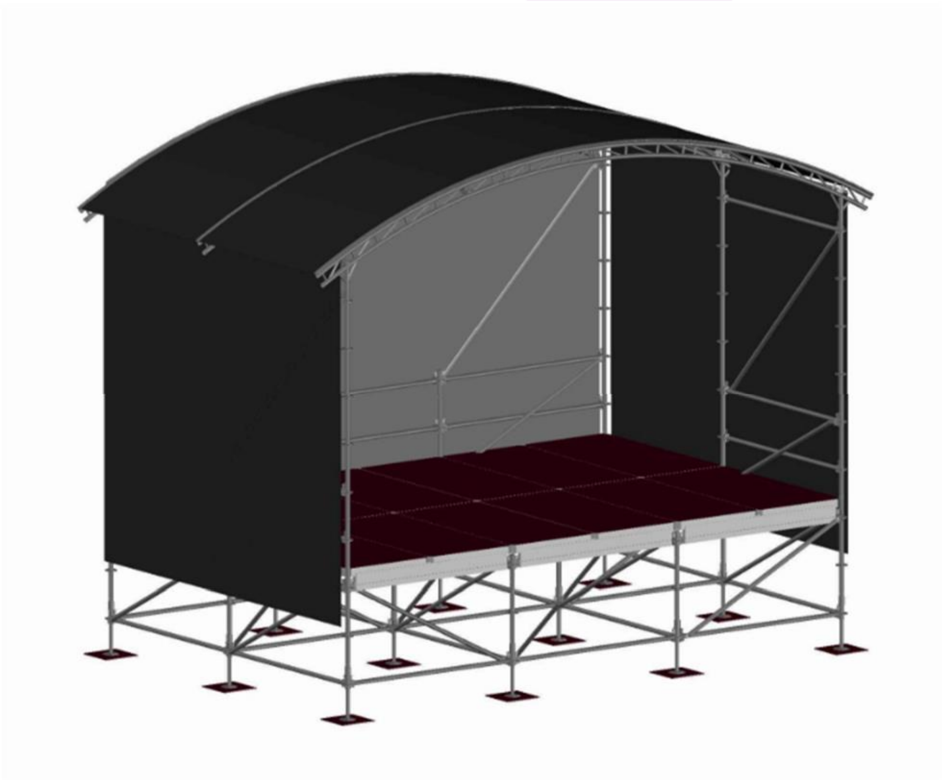
PODIUM – BOEK PAN

Eekels Verhuur 112023-01



Inhoudsopgave

Voorwoord

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

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

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

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

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

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

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

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

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

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

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

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

Overdekte podia zijn onder te verdelen in:
- (gedeeltelijk) met zijwanden van harde panelen of zeil
- zonder zijwanden
- voorzien van meer bouwlagen

Het gebruik van dit podium-boek is slechts voorbehouden aan Eekels Verhuur B.V..
Hallenstraat 20
P.O. Box 175
5530 AB Bladel
T: +31 0 73 6136867
E: info@eekelsverhuur.nl
I: www.eekelsverhuur.nl

NOODNUMMER: +31 0 467 870 112

1. Algemene informatie

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

1.1 Algemene gegevens fabrikant(en);

Zeil	**POLYMAR – FR COLOR 700**
Constructie	Interal T.C.
Type zeil	PVC; artikel 8509 5240

1.2 Algemene gegevens;

Naam	**PAN**
Type	DJ Cover
Configuratie(s)	4.14x4.14 – 6.21x3.11 – 6.21x4.14 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: 4.14x4.14 – 6.21x3.11 – 6.21x4.14 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.

6 Verklaring weeromstandigheden

Met welke weersomstandigheden dient de huurder rekening te houden.

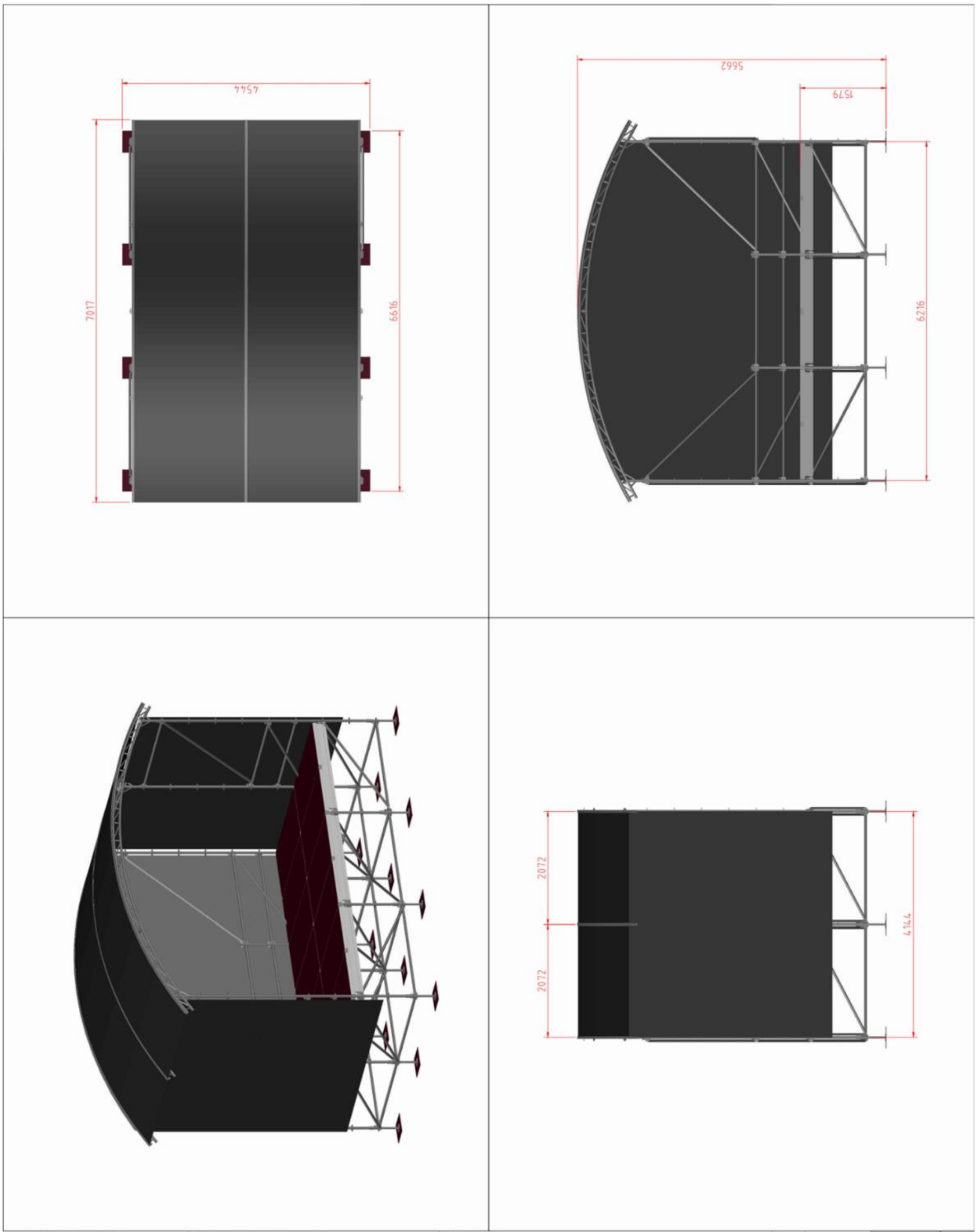
- Een constructie wordt berekend op een stuwdruk (de windbelasting per m2). De stuwdruk ontstaat door de windsnelheid. De windsnelheid is opgebouwd uit een stationair deel en een turbulent deel. Hierdoor ontstaan er pieken in de windsnelheid.
- Windsnelheid wordt standaard gemeten op 10 meter hoogte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

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

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

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

7 Bijlage I: Tekening(en)



DRAWN BY : Ivo Mulder	PROJECT NR : 2018013	REMARKS :	UNIT : MM	
DATE : 21-6-2018	CUSTOMER : INTERAL T.C.			
REVISION :	STATUS :			

DESCRIPTION :

DJ Cover 6.21X4.144

A3

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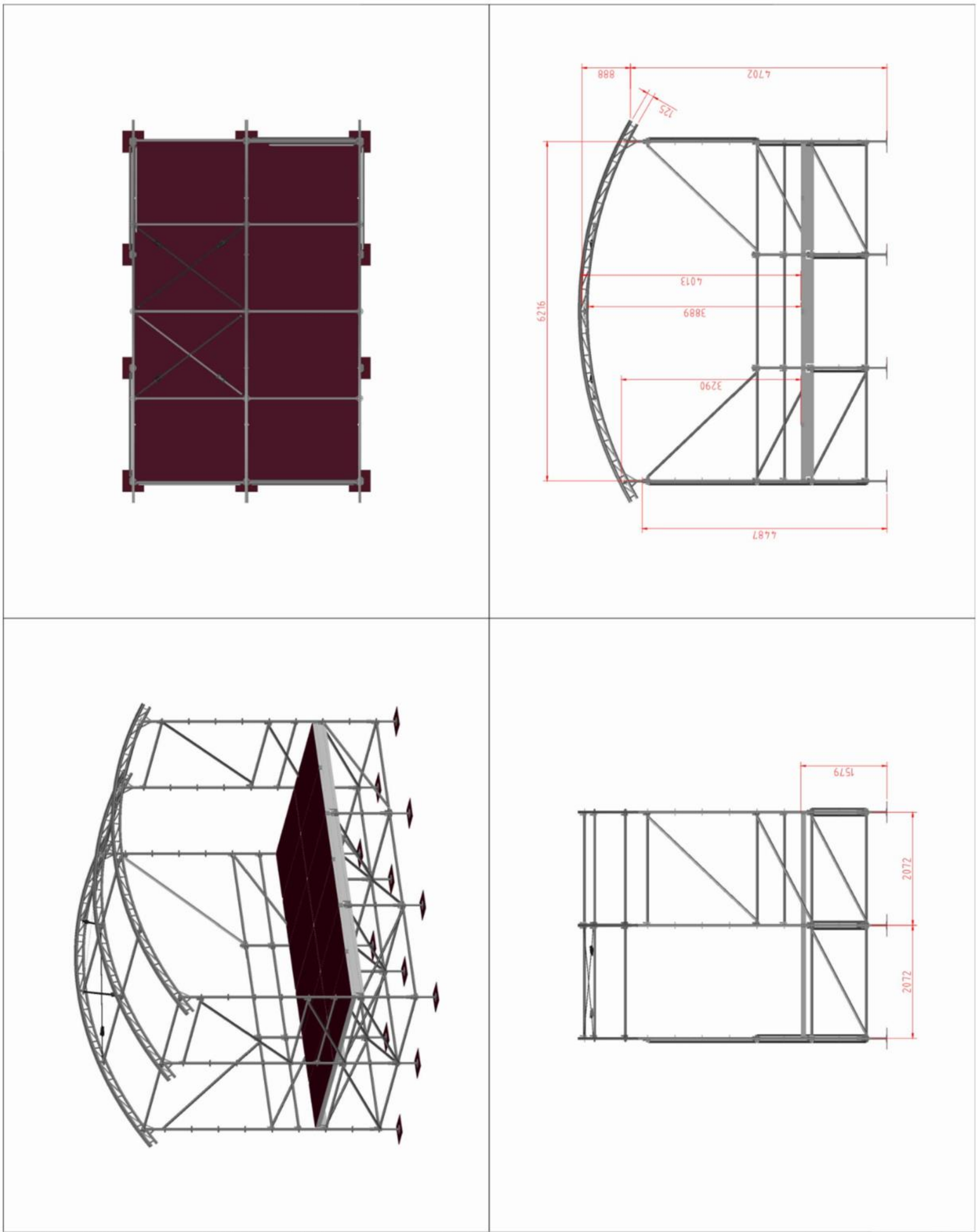

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DATE :	21-6-2018	CUSTOMER	: INTERAL T.C.		
REVISION :		STATUS	:		

DESCRIPTION :

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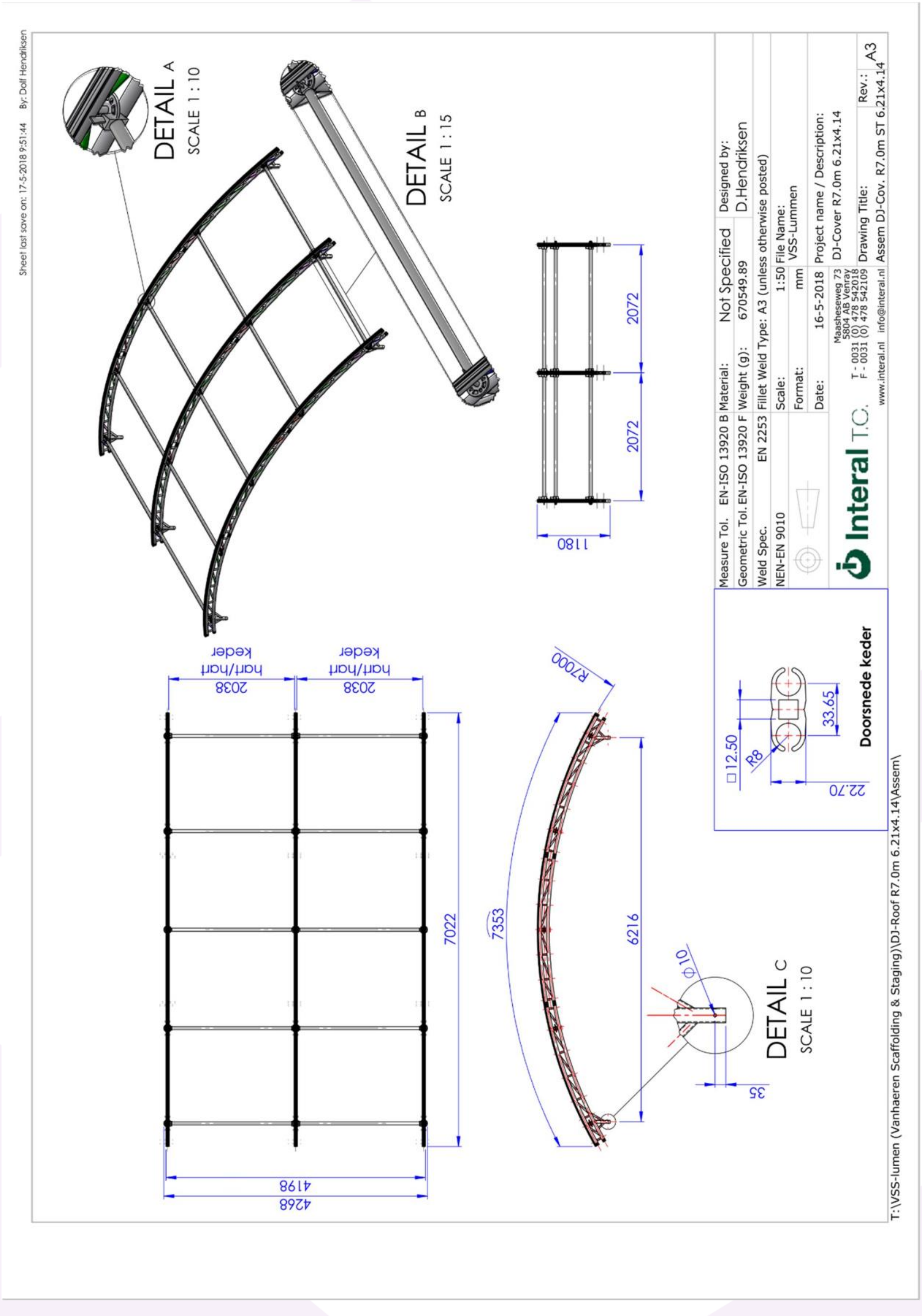
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Geometric Tol. EN-ISO 13920 F
Weld Spec. EN 2253
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Material: Not Specified
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Fillet Weld Type: A3 (unless otherwise posted)
Scale: 1:50
Format: mm
Date: 16-5-2018
Designed by:
D.Hendriksen
File Name:
VSS-Lummen
Project name / Description:
DJ-Cover R7.0m 6.21x4.14
Drawing Title:
Assem DJ-Cov. R7.0m ST 6.21x4.14
Rev.:
A3
Interal T.C.
Maasheseweg 73
5804 AB Venray
T - 0031 (0) 478 542018
F - 0031 (0) 478 542109
www.interal.nl info@interal.nl
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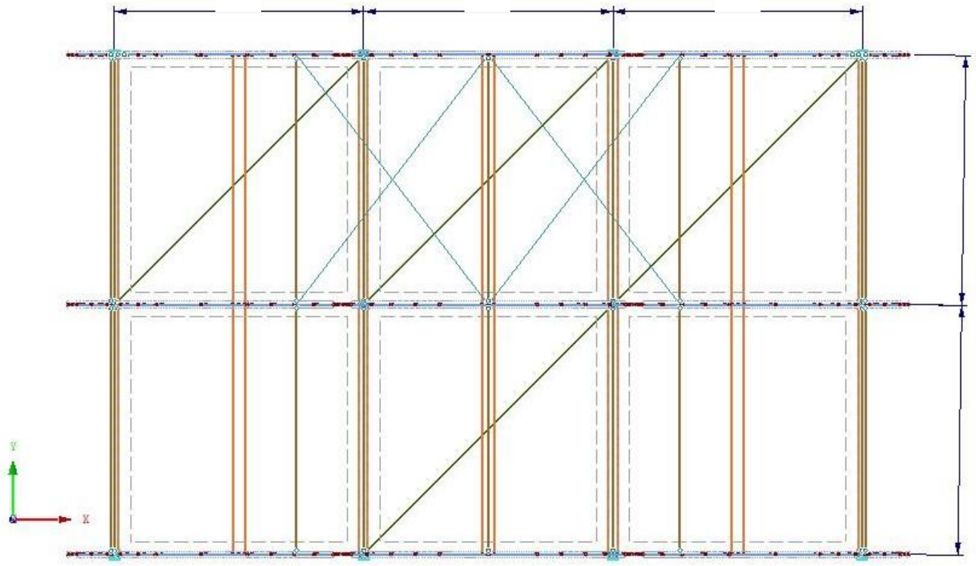
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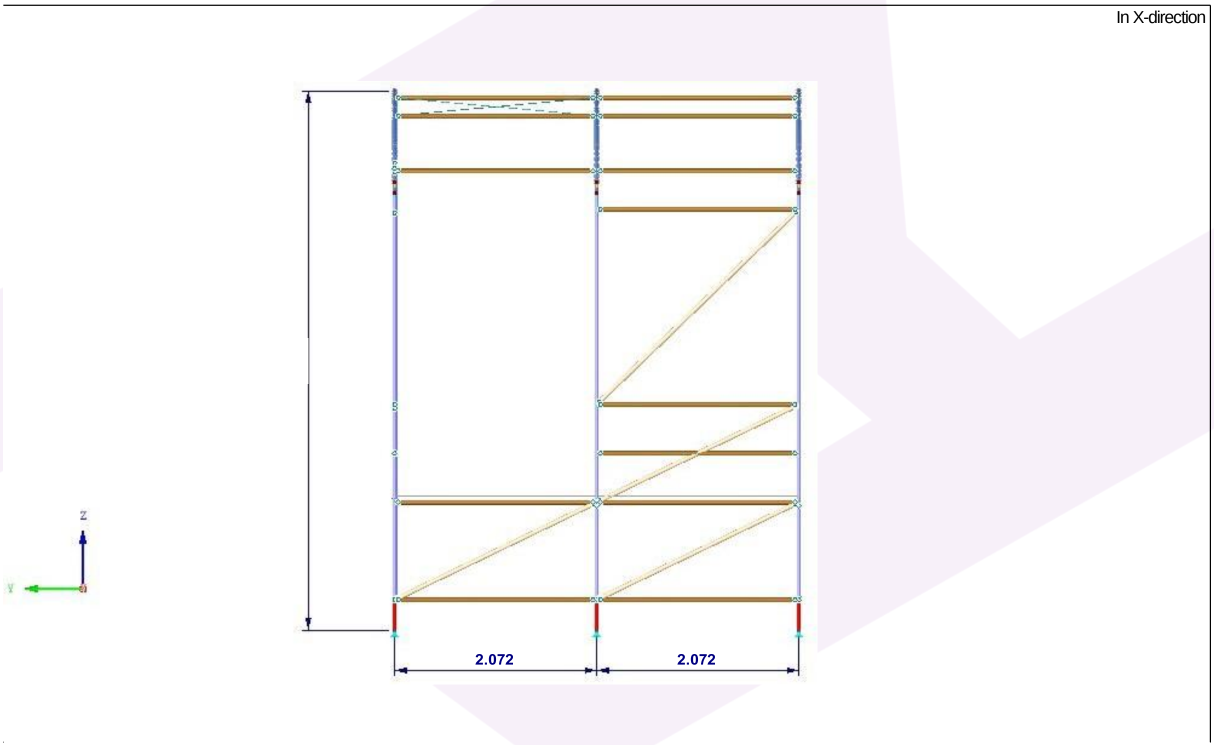
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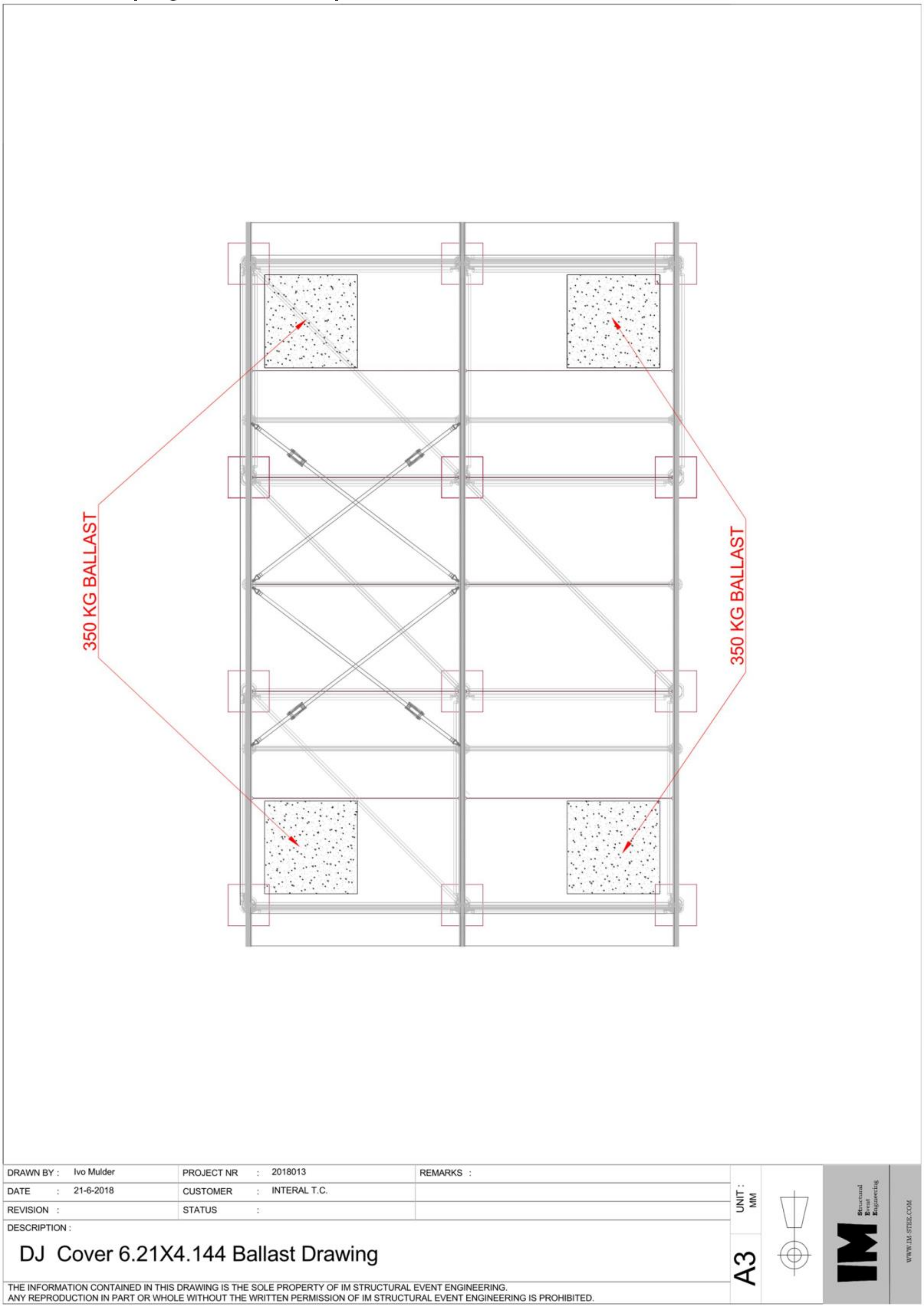
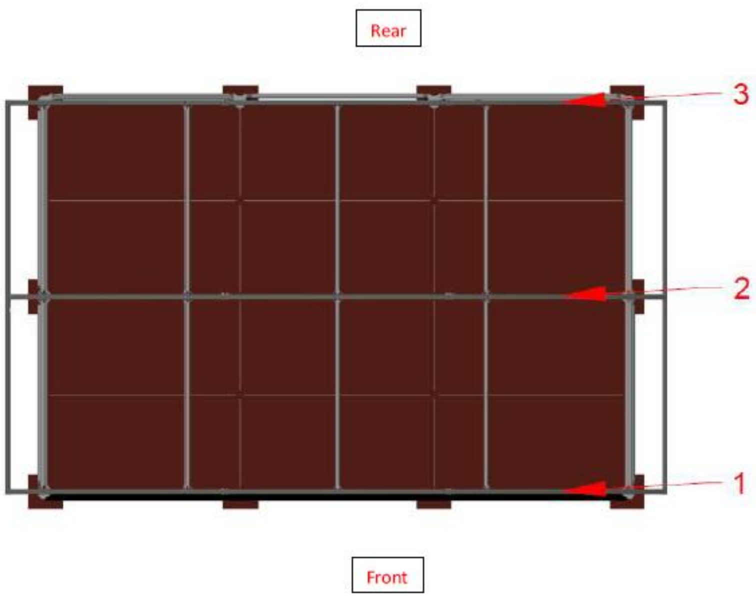
8 Bijlage II: Ballastplan

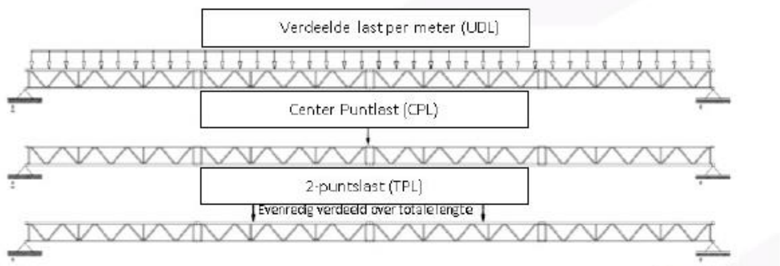


9 Bijlage III: Riggingscapaciteit

Riggingscapaciteit Pan 24/18/16



Naam	Waarde	Maximale Gebruiksbelasting per punt		
		1	2	3
A. Verdeelde last per meter (UDL)	kg/m	35	35	35
B. Center puntlast (CPL)	kg	100	100	100
C. 2-puntslast (TPL)	kg	100	100	100
D. 4-puntslast (FPL)	kg	75	75	75



Figuur 1

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

+31 497 870 136 sales@eekelsverhuur.nl www.eekelsverhuur.nl Eekels Verhuur BV
Hallenstraat 20
5531 AB Bladel

10 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	10.58	5	17.89	0.20kN/m^2
Onbebouwd	12.03	6	17.89	0.20kN/m^2
Bebouwd	17.57	7	17.89	0.20kN/m^2

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

Gebied	10 minuten gemiddelde windsnelheid (m/s)	Beaufort (Bft)	Piekwindsnelheid (m/s)	Stuwdruk (kN/m^2)
Kust	15.65	7	26.46	0.4375kN/m^2
Onbebouwd	17.79	8	26.46	0.4375kN/m^2
Bebouwd	25.99	9	26.46	0.4375kN/m^2

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

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

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

11 Bijlage V: Zeilcertificaat

MEHLER TEXNOLOGIES
A Low&Bonar solution

Technisches Datenblatt Nr.:		1017.14
Produkt:	POLYMAR®	FR COLOR 700
Artikel Nr.:	8509 5240	

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

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

VL/LB:

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

12 Bijlage VI: Berekening

Structural
Event
Engineering

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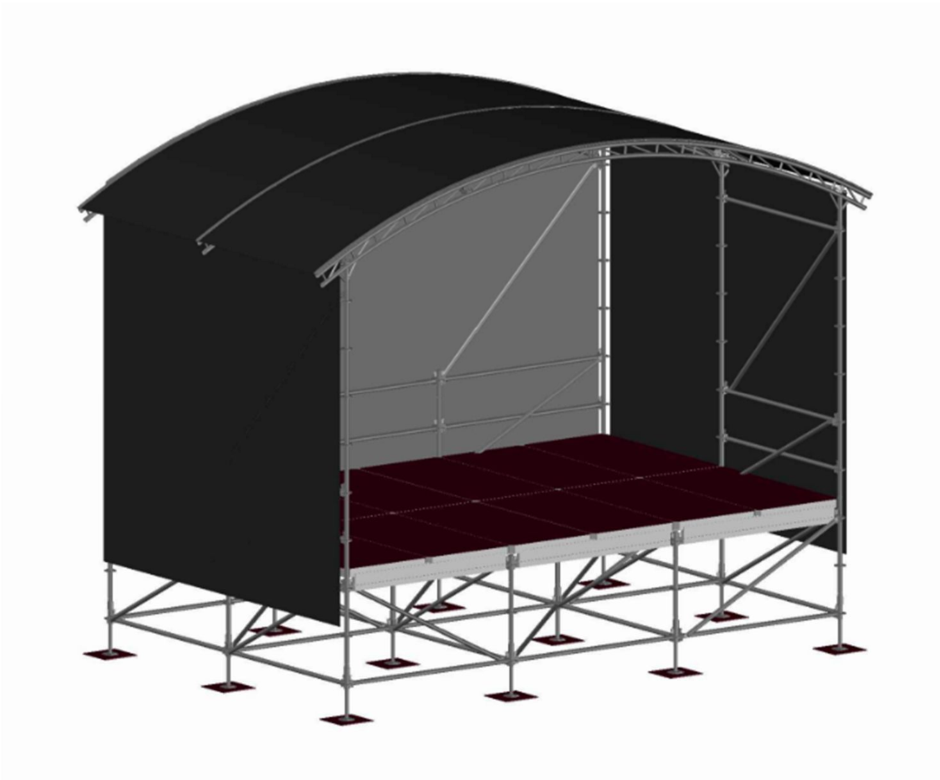

Project number: 2018013

Structural calculation Report

DJ Cover 6,21x4,14

Interal T.C.

Giovanni Eekels Verhuur B.V.
Gruttostraat 9
5212 VM
‘s-Hertogenbosch

Date: 12-4-2019

Ivo Mulder BCs

I.A. Mulder

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imulder@im-stee.com

Index

1 General Preliminary notes.

1.1 Project description.

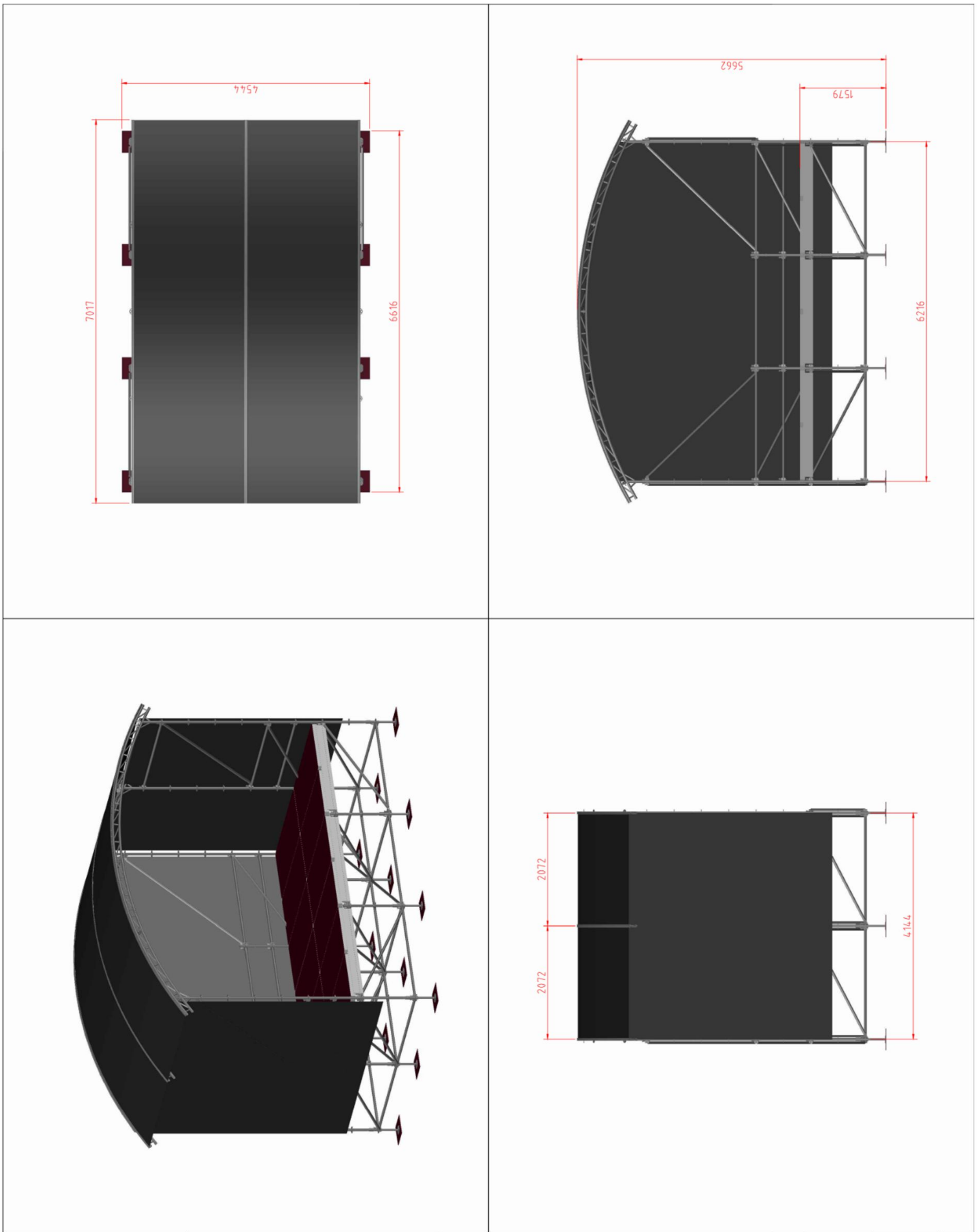
This project concerns the structural calculation of a DJ Cover on top of a Layher scaffolding construction. The size of the DJ Cover is based on non-metric Layher system and has the dimensions of 6.21x4.14 meter.

The roof construction is based on an aluminium ladder truss with a center to center distance of 125mm and main chords of aluminium 48.3x3 tubes.

The DJ cover is constructed on top of a Layher stage which is calculated as a fully integrated system. In this structural calculation a stage with a floor height of approx. 1.5 meter is taken into account, the DJ Cover can also be built with a 1-meter high stage.

All the uprights of the Layher system need to be connected with an M10 Bolt class 8.8 or a Layher spigot.

1.2 Construction drawing



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DATE : 21-6-2018	CUSTOMER : INTERAL T.C.		
REVISION :	STATUS :		A3

DESCRIPTION :

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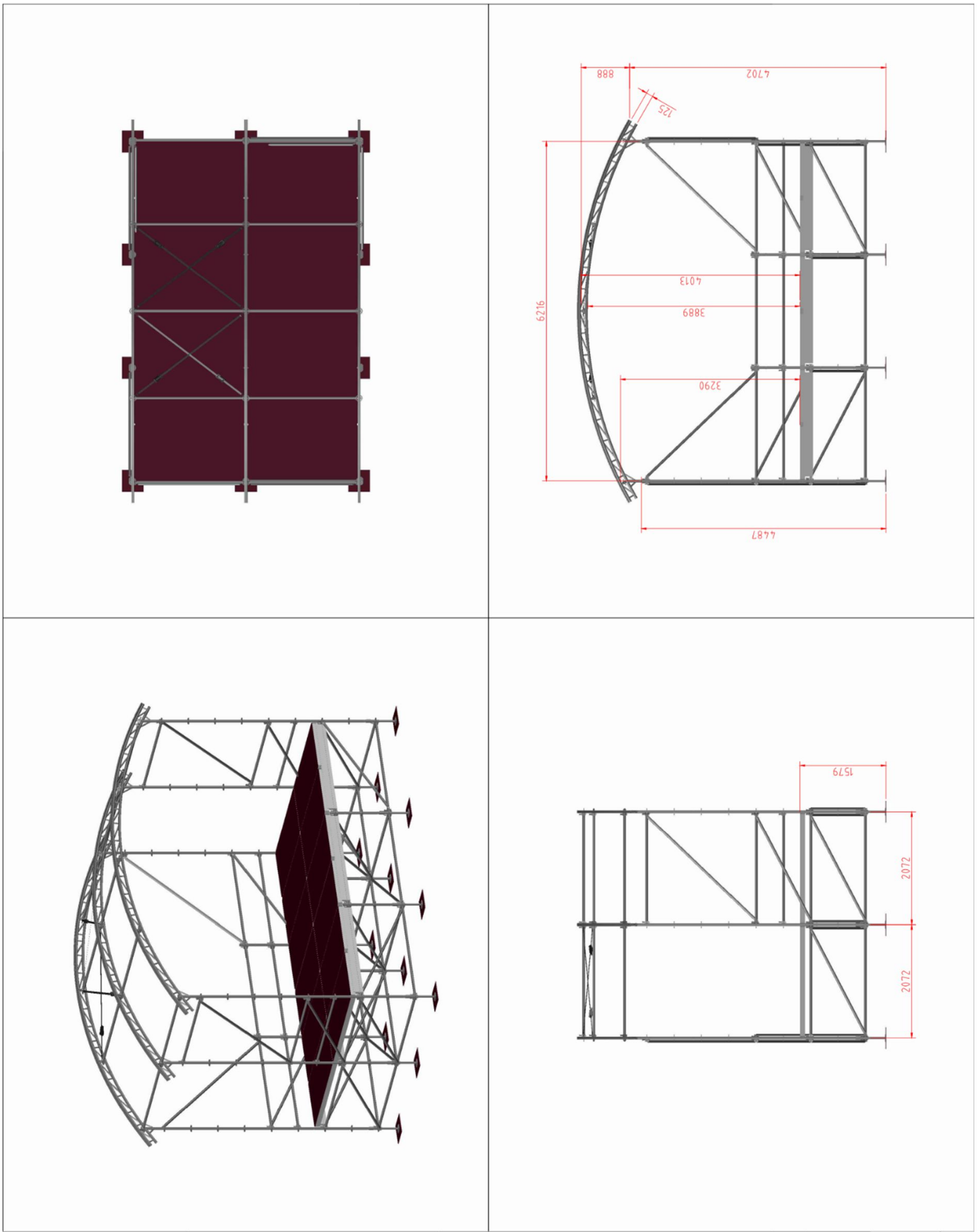

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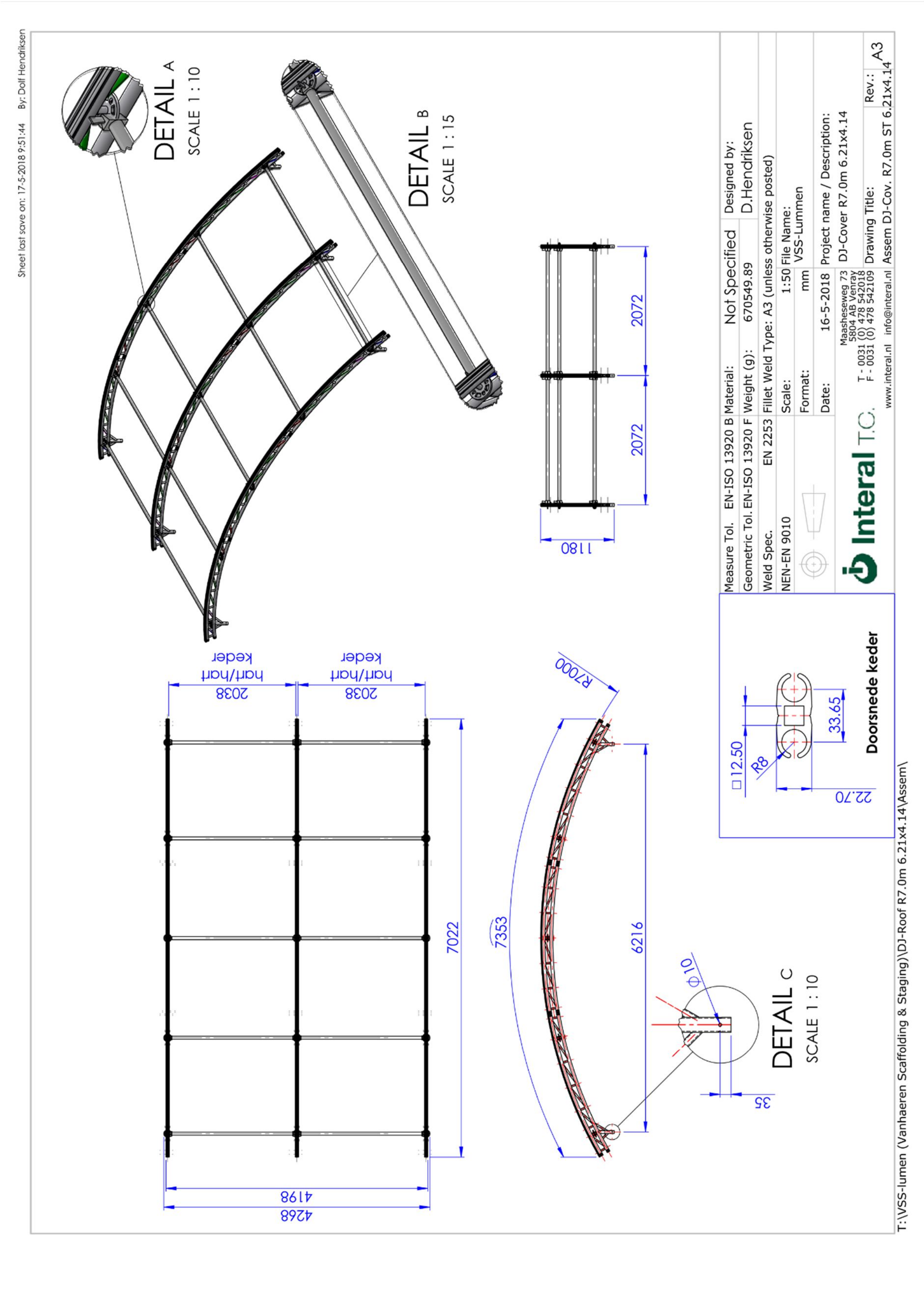
1.2.1 Production overview drawing



1.3 Used normalisation.

This calculation is based on the next parts of the Eurocodes.

NEN-EN 1990	(Eurocode 0) Basis of structural design.
NEN-EN 1991	(Eurocode 1) Action on structures.
NEN-EN 1993	(Eurocode 3) Design of steel structures.
NEN-EN 1999	(Eurocode 9) Design of Aluminium structures.
NEN-EN 13814	Fair ground and amusement park machinery and structures
NEN-EN 13782	Temporary Structures-Tents-Safety.
NEN-EN 12385	Steel wire ropes.

1.4 General load assumption explanation.

The loads which are taken into account in this calculation are based on the information gattered from the different parts of the Eurocodes. Some of the loading information's from the Eurocode are based on permanent building constructions which makes it not feasible to use this information for a temporary demountable construction. In these specific cases there will be an explanation of a well weighted decision why the calculation deviates from the information presented in the Eurocode.

1.5 Used materials.

The roof construction is built from aluminium Ladder truss in combination with Layher scaffolding tubes.

The stage floor and uprights are constructed from the Layher scaffolding system.

1.6 Load assumptions

1.6.1 Wind loading

According to the Eurocode 13814, two wind situation calculations are made of a temporary demountable structure. The first situation has a wind speed from 0 to 20 m/s and is called the in-service situation and the second situation has a wind speed from 20 m/s to 28 m/s and is called the out-service situation. These maximum wind speeds are the maximum wind gust measured at 10 meters high in a free environment. The in-service situation is the situation where the construction can be used for events. In this situation all the side walls are mounted. There is no danger concerning the structural integrity of the temporary demountable structure. Before the wind gust exceeds the maximum in-service wind speed of 20 m/s all the side walls and big scenery objects need to be removed, so the wind can pass underneath the roof. All these actions, and how they are executed need to be written in a method statement. When all the actions are finished the out-service situation is in place. In the out-service situation the only people who can be in the neighbourhood of the stage are professionals who know and understand the risk involved in temporary demountable structures and are well aware of the method statement. When there are wind gusts higher than the 28 m/s the construction side need to be completely cleared from all people.

The values of the extreme thrust are based on area's which have a reference wind speed of $V_{b,o}$, less or equal to 28 m/s with a return period of 5 years according to the NEN-EN 13814. If the construction will be used in an area which requires a higher extreme thrust, the user need to be aware that using the same extreme thrust value the return period will be less than 5 years.

In the NEN-EN 1991 there are 4 different terrain categories determined. In the tables on the next pages the maximum wind gust is presented which the construction can withstand in the in-service and the out-service situations, in conjunction with the height and the terrain category. The figure in the column with the head V_b in m/s is the mean wind velocity measured on 10m height in the concerning terrain category, it is recommended to use a professional weather station near to the place where the construction is build. The column with the head Max. wind gust is the maximum peak wind which is determined from the peak wind velocity by the law of Bernoulli.

Because the maximum height of the construction with a stage of 1.5-meter floor level is below 8 meter, only the table from 0 < 8 m is presented on the next page.

1.6.2 In-service situation.

The 20 m/s which is mentioned as the maximum wind gust for the in-service situation is based on an average between the wind gust of 17.89 m/s for 0 < 8 m and the wind gust 21.91 m/s for 8 < 20 m.

0 < 8 meter 0.20 kN/m²

Terrain category	V_b in m/s (1)	Max. wind gust (2)
Sea or coastal area exposed to open sea	10.58	17.89
Lakes or flat and horizontal area with negligible vegetation and without obstacles	11.02	17.89
Area with low vegetation such as grass and isolated obstacles (trees, buildings) with separations of at least 20 obstacle heights	12.03	17.89
Area with regular cover of vegetation or buildings with isolated obstacles with separations of maximum 20 obstacles heights (such as villages, suburban terrain permanent forest)	14.29	17.89
Area in which at least 15% of the surface is covered with buildings and their average heights exceeds 15 m.	17.57	17.89

1.6.3 Out-service situation.

The 28m m/s which is mentioned as the maximum wind gust for the out-service situation is based on an average between the wind gust 26.46 m/s for 0 < 8 m and the wind gust 31.62 m/s for 8 < 20 m.

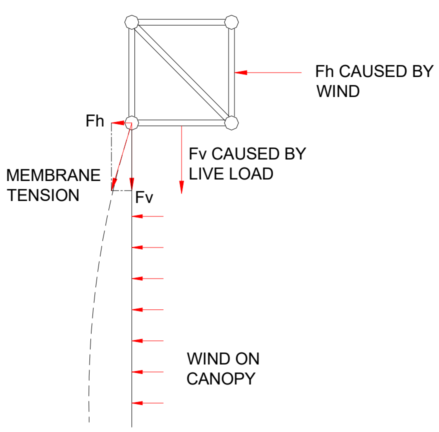
The wind pressure which is mentioned in the table below is increased with 20 % in comparison to the Eurocode 13814. This because the factor C_{tem}, which is 0.80 is taken out of the wind pressure values. Intentionally the factor C_{tem} is applied due to the fact that protection, reinforcement and sheltering is possible. In the case of these kind of structure’s this is not possible to do.

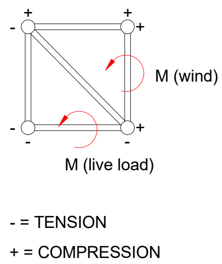
0 < 8 meter 0,4375 kN/m²

Terrain category	V_b in m/s (1)	Max. wind gust (2)
Sea or coastal area exposed to open sea	15.65	26.46
Lakes or flat and horizontal area with negligible vegetation and without obstacles	16.3	26.46
Area with low vegetation such as grass and isolated obstacles (trees, buildings) with separations of at least 20 obstacle heights	17.79	26.46
Area with regular cover of vegetation or buildings with isolated obstacles with separations of maximum 20 obstacles heights (such as villages, suburban terrain permanent forest)	21.14	26.46
Area in which at least 15% of the surface is covered with buildings and their average heights exceeds 15 m.	25.99	26.46

1.6.4 Membrane tension of the canopy due to wind influences.

If there is a wind pressure applied to a membrane this membrane will have reaction forces in two directions on the connection to the construction. This phenomenon is called membrane tension. And in some cases this extra loading need to be applied.





With a dynamic loading q=0.50 kN/m^2 applying an aerodynamic coefficient C_f =0.40 and a span of l=5.00 m a resulting membrane tension of Z=0.80 kN/m is derived.

$Z=(Zy^2+Zz^2)^{1/2}$ =0.80 kN/m with

Zz =0.5*0.4*5.0/2=0.50 kN/m
$Zy=(Z^2-Zz^2)^{1/2}=(0.80^2-0.50^2)^{1/2}=0.624$
$Zy/Zz=0.624/0.50=1.25 = 1 / 0.8$

1.6.5 Snow Loads.

Snow loads are not taken into account in this calculation. Erection of the construction is initially intended to be in appropriate weather conditions. If the construction should be built in winter season, the construction need to be reinforced or kept free from snow, the method how the structure will be kept free from snow need to be written in the method statement.

1.6.6 Live load.

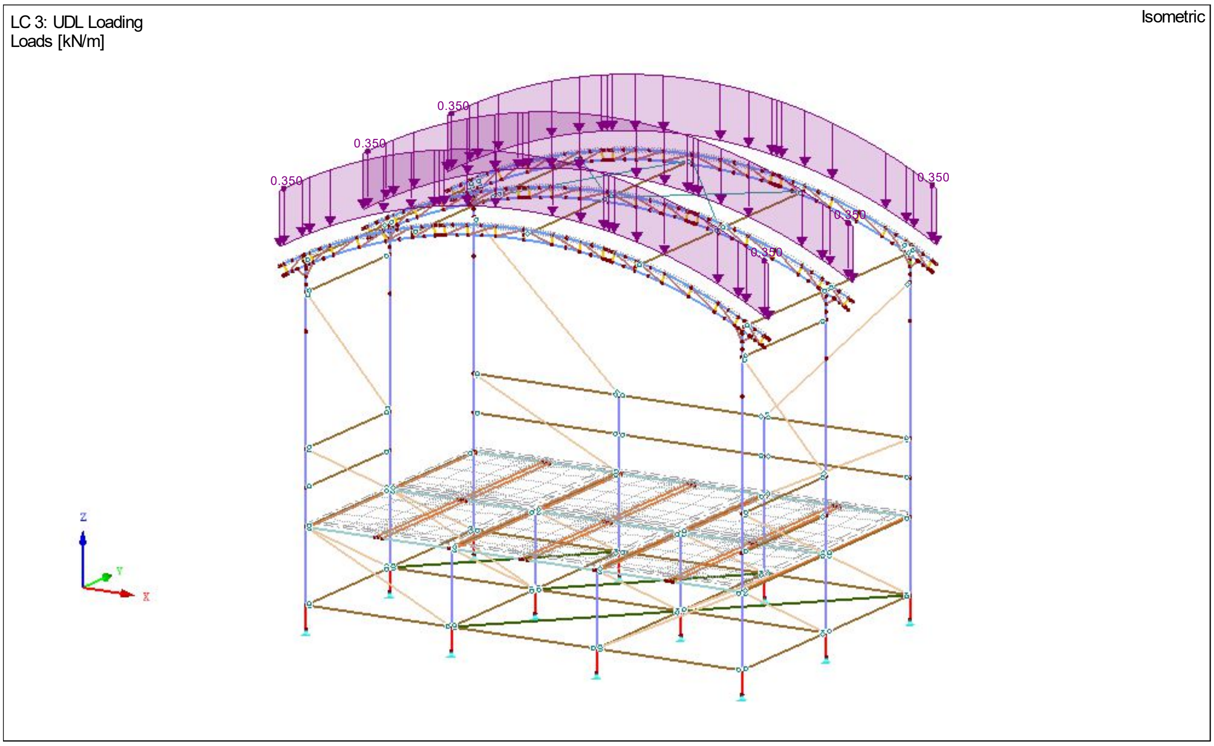
In this structural report there are Live load scenario’s presented. These are intended to give an indication of the Rigging possibilities in the construction. If the actual loading of the construction deviates from these Rigging plots an additional calculation need to be made. The shifting of Rigging point can influence the maximum loading of the construction.

Each Rigging point need to be attached to the node point of the truss.

1.7 Loading Configurations.

In the next 4 chapters the different live load setups are given.

1.7.1 UDL Loading setup



The loading which is taken into account in the UDL Loading setup are:

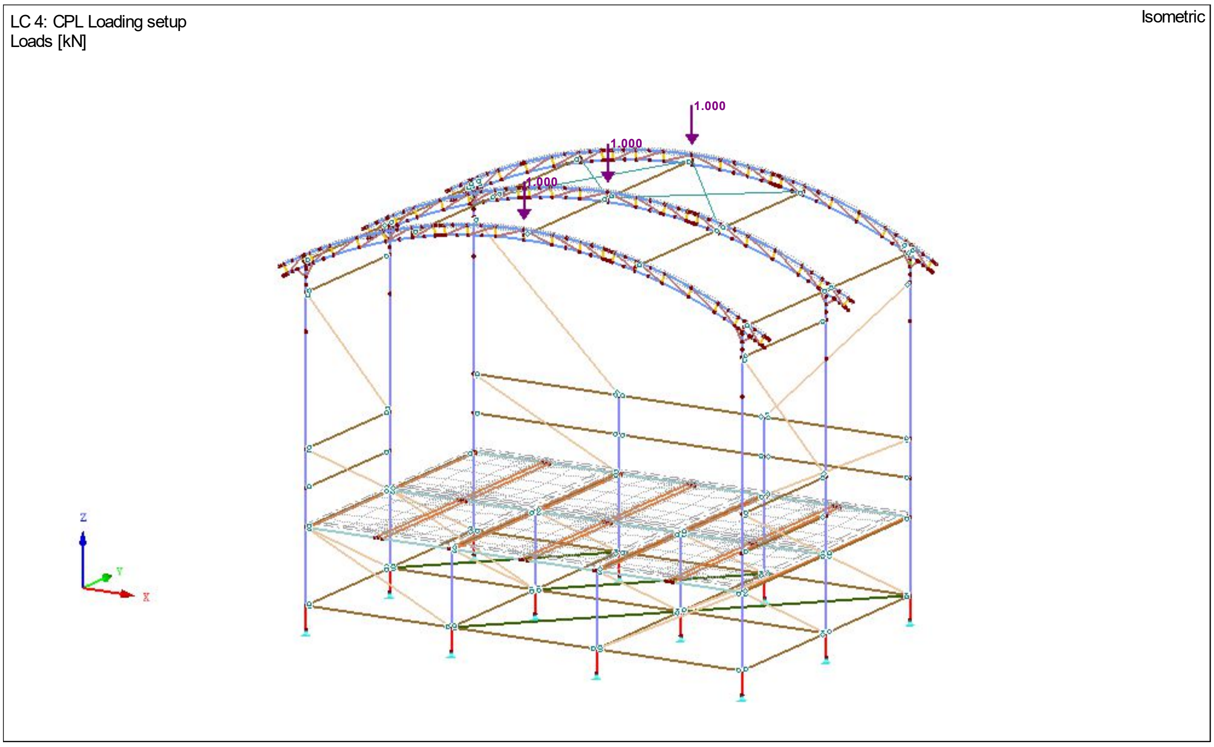
Span 1 = 35 kg/m^{-1}

Span 2 = 35 kg/m^{-1}

Span 3 = 35 kg/m^{-1}

The total UDL loading on the system is ~ 750 Kg

1.7.2 Center point load setup.



The loading which is taken into account in the Centre point Load setup are:

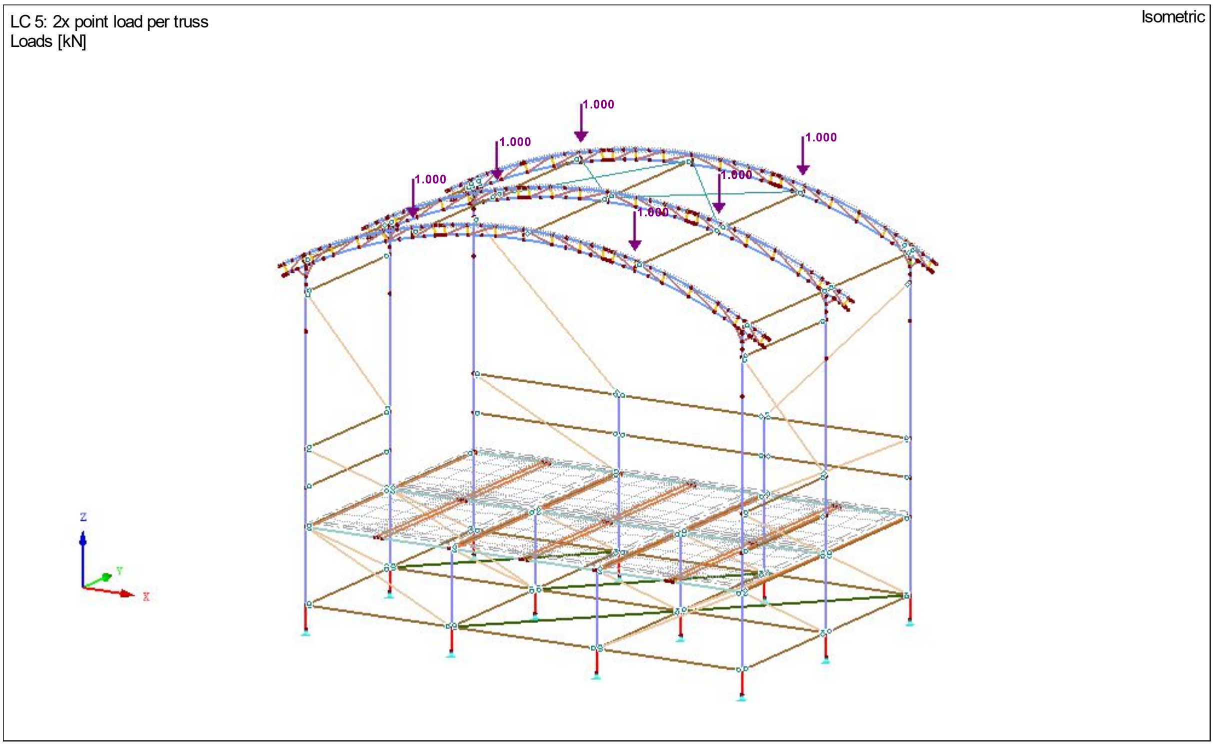
Span 1 = 100 kg

Span 2 = 100 kg

Span 3 = 100 kg

The total load on the system is = 300 Kg

1.7.3 2x Point load per truss.



The loading which is taken into account in the third point Loading setup are:

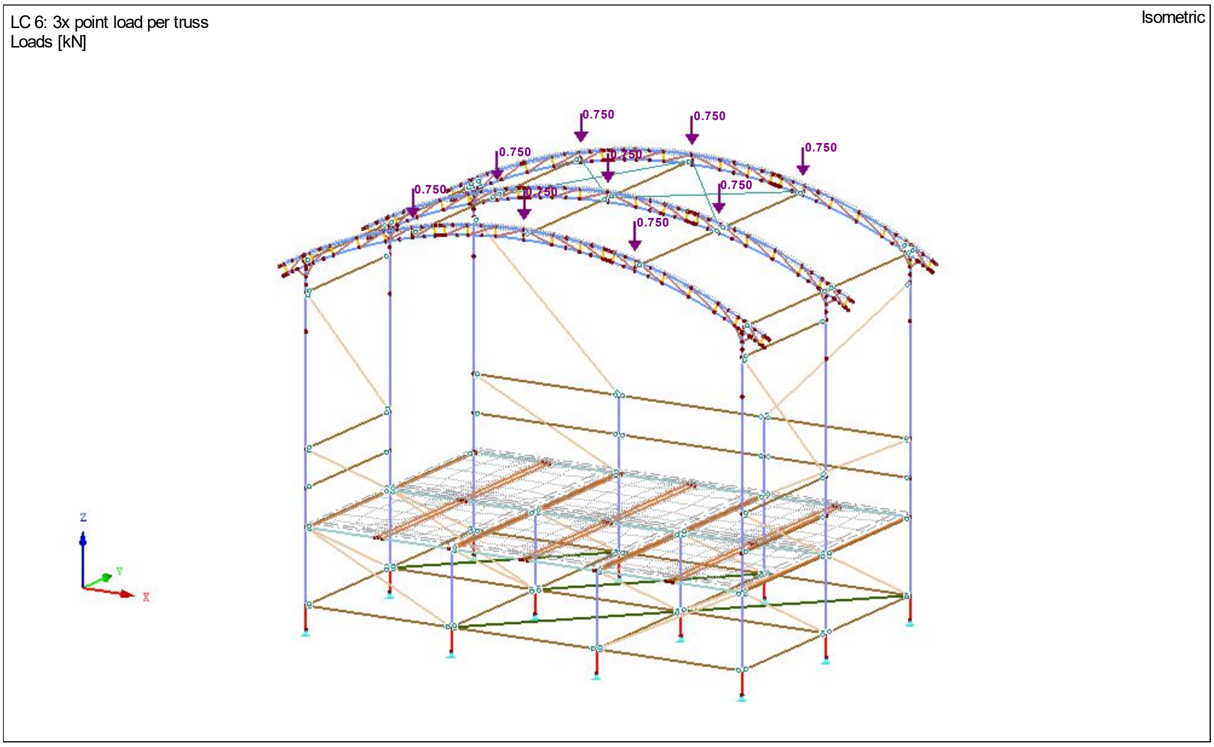
Span 1 = 2 x 100 kg

Span 2 = 2 x 100 kg

Span 3 = 2 x 100 kg

The total load on the system is = 600 Kg

1.7.4 3x Point load per truss.



