

PODIUM – BOEK

ARTEMIS

Eekels Verhuur 112023-09

Inhoudsopgave

Voorwoord.....	3
1. Algemene informatie.....	5
1.1 Algemene gegevens fabrikant(en);.....	5
1.2 Algemene gegevens;.....	5
2 Gegevens verhuurder of leverancier.....	6
3 Algemene technische gegevens van de overdekte podia.....	7
3.1 Algemeen.....	7
3.2 Bijzonderheden.....	7
4 Basis instandhouding- en ontruimingsprotocol.....	8
5 Verklaring weeromstandigheden.....	9
6 Bijlage I: Tekening(en).....	11
7 Bijlage II: Ballastplan.....	16
8 Bijlage III: Riggingscapaciteit.....	17
9 Bijlage IV: Beheersmaatregelen (WMP; Wind Management Plan).....	18
10 Bijlage V: Zeilcertificaat.....	19
11 Bijlage VI: Berekening.....	20

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..

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P.O. Box 175

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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
Type zeil	PVC; artikel 8509 5240

1.2 Algemene gegevens;

Naam	ARTEMIS
Type	PROLYTE ARC 8x6
Configuratie(s)	8.28x6.21 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: 8.28x6.21 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.

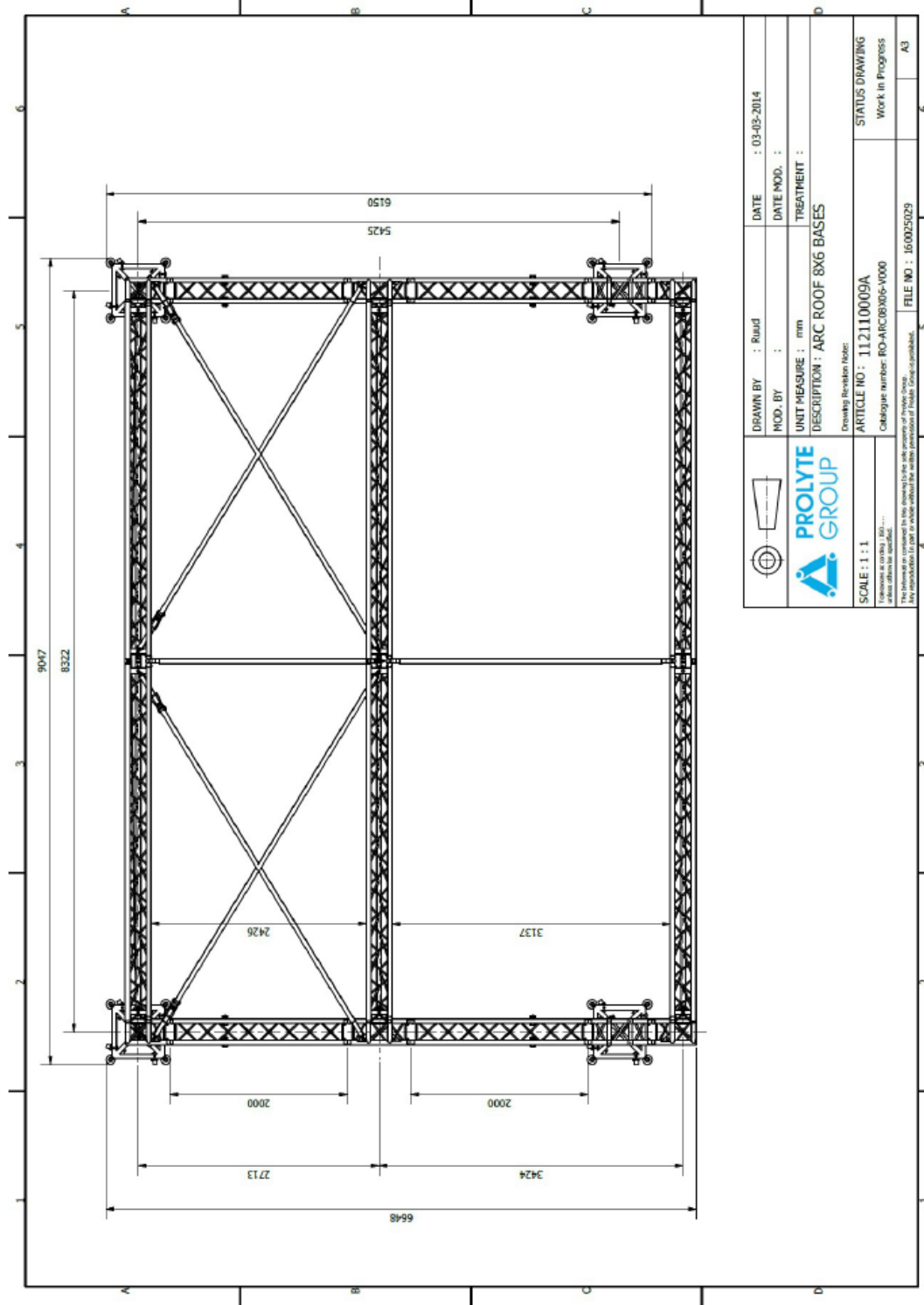
De windkracht volgens de Schaal van Beaufort (bron: KNMI). De schaal van Beaufort wordt gebruikt voor de gemiddelde windsnelheid, over minstens 10 minuten gemeten, niet voor de snelheid van rukwinden/windstoten (piekwind).

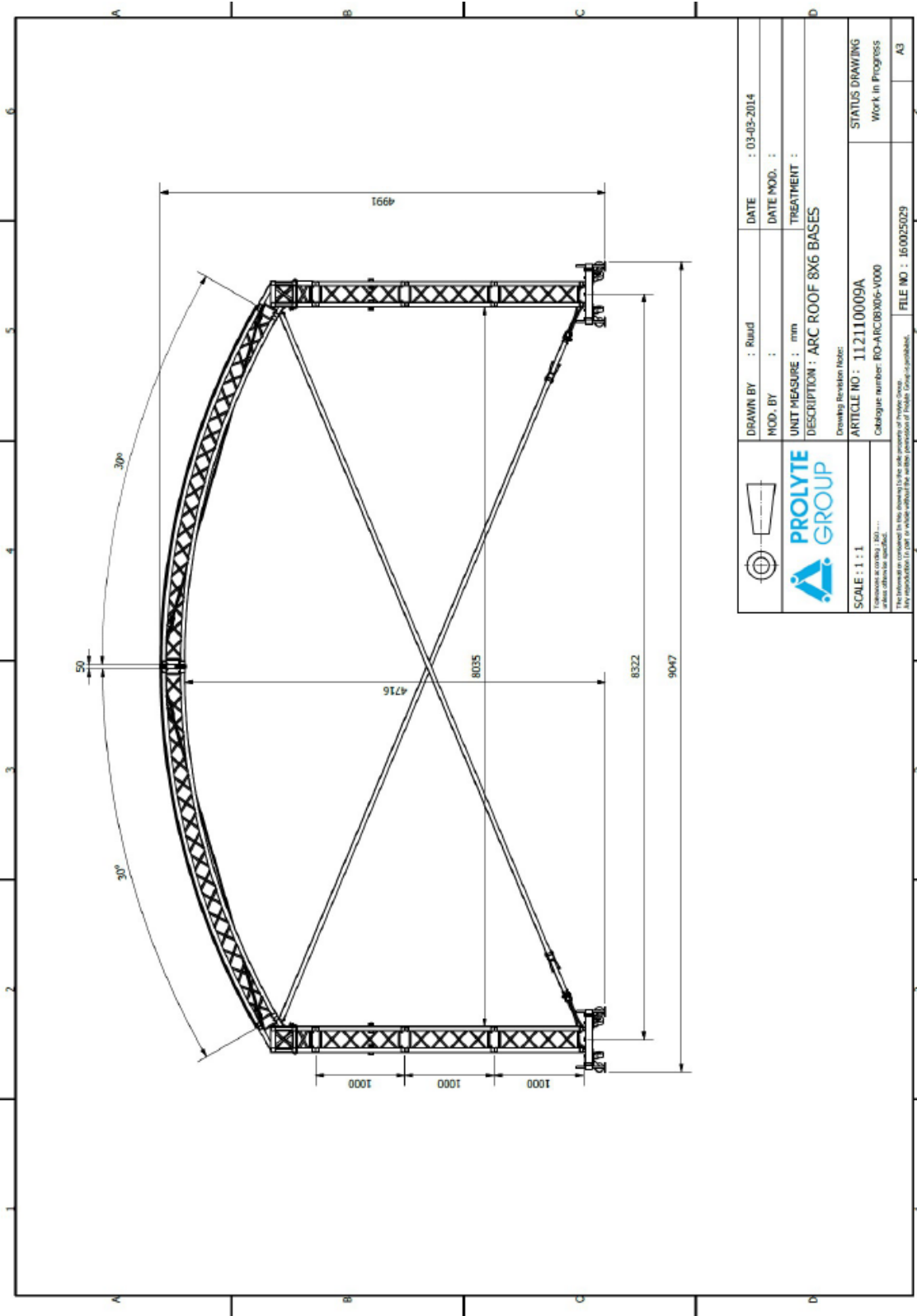
Kracht	Benaming van KNMI	Benaming in Zeevaart	Snelheid in km/h*	Snelheid in m/s*	Snelheid in knopen
0	Stil	Windstil	0-1	0-0,2	0-1
1	Zwak	Flauw en stil	1-5	0,3-1,5	1-3
2	Zwak	Flauwe koelte	6-11	1,6-3,3	4-6
3	Matig	Lichte koelte	12-19	3,4-5,4	7-10
4	Matig	Matige koelte	20-28	5,5-7,9	11-16
5	Vrij krachtig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

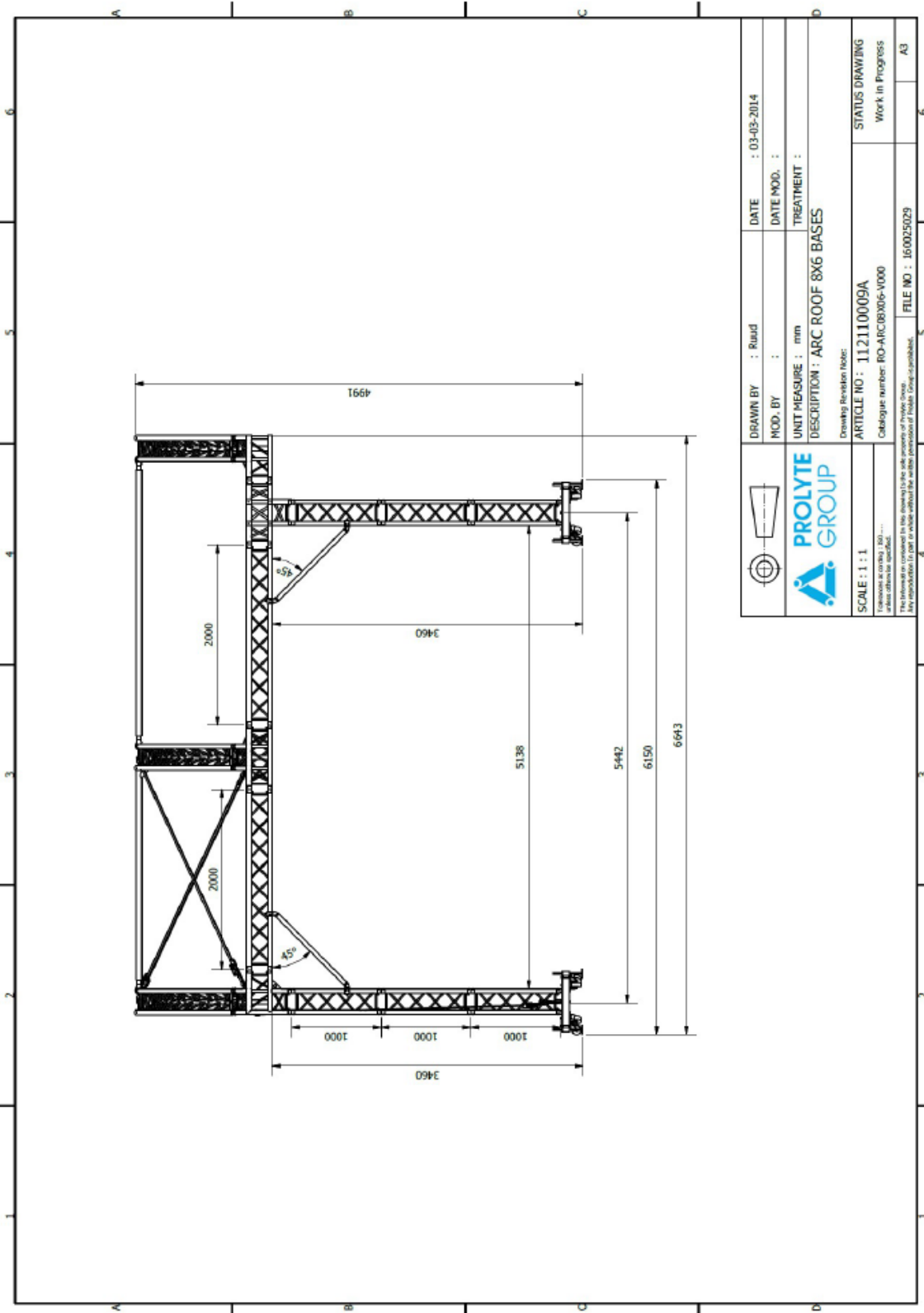
Organisator kan ook bij onder andere Meteovista en Meteoconsult gedurende de duur van het evenement een weerbewakingscontract aangaan om nog beter op de hoogte te zijn van de lokale weersomstandigheden.


6 Bijlage I: Tekening(en)

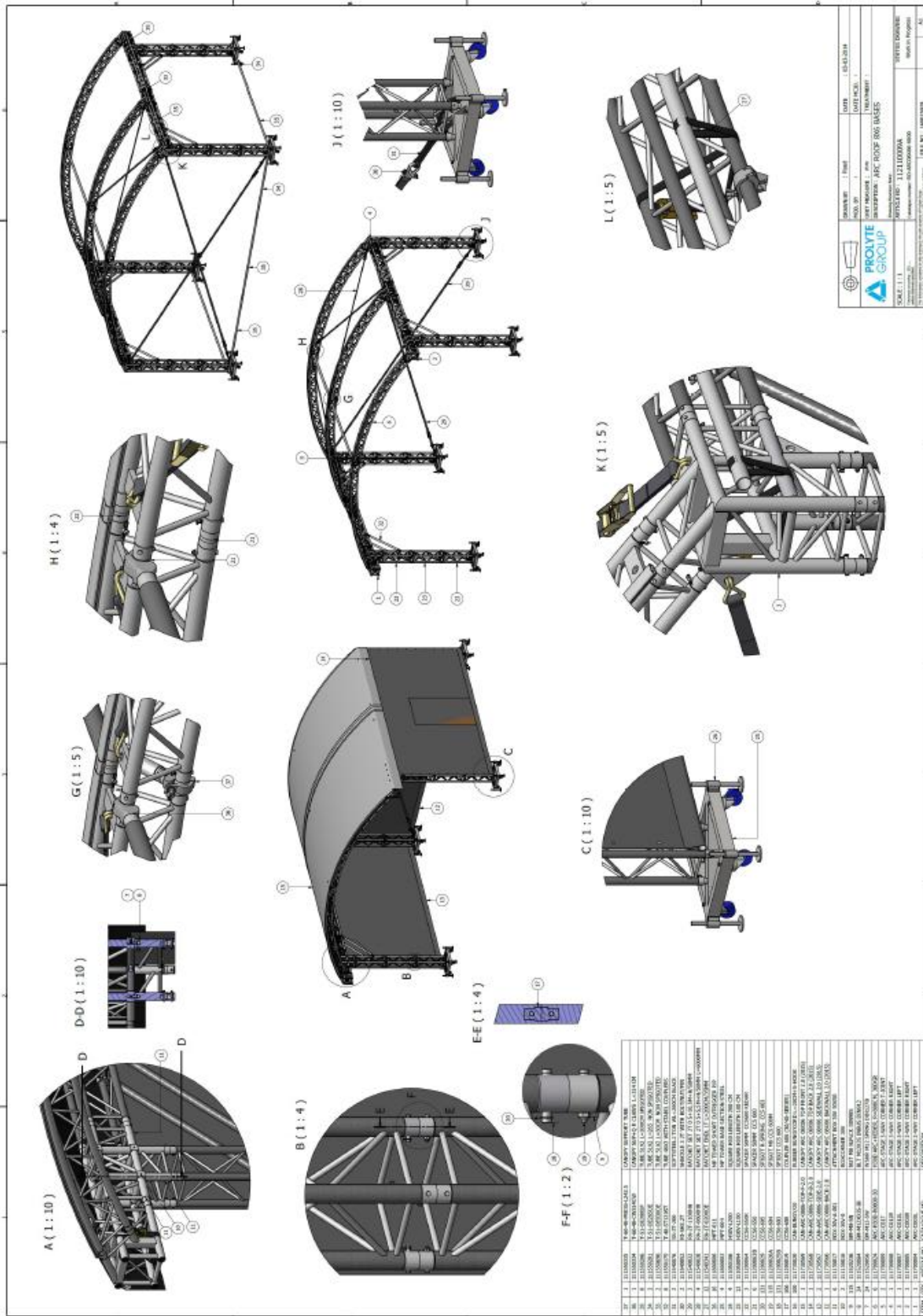


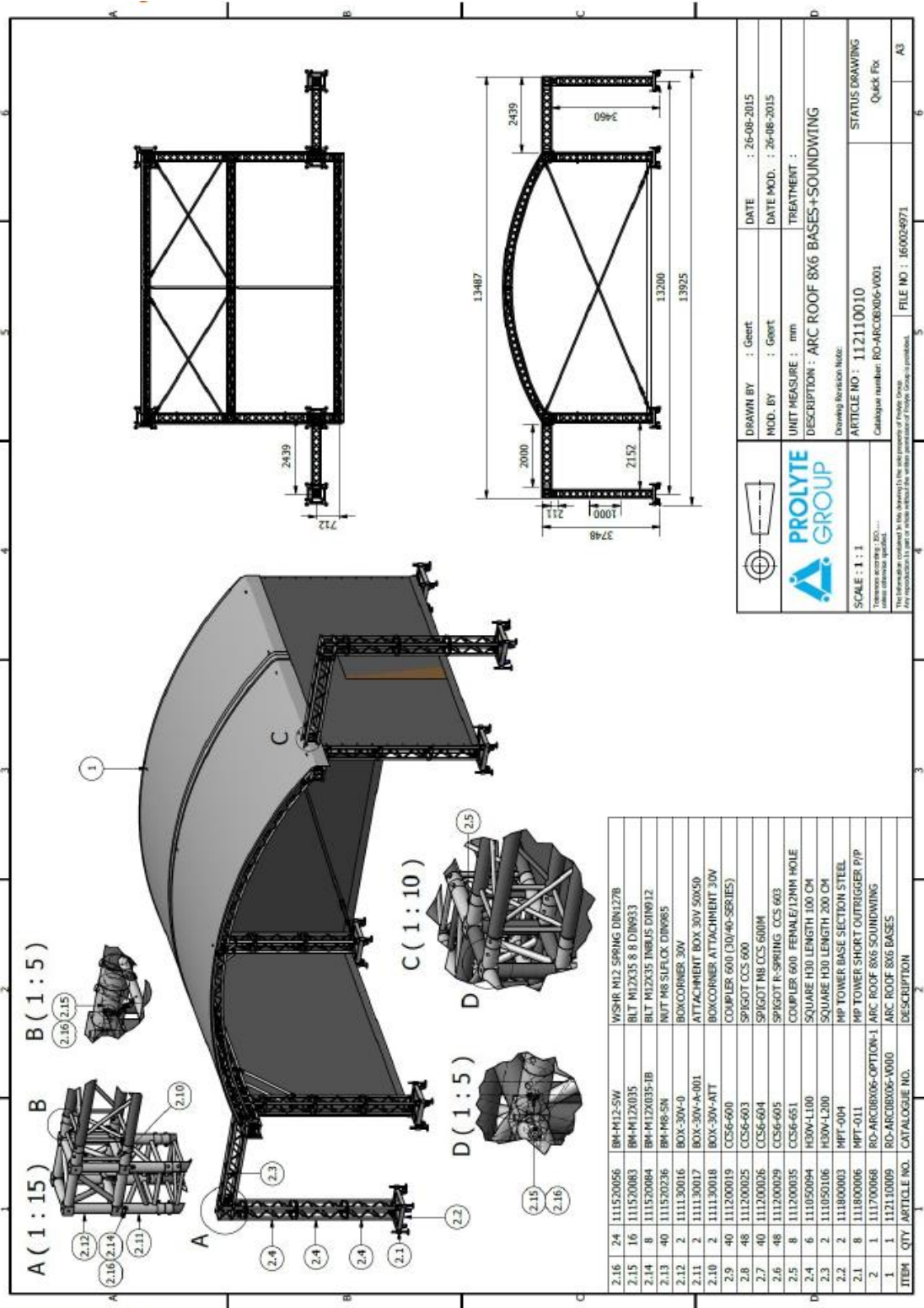


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	MOD. BY :	DATE MOD. :
	UNIT MEASURE : mm	TREATMENT :
	DESCRIPTION : ARC ROOF 8X6 BASES	
	Drawing Revision Note:	
	ARTICLE NO : 112110009A	STATUS DRAWING
	Catalogue number: BO-ARC/8X6-V000	Work in Progress
	SCALE : 1 : 1	FILE NO : 160025029
<small> To ensure accuracy, all dimensions are given in millimeters. All dimensions are rounded to the nearest millimeter. Any reproduction is done on a computer without the author's permission. (Alle afmetingen zijn in mm. Alle afmetingen zijn afgerond op de millimeter. Het kopiëren van dit tekening is niet toegestaan.) </small>		
		6



	DRAWN BY : Ruud MOD. BY : UNIT MEASURE : mm DESCRIPTION : ARC ROOF 8X6 BASES Drawing Revision Code: ARTICLE NO : 112110009A Catalogue number: RO-ARC08X06-V000 This information is contained in the drawing by the sole property of Prolyte Group. It is not to be used for other projects or other products of Prolyte Group or its subsidiaries.	DATE : 03-03-2014 DATE MOD. : TREATMENT :	STATUS DRAWING Work in Progress
SCALE : 1 : 1	FILE NO : 1610025029	6	A3





ITEM	QTY	ARTICLE NO.	CATALOGUE NO.	DESCRIPTION
2.16	24	111520056	BM-M12-SW	WISHR M12 SPRING DIN1278
2.15	16	111520035	BLT M12X35 8 R DIN933	BLT M12X35 8 R DIN933
2.14	8	111520084	BM-M12X35-IB	BLT M12X35 INBUS DIN912
2.13	40	111520236	BM-M6-SW	NUT M6 SUPLOC DIN985
2.12	2	111130016	BOX-30V-0	BOXCORNER 30V
2.11	2	111130017	BOX-30V-A-001	ATTACHMENT BOX 30V 50X50
2.10	2	111130018	BOX-30V-ATT	BOXCORNER ATTACHMENT 30V
2.9	40	111200019	CC56-600	COUPLER 600 (30/40-SERIES)
2.8	48	111200025	CC56-603	COUPLER 600 (30/40-SERIES)
2.7	40	111200026	CC56-604	COUPLER 600 (30/40-SERIES)
2.6	48	111200029	CC56-605	COUPLER 600 (30/40-SERIES)
2.5	8	111200035	CC56-651	COUPLER 600 FEMALE/12MM HOLE
2.4	6	111050094	H30W-L100	SQUARE H30 LENGTH 100 CM
2.3	2	111050106	H30W-L200	SQUARE H30 LENGTH 200 CM
2.2	2	111800003	MPT-004	MP TOWER BASE SECTION STEEL
2.1	8	111800006	MPT-011	MP TOWER SHORT OUTRIGGER PIP
2	1	111700068	RO-ARC080005-OPTION-1	ARC ROOF 8X6 SOUNDWING
1	1	112110009	RO-ARC080005-V000	ARC ROOF 8X6 BASES

PROLYTE GROUP

SCALE : 1 : 1

ARTICLE NO : 112110010

DESCRIPTION : ARC ROOF 8X6 BASES+SOUNDWING

UNIT MEASURE : mm

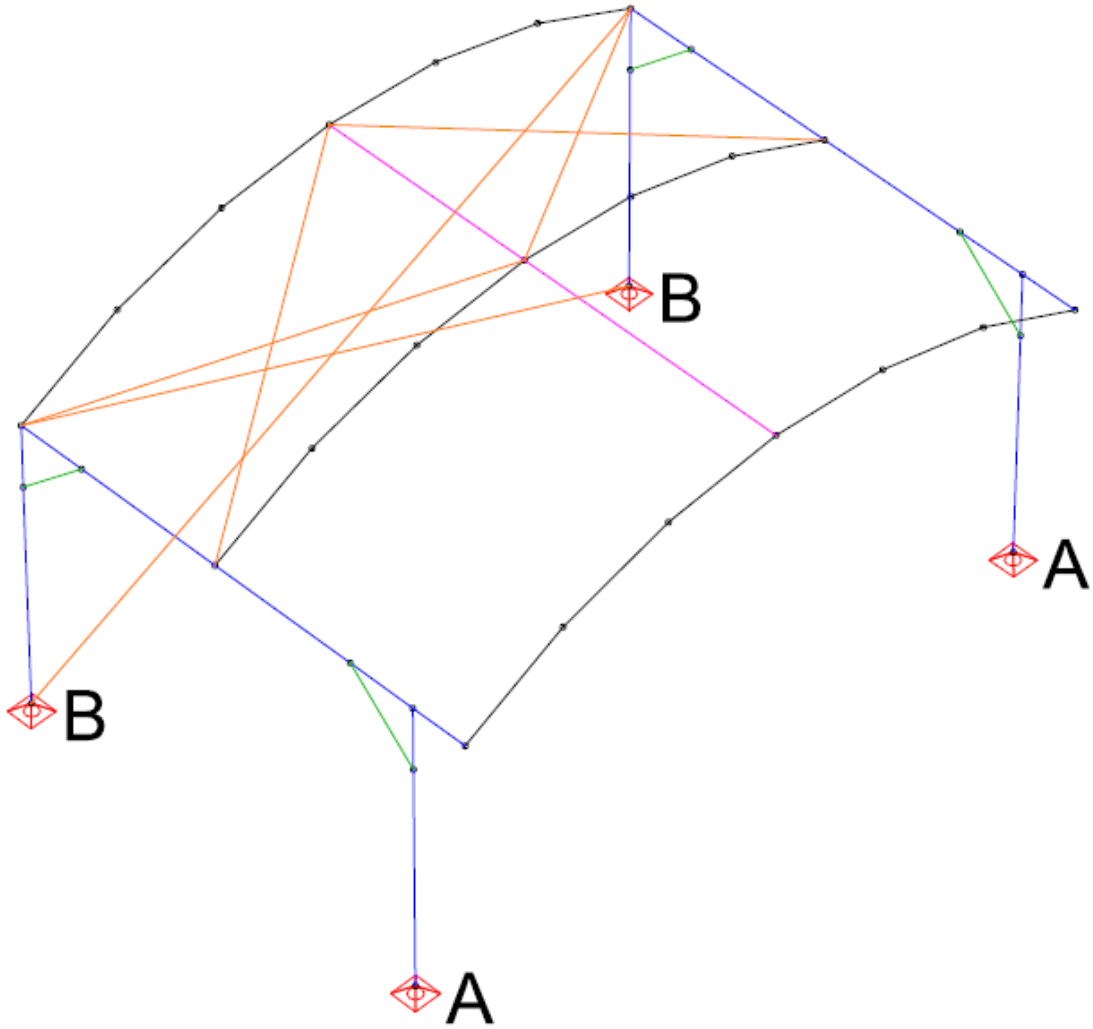
DATE : 26-08-2015

DATE MOD. : 26-08-2015

STATUS DRAWING : Quick Fix

FILE NO : 160024971

7 Bijlage II: Ballastplan

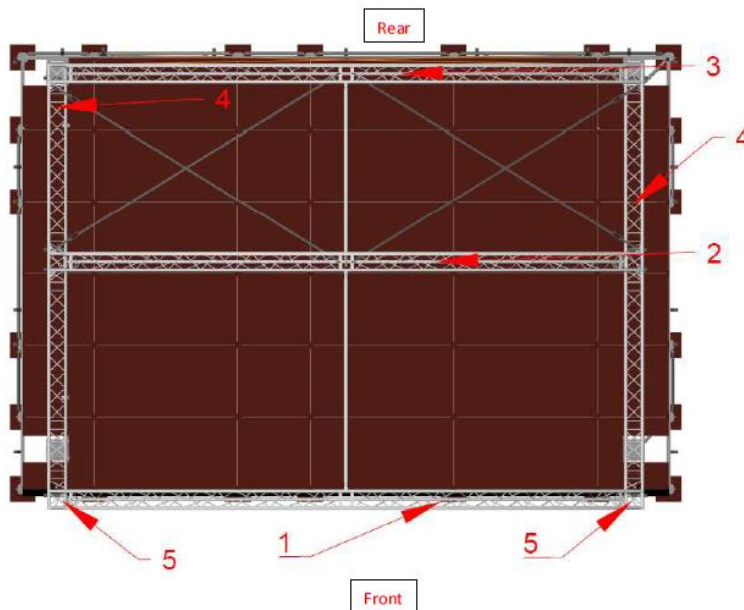


supports	A	B
ballast 8x6m	1500 kg (1900 kg)	1300 kg (1800 kg)

8 Bijlage III: Riggingscapaciteit

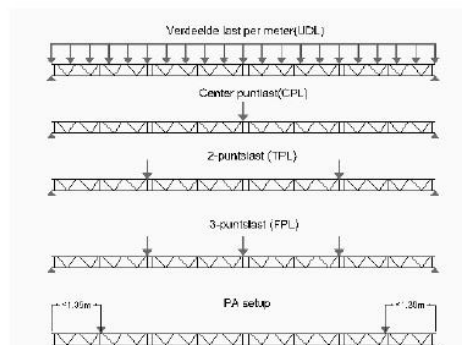


Riggingscapaciteit Artemis 54



Naam	Waarde	Maximale Gebruiksbelasting per punt				
		1	2	3	4	5
A. Verdeelde last per meter (UDL)	kg/m	50	50	50	50	-
B. Center puntlast (CPL)	kg	250	350	350	-	300
C. 2-puntslast (TPL)	kg	165	165	165	-	300
C. 3-puntslast (TPL)	kg	110	110	110	-	300

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



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

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

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

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

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

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

1. 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	16,7 m/s	7	30 m/s	0.455 kN/m ²
Onbebouwd	22,1 m/s	9	30 m/s	0.455kN/m ²
Bebouwd	23,6 m/s	9	30 m/s	0.455kN/m ²

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

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

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

10 Bijlage V: Zeilcertificaat



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.:	13288	REVISION 01
PROJECT:	STAGEROOF PROLYTE ARC-ROOF 8x6m-6x4m	
CUSTOMER:	Prolyte Group	
	Industriepark 9 9351 PA Leek Niederlande	

PREPARED:



DIPL.-ING. OLIVER SPORYS

DATE:

30.11.2015

PAGES:

1 – 170

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IBAN: DE90 3905 0000 0000 0234 08
BIC: AACSD33

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GESCHÄFTSFÜHRER: KRASENBRINK + BASTIANS VERWALTUNGSGESELLSCHAFT MBH
PERSÖNLICH HAFTENDE GESELLSCHAFTER: KRASENBRINK+BASTIANS VERWALTUNGSGESELLSCHAFT MBH ■ LOTHRINGERSTR. 37 ■
52062 AACHEN ■ HANDELSREGISTER AACHEN ■ HRB 17597 ■ AMTSGERICHT AACHEN

CONTENTS

1	Preamble	3
1.1	Applicable standards	3
1.2	Supporting documents	3
1.3	Construction elements	4
1.4	General preliminary notes	5
1.5	Terms of use	6
1.6	Drawings	8
1.7	Loading assumption	24
1.8	Permissible payloads	28
1.9	Necessary ballast load	34
	Structural calculation	38
2	Statical system	38
3	Loading	41
4	Calculation	65
5	Proofs	82
6	Sound Wings	97
7	Ballast load	99
8	Layher podium	118
9	Easyframe B podium	148
10	Truss data	167

PROJECT:
PROLYTE ARC-ROOF 8x6 - 6x4m

PROJECT-NO.:
13288–Revision 01

CUSTOMER:
PROLYTE GROUP

DATE:
30.11.2015

1 PREAMBLE

1.1 APPLICABLE STANDARDS

DIN EN 1990/ Eurocode 0	Basis of structural design
DIN EN 1991/ Eurocode 1	Actions on structures
DIN EN 1993/ Eurocode 3	Design of steel structures
DIN EN 1999/ Eurocode 9	Design of aluminium structures
DIN EN 13814	Fairground and amusement park machinery and structures
DIN EN 12385-4	Steel wire ropes

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

1.2 SUPPORTING DOCUMENTS

Technical data of the used truss systems.

The allowable loads and internal forces of the used truss system have been found by Krasenbrink + Bastians in an extra structural report.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.3 CONSTRUCTION ELEMENTS

Roof girders, curved:

Prolyte H30D
Alloy: EN AW-6082 T6

Columns, roof girders, groundring:

Prolyte H30V
Alloy: EN AW-6082 T6

Compression members roof :

Tube 50 x 4 / 60 x 4
Alloy: EN AW-6082 T6

Struts sidewalls:

Tube 48 x 3
Alloy: EN AW-6082 T6

Podium:

LAYHER Allround scaffolding system
Steel: S235 JR(H)

Easyframe B podium system
Alloy: EN AW-6082 T6
Steel: 9SMn28K, S235JR

Guy wires:

Ø8mm, e.g. wire class 6 x 19, 1770 N/mm²
with steel inlay

The specifications of the steel cables are only examples.
Equal constructions are possible.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.4 GENERAL PRELIMINARY NOTES

This report concerns a stage roof structure for Prolyte Group.
The roof can be assembled in 2 sizes: 8x6m and 6x4m, all with a maximum total height of 4,99m.

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

The whole structural framework consists of Aluminium trusses made by the company Prolyte, geometry is shown in chapter 1.6 and 2.

The roof area is enclosed with canopy, rear wall and sides can be closed with canopy or scrim walls, the wall canopy is fixed at the horizontal roof trusses as well as to the towers.

The structure is stiffened by means of guy wires in roof and rear- walls.
Guy wires need to be adequately tensioned before use. The sidewalls are stabilized by the corner stiffening with diagonal struts.

The constructions can be build up with soundwings as well.

Alternatively the constructions can be build up on podiums made from Layher K2000+ or Easyframe B. System heights approx. 1,0m lead to a higher total height.

The podium is calculated for payloads of 500 kg/m².
The podium covering must be chosen adequately.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.5 TERMS OF USE

WIND MANAGEMENT

LOAD CASE " IN SERVICE"

The construction is calculated to withstand peak gust wind speed up to **20 m/s**. Above peak gust wind speed of 20 m/s measured in a height of 10m the wall canopies must be removed. If the peak gust wind speed is measured in a height less than 10m the wall canopies must be removed at peak gust wind speed of **18 m/s**.

The wind speed has to be measured at the top of the structure in an unobstructed surrounding area.

LOAD CASE " OUT OF SERVICE"

The construction with removed wall canopies and enclosed roof is calculated according to DIN EN 13814. It is calculated with a wind pressure of 0,44 kN/m².

SNOWLOAD

Snow loads are not taken into account.

The set up of the structure shall only be made in appropriate weather conditions or the roof shall be kept free of snow (e.g. heating).

PAYLOADS

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.

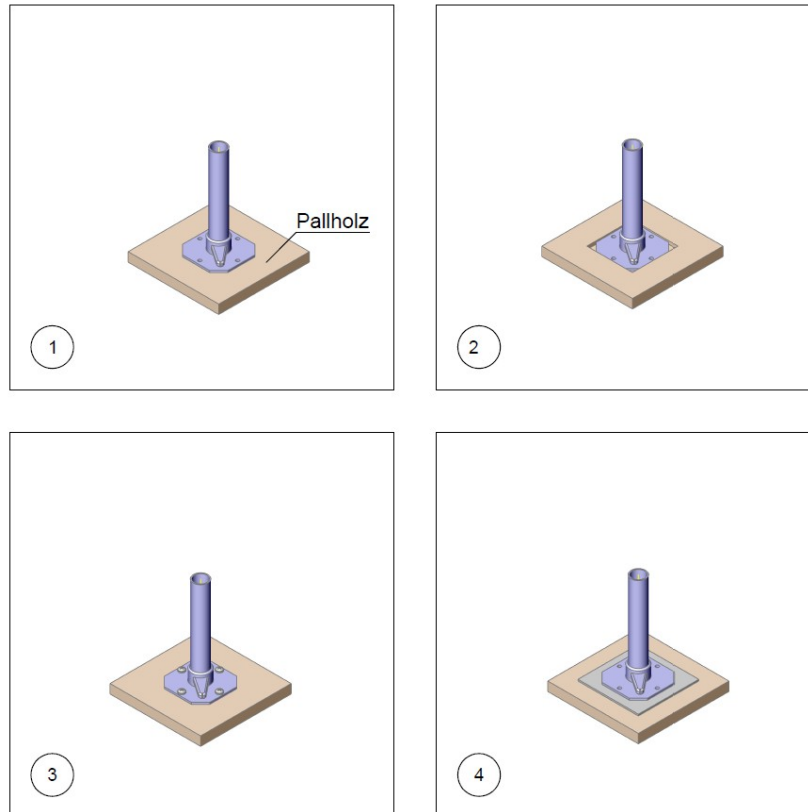
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

TIMBER SPREADER

drivable surface: timber spreader 300x300x20mm

In the case of softened soil there have to be chosen appropriate timber spreaders. (proof for 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 | $\mu = 0,60$ |

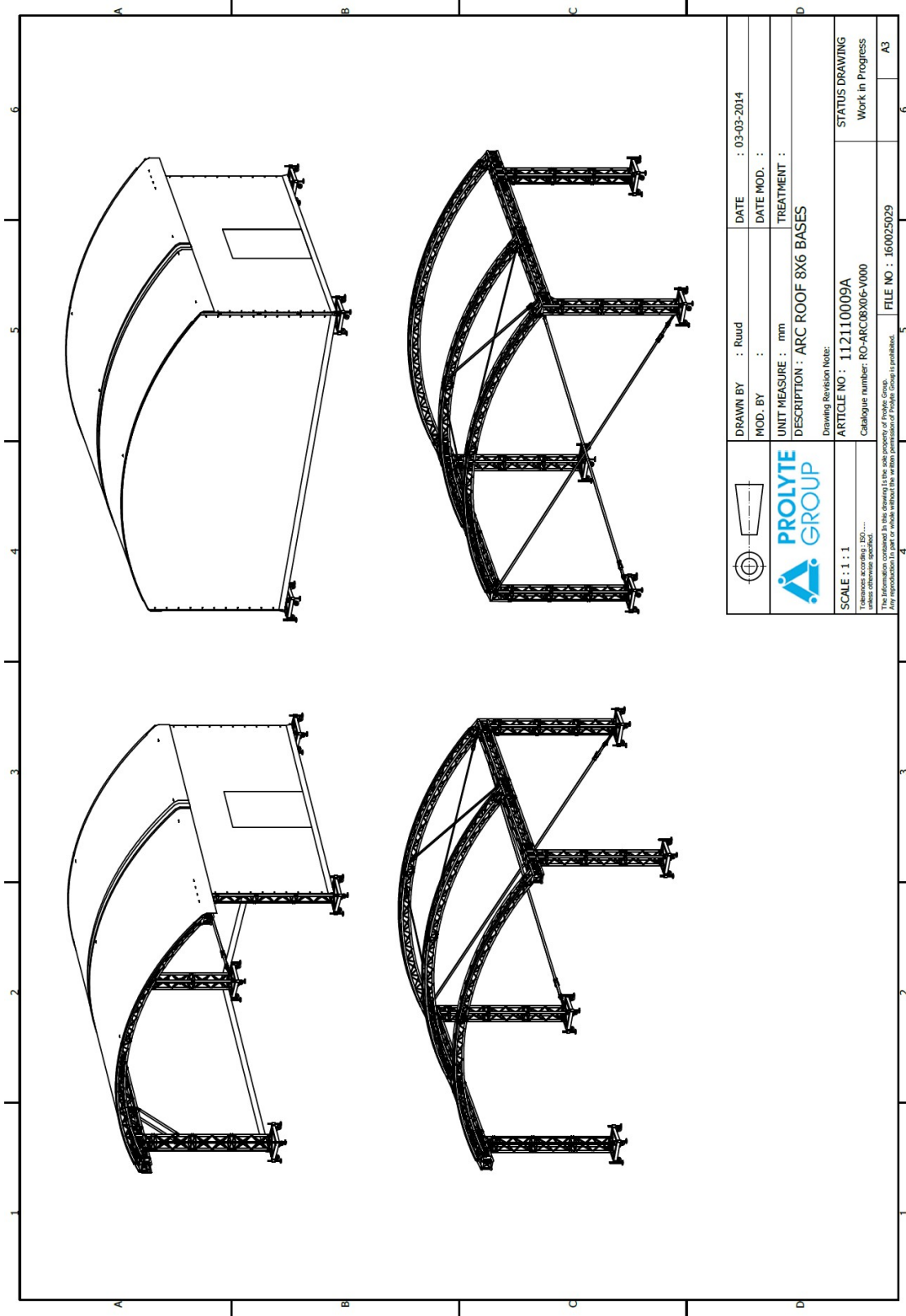
The timber spreader is laying on asphalt, concrete, paving, sand, gravel


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.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

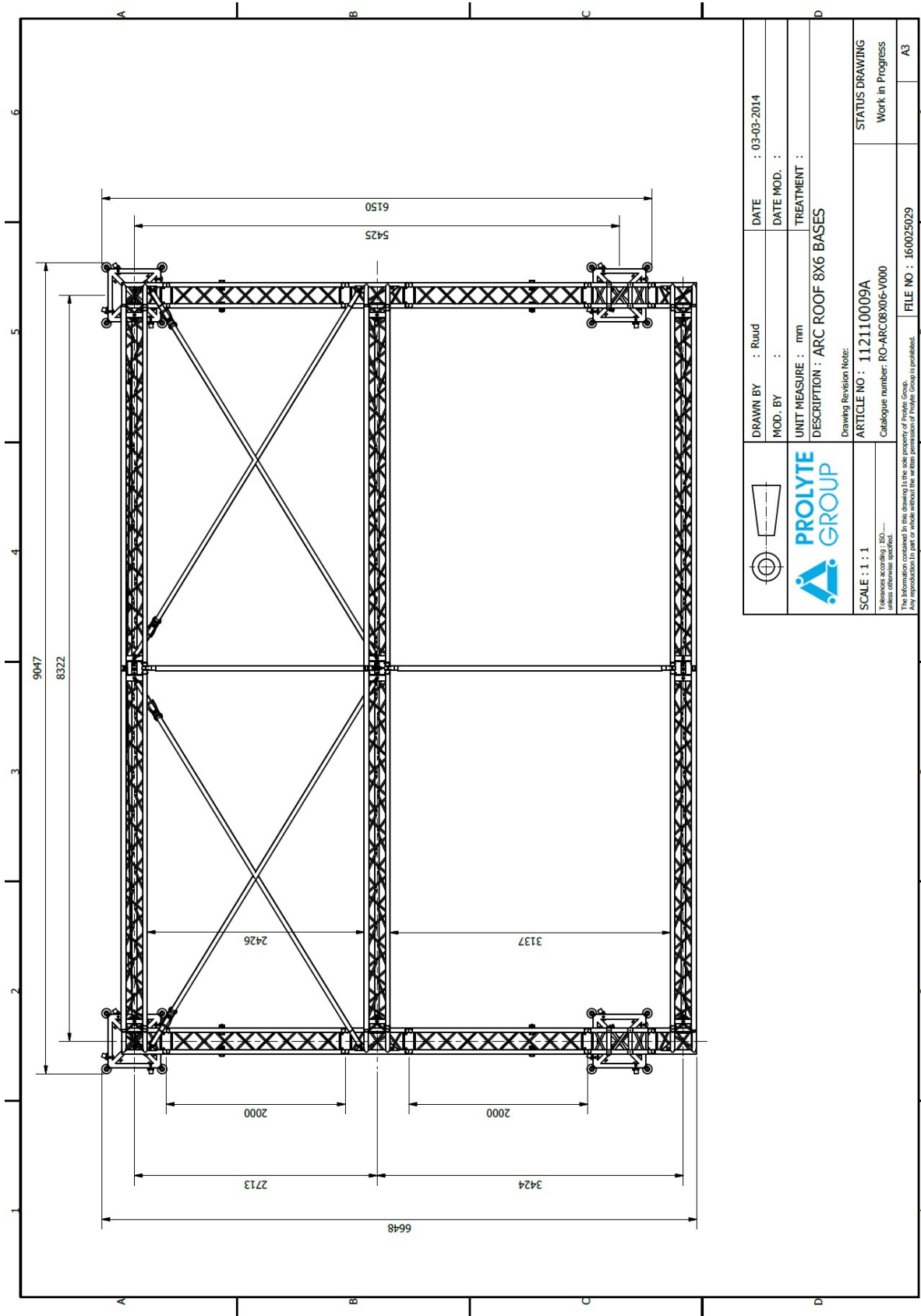
1.6 DRAWINGS


1.6.1 ROOF 8x6m



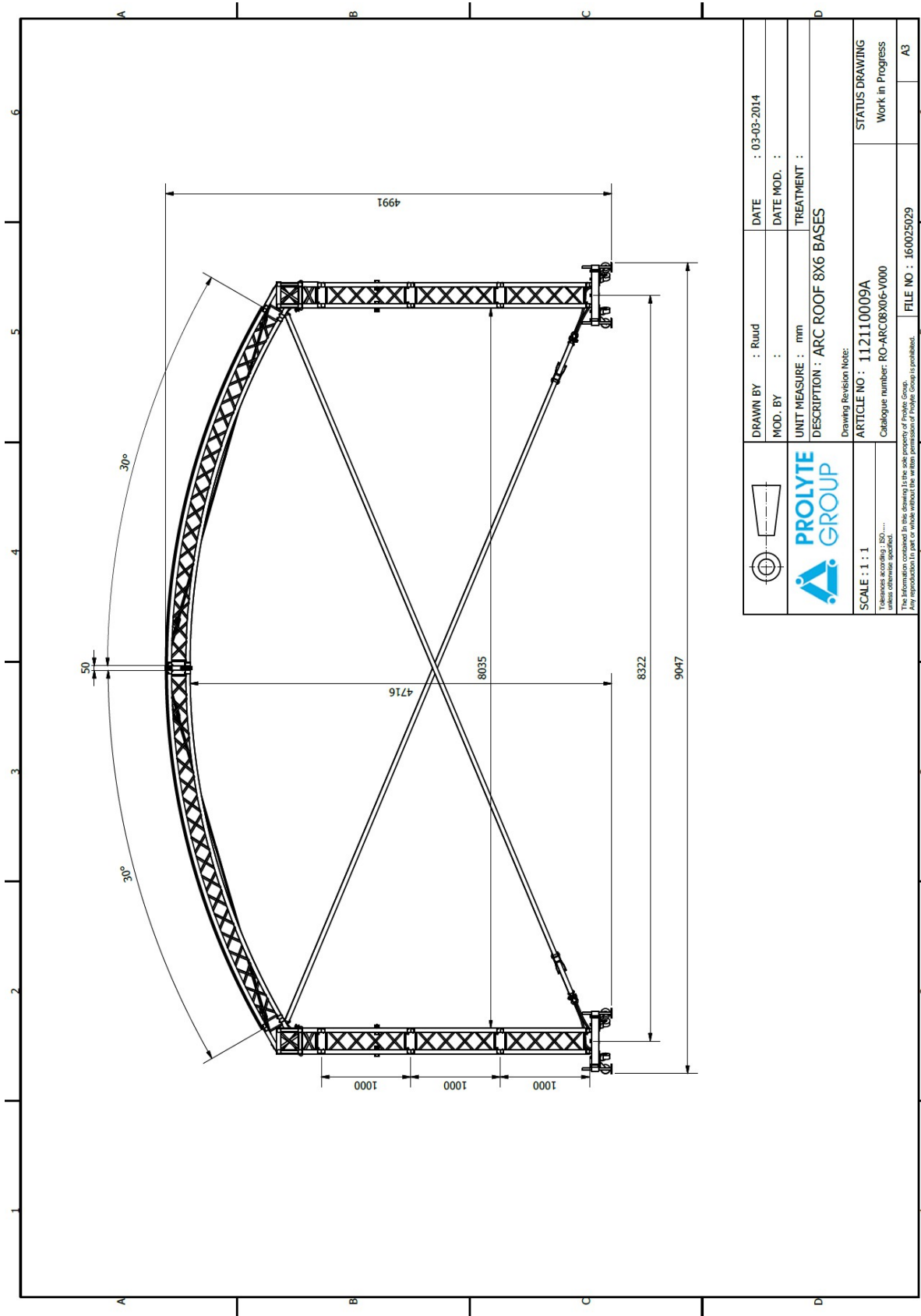
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Tolerances according to ISO 2768-M unless otherwise specified.	Catalogue number: RO-ARC08X06-V000	Work in Progress
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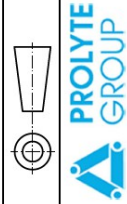
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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



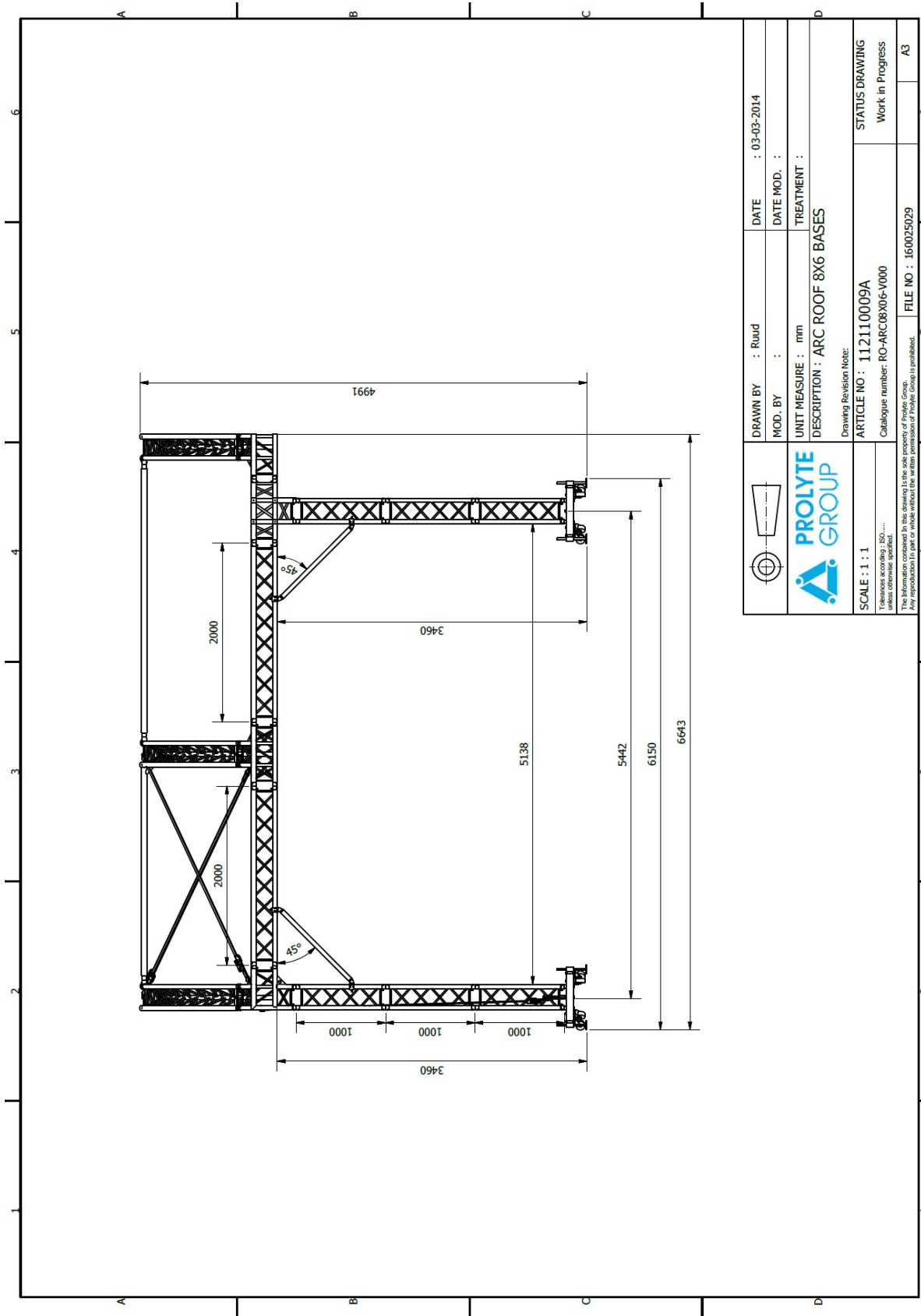
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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



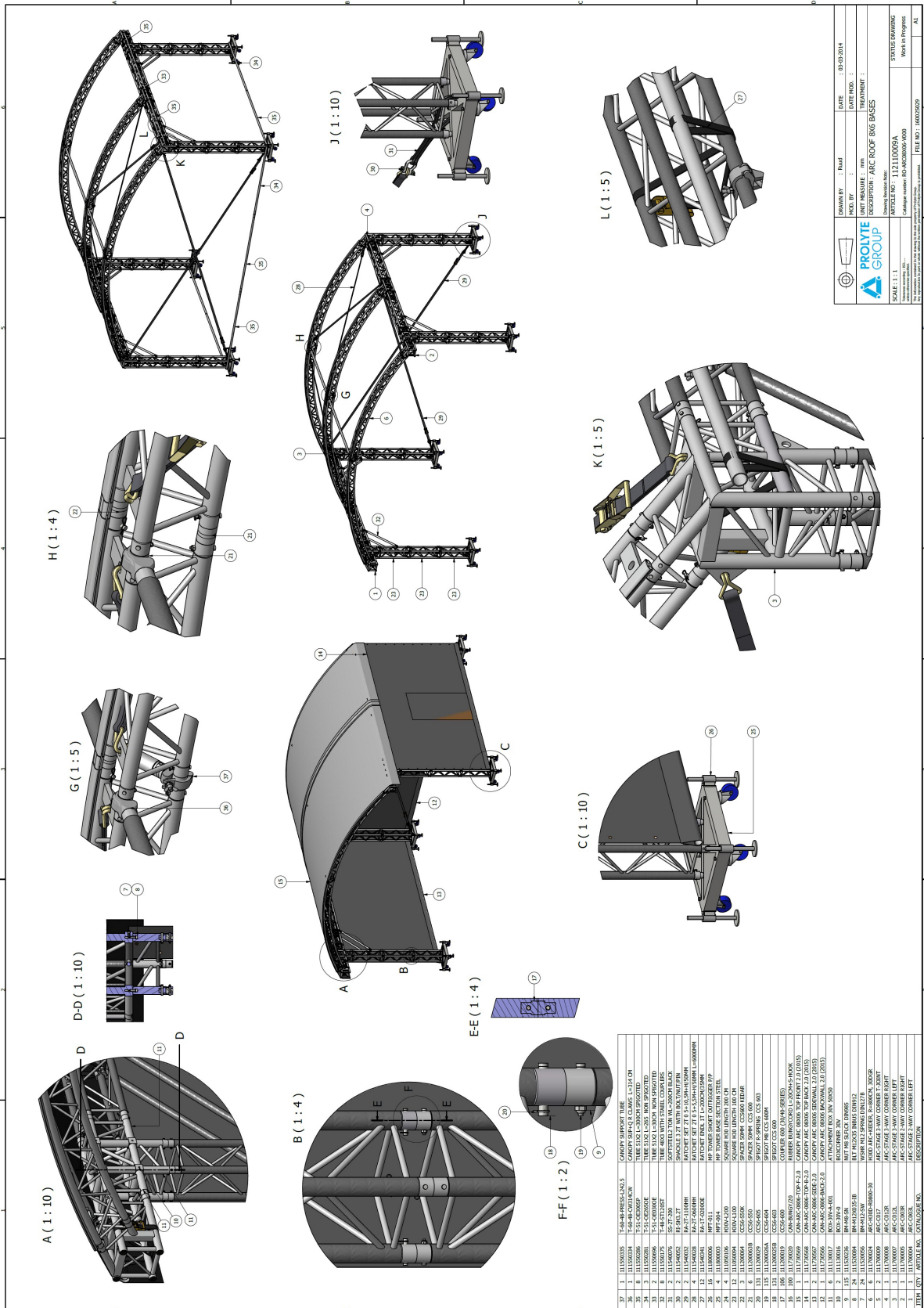
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The information contained in this drawing is the sole property of Prolyte Group. Any reproduction in part or whole without the written permission of Prolyte Group is prohibited.		FILE NO : 160025029
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PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



