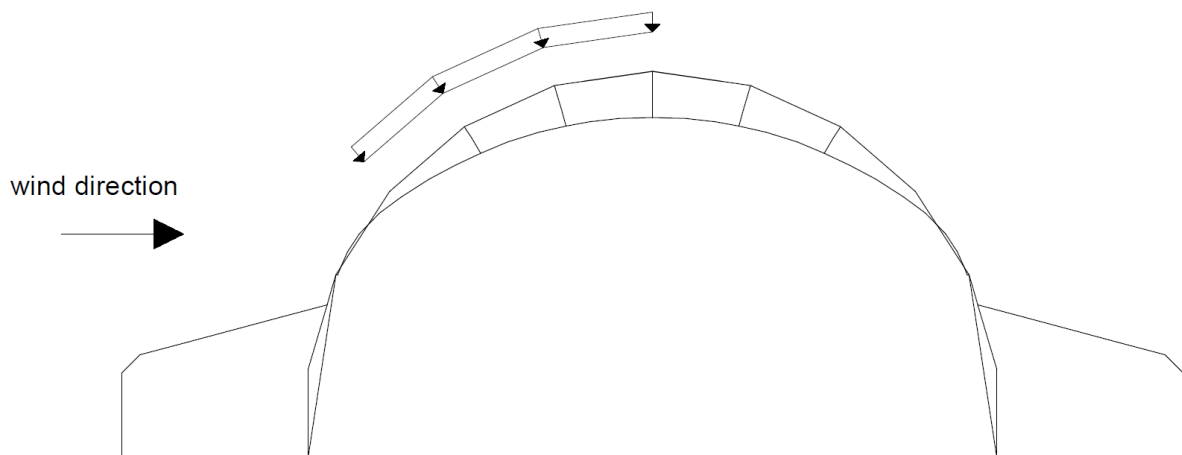
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

notice: For status out of service the construction must be regarded for different load situations according to freestanding roofs with either tension or compression of the whole roof and additionally only for one half of the roof.

pressure complete roof

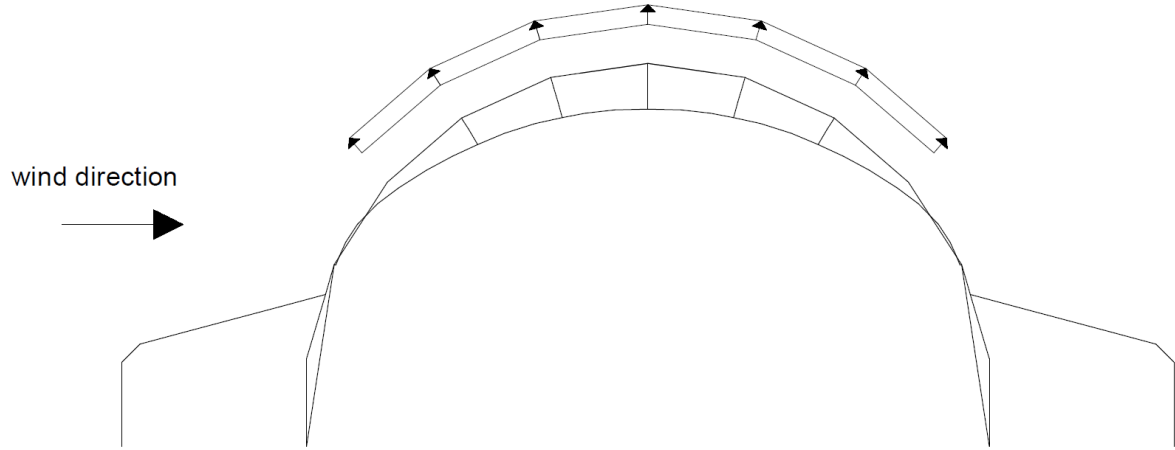


pressure 1/2 roof

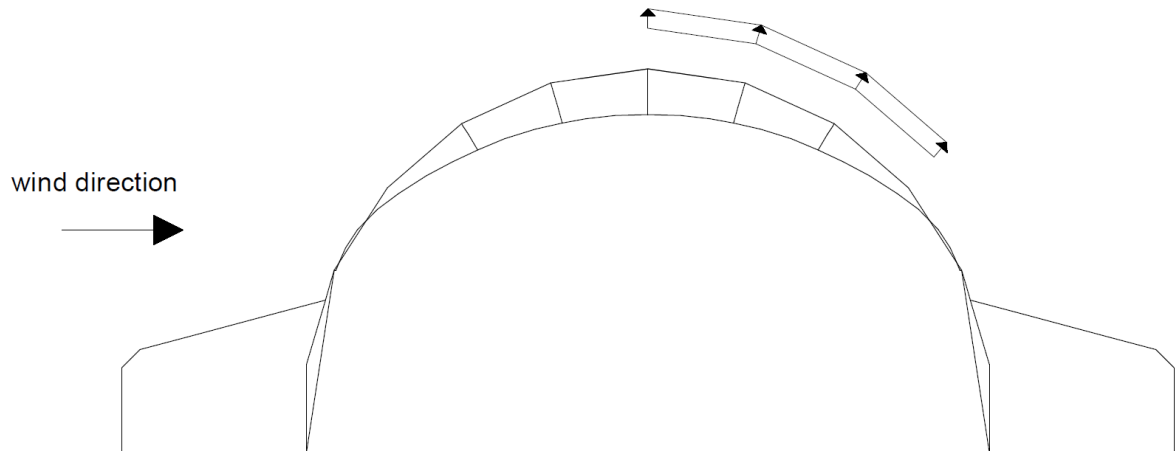


PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

suction complete roof



suction 1/2 roof

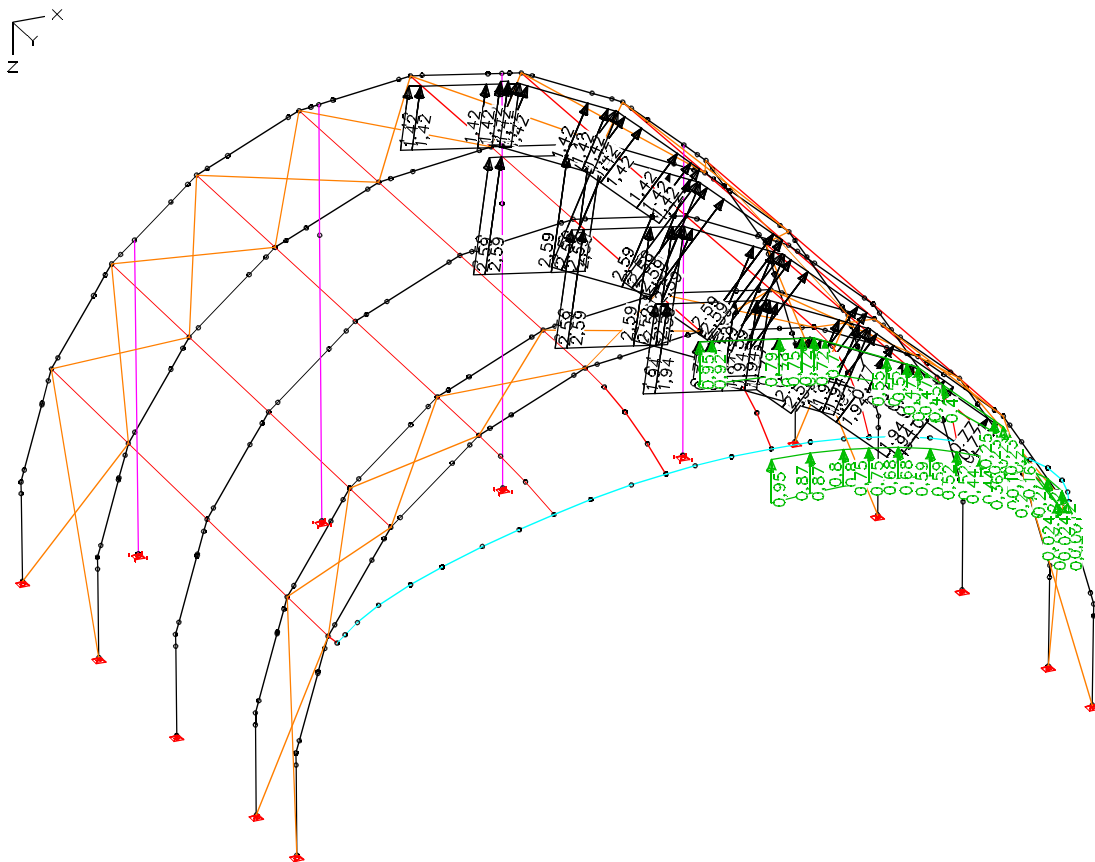


PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 20: wind roof right side – out of service

$$q = 0,44 \text{ kN/m}^2 \text{ or } 0,625 \text{ kN/m}^2 \quad c_{pe} = 1,0$$

$$\begin{aligned} w_1 &= 1,0 \times 0,44 \times 3,0 / 2 &= 0,66 \text{ kN/m} \\ w_2 &= 1,0 \times 0,625 \times 3,0 / 2 &= 0,94 \text{ kN/m} \\ w_3 &= 1,0 \times 0,625 \times (4,14/2 + 0,20) &= 1,419 \text{ kN/m} \\ w_4 &= 1,0 \times 0,625 \times 4,14 &= 2,583 \text{ kN/m} \\ w_5 &= 1,0 \times 0,625 \times (4,14+2,07) / 2 &= 1,941 \text{ kN/m} \\ w_6 &= 1,0 \times 0,625 \times (2,07/2 + 0,20) &= 0,772 \text{ kN/m} \end{aligned}$$



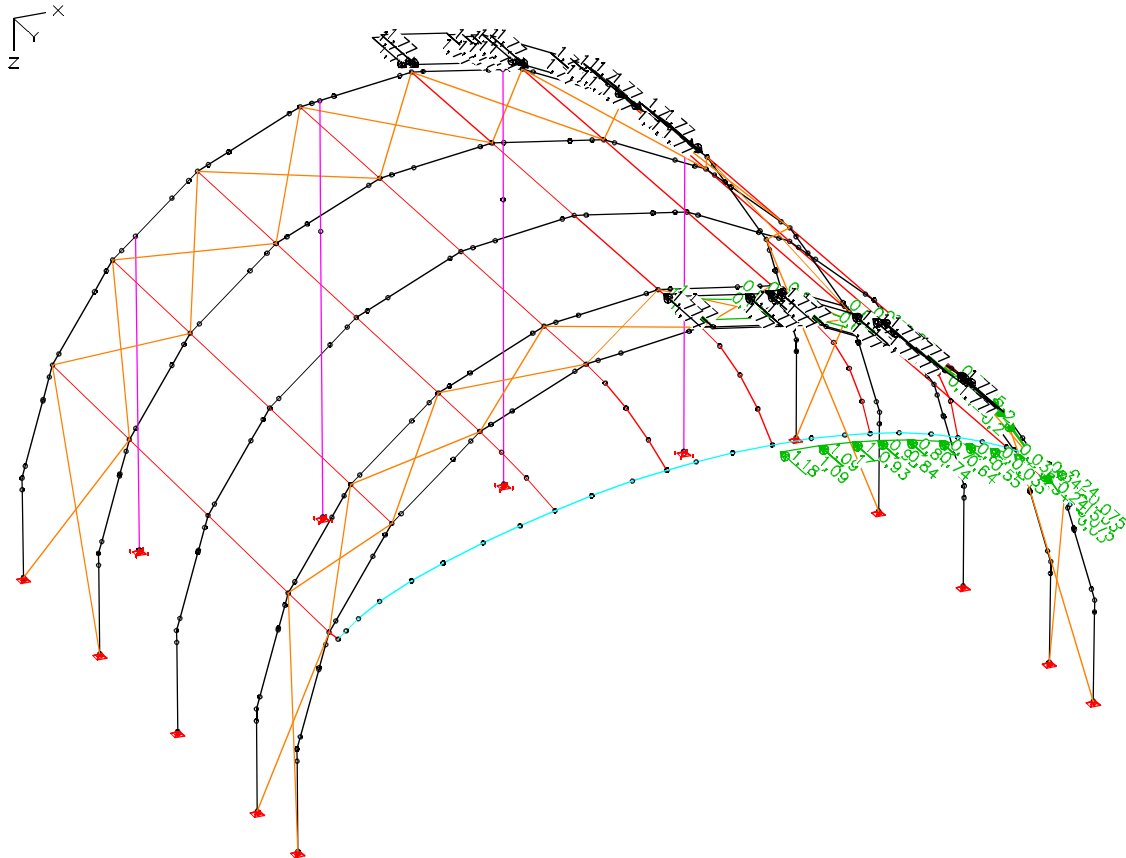
LC 20: Load, wind roof right side – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 21: membrane tension for LC 20

$$0,94 / 0,80 = 1,175 \text{ kN/m}$$

$$1,419 / 0,80 = 0,774 \text{ kN/m}$$

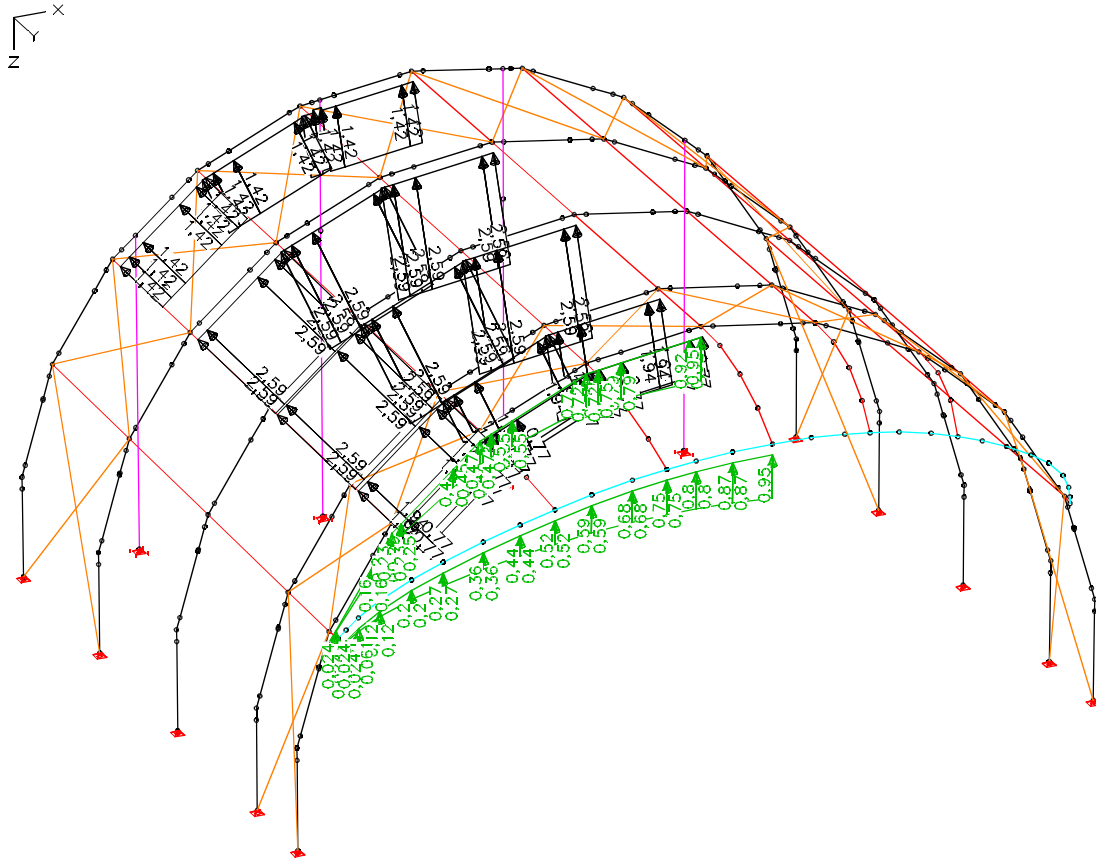


LC 21: Load, membrane tension for LC 20

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 22: wind roof left side – out of service

see LC 20

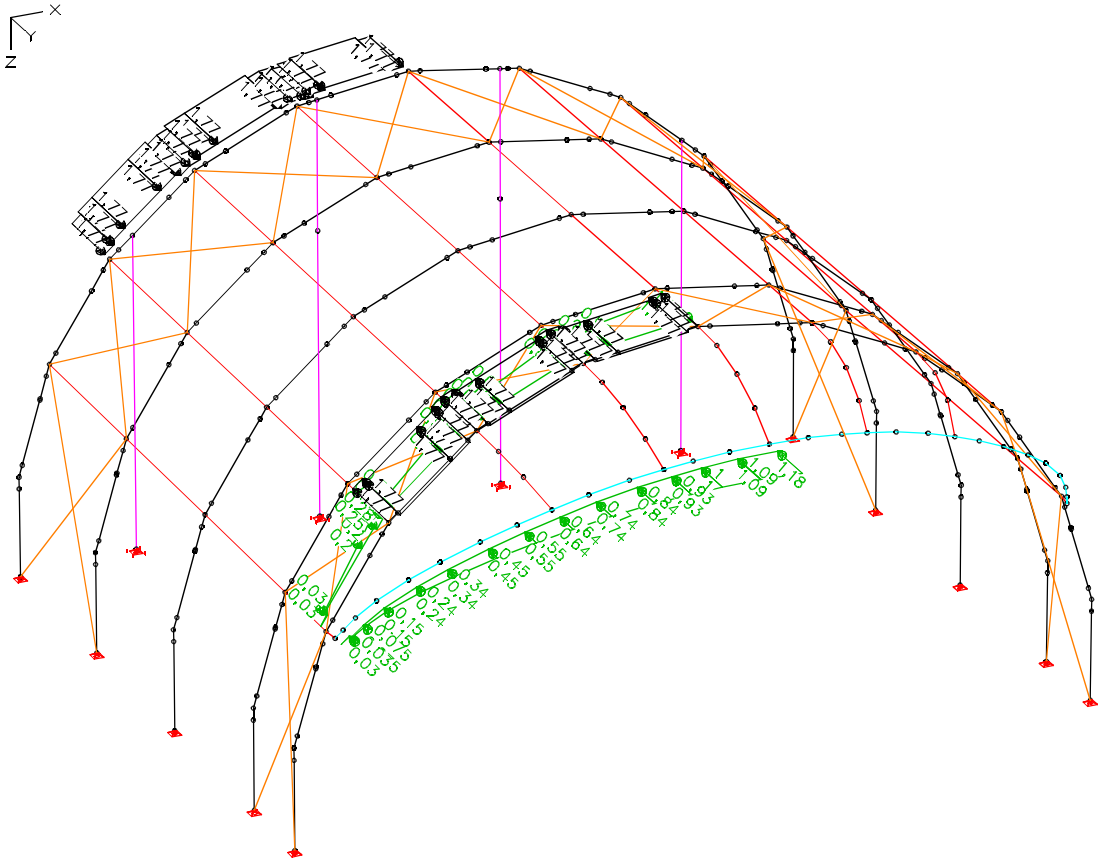


LC 22: Load, wind roof left side – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 23: membrane tension for LC 22

see LC 21



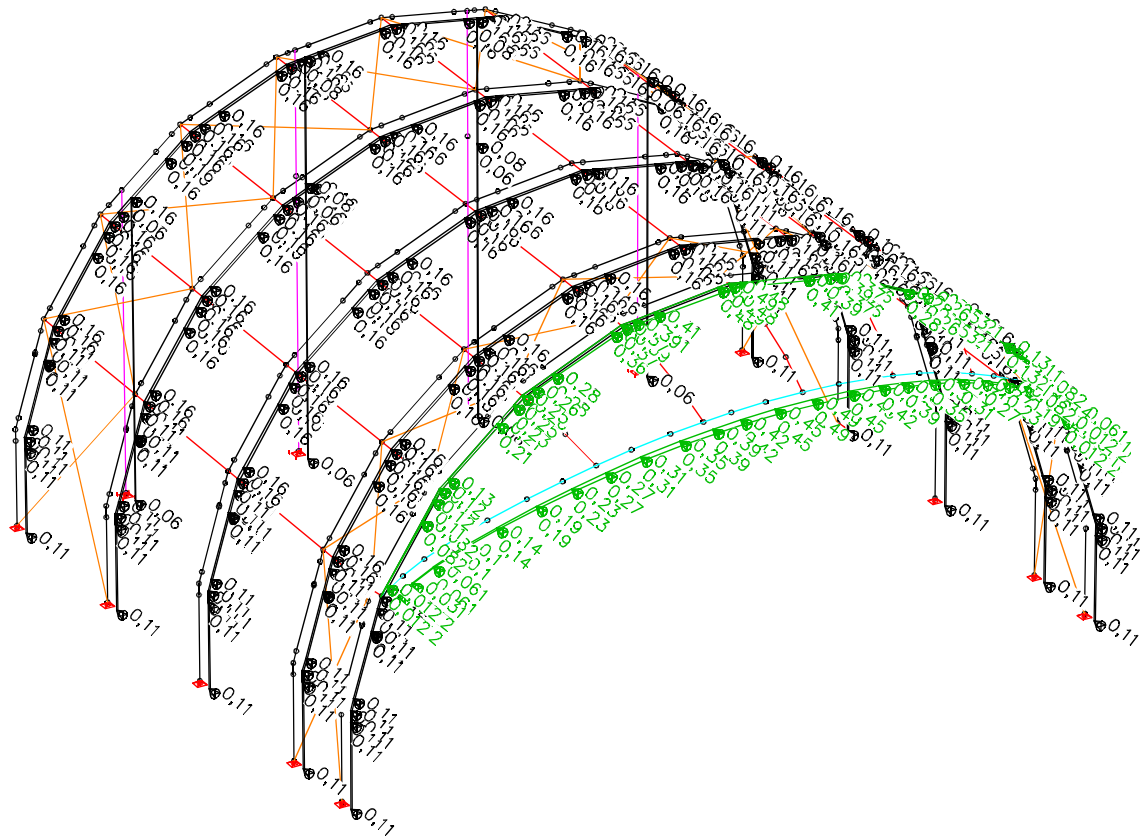
LC 23: Load, membrane tension for LC 22

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 24: wind horizontal y-dir. - out of service

$$\begin{aligned} \text{truss: } & 1,30 \times 0,50 \times 0,40 \times 0,625 = 0,16 \text{ kN/m} \\ & 1,30 \times 0,50 \times 0,40 \times 0,440 = 0,11 \text{ kN/m} \end{aligned}$$

$$\begin{aligned} \text{cantilever roof:} \\ & 1,30 \times 0,625 \times 1,20/2 = 0,49 \text{ kN/m} \end{aligned}$$

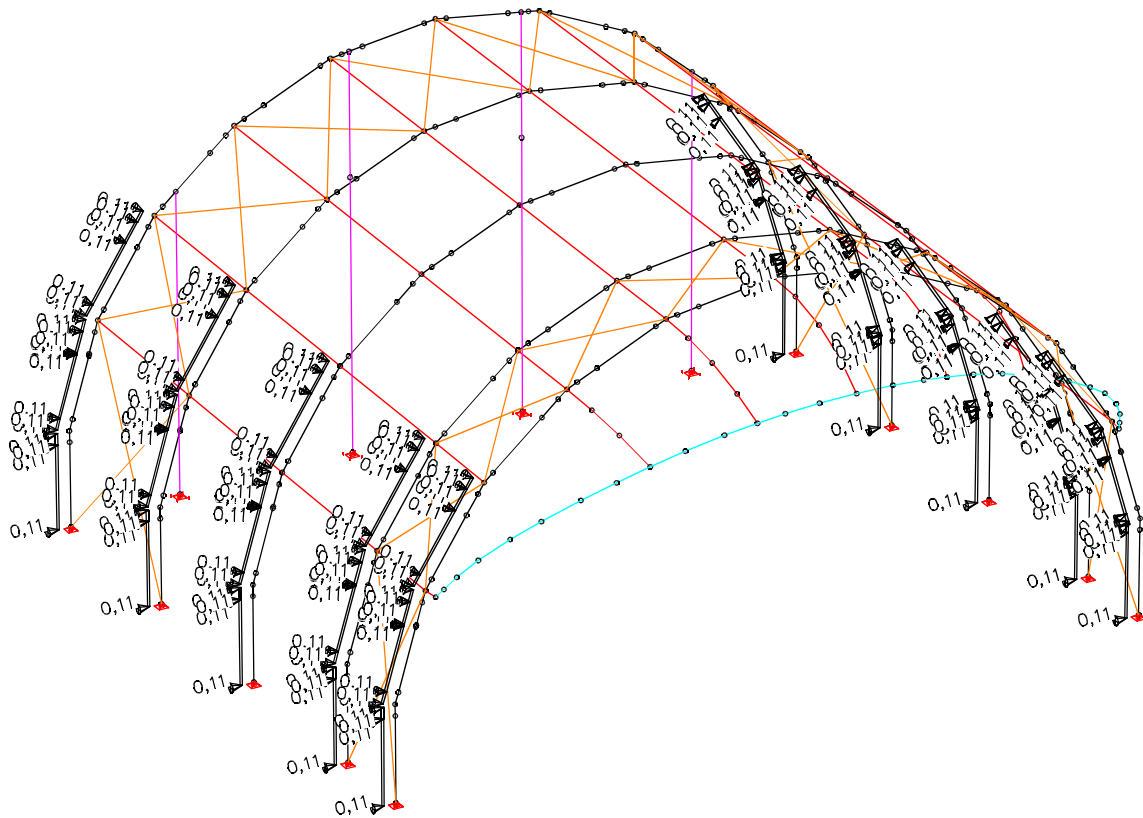


LC 24: Load, wind horizontal Y – out of service

<p>PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS</p>	<p>PROJECT-NO.: 16079</p>
<p>CUSTOMER/AUFTRAGGEBER: Prolyte Group</p>	<p>DATE/DATUM: 10.04.2016</p>

load case 25: wind horizontal x-dir. - out of service

truss: $1,30 \times 0,50 \times 0,40 \times 0,44 = 0,11 \text{ kN/m}$



LC 25: Load, wind horizontal X - out of service

PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
16079

CUSTOMER/AUFTRAGGEBER:
Polyte Group

DATE/DATUM:
10.04.2016

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:

1. roof, back wall and sides enclosed with fully closed canvas wall
LC101-103
2. roof enclosed with fully closed canvas wall, back wall removed and sides partly removed
LC 301-306

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

1. roof, back wall and sides enclosed: fully closed canvas wall for roof and walls**load case 101****Wind in service $\beta = 0^\circ$**

load case 10-11	=	0	
load case 12-13	=	1,30/ 0,50	= 2,60
load case 14-15	=	1,30/ 1,30	= 1,0

load case 102**Wind in service $\beta = 90^\circ$**

load case 10-11	=	1,0	
load case 12	=	-0,50/ 0,50	= -1,0
load case 13	=	1,0	

load case 103**Wind in service $\beta = 180^\circ$**

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

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2. roof enclosed with fully closed canvas wall, back wall removed and sides partly removed

load case 301 Wind out of service $\beta = 0^\circ$

load case 20-23 = 0,60
load case 24 = 1,00

load case 302 Wind out of service $\beta = 90^\circ$ - tension

load case 20-23 = 0,80
load case 25 = 1,00

load case 303 Wind out of service $\beta = 90^\circ$ - tension right side

load case 20-21 = 0,80
load case 22-23 = 0
load case 25 = 1,00

load case 304 Wind out of service $\beta = 90^\circ$ - compression

load case 20-20 = -0,40
load case 21-21 = 0,40
load case 22-22 = -0,40
load case 23-23 = 0,40
load case 25 = 1,00

load case 305 Wind out of service $\beta = 90^\circ$ - compression left side

load case 20-20 = 0
load case 21-21 = 0
load case 22-22 = -0,40
load case 23-23 = 0,40
load case 25 = 1,00

load case 306 Wind out of service $\beta = 180^\circ$

load case 20-23 = 0,60
load case 24 = -1,00

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

NOTICE:

Load case combination 91-93 with incorporate partial safety factors $\gamma_G = 1,1$ for steady loads and $\gamma_Q = 1,35$ for variable loads.
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(1+2) + LC(3-6) + LC(101-103)

LCC 83: LC(1+2) + LC(3-6) + LC(301-306)

load case combinations with safety factor for ballast loading:

LCC 82: LC(1+2) + 1,20 x LC(101-103)

LCC 84: LC(1+2) + 1,20 x LC(301-306)

load case combinations with design values:

LCC 91: 1,1 x LC(1+2) + 1,35 x LC(3-6) + 1,35 x LC(101-103)

LCC 93: 1,1 x LC(1+2) + 1,35 x LC(3-6) + 1,35 x LC(301-306)

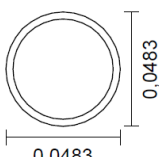
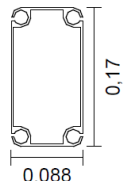
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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2.3 CALCULATION

System characteristics

- 287 Nodes
- 364 Beams
- 14 Supports
- 0 Link elements
- 6 Material properties
- 6 Section properties
- 27 Load cases
- 4 Load case combinations
- 5 Result locations in beam elements

Section properties

1	Beam	H40-V Area [m ²] Moments of inertia [m ⁴]	A = 1,6960e-03 I _x = 9,0000e-06 I _z = 4,1800e-05	I _y = 4,1800e-05 I _{yz} = 0,0000e+00
2	Beam	H30-V Area [m ²] Moments of inertia [m ⁴]	A = 1,6960e-03 I _x = 4,0000e-06 I _z = 2,0950e-05	I _y = 2,0950e-05 I _{yz} = 0,0000e+00
3	Library section 	RO 48,3 x 3 (EN 10219-2); RO48,3x3 Centroid [m] Area [m ²] Moments of inertia [m ⁴] Main axis angle [Grad]	ys = 0,000 A = 4,2700e-04 I _x = 2,1900e-07 I _y = 1,1000e-07 I _z = 1,1000e-07 Phi = 0,000	zs = 0,000 I _{yz} = 0,0000e+00 I ₁ = 1,1000e-07 I ₂ = 1,1000e-07
4	Polygon 	Keder 88x170 Centroid [m] Area [m ²] Moments of inertia [m ⁴] Main axis angle [Grad] Averaging of the lateral force shear stress over section width	ys = 0,000 A = 1,9554e-03 I _x = 4,2491e-06 I _y = 7,9022e-06 I _z = 2,3673e-06 Phi = -0,016	zs = 0,000 I _{yz} = 1,5251e-09 I ₁ = 7,9022e-06 I ₂ = 2,3673e-06
5	Tension member	ZugseilØ=12mm Area [m ²]	A = 1,1300e-04	
6	Beam	H30-D Area [m ²] Moments of inertia [m ⁴]	A = 1,2720e-03 I _x = 1,5000e-06 I _z = 1,0571e-05	I _y = 1,0573e-05 I _{yz} = 0,0000e+00

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Material Properties

	No.	Type	E-Modu. [MN/m ²]	GModule [MN/m ²]	alpha.t [1/K]	gamma [kN/m ³]	Miscellaneous
1	1	Frei	70000	27000	1,00e-05	0,000	
2	2	Frei	70000	27000	1,00e-05	0,000	
3	3	Frei	70000	27000	1,20e-05	0,000	fc = 240 [MN/m ²] ft = 240
4	4	Frei	70000	27000	1,00e-05	27,000	fc = 12 [MN/m ²] ft = 0
5	5	Frei	110000	81000	1,20e-05	0,100	
6	6	Frei	70000	27000	1,00e-05	0,000	

List of load cases

LC.	Label
1	deadweight
2	canopy 1kg/m ²
3	distributed load
4	center point load
5	third point load
6	forth point load
10	wind roof outer side
11	membrane tension for LC 10
12	wind roof inner side
13	membrane tension for LC 12
14	wind rear wall
15	membrane tension rear wall
20	wind roof right side - out of service
21	membrane tension for LC 20
22	wind roof left side - out of service
23	membrane tension for LC 22
24	wind horizontal Y - out of service
25	wind horizontal X - out of service
101	Wind β=0° - in service
102	Wind β=90° - in service
103	Wind β=180° - in service
301	Wind β=0° - out of service
302	Wind β=90°-tension - out of service
303	Wind β=90°-tension right - out of service
304	Wind β=90°-compression - out of service
305	Wind β=90°-compression left - out of service
306	Wind β=180° - out of service

Load case combination 81, in service

Permanent action	Factor
1 deadweight	1,000

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Load case combination 81, in service

Permanent action		Factor
2	canopy 1kg/m ²	1,000
1. Variable exclusive action		Factor
3	distributed load	1,000
4	center point load	1,000
5	third point load	1,000
6	forth point load	1,000
2. Variable exclusive action		Factor
101	Wind $\beta=0^\circ$ - in service	1,000
102	Wind $\beta=90^\circ$ - in service	1,000
103	Wind $\beta=180^\circ$ - in service	1,000

Load case combination 82, in service - ballast

Permanent action		Factor
1	deadweight	1,000
2	canopy 1kg/m ²	1,000
2. Variable exclusive action		Factor
101	Wind $\beta=0^\circ$ - in service	1,200
102	Wind $\beta=90^\circ$ - in service	1,200
103	Wind $\beta=180^\circ$ - in service	1,200

Load case combination 83, out of service

Permanent action		Factor
1	deadweight	1,000
2	canopy 1kg/m ²	1,000
1. Variable exclusive action		Factor
3	distributed load	1,000
4	center point load	1,000
5	third point load	1,000
6	forth point load	1,000
2. Variable exclusive action		Factor
301	Wind $\beta=0^\circ$ - out of service	1,000
302	Wind $\beta=90^\circ$ -tension - out of service	1,000
303	Wind $\beta=90^\circ$ -tension right - out of service	1,000
304	Wind $\beta=90^\circ$ -compression - out of service	1,000
305	Wind $\beta=90^\circ$ -compression left - out of service	1,000

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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Load case combination 83, out of service

2. Variable exclusive action		Factor
306	Wind $\beta=180^\circ$ - out of service	1,000

Load case combination 84, out of service - ballast

Permanent action		Factor
1	deadweight	1,000
2	canopy 1kg/m ²	1,000
2. Variable exclusive action		Factor
301	Wind $\beta=0^\circ$ - out of service	1,200
302	Wind $\beta=90^\circ$ -tension - out of service	1,200
303	Wind $\beta=90^\circ$ -tension right - out of service	1,200
304	Wind $\beta=90^\circ$ -compression - out of service	1,200
305	Wind $\beta=90^\circ$ -compression left - out of service	1,200
306	Wind $\beta=180^\circ$ - out of service	1,200

Load case combination 91, in service

Permanent action		Factor
1	deadweight	1,100
2	canopy 1kg/m ²	1,100
1. Variable exclusive action		Factor
3	distributed load	1,350
4	center point load	1,350
5	third point load	1,350
6	forth point load	1,350
2. Variable exclusive action		Factor
101	Wind $\beta=0^\circ$ - in service	1,350
102	Wind $\beta=90^\circ$ - in service	1,350
103	Wind $\beta=180^\circ$ - in service	1,350

Load case combination 93, out of service

Permanent action		Factor
1	deadweight	1,100
2	canopy 1kg/m ²	1,100
1. Variable exclusive action		Factor
3	distributed load	1,350

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Load case combination 93, out of service

1. Variable exclusive action		Factor
4	center point load	1,350
5	third point load	1,350
6	forth point load	1,350
2. Variable exclusive action		Factor
301	Wind $\beta=0^\circ$ - out of service	1,350
302	Wind $\beta=90^\circ$ -tension - out of service	1,350
303	Wind $\beta=90^\circ$ -tension right - out of service	1,350
304	Wind $\beta=90^\circ$ -compression - out of service	1,350
305	Wind $\beta=90^\circ$ -compression left - out of service	1,350
306	Wind $\beta=180^\circ$ - out of service	1,350

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	deadweight	0,000	0,000	22,500
	Support reactions	0,000	-0,000	22,500
2	canopy 1kg/m ²	0,000	-0,000	3,886
	Support reactions	-0,000	0,000	3,886
3	distributed load	0,000	-0,000	68,910
	Support reactions	0,000	0,000	68,910
4	center point load	-0,000	-0,000	39,045
	Support reactions	0,000	0,000	39,045
5	third point load	-0,000	-0,000	54,045
	Support reactions	0,000	0,000	54,045
6	forth point load	-0,000	-0,000	49,045
	Support reactions	0,000	-0,000	49,045
10	wind roof outer side	32,973	0,000	-49,058
	Support reactions	32,973	0,000	-49,058
11	membrane tension for LC 10	-0,000	0,027	0,000
	Support reactions	0,000	0,027	0,000
12	wind roof inner side	0,108	0,000	-40,236
	Support reactions	0,108	-0,000	-40,236
13	membrane tension for LC 12	-0,000	0,027	0,000
	Support reactions	0,000	0,027	-0,000
14	wind rear wall	0,000	-42,043	-0,000
	Support reactions	-0,000	-42,043	-0,000

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Sum of installed loads and support reactions

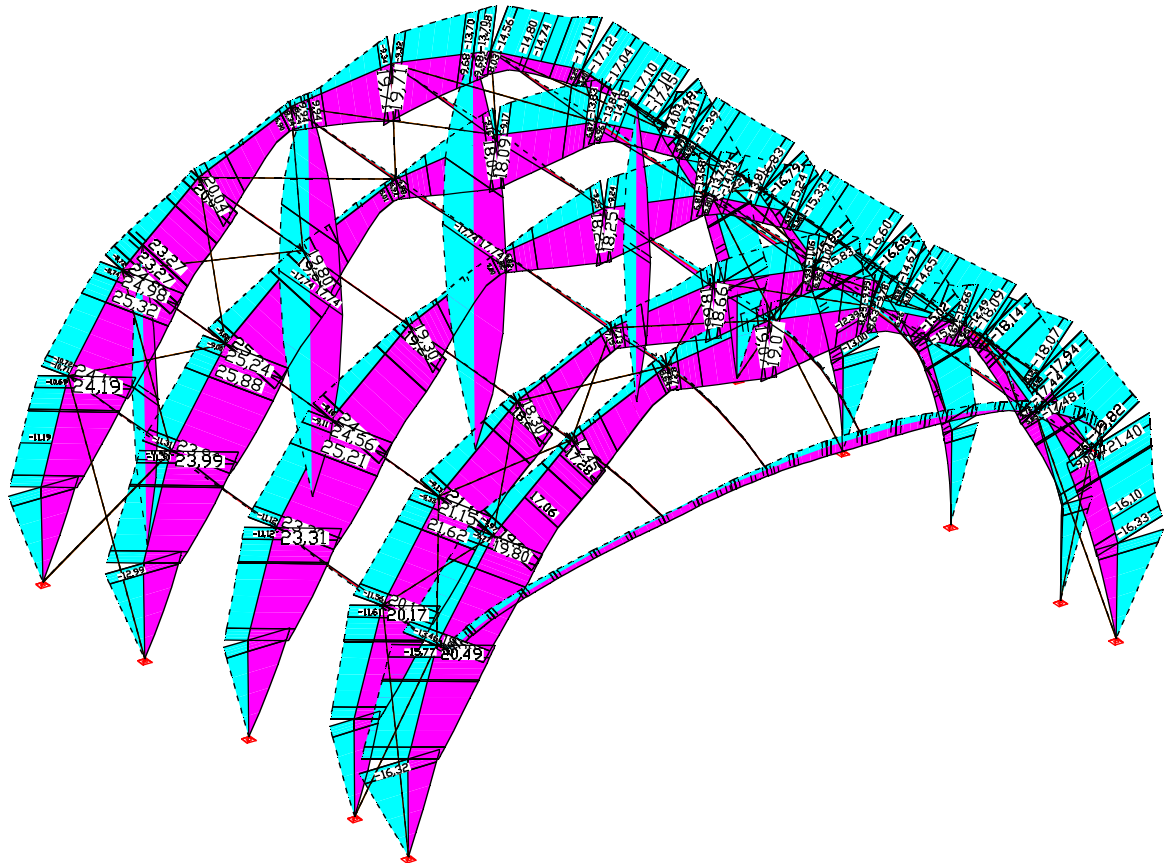
LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
15	membrane tension rear wall	0,000	-0,000	0,000
	Support reactions	0,000	-0,000	-0,000
20	wind roof right side - out of service	29,005	0,000	-72,641
	Support reactions	29,005	0,000	-72,641
21	membrane tension for LC 20	0,000	0,054	0,000
	Support reactions	0,000	0,054	0,000
22	wind roof left side - out of service	-28,554	0,000	-72,120
	Support reactions	-28,554	0,000	-72,120
23	membrane tension for LC 22	-0,000	0,054	0,000
	Support reactions	0,000	0,054	0,000
24	wind horizontal Y - out of service	-0,000	-33,715	0,000
	Support reactions	-0,000	-33,715	-0,000
25	wind horizontal X - out of service	7,507	-0,000	0,000
	Support reactions	7,507	0,000	-0,000
101	Wind $\beta=0^\circ$ - in service	0,281	-41,974	-104,613
	Support reactions	0,281	-41,974	-104,613
102	Wind $\beta=90^\circ$ - in service	32,865	0,053	-8,822
	Support reactions	32,865	0,053	-8,822
103	Wind $\beta=180^\circ$ - in service	0,022	42,048	-8,047
	Support reactions	0,022	42,048	-8,047
301	Wind $\beta=0^\circ$ - out of service	0,270	-33,650	-86,857
	Support reactions	0,270	-33,650	-86,857
302	Wind $\beta=90^\circ$ -tension - out of service	7,868	0,087	-115,809
	Support reactions	7,868	0,087	-115,809
303	Wind $\beta=90^\circ$ -tension right - out of se...	30,711	0,044	-58,112
	Support reactions	30,711	0,044	-58,112
304	Wind $\beta=90^\circ$ -compression - out of se...	7,327	0,043	57,904
	Support reactions	7,327	0,043	57,904
305	Wind $\beta=90^\circ$ -compression left - out o...	18,929	0,022	28,848
	Support reactions	18,929	0,022	28,848
306	Wind $\beta=180^\circ$ - out of service	0,270	33,780	-86,857
	Support reactions	0,270	33,780	-86,857

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internal forces

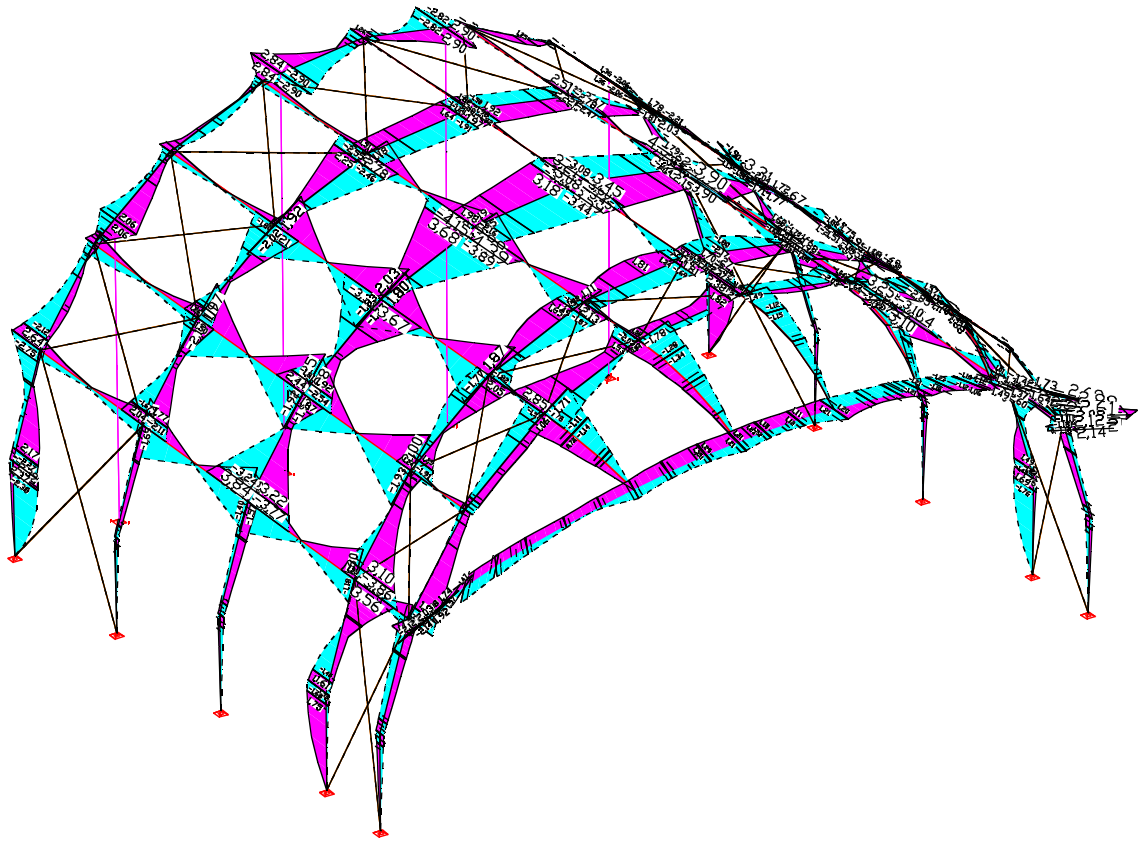
load case combination 91:

$M_{y,Ed}$



LCC 91: in service
 Internal forces min,max M_y [kNm]
 Value range (overall system, min/max): -21,40/25,88 [kNm]

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$M_{z,Ed}$ 

LCC 91: in service
Internal forces min,max M_z [kNm]
Value range (overall system, min/max): $-4,39/4,39$ [kNm]

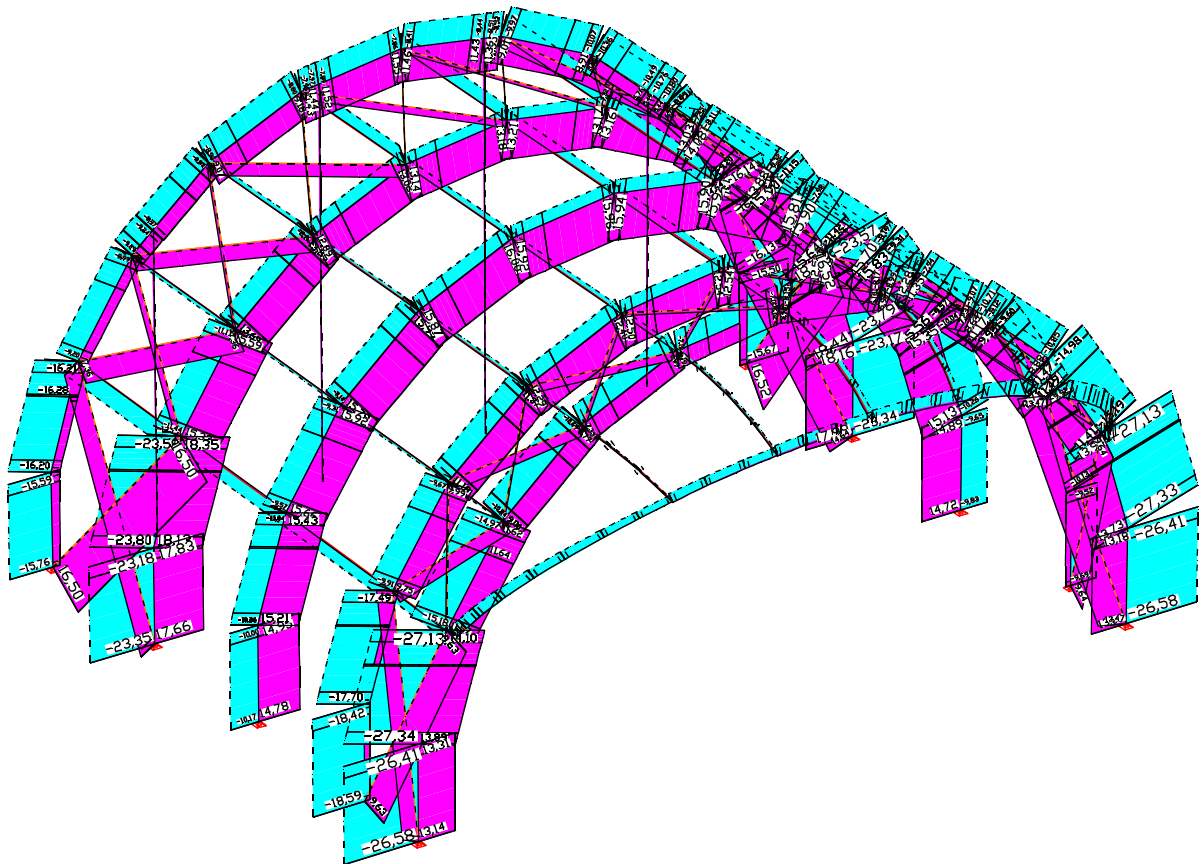
PROJECT:
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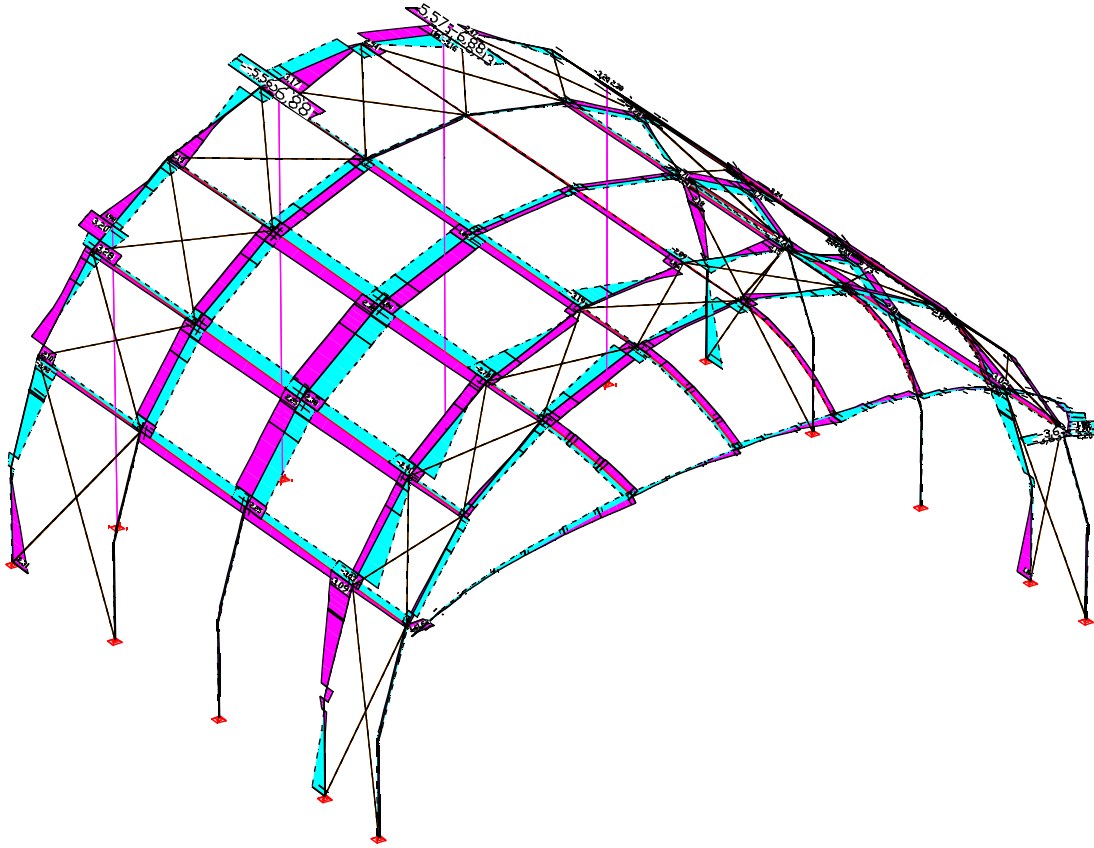
DATE/DATUM:
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$N_{x,Ed}$



LCC 91: in service
 Internal forces min,max N_x [kN]
 Value range (overall system, min/max): -27,34/18,66 [kN]

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$V_{y,Ed}$ 

LCC 91: in service
Internal forces min,max Q_y [kN]
Value range (overall system, min/max): $-6,93/6,93$ [kN]

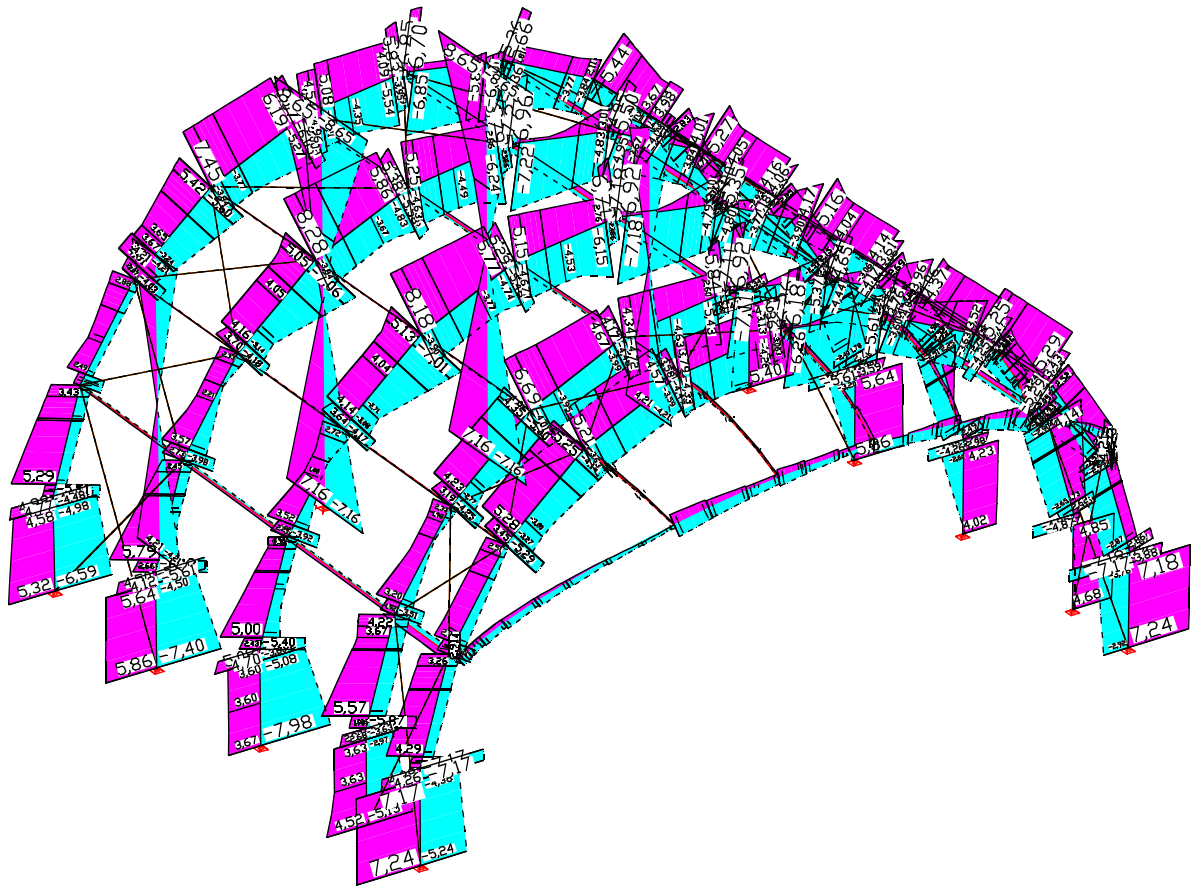
PROJECT:
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V_{z,Ed}

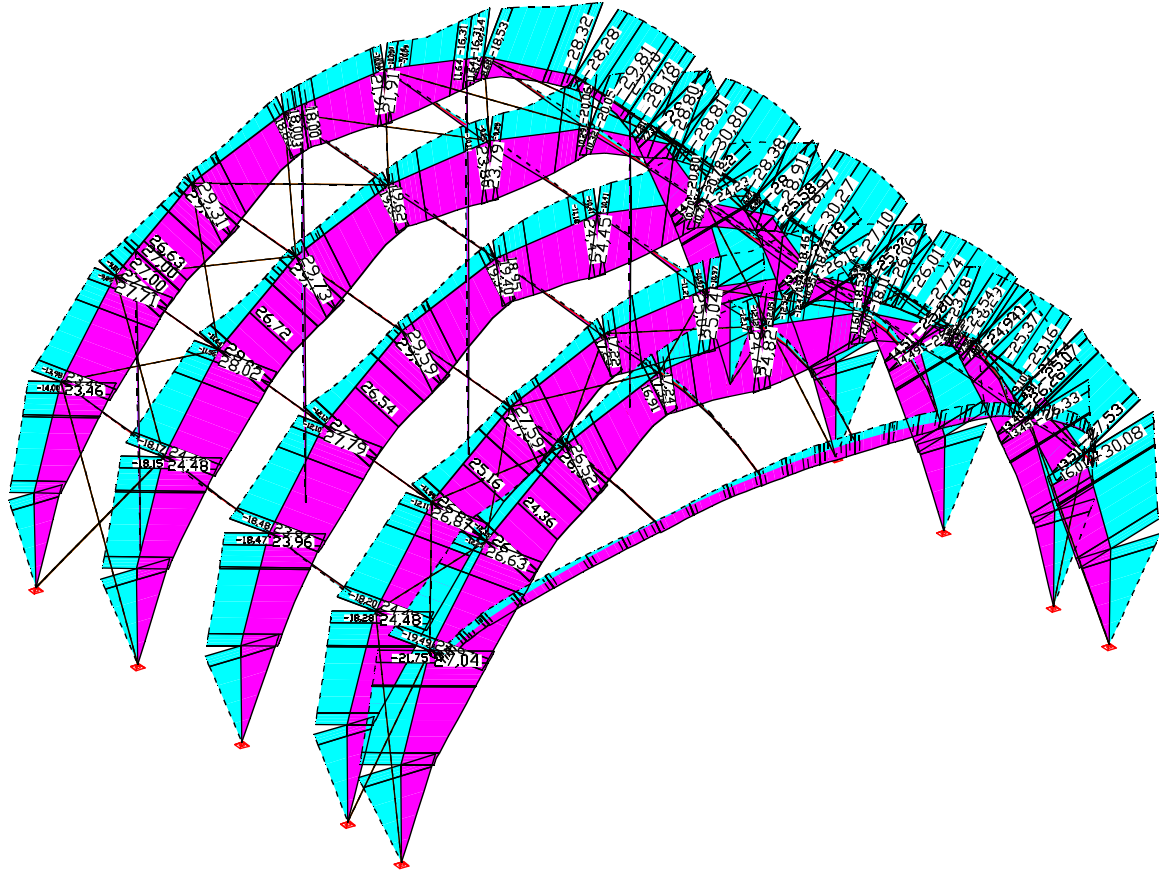


LCC 91: in service
 Internal forces min,max Qz [kN]
 Value range (overall system, min/max): -8,65/8,65 [kN]

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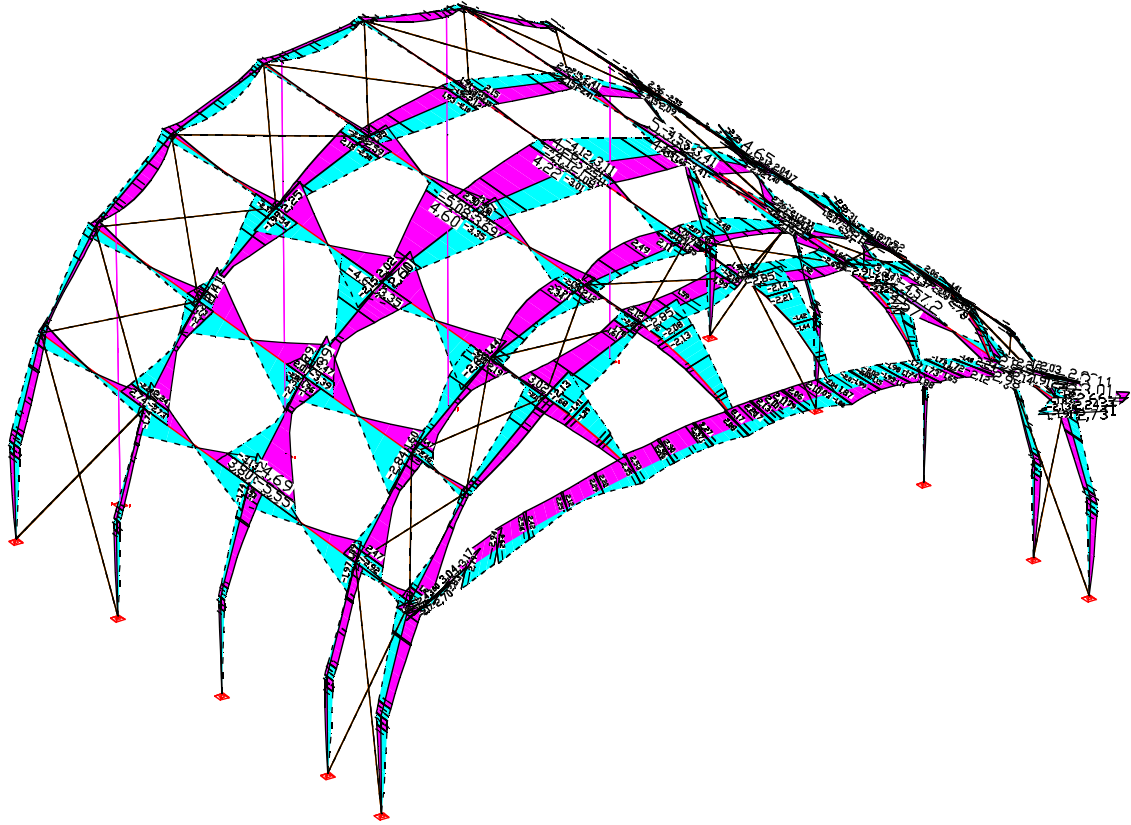
load case combination 93:

$M_{y,Ed}$



LCC 93: out of service
 Internal forces min,max M_y [kNm]
 Value range (overall system, min/max): -30,80/29,73 [kNm]

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$M_{z,Ed}$ 

LCC 93: out of service
Internal forces min,max M_z [kNm]
Value range (overall system, min/max): $-5,55/5,42$ [kNm]