The loading which is taken into account in the fourth point Loading setup are:

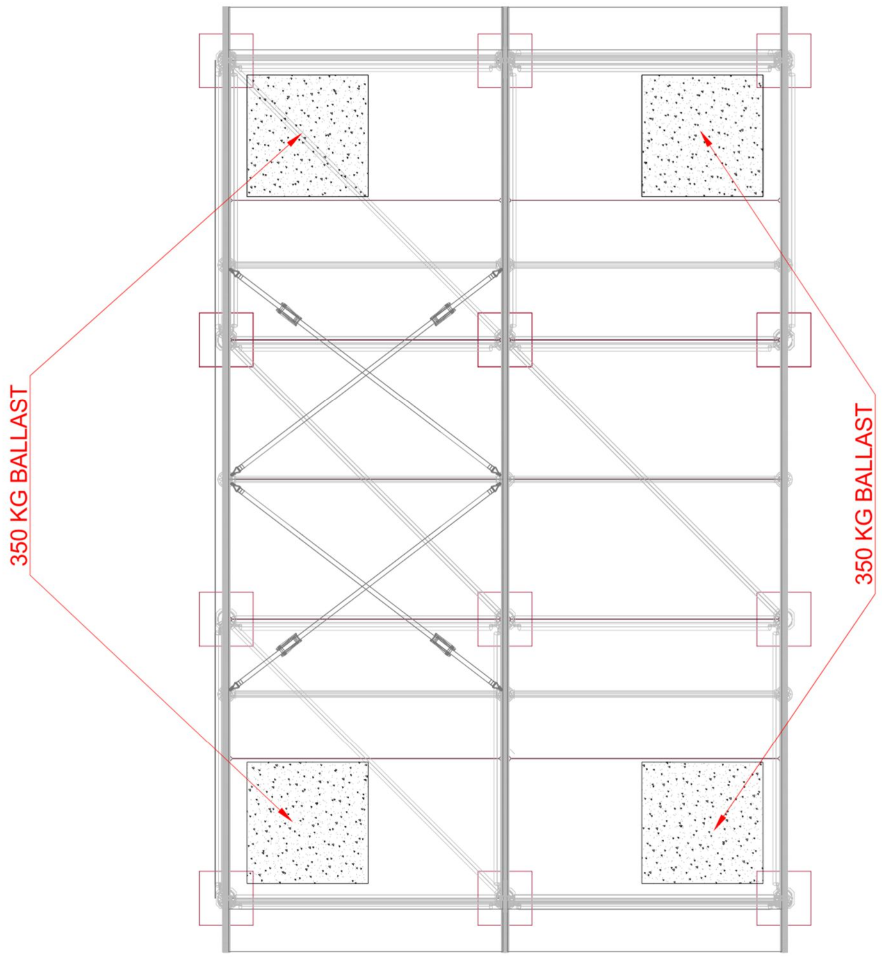
Span 1 = 3 x 75 kg

Span 2 = 3 x 75 kg

Span 3 = 3 x 75 kg

The total load on the system is = 675 Kg

1.8 Necessary Ballast loading.



DRAWN BY :	Ivo Mulder	PROJECT NR :	2018013	REMARKS :	
DATE :	21-6-2018	CUSTOMER :	INTERAL T.C.		
REVISION :		STATUS :			

DESCRIPTION :

DJ Cover 6.21X4.144 Ballast Drawing

UNIT : MM

A3

Structural Event Engineering

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The ballast will be checked for uplift, overturning and sliding. The Layher stage which is designed as a ridged stage will be taken into account.

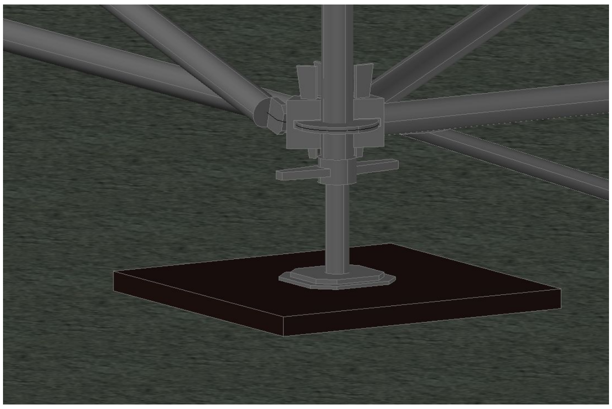
All permanent installed loading can be subtracted from the nearest Ballast position

The safety factor for the ballast calculation against slipping is set to 1.2 according to the NEN-EN 13814. This is based on a horizontal load which is relying on friction.
For the friction coefficient the factor of 0.4 has been taken into account.

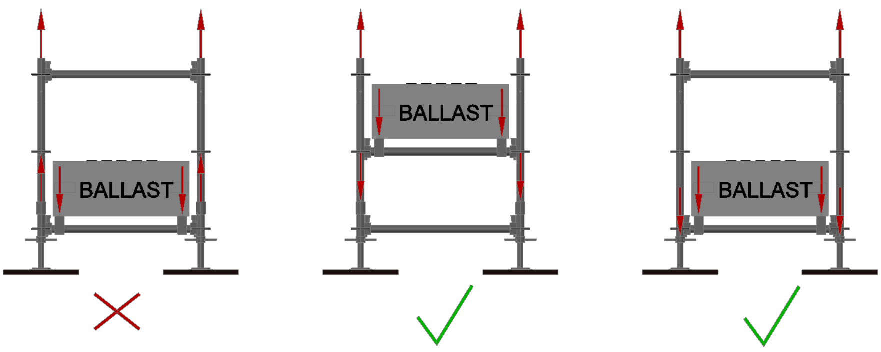
Table 3 — Coefficients of friction μ

	Wood	Steel	Concrete
Wood	0,4	0,4	0,6
Steel	0,4	0,1	0,2
Concrete	0,6	0,2	0,5
Clay[a]	0,25	0,2	0,25
Loam[a]	0,4	0,2	0,4
Sand and gravel	0,65	0,2	0,65

[a] At least of stiff consistency in accordance with ENV 1997-1.



The ballast need to be placed in such a way that it will be activated when lifting forces are applied. If the ballast is placed on the bottom level the use of Layher uprights with connected base collar is necessary.

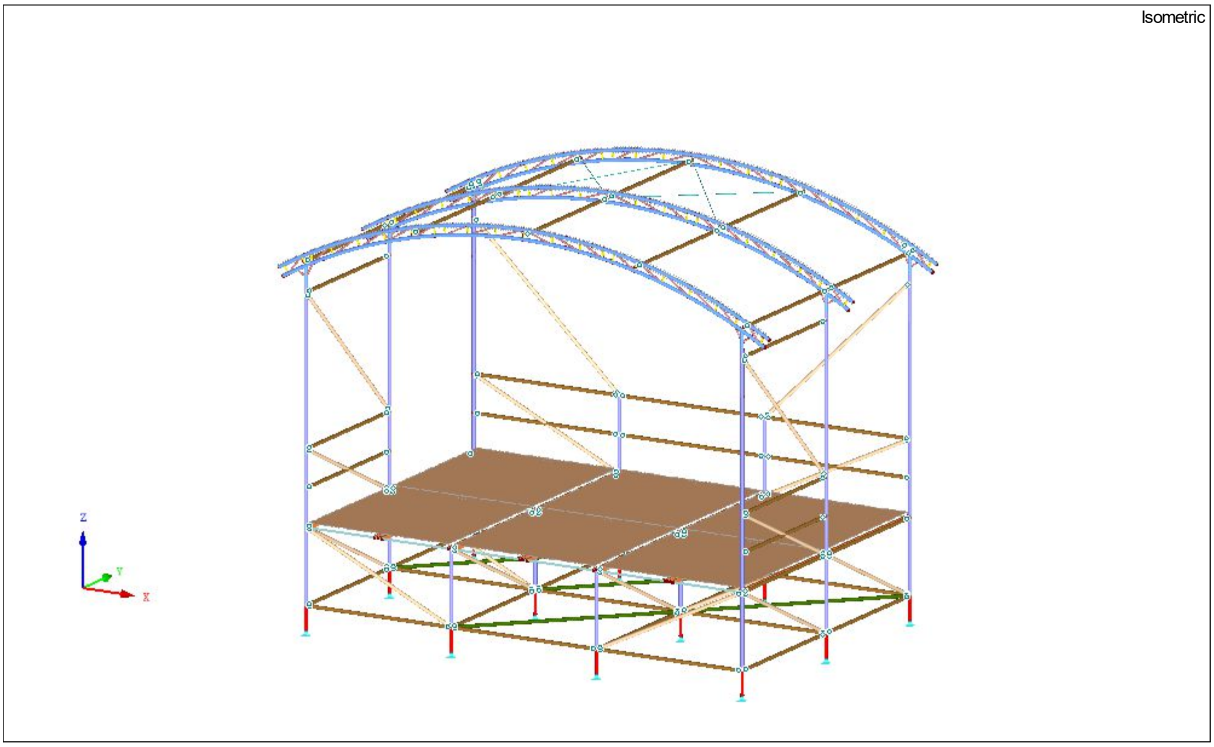


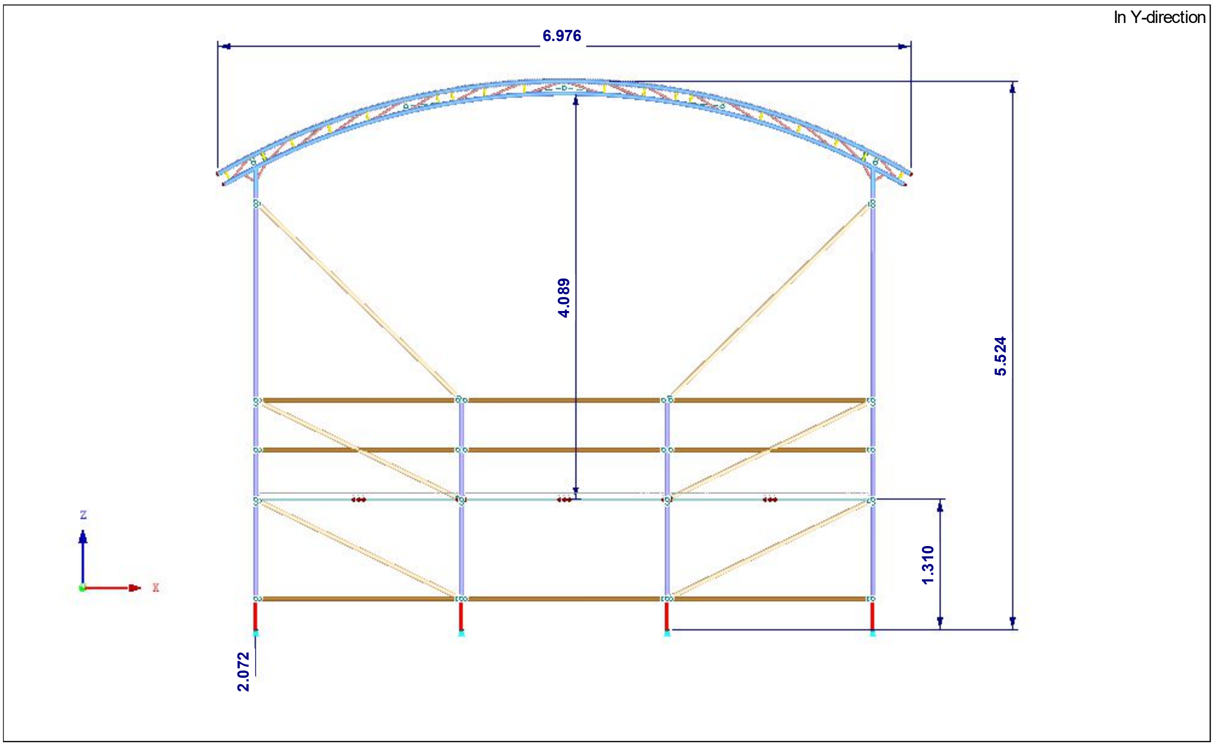
2.0 General calculation input.

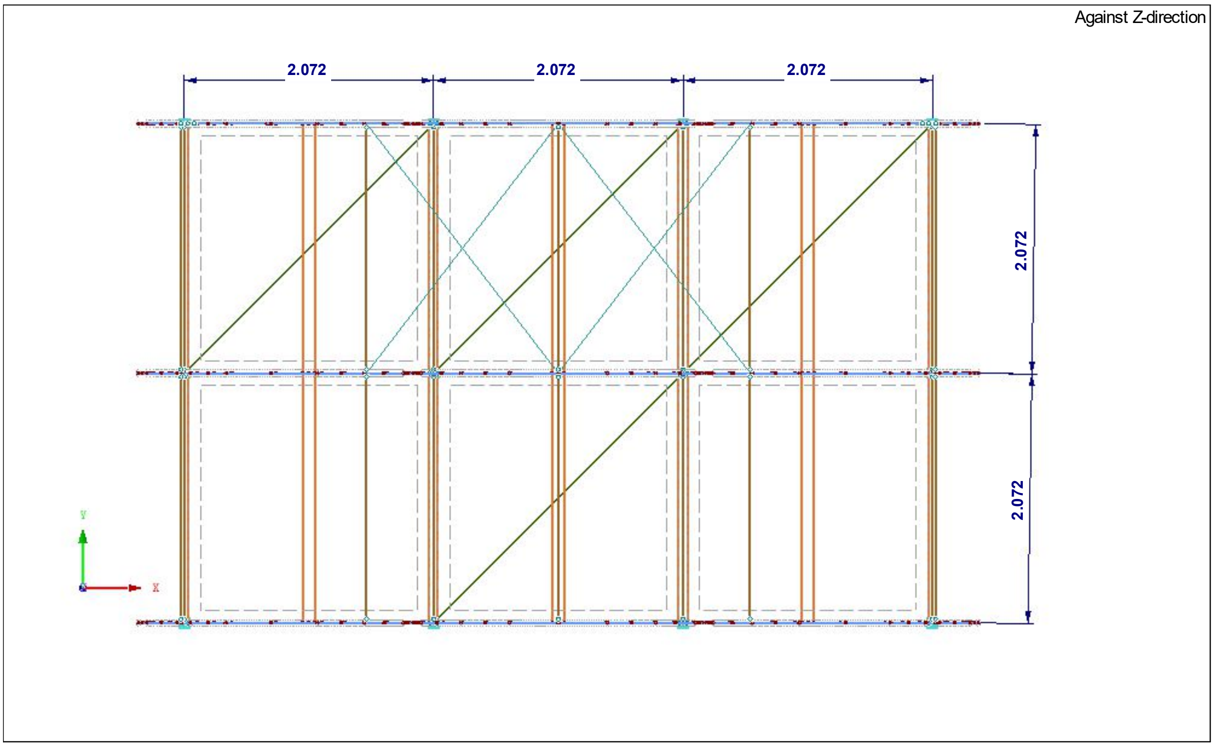
2.1 Information About the calculation program.

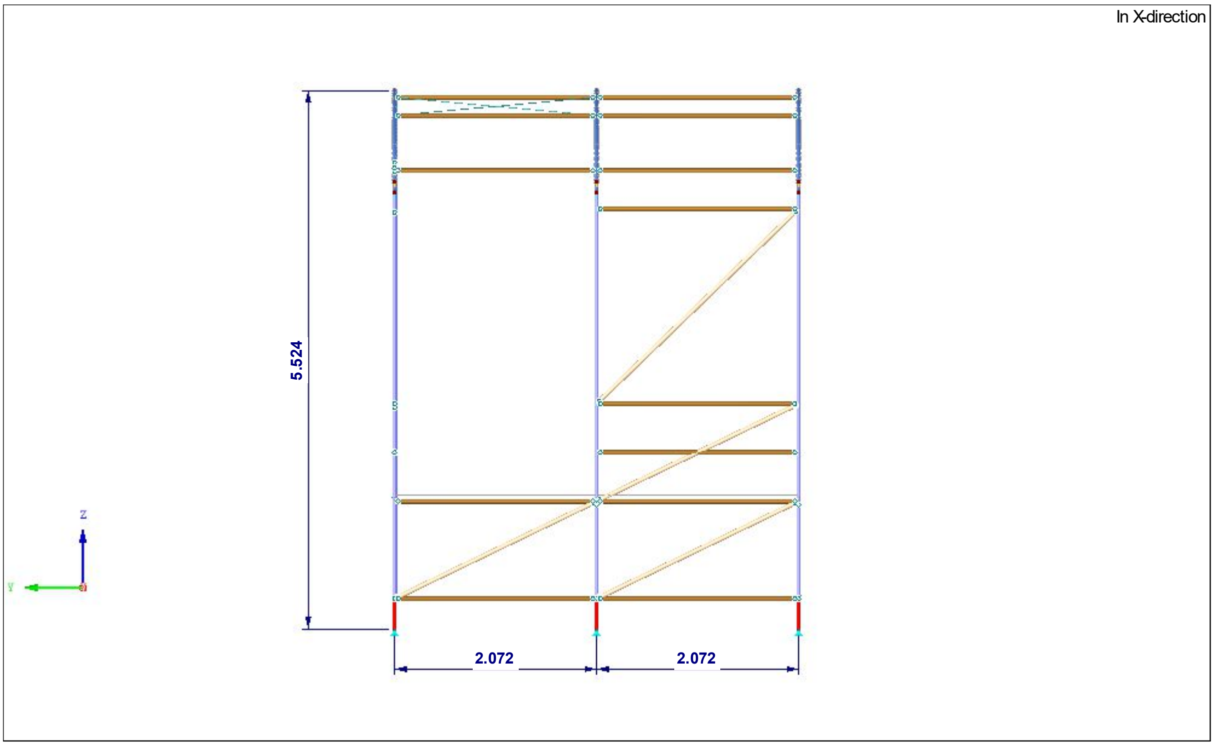
For the calculation of the construction the program RFem from Dlubal software GmbH has been used. The calculation of the Load cases has been made according to the Geometrically Linear analyses principle. The calculation of the Load combinations has been made according to the second order analysis (nonlinear) principle.

2.2 Construction model of the DJ cover.






Against Z-direction
2.072
2.072
2.072
2.072
2.072
Y
X


In X-direction
5.524
Z
Y
2.072
2.072

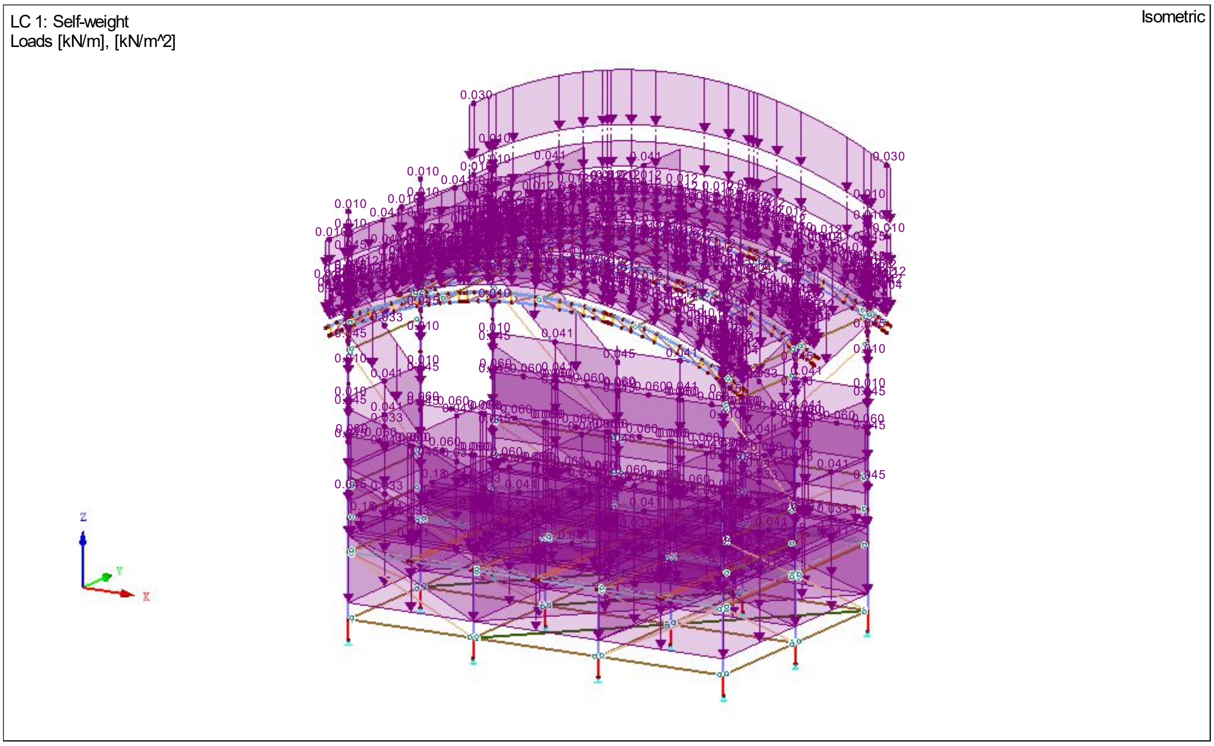
2.3 Different load cases.

For the calculation different load cases have been constructed in the program.

Load	Load Case	To	EN 1990 | CEN	Self-Weight - Factor in Direction			
Case	Description	Solve	Action Category	Active	X	Y	Z
LC1	Self-weight	+	Permanent	+	0,000	0,000	-1,000
LC2	Ballast Loading	+	Permanent/Imposed	-	0,000	0,000	0,000
LC3	UDL Loading	+	Permanent/Imposed	-	0,000	0,000	0,000
LC4	Centre point load	+	Permanent/Imposed	-	0,000	0,000	-1,000
LC5	Point loads in the third point	+	Permanent/Imposed	-	0,000	0,000	-1,000
LC6	Point loads in the fourth point	+	Permanent/Imposed	-	0,000	0,000	-1,000
LC7	Floor loading 0°	+	Permanent/Imposed	-	0,000	0,000	-1,000
LC8	Floor loading 90°	+	Permanent/Imposed	-	0,000	0,000	-1,000
LC9	Floor loading 180°	+	Permanent/Imposed	-	0,000	0,000	-1,000
LC10	In-service wind 0°	+	Wind	-	0,000	0,000	0,000
LC11	In-service wind 90°	+	Wind	-	0,000	0,000	0,000
LC12	In-service wind 180°	+	Wind	-	0,000	0,000	0,000
LC20	Out-service wind 0°	+	Wind	-	0,000	0,000	0,000
LC21	Out-service wind 90°	+	Wind	-	0,000	0,000	0,000
LC22	Out-service wind 180°	+	Wind	-	0,000	0,000	0,000

2.4 load case input

2.4.1 LC1 Self-Weight



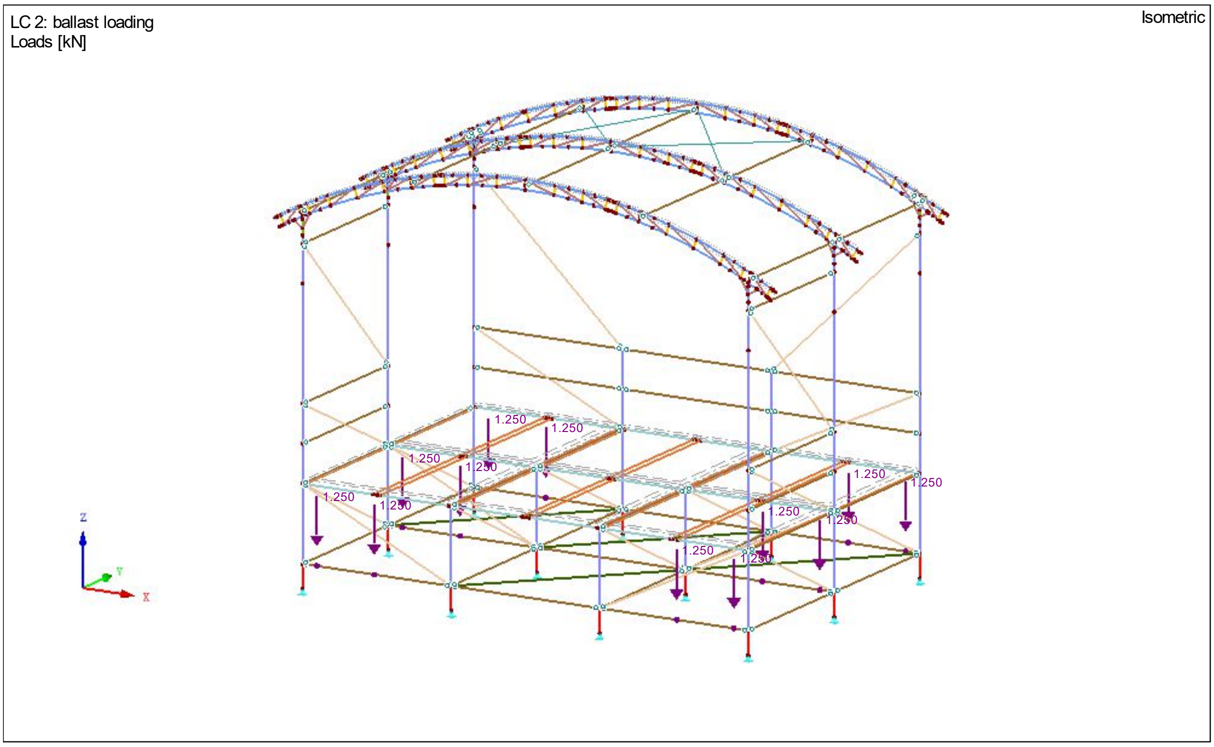
Layher pole = 0.045 kN/m^{-1}
Layher Ledger = 0.041 kN/m^{-1}
Layher Diagonal = 0.033 kN/m^{-1}
Layher event Ledger = 0.06 kN/m^{-1}

Truss Main tube 48x3 =0.012 kN/m^{-1}
Truss diagonal tube 25x3 =0.004 kN/m^{-1}

Layher event deck 18 kg/m²

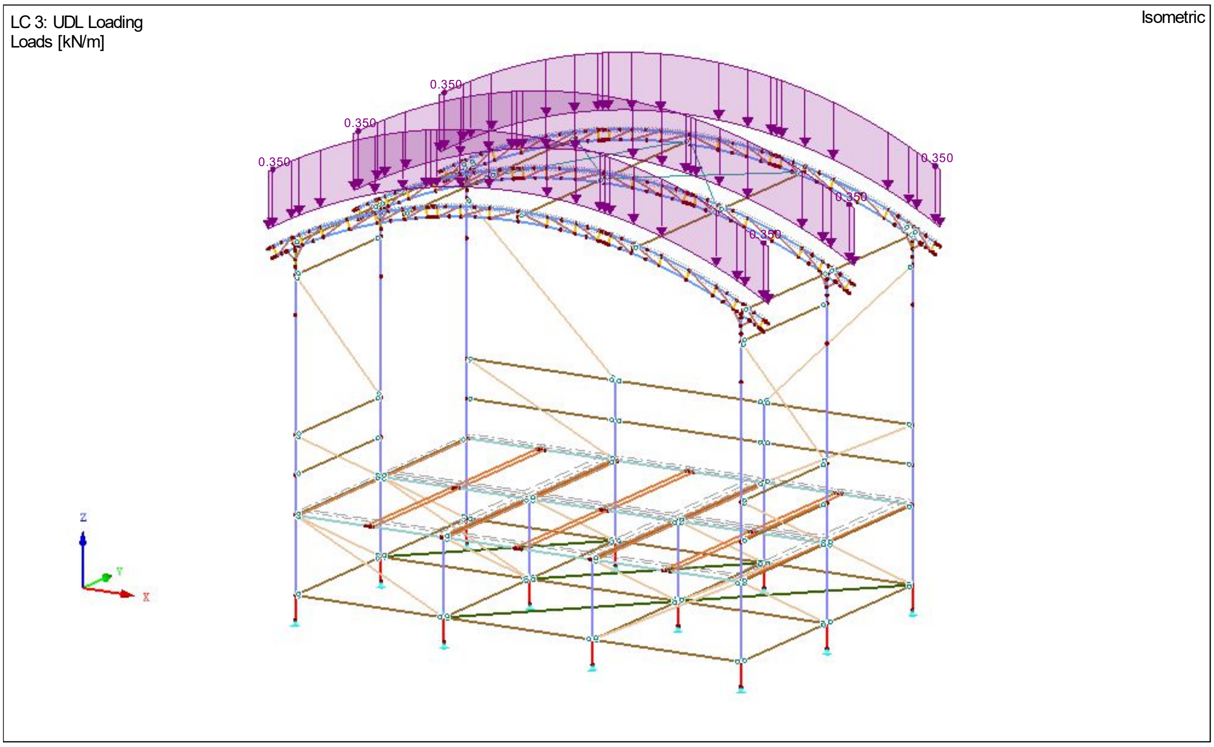
Canopy including all extra = 0.01 kN/m²

2.4.2 LC2 Ballast Loading



Each corner of the system need 350 kg of ballast The reaction forces are divided along the bottom Ledgers in the base grid of the Layher.

2.4.3 LC3 UDL Loading setup



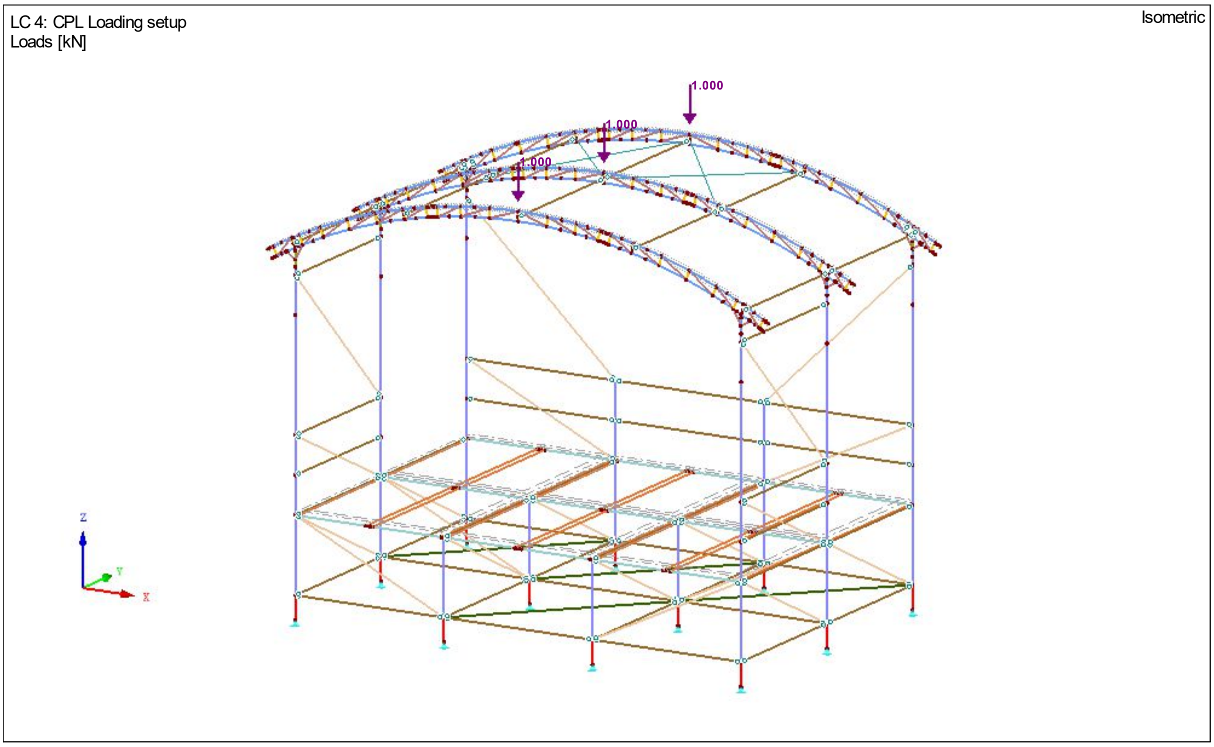
The loading which is taken into account in LC3 are:

Span 1 = 0.35 kN/m^{-1}

Span 2 = 0.35 kN/m^{-1}

Span 3 = 0.35 kN/m^{-1}

2.4.4 LC4 Center point load setup.



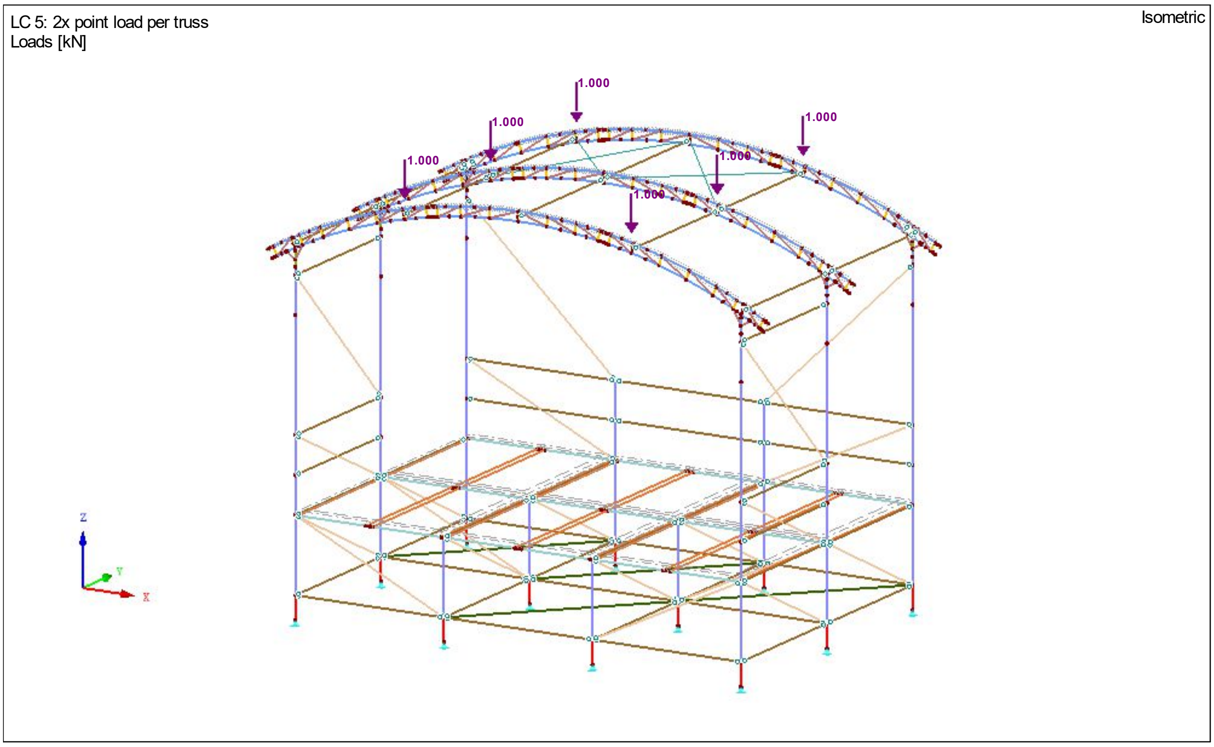
The loading which is taken into account in LC4 are:

Span 1 = 1.00 kN

Span 2 = 1.00 kN

Span 3 = 1.00 kN

2.4.5 LC5 2x Point load per truss.



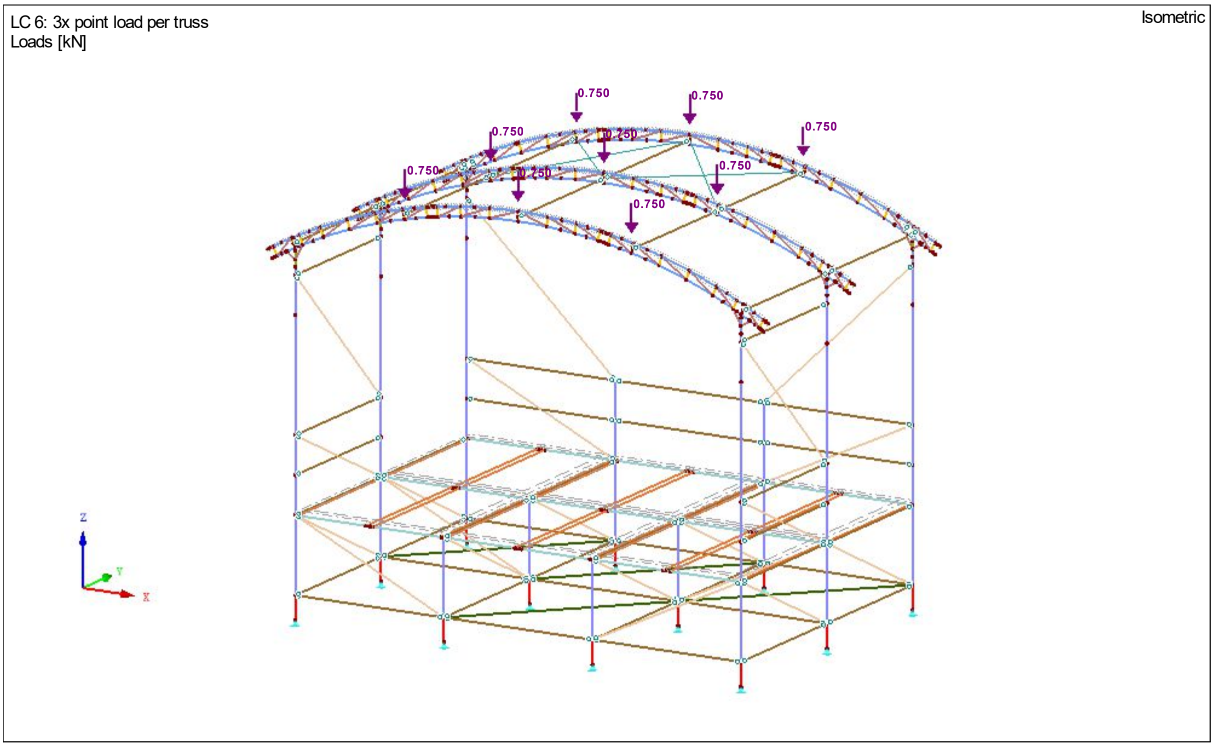
The loading which is taken into account in LC5 are:

Span 1 = 2 x 1.00 kN

Span 2 = 2 x 1.00 kN

Span 3 = 2 x 1.00 kN

2.4.6 LC6 3x Point load per truss.



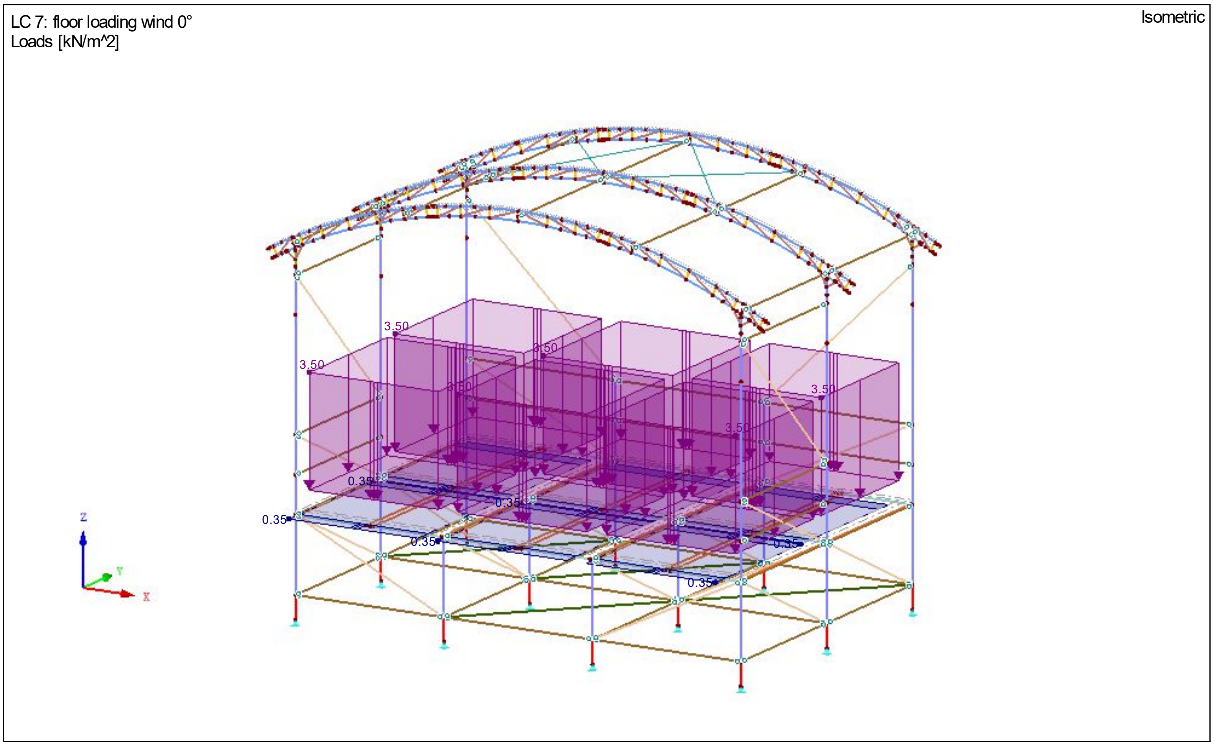
The loading which is taken into account in LC6 are:

Span 1 = 3 x 0.75 kN

Span 2 = 3 x 0.75 kN

Span 3 = 3 x 0.75 kN

2.4.7 LC7 Floor loading 0°.

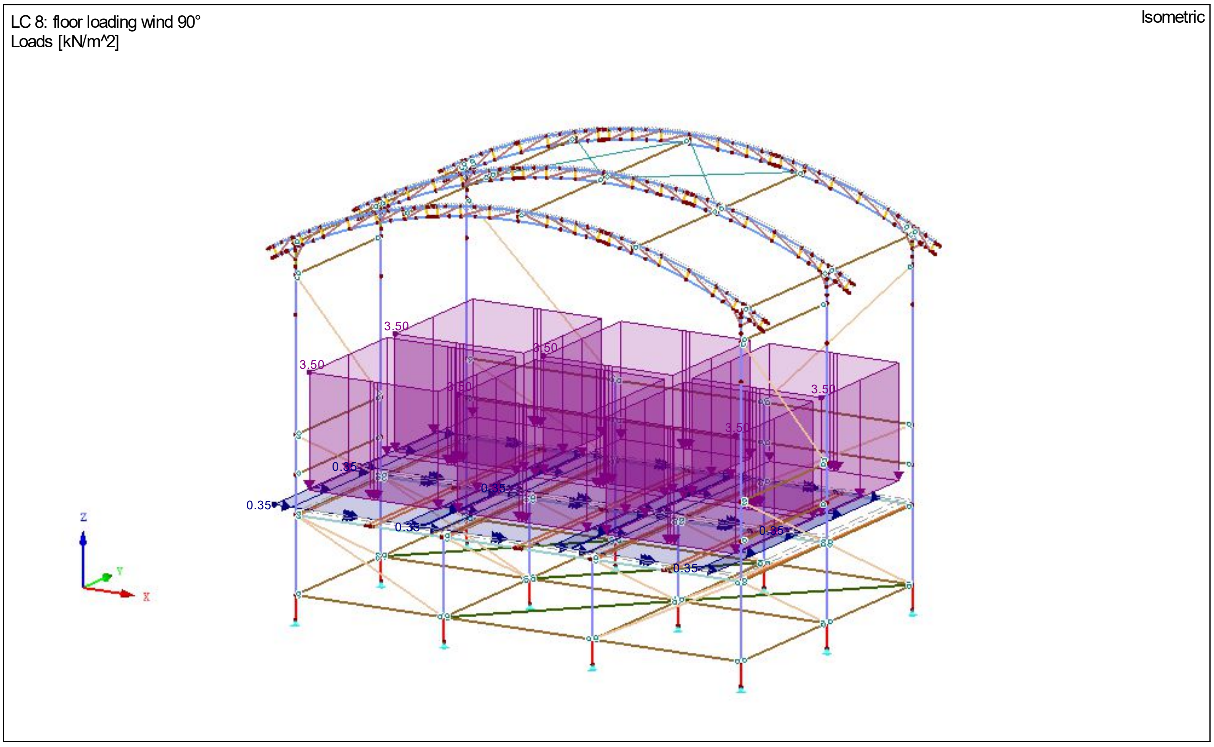


The loading which is taken into account in the floor loading 0° setup are:

Floor loading 350 kg/m²

According to the EN-AW-13814 an extra horizontal force of 10% of the vertical force, which is 35 kg/m^2, has been taken into account.

2.4.8 LC8 Floor loading 90°.

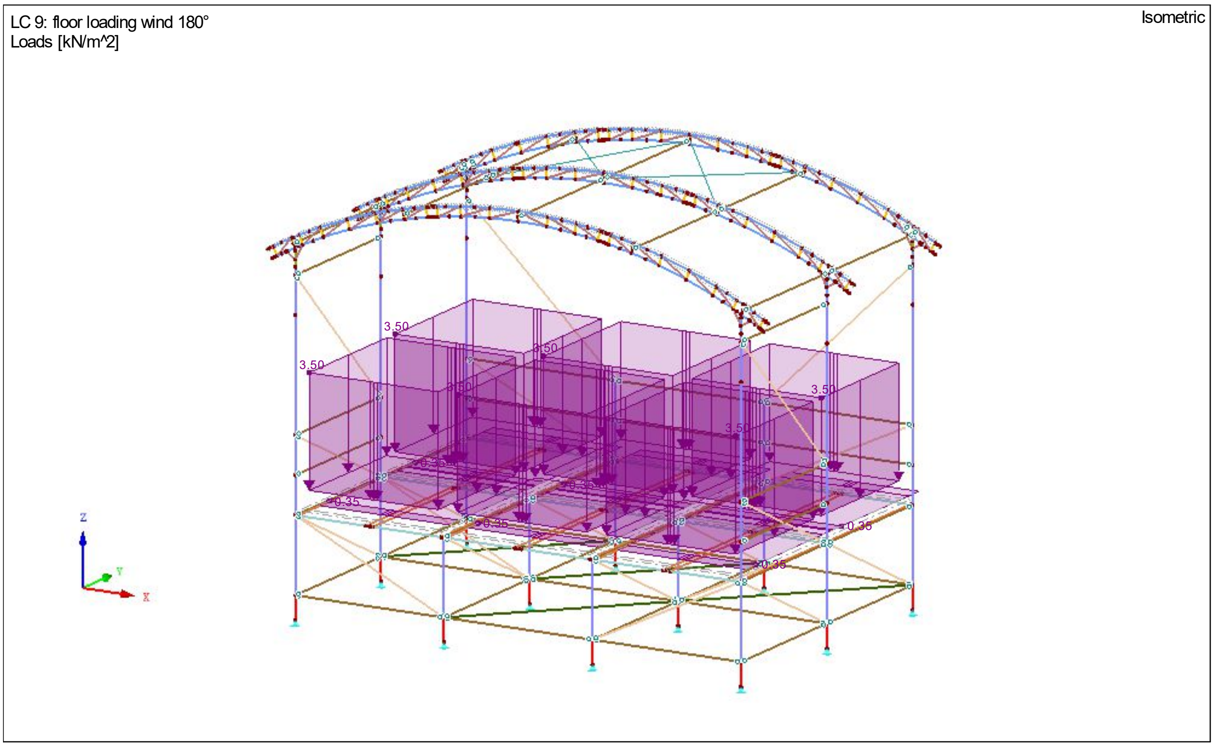


The loading which is taken into account in the floor loading 90° setup are:

Floor loading 350 kg/m²

According to the EN-AW-13814 an extra horizontal force of 10% of the vertical force, which is 35 kg/m^2, has been taken into account.

2.4.9 LC9 Floor loading 180°.



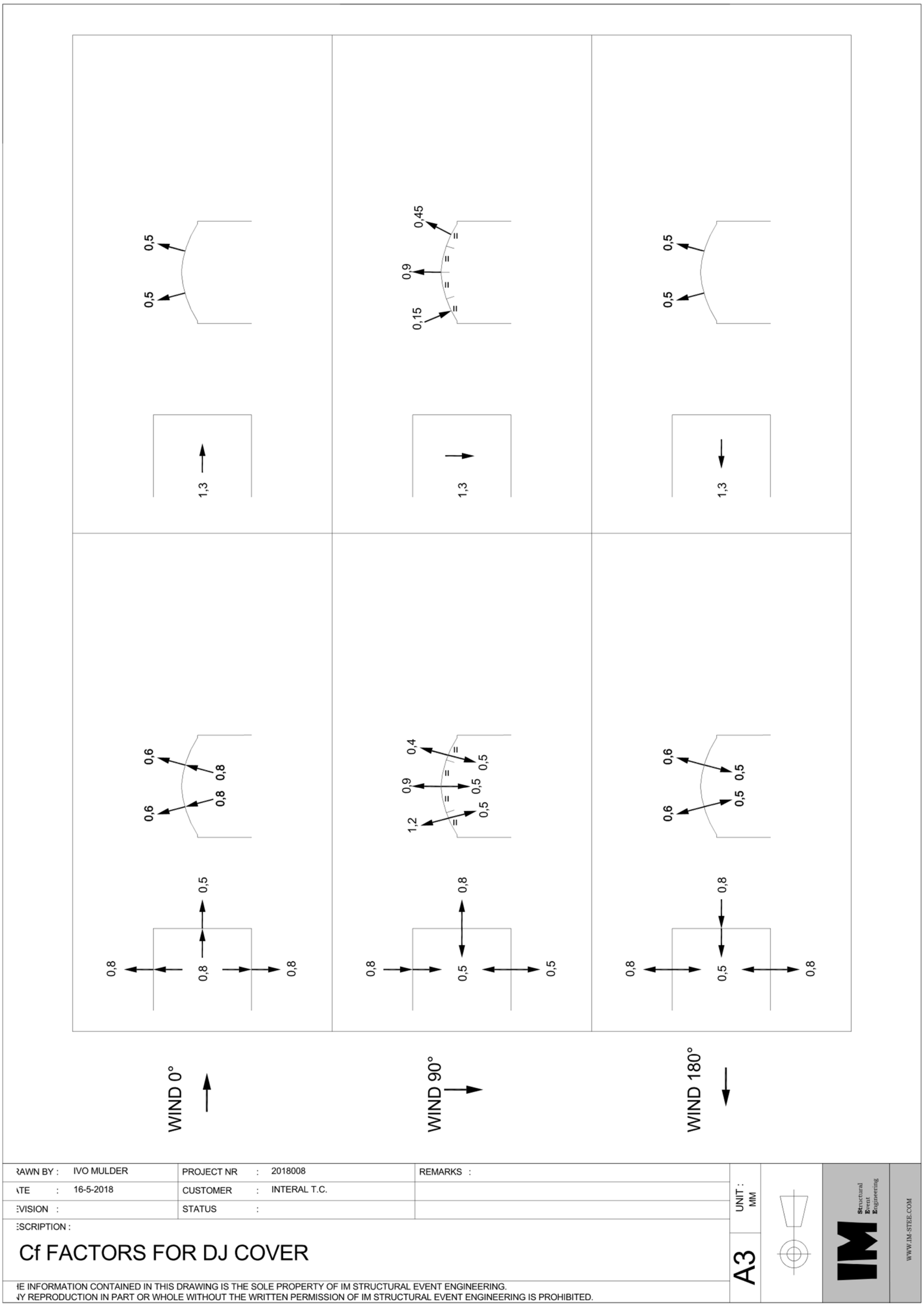
The loading which is taken into account in the floor loading 180° setup are:

Floor loading 350 kg/m²

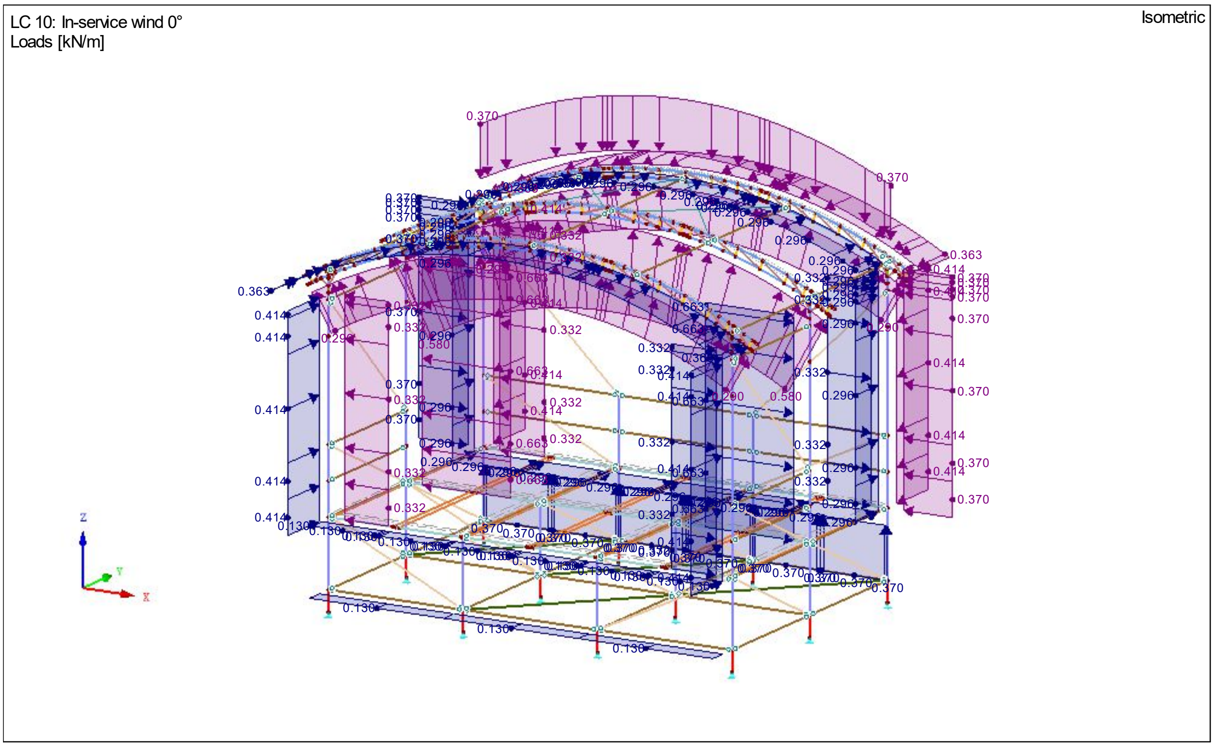
According to the EN-AW-13814 an extra horizontal force of 10% of the vertical force, which is 35 kg/m^2, has been taken into account.

2.5 Load cases concerning wing loading.

For the calculation of the wind loading the next wind coefficient are used. These factors are subtracted from the Eurocode NEN-EN 1991-1 1-4: general actions – wind actions and EN-AW-13814: Fairground and amusement park machinery and structures safety



2.5.1 LC10 In-service wind 0°.



Wind calculations Roof spans

$q_{w,\ \text{roof span 1}} = 1.4 * 0.2 * 1.036 = 0.290$ kN/m
$q_{w,\ \text{roof span 2}} = 1.4 * 0.2 * 2.072 = 0.580$ kN/m
$q_{w,\ \text{roof span 3}} = 1.4 * 0.2 * 2.072 = 0.290$ kN/m

Membrane tension of the top canopy

$q_{mt,\ \text{roof span 1 back side}} = 0.290 / 0.8 = 0.363$ kN/m
$q_{mt,\ \text{roof span 2 back side}} = 0$ kN/m
$q_{mt,\ \text{roof span 3 back side}} = 0.290 / 0.8 = 0.363$ kN/m

wind on side wall canopy's

$q_{w,\ \text{side walls profiles 1L,4L}} = 1.6 * 0.2 * 1.036 = 0.332$ kN/m
$q_{w,\ \text{side walls profiles 2L,2R}} = 1.6 * 0.2 * 2.072 = 0.663$ kN/m
$q_{w,\ \text{side walls profiles 3R,3R}} = 1.6 * 0.2 * 1.036 = 0.332$ kN/m

Membrane tension of the side walls canopy's

$q_{mt,\ \text{side walls profiles 1L,1R}} = 0.331 / 0.8 = 0.414$ kN/m
$q_{mt,\ \text{side walls profiles 4L,4R}} = 0.331 / 0.8 = 0.414$ kN/m

Wind on the back-wall canopy.

$A_{canopy} = 6.216 * ((3.3 + 3.9) / 2) = 22.38\ m^2$
$Q_{w,\ back\ wall\ canopy} = 1.3 * 0.2 * 22.38 = 5.82\ kN$

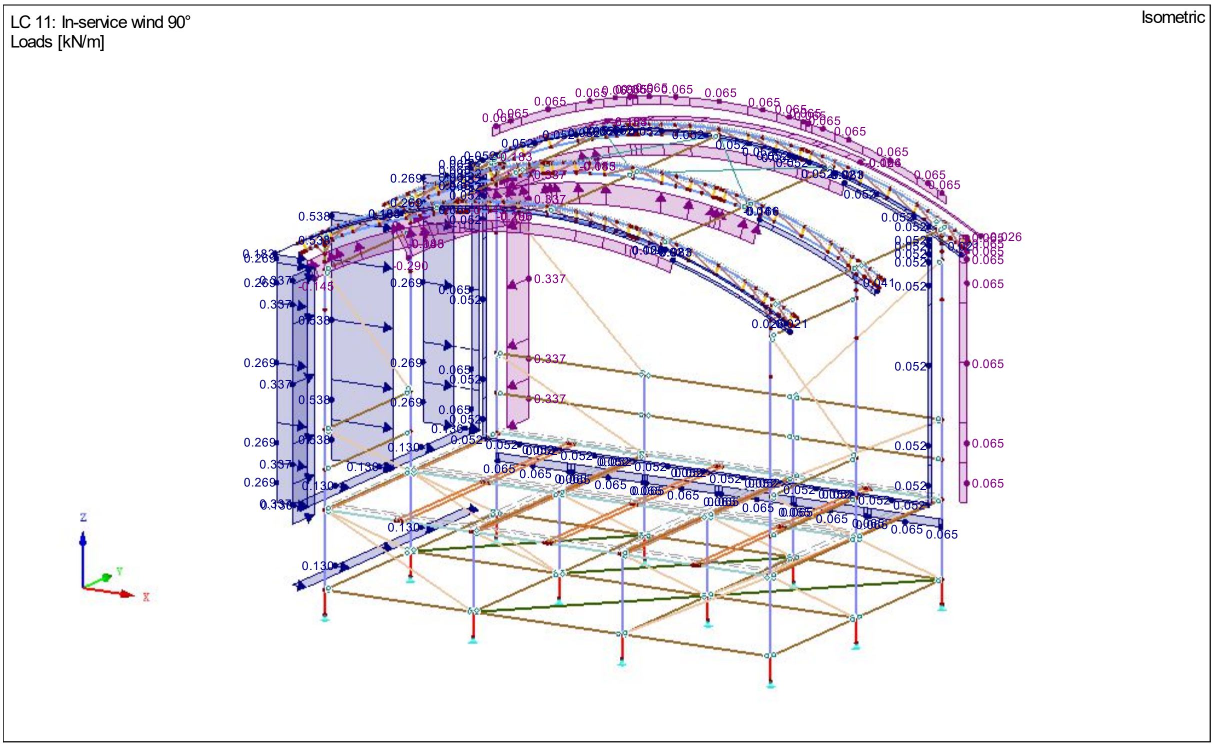
The backwall canopy is connected on the top, bottom and both sides
$q_{w,\ back\ wall\ canopy} = 5.82 / (2 * 6.216 + 2 * 3.6) = 0.296\ kN/m$

Membrane tension of the back-wall canopy

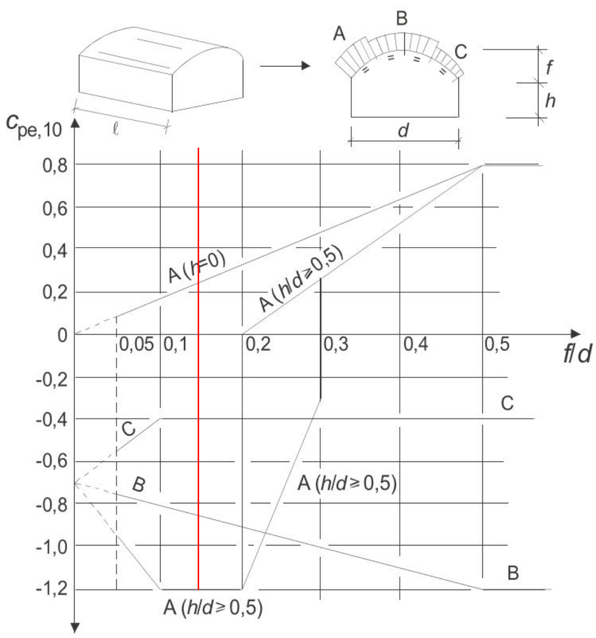
$Q_{mt,\ back\ wall\ canopy} = 0.296 / 0.8 = 0.370kN/m$

Wind on stage surface
This will be divided on the top and bottom ledger of the Layher system
$q_{w,\ wind\ on\ stage} = 1.3 * 0.2 * 0.5 = 0.13\ kN/m$

2.5.2 LC11 In-service situation wind 90°



To determine the wind loading on the walls the next diagram of the Eurocode NEN-EN 1991-1 1-4: General actions – wind actions has been used.