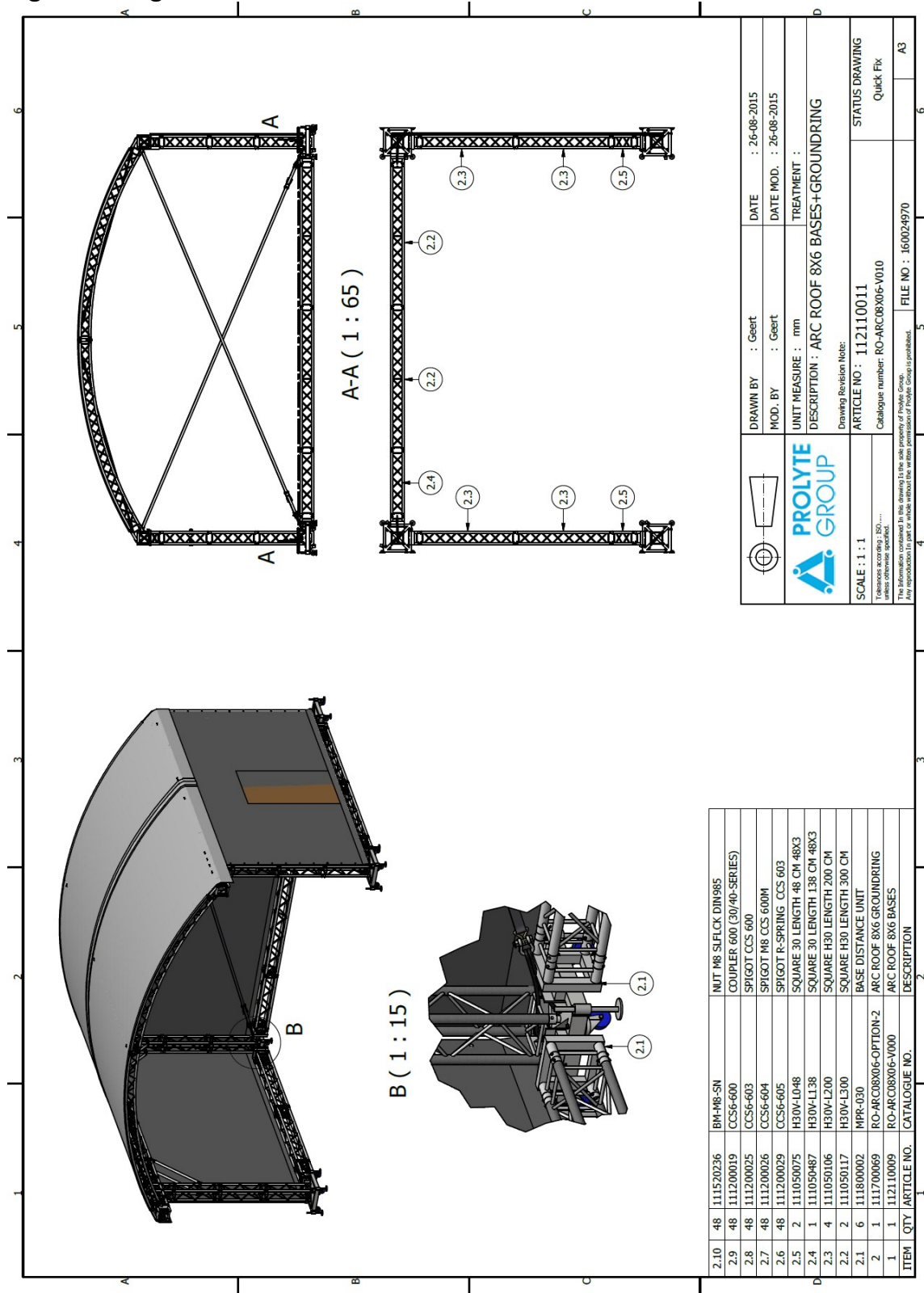
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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



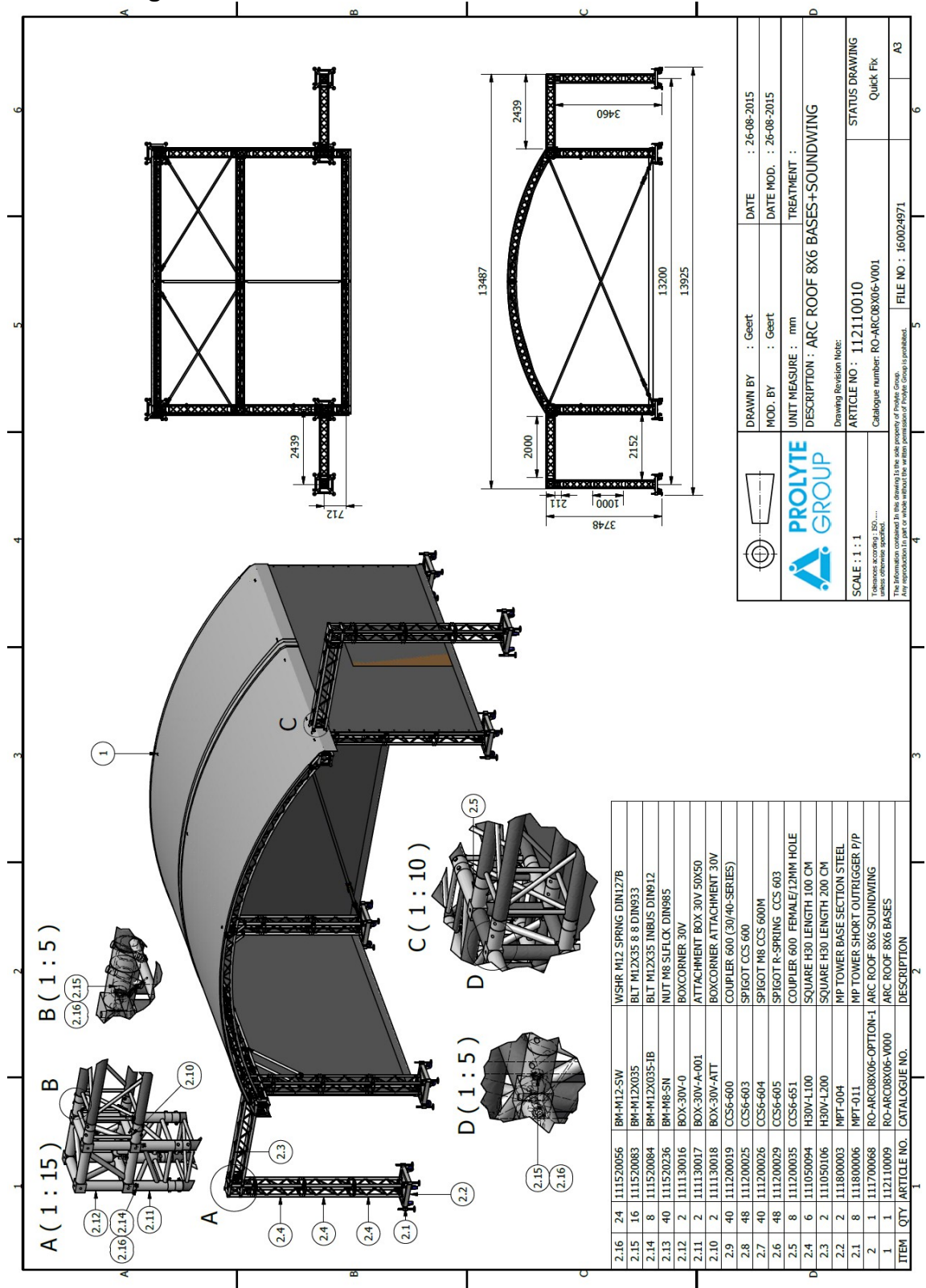
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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

with grounding



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

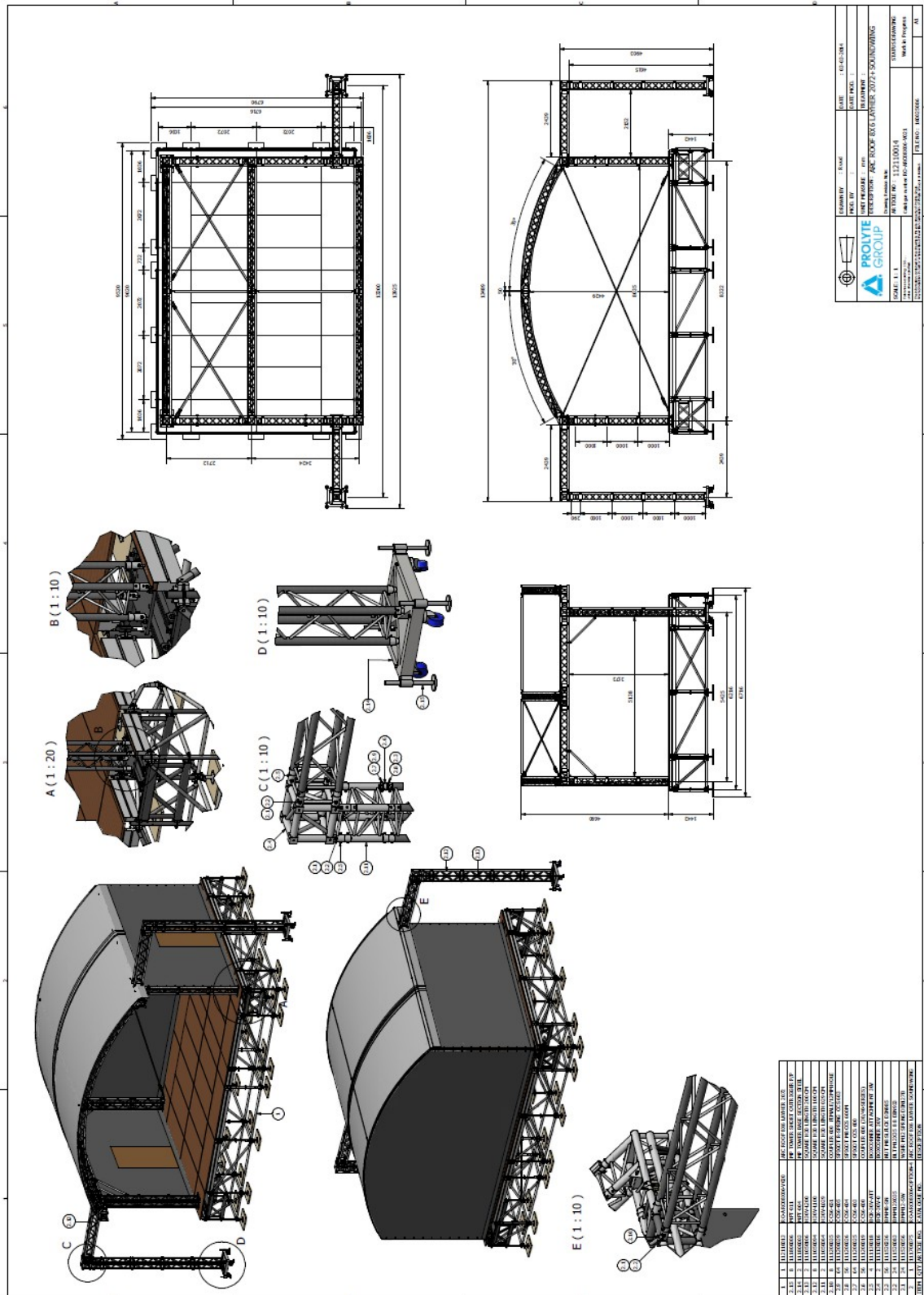
with soundwings



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MOD. BY : Geert	TREATMENT :
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Drawing Revision Note:	
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Catalogue number: RC-ARC08X06-V001	Quick Fix
FILE NO : 160024971	A3

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

on Layher/ (or Easyframe B) with soundwings



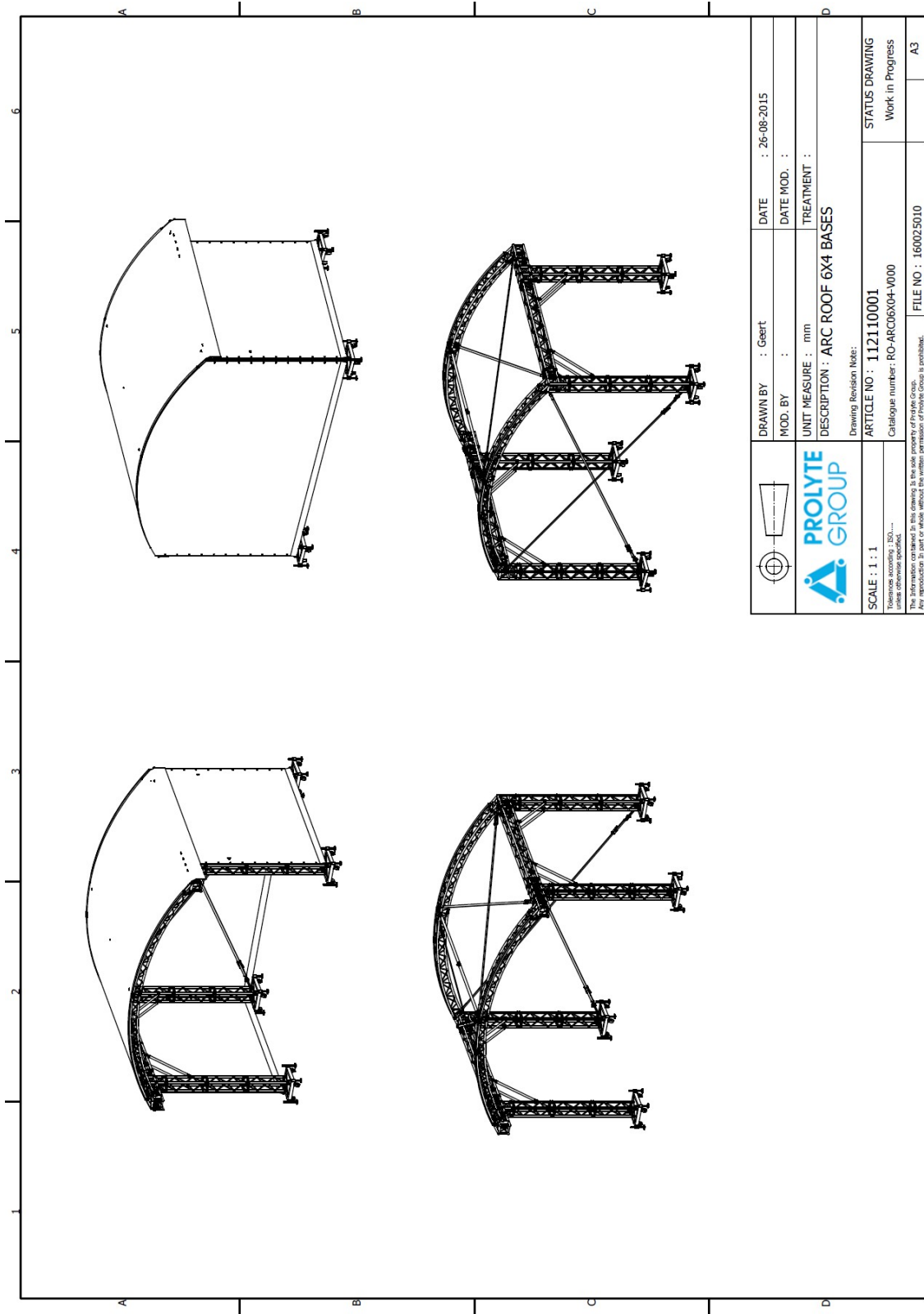
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PROLYTE ARC-ROOF 8x6 - 6x4m

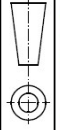
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PROLYTE GROUP

PROJECT-NO.:
13288-Revision 01

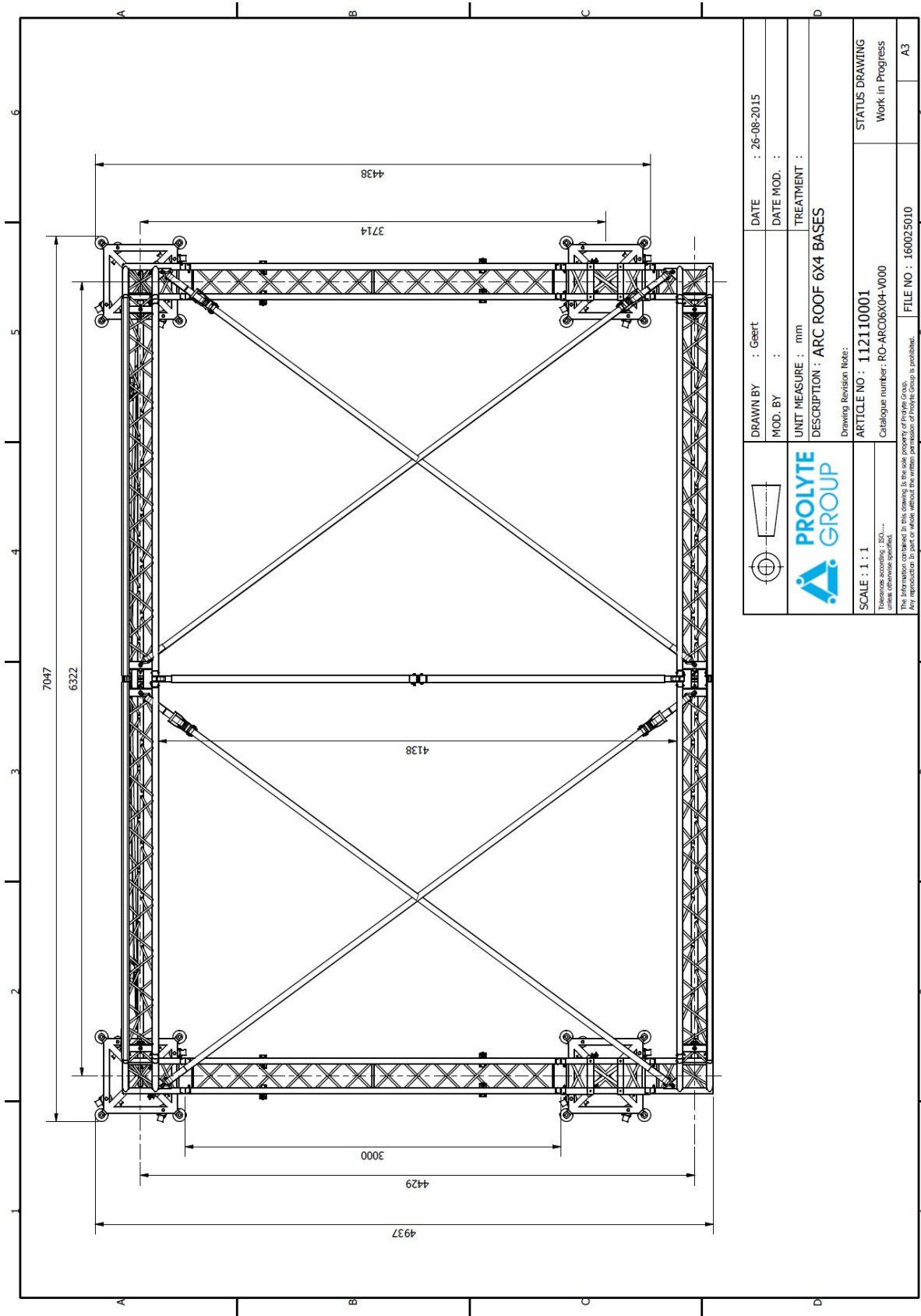
DATE:
30.11.2015


1.6.2 ROOF 6x4m



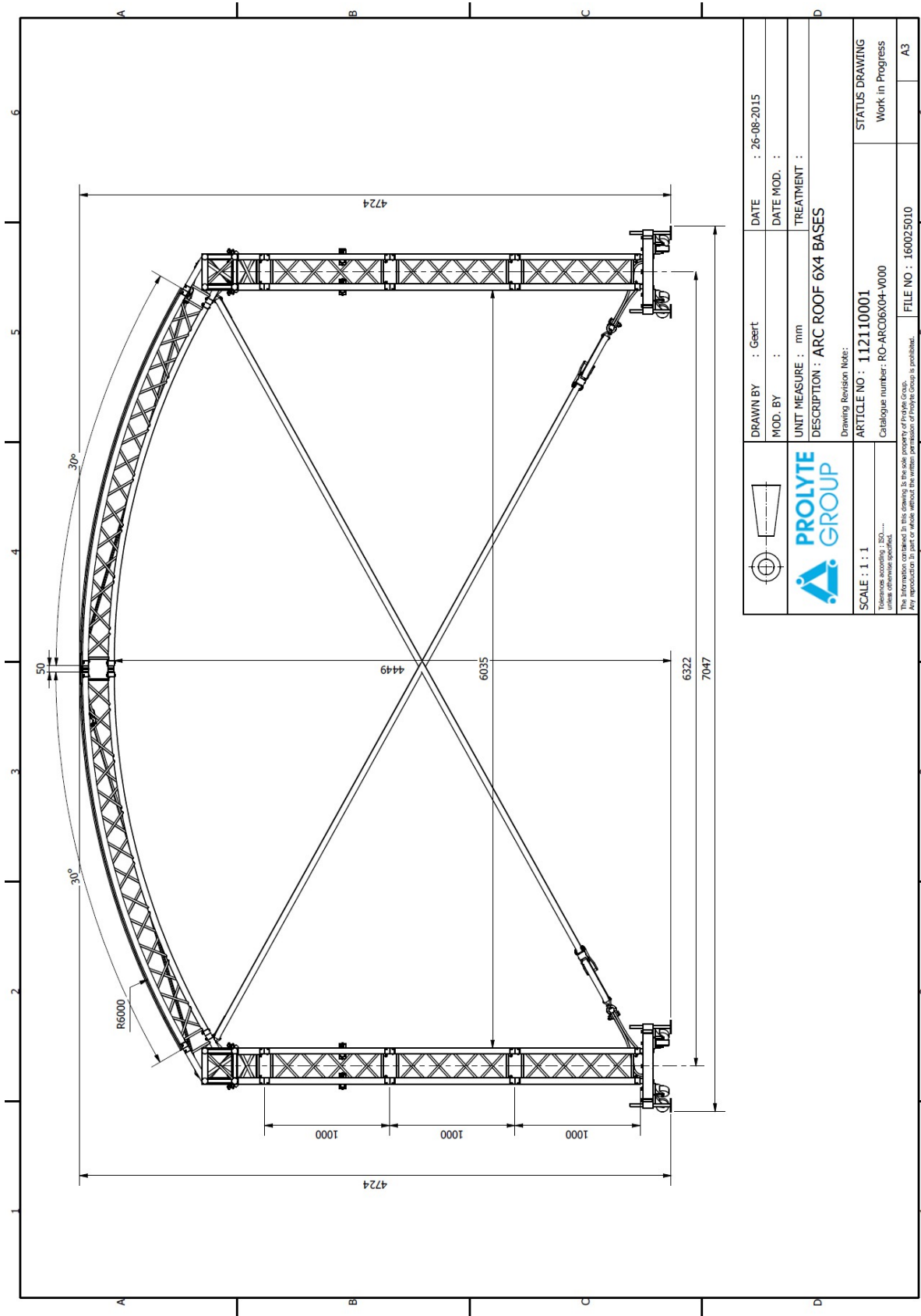
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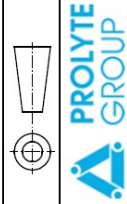
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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



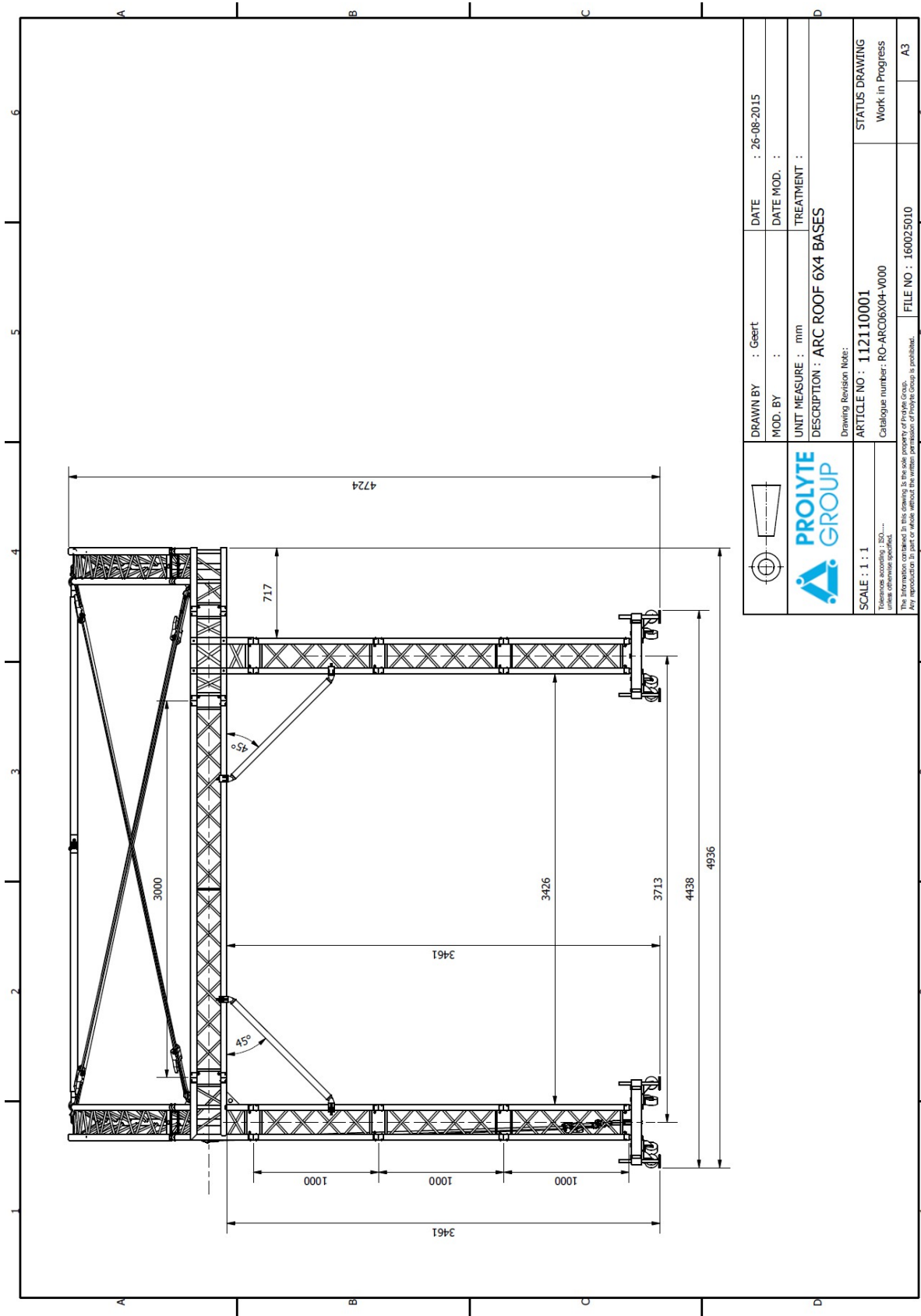
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	The information contained in this drawing is the sole property of Prolyte Group. Any reproduction in part or whole without the written permission of Prolyte Group is prohibited.			6
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PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
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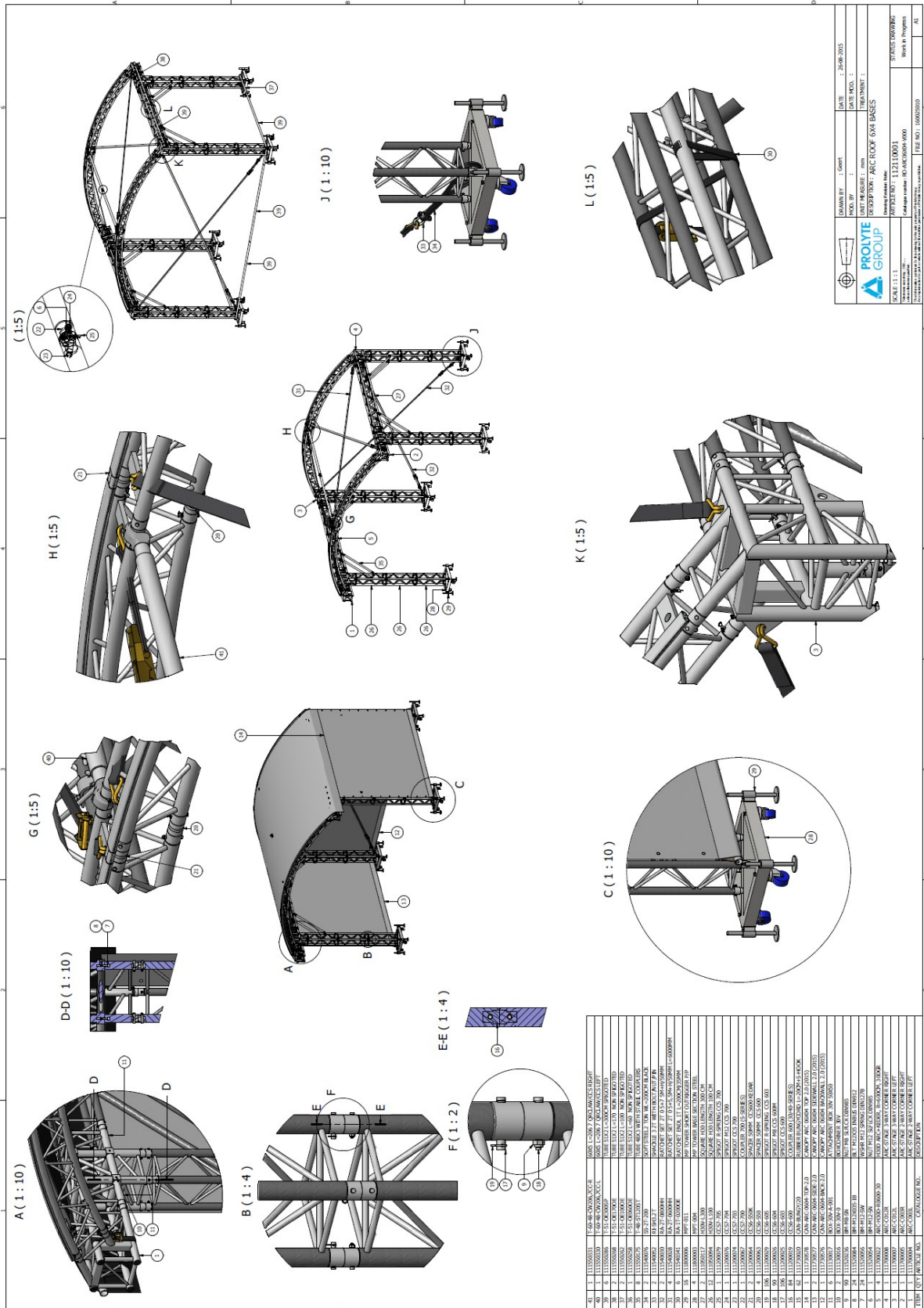
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PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



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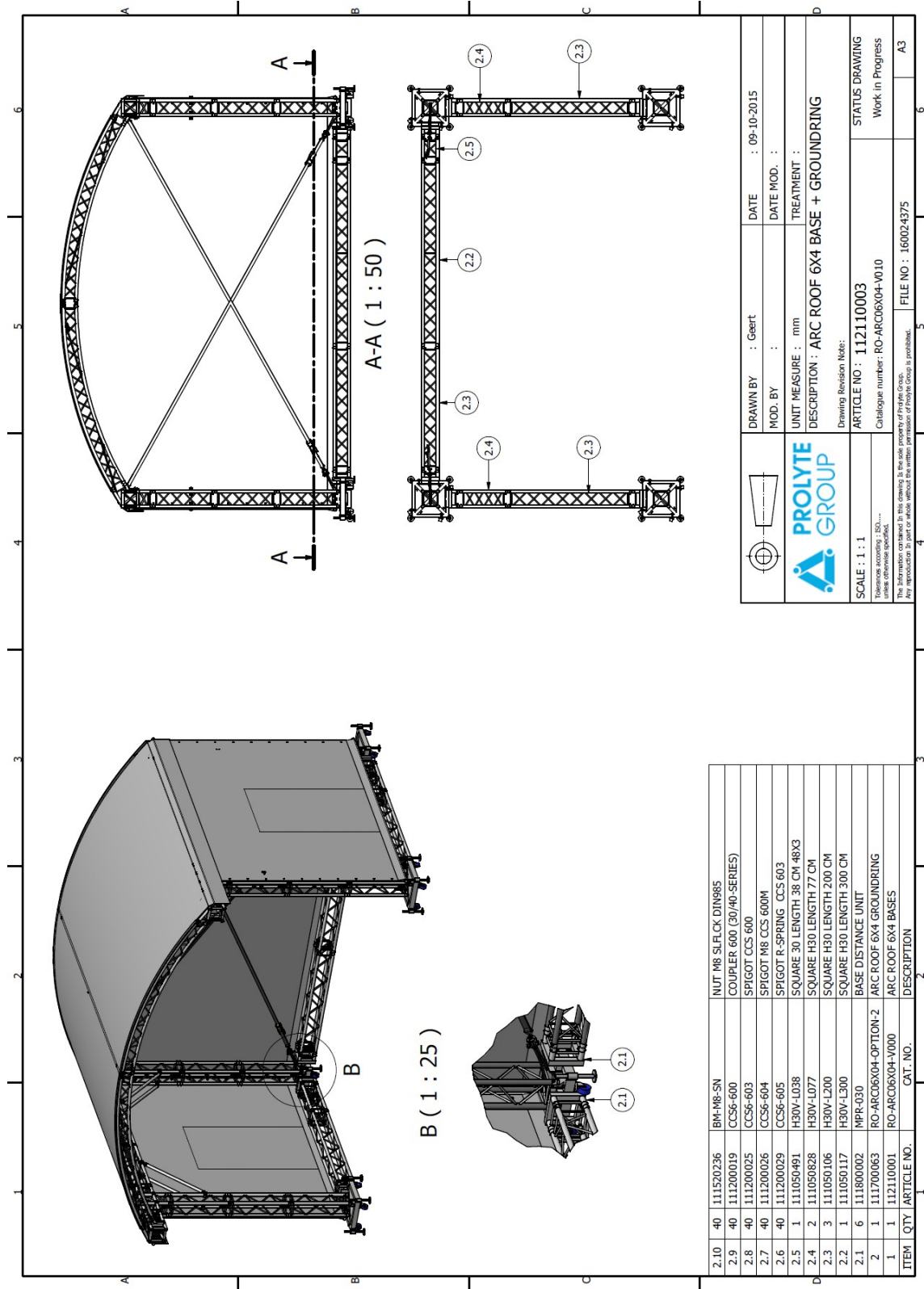
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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



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PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

with grounding

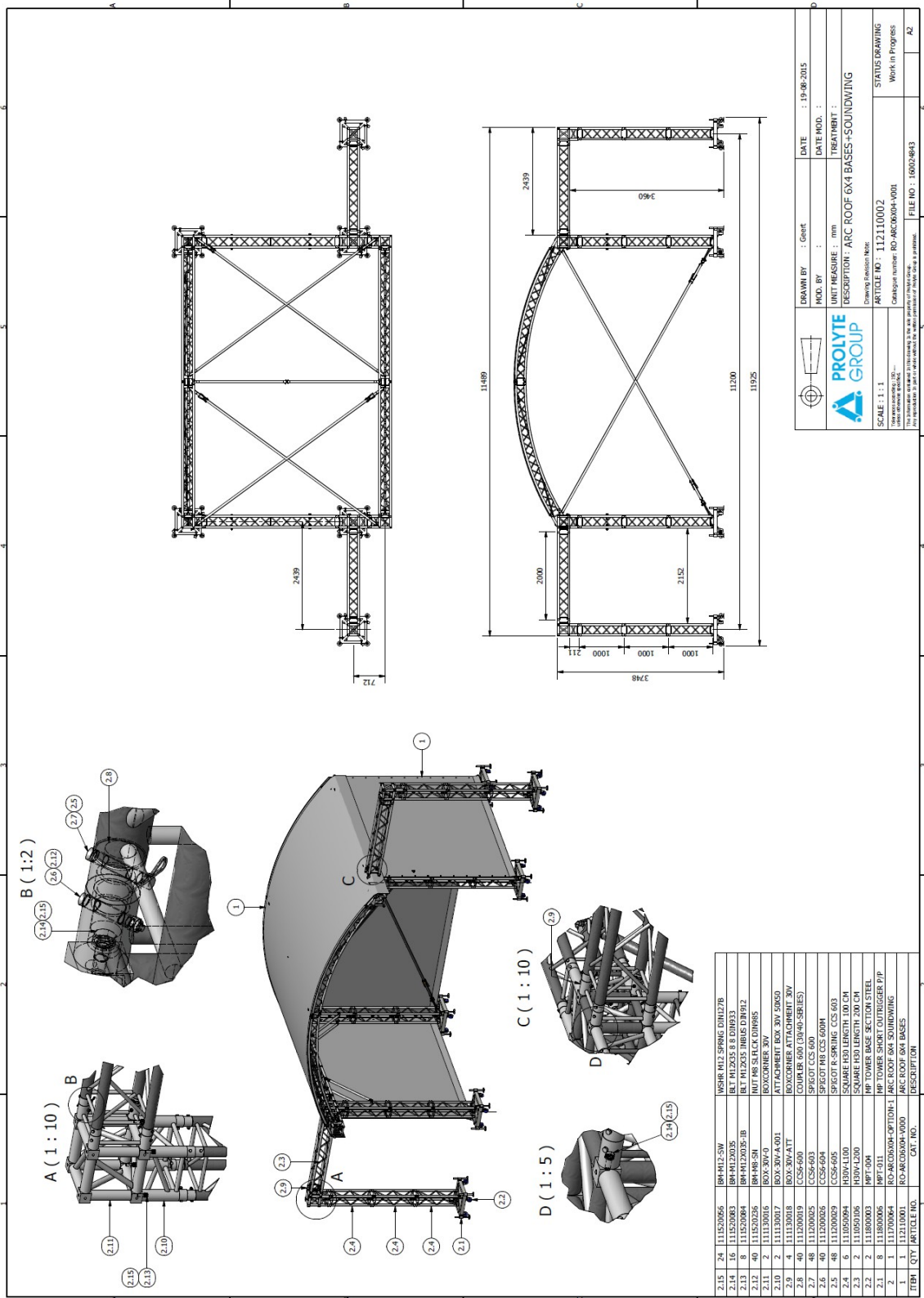


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2.9	40	111200019	CC56-600	COUPLER 600 (30/40-SERIES)
2.8	40	111200025	CC56-603	SPIGOT CCS 600
2.7	40	111200026	CC56-604	SPIGOT M8 CCS 600M
2.6	40	111200029	CC56-605	SPIGOT R-SPRING CCS 603
2.5	1	111050491	H30V-L038	SQUARE 30 LENGTH 38 CM 48X3
2.4	2	111050106	H30V-L200	SQUARE H30 LENGTH 200 CM
2.2	1	111050117	H30V-L300	SQUARE H30 LENGTH 300 CM
2.1	6	111800002	MPP-030	BASE DISTANCE UNIT
2	1	111700063	RO-ARC06X04-OPTION-2	ARC ROOF 6X4 GROUNDING
1	1	112110001	RO-ARC06X04-V000	ARC ROOF 6X4 BASES
ITEM	QTY	ARTICLE NO.	CAT. NO.	DESCRIPTION

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PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

with soundwings



PROLYTE GROUP

SCALE: 1 : 1
 This drawing is a part of a set which is the subject of a patent application.
 This drawing is a part of a set which is the subject of a patent application.

STATUS DRAWING: Work in Progress

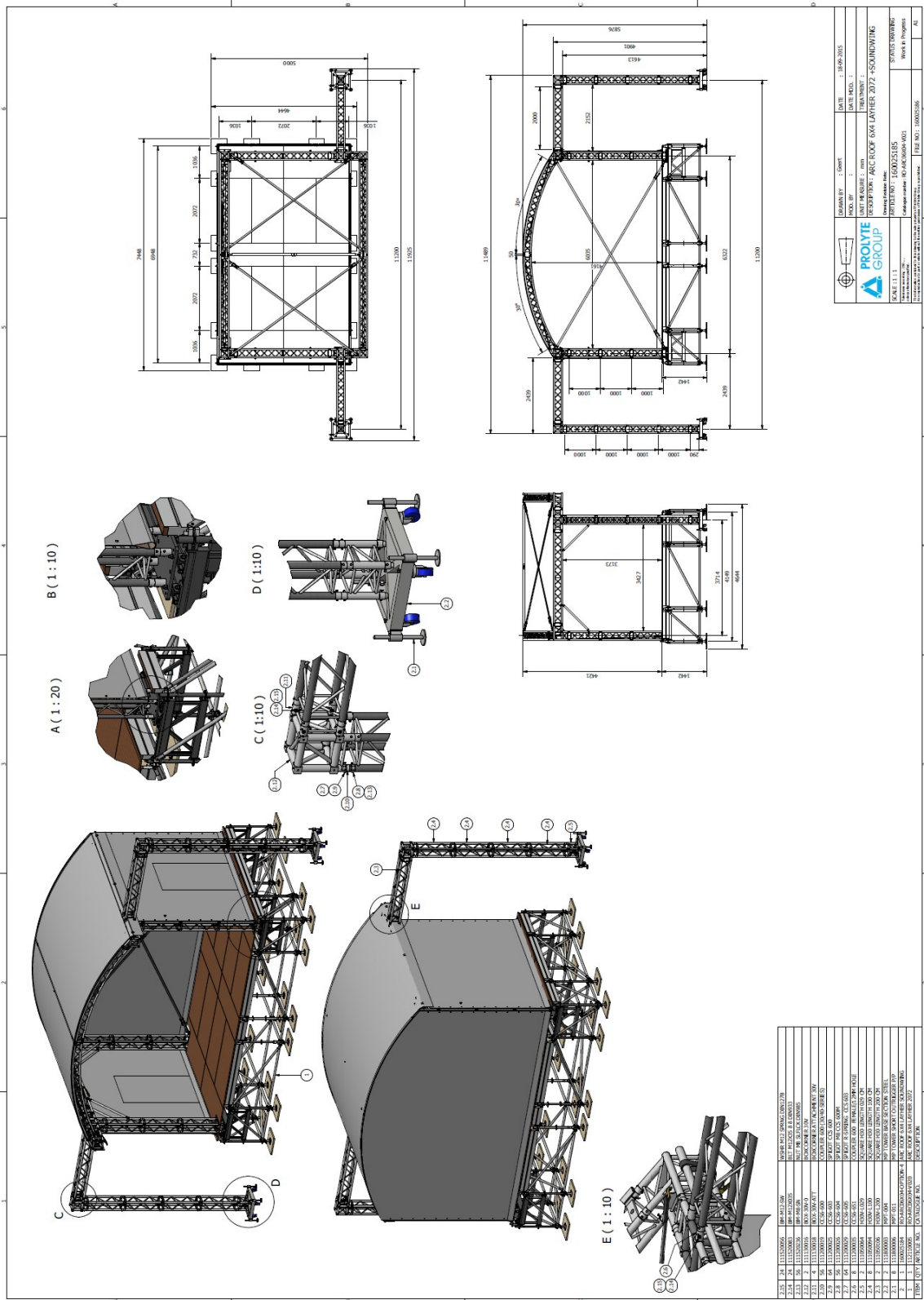
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 MOD BY:
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PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

on Layher/ (or Easyframe B) with soundwings



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.7 LOADING ASSUMPTION

General:

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

1.7.1 WINDLOADS

load assumption according to DIN EN 13814

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

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

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 .

$$h = 0 \leq 8 \text{ m}: q_p = 0,35 / 0,8 = 0,44 \text{ kN/m}^2$$

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

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

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

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.

PROJECT:
PROLYTE ARC-ROOF 8x6 - 6x4m

PROJECT-NO.:
13288–Revision 01

CUSTOMER:
PROLYTE GROUP

DATE:
30.11.2015

1.7.2 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.

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

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

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

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

1.7.3 SNOW LOADING

Snow loads are not taken into account.

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

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.8 PERMISSIBLE PAYLOADS

On following pages allowable payloads 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.

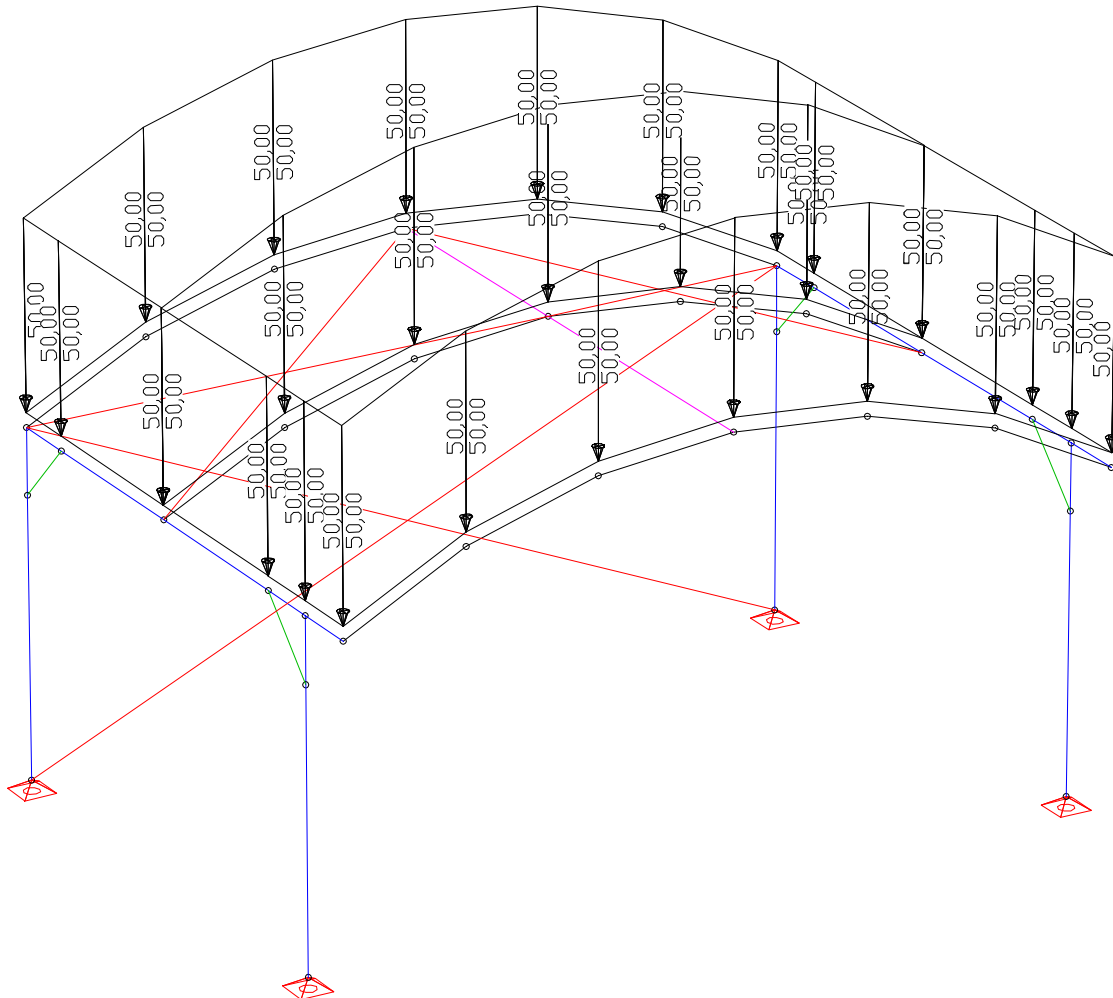
Loads up to 100 kg can be fastened at any position of the chord. Loads more than 100 kg have to be positioned at the node or adequate proofs have to be carried out. Loads shall be equally distributed over the trusses main chords.