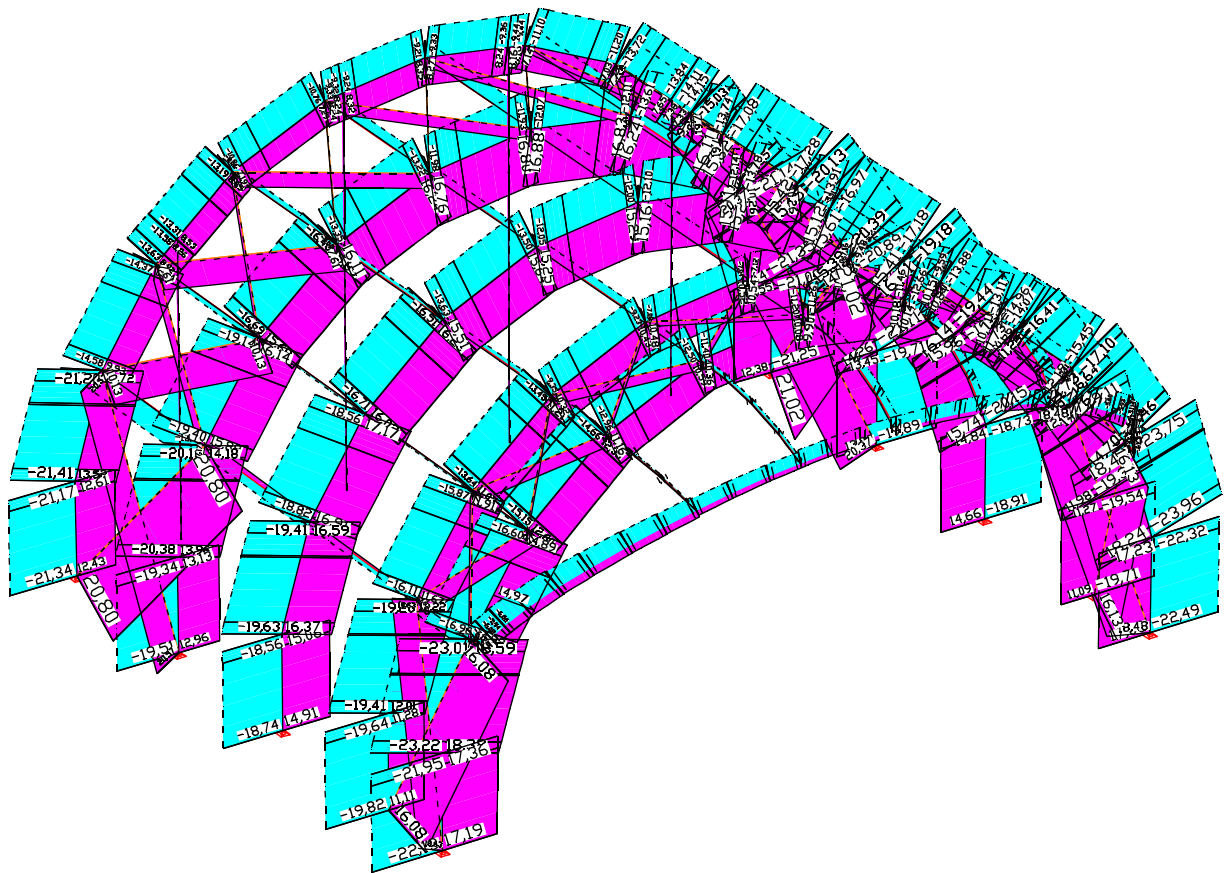
PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
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CUSTOMER/AUFTRAGGEBER:
Polyte Group

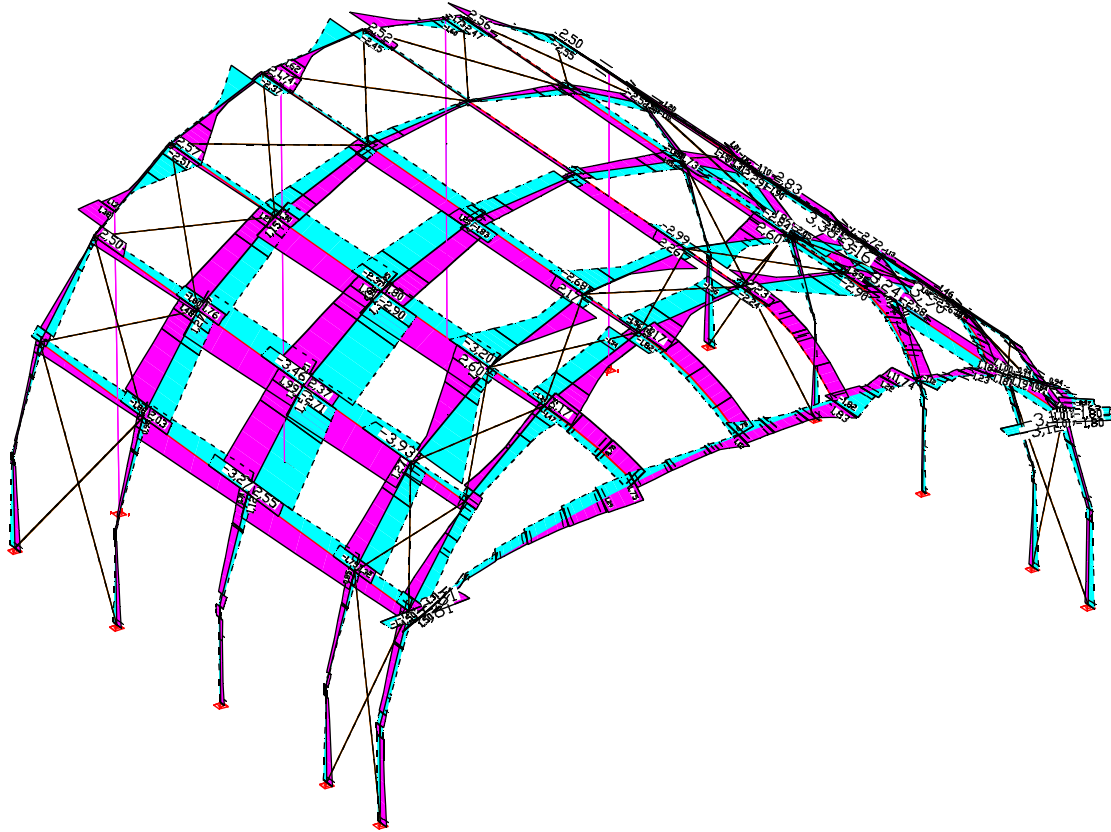
DATE/DATUM:
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$N_{x,Ed}$



LCC 93: out of service
 Internal forces min,max N_x [kN]
 Value range (overall system, min/max): -23,96/21,02 [kN]

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$V_{y,Ed}$ 

LCC 93: out of service
Internal forces min,max Q_y [kN]
Value range (overall system, min/max): $-3,93/3,90$ [kN]

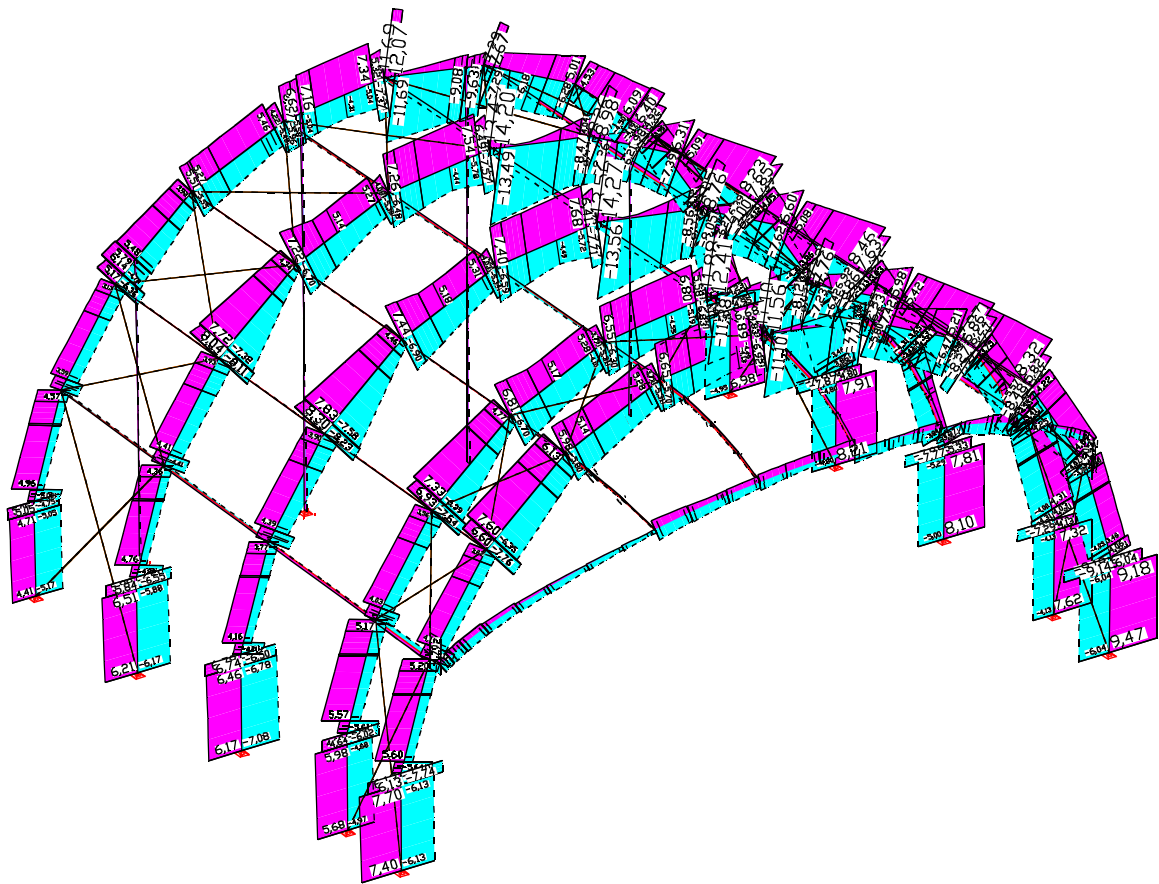
PROJECT:
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PROJECT-NO.:
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CUSTOMER/AUFTRAGGEBER:
Prolyte Group

DATE/DATUM:
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V_{z,Ed}

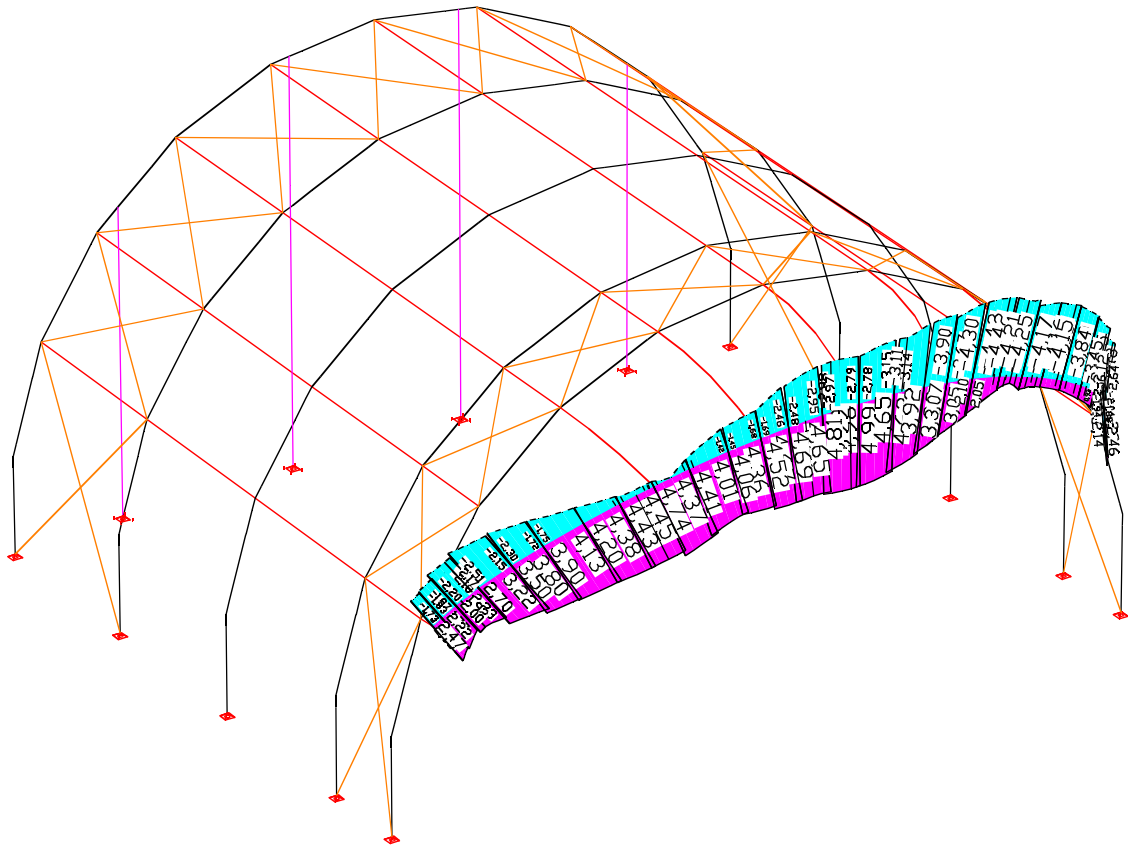


LCC 93: out of service
 Internal forces min,max Qz [kN]
 Value range (overall system, min/max): -13,56/14,27 [kN]

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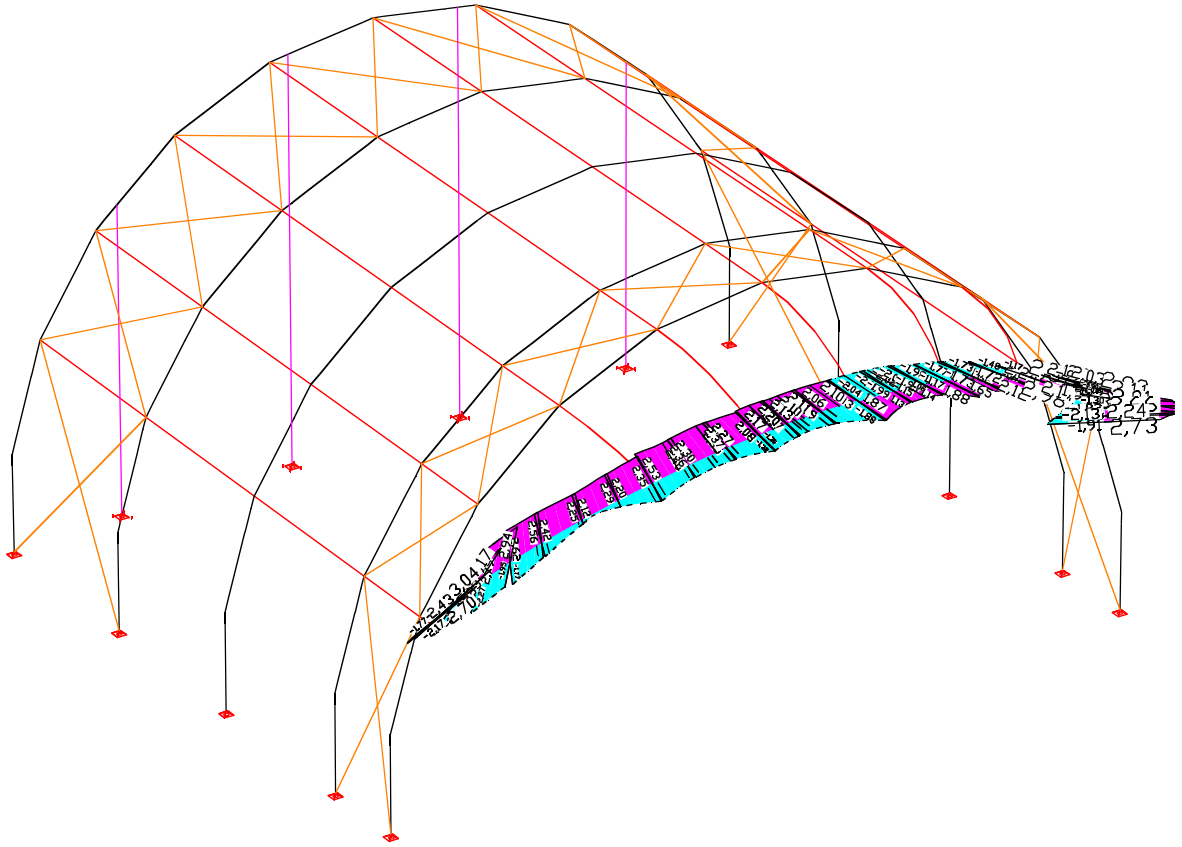
2.4 PROOFS

Canilever roof - H30D



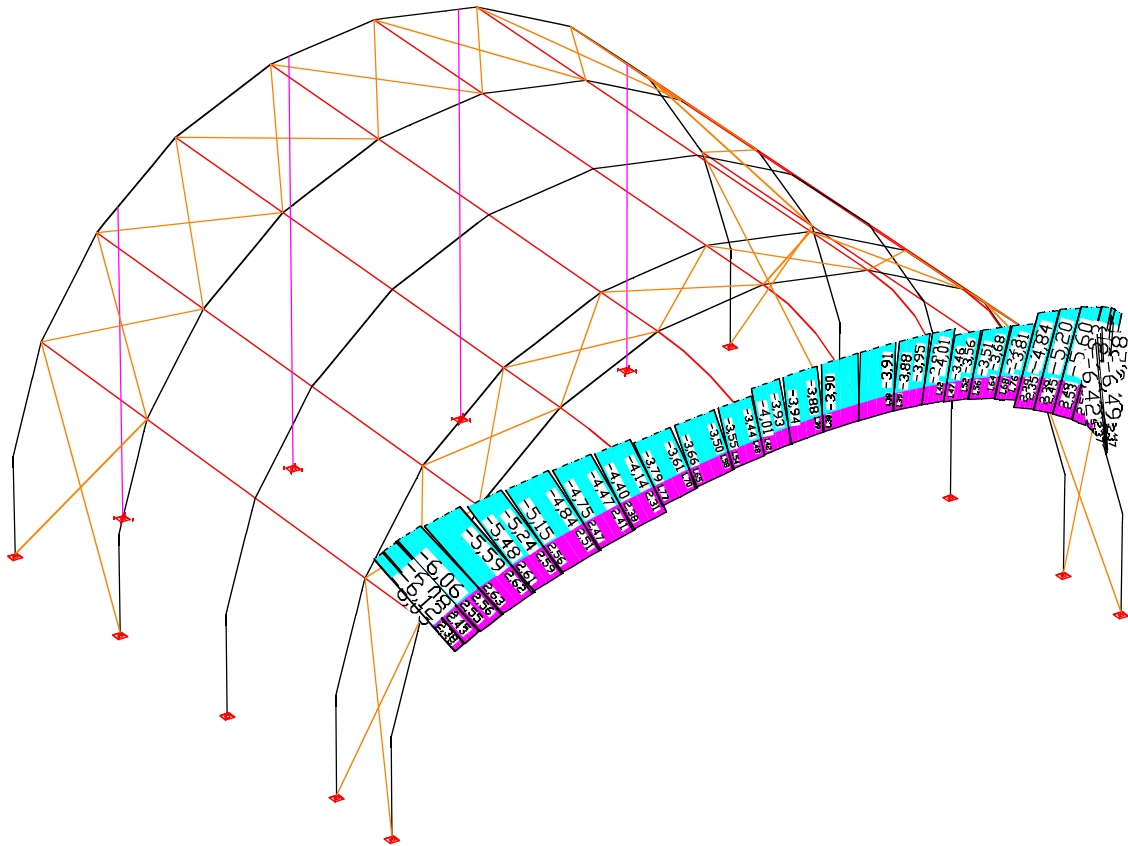
LCC 93: out of service
 Selected Internal forces min,max My [kNm]
 Value range (subsystem, min/max): -4,43/4,99 [kNm]

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LCC 93: out of service
 Selected Internal forces min,max M_z [kNm]
 Value range (subsystem, min/max): $-2,60/3,52$ [kNm]

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CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Selected Internal forces min,max Nx [kN]
 Value range (subsystem, min/max): -6,49/2,63 [kN]

Superposition of the maximum values:

single chord:

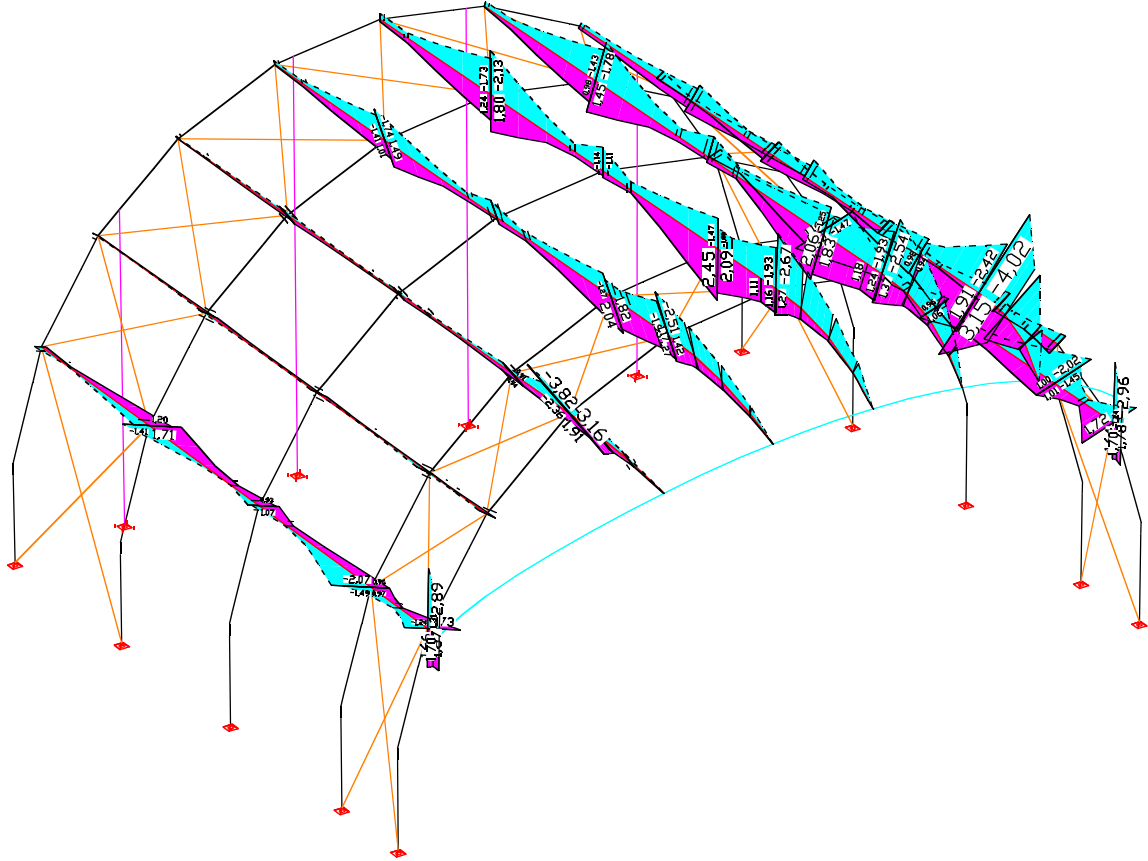
$$N_d = 4,99/0,207 + 6,49/3 = 26,27 \text{ kN} < 50,22 \text{ kN}$$

double chord:

$$N_d = 4,99/(2 \times 0,207) + 3,52/(2 \times 0,239) + 6,49/3 = 28,94 \text{ kN} < 50,22 \text{ kN}$$

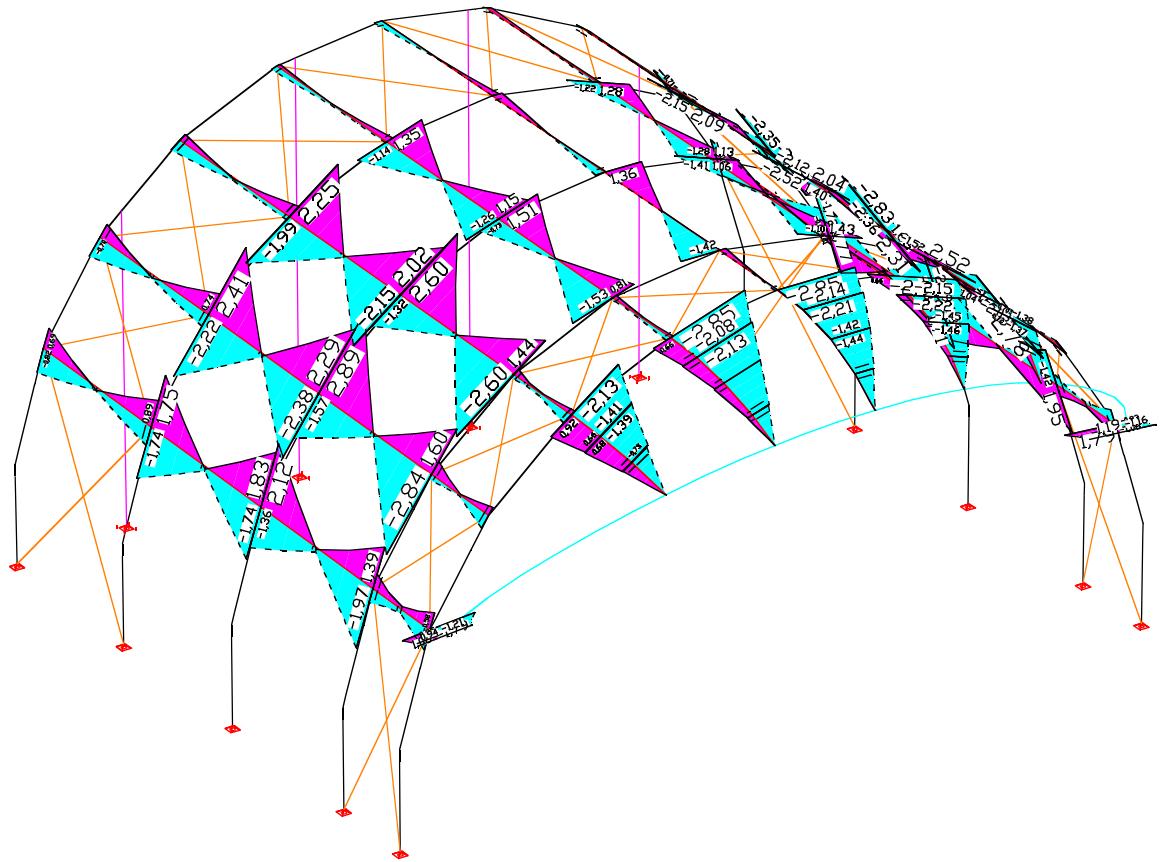
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Lateral braces - H30V



LCC 93: out of service
 Selected Internal forces min,max My [kNm]
 Value range (subsystem, min/max): -4,02/3,16 [kNm]

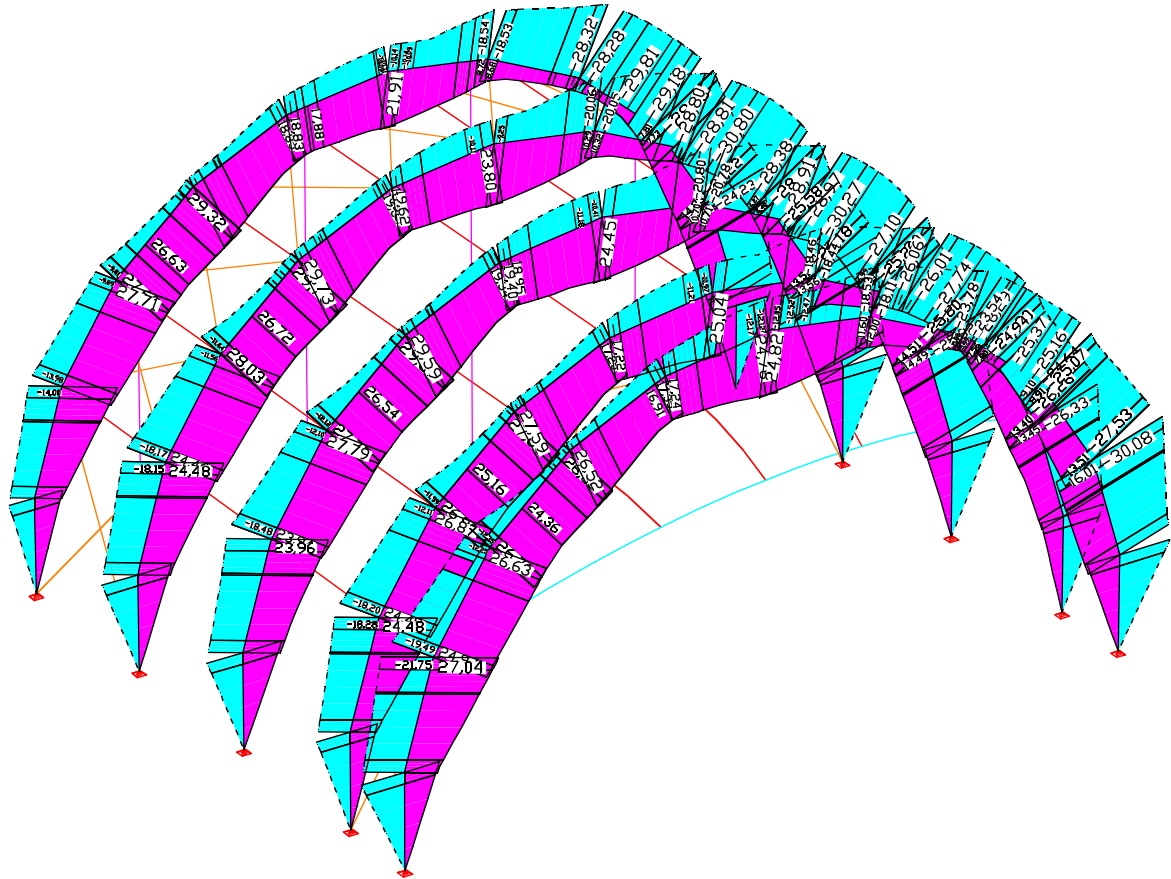
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Selected Internal forces min,max Mz [kNm]
 Value range (subsystem, min/max): -2,91/2,89 [kNm]

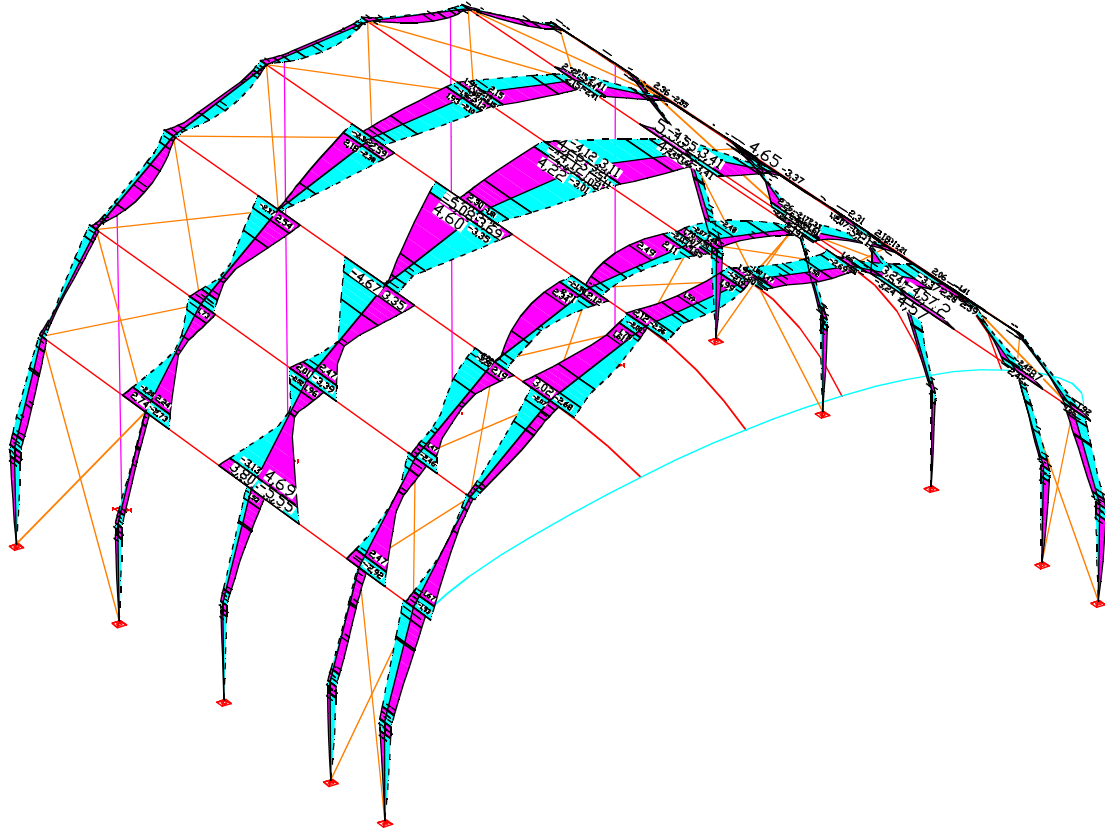
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Main bow - H40V



LCC 93: out of service
 Selected Internal forces min,max My [kNm]
 Value range (subsystem, min/max): -30,80/29,73 [kNm]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



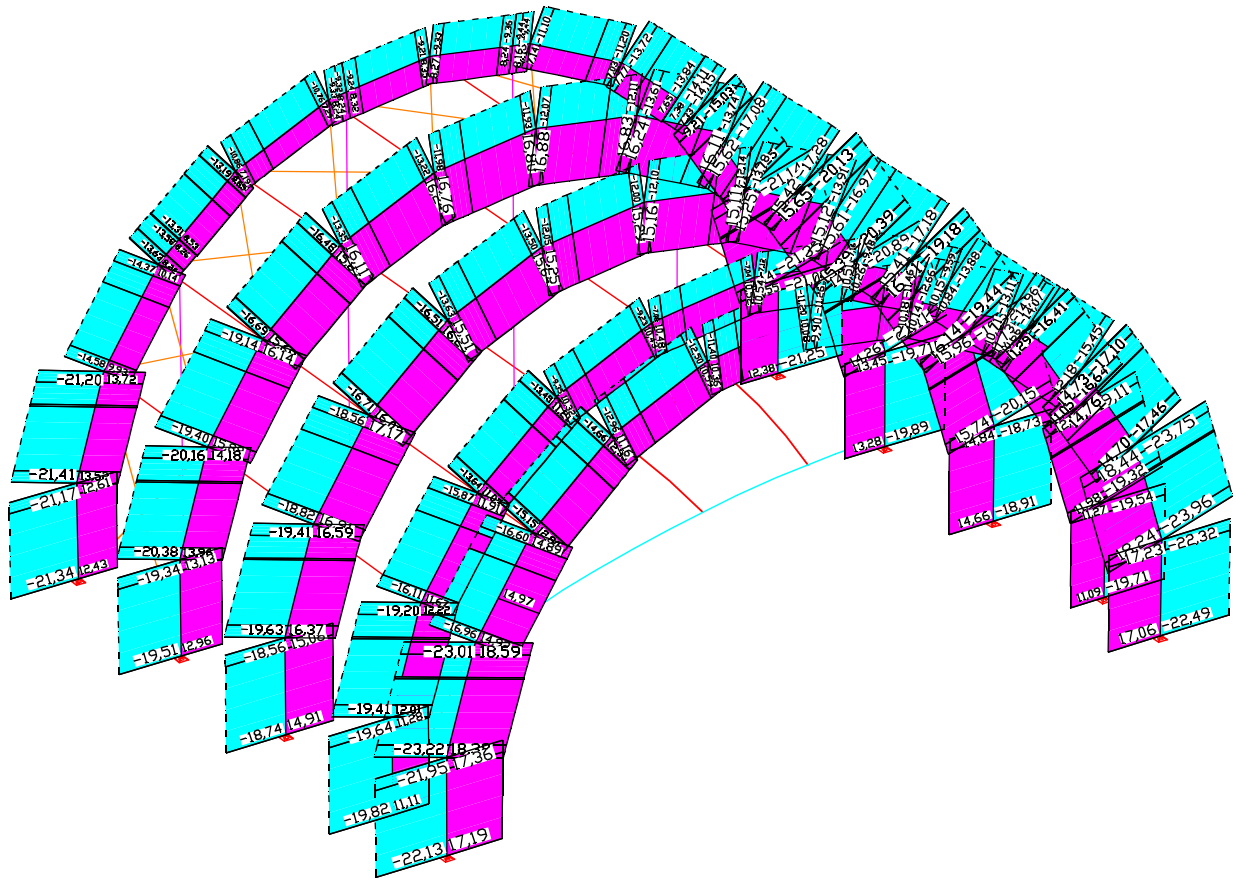
LCC 93: out of service
Selected Internal forces min,max Mz [kNm]
Value range (subsystem, min/max): -5,55/5,42 [kNm]

PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
16079

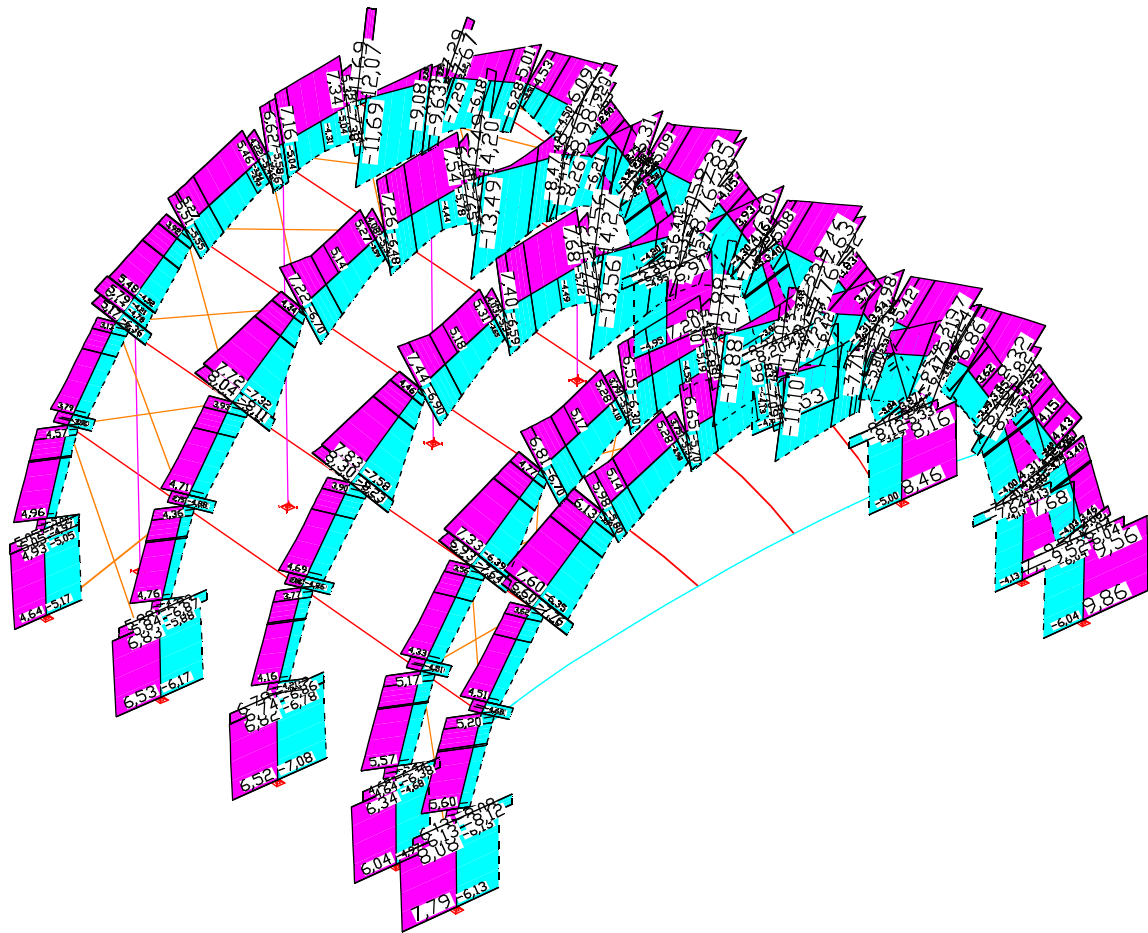
CUSTOMER/AUFTRAGGEBER:
Prolyte Group

DATE/DATUM:
10.04.2016



LCC 93: out of service
 Selected Internal forces min,max Nx [kN]
 Value range (subsystem, min/max): -23,96/18,59 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Selected Internal forces min,max Qz [kN]
 Value range (subsystem, min/max): -13,56/14,27 [kN]

< 18,94 kN

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Internal forces beam 1331

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]	
K91		-27,13	-14,50	0,12	0,02	0,66	-0,0	
		13,94	9,00	-0,11	-0,02	1,02	0,0	
		-12,09	-21,40	0,15	0,03	-2,99	-0,0	
		13,94	9,00	-0,11	-0,02	1,02	0,0	
		-3,40	-10,69	-0,50	-0,11	-1,90	0,0	
		-11,61	-13,40	0,75	0,16	-1,29	-0,1	
		-3,40	-10,69	-0,50	-0,11	-1,90	0,0	
		-11,61	-13,40	0,75	0,16	-1,29	-0,1	
		-12,09	-21,40	0,15	0,03	-2,99	-0,0	
		-16,80	-5,10	-0,40	-0,09	1,26	0,0	
		-11,61	-13,40	0,75	0,16	-1,29	-0,1	
		-3,40	-10,69	-0,50	-0,11	-1,90	0,0	
	K93		-23,75	-26,57	0,88	0,19	-2,08	-0,1
			18,44	16,01	-1,18	-0,60	0,88	0,0
			-17,99	-30,08	0,48	0,10	-3,61	-0,0
			18,44	16,01	-1,18	-0,60	0,88	0,0
		9,84	14,87	-1,27	-0,27	2,16	0,1	
		-22,13	-27,87	1,01	0,21	-2,58	-0,1	
		18,44	16,01	-1,18	-0,60	0,88	0,0	
		-18,58	-0,92	-0,03	0,35	2,31	0,1	
		-4,60	-22,17	-0,41	-0,09	-3,75	0,0	
		-9,88	9,79	-0,68	0,21	3,40	0,2	
	-22,13	-27,87	1,01	0,21	-2,58	-0,1		
	-9,88	9,79	-0,68	0,21	3,40	0,2		

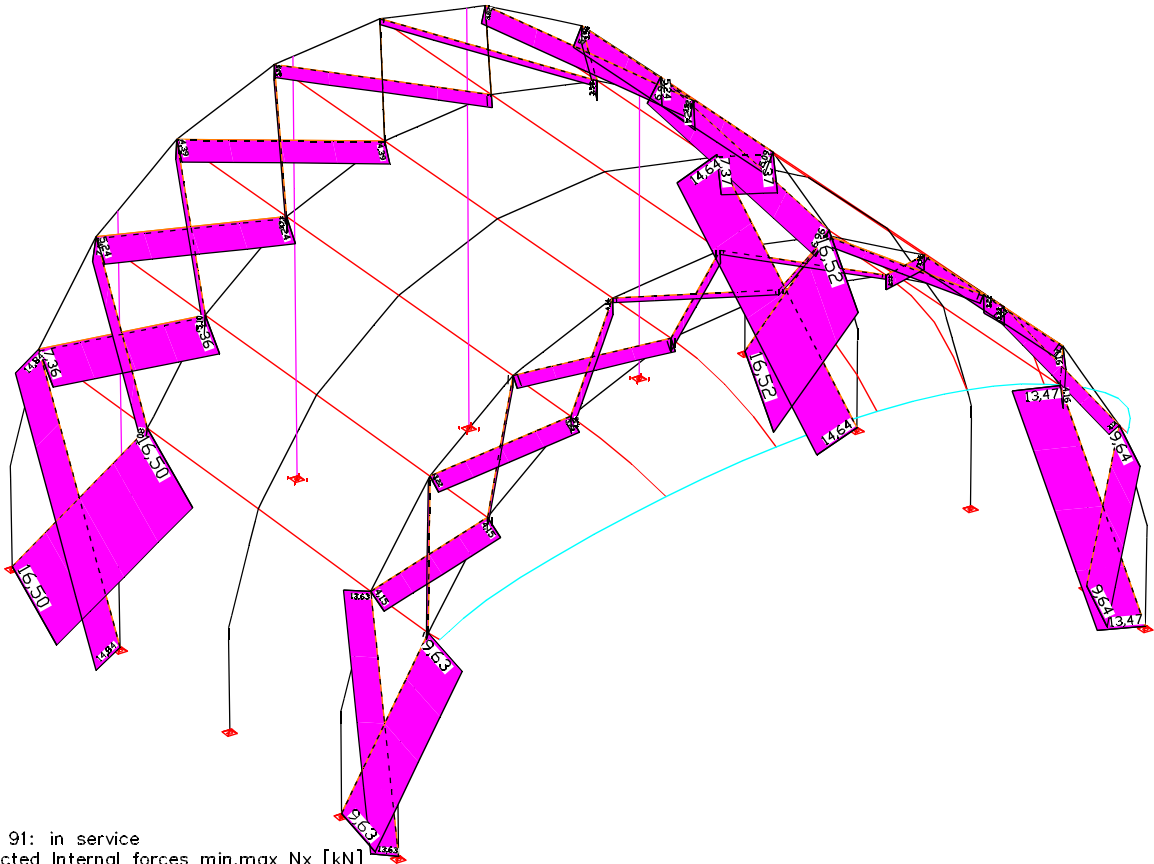
$$N_d = (30,08 + 0,48)/(2 \times 0,339) + 17,99/4 = 49,57 \text{ kN} < 50,22 \text{ kN}$$

$$N_d = (27,87 + 1,01)/(2 \times 0,339) + 22,13/4 = 48,13 \text{ kN} < 50,22 \text{ kN}$$

stabilisation not decisive

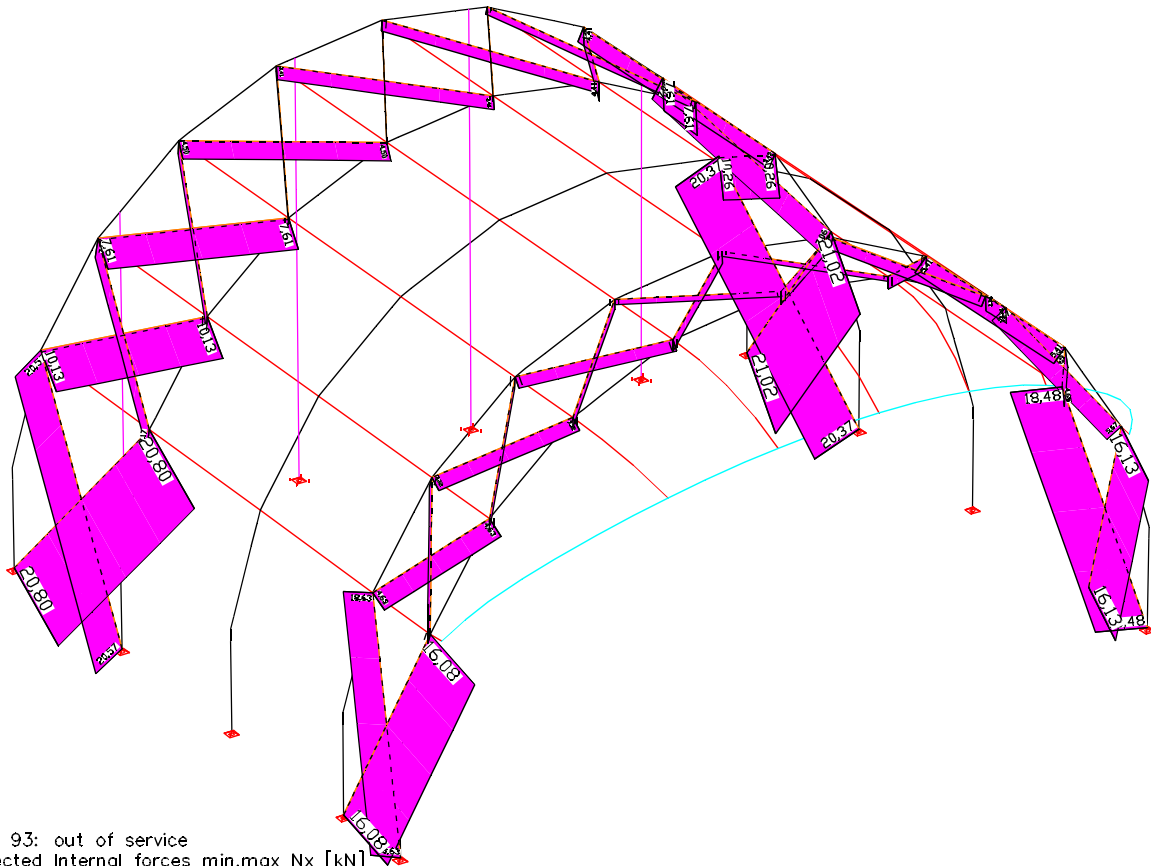
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

guy wires



LCC 91: in service
Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -0,00/16,52 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Selected Internal forces min,max Nx [kN]
 Value range (subsystem, min/max): -0,00/21,02 [kN]

max. $N_{Ed} = 21,02 \text{ kN}$

$\varnothing 10 \text{ mm}$ 1770 N/mm^2 DIN EN 12385-4

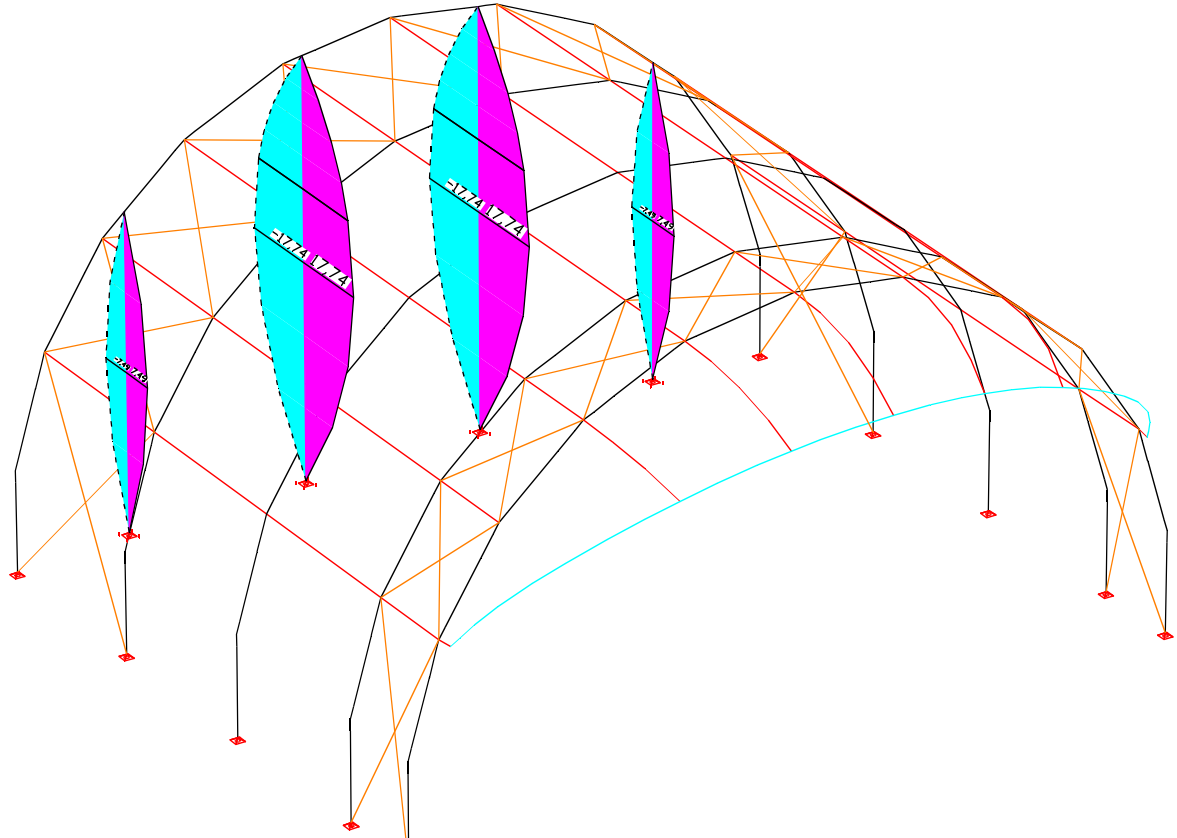
usage factor: $\gamma = 3,0$

$N_{U,d} = 58,80 \text{ kN}$

$21,02/1,35 = 15,57 < 58,80/3 = 19,60 \text{ kN}$

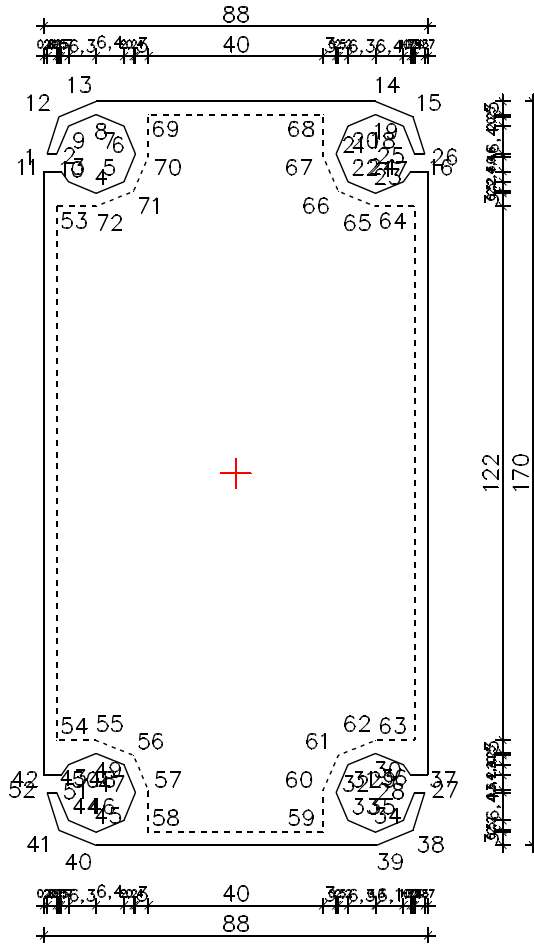
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Keder profiles



LCC 91: in service
 Selected Internal forces min,max My [kNm]
 Value range (subsystem, min/max): -17,74/17,74 [kNm]

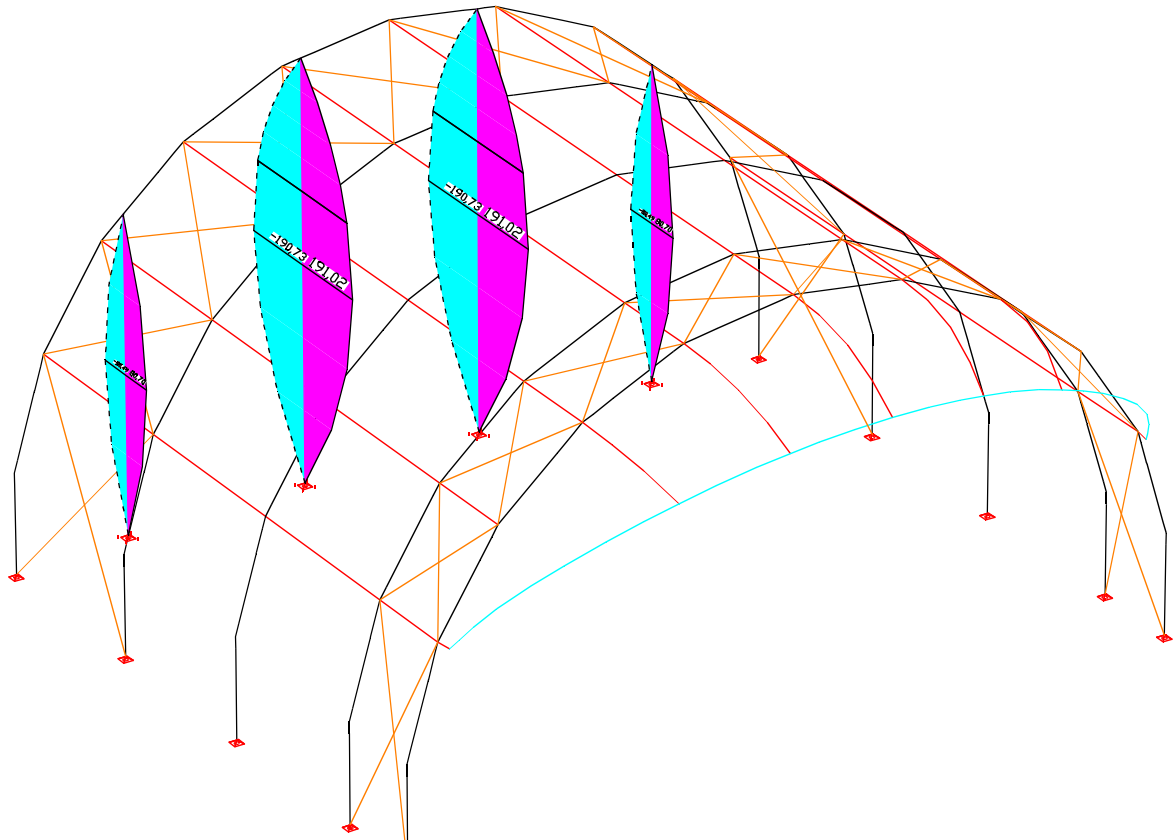
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



$Y_s = 0,00000 \text{ m}$ $Z_s = 0,00000 \text{ m}$
 $I_y = 7,90221\text{e-}006 \text{ m}^4$ $I_z = 2,36728\text{e-}006 \text{ m}^4$
 $I1 = 7,90221\text{e-}006 \text{ m}^4$ $I2 = 2,36728\text{e-}006 \text{ m}^4$
 $\text{Phi} = -0,01579 \text{ Grad}$ $A = 1,95541\text{e-}003 \text{ m}^2$

Section polygon 4 – Keder 88x170 [mm]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 91: in service
 Selected Stresses (general – elastic, directly from internal forces) min,max Sigma.x [MN/m²]
 Value range (subsystem, min/max): -190,73/191,02 [MN/m²]

$$< 250/1,1 = 227 \text{ MN/m}^2$$

Connector: 120x80x3 S355

$$W_{\text{plastic}} = 50 \text{ cm}^3$$

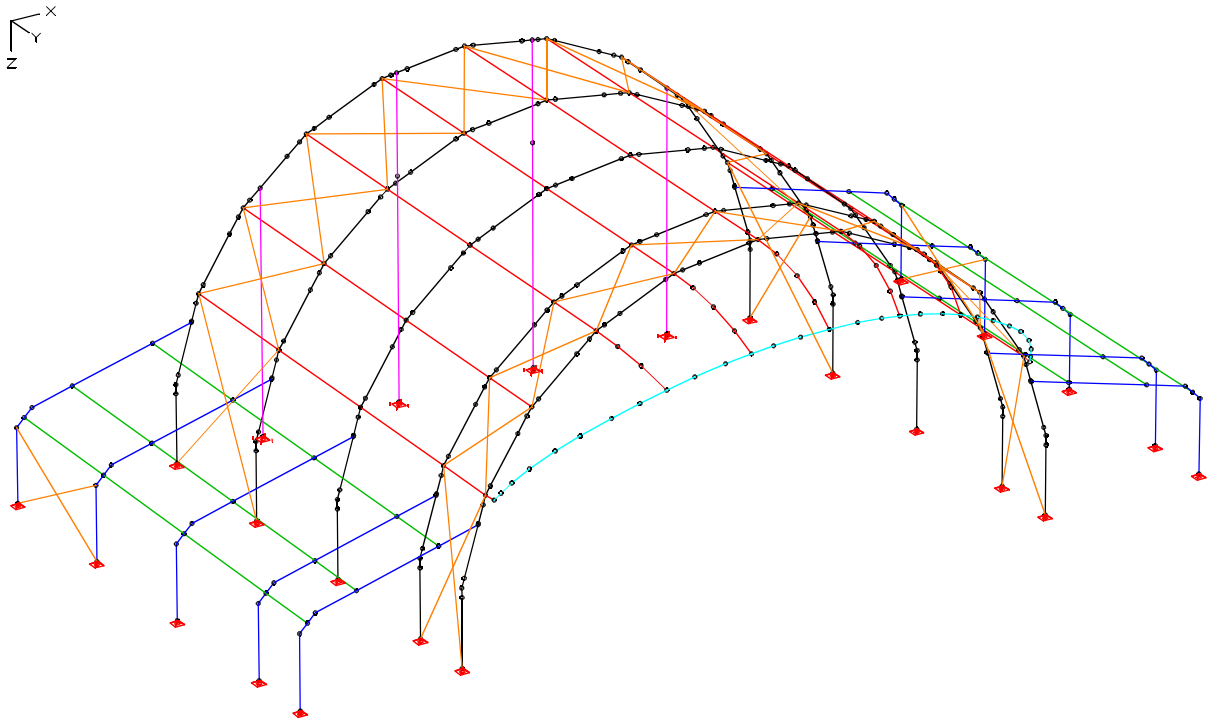
$$17,74 \times 10^3 / 50 = 354,8 \text{ MN/m}^2 < 355 \text{ MN/m}^2$$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

3 SYTEM 16x14m – with sidestages

3.1 Structural system

isometric:



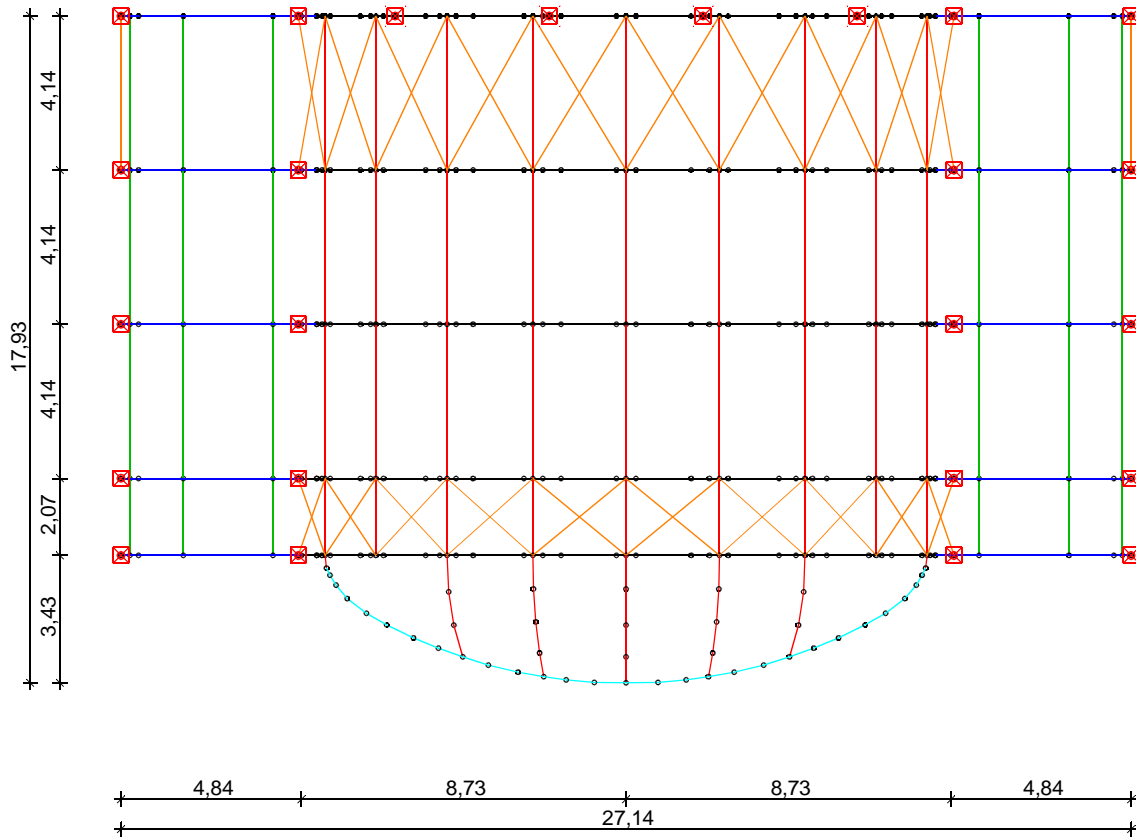
PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
16079

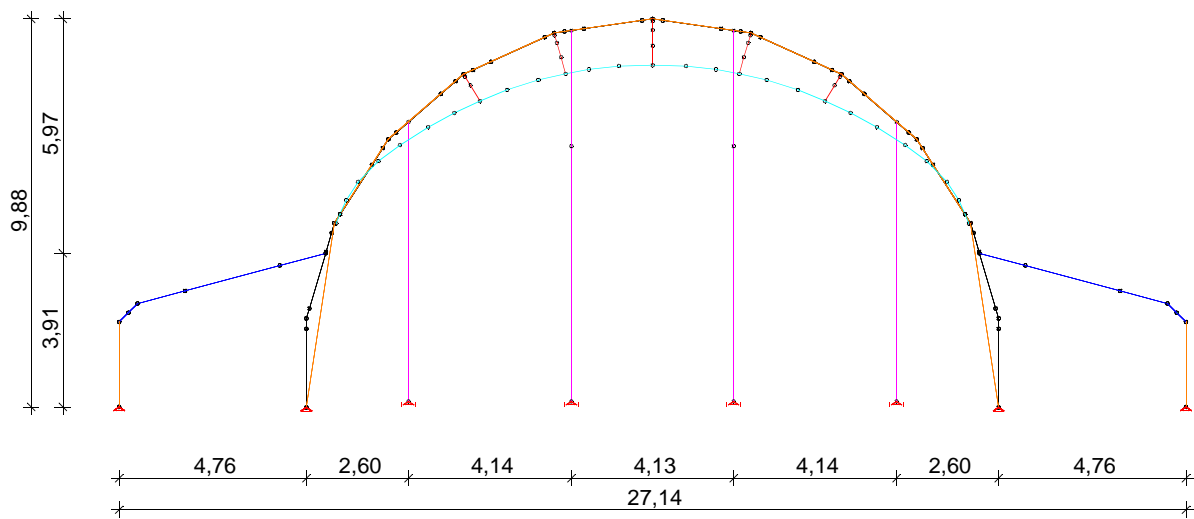
CUSTOMER/AUFTRAGGEBER:
Prolyte Group

DATE/DATUM:
10.04.2016

top view:

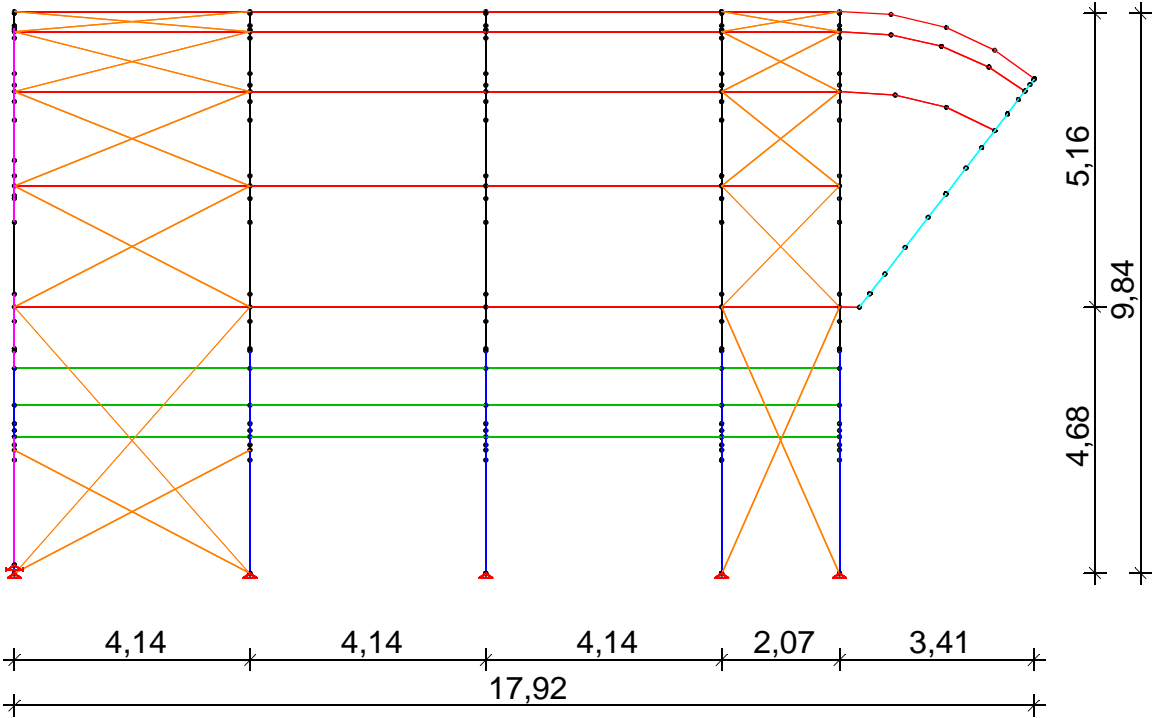


front view



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

side view:



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

3.2 LOADING

The load for the main structure is like in chapter 2. Only the loadcases

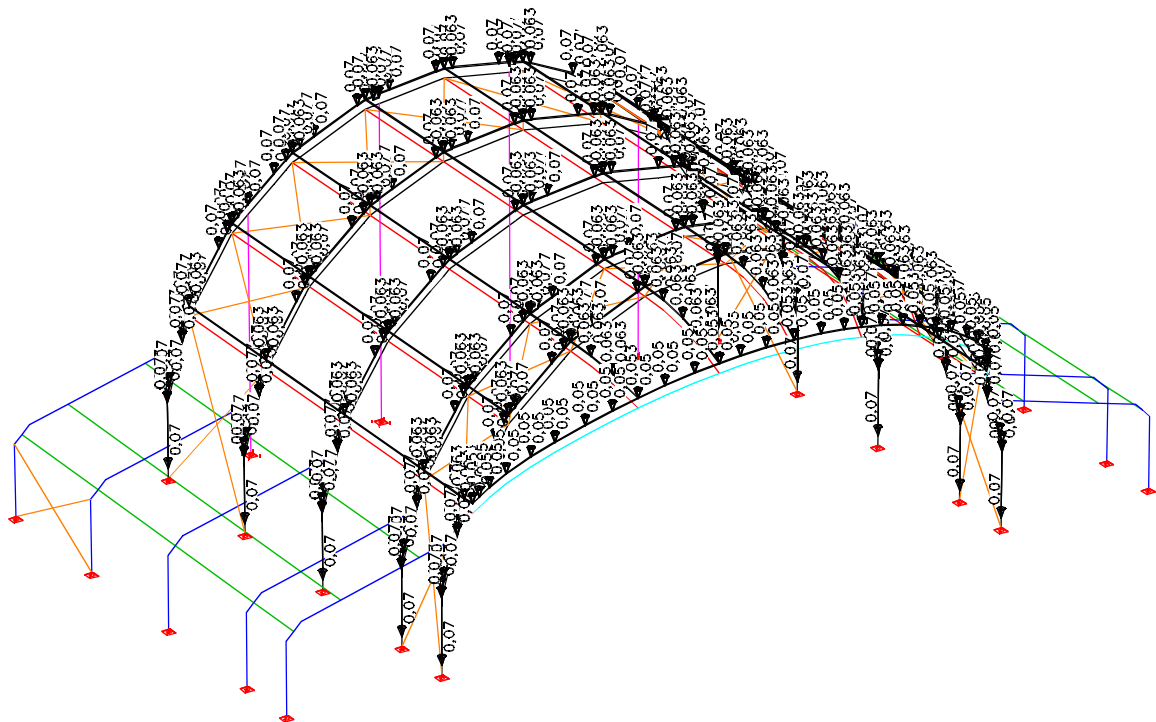
load case 1: dead weight truss

H30D: 0,050 kN/m

H30V: 0,063 kN/m

H40V: 0,070 kN/m

keder profile is taken into account by the software Infograph

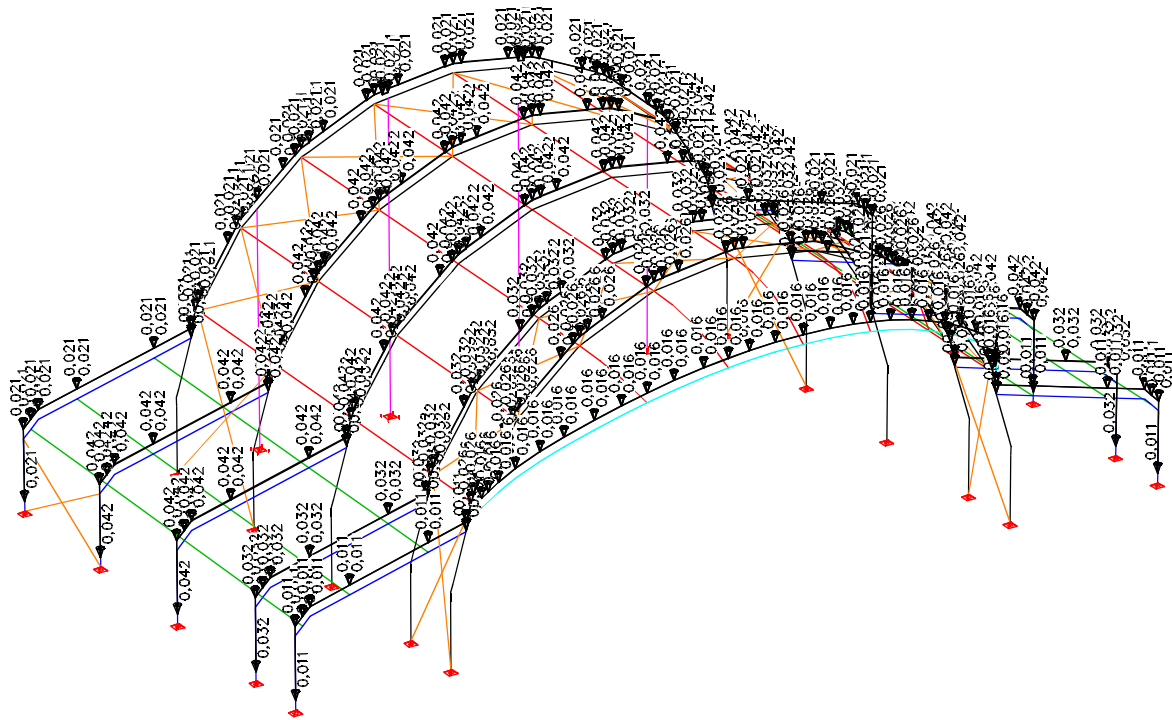


LC 1: Load, deadweight

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 2: canopy 1kg/m²

4,14/2 x 0,01 = 0,021 kN/m
 4,14 x 0,01 = 0,042 kN/m
 (4,14+2,07)/2 x 0,01 = 0,032 kN/m
 2,07/2 x 0,01 = 0,01 kN/m
 3,20/ 2 = 0,016 kN/m



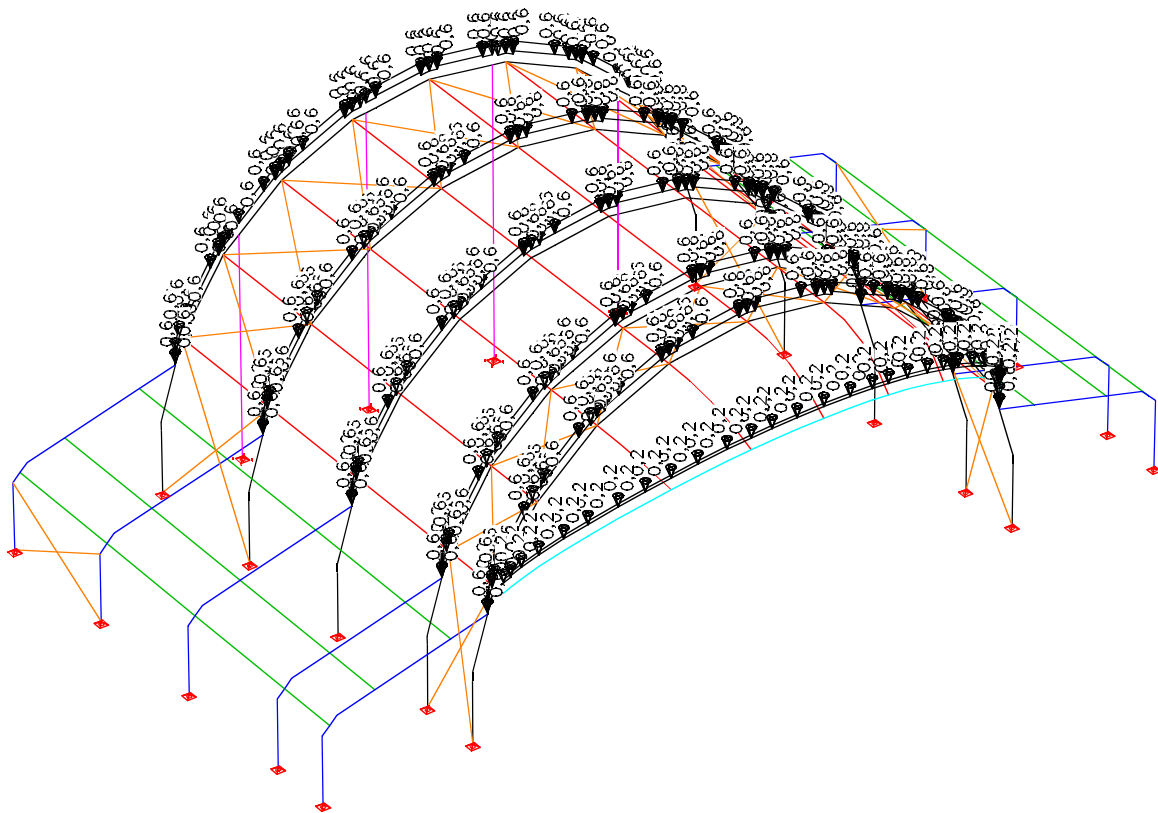
LC 2: Load, canopy 1kg/m²

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 3: distributed load

0,60 kN/m on bows

0,20 kN/m on cantilever roof

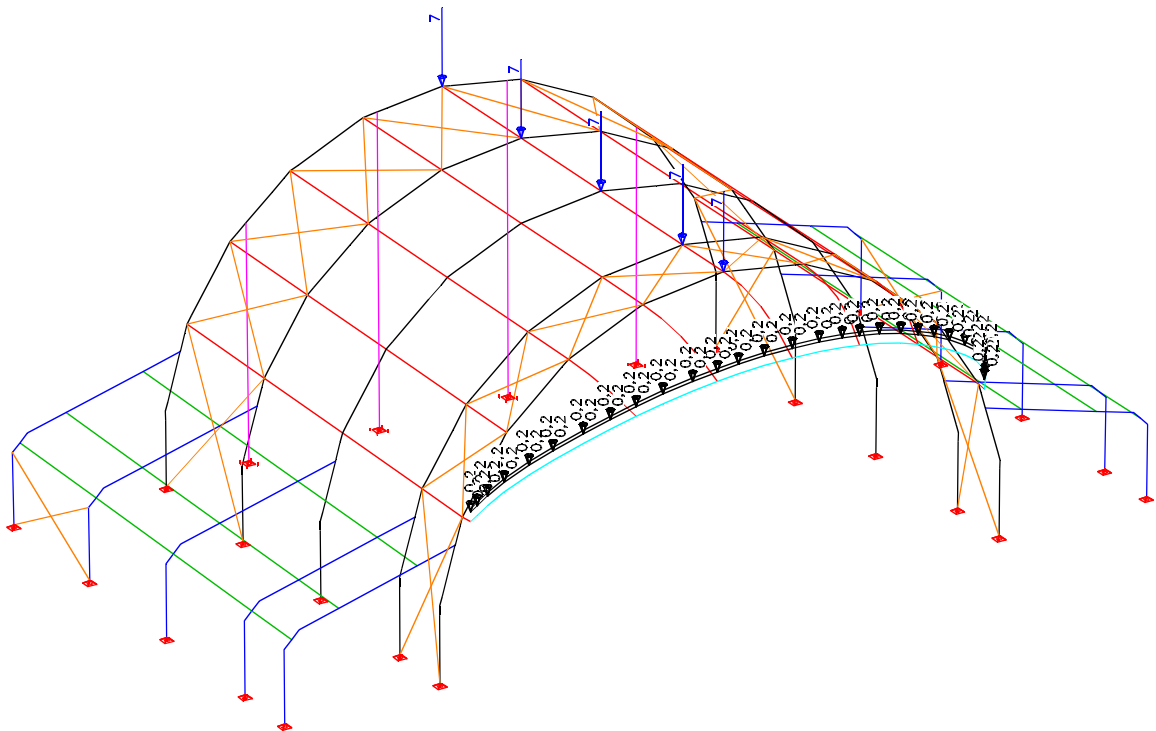


LC 3: Load, distributed load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 4: centre point load

7,0 kN in centre points of bows
0,20 kN/m on cantilever roof

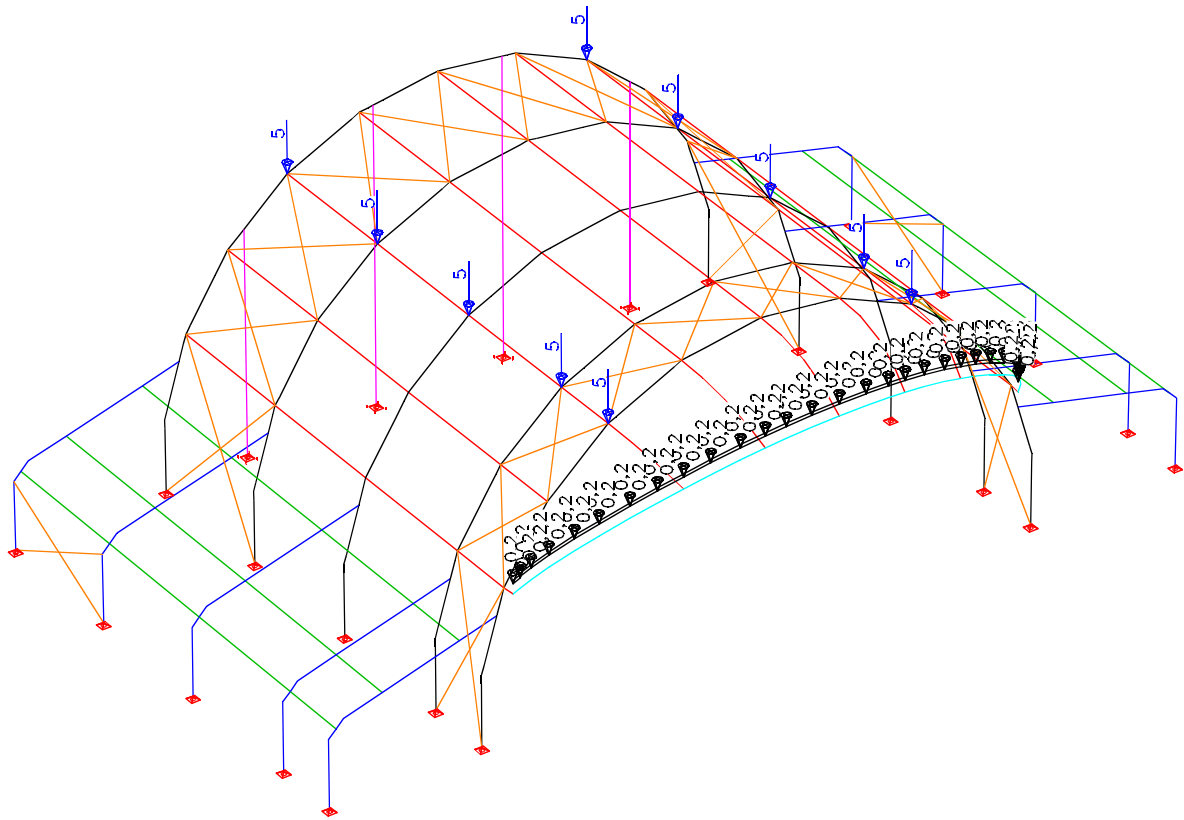


LC 4: Load, center point load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 5: third point load

7,0 kN in third points of bows
0,20 kN/m on cantilever roof

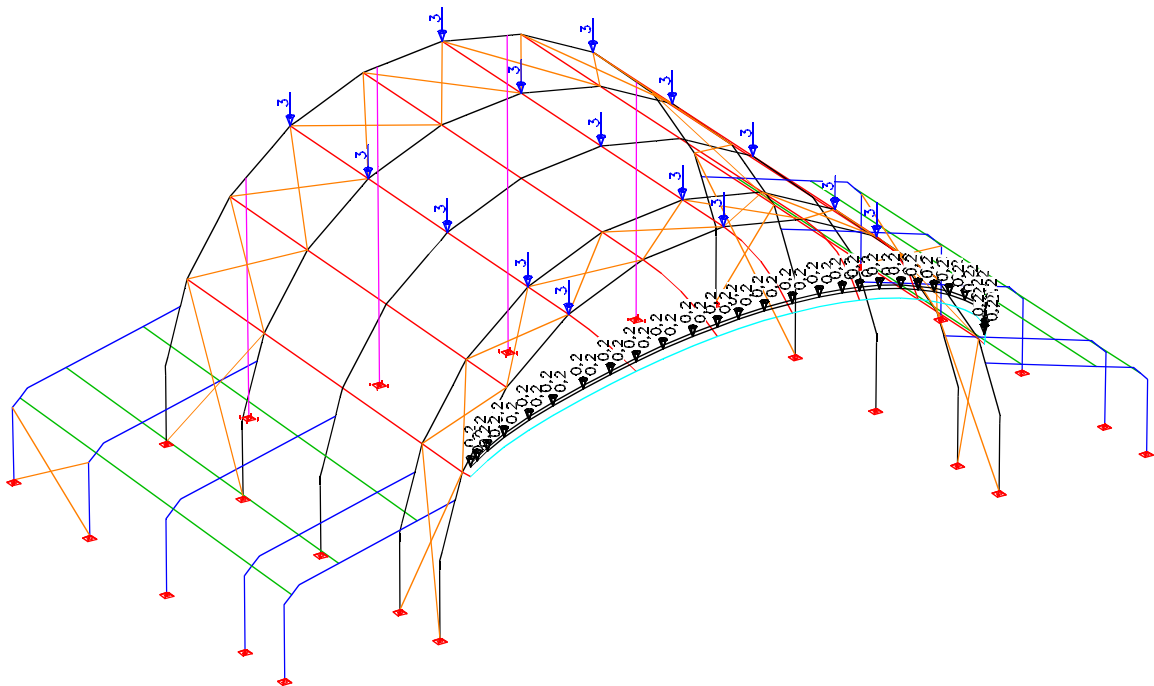


LC 5: Load, third point load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 6: fourth point load

3,0 kN in fourth points of bows
0,20 kN/m on cantilever roof



LC 6: Load, fourth point load

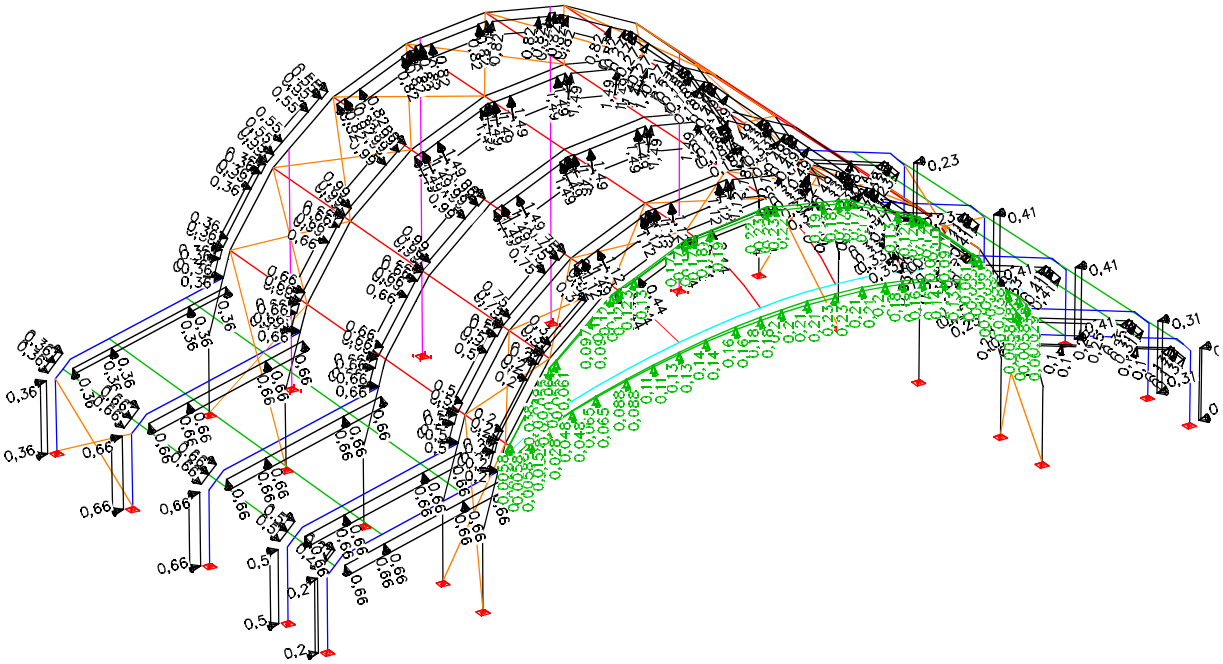
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 10: wind roof outer side

$$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +0,80/ -1,20/ -0,40/ -0,60$$

$w_1 = 0,80 \times 0,20 \times (4,14/2 + 0,20)$	$= 0,363 \text{ kN/m}$
$w_2 = 0,80 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,545 \text{ kN/m}$
$w_3 = 1,20 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,818 \text{ kN/m}$
$w_4 = 0,40 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,273 \text{ kN/m}$
$w_5 = 0,40 \times 0,20 \times (4,14/2 + 0,20)$	$= 0,182 \text{ kN/m}$
$w_6 = 0,80 \times 0,20 \times 4,14$	$= 0,662 \text{ kN/m}$
$w_7 = 0,80 \times 0,30 \times 4,14$	$= 0,994 \text{ kN/m}$
$w_8 = 1,20 \times 0,30 \times 4,14$	$= 1,491 \text{ kN/m}$
$w_9 = 0,40 \times 0,30 \times 4,14$	$= 0,497 \text{ kN/m}$
$w_{10} = 0,40 \times 0,20 \times 4,14$	$= 0,331 \text{ kN/m}$
$w_{11} = 0,80 \times 0,20 \times (4,14+2,07)/2$	$= 0,497 \text{ kN/m}$
$w_{12} = 0,80 \times 0,30 \times (4,14+2,07)/2$	$= 0,745 \text{ kN/m}$
$w_{13} = 1,20 \times 0,30 \times (4,14+2,07)/2$	$= 1,119 \text{ kN/m}$
$w_{14} = 0,40 \times 0,30 \times (4,14+2,07)/2$	$= 0,373 \text{ kN/m}$
$w_{15} = 0,40 \times 0,20 \times (4,14+2,07)/2$	$= 0,249 \text{ kN/m}$
$w_{16} = 0,80 \times 0,20 \times (2,07/2 + 0,20)$	$= 0,198 \text{ kN/m}$
$w_{17} = 0,80 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,296 \text{ kN/m}$
$w_{18} = 1,20 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,444 \text{ kN/m}$
$w_{19} = 0,40 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,148 \text{ kN/m}$
$w_{20} = 0,40 \times 0,20 \times (2,07/2 + 0,20)$	$= 0,100 \text{ kN/m}$
$w_{21} = 0,60 \times 0,25 \times 3,00/2$	$= 0,230 \text{ kN/m (cantilever roof)}$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

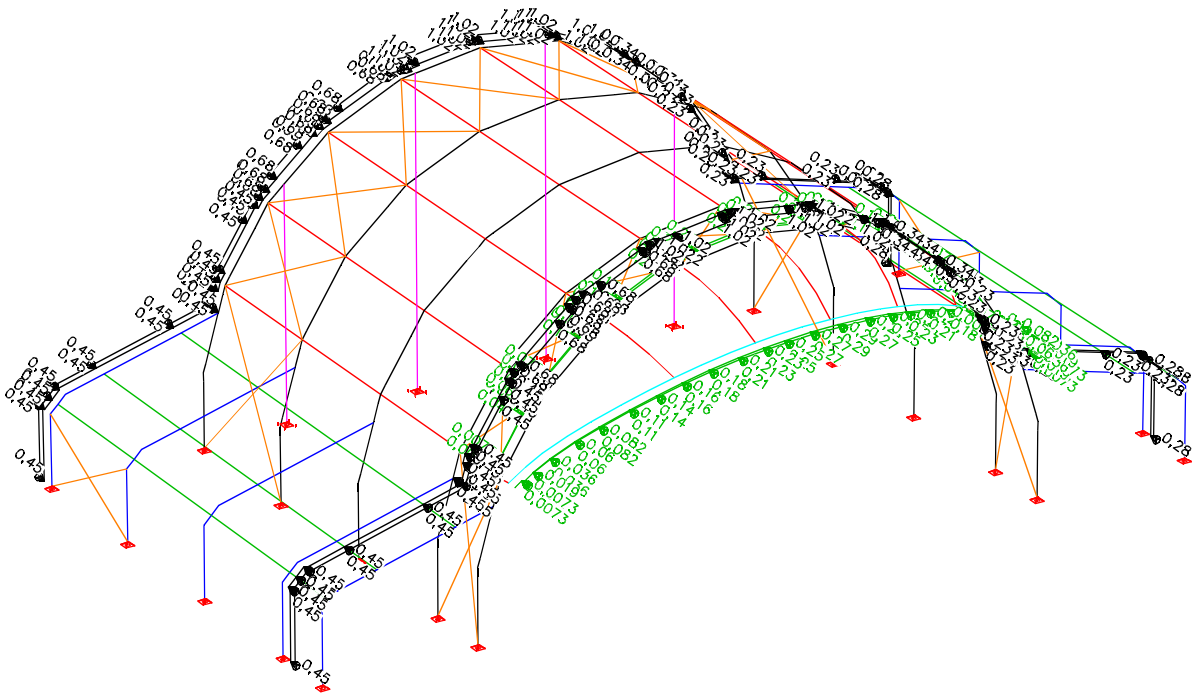


LC 10: Load, wind roof outer side

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 11: membrane tension for LC 10

- 0,363/ 0,80 = 0,454 kN/m
- 0,545/ 0,80 = 0,680 kN/m
- 0,818/ 0,80 = 1,023 kN/m
- 0,273/ 0,80 = 0,340 kN/m
- 0,182/ 0,80 = 0,227 kN/m
- 0,230/ 0,80 = 0,287 kN/m



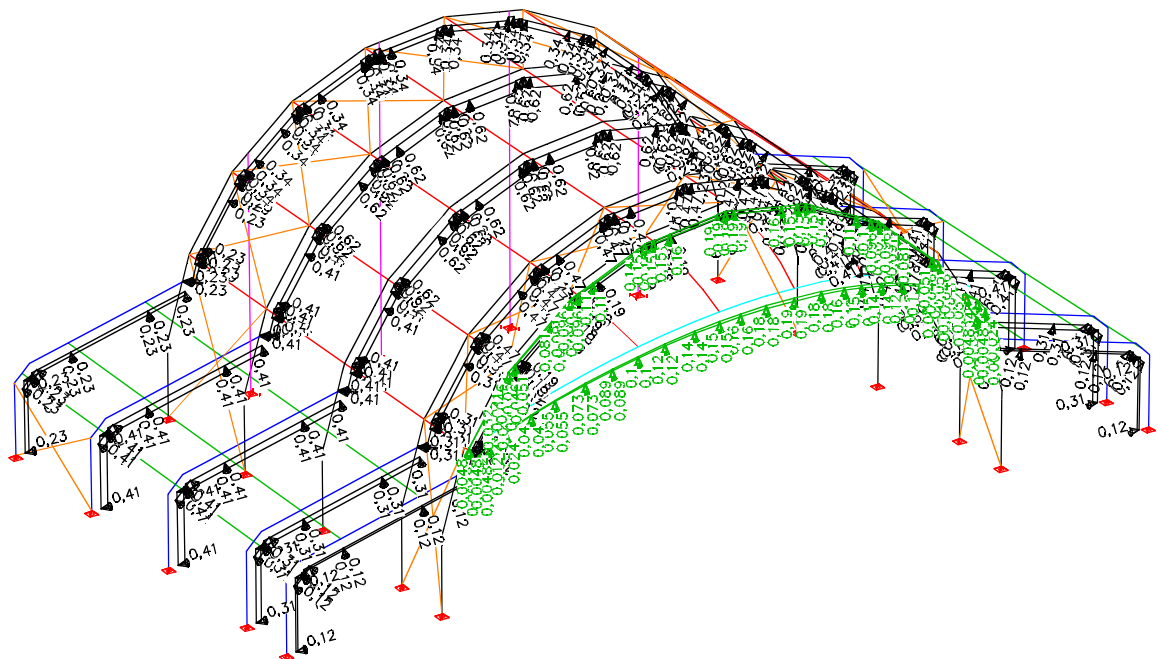
LC 11: Load, membrane tension for LC 10

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 12: wind roof inner side

$$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +0,50$$

$$\begin{aligned} w_1 &= 0,50 \times 0,20 \times (4,14/2 + 0,20) &= 0,227 \text{ kN/m} \\ w_2 &= 0,50 \times 0,30 \times (4,14/2 + 0,20) &= 0,341 \text{ kN/m} \\ w_6 &= 0,50 \times 0,20 \times 4,14 &= 0,414 \text{ kN/m} \\ w_7 &= 0,50 \times 0,30 \times 4,14 &= 0,621 \text{ kN/m} \\ w_{11} &= 0,50 \times 0,20 \times (4,14+2,07)/2 &= 0,311 \text{ kN/m} \\ w_{12} &= 0,50 \times 0,30 \times (4,14+2,07)/2 &= 0,467 \text{ kN/m} \\ w_{16} &= 0,50 \times 0,20 \times (2,07/2 + 0,20) &= 0,124 \text{ kN/m} \\ w_{17} &= 0,50 \times 0,30 \times (2,07/2 + 0,20) &= 0,185 \text{ kN/m} \\ w_{21} &= 0,50 \times 0,25 \times 3,00/2 &= 0,188 \text{ kN/m (cantilever roof)} \end{aligned}$$

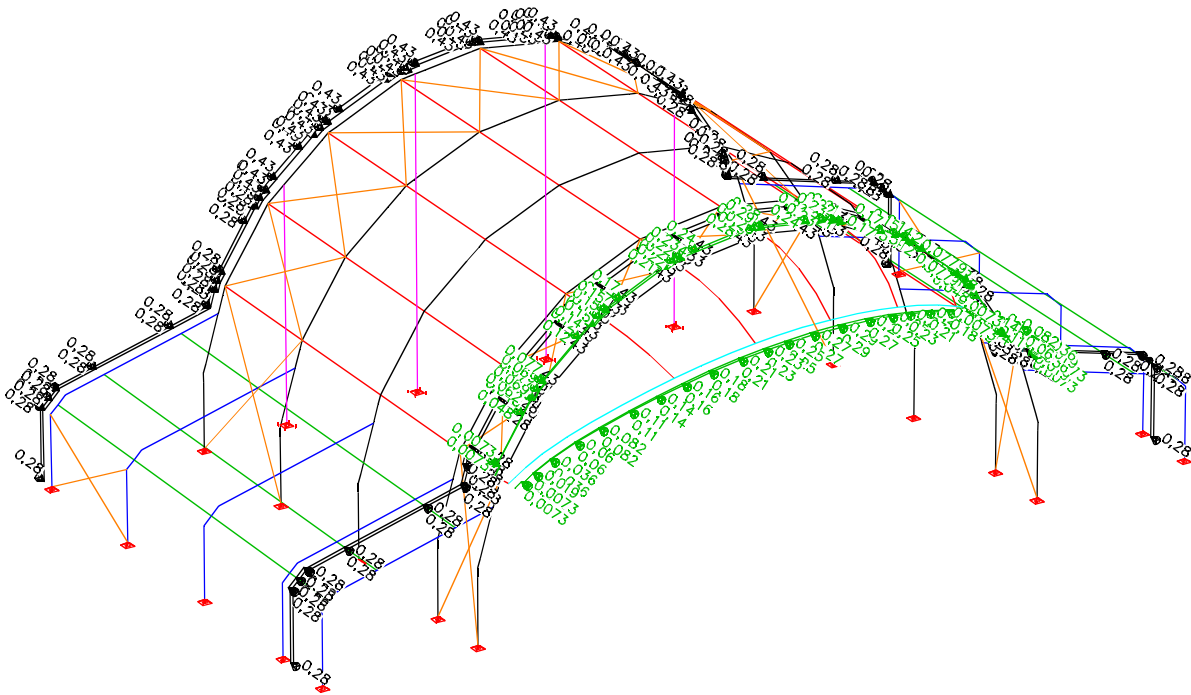


LC 12: Load, wind roof inner side

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 13: membrane tension for LC 12

$$\begin{aligned} 0,227 / 0,80 &= 0,284 \text{ kN/m} \\ 0,341 / 0,80 &= 0,426 \text{ kN/m} \\ 0,188 / 0,80 &= 0,235 \text{ kN/m} \end{aligned}$$



LC 13: Load, membrane tension for LC 12

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 14: wind rear wall

$$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +1,30$$

$$w_1 = 1,30 \times 0,20 \times 4,14 = 1,076 \text{ kN/m}$$

$$w_2 = 1,30 \times 0,30 \times 4,14 = 1,615 \text{ kN/m}$$

$$w_3 = 1,30 \times 0,20 \times (4,14+2,60)/2 = 0,876 \text{ kN/m}$$

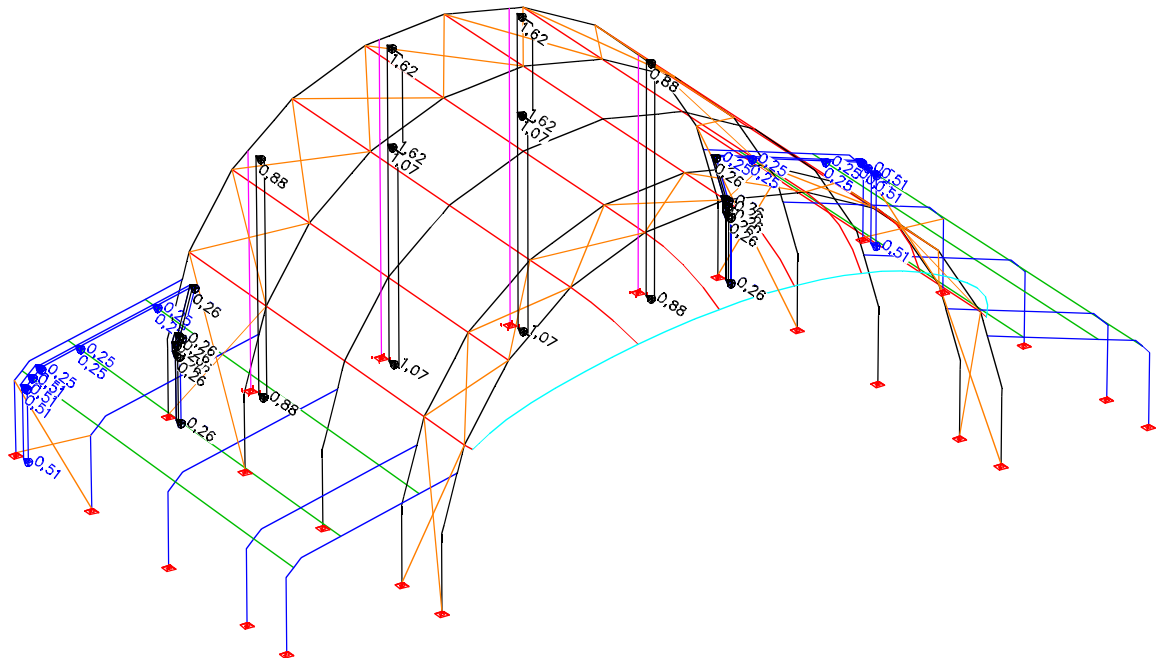
$$w_4 = 1,30 \times 0,20 \times 2,60/2 = 0,260 \text{ kN/m}$$

Wind on Side stages: 25% upper beam
37,5% each column

$$\text{total: } 1,3 \times 0,2 \times 3,8 \times 5,25 = 5,30 \text{ kN}$$

$$w_5 = 5,30 \times 0,25/5,25 = 0,25 \text{ kN/m}$$

$$w_6 = 5,30 \times 0,375/3,80 = 0,51 \text{ kN/m}$$



LC 14: Load, wind rear wall

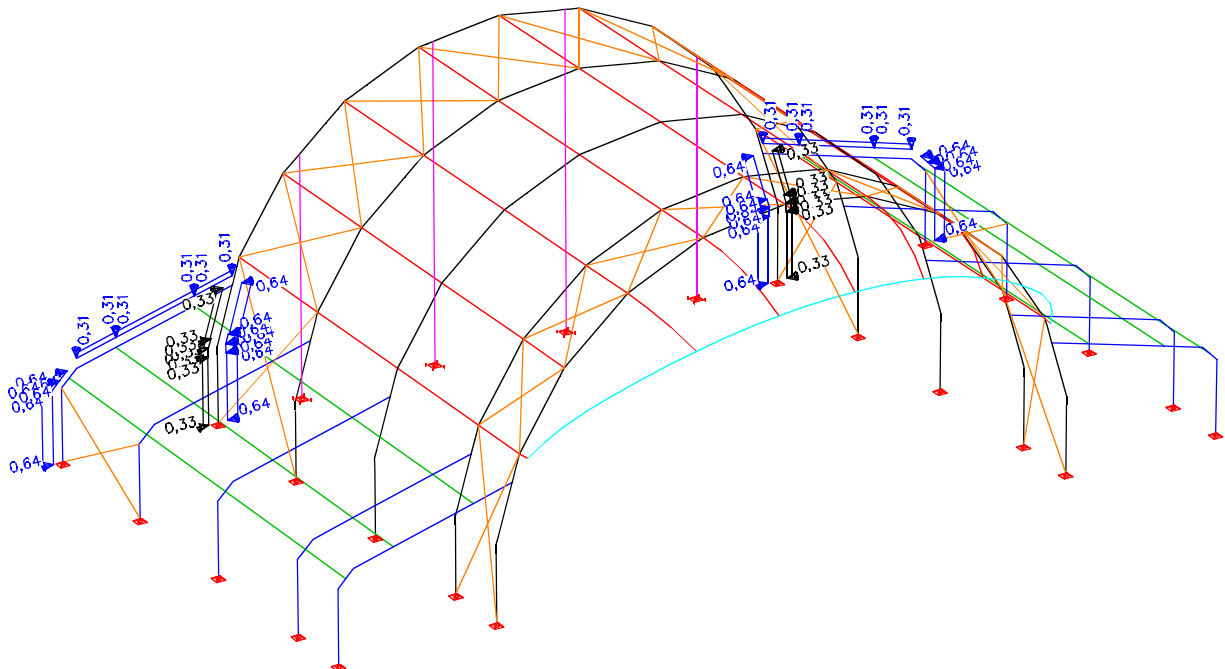
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 15: membrane tension for LC 14

$$0,26 / 0,80 = 0,33 \text{ kN/m}$$

$$0,25 / 0,80 = 0,31 \text{ kN/m}$$

$$0,51 / 0,80 = 0,64 \text{ kN/m}$$



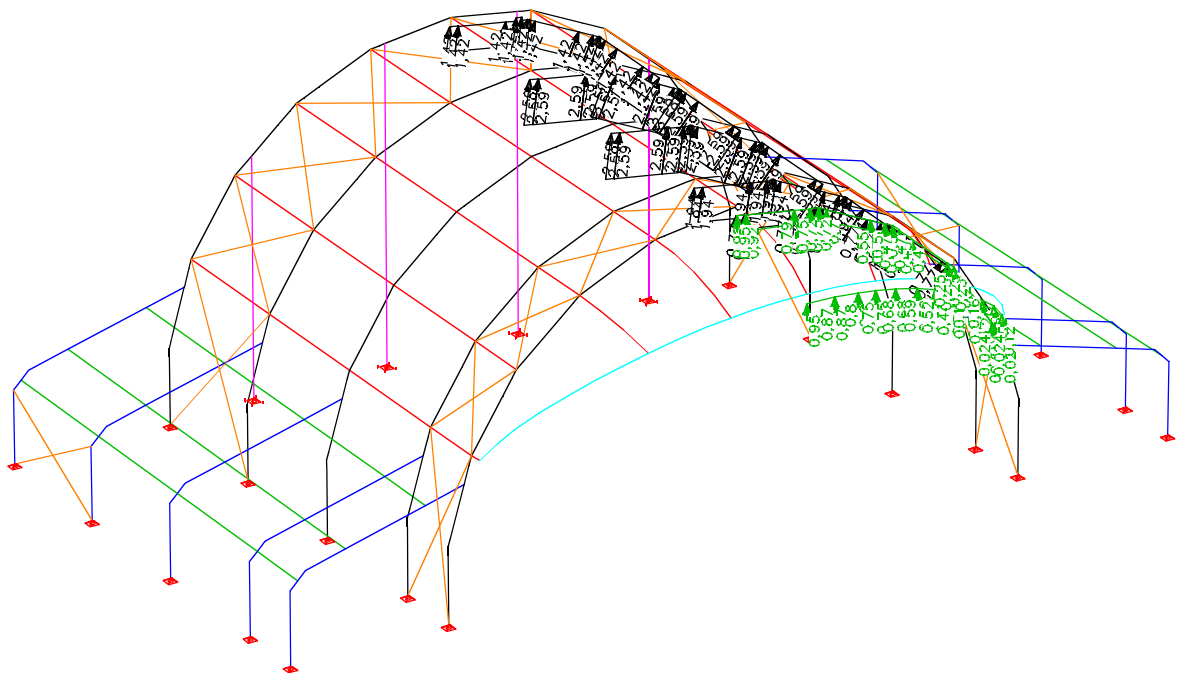
LC 15: Load, membrane tension rear wall

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

notice: For status out of service the construction must be regarded for different load situations according to freestanding roofs with either tension or compression of the whole roof and additionally only for one half of the roof.

load case 20: wind roof right side – out of service

$q = 0,44 \text{ kN/m}^2 \text{ or } 0,625 \text{ kN/m}^2$	$c_{pe} = 1,0$
$w_1 = 1,0 \times 0,44 \times 3,0 / 2$	$= 0,66 \text{ kN/m}$
$w_2 = 1,0 \times 0,625 \times 3,0 / 2$	$= 0,94 \text{ kN/m}$
$w_3 = 1,0 \times 0,625 \times (4,14/2 + 0,20)$	$= 1,419 \text{ kN/m}$
$w_4 = 1,0 \times 0,625 \times 4,14$	$= 2,583 \text{ kN/m}$
$w_5 = 1,0 \times 0,625 \times (4,14+2,07) / 2$	$= 1,941 \text{ kN/m}$
$w_6 = 1,0 \times 0,625 \times (2,07/2 + 0,20)$	$= 0,772 \text{ kN/m}$



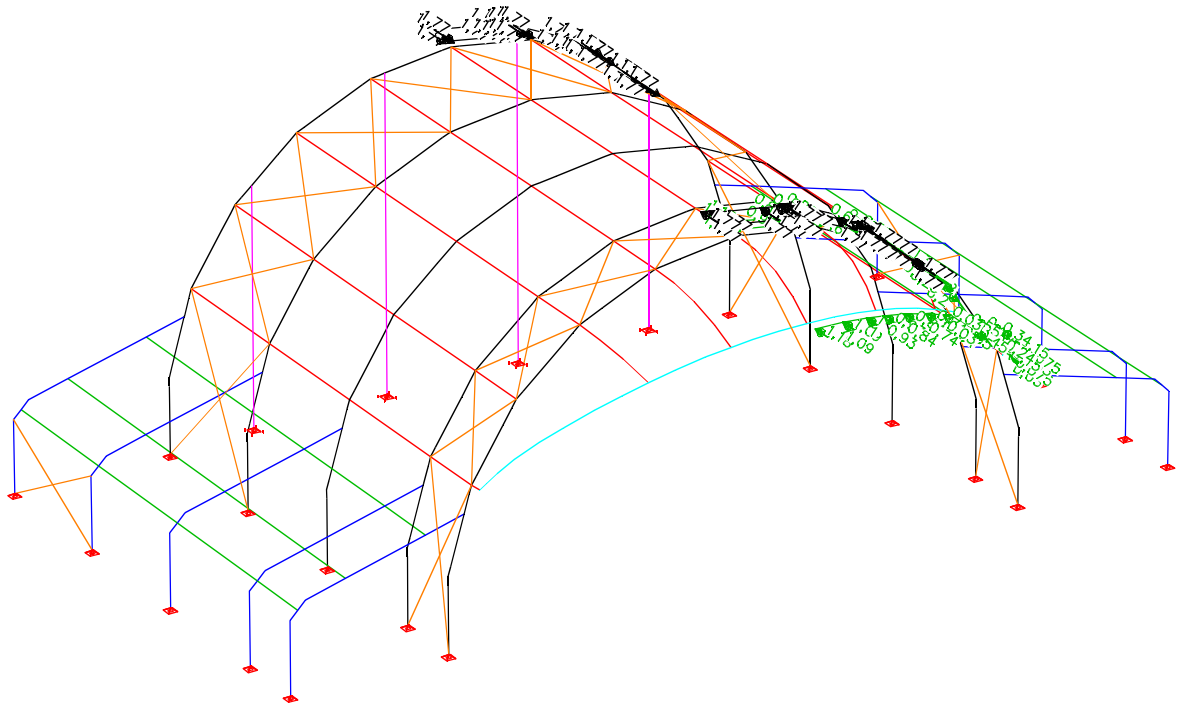
LC 20: Load, wind roof right side – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 21: membrane tension for LC 20

$$0,94 / 0,80 = 1,175 \text{ kN/m}$$

$$1,419 / 0,80 = 0,774 \text{ kN/m}$$

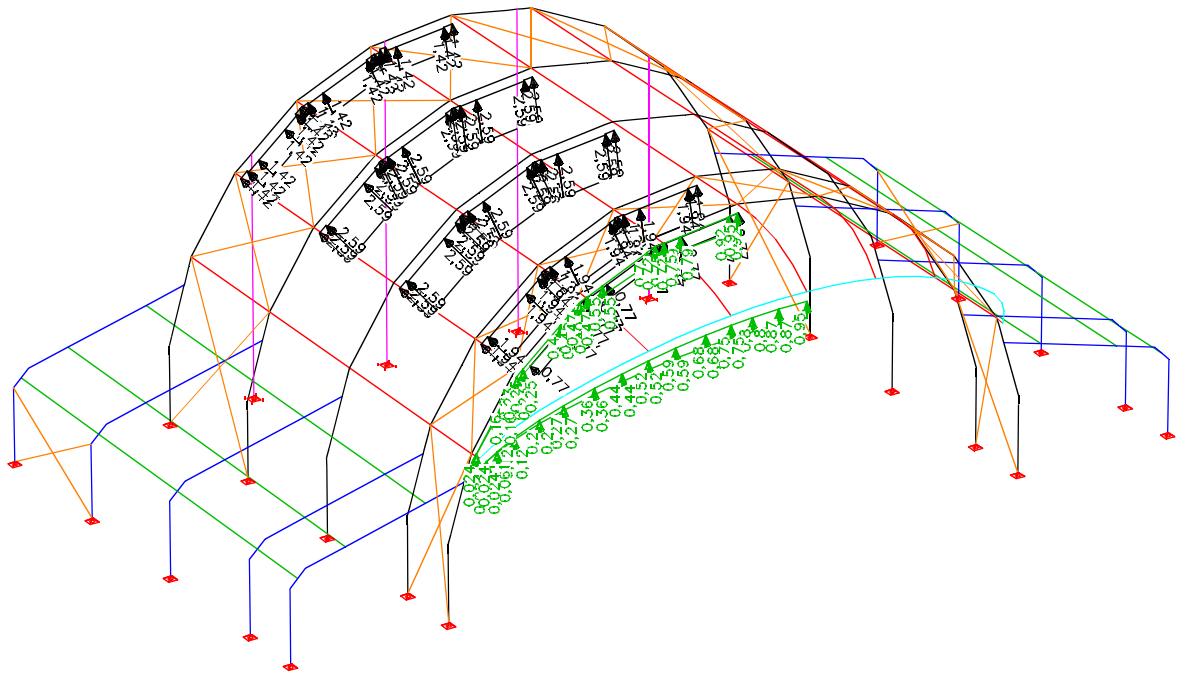


LC 21: Load, membrane tension for LC 20

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 22: wind roof left side – out of service

see LC 20

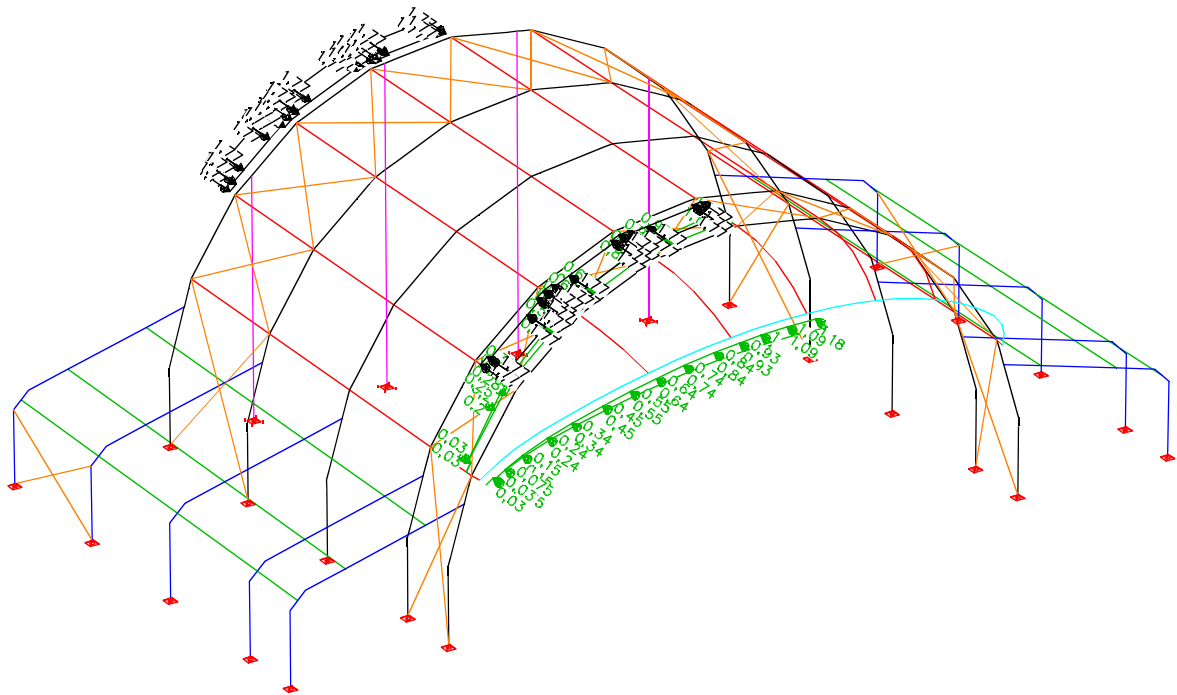


LC 22: Load, wind roof left side – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 23: membrane tension for LC 22

see LC 21



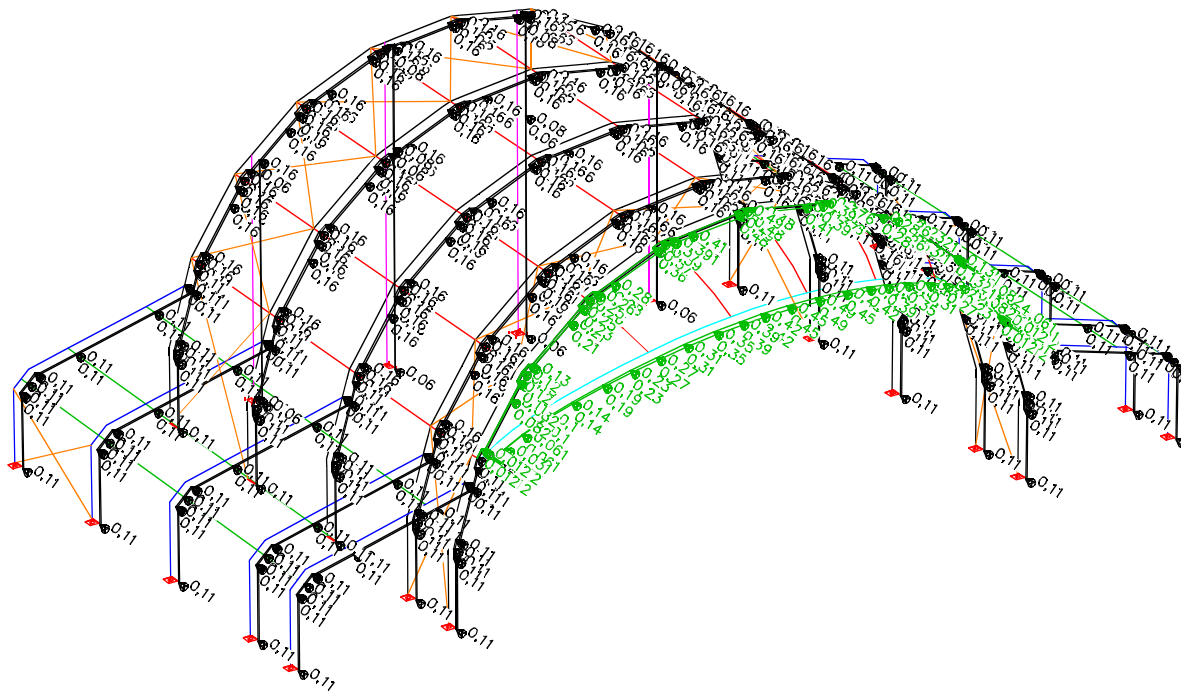
LC 23: Load, membrane tension for LC 22

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 24: wind horizontal y-dir. - out of service

truss: $1,30 \times 0,50 \times 0,40 \times 0,625 = 0,16 \text{ kN/m}$
 $1,30 \times 0,50 \times 0,40 \times 0,440 = 0,11 \text{ kN/m}$

cantilever roof:
 $1,30 \times 0,625 \times 1,20/2 = 0,49 \text{ kN/m}$

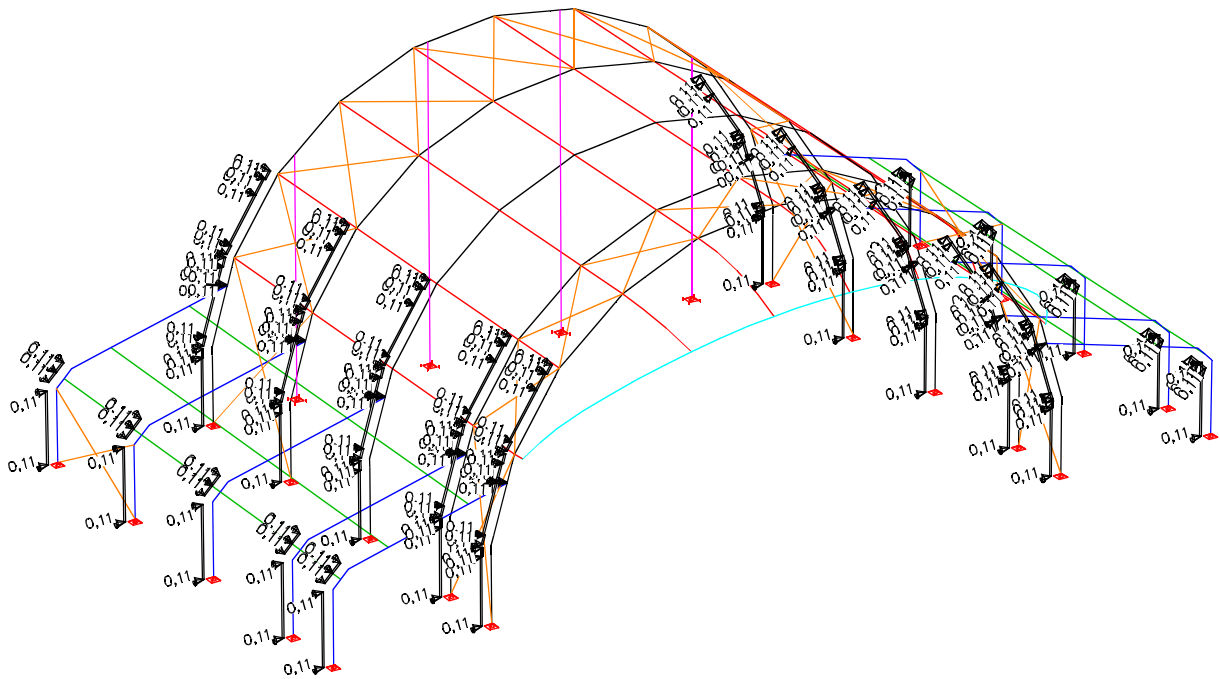


LC 24: Load, wind horizontal Y – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 25: wind horizontal x-dir. - out of service

truss: $1,30 \times 0,50 \times 0,40 \times 0,44 = 0,11 \text{ kN/m}$

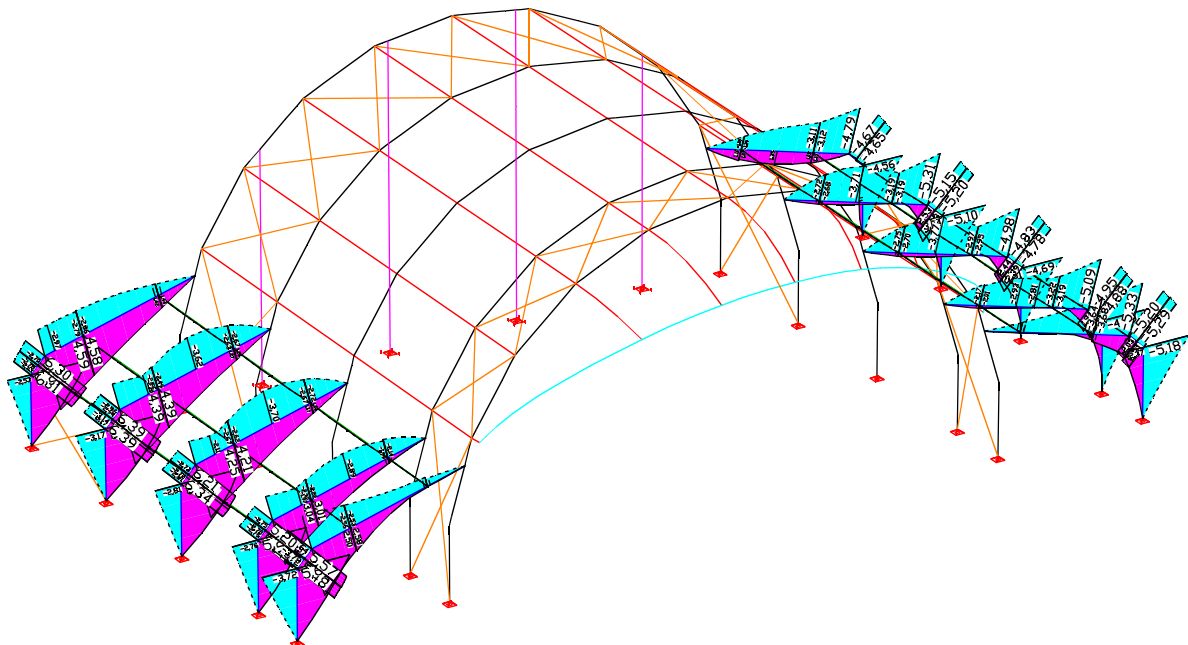


LC 25: Load, wind horizontal X – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

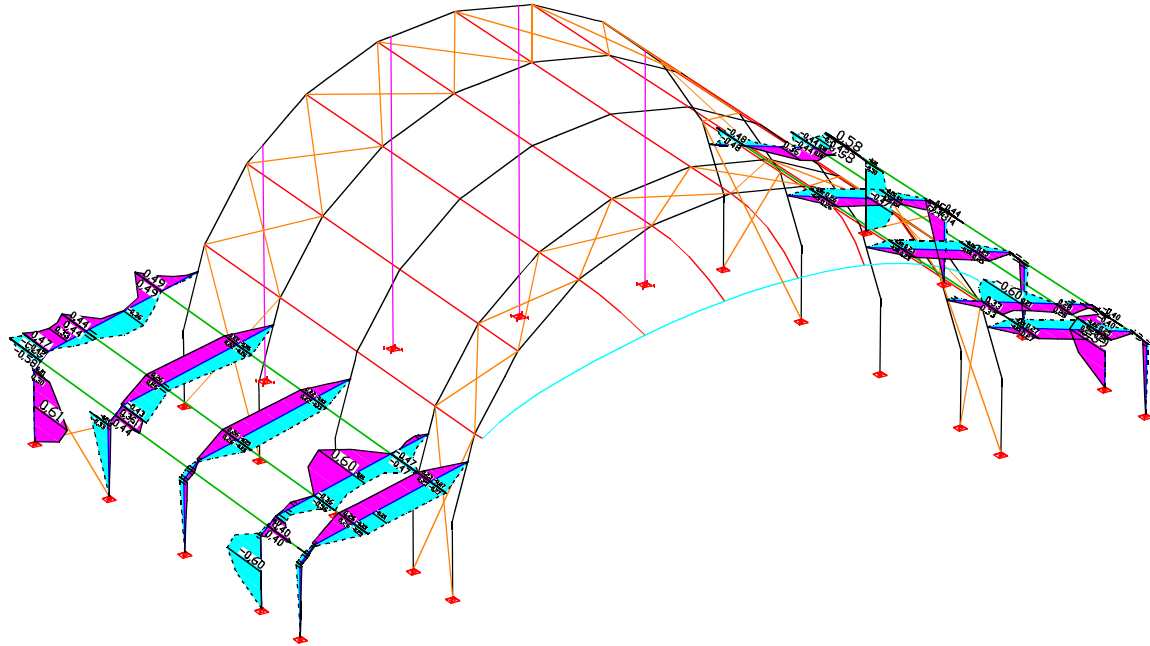
3.3 CALCULATION

The internal forces of the main structure are similar or smaller than in chapter 2
 Only the forces of the side stages are shown.