In which

f = 0.9 Meter

h = 4.7 meter

d = 6.216 meter

f / d = 0.95 / 6.216 = 0.145

h / d = 4.7 / 6.216 = 0.0.756

Extracting from the diagram the different C_{pe10} are,

A = -1.2 B = -0.9 C = -0.4

On the same time there is a Cf 0.5 working on the inside pulling the structure down.

The result of these two forces are

A = -0.7 B = -0.4 C = 0.1

Wind calculations for the Roof spans

$q_{w,\ roof\ span\ 1\ section\ A} = 0.7 * 0.2 * 1.036 = 0.145$ kN/m
$q_{w,\ roof\ span\ 1\ section\ B} = 0.4 * 0.2 * 1.036 = 0.083$ kN/m
$q_{w,\ roof\ span\ 1\ section\ C} = 0.1 * 0.2 * 1.036 = 0.021$ kN/m
$q_{w,\ roof\ span\ 2\ section\ A} = 0.7 * 0.2 * 2.072 = 0.290$ kN/m
$q_{w,\ roof\ span\ 2\ section\ B} = 0.4 * 0.2 * 2.072 = 0.166$ kN/m
$q_{w,\ roof\ span\ 2\ section\ C} = 0.1 * 0.2 * 2.072 = 0.041$ kN/m
$q_{w,\ roof\ span\ 3\ section\ A} = 0.7 * 0.2 * 1.036 = 0.145$ kN/m
$q_{w,\ roof\ span\ 3\ section\ B} = 0.4 * 0.2 * 1.036 = 0.082$ kN/m
$q_{w,\ roof\ span\ 3\ section\ C} = 0.1 * 0.2 * 1.036 = 0.021$ kN/m

membrane tension calculations for the Roof spans

$q_{mt,\ roof\ span\ 1\ section\ A} = 0.145 / 0.8 = 0.183$ kN/m
$q_{mt,\ roof\ span\ 1\ section\ B} = 0.083 / 0.8 = 0.104$ kN/m
$q_{mt,\ roof\ span\ 1\ section\ C} = 0.021 / 0.8 = 0.026$ kN/m
$q_{mt,\ roof\ span\ 2} = 0$ kN/m
$q_{mt,\ roof\ span\ 3\ section\ A} = 0.145 / 0.8 = 0.183$ kN/m
$q_{mt,\ roof\ span\ 3\ section\ B} = 0.083 / 0.8 = 0.104$ kN/m
$q_{mt,\ roof\ span\ 3\ section\ C} = 0.021 / 0.8 = 0.026$ kN/m

wind on side wall canopy's

$q_{w,\ side\ walls\ profiles\ 1L,3L} = 1.3 * 0.2 * 1.036 = 0.269$ kN/m
$q_{w,\ side\ walls\ profiles\ 2L} = 1.3 * 0.2 * 2.072 = 0.538$ kN/m

Membrane tension of the side walls canopy's

$q_{mt,\ side\ walls\ profiles\ 1L} = 0.269 / 0.8 = 0.337$ kN/m
$q_{mt,\ side\ walls\ profiles\ 2L} = 0$ kN/m
$q_{mt,\ side\ walls\ profiles\ 3L} = 0.269 / 0.8 = 0.337$ kN/m

Wind on the back-wall canopy.

$A_{canopy} = 6.216 * ((3.3 + 3.9) / 2) = 22.38\ m^2$
$Q_{w,\ back\ wall\ canopy} = 0.3 * 0.2 * 22.38 = 1.342\ kN$

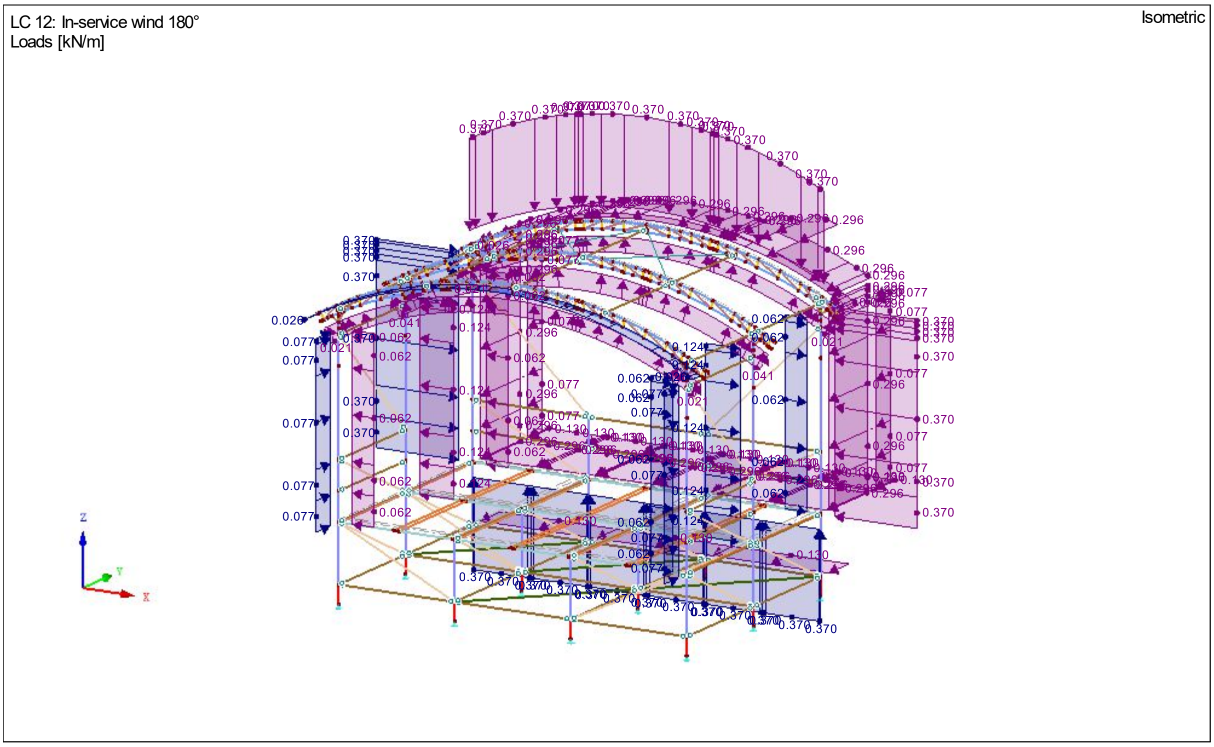
The backwall canopy is connected on the top, bottom and both sides
$q_{w,\ back\ wall\ canopy} = 1.342 / (2 * 6.216 + 2 * 3.6) = 0.052\ kN/m$

Membrane tension of the back-wall canopy

$Q_{mt,\ back\ wall\ canopy} = 0.052 / 0.8 = 0.065\ kN/m$

Wind on stage surface
This will be divided on the top and bottom ledger of the Layher system
$q_{w,\ wind\ on\ stage} = 1.3 * 0.2 * 0.5 = 0.13\ kN/m$

2.5.3 LC12 In-service wind 180°.



Wind calculations Roof spans

$q_{w,\text{ roof span 1}} = 0.1 * 0.2 * 1.036 = 0.021$ kN/m
$q_{w,\text{ roof span 2}} = 0.1 * 0.2 * 2.072 = 0.041$ kN/m
$q_{w,\text{ roof span 3}} = 0.1 * 0.2 * 1.036 = 0.021$ kN/m

Membrane tension of the top canopy

$q_{mt,\text{ roof span 1 back side}} = 0.021 / 0.8 = 0.026$ kN/m
$q_{mt,\text{ roof span 2 back side}} = 0$ kN/m
$q_{mt,\text{ roof span 3 back side}} = 0.021 / 0.8 = 0.026$ kN/m

wind on side wall canopy's

$q_{w,\text{ side walls profiles 1L,3L}} = 0.3 * 0.2 * 1.036 = 0.062$ kN/m
$q_{w,\text{ side walls profiles 1R,3R}} = 0.3 * 0.2 * 1.036 = 0.062$ kN/m
$q_{w,\text{ side walls profiles 2L}} = 0.3 * 0.2 * 2.072 = 0.124$ kN/m
$q_{w,\text{ side walls profiles 2R}} = 0.3 * 0.2 * 2.072 = 0.124$ kN/m

Membrane tension of the side walls canopy's

$q_{mt,\text{ side walls profiles 1L,1R}} = 0.062 / 0.8 = 0.077$ kN/m
$q_{mt,\text{ side walls profiles 4L,4R}} = 0.062 / 0.8 = 0.077$ kN/m

Wind on the back-wall canopy.

$A_{canopy} = 6.216 * ((3.3 + 3.9) / 2) = 22.38\ m^2$
$Q_{w, back\ wall\ canopy} = 1.3 * 0.2 * 22.38 = 5.82\ kN$

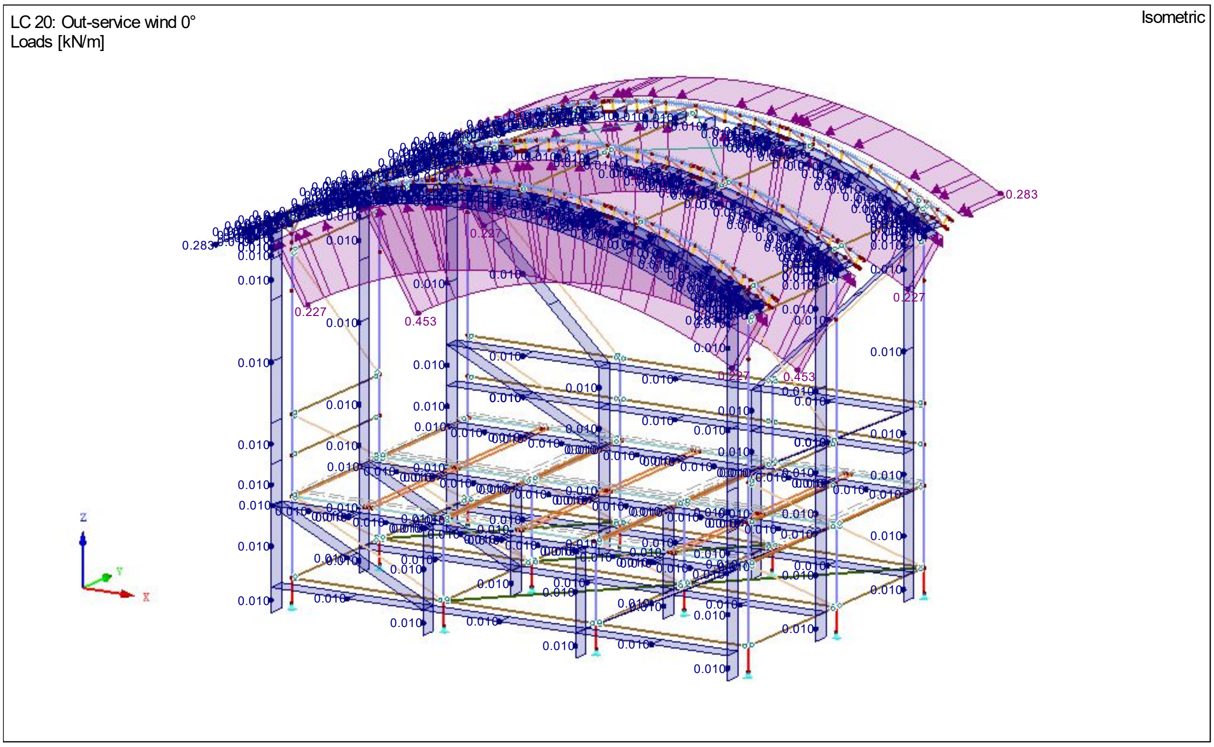
The backwall canopy is connected on the top, bottom and both sides
$q_{w, back\ wall\ canopy} = 5.82 / (2 * 6.216 + 2 * 3.6) = 0.296\ kN/m$

Membrane tension of the back-wall canopy

$Q_{mt, back\ wall\ canopy} = 0.296 / 0.8 = 0.370 kN/m$

Wind on stage surface
This will be divided on the top and bottom ledger of the Layher system
$q_{w, wind\ on\ stage} = 1.3 * 0.2 * 0.5 = 0.13\ kN/m$

2.5.4 LC20 Out-service wind 0°.



Wind calculations Roof spans

$q_{w,\ \text{roof span 1}} = 0.5 * 0.4375 * 1.036 = 0.227$ kN/m
$q_{w,\ \text{roof span 2}} = 0.5 * 0.4375 * 2.072 = 0.453$ kN/m
$q_{w,\ \text{roof span 3}} = 0.5 * 0.4375 * 1.036 = 0.227$ kN/m

Membrane tension of the top canopy

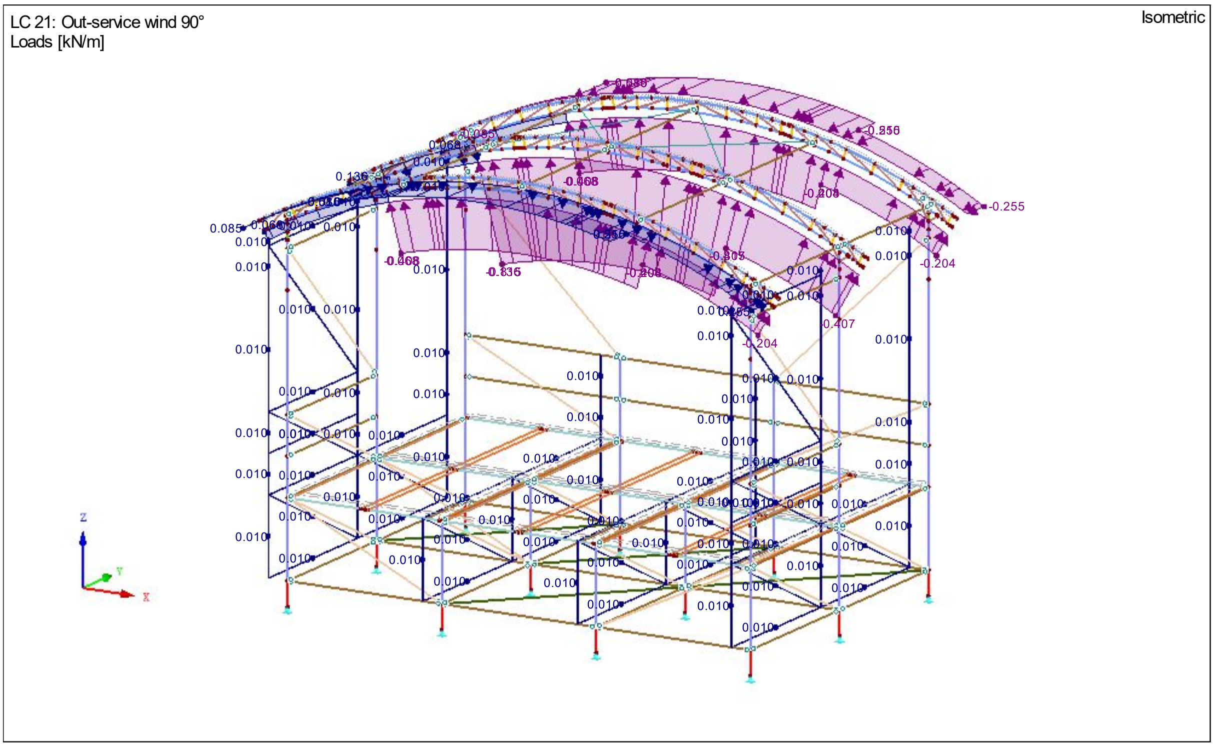
$q_{mt,\ \text{roof span 1 back side}} = 0.227 / 0.8 = 0.283$ kN/m
$q_{mt,\ \text{roof span 2 back side}} = 0$ kN/m
$q_{mt,\ \text{roof span 1 back side}} = 0.227 / 0.8 = 0.283$ kN/m

wind Layher Tubes.

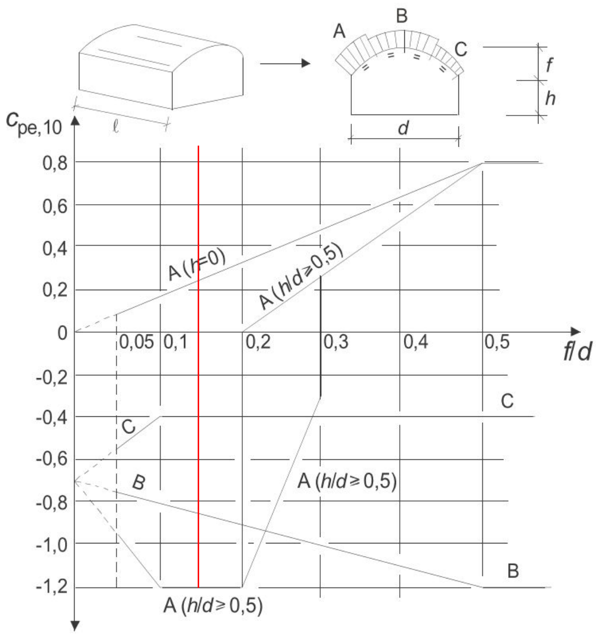
On all Layher tubes which are orientated perpendicular to the wind direction a wind loading has been set.

$q_{w,\ \text{round profile 48.3 mm}} = 0.5 * 0.4375 * 0.048 = 0.010$ kN/m

2.5.5 LC21 Out-service wind 90°



To determine the wind loading on the walls the next diagram of the Eurocode NEN-EN 1991-1 1-4: General actions – wind actions has been used.



In which

f = 0.9 Meter

h = 4.7 meter

d = 6.216 meter

f / d = 0.95 / 6.216 = 0.145

h / d = 4.7 / 6.216 = 0.0.756

Extracting from the diagram the different C_{pe10} are,

A = -1.2 B = -0.9 C = -0.4

On the same time there is a Cf 0.5 working on the inside pulling the structure down.

The result of these two forces are

A = -0.7 B = -0.4 C = 0.1

Wind calculations for the Roof spans

$q_{w,\ roof\ span\ 1\ section\ A} = 0.7 * 0.4375 * 1.036 = 0.068$ kN/m
$q_{w,\ roof\ span\ 1\ section\ B} = 0.4 * 0.4375 * 1.036 = 0.408$ kN/m
$q_{w,\ roof\ span\ 1\ section\ C} = 0.1 * 0.4375 * 1.036 = 0.204$ kN/m
$q_{w,\ roof\ span\ 2\ section\ A} = 0.7 * 0.4375 * 2.072 = 0.136$ kN/m
$q_{w,\ roof\ span\ 2\ section\ B} = 0.4 * 0.4375 * 2.072 = 0.815$ kN/m
$q_{w,\ roof\ span\ 2\ section\ C} = 0.1 * 0.4375 * 2.072 = 0.407$ kN/m
$q_{w,\ roof\ span\ 3\ section\ A} = 0.7 * 0.4375 * 1.036 = 0.068$ kN/m
$q_{w,\ roof\ span\ 3\ section\ B} = 0.4 * 0.4375 * 1.036 = 0.408$ kN/m
$q_{w,\ roof\ span\ 3\ section\ C} = 0.1 * 0.4375 * 1.036 = 0.204$ kN/m

membrane tension calculations for the Roof spans

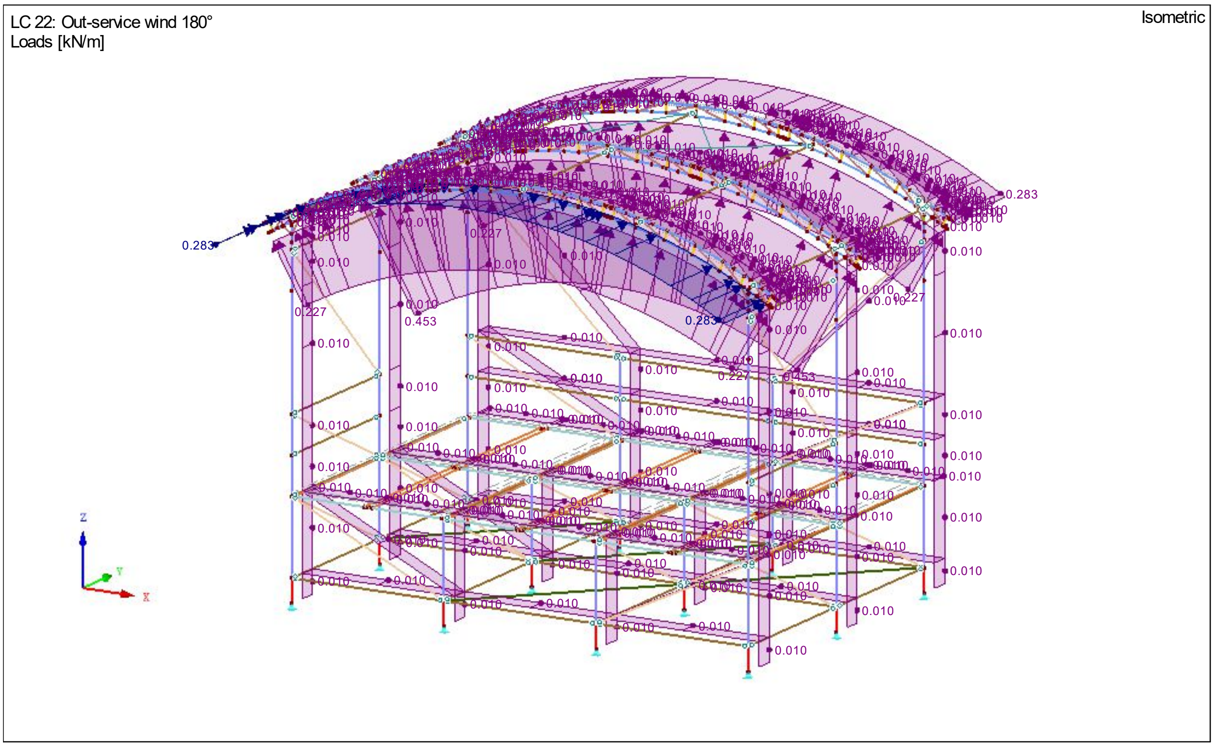
$q_{mt,\ roof\ span\ 1\ section\ A} = 0.068 / 0.8 = 0.085$ kN/m
$q_{mt,\ roof\ span\ 1\ section\ B} = 0.408 / 0.8 = 0.510$ kN/m
$q_{mt,\ roof\ span\ 1\ section\ C} = 0.204 / 0.8 = 0.255$ kN/m
$q_{mt,\ roof\ span\ 2} = 0$ kN/m
$q_{mt,\ roof\ span\ 3\ section\ A} = 0.068 / 0.8 = 0.085$ kN/m
$q_{mt,\ roof\ span\ 3\ section\ B} = 0.408 / 0.8 = 0.510$ kN/m
$q_{mt,\ roof\ span\ 3\ section\ C} = 0.204 / 0.8 = 0.255$ kN/m

wind Layher Tubes.

On all Layher tubes which are orientated perpendicular to the wind direction a wind loading has been set.

$q_{w,\ round\ profile\ 48.3\ mm} = 0.5 * 0.4375 * 0.048 = 0.010$ kN/m

2.5.6 LC22 Out-service wind 180°.



Wind calculations Roof spans

$q_{w,\ roof\ span\ 1} = 0.5 * 0.4375 * 1.036 = 0.227$ kN/m
$q_{w,\ roof\ span\ 2} = 0.5 * 0.4375 * 2.072 = 0.453$ kN/m
$q_{w,\ roof\ span\ 3} = 0.5 * 0.4375 * 1.036 = 0.227$ kN/m

Membrane tension of the top canopy

$q_{mt,\ roof\ span\ 1\ back\ side} = 0.227 / 0.8 = 0.283$ kN/m
$q_{mt,\ roof\ span\ 2\ back\ side} = 0$ kN/m
$q_{mt,\ roof\ span\ 1\ back\ side} = 0.227 / 0.8 = 0.283$ kN/m

wind Layher Tubes.

On all Layher tubes which are orientated perpendicular to the wind direction a wind loading has been set.

$q_{w,\ round\ profile\ 48.3\ mm} = 0.5 * 0.4375 * 0.048 = 0.010$ kN/m

2.6 Load combinations and result combinations

Different load combinations have been generated in the program.

The calculation has been done according to the stress capacity calculation.

The partial safety factors are According to the EN 13814:2004 chapter 5.3.6.1

γ_G = 1.1 or 1.35	Partial safety factors for permanent actions
$\gamma_{k, i}$ = 1.35	Partial safety factors for variable actions

The fundamental combinations are

$\Sigma\ \gamma_G\ G_k$	$(= \Sigma\ 1.35 * G_k)$
$\Sigma\ \gamma_G\ G_k + \Sigma\ \gamma_{k, i}\ Q_{k, I}$	$(= \Sigma\ 1.1 * G_k + \Sigma\ 1.35 * Q_{k, i})$
G_k	Characteristic value of permanent actions
$Q_{k, i}$	Characteristic value of one of the variable actions

The γ_G is set to 1.15 as an extra safety for all the small extra material which are used in the construction and which are not specific inserted in the Self-weight load case. These extra materials are for example retched straps, steel wire's, clamps….

2.6.1 load combinations.

CO1-CO4 General load combinations

CO10-CO38 Design calculation In-service situation

CO50-CO74 Characteristic calculation In-service situation

CO100-CO124 Design calculation In-service situation

CO150-CO174 Characteristic calculation In-service situation

Load	Load Combination		To	LC.1		LC.2		LC.3		LC.4		LC.5	
Combin.	DS	Description	Solve	Factor	No.	Factor	No.	Factor	No.	Factor	No.	Factor	No.
CO1	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3	+	1,150	LC1	1,150	LC2	1,350	LC3				
CO2	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4	+	1,150	LC1	1,150	LC2	1,350	LC4				
CO3	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5	+	1,150	LC1	1,150	LC2	1,350	LC5				
CO4	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6	+	1,150	LC1	1,150	LC2	1,350	LC6				
CO10	0	1.15*LC1 + 1.15*LC2 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC10				
CO11	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC10		
CO12	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC10		
CO13	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC10		
CO14	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC10		
CO15	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC7 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC7	1,350	LC10
CO16	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC7 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC7	1,350	LC10
CO17	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC7 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC7	1,350	LC10
CO18	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC7 + 1.35*LC10	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC7	1,350	LC10
CO20	0	1.15*LC1 + 1.15*LC2 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC11				
CO21	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC11		
CO22	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC11		
CO23	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC11		
CO24	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC11		
CO25	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC8 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC8	1,350	LC11
CO26	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC8 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC8	1,350	LC11
CO27	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC8 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC8	1,350	LC11
CO28	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC8 + 1.35*LC11	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC8	1,350	LC11
CO30	0	1.15*LC1 + 1.15*LC2 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC12				
CO31	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC12		
CO32	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC12		
CO33	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC12		
CO34	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC12		
CO35	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC9 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC9	1,350	LC12
CO36	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC9 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC9	1,350	LC12
CO37	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC9 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC9	1,350	LC12
CO38	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC9 + 1.35*LC12	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC9	1,350	LC12
CO50	0	LC1 + LC2 + LC10	+	1,000	LC1	1,000	LC2	1,000	LC10				
CO51	0	LC1 + LC2 + LC3 + LC10	+	1,000	LC1	1,000	LC2	1,000	LC3	1,000	LC10		
CO52	0	LC1 + LC2 + LC4 + LC10	+	1,000	LC1	1,000	LC2	1,000	LC4	1,000	LC10		
CO53	0	LC1 + LC2 + LC5 + LC10	+	1,000	LC1	1,000	LC2	1,000	LC5	1,000	LC10		
CO54	0	LC1 + LC2 + LC6 + LC10	+	1,000	LC1	1,000	LC2	1,000	LC6	1,000	LC10		
CO60	0	LC1 + LC2 + LC11	+	1,000	LC1	1,000	LC2	1,000	LC11				
CO61	0	LC1 + LC2 + LC3 + LC11	+	1,000	LC1	1,000	LC2	1,000	LC3	1,000	LC11		
CO62	0	LC1 + LC2 + LC4 + LC11	+	1,000	LC1	1,000	LC2	1,000	LC4	1,000	LC11		
CO63	0	LC1 + LC2 + LC5 + LC11	+	1,000	LC1	1,000	LC2	1,000	LC5	1,000	LC11		
CO64	0	LC1 + LC2 + LC6 + LC11	+	1,000	LC1	1,000	LC2	1,000	LC6	1,000	LC11		
CO70	0	LC1 + LC2 + LC12	+	1,000	LC1	1,000	LC2	1,000	LC12				
CO71	0	LC1 + LC2 + LC3 + LC12	+	1,000	LC1	1,000	LC2	1,000	LC3	1,000	LC12		
CO72	0	LC1 + LC2 + LC4 + LC12	+	1,000	LC1	1,000	LC2	1,000	LC4	1,000	LC12		
CO73	0	LC1 + LC2 + LC5 + LC12	+	1,000	LC1	1,000	LC2	1,000	LC5	1,000	LC12		
CO74	0	LC1 + LC2 + LC6 + LC12	+	1,000	LC1	1,000	LC2	1,000	LC6	1,000	LC12		
CO100	0	1.15*LC1 + 1.15*LC2 + 1.35*LC13	+	1,150	LC1	1,150	LC2	1,350	LC20				
CO101	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC13	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC20		
CO102	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC13	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC20		
CO103	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC13	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC20		
CO104	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC13	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC20		
CO110	0	1.15*LC1 + 1.15*LC2 + 1.35*LC14	+	1,150	LC1	1,150	LC2	1,350	LC21				
CO111	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC14	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC21		
CO112	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC14	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC21		
CO113	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC14	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC21		
CO114	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC14	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC21		

CO120	0	1.15*LC1 + 1.15*LC2 + 1.35*LC15	+	1,150	LC1	1,150	LC2	1,350	LC22					
CO121	0	1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC15	+	1,150	LC1	1,150	LC2	1,350	LC3	1,350	LC22			
CO122	0	1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC15	+	1,150	LC1	1,150	LC2	1,350	LC4	1,350	LC22			
CO123	0	1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC15	+	1,150	LC1	1,150	LC2	1,350	LC5	1,350	LC22			
CO124	0	1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC15	+	1,150	LC1	1,150	LC2	1,350	LC6	1,350	LC22			
CO150	0	LC1 + LC2 + LC13	+	1,000	LC1	1,000	LC2	1,000	LC20					
CO151	0	LC1 + LC2 + LC3 + LC13	+	1,000	LC1	1,000	LC2	1,000	LC3	1,000	LC20			
CO152	0	LC1 + LC2 + LC4 + LC13	+	1,000	LC1	1,000	LC2	1,000	LC4	1,000	LC20			
CO153	0	LC1 + LC2 + LC5 + LC13	+	1,000	LC1	1,000	LC2	1,000	LC5	1,000	LC20			
CO154	0	LC1 + LC2 + LC6 + LC13	+	1,000	LC1	1,000	LC2	1,000	LC6	1,000	LC20			
CO160	0	LC1 + LC2 + LC14	+	1,000	LC1	1,000	LC2	1,000	LC21					
CO161	0	LC1 + LC2 + LC3 + LC14	+	1,000	LC1	1,000	LC2	1,000	LC3	1,000	LC21			
CO162	0	LC1 + LC2 + LC4 + LC14	+	1,000	LC1	1,000	LC2	1,000	LC4	1,000	LC21			
CO163	0	LC1 + LC2 + LC5 + LC14	+	1,000	LC1	1,000	LC2	1,000	LC5	1,000	LC21			
CO164	0	LC1 + LC2 + LC6 + LC14	+	1,000	LC1	1,000	LC2	1,000	LC6	1,000	LC21			
CO170	0	LC1 + LC2 + LC15	+	1,000	LC1	1,000	LC2	1,000	LC22					
CO171	0	LC1 + LC2 + LC3 + LC15	+	1,000	LC1	1,000	LC2	1,000	LC3	1,000	LC22			
CO172	0	LC1 + LC2 + LC4 + LC15	+	1,000	LC1	1,000	LC2	1,000	LC4	1,000	LC22			
CO173	0	LC1 + LC2 + LC5 + LC15	+	1,000	LC1	1,000	LC2	1,000	LC5	1,000	LC22			
CO174	0	LC1 + LC2 + LC6 + LC15	+	1,000	LC1	1,000	LC2	1,000	LC6	1,000	LC22			

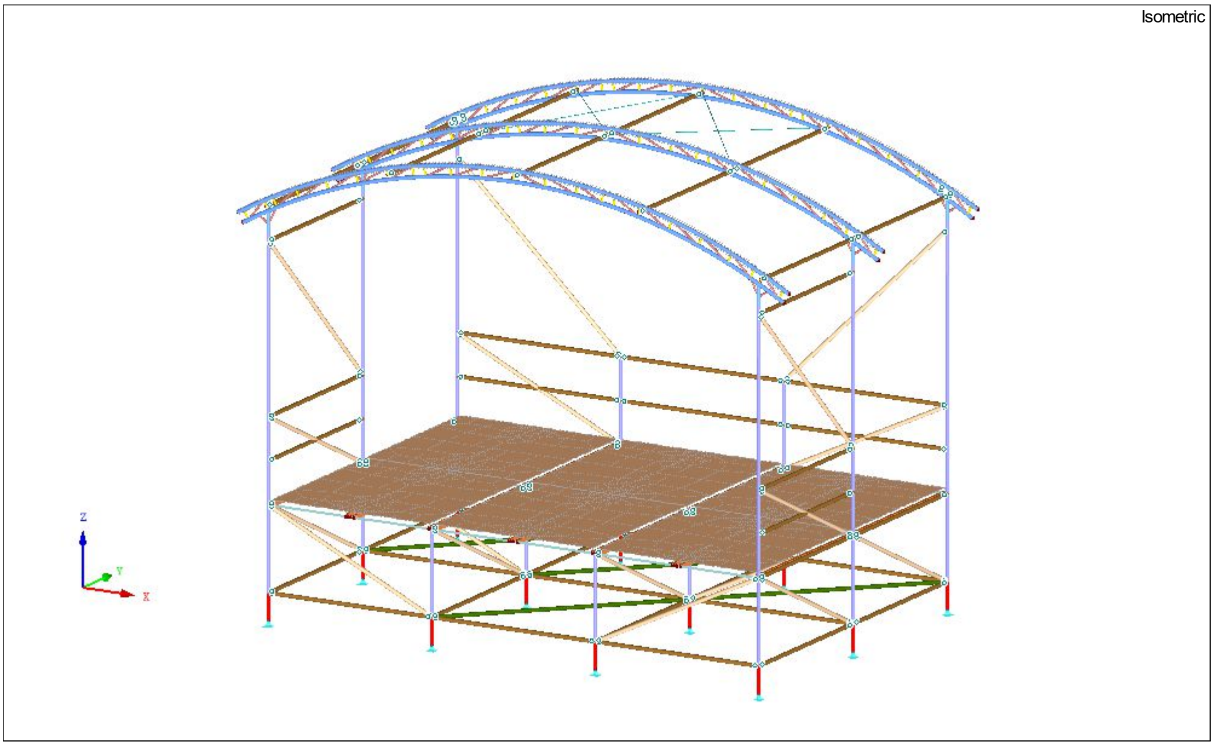
2.6.2 result combinations

Different Result calculation have been generated in the program.

RC1 - General loading without wind	: 1 * (CO1 or to CO4)
RC2 - Design values In-service	: 1 * (CO10 or to CO38)
RC3 - Characteristic values In-service	: 1 * (CO50 or to CO74)
RC4 - Design values Out-service	: 1 * (CO100 or to CO124)
RC5 - Characteristic values Out-service	: 1 * (CO150 or to CO174)

2.7 Calculation results

2.7.1 construction scheme



Cross-Sections
1: Ring 48/3; Aluminum EN-AW 6082 (EP,ET) T6
2: Ring 25/3; Aluminum EN-AW 6082 (EP,ET) T6
3: Ring 25/3; Aluminum EN-AW 6082 (EP,ET) T6
4: Ring 40/3; Steel S 235 JR
5: RO 38x4.5 | DIN EN 10220; Steel S 355 JR
6: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
7: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
8: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
9: RO 48.3x2.6 (Hot Formed); Steel S 235 JR
10: EV transom; Aluminum EN-AW 6005A (EP/O,ER/B) T6
11: HK 50/30/4/4/4/4; Aluminum EN-AW 6005A (EP/O,ER/B) T6
12: RD 8; steel 8.8 kw aliteit

2.7.2 Used Materials

Material No.	Material Description	Modulus of Elasticity E [kN/cm²]	Shear Modulus G [kN/cm²]	Poisson's Ratio ν [-]	Specific Weight γ [kN/m³]	Coeff. of Th. Exp. α [1/°C]	Partial Factor γ_M [-]	Material Model
1	Steel S 235 JR | EN 10025-2:2004-11	21000,00	8076,92	0,300	78,50	1,20E-05	1,000	Isotropic Linear Elastic
2	S320GD 1.0250 | EN 10346:2009-03	21000,00	8076,92	0,300	78,50	1,20E-05	1,000	Isotropic Linear Elastic
3	Steel S 355 JR | EN 10025-2:2004-11	21000,00	8076,92	0,300	78,50	1,20E-05	1,000	Isotropic Linear Elastic
4	Plywood, Class F20/10 E40/20, Plate Stress, Perpendicular | EN 12369-2:2011-06	200,00	3,50	3,286	5,00	5,00E-06	1,200	Orthotropic Elastic 2D...
5	Aluminum EN-AW 6005A (EP/O,ER/B) T6 | EN 1999-1-1:2007	7000,00	2700,00	0,296	27,00	2,30E-05	1,000	Isotropic Linear Elastic
6	Aluminum EN-AW 6082 (EP,ET) T6 | EN 1999-1-1:2007	7000,00	2700,00	0,296	27,00	2,30E-05	1,000	Isotropic Linear Elastic
7	steel 8.8 kwaliteit | EN 10346:2009-03	21000,00	8076,92	0,300	78,50	1,20E-05	1,000	Isotropic Linear Elastic

2.7.3 Used cross sections

Section	Cross-Section	Material	Moments of inertia [cm⁴]			Cross-Sectional Areas [cm²]			Principal Axes	Rotation	Overall Dimensions [mm]	
No.	Description [mm]	No.	Torsion J	Bending I_y	Bending I_z	Axial A	Shear A_y	Shear A_z	α [°]	α' [°]	Width b	Depth h
1	Ring 48/3	6	21,57	10,78	10,78	4,24	2,14	2,14	0,00	0,00	48,0	48,0
2	Ring 25/3	6	2,56	1,28	1,28	2,07	1,07	1,07	0,00	0,00	25,0	25,0
3	Ring 25/3	6	2,56	1,28	1,28	2,07	1,07	1,07	0,00	0,00	25,0	25,0
4	Ring 40/3	1	12,01	6,01	6,01	3,49	1,76	1,76	0,00	0,00	40,0	40,0
5	RO 38x4.5 | DIN EN 10220	3	13,53	6,76	6,76	4,74	2,38	2,38	0,00	0,00	38,0	38,0
6	RO 48.3x3.2 (Hot Formed)	2	23,20	11,60	11,60	4,53	2,26	2,26	0,00	0,00	48,3	48,3
7	RO 48.3x3.2 (Hot Formed)	2	23,20	11,60	11,60	4,53	2,26	2,26	0,00	0,00	48,3	48,3
8	RO 48.3x3.2 (Hot Formed)	2	23,20	11,60	11,60	4,53	2,26	2,26	0,00	0,00	48,3	48,3
9	RO 48.3x2.6 (Hot Formed)	1	19,60	9,78	9,78	3,73	1,85	1,85	0,00	0,00	48,3	48,3
10	EV transom	5	50,00	554,00	70,00	18,78	18,00	18,00	0,00	0,00	49,0	172,5
11	HK 50/30/4/4/4/4	5	16,87	17,67	7,52	5,76	1,62	3,48	0,00	0,00	30,0	50,0
12	RD 8	7	0,04	0,02	0,02	0,50	0,42	0,42	0,00	0,00	8,0	8,0

2.7.4 Calculation summary

	Description	Value	Unit	Comment
	Summary			
	Calculation Status	OK		
	Maximum displacement in X-direction	36,4	mm	CO28, Member No. 696, x: 2.880 m
	Maximum displacement in Y-direction	-67,6	mm	CO38, Member No. 141, x: 0.249 m
	Maximum displacement in Z-direction	-44,4	mm	CO34, Member No. 893, x: 0.054 m
	Maximum vectorial displacement	78,9	mm	CO38, FE Mesh Node No. 575 (X: 6.216, Y: 0.000, Z: 4.528 m)
	Maximum rotation about X-axis	30,8	mrad	CO25, FE Mesh Node No. 722 (X: 3.653, Y: 1.801, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,9	mrad	CO36, FE Mesh Node No. 1202 (X: 5.985, Y: -1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	-37,8	mrad	CO38, Member No. 969, x: 0.228 m
	Number of 1D finite elements (member elements)	1148		
	Number of 2D finite elements (surface elements)	780		
	Number of 3D finite elements (solid elements)	0		
	Number of FE mesh nodes	1273		
	Number of equations	7638		
	Matrix solver method	Direct		
	Maximum number of iterations	100		
	Number of divisions for member results	10		
	Number of divisions of members with cable, elastic foundation, taper, or plastic characteristic	10		
	Activate shear stiffness of members (A-y, A-z)	+		
	Plate bending theory	Mindlin		
	Activate ineffective supports	+		
	Allow failing members	+		
	Precision of convergence criteria of nonlinear calculation	1,0		

2.7.5 Calculation result of the separate load cases.

	Description	Value	Unit	Comment
	LC1 - Self-weight			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-14,41	kN	
	Sum of support forces in Z	-14,41	kN	Deviation: 0.00 %
	Resultant of reactions about X	-0,334	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	0,004	kNm	At center of gravity of model
	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	-2,2	mm	Member No. 573, x: 0.125 m
	Maximum displacement in Y-direction	-0,8	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-4,7	mm	Member No. 661, x: 0.296 m
	Maximum vectorial displacement	4,8	mm	Member No. 661, x: 0.296 m
	Maximum rotation about X-axis	2,4	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	2,3	mrad	Member No. 96, x: 0.569 m
	Maximum rotation about Z-axis	-0,6	mrad	Member No. 695, x: 2.880 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC2 - ballast loading			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-15,00	kN	
	Sum of support forces in Z	-15,00	kN	Deviation: 0.00 %
	Resultant of reactions about X	1,166	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	0,000	kNm	At center of gravity of model
	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	0,0	mm	Member No. 582, x: 0.063 m
	Maximum displacement in Y-direction	0,0	mm	Member No. 1027, x: 0.421 m
	Maximum displacement in Z-direction	-12,3	mm	Member No. 667, x: 1.000 m
	Maximum vectorial displacement	12,3	mm	Member No. 667, x: 1.000 m
	Maximum rotation about X-axis	0,0	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	20,0	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	0,0	mrad	Member No. 678, x: 0.000 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC3 - UDL Loading			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-7,67	kN	
	Sum of support forces in Z	-7,67	kN	Deviation: 0.00 %
	Resultant of reactions about X	0,596	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	0,000	kNm	At center of gravity of model
	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	-9,4	mm	Member No. 645, x: 0.125 m
	Maximum displacement in Y-direction	-3,0	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-19,4	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	19,6	mm	Member No. 1023, x: 0.421 m
	Maximum rotation about X-axis	7,1	mrad	Member No. 677, x: 0.296 m
	Maximum rotation about Y-axis	9,4	mrad	Member No. 82, x: 0.682 m
	Maximum rotation about Z-axis	-3,3	mrad	Member No. 695, x: 2.880 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC4 - CPL Loading setup			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-3,00	kN	
	Sum of support forces in Z	-3,00	kN	Deviation: 0.00 %
	Resultant of reactions about X	0,233	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	0,000	kNm	At center of gravity of model
	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	-6,6	mm	Member No. 645, x: 0.125 m
	Maximum displacement in Y-direction	-2,1	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-14,8	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	15,0	mm	Member No. 1023, x: 0.421 m
	Maximum rotation about X-axis	5,1	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	6,5	mrad	Member No. 82, x: 0.569 m
	Maximum rotation about Z-axis	-2,3	mrad	Member No. 695, x: 2.880 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC5 - 2x point load per truss			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-6,00	kN	
	Sum of support forces in Z	-6,00	kN	Deviation: 0.00 %
	Resultant of reactions about X	0,466	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	0,000	kNm	At center of gravity of model

	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	-9,5	mm	Member No. 645, x: 0.063 m
	Maximum displacement in Y-direction	-3,0	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-19,0	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	19,2	mm	Member No. 1023, x: 0.421 m
	Maximum rotation about X-axis	7,1	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	9,7	mrad	Member No. 82, x: 0.682 m
	Maximum rotation about Z-axis	3,3	mrad	Member No. 696, x: 2.880 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC6 - 3x point load per truss			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-6,75	kN	
	Sum of support forces in Z	-6,75	kN	Deviation: 0.00 %
	Resultant of reactions about X	0,525	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	0,000	kNm	At center of gravity of model
	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	-12,1	mm	Member No. 645, x: 0.125 m
	Maximum displacement in Y-direction	-3,9	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-25,4	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	25,6	mm	FE Mesh Node No. 646 (X: 6.216, Y: -2.072, Z: 4.528 m)
	Maximum rotation about X-axis	9,2	mrad	Member No. 677, x: 0.592 m
	Maximum rotation about Y-axis	12,2	mrad	Member No. 82, x: 0.569 m
	Maximum rotation about Z-axis	-4,2	mrad	Member No. 695, x: 2.880 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC7 - floor loading wind 0°			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	8,70	kN	
	Sum of support forces in Y	8,70	kN	Deviation: 0.00 %
	Sum of loads in Z	-87,02	kN	
	Sum of support forces in Z	-87,02	kN	Deviation: 0.00 %
	Resultant of reactions about X	10,947	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	-0,002	kNm	At center of gravity of model
	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	1,8	mm	Member No. 572, x: 0.300 m
	Maximum displacement in Y-direction	2,4	mm	Member No. 320, x: 0.500 m
	Maximum displacement in Z-direction	-9,8	mm	FE Mesh Node No. 135 (X: 3.549, Y: 1.035, Z: 0.314 m)
	Maximum vectorial displacement	9,9	mm	FE Mesh Node No. 135 (X: 3.549, Y: 1.035, Z: 0.314 m)
	Maximum rotation about X-axis	16,1	mrad	FE Mesh Node No. 353 (X: 7.796, Y: 1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	20,1	mrad	FE Mesh Node No. 253 (X: 6.447, Y: 1.029, Z: 0.314 m)
	Maximum rotation about Z-axis	-1,8	mrad	Member No. 728, x: 0.000 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC8 - floor loading wind 90°			
	Sum of loads in X	8,70	kN	
	Sum of support forces in X	8,70	kN	Deviation: 0.00 %
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-87,02	kN	
	Sum of support forces in Z	-87,02	kN	Deviation: 0.00 %
	Resultant of reactions about X	6,765	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	-4,184	kNm	At center of gravity of model
	Resultant of reactions about Z	0,676	kNm	At center of gravity of model
	Maximum displacement in X-direction	3,4	mm	Member No. 572, x: 0.300 m
	Maximum displacement in Y-direction	-3,0	mm	Member No. 731, x: 2.880 m
	Maximum displacement in Z-direction	-9,8	mm	FE Mesh Node No. 135 (X: 3.549, Y: 1.035, Z: 0.314 m)
	Maximum vectorial displacement	10,1	mm	FE Mesh Node No. 1017 (X: 8.883, Y: 1.037, Z: 0.314 m)
	Maximum rotation about X-axis	16,0	mrad	FE Mesh Node No. 353 (X: 7.796, Y: 1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	-20,1	mrad	FE Mesh Node No. 1202 (X: 5.985, Y: -1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	-1,7	mrad	Member No. 728, x: 0.000 m
	Method of analysis	Linear		Geometrically Linear Analysis
	LC9 - floor loading wind 180°			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-8,70	kN	
	Sum of support forces in Y	-8,70	kN	Deviation: 0.00 %
	Sum of loads in Z	-87,02	kN	
	Sum of support forces in Z	-87,02	kN	Deviation: 0.00 %
	Resultant of reactions about X	2,583	kNm	At center of gravity of model (X: 6.216, Y: 0.078, Z: 0.855 m)
	Resultant of reactions about Y	-0,002	kNm	At center of gravity of model
	Resultant of reactions about Z	0,000	kNm	At center of gravity of model
	Maximum displacement in X-direction	1,8	mm	Member No. 572, x: 0.300 m
	Maximum displacement in Y-direction	-4,0	mm	Member No. 731, x: 2.880 m
	Maximum displacement in Z-direction	-9,8	mm	FE Mesh Node No. 1268 (X: 7.693, Y: -1.035, Z: 0.314 m)
	Maximum vectorial displacement	9,9	mm	FE Mesh Node No. 1268 (X: 7.693, Y: -1.035, Z: 0.314 m)
	Maximum rotation about X-axis	-16,0	mrad	FE Mesh Node No. 898 (X: 4.636, Y: -1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	20,1	mrad	FE Mesh Node No. 604 (X: 6.447, Y: -1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	-1,5	mrad	Member No. 728, x: 0.000 m
	Method of analysis	Linear		Geometrically Linear Analysis

2.7.6 Calculation result of RC1 - General loading without wind 1 * (CO1 – CO4)

	Description	Value	Unit	Comment
	CO1 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-44,17	kN	
	Sum of support forces in Z	-44,17	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-15,2	mm	Member No. 573, x: 0.063 m
	Maximum displacement in Y-direction	-5,5	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-31,5	mm	Member No. 661, x: 0.888 m
	Maximum vectorial displacement	32,0	mm	Member No. 661, x: 0.888 m
	Maximum rotation about X-axis	13,0	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	-5,3	mrad	Member No. 695, x: 2.880 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$
	CO2 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-37,87	kN	
	Sum of support forces in Z	-37,87	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-11,4	mm	Member No. 573, x: 0.125 m
	Maximum displacement in Y-direction	-4,1	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-25,3	mm	Member No. 661, x: 0.691 m
	Maximum vectorial displacement	25,6	mm	Member No. 661, x: 0.691 m
	Maximum rotation about X-axis	10,1	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	-3,8	mrad	Member No. 695, x: 2.880 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$
	CO3 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-41,92	kN	
	Sum of support forces in Z	-41,92	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	15,4	mm	Member No. 576, x: 0.063 m
	Maximum displacement in Y-direction	-5,5	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-30,9	mm	Member No. 661, x: 1.036 m
	Maximum vectorial displacement	31,3	mm	Member No. 661, x: 1.036 m
	Maximum rotation about X-axis	13,0	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	-5,4	mrad	Member No. 695, x: 2.880 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$
	CO4 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	0,00	kN	
	Sum of support forces in Y	0,00	kN	
	Sum of loads in Z	-42,93	kN	
	Sum of support forces in Z	-42,93	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-18,9	mm	Member No. 573, x: 0.063 m
	Maximum displacement in Y-direction	-7,0	mm	Member No. 1023, x: 0.421 m
	Maximum displacement in Z-direction	-39,6	mm	Member No. 661, x: 1.036 m
	Maximum vectorial displacement	40,2	mm	Member No. 661, x: 1.036 m
	Maximum rotation about X-axis	16,0	mrad	Member No. 677, x: 0.000 m
	Maximum rotation about Y-axis	23,8	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	-6,6	mrad	Member No. 695, x: 2.880 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$

2.7.7 Calculation result of RC2 - Design values In-service: 1 * (CO10 – CO38)

	Description	Value	Unit	Comment
	CO10 - 1.15*LC1 + 1.15*LC2 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	9,92	kN	
	Sum of support forces in Y	9,92	kN	Deviation: 0.00 %
	Sum of loads in Z	-23,07	kN	
	Sum of support forces in Z	-23,07	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	8,0	mm	Member No. 588, x: 0.900 m
	Maximum displacement in Y-direction	50,3	mm	Member No. 141, x: 0.290 m
	Maximum displacement in Z-direction	15,2	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	50,6	mm	Member No. 141, x: 0.332 m
	Maximum rotation about X-axis	-28,9	mrad	Member No. 932, x: 0.035 m
	Maximum rotation about Y-axis	-23,9	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	23,4	mrad	Member No. 114, x: 0.695 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO11 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	9,92	kN	
	Sum of support forces in Y	9,92	kN	Deviation: 0.00 %
	Sum of loads in Z	-33,43	kN	
	Sum of support forces in Z	-33,43	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	16,9	mm	Member No. 588, x: 0.600 m
	Maximum displacement in Y-direction	51,6	mm	Member No. 141, x: 0.166 m
	Maximum displacement in Z-direction	-20,9	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	54,8	mm	Member No. 141, x: 0.290 m
	Maximum rotation about X-axis	-30,5	mrad	Member No. 932, x: 0.027 m
	Maximum rotation about Y-axis	-23,8	mrad	Member No. 683, x: 0.000 m
	Maximum rotation about Z-axis	24,9	mrad	Member No. 969, x: 0.304 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO12 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	9,92	kN	
	Sum of support forces in Y	9,92	kN	Deviation: 0.00 %
	Sum of loads in Z	-27,12	kN	
	Sum of support forces in Z	-27,12	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	13,9	mm	Member No. 588, x: 0.750 m
	Maximum displacement in Y-direction	50,4	mm	Member No. 141, x: 0.166 m
	Maximum displacement in Z-direction	-14,6	mm	Member No. 664, x: 1.000 m
	Maximum vectorial displacement	51,9	mm	Member No. 141, x: 0.249 m
	Maximum rotation about X-axis	-28,4	mrad	Member No. 932, x: 0.027 m
	Maximum rotation about Y-axis	-23,9	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	24,3	mrad	Member No. 114, x: 0.695 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO13 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	9,92	kN	
	Sum of support forces in Y	9,92	kN	Deviation: 0.00 %
	Sum of loads in Z	-31,17	kN	
	Sum of support forces in Z	-31,17	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	17,0	mm	Member No. 588, x: 0.600 m
	Maximum displacement in Y-direction	52,1	mm	Member No. 141, x: 0.166 m
	Maximum displacement in Z-direction	-20,3	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	55,2	mm	Member No. 141, x: 0.249 m
	Maximum rotation about X-axis	-30,6	mrad	Member No. 932, x: 0.027 m
	Maximum rotation about Y-axis	-23,8	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	25,1	mrad	Member No. 114, x: 0.695 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO14 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	9,92	kN	
	Sum of support forces in Y	9,92	kN	Deviation: 0.00 %
	Sum of loads in Z	-32,18	kN	
	Sum of support forces in Z	-32,18	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	19,7	mm	Member No. 588, x: 0.600 m
	Maximum displacement in Y-direction	51,9	mm	Member No. 141, x: 0.124 m

	Maximum displacement in Z-direction	-28,9	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	57,9	mm	Member No. 141, x: 0.332 m
	Maximum rotation about X-axis	-29,7	mrad	Member No. 932, x: 0.027 m
	Maximum rotation about Y-axis	-23,8	mrad	Member No. 683, x: 0.000 m
	Maximum rotation about Z-axis	25,4	mrad	Member No. 969, x: 0.304 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO15 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC7 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	21,66	kN	
	Sum of support forces in Y	21,66	kN	Deviation: 0.00 %
	Sum of loads in Z	-150,91	kN	
	Sum of support forces in Z	-150,91	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	14,7	mm	Member No. 588, x: 0.600 m
	Maximum displacement in Y-direction	54,1	mm	Member No. 141, x: 0.166 m
	Maximum displacement in Z-direction	-20,2	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	57,0	mm	Member No. 141, x: 0.249 m
	Maximum rotation about X-axis	30,6	mrad	FE Mesh Node No. 733 (X: 8.780, Y: 1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	41,7	mrad	FE Mesh Node No. 1004 (X: 8.519, Y: 1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	24,4	mrad	Member No. 967, x: 0.304 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO16 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC7 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	21,66	kN	
	Sum of support forces in Y	21,66	kN	Deviation: 0.00 %
	Sum of loads in Z	-144,60	kN	
	Sum of support forces in Z	-144,60	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	11,6	mm	Member No. 588, x: 0.750 m
	Maximum displacement in Y-direction	52,6	mm	Member No. 141, x: 0.166 m
	Maximum displacement in Z-direction	-19,0	mm	FE Mesh Node No. 1017 (X: 8.883, Y: 1.037, Z: 0.314 m)
	Maximum vectorial displacement	53,9	mm	Member No. 141, x: 0.249 m
	Maximum rotation about X-axis	30,6	mrad	FE Mesh Node No. 733 (X: 8.780, Y: 1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	41,6	mrad	FE Mesh Node No. 1004 (X: 8.519, Y: 1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	23,9	mrad	Member No. 967, x: 0.304 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO17 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC7 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	21,66	kN	
	Sum of support forces in Y	21,66	kN	Deviation: 0.00 %
	Sum of loads in Z	-148,65	kN	
	Sum of support forces in Z	-148,65	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	14,8	mm	Member No. 588, x: 0.600 m
	Maximum displacement in Y-direction	54,5	mm	Member No. 141, x: 0.166 m
	Maximum displacement in Z-direction	-19,6	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	57,3	mm	Member No. 141, x: 0.249 m
	Maximum rotation about X-axis	-30,6	mrad	Member No. 932, x: 0.027 m
	Maximum rotation about Y-axis	41,7	mrad	FE Mesh Node No. 1004 (X: 8.519, Y: 1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	24,7	mrad	Member No. 967, x: 0.304 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO18 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC7 + 1.35*LC10			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	21,66	kN	
	Sum of support forces in Y	21,66	kN	Deviation: 0.00 %
	Sum of loads in Z	-149,67	kN	
	Sum of support forces in Z	-149,67	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	17,7	mm	Member No. 659, x: 0.300 m
	Maximum displacement in Y-direction	54,5	mm	Member No. 141, x: 0.124 m
	Maximum displacement in Z-direction	-28,2	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	59,9	mm	Member No. 1021, x: 0.350 m
	Maximum rotation about X-axis	30,6	mrad	FE Mesh Node No. 733 (X: 8.780, Y: 1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	41,7	mrad	FE Mesh Node No. 1004 (X: 8.519, Y: 1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	24,8	mrad	Member No. 967, x: 0.304 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO20 - 1.15*LC1 + 1.15*LC2 + 1.35*LC11			
	Sum of loads in X	5,35	kN	
	Sum of support forces in X	5,35	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-31,10	kN	
	Sum of support forces in Z	-31,10	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	25,3	mm	Member No. 645, x: 0.250 m