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

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

kind of loading:

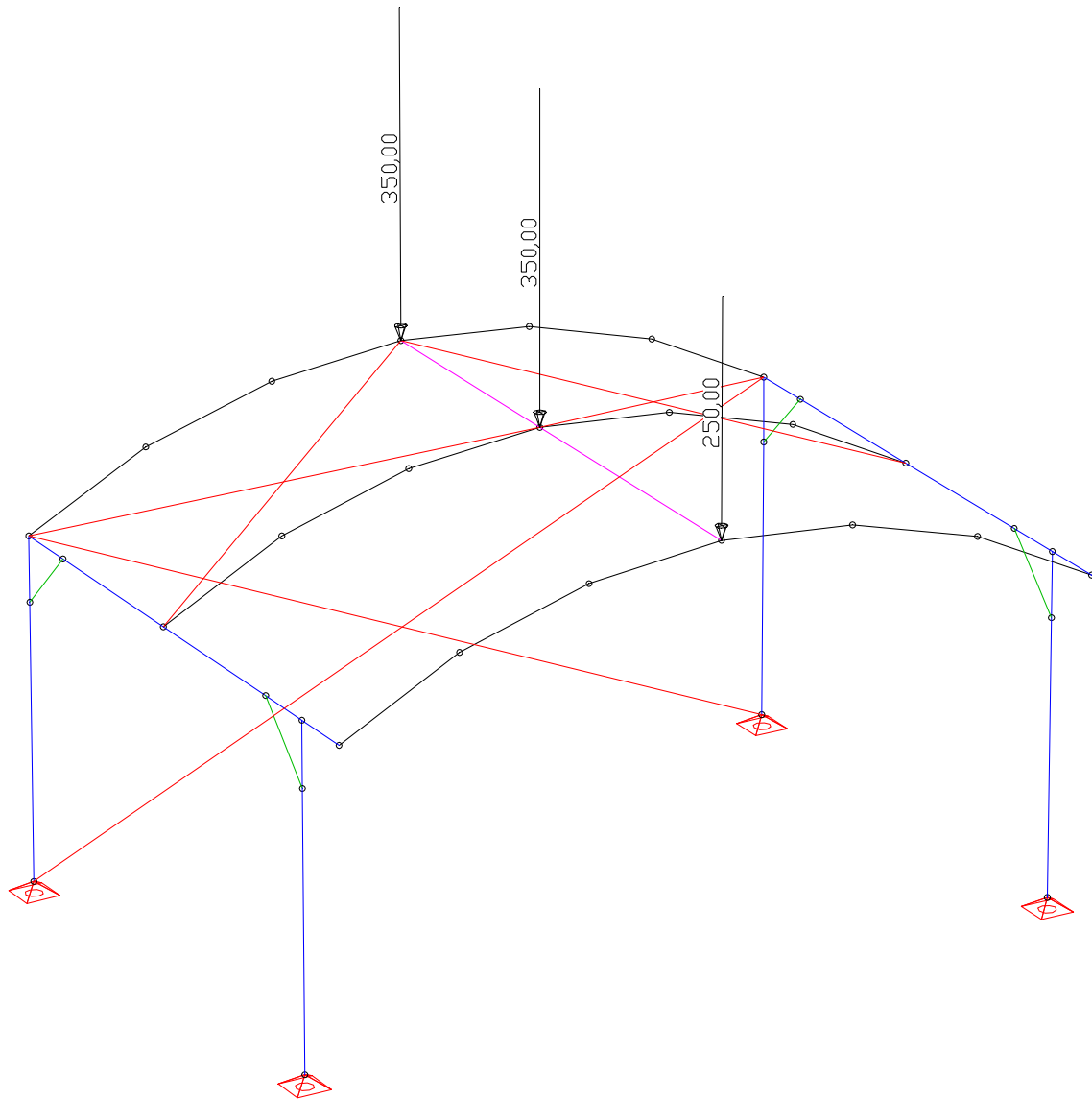
distributed load
[kg/m]



	front bow	rear bow	center bow	side truss
roof 8x6	50 kg/m	50 kg/m	50 kg/m	50 kg/m
roof 6x4	120 kg/m	120 kg/m	-	120 kg/m

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

center point load
[kg]



center point load (CPL)	front bow	rear bow	center bow	side truss
roof 8x6	250 kg	350 kg	350 kg	-
roof 6x4	400 kg	450 kg	-	-

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

distributed load: $M = q \times l^2 / 8$

third point load: $M = P \times l / 3$

fourth point load: $M = P \times l / 2$

bow front/ center/ rear: 8x6m

$$M = 0,50 \times 8,82^2 / 8 = 4,86 \text{ kNm}$$

→ third point load: $P = 4,86 \times 3 / 8,82 = 1,65 \text{ kN}$

→ fourth point load: $P = 4,86 \times 2 / 8,82 = 1,10 \text{ kN}$

bow front/ center/ rear: 6,4m

$$M = 1,20 \times 6,24^2 / 8 = 5,84 \text{ kNm}$$

→ third point load: $P = 5,84 \times 3 / 6,24 = 2,80 \text{ kN}$

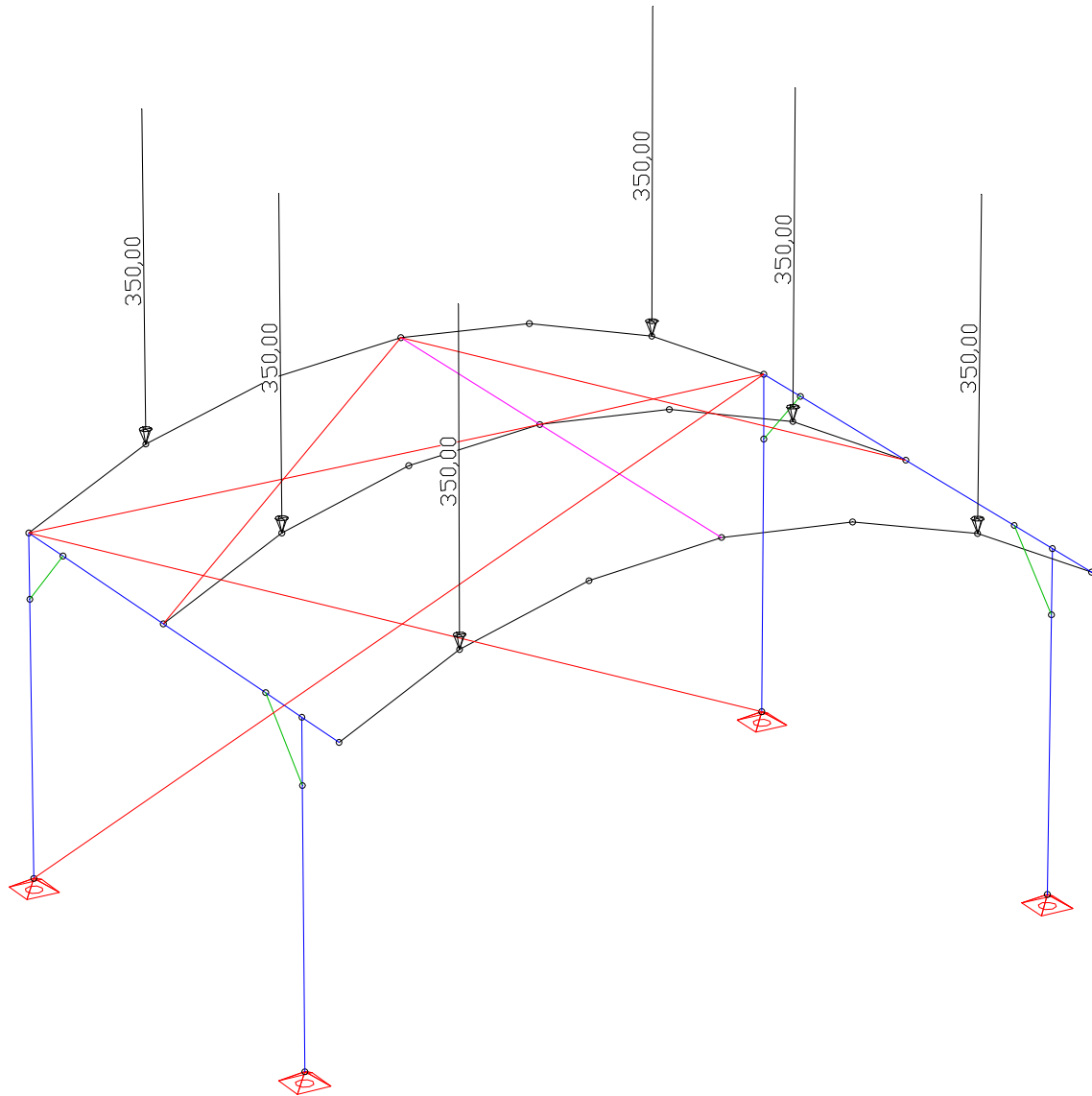
→ fourth point load: $P = 5,84 \times 2 / 6,24 = 1,85 \text{ kN}$

third point load (TPL)	front bow	rear bow	center bow	side truss
roof 8x6	165 kg	165 kg	165 kg	-
roof 6x4	280 kg	280 kg	-	-

fourth point load (FPL)	front bow	rear bow	center bow	side truss
roof 8x6	110 kg	110 kg	110 kg	-
roof 6x4	185 kg	185 kg	-	-

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

point load setup 2
[kg]

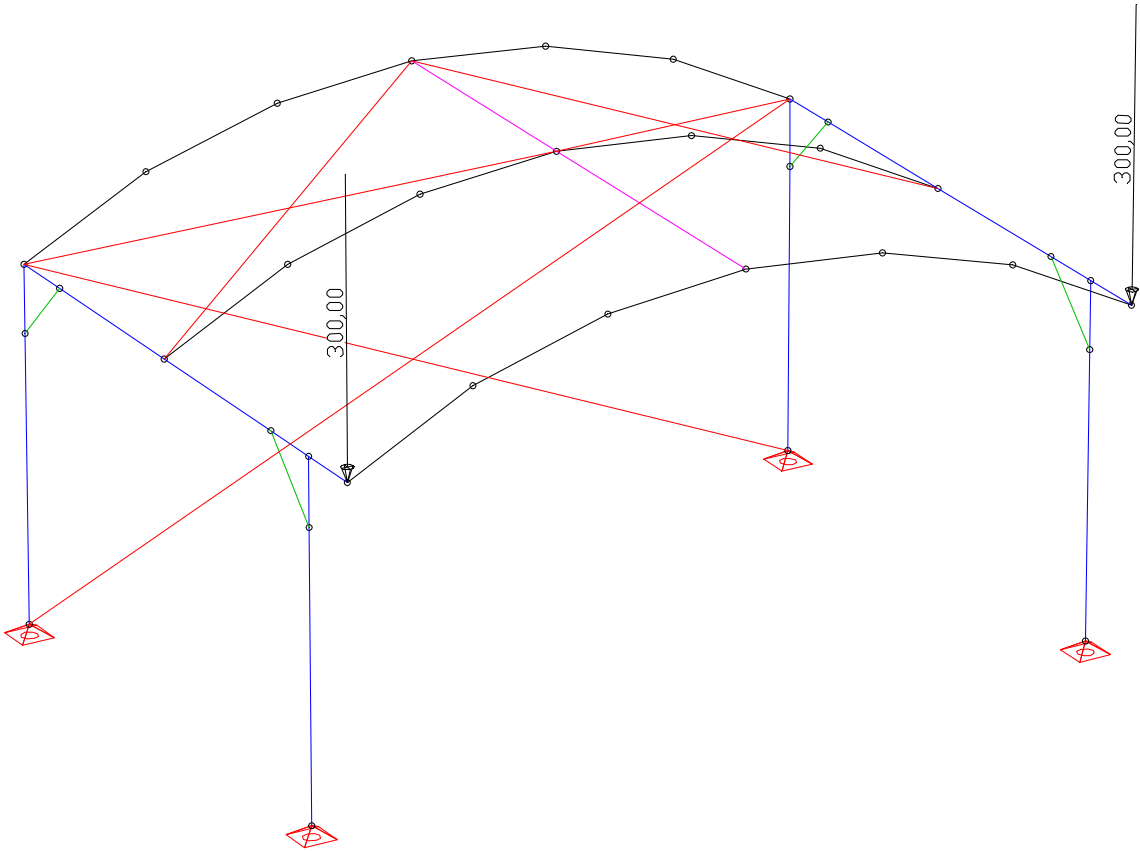


	front bow	rear bow	center bow	distance to tower
roof 8x6	350 kg	350 kg	350 kg	1,3m
roof 6x4	500 kg	500 kg	-	1,0m

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

additional PA-load
[kg]

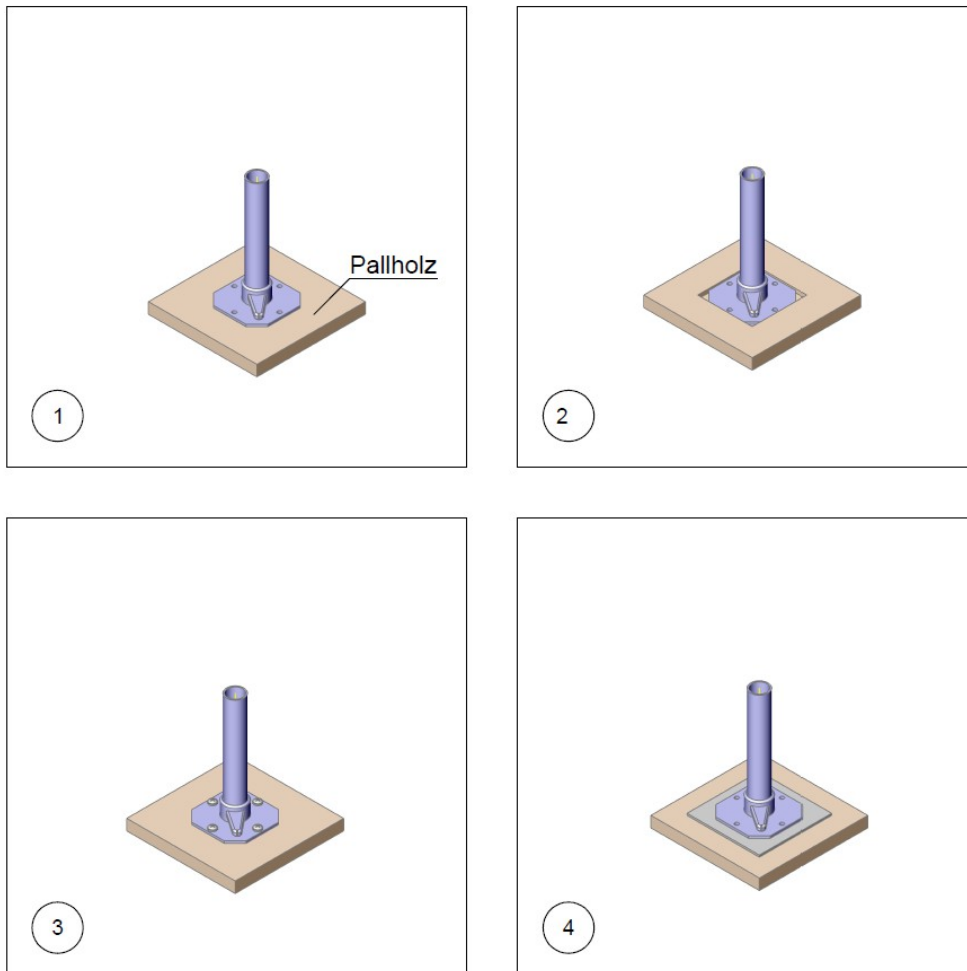
ARC Roof 8x6 and 6x4



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.9 NECESSARY BALLAST LOAD

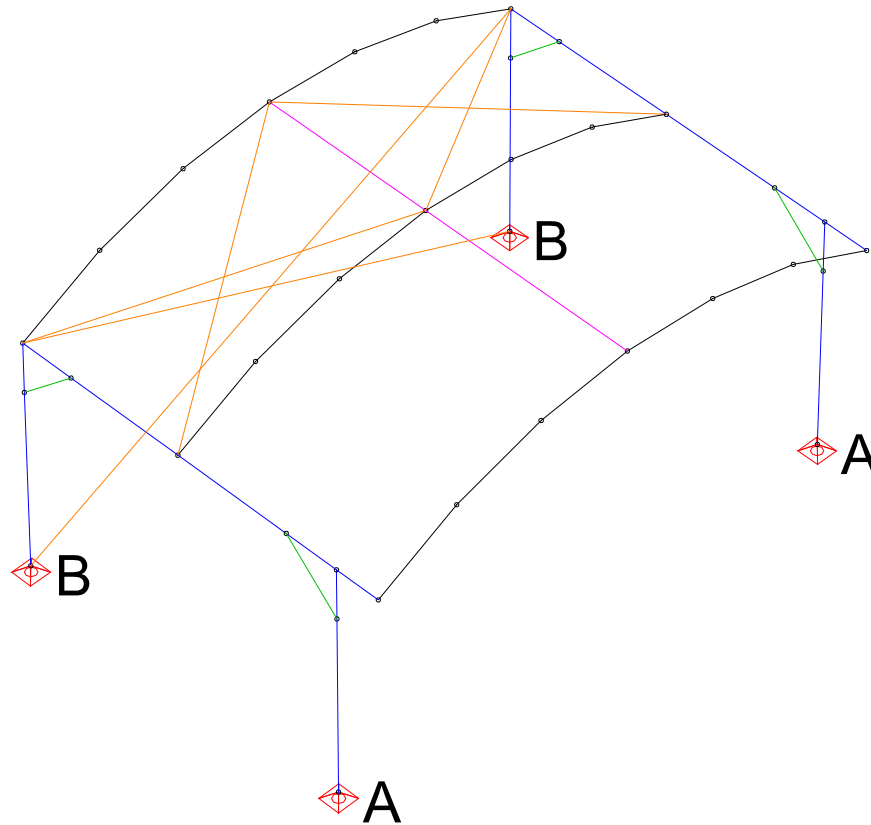
friction coefficient μ



- | | | |
|----|--------------------------------------|--------------|
| 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 | $\mu = 0,60$ |

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.9.1 SYSTEM 8x6



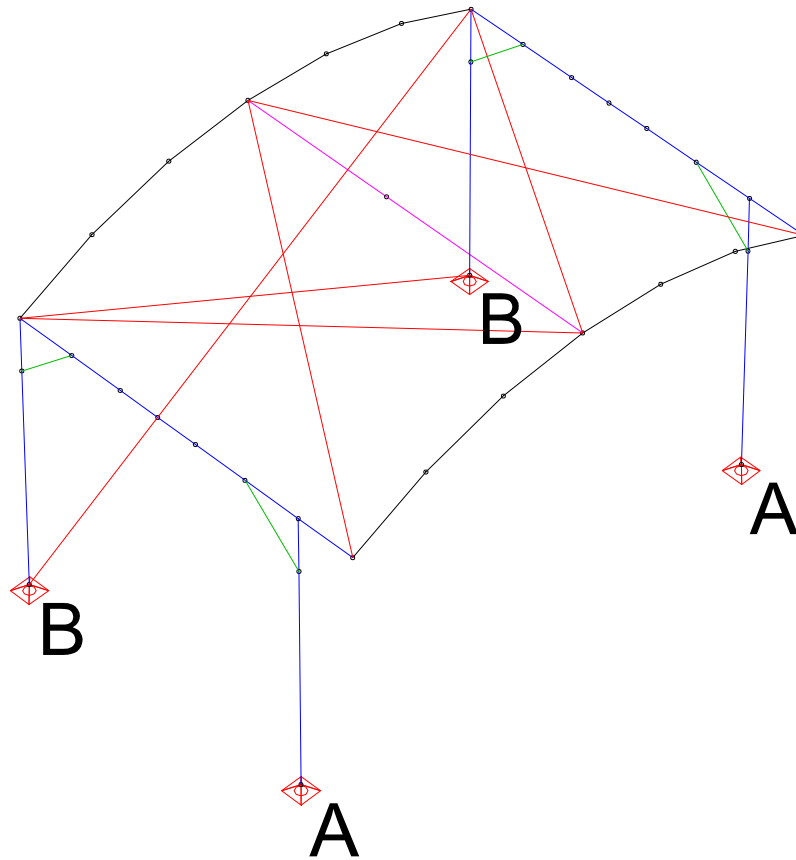
support	A	B
no groundring	1500 kg (1900 kg)	1300 kg (1800 kg)
with groundring	900 kg (1200 kg)	900 kg (1200 kg)
with Layher/ Easyframe B	450 kg (750 kg)	450 kg (750 kg)

(values in brackets for frictional coefficient $\mu=0,4$)

Permanently existing loads can be calculated proportionally against the ballast loads. (dead weights already taken into account)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.9.2 SYSTEM 6x4



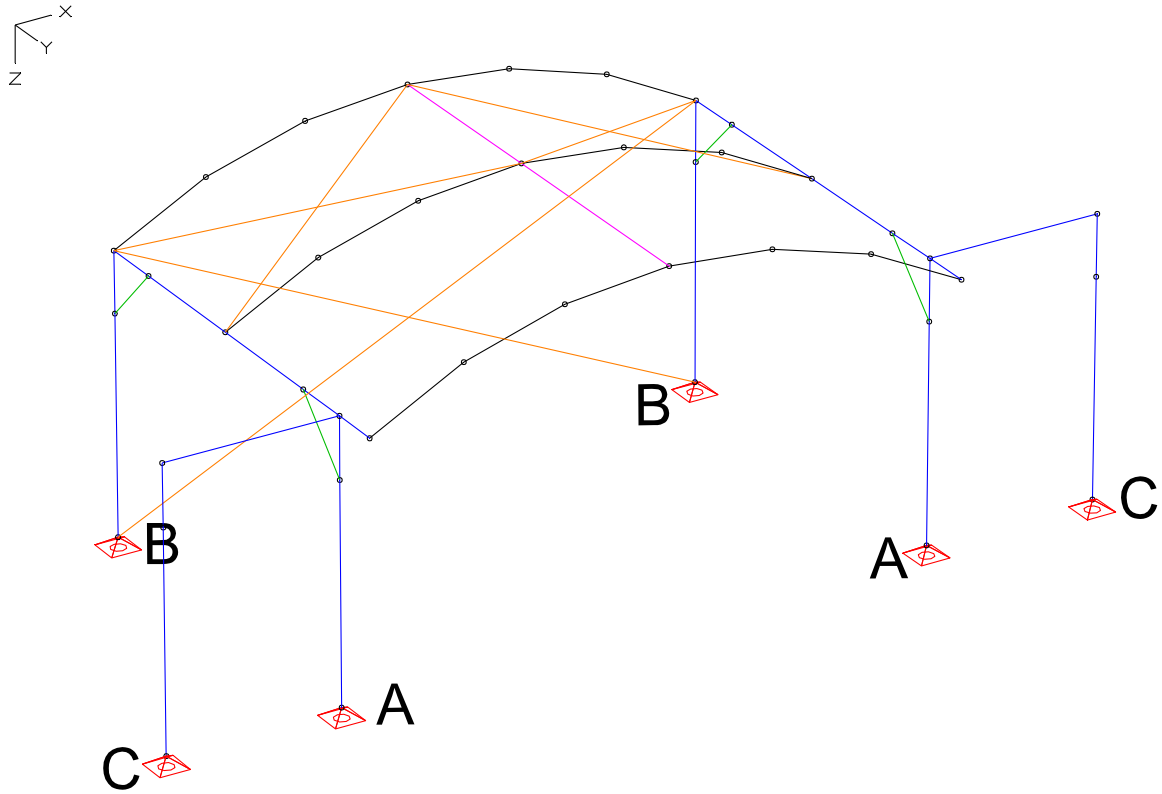
support	A	B
no groundring	1200 kg (1550 kg)	1100 kg (1450 kg)
with groundring	600 kg (800 kg)	600 kg (800 kg)
with Layher/ Easyframe B	400 kg (600 kg)	400 kg (600 kg)

(values in brackets for frictional coefficient $\mu=0,4$)

Permanently existing loads can be calculated proportionally against the ballast loads. (dead weights already taken into account)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

1.9.3 ADDITIONAL BALLAST WITH SOUNDWINGS



support	A	B	C
ballast 8x6m/ 6x4m	450 kg (600 kg)	300 kg (400 kg)	100 kg (200 kg)

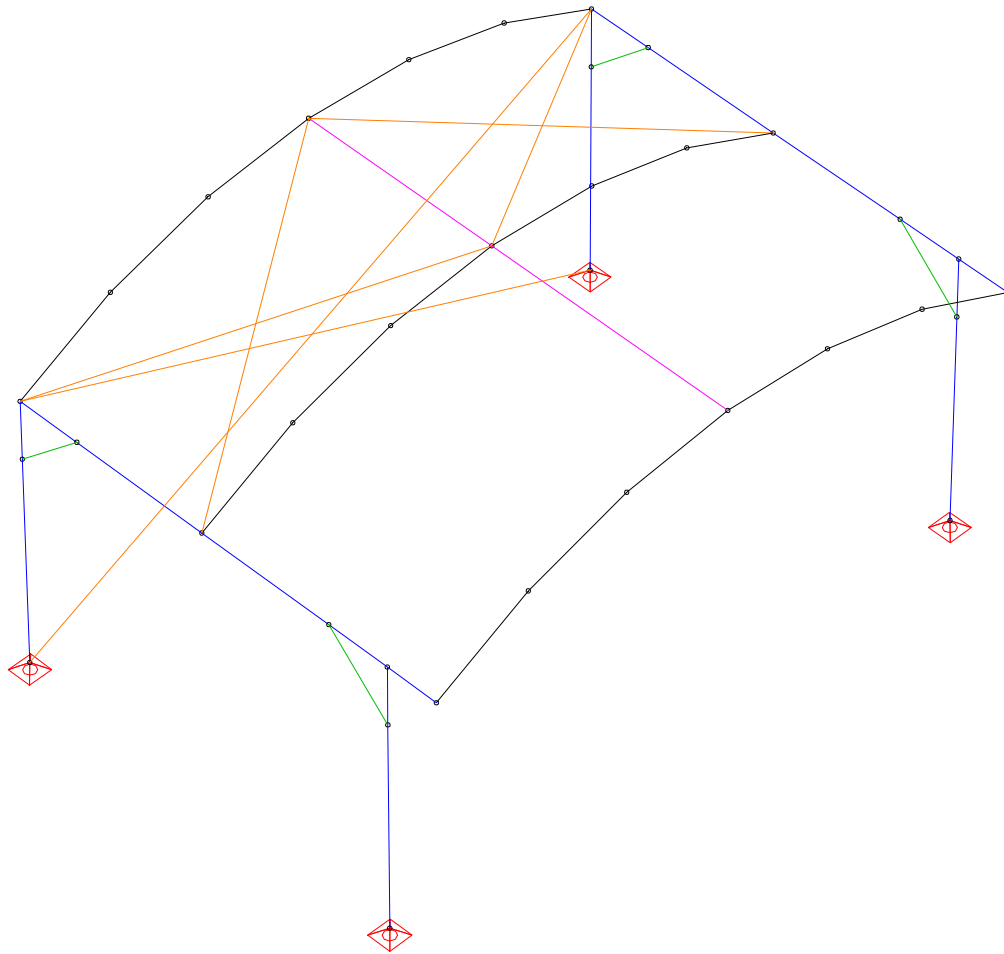
(values in brackets for friction coefficient 0,4)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

STRUCTURAL CALCULATION

2 STATICAL SYSTEM

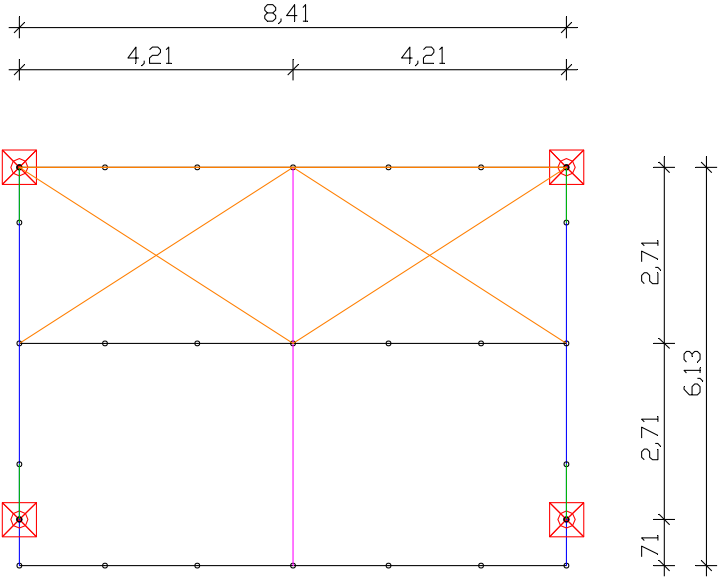
Isometric:



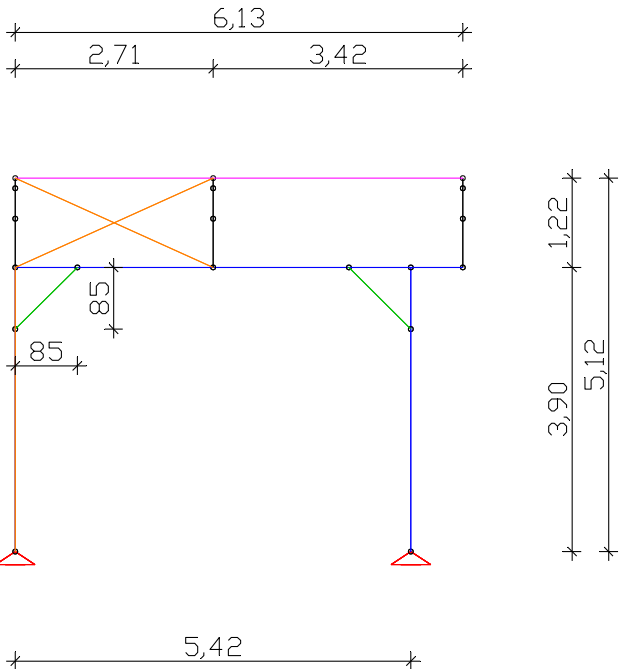
- black: PROLYTE H30D curved truss
- blue: PROLYTE H30V
- purple: tube Ø50x4 EN AW 6082 T6
- green: tube Ø48x3 EN AW 6082 T6

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

top view:



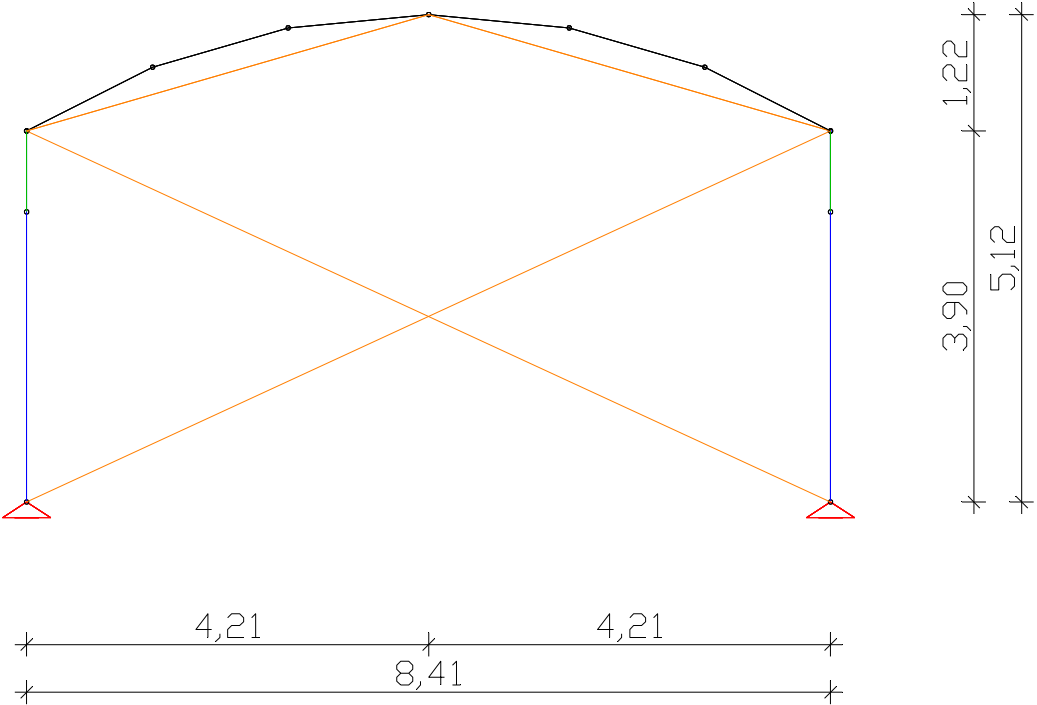
side view:



(The system is modelled with a slightly larger height, what leads to little loading capacities.)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

front view:



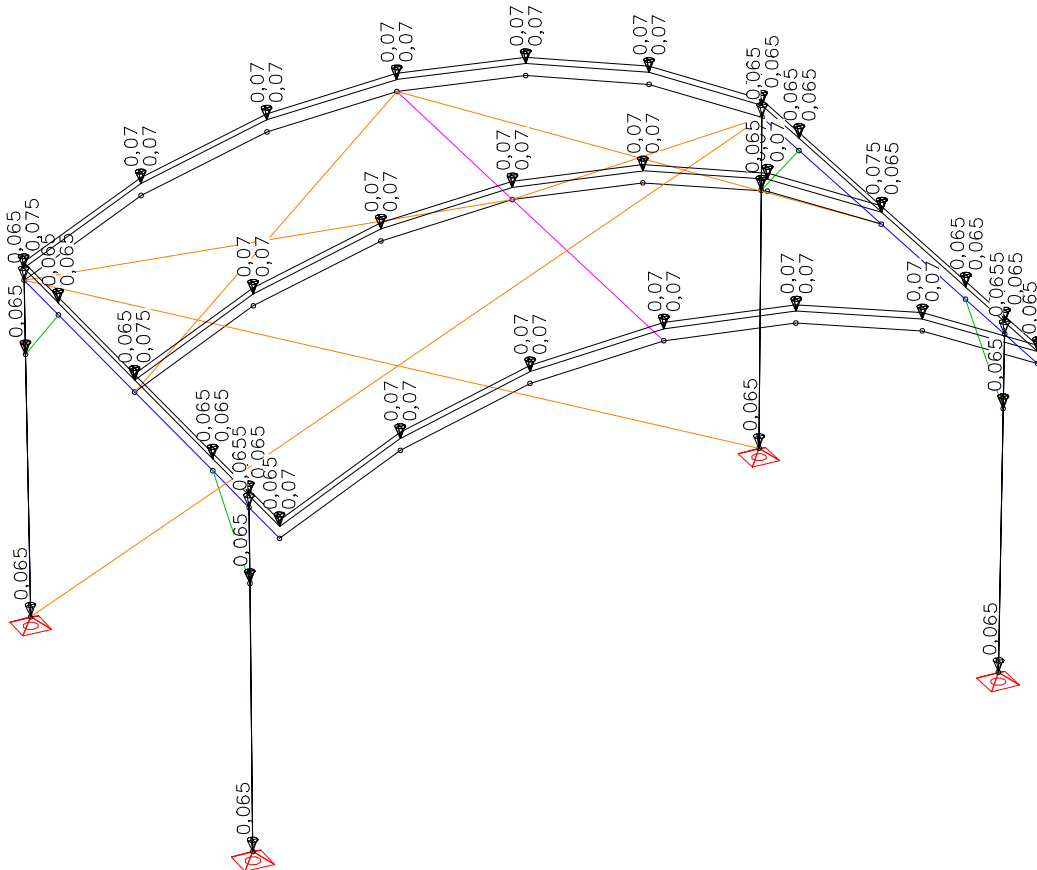
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

3 LOADING

Load case 1: dead weight

H30D Circular truss: $g_{k,1} \approx 0,070 \text{ kN/m}$ (7,0 kg/m)

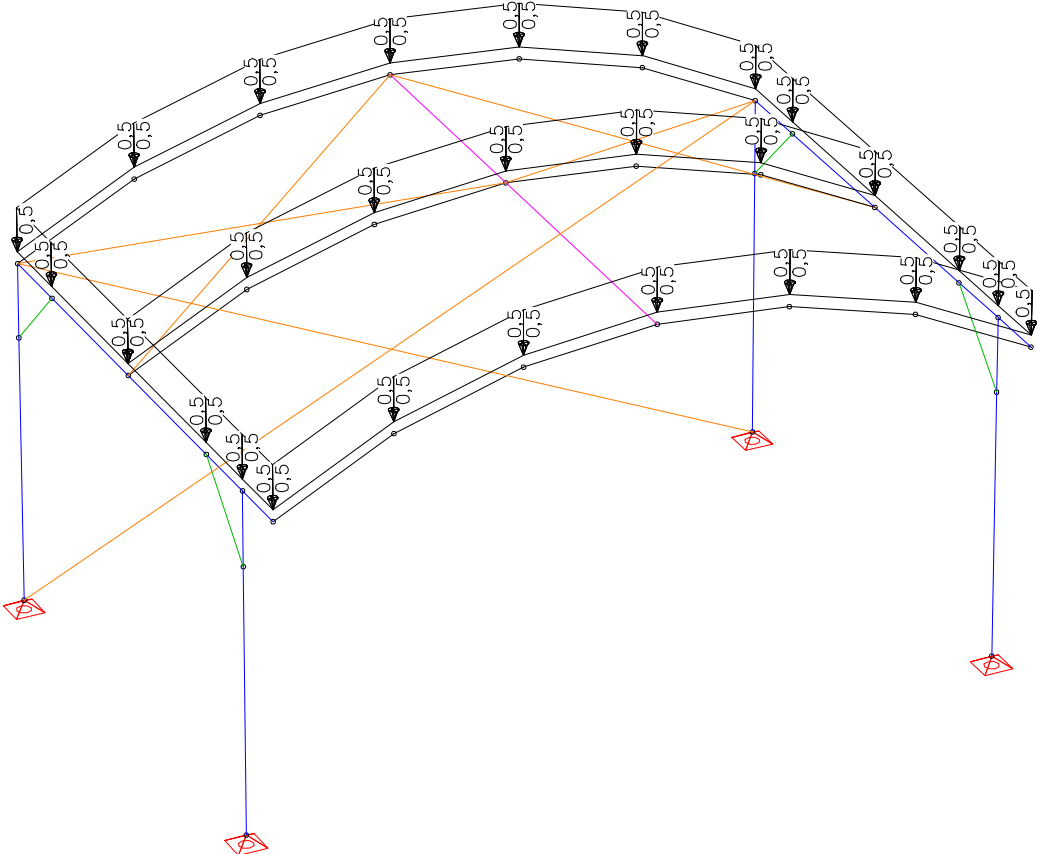
H30V: $g_{k,2} \approx 0,065 \text{ kN/m}$ (6,5 kg/m)



LC 1: Load, dead weight

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

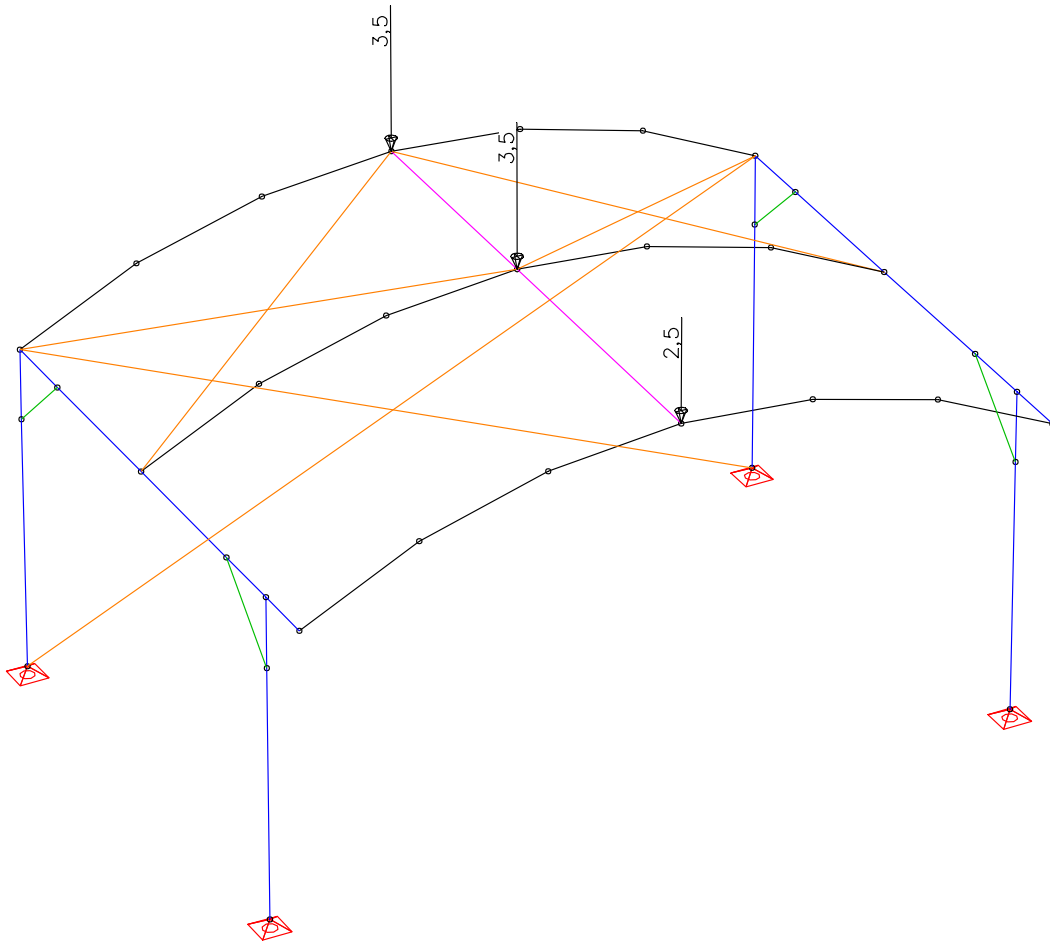
Load case 2: distributed payload
see chapter 1.6.3



LC 2: Load, distributed payload

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

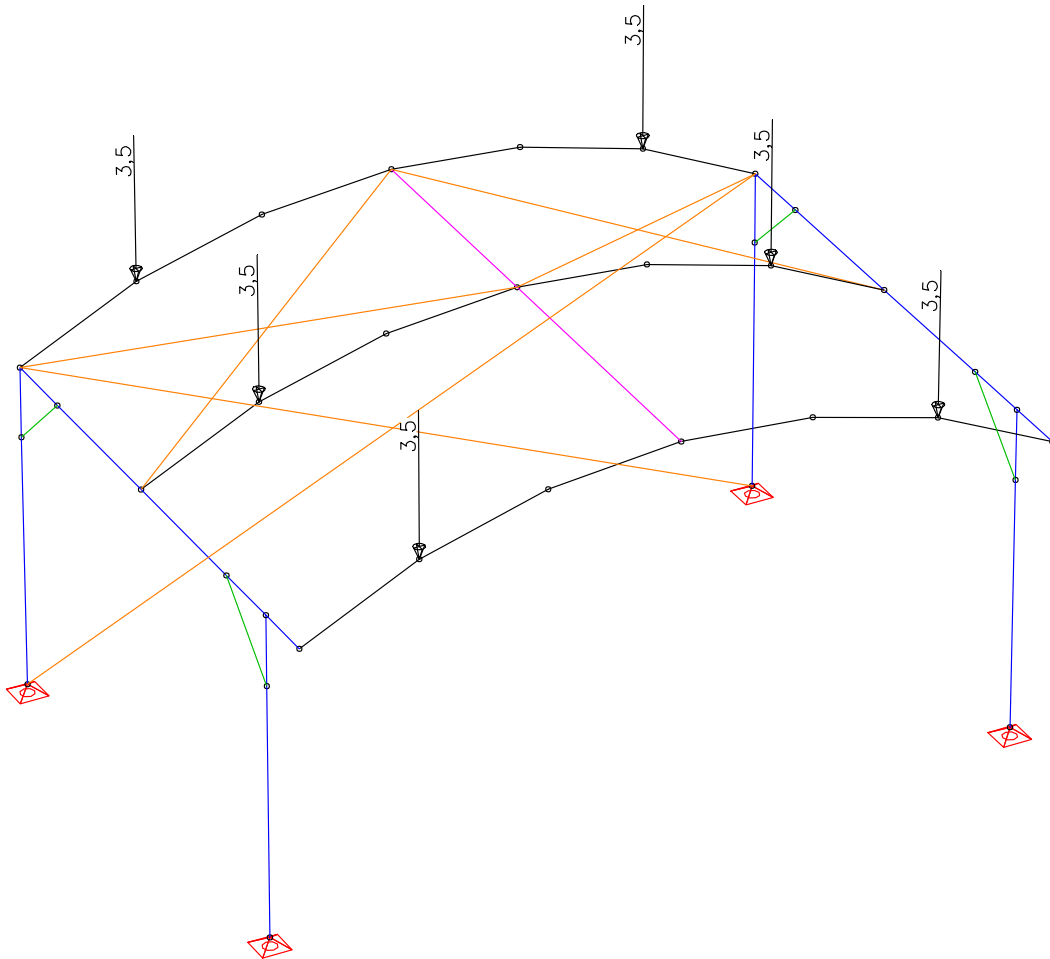
Load case 3: point load set up 1
see chapter 1.6.3



LC 3: Load, point load setup 1

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load case 4: point load set up 2
see chapter 1.6.3

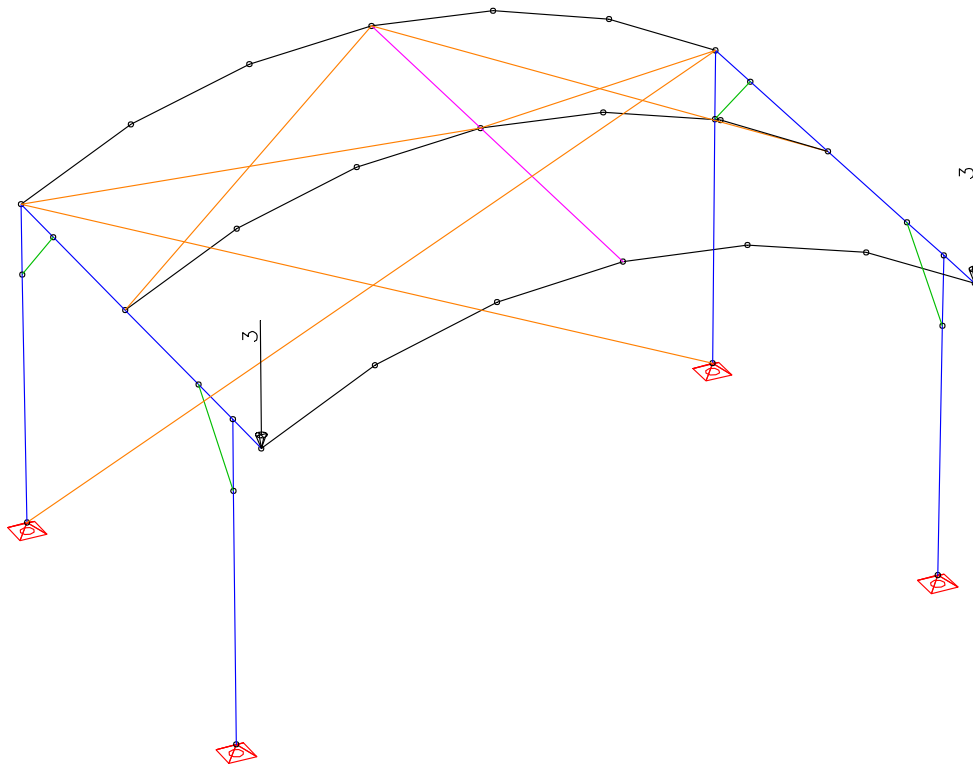


LC 4: Load, point load setup 2

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load case 5: PA-load

see chapter 1.6.3



LC 5: Load, PA-load

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

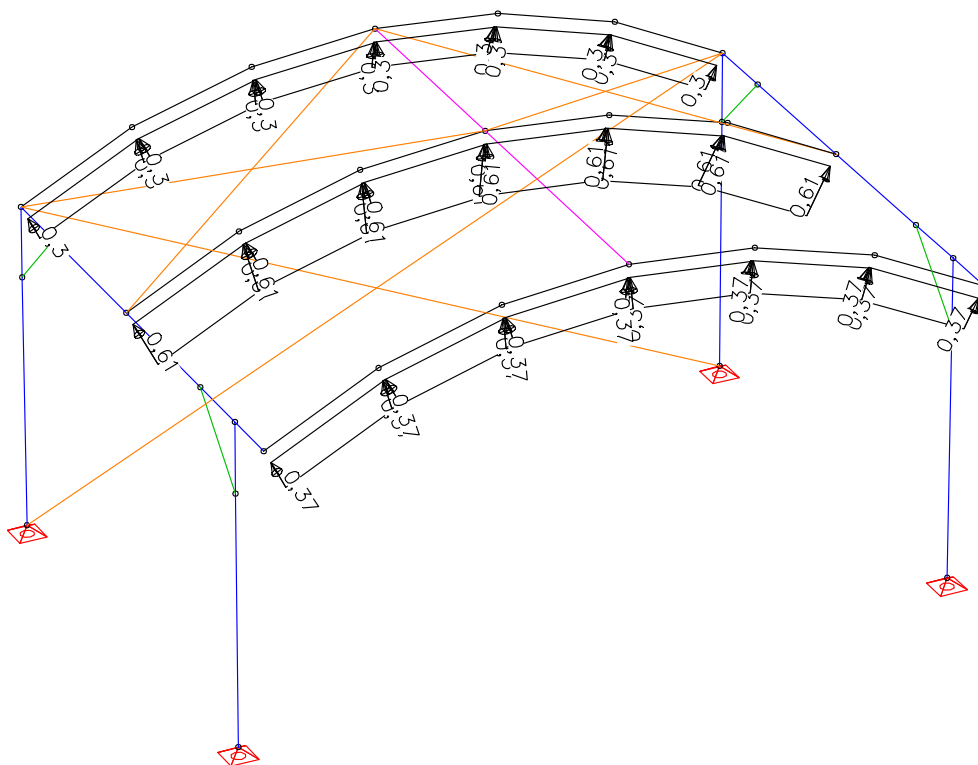
Load case 10: wind roof

$$q_b = 0.20 \text{ kN/m} \quad c_f = 1.00$$

$$0,20 \times 1,0 \times (2,71/2 + 0,15) = 0,301 \text{ kN/m}$$

$$0,20 \times 1,0 \times (2,71 + 3,42)/2 = 0,613 \text{ kN/m}$$

$$0,20 \times 1,0 \times (3,42/2 + 0,15) = 0,372 \text{ kN/m}$$

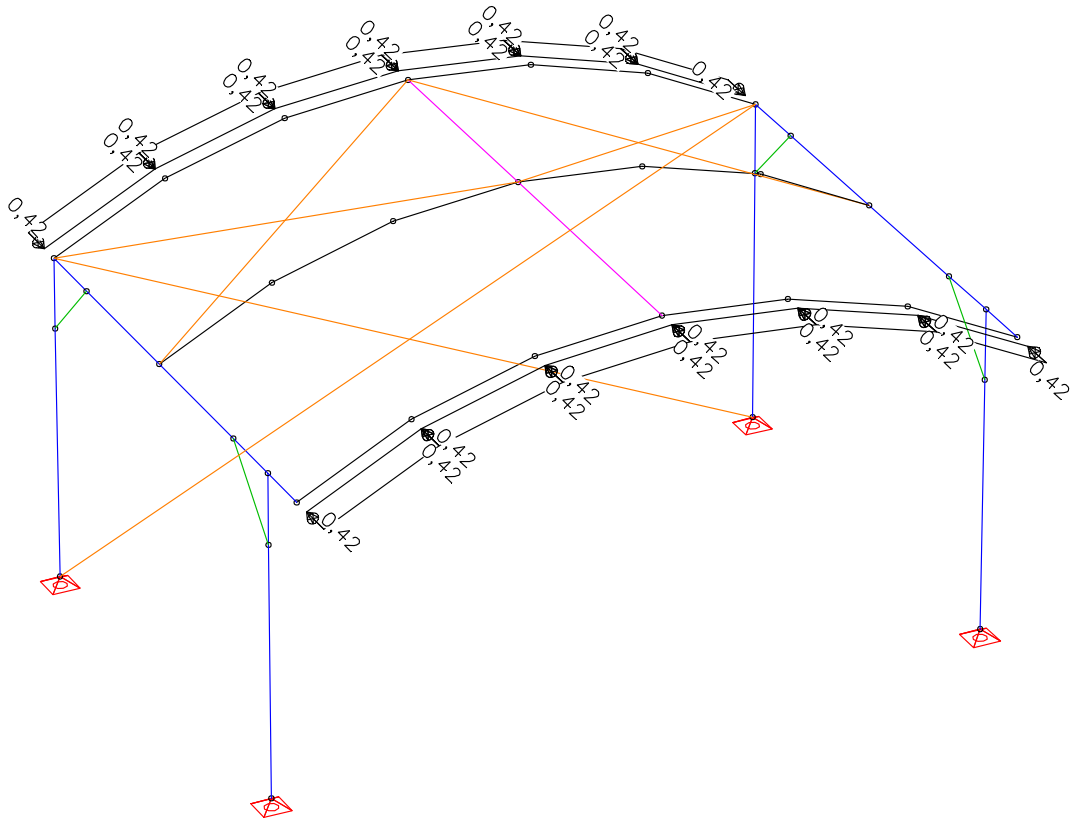


LC 10: Load, wind roof

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load case 11: membrane tension roof

$$z_1 = (0,301 + 0,372) / 2 \times 1/0,8 = 0,421 \text{ kN/m}$$



LC 11: Load, membrane tension roof

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

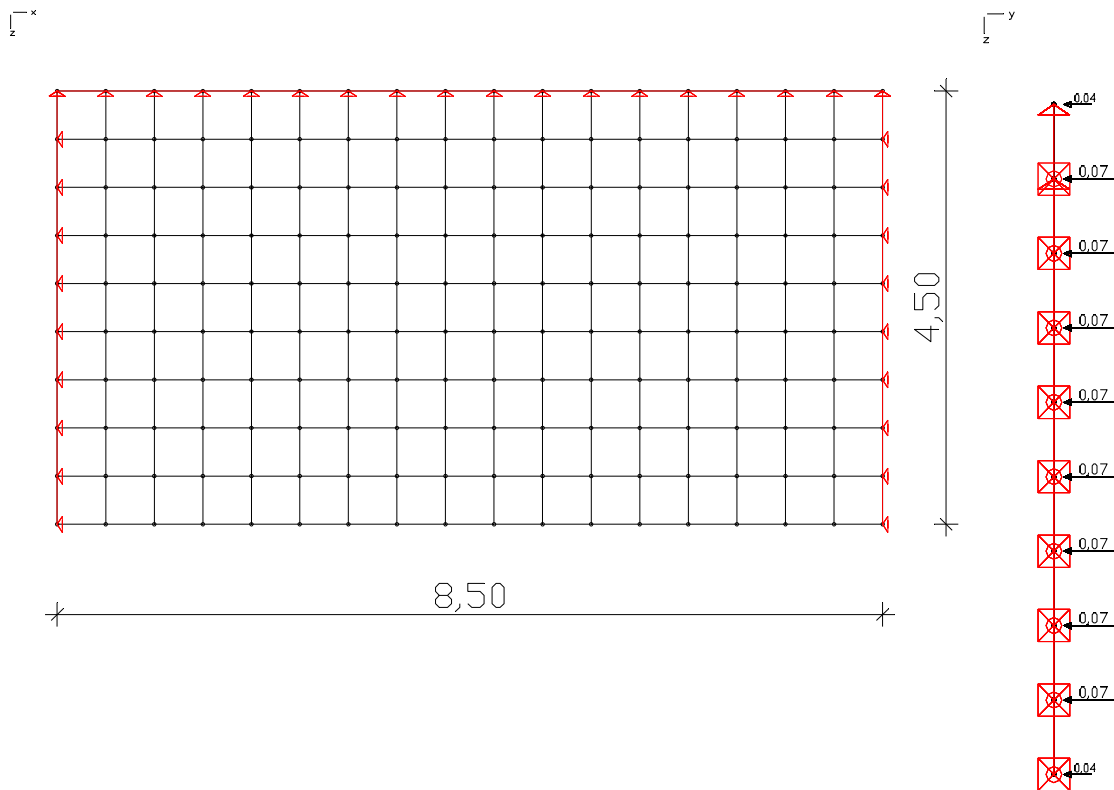
Load case 12: wind rear wall

The canopy is fixed at the roof and columns. The exact distribution of the load will be calculated with a FEM-analysis of the canopy.

grid: 50x50 cm
 cross section: 500 x 5 mm (5 mm Plane)
 E-Modul: 5 MN/m²

The calculation is done with a wind load of:
 $q_b = 0,15 \text{ kN/m}^2$

System:



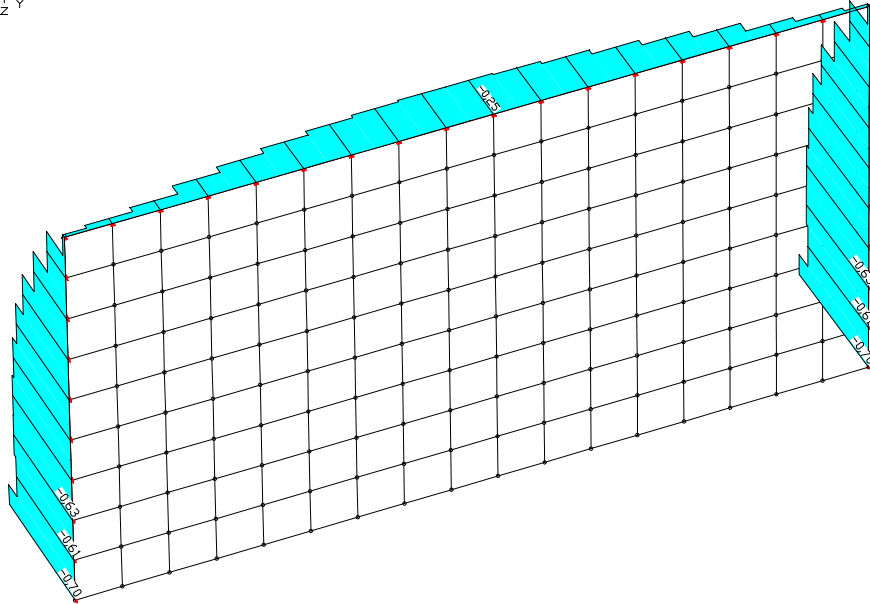
LF 1: Belastung, Windlast

$$q_{k,1} = 0,15 \times 0,5/2 = 0,0375 \text{ kN/m}$$

$$q_{k,2} = 0,15 \times 0,5 = 0,0750 \text{ kN/m}$$

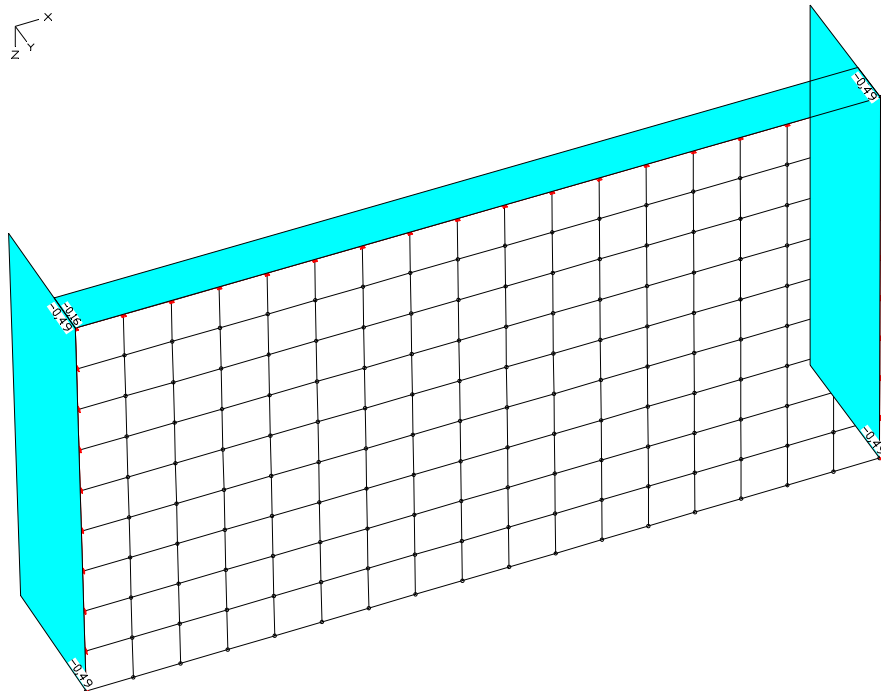
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Support reactions:



LF 1: Windlast
 Auflagerreaktionen im System der Lagerlinien $R_y(l)$ [kN/m]
 Summe im Globalsystem $R_y(g) = -9,24$ [kN]

in linearised form:



LF 1: Windlast
 Auflagerreaktionen (Mittel im Lagerliniensystem) $R_y(l)$ [kN/m]
 Summe im Globalsystem $R_y(g) = -9,24$ [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Roofgirder:

$$q = 0,32 \text{ kN/m} \quad \text{triangular}$$

Columns:

$$q = 0,49 \text{ kN/m}$$

$$\text{arc area:} \quad \sim 7,4 \text{ m}^2$$

Total wind load on rear wall :

$$0,15 \times 1,0 \times (8,4 \times 3,678 + 7,4) = 5,7 \text{ kN}$$

$$\text{arc length:} \quad L = 6 \times 1,48 = 8,88 \text{ m}$$

$$\text{Wind on roof girder:} \quad 8,88 \times 0,32/2 = 1,42 \text{ kN}$$

$$\text{Wind on tower:} \quad 5,7 - 1,42 = 4,28 \text{ kN}$$

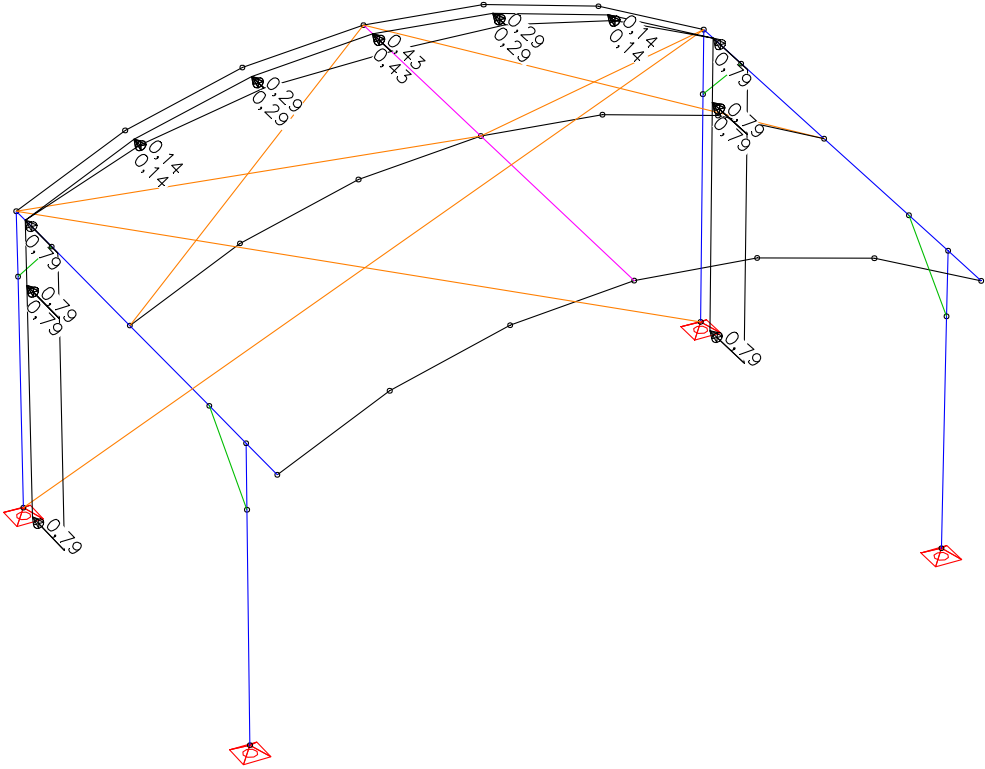
$$\rightarrow q = 4,28 / (2 \times 3,70) = 0,59 \text{ kN/m}$$

with $q_b = 0,20$:

$$q_{k,1} = 0,2/0,15 \times 0,32 = 0,427 \text{ kN/m}$$

$$q_{k,2} = 0,2/0,15 \times 0,59 = 0,787 \text{ kN/m}$$

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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LC 12: Load, wind rear wall

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

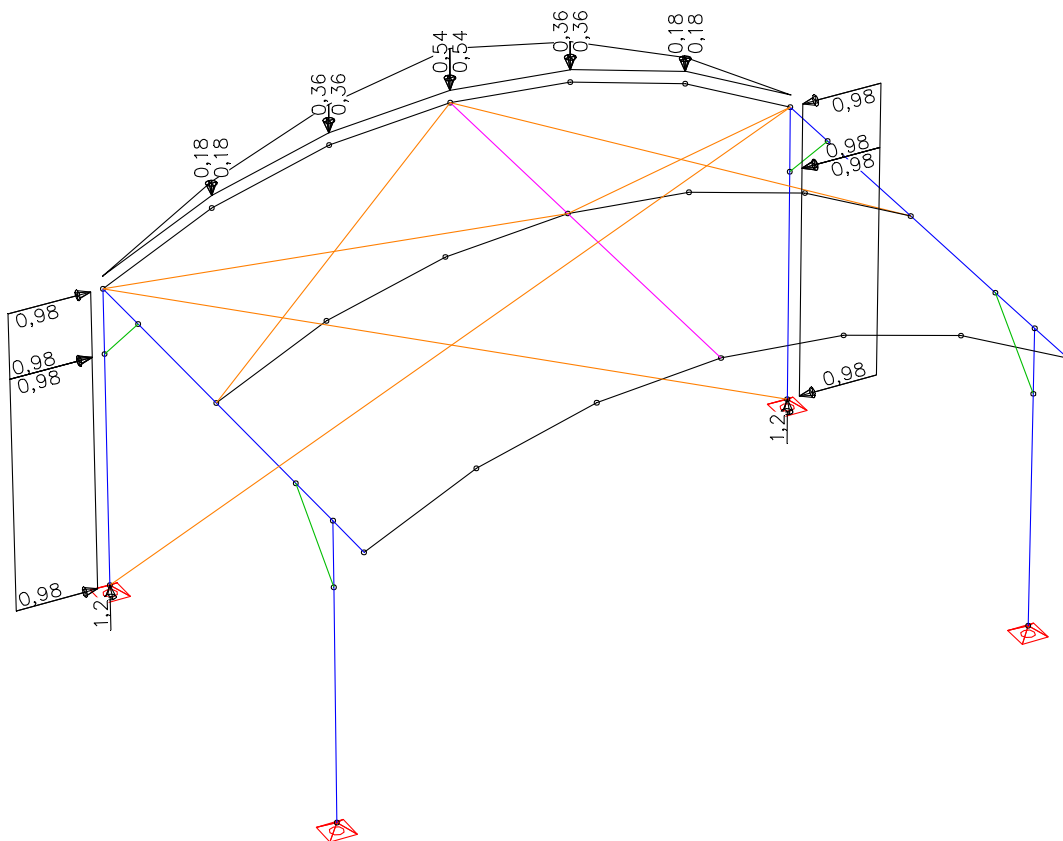
Load case 13: membrane tension rear wall

$$q_{k,1} = 0,427/0,8 = 0,534 \text{ kN/m}$$

$$q_{k,2} = 0,787/0,8 = 0,984 \text{ kN/m}$$

Reaction force due to membrane tension roof (inner forces)

$$Q_k = 1,20 \text{ kN}$$



LC 13: Load, membrane tension rear wall

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

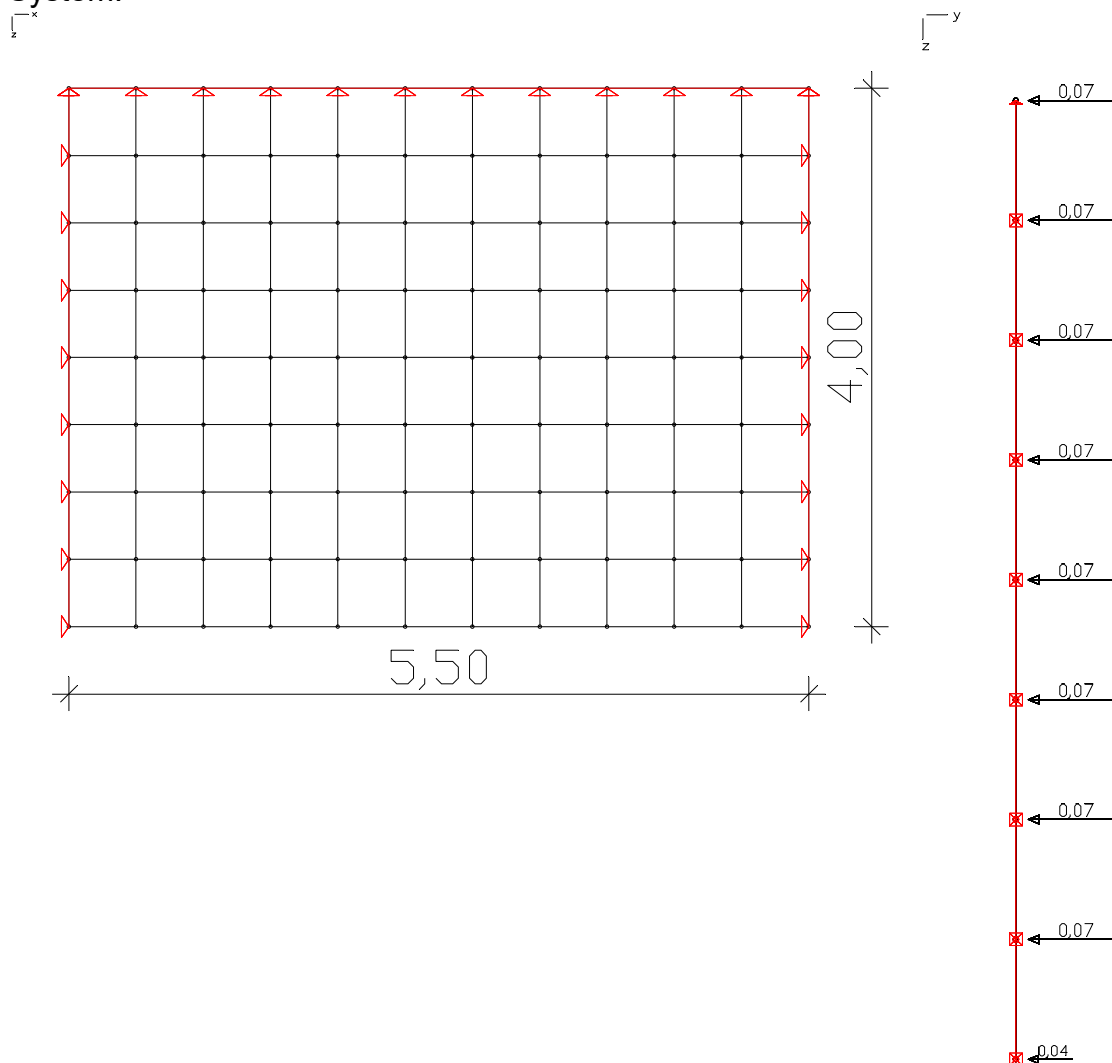
Load case 14: wind left wall

The canopy is fixed at the roof and columns. The exact distribution of the load will be calculated with a FEM-analysis of the canopy.

grid: 50x50 cm
 cross section: 500 x 5 mm (5 mm Plane)
 E-Modul: 5 MN/m²

The calculation is done with a wind load of:
 $q_b = 0,15 \text{ kN/m}^2$

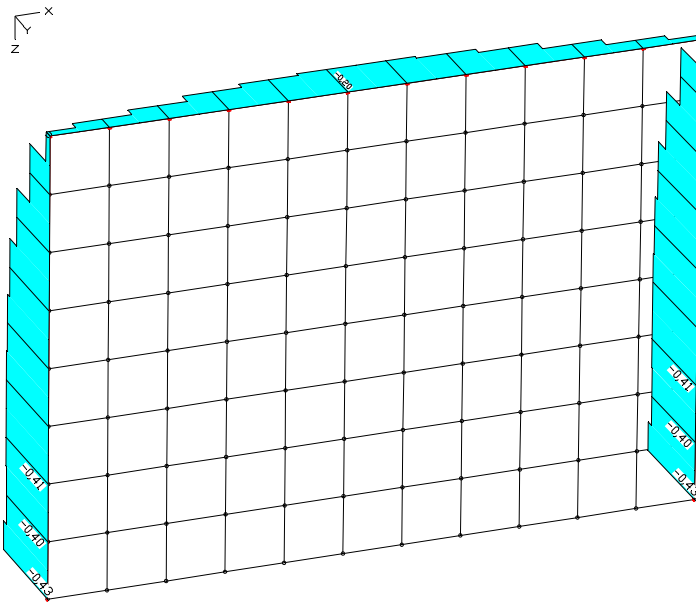
System:



LF 1: Belastung, Windlast

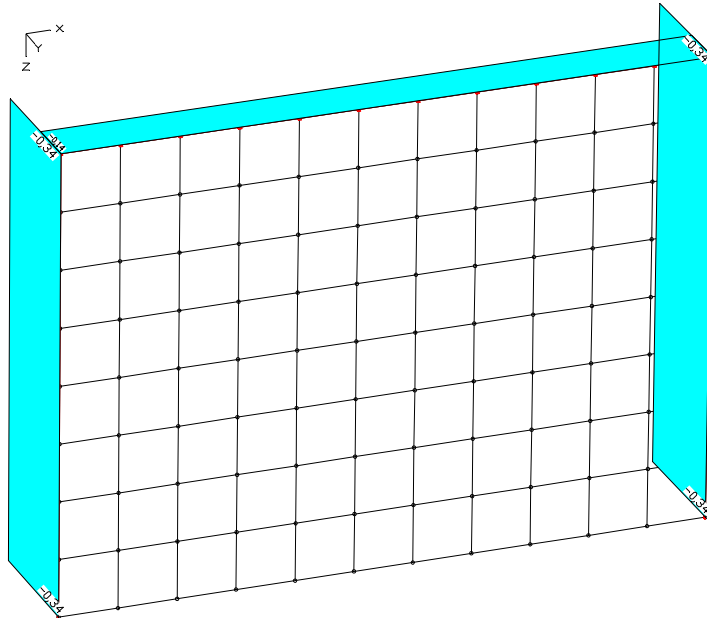
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

support reactions:



LF 1: Windlast
 Auflagerreaktionen im System der Lagerlinien $R_y(l)$ [kN/m]
 Summe im Globalsystem $R_y(g) = -9,24$ [kN]

in linearised form:



LF 1: Windlast
 Auflagerreaktionen (Mittel im Lagerliniensystem) $R_y(l)$ [kN/m]
 Summe im Globalsystem $R_y(g) = -9,24$ [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Columns:

$q = 0,34 \text{ kN/m}$

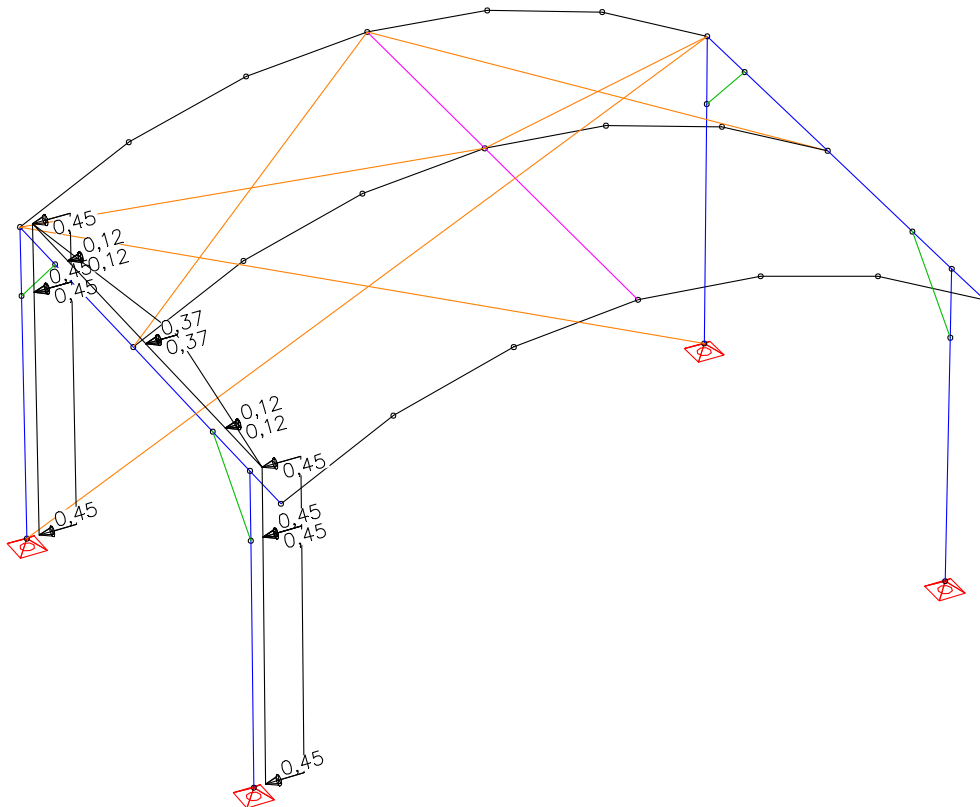
Roof girder:

$q = 0,28 \text{ kN/m}$ triangular

mit $q_b = 0,20$:

$$q_{k,1} = 0,2/0,15 \times 0,28 = 0,373 \text{ kN/m}$$

$$q_{k,2} = 0,2/0,15 \times 0,34 = 0,453 \text{ kN/m}$$



LC 14: Load, wind left wall

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

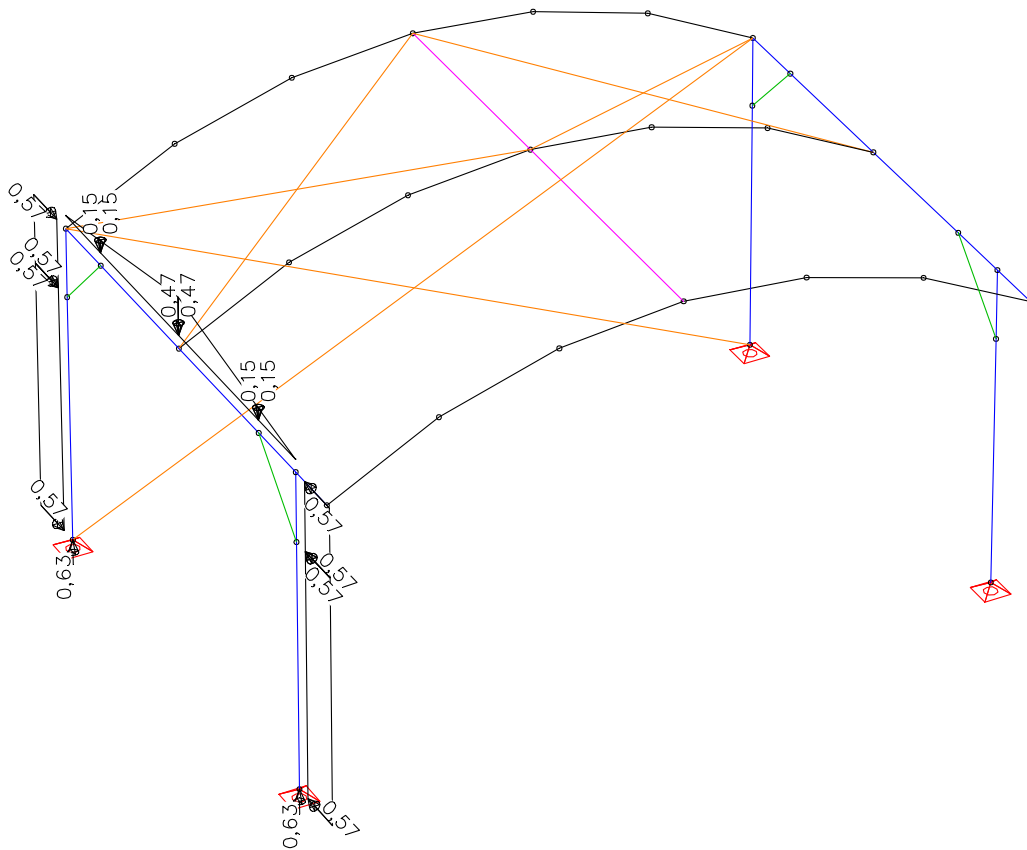
Load case 15: membrane tension left wall

$$q_{k,1} = 0,373/0,8 = 0,466 \text{ kN/m}$$

$$q_{k,2} = 0,453/0,8 = 0,566 \text{ kN/m}$$

Reaction force due to membrane tension roof (inner forces)

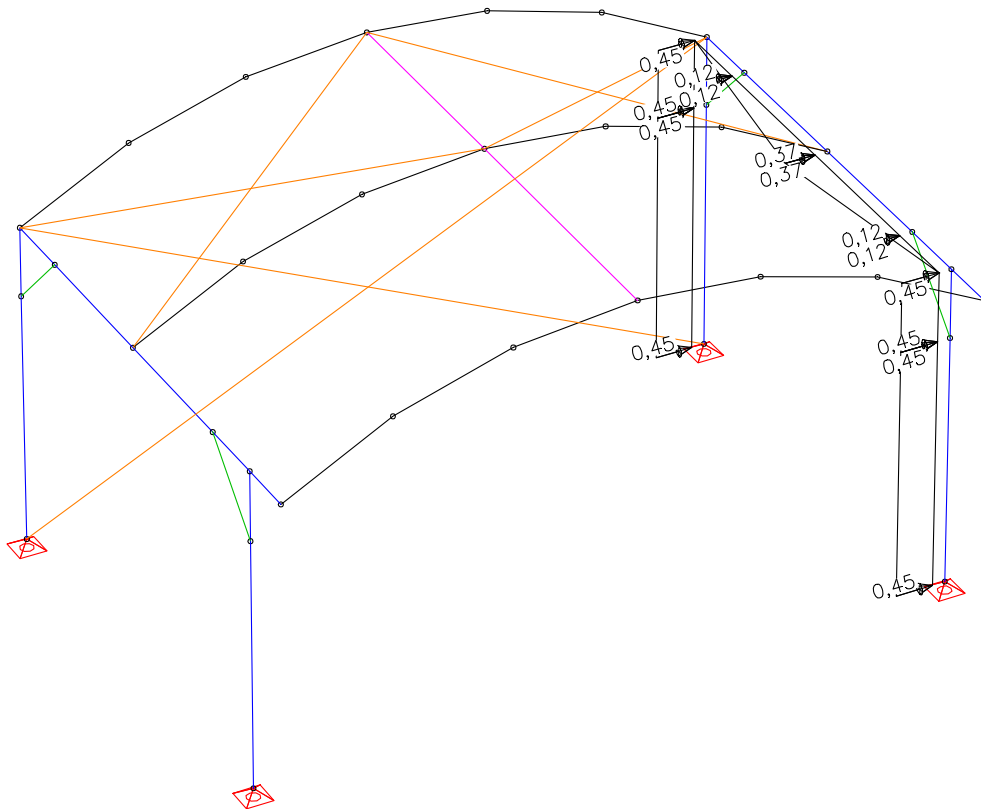
$$Q_k = 0,63 \text{ kN}$$



LC 15: Load, membrane tension left wall

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

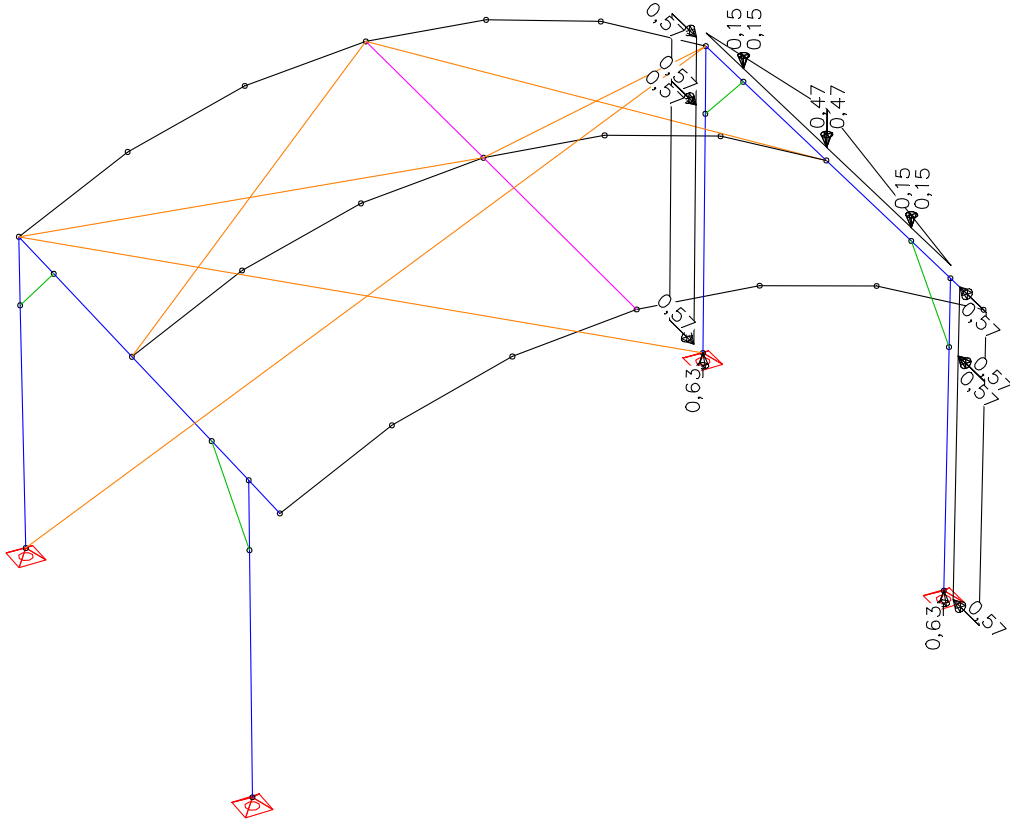
Load case 16: wind right side wall
see LC 14



LC 16: Load, wind right wall

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load case 17: membrane tension left wall
see LC 15



LC 17: Load, membrane tension right wall

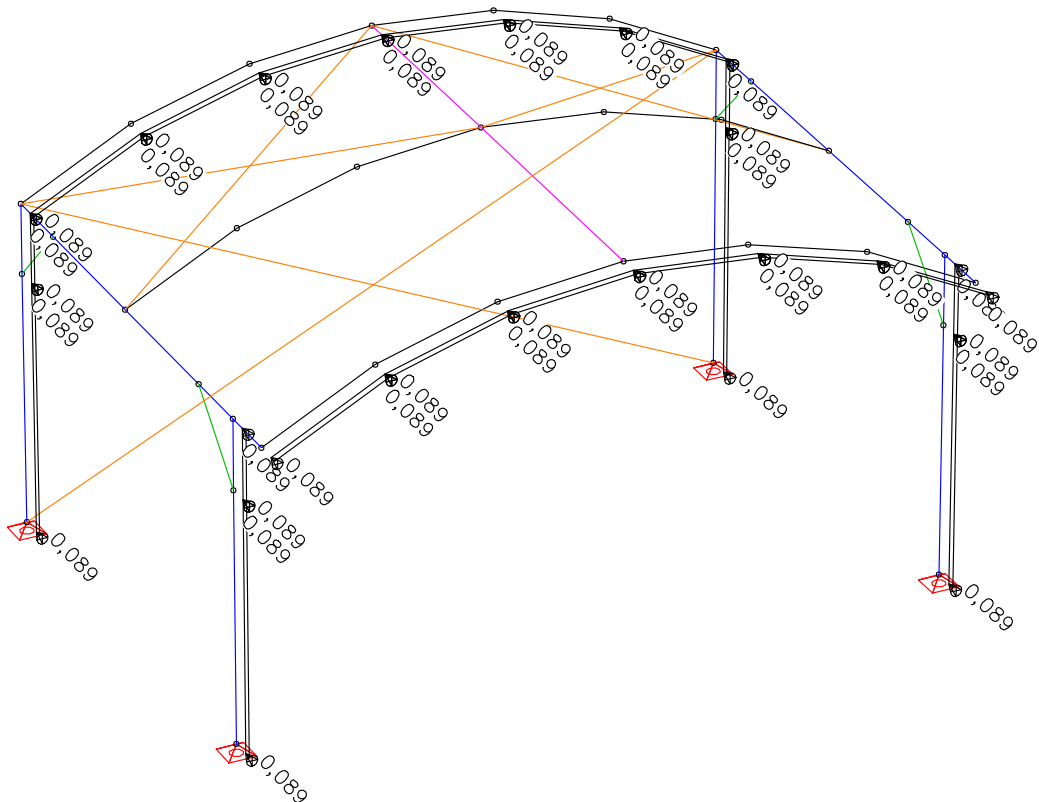
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load case 20: wind structure without wall canopy y-direction

Columns / Roof- 50% permeable

$$q_b = 0,455 \text{ kN/m} \quad c_f = 1,30 \quad b \sim 0,30 \text{ m:}$$

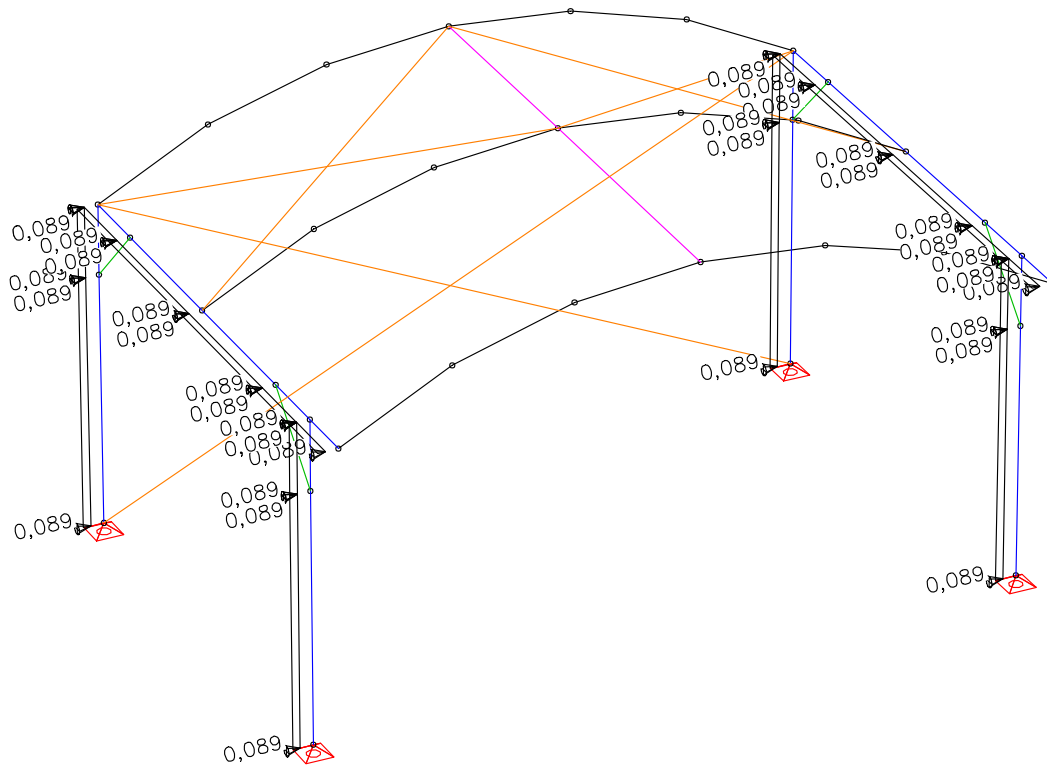
$$q_k = 1,3 \times 0,455 \times 0,3 \times 0,5 = 0,089 \text{ kN/m}$$



LC 20: Load, wind structure without wall canopy y-direction

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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load case 21: wind structure without wall canopy x-direction
see LC 20



LC 21: Load, wind structure without wall canopy x-direction

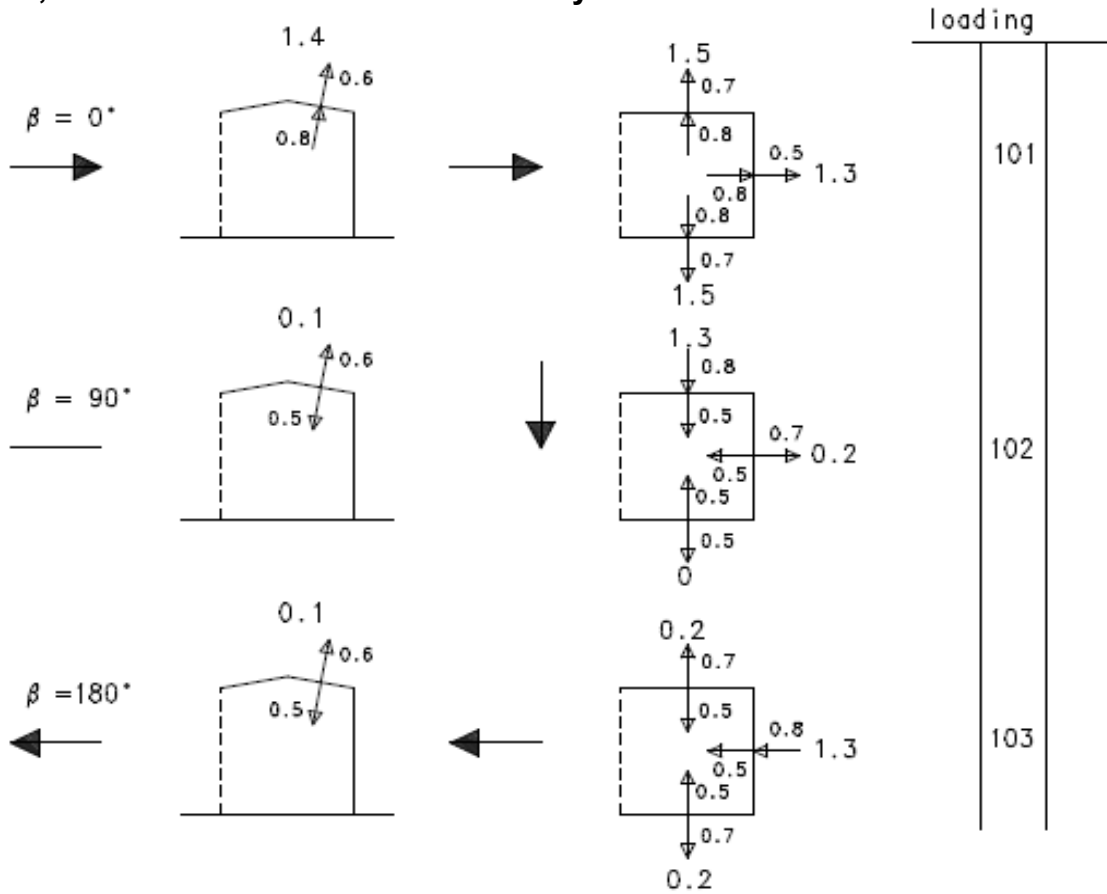
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

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

1. roof, back wall and sides enclosed with fully closed canvas wall
LC 101-103
2. roof enclosed with fully closed canvas wall, back wall and sides removed
LC 301-302

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

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



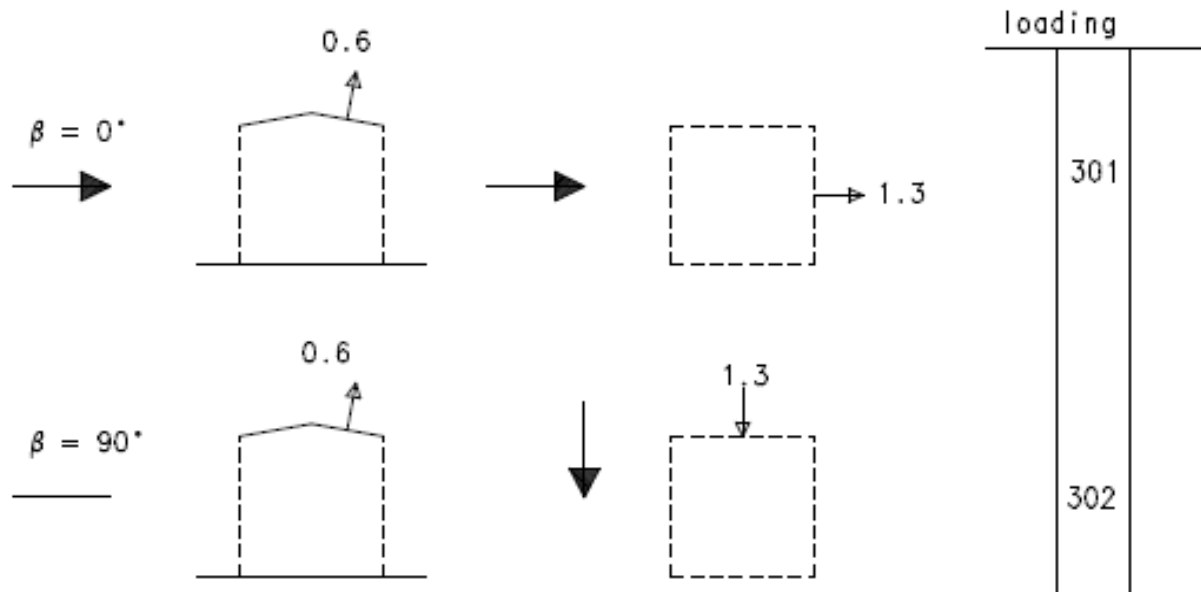
Loading scenario 101 **Wind $\beta = 0^\circ$**
 Load 10-11 = 1,40
 Load 12-13 = 1,30
 Load 14-17 = 1,50

Loading scenario 102 **Wind $\beta = 90^\circ$**
 Load 10-11 = 0,10
 Load 12-13 = 0,20
 Load 14 = -1,30
 Load 15 = 1,30
 Load 16-17 = 0

Loading scenario 103 **Wind $\beta = 180^\circ$**
 Load 10-11 = 0,10
 Load 12 = -1,30
 Load 13 = 1,30
 Load 14-17 = 0,20

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

2. roof closed, wall canopy removed



Loading scenario 301

Wind $\beta = 0^\circ$

Load 10-11 $0,455/0,2 \times 0,6 = 1,365$
 Load 20 $= 1,00$

Loading scenario 302

Wind $\beta = 90^\circ$

Load 10-11 $0,455/0,2 \times 0,6 = 1,365$
 Load 21 $= 1,00$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

For the dimensioning the given load cases are combined in load case combinations.

NOTICE:

Due to the calculation according to the new standard DIN EN 1999-1-1/ Eurocode 9 for aluminium, it is necessary to build some extra load case combinations.

A change in the calculation concept from permissible loads (DIN 4113) to stress capacity values with incorporate partial safety factors $\gamma_G = 1,1$ for steady loads and $\gamma_Q = 1,35$ for variable loads affords these extra load case combinations. (LCC 91-93)
The values for the partial safety factors are given in the DIN EN 13814 for fairground and amusement park machinery and structures.

Load combinations under characteristic loads:

LCC 81: LC1 + LC(2-4) + LC5 + LC(101-103)

LCC 83: LC1 + LC(2-4) + LC5 + LC(301-302)

LCC 85: max (LCC81; LCC83)

Load combinations under design loads:

LCC 91: $1,1 \times LC1 + 1,35 \times LC(2-4) + 1,35 \times LC5 + 1,35 \times LC(101-103)$

LCC 93: $1,1 \times LC1 + 1,35 \times LC(2-4) + 1,35 \times LC5 + 1,35 \times LC(301-302)$

LCC 95: max (LCC91; LCC93)

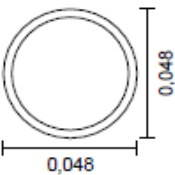
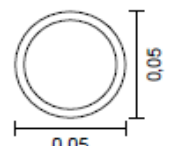
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

4 CALCULATION

System characteristics

- 35 Nodes
- 48 Beams
- 4 Supports
- 0 Link elements
- 5 Material properties
- 5 Section properties
- 20 Load cases
- 7 Load case combinations
- 5 Result locations in beam elements

Section properties

1	Beam	H30 D Area [m ²] Moments of inertia [m ⁴]	A = 1,2720e-03 I _x = 1,0000e-06 I _z = 1,0470e-05	I _y = 1,0570e-05 I _{yz} = 0,0000e+00
2	Beam	H30 V Area [m ²] Moments of inertia [m ⁴]	A = 1,6960e-03 I _x = 1,0000e-06 I _z = 2,1000e-05	I _y = 2,1000e-05 I _{yz} = 0,0000e+00
3	Polygon 	48x3 Centroid [m] Area [m ²] Moments of inertia [m ⁴] Main axis angle [Grad] Ignore I _{yz} in member stiffness.	ys = -0,000 A = 4,2140e-04 I _x = 2,1272e-07 I _y = 1,0645e-07 I _z = 1,0645e-07 Phi = 0,000	zs = -0,000 I _{yz} = 0,0000e+00 I ₁ = 1,0645e-07 I ₂ = 1,0645e-07
4	Tension member	Area [m ²]	A = 1,2000e-04	
5	Polygon 	50x4 Centroid [m] Area [m ²] Moments of inertia [m ⁴] Main axis angle [Grad]	ys = -0,000 A = 5,7435e-04 I _x = 3,0396e-07 I _y = 1,5208e-07 I _z = 1,5208e-07 Phi = 0,000	zs = -0,000 I _{yz} = 0,0000e+00 I ₁ = 1,5208e-07 I ₂ = 1,5208e-07

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	27,000	
2	2	Frei	70000	27000	1,00e-05	27,000	
3	3	Frei	70000	27000	1,00e-05	27,000	f _c = 1e+006 [MN/m ²] f _t = 1e+006
4	4	S235	210000	81000	1,20e-05	78,500	
5	5	Frei	70000	27000	1,00e-05	27,000	f _c = 1e+006 [MN/m ²] f _t = 1e+006

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

List of load cases

LC.	Label
1	dead weight
2	distributed payload
3	point load setup 1
4	point load setup 2
5	PA-load
10	wind roof
11	membrane tension roof
12	wind rear wall
13	membrane tension rear wall
14	wind left wall
15	membrane tension left wall
16	wind right wall
17	membrane tension right wall
20	wind structure without wall canopy y-direction
21	wind structure without wall canopy x-direction
101	Wind - in Betrieb $\beta=0$
102	Wind - in Betrieb $\beta=90$
103	Wind - in Betrieb $\beta=180$
301	Wind - $\beta=0$ nur Dach
302	Wind - $\beta=90$ nur Dach

Load data load case 101: Wind - in Betrieb $\beta=0$

No.	Insert loads (EINF)		weighting
	load case from	load case to	
1	10	11	1,400
2	12	12	1,300
3	13	13	1,300
4	14	14	1,500
5	15	15	1,500
6	16	16	1,500
7	17	17	1,500

Load data load case 102: Wind - in Betrieb $\beta=90$

No.	Insert loads (EINF)		weighting
	load case from	load case to	
1	10	11	0,100
2	12	12	0,200
3	13	13	0,200
4	14	14	-1,300
5	15	15	1,300
6	16	16	0,000
7	17	17	0,000

Load data load case 103: Wind - in Betrieb $\beta=180$

No.	Insert loads (EINF)		weighting
	load case from	load case to	
1	10	11	0,100
2	12	12	-1,300
3	13	13	1,300
4	14	14	0,200
5	15	15	0,200
6	16	16	0,200
7	17	17	0,200

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load data load case 301: Wind - $\beta=0$ nur Dach

No.	Insert loads (EINF) load case		weighting
	from	to	
1	10	11	1,365
2	20	20	1,000

Load data load case 302: Wind - $\beta=90$ nur Dach

No.	Insert loads (EINF) load case		weighting
	from	to	
1	10	11	1,365
2	21	21	1,000

Load case combination 81

Permanent action		Factor
1	dead weight	1,000
Variable inclusive action		Factor
5	PA-load	1,000
1. Variable exclusive action		Factor
101	Wind - in Betrieb $\beta=0$	1,000
102	Wind - in Betrieb $\beta=90$	1,000
103	Wind - in Betrieb $\beta=180$	1,000
2. Variable exclusive action		Factor
2	distributed payload	1,000
3	point load setup 1	1,000
4	point load setup 2	1,000

Load case combination 83

Permanent action		Factor
1	dead weight	1,000
Variable inclusive action		Factor
5	PA-load	1,000
1. Variable exclusive action		Factor
301	Wind - $\beta=0$ nur Dach	1,000
302	Wind - $\beta=90$ nur Dach	1,000
2. Variable exclusive action		Factor
2	distributed payload	1,000
3	point load setup 1	1,000
4	point load setup 2	1,000

Load case combination 85

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

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Load case combination 91

Permanent action		Factor
1	dead weight	1,100
Variable inclusive action		Factor
5	PA-load	1,350
1. Variable exclusive action		Factor
101	Wind - in Betrieb $\beta=0$	1,350
102	Wind - in Betrieb $\beta=90$	1,350
103	Wind - in Betrieb $\beta=180$	1,350
2. Variable exclusive action		Factor
2	distributed payload	1,350
3	point load setup 1	1,350
4	point load setup 2	1,350

Load case combination 93

Permanent action		Factor
1	dead weight	1,100
Variable inclusive action		Factor
5	PA-load	1,350
1. Variable exclusive action		Factor
301	Wind - $\beta=0$ nur Dach	1,350
302	Wind - $\beta=90$ nur Dach	1,350
2. Variable exclusive action		Factor
2	distributed payload	1,350
3	point load setup 1	1,350
4	point load setup 2	1,350

Load case combination 95

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

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	dead weight	0,000	0,000	3,672
	Support reactions	0,000	-0,000	3,672
2	distributed payload	0,000	0,000	19,425
	Support reactions	0,000	-0,000	19,425
3	point load setup 1	0,000	0,000	9,500
	Support reactions	0,000	0,000	9,500
4	point load setup 2	0,000	0,000	21,000
	Support reactions	0,000	0,000	21,000
5	PA-load	0,000	0,000	6,000
	Support reactions	-0,000	0,000	6,000
10	wind roof	-0,002	-0,000	-10,813
	Support reactions	-0,002	-0,000	-10,813

PROJECT:
PROLYTE ARC-ROOF 8x6 - 6x4m

PROJECT-NO.:
13288-Revision 01

CUSTOMER:
PROLYTE GROUP

DATE:
30.11.2015

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
11	membrane tension roof	0,000	0,000	0,000
	Support reactions	0,000	-0,000	-0,000
12	wind rear wall	-0,000	-8,042	0,000
	Support reactions	-0,000	-8,042	0,000
13	membrane tension rear wall	0,000	-0,000	-0,007
	Support reactions	0,000	-0,000	-0,007
14	wind left wall	-4,535	0,000	0,000
	Support reactions	-4,535	0,000	-0,000
15	membrane tension left wall	0,000	0,000	0,014
	Support reactions	0,000	-0,000	0,014
16	wind right wall	4,535	0,000	0,000
	Support reactions	4,535	0,000	-0,000
17	membrane tension right wall	-0,000	0,000	0,014
	Support reactions	0,000	0,000	0,014
20	wind structure without wall canopy y...	-0,000	-2,966	0,000
	Support reactions	0,000	-2,966	0,000
21	wind structure without wall canopy x...	2,479	0,000	0,000
	Support reactions	2,479	0,000	-0,000
101	Wind - in Betrieb $\beta=0$	-0,003	-10,454	-15,106
	Support reactions	-0,003	-10,454	-15,106
102	Wind - in Betrieb $\beta=90$	5,895	-1,608	-1,065
	Support reactions	5,895	-1,608	-1,065
103	Wind - in Betrieb $\beta=180$	-0,000	10,454	-1,085
	Support reactions	-0,000	10,454	-1,085
301	Wind - $\beta=0$ nur Dach	-0,003	-2,966	-14,759
	Support reactions	-0,003	-2,966	-14,759
302	Wind - $\beta=90$ nur Dach	2,476	-0,000	-14,759
	Support reactions	2,476	-0,000	-14,759

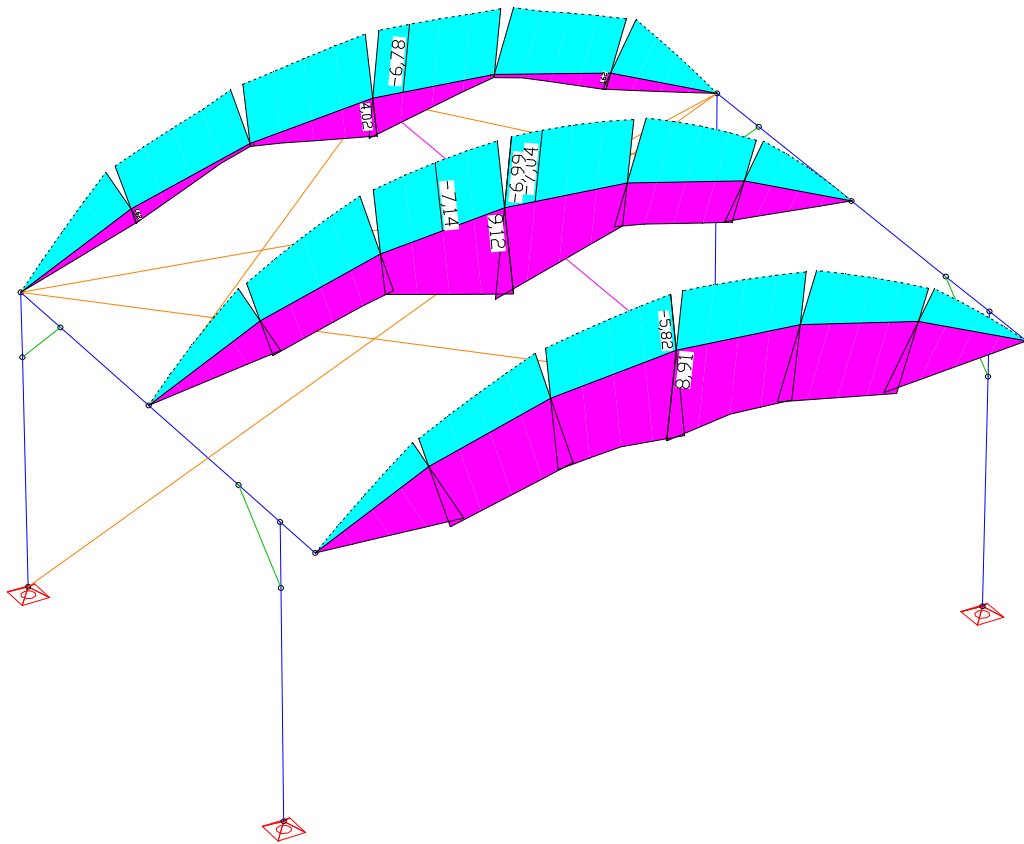
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Internal forces

Load case combination 95:

PROLYTE H30D:

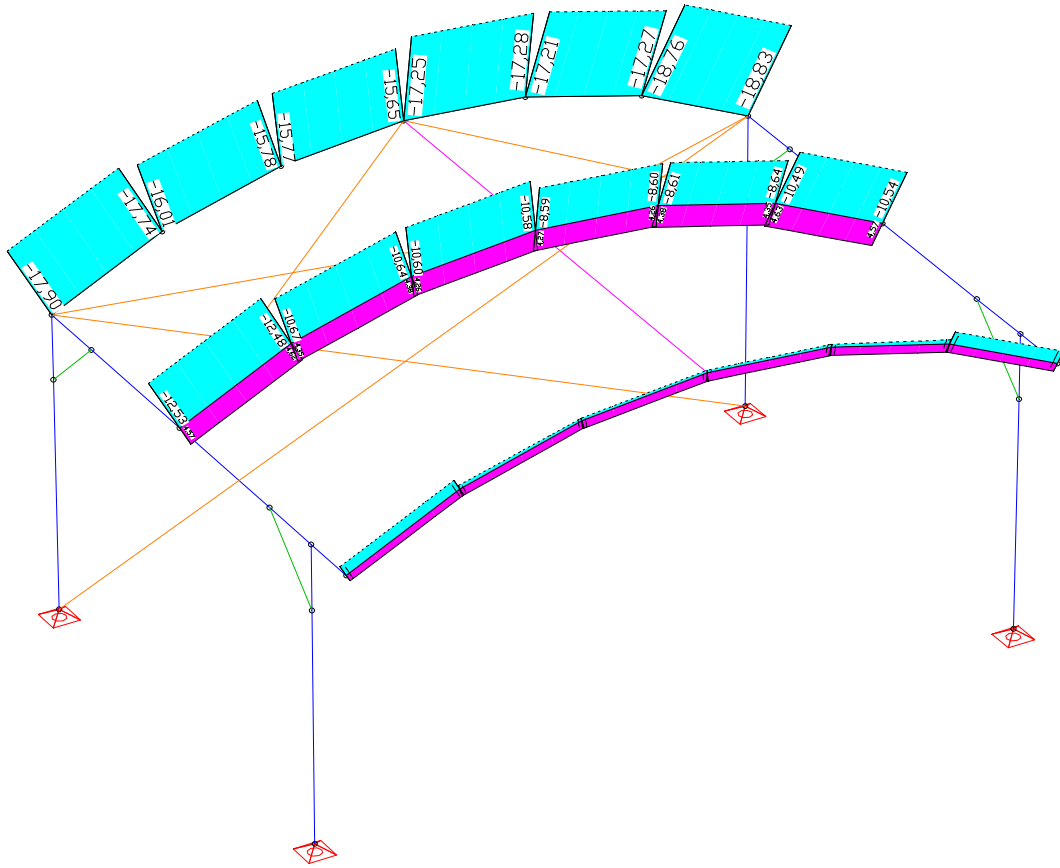
$M_{y,Ed}$



LCC 95: Selected Internal forces min,max M_y [kNm]
 Value range (subsystem, min/max): -7,14/9,12 [kNm]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

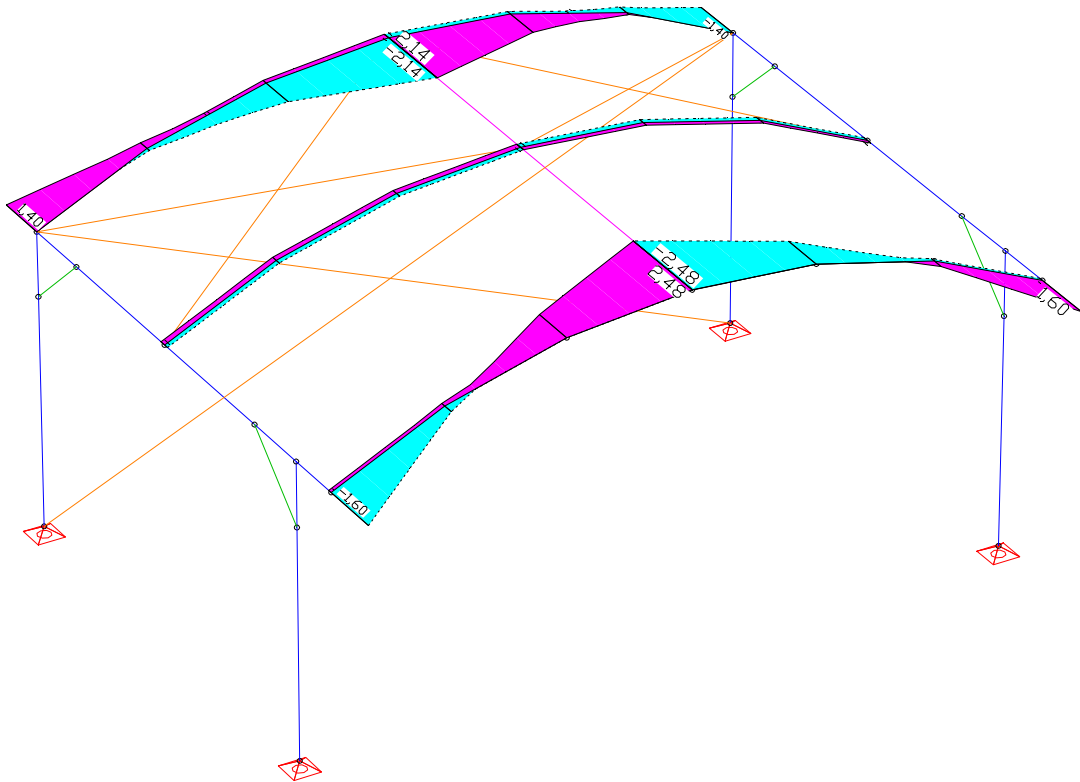
N_{Ed}



LCC 95: Selected Internal forces min,max N_x [kN]
 Value range (subsystem, min/max): -18,83/4,63 [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