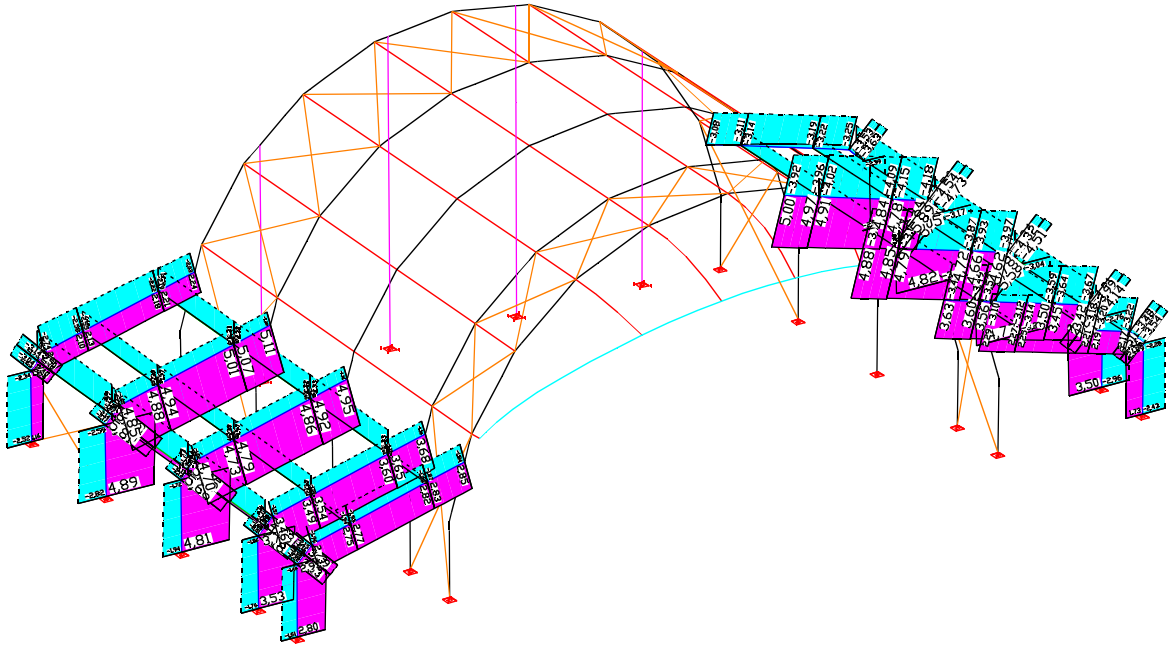
LCC 91: in service
 Selected internal forces min,max My [kNm]
 Value range (subsystem, min/max): -5,33/6,39 [kNm]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



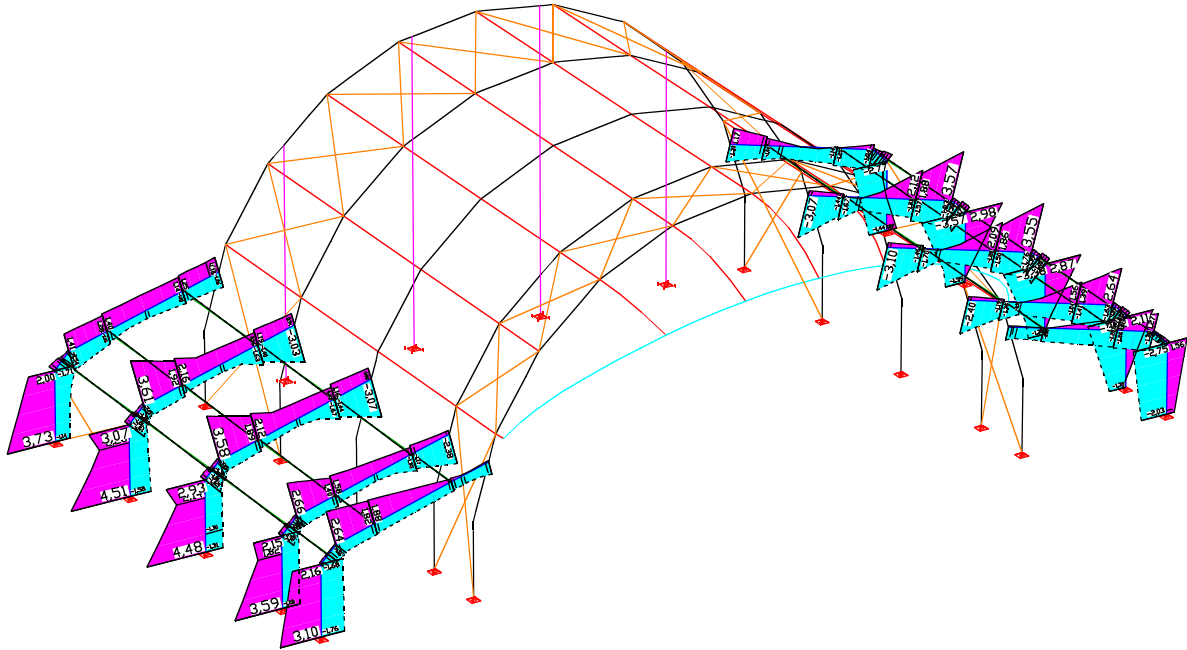
LCC 91: in service
 Selected Internal forces min,max Mz [kNm]
 Value range (subsystem, min/max): -0,60/0,61 [kNm]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



LCC 91: in service
Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -4,76/6,00 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



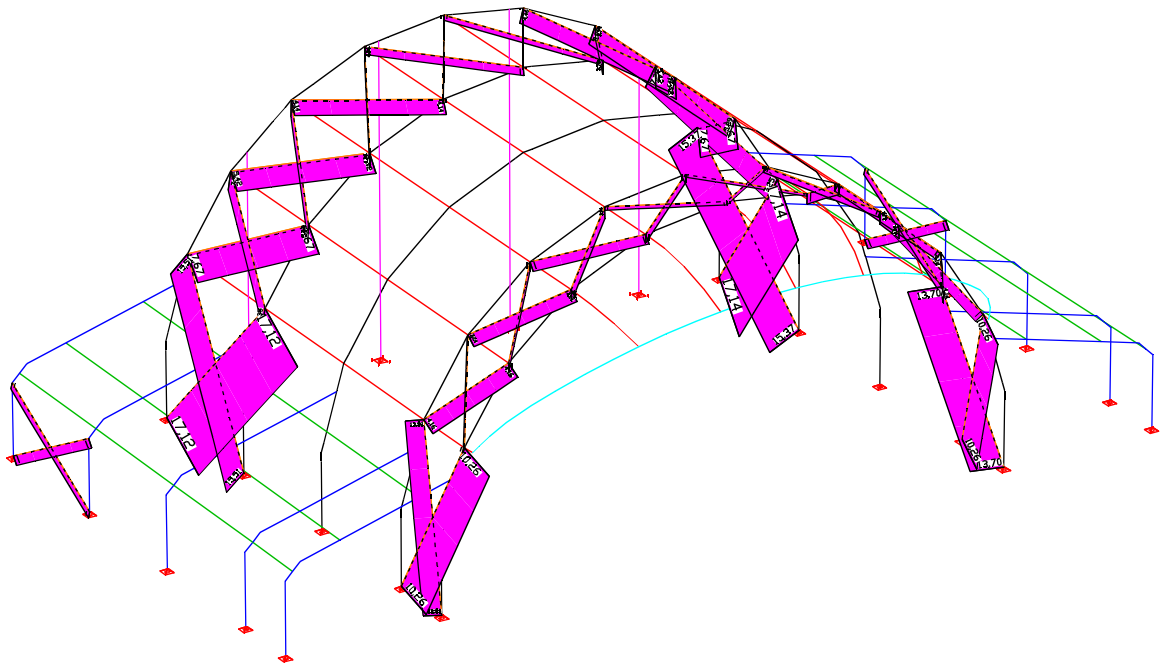
LCC 91: in service
 Selected Internal forces min,max Qz [kN]
 Value range (subsystem, min/max): -3,57/4,51 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

3.4 PROOFS

trusses see chapter 2

guy wires



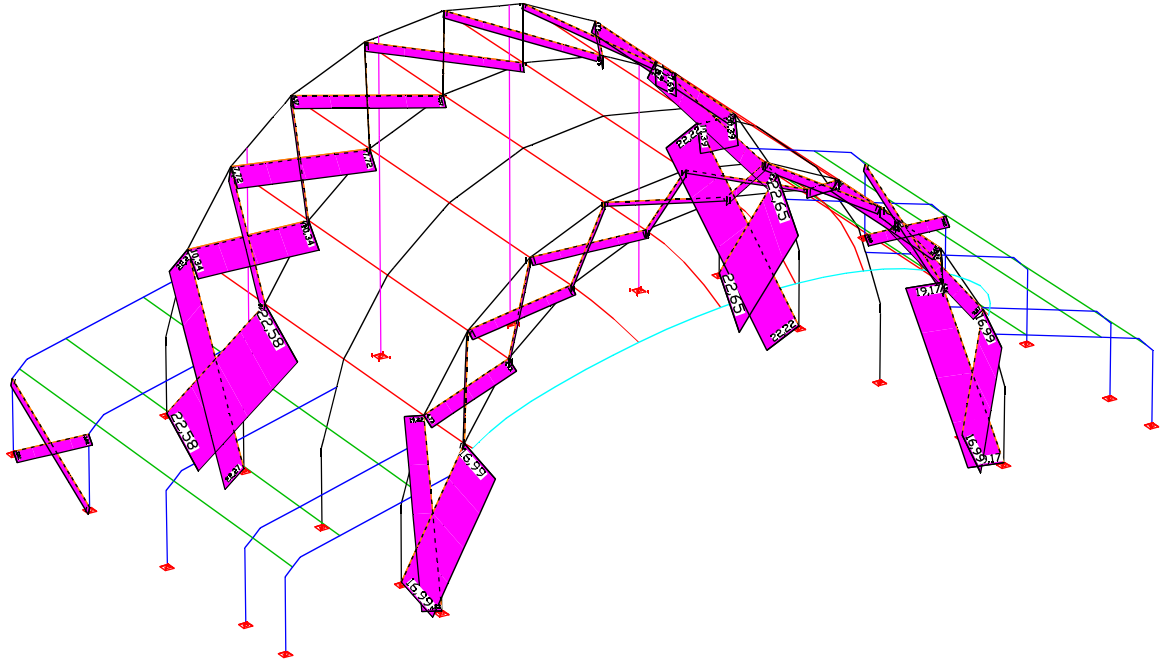
LCC 91: in service
Selected Internal forces min,max Nx [kN]
Value range (subsystem, min/max): -0,00/17,14 [kN]

PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
16079

CUSTOMER/AUFTRAGGEBER:
Prolyte Group

DATE/DATUM:
10.04.2016



LCC 93: out of service
 Selected internal forces min,max Nx [kN]
 Value range (subsystem, min/max): -0,00/22,65 [kN]

max. $N_{Ed} = 22,65 \text{ kN}$

$\varnothing 10 \text{ mm}$

1770 N/mm²

DIN EN 12385-4

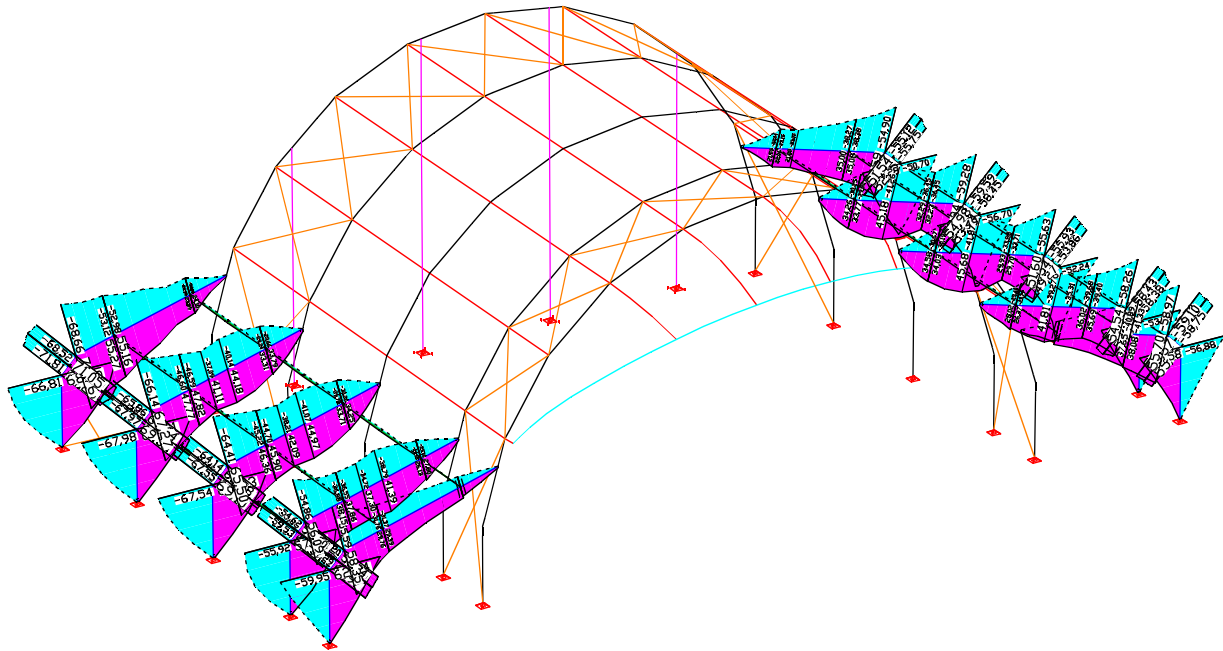
usage factor: $\gamma = 3,0$

$N_{U,d} = 58,80 \text{ kN}$

$22,65/1,35 = 16,77 < 58,80/3 = 19,60 \text{ kN}$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

keder profiles side stage



LCC 91: in service
 Selected Stresses (general - elastic, directly from internal forces) min,max Sigma.x [MN/m²]
 Value range (subsystem, min/max): -71,81/74,23 [MN/m²]

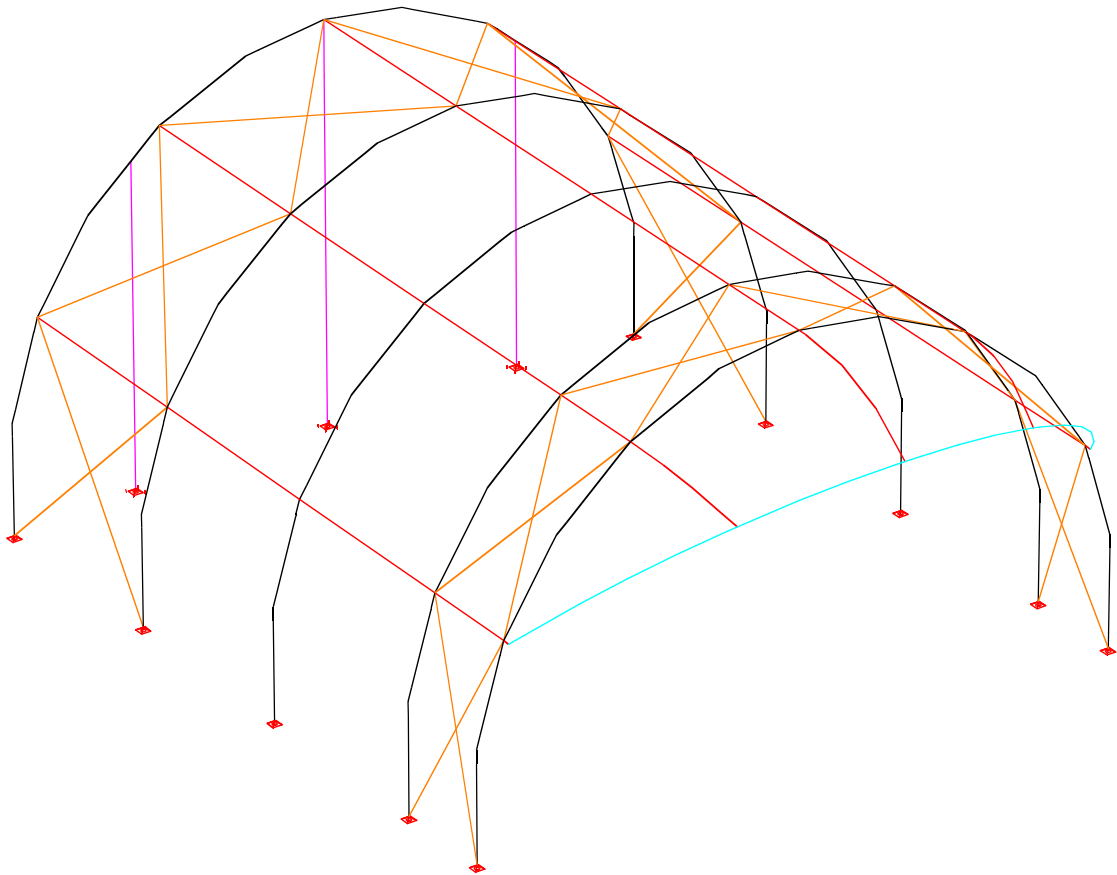
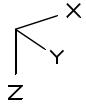
$$< 250/1,1 = 227 \text{ MN/m}^2$$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

4 SYTEM 12x14m – without sidestages

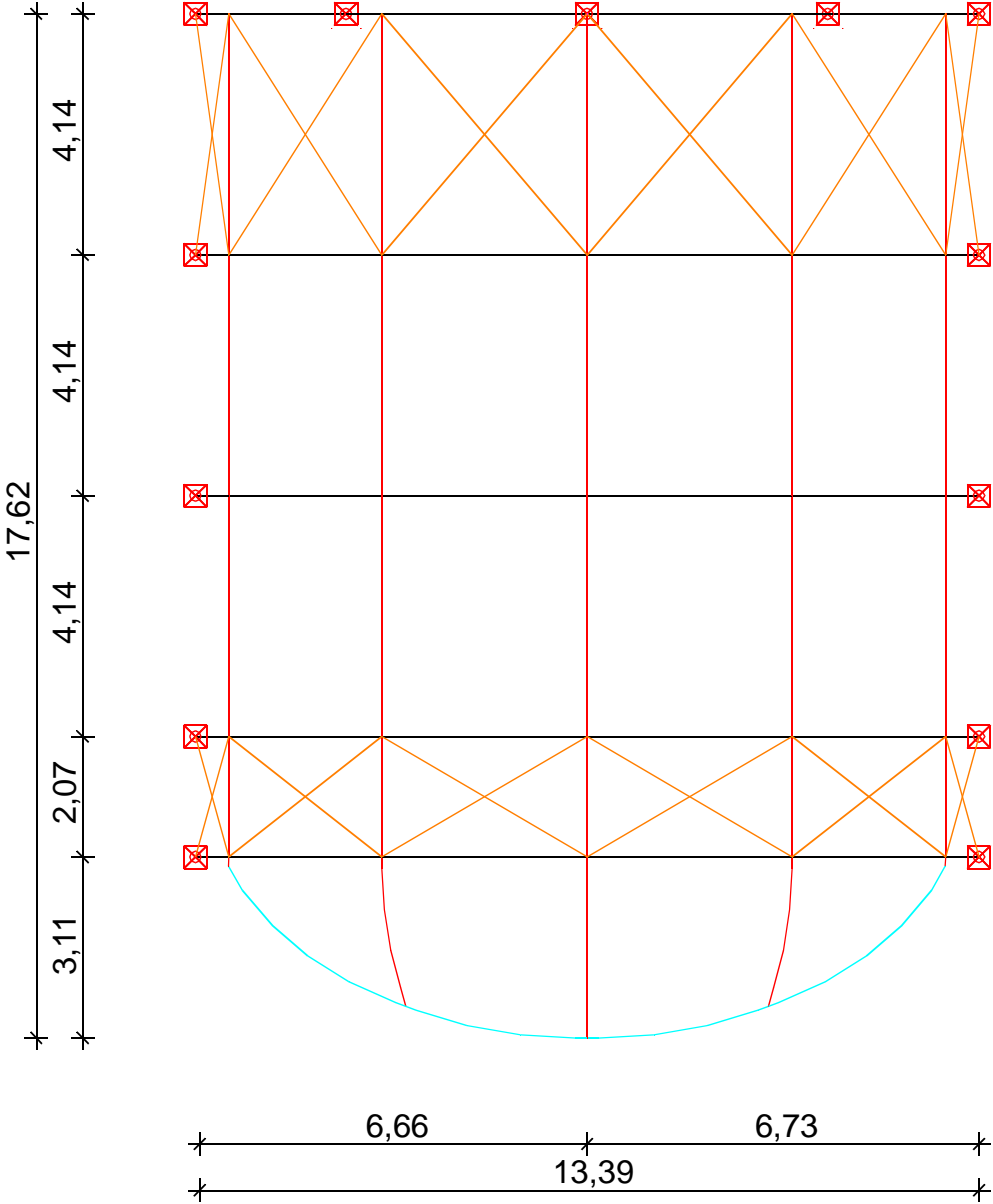
4.1 Structural system

isometric:



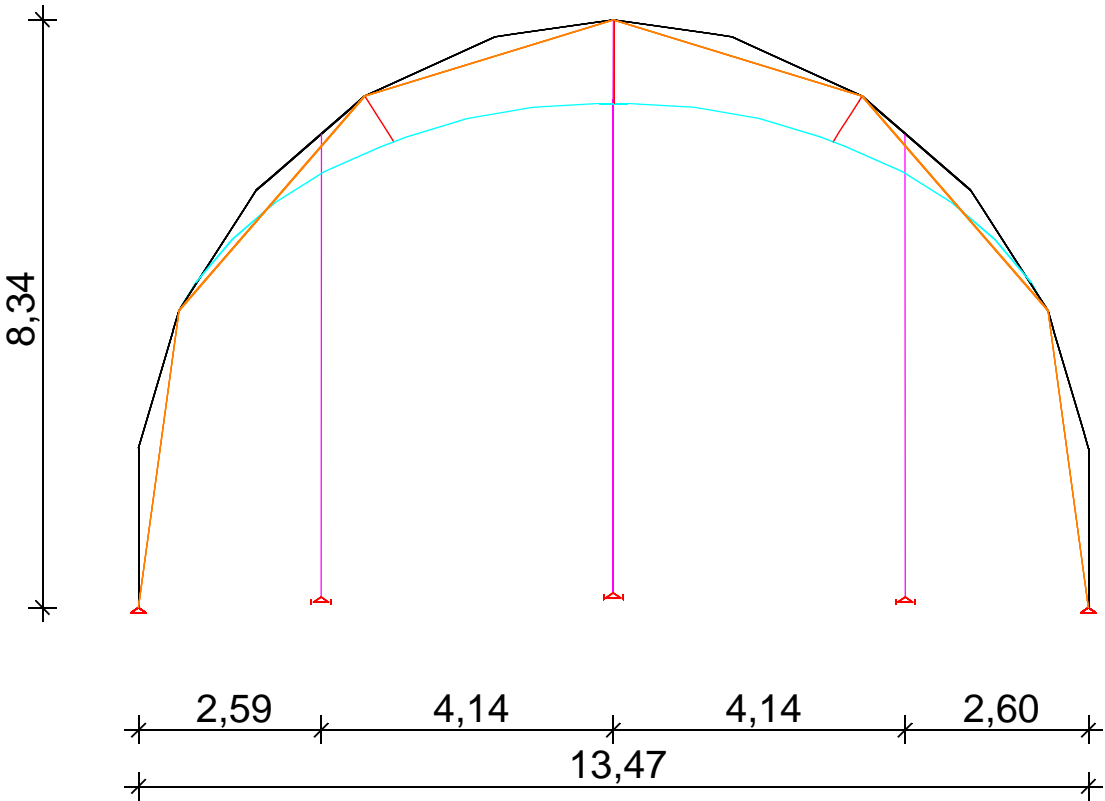
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

top view:



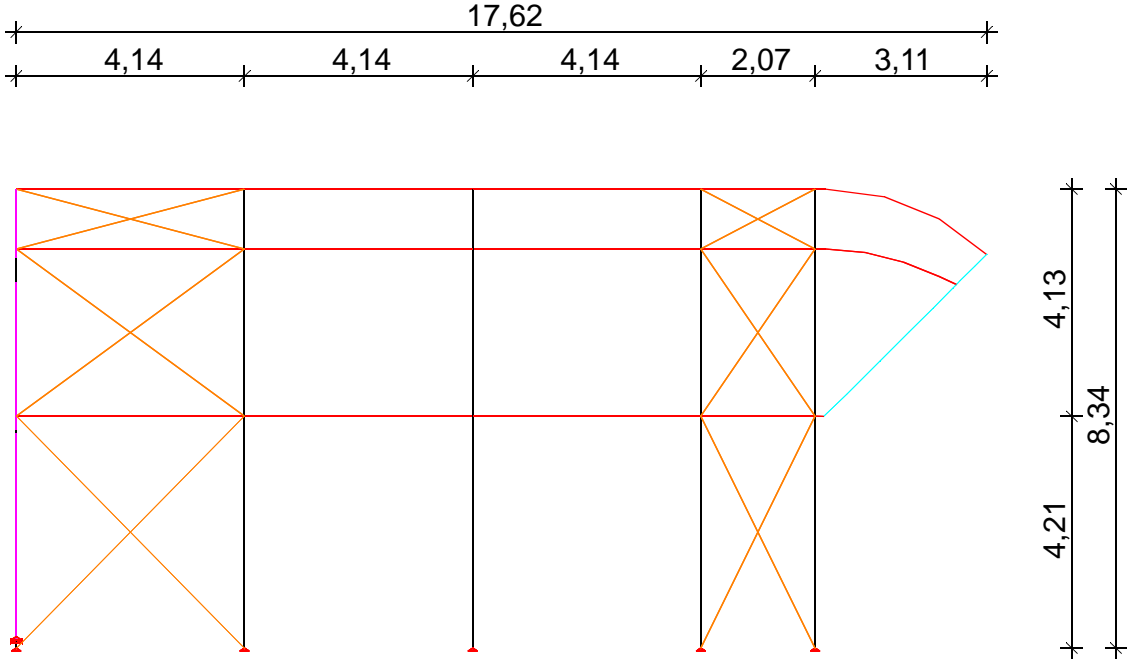
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

front view:



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

side view:



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

4.2 LOADING

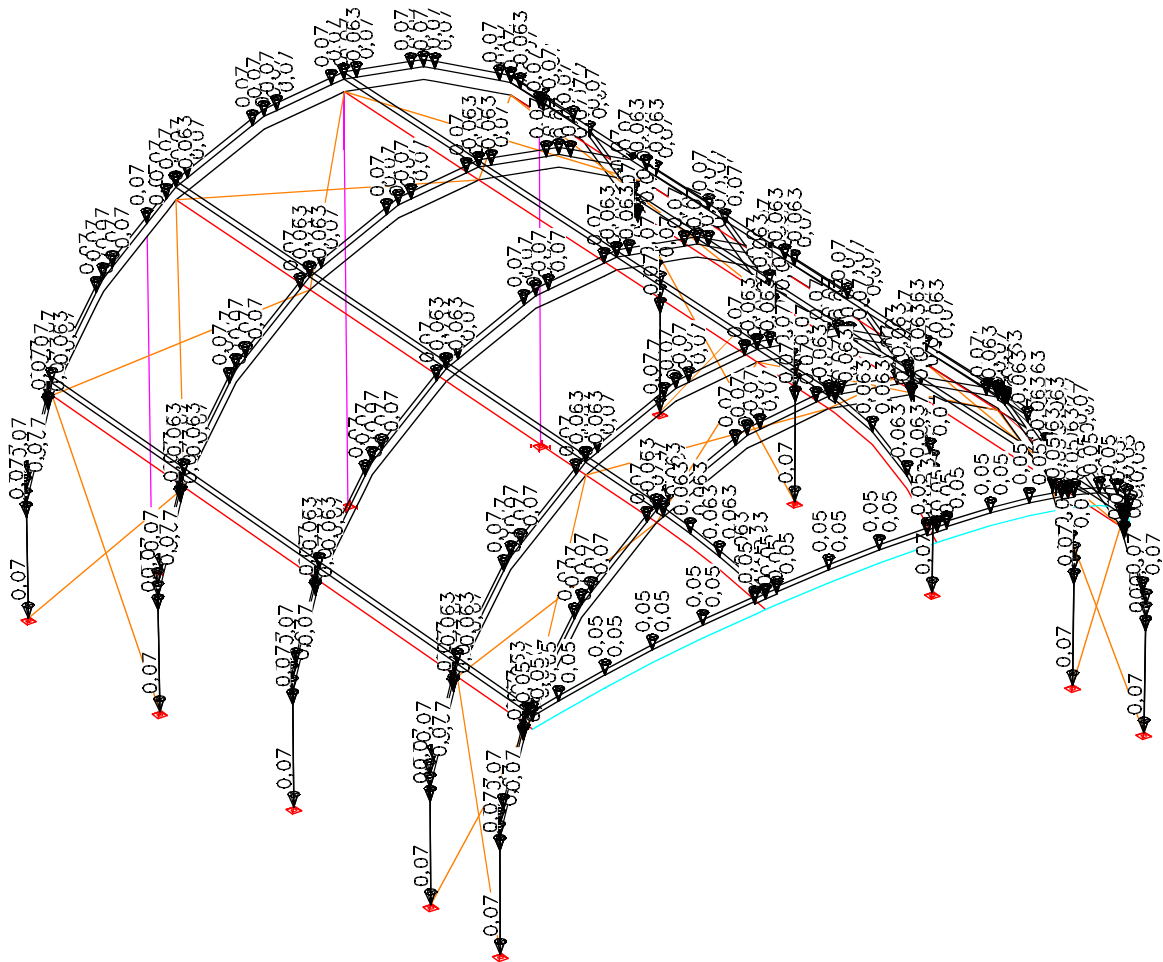
load case 1: dead weight truss

H30D: 0,050 kN/m

H30V: 0,063 kN/m

H40V: 0,070 kN/m

keder profile is taken into account by the software Infograph

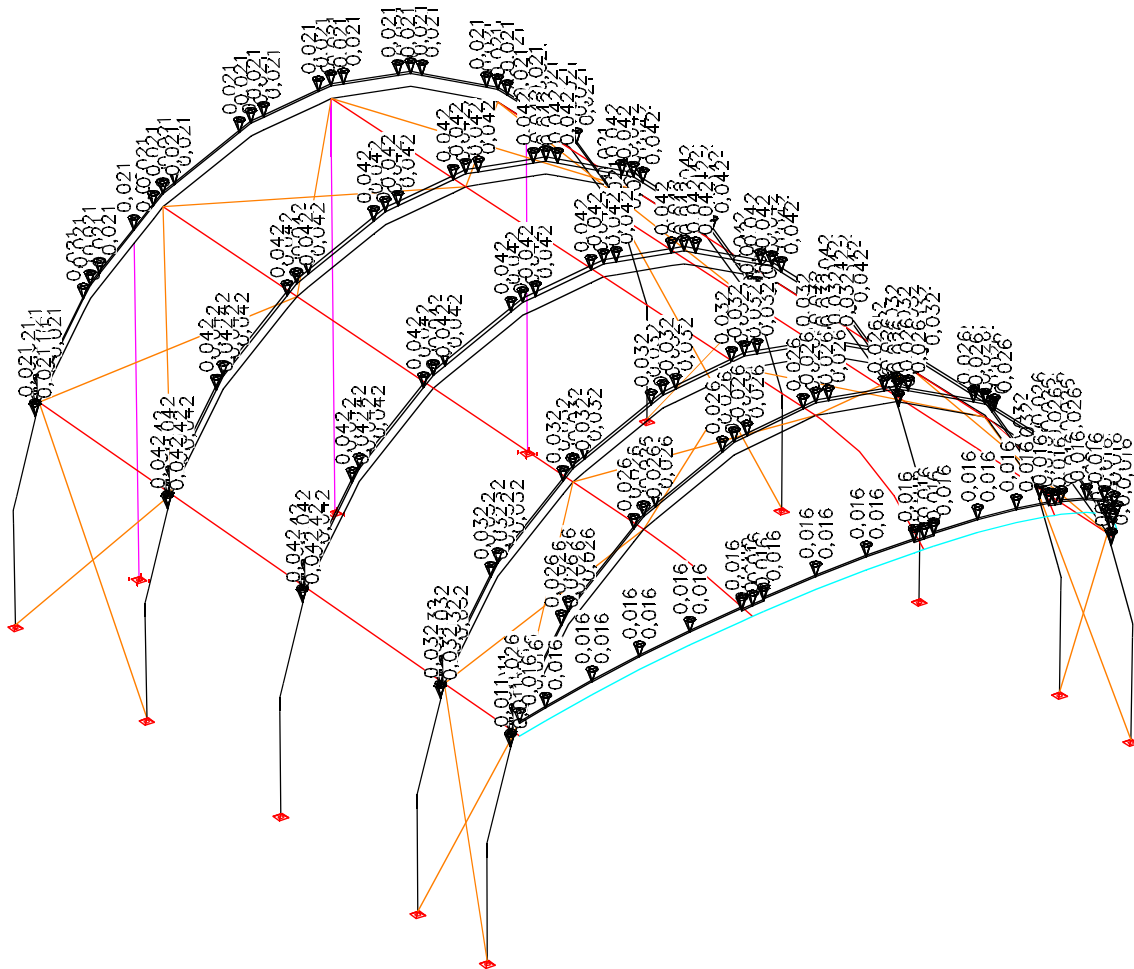


LC 1: Load, deadweight

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 2: canopy 1kg/m²

$4,14/2 \times 0,01 = 0,021 \text{ kN/m}$
 $4,14 \times 0,01 = 0,042 \text{ kN/m}$
 $(4,14+2,07)/2 \times 0,01 = 0,032 \text{ kN/m}$
 $2,07/2 \times 0,01 = 0,01 \text{ kN/m}$
 $3,20/2 = 0,016 \text{ kN/m}$

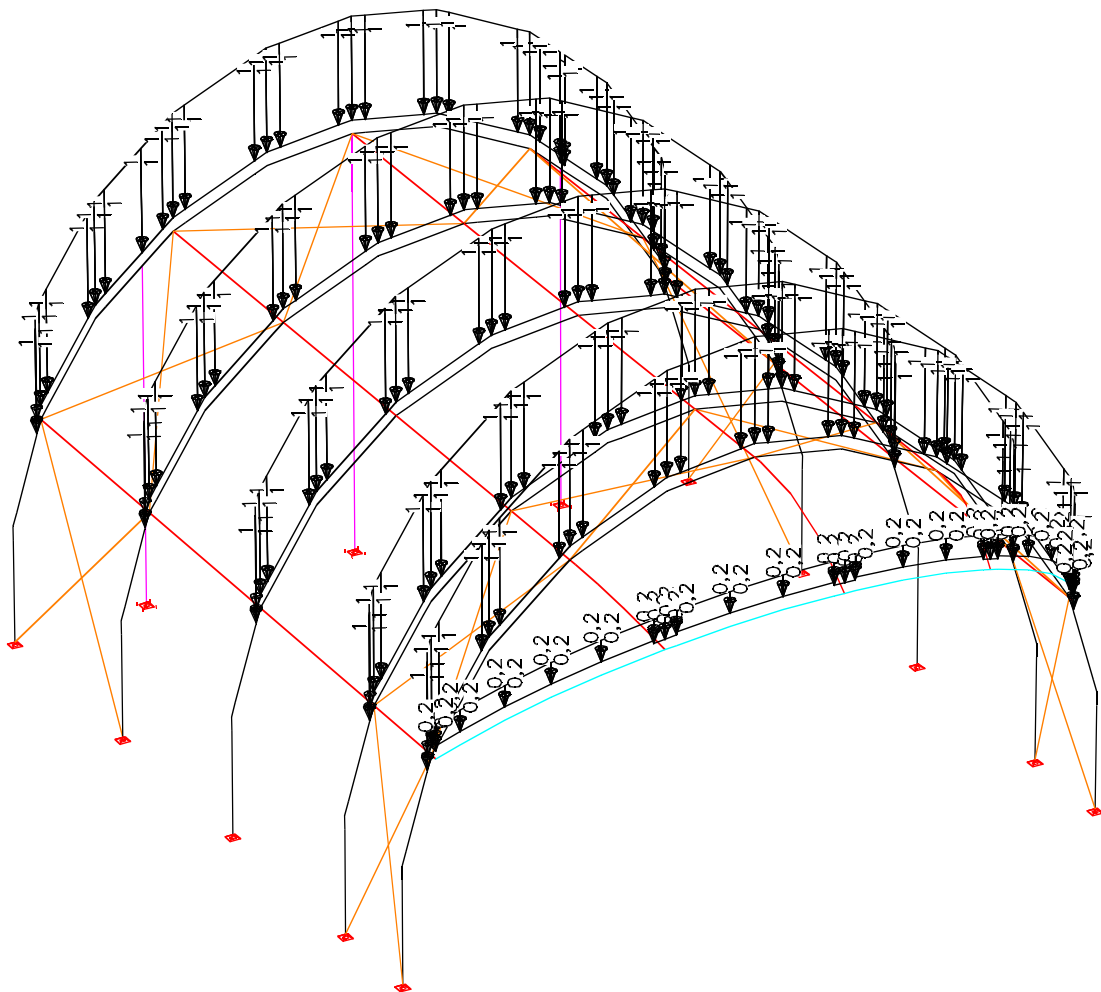


LC 2: Load, canopy 1kg/m²

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 3: distributed load

1,00 kN/m on bows
0,20 kN/m on cantilever roof

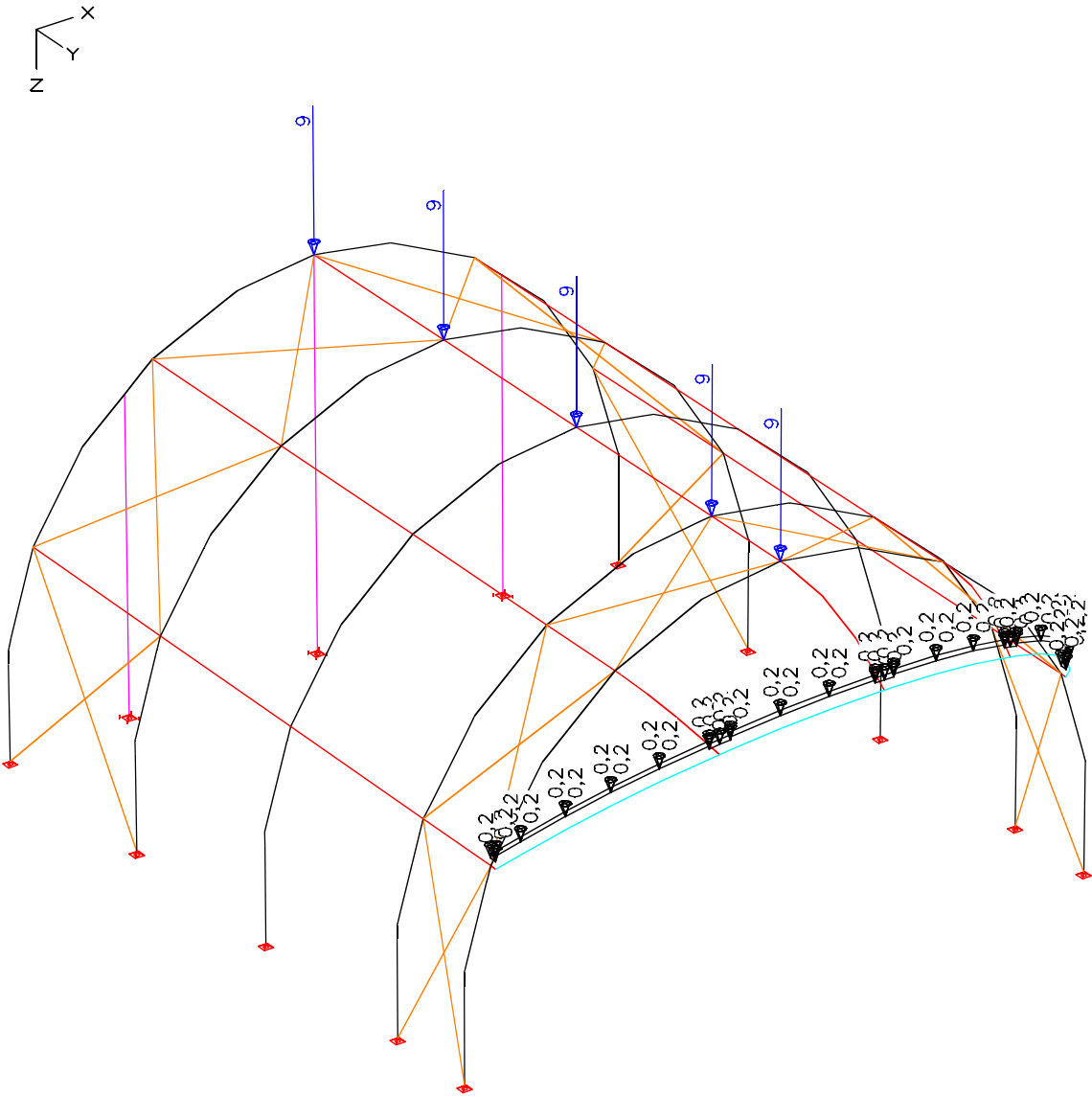


LC 3: Load, distributed load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 4: centre point load

9,0 kN in centre points of bows
0,20 kN/m on cantilever roof

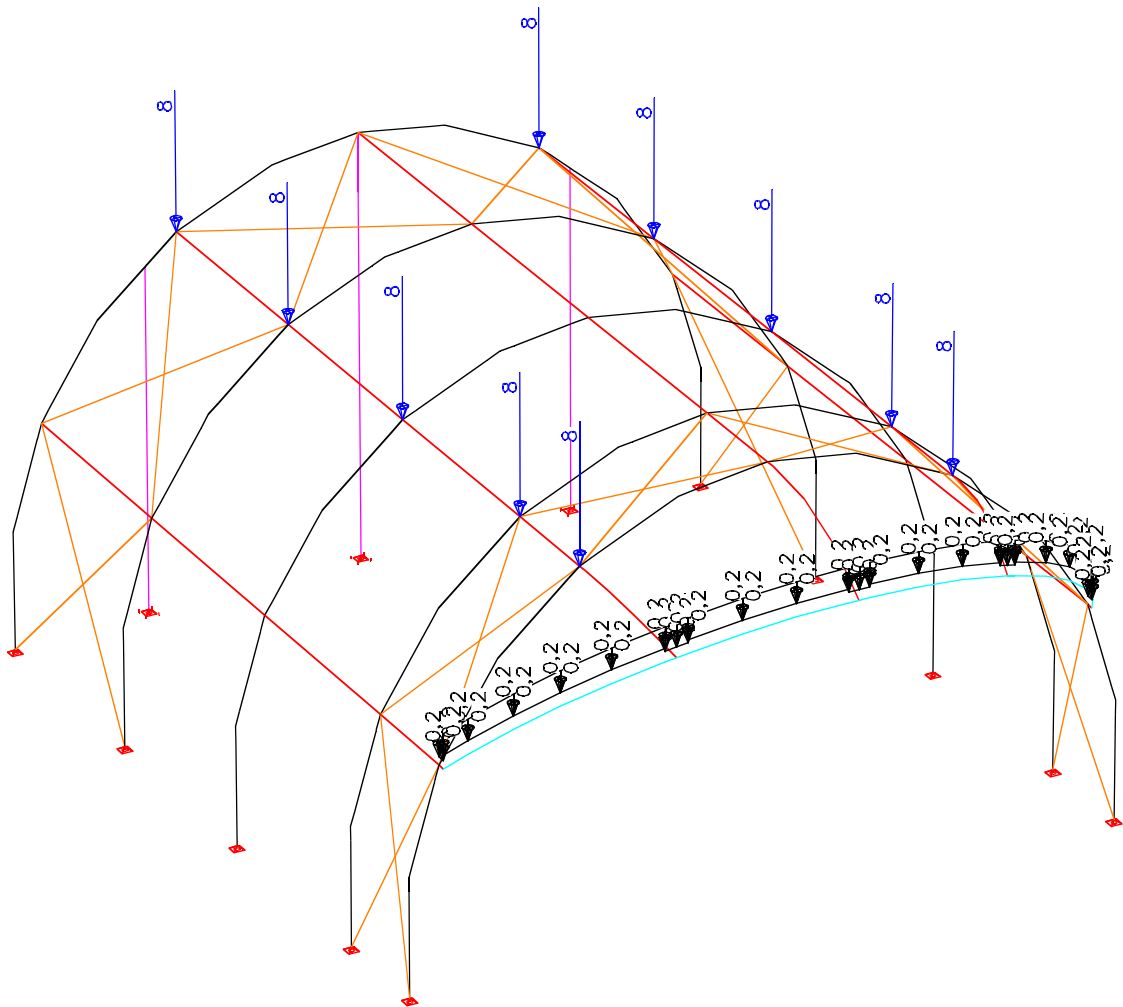


LC 4: Load, center point load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 5: third point load

8,0 kN in third points of bows
0,20 kN/m on cantilever roof

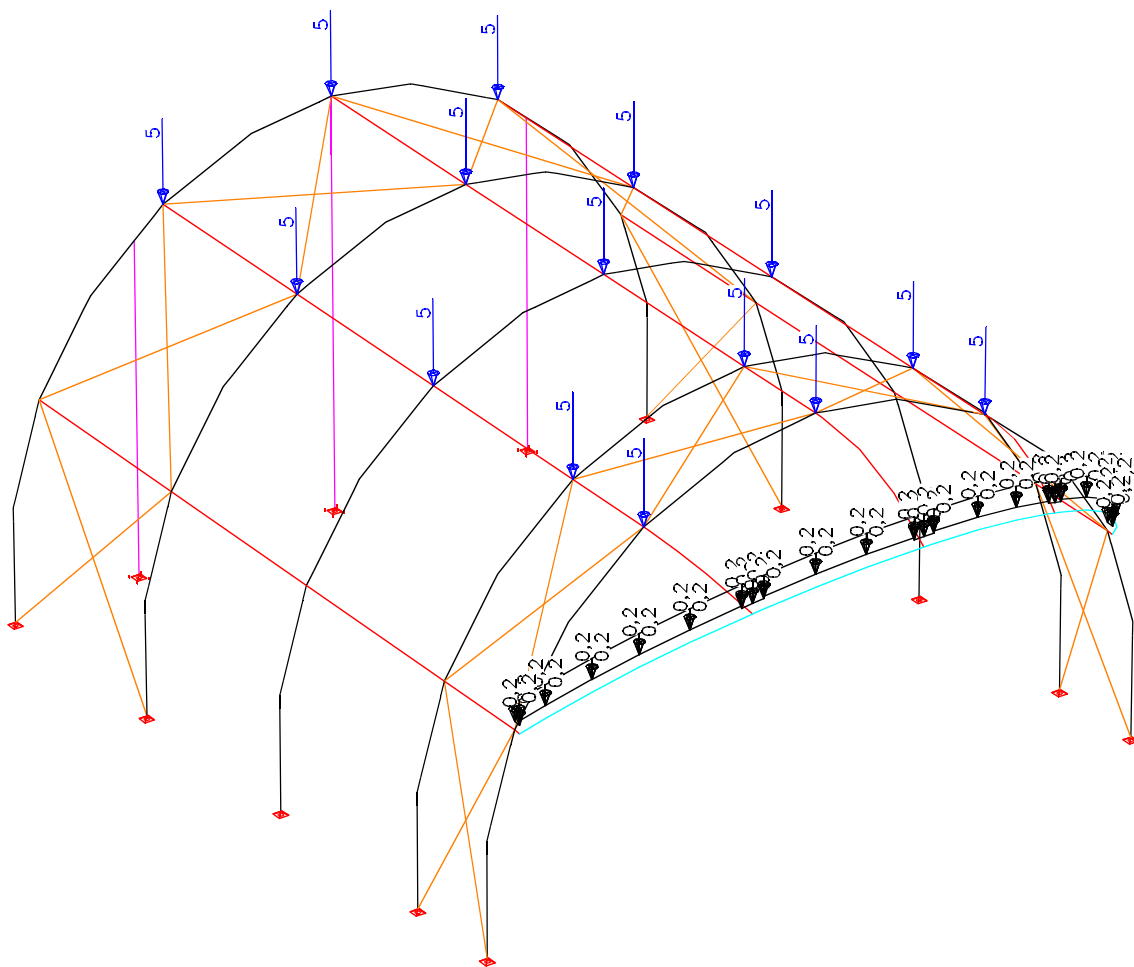


LC 5: Load, third point load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 6: fourth point load

5,0 kN in fourth points of bows
0,20 kN/m on cantilever roof



LC 6: Load, forth point load

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 10: wind roof outer side

$$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +0,80/ -1,20/ -0,40/ -0,60$$

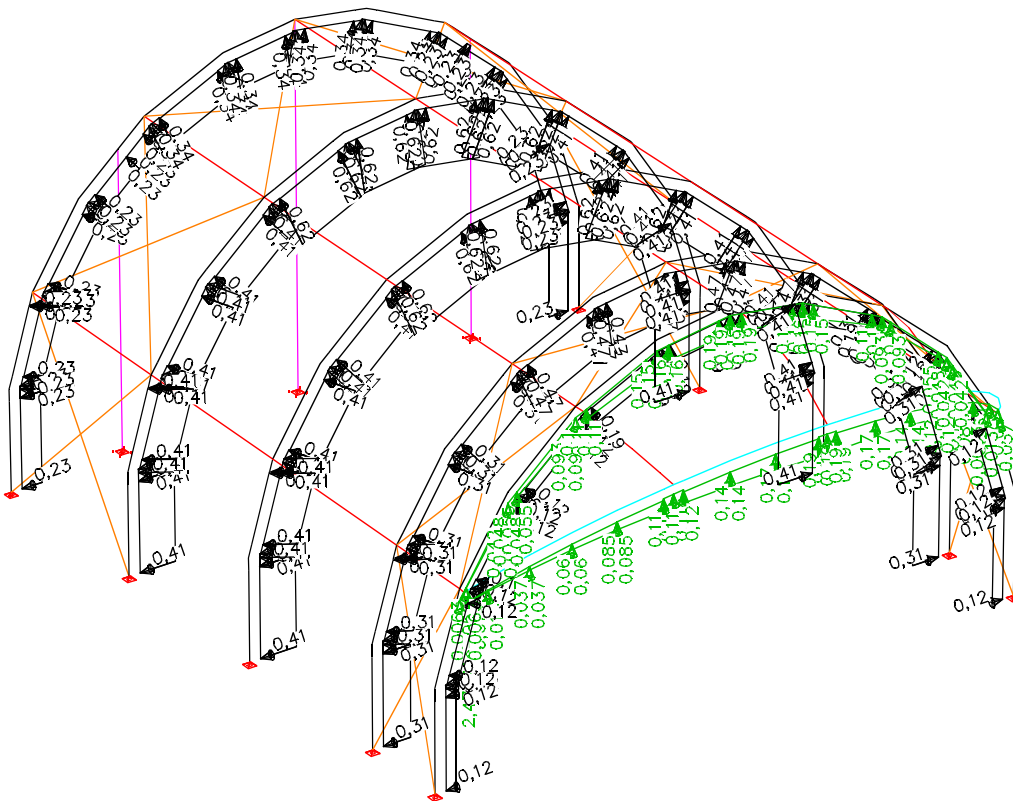
$w_1 = 0,80 \times 0,20 \times (4,14/2 + 0,20)$	$= 0,363 \text{ kN/m}$
$w_2 = 0,80 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,545 \text{ kN/m}$
$w_3 = 1,20 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,818 \text{ kN/m}$
$w_4 = 0,40 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,273 \text{ kN/m}$
$w_5 = 0,40 \times 0,20 \times (4,14/2 + 0,20)$	$= 0,182 \text{ kN/m}$
$w_6 = 0,80 \times 0,20 \times 4,14$	$= 0,662 \text{ kN/m}$
$w_7 = 0,80 \times 0,30 \times 4,14$	$= 0,994 \text{ kN/m}$
$w_8 = 1,20 \times 0,30 \times 4,14$	$= 1,491 \text{ kN/m}$
$w_9 = 0,40 \times 0,30 \times 4,14$	$= 0,497 \text{ kN/m}$
$w_{10} = 0,40 \times 0,20 \times 4,14$	$= 0,331 \text{ kN/m}$
$w_{11} = 0,80 \times 0,20 \times (4,14+2,07)/2$	$= 0,497 \text{ kN/m}$
$w_{12} = 0,80 \times 0,30 \times (4,14+2,07)/2$	$= 0,745 \text{ kN/m}$
$w_{13} = 1,20 \times 0,30 \times (4,14+2,07)/2$	$= 1,119 \text{ kN/m}$
$w_{14} = 0,40 \times 0,30 \times (4,14+2,07)/2$	$= 0,373 \text{ kN/m}$
$w_{15} = 0,40 \times 0,20 \times (4,14+2,07)/2$	$= 0,249 \text{ kN/m}$
$w_{16} = 0,80 \times 0,20 \times (2,07/2 + 0,20)$	$= 0,198 \text{ kN/m}$
$w_{17} = 0,80 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,296 \text{ kN/m}$
$w_{18} = 1,20 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,444 \text{ kN/m}$
$w_{19} = 0,40 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,148 \text{ kN/m}$
$w_{20} = 0,40 \times 0,20 \times (2,07/2 + 0,20)$	$= 0,100 \text{ kN/m}$
$w_{21} = 0,60 \times 0,25 \times 3,00/2$	$= 0,230 \text{ kN/m (cantilever roof)}$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 12: wind roof inner side

$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +0,50$

$w_1 = 0,50 \times 0,20 \times (4,14/2 + 0,20)$	$= 0,227 \text{ kN/m}$
$w_2 = 0,50 \times 0,30 \times (4,14/2 + 0,20)$	$= 0,341 \text{ kN/m}$
$w_6 = 0,50 \times 0,20 \times 4,14$	$= 0,414 \text{ kN/m}$
$w_7 = 0,50 \times 0,30 \times 4,14$	$= 0,621 \text{ kN/m}$
$w_{11} = 0,50 \times 0,20 \times (4,14+2,07)/2$	$= 0,311 \text{ kN/m}$
$w_{12} = 0,50 \times 0,30 \times (4,14+2,07)/2$	$= 0,467 \text{ kN/m}$
$w_{16} = 0,50 \times 0,20 \times (2,07/2 + 0,20)$	$= 0,124 \text{ kN/m}$
$w_{17} = 0,50 \times 0,30 \times (2,07/2 + 0,20)$	$= 0,185 \text{ kN/m}$
$w_{21} = 0,50 \times 0,25 \times 3,00/2$	$= 0,188 \text{ kN/m (cantilever roof)}$