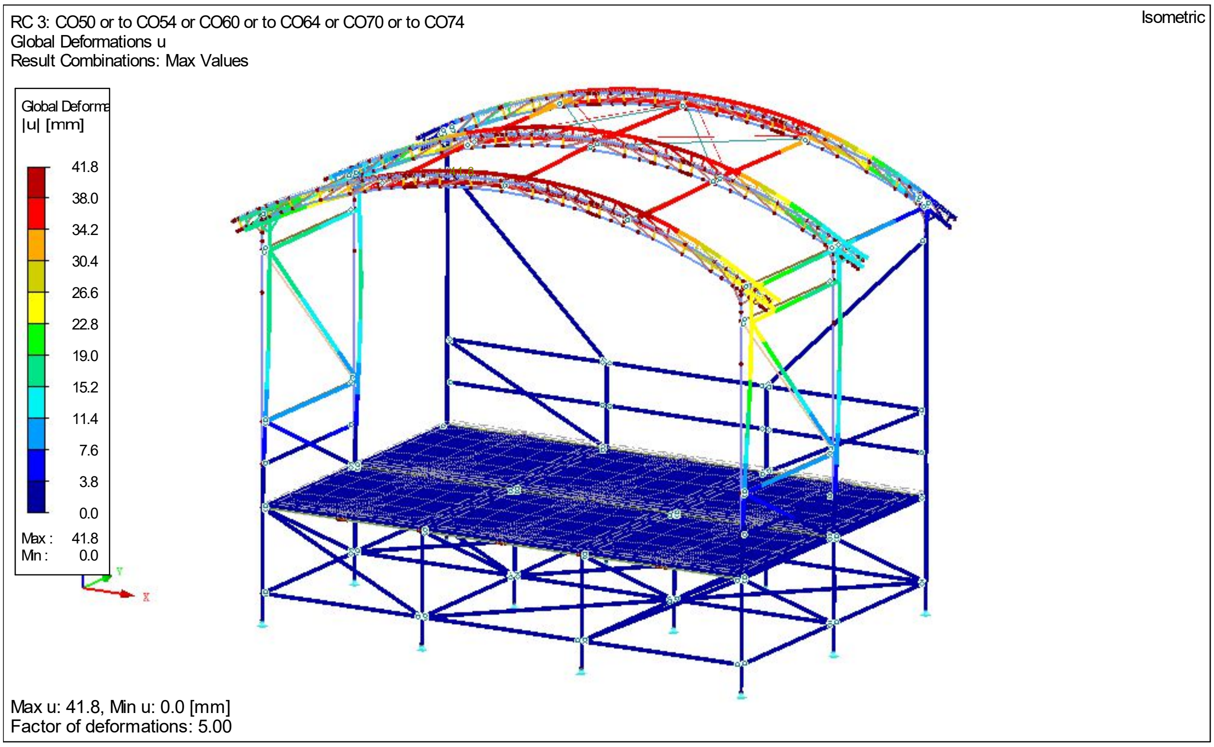
	Maximum displacement in Y-direction	15,5	mm	Member No. 35, x: 0.043 m
	Maximum displacement in Z-direction	-14,8	mm	Member No. 686, x: 1.000 m
	Maximum vectorial displacement	27,3	mm	Member No. 141, x: 0.000 m
	Maximum rotation about X-axis	-9,8	mrad	Member No. 863, x: 0.054 m
	Maximum rotation about Y-axis	-24,0	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	-9,0	mrad	Member No. 963, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO21 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC11			
	Sum of loads in X	5,35	kN	
	Sum of support forces in X	5,35	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-41,46	kN	
	Sum of support forces in Z	-41,46	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	31,5	mm	Member No. 655, x: 0.013 m
	Maximum displacement in Y-direction	14,3	mm	Member No. 34, x: 0.166 m
	Maximum displacement in Z-direction	-20,0	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	32,3	mm	Member No. 136, x: 0.284 m
	Maximum rotation about X-axis	-10,1	mrad	Member No. 863, x: 0.054 m
	Maximum rotation about Y-axis	-24,0	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	-8,8	mrad	Member No. 963, x: 0.190 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO22 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC11			
	Sum of loads in X	5,35	kN	
	Sum of support forces in X	5,35	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-35,15	kN	
	Sum of support forces in Z	-35,15	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	27,3	mm	Member No. 949, x: 0.000 m
	Maximum displacement in Y-direction	14,4	mm	Member No. 34, x: 0.249 m
	Maximum displacement in Z-direction	-14,8	mm	Member No. 686, x: 1.000 m
	Maximum vectorial displacement	28,7	mm	Member No. 141, x: 0.041 m
	Maximum rotation about X-axis	-9,9	mrad	Member No. 863, x: 0.054 m
	Maximum rotation about Y-axis	-24,0	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	-8,8	mrad	Member No. 963, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO23 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC11			
	Sum of loads in X	5,35	kN	
	Sum of support forces in X	5,35	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-39,20	kN	
	Sum of support forces in Z	-39,20	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	31,3	mm	Member No. 696, x: 2.880 m
	Maximum displacement in Y-direction	14,4	mm	Member No. 34, x: 0.166 m
	Maximum displacement in Z-direction	-19,4	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	32,0	mm	Member No. 1021, x: 0.234 m
	Maximum rotation about X-axis	-10,0	mrad	Member No. 863, x: 0.054 m
	Maximum rotation about Y-axis	-24,0	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	-8,9	mrad	Member No. 963, x: 0.190 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO24 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC11			
	Sum of loads in X	5,35	kN	
	Sum of support forces in X	5,35	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-40,22	kN	
	Sum of support forces in Z	-40,22	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	34,9	mm	Member No. 653, x: 0.438 m
	Maximum displacement in Y-direction	13,8	mm	Member No. 34, x: 0.124 m
	Maximum displacement in Z-direction	-28,2	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	37,2	mm	Member No. 1023, x: 0.234 m
	Maximum rotation about X-axis	-10,0	mrad	Member No. 1037, x: 0.037 m
	Maximum rotation about Y-axis	-24,0	mrad	Member No. 686, x: 0.000 m
	Maximum rotation about Z-axis	-8,7	mrad	Member No. 963, x: 0.190 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO25 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC8 + 1.35*LC11			
	Sum of loads in X	17,10	kN	
	Sum of support forces in X	17,10	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-158,94	kN	
	Sum of support forces in Z	-158,94	kN	Deviation: 0.00 %

	Maximum displacement in X-direction	33,2	mm	Member No. 949, x: 0.000 m
	Maximum displacement in Y-direction	14,5	mm	Member No. 34, x: 0.207 m
	Maximum displacement in Z-direction	-19,4	mm	FE Mesh Node No. 135 (X: 3.549, Y: 1.035, Z: 0.314 m)
	Maximum vectorial displacement	33,6	mm	Member No. 136, x: 0.203 m
	Maximum rotation about X-axis	30,8	mrad	FE Mesh Node No. 722 (X: 3.653, Y: 1.801, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,8	mrad	FE Mesh Node No. 160 (X: 3.913, Y: 1.029, Z: 0.314 m)
	Maximum rotation about Z-axis	7,8	mrad	Member No. 681, x: 0.000 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO26 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC8 + 1.35*LC11			
	Sum of loads in X	17,10	kN	
	Sum of support forces in X	17,10	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-152,64	kN	
	Sum of support forces in Z	-152,64	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	29,1	mm	Member No. 949, x: 0.000 m
	Maximum displacement in Y-direction	14,6	mm	Member No. 34, x: 0.249 m
	Maximum displacement in Z-direction	-19,4	mm	FE Mesh Node No. 135 (X: 3.549, Y: 1.035, Z: 0.314 m)
	Maximum vectorial displacement	30,3	mm	Member No. 952, x: 0.064 m
	Maximum rotation about X-axis	30,8	mrad	FE Mesh Node No. 722 (X: 3.653, Y: 1.801, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,7	mrad	FE Mesh Node No. 160 (X: 3.913, Y: 1.029, Z: 0.314 m)
	Maximum rotation about Z-axis	-7,8	mrad	Member No. 963, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO27 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC8 + 1.35*LC11			
	Sum of loads in X	17,10	kN	
	Sum of support forces in X	17,10	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-156,69	kN	
	Sum of support forces in Z	-156,69	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	32,9	mm	Member No. 949, x: 0.000 m
	Maximum displacement in Y-direction	14,6	mm	Member No. 34, x: 0.207 m
	Maximum displacement in Z-direction	-19,4	mm	FE Mesh Node No. 135 (X: 3.549, Y: 1.035, Z: 0.314 m)
	Maximum vectorial displacement	33,3	mm	Member No. 1021, x: 0.156 m
	Maximum rotation about X-axis	30,8	mrad	FE Mesh Node No. 722 (X: 3.653, Y: 1.801, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,8	mrad	FE Mesh Node No. 160 (X: 3.913, Y: 1.029, Z: 0.314 m)
	Maximum rotation about Z-axis	-7,8	mrad	Member No. 963, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO28 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC8 + 1.35*LC11			
	Sum of loads in X	17,10	kN	
	Sum of support forces in X	17,10	kN	Deviation: 0.00 %
	Sum of loads in Y	1,37	kN	
	Sum of support forces in Y	1,37	kN	Deviation: 0.00 %
	Sum of loads in Z	-157,70	kN	
	Sum of support forces in Z	-157,70	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	36,4	mm	Member No. 696, x: 2.880 m
	Maximum displacement in Y-direction	14,0	mm	Member No. 34, x: 0.166 m
	Maximum displacement in Z-direction	-27,4	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	38,1	mm	Member No. 1023, x: 0.187 m
	Maximum rotation about X-axis	30,8	mrad	FE Mesh Node No. 722 (X: 3.653, Y: 1.801, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,8	mrad	FE Mesh Node No. 160 (X: 3.913, Y: 1.029, Z: 0.314 m)
	Maximum rotation about Z-axis	7,7	mrad	Member No. 681, x: 0.592 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO30 - 1.15*LC1 + 1.15*LC2 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-9,96	kN	
	Sum of support forces in Y	-9,96	kN	Deviation: 0.00 %
	Sum of loads in Z	-33,21	kN	
	Sum of support forces in Z	-33,21	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-6,2	mm	Member No. 572, x: 1.200 m
	Maximum displacement in Y-direction	-52,6	mm	Member No. 150, x: 0.128 m
	Maximum displacement in Z-direction	-14,6	mm	Member No. 664, x: 1.000 m
	Maximum vectorial displacement	53,3	mm	Member No. 148, x: 0.166 m
	Maximum rotation about X-axis	23,0	mrad	Member No. 978, x: 0.210 m
	Maximum rotation about Y-axis	23,8	mrad	Member No. 664, x: 0.000 m
	Maximum rotation about Z-axis	-31,1	mrad	Member No. 969, x: 0.190 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO31 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-9,96	kN	
	Sum of support forces in Y	-9,96	kN	Deviation: 0.00 %
	Sum of loads in Z	-43,57	kN	

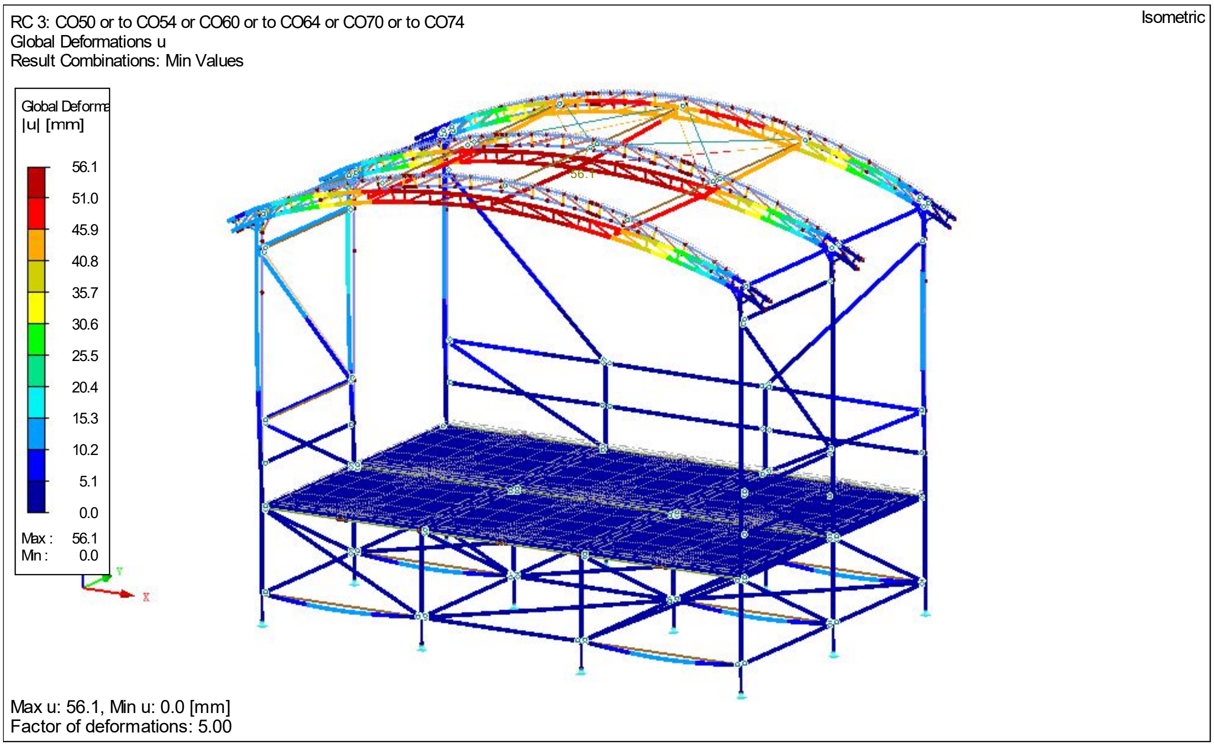
	Sum of support forces in Z	-43,57	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-18,9	mm	Member No. 573, x: 0.000 m
	Maximum displacement in Y-direction	-62,7	mm	Member No. 141, x: 0.207 m
	Maximum displacement in Z-direction	-36,3	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	71,2	mm	Member No. 1025, x: 0.376 m
	Maximum rotation about X-axis	28,7	mrad	Member No. 1005, x: 0.374 m
	Maximum rotation about Y-axis	23,9	mrad	Member No. 664, x: 0.000 m
	Maximum rotation about Z-axis	-35,4	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO32 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-9,96	kN	
	Sum of support forces in Y	-9,96	kN	Deviation: 0.00 %
	Sum of loads in Z	-37,26	kN	
	Sum of support forces in Z	-37,26	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-15,0	mm	Member No. 573, x: 0.000 m
	Maximum displacement in Y-direction	-58,5	mm	Member No. 134, x: 0.142 m
	Maximum displacement in Z-direction	-30,1	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	64,4	mm	Member No. 147, x: 0.203 m
	Maximum rotation about X-axis	25,6	mrad	Member No. 1006, x: 0.421 m
	Maximum rotation about Y-axis	23,9	mrad	Member No. 664, x: 0.000 m
	Maximum rotation about Z-axis	-33,8	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO33 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-9,96	kN	
	Sum of support forces in Y	-9,96	kN	Deviation: 0.00 %
	Sum of loads in Z	-41,31	kN	
	Sum of support forces in Z	-41,31	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	19,0	mm	Member No. 588, x: 0.000 m
	Maximum displacement in Y-direction	-63,2	mm	Member No. 141, x: 0.207 m
	Maximum displacement in Z-direction	-35,6	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	71,4	mm	Member No. 147, x: 0.203 m
	Maximum rotation about X-axis	28,9	mrad	Member No. 1005, x: 0.374 m
	Maximum rotation about Y-axis	23,9	mrad	Member No. 664, x: 0.000 m
	Maximum rotation about Z-axis	-35,6	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO34 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-9,96	kN	
	Sum of support forces in Y	-9,96	kN	Deviation: 0.00 %
	Sum of loads in Z	-42,33	kN	
	Sum of support forces in Z	-42,33	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-22,6	mm	Member No. 573, x: 0.000 m
	Maximum displacement in Y-direction	-65,6	mm	Member No. 141, x: 0.249 m
	Maximum displacement in Z-direction	-44,4	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	77,9	mm	Member No. 1027, x: 0.421 m
	Maximum rotation about X-axis	30,0	mrad	Member No. 1005, x: 0.374 m
	Maximum rotation about Y-axis	23,9	mrad	Member No. 664, x: 0.000 m
	Maximum rotation about Z-axis	-36,7	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO35 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC9 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-21,71	kN	
	Sum of support forces in Y	-21,71	kN	Deviation: 0.00 %
	Sum of loads in Z	-161,05	kN	
	Sum of support forces in Z	-161,05	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	17,5	mm	Member No. 576, x: 0.063 m
	Maximum displacement in Y-direction	-64,6	mm	Member No. 141, x: 0.207 m
	Maximum displacement in Z-direction	-35,2	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	72,3	mm	Member No. 147, x: 0.152 m
	Maximum rotation about X-axis	-30,5	mrad	FE Mesh Node No. 898 (X: 4.636, Y: -1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,9	mrad	FE Mesh Node No. 1202 (X: 5.985, Y: -1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	-36,5	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO36 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC9 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-21,71	kN	
	Sum of support forces in Y	-21,71	kN	Deviation: 0.00 %

	Sum of loads in Z	-154,75	kN	
	Sum of support forces in Z	-154,75	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-13,6	mm	Member No. 573, x: 0.063 m
	Maximum displacement in Y-direction	-60,4	mm	Member No. 150, x: 0.190 m
	Maximum displacement in Z-direction	-29,1	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	65,8	mm	Member No. 147, x: 0.203 m
	Maximum rotation about X-axis	-30,5	mrad	FE Mesh Node No. 898 (X: 4.636, Y: -1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,9	mrad	FE Mesh Node No. 1202 (X: 5.985, Y: -1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	-34,8	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO37 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC9 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-21,71	kN	
	Sum of support forces in Y	-21,71	kN	Deviation: 0.00 %
	Sum of loads in Z	-158,80	kN	
	Sum of support forces in Z	-158,80	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	17,7	mm	Member No. 576, x: 0.063 m
	Maximum displacement in Y-direction	-65,2	mm	Member No. 141, x: 0.207 m
	Maximum displacement in Z-direction	-34,5	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	72,6	mm	FE Mesh Node No. 104 (X: 5.609, Y: 0.000, Z: 4.501 m)
	Maximum rotation about X-axis	-30,5	mrad	FE Mesh Node No. 898 (X: 4.636, Y: -1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,9	mrad	FE Mesh Node No. 1202 (X: 5.985, Y: -1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	-36,7	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO38 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC9 + 1.35*LC12			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-21,71	kN	
	Sum of support forces in Y	-21,71	kN	Deviation: 0.00 %
	Sum of loads in Z	-159,81	kN	
	Sum of support forces in Z	-159,81	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-21,2	mm	Member No. 573, x: 0.063 m
	Maximum displacement in Y-direction	-67,6	mm	Member No. 141, x: 0.249 m
	Maximum displacement in Z-direction	-43,3	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	78,9	mm	FE Mesh Node No. 575 (X: 6.216, Y: 0.000, Z: 4.528 m)
	Maximum rotation about X-axis	-30,5	mrad	FE Mesh Node No. 898 (X: 4.636, Y: -1.800, Z: 0.314 m)
	Maximum rotation about Y-axis	-41,9	mrad	FE Mesh Node No. 1202 (X: 5.985, Y: -1.043, Z: 0.314 m)
	Maximum rotation about Z-axis	-37,8	mrad	Member No. 969, x: 0.228 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T

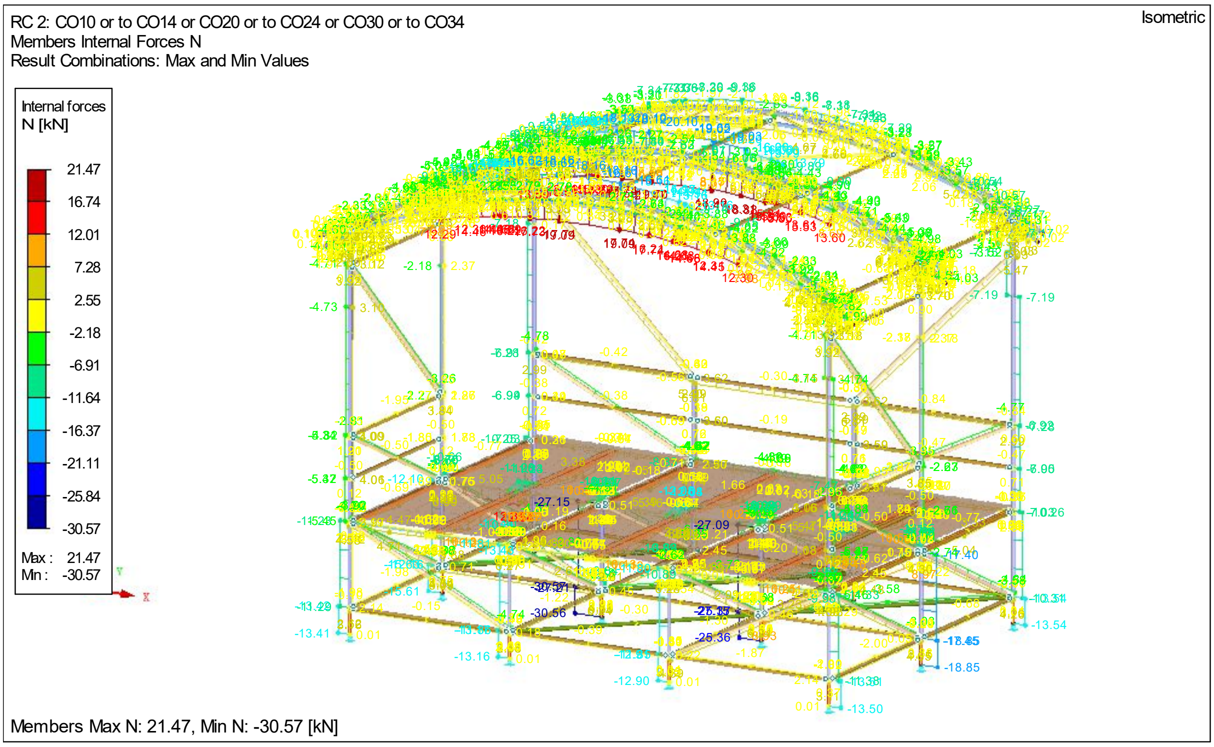
2.7.7.1 Deformation of the In-service situation characteristic maximum values.

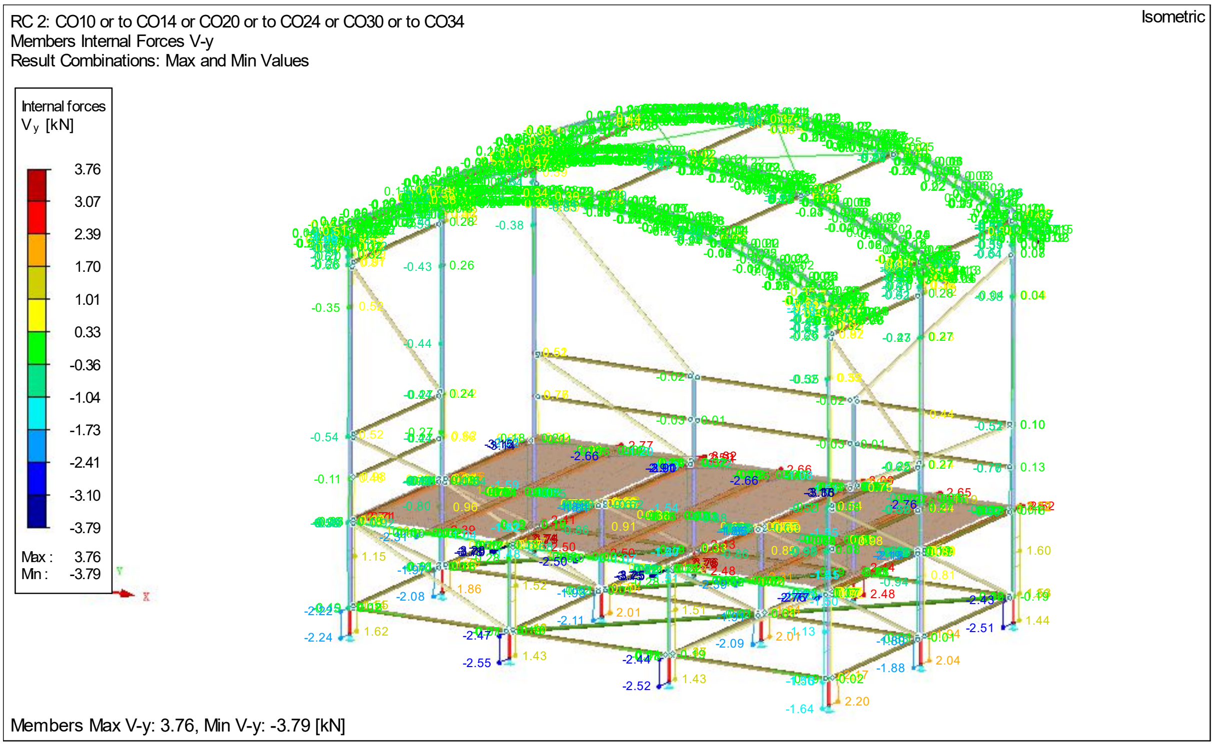


2.7.7.2 Deformation of the In-service situation characteristic minimum values.



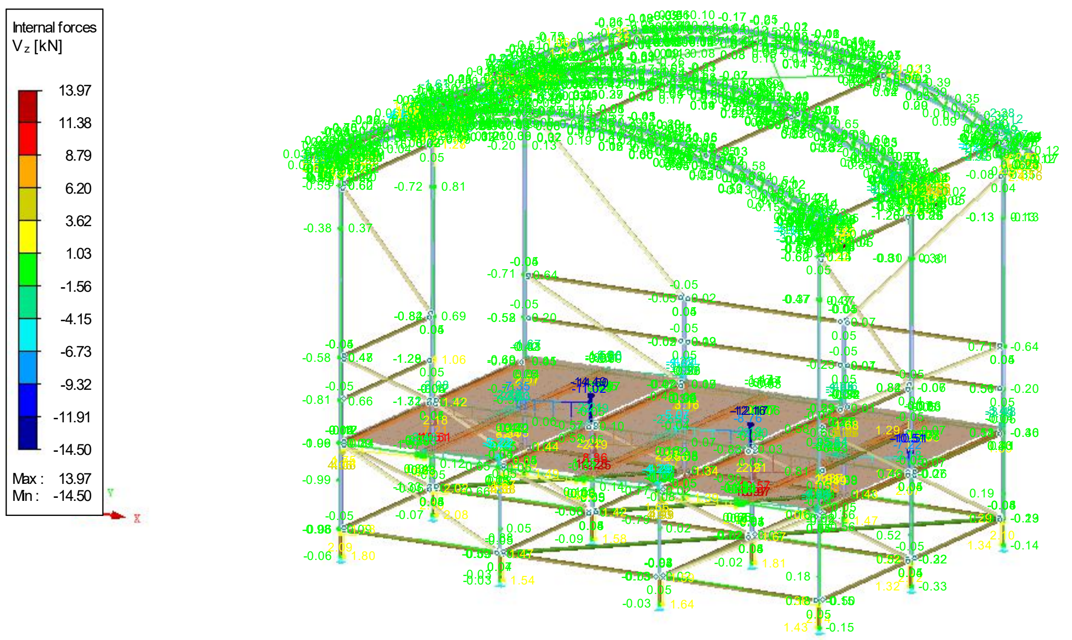
2.7.7.3 Internal force diagram result combination RC2 Design calculation In-service situation.





RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces V-z
Result Combinations: Max and Min Values

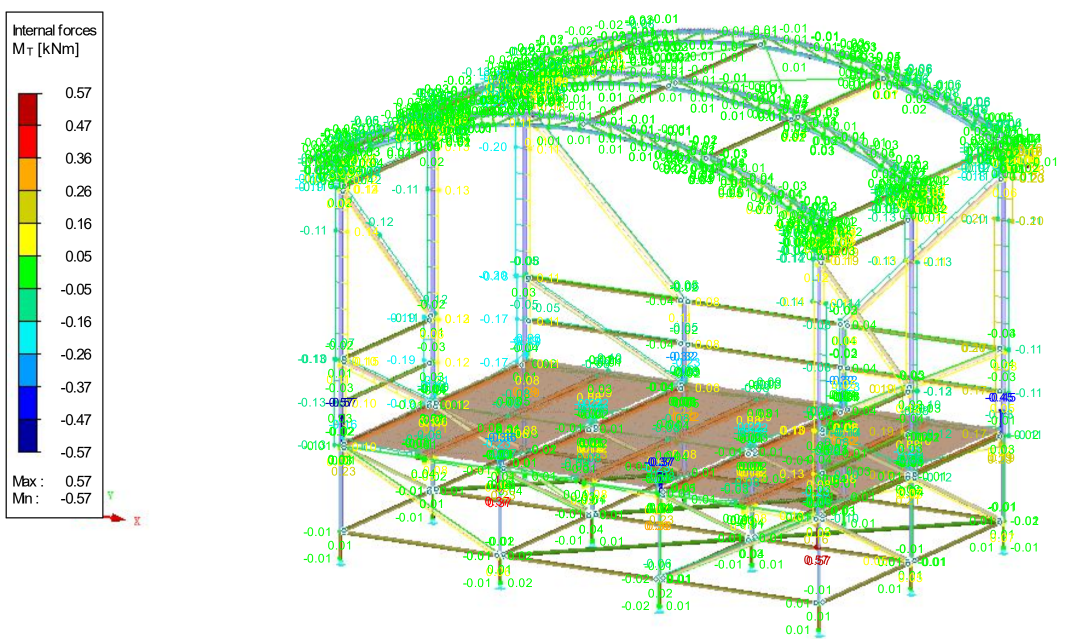
Isometric



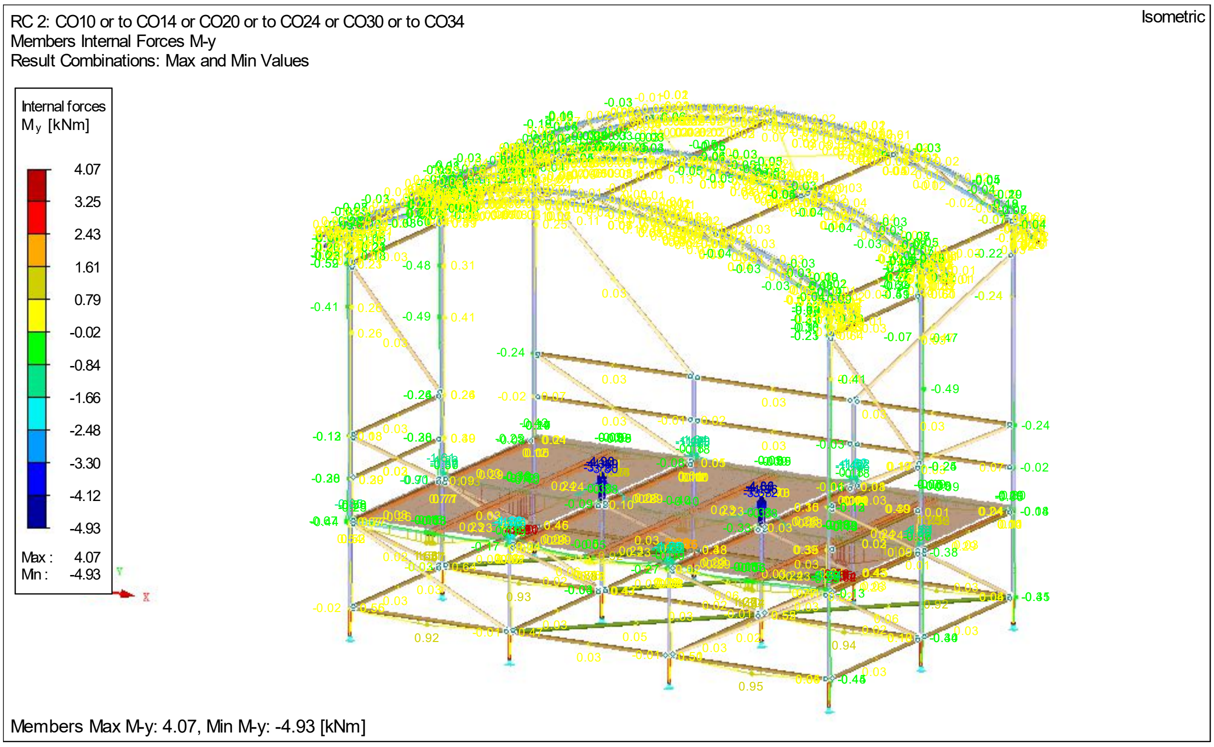
Members Max V-z: 13.97, Min V-z: -14.50 [kN]

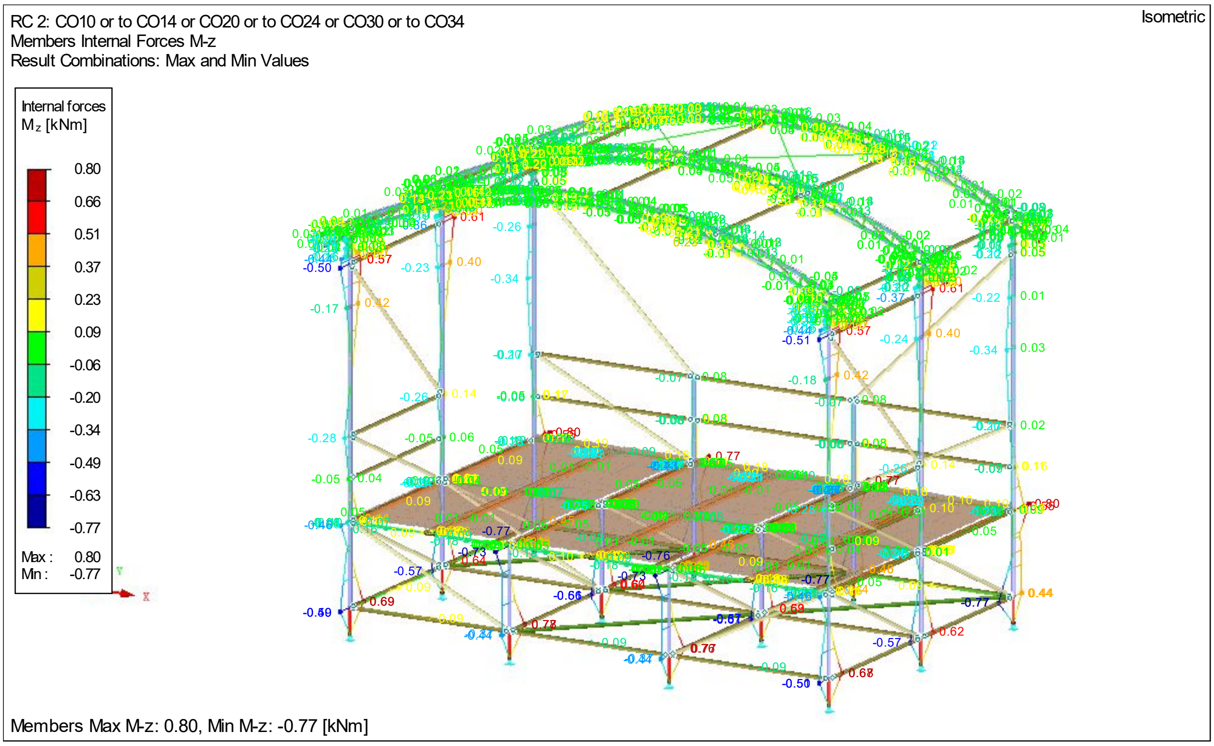
RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces M-T
Result Combinations: Max and Min Values

Isometric



Members Max M-T: 0.57, Min M-T: -0.57 [kNm]


RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces M-y
Result Combinations: Max and Min Values
Isometric
Internal forces
M_y [kNm]
4.07
3.25
2.43
1.61
0.79
-0.02
-0.84
-1.66
-2.48
-3.30
-4.12
-4.93
Max : 4.07
Min : -4.93
Members Max M-y: 4.07, Min M-y: -4.93 [kNm]


RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces M-z
Result Combinations: Max and Min Values
Isometric
Internal forces
M_z [kNm]
0.80
0.66
0.51
0.37
0.23
0.09
-0.06
-0.20
-0.34
-0.49
-0.63
-0.77
Max : 0.80
Min : -0.77
Members Max M-z: 0.80, Min M-z: -0.77 [kNm]

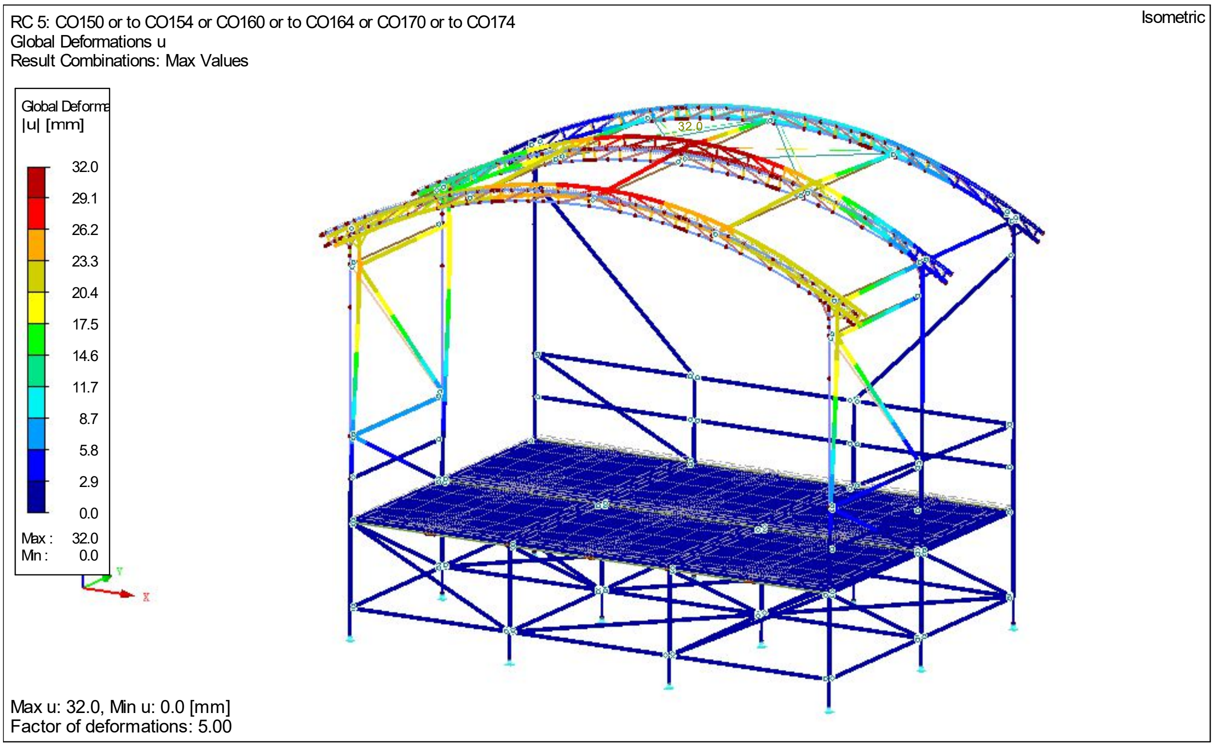
2.7.8 Calculation result of RC4 - Design values Out-service: 1 * (CO100 – CO124)

Description	Value	Unit	Comment
CO100 - 1.15*LC1 + 1.15*LC2 + 1.35*LC13			
Sum of loads in X	0,00	kN	
Sum of support forces in X	0,00	kN	
Sum of loads in Y	2,17	kN	
Sum of support forces in Y	2,17	kN	Deviation: 0.00 %
Sum of loads in Z	-25,28	kN	
Sum of support forces in Z	-25,28	kN	Deviation: 0.00 %
Maximum displacement in X-direction	11,4	mm	Member No. 573, x: 0.125 m
Maximum displacement in Y-direction	15,0	mm	Member No. 142, x: 0.203 m
Maximum displacement in Z-direction	23,5	mm	Member No. 893, x: 0.054 m
Maximum vectorial displacement	27,3	mm	Member No. 1027, x: 0.421 m
Maximum rotation about X-axis	-17,6	mrad	Member No. 932, x: 0.035 m
Maximum rotation about Y-axis	23,7	mrad	Member No. 665, x: 0.000 m
Maximum rotation about Z-axis	-9,5	mrad	Member No. 61, x: 0.569 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$
CO101 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC13			
Sum of loads in X	0,00	kN	
Sum of support forces in X	0,00	kN	
Sum of loads in Y	2,17	kN	
Sum of support forces in Y	2,17	kN	Deviation: 0.00 %
Sum of loads in Z	-35,63	kN	
Sum of support forces in Z	-35,63	kN	Deviation: 0.00 %
Maximum displacement in X-direction	6,6	mm	Member No. 653, x: 0.125 m
Maximum displacement in Y-direction	12,5	mm	Member No. 141, x: 0.290 m
Maximum displacement in Z-direction	-14,6	mm	Member No. 685, x: 1.000 m
Maximum vectorial displacement	18,3	mm	Member No. 143, x: 0.000 m
Maximum rotation about X-axis	-16,6	mrad	Member No. 932, x: 0.035 m
Maximum rotation about Y-axis	-23,7	mrad	Member No. 685, x: 0.000 m
Maximum rotation about Z-axis	-8,9	mrad	Member No. 61, x: 0.569 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$
CO102 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC13			
Sum of loads in X	0,00	kN	
Sum of support forces in X	0,00	kN	
Sum of loads in Y	2,17	kN	
Sum of support forces in Y	2,17	kN	Deviation: 0.00 %
Sum of loads in Z	-29,33	kN	
Sum of support forces in Z	-29,33	kN	Deviation: 0.00 %
Maximum displacement in X-direction	2,9	mm	Member No. 653, x: 0.250 m
Maximum displacement in Y-direction	13,0	mm	Member No. 1021, x: 0.350 m
Maximum displacement in Z-direction	-14,6	mm	Member No. 685, x: 1.000 m
Maximum vectorial displacement	14,7	mm	Member No. 1022, x: 0.421 m
Maximum rotation about X-axis	-16,4	mrad	Member No. 932, x: 0.035 m
Maximum rotation about Y-axis	-23,7	mrad	Member No. 685, x: 0.000 m
Maximum rotation about Z-axis	-8,9	mrad	Member No. 61, x: 0.569 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$
CO103 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC13			
Sum of loads in X	0,00	kN	
Sum of support forces in X	0,00	kN	
Sum of loads in Y	2,17	kN	
Sum of support forces in Y	2,17	kN	Deviation: 0.00 %
Sum of loads in Z	-33,38	kN	
Sum of support forces in Z	-33,38	kN	Deviation: 0.00 %
Maximum displacement in X-direction	6,8	mm	Member No. 653, x: 0.125 m
Maximum displacement in Y-direction	12,6	mm	Member No. 141, x: 0.290 m
Maximum displacement in Z-direction	-14,6	mm	Member No. 685, x: 1.000 m
Maximum vectorial displacement	18,1	mm	Member No. 142, x: 0.355 m
Maximum rotation about X-axis	-16,4	mrad	Member No. 932, x: 0.035 m
Maximum rotation about Y-axis	-23,7	mrad	Member No. 685, x: 0.000 m
Maximum rotation about Z-axis	-8,8	mrad	Member No. 61, x: 0.569 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		$N, V_y, V_z, M_y, M_z, M_T$
CO104 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC13			
Sum of loads in X	0,00	kN	
Sum of support forces in X	0,00	kN	
Sum of loads in Y	2,17	kN	
Sum of support forces in Y	2,17	kN	Deviation: 0.00 %
Sum of loads in Z	-34,39	kN	
Sum of support forces in Z	-34,39	kN	Deviation: 0.00 %
Maximum displacement in X-direction	10,4	mm	Member No. 653, x: 0.125 m
Maximum displacement in Y-direction	11,8	mm	Member No. 141, x: 0.166 m
Maximum displacement in Z-direction	-22,2	mm	Member No. 933, x: 0.054 m
Maximum vectorial displacement	24,6	mm	Member No. 1023, x: 0.421 m
Maximum rotation about X-axis	-15,5	mrad	Member No. 932, x: 0.035 m
Maximum rotation about Y-axis	-23,7	mrad	Member No. 686, x: 0.000 m
Maximum rotation about Z-axis	-8,5	mrad	Member No. 61, x: 0.455 m

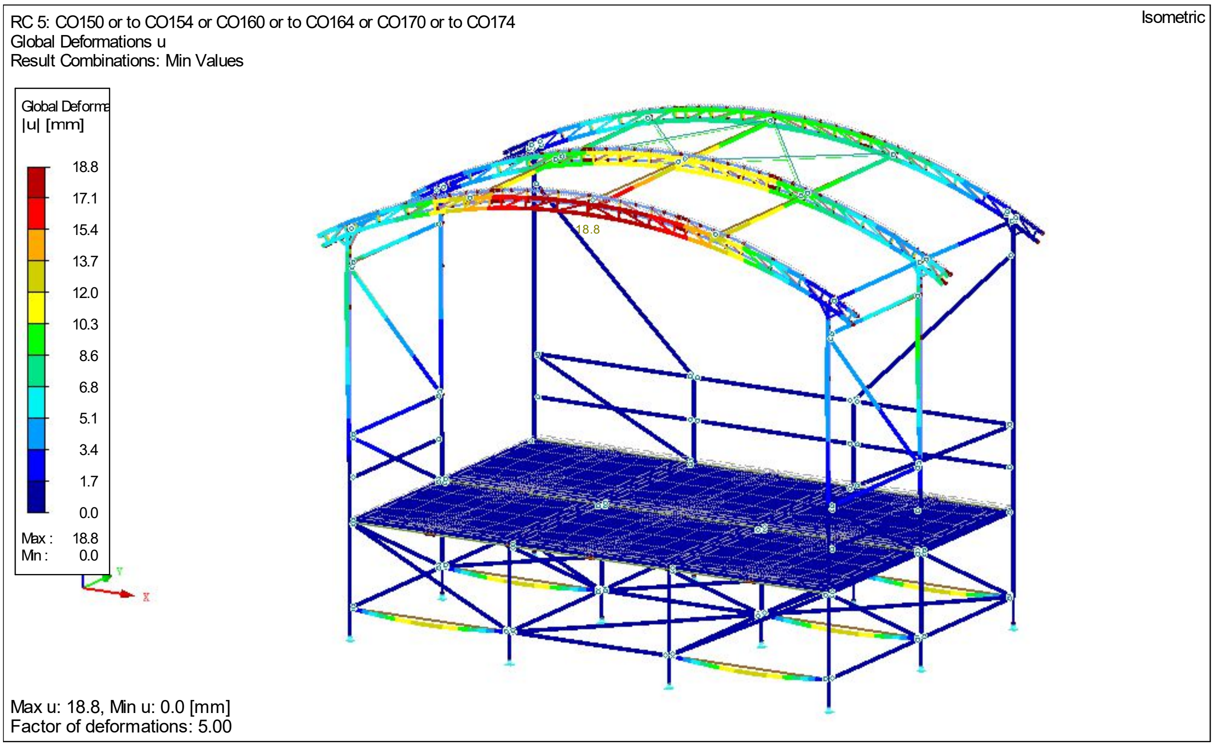
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
CO110 - 1.15*LC1 + 1.15*LC2 + 1.35*LC14			
Sum of loads in X	2,47	kN	
Sum of support forces in X	2,47	kN	Deviation: 0.00 %
Sum of loads in Y	0,00	kN	
Sum of support forces in Y	0,00	kN	
Sum of loads in Z	-24,64	kN	
Sum of support forces in Z	-24,64	kN	Deviation: 0.00 %
Maximum displacement in X-direction	32,2	mm	Member No. 695, x: 2.880 m
Maximum displacement in Y-direction	11,5	mm	Member No. 141, x: 0.249 m
Maximum displacement in Z-direction	41,0	mm	Member No. 151, x: 0.341 m
Maximum vectorial displacement	42,4	mm	Member No. 146, x: 0.232 m
Maximum rotation about X-axis	-21,7	mrad	Member No. 932, x: 0.035 m
Maximum rotation about Y-axis	-23,8	mrad	Member No. 686, x: 0.000 m
Maximum rotation about Z-axis	11,3	mrad	Member No. 681, x: 2.072 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
CO111 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC14			
Sum of loads in X	2,47	kN	
Sum of support forces in X	2,47	kN	Deviation: 0.00 %
Sum of loads in Y	0,00	kN	
Sum of support forces in Y	0,00	kN	
Sum of loads in Z	-34,99	kN	
Sum of support forces in Z	-34,99	kN	Deviation: 0.00 %
Maximum displacement in X-direction	26,7	mm	Member No. 1046, x: 0.000 m
Maximum displacement in Y-direction	9,4	mm	Member No. 141, x: 0.083 m
Maximum displacement in Z-direction	16,3	mm	Member No. 146, x: 0.232 m
Maximum vectorial displacement	27,6	mm	Member No. 141, x: 0.041 m
Maximum rotation about X-axis	21,0	mrad	Member No. 852, x: 0.035 m
Maximum rotation about Y-axis	-23,9	mrad	Member No. 686, x: 0.000 m
Maximum rotation about Z-axis	12,3	mrad	Member No. 681, x: 2.072 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
CO112 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC14			
Sum of loads in X	2,47	kN	
Sum of support forces in X	2,47	kN	Deviation: 0.00 %
Sum of loads in Y	0,00	kN	
Sum of support forces in Y	0,00	kN	
Sum of loads in Z	-28,69	kN	
Sum of support forces in Z	-28,69	kN	Deviation: 0.00 %
Maximum displacement in X-direction	25,2	mm	Member No. 83, x: 0.276 m
Maximum displacement in Y-direction	9,9	mm	Member No. 141, x: 0.166 m
Maximum displacement in Z-direction	21,9	mm	Member No. 146, x: 0.232 m
Maximum vectorial displacement	26,9	mm	Member No. 141, x: 0.041 m
Maximum rotation about X-axis	-20,3	mrad	Member No. 932, x: 0.035 m
Maximum rotation about Y-axis	-23,8	mrad	Member No. 686, x: 0.000 m
Maximum rotation about Z-axis	11,7	mrad	Member No. 681, x: 2.072 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
CO113 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC14			
Sum of loads in X	2,47	kN	
Sum of support forces in X	2,47	kN	Deviation: 0.00 %
Sum of loads in Y	0,00	kN	
Sum of support forces in Y	0,00	kN	
Sum of loads in Z	-32,74	kN	
Sum of support forces in Z	-32,74	kN	Deviation: 0.00 %
Maximum displacement in X-direction	26,4	mm	Member No. 949, x: 0.000 m
Maximum displacement in Y-direction	9,3	mm	Member No. 141, x: 0.083 m
Maximum displacement in Z-direction	16,9	mm	Member No. 146, x: 0.232 m
Maximum vectorial displacement	27,1	mm	Member No. 141, x: 0.083 m
Maximum rotation about X-axis	20,6	mrad	Member No. 852, x: 0.035 m
Maximum rotation about Y-axis	-23,9	mrad	Member No. 686, x: 0.000 m
Maximum rotation about Z-axis	12,1	mrad	Member No. 681, x: 2.072 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
CO114 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC14			
Sum of loads in X	2,47	kN	
Sum of support forces in X	2,47	kN	Deviation: 0.00 %
Sum of loads in Y	0,00	kN	
Sum of support forces in Y	0,00	kN	
Sum of loads in Z	-33,75	kN	
Sum of support forces in Z	-33,75	kN	Deviation: 0.00 %
Maximum displacement in X-direction	29,6	mm	Member No. 949, x: 0.000 m
Maximum displacement in Y-direction	8,6	mm	Member No. 952, x: 0.075 m
Maximum displacement in Z-direction	-14,7	mm	Member No. 686, x: 1.000 m
Maximum vectorial displacement	29,6	mm	Member No. 949, x: 0.000 m
Maximum rotation about X-axis	20,5	mrad	Member No. 852, x: 0.035 m
Maximum rotation about Y-axis	-23,9	mrad	Member No. 686, x: 0.000 m
Maximum rotation about Z-axis	12,2	mrad	Member No. 681, x: 2.072 m
Method of analysis	2nd Order		Second order analysis (Nonlinear)
Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
CO120 - 1.15*LC1 + 1.15*LC2 + 1.35*LC15			
Sum of loads in X	0,00	kN	

	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-2,17	kN	
	Sum of support forces in Y	-2,17	kN	Deviation: 0.00 %
	Sum of loads in Z	-25,28	kN	
	Sum of support forces in Z	-25,28	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-10,9	mm	Member No. 576, x: 0.125 m
	Maximum displacement in Y-direction	-7,6	mm	Member No. 67, x: 0.038 m
	Maximum displacement in Z-direction	22,4	mm	Member No. 893, x: 0.054 m
	Maximum vectorial displacement	22,9	mm	Member No. 1027, x: 0.421 m
	Maximum rotation about X-axis	14,5	mrad	Member No. 852, x: 0.035 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 665, x: 0.000 m
	Maximum rotation about Z-axis	5,8	mrad	Member No. 20, x: 0.569 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO121 - 1.15*LC1 + 1.15*LC2 + 1.35*LC3 + 1.35*LC15			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-2,17	kN	
	Sum of support forces in Y	-2,17	kN	Deviation: 0.00 %
	Sum of loads in Z	-35,63	kN	
	Sum of support forces in Z	-35,63	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-6,7	mm	Member No. 645, x: 0.125 m
	Maximum displacement in Y-direction	-11,0	mm	Member No. 162, x: 0.237 m
	Maximum displacement in Z-direction	-14,6	mm	Member No. 667, x: 1.000 m
	Maximum vectorial displacement	17,0	mm	Member No. 138, x: 0.341 m
	Maximum rotation about X-axis	15,6	mrad	Member No. 852, x: 0.035 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	6,9	mrad	Member No. 20, x: 0.569 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO122 - 1.15*LC1 + 1.15*LC2 + 1.35*LC4 + 1.35*LC15			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-2,17	kN	
	Sum of support forces in Y	-2,17	kN	Deviation: 0.00 %
	Sum of loads in Z	-29,33	kN	
	Sum of support forces in Z	-29,33	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-2,9	mm	Member No. 645, x: 0.250 m
	Maximum displacement in Y-direction	-9,7	mm	Member No. 162, x: 0.128 m
	Maximum displacement in Z-direction	-14,6	mm	Member No. 667, x: 1.000 m
	Maximum vectorial displacement	14,6	mm	Member No. 667, x: 1.000 m
	Maximum rotation about X-axis	14,6	mrad	Member No. 852, x: 0.035 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 664, x: 0.000 m
	Maximum rotation about Z-axis	6,5	mrad	Member No. 20, x: 0.569 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO123 - 1.15*LC1 + 1.15*LC2 + 1.35*LC5 + 1.35*LC15			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-2,17	kN	
	Sum of support forces in Y	-2,17	kN	Deviation: 0.00 %
	Sum of loads in Z	-33,38	kN	
	Sum of support forces in Z	-33,38	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-6,8	mm	Member No. 645, x: 0.125 m
	Maximum displacement in Y-direction	-11,1	mm	Member No. 162, x: 0.237 m
	Maximum displacement in Z-direction	-14,6	mm	Member No. 667, x: 1.000 m
	Maximum vectorial displacement	16,7	mm	Member No. 138, x: 0.341 m
	Maximum rotation about X-axis	15,4	mrad	Member No. 852, x: 0.035 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	6,9	mrad	Member No. 20, x: 0.569 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T
	CO124 - 1.15*LC1 + 1.15*LC2 + 1.35*LC6 + 1.35*LC15			
	Sum of loads in X	0,00	kN	
	Sum of support forces in X	0,00	kN	
	Sum of loads in Y	-2,17	kN	
	Sum of support forces in Y	-2,17	kN	Deviation: 0.00 %
	Sum of loads in Z	-34,39	kN	
	Sum of support forces in Z	-34,39	kN	Deviation: 0.00 %
	Maximum displacement in X-direction	-10,4	mm	Member No. 645, x: 0.125 m
	Maximum displacement in Y-direction	-12,2	mm	Member No. 1030, x: 0.350 m
	Maximum displacement in Z-direction	-22,3	mm	Member No. 933, x: 0.054 m
	Maximum vectorial displacement	24,8	mm	FE Mesh Node No. 641 (X: 6.216, Y: -2.072, Z: 4.403 m)
	Maximum rotation about X-axis	15,3	mrad	Member No. 852, x: 0.035 m
	Maximum rotation about Y-axis	23,7	mrad	Member No. 667, x: 0.000 m
	Maximum rotation about Z-axis	7,2	mrad	Member No. 20, x: 0.569 m
	Method of analysis	2nd Order		Second order analysis (Nonlinear)
	Internal forces referred to deformed system for...	+		N, V_y, V_z, M_y, M_z, M_T

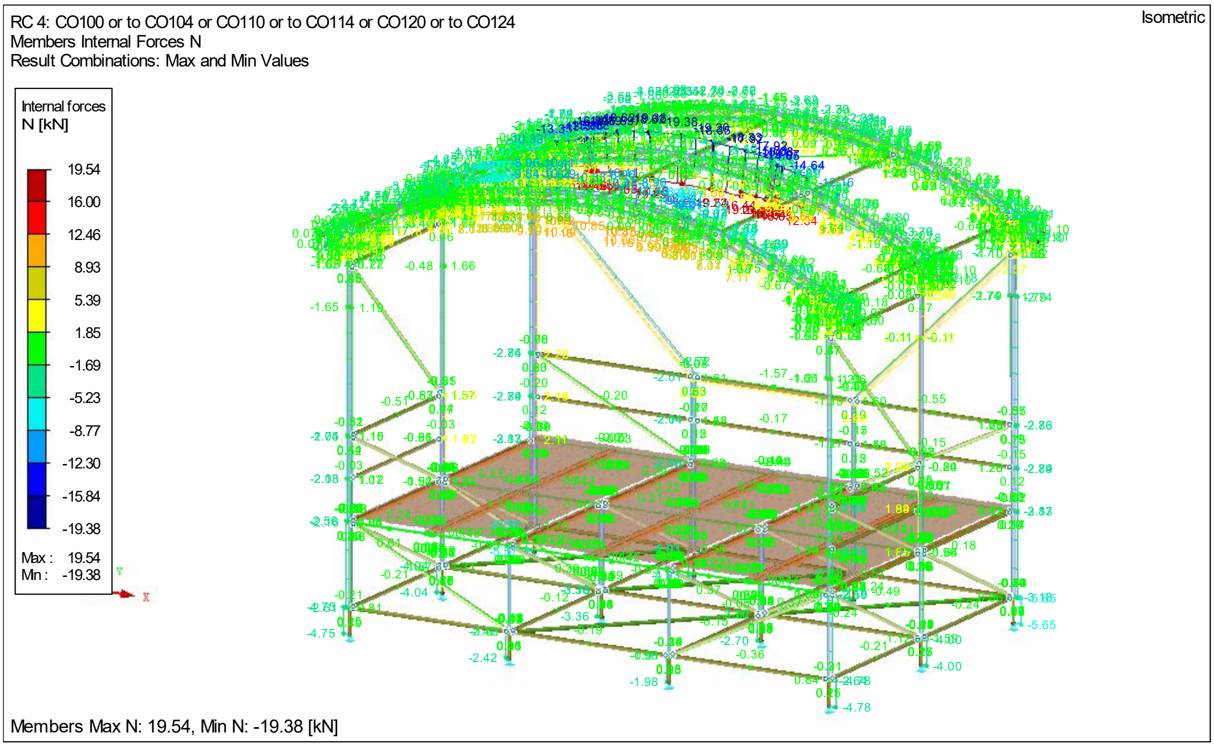
2.7.8.1 Deformation of the Out-service situation characteristic maximum values.

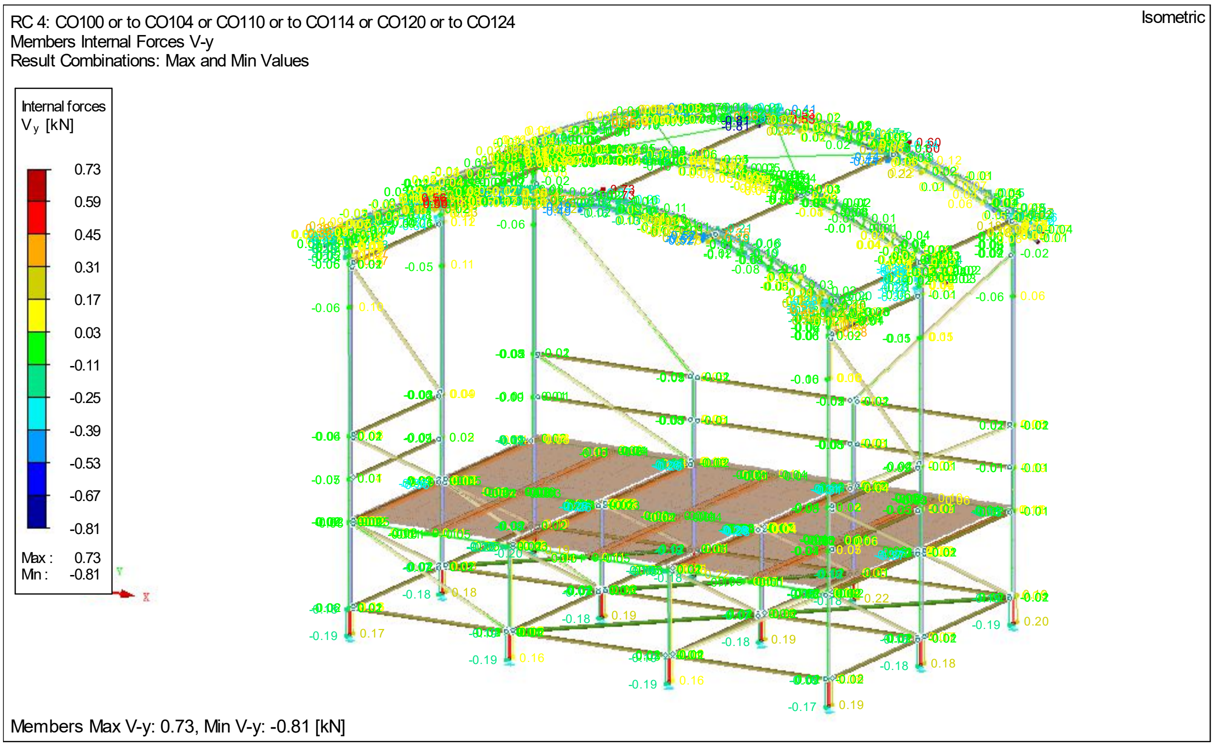


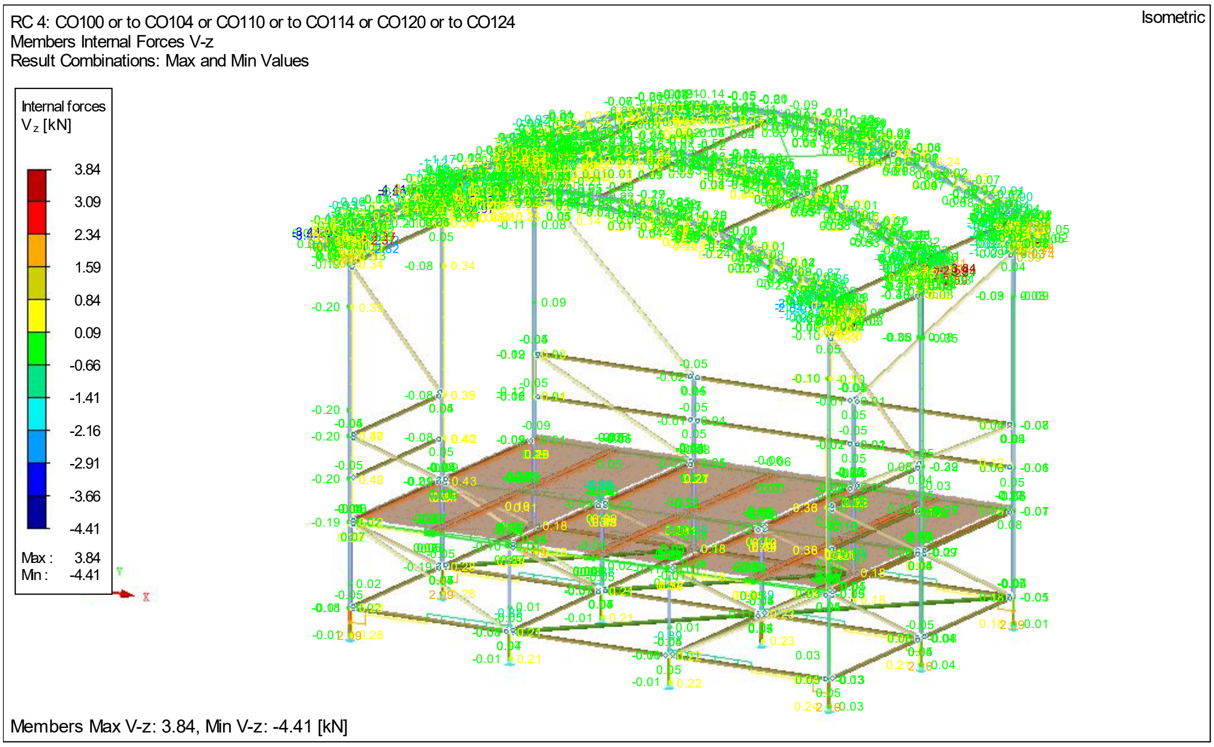
2.7.8.2 Deformation of the Out-service situation characteristic maximum values.