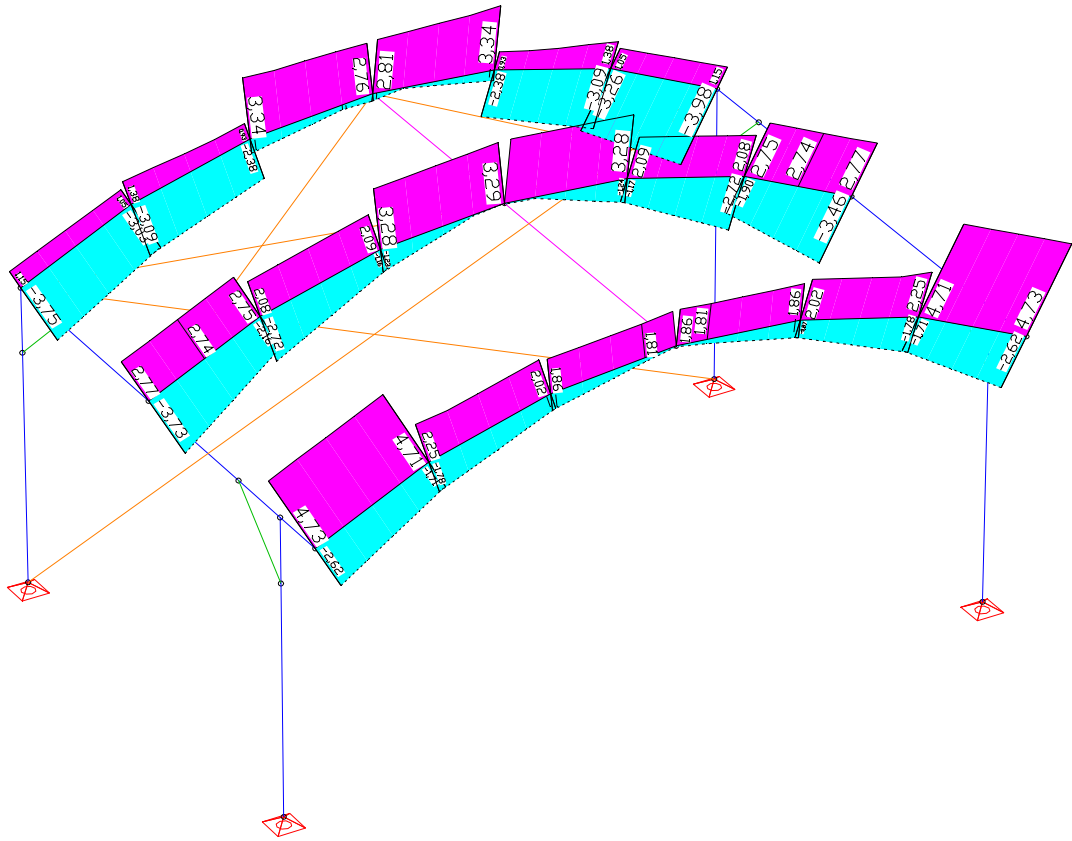
$V_{y,Ed}$



LCC 95: Selected Internal forces min,max Q_y [kN]
 Value range (subsystem, min/max): -2,48/2,48 [kN]

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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

$V_{z,Ed}$

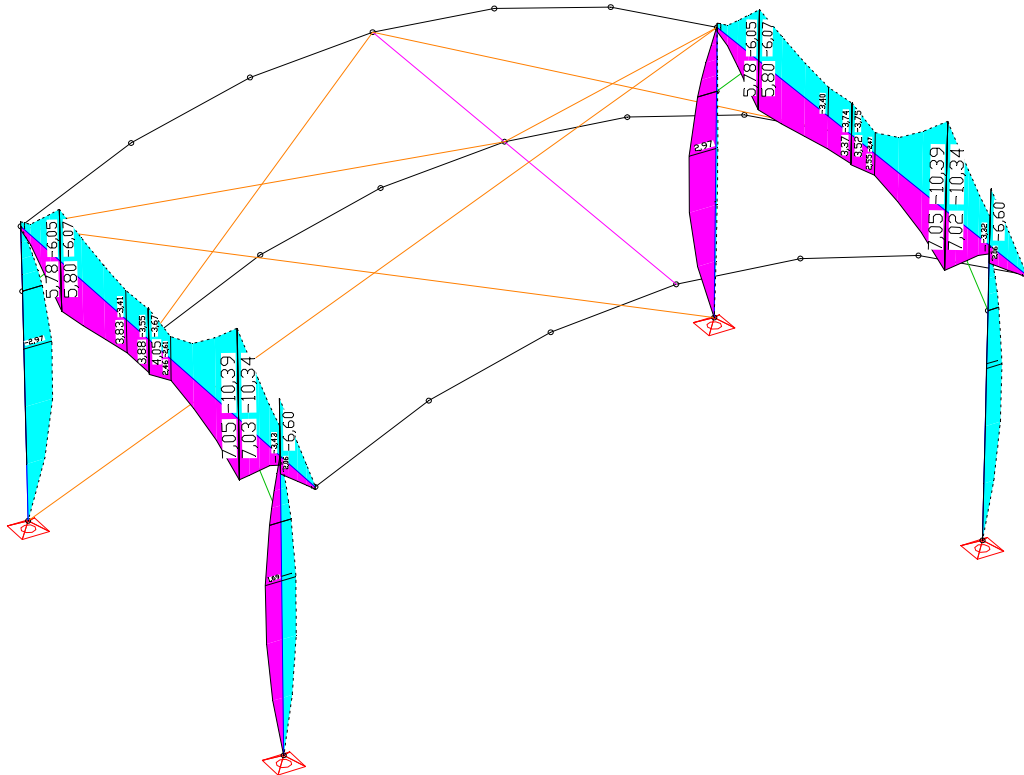


LCC 95: Selected Internal forces min,max Qz [kN]
 Value range (subsystem, min/max): -3,98/4,73 [kN]

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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

PROLYTE H30V:

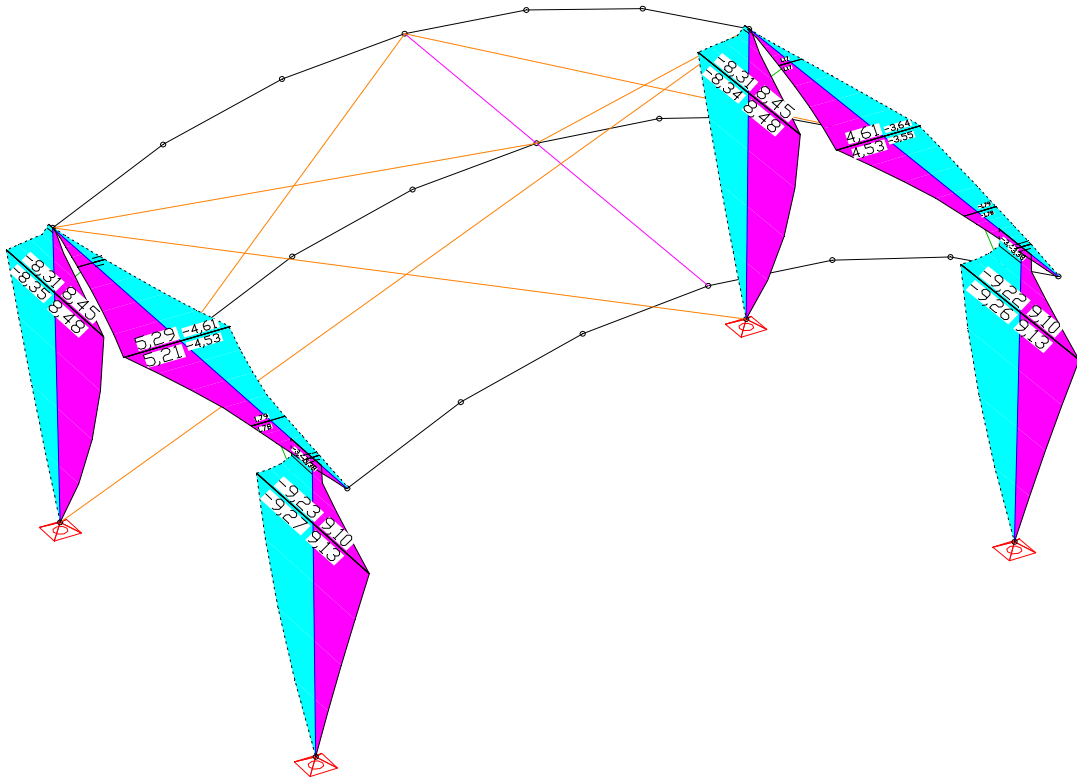
$M_{y,Ed}$



LCC 95: Selected internal forces min,max M_y [kNm]
 Value range (subsystem, min/max): -10,39/7,05 [kNm]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

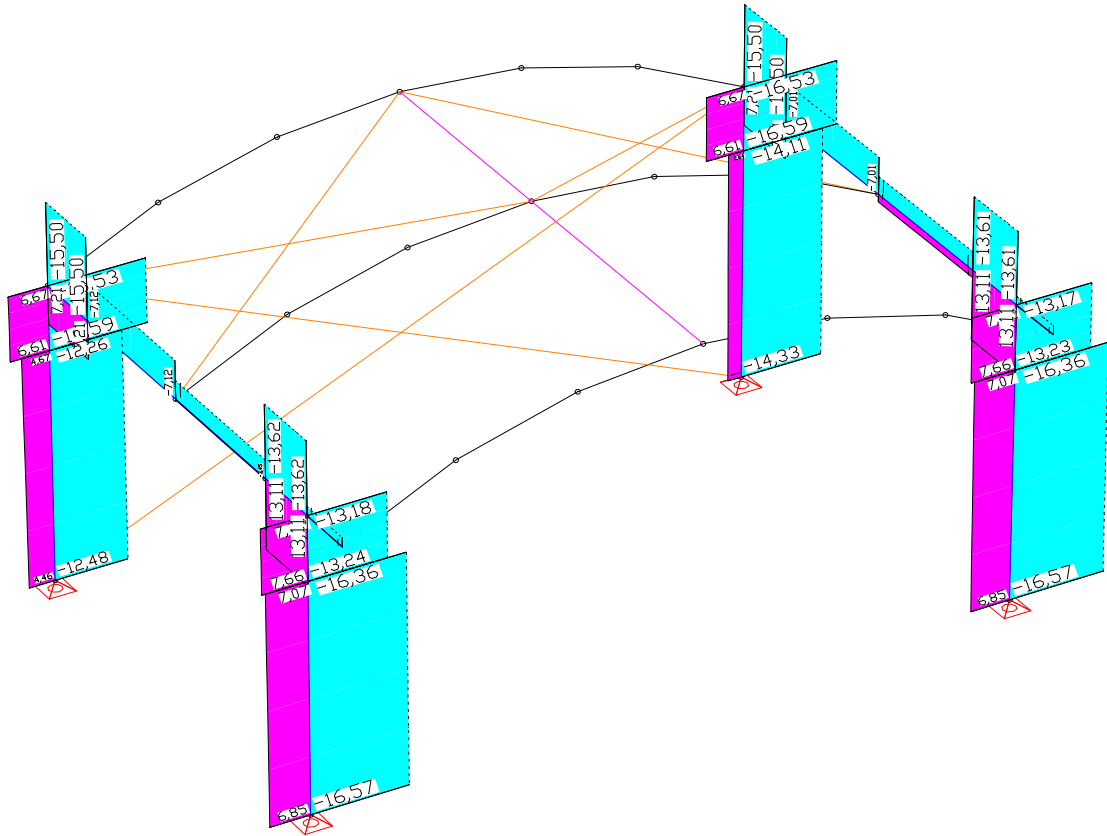
$M_{z,Ed}$



LCC 95: Selected Internal forces min,max M_z [kNm]
 Value range (overall system, min/max): -9,27/9,13 [kNm]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

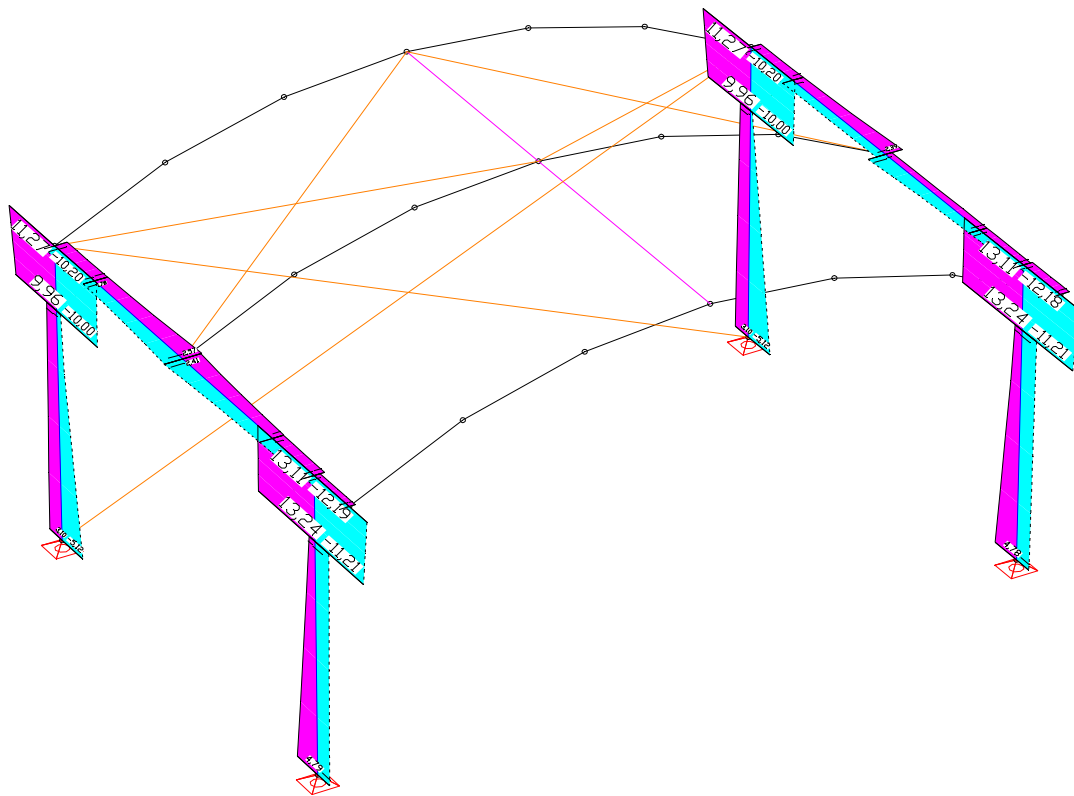
N_{Ed}



LCC 95: Selected Internal forces min,max Nx [kN]
 Value range (subsystem, min/max): -16,59/13,11 [kN]

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CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

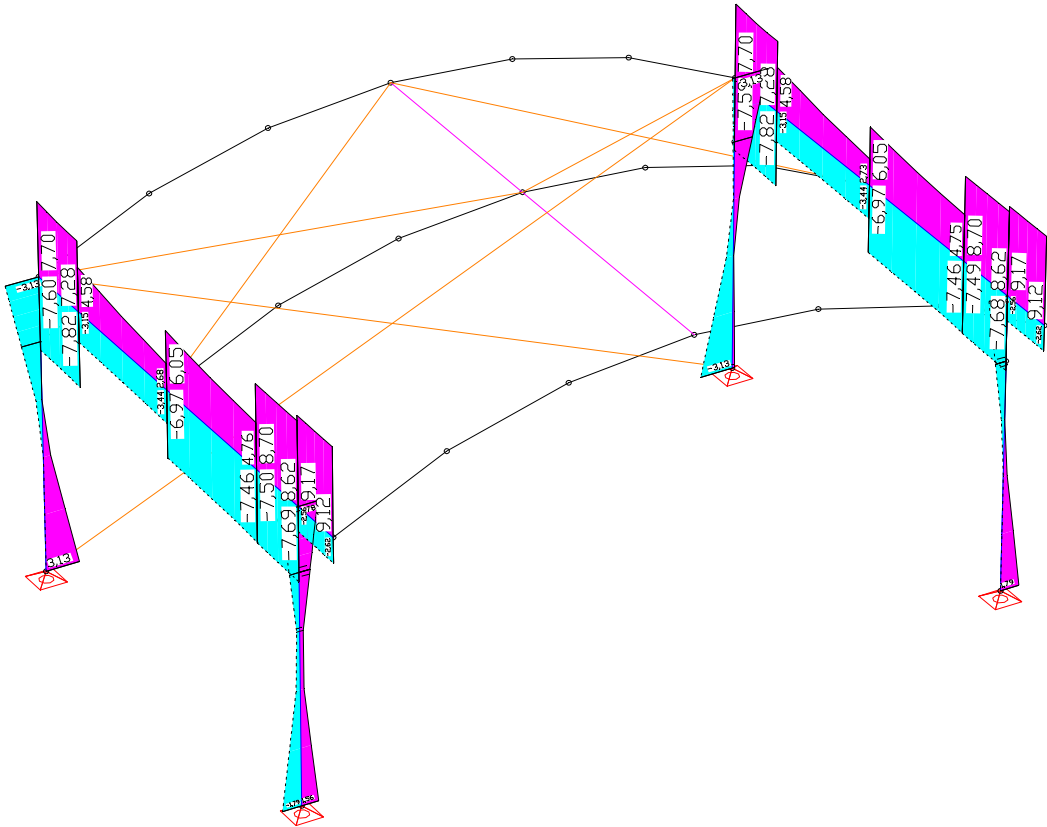
$V_{y,Ed}$



LCC 95: Selected Internal forces min,max Q_y [kN]
 Value range (subsystem, min/max): -12,19/13,24 [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

V_{z,Ed}

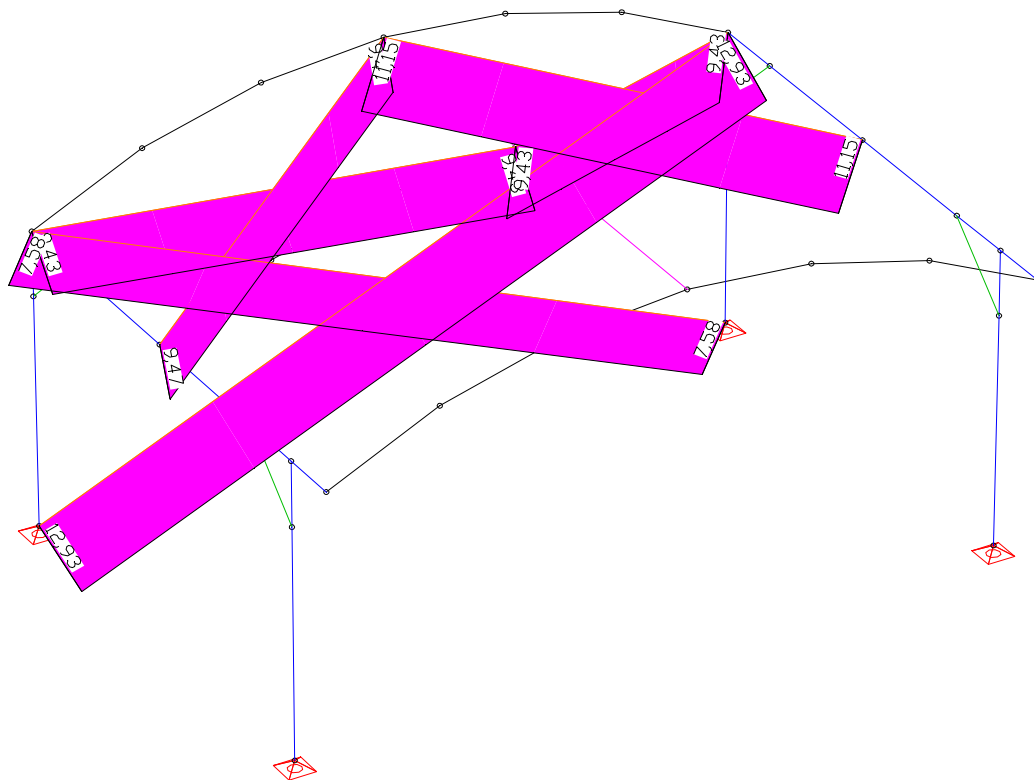


LCC 95: Selected Internal forces min,max Qz [kN]
Value range (subsystem, min/max): -7,82/9,17 [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

guy wires:

N_{Ed}

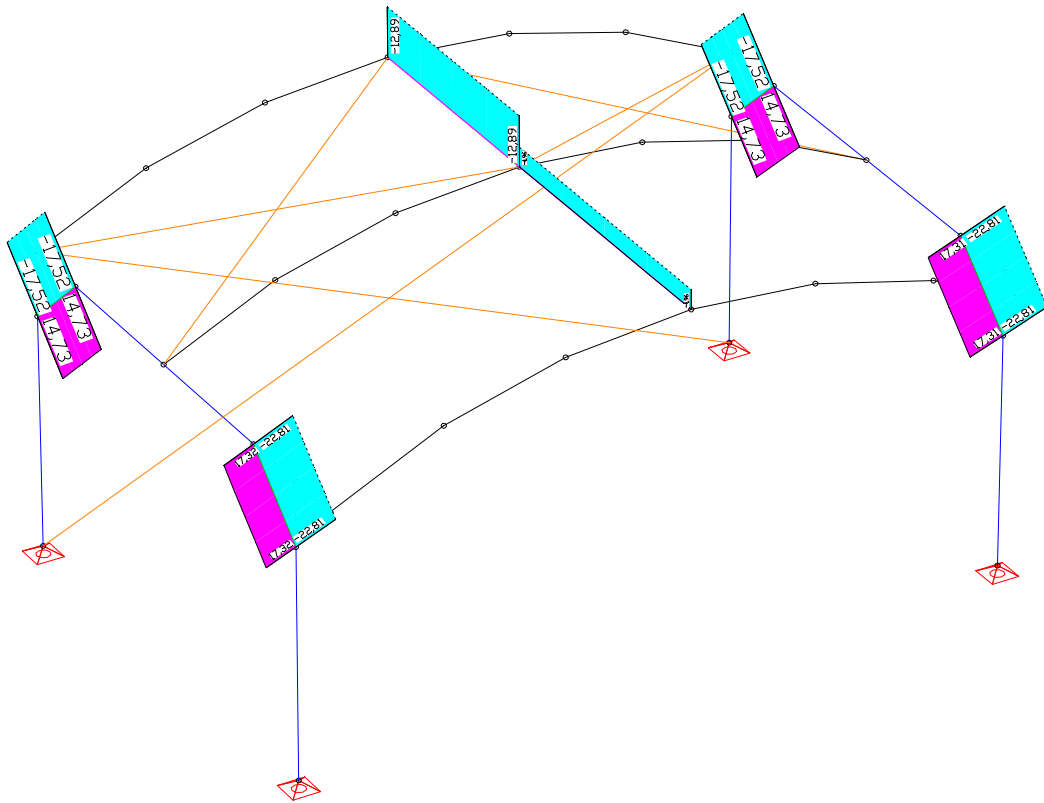


LCC 95: Selected Internal forces min,max N_x [kN]
 Value range (subsystem, min/max): 0,00/12,93 [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

pipes:

N_{Ed}



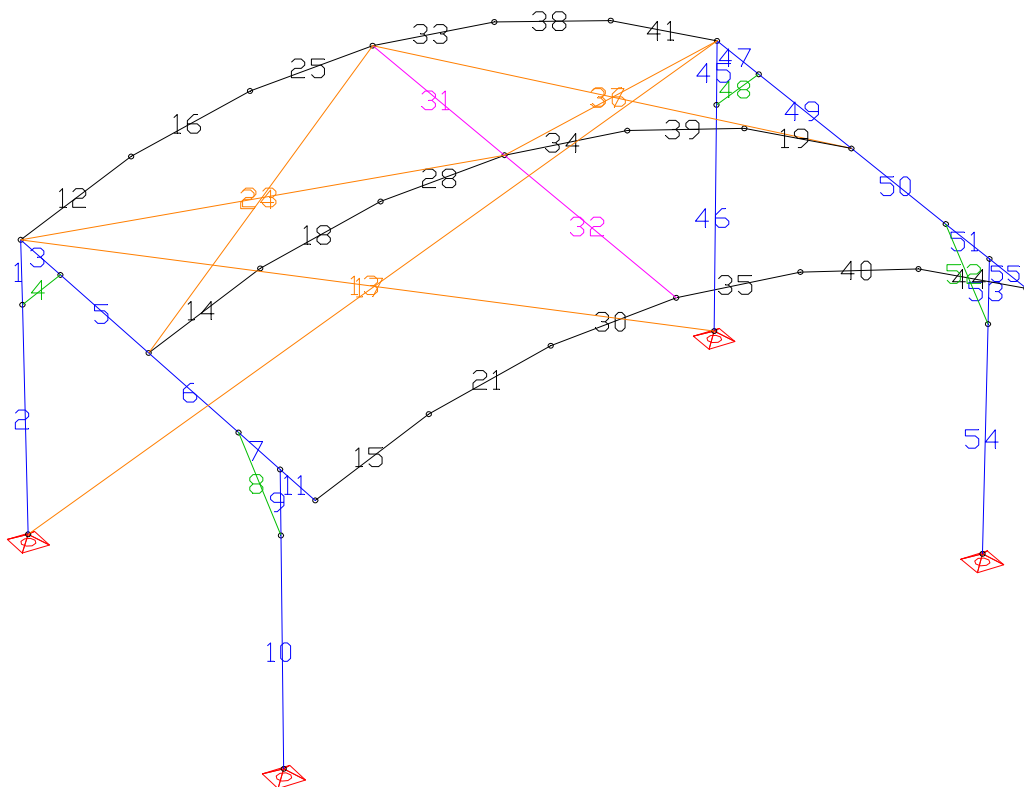
LCC 95: Selected Internal forces min,max N_x [kN]
 Value range (subsystem, min/max): -22,81/17,32 [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5 PROOFS

5.1 GENERAL PROOFS

Beam numbers:



Beam numbers

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

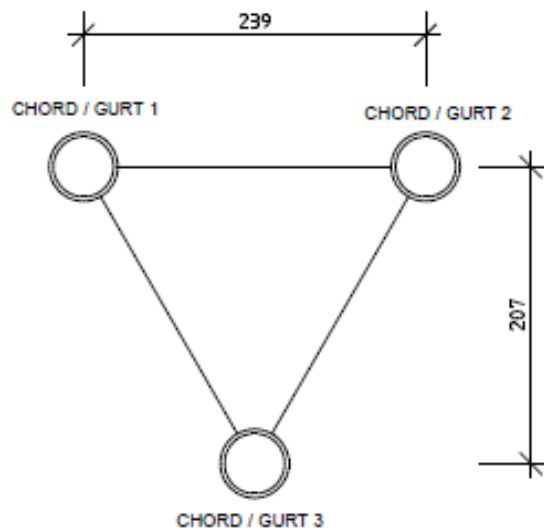
5.1.1 PROLYTE H30D

Proof of bearing capacity:

decisive:

Internal forces beam 28

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-10,58	2,80	0,70	0,15	1,24	0,06
	·	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	·	0,76	-6,99	-0,07	-0,01	0,59	-0,01
	·	-6,03	9,12	0,73	0,15	3,29	0,07
	·	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	·	-7,72	6,32	0,77	0,16	1,52	0,07
	·	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	·	-7,71	6,31	0,76	0,16	1,51	0,07
	·	0,00	0,00	0,00	0,00	0,00	0,00
	·	-6,03	9,12	0,73	0,15	3,29	0,07
	·	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	·	-7,71	6,31	0,76	0,16	1,51	0,07



$$N_{\text{chord},1,Ed} = -6,03/3 - 9,12/(2 \times 0,207) - 0,73/0,239 = -27,09 \text{ kN}$$

$$N_{\text{chord},2,Ed} = -6,03/3 - 9,12/(2 \times 0,207) + 0,73/0,239 = -20,98 \text{ kN}$$

$$N_{\text{chord},3,Ed} = -6,03/3 + 9,12/0,207 = 42,05 \text{ kN}$$

$$\max \eta = 42,05 / 50,22 = 0,837 < 1,0$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

M-V-Interaction:

$$V_{\text{chord},1,\text{Ed}} = 0,15/2 + 3,29/4 \times 1/\tan(60^\circ) = 0,550 \text{ kN}$$

$$V_{\text{chord},2,\text{Ed}} = 0,15/2 - 3,29/4 \times 1/\tan(60^\circ) = -0,400 \text{ kN}$$

$$V_{\text{chord},3,\text{Ed}} = 3,29/2 = 1,645 \text{ kN}$$

decisive:

$$\Delta M_{\text{chord},3,\text{Ed}} = 0,05 \times 1,645 = 0,0823 \text{ kN}$$

$$\sigma_{\text{chord},\text{Ed}} = 42,05 \times 10^1 / 4,241 + 0,0823 \times 10^3 / 4,493 = 117,5$$

$$\sigma_{\text{chord},\text{Ed}} / \sigma_{\text{Rd},\text{HAZ}} = 117,5 / 118,40 = 0,99 \leq 1,0$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

proof against buckling:

1. Buckling vertical to the arch plane

Buckling vertical to the arch plane only occurs on the front and the rear arch.

$$l = 8,42 \text{ m}; \quad \beta \approx 1,0; \quad L_{cr} = 1,0 \times 8,42 = 8,42 \text{ m}$$

$$N_{cr,d} = (\pi / 8,42)^2 \times 70000 \times 1,0571 \times 10^{-5} / 1,1 \times 10^3 = 93,64 \text{ kN}$$

$$\bar{\lambda} = \sqrt{(144,6 / 93,64)} = 1,243$$

$$\phi = 0,5 \times [1 + 0,2 \times (1,243 - 0,1) + 1,243^2] = 1,387$$

$$\chi_{min} = 1 / (1,387 + \sqrt{(1,387^2 - 1,243^2)}) = 0,500$$

decisive

Internal forces beam 25

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-15,65	0,95	-0,44	-1,35	0,34	-0,04
	·	0,00	0,00	0,00	0,00	0,00	0,00
	·	-2,19	-6,76	-1,90	-2,14	-0,08	-0,19
	·	-9,33	4,02	0,54	0,11	2,55	0,05
	·	-1,34	-4,99	-1,97	-1,89	0,17	-0,19
	·	-14,31	-2,31	0,70	0,19	0,47	0,06
	·	-2,17	-6,74	-1,89	-2,14	-0,08	-0,19
	·	-14,31	-2,31	0,70	0,19	0,47	0,06
	·	-5,42	-0,01	-0,93	-1,45	-0,39	-0,09
	·	-11,68	3,33	-0,99	-0,87	2,76	-0,09
	·	-2,17	-6,74	-1,89	-2,14	-0,08	-0,19
	·	-14,31	-2,31	0,70	0,19	0,47	0,06

$$[N_{Ed} / (\chi_{min} \times N_{Rd})]^{0,8} + [(M_{y,Ed} / M_{y,Rd})^{1,7} + (M_{z,Ed} / M_{z,Rd})^{1,7}]^{0,6} < 1,0:$$

$$[2,19 / (0,500 \times 150,66)]^{0,8} + [(6,76 / 10,39)^{1,7} + (1,90 / 12,0)^{1,7}]^{0,6} = 0,738 < 1,0$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

2. Buckling in arch plane

$$s = 8,88/2 = 4,44\text{m}; \quad \beta \approx 1,1; \quad L_{cr} = 1,1 \times 4,44 = 4,84 \text{ m}$$

$$N_{cr,d} = (\pi / 4,84)^2 \times 70000 \times 1,0573 \times 10^{-5} / 1,1 \times 10^3 = 283,5 \text{ kN}$$

$$\bar{\lambda} = \sqrt{(144,6 / 283,5)} = 0,714$$

$$\phi = 0,5 \times [1 + 0,2 \times (0,714 - 0,1) + 0,714^2] = 0,816$$

$$\chi_{min} = 1 / (0,816 + \sqrt{(0,816^2 - 0,714^2)}) = 0,825$$

decisive:

Internal forces beam 28

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-10,58	2,80	0,70	0,15	1,24	0,06
	.	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	.	0,76	-6,99	-0,07	-0,01	0,59	-0,01
	.	-6,03	9,12	0,73	0,15	3,29	0,07
	.	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	.	-7,72	6,32	0,77	0,16	1,52	0,07
	.	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	.	-7,71	6,31	0,76	0,16	1,51	0,07
	.	0,00	0,00	0,00	0,00	0,00	0,00
	.	-6,03	9,12	0,73	0,15	3,29	0,07
	.	4,27	-4,69	-0,65	-0,13	0,52	-0,06
	.	-7,71	6,31	0,76	0,16	1,51	0,07

$$[N_{Ed} / (\chi_{min} \times N_{Rd})]^{0,8} + [(M_{y,Ed} / M_{y,Rd})^{1,7} + (M_{z,Ed} / M_{z,Rd})^{1,7}]^{0,6} < 1,0:$$

$$[6,03 / (0,825 \times 150,66)]^{0,8} + [(9,12 / 10,39)^{1,7} + (0,73 / 12,02)^{1,7}]^{0,6} = 0,970 < 1,0$$

no further proof

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5.1.2 PROLYTE H30V

Proof of bearing capacity:

decisive:

Internal forces beam 6

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-3,45	-3,77	0,91	-1,32	-5,26	-0,00
	·	0,20	-1,58	0,06	-0,04	-0,88	0,00
	·	-2,90	-10,39	1,26	-0,66	-7,26	0,03
	·	-1,38	7,05	-1,04	1,50	4,76	-0,03
	·	-0,60	3,67	-1,34	0,79	3,66	-0,01
	·	-2,76	-8,99	1,79	-1,00	-5,68	0,02
	·	-2,86	-4,47	1,47	-1,68	-4,02	-0,00
	·	-1,38	7,05	-1,04	1,50	4,76	-0,03
	·	-3,10	-9,67	1,23	-0,64	-7,46	0,02
	·	-1,38	7,05	-1,04	1,50	4,76	-0,03
	·	-1,38	7,05	-1,04	1,50	4,76	-0,03
	·	-0,32	-2,56	0,61	-0,35	-3,33	0,04

$$N_{\text{chord,Ed}} = 2,90 / 4 + (10,39 + 1,26) / (2 \times 0,239) = 25,10 \text{ kN}$$

$$N_{\text{chord,Ed}} / N_{\text{chord,Rd}} = 25,10 / 50,22 = 0,50 < 1,0$$

M-V-Interaction:

The proof is done for the most unfavourable location:

$$\Delta M_{\text{Ed}} = 0,25 \times \sqrt{(0,66^2 + 7,26^2)} \times 0,05 = 0,091 \text{ kNm}$$

$$\sigma_{\text{Gurt,Ed}} = 25,10 \times 10^1 / 4,241 + 0,091 \times 10^3 / 4,493 = 79,46 \text{ N/mm}^2$$

$$\sigma_{\text{Gurt,Ed}} / \sigma_{\text{Rd,WEZ}} = 79,46 / 118,40 = 0,671 < 1,0$$

Buckling is not decisive, no further proof.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5.1.3 PROLYTE H30V Tower

Proof against buckling:

front tower:

$$\beta \leq 2,5 \quad L_{cr} = 2,5 \times 3,90 = 9,75\text{m} \quad i = 0,1112 \text{ m}$$

$$\bar{\lambda} = 9,75/0,1112 \times 1/\pi \times \sqrt{(250/70000)} = 1,668$$

$$\phi = 0,5 \times [1 + 0,2 \times (1,668 - 0,1) + 1,668^2] = 2,048$$

$$\chi_{min} = 1 / (2,048 + \sqrt{(2,048^2 - 1,668^2)}) = 0,309$$

decisive:

Internal forces beam 10

Location	Load case	Nx [kN]	My [kNm]	Mz [kNm]	Qy [kN]	Qz [kN]	Mx [kNm]
	K95	-16,36	0,18	7,73	-2,77	0,13	0,00
	·	7,07	1,16	-8,47	1,03	1,02	0,00
	·	-2,50	-1,05	1,71	-2,08	-0,87	0,00
	·	-0,63	1,19	-7,35	0,66	1,01	0,00
	·	2,49	1,16	-9,27	1,29	1,02	0,00
	·	-11,29	0,17	9,13	-3,23	0,13	-0,00
	·	-11,29	0,17	9,13	-3,23	0,13	-0,00
	·	1,45	-0,00	-4,67	1,35	0,00	0,00
	·	-10,21	-1,03	2,83	-2,44	-0,88	0,00
	·	7,07	1,16	-8,47	1,03	1,02	0,00
	·	0,00	0,00	0,00	0,00	0,00	0,00
	·	0,00	0,00	0,00	0,00	0,00	0,00

$$[N_{Ed} / (\chi_{min} \times N_{Rd})]^{0,8} + [(M_{y,Ed} / M_{y,Rd})^{1,7} + (M_{z,Ed} / M_{z,Rd})^{1,7}]^{0,6} < 1,0:$$

$$[16,36/(0,309 \times 200,88)]^{0,8} + [(0,18/24,0)^{1,7} + (7,73/24,0)^{1,7}]^{0,6} = 0,659 < 1,0$$

no further proofs

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5.1.4 Compressive strut roof

Stab 31: rear

$$\beta = 1,0 \quad L_{cr} < 2,71 \text{ m}$$

$$N_{cr} = (\pi^2 \times 70000 \times 1,541 \times 10^{-7}) / 2,71^2 \times 10^3 = 14,50 \text{ kN}$$

$$\bar{\lambda} = \sqrt{((5,781 \times 250 \times 10^{-1}) / 14,50)} = 3,157$$

$$\phi = 0,5 \times [1 + 0,2 \times (3,157 - 0,1) + 3,157^2] = 5,789$$

$$\chi = 1 / (5,789 + \sqrt{(5,789^2 - 3,157^2)}) = 0,094$$

$$N_{b,Rd} = 0,094 \times 5,781 \times 250 / 1,1 \times 10^{-1} = 12,35 \text{ kN}$$

$$\eta = 12,89 / 12,35 \approx 1,03$$

Stab 32: front

$$\beta = 1,0 \quad L_{cr} < 3,42 \text{ m}$$

$$N_{cr} = (\pi^2 \times 70000 \times 1,541 \times 10^{-7}) / 3,42^2 \times 10^3 = 9,102 \text{ kN}$$

$$\bar{\lambda} = \sqrt{((5,781 \times 250 \times 10^{-1}) / 9,102)} = 3,985$$

$$\phi = 0,5 \times [1 + 0,2 \times (3,985 - 0,1) + 3,985^2] = 8,829$$

$$\chi = 1 / (8,829 + \sqrt{(8,829^2 - 3,985^2)}) = 0,060$$

$$N_{b,Rd} = 0,060 \times 5,781 \times 250 / 1,1 \times 10^{-1} = 7,88 \text{ kN}$$

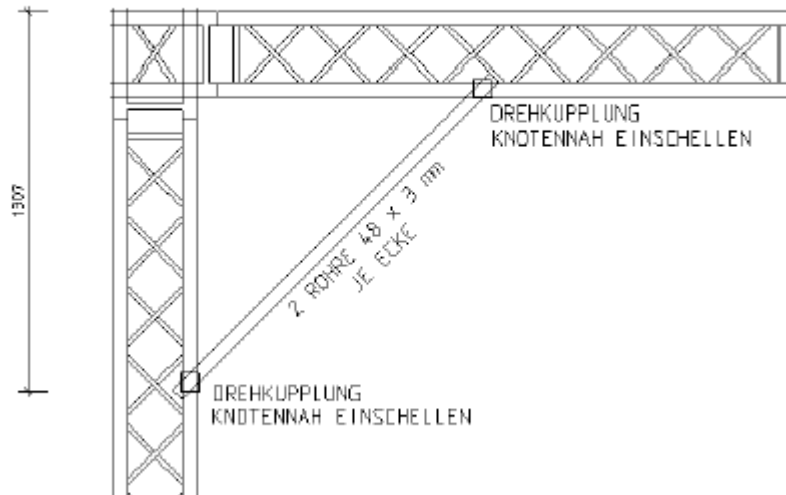
$$\eta = 4,96 / 7,88 = 0,629 < 1$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5.1.4 Proof corner reinforcement

The corners are stiffened by two diagonal struts (in each corner):

PRINZIPIELDARSTELLUNG ECKAUSSTEIFUNG



5.1.4.1 Proof of the pipes

$$N_{Ed} = 22,81 \text{ kN}$$

$$L_{cr} < 1,50 \text{ m}$$

$$N_{cr} = (\pi^2 \times 70000 \times 107,8 \times 10^3) / 1500^2 \times 10^{-3} = 33,10 \text{ kN}$$

$$\bar{\lambda} = \sqrt{((424,1 \times 140 \times 10^{-3}) / 33,10)} = 1,339$$

$$\phi = 0,5 \times [1 + 0,2 \times (1,339 - 0,1) + 1,339^2] = 1,520$$

$$\chi = 1 / (1,520 + \sqrt{(1,520^2 - 1,339^2)}) = 0,447$$

$$N_{b,Rd} = 0,447 \times 424,1 \times 140 / 1,1 \times 10^{-3} = 24,13 \text{ kN}$$

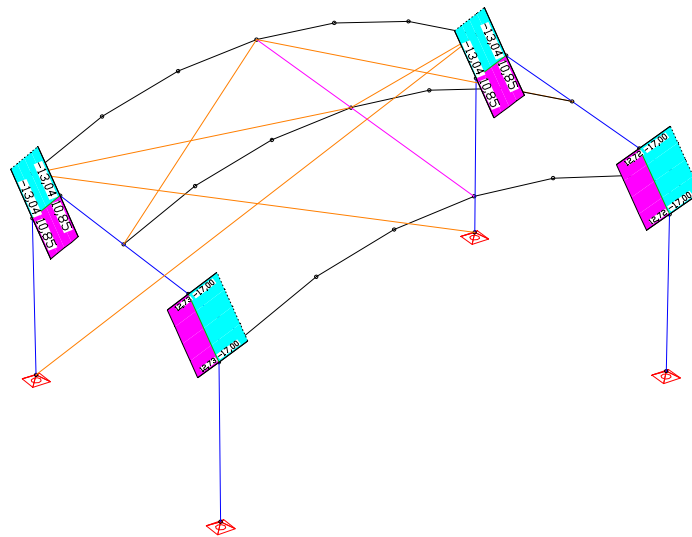
$$\eta = 22,81 / (2 \times 24,13) = 0,473 < 1$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5.1.4.2 Proof of the clamps

chosen: DOUGHTY SWL 750
or equal

N_k :



LFK 85: Ausgewählte Schnittgrößen min,max N_x [kN]
Wertebereich (Teilsystem, min/max): -17,00/12,73 [kN]

$$l_{\text{eff}} = 0,85 + 0,239/2 = 0,970$$

$$\rightarrow N_{\text{Ed}} = 0,85/0,97 \times 17,0 = 14,90$$

$$\eta = 14,90 / (2 \times 7,50) = 0,993 < 1$$

5.1.4.3 Proof for local chord bending:

$$N_{\text{H,Ed}} = 22,81 / 2 \times \cos(45^\circ) = 8,06 \text{ kN}$$

$$\Delta M_{\text{Ed}} = 8,06 \times 0,05/2 = 0,202 \text{ kNm}$$

$$\sigma_{\text{chord,Ed}} = 25,10 \times 10 / 4,241 + 0,202 \times 10^3 / 4,493 = 104,1 \text{ N/mm}^2$$

$$\eta = 104,1 / 118,40 = 0,879 < 1$$

No further proofs

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5.1.6 Grounding (Base point connection)

$$N_{Ed} = 15,0 \text{ kN}$$

The grounding is being carried out on three sides with trusses Prolyte H30V.

$$i_{y,z} = 11,12 \text{ cm}; A = 16,96 \text{ cm}^2$$

buckling length: $\sim 8,0 \text{ m}$

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

$$\bar{\lambda} = L_{CR} / (i \times \pi) \times \sqrt{(A_{eff} \times f_0) / (A \times E)} = 800 / (11,12 \times 3,14) \times \sqrt{(250 / 70000)} = 1,369$$

$$\Phi = 0,5 \times (1 + \alpha \times (\bar{\lambda} - \bar{\lambda}_0) + \bar{\lambda}^2) = 0,5 \times (1 + 0,2 \times (1,369 - 0,10) + 1,369^2) = 1,564$$

$$\chi = 1 / (\Phi + \sqrt{(\Phi^2 - \bar{\lambda}^2)}) = 1 / (1,564 + \sqrt{(1,564^2 - 1,369^2)}) = 0,431$$

$$N_{b,Rd} = 0,431 \times 200,88 = 86,58 \text{ kN} > 15,0 \text{ kN}$$

Adapter:

$$N_{Ed} = 15,0 \text{ kN} \quad (\text{pressure})$$

bending of the frame:

$$M_{Ed} = 15,0 / 2 \times 0,239 / 4 = 0,4481 \text{ kNm}$$

$$\text{RR50x50x4 (EN AW 6082 T6)} \quad W_{el} = 9,49 \text{ cm}^3$$

$$\sigma_{Ed} = 0,4481 \times 10^3 / 9,49 = 47,22 \text{ N/mm}^2 < 250 / 1,1 = 227,27 \text{ N/mm}^2 = \sigma_{Rd}$$

$$N_{Ed} = 15,0 \text{ kN} \quad (\text{safe side, tension in the side walls is much lower})$$

bending of the plates:

$$M_{Ed} = 15,0 / 2 \times 0,025 = 0,1875 \text{ kNm}$$

$$150 \times 122,5 \times 10 \text{ mm (EN AW 6061 T6)}$$

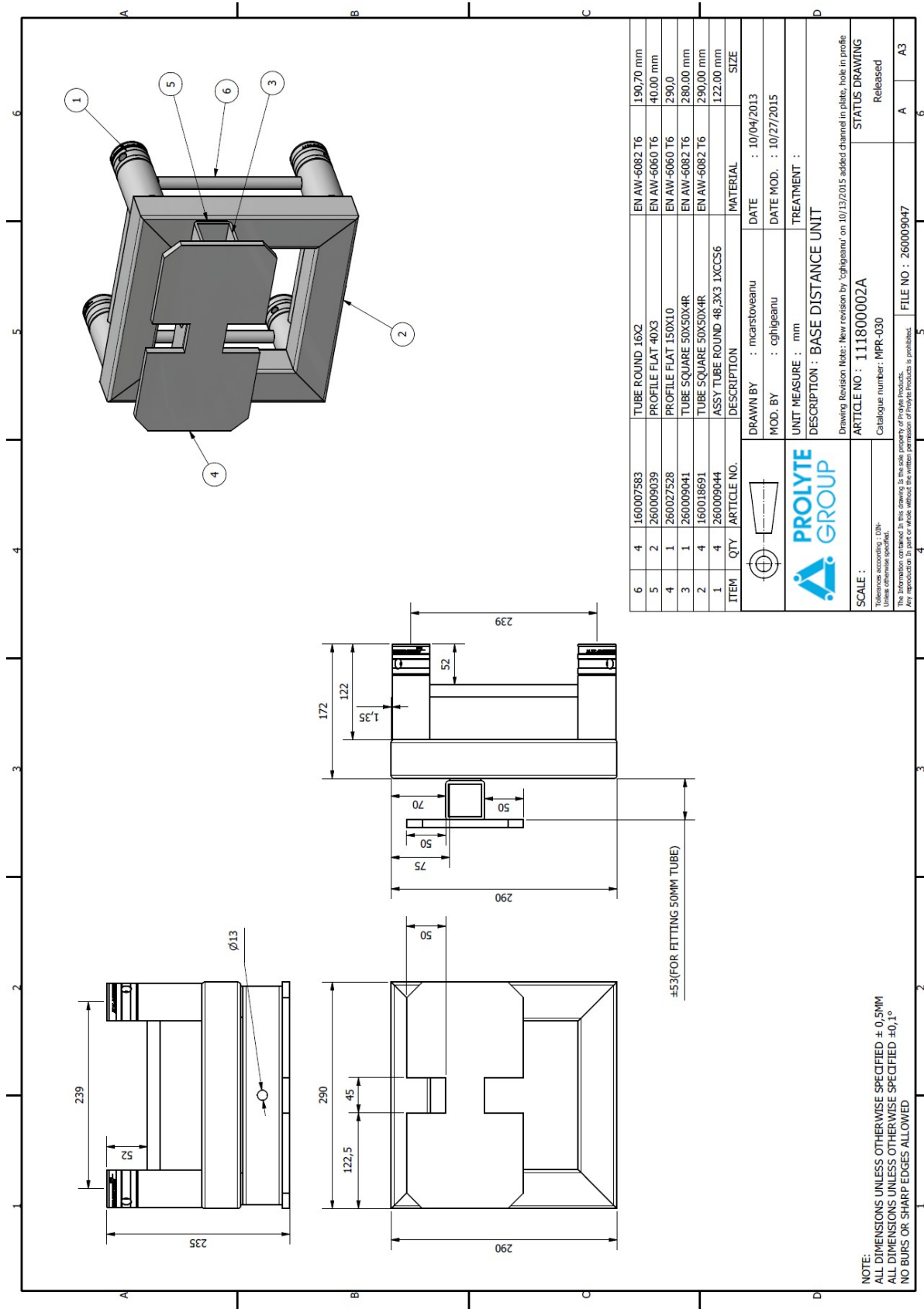
$$W_{el} = 12,0 \times 1,0^2 / 6 = 2,0 \text{ cm}^3$$

$$\sigma_{Ed,HAZ} = 0,1875 \times 10^3 / 2,0 = 93,75 \text{ N/mm}^2 < 0,8 \times 175 / 1,25 = 112 \text{ N/mm}^2 = \sigma_{Rd,HAZ}$$

Tension in the rear wall can be neglected due to attaching the guy wires on the bases.

no further proof

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



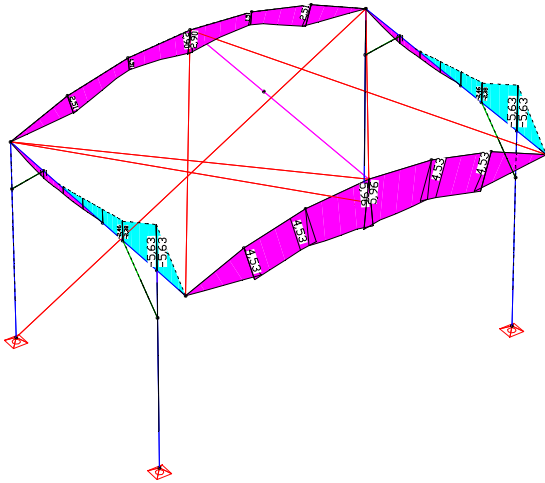
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

5.2 Permissible payload system 6x4

The permissible payload is determined with a comparative calculation. Only internal forces resulting from live load are compared to those of bigger state.

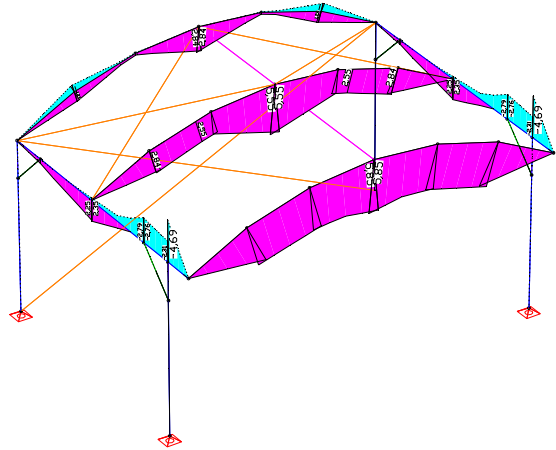
$M_{y,Ed}$

System 6x4:



LFK 100: Schnittgrößen min,max My [kNm]
Wertebereich (Gesamtsystem, min/max): -5,63/5,96 [kNm]

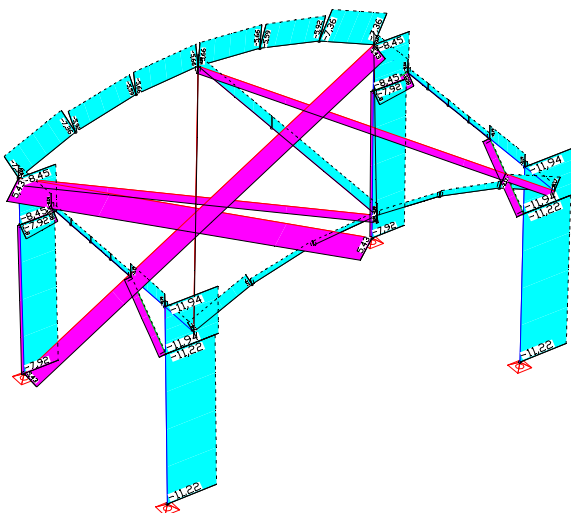
System 8x6:



LFK 100: Schnittgrößen min,max My [kNm]
Wertebereich (Gesamtsystem, min/max): -4,69/5,85 [kNm]

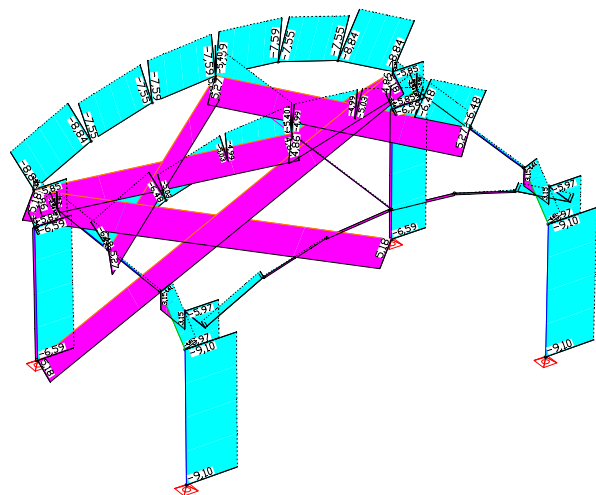
N_{Ed}

System 6x4:



LFK 100: Schnittgrößen min,max Nx [kN]
Wertebereich (Gesamtsystem, min/max): -11,94/5,43 [kN]

System 8x6:



LFK 100: Schnittgrößen min,max Nx [kN]
Wertebereich (Gesamtsystem, min/max): -9,10/5,27 [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

The changed usage of the single elements can be estimated in the following way:

Roof arches:

$$\eta_{6x4} \approx M_{y,6x4} / M_{y,8x6} \times \eta_{8x6} = 5,96/5,85 \times 0,769 = 0,783 < 1$$

Main grid:

$$\eta_{6x4} \approx M_{y,6x4} / M_{y,8x6} \times \eta_{8x6} = 5,64 / 4,69 \times 0,699 = 0,841 < 1$$

Towers:

$$\eta_{6x4} \approx N_{6x4} / N_{8x6} \times \eta_{8x6} = 11,22 / 9,10 \times 0,684 = 0,843 < 1$$

Guy wires:

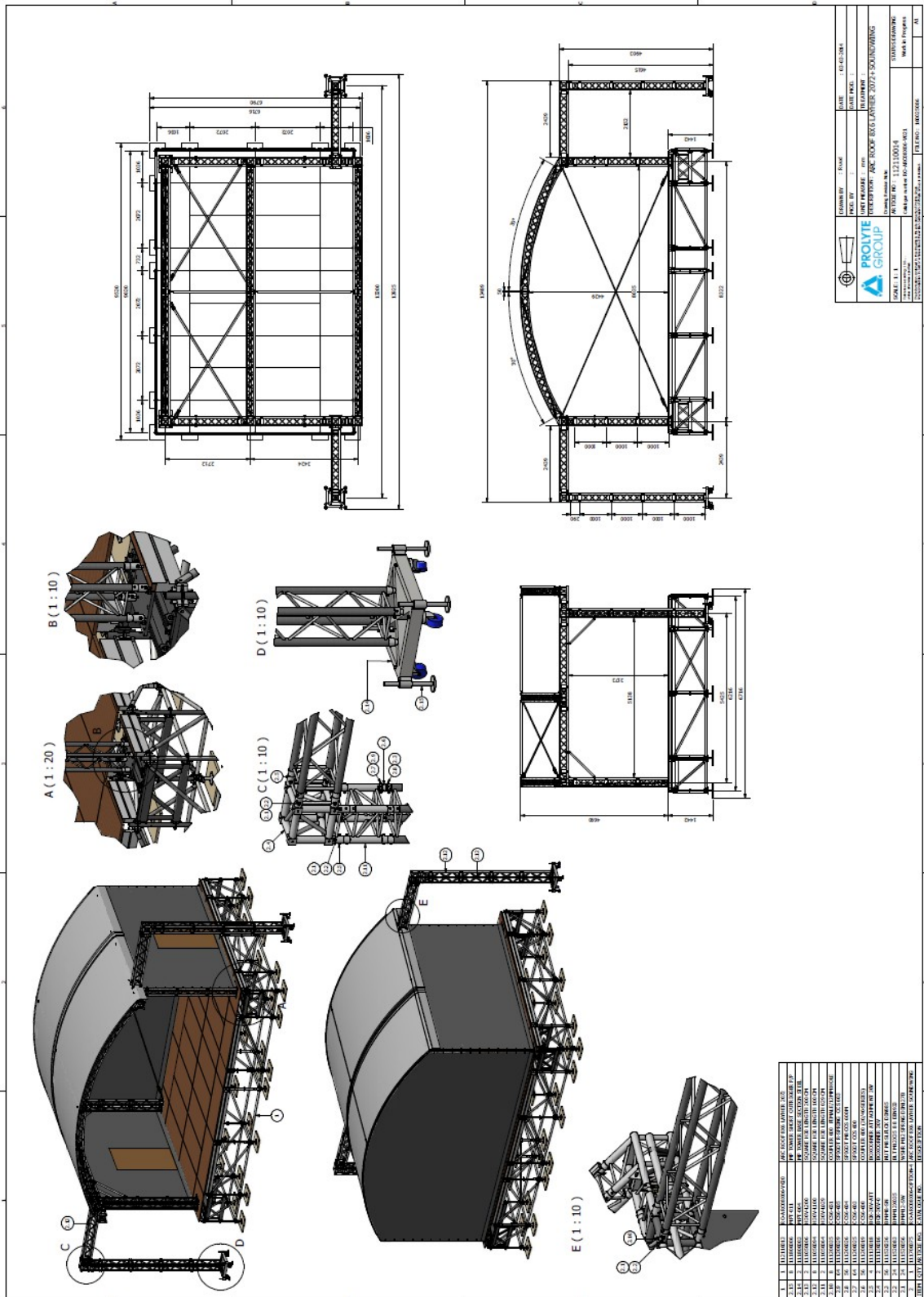
$$\eta_{6x4} \approx N_{6x4} / N_{8x6} \times \eta_{8x6} = 5,43 / 5,18 \times 0,977 = 1,02 < 1,03$$

These results are safe because the load reduction due to wind is not taken into account.

no further proof

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

6 SOUNDWINGS



PROJECT:
PROLYTE ARC-ROOF 8x6 - 6x4m

CUSTOMER:
PROLYTE GROUP

PROJECT-NO.:
13288–Revision 01

DATE:
30.11.2015

Optionally the construction can be build up with soundwings.