LC 12: Load, wind roof inner side

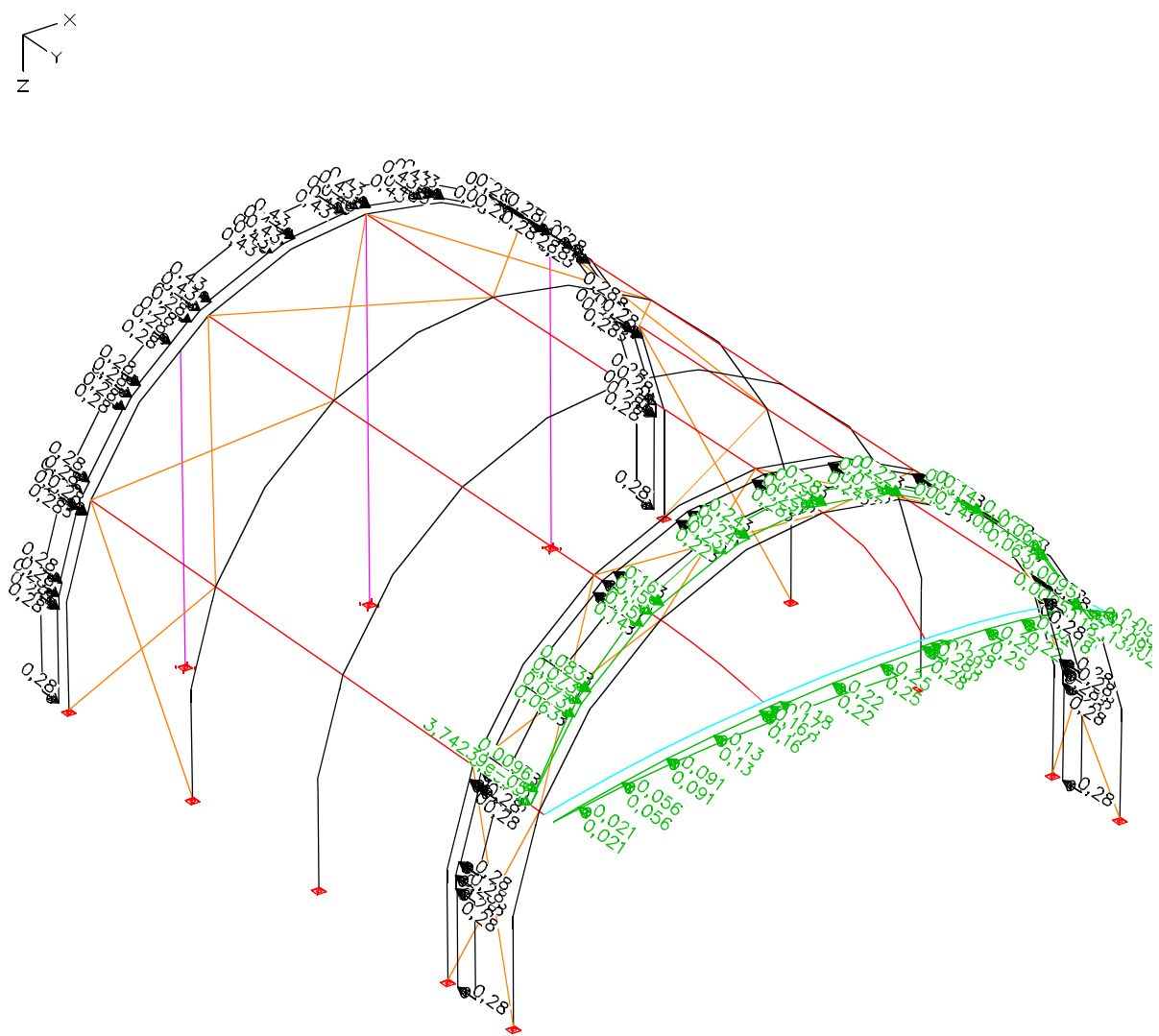
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 13: membrane tension for LC 12

$$0,227 / 0,80 = 0,284 \text{ kN/m}$$

$$0,341 / 0,80 = 0,426 \text{ kN/m}$$

$$0,188 / 0,80 = 0,235 \text{ kN/m}$$



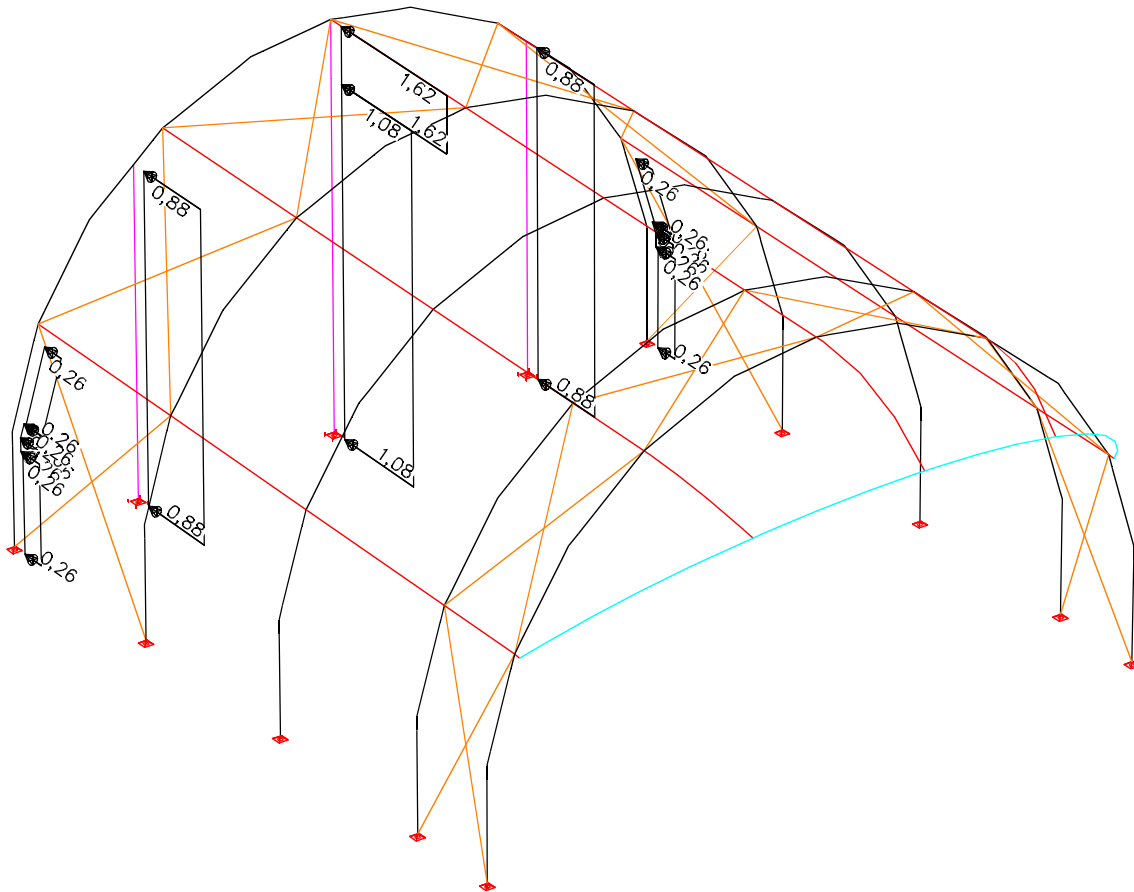
LC 13: Load, membrane tension for LC 12

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 14: wind rear wall

$q = 0,20 \text{ kN/m}^2 \text{ or } 0,30 \text{ kN/m}^2 \quad c_{pe} = +1,30$

$$\begin{aligned}
 w_1 &= 1,30 \times 0,20 \times 4,14 &= 1,076 \text{ kN/m} \\
 w_2 &= 1,30 \times 0,30 \times 4,14 &= 1,615 \text{ kN/m} \\
 w_3 &= 1,30 \times 0,20 \times (4,14+2,60)/2 &= 0,876 \text{ kN/m} \\
 w_4 &= 1,30 \times 0,20 \times 2,60/2 &= 0,260 \text{ kN/m}
 \end{aligned}$$

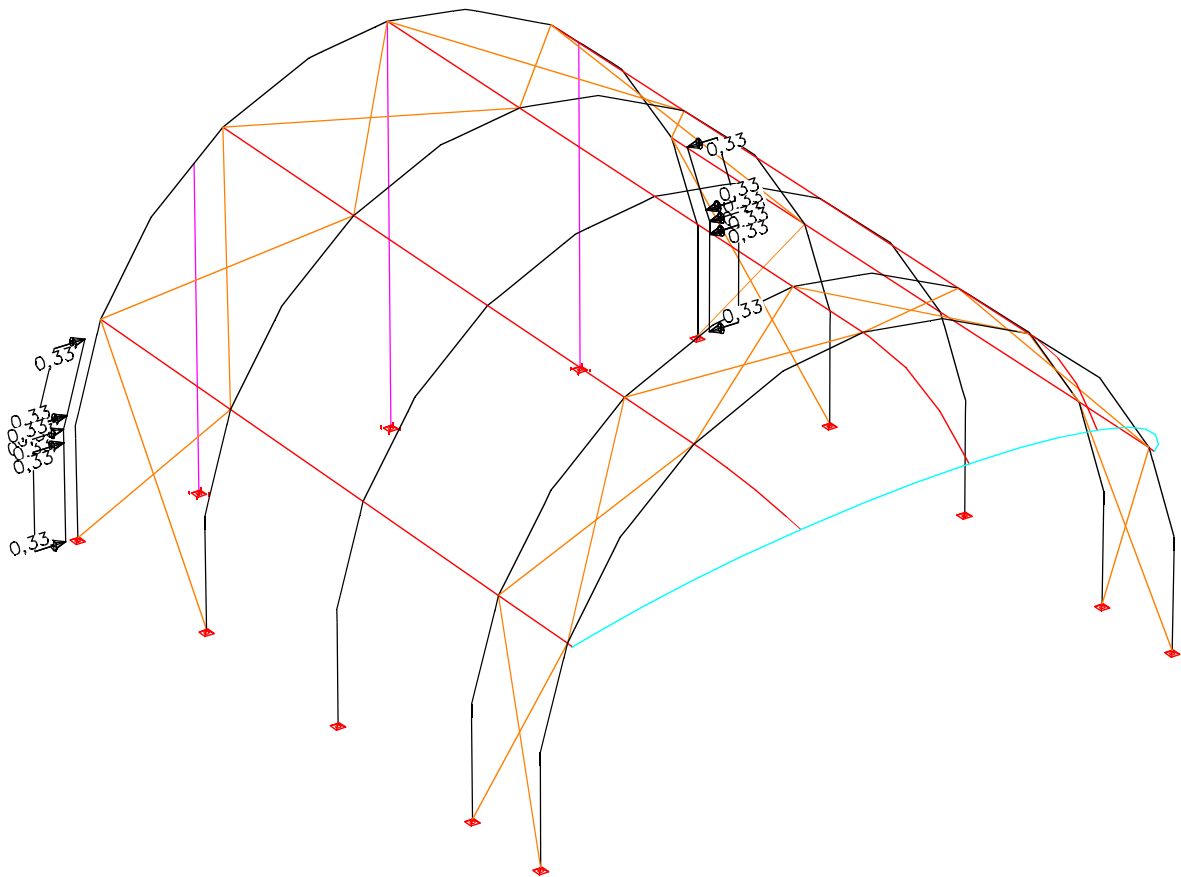


LC 14: Load, wind rear wall

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 15: membrane tension for LC 14

$$0,26 / 0,80 = 0,325 \text{ kN/m}$$



LC 15: Load, membrane tension rear wall

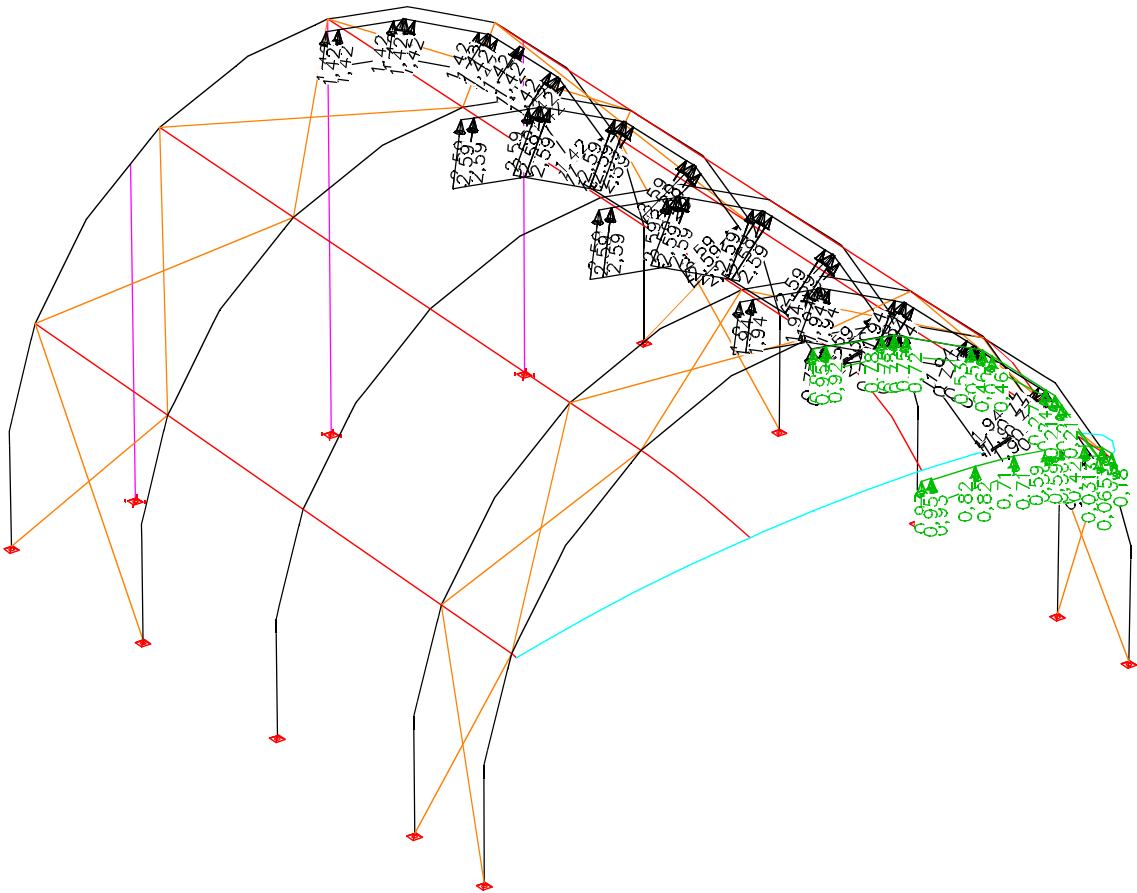
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

notice: For status out of service the construction must be regarded for different load situations according to freestanding roofs with either tension or compression of the whole roof and additionally only for one half of the roof.

load case 20: wind roof right side – out of service

$$\begin{aligned}q &= 0,44 \text{ kN/m}^2 \text{ or } 0,625 \text{ kN/m}^2 & c_{pe} &= 1,0 \\w_1 &= 1,0 \times 0,44 \times 3,0 / 2 & &= 0,66 \text{ kN/m} \\w_2 &= 1,0 \times 0,625 \times 3,0 / 2 & &= 0,94 \text{ kN/m} \\w_3 &= 1,0 \times 0,625 \times (4,14/2 + 0,20) & &= 1,419 \text{ kN/m} \\w_4 &= 1,0 \times 0,625 \times 4,14 & &= 2,583 \text{ kN/m} \\w_5 &= 1,0 \times 0,625 \times (4,14+2,07) / 2 & &= 1,941 \text{ kN/m} \\w_6 &= 1,0 \times 0,625 \times (2,07/2 + 0,20) & &= 0,772 \text{ kN/m}\end{aligned}$$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



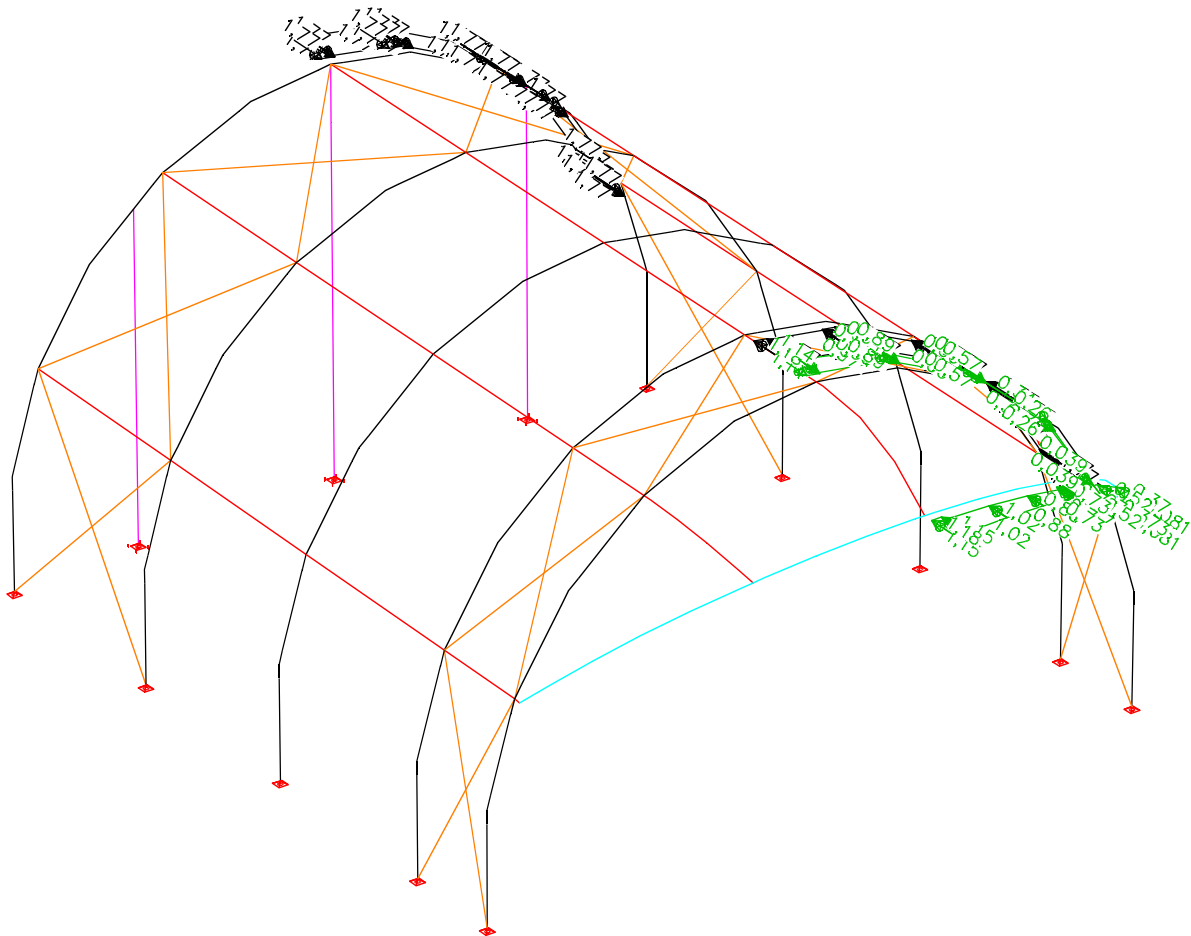
LC 20: Load, wind roof right side – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 21: membrane tension for LC 20

$$0,94 / 0,80 = 1,175 \text{ kN/m}$$

$$1,419 / 0,80 = 0,774 \text{ kN/m}$$

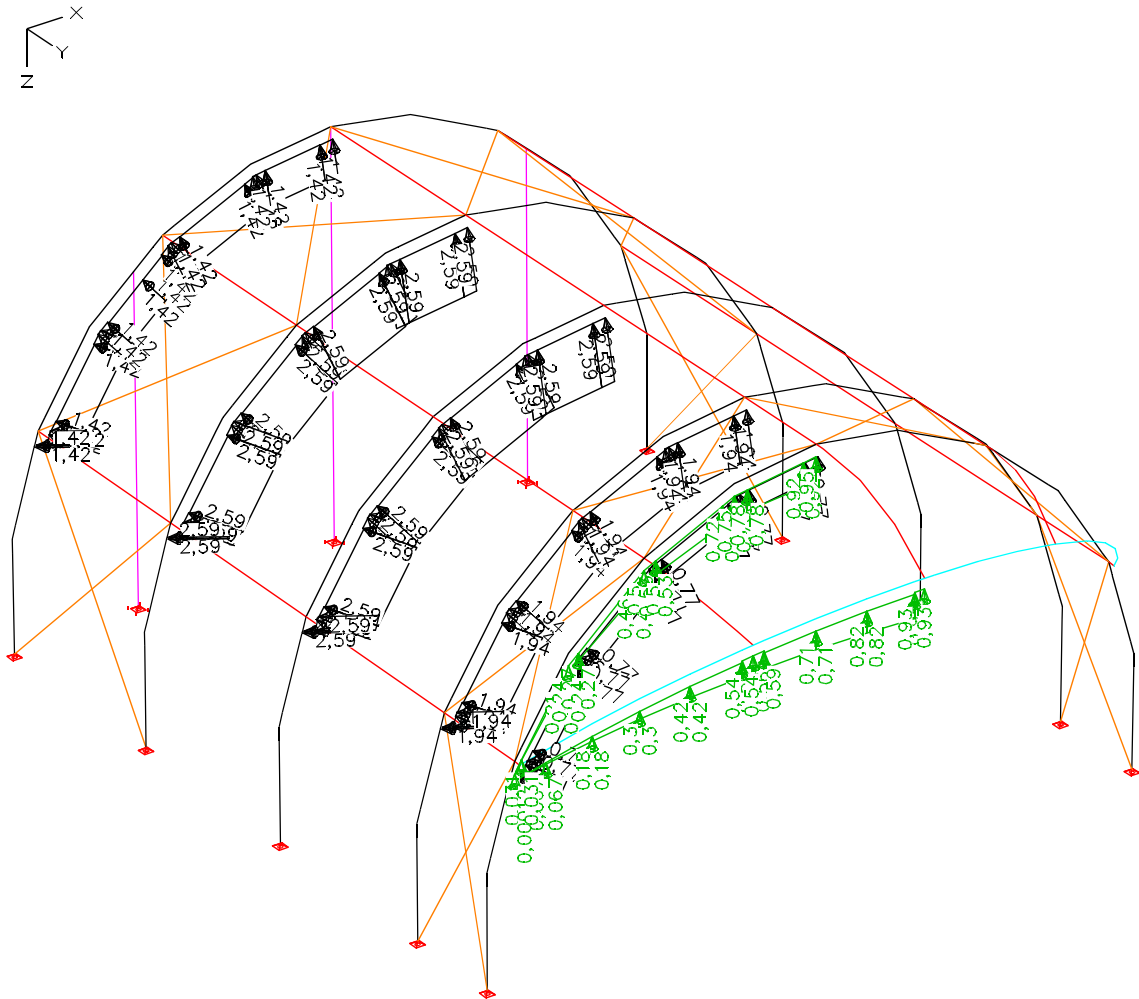


LC 21: Load, membrane tension for LC 20

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 22: wind roof left side – out of service

see LC 20

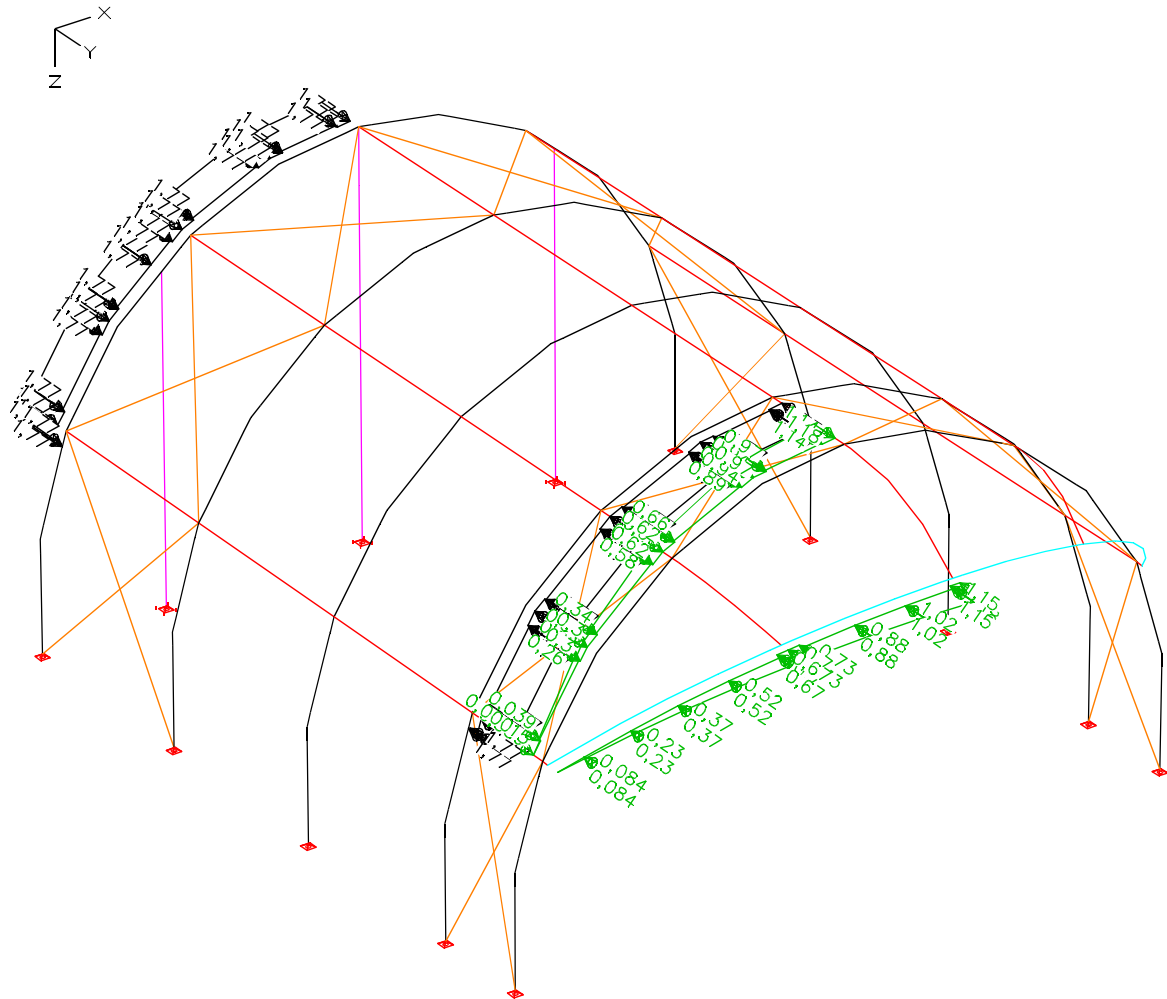


LC 22: Load, wind roof left side – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

load case 23: membrane tension for LC 22

see LC 21



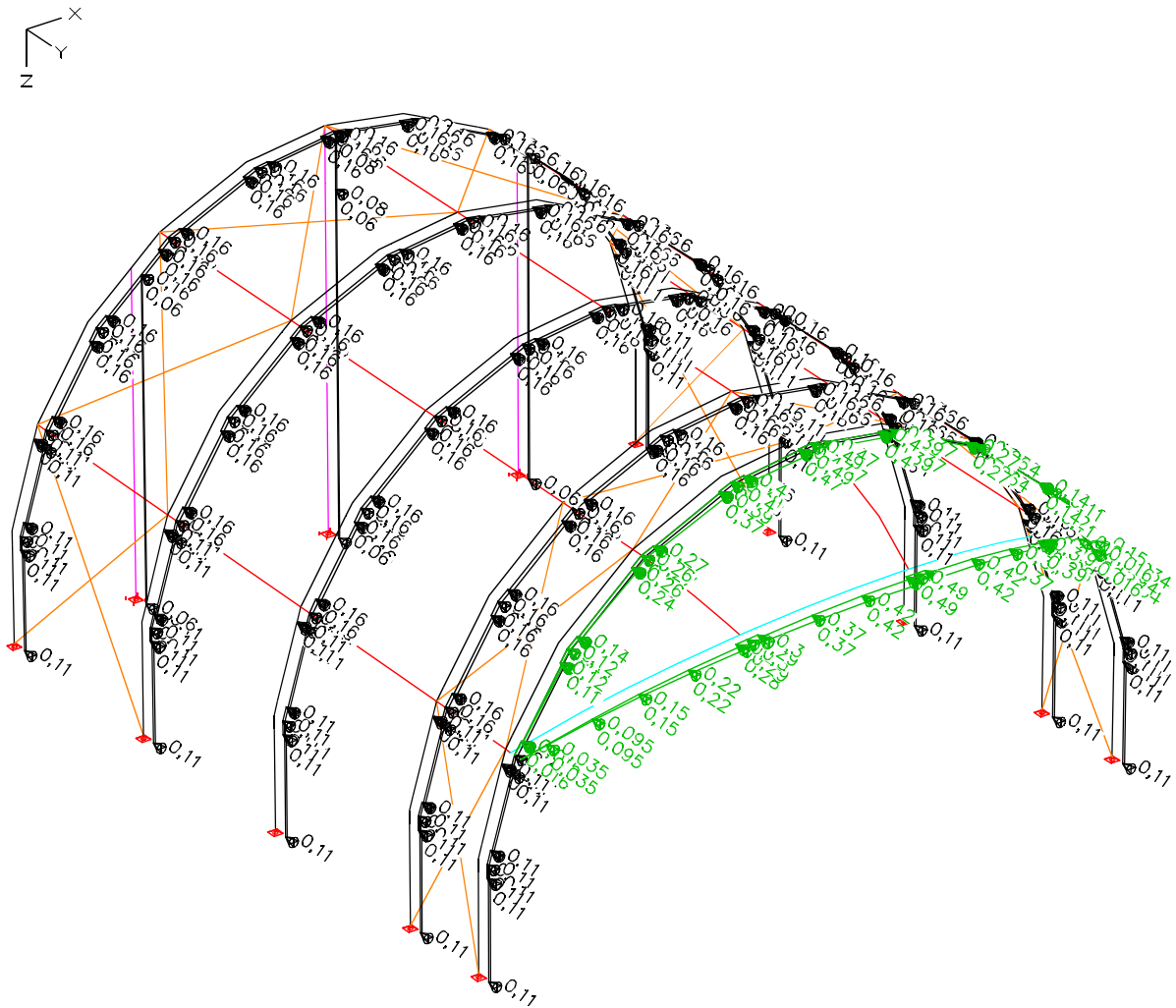
LC 23: Load, membrane tension for LC 22

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 24: wind horizontal y-dir. - out of service

truss: $1,30 \times 0,50 \times 0,40 \times 0,625 = 0,16 \text{ kN/m}$
 $1,30 \times 0,50 \times 0,40 \times 0,440 = 0,11 \text{ kN/m}$

cantilever roof:
 $1,30 \times 0,625 \times 1,20/2 = 0,49 \text{ kN/m}$

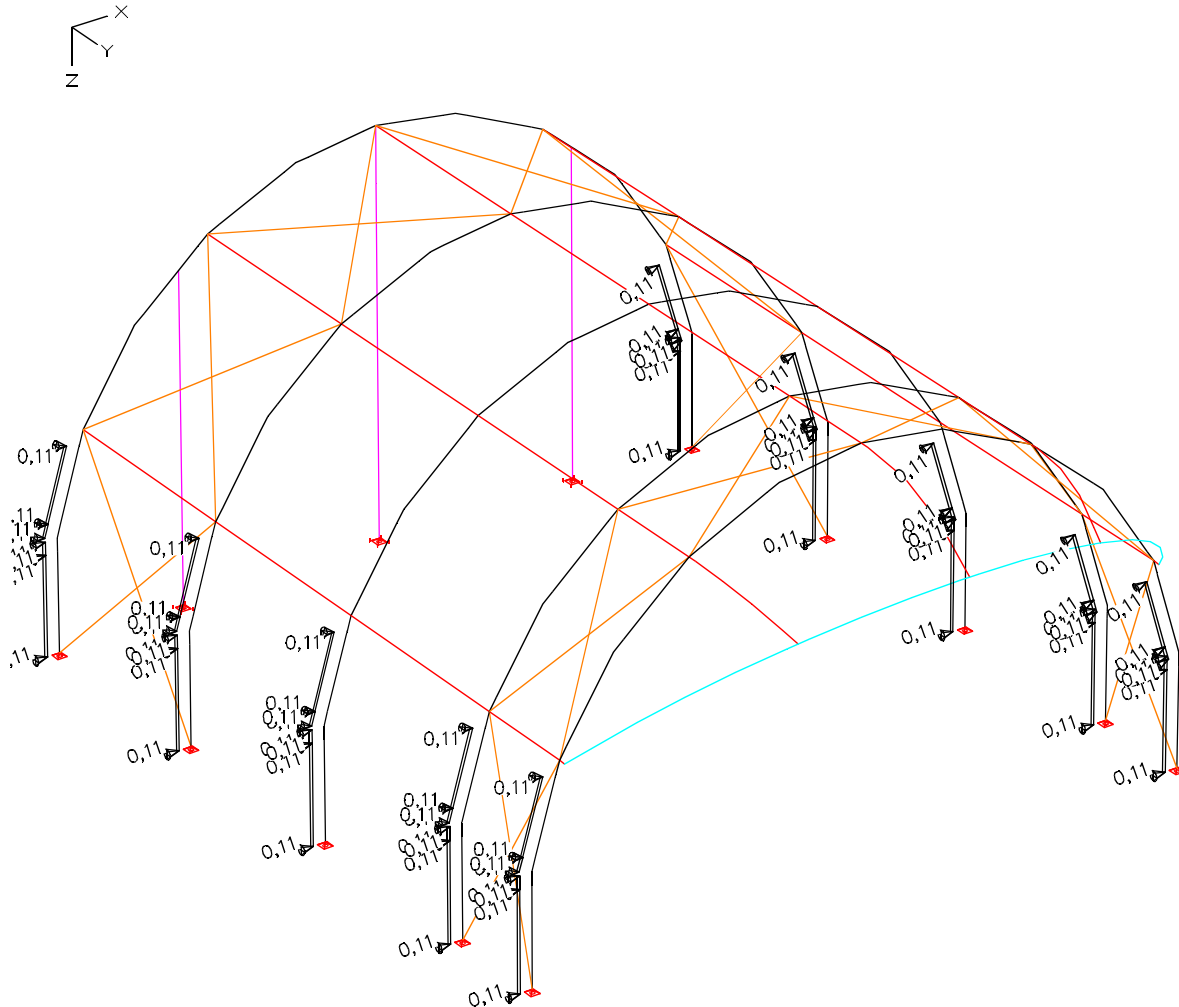


LC 24: Load, wind horizontal Y – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

load case 25: wind horizontal x-dir. - out of service

truss: $1,30 \times 0,50 \times 0,40 \times 0,44 = 0,11 \text{ kN/m}$

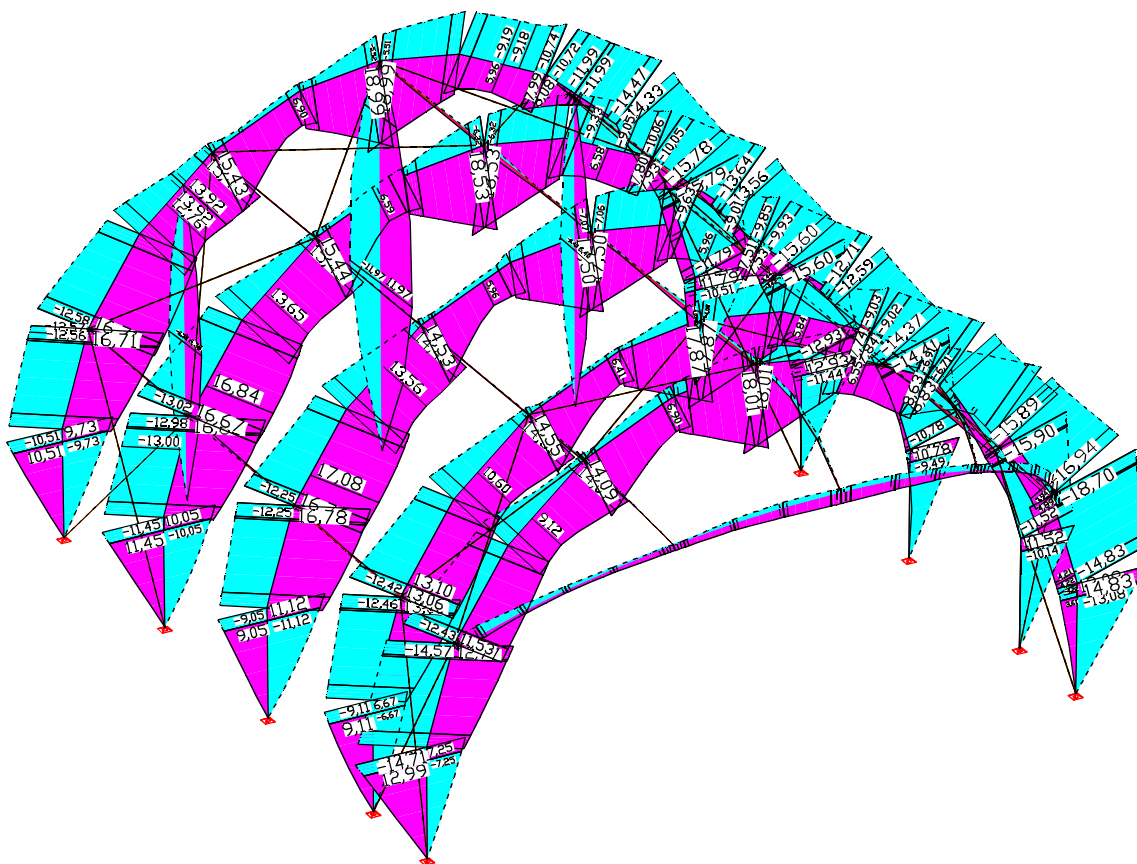


LC 25: Load, wind horizontal X – out of service

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

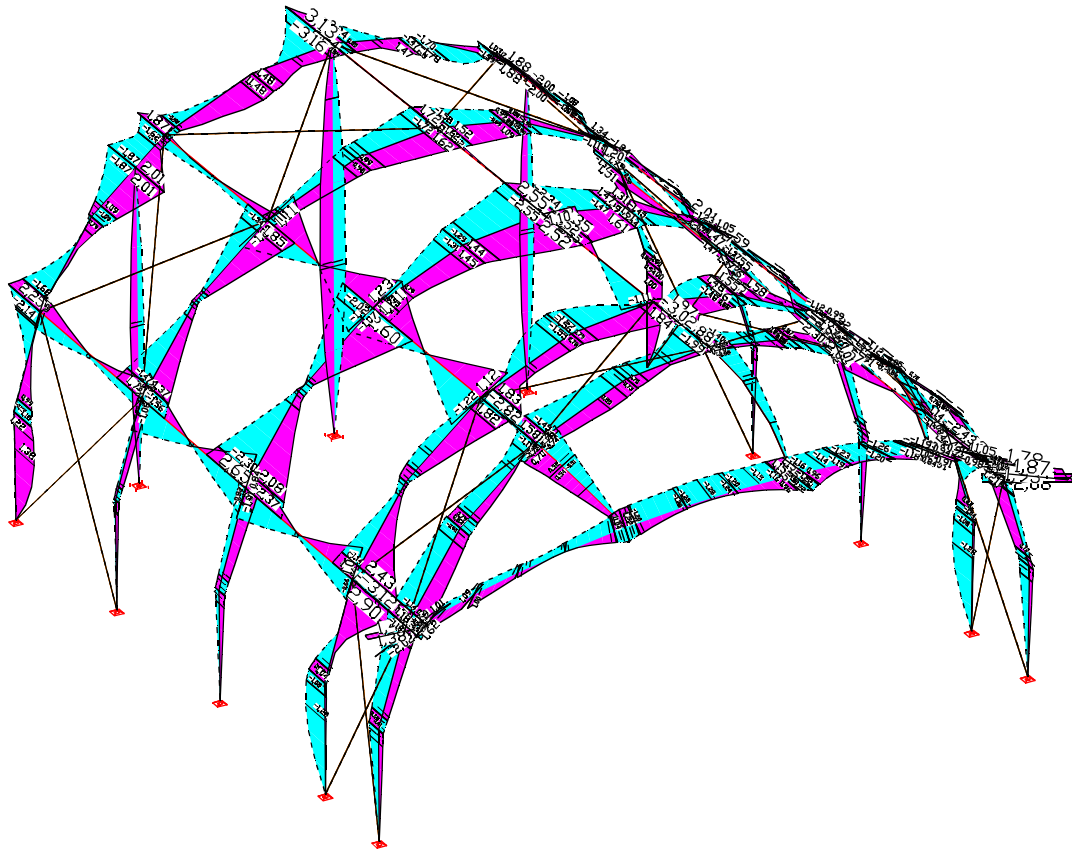
4.3 CALCULATION

Internal forces



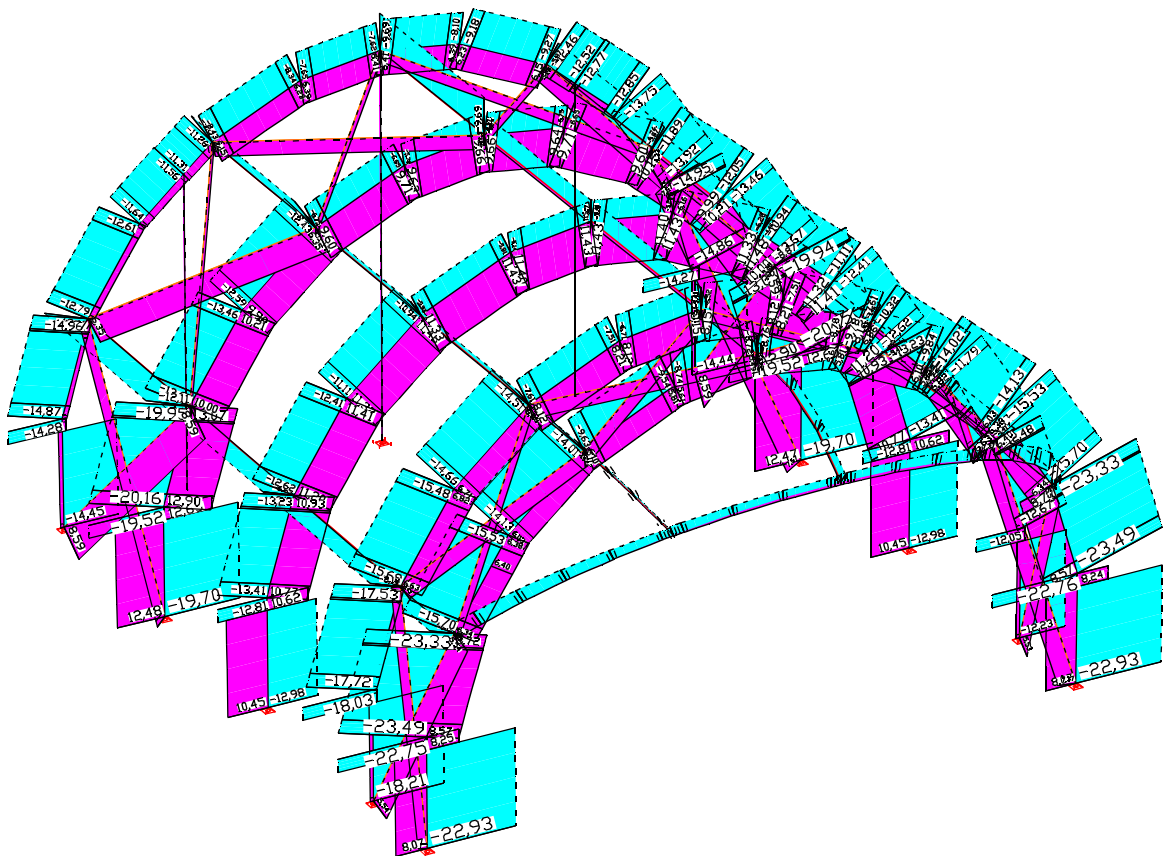
LCC 91: in service
 Internal forces min,max My [kNm]
 Value range (overall system, min/max): -18,70/18,99 [kNm]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



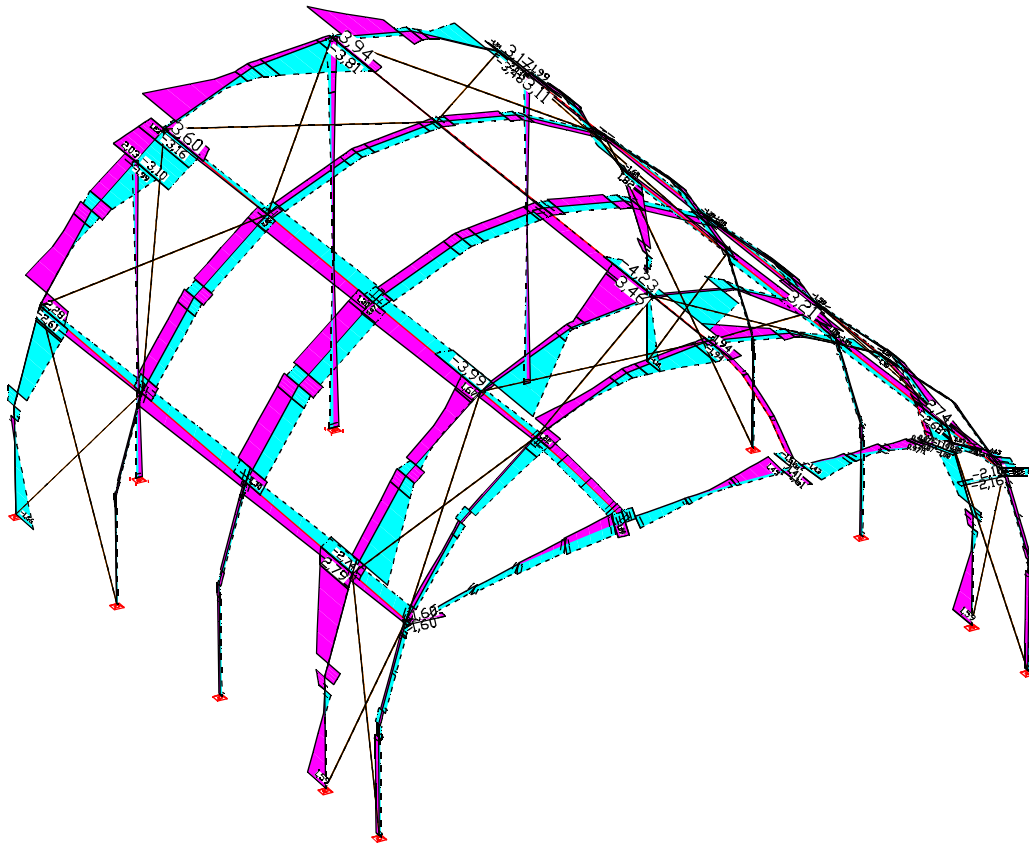
LCC 91: in service
 Internal forces min,max Mz [kNm]
 Value range (overall system, min/max): -3,16/3,13 [kNm]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



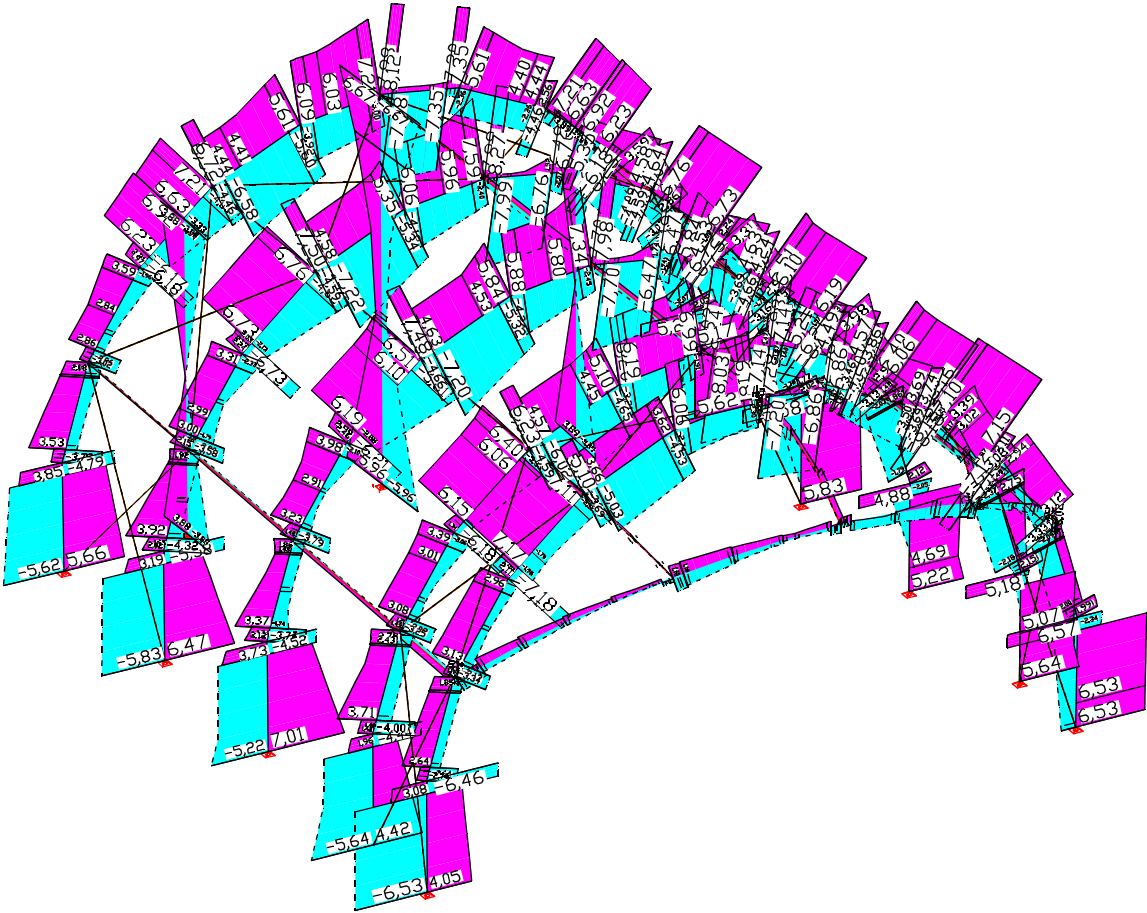
LCC 91: in service
 Internal forces min,max Nx [kN]
 Value range (overall system, min/max): -23,49/13,07 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



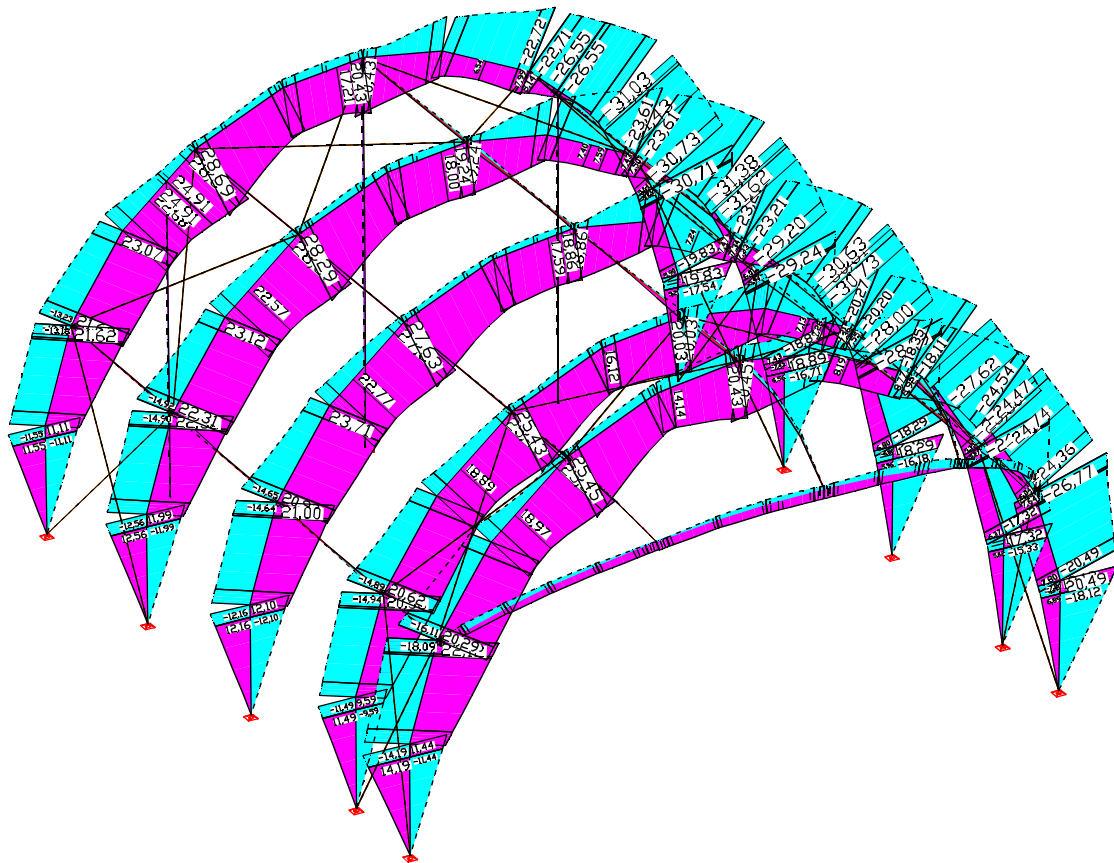
LCC 91: in service
 Internal forces min,max Q_y [kN]
 Value range (overall system, min/max): -4,23/3,94 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



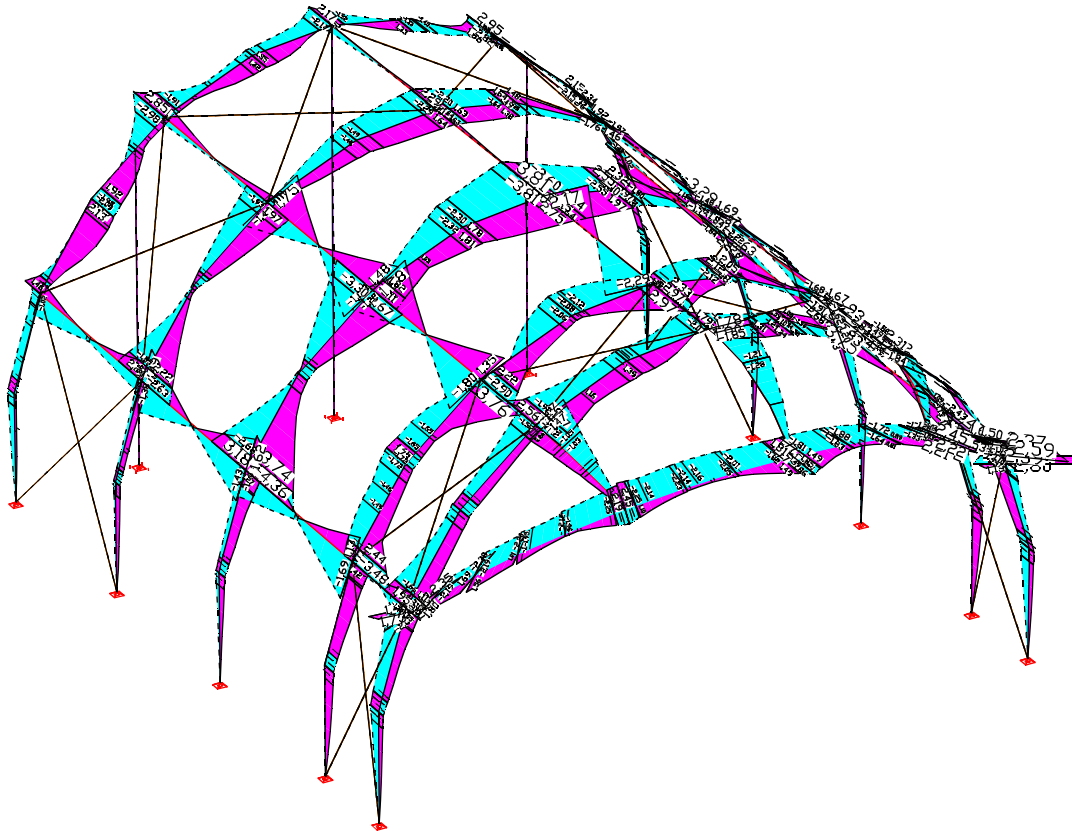
LCC 91: in service
Internal forces min,max Qz [kN]
Value range (overall system, min/max): -8,03/8,27 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Internal forces min,max My [kNm]
 Value range (overall system, min/max): -31,62/28,69 [kNm]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



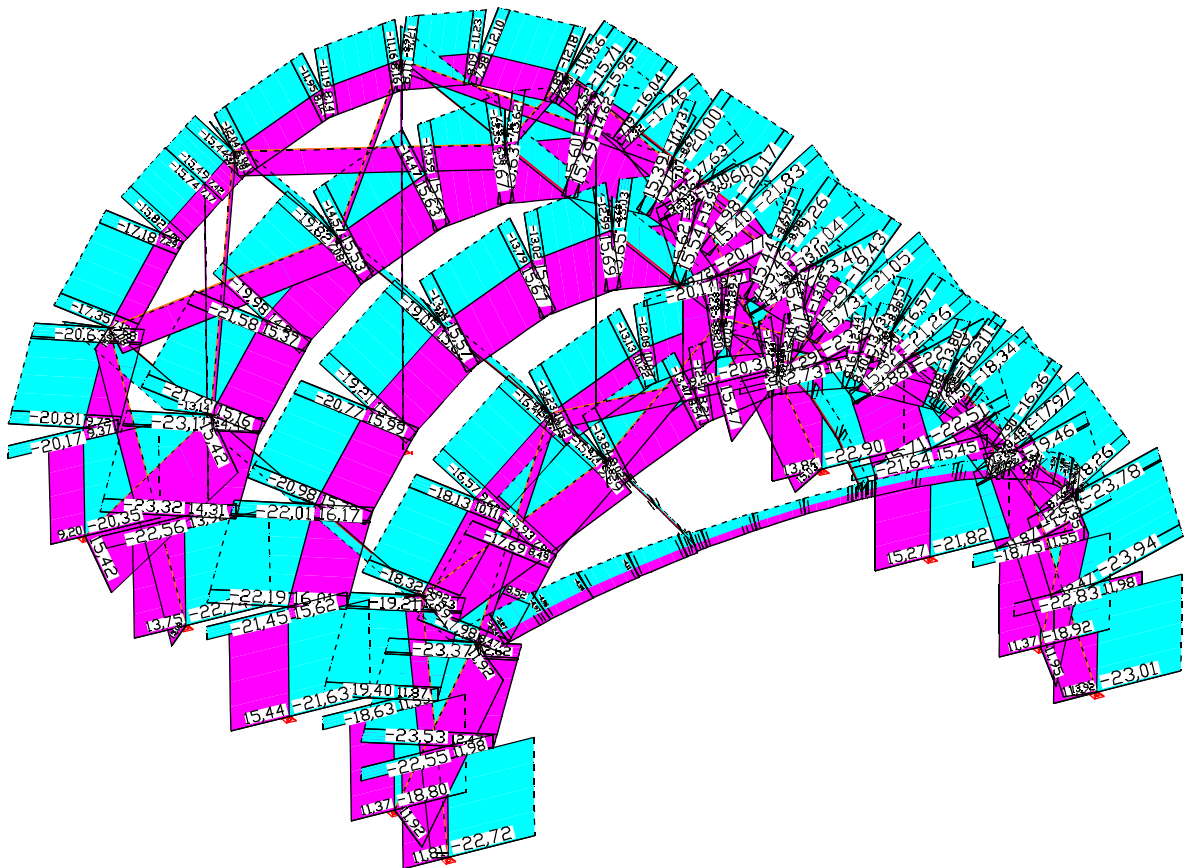
LCC 93: out of service
Internal forces min,max Mz [kNm]
Value range (overall system, min/max): -4,36/4,36 [kNm]

PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
16079

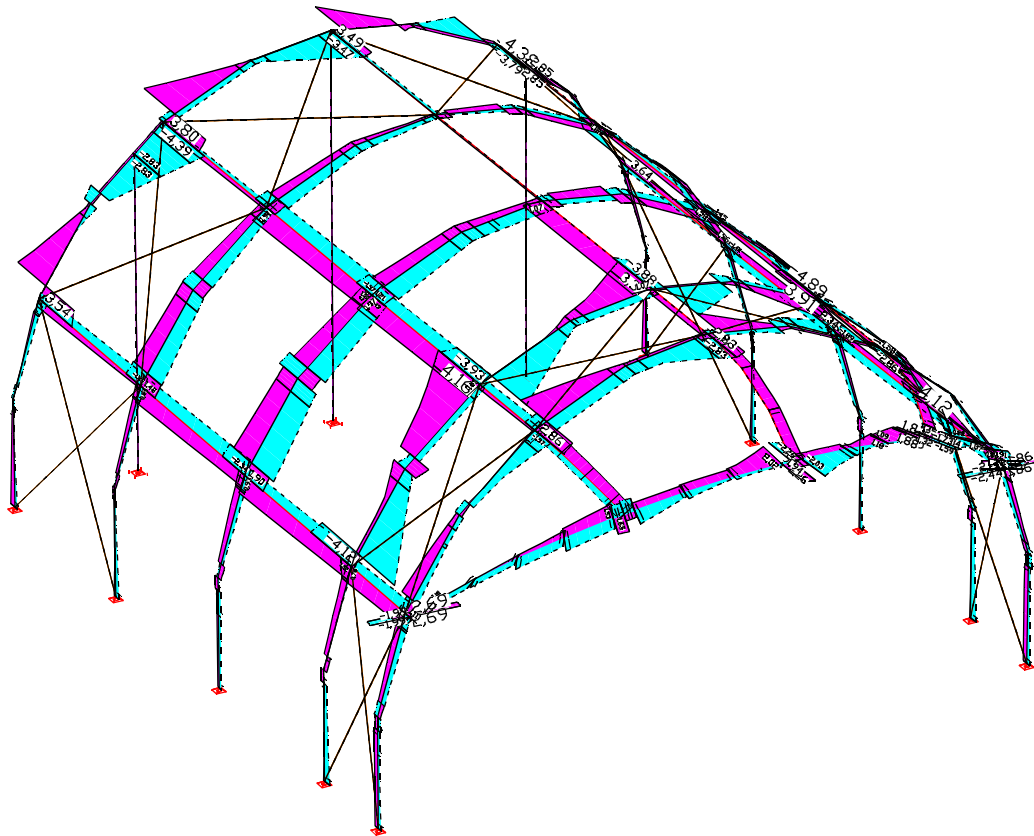
CUSTOMER/AUFTRAGGEBER:
Prolyte Group

DATE/DATUM:
10.04.2016



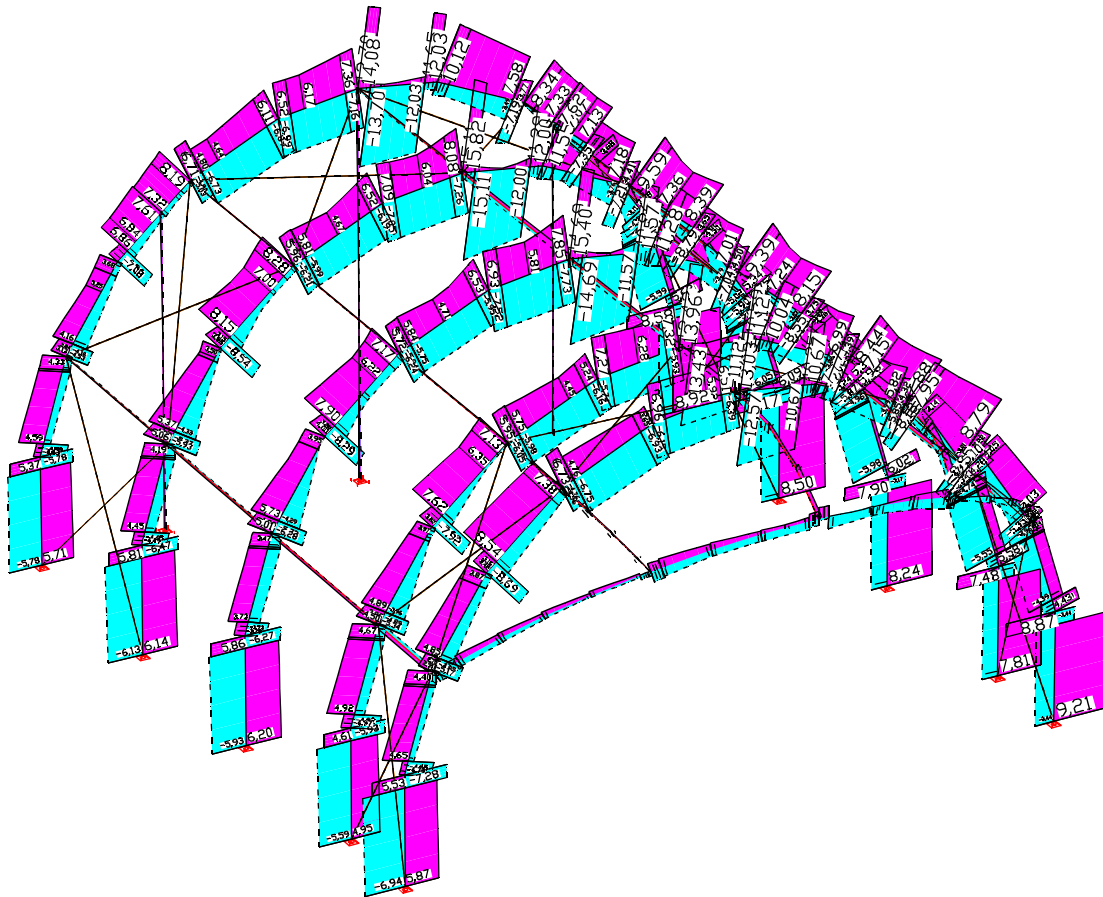
LCC 93: out of service
 Internal forces min,max Nx [kN]
 Value range (overall system, min/max): -23,94/16,17 [kN]

<p>PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS</p>	<p>PROJECT-NO.: 16079</p>
<p>CUSTOMER/AUFTRAGGEBER: Prolyte Group</p>	<p>DATE/DATUM: 10.04.2016</p>



LCC 93: out of service
 Internal forces min,max Q_y [kN]
 Value range (overall system, min/max): -4,89/4,38 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

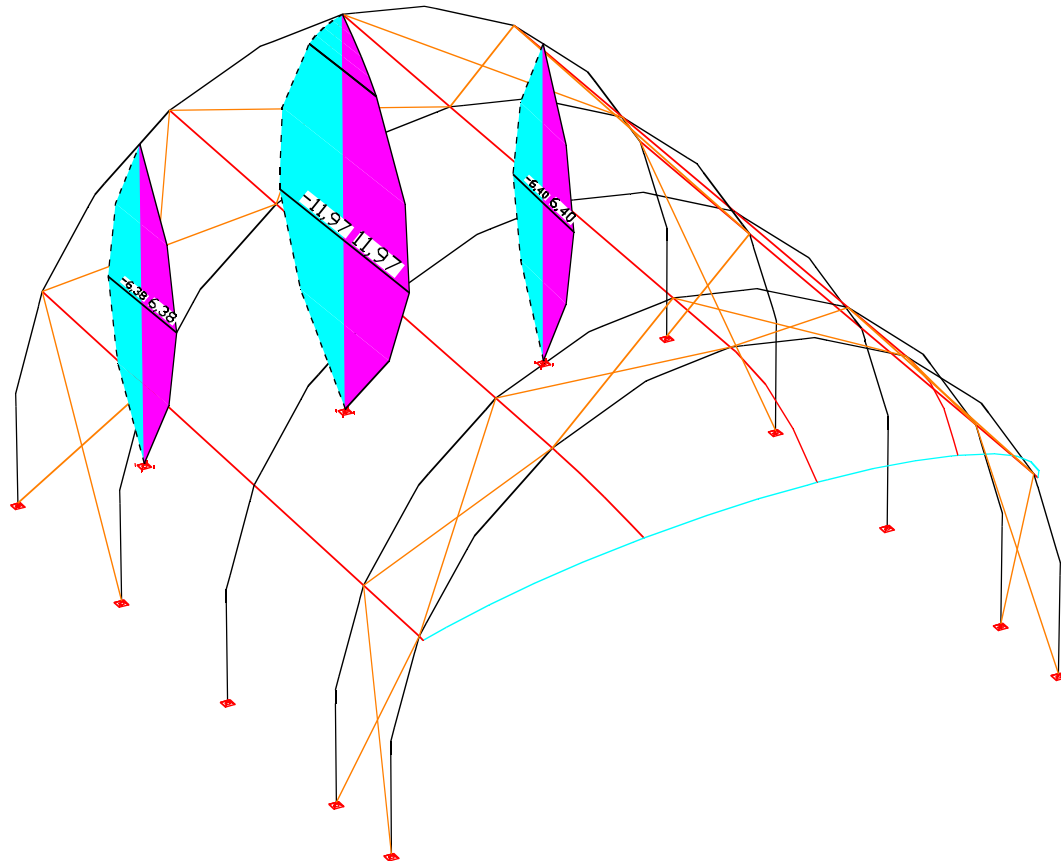


LCC 93: out of service
 Internal forces min,max Qz [kN]
 Value range (overall system, min/max): -15,11/15,82 [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

4.4 PROOFS

The internal forces are similar or smaller than the forces in chapter 2
 Only the connector of the keder profiles will be checked.