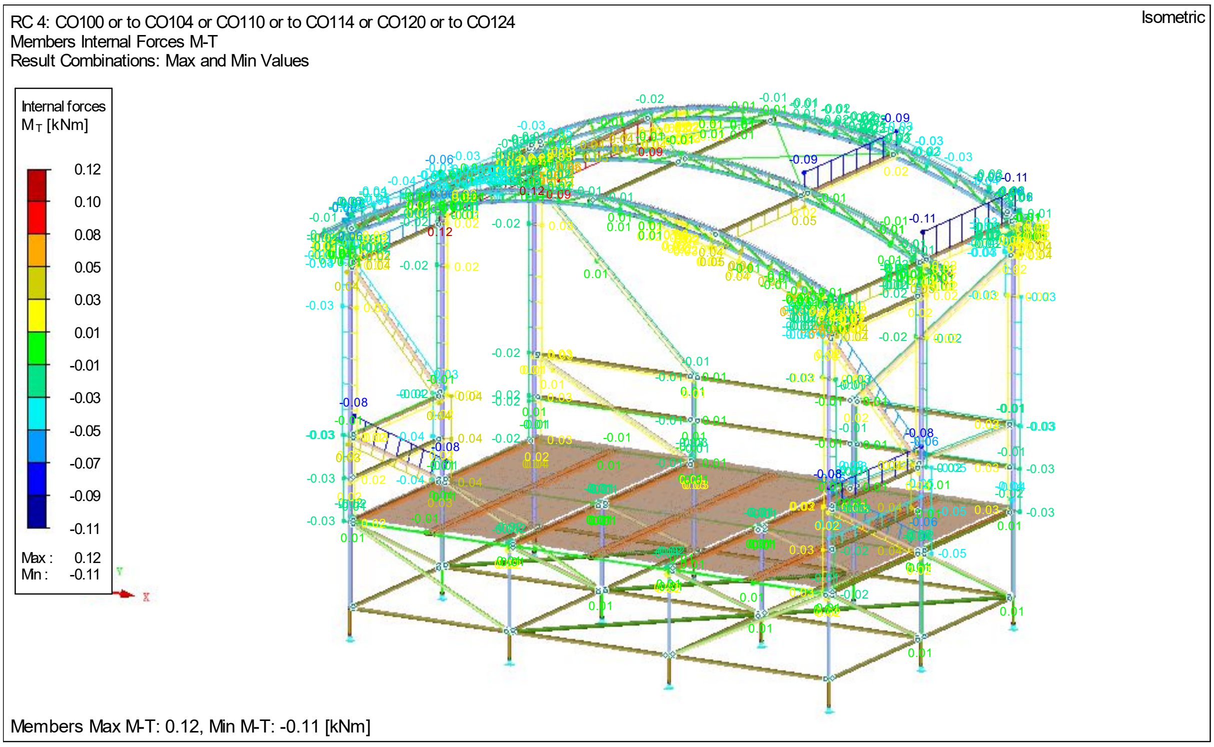


2.7.8.3 Internal force diagram result combination RC4 Design calculation Out-service situation.



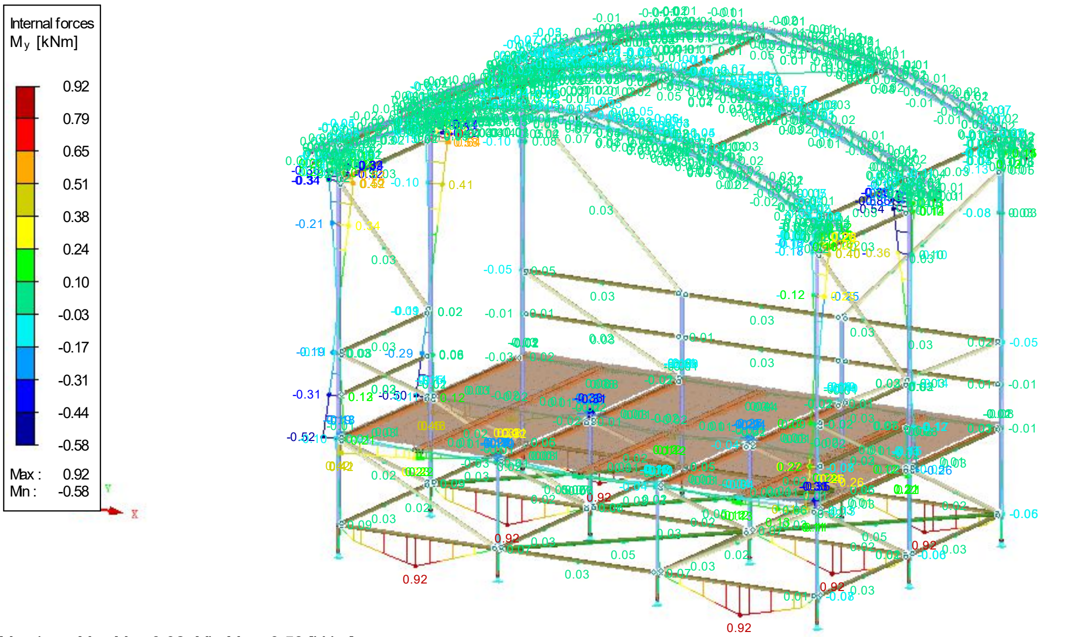



RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces V-z
Result Combinations: Max and Min Values
Isometric
Internal forces
V_z [kN]
3.84
3.09
2.34
1.59
0.84
0.09
-0.66
-1.41
-2.16
-2.91
-3.66
-4.41
Max : 3.84
Min : -4.41
Members Max V-z: 3.84, Min V-z: -4.41 [kN]


RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces M-T
Result Combinations: Max and Min Values
Isometric
Internal forces
M_T [kNm]
0.12
0.10
0.08
0.05
0.03
0.01
-0.01
-0.03
-0.05
-0.07
-0.09
-0.11
Max : 0.12
Min : -0.11
Members Max M-T: 0.12, Min M-T: -0.11 [kNm]

RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces M-y
Result Combinations: Max and Min Values

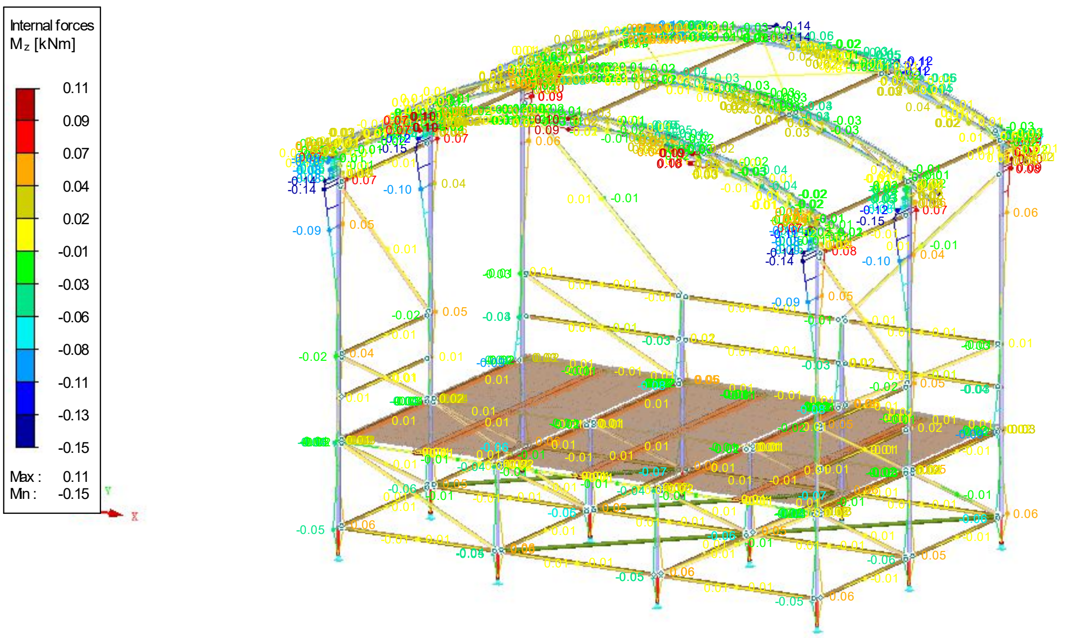
Isometric



Members Max M-y: 0.92, Min M-y: -0.58 [kNm]

RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces M-z
Result Combinations: Max and Min Values

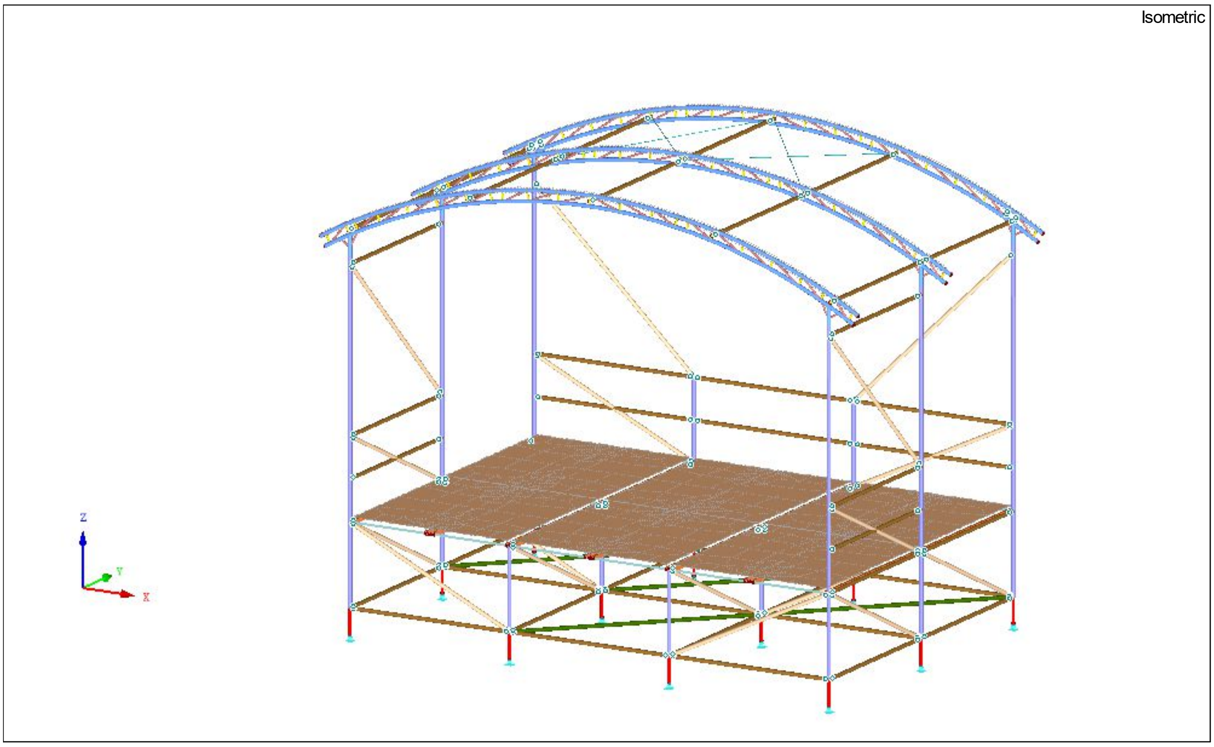
Isometric



Members Max M-z: 0.11, Min M-z: -0.15 [kNm]

2.8 Stress analyse calculation.

For the result combination RC1, RC2 and RC4 a stress analyse calculation has been made.



Cross-Sections
1: Ring 48/3; Aluminum EN-AW 6082 (EP,ET) T6
2: Ring 25/3; Aluminum EN-AW 6082 (EP,ET) T6
3: Ring 25/3; Aluminum EN-AW 6082 (EP,ET) T6
4: Ring 40/3; Steel S 235 JR
5: RO 38x4.5 | DIN EN 10220; Steel S 355 JR
6: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
7: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
8: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
9: RO 48.3x2.6 (Hot Formed); Steel S 235 JR
10: EV transom; Aluminum EN-AW 6005A (EP/O,ER/B) T6
11: HK 50/30/4/4/4/4; Aluminum EN-AW 6005A (EP/O,ER/B) T6
12: RD 8; steel 8.8 kw aliteit

2.8.1 stress analyse Cross sections description

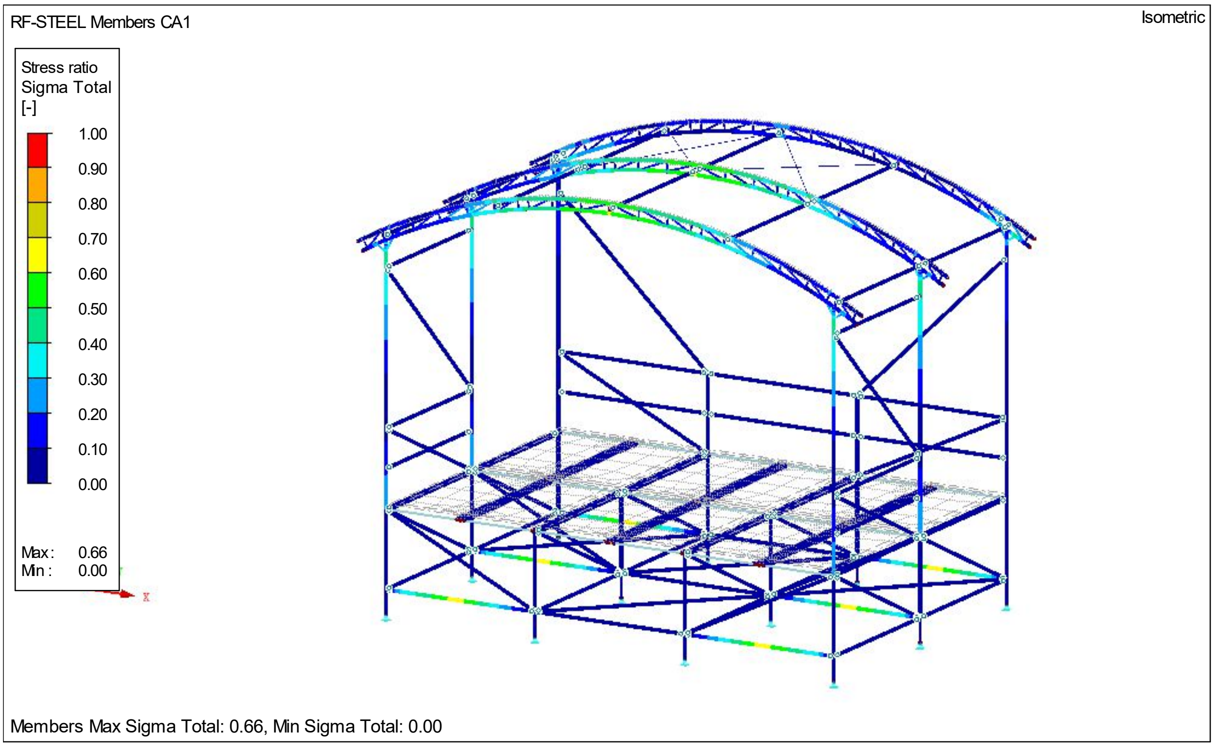
Section No.	Material No.	Cross-Section Description	Max. Design Ratio	Opti-mize
1	6	Ring 48/3	0,71	No
2	6	Ring 25/3	0,72	No
3	6	Ring 25/3	0,24	No
4	1	Ring 40/3	0,65	No
5	3	RO 38x4.5 | DIN EN 10220	0,05	No
6	2	RO 48.3x3.2 (Hot Formed)	0,46	No
7	2	RO 48.3x3.2 (Hot Formed)	0,66	No
8	2	RO 48.3x3.2 (Hot Formed)	0,04	No
9	1	RO 48.3x2.6 (Hot Formed)	0,08	No
10	5	EV transom		No
11	5	HK 50/30/4/4/4/4	0,02	No
12	7	RD 8	0,02	No

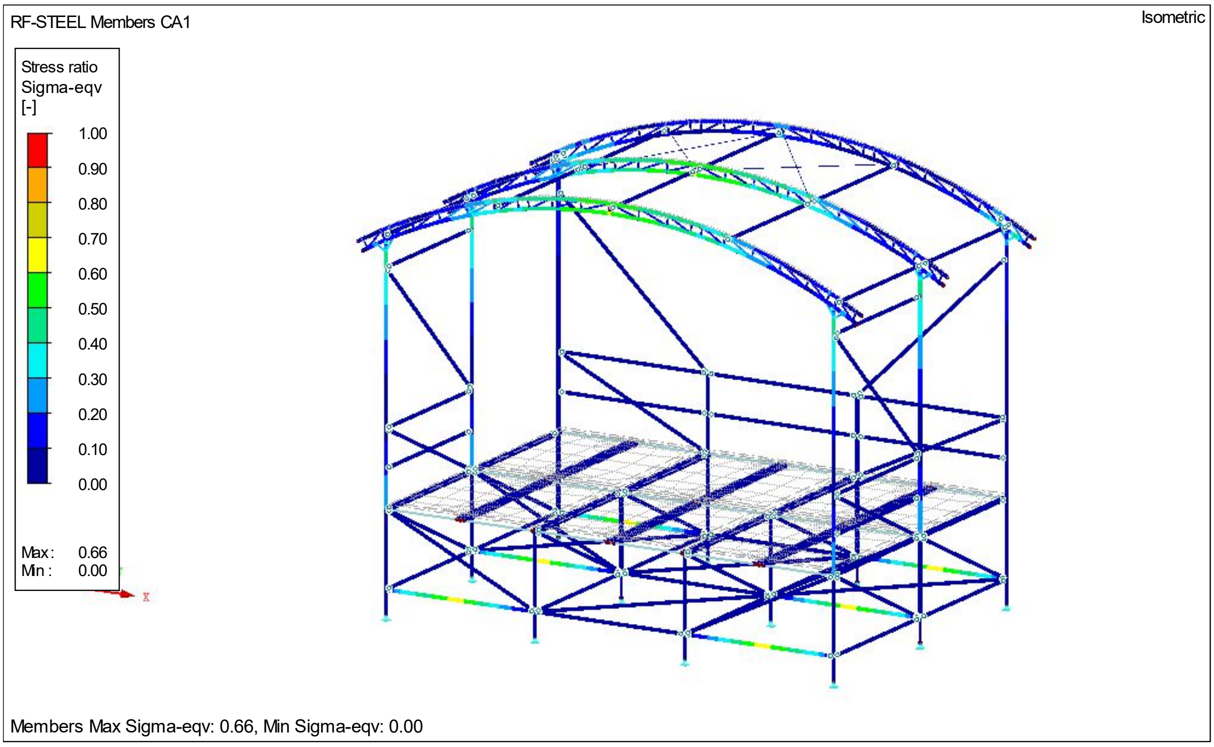
2.8.2 Used materials

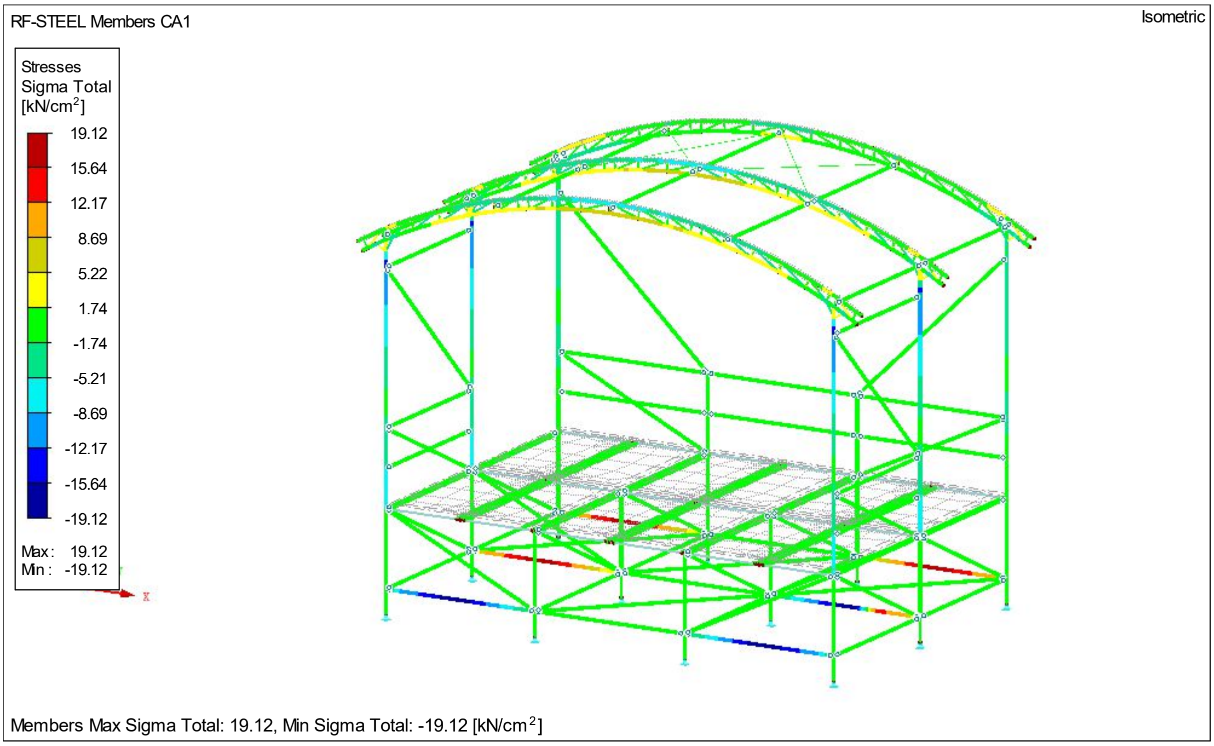
Material No.	Material Description	Safety Factor γ_M [-]	Yield Strength f_{yk} [kN/cm²]	Limit Stresses [kN/cm²] Manually	Limit σ_x	Limit τ	Limit σ_{eqv}
1	Steel S 235 JR* | EN 10025-2:2004-11	1,10	23,50	-	21,36	12,33	21,36
2	S320GD 1.0250* | EN 10346:2009-03	1,10	32,00	-	29,09	16,80	29,09
3	Steel S 355 JR* | EN 10025-2:2004-11	1,10	35,50	-	32,27	18,63	32,27
4	Plywood, Class F20/10 E40/20, Plate Stress, Perpendicular | EN 12369-2:2011-06	1,20	0,00	-	0,00	0,00	0,00
5	Aluminum EN-AW 6005A (EP/O,ER/B) T6* | EN 1999-1-1:2007	1,10	22,50	-	20,45	11,81	20,45
6	Aluminum EN-AW 6082 (EP,ET) T6* | EN 1999-1-1:2007	1,10	12,50	-	11,36	6,56	11,36
7	steel 8.8 kwaliteit* | EN 10346:2009-03	1,10	64,00	-	58,18	33,59	58,18

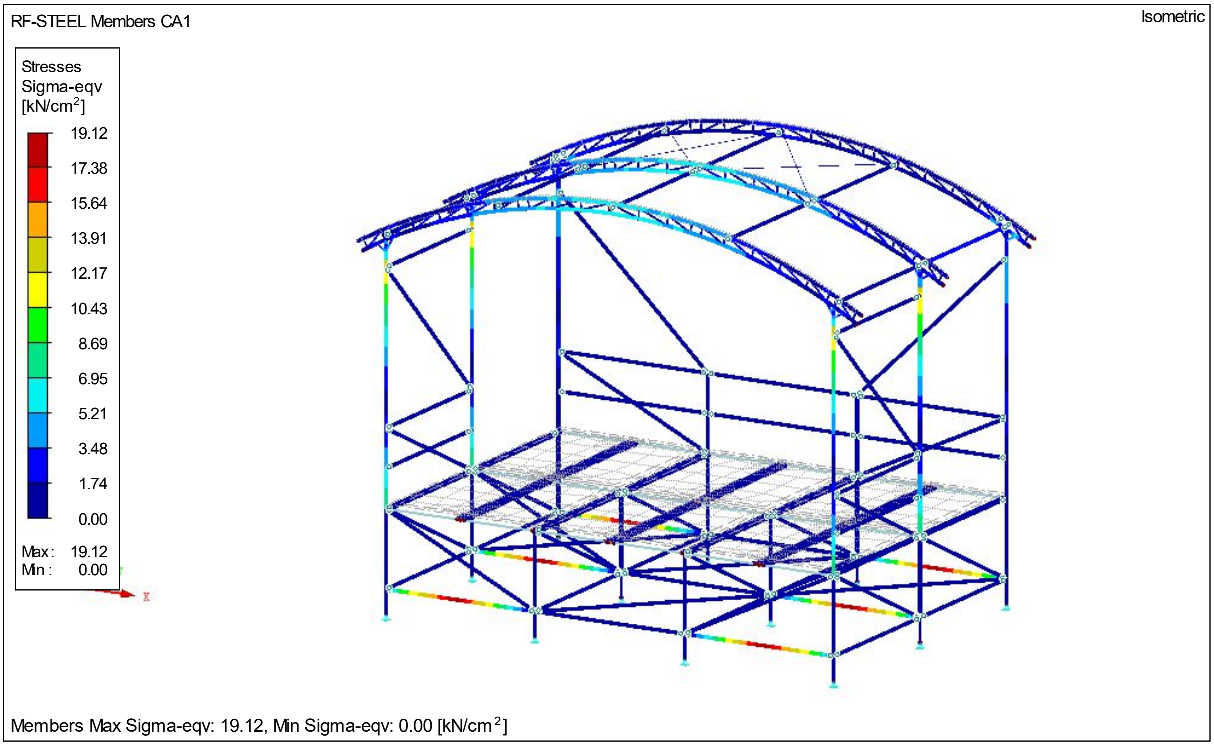
The Yield strength of material 6 has been manually changed. This is according to the Eurocode NEN-EN 1999-1-1 Table 3.2 the $f_{o,haz}$ for the heat affective zone. This check is concerning a welded construction with heat affective zones in the main elements, there for the choice to check the construction according to the lower $f_{o\ haz.}$

2.8.3 Results stress analyse calculation CA1 = RC1 General loading without wind





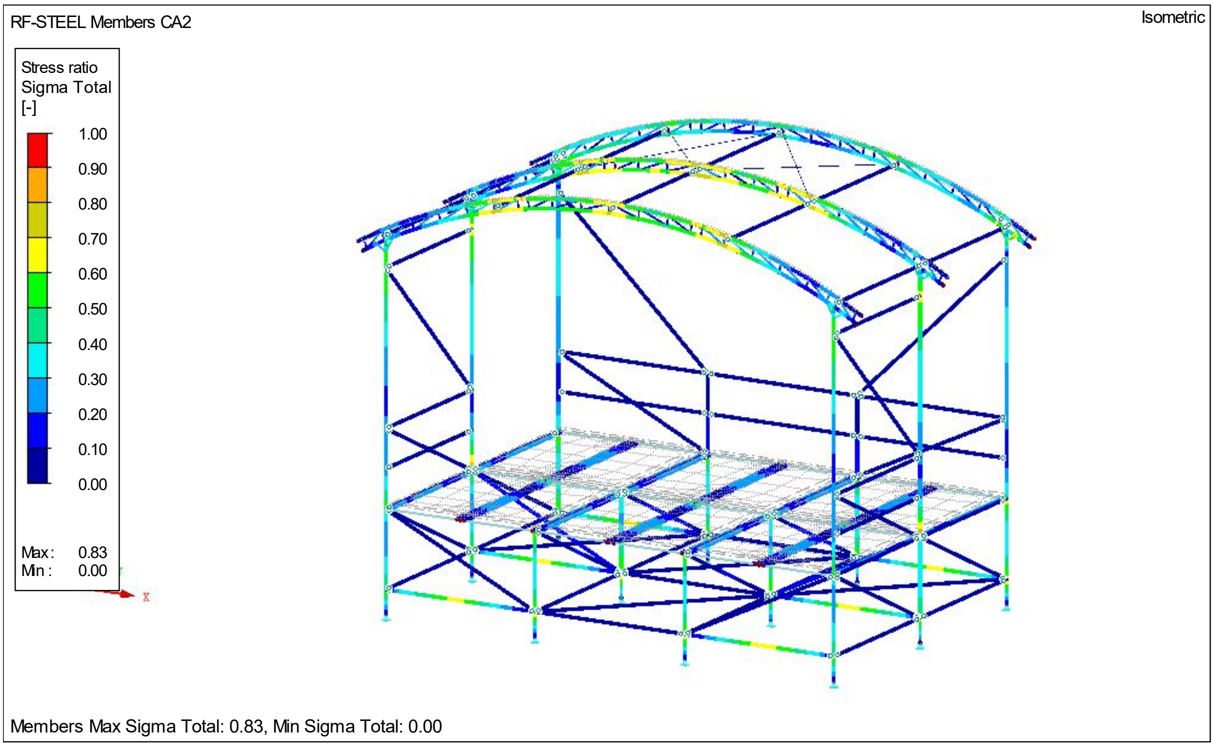

RF-STEEL Members CA1
Isometric
Stresses
Sigma Total
[kN/cm2]
19.12
15.64
12.17
8.69
5.22
1.74
-1.74
-5.21
-8.69
-12.17
-15.64
-19.12
Max: 19.12
Min: -19.12
Members Max Sigma Total: 19.12, Min Sigma Total: -19.12 [kN/cm2]

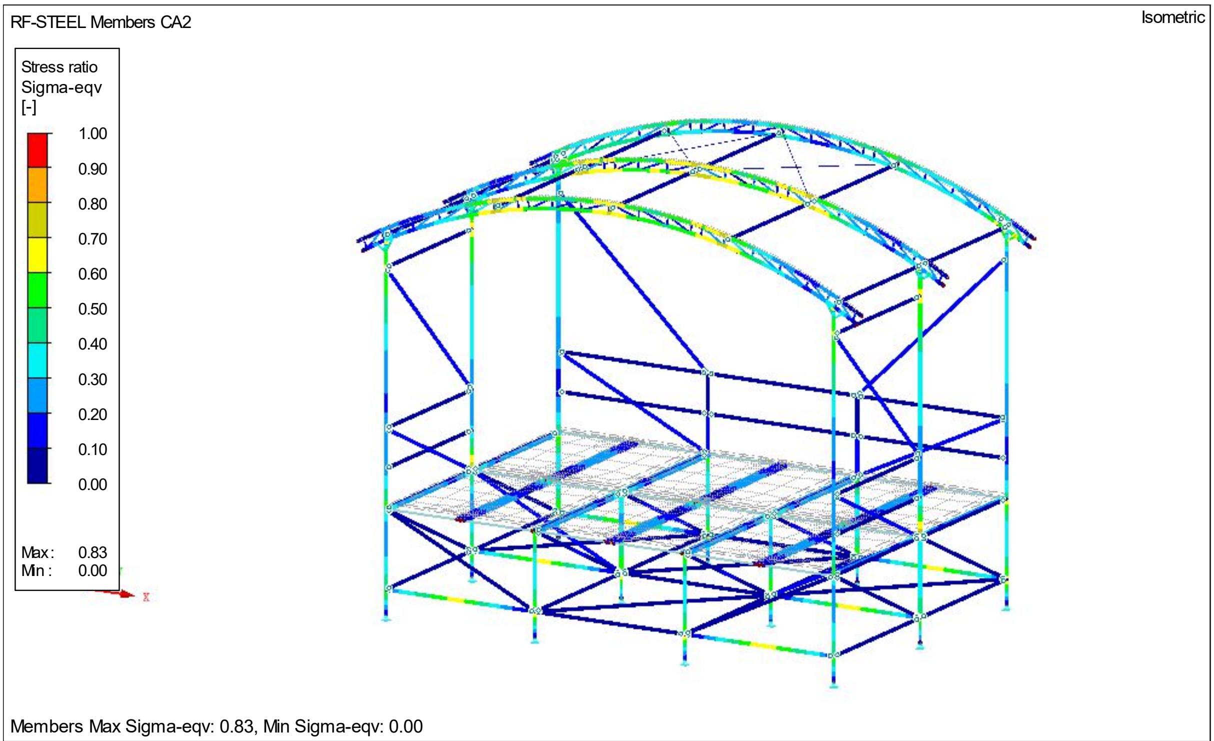

RF-STEEL Members CA1
Isometric
Stresses
Sigma-eqv
[kN/cm2]
19.12
17.38
15.64
13.91
12.17
10.43
8.69
6.95
5.21
3.48
1.74
0.00
Max: 19.12
Min: 0.00
Members Max Sigma-eqv: 19.12, Min Sigma-eqv: 0.00 [kN/cm2]

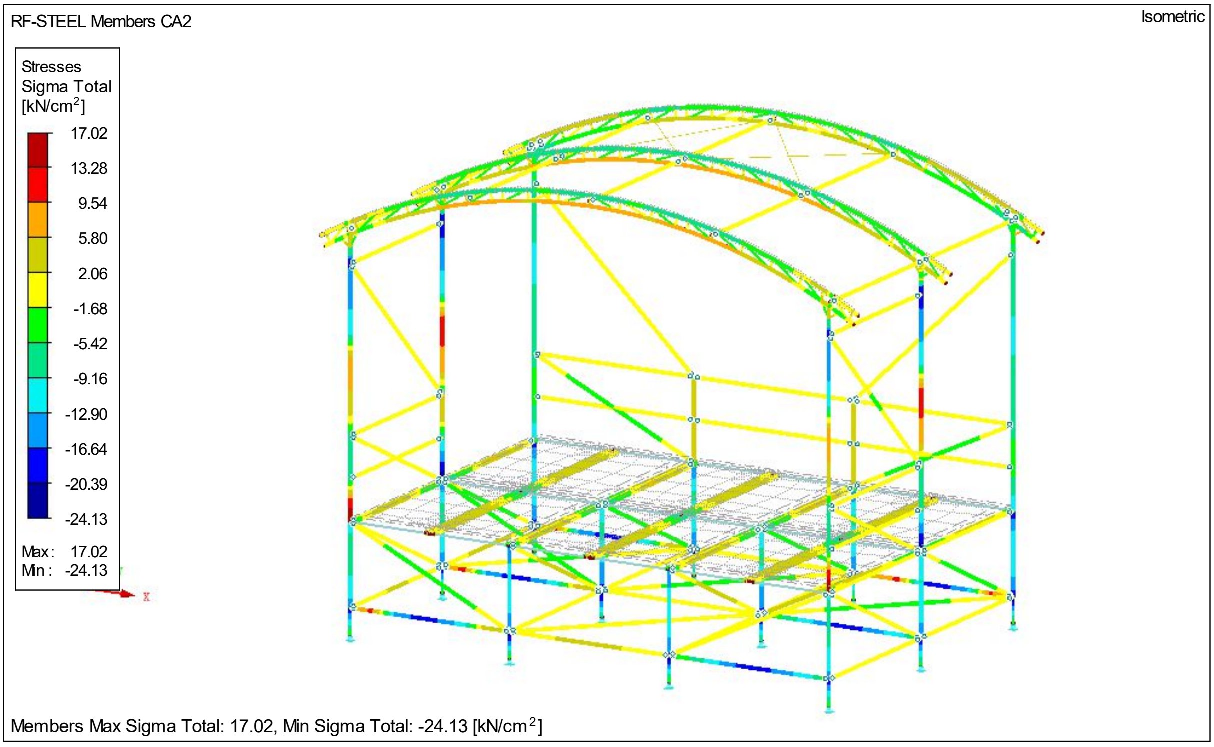
2.8.3.1 Results stress analyse calculation CA1 - RC1 utilisation per cross section

Section No.	Member No.	Location x [m]	S-Point No.	Load-ing	Stress Type	Stress [kN/cm²] Existing	Limit	Stress Ratio
1	Ring 48/3							
	145	0,405	29	CO4	Sigma Total	-6,99	11,36	0,62
	130	0,000	19	CO4	Tau Total	-2,14	6,56	0,33
	145	0,405	29	CO4	Sigma-eqv	6,99	11,36	0,62
2	Ring 25/3							
	840	0,000	10	CO4	Sigma Total	-6,59	11,36	0,58
	896	0,071	1	CO4	Tau Total	-1,36	6,56	0,21
	840	0,000	10	CO4	Sigma-eqv	6,59	11,36	0,58
3	Ring 25/3							
	1047	0,149	11	CO4	Sigma Total	4,89	11,36	0,43
	1041	0,000	2	CO4	Tau Total	-0,32	6,56	0,05
	1047	0,149	11	CO4	Sigma-eqv	4,89	11,36	0,43
4	Ring 40/3							
	122	0,099	28	CO4	Sigma Total	-13,76	21,36	0,64
	127	0,101	19	CO4	Tau Total	-1,79	12,33	0,15
	122	0,099	28	CO4	Sigma-eqv	13,77	21,36	0,64
5	RO 38x4.5 | DIN EN 10220							
	597	0,000	17	CO4	Sigma Total	-1,65	32,27	0,05
	640	0,000	3	CO4	Tau Total	-0,03	18,63	0,00
	597	0,000	17	CO4	Sigma-eqv	1,65	32,27	0,05
6	RO 48.3x3.2 (Hot Formed)							
	655	0,100	10	CO4	Sigma Total	-13,15	29,09	0,45
	592	0,100	1	CO4	Tau Total	-1,36	16,80	0,08
	655	0,100	10	CO4	Sigma-eqv	13,16	29,09	0,45
7	RO 48.3x3.2 (Hot Formed)							
	664	1,000	28	CO1	Sigma Total	19,12	29,09	0,66
	678	2,072	1	CO4	Tau Total	-1,35	16,80	0,08
	664	1,000	28	CO1	Sigma-eqv	19,12	29,09	0,66
8	RO 48.3x3.2 (Hot Formed)							
	730	1,465	10	CO1	Sigma Total	-1,08	29,09	0,04
	730	0,000	19	CO4	Tau Total	-0,04	16,80	0,00
	730	1,465	10	CO1	Sigma-eqv	1,08	29,09	0,04
9	RO 48.3x2.6 (Hot Formed)							
	728	1,440	28	CO4	Sigma Total	1,71	21,36	0,08
	695	0,000	19	CO4	Tau Total	-0,84	12,33	0,07
	728	1,440	28	CO4	Sigma-eqv	1,71	21,36	0,08
11	HK 50/30/4/4/4/4							
	471	2,072	10	CO4	Sigma Total	-0,40	20,45	0,02
	838	2,072	8	CO4	Tau Total	0,13	11,81	0,01
	471	2,072	10	CO4	Sigma-eqv	0,41	20,45	0,02
12	RD 8							
	1016	0,000	1	CO4	Sigma Total	1,39	58,18	0,02
	1014	0,000	1	CO1	Tau Total	0,00	33,59	0,00
	1016	0,000	1	CO4	Sigma-eqv	1,39	58,18	0,02

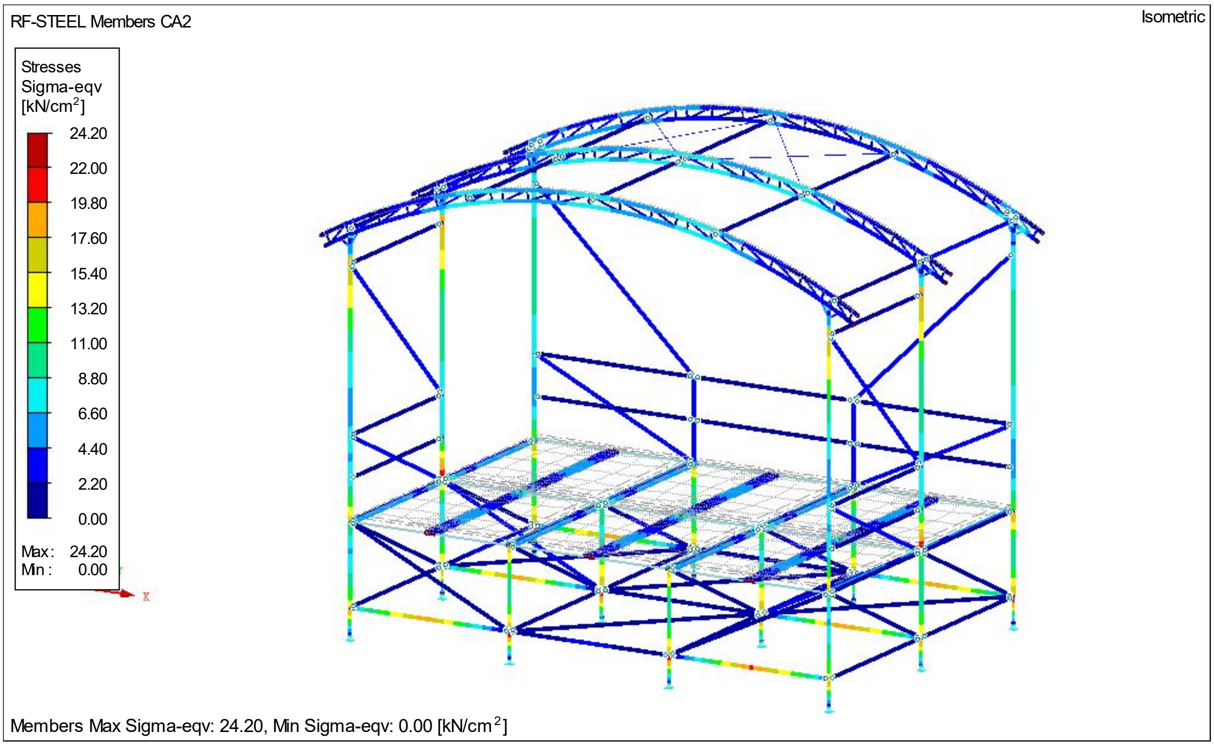
2.8.4 Results stress analyse calculation CA2 = RC2 Design Values In-service.







RF-STEEL Members CA2
Isometric
Stresses
Sigma Total
[kN/cm2]
17.02
13.28
9.54
5.80
2.06
-1.68
-5.42
-9.16
-12.90
-16.64
-20.39
-24.13
Max : 17.02
Min : -24.13
Members Max Sigma Total: 17.02, Min Sigma Total: -24.13 [kN/cm2]

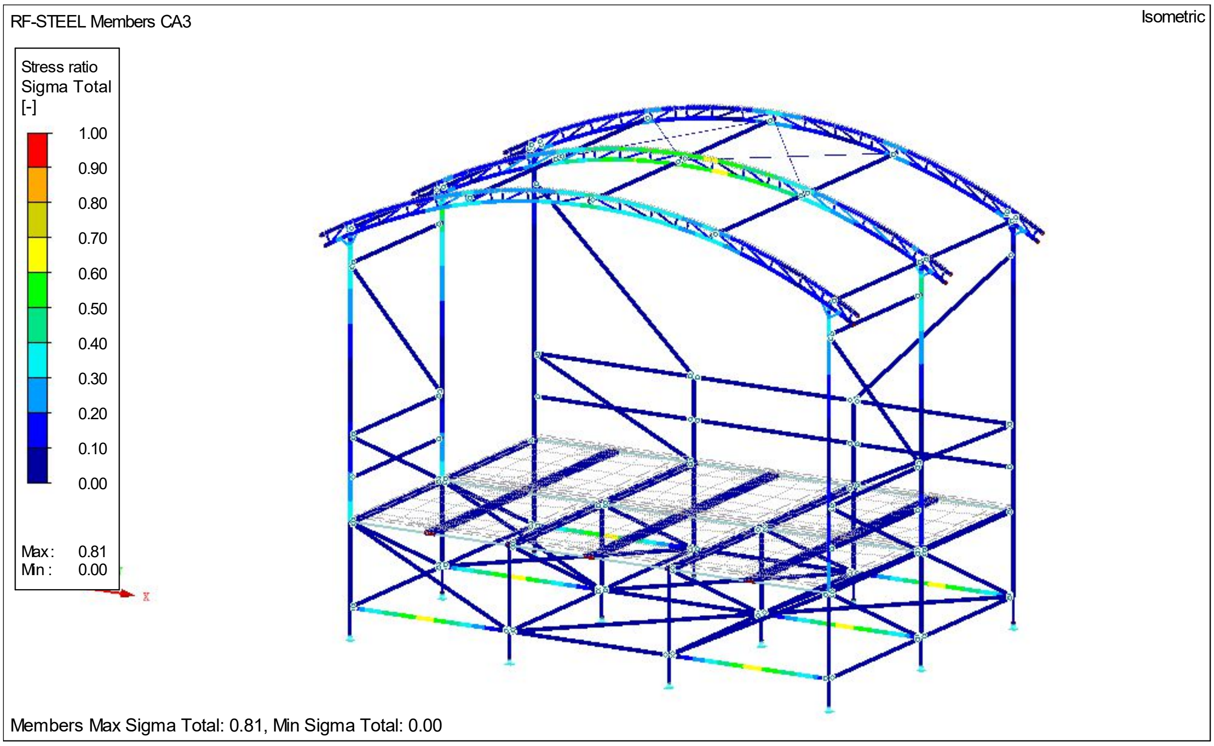


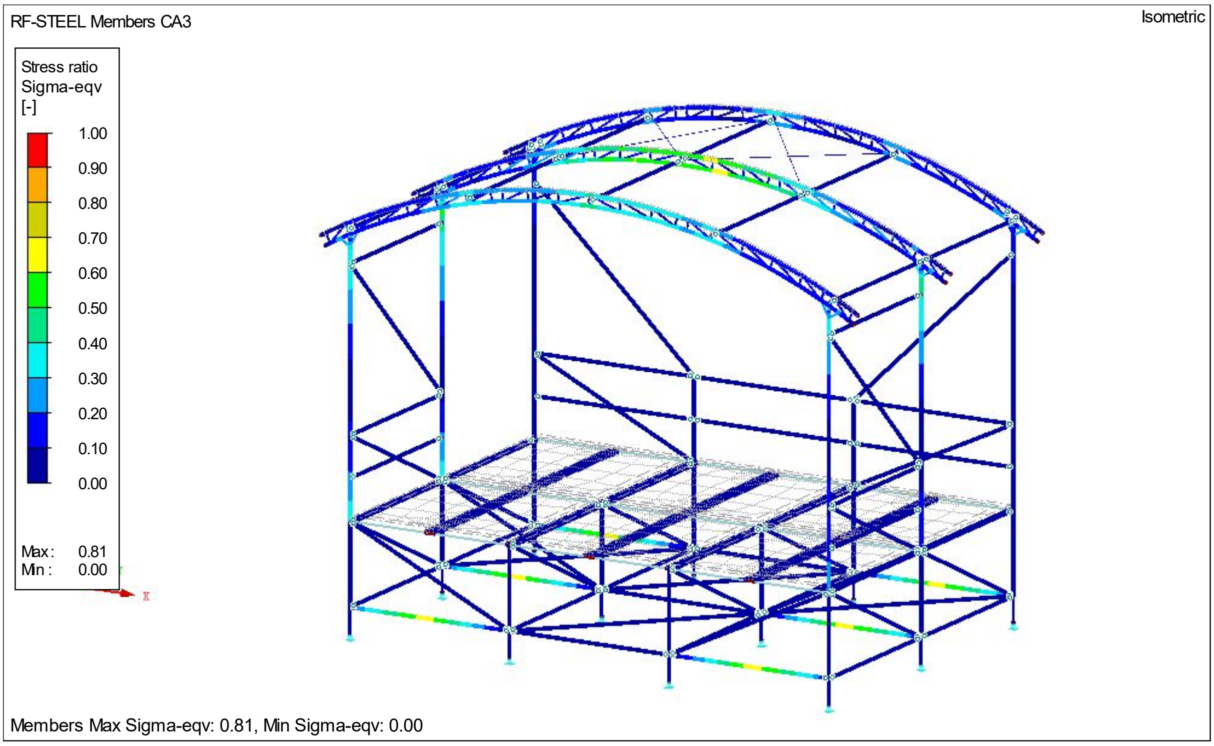
RF-STEEL Members CA2
Isometric
Stresses
Sigma-eqv
[kN/cm2]
24.20
22.00
19.80
17.60
15.40
13.20
11.00
8.80
6.60
4.40
2.20
0.00
Max : 24.20
Min : 0.00
Members Max Sigma-eqv: 24.20, Min Sigma-eqv: 0.00 [kN/cm2]

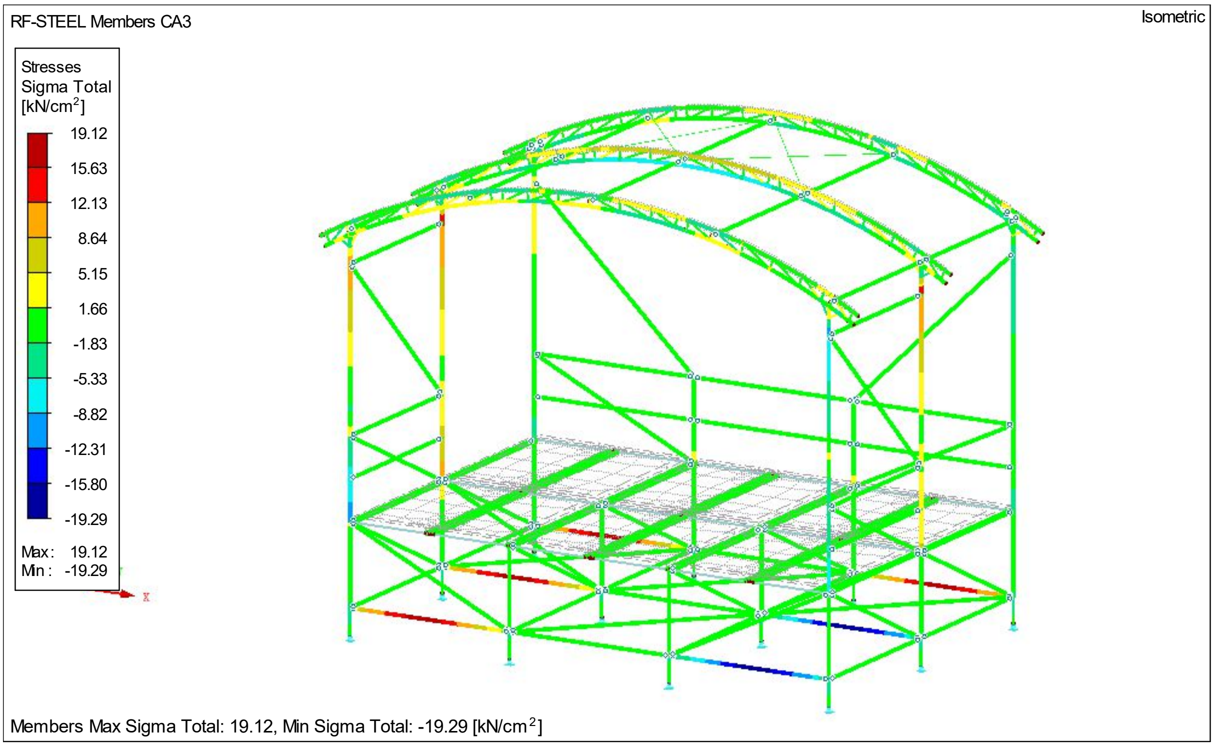
2.8.4.1 Results stress analyse calculation CA2 - RC2 utilisation per cross section.

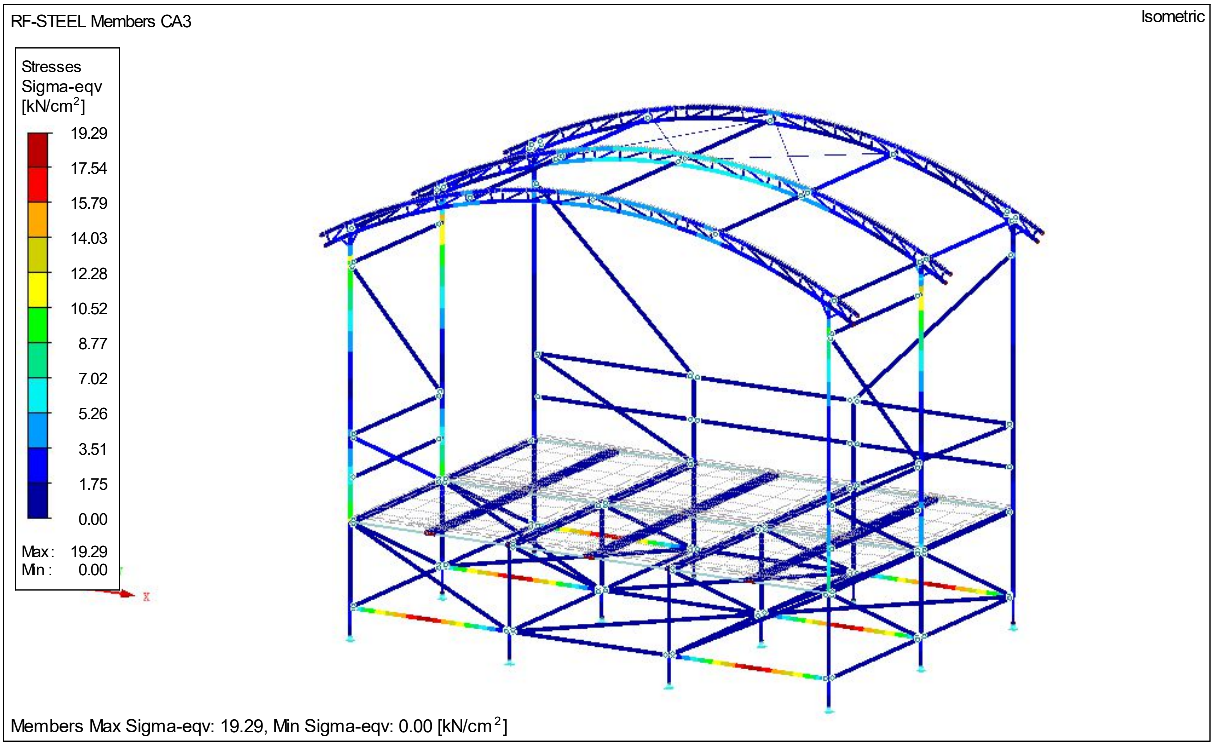
Section No.	Member No.	Location x [m]	S-Point No.	Load-ing	Stress Type	Stress [kN/cm²] Existing	Limit	Stress Ratio
1	Ring 48/3							
	151	0,398	6	CO34	Sigma Total	8,93	11,36	0,79
	126	0,000	19	CO34	Tau Total	3,91	6,56	0,60
	184	0,000	29	CO38	Sigma-eqv	8,94	11,36	0,79
2	Ring 25/3							
	840	0,000	7	CO38	Sigma Total	-8,31	11,36	0,73
	903	0,000	22	CO38	Tau Total	-2,05	6,56	0,31
	840	0,000	6	CO38	Sigma-eqv	8,45	11,36	0,74
3	Ring 25/3							
	1037	0,000	16	CO34	Sigma Total	9,07	11,36	0,80
	1043	0,000	10	CO34	Tau Total	1,29	6,56	0,20
	1043	0,149	16	CO34	Sigma-eqv	9,21	11,36	0,81
4	Ring 40/3							
	177	0,099	32	CO38	Sigma Total	-17,11	21,36	0,80
	131	0,099	2	CO34	Tau Total	-4,11	12,33	0,33
	177	0,099	32	CO38	Sigma-eqv	17,34	21,36	0,81
5	RO 38x4.5 | DIN EN 10220							
	597	0,000	19	CO38	Sigma Total	-23,86	32,27	0,74
	590	0,000	10	CO15	Tau Total	-1,16	18,63	0,06
	597	0,000	19	CO38	Sigma-eqv	23,86	32,27	0,74
6	RO 48.3x3.2 (Hot Formed)							
	5	0,500	11	CO18	Sigma Total	-24,13	29,09	0,83
	592	0,000	2	CO38	Tau Total	-4,39	16,80	0,26
	5	0,500	11	CO18	Sigma-eqv	24,20	29,09	0,83
7	RO 48.3x3.2 (Hot Formed)							
	686	1,000	10	CO28	Sigma Total	-20,11	29,09	0,69
	678	0,000	19	CO34	Tau Total	-1,47	16,80	0,09
	686	1,000	10	CO28	Sigma-eqv	20,11	29,09	0,69
8	RO 48.3x3.2 (Hot Formed)							
	688	1,465	10	CO25	Sigma Total	-2,04	29,09	0,07
	688	0,000	19	CO16	Tau Total	-0,12	16,80	0,01
	688	1,465	10	CO25	Sigma-eqv	2,05	29,09	0,07
9	RO 48.3x2.6 (Hot Formed)							
	717	1,150	10	CO25	Sigma Total	-3,04	21,36	0,14
	695	0,000	19	CO34	Tau Total	-1,55	12,33	0,13
	731	1,440	28	CO18	Sigma-eqv	3,21	21,36	0,15
11	HK 50/30/4/4/4/4							
	466	0,000	14	CO26	Sigma Total	-9,54	20,45	0,47
	359	2,072	8	CO26	Tau Total	2,87	11,81	0,24
	466	0,000	14	CO26	Sigma-eqv	9,62	20,45	0,47
12	RD 8							
	1017	0,000	1	CO38	Sigma Total	4,21	64,00	0,07
	1014	0,000	1	CO10	Tau Total	0,00	36,95	0,00
	1017	0,000	1	CO38	Sigma-eqv	4,21	64,00	0,07

2.8.5 Results stress analyse calculation CA3 = RC4 Design Values Out-service.






RF-STEEL Members CA3
Isometric
Stresses
Sigma Total
[kN/cm2]
19.12
15.63
12.13
8.64
5.15
1.66
-1.83
-5.33
-8.82
-12.31
-15.80
-19.29
Max: 19.12
Min: -19.29
X
Members Max Sigma Total: 19.12, Min Sigma Total: -19.29 [kN/cm2]


RF-STEEL Members CA3
Isometric
Stresses
Sigma-eqv
[kN/cm2]
19.29
17.54
15.79
14.03
12.28
10.52
8.77
7.02
5.26
3.51
1.75
0.00
Max: 19.29
Min: 0.00
X
Members Max Sigma-eqv: 19.29, Min Sigma-eqv: 0.00 [kN/cm2]

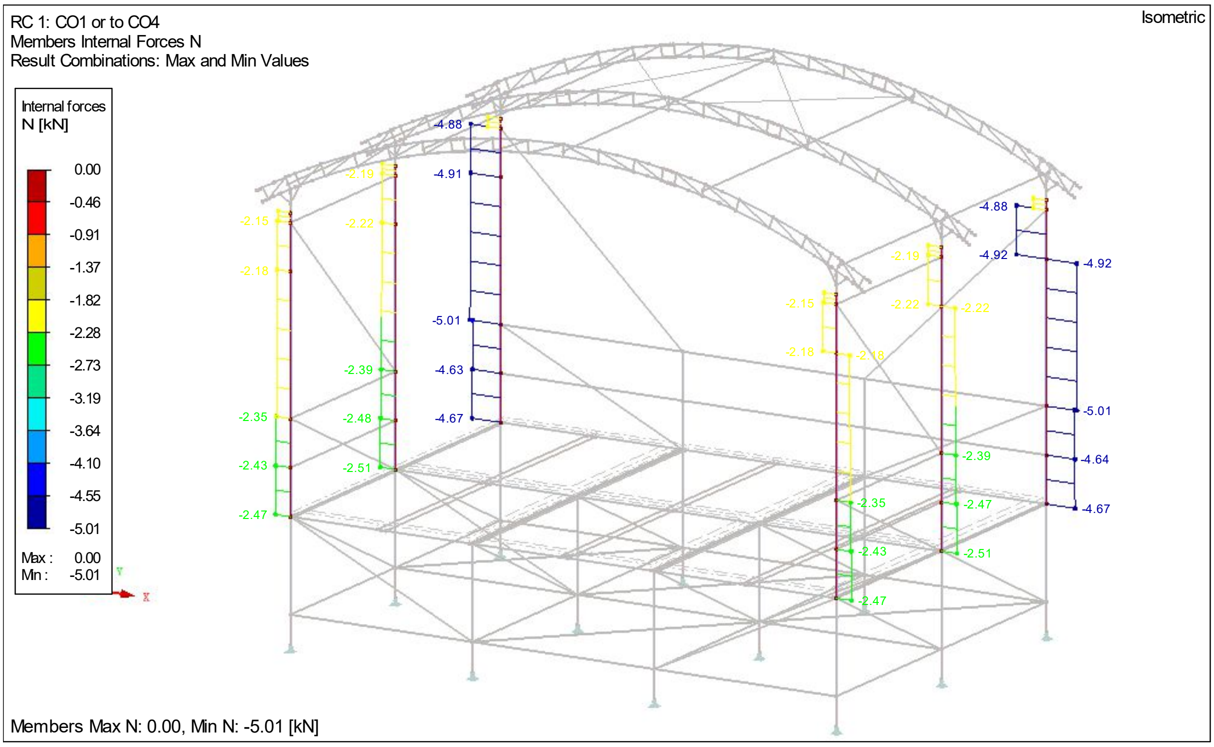
2.8.5.1 Results stress analyse calculation CA3 - RC4 utilisation per cross section.