The maximum width of the soundwings is 2,0m (truss piece).

The sound wings may be closed completely with canopies or may be loaded with a PA-load of 10 kN (CPL) with a maximum surface of 4m² up to wind speeds of 20 m/s. Above wind speeds of 20 m/s the canopies/ PA-load must be removed.

from PA-load:

$$10,0 \text{ kN} = 1000 \text{ kg} \quad (\text{dynamic load increase is taken into account})$$

from wind:

$$1,0 \times 0,20 \times 4,0 = 0,80 \text{ kN} \quad (\text{with PA})$$

$$1,0 \times 0,20 \times 4,9 / 2 = 0,49 \text{ kN/m} \quad (\text{with canopy})$$

from membrane tension:

$$0,49 / 0,80 = 0,6125 \text{ kN/m}$$

proof H30V:

with PA

$$M_{y,Ed} = 1,10 \times 0,063 \times 2,45^2 / 12 + 1,35 \times 1,2 \times 10,0 \times 2,45 / 8 = 4,99 \text{ kNm}$$

$$M_{z,Ed} = 1,35 \times 1,8 \times 0,80 \times 2,45 / 2 = 2,38 \text{ kNm} \quad (< M_{Rd,Boxcorner} = 9,13 \text{ kNm})$$

$$N_{Ed} = (4,99 + 2,38) / (2 \times 0,239) = 15,42 \text{ kN} < 50,22 \text{ kN}$$

$$V_{z,Ed} = 1,10 \times 0,063 \times 2,45 / 2 + 1,35 \times 1,2 \times 10,0 / 2 = 8,18 \text{ kN} < 18,94 \text{ kN}$$

with canopy

$$M_{y,Ed} = 1,10 \times 0,063 \times 2,45^2 / 12 + 1,35 \times 1,3 \times 0,6125 \times 2,45^2 / 12 = 0,57 \text{ kNm}$$

$$M_{z,Ed} = 1,35 \times 1,3 \times 0,49 \times 2,45^2 / 2 = 2,58 \text{ kNm}$$

(not decisive)

Proof of the pipes (side walls)

$$F_{H,d} = 1,35 \times 1,8 \times 0,80 = 1,95 \text{ kN} \quad (\text{from additional wind in the side walls})$$

$$M_{Ed} = 1,95 \times 3,90 / 2 = 3,80 \text{ kNm} \quad (\text{additional moment in the corners})$$

$$N_{Ed} = 3,80 / 0,85 \times \cos 45^\circ = 6,32 \text{ kN}$$

$$N_{Ed,sum} = 22,81 + 6,32 = 29,13 \text{ kN}$$

$$N_{b,Rd} = 0,447 \times 424,1 \times 140 / 1,1 \times 10^{-3} = 24,13 \text{ kN}$$

$$\eta = 29,13 / (2 \times 24,13) = 0,604 < 1$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

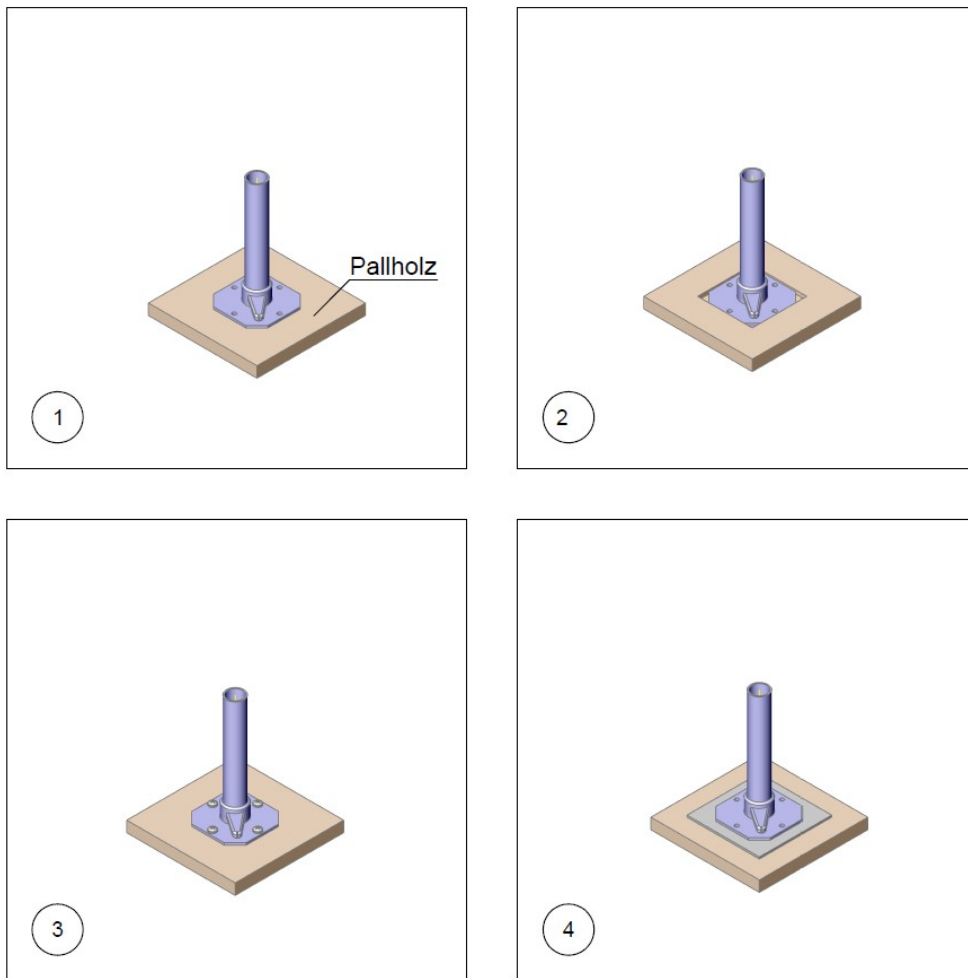
7 BALLAST LOAD

7.1 SYSTEMS WITHOUT GROUNDING

All lifting and displacing loads have to be secured locally by ballast.

safety factor 1,20

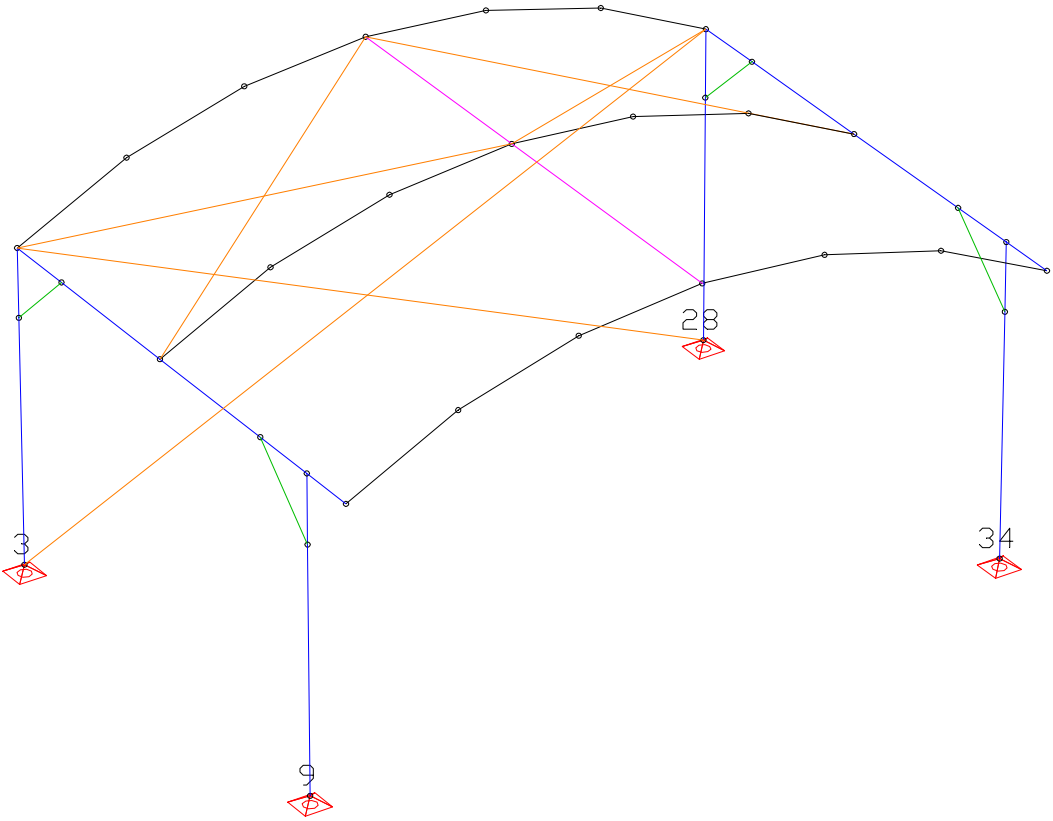
friction coefficient μ :



- 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 $\mu = 0,60$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

SYSTEM 8x6



Auflagennummern

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Support reactions from all load cases

Node	LC	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
3	1	0,48	-0,06	0,85	0,00	0,00	0,00
	2	3,42	-0,42	4,37	0,00	0,00	0,00
	3	4,71	-0,16	2,46	0,00	0,00	0,00
	4	3,90	-0,27	4,79	0,00	0,00	0,00
	5	0,00	0,19	-0,39	0,00	0,00	0,00
	10	-0,00	0,27	-2,35	0,00	0,00	0,00
	11	0,00	-0,01	-0,00	0,00	0,00	0,00
	12	0,46	-2,66	1,96	0,00	0,00	0,00
	13	2,50	-0,00	-0,00	0,00	0,00	0,00
	14	-0,88	-0,38	2,12	0,00	0,00	0,00
	15	0,00	0,84	0,01	0,00	0,00	0,00
	16	2,77	0,39	-2,12	0,00	0,00	0,00
	17	-0,00	-0,00	0,00	0,00	0,00	0,00
	20	0,30	-0,71	0,93	0,00	0,00	0,00
	21	1,96	0,27	-1,41	0,00	0,00	0,00
	101	1,16	-1,83	-0,73	0,00	0,00	0,00
	102	5,12	1,10	-2,58	0,00	0,00	0,00
	103	2,31	3,64	-2,79	0,00	0,00	0,00
	301	-0,00	-0,36	-2,27	0,00	0,00	0,00
	302	1,95	0,62	-4,61	0,00	0,00	0,00
9	1	-0,00	0,06	0,98	0,00	0,00	0,00
	2	-0,01	0,42	5,35	0,00	0,00	0,00
	3	-0,01	0,16	2,29	0,00	0,00	0,00
	4	-0,01	0,27	5,71	0,00	0,00	0,00
	5	-0,00	-0,19	3,39	0,00	0,00	0,00
	10	0,00	-0,27	-3,06	0,00	0,00	0,00
	11	0,00	0,01	0,00	0,00	0,00	0,00
	12	0,00	-1,37	-1,96	0,00	0,00	0,00
	13	0,00	0,00	0,00	0,00	0,00	0,00
	14	-0,89	-0,50	-0,83	0,00	0,00	0,00
	15	-0,00	-0,84	0,01	0,00	0,00	0,00
	16	0,00	0,50	0,83	0,00	0,00	0,00
	17	0,00	0,00	-0,00	0,00	0,00	0,00
	20	0,00	-0,77	-0,93	0,00	0,00	0,00
	21	0,18	0,35	0,58	0,00	0,00	0,00
	101	-1,32	-3,40	-6,82	0,00	0,00	0,00
	102	1,15	-0,75	0,39	0,00	0,00	0,00
	103	-0,17	1,58	2,25	0,00	0,00	0,00
	301	0,00	-1,12	-5,11	0,00	0,00	0,00
	302	0,18	-0,01	-3,60	0,00	0,00	0,00
28	1	-0,48	-0,06	0,85	0,00	0,00	0,00
	2	-3,42	-0,42	4,37	0,00	0,00	0,00
	3	-4,71	-0,16	2,46	0,00	0,00	0,00
	4	-3,90	-0,27	4,79	0,00	0,00	0,00
	5	-0,00	0,19	-0,39	0,00	0,00	0,00
	10	-0,00	0,27	-2,35	0,00	0,00	0,00
	11	-0,00	-0,01	-0,00	0,00	0,00	0,00
	12	-0,46	-2,66	1,96	0,00	0,00	0,00

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Support reactions from all load cases

Node	LC	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	13	-2,50	-0,00	-0,00	0,00	0,00	0,00
	14	-2,77	0,39	-2,12	0,00	0,00	0,00
	15	0,00	-0,00	0,00	0,00	0,00	0,00
	16	0,88	-0,38	2,12	0,00	0,00	0,00
	17	-0,00	0,84	0,01	0,00	0,00	0,00
	20	-0,30	-0,71	0,93	0,00	0,00	0,00
	21	0,17	-0,26	1,41	0,00	0,00	0,00
	101	-1,17	-1,83	-0,73	0,00	0,00	0,00
	102	-0,39	-1,00	2,91	0,00	0,00	0,00
	103	-2,31	3,64	-2,79	0,00	0,00	0,00
	301	-0,00	-0,36	-2,28	0,00	0,00	0,00
	302	0,17	0,09	-1,81	0,00	0,00	0,00
34	1	0,00	0,06	0,98	0,00	0,00	0,00
	2	0,01	0,42	5,35	0,00	0,00	0,00
	3	0,01	0,16	2,29	0,00	0,00	0,00
	4	0,01	0,27	5,71	0,00	0,00	0,00
	5	0,00	-0,19	3,39	0,00	0,00	0,00
	10	-0,00	-0,27	-3,06	0,00	0,00	0,00
	11	-0,00	0,01	0,00	0,00	0,00	0,00
	12	-0,00	-1,37	-1,96	0,00	0,00	0,00
	13	-0,00	0,00	0,00	0,00	0,00	0,00
	14	-0,00	0,50	0,83	0,00	0,00	0,00
	15	-0,00	0,00	-0,00	0,00	0,00	0,00
	16	0,89	-0,50	-0,83	0,00	0,00	0,00
	17	0,00	-0,84	0,01	0,00	0,00	0,00
	20	-0,00	-0,77	-0,93	0,00	0,00	0,00
	21	0,18	-0,35	-0,58	0,00	0,00	0,00
	101	1,32	-3,40	-6,82	0,00	0,00	0,00
	102	0,01	-0,95	-1,78	0,00	0,00	0,00
	103	0,17	1,58	2,25	0,00	0,00	0,00
	301	-0,00	-1,12	-5,10	0,00	0,00	0,00
	302	0,18	-0,70	-4,75	0,00	0,00	0,00

front supports, nodes 9+34:

deadweight = 0,98 kN

$R_x = 1,32$ kN

$R_y = 3,40$ kN

$R_z = -6,82$ kN

$$R_{res} = (R_x^2 + R_y^2)^{1/2} = 3,65 \text{ kN}$$

$\mu = 0,40$:

$$\text{req. ballast} = 1,20 \times (3,65/0,40 + 6,82) - 0,98 = 18,15 \text{ kN} \quad (1900 \text{ kg})$$

$\mu = 0,60$:

$$\text{req. ballast} = 1,20 \times (3,65/0,60 + 6,82) - 0,98 = 14,50 \text{ kN} \quad (1500 \text{ kg})$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

rear supports, nodes 3+28:

deadweight = 0,85 kN

 $R_x = 5,12 \text{ kN}$ $R_y = 1,10 \text{ kN}$ $R_z = -2,58 \text{ kN}$

$$R_{\text{res}} = (R_x^2 + R_y^2)^{1/2} = 5,24 \text{ kN}$$

 $\mu = 0,40:$

$$\text{req. ballast} = 1,20 \times (5,24/0,40 + 2,58) - 0,85 = 17,97 \text{ kN} \quad (1800 \text{ kg})$$

 $\mu = 0,60:$

$$\text{req. ballast} = 1,20 \times (5,24/0,60 + 2,58) - 0,85 = 12,73 \text{ kN} \quad (1300 \text{ kg})$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

SYSTEM 6x4:

A detailed calculation is being abstained from. The following estimation is done:

$$\text{factor rear wall: } 6,0 / 8,0 = 0,75$$

$$\text{factor side wall: } 4,0 / 6,0 = 0,66$$

$$\text{factor roof: } 6,0 \times 4,0 / (8,0 \times 6,0) = 0,50$$

The supporting loads consist of three parts:

1. horizontal load Faktor 0,75
2. lifting load from roof Faktor 0,50
3. lifting load from overturning Faktor 1,00

This part remains the same as with the reduction of the wall area the depth of the stage is reduced.

The lifting part from wind on roof to the total lifting load is as follows:

$$\text{load case 101: } R_z = 6,82 \text{ kN}$$

$$\begin{aligned} \text{suction roof area: } & (1,4 \times 0,20 \times 8,0 \times 6,0) / 4 \\ & = 3,36 \text{ kN (= 50\%)} \end{aligned}$$

The following factor can be taken into account for the lifting loads:

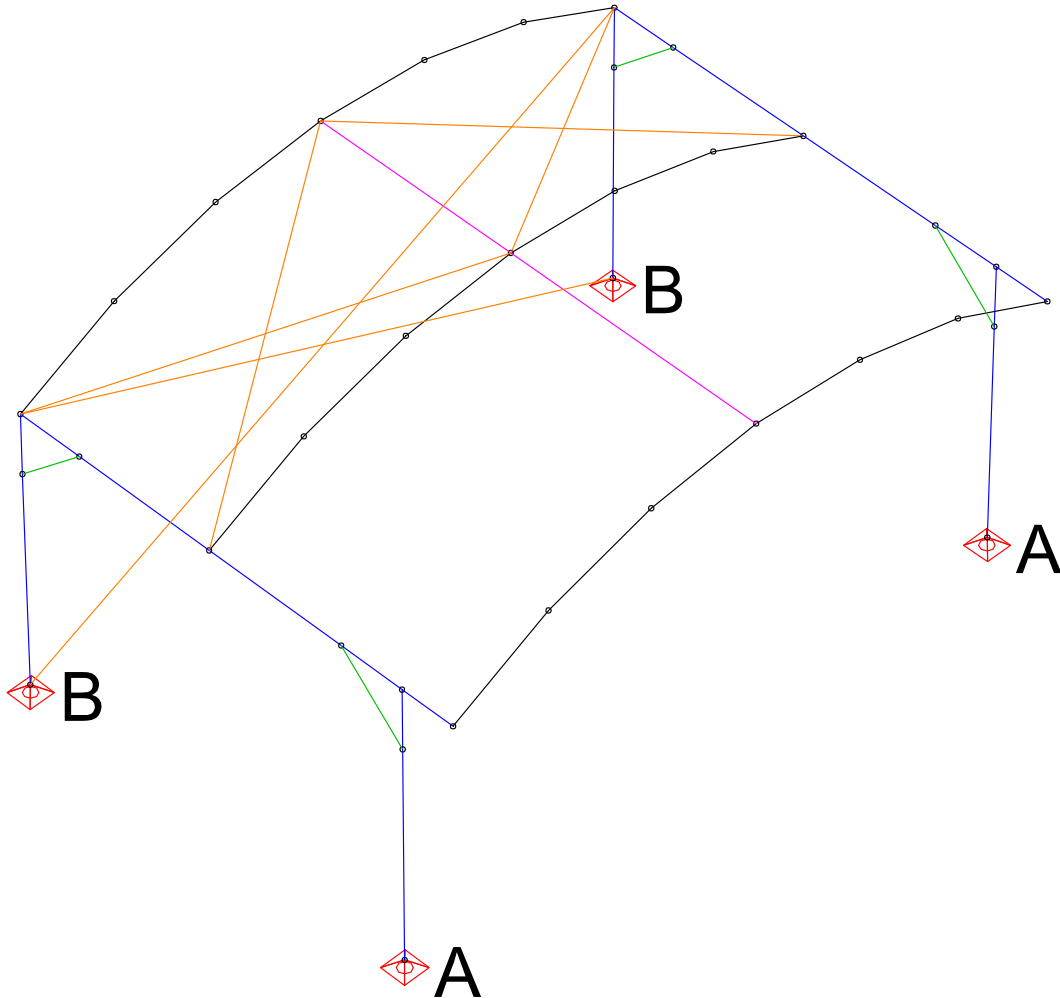
$$0,50 \times 1,00 + 0,50 \times 0,50 = 0,75$$

All calculated ballast loads can be multiplied on the safe side with a factor of 0,80 for a stage size of 8x6.

The factor is directly introduced into the following table.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

overview ballast



supports	A	B
ballast 8x6m	1500 kg (1900 kg)	1300 kg (1800 kg)

(values in brackets for friction coefficient 0,4)

supports	A	B
ballast 6x4m	1200 kg (1550 kg)	1100 kg (1450 kg)

(values in brackets for friction coefficient 0,4)

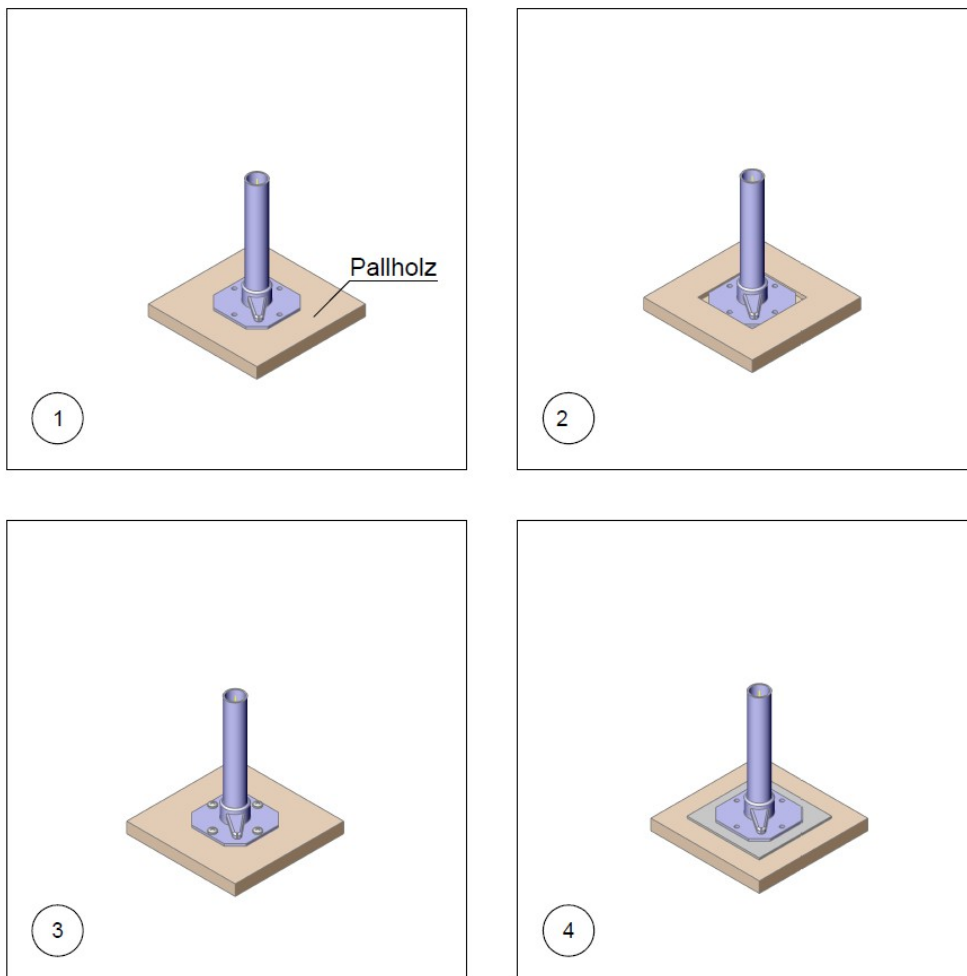
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

7.2 SYSTEMS WITH GROUNDING

All lifting loads have to be secured locally by ballast.
 The proof against sliding and overturning is done for the system as a whole.
 The grounding is being carried out circulating on 3 sides.

safety factor 1,20

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 | $\mu = 0,60$ |

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

front supports, nodes 9+34:

deadweight = 0,98 kN

 $R_x = 1,32 \text{ kN}$ $R_z = -6,82 \text{ kN}$

$$\text{req. ballast} = 1,0 \times (1,32 / 0,40 + 6,82) - 0,98 = 9,14 \text{ kN} \quad (900 \text{ kg}) \quad (*)$$

rear supports, nodes 3+28:

deadweight = 0,85 kN

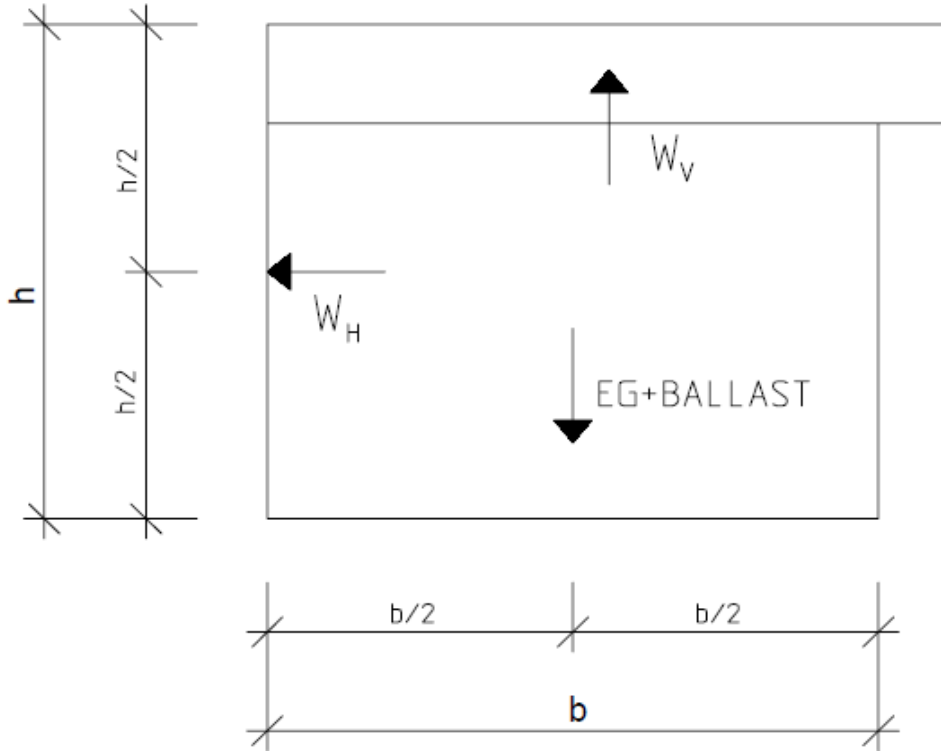
 $R_z = -4,61 \text{ kN}$

$$\text{req. ballast} = 1,0 \times 4,61 - 0,85 = 3,76 \text{ kN} \quad (400 \text{ kg}) \quad (*)$$

(*) see proof against sliding and overturning

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

System:



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

SYSTEM 8x6:

deadweight:

truss:

$$V_1 = 3,672 \text{ kN}$$

wind load:

decisive LC 101: $W_H = 10,454 \text{ kN}; \quad W_V = 15,106 \text{ kN}$ proof against sliding:

required ballast

$$\mu = 0,4: \quad 1,2 \times (10,454 / 0,4 + 15,106) - 3,672 = 45,82 \text{ kN}$$

$$\mu = 0,6: \quad 1,2 \times (10,454 / 0,6 + 15,106) - 3,672 = 35,36 \text{ kN}$$

chosen:

$$\mu = 0,4: \quad 48,0 \text{ kN} \quad \textbf{(4 x 1200 kg)}$$

$$[(48,0 + 3,67 - 1,2 \times 15,11) \times 0,4] / 10,45 = 1,28 > 1,20$$

$$\mu = 0,6: \quad 36,0 \text{ kN} \quad \textbf{(4 x 900 kg)}$$

$$[(36,0 + 3,67 - 1,2 \times 15,11) \times 0,6] / 10,45 = 1,24 > 1,20$$

proof against overturning:

$$M_{\text{Stand}} / M_{\text{kipp}} > 1,20$$

$$[(36,0 + 3,67) \times 5,71 / 2] / [(10,454 \times 4,99 / 2) + (15,11 \times 6,42 / 2)] = 1,51 > 1,20$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

SYSTEM 6x4:

deadweight:

truss: $V_2 = 2,39 \text{ kN}$

wind load: (decisive LC 101)

$$W_H = (4,99 \times 6,888) / (4,99 \times 8,956) \times 10,454 = 8,04 \text{ kN}$$

$$W_V = (6,612 \times 4,714) / (8,612 \times 6,427) \times 15,106 = 8,51 \text{ kN}$$

proof against sliding:

required ballast

$$\mu = 0,4: \quad 1,2 \times (8,04 / 0,4 + 8,51) - 2,39 = 31,94 \text{ kN}$$

$$\mu = 0,6: \quad 1,2 \times (8,04 / 0,6 + 8,51) - 2,39 = 23,90 \text{ kN}$$

chosen:

$$\mu = 0,4: \quad 32,0 \text{ kN} \quad \text{(4x 800 kg)}$$

$$[(32,0 + 2,39 - 1,2 \times 8,51) \times 0,4] / 8,04 = 1,20 \geq 1,20$$

$$\mu = 0,6: \quad 24,0 \text{ kN} \quad \text{(4 x 600 kg)}$$

$$[(24,0 + 2,39 - 1,2 \times 8,51) \times 0,6] / 8,04 = 1,21 \geq 1,20$$

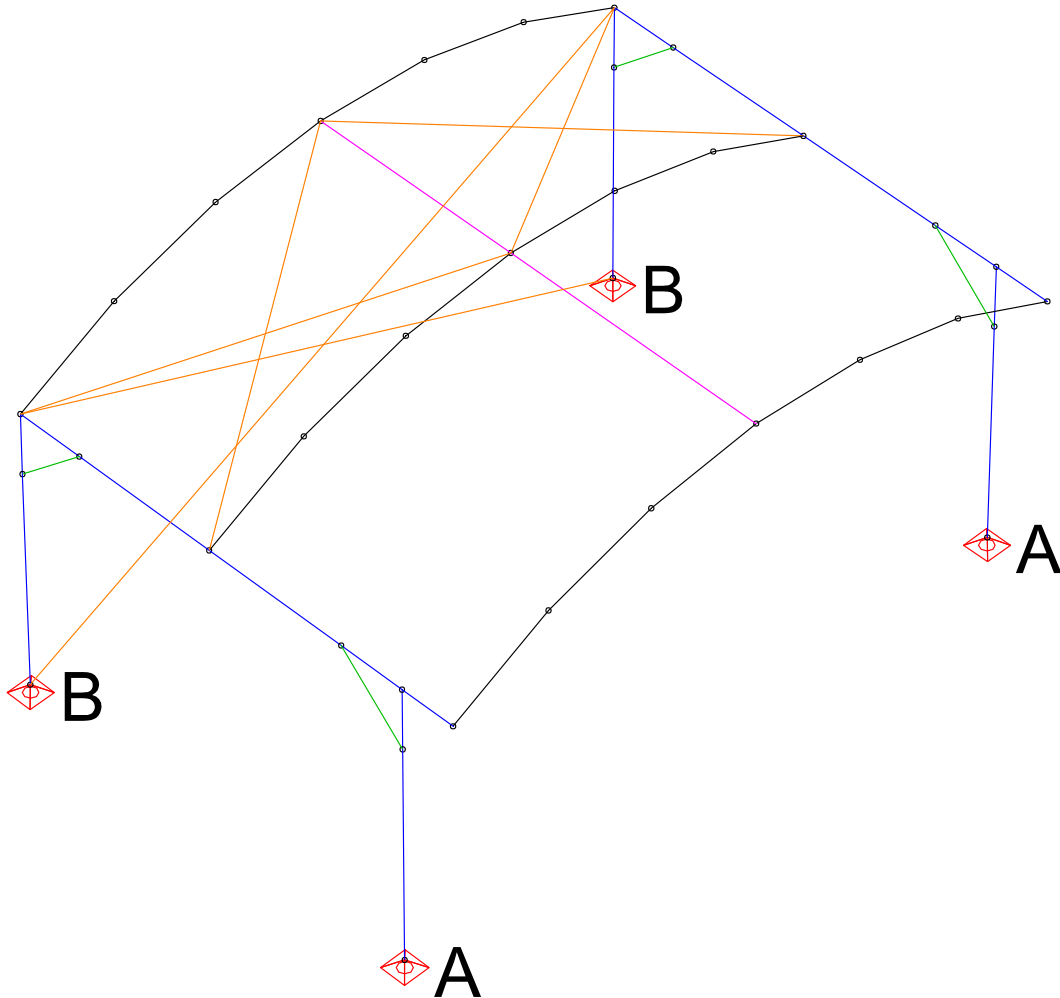
proof against overturning:

$$M_{\text{Stand}} / M_{\text{kipp}} > 1,20$$

$$[(24,0 + 2,39) \times 3,71 / 2] / [(8,04 \times 4,99 / 2) + (8,51 \times 4,71 / 2)] = 1,22 > 1,20$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

overview ballast:



supports	A	B
ballast 8x6m	900 kg (1200 kg)	900 kg (1200 kg)

(values in brackets for friction coefficient 0,4)

supports	A	B
ballast 6x4m	600 kg (800 kg)	600 kg (800 kg)

(values in brackets for friction coefficient 0,4)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

7.3 SYSTEMS WITH LAYHER PODIUM/ EASY FRAME B

For systems with Layher podium/ Easyframe B the total height of the stage increases by ~1m.

The required ballast loads are proportionally reduced by the dead weight of the layher podium.

The values are directly introduced into the following table.

8x6m:

$$8 \times 6 \times 0,40 = 19,20 \text{ kN} \quad (4 \times 480 \text{ kg})$$

6x4m:

$$6 \times 4 \times 0,40 = 9,60 \text{ kN} \quad (4 \times 240 \text{ kg})$$

supports	A	B
ballast 8x6m	450 kg (750 kg)	450 kg (750 kg)

(values in brackets for friction coefficient 0,4)

supports	A	B
ballast 6x4m	400 kg (600 kg)	400 kg (600 kg)

(values in brackets for friction coefficient 0,4)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

7.4 SYSTEMS WITH SOUNDWINGS

For systems with soundwings additional ballast is needed.

All lifting and displacing loads are secured locally by ballast.

The necessary ballast loads are basically the same for both roof sizes. Slight differences in height and depth are neglected.

lifting force:

$$H = 1,30 \times 4,90/2 \times 2,45 \times 0,20 = 1,56 \text{ kN} \quad (\text{safe side})$$

$$R_z = 1,56 \times 3,75/5,43 = 1,08 \text{ kN}$$

displacing force:

front columns $H = 1,56/2 + 1,30 \times 4,9/2 \times 2,45/2 \times 0,2 = 1,56 \text{ kN}$

$$\mu = 0,4:$$

$$1,2 \times (1,56/0,40 + 1,08) = 5,97 \text{ kN} \quad (600 \text{ kg})$$

$$\mu = 0,6:$$

$$1,2 \times (1,56/0,60 + 1,08) = 4,42 \text{ kN} \quad (450 \text{ kg})$$

rear columns $H = 1,56/2 = 0,78 \text{ kN}$

$$\mu = 0,4:$$

$$1,2 \times (0,78/0,40 + 1,08) = 3,60 \text{ kN} \quad (400 \text{ kg})$$

$$\mu = 0,6:$$

$$1,2 \times (0,78/0,60 + 1,08) = 2,86 \text{ kN} \quad (300 \text{ kg})$$

soundwing columns $H = 1,56/2 = 0,78 \text{ kN}$; deadweight $\sim 0,50 \text{ kN}$

$$\mu = 0,4:$$

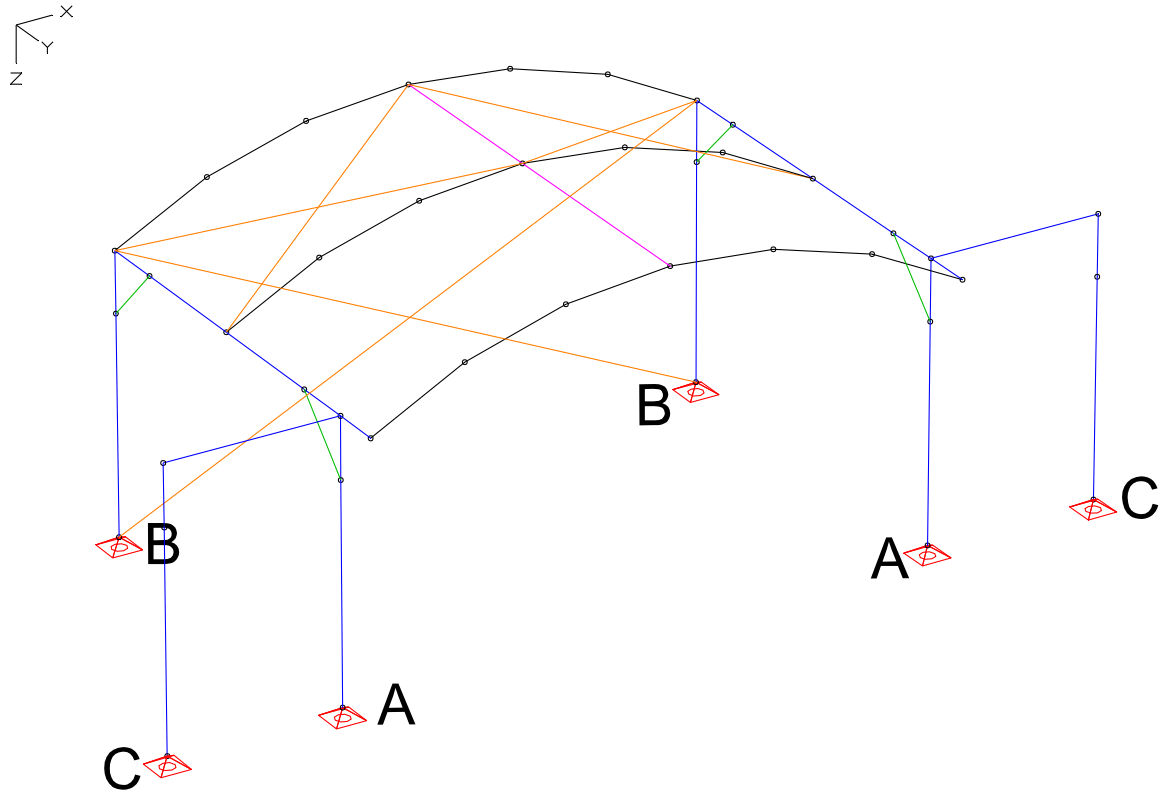
$$1,2 \times (0,78/0,40) - 0,50 = 1,84 \text{ kN} \quad (200 \text{ kg})$$

$$\mu = 0,6:$$

$$1,2 \times (0,78/0,60) - 0,50 = 1,06 \text{ kN} \quad (100 \text{ kg})$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

overview additional ballast:



supports	A	B	C
ballast 8x6m/ 6x4m	450 kg (600 kg)	300 kg (400 kg)	100 kg (200 kg)

(values in brackets for friction coefficient 0,4)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

8 LAYHER PODIUM

8.1 Universal Base

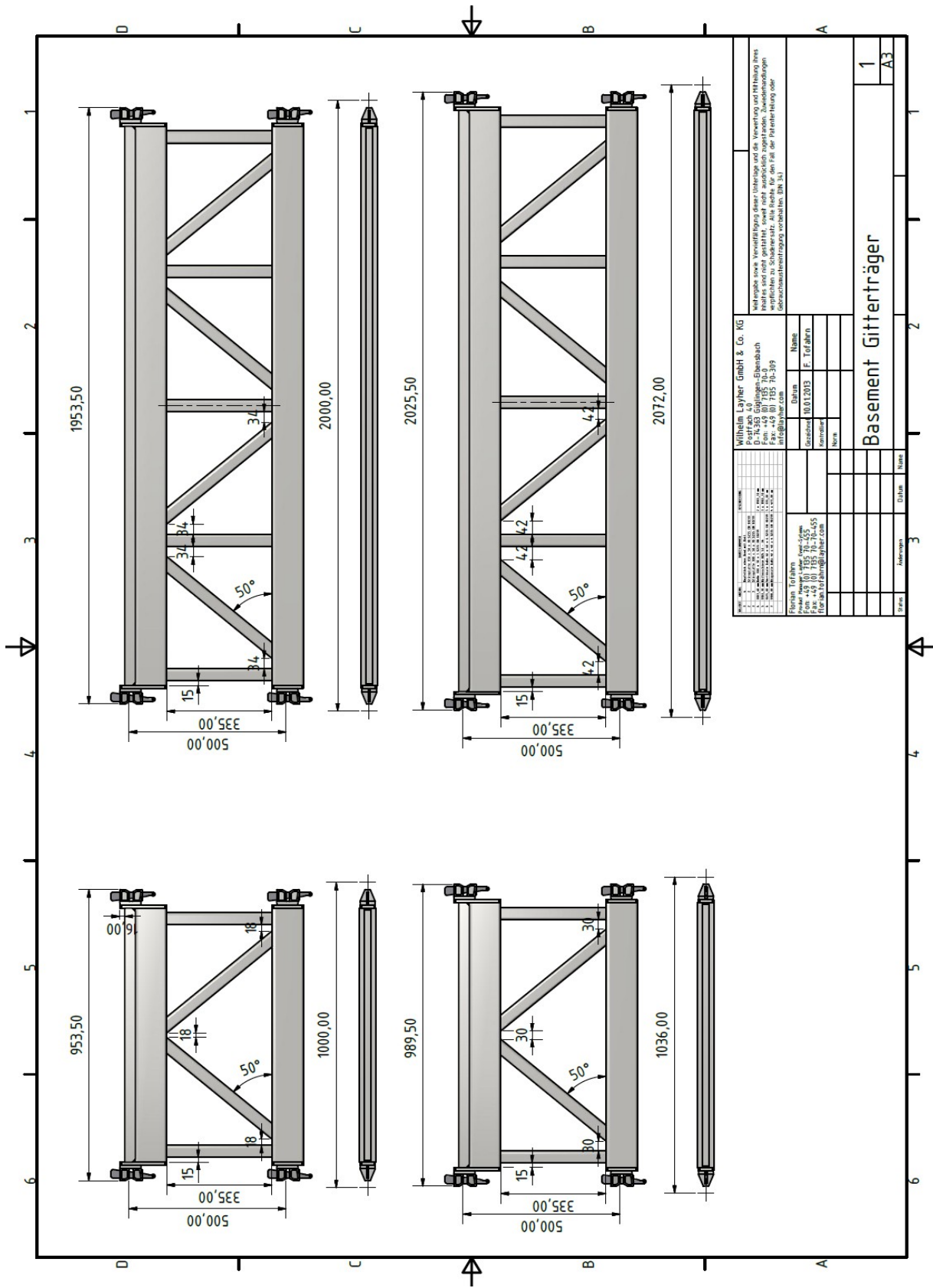
In case of setup with Layher podium the columns are placed on special bases made from steel.

The proof is done for bases with the outer measurements of 1,036x1,036m (1,00x1,00m metric system) for system heights of 1,0m or 1,50m.

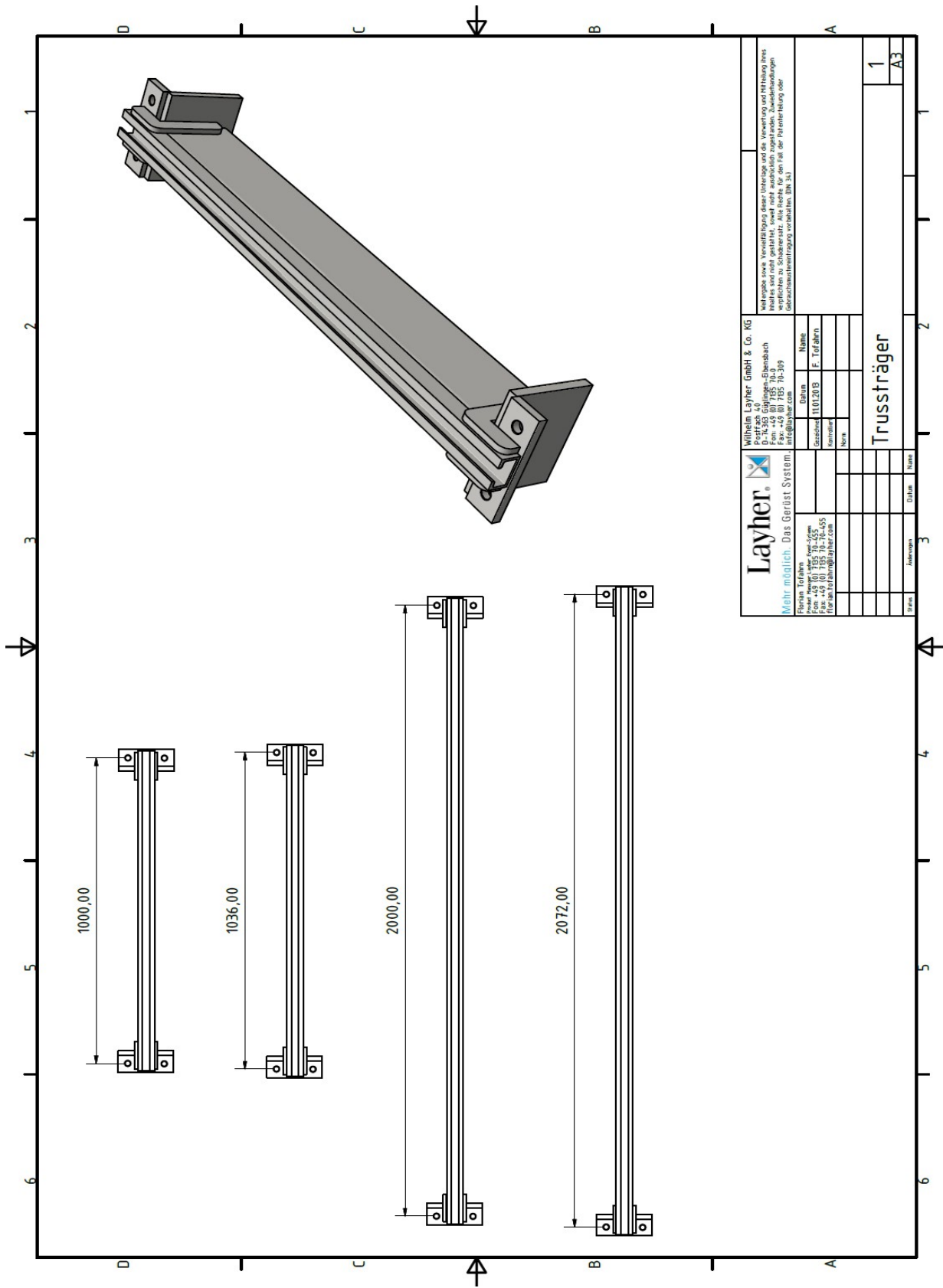
An adverse load in the middle as well as two positions near the edge are taken into account.