LCC 91: in service
 Selected Internal forces min,max My [kNm]
 Value range (subsystem, min/max): -11,97/11,97 [kNm]

Connector: 120x80x3 S235

$$W_{\text{plastic}} = 50 \text{ cm}^3$$

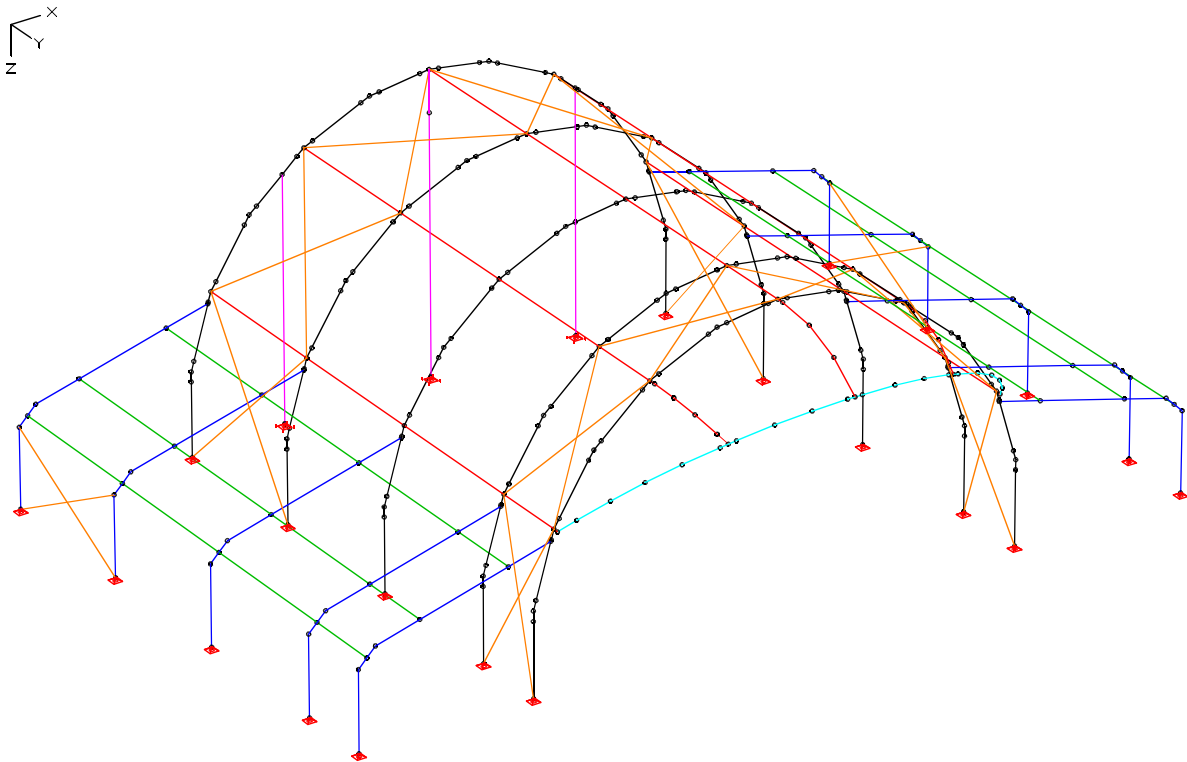
$$11,97 \times 10^3 / 50 = 239,4 \text{ MN/m}^2 \sim 235 \text{ MN/m}^2$$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

5 SYTEM 12x14m – with sidestages

Structural system

Isometric:



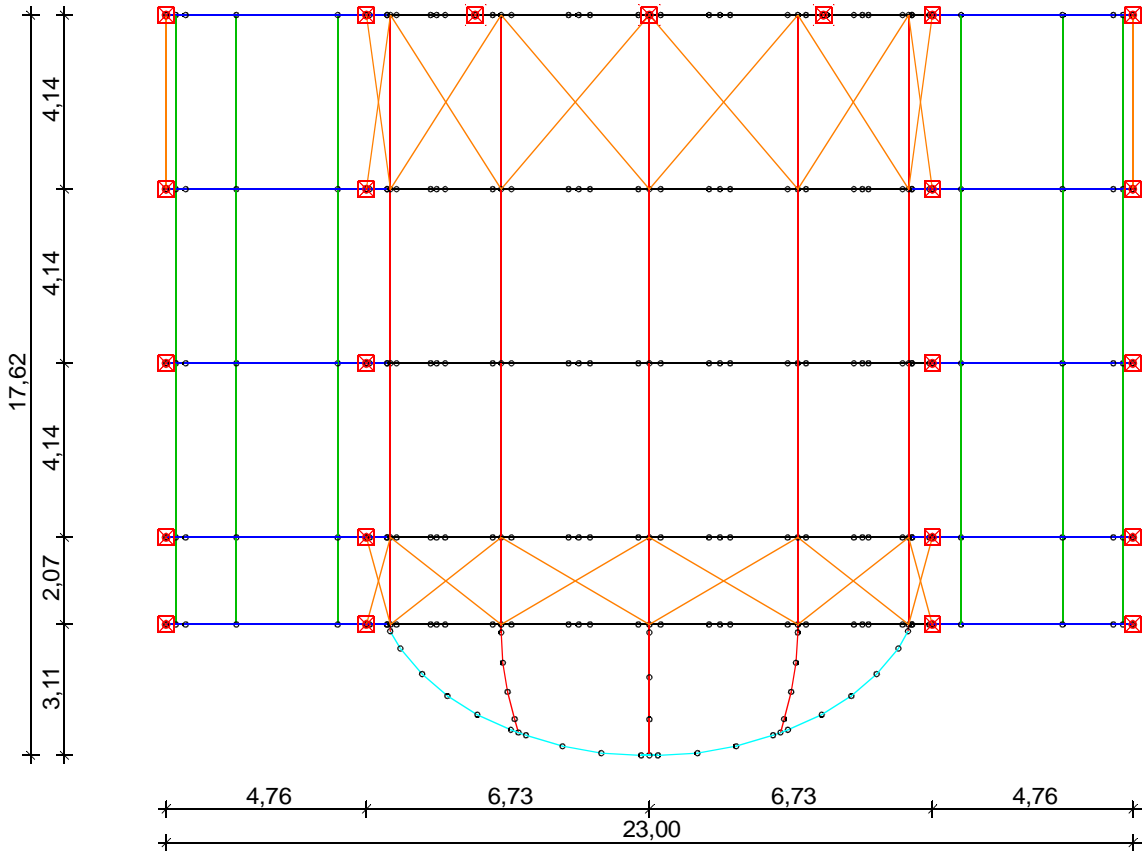
PROJECT:
TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS

PROJECT-NO.:
16079

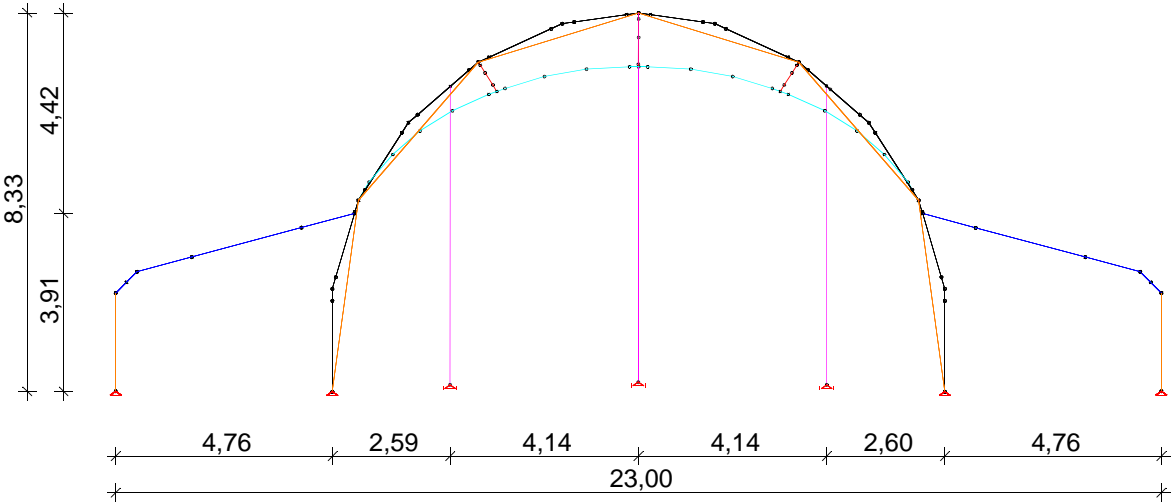
CUSTOMER/AUFTRAGGEBER:
Prolyte Group

DATE/DATUM:
10.04.2016

top view:

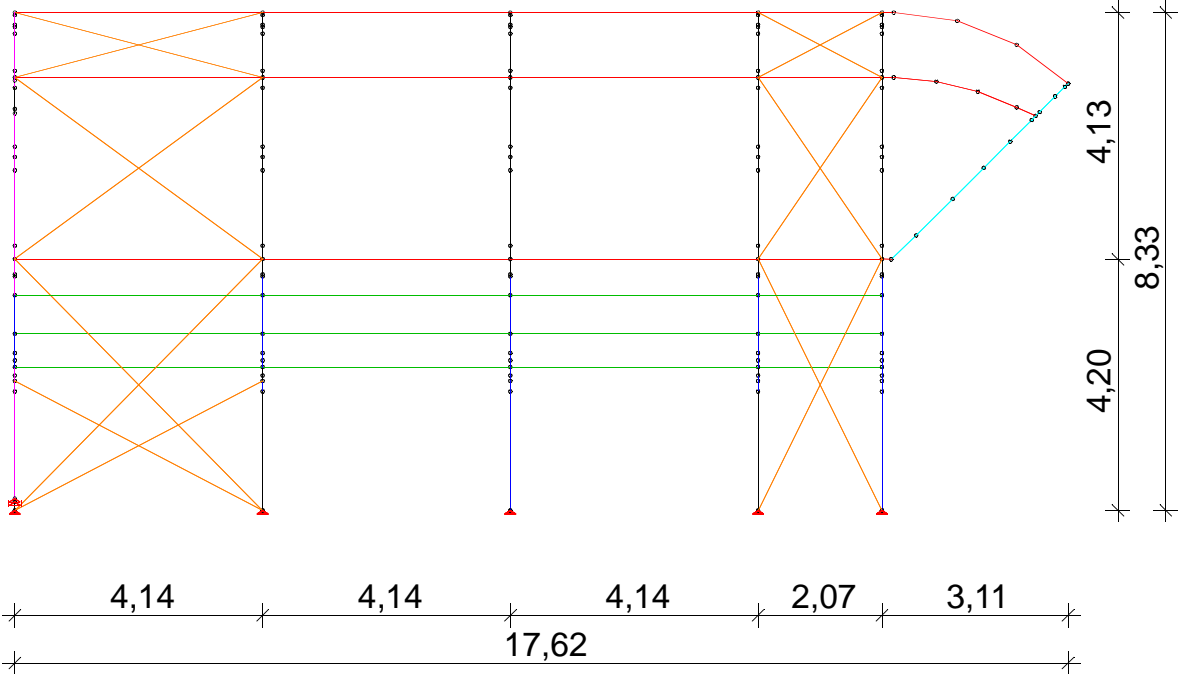


front view:



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

side view:



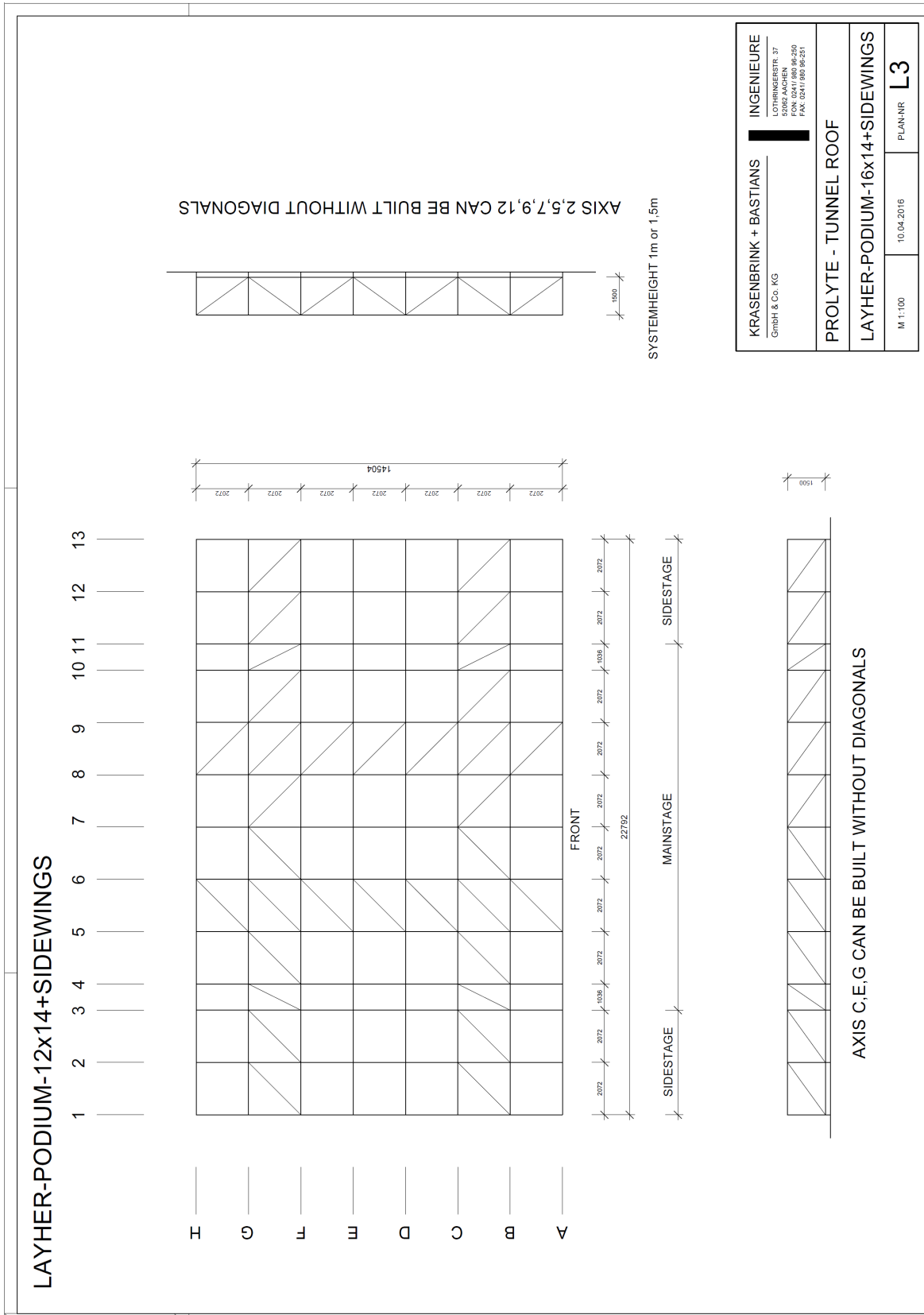
calculation and proofs the the previous chapter

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

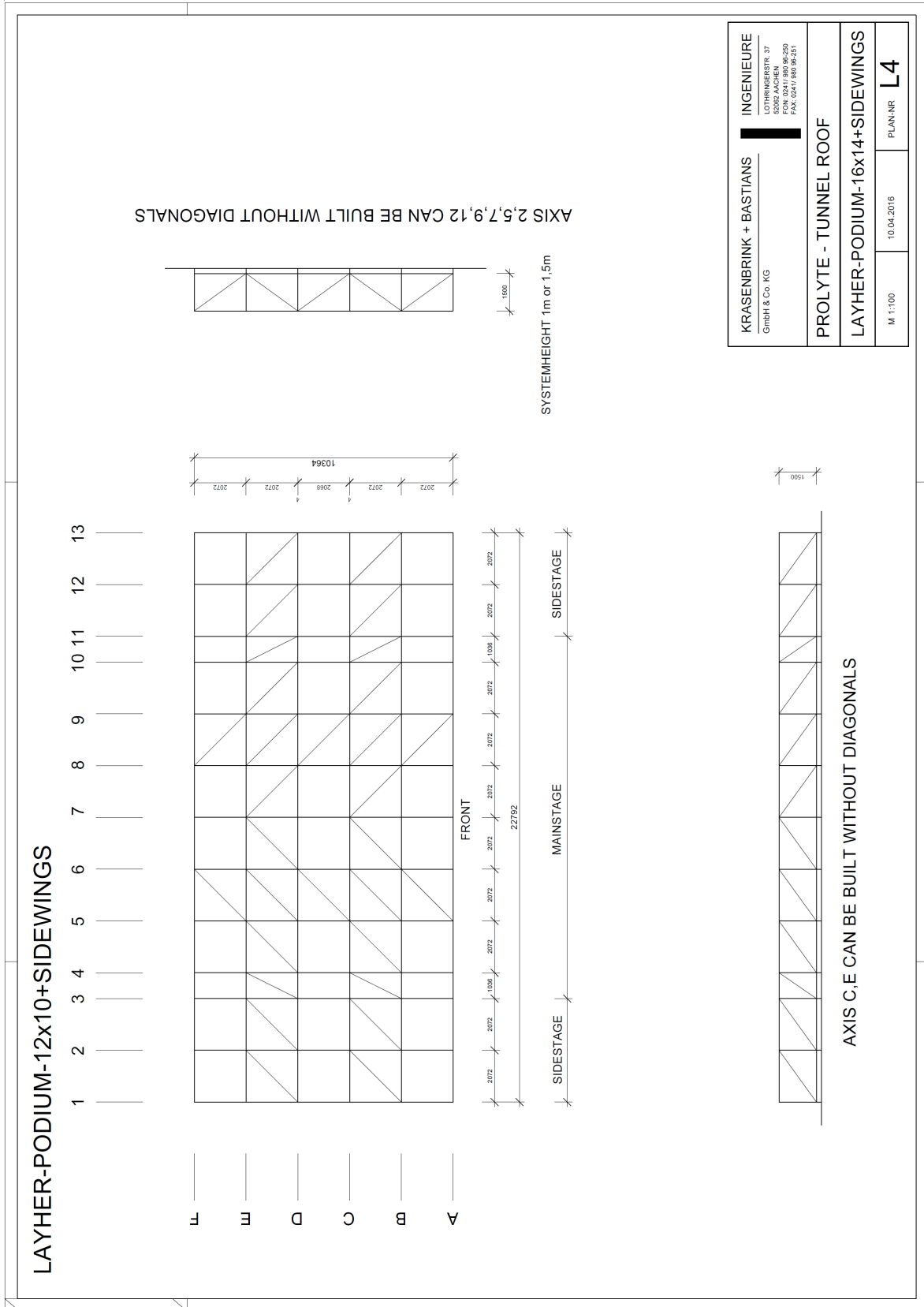
6 LAYHER PODIUM

The roof can be build up on Layher-podium with system heights of 1,0m or 1,50m.

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

diagonals:

16x14 without Sidewings

horizontal loads:

wind + $V/10$

wind on podium:

 $1,3 \times 0,44 \times 18,0 \times 1,50 = 15,44 \text{ kN}$

wind on rear wall:

41,76 kN (see chpt .2)

stabilizing load:

 $V = 5,0 \times 18,0 \times 14,5 = 1305 \text{ kN}$ $V/10 = 1305/10 = 130,5 \text{ kN}$

sum horizontal loads:

 $15,44 + 41,76 + 130,5 = 187,7 \text{ kN}$

number of diagonals:

each direction > 40

force each diagonal:

 $N = 187,7 / \cos 36^\circ / 40 = 5,80 \text{ kN}$ $N_d = 1,35 \times 5,8 = 7,83 \text{ kN} < 15,5 \text{ kN}$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

columns:

buckling is decisive:

$$\beta = 0,90$$

$$L_{cr} = 0,9 \times 1,50 = 1,35 \text{ m}$$

$$N_{cr} = (\pi^2 \times 210000 \times 1,16 \times 10^5) / (1,35 \times 10^3)^2 \times 10^{-3} = 178,09 \text{ kN}$$

$$\bar{\lambda} = \sqrt{(454,4 \times 320 \times 10^{-3}) / 178,09} = 0,904$$

KSL a: $\alpha = 0,21$

$$\phi = 0,5 \times [1 + 0,21 \times (0,904 - 0,2) + 0,904^2] = 0,983$$

$$\kappa = 1 / (0,983 + \sqrt{(0,983^2 - 0,904^2)}) = 0,73$$

$$N_{b,Rd} = 0,73 \times 454,4 \times 320 / 1,1 \times 10^{-3} = 96,50 \text{ kN}$$

$$\max N_{Ed} = 1,35 \times 2,072^2 \times 5,0 = 28,97 \text{ kN}$$

$$\eta = 28,97 / 96,50 = 0,30 < 1,0$$

no further proof

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Bearing capacities Layher system



Ultimate capacities

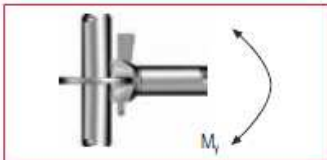
Stress capacity values* of the Allround ledger and the diagonal brace.

Z-8.22-64: K 2000+



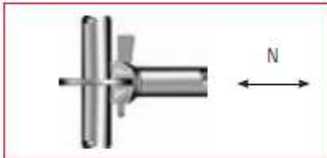
$M_{x,Rd} = \pm 52.9 \text{ kNcm}$

Connection moment



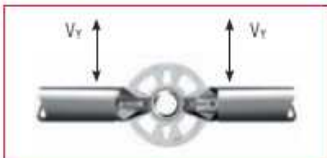
Connection moment
 $M_{y,Rd} = \pm 101.0 \text{ kNcm}$

Normal force

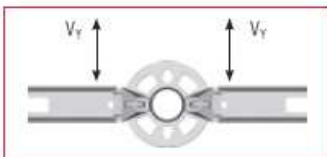


$N_{Rd} = \pm 31.0 \text{ kN}$

Horizontal force

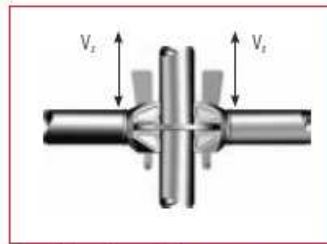


O-ledger: $V_{y,Rd} = \pm 10.0 \text{ kN}$



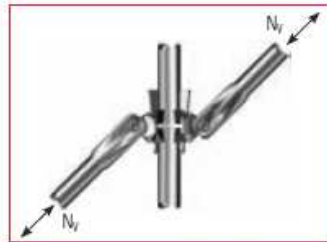
U-ledger: $V_{y,Rd} = \pm 5.9 \text{ kN}$

Vertical force



Vertical shear force single connection
 $V_{z,Rd} = \pm 26.4 \text{ kN}$
Vertical shear force per rosette
 $\Sigma V_{z,Rd} = \pm 105.6 \text{ kN}$

Axial force, diagonal brace



Normal force in the vertical diagonal brace for a bay height of 2.0 m for K 2000+:

Bay length [m]	Compression								Tension
	0.73	1.08	1.40	1.57	2.07	2.57	3.07	4.14	all bay lengths
$N_{y,Rd}$ [kN]	-16.6	-16.8	-15.5	-14.7	-12.4	-10.2	-8.4	-5.3	+17.9

The K 2000+ connector can be combined with the connector of Variant II. Higher stress capacities as per approval.

Normal force in the vertical diagonal brace for a bay height of 2.0 m for Variant II:

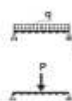
Bay length [m]	Compression								Tension
	0.73	1.08	1.40	1.57	2.07	2.57	3.07	4.14	all bay lengths
$N_{y,Rd}$ [kN]	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-8.4	-5.3	+8.4

When K 2000+ is used with Variant II, higher stress capacities are approved.

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Approved load bearing capacities

Z-8.22-64: K 2000+, steel, values are permissible loads.



Tab. 1 Load bearing capacity of ledgers

Bay length [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Evenly distributed load (q) [kN/m]	22.07	10.44	6.54	5.26	3.12	2.06	1.46
Point load (P) in the middle of the bay [kN]	7.43	5.21	4.17	3.77	2.96	2.42	2.06

Tab. 2 Load bearing capacity of diagonal braces, K 2000+

Bay width [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Diagonal brace Load capacity max. D [kN]	+11.93 - 11.1	+11.93 - 11.2	+11.93 - 10.33	+11.93 - 9.8	+11.93 - 8.3	+11.93 - 6.8	+11.93 - 5.6

Variant II, steel



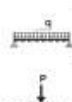
Tab. 3 Load bearing capacity of ledgers

Bay length [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Evenly distributed load (q) [kN/m]	22.07	8.81	4.63	3.48	1.79	1.07	0.70
Point load (P) in the middle of the bay [kN]	7.43	5.21	4.13	3.51	2.40	1.80	1.40

Tab. 4 Load bearing capacity of diagonal braces


Bay width [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07
Diagonal brace Load capacity max. D [kN]	± 5.6	± 5.6	± 5.6	± 5.6	± 5.6	± 5.6	± 5.6

K 2000+, also Variant II




Tab. 5 Load bearing capacity of U-transom (U), ledger, reinforced (V), round ledger (O)

Type of ledger and length [m]	U 0.73	U-V 1.09	U-V 1.40	O-V 1.09	O-V 1.28
Evenly distributed load (q) [kN/m]	19.01	17.34	10.42	21.82	15.56
Point load (P) in the middle of the bay [kN]	6.10	8.76	6.84	11.00	9.34



Tab. 6 Load bearing capacity of U-bridging ledgers

Type of bridging ledger [m]	1.57	2.07	2.57	3.07
Evenly distributed load (q) [kN/m]	15.16	8.65	5.12	3.59
Point load (P) in the middle of the bay [kN]	7.97	6.92	5.25	5.24



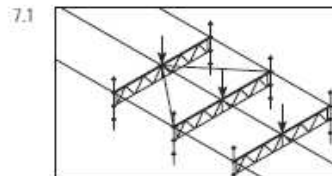
Tab. 7 Load bearing capacity of U-lattice beams, K 2000+

Length [m]	2.07	2.57	3.07	4.14	5.14	6.14
Evenly distributed load (q) [kN/m]**	17.3	12.5	10.2	7.3	5.2	4.3
Point load (P) in the middle of the bay [kN]**	25.1	26.6	8.2 ¹⁾ 19.5 ²⁾	16.2	15.9	10.9

¹⁾ Single point load exactly in the middle of the beam (= between the two middle posts)

²⁾ Single point load above one of the middle posts

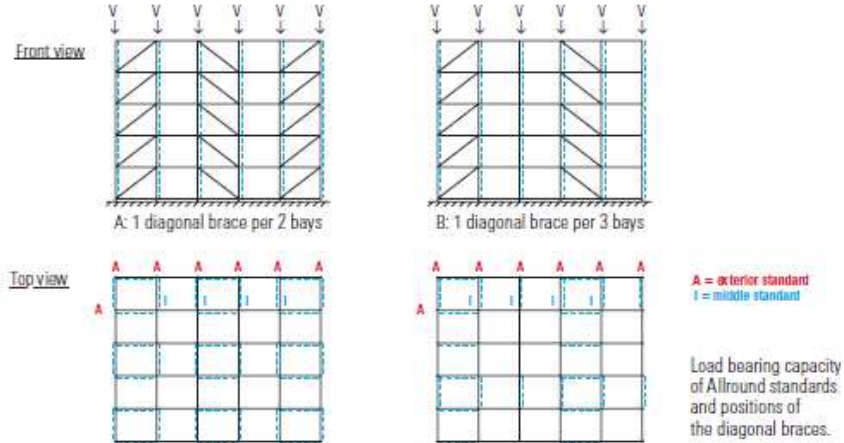
- * U-lattice beams completely covered with decking elements, secured with lock against lift-off.
- ** U-lattice beams completely covered with decking elements, secured with lock against lift-off. Alternatively the top chords of the beams – except U-lattice beam 2.57 m – can be braced by a bracing structure from tubes and couplers, connected to the posts of the beams.
Example: bracing of the U-lattice beam 4.14 m, as per drawing 7.1



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Load bearing capacity of Allround standards

Permissible loads for K 2000+ and Variant II.



Load bearing capacity of Allround standards
(The values are permissible loads)

Height of lift: 2 m
A = 1 diagonal brace per 2 bays
B = 1 diagonal brace per 3 bays

1. Erection with adjustable base plate 80 (Ref.: 4002.080)

- max. spindle extension: $h \leq 25$ cm
- with scaffold brace to base of spindle in the diagonal bays



Tab. 8 Middle standard												
Bay width [m]	0.73	1.09	1.57	2.07	2.57	3.07	Positioning of diagonal braces		A	B	A	B
max. vertical load V_i [kN]	33.9	29.6	43.5	38.9	45.7	43.1	45.9	43.8	45.4	43.7	44.8	43.2

2. Erection with adjustable base plate 60 (Ref.: 4001.060) (max. $h \leq 5$ cm)

- or
Erection with base plate (Ref.: 4001.000)



Tab. 9 Exterior standard												
Bay width [m]	0.73	1.09	1.57	2.07	2.57	3.07	Positioning of diagonal braces		A	B	A	B
max. vertical load V_i [kN]	33.9	29.6	40.8	38.9	40.3	39.5	39.5	39.0	39.5	38.1	38.1	37.7

3. Erection with adjustable base plate 60 (Ref.: 4001.060)

- max. spindle extension: $h \leq 25$ cm
- with scaffold brace to base of spindle in the diagonal bays



Tab. 10 Middle standard												
Bay width [m]	0.73	1.09	1.57	2.07	2.57	3.07	Positioning of diagonal braces		A	B	A	B
max. vertical load V_i [kN]	34.0	29.6	43.3	38.9	45.4	43.0	45.4	43.8	44.7	43.6	43.9	43.0

Tab. 11 Exterior standard												
Bay width [m]	0.73	1.09	1.57	2.07	2.57	3.07	Positioning of diagonal braces		A	B	A	B
max. vertical load V_i [kN]	34.0	29.6	41.0	38.9	40.6	39.8	39.7	39.3	38.8	38.6	38.1	37.9

Tab. 12 Middle standard												
Bay width [m]	0.73	1.09	1.57	2.07	2.57	3.07	Positioning of diagonal braces		A	B	A	B
max. vertical load V_i [kN]	33.9	29.6	39.0	34.8	41.6	37.7	43.0	39.2	43.7	40.3	43.7	40.8

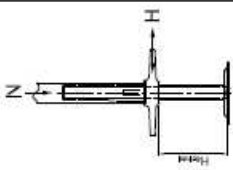
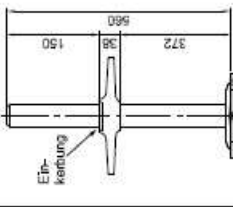
Tab. 13 Exterior standard												
Bay width [m]	0.73	1.09	1.57	2.07	2.57	3.07	Positioning of diagonal braces		A	B	A	B
max. vertical load V_i [kN]	33.9	29.6	39.0	34.8	40.3	37.7	39.3	38.7	38.4	37.8	37.7	37.2

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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17.01.2013

Zulässige Belastung von Layher Gerüstspindeln

Fußspindel 60 (Art.-Nr. 4001.060)

	<p>Skizze max. Ausspindelungslänge</p> 	<p>Ersatzquerschnittswerte des Gewindes</p> <p>A = 3,84 cm² W_d = 2,61 cm³ 1,25 W_d = 3,26 cm³ W_{sp} = 3,26 cm³ I = 3,74 cm⁴</p> <p>Material: EN 10210 - S235JRH → Rollgewinde: f_{yk} = 280 N/mm²</p>
---	--	---

Ausspindelungslänge H _{Spindel} [cm]	zulässige Vertikallast N [kN]* bei gleichzeitiger Wirkung einer Horizontallast H														zulässige Horizontallast H [kN] wenn N = 0
	H = 0,5 kN	H = 1,0 kN	H = 1,5 kN	H = 2,0 kN	H = 2,5 kN	H = 3,0 kN	H = 3,5 kN	H = 4,0 kN	H = 4,5 kN	H = 5,0 kN	H = 5,5 kN	H = 6,0 kN	H = 6,0 kN	H = 6,0 kN	
0	41	41	40	40	39	39	38	38	37	37	36	36	36	35	26,3
5	40	40	39	38	37	36	35	34	33	32	31	30	30	30	7,8
10	39	38	37	36	34	33	30	29	28	26	25	-	-	-	4,6
15	38	36	35	33	31	29	27	24	-	-	-	-	-	-	3,2
20	36	34	32	29	27	-	-	-	-	-	-	-	-	-	2,5
25	34	31	28	23	-	-	-	-	-	-	-	-	-	-	2,0
30	31	27	21	-	-	-	-	-	-	-	-	-	-	-	1,7
35	27	21	-	-	-	-	-	-	-	-	-	-	-	-	1,5
37	25	16	-	-	-	-	-	-	-	-	-	-	-	-	1,4

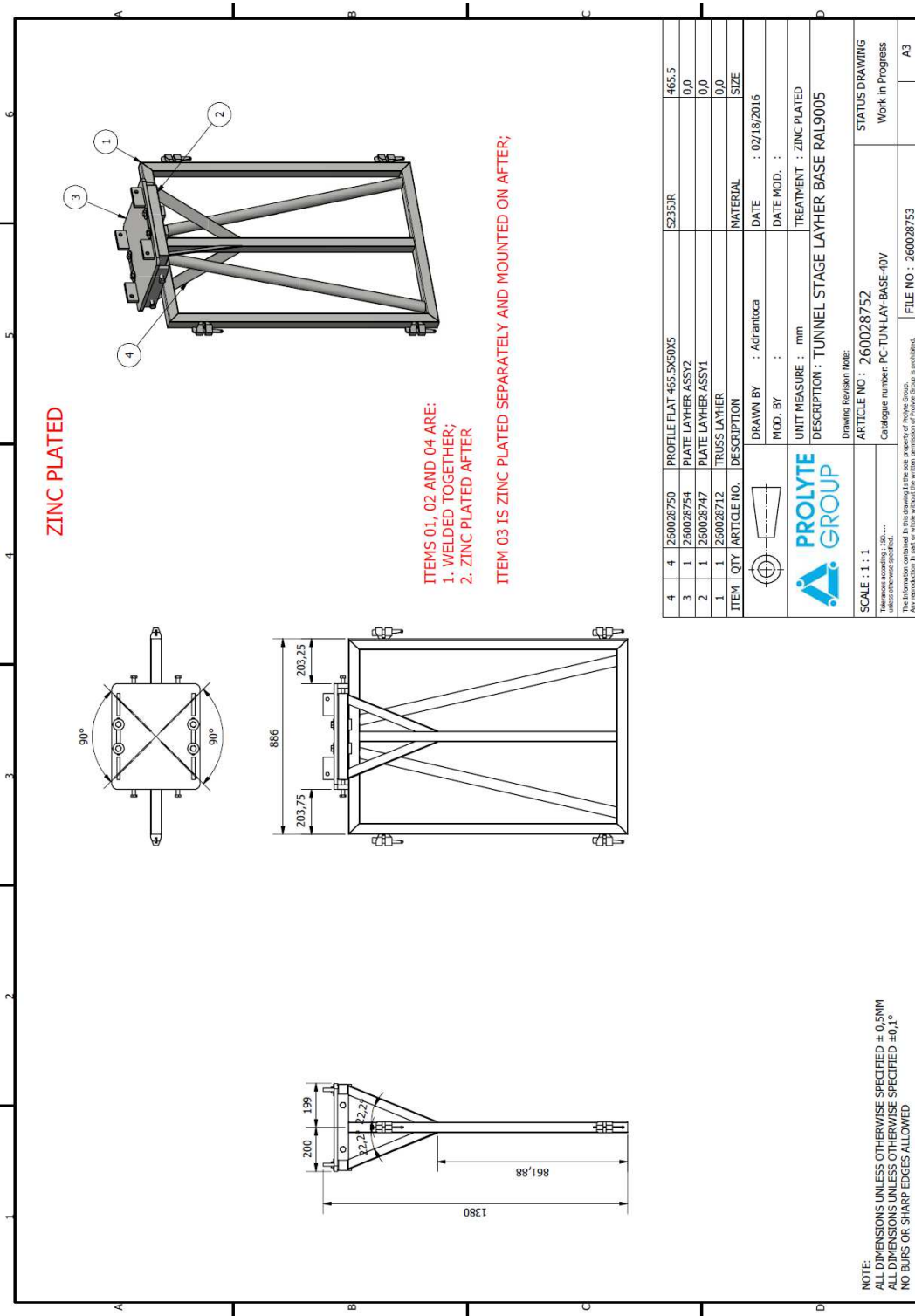
*Die zulässigen Vertikallasten wurden berechnet unter Anwendung des Berechnungsmodells nach EN 12811-1, Abs. 10.2.3.2. Zur Erfassung der Biegesteifigkeit des Ständerrohres und Anteile aus Theorie II. Ordnung wurde ein Raumgitter mit 2,0 m Lagenhöhe und 2,57 m Ständerabstand berücksichtigt.

(-) Bei dieser Kombination von Ausspindelungslänge und Horizontallast ist die Biegebeanspruchbarkeit der Spindel überschritten.

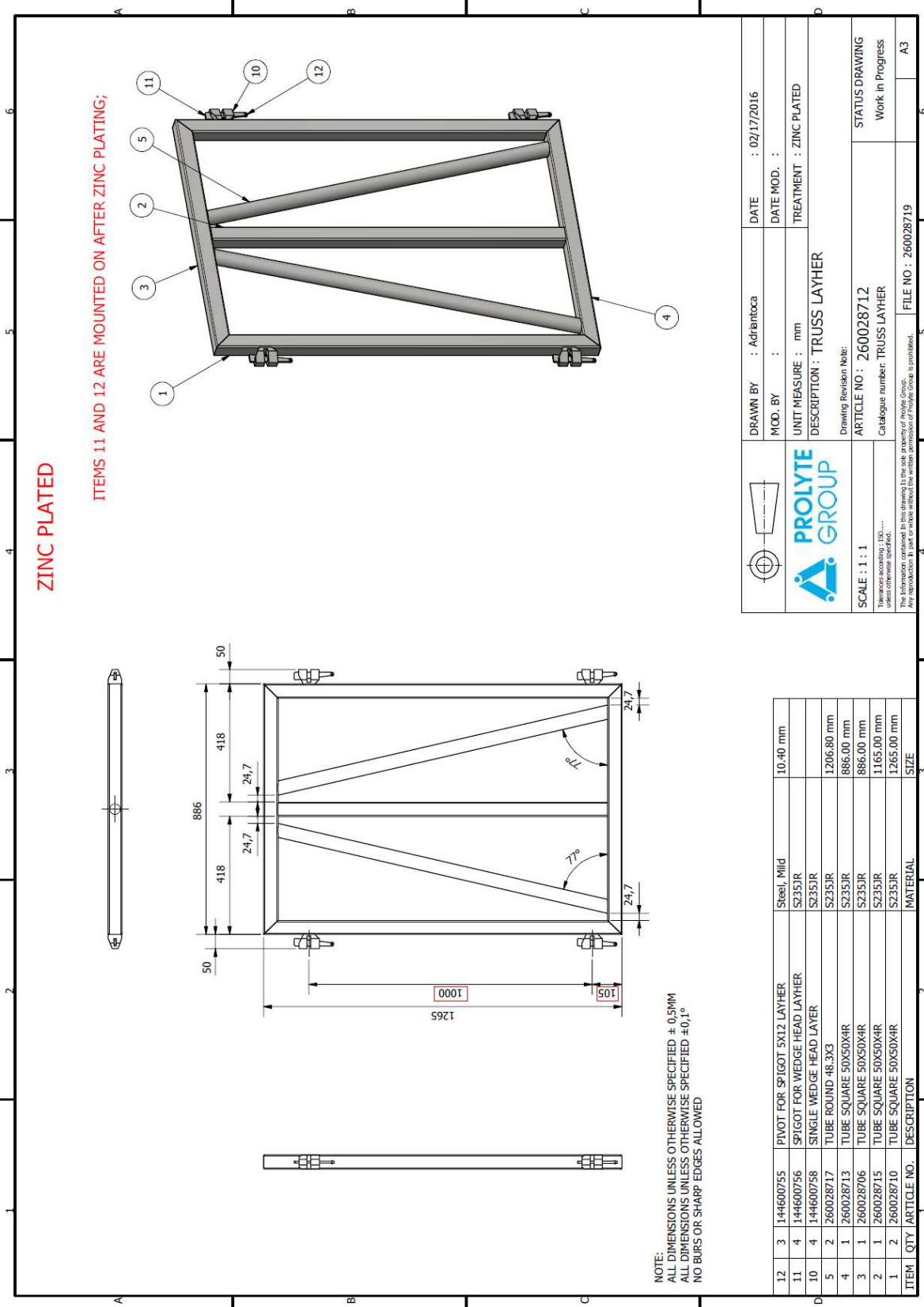
Wilhelm Layher GmbH + Co. KG, Ochsenbacher Straße 56, D-74363 Güglingen-Eibensbach

<p>PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS</p>	<p>PROJECT-NO.: 16079</p>
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Proof of the Special Layher base



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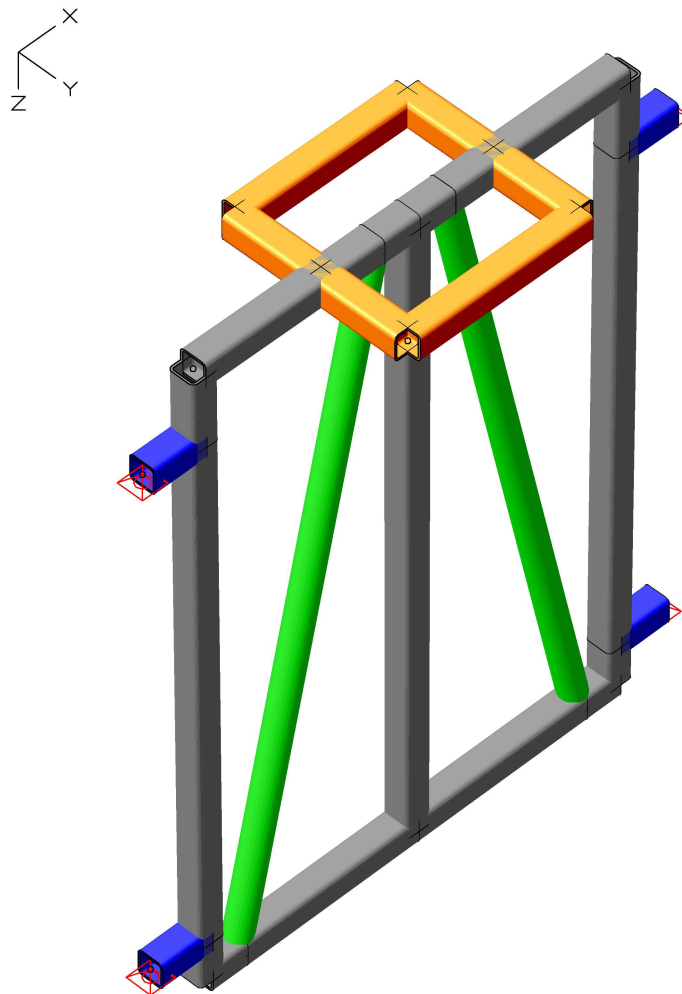


	DRAWN BY : Adriantoca	DATE : 02/17/2016
	MOD. BY :	DATE MOD. :
	UNIT MEASURE : mm	TREATMENT : ZINC PLATED
	DESCRIPTION : TRUSS LAYHER	
	Drawing Revision Note:	
	ARTICLE NO : 260028712	STATUS DRAWING
	Catalogue number: TRUSS LAYHER	Work in Progress
	FILE NO : 260028719	A3

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

maximum support reactions see chapter 7

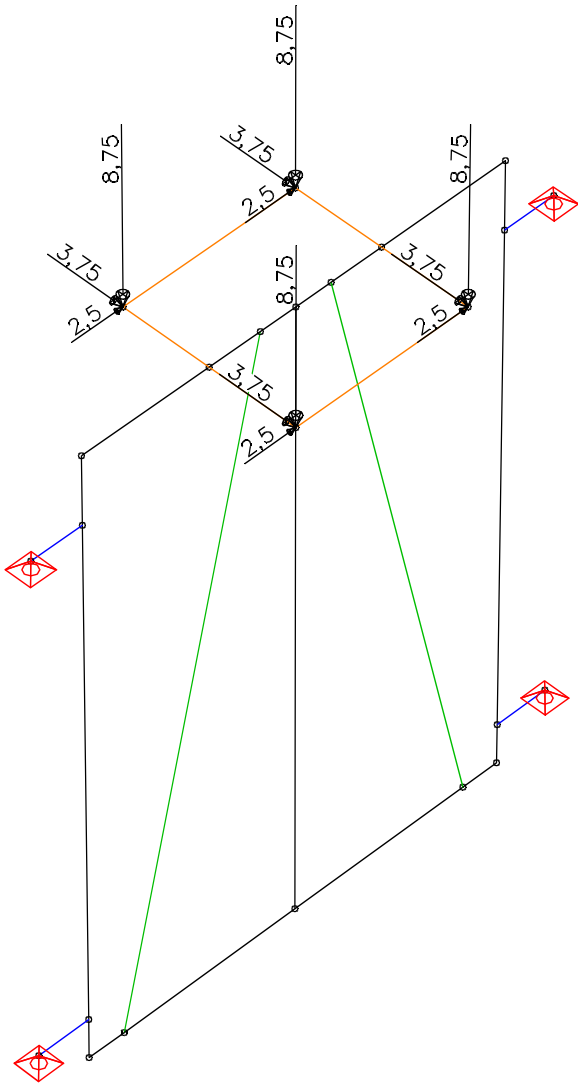
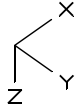
maximum values: $R_x = 8,60 \text{ kN}$
 $R_y = 14,30 \text{ kN}$
 $R_z = -34,10 \text{ kN} / 28,90 \text{ kN}$



grey, orange	50x50x4	S235
green	48,3x3	S235

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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Superposition of all maxium valus



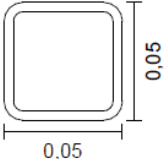
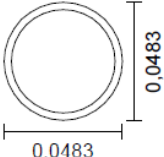
LC 1: Load, maximum

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

System characteristics

- 24 Nodes
- 29 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	Library section 	QRO 50 x 50 x 4 (EN 10219-2) Centroid [m] $y_s = 0,000$ $z_s = 0,000$ Area [m ²] $A = 6,9500e-04$ Moments of inertia [m ⁴] $I_x = 4,0420e-07$ $I_{yz} = 0,0000e+00$ $I_y = 2,3700e-07$ $I_1 = 2,3700e-07$ $I_z = 2,3700e-07$ $I_2 = 2,3700e-07$ Main axis angle [Grad] $\Phi = 0,000$
2	Library section 	RO 48,3 x 3 (EN 10219-2) Centroid [m] $y_s = 0,000$ $z_s = 0,000$ Area [m ²] $A = 4,2700e-04$ Moments of inertia [m ⁴] $I_x = 2,1900e-07$ $I_{yz} = 0,0000e+00$ $I_y = 1,1000e-07$ $I_1 = 1,1000e-07$ $I_z = 1,1000e-07$ $I_2 = 1,1000e-07$ Main axis angle [Grad] $\Phi = 0,000$

Material Properties

No.	Type	E-Modu. [MN/m ²]	GModule [MN/m ²]	alpha.t [1/K]	gamma [kN/m ³]	Miscellaneous
1	Stahl	210000	81000	1,20e-05	78,500	$f_{yk} = 240$ [MN/m ²]
2	Stahl	210000	81000	1,20e-05	78,500	$f_{yk} = 240$ [MN/m ²]

List of load cases

LC.	Label
1	maximum

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	maximum	10,000	15,000	35,000

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
	Support reactions	10,000	15,000	35,000

EN 1993-1-1 actions

Standard Bemessungsgruppe

Fd - Bemessungswerte von Einwirkungen

Load cases

1 maximum

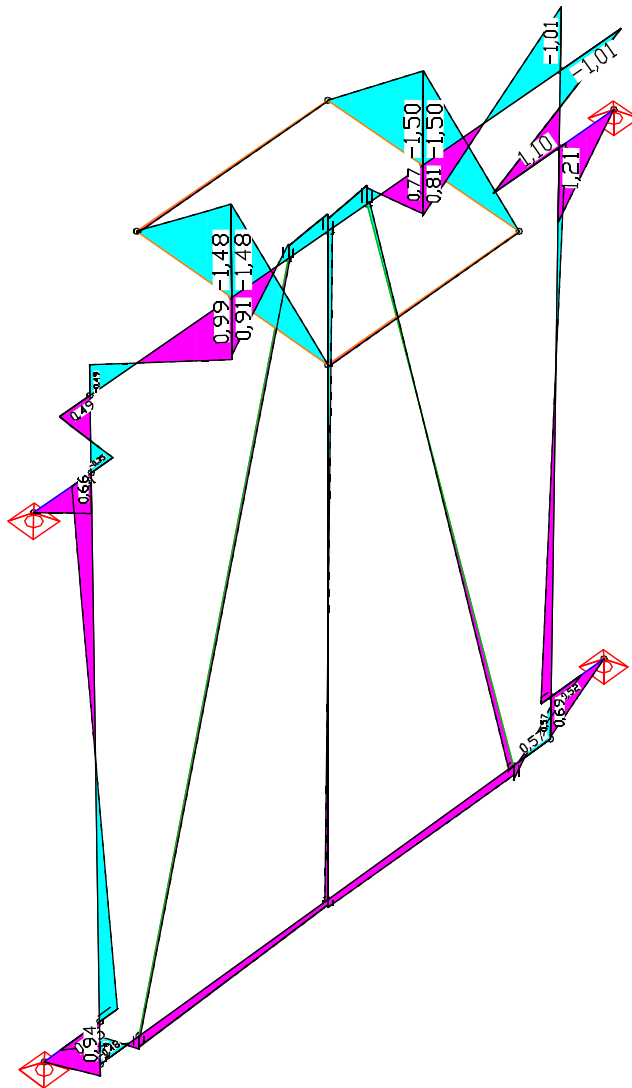
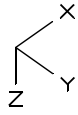
1. Permanent and temporary situation

Final state

Fd Bemessungswerte von Einwirkungen

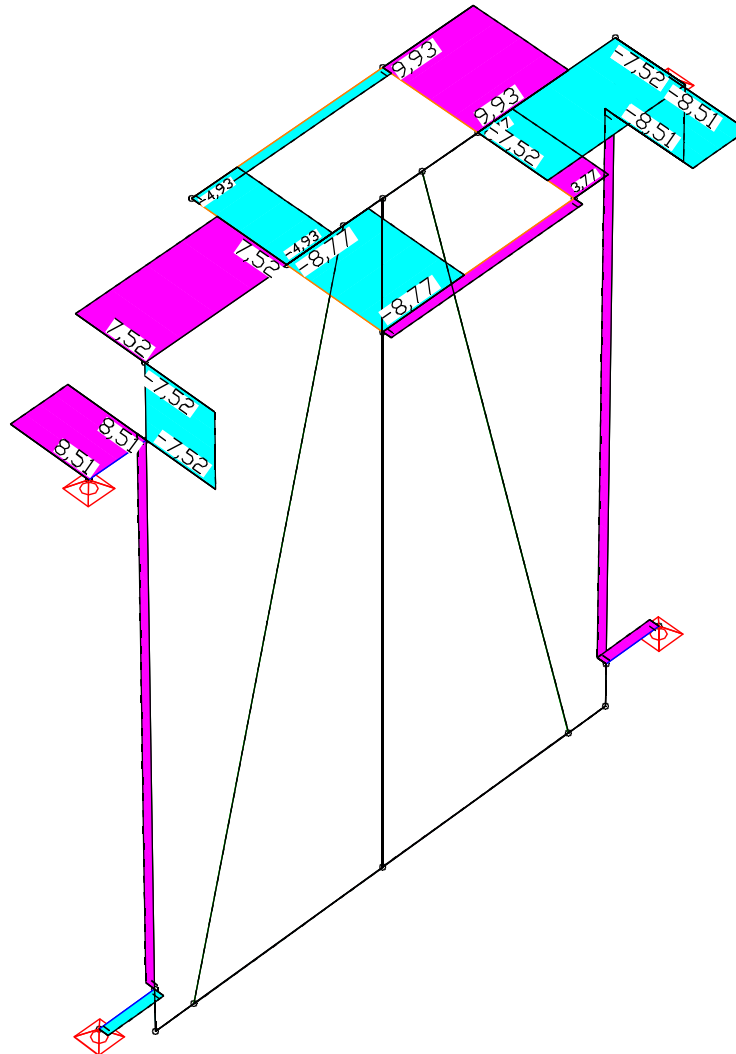
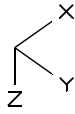
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Internal forces



LCC EN1993.SV.1: 1. Permanent and temporary situation, EN 1993-1-1
 Internal forces min,max My [kNm]
 Value range (overall system, min/max): -1,50/1,21 [kNm]

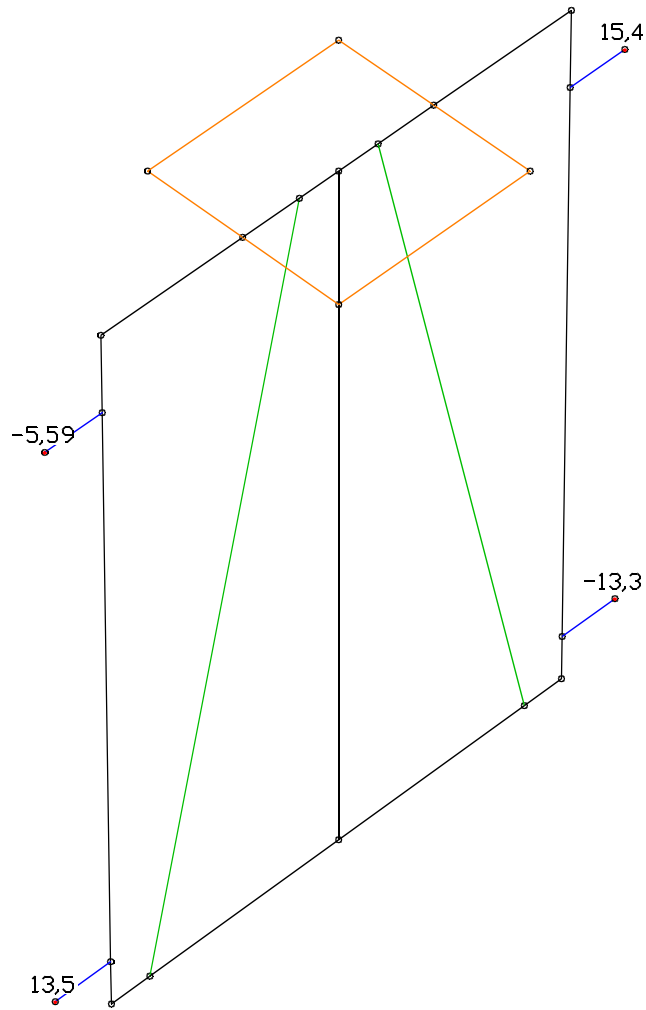
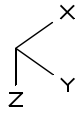
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC EN1993.SV.1: 1. Permanent and temporary situation, EN 1993-1-1
 Internal forces min,max Q_y [kN]
 Value range (overall system, min/max): $-8,77/9,93$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

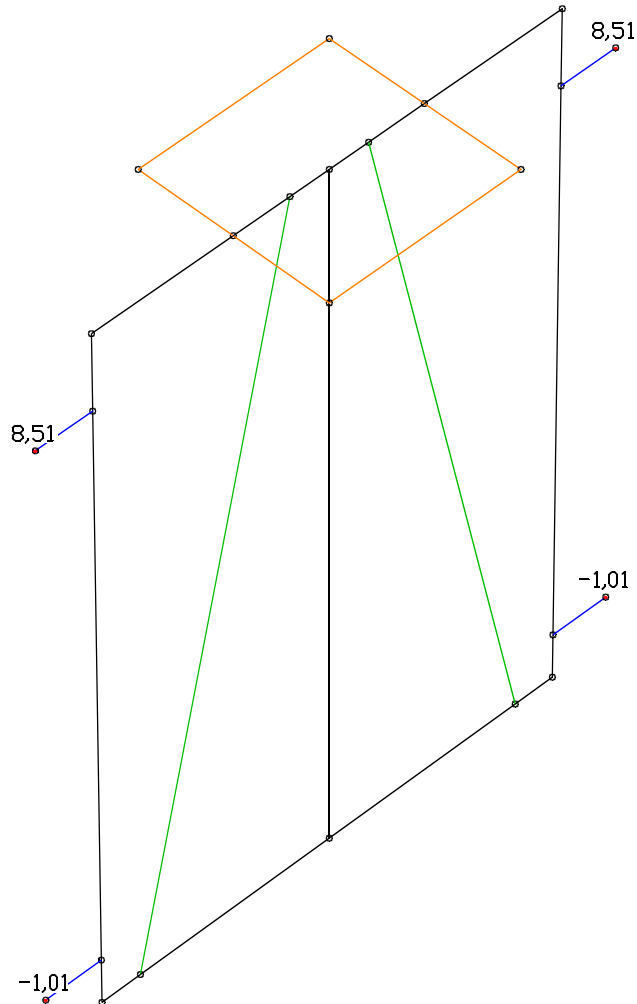
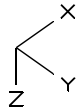
Support reactions