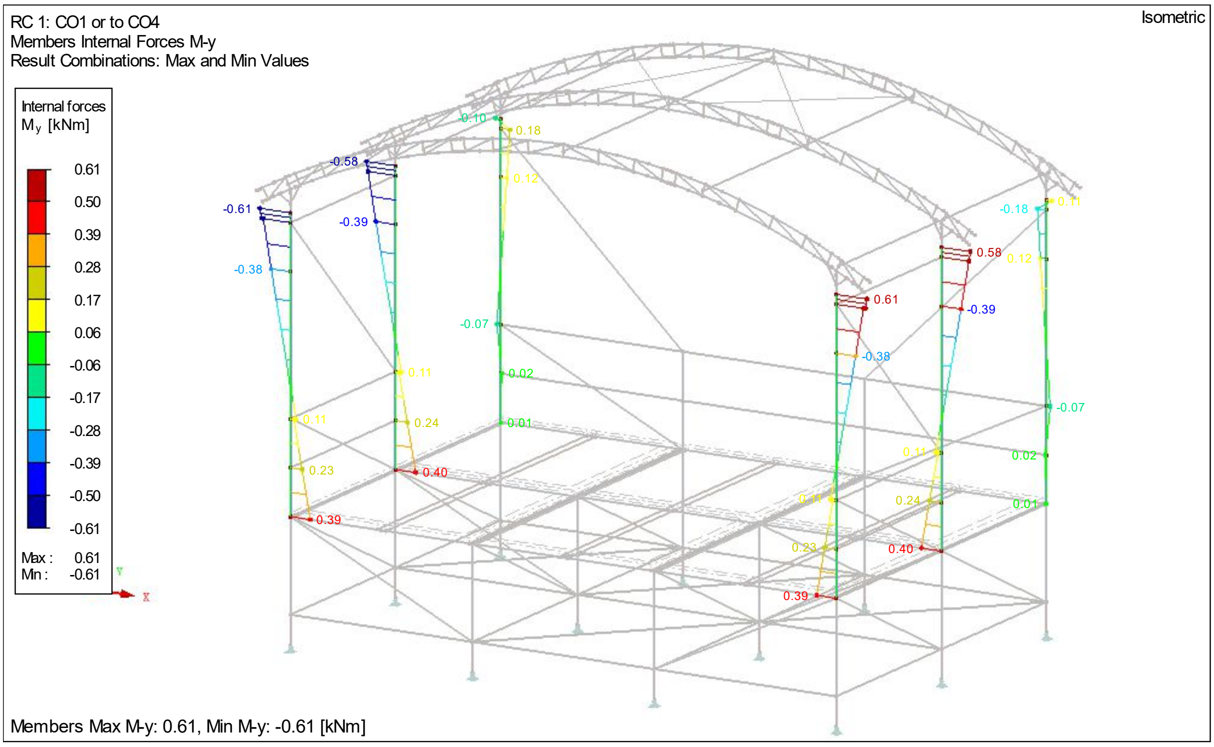
Section No.	Member No.	Location x [m]	S-Point No.	Load-ing	Stress Type	Stress [kN/cm²] Existing	Limit	Stress Ratio
1	Ring 48/3							
	145	0,405	29	CO110	Sigma Total	7,45	11,36	0,66
	129	0,043	1	CO110	Tau Total	-2,19	6,56	0,33
	145	0,405	29	CO110	Sigma-eqv	7,45	11,36	0,66
2	Ring 25/3							
	896	0,000	28	CO110	Sigma Total	9,18	11,36	0,81
	903	0,054	1	CO110	Tau Total	-2,06	6,56	0,31
	896	0,000	28	CO110	Sigma-eqv	9,18	11,36	0,81
3	Ring 25/3							
	1039	0,000	10	CO110	Sigma Total	-5,32	11,36	0,47
	1047	0,000	8	CO110	Tau Total	-0,53	6,56	0,08
	1039	0,000	10	CO110	Sigma-eqv	5,32	11,36	0,47
4	Ring 40/3							
	177	0,000	28	CO110	Sigma Total	14,97	21,36	0,70
	128	0,000	1	CO110	Tau Total	-1,82	12,33	0,15
	177	0,000	28	CO110	Sigma-eqv	14,97	21,36	0,70
5	RO 38x4.5 | DIN EN 10220							
	640	0,310	10	CO111	Sigma Total	-2,99	32,27	0,09
	569	0,000	19	CO110	Tau Total	-0,13	18,63	0,01
	640	0,310	10	CO111	Sigma-eqv	2,99	32,27	0,09
6	RO 48.3x3.2 (Hot Formed)							
	575	0,100	28	CO110	Sigma Total	14,25	29,09	0,49
	594	0,000	19	CO104	Tau Total	-1,18	16,80	0,07
	575	0,100	28	CO110	Sigma-eqv	14,25	29,09	0,49
7	RO 48.3x3.2 (Hot Formed)							
	686	1,000	10	CO114	Sigma Total	-19,29	29,09	0,66
	678	0,000	1	CO110	Tau Total	1,35	16,80	0,08
	686	1,000	10	CO114	Sigma-eqv	19,29	29,09	0,66
8	RO 48.3x3.2 (Hot Formed)							
	741	1,465	10	CO110	Sigma Total	-1,18	29,09	0,04
	730	2,930	19	CO110	Tau Total	0,04	16,80	0,00
	741	1,465	10	CO110	Sigma-eqv	1,18	29,09	0,04
9	RO 48.3x2.6 (Hot Formed)							
	728	1,440	10	CO110	Sigma Total	-1,51	21,36	0,07
	697	0,000	17	CO110	Tau Total	-1,05	12,33	0,09
	697	1,150	26	CO110	Sigma-eqv	1,90	21,36	0,09
11	HK 50/30/4/4/4/4							
	466	0,000	14	CO110	Sigma Total	-0,43	20,45	0,02
	835	2,072	8	CO114	Tau Total	0,13	11,81	0,01
	466	0,000	14	CO110	Sigma-eqv	0,43	20,45	0,02
12	RD 8							
	1017	0,000	1	CO110	Sigma Total	1,35	64,00	0,02
	1014	0,000	1	CO100	Tau Total	0,00	36,95	0,00
	1017	0,000	1	CO110	Sigma-eqv	1,35	64,00	0,02

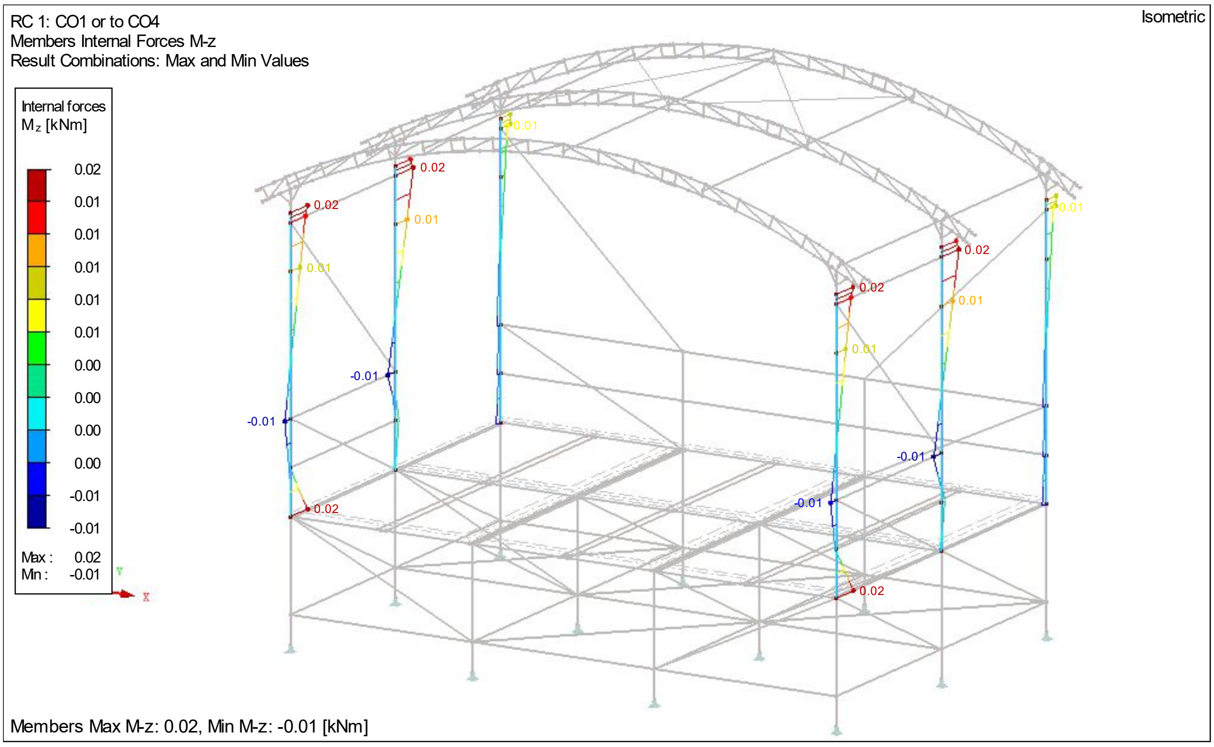
3.0 Detail calculations for different parts.

3.1 Detail Check of Layher uprights on the side.

3.1.1 RC1 – General loading without wind







Decisive load combination

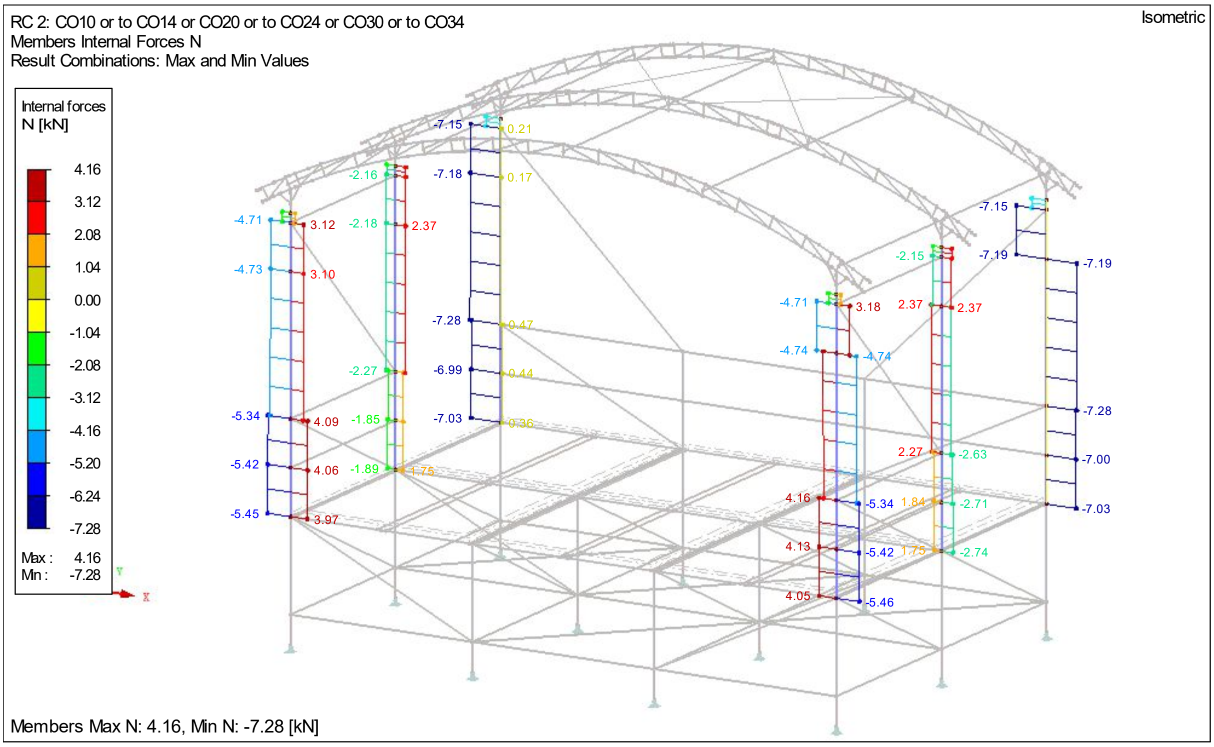
Normative	Forces [kN]			Moments [kNm]		
Load Combination	N	V_y	V_z	M_T	M_y	M_z
CO 4	-4,88	0	0,11	-0,01	0,18	0,01

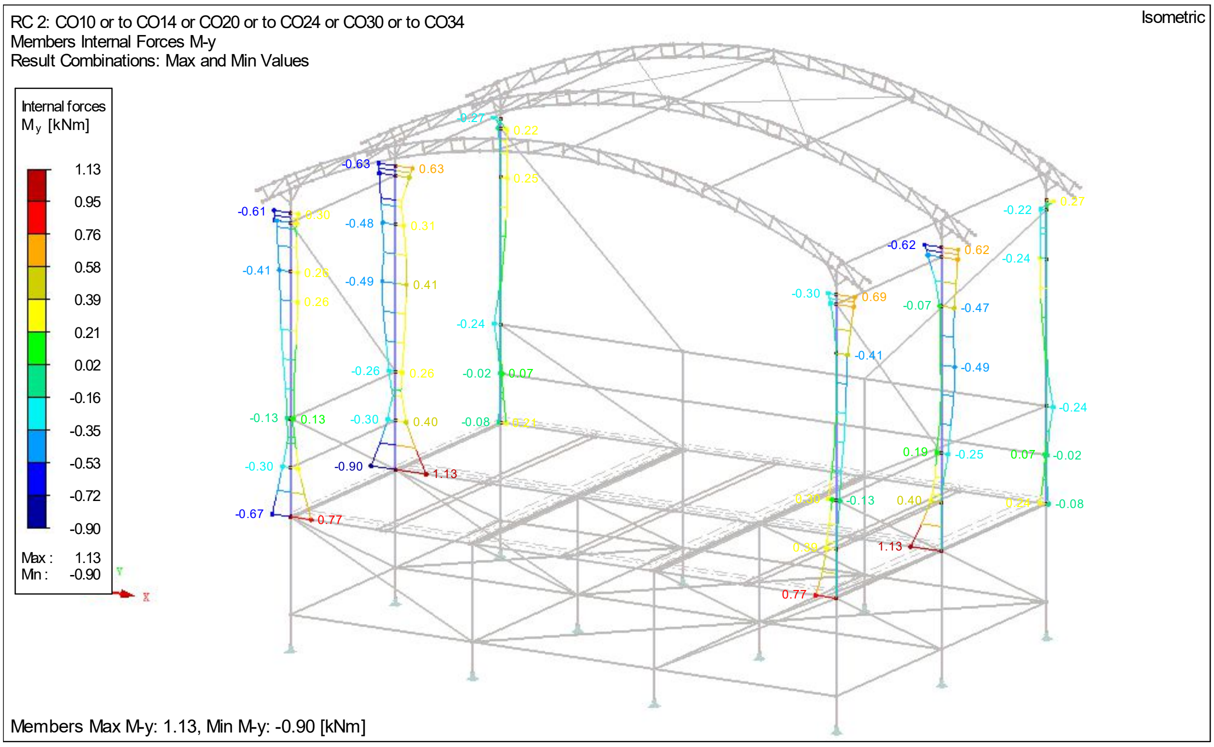
Buckling calculation Layher upright.

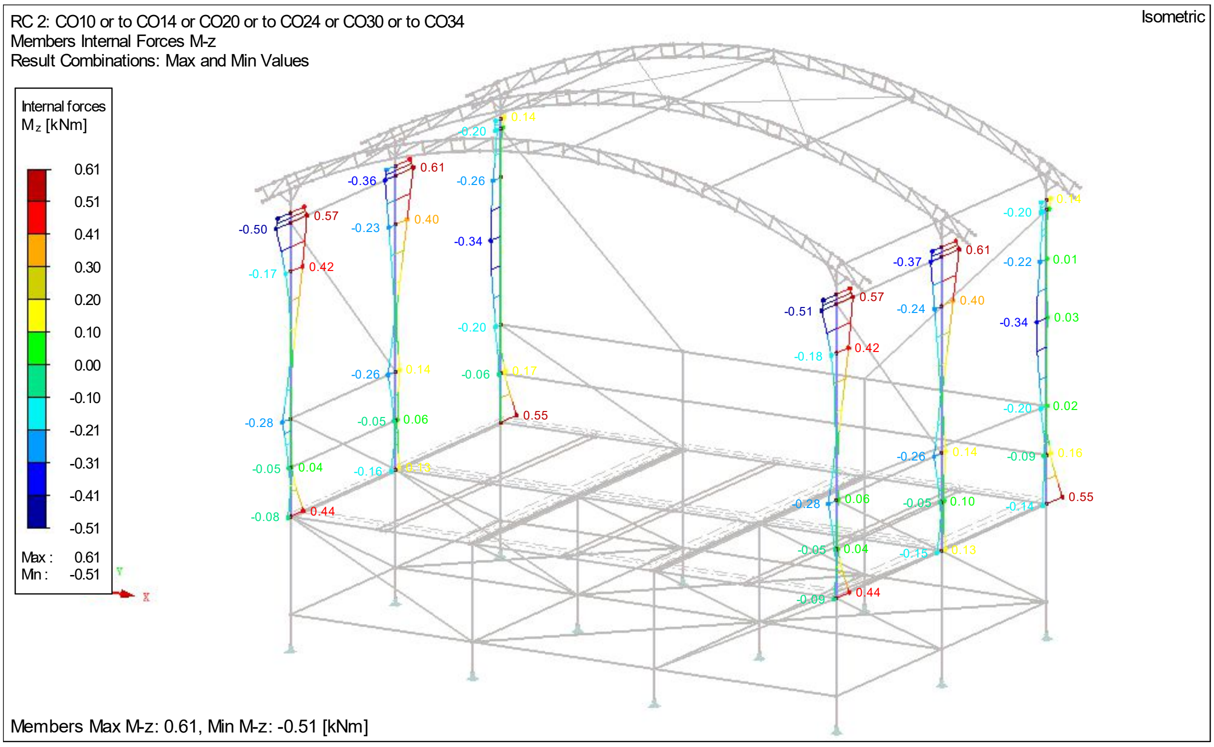
Buckling Length factor K = 1.2
The factor K is according to table 6,8 NEN-EN 1999-1-1
L = 300 cm
$L_{cr} = 1.2 * 300 = 360$
$I_y = \sqrt{} (I_y / A) = \sqrt{} (11.6 / 4.53) = 1.6$
$\lambda_z = L_{cr} / (i_z * \pi) * (\sqrt{} ((A_{eff} * f_y) / A * E))$
$\lambda_z = 360 / (1.6 * \pi) * \sqrt{} ((4.27 * 35.5) / (4.27 * 21000)) = 2.935$
$\Theta_z = 0.5 * (1 + \alpha * (\lambda_z - \lambda_0) + \lambda_z^2)$
$\Theta_z = 0.5 * (1 + 0.49 * (2.935 - 0.10) + 2.935^2) = 5.478$
$X_z = 1 / (\Theta_z + \sqrt{} (\Theta_z^2 - \lambda_z^2))$
$X_z = 1 / (5.478 + \sqrt{} (5.478^2 - 2.935^2)) = 0.099$
$N_{b,RD} = X_z * A * f_0 / 1.1 = 0.099 * 4.27 * 32 / 1.1 = 12.29$ kN
$M_{y,z,RD} = W_{pl} * f_0 / 1.1 = 6.17 * 32 / 1.1 = 179.5$ kNcm = 1.795 kNm

$N_{ed} / N_{b,RD} + M_{y,ed} / M_{y,RD} + M_{z,ed} / M_{z,RD} < 1$
$4.88 / 12.29 + 0.18 / 1.795 + 0.01 / 1.795 = 0.50 < 1$

3.1.2 RC2 – design values In-service







Decisive load combination

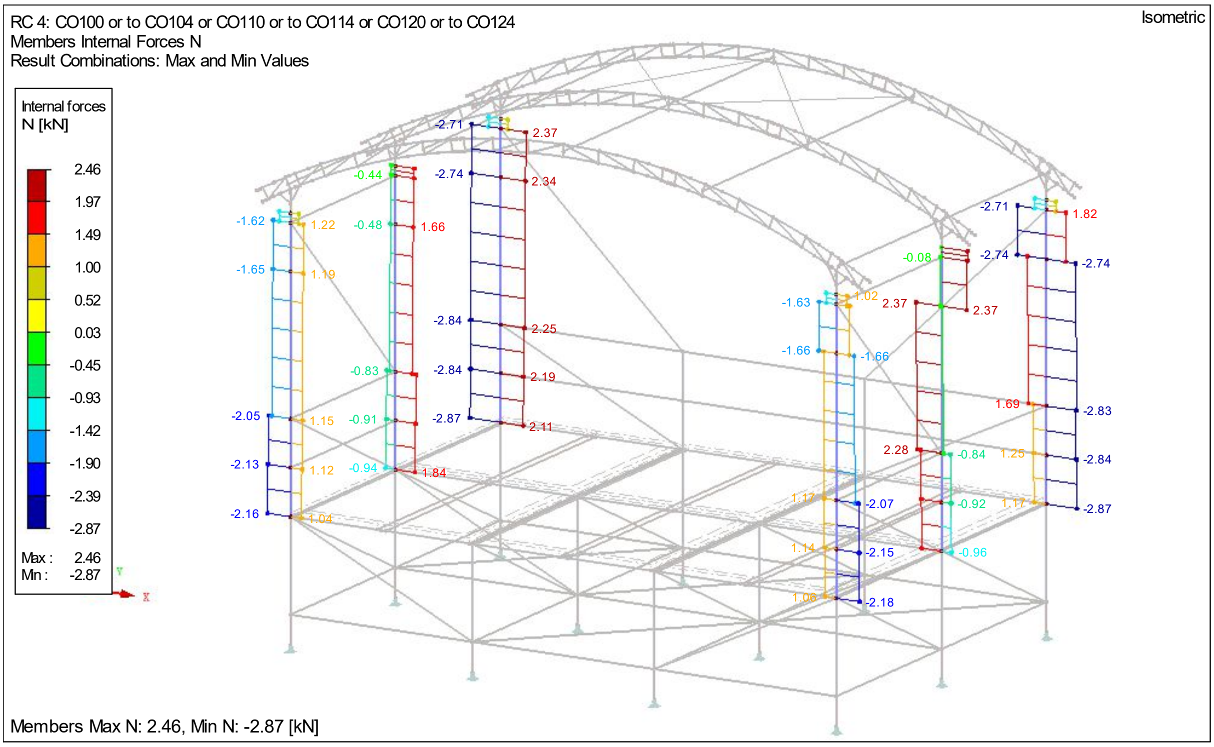
Normative	Forces [kN]			Moments [kNm]		
Load Combination	N	V_y	V_z	M_T	M_y	M_z
CO 38	-4,52	-0,26	-0,18	-0,1	-0,52	0,57

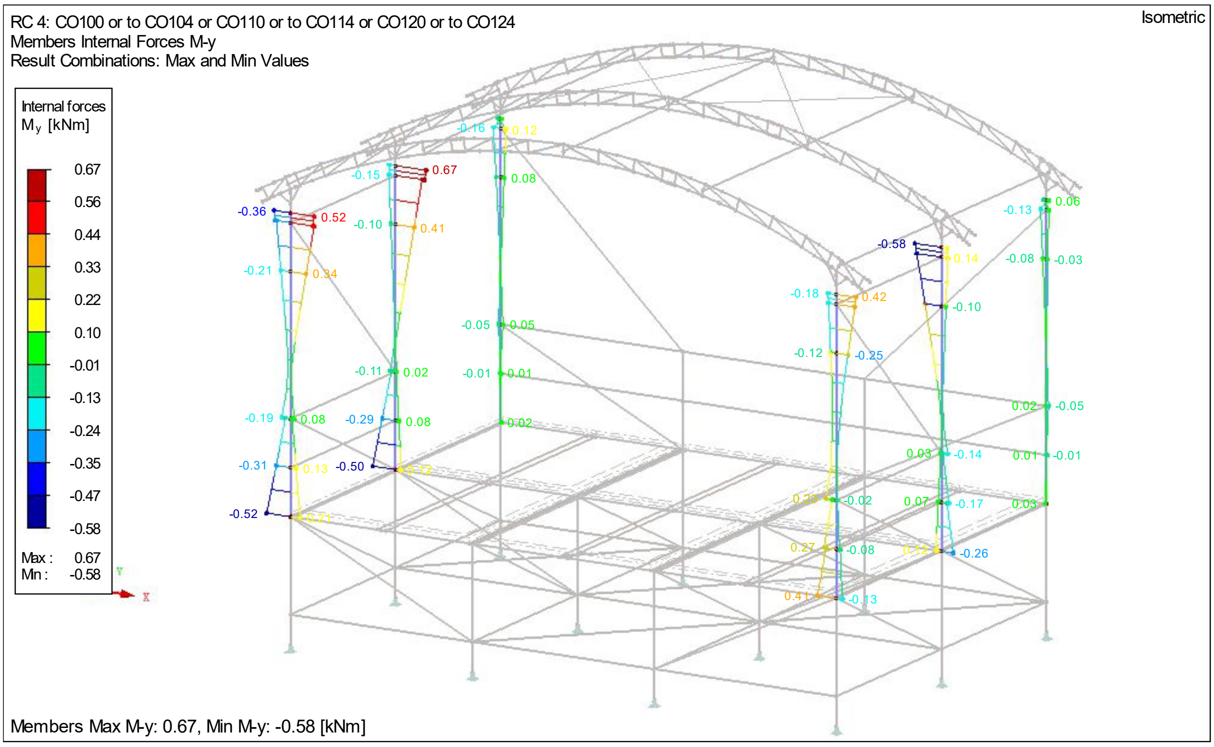
Buckling calculation Layher upright.

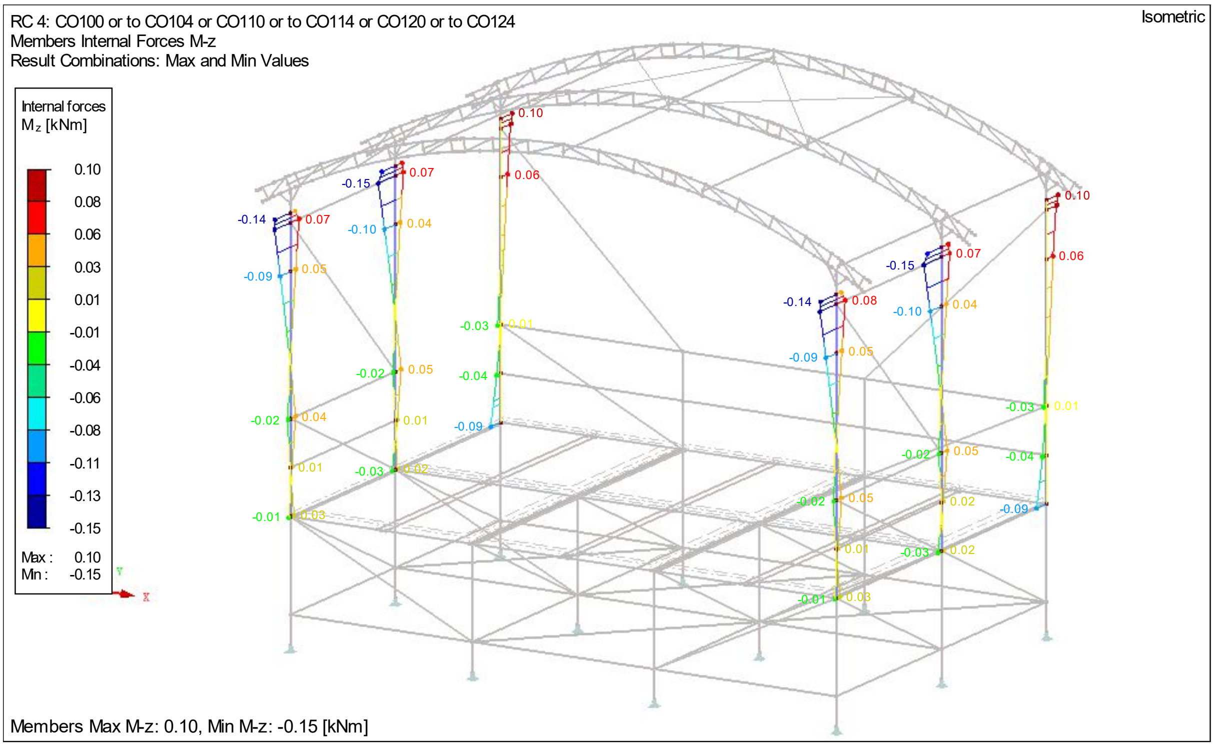
Buckling Length factor K = 1.2
The factor K is according to table 6,8 NEN-EN 1999-1-1
L = 300 cm
$L_{cr} = 1.2 * 300 = 360$
$I_y = \sqrt{}(I_y / A) = \sqrt{}(11.6 / 4.53) = 1.6$
$\lambda_z = L_{cr} / (i_z * \pi) * (\sqrt{}((A_{eff} * f_y) / A * E))$
$\lambda_z = 360 / (1.6 * \pi) * \sqrt{}((4.27 * 35.5) / (4.27 * 21000)) = 2.935$
$\Theta_z = 0.5 * (1 + \alpha * (\lambda_z - \lambda_0) + \lambda_z^2)$
$\Theta_z = 0.5 * (1 + 0.49 * (2.935 - 0.10) + 2.935^2) = 5.478$
$X_z = 1 / (\Theta_z + \sqrt{}(\Theta_z^2 - \lambda_z^2))$
$X_z = 1 / (5.478 + \sqrt{}(5.478^2 - 2.935^2)) = 0.099$
$N_{b,RD} = X_z * A * f_0 / 1.1 = 0.099 * 4.27 * 32 / 1.1 = 12.29$ kN
$M_{y,z,RD} = W_{pl} * f_0 / 1.1 = 6.17 * 32 / 1.1 = 179.5$ kNcm = 1.795 kNm

$N_{ed} / N_{b,RD} + M_{y,ed} / M_{y,RD} + M_{z,ed} / M_{z,RD} < 1$
$4.52 / 12.29 + 0.52 / 1.795 + 0.57 / 1.795 = 0.97 < 1$

3.1.3 RC4 – design values Out-service







Decisive load combination

Normative	Forces [kN]			Moments [kNm]		
Load Combination	N	V_y	V_z	M_T	M_y	M_z
CO 110	2,46	-0,29	-0,41	-0,01	-0,58	-0,09

Buckling calculation Layher upright.

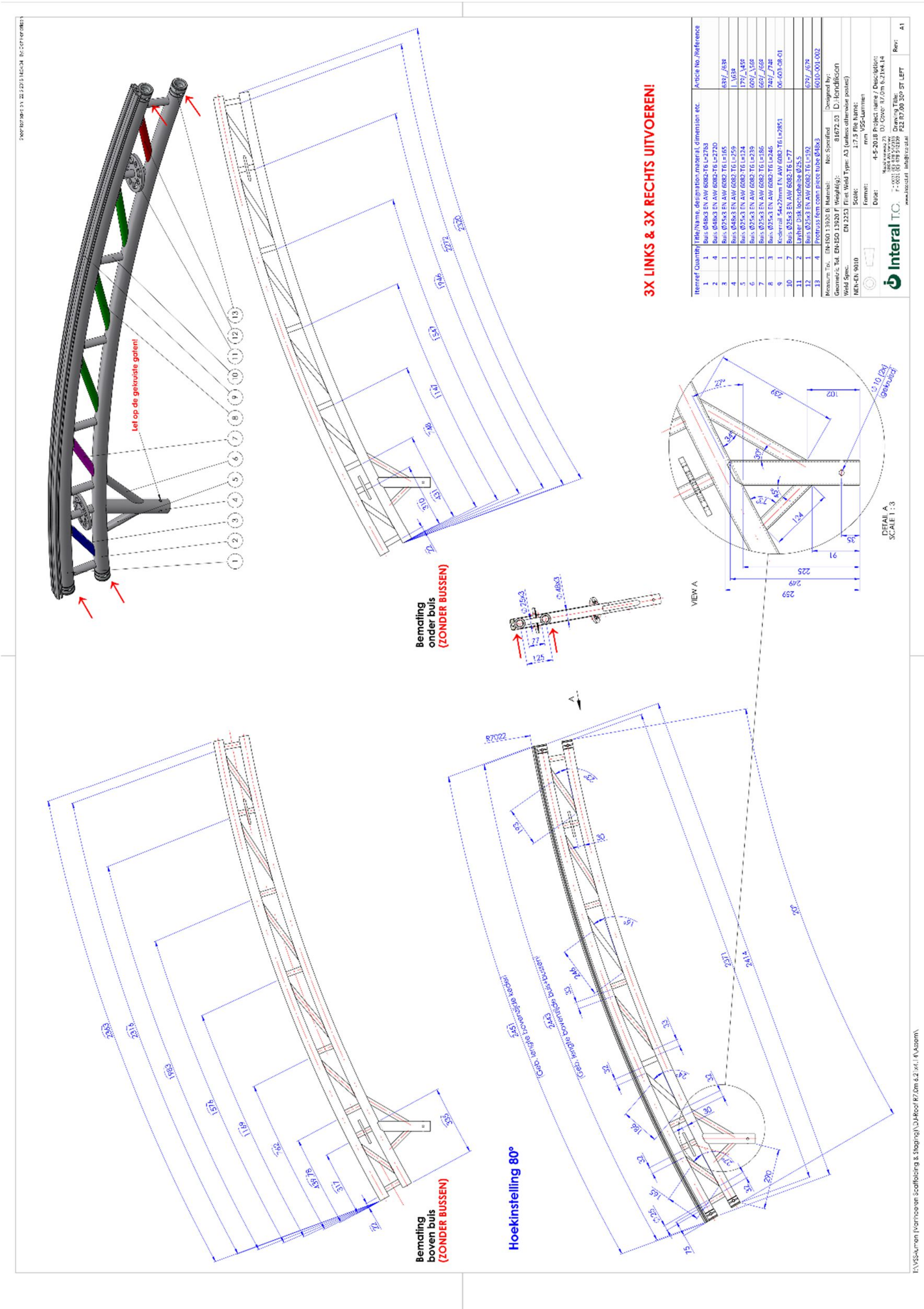
Buckling Length factor K = 1.2
The factor K is according to table 6,8 NEN-EN 1999-1-1
L = 300 cm
$L_{cr} = 1.2 * 300 = 360$
$I_y = \sqrt{}\,(I_y / A) = \sqrt{}\,(11.6 / 4.53) = 1.6$
$\lambda_z = L_{cr} / (i_z * \pi) * (\sqrt{}\,((A_{eff} * f_y) / A * E))$
$\lambda_z = 360 / (1.6 * \pi) * \sqrt{}\,((4.27 * 35.5) / (4.27 * 21000)) = 2.935$
$\Theta_z = 0.5 * (1 + \alpha * (\lambda_z - \lambda_0) + \lambda_z^2)$
$\Theta_z = 0.5 * (1 + 0.49 * (2.935 - 0.10) + 2.935^2) = 5.478$
$X_z = 1 / (\Theta_z + \sqrt{}\,(\Theta_z^2 - \lambda_z^2))$
$X_z = 1 / (5.478 + \sqrt{}\,(5.478^2 - 2.935^2)) = 0.099$
$N_{b,RD} = X_z * A * f_0 / 1.1 = 0.099 * 4.27 * 32 / 1.1 = 12.29$ kN
$M_{y,z,RD} = W_{pl} * f_0 / 1.1 = 6.17 * 32 / 1.1 = 179.5$ kNcm = 1.795 kNm

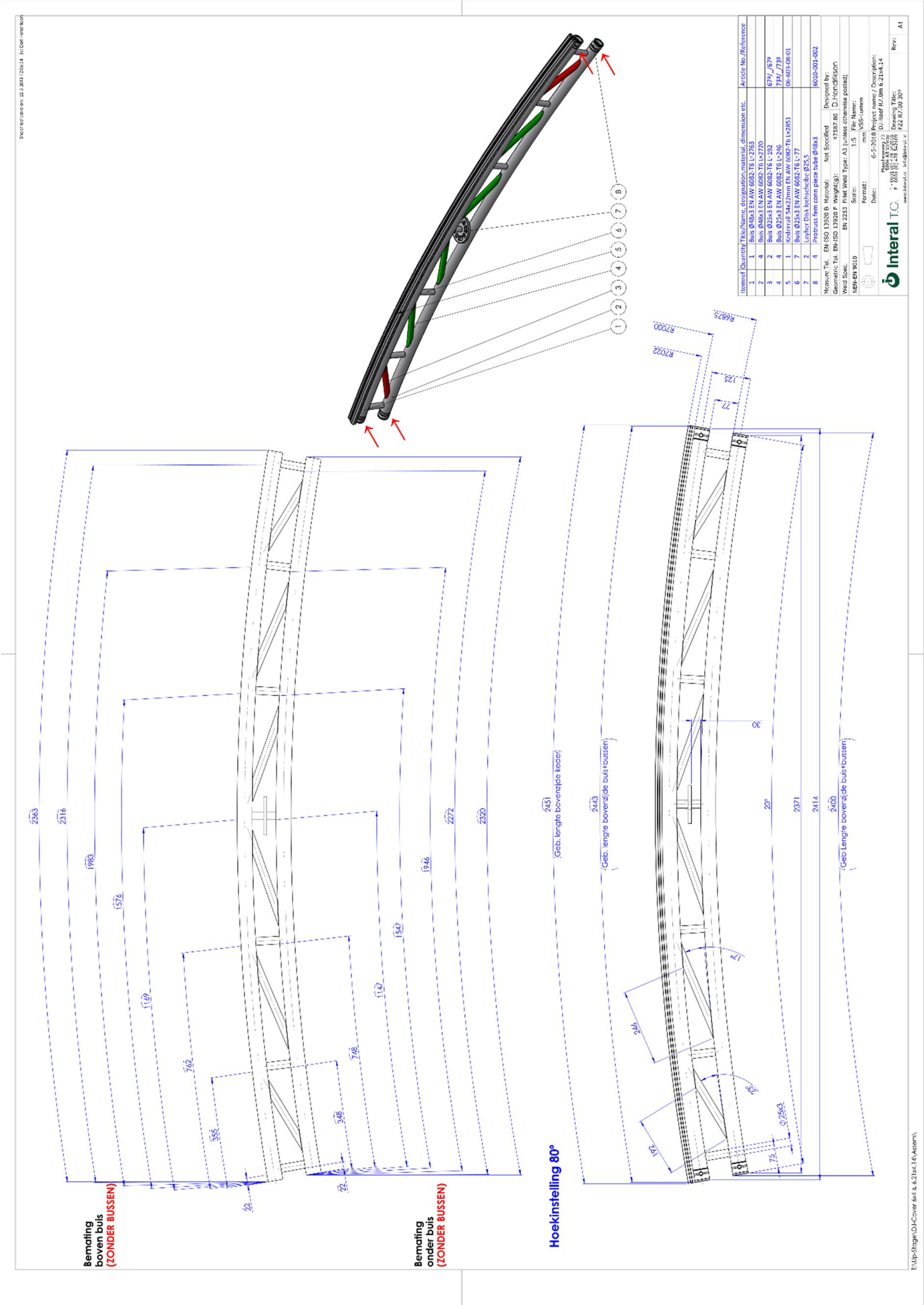
$N_{ed} / N_{b,RD} + M_{y,ed} / M_{y,RD} + M_{z,ed} / M_{z,RD} < 1$
$2.46 / 12.29 + 0.58 / 1.795 + 0.09 / 1.795 = 0.57 < 1$

3.2 Detail check of the roof ladder truss.

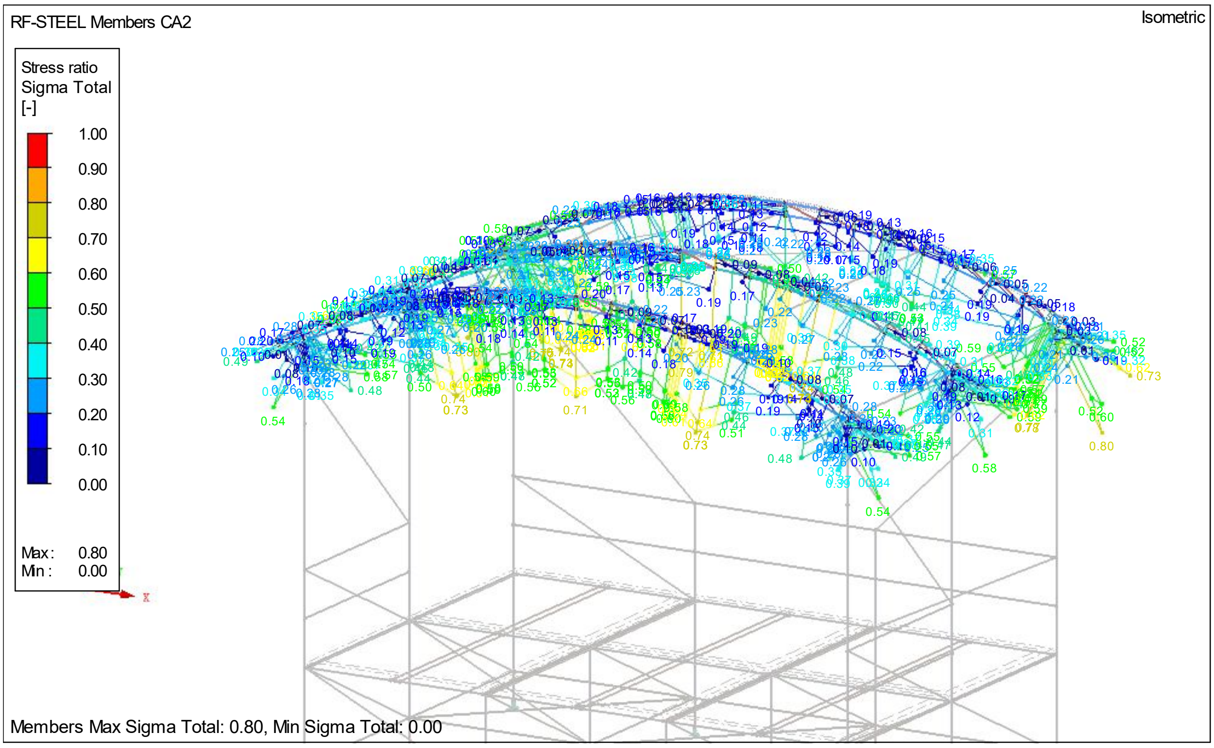
The check of the roof ladder trusses has been done by analysing the stress calculation result combination RC2 and RC4 Design values.

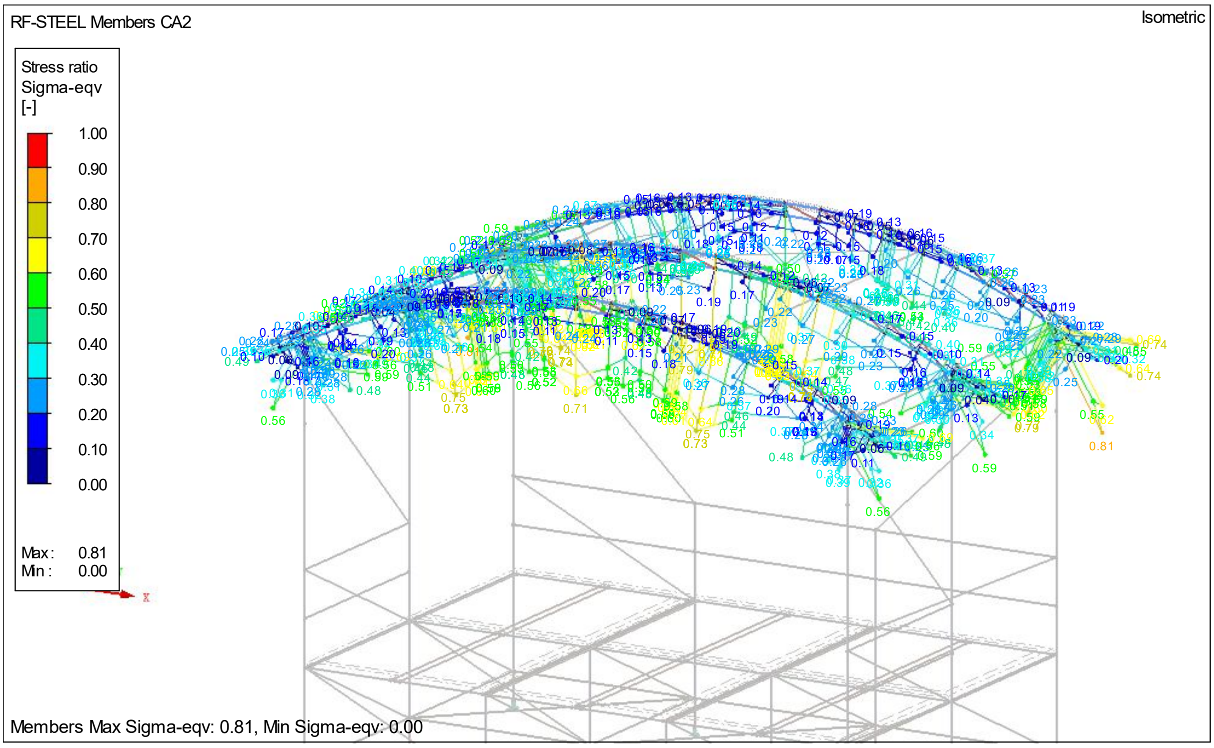
3.4.1 Drawings of the Roof Ladder truss

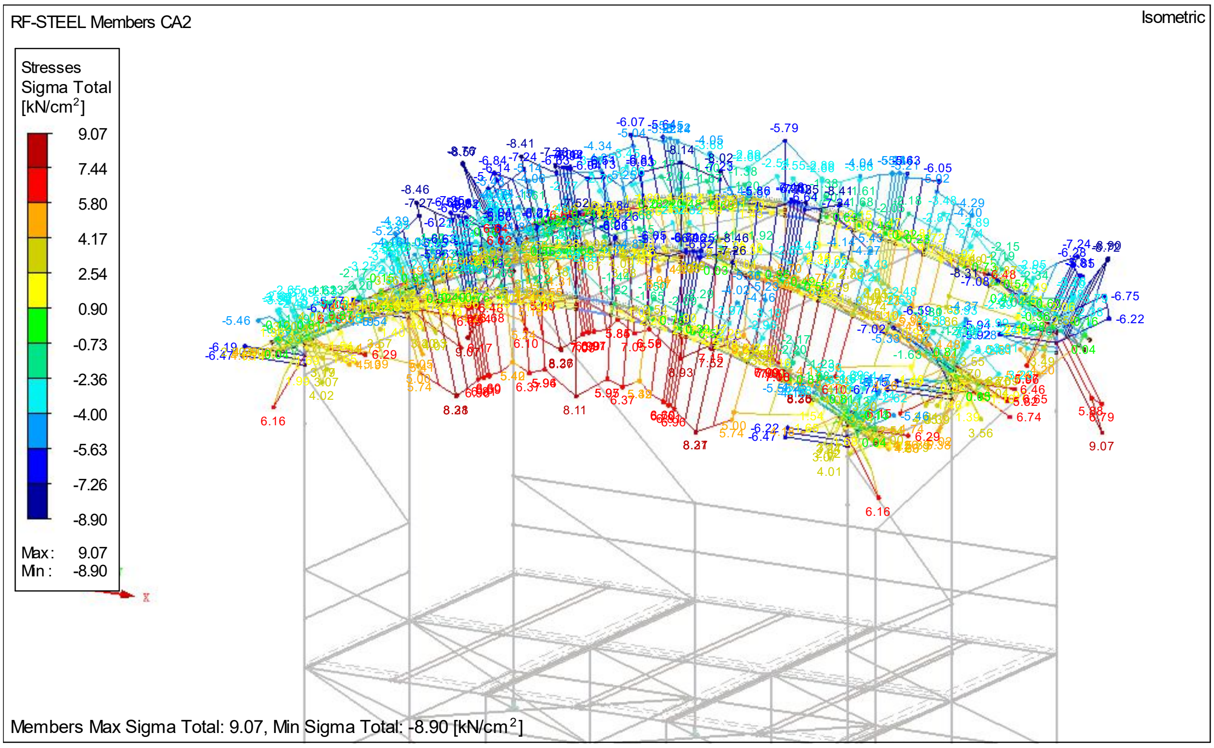


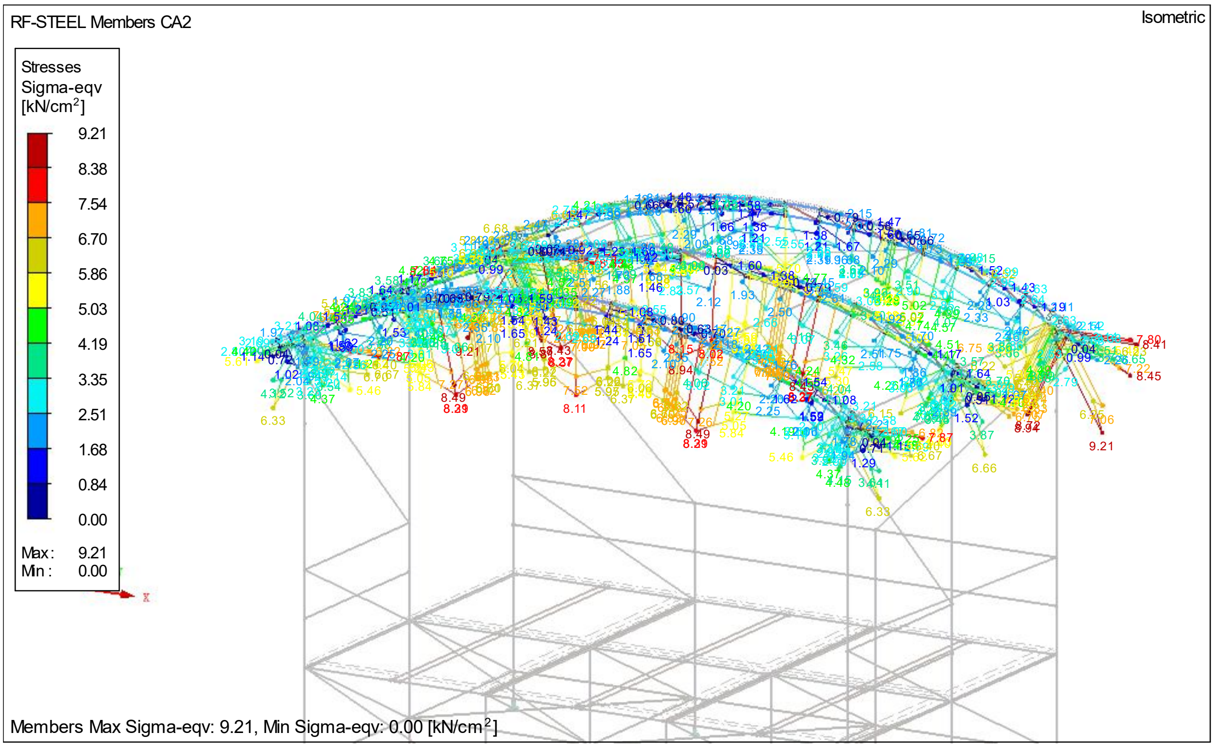

Bemating
boven buis
(ZONDER BUSSEN)
Bemating
onder buis
(ZONDER BUSSEN)
Hoekinstelling 80°
Interal T.C.

3.4.2 Stress analyse CA2 – RC2 design values In-service






RF-STEEL Members CA2
Isometric
Stresses
Sigma Total
[kN/cm²]
9.07
7.44
5.80
4.17
2.54
0.90
-0.73
-2.36
-4.00
-5.63
-7.26
-8.90
Max : 9.07
Min : -8.90
Members Max Sigma Total: 9.07, Min Sigma Total: -8.90 [kN/cm²]


RF-STEEL Members CA2
Isometric
Stresses
Sigma-eqv
[kN/cm²]
9.21
8.38
7.54
6.70
5.86
5.03
4.19
3.35
2.51
1.68
0.84
0.00
Max : 9.21
Min : 0.00
Members Max Sigma-eqv: 9.21, Min Sigma-eqv: 0.00 [kN/cm²]

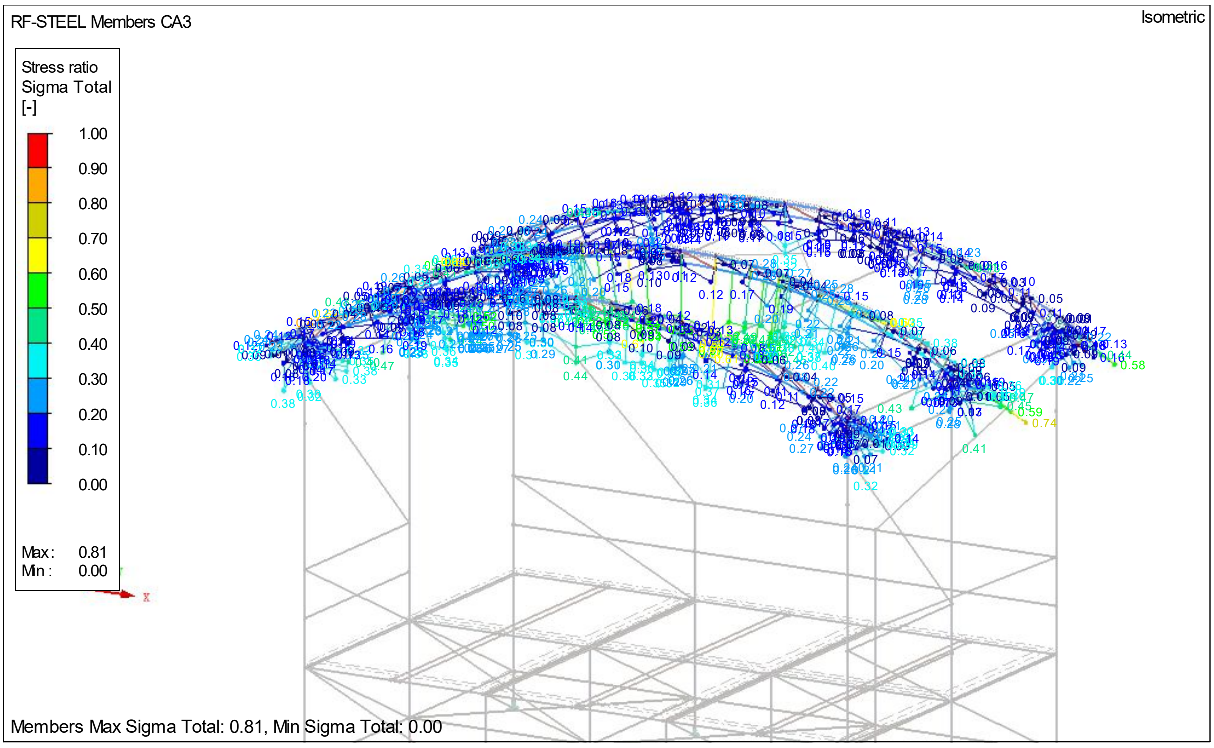
Maximum yield strength for different materials

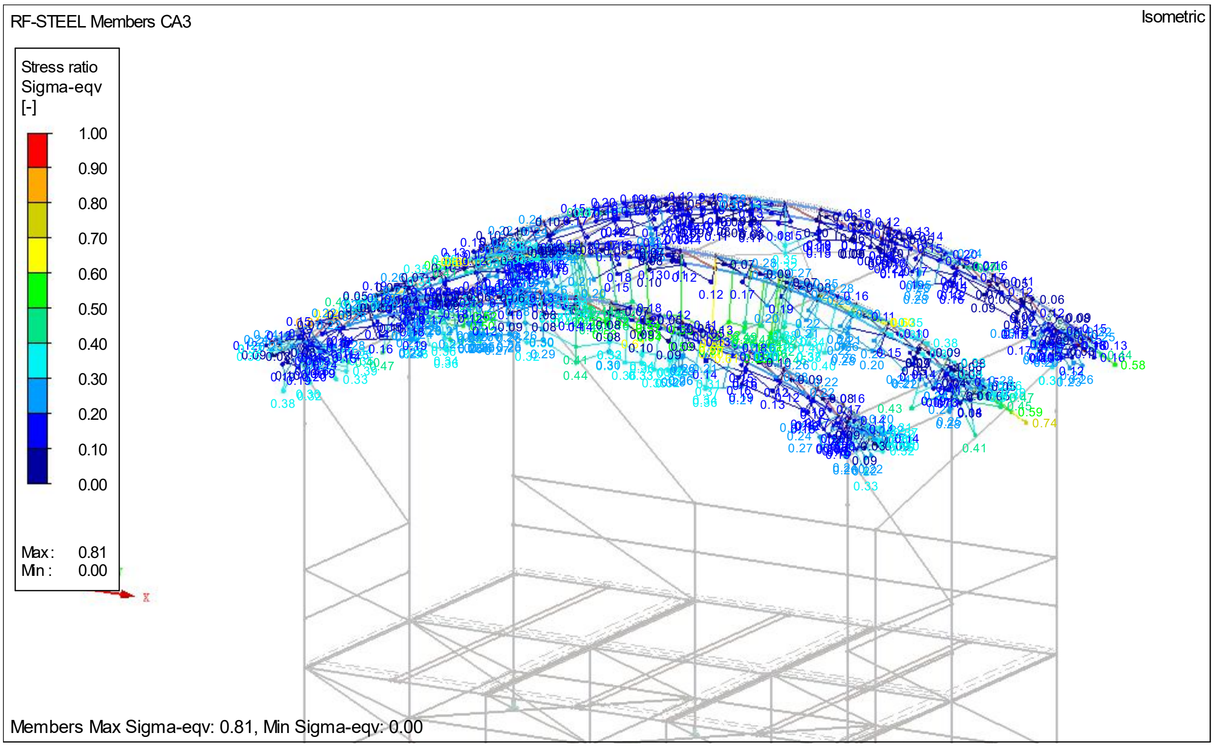
Material = EN-AW-6082 T6
$f_{o,haz}$ = 12.5 kN/cm²

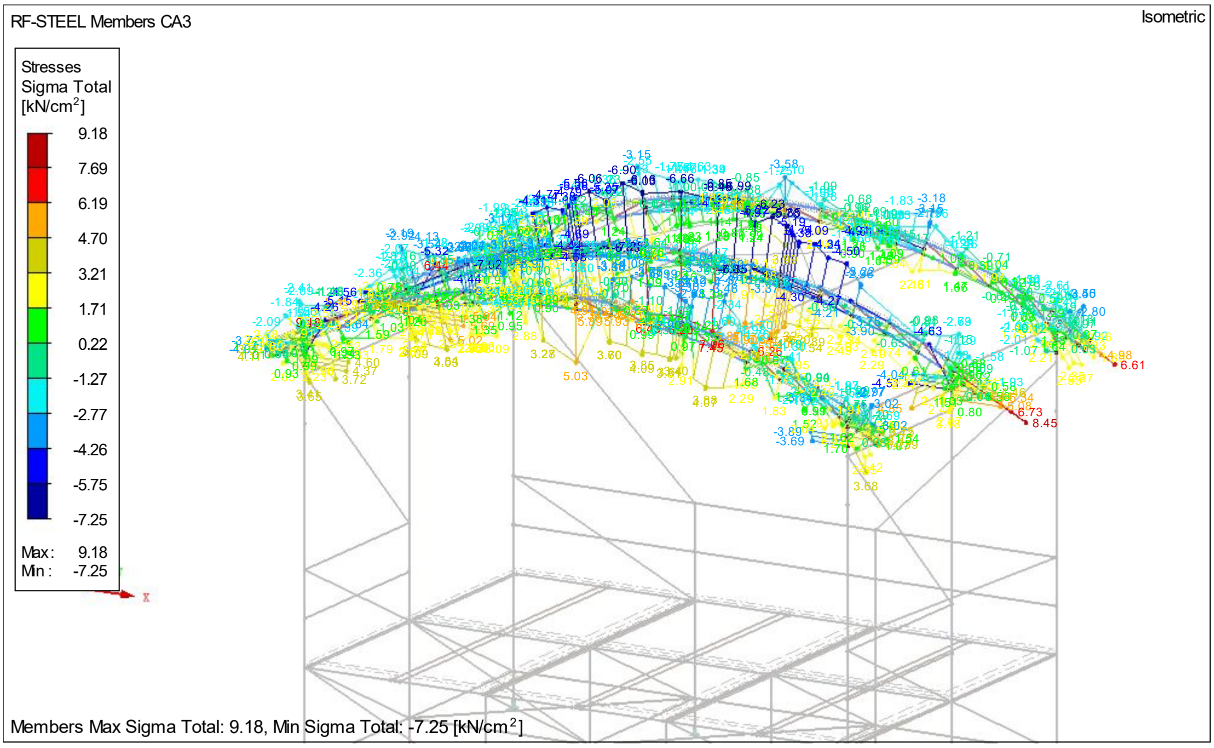
The Yield strength for the material EN-AW-6082 T6, has been manually changed into $f_{o,haz}$,This is according to the Eurocode NEN-EN 1999-1-1 Table 3.2 the $f_{o,haz}$ for the heat affective zone. This check is concerning a welded construction with heat affective zones in the main elements, there for the choice to check the construction according to the lower $f_{o\ haz}$.