The proof is done for an adverse combination of lifting forces and horizontal forces on one support as well as for a maximum pressure force.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

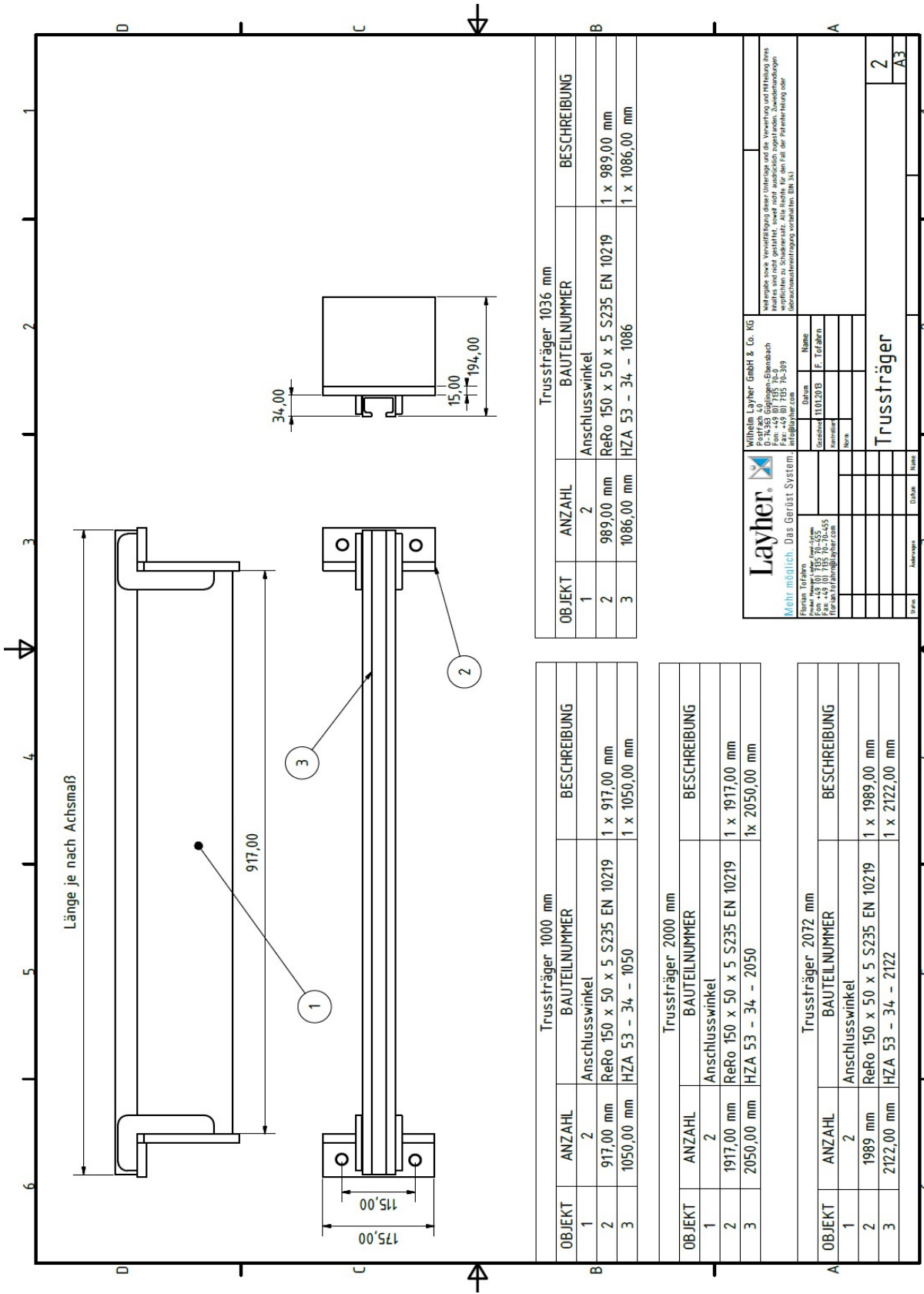


PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



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<p>Projekt-Nr.: 13288-Rev. 01 Date: 30.11.2015 Für: Layher/Prolyte Group</p>	<p>Gezeichnet: 11.01.2015 Name: _____ F. Teil: _____ Kontrolliert: _____ Name: _____</p>	<p>Trusstäger</p>	<p>1</p>	<p>A3</p>	<p>2</p>
<p>Name: _____ Datum: _____ Abgefragt: _____ Draht: _____</p>	<p>Name: _____ Datum: _____ Abgefragt: _____ Draht: _____</p>	<p>Name: _____ Datum: _____ Abgefragt: _____ Draht: _____</p>	<p>Name: _____ Datum: _____ Abgefragt: _____ Draht: _____</p>	<p>Name: _____ Datum: _____ Abgefragt: _____ Draht: _____</p>	<p>Name: _____ Datum: _____ Abgefragt: _____ Draht: _____</p>

<p>PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m</p>	<p>PROJECT-NO.: 13288-Revision 01</p>
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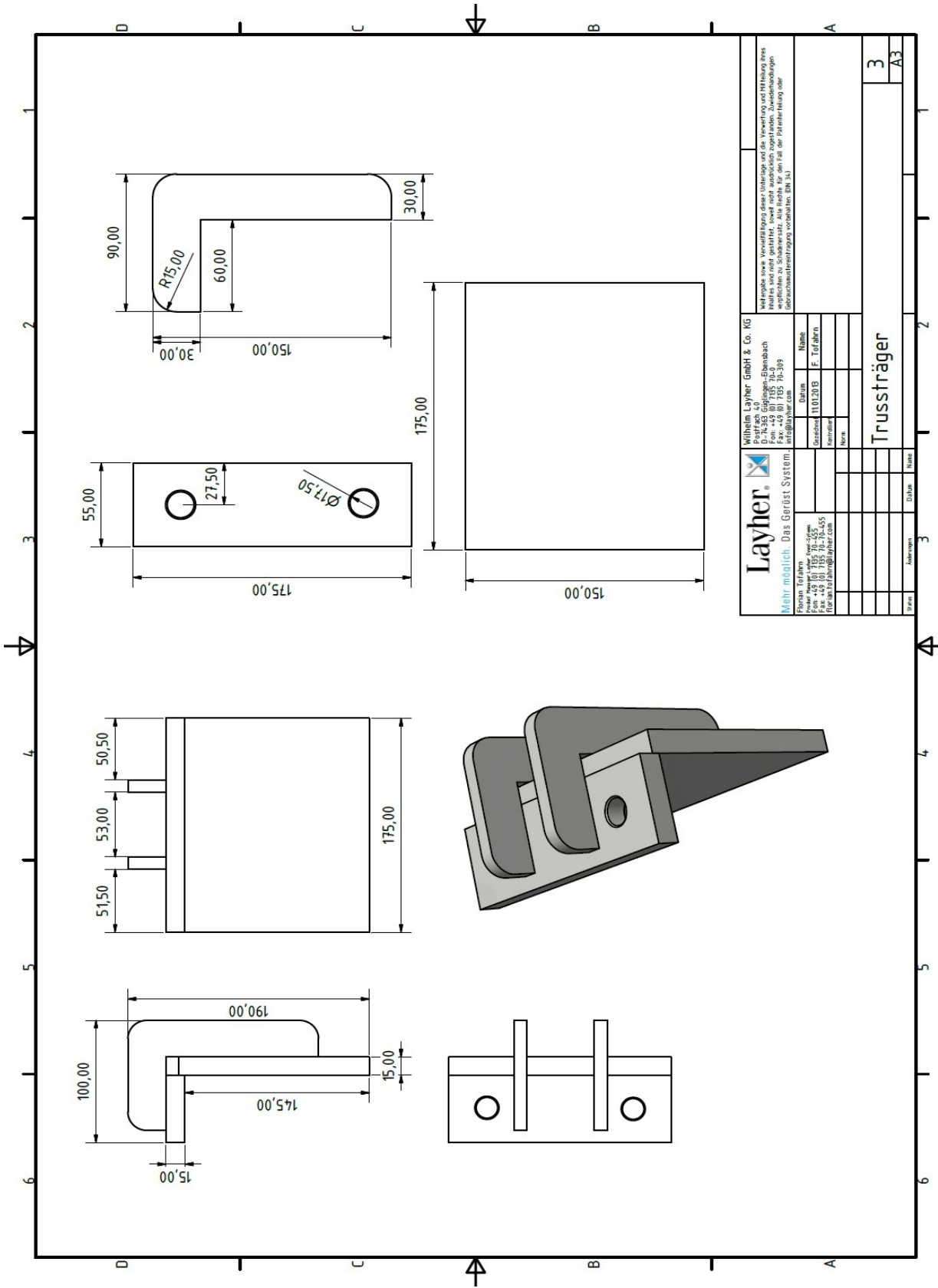
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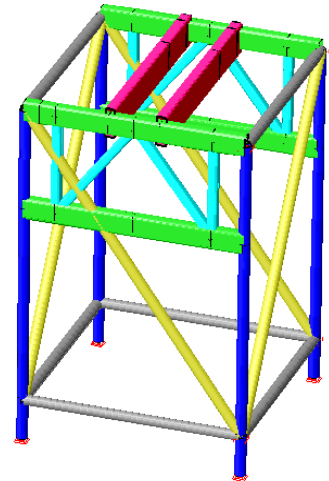
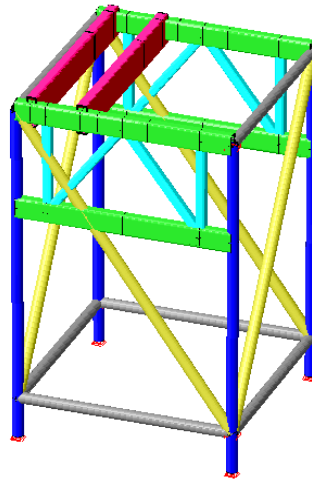
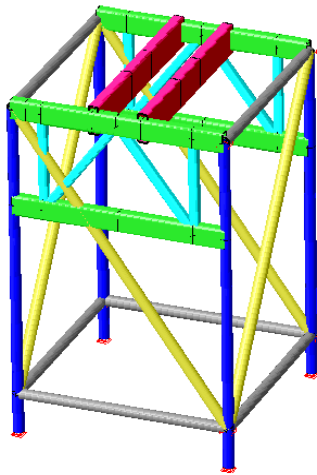
Titel	Trusstträger
Blatt	2
Blattzahl	A3

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

system:



red:	ReRo 150x50x5mm	(S235JR)
green:	ReRo 100x50x5mm	(S355JR)
light blue:	QRo 40x40x4mm	(S235JR)
yellow, grey, blue:	Ø48,3x3,2mm	(S235JR)

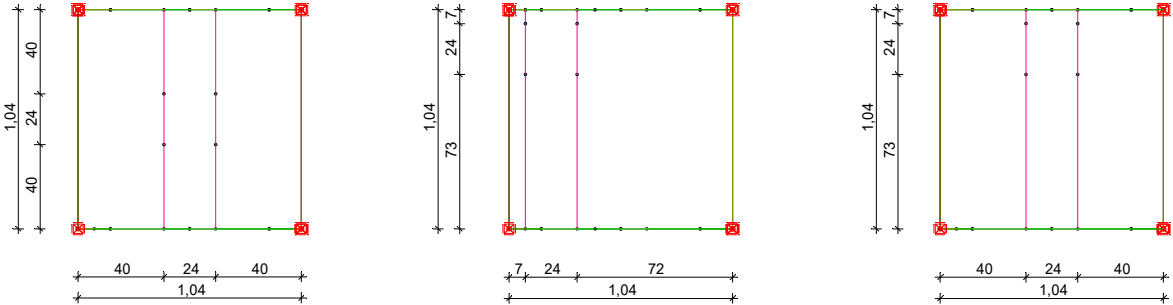
PROJECT:
PROLYTE ARC-ROOF 8x6 - 6x4m

PROJECT-NO.:
13288–Revision 01

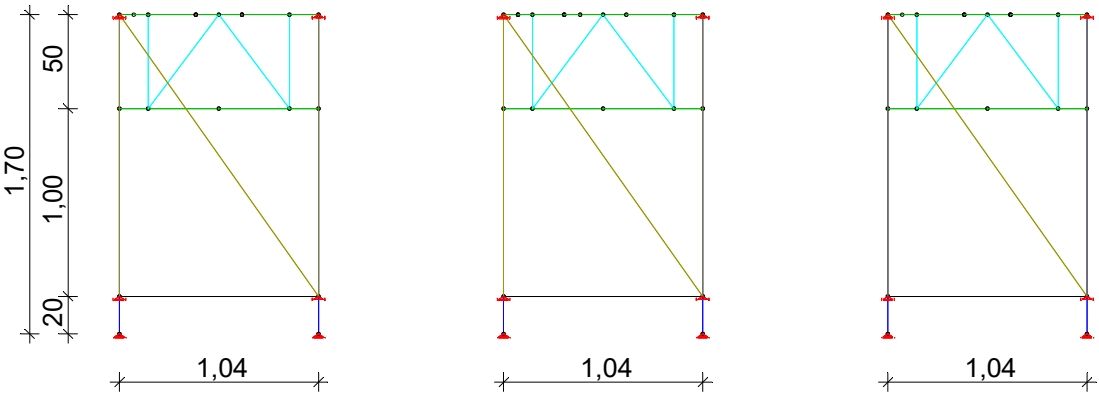
CUSTOMER:
PROLYTE GROUP

DATE:
30.11.2015

top view:



front view:

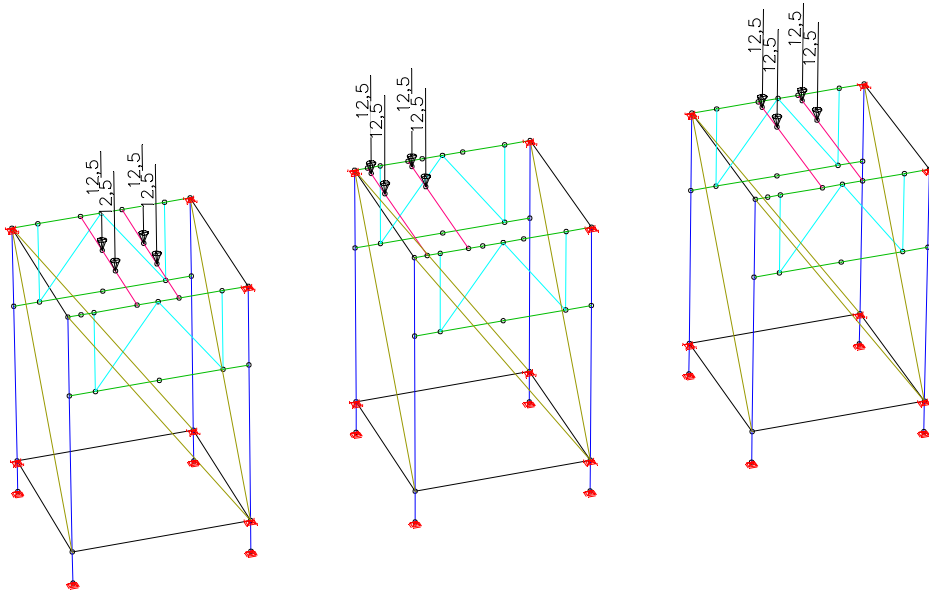


PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Loading

load case 1: max. N_{Ed}

$N_{Ed} < 50,0 \text{ kN}$
 $50 / 4 = 12,50 \text{ kN}$



LC 1: Load, max. N_{Ed}

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

load case 2: min. N_{Ed}

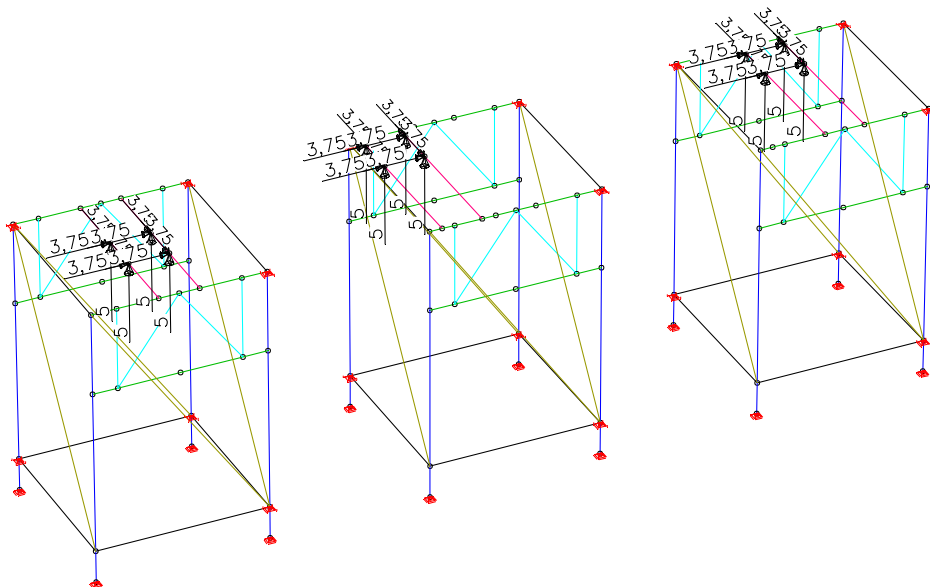
$$N_{Ed} = -20,0 \text{ kN (} R_{z,d} \text{)}$$

$$R_{x,d} = 15,0 \text{ kN}$$

$$R_{y,d} = 15,0 \text{ kN}$$

$$20 / 4 = 5,0 \text{ kN}$$

$$15 / 4 = 3,75 \text{ kN}$$



LC 2: Load, min. N_{Ed}

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Calculation

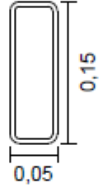
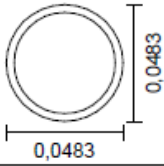

System characteristics

114 Nodes	
174 Elements	174 Beams
30 Supports	0 Slabs
0 Link elements	0 Plains
4 Material properties	0 Shells
4 Section properties	0 Cables
3 Load cases	0 Solids
0 LC Combinations	0 Spring elements
0 Tendon groups	

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

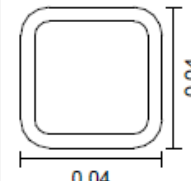
Rotated element systems
 0 Element systems
 0 Internal force systems
 0 Reinforcement systems

Section properties

1	Polygon 	Support beams Centroid [m] $y_s = 0,025$ $z_s = 0,000$ Area [m ²] $A = 1,8296e-03$ Moments of inertia [m ⁴] $I_x = 2,3025e-06$ $I_{yz} = 0,0000e+00$ $I_y = 4,5313e-06$ $I_1 = 4,5313e-06$ $I_z = 7,7566e-07$ $I_2 = 7,7566e-07$ Main axis angle [Grad] $\Phi = -0,000$ Averaging of the lateral force shear stress over section width
2	Library section 	RO 48,3 x 3,2 (MSH); Layher tubes Centroid [m] $y_s = 0,000$ $z_s = 0,000$ Area [m ²] $A = 4,5300e-04$ Moments of inertia [m ⁴] $I_x = 2,3200e-07$ $I_{yz} = 0,0000e+00$ $I_y = 1,1600e-07$ $I_1 = 1,1600e-07$ $I_z = 1,1600e-07$ $I_2 = 1,1600e-07$ Main axis angle [Grad] $\Phi = 0,000$
3	Library section 	RRO 100 x 50 x 5 (EN 10219-2); chord endframe Centroid [m] $y_s = 0,000$ $z_s = 0,000$ Area [m ²] $A = 1,3400e-03$ Moments of inertia [m ⁴] $I_x = 1,3500e-06$ $I_{yz} = 0,0000e+00$ $I_y = 1,5800e-06$ $I_1 = 1,5800e-06$ $I_z = 5,2500e-07$ $I_2 = 5,2500e-07$ Main axis angle [Grad] $\Phi = 0,000$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Section properties

4	Library section 	QRO 40 x 40 x 4 (EN 10219-2); diagonals endframe Centroid [m] $y_s = 0,000$ $z_s = 0,000$ Area [m ²] $A = 5,3500e-04$ Moments of inertia [m ⁴] $I_x = 1,9440e-07$ $I_{yz} = 0,0000e+00$ $I_y = 1,1100e-07$ $I_1 = 1,1100e-07$ $I_z = 1,1100e-07$ $I_2 = 1,1100e-07$ Main axis angle [Grad] $\Phi = 0,000$ Averaging of the lateral force shear stress over section width
---	------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Material properties

	No.	Type	E-Modu. [MN/m ²]	G-Modu. [MN/m ²]	Poiss. ratio	alpha.t [1/K]	gamma [kN/m ³]
1	1	S235-EN	210000	81000	0,30	1,200e-05	78,500
2	2	S235-EN	210000	81000	0,30	1,200e-05	78,500
3	3	S355-EN	210000	81000	0,30	1,200e-05	78,500
4	4	S235-EN	210000	81000	0,30	1,200e-05	78,500

List of load cases

LC.	Label
1	max. NEd
2	min. NEd

Sum of installed loads and support reactions

LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	max. NEd	0,000	-0,000	154,932
	Support reactions	-0,000	0,000	154,932
2	min. NEd	45,000	45,000	-60,000
	Support reactions	45,000	45,000	-60,000

DIN EN 1993-1-1 actions

Standard Bemessungsgruppe

Fd - Bemessungswerte von Einwirkungen

Load cases

1	max. NEd
---	----------

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Fd - Bemessungswerte von Einwirkungen

Load cases

2 min. NEd

1. Permanent and temporary situation

Final state

Fd Bemessungswerte von Einwirkungen

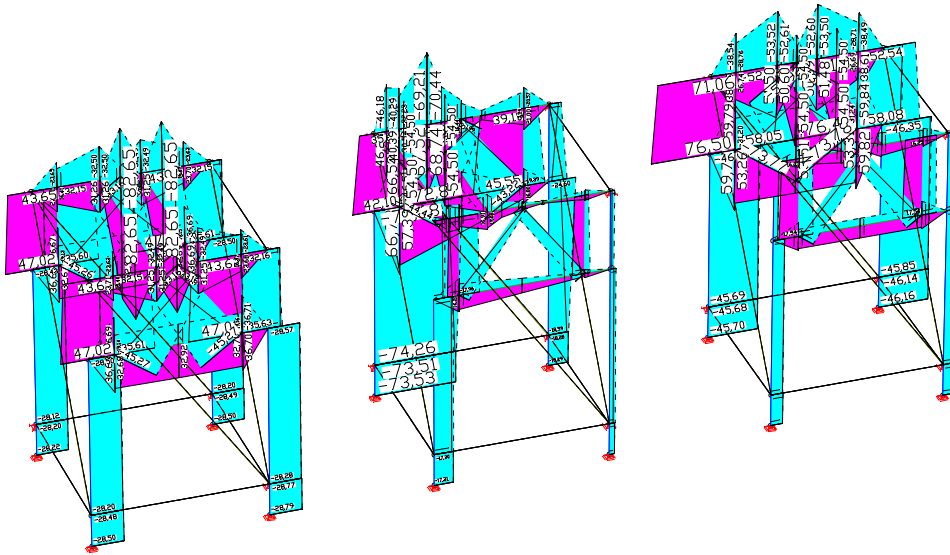
2. Permanent and temporary situation

Final state

Fd Bemessungswerte von Einwirkungen

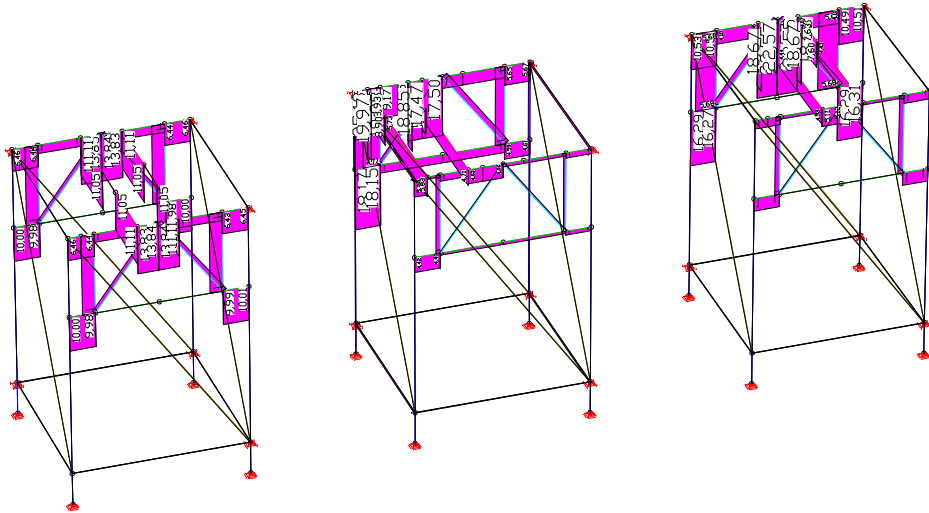
The proof is done within the software as steel checks regarding elastic (if necessary plastic) bearing capacities of the elements.

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



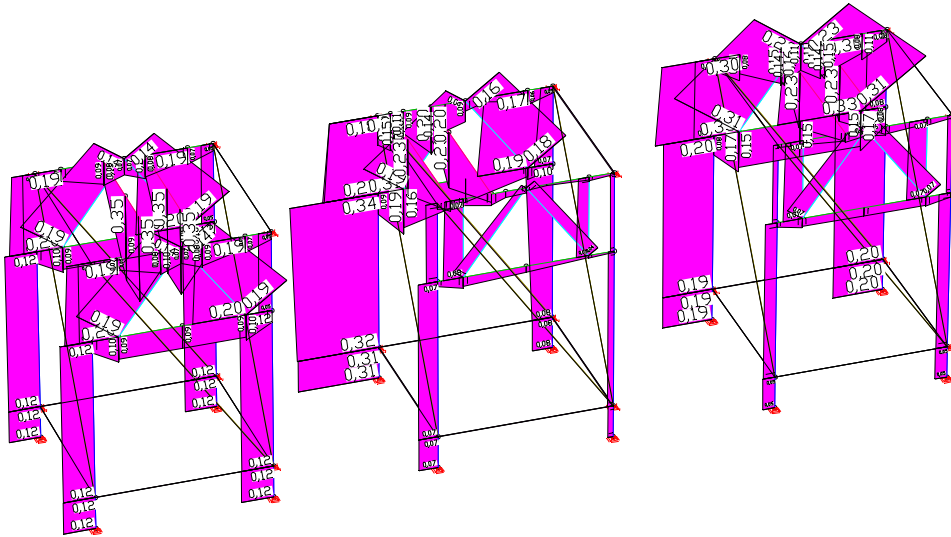
LCC EN1993.SV.1: 1. Permanent and temporary situation, DIN EN 1993-1-1
 Stresses (steel checks) min,max σ_{max} [MN/m²]
 Value range (overall system, min/max): -82,65/82,65 [MN/m²]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LCC EN1993.SV.1: 1. Permanent and temporary situation, DIN EN 1993-1-1
 Stresses (steel checks) max |Tau.xz| [MN/m²]
 Value range (overall system, min/max): 0,00/25,19 [MN/m²]

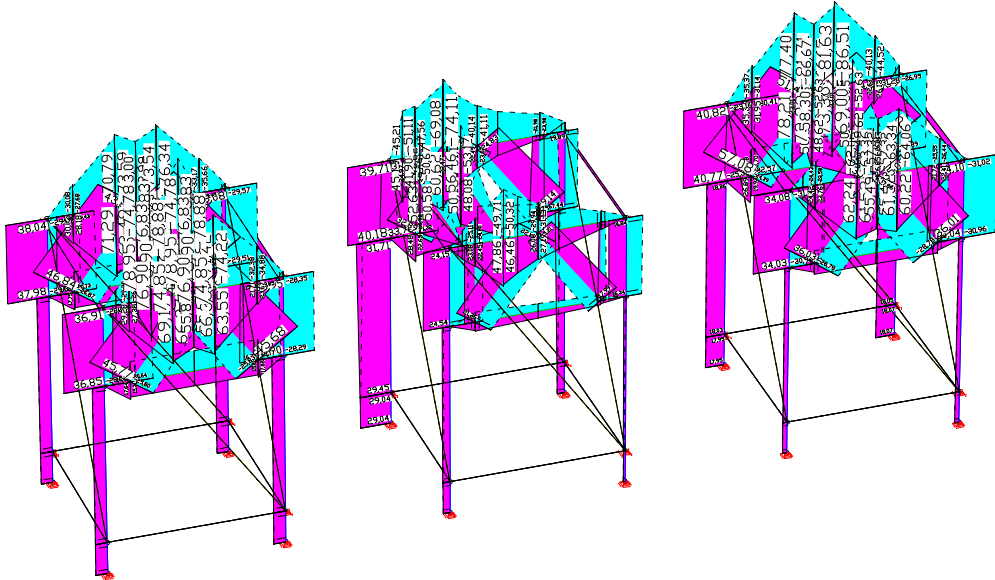
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LCC EN1993.SV.1: 1. Permanent and temporary situation, DIN EN 1993-1-1
 Utilization [-]
 Value range (overall system, min/max): 0,00/0,35 [-]

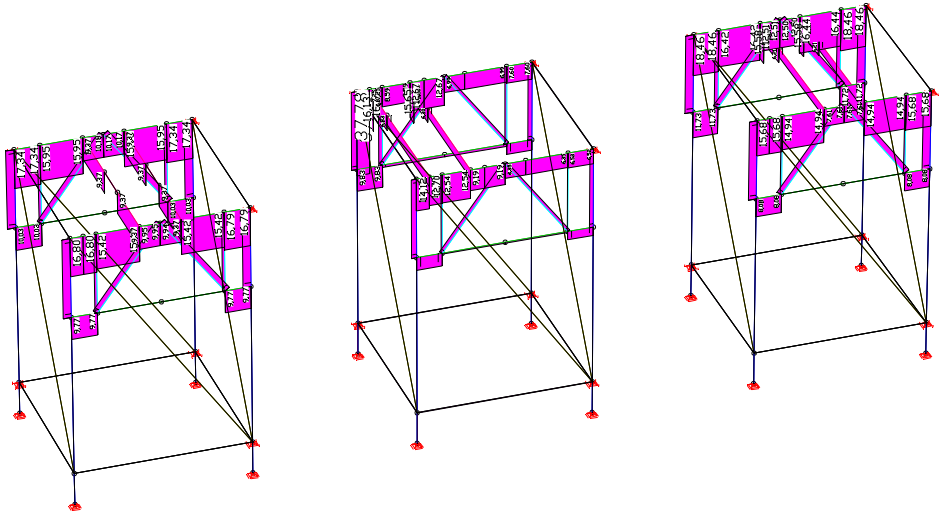
< 1,0

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



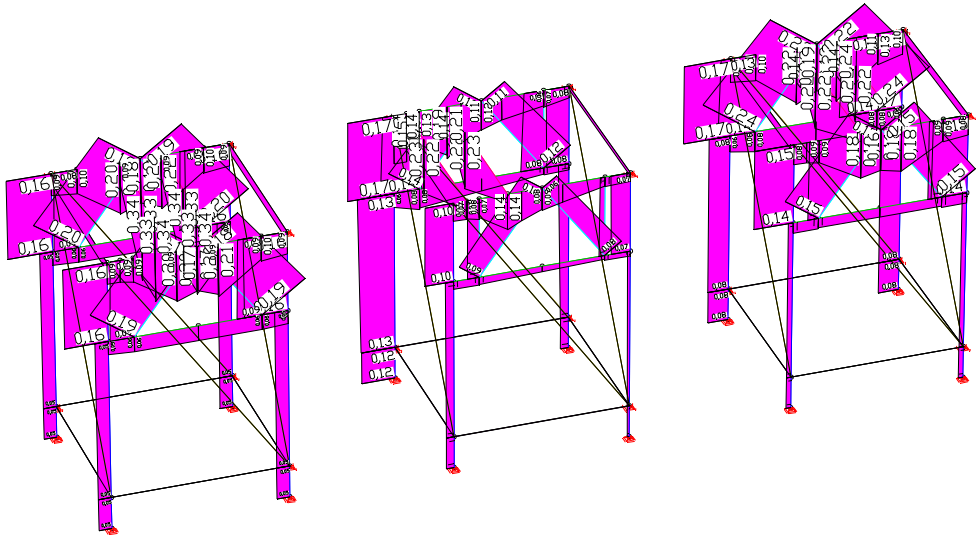
LCC EN1993.SV.2: 2. Permanent and temporary situation, DIN EN 1993-1-1
Stresses (steel checks) min,max Sigma.x [MN/m²]
Value range (overall system, min/max): -86,51/78,95 [MN/m²]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LCC EN1993.SV.2: 2. Permanent and temporary situation, DIN EN 1993-1-1
Stresses (steel checks) max |Tau.xy| [MN/m²]
Value range (overall system, min/max): 0,00/37,78 [MN/m²]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



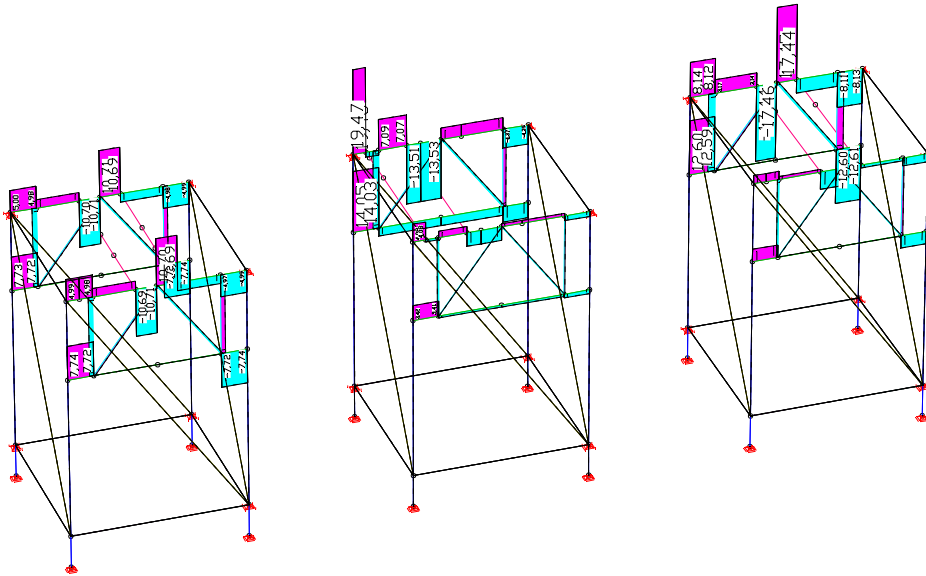
LCC EN1993.SV.2: 2. Permanent and temporary situation, DIN EN 1993-1-1
Utilization [-]
Value range (overall system, min/max): 0,00/0,34 [-]

< 1,0

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

proof of Layher-Coupler

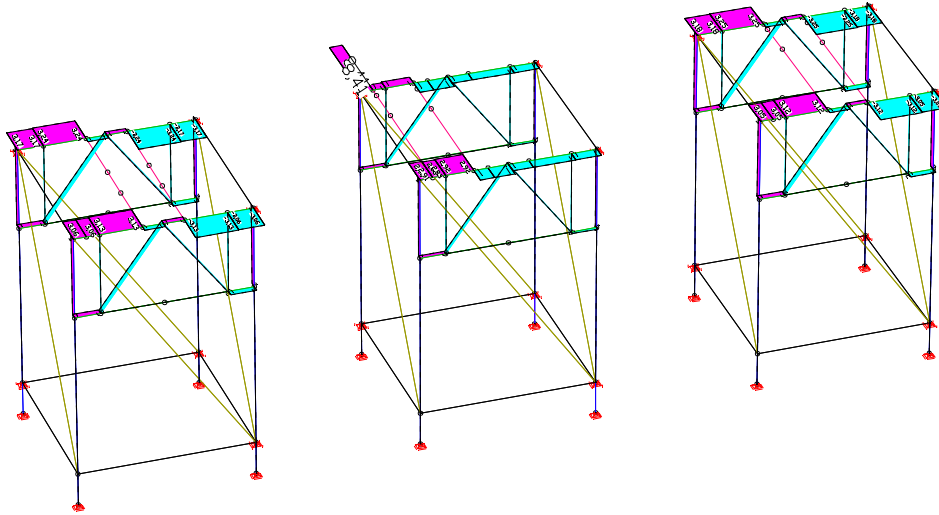
Only the decisive load cases are shown.



LCC EN1993.SV.1: 1. Permanent and temporary situation, DIN EN 1993-1-1
 Selected Internal forces min,max Qz [kN]
 Value range (subsystem, min/max): -17,46/19,48 [kN]

< 26,40 kN

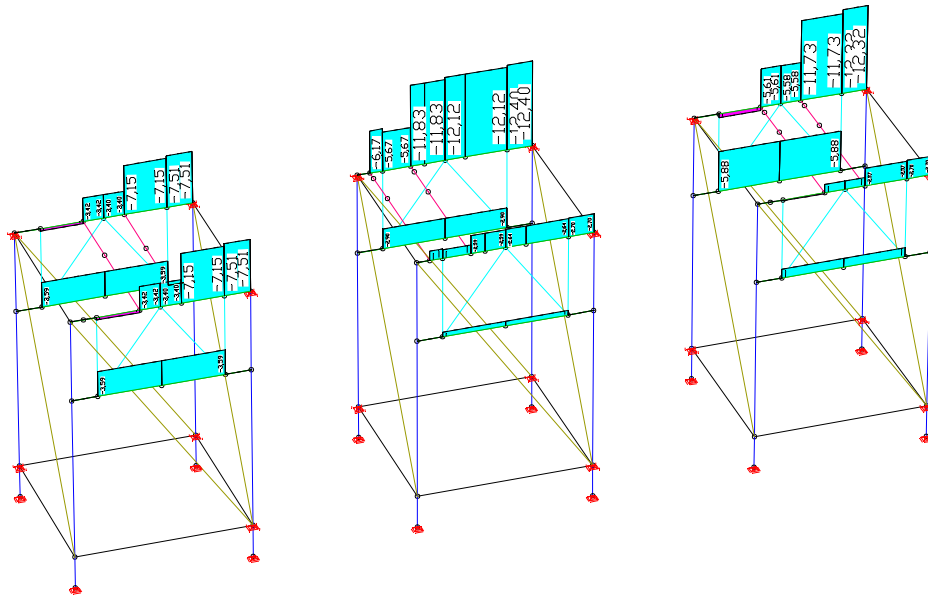
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LCC EN1993.SV.2: 2. Permanent and temporary situation, DIN EN 1993-1-1
 Selected Internal forces min,max Q_y [kN]
 Value range (subsystem, min/max): -3,25/8,41 [kN]

< 10,0 kN

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LCC EN1993.SV.2: 2. Permanent and temporary situation, DIN EN 1993-1-1
 Selected Internal forces min,max Nx [kN]
 Value range (subsystem, min/max): -12,40/0,54 [kN]

< 31,0 kN

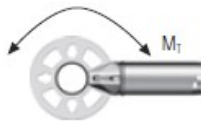
no further proof

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Ultimate capacities

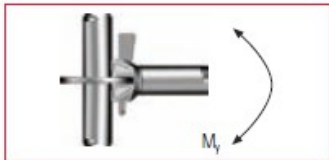
Stress capacity values* of the Allround ledger and the diagonal brace.

Z-8.22-64: K 2000+



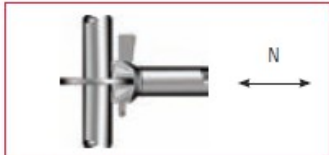
$M_{T,Rd} = \pm 52.9 \text{ kNcm}$

Connection moment



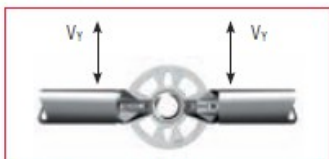
Connection moment
 $M_{Y,Rd} = \pm 101.0 \text{ kNcm}$

Normal force

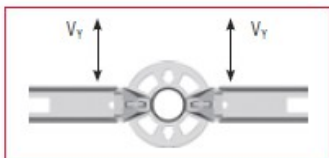


$N_{Rd} = \pm 31.0 \text{ kN}$

Horizontal force

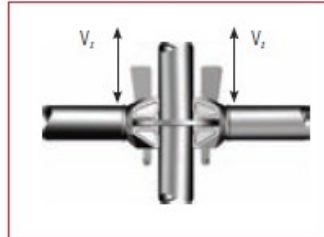


O-ledger: $V_{Y,Rd} = \pm 10.0 \text{ kN}$



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

Vertical force



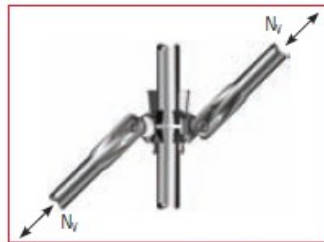
Vertical shear force single connection

$V_{z,Rd} = \pm 26.4 \text{ kN}$

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	1.09	1.40	1.57	2.07	2.57	3.07	4.14	
$N_{y,Rd}$ (kN)	-16.6	-16.8	-15.5	-14.7	-12.4	-10.2	-8.4	-5.3	+17.9

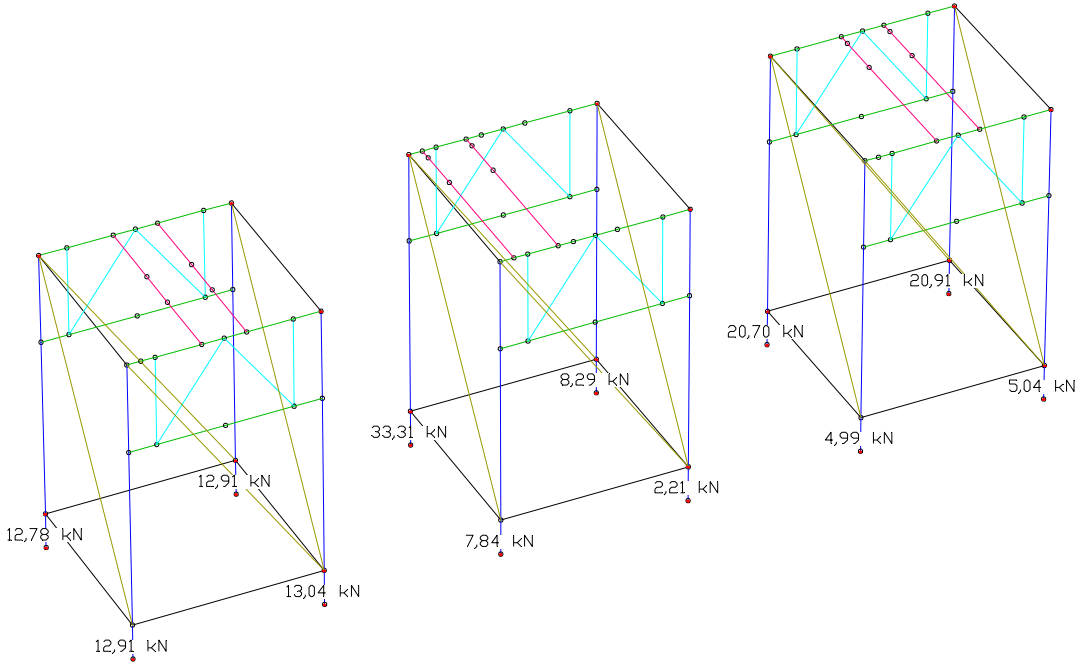
The K 2000+ connector can be combined with the connector of Variant II. Higher stress capacities as per approval.

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	1.09	1.40	1.57	2.07	2.57	3.07	4.14	
$N_{y,Rd}$ (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.

supports:



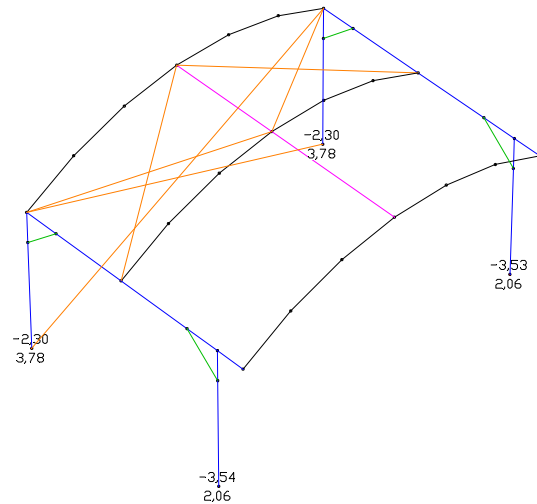
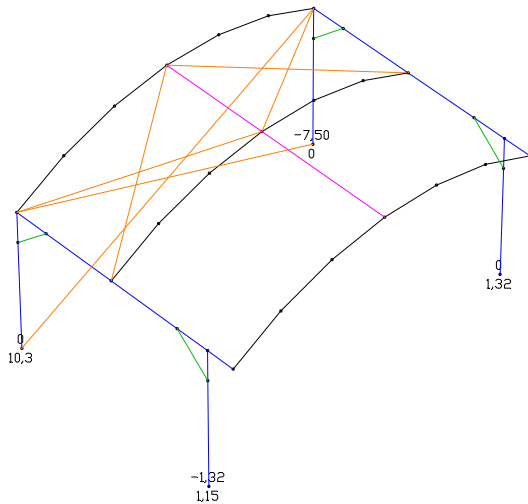
LC 1: max. NEd
Support reactions in the system of the support lines $Rz(l)$ [kN/m]
Sum in the global system $Rz(g) = 154,93$ [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

8.2 diagonals

resulting from:

tower:



LOC 85: Support reactions in the local system min,max Rx() [kN]

LOC 85: Support reactions in the local system min,max Ry() [kN]

$$F_{H,tower,x} = 10,3 \text{ kN}$$

$$F_{H,tower,y} = 3,78 \text{ kN}$$

live load podium:

$$H = V / 10:$$

$$F_{H,liveloading,x} = 8,806 / 2 \times 2,072 / 2 \times 5,0 / 10 = 2,28 \text{ kN}$$

$$F_{H,liveloading,y} = 6,216 / 2 \times 1,036 / 2 \times 5,0 / 10 = 0,81 \text{ kN}$$

wind on podium:

$$F_{H,wind,x} = 2,072 / 2 \times 0,20 = 0,207 \text{ kN}$$

$$F_{H,wind,y} = 1,036 / 2 \times 0,20 = 0,104 \text{ kN}$$

$$\max F_{H,x,Ed} = 1,35 \times (10,3 + 2,28 + 0,207) = 17,26 \text{ kN}$$

$$\max F_{H,y,Ed} = 1,35 \times (3,78 + 0,81 + 0,104) = 6,34 \text{ kN}$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

The horizontal force is distributed onto two diagonals (at least):

$$\text{angle } \alpha: \quad \text{arc tan } (1,0 / 2,072) = 25,8^\circ$$

$$\text{max } F_{V,Ed} = 17,26 / (2 \times \cos(25,8^\circ)) = 9,59 \text{ kN}$$

$$N_{V,Rd} = 16,8 \text{ kN}$$

$$\eta = 9,59 / 16,8 = 0,571 < 1,0$$

max. spindle extension:

$$\text{max } H = \max \{17,26 / (1,35 \times 7); 6,34 / (1,35 \times 6)\} = 1,83 \text{ kN} \quad \triangleq \underline{2,0 \text{ kN}}$$

$$\text{max } V < 16,57 / 1,1 + 1,036/2 \times 1,036/2 \times 5,0 = 16,4 \text{ kN}$$

$$< 2,072 \times 2,072 \times 5,0 = \underline{21,5 \text{ kN}}$$

$$H_{\text{Spindel}} \leq 25 \text{ cm}$$

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

8.3 standard poles

buckling is decisive:

$$\beta = 0,90$$

$$L_{cr} = 0,9 \times 1,0 = 0,90 \text{ m}$$

$$N_{cr} = (\pi^2 \times 210000 \times 1,16 \times 10^5) / (0,90 \times 10^3)^2 \times 10^{-3} = 296,5 \text{ kN}$$

$$\bar{\lambda} = \sqrt{((454,4 \times 320 \times 10^{-3}) / 296,5)} = 0,700$$

$$\text{KSL a: } \alpha = 0,21$$

$$\phi = 0,5 \times [1 + 0,21 \times (0,700 - 0,2) + 0,700^2] = 0,800$$

$$\kappa = 1 / (0,800 + \sqrt{(0,800^2 - 0,700^2)}) = 0,85$$

$$N_{b,Rd} = 0,85 \times 454,4 \times 320 / 1,1 \times 10^{-3} = 112,1 \text{ kN}$$

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

$$\eta = 28,97 / 112,1 = 0,258 < 1,0$$

no further proof

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

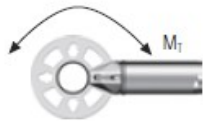
8.4 Bearing capacities Layher system



Ultimate capacities

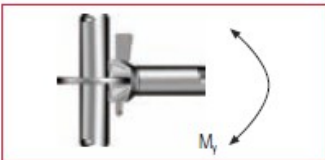
Stress capacity values* of the Allround ledger and the diagonal brace.

Z-8.22-64: K 2000+



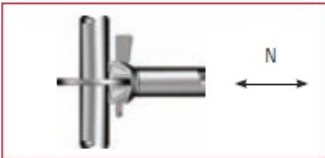
$M_{T,Rd} = \pm 52.9 \text{ kNcm}$

Connection moment



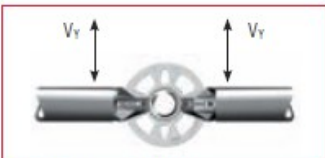
Connection moment
 $M_{Y,Rd} = \pm 101.0 \text{ kNcm}$

Normal force

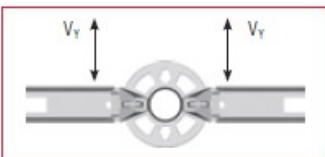


$N_{Rd} = \pm 31.0 \text{ kN}$

Horizontal force

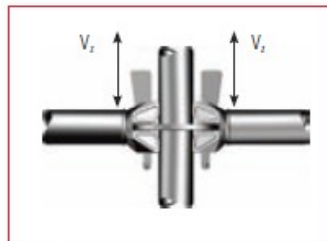


O-ledger: $V_{Y,Rd} = \pm 10.0 \text{ kN}$



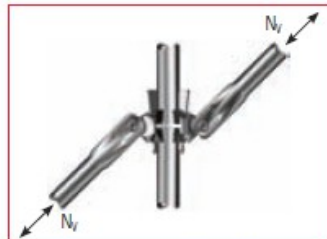
U-ledger: $V_{Y,Rd} = \pm 5.9 \text{ kN}$

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+**:

	Compression								Tension
Bay length [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07	4.14	all bay lengths
$N_{v,Rd}$ [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**:


	Compression								Tension
Bay length [m]	0.73	1.09	1.40	1.57	2.07	2.57	3.07	4.14	all bay lengths
$N_{v,Rd}$ [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: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

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+

Baywidth [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



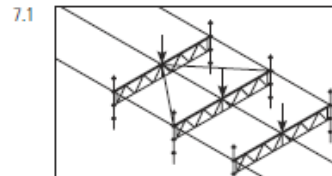
Tab. 7 Load bearing capacity of U-lattice beams, K 2000+

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

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

** Single point load above one of the middle posts

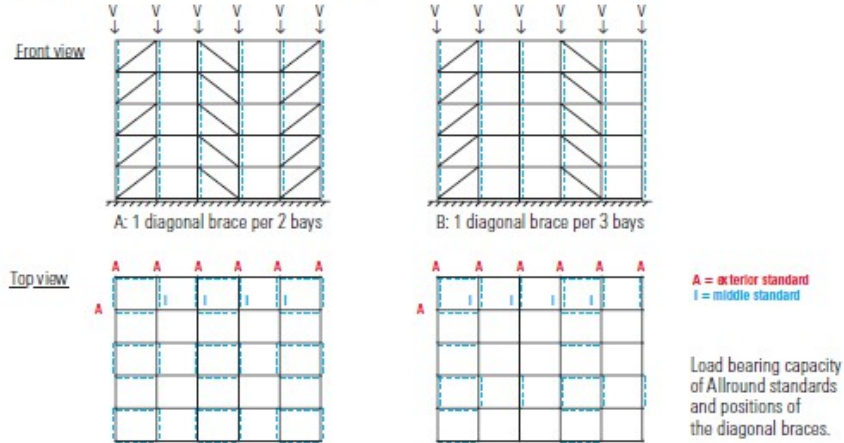
- * U-lattice beams completely covered with decking elements, secured with lock against lift-off.
- ** U-lattice beams completely covered with decking elements, secured with lock against lift-off. Alternatively the top chords of the beams – except U-lattice beam 2.57 m – can be braced by a bracing structure 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



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

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_k [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_k [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_k [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_k [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_k [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

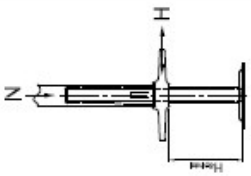
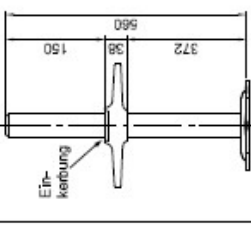
Tab. 13 Exterior standard												
Bay width [m]	0.73	1.09	1.57	2.07	2.57	3.07	Positioning of diagonal braces		A	B	A	B
max. vertical load V_k [kN]	33.9	29.6	39.0	34.8	40.3	37.7	39.3	38.7	38.4	37.8	37.7	37.2

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

17.01.2013

Zulässige Belastung von Layher Gerüstspindeln

Fußspindel 60 (Art.-Nr. 4001.060)

	<p>Skizze max. Auspindellänge</p> 	<p>Ersatzquerschnittswerte des Gewindes</p> <p> $A = 3,84 \text{ cm}^2$ $W_{dt} = 2,61 \text{ cm}^3$ $1,25 W_{dt} = 3,26 \text{ cm}^3$ $W_{dt} = 3,26 \text{ cm}^3$ $I = 3,74 \text{ cm}^4$ </p> <p>Material: EN 10210 - S235JRH → Rollgewinde: $f_{yk} = 260 \text{ N/mm}^2$ </p>
-------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Auspindellänge 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 =	H =				
0	41	41	40	40	39	39	38	38	37	36	36	35	34	33	32	31	30	26,3
5	40	40	39	38	37	36	35	34	33	32	31	30	29	28	26	25	-	7,8
10	39	38	37	36	34	33	32	31	29	27	24	-	-	-	-	-	-	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

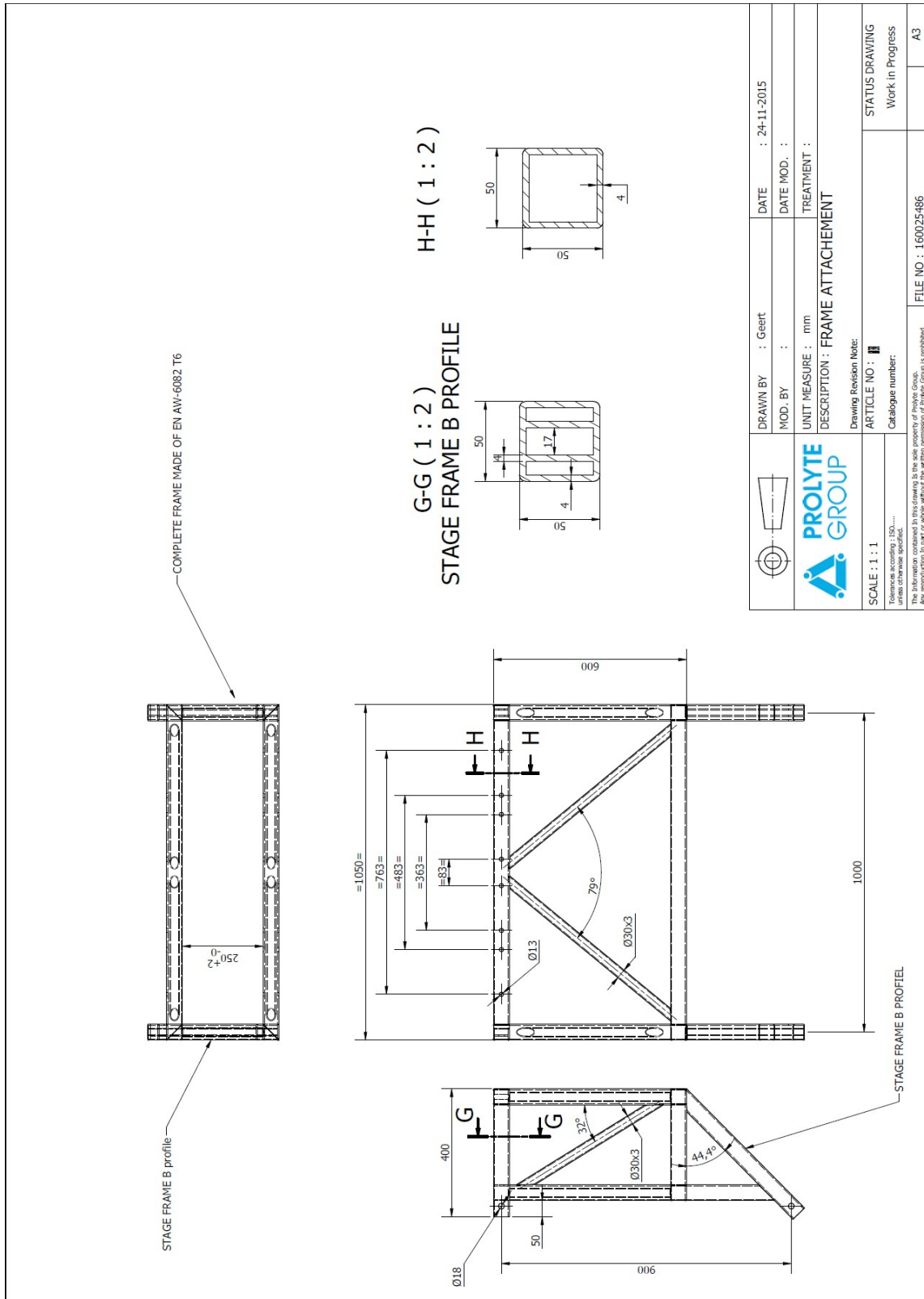
*Die zulässigen Vertikallasten wurden berechnet unter Anwendung des Berechnungsmodells nach EN 12811-1, Abs. 10.2.3.2. Zur Erfassung der Biegesteifigkeit des Ständerrohres und Anteile aus Theorie II. Ordnung wurde ein Raumgürst mit 2,0 m Lagenhöhe und 2,57 m Ständerabstand berücksichtigt.