LC 1: maximum
 Support reactions in the local system $R_x(l)$ [kN]
 Sum in the global system $R_x(g) = 10,00$ [kN]

< 31,0 kN

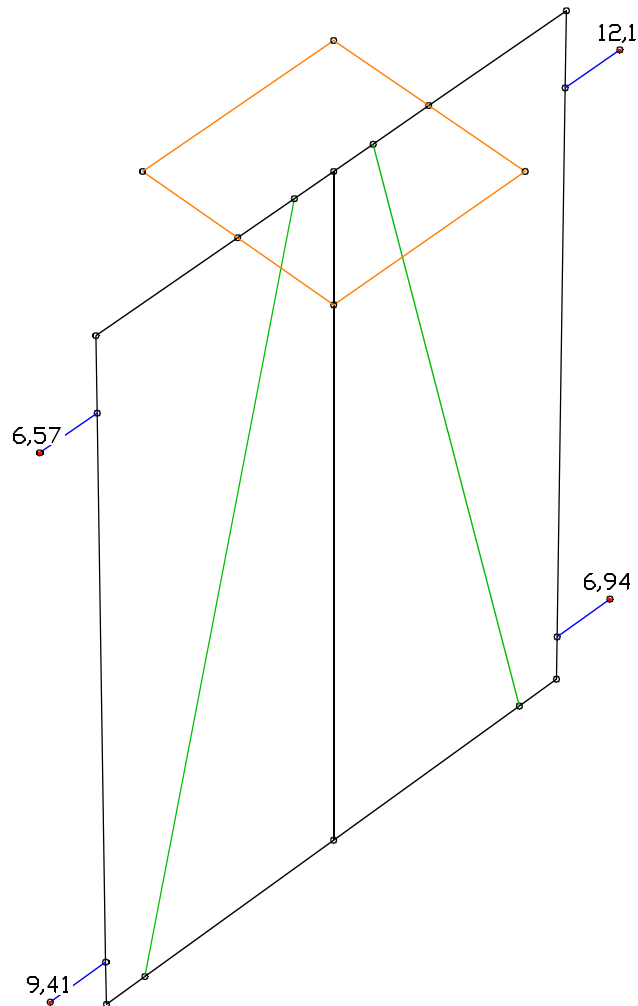
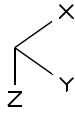
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LC 1: maximum
 Support reactions in the local system $R_y(l)$ [kN]
 Sum in the global system $R_y(g) = 15,00$ [kN]

< 10,0 kN

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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LC 1: maximum
 Support reactions in the local system $R_z(l)$ [kN]
 Sum in the global system $R_z(g) = 35,00$ [kN]

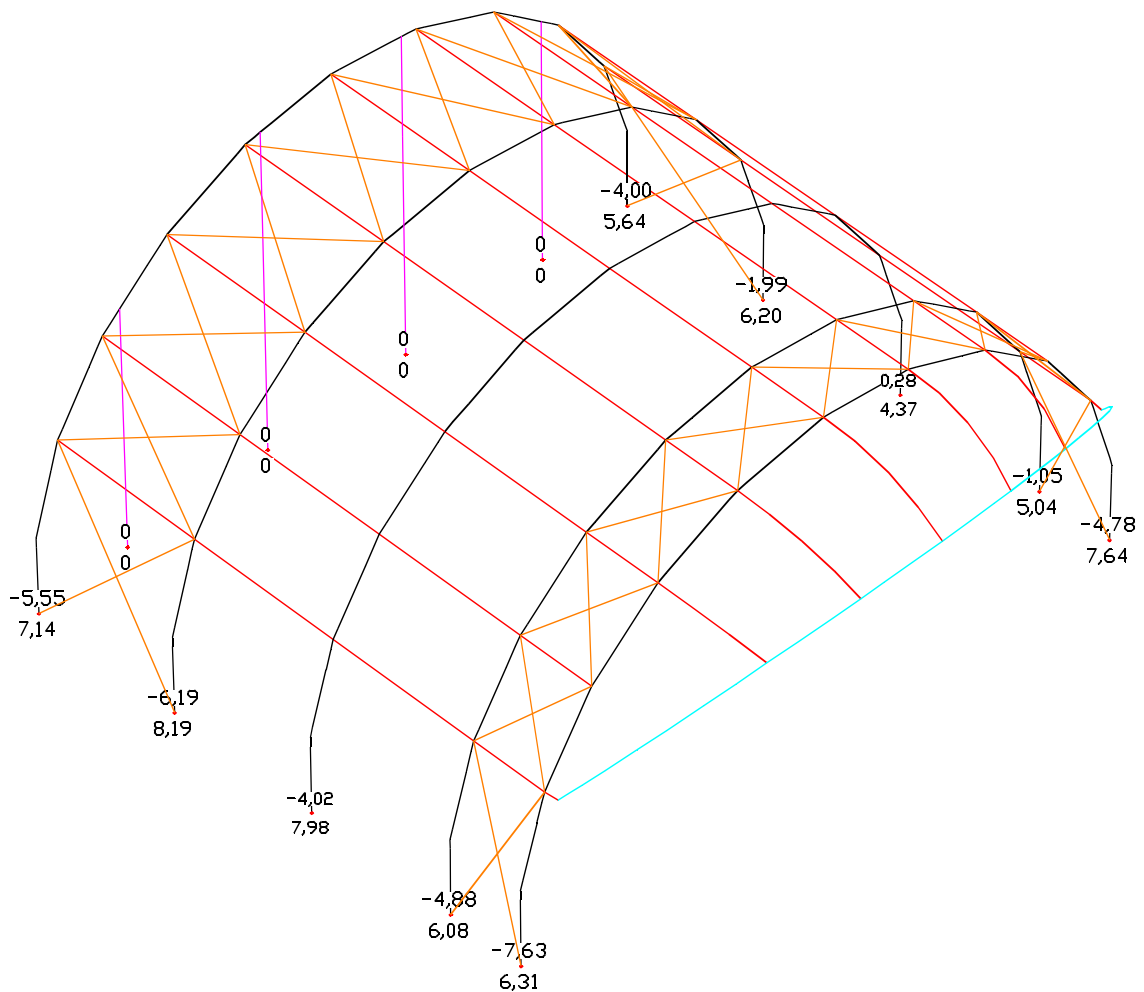
< 26,4 kN

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

7 SUPPORT REACTIONS / BALLASTLOADING

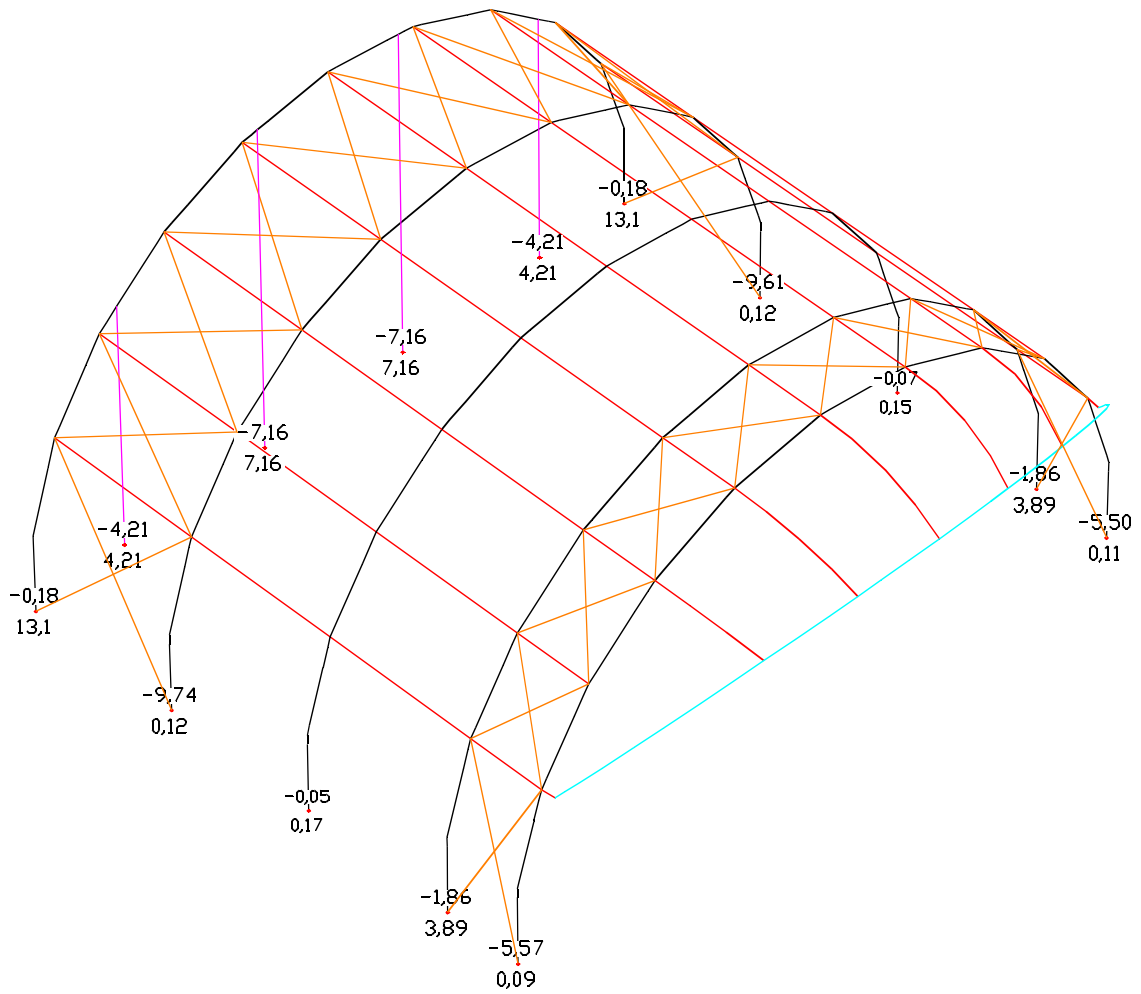
7.1 SYSTEM 16x14m / 16x10m

Support reactions



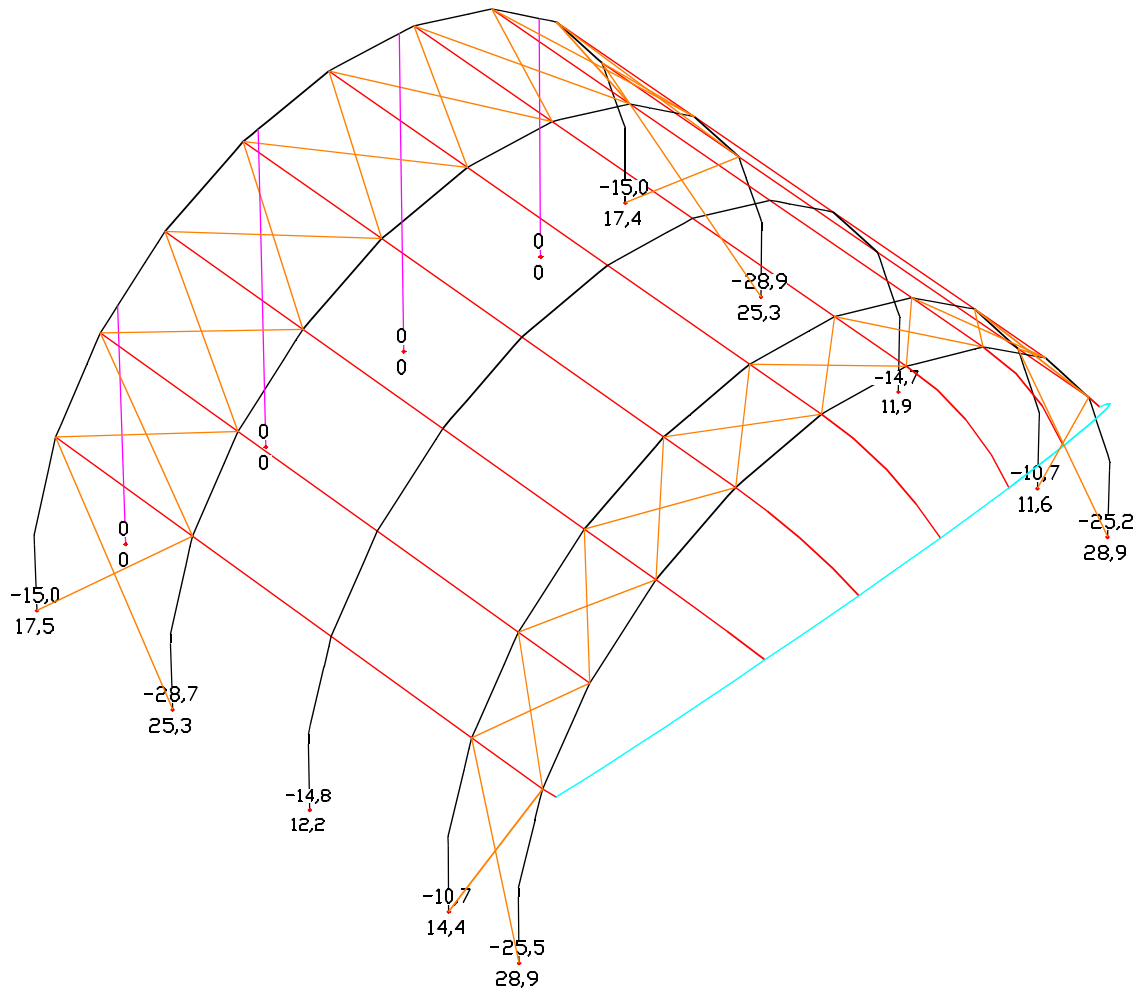
LCC 91: in service
 Support reactions in the local system min,max $R_x(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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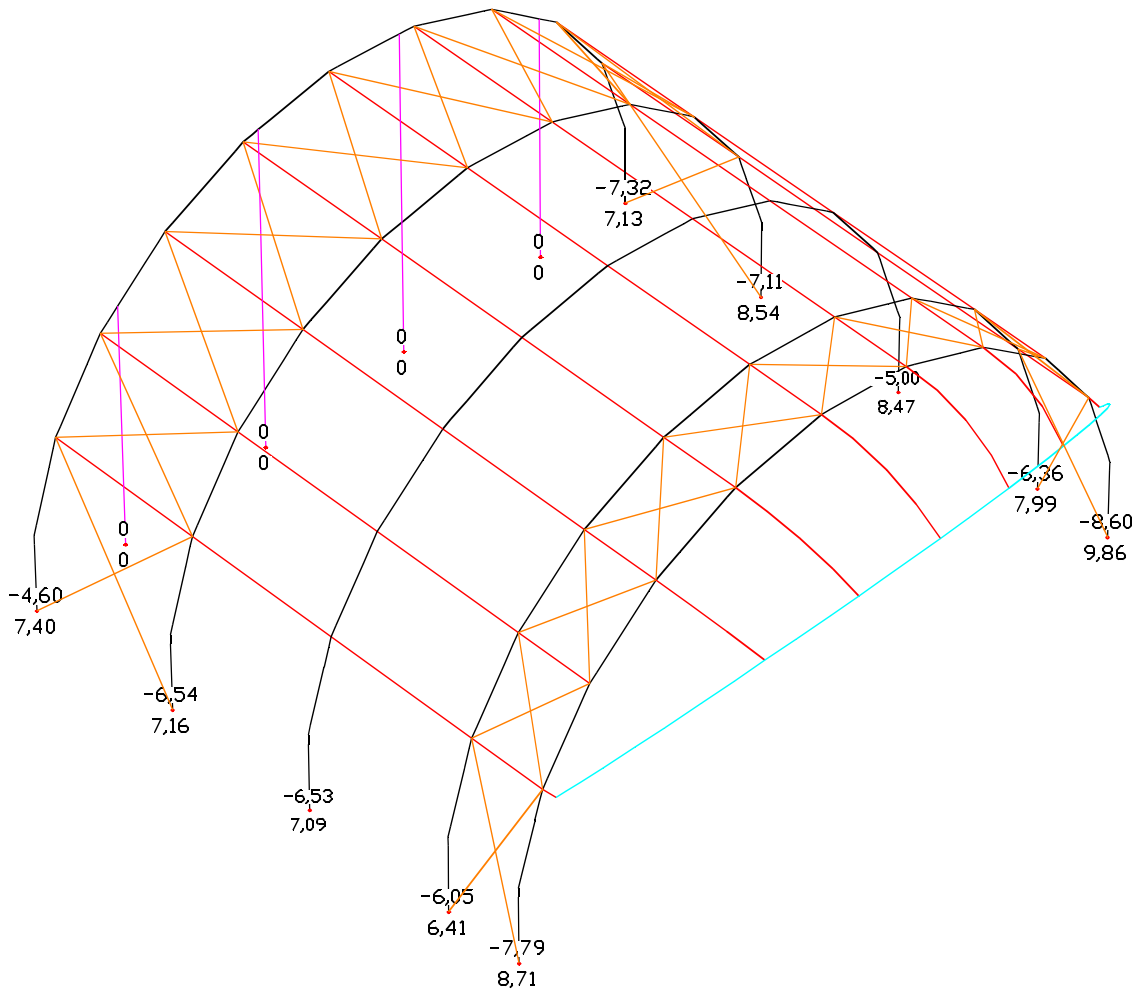
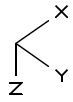
LCC 91: in service
 Support reactions in the local system min,max $R_y(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



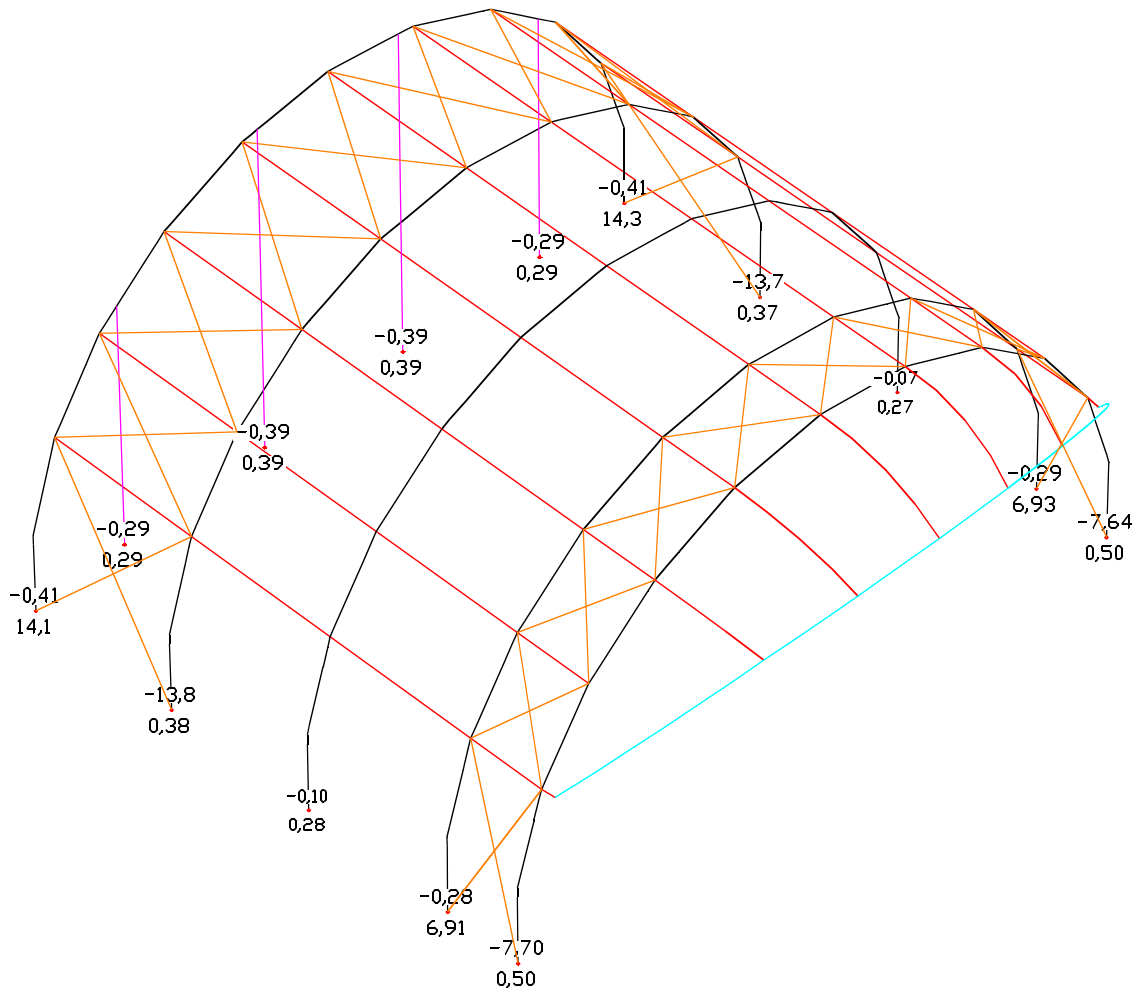
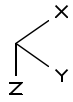
LCC 91: in service
 Support reactions in the local system min,max Rz(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Support reactions in the local system min,max $R_x(l)$ [kN]

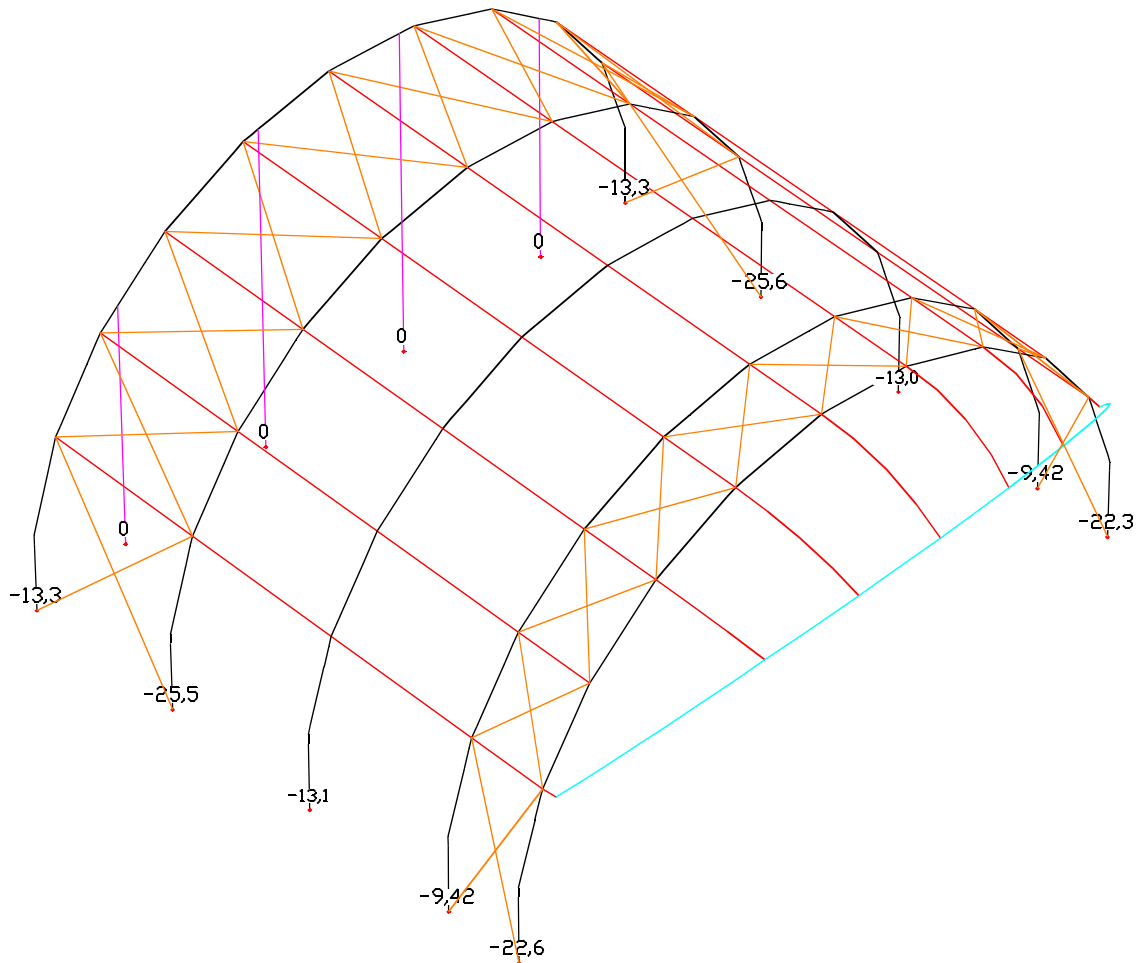
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Support reactions in the local system min,max $R_y(l)$ [kN]

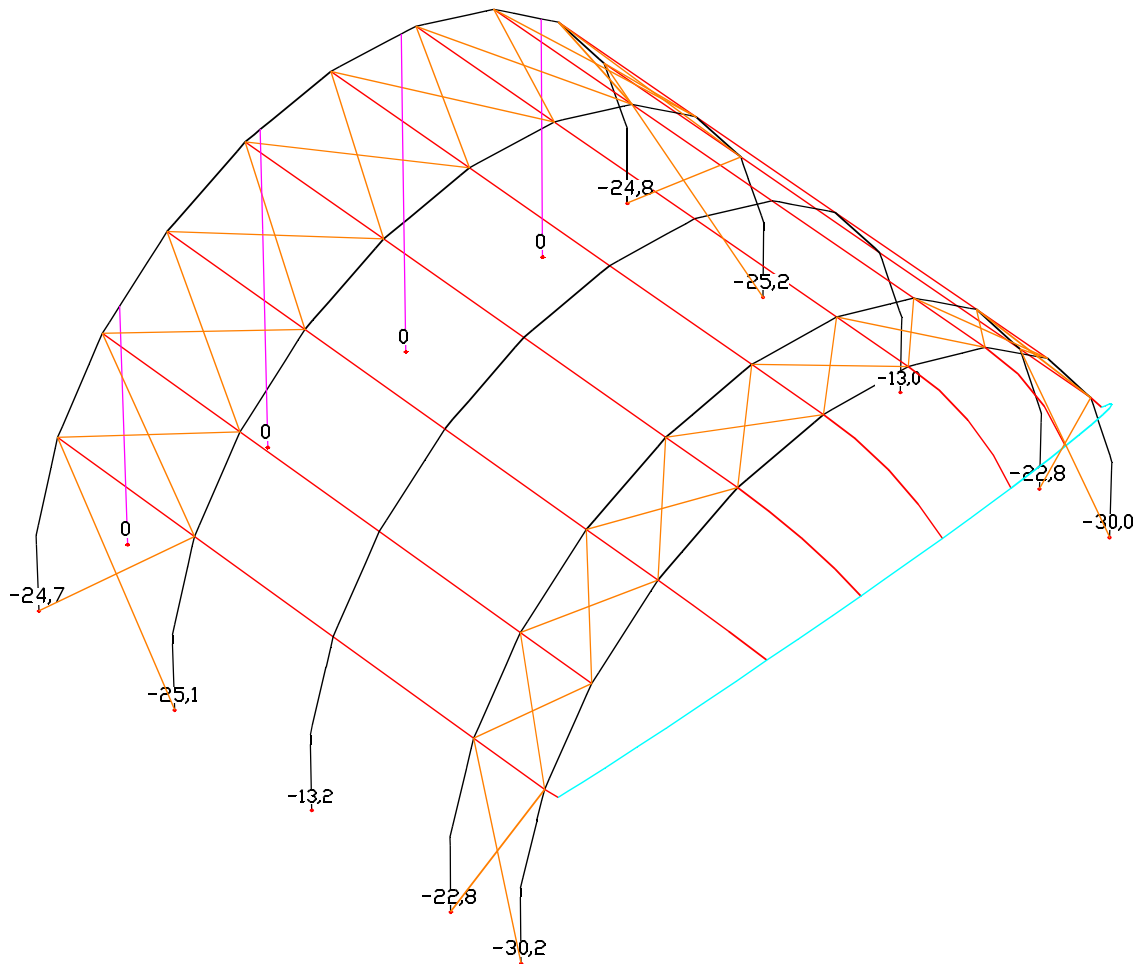
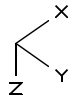
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Necessary ballast loading



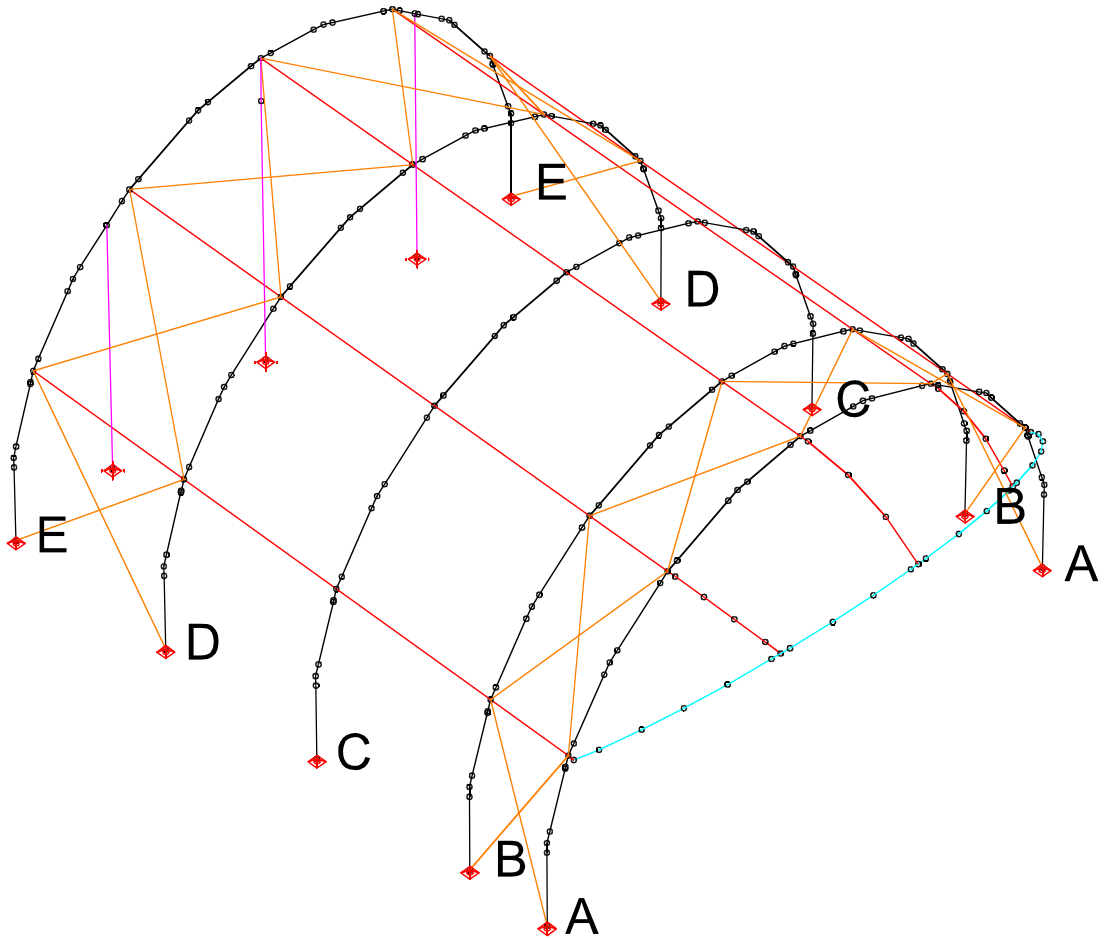
LCC 82: in service – ballast
 Support reactions in the local system min $R_z(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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LCC 84: out of service – ballast
 Support reactions in the local system min $R_z(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



- A 3000 kg
- B 2200 kg
- C 1300 kg
- D 2500 kg
- E 2500 kg

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016

Proof against sliding complete system:

Sum of installed loads and support reactions

LC.	Label	F _x [kN]	F _y [kN]	F _z [kN]
1	deadweight	0,000	0,000	22,500
	Support reactions	0,000	-0,000	22,500
2	canopy 1kg/m ²	0,000	-0,000	3,886
	Support reactions	-0,000	0,000	3,886
101	Wind β=0° - in service	0,281	-41,974	-104,613
	Support reactions	0,281	-41,974	-104,613
102	Wind β=90° - in service	32,865	0,053	-8,822
	Support reactions	32,865	0,053	-8,822
103	Wind β=180° - in service	0,022	42,048	-8,047
	Support reactions	0,022	42,048	-8,047
301	Wind β=0° - out of service	0,270	-33,650	-86,857
	Support reactions	0,270	-33,650	-86,857
302	Wind β=90°-tension - out of se	7,868	0,087	-115,809
	Support reactions	7,868	0,087	-115,809
303	Wind β=90°-tension right - out	30,711	0,044	-58,112
	Support reactions	30,711	0,044	-58,112
304	Wind β=90°-compression - out o	7,327	0,043	57,904
	Support reactions	7,327	0,043	57,904
305	Wind β=90°-compression left -	18,929	0,022	28,848
	Support reactions	18,929	0,022	28,848
306	Wind β=180° - out of service	0,270	33,780	-86,857
	Support reactions	0,270	33,780	-86,857

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Loadcase 101 is decisive: Wind of front

The wind on podium

$$\text{horizontal: } 0,20 \times 1,30 \times 18,0 \times 1,5 = 7,02 \text{ kN}$$

$$\text{vertical: } 0,20 \times 0,80 \times 18,0 \times 14,5 = 41,76 \text{ kN}$$

$$\text{Deadweight podium (45 kg/m}^2\text{): } 0,45 \times 14,5 \times 18,0 = 117,45 \text{ kN}$$

Sum horizontal loads:

$$41,97 + 7,02 = 48,99 \text{ kN}$$

Sum lifting loads:

$$104,61 - 41,76 = 62,85 \text{ kN}$$

Sum dead weight:

$$22,50 + 117,45 = 139,95 \text{ kN}$$

Sum ballast loading:

$$2 \times (25,0 + 25,0 + 13,0 + 22,0 + 30,0) = 230,00 \text{ kN}$$

$$(139,92 + 230,00 - 1,2 \times 62,85) \times 0,40 / 48,99 = 117,80 / 48,99 = 2,40 > 1,20$$

System 16x10:

$$\text{Deadweight podium; } 0,45 \times 10,50 \times 18,0 = 85,05 \text{ kN}$$

Sum dead weight:

$$22,50 + 85,05 = 107,55 \text{ kN}$$

Sum ballast loading:

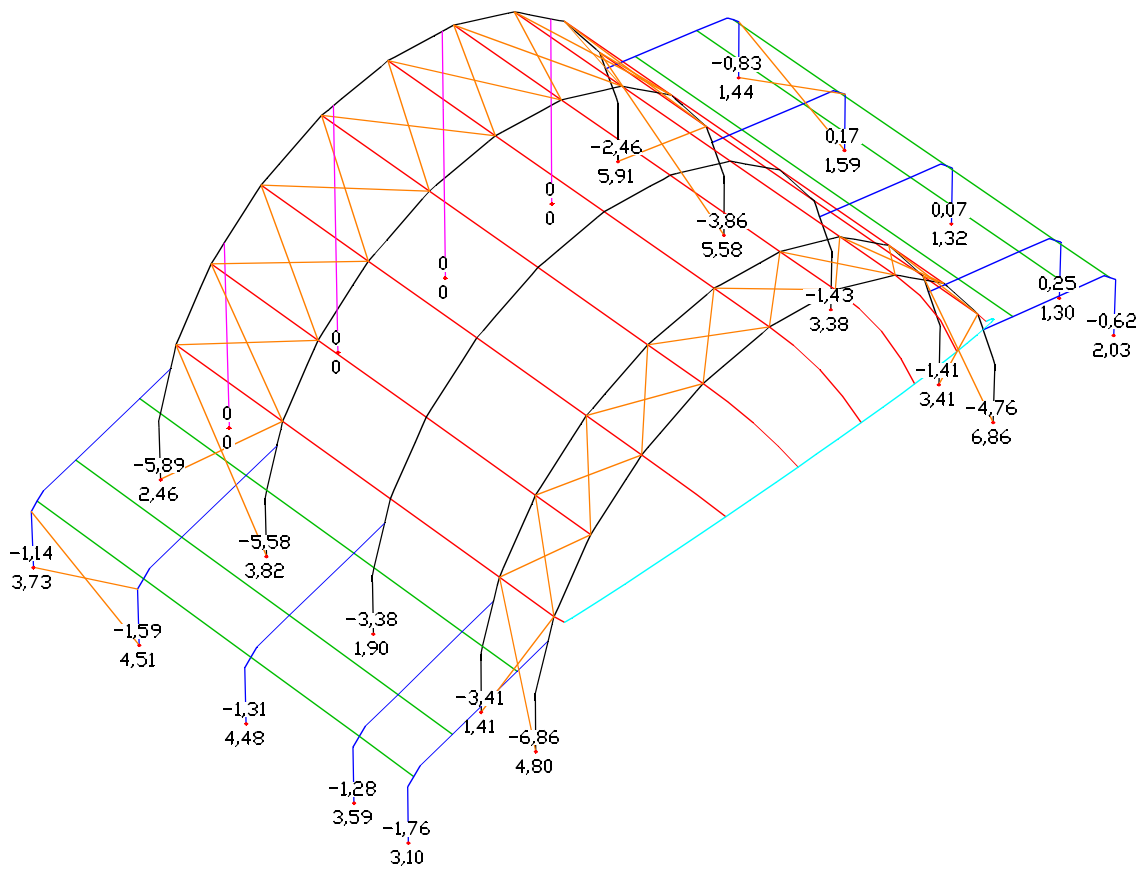
$$2 \times (25,0 + 25,0 + 22,0 + 30,0) = 204,00 \text{ kN}$$

$$(107,55 + 204,00 - 1,2 \times 62,85) \times 0,40 / 48,99 = 141,68 / 48,99 = 1,92 > 1,20$$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

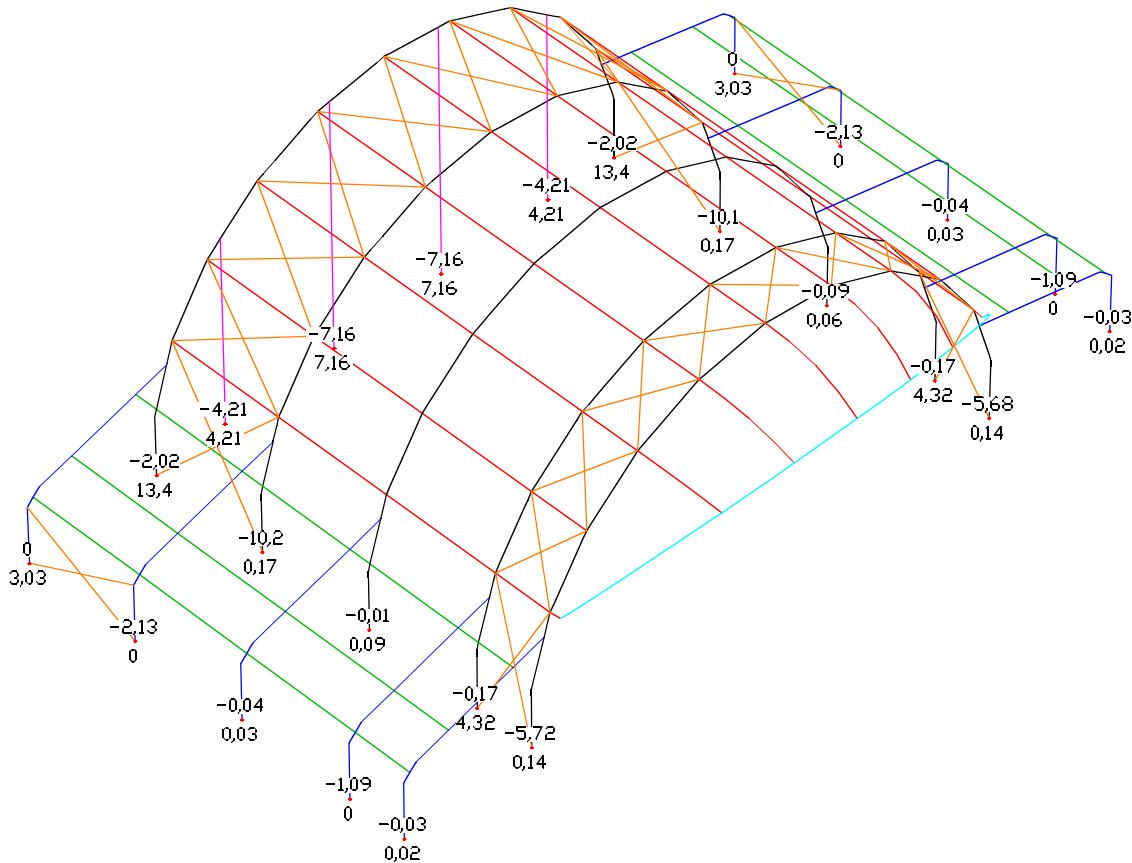
7.2 SYSTEM 16x14m / 16x10m + SIDESTAGES

Support reactions



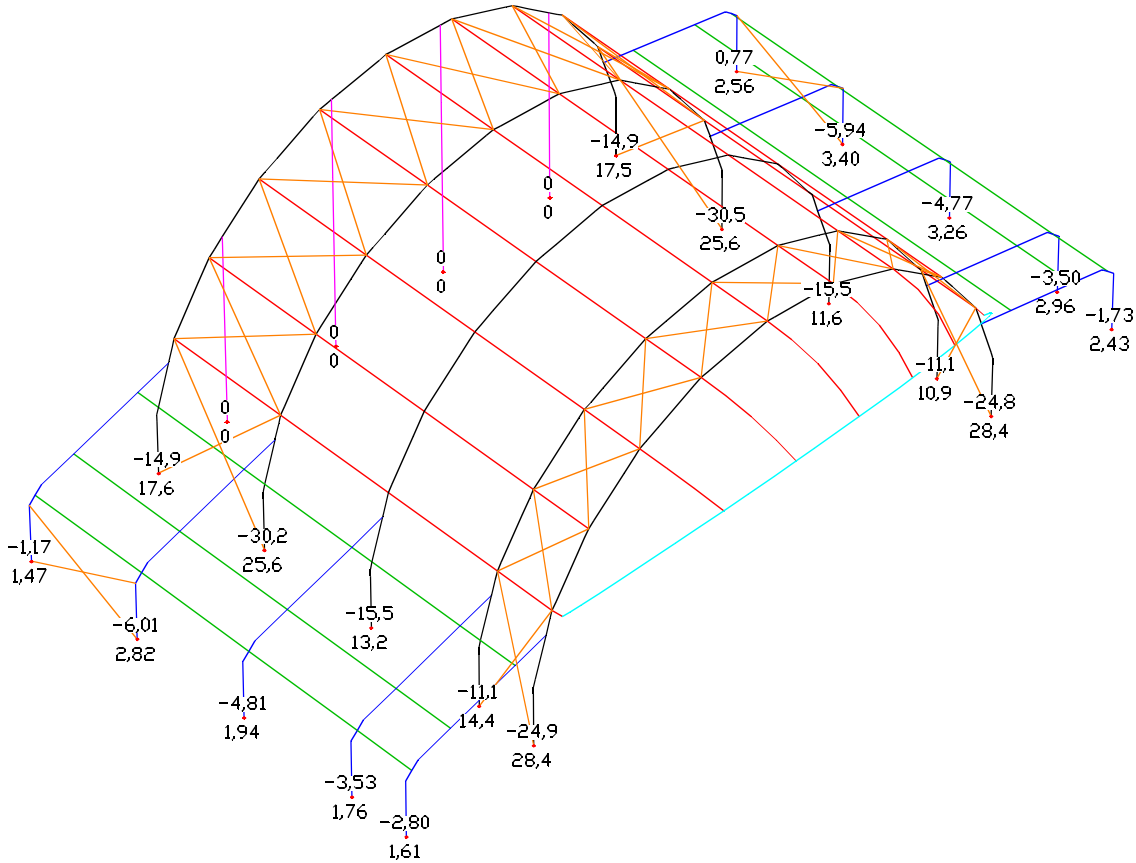
LCC 91: in service
 Support reactions in the local system min,max Rx(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



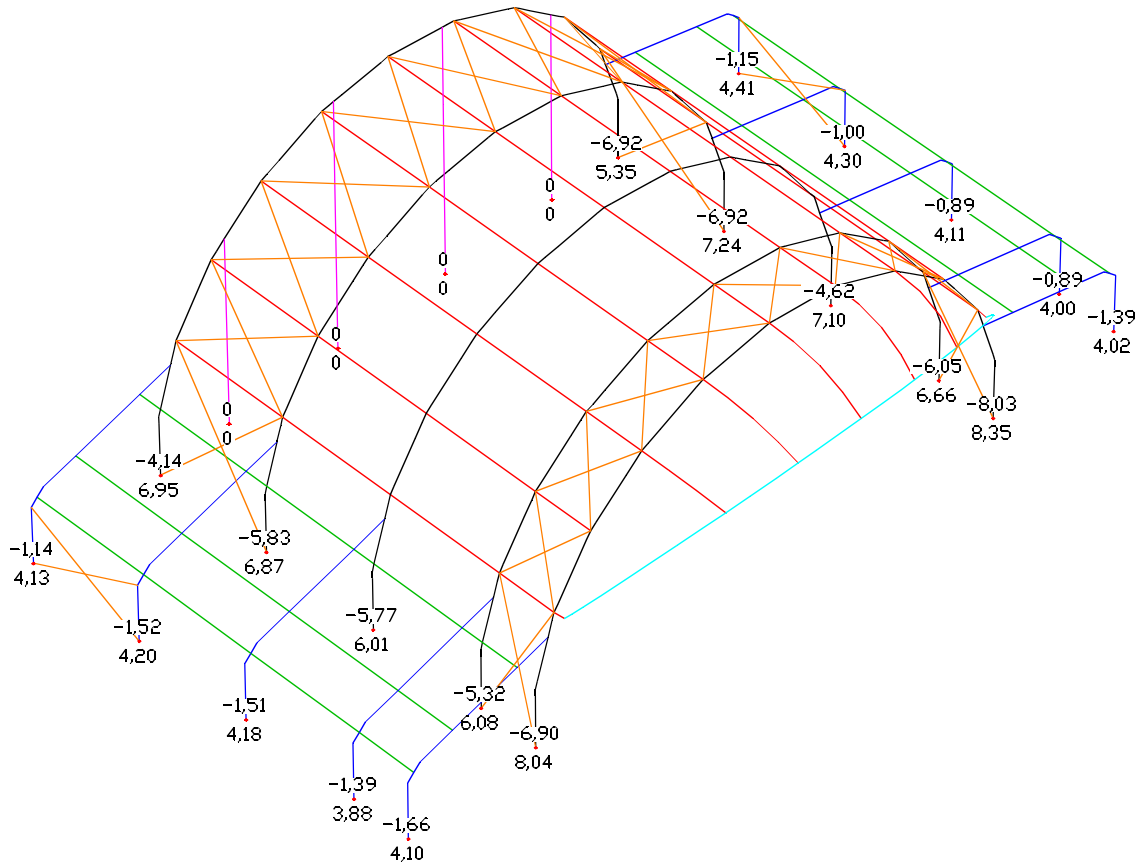
LCC 91: in service
Support reactions in the local system min,max $R_y(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



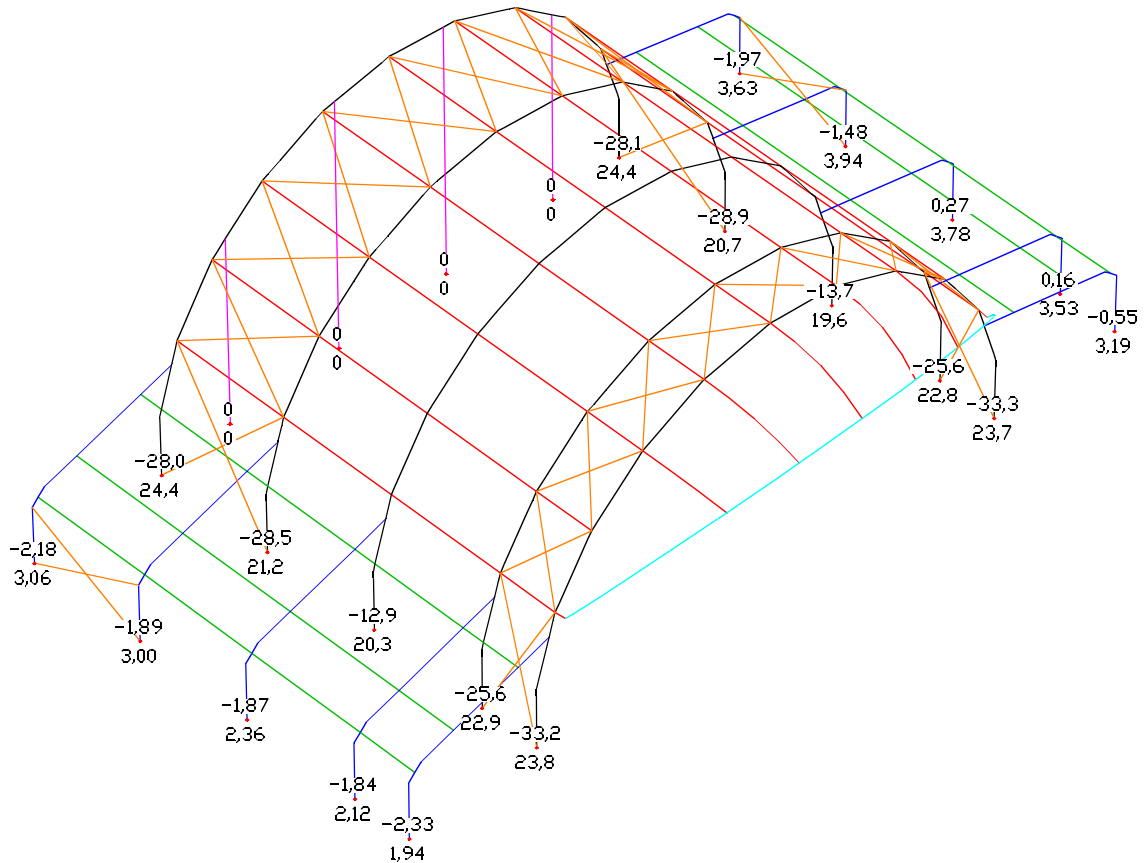
LCC 91: in service
Support reactions in the local system min,max Rz(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Support reactions in the local system min,max Rx(l) [kN]

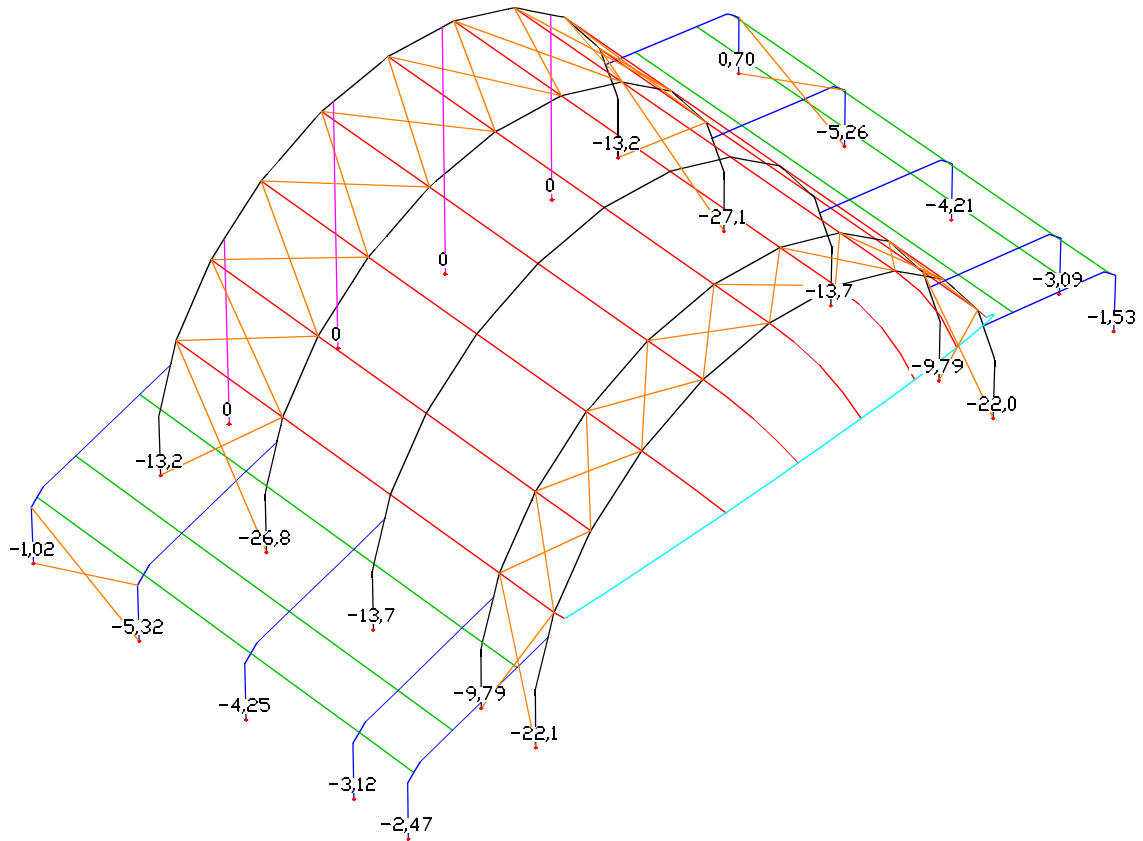
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
Support reactions in the local system min,max Rz(l) [kN]

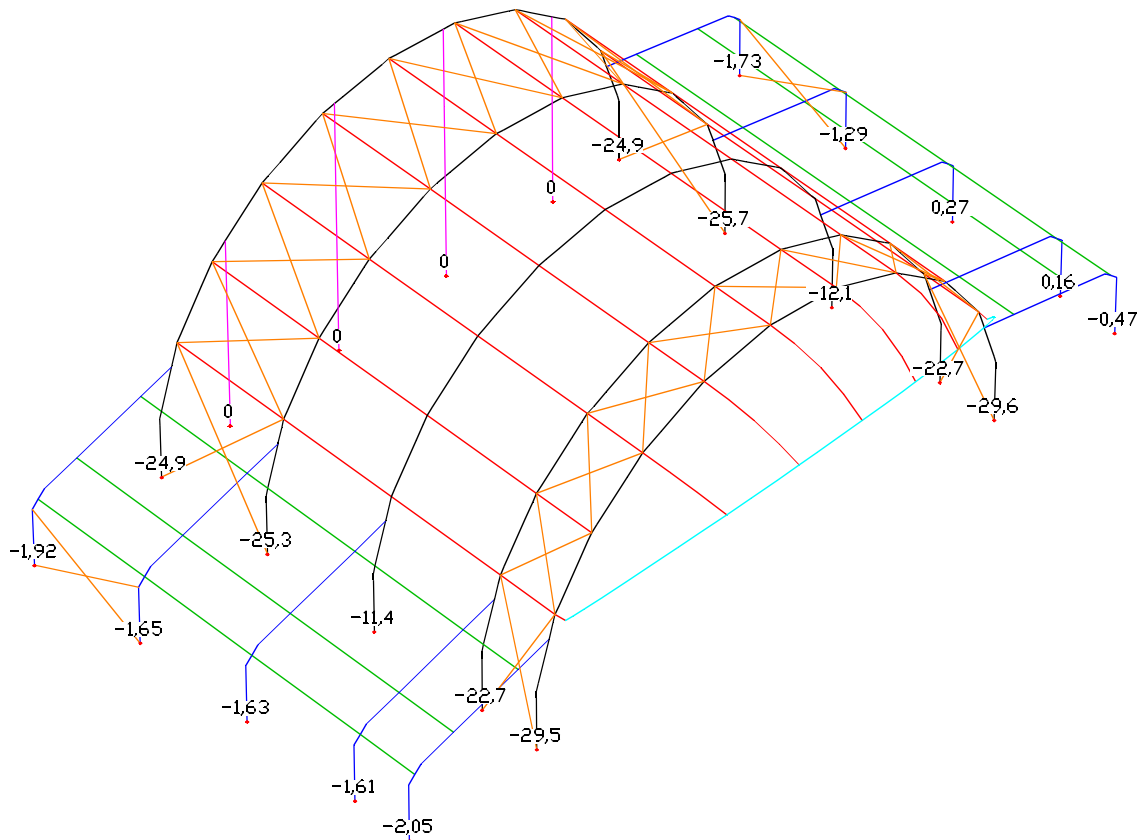
maximum values: $R_x = 8,35 \text{ kN}$
 $R_y = 15,40 \text{ kN}$
 $R_z = -33,20 \text{ kN} / 28,40 \text{ kN}$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 82: in service – ballast
Support reactions in the local system min $R_z(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



LCC 84: out of service – ballast
Support reactions in the local system min $R_z(l)$ [kN]

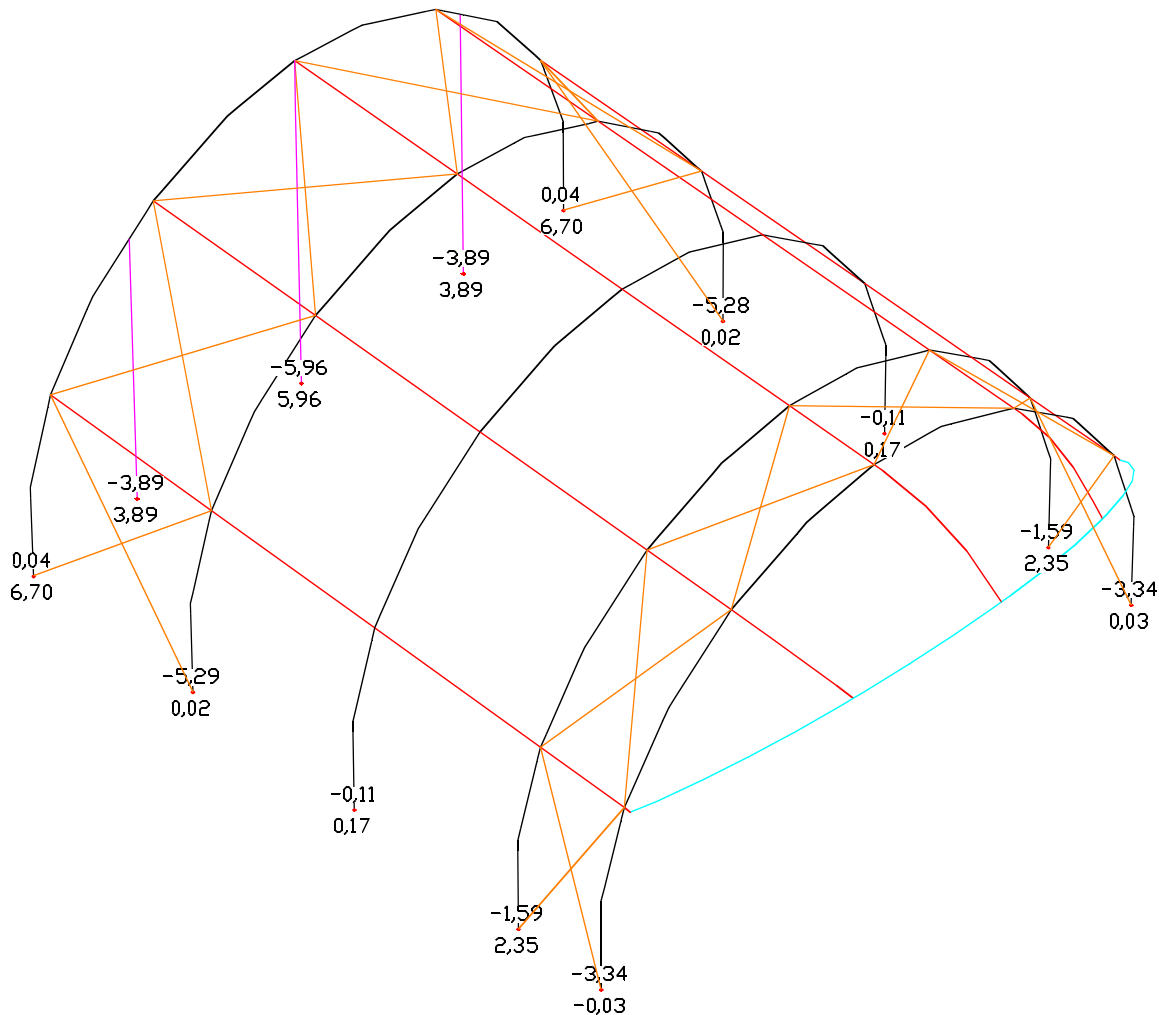
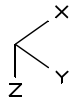
necessary ballast loadings similar to previous system.
Lifting forces of the sidestages are compensated by the podium

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Sum of installed loads and support reactions