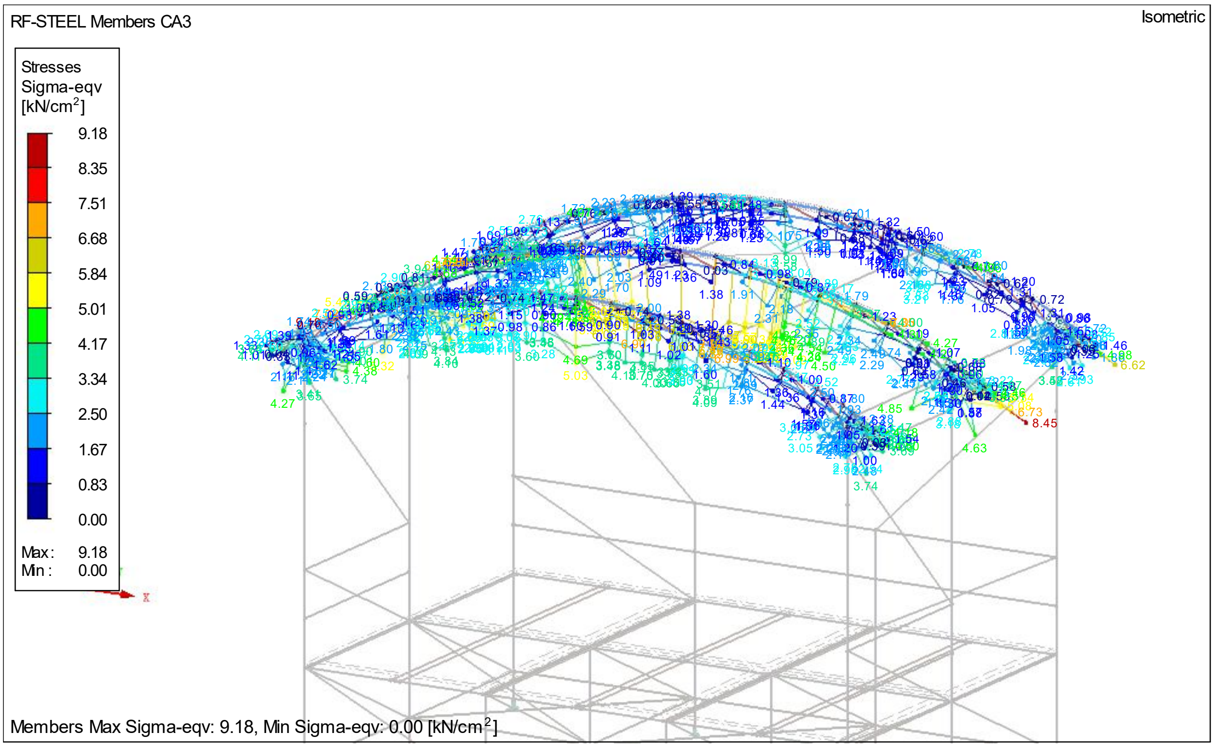
Section No.	Member No.	Location x [m]	S-Point No.	Load-ing	Stress Type	Stress [kN/cm²] Existing	Limit	Stress Ratio
1	Ring 48/3							
	151	0,398	6	CO34	Sigma Total	8,93	11,36	0,79
	126	0,000	19	CO34	Tau Total	3,91	6,56	0,60
	184	0,000	29	CO38	Sigma-eqv	8,94	11,36	0,79
2	Ring 25/3							
	840	0,000	7	CO38	Sigma Total	-8,31	11,36	0,73
	903	0,000	22	CO38	Tau Total	-2,05	6,56	0,31
	840	0,000	6	CO38	Sigma-eqv	8,45	11,36	0,74
3	Ring 25/3							
	1037	0,000	16	CO34	Sigma Total	9,07	11,36	0,80
	1043	0,000	10	CO34	Tau Total	1,29	6,56	0,20
	1043	0,149	16	CO34	Sigma-eqv	9,21	11,36	0,81

3.4.3 Stress analyse CA3 – RC4 design values Out-service






RF-STEEL Members CA3
Isometric
Stresses
Sigma Total
[kN/cm2]
9.18
7.69
6.19
4.70
3.21
1.71
0.22
-1.27
-2.77
-4.26
-5.75
-7.25
Max : 9.18
Min : -7.25
Members Max Sigma Total: 9.18, Min Sigma Total: -7.25 [kN/cm2]


RF-STEEL Members CA3
Isometric
Stresses
Sigma-eqv
[kN/cm2]
9.18
8.35
7.51
6.68
5.84
5.01
4.17
3.34
2.50
1.67
0.83
0.00
Max : 9.18
Min : 0.00
Members Max Sigma-eqv: 9.18, Min Sigma-eqv: 0.00 [kN/cm2]

Maximum yield strength for different materials

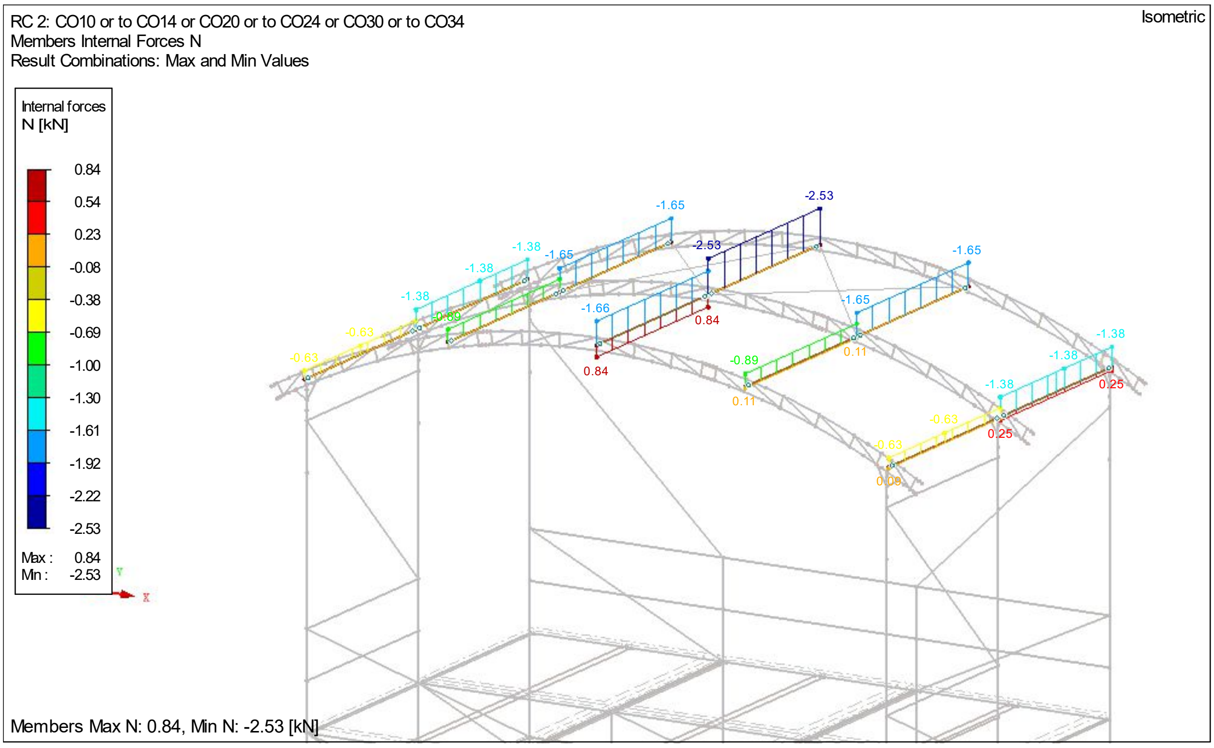
Material = EN-AW-6082 T6
$f_{o,haz}$ = 12.5 kN/cm²

The Yield strength for the material EN-AW-6082 T6 has been manually changed into $f_{o,haz}$,This is according to the Eurocode NEN-EN 1999-1-1 Table 3.2 the $f_{o,haz}$ for the heat affective zone. This check is concerning a welded construction with heat affective zones in the main elements, there for the choice to check the construction according to the lower $f_{o\ haz}$.

Section No.	Member No.	Location x [m]	S-Point No.	Load-ing	Stress Type	Stress [kN/cm²] Existing	Limit	Stress Ratio
1	Ring 48/3							
	145	0,405	29	CO110	Sigma Total	7,45	11,36	0,66
	129	0,043	1	CO110	Tau Total	-2,19	6,56	0,33
	145	0,405	29	CO110	Sigma-eqv	7,45	11,36	0,66
2	Ring 25/3							
	896	0,000	28	CO110	Sigma Total	9,18	11,36	0,81
	903	0,054	1	CO110	Tau Total	-2,06	6,56	0,31
	896	0,000	28	CO110	Sigma-eqv	9,18	11,36	0,81
3	Ring 25/3							
	1039	0,000	10	CO110	Sigma Total	-5,32	11,36	0,47
	1047	0,000	8	CO110	Tau Total	-0,53	6,56	0,08
	1039	0,000	10	CO110	Sigma-eqv	5,32	11,36	0,47

3.5 Check of the roof pressure tubes.

Decisive result combination RCs Design values In-service situation



Check of the roof pressure tubes

Maximum Normal force in a horizontal diagonal $N_{y,ed} = 2.53$ kN

Maximum resistance design of a Layher Ledger is according to the Layher info printed in chapter 4 page 104

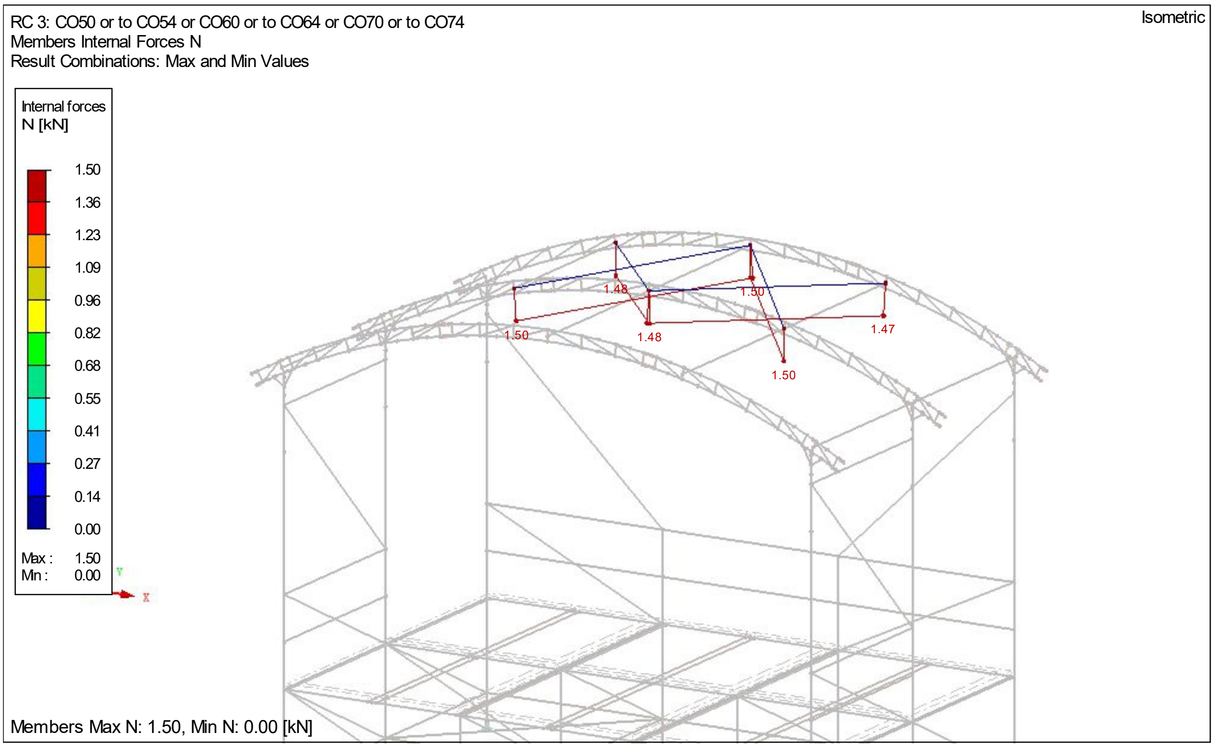
$N_{y,rd} = 31.0$ kN

$N_{y,ed} / N_{y,rd} < 1$

$2.53 / 31.0 = 0.08 < 1$

3.6 Check of the steel wire’s in the roof.

Decisive situation is the In-service situation.
The steel wire’s will be checked according to RC3: characteristic In service situation.



Maximum steel wire force is 1.50 kN.

For the steel wire is a safety factor required of 3.5.
Required steel wire 6x19 with rope core σ = 1770 kN/mm²
Diameter 6 mm with minimum breaking strength of 19.60 kN
Check 1.50 * 3.5 = 5.25 kN < 19.60 kN

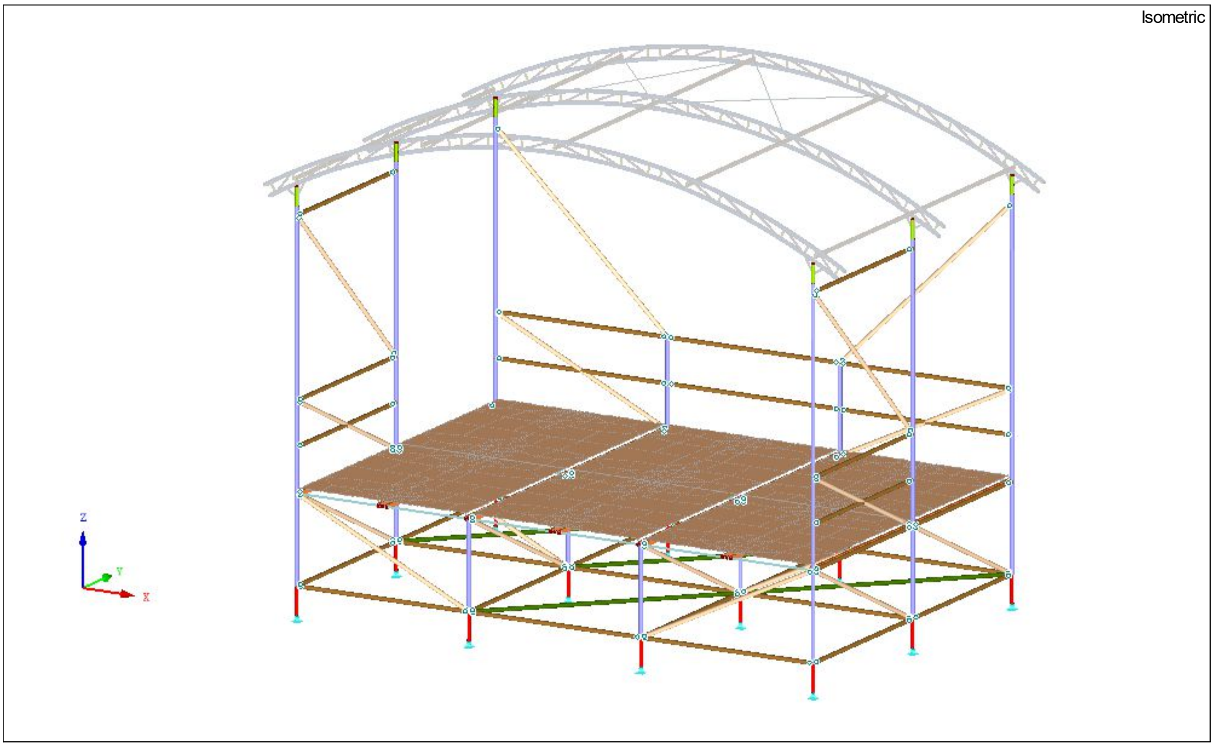
The steel wire can be replaced by any system which is suitable for these purposes.
The minimum required safety factor for these systems is 3.5

4.0 Calculation of the Layher System.

The staging system is built from the Layher scaffolding system. The type of Layher which is used in General is the k2000+ system. All the design figures which are taken into account in this calculation are taken from the k2000+ system.

4.1 RFem Layher stage Model

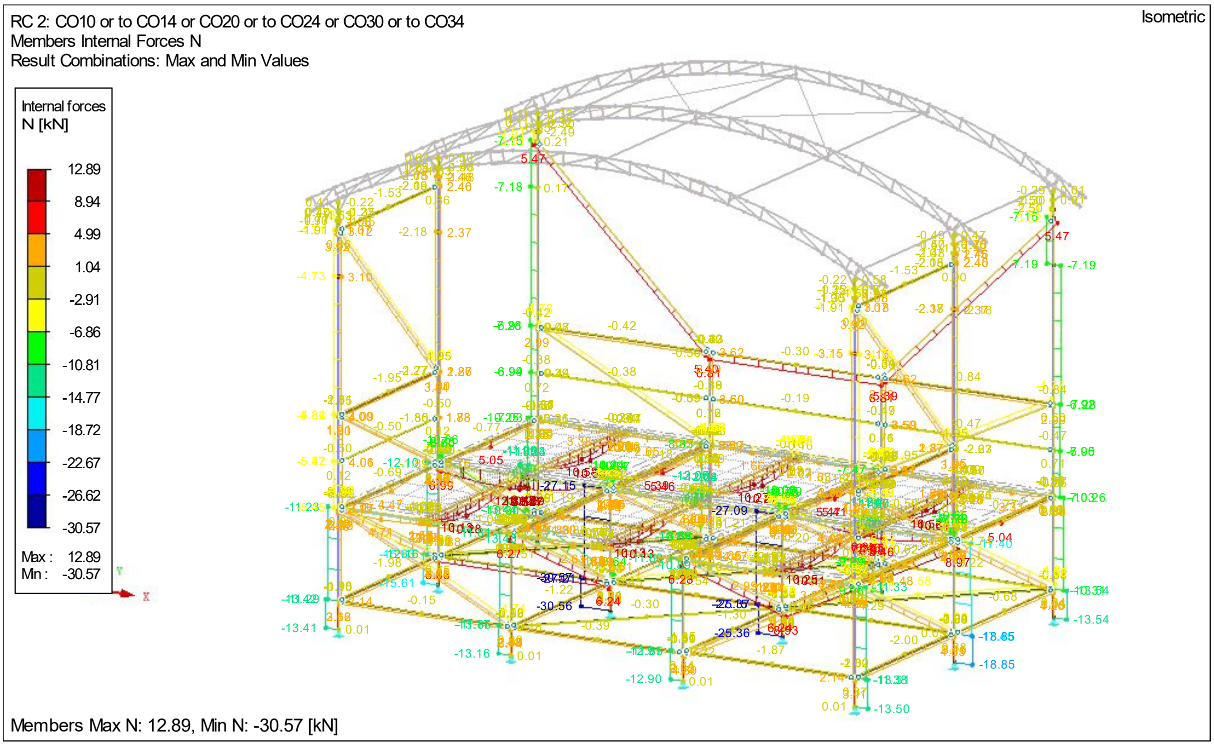
The Layher system is part of the main model and therefor all the reaction forces of the roof system are already in the model

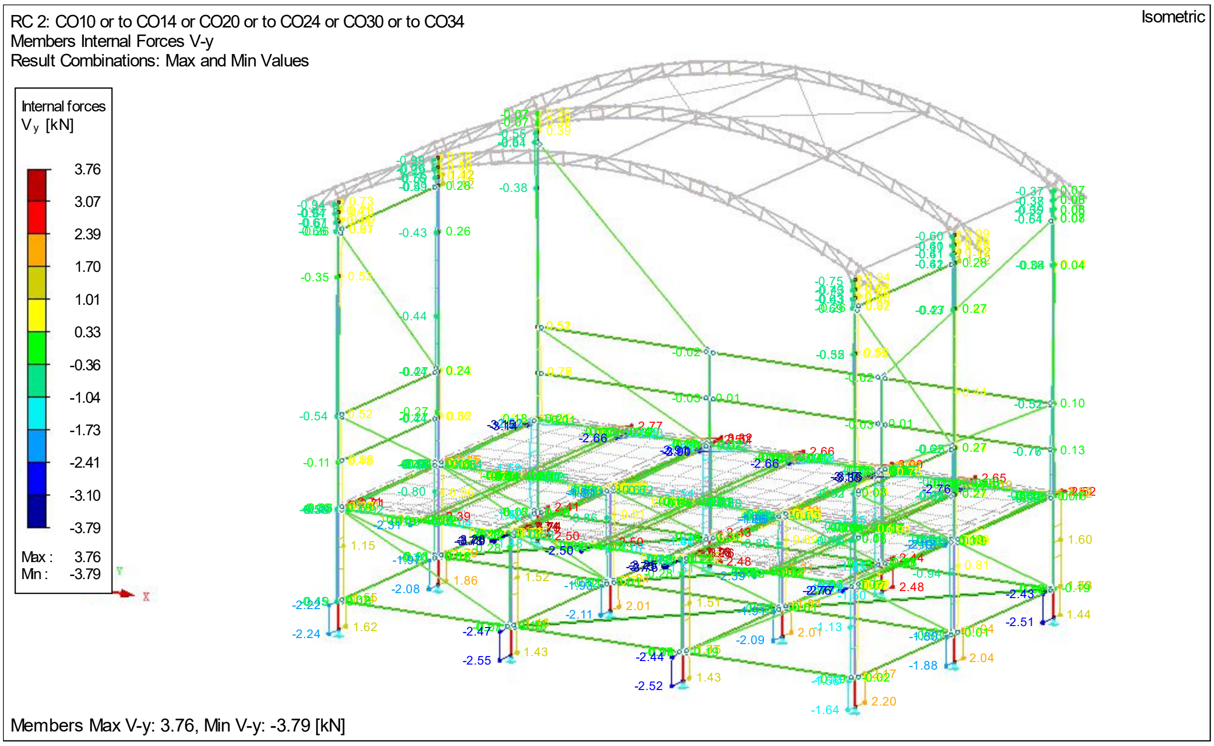


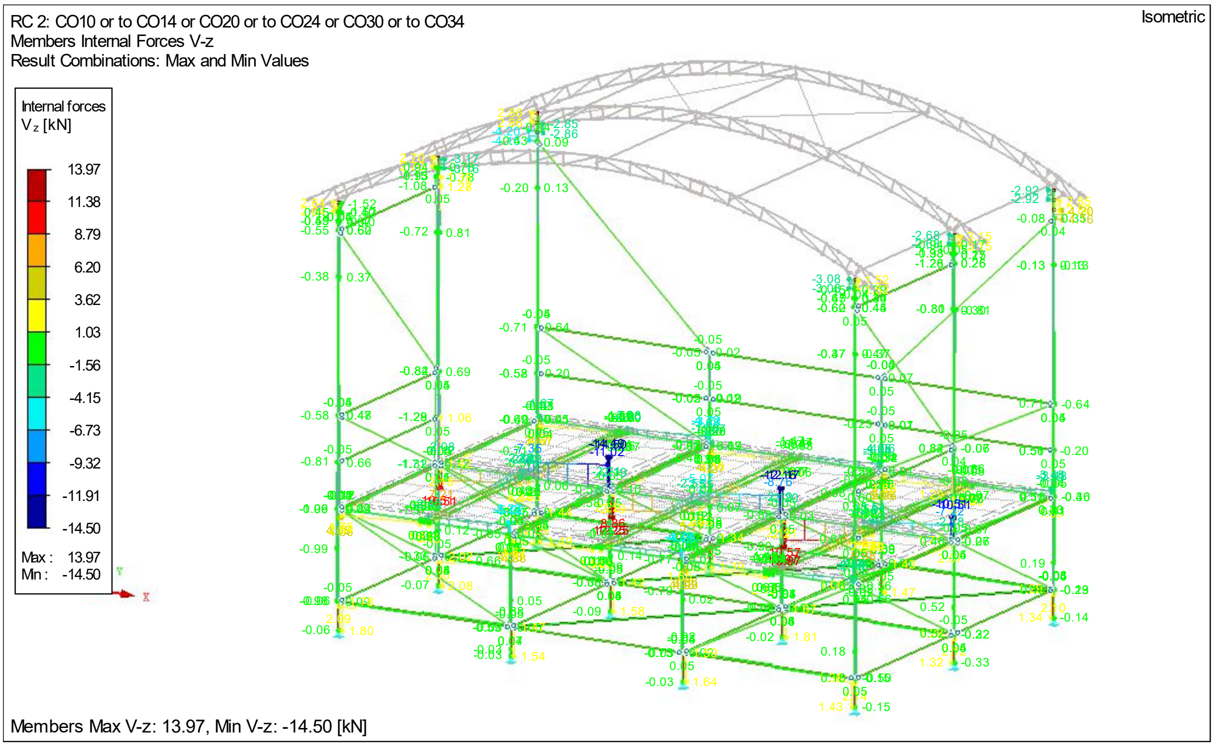
4: Ring 40/3; Steel S 235 JR
5: RO 38x4.5 | DIN EN 10220; Steel S 355 JR
6: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
7: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
8: RO 48.3x3.2 (Hot Formed); S320GD 1.0250
9: RO 48.3x2.6 (Hot Formed); Steel S 235 JR
10: EV transom; Aluminum EN-AW 6005A (EP/O,ER/B) T6
11: HK 50/30/4/4/4/4; Aluminum EN-AW 6005A (EP/O,ER/B) T6

4.2 Internal force diagram result combinations.

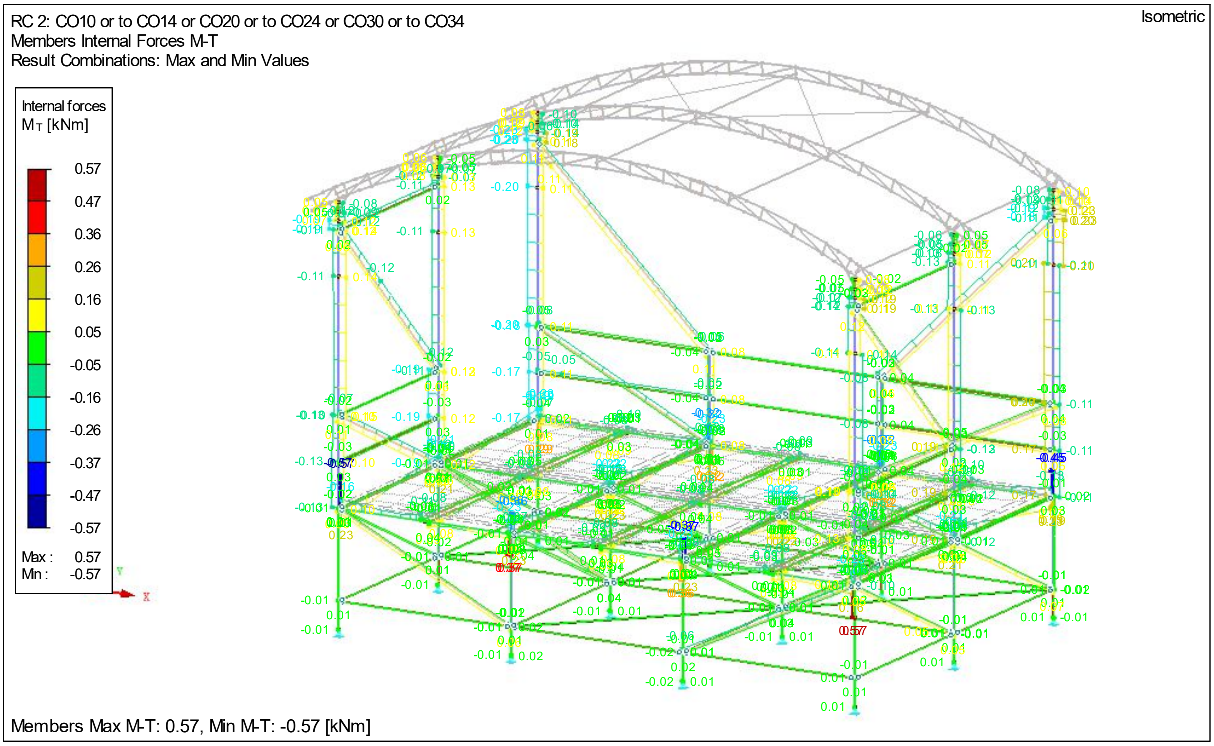
4.2.1 Internal force diagram result combination RC2 Design calculation In-service situation.



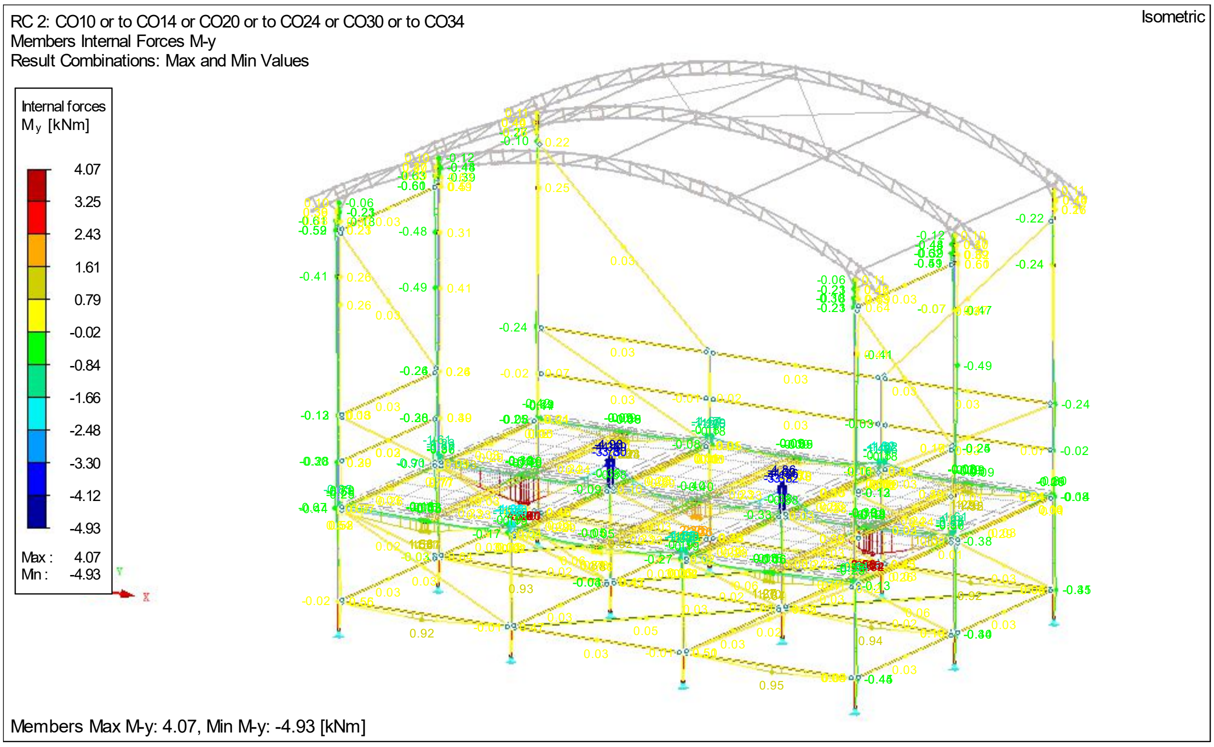


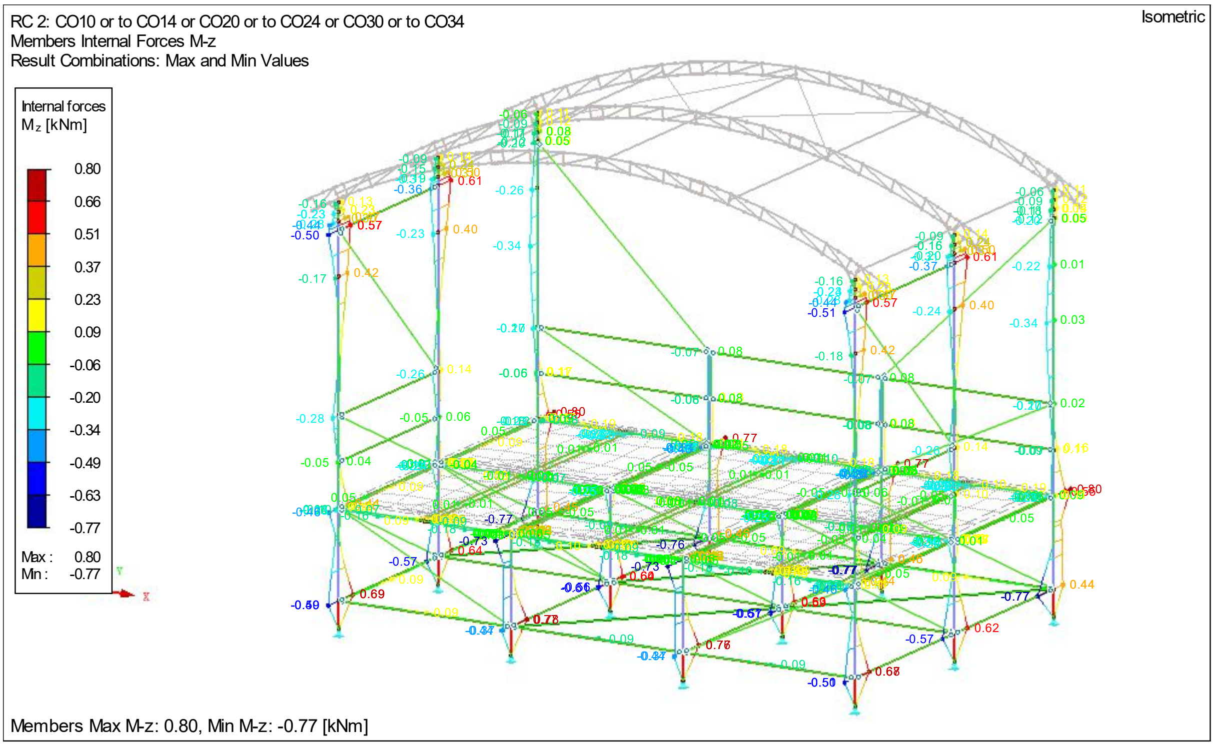


RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces V-z
Result Combinations: Max and Min Values
Isometric
Internal forces
V z [kN]
13.97
11.38
8.79
6.20
3.62
1.03
-1.56
-4.15
-6.73
-9.32
-11.91
-14.50
Max : 13.97
Min : -14.50
Members Max V-z: 13.97, Min V-z: -14.50 [kN]

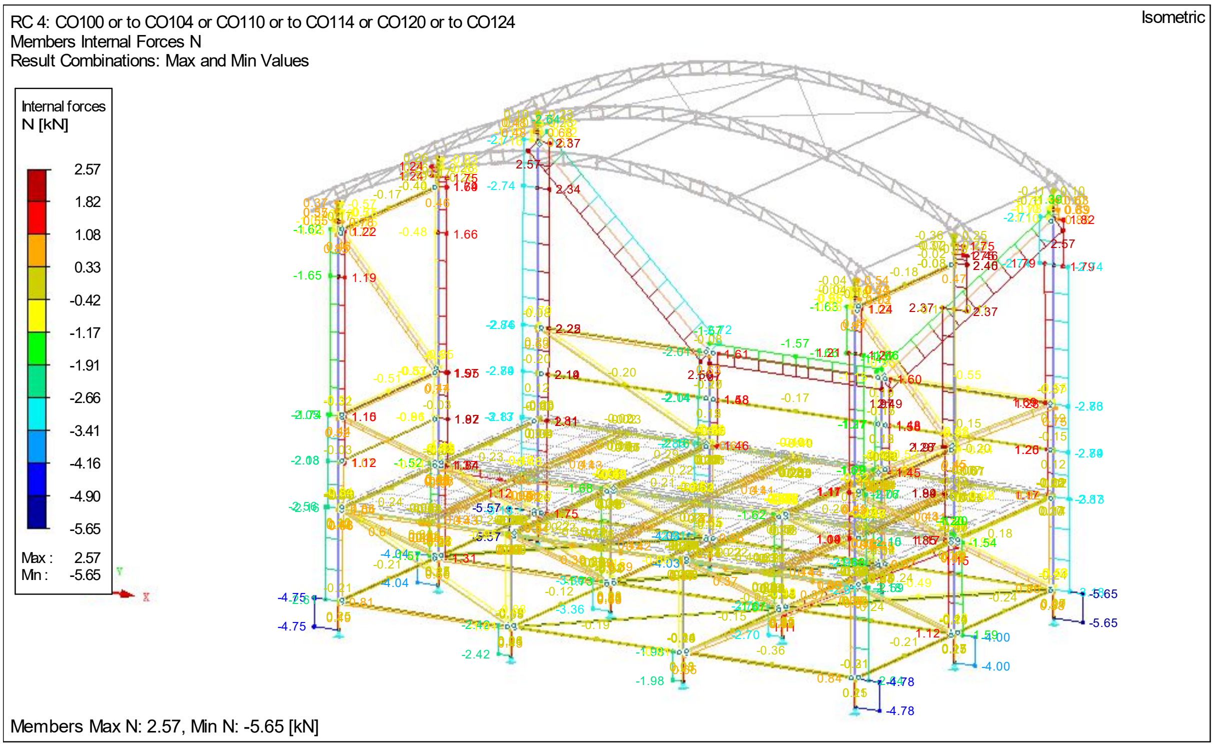


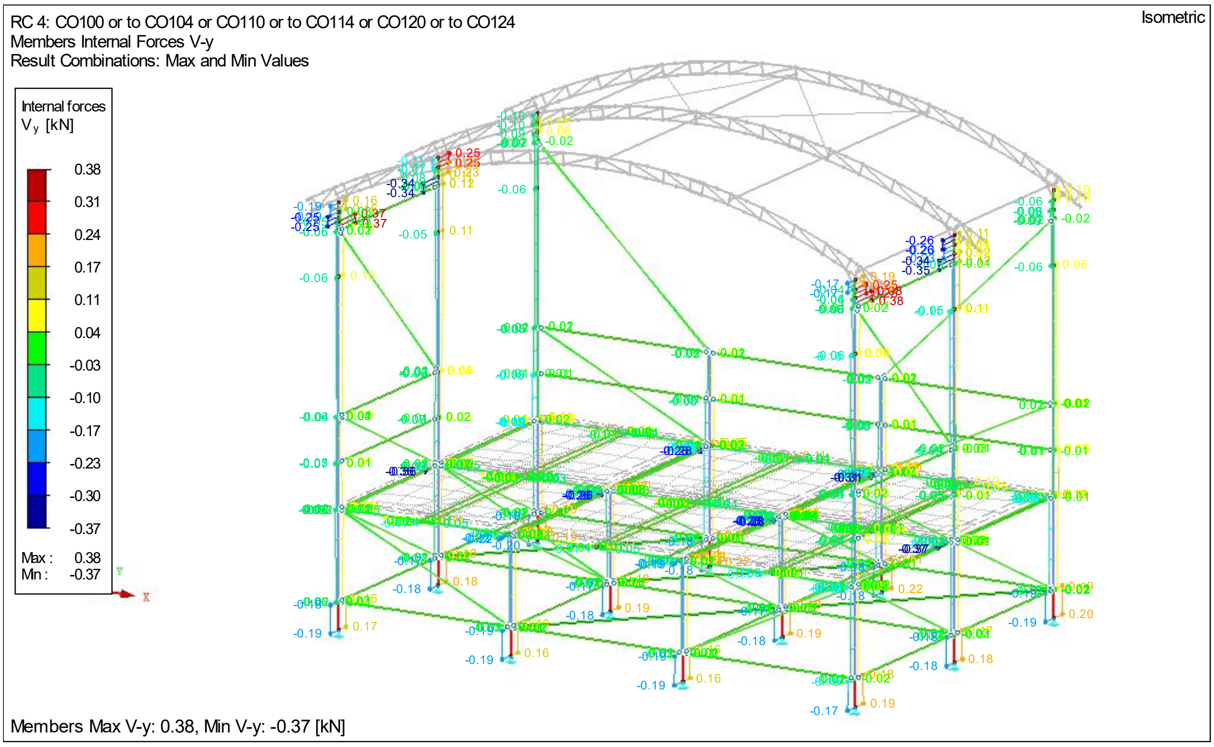
RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces M-T
Result Combinations: Max and Min Values
Isometric
Internal forces
M T [kNm]
0.57
0.47
0.36
0.26
0.16
0.05
-0.05
-0.16
-0.26
-0.37
-0.47
-0.57
Max : 0.57
Min : -0.57
Members Max M-T: 0.57, Min M-T: -0.57 [kNm]

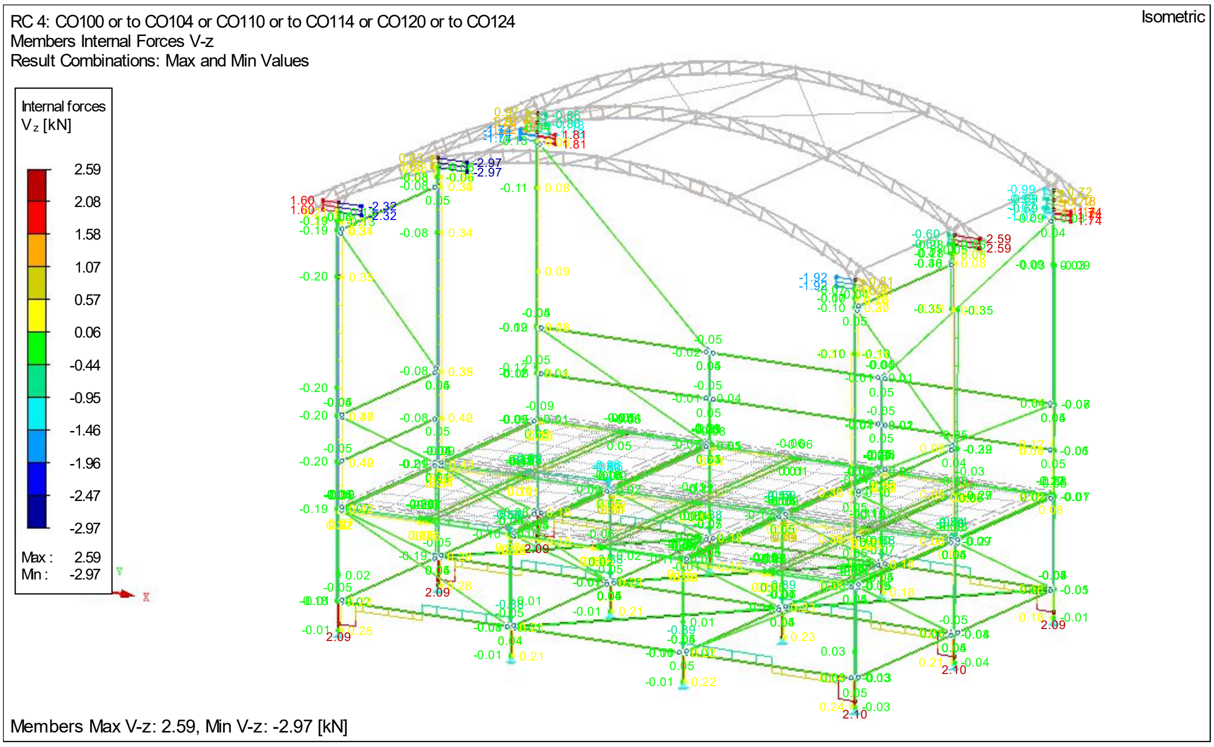

RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces M-y
Result Combinations: Max and Min Values
Isometric
Internal forces
M_y [kNm]
4.07
3.25
2.43
1.61
0.79
-0.02
-0.84
-1.66
-2.48
-3.30
-4.12
-4.93
Max : 4.07
Min : -4.93
Members Max M-y: 4.07, Min M-y: -4.93 [kNm]

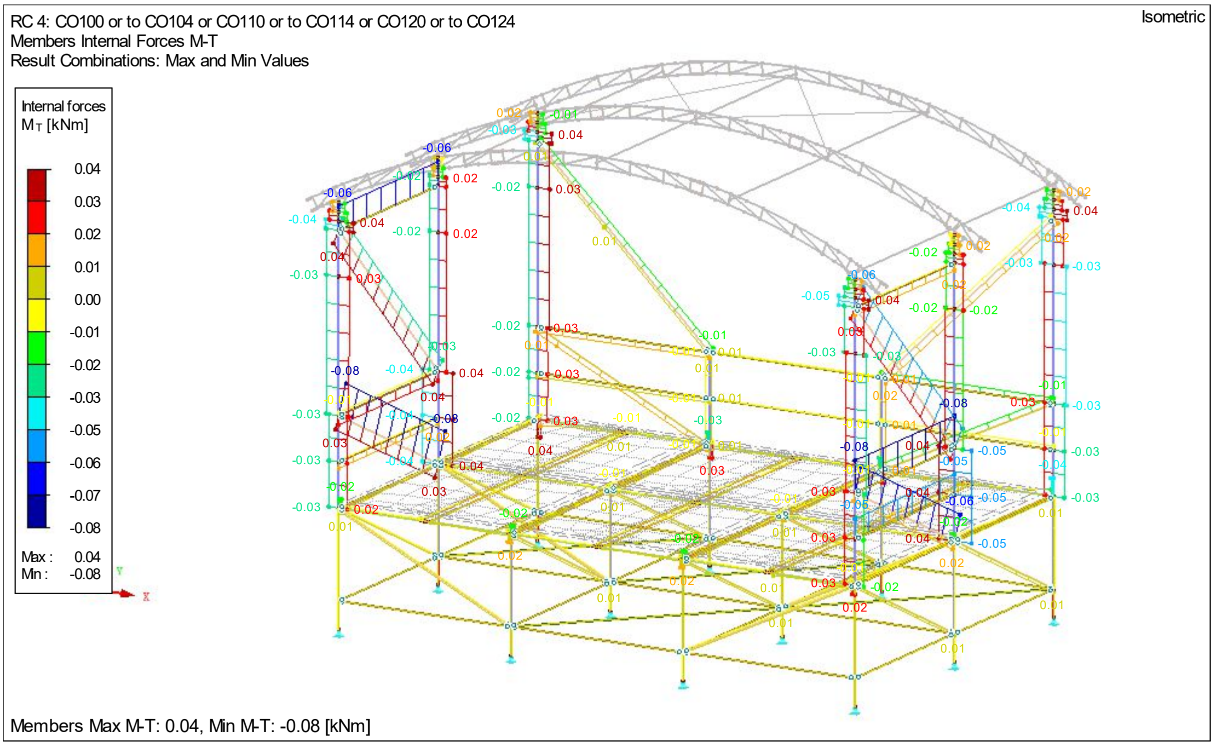

RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces M-z
Result Combinations: Max and Min Values
Isometric
Internal forces
M_z [kNm]
0.80
0.66
0.51
0.37
0.23
0.09
-0.06
-0.20
-0.34
-0.49
-0.63
-0.77
Max : 0.80
Min : -0.77
Members Max M-z: 0.80, Min M-z: -0.77 [kNm]

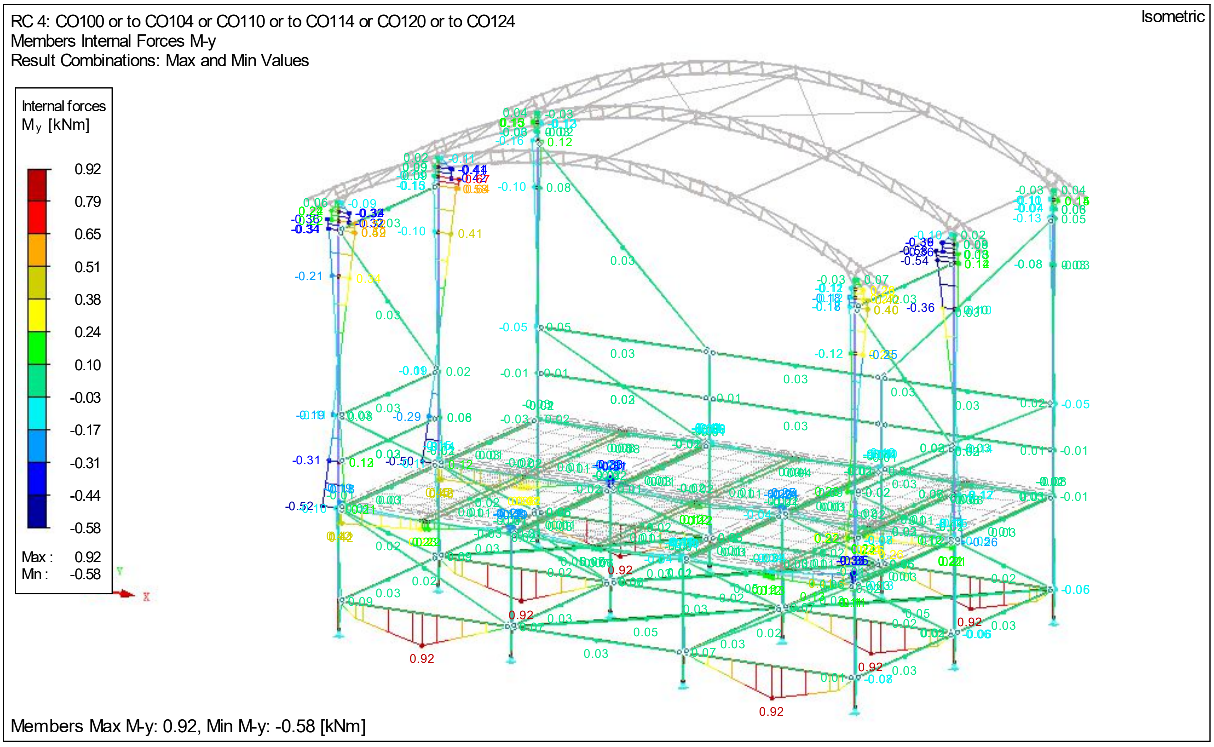
4.2.2 Internal force diagram result combination RC4 Design calculation Out-service situation.

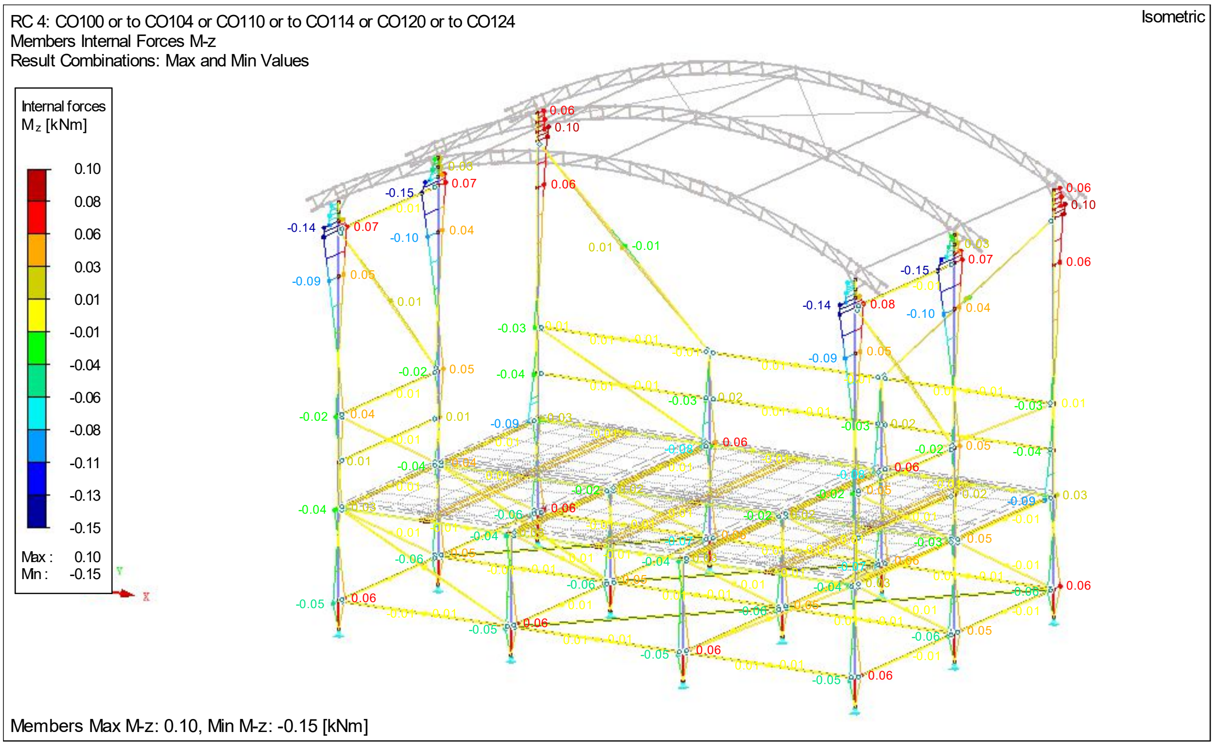





RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces V-z
Result Combinations: Max and Min Values
Isometric
Internal forces
V z [kN]
2.59
2.08
1.58
1.07
0.57
0.06
-0.44
-0.95
-1.46
-1.96
-2.47
-2.97
Max : 2.59
Min : -2.97
Members Max V-z: 2.59, Min V-z: -2.97 [kN]


RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces M-T
Result Combinations: Max and Min Values
Isometric
Internal forces
M T [kNm]
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.05
-0.06
-0.07
-0.08
Max : 0.04
Min : -0.08
Members Max M-T: 0.04, Min M-T: -0.08 [kNm]

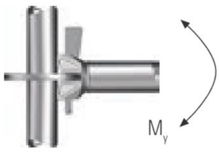

RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces M-y
Result Combinations: Max and Min Values
Isometric
Internal forces
My [kNm]
0.92
0.79
0.65
0.51
0.38
0.24
0.10
-0.03
-0.17
-0.31
-0.44
-0.58
Max : 0.92
Min : -0.58
Members Max M-y: 0.92, Min M-y: -0.58 [kNm]


RC 4: CO100 or to CO104 or CO110 or to CO114 or CO120 or to CO124
Members Internal Forces M-z
Result Combinations: Max and Min Values
Isometric
Internal forces
Mz [kNm]
0.10
0.08
0.06
0.03
0.01
-0.01
-0.04
-0.06
-0.08
-0.11
-0.13
-0.15
Max : 0.10
Min : -0.15
Members Max M-z: 0.10, Min M-z: -0.15 [kNm]

4.3 Layher information of different connections resistance design values

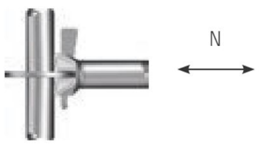
Z-8.22-64: K 2000+

Biegemoment



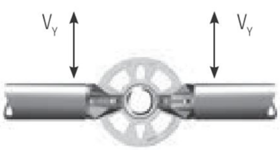
Biegemoment
$M_{y,\,Rd} = \pm\ 101{,}0$ kNcm

Normalkraft

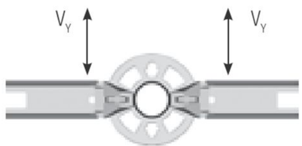


$N_{Rd} = \pm\ 31{,}0$ kN

Horizontale Querkraft

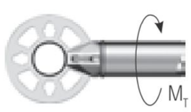


O-Riegel: $V_{y,\,Rd} = \pm\ 10{,}0$ kN



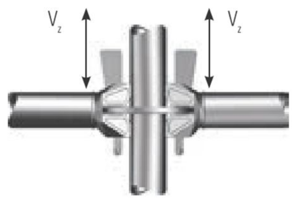
U-Riegel: $V_{y,\,Rd} = \pm\ 5{,}9$ kN

Torsionsmoment



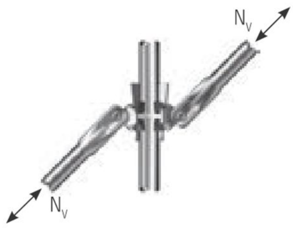
$M_{T,\,Rd} = \pm\ 52{,}5$ kNcm

Vertikale Querkraft



Vertikale Querkraft, Einzelanschluss
$V_{z,\,Rd} = \pm\ 26{,}4$ kN
Vertikale Querkraft je Lochscheibe
$\sum V_{z,\,Rd} = \pm\ 105{,}6$ kN

Normalkraft, Diagonale



Beanspruchbarkeiten der Vertikaldiagonalen für Feldhöhe 2,00 m für **K 2000+**:

	Druck								Zug
Feldlänge [m]	0,73	1,09	1,40	1,57	2,07	2,57	3,07	4,14	alle Feldlängen
N_{VRd} [kN]	-16,1	-16,8	-15,5	-14,8	-12,4	-10,2	-8,3	-5,3	+17,9

K 2000+ Bauteile können mit Bauteilen der Variante LW, Variante II und Variante I vermischt werden. Beanspruchbarkeiten siehe Zulassung Z-8.22-64 und Z-8.22-949.

Rd = Beanspruchbarkeit,
(enthält Teilsicherheitsbeiwert γ_M)

*„Zulässige Lasten" bzw. „Gebrauchslasten" erhält man durch Division der Beanspruchbarkeit durch 1,5 (= γ_F)

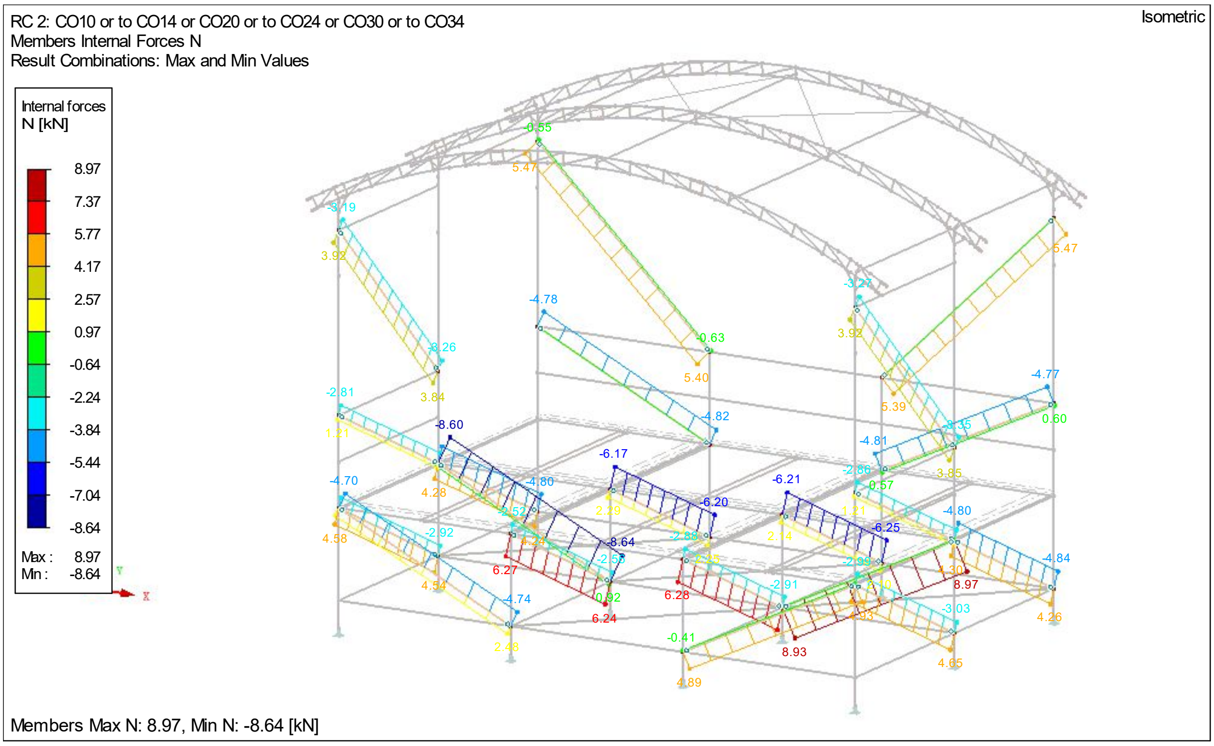
15

•

4.4 Detail check diagonals

Decisive result combination = RC2 design values In-service situation. This due to the fact that in the In service situation the floor loading has been taken into account. This floor loading is not allowed in the Out service situation.

4.4.1 result combination RC2 Design calculation In-service situation.