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

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

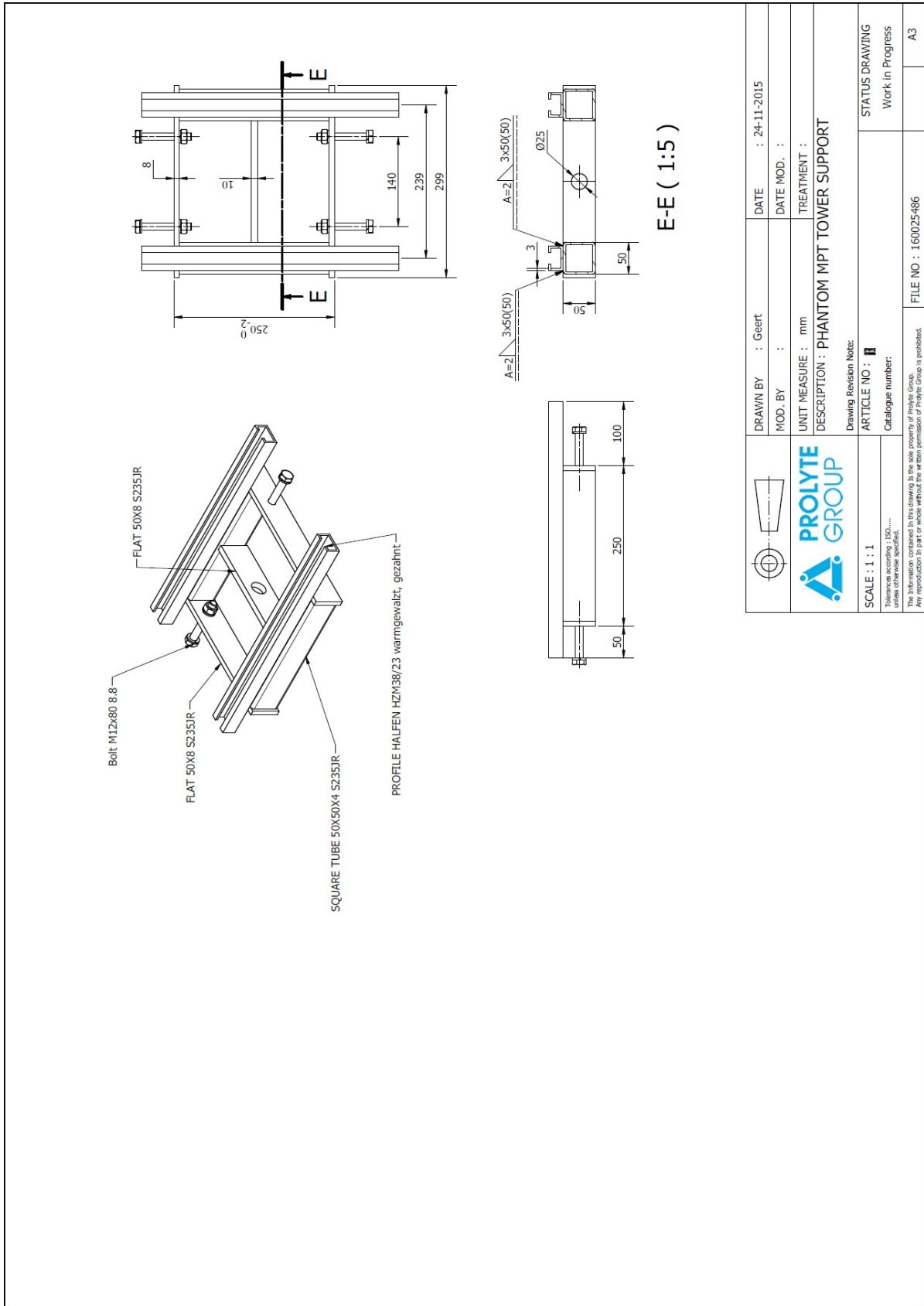
<p>PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m</p>	<p>PROJECT-NO.: 13288–Revision 01</p>
<p>CUSTOMER: PROLYTE GROUP</p>	<p>DATE: 30.11.2015</p>

9 EASYFRAME B PODIUM



	DRAWN BY : Geert	DATE : 24-11-2015
	MOD. BY :	DATE MOD. :
	UNIT MEASURE : mm	TREATMENT :
	DESCRIPTION : FRAME ATTACHEMENT	
Drawing Revision Note:		
SCALE : 1 : 1	ARTICLE NO : II	STATUS DRAWING
Tolerance according : ISO...		Work in Progress
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PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



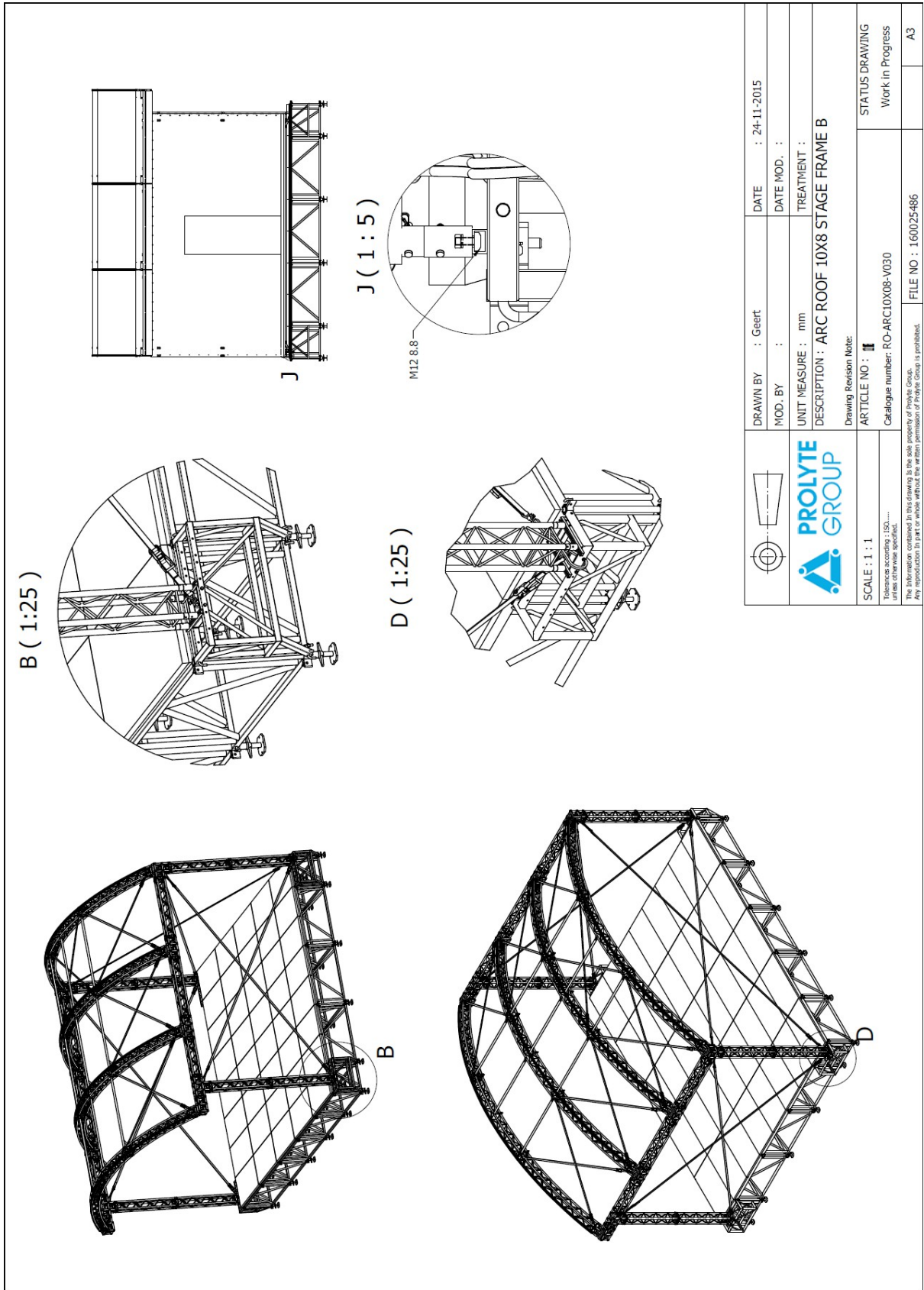
	DRAWN BY : Geert	DATE : 24-11-2015
	MOD. BY :	DATE MOD. :
UNIT MEASURE : mm		TREATMENT :
DESCRIPTION : PHANTOM MPT TOWER SUPPORT		
Drawing Revision Note:		
SCALE : 1 : 1	ARTICLE NO : 11	STATUS DRAWING
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FILE NO : 160025486		A3

PROJECT:
PROLYTE ARC-ROOF 8x6 - 6x4m

PROJECT-NO.:
13288-Revision 01

CUSTOMER:
PROLYTE GROUP

DATE:
30.11.2015



	DRAWN BY : Geert	DATE : 24-11-2015
	MOD. BY :	DATE MOD. :
	UNIT MEASURE : mm	TREATMENT :
	DESCRIPTION : ARC ROOF 10X8 STAGE FRAME B	
Drawing Revision Note:		
SCALE : 1 : 1	ARTICLE NO :	STATUS DRAWING
Tolerance according : ISO.....	Catalogue number: RO-ARC10X08-V030	Work in Progress
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	FILE NO : 160025486	A3

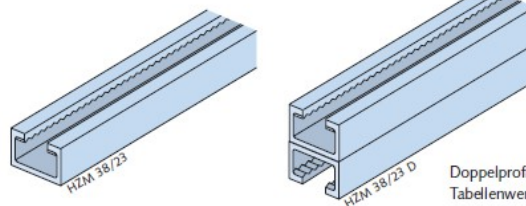
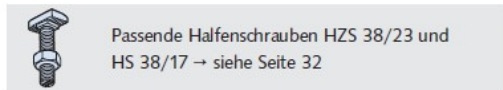
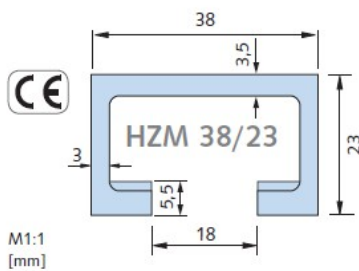
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

HALFEN MONTAGETECHNIK

Montageschienen – Schwere Tragsysteme

Montageschiene HZM 38/23

HZM 38/23 warmgewalzt, gezahnt

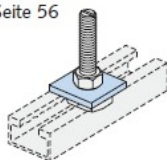


Abmessungen und Querschnittswerte								Tragfähigkeiten					
Material	Bestell-Nr.	Länge	Profilgewicht	Profilquerschnitt	Trägheitsmoment		Widerstandsmoment		Maximale Punkttragfähigkeit	Biegetragfähigkeit bei Spannweite L			
		[mm]	[kg/m]	[cm ²]	I_y	I_z	W_y	W_z	F_z [kN]	e_w [cm]	F [kN]		
											L [m]		
HZM 38/23	0284.								F_z [kN]	e_w [cm]	0,5 m	1,0 m	1,5 m
WB	060-00001								$F_{z,Rd}$		F_{Rd}		
FV	060-00003	6070	2,43	3,09	2,11	6,17	1,59	3,25	18,0	20	5,9	2,0	0,9
A4	060-00002								zul. F_z		zul. F		
									12,8		4,2	1,4	0,6

⊙ F_z = max. Tragfähigkeit der Schienenlippen - siehe auch Seite 66

Zubehör

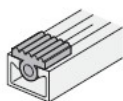
VUS 40/25
Unterlegscheibe
→ s. Seite 56



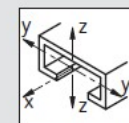
SIC 38/23
Sicherungsscheibe
→ s. Seite 56



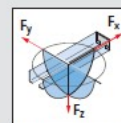
SDM - 36/6
Schalldämmprofil
→ s. Katalog MT-FFC



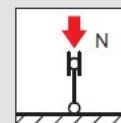
Weitere Profildaten, Statik



Querschnittswerte
Seite 60



Punkttragfähigkeiten
Seiten 66 - 67



Biegeknicke
Seite 70

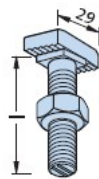
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

HALFEN MONTAGETECHNIK

Montageschienen – Schwere Tragsysteme

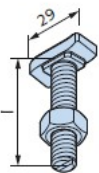
Halbschrauben HZS 38/23 und HS 38/17

Montageschienen



HZS 38/23
Halbschraube
gezahnt,
einschl. Mutter

Schwere Tragsysteme



HS 38/17
Halbschrauben
einschl. Mutter

Li = mit Linksgewinde

Mittelschwere Tragsysteme

Hochkorrosionsbeständige Edelstahl-Halbschrauben HS 38/17, Werkstoffbezeichnung HCR auf Anfrage.

Leichte Tragsysteme

Zubehör

Statik

Maschinenbau

HZS 38/23 Lieferprogramm					
Länge l [mm]	M12	M16	Länge l [mm]	M12	M16
30	GVs 8.8	GVs 8.8	80	GVs 8.8	GVs 8.8
40	GVs 8.8	GVs 8.8	100	GVs 8.8	GVs 8.8
50	GVs 8.8	GVs 8.8	125	GVs 8.8	GVs 8.8
60	GVs 8.8	GVs 8.8	150	GVs 8.8	GVs 8.8
			200	-	GVs 8.8
			300	-	GVs 8.8

HS 38/17 Lieferprogramm									
Länge l [mm]	M10	M12	M16	Länge l [mm]	M10	M12	M16		
20	GVs 4.6	GVs 4.6	GVs 4.6 ⊕	60	GVs 4.6	GVs 4.6	GVs 4.6		
25	-	A4-70	A4-50 ⊕		A4-70	GVs 8.8	GVs 8.8		
30	GVs 4.6	GVs 4.6	GVs 4.6	70	GVs 4.6	GVs 4.6	GVs 4.6		
	FV 4.6	FV 4.6	FV 4.6			FV 8.8	FV 8.8		
40	GVs 4.6	GVs 4.6	GVs 4.6	80	GVs 4.6	GVs 4.6	GVs 4.6		
	A4-70	A2-70	A2-50 ⊕			A4-70	A4-50		
50	GVs 4.6	GVs 4.6	GVs 4.6	80 Li	GVs 4.6	GVs 4.6	GVs 4.6		
	A4-70	A2-70	FV 4.6			A4-50	A4-50		
60	GVs 4.6	GVs 4.6	GVs 4.6	100	GVs 4.6	GVs 4.6	GVs 4.6		
						A4-70	A2-70	A2-50 ⊕	FV 4.6
						A4-70	A4-50	A4-50	A4-50
						A4-70	A4-50	A4-50	A4-50
70	GVs 4.6	GVs 4.6	GVs 4.6	125	GVs 4.6	GVs 4.6	GVs 4.6		
						A4-50 ⊕	A4-50	A4-50	
80	GVs 4.6	GVs 4.6	GVs 4.6	150	GVs 4.6	GVs 4.6	GVs 4.6		
						A4-50 ⊕	A4-50	A4-50	
90	GVs 4.6	GVs 4.6	GVs 4.6	200	GVs 4.6	GVs 4.6	GVs 4.6		
						A4-50 ⊕	A4-50	A4-50	

⊕ auf Anfrage

Tragfähigkeiten für Halbschrauben ⊕

Gewinde Ø	Tragfähigkeiten für Halbschrauben				Längszug		Empfohlene Anzugsdrehmomente			
	F [kN] ⊕				F _x [kN] ⊕		T _{inst} [Nm]			
38/23	HZS				HZS		HZS			
	8.8				A4-70		8.8			
	A4-70				Alle Festigkeitsklassen		A4-70			
	F _{Rd}	27,2	-	-	16,8	80	-	-	-	-
zul. F	19,4	-	-	12,0	120	120	-	-	-	
38/17	HS				HS		HS			
	4.6				HS		4.6			
	8.8				HS		8.8			
	A2-50; A4-50				HS		A2-50; A4-50			
A2-70; A4-70				HS		A2-70; A4-70				
M10	F _{Rd}	8,3	18,6	7,3	15,6	15	40	15	30	
	zul. F	5,9	13,3	5,2	11,2	25	70	25	50	
M12	F _{Rd}	12,1	27,0	10,6	22,7	65	180	60	130	
	zul. F	8,6	19,3	7,6	16,2	-	-	-	-	
M16	F _{Rd}	22,6	50,2	19,8	42,2	-	-	-	-	
	zul. F	16,1	35,9	14,1	30,2	-	-	-	-	

⊕ Profiltragfähigkeit beachten!

Bei gleichzeitiger Belastung in allen Richtungen (Längszug -x, Quer-y, zentrischer Zug-z) darf die Lastresultierende die Tragfähigkeiten nach Tabelle nicht überschreiten.



$$\sqrt{F_x^2 + F_y^2 + F_z^2} \leq \text{zul. F}$$

bzw.

$$\sqrt{F_{x,Ed}^2 + F_{y,Ed}^2 + F_{z,Ed}^2} \leq F_{Rd}$$

F_x, F_y, F_z = vorhandene Last
 zul. F = zul. Tragfähigkeit der Schraube bzw.
 F_{x,Ed}, F_{y,Ed}, F_{z,Ed} = Bemessungswerte der Einwirkung
 F_{Rd} = Bemessungswert der Beanspruchbarkeit

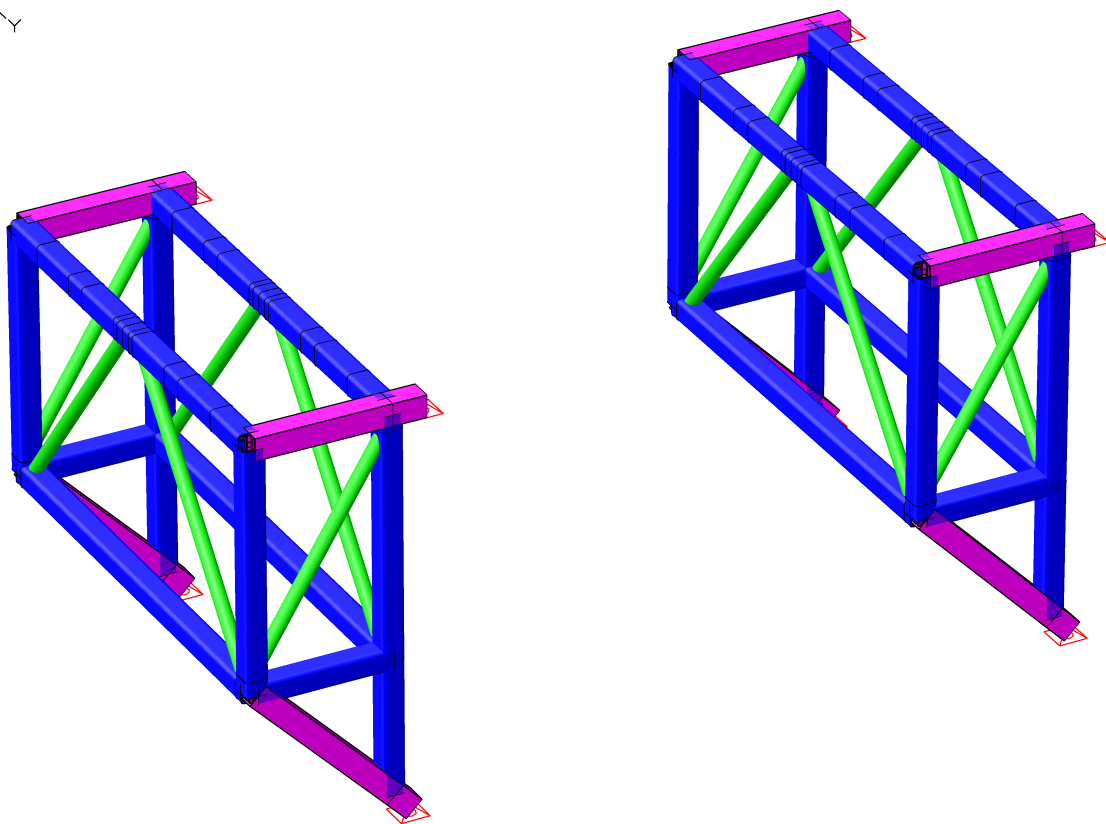
PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

In case of setup with Easyframe B podium the columns are placed on special attachments.

An adverse load in the middle as well as one position near the edge are taken into account.

The proof is done for an adverse combination of lifting forces and horizontal forces on one support as well as for a maximum pressure force.

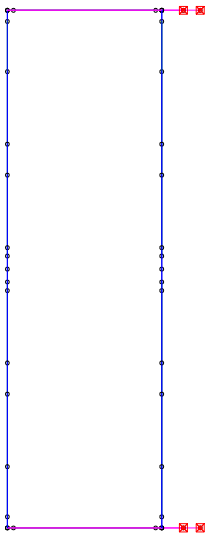
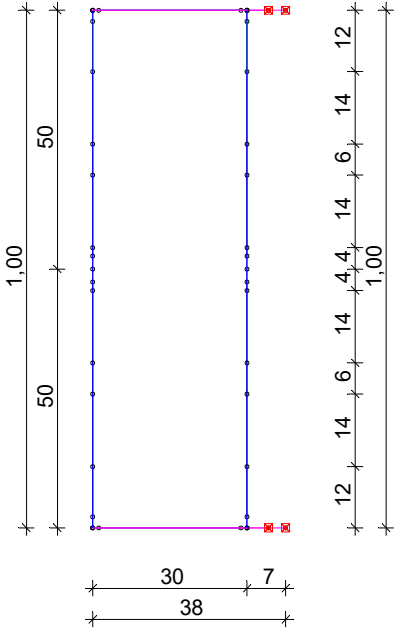
system:



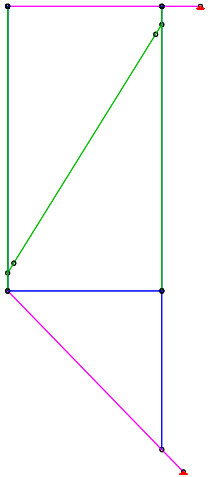
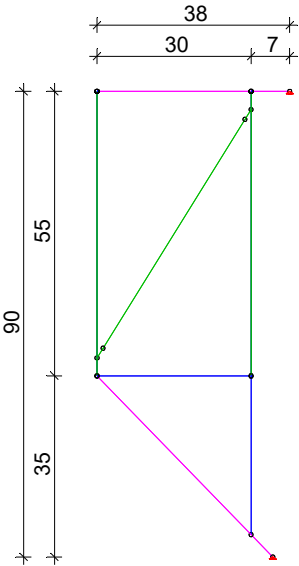
- blue: 50x50x4mm (EN AW 6082 T6)
- green: Ø30x3mm (EN AW 6082 T6)
- pink: special frame profile 50x50 (EN AW 6082 T6)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

top view:

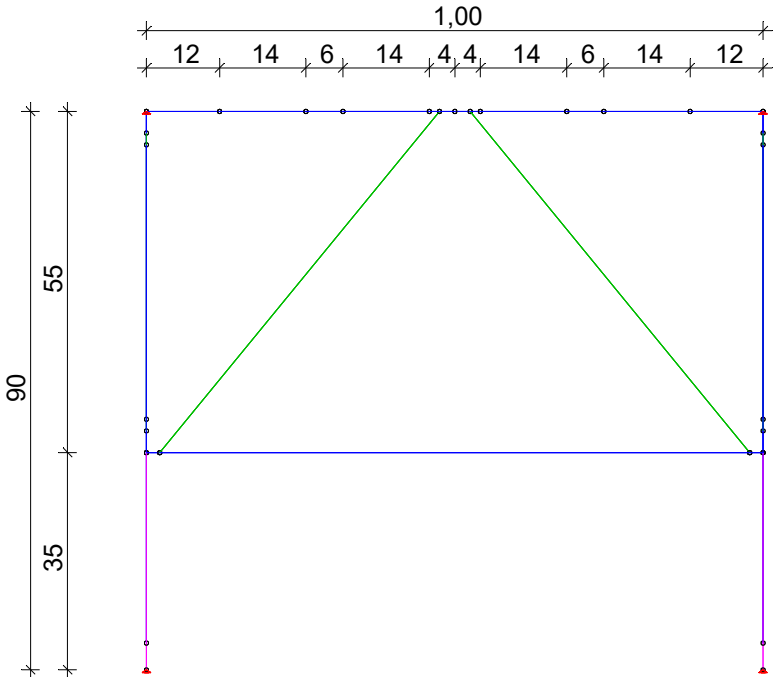


side view:



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

front view:

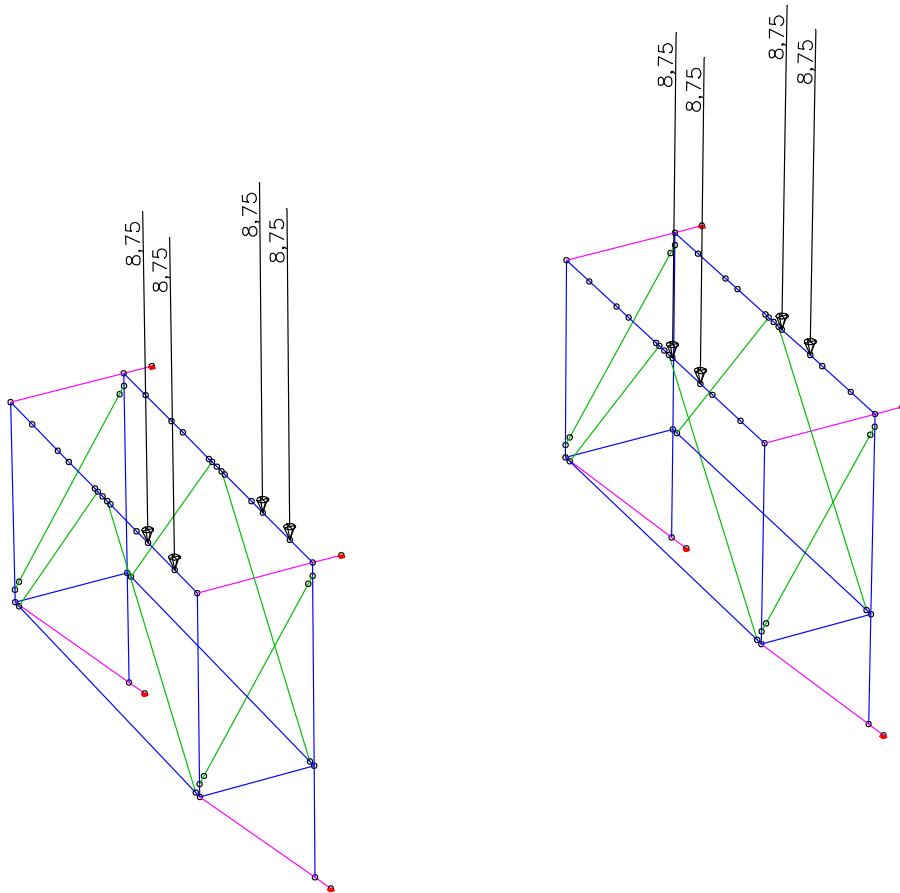


PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Loading

load case 1: max. N_{Ed}

$N_{Ed} < 35,0 \text{ kN}$
 $35 / 4 = 8,75 \text{ kN}$



LC 1: Load, max. N_{Ed}

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

load case 2: min. N_{Ed}

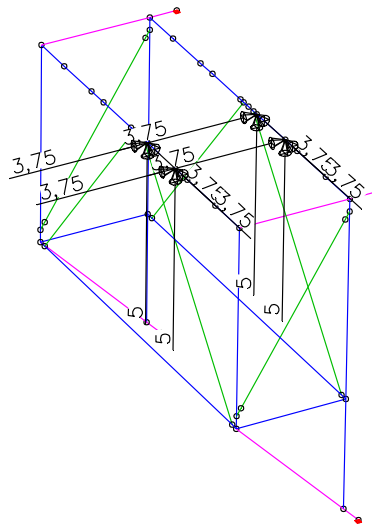
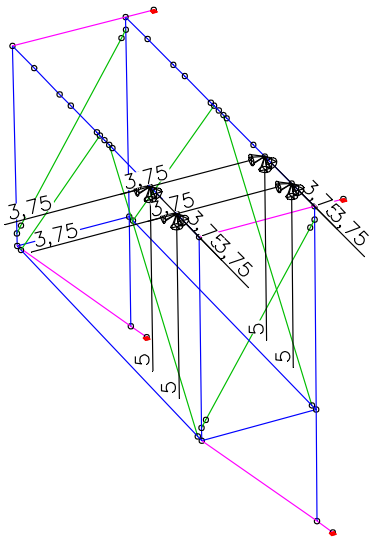
$$N_{Ed} = -20,0 \text{ kN (R}_{z,d}\text{)}$$

$$R_{x,d} = 15,0 \text{ kN}$$

$$R_{y,d} = 15,0 \text{ kN}$$

$$20/4 = 5,0 \text{ kN}$$

$$15/4 = 3,75 \text{ kN}$$



LC 2: Load, min. N_{Ed}

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Calculation

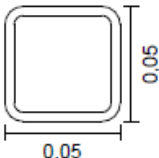
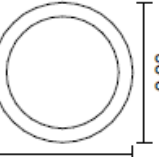
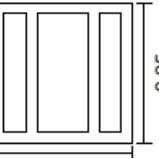
System characteristics

96 Nodes	
120 Elements	120 Beams
8 Supports	0 Slabs
0 Link elements	0 Plains
3 Material properties	0 Shells
3 Section properties	0 Cables
2 Load cases	0 Solids
0 LC Combinations	0 Spring elements
0 Tendon groups	

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

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

Section properties

1	Library section 	QRO 50 x 50 x 4 (EN 10219-2); 50x50x4 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	Polygon 	Tubes Centroid [m] $y_s = 0,000$ $z_s = 0,000$ Area [m ²] $A = 2,5284e-04$ Moments of inertia [m ⁴] $I_x = 4,6324e-08$ $I_{yz} = 0,0000e+00$ $I_y = 2,3175e-08$ $I_1 = 2,3175e-08$ $I_z = 2,3175e-08$ $I_2 = 2,3175e-08$ Main axis angle [Grad] $\Phi = 0,000$ Averaging of the lateral force shear stress over section width
3	Polygon 	Frame Profil Centroid [m] $y_s = 0,025$ $z_s = 0,025$ Area [m ²] $A = 1,0720e-03$ Moments of inertia [m ⁴] $I_x = 4,4565e-07$ $I_{yz} = 0,0000e+00$ $I_y = 3,1092e-07$ $I_1 = 3,1092e-07$ $I_z = 3,0263e-07$ $I_2 = 3,0263e-07$ Main axis angle [Grad] $\Phi = -0,000$ Averaging of the lateral force shear stress over section width

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

Material properties

	No.	Type	E-Modu. [MN/m ²]	G-Modu. [MN/m ²]	Poiss. ratio	alpha.t [1/K]	gamma [kN/m ³]	Miscellaneous
1	1	Frei	70000	27000	0,30	1,200e-05	27,000	fc = 235 [MN/m ²] ft = 235
2	2	Frei	70000	27000	0,30	1,200e-05	27,000	fc = 235 [MN/m ²] ft = 235
3	3	Frei	70000	27000	0,30	1,200e-05	27,000	fc = 235 [MN/m ²] ft = 235

List of load cases

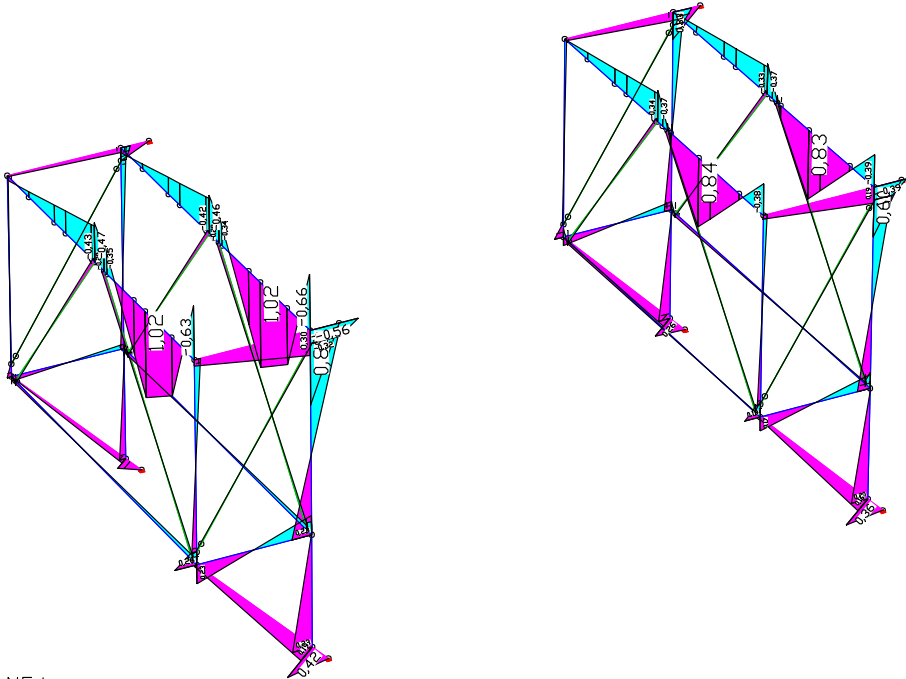
LC.	Label
1	max. NEd
2	min. NEd

Sum of installed loads and support reactions

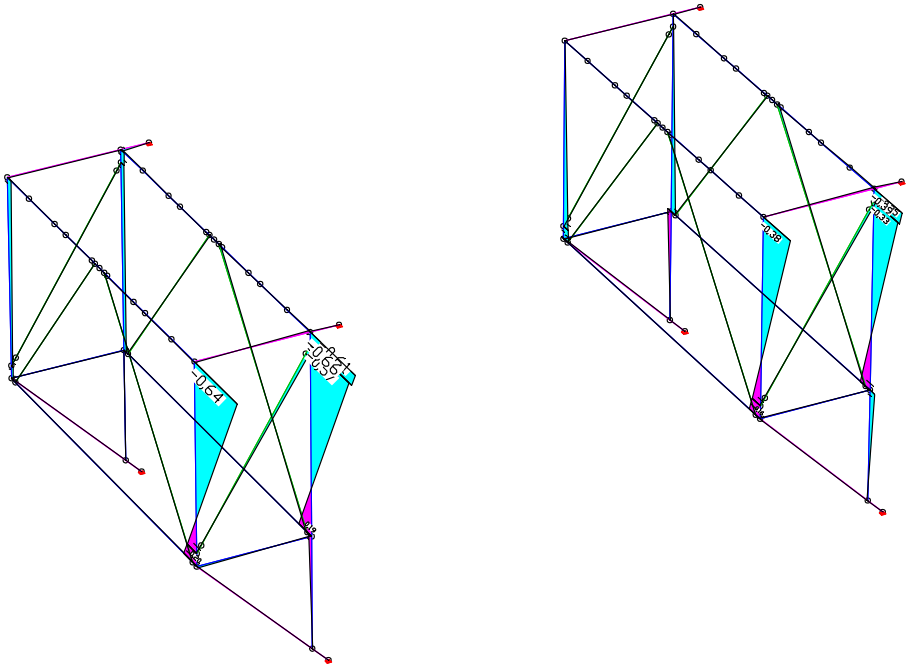
LC.	Label	Fx [kN]	Fy [kN]	Fz [kN]
1	max. NEd	0,000	0,000	70,433
	Support reactions	-0,000	0,000	70,433
2	min. NEd	30,000	-30,000	-40,000
	Support reactions	30,000	-30,000	-40,000

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

internal forces + stresses
LC1

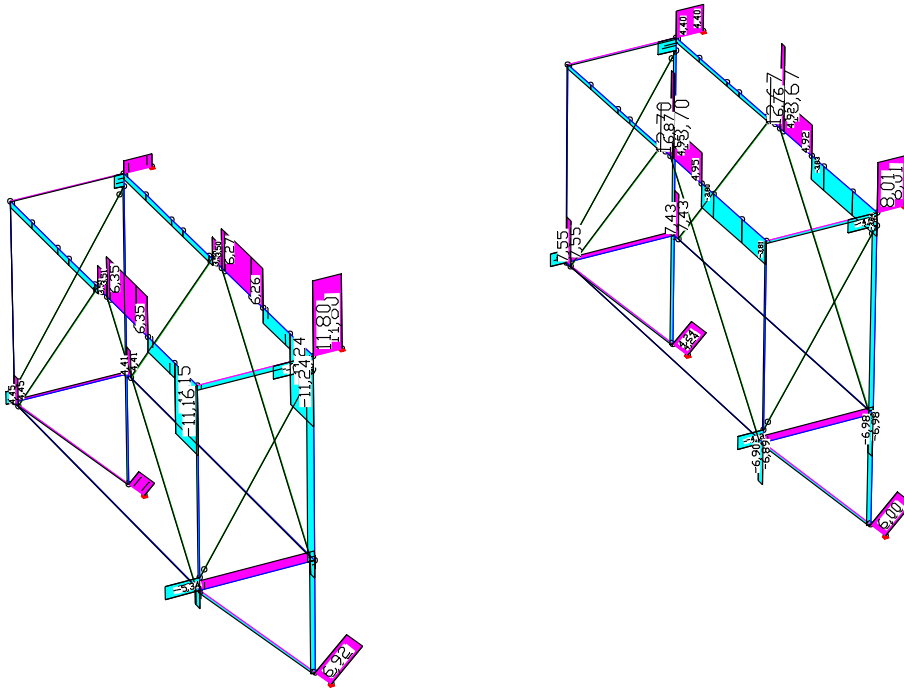


LC 1: max. NEd
Internal forces My [kNm]
Value range (overall system, min/max): -0,66/1,02 [kNm]

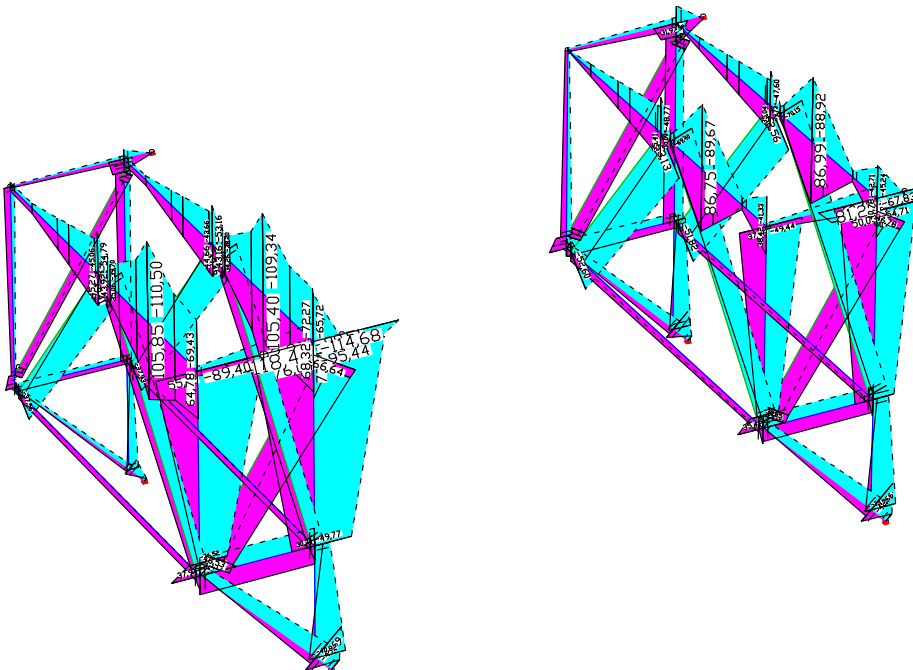


LC 1: max. NEd
Internal forces Mz [kNm]
Value range (overall system, min/max): -0,66/0,20 [kNm]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LC 1: max. NEd
 Internal forces Qz [kN]
 Value range (overall system, min/max): -11,24/13,70 [kN]

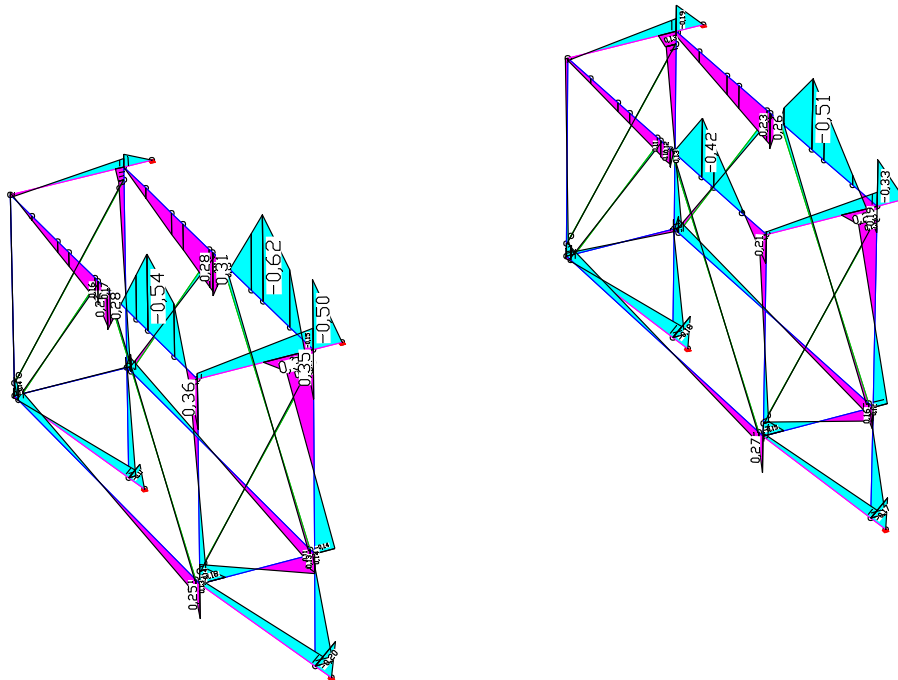


LC 1: max. NEd
 Stresses (general – elastic, directly from internal forces) min,max Sigma.x [MN/m²]
 Value range (overall system, min/max): -114,68/118,44 [MN/m²]

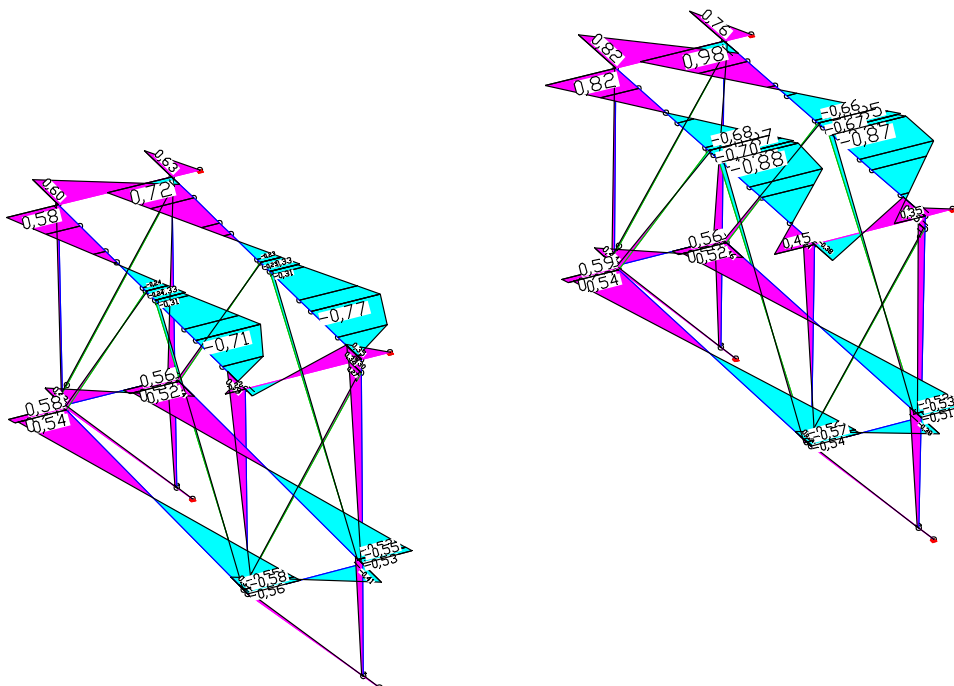
$\sigma_{Rd, HAZ} = 0,8 \times 185/1,25 = 118,4 \text{ N/mm}^2$ (at cut end of HAZ)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

LC2

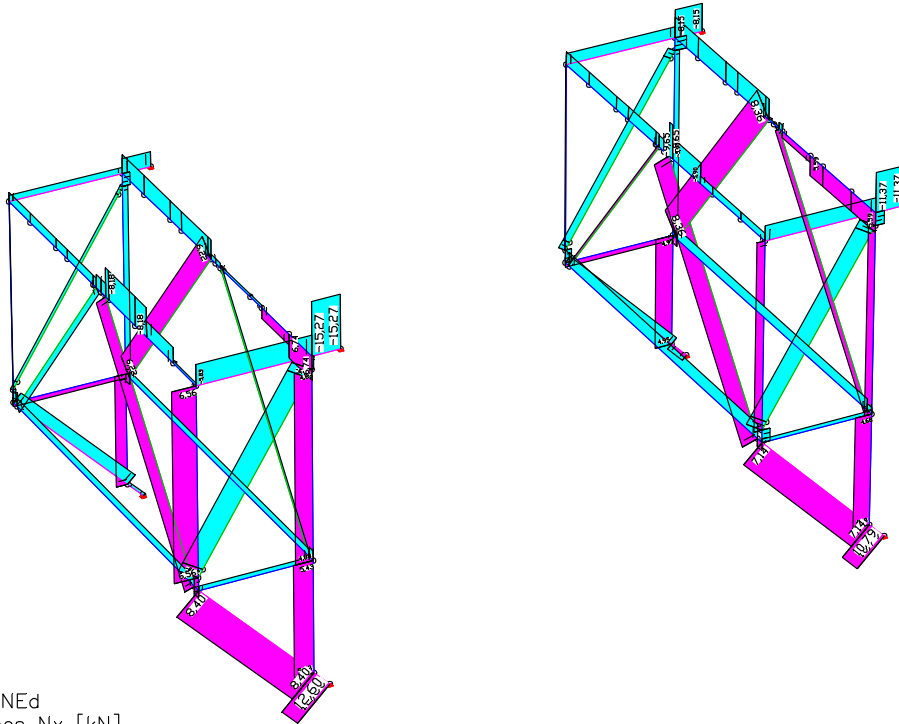


LC 2: min. NEd
 Internal forces My [kNm]
 Value range (overall system, min/max): -0,62/0,36 [kNm]

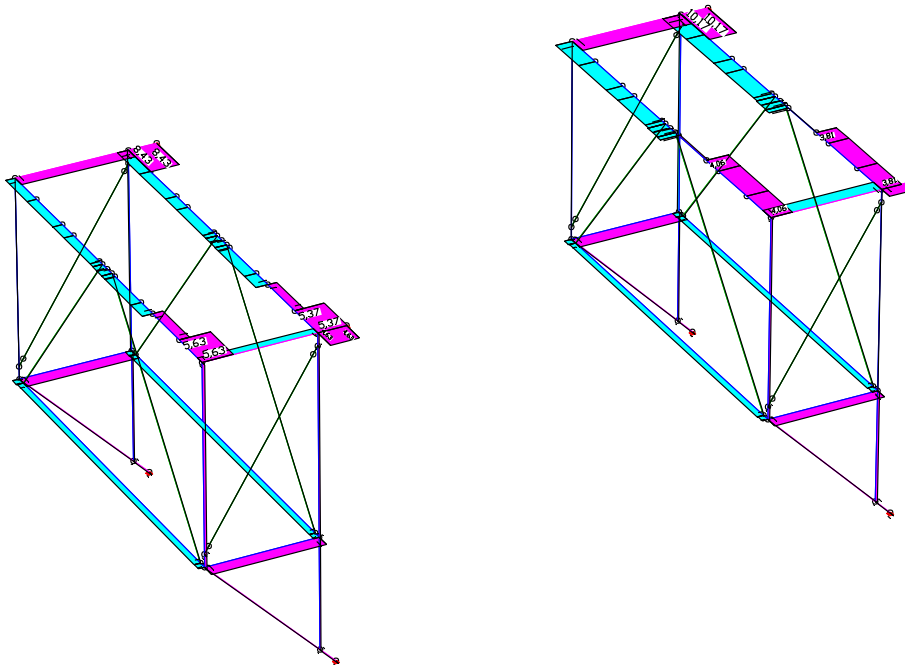


LC 2: min. NEd
 Internal forces Mz [kNm]
 Value range (overall system, min/max): -0,88/0,98 [kNm]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

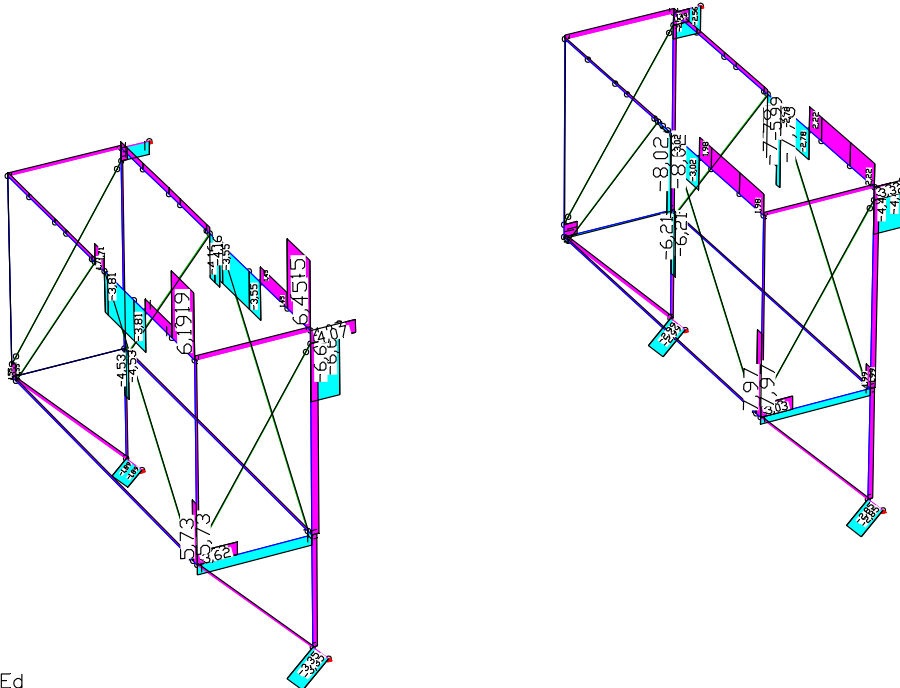


LC 2: min. NEd
 Internal forces N_x [kN]
 Value range (overall system, min/max): $-15,27/12,60$ [kN]

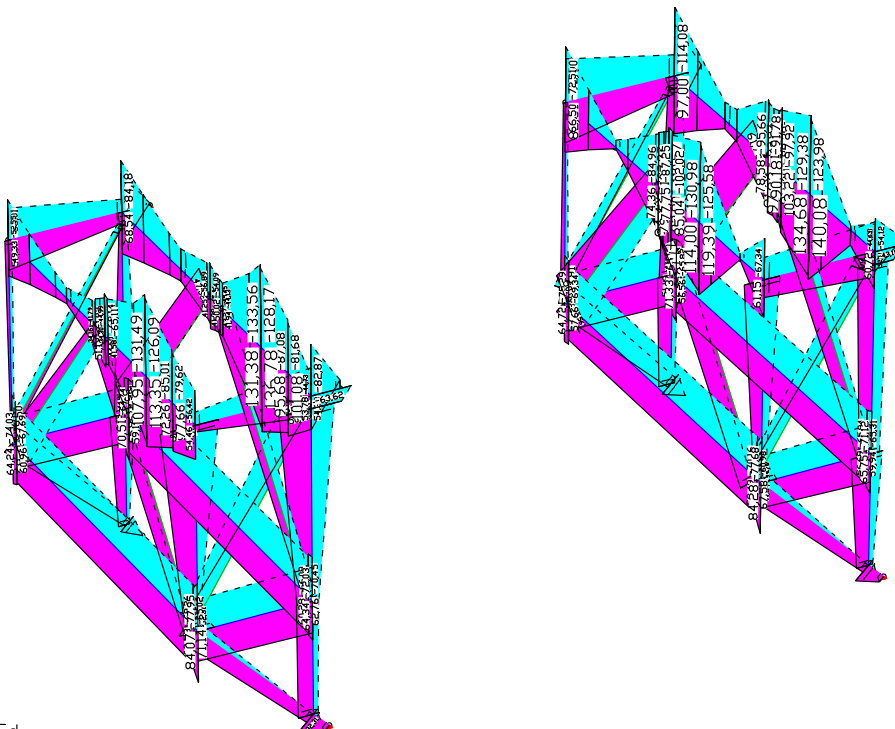


LC 2: min. NEd
 Internal forces Q_y [kN]
 Value range (overall system, min/max): $-3,69/10,17$ [kN]

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015



LC 2: min. NEd
 Internal forces Qz [kN]
 Value range (overall system, min/max): -8,02/7,97 [kN]



LC 2: min. NEd
 Stresses (general – elastic, directly from internal forces) min,max Sigma.x [MN/m²]
 Value range (overall system, min/max): -133,56/140,08 [MN/m²]

< $\sigma_{Rd, HAZ} = 0,8 \times 185 / 1,25 = 118,4 \text{ N/mm}^2$ (at cut end of HAZ)
< $\sigma_{Rd} = 250 / 1,1 = 227,27 \text{ N/mm}^2$ (in undisturbed material)

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

podium elements:

The proof for the connection to the Stageframe B podium is calculated for higher forces in a separate structural report.

Also the podium is proven for 750 kg/m² and a horizontal load of V/10 (2x2x7,5/10 = 3,0 kN) each element.

payload podium: 500 kg/m² < 750 kg/m²

max. R_{x,y,d} = 15,0 kN

H = 15,0/1,35/ 5 + 5,0 x 2x1,0/2/10 = 2,72 kN < 3,0 kN (5 elements in a row)

payload podium: 500 kg/m² < 750 kg/m²

characteristic values:

allowable Q = 23,0 kN ~> 1,4 x 23,0 = 32,2 kN = Q_{Rd}

allowable N = 23,0 kN ~> 1,4 x 23,0 = 32,2 kN = N_{Rd}

allowable M = 893 kNcm ~> 1,4 x 893 = 1250 kNcm = M_{Rd}

proof of guy wire attachment plate t=10mm, profile 50x50x4mm (W_{el} = 9,49 cm³):

max. R_{x,y,d} = 15,0 kN

M_{Ed} = 15,0 x 0,25/ 4 = 0,9375 kNm

σ_{Ed} = 0,9375 x 10³/ 2/ 9,49 = 49,40 N/mm² < 235 N/mm² (2 profiles, S235JR)

proof of Halfen rail HZM 38/23:

R_{z,d} = -20,0 kN

20/ 4 = 5,0 kN < 18,60 kN = F_{z,Rd}

The horizontal forces are not transmitted over the Halfen rail but are lead directly into the attachment.

R_{x,y,d} = 15,0 kN

bearing in the hole and shearing of 4 x M12, 8.8 without further proofs

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

10 TRUSS DATA

PROLYTE H30D

DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE

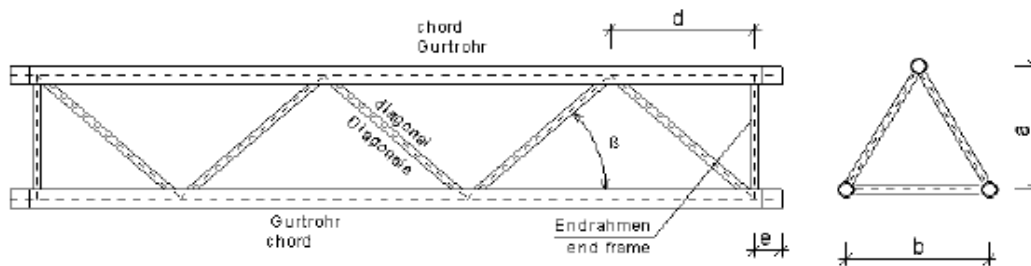
5,0 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm ²]	W [cm ³]	I [cm ⁴]	I _y [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/ TRAVERSEGEOMETRIE

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

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

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

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

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

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 _x [cm ⁴]	i _y [cm]	i _x [cm]	i _t [cm ⁴]
12,72	1057,29	1057,10	9,12	9,11	150

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

PROLYTE H30D

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
		$\sigma_{R,d} = f / \gamma_{(M1,M2)}$	$\tau_{R,d} = f / (\gamma_{(M1,M2)} \times \sqrt{3})$
$f_0; t > 5\text{mm}$	260,0	236,4	136,5
$f_0; t > 5\text{mm}$	310,0	248,0	
$f_0; t < 5\text{mm}$	250,0	227,3	131,2
$f_0; t < 5\text{mm}$	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 ρ_{HAZ} has to be multiplied by 0,8 / Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist ρ_{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_{M5}	1,25

SUMMARY / ZUSAMMENFASSUNG

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

DESIGN INTERNAL FORCES COMPLETE TRUSS / BEMESSUNGSSCHNITTGRÖSSEN GESAMTTRAVERSE

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

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

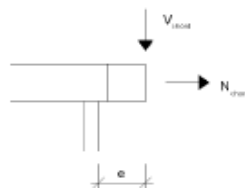
In case of occurrence of bending moment and transversal force the following term has to be analysed: Bei Auftreten von Moment und Querkraft, ist folgende Bedingung einzuhalten:

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

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

according to term / nach Gl. (8.43):

$$\eta = (N_{\text{chord/Gurt,Ed}} / N_{Rd})^{1,5} + M_{\text{chord/Gurt,Ed}} / M_{Rd} \leq 1$$



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288-Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

PROLYTE H30V

DEADWEIGHT TRUSS / EIGENGEWICHT TRAVERSE

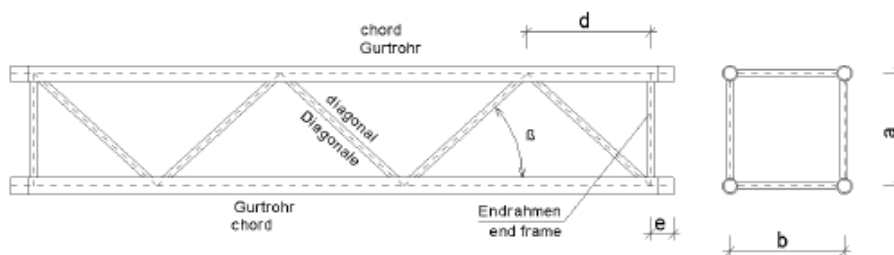
6,3 kg/m

CROSS SECTION TUBES / QUERSCHNITTSWERTE ROHRE

	D [mm]	t [mm]	A [cm ²]	W [cm ³]	I [cm ⁴]	I _y [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 GESAMTTTRAVERSE

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

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

$$i = (I / A)^{0,5}$$

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 _x [cm ⁴]	i _y [cm]	i _x [cm]	i _z [cm ⁴]
16,96	2095,86	2095,86	11,12	11,12	500

PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015

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_y 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	280,0	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	
$f_{0,2,HAZ}$	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 p_{HAZ} has to be multiplied by 0,8 / Alle Schweißnähte sind WIG geschweißt, entsprechend Fußnote 4 der Tabelle 3.2b ist p_{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_{MV}	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:	$M_{y,R,d} = 2 \times N_{R,d, \text{chord tube/Gurtehr}} \times 0,239 = 24,00$ kNm
bending moment/Biegemoment:	$M_{z,R,d} = 2 \times N_{R,d, \text{chord tube/Gurtehr}} \times 0,239 = 24,00$ kNm
normal force/Normalkraft:	$N_{R,d} = 4 \times N_{R,d, \text{chord tube/Gurtehr}} = 200,86$ 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:

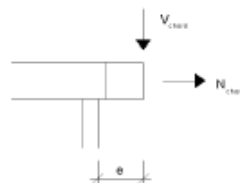
$$V_{d, \text{chord-Gurte}} = 0,25 \times V_{d, \text{totalgesamt}}$$

$$M_{d, \text{chordGurte}} = V_{d, \text{chordGurte}} \times e$$

$$e^* = 5,00$$

according to term / nach Gl. (8.43):

$$\eta = (N_{\text{chordGurte,Ed}} / N_{R,d})^{1,5} + M_{\text{chordGurte,Ed}} / M_{R,d} \leq 1$$



PROJECT: PROLYTE ARC-ROOF 8x6 - 6x4m	PROJECT-NO.: 13288–Revision 01
CUSTOMER: PROLYTE GROUP	DATE: 30.11.2015