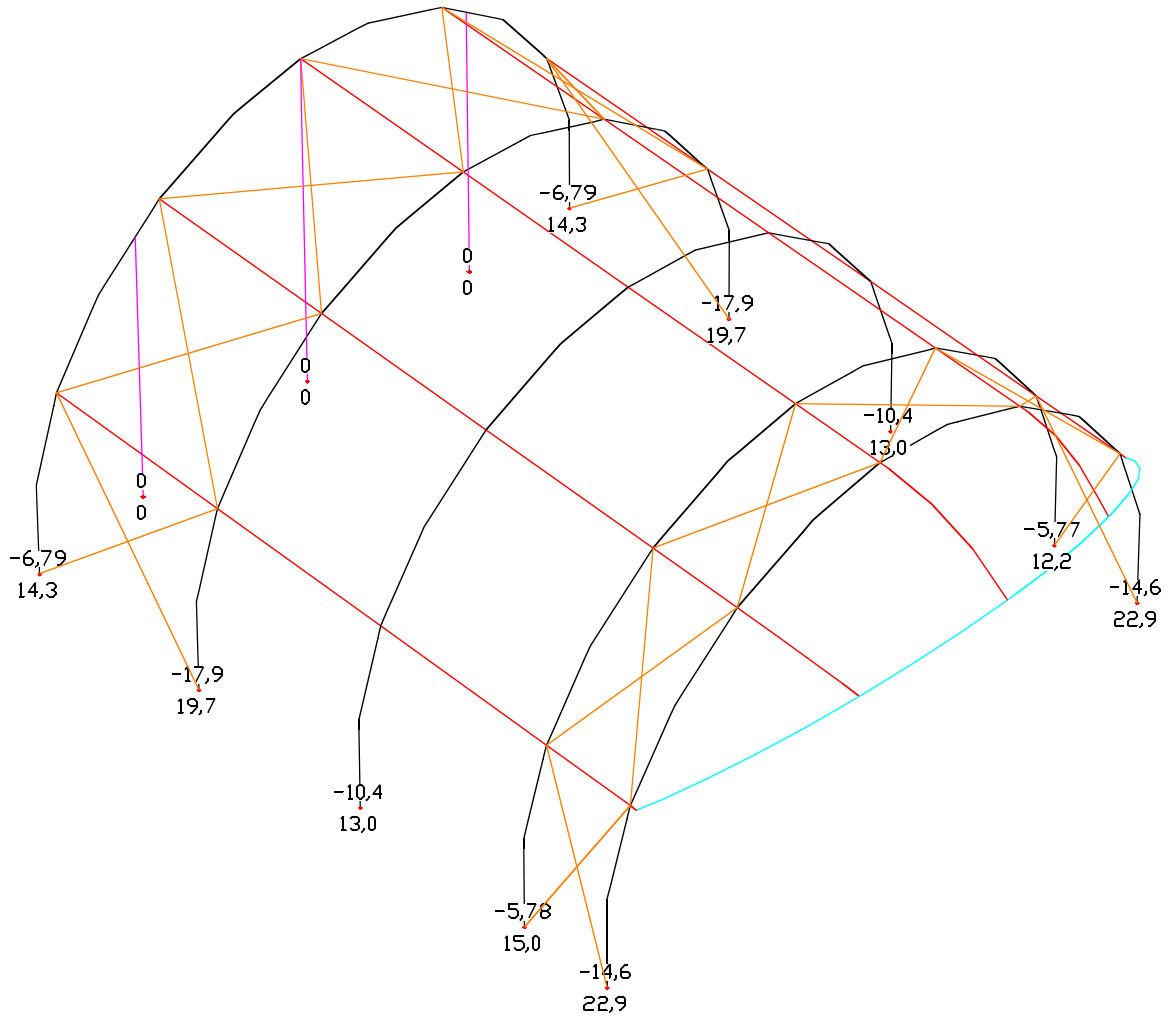
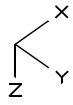
LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	deadweight	0,000	0,000	31,202
	Support reactions	0,000	0,000	31,202
2	canopy 1kg/m ²	0,000	-0,000	6,174
	Support reactions	-0,000	0,000	6,174
101	Wind $\beta=0^\circ$ - in service	0,281	-47,333	-138,457
	Support reactions	0,281	-47,333	-138,457
102	Wind $\beta=90^\circ$ - in service	20,243	0,053	-14,892
	Support reactions	20,243	0,053	-14,892
103	Wind $\beta=180^\circ$ - in service	0,022	47,408	-7,793
	Support reactions	0,022	47,408	-7,793
301	Wind $\beta=0^\circ$ - out of service	0,351	-42,207	-86,763
	Support reactions	0,351	-42,207	-86,763
302	Wind $\beta=90^\circ$ -tension - out of se	10,871	0,087	-115,684
	Support reactions	10,871	0,087	-115,684
303	Wind $\beta=90^\circ$ -tension right - out	33,607	0,044	-58,112
	Support reactions	33,607	0,044	-58,112
304	Wind $\beta=90^\circ$ -compression - out o	10,169	0,043	57,842
	Support reactions	10,169	0,043	57,842
305	Wind $\beta=90^\circ$ -compression left -	21,771	0,022	28,786
	Support reactions	21,771	0,022	28,786
306	Wind $\beta=180^\circ$ - out of service	0,351	42,337	-86,763
	Support reactions	0,351	42,337	-86,763

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



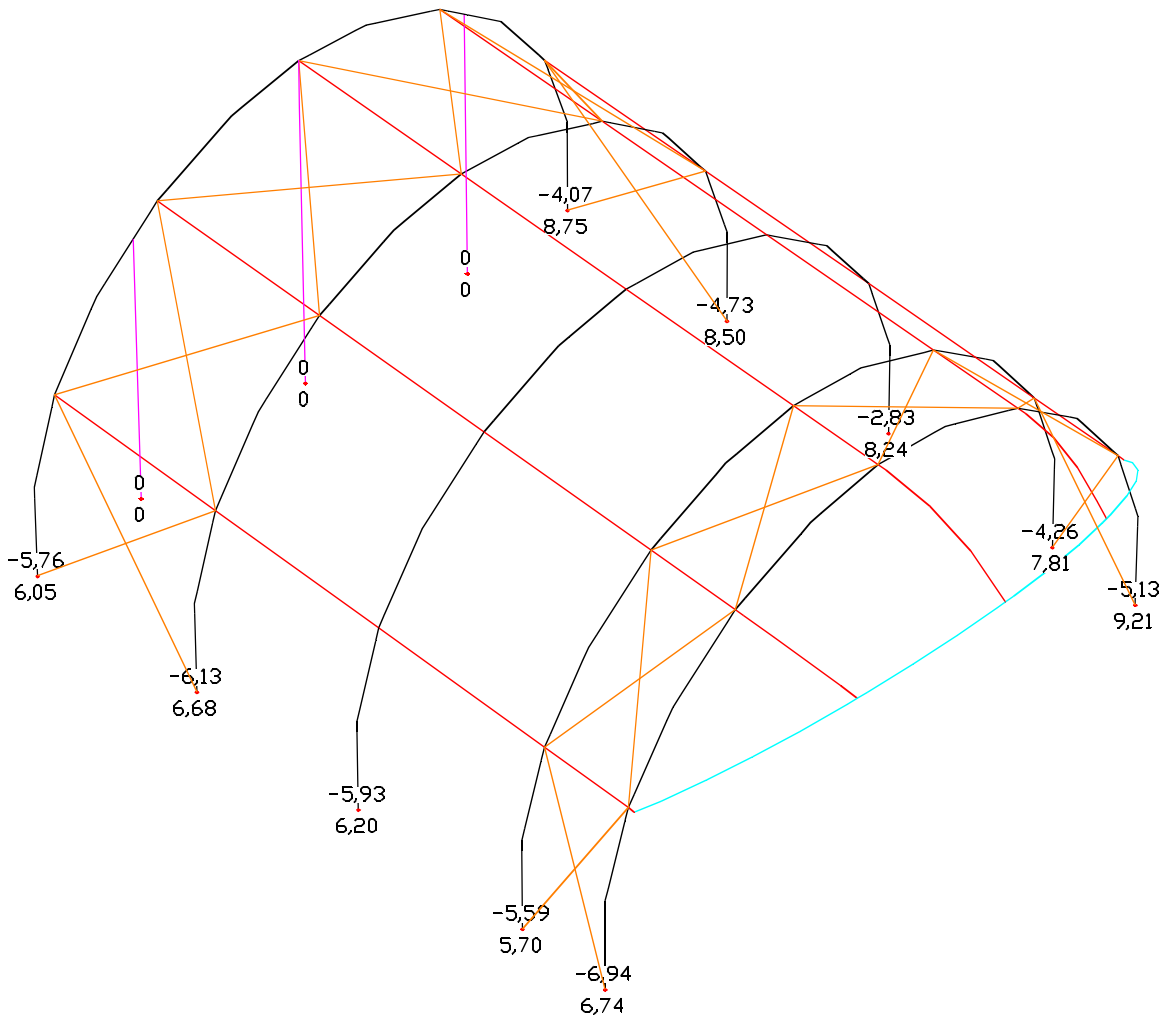
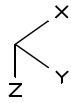
LCC 91: in service
Support reactions in the local system min,max $R_y(I)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



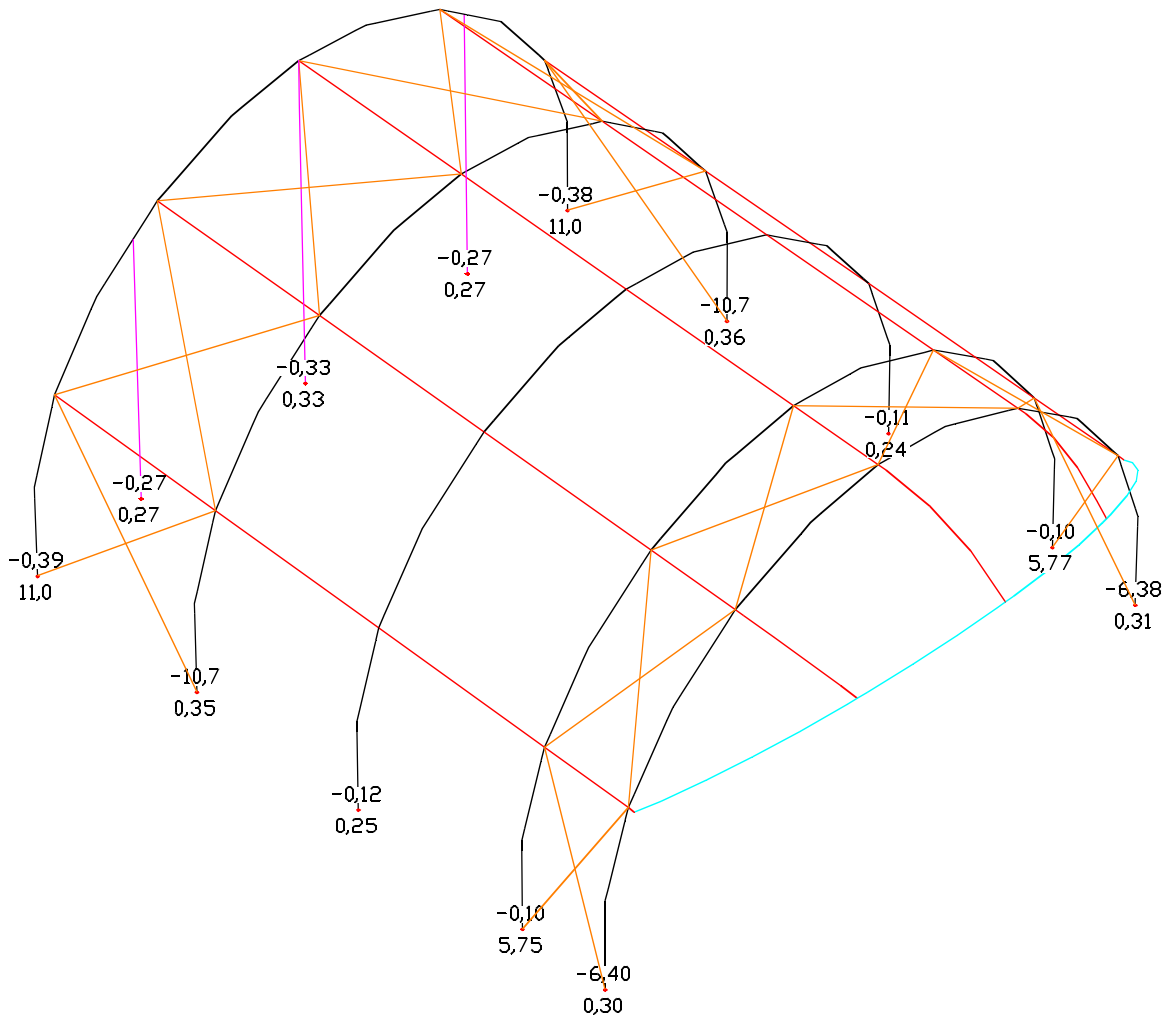
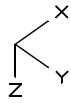
LCC 91: in service
 Support reactions in the local system min,max Rz(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



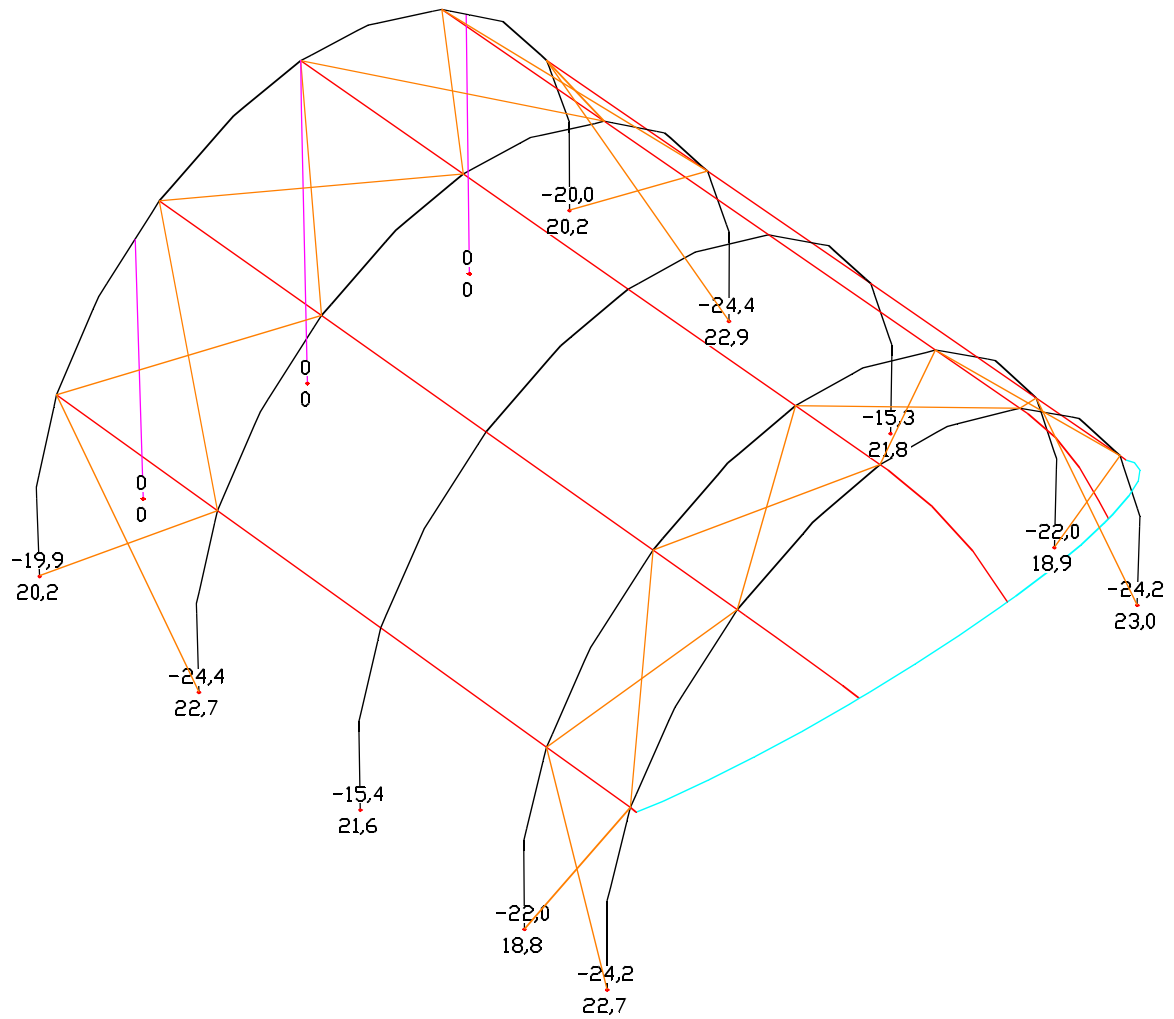
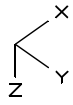
LCC 93: out of service
Support reactions in the local system min,max Rx(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
Support reactions in the local system min,max $R_y(I)$ [kN]

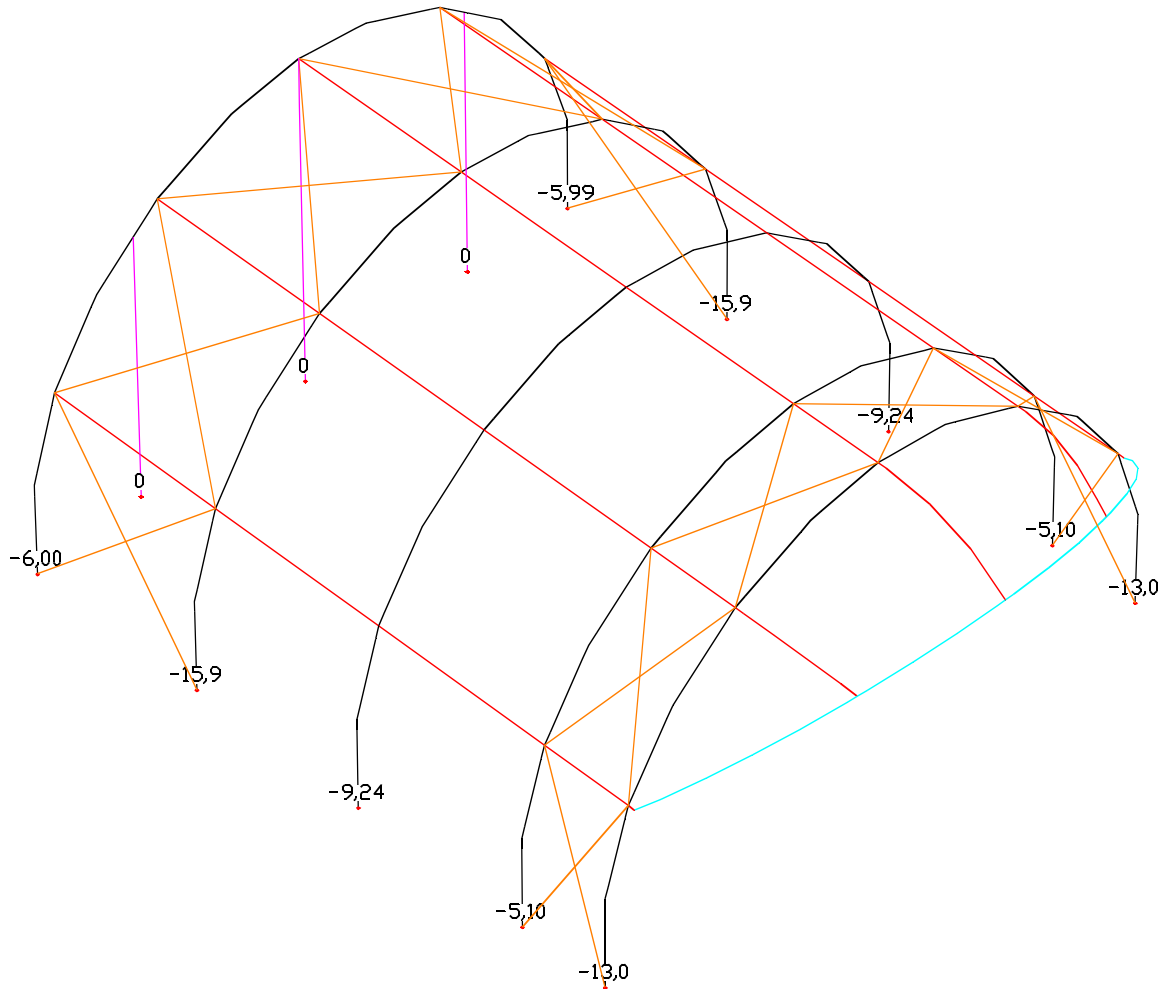
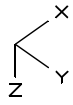
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
Support reactions in the local system min,max $R_z(l)$ [kN]

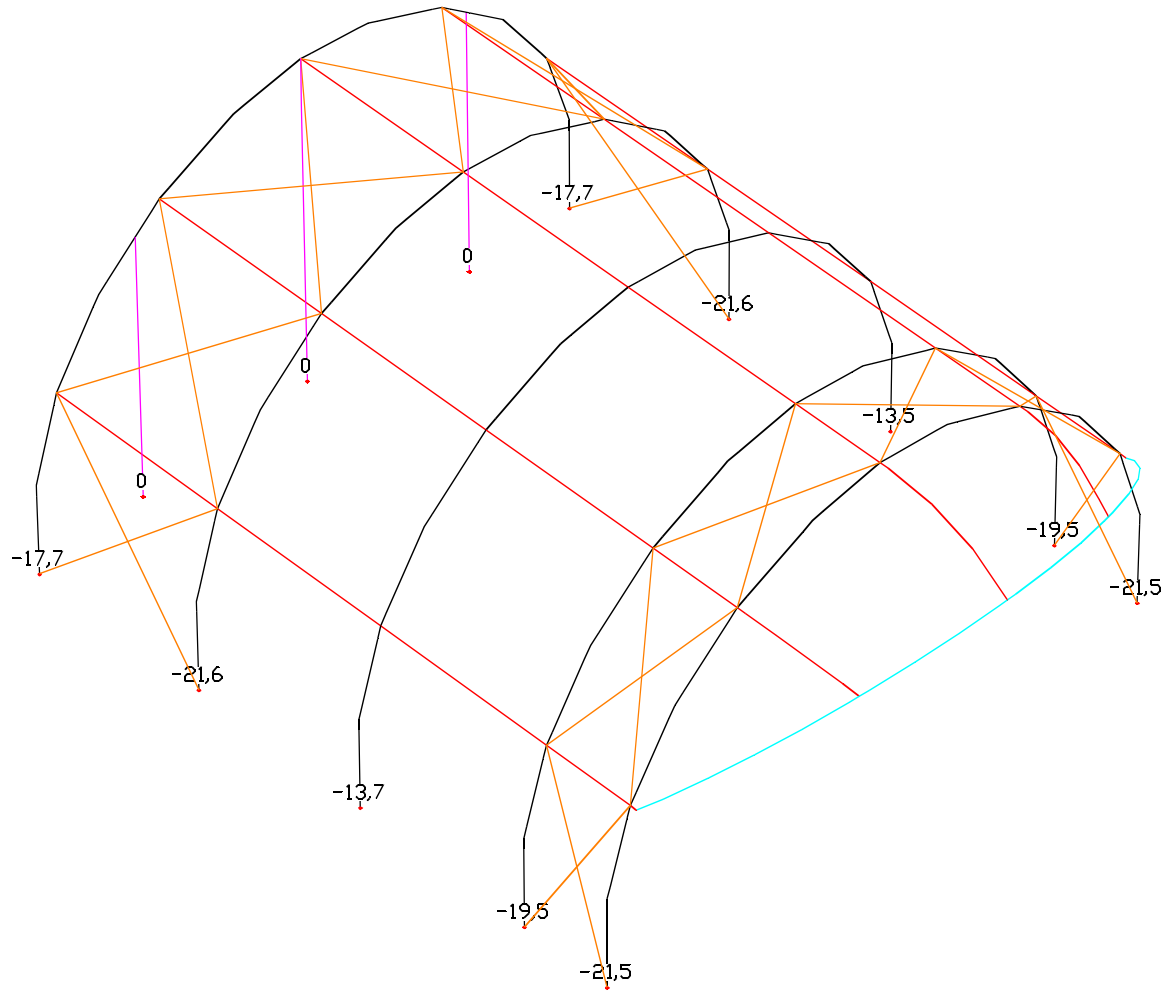
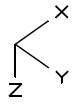
maximum values: $R_x = 9,21$ kN
 $R_y = 11,00$ kN
 $R_z = -24,20$ kN / $23,00$ kN

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 82: in service – ballast
 Support reactions in the local system min Rz(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 84: out of service – ballast
 Support reactions in the local system min $R_z(I)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

- A 2200 kg
- B 2000 kg
- C 1300 kg
- D 2200 kg
- E 1800 kg

Proof against sliding complete system:

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	deadweight	-0,000	0,000	15,527
	Support reactions	0,000	0,000	15,527
2	canopy 1kg/m ²	0,000	0,000	2,883
	Support reactions	0,000	0,000	2,883
101	Wind $\beta=0^\circ$ - in service	0,000	-23,047	-73,645
	Support reactions	0,000	-23,047	-73,645
102	Wind $\beta=90^\circ$ - in service	25,937	-0,056	-9,311
	Support reactions	25,937	-0,056	-9,311
103	Wind $\beta=180^\circ$ - in service	0,000	22,956	-5,665
	Support reactions	0,000	22,956	-5,665
301	Wind $\beta=0^\circ$ - out of service	0,000	-26,431	-78,718
	Support reactions	0,000	-26,431	-78,718
302	Wind $\beta=90^\circ$ -tension - out of se	4,317	-0,052	-104,957
	Support reactions	4,317	-0,052	-104,957
303	Wind $\beta=90^\circ$ -tension right - out	37,208	0,003	-52,474
	Support reactions	37,208	0,003	-52,474
304	Wind $\beta=90^\circ$ -compression - out o	4,317	-0,026	52,478
	Support reactions	4,317	-0,026	52,478
305	Wind $\beta=90^\circ$ -compression left -	20,763	-0,028	26,241
	Support reactions	20,763	-0,028	26,241
306	Wind $\beta=180^\circ$ - out of service	0,000	26,354	-78,718
	Support reactions	0,000	26,354	-78,718

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Loadcase 303 is decisive: Wind of side out of servic

The wind on podium

$$\text{horizontal: } 0,44 \times 1,30 \times 14,5 \times 1,5 = 12,44 \text{ kN}$$

$$\text{Deadweight podium (45 kg/m}^2\text{): } 0,45 \times 14,5 \times 14,0 = 91,35 \text{ kN}$$

Sum horizontal loads:

$$37,21 + 12,44 = 49,65 \text{ kN}$$

Sum lifting loads:

$$= 52,47 \text{ kN}$$

Sum dead weight:

$$15,53 + 91,35 = 106,88 \text{ kN}$$

Sum ballast loading:

$$2 \times (18,0+22,0+13,0+20,0+22,0) = 190,00 \text{ kN}$$

$$(106,88 + 190,00 - 1,2 \times 52,47) \times 0,40 / 49,65 = 93,57 / 49,64 = 1,88 > 1,20$$

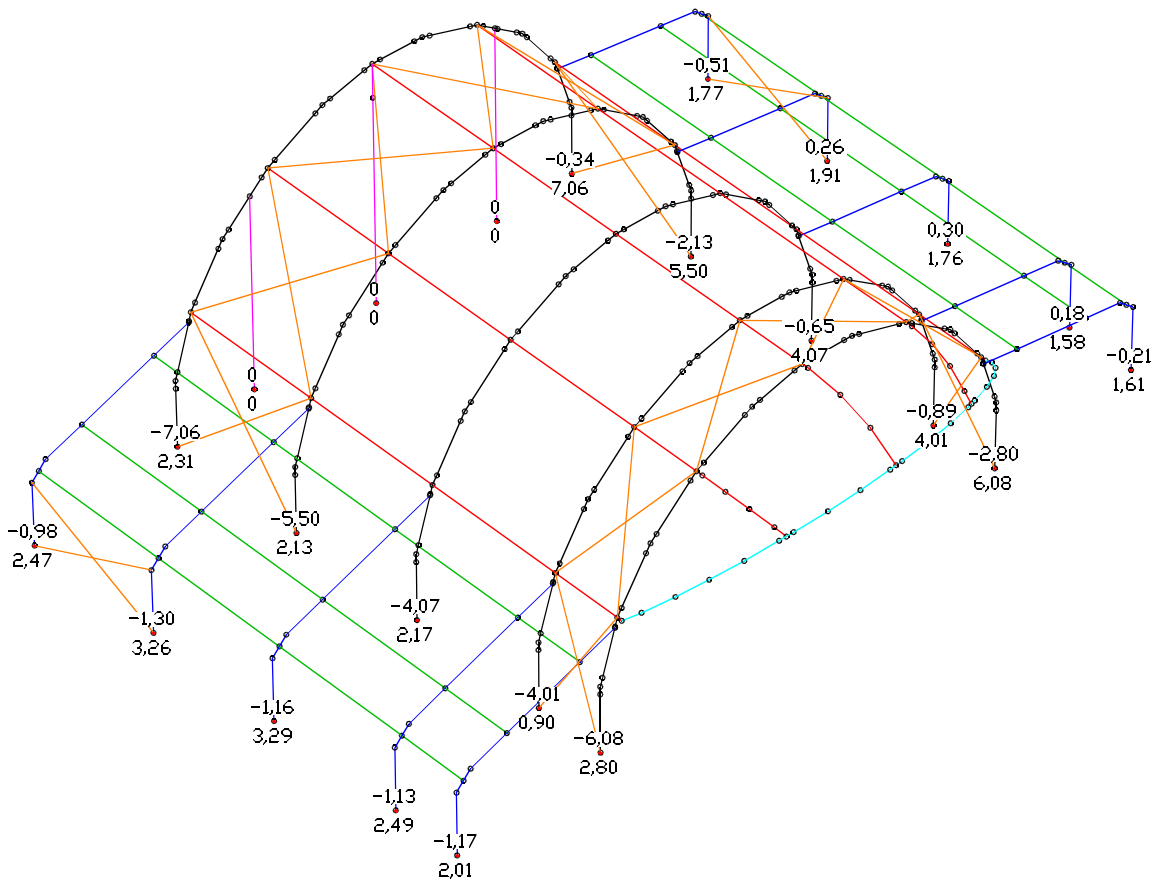
System 12x10:

similar, no extra proof

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

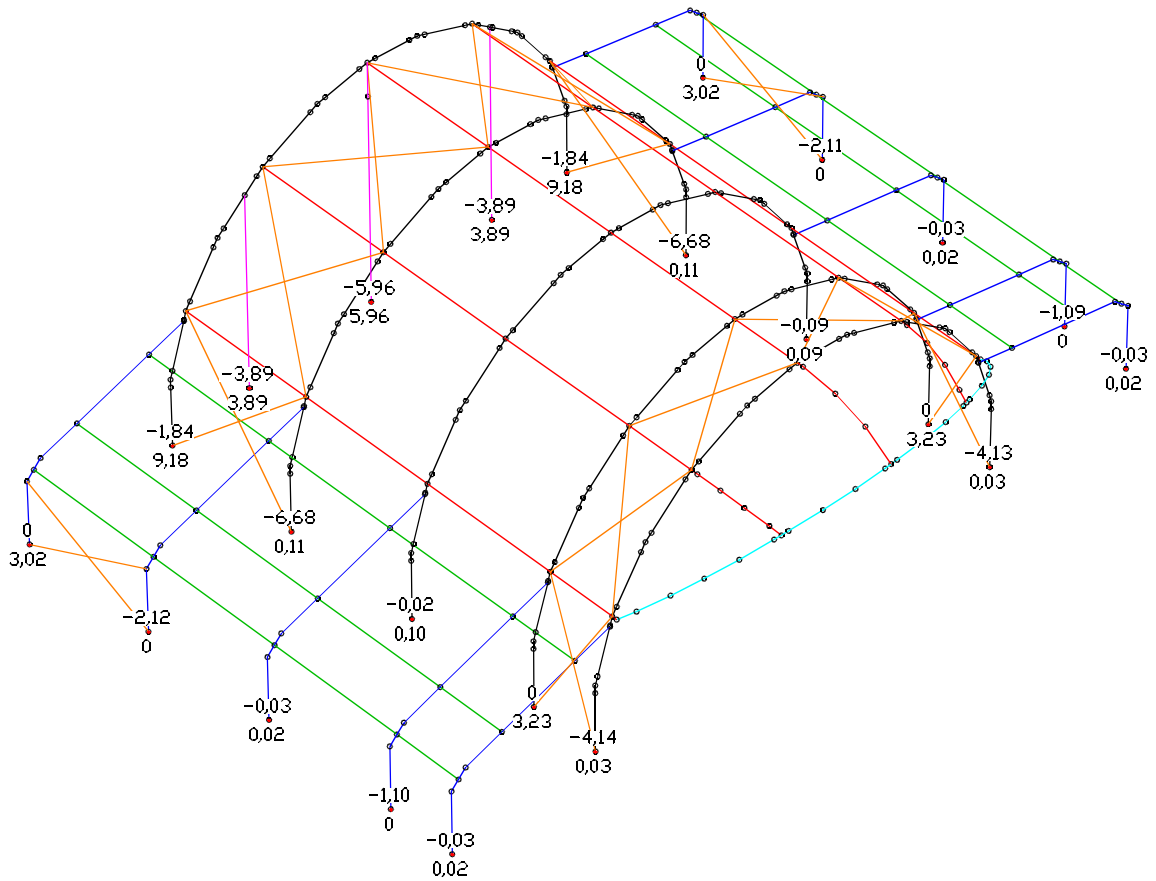
7.4 SYSTEM 12x14m / 12x10m + SIDESTAGES

Support reactions



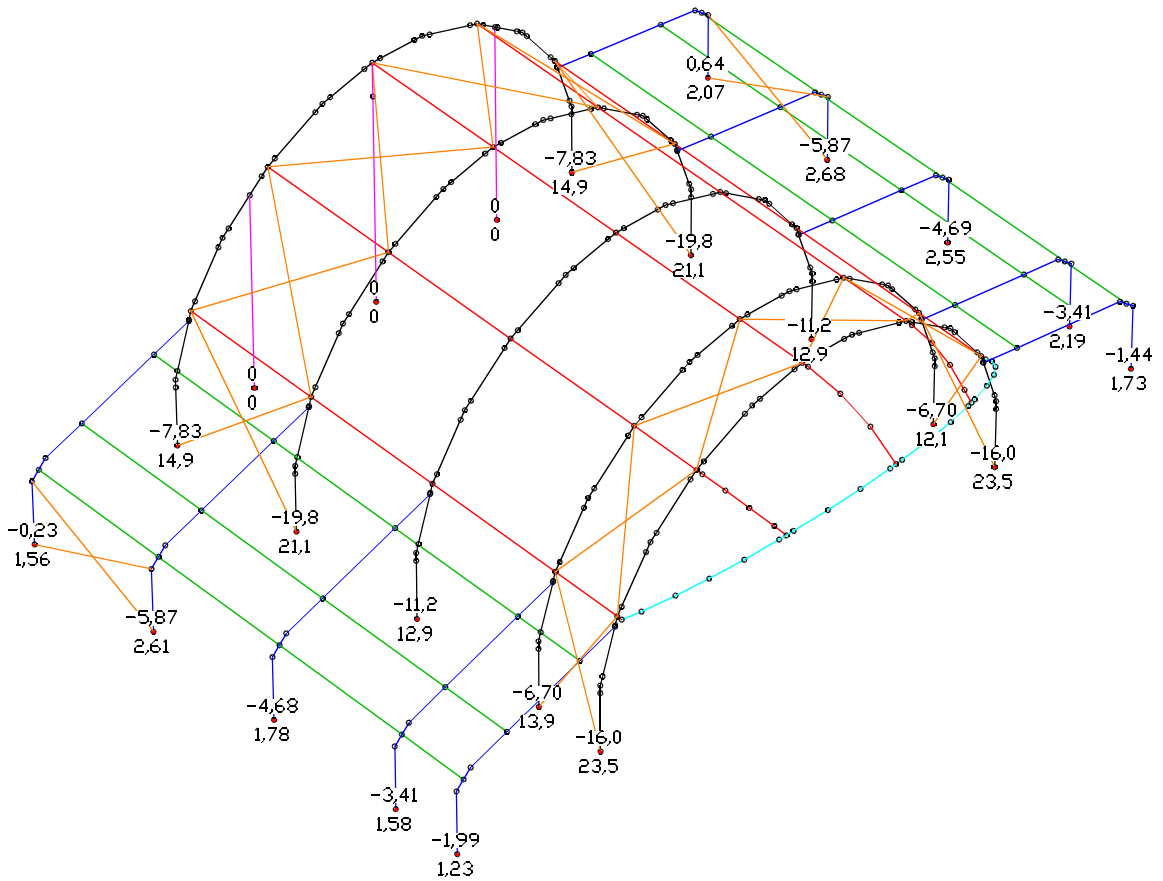
LCC 91: in service
 Support reactions in the local system min,max Rx(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



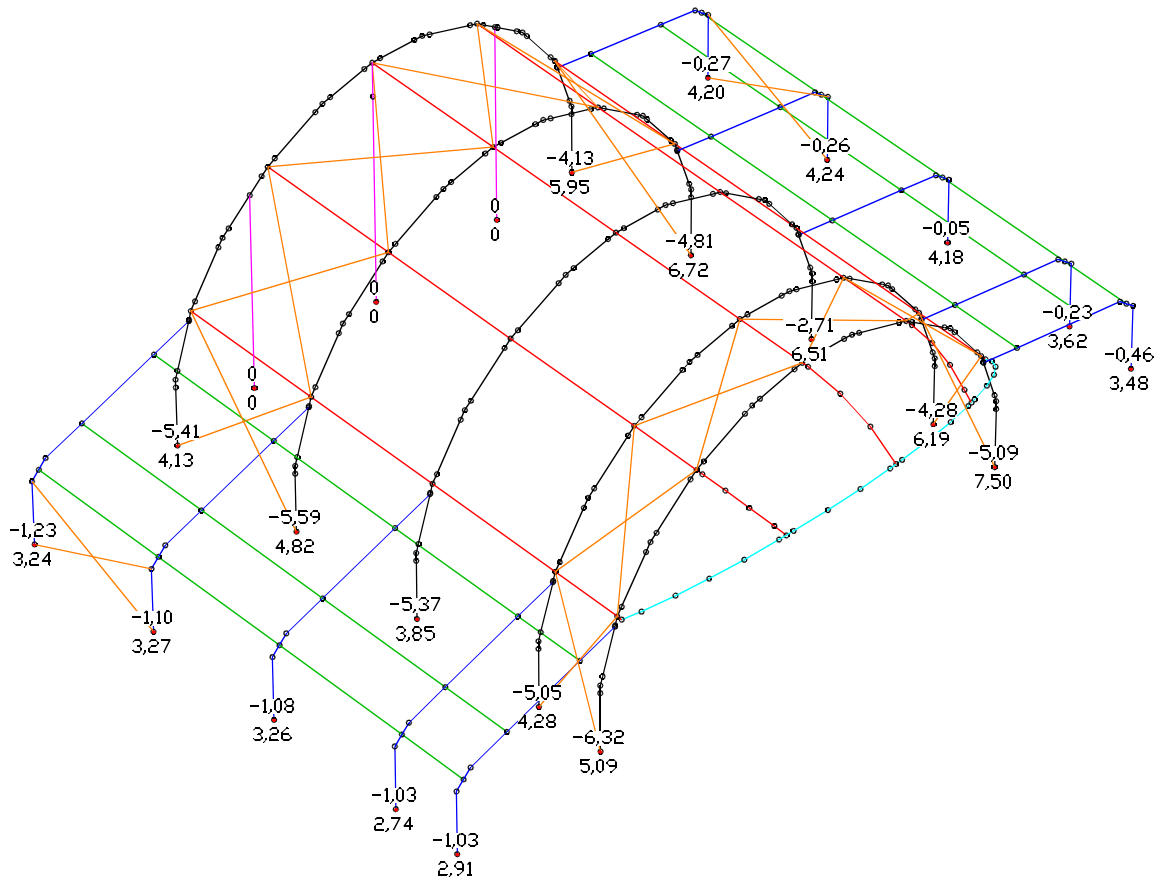
LCC 91: in service
Support reactions in the local system min,max $R_y(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Polyte Group	DATE/DATUM: 10.04.2016



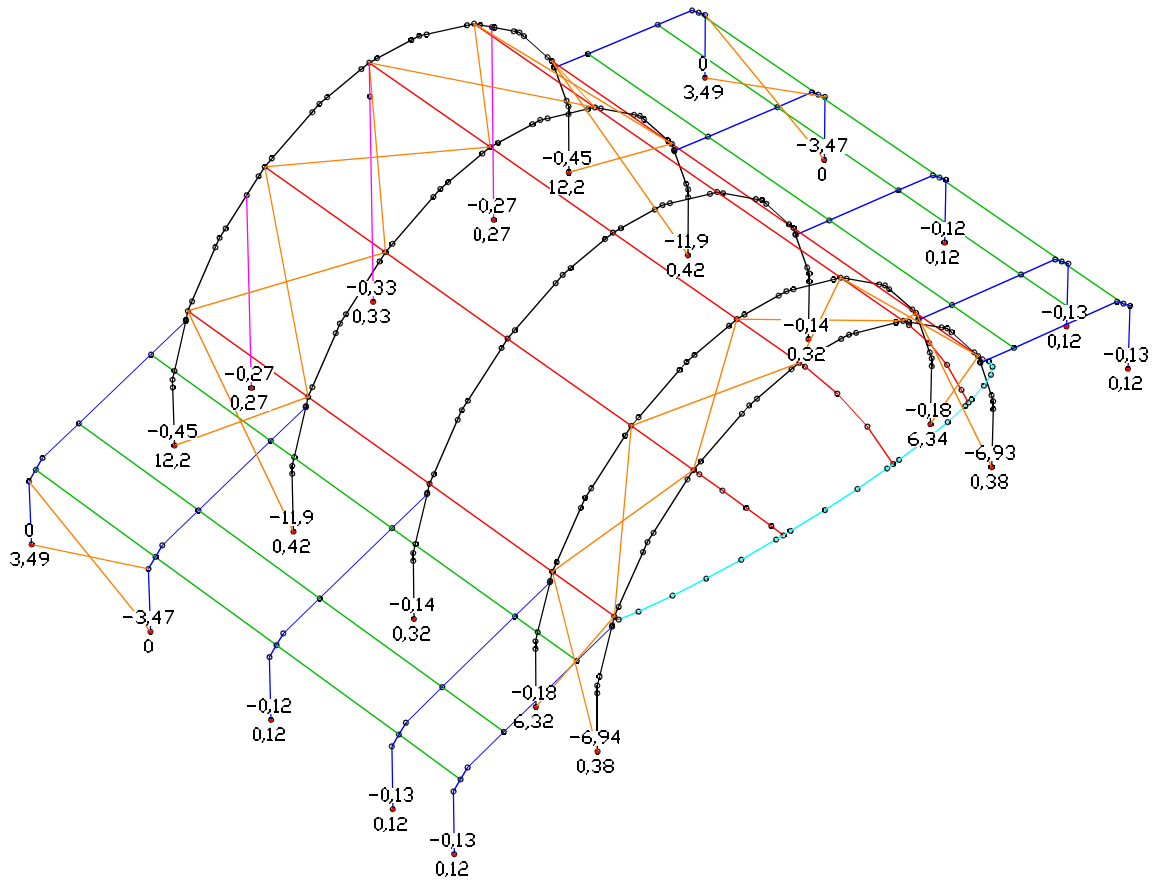
LCC 91: in service
 Support reactions in the local system min,max Rz(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



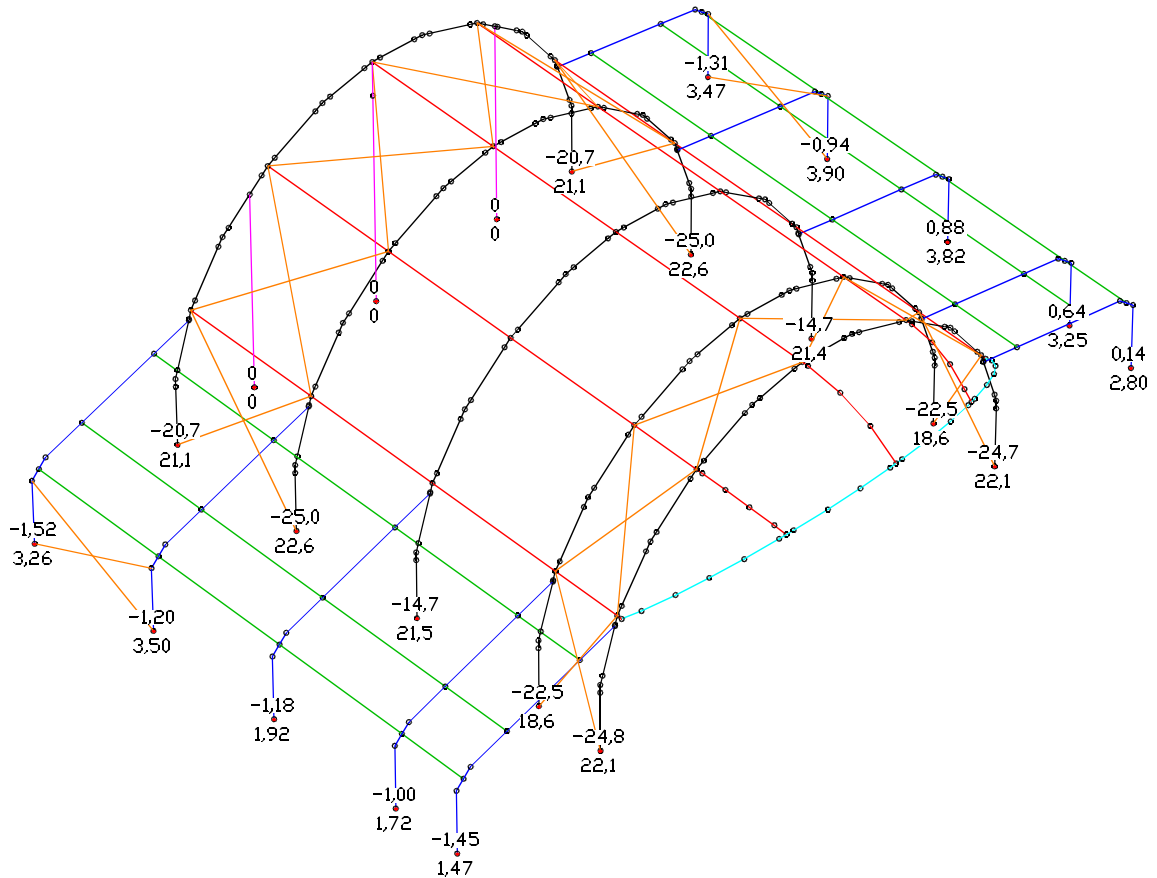
LCC 93: out of service
 Support reactions in the local system min,max $R_x(l)$ [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Support reactions in the local system min,max Ry(l) [kN]

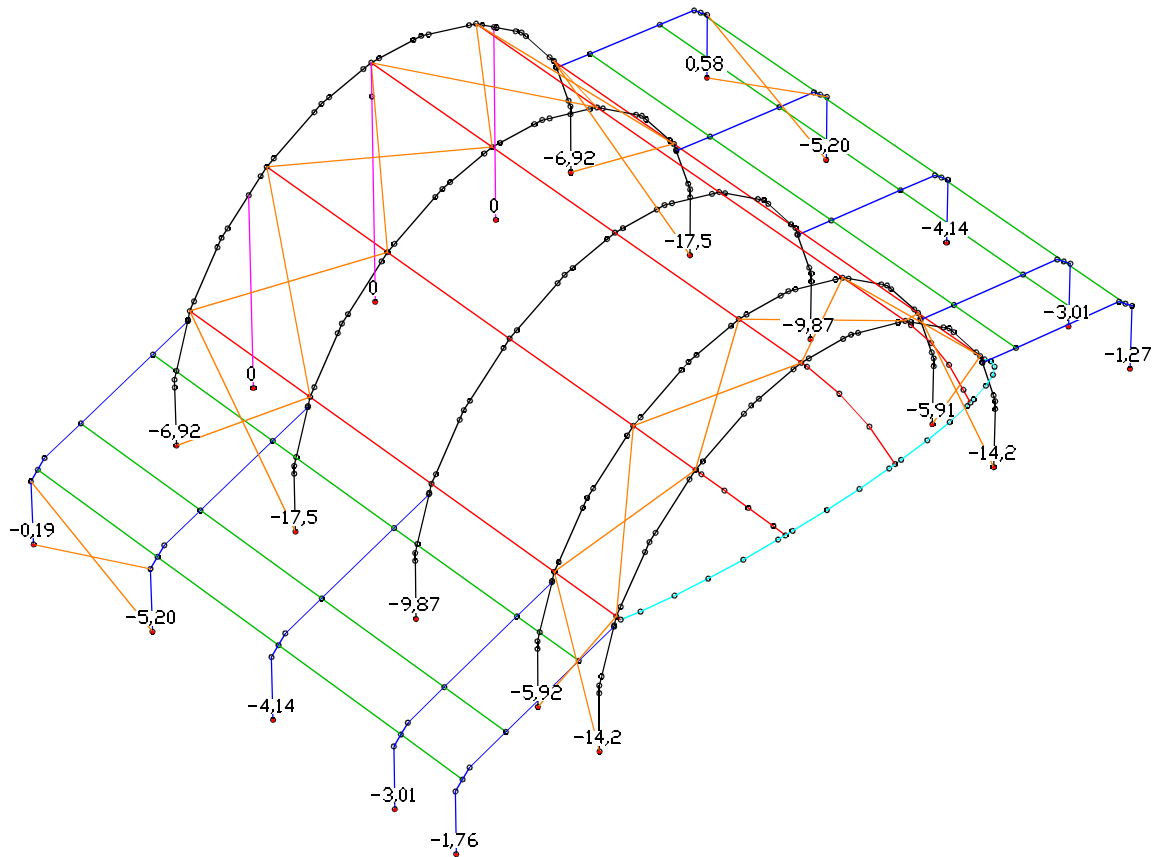
PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 93: out of service
 Support reactions in the local system min,max Rz(l) [kN]

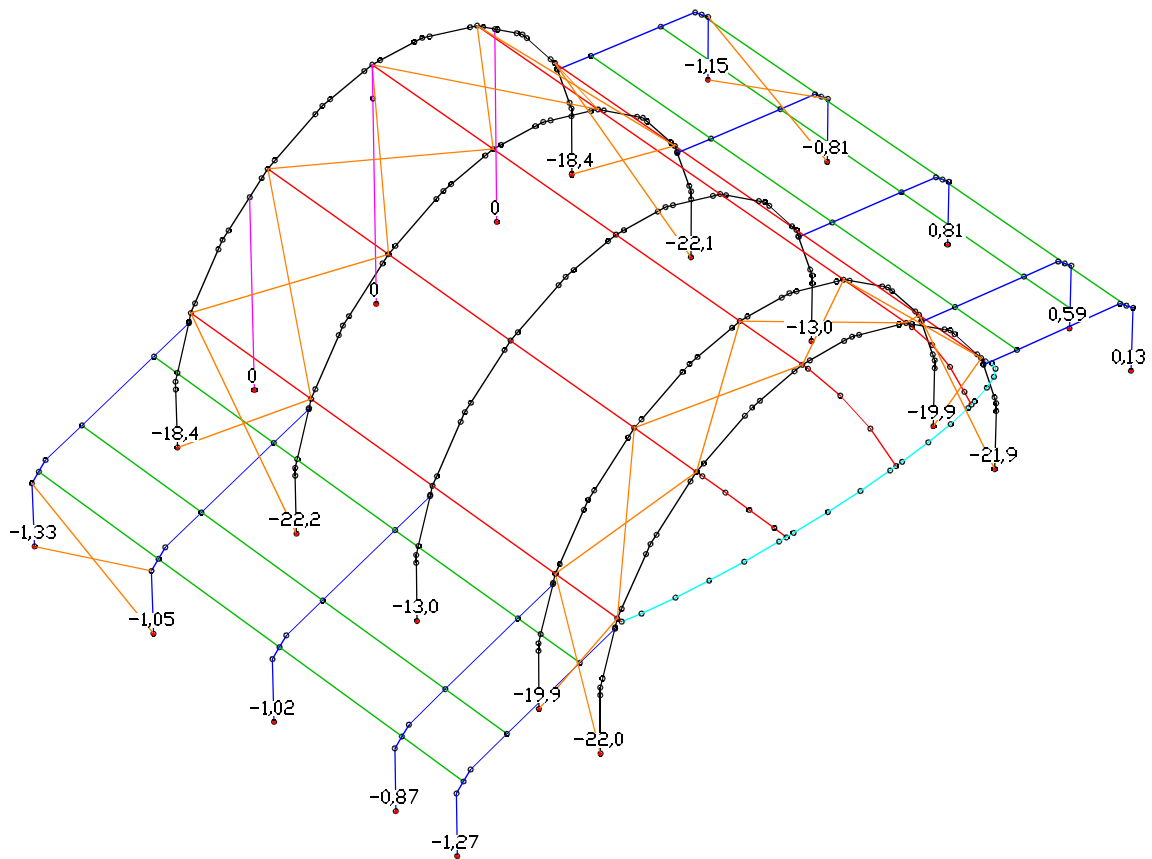
maximum values: $R_x = 7,50 \text{ kN}$
 $R_y = 12,20 \text{ kN}$
 $R_z = -24,80 \text{ kN} / 23,50 \text{ kN}$

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 82: in service – ballast
Support reactions in the local system min Rz(l) [kN]

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016



LCC 84: out of service – ballast
Support reactions in the local system min Rz(l) [kN]

necessary ballast loadings similar to previous system.
Lifting forces of the sidestages are compensated by the podium

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	deadweight	-0,000	0,000	24,229
	Support reactions	-0,000	0,000	24,229
2	canopy 1kg/m ²	0,000	0,000	5,170
	Support reactions	-0,000	0,000	5,170
101	Wind β=0° - in service	-0,000	-32,480	-107,489
	Support reactions	0,000	-32,480	-107,489
102	Wind β=90° - in service	19,771	-0,056	-15,380
	Support reactions	19,771	-0,056	-15,380
103	Wind β=180° - in service	-0,000	32,390	-5,411
	Support reactions	0,000	32,390	-5,411
301	Wind β=0° - out of service	0,000	-34,988	-78,718
	Support reactions	0,000	-34,988	-78,718
302	Wind β=90°-tension - out of se	7,213	-0,052	-104,957
	Support reactions	7,213	-0,052	-104,957
303	Wind β=90°-tension right - out	40,104	0,003	-52,474
	Support reactions	40,104	0,003	-52,474
304	Wind β=90°-compression - out o	7,213	-0,026	52,478
	Support reactions	7,213	-0,026	52,478
305	Wind β=90°-compression left -	23,659	-0,028	26,241
	Support reactions	23,659	-0,028	26,241
306	Wind β=180° - out of service	0,000	34,911	-78,718
	Support reactions	0,000	34,911	-78,718

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

8 TRUSS DATA

PROLYTE H30D

DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE

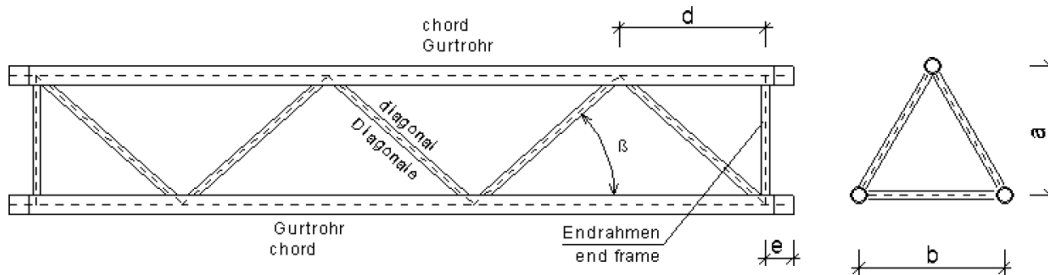
5,0 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm ²]	W [cm ³]	I [cm ⁴]	I _T [cm ⁴]	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	β _v	45,00
Distance diagonals horizontal /Abstand Diagonalen horizontal	d[cm]	23,90
Angle diagonals horizontal / Winkel Diagonalen horizontal	β _h	45,00
	e[cm]	5,00



CROSS SECTION TRUSS/ QUERSCHNITTSWERTE GESAMTTRAVERSE

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

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

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

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

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 [cm ²]	I _y [cm ⁴]	I _z [cm ⁴]	i _y [cm]	i _z [cm]	I _T [cm ⁴]
12,72	1057,29	1057,10	9,12	9,11	150

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

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/mm ²]	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 $\rho_{1,haz}$ has to be multiplied by 0,8 /
 Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist $\rho_{1,haz}$ 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, \text{chord tube/Gurtrohr}} \times 0,207 = $	10,39 kNm
bending moment/Biegemoment:	$M_{z,R,d} = N_{R,d, \text{chord tube/Gurtrohr}} \times 0,239 = $	12,00 kNm
normal force/Normalkraft:	$N_{R,d} = 3 \times N_{R,d, \text{chord tube/Gurtrohr}} = $	150,65 kN
transversal force/Querkraft	$V_{z,R,d} = 2 \times N_{R,d, \text{diagonal}} \times \sin 60^\circ \times \sin 45,00^\circ = $	12,76 kN
transversal force/Querkraft	$V_{y,R,d} = N_{R,d, \text{diagonal}} \times \sin 45,00^\circ = $	7,36 kN

The values shown above are design values. "Permissible loads" or "Working loads" are obtained 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 occurrence of bending moment and transversal force the following term has to be analysed:
 Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

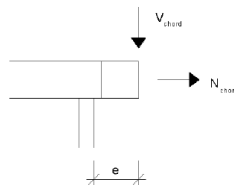
$$V_{d, \text{chord-Gurt}} = (1/3) \times V_{d, \text{totalgesamt}}$$

$$M_{d, \text{chord/Gurt}} = V_{d, \text{chord/Gurt}} \times e$$

$$e^* = 5,00$$

according to term / nach Gl. (6.43):

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



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
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PROLYTE H30V

DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE

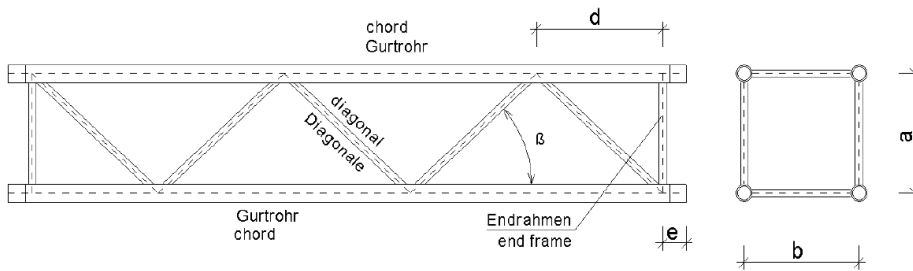
6,3 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm ²]	W [cm ³]	I [cm ⁴]	I _r [cm ⁴]	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	β _v	45,00
Distance diagonals horizontal /Abstand Diagonalen horizontal	d[cm]	23,90
Angle diagonals horizontal / Winkel Diagonalen horizontal	β _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 [cm ²]	I _y [cm ⁴]	I _z [cm ⁴]	i _y [cm]	i _z [cm]	I _r [cm ⁴]
16,96	2095,86	2095,86	11,12	11,12	500

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

PROLYTE H30V

MATERIAL

Characteristic values of 0,2% proof strength $f_{0,2}$ 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/mm ²]	normal stress/ Normalspannung	shear stress/ Schubspannung
		$\sigma_{R,d} = f / \gamma_{(M1,M2)}$	$\tau_{R,d} = f / (\gamma_{(M1,M2)} \times \sqrt{3})$
$f_{0,2}$; t > 5mm	260,0	236,4	136,5
f_u ; t > 5mm	310,0	248,0	
$f_{0,2}$; 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 $\rho_{L,haz}$ has to be multiplied by 0,8 / Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist $\rho_{L,haz}$ mit dem Faktor 0,8 zu multiplizieren.

Partial safety factors for ultimate limit states/ Teilsicherheitsbeiwerte für Grenzzustände der Tragfähigkeit (see tab. 6.1/ siehe Tabelle 6.1)

γ_{M1}	1,10
γ_{M2}	1,25
γ_{MW}	1,25

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

The values shown above are design values. "Permissible loads" or "Working loads" are obtained 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 occurrence of bending moment and transversal force the following term has to be analysed: Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

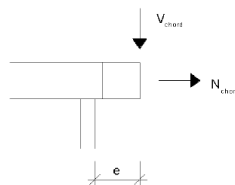
$$V_{d, \text{chord/Gurt}} = 0,25 \times V_{d, \text{total/gesamt}}$$

$$M_{d, \text{chord/Gurt}} = V_{d, \text{chord/Gurt}} \times e$$

$$e^* = 5,00$$

according to term / nach Gl. (6.43):

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



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

PROLYTE H40V

DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE

6,9 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm ²]	W [cm ³]	I [cm ⁴]	I _T [cm ⁴]	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	β _v	45,00
Distance diagonals horizontal /Abstand Diagonalen horizontal	d[cm]	33,90
Angle diagonals horizontal / Winkel Diagonalen horizontal	β _H	45,00
	e[cm]	5,00



CROSS SECTION TRUSS/ QUERSCHNITTSWERTE GESAMTTTRAVERSE

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

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

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

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 [cm ²]	I _y [cm ⁴]	I _z [cm ⁴]	i _y [cm]	i _z [cm]	I _T [cm ⁴]
16,96	4179,54	4179,54	15,70	15,70	900

PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016

PROLYTE H40V

MATERIAL

Characteristic values of 0,2% proof strength $f_{0,2}$ 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/mm ²]	normal stress/ Normalspannung	shear stress/ Schubspannung
		$\sigma_{R,d} = f / \gamma_{(M1,M2)}$	$\tau_{R,d} = f / (\gamma_{(M1,M2)} \times \sqrt{3})$
f_0 : t > 5mm	260,0	236,4	136,5
f_u : t > 5mm	310,0	248,0	
f_0 : t < 5mm	250,0	227,3	131,2
f_u : t < 5mm	290,0	232,0	
$f_{0,haz}$	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 $\rho_{l,haz}$ has to be multiplied by 0,8 / Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist $\rho_{l,haz}$ mit dem Faktor 0,8 zu multiplizieren.

Partial safety factors for ultimate limit states/ Teilsicherheitsbeiwerte für Grenzzustände der Tragfähigkeit (see tab. 6.1/ siehe Tabelle 6.1)

γ_{M1}	1,10
γ_{M2}	1,25
γ_{MW}	1,25

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

The values shown above are design values. "Permissible loads" or "Working loads" are obtained 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

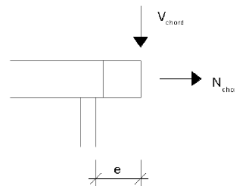
In case of occurrence of bending moment and transversal force the following term has to be analysed: Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

$$V_{d, \text{chord/Gurt}} = 0,25 \times V_{d, \text{total/gesamt}}$$

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

according to term / nach Gl. (6.43):

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



PROJECT: TUNNELROOF 16x14, 16x10, 12x14, 12x10m - GIOVANNI EEKELS	PROJECT-NO.: 16079
CUSTOMER/AUFTRAGGEBER: Prolyte Group	DATE/DATUM: 10.04.2016