Check of the vertical diagonal

Maximum Normal force in a diagonal $N_{y,ed}$ 8.97 kN

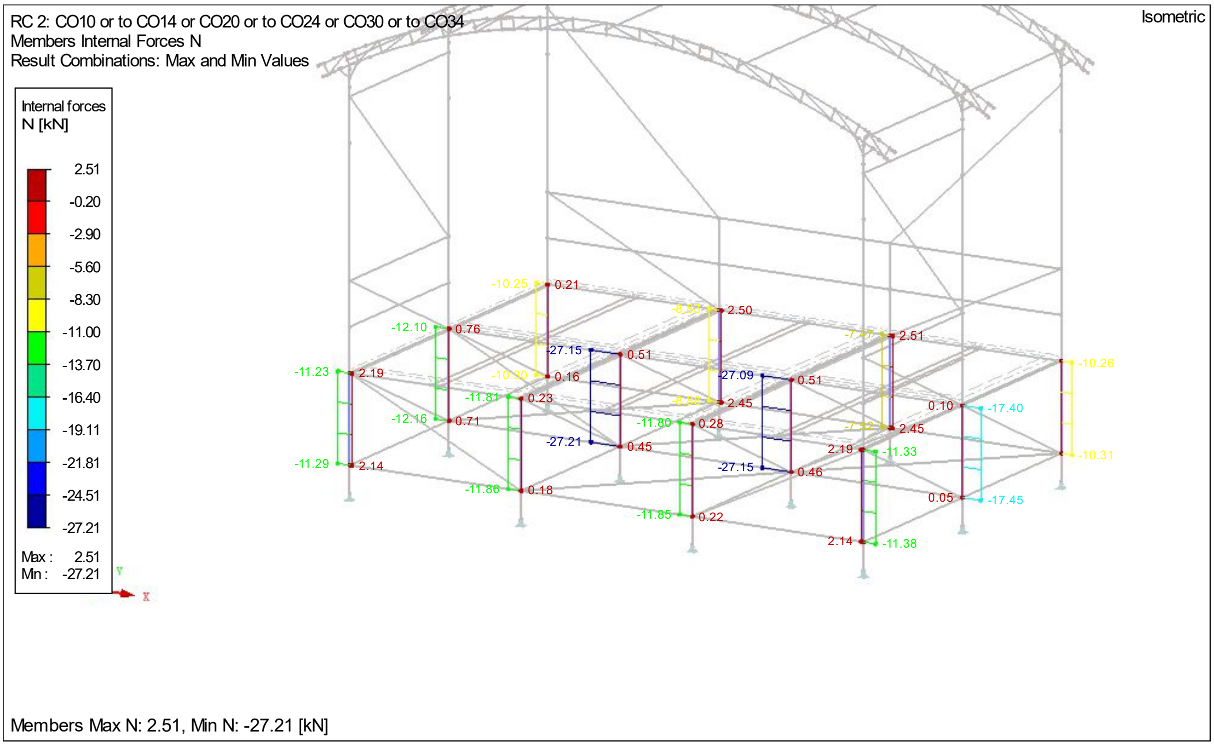
Maximum resistance design of a diagonal $N_{y,rd}$ = 12.4 kN

$N_{y,ed} / N_{y,rd} < 1$

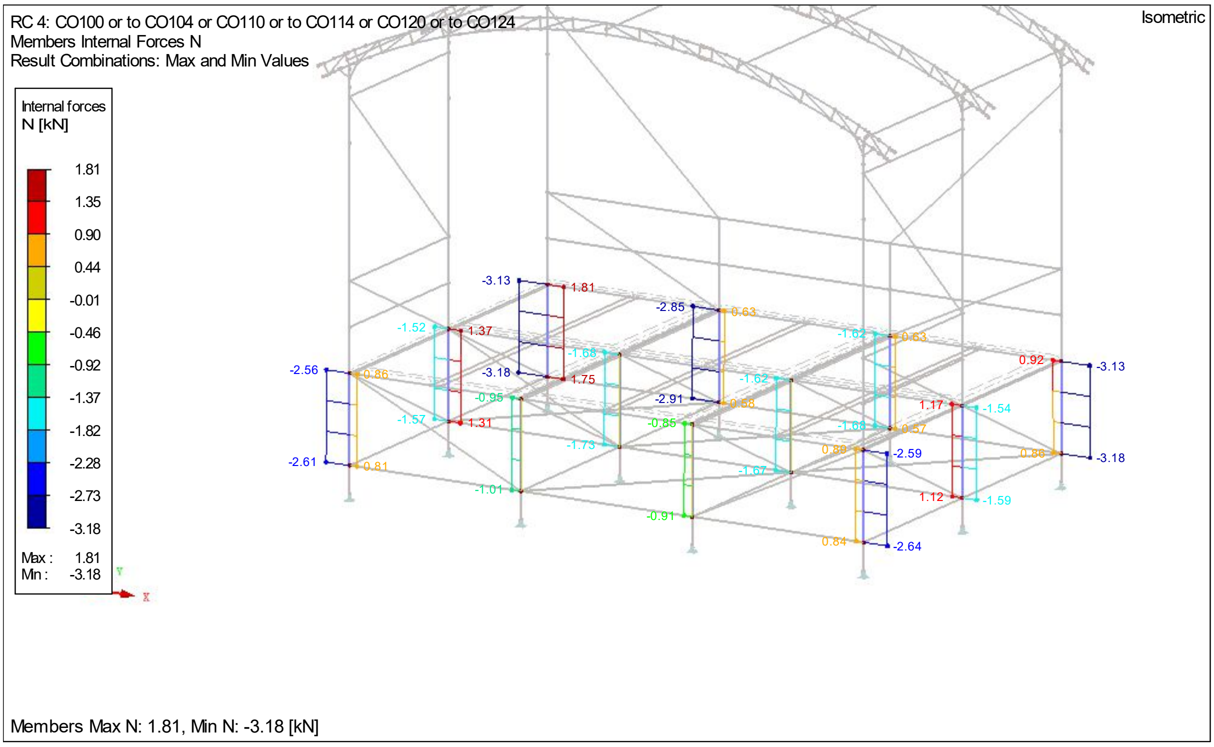
$8.97 / 12.4 = 0.72 < 1$

4.5 Detail check Layher upright underneath the stage.

4.5.1 result combination RC2 Design calculation In-service situation.



4.5.2 result combination RC4 Design calculation Out-service situation.



Buckling calculation Layher pole Maximum Normal force

N = 27.21 kN
M_y = 0.52 kNm
M_z = 0.60 kNm

Buckling Length factor K = 0.9

The factor K is according to table 6,8 NEN-EN 1999-1-1

L = 100 cm

$L_{cr} = 0.9 * 100 = 90$

$I_y = \sqrt{}(I_y / A) = \sqrt{}(11.6 / 4.53) = 1.6$

$\lambda_z = L_{cr} / (i_z * \pi) * (\sqrt{}((A_{eff} * f_y) / A * E))$

$\lambda_z = 90 / (1.6 * \pi) * \sqrt{}((4.27 * 35.5) / (4.27 * 21000)) = 0.733$

$\Theta_z = 0.5 * (1 + \alpha * (\lambda_z - \lambda_0) + \lambda_z^2)$

$\Theta_z = 0.5 * (1 + 0.49 * (0.733 - 0.10) + 0.733^2) = 0.900$

$X_z = 1 / (\Theta_z + \sqrt{}(\Theta_z^2 - \lambda_z^2))$

$X_z = 1 / (0.900 + \sqrt{}(0.900^2 - 0.733^2)) = 0.703$

$N_{b,RD} = X_z * A * f_0 / 1.1 = 0.703 * 4.27 * 32 / 1.1 = 87.40$ kN

$M_{y,z,RD} = W_{pl} * f_0 / 1.1 = 6.17 * 32 / 1.1 = 179.5$ kNcm = 1.795 kNm

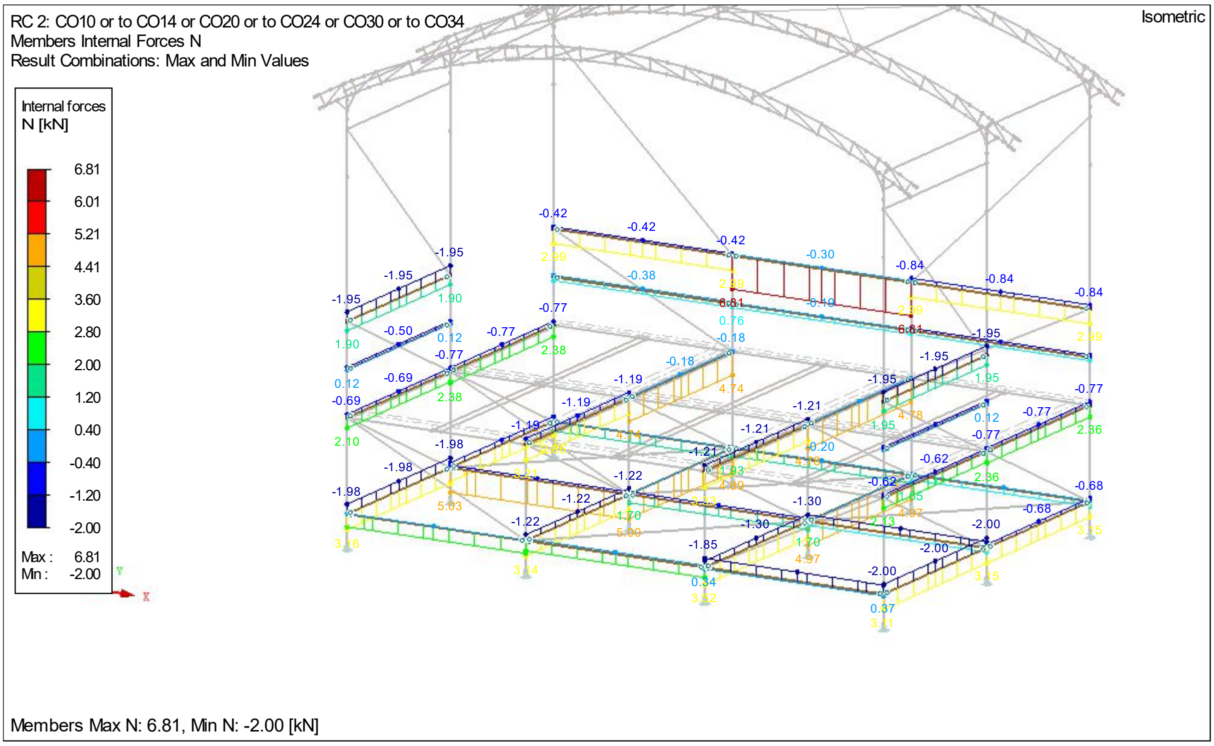
$N_{ed} / N_{b,RD} + M_{y,ed} / M_{y,RD} + M_{z,ed} / M_{z,RD} < 1$

$27.21 / 87.40 + 0.52 / 1.795 + 0.60 / 1.795 = 0.93 < 1$

4.6 Detail check of horizontal ledgers.

Decisive result combination = RC2 design values In-service situation.

4.6.1 result combination RC2 Design calculation In-service situation.



Check of the horizontal ledgers

Maximum Normal force in a horizontal diagonal $N_{y,ed} = 6.81$ kN

Maximum resistance design of a horizontal diagonal $N_{y,rd} = 31.0$ kN

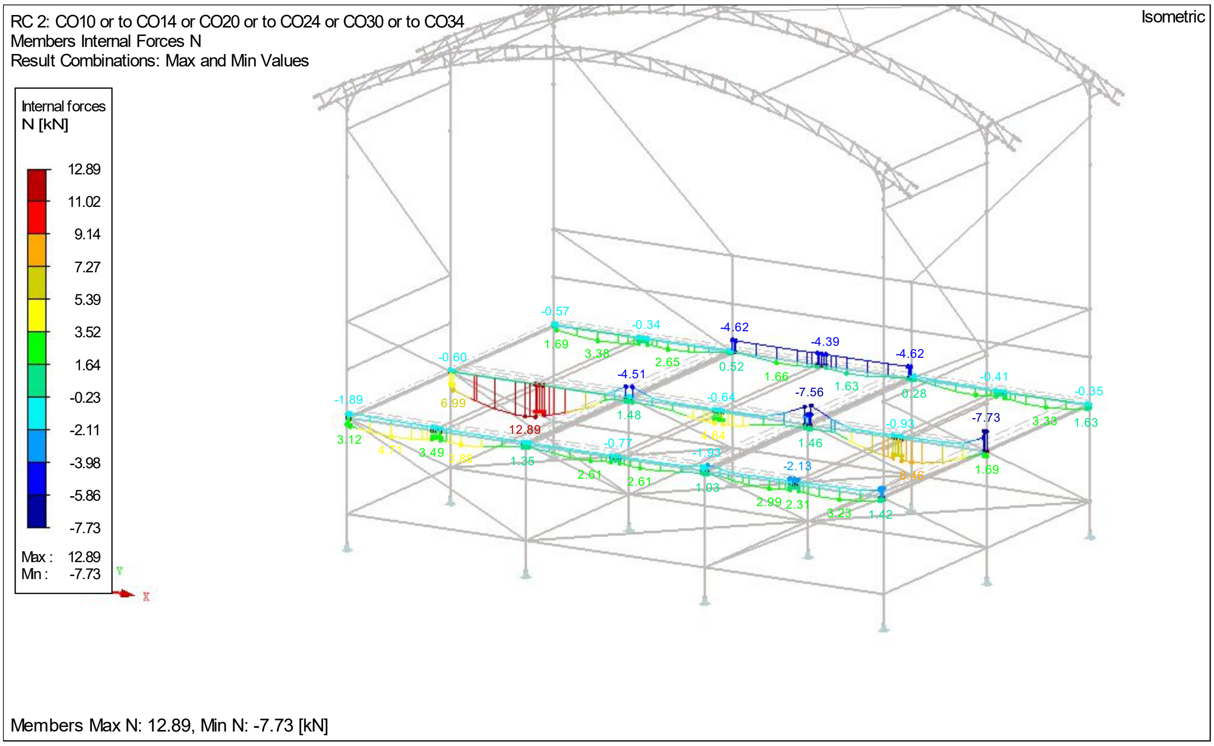
$N_{y,ed} / N_{y,rd} < 1$

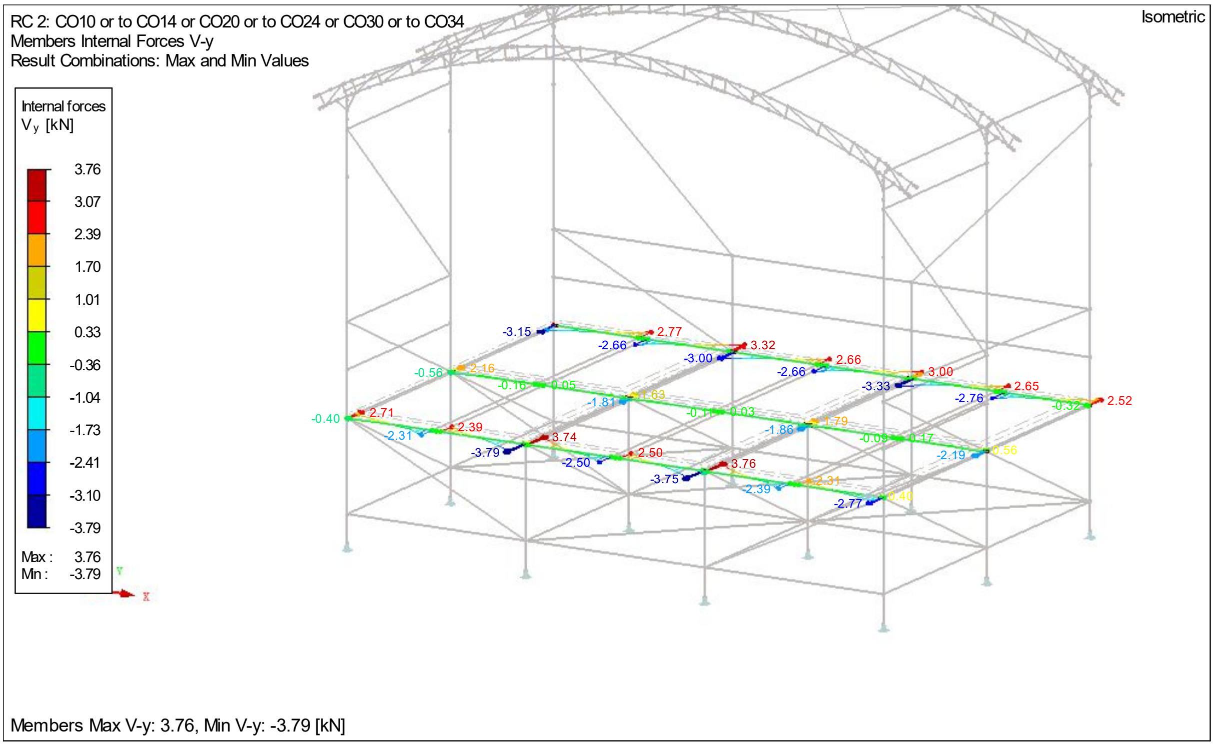
$6.81 / 31.0 = 0.21 < 1$

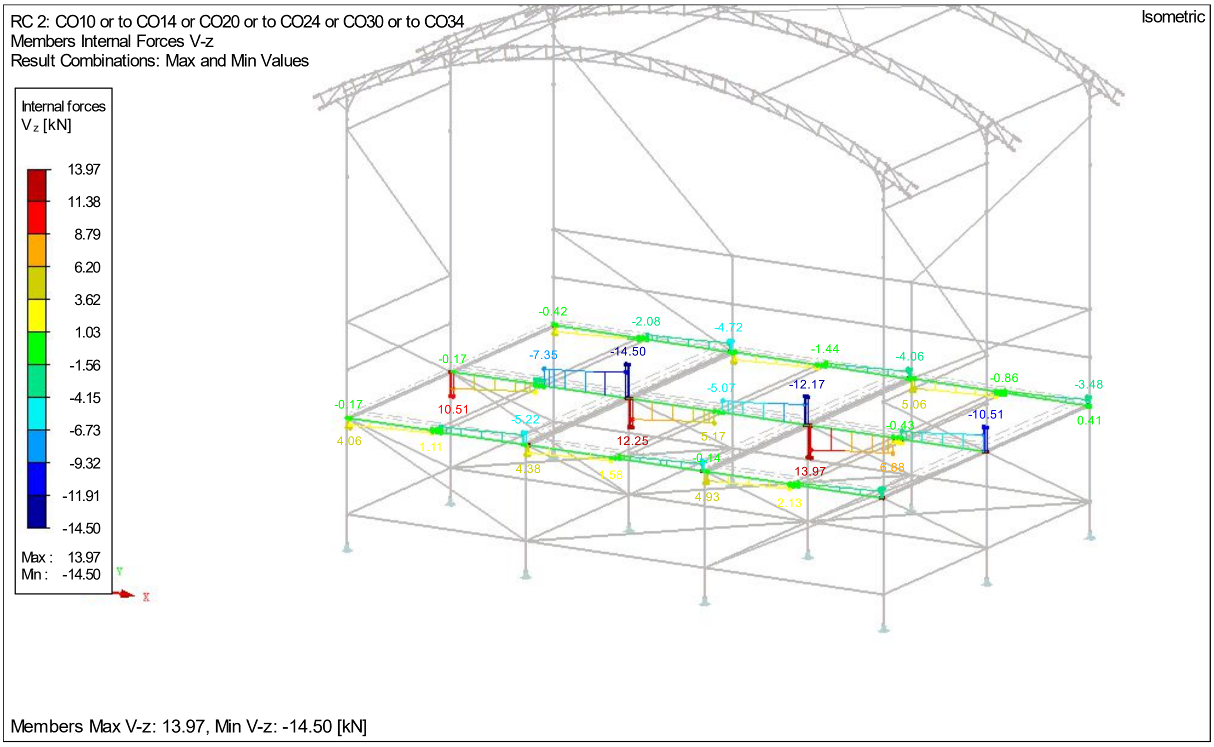
4.7 Detail check of floor beam

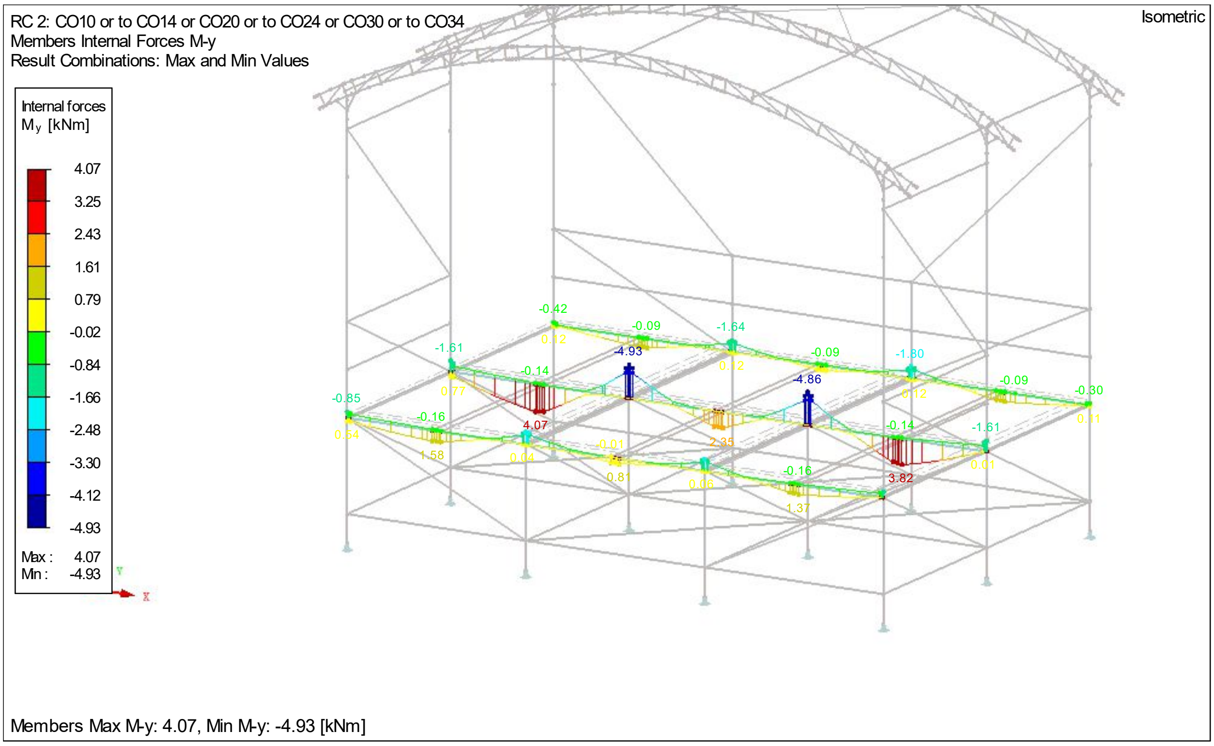
Decisive result combination = RC2 design values In-service situation.

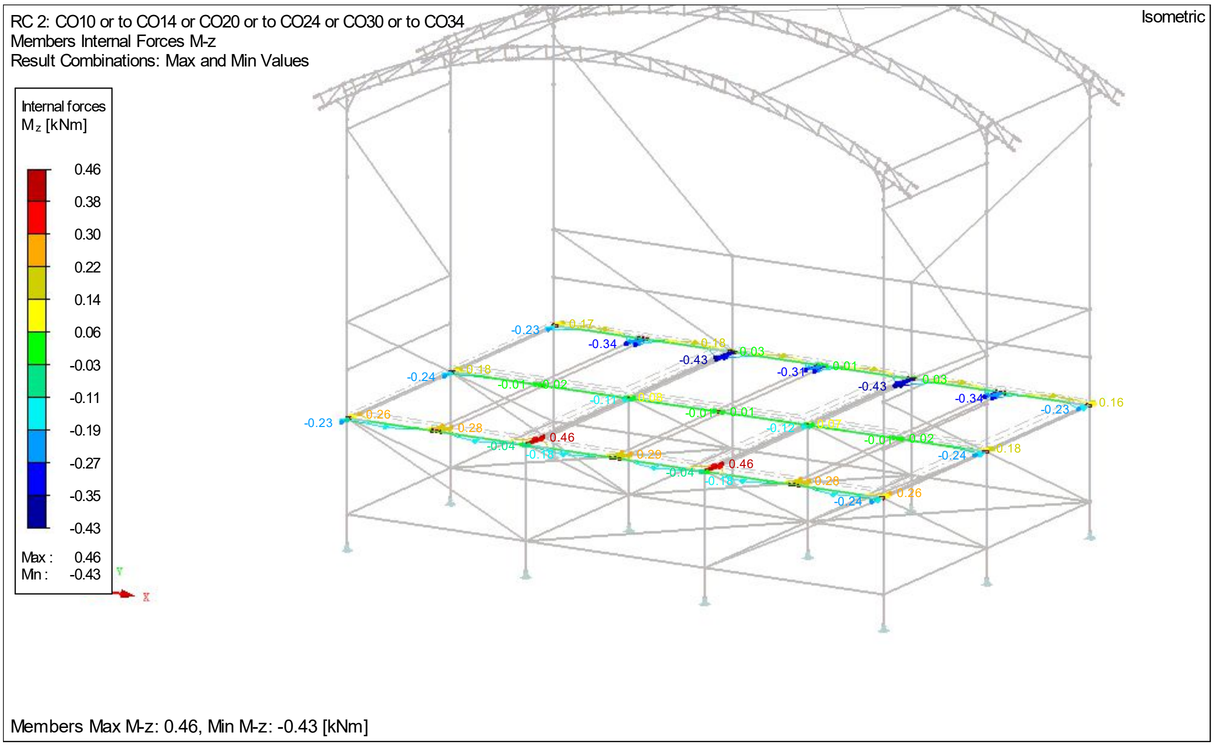
4.7.1 result combination RC2 Design calculation In-service situation.





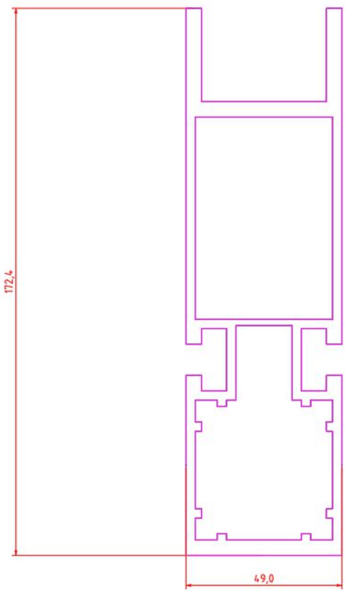

RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces V-z
Result Combinations: Max and Min Values
Isometric
Internal forces
V z [kN]
13.97
11.38
8.79
6.20
3.62
1.03
-1.56
-4.15
-6.73
-9.32
-11.91
-14.50
Max : 13.97
Min : -14.50
Members Max V-z: 13.97, Min V-z: -14.50 [kN]


RC 2: CO10 or to CO14 or CO20 or to CO24 or CO30 or to CO34
Members Internal Forces M-y
Result Combinations: Max and Min Values
Isometric
Internal forces
M_y [kNm]
4.07
3.25
2.43
1.61
0.79
-0.02
-0.84
-1.66
-2.48
-3.30
-4.12
-4.93
Max : 4.07
Min : -4.93
Members Max M-y: 4.07, Min M-y: -4.93 [kNm]



Profiel berekening.

Layher Event Beam speciaal profiel Aluminium 6005A T6



I_1	[INCH^4]	5542580
I_2	[INCH^4]	701985
S_c	[INCH]	90.03
S_t	[INCH]	82.38
A	[INCH^2]	1878.072

Wy= I_1 / e_y = 554 / 8.25 = 67.15 cm³

Wz= I_2 / e_z = 70.2 / 2.5 = 28.08 cm³

Stress calculation

N_{ed} = 12.89 kN
$\sigma N_{ed} = N_{ed}$ / A = 12.89 / 18.78 = 0.69 kN/cm²
$V_{y,ed}$ = 3.79 kN
$\sigma v_{z,ed} = V_{y,ed}$ / A = 3.79 / 18.78 = 0.20 kN/cm²
$V_{z,ed}$ = 14.50 kN
$\sigma v_{z,ed} = V_{z,ed}$ / A = 14.50 / 18.78 = 0.77 kN/cm²
My,ed = 4.93 kNm
$\sigma M_{y,ed} = M_{y,ed}$ / Wy = 493/ 67.15 = 7.34 kN/cm²
Mz,ed = 0.46 kNm
$\sigma M_{z,ed} = M_{z,ed}$ / Wy = 46 / 28.08 = 1.64 kN/cm²

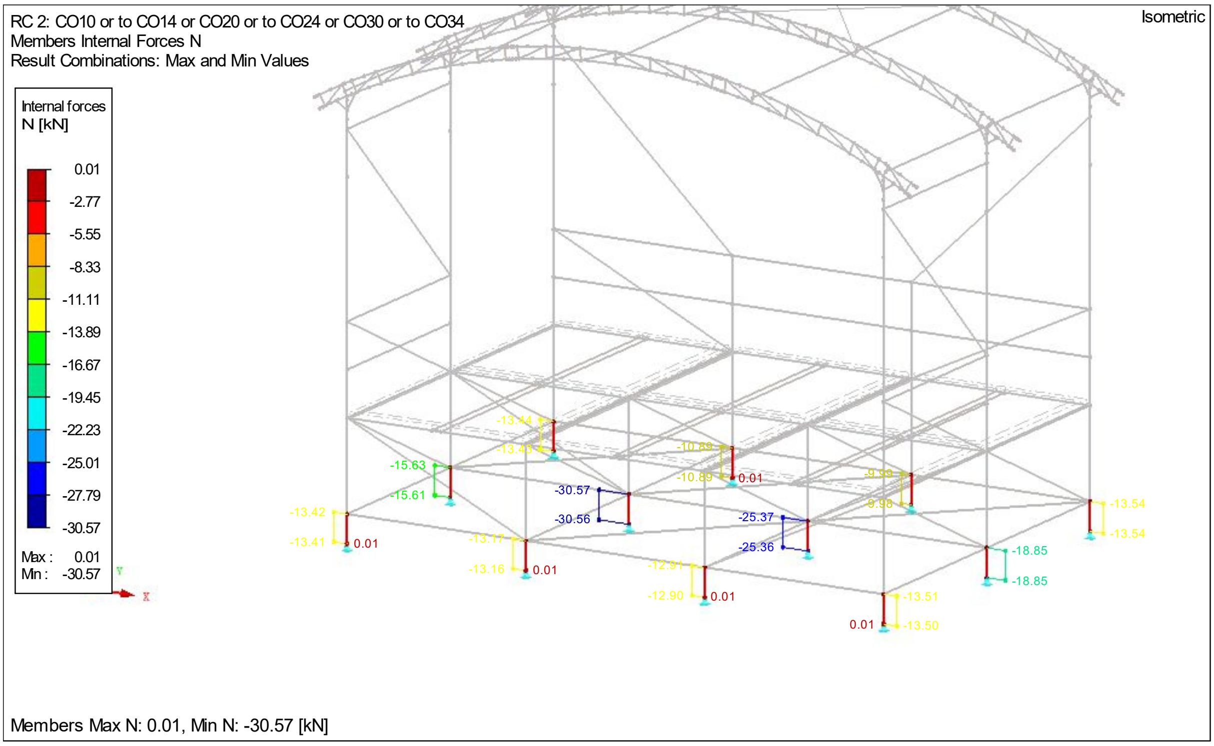
$\sigma tot = \sigma N_{ed} + 0{,}58 * \sigma v_{z,ed} + 0{,}58 * \sigma v_{z,ed} + \sigma M_{y,ed} + \sigma M_{y,ed}$
0.69 + 0.58 * 0.20 + 0.58 * 0.77 + 7.34 + 1.64 = 10.23 kN/cm²

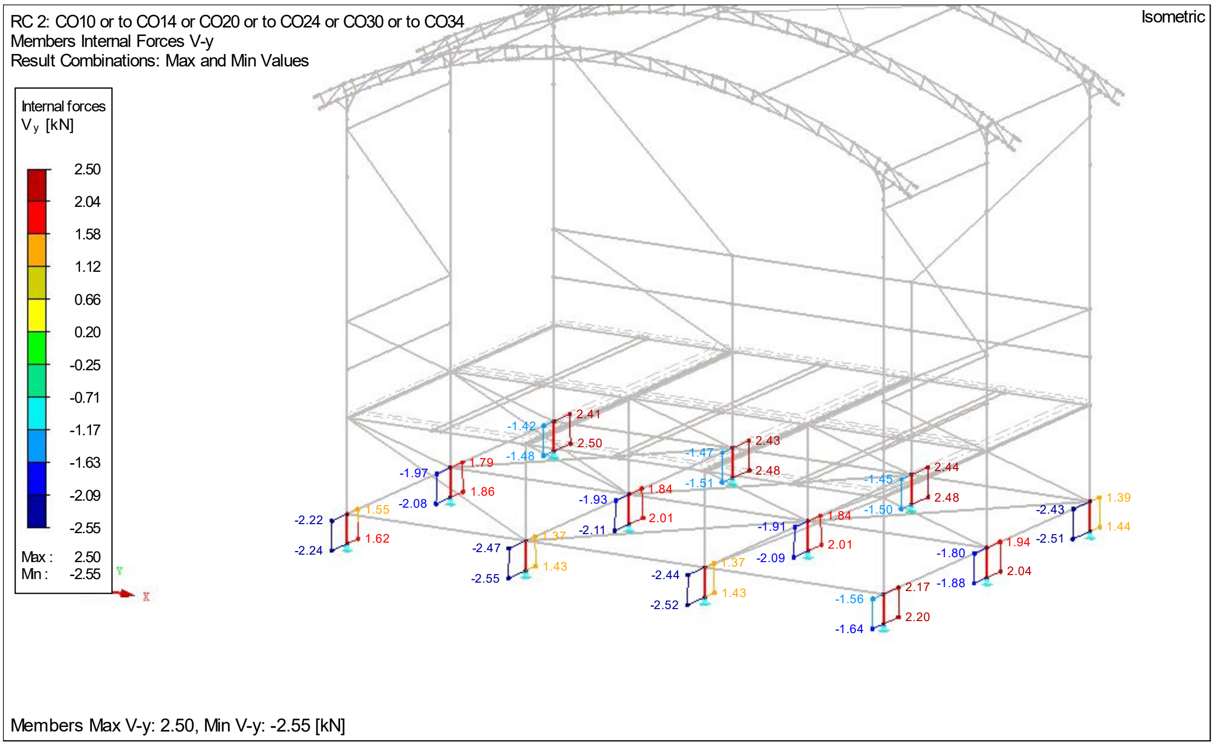
Check
$\sigma tot / (fy / \gamma) < 1$
10.23 / (22.5 / 1.1) = 0.50 < 1

4.8 Detail check of the Layher spindles.

Decisive result combination = RC2 design values In-service situation.

4.8.1 result combination RC2 Design calculation In-service situation.





Check of the Layher screw jack.

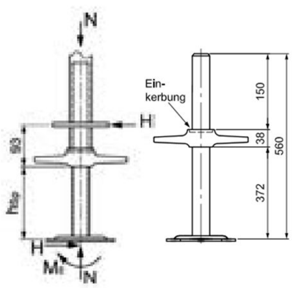
Maximum Normal force in a Layher screw jack $N_{y,ed}$ = 30.57 kN

Maximum horizontal force in this Layher screw jack $V_{y,ed}$ = 2.11 kN

According to the table 12 from the Layher technical information catalogue, a Screw jack with a horizontal load of 2.11 kN and a vertical load of 30.57 kN can have a maximum spindle length of 18 cm.

Fußspindeln – Belastungstabellen

FUSSSPINDEL 60



Ersatzquerschnittswerte der Spindel

A = 3,84 cm²
W_{el} = 2,61 cm³
W_{pl} = 3,26 cm³
I = 3,74 cm⁴

Material: EN 10219-S235JRH
→ Rollgewinde: $f_{y,k}$ = 280,0 N/mm²

Tab. 12 Belastung Fußspindeln

Ausspindellänge h_{Sp} [cm]	Zulässige Vertikallast N [kN]* bei gleichzeitiger Wirkung einer Horizontallast H [kN]: H = 0,0		H = 0,5		H = 1,0		H = 1,5		H = 2,0		H = 2,5		H = 3,0		H = 3,5		H = 4,0		H = 4,5		H = 5,0		H = 5,5		H = 6,0		Zul. Horizontallast H [kN] wenn N = 0
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2	
0	39	53	39	51	39	51	39	51	39	50	39	49	39	49	38	–	38	–	37	–	36	–	36	–	35	–	26,3
5	39	52	39	51	39	50	39	48	38	–	37	–	36	–	35	–	34	–	33	–	32	–	31	–	30	–	7,8
10	39	51	39	49	38	–	37	–	36	–	34	–	33	–	30	–	29	–	28	–	26	–	25	–	–	–	4,6
15	39	49	38	–	36	–	35	–	33	–	31	–	29	–	–	–	–	–	–	–	–	–	–	–	–	–	3,2
20	38	–	36	–	34	–	32	–	29	–	27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2,5
25	37	–	34	–	31	–	28	–	23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2,0
30	35	–	31	–	27	–	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,7
35	32	–	27	–	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,5
37	30	–	25	–	17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,4

*Die zulässigen Vertikallasten wurden berechnet unter Anwendung des Berechnungsmodells nach DIN EN 12811-1, Abs. 10.2.3.2. Zur Erfassung der Biegesteifigkeit des Ständerrohres, der Schnittgrößenanteile aus Theorie II. Ordnung und der maximalen Beanspruchbarkeit der Ständer wurden folgende Raumgerüste mit Rastermaß 2,57 x 2,57 m berücksichtigt:
2,00 m Lagenhöhe für Stieldruckkräfte $N_1 \leq 39$ kN
1,50 m Lagenhöhe für Stieldruckkräfte 39 kN < $N_2 \leq 54$ kN

(–) Bei dieser Kombination von Ausspindellänge und Horizontallast ist die Biegebeanspruchbarkeit der Spindel überschritten.

5.0 Ballast and support load calculations.

5.1 General information Ballast calculation.

The ballast will be checked for uplift, overturning and sliding. The Layher stage which is designed as a ridged stage will be taken into account.

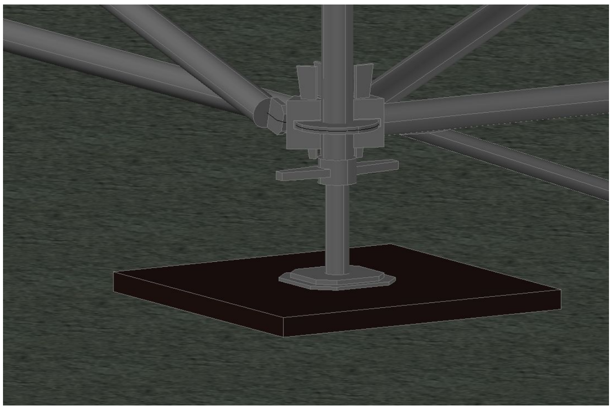
All permanent installed loading can be subtracted from the nearest Ballast position.

The safety factor for the ballast calculation against slipping is set to 1.2 according to the NEN-EN 13814. This is based on a horizontal load which is relying on friction.
For the friction coefficient the factor of 0.4 has been taken into account according to the table below.

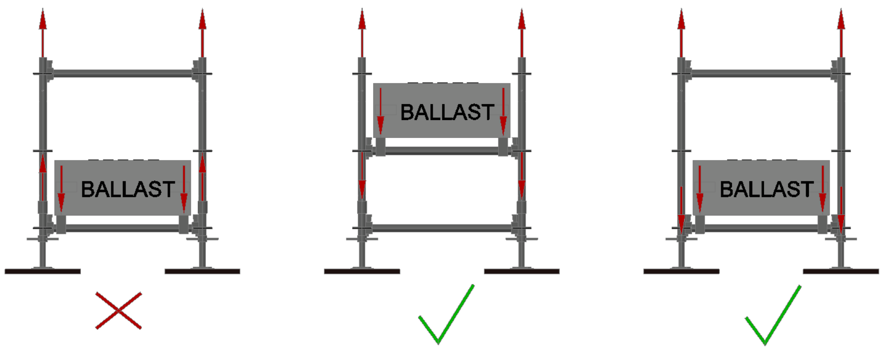
Table 3 — Coefficients of friction μ

	Wood	Steel	Concrete
Wood	0,4	0,4	0,6
Steel	0,4	0,1	0,2
Concrete	0,6	0,2	0,5
Clay[a]	0,25	0,2	0,25
Loam[a]	0,4	0,2	0,4
Sand and gravel	0,65	0,2	0,65

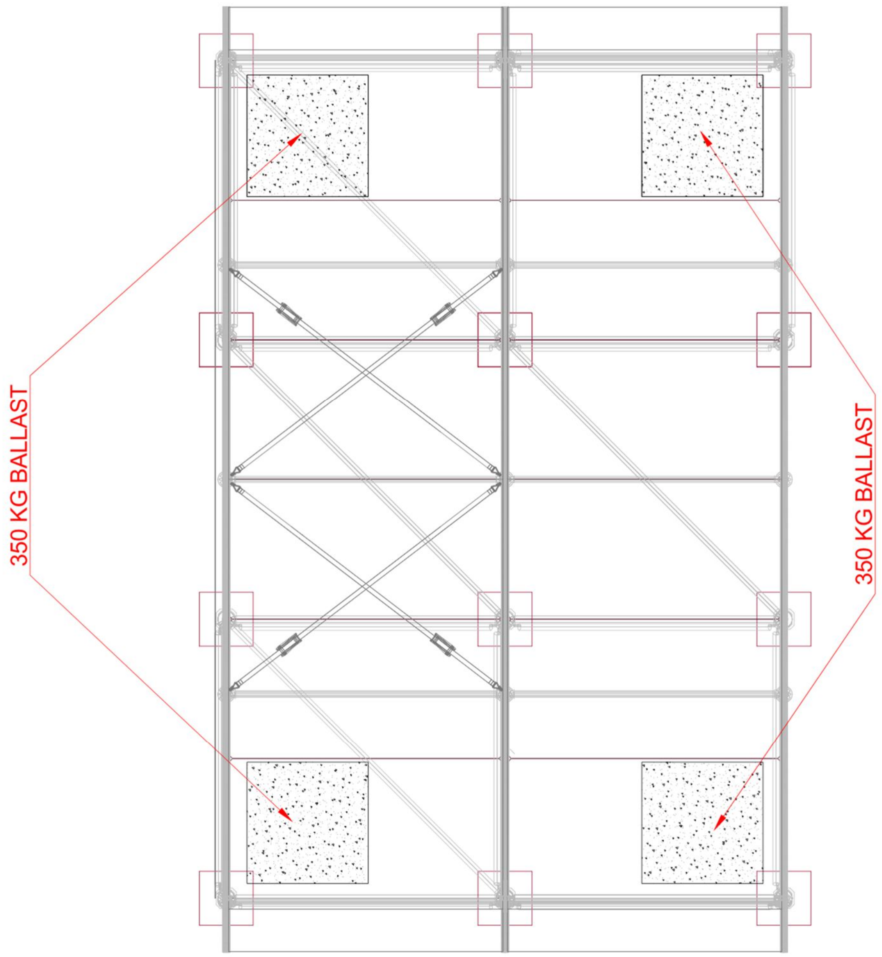
[a] At least of stiff consistency in accordance with ENV 1997-1.



The ballast need to be placed in such a way that it will be activated when lifting forces are applied. If the ballast is placed on the bottom level the use of Layher uprights with connected base collar is necessary.



5.2 Ballast configuration



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DATE : 21-6-2018	CUSTOMER : INTERAL T.C.			
REVISION :	STATUS :			
DESCRIPTION : DJ Cover 6.21X4.144 Ballast Drawing			A3	WWW.IM-STEE.COM

5.3 Ballast calculation against uplift.

For the uplift ballast calculation, the total uplift forces will be taken into account and divide over two positions of 375 Kg ballast on each side. The relatively small Layher stage is a structurally stiff system and will work as one system.

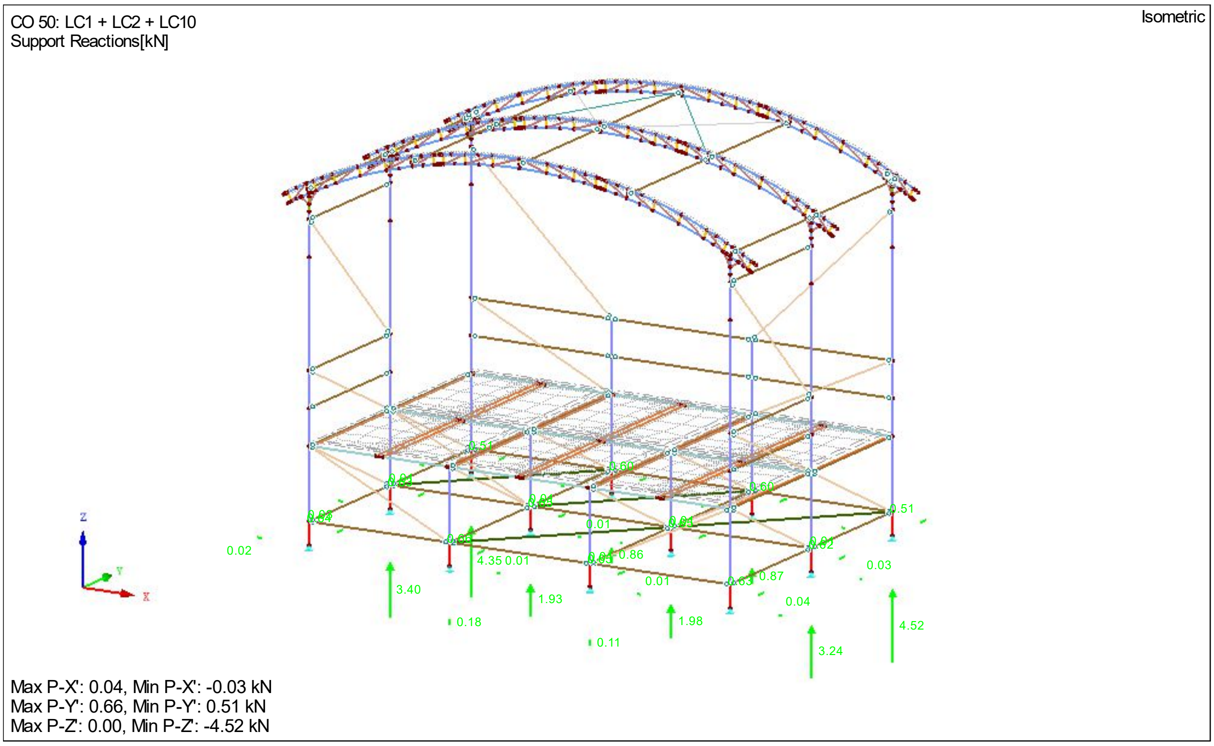
5.3.1 Lifting forces RC3 -characteristic values In-service

The load combinations LC50, LC55 and LC60 are decisive. These load cases have only self-weight, wind loading and no live load.

The self-weight of the system is already taken into account in the different calculations. The values are the actual values which need to be secured against ballast. The safety factor γ against overturning sliding and lifting are taken from table 2 of the EN-13814

For the uplift the γ = 1.2

Check Load combination CO50



Total amount of uplift force

Sum of loads in Z – Self-Weight – Ballast = uplift force

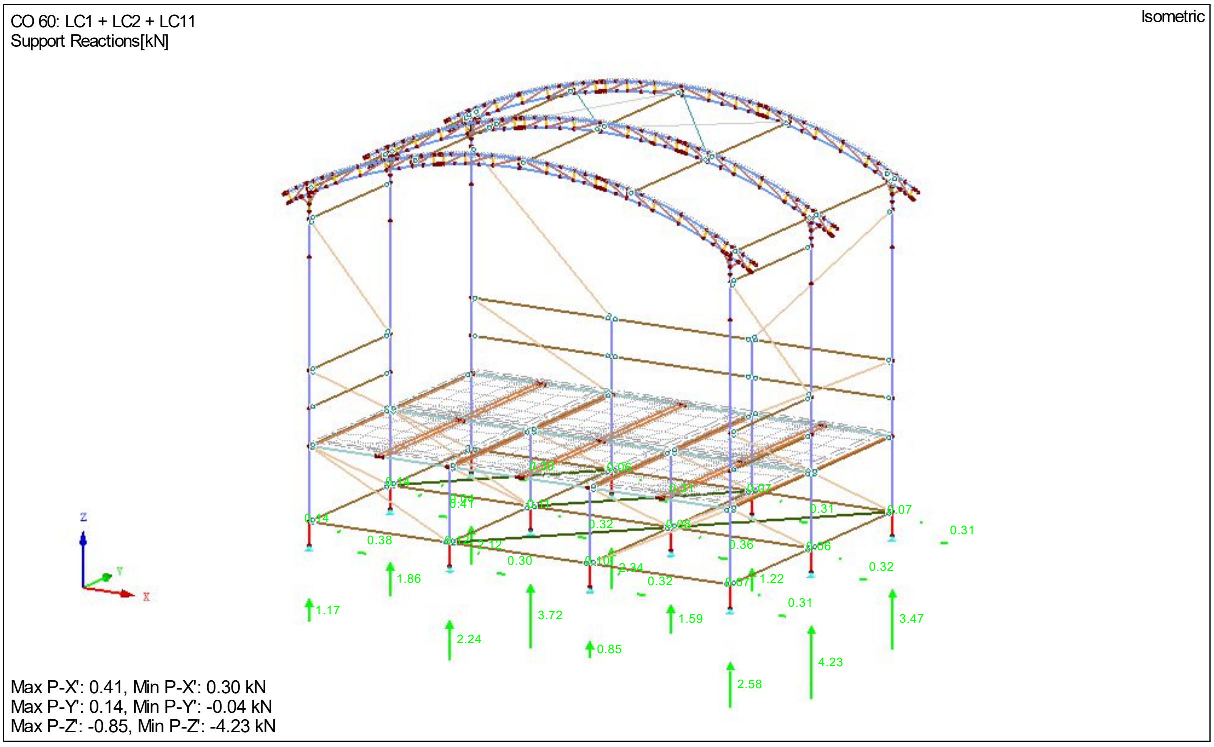
21.45 – 14.41 – 15.00 = 7.96 kN

Ballast check

(self-weight + Ballast) / Uplift force > 1.2

(14.43 + 15.00) / 7.96 = 3.7 > 1.2

Check Load combination CO60



Total amount of uplift force

Sum of loads in Z – Self-Weight – Ballast = uplift force

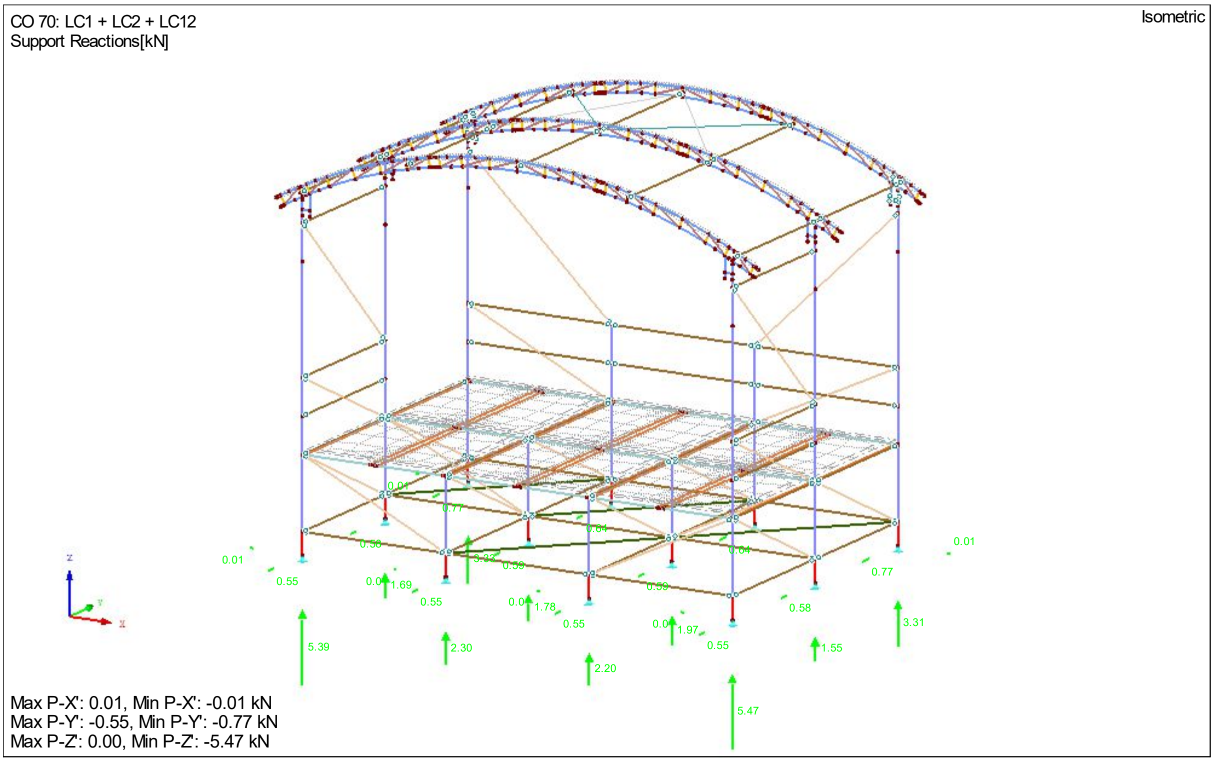
27.40 – 14.41 – 15.00 = 2.01 kN

Ballast check

(self-weight + Ballast) / Uplift force > 1.2

(14.41 + 15.00) / 2.01 = 14 > 1.2

Check Load combination CO70



Total amount of uplift force

Sum of loads in Z – Self-Weight – Ballast = uplift force

28.96 – 14.41 – 15.00 = 0.45 kN

Ballast check

(self-weight + Ballast) / Uplift force > 1.2

(14.41 + 15.00) / 0.45 = 65 > 1.2

5.4 Calculation of the system against overturning.

Results loading from the RFem model of the main construction for the different load combinations.

	Description	Value	Unit		Description	Value	Unit
	CO50 - LC1 + LC2 + LC10				**CO150 - LC1 + LC2 + LC13**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	7,35	kN		Sum of loads in Y	1,61	kN
	Sum of loads in Z	-21,45	kN		Sum of loads in Z	-23,08	kN
	CO51 - LC1 + LC2 + LC3 + LC10				**CO151 - LC1 + LC2 + LC3 + LC13**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	7,35	kN		Sum of loads in Y	1,61	kN
	Sum of loads in Z	-29,12	kN		Sum of loads in Z	-30,75	kN
	CO52 - LC1 + LC2 + LC4 + LC10				**CO152 - LC1 + LC2 + LC4 + LC13**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	7,35	kN		Sum of loads in Y	1,61	kN
	Sum of loads in Z	-24,45	kN		Sum of loads in Z	-26,08	kN
	CO53 - LC1 + LC2 + LC5 + LC10				**CO153 - LC1 + LC2 + LC5 + LC13**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	7,35	kN		Sum of loads in Y	1,61	kN
	Sum of loads in Z	-27,45	kN		Sum of loads in Z	-29,08	kN
	CO54 - LC1 + LC2 + LC6 + LC10				**CO154 - LC1 + LC2 + LC6 + LC13**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	7,35	kN		Sum of loads in Y	1,61	kN
	Sum of loads in Z	-28,20	kN		Sum of loads in Z	-29,83	kN
	CO60 - LC1 + LC2 + LC11				**CO160 - LC1 + LC2 + LC14**		
	Sum of loads in X	3,97	kN		Sum of loads in X	1,83	kN
	Sum of loads in Y	1,01	kN		Sum of loads in Y	0,00	kN
	Sum of loads in Z	-27,40	kN		Sum of loads in Z	-22,61	kN
	CO61 - LC1 + LC2 + LC3 + LC11				**CO161 - LC1 + LC2 + LC3 + LC14**		
	Sum of loads in X	3,97	kN		Sum of loads in X	1,83	kN
	Sum of loads in Y	1,01	kN		Sum of loads in Y	0,00	kN
	Sum of loads in Z	-35,07	kN		Sum of loads in Z	-30,28	kN
	CO62 - LC1 + LC2 + LC4 + LC11				**CO162 - LC1 + LC2 + LC4 + LC14**		
	Sum of loads in X	3,97	kN		Sum of loads in X	1,83	kN
	Sum of loads in Y	1,01	kN		Sum of loads in Y	0,00	kN
	Sum of loads in Z	-30,40	kN		Sum of loads in Z	-25,61	kN
	CO63 - LC1 + LC2 + LC5 + LC11				**CO163 - LC1 + LC2 + LC5 + LC14**		
	Sum of loads in X	3,97	kN		Sum of loads in X	1,83	kN
	Sum of loads in Y	1,01	kN		Sum of loads in Y	0,00	kN
	Sum of loads in Z	-33,40	kN		Sum of loads in Z	-28,61	kN
	CO64 - LC1 + LC2 + LC6 + LC11				**CO164 - LC1 + LC2 + LC6 + LC14**		
	Sum of loads in X	3,97	kN		Sum of loads in X	1,83	kN
	Sum of loads in Y	1,01	kN		Sum of loads in Y	0,00	kN
	Sum of loads in Z	-34,15	kN		Sum of loads in Z	-29,36	kN
	CO70 - LC1 + LC2 + LC12				**CO170 - LC1 + LC2 + LC15**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	-7,38	kN		Sum of loads in Y	-1,61	kN
	Sum of loads in Z	-28,96	kN		Sum of loads in Z	-23,08	kN
	CO71 - LC1 + LC2 + LC3 + LC12				**CO171 - LC1 + LC2 + LC3 + LC15**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	-7,38	kN		Sum of loads in Y	-1,61	kN
	Sum of loads in Z	-36,63	kN		Sum of loads in Z	-30,75	kN
	CO72 - LC1 + LC2 + LC4 + LC12				**CO172 - LC1 + LC2 + LC4 + LC15**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	-7,38	kN		Sum of loads in Y	-1,61	kN
	Sum of loads in Z	-31,96	kN		Sum of loads in Z	-26,08	kN
	CO73 - LC1 + LC2 + LC5 + LC12				**CO173 - LC1 + LC2 + LC5 + LC15**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	-7,38	kN		Sum of loads in Y	-1,61	kN
	Sum of loads in Z	-34,96	kN		Sum of loads in Z	-29,08	kN
	CO74 - LC1 + LC2 + LC6 + LC12				**CO174 - LC1 + LC2 + LC6 + LC15**		
	Sum of loads in X	0,00	kN		Sum of loads in X	0,00	kN
	Sum of loads in Y	-7,38	kN		Sum of loads in Y	-1,61	kN
	Sum of loads in Z	-35,71	kN		Sum of loads in Z	-29,83	kN

Decisive load combination CO50

CO50

Sum of load in Y direction = 7.35 kN
Sum of load in Z direction = 21.45 kN

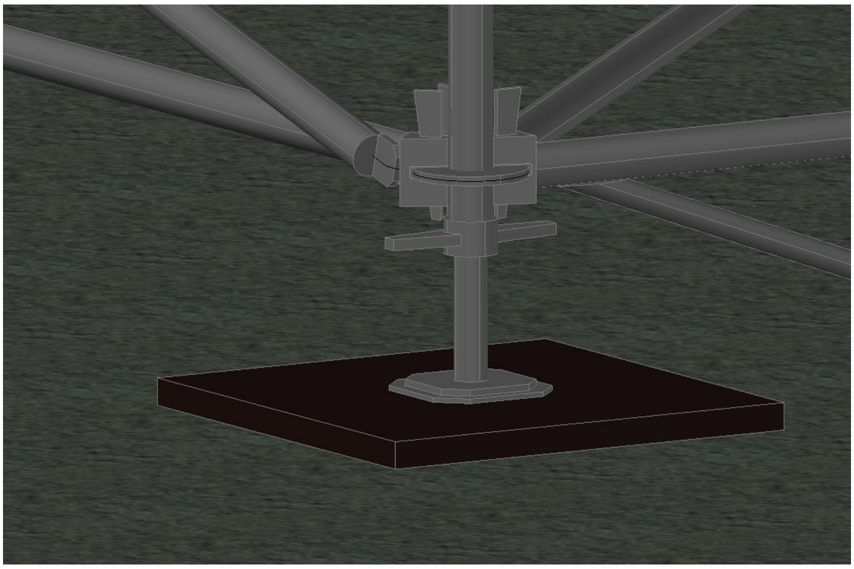
Overturning moment

M_{ov} = (7.35 * 5.6/2) + ((21.45-14.41-15) * 4.144 / 2) =
M_{ov} = 20.58 + 16.49 = 37.07 kNm
Stabilization moment
M_{stab} = (2 * 3.5 * 3.626) + (2 * 3.5 * 0.518) + (14.41 * 4.144 / 2)
M_{stab} = 25.38 + 3.626 + 29.86 = 58.86 kNm

M_{stab}/ M_{ov} = 58.86 / 37.07= 1.59 > 1.2

5.5 Ballast calculation against slipping.

Decisive load combination is CO50



Ballast requirement with μ = 0.4 Steel-wood-concrete/sand/gravel

Horizontal force = 7.35 kN

Total vertical force = -21.45 kN

Check

(total vertical force + ballast support) * friction coefficient / Horizontal Force > 1,2

(21.45 + 0.80) * 0.4 / 7.35 = 1.21 > 1.2